AIRCRAFT RECOGNITION

HOW TO IDENTIFY BRITISH, NAZI, AND ITALIAN PLANES

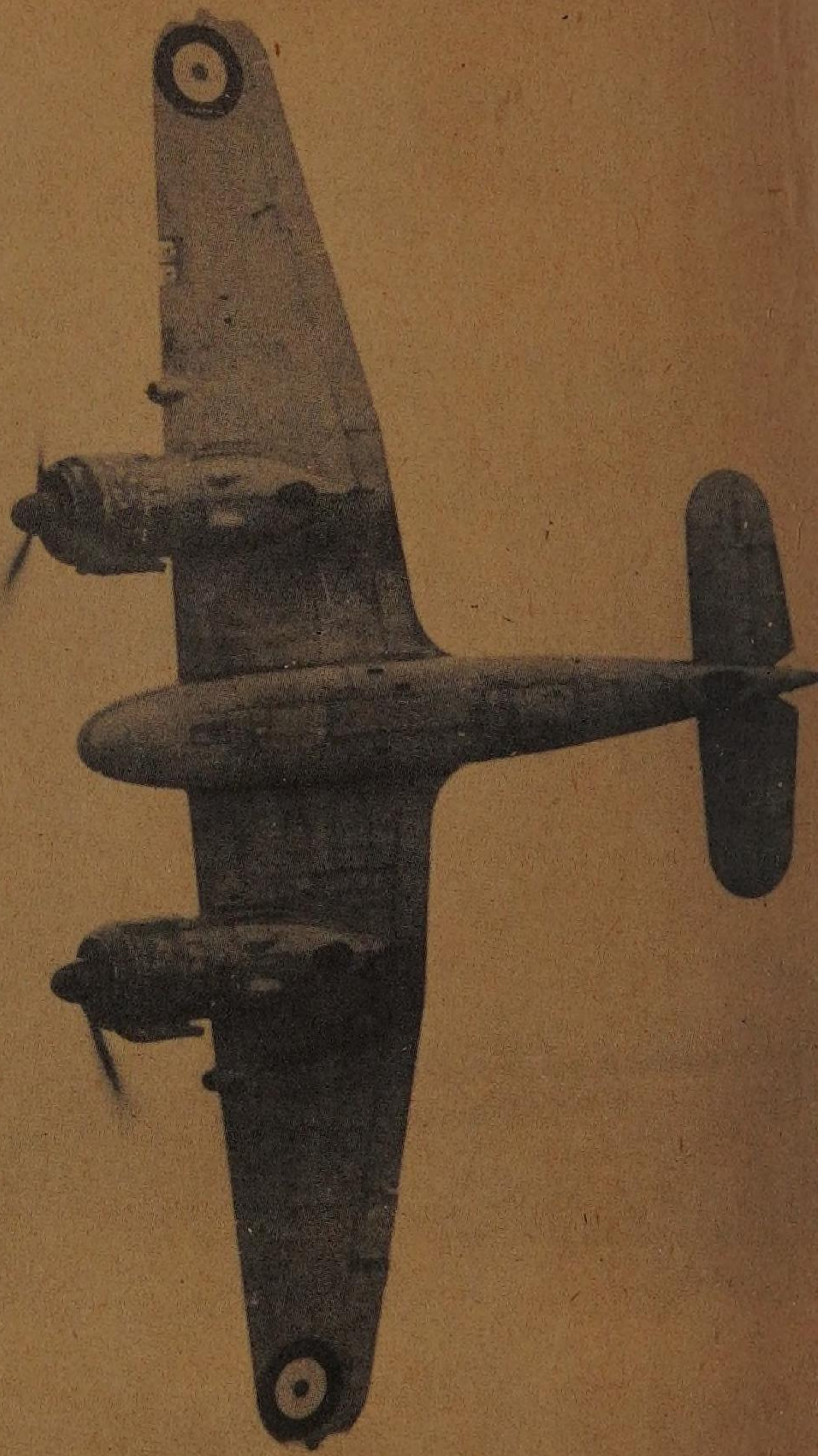
ENLARGED SECOND EDITION

NEW YORK

WASHINGTON

AIRCRAFT RECOGNITION

SECOND EDITION



"Beaufighter."

AIRCRAFT RECOGNITION

How To Identify
BRITISH, NAZI and ITALIAN PLANES

by

R. A. Saville-Sneath

Second Edition, Revised and Enlarged

TO MONICA

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CONTENTS

FOREWORD

The First Edition of "Aircraft Recognition" was written late in 1940 on the basis of spotters' experiences in the Battle of Britain. The book marked a real advance in the techniques of aircraft identification, and it resulted in widespread acceptance of these techniques. Quite aside from its immediate military importance, "Aircraft Recognition" has already made a most important contribution to aviation in that it has proved to thousands of people that it is possible to learn a great deal about aircraft without actually becoming a pilot. Not only have the readers of the First Edition found it possible, but they have also found that acquiring a knowledge of modern aircraft can become a real hobby. Yet the appeal of this book is not only to laymen and to spotters on land and on shipboard, for very many pilots and other flying personnel have found it an invaluable and handy reference book.

As of the date on which this foreword is being written, this new and greatly enlarged edition of Mr. Saville-Sneath's book appears to be by far the most complete spotters' volume of planes made in Britain, Germany and Italy. The book has been revised throughout, and those who are familiar with the First Edition will discover here silhouettes and descriptions of about thirty additional aircraft. All material appearing under the heading "Recognition Points" has been revised in accordance with recent battle experiences and advances in the theory of spotting. Many photographs and much supplemental material have also been added.

WALTER PITKIN, Jr.

New York
January, 1943

"Halifax."

AIRCRAFT RECOGNITION

SECOND EDITION

INTRODUCTION

Under the special conditions of modern warfare, interest in aircraft spotting is not confined to soldiers and sailors. A desire to be able to distinguish with **certainty** between friendly and hostile planes is widespread and natural. Many people, without conscious study, but possessing a trained or natural aptitude for observation, rapidly become familiar with the appearance of the types of aircraft most commonly seen in their own neighborhood. Others find that the recognition of airplanes—even of types frequently seen—is unexpectedly difficult. Some will go so far as to say that aircraft, and in particular, modern high-speed monoplane types, resemble one another as closely as peas from the proverbial pod.

The difficulty in recognizing different types is very rarely associated with defective vision—in a literal sense. Generally, it arises from lack of knowing **where to look** for certain distinctive points which, to the initiated, are as obvious and as easily recognizable as the features of a familiar face. This instantaneous, apparently instinctive, but **certain** recognition of aircraft in flight is the finished performance, the final stage of proficiency to which all training is directed.

The study of various types, "broken down" into their separate structural parts, re-assembled and mentally classified in the appropriate groups, is a necessary preparation for rapid progress to the desired standard.

It is customary to classify different types of aircraft according to any one of the following three methods:

(1) Country of origin.
(2) National markings.
(3) Service function.

None of these methods is entirely satisfactory when considered solely from the point of view of aircraft recognition. Experience suggests that a system of grouping based upon the principal structural characteristics of an aircraft is most likely to meet the requirements of the service or civilian spotter, and this method is used in the present book.

It has the important advantage of bringing **similar types** together for easy reference and comparison. Thus, the Ju 88, which by reason of the similarity of its principal structural features is frequently confused with the "Blenheim," is precisely by reason of this structural similarity, automatically grouped with the Mk 1 and Mk IV versions of the Bristol "Blenheim."

The index provides, in addition to the usual alphabetical cross-reference, a brief description of the principal structural features of each airplane, in the form of a single line of readily understood abbreviations placed in a definite order.

By reference tc the index alone, the country of origin and the principal structural features of each type can be ascertained. For example, against "Anson" we find:

GB, LW, E2, Tl, Re, Ur. pp. 84-5.

These abbreviations are expanded without difficulty to read: "**Country of origin,** Great Britain, Low-wing monoplane, twin-engine, simple tail unit, radial engines, undercarriage retracts. Fully described on pages 84-85."

CHAPTER I
A SIMPLE STRUCTURAL GROUPING

Of the many types of military aircraft commonly in action over Western Europe and the Mediterranean, by far the largest number consists of **Monoplanes.** These can conveniently be subdivided into three distinct structural groups based upon the position of the wings in relation to the fuselage.

These groups are:

Low-wing Monoplane: "Spitfire"

Mid-wing Monoplane: "Buffalo"

High-Wing Monoplane: "Lysander"

Continuing our grouping according to structural features, the remainder of our selection can be considered under two heads:

(4) Float Seaplanes and Flying-boats.

Float Seaplane: Heinkel 115

Flying Boat: "Lerwick"

(5) Biplanes (other than those in Group 4)

Biplane: "Gladiator"

We find little difficulty in recognizing the broad structural differences which distinguish any one of these **five principal groups** from the others.

Within each of the principal groups there are relatively few aircraft to consider and these, in turn, have clearly apparent differences in design. The most obvious difference from our point of view is the number of engines with which they are fitted. We therefore sub-divide each of the original groups into two classes:

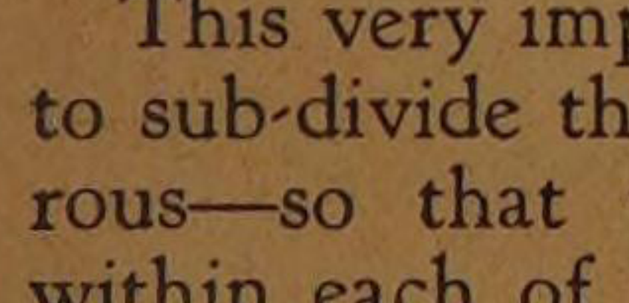
(i) Single-engine types.
(ii) Multi-engine types.

TELL-TALE TAILS

Turning to tails, frequently one of the most distinctive features of an airplane, we notice that while some types have a single large fin and rudder or **simple** tail unit, the designers of others prefer to fit two somewhat smaller fins and rudders, in other words, a **compound** tail unit. We also observe that compound tails with few exceptions are only fitted to multi-engined planes.

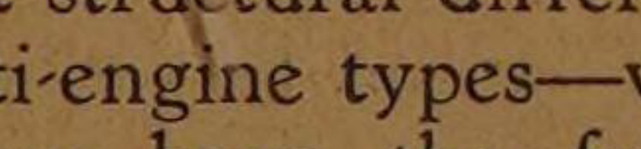
This very important structural difference enables us further to sub-divide the multi-engine types—which are rather numerous—so that we now have the following three sections within each of the five principal groups;

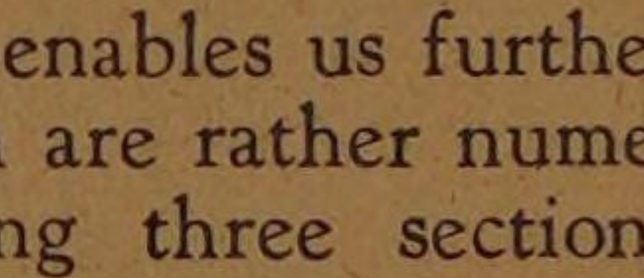
(i) Single-engine types;
(ii) Multi-engine types with **simple** tail unit;
(iii) Multi-engine types with **compound** tail unit.



Single-engine Type: "Hurricanes"

Multi-engine Type with Simple Tail Unit: Junkers 88





Multi-engine Type with Compound Tail Unit: Dornier 215

As examination of the various structural components proceeds, any early impression which we may have formed concerning the similarity of monoplane designs is replaced by astonishment at their extreme diversity.

Once this bridge is crossed, facility in aircraft recognition does not depend upon any rare or peculiar individual aptitude, but is simply a matter of regular observation and opportunity for practice.

PHOTOGRAPHS OR SILHOUETTES?

Actual observation of aircraft in flight naturally provides the ideal form of practice, but we may find that the experience gained in this manner is unfortunately—or fortunately!—limited to a relatively small number of already well-known types.

We should also remember that the true spotter derives his greatest satisfaction from the identification of a strange type when it first crosses his horizon. Even though it may prove to be friendly, his feelings, if he fails to identify it on that critical first occasion, can best be understood and expressed by the golfer who fluffs his drive from the first tee.

We must therefore rely upon the use of photographs and silhouettes (and films whenever these are available) as the preliminary, if not the principal, means of acquiring familiarity with a wide range of different types of aircraft.

Photographs which show close-up views of aircraft with lowered undercarriage, i.e. on the ground or during take-off and landing, may possess considerable general interest, but they are not the best possible thing for preliminary study. Often of course such photographs are the only ones available, in which case they are better than nothing. On the other hand, photographs, taken from a reasonable distance, depicting aircraft in characteristic flying attitudes, provide the best possible link between the fully detailed picture and the simple silhouette. We cannot have too much variety in our collection of this type of picture. Variety and frequent change are points which must be stressed, for the tendency to remember a particular type of aircraft by reference to some incidental feature of **landscape** becomes irresistible if the same photographs are repeatedly used.

CHAPTER II

WINGS

THEIR POSITION IN RELATION TO THE FUSELAGE

We have already seen that according to the relative position of the wings and fuselage a **monoplane** is described as of Low-wing, Mid-wing or High-wing type.

The Hurricane and Spitfire fighters are outstanding examples of modern low-wing monoplanes. Hampden and Wellington bombers and the different versions of the Blenheim are good examples of mid-wing design. The Lockheed "Hudson," although included for the sake of simplicity in the mid-wing group, is intermediate between low and mid-wing, and is better described as a low mid-wing type. "Flying wing" monoplanes, an unusual type in which the fuselage is merged into the centre section of the wing, may for convenience be included in the mid-wing group. There are too few of them to justify special grouping.

Low Mid wing Type:
Lockheed "Hudson"

Parasol High-wing:
Henschel 126

"Shoulder" High-wing
Dornier 17

Variants of the **high-wing** type are (i) **Parasol High-wing** aircraft, in which the main plane is mounted above and clear of the fuselage to which it is attached by struts, and (ii) **Shoulder-wing,** a type in which as the name implies the wing-roots join the fuselage at the "shoulder," i.e. lower than the normal high-wing but appreciably higher than the mid-wing position.

The Henschel 126 is an example of the parasol high-wing type, this arrangement of wings being commonly adopted for reconnaissance aircraft of relatively low speed. The shoulder-wing position may be observed in the two Dornier bombers, Do 17 and Do 215.

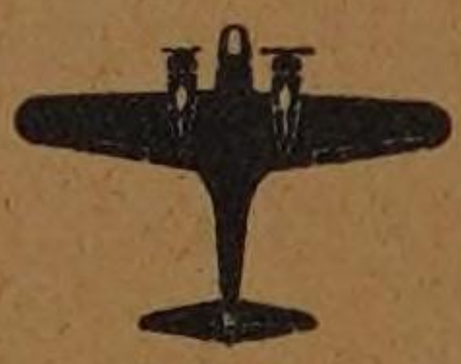
THE PLAN VIEW

Tapered wings predominate amongst modern types. Notable exceptions are, of course, the Spitfire wings of distinctive elliptical plan and the untapered wings of the Albacore, a biplane torpedo-carrier of the Fleet Air Arm.

The various combinations of straight edge and taper, together with the shape of the wing-tips, produce the characteristic wing silhouettes which are our chief recognition aids in the plan or overhead view.

The principal variations of wing plan are shown in the following illustrations.

Little or no taper:
"Albacore"



Moderate taper, about equal on both edges:
"Anson"

Full taper on both edges:
"Hudson"

Taper on leading edge only:
"Harvard"

Taper on trailing edge only:
"Boston"

Compound taper:
Junkers 88

Elliptical plan:
"Spitfire"

Sweepback is a characteristic of the wings which is clearly seen in the plan view. We should avoid a common tendency to confuse the term with **taper.** Sweepback describes the angle at which the wings are set—as viewed from above or below—rather than their form. Examples may be seen in the plan views of the Tiger Moth or the Stranraer, and it will be noticed that backswept wings may be completely without taper.

Sweepback is distinct from taper:
"Stranraer"

Aspect Ratio.—The ratio of span to chord can only be regarded as a valuable aid to recognition when it is distinctly above or below the average, e.g. Wellington, Wellesley, Me 110 (high aspect ratio) and Whitley, Ju 89 and 90 (low aspect ratio.) .

High-aspect Ratio: **"Wellesley"**

Low-aspect Ratio: **"Buffalo"**

Span.—As the span of current service types ranges from 30 ft. to about 150 ft. we should endeavour to keep an approximate idea of this important dimension in mind. It is not only a useful recognition point which may be observed from many angles but it is chiefly upon our recollection of the span of a particular plane that the accuracy of our estimate of its height depends. In all cases where the information is available, the span, length and height are given in the descriptive section.

THE HEAD-ON OR STERN VIEW

Dihedral Angle.—The head-on or stern view of an aircraft is generally considered to be the most difficult to recognize. Fortunately, from an observer's point of view, the set of the wings of different airplanes varies considerably in relation to the horizontal. This angular setting, termed positive or negative dihedral angle, is naturally most evident in the full head-on and stern views.

The upward inclination towards the wing tips, or **positive** dihedral, is occasionally combined with a downwards inclination, or **negative** dihedral, near to the fuselage. The Junkers 87 dive-bomber shows this characteristic to a very marked degree, and in consequence is easily recognizable in head-on or stern views without other aids. The combination of positive and negative dihedral seen in the Ju 87 is known as "inverted gull-wing."

The ordinary "gull-wing," in which the arrangement of

dihedral is the reverse of that just described, is less common, but the head-on silhouette of the Do 26 provides us with an excellent example.

Although the possible variations of dihedral are extremely numerous, we may usefully classify nine of the most usual forms. These are tabulated below, with typical examples selected from head-on silhouettes. The abbreviations D/0, etc., are suggested for use in conjunction with the brief descriptions given in the index.

D/0 Little or no dihedral;
D/1 Moderate dihedral;
D/2 Full dihedral;

D/0. Dornier 17

D/1. "Anson"

D/2. "Spitfire"

D/01 Little or no dihedral in center section, moderate dihedral in outer sections;
D/02 Little or no dihedral in center section, full dihedral in outer sections;
D/001 Dihedral in extreme outer sections only, i.e. near wing tips;

D/01. "Beaufort"

D/02. "Harvard"

D/001. "Skua"

D/GW Gull-wing;
GW/d1 Inverted gull-wing, moderate;
GW/d2 Inverted gull-wing, full.

D/GW. "Dornier" 26

GW/d1. "Master"

GW/d2. Junkers 87B

Span.—The importance of span has already been mentioned in considering the plan view. Its usefulness when the aircraft is seen from other angles is illustrated by the head-on silhouettes of Hurricane, Battle and He 113, which are here reproduced to the same scale.

" Hurricane"

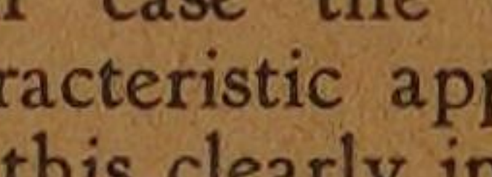
Heinkel 113

"Battle"

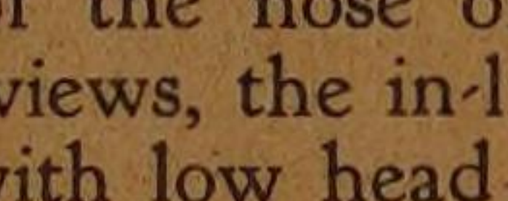
CHAPTER III
ENGINES

As recognition aids, the number and the type of engines fitted to an aircraft rank almost equally in importance to the wings. Although the wings are usually the largest structural members and as such have a predominating influence on the characteristic appearance of an airplane, it frequently happens in practice that a plane can be definitely described as of single or multi-engine type, as the case may be, before the wing position can be clearly distinguished. This is particularly likely to occur when a distant side or plan view is presented to the observer.

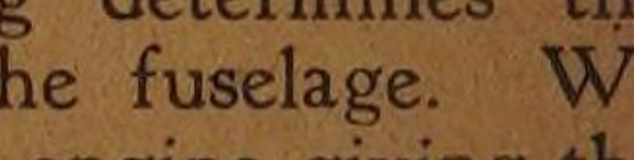
Assuming that we have succeeded in distinguishing the **number** of engines, it should soon be possible to decide upon their type—whether **IN-LINE** or **RADIAL** engines. This feature is much more evident in single-engine planes since in their case the engine cowling or fairing determines the characteristic appearance of the nose of the fuselage. We see this clearly in the side views, the in-line engine giving the clean sharp nose outline, with low head resistance—a feature which is termed "clean entry"—while the larger diameter of the radial engine produces a nose of blunt or stubby rounded appearance. This aerodynamic disadvantage is offset to some extent by the fact that the radial engine is air-cooled and does not require the additional weight and complication of a liquid-cooling system.



Liquid-cooled In-line Engine: "Hurricane"



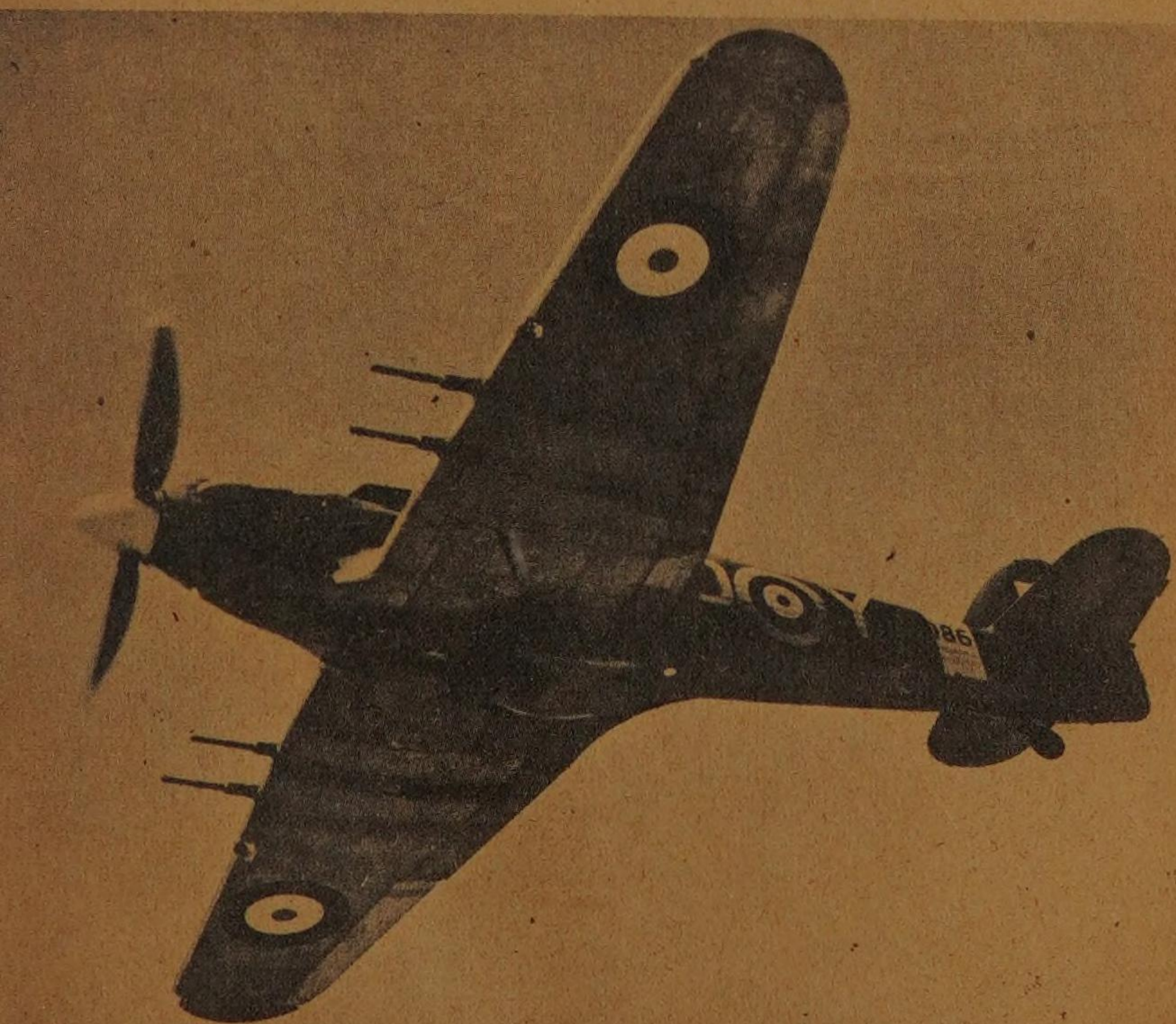
Air-cooled Radial Engine "Harvard"



Junkers 88 fitted with "Jumo" liquid-cooled in-line engines, the radiators of which resemble the cowling of radial engines

There is a notable exception to the general rule about the distinctive appearance of in-line and radial engines. If we refer to the silhouette of the Ju 88 we find that the engines, which are an unusually prominent feature, have the appearance of radial engines although they are in fact a type of

Heinkel 111K's are an old standby of the Luftwaffe. They are used both as bombers and as torpedo planes.



This "Hurricane" sports four 20mm. cannon, while another version carries twelve 30 calibre machine guns.

Junkers Jumo liquid-cooled in-line engine which is fitted with a radiator of circular section.

The present trend of design in the U. S. A. may eventually reduce the sharp distinction between the two types. Twin-row radial engines, of smaller diameter than the single-row type, are in certain cases enclosed in cowlings which follow the clean, sharp lines which we are accustomed to associate only with in-line engines.

Three-engine Aircraft.—These are uncommon (if we exclude those of the Italian Air Force), and this type should therefore present little difficulty. The Ju 52 is numerically the most important aircraft in this class.

Four-engine Aircraft.—Apart from two or three each of the well-known types of air-liners and land-based bombers, these are also comparatively uncommon. It is evident that careful observation of this point alone will greatly simplify our task since it will enable us to eliminate from consideration at least 90 per cent of other types.

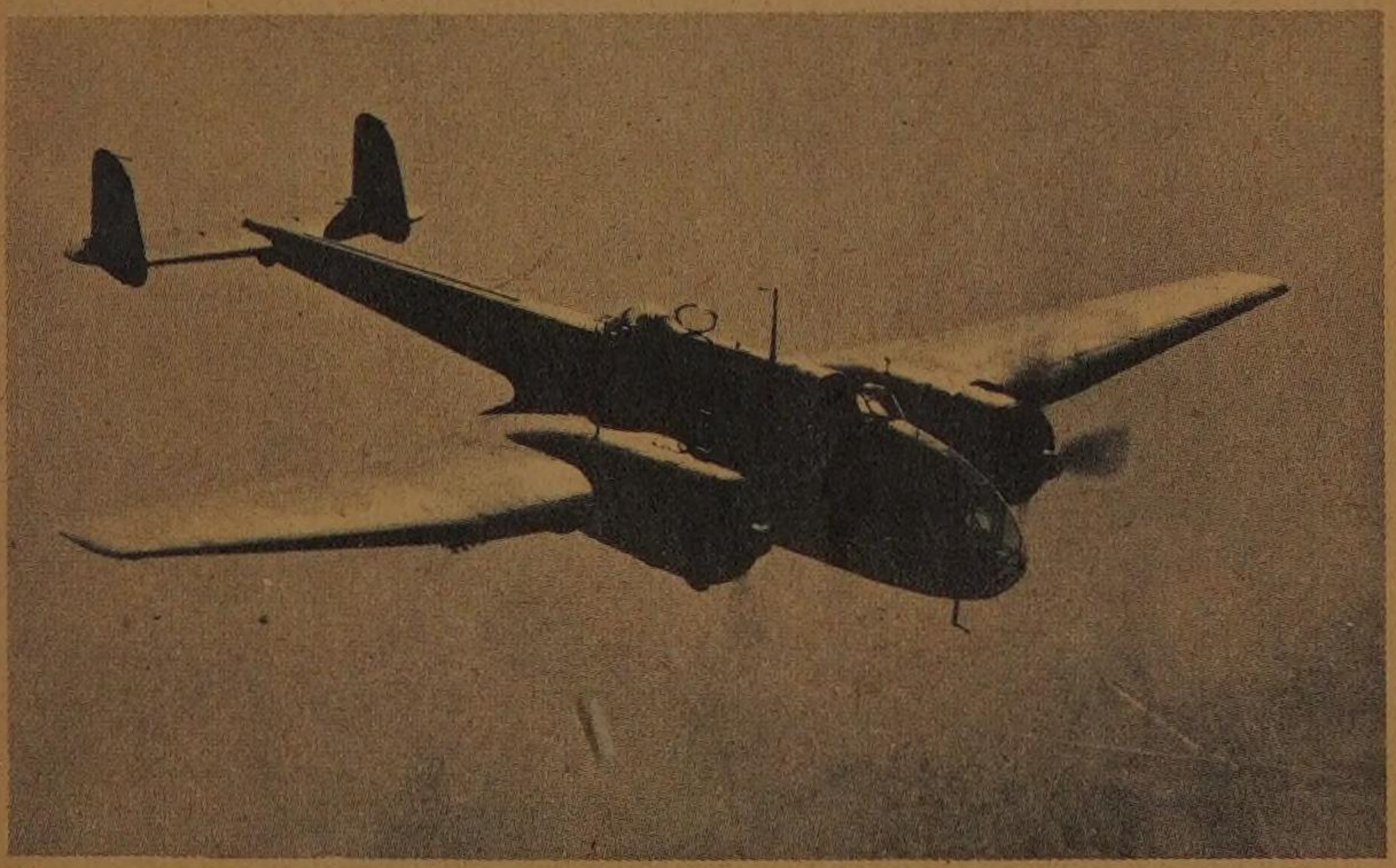
Twin-engine Aircraft.—In this very large group we may need every point which can be gleaned from observation not only of the type of engines fitted, but also of the manner in which they are installed. The engines are usually enclosed in nacelles, which may be mounted on the wing on their **center lines,** i.e. with roughly equal parts of the nacelle above and below the wing. They may be mounted **above** the wing or more or less completely **underslung.** In comparatively rare cases, of which the Do 18 is a good example, two engines are mounted in tandem and from certain viewpoints they may easily be mistaken for a single engine.

We should also note the extent to which the nacelles project forward of the leading edge, their position relative to the nose of the aircraft and their setting with regard to the fuselage, i.e. whether parallel with it or at an angle. Finally, we should notice the after end of the nacelle, which usually terminates in a narrow streamline fairing. Should these fairings project **behind** the trailing edge of the wings, we note this as a relatively uncommon feature which will considerably facilitate recognition.

Many of these details may appear at first glance to have little or no importance. We should remember, however, that even when they cannot be clearly distinguished indi-

Pointed fairings of engine nacelles project behind the trailing edge of wings: "**Boston**"

vidually, they contribute to the characteristic appearance and "set" of an airplane which we shall eventually recognize without conscious analysis of its component parts.



A "Hampden" bomber of the kind now used for mine-laying.

CHAPTER IV
THE TAIL UNIT, FUSELAGE, UNDERCARRIAGE AND RADIATOR
Tail Unit

In a large proportion of the aircraft with which we are concerned the tail unit is so individual and characteristic that it may also be regarded as the designer's signature. Like the design of a car radiator which survives unchanged many modifications of body and chassis, the customary curves of fins, rudder and tailplane frequently persist through several of the aircraft constructor's successive models. This holds good to such a degree that many spotters experience no difficulty in recognizing a number of current types from a view of the tail unit alone.

We have already referred to the broad distinction which enables us to sub-divide each of our five structural groups into the additional sections (ii) simple tail units and (iii) compound tail units.

The **simple** tail unit comprises a single fin, rudder, tailplane and elevator. The **compound** tail unit is usually fitted with two fins and rudders. Normally, these are mounted on the

Simple Tail Unit: (1) Single fin, (2) tailplane (3) elevator (4) rudder
Heinkel 113

single tailplane. Their position in relation to the tailplane varies with different designs. Frequently, as in many German types, they are placed at the extreme tips, and may be mounted with the greater part of their surface **above** the tailplane,. as in the Dornier 17 and 215 or near to their centers as seen in the Messerschmitt 110.

Compound Tail Unit: (1) Tailplane, (2) twin fins and rudders, (3) elevator, (4) rudder
Messerschmitt 110

The Whitley bomber is an excellent example of the information which may be gained by a single glance at the position of the fins and rudders. These are placed roughly mid-way between the fuselage and the tailplane tips. They are braced to the fuselage—an unusual practice in modern designs. What is even more remarkable, they sit on top of the tailplane, with no part of their surface visible beneath. To a practised observer they say "Whitley" in the clearest possible terms!

The well-known de Havilland four-engine air-liner, the biplane D.H. 86 or "Dragon Express," a "simple tail" type, was modified by the addition of two small auxiliary fins, making three in all. As a result, D.H.86b, the modified version, has a compound tail unit of unusual and easily recognizable type.

Obsolete types of aircraft with compound tail units comprising **biplane** tailplanes between which two or three fins and rudders are mounted—the old box-kite arrangement—may still occasionally be seen.

The trend of current design appears to be moving away from the twin tails which have become a common feature of present-day aircraft, in favour of the simple tail unit. A recent instance is the Douglas forty-passenger, four-engine airliner, D.C.4. Built in small numbers and flown experimentally during 1939 with **triple** fins and rudders, D.C.4 has now gone into regular production with a single large fin and rudder.

THE FUSELAGE

We have already seen, in discussing wings, that the general appearance of an aircraft is very largely determined by the position of the fuselage in relation to the wings. Together they form the main structural framework.

When we first meet a new acquaintance the nose is often a feature which irresistibly claims our attention. So it frequently happens upon making our first acquaintance with a new type of airplane. We remember a nose which is round, another which is long and pointed and yet another which is square and squat. If at the same time we can retain a clear idea of the projection of the nose in regard to neighboring features, we shall possess the first elements of a useful mental picture.

Occasionally the nearly vertical windows of a large control cabin show a distinct resemblance to the human brow, and the fertile imagination of an observer is not long in associating the facial outlines of different aircraft with those of his high, mid and low-brow friends. It would be tactless to carry the parallel further, for "pimples" and "blisters" are terms commonly used to describe different forms of gun-turret. Certain German types of fuselage conveniently have a hog-like snout!

The fuselage as a whole may be severe and rectangular in section; of fine, slender streamline form, or short and round as the barrel-like "Buffalo." In addition to these extreme types, an almost infinite variety of intermediate shapes may be observed. The position and type of control cabin, cock-

Rather high brow
Dornier 215

Distinctly low-brow
Junkers 86K

A hog-like snout
Junkers 52

pit, gun-turrets and any characteristic bulges which may be provided for additional armament or bomb-stowage are details which should not escape our attention.

In a few cases the shape of the fuselage provides the most obvious means of distinguishing between two aircraft which in other respects show many points of similarty. The Flamingo, for example, is similar in general arrangement to the

Dornier 17. Both are high-wing monoplanes fitted with two radial engines and twin fins and rudders. The fins and rudders in both cases are set at the extreme tips of the tailplane and when viewed from certain angles appear to be of similar shape. But few of us could mistake the deep roomy fuselage of the British air-liner for the slender outlines of the "Flying Pencil" bomber.

THE UNDERCARRIAGE

During normal flight the undercarriage of a modern landplane is conspicuous by its absence. It usually lies folded into the underside of the wings and fuselage, or in the case of multi-engine planes it may be drawn up into the engine nacelles. In the semi-retractable type of undercarriage, the lower part of the wheels remains exposed. This distinctive point may be clearly observed in some of the older types of service aircraft, such as the Anson and Battle.

When an undercarriage is observed to be heavily "trousered" or "spatted," i.e. fitted with streamline fairings which partially enclose the "legs" or wheels, respectively, we may reasonably assume that it is an undercarriage of the fixed type and accept this point as an aid to recognition. On the other hand, normally retractable undercarriages may be temporarily lowered during flight for a variety of reasons, amongst which we must include the possibility of ruse by a hostile pilot. The risk of mistaken identification will arise if, by attaching too much importance to the undercarriage, we permit our attention to be distracted from more reliable features.

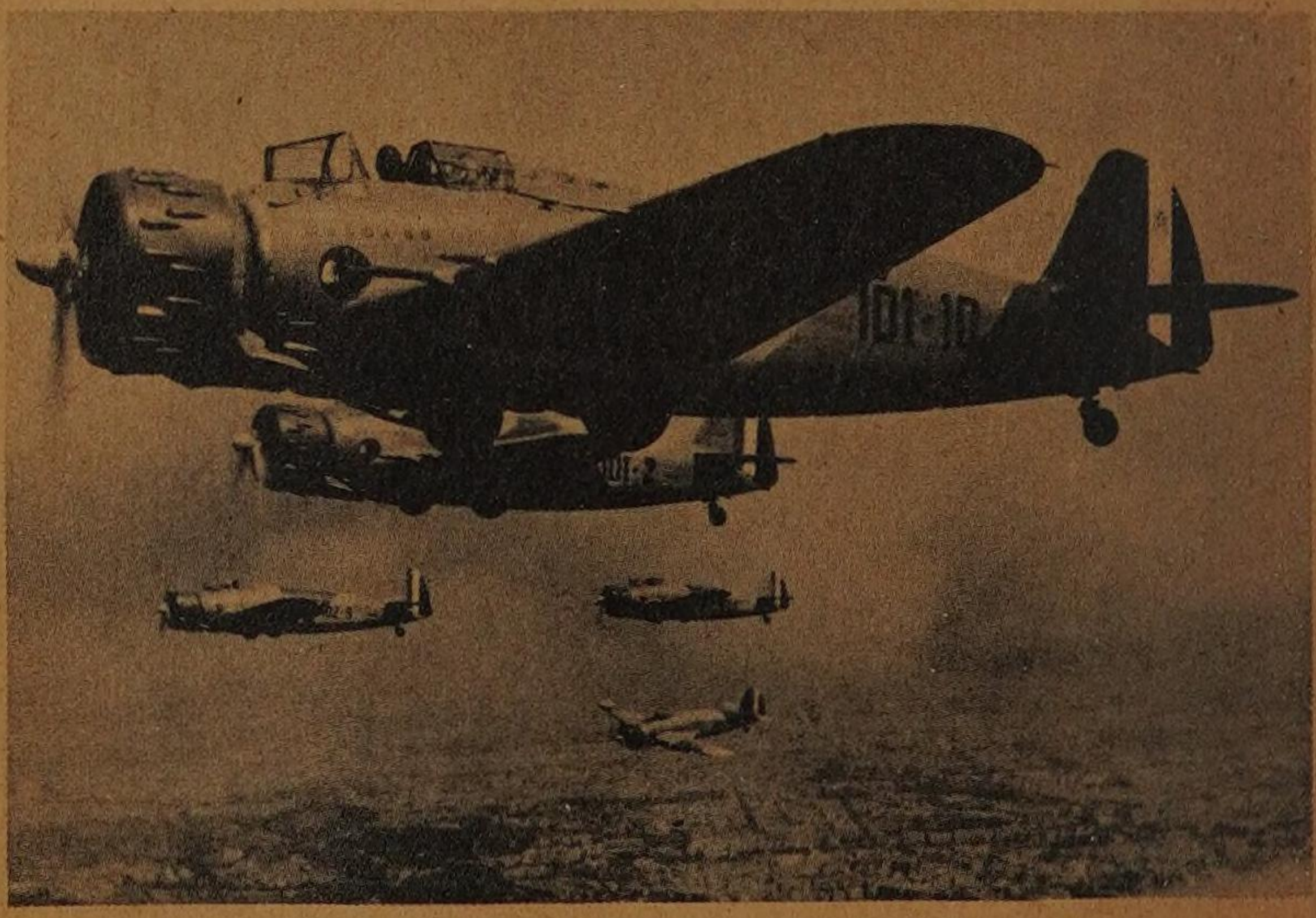
It is interesting, for example—though not virtually important—to know that the Gladiator is fitted with a fixed undercarriage of cantilever type and that by this point alone it may readily be distinguished from the earlier Gloster Gauntlet, which has the older type of fixed braced undercarriage.

THE RADIATOR, ETC.

Under this head we may conveniently group those subsidiary points which are of interest in connection with general design, but which play no really important role in practical aircraft recognition.

They include such details as the position of the radiator of liquid-cooled engines, external gun-mountings, bomb-racks, dive-brakes, fixed or retractable tailwheels, tail skids, etc.

In some multi-engine types the deep radiators below the engine nacelles emphasize the distinction between in-line and radial engines. In certain single-engine planes the radiator is large and is so placed as to cause a characteristic bulge in the outline of the fuselage. To that extent observation of minor details may usefully supplement our view of more obvious features. If, however, a spotter were overhead to say that he recognized a Spitfire by the radiator installed under the starboard wing, it would be much the same as if he claimed to recognize his girl friend by the mole on her right shoulder!



Italian Breda 65 bombers on maneuver.

CHAPTER V

RECOGNITION BY SOUND

Many hundreds of letters have been written to the lay and technical Press on this subject. They indicate an almost equal division of opinion between enthusiastic advocates of recognition by sound and those who consider that aural recognition is either completely impossible or of no practical utility. The correspondents quote many interesting examples in support of their respective points of view. This division of opinion is not surprising for most of us can recall from personal experience different incidents which could be quoted to reinforce arguments on **both** sides of the question.

There is much to support the view that recognition by sound is not only possible, but that it may be developed to a considerable degree of usefulness. On the other hand, those observers who by long practice have become most proficient in the art are usually well aware of its limitations and are least prone to make exaggerated claims on its behalf.

Many cases of supposed recognition by sound prove upon analysis to be compounded of one part hearing and one part inference. Certainly the distinction between comparatively slow single-engine trainers and high-speed single-engine fighters is very easily made by ear alone. But the conclusion that such single-engine trainers are friendly is less frequently based upon definite recognition of the individual "note" of a particular British engine or airplane than upon the reasonable assumption that hostile light training types would not knowingly venture to cross our coastline.

By a similar process of thought, a heavy twin-engine aircraft heard over West England at night may with some conviction be described as hostile. It usually is so described and, in the majority of cases, correctly. So long as we are prepared to concede that the inferential part may now and again lead our judgment astray, and refrain from positive statement, very little harm will result from the occasional error.

The following incident illustrates the tendency—which long

practice and proved ability in aural recognition does not entirely remove—to allow our impressions to be unduly influenced by the special conditions of the moment.

During an evening raid the familiar drone of enemy bombers formed an almost constant background of sound mingling with the crash of neighboring guns and the intermittent crump of a stick of bombs. Two observers had just handed over to their relief crew, so that four men were present at the time. The telephonist, on taking over, inquired whether a twin-engine plane which could be heard approaching was, as he expected, hostile. Three experienced listeners unanimously agreed that it had "the heavy beat of a Jerry."

The telephonist at that moment received a report that a friendly fighter, a twin-engine Blenheim, was approaching, and almost simultaneously the supposedly hostile bomber gave British recognition signals. The men concerned had repeatedly proved their ability to recognize a Blenheim by ear alone, and there is little doubt that in this instance their assumptions based upon the prevailing conditions, allowing for the physical difficulty of distinguishing any individual "note" under those conditions, were stronger than any impression derived from a characteristic note.

Under more favorable conditions the ability displayed by some observers in identifying **British** planes by sound is really amazing. Albacores or Lysanders will be named—tentatively, it is true, because observers are wisely trained to avoid positive statement in reports based solely upon sound—when flying above clouds at heights up to 10,000 feet or so. The identification is verified either by subsequent reports or by actual sight of the aircraft as it crosses a clear opening between clouds.

The fine distinction between a Merlin-engined Hurricane and a Spitfire is considered difficult to detect, but the Battle, also fitted with a Merlin engine, is generally distinguished from either of these fighters with comparative ease. Ansons and Harvards are regarded as "easy meat." On one occasion, someone inquired whether "Limping Lizzie" had been seen in the district. The name was so apt that it was at once recognized as an allusion to a particular Anson.

The Wellington has a high-pitched note by which it is

easily recognized at low altitudes. This note appears to be independent of exhaust noise and is probably aerodynamic. It cannot be heard by a ground observer when the Wellington is flying at any considerable height. Under these conditions the deeper notes, which carry further, predominate and the characteristic sound is completely changed.

The effects of height, cloud layers, reflected sound, cross currents, speed, direction and maneuvre upon an aircraft's customary note—which is a compound of engine, airscrew and aerodynamic noise—do not appear to be sufficiently considered by those who regard the aural method as being generally reliable. The engine beat, or resonance, which figures so largely in the correspondence to which I have referred, is common to practically all types of twin-engine aircraft and is to some extent controllable by the pilot.

The question may be asked: "If it is a fact that experienced spotters can recognize many types of **British** aircraft by their characteristic sound alone, why should there be greater difficulty or less certainty in the recognition of **hostile** types?" The answer, surprisingly enough, is lack of practice!

We may listen to the sound of hostile planes droning overhead night after night yet, if we are unable to verify by sight, or in some other manner, the opinions which we tentatively form at the time, they remain merely opinions, held without firm conviction. There is nevertheless little chance of them being successfully challenged. Thus we find that a night raider, flying above cloud and screened from searchlights, may be variously reported as a Dornier, a Heinkel or a Junkers. When a fortunate burst brings it down and the charred remains are examined, it probably proves to be a Messerschmitt 110!

Daylight raids carried out by formations of single-engine fighters and twin-engine bombers flying at great heights provide no better opportunity for singling out and impressing upon the memory the note of any individual hostile type. "Tip and run" raids accompanied by low altitude bombing and dive bombing, are most frequently carried out under conditions of general or local low visibility.

If we consider the unfavorable musical conditions of a raid—the prelude of the sirens, the bass accompaniment of the barrage, the dominating theme of large formations and the

incidental music contributed by interceptor fighters—we can readily appreciate that comparatively few spotters have had repeated opportunities of familiarizing themselves with the individual and characteristic notes of many different types of hostile aircraft.

CHAPTER VI
SUGGESTIONS FOR TRAINING

The first, second and third condition of rapid and successful training for any useful work is interest in the subject. Those who by duty or inclination are led to the study of aircraft are fortunate in the choice of a subject which possesses in the highest degree those qualities which excite and sustain keen interest. The airplane, in its various aspects, stimulates most of the human emotions. The simple wonder and astonishment which greeted its early stages of development; the ambition, desire and anticipatory thrill of the future pilot; the satisfaction of the craftsman; the quiet confidence of the seasoned aviator; the admiration of the artist for the sheer beauty of the engineers' creation; the dread and horror of the civil communities which lie under its menace; the desolation of the bereaved; the intense relief and thankfulness of all who have seen this most formidable weapon brilliantly and effectively wielded in defense of our cherished ideals—these are but a few of the reactions which contribute to its universal appeal.

Barely two generations have sufficed for the development of aircraft from the curious and precarious contrivances of a few seemingly crazed pioneers to the sleekly streamlined monoplanes, fantastic in their compactness of power and possibilities of speed, which are now produced in their thousands by a world-wide and highly organized industry.

Students of aircraft recognition run little risk of reaching finality, and consequent boredom, within their lifetime. Design is fluid, nothing is stereotyped, every month sees the introduction of new or the modification of old types. Thus the spotter who wishes to maintain a certain standard of proficiency may not rest on his laurels but will remain ever on the alert for new information.

INDIVIDUAL TRAINING

Readers who are approaching the subject for the first time, and those who are still in the elementary stages of

training may find in these simple methods of personal instruction an interesting pastime for leisure hours.

As a first step try to memorize unnamed photographs. Cut suitable pictures of aircraft in flight from current publications and paste them on to cards. These should be approximately uniform in size and not too large to fit the pocket. Eliminate from the photograph not only the title but also, as far as is practicable, distinctive backgrounds, recognizable landscapes and other non-essential features which might otherwise provide an artificial clue to the identity of the aircraft. Mark the back of each card with either a key number or an initial, reference to which, it is understood, may only be made under penalty of one point for each occasion.

At the start, it is better to begin with a small collection—say twelve different photos illustrating no more than four different types of aircraft—than to take thirty or forty pictures, each representing a different type. Build up your initial collection, adding a few pictures at a time, but do not increase the number at any stage until you have proved to your own satisfaction, or to that of your family— whichever is the more exacting standard—your ability to recognize any card in the pack without hesitation.

When the pack reaches modest dimensions, say fifty photographs representing about twenty-four friendly and hostile types of aircraft, further progress should be sought rather by increasing the difficulty of the test than by extending the list of aircraft studied. This can be done by adopting any one or a combination of all of the following methods:—

(a) Include head-on, plan and side-view silhouettes.

(b) Choose photographs of aircraft viewed from a greater distance, and having less obvious recognition features than the pictures originally selected.

(c) Modify silhouettes by pencilling out all white lines representing structural details which do not affect the characteristic outline.

(d) Reduce gradually to a maximum of about three seconds the interval of time during which pictures are viewed.

Photographs used in tests of this nature should be changed as frequently as possible in order to ensure that the recognition features of the type, rather than particular photographs, become familiar.

It is scarcely necessary to add that no opportunity of observing and identifying actual aircraft in flight should be missed.

TRACING AND FREEHAND SKETCHING

Tracing the outlines of silhouettes or of suitable photographs is a valuable means of impressing the salient features of an aircraft on the memory. Some people, however, can trace quite competently in a mechanical manner whilst their minds are actively engaged on other problems, in much the same way as they might quite unconsciously "doodle" an intricate pattern. On the other hand, freehand sketching demands real concentration if the resultant drawing is to be definitely recognizable as a particular type of aircraft. Sketching, therefore, is to be preferred to tracing, and sketching from memory is one of the quickest roads to real familiarity with the major recognition features of any selected group of types.

Sketching from memory can be turned into an amusing game when two or three friends who are at about the same stage of training take turns in suggesting a subject and sketching the answer. Amusement is inevitable when one artist after the other realizes how far his masterpiece falls short of the simple original. A stupid mistake, once made, however, is rarely repeated and few methods provide such a rapid and salutary corrective to false notions.

The game can be varied by the artist sketching a simple outline which purports to show certain definite recognition features. His colleagues should correctly identify the drawing and if they are unable to do so it will be up to the artist to convince his audience that he has really indicated all essential clues. At the end of the discussion it is more than likely that both the artist and his critics will have gleaned some new points.

As a further diversion a few friends may try their hands at communal drawing. No. 1 sketches a simple outline of, say, the main plane of an aircraft seen in either the head-on or plan view. The general characteristics indicated may be common to two or three different types, so that No. 2 may use some discretion when drawing in additional features, such as fuselage, engines or tail unit. When, however, No. 2 has

finished, the particular type which is now quite literally "on the drawing-board" should be sufficiently obvious to leave no alternative manner of completion open to No. 3.

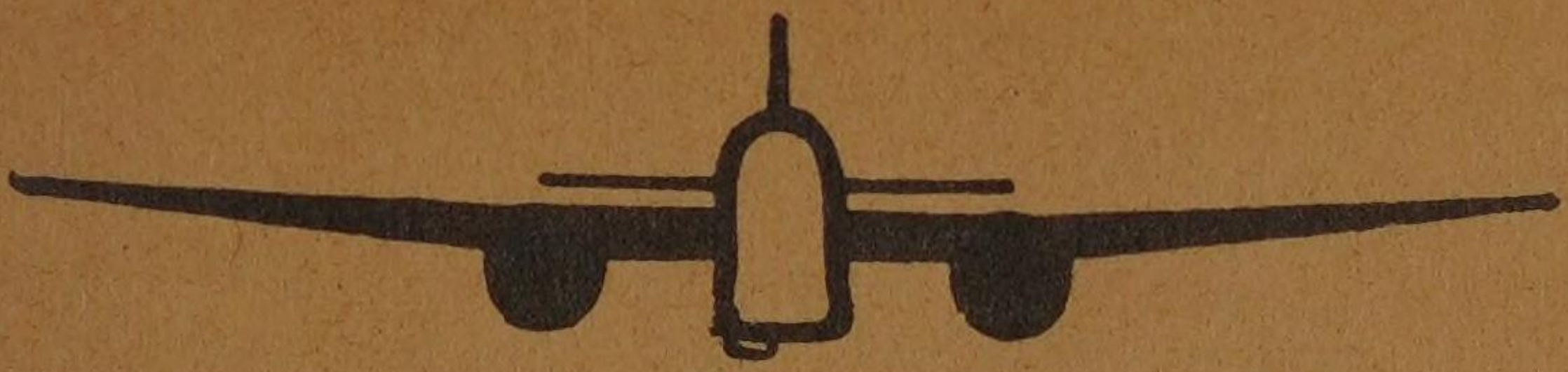
Readers should not be deterred by natural modesty concerning their artistic abilities from attempting to sketch aircraft in a clear, simplified and diagrammatic style. Artistic or technical is unnecessary. The head-on view of a monoplane with single engine of radial type is sufficiently indicated by two straight lines, representing the wings, and a circle outlining the section of the fuselage. A short horizontal line indicates the position of the tailplane, while one or more vertical lines show the type of fin and rudder.

A fuselage of oval section usually denotes—in the case of single-engine types—an aircraft fitted with an in-line engine. The wing lines are joined to the fuselage at the top, center, or bottom, in order to indicate a monoplane of high, mid, or low-wing type, respectively. They are inclined slightly upwards towards the tips to denote dihedral; variations of dihedral angle, such as straight center-section with dihedral on the outer section only, inverted gull wings, etc., are easily shown in the same diagrammatic manner. The extreme simplicity of this type of drawing, of which an example is given here, does not detract from its usefulness to the student.

THE DEVELOPMENT OF A COMMUNAL SKETCH

(a) No. 1 sketches ....? Evidently part of a head-on view. It may represent a high, mid or low wing type

(b) No. 2 makes it mid-wing with bell-shaped fuselage and single fin and rudder.



(c) No. 3 decides that "bell-shaped fuselage" chimes with Beaufort and adds the missing features: two under-slung radial engines, a long tailplane mounted fairly low and a gun blister offset to starboard.

MODEL-MAKING

Aircraft model-making is a fascinating hobby, frequently developed to a fine art. Its devotees gain a degree of familiarity with the essential lines of the craft which they build second only to that enjoyed by the original designers. The usefulness of model-making as a means of training in aircraft recognition, whether individual or in class, needs no emphasis. In view, however, of the time which is usually given to the construction of a single model, progress in the sister art of aircraft recognition would be slow if reliance were placed solely upon this form of instruction. If, on the other hand, aircraft modellers also make full use of other facilities for training, the practice of their hobby should give them the advantage of a flying start. The value of a collection of good scale models as an aid to training in aircraft recognition may be inferred from their general use in official training centers and their issue in increasingly generous numbers to those branches of the services which are especially concerned with countering air attack.

UNIFORM SCALE DESIRABLE

Familiarity with the relative size of aircraft can be acquired by noting the published figures of the leading dimensions and visualising these in comparison with the dimensions of some well-known and frequently seen type. The Hurricane, with its easily remembered span of 40 feet, provides a convenient yardstick. When sketching, this important factor should also be borne in mind. If space permits on sketch block, drawing-board, black-board or common slate, sketch roughly to scale. Short of seeing the actual aircraft, scale models provide the best and most convenient method

of teaching relative proportions, and many an experienced spotter has drastically revised his conception of the size of certain hostile types after seeing them in company with better-known British types modelled to the same scale.

A convenient scale for inexpensive models is 1/72, or one inch to six feet. This scale, which reduces the span of a Heinkel 113 to about 5", a Spitfire to 6", a Whitley to 14", and the latest Douglas giant bomber, B-19, to just under 3 feet,—is being increasingly adopted for instructional use.

Amateur model makers who are new to the game will find much helpful information concerning working drawings, materials and parts in the periodicals[1] which cater specially to their hobby.

[1] **Air Trails, Flying Aces, etc.**

CHAPTER VII
GROUP TRAINING

In the training of groups there is naturally a wider choice of methods and equipment, but the essential principles remain the same. These may be briefly summarized as:—

1. concentrate first of all upon a strictly limited objective;
2. progress by small and easy stages with sufficient revision to ensure that the foundations remain sound.
3. focus attention in each case upon the outline. Major recognition points of aircraft may conveniently be defined as those structural features which substantially form or deform the silhouetted outline as seen in any one of its three primary aspects: head-on, plan or side elevation;
4. increase the speed of recognition of known types before studying new types;
5. speedy recognition can only be reliable when it is based upon complete familiarity with the characteristic shape of the aircraft viewed from different angles;
6. aim at positive recognition, under average conditions of visibility, in a maximum of 3 or 4 seconds.
7. Seize every opportunity for practical field observation.

THE IMPORTANCE OF OUTLINES

The first two points are of fairly general application. The third is particularly important, since photographs and silhouettes usually show minor structural features which may easily be memorized instead of major recognition points. These details, although of undoubted interest, are but rarely visible at a distance. If too prominently shown they will distract and delude the student. Even if they carry him successfully through academic proficiency tests, he will fail in field work and in the long run bring discredit upon the training methods used.

Anyone who has had considerable experience of tests employing silhouettes in which minor features are prominently shown will be familiar with "trick recognition." Trick recognition is based upon the number and position of airspeed

Even the crew may become a recognition aid!

indicators, radio masts, loop aerials, landing-lights, wing-tip lights, and even the crew!

It also relies upon the numerous white lines indicating the relative position of ailerons, slots, flaps, detachable wing-tips and so forth. Perhaps the commonest example of this fallacious method is the use as a principal recognition feature of the white lines which, in plan silouettes, indicate the position of the retracted undercarriage.

A liaison officer of the R.A.F. recently revealed to me his memory aid for the plan silhouette of the Miles Master—two "V for victory" signs, each surmounting a wheel! With

TRICK RECOGNITION.....two "V for Victory" signs, each surmounting a wheel.

the aid of this and a bagful of similar trick recognition devices he sat for the Royal Observer Corps Club standard third

grade proficiency test and unblushingly gained full marks! The following day, back at his station, he chatted with a pilot as three fighters took off. "Darn good machines, these Tomahawks" said the pilot. My friend, recognizing only three Spitfires, then about 500 feet up, inquired "What Tomahawks?" "Why, the center one," came the answer, and ironically, "didn't you notice it on the tarmac?"

SPEED OF RECOGNITION

When real familiarity with the shape of an aircraft in its different aspects its attained, recognition in favorable conditions is practically instantaneous. Distance, glare, low visibility and other factors, however, introduce an unavoidable time lag which it is the object of training to reduce to the minimum. Service schools, concerned chiefly with the training of spotters working with A.A. gun crews, R.A.F. ground defences, etc., generally aim at a maximum of 3 or 4 seconds for positive recognition in average conditions. Should this time limit be exceeded, the possibilty of the gun crew taking effective action against attacking aircraft would be seriously reduced.

The standards set by the proficiency tests of the various Spotters Clubs are appreciably lower. Until recently an interval of 20 seconds was allowed for recognition of a highly detailed silhouette projected on to a screen so that the image should not be smaller than that of a Lysander flying at 500 feet. The period has lately been cut to 10 seconds and no doubt as proficiency increases it will be further reduced.

Possibly the reason for the adoption of lower standards in these proficiency tests is to be found in the assumption, frequently made, that as observers and spotters do not man guns there is less need in their case for instant recognition. This assumption cannot be justified, for even on those rare occasions when hostile aircraft obligingly cruise around in a clear sky, the observers' report sets in motion a number of defensive measures in any one of which a few seconds saved might prove to be of vital importance. In the more probable event of the enemy taking advantage of cloud cover, the observer may perhaps snatch only a fleeting glimpse of aircraft as they streak across a patch of blue to be swallowed by the next cloud-layer.

It would thus appear desirable progressively to reduce the time standard of existing Spotters' Club proficiency tests until they conform to the standards generally considered to be necessary and attainable by spotters operating with gun crews.

ORIGIN OF SOME CURRENT PROFICIENCY STANDARDS

After a short period of use of photos by the spotters' clubs, the tendency to recognize particular photos by unimportant details, including features of landscape, i.e. "trick recognition," became evident and silhouettes were adopted as the best means of insuring that the tests proved familiarity with the essential features of the aircraft. Many of the silhouettes used at that time were merely solid black drawings, showing little detail except the position of glazed cockpits, cabins or turrets—features which would naturally be apparent in a true silhouetted image. Observers who passed these tests could reasonably be assumed to be familiar with the characteristic shapes and would be unlikely to fail to recognize the same type if seen in the air.

With the lapse of time and the detailed knowledge of hostile aircraft which has become generally available, artists have polished up their drawings and "improved" their silhouettes until they are silhouettes no longer! They now resembel general arrangement drawings, in which the customary line drawing on a white ground has been reversed in order to give bold white outlines of structural parts against a solid black ground. However desirable this development may be for other fields of study, it directly encourages "trick recognition" in those proficiency tests which employ silhouettes exclusively.

In order to overcome this growing tendency, some spotter groups sanction the use of partially "blacked-out" silhouettes, that is, silhouettes from which all distracting and unnecessary structural lines have been deleted. This is a move in the right direction, but it also means that the tests cease to provide a uniform standard, since the level of skill required to pass the tests in which partially blacked-out or "twilight" silhouettes are used is appreciably greater than that needed when fully detailed silhouettes are employed.

For the same reason, instructors tend to revert to the use of photographs for recognition tests. There is now such an abundance of good pictures that frequent change is possible, and by suitable choice of photographs it is easy to arrange progressive tests, without increasing the number of types for study—a very important point.

R.A.F. BOSTON—A good example of a photographic silhouette: Characteristic features are clearly shown without unnecessary detail.

ARMY AND R.A.F. RECOGNITION METHODS

The British instructors of No. 1 Aircraft Recognition Wing, R. A. F., who find that an occasional "leg-pull" enlivens the class, tell this story of "trick recognition" against themselves. Six different photographs, close views of the stern of a twin-engined aircraft standing on the ground, were projected in spotting practice tests. Three photos showed Hampdens and three Herefords, but, viewed from the rear, the upper part of the Napier "Dagger" in-line engines fitted to the Herefords was in some cases indistinguishable from the cowling of the Hampden's radial engines. Three seconds of exposure gives little time for close examination and the photographs usually had everyone guessing—until a trick recognition expert noticed that three of the six photographs were taken when snow was on the ground. As one of these was clearly a Hampden, he made the lucky guess that all three "snowscapes" showed Hampdens. It followed that the three views without snow could safely be assumed to be Herefords! As the ingenuity of the trick recognition

specialist is only matched by his generosity in circulating his tips, soon the whole class was returning the correct answer to each picture, and the intended victims were quietly enjoying the astonishment of their instructors.

Having lately enjoyed the privilege of seeing and learning something of the methods employed for the training of instructors in aircraft recognition, both at the Army A.A. School of Aircraft Recognition and in the No. 1 Aircraft Recognition Wing, R.A.F., it is a pleasure to be able to affirm the essentially practical nature of official methods of instruction and to acknowledge my own indebtedness to them. In these schools, which between them are turning out hundreds of Service Instructors every month, the greatest stress is placed upon speedy recognition, complete familiarity with basic types, and knowledge of subsequent modifications. The method of reading silhouettes which is taught leaves little scope for trick recognition, since the student-instructors' attention is directed exclusively to the outline of the aircraft which he is trained to follow systematically in "reading" successively the head-on, plan and side views.

Whilst this method may at first sight appear to be mechanical, it is easily followed and as readily remembered. As a simple form of drill—equally applicable to outline drawings, photographs and silhouettes, with or without structural detail,—it has the great merit of piloting the student automatically past unnecessary detail, which, from the start, he is taught to ignore. The sequence in which the various features of the silhouetted outline are noted is logical and natural.

CHAPTER VIII
READING THE SILHOUETTE

Study first the head-on view, noting the shape of the FUSELAGE in section, whether round, oval, boxlike, bell-shape or of any other distinctive form. Note also the relative size and position of any projections from the fuselage, such as cockpit, cabin, turrets, radiator ducts, and gun positions. Next, mentally fit the WINGS to the fuselage, noting whether they are in the high, mid or low position. Look for their dihedral angle and note whether it is continuous from the roots or combined with a long or short straight centre-section. If the aircraft is of multi-engine type, the number and position of the ENGINES will next be noted, their type—whether in-line or radial—and the manner in which they are placed on the wing—whether underslung or centrally mounted. Here take note also of any features which protrude above or below the wing, such as bomb-racks, off-set radiators, undercarriage parts and fairings. Next comes the position of the TAILPLANE relative to the fuselage and finally, the FIN and RUDDER, which may be tall or short, and of single, twin or triple type.

THE PLAN VIEW

In reading the plan view, it is logical to begin at the beginning, or NOSE of the aircraft, which in single-engine types usually includes the engine and that part of the fuselage which projects forward of the wings. In multi-engine types the term usually means that part of the fuselage which is forward of the wing. The method assumes that the observer is watching an aircraft as it emerges from a cloud, and as the majority of airplanes fly nose first, the natural order of observation is from nose to tail. Startling as it may seem, one or two of the latest types now serving with the R.A.F do not fly nose first. The Beaufighter, for example, while not addicted to flying in reverse or tail first, has a relatively stumpy nose and unusually long engine nacelles, so that it normally flies with engines leading and nose a good second.

After deciding that the nose is long, short, sharp or stubby, glazed or unglazed, the student lets his eyes travel round the outline of one WING along the leading edge from root to tip, back along the trailing edge to the wing root, noting meanwhile taper, projection of engine nacelles forward or aft of the wing, and any other structural part which, protruding beyond the wing, breaks or changes the outline. In mentally tracing the wing outline the student will have formed a rough impression of the relationship between the span and the chord, in other words, the aspect ratio of the wing. He will have noted the characteristic shape of the tips—one of the most important recognition points—and the presence or absence of fillets[1] from wing to fuselage.

From the FUSELAGE, noting incidentally its characteristic shape, the outline is traced to the TAIL UNIT. The outline of the tailplane is followed in the same way as that of the wings, proceeding along the leading edge, round the tips and back along the trailing edge to the root. Frequently a V-shaped cut-away will be observed in the trailing edge, generally in the hinged rearward part or elevator.

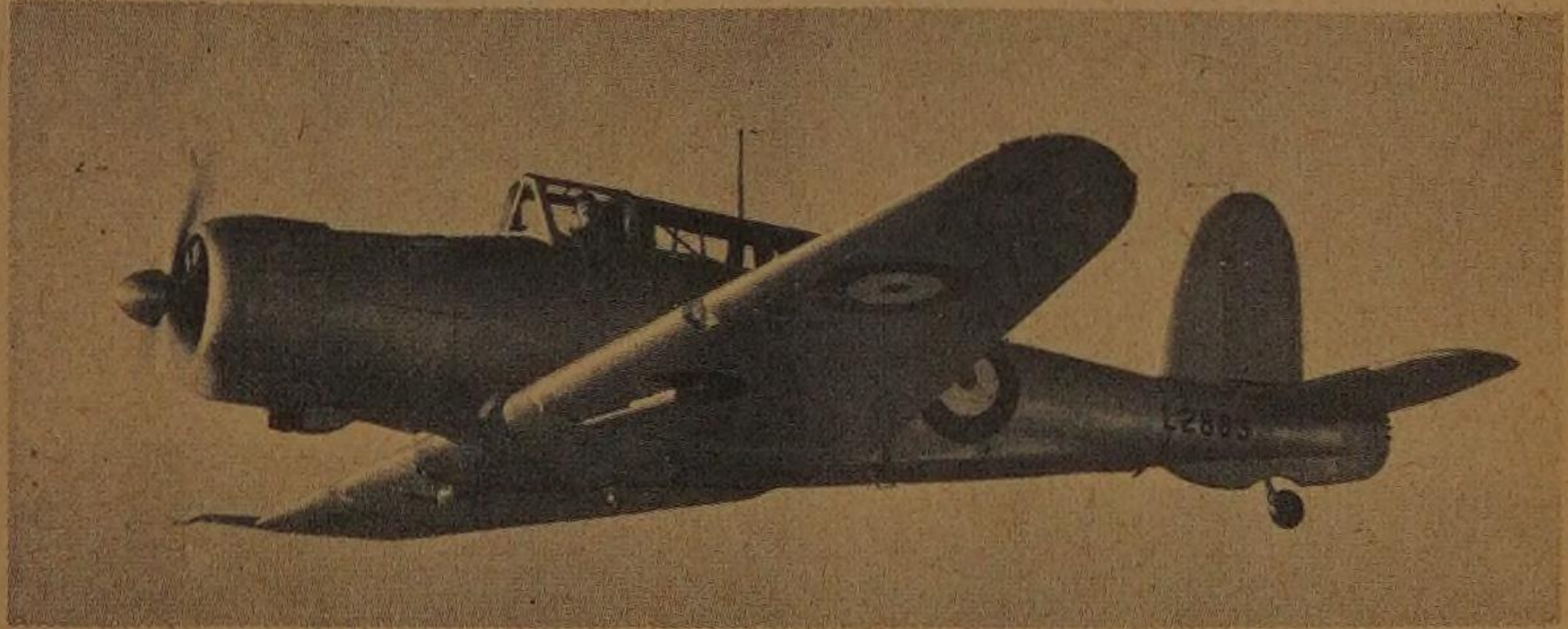
The Junkers 87 Dive Bomber. The rectangular tailplane has no cut-away.

The cut-away provides for free movement of the rudder, but there are many designs in which the rudder is placed so far aft that it cannot foul the elevator. Fulmar, Master, Ju 87 and Ju 88 are common examples of this arrangement.

1 NOTE.—A gracefully curved fillet from trailing edge to fuselage, such as may be seen in the plan view of the Beaufighter is a minor feature of many types, but a fillet from the leading edge to the fuselage is comparatively unusual. Curved fillets from both leading and trailing edges form a distinctive feature of the wing shape of the Dornier 17 and 215 bombers.

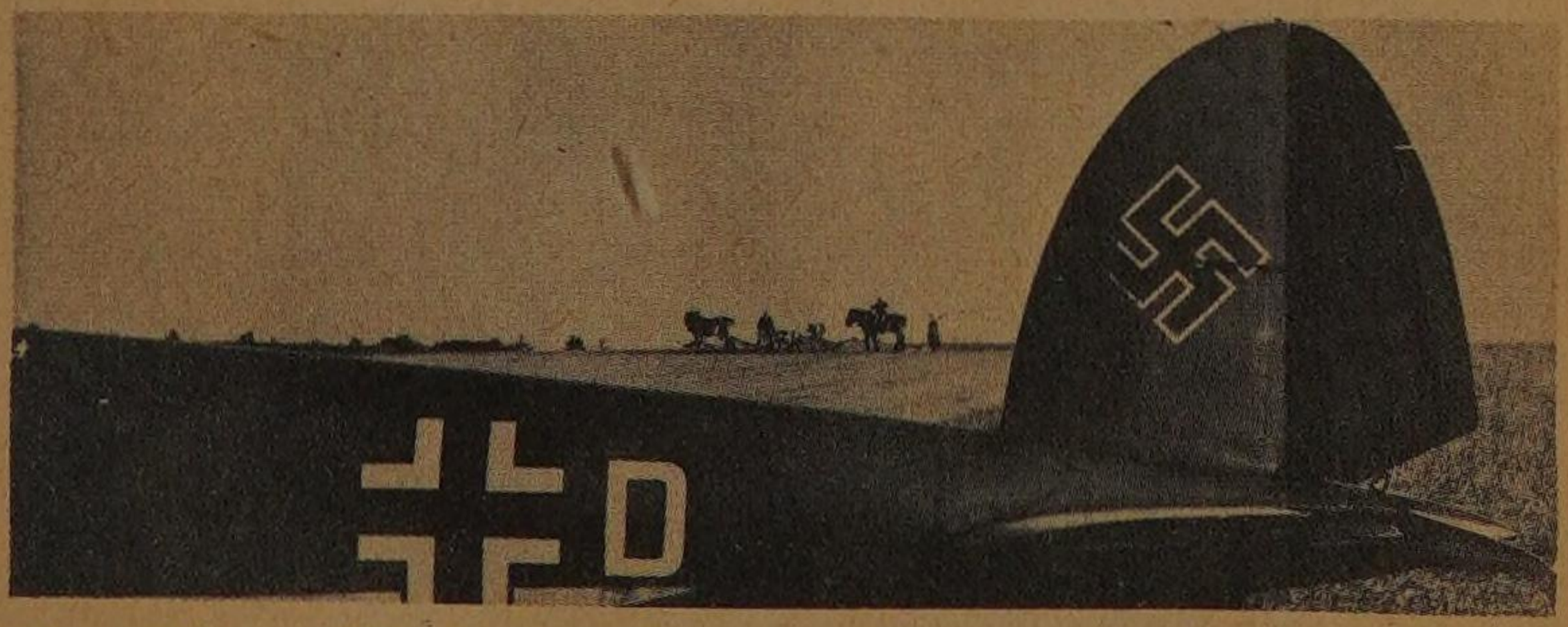
In other designs, such as the Wellington, the rudder is mounted high and clear of the elevator, so that a cut-away is unnecessary. In the unusual tail design of the Roc and Skua the rudder clears the elevator because it is mounted well forward.

A further variation is found in the tail unit of the Heinkel 111 K, where the characteristic elliptical tailplane shows no



The rudder of the Skua is mounted forward, clear of the elevator.

sign of a cut-away. In the side view, however, it will be noticed that the base of the rudder itself is cut away to allow free elevator movement, thus reversing the usual arrangement and providing a useful distinctive point.



The rudder of Heinkel 111K is cut away, instead of the elevator.

The Liberator and the Me 110 provide examples of twin-tail types in which the elevator is cut away at each end. With twin-tail units, however, the cut-away is usually a much less noticeable feature.

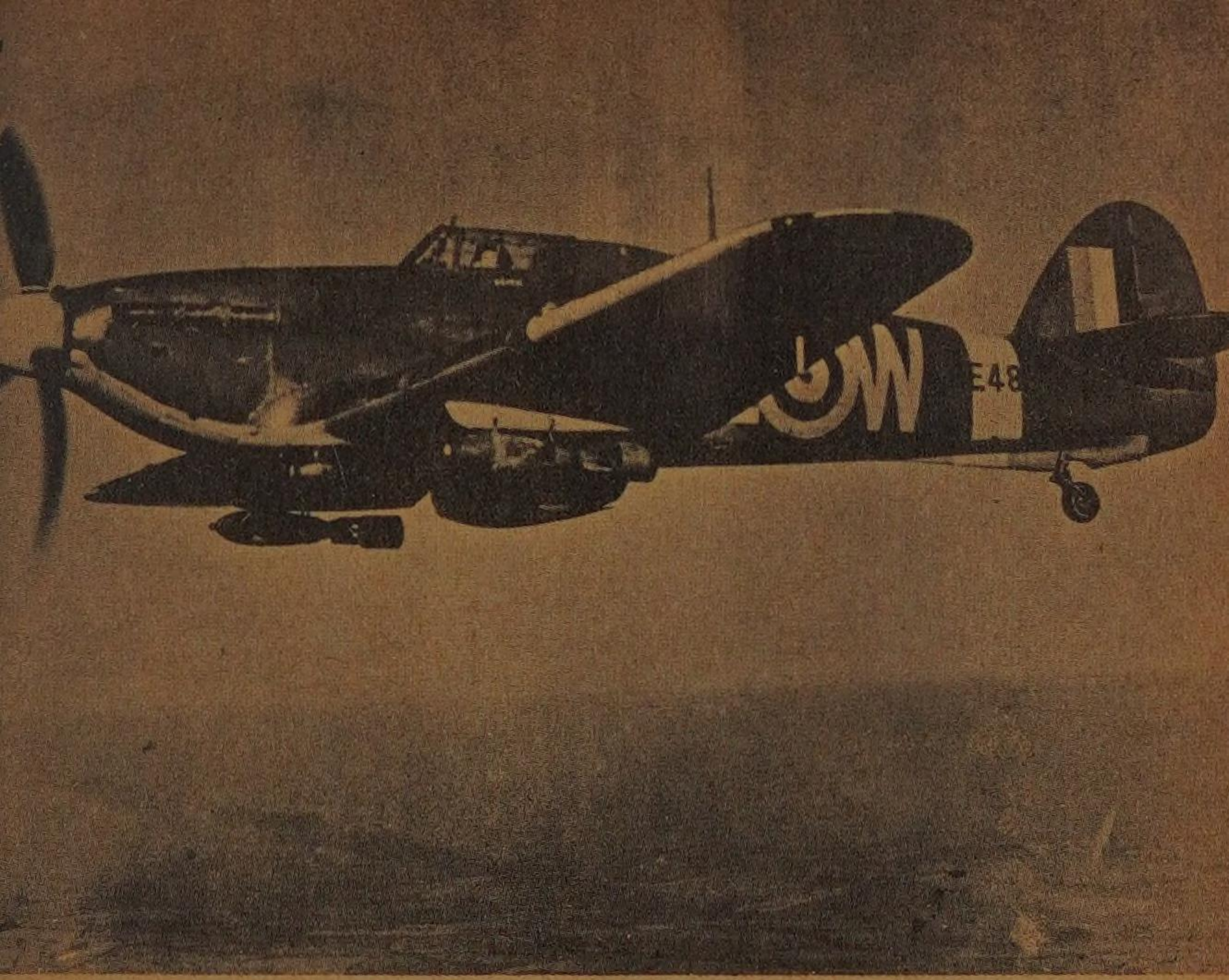
After the tail unit proper, the outline is in some cases prolonged by the extremity of the fuselage, which may pro-

trude aft in the form of an innocuous streamline fairing or as a blunt and business-like gun-turret—the sting in the tail.

SIDE VIEW

Now take the side view. Again begin at the NOSE—except for those unusual designs like the Beaufighter in which the engines precede the nose—and after noting its characteristic shape, proceed along the top of the silhouette, noting any projections such as cockpit, cabin, turrets and gun cupolas, until the tail unit is reached. Return to the nose or forward end and follow the underside of the silhouette taking particular note of any interruptions or deformations of its smooth sweep towards the tail. These may be caused by deep ducted radiators, large, prominent and underslung engine nacelles, bomb welts and under-gun positions. In older types it may be necessary to take note of a fixed or partially retracted undercarriage. When studying marine aircraft, the floats of a seaplane or the keel of a flying boat may each have particular characteristics which can most clearly be observed in the side view. With all of these the underside should be followed until the tail unit is reached, noting incidentally any tail gun-turrets. The "reading" of the silhouette concludes with careful observation of the size and shape of the fin(s) and rudder(s), generally one of the most important clues to the identity of an aircraft.

When a silhouette is read in this manner, some effort will be made, consciously or subconsciously, to visualize the airplane in each of three aspects. As a further stage, try to combine the most important elements of the three flat images into a three-dimensional perspective view. If this process be repeated and aided by reference to photographs until a clear picture of the aircraft is readily formed in the mind, the final goal of complete familiarity will not be far distant. There is little doubt that the type studied would be recognized in the air when actually seen for the first time and although the speed of recognition might not at first be all that could be desired, it should rapidly improve.



"Hurricane" with bombs.

CHAPTER IX

LOW-WING MONOPLANES

VICKERS-SUPERMARINE "SPITFIRE"

The "Spitfire" is a fighter with a history and a future. With the "Hurricane" it was largely responsible for the victory which the British gained over Goering's Luftwaffe in the summer and fall of 1940. Since then the "Spitfire" has seen constant service, and it has undergone considerable improvement. Variations in the power plant and the armament have been numerous. Shown in the accompanying silhouettes is the "Spitfire VB", a relatively late version with a three-blade propeller and a 1,300 h.p. Merlin liquid-cooled motor. Maximum speed of this model is in the neighborhood of 400 m.p.h.

As of December 1, 1942, the latest "Spitfire" is a machine with slightly larger dimensions than those of the VB. This new model also has a four-blade propeller and a new Rolls-Royce Merlin engine of unspecified power. It is apparently designed for high-altitude work. Armament consists of two 20 mm. cannon carried in the wings and four machine guns.

Recognition Points

General structural features: Low-wing monoplane; single in-line engine; elliptical wings and tailplane; outwards-retracting undercarriage.

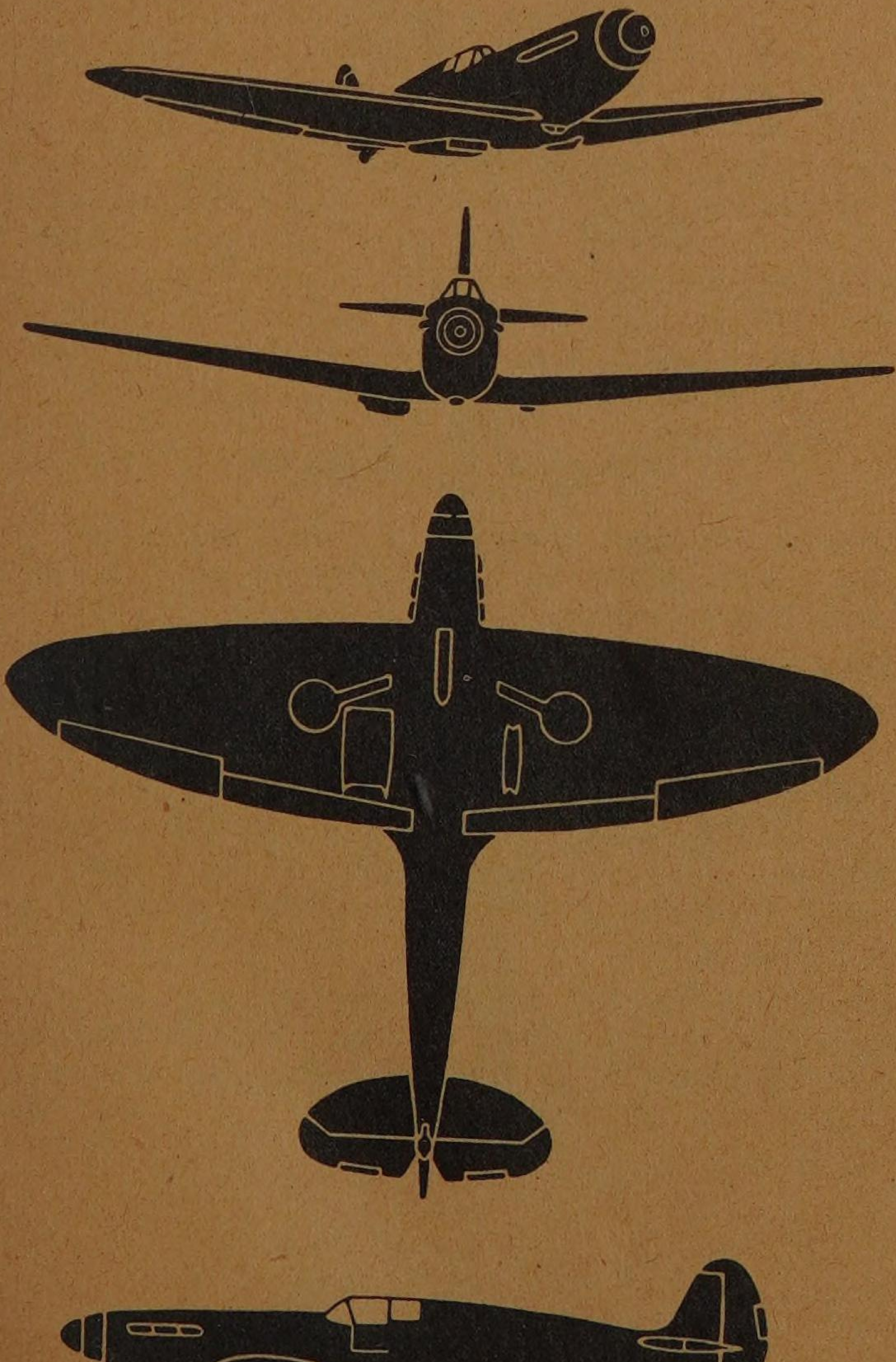
Head-on view: Oval cross-section of fuselage surmounted by glazed cockpit; dihedral on wings; distinctive airscoop for radiator under starboard wing; high tailplane.

Plan view: Elliptical wings with pointed tips; fillet from trailing edge to fuselage; finely streamlined fuselage; elliptical tailplane and elevator with cut-out for rudder.

Side view: Straight line from top of spinner to cockpit, then step-up and taper to fin and rudder, which are curved on leading edge, top, and trailing edge; outline of bottom of fuselage begins with a distinct bulge aft of spinner, is broken by radiator, and continues thence in a gentle upward curve to rudder.

"SPITFIRE" VB. (Merlin)
British Fighter

Span 36' 10" **Length 29' 11"** **Height 9' 3"**



HAWKER "HURRICANE"

This successful single-seat interceptor fighter is slightly larger than the "Spitfire" and not quite so fast, early models having a maximum speed of 335 m.p.h. In 1940 "Hurricane" and "Spitfire" squadrons together beat off innumerable massed raids against Britain, and although heavily outnumbered by escorting fighters, brilliantly sustained the R.A.F. tradition of fearless attack. The performance and armament of both aircraft is steadily being improved, and "Hurricanes" are currently equipped with either twelve machine guns or four 20 mm. cannon. Although "Hurricanes" were first used as high-altitude fighters, in the North African campaigns of late 1942 they were employed as light bombers, carrying two or more bombs slung under the wings. However, this should not be taken to mean that the machine is no longer used as a fighter.

Recognition Points

General structural features: Low-wing monoplane; single in-line engine; single fin and rudder; streamlined fuselage; retractable undercarriage.

Head-on view: Oval fuselage surmounted by glazed cockpit, with airscoop of radiator beneath; slight dihedral on outer sections of wings; tailplane rides high.

Plan view: Taper of wings to rounded tips more marked on the trailing edge; center section of wings untapered; conspicuous fillet from trailing edge; tailplane elliptical with cut-away for rudder; fuselage tapers sharply just aft of wings, then gently to tail.

Side view: Fuselage has hump-backed appearance; large, well-rounded fin and rudder continued beneath the fuselage; outline of underside of fuselage broken by radiator.

"HURRICANE" (Merlin)
British Single-Seat Fighter

Span 40' 0" **Length 31' 5"** **Height 11' 3"**

FOCKE-WULF 190

It was no secret in 1940 that the Germans were not satisfied with the Messerschmitt 109 series of fighters. Doubtless the FW 190 is one of the results of this dissatisfaction, although this machine can hardly be expected to replace the Messerschmitts. The FW 190 is apparently a highly specialized machine, which, within its limitations, is extremely deadly. It is powered by a 1,600 h.p. BMW 14-cylinder radial motor, which gives the machine a normal top speed of 375 m.p.h. at 18,000 feet. However, when the FW 190 gets into a very tight spot its speed may be boosted to 390 m.p.h. for one minute only, by the injection of a small quantity of super-high octane gasoline without burning out the engine. The FW 190 is armed with two 7.92 mm. machine guns and four 20 mm. cannon. The machine guns are mounted on the motor cowling and two Mauser cannon are mounted at the wing roots. All these guns fire through the airscrew. The two other cannon are mounted farther out on the wings. Although the total weight of fire is 610 pounds per minute, this can be maintained for only 7½ seconds at full intensity. Range of this machine is short, even for a fighter; 525 miles at 275 m.p.h. It should be added that all the above figures apply to the particular subspecies known as FW 190A3.

Recognition Points

General structural features: Low-wing monoplane; single radial engine; single fin and rudder; retractable undercarriage.

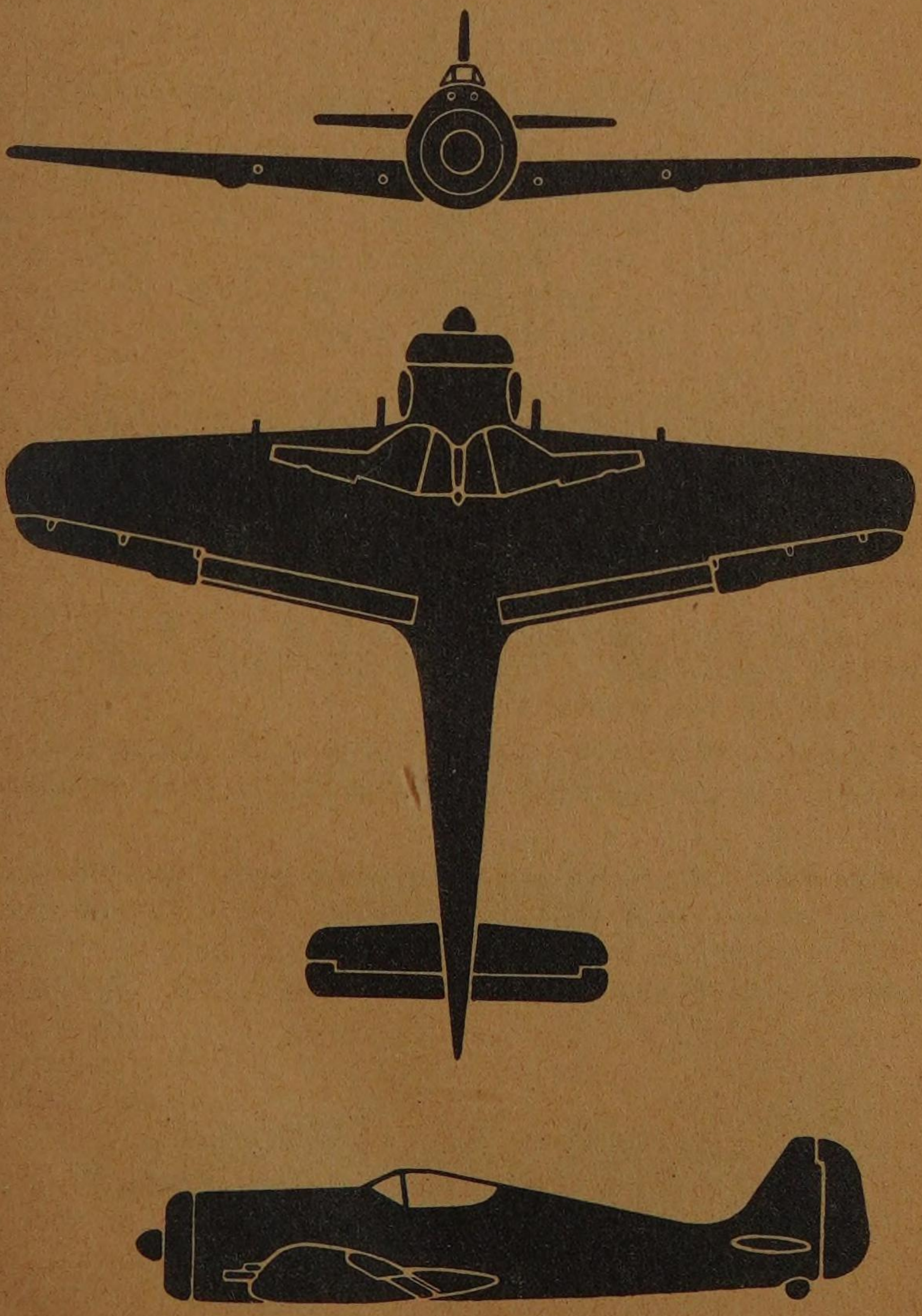
Head-on view: Circular section of fuselage surmounted by cockpit; tailplane mounted high; wings have dihedral from roots.

Plan view: Short, blunt nose; trailing edge of wings tapered more than leading edge; rounded wing tips; leading and trailing edges of horizontal elements of tail practically untapered, although slight taper may be visible on leading edge; fuselage extends rearwards of elevators.

Side view: Outline of top shows gentle rise from front of cowling to gentle step-up for cockpit; from top of cockpit outline falls off to bottom of fin; gently curved bottom line of fuselage broken only by tail wheel; rudder extends well back of horizontal parts of tail.

FOCKE-WULF 190 (B.M.W. 801D)
German Fighter

Span 34' 5" **Length 29' 4"**



MESSERSCHMITT 109E

The brunt of German short-range bomber escort work was, through 1940 and much of 1941, borne by the Messerschmitt 109E single-seat fighter. Originally armed with four machine-guns and one 23 mm. cannon, firing through the air-screw hub, later types were fitted with two machine-guns and a small cannon in each wing. Owing to the heavy casualties sustained by Nazi bombers, the Me 109E was on occasion used as a light bomber. With maximum speed of 354 m.p.h., the Me 109E fighter, after releasing its bombs, could more easily evade the attentions of the R.A.F. The power unit is the Daimler-Benz 601 liquid-cooled engine of 1,150 h.p. Silhouette shows an early Me 109E with D.B. 600 engine of 1,050 h.p. Although the 109E is now badly out of date, some may still be seen.

Recognition Points

General structural features: Low-wing monoplane; central radiator forward of wings; additional small radiators under each wing; single fin and rudder; outwardly retracting undercarriage.

Head-on view: Streamlined fuselage of oval section with enclosed glazed cockpit; wings with full dihedral; high braced tailplane; fin and rudder visible.

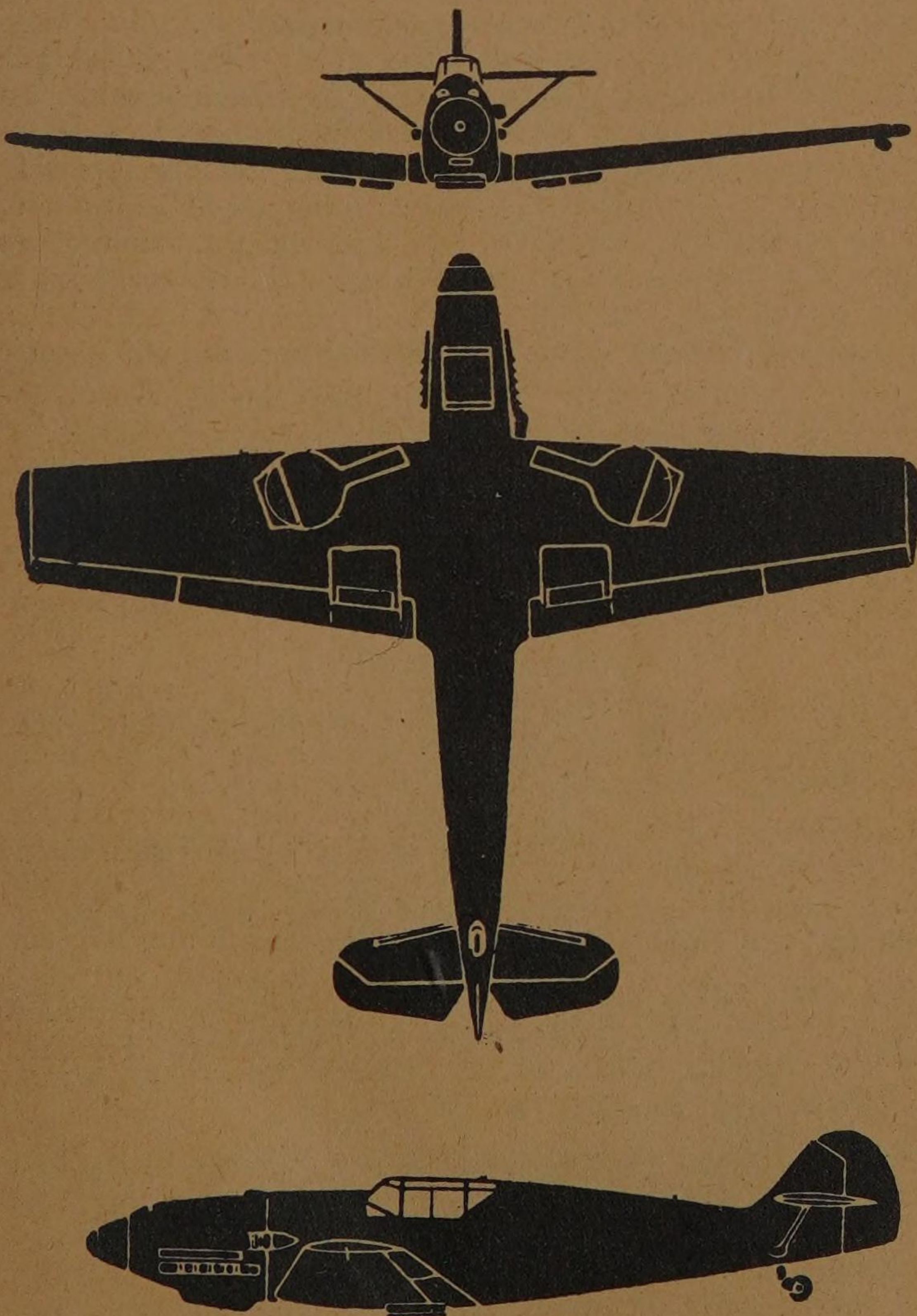
Plan view: Uniformly tapered wings with almost square-cut tips; slim, tapered fuselage; tapered tailplane with rounded tips.

Side view: Glazed sides of cockpit bite deeply into fuselage, giving broken back outline; underside tapers to tail from "chin" forward of wing; note characteristic shape of fin and rudder—smaller than "Hurricane," wider than "Spitfire."

MESSERSCHMITT 109E (D.B. 600)

German Single-Seat Fighter

Span 32' 5" Length 28' 3" Height 8' 4"



MESSERSCHMITT 109F

The modifications which distinguish the Me 109F from Me 109E are so considerable that it may almost be regarded as a distinct type. The first example to be forced down on British territory landed, practically undamaged, in July, 1941. The redesigned wing with rounded instead of square-cut tips is not unlike that of the "Hurricane." The fuselage retains its characteristic appearance of disproportionate length. A modern cantilever tailplane replaces the older braced and adjustable type. The Mercedes-Benz DB 601 liquid-cooled engine gives slightly over 1200 h.p. and its performance at heights is improved. Top speed is around 380 m.p.h. and service ceiling about 40,000 feet.

Armament: Mauser cannon firing 900 rounds per minute through the airscrew hub—and two machine-guns on top of the fuselage. Me 109 F-1 is provided with two hundred 20 mm. shells—sufficient for about 13 seconds continuous fire. Me 109 F-2 is fitted with a 15 mm. Mauser cannon and has other minor differences of equipment. A single 550 lb. bomb may be carried externally. Late in 1942 a new variation, the Me 109G, was reported in action over the Russian front.

Recognition Points

General structural features: Low-wing monoplane; bullet-shaped nose; single in-line engine; single fin and rudder; long slender fuselage; retractable undercarriage; small tail.

Head-on view: Oval fuselage wider at base, surmounted by small glazed cockpit; wings have dihedral from roots; two shallow radiators protrude beneath wings; high tailplane; visible fin and rudder of medium height.

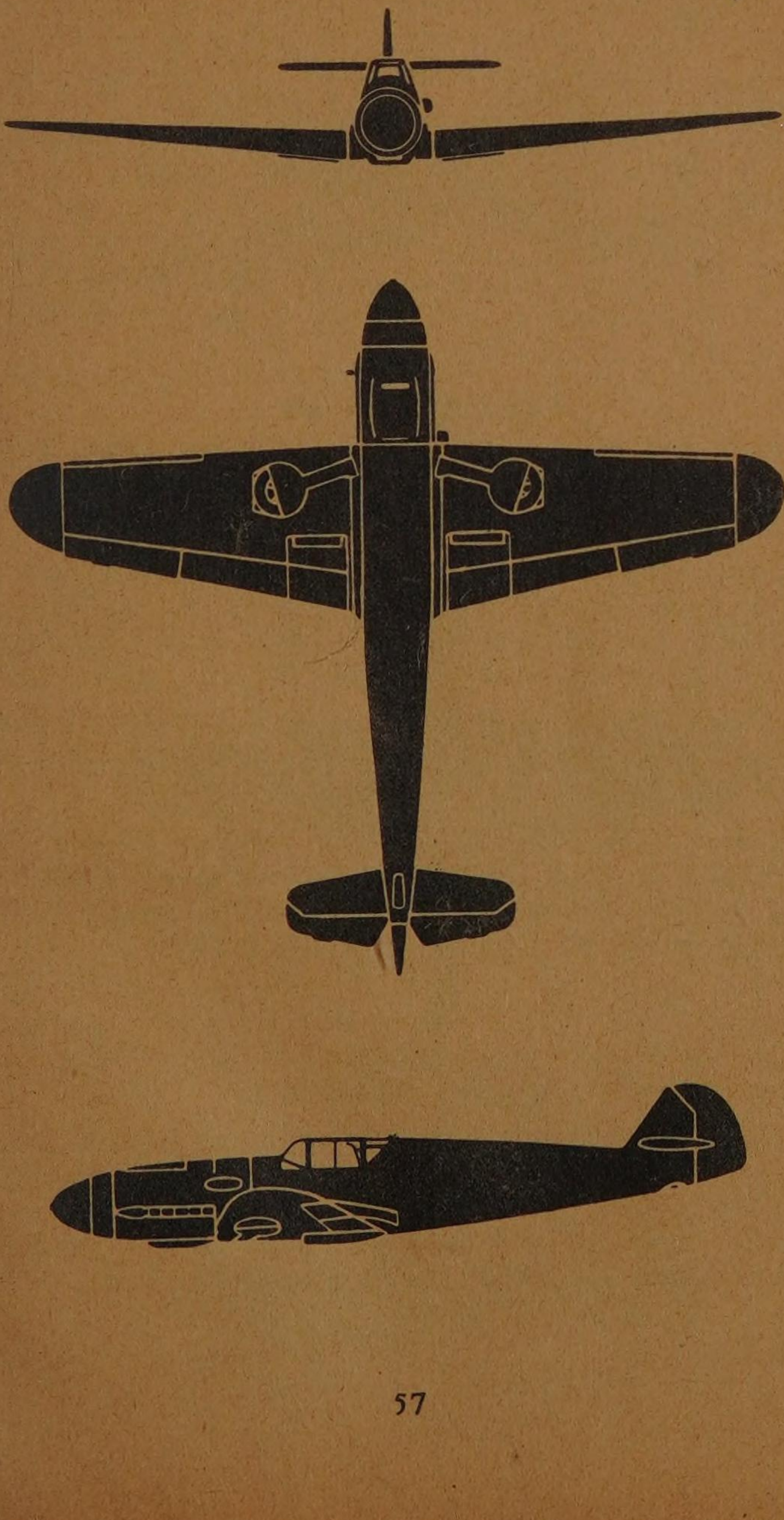
Plan view: Long, bullet-shaped nose; wing taper straight on leading-edge; more marked taper on trailing edge; rounded wing tips; fuselage tapers to tail; straight taper both edges of tailplane; wide rounded tips, V cutaway.

Side view: Bullet-shaped nose; straight fuselage to shallow cockpit, then taper to tail; underside, broken by forward radiator, tapers from amidships to tail; wide fin and rudder of medium height, with marked straight taper in leading edge, curved taper in trailing edge, wide rounded top.

MESSERSCHMITT 109F (D.B. 601N)
German Single-Seat Fighter

Span 32' 7"

Length 29' 9"



HEINKEL 113

This standard German fighter is in the same class as the Messerschmitt 109E, but is faster, having a maximum speed around 400 m.p.h. It is an improved version of the He 112, an unsuccessful design of which little has been heard since the early days of the war.

In place of the elliptical wings of the He 112, the new fighter has tapered wings, which in plan resemble those of the "Hurricane" or "Defiant." It is much smaller than either of these, the wing span of He 113 being 9 ft. shorter than the "Hurricane's" and 5 ft. shorter than the "Spitfire's" span. It is powered by a 1,500 h.p. Daimler-Benz liquid-cooled engine.

Recognition Points

General structural features: Low-wing monoplane; single in-line engine; single fin and rudder; fuselage of nearly circular section; undercarriage retracts inwards.

Head-on view: Nearly circular fuselage surmounted by closed cockpit; inverted gull wing formed by anhedral of center section and dihedral of outer section; high tailplane extends just beyond center wing section; fin and rudder visible.

Plan view: Long bullet-shaped nose; center section of wings untapered; outer section tapered to rounded tips; tapered tailplane with rounded tips, cutaways.

Side view: Clean outline of nose suggests large calibre shell; step-up in streamlined fuselage over glazed cabin; tall fin and square-cut rudder are very distinctive, their outline resembling the closed jaws of a movable spanner.

HEINKEL 113
German Single-Seat Fighter

Span 30' 11" Length 26' 7" Height 8' 2"

BOULTON PAUL "DEFIANT"

The first land fighter to be armed with a power-operated four-gun turret, the Boulton Paul "Defiant" two-seater fighter has an unusually wide field of fire. In 1940, in a surprise appearance over Dunkirk, 12 Defiants shot down 38 Nazi planes without loss to themselves. The bag included 16 twin-engine Messerschmitt 110's. The "Defiant" is fitted with a Rolls-Royce Merlin liquid-cooled engine, developing over 1,000 h.p.

Recognition Points

General structural features: Low-wing monoplane; wings not unlike the "Hurricane," for which it is frequently mistaken; single in-line engine; single fin and rudder; finely streamlined fuselage and enclosed cockpit with gun turret amidships; undercarriage retracts inwards.

Head-on view: Roughly oval fuselage, wider at the top, surmounted by glazed cockpit and gun turret, with radiator below; wide wing center section; underside of outer section tapers to tips, giving effect of dihedral; high, wide tailplane.

Plan view: Longer and slimmer nose than the "Hurricane"; taper of wings increases abruptly about half-way; tailplane tapers to rounded tips.

Side view: Streamlined curve of fuselage broken by cockpit and turret; line of underside broken by radiator; angular fin and rudder tapers to rounded tips.

"DEFIANT" (Merlin).
British Fighter

Span 39' 4" Length 35' 4" Height 12' 2"

FAIREY "BATTLE"

This famous and well-tried two-seat bomber has seen several years of service with the R.A.F. "Battles" were frequently in action with the advanced striking force in France. Later, with the Bomber and Coastal Commands, British and Polish "Battle" squadrons played their part in the destruction of the invasion fleets and bases. Armament consists of one fixed wing gun and one movable gun in the cockpit.

With a single Rolls-Royce Merlin liquid-cooled engine, developing 1035 h.p., the maximum speed is 257 m.p.h., with cruising range, at 200 m.p.h., of 1,000 miles. This performance is comparable to that of modern high-speed trainers, and large numbers of "Battles" are now giving excellent service as trainers in Britain and in Canada.

Recognition Points

General structural features: Low-wing monoplane; single in-line engine; single fin and rudder; streamlined fuselage, with large glazed "greenhouse," longer and more slender than "Hurricane"; undercarriage retracts backwards.

Head-on view: Oval fuselage section surmounted by glazed cockpit; slight dihedral; wide tailplane extends outward of partially exposed undercarriage; tall prominent fin and rudder.

Plan view: Nose projects further forward of leading edge than in "Hurricane"; uniformly tapered wings with rounded tips; curved fillet from wing roots to fuselage; tailplane, mounted low on fuselage, has full taper on leading edge only; rounded tips.

Side view: Streamlined curve of fuselage with step-up over large "greenhouse"; underside broken by radiator and partially exposed undercarriage; taper more marked on leading edge of tall angular fin and rudder.

"BATTLE" I (Merlin)

British Medium Bomber and Trainer

Span 54' 0" Length 42' 4" Height 15'0"

FAIREY "FULMAR"

A fast two-seat fighter in service with the Fleet Air Arm, the "Fulmar" has a strong family likeness to the "Battle." It is developed from the Fairey experimental type P 4, a design which was adopted by the Danish Navy before the outbreak of war. This had a maximum speed of over 300 m.p.h. and a cruising range of 1,000 miles.

The "Fulmar," fitted with a single 1,145 h.p. Rolls-Royce Merlin liquid-cooled in-line engine, may be assumed to have a higher performance, athough actual figures are not released. It was first officially mentioned in action early in September, 1940, when an Admiralty communiqué from the Eastern Mediterranean described the shooting down of five Junkers 87B dive-bombers by "Fulmars" and "Gladiators." The wings fold for stowage and the equipment includes catapult points, deck arrester and a dinghy. Armament: eight machine-guns in the wings.

Recognition Points

General structural features: Low-wing monoplane; single in-line engine; single fin and rudder; distinctive tail; long streamlined fuselage with large glazed divided cabin; retractable undercarriage; large radiator.

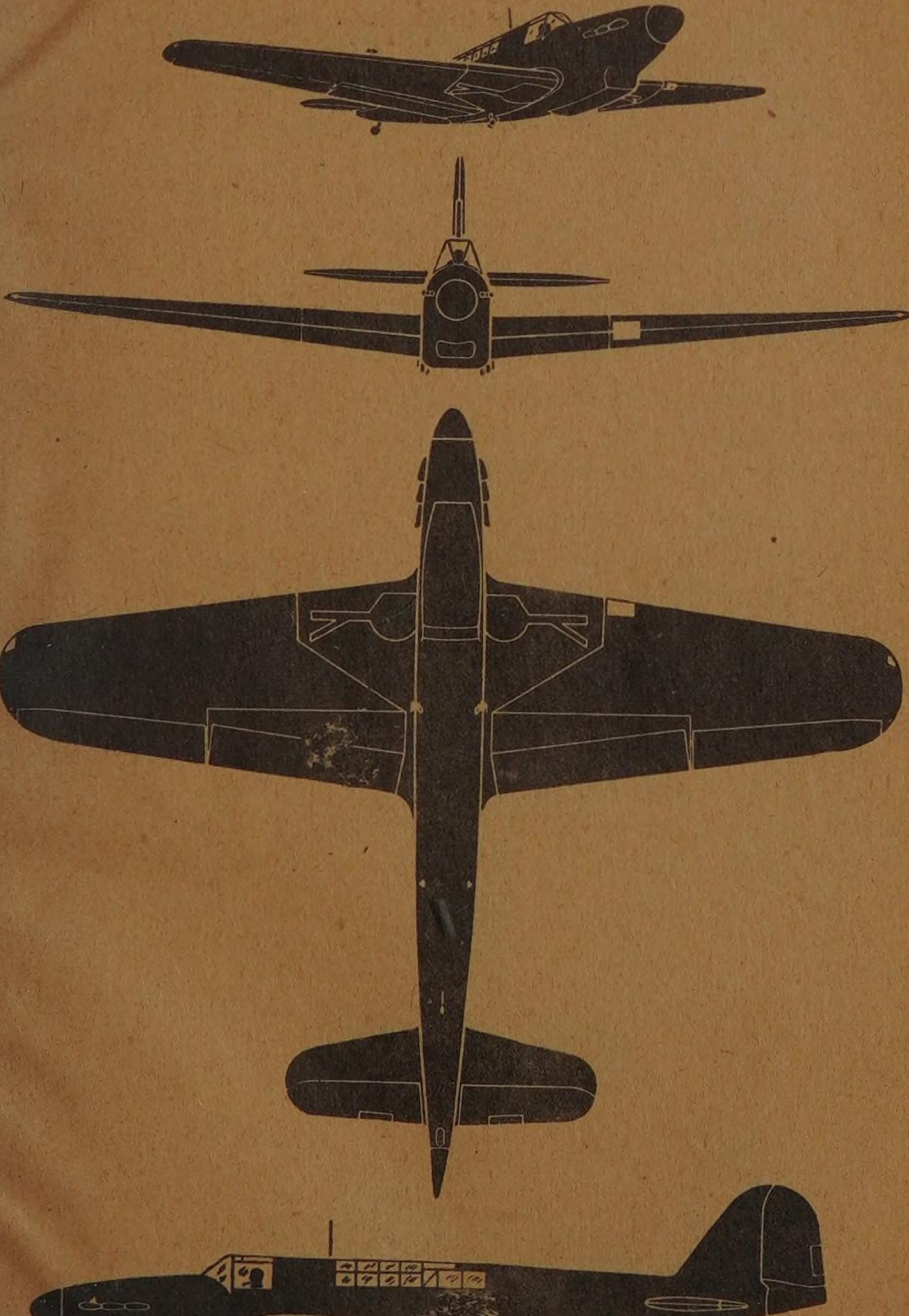
Head-on view: Boxlike fuselage with rounded top surmounted by glazed cockpit; ducted radiator below; marked dihedral from roots of wings; high tailplane; prominent fin and rudder.

Plan view: Long pointed nose; uniform, marked straight taper, wide rounded tips, small fillets on wings; fuselage tapers in slight curve to tail; tailplane has marked straight taper on leading edge, straight trailing edge, rounded tips; fin and rudder project well aft.

Side view: Pointed nose; long glazed cabin with wide opaque section behind pilot's seat; top of fuselage tapers straight to tail; large radiator forward breaks curve of underside to angular base of rudder; fin and rudder have large, wide base, wide rounded top, and marked straight taper on leading edge.

"FULMAR" (Merlin)
British Fighter (Fleet)

Span 46' 0" Length 40' 3" Height 11' 6"



BLACKBURN "SKUA"

The "Skua" fighter and dive bomber was the first **monoplane** operated by the British Fleet Air Arm from aircraft carriers. It is fitted with deck-landing arrestor, wings which fold for stowage, and is adapted for launching by catapult. The Bristol Perseus sleeve-valve radial engine, developing over 900 h.p. gives the "Skua" a maximum speed of 225 m.p.h. The specially designed water-tight fuselage enables the machine to remain afloat for some time after an emergency landing. Through 1941 the "Skua" was frequently in the news in connection with dive-bombing raids upon the channel invasion ports and coastal airdromes.

Recognition Points

General structural features: Low-wing monoplane; single radial engine; single fin and rudder; special flaps control diving speed; retractable undercarriage.

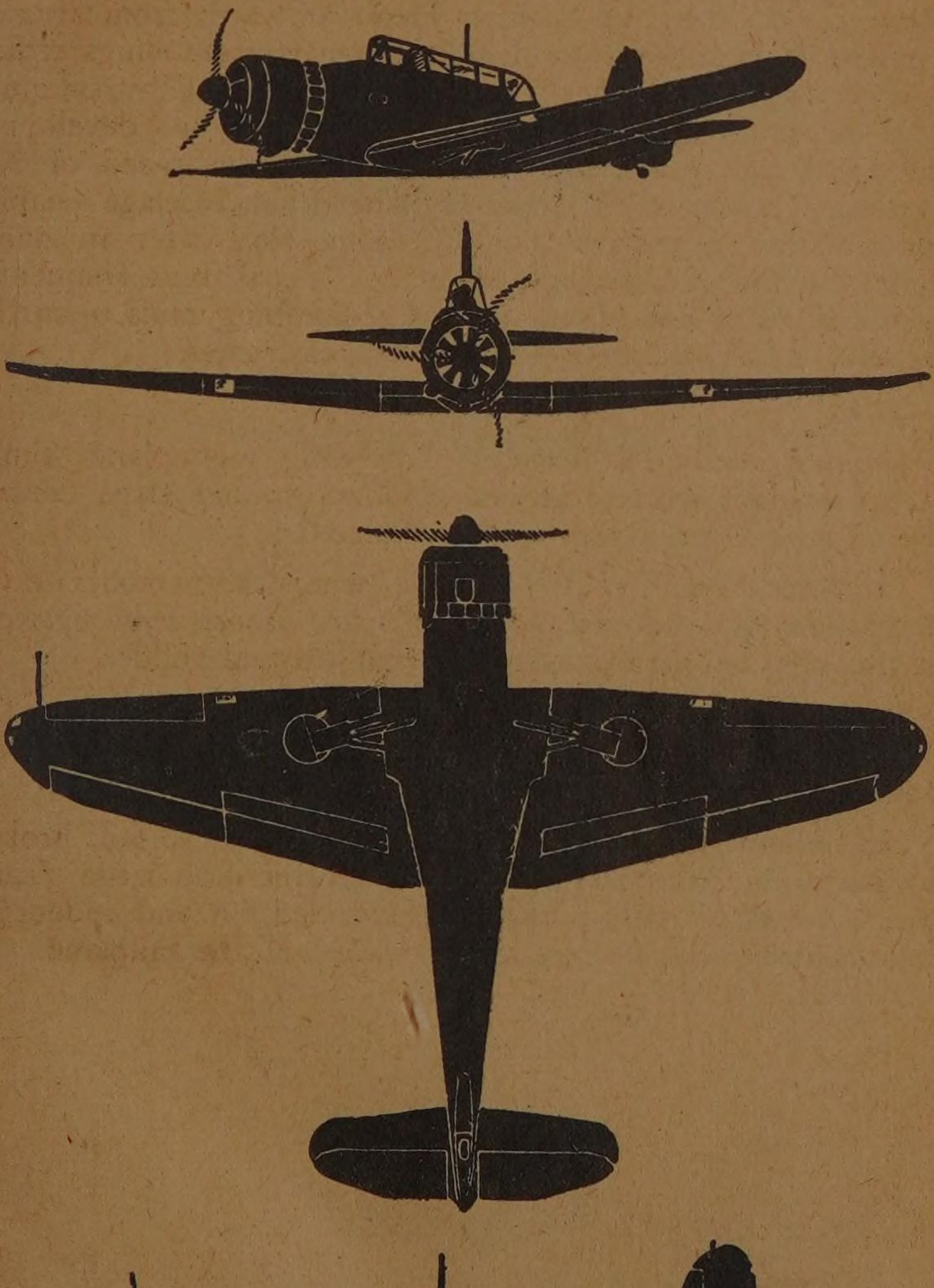
Head-on view: Circular fuselage; wings, with moderate dihedral throughout most of their span, are sharply upswept at the tips; tailplane high, wide; tall fin and rudder.

Plan view: Blunt nose; wing taper is more marked on the trailing edge; fuselage tapers to tail; long narrow tailplane with very slight taper and rounded tips.

Side view: Fuselage tapers from blunt nose to tail, broken by distinctive coupé type two-seat cockpit with large glazed panels between wide pillars; tall rounded fin and rudder of characteristic shape is set well forward of the tailplane.

"SKUA" (Perseus)
British Dive Bomber, Fighter

Span 46' 2" Length 35' 7" Height 10' 2"



BLACKBURN "ROC"

The Blackburn "Roc" is similar in general design to the "Skua," but is fitted with a Boulton Paul power-operated gun-turret immediately behind the pilot's cockpit. This rotatable turret, with four guns, provides an exceptionally wide field of fire. Thus the "Roc" in the ship-borne aircraft of the Fleet Air Arm corresponds roughly to the Boulton Paul turretted "Defiant" amongst landplane fighters. Like the "Skua," the "Roc's" wings fold for stowage and the watertight fuselage will keep the machine afloat for a considerable period in the event of an emergency landing. An alternative version is designed as a seaplane with fixed twin-float undercarriage.

Recognition Points

General structural features: Low-wing monoplane; single radial engine; single fin and rudder; large glazed turret behind pilot's cockpit; retractable undercarriage.

Head-on view: Circular fuselage with coupé front cockpit above; wings with moderate dihedral; high tailplane; tall fin and rudder.

Plan view: Blunt nose; wing taper is more marked on the trailing edge; fuselage tapers to tail; long narrow tailplane with very slight taper and rounded tips.

Side view: Blunt nose; distinctive cockpit with coupé front and large glazed turret immediately behind; tall rounded fin and rudder set well forward of tailplane; fin is continued beneath the tail.

"ROC" I (Perseus)
British Two-Seater Fighter, Fleet

Span 46' 0" Length 35' 7" Height 14' 2"

CAPRONI Re. 2000 "FALCO" I & II

The Caproni Reggiane 2000 owes its basic design to the Seversky-Republic types. Although it is known as "Falco" (Hawk), this craft should not be confused with the similarly named Fiat G.50. Developed in 1940, the Re. 2000 may be fitted with either a 1,000 h.p. Piaggio or an 1,100 h.p. Fiat radial air-cooled engine and has a top speed of about 330 m.p.h. An alternative type, "Falco II" (Re. 2001), with Mercedes-Benz DB 601 engine, is reported to attain 360 m.p.h. The range varies according to the power unit, the maximum being 750/800 miles, and service ceiling—with Fiat engine—is about 37,000 feet.

Armament consists of two heavy machine-guns installed in wings and two additional guns may be mounted in the fuselage.

Recognition Points

General structural features: Low-wing monoplane; single radial engine (alternative type with in-line engine); single fin and rudder, resembling fishtail; short streamlined fuselage; retractable undercarriage. Semi-elliptical wing plan and general design resembles the U. S. Army's Republic "Lancer," though fuselage is more slender, wing-chord rather shorter, dihedral less marked and trailing edge of rudder is less rounded.

Head-on view: Circular section of fuselage surmounted by small glazed cockpit; short center section of wings appears straight, but slight dihedral on outer sections; strut fairings of retracted undercarriage protrude beneath; tailplane in mid-position; fin and rudder fairly prominent.

Plan view: Short stubby nose with slight taper of long-chord cowlings; straight taper in leading edge of wings; marked curve on trailing edge; rounded wing tips; fuselage has curved taper to tail; tailplane resembles a wing-nut, with well-defined cut-away.

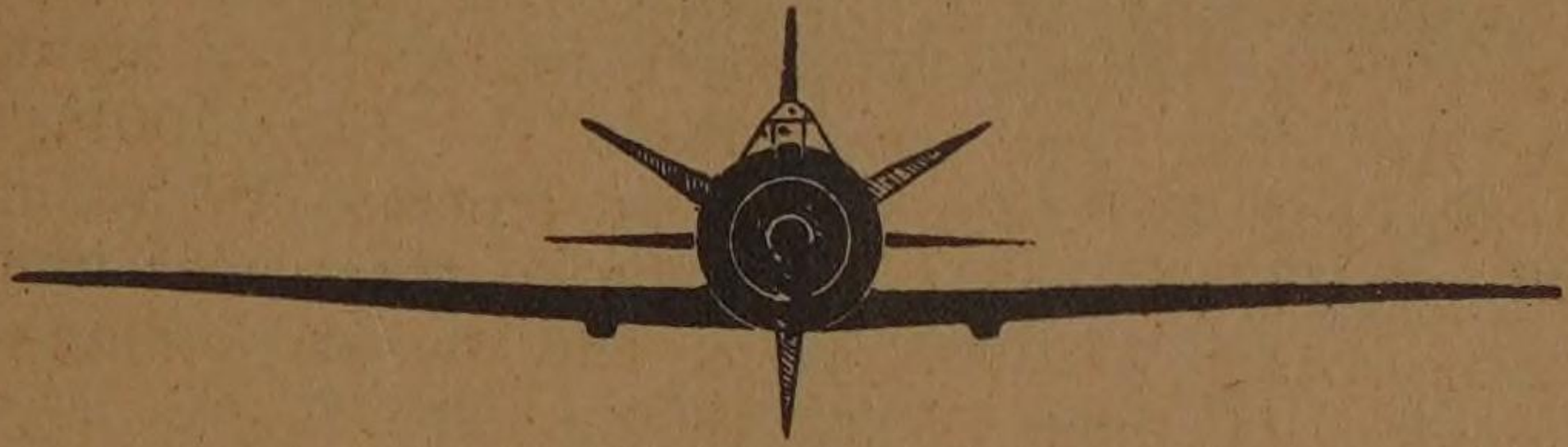
Side view: Short square-cut nose; step-up in fuselage over cockpit, then smooth curved taper to tail; underside practically straight to midships, broken slightly by protruding undercarriage fairings, thence smooth curved taper to tail; marked straight taper on leading edge of fin and rudder; less marked curved taper on trailing edge; top of fin and rudder appears pointed.

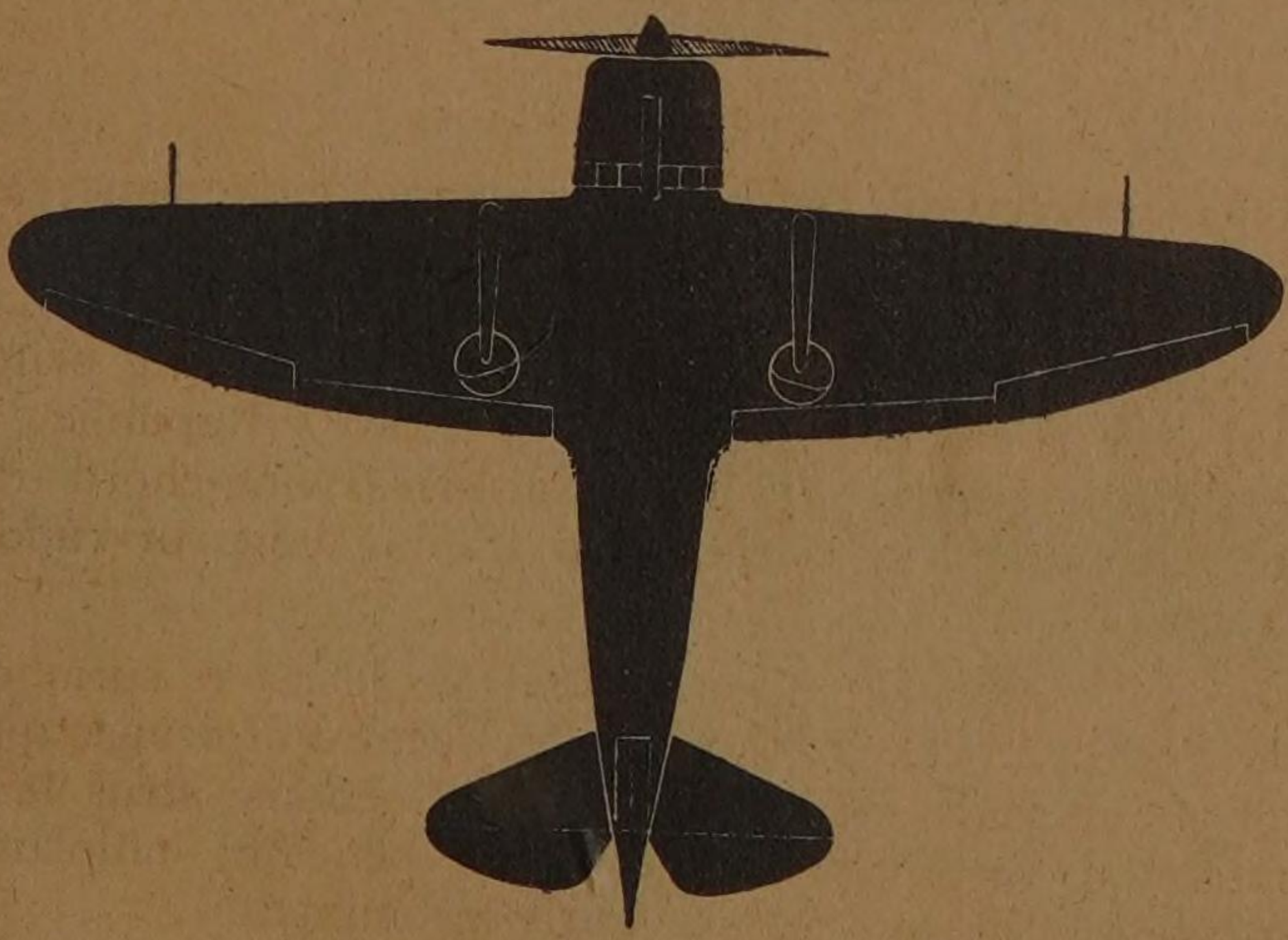
"FALCO" I
Italian Single-Seat Fighter

Span 36' 9"

Length 26' 0"

Height 12' 0"





FIAT G. 50 "FALCO"

Built by Aeronautica d'Italia, the aircraft division of the Fiat Company, of Turin, the G.50 has been in service for some years. The design, a considerable advance on its predecessors, the Fiat biplane fighters, is already obsolete by current standards. According to Italian custom, the name of its designer, Gabrielli, is indicated by the initial preceding the type number. G.50 fighters have frequently been reported in action in Libya and in the Mediterranean theatres of war. In the early days their superior speed enabled them to evade "Gladiator" biplanes, but, with a top speed of only 299 m.p.h. they stand little chance against our modern fighters. The power unit is a Fiat two-row radial air-cooled engine of 840 h.p., cruising range 435 miles and absolute ceiling 35,430 feet.

Armament: four machine-guns, two on top of the fuselage and two wing guns. For low-level attacks on troops 36 three kg. or 144 one kg. bombs may be carried.

Recognition Points

General structural features: Low-wing monoplane; slightly inverted gull wing, with unusual shoulder; single radial engine; single fin and rudder; elliptical tail unit; short, streamlined fuselage; retractable undercarriage.

Head-on view: Roughly round section of fuselage surmounted by small glazed cockpit; wing center-section tapers in thickness, giving appearance of slight anhedral, which, with slight dihedral of outer sections, suggests inverted gull wing; short tailplane in mid-position; tall, fairly prominent fin and rudder.

Plan view: Short, stubby, square-cut nose; short wing center section, with very marked straight taper in leading edge, suggesting a shoulder; leading edge of outer section straight to wide rounded tips; wing trailing edge has marked straight taper; smoothly tapering fuselage; tailplane appears elliptical, but curved taper less marked on trailing edge.

Side view: Short square-cut nose; fuselage curves up to cockpit, aft of wing trailing edge, thence tapers rapidly; practically straight underside, tapering in gentle curve to tail; tall, conical fin and rudder with rounded top, straight taper more marked on leading edge.

FIAT G.50
Italian Single-Seat Fighter

Span 35' 9"

Length 25' 7"

Height 9' 9"

MACCHI C. 200

Aeronautica Macchi, of Varese, Italy, aircraft constructors since 1912, won the Schneider Trophy in 1926 with their 39 seaplane, at a speed of 245 m.p.h. They were second when Great Britain won the trophy in 1929, in 1934 they raised the speed record to 440 m.p.h.; and their designs figured prominently in International speed records almost continuously up to 1937. In spite of this distinguished record, their single-seat fighter C.200 does not approach, either in speed or armament, the "Spitfire" which, like the Macchi fighter, was bred from a line of Schneider Trophy winners. Fitted with a Fiat 840 h.p. radial air-cooled engine, its top speed is 313 m.p.h., range 435 miles and service ceiling 31,000 feet. Another version, C. 202, is fitted with Mercedes-Benz DB 601 engines. The standard armament consists of two heavy machine-guns fixed on the cowling, firing through the airscrew radius. Light bombs may also be carried.

Recognition Points

General structural features: Low-wing monoplane; single radial engine; single fin and rudder; retractable undercarriage. Fluted cowling appears to be too large for fuselage and does not conform closely to general streamline design, as do American radial-engined fighters.

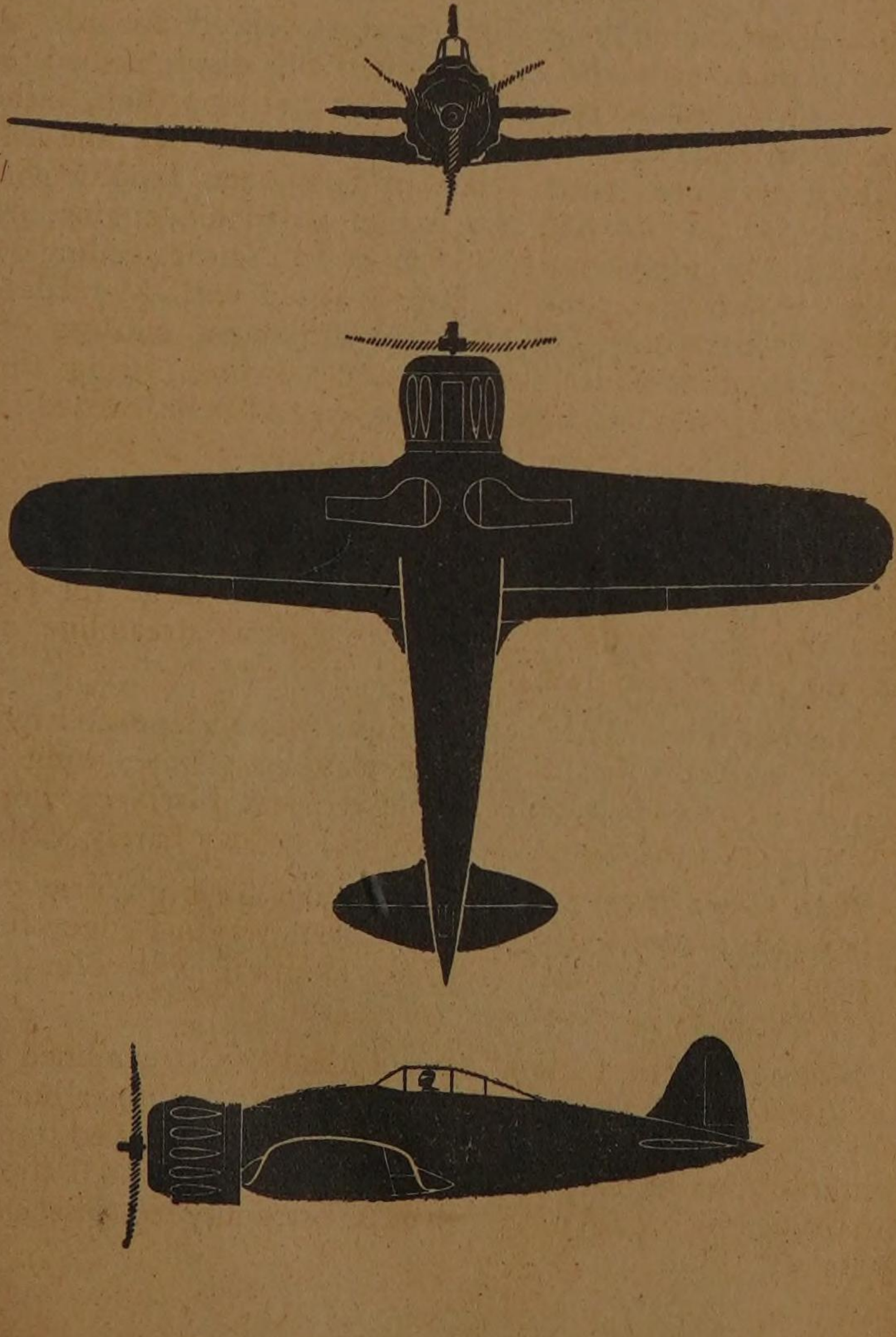
Head-on view: Fuselage roughly oval, surmounted by small glazed cockpit; fluted cowling may be visible; wings show dihedral from roots, which thicken near fuselage; short tailplane in mid-position; small fin and rudder barely visible.

Plan view: Short stubby nose; wings have uniform straight taper, wide rounded tips, fillet from trailing edge; fuselage tapers smoothly; small tailplane elliptical with semi-pointed tips; extremity of fuselage projects aft.

Side view: Short knob-like nose; smooth streamlined curves of fuselage increase to cockpit, which breaks upper line amidships, thence taper to tail; more marked curved taper on leading edge of fin and rudder, with semi-pointed top (outline resembles half of tailplane); extremity of fuselage projects aft.

MACCHI 200 (Fiat)
Italian Single-Seat Fighter

Span 34' 8" Length 26' 10" Height 11' 6"



MILES "MAGISTER I"

Developed from the successful Miles "Hawk" series of light low-wing touring monoplanes, the "Magister" has been in service with the R.A.F. since 1936. It is the only monoplane used by the British for **initial training.** Monoplanes of the "Master," "Harvard" and "Battle" types, capable of speeds exceeding 200 m.p.h., are used as advanced trainers. Since all modern designs of fighters and bombers are of monoplane type, primary training in monoplanes is likely to become more general.

Like the "Tiger Moth," the "Magister" is fitted with the 130 h.p. Gipsy Major inverted air-cooled in-line engine, giving a maximum speed of 142 m.p.h. and cruising speed around 130 m.p.h. The stalling speed of 45 m.p.h. is only slightly higher than that of standard biplane trainers. The Cirrus Major 150 in-line inverted air-cooled engine, developing 150 h.p., is an alternative power unit.

Recognition Points

General structural features: Low-wing monoplane; single in-line engine; single fin and rudder; fixed undercarriage with small streamline "spats."

Head-on view: Fuselage of roughly oval section with open cockpit above; wings with full dihedral; high tailplane extends just outboard of single-strutted (cantilever) vertical legs of fixed undercarriage; fin and rudder visible.

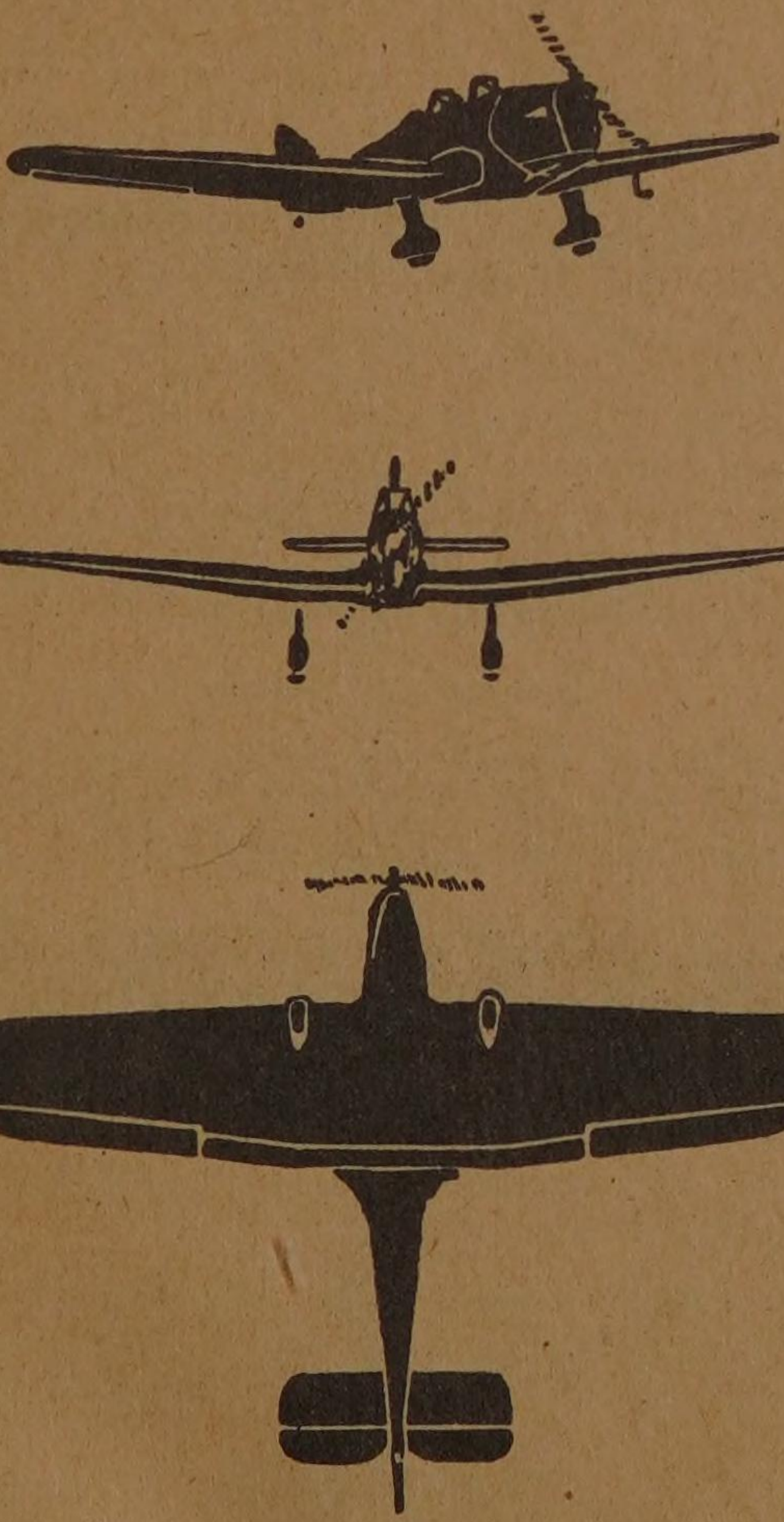
Plan view: Wings have very slight taper, wide rounded tips; streamline fillets from trailing edge to fuselage; tailplane mounted forward of rudder is almost rectangular.

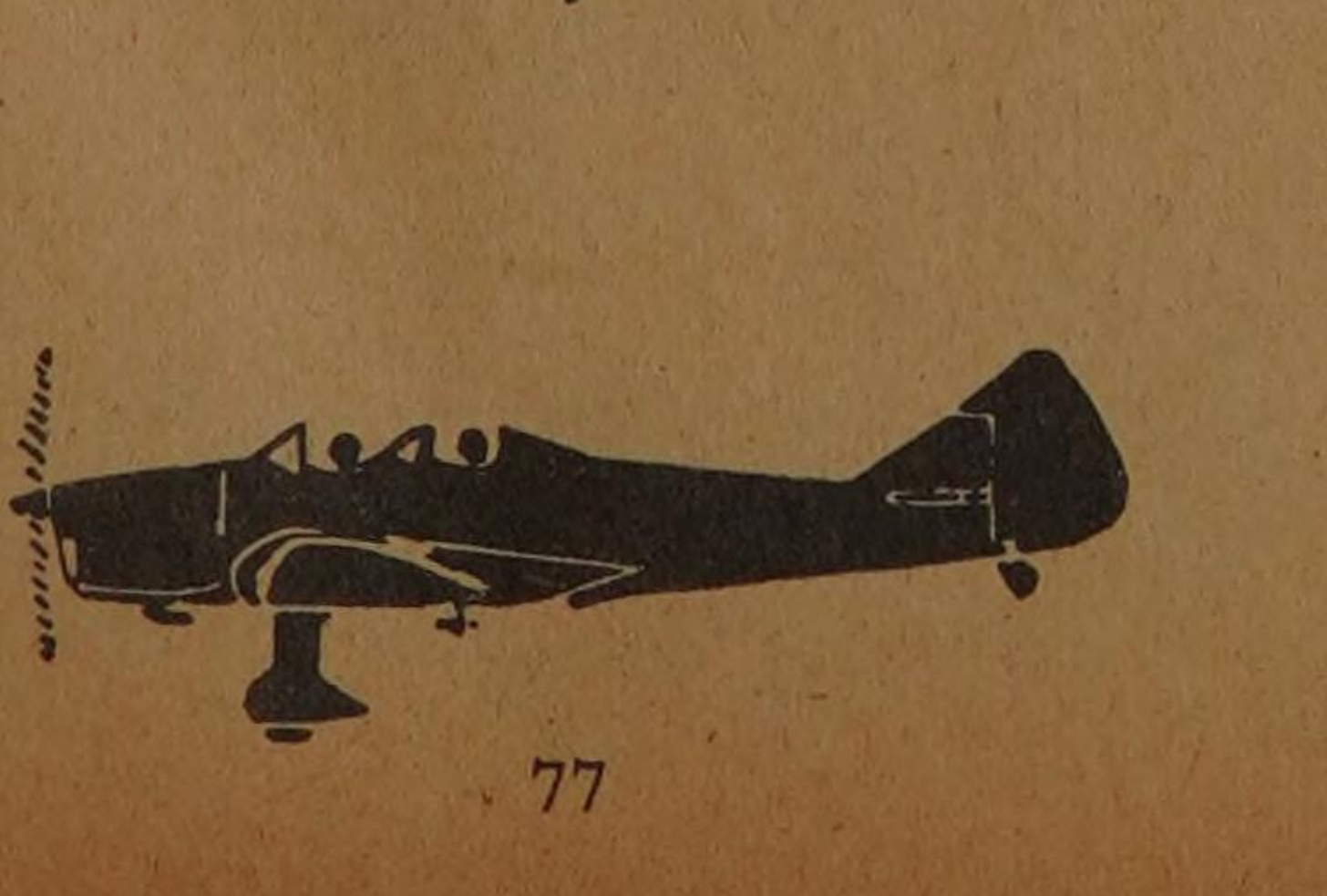
Side view: Blunt nose; fixed undercarriage with small streamline spats; two-seat open cockpits, in tandem; fin and rudder maintain the general angular appearance of the "Magister's" tail unit.

"MAGISTER" I (Gipsy Major)

British Trainer

Span 33' 10" Length 25' 3" Height 9' 9"





MILES "MASTER" I

A modified version of the 295 m.p.h. Miles "Kestrel" monoplane trainer produced by Phillips & Powis in 1937, considerable quantities of the "Master I" advanced trainer came into service in the R.A.F. in 1939.

Fitted with a single Rolls-Royce "Kestrel XXX" liquid-cooled in-line engine, developing 715 h.p., the "Master" cruises at 225 m.p.h., and has a top speed of 264 m.p.h., i.e. faster than the "Gladiator." Extremely maneuvrable, the flying and handling qualities of this advanced trainer correspond very closely to those of the "Hurricane" and "Spitfire." The large enclosed cockpit is fitted with dual control, "blind" flying equipment, etc., the instructor's and pilot's seats being arranged in tandem. Like the Miles "Magister," the "Master" is built of wood, and is particularly adapted for rapid production.

Recognition Points

General structural features: Low-wing monoplane; single in-line engine; single fin and rudder; deep fuselage with glazed two-seat cockpit; undercarriage retracts backward.

Head-on view: Oval fuselage section with large radiator below, glazed cockpit above; moderate inverted "gull-wing"; high tailplane; tall fin and rudder.

Plan view: Wings taper to rounded tips; fillets on trailing edge of wings; narrow fuselage tapers in streamline curve from nose to tail; untapered, almost rectangular tailplane, mounted forward of the rudder.

Side view: Pointed nose; step-up over glazed cockpit; deep radiator level with leading wing edge breaks underside line; unusually large fin and rudder with well-rounded top and wide base.

"MASTER" I (Kestrel)
British Trainer

Span 39' 0" Length 30' 8" Height 11' 6"

MILES "MASTER" II and III

The appearance of the Miles "Master" two-seat advanced trainer illustrated on the preceding page, is so much changed by the fitting of radial air-cooled engines that it may almost be regarded as a distinct type. The silhouette of the modified version provides a useful comparison with other low-wing, radial-engined aircraft. There are many interesting points of similarity between the British advanced trainer in its new form and one of the latest long-range escort fighters of the U. S. Navy, the Vought-Sikorsky F 4U-1, "Corsair." The power unit of the Master II is the 835/870 h.p. Bristol "Mercury" radial engine, giving a top speed of 260 m.p.h., cruising speed of 230 m.p.h. and service ceiling of 28,000 feet. Mark III, which is similar in general appearance, is fitted with a Pratt and Whitney "Wasp" radial engine of 875 h.p., giving approximately the same performance.

Recognition Points

General structural features: Low-wing monoplane; single radial engine, single fin and rudder; streamline fuselage with prominent two-seat cockpit; retractable undercarriage. The general design remains the same as the earlier type except for the change to radial engine, with the resultant disappearance of the large ducted radiator, formerly a prominent feature under the center-section.

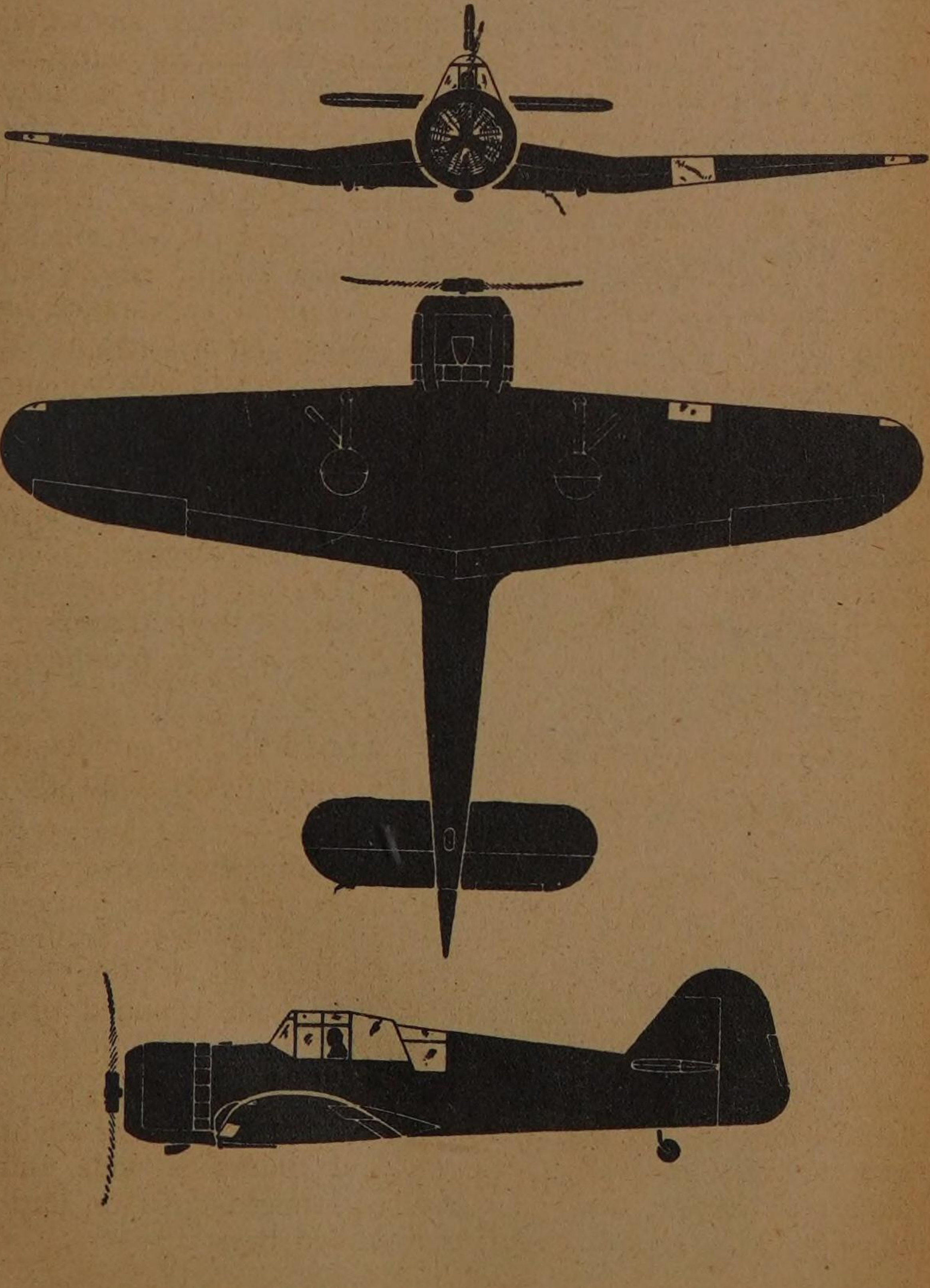
Head-on view: Fuselage circular, surmounted by prominent glazed cockpit; inverted gull-wings (moderate); high tailplane; tall fin and rudder.

Plan view: Blunt, stubby nose unusually short—even for radial-engined types; wings have straight taper, more marked on trailing edge; wide duo-curved tips; fillets from trailing edge of wing; fuselage tapers straight to tail; leading and trailing edges of tailplane parallel, with wide rounded tips; rudder projects aft.

Side view: Blunt, stubby nose; fuselage steps up over large glazed cabin, then tapers sharply to tail; underside has slight taper to tail; unusually large fin and rudder is wide and roughly triangular, with more marked straight taper on leading edge, wide rounded top and rounded base.

"MASTER" II (Mercury)
British Trainer

Span 39' 0" Length 29' 6" Height 11' 6"



JUNKERS 87 OR "STUKA"

The notorious "Stuka" two-seat dive-bomber, which usually carries one heavy bomb of about 1,100 lbs. and four light bombs of 110 lbs. each, proved its military value during the Spanish Civil War. Used in close co-operation with mechanized forces, it played a decisive part in the defeat of Poland, the Low Countries and France. Deprived of its usual ground support, it met with no success when opposed by the R.A.F. in the heavy raids of 1940. The early type, Ju 87a, was fitted with a Jumo 210 engine of 640 h.p. This earlier version may be distinguished from the better-known 87b by the unusually wide fairings or "trousers" on the fixed undercarriage legs. In contrast, 87b has normal type of leg fairings and large streamline wheel "spats." The 1,200 h.p. Jumo 211A engine installed in 87b gives a maximum speed of 242 m.p.h. A still later model, the Ju 87D, has a somewhat smaller radiator mounted farther from the spinner than in the sihouettes on the facing page.

Recognition Points

General structural features: Low-wing monoplane; single in-line engine; single fin and rudder; streamlined fuselage with glazed two-seat cockpit; Junkers "double wing" or flaps full length of trailing edge; dive brakes under wings.

Head-on view: Roughly oval fuselage with wider base surmounted by glazed cockpit; inverted "gull" wings; high, wide tailplane; fixed undercarriage.

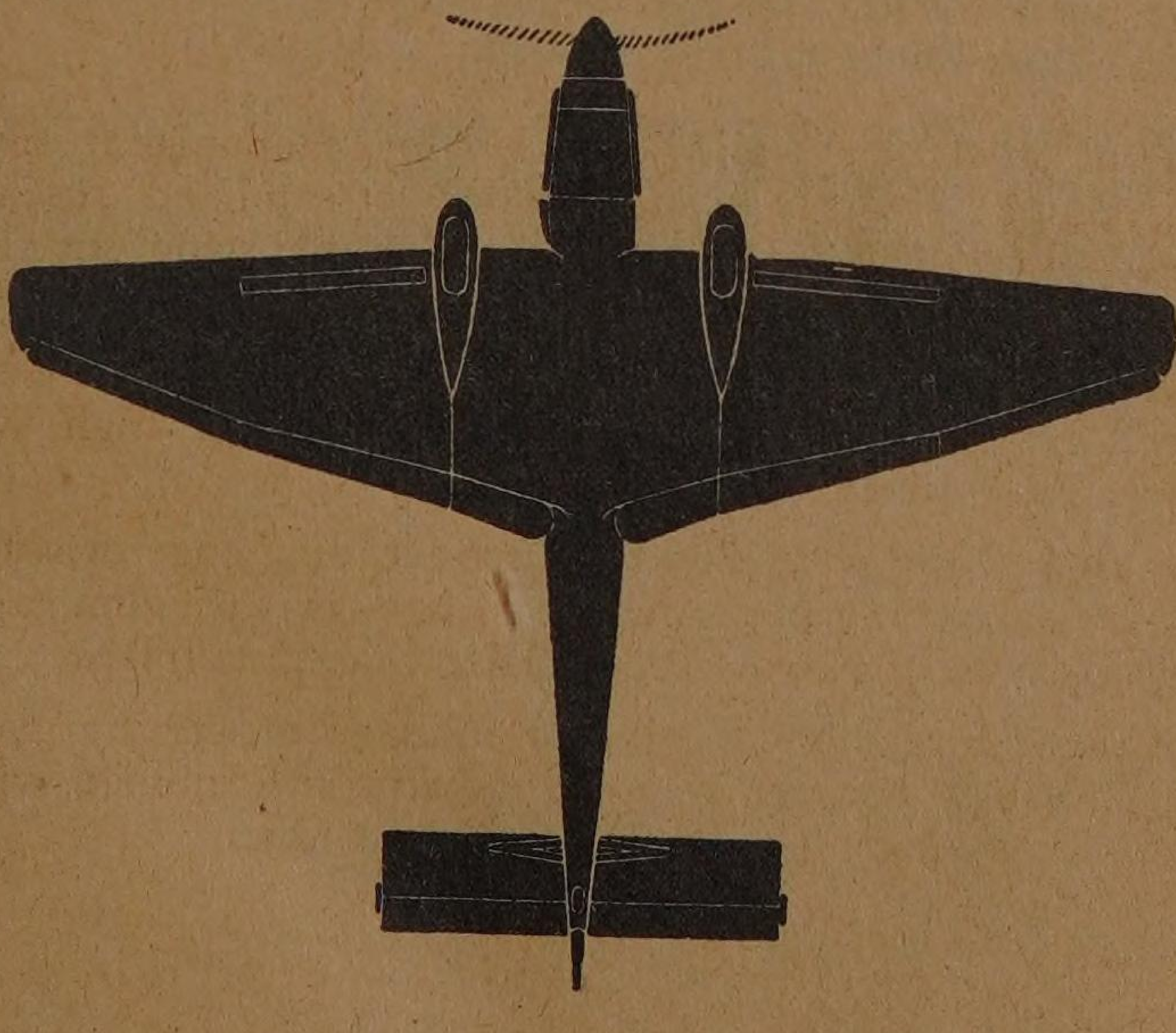
Plan view: Long nose; slight taper on leading edge of wings; full taper on trailing edge; nearly square-cut tips; slim tapering fuselage; long narrow rectangular braced tailplane.

Side view: Streamlined curve of fuselage broken by glazed cabin; underside broken by large radiator, streamlined wheel "spats"; large single fin and square-cut rudder.

JUNKERS 87B (Jumo 211A)

German Dive Bomber

Span 45' 3" Length 35' 4" Height 12' 8"



AVRO "ANSON"

In production for the R.A.F. for several years, the Avro "Anson" is still giving service on coastal reconnaissance work. Although its top speed is only 188 m.p.h. and cruising speed 158, it has successfully dealt with attacking fighters on numerous occasions. Powered by two 350 h.p. Armstrong-Siddeley "Cheetah" engines, "Ansons" are extensively used as twin-engined trainers.

Recognition Points

General structural features: Low-wing monoplane; twin radial engines mounted on their center lines; single fin and rudder; wheels partially retract into engine nacelles.

Head-on view: Box-like fuselage section with rounded top; fin and rudder just visible; twin engines mounted center; wings with moderate dihedral; tailplane not visible.

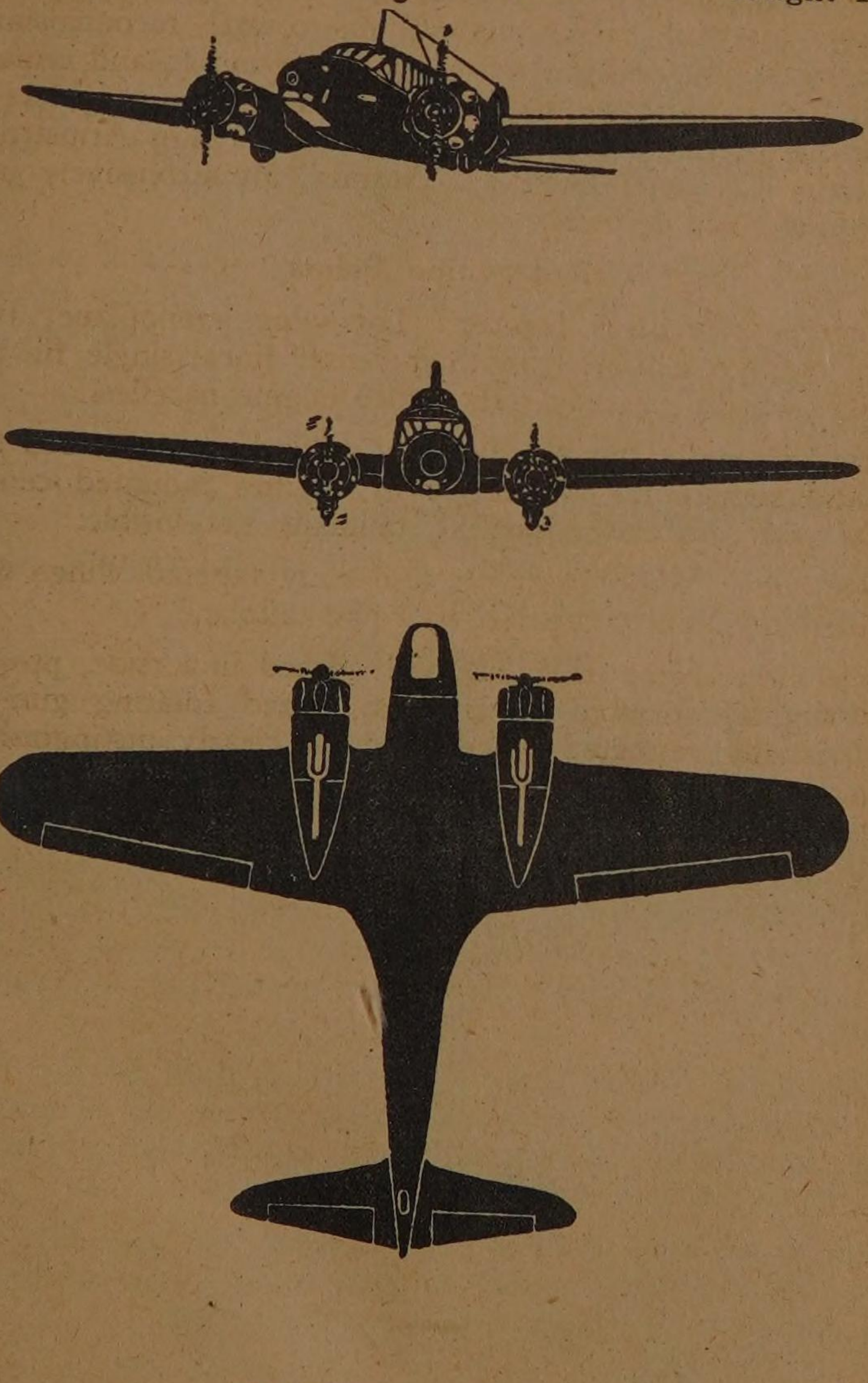
Plan view: Wide fuselage; uniformly tapered wings with rounded tips; finely tapered spur-like tailplane.

Side view: Nose of plane, with glazed underside, projects only slightly forward of engines; glazed rotating gun-turret; partially retracted wheels can be clearly distinguished; wide, well rounded fin and rudder; tailplane mounted low on fuselage.

"ANSON" (2 Cheetah IX)

British Reconnaissance and Training Plane

Span 56' 0" Length 42' 3" Height 13' 0"



AIRSPEED "OXFORD"

Before taking over the controls of a high-speed twin-engine bomber or fighter, the pilot and crew must be thoroughly trained in the handling of a two-motor aircraft, in navigation, photography, gunnery, etc. The "Oxford," specially designed for that purpose, is the standard twin-engine advanced trainer of the Royal Air Force. Many of them are in service in Canada.

Normally carrying a crew of three, the "Oxford" is fitted with dual control, and modifications of equipment provide for training in bomb-aiming, gunnery, aerial photography, radio communication, blind flying and navigation. The drawings show the version of the "Oxford" adapted for gunnery training and fitted with the Armstrong-Whitworth rotatable gun-turret.

Powered with two 375 h.p. "Cheetah X" air-cooled radial engines, the maximum speed is 190 m.p.h., cruising speed 166 m.p.h., and stalling speed 56 m.p.h.

Recognition Points

General structural features: Low-wing monoplane; two radial engines; single fin and rudder; slab-sided fuselage with control cabin forward; undercarriage retracts into engine nacelles; general design similar to "Anson."

Head-on view: Box-like fuselage surmounted by glazed cockpit and dorsal turret; wings with full dihedral; engine nacelles mounted somewhat above centers of the wings; tailplane extends to, and is level with, tops of engines; fin and rudder visible.

Plan view: Wings sharply tapered; engines project halfway to glazed nose; engine nacelles project aft of trailing edge; rounded wing tips; fillets at trailing edge of wings; distinctive rounded tailplane with cut-away.

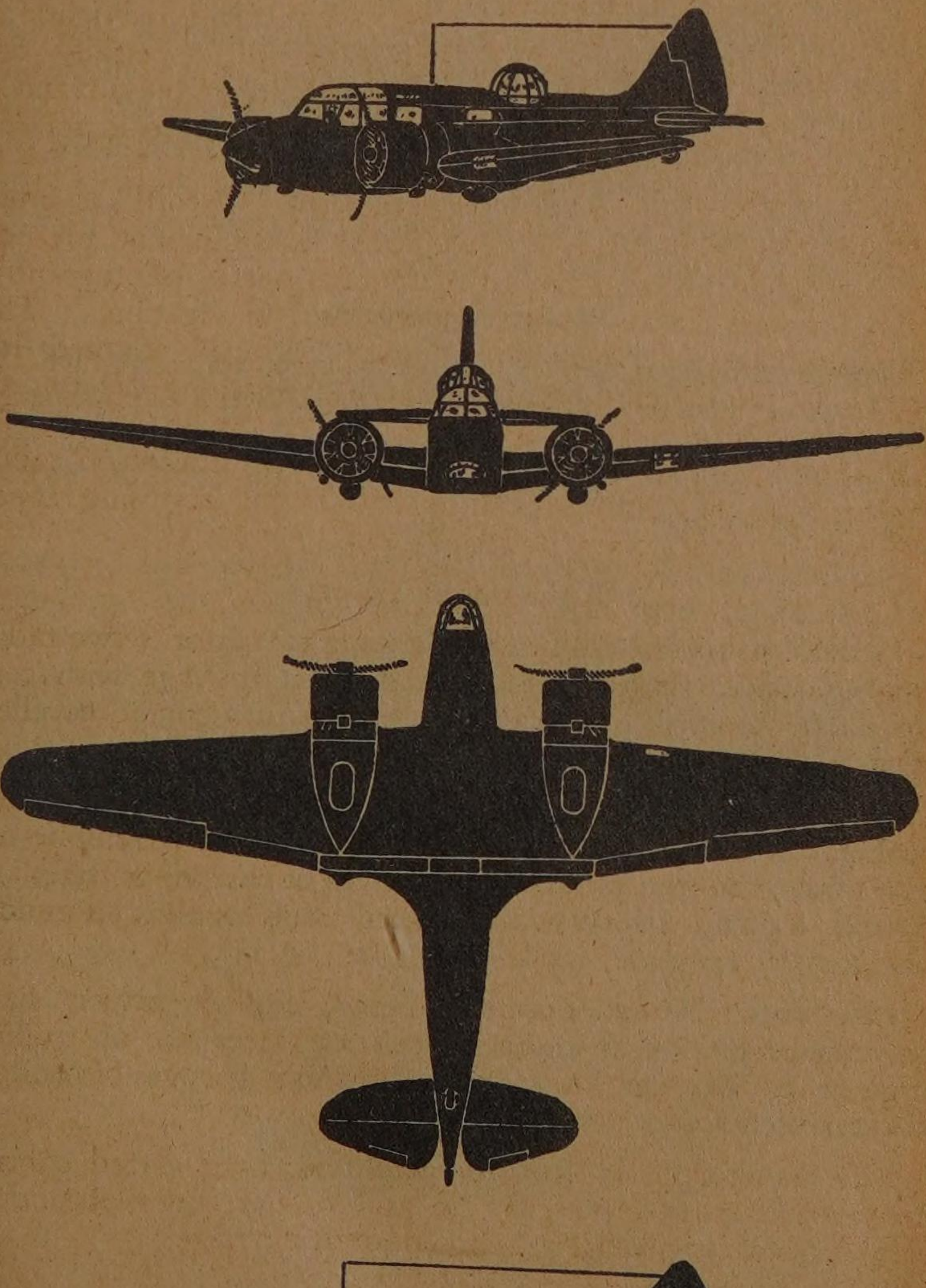
Side view: Step-up from pointed nose over glazed control cabin; characteristic angular fin and rudder; lines of underside broken by partially exposed undercarriage.

"OXFORD" (2 Cheetah X)
British Trainer

Span 53' 4"

Length 34' 6"

Height 11' 1¼"



MESSERSCHMITT 110 AND "JAGUAR"

This German long-range two or three-seat escort fighter is powered by two 1,150 h.p. Daimler-Benz liquid-cooled engines and has a maximum speed of 365 m.p.h. The main armament, usually consisting of four machine-guns and two 20 mm. shell guns, is installed in the nose. An additional machine-gun is mounted in the cockpit firing aft. The "Jaguar," a high-speed reconnaissance bomber version of Me 110, is chiefly distinguishable by the glazed bomb-aiming nose. With some sacrifice of speed and range, the "Jaguar" carries up to a half a ton of bombs.

Recognition Points

General structural features: Low-wing monoplane; two in-line engines; nacelles slightly underslung with deep radiators beneath (in some versions, radiators under each wing just outboard of engine nacelles); twin fins and rudders; retractable undercarriage.

Head-on view: Roughly oval fuselage surmounted by glazed cockpit; wings with slight dihedral; nacelles slightly underslung with deep radiators beneath; high tailplane extends just outboard of engines, with fins and rudders mounted at extreme tips.

Plan view: Wings with large span, small chord, uniformly tapered; rounded tips (some Me 110's brought down in England show square-cut wing tip, reducing overall wing span about one and a half feet); streamlined nose of fuselage extends slightly forward of engines; slim tapered fuselage; long narrow tailplane, with slight taper on leading edge only.

Side view: "Greenhouse," nacelles, and radiators break streamlined profile of fuselage; fins and rudders not unlike those of the Dornier 17, 215, and 217, but are more rounded, and mounted lower on tailplane.

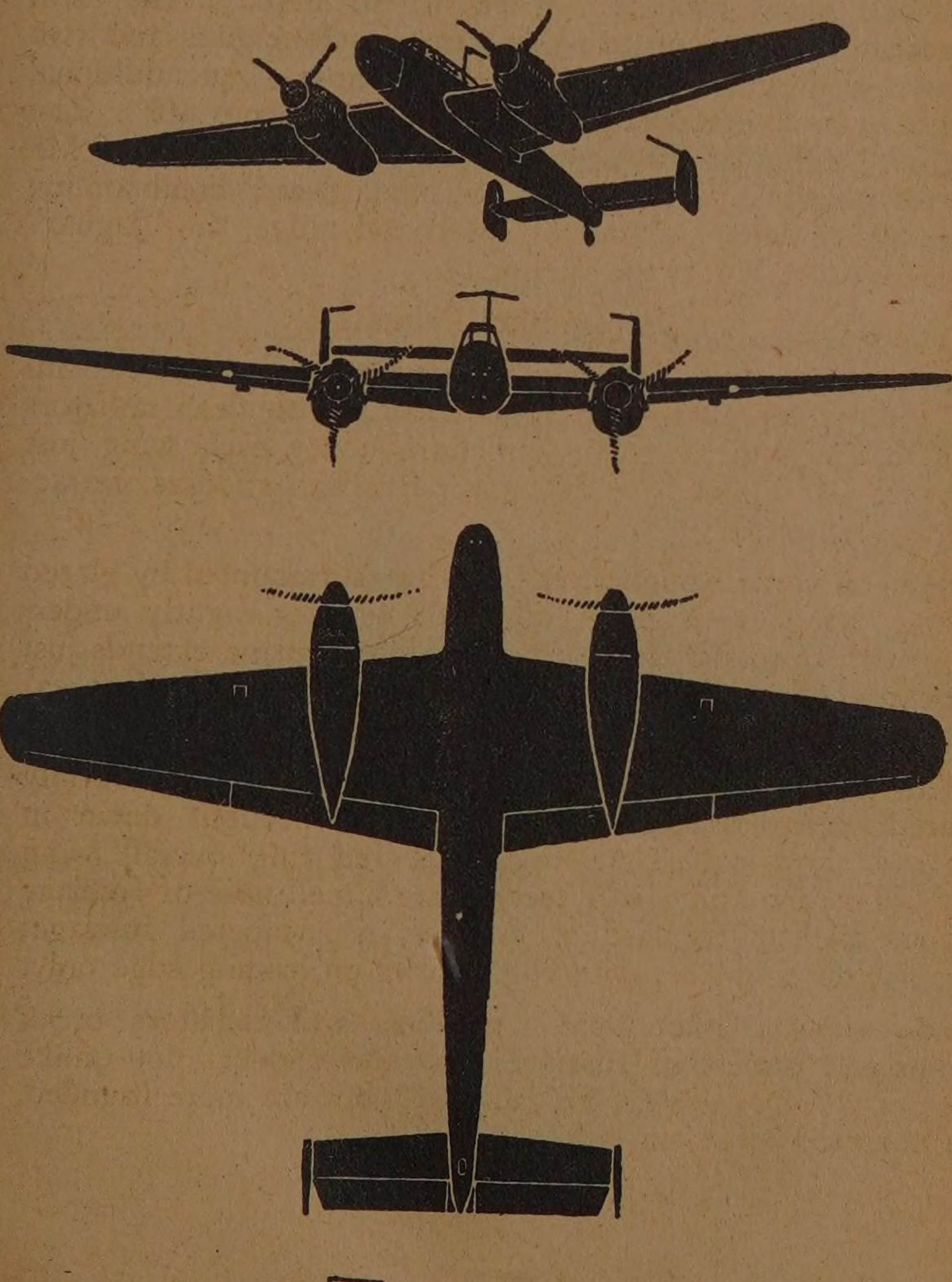
MESSERSCHMITT 110 (2 D.B.)

German Twin-Engine Fighter

Span 53' 4"

Length 40' 6"

Height 12' 0"



MESSERSCHMITT 210

This fighter-bomber is a development of the Me 110 and "Jaguar" designs. It is faster than its predecessors and has a larger bomb capacity. Power is supplied by two 1,450 Daimler-Benz 603 engines developing 1,450 h.p. each. Maximum speed is 385 m.p.h. The Russians have reported that, although this machine has a high performance level, it is not quite as dangerous as some people once feared it might be. Nevertheless, it is still a fast airplane that delivers a hard punch.

Recognition Points

General structural features: Low-wing monoplane; two in-line engines; single tail unit; retractable undercarriage.

Head-on view: Wings with moderate dihedral; cross-section of fuselage is bell-shaped; bulge of radiators makes engines seem slightly underslung, although they are mounted on center-lines. Distinguish from Me 110 by single fin and rudder and by rounded top of "greenhouse."

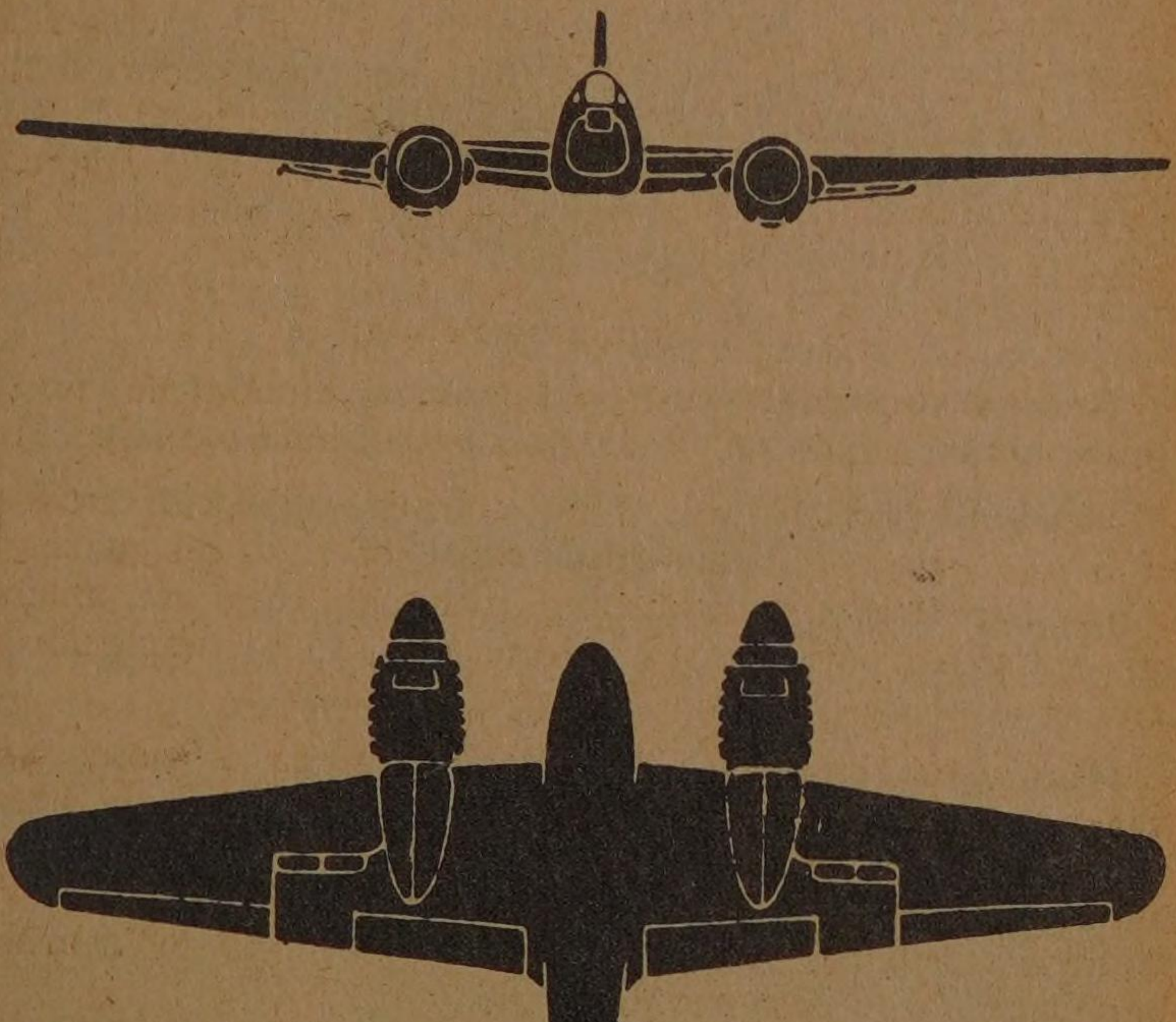
Plan view: Engines project well forward of nose; wings tapered evenly on both edges to rounded tips; finely streamlined fuselage; tailplane and elevators tapered slightly more on leading than on trailing edge to rounded tips; cut-aways between elevators. Distinguish from Me 110 by the short nose and the redesigned tailplane.

Side view: Distinguish from Me 110 by (1) concealment of nose by forward-projecting engines; (2) tall, single fin and rudder mounted on top of fuselage; and (3) by retractable tailwheel.

Note:—The plan view especially of Me 210 should be compared with the Bristol Beaufighter.

MESSERSCHMITT 210 (2 D.B. 603)
German Fighter Bomber

Span 53' 6"



HEINKEL 111K Mk V

In production since 1935, when with two 660 h.p. B.M.W. engines its maximum speed was only 211 m.p.h., the design of the Heinkel 111K has been frequently modified. The "K" for "Kreig," denotes the military version of the well-known Heinkel 111 civil air-liner. The silhouettes show a late design, Mk V. Earlier types which had wings of elliptical plan and inadequate armament proved easy meat for R.A.F. fighters. Mk V has fared little better. With two Daimler-Benz liquid-cooled engines of 1,150 h.p., the maximum speed is 274 m.p.h., and cruising speed 230 m.p.h. Specimens of a later series of Mk V fitted with 1,200 h.p. Junkers Jumo engines have also been shot down. The different military versions of the craft have been used as bombers and torpedo bombers.

Recognition Points

General structural features: Low-wing monoplane with tapered wings; two in-line engines; single fin and rudder; slender streamlined fuselage; undercarriage retracts into nacelles.

Head-on view: Circular fuselage section; wings with full dihedral; nacelles slightly underslung with radiators beneath; under-gun emplacement; tailplane not visible; fin and rudder tall, prominent.

Plan view: Glazed bomb-aiming nose projects only as far forward as engines; fully tapered wings, with rounded tips; slender streamlined fuselage; tailplane retains the characteristic elliptical plan of earlier versions; trailing edge of wings is swept forward near the roots in a "bite" characteristic of many Heinkel designs.

Side view: Engines and nose project equally far forward; under-gun emplacement just aft of wings; small glazed "pimple" screens upper gun position; tall rounded fin and rudder, with rudder cut away at its base.

HEINKEL 111K Mk V (2D.B. or 2 Jumo)

German Bomber

Span 74' 3" Length 54' 6" Height 13' 9"

JUNKERS 86 and 86K

Produced about 1935, the design of the Junkers 86 was specially adapted for rapid conversion to military use. While the civil type serves as a troop-carrier, Ju 86K, the fully militarized version shown in these drawings is designed as a bomber. It played a considerable part in crushing Polish resistance. Armament consists of one machine-gun in the nose, another on top of the fuselage aft of the wings, and a third in a retractable "dustbin" or rotatable under-gun turret. The Swedish Air Force includes a number of Ju 86K bombers fitted with Bristol radial engines. On the outbreak of war, the South African Airway's fleet of Ju 86 air liners was converted for military use by the S. A. Air Force.

Ju 86 Air Liner. Two 760 h.p. B.M.W. radial air-cooled engines. Top speed 233 m.p.h.

Ju 86K Bomber. Two 700 h.p. Junkers "Jumo" Diesel engines. Top speed 224 m.p.h., cruising speed 174 m.p.h. Maximum range exceeds 1,500 miles. Or two 880 h.p. B.M.W. air-cooled radial engines, maximum speed 238 m.p.h., cruising speed 214 m.p.h.

Recognition Points

General structural features: Low-wing monoplane; either two in-line or two radial engines; twin fins and rudders; fuselage of oval section with small control cabin; undercarriage retracts outwards.

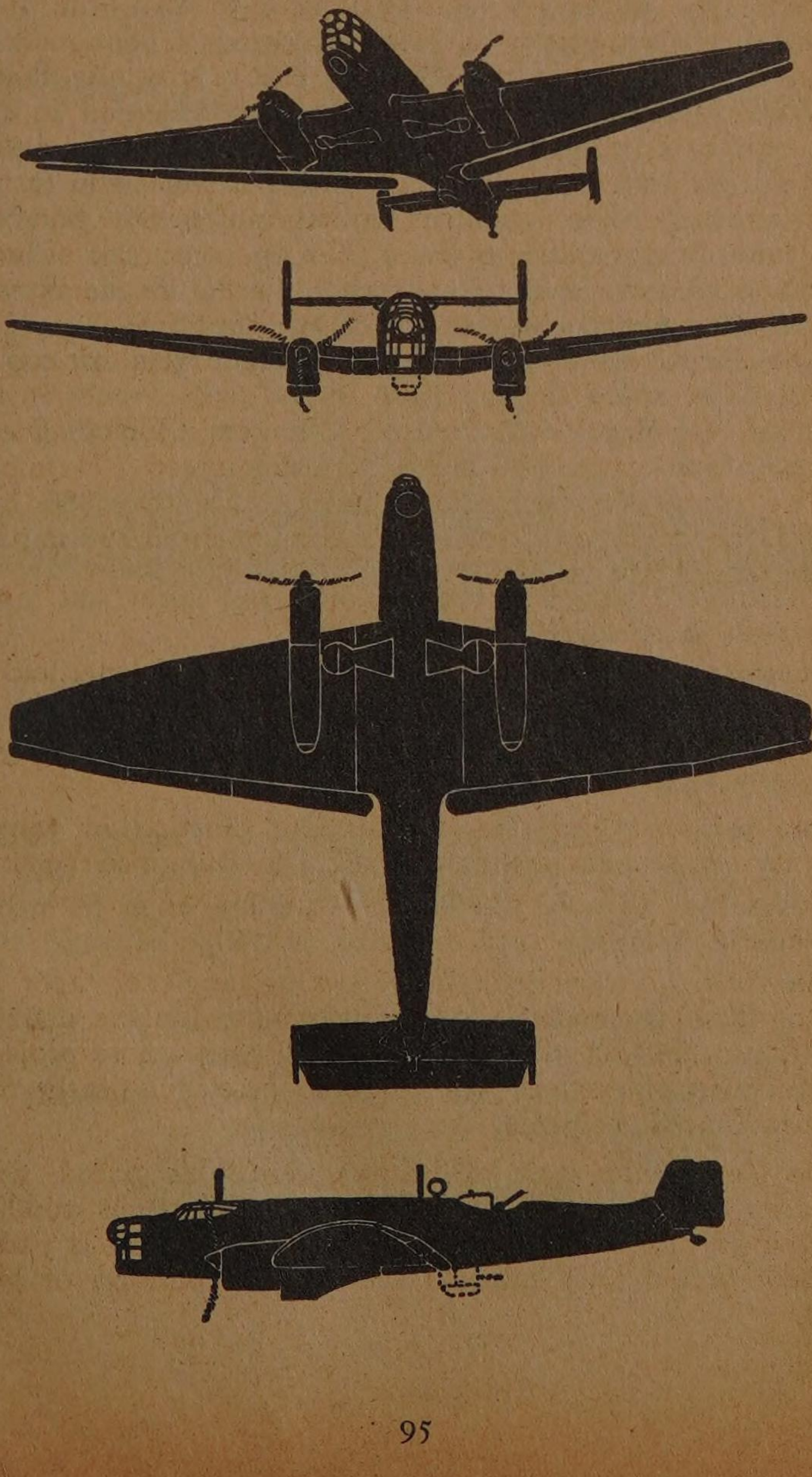
Head-on view: Oval fuselage section; dihedral in wings; deep narrow nacelles distinguish the Diesel-engined version; high tailplane with fins and rudders mounted at tips, just outboard of nacelles.

Plan view: Characteristic Junkers wing, angle of taper increasing abruptly midway along the wings; Junkers double-wing flaps, showing daylight, are fitted; glazed nose projects well forward of engines; slim tapered fuselage; nearly rectangular braced tailplane.

Side view: Blunt nose of bomber version is glazed, with projecting gun-turret; angular fins and square-cut rudders mounted at tips of tailplane; rear gunner's cockpit is partly enclosed; dotted lines indicate the lowered position of gun turret.

JUNKERS 86K
German Bomber

Span 73' 8" Length 57' 4" Height 15' 7"



FOCKE-WULF 189

Although this machine in some respects closely resembles America's Lockheed "Lightning," its performance and function are radically different from those of the American plane. While the "Lightning" is a high performance fighter with a top speed of about 400 m.p.h., the FW 189 is classified as a general-purpose machine. The Nazis are reported to have large numbers of the FW 189, its special merit apparently lying in the fact that it can take off from small fields and has extremely wide visibility for reconnaissance purposes. There are accommodations for a crew of three, and when it is used as an ambulance two stretchers can be loaded through the turret. Armament consists of two fixed machine guns firing forward under the nose, a movable gun on top of the fuselage, and a machine gun in the tail. Power is supplied by two Argus 410 inverted V motors developing only 450 h.p. each.

Recognition Points

General structural features: Low-wing monoplane; two in-line air-cooled engines; twin booms and twin tail units; retractable undercarriage.

Head-on view: Cross-section of fuselage is squared on bottom and sides, but rounded on top; rudders mounted immediately in line with underslung engines; dihedral from engines to wing-tips.

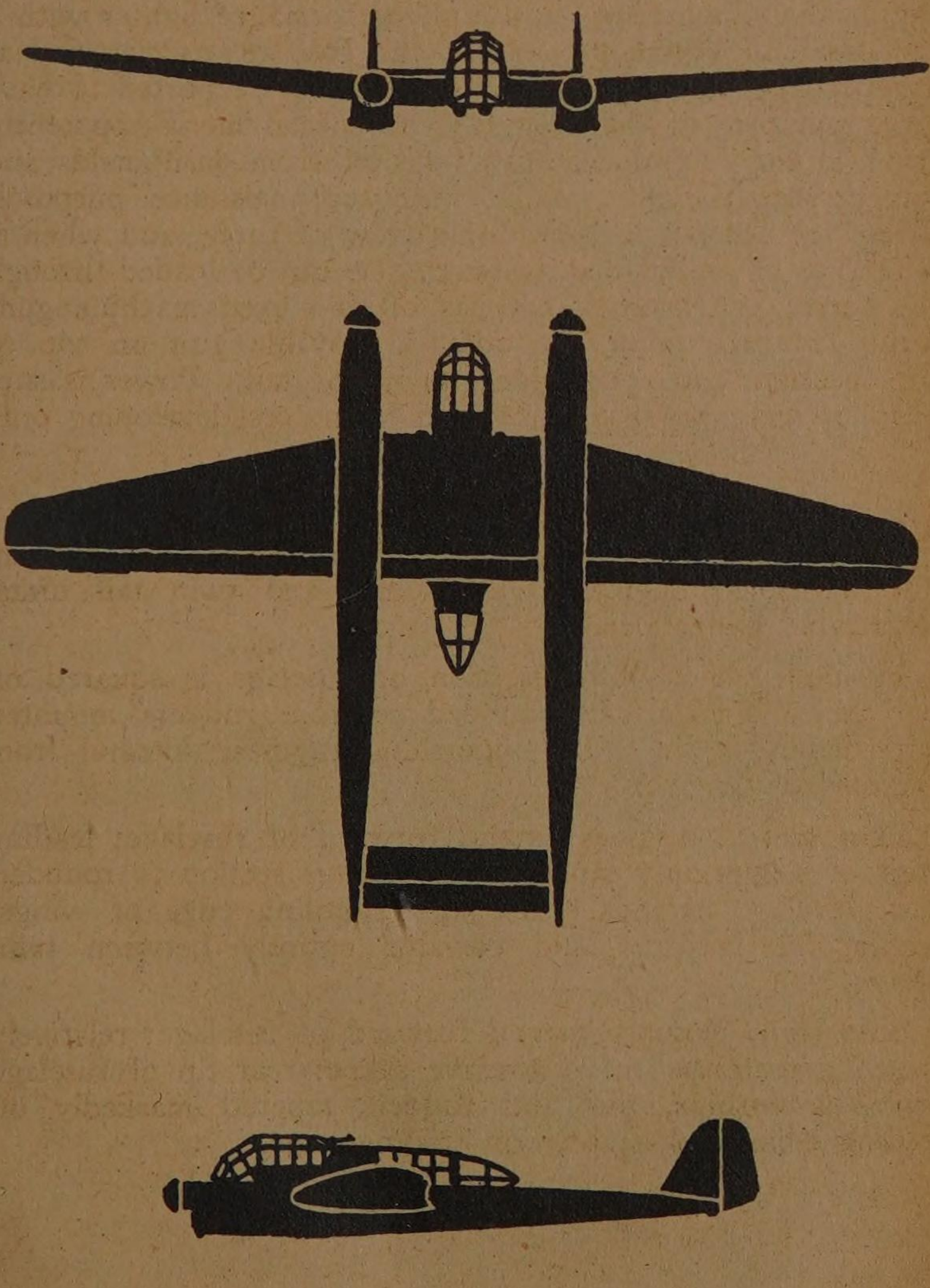
Plan view: Engines extend forward of fuselage; leading edge of wings only tapered from center section to rounded tips; fuselage extends rearward of trailing edge of wings; rectangular tailplane and elevator entirely between twin booms.

Side view: Engines extend forward of fuselage; relatively large "greenhouse" of distinctive shape; rear tip of fuselage visible amidships; fins and rudders tapered markedly on leading edge, and slightly on trailing edge.

FOCKE-WULF 189 (2 Argus 410)
German Reconnaissance Plane

Span 60' 4"

Length 39' 4"



FOCKE-WULF 187 "ZERSTÖRER"

The Focke-Wulf Flugzeugbau, whose principal works were at Bremen, is perhaps best known for the successful "Condor" four engine air liners from which the notorious convoy-raider "Kurier" has been developed. The F.W. 187 is designed primarily for long-range escort work. In general performance and armament it is comparable to the Me. 110, a type which has proved inferior to Britain's latest fighters. Powered by two 1,150 h.p. Mercedes-Benz DB 601 liquid-cooled in-line engines. Top speed is about 360 m.p.h. and service ceiling 38,700 ft. The Junkers "Jumo" 211 liquid-cooled in-line engine is an alternative power unit. Armament: Two cannon and four machine-guns in the nose. An additional machine-gun may be carried in the rear cockpit. The underside of the nose is fitted with transparent panels and provision is made for carrying light bombs.

Recognition Points

General Structural Features: Low-wing monoplane; two in-line engines; single fin and rudder; slender streamlined fuse-lage; retractable undercarriage.

Head-on view: Roughly oval fuselage wider at base, with glazed cockpit forming upper part of the oval; moderate inverted gull-wing, anhedral continuing just beyond engines, outer sections dihedral; engines appear completely under-slung, with unusually deep radiators; tall, prominent fin and rudder; tailplane about mid-position, extends slightly beyond engine centers.

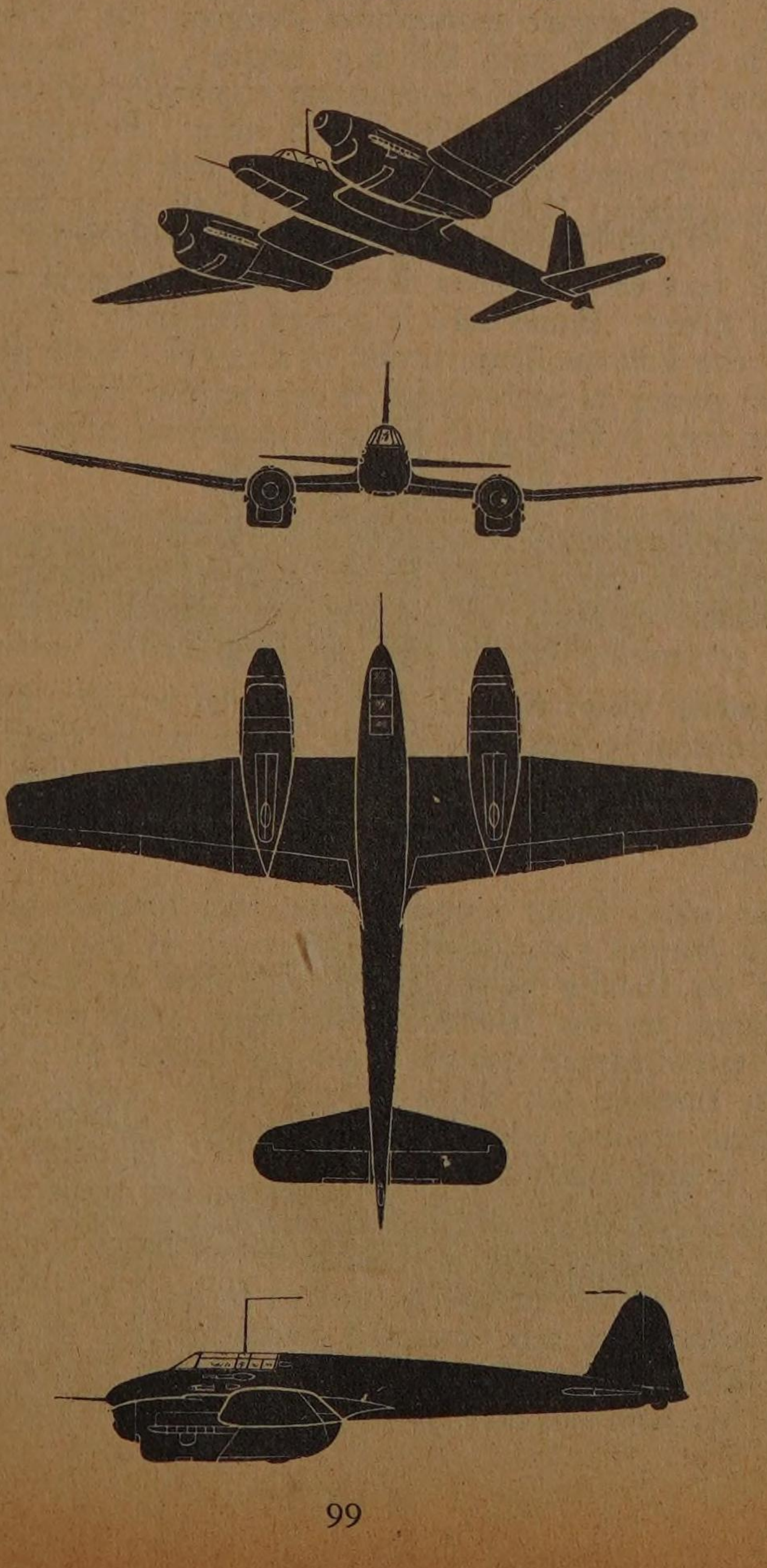
Plan view: Finely tapered nose protrudes only as far for-ward as long engine nacelles; wing center section appears straight; straight taper commences outboard of nacelles; wing tips narrow, slightly rounded; wing trailing edge has broken straight taper with fillets; unusually narrow fuselage. finely tapered; straight taper on leading edge of tailplane, with rounded tips, straight trailing edge; rudder projects aft.

Side view: Nose, hidden by engines, appears blunt and ir-regular; fuselage has step-up over cabin, then curved taper to tail; under side broken by deep nacelles which appear to double depth of forward part; thence gentle curved taper o tail; tall conical fin and rudder with rounded top.

FOCKE-WULF 187 (2 D.B. 601A)
German Twin-Engine Fighter

Span 50' 6" Length 39' 3" Height 15' 0"

(Dimensions approximate)



CAPRONI 310, 311 AND 312 bis

Aircraft of the Bergamaschi subsidiary of the Caproni company may readily be distinguished from other Caproni types. Twin-engine monoplanes designed for colonial work include "Ghibli," with 200 h.p. engines, and "Libeccio" or Caproni 310, with 430 h.p. radial engines. Caproni 311 is similar, with shorter, fully glazed nose. Powered by two 700 h.p. Piaggio radial air-cooled engines, top speed is 260 m.p.h., cruising 218 m.p.h., range 1,240 miles and service ceiling 27,000 ft. Armament: One forward-firing machine-gun in port wing and one flexibly mounted gun in retractable dorsal turret. Bomb load is stowed internally. Caproni 312 bis is the float seaplane version of Ca. 311. With engines of similar power its performance is appreciably lower. A variant of the type is fitted with a torpedo-carrying tube.

Recognition Points

General structural features (Ca. 311): Low-wing monoplane; two radial engines; single fin and rudder; triangular tailplane; slab-sided fuselage, very generously glazed; tapered wings with protruding nacelle tips; semi-retractable undercarriage.

Head-on view: Box-like fuselage (slab-sided) fully glazed, surmounted by small retractable turret; wings show dihedral from roots; centrally mounted engines; mid-position tailplane extends just beyond engine centers; tall prominent fin and rudder.

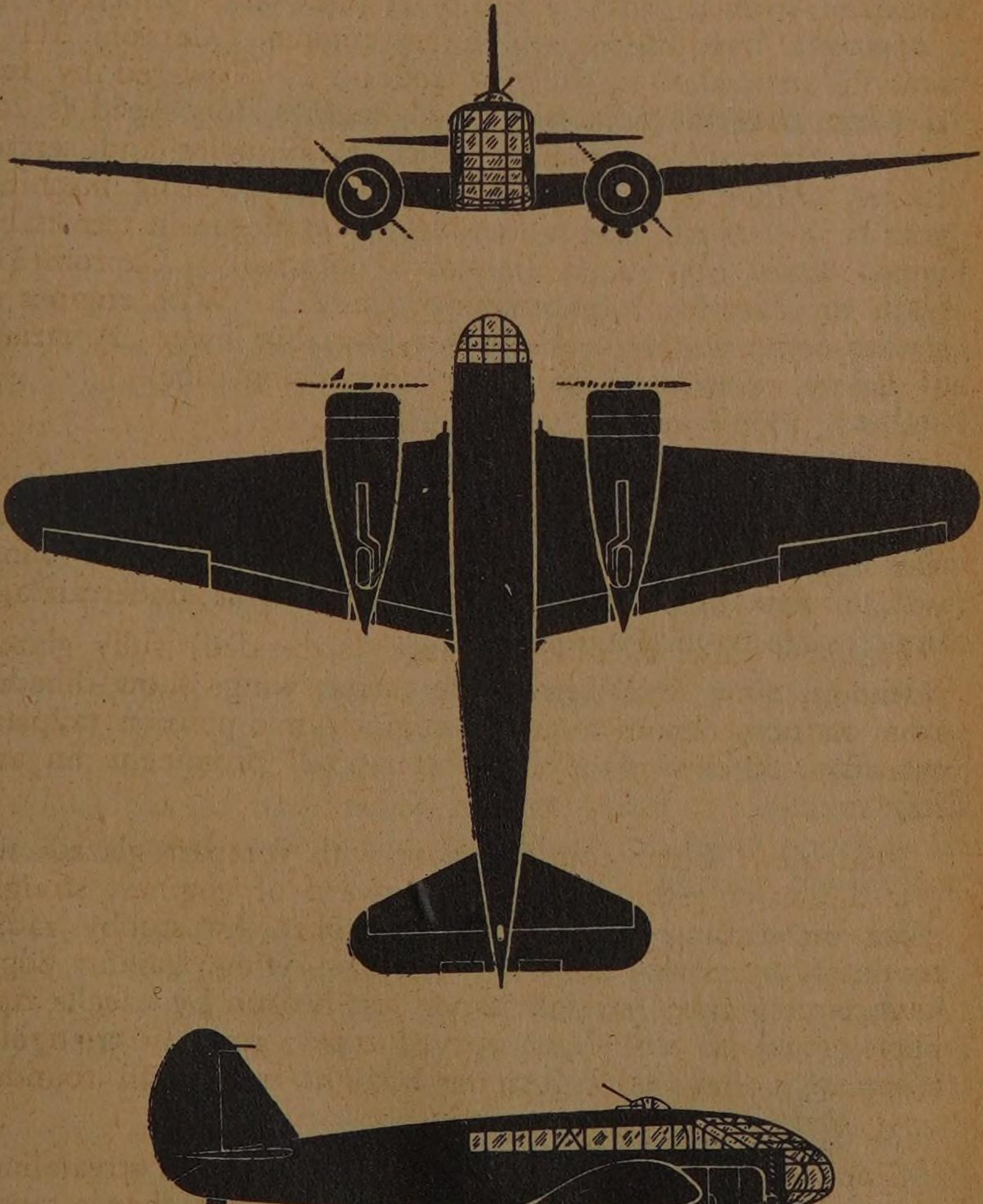
Plan view: Blunt rounded nose with forepart glazed; unglazed portion extends slightly forward of engines; straight taper on leading edge of wings broken by stubby radial cowlings; narrow rounded wing tips; wing trailing edges have more marked straight taper just broken by nacelle tips, fillets; fuselage has slight curved taper; roughly triangular tailplane, trailing edge forming straight base, with rounded tips; rudder protrudes slightly.

Side view: Short, rounded, glazed nose; smooth streamlined curve of fuselage broken by small dorsal turret, thence tapering gently to tail; underside, broken forward by deep nacelles and protruding semi-retracted undercarriage, thence tapers smoothly to tail; marked straight taper on leading edge of tailplane, semi-elliptical trailing edge, rounded top.

CAPRONI 311 (Piaggio)
Italian Reconnaissance Bomber

Span 53' 0"

Length 44' 0"



SAVOIA-MARCHETTI 79

The Savoia-Marchetti Company has chiefly concentrated upon the development of three-engine air liners and military types, some of their designs resembling modernized versions of the Junkers 52. S.M. 75 is an adaptation of the well-known air-liner to military transport functions. It can carry a complete but dismantled Fiat biplane fighter—hence its name "Marsupiale." S.M. 79 is adapted from an air liner by the addition of the peculiar humped gun position on top and another gun position beneath. S.M. 79 power plant is three 750 h.p. Alfa-Romeo radial air-cooled engines, giving a top speed of 270 m.p.h. and service ceiling of 23,000 ft. or three Piaggio 1,000 h.p. radial engines, giving top speed of 295 m.p.h. and service ceiling of 28,000 ft. Armament: One forward-firing machine-gun and two firing aft—one above and one below. One or more additional guns fire through side windows. Bomb-load is 2/3,000 lb.

Recognition Points

General structural features: Low-wing monoplane; three radial engines; single fin and rudder; slab-sided, hump-backed fuselage; retractable landing gear; aft=projecting nacelles; characteristic Savoia-Marchetti tail.

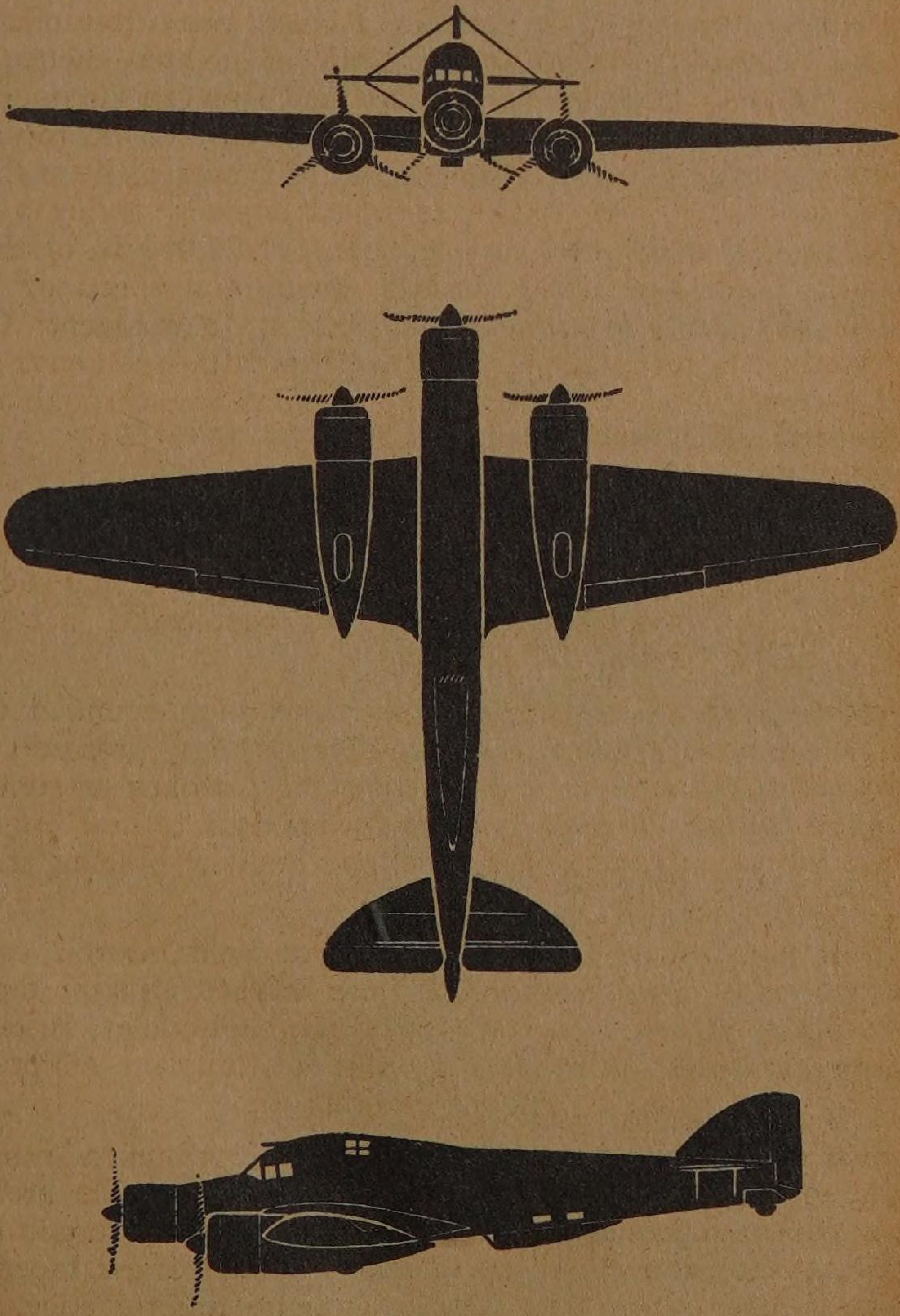
Head-on view: Fuselage box-like with high rounded top; motor on nose; bomb-aimer's legs, or fairings, protrude below; slight dihedral from roots of wings, broken by underslung nacelles; outboard engines lower than central engine; mid-position tailplane; visible fin and rudder; bracing struts in diamond pattern.

Plan view: Long blunt nose projects well beyond outer motors; wing trailing edge has more marked straight taper; rounded wing tips; nacelles project aft; slight fillet; fuselage tapers gently to tail; leading edge of tailplane elliptical, trailing edge straight; rudder projects aft.

Side view: Blunt stubby nose; fuselage curves up to "humpback" gun position, thence straight taper; underside broken forward by underslung nacelles, amidships by undergun position, thence straight taper to tail; marked curved taper in leading edge of fin and rudder, straight trailing edge, resembling half of tailplane.

SAVOIA 79 (3 Alfa Romeo R. C. 34)
Italian Bomber

Span 69' 0" **Length 53' 0"** **Height 13' 0"**



SAVOIA-MARCHETTI 81

The S.M. 81 dates from 1935 and was developed from the S.M. 73 air-liner. Several S.M. 73 liners of the Belgian S.A.B.E.N.A. services escaped to England in May, 1940, and were used for general transport purposes. The modifications for the military type S.M. 81 include a small gun-turret on top of the fuselage and another beneath. The power plant is three 700 h.p. Piaggio radial air-cooled engines, giving top speed of 211 m.p.h., range of 930 miles and service ceiling 23,000 ft. Alternatively, Alfa-Romeo radial engines may be fitted.

Armament: Five machine-guns, two in each hydraulically operated gun-turret and a flexibly mounted gun firing from either side of the fuselage. Bomb-load 2/3,000 lb.

Recognition Points

General structural features: Low-wing monoplane; three radial engines; single fin and rudder; large slab-sided fuselage; fixed undercarriage. Note the unusual wings and distinctive Savoia tail unit.

Head-on view: Fuselage deep, box-like, with rounded top, surmounted by small glazed turret; under-gun turret may protrude beneath; motor on nose; wings show dihedral from roots; outboard engines mounted about center; break line above and below; underside broken by braced struts supporting spatted wheels; mid-position tailplane extends beyond engines; braced fin and rudder just visible.

Plan view: Medium length blunt nose projects beyond outer motors; short straight center-section on wing leading edge to nacelles, then marked straight taper to rounded tips; slight straight taper on trailing edge; fillets; fuselage tapers, with fillets to tailplane; tailplane resembles outspread moth wings, cut away for rudder.

Side view: Stubby nose; step-up in fuselage to cabin, thence gently curved taper to tail, broken by small glazed turret forward; underside broken by nacelle, by braced undercarriage legs carrying streamlined "spats," and by the small gun position; fin and rudder have marked curved taper on leading edge, slightly rounded trailing edge, wide base.

SAVOIA 81
Italian Bomber

Span 79' 0" Length 57' 0" Height 15' 0"

JUNKERS 52

The civil version of this three-engine monoplane, type Ju 52/3M, one of the most successful Junkers designs, was extensively used in all parts of the world as a passenger and heavy transport plane for nearly ten years.

Although the design is old, the military version, adapted for parachutists or as an ordinary troop transport, has been built in large quantities. It played a very important role in the invasions of Norway, Crete and the Low Countries. The normal load of Ju 52 is about fourteen fully equipped parachutists, or as a short distance heavy transport it may carry more than two tons of arms and equipment. There is a machine-gun position on top of the fuselage well aft, and some versions have the "dustbin" type of under-gun position. Powered with three 760 h.p. B.M.W. air-cooled radial engines, the maximum speed is 189 m.p.h., cruising speed 175 m.p.h. and range at 149 m.p.h., 1,000 miles. Ju 52/W is a twin-float seaplane version.

Recognition Points

General structural features: Low-wing monoplane; three radial engines; single fin and rudder; large slab-sided fuselage with one engine mounted on the nose; fixed undercarriage. Daylight can usually be seen between wing and flap which runs full length of trailing edge.

Head-on view: Box-like fuselage, slab-sided, surmounted by glazed cockpit; wings with full dihedral; outboard engines mounted on their center-lines; "dust-bin" type of under-gun position; braced tailplane high; fin and rudder prominent; fixed undercarriage.

Plan view: Uniformly tapered wings with Junkers double-wings or flaps; narrow almost square tips; engine nacelles inclined inboard; characteristic long and narrow braced tail-plane; double-wing type elevators project beyond tips of tailplane.

Side view: Outboard engines extend to glazed cockpit; dorsal machine gun position aft; tall angular fin and rectangular rudder; fixed undercarriage; "dustbin" under-gun position.

JUNKERS 52 (3 B.M.W.)

German Parachute Troop Transport

Span 96' 0" Length 62' 0" Height 18' 0"

FOCKE-WULF 200B "CONDOR" II

The civil air-liner version of the F.W. 200 was produced about the end of 1937, to carry 22/30 passengers. A "Condor" in 1938 flew 4,000 miles non-stop from Berlin to New York with a crew of four. F.W. 200B, developed in 1939, was fitted with four B.M.W. radial air-cooled engines of 880 h.p., with modified wing and tail design and a four-wheeled undercarriage. A specially fitted "Condor" of this type—heavily escorted by fighters—serves as Hitler's flying headquarters.

"Condor II" is a military development of F.W. 200B, fitted with either 1,000 h.p. Bramo Fafnir radial engines or 1320 h.p. B.M.W. two-row radial engines. With the more powerful motors the top speed approaches 280 m.p.h., normal range is 2,300 miles and service ceiling over 28,000 feet. As a troop transport, accommodation is provided for thirty fully armed men. Its activities include bombing, mine-laying and convoy-raiding.

Recognition Points

General structural features: Low-wing monoplane; four radial engines; single fin and rudder; finely streamlined fuselage; narrow tapered wings; distinctive tail unit; retractable undercarriage (four wheels).

Head-on view: Box-like fuselage with rounded top; thick center-section of wings appears straight to outer nacelles; outer section dihedral to tips; inboard engines underslung; outer pair centrally mounted; long, rather low tailplane extends nearly to outer nacelles; tall, very prominent fin and rudder.

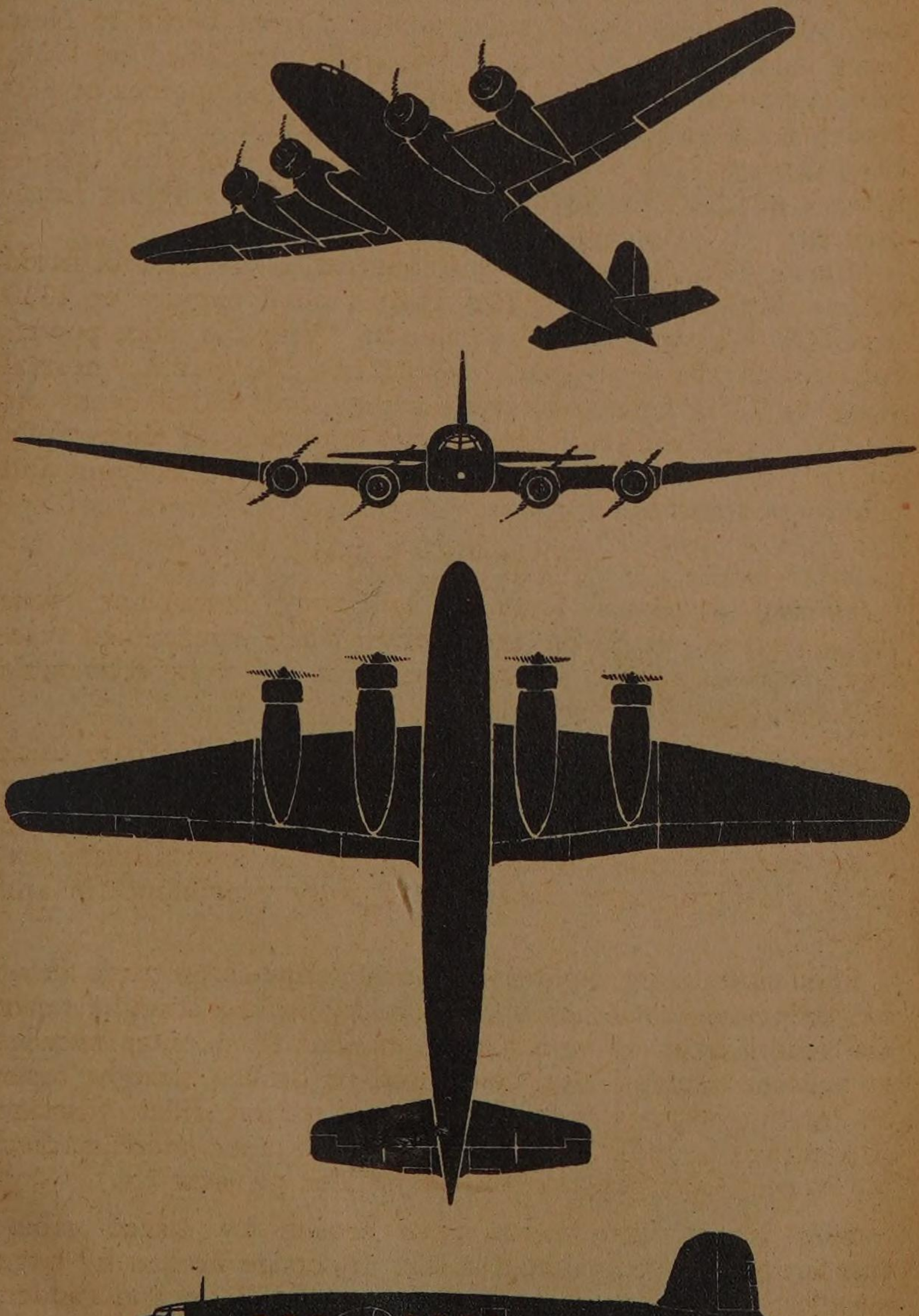
Plan view: Long, cigar-shaped nose; engines protrude about halfway, outer pair set slightly back; broken straight taper on leading edge of wings more marked from outer nacelles to narrow rounded tips; compound or broken straight taper on trailing edge, with straight center section, fillet; fuselage streamlined to tail; tailplane has straight taper, more marked on leading edge; square-cut tips; rudder projects aft.

Side view: Cigar-shaped nose broken by glazed cabin; fuselage gently streamlined to tail; underside broken by large nacelles; straight taper on both edges of tall fin and rudder, which have wide, rounded top; tip of fuselage projects aft.

FOCKE-WULF "CONDOR" (4 B.M.W.)

German Bomber, Transport and Mine Layer

Span 108' 0" Height 78' 0"



FOCKE-WULF 200K "KURIER"

F. W. 200K "Kurrier," the long-range bomber and convoy raider developed from the "Condor," usually operates in wide sweeps from bases on the Norwegian coast, southwards round Scotland and the west coast of Ireland to bases on the French Atlantic coast round Brest. "Kuriers" based on French ports maintain a shuttle service, sweeping northwards. They are in radio communication with submarines, whose operations they control. Power plants are the same as for "Condor" II, giving approximately the same performance.

Armament includes two power-operated four-gun turrets on top of the fuselage. Additional guns, including cannon, are in the long bomb welt underneath. The maximum bomb-load is 6/7,000 lb., bombs also being carried externally in racks visible alongside the outer nacelles.

Recognition Points

General structural features: Low-wing monoplane; four radial engines; single fin and rudder; streamlined fuselage; retractable undercarriage (four wheels); distinctive tail unit; dorsal turrets; bomb welt.

Head-on view: Box-like fuselage with rounded top; bomb-welt offset to starboard beneath; thick center-section of wing appears straight to bomb racks beyond outer nacelles; outer section dihedral to tips; inboard engines underslung; outer pair centrally mounted; long, rather low tailplane extends nearly to outer nacelles; tall fin and rudder very prominent.

Plan view: Long cigar-shaped nose; engines protrude about halfway, outer pair set slightly back; broken straight taper on leading edge of wings more marked from outer nacelles to narrow rounded tips; trailing edge compound, or broken straight taper, center section appearing straight; fillet; fuselage streamlined to tail; straight taper on tailplane more marked on leading edge; square-cut tips; rudder projects aft.

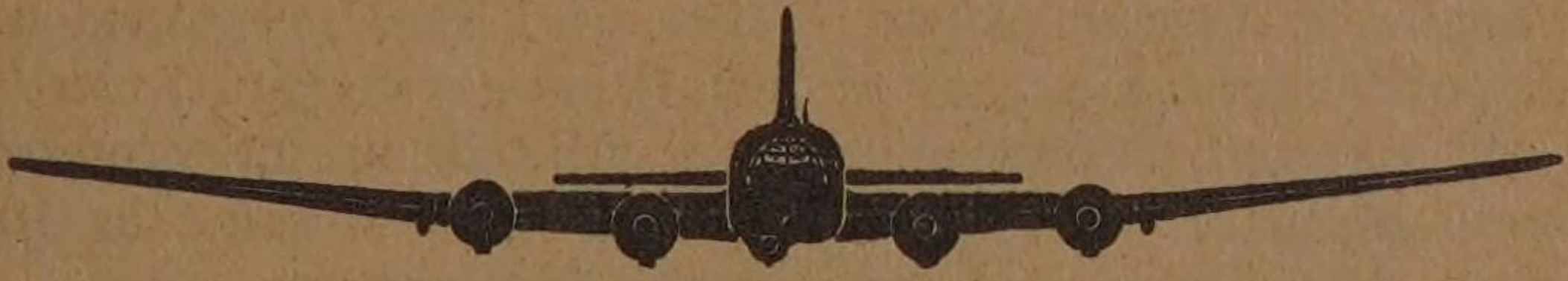
Side view: Cigar-shaped nose, broken by glazed cabin; gentle streamline of fuselage broken by two glazed gun turrets; underside broken by long deep bomb welt and large nacelles; straight taper on both edges of tall fin and rudder, with wide rounded top; tip of fuselage projects aft.

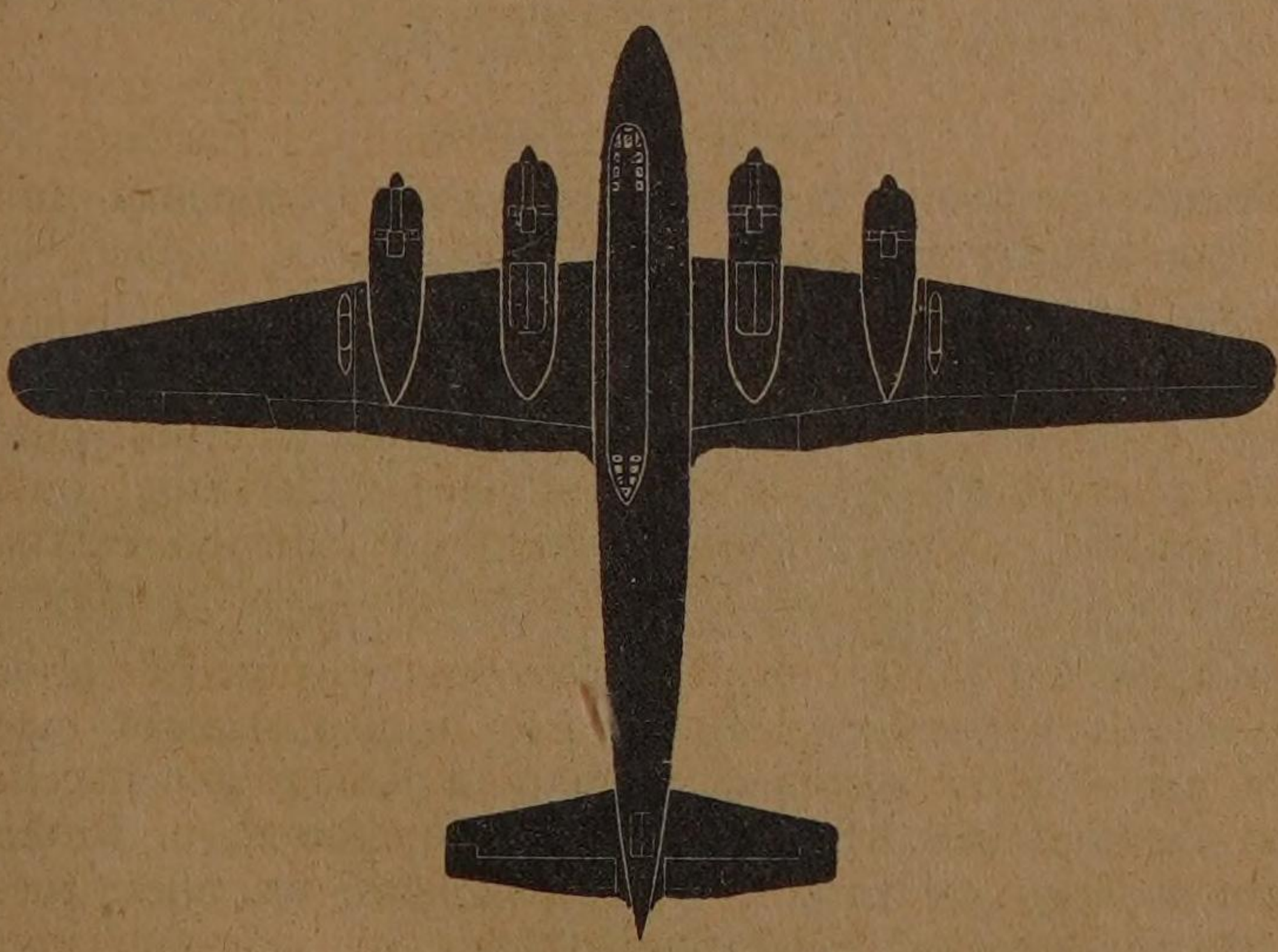
FOCKE-WULF 200K "KURIER" (4 B.M.W.)

German Heavy Bomber

Span 108' 0"

Length 78' 0"





JUNKERS 89 AND 90

Ju 89 is the military version of the Ju 90, a forty-passenger four-engine air liner in regular service since 1937 on the principal Lufthansa European air lines. The civil version, shown in these drawings, serves chiefly as a troop carrier and heavy transport plane. Crew and fuel included, it is capable of carrying a load of nearly seven tons.

Ju 90 is fitted with four 880 h.p. B.M.W. radial air-cooled engines giving a maximum speed of 217 m.p.h., cruising speed of 198 m.p.h. and range of 1,300 miles.

Ju 89, the bomber version, is fitted with four 1,200 h.p. Junkers "Jumo" liquid-cooled engines. It is believed to have a maximum speed of 225 m.p.h. and cruising speed around 200 m.p.h. There is a glazed bomb-aiming turret in the nose, a tail gun-turret and additional gun positions in the fuselage. Apart from these modifications, the general apperance of the civil and military types is the same.

Recognition Points

General structural features: Low-wing monoplane; Ju 89 has four in-line engines; Ju 90 has four radial engines; twin fins and rudders.

Head-on view: Large fuselage of roughly oval section; dihedral more marked from inboard engines to tips; fairings enclosing the retracted wheels visible under the inner nacelles; four centrally mounted engines; high, wide tailplane.

Plan view: Wing plan most characteristic, having very sharp taper on the leading edge, narrow tips swept inboard, and slightly back-swept trailing edge; Junkers "double-wing" flaps are fitted; outboard engines mounted further back than inboard pair; fuselage somewhat slab-sided forward, tapers to nose and to tail; tapered tailplane mounted on top of fuselage forward of the tail.

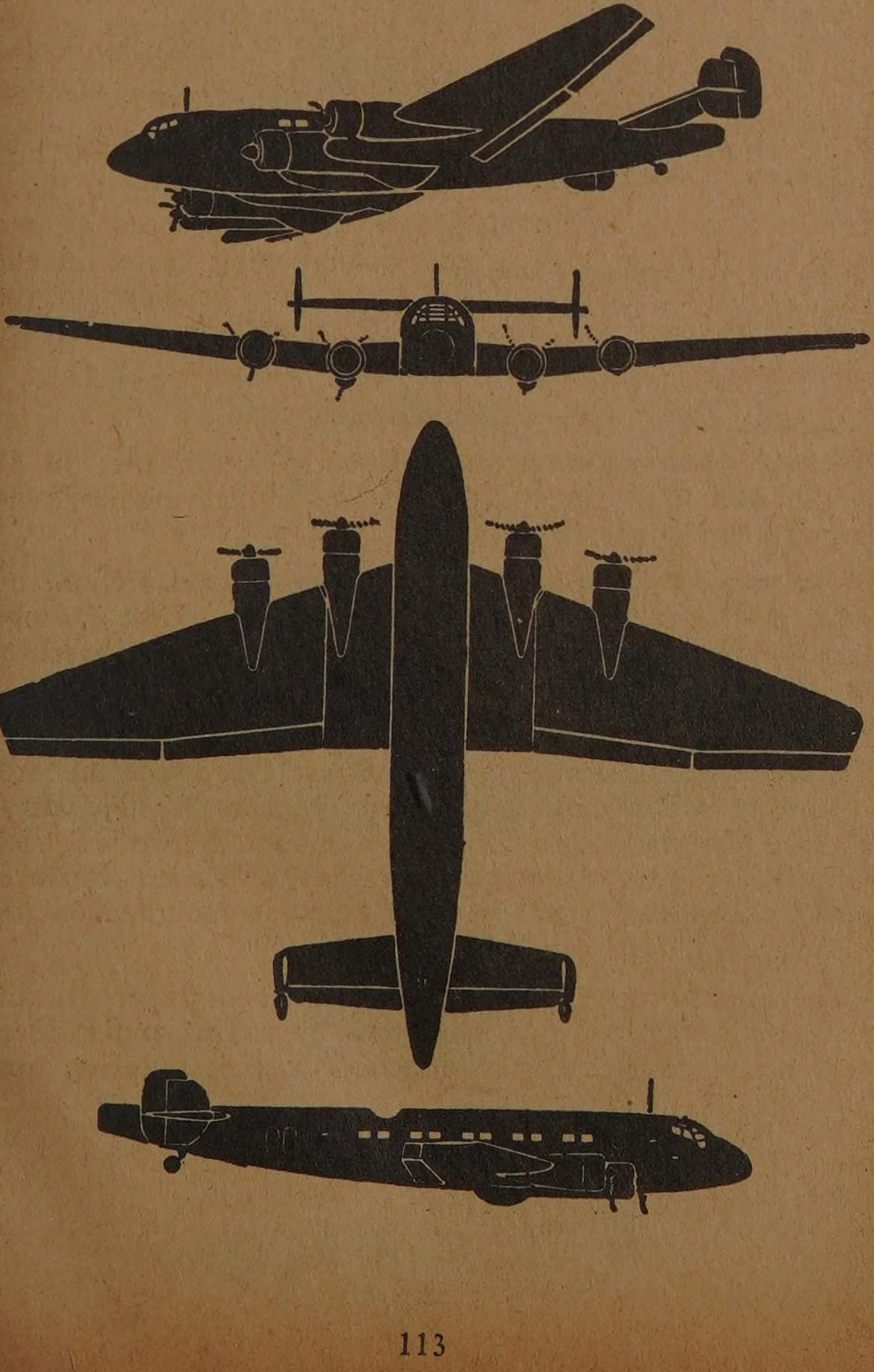
Side view: Fuselage deep forward, underside tapers to tail; nose projects far forward of engines; twin fins and rudders of distinctive Junkers design attached close to tailplane tips.

JUNKERS 90 (4 B.M.W. 132H)

German Communication and Troop Transport

Span 114' 10"

Length 86' 3"



BLOHM AND VOSS HA 142

While the production of a seaplane version of a successful land plane is a common occurrence, the development of a land plane from a successful ocean-going seaplane is unusual. The four-engine troop transport, Ha-142, developed from the long-range mail carrying seaplane Ha 139, is therefore of particular interest. It retains the principal features of the basic design—inverted "gull-wing," slender fuselage and twin-tail unit, but B.M.W. radial air-cooled engines are substituted for the Junkers "Jumo" Diesels of the Ha 139. A retractable undercarriage takes the place of fixed floats.

Recognition Points

General structural features: Low-wing monoplane; inverted "gull-wings;" four radial engines; twin fins and rudders; braced tailplane; streamlined fuselage of circular section; undercarriage retracts into nacelles of inboard engines.

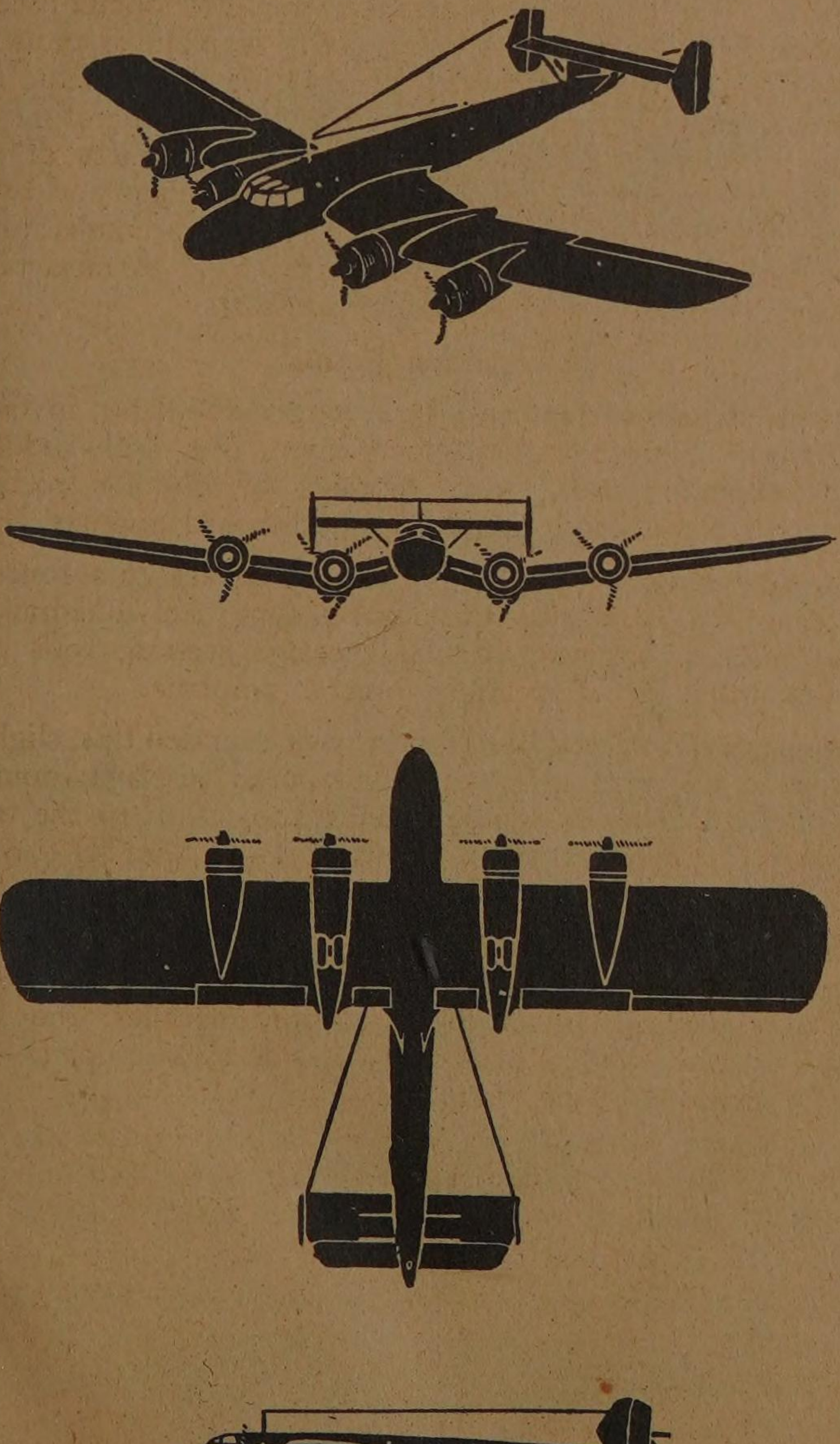
Head-on view: Inverted "gull-wings" makes this four-engine monoplane an easily recognizable type; full dihedral begins at inboard engines; circular fuselage section; four centrally mounted nacelles; high, braced tailplane.

Plan view: Untapered wings with wide rounded tips, slightly swept in at the trailing edge; slim tapered fuselage; pointed fairings of the inboard engine nacelles project aft of the trailing edge; fillets; rectangular tailplane, as in the Ha 139, is mounted on a central stub fin clear of the fuselage.

Side view: Fuselage steps up from pointed nose over glazed cockpit, then tapers to tail, which projects aft of tail unit; tapering underside broken by wing and nacelles; the four wheels of the undercarriage—two side-by-side pairs—are partially exposed when retracted.

BLOHM & VOSS Ha 142 (4 B.M.W. 132H)

Span 96' 9" Length 64' 0" Height 15' 6"



DE HAVILLAND 91 "ALBATROSS"

Developed about the same time as the "Condor" the De Havilland "Albatross" first flew in 1937. The efficiency of the design may be judged by comparison with the "Condor" of the same period. With four 720 h.p. engines, the early "Condors" had a maximum speed of 232 m.p.h. and cruising speed of 217 m.p.h. With four 525 h.p. De Havilland "Gipsy Twelve" air-cooled in-line engines, the top speed of the "Albatross" is 234 m.p.h. and cruising speed 210 m.p.h. Adapted for R.A.F. transport work, the normal range of the "Albatross" is 1,100 miles and service ceiling 17,900 feet. It carries up to thirty passengers. On either side of each engine in the leading edge of the wing are two air intake orifices, clearly visible in the plan view, through which the cooling air enters a system of pressure ducts. The exhausted air emerges through controlled flaps under the nacelles.

Recognition Points

General structural features: Low-wing monoplane; four in-line engines in unusually small and slender nacelles; distinctive twin tail unit; large finely-streamlined fuselage; retractable undercarriage.

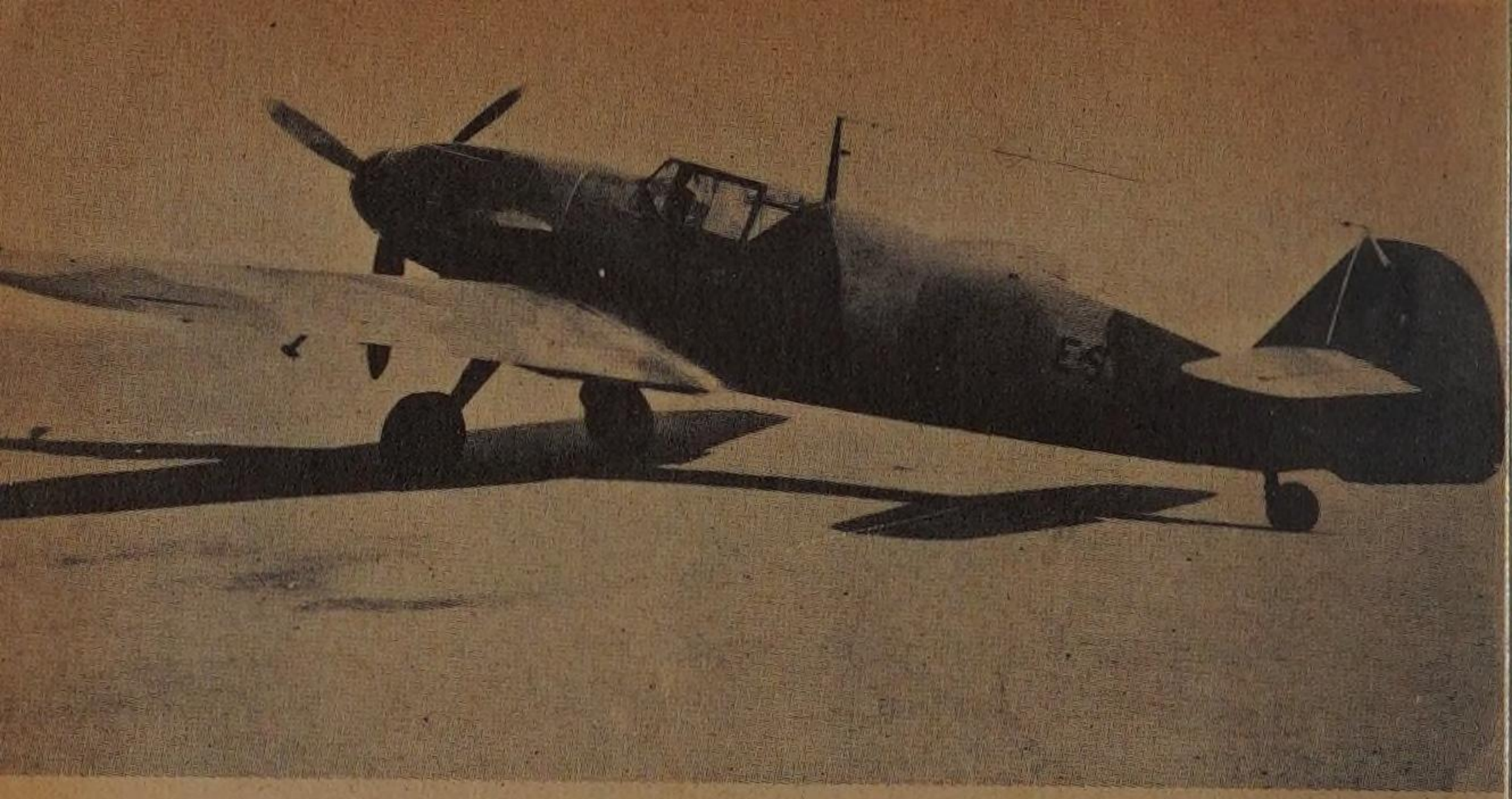
Head-on view: Circular fuselage with no projections; dihedral from roots of wings; engines, mounted about centers, scarcely break line of wing; mid-position tailplane extends beyond inner engine, shows dihedral from roots parallel to wing; about one-quarter of each outrigged fin and rudder protrudes beneath tailplane.

Plan view: Long tapered nose, resembling a projectile, extends far forward of engines; leading edge of wing has straight taper; serrated edge of center section caused by air ducts; trailing edge, with fillets, tapers more markedly, curves sharply toward narrow tips; fuselage tapers to tail; straight taper on leading edge of tail plane, practically untapered trailing edge to small cut-aways at each end; tip of fuselage just visible aft.

Side view: Slight step-up in pointed nose over cabin; line of fuselage is smooth streamlined curve to tail; fin and rudder pear-shaped and slightly tipped rearwards; tip of fuselge protrudes aft.

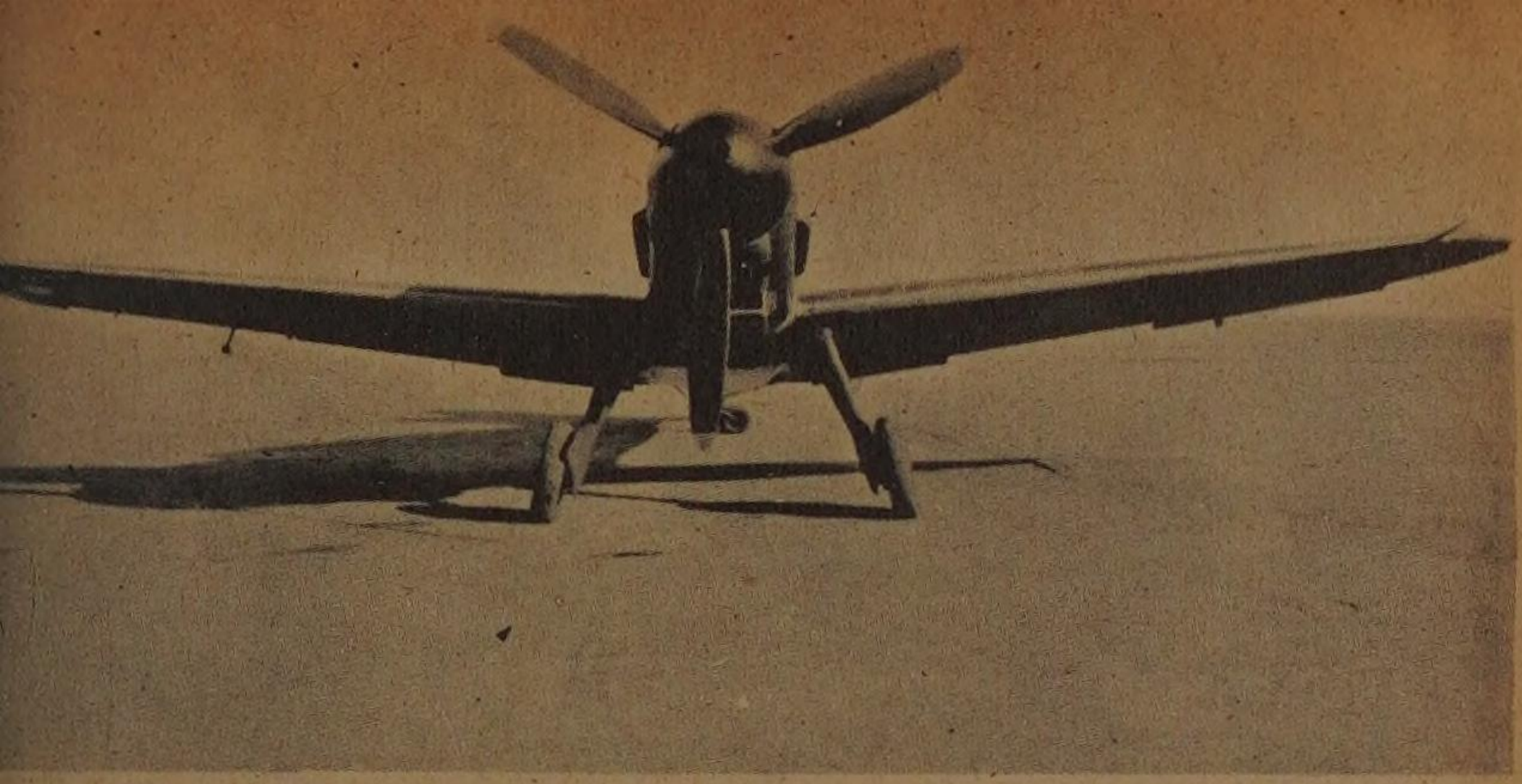
"ALBATROSS" (4 Gipsy-Twelve)
British Transport

Span 105' 0" Length 71' 6" Height 22' 3"

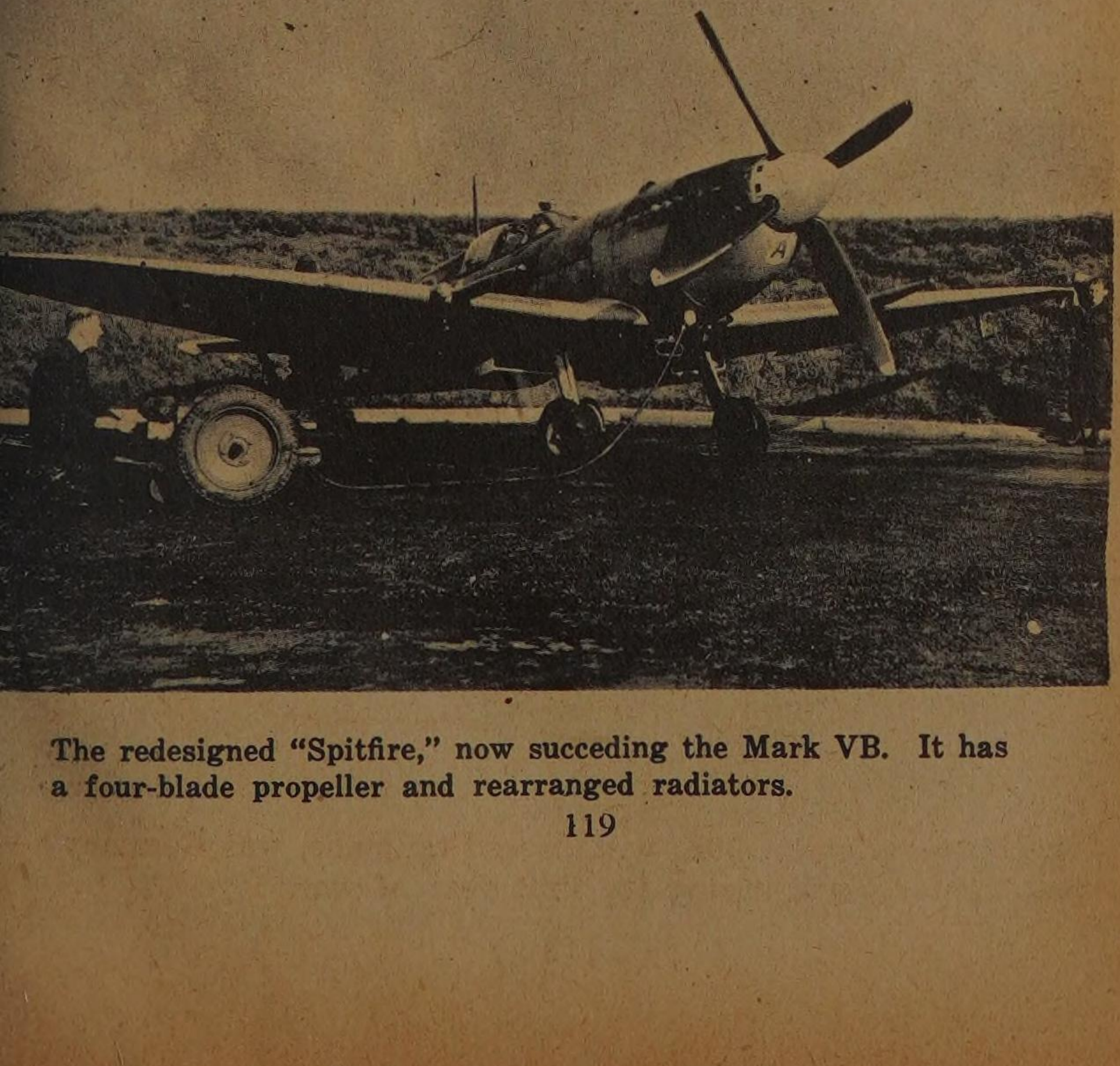


The Messerschmitt 109F is no match for the "Spitfire," so the Nazis are replacing it with FW 190's and Me 109G's.

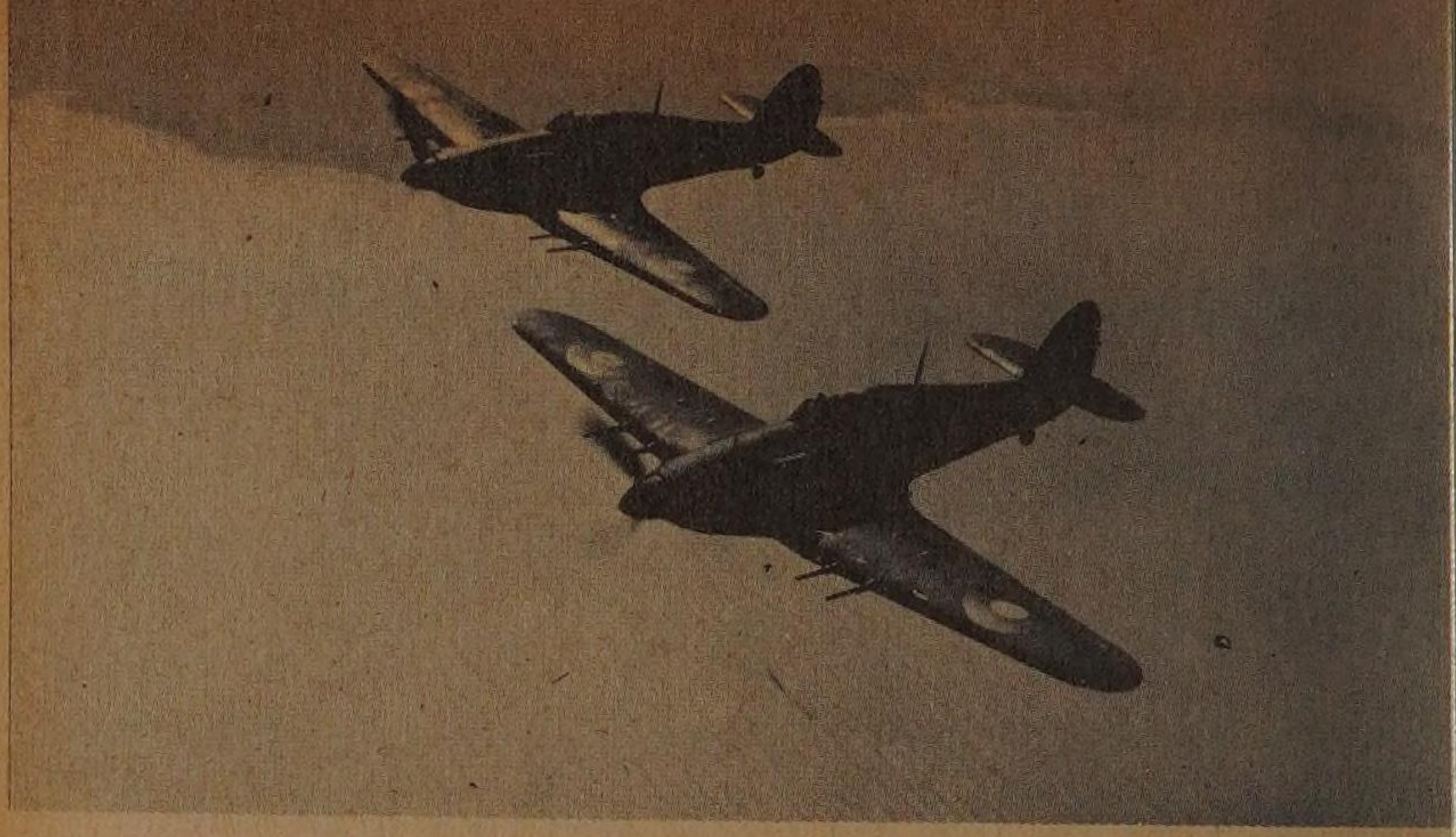
The Messerschmitt 109E, with braced tailplane, was Germany's best fighter plane during the first year of war.



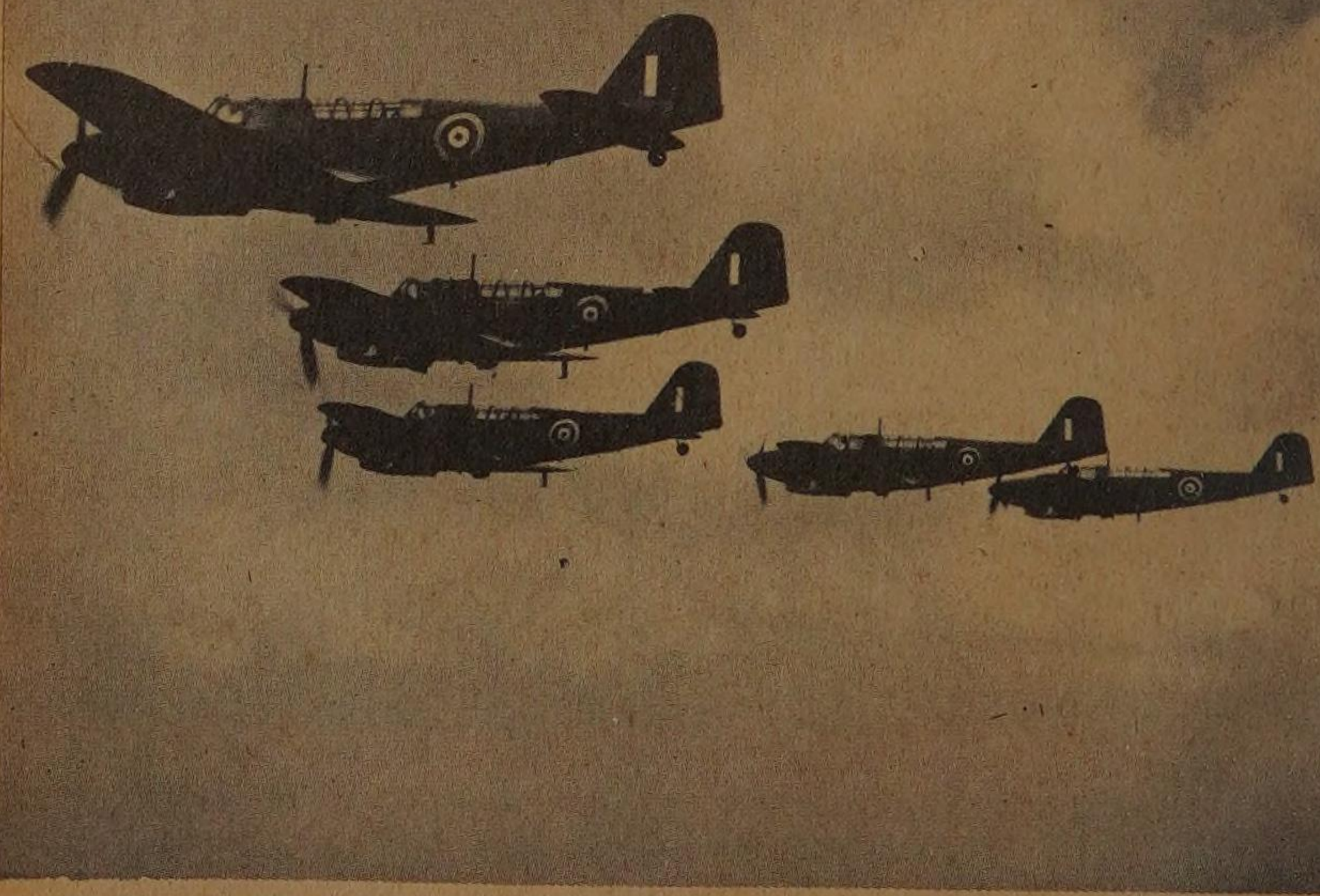
The Messerschmitt 109F again. The center one of the three radiators, and the dihedral on the wings, are striking.



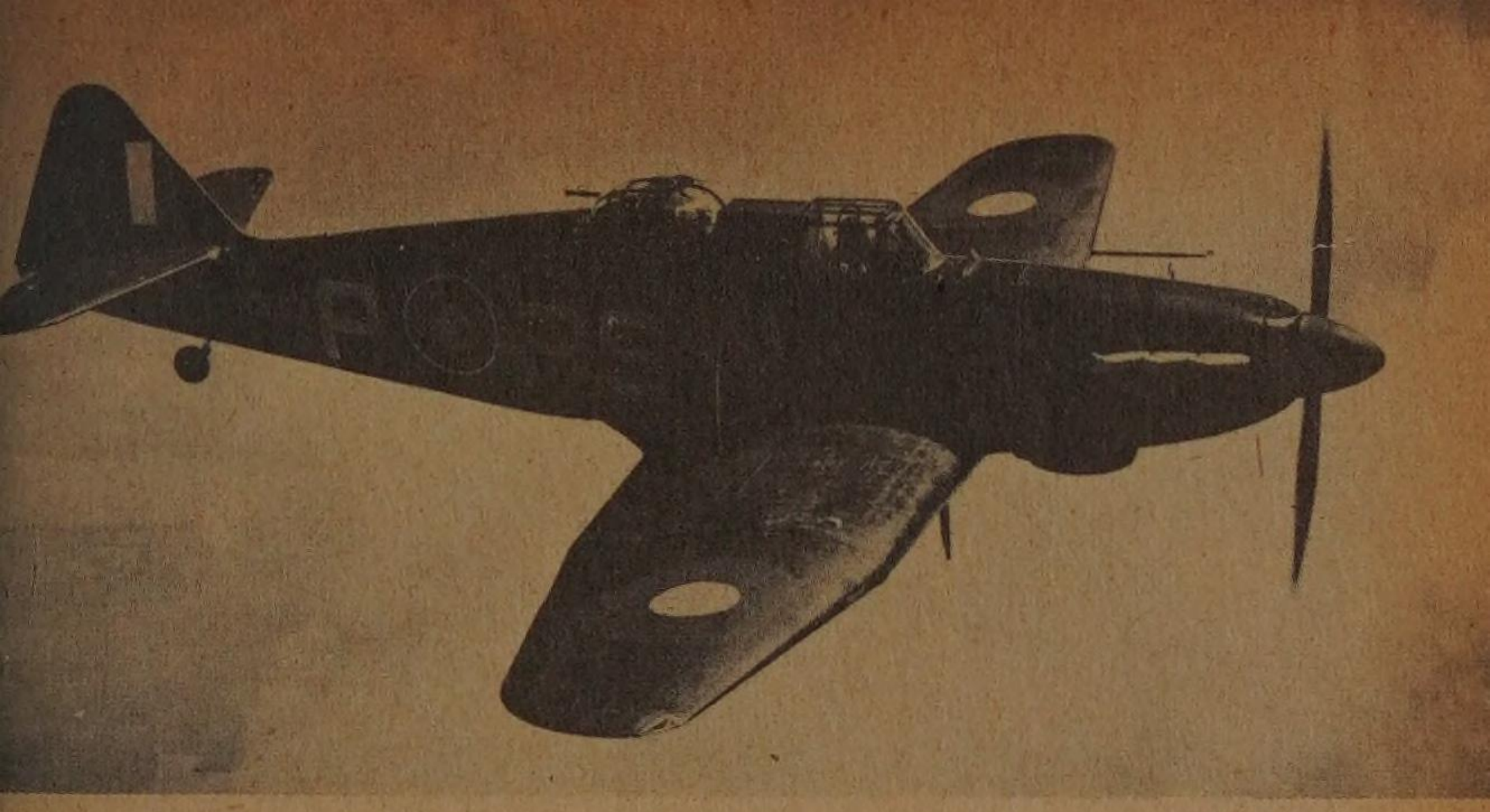
The redesigned "Spitfire," now succeding the Mark VB. It has a four-blade propeller and rearranged radiators.



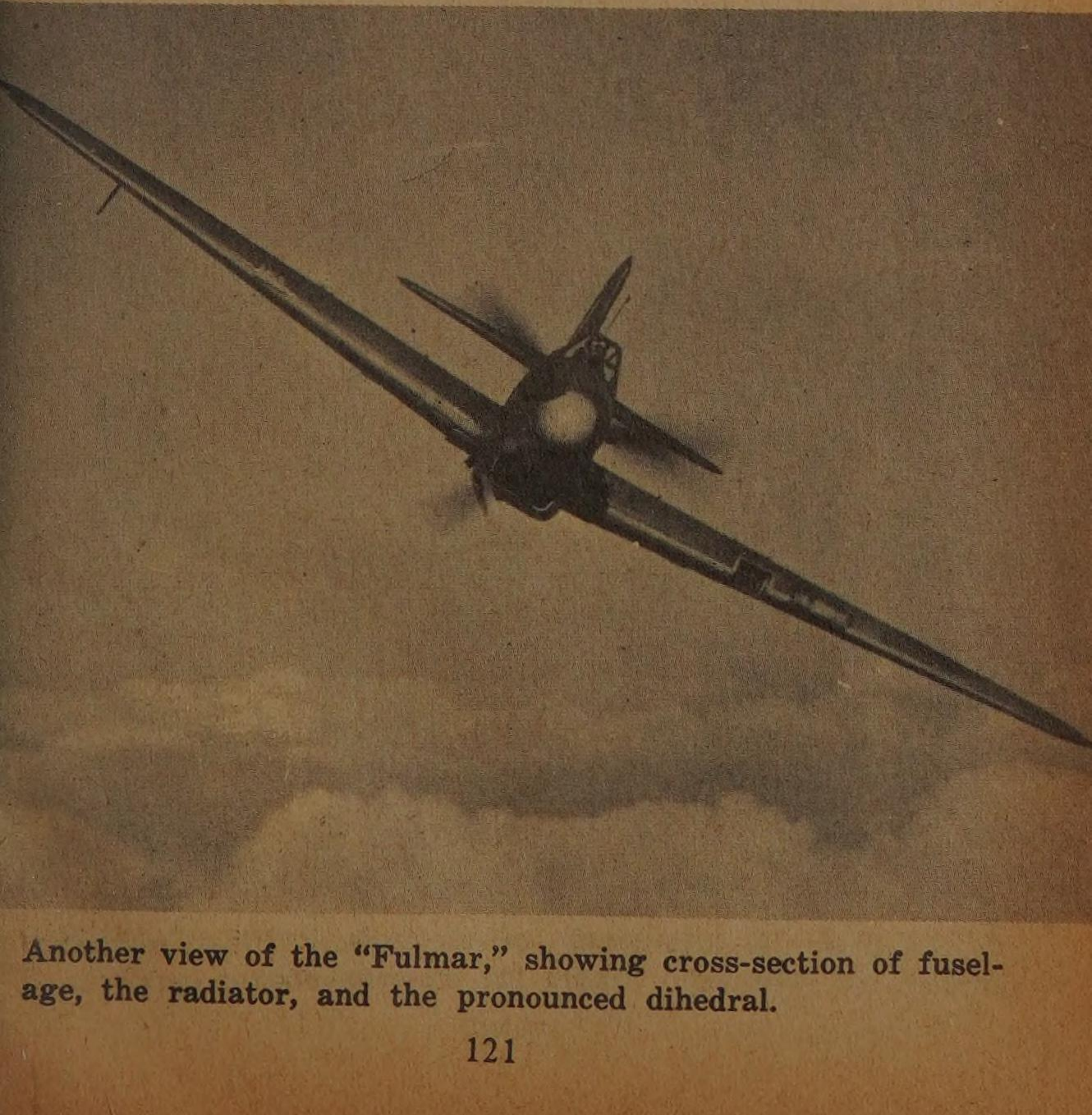
"Hurricanes" like the above have proved themselves to be among the most destructive planes used in this war.



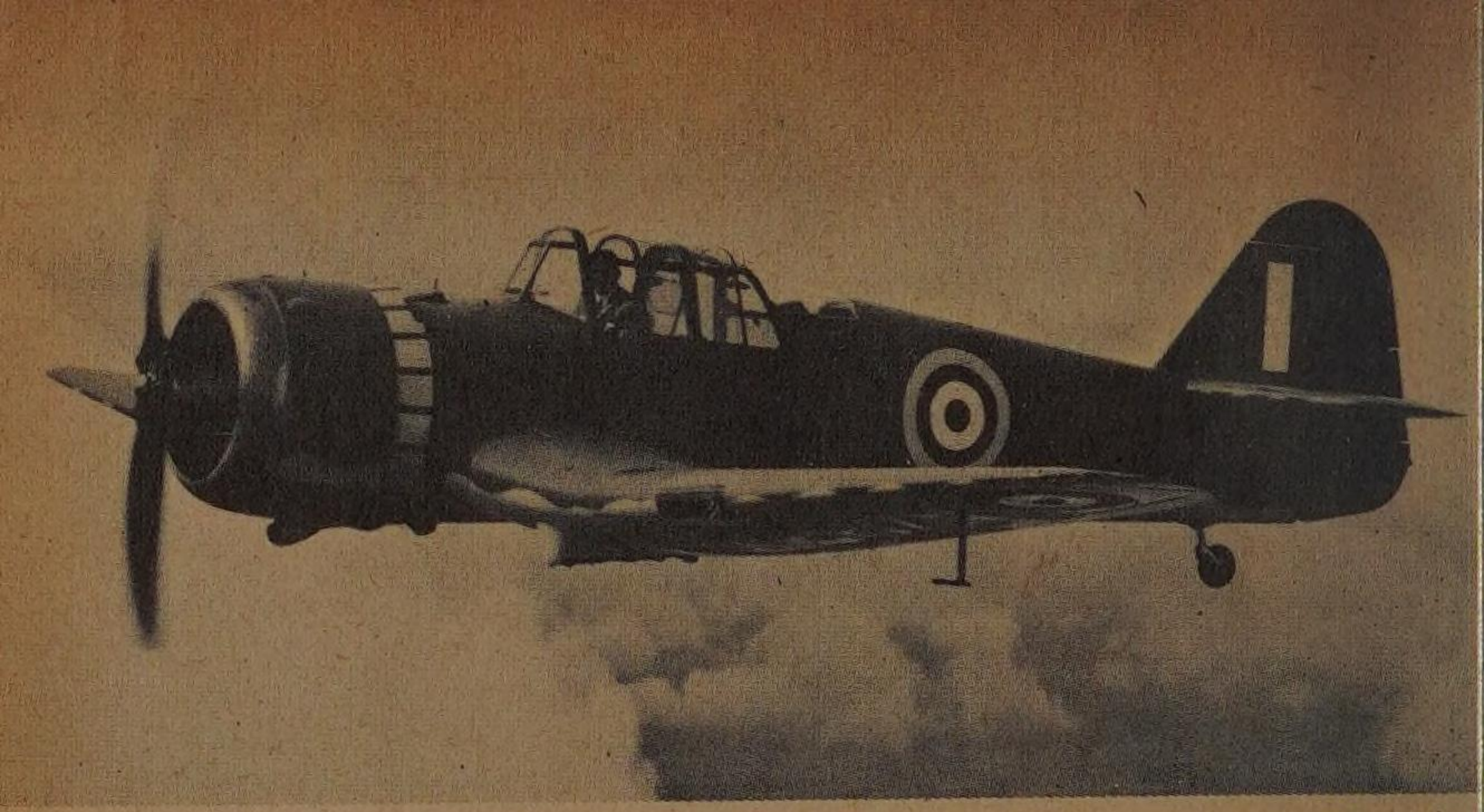
Two-seat Fairey "Fulmars" of the British Fleet Air Arm. Wings of these fighters fold for stowage aboard carriers.



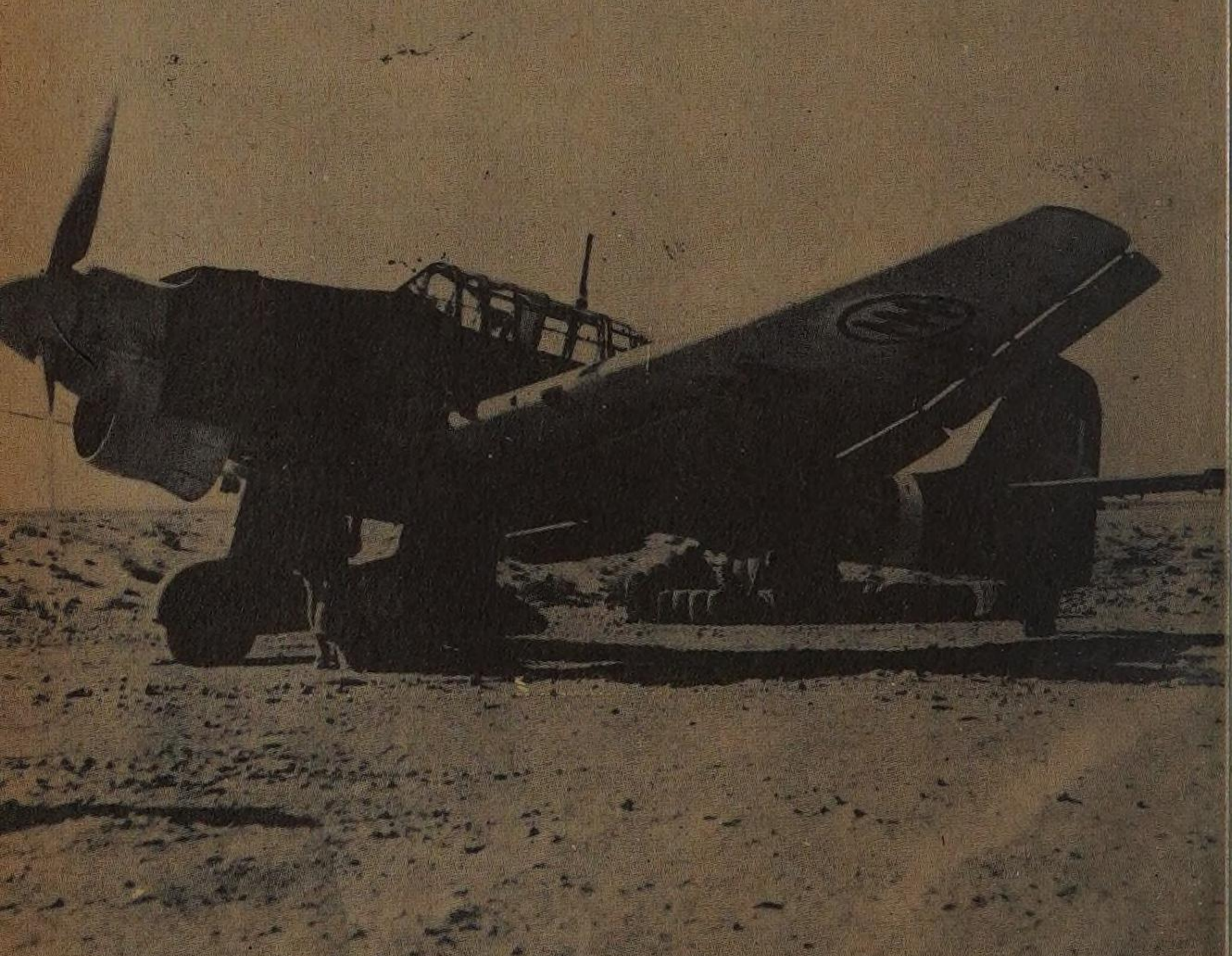
Boulton Paul "Defiants" such as this one are now being used effectively as night fighters. Note gun turret.



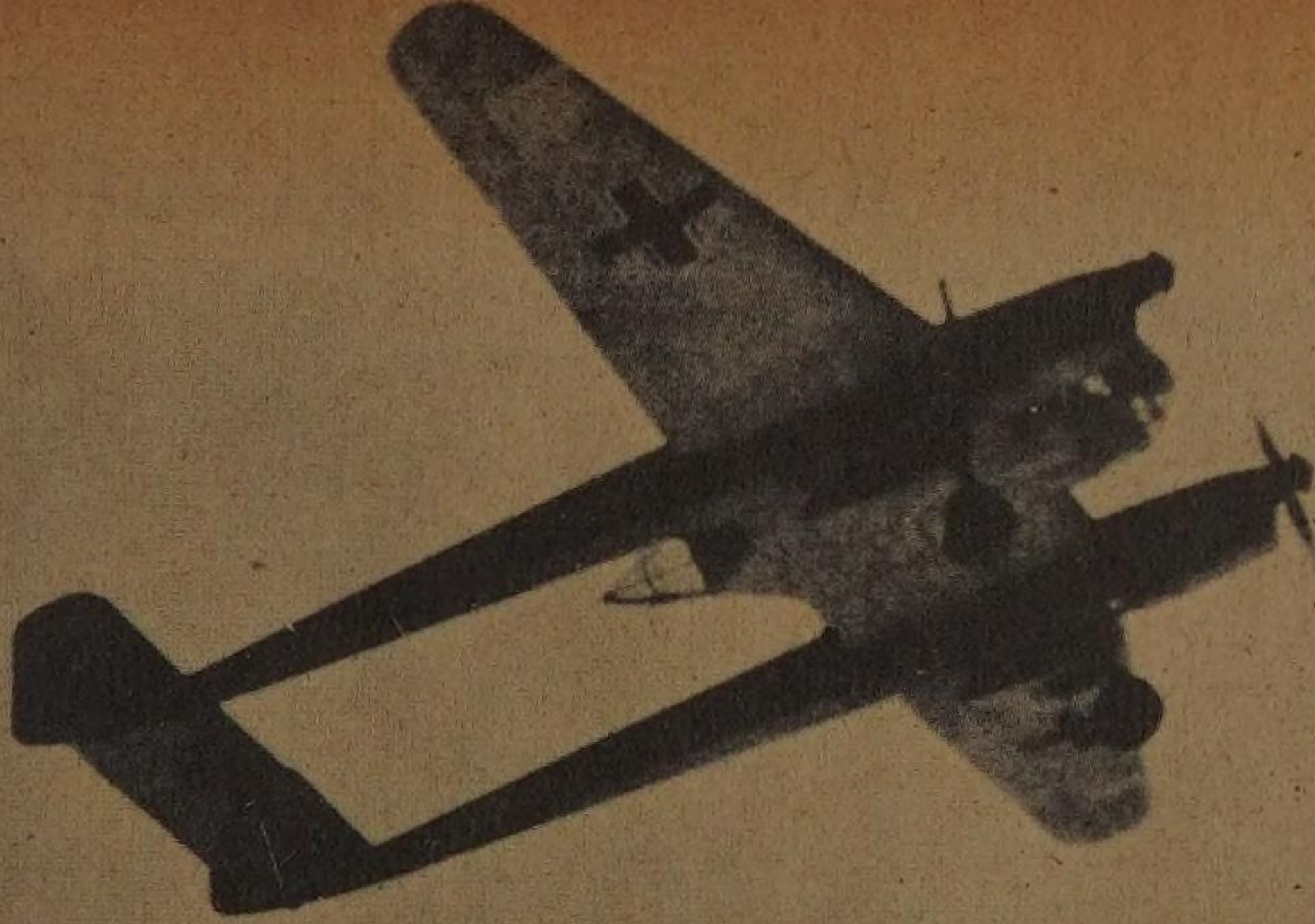
Another view of the "Fulmar," showing cross-section of fuselage, the radiator, and the pronounced dihedral.



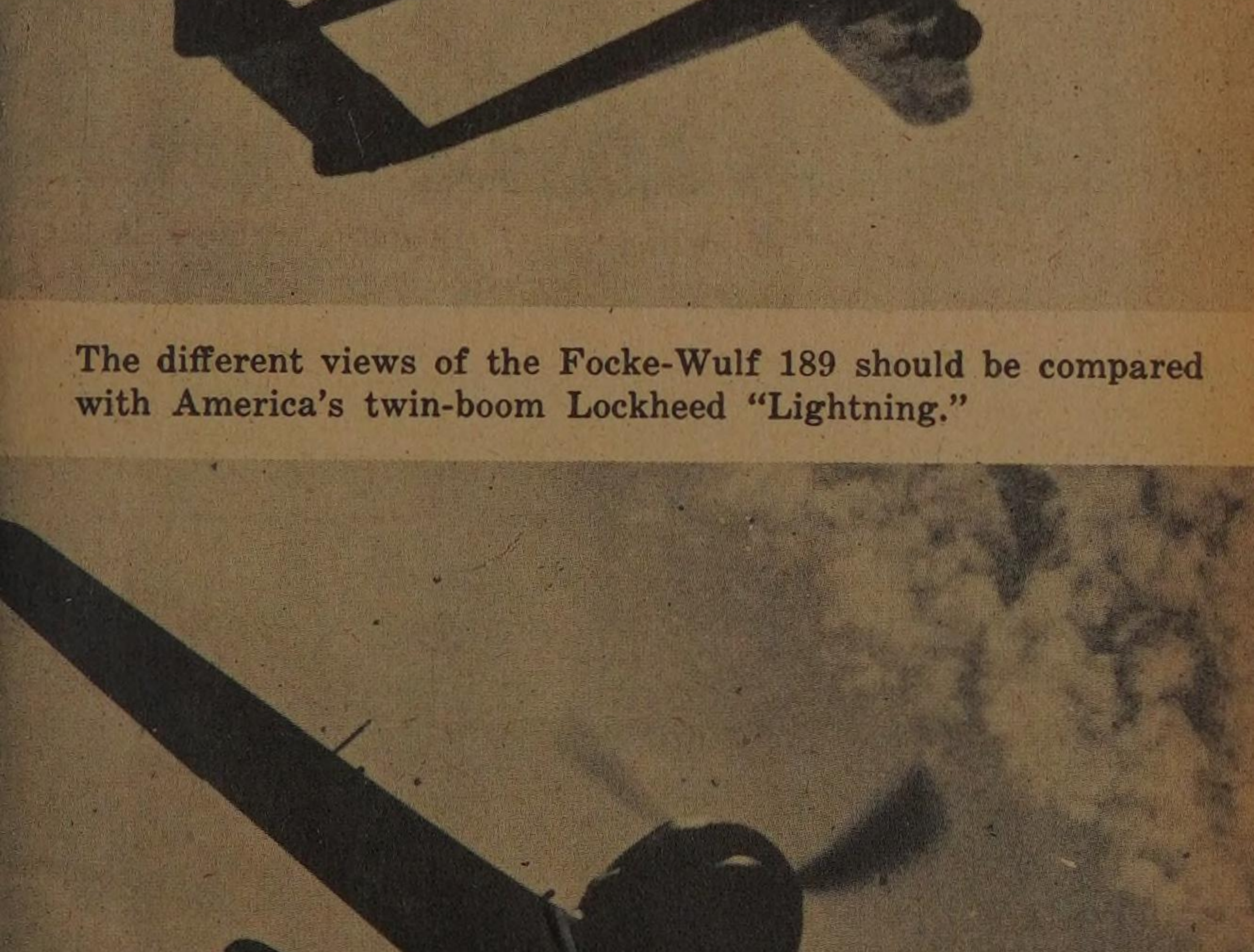
Most generally used of British-made advanced trainers is the Miles "Master," shown here with radial engine.



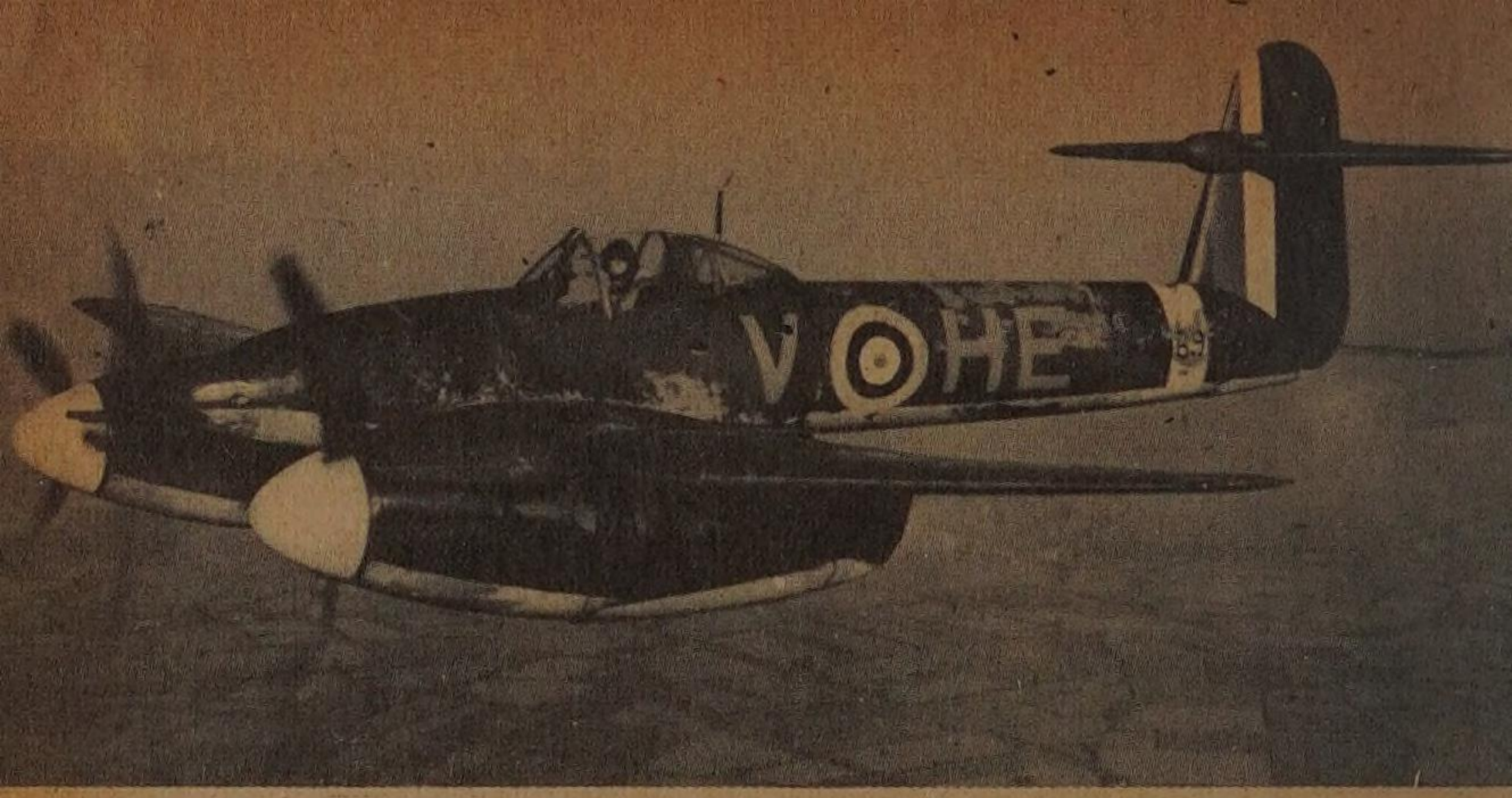
Forced down in British-held territory in North Africa, this Junkers 87 ("Stuka") carries Italian markings.



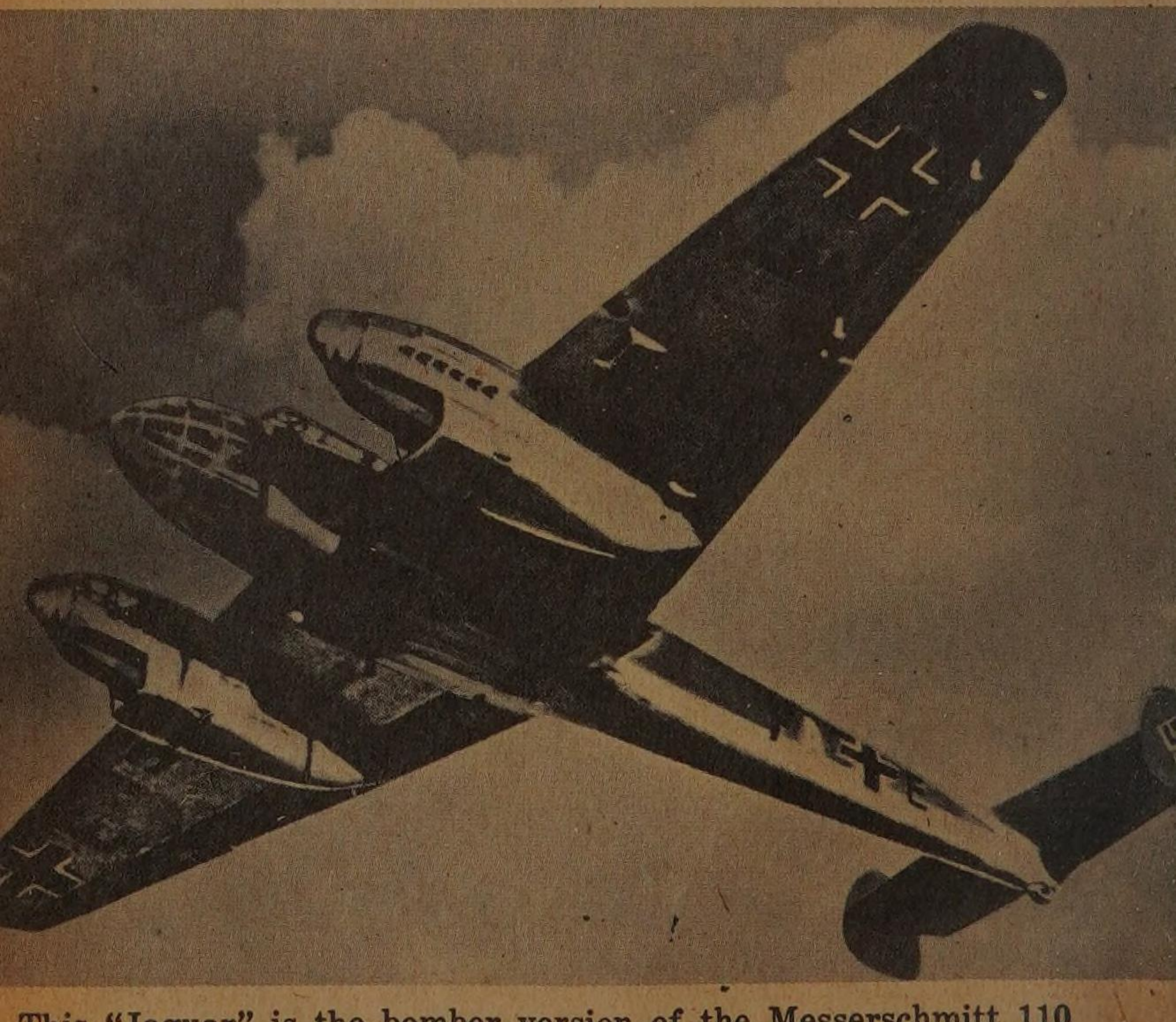
The different views of the Focke-Wulf 189 should be compared with America's twin-boom Lockheed "Lightning."



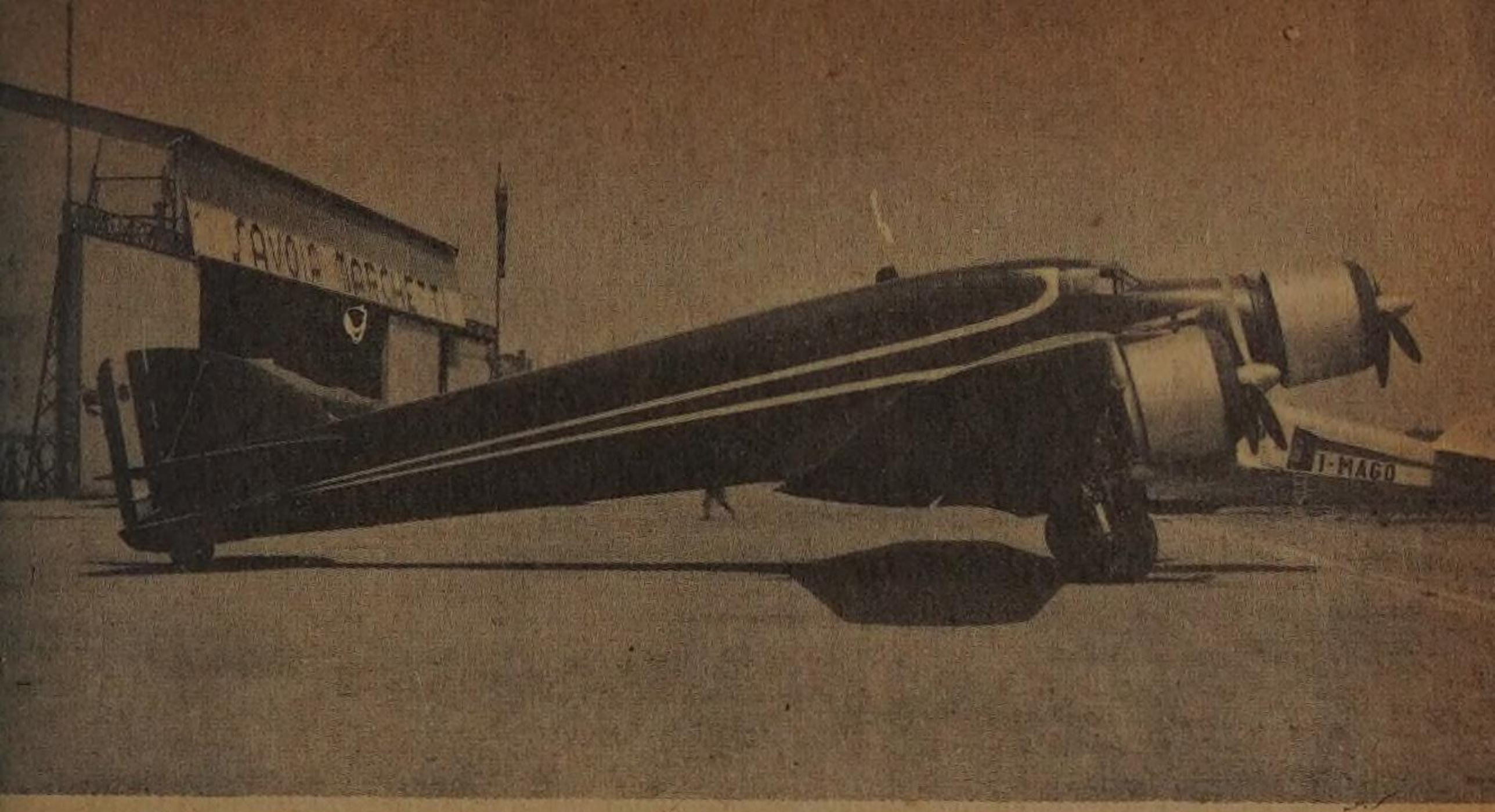
This Focke-Wulf 190 was captured by the British when it was forced down in England because of lack of fuel.



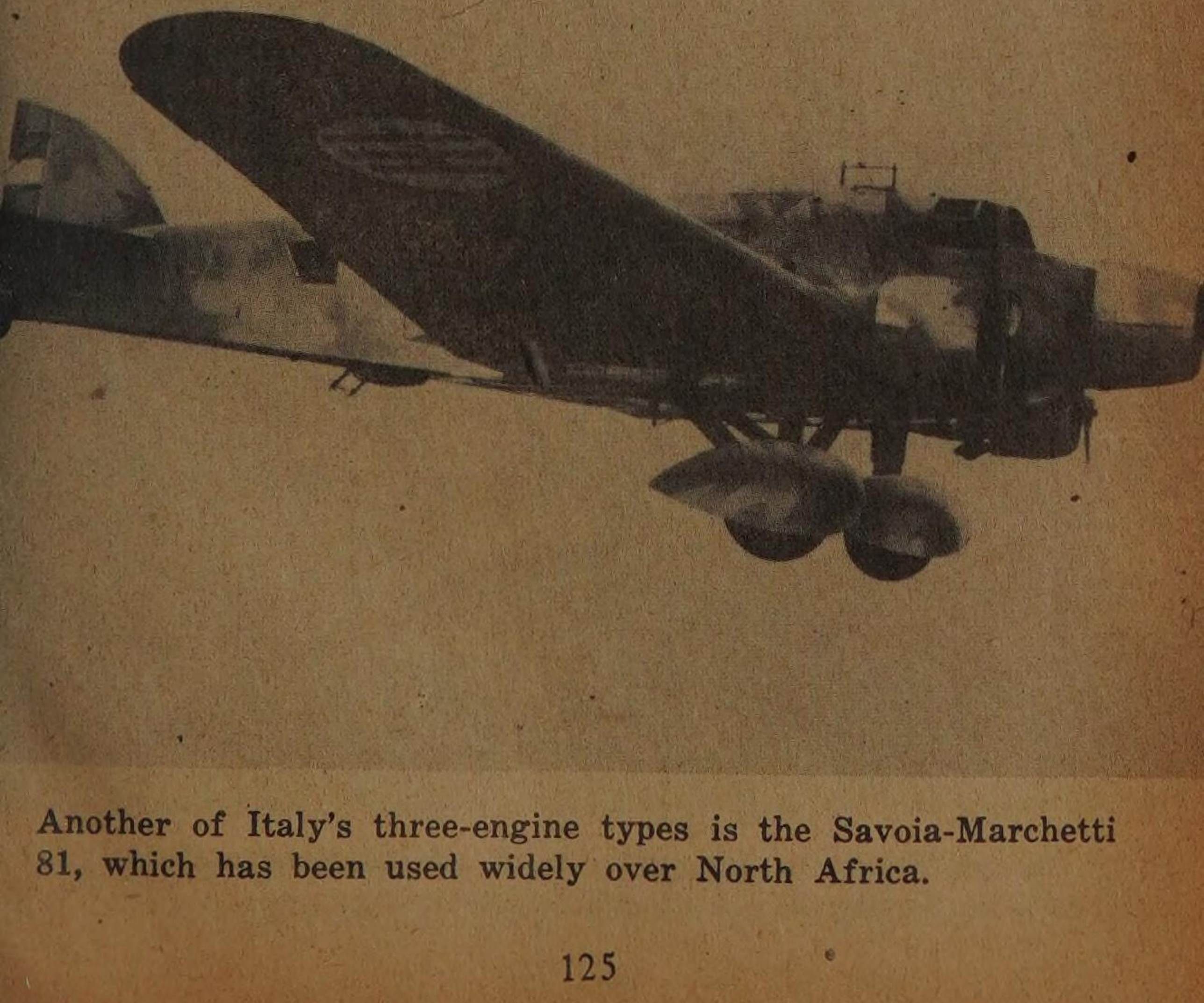
Long the subject of rumors, the Westland "Whirlwind," shown in this official British picture, is now hitting Nazi trains.



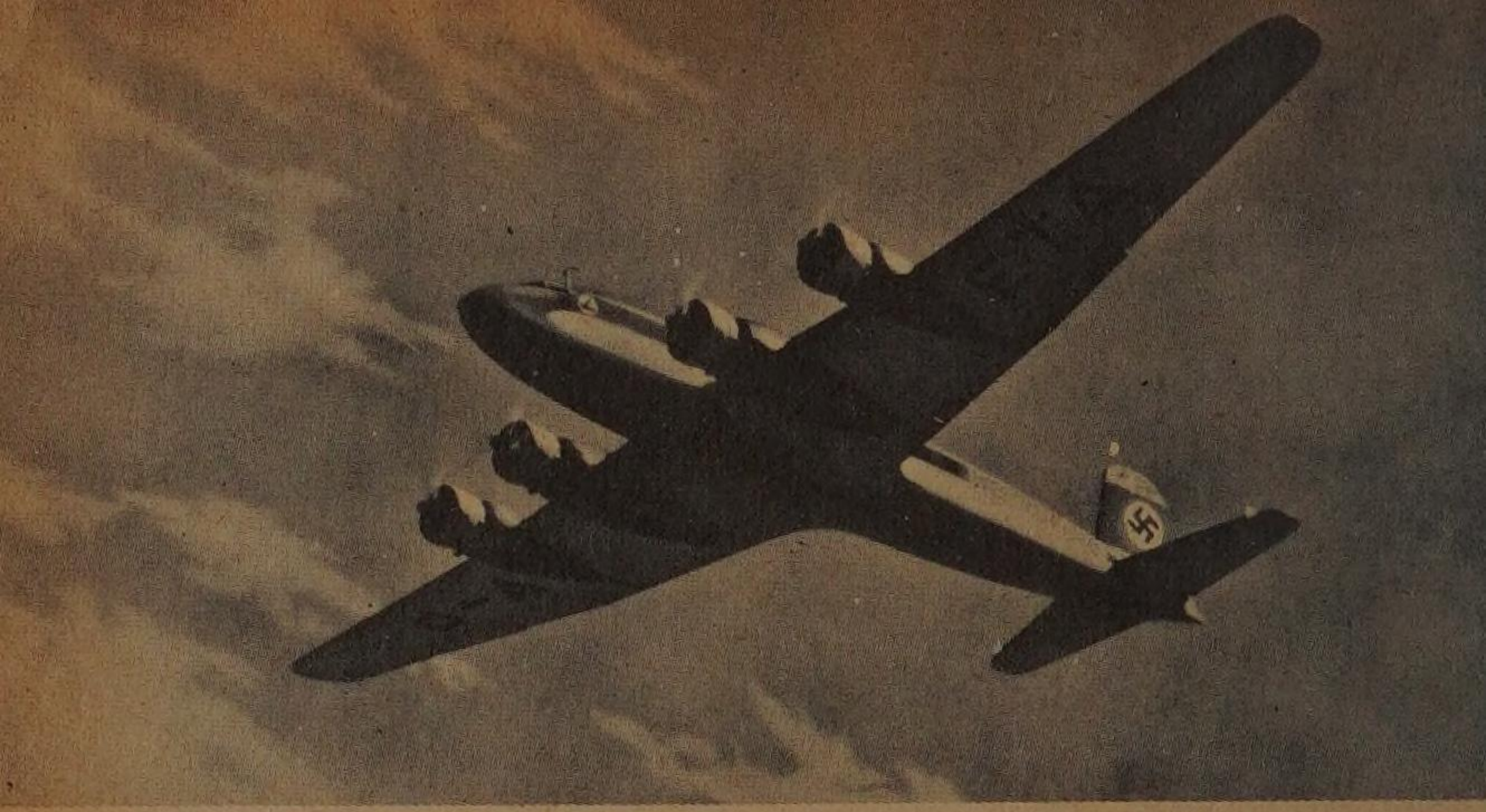
This "Jaguar" is the bomber version of the Messerschmitt 110 fighter. The bomber has a glazed bomb-aiming nose.



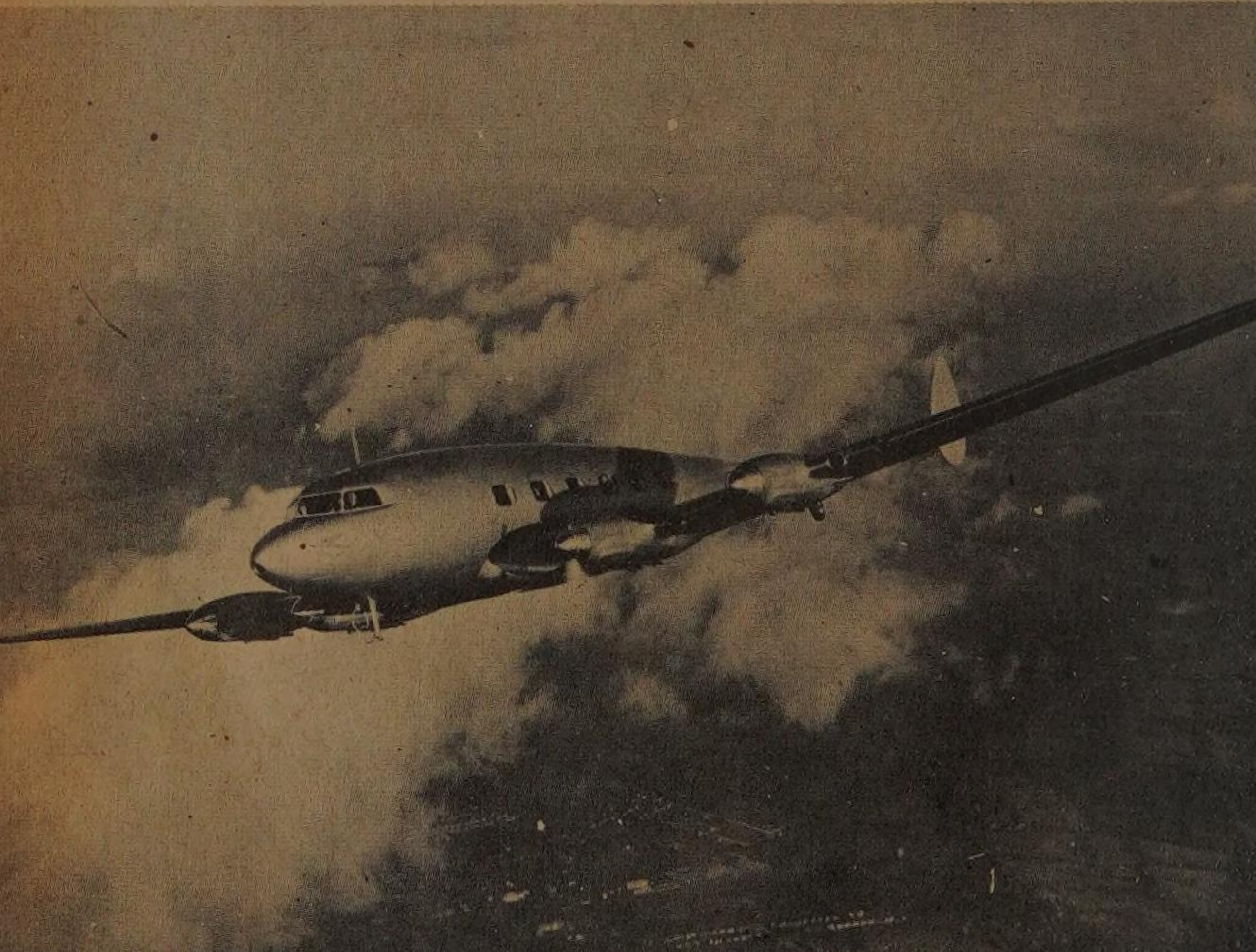
Showing the unadapted commercial transport version of Italy's three-engine Savoia-Marchetti 79 bomber.



Another of Italy's three-engine types is the Savoia-Marchetti 81, which has been used widely over North Africa.



Focke-Wulf "Condors" such as the above are much like "Kurriers," but lack the off-center bomb bay of the latter.



The de Havilland "Albatross." Many of these are understood to have been taken over by the R.A.F. as transports.

Short "Stirling."

CHAPTER X

MID-WING MONOPLANES

BREDA 65

The Breda Company of Milan is one of the most important engineering companies in Italy and it is one of the few concerns in Italy building all-metal aircraft. The Breda 65 is designed as a single-seat or two-seat bomber. Intended for close support work, its armament is heavier than is customary with Italian aircraft and it carries a large number of personnel bombs. Alternatively, a few heavy or medium bombs may be carried. The power unit is a Fiat or a Piaggio radial air-ccoled engine of 1,000 h.p. Single-seater top speed is 267 m.p.h., cruising speed 230 m.p.h. and service ceiling 27,000 ft. Two-seater top speed is 255 m.p.h.

Armament: Four Breda machine-guns, two large and two small, fixed in the wings and a flexibly mounted gun in the rear cockpit. Bomb-load may exceed 2,000 lb. for short range work.

Recognition Points

General structural features: Low mid-wing monoplane; single radial engine, single fin and rudder; unusual wing and tail design; semi-retractable undercarriage. Fluted cowling and semi-retracted undercarriage may be visible; protruding wing-guns seen at close range.

Head-on view: Circular fuselage surmounted by low glazed cockpit; wings show dihedral from roots; underside of wings broken by fairings and partly exposed wheels; fairly low tail-plane, braced, extends beyond undercarriage fairings; fin and rudder just visible.

Plan view: Medium length, square-cut nose; leading edge of wings without taper; rounded wing tips; trailing edge of wings has marked straight taper; large fillet; fuselage slightly waisted amidships, thence curved taper to tip, aft of tailplane; tailplane is elongated ellipse with curved cut-away in trailing edge.

Side view: Stubby square-cut nose; cowling not closely faired to fuselage; step-up in fuselage over irregular cockpit roof, then curvèd taper to tail; underside broken by protruding wheels; fin and rudder have straight taper on leading edge, curved taper on trailing edge, rounded top.

BREDA 65

Italian Ground Attack Fighter-Bomber

Span 39' 6" Length 31' 6" Height 10' 6"

VICKERS "WELLESLEY"

During the two days from the 5th to the 7th of November, 1938, Vickers "Wellesley" single engine monoplanes of the R.A.F. Long Range Development Unit, established a world's record for distance in a straight line by flying from Ismaila, Egypt, to Darwin, Australia, a non-stop flight of 7,162 miles. They covered the distance at an average speed of 149 m.p.h. The Wellesley's power unit is the Bristol "Pegasus XXII" radial air-cooled engine, developing 1,010 h.p. Apart from special tankage, the record-breaking machines were standard types. Top speed is 228 m.p.h. and maximum loaded range, with normal tankage, exceeds 2,500 miles. The Vickers-Wallis geodetic system of construction, so successfully tested in the "Wellesley" design, was further developed in the "Wellesley's" successor, the twin-engine "Wellington."

Armament consists of one fixed gun in the wing and a movable gun in the observer's cockpit. Bombs are carried in the float-like containers suspended under the wings.

Recognition Points

General structural features: Low mid-wing monoplane; single radial engine; single fin and rudder; fuselage of oval section with two enclosed cockpits; undercarriage retracts inwards.

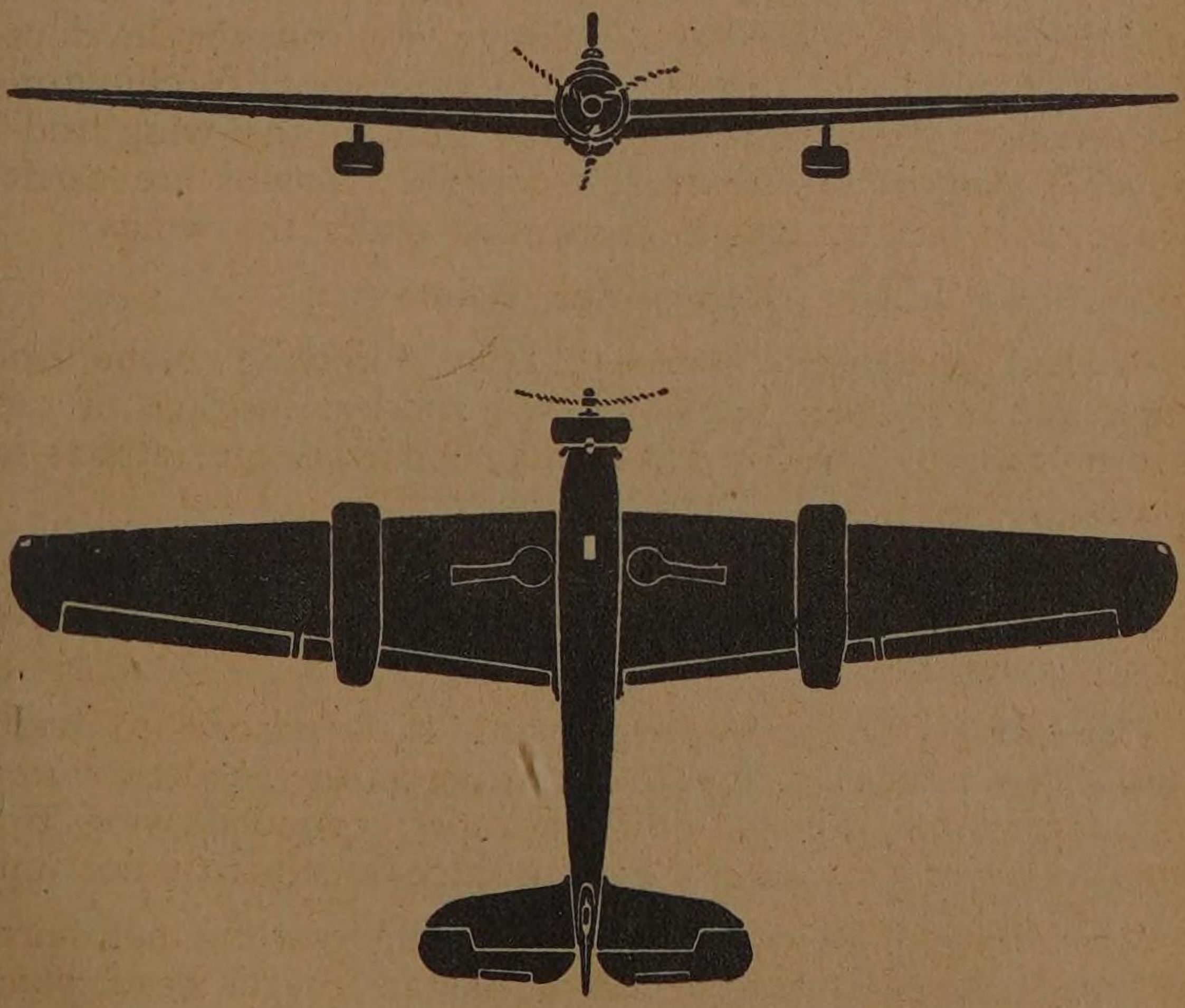
Head-on view: Oval fuselage section; fin and rudder visible; slight dihedral from roots of wide wings; unusual float-like bomb containers.

Plan view: Unusually large wing span relative to width (high aspect ratio), a feature derived from the geodetic system of construction; almost uniform taper; rounded wing tips, slightly swept back towards trailing edge; distinctive tail unit.

Side view: Older type of exhaust ring cowling not faired to fuselage appears semi-detached, like an insect's head; bomb containers break underside curve; unusual arrangement of pilot's cockpit forward and separate observer's cockpit well aft; fin and rudder distinctive.

"WELLESLEY" (Pegasus)
British Bomber

Span 74' 7" Length 39' 3" Height 15' 4"



HEINKEL 177

The work of designing this heavy bomber of the German Luftwaffe apparently began in 1939, and the first model of the plane is said to have been flown in the middle of 1940. However, the machine caused the Germans a lot of trouble, and it was not until 1942 that it was first reported in active service. The He 177 is a long-range, heavy bomber, and although it appears to be powered by two radial engines, it is actually equipped with four in-line engines housed in two nacelles having nose radiators similar to those of the Ju 88. Each pair of engines drives a single four-blade airscrew. The engines deliver 1,150 h.p. each, and bear the designation Mercedes-Benz DB 601. Because little is now known about the machine, the following data must be considered approximate only: maximum speed 280 m.p.h. at 19,000 feet; maximum range 7,040 miles at 180 m.p.h.; loaded weight 71,600 lb., with a maximum overload of 82,000.

Recognition Points

Important note: The silhouettes on the facing page are provisional as to many of the finer details of the He 177.

General structural features: Mid-wing monoplane; four engines looking like only two; simple tail unit; retractable undercarriage.

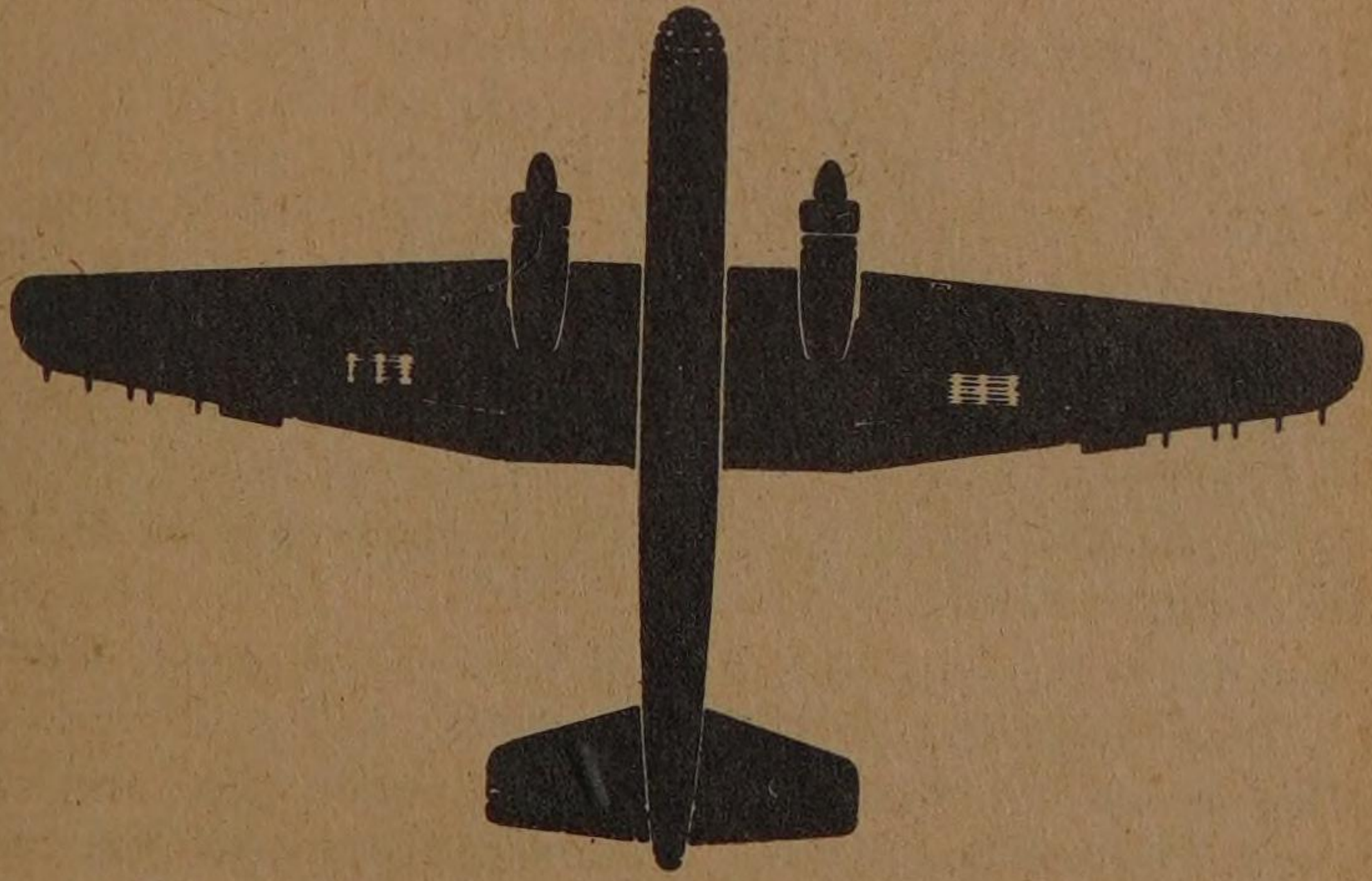
Head-on view: Slightly rounded cross-section of fuselage surmounted by gun turret; no dihedral on center section of wings, moderate dihedral on outer sections; engines mounted on their center lines; tall fin.

Plan view: Straight fuselage with rounded nose and taper beginning somewhat aft of trailing edge of wings; center section of wings evidently untapered; outer sections tapered more on trailing edge; duo-curved wing-tips; sharp taper on leading edge of tailplane, slight taper on trailing edge of elevators; stinger turret in rounded tail aft of elevators.

Side view: Outline of top of fuselage from well-rounded nose to fin broken only by forward gun turret; fin and rudder, mounted atop fuselage, have straight taper on leading and trailing edges, with slightly curved top, and cut-away at bottom of rudder.

HEINKEL 177 (4 D.B.601—only two nacelles)
German Heavy Bomber

Span 103' 4" Length 67' 3" Height 18' 2"



JUNKERS 88

A Junkers 88 prototype, in March, 1939, created an international record, carrying a two-ton load 620 miles at an average speed of 321 m.p.h. In July of the same year it carried a similar load 1240 miles at 311 m.p.h.

The version shown on the facing page, Ju 88-A1, has been modified by such additions as enlarged cockpit, under-gun emplacement, dive brakes, external bomb-racks, and a special device which, synchronized with the bomb-release mechanism, automatically pulls out of a diving attack when the pilot releases his bombs. Two 1,200 h.p. Junkers Jumo. 211A liquid-cooled engines provide the power plant. The latest version (Ju 88-A6) is similar in appearance and is powered by two Junkers Jumo 211G1 engines also delivering 1,200 h.p.

Recognition Points

General structural features: Mid-wing monoplane; two liquid-cooled in-line engines with radiators in the form of radial cowlings; single fin and rudder; streamlined fuselage with short glazed nose and large "greenhouse" forward; undercarriage retracts into nacelles.

Head-on view: Roughly oval fuselage with off-center under-gun emplacement beneath; wings with moderate dihedral; large underslung engines; tailplane just visible over wings; tall, prominent fin and rudder; four external bomb-racks visible under wings inboard of engines.

Plan view: Engines project well forward of wings and are on a level with the glazed nose; wings and tailplane more angular in outline than the Blenheim I, with which this machine is frequently confused; slim streamlined fuselage.

Side view: Oversize engines break lower line of fuselage, while the high glazed cockpit forward breaks the upper outline, giving this plane a nose-heavy appearance not observed in the Blenheim I; fin and rudder project well aft of tailplane.

JUNKERS 88 A1 (Jumo 211A)
German Long-Range Bomber

Span 59' 0" Length 46' 6" Height 15' 0"

ARMSTRONG-WHITWORTH "WHITLEY"

This long-range heavy bomber used to operate regularly against industrial targets hundreds of miles inside German territory, or as far afield as northern Italy, non-stop from bases in Great Britain. Although these machines are still in service, their importance has been considerably reduced by the rapid production of newer, heavier machines. The power-operated gun-turret in nose and tail enables the "Whitley" to fight off interceptors.

The earlier Whitleys (Mk I-III), are fitted with two Armstrong-Siddeley "Tiger" air-cooled radial engines of 850-918 h.p. Mk III has a top speed of 215 m.p.h., cruising speed of 177 m.p.h. and range of about 1,300 miles. Later types (Mks IV and V) are fitted with Rolls-Royce "Merlin" engines, developing over 1,000 h.p. Mk IV has a maximum speed of 245 m.p.h., cruising speed of 215 m.p.h., normal range of 1,250 miles and maximum range of 1,800 miles. Performance figures for Mk V are not available.

Recognition Points

General structural features: Mid-wing monoplane; two radial engines; twin fins and rudders, fins braced; engine nacelles three-quarters under-slung; wheels retracting into nacelles are partially exposed; nose and tail gun-turrets.

Head-on view: Fuselage roughly oval; underslung engines; moderate dihedral of wings begins well outboard of engines; tailplane not visible; fins and rudders visible.

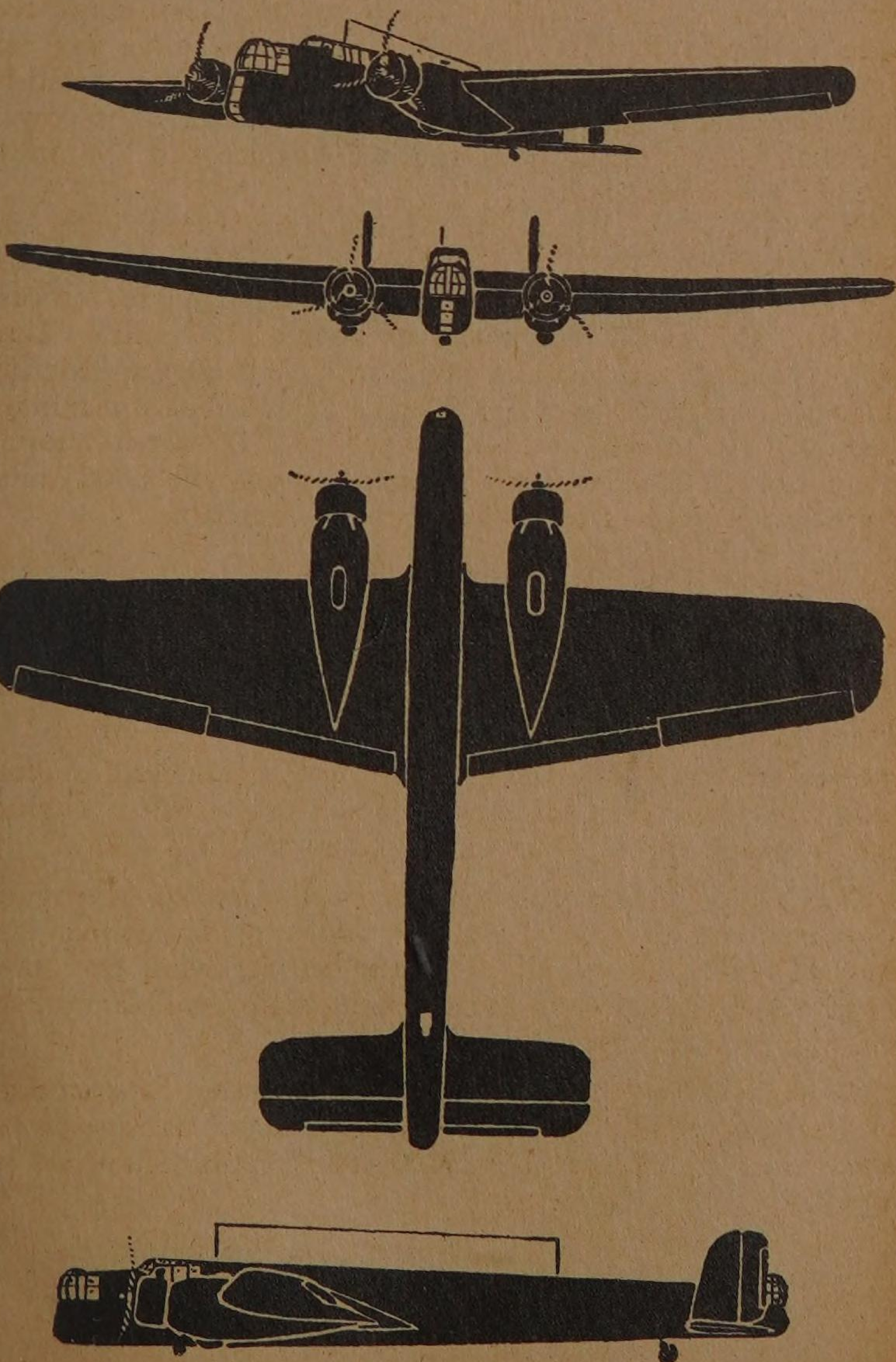
Plan view: Glazed nose projects well forward of engines; long narrow slab-sided fuselage; wings of large span and unusual width, or chord, with rounded-off wing tips; taper more marked on trailing edge; rounded tips; tailplane almost rectangular with rounded-off corners.

Side view: Nose-down flying attitude; glazed nose, cockpit, and tail turret; slight taper on under side of fuselage to tail; twin fins and rudders of characteristic angular shape do not project below tailplane.

"WHITLEY" Mk I (2 Tiger)

British Bomber

Span 84' 0" | Length 69' 3" | Height 15' 0"



ARMSTRONG-WHITWORTH "WHITLEY" MKS. IV AND V

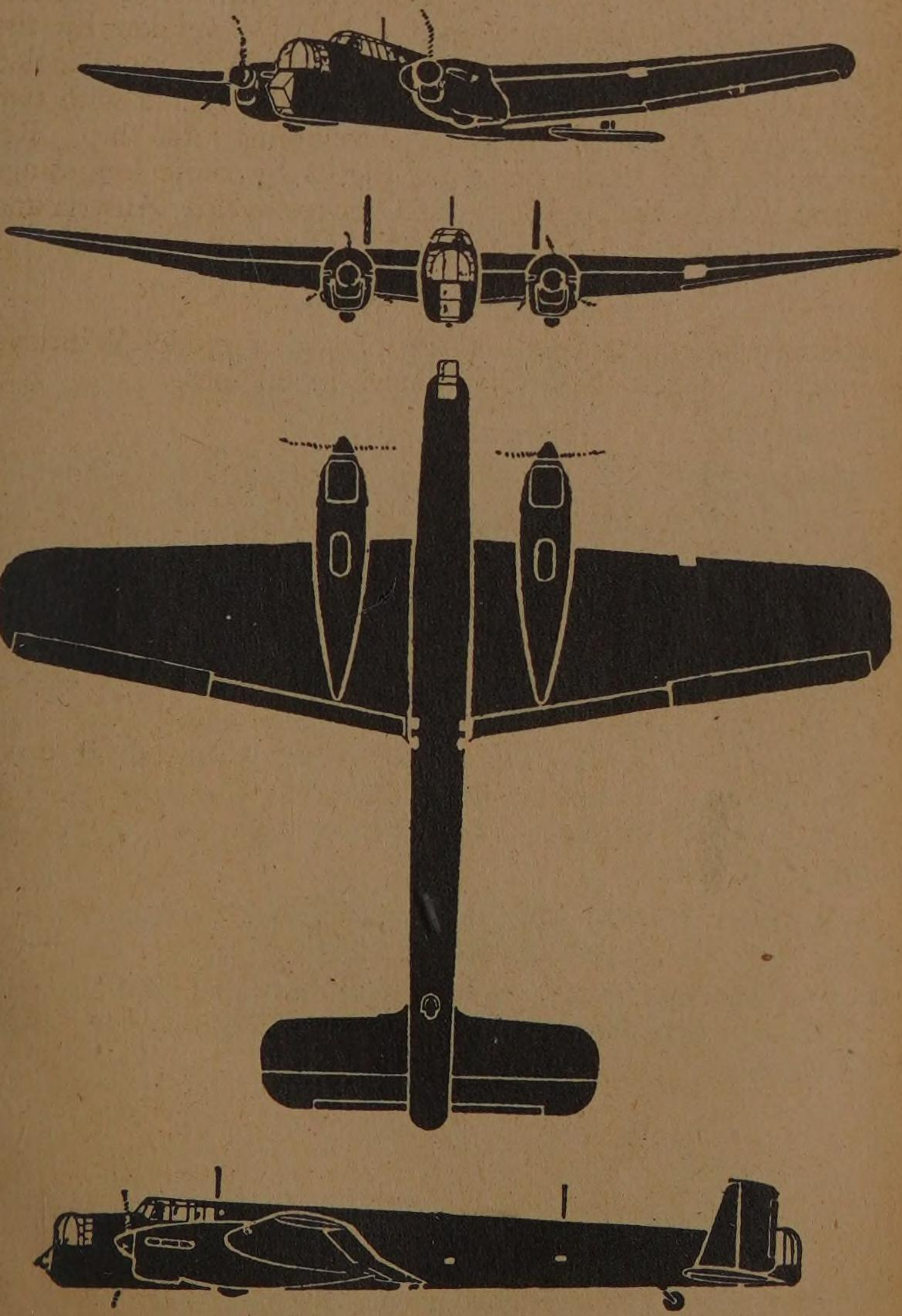
The performance of the "Whitley" heavy bomber, a type first developed by Armstrong-Whitworth, Ltd. in 1936, has been considerably improved in the Mk IV version by the fitting of 1,030 h.p. Rolls-Royce "Merlin IV" liquid-cooled in-line engines. A still later version, Mk V, is fitted with two Rolls-Royce "Merlin X" engines, developing 1,145 h.p. Reconnaissance and leaflet-dropping flights by these long-range bombers have penetrated as far as Czechoslovakia, Austria and Poland. Performance figures of Mk V are not available.

Recognition Points

Compare silhouettes with those of earlier model Whitleys, on previous page. Note differences in engines.

"WHITLEY" IV and V (2 Merlin)

Span 84' 0" Length 70' 6" Height 15' 0"



DE HAVILLAND "MOSQUITO"

Although it is not yet possible to be specific with regard to the armament, the power of the engines, and the general performance of the "Mosquito," it is no secret that for its size this machine delivers a heavy wallop. It will be recalled that a group of "Mosquitos" conducted a daylight raid on Oslo, deep in enemy-held territory, while certain important Nazis and Quislingists were conferring there. This fact alone is enough to prove that the machine is both very fast and capable of fighting off enemy pursuit craft with its many machine guns and cannon. Power is supplied by two Rolls-Royce liquid-cooled engines.

Recognition Points

General structural features: Mid-wing monoplane; two in-line engines; single fin and rudder; short nose; retractable undercarriage.

Head-on view: Oval cross-section of fuselage surmounted by glazed cabin; glazed bomb-aiming nose; underslung engines; moderate dihedral on wings; wide tailplane extends slightly beyond engines.

Plan view: Nose and engines project almost equally far forward; center section of wings projects noticeably farther forward than rest of wings on leading edge only; negligeable taper on leading edge; pointed wing tips; sharp taper on trailing edge, broken by slight extension of engine nacelles; almost elliptical tailplane and elevator with no cut-out for swing of rudder.

Side view: Pointed bomb-aiming nose of fuselage rises in curved line to glazed cover of cockpit, step-up and then taper to rear tip; fin and rudder, with rounded leading edge, pointed top, and slightly tapered trailing edge, are set fairly far forward.

"MOSQUITO"
British Medium Bomber

VICKERS "WELLINGTON"

The "Wellington" long-range heavy bomber distinguished itself in the first raids on Kiel and Wilhelmshaven and is largely used for bombing distant targets such as Berlin and the industrial regions of Northern Italy. With two Bristol Pegasus air-cooled engines, each developing 1,000 h.p., the "Wellington" Mk IA has a maximum speed of 250 m.p.h. and cruises at 232 m.p.h. Mk II is fitted with Rolls-Royce Merlin engines of 1,145 h.p., and has a top speed of about 275 m.p.h. Performance figures on the Mk III, with Bristol Hercules engines of 1,375 h.p., are not available. The Vickers-Wallis geodetic system of construction, first employed in the Wellesley special long-range single-engine bomber, is responsible for the unusually large wing span which is a feature of Wellington design. German fighters have learned to respect its power-operated gun-turrets in nose and tail.

Recognition Points

General structural features: Mid-wing monoplane; two radial (alternatively in-line) engines; large single fin and rudder; retractable undercarriage.

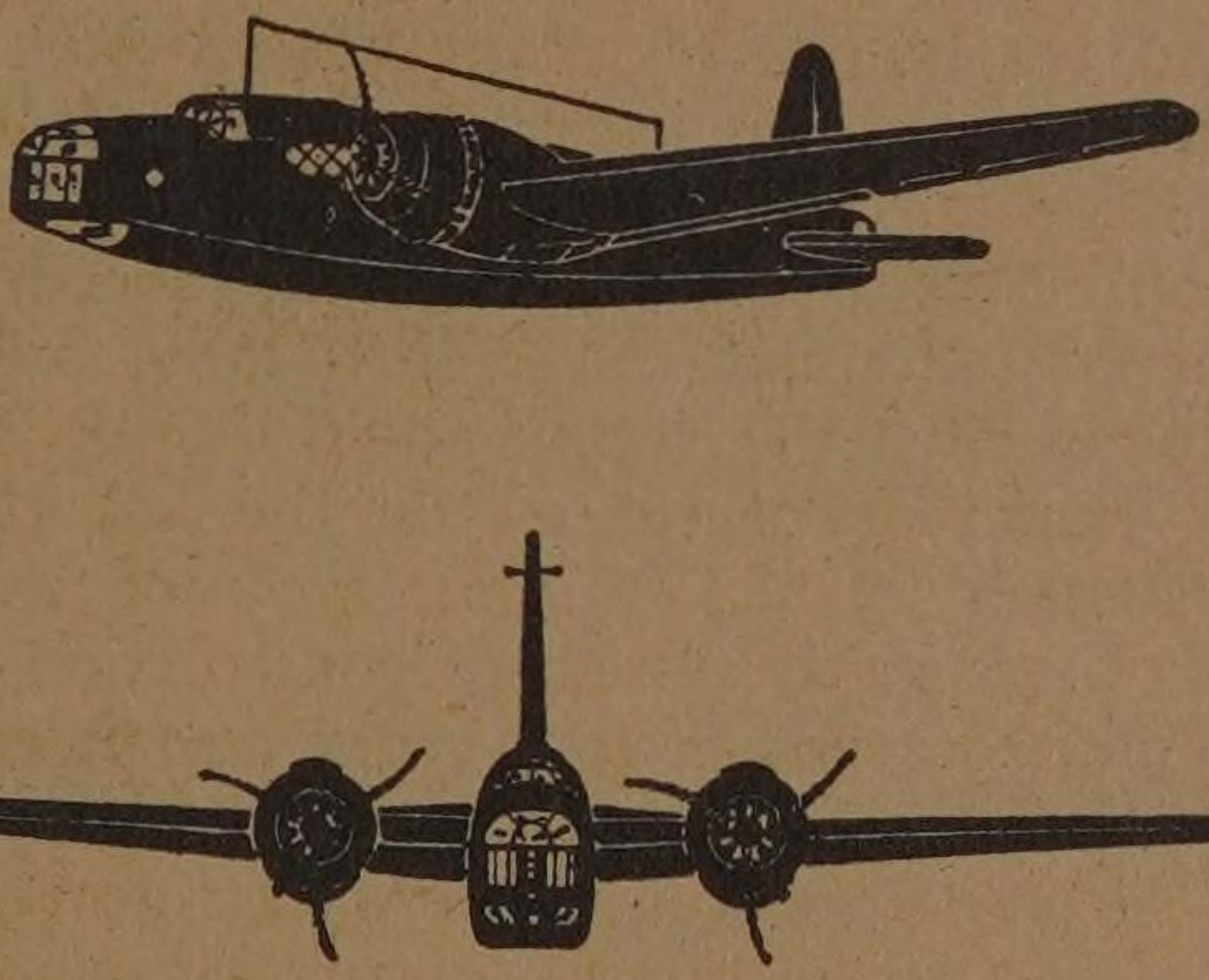
Head-on view: Fuselage of deep oval section; wings with moderate dihedral; radial engines mounted on their center lines; unusually tall fin and rudder.

Plan view: Glazed nose projects well forward of engines; fully tapered wings have particularly large span and small chord, with tips rounded off into trailing edge; slim streamlined fuselage; tailplane has taper on leading edge only.

Side view: Deep fuselage from blunt nose to glazed stinger turret which projects well behind tail unit; unusually tall angular fin and rudder set high on fuselage; small glazed cupola or "pimple" over naviator's seat.

"WELLINGTON" (2 Pegasus)
British Bomber

Span 86' 2" Length 61' 0" Height 22' 2"



HANDLEY PAGE "HAMPDEN" AND "HEREFORD"

Employed chiefly for medium-range work, the "Hampden," successor to the Handley Page "Harrow," has played a notable part in the R.A.F. raids on oil storage plants, communications and the heavy industries of the Ruhr. However, the "Hampden" itself is now out of production and is presently used for mine-laying. In addition to the pilot's fixed gun, there are three movable gun positions: in the nose, in the top of the fuselage amidships, and immediately beneath the trailing edge. The "Hampden," fitted with two 1,000 h.p. Bristol Pegasus XVIII air-cooled radial engines, has a top speed of 265 m.p.h. and cruises at 217 m.p.h. The Handley-Page "Hereford" is similar to the "Hampden," but is fitted with two 1,000 h.p. Napier Dagger in-line engines.

Recognition Points

General structural features: Mid-wing monoplane; "Hampden," two radial engines; "Hereford," two in-line engines; twin fins and rudders; undercarriage retracts into nacelles.

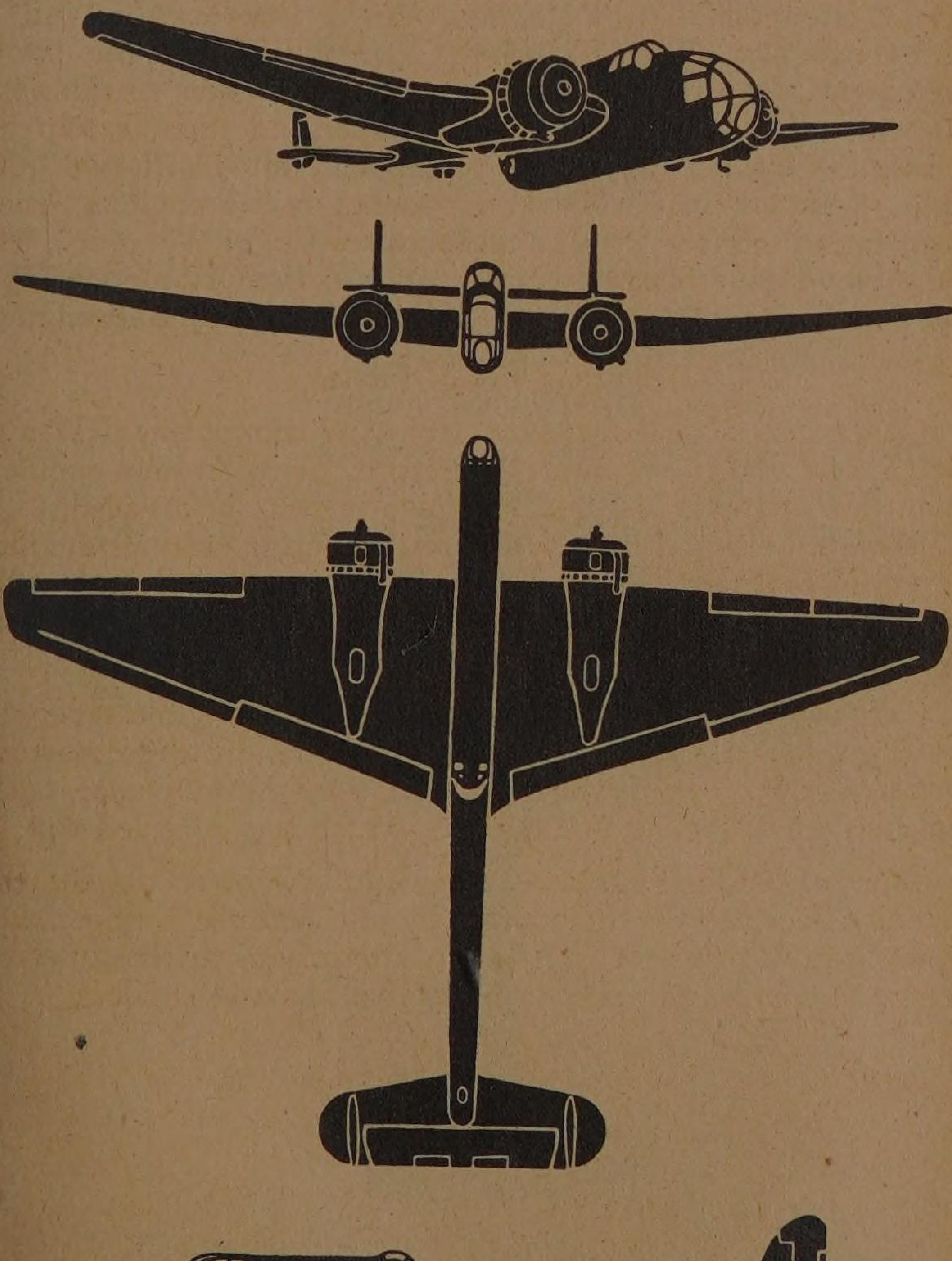
Head-on view: Deep narrow oval fuselage section; engines centrally mounted; dihedral on outer section of wings only; prominent fins and rudders are mounted inboard of tailplane tips.

Plan view: Distinctive wing plan, with negligible taper on leading edge and very marked taper on trailing edge; narrow fuselage tapers gently from glazed nose to tailplane; taper only on leading edge of tailplane, which has rounded tips.

Side view: Deep narrow slab-sided forward section of the fuselage has earned the name "Flying Suitcase"; upper and lower gun-turrets both facing aft; from these turrets fuselage tapers to slender tail boom; distinctive fins and rudders.

"HAMPDEN" (2 Pegasus)
British Bomber

Span 69' 4" **Length 53' 7"** **Height 14' 9"**



HANDLEY PAGE "HEREFORD"

The Handley Page "Hereford" was built by the Belfast firm of Short & Harland Ltd. to the same general design as the well-known "Hampden" bomber. The power plant consists of two 1,000 h.p. Napier "Dagger" air-cooled **in-line** engines instead of the Bristol "Pegasus" **radial** air-cooled engines fitted to the "Hampden." In other respects the appearance of the two versions is similar.

Short & Harland Ltd. is an aircraft construction company jointly founded by Harland & Wolf, the well-known shipbuilders, and Short Bros., builders of the famous "Empire" and "Sunderland" flying-boats. In addition to "Hereford" bombers the company has also built the Bristol "Bombay" troop transport.

Recognition Points

The Handley Page "Hereford" differs from the "Hampden" (see previous page) only in the substitution of two in-line engines for the radial engines found in the latter.

"HEREFORD" (2 Dagger)
British Bomber

Span 69' 4" Length 58' 7" Height 14' 9"

"BLENHEIM" I

In the early thirties the Bristol Aeroplane Company produced type 142, a twin-engined monoplane of exceptionally high performance. Subsequently christened "Britain First," it was presented to the Air Ministry by Lord Rothermere as an example of the capabilities of the British aircraft industry when suitably encouraged. The Bristol "Blenheim I," which went into production for the R.A.F. in 1936, is the militarized version of "Britain First." The Mk I, or short-nosed Blenheim is largely used as a long-range fighter. Powered with two 840 h.p. Bristol Mercury radial engines, its maximum speed is 285 m.p.h. At a cruising speed of 200 m.p.h. it has a range of 1,125 miles fully loaded.

Recognition Points

General structural features: Mid-wing monoplane; two radial engines; single fin and rudder; streamline fuselage with rear gun-turret mounted on top, mid-way; undercarriage retracts into nacelle.

Head-on view: Fuselage roughly oval with flat base; medium dihedral of center section of wings increases to full dihedral outboard of engines; tailplane mounted high; fin and rudder tall, prominent; two radial engines mounted on their center lines.

Plan view; Short glazed nose roughly in line with engines (this point is also observed in Ju 88, but projection more marked in latter); wings gracefully tapered to rounded tips; fillet to streamlined fuselage; leading edge of tailplane practically straight with well-rounded elevator and large cut-away V (in contrast to rather angular tailplane of Ju 88).

Side view: Clean lines of fuselage broken only by small gun-turret; contrast this outline with high "greenhouse" and low underslung engines of Ju 88; the "Blenheim" tail unit smaller, of distinctive shape.

"BLENHEIM" I (2 Mercury)
British Day Bomber

Span 56' 4" Length 39' 9" Height 9' 2"

BLENHEIM IV

The Blenheim IV, or long-nosed version, is developed from and closely resembles Mk I. It is easily distinguished from the earlier design—as also from Ju 88—by the nose, which, nearly three feet longer, projects well forward of the engines. With two Bristol Mercury radial air-cooled engines developing 930 h.p., Mk. IV has a maximum speed of 295 m.p.h. fully loaded, and a range of 2,000 miles.

Mk. IV **modified** (Mk. IV F) may be distinguished by a gun position projecting below the nose.

The Bristol "Bolingbroke" is a Canadian-built version of Blenheim IV, in service with the Royal Canadian Air Force. Pratt & Whitney Twin Wasp Junior engines of 750 h.p. are fitted as alternatives to Bristol Mercury engines. Additional versions of the "Bolingbroke" may be fitted with skis or floats.

Recognition Points

General structural features: Mid-wing monoplane; two radial engines; single fin and rudder; rear gun-turret mounted on top midway; undercarriage retracts into nacelles.

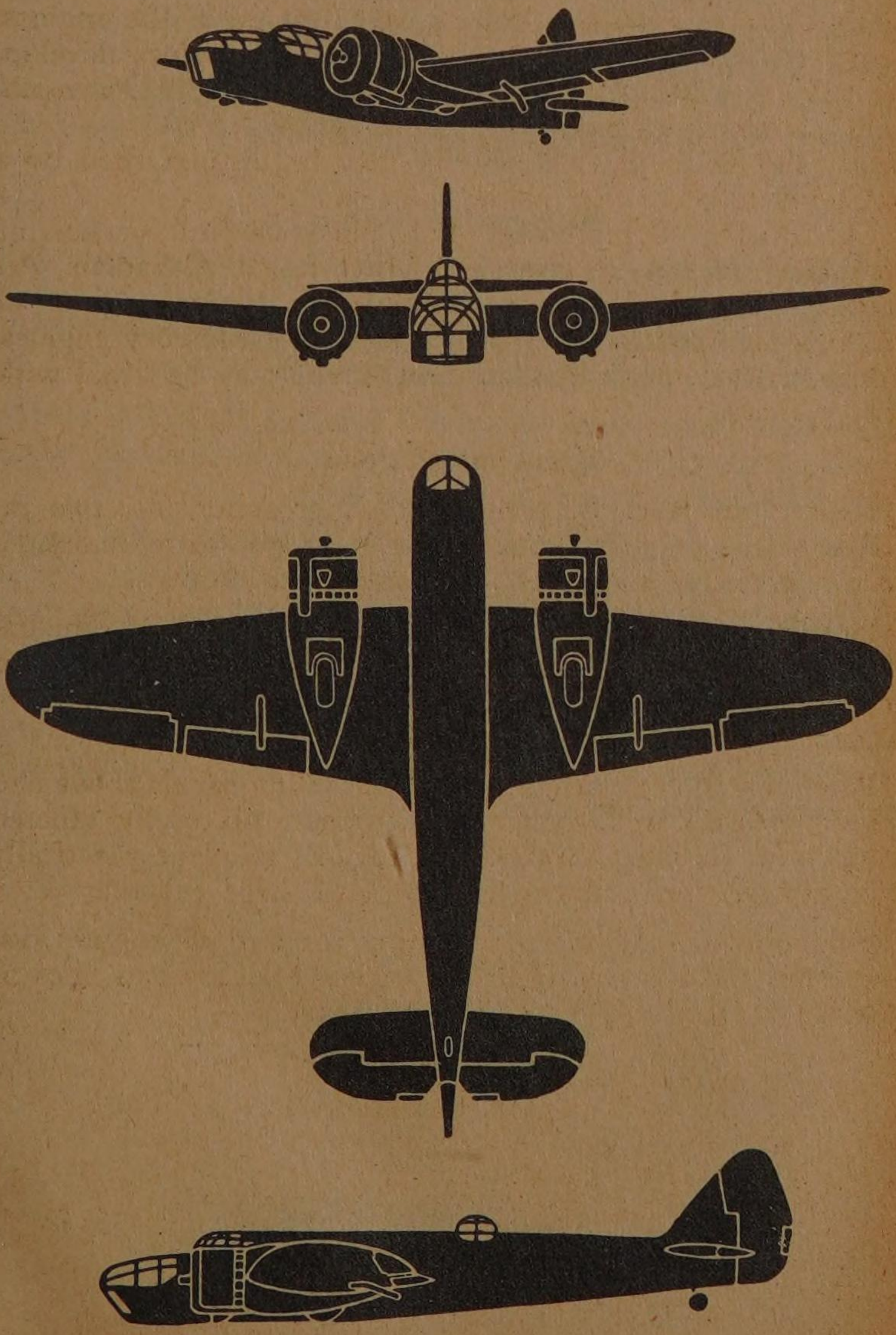
Head-on view: Roughly bell-like fuselage; medium dihedral of center section of wings increases to full dihedral outboard of engines; tailplane and tall fin and rudder visible; two radial engines mounted on their center lines.

Plan view: Nose, with glazed bomb-aiming panels above and below, projects well forward of engines; gracefully tapered wings with rounded tips; leading edge of tailplane practically straight with well-rounded elevator and large cut-away V.

Side view: Glazed nose projecting forward of engines distinguishes the Mk. IV from the earlier Mk. I; clean lines of fuselage broken only by small gun-turret.

"BLENHEIM" IV (2 Mercury)
British Medium Bomber

Span 56' 4" Length 42' 7" Height 9' 2"



BRISTOL "BEAUFORT"

The Bristol "Beaufort" (type 152), although having many points of resemblance to the famous Blenheim series, is specially designed as a torpedo-bomber-reconnaissance and general purpose plane. The power plant consists of two Bristol Taurus sleeve-valve air-cooled engines, each developing over 1,000 h.p. Actual performance figures are not available, but it is known to be appreciably faster than the Blenheims.

Recognition Points

General structural features: Mid-wing monoplane; two radial engines; single fin and rudder; distinctive "step-down" from deep forward section of fuselage to afterpart of normal Blenheim lines; undercarriage retracts into nacelles.

Head-on view: Deep slab-sided fuselage; tailplane visible, extending to twin engines, three-quarters underslung; wings show dihedral outboard of engines only.

Plan view: Engines project almost to glazed nose; round-tipped wings, with taper more marked in trailing edge, similar to Blenheim series; tailplane has taper in trailing edge only; slab-sided fuselage tapers aft of wing to tail.

Side view: Note high, glazed control cabin and glazed bomb-aiming nose; deep forward section of fuselage ends abruptly amidships where rear turret is mounted; fin and rudder unit has normal Blenheim lines.

"BEAUFORT" (2 Taurus)
British General-Purpose Aircraft

Span 57' 10" Length 44' 1½" Height 14' 3"

BRISTOL "BEAUFIGHTER" I and II

The "Beaufighter" is a development of the Bristol "Beaufort" design. The "Beaufighter" fills many roles including night and day interception and long-range escort work. Known also as the Bristol 156, this fighter corresponds to the Me. 110 and although a higher maximum speed is claimed for the German fighter, the armament of the "Beaufighter" is heavier and its normal cruising range is more than twice that of the Me. 110.

Powered by two 1,400 h.p. Bristol Hercules two-row radial air-cooled engines, the top speed of "Beaufighter" I exceeds 330 m.p.h., cruising range at 200 m.p.h. is 1,500 miles and service ceiling 28,900 feet. "Beaufighter" II has Rolls-Royce Merlin XX in-line engines of 1,280 h.p. Four 20 mm. cannon are mounted in the nose and six machine-guns in the wings.

Recognition Points

General structural features: Mid-wing monoplane: two engines (radial or in-line); single fin and rudder; retractable undercarriage; distinguished from Beaufort by short nose, straight back, and absence of step-down turret.

Head-on view: Deep, box-like section of fuselage, surmounted by glazed cabin, has rounded base; thick straight center section of wings extends to centrally mounted engines; outer section has dihedral; tailplane extends to, and is level with, top of cowlings: tall fin and rudder fairly prominent.

Note: Tailplanes with marked dihedral are now being installed on all "Beaufighters."

Plan view: Streamline nose shorter than nacelles which project well forward; wings have compound straight taper on leading edge, more marked taper on trailing edge, rounded tips; fillet between fuselage and trailing edge of wings; air ducts protrude from leading edge of wings, outboard of nacelles; fuselage tapers in smooth curve to tail; straight leading edge on tailplane; rounded tips; straight taper on trailing edge with cut-away for rudder which projects aft.

Side view: Nose screened by projecting engines (radial or in-line:) glazed cabin appears to sit on top of nacelles; slight curved taper of fuselage to tail broken midway by observer's cockpit; underside, aft of nacelles, is unbroken curved taper to tail; fin and rudder typical of "Blenheims" and "Beauforts."

"BEAUFIGHTER" (2 Hercules)
British Multi-Seater Fighter

Span 58' 0" Length 40' 11" Height 15' 9"

AVRO "MANCHESTER"

One of the types forming part of the "big bomber" program, the "Manchester" has been in service since November, 1940, and was first reported in action in the early months of 1941. Some of the first "Manchesters" in service were fitted with a large central fin, besides twin fins and rudders. In later types the twin fins and rudders were larger and the central fin had disappeared.

The "Manchester" has two 1,760 h.p. 24-cylinder Rolls-Royce "Vulture" engines. Armament includes two guns in the nose and dorsal turrets respectively, and four guns in the tail, power-operated.

Recognition Points

General structural features: Mid-wing monoplane; bulbous nose; two in-line engines; deep nacelles with double air-scoops; deep slab-sided fuselage; high cabin; wide straight center section of wing; tall elliptical twin fins and rudders (early types with additional central fin).

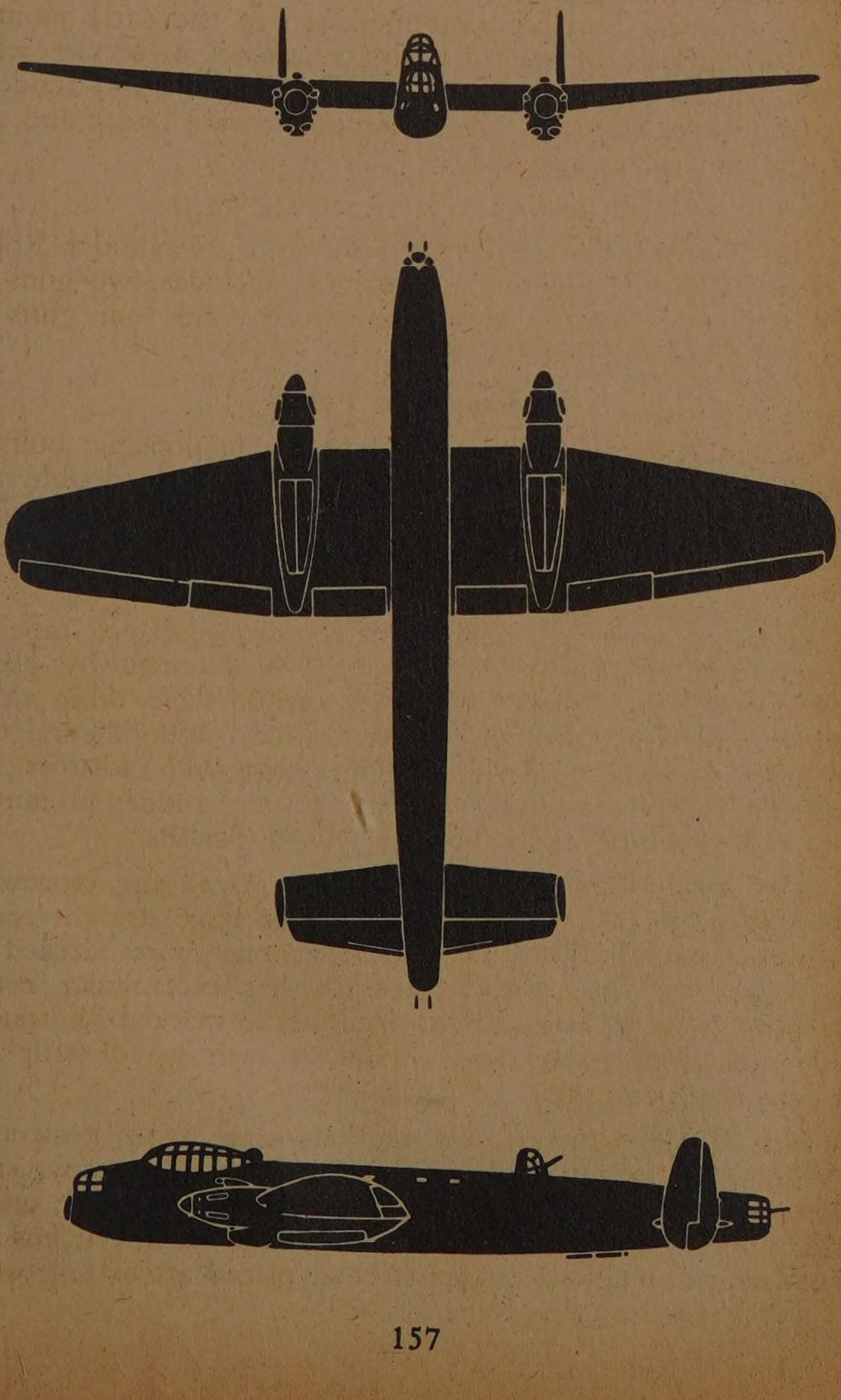
Head-on view: Roughly box-section fuselage, tapering from rounded base to narrow top, surmounted by glazed cabin and turret; glazed blisters protrude from cabin sides; wings have thick straight center section, with dihedral outboard of engines; underslung engines have deep radiators; low tailplane not visible; very tall, twin fin and rudder prominent above wings outboard of motors, visible beneath.

Plan view: Long nose tapers near glazed tip; streamline engines protrude about half-way; wings have straight center sections; straight taper on outer sections more marked on leading edge; round tips; fuselage has rectangular center section, tapering aft; straight taper more marked on trailing edge of tailplane; fin and rudder at each tip of tailplane; fuselage projects aft.

Side view: Deep glazed bulbous nose with protruding "chin"; step-up in fuselage over high glazed canopy, small step-down, then straight to dorsal turret, taper to tail; underside appears straight, tapering aft to large tailwheel; fins and rudders tall, elliptical, wider at base, placed aft of tail turret.

"MANCHESTER" (2 Vultures)
British Heavy Bomber

Span 90' 1" **Length 69' 4"**



CANT Z 1007 bis

This peculiar designation is an abbreviation of the constructor's name, Cantieri Riuniti dell'Adriatico, combined with the initial of the designer, Zappata. The suffix **bis** indicates the military version with single fin and rudder, Z1007 **ter** being a later modification having twin fins and rudders. The Z 1007 design was developed from their successful Z 506B three-engine float seaplane. The long range of the Cant bomber gives it a wide radius of action in the Mediterranean. In addition to normal bombing its duties include coastal patrol and raids on convoys. Power plant consists of three 1,000 h.p. Piaggio double-row radial air-cooled engines, giving a top speed of 280 m.p.h., cruising speed of 234 m.p.h., range exceeding 3,000 miles and service ceiling of 31,000 feet.

Armament is comparatively light, comprising one large-bore machine-gun in the dorsal gun-position and another in the ventral position. Z 1007 **ter** is more heavily armed.

Recognition Points

General structural features: Low mid-wing monoplane; three radial engines; Z 1007 **bis** has single fin and rudder; Z 1007 **ter** has twin fins and rudders; distinctive braced tail unit; retractable undercarriage.

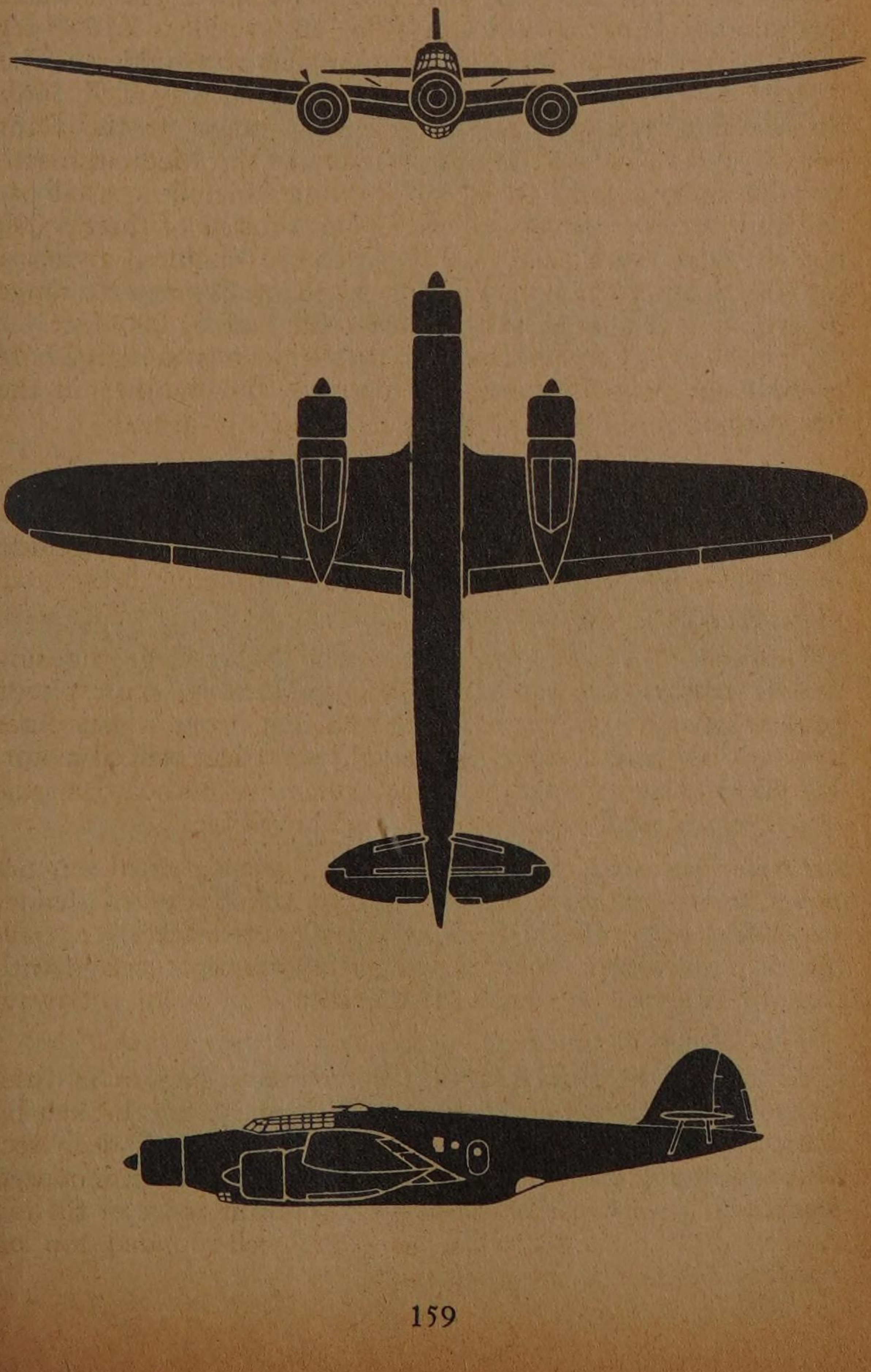
Head-on view: Narrow oval section of fuselage, housing central motor, is surmounted by glazed cabin, with glazed panels beneath; wings with full dihedral from roots; outer engines appear underslung, mounted lower than central motor; braced tailplane, in mid-position, extends to outboard engine centers; medium-height fin and rudder visible.

Plan view: Long narrow blunt nose; outer pair of engines protrude less than half-way to nose; leading edge of slender wings has small fillets; straight taper more marked on trailing edge of wings; rounded wing tips; narrow fuselage with straight taper to tail; elliptical tailplane with small cut-away; fuselage tip projects aft.

Side view: Medium length, tapered nose; step-up in fuselage over cabin, thence gentle curved taper to tail, broken by small dorsal turret; underside bellies forward, this deep section continuing to ventral gun position aft, thence pronounced waist, and taper to tail; curved taper on leading edge of fin and rudder, less marked on trailing edge; well-rounded top on rudders; fuselage tip protrudes aft.

CANT Z 1007 bis
Italian Bomber

Span 81' 4" Length 60' 6" Height 18' 6"



HANDLEY PAGE "HALIFAX" I & II

The "Halifax" was first reported in action in the early spring of 1941, about the same time as the R.A.F began to use the new and larger type of blast bomb. They have taken part in some of the heaviest raids on Berlin and Turin and a "Halifax" scored a direct hit on the "Scharnhorst" during a night raid on La Pallice. Designed by Handley Page Ltd., the "Halifax" is one of a long line of successful heavy bombers. It marks a great advance in size, speed, range and load over its famous predecessor the "Hampden," with which it has little in common except the twin tail unit. "Halifax" I is powered by four 1,010 h.p. Rolls-Royce Merlin X engines. Details of performance have not yet been released. Heavy armament includes power-operated gun turrets in nose and tail. "Halifax" II is fitted with a dorsal turret and is powered by four 1,175 h.p. Merlin XX motors. Bomb load exceeds five tons.

Recognition Points

General structural features: Mid-wing monoplane; blunt glazed nose; four in-line engines with deep radiators; wide wing span; twin tail unit.

Head-on view: deep, almost rectangular fuselage section with rounded glazed top; wings with thick straight center section, dihedral from inner nacelles; underslung engines with deep radiators; high tailplane extends just beyond inner motors; tall fins and rudders centrally mounted at tailplane tips, not visible below wings.

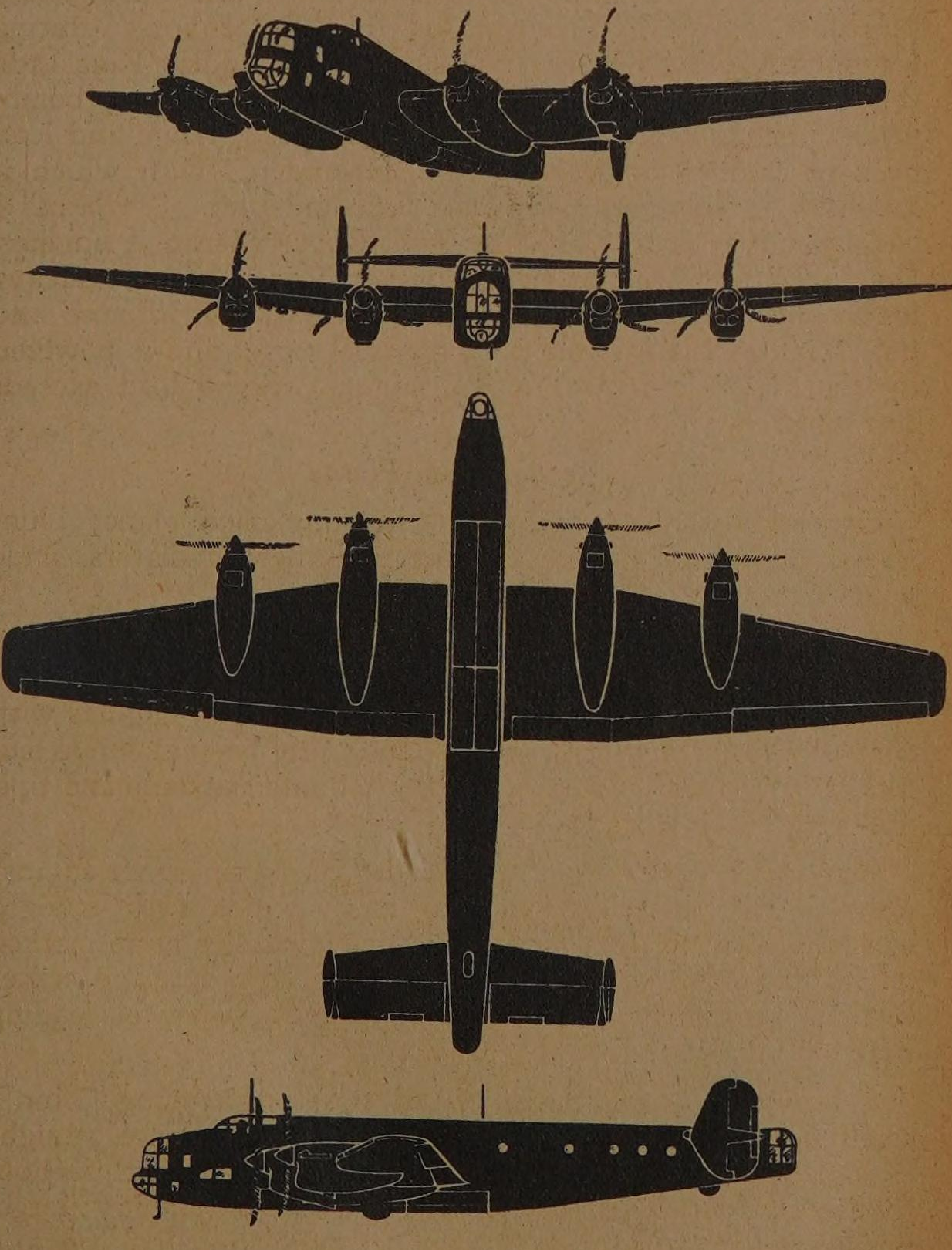
Plan view: Very long nose tapers to glazed tip; inner engines protrude less than half-way to nose; wings with straight center section; straight taper from inner nacelles more marked on leading edge of wings; square wing tips; fuselage center section rectangular, tapering aft; straight taper on leading edge of tailplane; fuselage projects aft.

Side view: Blunt, deep, glazed nose; protruding "chin"; small step-up in fuselage over glazed cabin, thence straight to tail; underside straight to end of deep forward section, thence straight taper to tail; wheels protrude slightly; large, wide, wedge-shaped fin and rudder with rounded top and base; each rudder in two sections; tail turret projects aft.

"HALIFAX" I (4 Merlin X)

British Bomber

Span 99' 0" **Length 69' 9"** **Height 22' 0"**



AVRO "LANCASTER"

This machine is one of the deadliest bombers ever designed, and at the time of writing it has the largest bomb capacity of any bomber in production. Its announced maximum bomb load is in the neighborhood of 18,000 pounds. The range (3,000 miles) of the the machine is sufficient so that Hitler could not possibly move any of his factories beyond the area where the "Lancaster" can strike. It has been used to blast railroad works, airplane factories, shipyards, and various arms factories, including the great Schneider works at Le Creusot, thirty miles east of Verdun, on October 17, 1942. Ninety-four "Lancasters" were used in the raid on the Schneider plant, which was conducted in full daylight. Only one failed to return.

The "Lancaster" is powered by four 1,280 h.p. Rolls-Royce Merlin liquid-cooled engines. Armament includes ten machine guns and, according to public announcement, the maximum speed with full load is almost 300 m.p.h.

Recognition Points

General structural features: Mid-wing monoplane; four in-line engines; slab-sided fuselage; twin fins and rudders; re-retractable landing gear.

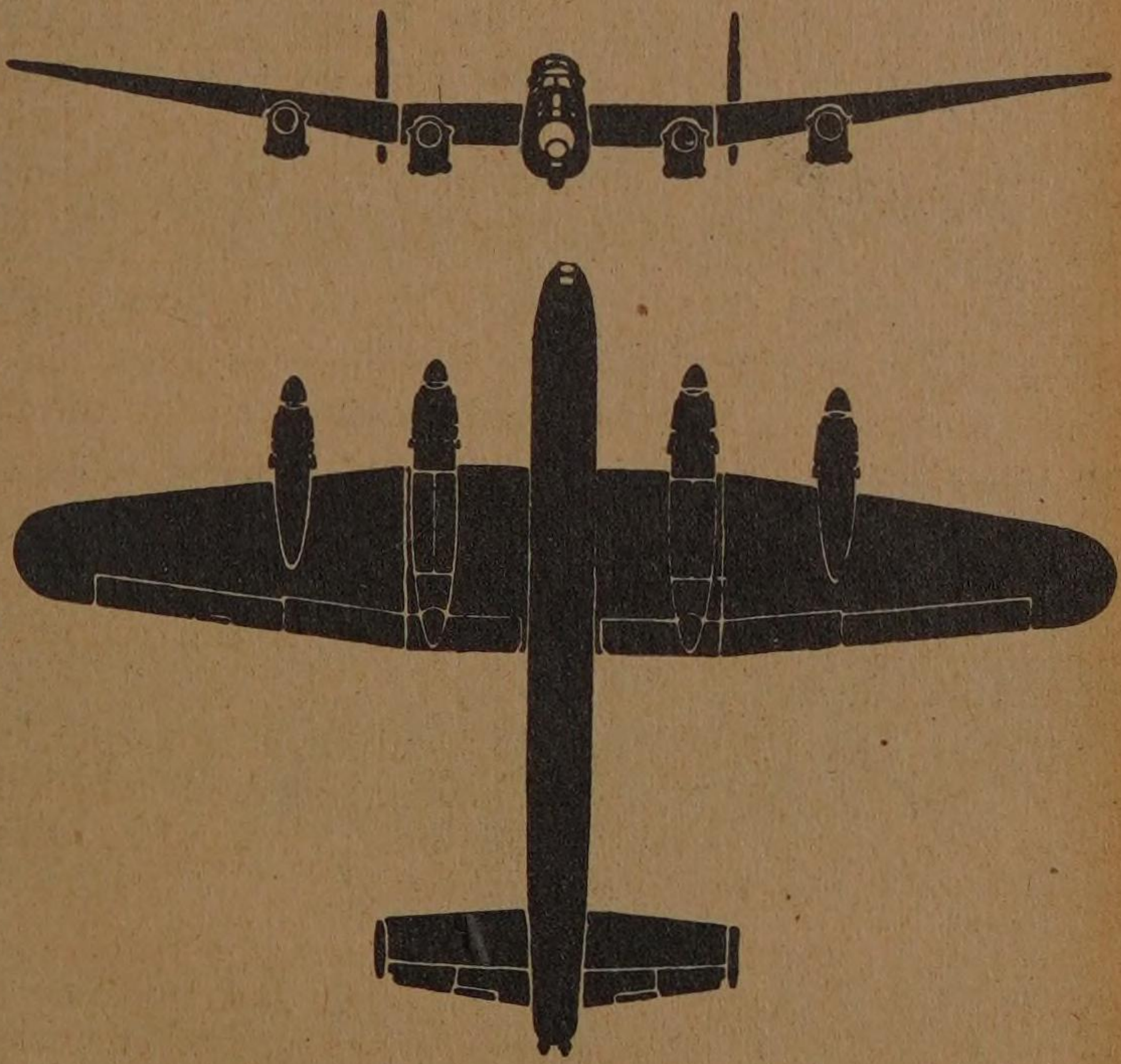
Head-on view: Deep, narrow, oval fuselage section, with glazed bomb-aiming nose; underslung engines; dihedral on wings from center section to tips only; fins and rudders appear between outer pair of engines.

Plan view: Outline of fuselage is straight from nose to tail; no taper on center sections of wings, but moderate taper on outer sections to rounded tips; inner pair of engines projects only slightly farther forward than outer pair; very slight taper on leading edge of tailplane, more pronounced taper on trailing edge of elevator; rounded tail of fuselage characteristic of heavy bombers with stinger turrets.

Side view: Two glazed bumps on nose; step-up over cabin, then straight line to gun turret half-way between wing and tail; straight line continues thence to tail; line of underside forms gentle curve, broken only by fixed tail wheel and by bottom of fin and rudder; stinger turret extends far behind large, elliptical fins and rudders.

"LANCASTER" (4 Merlin XX)
British Heavy Bomber

Span 102' 0" Length 69' 4" Height 20' 0"



SHORT "STIRLING"

Designed by Short Brothers Ltd., the prototype of the "Stirling" first flew in May, 1939. The "Stirling's" loaded weight exceeds 30 tons. It is capable of carrying eight tons of bombs from England to Berlin. In spite of its great size its handling qualities are such that one of the first squadrons to be equipped with "Stirlings" described it as a "fighter bomber." Powered by four 1,600 h.p. Bristol Hercules two-row radial air-cooled engines or by Wright Double Cyclone radial engines of similar output, top speed is nearly 300 m.p.h. and range exceeds 2,000 miles.

Armament: Eight 303" Browning guns, disposed in power-operated turrets in the nose, tail and dorsal positions. The dorsal turret, situated just aft of the trailing edge, replaces a retractable ventral turret formerly fitted. Neither type is shown in the official silhouette, facing.

Recognition Points

General structural features: Mid-wing monoplane; four radial engines; long, slab-sided fuselage; heavy snout-like nose; single fin and rudder; retractable undercarriage; tail-down flying attitude; wing and tail unit show family resemblance to "Sunderland."

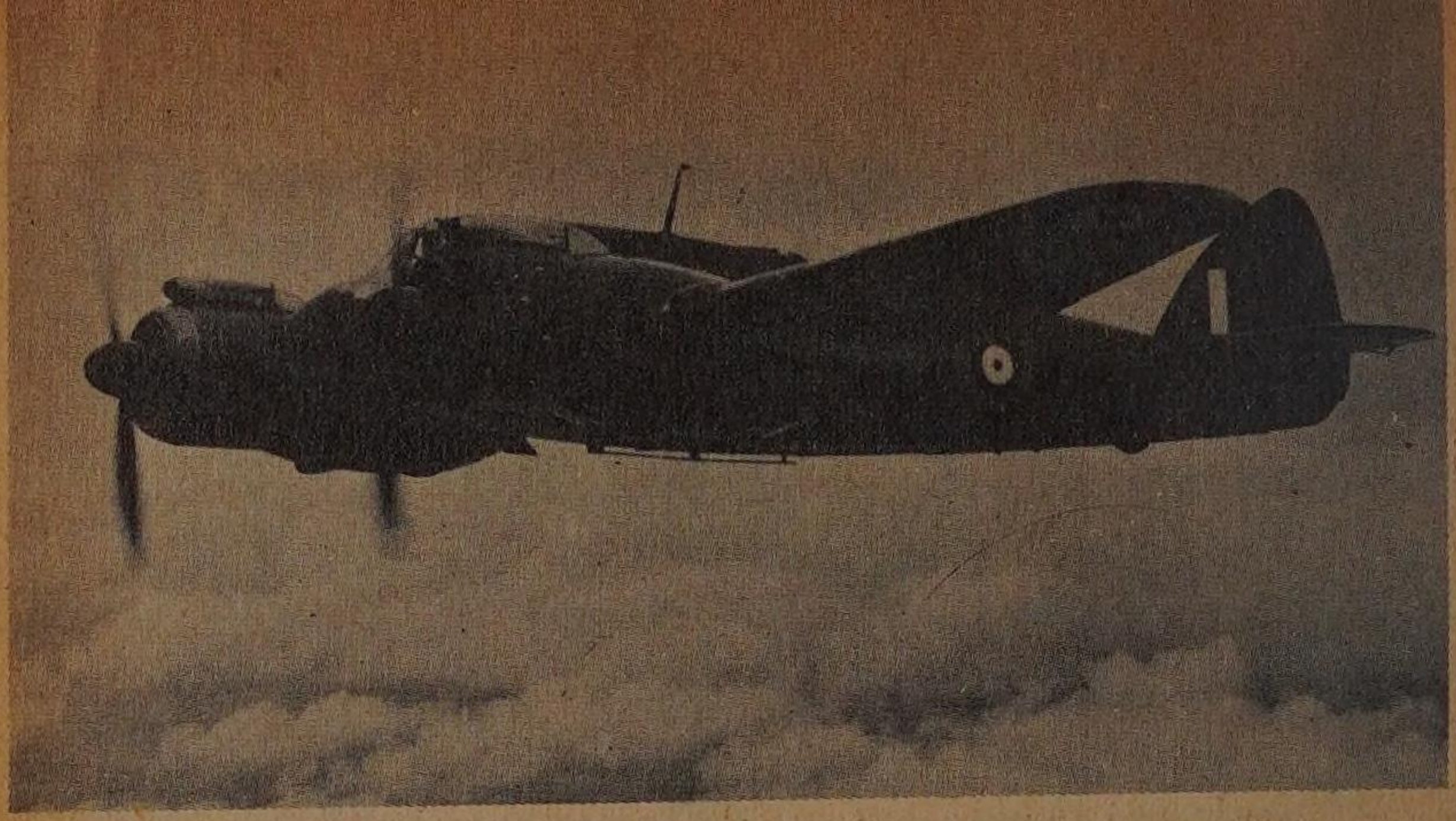
Head-on view: Bell-shaped fuselage surmounted by small turret; wings show dihedral from roots; inner engines underslung, with slightly protruding wheels; outer pair centrally mounted; low tailplane not visible; very tall fin and rudder prominent.

Plan view: Long wide nose tapers towards glazed tip; inner engines protrude half-way to nose; straight taper more marked on trailing edge of wings, with fillet, rounded tips; long fuselage with parallel sides, tapering slightly near tail; straight taper more marked on leading edge of tailplane; rounded tips; rounded tail of fuselage protrudes aft.

Side view: Large blunt nose glazed above and below; step-up in fuselage over glazed canopy, then straight to tail, broken by dorsal turret; underside parallel for two-thirds length, thence straight taper to blunt turretted tail; straight taper more marked on leading edge of tall, narrow fin and rudder, which have rounded top.

"STIRLING" I (4 Hercules)
British Bomber

Span 99' 0" Length 87' 3" Height 28, 10"



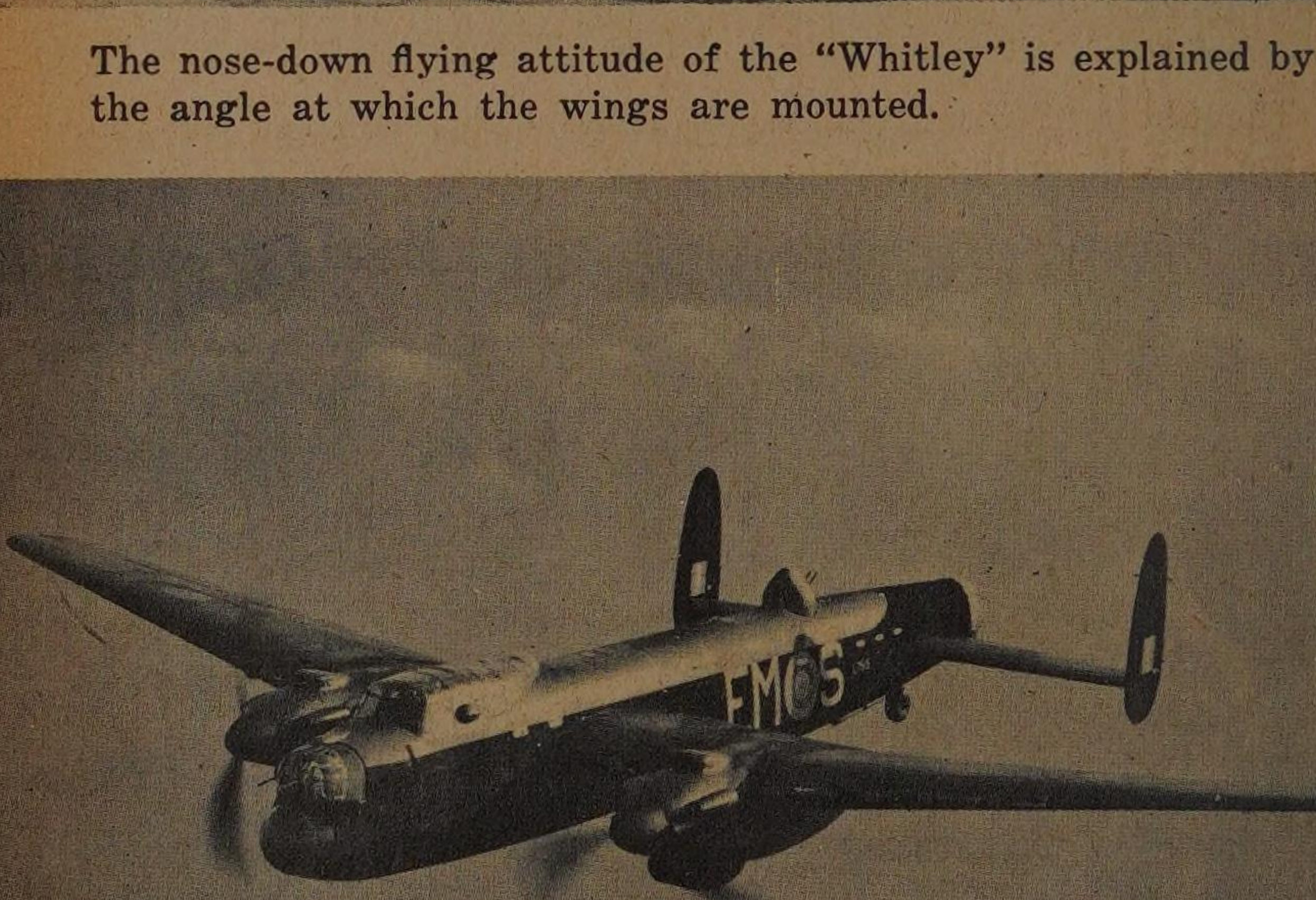
Britain's "Beaufighter" performs a variety of duties, including day and night fighting and long-range escorting.

The "Mosquito" is a fast bomber armed with cannon and machine guns. It has wrecked many a Nazi supply train.

Classified as a two-engine machine, the novel Heinkel 177 actually has four engines housed in two nacelles.

From almost any angle the Blenheim IV (above) can be distinguished from the Ju 88 by their different noses.

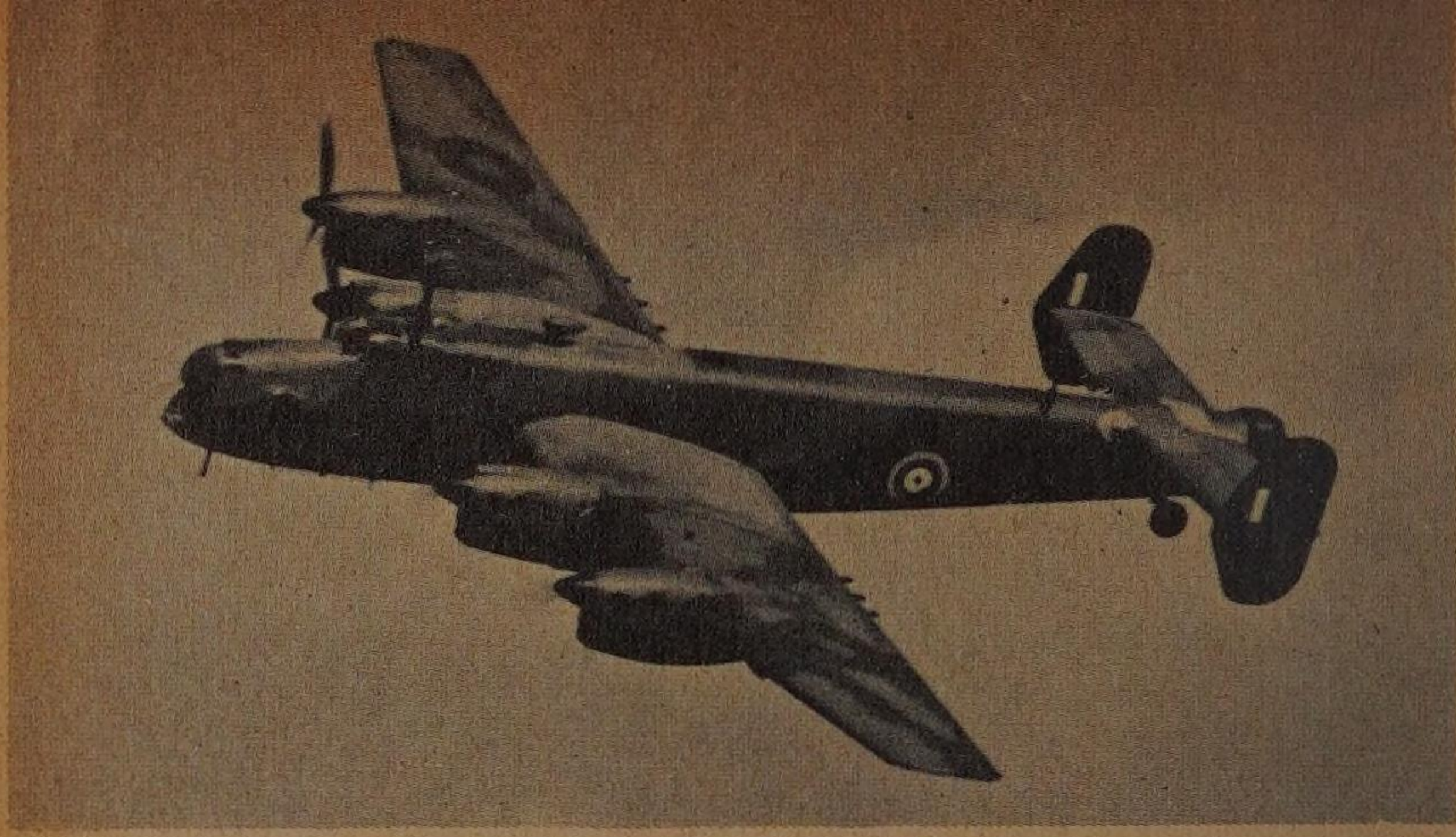
The nose-down flying attitude of the "Whitley" is explained by the angle at which the wings are mounted.



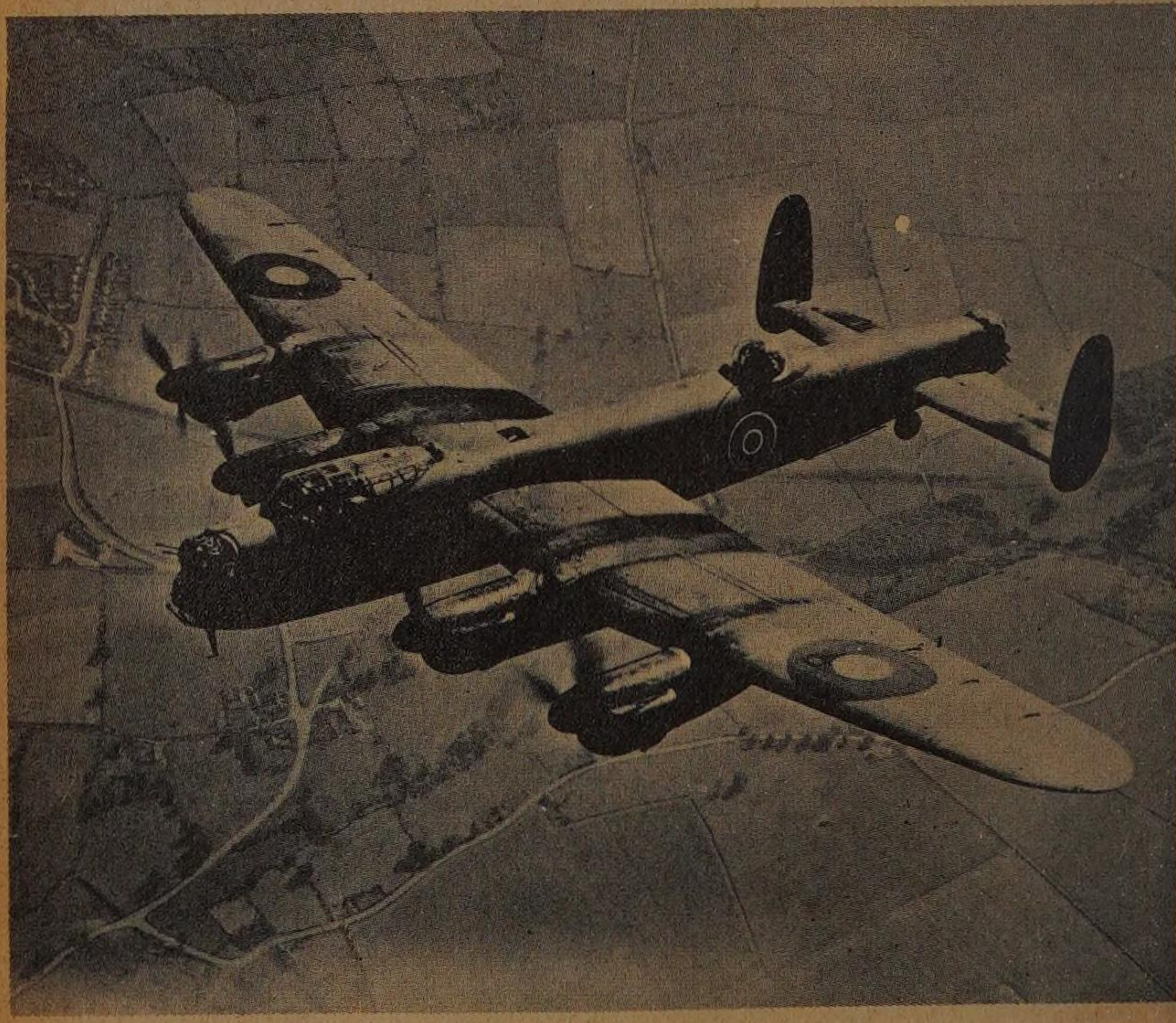
The Avro "Manchester," predecessor of the four-engine "Lancaster," is somewhat similar to the larger plane.

The Short "Stirling" is one of many heavy bombers used by the R.A.F. to level Nazi industrial installations.

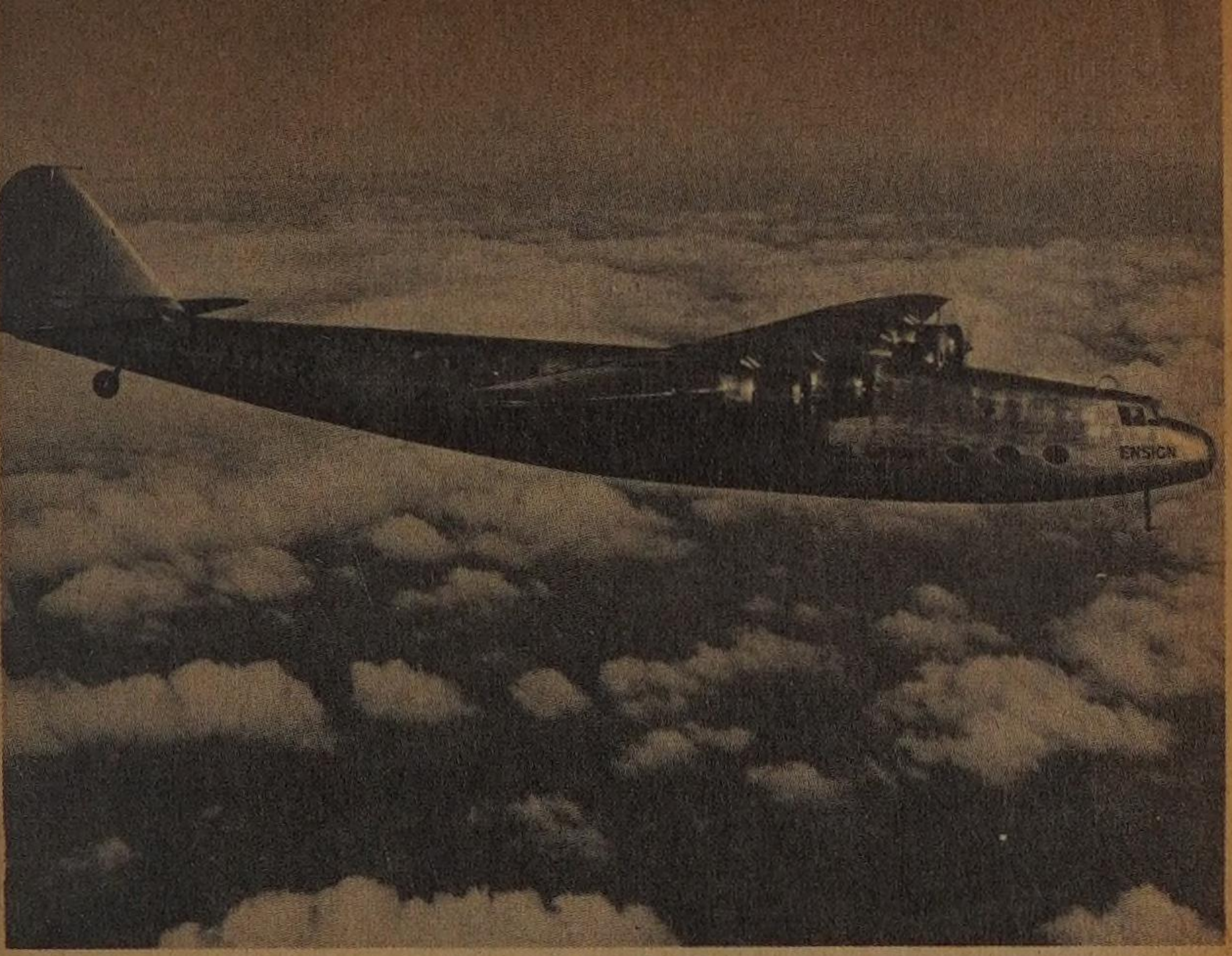
The earlier type of Avro "Manchester" had a large central fin in addition to the regular twin tail assembly.



In comparing the "Halifax" (above) with the "Lancaster" (below), note especially the differing twin tail units.



Britain's mighty Avro "Lancaster" has a bomb capacity of about nine tons and a top speed in the 300 m.p.h. class.



A forty-passenger "Ensign."

CHAPTER XI
HIGH-WING MONOPLANES

WESTLAND "LYSANDER"

Designed throughout for co-operation with an army in the field, this two-seater monoplane has many interesting features. It excels in ability to operate from small improvized flying fields, its take-off run to clear a fifty-foot obstacle being only 245 yards. With a useful maximum speed of 230 m.p.h., it can nevertheless fly fully loaded as slowly as 55 m.p.h. These figures refer to Mark II, fitted with a 905 h.p.h Bristol Perseus sleeve-valve air-cooled radial engine. Mark I is fitted with the Bristol Mercury radial engine of 890 h.p., which gives approximately the same performance. In addition to the observer's gun, a machine-gun is fixed in each of the wheel "spats" firing forward, clear of the airscrew. Detachable stub-wings, designed as carriers for light bombs or special equipment, can be fitted above the wheel "spats." A retractable hook enables the "Lysander" to collect messages.

Recognition Points

General structural features: High-wing monoplane; braced wings of distinctive plan with half-rounded tips; single radial engine; single fin and rudder; deep fuselage with large two-seat glazed cockpit; fixed undercarriage with large spats.

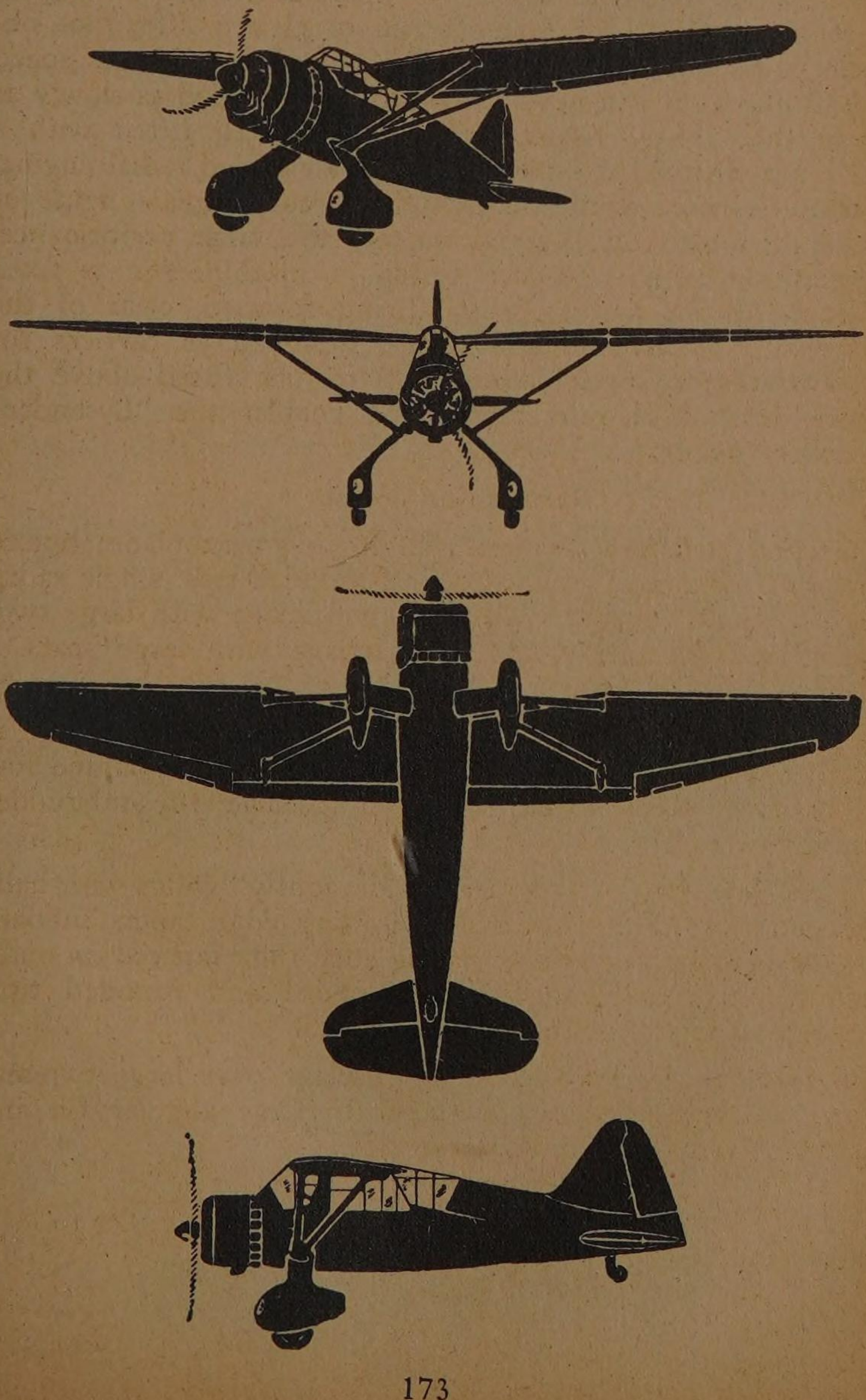
Head-on view: Pear-shaped fuselage section with glazed cockpit which separates wing roots; spatted undercarriage is fixed; braced wings with no dihedral; tailplane mounted low on fuselage, visible to either side of fuselage; fin and rudder visible.

Plan view: Easily recognizable "dragonfly" wings with half-rounded tips; center section of leading edge tapers **inboard** to give better observation; trailing edge fully tapered on outer section only; tailplane has long chord and rounded tips; fuselage tapers from blunt nose to tail.

Side view: Step-up in top of fuselage over large two-seat glazed cockpit, then curved taper to large angular fin and rudder; fixed, spatted undercarriage.

"LYSANDER" (Mercury)
British Army Co-operation Plane

Span 50' 0" Length 30' 0" Height 14' 0"



HENSCHEL 126

The Henschel 126 two-seat monoplane has something of the insect-like appearance of the R.A.F. "Lysander." It fulfils similar roles—photography, artillery spotting, communications and general reconnaissance. Powered with a B.M.W. radial air-cooled engine, developing 870 h.p., it has a maximum speed of 229 m.p.h. Armament consists of one fixed gun, firing through the airscrew disc, and one observer's gun, in contrast with the three guns of the "Lysander." Comparison of the two machines also suggests that the field of vision from the "Henschel" cockpit is inferior to that from the "greenhouse" of the "Lysander."

Recognition Points

General structural features: High-wing monoplane; braced wings of parasol type; single radial engine; single fin and rudder; streamlined fuselage of oval section; fixed undercarriage; spatted wheels.

Head-on view: Braced parasol-type wings have no dihedral; circular fuselage surmounted by glazed cockpit; braced tailplane carried high; fin and rudder barely visible over wings; distinctive fixed undercarriage.

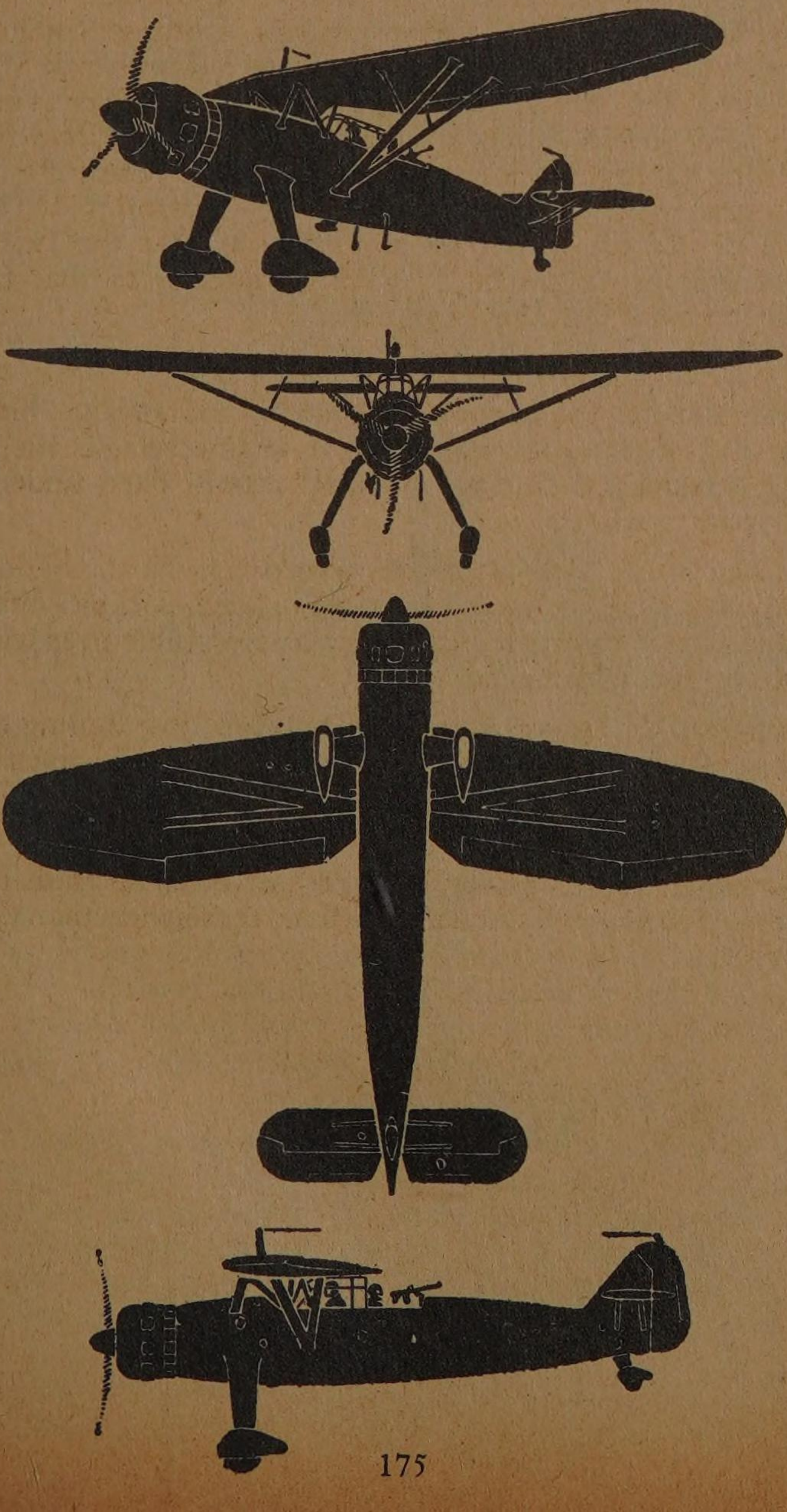
Plan view: Wings swept back to rounded tips; trailing edge swept forward to clear observer's line of vision; wings not separated by glazed roof, as in "Lysander"; untapered tailplane with rounded tips.

Side view: Struts obscure forward part of cabin; radial engine has fluted cowling; wheel spats are smaller than "Lysander's."

HENSCHEL 126 (B.M.W.)

German Army Co-operation Plane

Span 47' 7" Length 35' 7" Height 12' 4"



BLACKBURN "BOTHA" I

Designed as a reconnaissance bomber and general purpose aircraft, the Blackburn "Botha" is now in service with the R.A.F. and the Fleet Air Arm as a twin engine trainer. Its constructors, Blackburn Aircraft Ltd., also build the "Roc" and "Skua," the first monoplane fighters and dive-bombers to operate from the Fleet's aircraft carriers. The forward mounting of the fin and rudder is a characteristic of each of these types. In view of its use for the final training of bomber crews the "Botha" is provided with a prone bomb-aiming position and its armament includes a power-operated dorsal gun turret. Operating chiefly in coastal areas, when fully equipped it carries a collapsible dinghy. The power plant consists of two Bristol Perseus radial air-cooled engines developing 905 h.p. As may be expected of an operational trainer, the "Botha" has clean lines, is reasonably fast and has a good general performance. Actual details have not been released.

Recognition Points

General structural features: High wing monoplane; two underslung radial engines; single fin and rudder; distinctive turret and tail unit.

Head-on view: Fuselage roughly bell-shaped, surmounted by turret; straight wing center section; marked dihedral from nacelles; fully underslung engines; high tailplane not visible; tall, prominent fin and rudder.

Plan view: Wide, medium length, streamlined nose with glazed tip; engines protrude half-way; straight wing center section; taper of outer sections more marked on trailing edge; duo-curved tips; short span; torpedo-shaped fuselage, unusually long in relation to wing span; round-tipped, roughly triangular tailplane, with marked straight taper on leading edge, straight trailing edge.

Side view: Short, streamlined nose; step-up in fuselage over glazed cabin, then straight to tail, broken forward by dihedral of wing and amidships by dorsal turret; underside unbroken streamline to tail; marked straight taper on leading edge of tall, narrow fin and rudder, which have straight trailing edge and rounded top; fuselage tip projects aft.

"BOTHA" (2 Perseus)
British Trainer

Span 59' 0" Length 50' 11½" Height 12' 6"

BRISTOL "BOMBAY"

A slightly modified version of the Bristol type 130, the "Bombay" is the only twin-tail Bristol design in service with the R.A.F. Employed as a troop carrier, it has accommodation for a crew of three and twenty-four fully-armed troops. Alternatively it can take ten stretcher cases or heavy loads of equipment and spares. Formidable gun-turrets in nose and tail enable the "Bombay" to dispense with fighter escort. With two Bristol Pegasus air-cooled radial engines of 890 h.p., the top speed is 192 m.p.h., whilst its range at cruising speed of 160 m.p.h. exceeds 2,000 miles.

Recognition Points

General structural features: High-wing monoplane; two radial engines mounted on their center lines; twin fins and rudders; fuselage generally oval in section, but slab-sided in center; fixed undercarriage wheels usually without "spats."

Head-on view: Generally oval fuselage; wings with moderate dihedral outboard of engines, which are mounted on their center lines; braced fins and rudders visible just inboard of engines; fixed undercarriage.

Plan view: Tapered nose projects well forward of engines; unusual wing plan with negligible taper on leading edge (in contrast with fully tapered "Harrow" wings); wing-tips are outswept from leading edge; tailplane has little or no taper, rounded tips; fuselage projects aft.

Side view: Wings and nacelles break line of fuselage; underside broken by undercarriage; fins and rudders of irregular oval or kidney shape; fuselage appears to sag in the middle as if overloaded—a characteristic aspect easily recognized.

"BOMBAY" I (2 Pegasus)
British Transport

Span 95' 9" Length 69' 2" Height 19' 11"

DE HAVILLAND "FLAMINGO"

An outstanding example of modern British air-liner design, the de Havilland "Flamingo" or D.H. 95, first flew in December, 1938. This type of high performance twin-engine monoplane of medium size was badly needed on British Air Lines—hence the choice of an American "Lockheed" for Mr. Chamberlain's flight to Munich. Since the outbreak of war the "Flamingo" has been chiefly employed on communication and transport work. On important occasions Mr. Churchill has been pictured entering an airliner readily recognizable as a "Flamingo." No doubt his choice is a well-merited compliment to British designers. Two 930 h.p. Bristol "Perseus" sleeve-valve air-cooled radial engines form the power plant, giving a top speed of 239 m.p.h. and economical cruising speed of 200 m.p.h. The maximum range is 1,300 miles.

"Hertfordshire" is the R.A.F. troop-carrier version.

Recognition Points

General structural features: High-wing monoplane; two radial engines; twin fins and rudders; streamline fuselage; retractable undercarriage.

Head-on view: Box-like fuselage; no dihedral on wings; partially underslung radial engines; tailplane not visible; fins and rudders outboard of engine centers; retracted wheels are partially exposed.

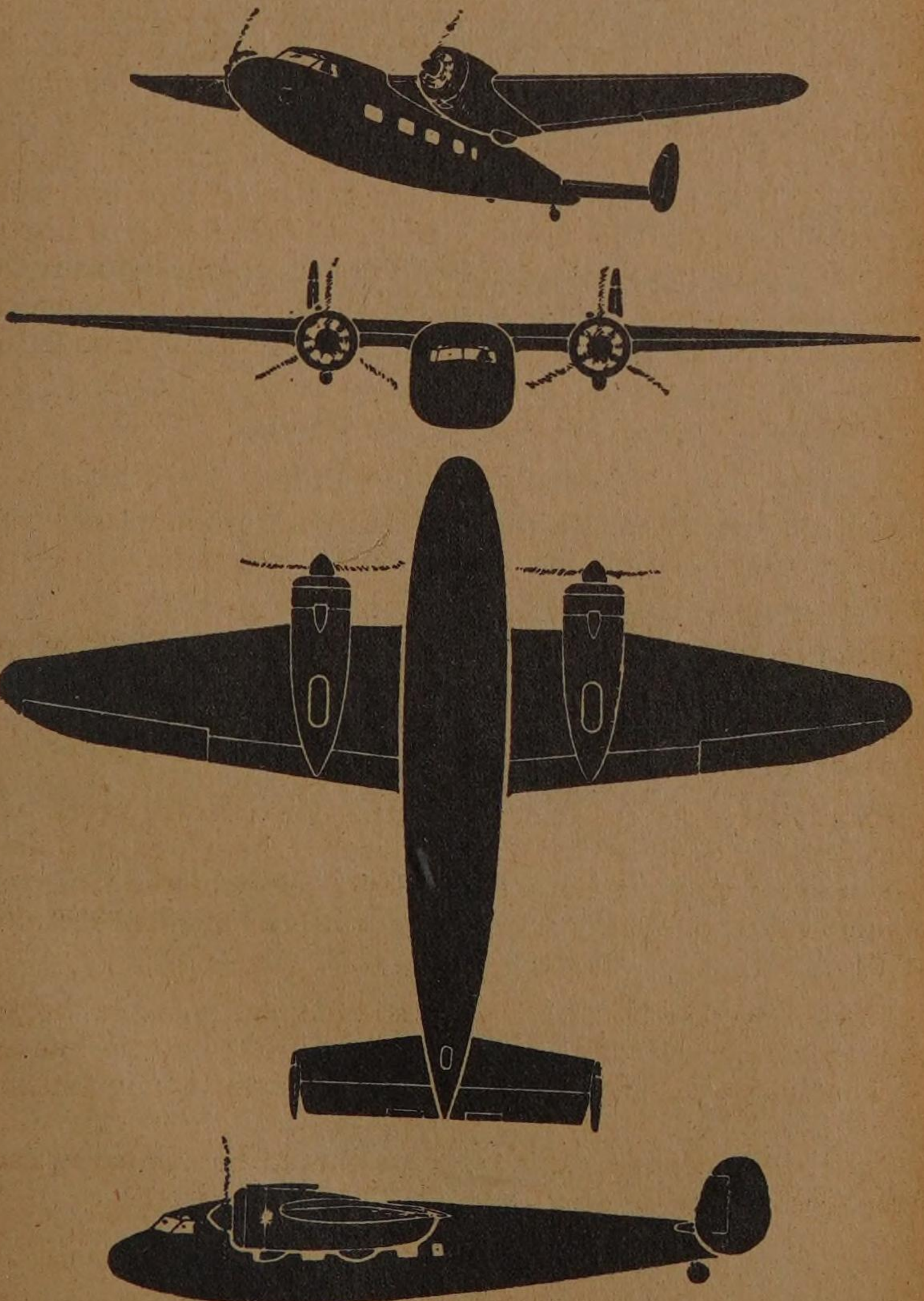
Plan view: Large streamlined fuselage; nose projects well ahead of the engines; wings are sharply tapered, except along the center section of the leading edge; semi-pointed tips; tail-plane tapered on leading edge only; fins and rudders mounted at tips.

Side view: Outline of top of streamlined fuselage broken slightly by control cabin and engine nacelles; bottom line unbroken forward of fixed tail wheel; pear-shaped twin fins and rudders.

Note: Silhouettes of this machine should be compared carefully with those of the Dornier 17, 215, and 217.

"FLAMINGO" or "HERTFORDSHIRE" (2 Perseus)
British Transport and Communications Plane

Span 70' 0" Length 51' 7" Height 15' 4"



DORNIER 17 (In-Line Engines)

Dornier bombers, mass produced for several years, have formed the backbone of the Luftwaffe. The Do 17, better known as the the "Flying Pencil," is characterized by extremely slender fuselage and long nose. Earlier versions were fitted with two 770 h.p. B.M.W. engines. The power plant of the machine shown in silhouette consists of two 1,050 h.p. Daimler-Benz 600 liquid-cooled engines, giving a maximum speed of 310 m.p.h. with economical cruising speed of 242 m.p.h. An alternative power unit is the 1,000 h.p. Bramo air-cooled radial engine.

Recognition Points

General structural features: High-wing monoplane; two engines, either in-line or radial type; twin fins and rudders; slender streamline fuselage of circular section; wheels retract into engine nacelles; tail wheel also retracts.

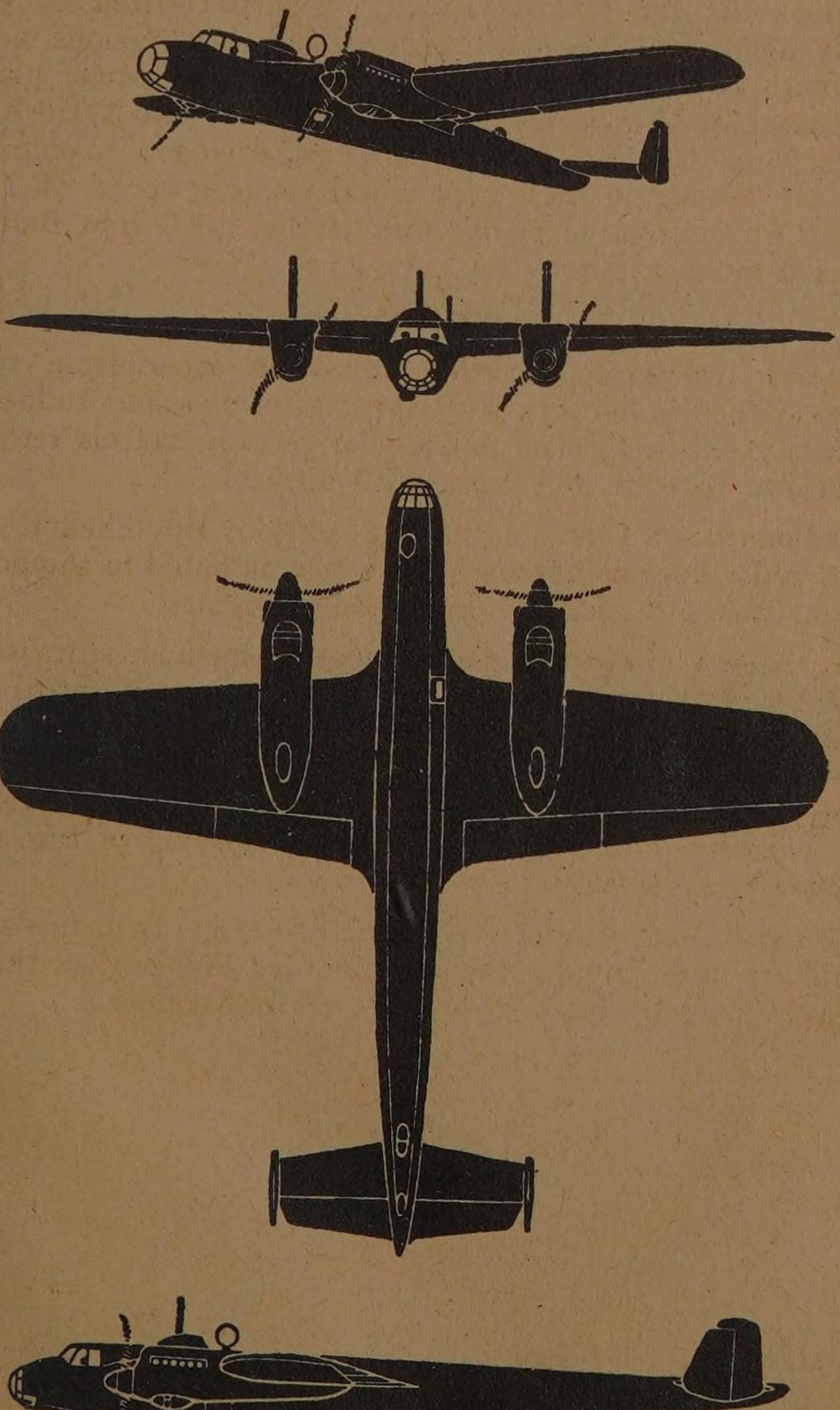
Head-on view: Circular fuselage section; no dihedral on wings; underslung engine nacelles; wings mounted in shoulder position; fins and rudders visible above engines.

Plan view: Uniformly tapered wings of medium span with rounded tips; slender streamlined nose projects forward of engines (Do 215 nose also projects forward of engines, but is shorter, more bulbous, and is fully glazed); fillet from both leading and trailing edges of wings; tailplane tapered both edges, with fins and rudders mounted at tips; tip of fuselage projects aft of elevator.

Side view: Long slender, streamlined fuselage; twin fins and rudders are more angular and are mounted higher than those of Me 110; tip of fuselage projects aft of rudders.

DORNIER 17 (2 D.B.)
German Heavy Bomber

Span 59' 0" Length 55' 4" Height 15' 0"



DORNIER 17 (Radial Engines)

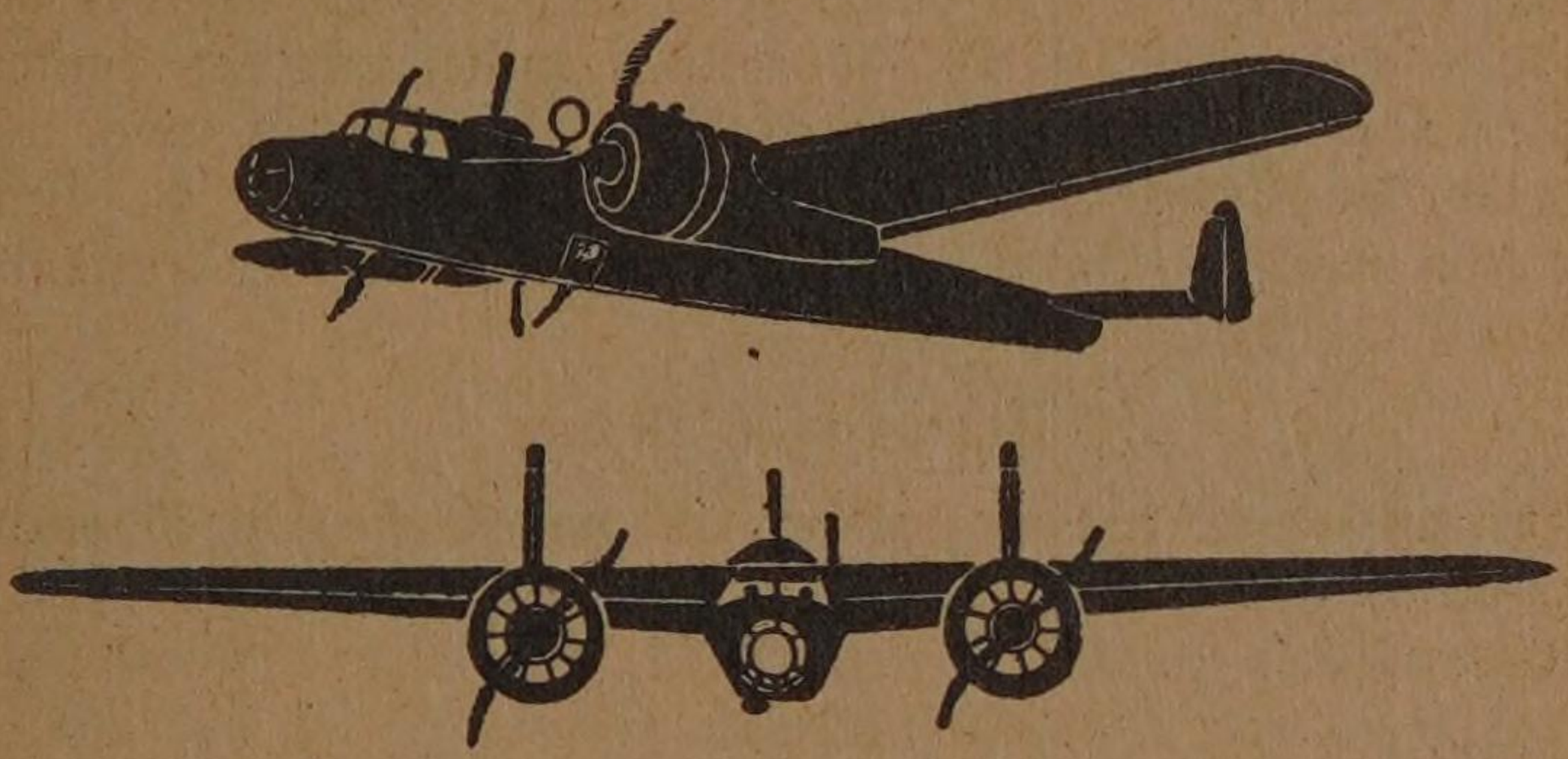
The appearance of the "Flying Pencil" or Do 17 is considerably changed by the fitting of large **radial engines** such as the 1,000 h.p. "Bramo" air-cooled radial engines depicted in the silhouettes facing this page. Alternatively, two 1,000 h.p. Gnome-Rhone radial air-cooled engines may be fitted. In other respects the Do 17 with radial engines resembles previous models.

Recognition Points

Compare these silhouettes with those of the Do 17 shown on preceding page. The only difference is in the type of engines used.

DORNIER 17 (2 Bramo 323)
German Heavy Bomber

Span 59' 0" Length 55' 4" Height 15' 0"



DORNIER 215

Developed from the Do 17 design, the Do 215 closely resembles the earlier type, the modifications chiefly affecting the fuselage forward of the wings. The Do 215 nose is shorter and is completely covered with glazed panels. .The deep cockpit forward of the wings accommodates a crew of four and is enclosed by a domed glazed top or "greenhouse." The power plant is usually two 1,150 h.p. Daimler-Benz 601A liquid-cooled engines, with alternative installations as for Do 17. The performance is similar, maximum speed being 312 m.p.h. At cruising speed of 264 m.p.h. the range is just under 1,000 miles.

A still later model, the Do 217, has now apparently replaced both the Do 215 and the Do 17 in production.

Recognition Points

General structural features: High-wing monoplane; two engines, either in-line or radial type; twin fins and rudders; slender streamlined fuselage with deep forward section; wheels retract into engine nacelles; tail wheel also retracts.

Head-on view: Circular fuselage section surmounted by large glazed "greenhouse"; underslung nacelles with radiators beneath (except when radial engines are used); no dihedral in wings; fins and rudders visible over engine nacelles.

Plan view: Fully glazed nose, much shorter than that of Do 17, projects forward of engines; uniformly tapered wings of medium span with well-rounded tips; fillet from both edges of wings; tailplane tapers on both edges.

Side view: Nose appears more bulbous than Do 17; addition of "greenhouse" is especially notable; long slender fuselage tapers to tail unit same as that of Do 17.

DORNIER 215
German Heavy Bomber

Span 59' 0" Length 53' 6" Height 15' 9"

DORNIER 217

A late arrival in the series of bombers to which the Do 17 and the Do 215 belong is the Do 217, which has a much greater bomb capacity, greater range, and heavier armament than its predecessors. It can be used for dive bombing, precision bombing, torpedo dropping, and long-range reconnaissance. At least two versions of the machine are known to be in service, and other variants have been reported. The Do 217E1 is driven by two BMW 801 14-cylinder two-row radial engines, each of which develops 1,600 h.p. at take-off and 1,480 h.p. at 14,700 feet. Maximum bomb load is about 6,600 lb. Top speed is probably in the neighborhood of 300-310 m.p.h. Do 217E2 is powered by 2,000 h.p. BMW 802 radial engines. Top speed of this machine is 324 m.p.h. Apparently all Do 217's can easily be equipped with a novel dive brake attached to the tip of the tail. The brake consists of a device which resembles an umbrella without a cover, and opens up when the craft goes into a dive.

Recognition Points

General structural features: Shoulder-wing monoplane; two radial engines; streamlined fuselage; twin fins and rudders; retractable undercarriage.

Head-on view: Underslung engines; no dihedral on wings; cross-section of fuselage is roughly circular, but flattened off on top of control cabin; fins and rudders appear immediately over engine centers.

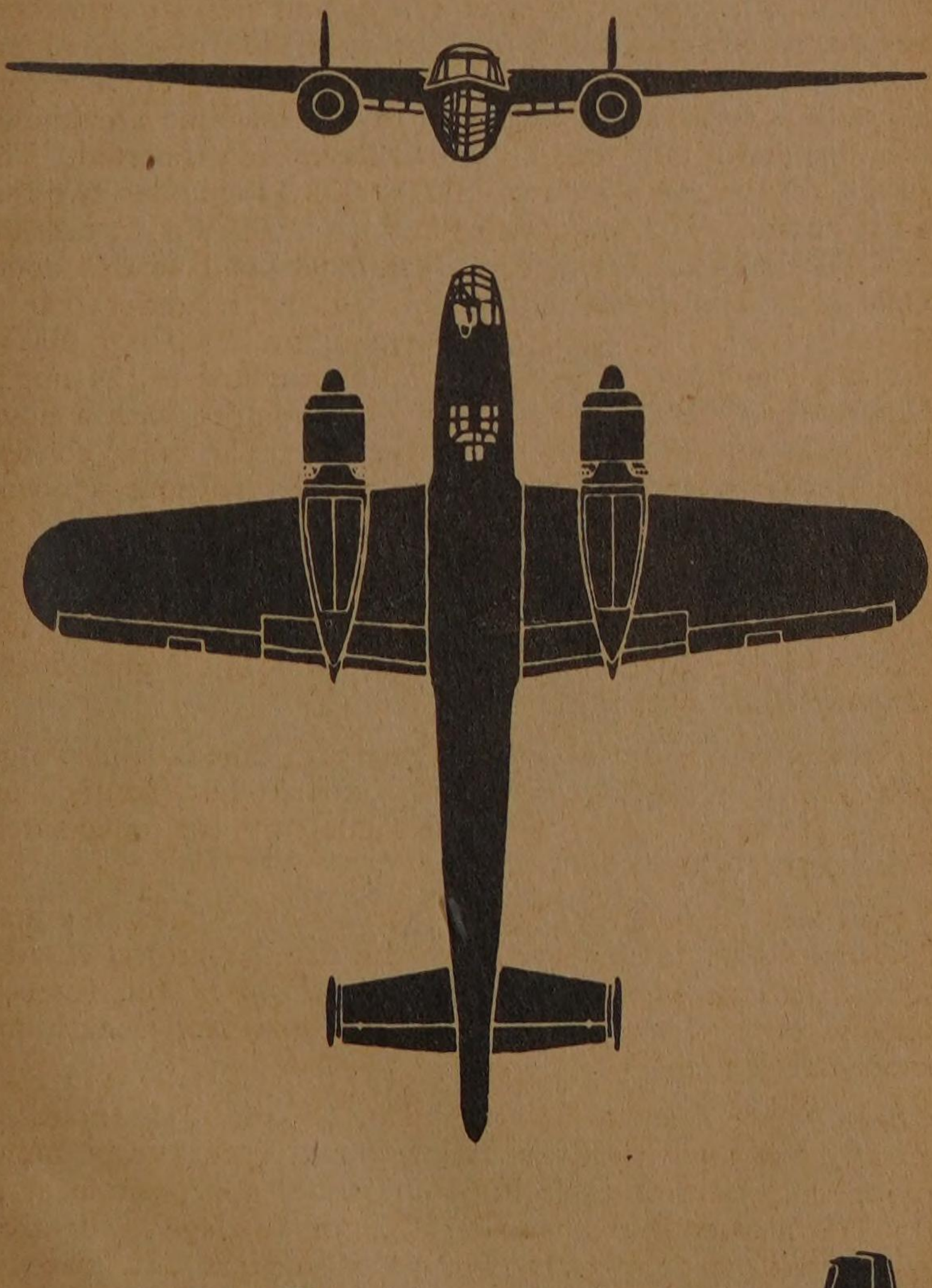
Plan view: Similar to Do 17, but note that fillet is practically non-existent; rear tips of engine nacelles project slightly behind trailing edge of wings; the rear tip of the fuselage extends farther aft of the elevators; span and length are somewhat greater.

Side view: Comparing with Do 17 and 215, note especially: bottom of bomb-aiming nose is cut away more, giving the effect of a weaker chin; under gun position as in Do 215; curved line of under side of fuselage distinctive; tip of fuselage projects farther aft of rudders. In place of gun position in the rear of the "greenhouse" of the Do 217E1, the Do 217E2 has a rotatable gun turret immediately to the rear of the "greenhouse."

DORNIER 217E1 (2 B.M.W. 801)
German Bomber

Span 62' 5"

Length 56' 6"



HANDLEY PAGE "HARROW"

The Handley Page "Harrow" came into regular service as a heavy bomber of the R.A.F. in 1936. Like the Bristol "Bombay," for which it is frequently mistaken, it is now chiefly used as a troop carrier and for general transport work. Its armament is similar, consisting of gun-turret in nose and tail, with a third gun position aft of the wings. The earlier type, equipped with two Bristol Pegasus X air-cooled radial engines, has a top speed of 190 m.p.h. and cruising speed of 154 m.p.h. The later, or Mk. II Harrow, fitted with Pegasus XX engines, is faster by about ten m.p.h. Its maximum range is close to 2,000 miles.

Recognition Points

General structural features: High-wing monoplane; two radial engines; twin fins and rudders; slab-sided fuselage; fixed spatted undercarriage; generally more angular than the "Bombay".

Head-on view: Twin engines mounted on their center lines; wings with moderate dihedral; fixed undercarriage; fins and rudders visible inboard of engines.

Plan view: Long, narrow nose projecting well forward of the engines; full taper of wings more marked in trailing edge; square-cut tips; tailplane tapered with rounded tips; fuselage projects aft.

Side view: Glazed nose turret, cockpit and tail turret; large streamlined spats in contrast with usually unspatted wheels of the "Bombay"; lacks the sagging appearance of the latter.

"HARROW" (2 Pegasus)
British Bomber-Transport

Span 88' 5" Length 82' 1" Height 20' 2"

ARMSTRONG WHITWORTH "ENSIGN"

Ensign air liners now known as the "E" class of British Overseas Airways Corporation's fleet, were built by Sir W. G. Armstrong Whitworth Aircraft Ltd. for Imperial Airways' European and Empire services. After the outbreak of war and until France was over-run, "Ensigns" were employed on official communication and transport services between London and Paris. Powered by four 935 h.p. Armstrong Siddeley Tiger IX radial air-cooled engines, the top speed is 205 m.p.h., cruising 170 m.p.h., range 860 miles and service ceiling 22,000 ft. A number of the "Ensigns" of British Overseas Airways are being refitted with 1,100 h.p. Wright Cyclone radial engines. The range of this type is increased by about 500 miles, but as the total weight is greater the general performance remains about the same as that of the Tiger-engined version.

Recognition Points

General structural features: High-wing monoplane; four underslung radial engines; long streamlined fuselage frequently mistaken for hull of flying boat; high wings mounted far back, nearly amidships; single fishtail fin and rudder; retractable undercarriage.

Head-on view: Roughly barrel-shaped fuselage; wings have thick roots, no dihedral; underslung engines, wheels protruding beneath inner pair; high tailplane not visible; tall prominent fin and rudder.

Plan view: Very long nose tapers forward; engines protrude less than quarter length of nose; straight taper more marked on trailing edge of wing; wide, slightly rounded wing tips; small fillet between fuselage and trailing edge of wings; fuselage has long, rectangular center section, curved taper aft; straight taper more marked on trailing edge of tailplane, with nearly square tips; small cut-away for rudder, which protrudes aft.

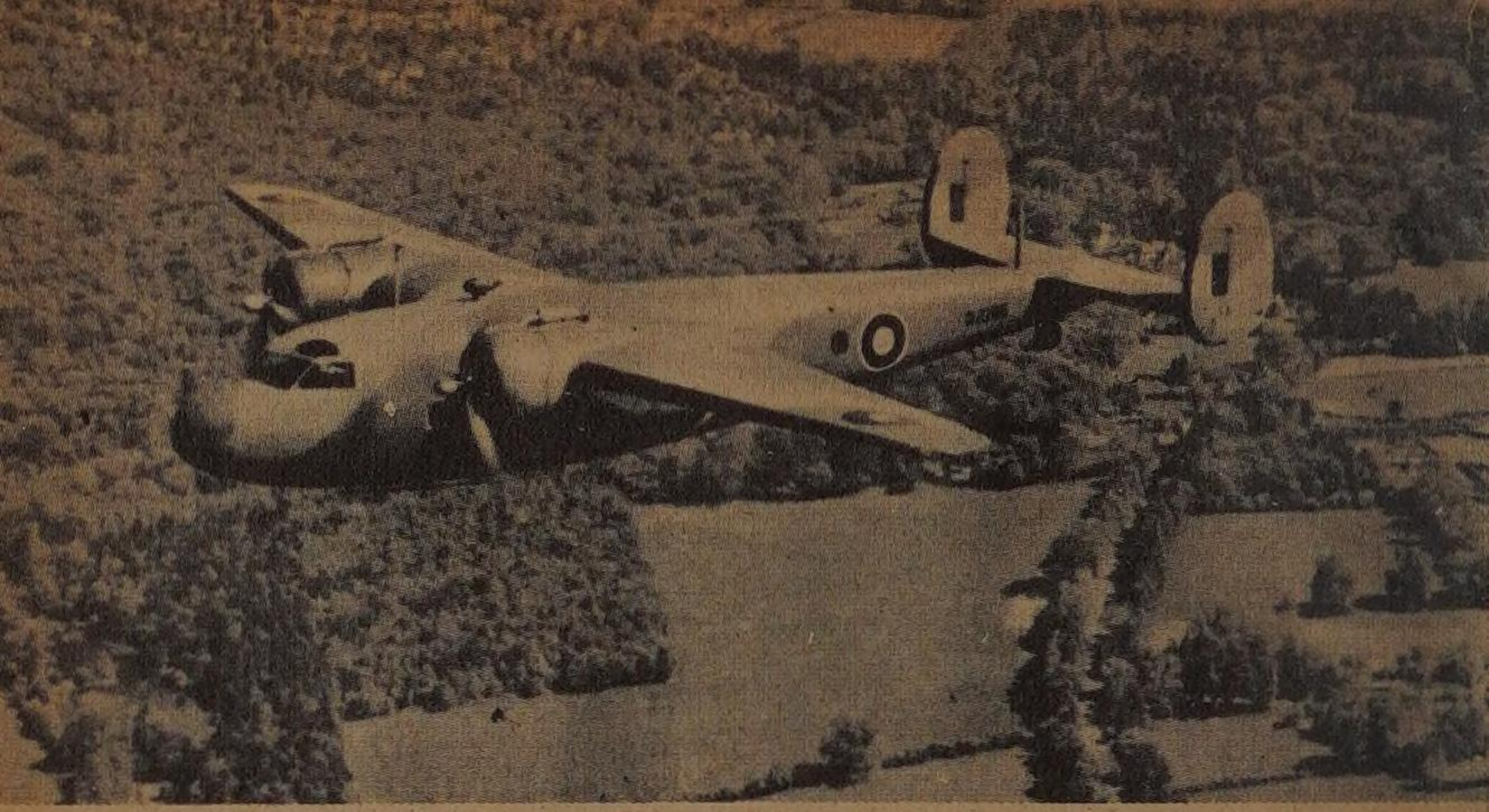
Side view: Long, reptilian nose; glazed cabin near tip; gentle streamlined curve of fuselage from cabin to tail broken by camber of wing; underside streamlined curve to tail; fin and rudder with marked straight taper on leading edge, straight trailing edge, well-rounded top and base.

"ENSIGN" (4 Tiger)
British Civil Plane

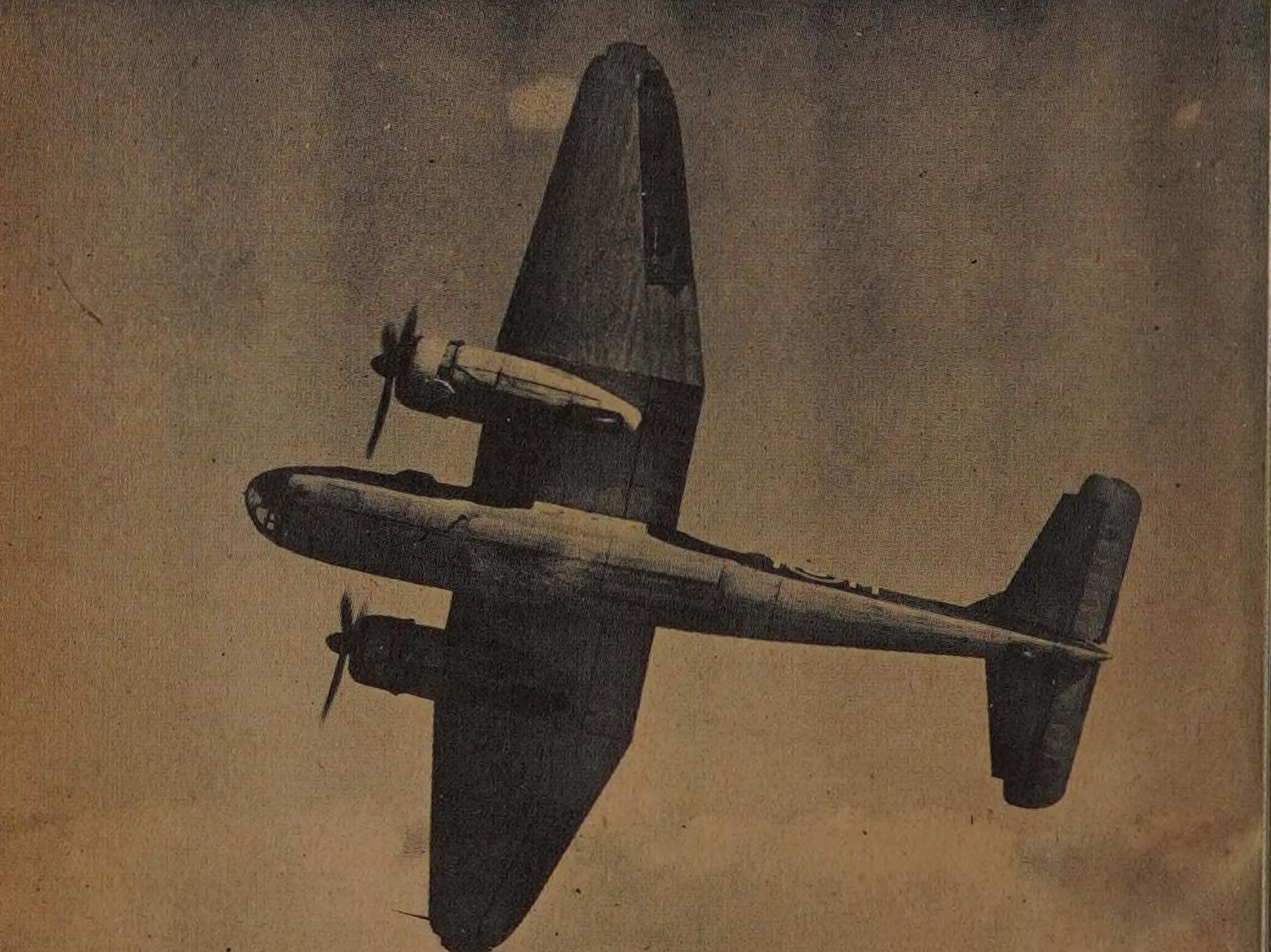
Span 123' 0"

Length 114' 0"

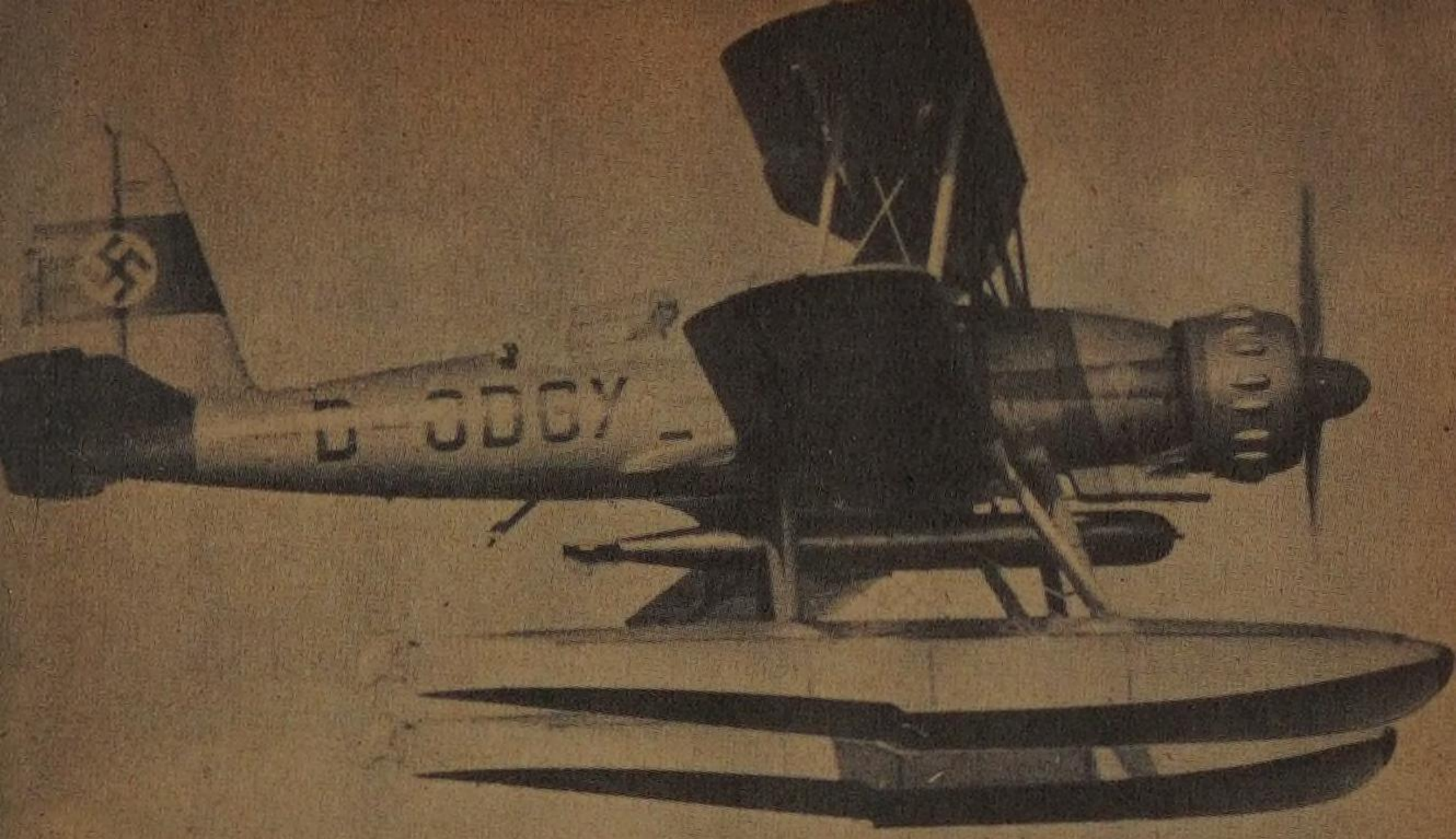
Height 29' 0"



The "Flamingo" is a fast civil air liner. With R.A.F. markings, as above, it's called the "Hertfordshire."



Now an operational trainer, the "Botha" was designed as a reconnaissance bomber and general purpose plane.



Arado 95-See.

CHAPTER XII
FLOAT PLANES AND FLYING BOATS

SUPERMARINE "WALRUS"

The Supermarine Company, designers of Schneider Trophy winners and of the "Spitfire," showed distinct versatility in producing the "Walrus" amphibian flying boat, which is probably the slowest aircraft, excluding initial trainers, operating with the R.A.F. In service in the Fleet Air Arm since 1935, its chief functions are general reconnaissance and submarine spotting, for which high cruising speeds are unnecessary. The retractable wheeled undercarriage which enables these flying boats to operate over land or sea greatly increases their utility. The "Walrus," designed for catapult launching, is the first amphibian to be catapulted with service load. As the "Seagull V," it has been in service with the Royal Australian Air Force for many years. Machine-gun cockpits are provided in the bow and aft of the wings. One 775 h.p. Bristol "Pegasus" radial air-cooled engine provides a maximum speed of 135 m.p.h., cruising speed of 95 m.p.h., and range of 600 miles. (Mk. II.)

Recognition Points

General structural features: Biplane; amphibian flying boat; wings of equal span; single radial engine, driving pusher air-screw; single fin and rudder; braced tailplane; single-step metal hull; fixed wing-tip floats; land undercarriage retracts.

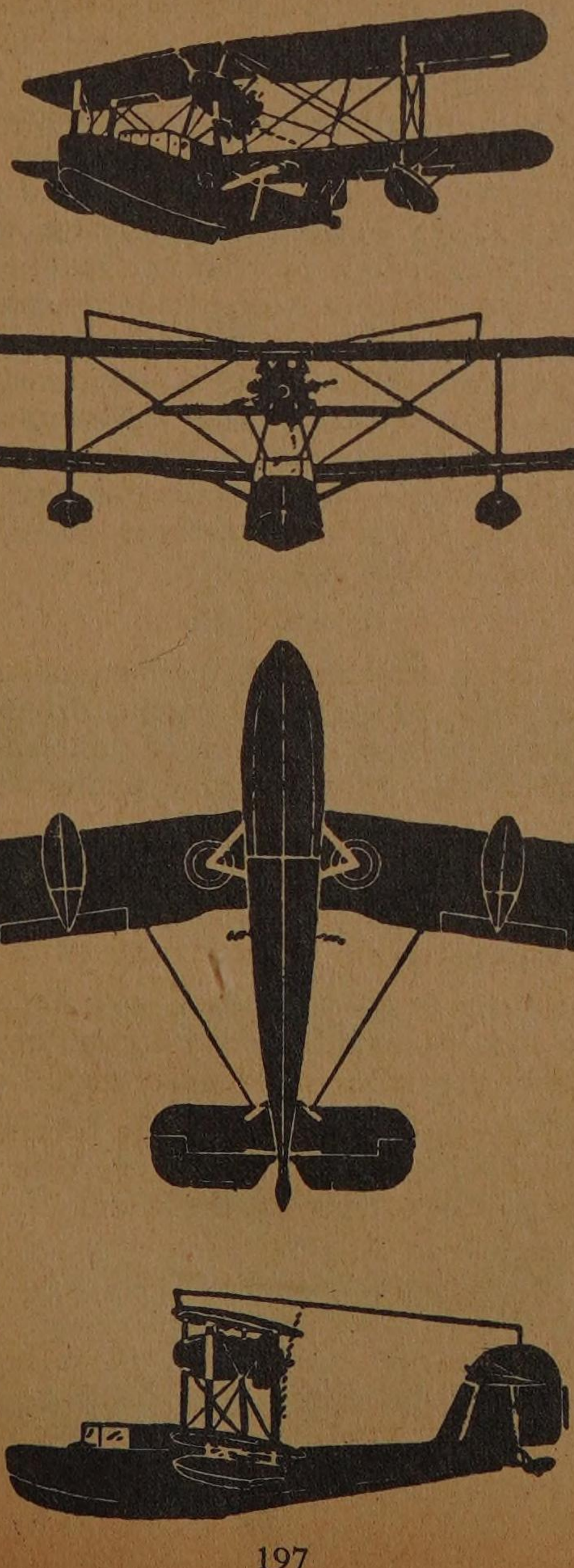
Head-on view: Moderate dihedral in single-bay biplane wings of equal span; uncowled radial engine slung between wings; tailplane visible at base of engine; wheels retract into wells under wings, leaving undercarriage struts visible.

Plan view: Wings are swept back without taper to wide rounded tips, and cut away at center section of trailing edge; braced tailplane of roughly rectangular plan.

Side view: Note pusher air-screw; large fin and rudder with wide rounded top; tailplane mounted near top of fin; uncowled engine is slung between the wings.

"WALRUS" (Pegasus II M2 or VI)
British Reconnaissance Plane

Span 45' 10" Length 38' 0" Height 15' 2"



ARADO 95

Built by the Arado Flugzeugwerke, the Arado 95 Seaplane is carried in German cruisers and is used for spotting, reconnaissance or as a torpedo aircraft. It is specially strengthened to withstand the strain of catapult-launching and, like most shipborne aircraft, its wings fold. Fitted with a single 880 h.p. B.M.W. air-cooled radial engine, the Ar. 95-See has a top speed of 187 m.p.h. and service ceiling of nearly 24,000 ft. Armament: One forward firing fixed gun and a flexibly mounted gun in the observer's cockpit. External bomb racks for six 110 lb. bombs, or a single 1,100 lb. bomb. Alternatively, a 1,760 lb. torpedo may be slung beneath the fuselage. A landplane version, Ar. 95-Land, is similar in general construction but is fitted with a fixed trousered undercarriage. Ar. 196A designed for the same functions as the Ar. 95-See, is a low-wing monoplane with similar fuselage and tail unit. The fluted cowling of the 920 h.p. Bramo Fafnir radial engine fitted to Ar. 196B resembles that of Ar. 95. Ar 196B is a single-float version.

Recognition Points

General structural features: Single-bay staggered biplane; float seaplane; single radial engine; single fin and rudder; long, fixed twin floats; characteristic tail unit.

Head-on view: Circular fuselage; small airscoop below lower wing; equal-span wings; lower wing has thick tapered center section and slight dihedral on outer sections (slight inverted gull-wing); N-struts carry floats.

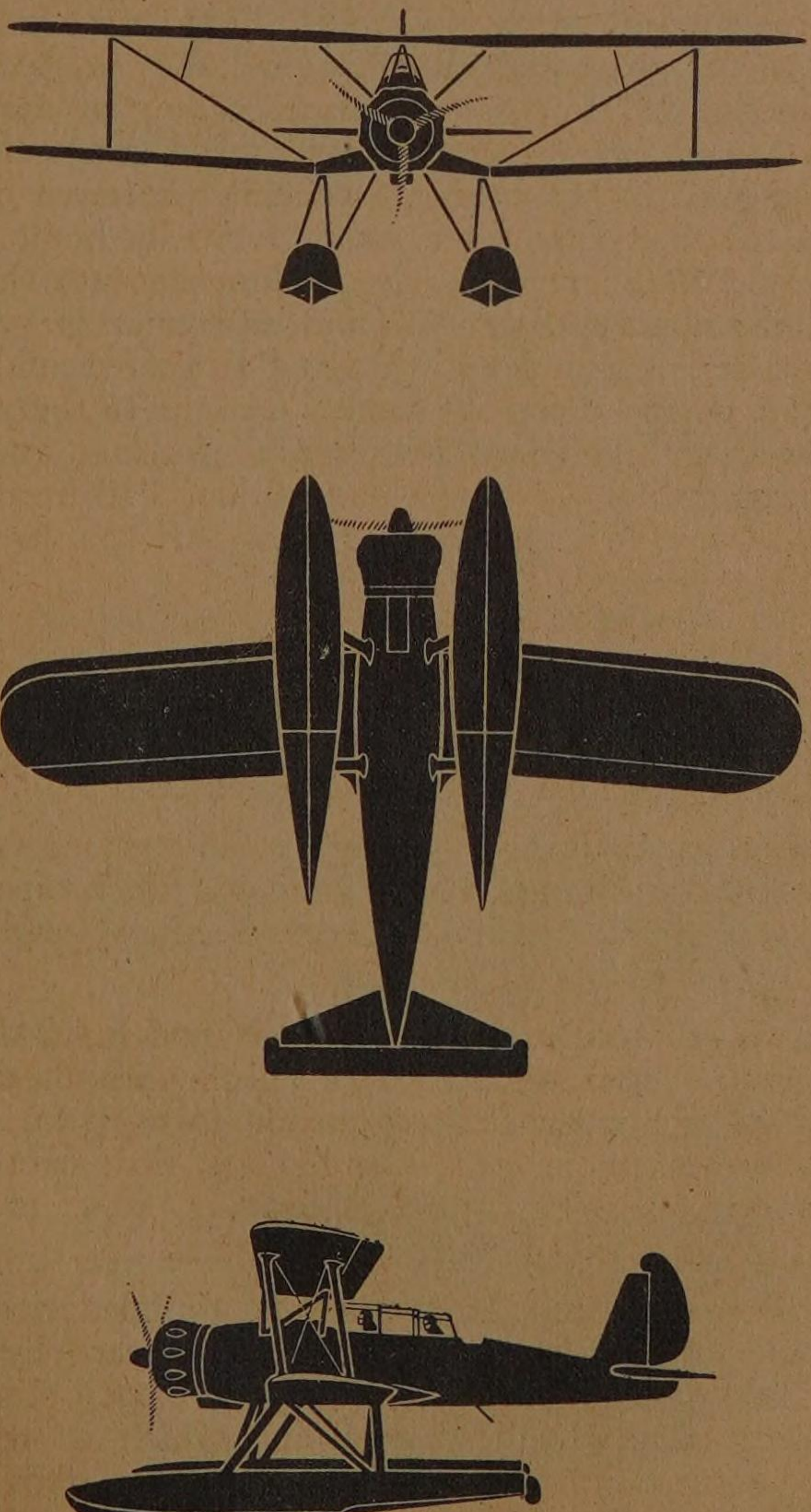
Plan view: Medium length dolly-shaped nose, dwarfed by floats; wings have moderate sweepback without taper, wide duo-curved tips; long floats protrude forward and aft; fuselage in streamline curve to slender tail; float-struts just visible; marked straight taper on leading edge of tailplane; straight trailing edge; narrow square-cut tips.

Side view: Medium length, blunt, rounded nose; streamlined curve of fuselage to tail broken forward by small airscoop and by float struts; long, stepped floats; straight taper on leading edge of tall, narrow fin, which is stepped near rounded top; rounded trailing edge cut away above elevator, which projects aft.

ARADO 95

German Torpedo-Bomber and Scout Seaplane

Span 41' 0" Length 36' 4" Height 17' 0"



FAIREY "SEAFOX"

One of the older operational types of the British Fleet Air Arm, the Fairey "Seafox," like its famous relative the "Swordfish," has seen many years of service. Specially designed to be carried in cruisers, the "Seafox" is used as a general scout and as a gunnery spotter. It is launched by catapult from the cruiser's deck and lifted inboard at the end of a flight. A "Seafox" launched in this manner from H.M.S. "Ajax" played a useful part in the River Plate battle which resulted in the destruction by scuttling of the battleship "Graf von Spee." A distinctive feature of this seaplane is the 395 h.p. Napier Rapier engine—a 16 cylinder H type in-line air-cooled motor with cowling of unusual shape. Performance figures are: Top speed 124 m.p.h., cruising speed 106 m.p.h., range 440 miles and service ceiling 11,000 ft. Armament: A flexibly mounted machine-gun in observer's cockpit.

Recognition Points

General structural features: Two-bay biplane; float seaplane; single in-line engine; deep narrow fuselage; numerous wing and float-struts; single fin and rudder; fixed twin floats.

Head-on view: Roughly oval fuselage section, surmounted by glazed cockpit; equal span wings with very short straight center section, slight dihedral outboard; braced struts beneath short center section carrying floats; fairly high, long tailplane; tall fin and rudder visible above wings.

Plan view: Nose tapers to blunt tip; floats protrude forward of nose; wings show slight sweepback without taper, cut-away in center section; wing tips appear square; float struts visible; almost rectangular tailplane with large cut-away.

Side view: Short, deep square-cut nose; streamlined curve of fuselage to tail broken by light float-struts; long, stepped floats; tall fin and rudder with nearly straight taper on leading edge, straight trailing edge with wide rounded top; round base carried lower than fuselage.

"SEAFOX" (Rapier)

British Fleet Spotter, Reconnaissance Plane

Span 40' 0" Length 33' 5½" Height 12' 1"

HEINKEL 115

Shortly before the war this type of high-performance float-seaplane established several international records, including a flight of 1,242 miles at an average speed of 204 m.p.h. with load of nearly two tons. This performance is of special interest in view of the Heinkel's present activities, which include torpedo carrying and mine laying. The He 115 has also been reported in action as a troop carrier. The design is developed from and broadly resembles that of the long range bomber Heinkel 111K. The power plant, consisting of two 880 h.p. B.M.W. radial air-cooled engines, gives a maximum speed of 220 m.p.h., cruising speed of 183 m.p.h. and range of 1,300 miles.

Recognition Points

General structural features: Mid-wing monoplane; float seaplane; two radial engines; single fin and rudder; long slender fuselage; fixed twin floats.

Head-on view: Fuselage of oval section, surmounted by "greenhouse"; radial engines mounted somewhat above their center lines; wings with moderate dihedral; high braced tailplane visible; float undercarriage.

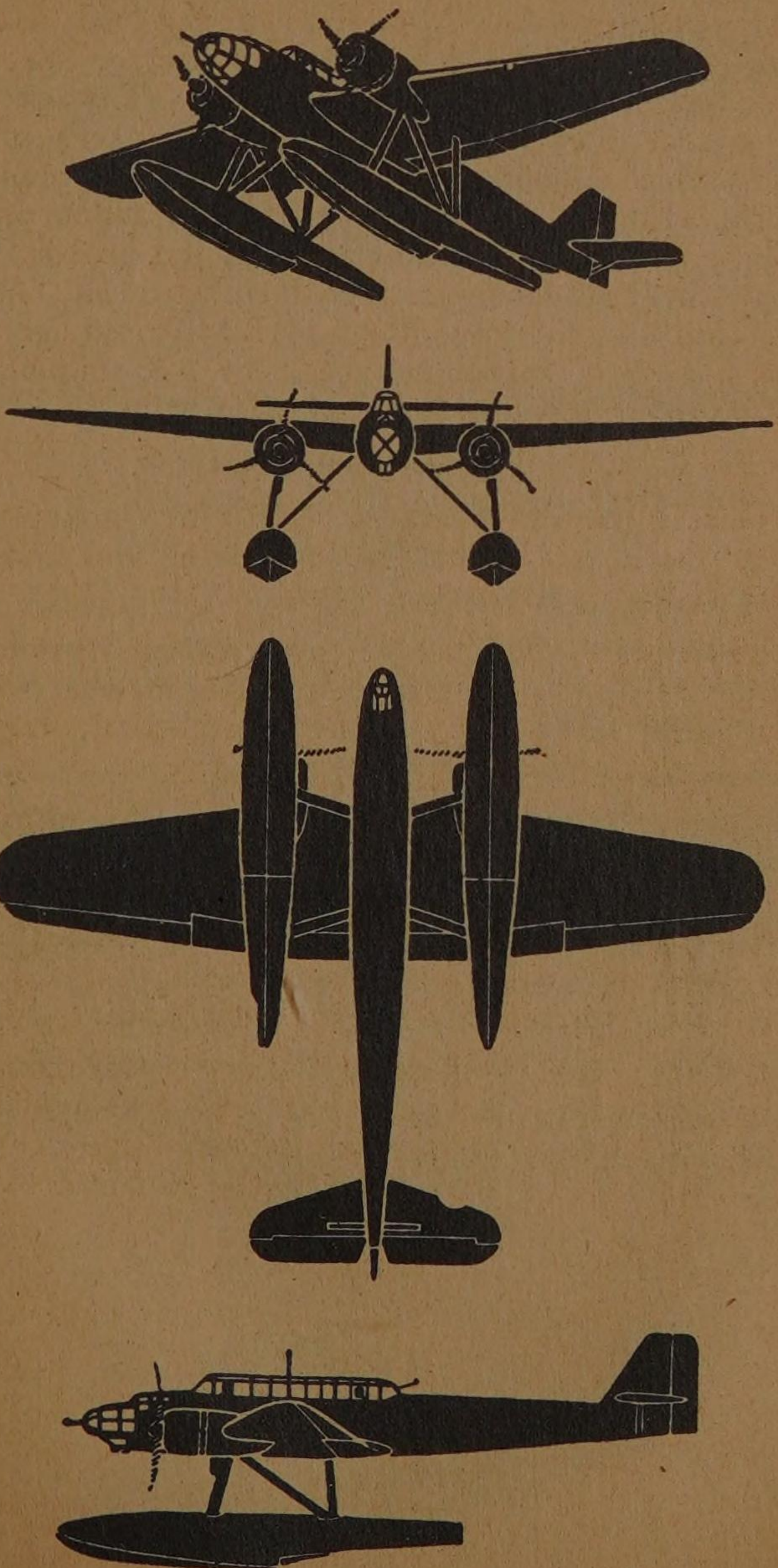
Plan view: Taper of wings is more marked on leading edge, outboard of engines; wings not unlike those of He 111 Mk. V without the "bite" out of the trailing edge; floats project forward of glazed nose; slender streamline fuselage resembles the long-nose version of He 111K; tailplane, with rounded tips, tapered on leading edge.

Side view: Glazed nose and large "greenhouse"; very angular fin with square-cut top and rectangular rudder; slender "N" struts of the float undercarriage contrast with wide tubular undercarriage legs of the Blohm & Voss floatplanes.

HEINKEL 115 (2 B.M.W.)

German Torpedo-Bomber Reconnaissance Plane

Span 73' 0" Length 56' 8"



SARO "LONDON"

Built by Saunders-Roe, of Cowes, coastal patrols of these twin-engine general purpose flying boats have been a familiar sight for several years. They have given excellent service in the R.A.F., five of them completing what is probably the longest formation flight yet attempted. Leaving Plymouth in December 1937, the formation flew to New South Wales, cruised round Australia and returned to Plymouth at the end of May, 1938, having completed a flight of over 30,000 miles. Gun positions are in the nose, amidships, and in the tail. A hinged door in the nose provides bomb-aiming position. Power plant (Mk II) consists of two 1,000 h.p. Bristol "Pegasus X" radial air-cooled engines, giving a maximum speed of 155 m.p.h., cruising speed of 137 m.p.h., economical cruising speed of 109 m.p.h. and range exceeding 1,700 miles.

Recognition Points

General structural features: Biplane; flying boat; wings of unequal span and chord; two radial engines mounted under the upper wing; twin fins and rudders; two-step metal hull; fixed wing-tip floats.

Head-on view: Unequal span of wings very marked; slight dihedral on wings; interplane struts in "W" form inboard of engines; underslung radial engines attached to upper wing.

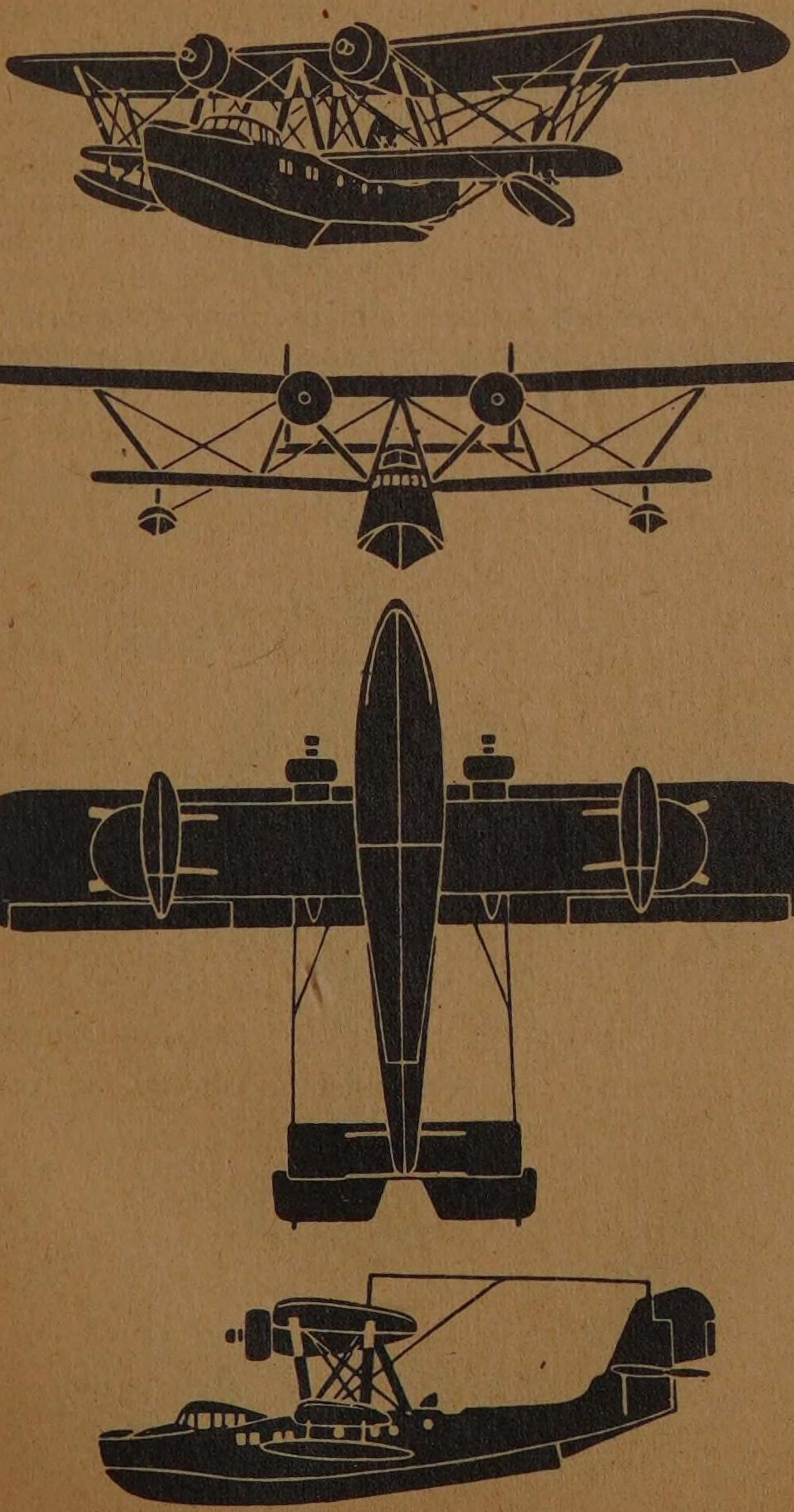
Plan view: Straight wings, of smaller span than the "Stranraer"; lower wing has shorter chord than upper wing; braced tail is square-cut with "stepped" appearance.

Side view: Note "humped" appearance of forward control cabin; wide rounded rudder overhangs the stern.

Note: Silhouettes of this machine should be compared carefully with those of the "Stranraer."

"LONDON" I (2 Pegasus III)
British Reconnaissance Plane

Span 80' 0" Length 56' 9½" Height 22' 0"



SARO "LERWICK"

Successor to the "London" biplane flying-boat, built at Cowes by the well-known marine designers, Saunders Roe Ltd., the "Lerwick" is a monoplane flying-boat not unlike a twin-engined version of the Short "Sunderland." Two Bristol Hercules double-row radial engines of 1,375 h.p. provide the power plant. Performance figures are not released. Armed with three power-operated gun turrets, it possesses considerable power of attack or defence.

Recognition Points

General structural features: High-wing monoplane; flying-boat; two radial engines; tall single fin and rudder; deep double-deck hull with clearly defined "step" about midway; fixed wing floats.

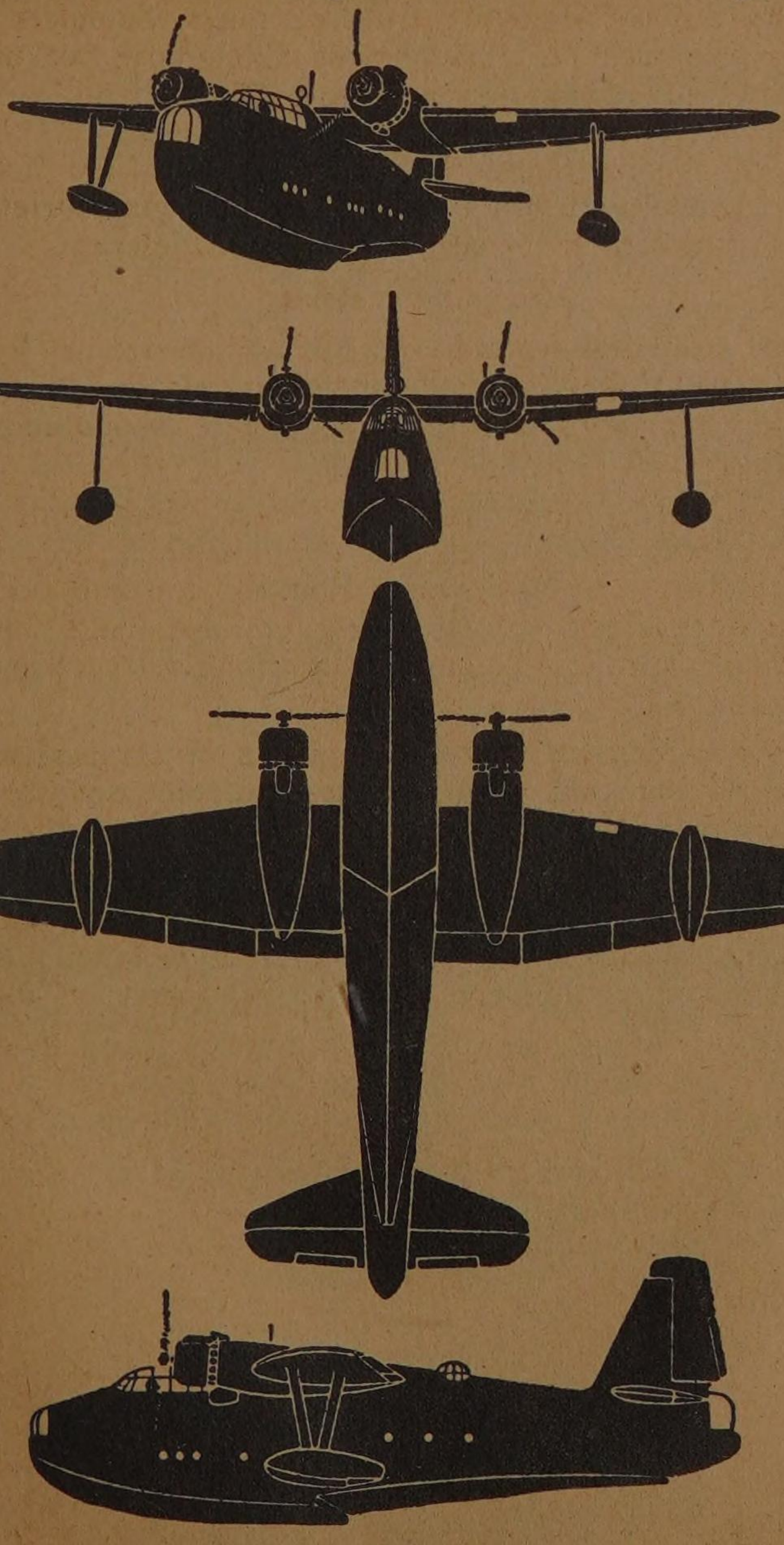
Head-on view: Two engines clearly distinguish the "Lerwick" from the four-engined "Sunderland"; somewhat conical section of the hull, narrow at the top and deep at the base, in contrast to the nearly uniform width of the "Sunderland"; cantilever mounting of wing-floats; tall prominent fin and rudder.

Plan view: Nose projects well forward of engines; wings taper sharply outboard of engines to semi-pointed tips; taper more marked on leading edge of tailplane, with curved tips.

Side view: The following points distinguish "Lerwick" from "Sunderland"; square-cut top of large fin and rudder; "bite" below rudder where the tail turret is mounted ("Sunderland" turret projects aft of tail); gun-turret on top of fuselage.

"LERWICK" (2 Bristol Hercules)
British General Purposes Flying Boat

Span 80' 10" Length 63' 7½" Height 23' 5"



SUPERMARINE "STRANRAER"

This twin-engine general purpose flying boat is built by the Supermarine Company whose famous high-speed sea-planes distinguished themselves by winning the Schneider Trophy outright for Britain. From the successful Schneider Trophy machine the brilliant "Spitfire" design was developed. The "Stranraer" biplane flying boat does not aspire to "Spitfire" performance, but has several years of R.A.F. patrol and general reconnaissance work to its credit. Like the "London," the "Stranraer" has a machine-gun position and bomb-aiming post in the nose, a machine-gun position amid-ships and a third gun position in the tail.

The power plant also is similar to that of the Saro "London II"—two 1,000 h.p. Bristol "Pegasus X" radial air-cooled engines—but the top speed, 165 m.p.h., is slightly faster. On the other hand, the cruising range is only 1,000 miles compared with 1,700 miles of the "London II."

Recognition Points

General structural features: Biplane; flying boat; back-wings of unequal span with rounded tips and slight dihedral; two radial engines mounted under the upper wings; twin fins and rudders; two-step metal hull; fixed wing-tip floats. In view of the similarity of design, these notes should be read with those relating to the Saro "London."

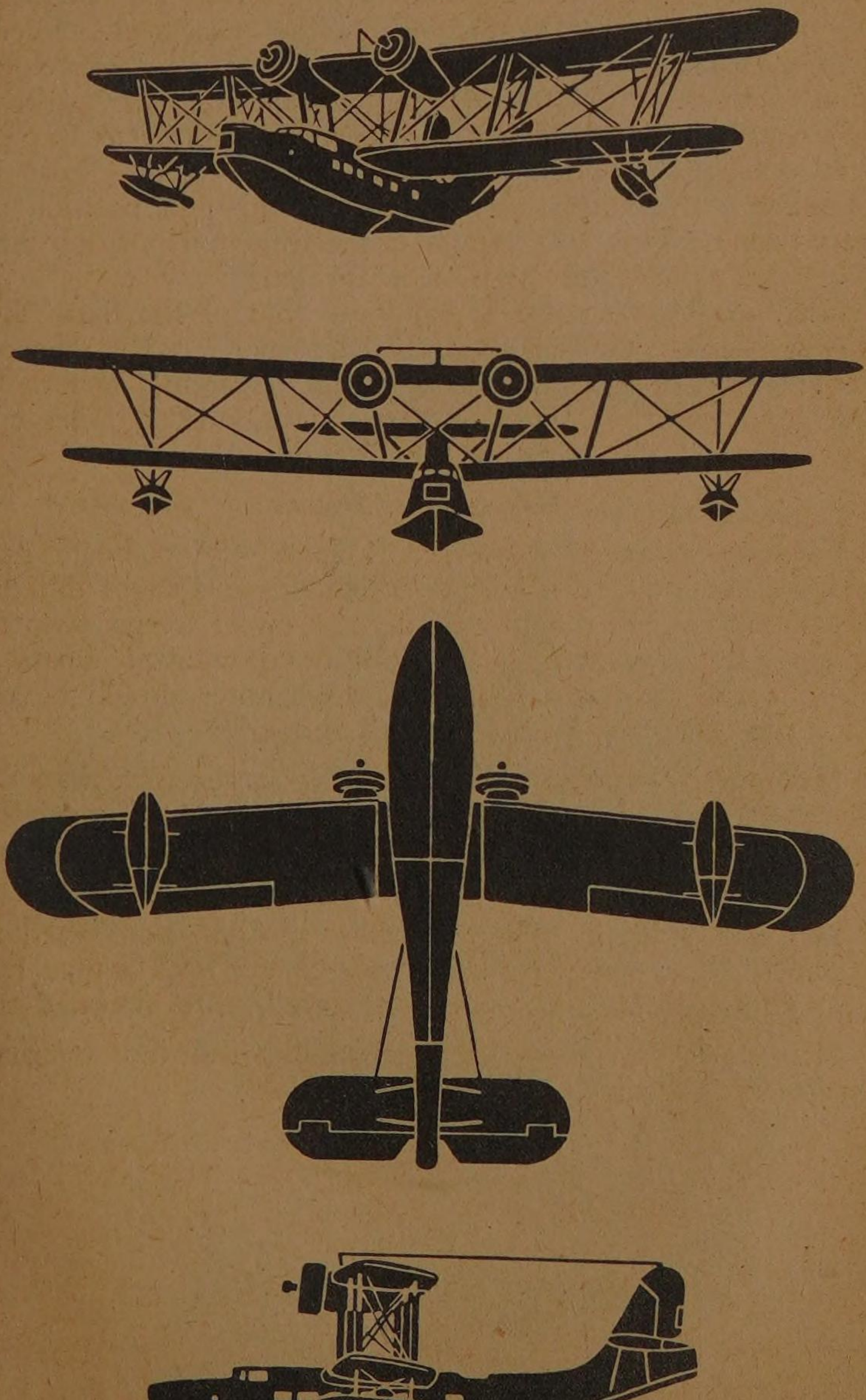
Head-on view: Wings of appreciably larger span than Saro "London"; lower wing of only slightly shorter span than upper wing; simpler arrangement of interplane struts; sides of hull are curved.

Plan view: Wings, longer and of smaller chord than the "London," are swept back without taper; both wings have equal chord; braced tailplane, untapered, with rounded tips.

Side view: Tall narrow fins and rudders do not overhang the stern, in contrast to Saro "London."

"STRANRAER" (2 Pegasus)
British Reconnaissance Flying Boat

Span 85' 0" Length 54' 6" Height 23' 3"



BLOHM & VOSS Ha 140

Designed on more orthodox lines than its predecessor, the Blohm & Voss Ha 140 twin-engine float seaplane retains several features which characterised Ha 139, notably the wide tubular undercarriage legs and the twin tail unit mounted clear of the fuselage on a central stub fin. Essentially a military type, it may be used for reconnaissance, bombing or as a torpedo plane. The glazed bomb-aiming nose is fitted with a small shell-gun; immediately above is a machine-gun turret, and additional gun positions are above and below the fuselage aft of the wings. The power plant, consisting of two 880 h.p. B.M.W. radial air-cooled engines, gives a top speed of just under 200 m.p.h., cruising speed 183 m.p.h., normal cruising range at 160 m.p.h., 715 miles, and maximum range 1,550 miles.

Recognition Points

General structural features: Mid-wing monoplane with fixed twin floats; twin radial engines; twin fins and rudders; braced tailplane; streamlined fuselage slab-sided forward, with glazed nose.

Head-on view: Wings with full dihedral outboard of engines; deep, roughly oval fuselage; engines mounted centrally over wide vertical tubular undercarriage legs (compare with He 115, in which engines are slightly inboard of slender strutted floats); braced tailplane mounted high; twin fins and rudders visible just outboard of engines.

Plan view: Wings taper outboard of engines; low aspect ratio (long chord relative to span); floats project just beyond glazed nose; slender fuselage; rectangular tailplane.

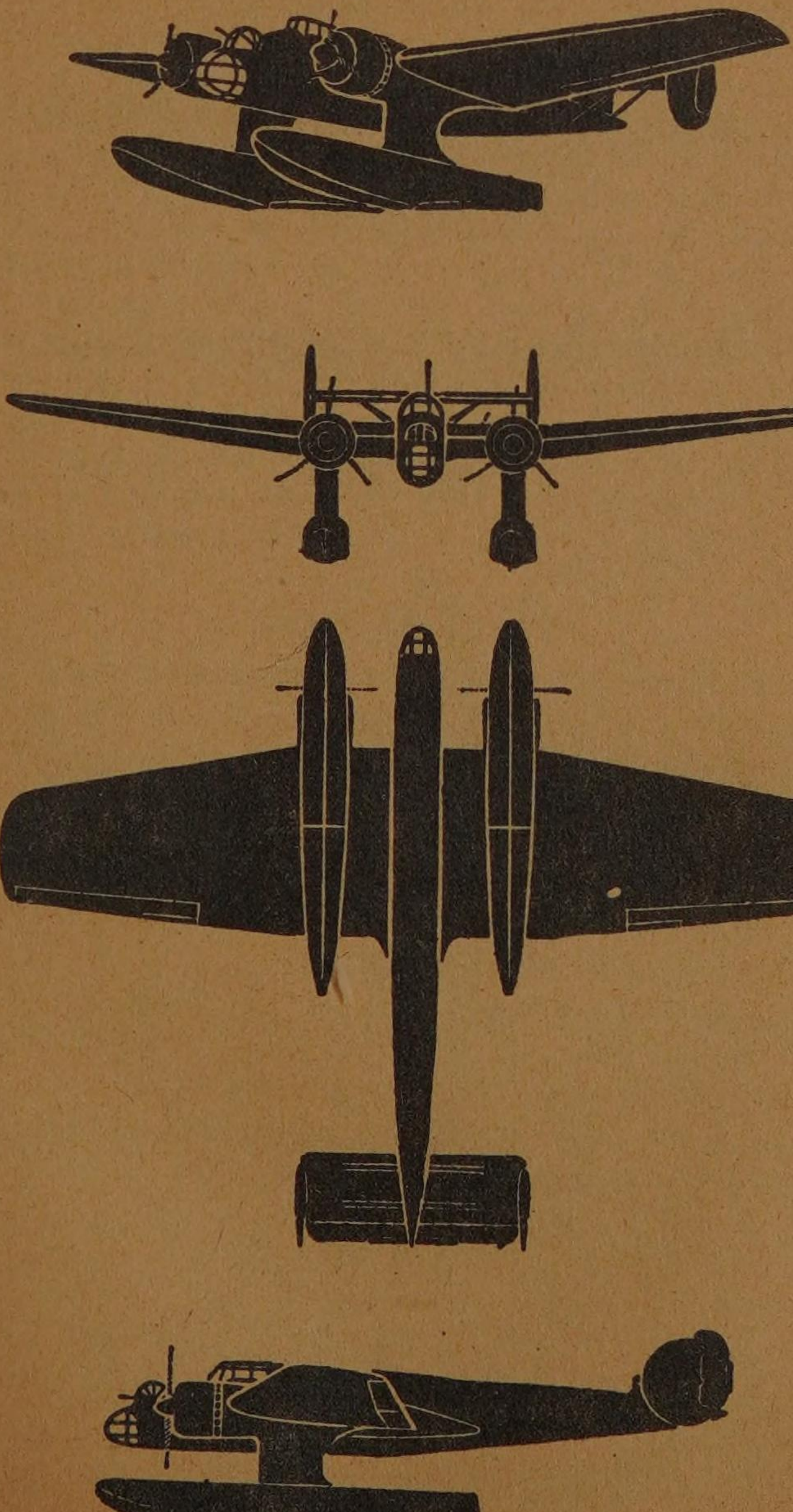
Side view: Note gun cupola immediately above glazed nose; fins and rudders almost circular; fuselage does not project aft as in Ha 139.

BLOHM & VOSS Ha 140 (2 B.M.W.)

German Reconnaissance Seaplane

Span 69' 0"

Length 57' 9"



DORNIER 18

Less widely known than its immediate predecessor Do 17, or "Flying Pencil," the Do 18 twin-engine flying boat has an excellent record in civil aviation. Built by the firm which produced the world's largest flying boat, the twelve-engined giant Do X, the Do 18 was developed from the successful Dornier "Wal" flying boats, which first operated a regular South Atlantic mail serivce. Like the "Wal," the Do 18 flying boats are designed for catapult launching. In 1936 a Do 18 made the first crossing of the North Atlantic by regular passenger flying boat. After refuelling at the Azores it was catapult-launched from the mother ship **Schwabenland,** continuing non-stop to New York. Do 18 K, the military version, has earned ill-fame by attacking unarmed lightships and fishing boats. Fitted with two Junkers 500/560 h.p. "Jumo" 205 water-cooled Diesel engines, mounted in tandem, the maximum speed is 155 m.p.h., cruising speed 136 m.p.h., and range 3,600 miles.

Recognition Points

General structural features: High-wing monoplane; flying boat; two in-line engines mounted in tandem above wings; single fin and rudder; braced tailplane; long slender two-step metal hull, with sponsons.

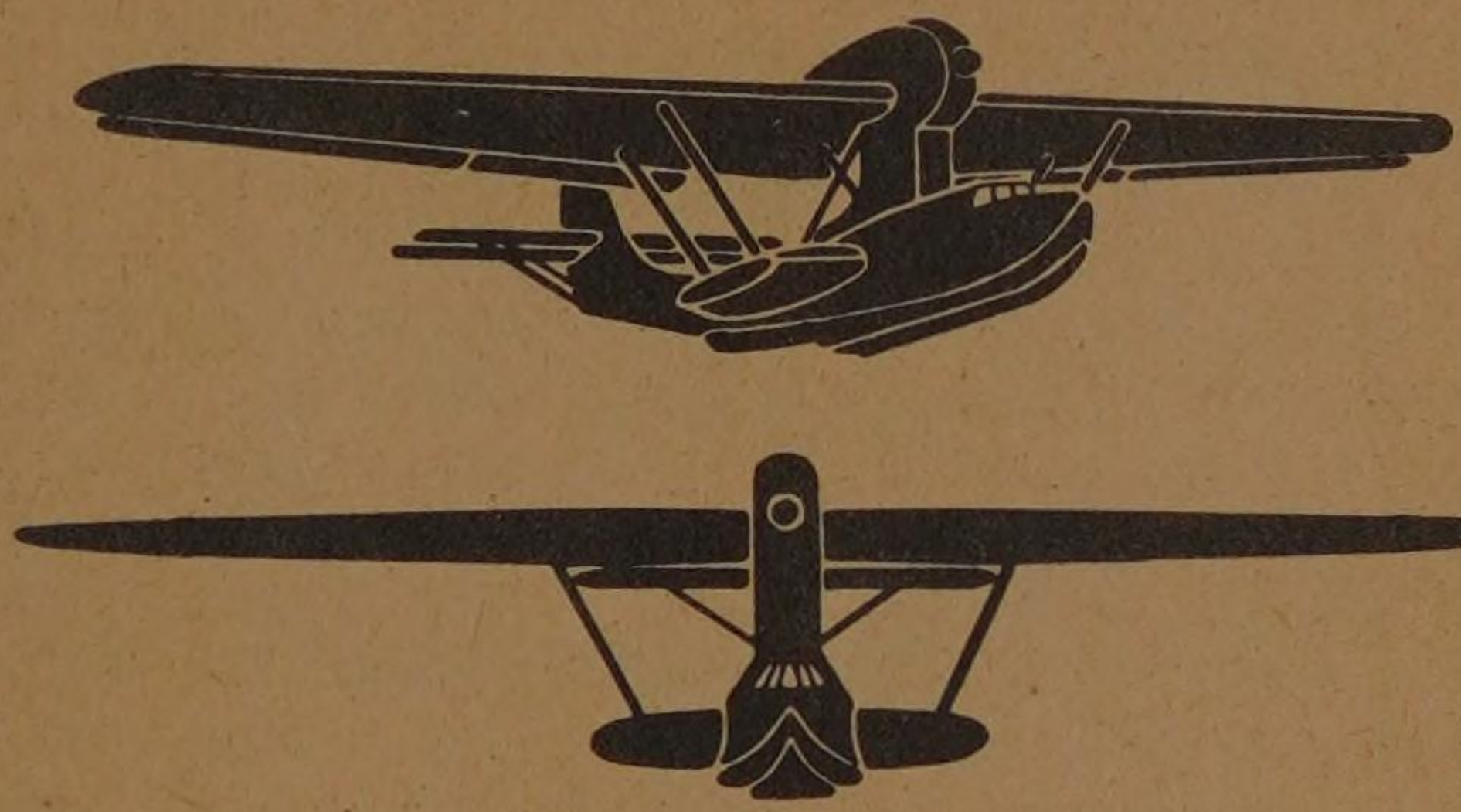
Head-on view: Tandem engines viewed head-on resemble single engine; no dihedral in wings; lateral sponson—or stub wings—built-into hull serve as stabilizers in place of wing floats; braced wings and tailplane.

Plan view: Slender hull; uniformly tapered wings of large chord; rounded wing tips resemble those of Do 17 and 215 bombers; note unusual design of tail unit.

Side view: Tandem engines very distinctive in appearance; long, slender two-step metal hull.

DORNIER 18 (2-Jumo 205)
German Reconnaissance or Bomber

Span 77' 8" Length 63' 2" Height 17' 9"



DORNIER 24

Built by the Dornier-Werke of Friedrichshafen, the Do 24, with slender metal hull fitted with sponsons in place of wing floats, shows a strong family likeness to the Do "Wal" and Do 18 flying boats which in peace time maintained a regular service across the South Atlantic. The design provides for a power plant consisting of three radial air-cooled engines, each developing about 700/900 h.p. A number of Do 24 flying boats supplied to the Netherlands Government were fitted with Wright Cyclone engines, giving a maximum speed of 211 m.p.h. and a cruising range exceeding 2,000 miles. Those operating with the Luftwaffe are equipped with 880 h.p. BMW, or Bramo "Fafnir" radial engines, developing about 1,000 h.p. Two rotatable gun-turrets can be seen in the lower drawing, one in the nose and another amidships. A third is fitted in the tail. The first Do 24 to be officially reported over England was shot down by A.A. in August, 1940.

Recognition Points

General structural features: High-wing monoplane; flying boat; three radial engines; twin fins and rudders; two-step metal hull with sponsons (stub wings).

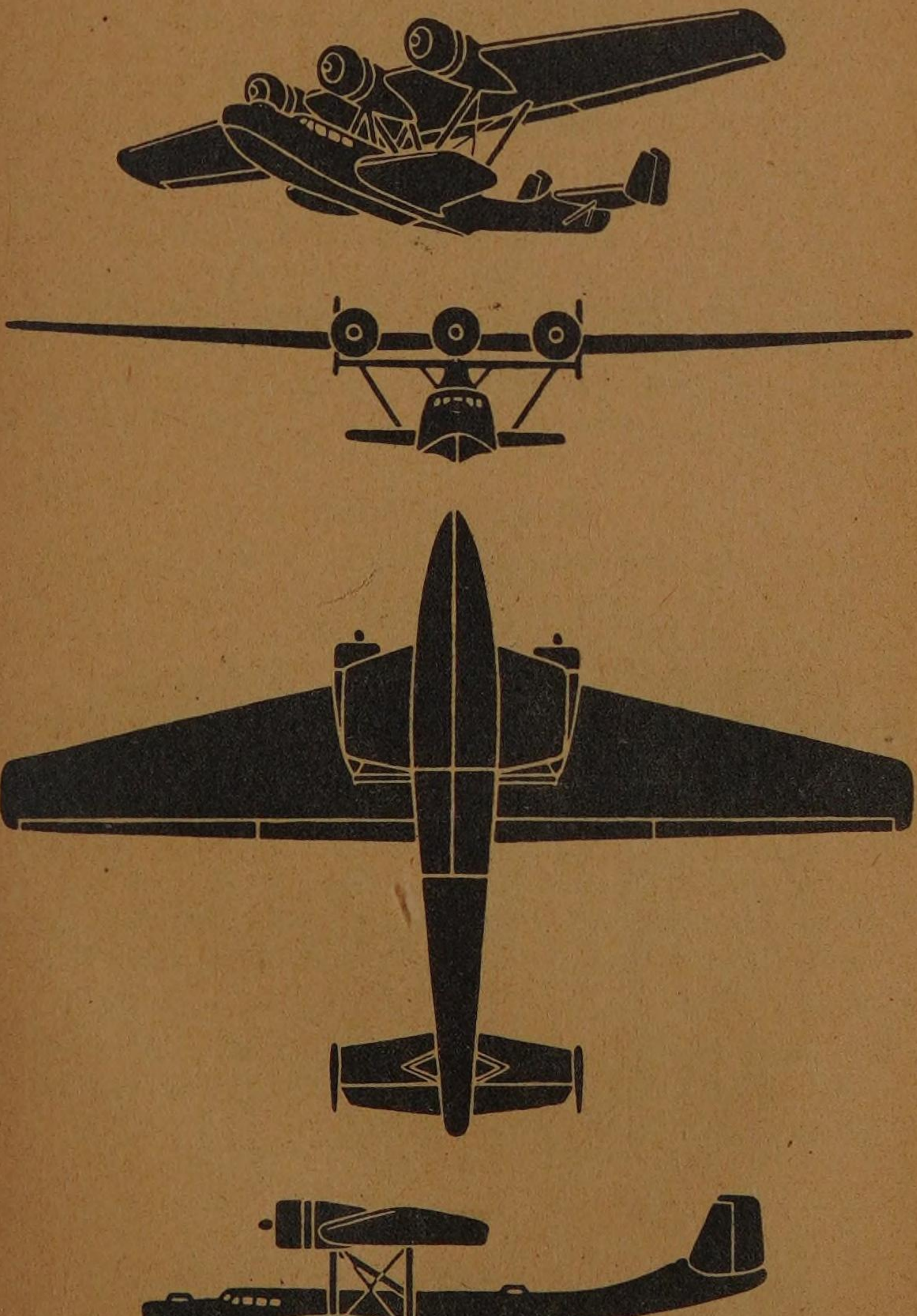
Head-on view: Large-span wings, supported centrally by inverted V struts, braced to lateral sponsons; very slight dihedral on outer sections; three radial engines mounted slightly below their centers; braced tailplane visible; twin fins and rudders scarcely visible outboard of engines.

Plan view: Center-section of wing is rectangular, outer sections are tapered on leading edge only; square-cut tips; stern projects aft of tapered tailplane.

Side view: Distinctive braced tail unit carried high on slender streamline stern; angular fins and rudders resemble those of the Do 17 and 215; glazed turrets in nose, tail and amidships.

DORNIER 24
German Reconnaissance Plane

Span 88' 7" Length 72' 0" Height 18' 10"



BLOHM & VOSS Ha 138

Blohm & Voss, well-known German shipbuilders, entered the aircraft industry several years ago, and through their subsidiary company, the Hamburger Flugzeugbau, are responsible for at least four interesting types now in service with the Luftwaffe. These are the Ha 138, 139, 140 and 142, the abbreviation "Ha" indicating the constructing company. Ha 138 is a three-engine flying boat of unusual type with single-step metal hull, the stern of which is cut off short, whilst the tail unit is carried high on two long booms. With power plant consisting of three 600 h.p. Junkers "Jumo" Diesel engines, the maximum speed is 171 m.p.h., and normal range at cruising speed of 146 m.p.h. about 1,500 miles. The gun turret near the nose is retractable. Two additional turrets, one at the end of the central engine nacelle and another in the stern, respectively command fields of fire above and below the tail boom.

Recognition Points

General structural features: High-wing monoplane; flying boat; three in-line engines; twin fins and rudders mounted on twin booms; short metal single-step hull with nose and stern turrets; fixed wing floats.

Head-on view: Wings with moderate dihedral from roots; central engine mounted high over center section of wings; tailplane visible; braced fixed floats near wing tips.

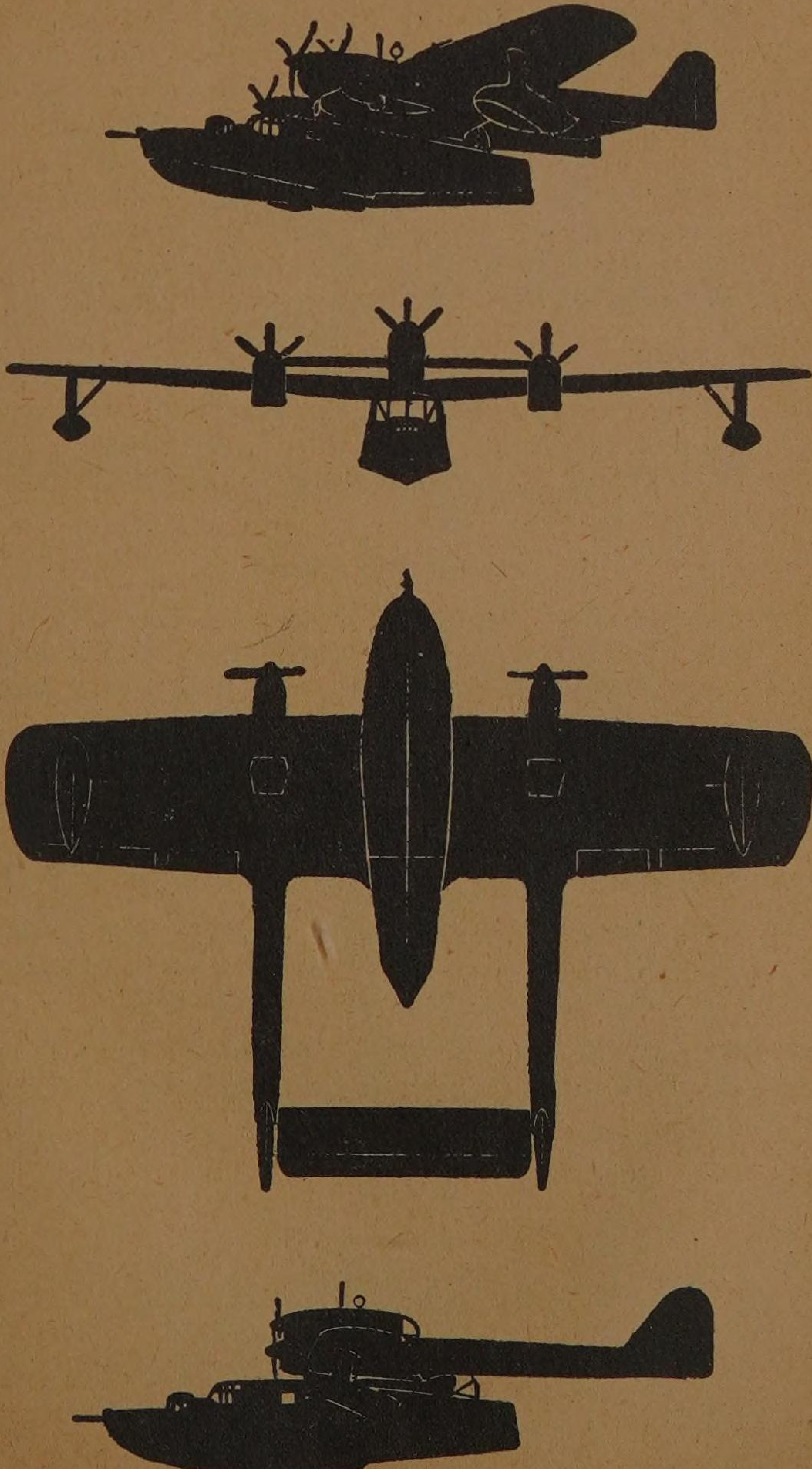
Plan view: Moderately tapered wings with long chord and wide rounded tips; twin booms carrying the tail unit are faired into the outboard engine nacelles, of which they appear to be extensions; rectangular tailplane; hull projects well ahead of engines.

Side view: Short metal single step hull with nose and stern turrets; twin fins and rudders are carried high and well aft of the stern.

BLOHM & VOSS Ha 138 (3-Jumo)
German Reconnaissance Plane

Span 88' 7"

Length 65' 4"



BLOHM & VOSS Ha 139

Built by the Hamburg subsidiary of the well-known German shipbuilders, the Ha 139, four-engine float seaplane, is no less original in design than the 138. The unusually long, slender fuselage, inverted "gull-wings" and short squat legs give this seaplane a peculiarly reptilian appearance.

Like the Dornier flying boats, the civil versions were built for the Lufthansa North and South Atlantic services, and are designed for catapult launching. Before the outbreak of war Ha 139 seaplanes operating these services had completed considerably more than one hundred Atlantic crossings.

A recent type, 139 B, is fitted with four 600 h.p. Junkers "Jumo" Diesel engines, giving a top speed of just over 200 m.p.h., cruising speed of 167 m.p.h. and cruising range of over 3,000 miles. An interesting development is the landplane version, Ha 142.

Recognition Points

General structural features: Low-wing monoplane with fixed twin floats: inverted gull wings; four in-line engines; twin fins and rudders on braced tailplane; streamlined fuselage.

Head-on view: Inverted "gull-wings"; four in-line engines mounted high on the wing; short, squat tubular undercarriage legs; circular fuselage section; braced tailplane mounted clear of the fuselage on short central stub fin; fins and rudders mounted at tips.

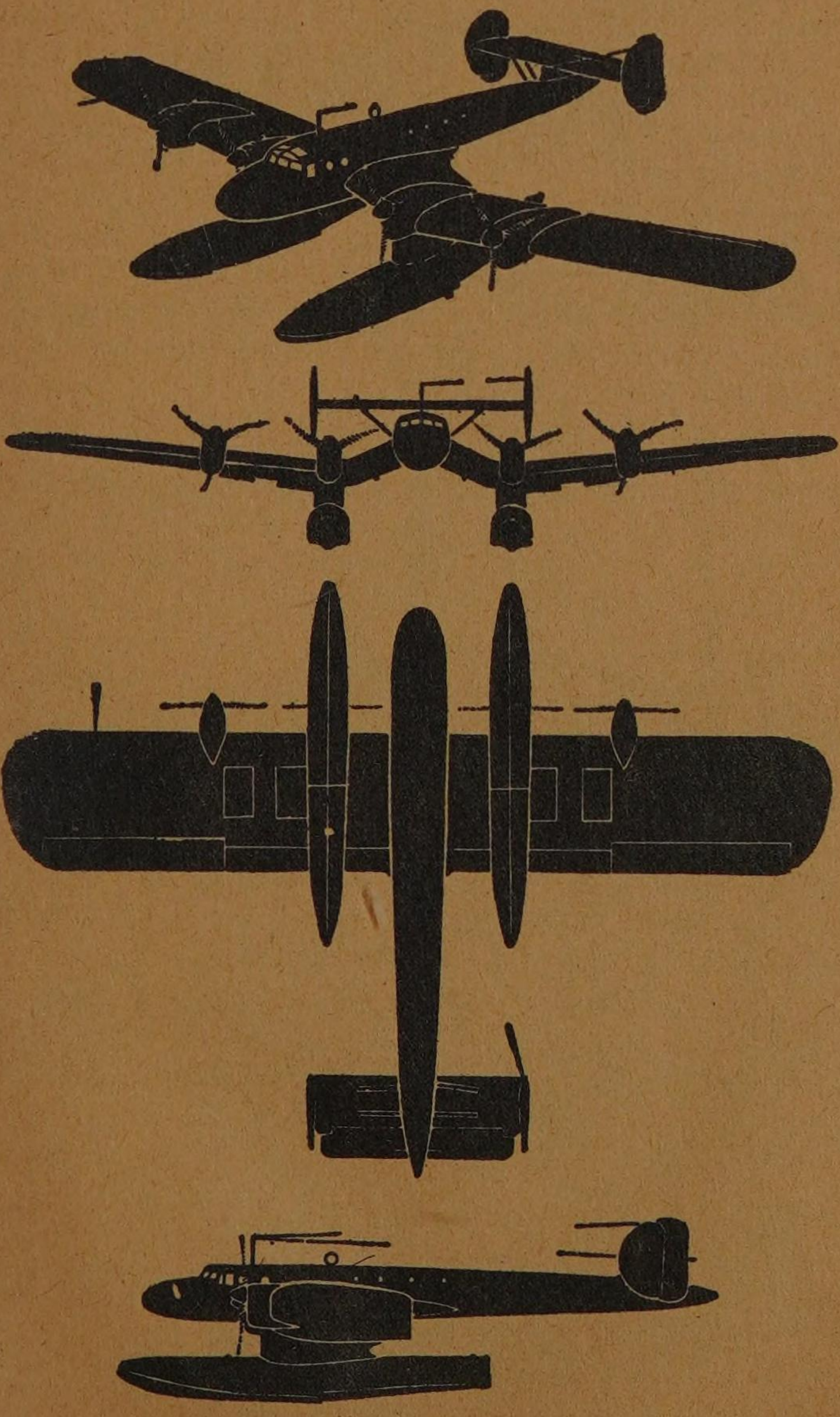
Plan view: Wings untapered, with rounded tips; floats project forward of nose; streamline fuselage tapers to point aft of elevator; untapered tailplane with square tips.

Side view: Twin fins and rudders of distinctive shape; great width of undercarriage legs due to streamlined fairings or "trousers."

BLOHM & VOSS Ha 139 (4-Jumo 205)

German Communication and Troop Transport

Span 80' 7" **Length 64' 0"** **Height 14' 7"**



DORNIER 26

Do 26 is not fitted with the lateral sponsons which are characteristic features of the Do "Wal," Do 18 and 24, but has retractable wing floats. These fold into the underside of the wing during flight. The four 600 h.p. Junkers "Jumo" water-cooled Diesel engines are arranged in tandem pairs. During take-off, the two aft engines are tilted through 10° so that the propellers are lifted clear of spray. In spite of the fully-loaded weight of twenty tons, Do 26 flying boats, like their predecessors, are designed for catapult launching. They operated the Lufthansa North Atlantic mail service, using the catapult ship **Friesland** as a base. Top speed is 208 m.p.h., cruising speed 193 m.p.h., and maximum range, at 130 m.p.h., 5,600 miles.

Recognition Points

General structural features: High-wing monoplane; flying boat; gull wings; four in-line engines mounted in tandem pairs; single fin and rudder; braced tailplane; two step metal hull; retractable wing-floats.

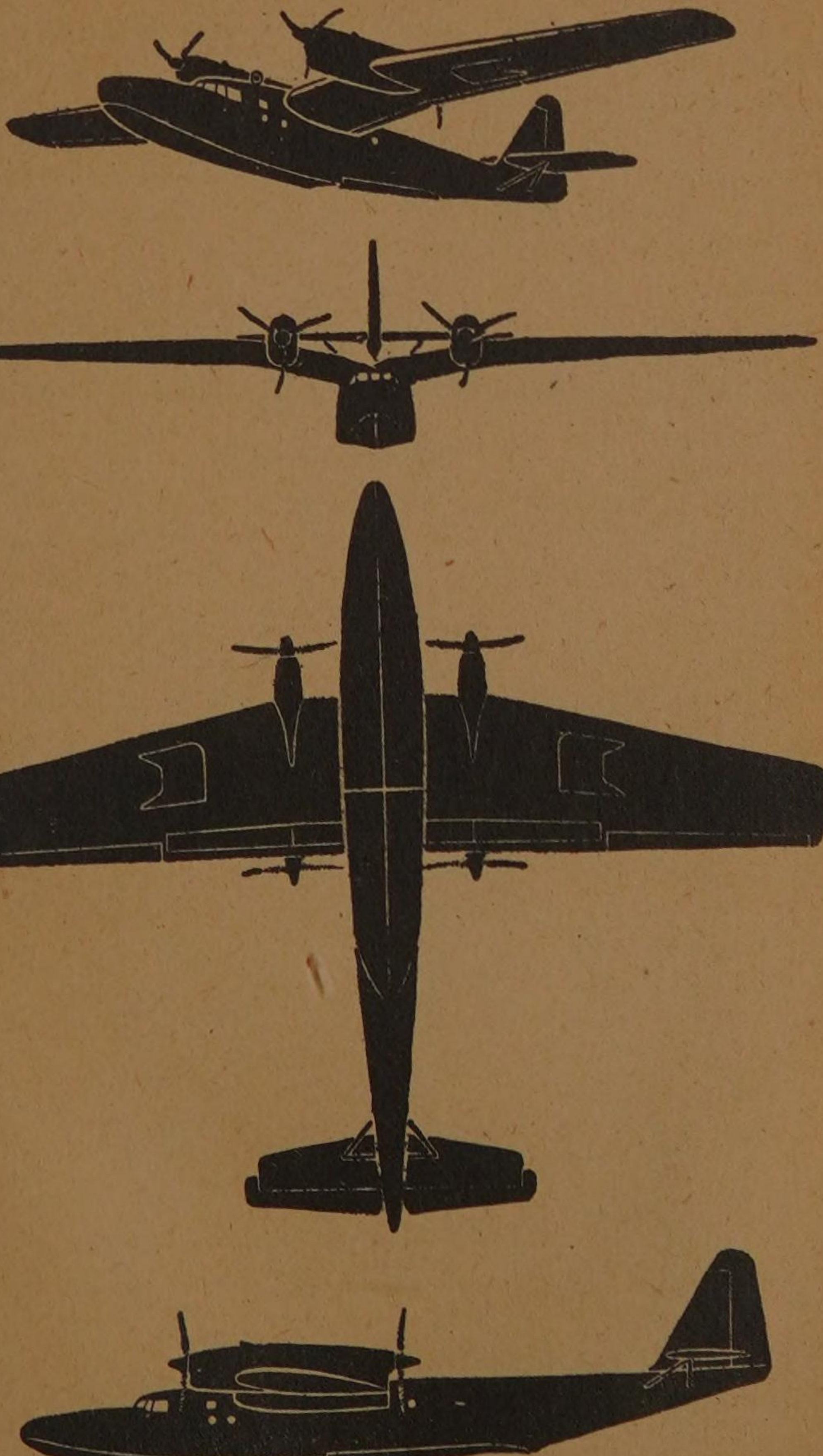
Head-on view: Marked dihedral in wings from hull to engines, levelling out to negligible dihedral on the outboard sections; tandem engines might easily be mistaken for twin engines; tailplane extends outboard of engine nacelles; tall, prominent fin and rudder.

Plan view: Wings with full taper on leading edge, outboard of engines, and none on trailing edge; wing tips swept in slightly towards trailing edge; the four engines in tandem can be clearly observed; distinctive tailplane.

Side view: Tandem engines clearly visible; tall single fin and rudder is more angular than that of Do 18; hull lines are very slender, in marked contrast to British flying boats.

DORNIER 26 (4 Jumo)
German Reconnaissance Plane

Span 98' 0" Length 80' 5" Height 22' 5"



SHORT "SUNDERLAND"

Developed from the well-known Short "Empire" flying-boats for long distance coastal reconnaissance, the "Sunderland's" power plant consists of four Bristol Pegasus air-cooled radial engines of 850 h.p., giving maximum and cruising speeds of 210 m.p.h. and 178 m.p.h., respectively. The normal range of 1,780 miles can be increased by special tankage to nearly 3,000 miles. The control cabin, on the upper deck forward, accommodates two pilots, the radio operator, navigator and engineer. The Fraser-Nash gun-turret in the nose is retractable for mooring. With a similar power-operated gun-turret in the tail, the "Sunderland" has been dubbed "The Flying Porcupine" by German fighters who have found its armament disagreeably effective.

Recognition Points

General structural features: High-wing monoplane flying-boat; normally tapered wings; four radial engines; single large fin and rudder; tailplane carried high on fuselage.

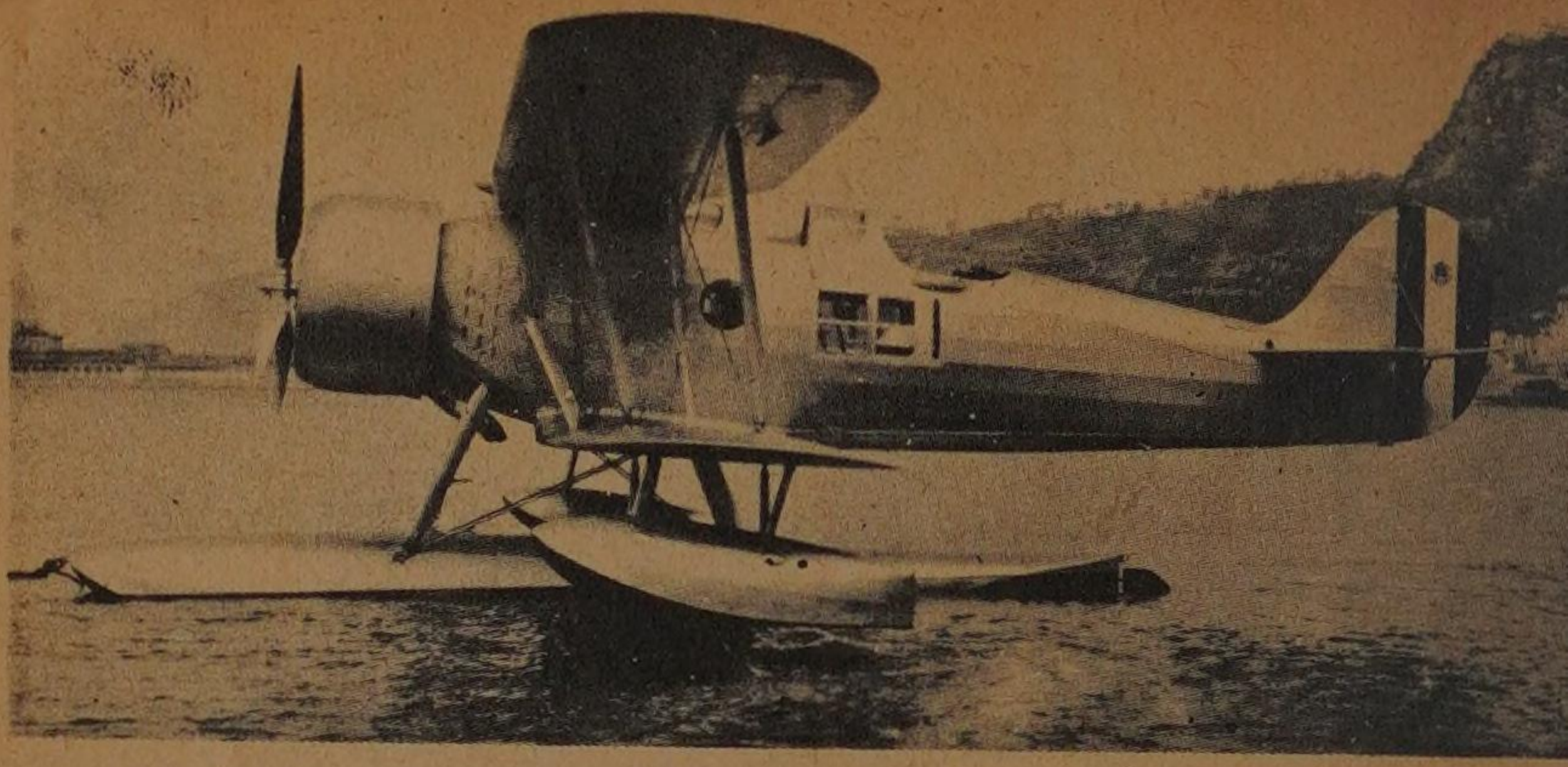
Head-on view: Four engines mounted on their center lines; deep hull; two fixed, strutted and braced wing floats; unusually tall fin and rudder; wings with slight dihedral.

Plan view: Normally tapered wings with rounded tips; tailplane similar in outline to wings; outer nacelles inclined slightly inboard; nose projects well forward of engines.

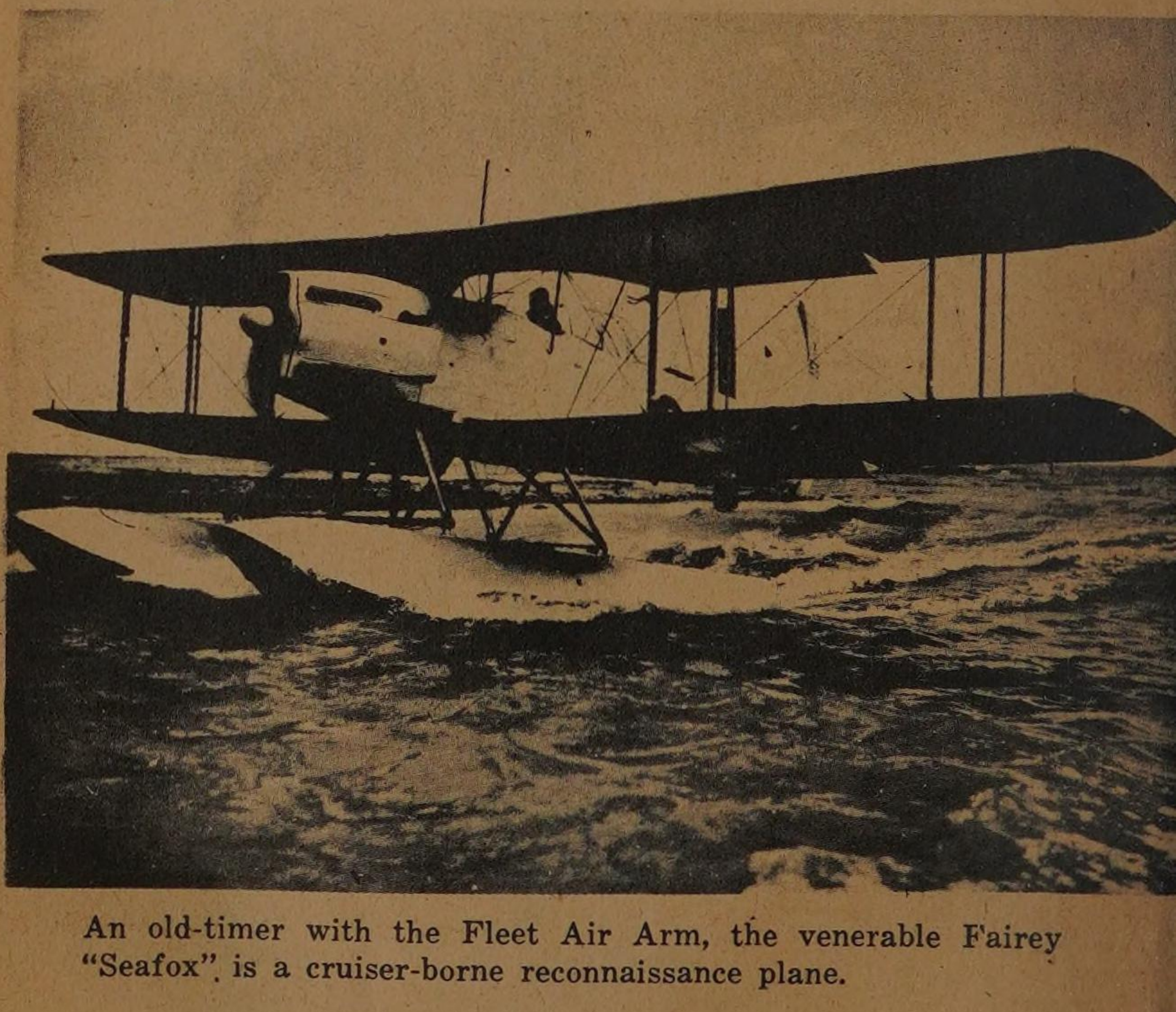
Side view: Deep double-deck hull with two "steps"; forward gun-turret gives snout-like appearance; fin and rudder, with rounded top, carried high on fuselage; tail gun-turret projects behind tail unit.

"SUNDERLAND" (4 Pegasus)
British Reconnaissance Plane

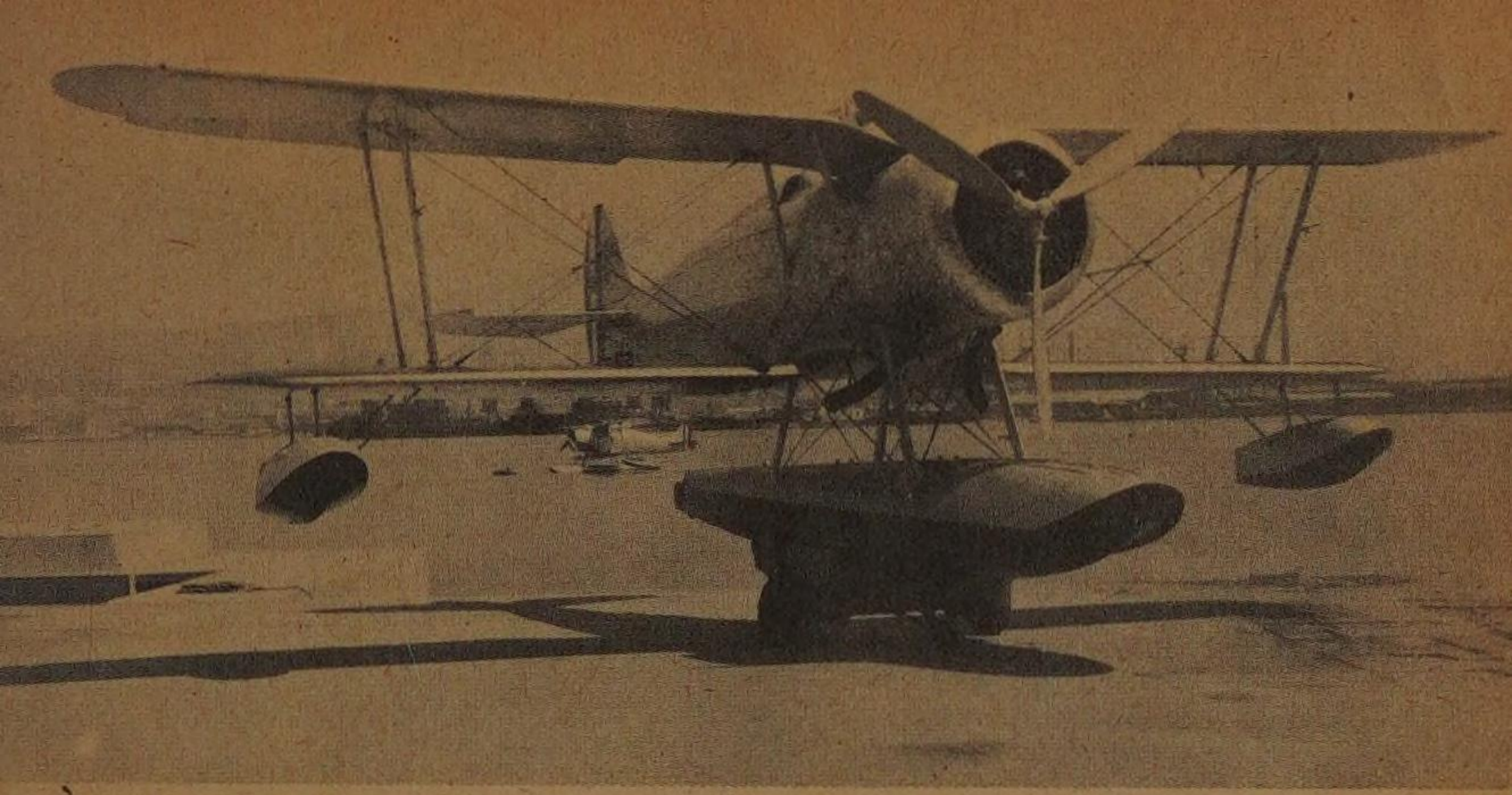
Span 112' 9½" Length 85' 4" Height 32' 10½"



Italy's Meridionali Romeo 43 reconnaissance plane is used to shadow Allied convoys in the Mediterranean.



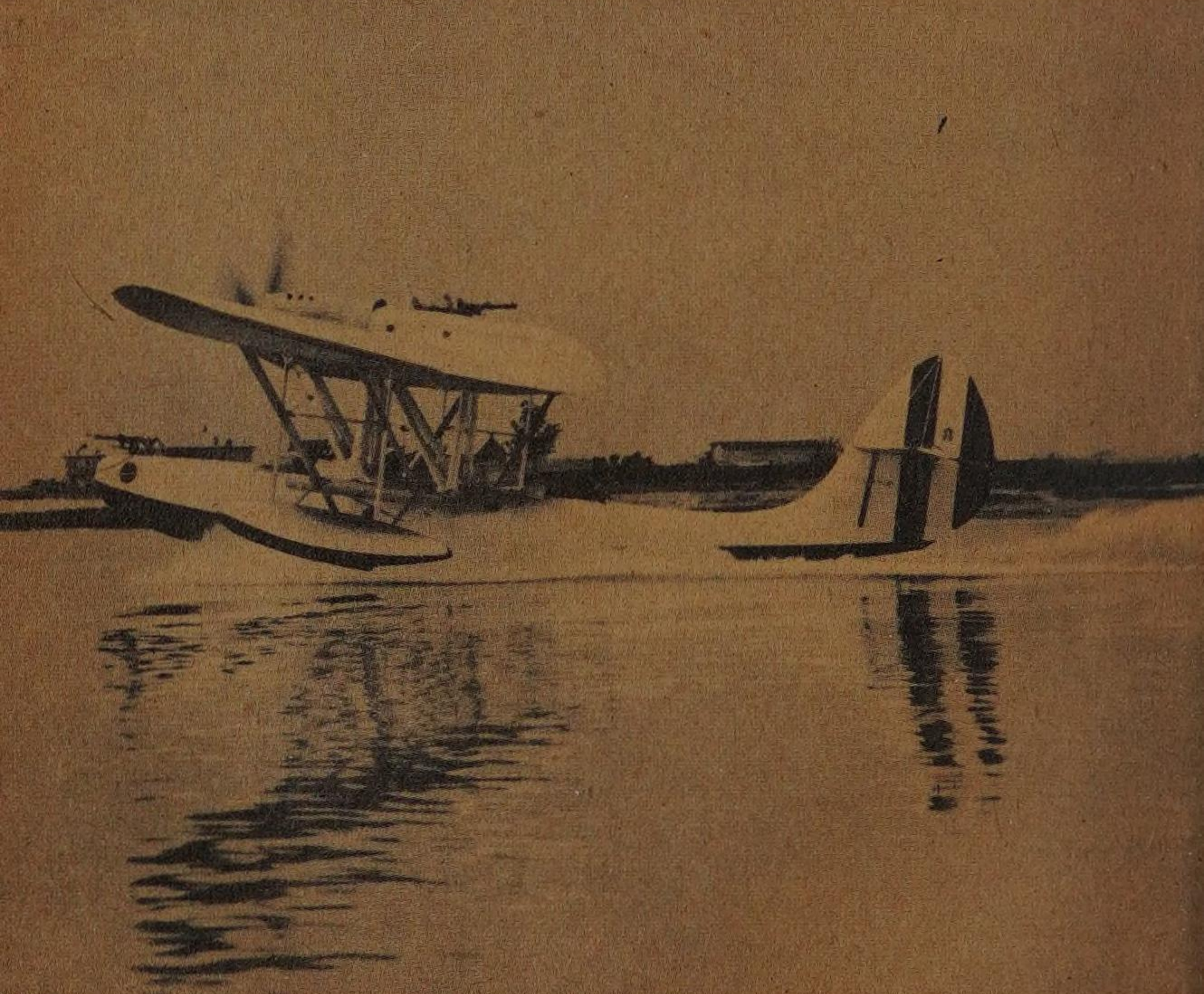
An old-timer with the Fleet Air Arm, the venerable Fairey "Seafox", is a cruiser-borne reconnaissance plane.



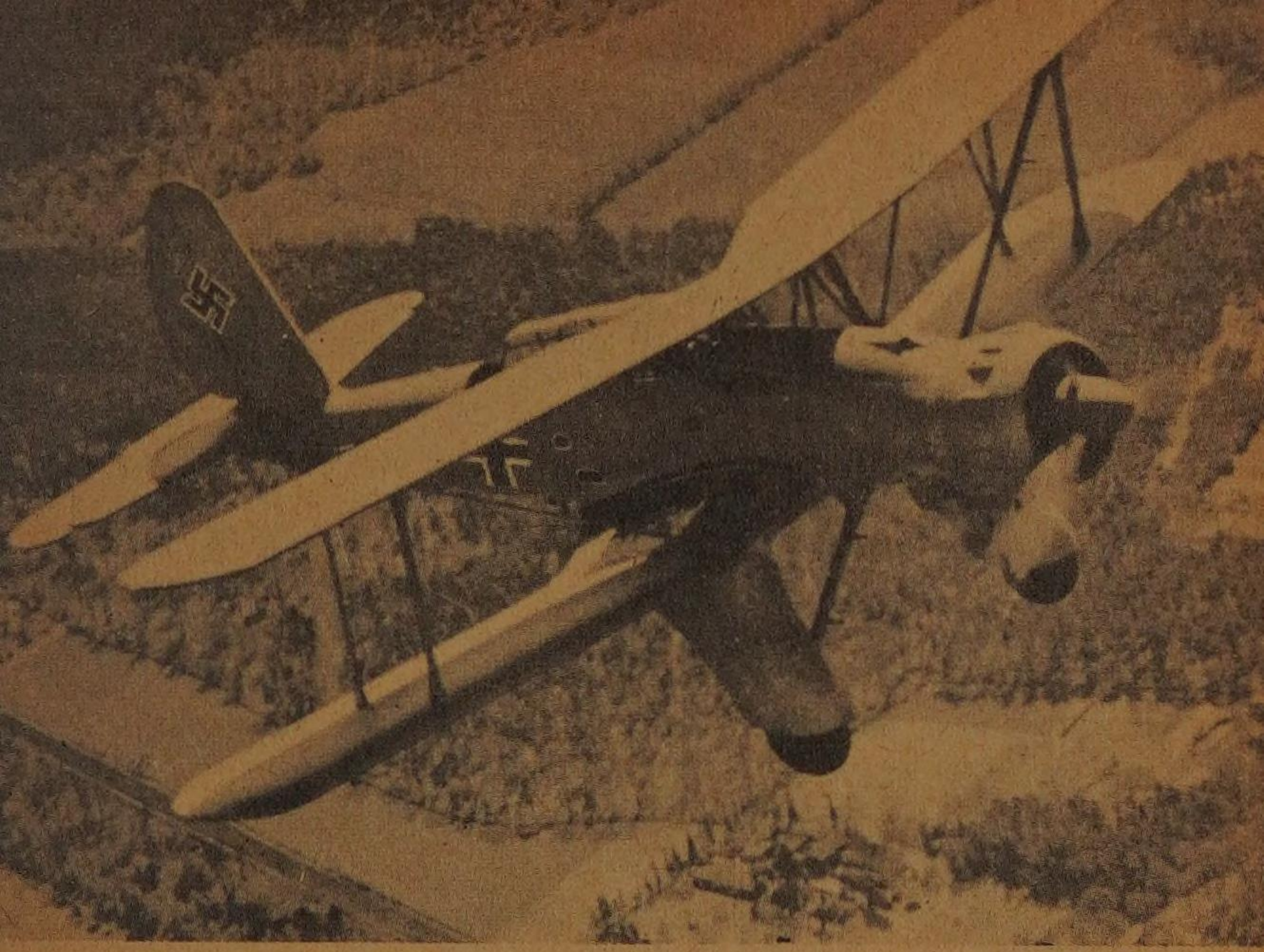
A catapult-launched single-seat fighter, the Meridionali Romeo 44 has a maximum speed of less than 200 m.p.h.

Fokker T8-W reconnaissance planes of the Dutch Naval Air Service co-operate with the R.A.F. on convoy patrol.

Cant. Z506B Italian torpedo bomber, seaplane version of the Cant. Z1007 "bis" long-range bomber (see Chapt. X).



Cant. Z501: An Italian reconnaissance plane. One Isotta Fraschini engine gives it a top speed of 171 m.p.h.



Arado 95-Land.

CHAPTER XIII

LAND AND CARRIER BASED BIPLANES

DE HAVILLAND "TIGER MOTH"

Probably more R.A.F. pilots have received their initial training in "Tiger Moths" than in any other type. The first de Havilland "Moth" type, D.H. 60, introduced about 1925, rapidly became the most popular light biplane for private owners and the standard training machine of British flying clubs. D.H. 82A, the "Tiger Moth," is a later development, fitted with the more powerful Gipsy "Major" inverted air-cooled in-line engine. This develops 130 h.p. and gives the "Tiger" a top speed of 109 m.p.h. with cruising speed of 93 m.p.h. Brought into service in the R.A.F. in 1932, the "Tiger Moth" is fitted with dual control and may be equipped with hood and instruments for training in "blind" flying. Extremely maneuvrable, it is fully stressed for aerobatics, and the low stalling speed of 43 m.p.h. provides a high factor of safety. A twin-float version is used as a seaplane trainer. Skis may be substituted for the normal undercarriage.

Recognition Points

General structural features: Single-bay biplane; staggered wings swept back; single in-line engine; single fin and rudder; fuselage of roughly oval section with two seats in tandem; fixed undercarriage.

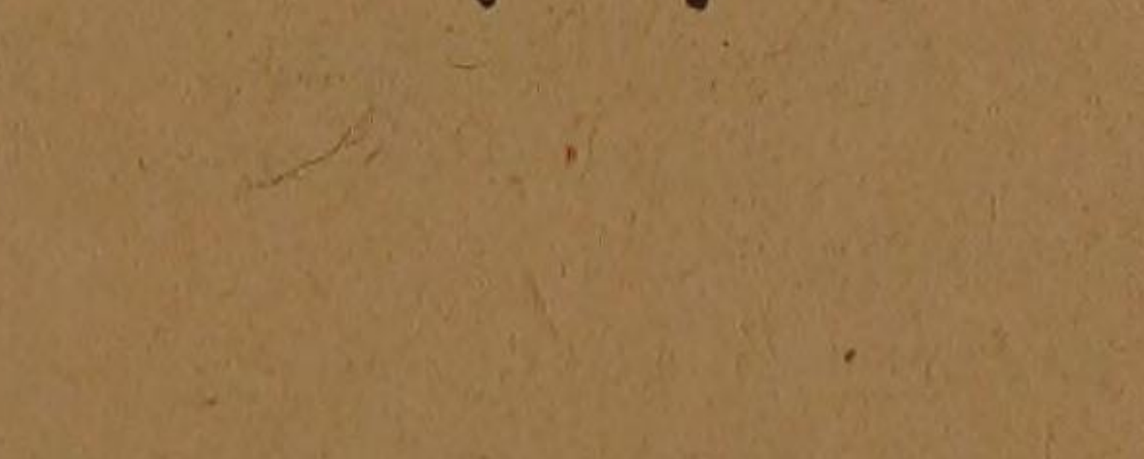
Head-on view: Slight dihedral on wings of equal span; braced tailplane visible; short, compact, fixed undercarriage without "spats."

Plan view: Wings with marked stagger are swept back without taper to the tips, which are rounded off and swept out to the trailing edge; tailplane suggests a moth with open wings; slender, slightly tapered fuselage.

Side view: In-line engine with characteristic bulge beneath spinner; open cockpits; distinctive fin and rudder, resembling a moth with closed wings.

"TIGER MOTH" (Gipsy III)
British Trainer

Span 29' 4" Length 23' 11" Height 8' 9½"



"AUDAX" and "HART VARIANTS"

"Audax," the army co-operation version of the Hawker "Hart" Day Bomber, is one of a numerous and distinguished series of R.A.F. biplanes built by the firm which has since produced the famous "Hurricane" fighter. These modifications of the "Hart" two-seat biplane include the "Demon," "Hind" and "Osprey," powered with single Rolls-Royce "Kestrel" liquid-cooled engines developing from 480-640 h.p. according to type. Training versions of these machines fitted with dual control have been in service since 1936. Subsequently, as high-speed monoplanes displaced biplanes in squadron service, large numbers of these types have been employed as advanced trainers. In view of their similarity in basic design they are usually described as "Hart variants." They are painted yellow, the standard color for trainers. Top speed is around 170-180 m.p.h.

Recognition Points

General structural features: Single bay biplane; staggered wings of unequal span; single in-line engine; single fin and rudder; fixed undercarriage.

Head-on view: Wings of unequal span, with slight dihedral in upper wing, full dihedral in lower wing; fuselage of oval section; radiator beneath fuselage between forward struts of braced undercarriage; unspatted wheels.

Plan view: Marked stagger and unequal span of wings; upper wing swept back, lower wing straight; no taper; wide, rounded tips; cut-away at center section of trailing edge, particularly noticeable over pilot's seat; elliptical tailplane.

Side view: Fuselage faired into engine, with distinctive pointed nose; two open cockpits in tandem; typical "Hawker" wide fin and rudder with rounded top.

"AUDAX" (Kestrel 1B)
British Army Co-operation Plane

Span 37' 3" Length 29' 6½" Height 11' 6"

"GLADIATOR" AND "SEA GLADIATOR"

Designed by the Gloster Company in 1934 as a private venture, the "Gladiator" has an excellent record of service in all parts of the world. Although biplane fighters must now be regarded as obsolescent, "Gladiators" of the auxiliary squadrons gave a good account of themselves during the early attacks on the Firth of Forth. They have also done well in Norway and in the Mediterranean. Owing to their greater maneuvrability and ease of stowage, biplane fighters were long used aboard aircraft carriers. The "Sea Gladiator" shown in these drawings differs only in details, such as the fitting of deck landing hook, catapult points and a collapsible dinghy, from the well-known landplane. Both types are fitted with one 840 h.p. Bristol "Mercury IX" air-cooled radial engine, giving a maximum speed of 250 m.p.h. Armament consists of four machine-guns, two mounted under the lower wings and two fixed in the side of the fuselage.

Recognition Points

General structural features: Single-bay biplane; wings of equal span; single radial engine; single fin and rudder; fuselage of oval section with single enclosed cockpit; fixed undercarriage.

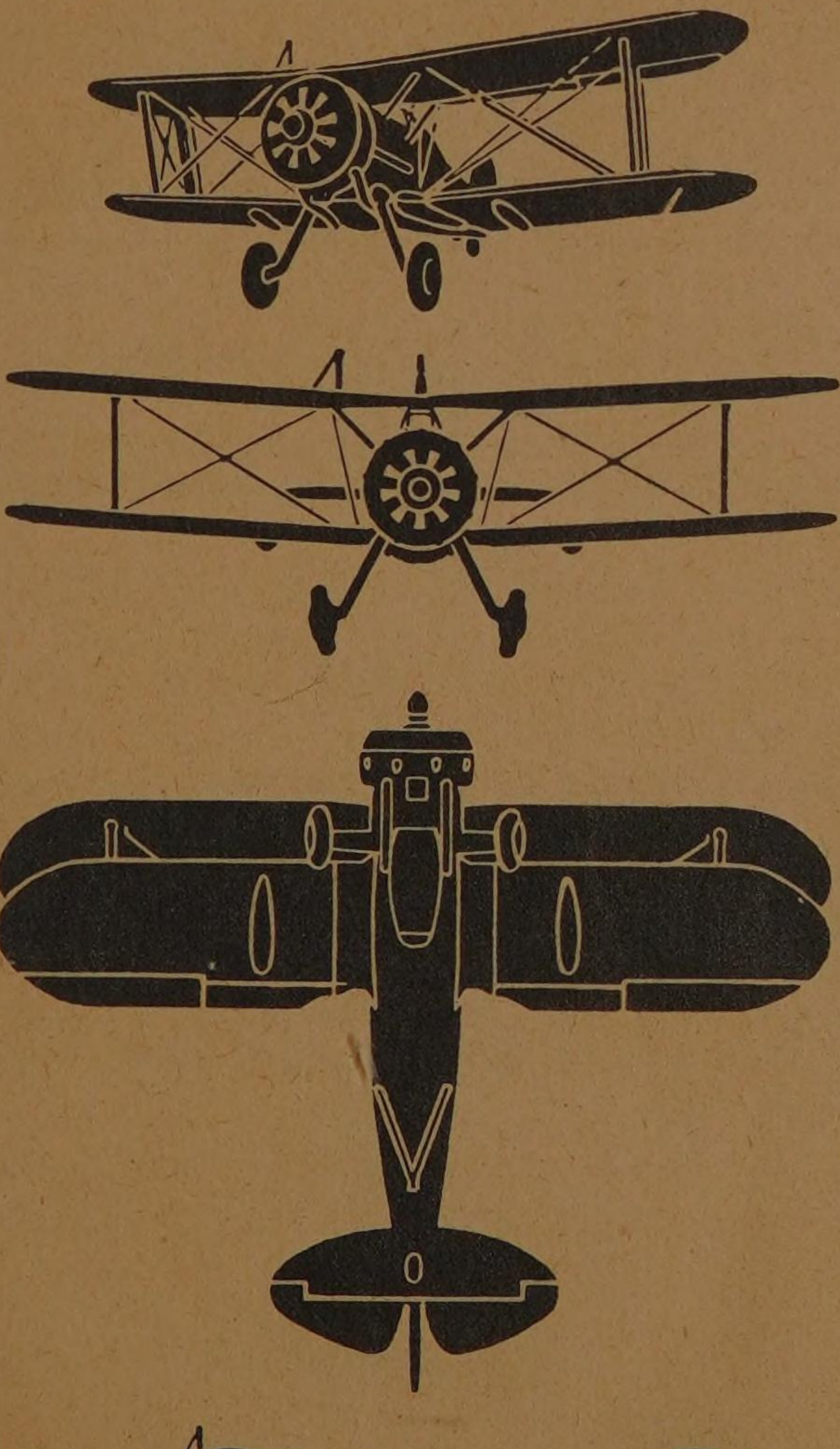
Head-on view: Equal-span wings with slight dihedral; fuselage of circular section; cantilever undercarriage; single-bay wings.

Plan view: Untapered wings fully staggered; rounded tips; "bites" at center of trailing edges; characteristic tail unit with curved taper.

Side view: Radial engine not faired into fuselage; fully staggered wings; characteristic wide well-rounded fin and rudder; tailplane mounted low.

"SEA GLADIATOR" (Mercury)
British Single-Seat Fleet Fighter

Span 32' 3" Length 27' 5" Height 10' 9½"



FAIREY "ALBACORE"

One of the torpedo-spotter-reconnaissance biplanes of the Fleet Air Arm, the "Albacore," operating from aircraft carriers, is an example of modern biplane construction, having folding wings of small span specially designed to save stowage space. Successor to the well-known Fairey "Swordfish," which carried out the brilliant torpedo attack on the Italian fleet at Taranto, it has cleaner lines and is fitted with the more powerful Bristol Taurus sleeve-valve radial engine of 1,065 h.p. The "Albacore" has taken part in many raids on invasion ports and coastal aerodromes.

Recognition Points

General structural features: Single-bay biplane; wings of equal span; single radial engine; single fin and rudder; fixed undercarriage.

Head-on view: Moderate dihedral on wings of equal span; fuselage of oval section; wheels without "spats," roof of large glazed cockpit divides the upper wings; fin and rudder and wide tailplane visible.

Plan view: Untapered wings with rounded tips, and trailing edge cut away near fuselage; tailplane, tapered on leading edge only, has rounded tips and large V cut-away from center elevator section.

Side view: Glazed cockpit projects forward of leading edge of wing with brow-like effect; large, wide fin and rudder have well-rounded top and distinctive shape; "trousered" undercarriage legs.

"ALBACORE" (Taurus)

British Torpedo Spotter, Reconnaissance Plane

Span 50' 0" **Length 40' 1"** **Height 15' 1"**

Acting as escort, an old-fashion Fairey "Swordfish" of the Fleet Air Arm flies beside a British destroyer.

A formation flight of Fleet Air Arm "Albacores" starting out on an exercise. Each plane is carrying one torpedo.

GLOSSARY

The definitions below refer only to the common meaning of the terms when used in connection with aircraft recognition. Readers seeking precise scientific definitions should consult standard aeronautical textbooks.

Service spotters are primarily concerned with the general appearance of aircraft in flight, as seen from a considerable distance. In consequence, many of the descriptive terms are frequently used in an approximate sense. Thus "untapered wings with square-cut tips and no dihedral," may accurately convey an observer's general impression of a particular aircraft, although the description may not be in strict agreement with dimensioned drawings.

AEROFOIL.—Term generally used in referring to the wings, ailerons, tailplane, fins, etc., when considered apart from the airplane.

AILERONS.—Hinged flaps on the trailing edge of the wings, near to the tips, which provide lateral control. They are so coupled that one is raised as the other is lowered. By this means the pilot executes the movement known as "banking."

AIR BRAKES.—See Dive Brakes.

AIRSCREW.—General term recommended in preference to "propeller," which means a screw placed at the stern pushing the ship along. The "pusher" type of airscrew is less common than the "tractor" type. The latter, placed in front, "pulls" an airplane through the air.

AIRSCREW DISC OR RADIUS.—The area, or radius, of the circle swept by the airscrew blades. When guns fire through the airscrew disc their speed of operation must be synchronized with rotating airscrew by the use of interrupter gear. This reduces the rate of fire.

AIRSCREW SPINNER.—A streamline cap, usually in light alloy, which is fitted over the flat central "boss" of an airscrew in order to reduce head resistance.

AMPHIBIAN.—A type of aircraft which, being provided with a hull or floats in addition to a wheeled undercarriage, can operate from land or water.

ANHEDRAL.—Or "negative dihedral," is the angle between each wing and the horizontal when the wings are inclined **downwards** towards the tips. (See Dihedral.)

ASPECT RATIO.—The ratio of span to chord, represented by $\frac{\text{Span}}{\text{Chord}}$

Example.—40-feet span divided by 5-feet chord equals aspect ratio of 8. In the case of tapered or elliptical wing forms where **chord** varies, the numerical value is obtained by dividing the square of **span** by the **wing area.** $\frac{\text{Span}^2}{\text{(Wing area)}}$.

Sailplane wings have very high aspect ratio. The "Wellington" is an example of a heavy bomber with high aspect ratio wings, the value being nearly 10. The "Wellesley" ration of 8-8 is also high. The "Flamingo," around 7-5, is moderate, while the "Hurricane," about 6-2, and the "Whitley," 5-8, are examples of rather low aspect ratio.

BACKSWEPT.—See Sweepback.

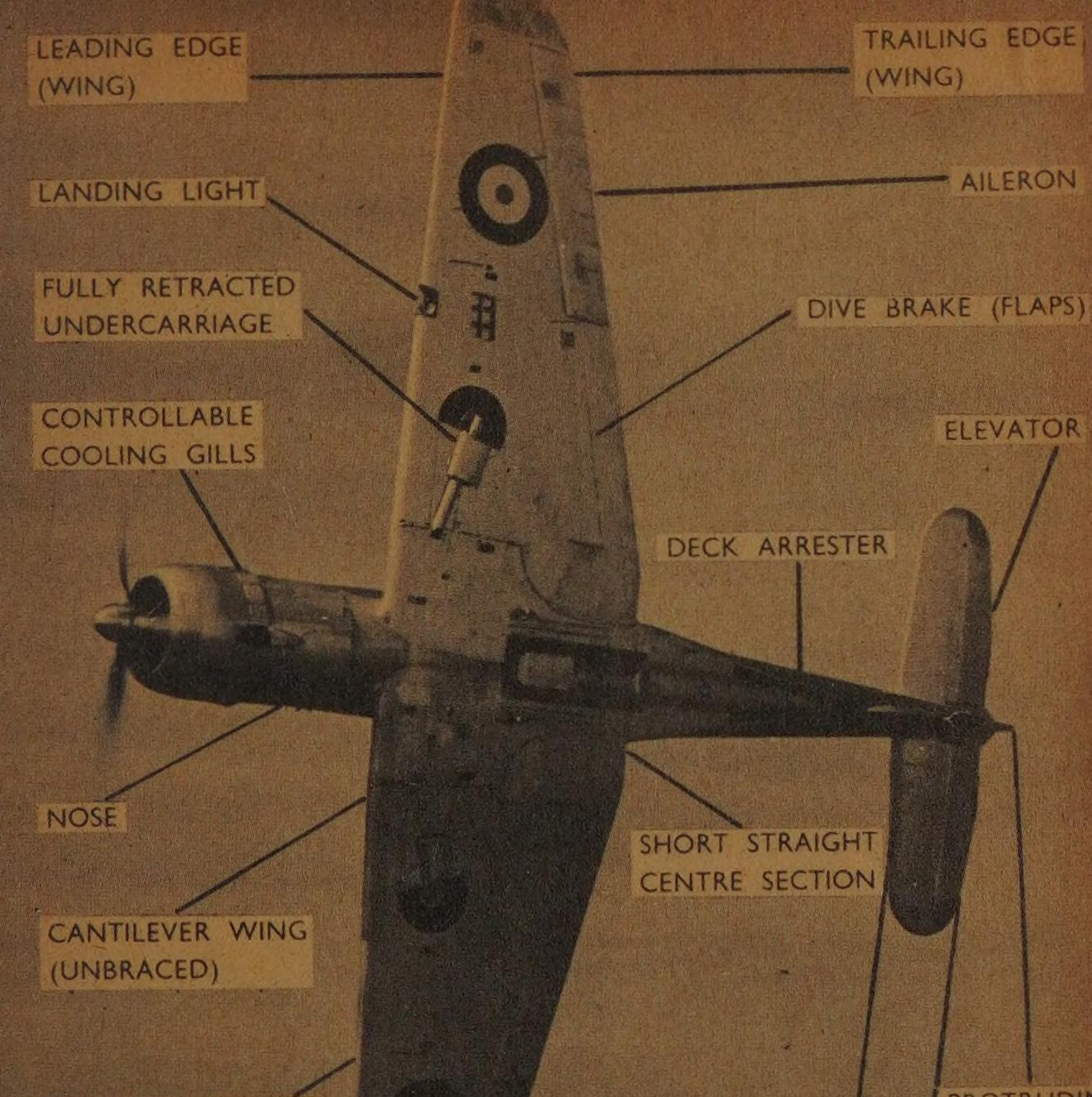
BALANCE, MASS OR STATIC.—The arrangement of hinged control surfaces, such as rudders and elevators, in such a way that the moment of the part forward of the hinge balances that of the after part.

BALANCE, AERODYNAMIC.—The arrangement of hinged control surfaces so that the pressure of the airflow on the smaller area forward of the hinge tends to balance the pressure on the main control surface behind the hinge.

BAY.—Biplane wings are supported by interplane struts which subdivide the span into sections termed "bays."

"BITE."—Self-explanatory term used to indicate a curved indentation. (See Cut-away.)

BRACED.—Usually refers to bracing wires or rods, but is also used in a wider sense to describe surfaces supported by struts or other external members, e.g. "braced tailplane," as opposed to the more modern "cantilever" construction. (See Cantilever.)



Blackburn "Skua": A carrier-based fighter-dive-bomber.

CAMBER.—The curvature of the upper or lower surface of a wing or of any aerofoil.

CANTILEVER.—A method of construction applied chiefly to wings, fins, tailplanes and undercarriage, in which no external struts, braces or supports are employed. Cantilever construction gives clean lines with low head resistance. As it is normally employed for the wings, fins and tail-plane of modern aircraft, the term is rarely used in the descriptive notes. Cantilever construction may be assumed in all cases where these components are not specifically described as "strutted" or "braced."

CEILING (ABSOLUTE).—Height beyond which the aircraft cannot climb, and at which only one speed of flight is possible.

CEILING (SERVICE).—Height beyond which the rate of climb falls below 100 feet per minute.

CHORD.—Width of wing or aerofoil from leading to trailing edge measured in a straight line, disregarding camber.

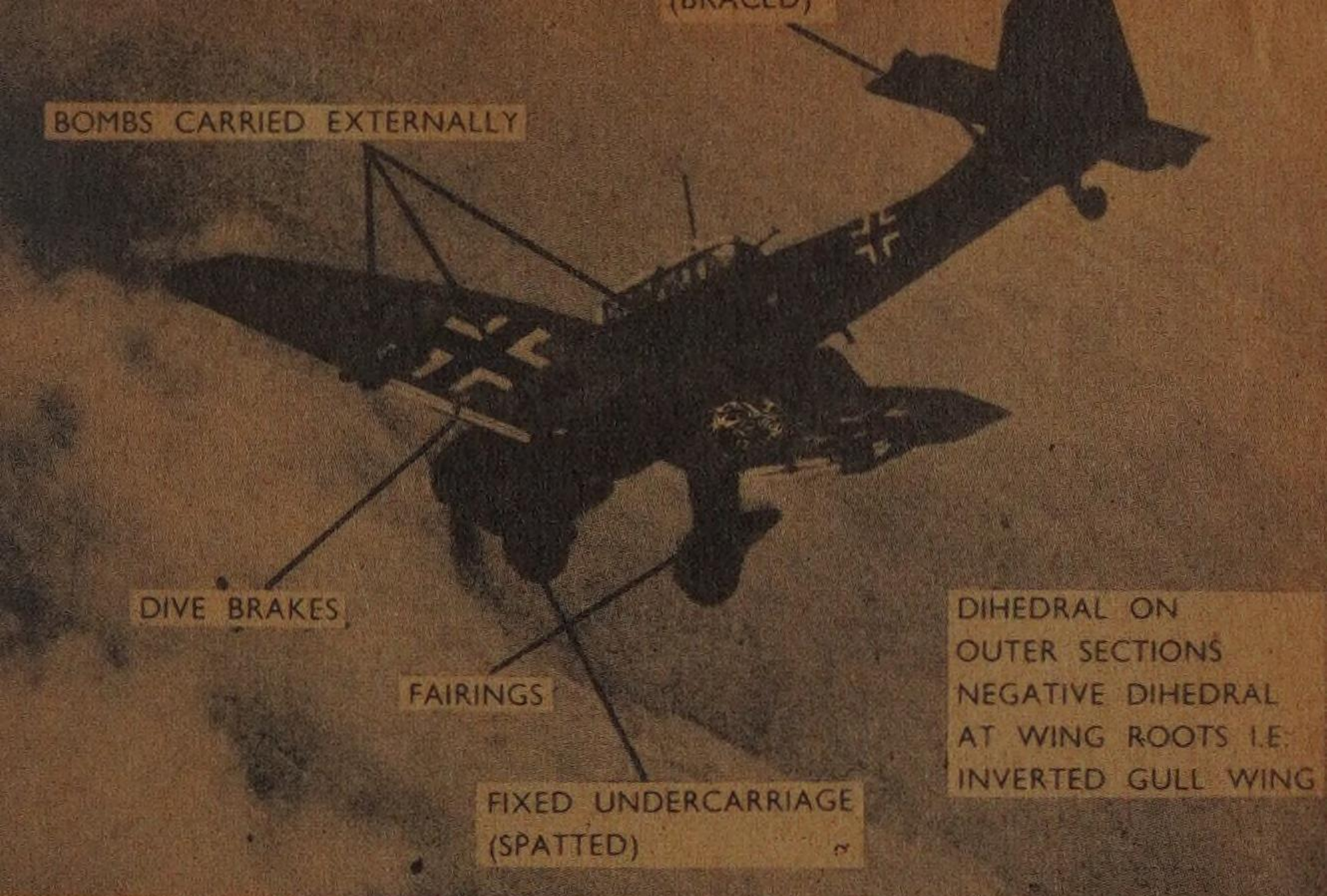
CONSERVATORY.—Colloquial description of the large glazed roof enclosing the cabin of certain planes, e.g. "Anson," "Battle," etc. Also termed "greenhouse."

COWLING.—Sheet metal cover of streamline form which more or less encloses the engine. On radial engines the cowling is usually combined with an exhaust collector ring and air-cooling ducts.

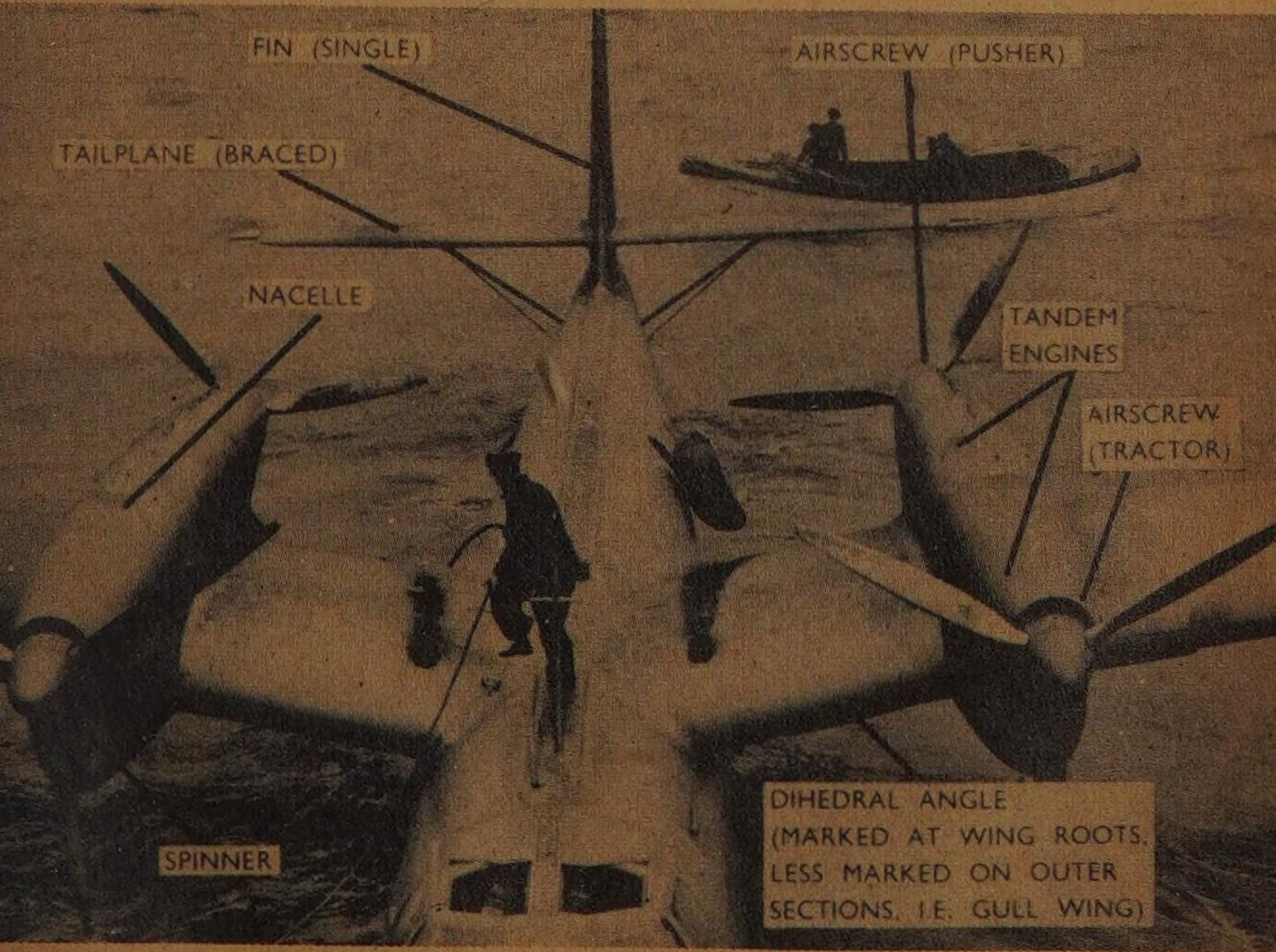
CUT-AWAY.—Denotes that the regular outline of a wing or elevator for example, is cut away, to enlarge the pilot's field of view or to give rudder clearance.

DIHEDRAL.—Or "positive dihedral," is the angle between each wing and the horizontal when the wings are inclined **upwards** towards the tips. (See Anhedral.)

DIVE BRAKES.—Flaps, special fairings or other movable surfaces which in normal flight lie parallel to the airflow. During a dive these "air brakes" can be turned through 90° to increase head resistance, thereby reducing the diving speed. (See Flaps.)



The Junkers 87b or "Stuka" dive bomber.



Dornier 26 flying boat.

ELEVATOR.—The hinged portion of the tailplane by means of which the pilot climbs, dives or keeps his craft in level flight, i.e.. maintains longitudinal control.

FAIRING.—Light covering of streamline form fitted to reduce resistance to airflow. Undercarriage legs so enclosed are colloquially described as "trousered." Wheels partially enclosed in fairings are "spatted." (See Fillet.)

FILLET.—An extension of the wing, fin or other surface at the point of attachment to the fuselage. Usually curved and of streamline form, it is another type of fairing designed to improve airflow. (See Fairing.)

FIN.—The fixed vertical part of the tail unit, to which the rudder is usually hinged. Like the fin of a fish or the keel of a boat, it increases directional and lateral stability.

FLAPS.—Movable surfaces at the trailing edge, so arranged that their position and angle in relation to the trailing edge may be controlled by the pilot. They serve as air brakes, enabling the pilot to steepen the landing glide without gaining excessive speed, or as dive brakes. As variable camber devices they improve "lift" at low speeds, providing increased safety and control during take-off and landing. (See Dive Brakes.)

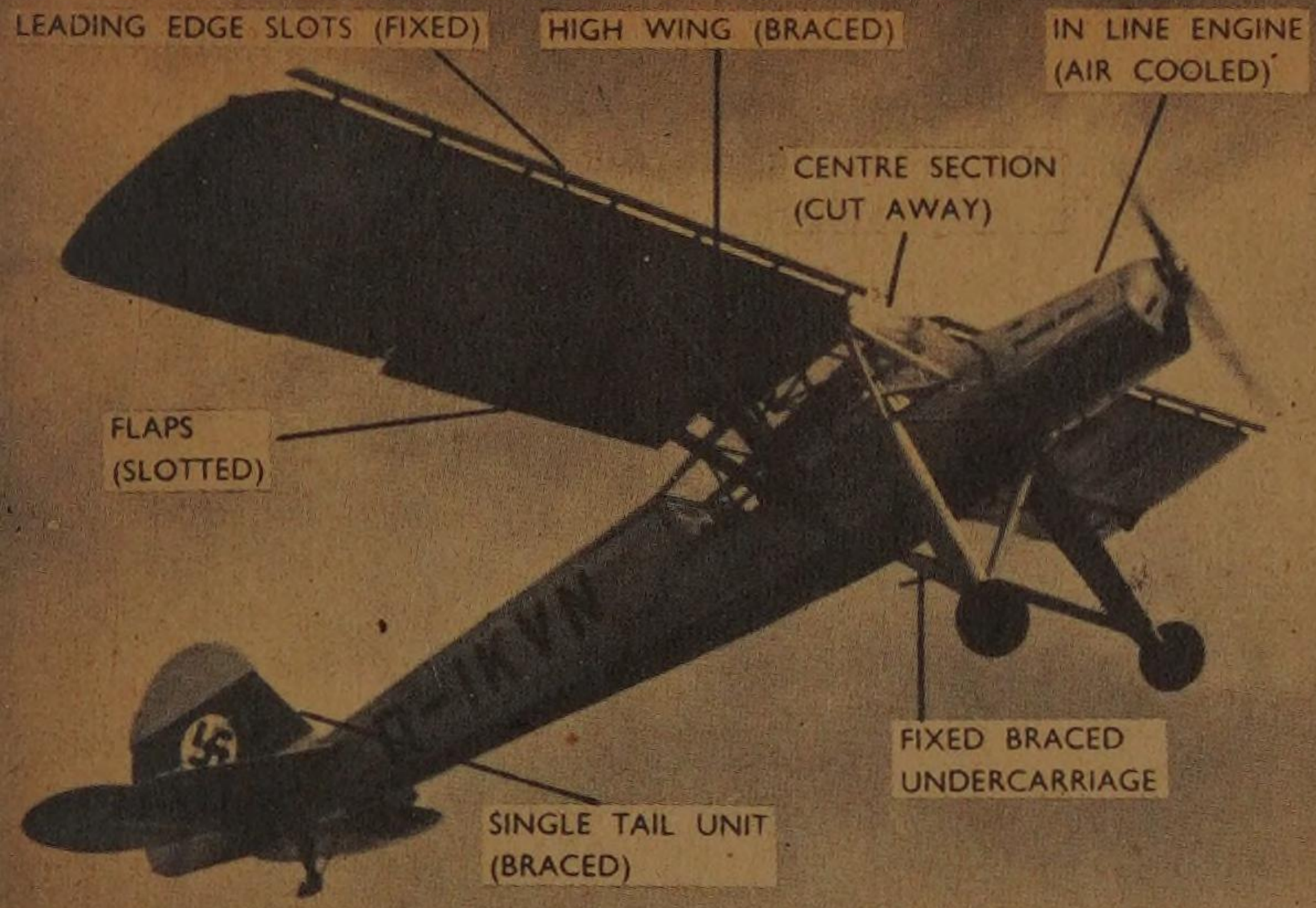
FLOAT.—A buoyant watertight support resembling an elongated boat which is fitted to the undercarriage of seaplanes. Fitted to the underside of the wings of flying-boats, floats serve as stabilisers, preventing damage to the wings in a heavy sea.

FLOAT SEAPLANE.—An airplane, designed for operating from water, in which floats replace wheels.

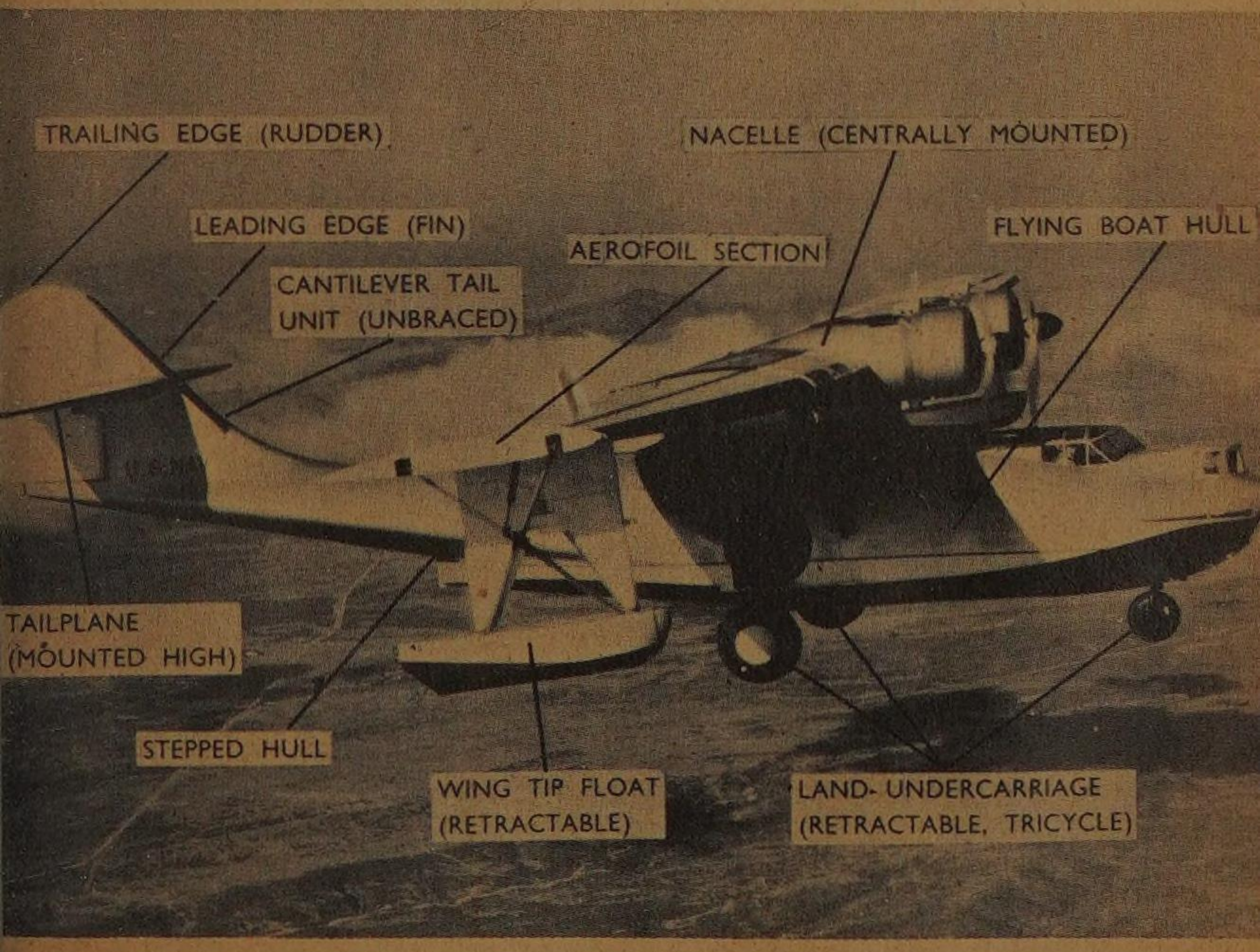
FLYING-BOAT.—An airplane, designed for long overseas flights, in which a seaworthy hull replaces the fuselage and float undercarriage of a seaplane.

FLYING WING.—See Fuselage.

FUSELAGE.—The body of an airplane in which the pilot, crew and load are accommodated and to which other main structural parts are attached. In the "flying-wing" type, the fuselage is merged into the centre section of a single large wing of special design.



Fieseler "Storch": Nazi army co-operation plane.



Consolidated PBY-5A: Amphibian version.

GAP.—The distance between the upper and lower planes of a biplane.

GEODETIC CONSTRUCTION.—The Vickers-Wallis system in which a curved lattice-work of light alloy girders replaces heavy spars and ribs in the construction of wings, fuselage, etc. The name is derived from "geodetic" line, i.e. the shortest line joining two points lying along the surface of a sphere.

GREENHOUSE.—See Conservatory.

GULL-WINGS.—Wings which have marked dihedral angle near to the fuselage, changing abruptly to little or no dihedral towards the tips and resembling the outspread wings of a gull. Inverted gull-wings have marked anhedral (negative dihedral) near the fuselage, with more or less full dihedral throughout the remainder of their span.

IN-LINE ENGINES.—Consisting of one or more blocks of cylinders arranged in line as in motor-car engines. The Rolls-Royce "Merlin" is an in-line V-type liquid-cooled engine, the two blocks of six cylinders in line being arranged in V form. The Napier "Dagger" air-cooled engine has four in-line blocks, each of six cylinders, arranged approximately in H form.

INVERTED GULL-WINGS.—See Gull-Wings.

LEADING EDGE.—The forward edge of wings, tailplane, fins, etc.

MONOCOQUE CONSTRUCTION.—Term applied to fuselage built in a single shell around formers which are spaced along its length.

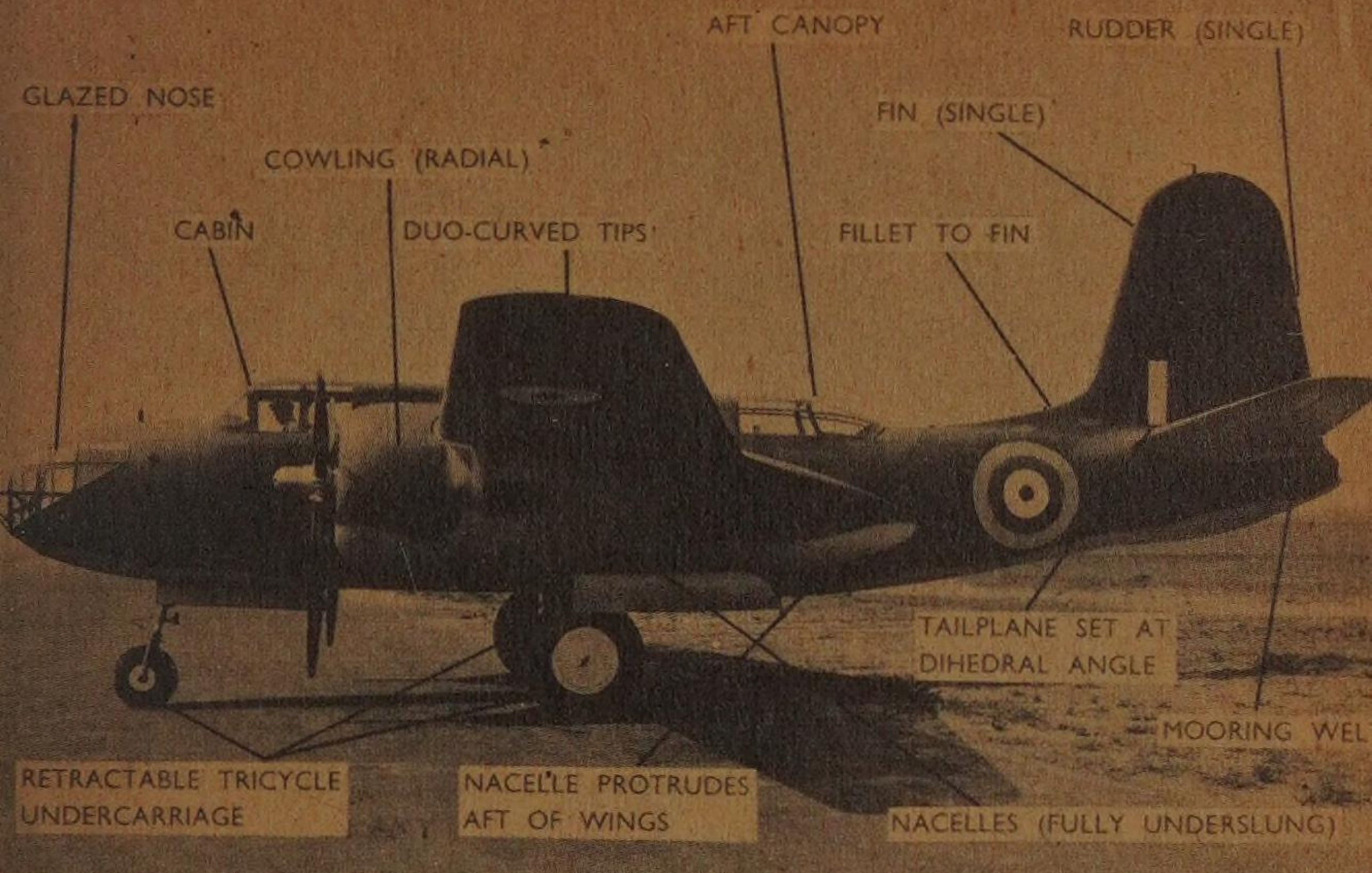
NACELLES.—Streamline housings outside the fuselage which usually enclose the engines of a multi-engined aircraft.

NEGATIVE DIHEDRAL.—See Anhedral and Dihedral.

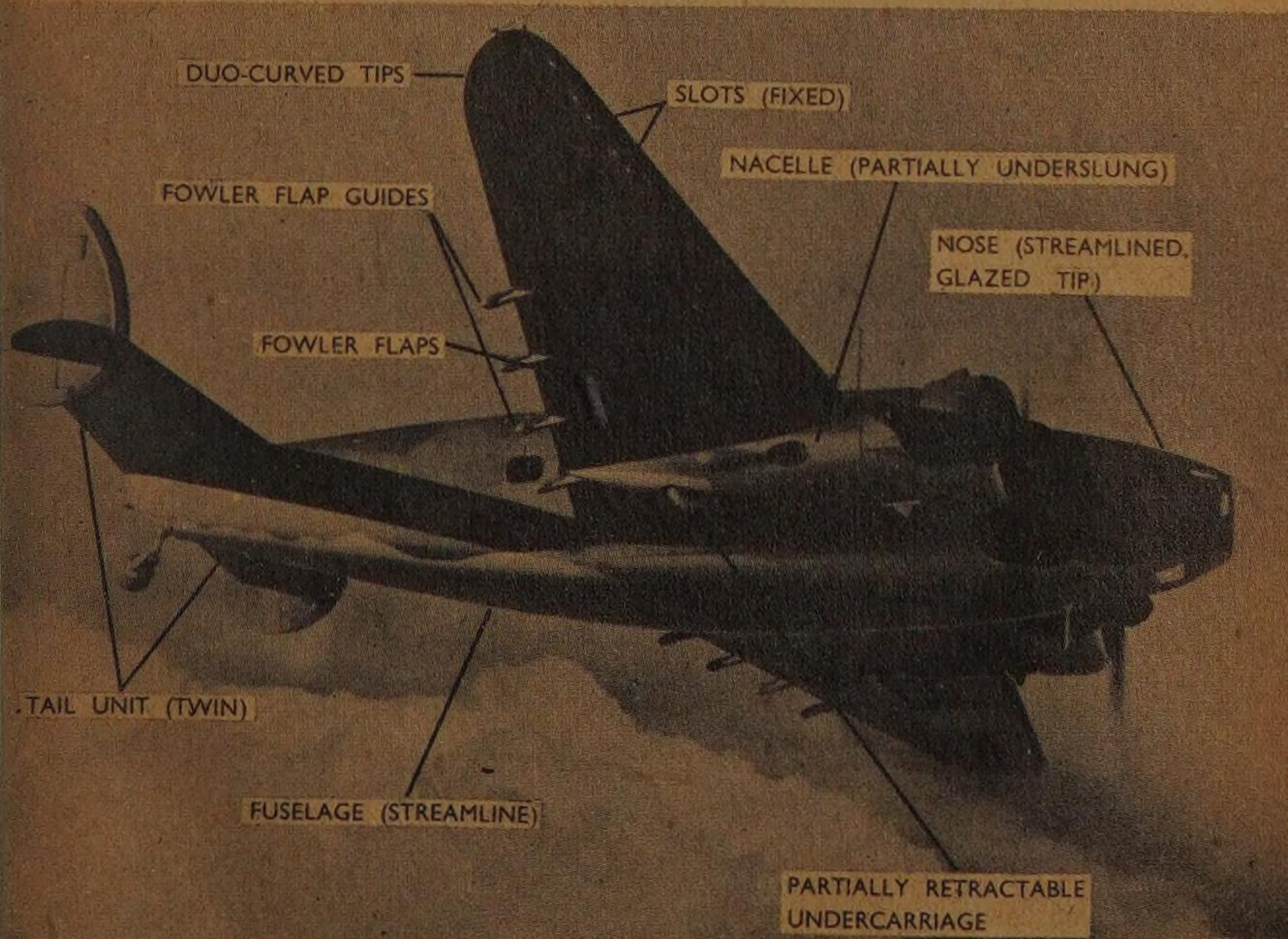
PROPELLER.—See Airscrew.

PUSHER AIRSCREW.—See Airscrew.

RADIAL ENGINE.—That type of engine in which the cylinders are arranged radially around a central crankshaft. In contrast to the older type of rotary engine, the cylinder block is stationary while the crank revolves.



Douglas "Boston."



Lockheed "Hudson."

Usually air-cooled, radial engines are partially enclosed in a streamline cowling of circular section. The most numerous types consist of a single row of seven or nine cylinders arranged star-wise. Later types, termed "twin-row" or "double-row" radials, consist of fourteen or eighteen cylinders arranged radially in two rows.

RETRACTABLE (Float, Gun-Turret, Undercarriage).—Capable of being drawn up or folded under the aircraft during flight in order to reduce head resistance.

RUDDER.—Movable control surface hinged at the fin, which in normal flying attitude is vertical and, like the rudder of a boat, provides directional control. When an airplane is banked, the rudder, no longer vertical, exchanges functions with the elevator in proportion as the angle of bank is increased.

SEMI-RETRACTABLE UNDERCARRIAGE.—Undercarriage, of which the wheels are only partly retracted, enabling a safe landing to be made should the extending mechanism fail to operate.

SESQUIPLANE.—A biplane in which one of the main planes is very much smaller than the other. Literally "one-and-a-half" planes.

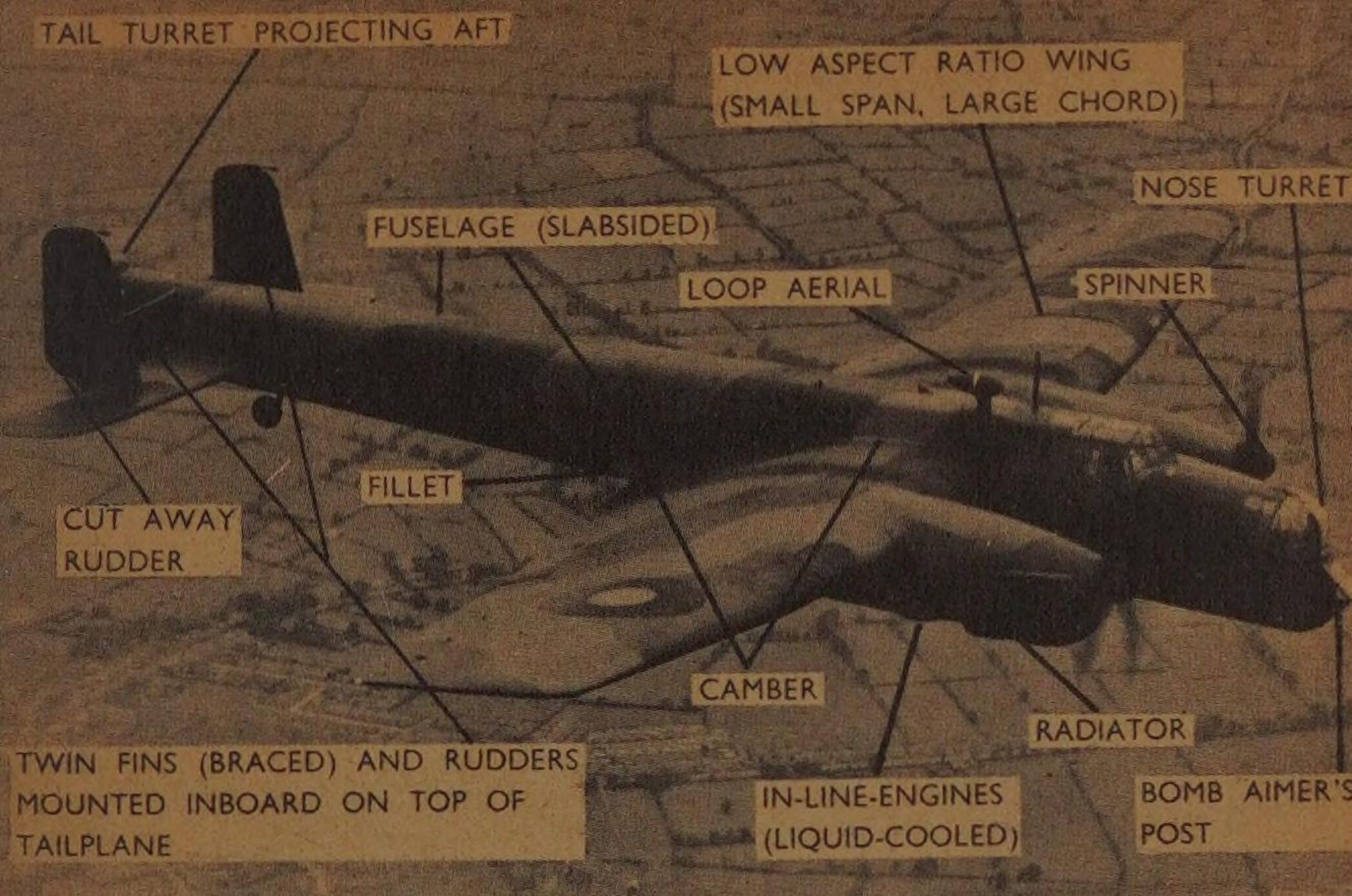
SLAB-SIDED.—Self-explanatory term applied to the type of fuselage which, although not fully rectangular in section, has flat sides.

SLOTS.—Small slats of streamline section, fitted near to the leading edge of the wings. In normal flight they remain closed, but open automatically at low speeds forming a narrow slot which induces a better flow of air over the wing surface. The "lift" of the wing is thereby increased, and the stalling speed of the aircraft proportionately reduced. Fixed slots consist of a series of small slots, permanently open, arranged near the leading edge of the wing.

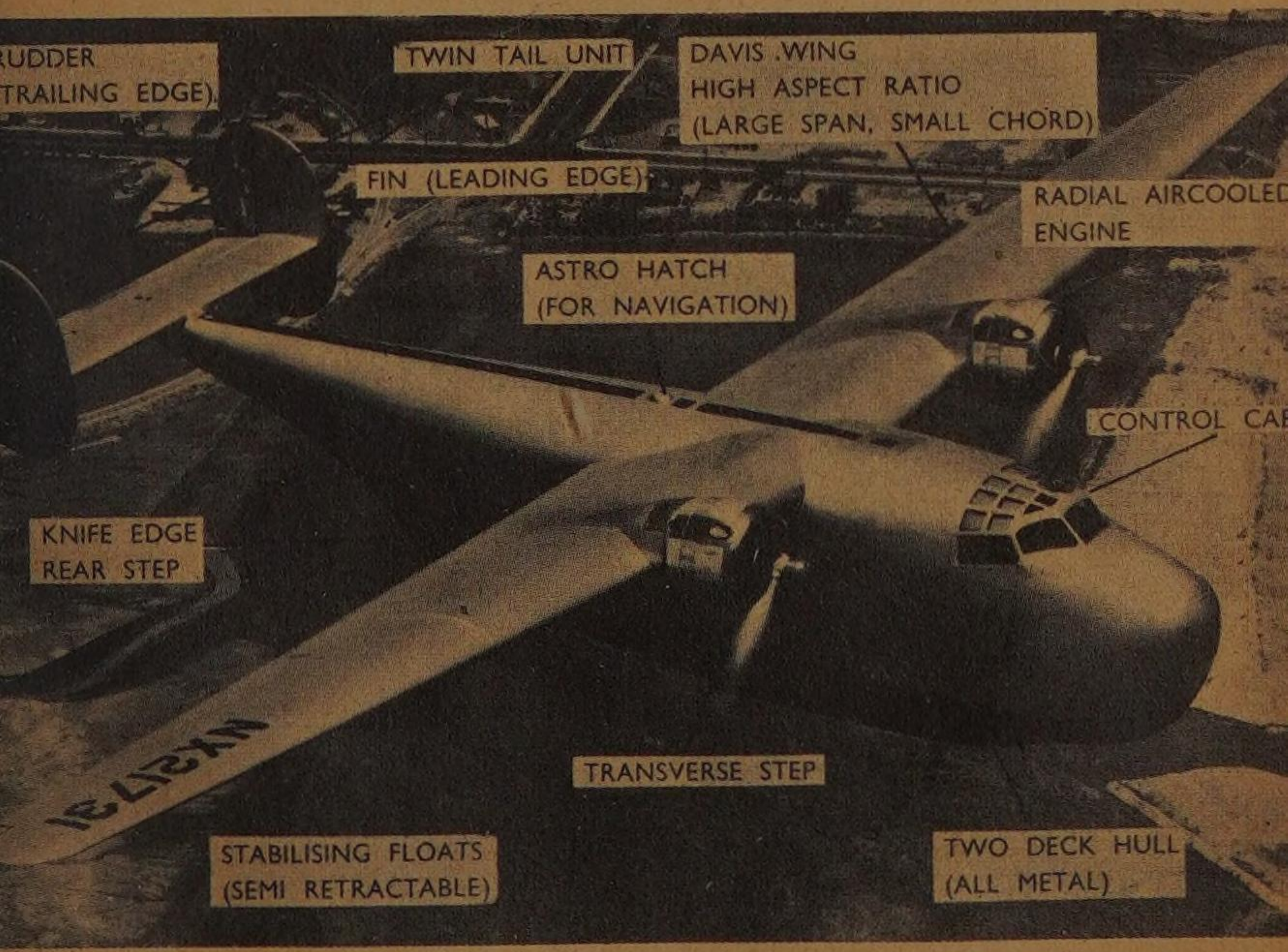
SPAN.—The distance between the extreme tips of the longest main plane.

"SPATTED" UNDERCARRIAGE.—See Fairings.

SPONSON.—See Stub Wings.



The Armstrong-Whitworth "Whitley": Mks. IV and V.



Consolidated 31 flying boat.

STAGGER.—When the upper wings of a biplane are forward of the lower wings they are said to be staggered. This arrangement, also termed forward or positive stagger, is quite common. The opposite arrangement, in which the upper wings are behind, termed backward or negative stagger, is unusual.

STALLING SPEED.—The speed at which the flying controls become ineffective and the lift derived from airflow is insufficient to sustain flight.

STREAMLINE.—So shaped as to produce the least resistance to the airflow.

SWEEPBACK.—Term describing the angular setting of wings, viewed in plan. Wings which have sweepback are inclined towards the tail. (Should not be confused with taper.)

STUB WINGS.—Also termed "sponsons." Very short wings, little more than stubby wing-roots, built on to the hull of flying-boats near the water-line. They are a distinctive feature of Dornier and of certain American flying-boats. Stub wings have a stabilizing effect in a heavy sea, and in this respect replace wing floats.

TAIL.—The tailplane and elevators of an aircraft. Also used in a wider sense, meaning the extremity of the fuselage and/or the tail unit.

TAILPLANE.— The fixed part of the horizontal control surfaces at the after end of the fuselage.

TAIL UNIT.—The complete assembly of the tailplane(s), elevator(s), fin(s), and rudder(s).

TANDEM.—(On tandem.) Arranged in line one behind the other.

TRACTOR AIRSCREW.—See Airscrew.

TRAILING EDGE.—The rearward edge of the wings, tailplane, fins, etc.

"TROUSERED" UNDERCARRIAGE.— See Fairings.

TWIN TAIL.—Compound tail unit having two fins and two rudders.

INDEX

With abbreviated description of principal structural features.

ABBREVIATIONS

Principal Groups:
LW: Low-wing monoplane.
MW: Mid-wing monoplane, including L.mw: Low mid-wing.
HW: High-wing monoplane, including Sh.w: Shoulder wing.
Fl. bt.: Flying-boat. S.pl.: Seaplane.
Amph.: Amphibian. Ff.: Floats fixed. Fr.: Floats retract. Sp: Sponsons or stub wings.
Bi: Biplane.

Number of Engine:
El, E2, E3, E4, etc.

Tail Unit:
Tl: Simple, i.e. single fin and rudder.
T2: compound, i.e. two or more fins and/or rudders.
2 bms: Twin tail booms.
T2/3: Compound tail with three fins and/or rudders.

Type of Engine:
Re: Radial engine. Le: In-line engine.

Type of Undercarriage:
Uf: Undercarriage fixed. Uf (Flt): Float plane.
Uf (3 Flt): Float plane central float.
Uf/2 x 2: 2 side-by-side pairs wheels.
Uf/2 tan prs: 2 prs tandem wheels.
Ur: Undercarriage retracts. Ur/3: Tricycle undercarriage, i.e. with single front wheel.

Country of Origin:
B.: Belgium. C.: Canada. F.: France. G.: Germany. G.B.: Great Britain. H.: Holland. I.: Italy. U.S.A.: United States of America.

INDEX

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