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THE HORTEN TAILLESS AIRCRAFT

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COMBINED INTELLIGENCE OBJECTIVES
SUB-COMMITTEE

LONDON - H.M. STATIONERY OFFICE

THE HORTEN TAILLESS AIRCRAFT

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SUMMARY

The information given in this Report has been obtained from examination of documents found at the target and from the interrogation of a designer employed in connection with Horten concerns.

A brief account is given of the Horten Brothers' careers and of their interest in tailless gliders and powered aircraft which has led, during the War, to the development of a jet-propelled fighter and a six-engined transport intended for post war civil use.

Descriptions are given of Horten Types I to XII and details are included of special aerodynamic, structural and mechanical features.

Information on the location and personnel of establishments connected with Horten activities is appended and notes are given of other items upon which information was obtained incidentally to the main subject of the investigation.

1. Introduction

The Horten Brothers' activities at BONN had been carried out in the family house at VENUSBERGWEG 12. At this house the team found drawings, photographs and models of the Horten tailless aircraft, and also living there, HERR F.J. BERGER, a draughtsman-designer who had been with the Horten organisation since about 1933. This man was found very willing to talk and it appeared that the only limitation on the accuracy of the data required would be due to his lack of deep technical knowledge. From March 11th to March 14th, 1945, inclusive, was spent in Bonn.

2. History and character of F.J. Berger

Berger was born in 1906. He became interested in sail planes and gliding in 1926 and has had considerable experience in modifications and minor constructional work, in addition to which he has had a basic technical training. He was approached by the Horten Brothers in 1931 and helped them at first without payment. After a period during which the work was interrupted by the younger Horten's call-up for military training he joined them again. His last position held the rank of REICHSANGESTELLTE in LUFTWAFFE KOMMANDO 9, and he was at their GÖTTINGEN headquarters from April 1942, to March 1943. He was then sent to their outstation at AEGIDIENBERG where he remained until about the end of January 1945. He then returned to Bonn apparently at the suggestion of the Hortens in order to make contact with the American or British authorities with a view to continuing the Hortens' tailless work after the war. During his time at Aegidienberg he had visited most of the other outstations of Kommando 9 on official duties.

Berger showed great willingness to provide information and the opinion was gained that he has no more technical information of any value to give. It should be borne in mind, however, that his position was only that of a junior designer and he would not therefore be expected to know details of policy, aircraft performance and other matters on which he would not need to have direct information. There seemed no reason to suppose that he was not, within the limits of his knowledge, speaking the truth.

3. History of the Horten Brothers' activities

Professor Dr. Max Horten was professor of Oriental Culture in the University of Bonn until he retired two years ago and went to live in the Harz Gebirge. He is about 60 years old. He had two sons, Walter, born on 13/11/13, and Riemar, born 3/12/15, and a daughter Gunhild. Walter is now a Major and Riemar an Oberleutnant in the Luftwaffe. Most of the original ideas on tailless aircraft came from Riemar, while Walter is a more political type and has fairly good contacts in the R.L.M. (German Air Ministry). Walter married a former secretary of the late Udet.

In 1931, after many model experiments, the brothers started work on their first tailless aircraft, the Horten I, constructing it in the house at Venusbergweg. This won a prize at the Rhoen competitions in 1934, and was then scrapped in favour of the Horten II, built at Bonn during 1933 - 34. This aircraft was later fitted with a small engine and extensively tested. Their work was interrupted for a period by the requirements of military service but was resumed with the manufacture of the Horten III at Berlin TEMPLEHOF in 1938.

After the outbreak of war Walter Horten seems to have been able to use his position in the R.L.M. to set up a special unit (LUFTWAFFE SONDER-KOMMANDO 9) with headquarters at GÖTTINGEN, to continue development of the Horten tailless aircraft. Riemar Horten was recalled to the Luftwaffe at the outbreak of war and is also working for this organisation.

During 1938 - 39 discussions took place with the Heinkel Company with a view to their engaging Riemar to be in charge of a design office working on tailless aircraft. Heinkels were to have had all the results of the Hortens' experience during the previous years and were to have taken out patents on this work in the name of Professor Heinkel. Three experimental prototypes of the Horten VII, a development of the Horten V, intended for use as a fighter-bomber, were to have been made.

The R.L.M. were interested in this development. Horten was not, however, satisfied with the terms offered by Heinkel and after a stormy meeting discussions broke down.

Similar discussions with Messerschmitt also broke down.

4. <u>Description of the Horten aircraft</u>

4.1 <u>General</u>

Riemar Horten was convinced at a very early stage that the most efficient form of aircraft would be the all-wing type and all his subsequent efforts appear to have been directed towards achieving this ideal. Evidence of this is shown by the complete absence of vertical stabilising or control surfaces on all Horten aircraft and the placing of the pilot in a prone position in the Horten IV in order to reduce cockpit size. Characteristics common to all the aircraft are a medium amount of sweep back (20 - 30°) and substantial wash-out (6 - 8°).

In the following paragraphs a general description will be given of each aircraft. Features such as the control system, spoiler details and structure common to several types are described in later paragraphs. Nos. I - V have been described fairly fully in the technical press. The details given here will be confined to those necessary to give a general picture of the lines of the Horten development.

R.L.M. numbers of the aircraft are given in Appendix III.

4.2 Horten I

The Horten I was built at Bonn during the period 1931 - 32 and had a flying life of about 7 hours. It was apparently fairly successful but did not fully satisfy the Hortens and they set it on fire in 1934.

It had a span of 12.4 m. (40 ft.) and a wing loading of about 2 lb. per square foot. The aircraft was of wooden construction, the wings being fabric covered. Only one control surface was fitted on each side, serving for both longitudinal and lateral control. Directional control was provided by brake flaps situated above and below the surface at the wing leading edge near the tips.

4.3 Horten II

The Horten II was built at Bonn during 1933 - 34, and incorporated experience gained from the Horten I. The span was 16 m. (54 ft.). It was first flown as a glider, but in 1935 a HIRTH H.M. 60R engine of 80 h.p. was fitted. The engine was submerged in the wing and drove a pusher propeller through an extension shaft. Wooden construction was used and rudder control was again provided by the use of brake flaps at the wing tips.

The Horten II was very extensively tested and is reported as having had good flying qualities. A report by Hanna Reitsch is given in Appendix V. It was almost impossible to spin the aeroplane since the wings had a large wash-out and as speed was reduced the wing root stalled, while the wing tips remained unstalled, causing the nose to drop while the wings remained level. Three further examples of the Horten II were built as gliders.

4.4 Horten III

The Horten III was built at Templehof, Berlin, in 1938, and a second aircraft, the IIIB was built by PESCHKE FLUGZEUGBAU in Berlin.

The span was 20 m. (66 ft.). The centre section was built up of welded steel tubes, while the outer wings were of wood. The undercarriage consisted of two retractable wheels arranged in tandem.

On the trailing edge of each wing were provided three moving surfaces. The innermost of these were used as landing flaps, while the middle and outer surfaces were used differentially as ailerons and elevators. Trimming tabs were provided. Directional control was provided by brake flaps at the wing tips.

Various experimental modifications were made to the Horten III. Dive brake flaps were fitted above and below the wing centre section near the leading edge and one aircraft was also fitted with automatic flaps on the under surface in order to limit the maximum diving speed. Later, "waggle tips" (see Fig. 33) giving lateral control by rotating the wing tip about a skew axis were tried out.

The Horten IIIC was fitted with a small additional wing forward of the main wing in order to give control down to low speeds. The Horten IIID was a motor sail plane with a propeller whose blades could be folded to reduce drag during gliding.

4.5 Horten IV

The Horten IV had a span of 20 m. (the same as the III) but had a very high aspect ratio (21.16). The first IV was completed at KOENIGSBERG-NEUHAUS in 1941.

A development of the Horten IVB with a laminar flow wing was built at HERSFELD. This aircraft was unsatisfactory owing to bad stalling characteristics of the wing, and it finally crashed in a spin.

The centre section of the wing was made of wood, fabric covered, while the outer wings were of light metal, this part being too thin for wooden construction to be practicable. The undercarriage consisted of a wooden skid which was retractable. Another feature was that the pilot occupied a half kneeling position in order to reduce the frontal area of the cockpit. (See Fig.13).

The Horten IV had three trailing edge control surfaces on each side, (see Fig.30). The outermost surfaces on each side were operated by rotary motion of the control column in the usual way and provided lateral control. The middle and innermost portions on each side were operated by fore and aft movement of the control column through common control rods. A system of cranks at the point of separation of these two surfaces was so arranged that aft movement of the stick caused the middle control surfaces to move upwards, while the innermost control surfaces displaced only slightly. Forward movement of the stick caused movement of the innermost control surface downwards, but only slight movement of the central surfaces. In this way the effective wash-out of the wing was maintained over the range of longitudinal control.

4.6 Horten V

The Horten V was designed from the outset as a powered aircraft using two Hirth HM.60R engines rotating in opposite directions. It had a span of 16.0 m. (50 ft.) and an aspect ratio of 6.1. The wing thickness ratio at the root was 16% and at the tip 8%. The centre section and fuselage were of welded steel tube construction, while the outer wings were of wood. It had the usual Horten control surfaces consisting of two pairs of surfaces operating differentially and was provided also with landing flaps under the centre section, and spoilers at the wing tips. The engines were completely buried in the wing and drove pusher propellers through extension shafts.

The undercarriage was of the tricycle type with a castorable nosewheel; all three legs were fixed.

The first Horten V was built at OSTHEIM from 1936 - 1938, and was originally a two-seater. It was rebuilt and converted to a single seater during 1941 - 42 in the Peschke factory at Minden, and was extensively test flown at GÖTTINGEN in 1943. The second aircraft was built almost entirely of plastic material. Details of the structure are given in para. 5.2.2. The cockpit of this aircraft was completely enclosed within the wing contour, and the undercarriage was retractable. It was provided with "waggle tips", but on the first test flight which was carried out under rather high wind conditions the aircraft bounced on landing. The pilot gave full throttle but only one engine responded, and the aircraft crashed on one wing tip.

4.7 Horten Glider Tug

The Hortens put forward a proposal for the use of a development of the Horten V as a towing aircraft for gliders. The chief advantage claimed was that the point of attachment of the towing cable could be very close to the centre of gravity and the tug would therefore be less susceptible to the position of the glider.

4.8 Horten Parabola

The Hortens constructed a glider whose wing plan form was that of two parabolas meeting at the wing tips. (see Fig. 23). It was built at AEGIDIENBERG, but was unfortunately damaged while being transported and never flew.

4.9 Horten VI

The Horten VI was a version of the Horten IV with an increased span and less dihedral. (See Fig. 21). It also was built at Aegidienberg. It was thought to be too awkward in handling to be a practicable proposition.

4.10 Horten VII

The Horten VII is basically similar to the V but is powered with two Argus AS10C motors of 240 h.p. each. It appears to be intended chiefly for the training of pilots in tailless aircraft. The first was built by Peschke of Minden and is known to have been at Oranienburg in March 1945. At that time the second aircraft was nearing completion at Minden and altogether some twenty were to have been built.

A difference from the V is that directional control is provided by means of a bar which projects spanwise from the wing tip to give additional drag. (See para. 5.1.2). An explosive hub is being designed for jettisoning the propellers of this aircraft in an emergency.

4.11 Horten VIII

The Horten VIII is an all wing aircraft of about 48 m. (158 ft.) span powered by 6 B.M.W.6 motors of 600 h.p. each, driving pusher propellers. The first prototype, being built at Göttingen, was expected to be ready for flight in about November 1945.

It has been designed as a commercial aircraft for use on services such as the Atlantic crossing with accommodation for about 60 passengers. The original span was to be 60 to 80 m. but it was restricted to 48 m. because that was the greatest that could be accommodated at Göttingen. The centre section of the wing is of welded steel tube construction while the outer wings are of wood with one main spar and one auxiliary spar. No pressure cabin is fitted. The control system is similar to that of the other Horten types.

Informant thought that the range would be 6000 km. at 300 - 350 km. per hour cruising speed, at an altitude of 1000 - 2000 m.

4.12 Horten IX

4.12.1 General. The Horten IX is a single seater fighter bomber of about 16 m. (50 ft.) span with two jet engines. The general arrangement drawing, shown in Fig. 25 was developed from a project drawing found at Bonn and incorporates corrections supplied by informant. The plan form is very similar to that of the Horten V, but differs in that the cabin is prolonged aft of the trailing edge of the centre line so that it comes to a sharp backward facing point. The engines were said to be a B.M.W. jet (model number not quoted) and informant thought that they gave 500 kg. static thrust. This is of course low.

4.12.2 <u>Sub types.</u> Sub-types V-1, V-2, V-3 and V-4 were mentioned. In the design the jet engines are built through the main spar of the wing and after V-1 had been built it was found that the diameter of the engine was larger than had been expected. The aircraft was therefore completed as a glider for flight tests. V-2 was built to take the large diameter engines. Both V-1 and V-2 were built at Göttingen. The production order had been given to the Gotha Company and they were building V-3 as a check on the suitability of the aircraft for series production.

V-4 was mentioned as being a two-seater version intended as a night fighter with the cockpit extended forward of the leading edge.

All details given below refer to V-2 since informant had no detailed information on the later models.

4.12.3 <u>Structure.</u> The wing had one main spar and one auxiliary spar. The centre section is built up from welded steel tubing and the outer section is of wood with plywood covering. The wing tips are of metal. Special attention has been paid to obtain a smooth finish on the wing by the use of a surface lacquer.

The undercarriage is of the tricycle type. The main wheels retract inwards and the nose wheel backwards. The nose wheel is castorable and is centred by a roller and cam.

4.12.4 <u>Control System.</u> The trailing edge of the wing is divided up into three sections on each side, each of which is independently movable. The innermost section is locked up on V-2 but will probably be used as a landing flap on later models. The middle and outermost sections are used for lateral and longitudinal control. Typical displacements are given in the table in para. 5.1.1.

The system for giving lateral control is described in para. 5.1.1.

In order to increase the pilot's advantage at high speeds, the lever arm of the control column may be doubled by lifting the whole control column a few inches upwards.

Tabs are fitted to the middle controls only, and are of the combined geared balance and trim type.

On the V-2 the control surfaces are made of metal but informant thought that this might later be changed to wood.

4.12.5 Armament. The normal full load equipment of the aircraft is 4 x 35 mm. cannon in the centre section and 2000 kg. bombs. No armour plating is provided on V-1 and V-2.

4.12.6 Performance. The only reliable figure provided by the informant is that the wing loading was 180 - 190 kg. per square metre (38 lb. per square foot) with the full load of bombs, cannon and fuel. On this basis the gross weight of the aircraft would be about 8000 kg. The top speed was given as 1160 km. per hour (720 miles per hour) at 6000 - 7000 metres (21,000 ft.). An estimate based on the layout shown in Fig. 25 and a thrust of 1600 lb. per turbine gives a top speed of 520 m.p.h. at 20,000 ft.

The take-off speed at light load was stated to be 130 - 140 km. per hour and the ground run 500 m.; at full load the estimated run is 1000 m. Rocket assistance was not therefore contemplated.

Endurance at full load was stated to be 4½ hours. Estimates based on the probable tank capacity obtained from the space available in the wings shows an endurance of 4 hours and a cruising range of 1650 miles.

4.12.7 Miscellaneous. A spring catapult seat is provided for ejecting the pilot in emergencies. On the experimental models there is no provision for de-icing nor are leak proof tanks provided.

As may be seen from the drawings the turbine exhausts are on the upper surface of the wing, and to protect the wing, metal plates are provided aft of the exhaust at a distance of about 10 mm. from the wing surface.

4.13 Horten X

The Horten X is being built at HERSFELD.

Informant did not know the exact description of Horten X but thought it was either:-

(i) A Horten III with the "waggle tips" (controllable wing tips)

or (ii) A glider with very sharply swept back wing.

He thought that the Hortens had not abandoned the idea of the controllable wing tips and they also had been doing a lot of research on very high sweepbacks, involving the testing of models.

4.14 Horten XI

The Horten XI is also being built at HERSFELD. It is a single seater glider of about 8 metres span, and is specially designed to be fully aerobatic.

4.15 Horten XII

The Horten XII was designed at GÖTTINGEN and is being built at KIRTORF. Informant thought that this aircraft had reached the flight test stage. It is a two seater, side by side, with a 50 h.p. D.K.W. or Hirth engine and is intended as a private transport aircraft. It is basically similar to the Horten III. Informant stated that the R.L.M. were interested in this aeroplane.

5. Special Features of the Horten Aircraft

5.1 Control

5.1.1 Longitudinal and Lateral Control. The first Horten aircraft (the H.1) was fitted with one trailing edge control surface on each wing which acted in the usual way as an elevon giving longitudinal and lateral control. Landing flaps were not fitted.

On the H.II two trailing edge control surfaces were fitted on each wing and were coupled so that the outboard surfaces give primarily lateral control and the inboard surfaces primarily longitudinal control. Owing to the kinematics of the linkage system, however, slight displacements of the inboard surfaces occur when the stick was put to the left or right and slight displacements to outer surfaces when the stick was put forward or back.

The H.III had two pairs of control surfaces working as on the H.II and in addition was provided with landing flaps on the innermost section of the wing.

On the H. IV the controls were still further split up. A diagram of the system is given in Fig. 30. There are three movable control surfaces on each wing. The outermost of these surfaces give primarily lateral control by a symmetrical motion when the stick is put to the left or right, but they also deflect slightly when the stick is pushed forward or back, The middle surfaces are capable of a large deflection upward but only a small deflection downward, while the innermost surfaces are capable of a large deflection downward and only a small deflection upward. By suitable coupling between the control system and the control surfaces it is so arranged that the deflections of the three controls for a given stick position increase or decrease progressively along the span. Thus, on a down-going wing, the outermost control will have the greatest deflection, the middle control the lesser deflection and the innermost control the least deflection; while on an up-going wing, the innermost control will have the greatest deflection and the outermost control the least. By this means the washout of the wing is maintained even when the controls are displaced.

With the H.V a reversion to the two-control system was made (see Fig. 22). On this aircraft the outer controls are used to produce a nose up pitching moment, while the inner controls are used to produce nose down moments. The relationship between the deflections of the two pairs of surfaces is arranged to keep the wing twist constant whatever the amount of control applied. By using the elevating control on one side and the depressing control on the other an aileron effect is obtained. It is claimed that by this use of the controls, no adverse yaw is caused.

The H.V is provided with three flaps for take-off and landing. These are situated on the centre section. The part of the flaps between the engines drops to 60°, the parts just outboard to the engines to 40°, while on the original version of the aircraft, the inner control surfaces were arranged to drop 30° while still retaining their function as elevators giving nose down moments.

The control systems on the HVI and HVII are respectively similar to those on the HIV and HV.

The Hortens appear to have been satisfied with the use of two pairs of control surfaces in this way because the same scheme has been adopted on the HVIII and HIX. The maximum control deflections are said to be as follows:-

Control column position	Outermost control, port wing	Middle control port wing	Middle control starboard wing	Outermost control starboard wing
Left	20° up	2° up	20° down	2° down
Right	2° down	20° down	2° up	20° up
Forward	5° up	30° down	30° down	5° up
Back	30 - 45° up	5° up	5° up	30 - 45° up

With regard to control shapes, the final practice seems to be the use of a Friese nose on the outermost control (which functions mainly as an aileron) usually with a large amount of forward balance. The inner controls have usually blunt rounded noses or a very blunt nosed Friese section and a combined trim and balance tab is normally fitted. On the H.IV the Friese aileron is mounted on a skew hinge whose effect is to cause a large projection of the nose below the wing surfaces when the aileron is displaced upward (see Fig.16). This helps to give a favourable yawing moment.

5.1.2 Directional Control. On all the Horten aircraft, directional control is provided by drag rudders operated in the usual way. None of the aircraft are fitted with vertical fins. On the H.I, II, III and V, the control is situated on the leading edge near the wing tip. The portions of the wing surfaces between the stagnation point and the main spar are arranged to pivot outwards about a hinge line approximately at the stagnation point (see Fig.11), this gives a drag force on the appropriate wing.

On the H.IV and H.VI a plate type spoiler is provided on the top and bottom surfaces of each wing between the ailerons and the front spar. The plates project when the rudder bar is deflected. A similar system is believed to be used on the H.VIII.

On the H.IX, this development has been taken a stage further. The installation consists of a large and a smaller spoiler on the upper surface and a similar pair on the lower surface just behind the main spar near the wing tip. Spring links are incorporated in the control system so that as control is applied the two smaller spoilers on one side appear first and are followed by the two large spoilers when the former are fully deflected. This is, of course, to give smooth and progressive control at high speed combined with adequate control at low speeds.

The H.VII was stated to be fitted with an entirely different type of directional control. A wooden bar is mounted on a system of rollers behind and parallel to the main spar at each wing tip. Displacement of the rudder bar causes the bar on one side to project in a spanwise direction from the wing tip causing a drag on this side. This control was said to be very pleasant and satisfactory in flight. It has the advantage over the other types of drag rudders that it does not blanket the effect of the ailerons.

The use of a movable wing tip to give lateral control has been actively investigated by the Horten Brothers. In short, the whole wing tip is hinged on a skew axis so that it can rotate forward with a decreasing incidence or backward with increasing incidence, (see Fig. 33). A geared tab may be provided to balance the loads on this control.

The Horten III was first modified to take this control but the flight results were not satisfactory. The pilot reported that he was unable to hold the stick which was threshing about fairly violently in all directions.

The plastic version of the H.V was built with an improved form of this control but as this aircraft crashed on its first flight (for other causes see paragraph 4.6) no information is available on its behaviour. Informant was of the opinion that the Hortens had not given up hope of making this type of control satisfactory.

5.1.3 Brake Flaps. The Horten III was the first of the series of gliders to be fitted with brake flaps as distinct from drag rudders. These were in the form of blunt flaps situated on either side of the cockpit at about 30% chord on the upper surface of the wing. The flaps hinge forward against the air stream.

One version of the H.III was also fitted for experimental purposes with flaps on the under surface of the wing intended automatically to limit the diving speed. These were double flaps, hinged so that in the closed position their free edges were adjacent. The opening of the flaps was controlled by a small flap on the upper surface of the wing near the leading edge, this small flap being sensitive to the pressure change occurring at negative incidence.

The H.IV and H.VI are fitted with brake flaps just aft of the main spar and inboard of the main control surfaces. Two drag flaps are installed on each wing and extend at right angles to the wing surfaces, one above and one below the wing, (see Fig. 14).

5.2 Structural and Mechanical Details

5.2.1 No detailed weight analyses were obtained from the Informant and he did not know any details of strength factors or basic design conditions. No results were obtained of strength tests. Features of structural and mechanical interest are described below.

5.2.2 Structure. Laminated spar booms are a conspicuous characteristic of the Horten designs and the H.VI spars illustrated in Fig. 34 are a typical example of spar boom construction and the method of fixing at the root. In the case of the H.VI the laminations are a mixture of plain wood and "Lignofol" (thought to be impregnated, compressed wood), and the spar has three plywood webs. The H. IX has plain wood laminated spars and the H.V plastic wing had spars built up of plastic laminations.

The leading edge of the H.IV wing was of plastic construction and was manufactured at Dynamit A.G. Troisdorf. It is a sandwich with inner and outer skins of "Dynal" stabilised by a "Tronal" core. Details of the manufacturing processes used are given in Document 4 of Appendix IV. A short summary of this document with comments is given in Appendix VI.

From sketches made by the Informant it was gathered that the H.V plastic wing was covered with plastic sheeting, which was reinforced spanwise by triangular section stringers glued to the sheet, and was screwed on to wooden rib booms. The rib webs were of plastic sheet. The main spar had plastic laminated booms with a lattice type web of plastic sheet with triangular cut outs, the sheet being reinforced with plastic sections. The Informant's references simply to "glueing" suggested the general use of some form of cold setting adhesive. (An account of the construction of this aeroplane is given in R.T.P.3. Translation No. 2337).

5.2.3 Mechanical Details. The aileron operating mechanism used on the H.IV is novel; it was reported to have been quite satisfactory in use. It is illustrated in Fig. 32. Operation of the push rod causes motion in the horizontal plane of a bar which pivots at a point on the aileron hinge line. The pivot is at an angle both with the hinge line and with the vertical in side elevation, so that movement of the bar produces angular movement of the aileron.

The same principle is applied in the mechanism operating the spoilers on the H.VII. This is illustrated in Fig. 31. It is interesting to note the simple method of sealing the spoiler slit when the spoiler is retracted.

6. Incidental Intelligence

6.1 Dr. Lippisch

Informant stated that after the Hortens' discussions with Messerschmitt broke down Messerschmitt's engaged Dr. Lippisch, and he designed the Me. 163. Informant thought that Lippisch had now left Messerschmitt and was working on his won in Vienna.

Relations with the Horten Brothers and D.F.S., with which Lippisch was actively concerned, have never been good, allegedly because Lippisch had predicted that the Horten aircraft would be directionally unstable unless vertical fins were fitted This has not proved to be the case.

6.2 Me.262 - Ar. 234

Informant stated that the speed of the Me. 262 was 900 km. per hour and of the Ar.234 was well over 800 km. per hour. He stated that the Horten IX was considerably faster than either of these.

6.3 Do. 335

Informant thought that this aircraft was fitted with explosive for jettisoning the propeller in emergencies. The explosive is retained in an external collar fixed to the hollow propeller shaft. He believed that the operation of this was synchronised with the blowing off of the cockpit hood and the ejection of the pilot by means of a catapult seat.

6.4 Tailless Pilotless Aircraft

Informant had never heard of any radio controlled tailless aircraft and thought he would have done so if the Horten organisation had been involved in any way in their development.

6.4 Göttingen Aerodynamic Research Establishment

Informant had little knowledge on the activities of the main Göttingen Research Establishment but was sure that they had a high speed wind tunnel which was operated by compressed air and could be used only for a few seconds at a time. He mentioned that Hortens had proposed the building of a venturi of 3 metres throat diameter under the tip of the Horten VIII so as to provide a flying wind tunnel in which model experiments could be carried out.

APPENDIX I

LOCATIONS OF HORTEN ACTIVITIES

Both the Horten brothers are attached to Luftwaffe Sonder-Kommando 9, of which Walter Horten (Major) is in command. The headquarters are located in Göttingen. The activities of Luftwaffe Sonder-Kommando 9 are carried on in the following localities:-

1. Göttingen

Headquarters of Luftwaffe Sonder-Kommando 9. Located at the Reichsautobahnenmeisterei, which is about 100 yards off the main Autobahn into Göttingen. The H.VIII is being built here, as were the H. IX V-I and V-2.

2. Hersfeld (35 miles S. of Kassel; 9° 40', 50° 50')

The H.IVB the model of the aircraft with pronounced sweepback (the "flying arrow") and the wing with movable tips were built here, at the Reichsautobahnenmeisterei.

3. Kirtorf (9° 10'; 50° 45')

The H.XII is being built here.

4. Hornberg (Near Schwabisch Gmünd, in the Black Forest)

Work here includes flight tests and performance calculations. The establishment is at the N.S.F.K. School.

5. Gut Tierstein (Near Rottweil, in the Black Forest; 8°40', 48° 20')

This is a new installation, located in the Bauernhof.

6. Aegidienberg (West of Koblenz)

The metal outer panels for the H.IVB may be being built here, in a factory housed in the dance hall.

7. Berlin - Oranienburg

H.IX, V-1 and V-2 were here for testing about the end of January 1945. The H.VII has also been tested here.

8. Peschke Fluggengbau-Minden

The factory here is working for Luftwaffe Kommando 9. Repairs to different types of aircraft are done here. The factory has made wings for the Fieseler Storch. The first H.VII was made here and the second is nearing completion. The factory is to undertake production of H.VII.

9. Gotha Waggon Fabrick

The H. IX V-3 is being built here; one is nearing completion.

APPENDIX II

PERSONNEL AT ESTABLISHMENTS CONNECTED WITH HORTEN ACTIVITIES

The following is a list given by the Informant of personnel engaged on work connected with Horten activities in the factories and establishments given in Appendix I.

1. **Göttingen**

Albert Schmitt	Office
Alfons Mirgel	"
Mirgel	"
Albert Metzger	Foreman in charge of metal work
Sebode	Foreman in charge of wood construction
Friedholm Hildebrand	(Materialanderung)
Krack	(Material verwaltung)
Kurt Naul	Designer
Franz Brüne	"
Ewers	"
Kurt Trieb	"

About 40 others are employed here, of which about 20 are workmen and 20 are soldiers.

2. **Hersfeld**

Matias Ludwig	Manager
Walter Frömann	Designer
Gunter Penschuk	"
Keller	"

There are about a dozen other civilians, including mechanics and carpenters, and also 4 or 5 soldiers.

3. **Kirtorf**

Wierling	Manager
Walter Günter	Designer
Warmund	Designer

There are eight or nine others, including mechanics, carpenters and labourers.

4. Hornberg

Gunhild Horten	....	Calculator
Oberleutnant Wagner	....	In charge
Karl Nickel	....	Flight Organiser
Mallinovski	....	" "
Georg Schaden	....	" "

5. Gut Tierstein

Rolf Schmied	....	In charge
Max Schmied	....	Manager
Hans Rosskamp	....	Carpenter

6. Aegidienberg

Karl Hoch	....	Manager
Winkels) Tendler) Metzger)	....	Craftsmen

7. Berlin - Oranienburg

Leutnant Ziller	....	Test Pilot
Oberleutnant Scheithauer	......	" "
Preubler	....	In charge
Erwin Schier	....	Mechanic

8. Peschke Fluggengbau - Minden

König	....	Designer
Leutnant Sessig	....	"

APPENDIX III

R.L.M. NUMBERS OF HORTEN AIRCRAFT

Horten Aircraft No.	R.L.M. No.
H.III	250
H. IV	251
H. V	252
H. VI	253
H.VII	226

APPENDIX IV

INDEX OF DOCUMENTS RECOVERED BY THE VISITING TEAM

These documents may be obtained on loan by application to the C.I.O.S. Secretariat.

(Note.- Documents 1 - 88 contain technical information
Documents 101 - 106 contain personal and general information)

Document Number	Description of Document
1	Flugzeng-Typenbuch 1940. Contains details of the H.II, as glider and powered version, the H.III and the H.V.
2	Flugzeng-Typenbuch 1944.
	The above publications give details of German aircraft in a form similar to Janes' publications.
3	Report on Flight Tests of H.II, made by Hanna Reitsch. (A translation of this Report is given in Appendix V).
4	Folder on the use of plastics. (A summary of the contents of this folder is given in Appendix VI).
5	Bauvorschriften für Segel-Flugzunge - Heft 1 "Vorschriften für die Festigkeit von Segel-Flugzeugen" Oct. 1936.
6	Bauvorschriften für Segelflugzeuge (BVS) - Heft 3 "Flugwerk" Aug. 1939.
7	Data on kinematics of Control Systems. There are three separate diagrams, giving graphs of the relationship of stick and control surface angular movement. The precise type to which these diagrams refer is not identified.
8	Photograph of H.II, H.III and H.IV (these views are similar to those in Fig. 8 of this Report).
9	Photograph of H.II with H.M.60 Engine, on ground.
10	Photograph of H.II glider in flight
11	" " H.II " " "
12	" " H.III " " "

Document Number	Description of Document
13	Photograph of H.IV Brake Flaps (This is reproduced in Fig. 14 of this Report)
14	Photograph of H.IV aileron (This is reproduced in Fig. 16 of this Report).
15	Photograph of H.IV in flight, with upper and lower brake flaps extended.
16	Two large photographs of H.II in flight.
17	Two large photographs of H.IV in flight.
18	Large close-up photograph of H.IV on ground
19	Photograph of H.IV in flight
20	Small rear view photograph of H.V plastic version
21	Rear view photograph of H.VII in flight
22	Photograph of H.VII wing under construction
23	Photographs of H.IX - Installation of Jet Engines (These are reproduced in Figs. 1 - 7 of this Report).
24	Tracing of H.I, II, III, IV and VI (the details on this drawing are similar to those given in Figs. 17, 18, 19, 20 and 21 of this Report).
25	Drawing of H.I, II, III, IV, V and Parabola. (The details in this drawing are similar to those given in Figs. 17, 18, 19, 20, 22 and 23 of this Report).
26	G.A. of H.II (The details of this drawing are similar to those in Fig. 18 of this Report).
27	Drawing of H.IIL dated 3.9.36
28	Drawing of H.IIIB - G.A.
29	Large G.A. of H.IIIB dated 7.7.39 No. 108 - 250 Sl.
30	Large G.A. of H.IIID (motor version) dated 18.11.40 No. 108 - 250 Sl

Document Number	Description of Document
31	Large G.A. of H.IIID dated 21.5.44 showing folding propeller.
32	Drawing of control system of H.IIID dated 9.12.40. No. 108.250.41.U (see also document No. 69).
33	Drawing of control system of H.IIIB dated 22.6.39. No.108. 250.41.
34	Small tracing of H.IV G.A.
35	Drawing of H.IVB Elevon Nose Shapes of plastic construction. No internal construction shown. No. 108.251. 60; dated 17.12.43.
36	Drawing of H.IVB aileron operating gear. No.108.251.60 dated 8.12.43. (This gives details of the operating gear shown in Fig. 32 of this Report).
37	Drawing of H.VC Model, dated 18.10.41
38	Drawing of H.VC Model, dated 4.10.41
39	Drawing of H.VC Model, dated 3.10.41
40	G.A. drawing of H.V. showing control system; dated 30.5.41
41	G.A. drawing of H.VD (two-seat version) No.8.252.0 dated 19.3.42
42	G.A. drawing of H.VD (single seat version) No.8.252.0 dated 23.3.42.
43	G.A. tracing of H.VIA No. 108.253.00 dated 16.5.44.
44	Tracing of H.VI Wing G.A., showing ribs and control runs. No. 108.253.51 dated 16.1.43.
45	Tracing of H.VIA outer wing, with a section across the spoilers. No. 108.253.60 dated 22.9.43.
46	Drawing of H.VI welded steel centre section spar. No. 108.253.11 dated 25.9.42.
47	Tracing of H.VI laminated spar showing wing root fixing. No. 108.253.51 dated 29.9.42.

Document Number	Description of Document
48	Tracing of H.VI laminated spar showing complete spar and details of laminations. No.108.253.51 dated 18.9.42.
49	Drawing of H.VIA outboard elevon. No.108.253.35 dated 20.9.43.
50	Tracing showing H.VI wing sections at ribs 14.5, 15 and 15.5 with details of construction. No.108.253.50 dated 8.12.42.
51	Tracing showing H.VI wing sections at Ribs 2.25 and 2.5 No. 108.253.50 dated 12.10.42. (Note the sketch in Fig. 34 of this Report is based on documents Nos. 47, 48 and 51).
52	Drawing of H.VII Top Inner Spoilers. No. 8.226.37 dated 9.1.44
53	Drawing of H.VII Left Spoilers No. 8.226.37 dated 6.1.44
54	Drawing of H.VII Lower Spoilers. No.8.226.37 dated 7.1.43.
55	Drawing of H.VII Top Outer Spoilers No. 8.226.37 dated 10.1.44
56	Drawing showing sheet metal body of spoiler for H.VII No. 8.226.37.01.01 dated 8.1.44
57	Drawing showing sheet metal body of spoiler for H.VII No. 8.226.37.03.01 dated 12.1.44
58	Drawing showing sheet metal details of spoiler operating arm, for H.VII
59	Drawing showing sheet metal details of spoiler operating arm, for H.VII
60	Drawing showing machined fittings and assembly of spoiler operating linkage for H.VII No.8.226.37.00 dated 14.1.44
61	Drawing showing further detailed fittings of the spoiler operating linkage for H.VII, No. 8.226.37 dated 14.1.44 (see Note on next page)

Document Number	Description of Document
61 (contd.)	(Note: a sketch of the method of operation of the above is given in Fig. 31 of the Report).
62	G.A. drawing of the H.IX V-1 project dated 26.3.42 (a drawing of the developed aircraft is given in Fig.25 of this Report).
63	Sketch of H.VIII (This is reproduced in Fig.24 of this Report).
64	G.A. Tracing of Horten Tug dated -, 12, 40 (This is reproduced in Fig. 28 of this Report).
65	Small two-view G.A. of Horten Tug
66	Draft report by Riemar Horten outlining proposals for the development of the Horten tug.
67	Drawing of a retractable cable system for glider towing
68	Tracing of a proposal for a highly loaded motor sailplane.
69	Outline drawing of H.IIID control system, giving angles of movement. No.105.250.40 (see also document 32).
70	Drawing of H.V control system (This is reproduced in Fig. 29 of this Report.)
71	Drawings giving performance data on the H.V
72	Photograph of Horten Parabola (This is reproduced in Fig. 12 of this Report)
73	Photograph of H.II, H.III, H.IV and H.V (This is reproduced in Fig. 8 of this Report)
74	12 different photographs of the H.V. (Two of these are reproduced in Figs. 9 and 10 of this Report. Others show centre section and wing structure.)
75	6 different photographs of the H.IV (Two of these are reproduced in Figs. 13 and 14 of this Report. Others show spoiler operating mechanism and control surface construction).

Document Number	Description of Document
76	3 photographs of the H.III drag rudder. (One of these is reproduced in Fig. 11 of this Report).
77	Photograph of H.IV wing under construction
78	Photograph of H.III wing with control surfaces deflected
79	Close-up aft view of H.II on ground
80	2 photographs of model with highly swept back wing
81	Close-up view of centre section structure and pilot's control of H.VI
82	Photograph of H.III wing damaged in crash
83	Close-up view of H.III wing tip with aileron deflected
84	Photograph of upper surface of H.III wing with spoiler deflected
85	Close-up front view of H.V.
86	Drawing of spoiler for H.IIIB and D
87	Explanatory sketches made by F. Berger during interrogation.
88	List of personnel at Kommando 9 establishments (Appendix II of this Report includes the more important personalities of this list).
101	Berlin Technical Highschool Yearbook 1939
102	Organisation of Fighter Squadron No. 26 for War
103	General correspondence of the Horten Brothers
104	Correspondence on dealings between the Horten Brothers and Heinkel
105	Identity Pass with photograph for Riemar Horten to D.A.G. Troisdorf
106	Identity Pass with photograph for Walter Horten to D.A.G. Troisdorf

APPENDIX V

FLIGHT TESTS OF THE HORTEN II

The following is a translation of a German report on the flying characteristics of the Horten II, prepared by the well-known Hanna Reitsch.

Flight Tests of the Horten II, D-11-187 on the 17.11.1938 in Rangsdorf

The Horten II was tested by Hanna Reitsch (D.F.S. Darmstadt) at the request of General Udet.

The type tested was built in 1934 and has since been further developed and improved in types H.III, H.IV and H.V. (The Horten III was successfully flown in the 1938 Rhoen competitions and attained a height of 8,000 metres (26,000 ft.); it was destroyed in a hail storm but was flown again in 1939. The H.IV and H.V were completed in December 1938). The following report on the flying characteristics must not therefore be regarded as representing the present stage of development of tailless aircraft by the Horten Brothers. The flying qualities do not correspond to present day demands. The following should however be noted:- it possesses great static longitudinal stability and complete safety in relation to the spin.

Flying Characteristics

The builders of the Horten II did not have sufficient raw materials available for its manufacture, and the aircraft shows this; the resulting construction has made testing very difficult. For lack of ball bearings the control surfaces are so heavy that measurements of stability cannot be carried out.

(A) Cockpit

- (i) Comfort. Not exceptional.
- (ii) View. View is bad since the edges of the cockpit hood cut off the view at eye level.
- (iii) Entry and Exit. Only possible for athletes.
- (iv) Parachute arrangements. Satisfactory
- (v) Arrangement of the Instruments. Not very satisfactory.
- (vi) Arrangement and operation of the retractable undercarriage. Only possible for long armed pilots.
- (vii) Friction of the control surfaces. Unsatisfactory.

(B) Take-off and landing characteristics

Take-off

The use of normal take-off technique is not recommended because of the long run that results. The take-off is best carried out with the control column fully back until the aeroplane rises from the ground without change of incidence. When two or three metres height is reached the control column may be put forward so that the aeroplane attains a normal flying attitude. It is thought that the long take-off which otherwise results is caused by the unsatisfactory arrangement of the undercarriage.

Landing

Landing, even on a small field, is easily made by means of the landing flaps and use of the drag rudders on both sides so that they act as dive brakes. The landing run is normal.

(C) Balance and stability

Balance and stability could not be adequately tested since the control column would remain in any position in which it was put because of friction. Static longitudinal stability is good.

(D) Controllability and control forces

Longitudinal control

The motion is strongly damped. Loads are normal.

Lateral Control

Response is inadequate and unpleasant due to a large negative yawing moment which appears when the controls are displaced. The control forces could not be accurately judged because of friction and also buffeting of the control column caused by gusts. This fluttering of the ailerons is probably caused by the lack of static balance of the control surfaces. The over balance of the controls also gives a feeling of lateral instability which however is not present during flight in calm air.

Directional control

There are upper and lower surface spoilers on the outboard wing. When they are operated response occurs suddenly. Operation of the directional control suddenly slows down the inner wing and the aeroplane turns immediately about both the vertical and the longitudinal axes.

The relation between the forces on the three controls is not satisfactory.

(E) Turning flight

Turns are only possible with difficulty, i.e. they are impossible with ailerons alone and can only be made using the drag rudder.

Manoeuvrability

If strong drag rudder movement is applied, manoeuvrability is good. The true bank cannot be easily obtained (it must be noted that the test pilot could retract the undercarriage and this would adversely influence the banking properties).

(F) Side Slip

Side slipping cannot be carried out on the Horten II.

(G) Characteristics in the Stalled Flying Condition

The aeroplane cannot by any sort of control movements be made to drop the wing or to spin. With the control column pulled right back the machine pitches lightly forward and sinks without reaching a speed of more than 90 kilometres/hour. (This is a great help in flying through cloud if the instruments are iced up).

General

The above failings are to be taken up with the Horten Brothers with regard to further developments of the machine.

Darmstadt Airfield 12.11.38

APPENDIX VI

Test Note by Dynamit A.G. Troisdorf - Cologne on an experimental main plane leading edge for the Horten IV constructed in a sandwich material.

The object of the experiment was to try the possibilities of alternative materials and to try a very simple method of assembly.

The leading edge was constructed of two skins of a paper-reinforced phenolic resin sheet ("Dynal") stabilized by a core of wall board ("Tronal"). The core was stuck to the skins by an acid-catalysed cold-setting phenolformaldehyde resin ("Polystal" or "K.10") and the whole assembly was done cold, using flat sheets pressed into a female jig by a shaped wooden male former actuated by a screw clamp. Various densities and thicknesses of wall board were tried, as well as different techniques for spreading the glue.

This very simple method of assembly is only possible if very weak low quality materials are used. Thoroughly impregnated phenolic sheet would be too brittle to bend round such a small radius, so a very unevenly impregnated material is used which is probably made by pressing up alternate sheets of kraft paper and Tego-filling. The low resin content of patchy impregnation would give a material of low stiffness and very bad water-resistance. The core appears to be a low quality wall-board. The whole assembly would deteriorate very much in stiffness and probably buckle badly when wet. No weathering tests are recorded.

Attached to the report are notes on a cold-setting acid-catalysed phenol-formaldehyde resin glue for metals. The strength figures are reasonable (but on the whole lower than those achieved by Redux and other methods), but no corrosion tests are mentioned, and it seems that this is likely to be critical. It is not clear whether the glue was used pure or whether some thermoplastic resin was added - but it would be worth investigating the possibilities further. If it does not cause corrosion, a cold-setting adhesive for metals is very attractive.

LIST OF ILLUSTRATIONS

FIG. 1.

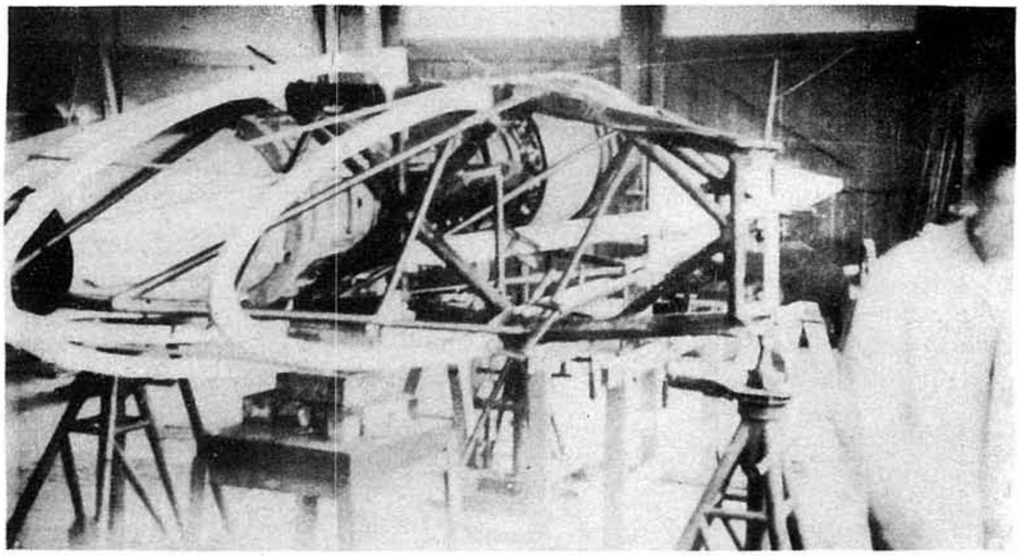
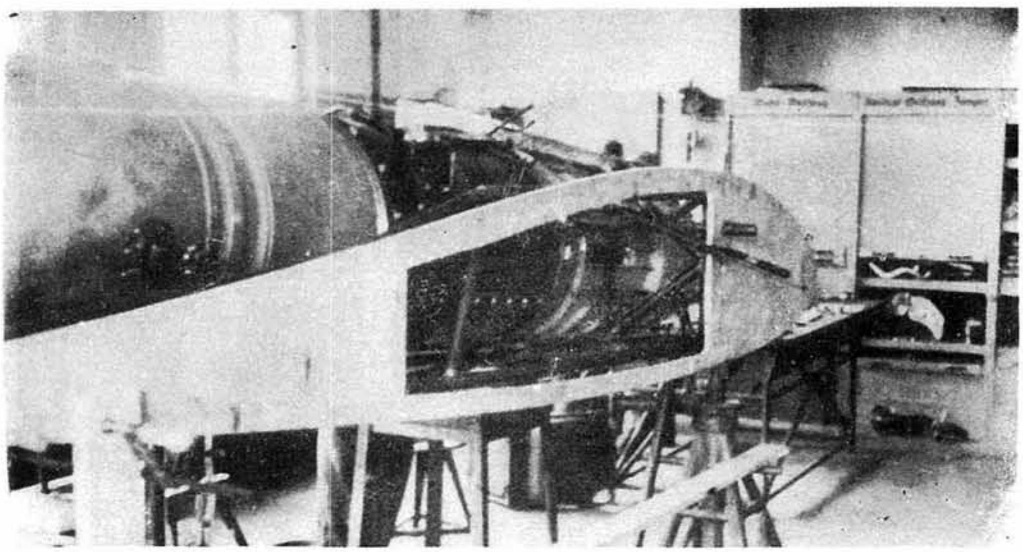


FIG. 2.



MOUNTING OF JET ENGINE IN HORTEN IX.

ROYAL AIRCRAFT ESTABLISHMENT
PHOTOGRAPHIC DIVISION
COPY NEG No. 61044
DATE 27. 3. 45.

FIG. 3.

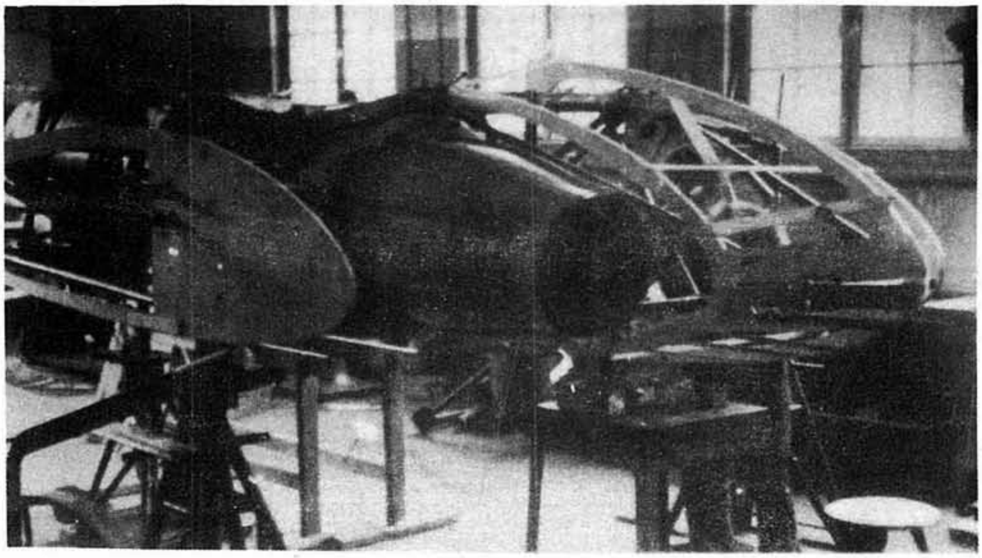
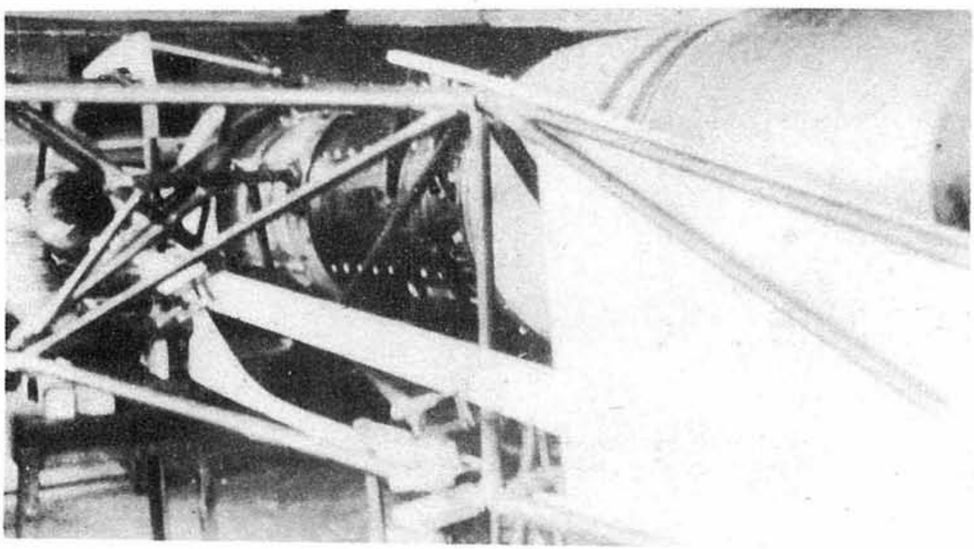


FIG 4.



MOUNTING OF JET ENGINE IN HORTEN IX

FIG. 5.

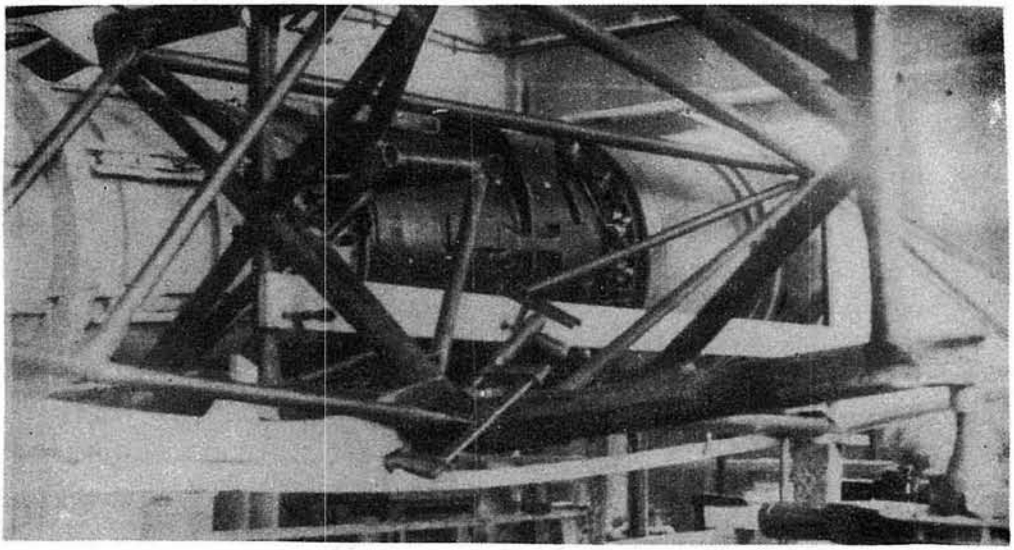
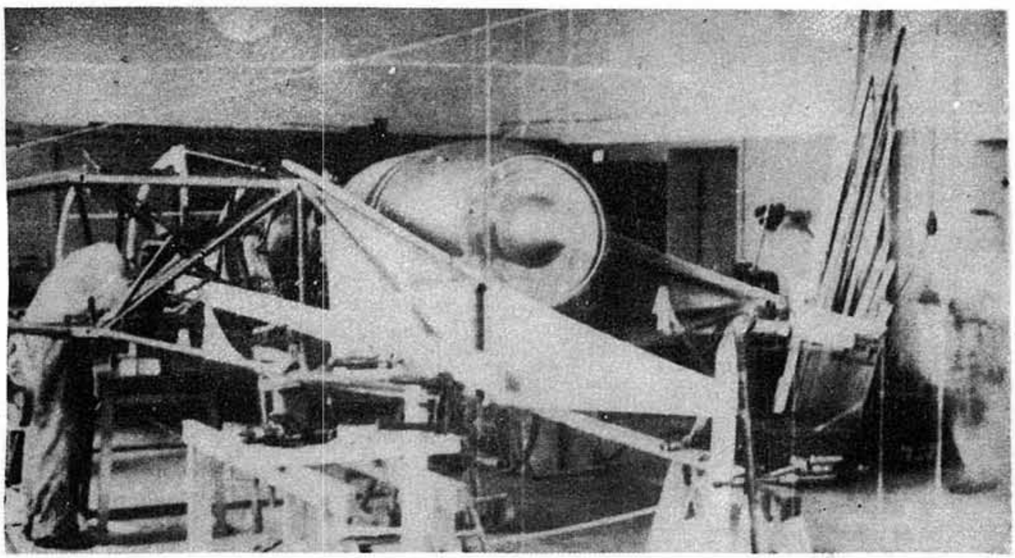


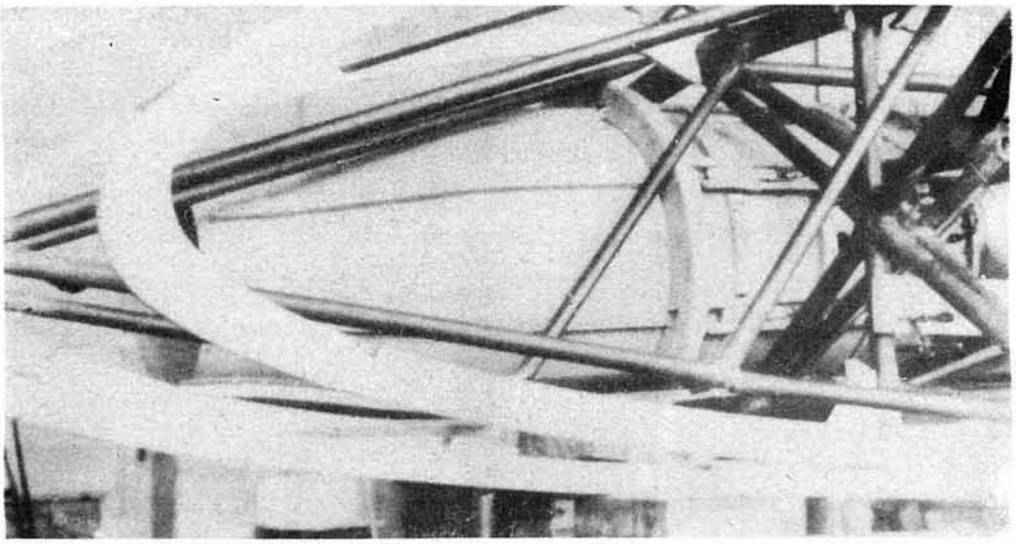
FIG. 6



MOUNTING OF JET ENGINE IN HORTON IX

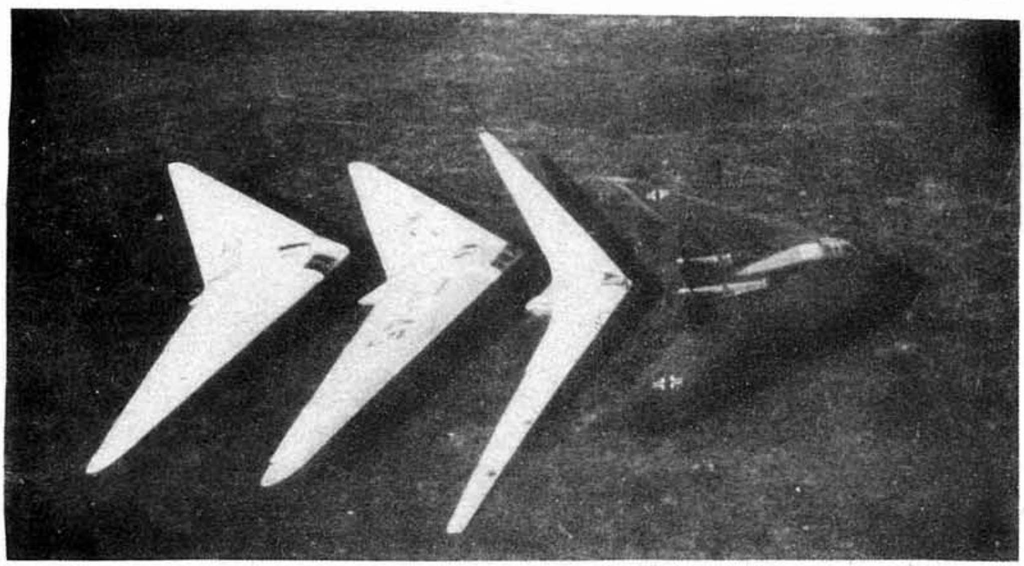
ROYAL AIRCRAFT ESTABLISHMENT
PHOTOGRAPHIC DIVISION
COPY NEG No 61046
DATE 27-3-45.

FIG. 7.



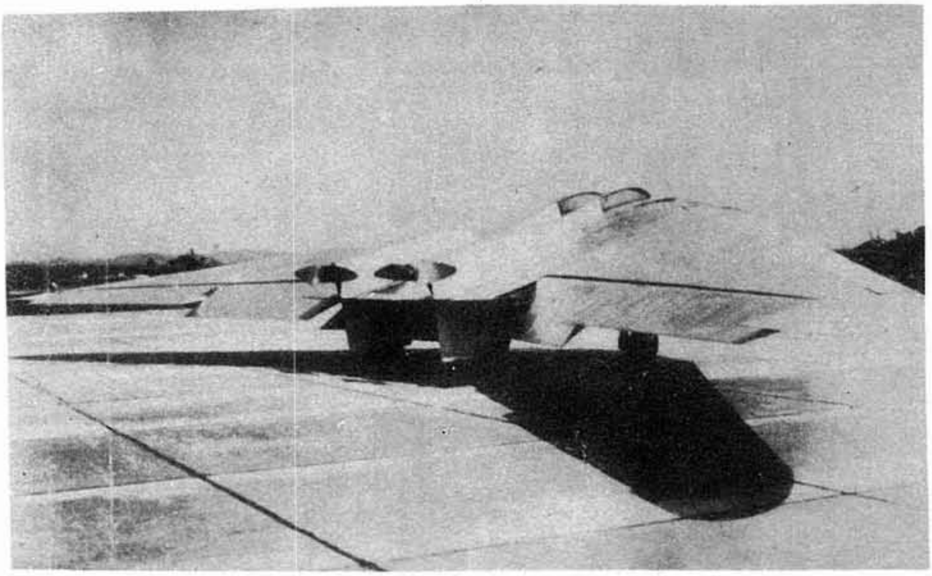
MOUNTING OF JET ENGINE IN HORTEN IX

FIG. 8.



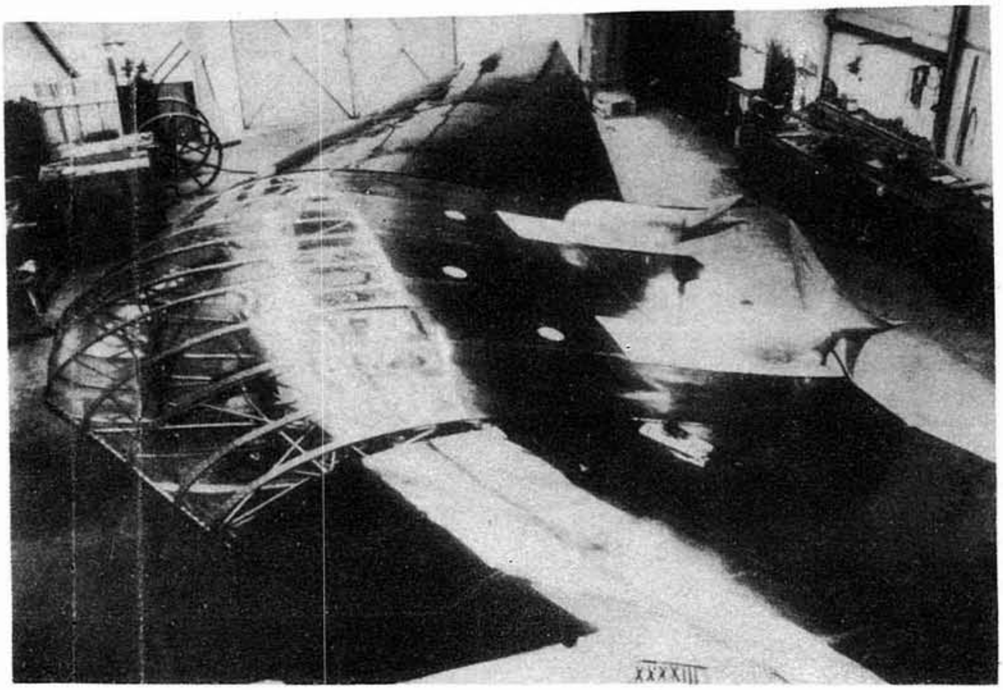
HORTEN II, III, IV AND V
(FROM LEFT TO RIGHT.)

FIG. 9.



HORTEN V ORIGINAL VERSION.

FIG. 10.



PLASTIC VERSION OF HORTEN V

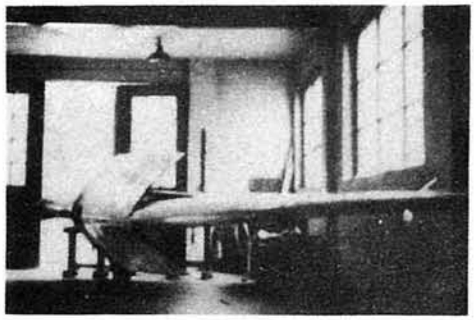


FIG.11.

HORTEN III. DRAG RUDDER

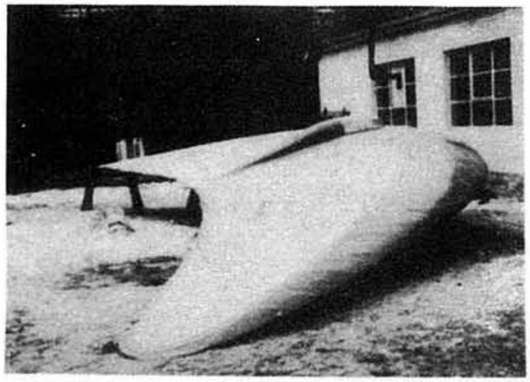


FIG.12.

HORTEN PARABOLA.

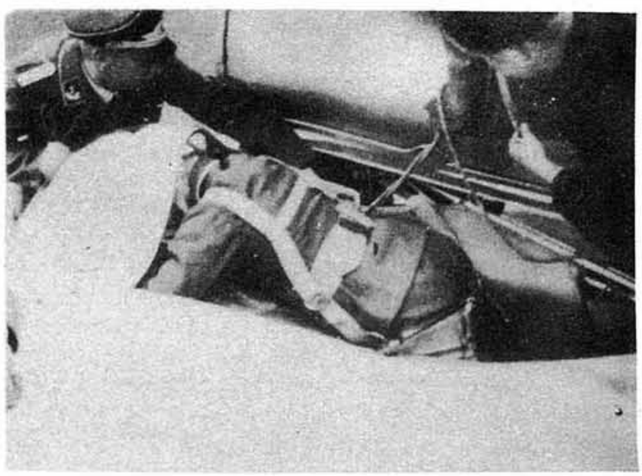
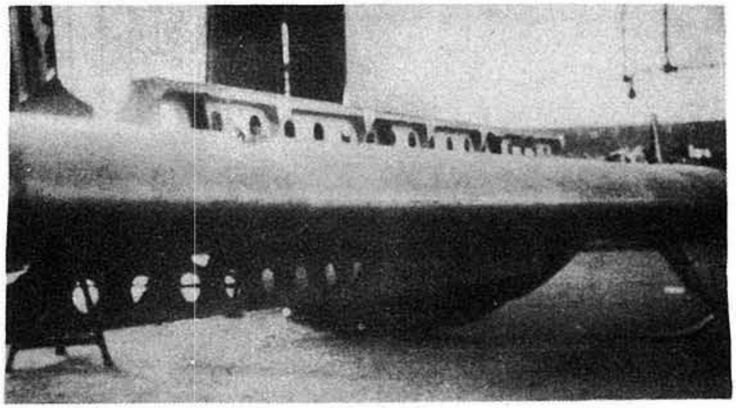


FIG.13.

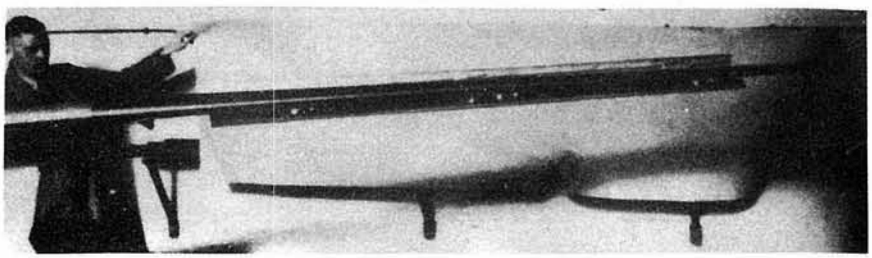
HORTEN IV PILOTS POSITION.

FIG. 14.



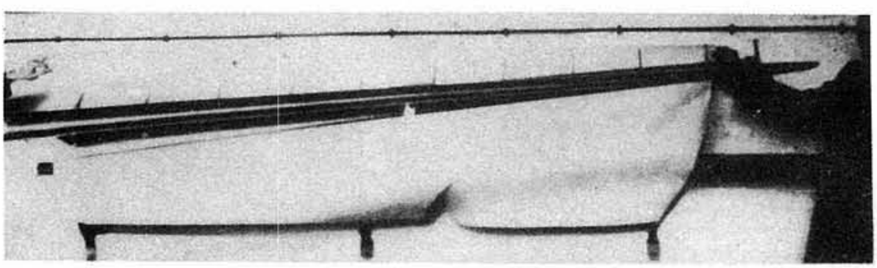
HORTEN IV. BRAKE FLAPS.

FIG. 15.



HORTEN IV. DRAG RUDDER.

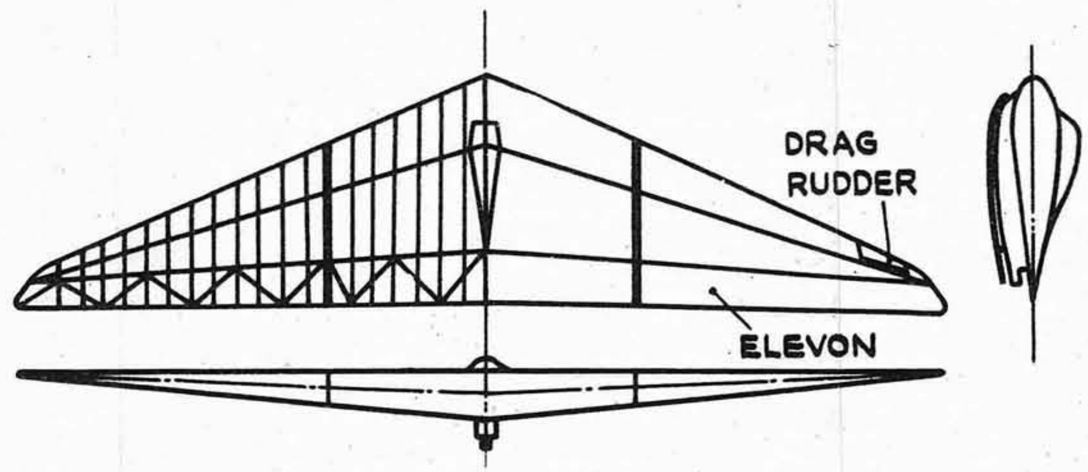
FIG. 16.



HORTEN IV AILERON, SHOWING SKEW HINGE.

SPAN	12·4 m. (40·7 ft.)
AREA	21·0 m^2 (226 $ft.^2$)
ASPECT RATIO:	7·27
WEIGHT, EMPTY	120 kg (264 lb)
WEIGHT, LOADED	200 kg (440 lb)
WING LOADING	9·44 kg/m^2 (1·9 lb/ft^2)
GLIDING ANGLE	21·0°
SINKING SPEED	0·85 m/s (2·8 f.p.s.)

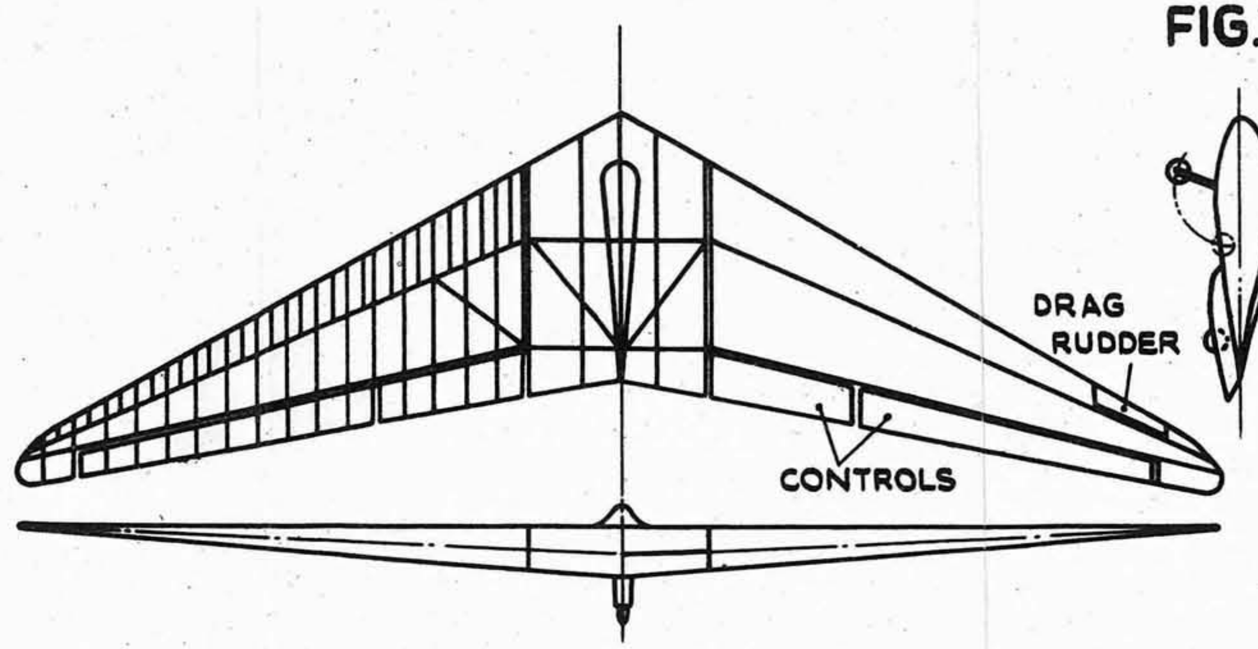
FIG. 17



HORTEN I

SPAN	16·5 m (54·1 ft.)
AREA	32·0 m^2 (34·4 $ft.^2$)
ASPECT RATIO:	8·48
WEIGHT, EMPTY	275 kg (606 lb)
WEIGHT, LOADED	375 kg (827 lb)
WING LOADING	11·38 kg/m^2 (2·33 lb/ft^2)
GLIDING ANGLE	24·0°
SINKING SPEED	0·80 m/s (2·62 f.p.s.)

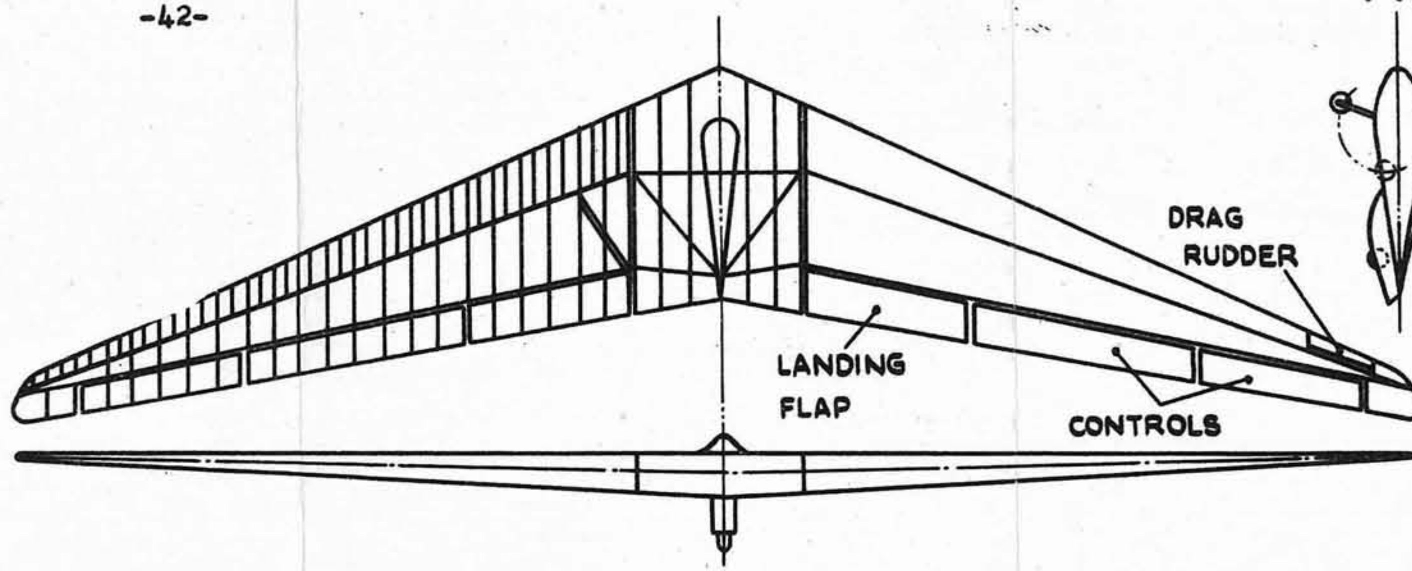
FIG. 18



HORTEN II

SPAN	20·0 m (65·6 ft.)
AREA	37·5 m² (403 ft²)
ASPECT RATIO	10·66
WEIGHT, EMPTY	250 kg. (550 lb.)
WEIGHT, LOADED	350 kg. (770 lb.)
WING LOADING	9·33 kg./m² (1·91 lb./ft.²)
GLIDING ANGLE	28·0°
SINKING SPEED	0·65 m/s (2·13 f.p.s.)

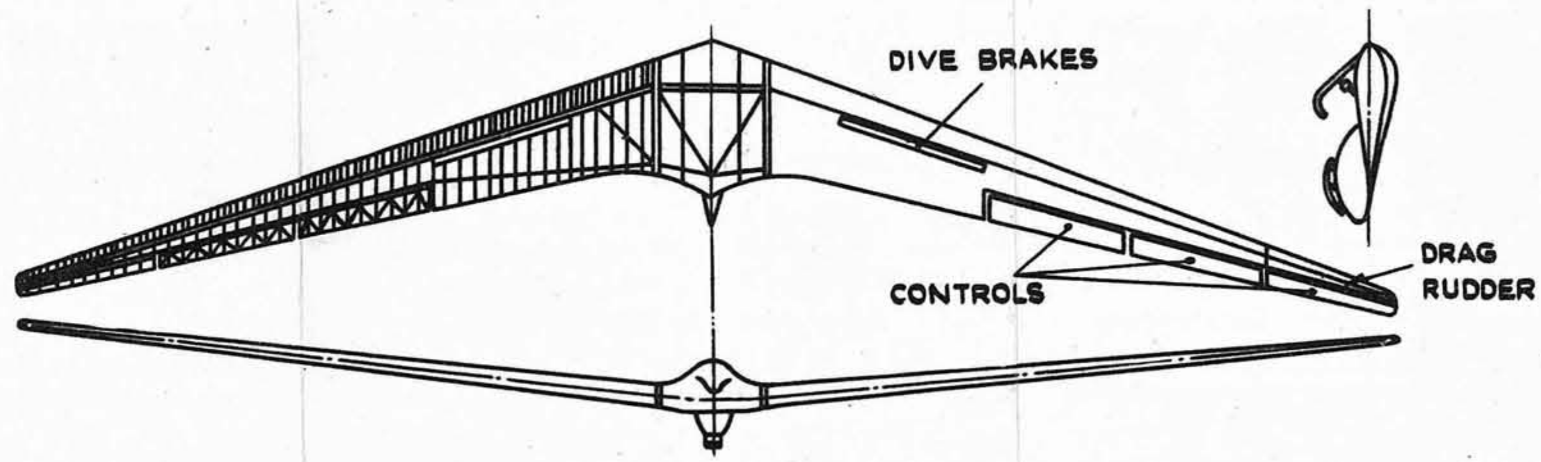
FIG. 19



HORTEN III

SPAN	20·0 m (65·6 ft)
AREA	18·9 m² (203 ft²)
ASPECT RATIO	21·16
WEIGHT, EMPTY	200 kg. (440 lb.)
WEIGHT, LOADED	300 kg. (660 lb.)
WING LOADING	15·87 kg./m² (3·5 lb/ft²)
GLIDING ANGLE	37·0°
SINKING SPEED	0·54 m/s (1·77 f.p.s.)

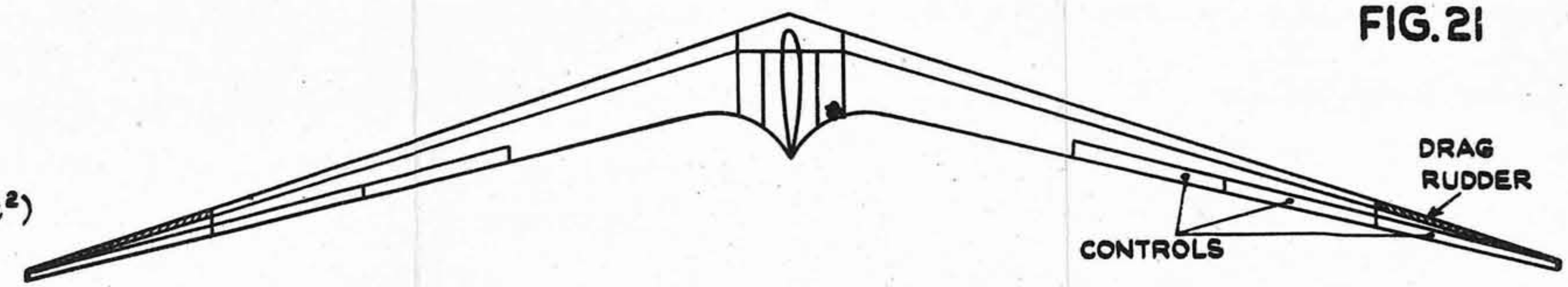
FIG. 20



HORTEN IV

SPAN	24·0 m. (78·7 ft.)
AREA	17·8 m² (191 ft²)
ASPECT RATIO	32·4
WEIGHT, EMPTY	250 kg. (550 lb.)
WEIGHT, LOADED	350 kg. (770 lb.)
WING LOADING	19·68 kg./m² (4·0 lb/ft²)
GLIDING ANGLE	
SINKING SPEED	

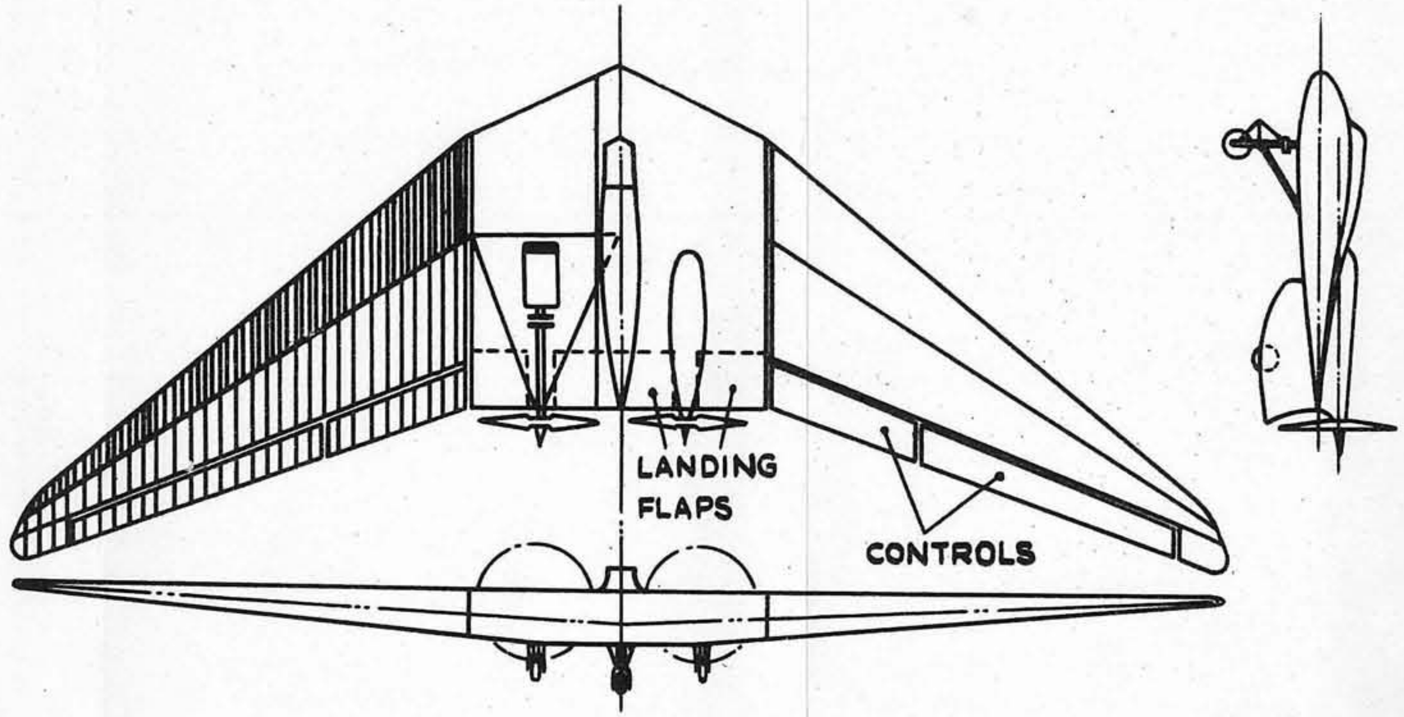
FIG. 21



HORTEN VI

FIG. 22

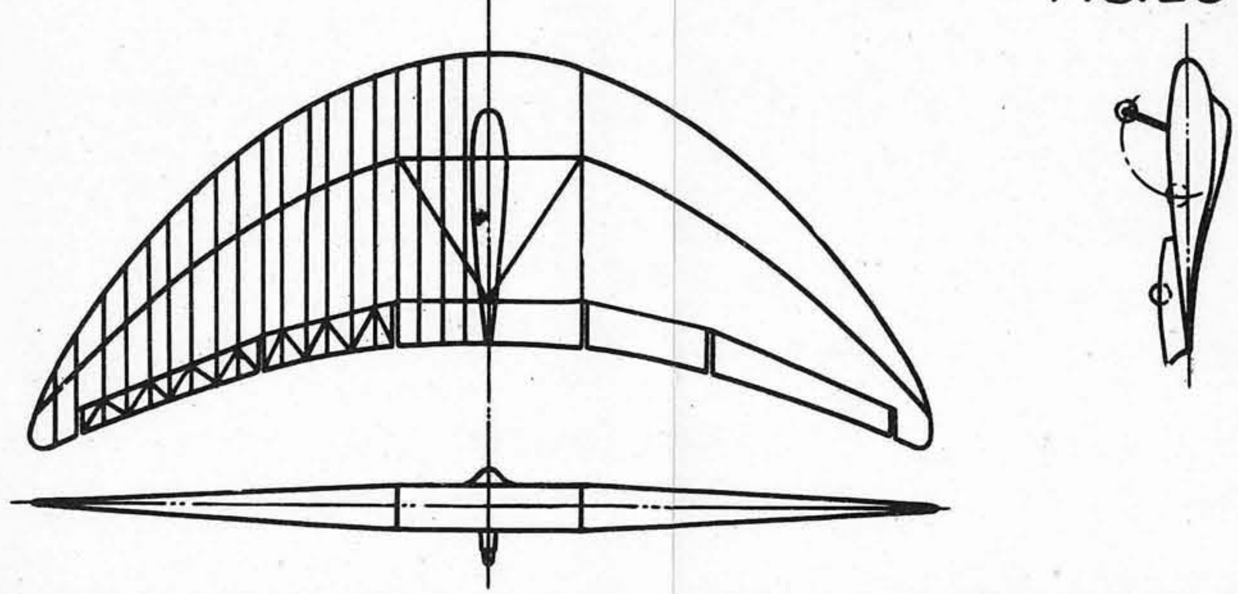
SPAN	16·0 m. (52·5 ft.)
AREA	42·0 m² (451 ft²)
ASPECT RATIO	6·1
WEIGHT, EMPTY	1050 kg. (2310 lb)
WEIGHT, LOADED	1250 kg. (2760 lb)
WING LOADING	29·8 kg/m² (6·1 lb/ft.²)
MAXIMUM SPEED	215 km/hr (134 m.p.h.)
LANDING SPEED	75 km/hr (47 m.p.h.)



HORTEN V

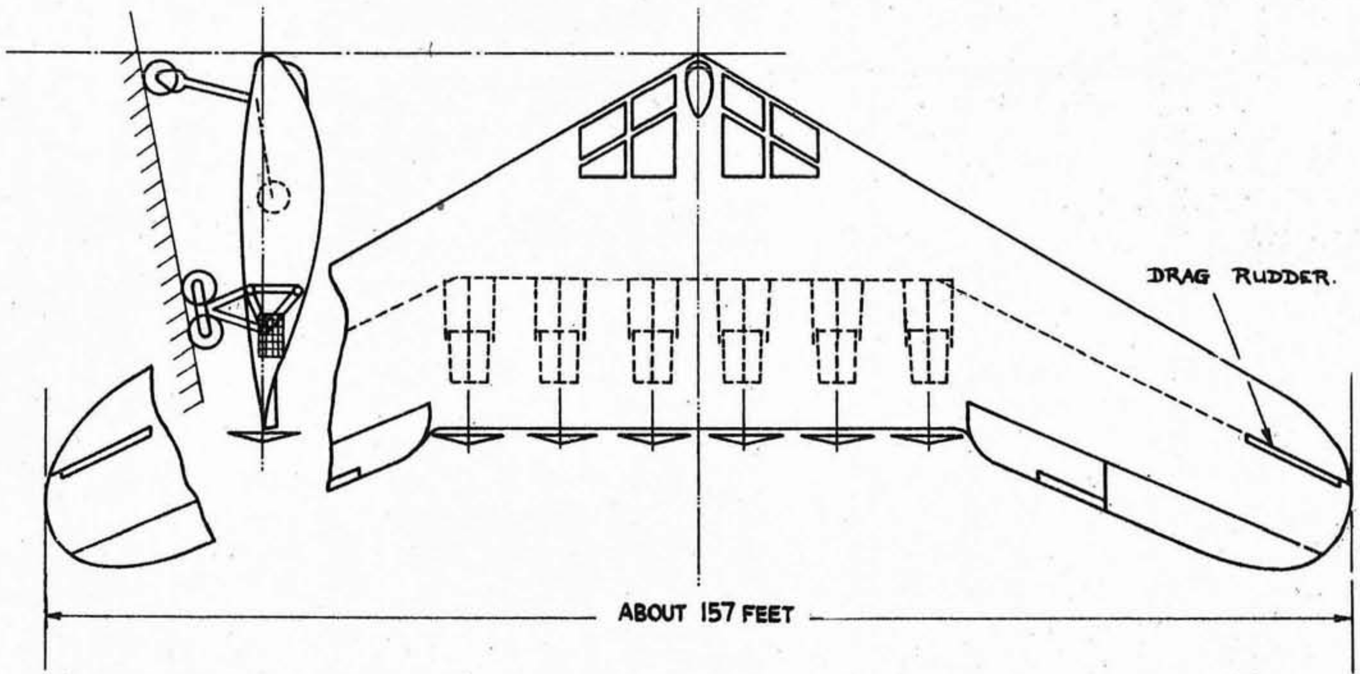
FIG. 23

SPAN	12·0 m (39·4 ft.)
AREA	33·0 m² (355 ft²)
ASPECT RATIO	4·37
WEIGHT, EMPTY	90 kg. (198 lb.)
WEIGHT, LOADED	170 kg. (375 lb.)
WING LOADING	5·05 kg/m² (1·01b/ft²)
GLIDING ANGLE	19·0°
SINKING SPEED	0·65 m/sec (2·13 f.p.s)



HORTEN PARABOLA

Nº AER 10331
DR
TR O.D. 9.4.45
CH
APP



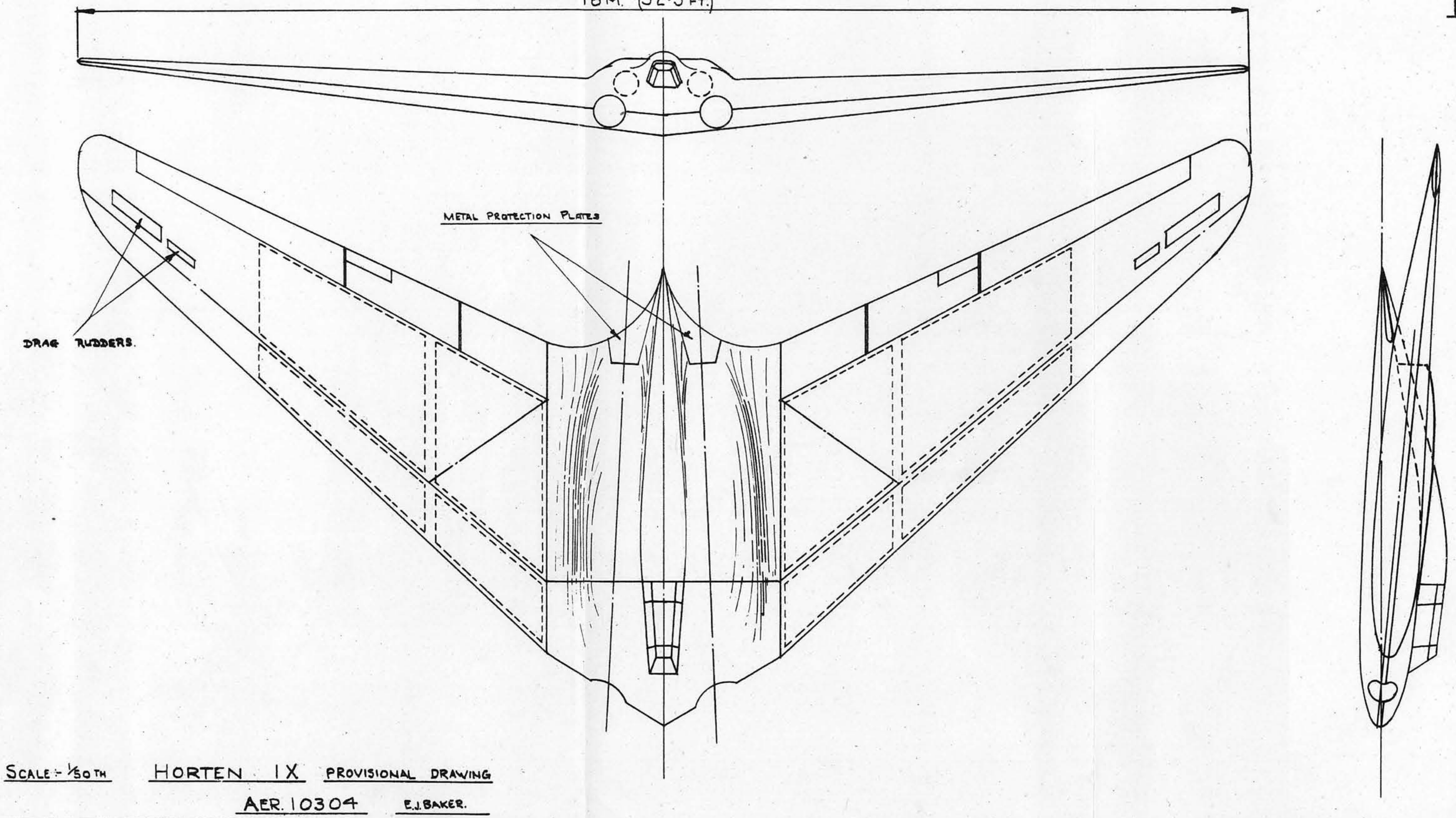
HORTEN VIII TRANSPORT

NOT TO SCALE

FIG. 24.

R.

FIG. 25.

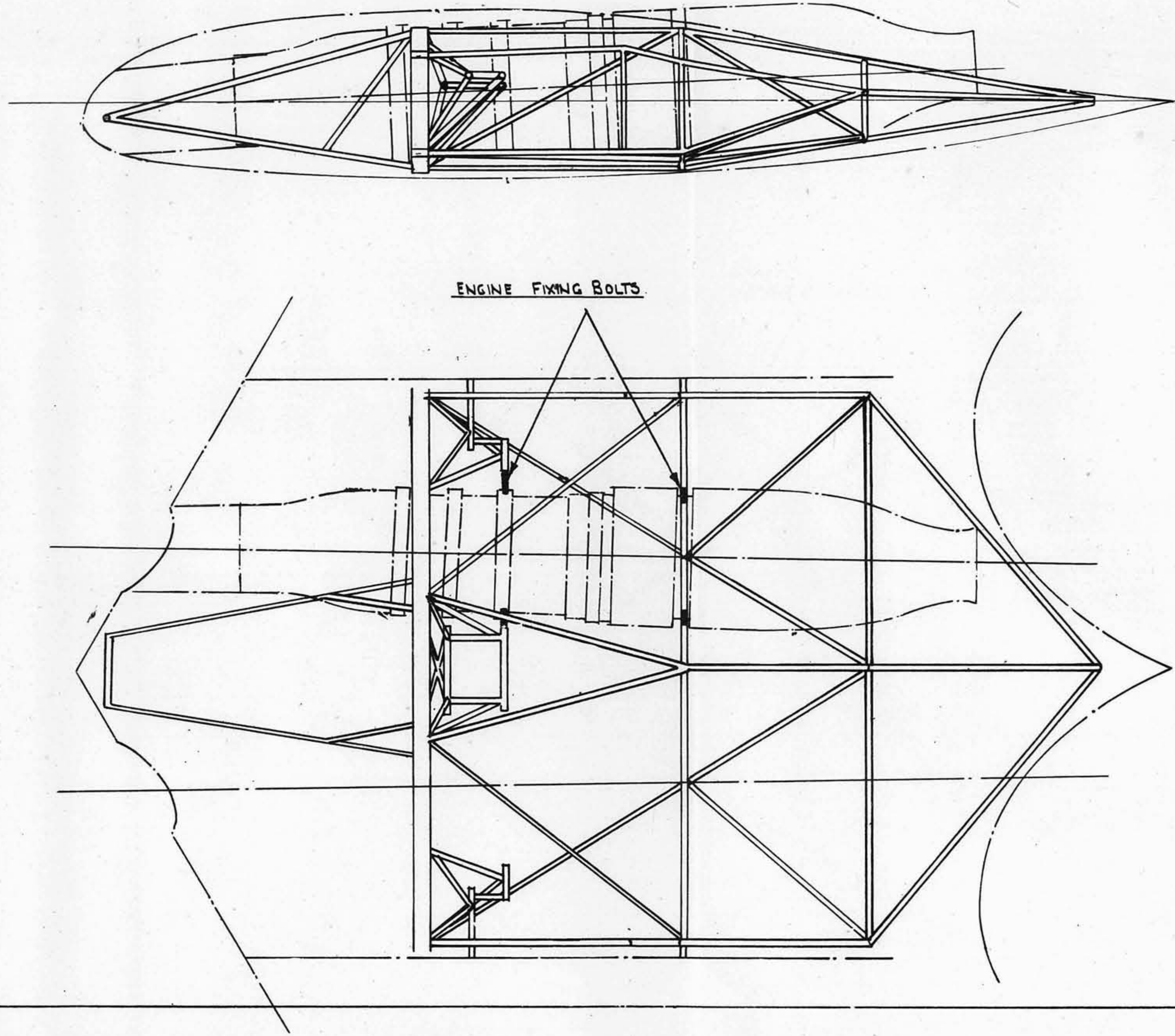


SCALE :- 1/50TH HORTEN IX PROVISIONAL DRAWING

AER. 10304 E.J. BAKER.

FIG. 26.

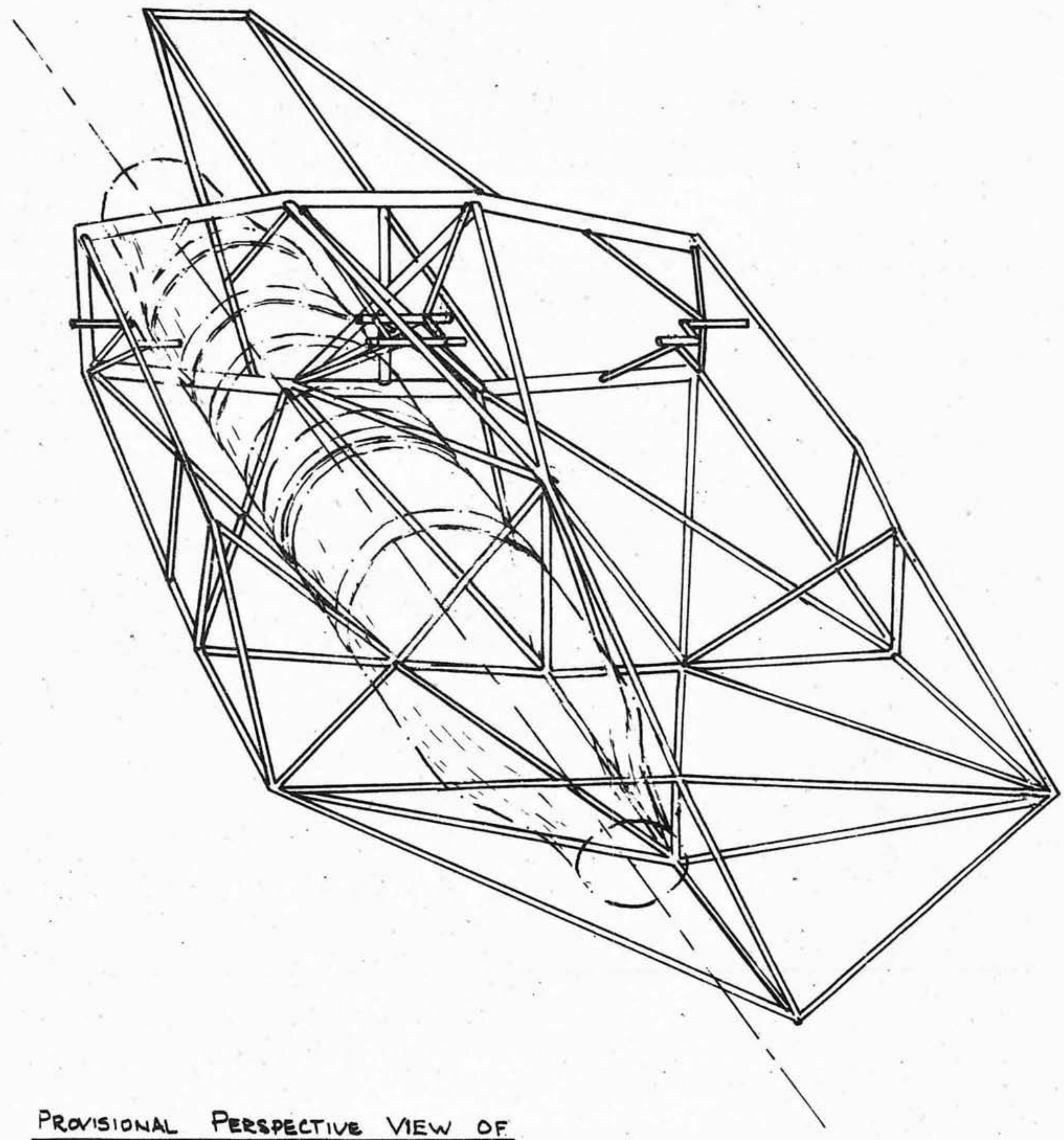
HORTEN IX. PROVISIONAL PLAN OF CENTRE SECTION SHOWING STRUCTURE



AER. 10364.

DRAWN. E.J. BAKER.

FIG. 27.

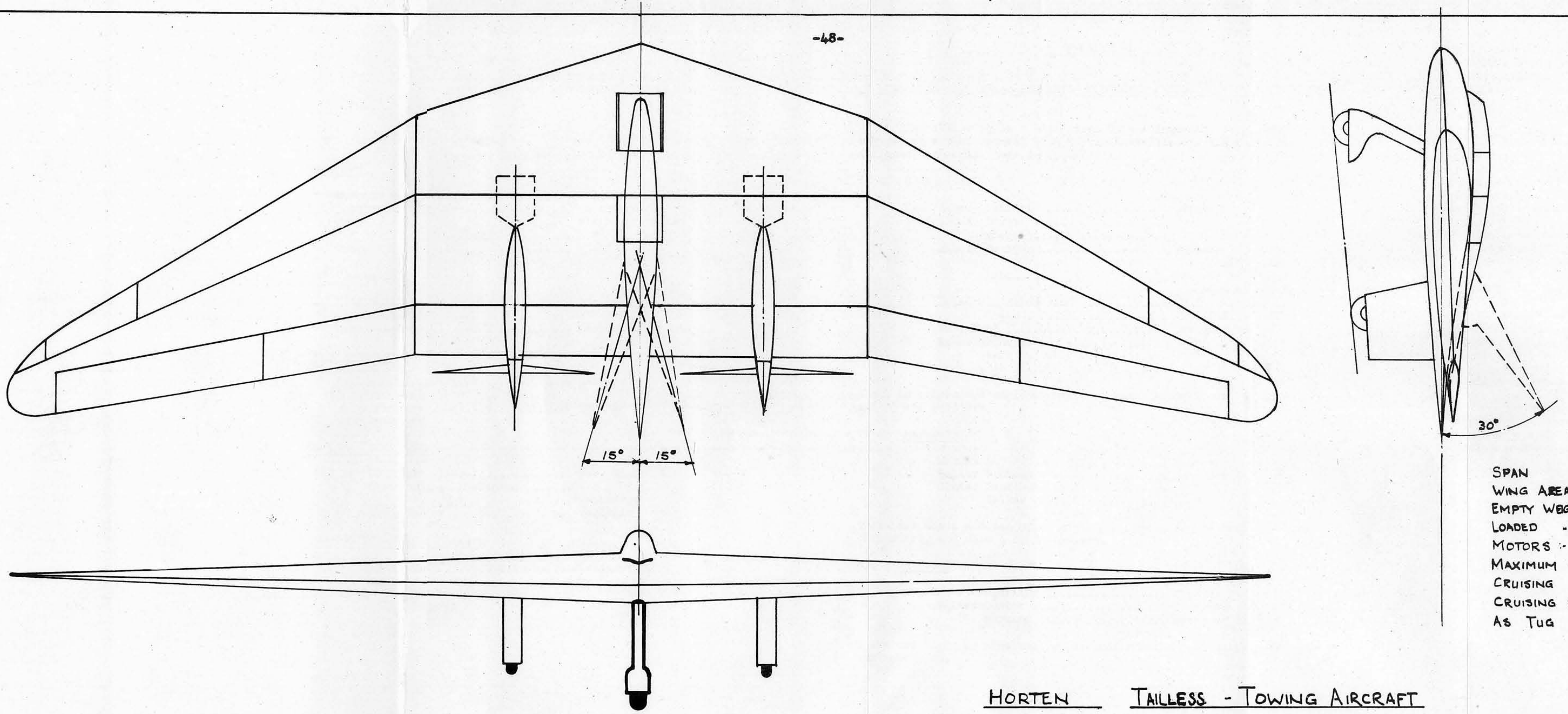


PROVISIONAL PERSPECTIVE VIEW OF

CENTRE SECTION OF HORTEN IX SHOWING TUBULAR CONSTRUCTION.

DRAWN :- E.J.BAKER. AER 10359.

FIG. 28.

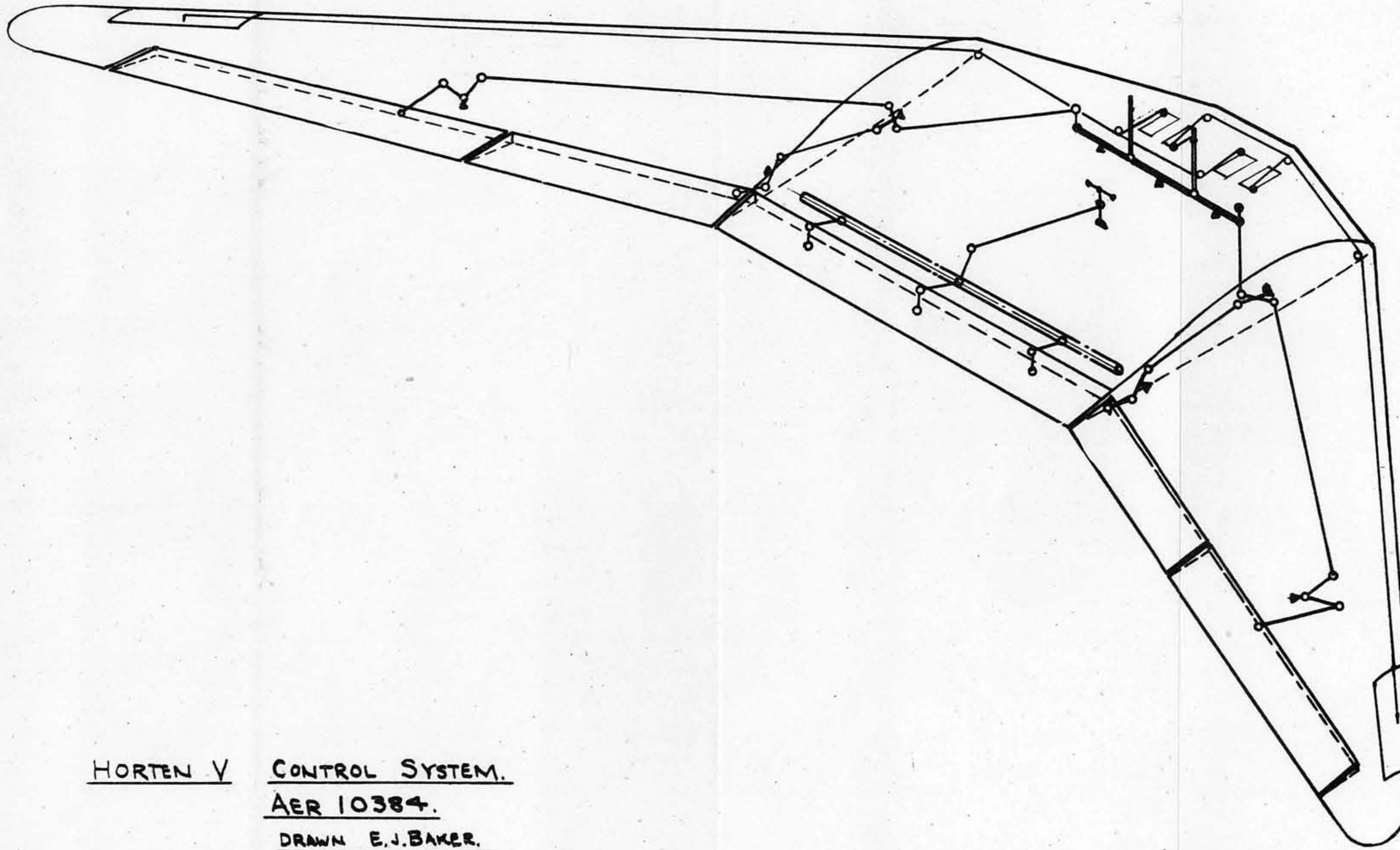


SPAN 20 M.
WING AREA 61 M^2
EMPTY WEIGHT 1200 KG
LOADED - 2500 KG
MOTORS :- ARGUS AS. 10 C
MAXIMUM SPEED 290 Km/hr.
CRUISING - 260 Km/hr.
CRUISING SPEED
AS TUG :- 230 Km/hr.

HORTEN TAILLESS - TOWING AIRCRAFT

SCALE:- 1:50 E J BAKER AER. 10354.

FIG. 29.

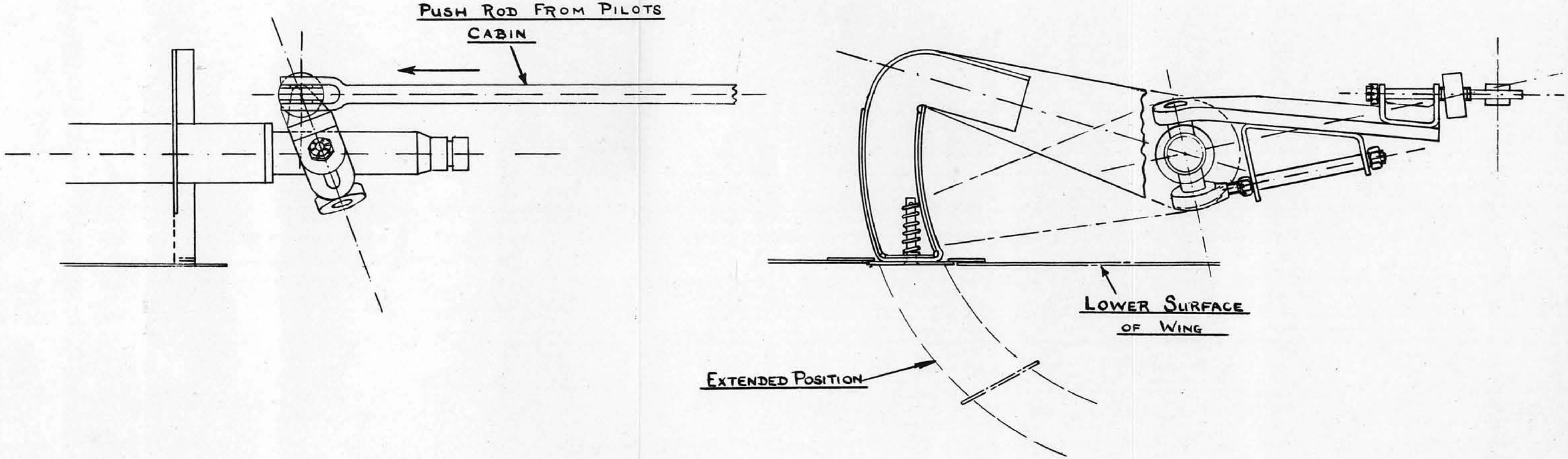


HORTEN V CONTROL SYSTEM.

AER 10384.

DRAWN E.J.BAKER.

FIG. 31.



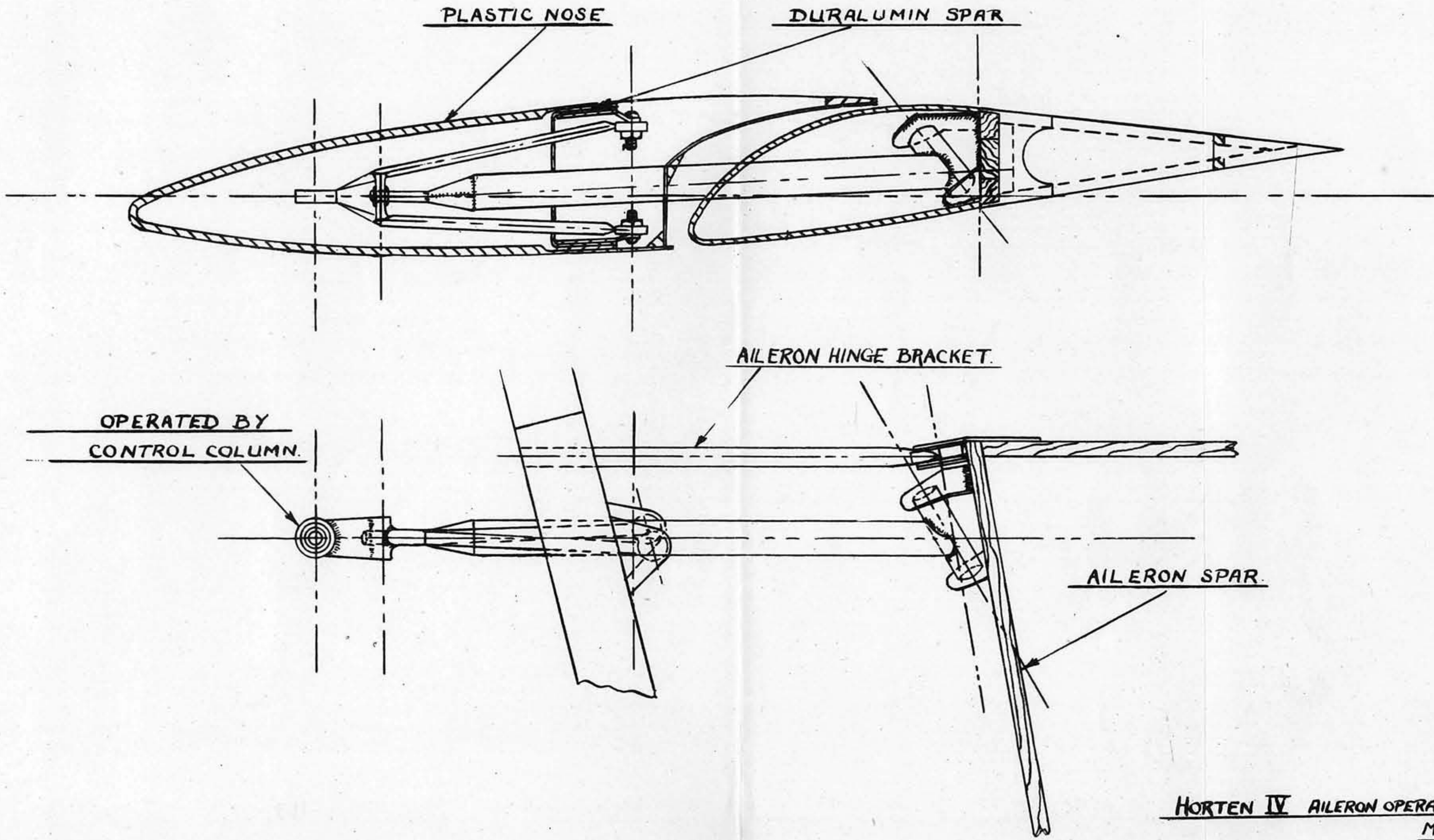
DRAWN. E.J.BAKER.

LOWER HALF OF HORTEN VII WING DRAG RUDDER.

SCALE :- ½ FULL SIZE.

AER. 10378.

Fig. 32.

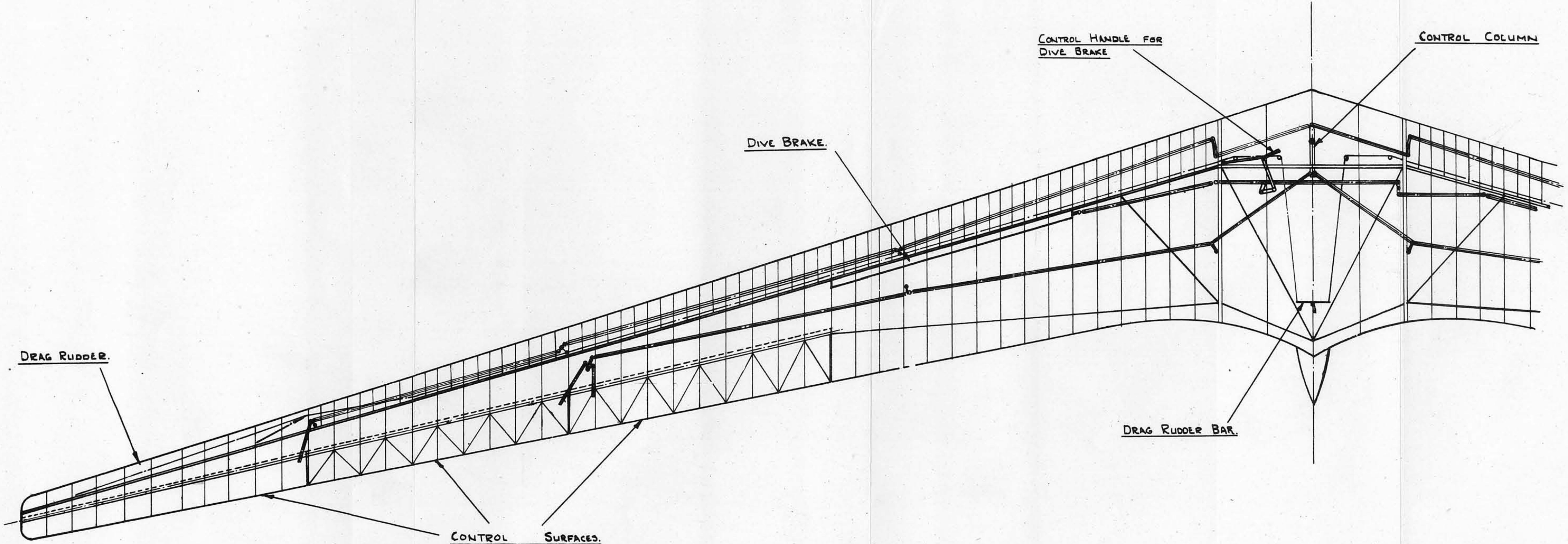


HORTEN IV AILERON OPERATING MECHANISM.

DRAWN BY G.E. Dugdale.

AER/0440

Fig. 30.



HORTEN IV

Aer. 10342.

Drawn E.J. Baker.