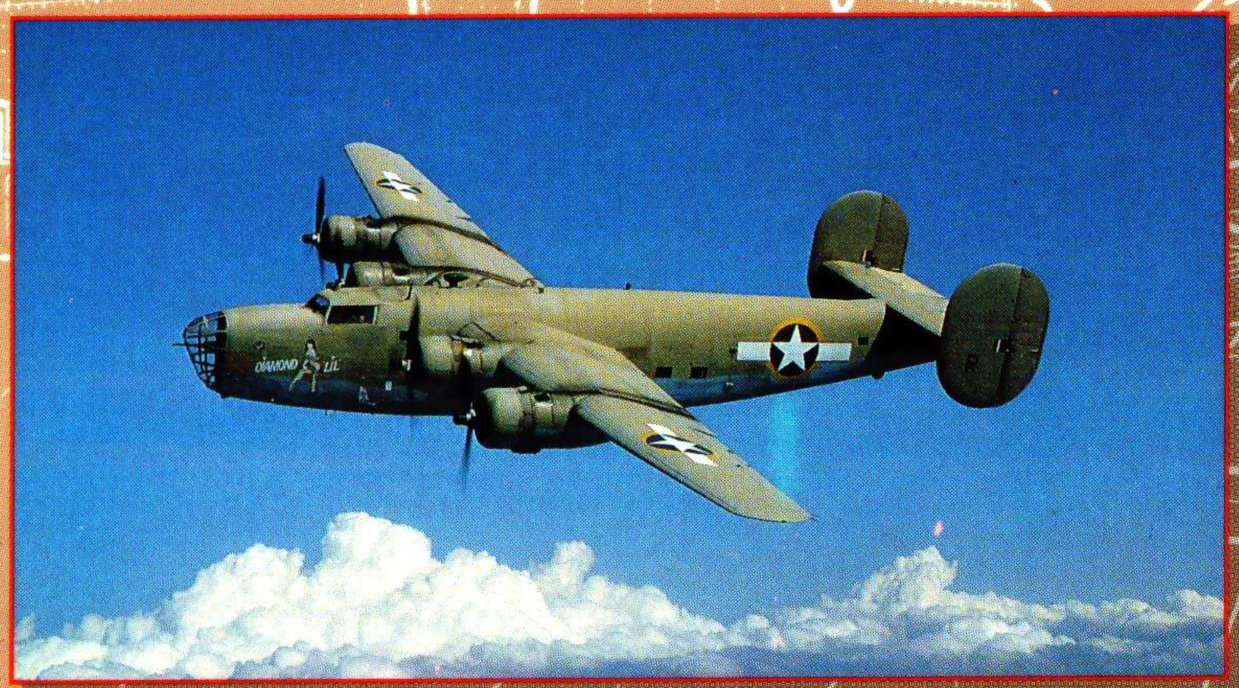
From the Publishers of Model Airplane News

by PETER M. BOWERS

Scale Aircraft DRAWINGS

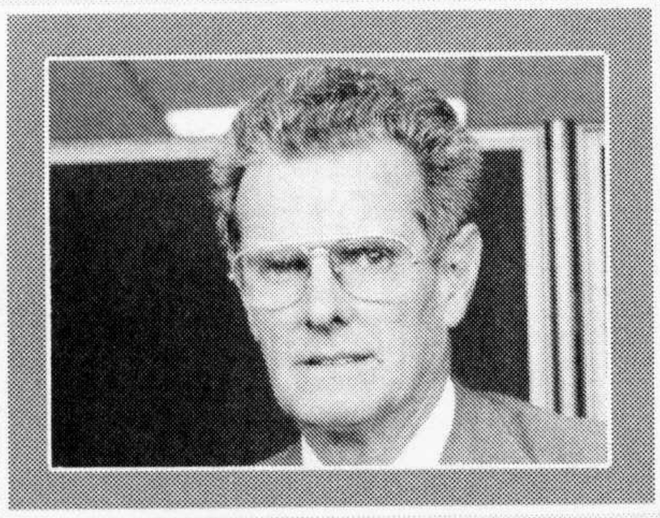
Volume II World War II

Scale Drawings, Rare Photos, and Historical Data on Popular WW II Aircraft



Scale Aircraft DRAWINGS

by PETER M. BOWERS



ABOUT THE AUTHOR

Peter M. Bowers began to build model airplanes soon after Lindbergh flew across the Atlantic in 1927. He began to write for publication in the mid-1930s when the editors of model aviation publications, including Model Airplane News, asked him to write articles and draw up plans for his outstanding models.

From 1940 to 1942, he studied aeronautical engineering at the prestigious Boeing School of Aeronautics, and he began to amass one of the largest, most comprehensive, private collections of airplane photos in the world. Scale Aircraft Drawings—Volume II: World War II draws extensively on this collection.

After five years in the U.S. Army Air Forces as a Maintenance and Technical Intelligence Officer, he joined the Boeing Airplane Company as an engineer, and he retired in 1983 after 36½ years. Meanwhile, his model building had expanded to include the design and construction of pilot-carrying, "home-built" airplanes. His single-seat Fly Baby won the national EAA design contest in 1962, and he has been selling plans to amateur builders ever since.

Over the years, his many books and magazine articles have led to his worldwide recognition as an aviation historian, model builder and airplane designer.

★ ★ ★

Scale Aircraft Drawings—WW II—Volume II

Group Publisher: Louis V. DeFrancesco Jr.
Publication Director: Ed Schenk
Book Design: Alan J. Palermo
Publication Coordinator: Sally Williams
Copy Director: Lynne Sewell
Copy Editor: Karen Jeffcoat
Art Assistants: Allyson Nickowitz, Walter Sidas
Cover Photos: Budd Davisson

Copyright © 1991 by Air Age Publishing, Inc. ISBN: 0-911295-14-3. All rights reserved, including the right of reproduction in whole or in part in any form. This book, or parts thereof, may not be reproduced without the publisher's permission.

Published by Air Age Publishing, Inc.
251 Danbury Road
Wilton, CT 06897
PRINTED IN THE USA.

CONTENTS

INTRODUCTION 4

WORLD WAR II COLOR AND MARKINGS 5

DESIGNATIONS 11

AIRCRAFT

Avro Lancaster 12

Boeing B-17 Flying Fortress 14

Boeing B-29 18

Consolidated PBY-5A Catalina 22

Consolidated B-24 Liberator 24

Curtiss P-40 D-E-F Kittyhawk 26

Curtiss SB2C Helldiver 30

Douglas Boston/Havoc/A-20 32

Douglas A-26 Invader 38

Douglas C-54 Skymaster 40

Fairchild PT-19, PT-23, PT-26 44

Fiat CR 42 Falcon 46

Focke-Wulf 190A 48

Gloster Gladiator 50

Grumman F4F Wildcat 52

Grumman TBF Avenger 58

Grumman F6F Hellcat 64

Hawker Hurricane 70

Kawasaki Ki 61 Tony 76

Lockheed Hudson 78

Martin PBM Mariner 82

Martin B-26 Marauder 88

Messerschmitt Me 109 92

Messerschmitt Me 262 Swallow 96

Mitsubishi A6M Zero 102

Mitsubishi G4M Betty 104

Nakajima Ki-84 Frank 106

North American P-51B Mustang 108

Northrop P-61 Black Widow 110

Republic P-47 Thunderbolt 112

Stearman Kaydet 116

Supermarine Spitfire 118

Vega Ventura 126

Vought SB2U Chesapeake/Vindicator 132

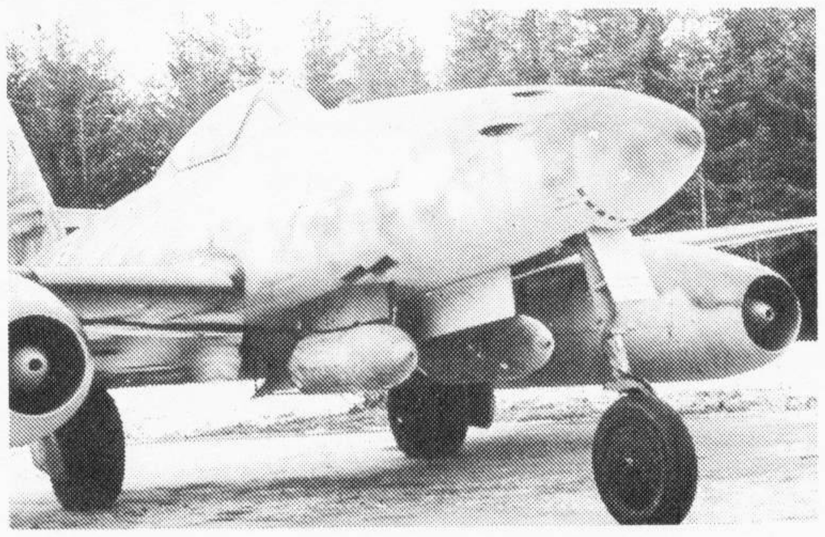
Vought OS2U Kingfisher 136

Westland Lysander 138

Westland Whirlwind 144

INTRODUCTION

by PETER BOWERS



■ *Above:*
Me 262 nose details. At left, an Me 262A-2a with two 250kg (550-pound) bombs under the fuselage. At right, an Me 262A-1a fighter. Note the ports for the 30mm cannon in the upper nose.

This book, Volume II of the Air Age Scale Aircraft Drawings series, covers 37 representative WW II airplanes. Some are prewar service models that served at the beginning of hostilities but were soon replaced, while others are more modern types that, with continual upgrading, were able to serve until the end. It's interesting that very few of the models that originated after the onset of the war actually saw combat.

Some of these drawings were made during the war when data was scarce or even restricted, but they're as accurate as possible under the circumstances. In fact, artist William Wylam drew some of them so well that the U.S. Army took him to task for being *too* accurate in depicting designs that were still classified. As a result, he deliberately included minor discrepancies in some subsequent drawings, notably the vertical tail of the B-29.

Some of these discrepancies are mentioned in the text that accompanies each airplane; each includes a brief history and details of the plane's development and operational use. With modelers in mind, I carefully selected the photos from my collection, and they combine the best views of the airplanes' structural detail and markings.

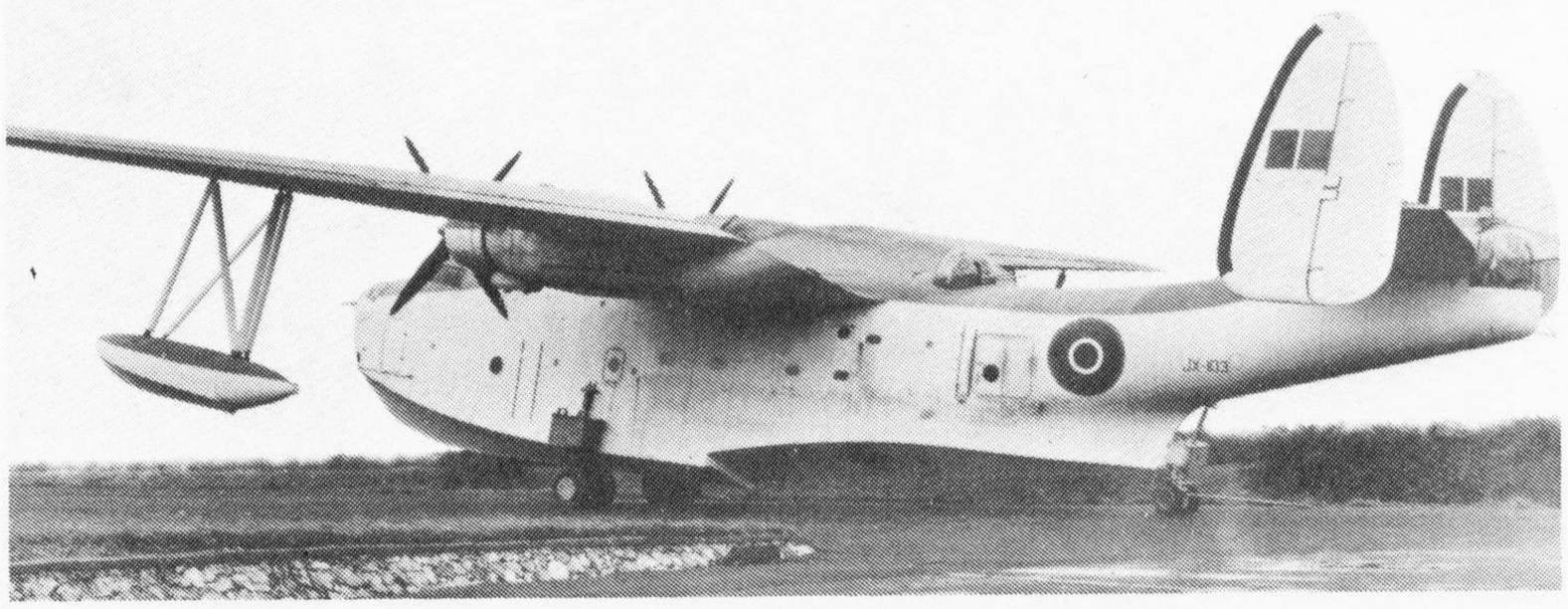
It should be noted that the drawings and photos in this book are, at best, rather general, and serious modelers who build for scale competition will need additional supporting data to verify their efforts.

The most common errors found on models, illustrations and even restored military airplanes are national insignia of incorrect proportions, and incorrect markings for the period of aircraft operation being depicted. Accurate data on this complicated subject isn't generally available to modelers, so I've devoted a section to these markings (as obtained from official markings charts).

I've also included a section on designations, which discusses the basics of the various national designating systems. It also explains why an American-built airplane like the Douglas DB-7 (factory designation) was operated as a "DB-7" only by France; while Great Britain called it either a "Boston" or a "Havoc;" the U.S. Army called it an "A-20" or a "P-70;" and the U.S. Navy used it as a "BD."

Finally, I explain why different designations were used on otherwise identical U.S. Navy airplanes (such as the SB2C-4 and the SBW-4), as well as the meaning of "B-17G-BO," "B-17G-VE" and "B-17G-DL."

■ *Below:*
One of six PBM-3Bs sent to England as "Mariner I," painted in the British Coastal Command's white and gray color scheme. The Mariners didn't meet British requirements and were returned to the U.S. Navy. Note the powered two-gun tail turret.

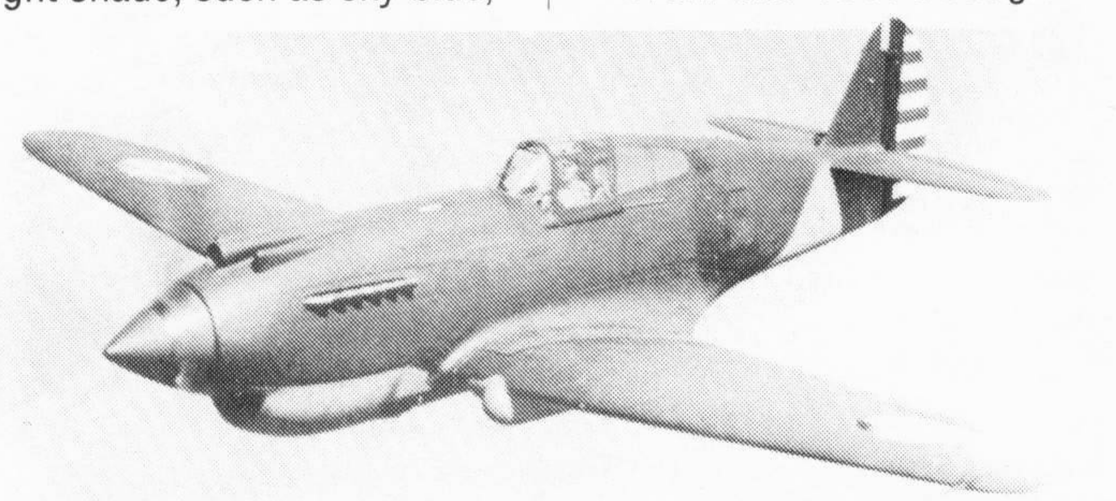


WORLD WAR II COLOR AND MARKINGS

The enormously complex subject of WW II markings and insignia fills many books. The best that can be done to address the subject in this limited volume is to present an outline of the basic colors used, the proper proportions and placement of national insignia, and the time during which these markings were used.

AIRPLANE COLORING

Most military airplanes were not camouflaged after the end of WW I, but, as WW II approached, "war paint" gradually came back into use: in England and Germany in 1937; in France in 1939; in the U.S. Army in 1940; and in the U.S. Navy in 1941. In general, European airplanes used a combination of several earth tones on the top and sides, and a light shade, such as sky blue, below. These changed extensively during the war according to theater of operation, season, mission, etc.



(Figure 1) The early Curtiss P-40 (shown) and Douglas A-20A were the only camouflaged U.S. Army airplanes delivered with the distinctive Army rudder stripes and star insignia on both wing tips. Rudder stripes were eliminated from camouflaged airplanes in February 1942, and the star configuration changed to one on the upper left wing, one on the lower right wing and one on each side of the rear fuselage.

U.S. ARMY—In 1940, the U.S. Army adopted olive-drab coloring for the top and sides and light gray for the undersurfaces of the first Curtiss P-40s and Douglas A-20As. These planes carried the then-standard insignia arrangement of stars on both wings (top and bottom), and the distinctive rudder stripes used only by the Army since 1927 (Figure 1). Starting in February 1941, the same coloring was extended to other Army tactical models, and the insignia were rearranged (as described later).

From mid-1941 through 1943, many U.S. Army airplanes appeared in British camouflage because they had been appropriated by the Army through British contracts with U.S. manufacturers. Other basic colors for Army airplanes were matte black for night fighters (later changed to glossy black) and a light shade (almost pink) for planes flying in North African desert operations. Early in 1944, it was decided that camouflage wasn't really necessary for most combat types; it was costly to apply and maintain, and it decreased airplane performance. Camouflage was eliminated from most subsequent production, though some metal-finished B-24s and B-29s were painted glossy black underneath when they were used for night bombing.

Until early 1942, primary trainers (like the Stearman/Boeing Kaydet) and basic trainers were delivered in prewar yellow and blue with rudder stripes. They were subsequently delivered in overall silver dope or natural metal. Some yellow and blue planes were repainted silver, but others survived the war in their original prewar colors.

U.S. NAVY—Prewar U.S. Navy airplanes were silver, with chrome yellow on the uppermost wing surface. In February 1941, overall light-gray camouflage was adopted for fleet-type airplanes, and the stars were placed as on the camouflaged Army planes. Late in 1941, tactical models operating over water adopted a dull blue-gray for the top and sides and retained the gray undersides. Planes with folding wings, on which the underside of the wing was visible from above when folded, had the topside coloring applied to the undersurface of the folded wing. A few Navy fleet airplanes retained the overall gray into early 1942.

Early in 1943, the camouflage was changed to dark sea-blue on top surfaces, graduating through lighter shades to glossy white undersurfaces.

Early in 1944, glossy sea-blue was adopted as camouflage for carrier-based fighters. Soon afterward, this coloring was extended to all other fleet models. There were other special camouflage schemes for specific missions, such as the dull-gray top surfaces on otherwise all-white planes, which were used on sea-search and anti-submarine missions, and overall matte black on planes used for night missions, etc.

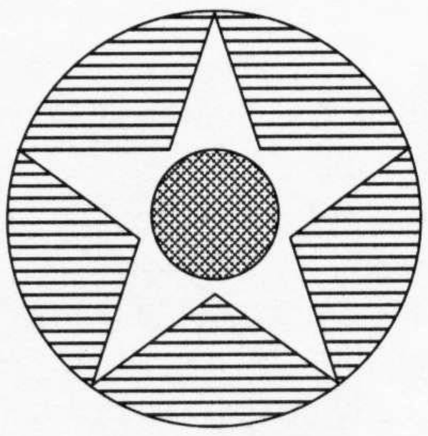
NATIONAL MARKINGS

The following drawings and photos are presented to give model builders the correct proportions and locations of the national markings used by the warring powers. Although there have been many variations and exceptions, these can be regarded as "standard."

WORLD WAR II COLOR AND MARKINGS

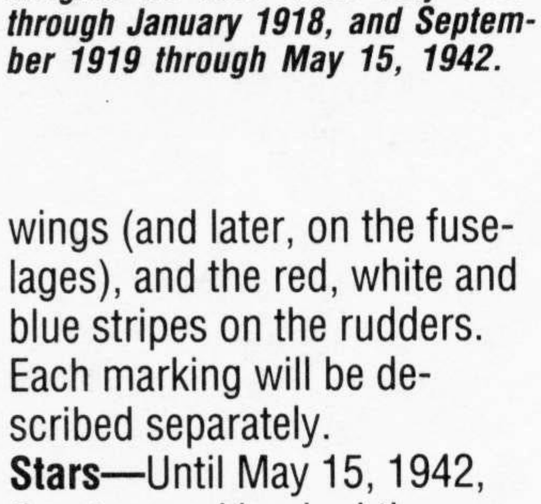
RED BLUE WHITE

UNITED STATES—From 1919 through 1942, the U.S. Army and Navy (which included the Marine Corps) used two separate national markings for their aircraft: the common star-in-circle markings on the wings (and later, on the fuselages), and the red, white and blue stripes on the rudders. Each marking will be described separately.



(Figure 2) An American Star-in-Circle insignia as used from May 1917 through January 1918, and September 1919 through May 15, 1942.

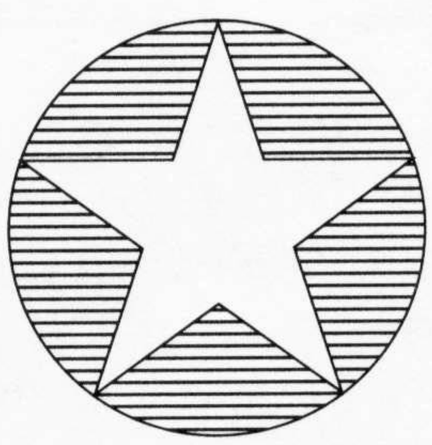
Stars—Until May 15, 1942, the star marking had three colors: a red center disc inside a white, five-pointed star against a blue circle (Figure 2). (The very dark shade called "Insignia Blue" came into use in the late 1920s and early '30s, and replaced the brighter "True Blue" shade). As shown in Figure 2A, the red center was tangent to projections of the star arms across the center of the star. The most common error made when this marking is applied to models occurs when the center is made too large, and sometimes actually touches the blue circle.



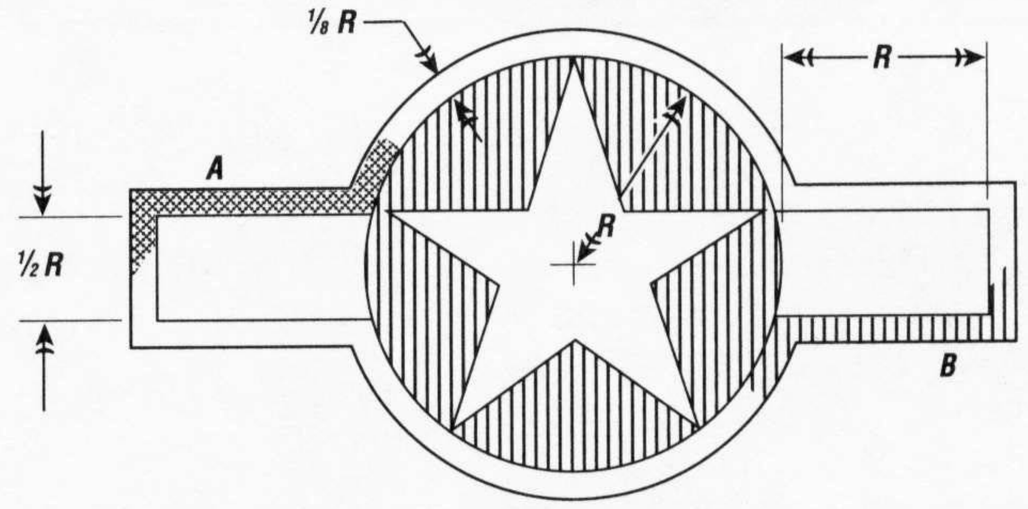
(Figure 2A) This enlarged detail of Figure 2 shows that the red center circle is tangent to projections of the star arms across the center of the star.

In February 1941, the star was removed from the upper right and lower left wings of camouflaged Army and Navy planes, and one was added to each side of the rear fuselage (or to the noses of flying boats). The purpose of this arrangement was psychological. Tests showed that a gunner aiming at an airplane with two bright insignia on it would tend to sight between the bright spots, or right on the cockpit, when the markings were on the wing tips. By having one insignia on a wing tip and the other on the fuselage, the gunner—it was hoped—would center his aim on the empty space between the wing tip and the fuselage.

To avoid possible confusion with the red disc of the Japanese insignia, the red disc was removed from the American star insignia on May 15, 1942 (Figure 3). At the end of June 1943, the insignia was made more visible when white rectangles were added to each side of it, and the whole marking was surrounded by a red border (in the proportions of Figure 4). In the heat of combat, however, a glimpse of red could be mistaken for the Japanese marking, so the red border was changed to blue in September 1943. The blue border is still in use today.



(Figure 3)The red center was removed from the U.S. insignia on May 15, 1942. The insignia remained in this form through June 1943.



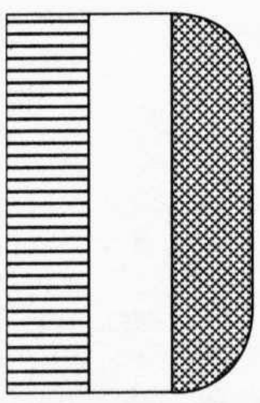
(Figure 4) A directive of June 28, 1943 added white rectangles to the U.S. insignia and surrounded the entire marking with a red border in the proportions shown(A). On September 4, 1943, it was directed that the red border be changed to blue(B).

This use of a blue border around a blue circle has always been a major source of confusion. Blue-around-blue made sense only for the period when an existing red border was painted over with blue. I am not alone in believing that the blue border should have been retained only around the white rectangles, and not around the blue circle. Many modelers, artists and even some airplane manufacturers believe that the marking should be made that way, and they paint their aircraft accordingly.

The other major application error is made when the rectangles are the wrong proportion and misaligned; the tops of the rectangles should line up with the sides of the upper star points (Figure 4).

After Pearl Harbor, the Navy put the stars back on both wings of all its airplanes to

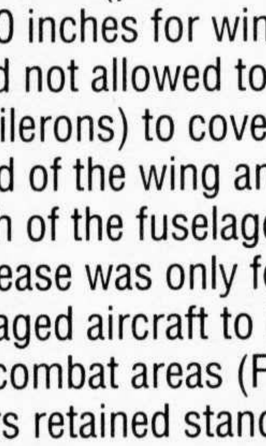
(Figure 5) Gray-painted Douglas SBD-3 Dauntless dive bombers onboard a U.S. Navy aircraft carrier early in 1942. Note the return of stars to both wings, and the variation in sizes used—even on the same airplane.



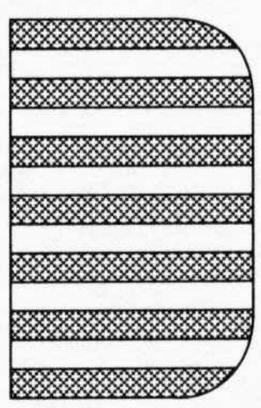
(Figure 6) Vertical rudder stripes as used by the U.S. Army and Navy from May 1917 through January 1918, and from September 1919 through 1926. Navy and Marine Corps made decreasing use of this arrangement up to WW II.

increase visibility for positive identification. It also increased the stars' size (previously limited to 60 inches for wing stars and not allowed to overlap the ailerons) to cover the full chord of the wing and the full depth of the fuselage. This size increase was only for camouflaged aircraft to be used in combat areas (Figure 5); others retained standard-size markings. Early in 1943, both services standardized the arrangement: one star was placed on the upper left wing tip, one was put on the lower right, and one was positioned on each side of the fuselage.

Stripes—From late 1919



(Figure 7) The U.S. Army adopted this new rudder stripe arrangement in November 1926. It was eliminated from camouflaged airplanes in February 1941, and from all others on May 15, 1942.



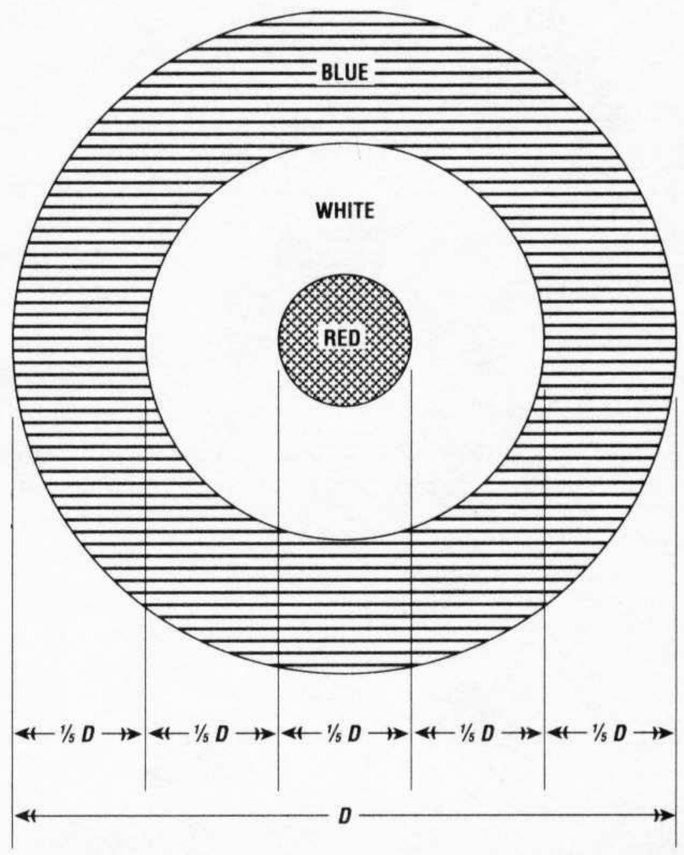
(Figure 8) On January 5, 1942, the U.S. Navy adopted this red-and-white variation of the Army rudder stripes for use on camouflaged airplanes, but used it only until May 15, 1942.

through 1926, the Army and Navy used the same rudder markings: three vertical stripes of equal width with red at the trailing edge, then white and blue forward (Figure 6). This duplicated the French and British markings.

After 1926, the Army deleted the vertical red and white stripes and replaced them with 13 alternating red and white stripes, as used on the American flag (Figure 7). This marking was eliminated from camouflaged Army planes in February 1941, and from all other Army planes on May 15, 1942.

The most common error in present-day model and real airplane restorations occurs when the vertical blue stripe is made the same width as the horizontal stripes. Whatever the shape of the rudder, the width of the vertical blue stripe should be one-third the maximum chord of the rudder.

After 1926, the Navy used rudder stripes less often, and they were eliminated by 1941. In January 1942, the Navy adopted a variation of the Army rudder stripes for camouflaged airplanes by deleting the vertical blue stripe and



(Figure 9) A British Type A roundel, as used from WW I through June 1942. Note that the diameter of the roundel is divided into equal fifths by the three circles.

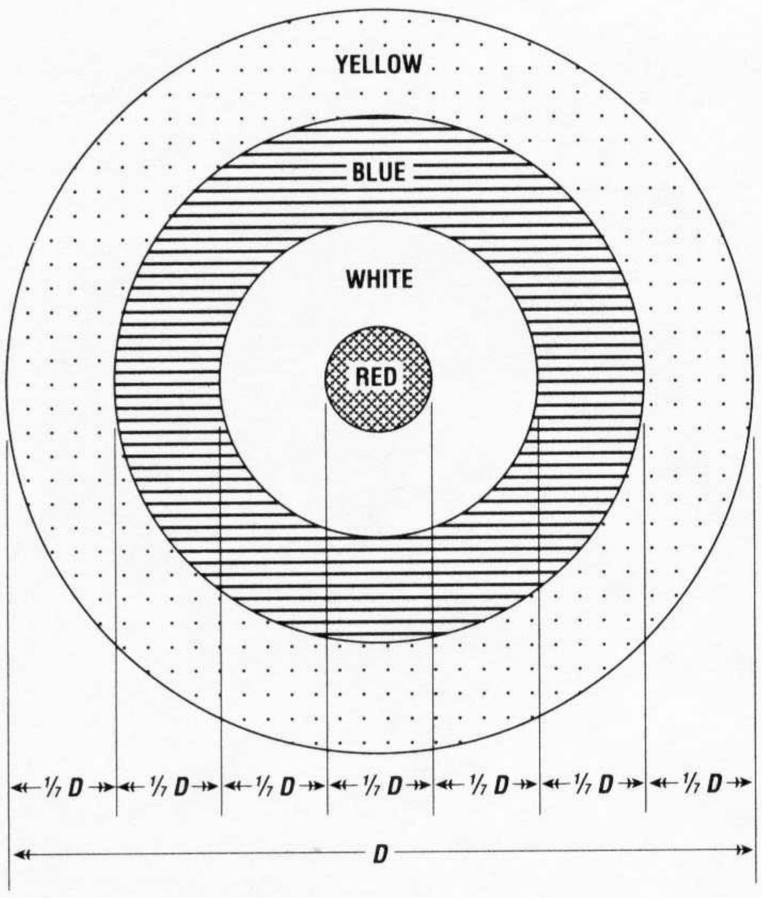
running the horizontal stripes full-chord of the rudder (Figure 8). This marking was eliminated on May 15, 1942, along with the red center of the star insignia.

GREAT BRITAIN—Beginning early in WW I, British Empire forces used three-color circle insignia called "roundels," and three vertical rudder stripes with the blue forward. To avoid duplication of the similar French rudder stripes, the order was reversed in 1931. By 1937, however, when camouflage was adopted, rudder stripes were uncommon.

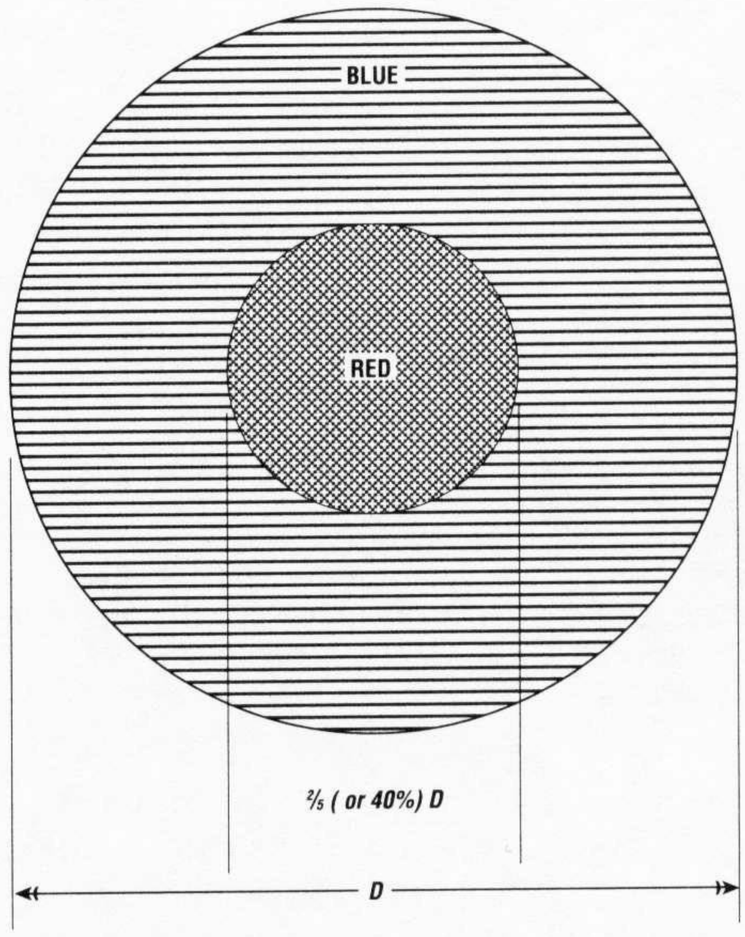
Roundels—The British roundels had standard proportions and were used in three basic arrangements during WW II. Figure 9 shows the standard proportions of the Type A roundel as it was used from 1916 through June 1942. Note that the diameter of the insignia is divided into fifths. With the adoption of camouflage in 1937, the roundel was modified to Type A.1 (Figure 10) by the addition of a yellow ring around the blue, which divided the basic circle into sevenths. At first, type A.1 was used against all dark surfaces, but after 1940, it was used only on the fuselage sides of camouflaged planes. Type A was then used only on the undersides of wings, though it was used briefly on camouflaged sides in late 1939 and early 1940 in place of type A.1.

The Type B roundel originated in WW I as a reduced-visibility marking for night operations, and it remained in use on both day and night operations through WW II. Figure 11 shows that the red center was two-fifths (or 40 percent) the diameter of the overall marking. Type B was

WORLD WAR II COLOR AND MARKINGS



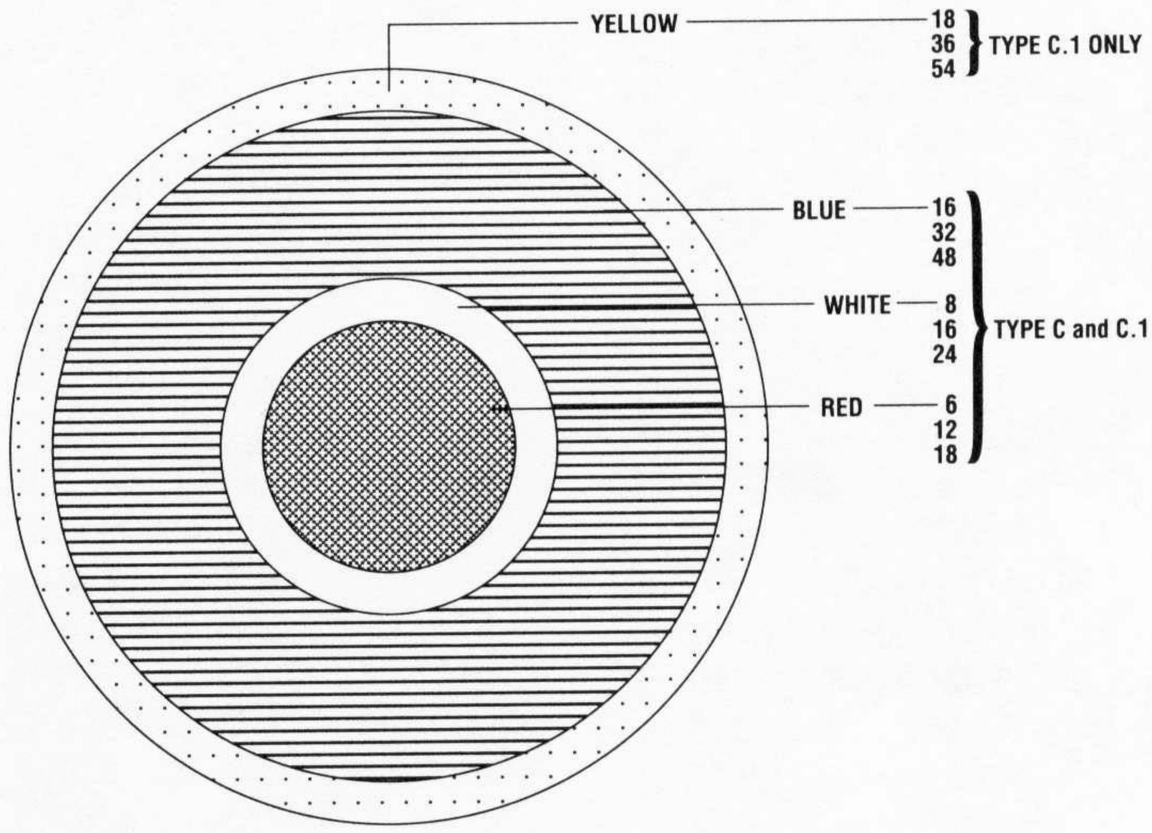
(Figure 10) The addition of a yellow outer ring to the Type A British roundel divided the diameter of the new Type A.1 marking into equal sevenths. It was used on camouflaged surfaces from 1937 through June 1942.



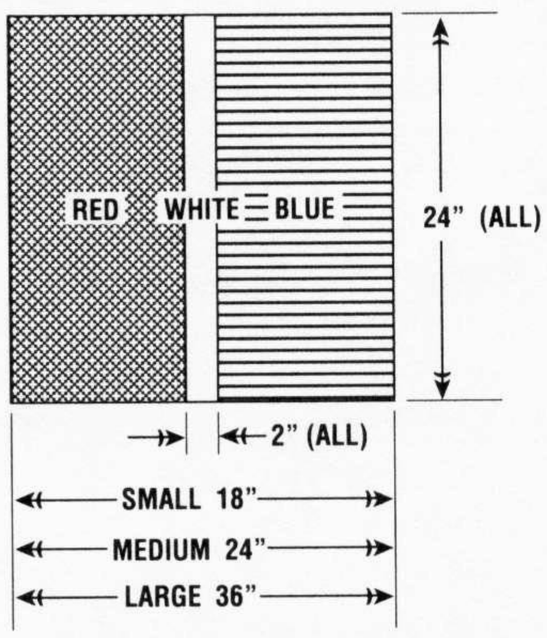
(Figure 11) This British Type B roundel was used for night operations, beginning in WW I, and was used on the upper wing surfaces of most other aircraft from 1940 until the end of WW II.

used mainly on upper wing surfaces through WW II, but it appeared on the fuselages and underwings of some special-purpose aircraft, such as blue-painted reconnaissance planes.

Type C and C.1 roundels were adopted in July 1942 as direct replacements for Types A and A.1. They were applied in only three sizes—small, medium and large—and were laid out to given dimensions rather than to fractions of the overall diameter. Figure 12 gives the dimensions in inches for all three sizes in ascending order. Note that the yellow ring is used only on Type C.1. Some Type C roundels began to appear on upper wing surfaces just before the war ended.



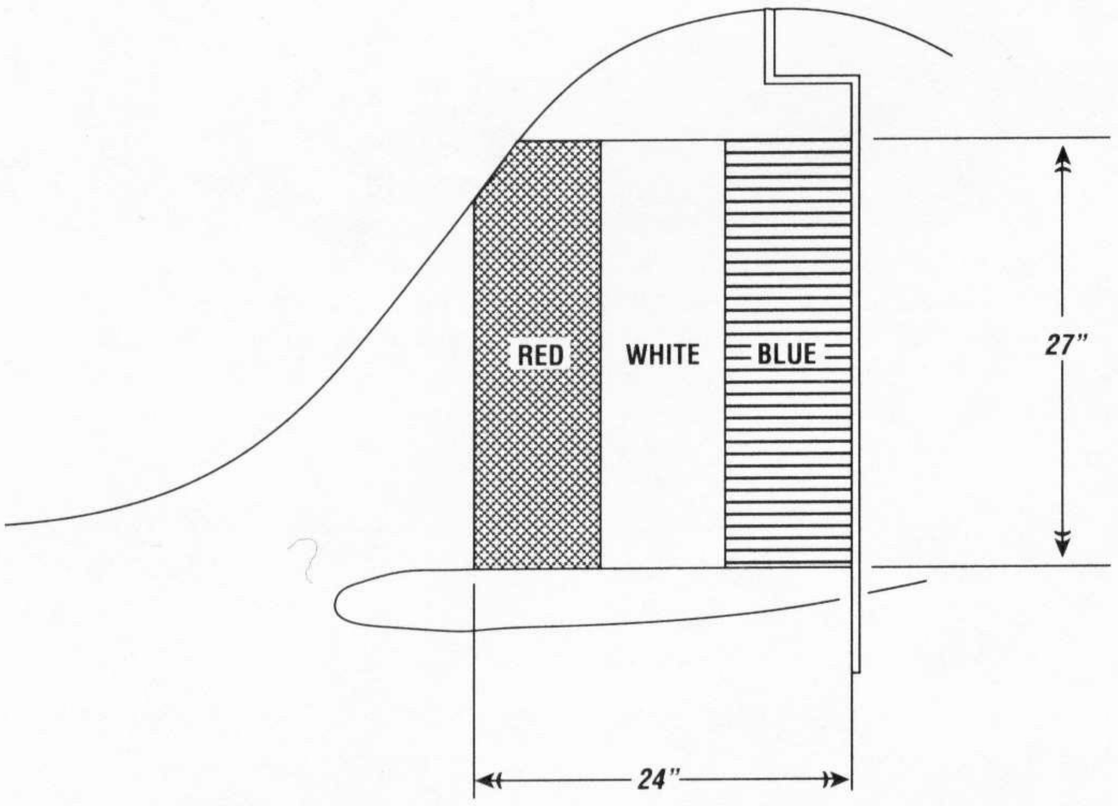
(Figure 12) British Type C and C.1 roundels were adopted in July 1942, and were laid out in the three sizes shown, rather than being divided into percentages of the overall diameter. They were used as direct replacements for Types A and A.1 roundels.



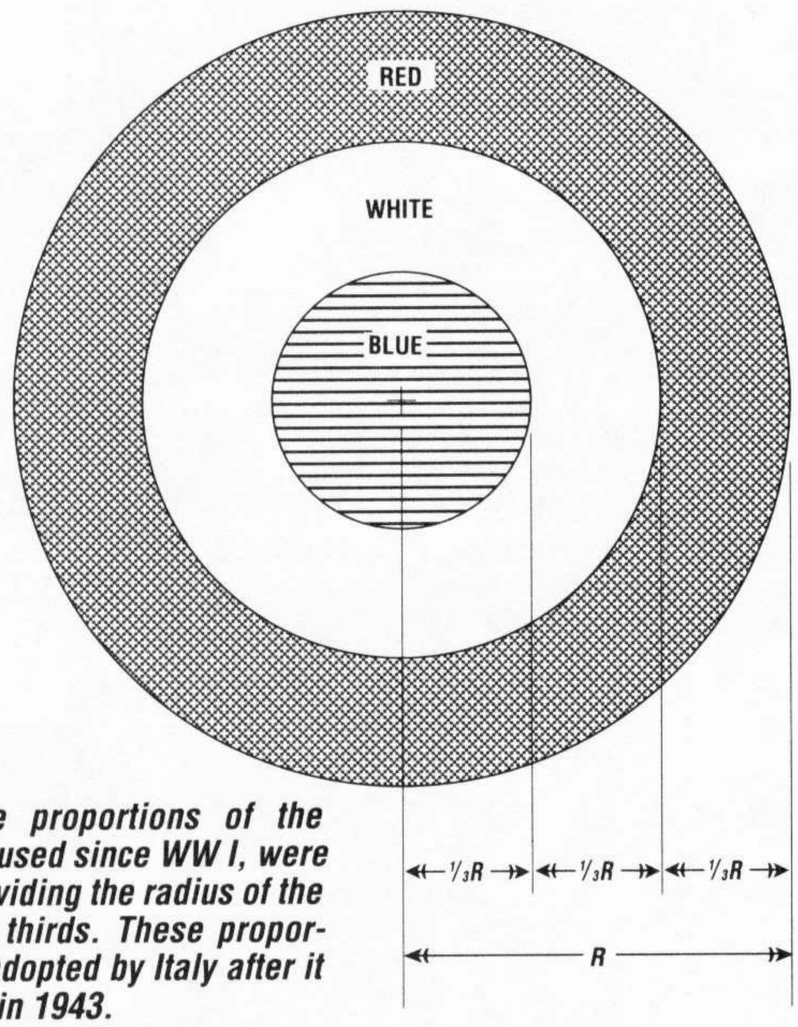
(Figure 14) The revised British Fin Flash of July 1942 was 24 inches high and used three widths (shown), all with a 2-inch-wide white center stripe.

Fin Flashes—During the Battle of France (May 1940), the Royal Air Force briefly used rudder stripes again. They were quickly abandoned, however, for what was called a "Fin Flash"; a smaller set of equal-width red, white and blue vertical stripes, with red forward, painted on the vertical fin. From late 1940 through June 1942, the flash was standardized at 24 inches wide and 27 inches high (Figure 13). After July 1942, the width of the white stripe was reduced to 2 inches. The standard flash then had a height of 24 inches, and it used red and blue stripes in three widths (Figure 14).

FRANCE—France originated the use of national airplane insignia before WW I, and it called its tricolor circles "cocardes." These were used only on wings until they were added to fuselages at the onset of WW II. Mainly, the proportions were as in Figure 15, with the radius divided into thirds. Rudder stripes, with the blue forward, were used from WW I through WW II. France was one of the few nations to retain rudder stripes after most of the others had moved tail markings to the fin. The French marking situation was complicated after June 1940,



(Figure 13) The British Fin Flash was standardized late in 1940, and remained this size through June 1942. On airplanes with small fins (such as the Supermarine Spitfire), it was sometimes necessary to cut an upper corner of the flash.



(Figure 15) The proportions of the French Cocarde, used since WW I, were determined by dividing the radius of the outer circle into thirds. These proportions were also adopted by Italy after it joined the Allies in 1943.

because "Vichy France" was subservient to Hitler, but "Free French" forces (who had escaped) joined the Allies, and both used the same basic national markings.

GERMANY—Germany was prohibited from having an air force by the Treaty of Versailles, which ended WW I. A secret Luftwaffe, however, was created in the early 1930s with airplanes that flew in civil markings. Proper military markings appeared when the new Luftwaffe was revealed to the world in 1935.

Crosses—White-bordered black crosses in various proportions were used from 1935 through 1939. These crosses were positioned midway between the trailing edge of the wing and the leading edge of the horizontal tail, and very close to the wing tips. After the Polish campaign that started the war, the proportions were standardized.

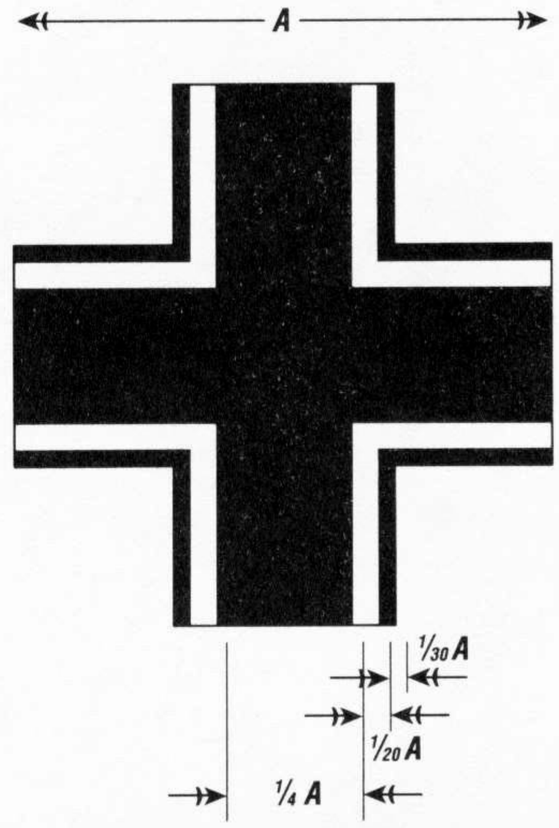
In the interest of reduced visibility, narrow-bordered crosses (Figure 16) were now used only on upper wing surfaces, and they were positioned 2 meters (6 feet, 6 inches) in from the wing tips.

Wide-bordered crosses (Figure 17) were used on the fuselage and on the underside of the wing, usually midway between the wing tip and the fuselage on single-engine types, and midway between the wing tip and the outer engine nacelle on multi-engine types.

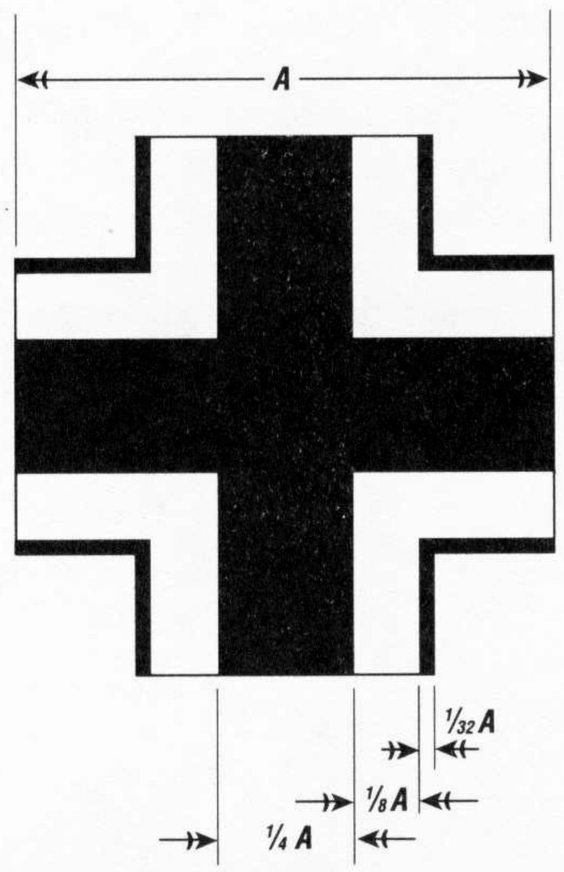
Late in the war, the black part of the cross was sometimes omitted, leaving only a white border against the airplane's basic color. In other cases, the white outline was replaced by black (Figure 18).

Swastika—From 1935 through 1938, the German tail marking for all airplanes was a wide red band that covered the full chord of the fin and rudder. A white circle containing a black swastika standing on its corner was centered on the red band (Figure 19).

Before the war started, the red band and white circle were deleted from German Military



(Figure 16) The standard proportions of the narrow-bordered German cross, as used on upper wing surfaces from 1940 until the end of the war.



(Figure 17) Standard proportions of the wide-bordered German cross, as used on fuselage sides and wing under-surfaces from 1940 until the end of the war.

airplanes only. Some military prototypes were subsequently tested with civil markings, but camouflaged planes retained the band and circle.

The swastika was laid out to very rigid specifications

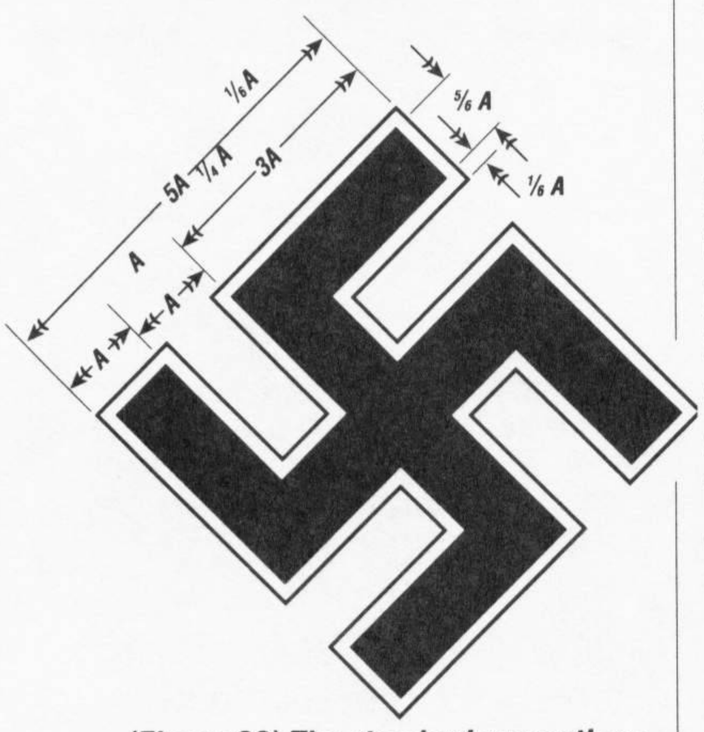
WORLD WAR II COLOR AND MARKINGS

(Figure 18) A German Focke-Wulf Fw.190A-3 carrying the black outlines of fuselage and wing crosses late in the war. Note the absence of a white border around the swastika on the fin.

(Figure 19) Panchromatic film and a filter lighten and emphasize the red band used on the vertical fins of German military airplanes from 1935 into 1938. The black swastika was moved to the fin after the red band and white circle were deleted. Civil-registered German airplanes retained the red band and white circle throughout the war.

(Figure 20), and on dark backgrounds, it had a narrow white border. For a short time after the red band had been removed, the swastika remained centered between the fin and the rudder. It was soon moved to the fin on most planes, but it was placed on the larger rudders of some aircraft with small fins.

It should be noted that very few WW II German aircraft models appear with swastikas today. Since the war's end, it has been against the law to display the swastika in Germany, and photos of wartime planes that appear in post-war issues of German magazines sometimes have the swastikas blanked out. Various anti-Nazi groups continue working to keep swastikas off all toys and representations of Nazi-era equipment, even in the United States.



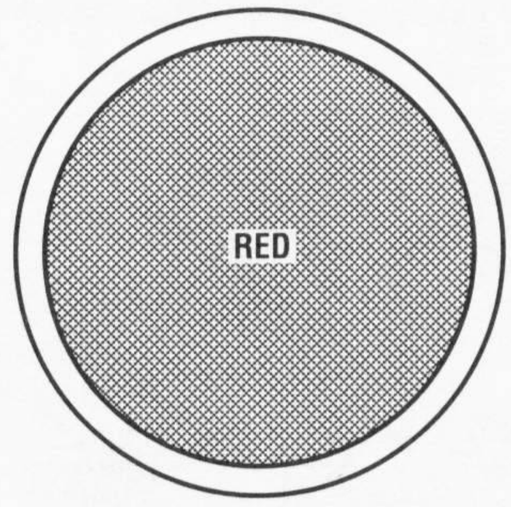
(Figure 20) The standard proportions of this white-bordered swastika were applied to the vertical fin of German airplanes from 1940 until the end of the war. The white border was eliminated on some light-colored airplanes.

JAPAN—Since WW I, Japan has used the "Rising Sun," or "Hinomaru," (the red disc of the Japanese flag), as its national aircraft marking. The Allies, particularly the Americans, derisively called it the "Meatball." When the Hinomaru was used against dark surfaces, it was usually outlined with a white border that was approximately 2 inches wide (Figure 21). The marking was standard for both the Japanese Army and its Navy. (The Hinomaru Red was much lighter and brighter than the dark American Insignia Red.)

At the war's end, a few Japanese military airplanes were allowed to fly during and beyond the surrender negotiations. These planes were painted white and were marked with dark green crosses (Figure 22). In a few cases, airplanes still in camouflage carried their new crosses on white squares that had been painted over the Hinomarus.

INVASION STRIPES

For the invasion of France in June 1944, participating U.S. and British airplanes carried hastily applied "Invasion Stripes" for quick, positive identification. These consisted of three white and two black equal-width stripes that completely encircled the rear fuselage and were applied full-chord to both upper and lower wing surfaces (Figure 23).



(Figure 21) The Japanese red circle marking, officially called "Hinomaru," was usually outlined with a white border, approximately 2 inches wide, when it was used on dark surfaces.

Widths varied from 18 inches (on the P-51) to 20 inches (B-26 and P-47), and 24 inches (A-20). Four-engine bombers didn't use the stripes unless they had been diverted to glider-towing.

After the invasion of Normandy, the stripes were removed from the upper half of the fuselage and from the top of the wing. The stripes were retained on the lower surfaces for subsequent large-scale, airborne invasions, with some used on planes involved in the crossing of the Rhine in March 1945.

Invasion stripes are popular today for restored, camouflaged WW II airplanes, and they add variety to a collection of similarly camouflaged U.S. or British scale models.

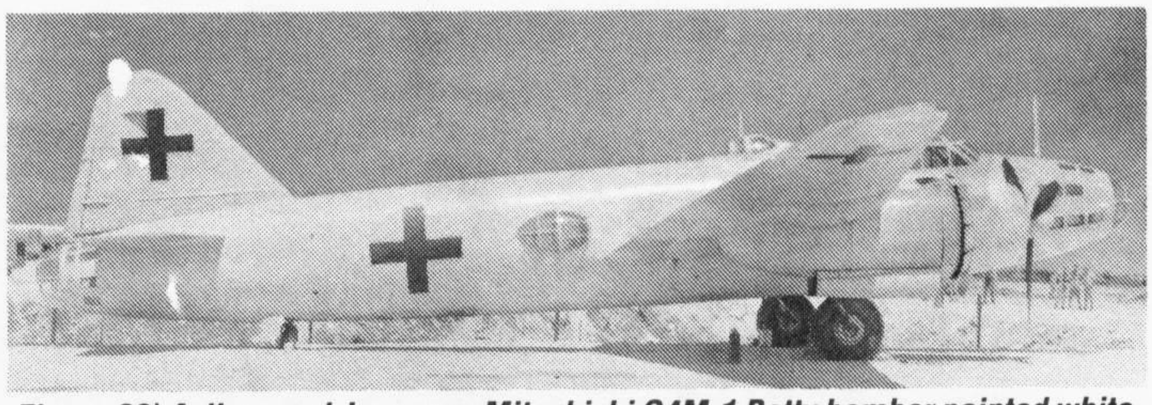


Figure 22) A disarmed Japanese Mitsubishi G4M-1 Betty bomber painted white, with green crosses replacing the Hinomaru marking. It was used to transport Japanese surrender emissaries to Allied headquarters in August 1945.

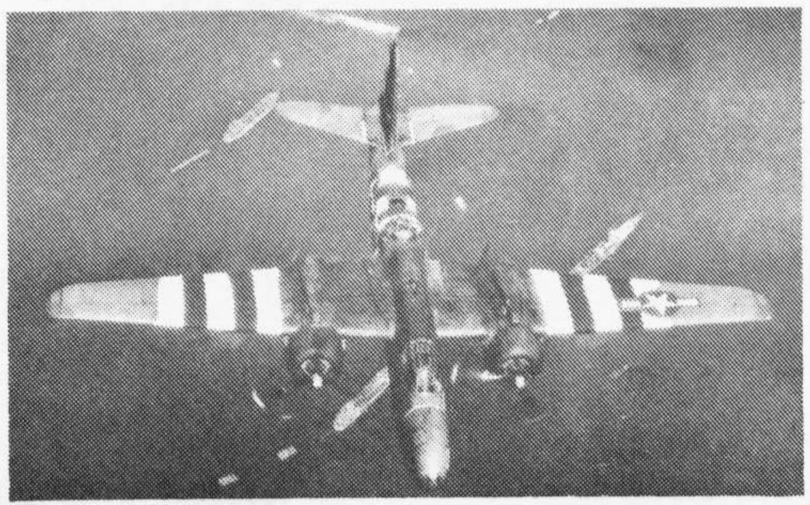


Figure 23) An olive-drab Douglas A-20G with crudely applied black-and-white Invasion Stripes flies over the Allied Invasion Fleet on D-day, June 6, 1944.

DESIGNATIONS

The nations involved in WW II identified their military airplanes differently. France, Germany and Italy simply used the manufacturer's model designations (e.g., Messerschmitt 109, Fiat CR 42, etc.) France added the mission and seating to the designation painted on the rudder, as in "Douglas DB-7-B3." The "B3" indicated that it was a three-place bomber. A pursuit, like the Curtiss 75, was "75-C1," ("C1" indicated a one-place Chasse, or pursuit, type). The more involved British, U.S. and Japanese systems are described separately here.

GREAT BRITAIN—Great Britain used given names followed by progressive "Mark Numbers," such as the Westland Lysander Mk I, II, III, etc. Minor variants that didn't qualify for a new Mark number were given letters, such as "Lysander Mk IIIA." In some cases, the added letter identified a special feature, as with the Hawker Hurricane Mk IIC with cannon armament. Similar airplanes used for vastly different missions were sometimes given different names, such as the Douglas DB-7, which was called a "Boston" when it was used as a bomber, but a "Havoc" when it was used as a night fighter.

The practice of using different names or Mark Numbers for different missions was abandoned mid-war, in favor of adding prefix letters to identify the mission, such as "Spitfire F Mk IX" for a fighter, and "P.R. Mk XI" for photoreconnaissance. The letters "N.F." identified night fighters, and "T.T." identified target tugs.

UNITED STATES—The U.S. Army and Navy used two separate systems to identify the type, model, series and manufacturer of each airplane. The systems are too extensive to list here in their entirety, so only the basics will be presented.

U.S. Army—The Army used a Type-Model-Series system that was formalized in 1924 and is still used today by the U.S. Air Force. The type letter identified the basic mission of the airplane (e.g., "B" for bomber). The model number identified the number of the particular type contracted for, but not necessarily procured by, the Army, such as "B-17." The series letter identified the stage of model development, such as "B-17A." Starting in 1942, suffix letters were added to the Army designation to identify the actual builder of the airplane.

In early 1942, minor changes were often made that didn't justify a new series letter. Instead, the airplanes were identified with a block number, e.g., -1, -5, -10, and so on. The intervening numbers were reserved for changes made at modification centers (e.g., changes to a Republic P-47D-25 made it a P-47D-28).

U.S. Navy—The Navy tied in the airplane manufacturer with the airplane type and model designation, as with the "Grumman F4F-4." The first letter identified the type (e.g., "F" for fighter). The following number identified the number of different fighter designs ordered from that manufacturer, and the second letter identified the particular manufacturer. In this case the "F" identified "Grumman" because the logical letter "G" was in use by another manufacturer when Grumman became a Navy customer. The number "1" wasn't used for a manufacturer's first Navy model. Grumman's first Navy fighter was the FF-1, followed by the F2F-1, F3F-1, F3F-2, etc. The dash number that followed the last letter identified not the model number, but the sequential configuration of that model.

Multi-purpose Navy planes appeared in 1934 and were identified by two type letters, as in "PBY-5" for Consolidated's first Patrol Bomber. Specialized configurations were identified by suffix letters, as in "PBY-5A" for an amphibious version and "SB2C-4E" for a Scout bomber modified for electronics missions.

U.S. Popular Names—In October 1941, the U.S. Government adopted "popular" names for its military aircraft, such as "Mariner" for the Martin PBM and "Wildcat" for the Grumman F4F. Some names were already in use and were easy to adapt—Boeing had already been calling its B-17 the Flying Fortress—and other names were picked up from previous British use of American designs, such as "Catalina" for the PBY.

The purpose of catchall names was to conceal the actual development stage of a combat plane when it was discussed in the public press. A Flying Fortress was simply a B-17, not specifically a B17E, F, or G. These names were almost totally ignored by those associated with the airplanes (to whom accurate designations were important), and they didn't "take" well with the public, despite the efforts of the press.

JAPAN—The Japanese Army and Navy used a type identification system based on the named type and a one- or two-digit number identifying the Japanese Dynastic Year in which the airplane entered production, such as "Bomber Type 1" for the Mitsubishi G4M-1. The figure "1" in this case is the last digit of the year 2601 (equivalent to our calendar year 1941). The Japanese also gave names to many, but not all, of their military aircraft.

The Japanese Army also used a sequential "Kitai" numbering system that started in 1932, with the number for the Kawasaki Type 3 fighter appearing as "K1 61 Hein." The Japanese Navy system was based on the U.S. Navy system that identified the airplane by type and number of models procured from a particular manufacturer, such as "Mitsubishi A6M-2 Type 0" (1940) fighter Raiden.

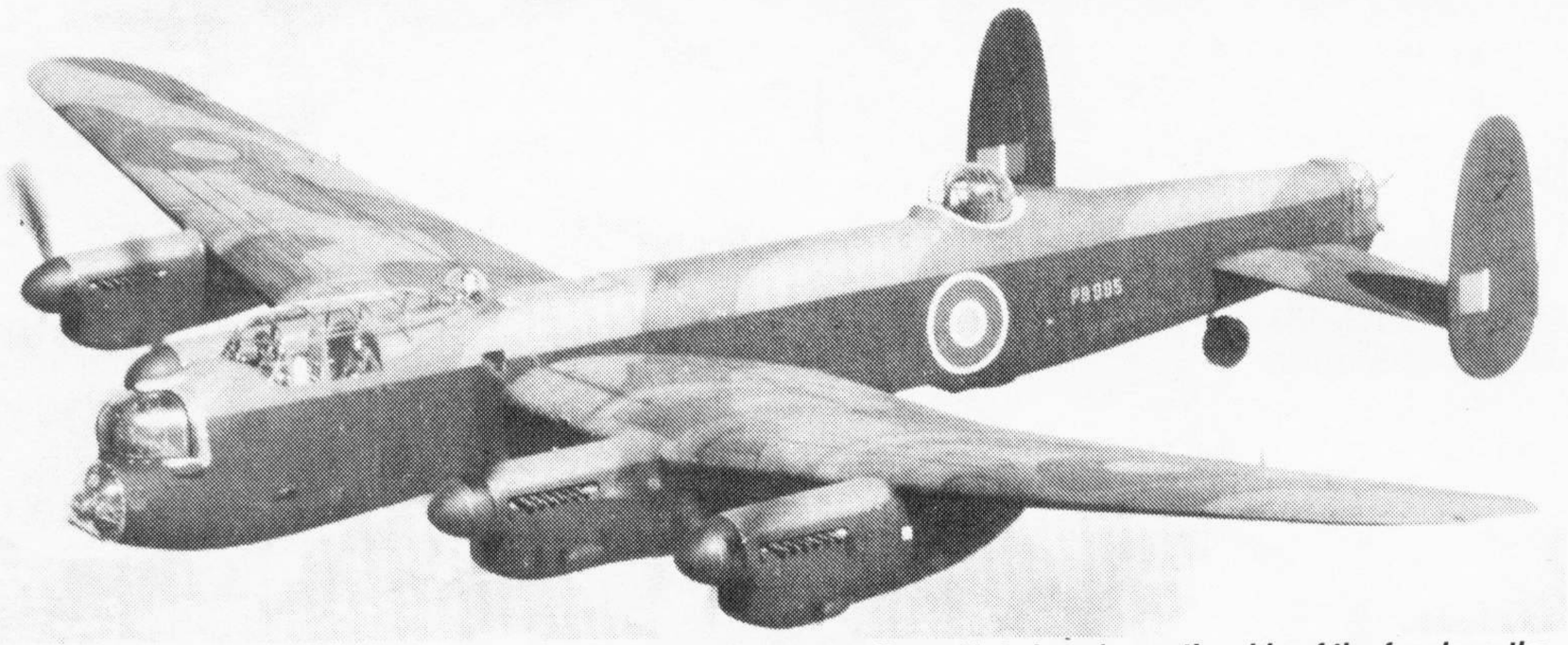
The Allies stopped trying to use the various Japanese systems and gave all Japanese airplanes code names, such as "Tony" for the Ki 61 and "Zeke" for the A6M-2.

MULTIPLE MANUFACTURERS—In all of the warring nations, major combat planes were built in factories other than those of the original designers. In England and Germany, Spitfires and Me 109s were built by several manufacturers, with no indication in their designations as to who actually built them. Designations were different in the U.S.

U.S. Army—A B-17G was still a B-17G, no matter who built it, but the factories involved were included in the designation early in 1942. Boeing's Seattle plant built the B-17G-BO, Vega built the B-17G-VE and Douglas' Long Beach plant built the B-17G-DL. Different factories of the same manufacturer also got distinguishing letter designations, such as "BW" for Boeing's Wichita, KS, plant, and "BN" for its plant in Renton, WA.

U.S. Navy—When an established design, such as the Curtiss SB2C-4, was built by another firm, that firm used the same type designation but a different manufacturer's letter. The SB2C-4, built in Canada by Fairchild, became the SBF-4 because Canadian Fairchild had never built an SB type for the Navy. The same model built by Canadian Car & Foundry became the SBW-4 for the same reason.

AVRO LANCASTER



An Avro Lancaster I carrying standard British night-bomber camouflage. Note how far up the side of the fuselage the matte-black underside paint extends. Type B roundels are on top of the wing; Type C.1 roundels are on the fuselage. The fin flash is 24x36 inches.

THE Avro Lancaster was the most famous and widely used four-engine British bomber of WW II. Oddly, however, it didn't originate as a four-engine design. In 1937, the British Air Ministry issued a requirement for a heavy bomber to be powered with two new and still experimental 1,760hp Rolls-Royce Vulture engines.

A.V. Roe and Co., Ltd., of Newton Heath, Manchester, won the order with its Model 679—named "Manchester" by the Royal Air Force. The prototype was first flown in July 1939. The program was seriously delayed by a German air raid, and it was then ended by the shortcomings of the still-troublesome Vulture engine (priorities for the Merlin engine prevented Rolls-Royce from perfecting the Vulture). Only 200 Manchesters were built, some of which saw action over Germany (February 1941 to June 1942).

To save the Manchester program, Avro developed a four-engine modification of the basic airframe. It had a wider center section and longer wing panels for use with the 1,145hp Rolls-Royce Merlin engine (as used in the Hawker Hurricane and Supermarine Spitfire fighter). These changes increased the wingspan from 90 feet, 1 inch to 102 feet for the same 50,000-pound gross weight. The converted airframe, originally named "Manchester III," first flew on January 9, 1941. The Air Ministry was pleased with its performance and immediately ordered the revised design into production designated as the "Avro Model 683 Lancaster."

Demand was more than Avro could handle, so production of an eventual 7,374 Lancasters was distributed among two Avro plants and one Canadian and four other British manufacturers. The first production Lancaster I, powered by 1,260hp Merlin XX engines, flew on October 31, 1941. The short time it took to move the Lancaster from prototype to production can be attributed to its being essentially a modified Manchester, not a completely new design.

Both offensively and defensively, the Lancaster I was a formidable machine, with a gross weight of 65,000 pounds—greater than that of the American Boeing B-17. It could usually carry 7,000 pounds of bombs and was defended by four powered machine-gun turrets with 10 to 12 .303-caliber guns. Lancasters first went into action in March 1942 and were the backbone of the British heavy bomber fleet for the rest of the war.

As a precaution against a shortage of Merlin engines, a Lancaster II using the 1,650hp Bristol Hercules VI air-cooled radial engine was developed. A large production order was placed with one of the subcontractors, but the anticipated Merlin shortage didn't materialize, so the Lancaster II order was progressively reduced until only 300 were delivered. Lancasters that had Merlin engines built in the U.S. by Packard were designated "Lancaster III" (2,990 produced). The 430 built in Canada with Packard Merlins were identified as "Lancaster X."

Intermediate marks identified various improved versions: Marks IV and V were special long-range versions; Mark VI had improved 1,750hp Merlins; and Mark VII had 1,620hp Merlins but a gross weight of 68,000 pounds. Marks VIII and IX weren't used.

The Lancasters were used primarily as night bombers in the Allied program that bombed Germany "around the clock"—the Americans attacking by day, the British by night. Specially modified Lancasters were used on some spectacular missions, such as the breaching of the Möhne and Eder dams in May 1943 and the sinking of the battleship Tirpitz, hidden in a Norwegian fjord, with a single 12,000-pound bomb in November 1944. Special Lancasters modified to carry 22,000-pound Grand Slam bombs had gross weights of 72,000 pounds.

Lancasters remained in service with the Royal Air Force until February 1954 and with the Royal Canadian Air Force until April 1964. Only two flyable Lancasters remain today.

SPECIFICATIONS AND PERFORMANCE

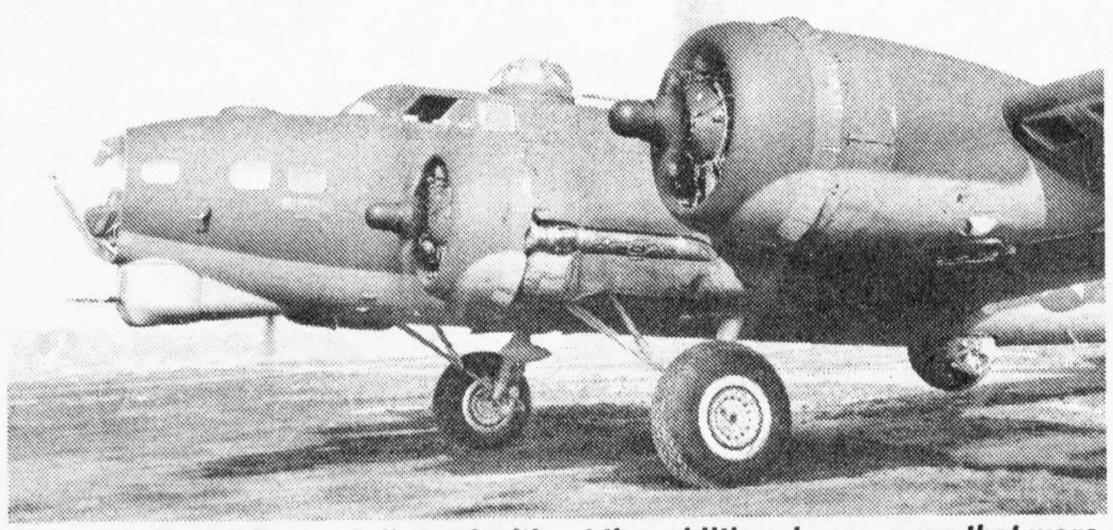
Wingspan	*102 ft.*
High Speed	*287mph*
Length	*69 ft., 4 in.*
Cruising Speed	*200mph*
Wing Area	*1,279 sq. ft.*
Initial Climb	*250 ft./min.*
Empty Weight	*36,457 lbs.*
Ceiling	*19,000 ft.*
Gross Weight	*68,000 lbs.*
Range	*2,530 miles*

303 cal. twin machine guns
in all powered-turrets
trim tab
balance tab
fabric covered elevators
mass balance
all metal stabilizer
de-icing strip
flame damper
computing sight
Rolls-Royce "Merlin XX" - 1,260 h.p. engines
flap panel
fairing panel
molding strap
trim tab
balance tab
fabric covered ailerons
formation light
navigation light
observation blister
direction finder
navigator's sighting dome
front powered-turret
landing light
de-icing strip
DeHavilland constant-speed
full-feathering propellers
ventilator
bombardier's flat
bomb bay
camera aperture
front entrance
pitot tube
cowl flap
antenna mast
hinged leading edge
cabin air intake
ground line at rolling radius
landing gear door
hydraulic brake
flame damping exhaust muff
carburetor air intake
glycol cooler
oil cooler
Green-haze and sandy-brown camouflage on top
surface only. Dull-black on side and lower surfaces.
airfoil section
six-inch squares
yellow
red
white
blue
gray
upper powered-turret
radio antenna
rear powered-turret
trailing radio antenna
telescoping ground post
landing gear door
landing gear actuating arm
static suppressor
rear entrance
lower powered-turret
identification light
all metal rudders and
vertical stabilizers
non-retracting
William A. Wylam
0" 5' 10' 15' 20'

AVRO LANCASTER

WW II SCALE AIRCRAFT DRAWINGS

BOEING B-17 FLYING FORTRESS



This B-17G-15-BO was delivered without the additional nose guns that were added to early B-17Gs at modification centers. Note that the exhausts for inboard engines are on the outer sides of nacelles; exhausts on the outboard engines are on the bottoms of nacelles. Also note the camouflage pattern on engine cowlings.

THE Boeing B-17 Flying Fortress was one of the few U.S. warplanes to have an accepted name as well as a standard military designation *before* being named by the British or included on the U.S. government's list of so-called "popular" planes late in 1941.

The B-17, a daring design at the time, was developed in response to a U.S. Army fly-off competition for multi-engine bombers announced in 1934. "Multi-engine" at that time was generally understood to mean "twin engine." Boeing realized that all the contestants, using the available engines and state-of-the-art airframes, would perform similarly, so it decided to take a gamble: use four engines to improve the performance of its entry while carrying the same bomb load as the competition. Previously, additional engines had been used to get larger airplanes with heavier loads into the air, rather than to improve the performance of smaller airplanes.

Built as the company-owned Model 299, the prototype of the 12,726 B-17s that were eventually built rolled out of the factory in July 1935. The name "Flying Fortress" (later copyrighted by Boeing) was bestowed on it by a Seattle newspaper reporter who was impressed by the five defensive machine-gun turrets of the new bomber. The aircraft's name was a natural, owing to its armament and the fact that it was intended to defend the U.S. coastline from invading surface fleets accompanied by carrier-based fighters.

Model 299 ran away with the contest. Performance was sensational—a top speed of 236mph at a gross weight of 38,059 pounds; a cruising speed of 140mph; and a range of 3,101 miles. On October 30, an army pilot took off with the control locks inadvertently engaged. The crash eliminated the Boeing from the competition, but the Army was sufficiently impressed with it to order 13 nearly identical planes for service testing as the YB-17. At the Army's request, the engines were changed from 750hp Pratt & Whitney R-1690 Hornets to 850hp Wright R-1820 Cyclones. Shortly before the first flight on December 2, 1936, the YB-17 designation was changed to Y1B-17.

The strength of an early Y1B-17 was proven in a violent storm, so the Army directed that a fourteenth airframe, ordered for a static test, be completed as the single Y1B-17A flight article. Boeing used this to develop turbosupercharger installations used on all subsequent B-17s for improved altitude capability.

Orders for 39 production B-17Bs trickled in over nearly three years, owing mostly to cost problems—Boeing's cost of building the planes in small numbers and the Army's reluctance to pay the price. Many officials thought that the B-17 was too much airplane for pilots to handle, and they urged that the money instead be spent on smaller bombers.

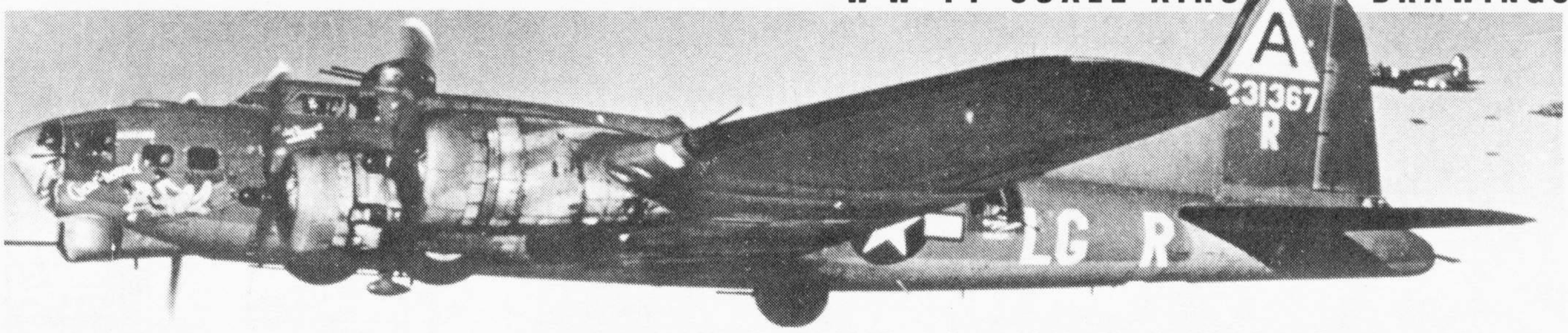
Thirty-eight B-17Cs and 42 B-17Ds were delivered through April 1941, thanks to the increasing urgency of the war situation. They resembled the Y1B-17A, except for minor improvements and gradual upgrading of the armament installations, which had been designed according to out-of-date Army specifications. Armor was added, and fuel tanks were changed to the latest self-sealing type. The B-17D had 1,200hp R-1820-51 engines and a bomb load of 4,000 pounds at a gross weight of 47,242 pounds.

The combat inadequacies of the B-17 were revealed on 20 B-17Cs, which the U.S. Army transferred to the British as "Fortress I." Their first combat use was a raid on Wilhelmshaven, Germany, on July 8, 1941. The systems and armament of the B-17 had not been designed or modified for high-altitude operations under European combat conditions, so the Fortresses were quickly withdrawn.

In the Pacific, the few surviving B-17Cs and Ds did much better. Their perfor-

SPECIFICATIONS AND PERFORMANCE

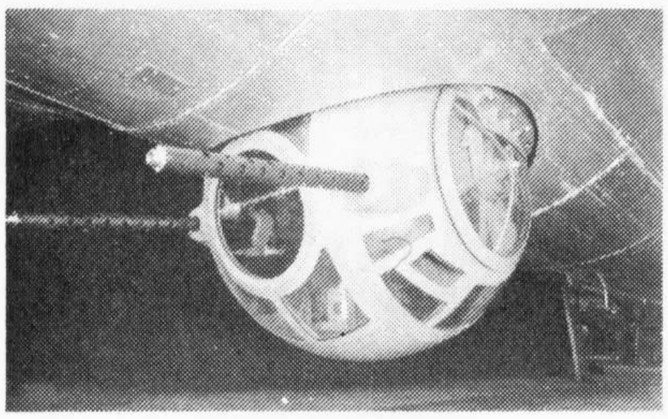
Powerplant	*Wright R-1820-97 1,200hp at 25,000 ft.*
Wingspan	*103 ft., 9 in.*
Length	*74 ft., 9 in.*
Wing Area	*1,420 sq. ft.*
Empty Weight	*36,135 lbs.*
Gross Weight	*65,500 lbs.*
Top Speed	*287mph at 25,000 ft.*
Cruising Speed	*182mph*
Service Ceiling	*35,600 ft.*
Range	*2,000 miles with 6,000-lb. bombs*
Armament	*13, .50-caliber machine guns*



A B-17G-15-BO with representative 8th Air Force markings. Triangle A identifies the 91st Bomb Group, LG identifies the 322nd Bomb Squadron and R identifies the individual airplane in the group. Note the name "Chow Hound," and cartoon on the nose and the row of painted bombs indicating nine bombing missions.

mance and versatility so impressed the Japanese that they were described as "four-engine fighters used for all purposes."

The lessons of the European war came together in the first of 512 B-17Es, which left the factory in September 1941. The aircraft had a new rear fuselage structure that housed a tail "stinger" with



The first 112 B-17Es had small, remotely sighted belly turrets. The 113th B-17E and all later models used the manned Sperry Ball turret (shown).

two .50-caliber guns and top and bottom powered turrets, each with two .50s, and a single .50 in the waist stations and radio room (a total of nine .50s), plus the single .30 in the nose. The tail stinger was a big surprise to the Japanese, making them wary to approach all B-17s from the rear. Crews of older B-17s took advantage of this by putting dummy guns in their tail cones.

The most distinctive external feature of the B-17E was the larger vertical tail with a long dorsal fin. American B-17 operations over Europe began with a raid of 12 B-17Es over Rouen, France, on August 17, 1942, but it wasn't an all-American operation; the escorting fighters were British Spitfires.

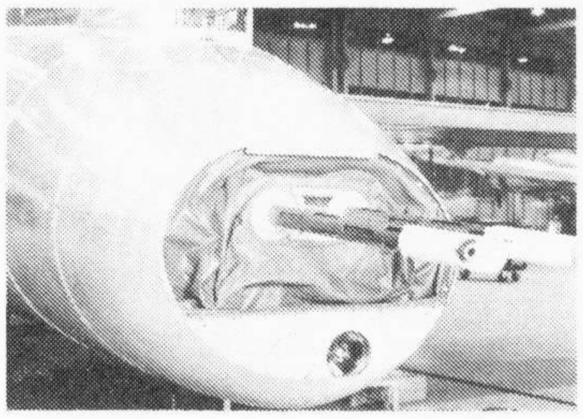
The B-17F was outwardly similar to the E except for a slightly longer molded Plexiglas nose cone. Its bomb load increased to 8,000 pounds by using external bomb racks under the wings.

With wartime demand exceeding Boeing's capability, Douglas and Vega (subsidiaries of Lockheed) were called on to build additional B-17Fs. The 2,300 built by Boeing were B-17F-BO; the 500 by Vega were -VE; and the 605 by Douglas were -DL. The B-17Fs were the first to use the block number system, but there was no direct correlation between, say, a B-17F-5 built by Boeing, Vega, or Douglas.

Combat with B-17Es and early B-17Fs revealed the plane's vulnerability to fighter attack from straight ahead, so various additional nose-gun arrangements were tried on B-17Fs in combat. The best solution was to replace the .30-caliber nose gun with one or two .50s in the nose cone and to add a single .50 in a bulged blister on each side of the nose. (This permitted almost straight-ahead fire.) Boeing developed a two-gun "chin" turret that was installed on the very last B-17F-VEs and -DLs and was to have been on the B-17F-135-BO. Boeing cancelled the F-135 and combined the new turret with other changes to produce the B-17G-1.

The B-17G looked identical to the late B-17Fs with chin turrets. Boeing built 4,035; Vega, 2,250; and Douglas, 2,395. The B-17G was the last production B-17. Designations as high as B-17P were post-war modifications.

Britain obtained additional Fortresses under Lend-Lease. The 19 Fortress IIs were B-17Fs. The 45 Fortress IIAs were B-17Es that carried later designations because existing airplanes were obtained while the Fortress IIs were being built. The 85 Fortress IIIs were B-17Gs; the first 30 built by Boeing and the remainder by Vega.

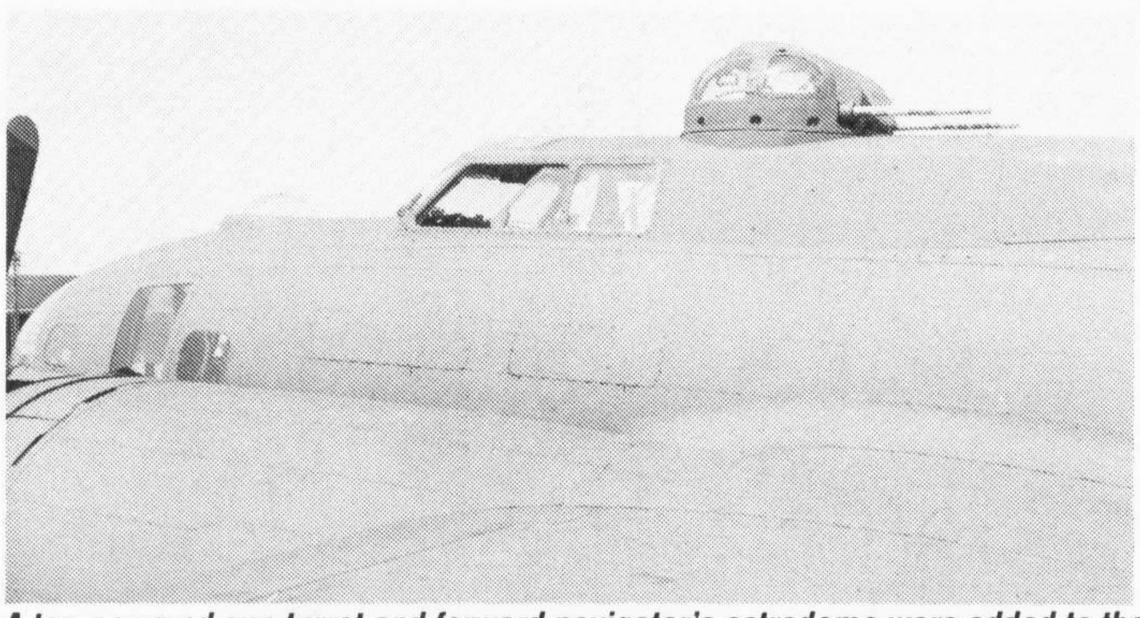


Tail-gunner's station from the B-17E midway through B-17G production. Late Gs had a revised design that was developed at United Air Lines' modification center, site of earlier modifications.

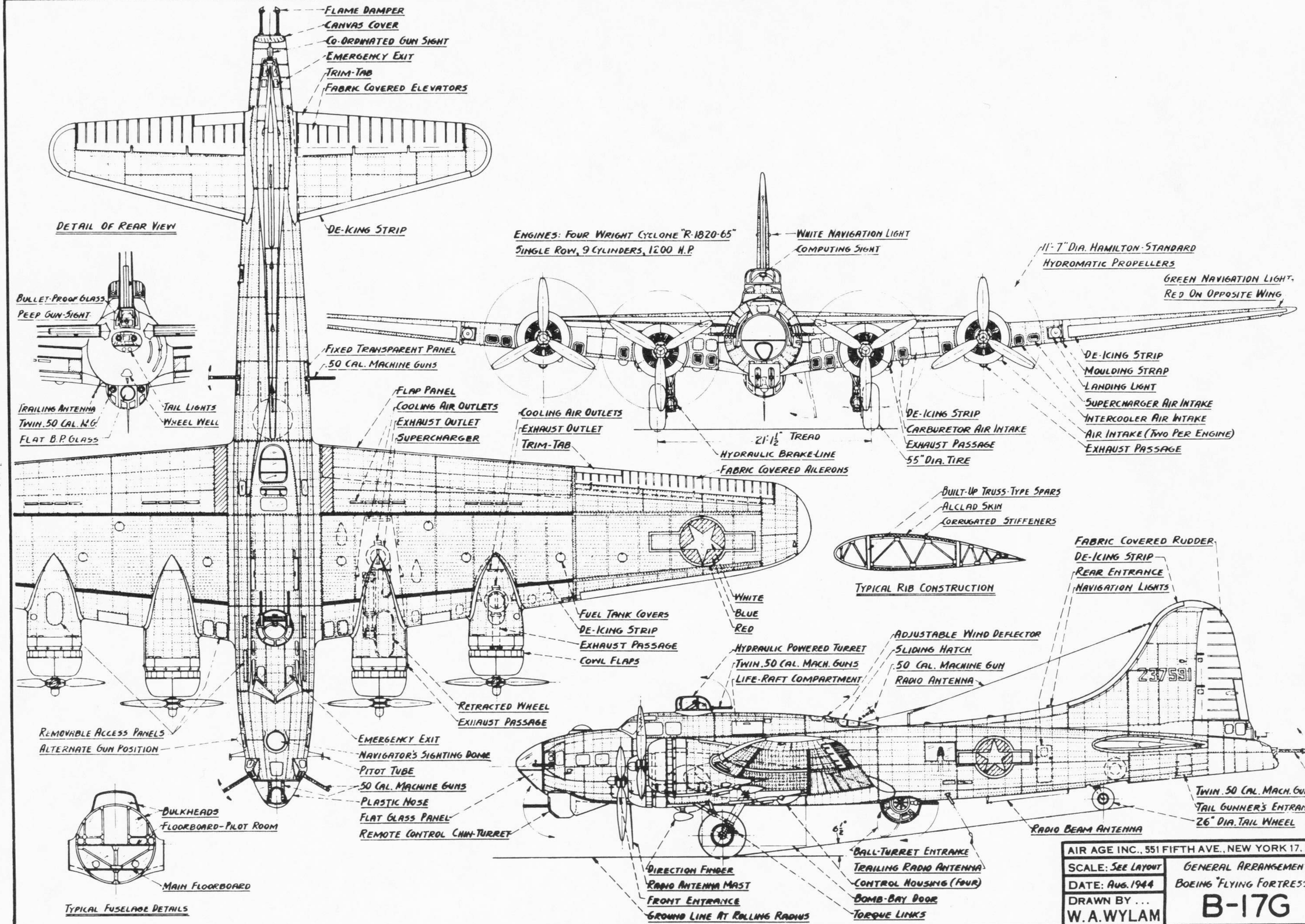
The American bombing career of the B-17 ended on V-E Day, but the B-17s served the Army and, later, the U.S. Air Force (created September 18, 1947) in many utility roles until 1960. Its final role was as a live target for anti-aircraft missiles that were built, ironically, by Boeing.

Odd B-17F variants were the B-40, the XB-40 modified by Vega and 20 service-test YB-40s converted by Douglas. They had two top turrets, twin, powered waist guns and extra armor, and they carried double the usual ammunition. They were intended as escorts for other B-17s before the long-range fighters were introduced. Their major shortcoming was that owing to the weight of their extra guns and armor, they couldn't keep up with the fast, light empty bombers on the run home.

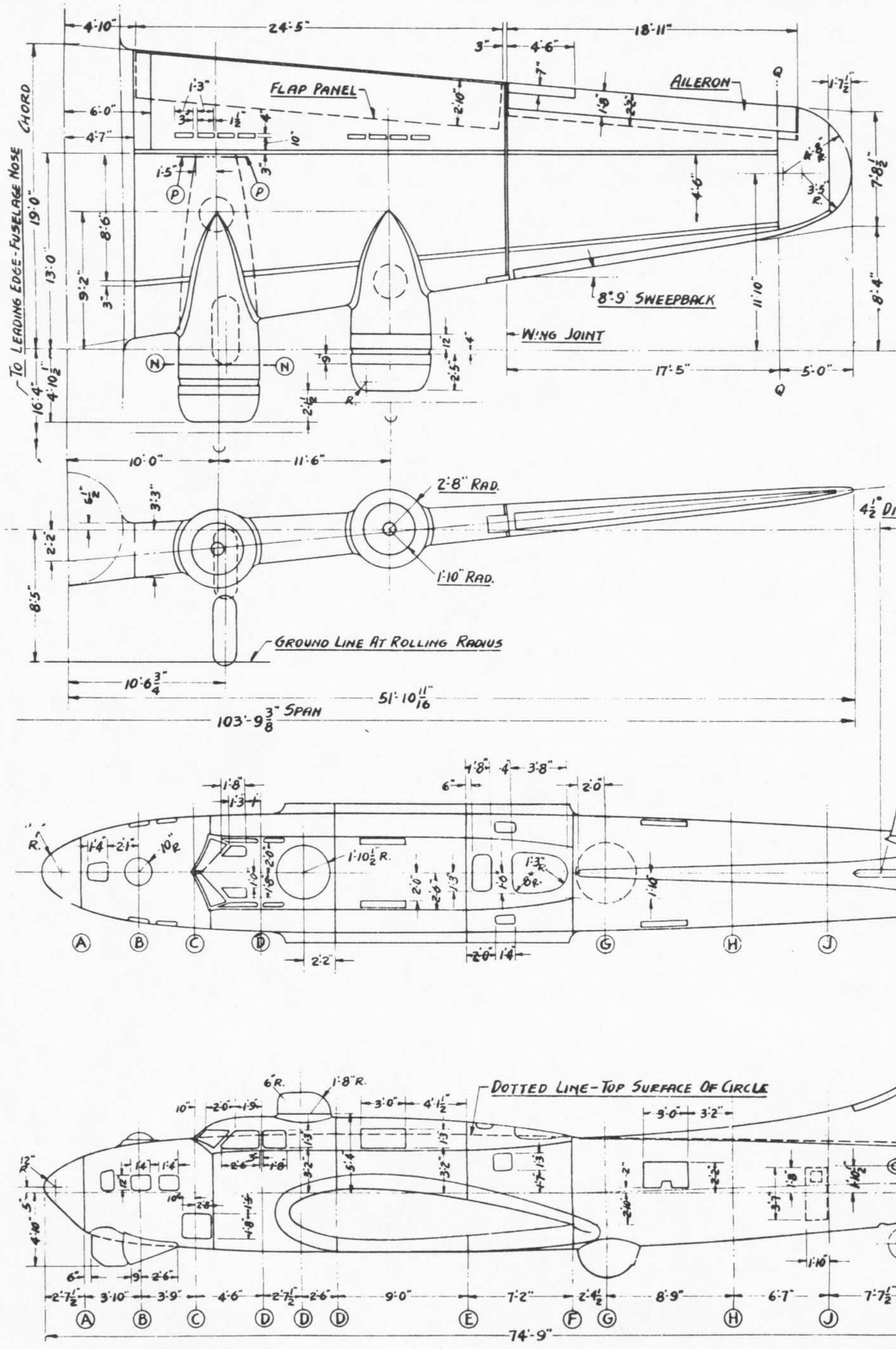
At the end of the war, the U.S. Navy obtained 31 late B-17Gs for use as unarmed, radar-equipped PB-1Ws (Patrol, Boeing, Anti-Submarine Warfare). The U.S. Coast Guard also acquired 17 B-17Gs (designated "PB-1G"—"G" for Coast Guard) and used them for air-sea rescue work (sometimes with lifeboats under their bellies) and for routine patrol and mapping work. The last PB-1G mission was in October 1957.

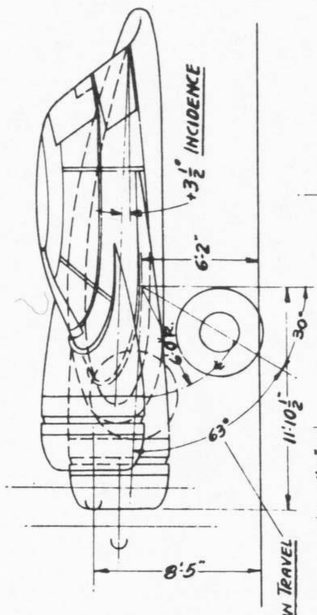


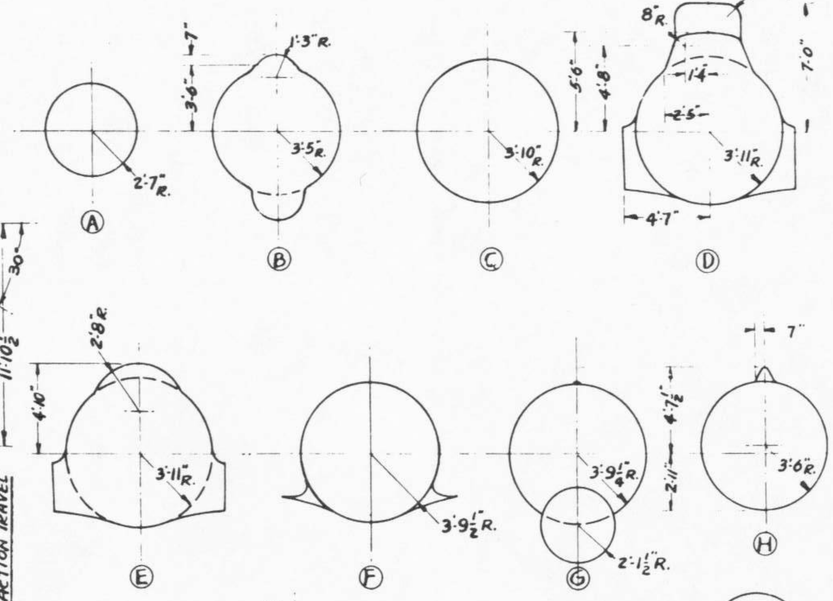
A top-powered gun turret and forward navigator's astrodome were added to the B-17E and retained through subsequent models.

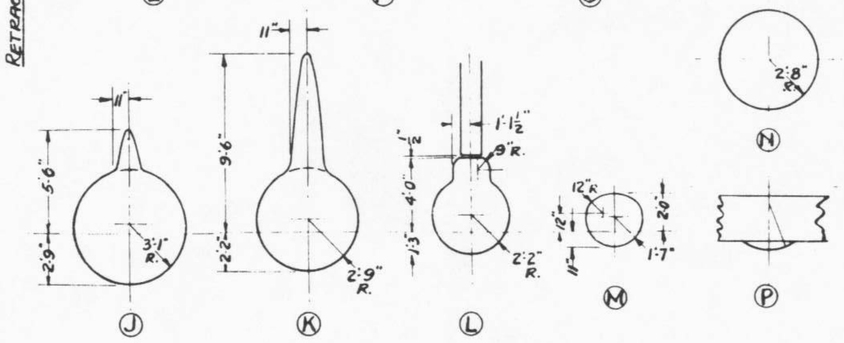


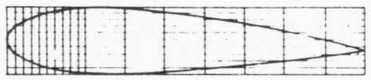
AIR AGE INC., 551 FIFTH AVE., NEW YORK 17, N.Y.	
SCALE: See Layout	General Arrangement
DATE: Aug. 1944	Boeing "Flying Fortress"
DRAWN BY ... W. A. WYLAM	B-17G





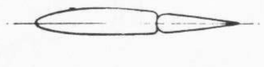






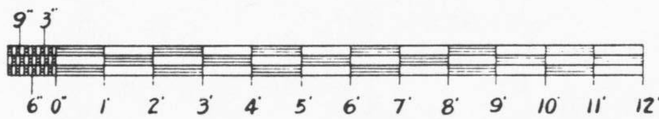
TYPICAL BOEING AIRFOIL

SECTION "Q-Q"



HORIZONTAL STABILIZER

VERTICAL STABILIZER

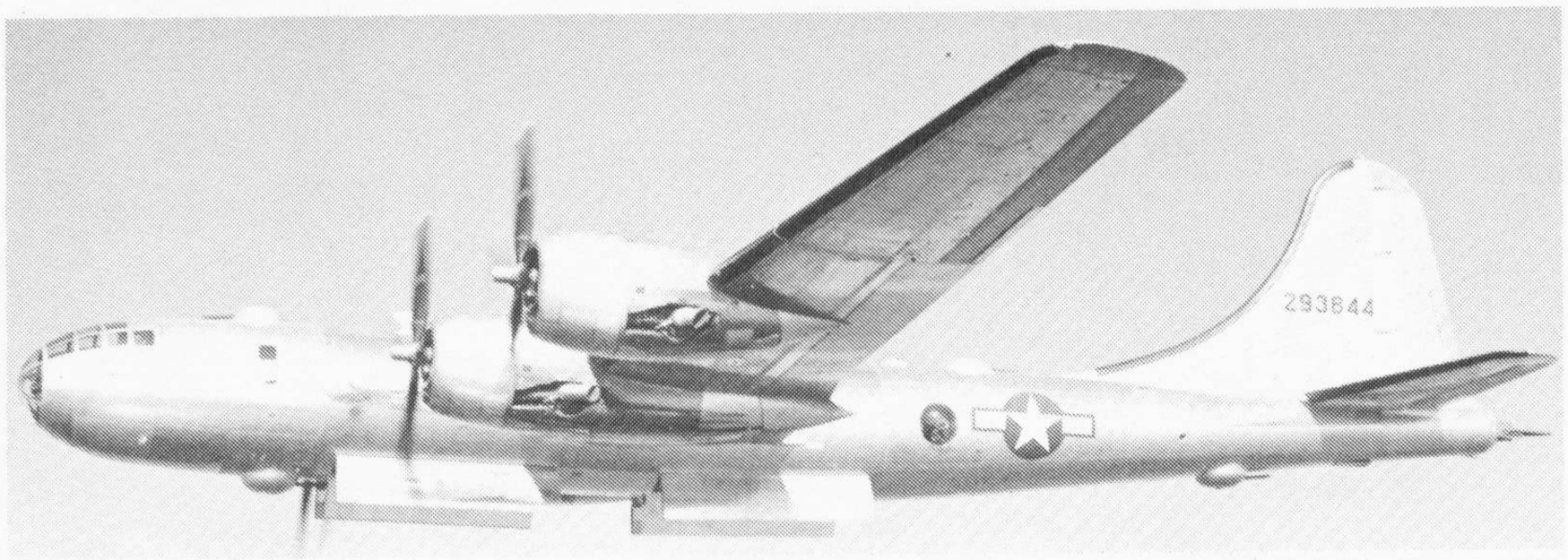


AIR AGE INC., 551 FIFTH AVE., NEW YORK 17, N.Y.	
SCALE: SEE ABOVE	LAYOUTS & CROSS SECTIONS BOEING "FLYING FORTRESS"
DATE: AUG. 1944	B-17G
DRAWN BY ... W. A. WYLAM	

WW II SCALE AIRCRAFT DRAWINGS

BOEING B-17 FLYING FORTRESS

BOEING B-29



A Boeing B-29A-5-BN in flight with both sets of bomb-bay doors open. Note the four powered, remote-control gun turrets above and below the fuselage, and the 20mm cannon supplementing two .50-caliber machine guns in the tail turret.

WHEN it entered service in June 1944, the Boeing B-29 was the largest, heaviest and most complex production airplane of its time—a masterpiece that pushed the state of the art to its limits. It had an 11-man crew, five powered gun turrets (each with two .50-caliber guns), a 20mm cannon in the tail turret, a pressurized fuselage and two bomb bays with a capacity of up to 20,000 pounds of bombs. Four 2,200hp Wright R-3350 engines, each fitted with two turbo-superchargers, plus slick aerodynamics, gave it the ability to bomb from over 30,000 feet and attain a top speed of 365mph at 25,000 feet and a range of 4,100 miles.

Development of the B-29 began in May 1939, after the U.S. had assessed its future airplane needs. It needed a bomber with a speed of 400mph, a range of 5,333 miles and the ability to deliver a 1-ton bomb load at the halfway point. The U.S. aircraft industry received the specification for such a bomber in February 1940, and Boeing responded with Model 341. The Army, however, kept changing its requirements for equipment, armor and armament, and self-sealing fuel cells, so Boeing had to develop a new Model 354 to keep up. In June 1940, Boeing and Lockheed received Army contracts to build wooden mock-ups for evaluation. Lockheed dropped out, but Boeing was awarded a contract for two XB-29 prototypes in August, and Consolidated was to build a competing XB-32. Both received orders for a single additional XB in December.

The B-29 had an unprecedented procurement and development history. Army officials doubted Boeing's engineering and wind-tunnel test figures and insisted on a larger wing to reduce the then-fantastic wing loading of 69 pounds per square foot (much higher than that of contemporary fighters). Boeing argued that this would reduce speed and range, and that the B-29's huge Fowler flaps would keep landing speeds within reasonable limits. The Army was finally convinced and ordered 1,500 B-29s before the prototype flew.

With Boeing's Seattle factory choked with B-17s, the Army built a new factory for B-29 production alongside Boeing's existing plant in Wichita, KS, where the Kaydet trainers were being built. In February 1942, the Army started new plants for two other manufacturers—Bell Aircraft at Marietta, GA, and Glenn L. Martin Co. at Omaha, NE. The U.S. Navy had built a new factory at Renton, WA, near Seattle, for Boeing to build PBB-1 flying boats, but it cancelled the boats and turned the plant over to the Army for B-29 production.

Built in Seattle, the first of the three XB-29s flew on September 21, 1942. The test program was seriously delayed by chronic troubles with the R-3350 engines, which had never been used in a production airplane. Fourteen service-

SPECIFICATIONS AND PERFORMANCE

Powerplant	*Wright R-3350-23 2200hp at 25,000 ft.*
Wingspan	*141 ft., 3 in.*
Length	*99 ft.*
Wing Area	*1,736 sq. ft.*
Empty Weight	*70,140 lbs.*
Gross Weight	*124,000 lbs.*
Top Speed	*358mph at 25,000 ft.*
Cruising Speed	*230mph*
Service Ceiling	*3,1850 ft.*
Range	*3,250 miles (B-29A, 4,100 miles)*

The Eddie Allen, named for the famous war correspondent, was paid for by Boeing-Wichita employees. Here it displays four camels on its nose, indicating four round-trip supply trips over the "Hump." This plane was so badly damaged over Tokyo in May 1945 that it had to be scrapped.

test YB-17s were built in Wichita, KS, but they, too (as well as early production models), were plagued with engine problems and difficulties with all the new equipment (from remotely sighted and controlled gun turrets to cabin pressurization), electrical trouble and radar installations.

Airplane deliveries were hampered by delays of material and equipment from the greatest network of sub-contractors and suppliers ever set up for an airplane production program. To prevent delays on the production lines, the planes were rushed through incomplete and sent to modification centers for final installations and necessary changes, particularly to the still-troublesome R-3350 engines.

Getting the first B-29s into combat was also an unprecedented operation. Japan was beyond the range of even the B-29 from U.S.-held bases in the Pacific, so several airfields were built by Chinese coolie labor in the vicinity of Chengtu, China, 1600 miles from the southern tip of Japan. The B-29s that used them were based in India but used the Chinese fields as points of departure for Japan. With no roads open for supply, all supplies (fuel, bombs, ammunition, spare engines, food, etc.) had to be air-lifted from India, 1,500 miles away, over the infamous "Hump" of the Himalaya Mountains. Each B-29 had to make several round trips to support one raid on Japan. Some B-29s were stripped of all military equipment and fitted with bomb-bay tanks, and they could ferry up to 4,000 gallons of fuel. These were facetiously called C-29s.

The first Asiatic B-29 raid was a 2,000-mile round trip from India to Bangkok, Thailand, on June 5, 1944. This was reported by Radio Tokyo as having been flown by B-24s. The first raid against Japan was over the steel works at Yawata. Sixty-eight B-29s took off from Chengtu on June 15, but, hindered by bad weather, only 47 reached and bombed their target. Despite the B-29's capacious bomb bays, each plane carried only 1 ton of bombs in a necessary trade-off between bomb load and fuel for range. Seven B-29s were lost on that first raid; none to Japanese action.

As supplies increased, attacks on Japan from China increased, but they ended late in 1944 when the Japanese-held Marianas Islands in the Western Pacific were captured, and B-29 bases were built there. The distance from there to Japan was only slightly less, but supplies could be delivered by ship and the B-29s could fly westward from the U.S., instead of eastward via Africa and India. Bomb loads didn't increase significantly at first, because of the fuel required to reach the bombing altitude of 30,000 feet that was necessary to elude fighters and flak, and to battle the terrific head winds. The first strike against Tokyo since the Doolittle raid of April 1942, with B-25s launched from the aircraft carrier Hornet, was made of Saipan on November 24, 1944, with over 100 B-29s.

After capture, Iwo Jima,which is halfway between Saipan and Japan, served as a safe haven for damaged B-29s and for those low on fuel, and it also provided a base for P-51 fighters that could now accompany the B-29s to Japan. With Japanese fighter opposition virtually eliminated, the B-29s could go in at a lower altitude and with bigger bomb loads. This was the beginning of the end. Incendiary bombs virtually wiped out whole cities until, on August 6 and 9, two atomic bombs were dropped on Hiroshima and Nagasaki to force a speedy end to the war.

During the war, some 118 B-29s were converted to long-range F-13 photo-reconnaissance planes and used to select targets in Japan and evaluate bomb damage after raids. Their photos also helped those who planned the U.S. invasion of the Philippines.

B-29 Production—Between them, the four factories turned out 3,960 B-29s, with the last one delivered from Renton in May 1946. Over 5,000 B-29s still on order were cancelled after V-J Day.

B-29—Most B-29s were designated simply "B-29." The final models differed in detail from the early models, most notably in having four-gun upper forward turrets instead of two-gun turrets. Boeing built 1,634 B-29-BWs; Bell built 668 -BAs; and Martin built 536 -MOs.

B-29A—The B-29A had a new wing center section structure that added 1 foot to its wingspan. All 1,119 B-29A-BNs were built in Renton.

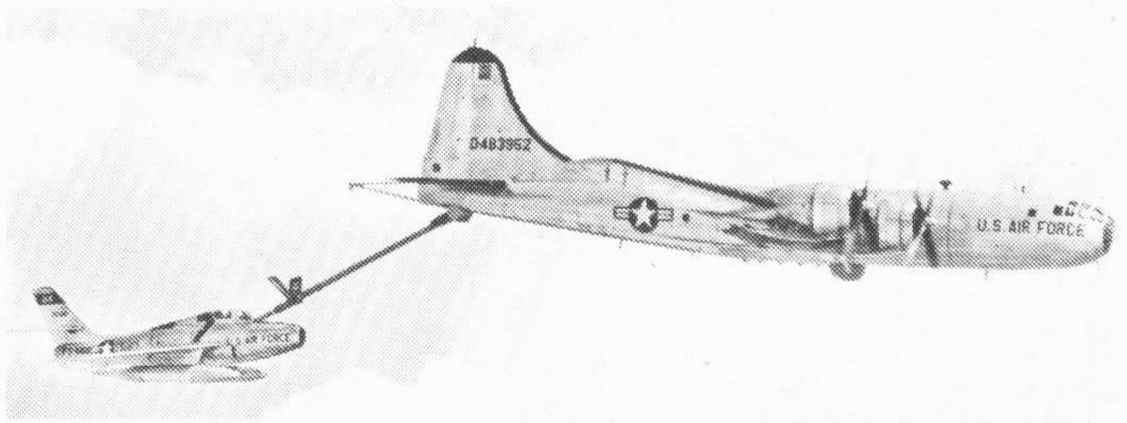
B-29B—A total of 311 Bell B-29s were modified in the factory and delivered as B-29Bs, stripped of all but tail guns. This cleaned-up version was as fast as Japanese fighters and could be attacked only from the rear. Also, the tail guns were aimed and fired by a new AN/APG-15B radar fire-control system. The weight saved went to additional bomb load.

B-29C—This aircraft was to have been a B-29 with improved R-3350 engines, but it was never built.

B-29D—The B-29D was a major improvement of the B-29, with 3,500hp Pratt & Whitney R-4360 engines, a 75ST aluminum structure instead of 24ST, thermal anti-icing instead of rubber boots, and a taller tail. Two hundred were cancelled after V-J Day, but the Army got 60 reinstated by saying that they were 75-percent-new airplanes designated "B-50." A total of 371 B-50s through TB-50H were built through March 1953.

B-29s Postwar—The B-29 remained the standby of the Strategic Air Command in the early, post-WW II years and served in the Korean War of 1950-53, with many of its logical targets declared off limits by political considerations. Its range was increased for global operations in 1948 by converting 92 B-29s to KB-29M hose tankers and another 74, supplemented by B-50As, to hose receiver B-29MRs. Later, 116 were converted to KB-29P boom tankers.

After Korea, a few B-29s continued to serve the Air Force in utility and training roles until 1960. One flyable B-29 survives today, and several are on view in museums.



Major postwar use of the B-29 after Korea was as an aerial refueling tanker fitted with Boeing's "flying boom" refueling system. Here, a KB-29P refuels a Republic F-84F.

20 m.m. CANNON
BALL-SHAPE GUN SHEATHE
REAR GUNNER'S STATION
METAL TRIM-TAB
FABRIC COVERED ELEVATORS

DE-ICING STRIP
FIXED METAL HORIZONTAL STABILIZER
FLUSH RIVETS
EMERENGCY EXIT
FIXED METAL VERTICAL STABILIZER

ALL ALUMINUN SKIN-PLATES ARE BUTT-JOINED, NOT OVERLAPPED. ALL RIVETS ARE FLUSH. ALL SUPERCH'R. ASSEMBLY ARE ENCLOSED.

ALL GUN TURRETS ARE AIMED & FIRED BY REMOTE CONTROL FROM TRANSPARENT GUN SIGHTING DOMES. ALL TURRETS ARE OPAQUE AND EACH TURRET MOUNTS TWO .50 CAL. MACHINE GUNS.

ENGINE: WRIGHT CYCLONE 18 CYL'S., DOUBLE ROW, 2,200 H.P.
HAMILTON-STANDARD HYDROMATIC PROPELLERS - 16'-6" DIAMETER

LANDING LIGHT
AIR INTAKE

LANDING GEAR DOOR
DOUBLE LANDING WHEELS

FUSELAGE JOINT
FOWLER FLAP PANEL
DE-ICING STRIP

LANDING LIGHT
METAL TRIM-TAB
FABRIC-COVERED AILERONS

AIR INTAKE
NOSE WHEEL DOORS
DOUBLE NOSE WHEELS

NAVIGATION LIGHT
DE-ICING STRIP

RED
WHITE
BLUE

MOULDING STRAP
FUEL TANK COVER
REMOVABLE ACCESS PANELS
CONTROLLABLE COWL-FLAPS
REMOTE CONTROLLED TURRET
EMERENGCY EXIT

FLAT TRANSPARENT PANEL
CO-ORDINATED GUN SIGHT
20 m.m. CANNON

REAR ENTRANCE DOOR

REAR VIEW

FABRIC-COVERED RUDDER

NAV. & GUN SIGHTING DOME
DIRECTION FINDER
RADIO ANTENNA

GUN SIGHTING DOME
REMOTE CONTROLLED TURRET
50 CAL. TWIN MACH. GUNS
DE-ICING STRIP

22441

METAL TRIM-TAB

FLAT TRANSPARENT PANEL
TRACTOR HOOK

FUSELAGE ℄

TRANSPARENT PANEL
REAR ENTRANCE

TAIL BUMPER
REMOTE CONTROLLED TURRET

SLIDING LADDER
BOMB-BAY DOORS

REMOTE CONTROLLED TURRET
RETRACTED POSITION-NOSE WHEEL
TORQUE LINKS
GROUND LINE

TORQUE LINKS
RADIO BEAM ANTENNA
RETRACTED POSITION-LANDING WHEELS
BOMB BAY DOORS

SPECIFICATIONS

WING SPAN	141'-3"
LENGTH OVERALL	99'-0"
HEIGHT OVERALL	27'-0"
PROPELLER DIA.	16'-6"
ENGINE H.P. (EACH)	2,200 H.P.

0" 6' 12' 18' 24' 30' 36'

AIR AGE INC., 551 FIFTH AVE., NEW YORK 17, N.Y.

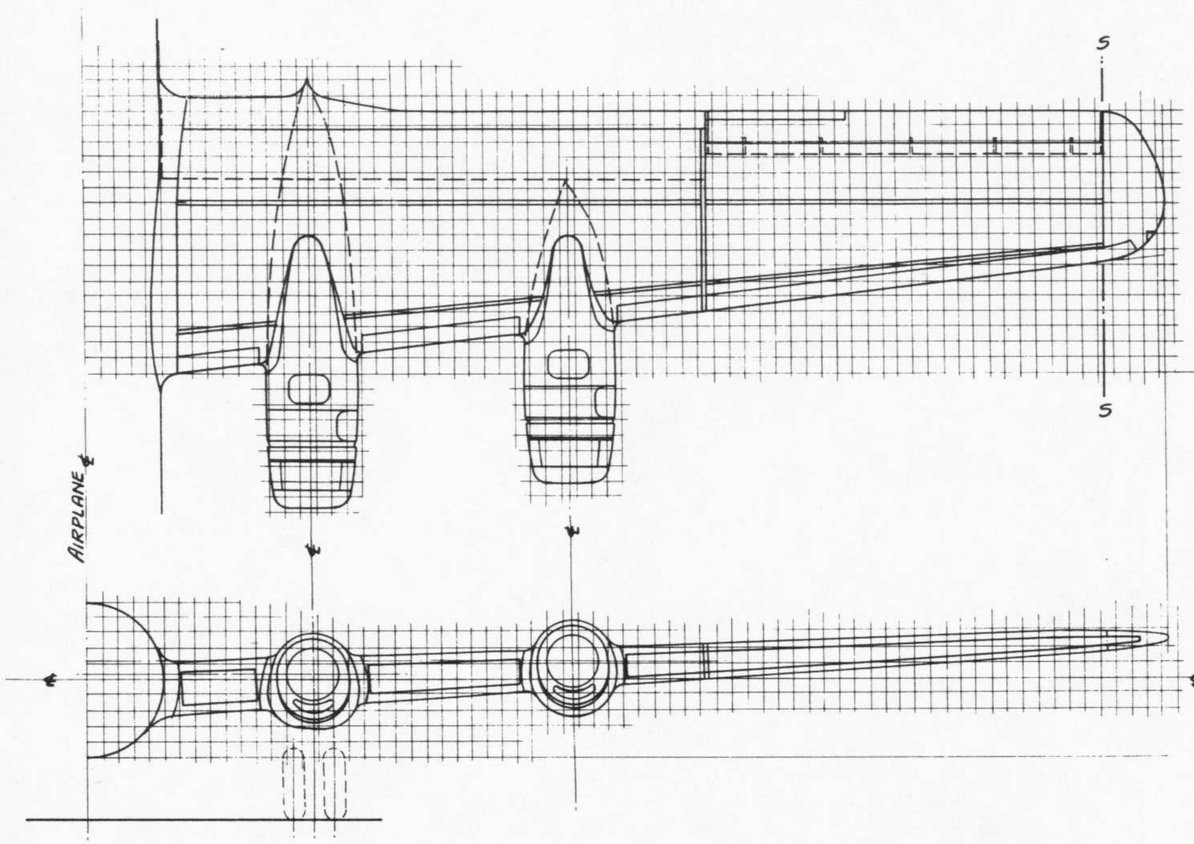
SCALE: 1/16" = 1'-0"

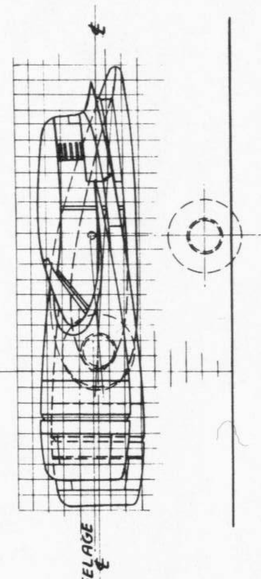
DATE: SEPT. 1944

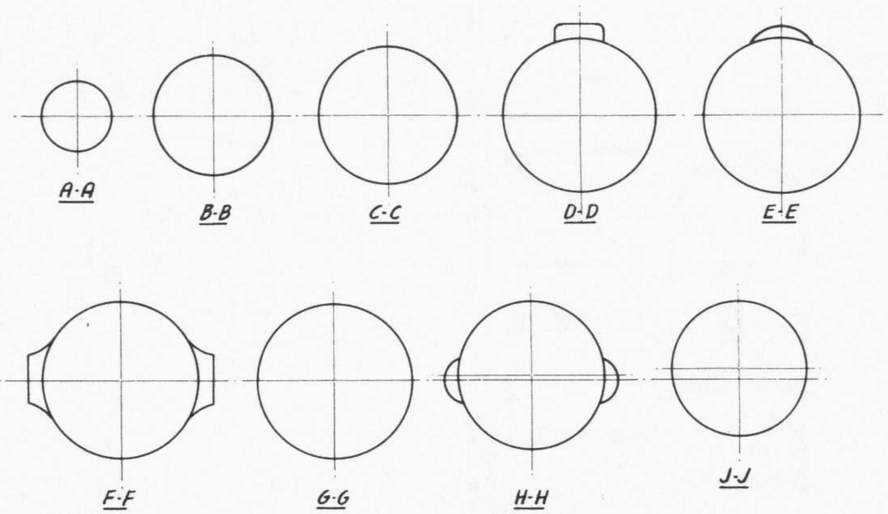
DRAWN BY ... W.A.WYLAM

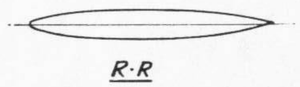
GENERAL ARRANGEMENT
BOEING "SUPER-FORTRESS"

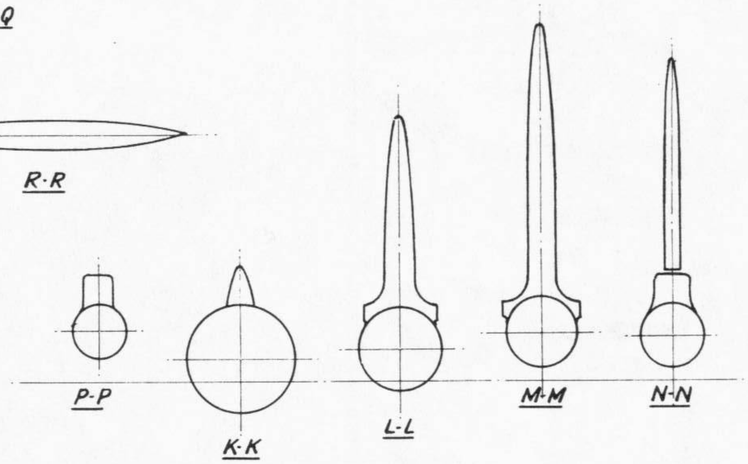
B-29



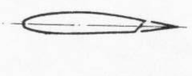




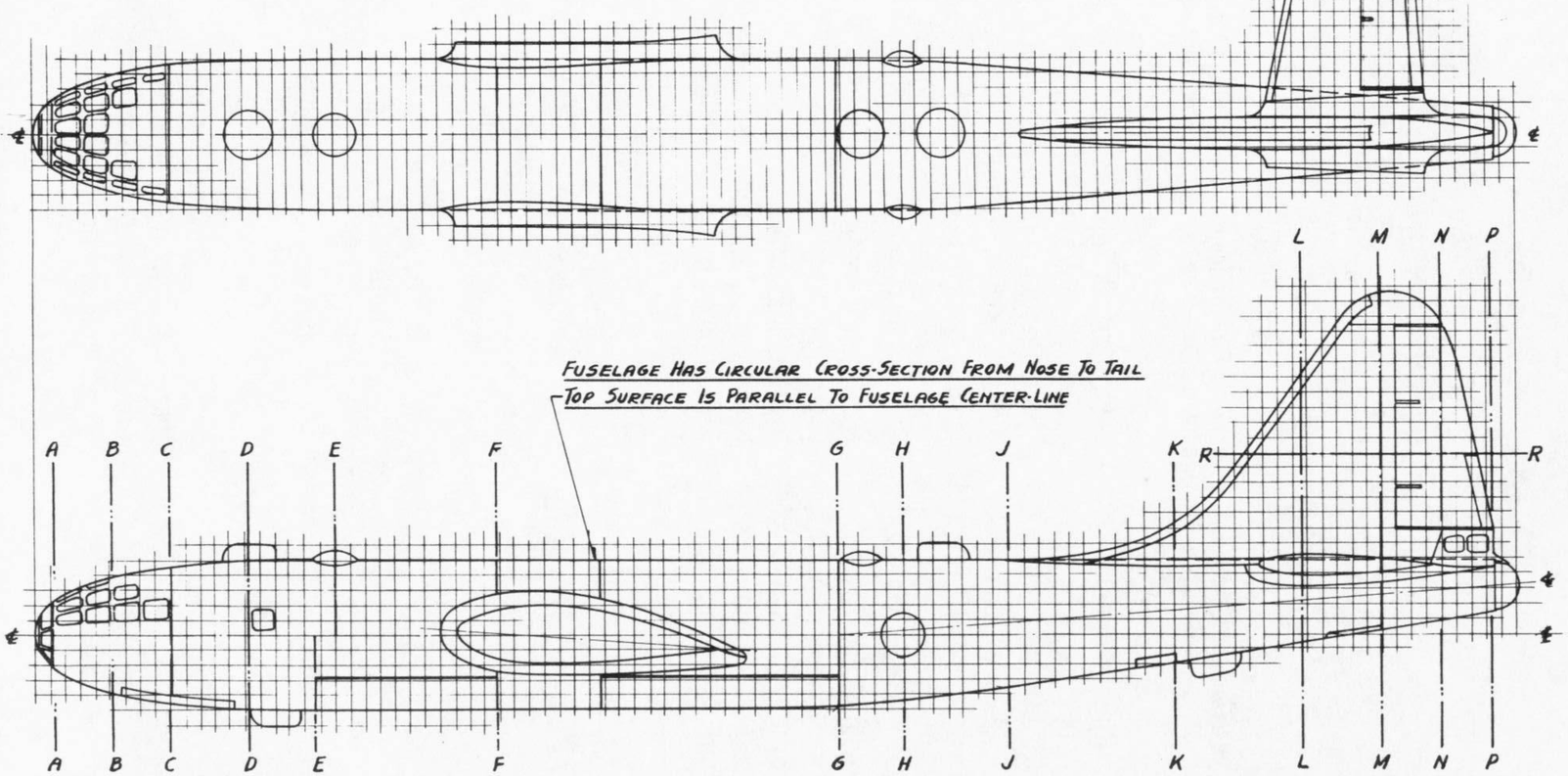




AIRFOIL AT ROOT



ALL SQUARES ARE 12"

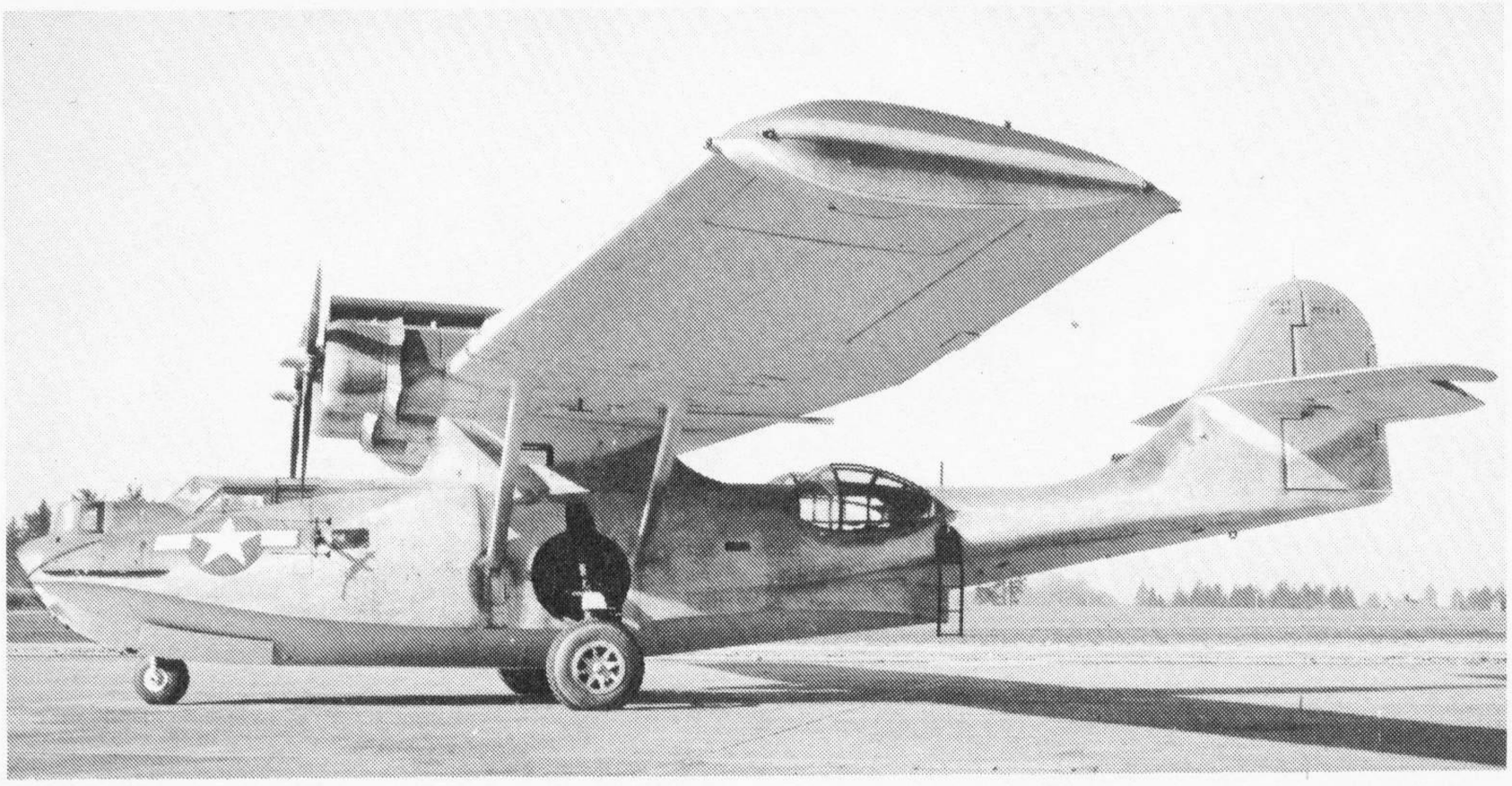


AIR AGE INC., 551 FIFTH AVE., NEW YORK 17, N.Y.	
SCALE: 1/16" = 1'-0"	LAYOUT DATA & CROSS-SECTIONS
DATE: SEPT. 1944	BOEING "SUPER-FORTRESS"
DRAWN BY ... W.A.WYLAM	B-29

WW II SCALE AIRCRAFT DRAWINGS

BOEING B-29

CONSOLIDATED PBY-5A CATALINA



A Consolidated PBY-5A ashore. Note the ram air scoops on the tops of the engines (not shown on drawing) and the hook-on access ladder at the side blister. Sea-blue camouflage on top of the wing is carried around to the bottom of the retracted wing-tip float.

THE Consolidated PBY flying boat, named "Catalina" by the British, was one of the oddities of the war. A 1933 design, it was widely used by the U.S. Navy, but was nearly obsolete by 1940. With no immediate replacement in sight, it was kept in production by the U.S. Naval Aircraft Factory (N.A.F.) at two Consolidated factories and in two Canadian plants. Eventually, it distinguished itself by becoming the most prevalent flying boat of all time: 3,276 were built in the U.S. and Canada, plus an estimated 150 under license in Russia.

In competition against the Douglas XP3D-1 patrol plane, Consolidated's XP3Y-1 was the winner and went into production as the dual-purpose PBY-1 patrol bomber—the first monoplane ordered by the Navy for service with the fleet.

The prototype's powerplant was the 825hp Pratt & Whitney R-1830-58 twin-row engine, but this grew to the 1,200hp R-1830-92 in the final PBY-5A and PBY-6A models. The most notable outward changes were the large, transparent blisters over the side gun ports (first shown on the PBY-4) and the retractable tricycle landing gear introduced on the PBY-5A ("A" for amphibian), which greatly increased its usefulness and production life. A taller tail appeared on the N.A.F. PBN-1 and the later PBY-6A.

A Consolidated plant was built in New Orleans to supplement PBY-5 production at San Diego. The N.A.F. made minor changes to the 156 versions of the PBY-5, which was originally built as the "PBN-1" and later renamed "Nomad."

The Vickers plant in Cartierville, Canada, built 369 PBY-5s as "PBV-1As," with 230 going to the U.S. Army as "OA-10A" Observation Amphibians and 139 to the R.C.A.F., which named them "Cansos."

Boeing's Canadian plant in Vancouver built 317 PBY-5s on U.S. Navy contracts as "PB2B." The slight difference in designation was owing to Boeing's having already built a PBB-1 design of its own. Boeing built 250 PB2B-1s, some of which were assembled from parts provided by Consolidated. Sixty-seven more PB2B-2s duplicated the high-tailed PBN-1 flying boat. Boeing also built 17 Catalina boats for the R.C.A.F. and 55 Canso amphibians. Consolidated built one PBY-5, 782 PBY-5As and 237 PBY-6As at New Orleans, with 75 of those 237 going to the U.S. Army as "OA-10Bs."

The PBYs saw service in all theaters of the war. An R.A.F. Catalina spotted the elusive German battleship Bismark, and this lead to its destruction. U.S. Navy PBY-5s and 5As were used for the additional duty of air-sea rescue, particularly in the Pacific, where some carried lifeboats under their wings. Other PBYs, painted dull, matte black, were used for night intruder operations against the Japanese. Rescue PBYs were nicknamed "Dumbo," while the intruders were referred to as "Black Cats."

The U.S. Navy operated PBYs until the late 1940s, but the Coast Guard and the Naval Reserves retained them until 1954 and '57, respectively.

A PBY-5A afloat with its landing gear retracted.

SPECIFICATIONS AND PERFORMANCE

Wingspan	*104 ft.*
Length	*63 ft., 10 in.*
Wing Area	*1,400 sq. ft.*
Empty Weight	*20,190 lbs.*
Gross Weight	*35,420 lbs.*
High Speed	*175mph at 7,000 ft.*
Cruising Speed	*1,13mph*
Armament	*3x.30-caliber MG; 2x.50-caliber MG; 4x1,000-lb. bombs or depth charges.*

DE-ICING STRIP
FABRIC COVERED ELEVATORS
METAL TRIM-TAB

MOLD STRAP
CARBURETER INTAKE
WALK WAY
PULL-OUT STEPS
DOME LIGHT
HAND GRIP
BOMBARDIER STATION
(VENETIAN BLIND FOR
SEAWATER PROTECTN)

OIL COOLER
COVER PLATES
HYDRAULIC
BRAKE LINE

PITOT TUBE
COVER PLATE

ANTENNA MAST
AILERON HINGE
ACTUATING ARM
RADIUS STRUTS
RADIUS PANEL

VIEW AT "Y-Z"

VIEW OF RETRACTED WHEEL

FLOAT'S CROSS-SECTIONS

N P

METAL TRIM-TAB
FABRIC COVERED AILERONS

RED
WHITE
BLUE

REF. LINE

HULL'S CROSS-SECTIONS

PRATT & WHITNEY TWIN WASP
"SC3-G", 1200 H.P., 14 CYLINDERS

FUEL TANK COVER
EXHAUST STACK
LANDING LIGHT

HYDROMATIC CONTROLLABLE
PITCH PROPELLERS

DE-ICING STRIP
ENGINE COWL FLAPS
ANTENNA MAST
DIRECTIONAL FINDER
ENGINEER'S STATION

RED NAV. LIGHT
RADIO LEAD-IN WIRE
RADIO ANTENNA

FIXED BLISTER'S NOSE & SIDE
SLIDING BLISTER'S LID
PULL-OUT STEPS
DE-ICING STRIP

FABRIC
COVERED
RUDDER

WING'S CROSS-SECTIONS

SLIDING HATCH
TRANSPARENT PANEL
SPONSON
ROTATABLE TURRET

SECTION "M-M"

SECTION "L-L"

WATER
LINE

REF. LINE

U.S.NAVY

OPENING FOR
HORIZONTAL
STABILIZER

ANCHOR RING

REAR GUNNER'S
STATION

REF. LINE

NOSE WHEEL DOORS
RETRACTABLE NOSE WHEEL

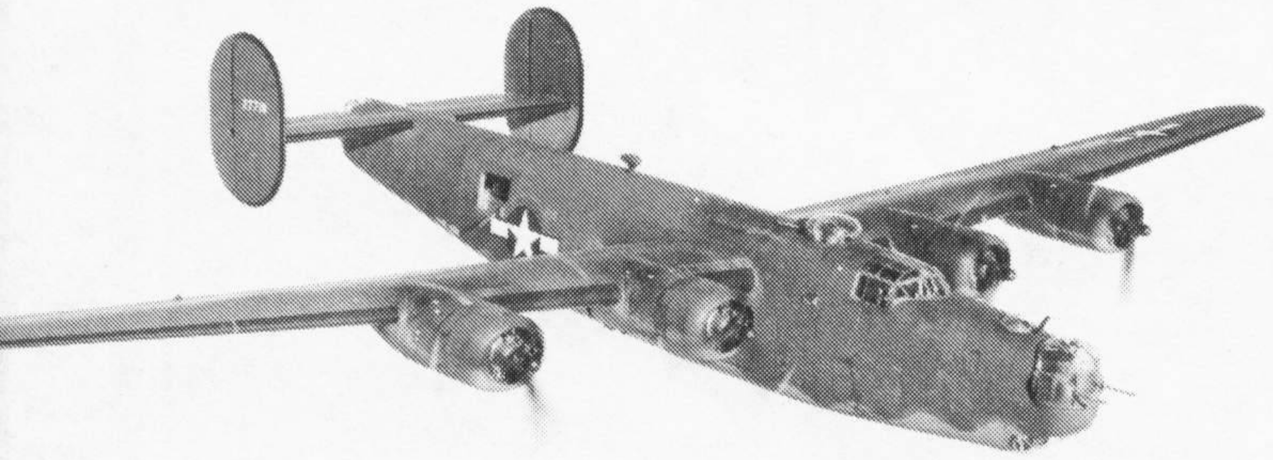
wwp02020
WILLIAM A. WYLAM

CONSOLIDATED

CONSOLIDATED PBY-5A CATALINA

W W II SCALE AIRCRAFT DRAWINGS

CONSOLIDATED B-24 LIBERATOR



The B-24H-5-FO was built by the Ford Motor Co. with late-type waist gunners' windows. Camouflage was deleted from most U.S. Army combat planes in production early in 1944.

BESIDES being one of the major U.S. heavy bombers of the war, the Consolidated B-24, named the "Liberator," has a distinction held by no other American military airplane: more B-24s were built (18,482) than any other mass-produced fighters, including the Curtiss P-40 (13,738) and the Republic P-47 (15,683).

The design of the B-24, Consolidated Model 32, originated in January 1939, as a counter-proposal to a U.S. Army request that Consolidated build Boeing B-17s under license. The proposal was accepted, and the XB-24 flew on December 29, 1939. Such rapid development of a new model resulted from fitting a new bomber fuselage to the wing and tail of the existing Model 31 flying boat and adding two engines.

The Liberator was continually improved throughout the war. The early B-24A had 1,200hp Pratt & Whitney R-1830-33 engines without turbo-superchargers, but no armor or self-sealing fuel tanks, and it was defended by six .30-caliber, hand-swung machine guns. A powered top turret with two .50-caliber guns was added to the B-24C, as was a similar tail turret. Turbo-superchargers were added to the R-1830-41 engines of the B-24C to maintain takeoff power to 25,000 feet. The first significant production version, and the first to be combat-worthy, was the B-24D. A few of the final B-24Ds had retractable two-gun belly turrets, but that feature did not become standard until the B-24G, which also introduced a powered nose turret midway through production. Final defensive armament was 10, .50-caliber machine guns. Maximum bomb load was 8,000 pounds, usually reduced by the trade-off between bomb load and fuel for range.

Consolidated was allowed to build export versions for France, designated the "LB-30," and at the same time, the earliest B-24s were being built for the Army. This order was taken over by Britain. The R.A.F. also took some of the earliest B-24s, including six of the seven service-test YB-24s, but it released 26 of them, following the LB-30s to the U.S. Army. The Army used them initially as unarmed, long-range transports, but it used some as bombers in the Southwest Pacific after Pearl Harbor. Later, the Army requisitioned 75 undelivered LB-30s, but it eventually returned 23 to the R.A.F.

The B-24 was superior to the B-17 only in range, thanks to its high-aspect-ratio wing and new Davis airfoil section, so B-24s took over the long-range bombing in the Pacific until the B-29 came along. In Europe and North Africa, B-24s competed intensely against the B-17. The U.S. Navy acquired 977 B-24s from D through J. Despite their significant differences, all were designated "PB4Y-1 Patrol Bombers."

To meet its need for long-range transports, the Army had consolidated complete 287 B-24 airframes as unarmed C-87s, with elongated, streamlined noses and an airliner-type cabin, complete with passenger windows.

Britain ordered 159 LB-30s on cash contracts as "Liberator I" and "II," then received 2,040 B-24s from "D" through "L" under Lend-Lease. The British Liberator Mark numbers did not correspond directly to equivalent U.S. Army models. The 222 British B-24Ds were either Liberator Mark III bombers or Mark V patrol and reconnaissance planes, depending on how they were equipped. A mix of mostly B-24Js and a few Ls became 1,618 Liberator VIs and VIIIs. The 24 Mark VIIs were C-87s, not B-24s.

A few B-24s were converted and redesignated for other purposes—C-109 fuel transporters used in Africa and China, F-7 long-range photo-planes and AT-22 navigation trainers.

The demand for B-24s far exceeded the capacity of Consolidated's San Diego plant to produce them (it was also building PBY and PB2Y flying boats), so a Consolidated plant was built in Ft. Worth, TX. Three other manufacturers were also called on to supplement B-24 production. The output of B-24s at all five factories is listed below:

Consolidated, San Diego, CA *(-CO)—1 XB-24 (converted to XB-24B); 159 LB-30; 7 YB-24; 9 B-24A; 9 B-24C. Mass-production of 2,452 D; 1,780 H; 2,792 J; 417 L; 916 M.*

Consolidated, Ft. Worth, TX *(-CF)—303 D; 244 F; 738 H; 1,558 J.*

Douglas, Tulsa, OK *(-DT)—10 D; 167 E; 582 H; 205 J.*

Ford Motor Co., Ypsilanti, MI *(-FO, built specifically for B-24 production)—480 E; 1,780 H; 1,587 J; 1,250 K; 1,677 M; 1 XB-24N; 7YB-24N.*

North American, Dallas, TX *(-NT)—430 G (-NT only); 536 J.*

SPECIFICATIONS AND PERFORMANCE

Powerplant	*P&W R-1830-65 1,200hp at 25,000 ft.*
Wingspan	*110 ft.*
Length	*67 ft., 2 in.*
Wing Area	*1,048 sq. ft.*
Empty Weight	*36,500 lbs.*
Gross Weight	*64,500 lbs.*
High Speed	*300mph at 30,000 ft.*
Range	*2,100 miles at 215mph at 25,000 ft.*

CONSOLIDATED B-24 LIBERATOR

WW II SCALE AIRCRAFT DRAWINGS

DURAL TABS
FABRIC COVERED ELEVATORS
FABRIC COVERED RUDDERS
ALL METAL FIXED FINS
DEICING RUBBER EQUIPMENT
ALL METAL FIXED STABILIZERS
RIB SECTION "A-A"
RIB SECTION "B-B"
SECTION "L-L"
SECTION "M-M"
SLIDING FOWLER FLAPS
STREAMLINE WHEEL FAIRING
FABRIC COVERED AILERONS
DETACHABLE COWLS
COOLING GILLS
"G-G" ESCAPE HATCH
LIFE RAFT
OUTLINE OF UNDERCARRIAGE FAIRINGS
DEICING RUBBER EQUIPMENT
WHITE
BLUE
RED
SECTION "C-C"
SECTION "D-D"
SECTION "E-E"
SECTION "F-F"
SECTION "G-G"
SECTION "H-H"
SECTION "J-J"
SECTION "K-K"
GREEN NAV. LIGHT
OIL COOLER AIR SCOOP
1200 H.P. TURBO-SUPERCHARGED PRATT & WHITNEY "TWIN WASP"
FAIRING PLATES
"A-A"
LANDING LIGHT
RED NAV. LIGHT
INTERCOOLER AIR SCOOP
STEEL HAMILTON-STANDARD HYDROMATIC PROPELLER
RETRACTING LINE OF UNDERCARRIAGE

EMERSON POWERED TURRET
TWO .50 CAL. MACH. GUNS
NAV. LIGHT
REAR ENTRANCE
DURAL LADDER
TWO .50 CAL. MACH. GUN'S STATIONS
RETRACTABLE (TAIL BUMPER)
SPERRY RETRACTABLE POWERED BALL TURRET
TWO .50 CAL. MACH. GUNS
FLEXIBLE RADIO MAST
RADIO AERIAL
RADIO LOOP
MARTIN POWERED TURRET
TWO .50 CAL. MACH. GUNS
SLIDING PANELS (FOUR)
MAIN ENTRANCE & BOMB BAY
NOSE WHEEL
CELESTIAL DOME
EMERSON POWERED TURRET
TWO .50 CAL. MACH. GUNS
BOMBARDIER'S SECTION

CURTISS P-40 D-E-F KITTYHAWK

☆ ☆ ☆

The British Curtiss Model 87A-2 Kittyhawk is similar to the U.S. Army P-40D. It has the standard coloring of the 1941-early 1942 period, with sand-and-spinach camouflage on the top and side surfaces, light-blue underneath, Type A roundels under the wing, Type B on top of the wing and Type A.1 on the side of the fuselage.

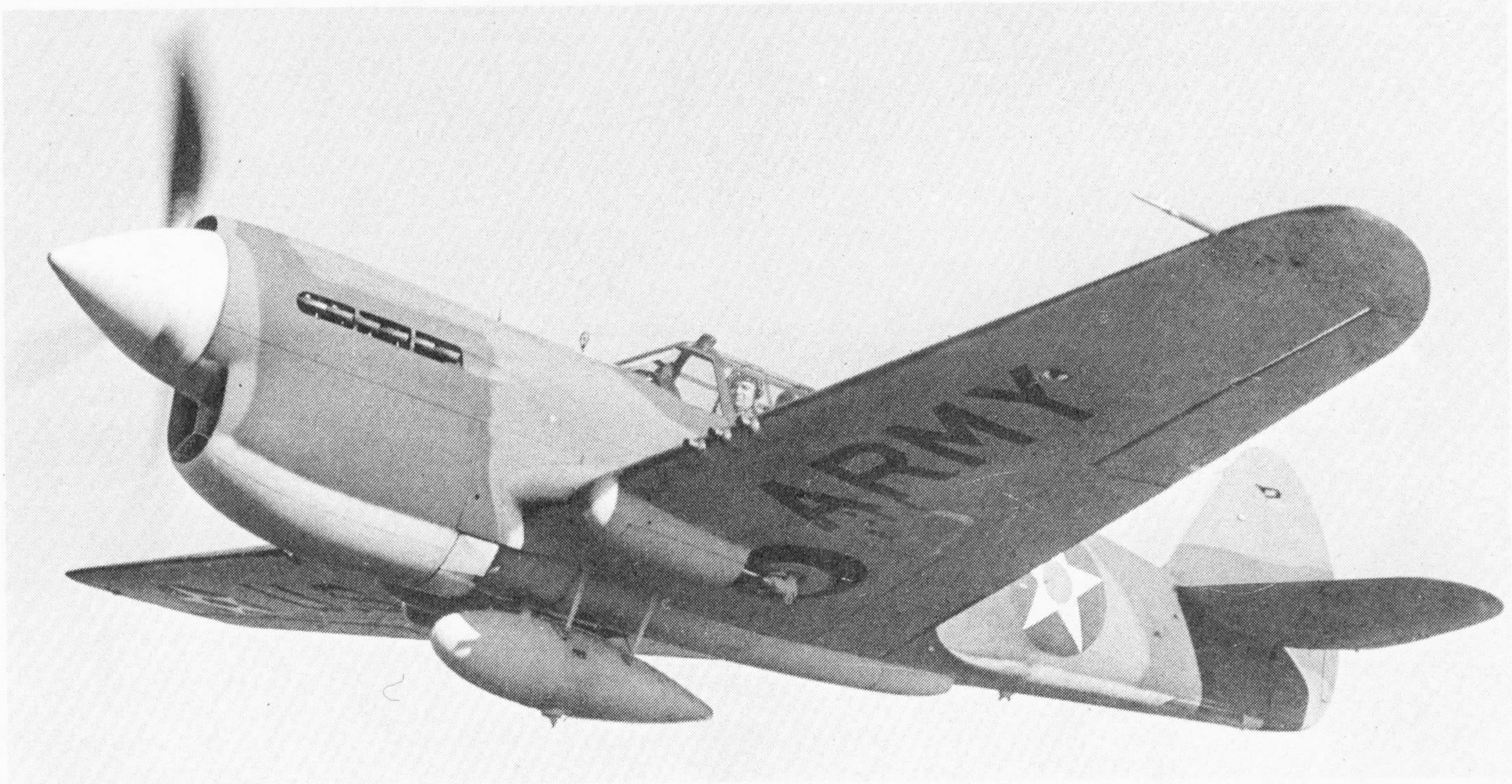
THE P-40 was already obsolete when it first appeared in 1939, because it was a variant of the Curtiss Model 75, which was a prototype of the radial-engined U.S. Army P-36A that flew early in 1935. Export sales of the 81 and 87 models with liquid-cooled Allison V-1710 engines were good because of the desperate need for fighters of any kind. The P-40 was kept in production long past its prime.

U.S. Army Models—The Curtiss Model 87, used by the Army as the P-40D, E and F (plus later P-40s not listed here), differed notably from the earlier P-40 through P-40C (Curtiss Model 81) because the 1,040hp planetary-geared Allison V-1710-33 engine was replaced with the 1,150hp -39 model that used spur gears, which raised the thrust line and notably changed the nose contours. In the 22 P-40Ds,the two .50-caliber machine guns were omitted from the nose, and two .50s were put in each wing panel to replace the two .30s there. Cockpit rear-view windows were also enlarged. Empty weight of the P-40D was 5,790 pounds; gross weight was 8,670 pounds; top speed was 354mph at 15,000 feet. Wing area was the same as earlier models—236 square feet.

P-40E—These models were improved P-40Ds, with -39 engines, six wing guns and a gross weight of 8,840 pounds. The Army bought 2,320. Early versions saw action in the Pacific and China, but most were used as fighter-trainers in the U.S.

P-40E-1—With passage of the famous Lend-Lease Act of March 1941, the U.S. provided the Allies with military aircraft. Because these were procured and paid for through the appropriate military channels, they were required to have standard U.S. designations and serial numbers and to conform more closely to U.S. specifications. The Kittyhawk IA that was on order by Britain was almost a duplicate of the Army's P-40E, differing mainly in its use of British equipment and civil Allison V-1710-F3R engines. One year before adoption of the block number system, it was given the U.S. Army designation of P-40E-1 to accommodate its differences in the U.S. system. Some P-40E-1s were used by the U.S. Army and flew with U.S. markings over their British camouflage.

P-40F—A serious attempt was made to improve the performance of the obsolete P-40 when the Allison engine was replaced with the Ameri-



P-40E-1 was the U.S. Army designation given to Kittyhawk IAs that were delivered to Britain. This one has Army markings over British camouflage. Note the 52-gallon auxiliary fuel tank on the belly bomb rack.

canized 1,300hp British Rolls-Royce Merlin engine (built by Packard as the V-1650-1). Unfortunately, the P-40 was too old, structurally and aerodynamically, to benefit as much from this change as did the North American P-51. The only outward difference from the P-40E was the elimination of the carburetor air scoop on top of the nose. Its gross weight increased to 9,870 pounds, and the only improvement was the speed at altitude — 364mph at 20,000 feet.

Despite this, the Army bought 1,311 P-40Fs (calling it Warhawk instead of Kittyhawk) as well as later models through P-40N. The first 699 P-40Fs were delivered before adoption of the block number system. The P-40F-5s and on had the rear fuselage lengthened 20 inches to improve directional stability. The Army took over 150 P-40Fs built for Britain as Kittyhawk II for use in North Africa in 1942 and '43.

British Designations—The Royal Air Force called its early Model 81 P-40s "Tomahawk," but the improved Model 87 was called "Kittyhawk," and retained its identification with Curtiss's "Hawk" for its export fighters.

The export Model 87 was originally ordered by France, but Britain took over the order. Major British use of Tomahawks and Kittyhawks was in North Africa starting in mid-1940.

Kittyhawk I—Britain bought 560 equivalents of the four-gun P-40D on cash contracts, with deliveries beginning in August 1941.

Kittyhawk IA—The 1,500 Kittyhawk IAs were equivalent to the P-40E and were delivered under Lend-Lease as P-40E-1 because of their differences in detail.

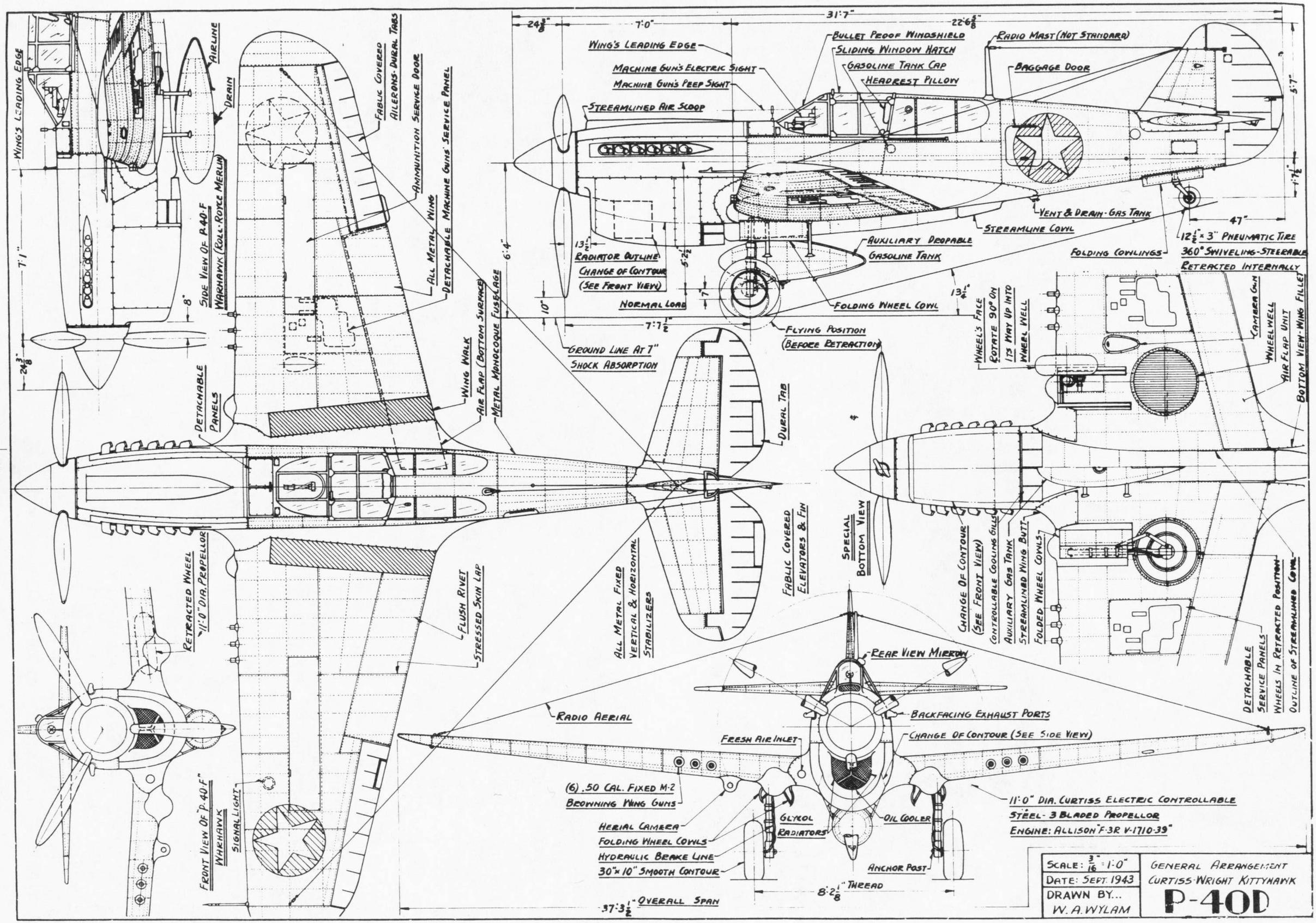
Kittyhawk II—The R.A.F. did not adopt the American name of Warhawk when it acquired 330 P-40Fs and P-40Ls, but simply called them Kittyhawk II and Kittyhawk IIA. Eighty-one already delivered to the R.A.F. were transferred to the U.S. Army for use in North Africa, and others, with U.S. insignia over British camouflage, were delivered to the Army straight from the Curtiss factory.

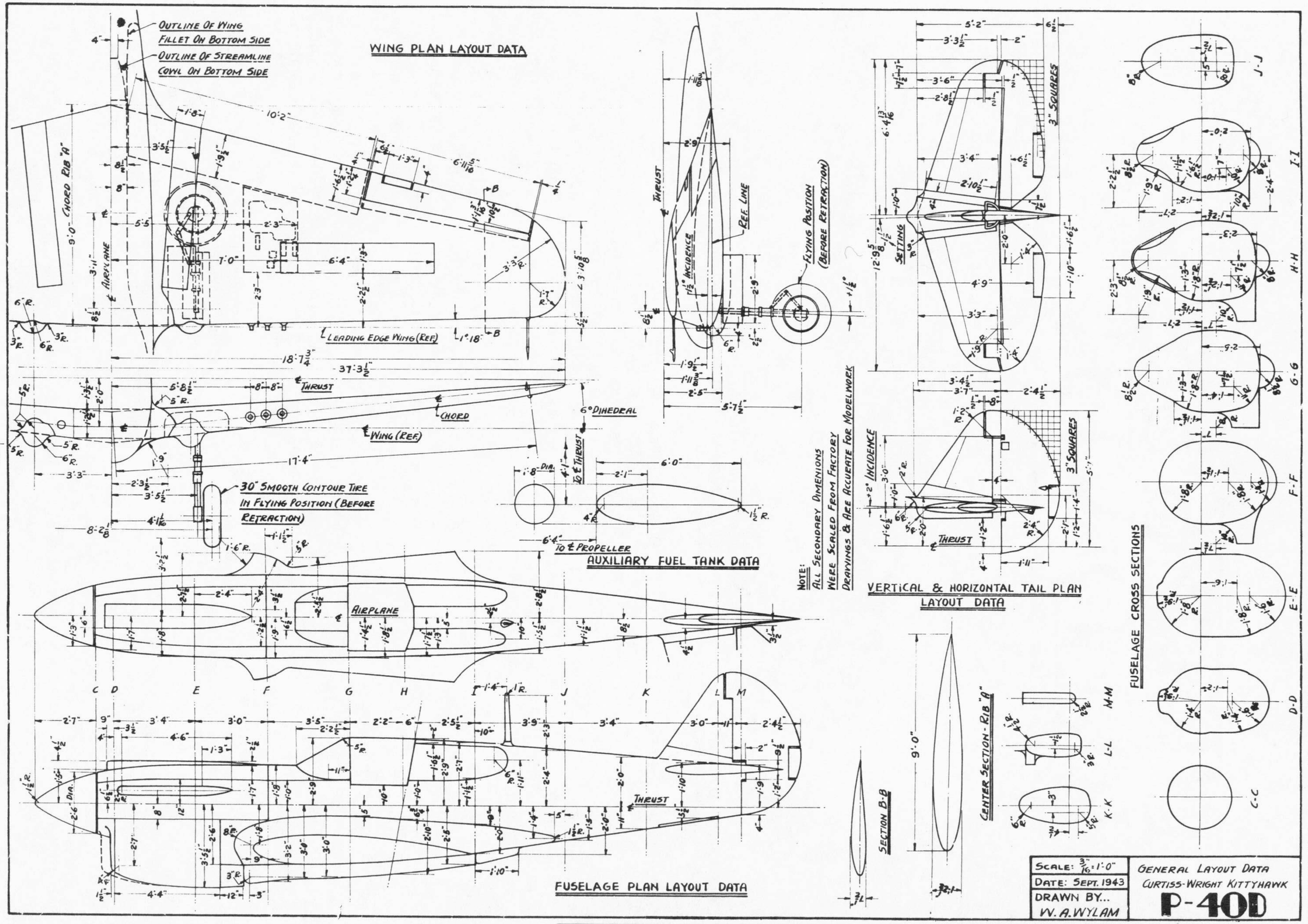
Several P-40Es and ex-R.C.A.F. Kittyhawks can be seen flying today in the Warbird movement.

This P-40F was repossessed from a British Kittyhawk II order and used by the U.S. Army in North Africa in 1943. Note the British-type unit markings, camouflage and fin flash.

★ ★ ★

Note: To match the Wylam drawings, this description will cover only the "Short Fuselage" Curtiss Model 87s; the U.S. Army P-40D through P-40F; and the British "Kittyhawk" series.

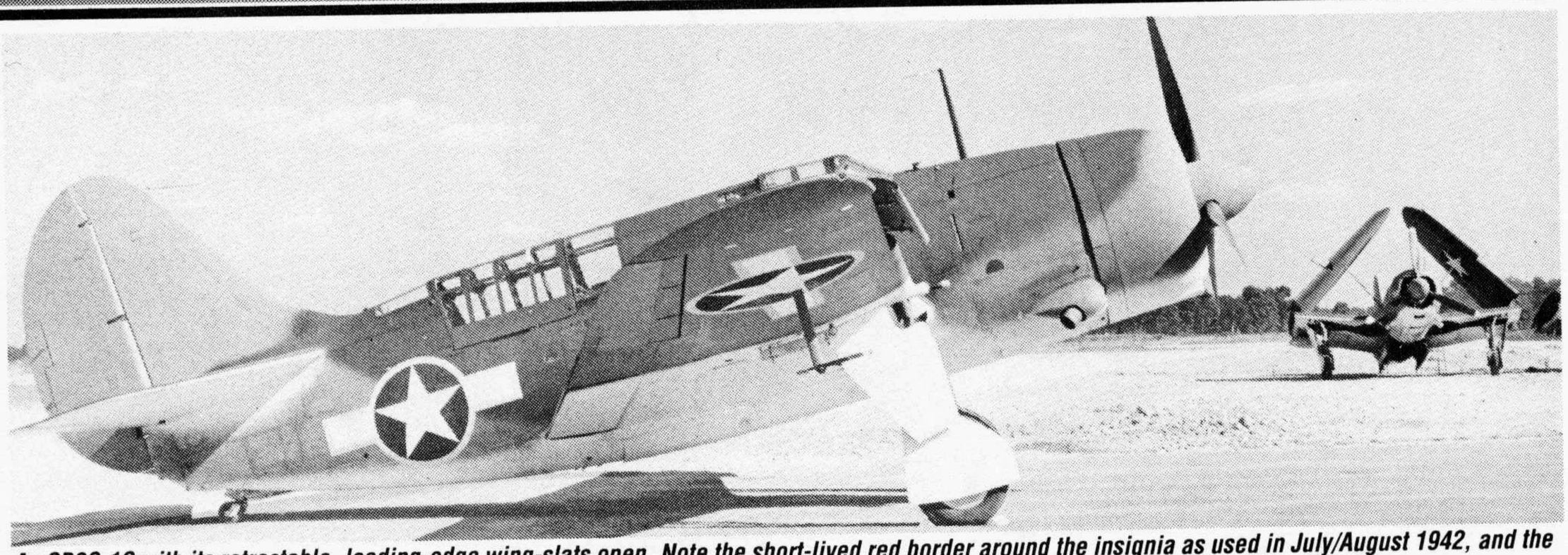

WING'S LEADING EDGE
AIRLINE
DRAIN
SIDE VIEW OF P-40-F
WARHAWK (ROLL-ROYCE MERLIN)
FABLIC COVERED AILERONS-DURAL TABS
AMMUNITION SERVICE DOOR
ALL METAL WING
DETACHABLE MACHINE GUNS SERVICE PANEL
WING WALK
AIR FLAP (BOTTOM SURFACE)
METAL MONOCOQUE FUSELAGE
DETACHABLE PANELS
DURAL TAB
RETRACTED WHEEL
11'0" DIA. PROPELLOR
FLUSH RIVET
STRESSED SKIN LAP
ALL METAL FIXED VERTICAL & HORIZONTAL STABILIZERS
FABLIC COVERED ELEVATORS & FIN
SPECIAL BOTTOM VIEW
FRONT VIEW OF P-40-F WARHAWK
SIGNAL LIGHT
REAR VIEW MIRROR
RADIO AERIAL
BACKFACING EXHAUST PORTS
FRESH AIR INLET
CHANGE OF CONTOUR (SEE SIDE VIEW)
(6) .50 CAL. FIXED M-2 BROWNING WING GUNS
HERIAL CAMERA
FOLDING WHEEL COWLS
HYDRAULIC BRAKE LINE
30"x 10" SMOOTH CONTOUR
GLYCOL RADIATORS
OIL COOLER
ANCHOR POST
11'0" DIA. CURTISS ELECTRIC CONTROLLABLE STEEL-3 BLADED PROPELLOR
ENGINE: ALLISON F-3R V-1710-39
37'3½" OVERALL SPAN
8'2⅛" TREAD
WING'S LEADING EDGE
MACHINE GUN'S ELECTRIC SIGHT
MACHINE GUN'S PEEP SIGHT
STREAMLINED AIR SCOOP
BULLET PROOF WINDSHIELD
SLIDING WINDOW HATCH
GASOLINE TANK CAP
HEADREST PILLOW
RADIO MAST (NOT STANDARD)
BAGGAGE DOOR
VENT & DRAIN-GAS TANK
STREAMLINE COWL
AUXILIARY DROPABLE GASOLINE TANK
FOLDING COWLINGS
12½" x 3" PNEUMATIC TIRE
360° SWIVELING-STEERABLE
RETRACTED INTERNALLY
RADIATOR OUTLINE
CHANGE OF CONTOUR
(SEE FRONT VIEW)
NORMAL LOAD
FOLDING WHEEL COWL
FLYING POSITION
(BEFORE RETRACTION)
GROUND LINE AT 7"
SHOCK ABSORPTION
WHEEL'S FACE ROTATE 90° ON 175 WAY UP INTO WHEEL WELL
CAMERA GUN
WHEEL WELL
AIR FLAP UNIT
BOTTOM VIEW-WING FILLET
CHANGE OF CONTOUR (SEE FRONT VIEW)
CONTROLLABLE COOLING GILLS
AUXILIARY GAS TANK
STREAMLINED WING BUTT
FOLDED WHEEL COWLS
DETACHABLE SERVICE PANELS
WHEELS IN RETRACTED POSITION
OUTLINE OF STREAMLINED COWL
SCALE: 3/16" = 1'0"
DATE: SEPT. 1943
DRAWN BY... W. A. WYLAM
GENERAL ARRANGEMENT
CURTISS-WRIGHT KITTYHAWK
P-40D



W W II SCALE AIRCRAFT DRAWINGS

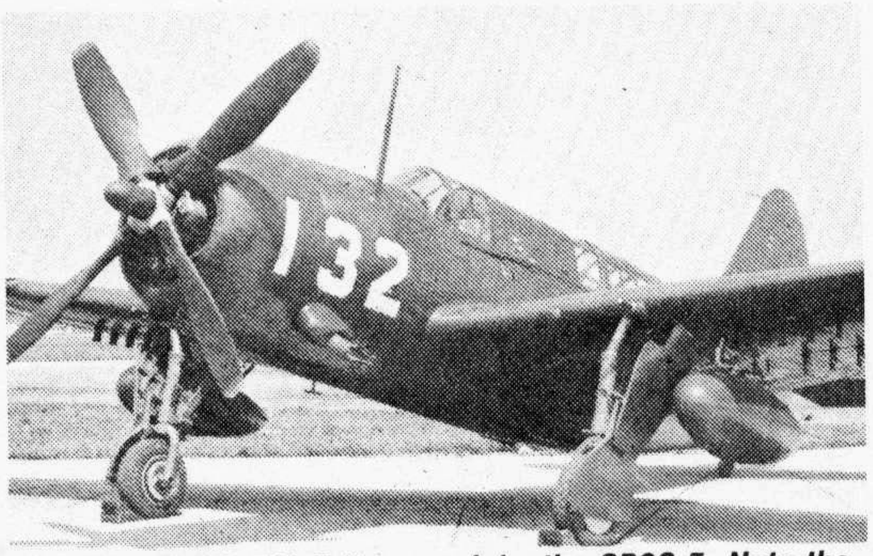
CURTISS P-40 D-E-F KITTYHAWK

CURTISS SB2C HELLDIVER



An SB2C-1C with its retractable, leading-edge wing-slats open. Note the short-lived red border around the insignia as used in July/August 1942, and the use of topside camouflage on the outer (folding) panels of the wing. The plane in the background has folded wings and open bomb-bay doors.

THE SB2C Helldiver, which was the third Curtiss dive bomber to carry the name, became an effective attack plane late in the war, after a long development and debugging period. The XSB2C-1 flew in December 1940, but the production version didn't appear until June 1942. The design was seriously handicapped by contradictory Navy requirements, with dimensions limited by aircraft carrier space requirements and performance handicapped by the required military payload and equipment. Helldiver operations began in the Pacific in November 1943.



The final Curtiss Helldiver model—the SB2C-5. Note the four-blade propeller, the 100-gallon drop tanks on wing bomb racks, the mounts for 5-inch rockets and the overall midnight-blue finish adopted for carrier-based airplanes early in 1944.

Helldivers were built in great variety. The 200 SB2C-1S ("SB" for Scout Bomber) were armed with four .50-caliber machine guns in the wings, two power-driven .50s in the rear cockpit, a 1,000-pound bomb in an internal bomb bay and an additional 1,000 pounds of bombs under the wings. Wing area was 422 square feet and gross weight was 16,607 pounds. Top speed was 273mph at 13,000 feet, but diving speed was limited by perforated and split trailing-edge flaps that served as dive brakes.

An oddity of the SB2Cs with 1942 to '43-style camouflage was that the undersides of the outer wing panels carried dark topside camouflage because the undersurfaces were visible from above when the wings were folded.

The U.S. Army ordered 900 SB2C-1s under the designation of A-25A. These were built in Curtiss' existing St. Louis plant instead of the Columbus, OH, plant that had been built for SB2C production. Ten A-25As were sent to the Royal Australian Air Force, but they were rejected.

The 410 SB2C-1As were A-25As that were transferred to the U.S. Marines for use as trainers. The 778 SB2C-1Cs ("C" for Cannon) were successors to the SB2C-1, with two 20mm cannon substituting for the four .50-caliber machine guns in the wings. This was the standard armament for subsequent Helldivers. The single XSB2C-2 was a twin-float seaplane that wasn't successful.

The 1,112 SB2C-3s were improved structurally and aerodynamically and used four-blade propellers on 1,900hp R-2600-20 engines. These were followed by 1,985 SB2C-4s, which had wing racks added for eight 5-inch rockets. Some SB2C-4s were fitted with a radar pod on the right-wing bomb rack for night operations and were designated SB2C-4E ("E" for Electronics). Curtiss' final production models were 970 SB2C-5s with increased fuel capacity.

Other manufacturers were called on to increase Helldiver production. The Canadian branch of Fairchild built 50 SB2C-1s as SBF-1 and 150 SB2C-3s as SBF-3. These were followed by 100 SB2C-4Es as SBF-4E.

Canadian Car and Foundry Company (Can-Car) built 40 SB2C-1s as SBW-1. A further 26 out of 200 ordered by Britain were delivered as SBW-1B ("B" for Britain). Can-Car then built 413 SB2C-3s as SBW-3, followed by 96 SB2C-4Es as SBW-4E. The 86 SBW-5s were completed from the cancelled SBW-1B order.

CURTISS SB2C HELLDIVER

WING AIRFOIL SECTION

VERTICAL STABILIZER AIRFOIL

HORIZONTAL STABILIZER AIRFOIL

TRIM-TAB CONTROL
TRIM-TAB
FABRIC COVERED ELEVATORS
RADIO ANTENNA
TRANSPARENT PANEL
WIND DEFLECTOR
COLLAPSIBLE TURTLEDECK
SLIDING HATCH
HINGE COVER PLATES
FORMATION LIGHT
NAVIGATION LIGHT
RADIO ANTENNA (LEAD-IN)
.50 CAL. TWIN SWIVEL GUNS
INSTRUMENT ACCESS PANELS
REMOVABLE PANELS
COWL FLAPS
PITOT TUBE
AIR-SLOT PANEL
K
K

SECTION "K-K"

SLIDING HATCH IN EXTREME FORWARD POSITION

VIEW SHOWING COLLAPSED TURTLEDECK

A B C D E F G H J

SIX-INCH SQUARES

EXTREME FOLDED POSITION

WRIGHT "CYCLONE" 14 CYLINDERS
DOUBLE ROW - 1,700 H.P. ENGINE

CARBURETOR AIR INTAKE
CURTISS ELECTRIC PROPELLER
.50 CAL. MACHINE GUNS
HINGED COVER PLATE
FIXED COVER PLATE
SMOOTH CONTOUR TIRE

WING SPAN	49'-9"
OVERALL LENGTH	36'-8"
PROPELLER DIA.	12'-0"
TREAD	16'-0"
WING DIHEDRAL	5°

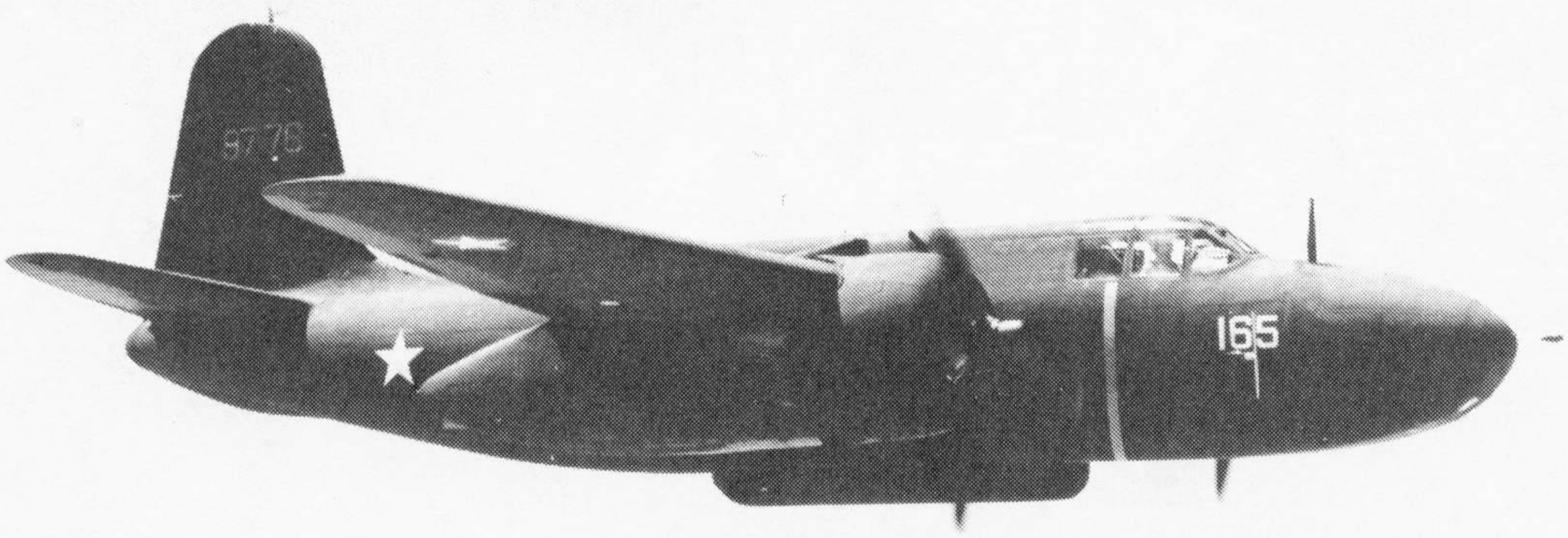
ANTENNA MAST
GUN SIGHT (OPTIONAL)
GUN SIGHT (ELECTRIC)
HEADREST
CRASH PYLON
ACCESS PANELS
FABRIC COVERED RUDDER
RADIO ANTENNA

AIR INTAKE
EXHAUST STACK
OIL COOLER SHUTTER
BOMB BAY DOORS
LANDING GEAR ACTUATING ARM
15°
TORQUE LINKS
GROUND LINE AT ROLLING RADIUS

ACCESS PANELS
EXTENDED POSITION
RETRACTED POSITION
DECK ARRESTING GEAR

WWP02028
WILLIAM A. WYLAIN

DOUGLAS BOSTON/ HAVOC/A-20



Sixty of the U.S. Army Douglas A-20s were completed as radar-equipped night fighters armed with four 20mm cannon in a belly pack. Note the overall matte-black finish and undersize national insignia.

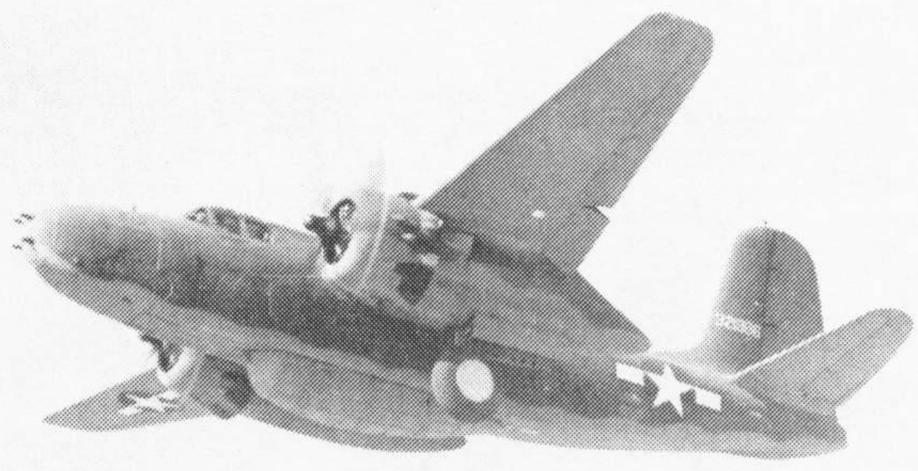
DB-7s—This designation stood for Douglas Bomber, Model 7. The first production version was ordered by France in February 1939 as a three-seat bomber powered with 1,000hp Pratt & Whitney R-1830-SC3-G Twin Wasp engines. It had a transparent bomber nose, four fixed forward-firing French machine guns, one flexible gun in the rear cockpit and a 2,000-bomb load.

DB-7A—Improved DB-7s with 1,600hp Wright R-2600-A5B Twin Cyclone engines and higher vertical tails. All DB-7As ordered by France were delivered to Britain.

DB-7B—Further improved models ordered by Britain.

DB-7C—Improved DB-7B; 48 were ordered for the Netherlands East Indies with interchangeable noses; one for a bomber and one containing four 20mm cannon. Only half of the order could be delivered, and it was in U.S. Army A-20C form.

DB-73—Similar to the DB-7B, 480 were ordered by France in May 1940. They were redesignated by Douglas to distinguish them from the differently equipped DB-7Bs for Britain.



At left: an early Douglas A-20A. Note the DB-7B-type nose, external pack for nose machine guns and use of rudder stripes and two wing stars before the marking change of February 1941. At right: an A-20G-40 with four .50-caliber nose machine guns and a long-range ferry tank under the belly.

British Designations—Britain's Royal Air Force identified its airplanes by given names rather than model numbers, so the diverted French DB-7s and the new American models were named "Havoc" and "Boston".

Havoc I—Former French DB-7s modified to British standards. Four different missions were performed by Havoc Is, with the following special configurations:

1. *Intruder*—Essentially French DB-7s with British armament and instruments replacing the French originals.

2. *Night Fighter*—These had solid noses containing British AI Mk.IV radar, eight .303-caliber machine guns and a crew capacity reduced to two.

3. *Pandora*—Twenty DB-7s with bomb bays modified to carry a large aerial mine and 2,000 feet of cable. The object was to trail the mine ahead of enemy bomber formations and hope that it would hit one.

4. *Turbinlite*—Twenty unarmed ex-night fighters fitted in the nose with 2,700 million candlepower searchlights for finding and illuminating enemy aircraft for the night fighters.

Havoc II— One hundred ex-French DB-7As converted to night fighters with 12 .303 guns in a solid nose.

Boston I—Twenty of the earliest French DB-7s used as trainers by the R.A.F.

Boston II—Original designation for later French DB-7s; later redesignated Havoc I.

Boston III—The initial British order for 300 DB-7Bs was followed by the transfer of 240 French-ordered DB-73s built by Douglas, and 240 that Douglas sub-contracted to Boeing. Tankage increased from the DB-7A's 240 U.S. gallons to

The British Havoc IV is a U.S. Army A-20J with the original Army serial number on the fin painted out. Note the lengthened Plexiglas nose, power turret and 500-pound bomb on the wing rack.

394 gallons to allow bomber operations over occupied Europe from England. Starting in mid-1941, many Boston IIIs were drafted into the U.S. Army Air Forces.

Boston IIIA—Later DB-7Bs procured for Britain via Lend-Lease were identified by the U.S. Army as A-20C and by Britain as Boston IIIA because of their differences from the all-British Boston III.

Boston IV—U.S. Army A-20Js, complete with American armament and coloring; 169 delivered to the R.A.F.

Boston V—Ninety U.S. Army A-20Ks delivered to the R.A.F.

U.S. Designations—There were several experimental and one-off variants of the U.S. Army A-20 and P-70 models, but only significant production versions will be detailed here. When the U.S. gave "popular" names to military aircraft for public discussion in October 1941, the A-20s and P-70s were given the existing British name of Havoc.

A-20—An improved DB-7A with side-mounted turbo-superchargers on 1,700hp military R-2600-7 engines (as distinguished from the civil-designated engines of the export models). Original armament was four .30-caliber machine guns in the nose, two flexible .30s in the rear cockpit, a flexible .30 in a ventral tunnel and a fixed .30 in each engine nacelle firing rearward. Normal bomb load was 16 100-pound bombs or four 250-pounders. Self-sealing, 394-gallon fuel tanks were an innovation for an American warplane.

The turbo proved to be troublesome, so it was removed (since a plane intended for low-altitude work didn't need the high-altitude benefits of such an installation). The first A-20 was converted to the XP-70 night-fighter prototype, and three others became XF and YF-3 photoplanes. The remaining 59 A-20s were converted to P-70s.

A-20A—A further 123 improved models ordered on the same June 30, 1939, contract as the A-20s, but all were delivered with R-2600-11 engines without turbos.

A-20B—Improved A-20A with DB-7 nose, which was its principal recognition feature.

A-20C—Production models similar to the DB-7B except for their U.S. equipment; 375 were built by Douglas as A-20C-DO and 140 by Boeing as A-20C-BO.

A-20G—Major production A-20; 2,850 were built with solid noses and R-2600-23 engines. Early versions had four 20mm cannon in the nose, but these were replaced by four to six .50-caliber machine guns starting at A-20G-5. From A-20G-20 and on, the single .50-caliber gun in the rear cockpit was replaced by a pair of .50s in a Martin-powered turret, and a single .50 replaced the .30 in the ventral tunnel. Internal bomb load was 2,000 pounds, but an additional 2,000 pounds could be carried on four wing racks. Gross weight increased to 25,700 pounds.

A-20H—Similar to late A-20Gs but used 1,700hp R-2600-29 engines; 412 built.

A-20J—The 450 A-20Js featured a lengthened Plexiglas bomber nose that contained two fixed .50-caliber guns and the famous Norden bomb sight. These were "Lead Bombers" that sighted the target for other A-20s that released their bombs when signaled by the leader.

A-20K—This was the final model of the A-20 series, with the last of the 413 built delivered September 20, 1944. The airframe was similar to the A-20H, but it was equipped as the A-20J.

F-3 Series—The seventh A-20 was converted to the XF-3 photographic plane, still with turbos. The bomb racks were removed and a T-3A camera was installed in the bomb bay, but the defensive armament was retained. Two other A-20s became YF-3s without the turbos. In 1944, 46 A-20Js and A-20Ks were converted to F-3As and saw action in Europe.

P-70 Series—Sixty A-20s were re-equipped as matte-black night fighters and redesignated P-70. These had radar in a solid nose and four 20mm cannon in a pack under the bomb bay. Engines were non-turbo R-2600-11s. The 39 P-70A-1s were A-20Cs with improved radar and six to eight .50-caliber guns in a belly pack. The A-20C defensive armament was retained. The 65 P-70A-2s were A-20Gs that were equipped as the P-70A-1s except for the deletion of flexible guns and the change to a glossy black finish. The P-70B-2s were modifications of 105 A 20Gs and A-20Js. The single P-70B-1 was an experimental model.

U.S. Navy BD Series—After testing of a former A-20 as the XF-3, the same airplane was stripped of armament and turbos, refitted with R-2600-3 engines and delivered to the U.S. Navy as the BD-1 (Bomber, first model from Douglas, initial configuration) for utility work, such as target towing. It was followed by eight A-20Bs that were designated BD-2.

☆ ☆ ☆

NOTE: Since the Nye drawings contain production figures, dimensions and performance data, the text concentrates on model designations and the differences between them.

THE DOUGLAS TYPE A-20 ATTACK BOMBER.
THIS AIRPLANE WAS KNOWN AS THE DB-7 SERIES IN ENGLAND, FRANCE AND THE NETHERLANDS. IN THE U.S.A.A.F AND IN RUSSIA IT WAS DESIGNATED AS THE A-20. THERE WERE EIGHTEEN MODELS OF THIS AIRPLANE, OF WHICH 17 WERE BUILT. 7097 AIRPLANES WERE SUPPLIED TO THE ARMED FORCES OF THE ALLIED NATIONS. OF THIS AMOUNT, THE U.S.A.A.F. RECEIVED 5289. THIS AIRPLANE SERVED IN EVERY THEATER OF WORLD WAR II. IT WAS FLOWN BY THE A.A.F. AS WELL AS ALLIED AIR FORCES.

THE FOLLOWING ARE THE BASIC MODELS OF THIS AIRPLANE:

MODEL 7A (ENGINEERING DESIGN ONLY)
- 〃 7B (EXPERIMENTAL PROTOTYPE BUILT)
- 〃 DB-7 (FRENCH AIR COMMISSION) 100 PLANES.
- 〃 DB-13 (TWIN TAIL VERSION) 1 PROTOTYPE.
- 〃 DB-7A (R.A.F "BOSTON I".) 75 PLANES.
- 〃 A-20A (SEE BELOW).
- 〃 F-3 (PHOTO VERSION)
- 〃 DB-7B (R.A.F "BOSTON" II.) (NETHERLANDS)
- 〃 A-20B (RUSSIAN LEND-LEASE 990 PLANES)
- 〃 A-20C (SEE BELOW)
- 〃 A-20 (SEE BELOW)
- 〃 P-70 (RADAR NIGHT FIGHTER)
- 〃 DB-7C (R.A.F. "BOSTON" III.)
- 〃 A-20G (SEE BELOW)
- 〃 A-20J (〃 〃)
- 〃 A-20H (〃 〃)
- 〃 A-20K (〃 〃)

THE FOLLOWING ARE THE MODELS SUPPLIED TO U.S.A.A.F.: (HAVOC)

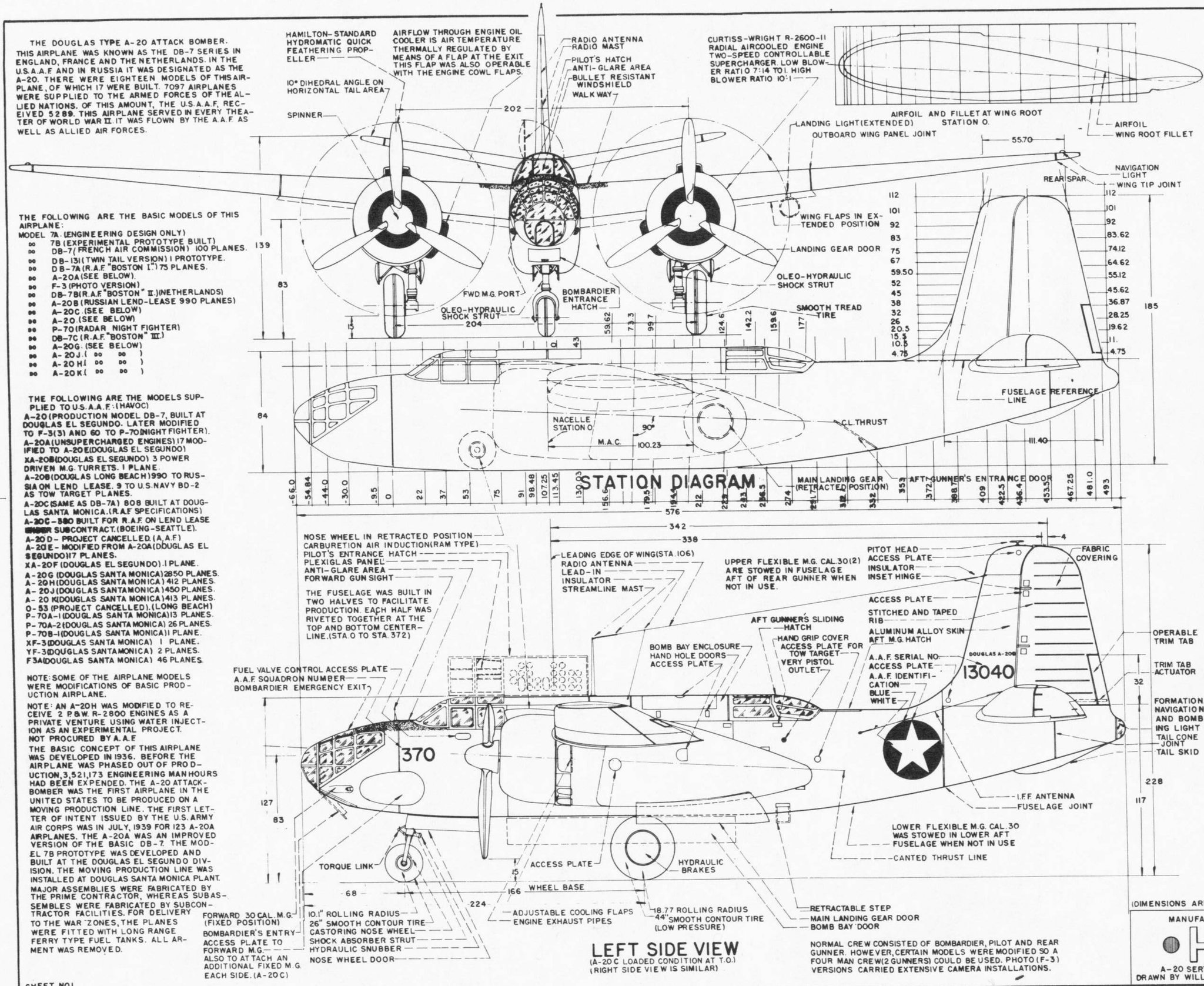
A-20 (PRODUCTION MODEL DB-7, BUILT AT DOUGLAS EL SEGUNDO. LATER MODIFIED TO F-3 (3) AND 60 TO P-70 (NIGHT FIGHTER).
A-20A (UNSUPERCHARGED ENGINES) 17 MODIFIED TO A-20E (DOUGLAS EL SEGUNDO)
XA-20B (DOUGLAS EL SEGUNDO) 3 POWER DRIVEN M.G. TURRETS. 1 PLANE.
A-20B (DOUGLAS LONG BEACH) 990 TO RUSSIA ON LEND LEASE. 9 TO U.S. NAVY BD-2 AS TOW TARGET PLANES.
A-20C (SAME AS DB-7A) 808 BUILT AT DOUGLAS SANTA MONICA. (R.A.F SPECIFICATIONS)
A-20C-BO BUILT FOR R.A.F. ON LEND LEASE UNDER SUBCONTRACT. (BOEING-SEATTLE).
A-20D - PROJECT CANCELLED. (A.A.F)
A-20E - MODIFIED FROM A-20A (DOUGLAS EL SEGUNDO) 17 PLANES.
XA-20F (DOUGLAS EL SEGUNDO) .1 PLANE.
A-20G (DOUGLAS SANTA MONICA) 2850 PLANES.
A-20H (DOUGLAS SANTA MONICA) 412 PLANES.
A-20J (DOUGLAS SANTA MONICA) 450 PLANES.
A-20K (DOUGLAS SANTA MONICA) 413 PLANES.
O-53 (PROJECT CANCELLED). (LONG BEACH)
P-70A-1 (DOUGLAS SANTA MONICA) 13 PLANES.
P-70A-2 (DOUGLAS SANTA MONICA) 26 PLANES.
P-70B-1 (DOUGLAS SANTA MONICA) 1 PLANE.
XF-3 (DOUGLAS SANTA MONICA) 1 PLANE.
YF-3 (DOUGLAS SANTA MONICA) 2 PLANES.
F3A (DOUGLAS SANTA MONICA) 46 PLANES.

NOTE: SOME OF THE AIRPLANE MODELS WERE MODIFICATIONS OF BASIC PRODUCTION AIRPLANE.

NOTE: AN A-20H WAS MODIFIED TO RECEIVE 2 P&W. R-2800 ENGINES AS A PRIVATE VENTURE USING WATER INJECTION AS AN EXPERIMENTAL PROJECT. NOT PROCURED BY A.A.F

THE BASIC CONCEPT OF THIS AIRPLANE WAS DEVELOPED IN 1936. BEFORE THE AIRPLANE WAS PHASED OUT OF PRODUCTION, 3,521,173 ENGINEERING MAN HOURS HAD BEEN EXPENDED. THE A-20 ATTACK-BOMBER WAS THE FIRST AIRPLANE IN THE UNITED STATES TO BE PRODUCED ON A MOVING PRODUCTION LINE. THE FIRST LETTER OF INTENT ISSUED BY THE U.S. ARMY AIR CORPS WAS IN JULY, 1939 FOR 123 A-20A AIRPLANES. THE A-20A WAS AN IMPROVED VERSION OF THE BASIC DB-7. THE MODEL 7B PROTOTYPE WAS DEVELOPED AND BUILT AT THE DOUGLAS EL SEGUNDO DIVISION. THE MOVING PRODUCTION LINE WAS INSTALLED AT DOUGLAS SANTA MONICA PLANT. MAJOR ASSEMBLIES WERE FABRICATED BY THE PRIME CONTRACTOR, WHEREAS SUBASSEMBLES WERE FABRICATED BY SUBCONTRACTOR FACILITIES. FOR DELIVERY TO THE WAR ZONES, THE PLANES WERE FITTED WITH LONG RANGE FERRY TYPE FUEL TANKS. ALL ARMENT WAS REMOVED.

SHEET NO.1



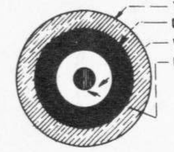
LEFT SIDE VIEW
(A-20C LOADED CONDITION AT T.O.)
(RIGHT SIDE VIEW IS SIMILAR)

NORMAL CREW CONSISTED OF BOMBARDIER, PILOT AND REAR GUNNER. HOWEVER, CERTAIN MODELS WERE MODIFIED SO A FOUR MAN CREW (2 GUNNERS) COULD BE USED. PHOTO (F-3) VERSIONS CARRIED EXTENSIVE CAMERA INSTALLATIONS.

TECHNICAL DATA DOUGLAS A-20

WING AIRFOIL (ROOT)	NACA 23018
〃 (TIP)	〃 23010
TOTAL WING AREA	464.8 SQ.FT.
WING SPAN	61'-4"
WING ROOT CHORD	138.5
〃 TIP 〃	44.5
〃 TAPER RATIO	.32
〃 INCIDENCE INBOARD PANEL	3°
〃 〃 OUTBOARD (ROOT)	3°
〃 〃 〃 (TIP)	-1°
〃 DIHEDRAL ANGLE	4°7'
〃 SWEEPBACK	0°
〃 MAXIMUM RIB SPACING	15.5"
〃 LOCATION - MAIN SPAR	38%
〃 〃 SHEAR WEB	65.9%
〃 ASPECT RATIO	8.07
〃 M.A.C. LENGTH	100.23
〃 THICKNESS (ROOT CHORD)	24.93
〃 〃 (TIP CHORD)	4.40
AILERON AREA	42.1 SQ.FT.
ANGULAR MOVEMENT UP 30° DOWN 20°	
DIFFERENTIAL MOTIO RATIO	1.5:1
DISTANCE FROM PLANE OF SYMMETRY TO CENTROID OF AILERON AREA	260"
HORIZONTAL TAIL SURFACE AREA	100 SQ.FT.
〃 〃 〃 SPAN	21'-1.5"
DISTANCE FROM DESIGN GROSS WEIGHT C.G. TO 1/3 MAXIMUM CHORD POINT	294"
HORIZONTAL STABILIZER AREA	60.8 SQ.FT.
〃 〃 INCIDENCE	2°
ELEVATOR AREA	38.2 SQ.FT.
〃 ANGULAR MOVEMENT UP 30° DOWN 30°	
VERTICAL STABILIZER AREA	24.8 SQ.FT.
NORMAL SETTING	0°
ANGULAR MOVEMENT	0°
RUDDER AREA	36.1 SQ.FT.
RUDDER ANGULAR MOVEMENT:	
〃 〃 RIGHT AND LEFT	22.5°
FUEL 540 GALLONS	3300 POUNDS
OIL 40 〃	310 〃
2100 ROUNDS FIXED GUNS	654 〃
1200 〃 FLEXIBLE GUNS	373 〃
FUEL SYSTEM WEIGHT PER GALLON	2.3 POUNDS
OIL 〃 〃 〃	8.5 〃
WING GROUP 5 POUNDS PER SQUARE FOOT	
TAIL 〃 2.2 〃 〃 〃	
ATTACK CONDITION GROSS WEIGHT:	
C.G. LOCATION, WHEELS UP, AFT L.E. M.A.C. 30% M.A.C.	
C.G. LOCATION, WHEELS UP, BELOW L.E. M.A.C. 15.6% M.A.C.	
C.G. LOCATION, WHEELS DOWN, AFT L.E. M.A.C. 29.4% M.A.C.	
FLYING BALANCE RANGE 16% AND 30% WITH WHEELS UP OR DOWN.	
AT DESIGN GROSS WEIGHT OF 19,750 POUNDS.	
POSITIVE LOAD MANEUVERLOAD FACTOR	4.0
NEGATIVE 〃 〃 〃 〃	-2.0
LIMIT GUST LOAD FACTOR, AT DESIGN GROSS WEIGHT, FLAPS UP, POSITIVE	4.0
AT DESIGN GROSS WEIGHT, FLAPS DOWN, POSITIVE	2.27
LIMIT LANDING FACTOR, GROUND LANDINGS, AT DESIGN GROSS WEIGHT, (19,750 POUNDS)	3.33
LIMIT DIVING SPEED, 120% OF MAXIMUM LEVEL FLIGHT SPEED AT DESIGN GROSS WT.	
ULTIMATE LOAD FACTOR	9 Ga.
TAKE-OFF RUN 1900 FT. OVER 50 FT. OBSTACLE.	
STALLING SPEED I.A.S.	115 M.P.H.
NORMAL LANDING SPEED I.A.S.	100 M.P.H.
CLIMBING SPEED (23,000)	167 M.P.H.
GROUND ROLL (23,000 LBS.)	1850 FT.
MAXIMUM FLIGHT RANGE (760 GALS)	1200 MILES
HIGH SPEED AT 5000 FT.	354 M.P.H.
ANGLE OF THRUST TO FUSELAGE R.L.	2°

THE A-20C WILL MAINTAIN ALTITUDE ON ONE ENGINE, PROVIDED THE ENGINE IS DEVELOPING MAXIMUM RATED POWER AND THE GROSS WEIGHT DOES NOT EXCEED 27,800 POUNDS AT 4,000 FEET ALTITUDE.



R.A.F. IDENTIFICATION (FUSELAGE)

(DIMENSIONS ARE ALL SHOWN IN INCHES. DRWG. SCALE 0 1 2)

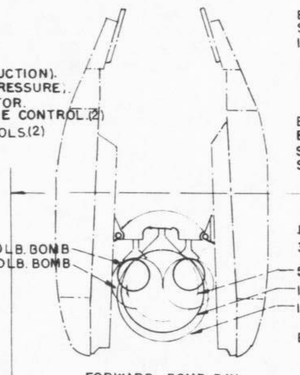
MANUFACTURED BY DOUGLAS AIRCRAFT COMPANY INC.

HAVOC

A-20 SERIES ATTACK BOMBER BUILT FOR W.W.II.
DRAWN BY WILLIS L. NYE FOR MODEL AIRPLANE NEWS 6-7-59

PILOT'S COCKPIT A-20

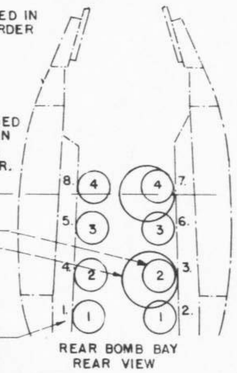
1. FUEL CROSS-FEED CONTROL(SUCTION).
2. ENGINE CROSS FEED CONTROL(PRESSURE).
3. L.H. AND R.H. FUEL TANK SELECTOR.
4. CARBURETOR AIR TEMPERATURE CONTROL.(2)
5. ENGINE SUPERCHARGER CONTROLS.(2)
6. FUEL VALVE PANEL LIGHT.
7. PROPELLER CONTROL FRICTION ADJUSTER.
8. ENGINE CONTROL FRICTION ADJUSTER.
9. FUEL MIXTURE CONTROL.(2)
10. THROTTLE CONTROLS.(2)
11. PROPELLER CONTROLS.(2)
12. LOWER ELECTRICAL PANEL.
13. ENGINE CONTROLS LIGHT.
14. UPPER ELECTRICAL PANEL.
15. ENGINE IGNITION SWITCH.
16. CONTROL COLUMN.
17. SURFACE CONTROLS LOCK RELEASE.
18. FIXED GUNS FIRING SWITCH.
19. ENGINE PRIMER PUMP CONTROL.
20. MANIFOLD PRESSURE DRAIN COCK.
21. RADIO CONTROLS LIGHT.
22. RECOGNITION LIGHTS MORSE KEY.
23. OXYGEN OUTLET.
24. TELEGRAPH KEY.
25. RECOGNITION LIGHTS SWITCH PANEL.
26. R3003 RECEIVER MASTER SWITCH.
27. RADIO CONTROL PANEL.
28. COMPASS LIGHT.
29. TRIM TAB CONTROLS LIGHT.
30. COCKPIT EXTENSION LIGHT.
31. RUDDER TRIM TAB CONTROL.
32. ELEVATOR TRIM TAB CONTROL.
33. AILERON TRIM TAB CONTROL.
34. LANDING GEAR EMERGENCY RELEASE.
35. LANDING FLARE RELEASE.
36. FUEL DUMP VALVE CONTROL.
37. MAGNETIC COMPASS.
38. BOMB RELEASE CONTROL PANEL.
39. OXYGEN FLOW REGULATOR.
40. HEATING AND VENTILATING SYSTEM OUTLET CONTROL.
41. FIXED GUN CHARGING CONTROLS.
42. RUDDER AND BRAKE PEDALS.
43. RUDDER PEDAL ADJUSTMENT RELEASE.
44. WOBBLE TYPE FUEL PUMP.
45. BOMB BAY DOOR CONTROL.
46. OXYGEN PRESSURE REGULATOR.
47. HEATING AND VENTILATING SYSTEM CONTROL.
48. UPPER ENGINE COWL FLAP CONTROL.
50. LOWER ENGINE COWL FLAP AND ENGINE OIL COOLER FLAP CONTROL.
51. PILOT SEAT ADJUSTMENT CONTROL.
52. HYDRAULIC HANDPUMP BY-PASS VALVE CONTROL.
53. WING FLAP POSITION CONTROL.
54. LANDING GEAR HYDRAULIC CONTROL.
55. HYDRAULIC HAND PUMP CONTROL.
56. SURFACE CONTROL LOCK.
57. PARKING BRAKE CONTROL.
58. BANK AND INDICATOR THROTTLE VALVE CONTROL.
59. FREE AIR TEMPERATURE.
60. CLOCK.(WINDING 8 DAY).
61. SUCTION GAUGE.
62. STEERING INDICATOR.
63. AIR SPEED INDICATOR.
64. ALTIMETER.
65. LANDING GEAR AND WING FLAP POSITION INDICATOR.
66. GYRO-HORIZON.
67. DIRECTIONAL GYRO.
68. RATE OF CLIMB INDICATOR.
69. BANK AND TURN INDICATOR.
70. L.H. MANIFOLD PRESSURE GAUGE.
71. R.H. MANIFOLD PRESSURE GAUGE.
72. L.H. TACHOMETER.(NO.1 ENGINE).
73. R.H. TACHOMETER.(NO.2 ENGINE).
74. L.H. OIL PRESSURE GAUGE.
75. R.H. OIL PRESSURE GAUGE.
76. L.H. FUEL PRESSURE GAUGE.
77. R.H. FUEL PRESSURE GAUGE.
78. HYDRAULIC PRESSURE GAUGE.
79. L.H. OIL TEMPERATURE GAUGE.
80. R.H. OIL TEMPERATURE GAUGE.
81. L.H. CARBURETOR AIR TEMPERATURE GAUGE.
82. R.H. CARBURETOR AIR TEMPERATURE GAUGE.
83. L.H. CYLINDER HEAD TEMPERATURE GAUGE.
84. R.H. CYLINDER HEAD TEMPERATURE GAUGE.
85. FUEL QUANTITY GAUGE.
86. ARMOR PLATE RELEASE.



FORWARD BOMB BAY ARRANGED FOR GLIDE BOMBS (REAR VIEW)

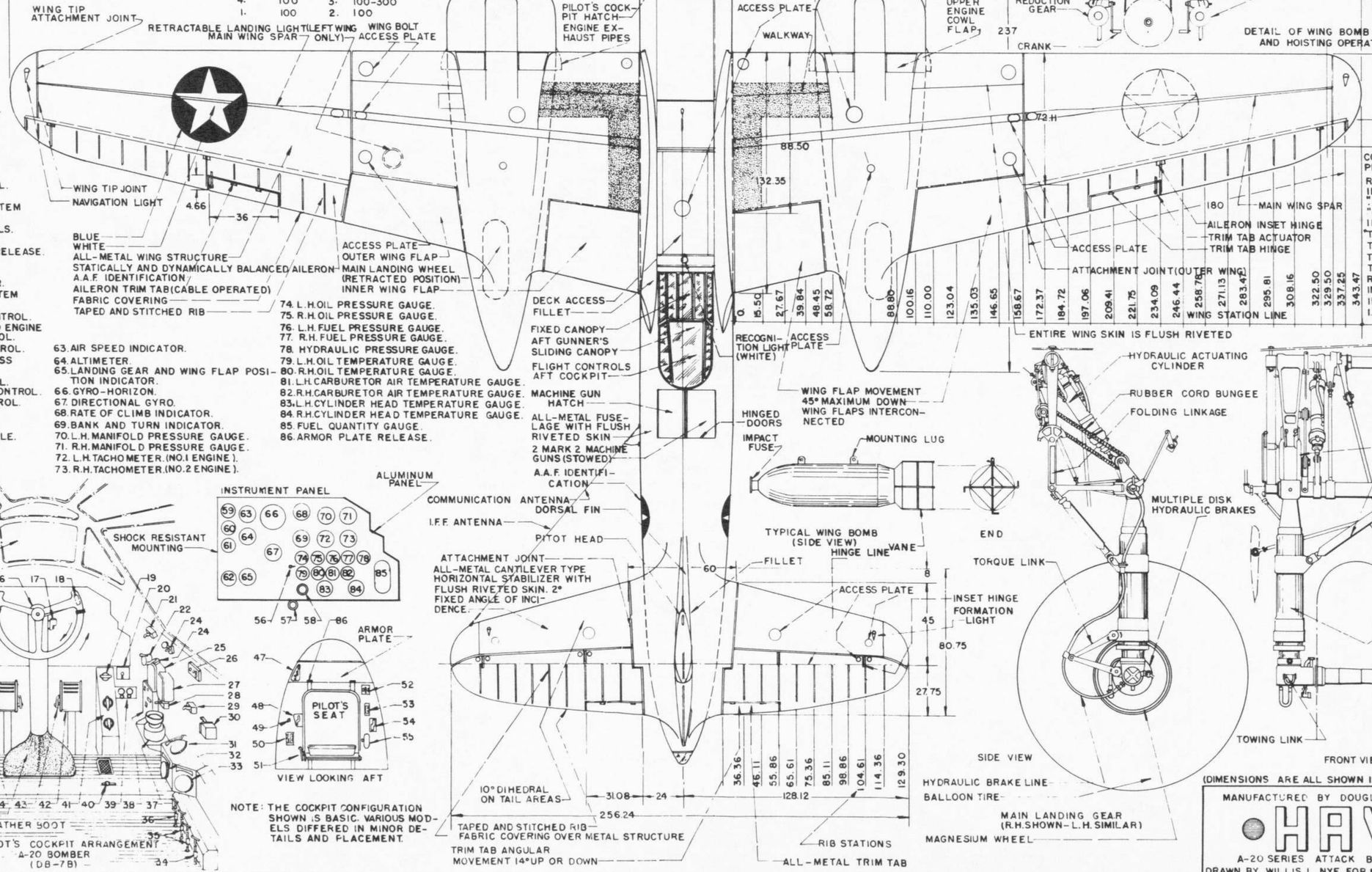
BOMBS RELEASED IN SALVO IN THE ORDER INDICATED.

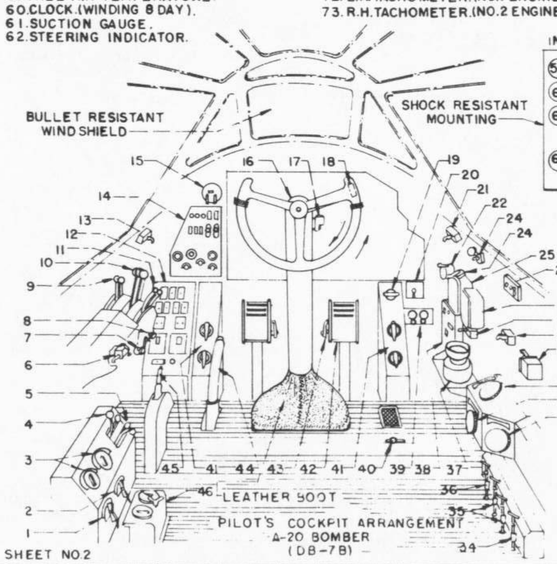
BOMBS RELEASED ELECTRICALLY IN SAME ORDER AS STATION NUMBER.



REAR BOMB BAY REAR VIEW

LEFT SIDE STATION	BOMB	RIGHT SIDE STATION	BOMB
8.	100	7.	100-300
5.	100	6.	100
4.	100	3.	100-300
1.	100	2.	100





NOTE: THE COCKPIT CONFIGURATION SHOWN IS BASIC. VARIOUS MODELS DIFFERED IN MINOR DETAILS AND PLACEMENT.

SHEET NO.2

(DIMENSIONS ARE ALL SHOWN IN INCHES. DRWG. SCALE 0 1 2)

MANUFACTURED BY DOUGLAS AIRCRAFT COMPANY INC.

HAVOC

A-20 SERIES ATTACK BOMBER BUILT FOR W.W.II.

DRAWN BY WILLIS L. NYE FOR MODEL AIRPLANE NEWS 6-7-59.

DOUGLAS BOSTON/HAVOC/A-20

— HYDRAULIC SYSTEM COMPONENT LIST.—
ENGINE-DRIVEN HYDRAULIC PUMPS(2)
HYDRAULIC FLUID PRESSURE ACCUMULATOR.
LANDING GEAR ACTUATING CYLINDERS(2).
WING FLAP ACTUATING CYLINDERS(2).
BOMB BAY DOORS ACTUATING CYLINDER(1).
WING FLAP PRESSURE RELIEF VALVE(2).
COWL FLAP ACTUATING CYLINDER(4).
HYDRAULIC FLUID RESERVOIR.(7.28 CU.IN).
LOWER COWL FOUR WAY VALVE(2).
HYDRAULIC PRESSURE GAUGE.
HYDRAULIC BRAKE CONTROL VALVE(2).
NOSE WHEEL ACTUATING CYLINDER.
WING FLAP FOUR WAY VALVE.
BOMB BAY DOORS ADJUSTABLE RELIEF VALVE.
BOMB BAY DOORS FOUR WAY VALVE.
R.H. MANIFOLD BLOCK(1).
HAND HYDRAULIC PUMP.(1).
LANDING GEAR RELIEF VALVE.
L.H.MANIFOLD BLOCK(1).
LANDING GEAR FOUR WAY VALVE.
HYDRAULIC PRESSURE REGULATOR.
HYDRAULIC BRAKE DEBOOSTER.(2)
CHECK VALVES.
RESTRICTORS.
HYDRAULIC GUN CHARGER(NOSE GUNS)
BY-PASS VALVES.
PRESSURE REDUCING CYLINDERS.
SPRING LOADED RETURN VALVE.
BRAKE VALVES(2).
DISCONNECT VALVES.
HYDRAULIC FLUID FILTER.
NOSE WHEEL HYDRAULIC SNUBBER.
ORIFICE CHECK VALVE AND CONSTANT FLOW DIVIDER.
HAND PUMP BY-PASS VALVE.
HYDRAULIC DISCONNECT VALVE.
BRAKE LINE SWIVEL JOINT.
GUN CHARGER CONTROL VALVE.
HYDRAULIC PRESSURE AND SUPPLY LINES.

FOLDING BRACKET
AMMO BOX
ARMOR PLATE
CAL.30 AIRCRAFT TYPE MACHINE GUN TYPE M-2
GUN GRIP
HINGE PIN
GUN SIGHT
PLAN VIEW
FOLDING BRACKET
STA.312 FUSELAGE
AFT LOWER MACHINE GUN MOUNT (SIDE VIEW)

AFT 30 CALIBER MACHINE ATTACHED TO A FOLDING BRACKET. IT IS OPERABLE WHEN AFT LOWER DOOR IS OPENED
NOSE WHEEL DOORS
BOMB BAY DOOR
FLARE CHUTE DOOR (NIGHT LANDING)
BOMBARDIER'S ACCESS DOOR
PLEXIGLAS NOSE
RED, AMBER AND GREEN RECOGNITION LIGHTS
AFT GUNNER ACCESS DOOR
ACCESS PLATES
INNER WING FLAP
FILLET
LANDING GEAR NACELLE DOORS
RECONNAISSANCE FLARE DOOR
TAIL SKID
EXHAUST COLLECTOR PIPE MADE IN THREE SECTIONS

—BOTTOM VIEW A-20—
I.F.F. ANTENNA
FORMATION LIGHT

— PILOT'S COMPARTMENT —
ENGINE COWL FLAP CONTROLS.
HEATING AND VENTILATION CONTROLS.
FOOD PACKET.
LANDING GEAR EMERGENCY RELEASE.
LANDING FLARE RELEASE.
PILOT'S ENCLOSURE EMERGENCY RELEASE.
ENGINE FIRE EXTINGUISHER.
PROPELLER FEATHERING CONTROLS.
ELECTRICAL PANEL.
EMERGENCY BRAKE CONTROL.
FUEL CONTROLS.
ENGINE CONTROLS.
CONTROL COLUMN.
FIRING CONTROLS.
REFLECTOR TYPE GUN SIGHT.
PARACHUTE.
HEATER FOR FLYING SUIT
OXYGEN TANK

BOMB RELEASE CONTROLS.
BOMB BAY DOOR CONTROL.
ELECTRICAL PANEL.
VERY PISTOL AND CARTRIDGES.
SAFETY BELT.
FIREMAN'S AXE.
GUN CAMERA.
BOMBARDIER'S INSTRUMENT PANEL.
BOMBSIGHT.
RELIEF TUBE.
INTERVALOMETER.
INTERPHONE JACK BOX.
FOOD KIT.
WATER FLASK.
WARNING BELL.
INSTRUMENT PANEL

SEAT TYPE FLOTATION CUSHION—PARACHUTE ACCESS DOOR
FOLDING BOMBARDIER'S SEAT—ARMOR PLATE

PILOT'S MISCELLANEOUS EQUIPMENT
BACK TYPE FLOTATION JACKET.
RELIEF TUBE.
OXYGEN MASK AND PRESSURE REGULATOR.
DATA CASE.
CHECK LIST HOLDER.
COMPASS CORRECTION CARD.
NAVIGATION KIT.
FIRST AID PACKET.
INTERPHONE JACK BOX.
MICROPHONE.(THROAT AND HAND).
BC-646A CONTROL BOX.
MICROPHONE CONTROL.
RECEIVER CONTROL BOX.
TRANSMITTER CONTROL BOX.
INTERPHONE SWITCH BOX.
FILTER BOX.
VACUUM FLASK.
BOMB JETTISON SWITCH.
GUN CHARGERS(2).
HEATER FOR FLYING SUIT.
SAFETY BELT.
CARBURETOR HEAT.
GUNNERY CONTROLS.
GENERATOR CONTROLS.

— COMMUNICATION'S EQUIPMENT —
BC-457A(4.0-5.3 M.C.).
BC-458A(5.3-7.3 M.C.).
BC-456A.
DYNAMOTOR UNIT DM-33A.
ANTENNA UNIT BC-442A.
RECEIVER BC-453A.
RECEIVER BC-454A.
RECEIVER BC-455A.
ADAPTER FT-238A.
DYNAMOTOR UNIT DM-32A.
RECEIVER TUNING SHAFT.
TUNING SHAFT COUPLING.
SCR-535(I.F.F. AND DETONATOR)
RADIO MAST
ARMOR PLATE

— AFT GUNNER'S COMPARTMENT —
UPPER SINGLE CAL.30 FLEXIBLE M.G. (FIRING AND STOWED POSITION).
OXYGEN BOTTLES(3).
GUN TRACK.
PARACHUTE.
FOOD PACKET.
FIRST AID PACKET.
WATER FLASK.
FIREMEN'S AXE.
GUNNER'S ENCLOSURE EXTERIOR RELEASE.
GUN CHARGER.
WARNING BELL.
CONTROL UNIT.
AFT JOYSTICK AND RUDDER PEDALS
PARACHUTE.
TOW TARGET EQUIP'T.
FIRING
STOWED

7 RECONNAISSANCE FLARES WERE CARRIED ON NIGHT BOMBING MISSIONS. (STA. 372)

FORWARD BOMB BAY (GLIDE BOMB RACKS)
AFT BOMB BAY (DEMOLITION BOMB RACKS)

LOWER BOX KEEL
FUSELAGE TRUSS
ANTI-ICER FLUID TANK
BOMB BAY DOORS
BOMB BAY DOORS HYDRAULIC ACTUATOR
NOSE WHEEL DOOR
PARTIAL INBOARD PROFILE A-20C-ATTACK BOMBER
NOSE WHEEL WELL
STORAGE BATTERIES (BATTERY CART RECEPTACLE IN WHEEL WELL)
OXYGEN TANK

HEATING SYSTEM CONSIST OF LINES, DUCTS, VALVES, STEAM TRAP, BOILER ON RIGHT ENGINE, RADIATOR, SAFETY VALVE, DRAIN, WATER TANK, CONTROLS AT AIRCREW STATIONS.

AMMO GUNNER'S BOXES DOOR
CORRUGATED FLOOR
AFT LOWER M.G. STOWED
UPPER BOX BEAM
OXYGEN TANK

MISCELLANEOUS EQUIPMENT (AFT GUNNER)
RADIO DIAGRAM HOLDER.
RELIEF TUBE.
OXYGEN PRESSURE REGULATOR.
SEAT TYPE FLOTATION CUSHION.
GUNNERY DATA CASE.
GUNNER'S STORAGE CONTAINER.
SAFETY BELTS(2).
AIRPLANE TOOL KIT.
MICROPHONE.
INTER PHONE JACK BOX AND ELECTRICAL PANEL.
BC-648 CONTROL BOX.
FIRE EXTINGUISHER.

MISC. EQUIPMENT
ENGINE COVERS(2).
JACK PADS.
L.G. GROUND LOCKS.
ENGINE TOOL KIT.
AIRCRAFT TOOL KIT.
OIL TANK FILLER.
ENGINE STARTER HAND CRANK.
FORWARD SPAR
MAIN SPAR

OUTER WING FLAP
ACCESS PLATE
MAIN SPAR
DEMOUNTABLE OUTER WING
FORWARD SPAR
HORIZONTAL STABILIZER
ROOT STRUCTURE
ELEVATOR TORQUE TUBE
TRIM TAB
AILERON
MAIN ELEVATOR SPAR
SELF-ALIGNMENT INSET BALL-BEARING HINGE
CHANNEL SECTION RIB
RUDDER TORQUE TUBE
TRIM TAB
MAIN SPAR
PLEXIGLAS DOME
3 SEGMENT ENGINE COWL
LANDING LIGHT(RETRACTABLE)
MAIN SPAR JOINT
ACCESS PLATE
OUTER WING BOMB RACK (CHEMICAL SMOKE TANK)
BOMBS RELEASED BY ELECTRICAL SOLENOID OPERATION. SMOKE TANKS ARE ELECTRICALLY ACTUATED.
WING TIP JOINT
NAVIGATION LIGHT
UPPER HINGED HATCH
BOMB HOISTS STOWED IN UPPER COMPARTMENT
UPPER BOX BEAM
FUSELAGE TRUSS
CORRUGATED PANEL
LONGITUDINAL STRINGER (EXTRUDED)
FORMER(SOLID WEB)
FLUSH RIVETED SKIN
KEEL BOX STRUCTURE
BOMB BAY
BOMB BAY DOORS

FUSELAGE STRUCTURE (TYPICAL FOR BOMB BAY)

FORMER BULKHEAD
LONGITUDINAL STRINGER

— FUEL SYSTEM COMPONENTS —
FOR LONG RANGE FLIGHT, A BOMB BAY FUEL TANK(100 GALS.), AN EXTERNAL FUSELAGE BELLY TANK(380 GALS.) IN ADDITION TO REGULAR FUEL TANKS WERE FITTED. FULL OVERLOAD ENGINE OIL CAPACITY IS CARRIED.
SELF-SEALING FUEL CONTAINERS.
FUEL TRANSFER SELECTOR VALVES.
FUEL STRAINERS.
ENGINE-DRIVEN FUEL PUMPS.
ENGINE FUEL PRIMER.
MAIN FUEL SELECTOR VALVES.
FUEL QUANTITY GAUGES (WITH TRANSMITTERS).
FUEL PRESSURE GAUGES.
AUXILIARY FUEL PUMPS.(TRANSFER AND BOOSTER)
FUEL PRIMERS.
FUEL SHUT-OFF VALVES.

— FIRE EXTINGUISHING COMPONENTS —
HIGH PRESSURE CO_2 CYLINDERS AND SUPPLY LINES.
SOLENOID VALVES(2).
HAND EXTINGUISHERS(3).

INSTRUMENT PITOT AND VACUUM SYSTEM COMPONENTS
ENGINE OIL SEPARATOR.
AIR RELIEF VALVE.
AIR CHECK VALVE.
ENGINE-DRIVEN VACUUM PUMP.
THROTTLE VALVE.
VACUUM "Y" VALVE.
SUCTION REGULATOR.
AIR ACTUATED INSTRUMENTS.

— OIL SYSTEM COMPONENTS —
ENGINE OIL TANKS(2).
HYDROMATIC OIL PUMP.
"Y" DRAIN COCKS(2).
ENGINE OIL COOLERS(2).
OIL DILUTION SOLENOID VALVES(2).
OIL PRESSURE GAUGES(2).
OIL TEMPERATURE GAUGES(2).

— OXYGEN SYSTEM COMPONENTS —
OXYGEN TANKS(8 LOW PRESSURE)
FLOW INDICATORS(4).
PRESSURE REGULATOR.
MANIFOLDS(2).
OXYGEN VALVE.

— A-20C ELECTRICAL CIRCUITRY LIST. —
FUEL QUANTITY GAUGES.(L. & R. TANKS)
OIL TEMPERATURE GAUGE.
OIL DILUTION SYSTEM.
HEATER SYSTEM.
PITOT HEAD HEATER SYSTEM.
BOMBARDIER'S FREE AIR THERMOMETER.
ENGINE CYLINDER HEAD TEMPERATURE INDICATORS.
CARBURETOR AIR TEMPERATURE INDICATOR.
PROPELLER FEATHERING SYSTEM.
RADIO RECEPTION CIRCUITS.
RADIO POWER CIRCUITS.
RADIO TRANSMISSION CIRCUITS.
ENGINE TACHOMETER INDICATORS.
TOW TARGET EQUIPMENT.
BOMBARDIER'S ELECTRICAL PANEL.
PILOT'S ELECTRICAL PANEL.
ENGINE STARTERS.
ENGINE-DRIVEN GENERATORS.
STORAGE BATTERY CONTROLS.
RECOGNITION LIGHTS.
LANDING GEAR WARNING HORN.
LANDING LIGHT(LEFT WING ONLY)
CREW POSITION LIGHTS.
CALL LIGHTS.
INSTRUMENT LIGHTING.
FORMATION LIGHTS.
RUNNING LIGHTS.
ENGINE IGNITION.
AERIAL CAMERA.
WARNING BELLS.
GUN CAMERAS.
BOMB ARMING CONTROLS.
DEMOLITION AND GLIDE BOMB RACKS.
BOMB RELEASE MECHANISM.
OUTBOARD BOMB RELEASES.
WING BOMB CIRCUITS.
WING SMOKE TANKS.
GUN SIGHT.(PILOT)
FUEL PUMPS.
FUEL PRIMER SOLENOIDS.
FUEL QUANTITY GAUGES(MAIN AND AUXILIARY FUEL TANKS).
FUEL QUANTITY GAUGES(AFT BOMB BAY FUEL TANK).
FUEL QUANTITY GAUGE(LONG RANGE FUEL TANKS).
FUEL TRANSFER PUMPS.
PROPELLER ANTI-ICER.
BOMBSIGHT.
INTERVALOMETER.
I.F.F. EQUIPMENT.
TORPEDO DIRECTOR SIGHT.
MULTI-PLACE INTERPHONE.
HEATER FOR FLYING SUITS.
ELECTRICAL VOLTAGE: 28

— CABLE CONTROLS LIST —
LANDING GEAR MECHANICAL RELEASE.
CARBURETOR AIR MIXTURE.
SUPERCHARGER CONTROLS.
THROTTLE CONTROLS.
FUEL MIXTURE CONTROLS.
PROPELLER PITCH CONTROLS.
FUEL VALVE CONTROLS.
AILERON CONTROLS.
AILERON TRIM TAB CONTROL.
ELEVATOR CONTROL.
ELEVATOR TRIM TAB CONTROL.
RUDDER CONTROL CONTROL.
RUDDER TRIM TAB CONTROL.
FLARE RELEASE.
BRAKE SYSTEM CONTROLS.
BOMBARDIER EMERGENCY BOMB BAY DOOR RELEASE.

— PROPELLER ANTI-ICER SYSTEM COMPONENTS
ELECTRIC FLUID PUMP
SOLENOID VALVE, CHECK VALVE.
FLUID FILTER.
FLUID TANK AND SUPPLY LINES

THE NOSE GUNS(2 FIXED) WERE ATTACHED TO A HEAVY ALUMINUM FORGING MOUNT BOLTED TO THE FUSELAGE NOSE STRUCTURE. THE GUNS WERE CHARGED HYDRAULICALLY. PROVISION WAS MADE FOR 200 ROUNDS OF AMMO PER GUN.(FIRED BY PILOT)

LONG RANGE EXTERNAL FUEL TANK

BOMB BAY DOORS IN OPEN POSITION

FOR LONG RANGE OPERATION: 4 ADDITIONAL WATER FLASKS, PORTABLE EMERGENCY RADIO, INFLATABLE LIFE RAFT, 400 ROUNDS AMMUNITION, WERE CARRIED, IN ADDITION TO EXTRA FUEL TANKS.

— LONGITUDINAL STRUCTURAL CONFIGURATION A-20 —
(PLANE DRAWN WITH WING AT ZERO ANGLE OF ATTACK)

FUSELAGE SKIN:	WING SKIN	TAIL SKIN
.020	.025	.022
.025	.032	.032
.032	.040	
.072	.051, .064, .072.	

ALL SKIN PLATING IS ALCLAD 24ST ALLOY.

THE AUTHOR OF THESE DRAWINGS WAS CIVILIAN ADMINISTRATOR IN CHARGE, AIR TECHNICAL SERVICE COMMAND, A.A.F. OF PROCUREMENT OF ALL SPARE PARTS, SPECIAL MAINTENANCE TOOLS, ALL TECHNICAL DATA, AND SPECIAL PROJECT MATERIEL, FOR 999 A-20B PRODUCED AT DOUGLAS LONG BEACH PLANT 1942-1943.
SHEET NO 3

(DIMENSIONS ARE ALL SHOWN IN INCHES. DRWG SCALE) 0 1 2

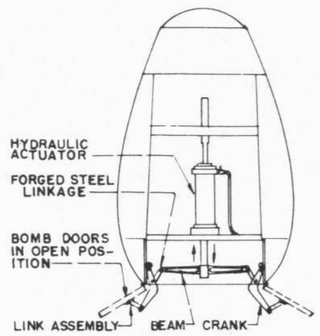
MANUFACTURED BY DOUGLAS AIRCRAFT COMPANY, INC.

HAVOC

A-20 SERIES ATTACK BOMBER BUILT FOR W.W.II.

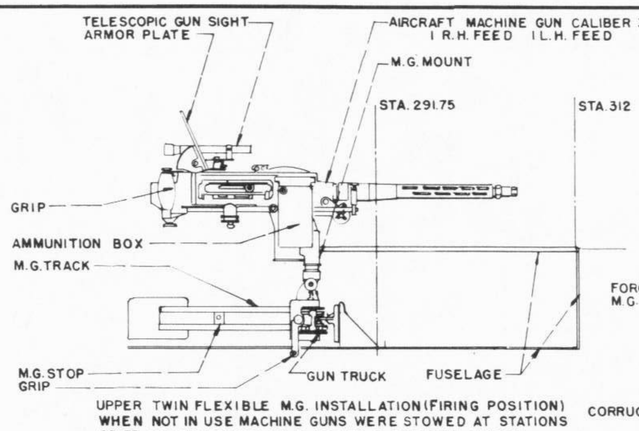
DRAWN BY WILLIS L. NYE FOR MODEL AIRPLANE NEWS 6-7-59.

NOTE: TWO KINDS OF BOMB RACKS WERE FITTED IN THE BOMB BAY, I.E. ONE FOR FRAGMENTATION BOMBS AND ONE FOR DEMOLITION BOMBS.



BOMB BAY DOORS ACTUATING MECHANISM (BOMB BAY CROSS SECTION)

NOTE: BOMB BAY DOORS WERE PROVIDED WITH A CABLE OPERATED SYSTEM FOR EMERGENCY OPERATION. THIS SYSTEM WAS OPERABLE BY THE BOMBARDIER.



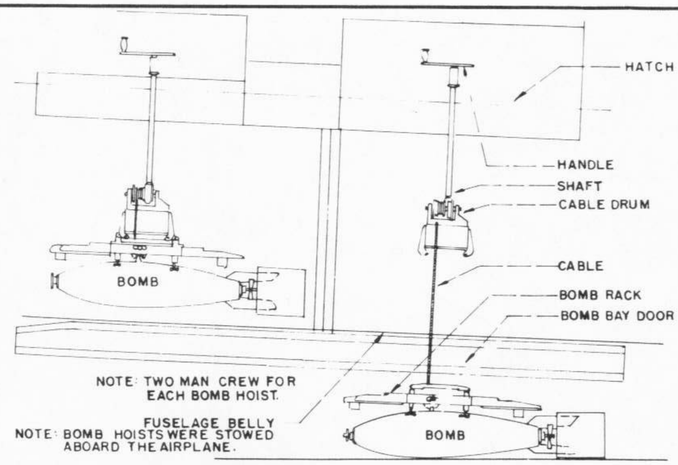
UPPER TWIN FLEXIBLE M.G. INSTALLATION (FIRING POSITION) WHEN NOT IN USE MACHINE GUNS WERE STOWED AT STATIONS 291.75 AND 312, BOLTED IN PLACE TO CLEAR THE CANOPY. TWO HINGED DOORS COVERED THE GUNS WHEN NOT IN USE.

NOTE: FOR LONG RANGE FERRY FLIGHTS, THE FOLLOWING FUEL CAPACITIES ARE CARRIED:

BOMB BAY FUEL TANK	600	GALLONS
WING TANKS (RIGHT)	195	DO
WING TANK (LEFT)	195	DO
FUSELAGE FUEL TANK	100	DO
EXTERNAL FUEL TANK	380	DO

THE INSIGNIA, MARKING AND CAMOUFLAGE
THE INSIGNIA, MARKING AND CAMOUFLAGE ON THE EXTERIOR SURFACES OF THE AIRPLANE IS AS FOLLOWS:
ENTIRE TOP SURFACE: DARK OLIVE DRAB.
ENTIRE LOWER SURFACE: NEUTRAL GRAY.
ON THE FUSELAGE AND ENGINE NACELLES, AS WELL AS THE WINGS THE COLORS ARE MERGED ALONG AN IRREGULAR LINE.
R.A.F. DB-7 AIRCRAFT WERE COLORED DARK OLIVE DRAB AND IRREGULAR GREEN.
LANDING GEAR TIRES: BLACK.
NOSE GEAR TIRE: BLACK.
LANDING STRUCTURE: ALUMINUM.
NOSE GEAR STRUCTURE: ALUMINUM.
PROPELLERS: ALUMINUM.
WALKWAYS: BLACK.
CREW COMPARTMENT: LIGHT GREEN.

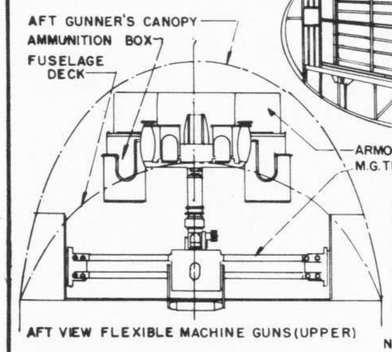
THE BULLET SEALING FUEL CELL IS MADE OF 3-PLY LAMINATED MATERIAL:
U.S. RUBBER CO. 1897 FABRIC NEOPRENE ON THE FUEL AND A PLASTIC MATERIAL ON THE EXTERIOR SURFACE.
FABRIC RETAINER NO. 3, U.S. RUBBER CO.
U.S. RUBBER SEALANT.
THE LINER FORMS A SEMI-RIGID SELF-SUPPORTING FUEL CELL THAT IS SHAPED TO FIT INTO THE WING OR FUSELAGE.



NOTE: TWO MAN CREW FOR EACH BOMB HOIST.

NOTE: BOMB HOISTS WERE STOWED ABOARD THE AIRPLANE.

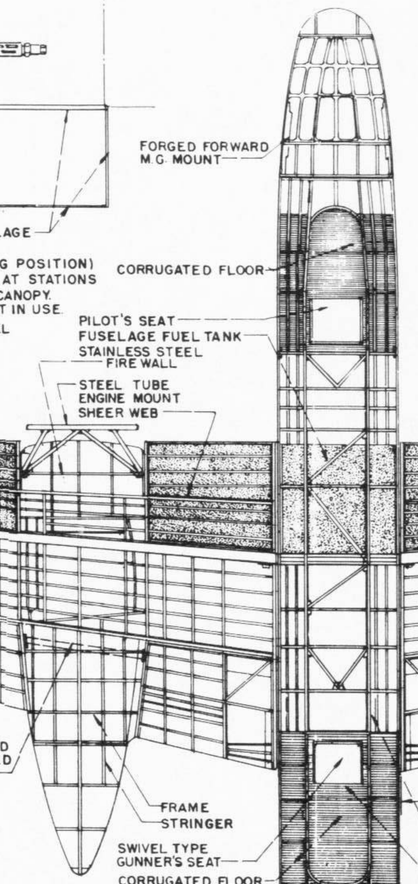
BOMB HOISTING OPERATION OF FRAGMENTATION BOMBS



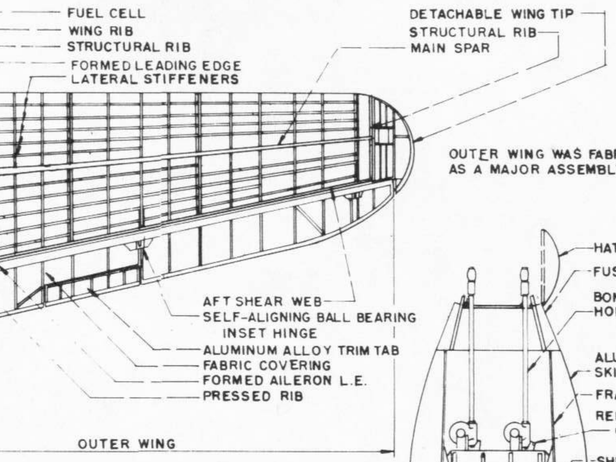
AFT VIEW FLEXIBLE MACHINE GUNS (UPPER)

THE FOLLOWING RADIO EQUIPMENT IS MOUNTED AT AFT END OF THE REAR BOMB BAY:
ANTENNA LOADING UNIT.
INTERPHONE AMPLIFIER.
ANTENNA TRANSFER AND GROUNDING SWITCH.
RECEIVER.
TRANSMITTER POWER SUPPLY.
TRANSMITTER.
RECEIVER.
RECEIVER CONTROL UNIT.

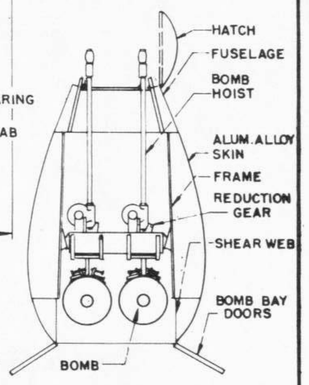
NOTE: THE ENGINE OIL COOLER EXIT DOORS AND THE EMERGENCY LANDING GEAR EXTENSION ARE CABLE OPERATED BY THE PILOT.



ENGINE MOUNT ATTACHED TO LORD TYPE RUBBER SHOCK MOUNT AT FOUR POINTS. ALL WELDED JOINTS.



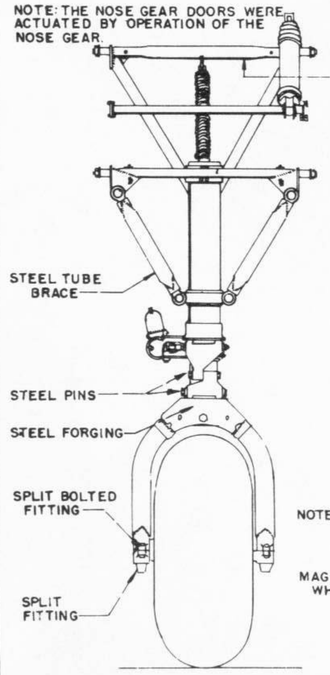
OUTER WING WAS FABRICATED AS A MAJOR ASSEMBLY

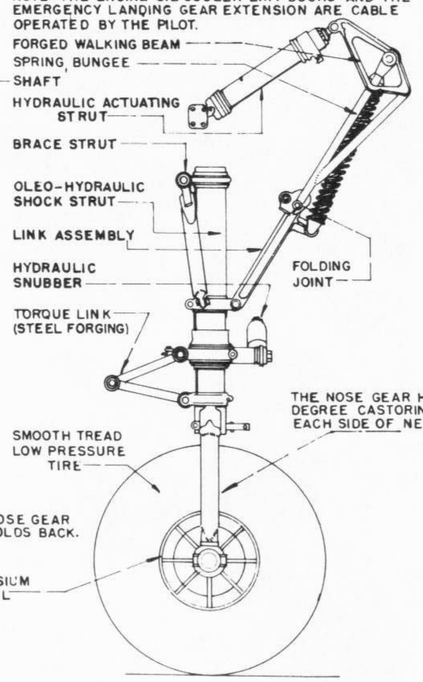


LOADING OF FRAGMENTATION BOMBS (CROSS SECTION)

NOTE: EACH ENGINE COMPARTMENT WAS PROVIDED WITH A FIRE WARNING SYSTEM AND A CARBON DIOXIDE PRESSURE TYPE FIRE EXTINGUISHING SYSTEM OPERABLE BY THE PILOT.

NOTE: THE NOSE GEAR DOORS WERE ACTUATED BY OPERATION OF THE NOSE GEAR.





THE NOSE GEAR HAS 36 DEGREE CASTORING ACTION EACH SIDE OF NEUTRAL.

NOTE: NOSE GEAR FOLDS BACK.

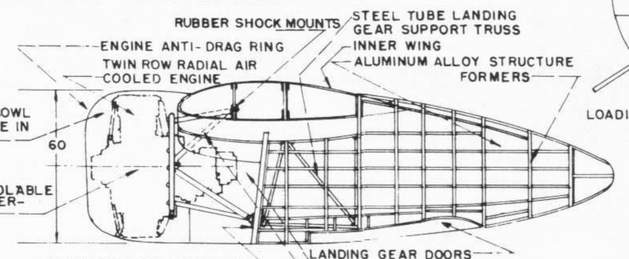
DETAILS OF NOSE WHEEL

THE BASIC WING STRUCTURE WAS MADE IN FOUR MAJOR ASSEMBLIES AND JOINED TOGETHER AT FOUR FITTINGS. AT EACH FITTING HIGH STRENGTH BOLTS WITH A PRESSED FIT AND RECESSED HEAD NUTS SECURED EACH MAJOR ASSEMBLY. INNER WINGS ATTACHED TO THE MAIN FUSELAGE FRAME.

THE FUSELAGE WAS MADE IN TWO HALVES FOR FAST PRODUCTION AND RIVETED TOGETHER AFTER ALL FUNCTIONAL COMPONENTS WERE INSTALLED.

NOTE: ALL FLIGHT CONTROLS ARE CABLE OPERATED USING THE CONVENTIONAL "DEP" TYPE CONFIGURATION.
TRIM TABS WERE ALSO CABLE OPERATED.
PROPELLER PITCH, ENGINE THROTTLE EMERGENCY FLARES, AND FUEL CONTROLS WERE CABLE OPERATED.

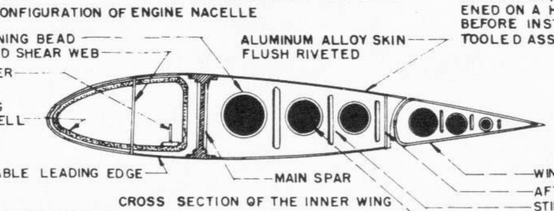
ENGINE NACELLE AND INNER WING WERE JOINED IN ONE BASIC ASSEMBLY.



STRUCTURAL CONFIGURATION OF ENGINE NACELLE

MAIN WING SPAR

THE MAIN WING SPAR WAS MADE FROM A SPECIAL ALUMINUM ALLOY HIGH STRENGTH BILLET. THIS BILLET WAS MACHINED TO THE REQUIRED CROSS SECTION ON A SPAR CAP MILLING MACHINE. AFTER THE SPAR WAS MILLED, IT WAS STRAIGHTENED ON A HYDRAULIC PRESS BEFORE INSTALLING IT IN A TOOLED ASSEMBLY JIG.



CROSS SECTION OF THE INNER WING

SELF-ALIGNING BALL BEARING INSET HINGE
ALUMINUM ALLOY STRUCTURE (RIVETED JOINTS).
FABRIC COVERING
STATIC AND DYNAMIC BALANCED TAIL SURFACES
ALUMINUM ALLOY TRIM TAB
PLEXIGLAS TAIL LIGHT COVER

(DIMENSIONS ARE ALL SHOWN IN INCHES, DRWG SCALE) 0 1 2

MANUFACTURED BY DOUGLAS AIRCRAFT COMPANY, INC.

HAVOC

A-20 SERIES ATTACK BOMBER BUILT FOR W.W.II.

DRAWN BY WILLIS L. NYE FOR MODEL AIRPLANE NEWS 6-7-59.

SHEET NO. 4.

DOUGLAS BOSTON/HAVOC/A-20

DOUGLAS A-26 INVADER

Close-up of a black-painted A-26C shows the molded Plexiglas bomber nose and the bulged pilots' canopy adopted after early A-26 combat experience.

THE Douglas A-26 Invader was a logical successor to the A-20 Havoc that took advantage of combat experience, updated technology and improved mass-production methods. The design was proposed to the Army in January 1941, and a contract for three prototypes was received soon after. The first, designated XA-26, was a three-seat bomber similar to the A-20A; the second, XA-26A, was a two-seat night fighter. The XA-26B used the same airframe, but mounted a 75mm cannon in the right side of the nose.

The principal differences from the A-20 were a wider fuselage with side-by-side seating for the pilot and co-pilot/bombardier, two remotely-sighted turrets, each with two .50-caliber guns, and 2,000hp Pratt & Whitney R-2800 Double Wasp engines.

SPECIFICATIONS AND PERFORMANCE A-26B

Wingspan	*70 ft., 0 in.*
Length	*50 ft., 0 in.*
Wing Area	*540 sq. ft.*
Empty Weight	*22,370 lbs.*
Gross Weight	*27,600 lbs.*
High Speed	*355mph at 15,000 ft.*
Normal Range	*1,400 miles*

The night-fighter concept was dropped, and production concentrated on two basic versions. The three-seat A-26B attack plane had a solid nose and a variety of fixed, forward-firing, .50-caliber guns. Six to eight were in the nose, and, in some cases, an additional four were carried in paired pods on each side of the nose. Some late versions even had three guns in each outer wing panel, plus wing racks for bombs or 5-inch rockets. With external bombs, the total bomb load was 6,000 pounds. As a result of early A-26 combat experience, the pilots' canopy was bulged slightly upward, which increased head room and greatly improved all-around visibility.

The A-26C was the light bomber variant, still with the turrets but normally carrying only two .50-caliber guns in a lengthened Plexiglas bomber nose. Late A-26Cs also carried six wing guns.

The XA-26 first flew on July 10, 1942, and production models were in combat in the Pacific by the spring of 1944, but were not notably successful until improvements were made. Operations in Europe, starting in September, were more successful.

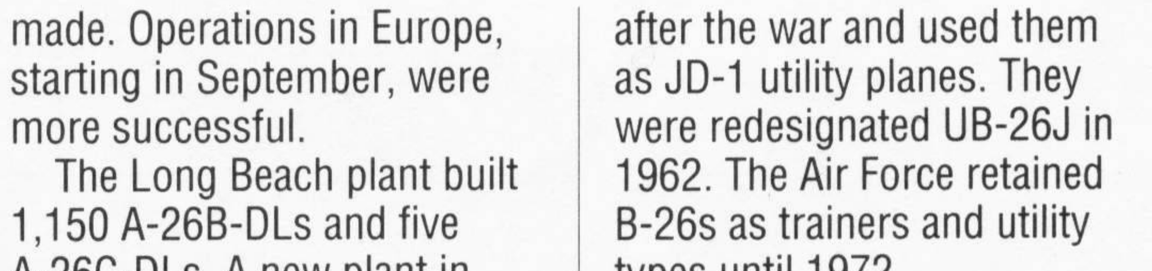
The Long Beach plant built 1,150 A-26B-DLs and five A-26C-DLs. A new plant in Tulsa, OK, built 205 A-26B-DTs and 1,086 A-26C-DTs.

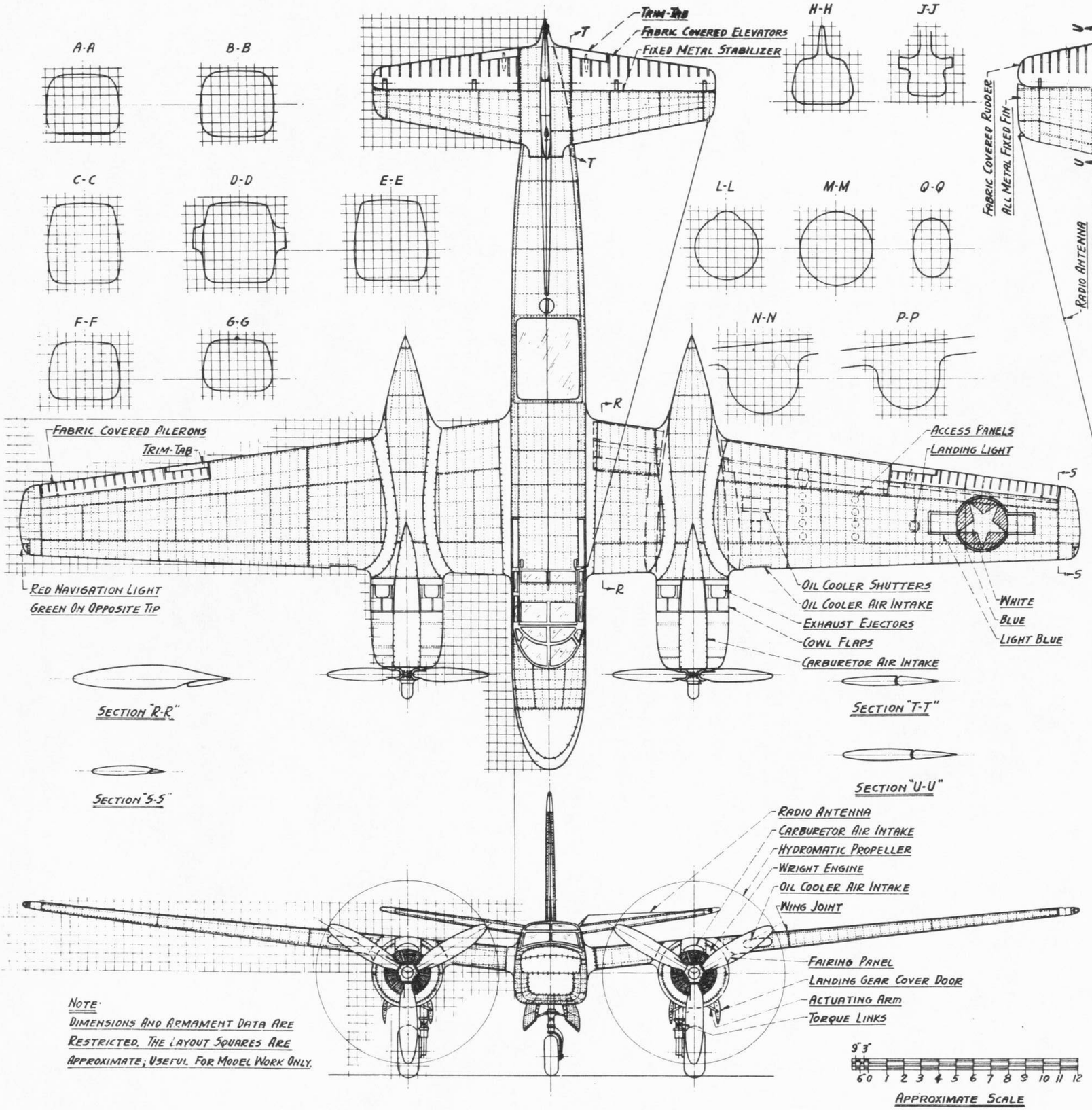
The A-26s were redesignated B-26 in 1948 and saw extensive service in the Korean War, and some service in the Vietnam war until 1969. The R.A.F. had ordered 140 A-26Bs but received only two before V-J day. The U.S. Navy received 152 surplus A-26Cs after the war and used them as JD-1 utility planes. They were redesignated UB-26J in 1962. The Air Force retained B-26s as trainers and utility types until 1972.

☆ ☆ ☆

The XA-26B below shows the large propeller spinners used only on the prototypes and the 75mm cannon that was fitted to some production A-26Bs.

Bottom:A Douglas A-26B-30-DL with four .50-caliber machine guns in the right side of the nose and two in the left. The standard turrets for all A-26s are not shown on the drawing.





NOTE:
DIMENSIONS AND ARMAMENT DATA ARE RESTRICTED. THE LAYOUT SQUARES ARE APPROXIMATE; USEFUL FOR MODEL WORK ONLY.

AIR AGE INC., 551 FIFTH AVE., NEW YORK 17, N.Y.	
SCALE: See Left	General Arrangement
DATE:	Douglas "Invader"
DRAWN BY ... W. A. WYLAM	A-26

W W II SCALE AIRCRAFT DRAWINGS

DOUGLAS A-26 INVADER

DOUGLAS C-54 SKYMASTER

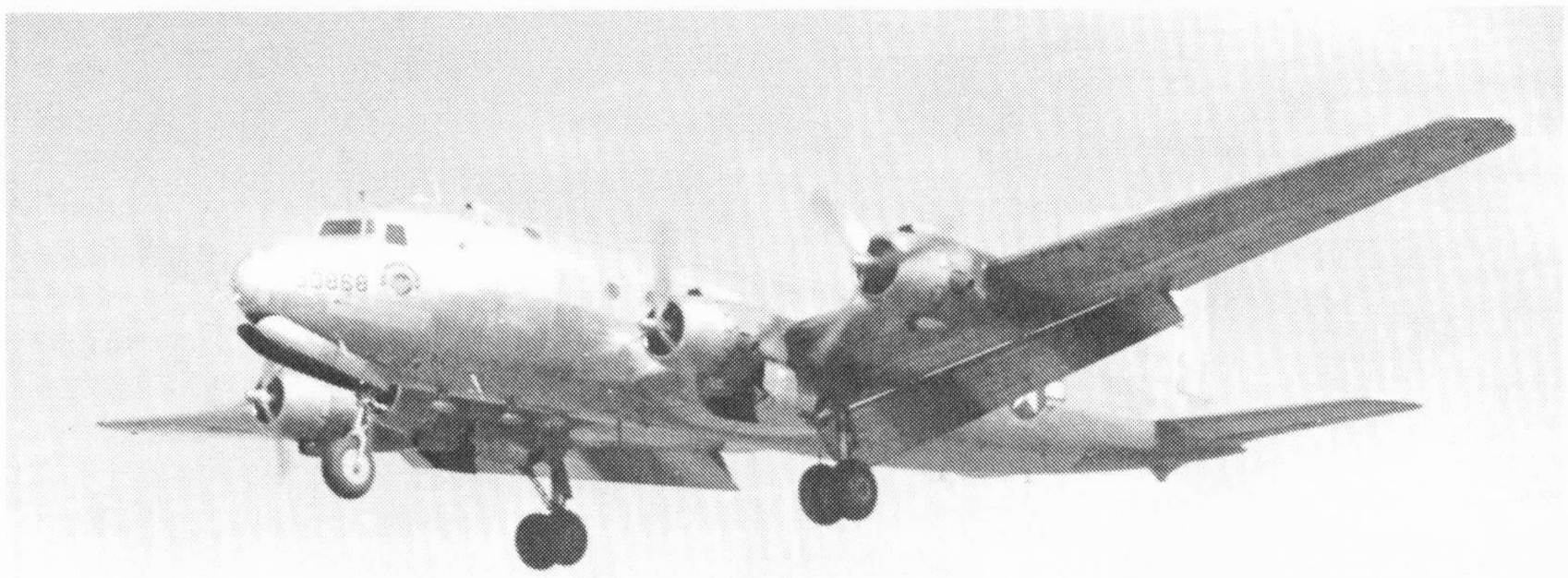
The third Douglas DC-4 was built as an airliner but was delivered to the U.S. Army in war paint as a C-54.

THE Douglas DC-4 Skymaster, which was produced for the U.S. Army as the C-54, was the most widely used four-engine transport and cargo plane of World War II, with 953 planes built in seven Army versions. Surprisingly, though, the plane didn't originate as a military airplane.

Early in 1936, five U.S. airlines put up $100,000 each to help Douglas develop a new, long-range airliner, the DC-4, that would meet their anticipated requirements. Two airlines soon backed out, but the DC-4 was completed and flown in June 1938. Its powerplants were new 1,450hp Pratt & Whitney R-2180-S1A1-Gs; its wingspan was 138 feet, 3 inches; and its gross weight was 65,000 pounds. It proved to be too difficult to maintain, however, and with a passenger capacity of only 52, it wasn't cost-effective. After the DC-4 was tested on the three airlines' routes, the airlines and Douglas decided to develop a smaller, more efficient model, still called DC-4. The original was then redesignated DC-4E (" E " for Experimental) and was sold to Japan.

In mid-1939, Douglas began work on a new design to meet the airlines' revised requirements. This airplane had a wingspan of only 117 feet and a wing area of 1,460 square feet (compared to the 2,155-square-foot wingspan of the DC-4Es). Gross weight was 62,000 pounds, and passenger seating was 40, with a four-man cockpit crew. The engines were 1,350hp Pratt & Whitney R-2000-2SD1-Gs, and the production DC-4 and its military successors were the only airplanes to use them. About the only significant detail retained from the DC-4E was the tricycle landing gear, which was an innovation that proved to be well-suited to large airplanes. Top speed was 265mph; cruising speed was 192mph at 10,000 feet.

Douglas started a production line at Santa Monica for 61 DC-4s that were ordered by the airlines, but military demands precluded their delivery. Even before the first DC-4 flew in February 1942, the entire production was requisitioned by the U.S. Army. The first 24, which were well along in construction as airliners, were designated C-54. Later airframes, which could be modified to meet military requirements, were designated C-54A.



This U.S. Navy R5D-2 was originally a C-54B built for the Army. Note the large, single-wing, trailing-edge flaps and the application of a U.S. Navy serial number and Naval Air Transport Service insignia to the nose.

This view of a C-54D shows the large, two-section cargo doors fitted to all C-54s from the C-54A on. Note the Army Air Transport Command insignia on the rear fuselage.

The demand for C-54s was so great that Douglas established a new plant in Chicago for additional production. The C-54s built in Santa Monica were designated C-54-DO; those built in Chicago were designated C-54-DC. The U.S. Navy also used C-54s under the designation of R5D, but they weren't ordered directly from Douglas. All the Navy models were transferred from the Army, as were 23 Skymasters for Britain.

Only the first few C-54s, and none of the R5Ds,were camouflaged, as they weren't expected to fly into combat zones. Army C-54s were procured in the following versions:

C-54—The initial 24 started as airliners and were delivered to the Army with minimal modification. Four fuel tanks were installed in the cabin for extra range, and an extra compartment was built ahead of a shorter cabin for additional military crew. Passenger capacity was reduced to 14. The civil engines were redesignated R-2000-3.

C-54A—The remainder of the original airline orders and later Army production totaled 252: 97 C-54A-DOs and 155 C-54-DCs. Major changes were a large 67x94-inch, two-section cargo door on the left side of the fuselage and a reinforced floor to accommodate heavy cargo. Gross weight increased to 73,000 pounds with the addition of R-2000-7 engines.

C-54B—These were improved C-54As with additional wing fuel tanks replacing two of the cabin tanks. There were 100 C-54B-DOs and 120 C-54B-DCs produced.

C-54C—One C-54A-DO was modified for President Franklin D. Roosevelt, and included a cargo elevator (for bringing him aboard in his wheelchair), luxurious cabin furnishings and amenities suited to a VIP. The airplane was given such special attention that it was irreverently nicknamed "The Sacred Cow."

C-54D—Built only in Chicago, the 380 C-54D-DCs were improved C-54Bs with R-2000-11 engines.

C-54E—The 125 C-54E DOs were built in Santa Monica and were similar to C-54Bs except for their increased fuel capacity. The cabin was rearranged to permit a quick change from all-cargo to 50 troops in canvas seats.

XC-54F—One C-54B-DC had jump doors on each side of the fuselage for testing as a paratroop deployment aircraft. No production was undertaken on this model.

C-54G—The final production model was the C-54G, with 162 built at Santa Monica as personnel transports. A further 235 were cancelled at the war's end, but Douglas completed them, and built others, as civil transports.

Below: this photo of the original DC-4E shows the many differences between it and the production-model DC-4. The plane's main contribution to later models was the tricycle landing gear.

U.S. Navy Skymasters—The C-54s transferred to the U.S. Navy were designated as follows: R5D-1: 56 C-54A, R5D-2: 30 C-54B, R5D-3: 86 C-54D, R5D-4: 20 C-54E and R5D-5: 13 C-54G.

Postwar Use—Civil DC-4s and converted C-54s went into airline service soon after the war. Although they outnumbered the newer Lockheed Constellation, they were at a competitive disadvantage because they weren't pressurized. The most notable postwar uses of the C-54 RHD were the Berlin Airlift of 1948-49, with 336 Skymasters involved, and a major airlift operation during the Korean War.

Postwar modifications and redesignations of C-54s and R5Ds resulted in designations as high as C-54S. The last Air Force and Navy C-54s weren't retired until the early 1970s.

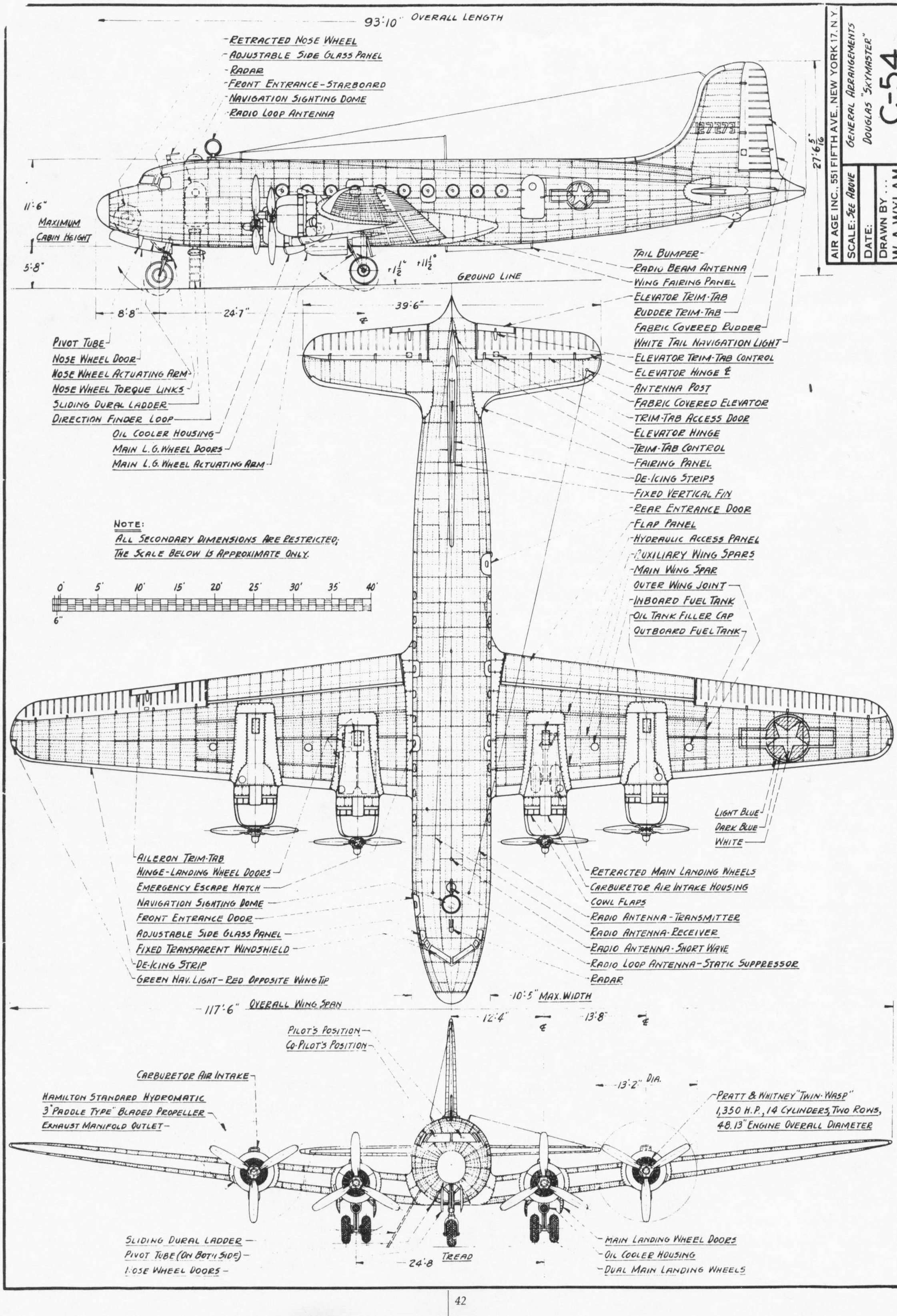
AIR AGE INC., 551 FIFTH AVE., NEW YORK 17, N.Y.

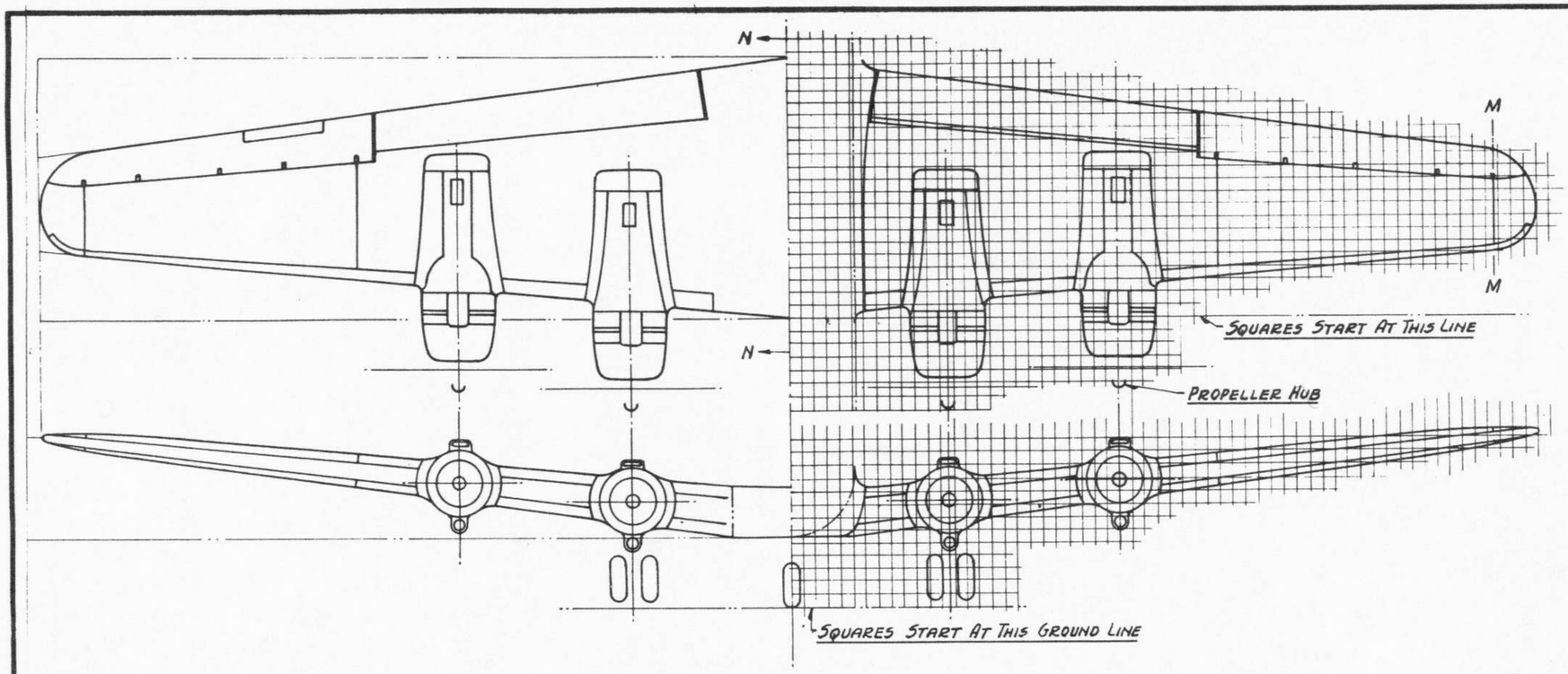
SCALE: See Above

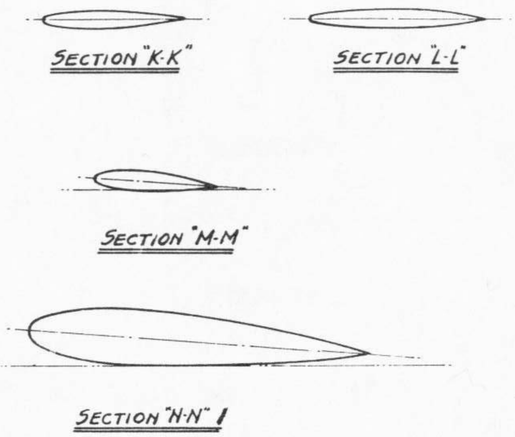
DATE:

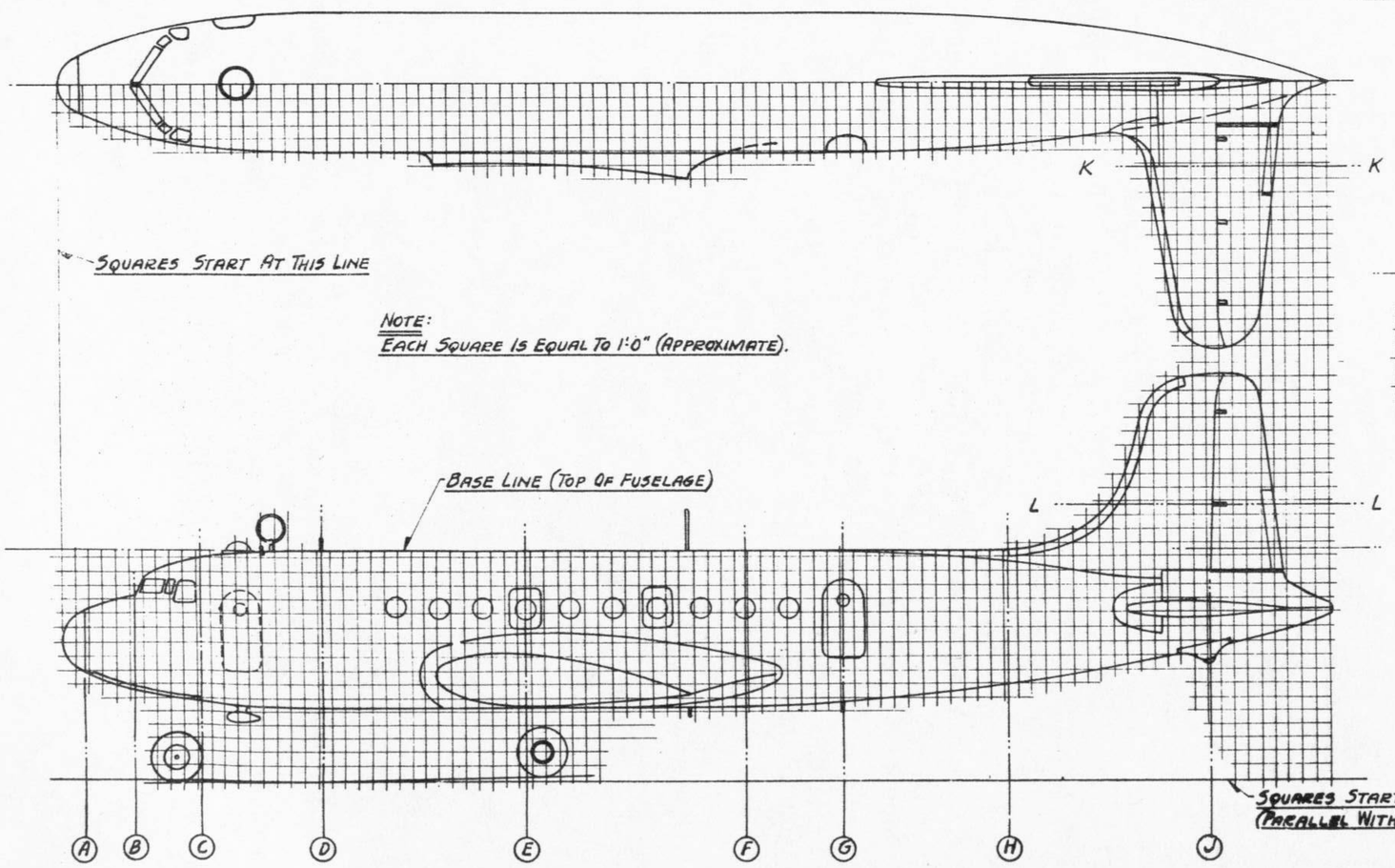
DRAWN BY ... W.A.WYLAM

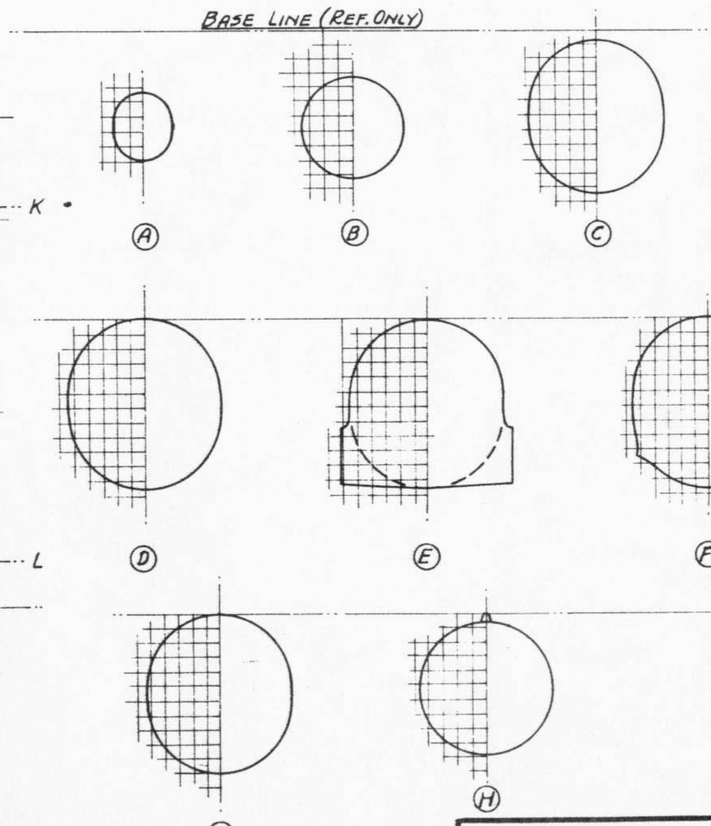
General Arrangements
Douglas "Skymaster"
C-54











AIR AGE INC., 551 FIFTH AVE., NEW YORK 17, N.Y.	
SCALE: See Note	Layout Plans & Sections Douglas "Skymaster"
DATE:	C-54
DRAWN BY ... W. A. WYLAM	

DOUGLAS C-54 SKYMASTER

FAIRCHILD PT-19, PT-23, PT-26

A silver Fairchild-built PT-23 with 220hp Continental Radial engine and 1942-43 star markings.

THE Fairchild M-62, which was the U.S. Army PT-19, was one of several successful entrants in a 1939 competition for new Army primary trainers and, with another winner, the Ryan ST-A (PT-16), it introduced monoplane primary trainers to the Army.

The PT-19 had a welded steel-tube fuselage with plywood-covered wooden wing and fixed tail surfaces, and fabric covering for fuselage and control surfaces. Its initial powerplant was the 175hp inverted, six-cylinder, air-cooled Ranger L-440-1 engine. Because of the low-wing configuration, a stout steel turnover pylon was built between the two open cockpits.

The initial 1939 order for 270 PT-19s was soon supplemented by orders for 3,702 PT-19As with 200hp L-440-3 engines and 917 PT-19Bs equipped for instrument training. The demand for PT-19As was more than Fairchild could handle, so the work was split up. Fairchild built 3,181 PT-19A-FAs, Aeronca (-AE) built 477 and St. Louis (-SL) built 44. Aeronca also built 143 PT-19Bs; Fairchild built 774.

As a hedge against a shortage of Ranger engines, the 220hp Continental R-670-4 radial engine was substituted in two PT-23s that were built by Fairchild, 375 by Aeronca, 199 by Howard (-HO), 200 by St. Louis and 93 by Fleet Aircraft in Canada (-FE).

Under the Lend-Lease Program of March 1941, the U.S. Army provided British Empire forces with a winterized version of the PT-19A, which was designated PT-26. Fairchild built 670 as Cornell I; Fleet built 807 as Cornell II. Fleet built a further 250 PT-26Bs as Cornell III. Most of these carried R.A.F. or R.C.A.F. markings and serial numbers and were painted yellow, and because they were being paid for with U.S. Army funds, they also carried the appropriate U.S. Army designation and serial numbers. The U.S. Army received 517 Canadian-built PT-26As with U.S. markings.

The drawing shows an R.C.A.F. Cornell II built by Fleet. Although it was delivered in 1943, it carried the wide, late-1940-style fin flash and the Type-A roundels that were discontinued in June 1942. Canada was noted for using older markings on new-production aircraft until the end of the war.

The plane illustrated here carried three military serial numbers—U.S. Army 42-65690; FV215, originally assigned by the R.A.F.; and 15116, adopted after it was transferred to the R.C.A.F. Most PT-26s were yellow, but some were finished in silver. U.S. Army PT-19s were prewar blue and yellow through the spring of 1942; after that, they were silver.

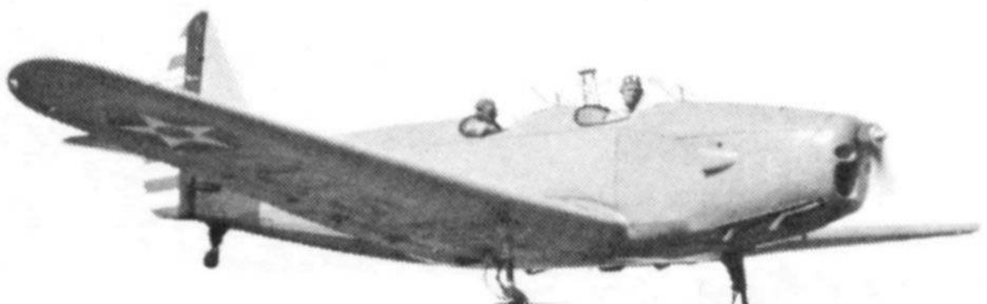
The low cost and simplicity of the various Fairchild PTs made them popular on the surplus market after the war, and many are still used by private owners.

SPECIFICATIONS AND PERFORMANCE PT-26A

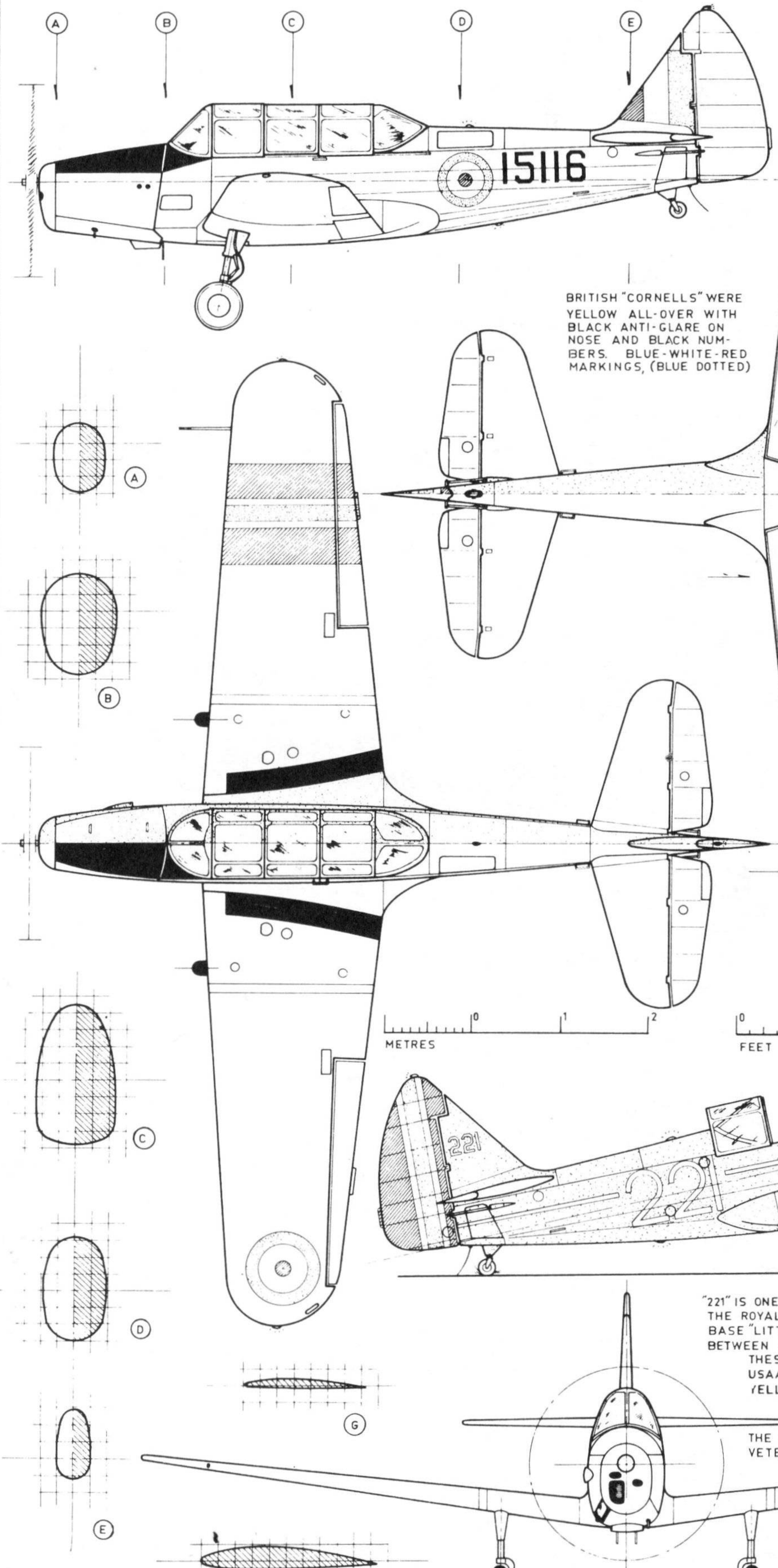
Wingspan	*35 ft., 11 in.*
Length	*27 ft., 8 in.*
Wing Area	*200 sq. ft.*
Empty Weight	*2,020 lbs.*
Gross Weight	*2,630 lbs.*
High Speed	*128mph*

Above: The first Fairchild-built PT-26 was a winterized PT-19A with enclosed cockpits. This airplane carried Royal Air Force serial number FH651 and U.S. Army serial number 42-12499. The R.A.F. designation was Cornell I. Roundels and fin flash are correct for the 1940 to mid-1941 period.

Below: A blue and yellow U.S. Army Fairchild PT-19 over Randolph Field, TX, in 1941.



FAIRCHILD PT-19, PT-23, PT-26

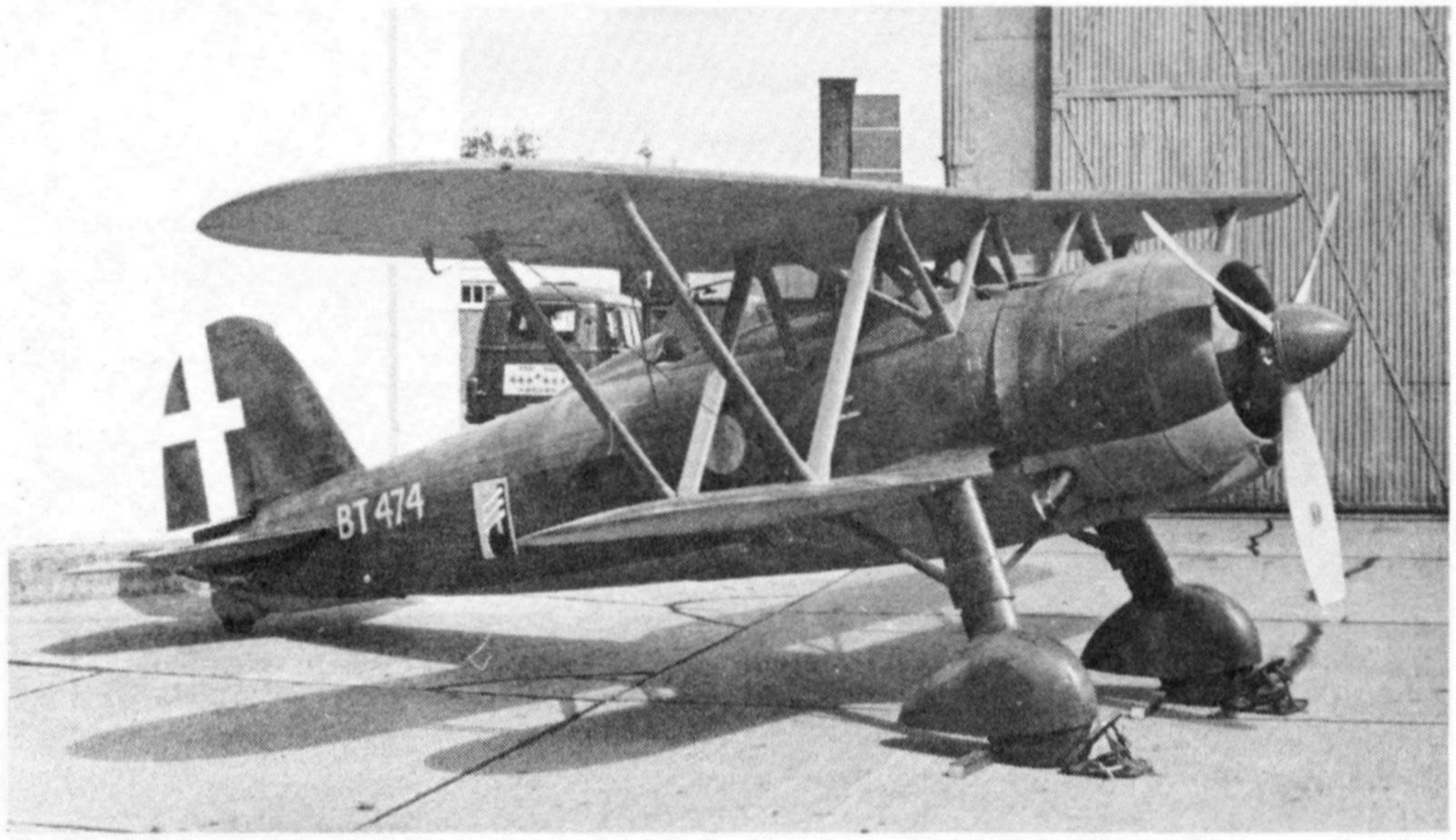


FIAT CR 42 FALCON

THE Italian Fiat CR 42 Falco (Falcon) has the distinction of being the last biplane fighter to be produced and put into first-line service by a major warring power. The prototype of this thoroughly anachronistic, open-cockpit, fabric-covered biplane with fixed landing gear flew early in 1939. Production continued into 1942, and 1,781 were built.

The initials "CR" in the designation identify Celestino Rosatelli, a famous designer of long standing. His CR 42 evolved from a long line of CR fighters, starting with the CR 20 of 1923. All shared the unique feature of the Warren-Truss arrangement of the wing struts. All models through the CR 33 featured liquid-cooled engines, while subsequent models used air-cooled radial engines.

Its powerplant was the 840hp Fiat A.74 R.C.38 twin-row radial engine, and the initial armament was one 7.7mm and one 12.7mm machine gun in the nose. The later CR 42*ter* (third version) had four 12.7mm guns, two of which were in blisters in the lower wing. The CR 42 A.S. ("A.S." for "Africa Settentrionale," or North Africa) was a ground-attack version with two 220-pound bombs, and the CR 42 C.N. ("CN" for "Caccia Notturna," or Night Fighter) was used as a defensive night fighter in Northern Italy. There was also a twin-float seaplane version, the ICR 42 ("I" for "Idrovolante," or Seaplane).



The CR 42 that was captured during the Battle of Britain is shown here, with its original 1940 Italian camouflage and markings restored. The number BT474 on the fuselage isn't Italian; it's the R.A.F. serial number assigned to the plane when it was test-flown in England.

One CR 42 was fitted with a 1,020hp German Daimler-Benz DB-601 liquid-cooled engine, (used in the Me.109 as CR 42B), and turned in the almost unbelievable speed (for a biplane) of 323mph.

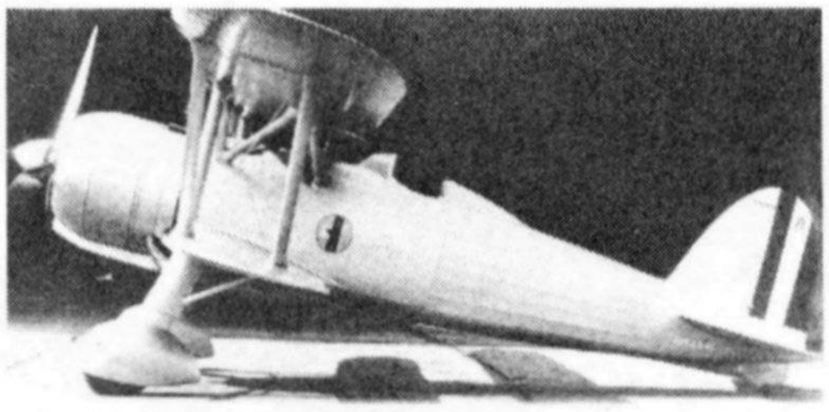
Italy entered the war on June 10, 1940, with 300 CR 42s. These planes fought everywhere the Italian Air Force was engaged, and were involved in some of the last significant biplane vs. biplane battles when CR 42s fought British Gloster Gladiators over Greece, North Africa and Malta.

Some CR 42s took part in Italy's token raids on England during the Battle of Britain in the fall of 1940. One was forced down intact and can be seen today in the Battle of Britain Museum near London. At least 113 CR 42s were still in service when Italy surrendered to the Allies on September 8, 1943. Italy joined the Allies and declared war on Germany on October 13, but the CR 42s were all in the hands of the part of Italy that remained loyal to Hitler. Four "escaped," however, to join the anti-Fascist Co-Belligerent Air Force.

The performance and price of the CR 42 made it popular on the export market. Sweden bought 72 CR 42*bis* (second version) models, each with two 12.7mm guns, and kept them in first-line service until 1945. Belgium bought 34 in September 1939, but most of these were destroyed on the ground by the Luftwaffe in the 1940 Blitz. Hungary also bought export models.

SPECIFICATIONS AND PERFORMANCE CR-42

Wingspan	*31 ft., 9 3/4 in.*
Length	*27 ft., 2 3/4 in.*
Wing Area	*240.5 sq. ft.*
Gross Weight	*5,042 lbs.*
High Speed	*244mph at 6,560 ft.*



Prewar Italian rudder markings were red, white and green stripes, with the crest of the ruling House of Savoy at the top of the white stripe.

0' 5' 10' 15'
SCALE IN FEET

CONSTRUCTION:
THE WHOLE SUPERSTRUCTURE IN METAL.
COVERING: SHEET ALUMINIUM AND FABRIC

NATIONAL INSIGNIA:
A GREY DISC OUTLINED IN BLACK ON WHICH THREE BLACK "FASCES" WERE PAINTED. MARKING ON FUSELAGE SIMILAR BUT THE AXE PAINTED SILVER. TIES OVER FAGGOT BUNDLE IN GOLD.

STEP PRESSINGS

X-WIRES BETWEEN OUTER STRUTS ONLY. - SEE SIDE VIEW.

TYPICAL AIRFOILS:
UPPER WING
LOWER WING

AIR INTAKE TO OIL COOLER IN EACH WING ROOT.

CARBURATOR AIR INTAKE

COLORSCHEME:
UPPER SURFACES: CAMOUFLAGED WITH IRREGULAR PATCHES OF BROWN AND TERRACOTTA AGAINST A LIGHT GREEN BACKGROUND.
UNDER SURFACES: SANDY BROWN OR DULL SILVER.

WHITE CROSS

ARMS OF THE HOUSE OF SAVOY. (A RED SHIELD WITH A WHITE CROSS SURMOUNTED BY A CROWN, ALL EDGED IN GOLD.)

ARMAMENT:
TWO 12,7-MM MG:s

SPINNER, PAINTED AS FUSELAGE

METAL COVERED TURTLEDECK

FABRIC COVERING

BLACK AXE ON RED BACKGROUND. YELLOW ARROWS.

360° SWIVELLING TAIL WHEEL

WHITE LETTERING

COLOR LINE

EXHAUST

SHOCK TRAVEL

LIGHT GREY EDGED IN BLACK

POWERPLANT:
ONE 14-CYL. TWIN-ROW 840-HP FIAT A 74.R.C.38 GEARED AND SUPERCHARGED ENGINE.

ENGINE GLYCOL COOLER

SHUTTER

FIAT C.R. 42 B
1941 APPEARED A VERSION WITH THE 1010-HP DAIMLER-BENZ D.B.-601-ENGINE. TOP SPEED: 323 MPH!

COMPRESSOR AIR INTAKE

1939 FIAT C.R. 42 bis "FALCO"
SCALE: 3/16"-1'0" DRAWN BY: BJÖRN KARLSTRÖM

60-15-10-7

FIAT CR 42 FALCON

FOCKE-WULF 190A

A "factory-fresh" FW-190A-1. Note the distinctive rear-sliding canopy and the wide-track landing gear. The unit markings on the fuselage are black.

THE design of the Focke-Wulf 190 began in 1937 as a back-up to the Messerschmitt 109 that had been selected as the standard German fighter. The design concept was entirely different, featuring an air-cooled BMW radial engine and a wide-track, inward-retracting landing gear. The first flight of the FW-190V-1 prototype was on June 1, 1939, but production models weren't in combat until September 1941.

As a fighter, the FW-190A outperformed the older British Spitfire Vs that were surpassing the contemporary Me-109s. The Spitfire didn't catch up to the FW-190A until the appearance of the Spitfire IX in July 1942. Although it was designed as a fighter, the FW-190 was readily adaptable to many other missions. The FW-190A reached the -10 variant, with many sub-variants carrying special equipment for specialized missions. These included aerial cameras for reconnaissance, batteries of up to six 30mm cannon for use against tanks and naval torpedoes for attacks against ships. There were even two-seat trainer versions.

Twin-engine German bombers had difficulty reaching targets in England in 1942 and 1943, so some FW-190A-5s were fitted with bomb racks and auxiliary fuel tanks. Normal bomb load was one 500kg (1,100-pound) bomb under the fuselage and two 250kg (550-pound) bombs under the wings, but some could carry a single 1,000kg (2,200-pound) bomb. This was so close to the ground that the lower fin of the bomb had to be clipped for the plane to take off. These long-range fighter-bombers were very successful in penetrating British defenses and completing effective raids.

The armament differed greatly in fighter versions, from the initial four 7.9mm machine guns (two in the nose and two in the wings), to a standard of two nose guns and a variety of up to four wing guns or four 20mm wing cannon. For attacks on Allied bomber formations, some FW-190A-5/R6s were fitted with underwing pods for 210mm rockets.

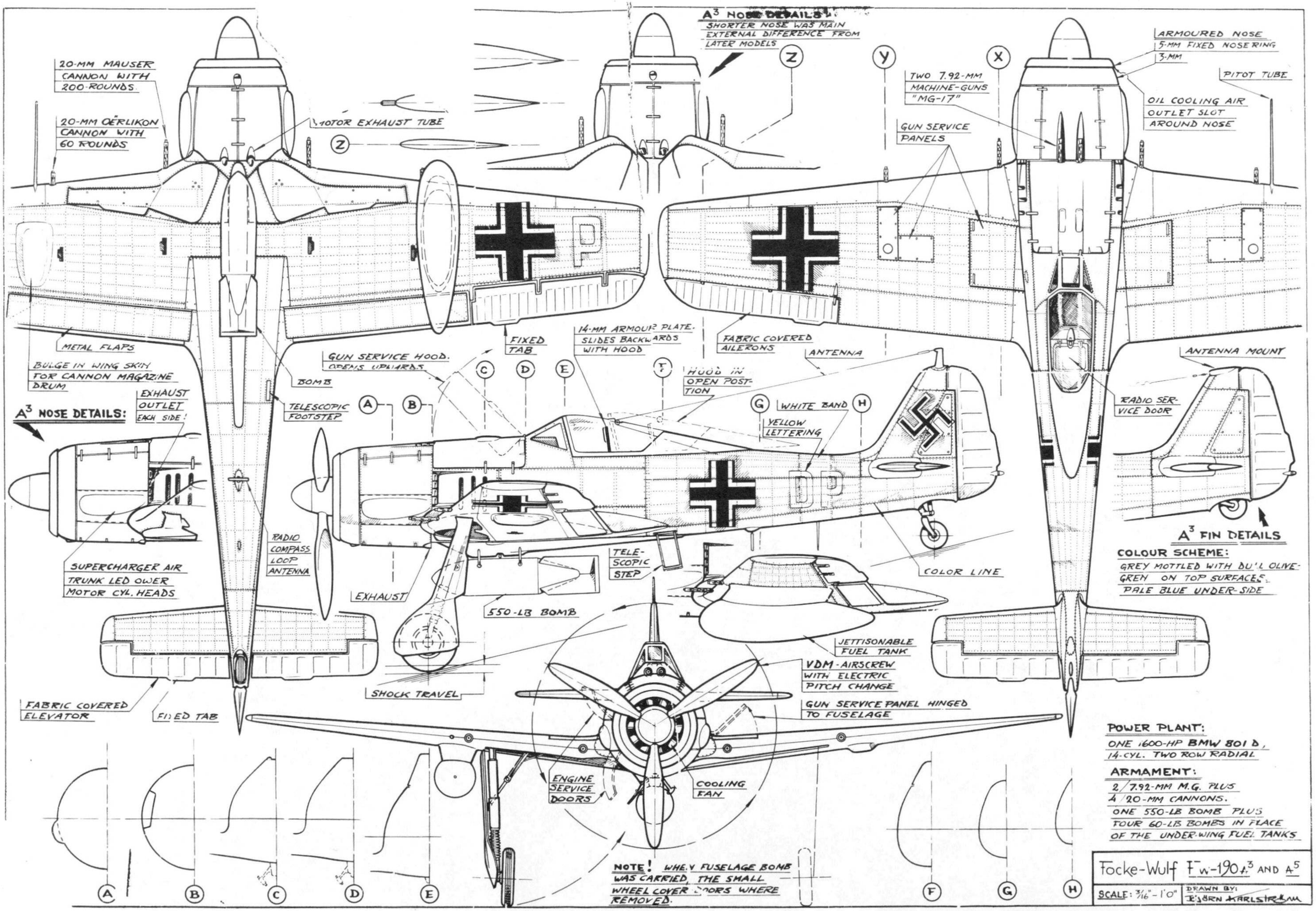
Improved versions of the FW-190 were tested with features such as cabin pressurization and a water-methanol injection that increased the normal 1,600hp of the engine to 2,100hp for brief periods. Other engines were tried: the Me-109's 1,750hp Daimler-Benz DB-603, used in the experimental FW-190C, and the 1,776hp Junkers Jumo 213A, used in the production FW-190D. Later FW-190D variants were so extensively altered from the short-nose, radial-engined FW-190A series that they were redesignated "Ta-152" (for designer Kurt Tank).

Altogether, some 20,000 FW-190s were built in six Focke-Wulf plants, two Arado plants, one Ago plant and one Fieseler plant.

This elevated view of an FW-190A-0 corrects the erroneous crosses on the drawing. Note the narrow borders and the locations of the upper wing crosses. The crosses on the underside of the wing are in the same position, but they're the wide-border type used on the fuselage.

SPECIFICATIONS AND PERFORMANCE FW-190A-8

Wingspan ..... 34 ft., 5½ in.
Length ..... 20 ft.
Wing Area ..... 196.9 sq. ft.
Empty Weight ..... 7,000 lbs.
Gross Weight ..... 9,750 lbs.
Overload Weight . 10,805 lbs.
High Speed ..... 408mph at 19,680 ft.; 355mph at sea level.
Normal Range ..... 500 miles



FOCKE-WULF 190A

GLOSTER GLADIATOR

This restored Gladiator I has the postwar British civil registration G-AMRK. The prewar R.A.F. serial number was L8032. Note the absence of guns from fuselage troughs and underwing pods.

THE evolution of the Gloster Gladiator, England's last biplane fighter, can be traced back to WW I. It was designed by H.P. Folland, who also designed the famous SE-5 used in that war, and the particular chord-gap-stagger relationships of the Gladiator's wings are strongly reminiscent of the SE-5. The Gladiator represented the final stage in England's development of the classic biplane fighter. It featured such latter-day refinements as single-leg landing gear and enclosed cockpit, and it reflected the trend toward increased armament.

The company-owned prototype, then designated S.S.17, flew in September 1934. Orders for 23 and then 186 were placed in July 1935. The Gladiator I's powerplant was the 840hp Bristol Mercury I, which drove a two-blade, fixed-pitch, wooden propeller. Its armament was four .303-caliber machine guns (two in troughs in the fuselage sides and two in the lower wing). Later, a fixed-pitch, three-blade metal propeller was adopted.

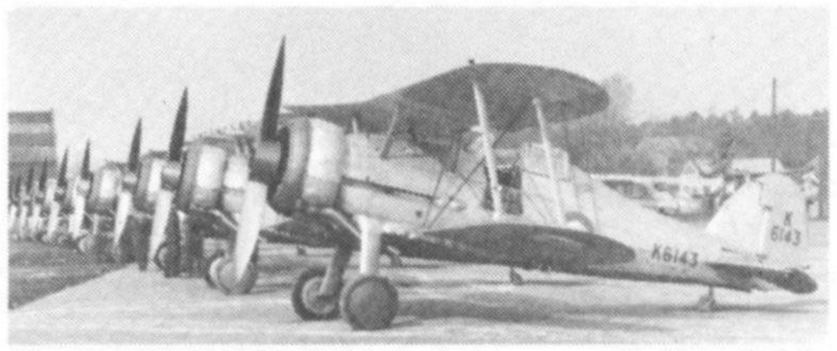
SPECIFICATIONS AND PERFORMANCE GLADIATOR I

Wingspan	*32 ft., 3 in.*
Length	*27 ft., 5 in.*
Wing Area	*323 sq. ft.*
Gross Weight	*4,750 lbs.*
High Speed	*253mph at 14,500 ft.*

By the time war started in September 1939, 13 R.A.F. squadrons were equipped with Gladiators, and several squadrons of "navalized" Sea Gladiators were in service aboard aircraft carriers. Extensive export sales started in 1937 and continued after the war began. Twenty-six went to Latvia, 14 to Lithuania and 36 to China. Sweden ordered 55, but 30 of these were later passed to Finland, where they fought Russian Polikarpov L-153 biplanes in the Russo-Finnish war of 1940. Some of these operated on skis.

Belgium received 22 Gladiators; Norway received 12. Most of these, however, were destroyed on the ground by the Luftwaffe in April and May of 1940. Almost all of the 15 Gladiators sold to Iraq were destroyed by the R.A.F. when they suppressed a revolt there in May 1941.

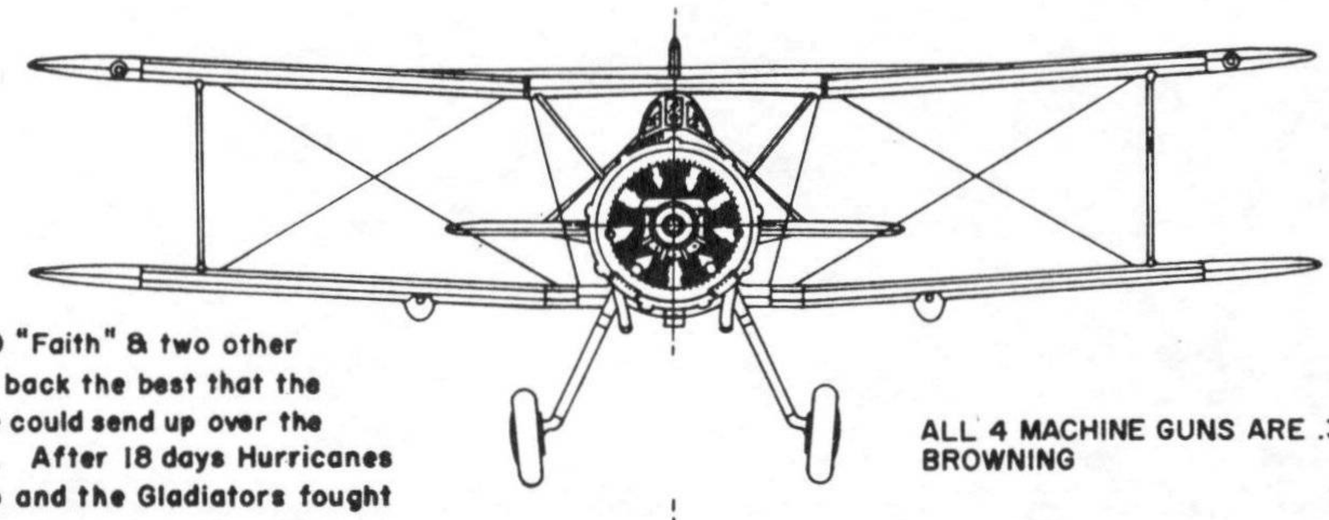
Two R.A.F. Gladiator squadrons were sent to France as soon as the war started. In April 1940, one squadron was flown to Norway to assist in its defense and was soon joined by several squadrons of Sea Gladiators. In the absence of suitable airfields, these fighters operated from the surfaces of frozen lakes. One squadron of Gladiators fought over England during the Battle of Britain.

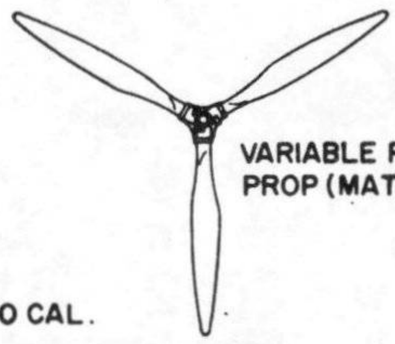


Line-up of nine Gladiator Is in prewar, all-silver finish. Note the large, fixed-pitch wooden propellers, (later replaced with three-blade metal models), and the hinge-down door for cockpit access.

Sea Gladiators saw extensive action in the Mediterranean Theater and engaged Italian Fiat CR 42 biplanes over Greece, North Africa and particularly Malta, where four won great fame during their lone defense of the island in April 1940. The last Gladiators were retired from the R.A.F. late in 1941, but some of the exported and passed-on models continued to fight on.

GLOSTER GLADIATOR

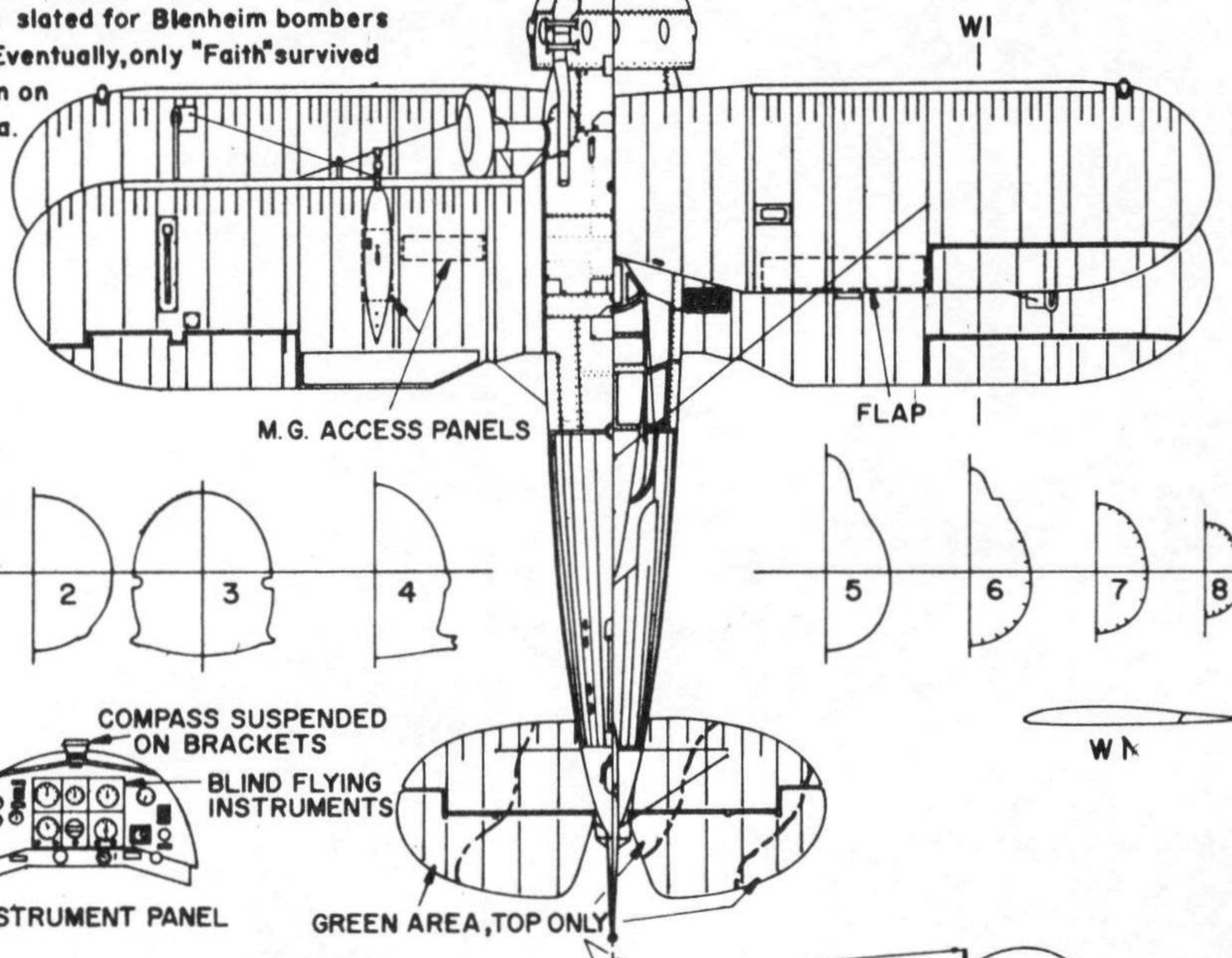




VARIABLE PITCH PROP (MATT BLACK)

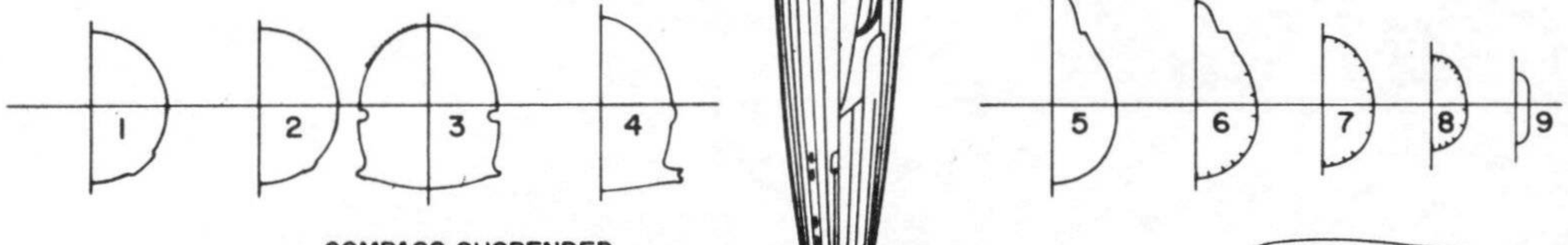
ALL 4 MACHINE GUNS ARE .30 CAL. BROWNING

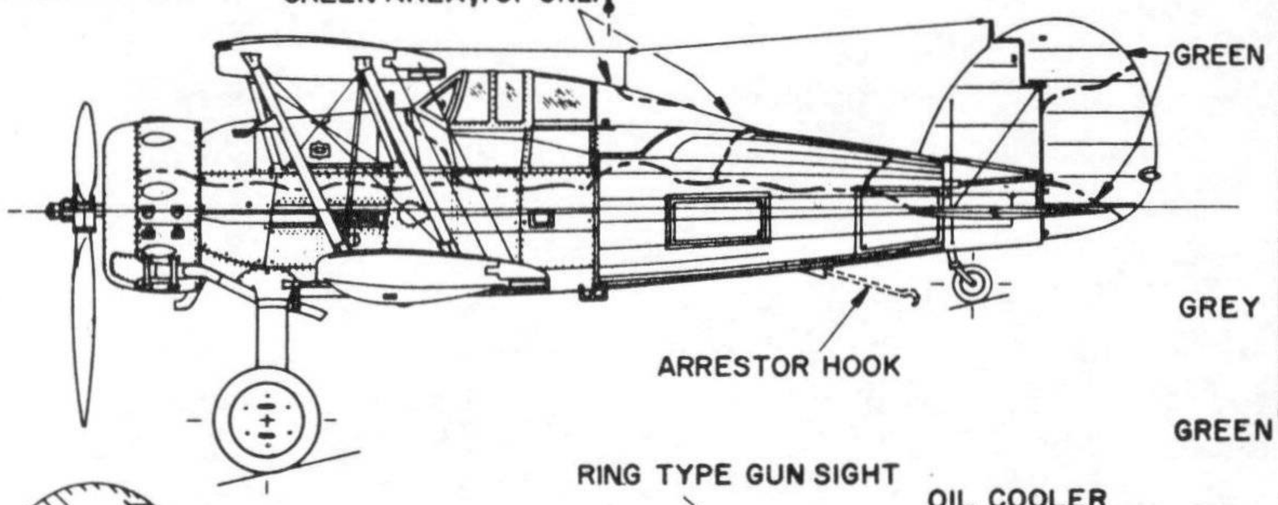
In April of 1940 "Faith" & two other Gladiators held back the best that the Italian Air Force could send up over the island of Malta. After 18 days Hurricanes arrived to help and the Gladiators fought on. The throttle stops were cut out to push the engines beyond their specs; when they wore out, Mercury XV's slated for Blenheim bombers were installed. Eventually, only "Faith" survived & still can be seen on the island of Malta.

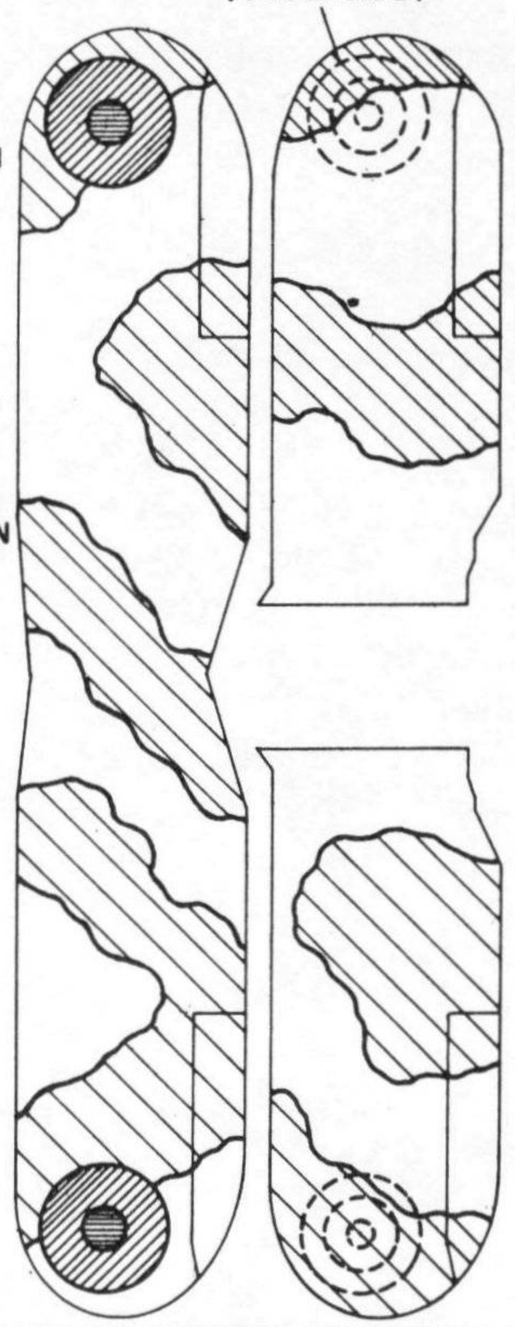


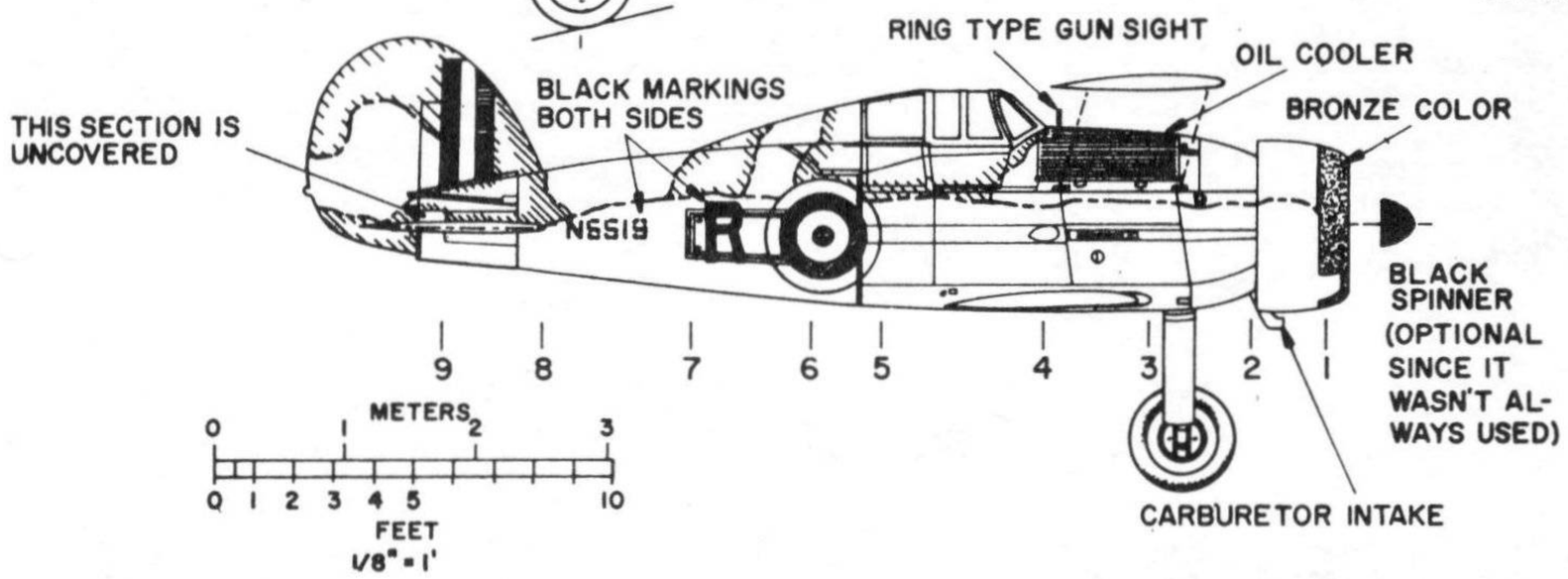
COLOR SCHEME

UPPER SURFACES ARE MEDIUM GREEN AND SLATE GREY. UNDER SURFACES AND ALL STRUTS ARE LIGHT GREY. ALL PAINT HAS A MATT FINISH.









MAX. SPEED 245 M.P.H. AT 15,000 FT.
CRUIS. SPEED 212 M.P.H. AT 15,500 FT.
RANGE 410 MILES
INITIAL CLIMB RATE 2,300 FT. PER MIN.
9.5 MIN. TO 20,000 FT.
CEILING 32,000 FT.
ENGINE 840 H.P.

As a matter of interest, Flight Lieutenant Marmaduke Pattle shot down 13 of his total score of 28 in an identical machine.

Gloster Sea Gladiator "Faith"	
DRAWN BY C. Graham	MODEL II
SCALE 1/8" EQUALS 1'	MERCURY XV ENG.

GRUMMAN F4F WILDCAT

FROM 1934, when Boeing delivered its last F4B-4, until 1939, the Grumman Aircraft Company of Bethpage, Long Island, NY, was the sole supplier of single-seat fighters to the U.S. Navy. In 1936, Grumman designed its Model 16, a biplane fighter that was designated "XF4F-1." Before it was built, however, the Navy ordered a new monoplane fighter, the XF2A-1, from Brewster. Realizing that the era of the biplane fighter was ending, Grumman got Navy authorization to discontinue the XF4F-1 and redesign it as a monoplane, designated "XF4F-2," Grumman Model 18. It flew on September 2, 1937.

The XF4F-2 was powered with a 1,050hp Pratt & Whitney R-1830-66 engine and had two .50-caliber guns mounted in the nose. It lost to the XF2A-1 in the initial Navy fly-off competition, returned to the factory and was extensively rebuilt as the XF3F-3, Grumman Model 36. Grumman won an order for an eventual 285 F4F-3s and 95 F4F-3As named "Wildcat," which started the famous line of Grumman Navy fighters with various "Cat" names that continues today.

A Grumman F4F-3 ready for delivery to Squadron VF-41 aboard the carrier U.S.S. Ranger in December 1940. It was silver, with chrome-yellow wing tops and the green tail that was on all Ranger aircraft. The star insignia on the nose identifies the plane as one that was used in the U.S. Navy's Atlantic Neutrality Patrol in 1940-41.

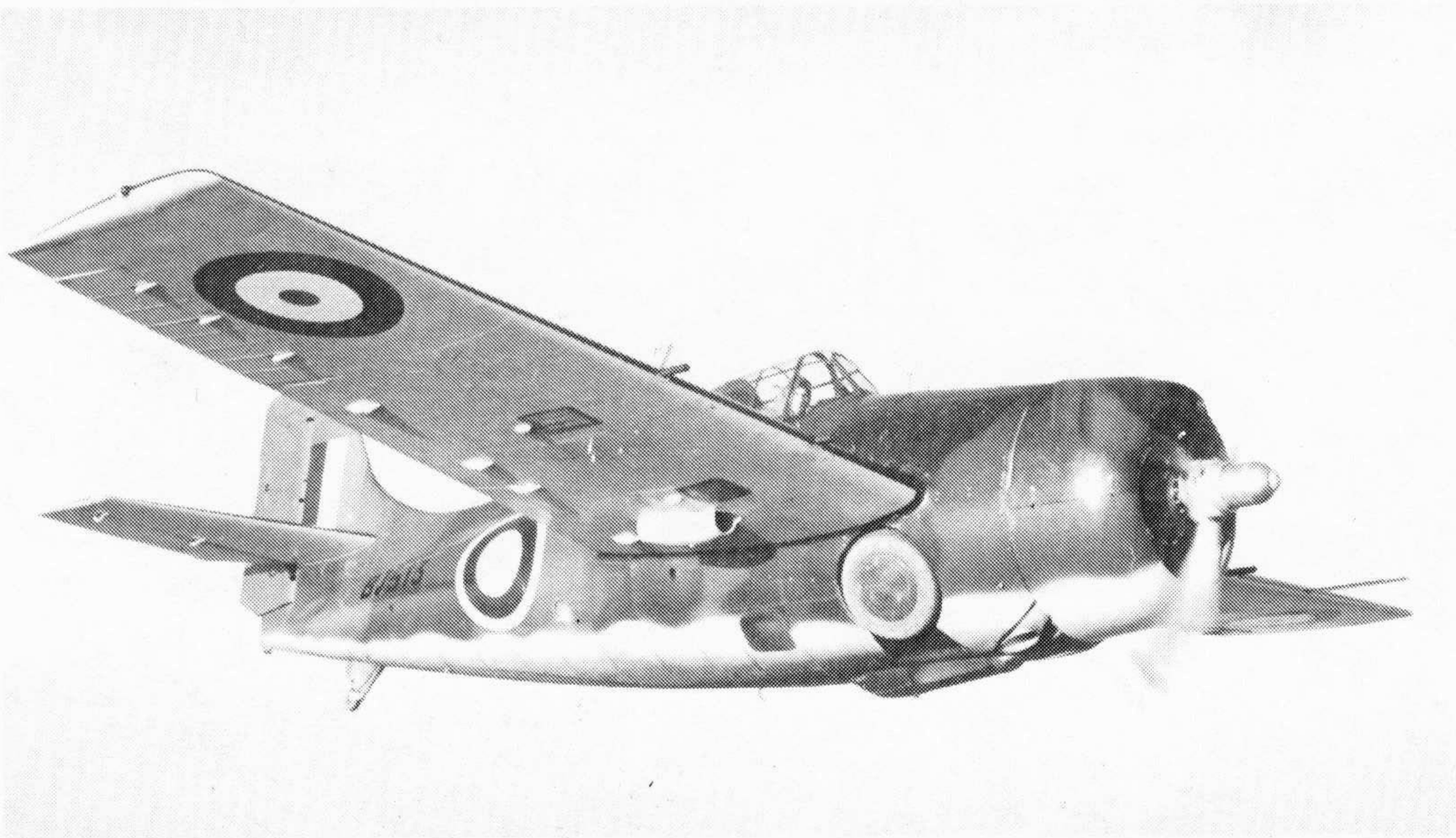
PRODUCTION GRUMMAN WILDCATS—The production F4F-3s differed from the prototype in that they had a 1,200hp R-1830-76 or -86 engine and four .50-caliber guns in the fixed wings instead of two in the nose. One plane was tested as the F4F-3S seaplane on twin floats, but it wasn't produced. The F4F-3As had a 1,200hp R-1830-90 engine with single-stage superchargers instead of the two-stage models of the F4F-3. Deliveries of the F4F-3 began in August 1940 and didn't end until May 1943, five months after the last F4F-4 was delivered.

Grumman's major production model was the F4F-4, which differed from the -3 in that it had manually folded wings and six wing guns. Grumman built 1,168 F4F-4s and 220 F4F-4Bs that went to the R.A.F. as "Wildcat IV." The first F4F-4 flew on November 7, 1941; the last was delivered on December 31, 1942.

Grumman built experimental variants of the Wildcat through XF8F-8, but they didn't build any production versions.

GENERAL MOTORS WILDCATS—When Grumman couldn't keep up with the demand for Wildcats, the Navy asked General Motors to become a second source. Parts were built in three GM plants in New Jersey and were brought together for final assembly at GM's Eastern Aircraft Division in Linden, NJ. The 1,060 FM-1s differed from the F4F-4 mainly in that they had only four wing guns but carried more ammunition. The 4,777 FM-2s were production versions of Grumman's XF4F-8, a lighter version of the Wildcat intended for operations from small escort carriers. This model had only four guns and was powered by the 1,350hp Wright R-1820-56 single-row engine. The most notable feature of the XF4F-8 and the FM-2 was the higher vertical tail. Late FM-2s could

An F4F-3 Wildcat with the oversize star insignia and the rudder stripes that were used early in 1942 for positive identification. The fuselage legend 41-F-8 identifies Airplane No. 8 of the first (of two) fighter squadrons aboard Ranger (CV-4), identified by the figure "4." At that time, carrier-based squadrons used the hull number of their parent carrier.



The British Martlet I was one of the 91 Grumman G-36As built for France that couldn't be delivered. This model had two nose guns and two to four wing guns, and Wright Cyclone engines instead of the Pratt & Whitney Twin Wasp of the equivalent F4F-3.

carry up to six 5-inch rockets under the wings. Production of the FM-2 continued until August 1945.

EXPORTED WILDCATS AND MARTLETS—Late in 1939, the Navy authorized the sale of the Grumman Model G-36A (export equivalents of the F4F-3) to France. These differed from the Navy models in that they used the 1,200hp commercial Wright Cyclone G-205A (R-1820) engine, French instrumentation, and the unique French reverse-throttle system in which the throttle was pulled back (rather than pushed forward) for "open." Its armament was a pair of French Darne 7.5mm guns in the nose and two to four others in the wings. The first of 91 G-36As flew on May 10, 1940, the day Hitler invaded France, so the planes were taken over by Britain. Early in 1941, the Navy released 30 F4F-3As to Greece. These were sent by ship in March, but Greece fell to Hitler while they were at sea, and they were diverted to England.

BRITISH MARTLETS AND WILDCATS—In addition to the aircraft that it ordered from the U.S., Britain acquired many planes that had been ordered by other countries but couldn't be delivered. The 91 Martlet Is, so named before the Navy named the Wildcat, were French G-36As modified to use British equipment. The 100 Martlet IIs were ordered by the R.A.F. as equivalents to the F4F-3A, but with civil Pratt & Whitney S3C-4G Twin Wasp engines. The first 10 had fixed wings and four guns; the rest had folding wings and six guns.

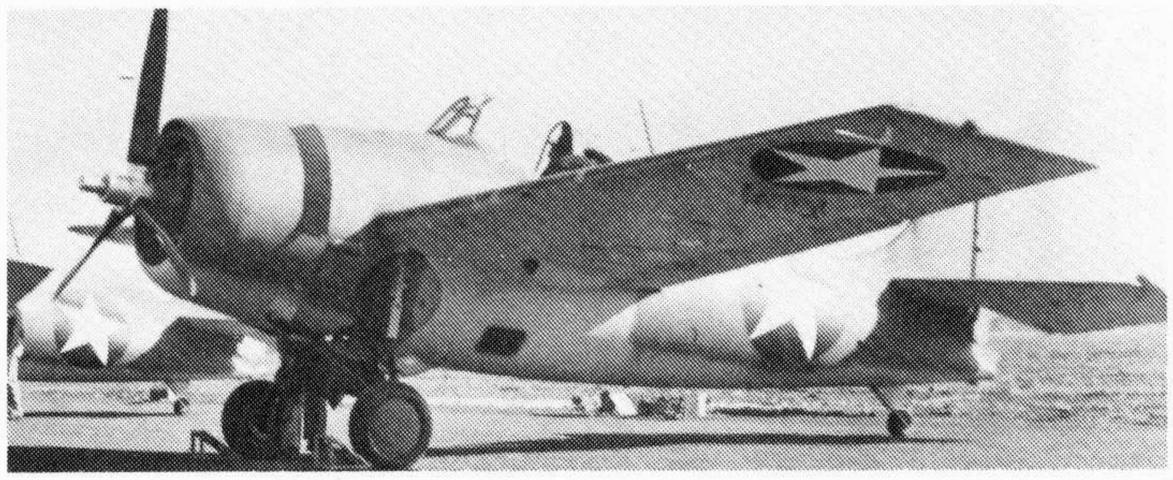
Britain decided to go along with the Navy name for the Lend-Lease Wildcats that they received. The 30 F4F-3As destined for Greece were therefore designated "Wildcat III," using the Navy name, but continuing to use the Martlet numbers. The 220 Wildcat IVs were Lend-Lease F4B-4Bs ("B" for Britain), the 312 Wildcat Vs were FM-1s and the 370 Wildcat VIs were FM-2s.

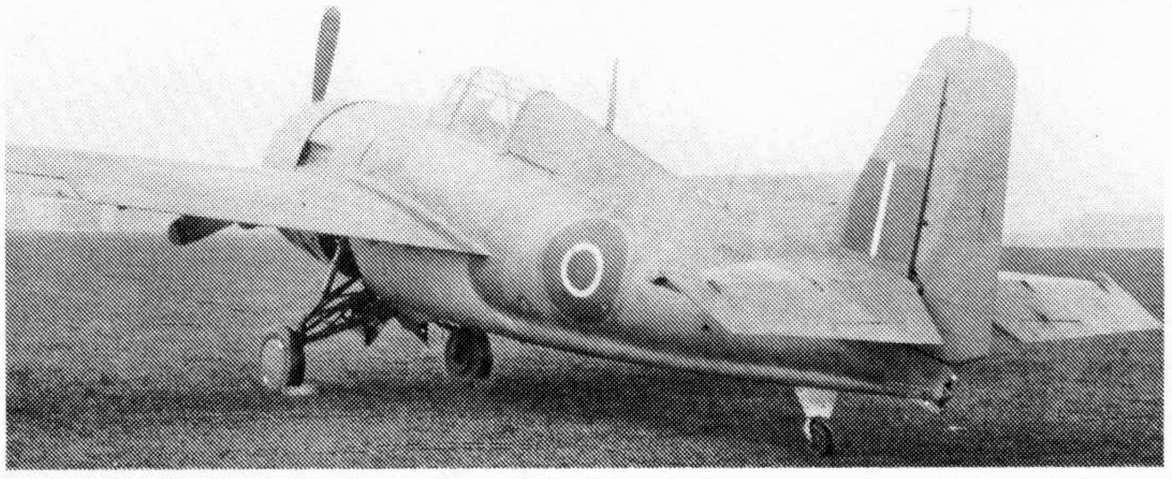
WILDCATS IN ACTION—The first combat by Wildcats (actually Martlets) was in October 1940. One of the ex-French G-36As of the Fleet Air Arm based in the Orkney Islands shot down a Junkers Ju 88 for the first victory by an American fighter in British service. Martlets and Wildcats saw extensive service from British carriers throughout the war, including the invasions of North Africa, Sicily and Italy. Their main service was in the North Atlantic, operating from small escort carriers, where they were highly successful in destroying German aircraft that were shadowing and attacking the Allied convoys.

Initial U.S. Navy and Marine Corps wartime experience with Wildcats was disastrous. Many were destroyed on the ground during the attacks on Wake Island and Hawaii, and the surviving F4F-3s on Wake Island were soon overwhelmed by superior Japanese forces. The Wildcat was no match for the Japanese Zero, but it could absorb punishment better. By the time the U.S. went on the offensive in August 1942, the Navy had developed Wildcat tactics specifically for use against the Zero, and the victory record became impressive. Of 11 Marine Corps pilots who won the Medal of Honor during the war, six flew Wildcats.

As the Wildcats were replaced on the large carriers by Hellcats, they were reassigned to the smaller escort carriers and saw extensive service in support of the U.S. invasions of Japanese-held islands in the Pacific. Carrier-based Wildcats supported the U.S. invasion of North Africa in November 1942, and, accompanied by British Martlets, shot down many defending Vichy French aircraft, including American-built Curtiss 75 fighters.

Below: General Motors Wildcats. At left, an FM-1, similar to Grumman's F4F-4. At right, an FM-2 in British markings as "Wildcat VI." Note the increased height of the vertical tail on this Cyclone-powered plane.





PRIMARY ASSEMBLIES

PROPELLER DOME.
PROPELLER (CURTISS 5325D-A32)
ENGINE COWL.
ENGINE (R-1830-56 CURTISS-WRIGHT)
INTERCYLINDER DUCT (FURNISHED G.F.E.)
ENGINE BAFFLE.
ENGINE MOUNT (WELDED STEEL TUBES)
ENGINE OIL TANK.
ACCESSORY COMPARTMENT COWL.
MAIN LANDING WHEELS (BENDIX)
LANDING GEAR.
BRAKE INSTALLATION (2)
FUSELAGE SHELL STRUCTURE.
LANDING GEAR DRAG LINK FAIRING.
FUSELAGE BELLY SKIN.
REMOVABLE FUSELAGE LONGERON STA 2-5
SELF-SEALING FUEL CELL (FUSELAGE)
TAIL WHEEL.
L.H. HORIZONTAL STABILIZER.
R.H. HORIZONTAL STABILIZER.
R.H. ELEVATOR.
L.H. ELEVATOR.
R.H. ELEVATOR TRIM TAB.
L.H. ELEVATOR TRIM TAB.
TAIL CONE.
ARRESTING GEAR.
VERTICAL STABILIZER.
VERTICAL STABILIZER FAIRING.
RUDDER.
RUDDER TRIM TAB.
RADIO ANTENNA.
REMOVABLE TURTLE BACK FAIRING.
SLIDING PILOT ENCLOSURE.
WINDSHIELD.
HEAD REST.
PILOT'S SEAT.
ABK RADIO ANTENNA.
WING ROOT FAIRING (2)
L.H. STUB WING.
R.H. STUB WING.
L.H. OUTER WING PANEL.
R.H. OUTER WING PANEL.
L.H. WING LEADING EDGE.
R.H. WING LEADING EDGE.
PITOT TUBE.
L.H. WING TIP.
R.H. WING TIP.
L.H. INBOARD WING FLAP.
R.H. INBOARD WING FLAP.
L.H. OUTBOARD WING FLAP.
R.H. OUTBOARD WING FLAP.
L.H. GUN COMPARTMENT COVER.
R.H. GUN COMPARTMENT COVER.
L.H. AILERON.
R.H. AILERON.
AILERON ADJUSTABLE TAB.
AILERON FIXED TAB.
L.H. JETTISONABLE FUEL TANK (G.F.E.)
R.H. JETTISONABLE FUEL TANK (G.F.E.)

THE ABOVE LIST OF PARTS COMPRISE THE BASIC PRODUCTION ASSEMBLIES OF THE F4F-4 AND THE FM-1 AND -2 AIRPLANES.

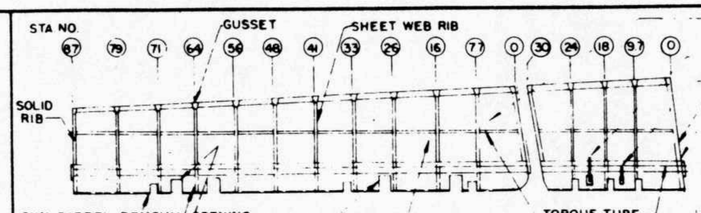
FM-1 AND FM-2

MODELS FM-1 (F4F-4) AND FM-2 WERE MANUFACTURED BY GENERAL MOTORS CORPORATION, EASTERN AIRCRAFT DIVISION IN FIVE PLANTS UNDER LICENSE. FIRST PLANE DELIVERED SEPTEMBER 1942. JANUARY, 1943 SAW 17 FM-1 DELIVERED. BY APRIL, 1943, PRODUCTION WAS 300 AIRPLANES PER MONTH. MORE THAN 2500 WILDCATS WERE BUILT. PRODUCTION ENDED IN JUNE, 1944.
BASICALLY, THE FM-2 WAS AN IMPROVED F4F-4. THE ENGINE WAS A CURTISS-WRIGHT R-1820-56 RADIAL AIRCOOLED ENGINE. THIS ENGINE HAD FORGED CYLINDER HEADS BECAUSE OF INCREASED ENGINE POWER AND LIGHTER WEIGHT, THE FM-2 HAD INCREASED PERFORMANCE AND A SHORTER TAKEOFF. THE FLIGHT RANGE WAS ALSO IMPROVED. ENTIRE AIRPLANE WAS IMPROVED IN DETAIL DESIGN. IMPROVED ENGINE OIL COOLING.

RADIO INSTALLATION

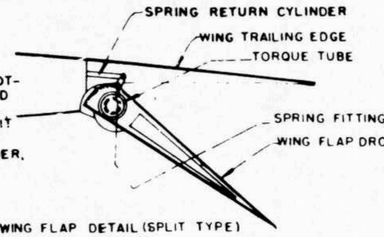
G.F. TRANSMITTER.
R.U. RECEIVER.
RECEIVER DUAL COIL.
ZB ADAPTER AND SWITCH RELAY.
ANTENNA UNIT (RELAY)
RADIO JUNCTION BOX.
I.F.F. CIRCUIT TESTER BOX.
I.F.F. INERTIA SWITCH.
RADIO CALIBRATION CHART.
GF/RU DYNAMOTOR.
CONTROL UNIT.
THROAT MICROPHONE.
ANTENNA MAST.
TWO TYPES OF I.F.F. EQUIPMENT WERE USED ON VARIOUS F4F AIRCRAFT.
24-VOLT POWER SUPPLY.

SHEET NO. 1

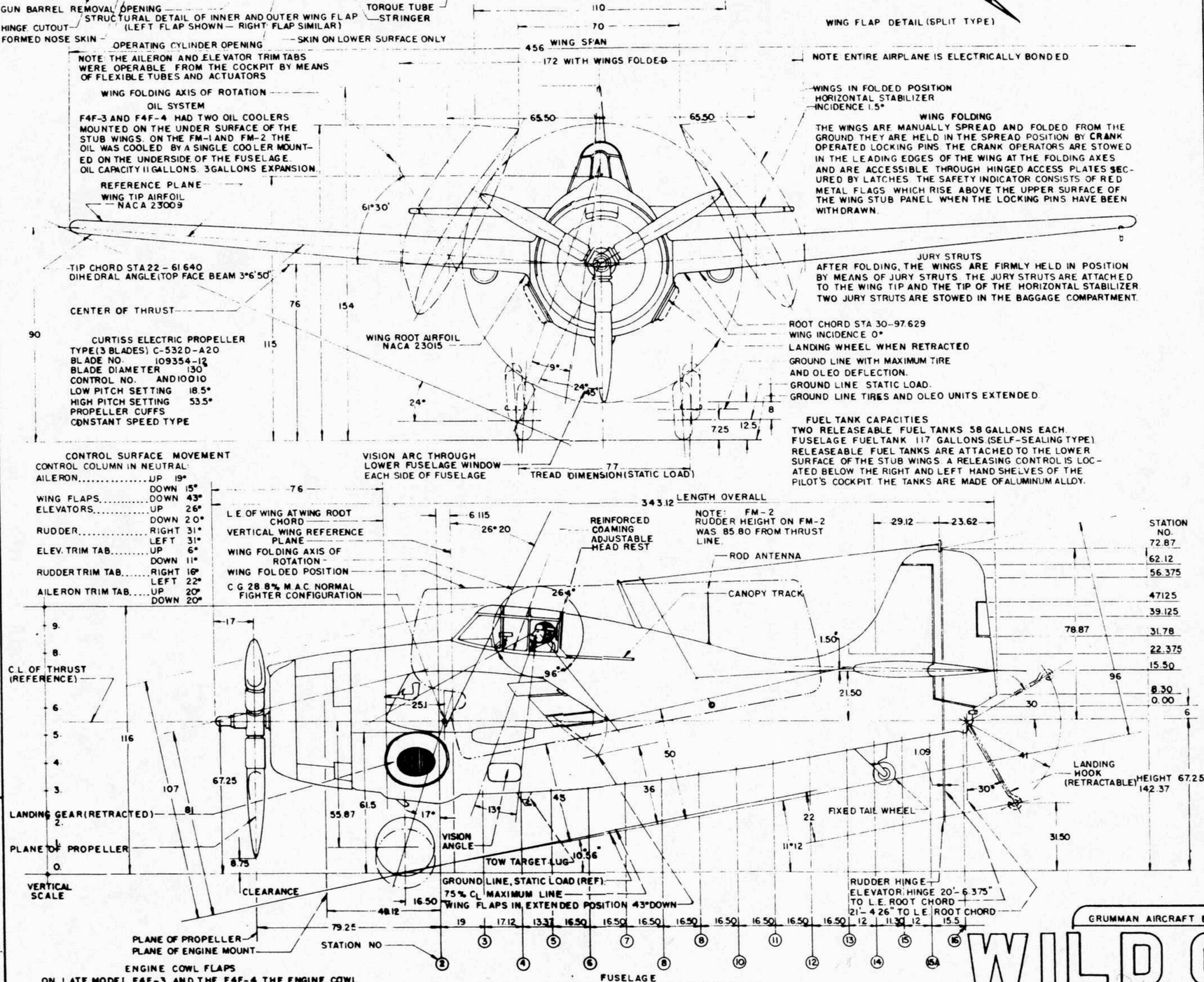


SURFACE CONTROLS

THE AILERONS AND ELEVATORS ARE CONTROLLY A STANDARD TYPE STICK. THE RUDDER IS OPERATED BY ADJUSTABLE TYPE UNDERHUNG PEDALS. TRIM TAB CONTROLS ARE ROTATED IN THE DIRECTION OF THE DESIRED RESULTANT MOTION OF THE AIRPLANE. A COCKPIT CONTROLLED TRIM TAB IS PROVIDED ON THE LEFT AILERON. RUDDER AND ELEVATORS EACH HAVE COCKPIT CONTROLED ADJUSTABLE TRIM TABS. A FIXED TAB IS PROVIDED ON THE RIGHT AILERON. RUDDER, ELEVATORS, ETC., ARE CABLE OPERATED. PUSH-PULL TUBES OPERATE THE AILERONS.



WING FLAP DETAIL (SPLIT TYPE)



CONTROL SURFACE MOVEMENT

CONTROL COLUMN IN NEUTRAL

AILERON	UP	19°
	DOWN	15°
WING FLAPS	DOWN	43°
ELEVATORS	UP	26°
	DOWN	20°
RUDDER	RIGHT	31°
	LEFT	31°
ELEV. TRIM TAB	UP	6°
	DOWN	11°
RUDDER TRIM TAB	RIGHT	16°
	LEFT	22°
AILERON TRIM TAB	UP	20°
	DOWN	20°

ENGINE COWL FLAPS

ON LATE MODEL F4F-3 AND THE F4F-4, THE ENGINE COWL CONFIGURATION WAS CHANGED TO THAT SHOWN ON SHEET NO. 2. THE FM-1 AND FM-2 WERE SIMILAR.

FUSELAGE

FUSELAGE LENGTH WITHOUT ENGINE MOUNT 233.12
DO DO WITH ENGINE MOUNT 278.80

ALL DIMENSIONS ARE INCHES. SCALE: 0 1' 2' 3' (12" 24" 36")

WILDCAT

GRUMMAN AIRCRAFT ENGINEERING CORPORATION (F4F PLANES).

DRAWN BY WILLIS L. NYE FOR MODEL AIRPLANE NEWS 11-3-59.

LEST WE FORGET!

THE GRUMMAN WILDCAT F4F SERIES OF NAVAL FIGHTERS WAS WITHOUT A DOUBT THE BEST LIGHTWEIGHT CARRIER PLANE IN WORLD WAR TWO. BUT AIRPLANES ARE NO BETTER THAN THE MEN WHO FLY THE PLANES IN COMBAT.

THIS DRAWING IS DEDICATED TO MY FORMER FRIEND AND NEIGHBOR, MAJOR ROBERT F. STOUT, U.S.M.C., 81ST RANKING U.S. MARINE CORPS ACE. (6 JAPANESE PLANES SHOT DOWN) U.S. NAVY CROSS FOR GALLANTRY. COMMANDER FAMED SQUADRON U.S.M.C. FIGHTING VMF-212 (GUADALCANAL 2-6-43 TO 4-2-43, AND VMF-114 AT PELILIU ISLANDS. SHOT DOWN BY JAPANESE ANTI-AIRCRAFT FIRE, 3-4-45 OVER KOROR ISLAND IN THE PELILIU GROUP. HE DID NOT SURVIVE HIS LAST FLIGHT HE FLEW THE WILDCAT F4F-3 AT GUADALCANAL.

LEND-LEASE

MARTLET I R-1820-G-20A 4 CAL 30 M.G. FIXED WINGS. AL231-AL262. 5 OF THESE PLANES TO R.C.A.F.
AX725-AX738 ON FOREIGN CONTRACT. AX824-AX829 SUPPLIED IN LIEU OF THOSE SUPPLIED TO R.C.A.F.
BJ507-BJ527 ABSORBED BELGIAN ORDER
BJ554-BJ570 DO DO DO
BT447-BT456 LOST AT SEA.
MARTLET II R-1830-S3C4G AJ100-AJ153. FOLDING WINGS.
MARTLET III (F4F-3A) FIXED WINGS AM954-AM963.
30 PLANES ON GREEK CONTRACT LATER SUPPLIED ON LEND-LEASE.
WILDCAT IV R-1830-86 (F4F-4B) FOLDING WINGS, FIRST LEND-LEASE VERSION 6 M.G. FN100-FN319.
WILDCAT V R-1830-86 JV325-636. FM-1 PRODUCTION VERSION OF F4F-4 BY THE EASTERN AIRCRAFT DIVISION OF GENERAL MOTORS CORPORATION (5 PLANTS)
WILDCAT VI R-1830-56 FM-2 JV637-JV924.
JW785-JW836.
JZ860-JZ889.
FM-2 HAD NEW TYPE ENGINE, DETAIL CHANGES, TALLER VERTICAL STABILIZER, WAS THE LAST OF THE WILDCAT FIGHTER SERIES THAT WAS BUILT.
MARTLETS AND WILDCATS SERVED ON BRITISH NAVY CARRIERS.

BATTLE HONORS

CASABLANCA	NORTH AFRICA
WAKE ISLAND	CENTRAL PACIFIC
MIDWAY ISLAND	CENTRAL PACIFIC
GUADALCANAL	SOUTH PACIFIC
BUKA ISLAND	SOUTH PACIFIC
TULAGI ISLAND	SOUTH PACIFIC
NEW GEORGIA ISLAND	SOUTH PACIFIC
MUNDA ISLAND	SOUTH PACIFIC
BATTLE OF THE EASTERN SOLOMONS	
GAVUTU	SOUTH PACIFIC
TANAMBOGO	SOUTH PACIFIC
ANTI-SUBMARINE DUTY	PACIFIC OCEAN AREA
ANTI-SUBMARINE DUTY	ATLANTIC OCEAN AREA
ANTI-SUBMARINE DUTY	CARIBBEAN SEA
NEUTRALITY PATROL (1941)	ATLANTIC OCEAN
RENDOVA ISLAND	SOUTH PACIFIC

ON DECEMBER 6TH 1941, U.S.M.C. FIGHTER STRENGTH CONSISTED OF 57 F4F-3 FIGHTER PLANES. (12 ON WAKE ISLAND).

PROTOTYPE PLANES.

THE BASIC PROTOTYPE AIRPLANES WERE THE XF4F-1 AND XF4F-2. PRODUCTION STARTED WITH THE F4F-3 HAVING RIGID WINGS. THIS AIRPLANE WAS A FOLLOW ON DEVELOPEMENT OF THE TWO EARLY PROTOTYPES. PRODUCTION STARTED IN 1940 AND TERMINATED IN 1942 WHEN THE FM-1 PROJECT BEGAN. THE F4F-3 WERE POWERED WITH TWIN WASP, P. AND W. AIRCOOLED R-1830-30 ENGINES, CURTISS ELECTRIC CONTROLLABLE PITCH PROPELLERS.

ACKNOWLEDGEMENTS:

FRANK COLEMAN, A.A.H.S.
RON GERDES, LT. U.S.N.R., A.A.H.S.
WILLIAM WINTER, EDITOR, M.A.N. & A.A.H.S.
GEORGE LEE, A.A.H.S.
GRUMMAN AIRCRAFT ENGINEERING CORP.

INSTRUMENT COMPONENTS

ENGINE CYLINDER HEAD TEMPERATURE (1) INDICATOR.
ENGINE IGNITION SWITCH.(2)
CLOCK.(3)
WINDSHIELD DEFROSTER CONTROL.(4)
PROPELLER GOVERNOR CONTROL.(5)
PROPELLER SELECTOR SWITCH AND CIRCUIT BREAKER.(6)
REFLECTOR TYPE GUNSIGHT AND RHEOSTAT CONTROL.(7)
CARBURETOR AIR CONTROL.(8)
FUEL QUANTITY WARNING LIGHT.(9)
FUEL QUANTITY INDICATOR.(10)
EMERGENCY FUEL PUMP SWITCH.(11)
BAROMETRIC ALTIMETER.(12)
DIRECTIONAL GYRO INDICATOR.(13)
AIRSPEED INDICATOR.(14)
TURN AND BANK INDICATOR.(15)
RATE OF CLIMB INDICATOR.(16)
GYRO HORIZON.(17)
ENGINE MANIFOLD PRESSURE INDICATOR(18)
ENGINE TACHOMETER.(19)
OXYGEN FLOW INDICATOR.(20)
ENGINE OIL DILUTION SWITCH.(21)
ENGINE GAUGE.(22)(MANIFOLD PRESSURE)
ENGINE COWL FLAP CONTROL CRANK.(23)
RUDDER PEDAL ADJUSTMENT LEVERS(24)
RUDDER PEDALS.(28)
NAVIGATION CHART BOARD.(26)
JOYSTICK.(27)
COMPASS.(28)
COCKPIT AIR INTAKE CONTROL.(29)

INSTRUMENT VACUUM SYSTEM.
THIS SYSTEM CONSISTS OF THE FOLLOWING
SUCTION REGULATOR.
ARTIFICIAL HORIZON GYRO.
DIRECTIONAL GYRO HORIZON.
ENGINE OIL SEPARATOR.
ENGINE-DRIVEN VACUUM PUMP.

PITOT AND STATIC LINES
AIRSPEED INDICATOR.
RATE OF CLIMB INDICATOR.
STATIC AND PRESSURE LINES.

ENGINE ACCESSORIES.
ENGINE MAGNETO (2)
ENGINE ELECTRICAL JUNCTION BOX (2)
CARTRIDGE TYPE ENGINE STARTER.
ENGINE OIL PUMP.
FUEL DRAIN VALVE.
ENGINE OIL IN AND OUT LINES.
ENGINE OIL COOLER AND COOLING AIR DUCT.
ELECTRICAL GENERATOR DISCONNECT PLUG.
EMERGENCY FUEL PUMP.
FUEL STRAINER.
ENGINE-DRIVEN GENERATOR.
STARTER CARTRIDGE STOWAGE BOX.
TACHOMETER GENERATOR.
ENGINE OIL DRAIN VALVE.
ENGINE OIL PUMP.
ENGINE SUPERCHARGER CONTROL.
PROPELLER GOVERNOR CONTROL BOX.
DEFROSTER TUBE.
ENGINE STARTER EXHAUST TUBE.
ENGINE EXHAUST MANIFOLD.
ENGINE OIL QUANTITY DIP STICK.
CARBURETOR.
VACUUM SEPARATOR.
INSTRUMENT VACUUM CHECK VALVE.
ENGINE JUNCTION BLOCK.
ENGINE STARTER BREECH.
CARBURETOR ALTERNATE AIR INTAKE DOOR.
ENGINE OIL TANK.
ENGINE OIL DILUTION SOLENOID.

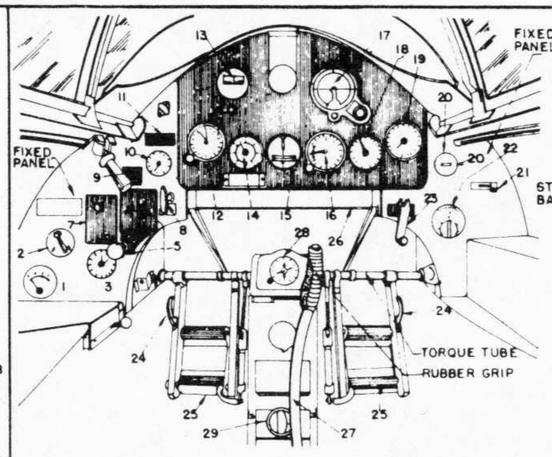
WING FLAP OPERATING SYSTEM.
VACUUM TANK (LOW PRESSURE).
VALVE. SELECTOR TYPE).
AIR CHECK VALVE.
WING FLAP ACTUATING CYLINERS(2).
AUXILIARY RETURN SPRINGS(2).

PILOT'S OXYGEN SYSTEM.
OXYGEN FLOW INDICATOR.
DILUTER DEMAND OXYGEN REGULATOR.
OXYGEN SHUT-OFF CONTROL VALVE.
OXYGEN BOTTLE.(514 CU. IN.)

FUEL SYSTEM
ENGINE JUNCTION BLOCK
ENGINE-DRIVEN FUEL PUMP.
FUEL STRAINER.
DROPPABLE FUEL TANK.
FUEL TANK SELECTOR VALVE.
FUEL SELECTOR VALVE CONTROL.
FUEL CHECK VALVE.
FUEL TANK.
FUEL QUANTITY TRANSMITTER.
EMERGENCY FUEL PUMP.

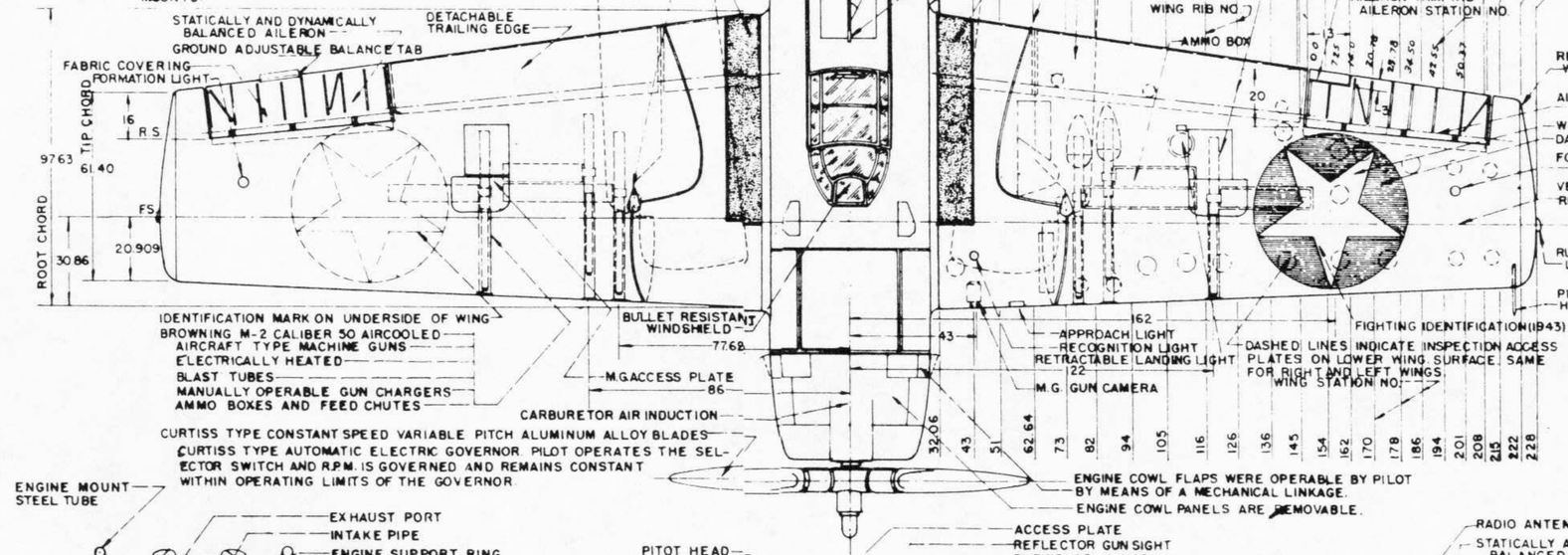
PROPELLER CONTROLS
FLEXIBLE CONTROL ASSEMBLY.
PROPELLER GOVERNOR.
CIRCUIT BREAKERS.
SELECTOR SWITCHES.
RESET SWITCH.

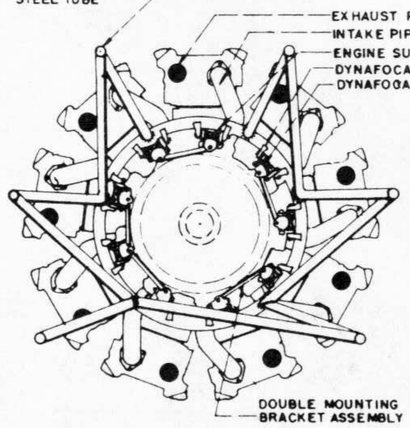
SHEET NO.2



INSTRUMENT PANEL F4F-4

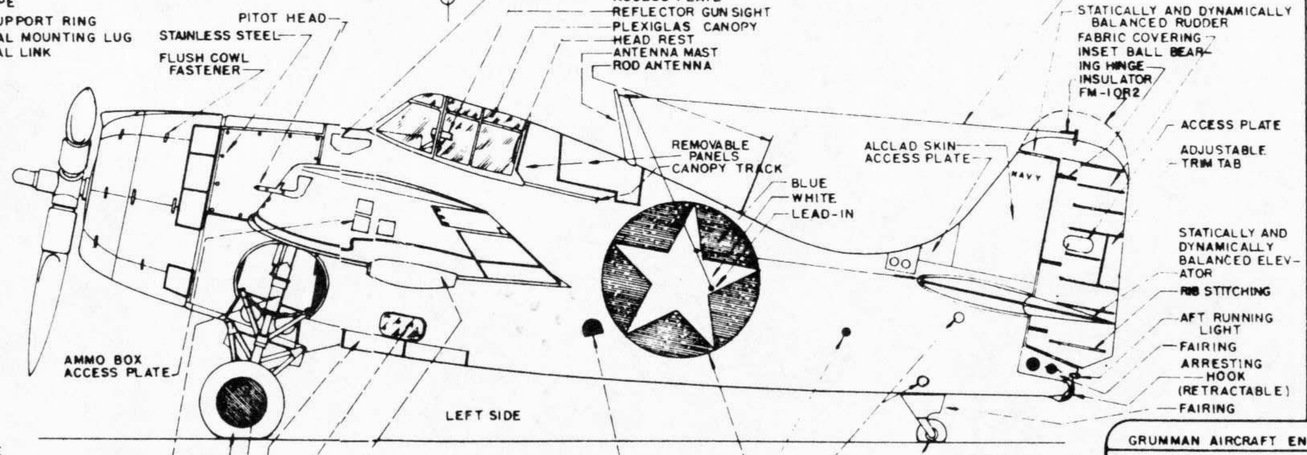
NOTE: THE INSTRUMENT PANEL IS DIVIDED INTO THREE SECTIONS. THE RIGHT AND LEFT SECTIONS ARE FIXED IN THE FUSELAGE. THE CENTER PANEL IS REMOVABLE AND IS MOUNTED ON RUBBER SHOCK MOUNTS

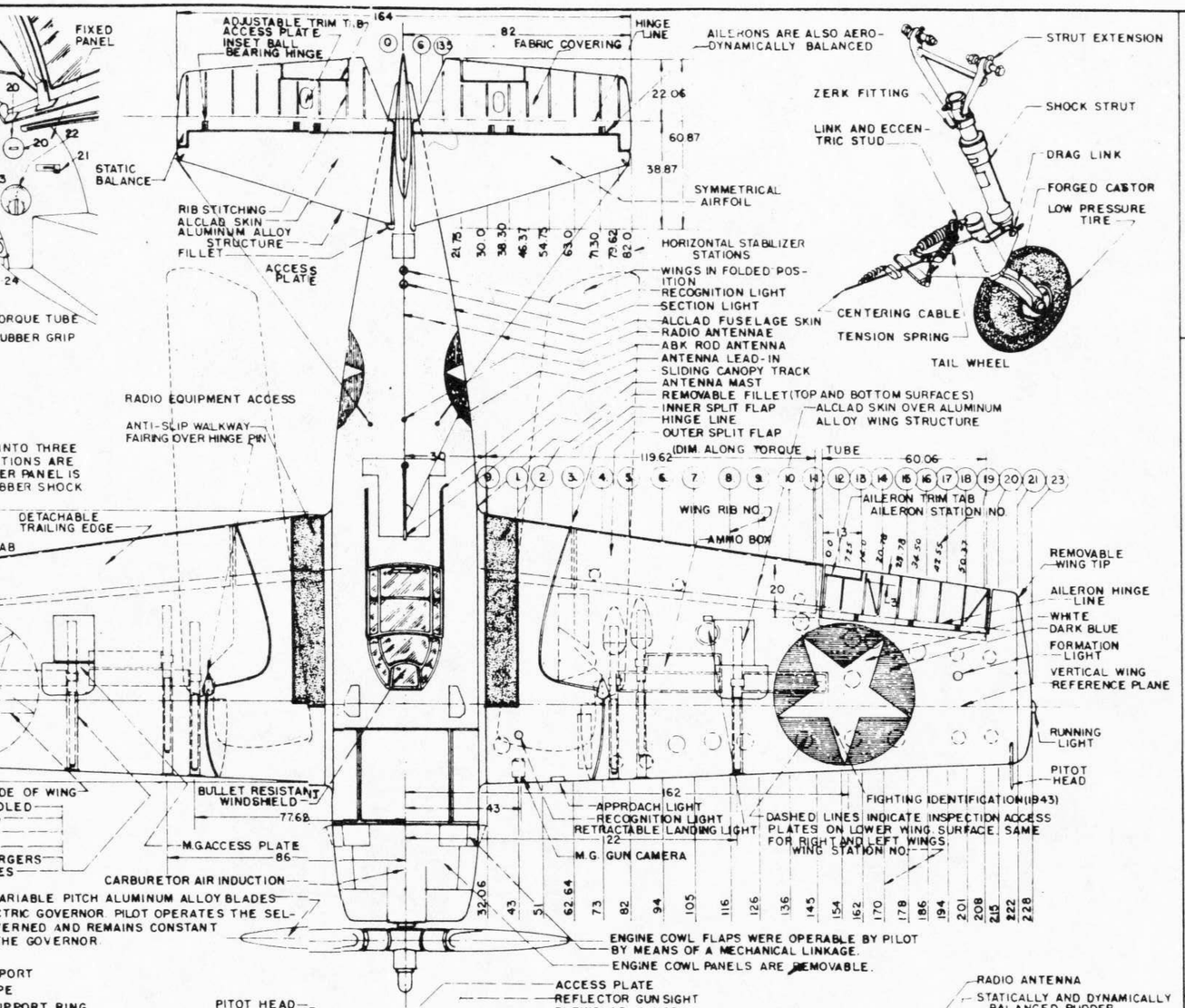




AFT VIEW OF ENGINE SHOWING DYNAFOCAL INSTALLATION AND ENGINE MOUNT

LANDING GEAR IS MECHANICALLY RETRACTED INTO THE FUSELAGE BY THE ACTION OF A HANDCRANK OPERATED BY THE PILOT. 28 REVOLUTIONS OF THE HANDCRANK ARE REQUIRED TO RAISE OR LOWER THE LANDING GEAR. THE POSITION OF THE LANDING GEAR IS SHOWN BY AN INDICATOR, LINKED MECHANICALLY TO THE HANDCRANK REDUCTION GEARBOX. THE LANDING GEAR TRUSS STRUCTURE IS OF WELDED STEEL TUBE.





ALL DIMENSIONS ARE INCHES. SCALE: 0 1 2 3 / 0 12 24 36

AERODYNAMIC DATA

WING AREA (INCL. 37.60 SQ.FT. BODY)	260.0 SQ.FT
CONTROL SURFACE AREAS:	
TOTAL AILERON AREA (INCL. TABS)	13.26 SQ.FT
HORIZONTAL STABILIZER AREA	30.43 " "
ELEVATOR AREAS	18.62 " "
TOTAL HORIZONTAL TAIL AREA	49.05 " "
VERTICAL STABILIZER AREA	13.20 " "
RUDDER AREA	9.38 " "
TOTAL VERTICAL TAIL AREA	22.58 " "
TOTAL WING FLAP AREA	29.70 " "
AIRFOIL WING ROOT	NACA 23015
AIRFOIL WING TIP	NACA 23009
TAIL SURFACE AIRFOILS	SYMMETRICAL
MEAN AERODYNAMIC CHORD	84.14"

LOCATION OF L.E. M.A.C. AFT L.E. ROOT CHORD IS 3.33"
LOCATION OF THE M.A.C. ABOVE THE THRUST LINE IS 9.52"
INCIDENCE OF THE WINGS 0°
INCIDENCE OF THE HORIZONTAL STABILIZER IS POSITIVE 1.5°.

ELECTRICAL COMPONENTS

REFLECTOR GUNSIGHT AND RHEOSTAT.
COMPASS.
AMMO ROUNDS COUNTER.
EMERGENCY FUEL PUMP.
PROPELLER RELAY.
ENGINE IGNITION SWITCH.
RUNNING LIGHTS (3) AND SWITCH.
ARRESTING HOOK.
APPROACH LIGHT AND SWITCH.
TAIL JUNCTION BOX.
RECOGNITION LIGHTS (3) AND SWITCH.
SECTION LIGHTS AND SWITCH.
REMOTE COMPASS TRANSMITTER.
REMOTE COMPASS JUNCTION BOX.
STORAGE BATTERY AND JUNCTION BOX.
RADIO JUNCTION BOX.
REMOTE COMPASS INVERTER.
LIGHT SWITCH BOX.
HEATER JUNCTION BOX.
MACHINE GUN HEATERS (6)
WING INBOARD JUNCTION BOX.
WING OUTBOARD JUNCTION BOX
LEFT WING JUNCTION BOX.
FUEL QUANTITY GAUGE.
QUICK CHANGE DISCONNECT.
M.G. CAMERA.
M.G. TRIGGER JUNCTION BOX
RIGHT WING JUNCTION BOX.
OIL TEMPERATURE INDICATOR BULB
ENGINE TACHOMETER GENERATOR.
ENGINE-DRIVEN GENERATOR.
ENGINE OIL DIVERTER VALVE.
ENGINE-DRIVEN GENERATOR GOVERNOR.
PITOT TUBE HEATING ELEMENT.
ENGINE EMERGENCY FUEL PUMP.
ENGINE OIL DILUTION VALVE AND SWITCH.
INSTRUMENT PANEL BOX.
ENGINE TACHOMETER INDICATOR
INSTRUMENT LIGHTING BOX
ELECTRICAL DISTRIBUTION PANEL.
MAIN ELECTRICAL JUNCTION BOX.
GENERATOR CUTOUT.
ELECTRIC FUEL PRIMER.
ENGINE STARTER BREECH.
ENGINE ELECTRICAL JUNCTION BOX.
ENGINE MAGNETO (2).
PROPELLER ELECTRICAL JUNCTION BOX.
PROPELLER BRUSHES.
M.G. GUN HEATERS.
M.G. FIRING SOLENOID.

SETTINGS AND RANGES OF MOVEMENTS OF CONTROL SURFACES

AILERONS	JOYSTICK IN NEUTRAL	3/8"
	UP	18°
	DOWN	15°
WING FLAPS	DOWN	43°
ELEVATORS	UP	26°
	DOWN	20°
RUDDER	RIGHT/LEFT	31°
TRIM TABS:		
ELEVATOR	UP	5°30"
	DOWN	13°30"
RUDDER	RIGHT	16°21"
	LEFT	22°18"
AILERON	UP	20
	DOWN	20°

CABLE CONTROLS
ELEVATORS, RUDDER.
TAIL WHEEL CENTERING.
GUN CHARGERS.
PUSH-PULL TUBE
AILERONS.
MECHANICAL LINKAGE
ENGINE COWL FLAPS.
LANDING GEAR.
AILERON, RUDDER, ELEVATOR TRIM TABS.

GRUMMAN AIRCRAFT ENGINEERING CORPORATION (F4F PLANES)

WILDCAT

DRAWN BY WILLIS L. NYE FOR MODEL AIRPLANE NEWS 11-3-59

WW II SCALE AIRCRAFT DRAWINGS

GRUMMAN F4F WILDCAT

BRAKE SYSTEM
LOW PRESSURE LINES.
HIGH PRESSURE LINES.
HYDRAULIC BRAKE CONTROL UNIT.(2)
BRAKE PEDAL LINKAGE.(2)
BRAKE CYLINDERS.(2)

CARBURETION AIR INDUCTION SYSTEM
OUTSIDE AIR INTAKES (2).
AIR FILTERS(2).
DOWN DRAFT CARBURETOR
AIR INDUCTION DUCT.
AIR HEATER DUCT.
AUXILIARY AIR DOOR.
ENGINE THROTTLE CONTROL.
FUEL MIXTURE CONTROL.
SUPERCHARGER CONTROL.
CONTROL CABLE.

MISCELLANEOUS FIXED EQUIPMENT
WIND SHIELD DEFROSTER.
COCKPIT VENTILATOR.
PILOT'S RELIEF TUBE.
SAFETY BELT.
PILOT'S SEAT.
LIFE RAFT.
VERY FLARE PISTOL.
FLARE HOLDER.
EMERGENCY LIFE RAFT.
DATA CASE.
EQUIPMENT KIT.

ENGINE STARTING SYSTEM
PRESSURE RELIEF VALVE.
CARTRIDGE CONTAINER.
BREEZE CARTRIDGE STARTER
STARTER TUBE.
EXHAUST TUBE.
STARTER CONTROL SWITCH.

ENGINE COWL FLAP CONTROLS
MECHANICAL LINKAGES.
CONTROL HANDLE.
FORE AND AFT SCREW ASSEMBLY.
COWL FLAP SUPPORT RING.
COWL FLAP ASSEMBLIES.

ENGINE OIL SYSTEM
ENGINE OIL TANK ASSEMBLIES.
ENGINE OIL COOLER(2).
ENGINE NOSE SUMP.
ENGINE OIL DILUTION VALVE.
OIL PRESSURE AND RETURN LINES.
STRAINER AND FILTER.
INSTRUMENT LINE.
VENTILATION LINES.
QUANTITY GAUGE ROD.
OIL COOLER AIR DUCTS.
CHECK VALVE.
DRAIN VALVE.
DIVERTER VALVE.
OIL RESTRICTOR.

ARRESTING GEAR
LANDING HOOK.
AUTOMATIC LATCH.
RECOIL STRUT.
CONTROL CABLE.
TRACK.
TRACK SUPPORT.
EYE BOLT.
LINK.
SHAFT.
CARRIAGE.

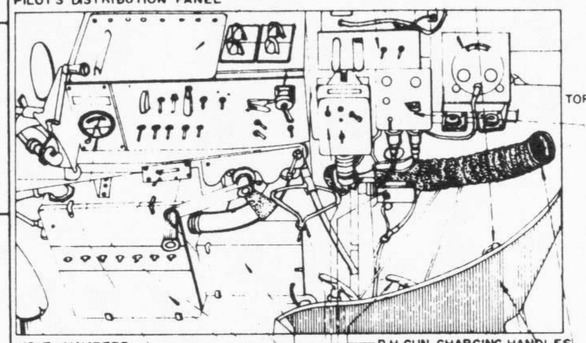
WINDSHIELD DEFROSTER
WARM AIR LINES.
AIR FILTER.
VALVE CONTROL.
VALVE ASSEMBLY.

PITOT AND STATIC LINE SYSTEM
PITOT HEAD ASSEMBLY.
ALTIMETER (ANEROID)
AIRSPEED INDICATOR.
RATE OF CLIMB INDICATOR.
PRESSURE LINES.
DRAIN VALVE.
STATIC LINES.

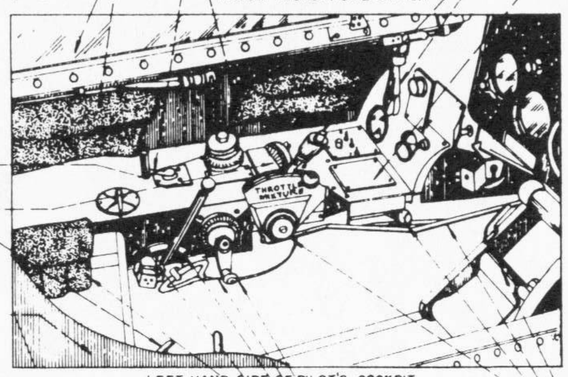
ENGINE CONTROLS
THROTTLE.
FUEL MIXTURE.
THROTTLE LIMIT SWITCH.
SUPERCHARGER LIMIT SWITCH.
FLEXIBLE CONTROLS.
ENGINE QUADRANT.
SUPERCHARGER QUADRANT.
M.A.P. REGULATOR.
BELL CRANKS.
CONTROL RODS.

ELECTRICAL SYSTEM
THE ELECTRICAL SYSTEM IS A SINGLE WIRE GROUND RETURN TYPE SUPPLIED BY A 24-VOLT STORAGE BATTERY CHARGED BY AN ENGINE-DRIVEN GENERATOR.

SHEET NO.3

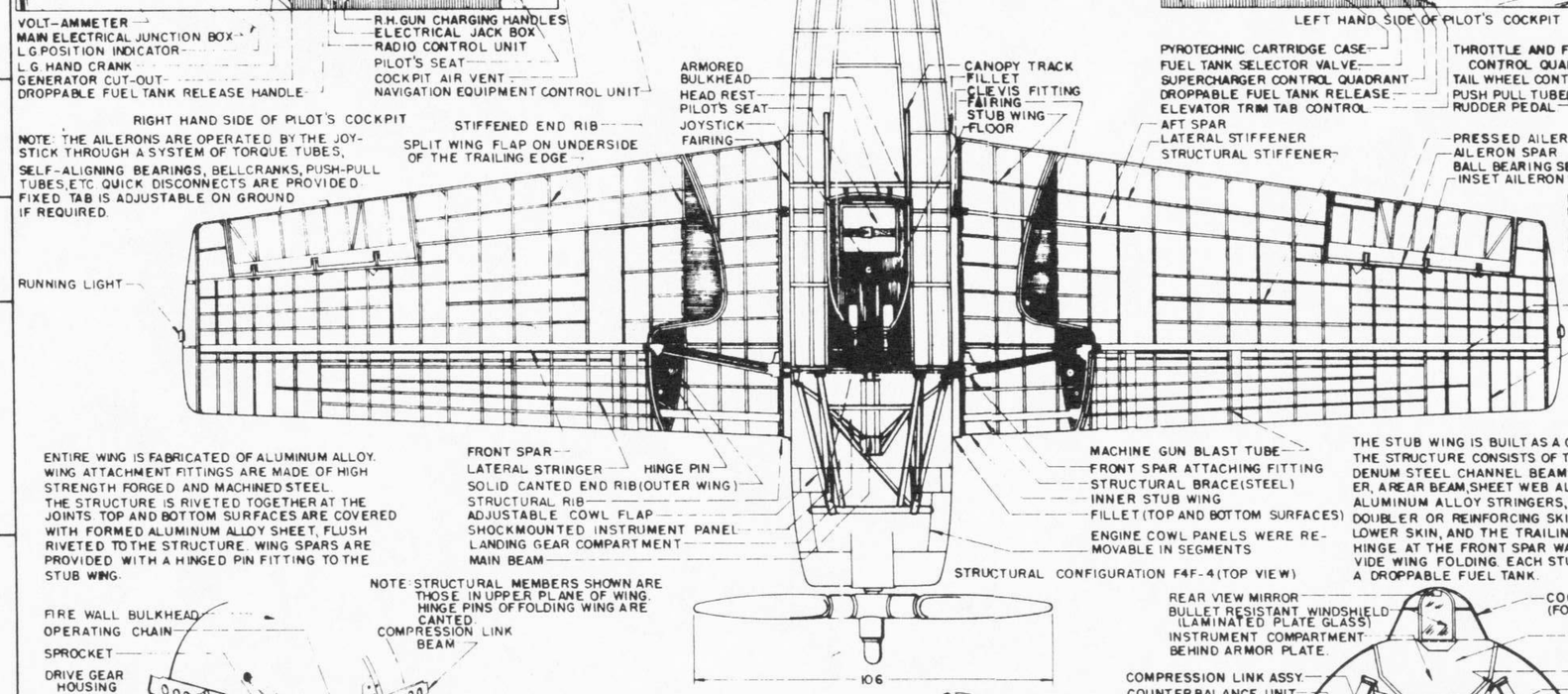


RIGHT HAND SIDE OF PILOT'S COCKPIT



LEFT HAND SIDE OF PILOT'S COCKPIT

NOTE: THE AILERONS ARE OPERATED BY THE JOY-STICK THROUGH A SYSTEM OF TORQUE TUBES, SELF-ALIGNING BEARINGS, BELLCRANKS, PUSH-PULL TUBES, ETC. QUICK DISCONNECTS ARE PROVIDED. FIXED TAB IS ADJUSTABLE ON GROUND IF REQUIRED.

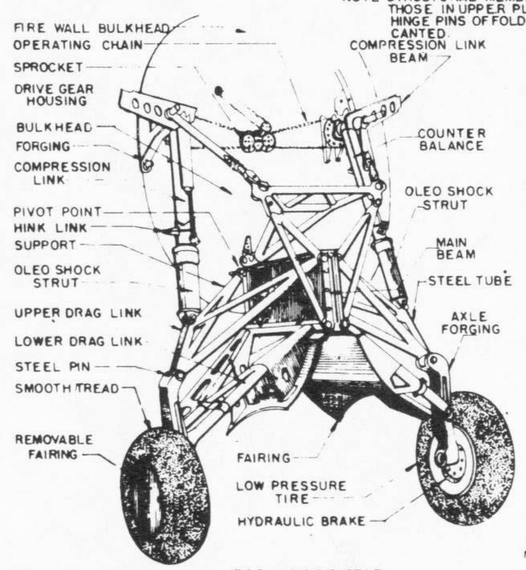


STRUCTURAL CONFIGURATION F4F-4 (TOP VIEW)

ENTIRE WING IS FABRICATED OF ALUMINUM ALLOY. WING ATTACHMENT FITTINGS ARE MADE OF HIGH STRENGTH FORGED AND MACHINED STEEL. THE STRUCTURE IS RIVETED TOGETHER AT THE JOINTS. TOP AND BOTTOM SURFACES ARE COVERED WITH FORMED ALUMINUM ALLOY SHEET, FLUSH RIVETED TO THE STRUCTURE. WING SPARS ARE PROVIDED WITH A HINGED PIN FITTING TO THE STUB WING.

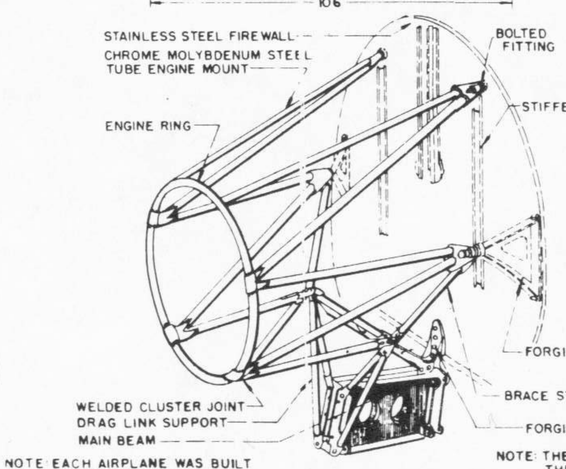
THE STUB WING IS BUILT AS A COMPLETE ASSEMBLY. THE STRUCTURE CONSISTS OF TWO CHROME-MOLYBDENUM STEEL CHANNEL BEAMS, AN UPPER AND LOWER, A REAR BEAM, SHEET WEB ALUMINUM ALLOY RIBS, ALUMINUM ALLOY STRINGERS, AN ALUMINUM ALLOY DOUBLER OR REINFORCING SKIN, AN UPPER SKIN, LOWER SKIN, AND THE TRAILING EDGE SKIN. THE HINGE AT THE FRONT SPAR WAS CANTED TO PROVIDE WING FOLDING. EACH STUB WING CAN CARRY A DROPPABLE FUEL TANK.

NOTE: STRUCTURAL MEMBERS SHOWN ARE THOSE IN UPPER PLANE OF WING. HINGE PINS OF FOLDING WING ARE CANTED.



NOTE: ALL LINKAGE FITTINGS WERE BRONZE BUSHED

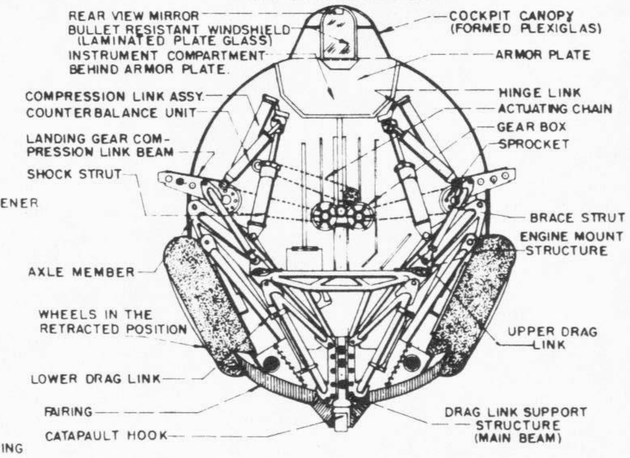
F4F LANDING GEAR (EXTENDED POSITION)



NOTE: EACH AIRPLANE WAS BUILT AND PROVIDED WITH A QUICK ENGINE CHANGE UNIT AS A SPARE PART.

F4F ENGINE MOUNT

NOTE: THE SHOCK STRUT WAS HINGED IN THE CENTER AND SO COULD IT COULD BE RETRACTED. THE HYDRAULIC COUNTERBALANCE UNIT MAINTAINED IT RIGID WHEN THE STRUT WAS EXTENDED.



LANDING GEAR—RETRACTED (STATION NO.2)

ARMAMENT INSTALLATION

THE ARMAMENT OF THE F4F-4 CONSISTS OF SIX 50-CALIBER MACHINE GUNS, THREE MOUNTED IN EACH OUTER WING PANEL. SIX AMMO BOXES, SIX ELECTRICAL GUN HEATERS, AND SIX MANUALLLY ACTUATED GUN CHARGERS COMPRISE ACCESSORY EQUIPMENT. AN ELECTRICAL REFLECTOR TYPE GUN SIGHT IS MOUNTED ON THE FUSELAGE COWL FORWARD OF THE PILOT. THE FIRING OF THE GUNS IS CONTROLLED BY A TRIGGER ON THE JOYSTICK. FIRING ACTION IS BY MEANS OF AN ELECTRICAL SOLENOID. THE GUNS ARE FED BY MEANS OF A METALLIC DISINTEGRATING LINK BELT. THE GUNS ARE SECURED TO THE GUN MOUNTS BY MARK I QUICK DETACHABLE TRUNNION BOLT ASSEMBLIES AND MOUNTING POSTS. BLAST TUBES PROTECT THE INTERNAL WING STRUCTURE FROM THE EXPLOSIVE BLAST OF THE CARTRIDGES. THE GUNS CAN BE FIRED SINGLY OR IN SALVO BY MEANS THE GUN SELECTOR SWITCH. A GUN CAMERA IS LOCATED IN THE LEFT STUB WING (16 M.M.) THERE IS A PROVISION FOR A TOW TARGET INSTALLATION. A PYROTECHNIC PISTOL IS CARRIED IN THE COCKPIT FLOOR TO THE RIGHT OF THE PILOT. THREE MK-5 ROCKET LAUNCHERS ARE MOUNTED ON THE UNDERSIDE OF EACH WING. THE ROCKETS ARE FIRED ELECTRICALLY, IN PAIRS OR SINGLE.

WING FLAP OPERATION

SPLIT TYPE WING FLAPS OPERATE FROM THE AILERONS INBOARD TO THE FUSELAGE BUT ARE DIVIDED INTO INBOARD AND OUTBOARD FLAPS BY THE WING FOLD. DUE TO AN OVERLAP AT THE WING FOLD, THE TWO SECTIONS OPERATE AS A UNIT CAPABLE OF BEING OPERATED TO AN ANGLE OF 43° BY THE VACUUM SYSTEM. THE OPERATING PARTIAL VACUUM IS OBTAINED FROM THE CARBURETION INTAKE MANIFOLD. THIS PARTIAL VACUUM FORCE IS APPLIED DIRECTLY TO THE ACTUATING CYLINDER OR STORED IN THE VACUUM TANK LOCATED IN THE STORAGE COMPARTMENT. THIS STORAGE TANK HAS SUFFICIENT CAPACITY TO OPERATE THE WING FLAPS TWICE WITH THE ENGINE SHUT-OFF. THE ENGINE WILL STILL PRODUCE VACUUM POWER WITH THE THROTTLE CLOSED. THE ACTUATING FORCE CREATED IS SUFFICIENT TO HOLD THE FLAPS DOWN WHEN THE ENGINE IS IDLED. IN FLIGHT, AS THE ENGINE POWER INCREASES, THE WING FLAPS WILL RETRACT UNTIL AN AIRSPEED OF 130 KNOTS. THE ANGLE OF DROOP WILL BE APPROXIMATELY 10°. IF THE POWER IS THEN REMOVED, THE WING FLAPS WILL RETURN TO THE MAXIMUM ANGLE OF EXTENSION OF 43°. IN A TAKE-OFF, THE CONTROL VALVE IS LEFT IN THE "DOWN" POSITION UNTIL AMPLE AIRSPEED AND ALTITUDE ARE ATTAINED FOR FORCING THE WING FLAPS TO RETRACT. IF THE CONTROL VALVE IS THEN TURNED TO THE "UP" POSITION, ANY SINK EFFECT IS ELIMINATED. THIS WING FLAP SYSTEM IS SUBJECT TO THE EFFECT OF AIR DENSITY AT ALTITUDE.

ANTI-DETONANT SYSTEM

THE ANTI-DETONANT INJECTION SYSTEM IS USED WHEN THE ENGINE IS EQUIPPED FOR ITS USE. THE FLUID TANK IS LOCATED IN THE ACCESSORY COMPARTMENT AND CONTAINS A TEN MINUTE SUPPLY. THE FLUID IS PRESSURIZED THROUG A BOOST PRESSURE SUPPLY LINE. A CHECK VALVE IN THE LINE PREVENTS LOSS OF PRESSURE IN THE TANK WHEN THE ENGINE MANIFOLD PRESSURE IS REDUCED FOLLOWING TAKE-OFF. THE ADIS SYSTEM WAS USED IN COMBAT AND TAKE-OFF THE SYSTEM IS ELECTRICALLY CONTROLED.

L.G. EXTENDED POSITION LOCK

WHEN THE LANDING GEAR IS EXTENDED TO THE FULL DOWN POSITION, SUFFICIENT LOCKING FORCE IS EXERTED BY THE OPERATING CHAINS, SUPPLEMENTED BY THE SPRING COUNTERBALANCE UNIT IN ORDER TO PREVENT THE WHEELS RETRACTING DURING TAKE-OFF AND LANDING.

BRAKE CONTROLS

THE DUO-SERVO HYDRAULIC BRAKES ARE OPERATED BY TOE PRESSURE ON THE UPPER PART OF THE RUDDER PEDALS.

GRUMMAN AIRCRAFT ENGINEERING CORPORATION (F4F PLANES)

WILDCAT

DRAWN BY WILLIS L. NYE FOR MODEL AIRPLANE NEWS 11-3-59.

WINDSHIELD DEFROSTING
THE WINDSHIELD IS DEFROSTED BY THE INTRODUCTION OF HEATED AIR INTO THE SPACE BE THE FORWARD GLASS AND THE BULLET RESISTANT GLASS. THE HEATED AIR IS OBTAINED FROM FROM A SHROUD AND DUCTED TO THE BASE OF THE WINDSHIELD. A CONTROL VALVE OPERABLE BY THE PILOT BY MEANS OF A FLEXIBLE SHAFT IS INSTALLED AS WELL AS AN AIR FILTER.

ARRESTING GEAR OPERATION
THE ARRESTING GEAR CONSISTS OF A CARRIAGE AND A HOOK OPERATING IN A TRACK INSTALLED AT FUSELAGE STATION 13. THE OPERATION OF THE HOOK IS CONTROLLED BY THE PILOT BY MEANS OF A CABLE. THE HOOK CAN BE LOCKED IN THE EXTENDED OR RETRACTED POSITION. TANGENTIAL OR AXIAL LOADS ON THE HOOK ARE PREVENTED FROM REACHING THE CABLE BY MEANS OF A LATCH. ARRESTING HOOK LOADS ARE TRANSMITTED DIRECTLY TO THE FUSELAGE STRUCTURE. A SPRING AND OLEO STRUT MAINTAINS FORCE ON THE HOOK WHEN IT IS EXTENDED.

CATAPAULTING
THE AIRPLANE CAN BE CATAPAULTED FROM THE DECK OF AN AIRCRAFT CARRIER. FITTINGS ARE PROVIDED ON THE LANDING GEAR SUPPORT STRUCTURE AND THE EMPENNAGE.

ENGINE OIL DILUTION
ENGINE OIL LINES.
SOLENOID VALVE.
DIVERTER VALVE.
RESTRICTED OIL DILUTION FITTING.
MANUALLY OPERATED SHUT-OFF VALVE.

PROPELLER GOVERNOR OPERATION
THE ENTIRE OPERATION IS ELECTRICALLY CONTROLLED. PROPELLER R.P.M. IS CONTROLLABLE BY THE PILOT WITHIN THE RANGE OF THE GOVERNOR. ONCE THE R.P.M. IS SELECTED IT REMAINS CONSTANT WITHIN THE OPERATING RANGE OF THE GOVERNOR. THE GOVERNOR IS NOT EFFECTIVE OVER 2700 R.P.M.

ENGINE STARTER OPERATION
THE ENGINE STARTER BREECH IS LOCATED ON THE RIGHT SIDE OF THE ENGINE COMPARTMENT. A CARTRIDGE IS INSERTED INTO THE BREECH. PILOT FIRES THE CARTRIDGE ELECTRICALLY, EXPANDING GASES ENERGIZE THE STARTER, WHICH IN TURN MESHES WITH THE ENGINE GEAR MECHANISM. 8 CARTRIDGES ARE CARRIED IN A CONTAINER.

ENGINE EXHAUST SYSTEM
THE EXHAUST PIPES ARE ATTACHED TO THE ENGINE EXHAUST PORTS. FOUR PIPES ON THE LEFT SIDE AND FIVE ON THE RIGHT SIDE. THE ENGINE COWLING IS CONCAVE AT THE EDUCTION AREA AND IS MADE OF STAINLESS STEEL.

ENGINE QUICK CHANGE UNIT
THE ENGINE QUICK CHANGE UNIT IS SUPPLIED AS A SPARE TO FACILITATE ENGINE CHANGE AND REPAIR UNDER COMBAT MAINTENANCE CONDITIONS. THE UNIT CONSISTS OF ALL COMPONENTS OF FUNCTIONAL SYSTEMS WHICH ARE ATTACHED TO THE ENGINE OR THE ENGINE MOUNT. INCLUDED IN THE UNIT ARE THE COWLING AND THE ENGINE MOUNT.

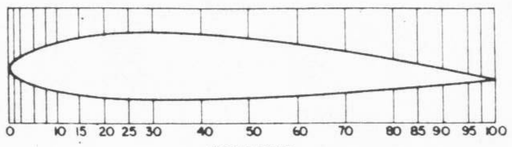
CARBURETOR AIR FILTER
AIR FILTERS ARE INSTALLED OVER EACH AIR DOOR IN THE CARBURETOR AIR HEADER.

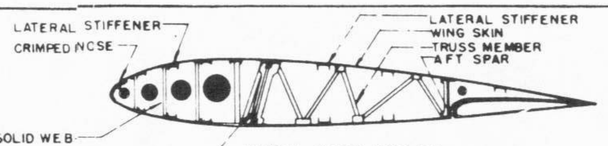
ENGINE SUPERCHARGER
THE TWO SPEED SUPERCHARGER IS LOCATED IN THE AIR INTAKE MANIFOLD CHAMBER. THE FUEL-AIR MIXTURE ENTERS THE IMPELLER AFTER LEAVING THE CARBURETOR. IT IS BOOSTED TO GREATER PRESSURE AND FLOWS IN THE INTAKE MANIFOLD TO THE ENGINE CYLINDERS. THE IMPELLER IS GEARED TO THE ENGINE CRANKSHAFT, AND ALWAYS OPERATES IN LOW OR HIGH BLOWER, DEPENDING ON THE PILOT'S SETTING OF THE SUPERCHARGER CONTROL LEVER.

MACHINE GUN CHARGERS
THE GUN CHARGERS ARE CABLE OPERATED. THE HANDLES FOR MANUAL OPERATION ARE LOCATED ON EACH SIDE OF THE PILOT'S SEAT; AN UPWARD PULL CHARGES THE GUN.

MACHINE GUN FIRING
THE GUNS ARE FIRED ELECTRICALLY BY SOLENOIDS MOUNTED ON EACH GUN. THEY CAN BE FIRED AS A BATTERY OR IN UNITS OF TWO INBOARD OR TWO OUTBOARD. A SELECTOR SWITCH MAKES THIS POSSIBLE. THE TRIGGER IS THE STANDARD CONTROL STICK TYPES. GUNS ARE MANUALLY AND OPTICALLY BORESIGHTED.

SHEET NO. 4





NOTE:
THE F4F-4 COULD NOT OUTPERFORM THE JAPANESE ZERO FIGHTER, BUT BEING A STURDY BUILT AIRPLANE, IT COULD WITHSTAND AERIAL COMBAT DAMAGE TO A GREATER DEGREE AND PROVIDE SAFETY FOR THE PILOT. SEE "SAMURAI" BY SABURO SAKAI, JAPANESE ACE. SAKAI FOUGHT AGAINST THE WILDCAT.

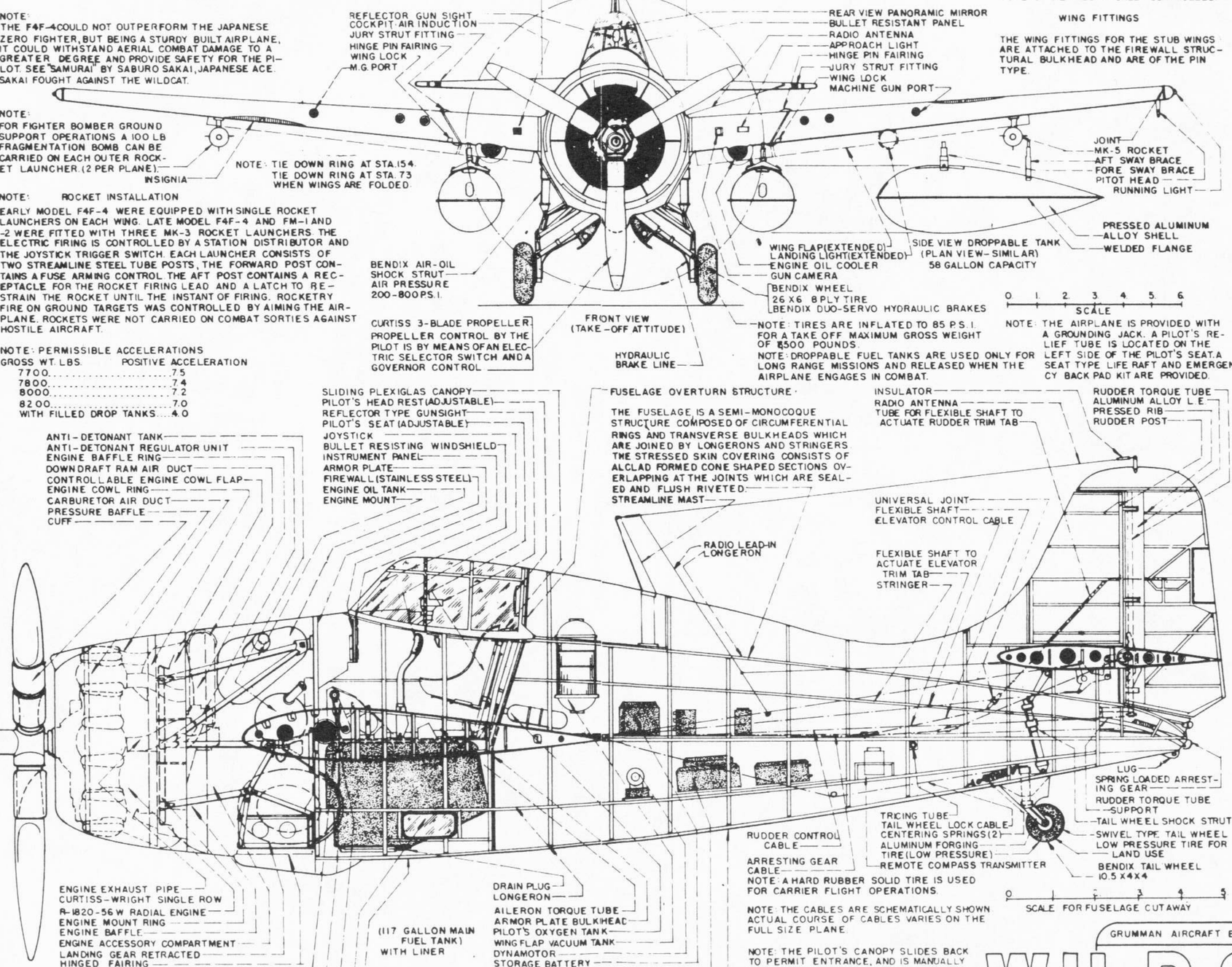
NOTE:
FOR FIGHTER BOMBER GROUND SUPPORT OPERATIONS A 100 LB FRAGMENTATION BOMB CAN BE CARRIED ON EACH OUTER ROCKET LAUNCHER. (2 PER PLANE).

NOTE: TIE DOWN RING AT STA.154. TIE DOWN RING AT STA. 73 WHEN WINGS ARE FOLDED.

NOTE: ROCKET INSTALLATION
EARLY MODEL F4F-4 WERE EQUIPPED WITH SINGLE ROCKET LAUNCHERS ON EACH WING. LATE MODEL F4F-4 AND FM-1 AND -2 WERE FITTED WITH THREE MK-3 ROCKET LAUNCHERS. THE ELECTRIC FIRING IS CONTROLLED BY A STATION DISTRIBUTOR AND THE JOYSTICK TRIGGER SWITCH. EACH LAUNCHER CONSISTS OF TWO STREAMLINE STEEL TUBE POSTS, THE FORWARD POST CONTAINS A FUSE ARMING CONTROL. THE AFT POST CONTAINS A RECEPTACLE FOR THE ROCKET FIRING LEAD AND A LATCH TO RESTRAIN THE ROCKET UNTIL THE INSTANT OF FIRING. ROCKETRY FIRE ON GROUND TARGETS WAS CONTROLLED BY AIMING THE AIRPLANE. ROCKETS WERE NOT CARRIED ON COMBAT SORTIES AGAINST HOSTILE AIRCRAFT.

NOTE: PERMISSIBLE ACCELERATIONS

GROSS WT. LBS.	POSITIVE ACCELERATION
7700	7.5
7800	7.4
8000	7.2
8200	7.0
WITH FILLED DROP TANKS	4.0



NOTE: TIRES ARE INFLATED TO 85 P.S.I. FOR A TAKE OFF MAXIMUM GROSS WEIGHT OF 8500 POUNDS.

NOTE: DROPPABLE FUEL TANKS ARE USED ONLY FOR LONG RANGE MISSIONS AND RELEASED WHEN THE AIRPLANE ENGAGES IN COMBAT.

NOTE: THE AIRPLANE IS PROVIDED WITH A GROUNDING JACK. A PILOT'S RELIEF TUBE IS LOCATED ON THE LEFT SIDE OF THE PILOT'S SEAT. A SEAT TYPE LIFE RAFT AND EMERGENCY BACK PAD KIT ARE PROVIDED.

NOTE: A PILOT'S BAGGAGE COMPARTMENT IS ACCESSIBLE THROUGH A HINGED ACCESS DOOR AT STATION 9 RIGHT SIDE OF FUSELAGE.

NOTE: THE FUEL TANK CAN BE REMOVED BY REMOVAL OF THE ACCESS PANELS BETWEEN STATIONS 2 AND 5 ON THE BELLY OF THE FUSELAGE.

NOTE: A HARD RUBBER SOLID TIRE IS USED FOR CARRIER FLIGHT OPERATIONS.

NOTE: THE CABLES ARE SCHEMATICALLY SHOWN ACTUAL COURSE OF CABLES VARIES ON THE FULL SIZE PLANE.

NOTE: THE PILOT'S CANOPY SLIDES BACK TO PERMIT ENTRANCE, AND IS MANUALLY OPERATED IT CAN BE LOCKED AT FOUR POSITIONS. FOR EMERGENCY EXIT, THE CANOPY IS PROVIDED WITH TWO INSIDE QUICK RELEASE LATCHES. AN EXTERIOR RELEASE LATCH IS ALSO PROVIDED. THE SIDE LIGHTS ARE CLEAR PLEXIGLAS.

COCKPIT VENTILATION
FRESH AIR IS INDUCTED INTO THE COCKPIT BY MEANS OF AN AIR DUCT IN THE RIGHT STUB WING. FLEXIBLE TUBING LEADS IT TO THE COCKPIT AT THE CENTERLINE OF THE COCKPIT FORWARD OF THE JOYSTICK.

GUN CAMERA
A 16 M.M. ELECTRICALLY OPERATED AND HEATED GUN CAMERA IS LOCATED IN THE LEFT WING STUB WHEN THE GUN TRIGGER IS OPERATED, THE CAMERA TAKES A MOVING PICTURE AUTOMATICALLY. THE MOVIE FILM CAN BE PROJECTED TO CHECK GUNNERY RESULTS. THE CAMERA TEMPERATURE IS THERMOSTATICALLY CONTROLLED.

WING FITTINGS
THE WING FITTINGS FOR THE STUB WINGS ARE ATTACHED TO THE FIREWALL STRUCTURAL BULKHEAD AND ARE OF THE PIN TYPE.

U.S. NAVY F4F-3P
NAVY F4F-3P WAS A MODIFIED VERSION INTENDED FOR LONG RANGE PHOTO RECONNAISSANCE. IT WAS EQUIPPED WITH LONG RANGE FUEL TANKS AND A MULTIPLE AERIAL CAMERA INSTALLATION. ONLY A FEW PLANES WERE SO MODIFIED.

GRUMMAN G-36
THIS AIRPLANE WAS BUILT FOR EXPORT AND VARIED FROM THE U.S. NAVY F4F-3 IN SEVERAL EQUIPMENT DETAILS. THE G-36 WAS ESSENTIALLY A FIGHTER BOMBER.

FIRST PRODUCTION
THE FIRST FIGHTERS COMPLYING WITH NAVAL CARRIER QUALIFICATIONS WERE THE MODEL F4F-3 WITH RIGID WINGS. THE FIRST AIRPLANE CONTRACT FOR F4F-3 "WILDCATS" WAS DELIVERED TO THE U.S. NAVY IN 1940.

MACHINE GUN HEATERS
GUN HEATERS ARE LOCATED OVER THE GUN BREECH AND RETRACTING SLIDE. THE CIRCUIT IS CONNECTED DIRECTLY TO THE ELECTRIC GENERATOR.

ELECTRICAL SWITCHES
SECTION LIGHTS.
FORMATION LIGHTS.
FLASH SWITCH.
WING RUNNING LIGHTS.
TAIL RUNNING LIGHT.
GUN MASTER SWITCH.
GUN CAMERA.
PITOT TUBE HEATER.
ENGINE STARTER.
FUEL PRIMER.
GUN SELECTOR. (2)
STORAGE BATTERY.
RECOGNITION LIGHTS.
GENERATOR FIELD.
ENGINE OIL DILUTION.
MASTER RADIO SWITCH.
APPROACH LIGHT MANUAL
RADIO DESTRUCTOR.
MACHINE GUN HEATER.
ENGINE IGNITION.

RHEOSTATS
ELECTRIC PANEL LIGHTS.
COCKPIT LIGHTS.
COMPASS LIGHT.
INSTRUMENT PANEL
CHART BOARD LIGHT.

PERFORMANCE DATA

GROSS WEIGHT	7340 LBS.
TAKE-OFF DISTANCE (17 M.P.H. HEAD WIND) IS	283 FT. GRD. RUN
BEST CLIMBING SPEED AT SEA LEVEL	144 M.P.H.
LANDING RUN AT SEA LEVEL	794 FEET.
LANDING SPEED (I.A.S.)	84 M.P.H.
ENGINE MILITARY POWER	2600 H.P.
ENGINE MANIFOLD PRESSURE	46.5 H.G.
BLOWER SETTING	LOW
MIXTURE SETTING	AUTO LEAN
FUEL CONSUMPTION (MAXIMUM)	147 G.P.H.
CRUISING SPEED (25,000 FT.)	252 M.P.H.
FUEL CONSUMPTION (CRUISE)	56 G.P.H.
MAXIMUM AIR SPEED (C.A.A.)	365 M.P.H.
TAKE-OFF POWER (2700 R.P.M.)	1300 H.P.
NORMAL RATED POWER	1200 H.P.
FUEL GRADE	100/130 SPEC
SERVICE CEILING	28,000 FT.
MAXIMUM RATE OF CLIMB	3240 F.P.M.
NORMAL RANGE (STILL AIR)	900 MILES

COLOR SYSTEM
THE EXTERIOR SURFACES WERE PAINTED NON-SPECULAR WHITE, INTERMEDIATE BLUE, SEA BLUE AND SEA BLUE SEMI-GLOSS. VARIOUS COLORS ARE BLENDED. DEFINITE LINES OF DEMARCATION ARE AVOIDED BY APPLYING THE COLORS IN AN IRREGULAR WAVY LINE AND THEN FEATHERING.

INSTRUMENT PANEL	BLACK.
COCKPIT INTERIOR	DARK GREEN.
LANDING GEAR FAIRING	BLACK.
PITOT TUBE	NON-SPECULAR RED.
LANDING GEAR	NON-SPECULAR BLACK.
WHEELS	TO MATCH FUSELAGE AREA.
WALKWAYS	BLACK OUTLINE.
ENGINE	BLACK.
PROPELLER HUB	BLACK.
PROPELLER CUFF	BLACK.
PROPELLER BLADE (REAR)	BLACK.
PROPELLER BLADE (FRONT)	ALUMINUM.
TIRES	BLACK.
DROP TANKS	WHITE.

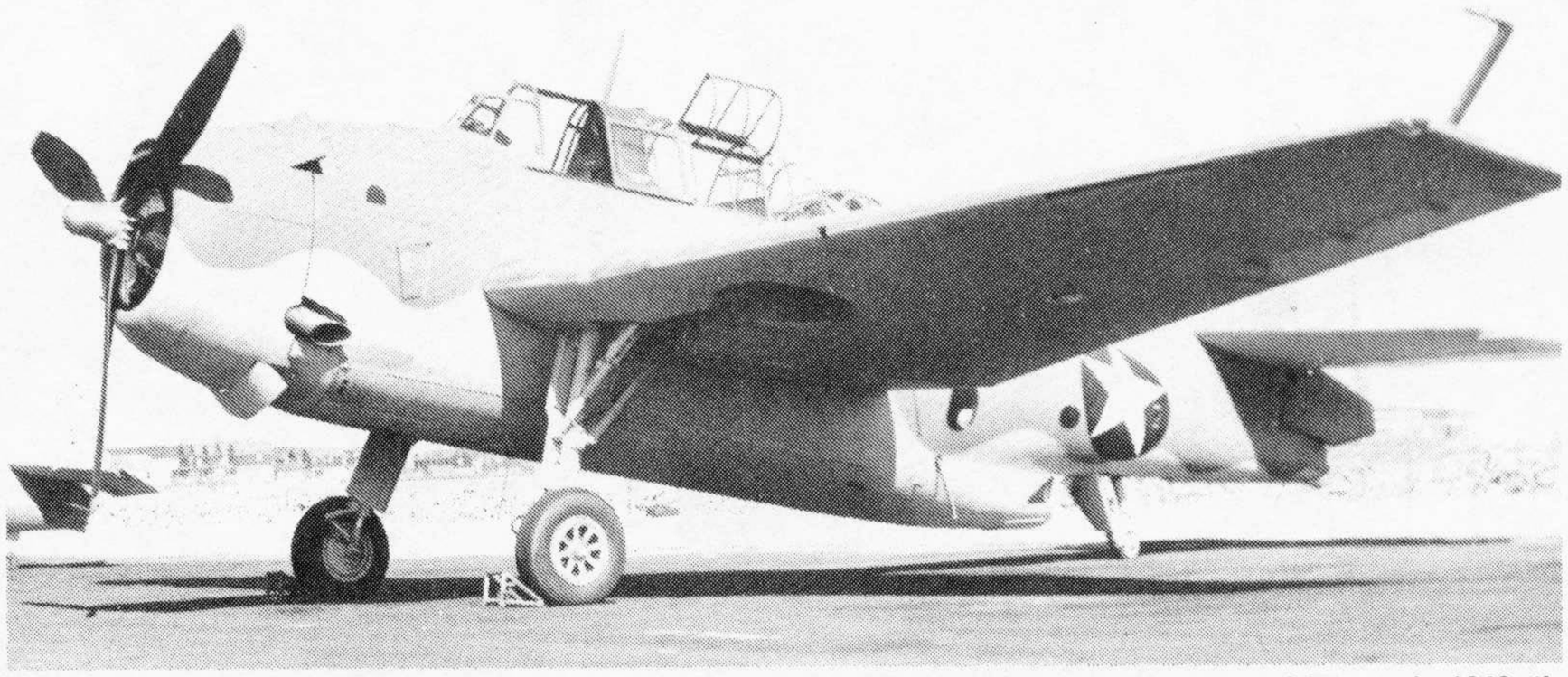
GRUMMAN AIRCRAFT ENGINEERING CORPORATION (F4F PLANES)

WILDCAT

DRAWN BY WILLIS L. NYE FOR MODEL AIRPLANE NEWS 11-3-59.

GRUMMAN F4F WILDCAT

GRUMMAN TBF AVENGER



A General Motors-built TBM-1 Avenger. The blue-gray and light-gray color scheme was used into early 1943; the centerless, unbordered star was used from May 15, 1942, through June 29, 1943.

WHEN the obsolete Douglas TBD-1 Devastator was retired after the Battle of Midway in June 1942, the Grumman-designed Avenger became the only designated Torpedo-Bomber to serve with the U.S. Navy. Other types could and did carry and launch torpedoes, but that wasn't their primary duty.

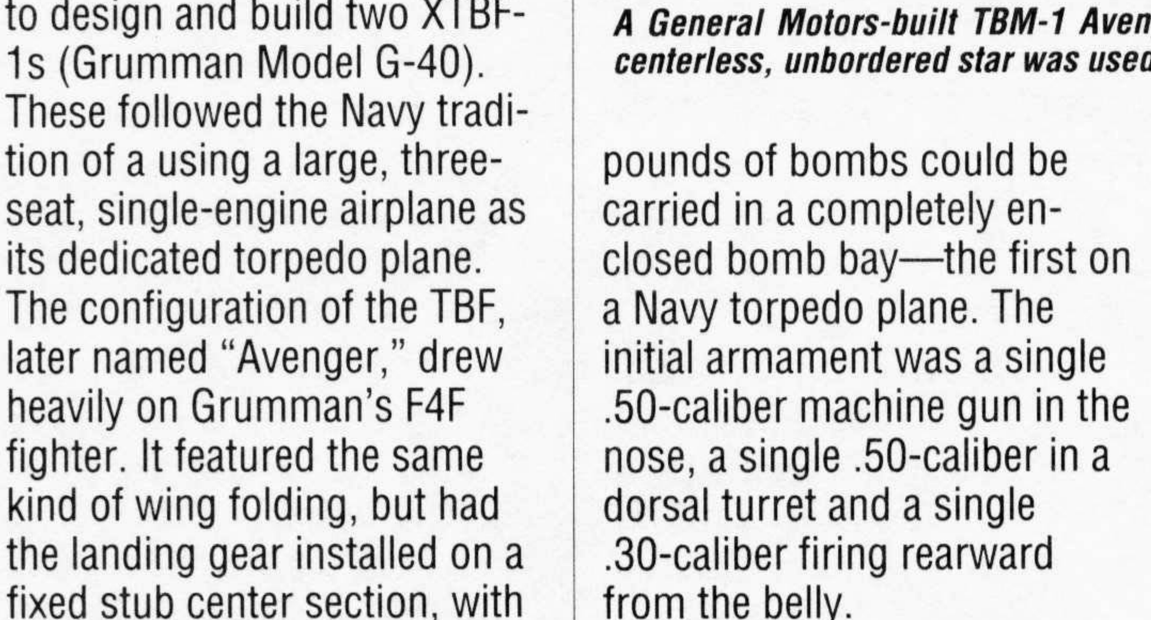
In April 1940, the Navy awarded Grumman a contract to design and build two XTBF-1s (Grumman Model G-40). These followed the Navy tradition of a using a large, three-seat, single-engine airplane as its dedicated torpedo plane. The configuration of the TBF, later named "Avenger," drew heavily on Grumman's F4F fighter. It featured the same kind of wing folding, but had the landing gear installed on a fixed stub center section, with the wheels retracting outward into the outer wing panels. A naval torpedo or up to 2,000 pounds of bombs could be carried in a completely enclosed bomb bay—the first on a Navy torpedo plane. The initial armament was a single .50-caliber machine gun in the nose, a single .50-caliber in a dorsal turret and a single .30-caliber firing rearward from the belly.

The first XTBF-1 flew on August 1, 1941; the first production model, ordered in December 1940, flew in January 1942. Because Grumman's plant was heavily involved in fighter production, the Eastern Aircraft plant of General Motors was asked to build Avengers (in addition to the Wildcats already being built there), and designate them "TBMs." The two plants produced 9,836 Avengers: 2,990 by Grumman and 7,546 by General Motors. Grumman's production ended early in 1944, but General Motors carried on until the postwar cancellations.

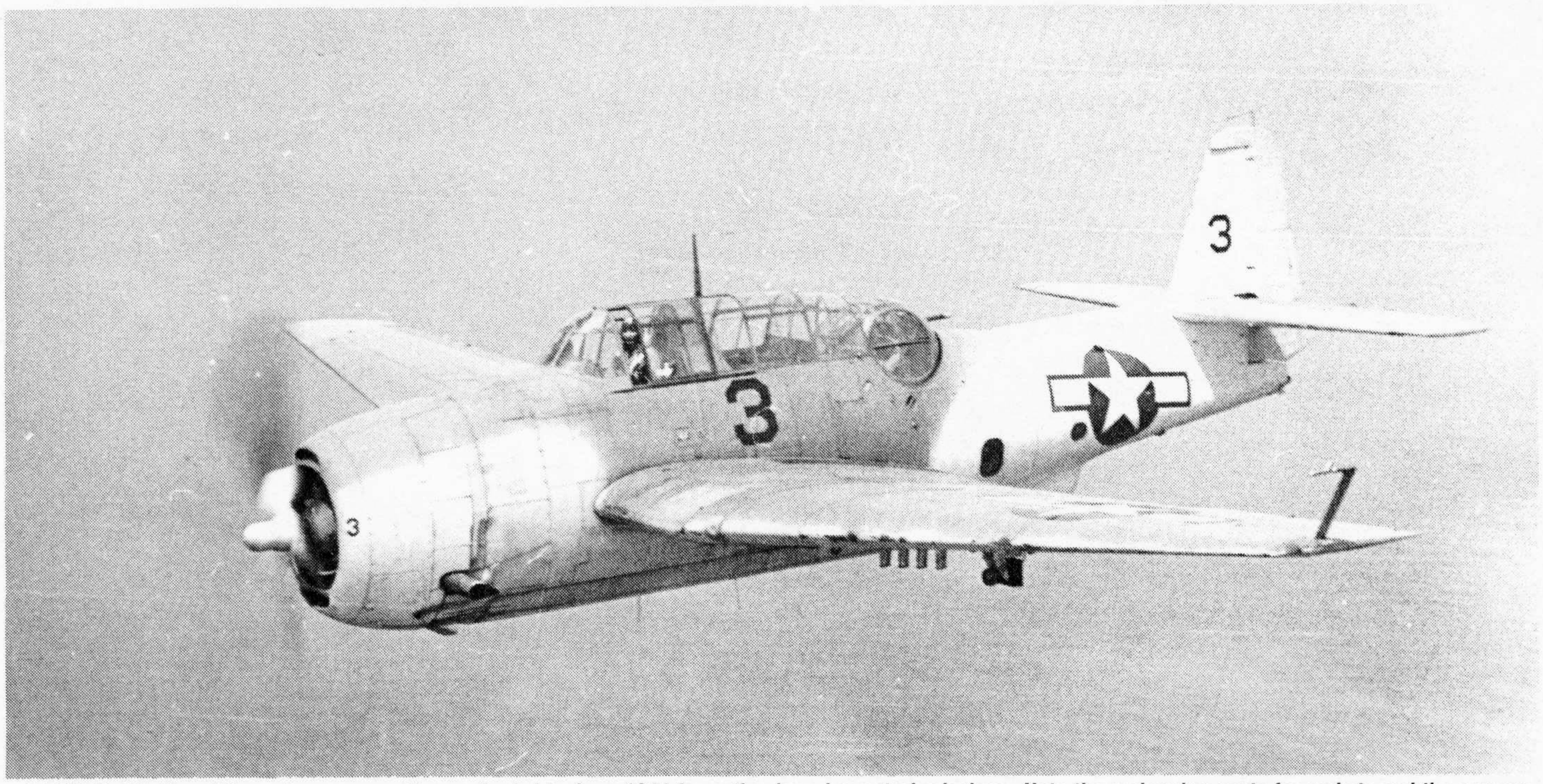
While both firms developed several experimental variants of the Avenger, the principal production versions were -1s from Grumman and -1s and -3s from GM. Grumman built 1,525 TBF-1s and 764 TBF-1Cs (the latter had two .50-caliber guns in the wings). General Motors built 550 TBM-1s, 2,730 TBM-1Cs and 4,657 TBM-3s.

Special-purpose variants of the Avenger were plentiful. The TBF-1D had special radar, and the TBF-1CP had reconnaissance cameras. The TBF-1E had search radar for anti-submarine patrol, the TBF-1J was equipped for all-weather flying, and the TBF-1L carried a searchlight in the bomb bay for night attack missions.

Similar suffix letters (plus others) applied to the TBM-3s. The TBM-3H had special search radar, and the TBM-3W, widely used after the war, had APS-20 search radar in a large belly radome, which required additional vertical fins for longitudinal stability. The similar TBM-3W2 had the dorsal turret removed and faired over. These planes teamed with TBM-3S Strike variants to form anti-submarine Hunter-Killer pairs. Other postwar TMB-3 variants were the TBM-3U target tug, the TBM-3N night fighter, the



A Grumman TBF-1 with two-tone camouflage and the Navy rudder stripes used only from January 4, 1942, through May 15, 1942.



A TBM-3 with the white and gray camouflage adopted in June 1944 for anti-submarine patrol missions. Note the underwing posts for rockets and the camera outboard of the rocket mounts.

TBM-3Q (for radar countermeasures) and the seven-seat TBM-3R transport.

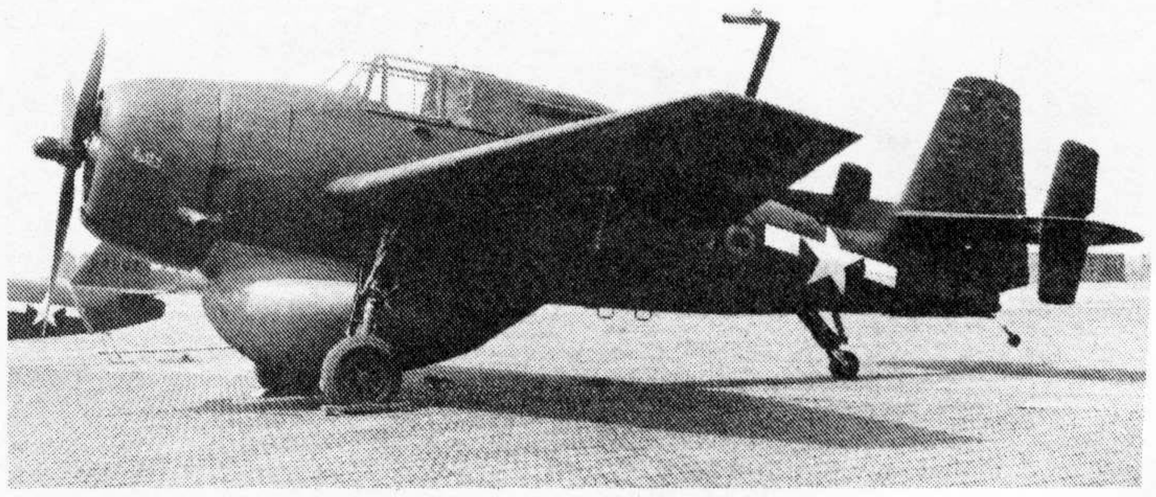
Britain's Royal Navy received 957 Avengers (which they originally named "Tarpon") as follows: Avenger I, 401 TBF-1Bs ("B" for Britain) and TBF-1Cs; Avenger II, 334 TBM-1s; Avenger III, 222 TBM-3.

The combat debut of the Avenger at the Battle of Midway on June 6, 1942, was a complete disaster. Crews from Torpedo Squadron 8 on the carrier U.S.S. Hornet flew six new TBF-1s from the East Coast all the way to Hawaii. There they found that their ship, with the squadron's old TBDs, had already left for Midway Island, so the Avengers had to fly there.

The battle, although a major victory for the U.S., was a disaster for Torpedo 8. It proved that big, slow, low-level torpedo planes couldn't penetrate the defenses of a complete fleet on the open sea that was defended by surface guns and carrier-based fighters. All of Torpedo 8's TBDs and five of its six TBFs were wiped out, and the survivor was severely crippled. The major damage to the Japanese ships was done by Douglas SBD Dauntless dive bombers.

Loss of the torpedo planes in this first attack on a complete high-seas fleet didn't diminish the Navy's interest in the type (as shown by the production figures), but it did change their tactics. TBMs remained in first-line fleet service until June 1954, and others served in the reserve training squadrons for several more years. Surplus Avengers were widely used as aerial tankers (to fight forest fires), and some are still in use in 1990—50 years after the Avenger was designed.

In a typical WW II publicity photo, Navy crewmen load a torpedo into the bomb bay of a TBM-1.



A General Motors TBM-3 Guppy with a belly radome and faired-over dorsal gun turret. Note the added fin area. It had the overall glossy sea-blue camouflage adopted for ship-based fighters in March 1944. Other carrier types adopted it in October.

TBM-3 "AVENGER"

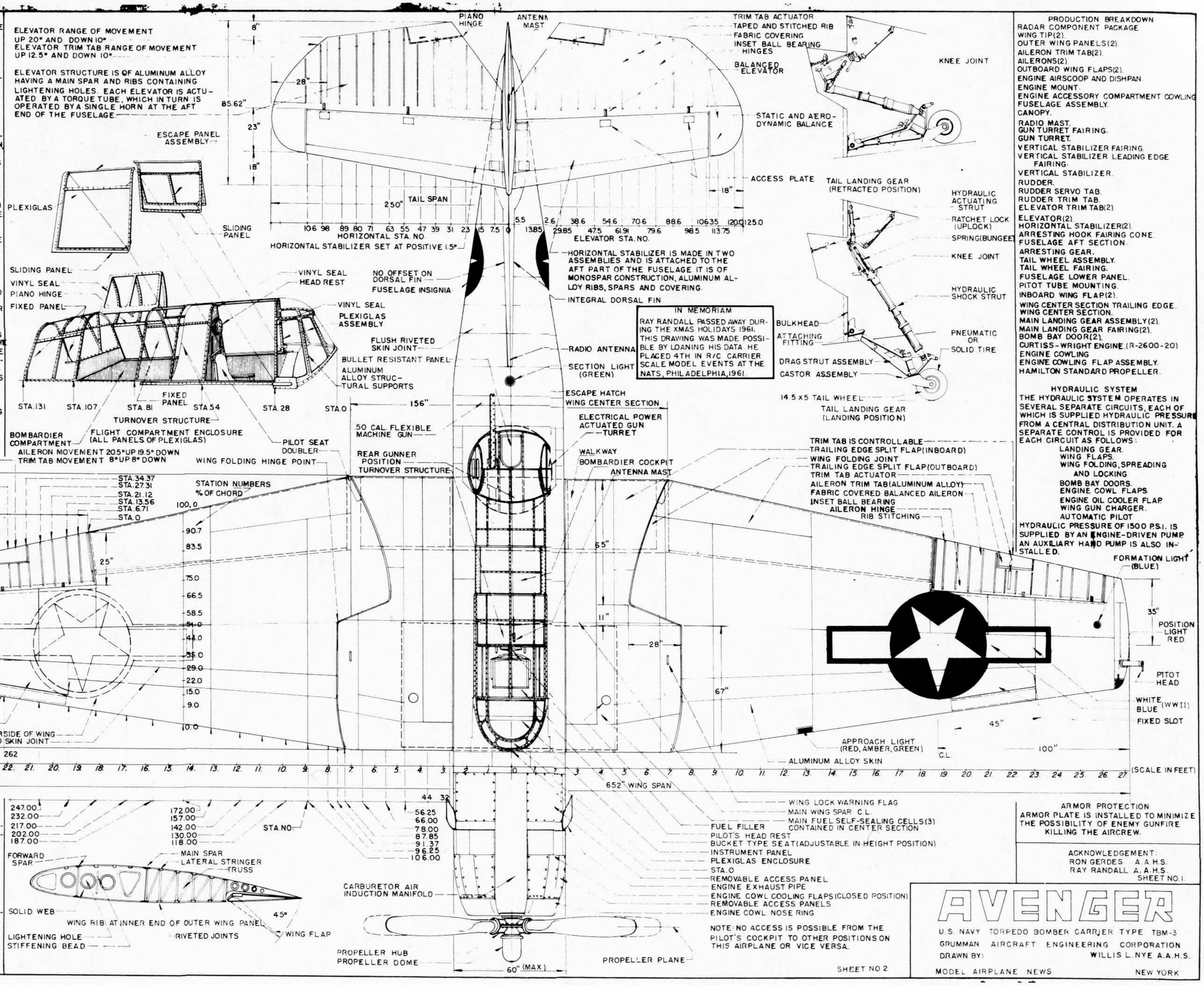
THE TBM-3 "AVENGER" IS A SINGLE ENGINE MID-WING, ALL METAL MONOPLANE OF SEMI-MONOCOQUE CONSTRUCTION. IT IS FLOWN FROM CARRIERS OR FROM SHORE BASED NAVAL AIR STATIONS. IT IS USED FOR MANY NAVAL AIR FUNCTIONS. THE AVENGER WITH A TORPEDO OR BOMBS CARRIED IN THE BOMB BAY, AND WITH RADAR AND GUN PACKAGES CARRIED UNDER THE WINGS, FIXED GUNS IN ADDITION TO THE TURRET MOUNTED FLEXIBLE GUN, MAKES THE TORPEDO BOMBER A FORMIDABLE WEAPON OF THE CARRIER AIR GROUP. THE AVENGER WAS MANUFACTURED BY THE EASTERN AIRCRAFT DIVISION, GENERAL MOTORS CORPORATION, AT TRENTON, NEW JERSEY. THE DESIGN WAS MADE UNDER LICENSE FROM GRUMMAN AIRCRAFT ENGINEERING CORPORATION.

WING FLAP INSTALLATION

THE WING FLAPS ARE MADE OF ALUMINUM ALLOY ARE OF THE SPLIT BALANCED TYPE. THE INBOARD FLAP EXTENDS FROM THE FUSELAGE TO THE OUTER WING PANEL. THE OUTBOARD FLAP EXTENDS FROM THE INBOARD END OF THE OUTER PANEL TO THE INNER END OF THE AILERON. THE OUTBOARD FLAP IS CARRIED ON FOUR HINGES. THE INBOARD FLAP IS HINGED TO THE CENTER SECTION AT TWO FITTINGS. THE OUTBOARD FLAPS ARE EXTENDED AND RETRACTED BY HYDRAULIC ACTUATING CYLINDERS(2). THE ACTION OF THE OUTER WING FLAPS IS TRANSFERED TO THE IN- ER FLAPS BY BEARING BLOCKS. THE NER FLAPS ARE RETRACTED BY MEANS TENSION SPRINGS. WING FLAPS ON THE T BOARD WINGS EXTEND 45° DOWN. THE BOARD FLAPS EXTEND TO 50°. THE LAND- EAR AND WING FLAP OPERATE IN U- N AND ARE INTERCONNECTED UNLESS FIED. THE INNER FLAPS ARE RE- CTED IN EXTENDING BEYOND 50° AND ATE SIMULTANEOUSLY WITH OUTER S BY MEANS OF DURALUMIN BEARING KS.

ELEVATOR RANGE OF MOVEMENT
UP 20° AND DOWN 10°
ELEVATOR TRIM TAB RANGE OF MOVEMENT
UP 12.5° AND DOWN 10°

ELEVATOR STRUCTURE IS OF ALUMINUM ALLOY HAVING A MAIN SPAR AND RIBS CONTAINING LIGHTENING HOLES. EACH ELEVATOR IS ACTUATED BY A TORQUE TUBE, WHICH IN TURN IS OPERATED BY A SINGLE HORN AT THE AFT END OF THE FUSELAGE.



NOTE: NO ACCESS IS POSSIBLE FROM THE PILOT'S COCKPIT TO OTHER POSITIONS ON THIS AIRPLANE OR VICE VERSA.

SHEET NO.2

ELECTRICAL SYSTEM

THE ELECTRICAL SYSTEM IS A SINGLE WIRE GROUND RETURN TYPE. CURRENT IS SUPPLIED BY AN ENGINE-DRIVEN GENERATOR WHICH CARRIES THE ELECTRICAL LOAD AND ALSO RECHARGES TWO 12-VOLT, 34-AMPERE-HOUR STORAGE BATTERIES, CONNECTED IN A SERIES HOOK-UP.
A DIRECT CURRENT RECEPTACLE IS PROVIDED FOR PLUGGING TO A BATTERY CART POWER SOURCE FOR ENGINE STARTING, FOR OPERATION OF THE GUN-TURRET WHEN THE AIRPLANE IS GROUNDED, OR FOR PERFORMING AN ELECTRICAL WHEN ON THE GROUND. AN ALTERNATING CURRENT POWER RECEPTACLE IS AVAILABLE TO CHECK ELECTRONIC AND RADIO DEVICES.

PRODUCTION BREAKDOWN

RADAR COMPONENT PACKAGE.
WING TIP(2).
OUTER WING PANELS(2).
AILERON TRIM TAB(2).
AILERONS(2).
OUTBOARD WING FLAPS(2).
ENGINE AIRSCOOP AND DISHPAN.
ENGINE MOUNT.
ENGINE ACCESSORY COMPARTMENT COWLING.
FUSELAGE ASSEMBLY.
CANOPY.
RADIO MAST.
GUN TURRET FAIRING.
GUN TURRET.
VERTICAL STABILIZER FAIRING.
VERTICAL STABILIZER LEADING EDGE FAIRING.
VERTICAL STABILIZER.
RUDDER.
RUDDER SERVO TAB.
RUDDER TRIM TAB.
ELEVATOR TRIM TAB(2)
ELEVATOR(2).
HORIZONTAL STABILIZER(2).
ARRESTING HOOK FAIRING CONE.
FUSELAGE AFT SECTION.
ARRESTING GEAR.
TAIL WHEEL ASSEMBLY.
TAIL WHEEL FAIRING.
FUSELAGE LOWER PANEL.
PITOT TUBE MOUNTING.
INBOARD WING FLAP(2).
WING CENTER SECTION TRAILING EDGE.
WING CENTER SECTION.
MAIN LANDING GEAR ASSEMBLY(2).
MAIN LANDING GEAR FAIRING(2).
BOMB BAY DOOR(2).
CURTISS-WRIGHT ENGINE.(R-2600-20)
ENGINE COWLING
ENGINE COWLING FLAP ASSEMBLY.
HAMILTON STANDARD PROPELLER.

HYDRAULIC SYSTEM

THE HYDRAULIC SYSTEM OPERATES IN SEVERAL SEPARATE CIRCUITS, EACH OF WHICH IS SUPPLIED HYDRAULIC PRESSURE FROM A CENTRAL DISTRIBUTION UNIT. A SEPARATE CONTROL IS PROVIDED FOR EACH CIRCUIT AS FOLLOWS:

LANDING GEAR.
WING FLAPS.
WING FOLDING, SPREADING AND LOCKING
BOMB BAY DOORS.
ENGINE COWL FLAPS.
ENGINE OIL COOLER FLAP.
WING GUN CHARGER.
AUTOMATIC PILOT

HYDRAULIC PRESSURE OF 1500 P.S.I. IS SUPPLIED BY AN ENGINE-DRIVEN PUMP. AN AUXILIARY HAND PUMP IS ALSO INSTALLED.

ARMOR PROTECTION

ARMOR PLATE IS INSTALLED TO MINIMIZE THE POSSIBILITY OF ENEMY GUNFIRE KILLING THE AIRCREW.

ACKNOWLEDGEMENT:
RON GERDES A.A.H.S.
RAY RANDALL A.A.H.S.

SHEET NO.1

AVENGER

U.S. NAVY TORPEDO BOMBER CARRIER TYPE TBM-3

GRUMMAN AIRCRAFT ENGINEERING CORPORATION
DRAWN BY: WILLIS L. NYE A.A.H.S.

MODEL AIRPLANE NEWS NEW YORK

TBF MODIFICATIONS OF WORLD WAR II.
THE TBF PLANE HAD ITS FIRST COMBAT ACTION AT THE BATTLE OF MIDWAY. SIX PLANES OF THIS TYPE FOUGHT THERE.

XTBF-1	GRUMMAN AIRCRAFT	
XTBF-2	"	
XTBF-3	"	
TBF-1	"	
TBF-1B	"	
TBF-1C	"	
XTBM-3	EASTERN AIRCRAFT	
XTBM-4	"	"
TBM-1	"	"
TBM-1C	"	"
TBM-3	"	"
TBM-3E	"	"
TBM-4	"	"
TBM-3S (FOR ANTI-SUBMARINE USE)		

9836 PLANES OF THIS TYPE WERE BUILT. SURPLUS PLANES WERE MODIFIED FOR FOREST FIRE FIGHTING.

GUN TURRET

THE ELECTRICALLY OPERATED GUN TURRET IS EQUIPPED WITH A 50-CALIBER AUTOMATIC MACHINE GUN. 200 ROUNDS OF AMMO ARE CARRIED. AN ILLUMINATED GUN SIGHT, A GUN CAMERA, AN OXYGEN REGULATOR, AN OXYGEN FLOW INDICATOR, A RADIO CONTROL BOX AND A LIGHT ARE PROVIDED. THE CONTROL OF THE TURRET IS SUCH AS TO PERMIT NORMAL SPEED FOR ELEVATION AND TRAIN AND A HIGHER SPEED FOR SLEWING. THE NORMAL SPEED FOR ELEVATION IS 12° PER SECOND AND THE NORMAL TRAIN SPEED IS 20° PER SECOND. THE HIGH SPEED SWITCH SWITCH ON THE CONTROL UNIT INCREASES THE SPEED TO 30° PER SECOND FOR ELEVATION AND 45° FOR TRAIN OPERATION. THE VERTICAL MOTION HAS A RANGE OF 115° 30° BELOW TO 85° ABOVE THE HORIZONTAL. THE TRAIN OPERATION IS EITHER CLOCKWISE OR COUNTERCLOCKWISE THROUGH 360° IN AN EMERGENCY, THE TURRET CAN BE MANUALLY OPERATED.

OXYGEN SYSTEM

A HIGH PRESSURE, DILUTER DEMAND TYPE OXYGEN SYSTEM IS INSTALLED. THE OXYGEN CYLINDER HAS A CUBIC CAPACITY OF 314 CUBIC INCHES OF OXYGEN AT 1800 P.S.I. EACH CREW MEMBER HAS ACCESS TO THE OXYGEN AT ALL TIMES DURING FLIGHT.

HEATING AND VENTILATION

HEATERS BURNING GASOLINE ARE INSTALLED TO KEEP THE AIRCREW WARM. WITH THE WARM AIR SUPPLY AVAILABLE, CONTROL VALVES DIRECT IT AS DESIRED TO THE AIRCREW STATIONS. THE SYSTEM CAN BE USED FOR COLD AIR VENTILATION WHEN THE HEATER CONTROLS ARE OFF.

AUTOMATIC PILOT

A TYPE G-1 AUTOMATIC PILOT IS INSTALLED AND PROVIDES CONTROL OF ALL FLIGHT SYSTEMS AS SET BY THE PILOT. THE AUTOMATIC PILOT GIVES AN INSTRUMENT INDICATION OF ALL NORMAL MOVEMENTS OF THE AIRPLANE FOR MANUAL OR AUTOMATIC FLIGHT. IT IS OPERATED BY HYDRAULIC PRESSURE OF 150 P.S.I. SUPPLIED BY THE ENGINE-DRIVEN HYDRAULIC PUMP.

AIRFOIL SECTION

WING ROOT AIRFOIL	NACA 23015
WING TIP AIRFOIL	NACA 23009
WING ROOT CHORD	143"

LIFE RAFT

A MARK 4, TYPE D, LIFERAFT IS STOWED IN A FUSELAGE COMPARTMENT ON THE UPPER PART OF THE STRUCTURE BETWEEN THE MIDDLE COCKPIT AND THE GUN TURRET.

TOW TARGET

PROVISION IS MADE FOR A TOW TARGET.

DROP TARGET

PROVISION IS MADE FOR A DROP TARGET.

SMOKE TANK

THE SMOKE SCREEN TANK IS CARRIED IN THE BOMB BAY. IT CAN BE RELEASED ELECTRICALLY OR MANUALLY.

PYROTECHNICS

EIGHT A-NMARK 4 FLOAT LIGHTS ARE STOWED IN A RACK IN THE BOMBARDIER'S COMPARTMENT.

PILOT'S CHARTBOARD

THE CHARTBOARD BELOW AND FORWARD OF THE MAIN INSTRUMENT PANEL.

SPARE AMMUNITION

200 ROUNDS OF SPARE AMMUNITION ARE CARRIED FOR GUN IN THE TURRET.

LOWER AFT MACHINE GUN

THIS M.G. IS MANUALLY FIRED. 200 ROUNDS OF AMMUNITION ARE CARRIED.

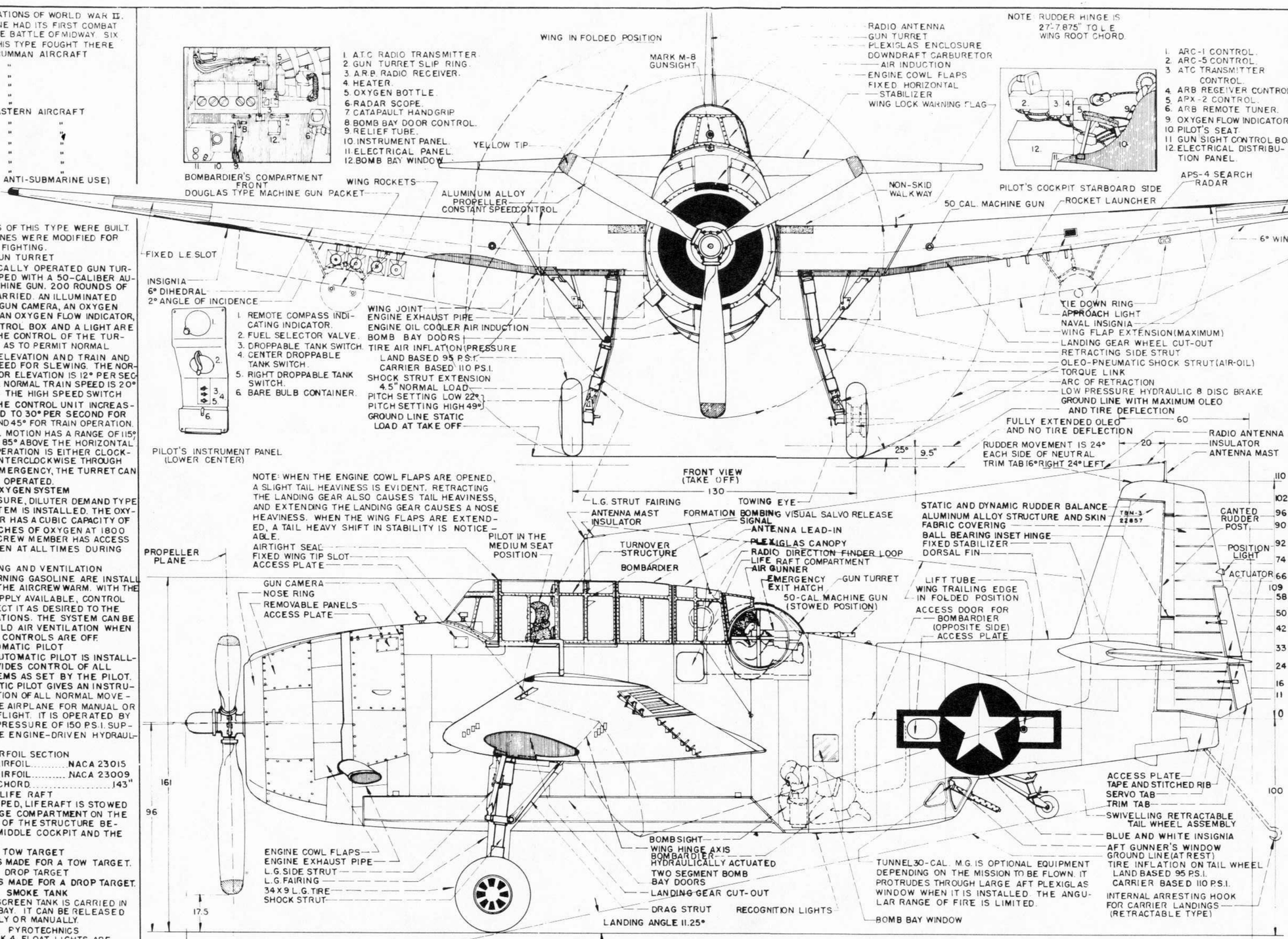
AIRCREW

A NORMAL AIRCREW OF PILOT, BOMBARDIER AND TURRET GUNNER IS CARRIED ON TORPEDO, SCOUTING AND BOMBING MISSIONS.

BOMBARDIER'S COMPARTMENT FRONT

DOUGLAS TYPE MACHINE GUN PACKET

PILOT'S INSTRUMENT PANEL (LOWER CENTER)



NOTE: RUDDER HINGE IS 27-7.875" TO L.E. WING ROOT CHORD.

ENGINE INSTALLATION

THE TBM-3 IS POWERED WITH A CURTISS-WRIGHT CYCLONE 14 CYLINDER AIRCRAFT ENGINE, SERIES C-14 BB, MODEL R-2600-20 MANUFACTURED BY THE WRIGHT AERONAUTICAL CORPORATION. THE TWO BANKS OF CYLINDERS ARE STAGGERED IN A RADIAL CONFIGERATION AND ARE AIR COOLED. THE PROPELLER IS DRIVEN AT A RATIO OF 16 TO 9 CRANKSHAFT SPEED BY MEANS OF REDUCTION GEARS. THE SUPERCHARGER IS OF THE TWO SPEED TYPE, SINGLE STAGE CENTRIFUGAL CONFIGERATION. IT HAS AN IMPELLER WHICH IS DRIVEN AT A RATIO OF 7.06 TO 1 WHEN OPERATING IN THE LOW BLOWER SETTING, AND A RATIO OF 10.06 TO 1 CRANKSHAFT SPEED WHEN OPERATING IN THE HIGH BLOWER SETTING. THE CARBURETOR IS A MODEL PR-48-A3 STROMBERG INJECTION TYPE, AND HAS AN AUTOMATIC ALTITUDE FUEL MIXTURE CONTROL AND IDLE CUT-OFF.

MILITARY POWER

THE ENGINE MAY BE OPERATED AT THIS POWER OUTPUT FOR 5 MINUTES PROVIDED CYLINDER HEAD TEMPERATURE LIMITS ARE NOT EXCEEDED.

PROPELLER

THE HAMILTON-STANDARD HYDROMATIC PROPELLER HAS A CONSTANT SPEED CONTROL. THE MANUAL SPEED CONTROL ON THE PILOT'S INSTRUMENT PANEL.

ENGINE OIL SYSTEM

THE NORMAL AMOUNT OF ENGINE OIL IN THE TANK AND THE LINES IS 13 GALLONS. SCAVENGED OIL FLOWS THROUGH AN OIL COOLER, EQUIPPED WITH AN AUTOMATIC TEMPERATURE REGULATOR AND A BY-PASS VALVE TO CAUSE THE OIL TO FLOW THROUGH THE COOLER OR BE BY-PASSED TO THE OIL TANK. A HYDRAULICALLY OPERATED COOLER FLAP, LOCATED BELOW THE ENGINE COMPARTMENT CONTROLS THE VOLUME OF AIR FLOWING THROUGH THE COOLER. THE CONTROL OF THIS FLAP IS BY MANUAL ACTION.

ENGINE OIL DILUTION SYSTEM

AN ENGINE OIL DILUTION SYSTEM, OPERABLE BY THE PILOT, IS PROVIDED WHERE THESE AIRPLANES OPERATE IN COLD WEATHER.

ENGINE FUEL SYSTEM

FUEL GRADE 100/130 IS BURNED.
FUEL IS CARRIED IN THE WING CENTER SECTION IN 3 SELF SEALING FUEL CELLS. A DROPPABLE FUEL TANK CAN BE CARRIED IN THE BOMB BAY AND UNDER EACH WING.

FUEL TANK CAPACITIES

CENTER MAIN	145 GALS.
LEFT MAIN	90
RIGHT MAIN	90
BOMB BAY (FIXED)	212
BOMB BAY (DROPPABLE)	270
RIGHT WING (DROPPABLE)	58 OR 100
LEFT WING (DROPPABLE)	58 OR 100

FUEL IS SUPPLIED BY AN ENGINE-DRIVEN FUEL PUMP. AN ELECTRICALLY-DRIVEN FUEL PUMP IS ALSO AVAILABLE TO MAINTAIN FUEL PRESSURE IN EMERGENCY OR WHEN THE PILOT IS SWITCHING FROM ONE FUEL TANK TO ANOTHER.

FLYING CHARACTERISTICS

LONGITUDINAL STABILITY IS NORMAL WITH THE C.G. AS FAR AFT AS 29% M.A.C. ELEVATOR FORCES ARE HEAVY. LATERAL STABILITY IS NORMAL IN THE CLEAN CONFIGURATION. AILERON CONTROL IS HEAVY AT SMALL ANGLES OF DEFLECTION AND LESS AT LARGE ANGLES. DIRECTIONAL STABILITY IS NORMAL IN THE CLEAN CONDITION. HOWEVER, LOWERING THE LANDING GEAR CHANGES THE STABILITY ABOUT THE THREE MAJOR AXES. THE CHANGE IN STABILITY CAN BE OVERCOME BY OPERATION OF THE CONTROLLABLE TRIM TABS. FLIGHT FORCES ON THE TRIM TABS ARE NOMINAL.

AVENGER

U.S. NAVY TORPEDO BOMBER CARRIER TYPE TBM-3
GRUMMAN AIRCRAFT ENGINEERING CORPORATION
DRAWN BY: WILLIS L. NYE A.A.H.S.
MODEL AIRPLANE NEWS NEW YORK.

SHEET NO. 1

W W II SCALE AIRCRAFT DRAWINGS

GRUMMAN TBF AVENGER

BOMB BAY DOORS

THE BOMB BAY DOORS EXTEND FROM STATIONS 33 TO 160 AND COMPLETE THE LOWER CONTOUR OF THE FUSELAGE. EACH OF THE TWO DOORS IS CONSTRUCTED OF TWO HINGED PANELS, THE OUTER PANEL BEING HINGED TO THE FUSELAGE STRUCTURE AND THE INNER PANELS BEING HINGED TO THE OUTER PANEL. A CROSS LINK ROD CONNECTS TWO ACTUATING LEVERS AT EACH END OF THE DOORS IN THE CLOSED POSITION.

THE BOMB BAY DOORS ARE OPERATED BY A LINKAGE OF LEVERS ENERGIZED BY TWO HYDRAULIC ACTUATING CYLINDERS, LOCATED AT EACH END OF THE BOMB BAY. A SYSTEM OF BALANCE CABLES ASSURES OPEN AND CLOSURE OF THE DOORS. PILOT OR BOMBARDIER MAY OPERATE THE DOORS.

DEMOUNTABLE ENGINE UNIT

THE ENTIRE ENGINE INSTALLATION IS REMOVABLE AS A UNIT. QUICK DISCONNECT TYPE FITTINGS ARE PROVIDED AT THE FIREWALL. THE POWER PLANT INSTALLATION CONSISTS OF THE PROPELLER, ENGINE, ENGINE ACCESSORIES, ENGINE MOUNT, AND AN OIL SYSTEM TO LUBRICATE THE ENGINE AND TO OPERATE THE HYDROMATIC PROPELLER.

GUN TURRET CONTROLS

THE FOLLOWING COMPRISE THE GUN TURRET CONTROLS:

- MAIN CONTROL UNIT.
- MASTER POWER SWITCH.
- CONTROL UNIT.
- SLEWING SWITCH.
- CONTROL HANDLE.
- ELECTRICAL GUN TRIGGER.
- ACTION SWITCH.
- ELEVATION SWITCH.
- TRAIN POWER SWITCH.
- GUN SIGHT LIGHT SWITCH.
- EMERGENCY SWITCH.
- FIRING CIRCUIT RESET BUTTON.

HYDRAULIC BRAKE SYSTEM

E BRAKE SYSTEM IS AN INDEPENT SYS- M NOT CONNECTED TO THE MAIN HY- AULIC POWER SYSTEM. TWO PEDALS, O MASTER CYLINDERS, TWO BRAKE U- S AND CONNECTING LINES COMPRIZE INSTALLATION.

MERGENCY LANDING GEAR OPERATION

EMERGENCY LANDING GEAR OPERA- IS ACCOMPLISHED BY A CABLE ACTU- DEVICE THAT RELEASES THE UPLOCK. HE HYDRAULIC PRESSURE UNLOAD- LVE. THE LANDING GEAR LOCKS INTO XTENDED POSITION BY GRAVITY.

NGINE COWL FLAPS

ASSEMBLY CONSISTS OF 4 FLAP ENTS ON EACH SIDE OF THE ENGINE LLATION MOUNTED ON A SUPPORT- TRUCTURE ATTACHED TO THE EN- MOUNT.

TORPEDO INSTALLATION

K 13 TYPE TORPEDO CAN BE IN- D IN THE BOMB AND IS SIMILAR TO TALLATION OF THE 1,000 AND B BOMBS. SWAY BRACES HOLD THE DO IN POSITION. THE TORPEDO IS OPERATIONAL BY MEANS OF A ING LANYARD OPERATED BY THE THE TORPEDO IS RELEASED MAN- LY OR ELECTRICALLY BY THE PILOT. DEPTH CONTROL SETTING IS ACCESS LE IN FLIGHT TO THE BOMBARDIER. THE RPEDO IS RESTRAINED IN FORE AND T MOVEMENT DRAG BRACES.

BOMB INSTALLATION

THE VARIOUS BOMB INSTALLATIONS ARE CARRIED ON A FRAMEWORK ATTACHED TO THE BOMB BAY STRUCTURE. THIS STRUCTURE VARIES DEPENDING ON THE BOMB LOAD WHICH IS CARRIED. THE BOMBS ARE ARMED ELECTRICALLY.

BOMB STATION DISTRIBUTOR

THIS DEVICE IS SET TO CONTROL THE SEQUENCE IN THE BOMB LOAD IS TO BE RELEASED. AFTER THE FIRST BOMB SELECTED IS RELEASED, IT RESETS THE CIRCUIT FOR RELEASING THE NEXT BOMB IN LINE.

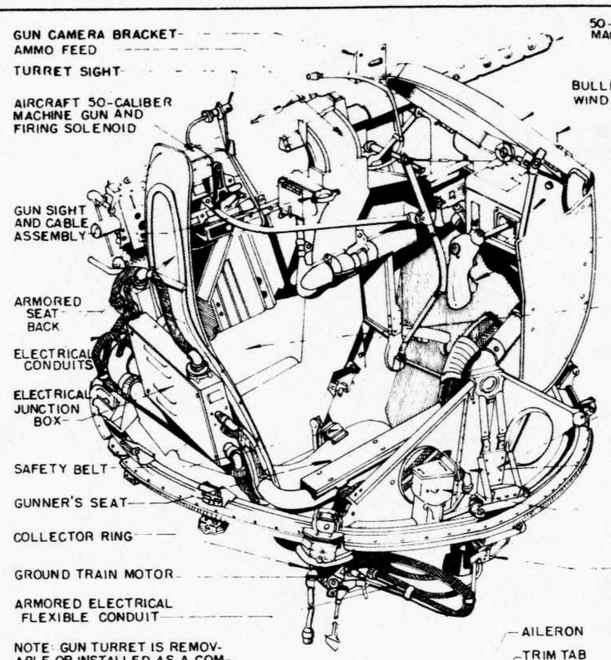
INTERVALOMETER

THIS INSTRUMENT CAN BE ACTUATED BY THE PILOT'S BOMB RELEASE SWITCH, THE BOMBARDIER'S FIRING KEY OR THE BOMB SIGHT. THE FUNCTION OF THIS DEVICE IS TO SPACE THE DROPPING OF BOMBS IN TRAIN.

COLORATION

ENTIRE AIRFRAME AND WINGS ARE FINISHED IN DARK NAVY BLUE.

INSIGNIA IN WHITE. PROPELLER AND LANDING GEAR IN ALUMINUM. TIRES ARE BLACK. LETTERING AND NUMERALS IN WHITE. ENGINE IN BLACK. WAR TIME CAMOUFLAGE PATTERN CONSISTING OF SEA BLUE, INTERMEDIATE BLUE, WHITE AND GRADED TONE AREAS WERE USED UNTIL MID 1943.



NOTE: GUN TURRET IS REMOVABLE OR INSTALLED AS A COMPLETE UNIT ASSEMBLY.

GUN TURRET ASSEMBLY TBM-3 (GRUMMAN TYPE 150SE-2)

50-CALIBER AIRCOOLED MACHINE GUN

BULLET RESISTANT WINDSHIELD

TURRET GUN SIGHT

ELECTRICAL CONTROL UNIT

FIRING TRIGGER SWITCH

HOUSING CONTAINS ELEVATION DRIVE AMPLIDYNE, TRAIN DRIVE AMPLIDYNE, ELEVATION MOTOR, SWITCH BOX, GUN FIRE INTERRUPTER CAM, GROUND TO THE STRUCTURE

TURRET TRUNNION

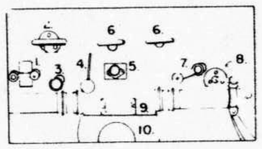
RADIO CONTROL BOX (BEHIND TRUNNION)

TRAIN RETURN TO NEUTRAL SWITCH

TRAIN DRIVE MOTOR

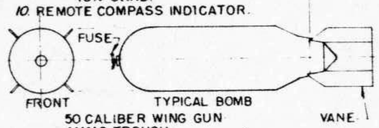
LATERAL STIFFENER

WING FLAP IS SPLIT TRAILING EDGE TYPE

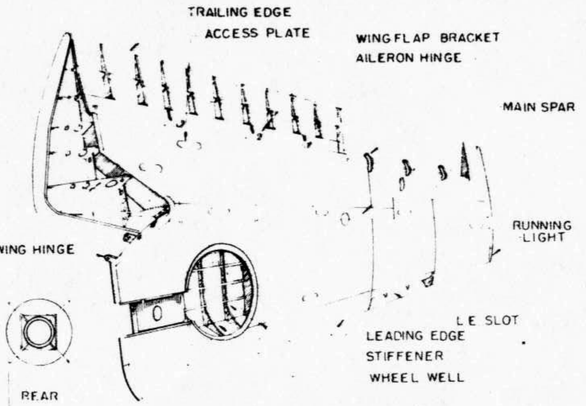


PILOT'S SUB PANEL

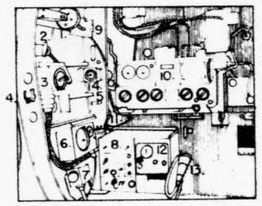
1. ENGINE COWL FLAP CONTROL
2. EMERGENCY BOMB RELEASE
3. FUEL STRAINER CONTROL
4. BOMB DOOR CONTROL
5. COMPASS LIGHT
6. WING DROPPABLE FUEL TANK CONTROL.
7. WING FOLDING CONTROL.
8. WING LOCK CONTROL.
9. INDICATING COMPASS CORRECTION CARD.
10. REMOTE COMPASS INDICATOR.



50 CALIBER WING GUN AMMO TROUGH AMMO BOX

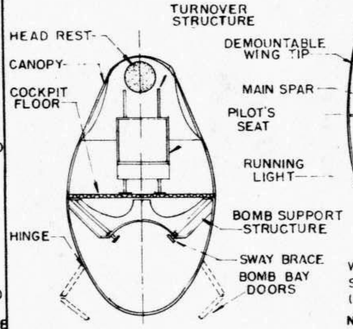


UNDERSIDE VIEW OF OUTER WING PANEL

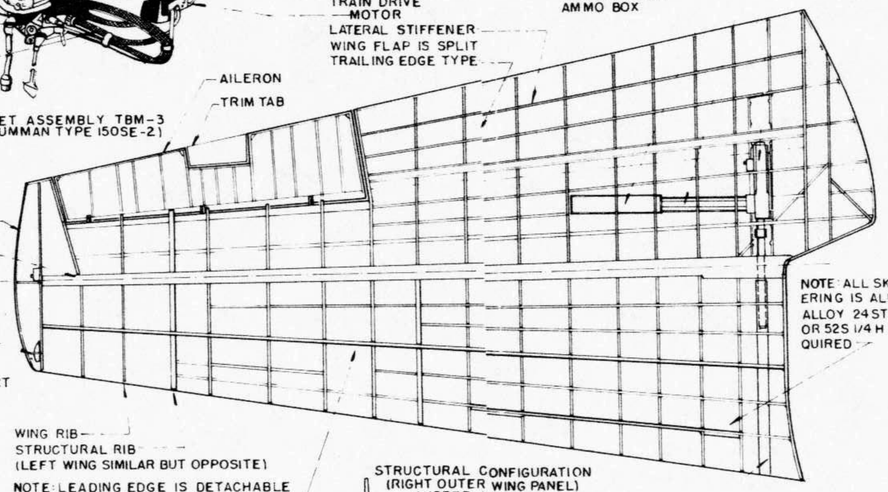


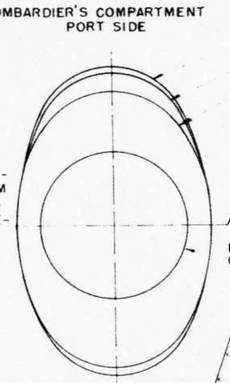
1. SMOKE TANK REEL.
2. SMOKE TANK CONTROL.
3. STATION DISTRIBUTOR.
4. MICROPHONE.
5. FIRING KEY.
6. INTERVALOMETER.
7. INTERPHONE CONTROL.
8. ELECTRICAL CONTROL PANEL.
9. TURRET POWER SWITCH.
10. TRANSMITTER.
11. SENDING KEY.
12. INSTRUMENT PANEL.
13. RELIEF TUBE.
14. OXYGEN FLOW INDICATOR.

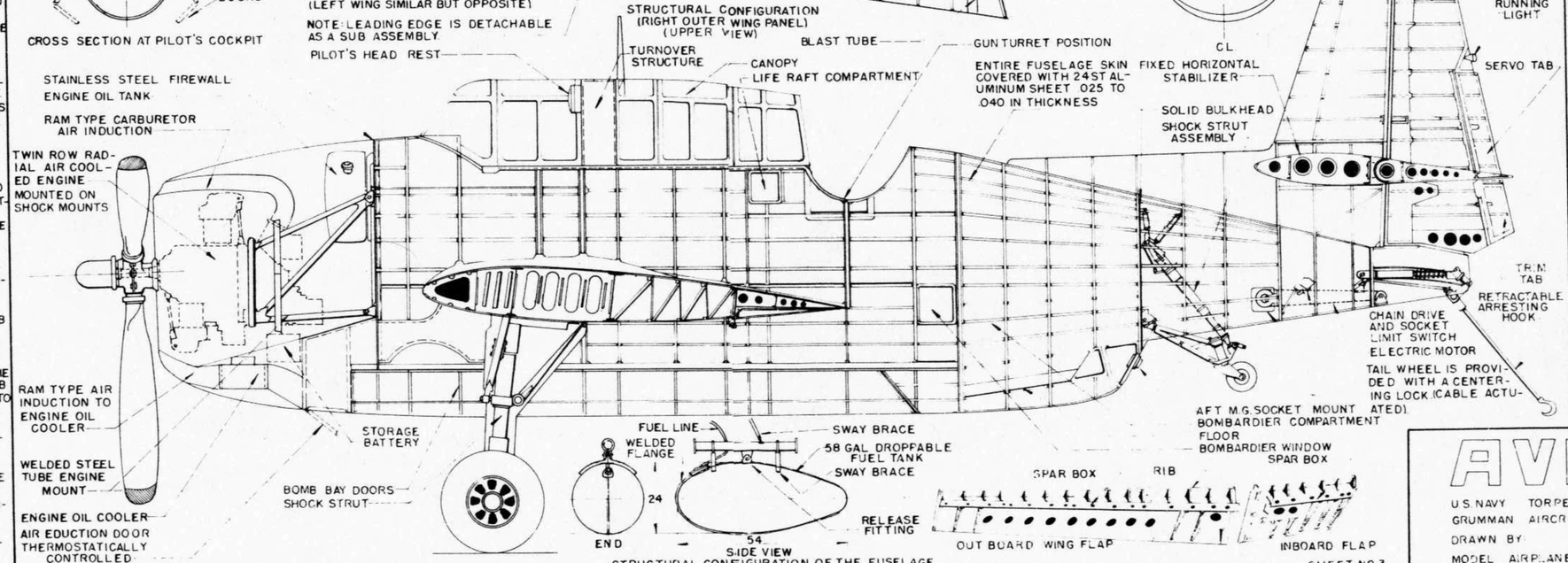
BOMBARDIER'S COMPARTMENT PORT SIDE



CROSS SECTION AT PILOT'S COCKPIT







STRUCTURAL CONFIGURATION OF THE FUSELAGE (PARTIAL CUTAWAY)

UPPER VIEW WING FLAP STRUCTURE

UPLOCKS AND DOWNLOCKS

THE RETRACTABLE LANDING GEAR AND TAIL WHEEL ARE PROVIDED WITH AN UPLOCK AND A DOWN LOCK WITH AN APPROPRIATE MANUALLY OPERATED EMERGENCY RELEASE MECHANISM. THE RETRACTABLE ARRESTING HOOK ALSO HAD AN EMERGENCY RELEASE MECHANISM OPERABLE BY THE PILOT. HOWEVER, ONCE EXTENDED THE HOOK COULD NOT BE RETRACTED MANUALLY.

GROSS WEIGHT

A MAXIMUM GROSS WEIGHT RANGING FROM 15,500 TO 18,100 POUNDS IS PERMISSIBLE.

GLIDE BOMBING

GLIDE BOMBING IS PERMISSIBLE WITH THE BOMB BAY DOORS OPEN OR CLOSED, SUBJECT TO SPEED LIMITATIONS.

CATAPAULT

THIS AIRPLANE IS EQUIPPED FOR LAUNCHING BY CARRIER CATAPAULT. TBM AIRCRAFT SERVED ABOARD ESCORT CARRIERS IN WORLD WAR II. THEY WERE LAUNCHED OFF THESE SHIPS BY MEANS OF A CATAPAULT.

LIFE RAFT

A MARK 4, TYPE "D", DROPPABLE LIFE RAFT IS STOWED IN THE FUSELAGE COMPARTMENT. ACCESS DOORS ARE PROVIDED ON EACH SIDE OF THE FUSELAGE. THE LIFE RAFT IS INFLATABLE BY MEANS OF A CO_2 CYLINDER.

EMERGENCY EQUIPMENT

FIRST AID KIT.
EMERGENCY RATIONS
DRINKING WATER CANTEEN.
SEA MARKER PACKET.
M-8 SMOKE GRENADES.
TWO 5FT OARS.
EMERGENCY HAND PUMP.
TWO SAILS.
SMOKE GRENADE HOLDING CLAMP.
FISHING KIT.
MATCHES.
KNIFE.
ROPE COIL.
CHROMIUM REFLECTOR PLATE.
FISH SPEAR.
TIRE PATCHES AND RUBBER CEME
PLIERS AND SCISSORS.
LEAK PLUGS.

GUN TURRET CONTROLS

MAIN CONTROL UNIT.
MASTER POWER SWITCH.
CONTROL HANDLE.
SWITCH BOX AND SWITCHES.
EMERGENCY SWITCH.

BOMBING EQUIPMENT

BOMB BAY DOOR CONTROL HANDLE.
ELECTRICAL SWITCHES.
MARK 8 GUNSIGHT.
BOMB RELEASE BUTTON.
EMERGENCY BOMB RELEASE HA
BOMBARDIER'S ELECTRICAL PANEL.
STATION DISTRIBUTOR.
INTERVALOMETER.
ARM SAFE LEVER.
FIRING KEY.

TBM-3S TYPE

THIS TYPE OF PLANE WAS A SPECIAL VERSION MODIFIED FOR ANTI-SUBMARINE OPERATIONS. THE GUN TURRET WAS REMOVED AND PROVISIONS WERE MADE TO CARRY AN ADDITIONAL CREWMAN PLUS ANTI-SUBMARINE WEAPONRY. MODIFICATION WAS MADE IN THE FIELD.

CARBURETION AIR INDUCTION

TWO SYSTEMS OF CARBURETION AIR INDUCTION ARE PROVIDED, I.E. DIRECT AND THE ALTERNATE. THE DIRECT SYSTEM IS USED FOR NORMAL OPERATIONS. WHERE DUST, COLD AIR, HEAVY RAIN, OR ICING CONDITIONS ARE PRESENT, THE ALTERNATE SYSTEM IS USED.

BOMBARDIER'S COMPARTMENT DOOR

THIS DOOR IS LOCATED ON THE RIGHT SIDE OF THE FUSELAGE BETWEEN STATIONS 186 AND 216 AND IS SUPPORTED AT THE FORWARD END BY TWO HINGES.

ENGINE EXHAUST PIPES

THE COLLECTOR PIPES FOR THE ENGINE EXHAUST ARE COMPRISED OF TWO MAIN ASSEMBLIES BUT ARE INDIVIDUALLY NOT INTERCONNECTED. EACH COLLECTOR PIPE EXHAUSTS TO RIGHT AND LEFT ON THE OUTSIDE. THE COLLECTOR PIPES ARE MADE OF STAINLESS STEEL OF MULTIPLE SEGMENTS JOINED TOGETHER BY CONNECTOR CLAMPS.

AVENGER

U.S. NAVY TORPEDO BOMBER CARRIER TYPE TBM-3
GRUMMAN AIRCRAFT ENGINEERING CORPORATION

DRAWN BY WILLIS L. NYE A.A.H.S.
MODEL AIRPLANE NEWS NEW YORK

SHEET NO 3

ARMAMENT

THE TBM-3 IS EQUIPPED WITH 3 50-CAL. MACHINE GUNS. THE AFT TURRET IS FIRED AS THE TURRET IS OPERATED. ONE 50-CAL IS MOUNTED IN A FIXED POSITION WITHIN EACH OUTER PANEL OF THE WING. THE AMMO BOXES ARE LOADED PRIOR TO FLIGHT. WING GUNS ARE LOADED PRIOR TO FLIGHT AND ARE HYDRAULICALLY CHARGEABLE IN FLIGHT. EACH GUN IS ELECTRICALLY FIRED. SHELL CASES AND CARTRIDGE BELT LINKS ARE EJECTED DOWNWARD AND CLEAR OF THE LOWER SURFACE OF THE WING BY MEANS OF EJECTION CHUTES. THE AMMO LOAD IS 280 ROUNDS PER GUN PLUS 40 ROUNDS IN THE AMMO FEED CHUTE.

WING GUN SIGHT

A MARK 8 ILLUMINATED GUN SIGHT IS USED TO SIGHT THE GUNS AS WELL AS THE BOMBS AND TORPEDO.

TORPEDO CAMERA

A TORPEDO CAMERA IS INSTALLED.

GUN CAMERA

A 35 M.M. GUN CAMERA OF THE FIXED FOCUS TYPE EQUIPPED WITH A FOOTAGE INDICATOR OPERATES WHEN THE MACHINE GUNS ARE FIRED.

GUN PACKAGE

A DOUGLAS TYPE GUN PACKAGE OR A 500 POUND BOMB CAN BE ATTACHED TO THE UNDERSIDE OF EACH OUTER WING PANEL OUTBOARD OF THE ROCKET PROJECTILE INSTALLATION. THE GUN PACKAGE IS SELF-CONTAINED AND CONSISTS OF 2 .50-CAL. MACHINE GUNS AND 340 ROUNDS OF AMMO. THE GUNS ARE CHARGED AND FIRED ELECTRICALLY. THE GUNS MAY BE FIRED INDIVIDUALLY OR IN SALVO. THE GUN PACKAGES ARE JETTISONABLE IN FLIGHT.

ROCKET PROJECTILES

FOUR ROCKET PROJECTILES ARE CARRIED UNDER EACH OUTER WING PANEL. THE ROCKETS ARE MOUNTED ON MARK ZERO LAUNCHERS AND ARE FIRED ELECTRICALLY IN PAIRS, THE CORRESPONDING ROCKETS ON EACH WING BEING FIRED SIMULTANEOUSLY. A ROCKET SELECTOR SWITCH PERMITS THE PILOT TO SELECT THE ROCKET TO BE FIRED IN SEQUENCE OR SALVO.

BOMBING EQUIPMENT

BOMB BAY DOORS ARE HYDRAULICALLY OPERABLE AND RELEASE OF THE BOMBS IS CONTROLLED ELECTRICALLY BY THE BOMBARDIER OR MANUALLY BY THE PILOT ONLY. THE FOLLOWING IS THE BOMB LOAD COMBINATIONS:

- 12 - 100 LB. CLASS BOMBS
- 4 - 500 LB. D. D.
- 1 - 1000 LB. G.P. D.
- 2 - 1000 LB. A.P. D.
- 1 - 1600 LB. D. D.
- 1 - 2000 LB. G.P. D.
- 1 - TORPEDO MK. 13 MOD. 2.
- 2 - 1000 G.P. BOMBS IN TANDEM.
- 1 - SMOKE TANK.

ARRESTING HOOK

TWO TYPES OF ARRESTING HOOKS ARE USED FOR CARRIER LANDINGS, INTERNAL AND EXTERNAL. THE INTERNAL TYPE IS ELECTRICALLY ACTUATED. THE APPROACH LIGHT OPERATES WHEN THE HOOK IS EXTENDED. A SHOCK ABSORBER AND AN AUTOMATIC LATCH IS PROVIDED TO THE LATCH IN THE UP OR DOWN POSITION. AN ELECTRIC MOTOR EXTENDS OR RETRACTS THE HOOK. EXTERNAL HOOKS ARE MANUALLY OPERATED.

WING LOCK CONTROL

THE WING LOCK CONTROL SYSTEM IS MANUALLY OPERATED BY THE PILOT. IT CONSISTS OF HYDRAULIC CYLINDERS TO ACTUATE THE LOCKING PIN, CABLE CONTROLS, BELLCRANKS, CLAMPS, FAIRLEADS, ETC.

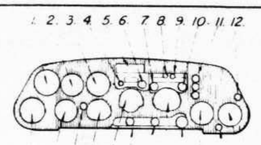
LANDING GEAR EXTENDED LOCK CONTROL. THE L.G. EXTENDED LOCK CONTROL SYSTEM PREVENTS UNTENTIONAL RETRACTION OF THE L.G. WHEN THE AIRPLANE IS ON THE GROUND. IT FUNCTIONS AS A CIRCUIT OF THE L.G. HYDRAULIC SYSTEM WHEN THE LEFT MAIN SHOCK STRUT IS COMPRESSED, THE L.G. CONTROL HANDLE CANNOT BE MANUALLY OPERATED.

ENGINE STARTING SYSTEM

THE ENGINE STARTER IS ENERGIZED BY THE STORAGE BATTERY. STARTER IS THE DIRECT CRANKING TYPE. A MANUAL TYPE GEAR BOX AND CRANK ARE PROVIDED FOR EMERGENCY OPERATION.

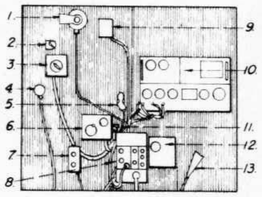
DROPPABLE FUEL TANKS

THE DROPPABLE FUEL TANKS CARRIED ON THE UNDERSIDES OF OUTER WING PANELS AND IN THE BOMB BAY ARE RELEASABLE MANUALLY BY THE PILOT WHEN EMPTY OR IN COMBAT.



1. ENGINE MANIFOLD PRESSURE GAUGE.
2. ALTIMETER.
3. AIR SPEED INDICATOR.
4. RUDDER SENSITIVITY TRIM.
5. AIRSPEED CORRECTION PLACARD.
6. RUDDER TRIM CONTROL.
7. AILERON TRIM CONTROL.
8. AILERON SENSITIVITY CONTROL.
9. ELEVATOR SENSITIVITY CONTROL.
10. ELEVATOR TRIM CONTROL.
11. RADIO ALTIMETER LIGHT.
12. AN/APN-1 ALTIMETER RANGE CONTROL.
13. ENGINE R.P.M. INDICATOR.
14. CLIMB INDICATOR.
15. CHART BOARD LIGHT.
16. TURN AND BANK INDICATOR.
17. DIRECTIONAL GYRO.
18. DIRECTIONAL GYRO CONTROL.
19. AUTOMATIC PILOT CONTROL SWITCH.
20. BANK AND CLIMB GYRO.
21. BANK AND CLIMB GYRO.
22. AN/APN-1 LIMIT SWITCH.
23. AN/APN-1 ALTIMETER CONTROL SWITCH.
24. AN/APN-1 ALTIMETER.

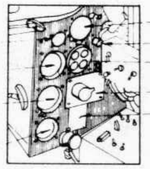
PILOT'S INSTRUMENT PANEL TOP CENTER



1. SMOKE TANK REEL
2. SMOKE TANK CONTROL
3. STATION DISTRIBUTOR
4. MICROPHONE.
5. FIRING KEY.
6. INTERVALOMETER.
7. INTERPHONE CONTROL.
8. ELECTRICAL PANEL.
9. TURRET POWERED.
10. TRANSMITTER
11. SENDING KEY
12. INSTRUMENT PANEL
13. RELIEF TUBE

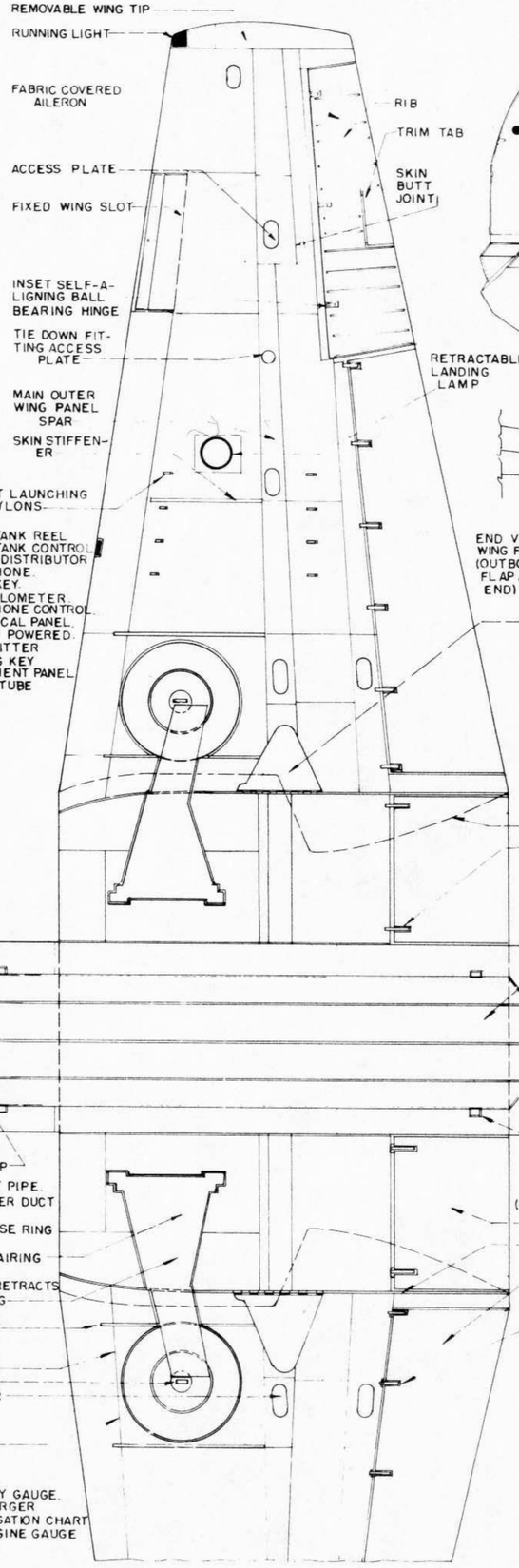
BOMBARDIER'S COMPARTMENT - PORT SIDE

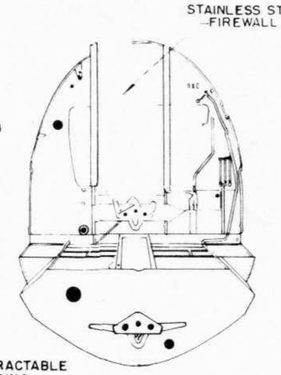
HAMILTON-STANDARD
3-BLADE HYDROMATIC
HUB 23E50-489
BLADE NO. 6501A
CONTROL 4G10-G10-G38D
LOW PITCH 22°
HIGH PITCH 49°

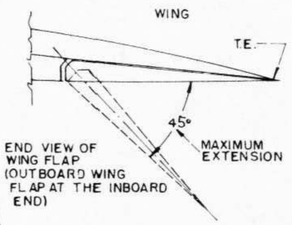


PILOT'S INSTRUMENT PANEL (LOWER STARBOARD)

1. OXYGEN FLOW INDICATOR
2. UNIT ENGINE GAUGE.
3. ACCELEROMETER.
4. CLOCK.
5. BOMB BAY DOOR LIGHT.
6. FUEL QUANTITY GAUGE.
7. WING GUN CHARGER.
8. FUEL COMPENSATION CHART
9. CYLINDER ENGINE GAUGE







END VIEW OF WING FLAP (OUTBOARD WING FLAP AT THE INBOARD END)

TO COVER THE CUT OUT PORTION OF THE OUTER WING PANEL WHICH PERMITS THE WING TO FOLD FREELY, AN AUTOMATICALLY OPERATED TRIANGULAR DOOR OPENS AND CLOSES WITH FOLDING AND SPREADING OPERATIONS OF THE WINGS. THE DOOR IS HINGED TO THE WING STUB OF THE CENTER SECTION. IT IS CABLE ACTUATED. SPRING LOADING PREVENTS INTERFERENCE WITH OTHER LINES OR CABLES.

CENTER OF GRAVITY IS LOCATED AT 44.48" AFT OF LEADING EDGE OF CENTER SECTION OF THE WING AT NORMAL GROSS WEIGHT.

TOP SURFACE WING JOINT

WING FLAP HINGE

TWO PIECE BOMB BAY DOORS, HYDRAULICALLY ACTUATED, PILOT CONTROLLED.

RECOGNITION LIGHTS AMBER, GREEN, WHITE

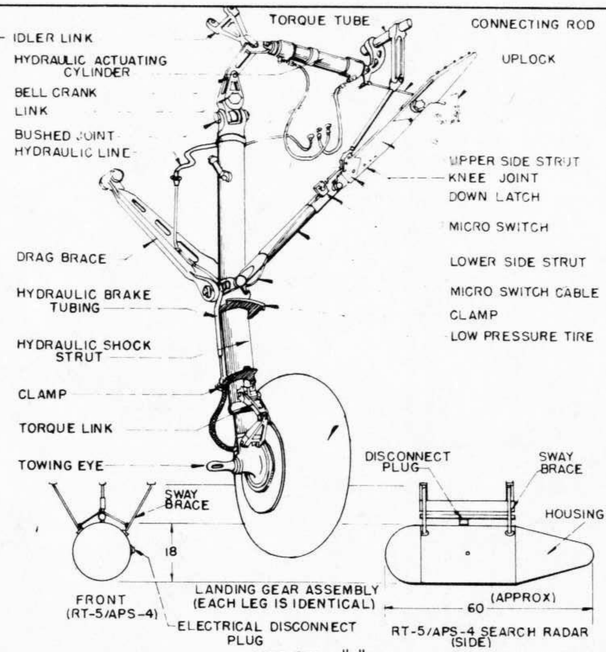
BOTTOM VIEW (SCALE: 0 1 2 3 4)

INBOARD WING FLAP

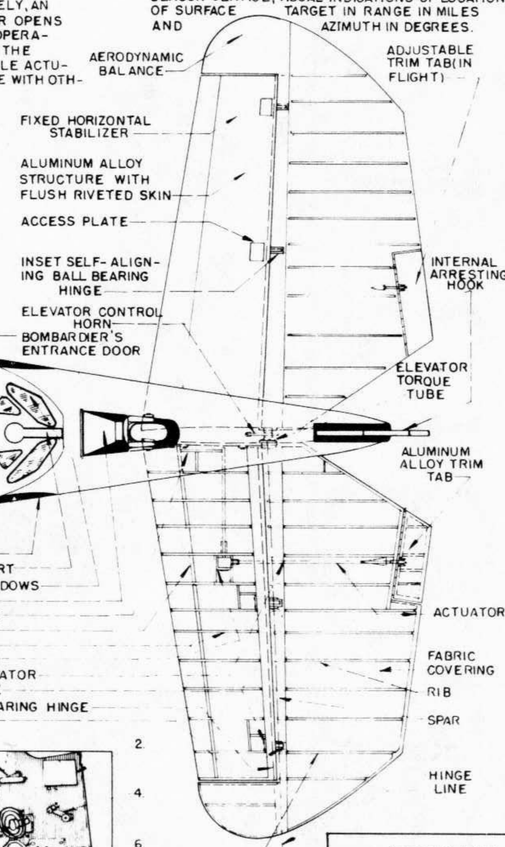
WING FOLDING JOINT

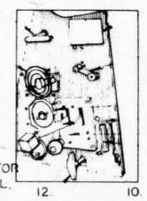
OUTBOARD WING FLAP (RETRACTS FLUSH)

WING FLAP HINGE



OPERATES IN "X" BAND AND PROVIDES RADAR AND BEACON SERVICE, VISUAL INDICATIONS OF LOCATION OF SURFACE TARGET IN RANGE IN MILES AND AZIMUTH IN DEGREES.





1. CARBURETOR AIR.
2. PILOT CHECK LIST.
3. IGNITION SWITCH.
4. OIL COOLER CONTROL.
5. PROPELLER CONTROL.
6. R.P.S. SELECTOR SWITCH.
7. L.G. CONTROL.
8. WING FLAPS CONTROL.
9. AIR THERMOMETER.
10. L.G. POSITION INDICATOR.
11. FLAPS POSITION INDICATOR.
12. EMERGENCY L.G. CONTROL.

PILOT'S INSTRUMENT PANEL (LOWER PORT)

COMMUNICATIONS EQUIPMENT

RADIO COMMUNICATION EQUIPMENT CONSISTS OF THE FOLLOWING:

- AN/ART-13 TRANSMITTER
- ARB AND AN/ARC-5 RECEIVER
- AN/ARC-1 VHF TRANSCEIVER.
- AN/APX-2 I.F.F. EQUIPMENT.

RADIO NAVIGATION EQUIPMENT.

- AN/ARR-2 RECEIVER.
- AN/APN-1 ALTIMETER.

INTERPHONE UNIT RL-7

- I.F.F. EQUIPMENT
- AN/APX TRANSPONDER.
- C57/APX-2 PILOT CONTROL.
- C56/APX-2 BOMBARDIER CONTROL.
- IMPACT DESTRUCTOR.

RADAR EQUIPMENT

- SEARCH RADAR AN/APS-4.
- RT-5A/APS-4 TRANSMITTER-RECEIVER UNIT.
- JUNCTION BOX CONTROL BOX.
- PILOT'S INDICATOR.
- PILOT'S INDICATOR AMPLIFIER.
- OPERATOR'S INDICATOR.
- OPERATOR'S INDICATOR AMPLIFIER.

AERODYNAMIC AREAS

WING (INCLUDING 59 SQ.FT. OF FUSELAGE AND AILERONS)	490 SQ.FT.
AILERONS INCLUDING TRIM TABS	19 SQ.FT.
AILERON TRIM TABS	7.5 SQ.FT.
WING FLAPS	62.5 SQ.FT.
HORIZONTAL TAIL	110.84 SQ.FT.
ELEVATORS	46.90 SQ.FT.
HORIZONTAL STABILIZER	63.94 SQ.FT.
ELEVATOR TRIM TABS	2.32 SQ.FT.
VERTICAL TAIL	42.67 SQ.FT.
VERTICAL STABILIZER	26.43 SQ.FT.
RUDDER	16.24 SQ.FT.
RUDDER TRIM TAB	2.03 SQ.FT.

WING FOLDING AND SPREADING CONTROL. THE OUTER WING PANELS ARE SPREAD AND FOLDED BY HYDRAULIC ACTUATING CYLINDERS CONTROLLED BY THE PILOT. THE WINGS ARE HELD IN POSITION BY LOCKING PINS ACTUATED BY HYDRAULIC CYLINDERS. WARNING FLAGS ON THE LEADING EDGE OF THE WING, ADJACENT TO THE FOLDING AXIS OF THE OUTER WING PANEL AND AN ELECTRICAL HOWLER FUNCTION UNTIL THE LOCKING PINS ARE IN PLACE AND SAFETIED.

FLIGHT CONTROLS

A CONVENTIONAL JOYSTICK WITH A PISTOL GRIP IS INSTALLED. RUDDER AND BRAKE CONTROLS ARE OF THE STANDARD UNDERHUNG TYPE. ELEVATOR TRIM TAB CONTROL WHEEL AT LEFT OF PILOTS SEAT ADJUSTS LONGITUDINAL TRIM. RUDDER TRIM TAB CONTROL ON TOP OF THE CONTROL UNIT AT LEFT OF PILOTS SEAT ADJUSTS DIRECTIONAL TRIM. AILERON TRIM CONTROL ON THE FORWARD END OF THE CONTROL UNIT ADJUSTS THE LATERAL TRIM. RUDDER AND ELEVATORS ARE CABLE OPERATED. SAME FOR TRIM TAB. THE AILERONS AND TRIM TAB ARE TORQUE TUBE ACTUATED.

OPERATIONAL CONTROLS

- FUEL STRAINER DRAIN.
- FUEL QUANTITY INDICATORS.
- FUEL TANK SELECTOR.
- AUXILIARY FUEL PUMP.
- THROTTLE.
- FUEL MIXTURE.
- CARBURETOR AIR.
- ENGINE COWL FLAPS (HYDRAULIC TYPE)
- ENGINE IGNITION SWITCH.
- ENGINE STARTER.
- ENGINE FUEL PRIMER.
- ENGINE OIL COOLER FLAP.
- PROPELLER CONTROL.
- DROPPABLE FUEL TANKS.
- ALIGHTING GEAR.
- MAIN WHEEL LOCKS.
- TAIL WHEEL CASTER LOCK.
- ARRESTING HOOK.
- WING FLAPS.
- WING LOCK CONTROL.

AIRPLANE PERFORMANCE

HIGH SPEED	278 M.P.H.
LANDING SPEED (15,750 LBS.)	98 M.P.H.
LANDING GROUND ROLL (0 WIND)	1100 FT.
CLIMBING SPEED	140 M.P.H.
TAKE-OFF DISTANCE (0 WIND)	910 FT.
RATE OF CLIMB (15,750 LBS.)	1650 FT. S.L.

AVENGER

U.S. NAVY TORPEDO BOMBER CARRIER TYPE TBM-3

GRUMMAN AIRCRAFT ENGINEERING CORPORATION

DRAWN BY: WILLIS L. NYE A.A.H.S.

MODEL AIRPLANE NEWS NEW YORK

SHEET NO. 4

GRUMMAN TBF AVENGER

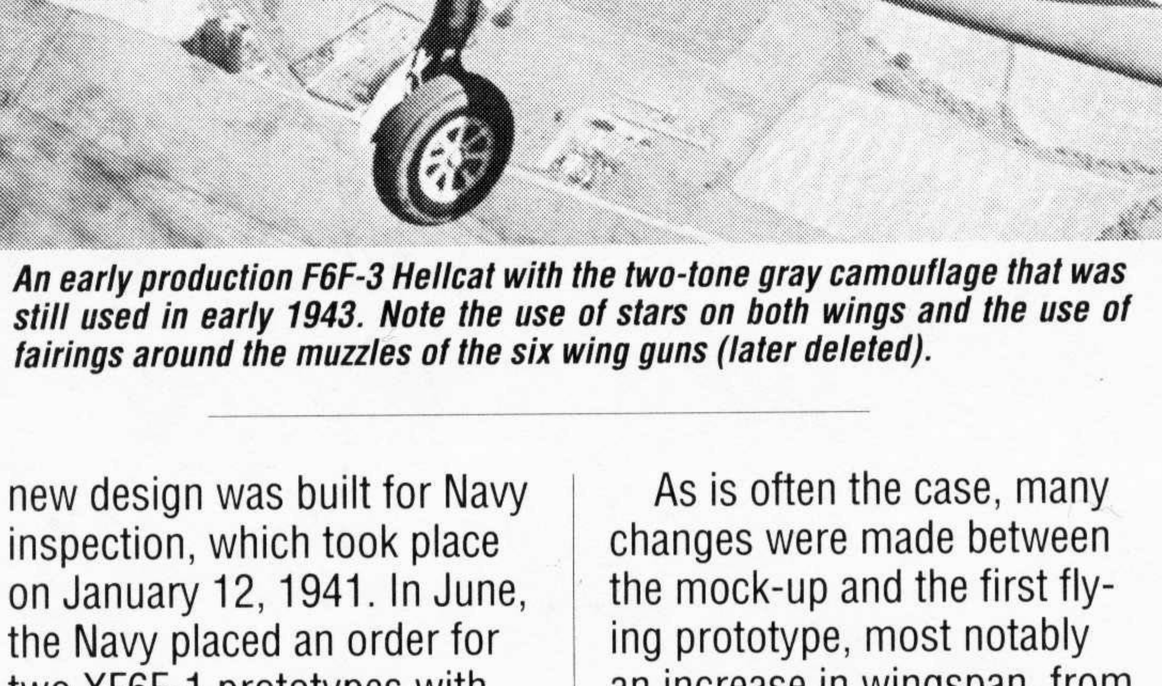
GRUMMAN F6F HELLCAT

An early production F6F-3 Hellcat with the two-tone gray camouflage that was still used in early 1943. Note the use of stars on both wings and the use of fairings around the muzzles of the six wing guns (later deleted).

AFTER studies convinced Grumman that the performance of the F4F Wildcat couldn't be improved by the installation of a larger engine, the company opted for an entirely new design—the Grumman 50. The model carried six .50-caliber machine guns and was powered by the 1,600hp Wright R-2600 Twin Cyclone engine. It differed most from the F4F in that its wing was lower and it had rearward-retracting landing gear, which was in the wing rather than in the fuselage. Also, the landing gear retracted aft while rotating 90 degrees to lay flat in the trailing edge of the wing in the same manner as the Curtiss P-40. Retained from the F4F was the manually folding wing with a 45-degree hinge.

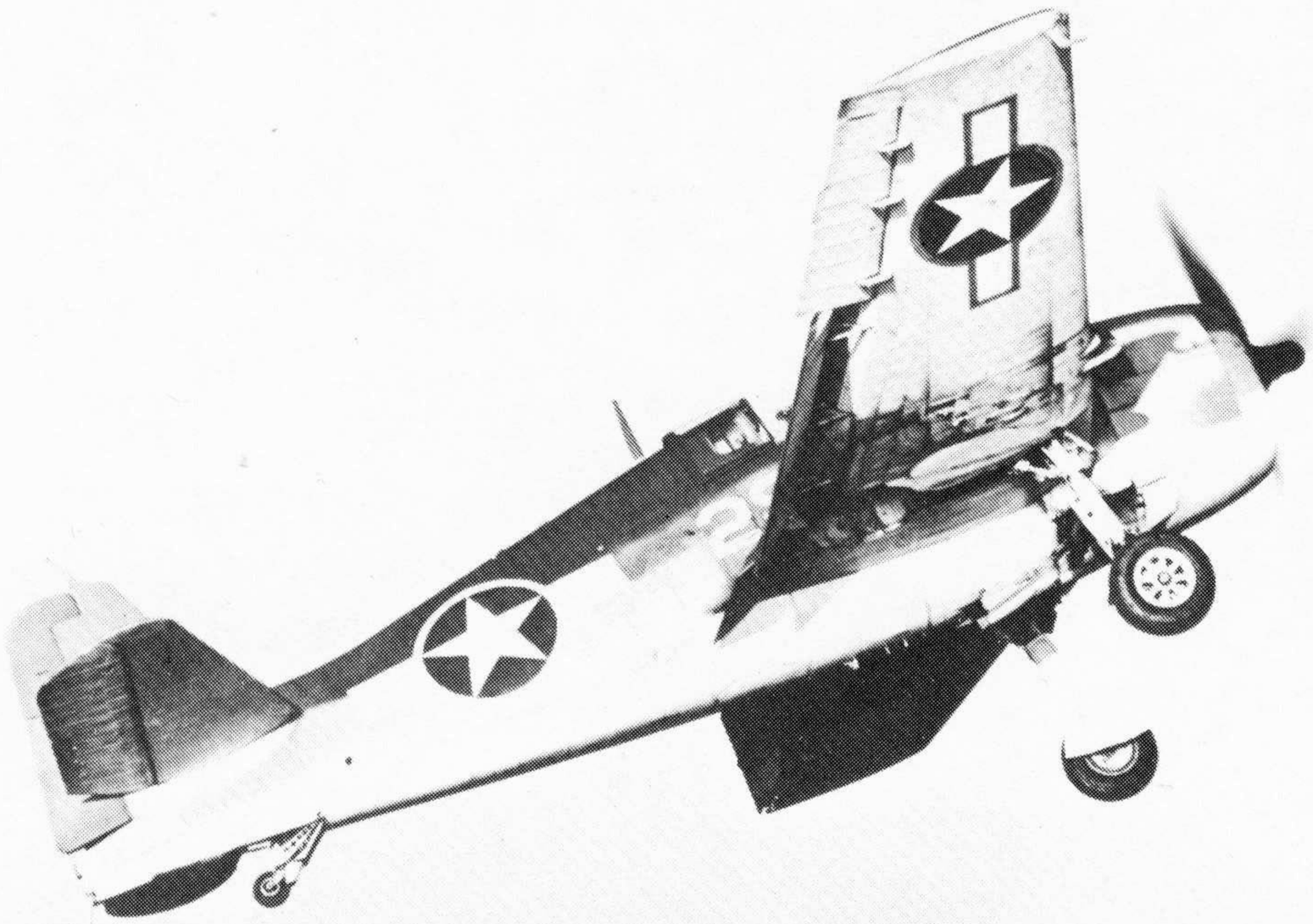
A wooden mock-up of the new design was built for Navy inspection, which took place on January 12, 1941. In June, the Navy placed an order for two XF6F-1 prototypes with 1,700hp (T.O.) R-2600-10 engines.

As is often the case, many changes were made between the mock-up and the first flying prototype, most notably an increase in wingspan, from 31 feet, 4 inches to 33 feet, 6.5 inches; wing area, from 290 to 334 square feet; and length, from 41 feet, 6 inches to 42 feet, 10 inches. There were also many changes in installed equipment. The first XF6F-1, now officially named "Hellcat," flew on June 21, 1942. A notable detail not seen on the production Hellcats was a large propeller spinner.

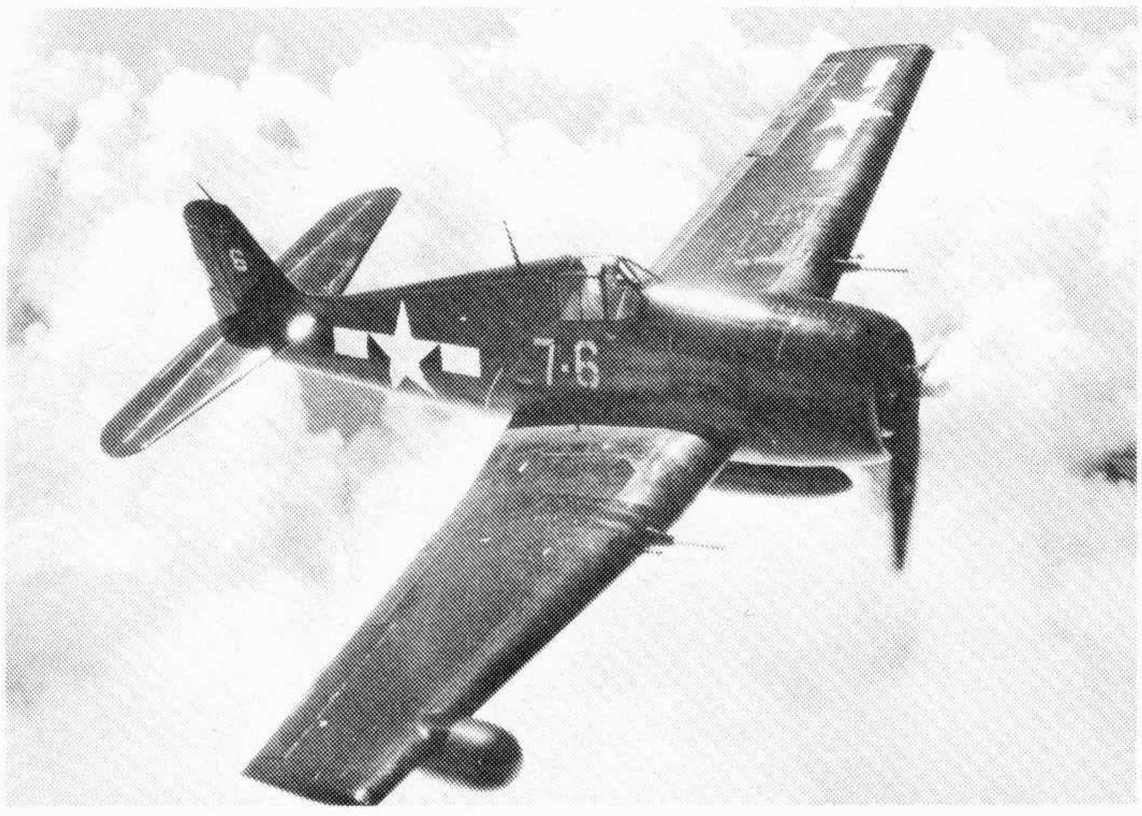


F6F-5s on the deck of the USS Essex in April 1945. Note the belly tanks and underwing rockets on both airplanes, and the deck crew manually folding one plane's wing (center). The various white markings shown here were adopted in late 1943 to identify airplanes from different aircraft carriers.

The second prototype would have had a turbo-supercharged version of the R-2600 engine and been redesignated "XF6F-2." The Navy, however, directed a change to the 2,000hp (T.O.) Pratt & Whitney R-2800-10 engine, so the airplane was redesignated "XF6F-3" and became the prototype of the production articles. It first flew on July 30, 1942. After a crash caused by engine failure, the XF6F-3 was rebuilt as the XF6F-4 with an



Shown above is an F6F-3 with the short-lived red-bordered insignia and the new (since February 1943) camouflage that used dark blue-gray for top surfaces and graduated to glossy white for undersurfaces. Below: an F6F-5N (with a 20mm cannon and a wing-tip radar pod) that shows off the glossy, overall sea-blue camouflage that was adopted for carrier-based fighters in February 1944 and later expanded to cover most U.S. Navy tactical planes and some support planes.



R-2800-27 engine, and was later used to test cannon armament.

The abandoned XF6F-2 designation was revived in 1944 when the last production F6F-3 was fitted with a turbo-supercharged R-2800 engine with a four-blade propeller.

Delivery of the 4,402 production F6F-3s from Bethpage began early in 1943. The Hellcats entered combat on August 31, 1943, during an attack on Marcus Island in the Western Pacific. Later-production -3s had a rack under the right wing for up to 1,000 pounds of bombs.

Production variants of the F6F-3 were 150 F6F-3N night fighters with APS-6 radar in a pod built into the right wing; 18 similar F6F-3E night intruders with APS-4 radar; and several F6F-3Ps with long-focal-length cameras mounted vertically in the fuselage. All of these variants retained their six-gun wing armament and could also carry a 150-gallon drop tank under the fuselage. A total of 252 F6F-3s was provided to Britain's Fleet Air Arm (FAA) under Lend-Lease. They were to have been designated "Gannet," but the British decided to use the American designation of "Hellcat I."

After the war, many F6F-3s were converted to unmanned, radio-controlled drones that were designated "F6F-3K" for use as anti-aircraft targets, for research into atom-bomb clouds and, in some cases, as guided bombs.

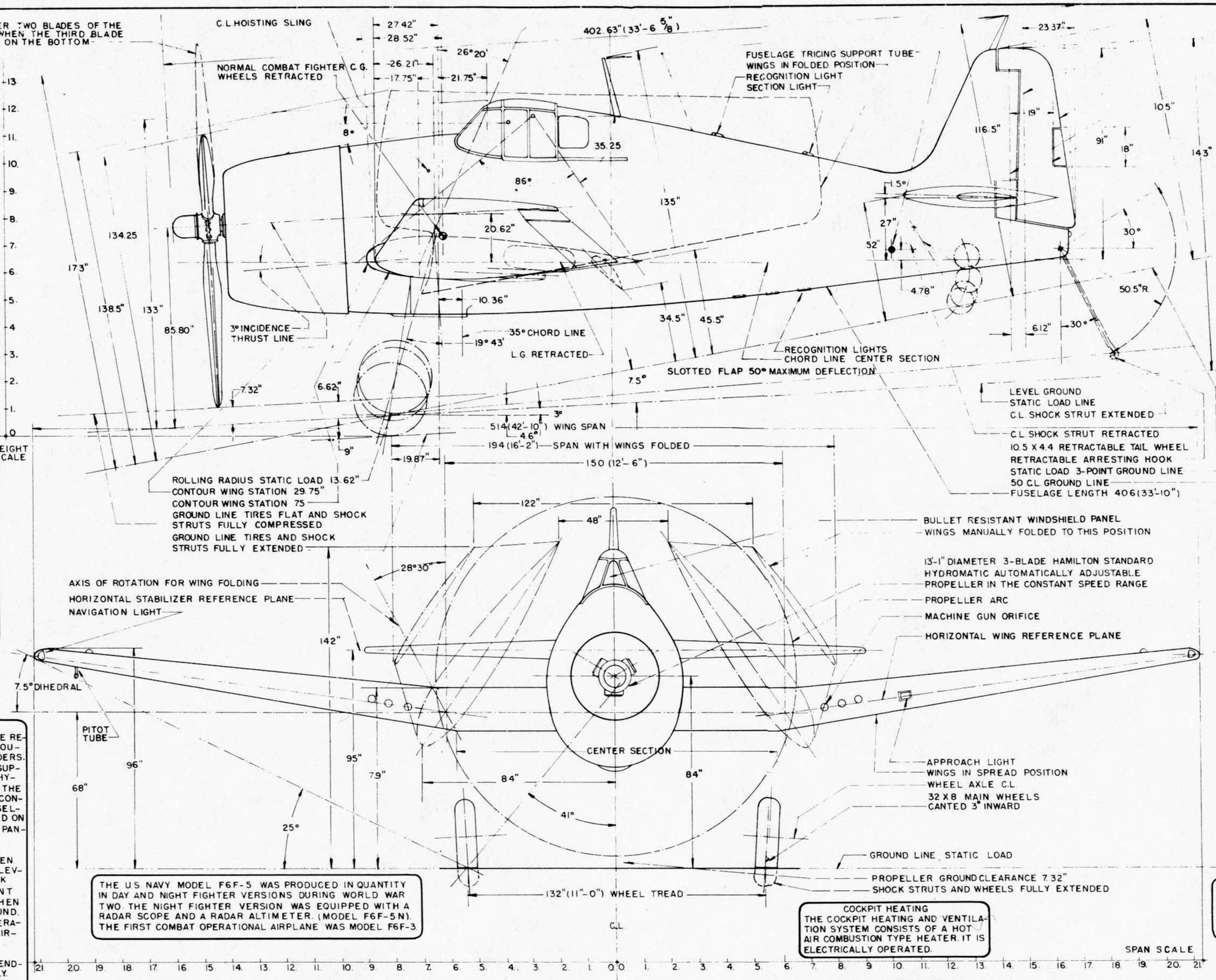
Although outwardly similar to the F6F-3, the 7,868 F6F-5s differed in that they had water-injected R-2800-10W engines, additional armor and revised engine cowlings and windshields. Racks for up to 1,000 pounds of bombs could now be carried under each wing, and late production articles could be fitted with racks for five 5-inch rockets under each wing. Deliveries began in April 1944.

Variants were as for the F6F-3, notably 1,189 F6F-5Ns with APS-6 radar pods. Some late -5Ns had their inboard .50-caliber machine guns replaced with 20mm cannon. There were also F6F-5E night intruders and F6F-5P photoplanes. Britain received 925 F6F-5s.

It should be noted that by 1944, Britain had begun to use prefix letters to identify special-purpose variants of basic models. The 849 plain F6F-5s became Hellcat II, but the 76 F6F-5Ns became Hellcat N.F.II ("N.F." for Night Fighters).

The last of 12,275 Hellcats, all built at Bethpage, was delivered on November 21, 1944. After the war, some F6F-5s were converted to F6F-5K drones, while others became F6F-5D drone controllers. In later years, F6F-5s were provided to Argentina, France, Paraguay and Uruguay for their naval air forces. The U.S. Navy used F6F-5Ns as night fighters until 1953, and others were used by the reserve training squadrons into 1956.

The Hellcat was the Navy's most numerous carrier-based fighter and it quickly proved its superiority over the previously invincible Mitsubishi A6M Zero. It was also the Navy's most combat-effective fighter and is officially credited with 4,947 air-to-air victories by carrier-based units, with a further 209 credited to land-based and Marine Corps units. Some of the British Hellcats were modified in England to carry British rocket launchers and became Hellcat F.R. II fighter-reconnaissance models, while a few became P.R. II photo-reconnaissance versions. Put into service in December 1943, the British Hellcats saw action over the English Channel in April 1944. Eleven squadrons served in Southeast Asia seas until the end of the war. The last Hellcats left British service in August 1946 and were returned to the U.S. with the other Lend-Lease models.



HYDRAULIC SYSTEM

THE HYDRAULIC SYSTEM IS COMPRISED OF THE FOLLOWING COMPONENTS:

WING FLAP ACTUATING CYLINDER.
RESTRICTOR.
GUN CHARGING CYLINDER.
WING LOCK CYLINDER.
WING FOLDING TIMER CHECK VALVE.
LANDING GEAR ACTUATING CYLINDER.
SHUTTLE VALVE.
HYDRAULIC FLUID RESERVOIR.
HYDRAULIC PRESSURE ACCUMULATOR.
HYDRAULIC FLUID FILTER.
UNLOADER VALVE.
ENGINE-DRIVEN HYDRAULIC PUMP.
INTERCOOLER FLAP ACTUATING CYLINDER.
ENGINE COWL FLAP ACTUATING CYLINDER.
RESTRICTOR.
GUN CHARGING VALVE.
LANDING GEAR DUMP VALVE.
LANDING GEAR VENT VALVE.
LANDING GEAR POSITION SELECTOR VALVE.
ENGINE COWL FLAP POSITION SELECTOR VALVE.
ENGINE OIL COOLER POSITION SELECTOR VALVE.
WING FLAP POSITION SELECTOR VALVE.
AIR PRESSURE BOTTLE.
CHECK RELIEF MANIFOLD.
WING LOCK SELECTOR VALVE.
AIR PRESSURE INDICATOR.
AIR BOTTLE FILLING VALVE.
HYDRAULIC PRESSURE INDICATOR.
HYDRAULIC HANDPUMP.
ENGINE OIL COOLER FLAP ACTUATING CYLINDER.
TAIL WHEEL ACTUATING CYLINDER.
HYDRAULIC PRESSURE RELIEF VALVE.
INTERCOOLER SELECTOR VALVE.
HYDRAULIC FLUID FILTER.
HYDRAULIC PRESSURE SNUBBER.
HYDRAULIC HANDPUMP SELECTOR CONTROL.

LANDING GEAR CONTROL

THE MAIN AND TAIL WHEELS ARE RETRACTED AND EXTENDED BY DOUBLE ACTING HYDRAULIC CYLINDERS. THE OPERATING PRESSURE IS SUPPLIED BY AN ENGINE-DRIVEN HYDRAULIC PUMP OR HAND PUMP. THE ACTION OF THE CYLINDERS IS CONTROLED BY A TWO POSITION SELECTOR VALVE HANDLE LOCATED ON THE LEFT HAND INSTRUMENT PANEL.

LANDING GEAR LOCK:
THE MECHANICAL LOCK BETWEEN THE LANDING GEAR CONTROL LEVER AND THE LEFT HAND SHOCK STRUT PREVENTS INADVERTANT LANDING GEAR RETRACTION WHEN THE AIRPLANE IS ON THE GROUND. THE CONTROL LEVER IS INOPERATIVE UNTIL THE AIRPLANE IS AIRBORNE.

ARRESTING HOOK CONTROL:
THE ARRESTING HOOK IS EXTEND- AND RETRACTED ELECTRICALLY. THE EXTENSION OF THE ARRESTING HOOK TURNS ON THE APPROACH LIGHT. THE OPERATION OF THE ARRESTING HOOK IS CONTROLED BY AN ELECTRIC SWITCH ON THE ELECTRICAL DISTRIBUTION PANEL IN THE COCKPIT.

AUTOMATIC PILOT

THE F6F-5 IS EQUIPPED WITH A TYPE GR-1 AUTOMATIC PILOT. THE AUTO-PILOT IS SELF-SYNCHRONOUS. IT MAY BE ENGAGED IN NORMAL FLIGHT ATTITUDE AND WILL TAKE OVER AND MAINTAIN THE AIRPLANE UNTIL IT IS CHANGED BY THE AUTOMATIC FLIGHT CONTROLLER. THE CONTROLLER IS MANUALLY OPERATED BY THE PILOT. THE FOLLOWING IS THE AUTOMATIC PILOT COMPONENTS:

TRANSFER VALVES.
RUDDER SERVO CYLINDER.
BANK AND CLIMB GYRO CONTROL.
AUTO-PILOT CONTROLLER.
DIRECTIONAL GYRO CONTROL.
AIR FILTER.
ON-OFF CONTROL UNIT.
ELEVATOR SERVO CYLINDER.
HYDRAULIC FILTER.
STABILIZER UNIT.
AILERON SERVO CYLINDER.
RELAY UNIT.

DE-ICER EQUIPMENT

THE WINDSHIELD IS DE-ICED BY ANTI-ICER FLUID SPRAYED ON IT BY MANUAL OPERATION OF THE SPRAY CONTROL VALVE. THE ANTI-ICER FLUID TANK IS ONE GALLON IN CAPACITY. THE T... IS LOCATED FORWARD OF THE FIREWALL.

WING FOLDING

THE WINGS ARE SPREAD OR M... UALLY FOLDED ON THE GROUN... AND AUTOMATICALLY LOCKED ... POSITION. THE WINGS ARE LOC... ED IN THE SPREAD POSITION, ... AND UNLOCKED BEFORE FOLD... ING, BY HYDRAULICALLY OPER... ATED LOCKING PINS CONTROL... ED FROM THE COCKPIT. THE ... TWO POSITION HYDRAULIC CO... TROL LEVER IS LOCATED IN TH... COCKPIT. WING SAFETY LOCK... PINS ARE CONTROLED FROM TH... COCKPIT. THESE PINS ARE USED TO SAFETY THE MAIN LOCKING PINS AFTER THE OUTER PANELS ARE MOVED TO THE SPREAD POSITION AND THE MAIN LOCKING PINS ARE FULLY HOME. THESE SAFETY LOCK... PINS, WHEN ENGAGED, PREVENT THE LOCKING PINS FROM FALLING OUT, REGARDLESS OF A LOSS OF HYDRAULIC PRESSURE. VISUAL INDICATORS ON EACH WING ALSO SHOW IF THE LOCKING SAFETY PINS ARE PROPERLY ENGAGED.

THE U.S. NAVY MODEL F6F-5 WAS PRODUCED IN QUANTITY IN DAY AND NIGHT FIGHTER VERSIONS DURING WORLD WAR TWO. THE NIGHT FIGHTER VERSION WAS EQUIPPED WITH A RADAR SCOPE AND A RADAR ALTIMETER. (MODEL F6F-5N). THE FIRST COMBAT OPERATIONAL AIRPLANE WAS MODEL F6F-3.

THE HYDRAULIC SYSTEM IS OPERATED BY AN ENGINE-DRIVEN HYDRAULIC PUMP LOCATED IN THE ENGINE ACCESSORY COMPARTMENT. VARIOUS MECHANICAL FUNCTIONS ARE CONTROLED BY MANUAL OPERATION OF POSITION SELECTOR VALVES. THE NORMAL HYDRAULIC OPERATIONAL PRESSURE IS 1500 POUNDS P.S.I. FOUR GALLONS OF FLUID ARE CONTAINED IN THE SYSTEM. AN AUXILIARY HAND PUMP IS USED TO ENERGIZE THE SYSTEM IN CASE OF ENGINE PUMP FAILURE. SPECIFICATION AN-VV-O-366 HYDRAULIC FLUID IS USED.

COCKPIT HEATING

THE COCKPIT HEATING AND VENTILATION SYSTEM CONSISTS OF A HOT AIR COMBUSTION TYPE HEATER. IT IS ELECTRICALLY OPERATED.

OIL DILUTION SYSTEM

FOR COLD WEATHER OPERATION, AN ELECTRICALLY ENERGIZED ENGINE OIL DILUTION SYSTEM IS PROVIDED. THE OIL DILUTION CONTROL VALVE AND OIL DIVERTER VALVE ELECTRIC SWITCH ARE LOCATED ON THE FUEL CONTROL PANEL.

F6F BASIC DIMENSIONS

HELLCAT

U.S. NAVY MODEL F6F-5 CARRIER FIGHTER – WORLD WAR II.
MANUFACTURED BY GRUMMAN AIRCRAFT ENGINEERING CORPORATION,
DRAWN BY: WILLIS L. NYE FOR MODEL AIRPLANE NEWS.

1

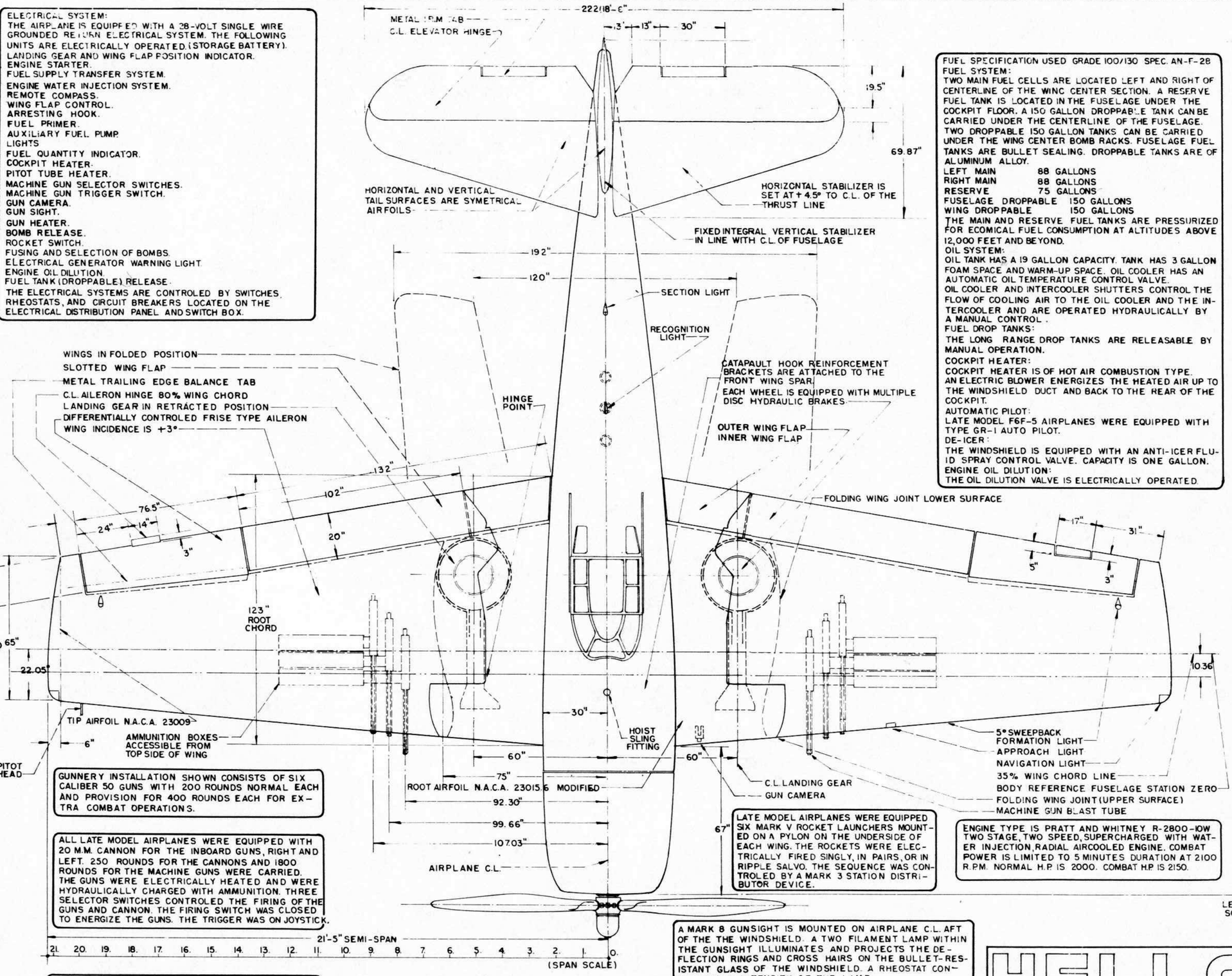
ACKNOWLEDGEMENT:
RON GERDES, A.A.H.S.
GRUMMAN AIRCRAFT ENGINEERING CORPORATION.
WILLIAM WINTER, EDITOR, M.A.N.

ELECTRICAL SYSTEM:
THE AIRPLANE IS EQUIPPED WITH A 28-VOLT SINGLE WIRE GROUNDED RETURN ELECTRICAL SYSTEM. THE FOLLOWING UNITS ARE ELECTRICALLY OPERATED (STORAGE BATTERY).
LANDING GEAR AND WING FLAP POSITION INDICATOR.
ENGINE STARTER.
FUEL SUPPLY TRANSFER SYSTEM.
ENGINE WATER INJECTION SYSTEM.
REMOTE COMPASS.
WING FLAP CONTROL.
ARRESTING HOOK.
FUEL PRIMER.
AUXILIARY FUEL PUMP.
LIGHTS
FUEL QUANTITY INDICATOR.
COCKPIT HEATER.
PITOT TUBE HEATER.
MACHINE GUN SELECTOR SWITCHES.
MACHINE GUN TRIGGER SWITCH.
GUN CAMERA.
GUN SIGHT.
GUN HEATER.
BOMB RELEASE.
ROCKET SWITCH.
FUSING AND SELECTION OF BOMBS.
ELECTRICAL GENERATOR WARNING LIGHT.
ENGINE OIL DILUTION.
FUEL TANK (DROPPABLE) RELEASE.
THE ELECTRICAL SYSTEMS ARE CONTROLED BY SWITCHES, RHEOSTATS, AND CIRCUIT BREAKERS LOCATED ON THE ELECTRICAL DISTRIBUTION PANEL AND SWITCH BOX.

MANUAL RESET TYPE CIRCUIT BREAKERS
LFF RADIO
GUNSIGHT.
EXTERIOR LIGHTS.
INSTRUMENTS.
COCKPIT LIGHTS.
BOMB FUSING.
DROPPABLE FUEL TANKS.
GUN CAMERA SOLENOID.
GUN CAMERA HEATER.
RECOGNITION LIGHTS.
GUN HEATERS.
PANEL RECEPTACLE.
REMOTE COMPASS.
ARRESTING HOOK.

ELECTRICAL SWITCHES
SECTION LIGHTS.
WING RUNNING LIGHTS.
TAIL RUNNING LIGHT.
FORMATION LIGHT.
MASTER EXTERIOR LIGHTS.
ARRESTING HOOK.
ENGINE STARTER.
PITOT TUBE HEAT.
RADIO MASTER.
FUEL PRIMER.
STORAGE BATTERY.
MACHINE GUN SELECTOR.
MACHINE GUN SIGHT.
MACHINE GUN CAMERA.
MACHINE GUN MASTER.
BOMB SELECTOR.
BOMB FUSING.

RHEOSTAT—LIGHTS
CHARTBOARD.
INSTRUMENT PANEL.
COCKPIT.
GUNSIGHT.



GUNNERY INSTALLATION SHOWN CONSISTS OF SIX CALIBER 50 GUNS WITH 200 ROUNDS NORMAL EACH AND PROVISION FOR 400 ROUNDS EACH FOR EXTRA COMBAT OPERATIONS.

ALL LATE MODEL AIRPLANES WERE EQUIPPED WITH 20 M.M. CANNON FOR THE INBOARD GUNS, RIGHT AND LEFT. 250 ROUNDS FOR THE CANNONS AND 1800 ROUNDS FOR THE MACHINE GUNS WERE CARRIED. THE GUNS WERE ELECTRICALLY HEATED AND WERE HYDRAULICALLY CHARGED WITH AMMUNITION. THREE SELECTOR SWITCHES CONTROLED THE FIRING OF THE GUNS AND CANNON. THE FIRING SWITCH WAS CLOSED TO ENERGIZE THE GUNS. THE TRIGGER WAS ON JOYSTICK.

THE GUNS ARE OPTICALLY BORE SIGHTED SO THE CONE OF FIRE WILL CONVERGE AT 300 YARDS IN FRONT OF THE AIRPLANE. THE GUN SIGHT LINE IS PARALLEL TO THE FUSELAGE DATUM LINE AND THE GUNS FIRE UP TO AND CONVERGE WITH THE LINE OF SIGHT AT 300 YARDS.

LATE MODEL AIRPLANES WERE EQUIPPED SIX MARK V ROCKET LAUNCHERS MOUNTED ON A PYLON ON THE UNDERSIDE OF EACH WING. THE ROCKETS WERE ELECTRICALLY FIRED SINGLY, IN PAIRS, OR IN RIPPLE SALVO. THE SEQUENCE WAS CONTROLED BY A MARK 3 STATION DISTRIBUTOR DEVICE.

A MARK 8 GUNSIGHT IS MOUNTED ON AIRPLANE C.L. AFT OF THE THE WINDSHIELD. A TWO FILAMENT LAMP WITHIN THE GUNSIGHT ILLUMINATES AND PROJECTS THE DEFLECTION RINGS AND CROSS HAIRS ON THE BULLET-RESISTANT GLASS OF THE WINDSHIELD. A RHEOSTAT CONTROLS THE INTENSITY OF THE LAMP.

FUEL SPECIFICATION USED GRADE 100/130 SPEC. AN-F-28
FUEL SYSTEM:
TWO MAIN FUEL CELLS ARE LOCATED LEFT AND RIGHT OF CENTERLINE OF THE WING CENTER SECTION. A RESERVE FUEL TANK IS LOCATED IN THE FUSELAGE UNDER THE COCKPIT FLOOR. A 150 GALLON DROPPABLE TANK CAN BE CARRIED UNDER THE CENTERLINE OF THE FUSELAGE. TWO DROPPABLE 150 GALLON TANKS CAN BE CARRIED UNDER THE WING CENTER BOMB RACKS. FUSELAGE FUEL TANKS ARE BULLET SEALING. DROPPABLE TANKS ARE OF ALUMINUM ALLOY.

LEFT MAIN	88 GALLONS
RIGHT MAIN	88 GALLONS
RESERVE	75 GALLONS
FUSELAGE DROPPABLE	150 GALLONS
WING DROPPABLE	150 GALLONS

THE MAIN AND RESERVE FUEL TANKS ARE PRESSURIZED FOR ECOMICAL FUEL CONSUMPTION AT ALTITUDES ABOVE 12,000 FEET AND BEYOND.
OIL SYSTEM:
OIL TANK HAS A 19 GALLON CAPACITY. TANK HAS 3 GALLON FOAM SPACE AND WARM-UP SPACE. OIL COOLER HAS AN AUTOMATIC OIL TEMPERATURE CONTROL VALVE.
OIL COOLER AND INTERCOOLER SHUTTERS CONTROL THE FLOW OF COOLING AIR TO THE OIL COOLER AND THE INTERCOOLER AND ARE OPERATED HYDRAULICALLY BY A MANUAL CONTROL.
FUEL DROP TANKS:
THE LONG RANGE DROP TANKS ARE RELEASABLE BY MANUAL OPERATION.
COCKPIT HEATER:
COCKPIT HEATER IS OF HOT AIR COMBUSTION TYPE. AN ELECTRIC BLOWER ENERGIZES THE HEATED AIR UP TO THE WINDSHIELD DUCT AND BACK TO THE REAR OF THE COCKPIT.
AUTOMATIC PILOT:
LATE MODEL F6F-5 AIRPLANES WERE EQUIPPED WITH TYPE GR-1 AUTO PILOT.
DE-ICER:
THE WINDSHIELD IS EQUIPPED WITH AN ANTI-ICER FLUID SPRAY CONTROL VALVE. CAPACITY IS ONE GALLON.
ENGINE OIL DILUTION:
THE OIL DILUTION VALVE IS ELECTRICALLY OPERATED.

ENGINE TYPE IS PRATT AND WHITNEY R-2800-10W TWO STAGE, TWO SPEED, SUPERCHARGED WITH WATER INJECTION, RADIAL AIRCOOLED ENGINE. COMBAT POWER IS LIMITED TO 5 MINUTES DURATION AT 2100 R.P.M. NORMAL H.P. IS 2000. COMBAT H.P. IS 2150.

THE F6F-5 WHILE IT WAS PRIMARILY A CARRIER FIGHTER, WAS ALSO FLOWN BY U.S. MARINE CORPS PILOTS AS A FIGHTER BOMBER, AS A NIGHT FIGHTER, AND AS A PHOTO PLANE. SEVERAL THOUSAND PLANES OF THIS TYPE WERE BUILT BY GRUMMAN. THE F6F REMAINED IN NAVAL SERVICE UNTIL 1949.

WING FOLDING HINGES
THE WING FOLDING HINGES ARE BOLTED TO THE FRONT WING SPAR. THE LOCKING UNIT WHICH HOLDS THE OUTER PANEL IN THE SPREAD POSITION IS ATTACHED TO THE AFT WING SPAR. HINGES ARE OF FORGED STEEL.

FUSELAGE ATTACHMENT
THE FUSELAGE IS ATTACHED TO WING CENTER SECTION BY MEANS OF TWO MAIN BOLTS AND FOUR NUTS AND TWO ATTACHING ANGLES ON THE WING CENTER SECTION.

F6F BASIC DIMENSIONS
(PLAN)

HELLCAT
U.S. NAVY MODEL F6F-5 CARRIER FIGHTER WORLD WAR II.
MANUFACTURED BY GRUMMAN AIRCRAFT ENGINEERING CORPORATION.
DRAWN BY WILLIS L. NYE FOR MODEL AIRPLANE NEWS.
2

GRUMMAN F6F HELLCAT

HEAD REST
ARMOR PLATE
COCKPIT RING
FLANGED RING
COCKPIT FLOOR
91"
54"
(J)
(H)

SELF-SEALING FUEL TANK
FRONT WING SPAR
WEB
STIFFENER
BOLT
77"
33"
5"
5.8" MAIN BULKHEAD
(K)

MAIN BULKHEAD CANTED AT LOWER PART
72"
58" (L)
FIREWALL BULKHEAD (STAINLESS STEEL)

HAMILTON-STANDARD HYDROMATIC 3-BLADE PROPELLER
DUCT FOR COOLING AIR FOR ENGINE OIL COOLER

C.M. TUBE ENGINE MOUNT
ENGINE CARRIED ON LORD MOUNTS WITH RUBBER BUSHINGS
HYDRAULIC FLUID RESERVOIR
P. & W. R-2800-10W TWIN ROW RADIAL AIR COOLED ENGINE
NOSE RING
ENGINE OIL COOLER DUCT
INTERCOOLER AIR INTAKE DUCT
ADJUSTABLE BRAKE AND RUDDER PEDALS
HYDRAULIC BRAKES

ARMOR PLATE
ENGINE OIL TANK
MAIN BULKHEAD
WELDED FITTING
INSTRUMENT PANEL
THROTTLE LINKAGES
REFLECTOR GUNSIGHT
FUEL FILLER
L.H. ENGINE CONTROLS
HEAD REST
ARMOR PLATE
PILOT'S ADJUSTABLE SEAT
OXYGEN TANK AND PRESSURE REGULATOR
RADIO MAST
W.E.P. WATER TANK
RADIO EQUIPMENT
ALUMINUM ALLOY SKIN
WATER FILLER
ROD ANTENNA
RECOGNITION LIGHT
CIRCUMFERENTIAL RING
LONGERON
RADIO MAST
FIXED VERTICAL STABILIZER
ALUMINUM ALLOY RIB
SECTION LIGHT
STRUCTURAL RIB

SLOTTED WING FLAP
STRUCTURAL RIB
RESERVE FUEL TANK
LEFT MAIN FUEL TANK
ENGINE OIL COOLER AIR EDUCTION
LANDING GEAR ACTUATING LINK
HYDRAULIC SHOCK ABSORBER
TORQUE LINKAGE
HYDRAULIC BRAKE LINE
ALUMINUM ALLOY FAIRING
CAST MAGNESIUM WHEEL

TRICING TUBE SUPPORT
ROD ANTENNA
DESTRUCTOR DEVICE
RADIO EQUIPMENT

ARRESTING HOOK (STOWED POSITION)
NAVIGATION LIGHT
RUDDER
RUDDER TRIM TAB
TAIL WHEEL CENTERING DEVICE
RETRACTABLE TAIL WHEEL
HYDRAULIC SHOCK ABSORBER
HYDRAULIC ACTUATING CYLINDER

LONGITUDINAL CUT-AWAY SHOWING STRUCTURE

ELEVATORS 30° UP OR DOWN
RUDDER 30° RIGHT OR LEFT
FLANGED RING
FABRIC TAPE ADJUSTABLE TRIM TAB
FIXED HORIZONTAL STABILIZER
FABRIC COVERING INSET HINGE
TRICING SUPPORT TUBE
SECTION LIGHT
INSIGNIA
RADIO ANTENNA
INSET HINGE
ADJUSTABLE TRIM TAB
FABRIC COVERING
INBOARD FLAP (HYDRAULICALLY OPERATED)
OUTBOARD FLAP (HYDRAULICALLY OPERATED)
WALKWAY
FUEL FILLERS ON BOTH SIDES OF THE FUSELAGE
20° UP OR DOWN AILERON MOVEMENT
RECOGNITION LIGHT
FABRIC TAPE BALANCE TAB

PITOT HEAD
NAVIGATION LIGHT
FORMATION LIGHT
WHITE INSIGNIA ON UNDER SURFACE OF WING
ENGINE EXHAUST BY-PASS AREA
HOISTING SLING ACCESS PLATE
TIE DOWN RINGS LOCATED ON THE UNDERSIDE OF EACH WING

MACHINE GUN
WHITE INSIGNIA
ACCESS PLATE FOR MACHINE GUNS AMMUNITION BOXES STOWED ON UNDERSIDE OF OUTER WING
REMOVABLE ENGINE COWL PANEL
NOSE RING STRUCTURE

F6F-5 TOP VIEW

(D)

STIFFENER
BRACE
(F)
STIFFENER

BRACE
(E)
(CIRCUMFERENTIAL RINGS)

STIFFENER
FLANGED RING
(G)

WEB
STIFFENER
CUT OUT
(C)
(B)
(A)
VERTICAL STABILIZER

COMMUNICATIONS EQUIPMENT

COMMUNICATIONS EQUIPMENT IS GROUPED AS FOLLOWS:
RADIO RECEIVERS AND TRANSMITTERS.
I.F.F. EQUIPMENT. (DESTRUCTOR DEVICE).
RADIO ALTIMETER.
RADAR EQUIPMENT.

AN/ARC-5 HIGH FREQUENCY AND AN/ARC-1 ARE USED FOR GENERAL COMMUNICATIONS. THE AN/ARC-1 CONSISTS OF AN MF TRANSMITTER AND A RANGE RECEIVER. AN/ARR-2 RECEIVER AND THE LF RADIO RANGE RECEIVER ARE USED FOR NAVIGATION.
RADIO MASTER SWITCH.
MASK MICROPHONE.
HAND MICROPHONE.
C-38/ARC-5 RECEIVER CONTROL UNIT.
C-26/ARC-5 RADIO RANGE CONTROL.
C-45/ARC-1 TRANSMITTER CONTROL.
RADIO ALTIMETERS AND RADAR EQUIPMENT ARE INSTALLED IN MODELS F6F-3N OR F6F-5N USED FOR NIGHT FIGHTING.

OXYGEN SYSTEM IS OF THE DILUTER DEMAND TYPE. OXYGEN TANK IS 514 CU. IN. CAPACITY. NORMAL PRESSURE IS 1800 PSI. A PRESSURE REGULATOR AND A PRESSURE GAUGE ARE MOUNTED TO LEFT OF THE PILOT'S SEAT. THE OXYGEN FLOW INDICATOR IS LOCATED ADJACENT TO THE LANDING GEAR CONTROL.

WING FLAPS ARE ACTUATED BY FOUR HYDRAULIC CYLINDERS, TWO BEING INSTALLED IN EACH WING INBOARD AND OUTBOARD. A COMBINED WING FLAP AND LANDING GEAR POSITION INDICATOR IS LOCATED ADJACENT TO THE LANDING GEAR CONTROL LEVER. THE WING FLAP HYDRAULIC CONTROL WHICH ACTUATES WING FLAP HYDRAULIC CYLINDERS IS OPERATED BY AN ELECTRIC SERVO MOTOR AND CONTROLED BY A TOGGLE SWITCH.

THE FLIGHT CONTROLS ARE ACTUATED BY DOUBLE STAINLESS STEEL CABLES RIGGED TO THE JOYSTICK AND RUDDER PEDALS. THE JOYSTICK HAS A PISTOL GRIP EQUIPPED WITH A GUN TRIGGER AND BOMB RELEASE BUTTON SWITCH. ADJUSTABLE TRIM TABS ARE ACTUATED BY SINGLE STAINLESS STEEL CABLES. A CONTROL HEAD WITH HANDWHEELS, HAVING FINE ADJUSTMENT, CONTROLS THE SETTING. THE TAIL WHEEL STEERING IS CONTROLED BY CABLES ATTACHED TO THE RUDDER PEDALS.

ENGINE OIL SYSTEM COMPONENTS

OIL TANK
DIP STICK
FILLER CAP
ENGINE OIL RETURN LINE
ENGINE OIL RETURN LINE TO WARM-UP COMPARTMENT
ENGINE OIL IN LINE
OIL DIVERTER VALVE
OIL FLOW CHECK VALVE
OIL TANK DRAIN VALVE
ENGINE OIL COOLER
ENGINE OIL OUT LINE
OIL DILUTION LINE
OIL DILUTION SOLENOID VALVE
WARM UP COMPARTMENT
OIL VENT LINE

MODEL F6F-5 WAS PROVIDED WITH TOW TARGET EQUIPMENT INCLUDING A RELEASE CONTROL OPERABLE BY THE PILOT.

TAIL WHEEL:
THE TAIL WHEEL HAD SWIVEL ACTION OF 180°. IT WAS LOCKED IN CENTER POSITION DURING LANDING BY THE PILOT.

THE ENTIRE AIRFRAME OF THE F6F-5 WAS FINISHED IN DARK BLUE. THE EXTERIOR SURFACE IS MIRROR SMOOTH.
BLACK FINISH ON PROPELLER.
YELLOW TIP
BLACK ENGINE (P&W R-2800-10W)
ENGINE OIL COOLER
SUPERCHARGER INTERCOOLER INTAKE
APPROACH LIGHT
GUN CAMERA
BLACK-ROCKETS
DARK BLUE-FAIRING
CHROMIUM PLATED SHOCK STRUT
YELLOW-BOMBS
BLACK-LANDING GEAR TIRES
DARK BLUE FUEL TANK (LONG RANGE)
ALUMINUM WHEEL HUBS

CANOPY-BLACK FINISH
ANTI-GLARE AREA-BLACK
WING WALKWAY-BLACK
WING JOINT
MACHINE GUNS
PITOT HEAD
ROCKET
MARK V ROCKET LAUNCHER
UNDERSIDE OF WINGS AND FUSELAGE FINISHED IN DARK BLUE
WING FOLDING JOINT
NON-SKID TIRE TREAD
LONG RANGE FUEL TANK SUPPORT

F6F IN TAKE-OFF ATTITUDE
(LANDING SHOCKS COMPRESSED)

LONG RANGE FUEL TANK MADE OF ALUMINUM ALLOY. INTERNAL BAFFLE PLATES AND PRESS FORMED SKIN COMPRISE THE STRUCTURE.

WATER TANK FILLER ACCESS PLATE
PLEXIGLAS CANOPY SLIDES AFT
REFLECTOR GUN SIGHT
HYDRAULICALLY ACTUATED ENGINE COWL FLAPS
REMOVABLE PANELS DEPRESSED AREA

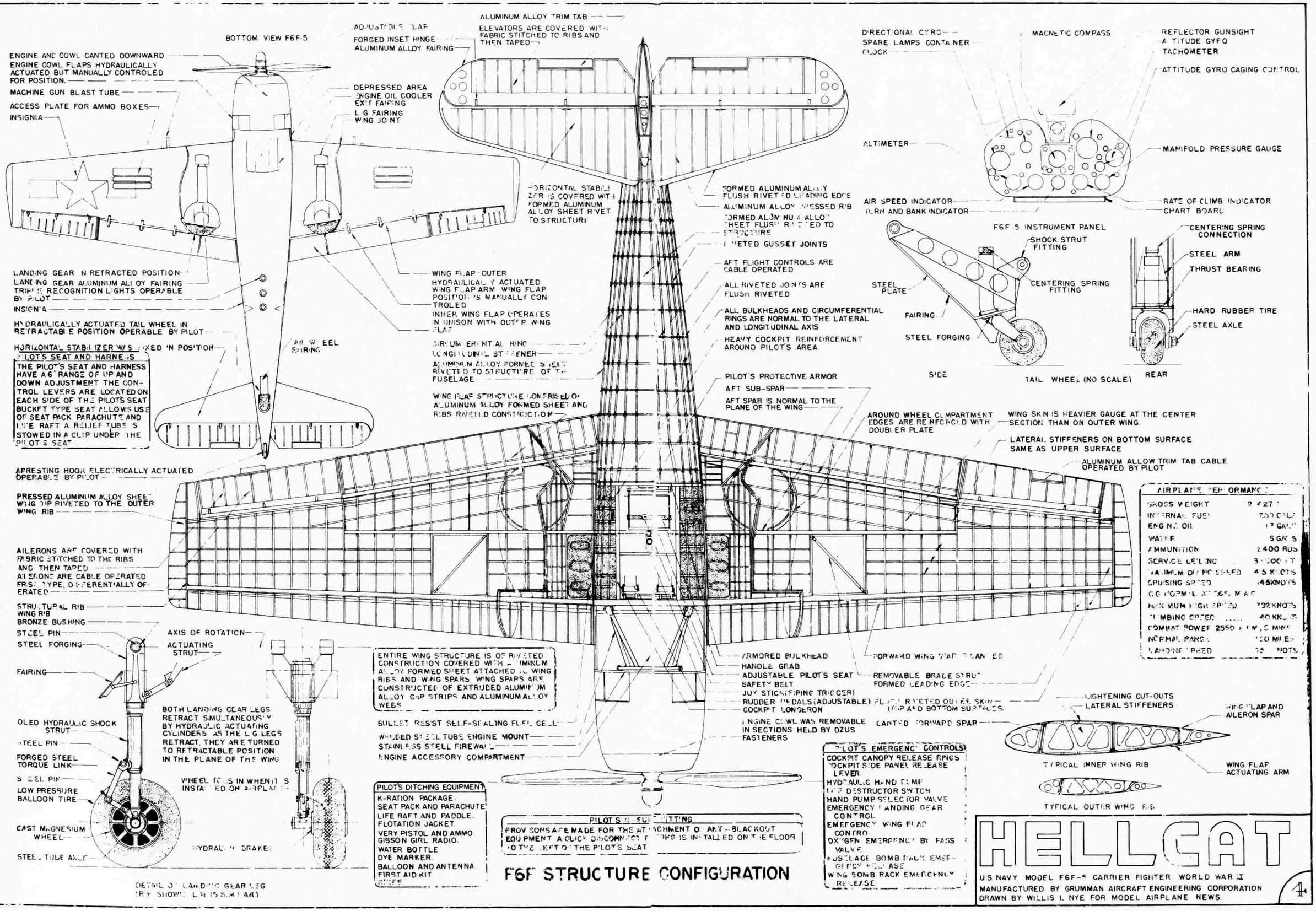
RECOGNITION LIGHT
TRANCEIVER ROD ANTENNA
SECTION LIGHT
RADIO ANTENNA MAST
RUDDER IS STATICALLY AND DYNAMICALLY BALANCED
INSET HINGE
ACCESS PLATE
FABRIC COVERING
NAVY F6F-5
ADJUSTABLE TRIM TAB ELEVATORS ARE STATICALLY AND DYNAMICALLY BALANCED
NAVIGATION LIGHT
HARD RUBBER TIRE
RETRACTABLE AND STEERABLE TAIL WHEEL
TRICING SLING SUPPORT TUBE
STEP
I.F.F. RADIO ANTENNA
ACCESS PLATE
LONG RANGE FUEL TANK (JETTISONABLE) (BLACK FINISH)

F6F-5 IN TAKE-OFF ATTITUDE-SHOCKS EXTENDED
NACA 23015.6 AIRFOIL
NACA 23009 AIRFOIL
63" TIP CHORD
120" ROOT CHORD

HELLCAT

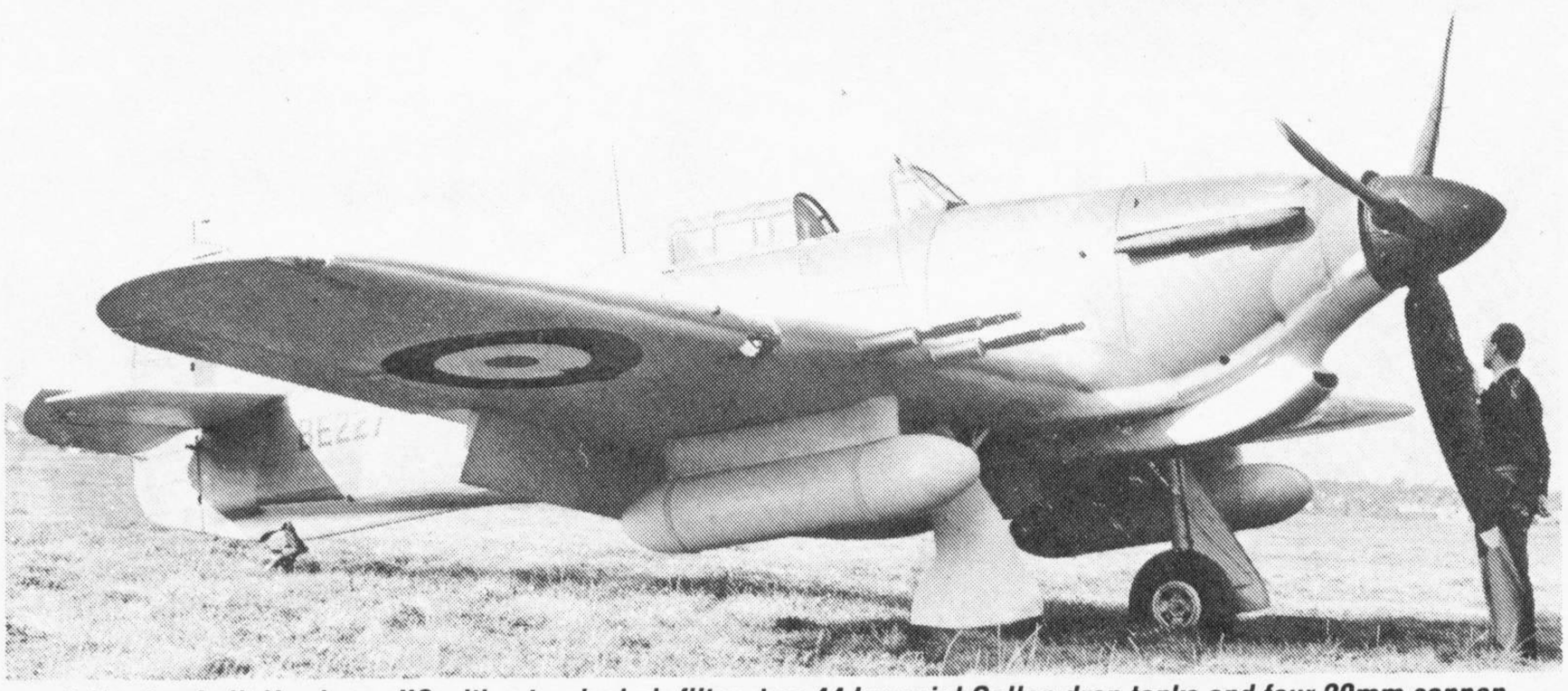
U.S. NAVY MODEL F6F-5 CARRIER FIGHTER - WORLD WAR II.
MANUFACTURED BY GRUMMAN AIRCRAFT ENGINEERING CORPORATION.
DRAWN BY WILLIS L. NYE FOR MODEL AIRPLANE NEWS.

3



GRUMMAN F6F HELLCAT

HAWKER HURRICANE



A Hawker-built Hurricane IIC with a tropical air filter, two 44 Imperial Gallon drop tanks and four 20mm cannon.

THE Hawker Hurricane was a major milestone in the evolution of British fighter planes. Monoplanes weren't new to the type, but the Hurricane set new standards of armament and performance in one stroke. When it appeared in 1935, with eight guns, it was the world's most heavily armed fighter, and it was Britain's first to exceed 300mph.

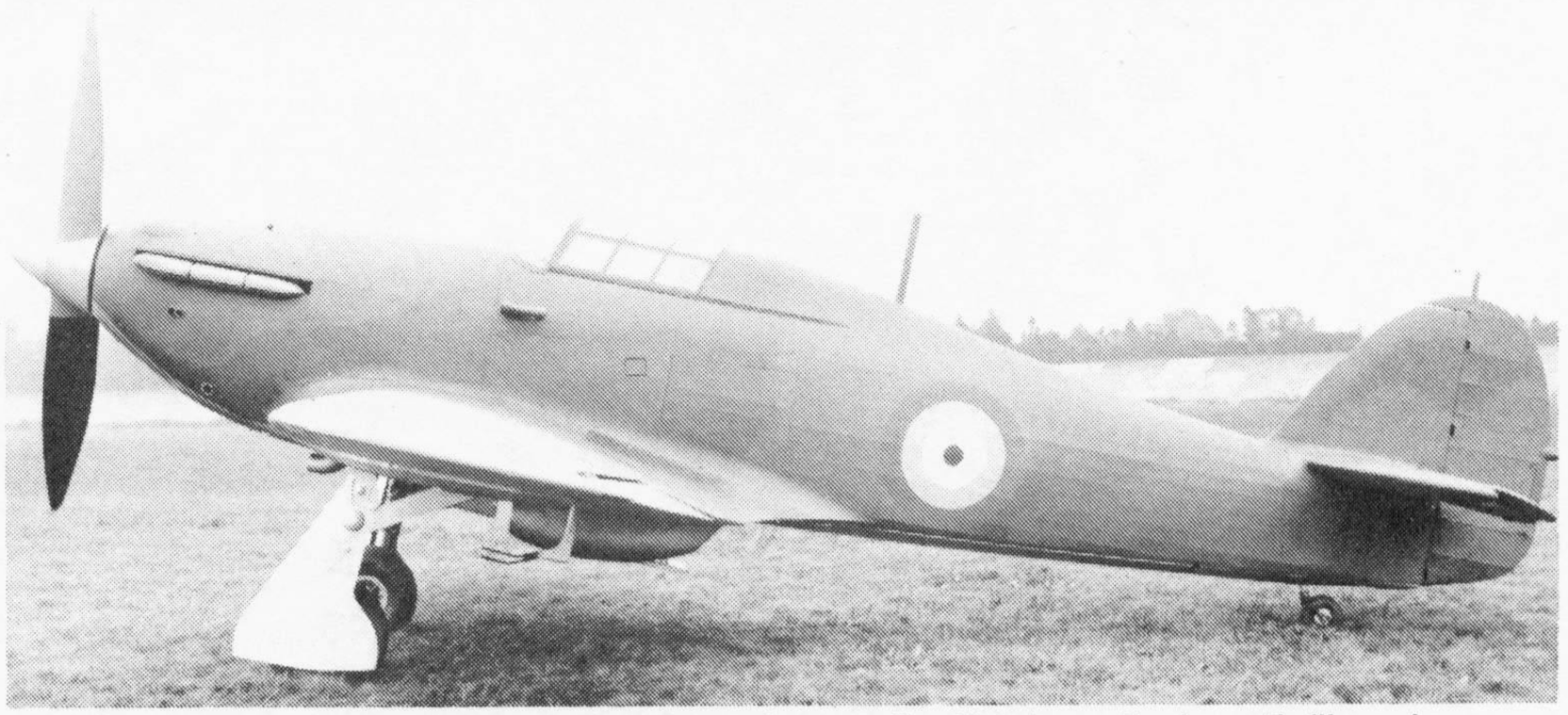
Delivery of the Hurricane to the squadrons began at the end of 1937, and the plane went on to play a major role in the Battle of Britain in 1940. Although much of that glory must be shared with the Supermarine Spitfire, the Hurricane did the majority of the defensive work. There were 32 Hurricane squadrons in the battle (compared to 19 Spitfire squadrons), and the Hurricane's simple structure enabled damaged aircraft to be repaired more quickly. Its easy-maintenance features also reduced turnaround time.

Design of the Hurricane began as a private venture by the Hawker Aircraft Company of Kingston-On-Thames in January 1934, when Sidney Camm became aware of a new 910hp Rolls-Royce engine that was being developed. Camm sought to design a new monoplane to capitalize on this advanced engine, which was later ordered into production as the famous "Merlin."

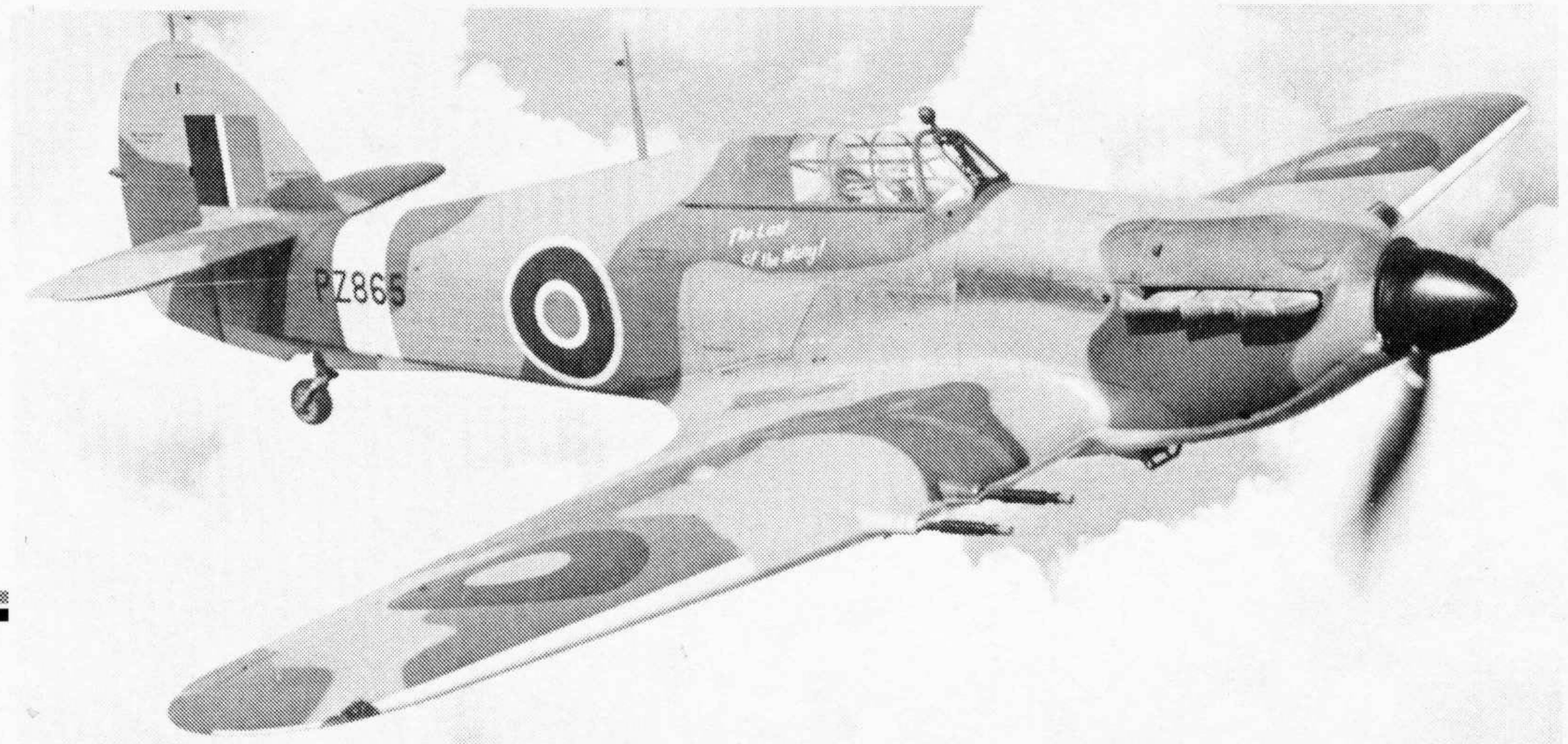
Previous Hawker fighters had all been biplanes, and the new Hurricane was a prime example of a transitional design. The details of the fuselage, tail, nose and radiator of the monoplane closely resembled those of the biplanes, but its major difference was the fitting of a metal-frame, fabric-covered monoplane wing that contained an inward-retracting landing gear in place cf the biplane's lower wing. In September 1934, Hawker showed drawings of the new design (which used two nose guns and one gun in each wing) to the Air Ministry. An official specification was written to cover the design, and a contract for a prototype was awarded on January 10, 1934.

During construction, the armament was revised to use eight .303-rifle-caliber machine guns that were entirely enclosed in the thick wing (the guns noted on the drawings should be .303 rather than the stated .30 caliber). The prototype flew on November 1, 1935, and demonstrated a high speed of 315mph at 16,200 feet (5,000 meters). Production orders followed for a total of 3,759 Hurricane Is, and later models brought the total number of Hurricanes to 14,557.

Early production Hurricanes were fitted with 1,030hp Merlin II engines that drove two-blade, fixed-pitch,



The first production Hurricane I, with a fixed-pitch, wooden propeller. Note how orthochromatic film makes the red and yellow of the Type A.1 fuselage roundel appear dark, and the blue appear light.



The last Hurricane built: a Mark IIC. Note "The Last of the Many" painted below the cockpit. There's a Type C.1 roundel on the fuselage and a Type B roundel on the wing top.

wooden propellers, but these were soon replaced with variable-pitch, three-blade metal units. Production was increased by building Hurricanes at the Gloster Aircraft Company and the Austin Motor Company in England and at the Canadian Car and Foundry Company in Canada. Licenses to build Hurricanes were also granted to some "friendly" countries, but the outbreak of war cancelled most of these projects.

The Hurricane adopted several significant state-of-the-art improvements during the production of the Mark I. The wing structure was changed to all-metal; constant-speed propellers were adopted; and armor for the pilot and fuel tanks was added. For service in North Africa and in the Middle East, a "tropicalized" version was developed that featured dust filters for the engine air intake and other details which were dictated by operations and maintenance in desert conditions. Hurricanes were also adapted to naval operations from aircraft carriers by the fitting of arrester hooks, and operated under the name "Sea Hurricane."

The appearance of the 1,280hp Merlin XX engine with a two-stage supercharger resulted in the major Hurricane model—the Mark II—which had many variants, mostly in the arrangement of armament. Two different wings were built, one for 12 .303 guns (Mark IIB) and the other for four 20mm cannon, plus hard points for up to 500-pound bombs (Mark IIC). The Mark IIA had the original eight-gun wing; the Mark IID had two 40mm cannon that were mounted below the wing.

There was to have been a British-built Hurricane III with the American Packard-Merlin engine, but it was never produced. The Hurricane IV (originally the "Mark IIE"), with a 1,620hp Merlin 27 engine, was designed for low-level attack missions with a wing that could be fitted with two 40mm cannons, bombs, drop tanks, or rockets. There were only two Hurricane Vs. These were Mark IVs that were fitted with 1,635hp Merlin 32 engines and four-blade propellers. After testing, they were reconverted to Mark IVs.

In Canada, use of the Packard-Merlin 28 engine and American Hamilton-Standard propellers in the basic Mark IIB airframe resulted in the Mark X in 1941. The Mark XI was similar except for its Canadian equipment. The Mark XII used the Packard-Merlin 29 and had a 12-gun wing; the Mark XIIA had eight guns.

Altogether, Hawker built 9,900 Hurricanes; Gloster, 2,749; Austin, 300; Canadian Car, 1,606; and Avions Fairey (in Belgium), 2. The last Hurricane built, a Mark IIC, was delivered by Hawker in September 1944.

As a fighter, the Hurricane was generally surpassed by the German Messerschmitt Me 109. As the Hurricane was improved, so was the Me 109. The Hurricane was outclassed as an interceptor fighter by mid-1942, but with the new wing and heavier armament, it became a highly successful low-level fighter-bomber and tank buster.

Some 2,952 Mark IIs and IVs were supplied to Russia during the war, and this produced quite an oddity. Hawker sold 12 Hurricanes to Finland in January 1940 during that country's first war with Russia, and by the time of the second, or "Continuation," war, the Russians also had Hurricanes. Further, in a reversed Lend-Lease operation, Britain supplied Hurricanes to American fighter squadrons that arrived in Europe and North Africa but were not yet equipped with American fighters.

A Gloster-built Sea Hurricane IB with an arrester hook extended (top), and a Hawker-built IIB carrying 250-pound bombs. Compare the color rendition of the roundels when photographed on panchromatic film with a yellow filter.

HAWKER HURRICANE

THE PROTOTYPE FOR THE FIRST OF THE MANY WAS SERIAL NO. K 5083 AND WAS TEST FLOWN IN NOVEMBER 1935. PLANE SERIAL NO. PZ 865 WAS THE LAST OF THE MANY. 13,927 HAWKER HURRICANES WERE MANUFACTURED DURING THE WAR YEARS, MAKING THIS AIRPLANE ONE OF FAMOUS OF ALL TIME. IT WAS DESIGNED BY SIR SIDNEY CAMM TO AIR MINISTRY SPECIFICATION F7/30 AND COMPLIED OR EXCEEDED THE TECHINICAL REQUIREMENTS.

HAWKER HURRICANE TYPES

F34/36 PROTYPE (MERLIN "C" ENGINE)
MARK I (8 30 CAL. M.G. FABRIC COVERED WINGS)
MARK II (MERLIN XX ENGINE)
MARK IIA
MARK IIB (12 30-CAL M.G.)
MARK IIC (4 20 M.M. CANNON)
MARK IID (2 40 M.M. ANTI-TANK GUNS)
SEA HURRICANE IC (4 20 M.M. GUNS)
MARK IV (ARMORED)

ENGINE INSTALLATION

ROLLS-ROYCE MERLIN XX. ENGINE DEVELOPES 1260 H.P. AT 3,000 R.P.M. AT 11,750 FEET IN MS GEAR, AND 1,160 B.H.P AT 3,000 R.P.M. AT 20,000 FEET IN S-GEAR. SEA LEVEL TAKE-OFF POWER 1,300 B.H.P AT 3,000 R.P.M.

PROPELLER

THREE BLADE ROTOL R.S.5/2 WITH SCHWARTZ BLADES. GEAR RATIO 0.42'

DATUM POINT

21.6" BELOW THRUST LINE.
30" FORWARD OF WING LEADING EDGE EXTENDED TO CENTERLINE.

WING LOADING

WING LOADING AT 7200 LBS. IS 28.0 LB/SQ.FT.

CENTER OF GRAVITY

CENTER OF GRAVITY AT TARE WEIGHT IS 9.9" ABOVE AND 55.8" AFT OF DATUM POINT.
C.G. AT NORMAL LOADED WEIGHT, 9.45" ABOVE AND 59.5" AFT OF DATUM POINT. C.G. LIMITS: 57-60" AFT OF DATUM POINT.

CATEGORIES OF TYPES

MARK IIC WITH 18 GALLONS OF COOLANT WEIGHED 5,658 LBS. NORMAL GROSS WEIGHT OF 7,544 LBS. THIS TEMPERATE CONFIGURATION.
MARK IIC TROPICAL CONFIGURATION WEIGHED 7,707 LBS. TARE WEIGHT IS 5,785 LBS. THE TROPICAL VERSION CARRIED DESERT SURVIVAL EQUIPMENT. TEMPERATE VERSIONS COULD ALSO CARRY 2 90-GALLON FERRY TANKS. THE TROPICAL VERSION WAS PROVIDED WITH EXTERNAL BOMB RACKS TO CARRY TWO 250 LB BOMBS. S-GEAR OR MS GEAR REFERS TO ENGINE ASPIRATION.

PERFORMANCE

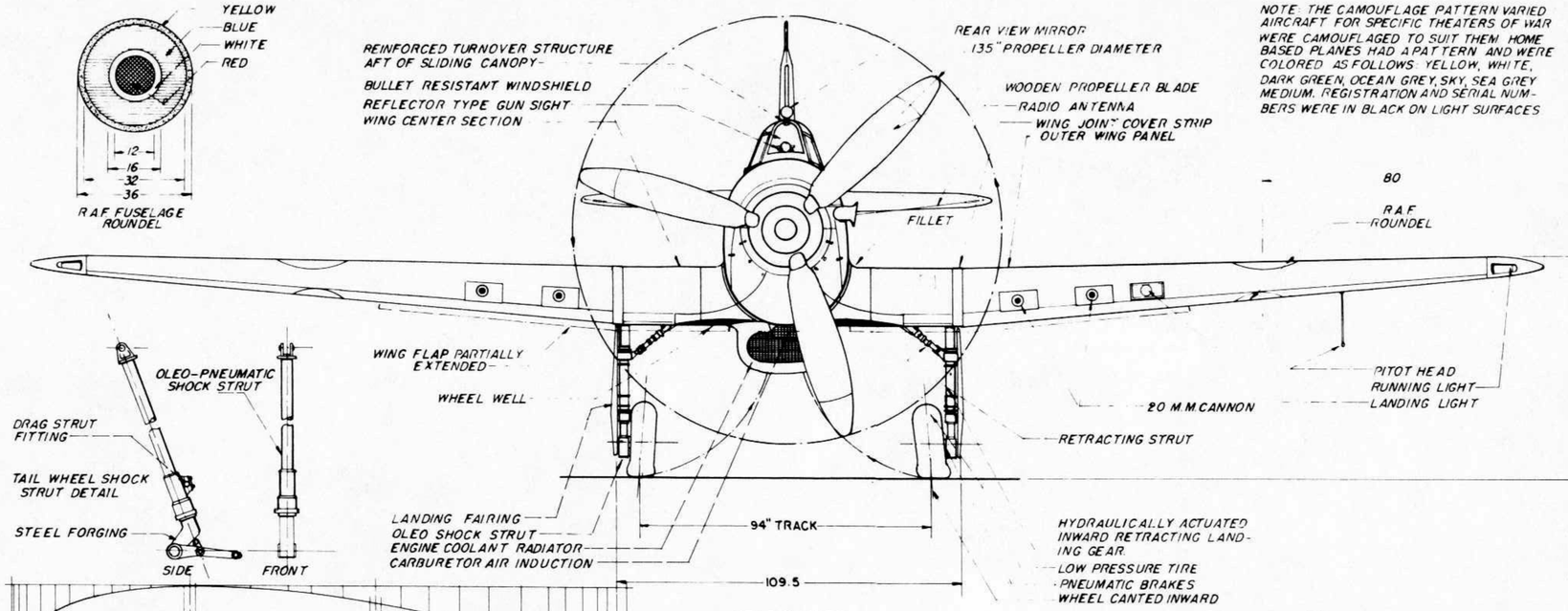
CLEAN AIRCRAFT MARK IIC FIGHTER
STALLING SPEED 75-85 M.P.H. I.A.S.
OPTIMUM RANGE SPEED 178 M.P.H. T.A.S.
RANGE IN STATUTE MILES 460.
MAXIMUM ALTITUDE 34,000 FT.
TIME TO CLIMB TO 34,000 FT. 21 MINUTES.
RATE OF CLIMB 3200 F.P.M.
MAXIMUM SPEED 326 M.P.H. AT 17,500 FT.
LONG RANGE 2 44 GAL. TANKS (EXTERNAL) 920 MILES.
LONG RANGE 2 90 GAL. TANKS (EXTERNAL) 1,086 MILES.

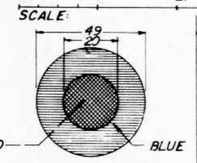
WEIGHT DATA MARK IIC

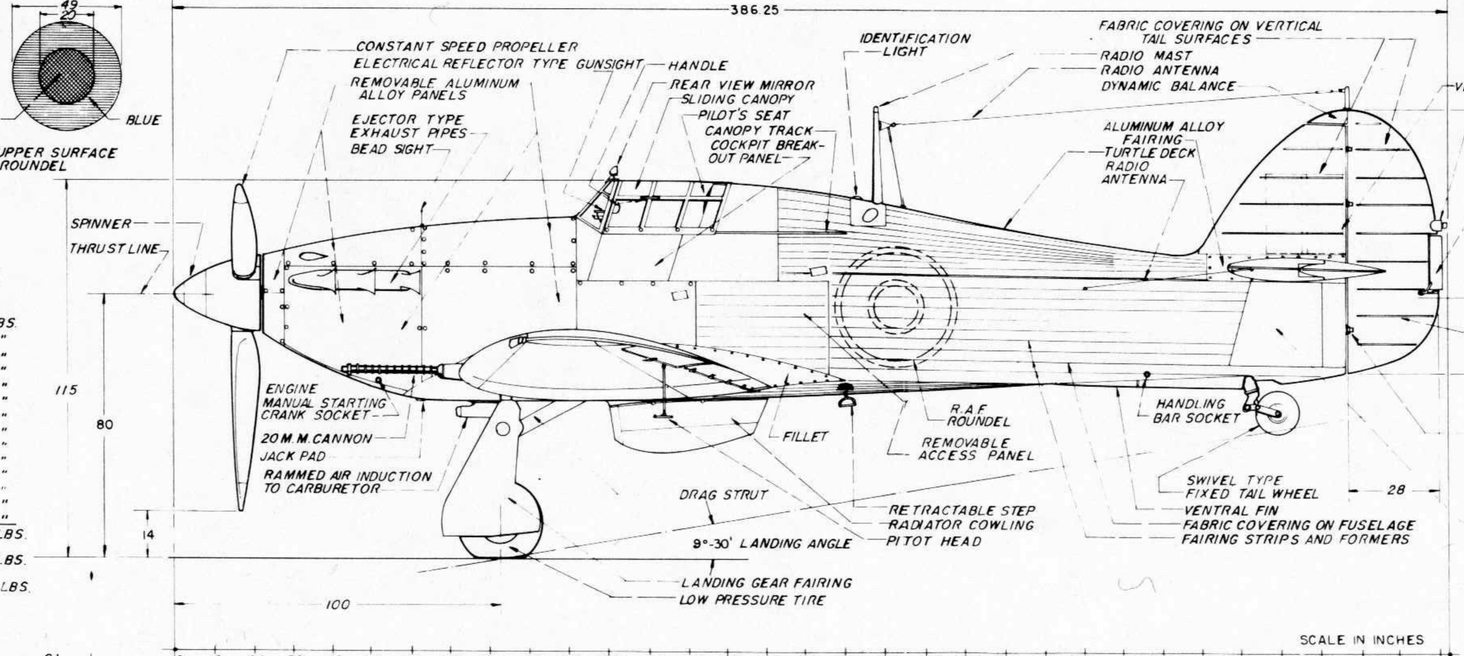
TARE WEIGHT WITH 18 GALLONS OF COOLANT	5,658 LBS.
PILOT AND PARACHUTE	200 "
FOUR 20 M.M. GUNS	425 "
AMMO BOXES AND BELT FEEDS (364 RDS)	327 "
GUNSIGHT	17 "
GUN CAMERA	9 "
PYROTECHNICS	18 "
OXYGEN EQUIPMENT	15 "
FIRST AID PACKET	3 "
T.R.1133 RADIO	79 "
R.3002 RADIO	24 "
RESERVE FUEL (28 GALS)	202 "
MAIN FUEL (69 GALS)	497 "
LUBRICATING OIL (7.5 GALS)	68 "
NORMAL LOADED WEIGHT	7,544 LBS.
NORMAL FERRY WEIGHT	7,619 LBS.
OVERLOAD COMBAT WEIGHT	8,044 LBS.

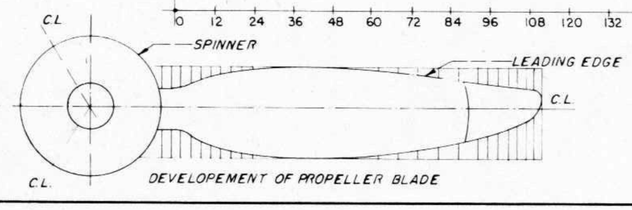
HURRICANE PRODUCTION

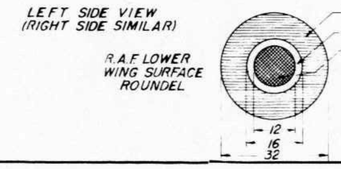
HURRICANE FIGHTERS WERE BUILT IN QUANTITY PRODUCTION BY HAWKER AIRCRAFT LTD., GLOSTER AIRCRAFT AND CANADIAN CAR AND FOUNDRY CO. HURRICANES WERE SUPPLIED TO:
BELGIUM.
YUGOSLAVIA.
PERSIA.
TURKEY.
RUMANIA.
CANADA.
SOUTH AFRICA.
FINLAND.
PORTUGAL.
INDIA.

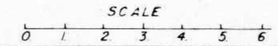


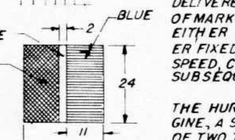












NOTE: THE CAMOUFLAGE PATTERN VARIED AIRCRAFT FOR SPECIFIC THEATERS OF WAR WERE CAMOUFLAGED TO SUIT THEM. HOME BASED PLANES HAD A PATTERN AND WERE COLORED AS FOLLOWS: YELLOW, WHITE, DARK GREEN, OCEAN GREY, SKY, SEA GREY MEDIUM. REGISTRATION AND SERIAL NUMBERS WERE IN BLACK ON LIGHT SURFACES.

HURRICANE ARMAMENT

THE MARK I HURRICANE WAS ARMED WITH 8 .30-CALIBER AIRCRAFT MACHINE GUNS MOUNTED IN THE WINGS, PERMANENTLY FIXED, AND BORESIGHTED TO CONVERGE AT A POINT 200 YARDS AHEAD OF THE AIRPLANE. THE RATE OF FIRE OF EACH GUN WAS 1200 ROUNDS PER MINUTE. THE GUNS WERE ELECTRICALLY FIRED AND PNEUMATICALLY CHARGED. THE AMMO WAS CONTAINED IN LONG LINK TYPE BELTS LOADED INTO METAL COMPARTMENTS BUILT INTO THE WING STRUCTURE. ACCESS TO THE AMMO COMPARTMENTS IS BY MEANS OF REMOVABLE STRESS PLATES LOCATED ON TOP OF EACH WING. ARMOR PIERCING, INCINDIARY AND TRACER BULLETS ARE INSERTED IN THE CARTRIDGE BELTS IN THAT ORDER.

COMBAT SERVICING

THE HURRICANE WAS DESIGNED FOR FAST GROUND SERVICING IN COMBAT. THE AMMO, FUEL AND COOLANT COULD BE REPLACED IN 10 MINUTES BY A TRAINED GROUND CREW. SPECIAL SERVICING RIGS WERE USED TO FACILITATE THIS OPERATION.

ENGINE STARTING

ON THE HURRICANE FIGHTER, A DIRECT DRIVE, GEARED, INERTIA TYPE, MANUAL CRANKING ENGINE STARTING SYSTEM WAS USED.

PRODUCTION HURRICANES

THE FIRST PRODUCTION AIRPLANE SERIAL NO. L1457, POWERED WITH A ROLLS ROYCE, MERLIN II ENGINE FLEW ON OCT. 12, 1937. IT WAS AN IMPROVED VERSION OF THE PROTYPE, HAVING STUB ENGINE EXHAUST PIPES, IMPROVED LANDING GEAR DOORS, RUDDER MASS BALANCE AND A STRENGTHENED CANOPY. A VENTRAL FIN WAS INSTALLED TO IMPROVE RECOVERY FROM A TAIL SPIN. ARMOR PLATE TO PROTECT THE PILOT AND A BULLET RESISTANT WINDSHIELD WERE INSTALLED IN LATER PRODUCTION AIRCRAFT.

BY SEPT. 3RD, 1939, 497 HURRICANES HAD BEEN DELIVERED TO 18 SQUADRONS. ALL OF THESE WERE OF MARK I TYPE ARMED 8 30-CAL. MACHINE GUNS EITHER A WATTS TYPE 2 BLADE WOOD PROPELLER FIXED PITCH, OR A ROTOL 3 BLADE, CONSTANT SPEED, CONTROLLABLE PITCH PROPELLER IN SUBSEQUENT PLANES.

THE HURRICANE MARK II HAD A MERLIN XX ENGINE, A STRENGTHENED FUSELAGE AND WINGS OF TWO TYPES, ONE TYPE FOR 12 30-CAL. MACHINE GUNS AND THE OTHER FOR 4 20 M.M. CANNONS. BOTH TYPES OF WINGS COULD CARRY LONG RANGE FUEL TANKS OR 500 LBS. IN BOMBS.

THE HURRICANE MARK IIA WAS AN INTERIM PRODUCTION VERSION WITH 8 GUNS. WAS INTENDED FOR MODIFICATION.

THE HURRICANE MARK IIB WAS FITTED WITH 12 30-CAL. MACHINE GUNS.

THE HURRICANE MARK IIC WAS FITTED WITH 4 HISPANO TYPE 20 M.M. CANNON.

SEA HURRICANE WAS SAME AS A MARK IIC HAVING A REINFORCED FUSELAGE WITH AN ARRESTING HOOK. IT WAS FITTED WITH NAVAL RADIO EQUIPMENT AND SEA SURVIVAL EQUIPMENT.

THE HURRICANE MARK IID WAS FITTED WITH 2 30-CAL. MACHINE GUNS AND 2 VICKERS ANTI-TANK GUNS. THIS AIRPLANE WAS A TROPICAL CONFIGURATION.

THE HURRICANE MARK IV WAS A TROPICAL VERSION IMPROVEMENT OVER THE MARK IID AND GROSSED 8,462 LBS.

TROPICAL VERSION HURRICANE FIGHTERS WERE PROVIDED WITH DUST EXCLUDERS AND AIR FILTERS FOR THE COOLANT SYSTEM AND CARBURETOR AIR INDUCTION SYSTEM. GUNS AND OTHER FUNCTIONAL OPENINGS WERE PROVIDED WITH COVERS OR SEALS.

MAXIMUM GROSS WEIGHT

EACH MARK NUMBER AND VARIENT GROSSED AT A DIFFERENT WEIGHT. THE VARIATIONS IN THE GROSS WEIGHT AND ENGINE POWER IN TURN MODIFIED THE TOTAL OVERALL PERFORMANCE. PRODUCTION AIRCRAFT EXHIBITED A MARKED DEFICIENCY IN TOTAL PERFORMANCE WHEN THEY ARE COMPARED TO TEST AIRCRAFT.

HAWKER MARK IIC HURRICANE

HAWKER AIRCRAFT, LIMITED. KINGSTON-ON-THAMES, SURREY, ENGLAND.

DRAWN BY: WILLIS L. NYE, A.A.H.S. FOR MODEL AIRPLANE NEWS, NEW YORK CITY, NEW YORK

RUDDER STRUCTURE
THE RUDDER STRUCTURE IS OF COMPOSITE CONSTRUCTION AND IS WELL ADAPTABLE TO MASS PRODUCTION. THE RUDDER POST IS OF STEEL TUBING AND IS THE MAIN STRUCTURAL COMPONENT. NO WELDED CONNECTIONS ARE USED TO MAINTAIN THE INTEGRITY OF THE STRUCTURAL CONFIGURATION. THE RIBS ARE OF STEEL TUBING AND ATTACHMENT TO THE PRIMARY AND SECONDARY STRUCTURAL MEMBERS IS MADE BY MEANS OF RIVETED FITTINGS SOLID RIVETS, HOLLOW RIVETS, AND BOLTS WITH LOCKNUTS ARE USED AT THE FITTINGS. RUDDER AND TRIM TAB ARE CABLE OPERATED. RIB ENDS WERE SWAGED AT TRAILING EDGE RIVETED JOINTS. RUDDER PERIMETER WAS OF STEEL TUBE.

VERTICAL STABILIZER
THE VERTICAL STABILIZER STRUCTURE IS OF COMPOSITE CONSTRUCTION. THE PRIMARY STRUCTURE CONSISTS OF STEEL TUBING. RIBS AND THE PERIMETER CONSIST OF STEEL TUBE. ALL JOINTS ARE OF THE RIVETED OR BOLTED TYPE. THE LEADING EDGE FAIRING IS SHEET ALUMINUM ALLOY. THE STRUCTURE IS ATTACHED TO THE FUSELAGE WITH TO HEAVY BOLTED FITTINGS. THE FIN POST HAS 3 CLEVIS TYPE HINGES ON WHICH THE RUDDER IS ATTACHED.

HORIZONTAL STABILIZER
THE HORIZONTAL STABILIZER STRUCTURE IS OF COMPOSITE CONSTRUCTION. IT IS FIXED BUT ADJUSTABLE ON THE GROUND. STRUCTURE CONSISTS OF STEEL TUBING THROUGHOUT WITH RIVETED OR BOLTED FITTINGS. THE LEADING EDGE WAS COVERED WITH SHEET ALUMINUM ALLOY. ATTACHMENT TO THE FUSELAGE WAS BY MEANS OF BOLTED FITTINGS. FOUR HINGES TO CARRY THE ELEVATOR WERE ATTACHED TO THE AFT SPAR.

ELEVATORS
THE ELEVATOR STRUCTURE IS OF THE COMPOSITE CONSTRUCTION OF STEEL TUBING. THE SPACE FRAMEWORK STRUCTURE HAS RIVETED TYPE CONNECTIONS. EACH ELEVATOR IS IDENTICAL AND SYMMETRICAL. A CENTRAL LEVER ACTUATES THE ELEVATOR SPAR WHICH IS JOINED AT THE INBOARD ENDS. TRIM TAB ACTUATING CABLES ARE ENCASED IN ALUMINUM CONDUITS.

ENGINE STARTING
MANUAL ENGINE STARTING WAS USED WHICH EMPLOYED AN INERTIA TYPE DIRECT GEARED CRANKING SYSTEM. A BOOSTER TYPE STARTING MAGNETO WAS USED TO ACCELERATE ENGINE STARTS.

WING FLAPS
WING FLAPS ARE OF THE SPLIT TRAILING EDGE TYPE WITH A MULTIPLE SEGMENT CONFIGURATION. THE TWO SEGMENT CENTER SECTION FLAP AND THE OUTER WING PANEL FLAPS ARE INTERCONNECTED BY MEANS OF A TORQUE TUBE. A TORQUE LEVER ACTUATED BY A HYDRAULIC ACTUATING CYLINDER ACTUATES THE FLAP TORQUE TUBE. THE WING FLAP TORQUE TUBE IS CONTINUOUS THROUGHOUT THE SPAN OF THE WING FLAPS. WING FLAPS ARE AN ALUMINUM ALLOY STRUCTURE ATTACHED TO THE TORQUE TUBE. UNIVERSAL JOINTS IN THE TORQUE TUBE MAINTAIN ALIGNMENT. THE PILOT CONTROLS THE WING FLAP SETTING FOR TAKE-OFF OR LANDING.

FLIGHT CONTROLS
FLIGHT CONTROLS ARE OF THE CONVENTIONAL DEP TYPE. A SPECTICLE TYPE JOY STICK IS USED BY THE PILOT TO CONTROL THE AIRPLANE. CABLE OF STRANDED STEEL WIRES RUNS TO THE CONTROL SURFACES. TRIM TABS ARE SIMILARLY CONTROLLED.

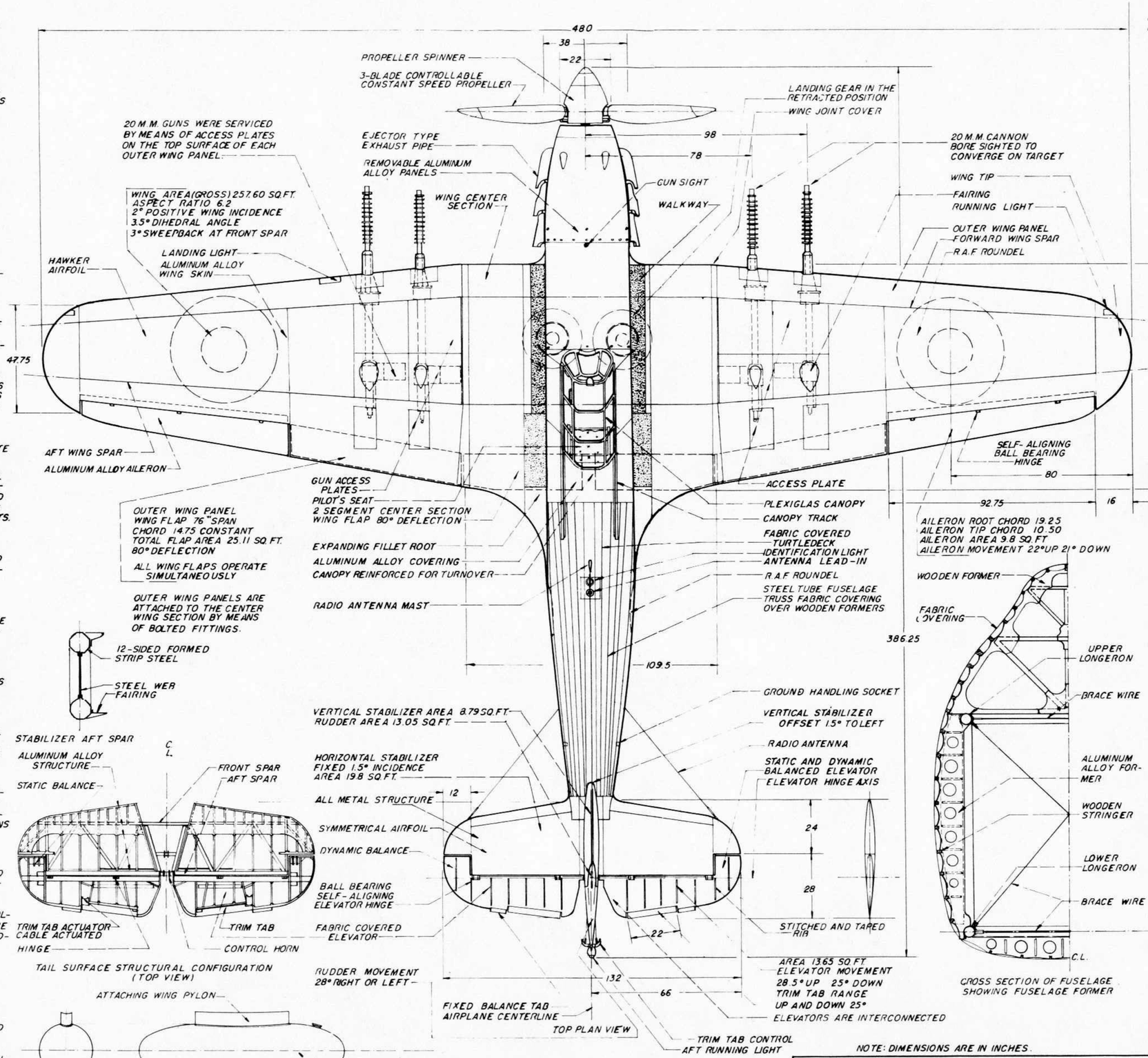
ENGINE COOLING
THE ROLLS ROYCE MERLIN XX LIQUID COOLED ENGINE USED ETHYL GLOCOL AS THE COOLANT. THE COOLANT WAS CIRCULATED BY AN ENGINE-DRIVEN PUMP THROUGH RADIATOR. AIRFLOW THROUGH THE RADIATOR IS CONTROLED BY A MANUALLY OPERATED EXIT FLAP. THE COOLANT AFTER FLOWING THROUGH THE RADIATOR, RISES TO THE HEADER TANK AND THEN TO THE ENGINE.

ENGINE OIL COOLER
THE ENGINE OIL COOLER WAS AN INTEGRAL PART OF THE ENGINE COOLANT RADIATOR.

ENGINE OIL TANK
THIS TANK IS LOCATED AT THE LOWER AFT END OF THE ENGINE COMPARTMENT. LUBRICATING OIL IS CIRCULATED UNDER PRESSURE TO THE ENGINE, THEN TO THE ENGINE COOLER 7.5 GALLONS OF OIL WERE CARRIED. AN AUXILIARY OIL SYSTEM WAS ALSO PART OF MAIN OIL SYSTEM.

0 1 2 3 4 5 6 7
SCALE IN FEET

SHEET NO. 2.



NOTE: 90-GALLON LONG RANGE FUEL TANK IS SIMILAR.

NOTE: FUEL WAS SUPPLIED FROM LONG RANGE TANKS BY MEANS OF ELECTRIC FUEL PUMPS. TANKS COULD BE JETTISONED PRIOR TO COMBAT OR WHEN EMPTY.

NOTE: DIMENSIONS ARE IN INCHES.

TAIL WHEEL
THE TAIL WHEEL IS NOT RETRACTABLE BUT CASTORING ACTION TO FACILITATE TURNING ON THE GROUND DURING TAXYING IS PROVIDED. AN OLEO HYDRAULIC SHOCK IS PROVIDED TO EASE THE SHOCK OF ALIGHTING AT A SPEED OF 85 M.P.H.

LANDING GEAR
THE LANDING GEAR IS RETRACTABLE BY MEANS OF HYDRAULIC ACTION. AT THE ATTACHING POINT AT THE FUSELAGE THE TWO LEGS OF THE LANDING GEAR SIMULTANEOUSLY ROTATE INWARDS AND UPWARDS INTO THE FUSELAGE. FAIRINGS ATTACHED TO THE LANDING GEAR LEG, FAIR THE ASSEMBLIES INTO THE BOTTOM OF THE WING CENTER SECTION AND FUSELAGE. THE HYDRAULIC SYSTEM IS A LOW PRESSURE MANUALLY OPERABLE CONFIGURATION. AN ACTUATING CYLINDER OPERATES THE RETRACTING LINKAGE. A MECHANICAL UPLOCK AND DOWNLOCK ARE PROVIDED. AN ENGINE ENERGIZED COMPRESSOR PROVIDES PNEUMATIC POWER FOR THE AIR BRAKES. LOW PRESSURE TIRES ARE FITTED. THE CENTER SECTION STEEL STRUT BRACING STRUCTURE CARRIES THE LANDING GEAR LOADS.

FLAME DAMPENERS
FOR NIGHT FLIGHT OPERATIONS, FLAME DAMPENERS WERE INSTALLED ON THE ENGINE EXHAUST MANIFOLD SYSTEM.

VACUUM SYSTEM
AN ENGINE-DRIVEN VACUUM PUMP SUPPLIES VACUUM EFFORT TO OPERATE THE GYRO INSTRUMENTS.

WING FLAP POSITION INDICATOR
A WING FLAP POSITION INDICATOR REVEALS THE FLAP POSITION FROM 0° TO 80° EXTENSION.

ARMOR PLATE
THE ENGINE COMPARTMENT FIREWALL IS COMPRISED OF ARMOR PLATE. THE BACK OF THE PILOT'S SEAT IS ARMORED.

GUST LOCK
A FLIGHT CONTROL GUST LOCK IS PROVIDED.

COCKPIT AIR CONDITIONING
THE PILOT'S COCKPIT IS HEATED BY WARM AIR. FRESH AIR INTAKES ARE ALSO PROVIDED.

PILOT'S CANOPY
THE PILOT'S CANOPY IS COMPRISED OF FORMED ALUMINUM ALLOY FRAMES WITH CLEAR PLEXIGLASS PANELS. THIS CANOPY OVER THE COCKPIT SLIDES BACKWARDS ON A TRACK. THE SLIDING PANEL HAS FRICTIONAL POSITION ADJUSTMENT. AN INTERIOR AND EXTERIOR HANDLE PERMITS MOVEMENT OF THE CANOPY. THE CONSTRUCTION IS DRAFT PROOFED AT THE JOINTS. THE WINDSHIELD STRUCTURE IS A STRUCTURAL CONFIGURATION THAT WILL WITHSTAND TURNOVER LOADS AND IMPACTS. THE CENTER PANEL IS BULLET-RESISTANT PLATE GLASS. THE WINDSHIELD IS PROVIDED WITH AN ANTI-ICING SYSTEM USING ALCOHOL AND WARM AIR FOR DEFROSTING.

ELECTRICAL BONDING
THE ENTIRE AIRFRAME STRUCTURE IS BONDED AND GROUNDED FOR RADIO COMMUNICATION PURPOSES.

RADIO COMMUNICATION
THE FOLLOWING COMPRISES THE RADIO COMMUNICATION INSTALLATION:
RADIO ANTENNA.
TR9D.
TR1133.
R3002
ON CERTAIN AIRPLANES OF THIS TYPE, RADIO BEAM EQUIPMENT WAS INSTALLED.
ARMY TYPE 19.
TR 196A.
STORAGE BATTERIES PROVIDED ELECTRICAL ENERGY FOR OPERATION.

OXYGEN SYSTEM
A SIMPLE OXYGEN SYSTEM IS PROVIDED FOR HIGH ALTITUDE OPERATIONS.

ACKNOWLEDGEMENT
THE HAWKER ENGINEERING DRAWINGS FROM WHICH THIS DATA WAS PREPARED WERE SUPPLIED BY THE COURTESY OF MR. DON CAMPBELL OF KAPUSKASING, ONTARIO, CANADA.
MAX O'STARR, A.A.H.S. HAYWARD, CALIFORNIA

HAWKER MARK IIC HURRICANE

HAWKER AIRCRAFT, LIMITED. KINGSTON-ON-THAMES, SURREY, ENGLAND.

DRAWN BY: WILLIS L. NYE, A.A.H.S. FOR MODEL AIRPLANE NEWS, NEW YORK CITY, NEW YORK

HAWKER HURRICANE

HAWKER HURRICANE PROTOTYPE

THE HAWKER HURRICANE PROTYPE DIFFERED CONSIDERABLY FROM THE PRODUCTION TYPE COMBAT FIGHTERS IN THE FOLLO WING MAJOR DESIGN FACTORS:

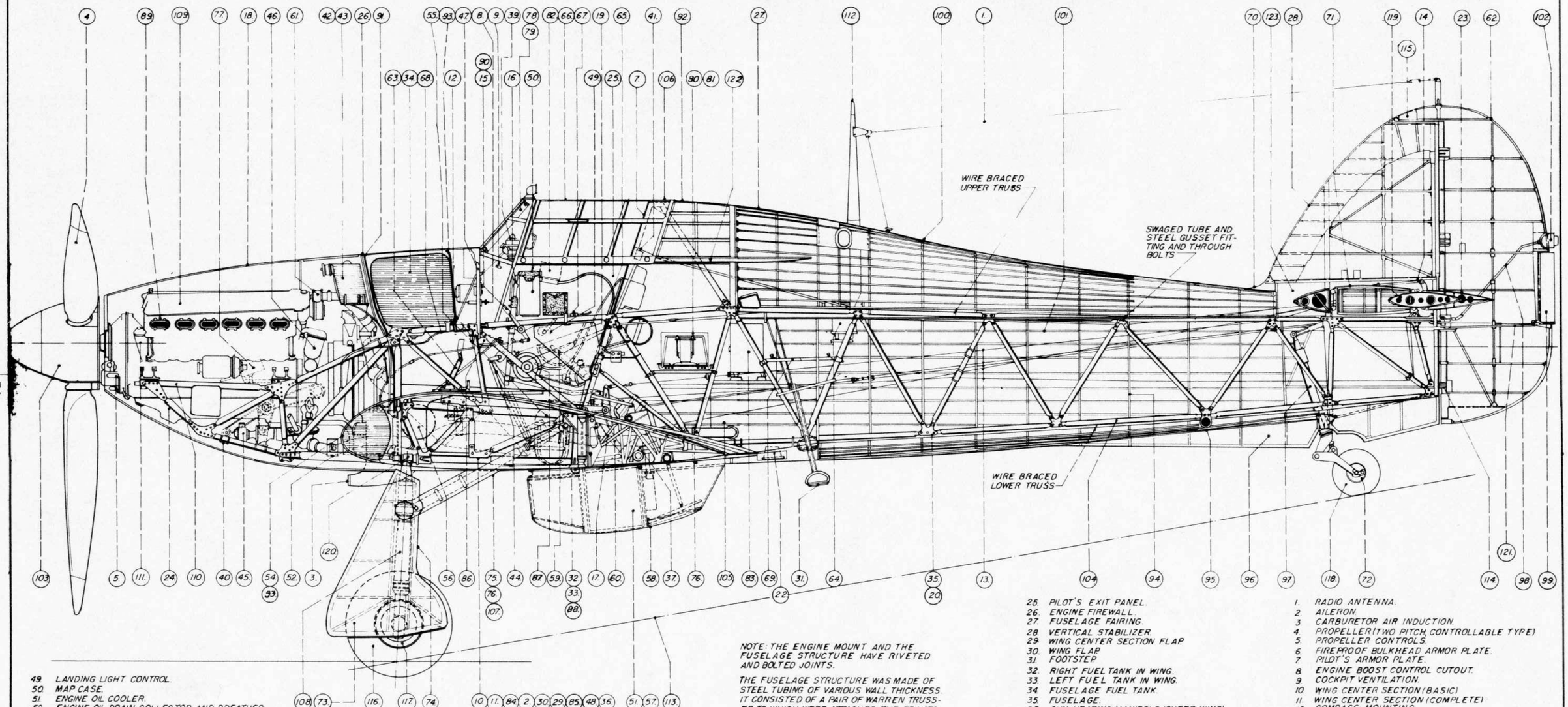
(1). TWO BLADE PROPELLER (FIXED PITCH)
(2). RETRACTABLE TAIL WHEEL.
(3). NO RADIO ANTENNA MAST.
(4). EXTERNALLY BRACED HORIZONTAL STABILIZER.
(5). CANOPY OF TWO FRAMES.
(6). 5420 LBS. GROSS WEIGHT.
(7). FABRIC COVERING ON OUTER WING PANELS.
(8). WIDIVIDUAL ENGINE EXHAUST PORTS.
(9). SHORTENED NOSE.
(10). NO VENTRAL FIN.
(11). SMALLER RUDDER.
(12). NO ARMOR PLATE.

LANDING GEAR OPERATION

LANDING GEAR RETRACTION IS ACCOMPLISHED BY MANUAL OPERATION OF A HYDRAULIC HANDPUMP. THE LANDING GEAR RETRACTS INWARD AND AFT. THE WHEELS MEET CLOSE TO THE FUSELAGE CENTERLINE, NEST IN RETRACTED POSITION BETWEEN THE WING SPARS AND FAIRED INTO THE WING CENTER SECTION. THE SIDE BRACE STRUT HINGES IN THE MIDDLE AND IS DRAWN BACK BY MEANS OF A RADIUS LINK.

GUN HARMONIZATION

THE GUNS ARE BORESIGHTED TO HARMONIZE AND TO CONVERGE AT 200 YARDS AHEAD OF THE AIRPLANE. THE CANNONS WERE FIRED SINGLY OR IN RIPPLE SALVO.



NOTE: THE ENGINE MOUNT AND THE FUSELAGE STRUCTURE HAVE RIVETED AND BOLTED JOINTS.

THE FUSELAGE STRUCTURE WAS MADE OF STEEL TUBING OF VARIOUS WALL THICKNESS. IT CONSISTED OF A PAIR OF WARREN TRUSSES TO WHICH WERE ATTACHED THE FRAMES CARRYING THE FAIRING STRINGERS. EACH STEEL TUBE OF A TRUSS WAS SWAGED SO THAT ATTACHING STRUTS COULD BE ATTACHED BY MEANS OF GUSSET FITTINGS AND THROUGH BOLTS. DIAGONAL STEEL BRACE WIRES COMPLETED TRANSVERSE AND LONGITUDINAL BRACING.

INBOARD PROFILE OF TYPICAL HAWKER HURRICANE MARK IIC

VENTRAL FIN

THE VENTRAL FIN AND AN ENLARGED RUDDER WERE INSTALLED ON PRODUCTION AIRCRAFT TO PROVIDE IMPROVED RECOVERY FROM AUTO-ROTATION THAT WAS UNINTENTIONAL.

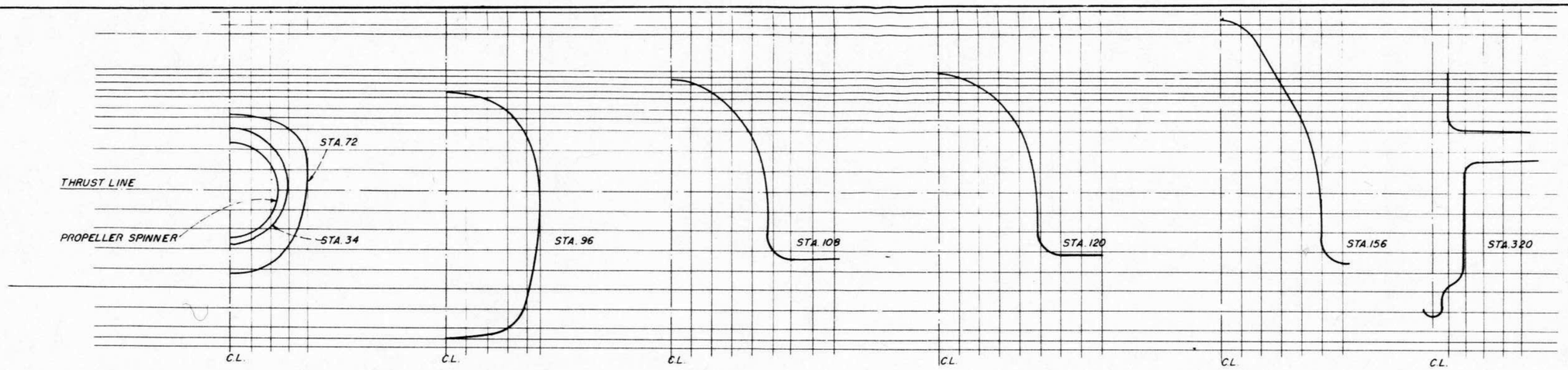
1. RADIO ANTENNA.
2. AILERON.
3. CARBURETOR AIR INDUCTION.
4. PROPELLER (TWO PITCH, CONTROLLABLE TYPE)
5. PROPELLER CONTROLS.
6. FIREPROOF BULKHEAD ARMOR PLATE.
7. PILOT'S ARMOR PLATE.
8. ENGINE BOOST CONTROL CUTOUT.
9. COCKPIT VENTILATION.
10. WING CENTER SECTION (BASIC)
11. WING CENTER SECTION (COMPLETE)
12. COMPASS MOUNTING.
13. CONTROL CABLES.
14. ELEVATOR CONTROLS.
15. ENGINE CONTROLS.
16. FLIGHT CONTROLS.
17. ENGINE COOLING SYSTEM.
18. ENGINE COWLING.
19. RUDDER TRIM TAB CONTROLS.
20. FLOOR OF COCKPIT.
21. BOMB RELEASE CONTROLS.
22. ELECTRICAL EQUIPMENT.
23. ELEVATOR.
24. ENGINE MOUNT.
25. PILOT'S EXIT PANEL.
26. ENGINE FIREWALL.
27. FUSELAGE FAIRING.
28. VERTICAL STABILIZER.
29. WING CENTER SECTION FLAP.
30. WING FLAP.
31. FOOTSTEP.
32. RIGHT FUEL TANK IN WING.
33. LEFT FUEL TANK IN WING.
34. FUSELAGE FUEL TANK.
35. FUSELAGE.
36. GUN HEATING MANIFOLD (OUTER WING).
37. GUN HEATING MANIFOLD (CENTER SECTION).
38. CANNON INSTALLATION. (AMMO. BOXES)
39. REFLECTOR TYPE GUNSIGHT.
40. MANUAL TYPE INERTIA STARTER.
41. PILOT'S SAFETY HARNESS.
42. ENGINE COOLANT HEADER TANK.
43. ENGINE COOLANT HEADER TANK MOUNT.
44. HYDRAULIC SELECTOR GEAR.
45. HYDRAULIC SYSTEM.
46. ENGINE IGNITION WIRING.
47. PILOT'S INSTRUMENT PANEL.
48. OUTER WING PANEL JOINT PINS.
49. LANDING LIGHT CONTROL.
50. MAP CASE.
51. ENGINE OIL COOLER.
52. ENGINE OIL DRAIN COLLECTOR AND BREATHER.
53. ENGINE OIL SYSTEM.
54. ENGINE OIL TANK.
55. PILOT'S OXYGEN SYSTEM.
56. PNEUMATIC SYSTEM AIR TANK.
57. ENGINE COOLANT RADIATOR.
58. RADIATOR FAIRING FLAP (MANUALLY OPERABLE)
59. RADIATOR FLAP CONTROL.
60. RADIATOR MOUNTING.
61. ENGINE R.P.M. INDICATOR DRIVE.
62. RUDDER.
63. RUDDER PEDAL.
64. UPWARD FIRING RECOGNITION DEVICE.
65. PILOT'S SEAT.
66. SLIDING CANOPY.
67. SLIDING CANOPY RATCHET CONTROL.
68. ENGINE SUPERCHARGER CONTROL.
69. SUPPORT RAIL.
70. FAIRING.
71. HORIZONTAL STABILIZER.
72. FIXED TAIL WHEEL ASSEMBLY.
73. RETRACTABLE LANDING GEAR.
74. LANDING GEAR FAIRING.
75. LANDING GEAR HYDRAULIC ACTUATING SYSTEM.
76. ALUMINUM ALLOY FAIRING.
77. ENGINE-DRIVEN VACUUM PUMP.
78. BULLET-RESISTANT WINDSHIELD.
79. WINDSHIELD DE-ICER.
80. RADIO EQUIPMENT TR9D.
81. RADIO EQUIPMENT TR1133.
82. RADIO EQUIPMENT TR1133.
83. RADIO EQUIPMENT R3002.
84. 20 M.M. CANNONS (4). (OUTBOARD WING PANEL)
85. GUN MOUNTING. (OUTBOARD WING PANEL).
86. ENGINE FUEL SYSTEM.
87. ELEVATOR TRIM TAB CONTROLS.
88. WING CENTER SECTION FUEL TANK.
89. ENGINE EXHAUST PORT (RIGHT AND LEFT).
90. GROUNDING SYSTEM.
91. FIREWALL ARMOR PLATE.
92. DECKING.
93. FIREPROOF BAFFLE.
94. FUSELAGE FAIRING FORMER.
95. AFT HANDLING SOCKET.
96. VENTRAL FIN STRUCTURE.
97. TAIL WHEEL SHOCK STRUT.
98. NAVIGATION LIGHT CONDUIT.
99. RUDDER TRIM TAB.
100. FUSELAGE FAIRING FORMER.
101. FAIRING STRINGER.
102. AFT RUNNING LIGHT.
103. PROPELLER SPINNER.
104. STATICALLY DETERMINATE FUSELAGE TRUSS.
105. WING-FUSELAGE FILLET.
106. TURNOVER STRUCTURE.
107. LANDING GEAR DRAG STRUT.
108. LANDING GEAR SHOCK STRUT.
109. ROLLS ROYCE MERLIN XX ENGINE.
110. ENGINE BEARER.
111. PROPELLER THRUST LINE.
112. RADIO ANTENNA POLE.
113. GROUND LINE.
114. RUDDER HINGE.
115. RUDDER STATIC BALANCE.
116. LOW PRESSURE TIRE.
117. BRAKE DRUM. (PNEUMATIC BRAKES)
118. PNEUMATIC TIRE.
119. ELEVATOR BALANCE.
120. LANDING GEAR FULCRUM.
121. RUDDER TRIM TAB ACTUATOR.
122. SLIDING CANOPY TRACK.
123. FAIRING.
124. GUN BLAST TUBES.

HAWKER MARK IIC HURRICANE

HAWKER AIRCRAFT, LIMITED — KINGSTON-ON-THAMES, SURREY, ENGLAND.

DRAWN BY: WILLIS L. NYE, A.A.H.S. FOR MODEL AIRPLANE NEWS, NEW YORK CITY, NEW YORK

SHEET NO. 3



INSTRUMENT PANEL CALLOUT
58. ELECTRICAL SWITCH.
42. DOWTY L.G. POSITION INDICATOR.
59. COMPASS DEVIATION CARD.
43. ENGINE TACHOMETER.
41. ELECTRICAL SWITCH.
D. OXYGEN PRESSURE REGULATOR.
32. UNKNOWN.
53. ARTIFICIAL HORIZON.
54. RATE OF CLIMB INDICATOR.
44. ENGINE BOOST INDICATOR.
C. FUEL GAUGE SELECTOR SWITCH.
39. TIME OF FLIGHT CLOCK.
55. ALTIMETER.
56. DIRECTIONAL GYRO.
57. TURN INDICATOR.
46. ENGINE OIL PRESSURE GAUGE.
B. FUEL QUANTITY GAUGE.
37. ELECTRICAL SWITCH BOX.
38. ELECTRICAL SWITCH BOX.
47. ENGINE OIL THERMOMETER.
48. ENGINE COOLANT THERMOMETER.
23. UNKNOWN.
A. ENGINE BOOST CONTROL.
E. FUEL PRESSURE INDICATOR.

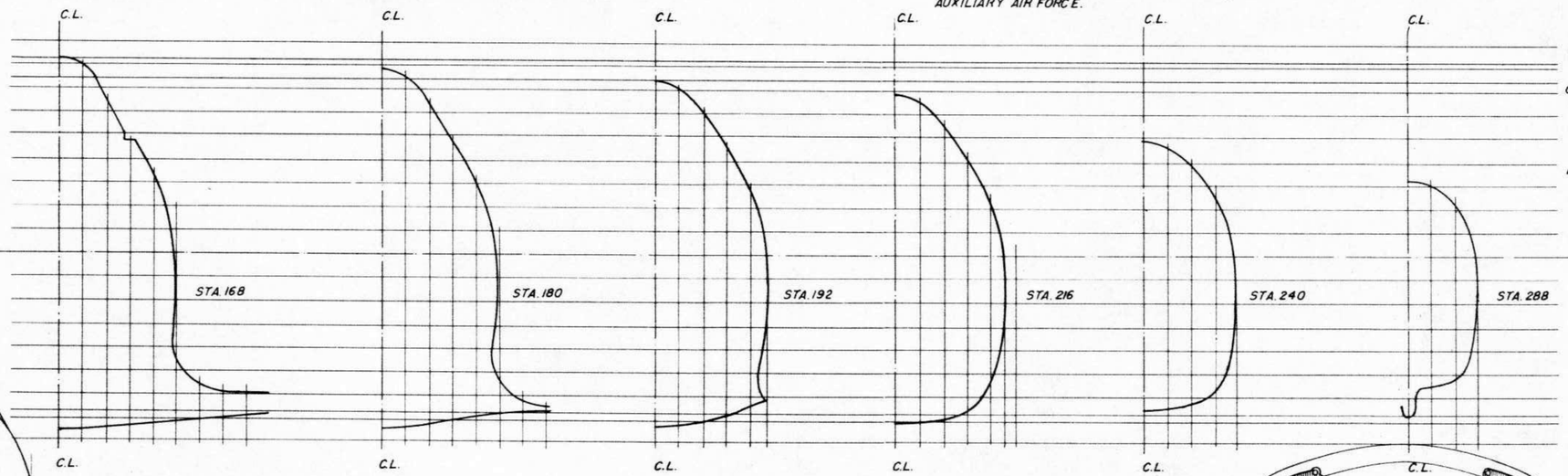
NOTE: THE MODEL MARK II D WAS ALSO MODIFIED TO USE RAIL TYPE ROCKET LAUNCHERS, 6 BEING FITTED TO THE UNDERSIDE OF THE WING. ROCKETS WERE FIRED ELECTRICALLY. 500 POUND HIGH EXPLOSIVE BOMBS COULD ALSO BE CARRIED AT THE UNDERWING PYLONS. SMOKE CURTAIN TANKS COULD ALSO BE CARRIED ON THE UNDERWING PYLONS.

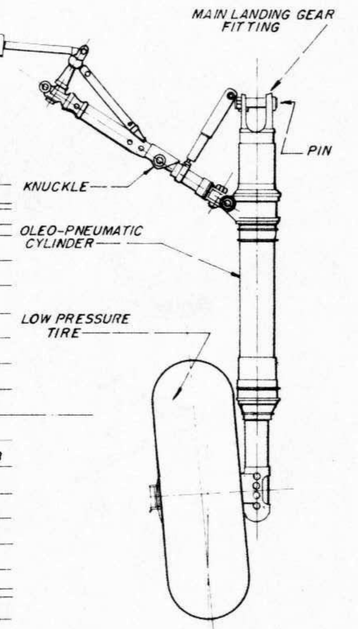
NOTE: REFER TO SHEET NO. 1 FOR STATION NUMBERS. FUSELAGE SECTIONS ARE SYMMETRICAL ABOUT THE CENTERLINE.

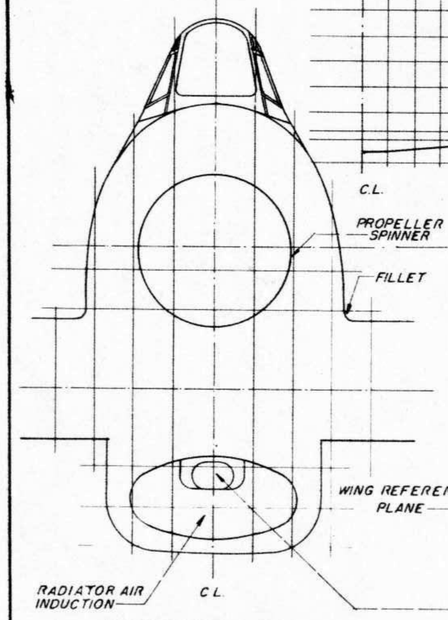
NOTE: HAWKER HURRICANE MARK II D WAS MODIFIED TO CARRY TWO 40 M.M. ANTI-TANK GUNS FOR TACTICAL AIR SUPPORT FUNCTIONS. ROLLS-ROYCE AND VICKERS BELT FED INSTALLATIONS WERE MADE AND 12 TO 15 ROUNDS WERE CARRIED. TWO 30-GAL. GUNS WERE ALSO CARRIED FIRING BALL AND TRACER AMMO FOR AIMING PURPOSES. THE ANTI-TANK GUNS WERE CARRIED IN PODS ON THE UNDERWING PYLONS.

NOTE: INSTRUMENTATION VARIED WITH DIFFERENT SERIES OR MARK NUMBER HURRICANES. VACANT SPACE ON THE INSTRUMENT PANEL WAS INTENDED FOR SPECIALIZED ELECTRONIC DEVICES.

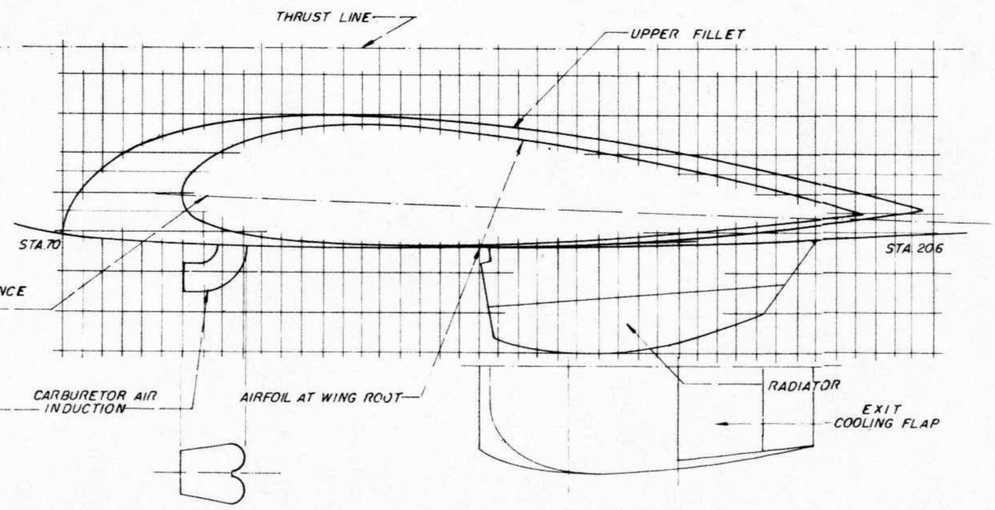
PLANE L1592, REPRESENTATIVE OF THE BATTLE OF BRITAIN, IS PRESERVED AT THE SCIENCE MUSEUM IN LONDON. IT HAS THE MARKINGS OF NO. 615, ROYAL AUXILIARY AIR FORCE.





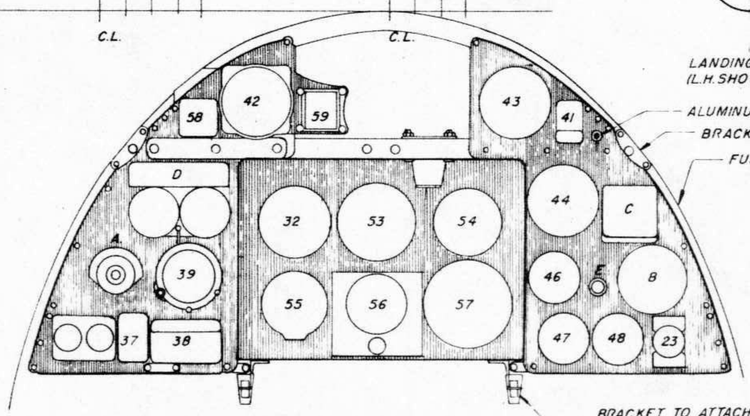


CROSS SECTION OF FUSELAGE STA. 125

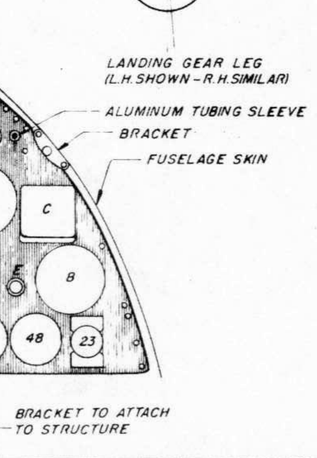


PLAN

RADIATOR PLAN



INSTRUMENT PANEL LAYOUT (MARK II C)



HAWKER MARK IIC HURRICANE

HAWKER AIRCRAFT, LIMITED. KINGSTON-ON-THAMES, SURREY, ENGLAND.

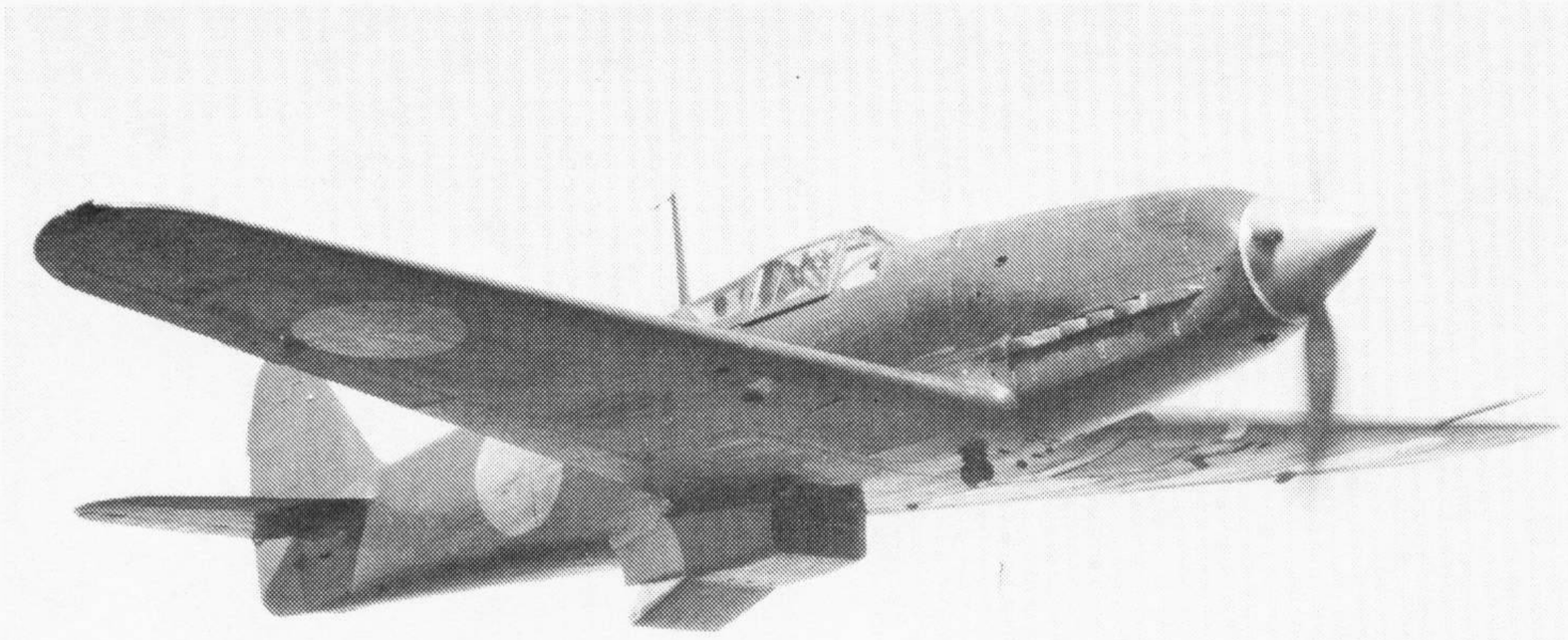
DRAWN BY: WILLIS L. NYE, A.A.H.S. FOR MODEL AIRPLANE NEWS, NEW YORK CITY, NEW YORK.

SHEET NO. 4.

WW II SCALE AIRCRAFT DRAWINGS

HAWKER HURRICANE

KAWASAKI KI 61 TONY



A flight view of a Kawasaki Ki 61-I Tony that was captured by the Allies and tested after being repainted with non-standard coloring. The restored Japanese insignia was used for publicity purposes. Note the extremely clean design and radiator installation similar to the North American P-51.

THIS Kawasaki fighter, like other Japanese aircraft of WW II, is a source of confusion to Westerners because it has several designations. In the official sequential Kitai Army aircraft numbering system adopted in 1932, it's "Ki 61." It's also "Army Type 3 fighter" in the system where the number is the last digit of the Japanese dynastic Year 2603, (equivalent to 1940), the year in which the aircraft was designed. Further, the Allies, not knowing the true Japanese designations, assigned code names to all known Japanese airplanes. Believing that the Ki 61 was derived from an Italian design, they code-named it "Tony."

While most Japanese fighters used air-cooled radial engines prior to the war, the Ki 61 used a Japanese version of the 1,050hp German Daimler-Benz DB-601A that the Kawasaki Aircraft Engineering Co. built under license as the Ha 40. Kawasaki then built the Ki 61 to utilize this engine. This aircraft was a major departure from traditional Japanese design, and was the first to incorporate features found essential in the first year of European WW II operations—armor, self-sealing fuel tanks and heavier firepower. The prototype Ki 61 first flew in December 1941.

SPECIFICATIONS AND PERFORMANCE KI 61-1b

Wingspan ..... 39 ft., 4 7/16 in.
Length ..... 28 ft., 8 1/2 in.
Wing Area ..... 215.2 sq. ft.
Empty Weight ..... 4,872 lbs.
Gross Weight ..... 6,504 lbs.
(7,165 lbs. with overload)
High Speed ..... 368mph at 15,945 ft.
Service Ceiling ..... 37,730 ft.
Max Range ..... 684 miles

Its initial armament was a pair of 12.7mm machine guns on the nose, and two 7.9mm guns in each wing on Ki 61-1a or one 12.7mm gun in each wing on Ki 61-Ib. These more than doubled the firepower of Japanese fighters then in service. Later versions adopted two and even four 20mm wing cannon. A few even had 30mm cannon.

The Tonys went into action in New Guinea in April 1943 and quickly became the principal Japanese Army fighter. Larger and heavier than the Japanese Navy's Mitsubishi Zeke, the Tony wasn't a dogfighter like the Zeke, but was better suited to the hit-and-run techniques that the Allies had developed to combat the Zeke. In any case, the Tony was superior to the principal land-based fighters that initially opposed it: the Bell P-39 and the Curtiss P-40.

Improved versions of the Tony were developed but didn't achieve true mass production. A slightly enlarged Ki 61-II had a 1,500hp development of the Ha 40, designated "Ha 140," but this engine was plagued with problems to the point where 275 of the Ki 61-IIs were completed as "Ki 100," with 1,500hp Mitsubishi Ha 112 radial engines. Peak production of the Tony (254 a month) was achieved in July 1944.

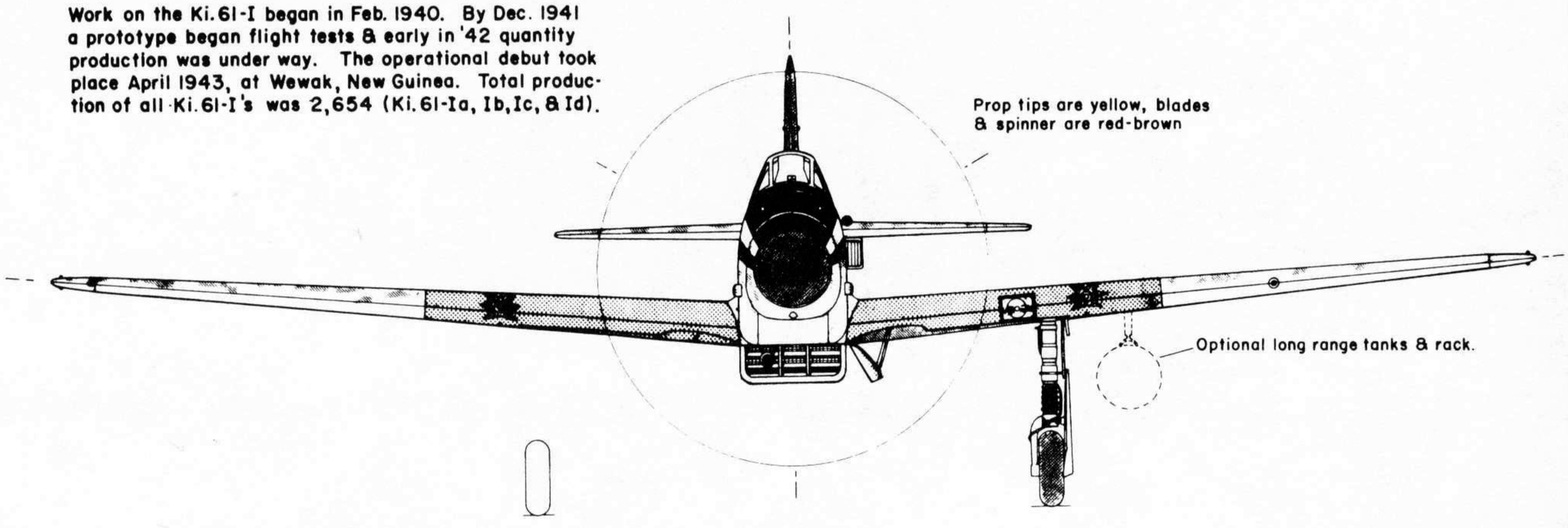
The final operations of the Tony were against Allied aircraft that were attacking the Japanese home islands. Only Ki 61-IIs with the altitude-rated Ha 140 engine could reach, and were effective against, the operating altitude of the B-29. Others did well against carrier-based fighters and were outclassed only by the U.S. Army P-51s operating from nearby Iwo Jima.

This ground view of a Ki 61-I shows the wide-track landing gear and basic natural-metal finish. Various camouflage patterns were often applied in the field.

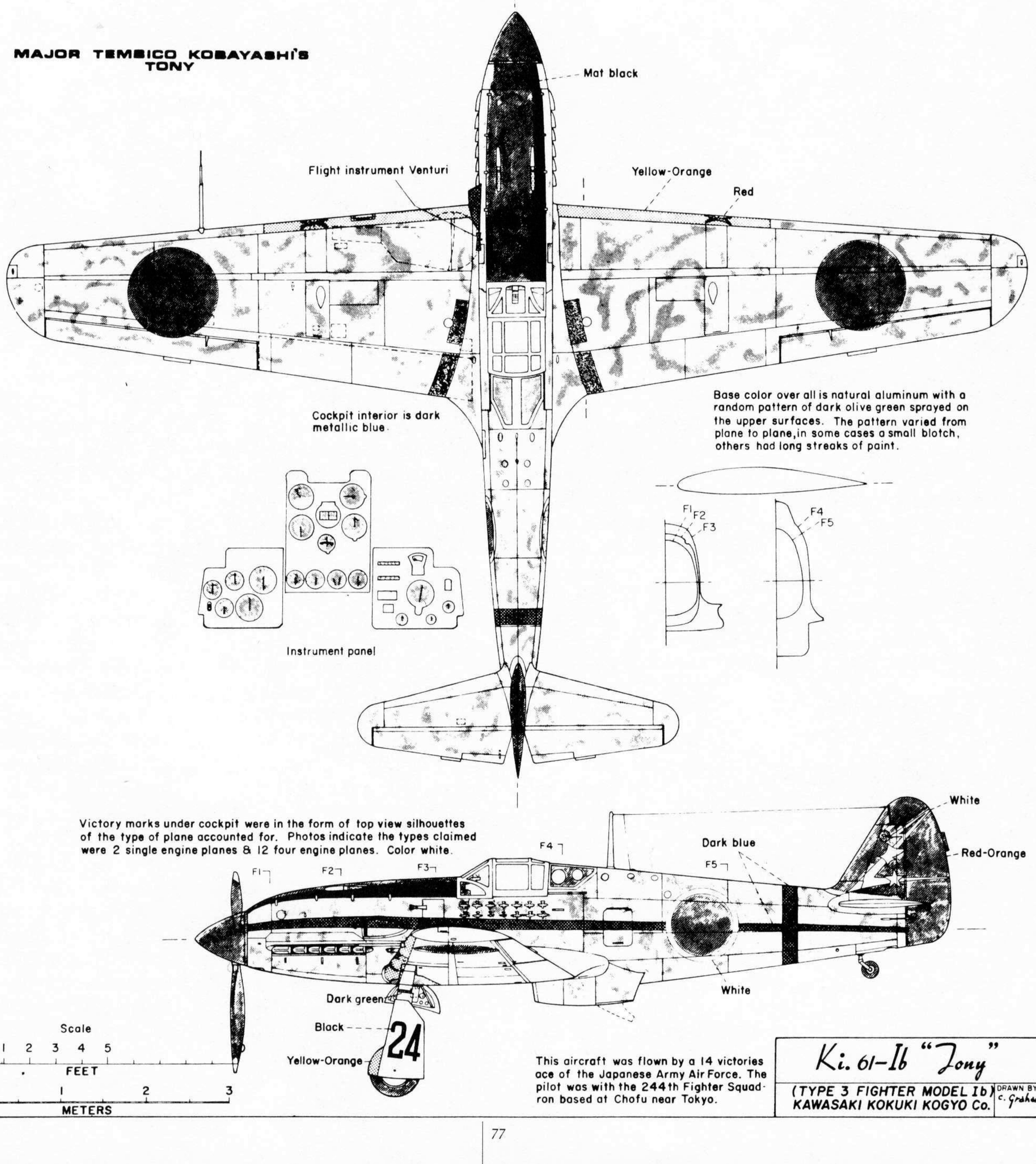
Production of the Tony ended in January 1945, owing to Allied bombing of the airframe and engine factories. Altogether, 3,078 Tonys were built: 2,654 Ki 61-Is (per the drawing), plus 12 prototype and pre-production Ki 61-Is and 412 Ki 61-IIs.

KAWASAKI KI 61 TONY

Work on the Ki.61-I began in Feb. 1940. By Dec. 1941 a prototype began flight tests & early in '42 quantity production was under way. The operational debut took place April 1943, at Wewak, New Guinea. Total production of all Ki.61-I's was 2,654 (Ki.61-Ia, Ib, Ic, & Id).



MAJOR TEMBICO KOBAYASHI'S TONY



Scale

0 1 2 3 4 5

FEET

0 1 2 3

METERS

This aircraft was flown by a 14 victories ace of the Japanese Army Air Force. The pilot was with the 244th Fighter Squadron based at Chofu near Tokyo.

Ki. 61-Ib "Tony"

(TYPE 3 FIGHTER MODEL Ib)
KAWASAKI KOKUKI KOGYO Co.

DRAWN BY C. Graham

LOCKHEED HUDSON

A Lockheed Hudson I displays the early 1940 form of the British fin flash, which ran the full height of the fin.

THE Lockheed Hudson is an outstanding example of a successful transport plane—the 1937 14-passenger Lockheed Model 14—that became an even more successful bomber. The airliner was offered with a variety of radial engines in the 750-1,100hp range, and 112 were sold. Ironically, some planes, with a manufacturing license, were sold to Japan. During the war, the Allies code-named the Japanese versions "Thelma" and the imports "Toby."

In February 1938, aware of an upcoming visit by a British purchasing commission interested in obtaining American bombers, Lockheed rushed to produce a wooden mock-up of a Model 14 bomber fuselage. The British liked what they saw, but it didn't fully meet their needs. They wanted a reconnaissance bomber that would have a navigator as a key crew member. He needed to be close to the pilot and have an excellent field of view. Within 24 hours, Lockheed had modified the mock-up by increasing the number of windows in its nose.

Following two months of intensive discussion about aircraft details and equipment, the Air Ministry ordered 200 Lockheed B-14Ls under the British designation "Hudson I" (at a cost of $25,000,000), and as many more as could be delivered by December 1939.

SPECIFICATIONS AND PERFORMANCE LOCKHEED HUDSON

Wing Area	*551 sq. ft.*
Empty Weight	*11,630 lbs.*
Gross Weight	*17,500 lbs.*
Top Speed	*246mph at 6,500 ft.*
Cruising Speed	*170mph*
Ceiling	*25,000 ft.*
Range	*1,700 miles*

The Hudson's airframe was the same as the airliner's, and it marked the first military use of the new Fowler wing flap that had been introduced on the Model 14. It extended rearward and down, which increased wing area. An advanced feature, by U.S. military standards, was a British Boulton & Paul powered dorsal gun turret, which contained two British .303-caliber Vickers machine guns. Two fixed .303 guns were installed in the nose, and a bomb bay for up to 1,400 pounds of bombs or depth charges was located beneath the airliner floor. The powerplant for the Hudson I was the 1,100 takeoff hp Wright GR-1820-G302A Cyclone single-row engine.

The first flight of the Hudson was on December 10, 1938, and in February the first plane was shipped to England, where armament was installed. In the absence of a British turret in the U.S., the first Hudson was tested with a wooden mock-up of the turret.

The earliest Hudsons were shipped to England from California, or flown to New York and loaded aboard ships. Later Hudsons were sent to Canada for delivery to England by air, but because of U.S. neutrality at the time, they couldn't be flown across the Canadian border. They were flown by U.S. crews to airports right on the border, towed across the line, and flown on by Canadian crews.

Altogether, 2,940 Hudsons were built under six basic designations for British Commonwealth forces, two U.S. Army designations and one U.S. Navy designation, as follows:

BRITISH HUDSONS

Hudson I—The original 200 on the British direct-purchase order, plus an additional 150, all with Cyclone engines. Australia complicated the picture by ordering 50 Lockheed B-14Ss as "Hudson I" but specified the 1,100hp Pratt & Whitney R-1830-SC3G Twin Wasp, a twin-row engine. In recognition of the identity problem, a further 50 Australian Hudsons were ordered as "Hudson II," and the Australian Hudson Is were redesignated "Hudson IV."

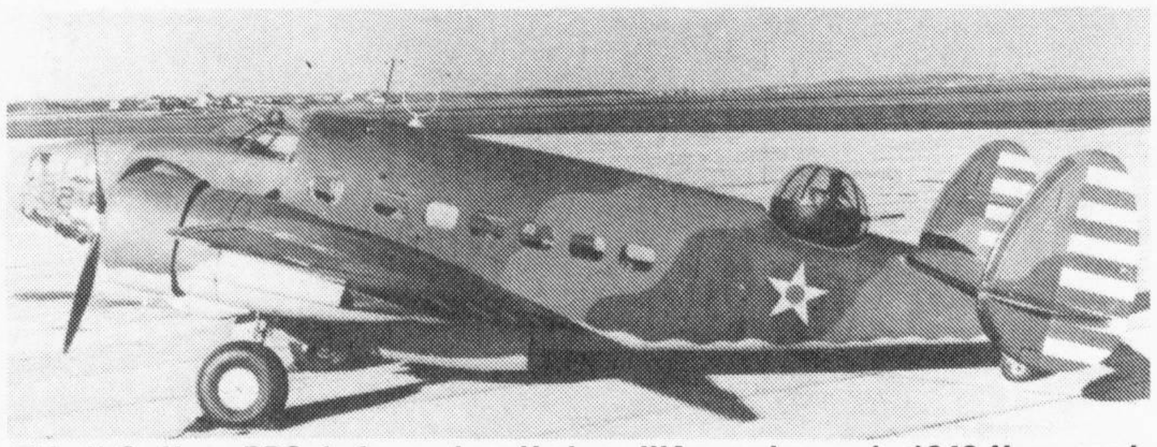
Hudson II— Distinguishing

A Hudson V without a turret on a factory test flight in June 1941. Compare the cowling for the Pratt & Whitney engines with those of Wright-powered models in the drawing and other photos. Also note the rearward as well as the downward extension of the Fowler flaps.

external details of these twin-row engine Hudsons were deeper cowlings fitted with cooling flaps. The Australian Mark IIs differed from the Mark Is in that they had constant-speed propellers and a strengthened airframe.

Hudson III—The 428 Hudson IIIs had the airframe and propellers of the Mark II, upgraded 1,200 takeoff hp GR-1820-G205A engines, and three additional .303-caliber machine guns (one on each side of the rear fuselage and another in a ventral station).

Hudson IIIA—The 616 Mark IIIs obtained under the Lend-Lease program were designated "Hudson IIIA" to reflect their closer conformity to U.S. Army specifications and equipment. Because they were procured with U.S. funds through U.S. Army channels, they were given U.S. Army designations (in this case, "A-29"). The civil Cyclone engines were redesignated as Army R-1820-87s.



This U.S. Navy PBO-1, formerly a Hudson IIIA, carries early 1942 Navy markings, is fitted with the British Boulton & Paul gun turret and retains its original British "Sand and Spinach" camouflage.

Hudson IV—Redesignation of the original Australian Mark Is and Mark IIs as "Hudson IV." An additional 30 were sent to England.

Hudson IVA— 52 Mark IVs supplied to Australia under Lend-Lease with the U.S. Army designation "A-28." The engines were now R-1830-45.

Hudson V—The 408 Hudson Vs with Twin-Wasp engines were the last Hudsons procured on British direct-purchase contracts. They had the same equipment as the Mark IIIs.

Hudson VI—Improved Mark Vs with 1,200 takeoff hp R-1830-67 engines built by Chevrolet; 450 were procured through the U.S. Army as "A-28A."

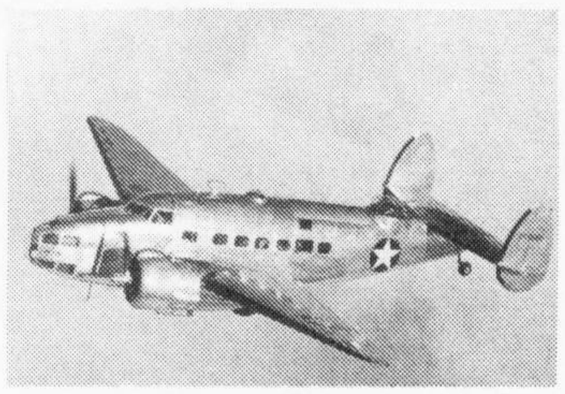
U.S. HUDSONS

Even before Lend-Lease and the assignment of U.S. designations to the Hudsons, the Army "drafted" some undelivered Hudsons from British contracts to meet its own increasing need for new aircraft. Most of these were used in unarmed transport and training roles. Because they didn't meet U.S. Army specifications at the time, they operated as "Lockheed Model 414" under their original British serial numbers, and they often used British insignia. Under Lend-Lease, new Army specifications were written to fit the existing airplanes so that they could be given the standard Army designations A-28 and A-29.

A-28—Lend-Lease designation for the Hudson IVA. Many were retained by the U.S. Army for use as bomber-trainers.

A-28A—Improved Mark Vs delivered as "Hudson VI."

A-29—Eight hundred Mark IIIAs built under Lend-Lease. Late in 1941, some were taken from the British order, armed and used to patrol the U.S. coastline. With no British turrets available, the armed A-29s were fitted with a single, hand-swung, .50-caliber machine gun in an open cockpit that replaced the turret.



A U.S. Army AT-18 gunnery trainer with a molded Plexiglas Martin gun turret. The rubber de-icer boots on the wings and tail are prominent on this unpainted airplane.

A-29A—The 184 A-29As were A-29s with cabins modified for alternative use as unarmed troop transports.

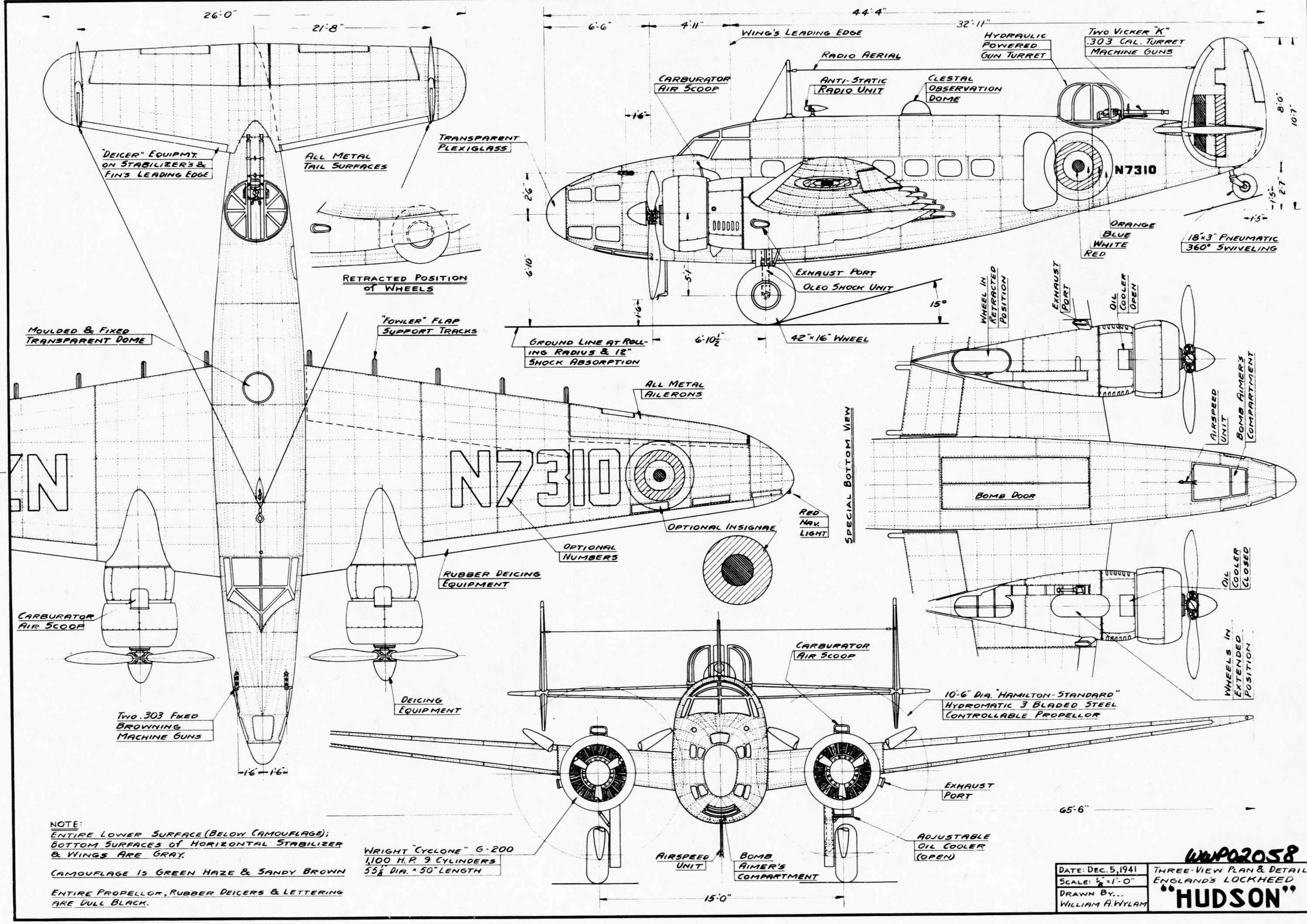
A-29B—Twenty-four A-29s that were modified for use as photo-survey planes.

AT-18—The only Hudsons built from scratch for the U.S. Army were the AT-18 Advanced Trainers. The 217 AT-18s were gunnery trainers fitted with American Martin turrets that used .50-caliber Browning machine guns. The engines were R-1820-87s.

AT-18A—The 83 unarmed AT-18As were navigation trainers (with the cabins arranged for trainee navigators and their instructors).

PBO-1—The U.S. Navy acquired 20 Hudson IIIAs with British turrets late in 1941 and designated them "PBO-1" ("PB" for "Patrol Bomber" and "O" for "Lockheed"). Engines were Navy (even dash number) R-1820-40s. Equipped with four 325-pound depth bombs, one PBO-1 sank a German U-boat on March 1, 1942, and another sank one on March 15. These were the first U.S. aircraft sinkings of U-boats.

Over the entire Hudson series, gross weight varied from 17,500 pounds (I) to 22,360 pounds (AT-18A); top speeds varied from 246 (I) to 261 (AT-18A).



NOTE:
ENTIRE LOWER SURFACE (BELOW CAMOUFLAGE); BOTTOM SURFACES OF HORIZONTAL STABILIZER & WINGS ARE GRAY.

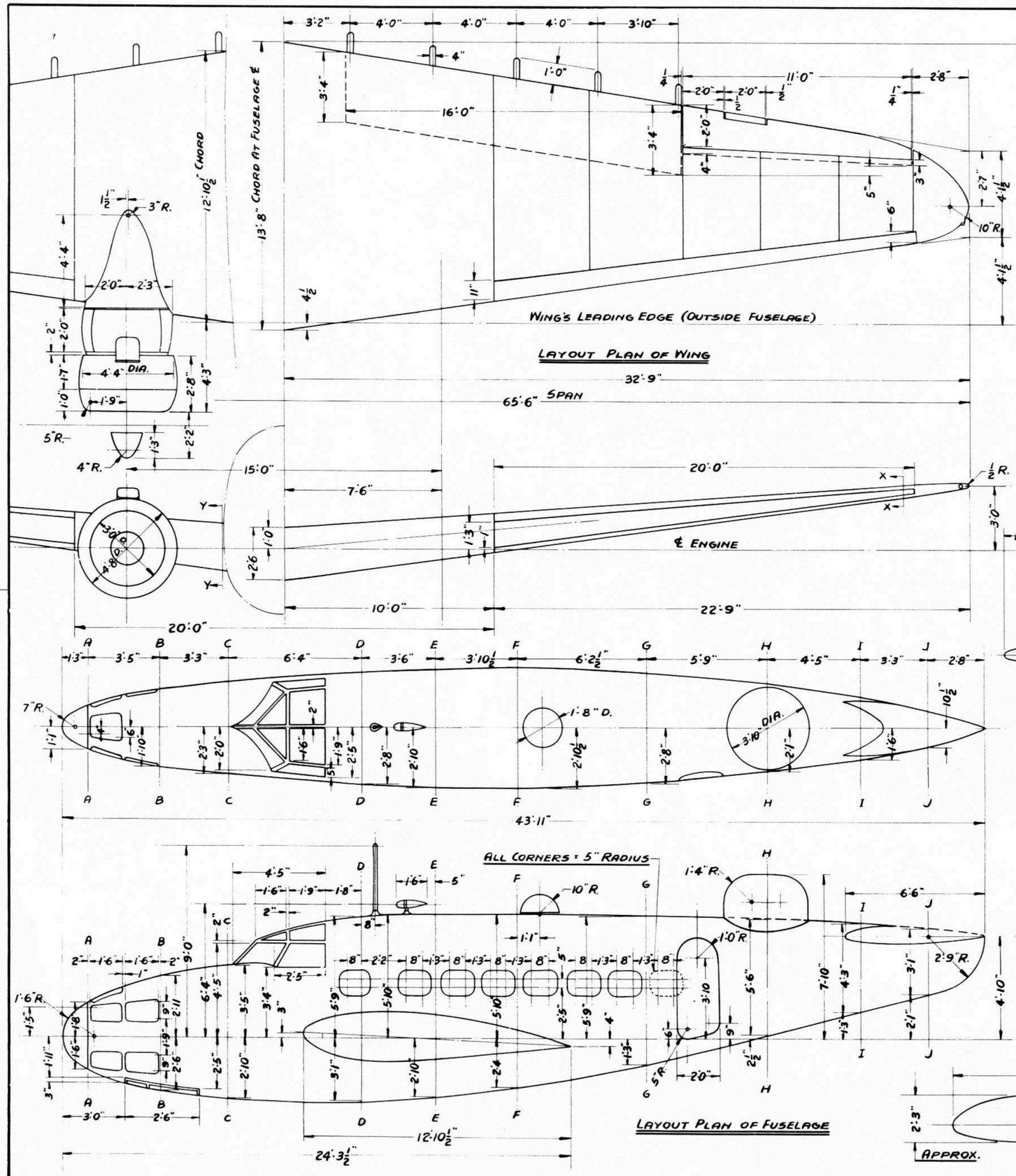
CAMOUFLAGE IS GREEN HAZE & SANDY BROWN

ENTIRE PROPELLOR, RUBBER DEICERS & LETTERING ARE DULL BLACK.

WNP02058

DATE: DEC. 5, 1941	THREE-VIEW PLAN & DETAILS ENGLAND'S LOCKHEED
SCALE: ⅛"=1'-0"	"HUDSON"
DRAWN BY... WILLIAM A. WYLAM	

80



W W II SCALE AIRCRAFT DRAWINGS

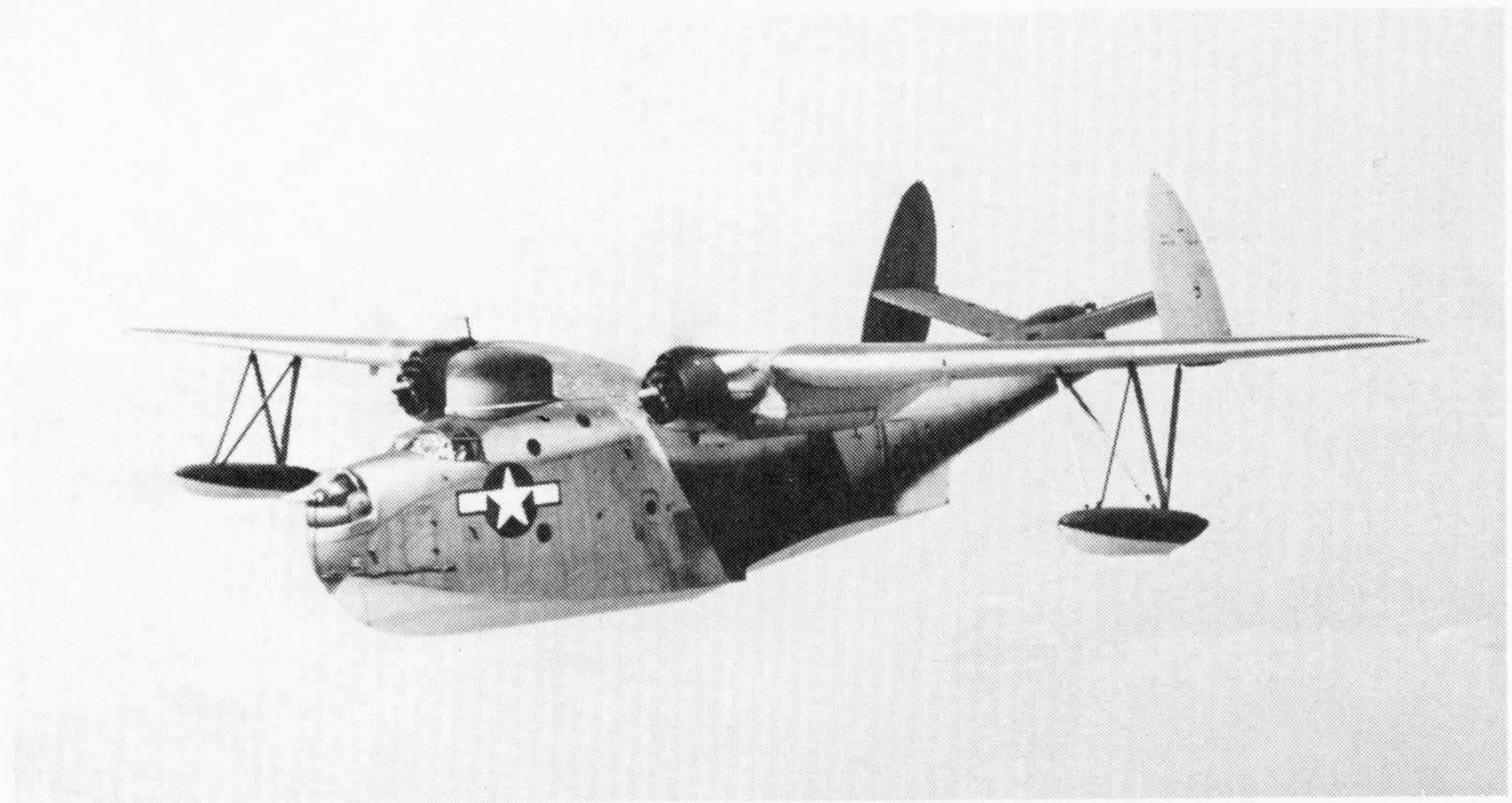
LOCKHEED HUDSON

MARTIN PBM MARINER

FOUNDED in 1918, the Glenn L. Martin Company was one of the oldest American aircraft manufacturers. Martin was a major builder of flying boats, beginning in 1930 with the Navy-designed PM-1 and P3M-1 models built in its new plant in Baltimore, MD. The most famous Martin flying boat of original design was the four-engine "China Clipper" (Model 130), that opened trans-Pacific mail and passenger routes in 1935.

In June 1937, Martin was awarded a U.S. Navy contract for a single twin-engine flying boat: the Martin Model 162, designated "XPBM-1." It was intended as a follow-up and possible replacement for the Consolidated PBY model that was then in production. While the XPBM-1 had double the gross weight, and a wing that was only 14 feet longer than the PBY's, it had more powerful 1,600hp Wright R-2600-6 engines. In a very unusual move, Martin built a manned, quarter-scale flying model (Model 162A) for aerodynamic testing of the unique gull-wing design. The first flight of the XPBM-1 was on February 18, 1939.

The notable features of the XPBM-1 were its gulled wing; a powered nose turret with a single gun; a two-gun, powered dorsal turret just aft of the wing; a single gun in the tail cone; and single guns in hemispherical, hand-swung blister turrets on each side of the hull aft of the wing. Twin fins and rudders were at the ends of a straight, horizontal stabilizer, and the wing-tip floats retracted inward to lay flush against the underside of the wing. Up to 2,000 pounds of bombs or depth charges could be carried.



The Martin PBM-3D Mariner with late 1943 color and markings. Note the two-gun nose and tail turrets, the large radome on top of the hull and flush panels enclosing the side guns.

In a rare move of its own, the Navy ordered 20 production PBM-1s in December 1937, 14 months before the prototype flew. They were outwardly identical to the XPBM-1 except for the dihedral in the horizontal tail. An odd feature here was that the fins and rudders, instead of being vertical, were mounted perpendicular to the stabilizer. Wind-tunnel tests had revealed that there was less aerodynamic drag from a right-angle intersection between the fins and rudders and the stabilizer than when the fins were vertical to produce one acute and one obtuse angle of intersection.

The single XPBM-2, ordered at the same time, was similar to the PBM-1, except that it had increased fuel capacity and was stressed for catapult landing. Production PBM-1s began to reach the fleet in September 1940 and were given the name "Mariner" in October 1941.

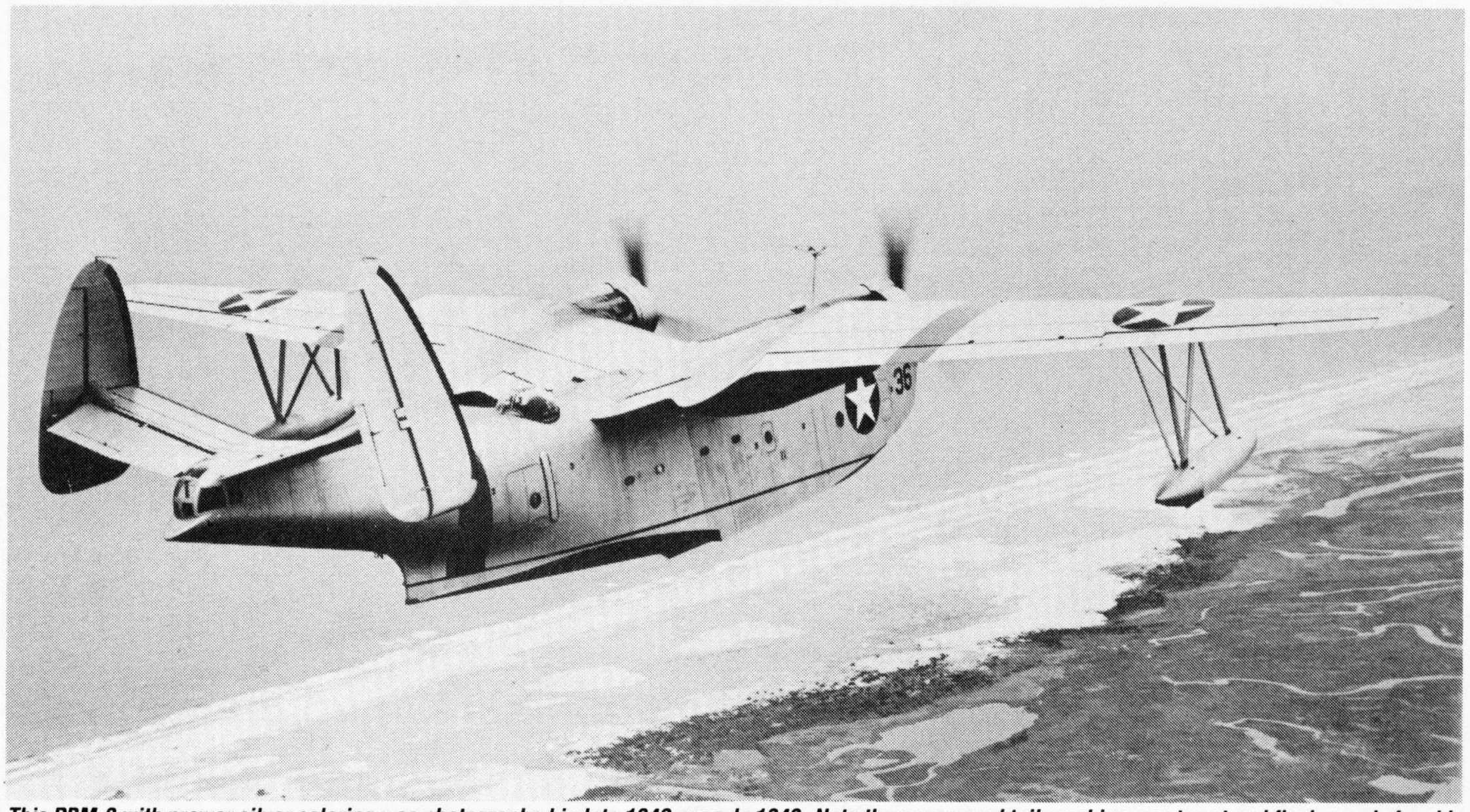
PBM-3—True mass production of the Mariner began with the PBM-3, 379 of which were ordered in November 1940. They had 1,700hp R-2600-12 engines in lengthened nacelles that contained completely enclosed bomb bays. Armament was two .50-caliber guns in the nose turret and one each in the dorsal, tail and side positions. The side blister turrets of the PBM-1 were eliminated and the side guns then fired through flat panels that opened when required. The most notable outward change was the replacement of the retractable wing floats with the fixed type on five long struts.

PBM-3 Variants

PBM-3B—Six PBM-3B were supplied to the R.A.F. as "Mariner I," but they didn't measure up to British requirements and were returned to the U.S. Navy.

PBM-3C—The 274 PBM-3Cs had increased protective armor and could carry up to 4,000 pounds of bombs. Some were fitted with a large radome for search radar on top of the hull between the cockpit and the wing.

PBM-3D—Greater changes came with the 201 PBM-3Ds. They had 1,900hp R-2600-22 engines driving four-blade



This PBM-3 with prewar silver coloring was photographed in late 1942 or early 1943. Note the unpowered tail machine-gun turret and flush panels for side gun stations. The red bands on the wings and hull (later changed to green) identify an instrument trainer.

propellers; twin guns in the nose; dorsal and tail turrets; and single side guns. Bomb capacity was now 8,000 pounds, and some Ds had the large radome that was introduced on the PBM-3C.

PBM-3R—The 20 PBM-3Rs were unarmed transports with seating for 20 passengers and a reinforced cabin floor for heavy cargo.

PBM-3S—The 156 PBM-3Ss were specialized antisubmarine versions that carried four 325-pound depth bombs, extra fuel, and only four guns.

PBM-4—There were to have been 180 PBM-4s (essentially PBM-3s upgraded to use new, four-row 23,000hp Wright R-3350-8 engines). They weren't produced because the PBM-5 was built instead.

PBM-5—The 631 PBM-5s were outwardly similar to the PBM-3D, but they used 2,100hp Pratt & Whitney R-2800-22 or -34 engines. Six were converted to PBM-5A amphibians, and one was completed as the single-tail XP5M-1, of which 239 P5M-1 and -2 models were built after the war.

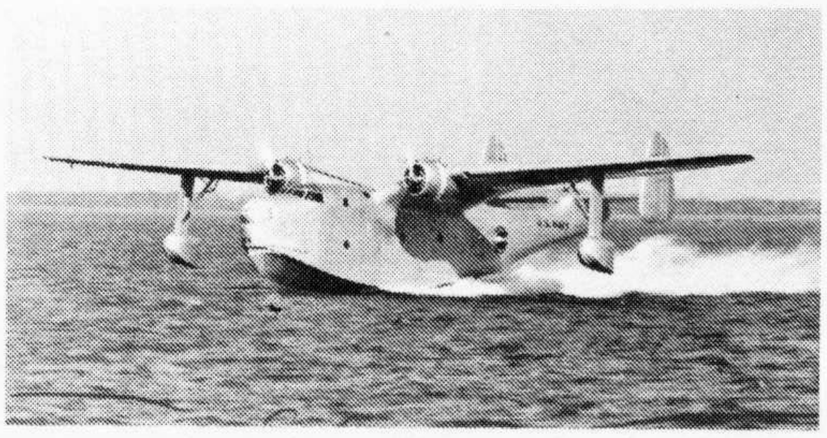
PBM-5 Variants

PBM-5E—PBM-5s fitted with search radar were technically designated "PBM-5E," but because the use of special-mission suffix letters was just beginning, the designation was seldom used in airplane paperwork or by the crews.

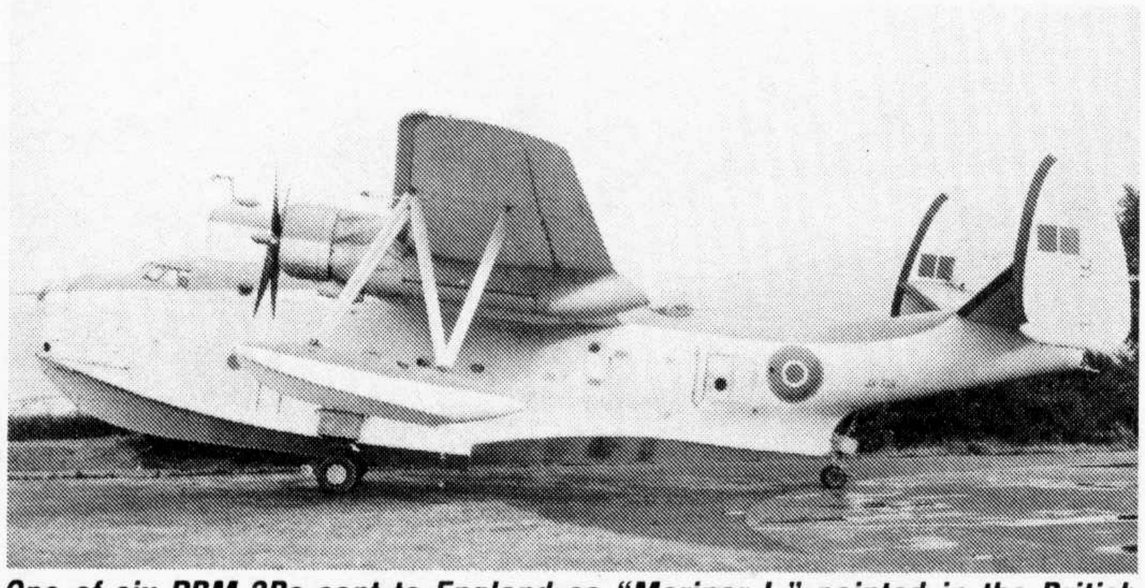
PBM-5G—During the war, several PBM-5s were transferred to the U.S. Coast Guard without a change of designation. After the war, these and other Navy transfers acquired the suffix letter "G" (as "PBM-5G"), which identified modifications made for specialized Coast Guard missions, most notably air-sea rescue.

PBM-5A—The final production model of the Mariner was the PBM-5A amphibian, with 36 built to complete the production of 1,366 Mariners by March 1949. The last Mariners were withdrawn from squadron use in July 1956.

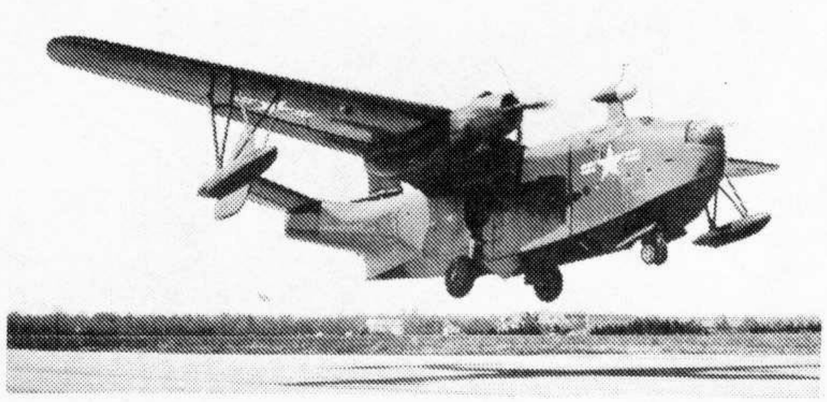
It's odd that the amphibious version of the Mariner appeared so late in its career. If the feature had been added earlier, it might have added greatly to the airplane's utility (as it had done with the PBY) and given the Mariner a greater role in WW II naval aviation.



The first and the last: the XPBM-1 in its original form with a straight, horizontal tail and side gun blisters, and the PBM-5A amphibian that ended the Mariner line in 1949. The red bars were added to the insignia in January 1947.



One of six PBM-3Bs sent to England as "Mariner I," painted in the British Coastal Command's white and gray color scheme. The Mariners didn't meet British requirements and were returned to the U.S. Navy.



MARTIN MARINER PBM-3C

THE MARINER IS A TWIN-ENGINE GULL WING FLYING BOAT. FOLLOWING MISSIONS ARE PERFORMED IN NAVAL OPERATIONS:

ANTI-SUBMARINE PATROL.
PATROL BOMBER.
PASSENGER TRANSPORT.
CARGO TRANSPORT.

FIRST PROTOTYPE WAS BUILT IN 1937, AS PBM-1. PBM-3 WERE FIRST BUILT IN 1943. DESIGN GROSS WEIGHT 48,500 POUNDS. MARINER WAS IN CONTINUOUS PRODUCTION FROM 6-30-37 THROUGH 3-31-49. 1366 PLANES OF THIS TYPE WERE BUILT.

ENGINE INSTALLATION

TWO WRIGHT, MODEL R-2600-12, TWIN-ROW RADIAL AIR-COOLED 14 CYLINDER, SUPER-CHARGED GEARED ENGINES, COMPRISE THE ENGINE INSTALLATION. THE SUPER-CHARGER GEAR RATIO IS 7.06:1 AND THE PROPELLER GEAR RATIO IS 16.7.
TAKE-OFF 1700 B.H.P. 2600 R.P.M. SEA LEVEL
NORMAL 1500 B.H.P. 2400 R.P.M. SEA LEVEL TO 5800 FT. LOW BLOWER.
NORMAL 1350 B.H.P. 2400 R.P.M. 5800 FT TO 13500 FT HIGH BLOWER.

ENGINE MOUNTS

ENGINE MOUNTS ARE CONSTRUCTED OF 4130 STEEL TUBING WITH GUSSET REINFORCEMENTS AT THE JOINTS AND RING OF WELDED CONSTRUCTION. AFT PORTION OF ENGINE MOUNT TERMINATES IN SOCKETS FOR ATTACHMENT TO THE MOUNTING PADS ON THE FRONT SPAR.

ENGINE COWLS

THE COWLS ARE MADE OF ALUMINUM ALLOY SHEET AND CONSIST OF 6 PANELS SECURED TO THE FIREWALL AND TO THE WING FAIRING WITH FLUSH FASTENERS.

ENGINE ACCESSORY COWL

THIS STRUCTURE IS COMPRISED OF 6 STAINLESS STEEL PANELS SECURED BY FLUSH FASTENERS TO THE FIREWALL AND FORWARD BAFFLE.

PAINT SCHEDULE

HULL UNDER SURFACE TO CHINE:
NON-SPECULAR LIGHT GRAY.
HULL UPPER SURFACES:
NON-SPECULAR BLUE GRAY.
FLOAT UPPER SURFACE AND STRUTS:
BLUE GRAY.
FLOAT UNDER SURFACE:
NON-SPECULAR LIGHT GRAY.
ENGINE NACELLES UPPER:
NON-SPECULAR BLUE GRAY.
ENGINE NACELLES LOWER:
NON-SPECULAR LIGHT GRAY.
WINGS UPPER:
NON-SPECULAR BLUE GRAY.
WINGS LOWER:
NON-SPECULAR LIGHT GRAY.
HORIZONTAL TAIL: SAME AS WINGS.
VERTICAL TAIL: NON-SPECULAR BLUE GRAY.

ENGINE COWL FLAPS

THE ENGINE COWL FLAPS ARE MADE OF STAINLESS STEEL AND ARE A SEPARATE AND INDEPENDENT INSTALLATION WHICH FUNCTIONS AS A PART OF THE ENGINE COWL TRAILING EDGE. THE FLAP ASSEMBLY IS ATTACHED TO THE REAR COWL SUPPORT RING. THE FLAPS ARE ELECTRICALLY OPERATED.

ENGINE EXHAUST MANIFOLD

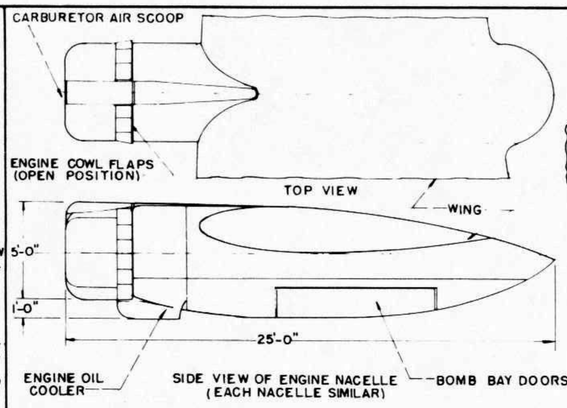
THE ENGINE EXHAUST MANIFOLD CONSISTS OF 7 ASSEMBLIES PROVIDED WITH FLAME SUPPRESSORS. EACH ASSEMBLY EXHAUSTS 2 CYLINDERS.

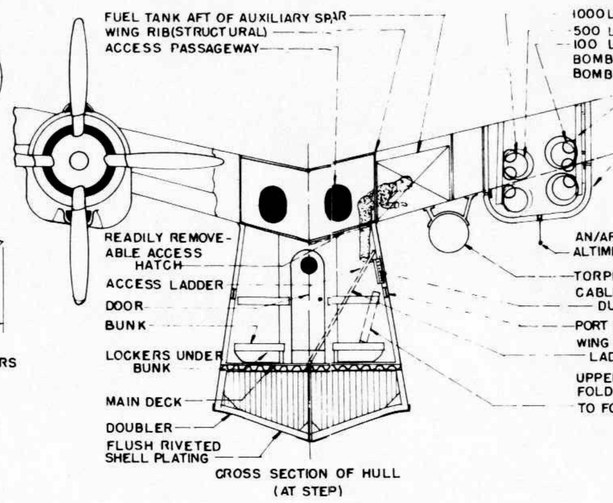
ENGINE FIREWALL

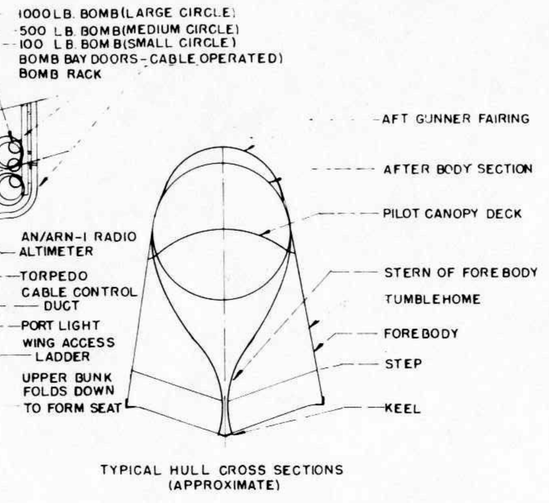
THE ENGINE FIREWALL IS LOCATED ON THE ENGINE MOUNT MIDWAY ALONG THE LENGTH. IT IS MADE OF STAINLESS STEEL.

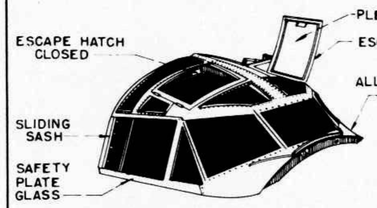
CARBURETOR AIR SYSTEM

A DOWNDRAFT RAM AIR TYPE CARBURETION SYSTEM IS USED. WARM OR COOL AIR MAY BE USED. THE SYSTEM IS DESIGNED SO A MINIMUM OF HEAT IS NECESSARY TO PREVENT ICING.









PROPELLER INSTALLATION

FOUR BLADE, VARIABLE PITCH, CONSTANT SPEED, FULL-FEATHERING, ELECTRICALLY OPERATED CURTISS-WRIGHT PROPELLERS ARE INSTALLED. ANTI-ICING EQUIPMENT AND CUFFS ARE PROVIDED. ELECTRICAL AND CABLE QUADRANTS CONTROL GOVERN OPERATION.

ENGINE CONTROL SYSTEM

THE CONTROLS ARE CABLE OPERATED FROM THE HULL TO THE ENGINE NACELLE. WITHIN THE NACELLE THE CONTROLS ARE FLEXIBLE PUSH-PULL CONTROLS.

PILOT'S CONTROLS (ENGINES)

PILOT AND CO-PILOT CONTROLS FOR THE ENGINE ARE READILY ACCESSIBLE TO EACH MAN AND CONSIST OF A QUADRANT MOUNTING FOR THE THROTTLES AND PROPELLER CONTROLS. THIS QUADRANT IS CONNECTED BY CABLES TO THE FLIGHT ENGINEER'S QUADRANT SO HE CAN ALSO OPERATE THE ENGINES.

ENGINEER CONTROLS

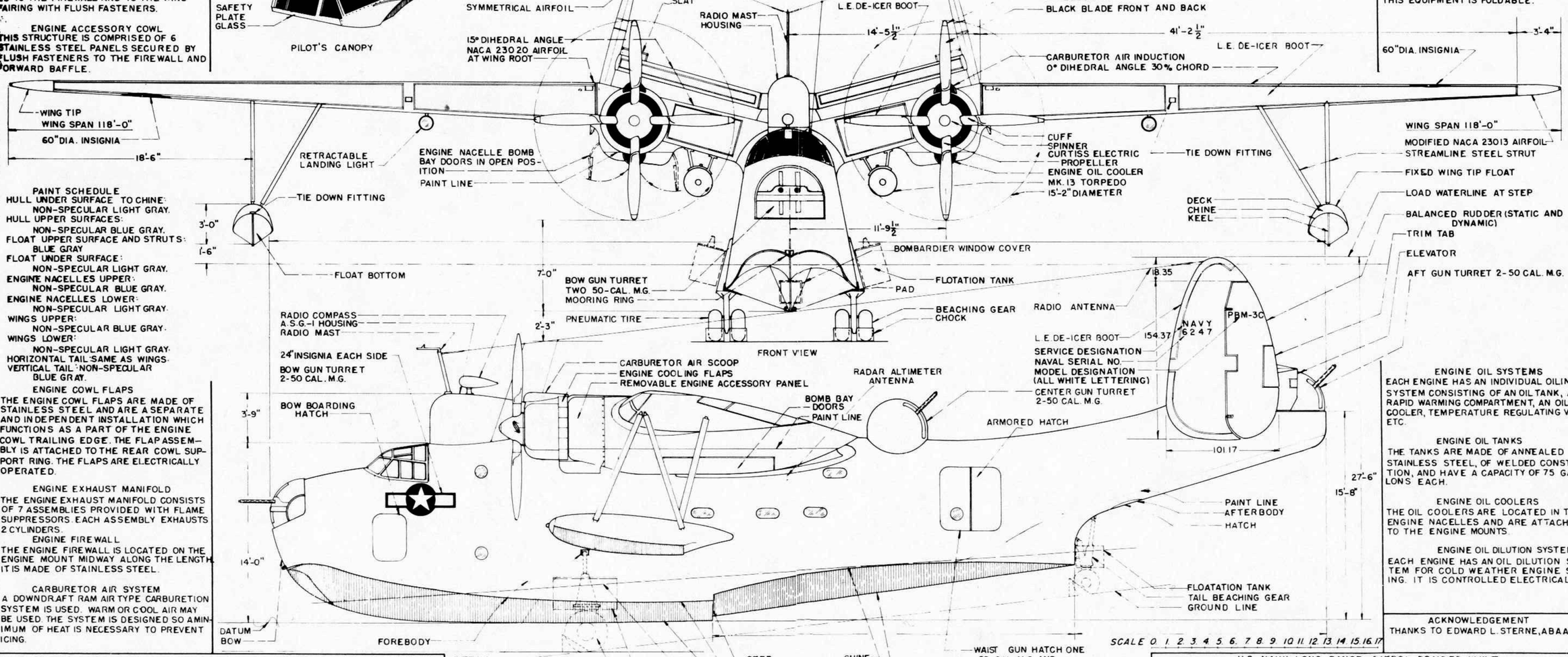
THEY CONSIST OF THE CARBURETOR AIR MIXTURE CONTROL, 2-SPEED SUPERCHARGER CONTROL, ETC.

ENGINE PRE-HEATERS

FOR COLD WEATHER OPERATION, THE ENGINES ARE PRE-HEATED BY RESISTANCE ELEMENTS POWERED BY THE AUXILIARY POWER PLANT.

ENGINE WORKING PLATFORM

AN ENGINE WORKING PLATFORM IS STOWED IN THE HULL AS ARE A LADDER, A HOIST AND 2 ENGINE COVERS. ALL OF THIS EQUIPMENT IS FOLDABLE.



ENGINE OIL SYSTEMS

EACH ENGINE HAS AN INDIVIDUAL OILING SYSTEM CONSISTING OF AN OIL TANK, A RAPID WARMING COMPARTMENT, AN OIL COOLER, TEMPERATURE REGULATING VALVE ETC.

ENGINE OIL TANKS

THE TANKS ARE MADE OF ANNEALED STAINLESS STEEL, OF WELDED CONSTRUCTION, AND HAVE A CAPACITY OF 75 GALLONS EACH.

ENGINE OIL COOLERS

THE OIL COOLERS ARE LOCATED IN THE ENGINE NACELLES AND ARE ATTACHED TO THE ENGINE MOUNTS.

ENGINE OIL DILUTION SYSTEM

EACH ENGINE HAS AN OIL DILUTION SYSTEM FOR COLD WEATHER ENGINE STARTING. IT IS CONTROLLED ELECTRICALLY.

ACKNOWLEDGEMENT

THANKS TO EDWARD L. STERNE, ABAA, AAHS

MARINER PBM-3C

U.S. NAVY LONG RANGE PATROL BOMBER W.W. II
GLENN L. MARTIN COMPANY BALTIMORE, MARYLAND
MODEL AIRPLANE NEWS NEW YORK CITY, N.Y.
DRAWN BY: WILLIS L. NYE, A.A.I.S.
SHEET NO. 1 OF 4 SHEETS

WING AND TAIL DE-ICER SYSTEM

INFLATABLE RUBBER SHOE TYPE DE-ICERS ARE FITTED TO THE LEADING EDGES OF EACH WING AND TAIL SURFACE. THE DE-ICERS ARE ENERGIZED BY AIR PUMPS AND AN AIR DISTRIBUTION VALVE. OTHER COMPONENTS OF THE SYSTEM ARE AIR PRESSURE RELIEF VALVES, OIL SEPARATORS, CHECK VALVES, REGULATOR VALVES, VACUUM RELIEF VALVES, AND SUPPLY LINES. THE INFLATION OF THE DE-ICERS AND THE DEFLATION IS CONTROLLED BY THE ELECTRICALLY-DRIVEN AIR DISTRIBUTION VALVE.

WINDSHIELD WASHING SYSTEM

PROVISIONS ARE MADE TO WASH THE WINDSHIELD AFTER TAKE-OFF WITH FRESH WATER.

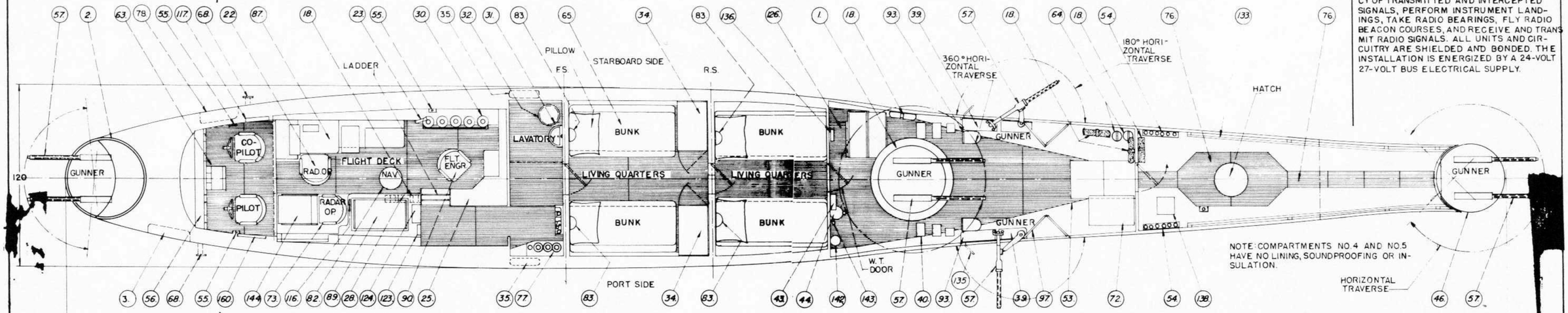
1. DECK TURRET, POWER OPERATED.
2. BOW TURRET, POWER OPERATED.
3. MOORING HATCH.
4. EMERGENCY WATER BREAKERS.
5. TOWING RING.
6. BOMBARDIER'S PICK-UP WINDOW.
7. ANCHOR.
8. BOMBSIGHT.
9. BOMBARDIER.
10. ASG-1 HOUSING.
11. GYRO FLUX GATE COMPASS AMPLIFIER.
12. MAIN ENTRANCE HATCH.
13. ANCHOR DAVIT.
14. SIGNAL HATCH, LEFT HAND HINGED.
15. ENGINE IGNITION SWITCH.
16. ENGINE THROTTLE AND PROPELLER CONTROL.
17. STOWAGE FOR NAVIGATION EQUIPMENT.
18. PARACHUTE STOWAGE.
19. NAVIGATOR'S STATION BOX.
20. RADIO MAST.
21. RADIO DIRECTION FINDER LOOP.
22. RADIO OPERATOR'S CHAIR.
23. RADIO ANTENNA REEL.
24. NAVIGATOR'S ASTRO COMPASS STOOL.
25. FLIGHT ENGINEER INSTRUMENT PANEL.
26. BOAT HOOK.
27. WING ACCESS HATCH.
28. WATER BREAKER.
29. FIRE EXTINGUISHER.
30. BREATHING OXYGEN TANKS.
31. WASH BASIN.
32. AIRCREW CHEMICAL TOILET.
33. REMOVEABLE PORT LIGHT.
34. CLOTHING STOWAGE.
35. BEACHING GEAR STOWAGE.
36. FLIGHT ENGINEER DATA CASE.
37. WAIST GUN HATCH.
38. WAIST GUN MOUNT.
39. WAIST GUNNER'S STEP.
40. CAL. 50 AMMO BOX.
41. NAVIGATOR'S EXIT HATCH.
42. EXIT HATCH.
43. AFT MAIN ELECTRICAL DISTRIBUTION BOX.
44. WATER DISTILLER.
45. DOME LIGHT.
46. POWER OPERATED TAIL TURRET.
47. M-8 SIGNAL PISTOL.
48. LIFE RAFT STOWAGE.
49. GYRO FLUXGATE COMPASS.
50. H.C. SMOKE GRENADES.
51. H.C. SMOKE GRENADE HANDLE.
52. STORAGE BATTERY.
53. STEPS.
54. FLOAT LIGHT STORAGE.
55. PILOT'S INTERPHONE STATION BOX.
56. INSTRUMENT PANEL.
57. CAL. 50 MACHINE GUN.
58. ATA/ARA PILOT'S CONTROL.
59. "ZA" PILOT'S CONTROL.
60. "ZB" PILOT'S CONTROL.
61. ELECTRONIC ADAPTOR UNIT.
62. HATCH.
63. CONTROL PEDESTAL.
64. PARACHUTE FLARE TUBES.
65. UPPER BUNK.
66. FUEL TANK PUMP (MANUAL)
67. CABLE AND TORQUE TUBE DUCT.
68. SNUBBING POST.
69. NAVIGATOR'S INDICATOR BOX.
70. BUNK.
71. BERTH CURTAINS.
72. PARACHUTE FLARES (STOWED)
73. RADAR OPERATOR'S SEAT.
74. AUXILIARY POWER PLANT.
75. BOMBSIGHT DOOR (MOVABLE)
76. WALKWAY.
77. REFUELING STATION.
78. HATCH.
79. RADIO ALTIMETER.
80. SPERRY AUTO-PILOT.
81. GUNNER'S WINDSHIELD OR SPOILER.
82. NAVIGATOR'S STOOL.
83. BERTH LIGHT.
84. EMERGENCY WING FLAP CONTROLS (MANUAL)
85. WING ACCESS LADDER.
86. TAIL GUNNER.
87. RADIO TABLE.
88. PORT LIGHT.
89. NAVIGATOR'S CHART TABLE.
90. FLIGHT ENGINEER'S CHAIR.

COMMUNICATIONS EQUIPMENT

THE UNITS OF THE SYSTEM ARE:

- ATA/ARA INTERSQUADRON COMMUNICATION
- L.M. FREQUENCY METER.
- D.Z. DIRECTION FINDING.
- R.A.X. COMMUNICATION RECEIVERS.
- ZA. INSTRUMENT LANDING.
- G.O.-9 COMMUNICATIONS TRANSMITTER.
- R.L.24-C INTERPHONE.
- ZB. HOMING ADAPTER EQUIPMENT.
- ABD/ABK-1 RECOGNITION EQUIPMENT.
- ASG-1 SEARCH RADAR.
- AN/ARN-1 ABSOLUTE ALTIMETER.

WITH THE ABOVE EQUIPMENT INTERCOMMUNICATION BETWEEN AIRCREW MEMBERS IS PROVIDED, BETWEEN PLANE AND SURFACE STATIONS, BETWEEN OTHER AIRBORNE PLANES, MEASURE THE FREQUENCY OF TRANSMITTED AND INTERCEPTED SIGNALS, PERFORM INSTRUMENT LANDINGS, TAKE RADIO BEARINGS, FLY RADIO BEACON COURSES, AND RECEIVE AND TRANSMIT RADIO SIGNALS. ALL UNITS AND CIRCUITRY ARE SHIELDED AND BONDED. THE INSTALLATION IS ENERGIZED BY A 24-VOLT 27-VOLT BUS ELECTRICAL SUPPLY.



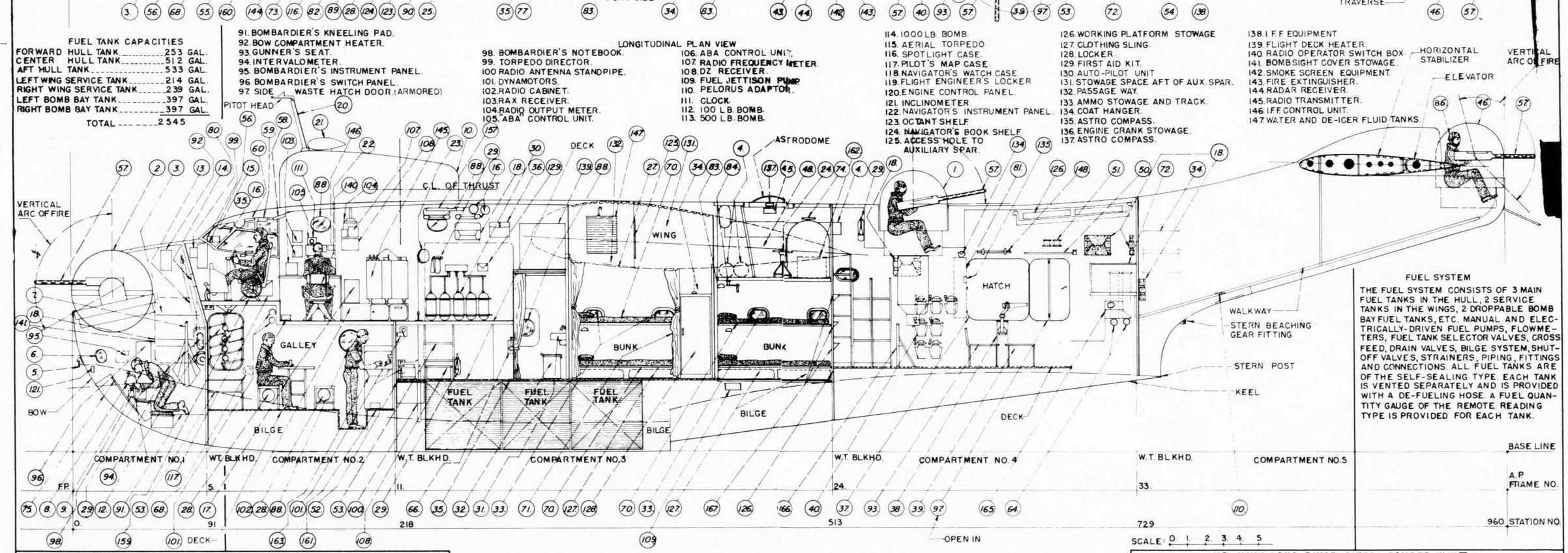
FUEL TANK CAPACITIES

FORWARD HULL TANK	253	GAL.
CENTER HULL TANK	512	GAL.
AFT HULL TANK	533	GAL.
LEFT WING SERVICE TANK	214	GAL.
RIGHT WING SERVICE TANK	239	GAL.
LEFT BOMB BAY TANK	397	GAL.
RIGHT BOMB BAY TANK	397	GAL.
TOTAL	2545	

91. BOMBARDIER'S KNEELING PAD.
92. BOW COMPARTMENT HEATER.
93. GUNNER'S SEAT.
94. INTERVALOMETER.
95. BOMBARDIER'S INSTRUMENT PANEL.
96. BOMBARDIER'S SWITCH PANEL.
97. SIDE WASTE HATCH DOOR (ARMORED)

LONGITUDINAL PLAN VIEW

98. BOMBARDIER'S NOTEBOOK.
99. TORPEDO DIRECTOR.
100. RADIO ANTENNA STANDPIPE.
101. DYNAMOTORS.
102. RADIO CABINET.
103. RAX RECEIVER.
104. RADIO OUTPUT METER.
105. "ABA" CONTROL UNIT.
106. ABA CONTROL UNIT.
107. RADIO FREQUENCY METER.
108. DZ RECEIVER.
109. FUEL JETTISON PUMP.
110. PELORUS ADAPTOR.
111. CLOCK.
112. 100 LB. BOMB.
113. 500 LB. BOMB.
114. 1000 LB. BOMB.
115. AERIAL TORPEDO.
116. SPOTLIGHT CASE.
117. PILOT'S MAP CASE.
118. NAVIGATOR'S WATCH CASE.
119. FLIGHT ENGINEER'S LOCKER
120. ENGINE CONTROL PANEL.
121. INCLINOMETER.
122. NAVIGATOR'S INSTRUMENT PANEL.
123. OCTANT SHELF.
124. NAVIGATOR'S BOOK SHELF.
125. ACCESS HOLE TO AUXILIARY SPAR.
126. WORKING PLATFORM STOWAGE.
127. CLOTHING SLING.
128. LOCKER.
129. FIRST AID KIT.
130. AUTO-PILOT UNIT.
131. STOWAGE SPACE AFT OF AUX. SPAR.
132. PASSAGE WAY.
133. AMMO STOWAGE AND TRACK.
134. COAT HANGER.
135. ASTRO COMPASS.
136. ENGINE CRANK STOWAGE.
137. ASTRO COMPASS.
138. I.F.F. EQUIPMENT.
139. FLIGHT DECK HEATER.
140. RADIO OPERATOR SWITCH BOX.
141. BOMBSIGHT COVER STOWAGE.
142. SMOKE SCREEN EQUIPMENT.
143. FIRE EXTINGUISHER.
144. RADAR RECEIVER.
145. RADIO TRANSMITTER.
146. I.F.F. CONTROL UNIT.
147. WATER AND DE-ICER FLUID TANKS.



FUEL SYSTEM

THE FUEL SYSTEM CONSISTS OF 3 MAIN FUEL TANKS IN THE HULL, 2 SERVICE TANKS IN THE WINGS, 2 DROPPABLE BOMB BAY FUEL TANKS, ETC. MANUAL AND ELECTRICALLY-DRIVEN FUEL PUMPS, FLOWMETERS, FUEL TANK SELECTOR VALVES, CROSS FEED, DRAIN VALVES, BILGE SYSTEM, SHUT-OFF VALVES, STRAINERS, PIPING, FITTINGS AND CONNECTIONS. ALL FUEL TANKS ARE OF THE SELF-SEALING TYPE. EACH TANK IS VENTED SEPARATELY AND IS PROVIDED WITH A DE-FUELING HOSE. A FUEL QUANTITY GAUGE OF THE REMOTE READING TYPE IS PROVIDED FOR EACH TANK.

MARINER PBM-3C

FUEL TANKS PORT SIDE (3)
FUEL TANKS STARBOARD SIDE (2)

LONGITUDINAL INBOARD PROFILE AT C.L. (PORT SIDE)

NOTE: REFER TO SHEET NO. 4 FOR ADDITIONAL CALL OUTS.

U.S. NAVY LONG RANGE PATROL BOMBER W.W. II
GLENN L. MARTIN COMPANY — BALTIMORE, MARYLAND.
MODEL AIRPLANE NEWS — NEW YORK CITY, N.Y.
DRAWN BY: WILLIS L. NYE, A.A.H.S.
SHEET NO. 2 OF 4 SHEETS.

W W II SCALE AIRCRAFT DRAWINGS

MARTIN PBM MARINER

GUN TURRET

THE GUN TURRET IS A SELF-CONTAINED UNIT WHICH IS MOUNTED IN THE DECK POSITION. IT HAS A 24-VOLT D.C. PLUG IN CONNECTION FOR OPERATION. THE GUN CARRIAGE ASSEMBLY CONTAINS 2 BROWNING MODIFIED 50-CAL. AIRCRAFT MACHINE GUNS. THE GUNS ARE LOCATED ON EACH SIDE OF THE CENTERLINE OF THE TURRET, AND ARE SUFFICIENTLY FAR APART TO CLEAR THE AIRGUNNER'S SHOULDERS. THE GUN BARRELS AND COOLING JACKETS EXTEND FROM A TRANSPARENT ONE-PIECE PLEXIGLASS ENCLOSURE, HOUSING THE AIRGUNNER, GUNS, ARMORPLATE, POWER DRIVE MECHANISM, AND RELATED ACCESSORIES.

TURRET COMPONENTS

(1) MAIN CHASSIS.
(2) MOUNTING RING.
(3) GUN CRADLES.
(4) TORQUE DRIVE.
(5) PLEXIGLAS ENCLOSURE.
(6) ARMOR PLATES.
(7) AMMO BOXES.
(8) EJECTION CASE AND LINK BOXES.
(9) TURRET DRIVE CONTROLS.
(10) AZIMUTH DRIVE.
(11) ELEVATION DRIVE.
(12) AMMO BOOSTERS.
(13) AIRGUNNER'S SEAT.
(14) GUN CHARGERS.
(15) GUN SIGHT.
(16) GUN CAMERA.
(17) OXYGEN REBREATHER.
(18) GUNFIRE INTERRUPTER.
(19) PRESSURE ACCUMULATOR.
(20) PRESSURE GAUGES.
(21) SPOTLIGHTS.
(22) INTERPHONE SYSTEM.

1,000 ROUNDS OF AMMUNITION ARE PROVIDED FOR EACH GUN. THE AMMO BOXES ARE LOCATED IN THE HULL (PORT AND STARBOARD). THE AMMO MOVES IN TRACKS TO THE GUNS. USED LINKS ARE EJECTED OVERBOARD.

WAIST GUNS

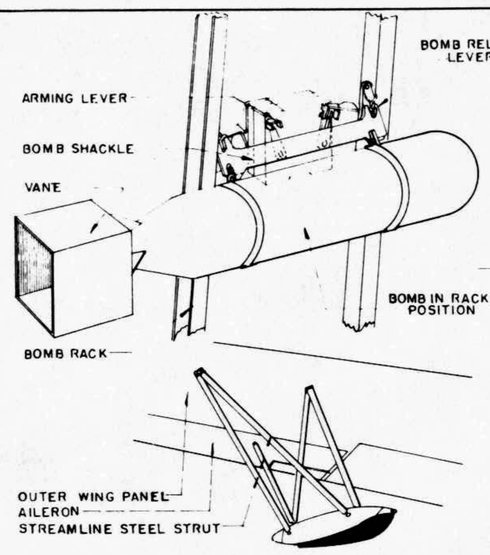
A 50-CAL. MACHINE GUN IS MOUNTED IN THE HULL AMIDSHIPS, PORT AND STARBOARD, ON FLEXIBLE MOUNTS. LARGE HATCHES PROVIDE LARGE ANGULAR ARCS OF FIRE. THE GUNS ARE EQUIPPED WITH AMMO BOOSTERS. AMMO TRAVELS IN ROLLER TRACKS FROM THE AMMO BOXES. HATCH IS ARMORED.

BEACHING GEAR

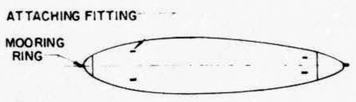
THE BEACHING GEAR CONSISTS OF 2 MAIN UNITS FOR THE HULL AND A TAIL GEAR. EACH MAIN BEACHING GEAR TIRE WILL SUPPORT 12,500 LBS. THE TAIL GEAR TIRES SUPPORT 6,000 LBS. EACH. THE BEACHING GEAR UNITS EACH HAVE A BUOYANCY TANK FOR FLOTATION EACH BEACHING GEAR UNIT IS PROVIDED WITH A HYDRAULIC BRAKE SYSTEM AND A CONTROL LEVER. FOR GROUND HANDLING CONTROL, THE MAIN BEACHING GEAR UNIT MAY BE SWIVELED THROUGH A FULL 360° AND MAY BE LOCKED IN ANY ONE OF 8 POSITIONS, 45° APART; 2 OF THESE PROVISIONS PROVIDE FOR FORE AND AFT AND ATHWARTSHIP DIRECTION OF MOVEMENT. THE BEACHING GEAR, WHEN CARRIED ABOARD THE AIRPLANE, IS BOLTED TO THE BOMB RACK RAILS OF THE INNER BOMB BAY. OPERATION OF THE TAIL GEAR IS SIMILAR TO THAT OF THE MAIN BEACHING GEAR. PNEUMATIC TIRES ARE USED.

NOTE: DIMENSIONS ARE IN INCHES.

MARINER PBM-3C

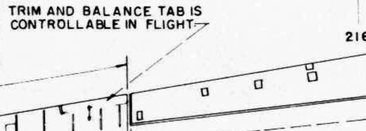


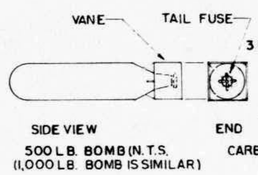
WING TIP FLOAT AND STRUTS (PORT AND STARBOARD)

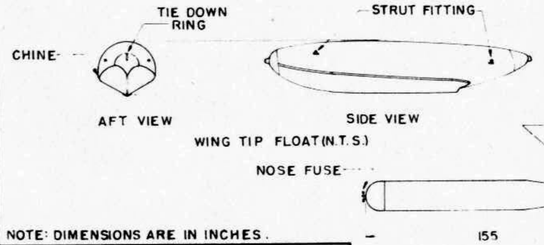


PLAN OF WING TIP FLOAT (N.T.S.)

FOR LONG RANGE, FUEL TANKS CAN ALSO BE CARRIED IN THE BOMB BAY.







PYROTECHNICS

TWO PARACHUTE RELEASE CONTAINERS ARE PROVIDED FOR THE RELEASE OF MARK 5 FLARES.

VERY PISTOL
AN M-8 PYROTECHNIC PISTOL AND AMMO IS PROVIDED.

AIRCRAFT FLARES
PROVISIONS ARE MADE FOR CARRYING 36 AIRCRAFT FLARES.

AIRCRAFT FLOAT LIGHTS
RACKS TO HOLD 18 AIRCRAFT FLOAT LIGHTS ARE PROVIDED.

TOW TARGET
A TOW TARGET REEL IS INSTALLED ON CENTERLINE OF THE HULL.

AUXILIARY POWER PLANT
THIS UNIT IS A SELF-CONTAINED POWER PLANT CONSISTING OF AN 8 K.W. 30-AMP. D.C. GENERATOR CONNECTED TO A 37 H.P. GASOLINE ENGINE.

WATER STILL
A GASOLINE FIRED WATER STILL IS CARRIED FOR DISTILLATION OF SALT WATER IF NECESSARY.

WINDSHIELD WIPING SYSTEM
ELECTRIC WINDSHIELD WIPERS ARE INSTALLED.

PARACHUTES
A PARACHUTE IS CARRIED FOR EACH MEMBER OF THE AIRCREW. PARACHUTES ARE STOWED IN RACKS

LIFE RAFTS
THREE LIFE RAFTS ARE CARRIED. THESE RAFTS ARE INFLATABLE AND ARE STOWED ADJACENT TO THE UPPER EXIT HATCH.

SURFACE CONTROL LOCK
A SURFACE CONTROL LOCK IS PROVIDED AT THE PILOT'S CONTROL.

BILGE SYSTEM

THE BILGE SYSTEM IS DIVIDED INTO 2 SECTIONS, THE HULL BILGING AND FUEL TANK BILGING. THE FUEL TANK BILGING SYSTEM IS PART OF THE FUEL SYSTEM. THE PUMP FOR BILGING OPERATIONS IS PART OF THE FUEL JETTISON SYSTEM, BUT WHEN HULL BILGING IS TO BE PERFORMED, THE PUMP IS DISCONNECTED FROM THE FUEL JETTISON SYSTEM. A FLEXIBLE HOSE IS ATTACHED TO THE PUMP FOR INSERTION IN THE BILGE COMPARTMENT AND BILGE WATER IS DISCHARGED OVERBOARD THROUGH THE FUEL JETTISON SYSTEM. THE PUMP IS ELECTRICALLY-DRIVEN. IT CAN ALSO BE USED AS A PORTABLE PUMP UNIT FOR USE ALONG THE HULL WHERE ELECTRIC POWER IS AVAILABLE.

GALLEY

THE GALLEY COMPARTMENT IS PROVIDED WITH AN ELECTRIC RANGE AND HEATED FOOD DRAWERS. A SINK FOR COOKING PURPOSES IS ALSO PROVIDED. A BENCH FOR USE OF THE CREW DURING EATING AND TWO ELECTRIC HOT PLATES ARE ALSO AVAILABLE. WATER BREAKERS ARE STOWED THROUGHOUT THE HULL AT CREW STATIONS.

0 1 2 3 4 5 6 7 8 9 10
SCALE (PLAN)

U.S. NAVY LONGE RANGE PATROL BOMBER W.W.II
GLENN L. MARTIN COMPANY BALTIMORE, MARYLAND
MODEL AIRPLANE NEWS NEW YORK CITY, N.Y.
DRAWN BY: WILLIS L. NYE, A.A.H.S.
SHEET NO.3 OF 4 SHEETS.

WING FLAPS

WING FLAPS ARE A MARTIN MODIFIED FOWLER TYPE HAVING A HINGED ATTACHMENT TO THE WING AFT STRUCTURE. THE FLAP STRUCTURE IS ALUMINUM ALLOY. THE FLAP CONSISTS OF A TORQUE RESISTING BOX STRUCTURE AT THE LEADING EDGE AND ALUMINUM ALLOY SHEET COVERING THE RIBS AFT OF THE TORQUE BOX STRUCTURE. THE OUTER FLAP HAS FOUR SUPPORT POINTS AND TWO CONTROL POINTS. THE INNER FLAP HAS TWO SUPPORT POINTS AND ONE CONTROL POINT. MECHANICAL MOTION IS OBTAINED BY MEANS OF ACTUATING LINKAGES AT SUPPORT POINTS AND MOTIVATED BY ELECTRIC POWER. WHEN POWER IS APPLIED, THE LINKAGE IMPARTS AN AFT AND ANGULAR MOTION TO THE WING FLAP.

ELECTRICAL SYSTEM

THE ELECTRICAL SYSTEM IS A 28.5 VOLT CONVENTIONAL BATTERY, GENERATOR, GROUND RETURN SINGLE BUS SYSTEM. THIS SYSTEM IS ENERGIZED BY 2 ENGINE-DRIVEN GENERATORS. ELECTRICAL POWER FOR THE PERSONNEL, LIVING NEEDS, COOKING AND LIGHTING IS SUPPLIED BY AN ENGINE-DRIVEN AUXILIARY POWER PLANT. THERE ARE 36 ELECTRICAL CIRCUITS ON THIS PLANE.

FIRE PREVENTION SYSTEM

THIS SYSTEM IS DESIGNED AS A FIRE PREVENTION SYSTEM IN THE FUEL TANK AREA AND NOT AS AN EXTINGUISHING INSTALLATION. WHEN THE PLANE ENGAGES IN COMBAT, CARBON-DIOXIDE GAS IS RELEASED BY MANUAL CONTROL BY THE PILOT. THIS VAPOR DILUTION SYSTEM FLOODS THE FUEL TANK AREA AND MINIMIZES THE DANGER OF FIRE CAUSED BY INCENDIARY BULLETS. THE CARBON-DIOXIDE GAS IS STORED UNDER PRESSURE IN STEEL CYLINDERS. PORTABLE HAND FIRE EXTINGUISHERS ARE POSTED AT CREW STATIONS. ENGINES ARE PROVIDED WITH A CARBON-DIOXIDE FIRE EXTINGUISHING SYSTEM.

INSTRUMENTATION (PILOT)

AUTO-PILOT.
ENGINE OIL PRESSURE INDICATOR (2)
GYRO HORIZON.
AIRSPEED INDICATORS (2).
ALTIMETERS (2).
CLOCK.
COMPASS (2).
TURN AND BANK INDICATORS (2).
TACHOMETERS (2).
PILOT BOMBSIGHT DIRECTOR.
DIRECTIONAL GYRO.
MANIFOLD PRESSURE INDICATOR (2).
RATE OF CLIMB INDICATORS (2).
AIR TEMPERATURE INDICATOR.
ENGINE SYNCHROSCOPE.
WING FLAP POSITION INDICATOR.
ASG-1 INDICATOR.
ZA BLIND LANDING INDICATOR.
ALTITUDE LIMIT SWITCH.
ALTITUDE INDICATOR (ELECTRONIC).

FLIGHT ENGINEER

TACHOMETERS (2).
ENGINE SYNCHROSCOPE.
MANIFOLD PRESSURE INDICATORS (2).
CYLINDER PRESSURE INDICATORS (3).
FUEL PRESSURE INDICATORS (2).
ENGINE OIL PRESSURE INDICATORS (2).
ENGINE OIL THERMOMETER (2).
FUEL FLOW METERS (2).
ENGINE HORSEPOWER INDICATOR.
INCLINOMETER.
ENGINE OIL QUANTITY INDICATOR.
FUEL QUANTITY INDICATOR.
CLOCK.
CARBURETOR AIR TEMPERATURE.
ANTI-ICER PRESSURE GAUGE.
OIL PRESSURE GAUGE (AUX. PWR. PLANT).
THERMOCOUPLE (AUX. PWR. PLANT).

NAVIGATOR

GYRO FLUX GATE COMPASS (INDICATOR)
APERIODIC COMPASS.
AIRSPEED INDICATOR.
CLOCK.
ALTIMETER.

BOMBARDIER

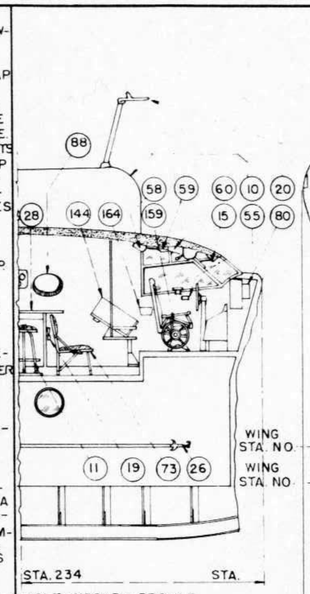
INCLINOMETER.
OUTSIDE AIR THERMOMETER.
ALTIMETER.
AIRSPEED INDICATOR.

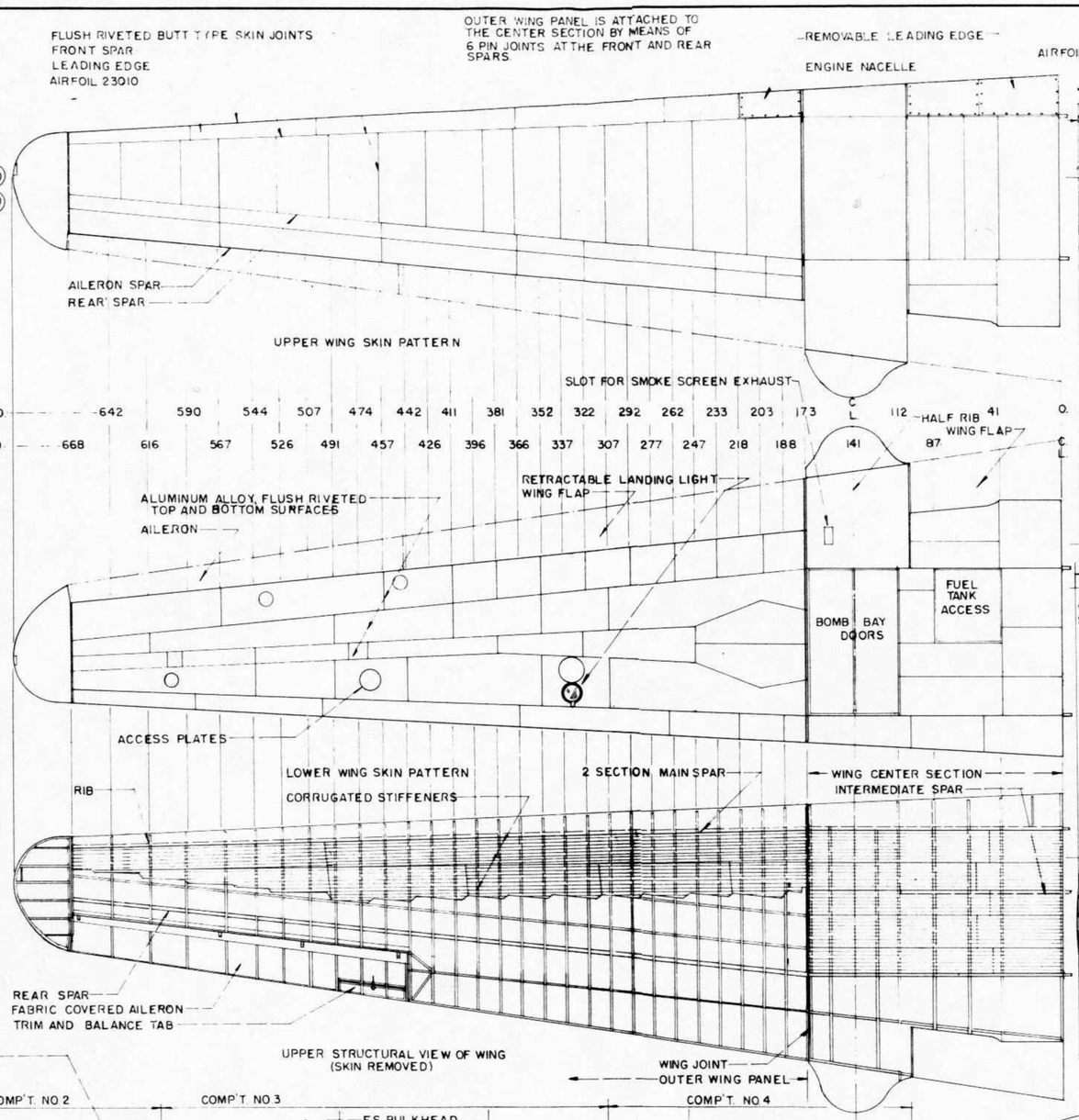
RADIO OPERATOR

CLOCK.

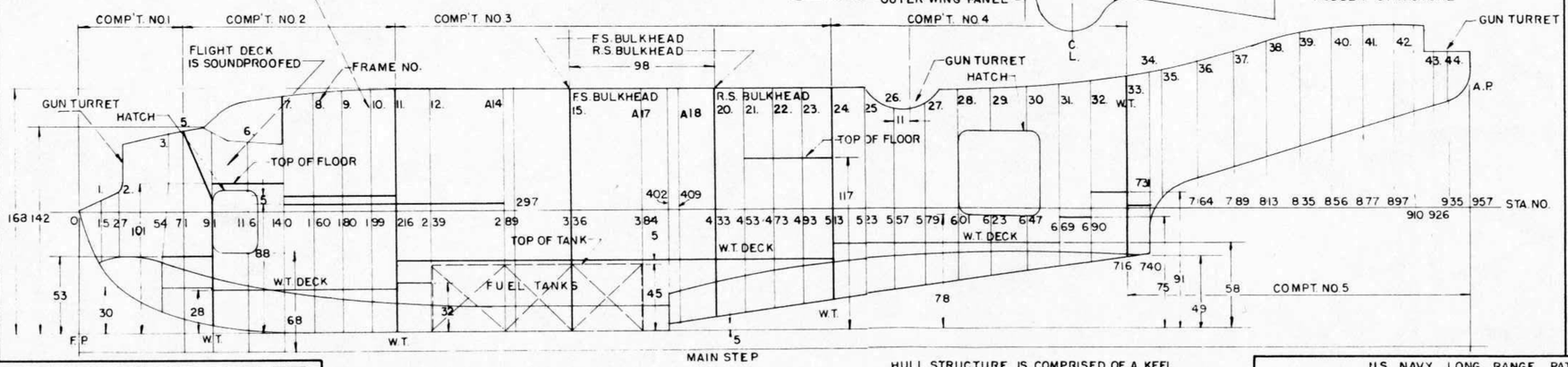
RADAR OPERATOR

INCLINOMETER.





FUSELAGE SKIN IS LAID ON THE STRUCTURE IN VERTICAL PANELS AND FLUSH RIVETED.



HULL STRUCTURAL DIMENSIONS (LONGITUDINAL PROFILE)

F.P. = FORE PEAK.
A.P. = AFT PEAK.
W.T. = WATERTIGHT BULKHEAD.

HULL STRUCTURE IS COMPRISED OF A KEEL STRUCTURE, WATERTIGHT BULKHEADS, CIRCUMFERENTIAL FRAMES AND LONGITUDINAL STRINGERS.

NOTE: DIMENSIONS IN INCHES

FLOODING

THE AIRPLANE WILL REMAIN AFLOAT ALTHOUGH ONE COMPARTMENT HAS BEEN FLOODED. WATERTIGHTNESS OF THE HULL IS OBTAINED BY MEANS OF A GASKET MATERIAL CEMENTED BETWEEN THE FAYING SURFACES OF ALL SKIN PANELS. BELOW THE FLOOD WATERLINE, FRICTION TAPE COATED WITH BAKELITE VARNISH IS USED. ABOVE THE FLOOD WATERLINE ZINC-CHROMATE PRIMER IS USED. ALL WATERTIGHT BULKHEADS ARE SEALED WITH ZINC-CHROMATE PRIMER. ALL HATCHES AND DOORS ARE SEALED WITH NEOPRENE GASKETS.

SOUNDPROOFING AND TRIM

SOUNDPROOFING THICKNESS RANGES FROM 1" TO 3" OF FIBER GLASS IN THE FUSELAGE. A 4" THICKNESS IS USED IN THE PLANE OF THE PROPELLER DISC.

OXYGEN SUPPLY SYSTEM

A CENTRAL SUPPLY OXYGEN SYSTEM IS INSTALLED. THE GAS IS CARRIED IN 5 BOTTLES AND FLOWS THROUGH A PRESSURE MANIFOLD TO A REBREATHING UNIT. OUTLETS ARE LOCATED AT CREW STATIONS. CONTROLS ARE OF THE MANUAL TYPE.

HEATING AND VENTILATION

TWO GASOLINE FIRED HEATERS, PROVIDED WITH ELECTRIC CONTROLS AND DISTRIBUTION DUCTS, ARE INSTALLED. ONE HEATER WARMS THE FLIGHT, GALLEY AND BOMBARDIER STATIONS. ANOTHER HEATER WARMS THE CREW STATIONS.

TORPEDO INSTALLATION

TWO TORPEDOES CAN BE CARRIED INBOARD OF EACH NACELLE. A TORPEDO DIRECTOR AS WELL AS A TRAINING CAMERA ARE INSTALLED.

BOMB RELEASE SYSTEM

BOMBS ARE ELECTRICALLY OR MECHANICALLY RELEASEABLE.
4 INTERNAL BOMB RACKS.
16 BOMB RELEASE UNITS.
16 BOMB SHACKLE ASSEMBLIES.
2 BOMBARDIER HANDLES (PILOT)
1 BOMBARDIER ELECTRICAL PANEL. EMERGENCY MANUAL SALVO RELEASE.
2 FIRING KEYS.
1 PILOT DIRECTOR INDICATOR.
1 INTERVALOMETER.
1 BOMBSIGHT.
2 BOMBRACK SELECTORS
1 SELECTIVE ELECTRIC BOMB RELEASE.
1 SALVO BOMB RELEASE.
8 SELECTIVE FUSING DEVICES.
1 TORPEDO DIRECTOR.
BOMB RACK CONTROLS.

AUTOMATIC PILOT

A MARK-3 SPERRY AUTO-PILOT IS INSTALLED.

FLIGHT CONTROLS

THE CONTROL SURFACES ARE CABLE OPERATED. THE TRIM TABS ARE TORQUE TUBE OPERATED. TWO CONTROL COLUMNS FOR DUAL CONTROLS ARE PROVIDED.

PLUMBING SYSTEM

A FRESH WATER SYSTEM IS INSTALLED FOR THE GALLEY AND LAVATORY SINKS. A TANK HOLDING 15 GALLONS OF FRESH WATER IS INSTALLED.

PROPELLER ANTI-ICER SYSTEM

EACH PROPELLER HAS A SLINGER RING WHICH SUPPLIES ANTI-ICER FLUID TO THE L.E. OF EACH PROPELLER BLADE BY THE MEANS OF AN ELECTRIC PUMP.

ENGINE STARTING SYSTEM

TWO INERTIA TYPE DIRECT CRANKING ELECTRIC ENGINE STARTERS ARE INSTALLED AS WELL AS ELECTRICAL FUEL PRIMERS.

FIRE EXTINGUISHING SYSTEM

EACH ENGINE INSTALLATION IS PROVIDED WITH A CARBON-DIOXIDE GAS EXTINGUISHING SYSTEM. HAND FIRE EXTINGUISHERS ARE PROVIDED FOR CREWS QUARTERS.

FLIGHT RANGE

THE MARTIN PBM-3C HAD A FLIGHT RANGE OF 3,000 MILES WITH MILITARY LOAD. GROSS WEIGHT IS 48,000 LBS.

JATO TAKE-OFF

JATO BOTTLES CAN BE USED TO ASSIST TAKE DURING ADVERSE SEA CONDITIONS.

MARINER PBM-3C

U.S. NAVY LONG RANGE PATROL BOMBER W.W II.
GLENN L. MARTIN COMPANY BALTIMORE, MARYLAND
MODEL AIRPLANE NEWS NEW YORK CITY, N.Y.
DRAWN BY: WILLIS L. NYE, A.A.H.S.
SHEET NO. 4 OF 4 SHEETS

W W II SCALE AIRCRAFT DRAWINGS

MARTIN PBM MARINER

MARTIN B-26 MARAUDER

This early B-26 shows the initial installation of a .30-caliber tail machine gun. The photo was taken late in 1941, before the U.S. Army serial number was added to the vertical tail.

IN addition to its impressive record as a warplane, the Martin B-26 Marauder should be considered an historic U.S. Army design for another reason: it was the first warplane ever to be ordered into mass production "right off the drawing board" without having a prototype tested first. In January 1939, the U.S. Army, foreseeing an immediate need for new, high-performance airplanes, asked for proposals from the aircraft industry for a new medium bomber that would have an unprecedented high speed for the industry and carry five crew men, four .30-caliber machine guns and 2,000 pounds of bombs. By omitting requirements for low-speed handling characteristics, the Army implied that it was willing to accept a "hot" airplane to get the desired top-end performance. The Glenn L. Martin Co. submitted its paper Model 179 on July 5, 1939. After evaluating it against other proposals, the Army awarded Martin a contract for 201 production bombers and designated them "B-26."

B-26—First flown on November 25, 1940, the new B-26 was powered with 1,850hp Pratt & Whitney R-2800-5 engines. Its initial armament was a single flexible, .30-caliber machine gun in the nose and another in a manned tail position, and two .50-caliber guns in a powered, Martin-designed dorsal turret—the first such device to be installed in a U.S. bomber. The B-26 was also the first U.S. warplane to have been designed from the start with self-sealing fuel tanks. The bomb load was 4,800 pounds.

A wingspan of only 65 feet with an area of 602 square feet combined with the 32,000-pound gross weight to create the highest wing loading ever used on an Army airplane to that time. This horrified the pilots—and time was to justify their fears. The early models used for crew training soon earned the nickname "Widow Maker," and they almost lived up to the derisive reference "One a Day in Tampa Bay" at a Florida training center.

Later models had more span and area, but the wing loading didn't decrease, because the gross weight was increased. The early "Short Wing" B-26s were the fastest of all, with top speeds of 317mph at 15,000 feet.

B-26A—The B-26s were

☆ ☆ ☆

followed by 139 B-26As with minor refinements and a fuselage that was lengthened by 2 feet, 3 inches. All four guns were now .50 caliber, and provision was made for carrying naval torpedoes and bombs.

B-26B—There were 1,883 B-26Bs, but a major change was made with the B-26B-10 that tamed it, and almost made it a different airplane. The wingspan was increased

Note: *While Bill Wylam's drawing is titled "B-26D," the airplane shown is actually representative of late B-26B models. Although detailed photos were released to the public during the war, accurate designations weren't given. For security reasons, all information relative to the B-26 was given under the designation "Marauder," without reference to the particular stage of model development. This was a major reason for the use of "popular" names for U.S. military airplanes. Mr. Wylam made as close a guess as he could for the designation based on the information that was available to him.*

A B-26F-1-MA in the natural metal finish adopted for most U.S. Army combat planes early in 1944. Note the external "package guns" on the lower fuselage.

by 6 feet to make it 71 feet; the wing area increased to 659 square feet; and the height of the vertical tail was increased. Other changes common to all B-26Bs were a 24-volt (rather than a 12-volt) electrical system, 2,000hp R-2800-41 engines and increased protective armor.

For defense, the single hand-swung tail gun was replaced with two .50 calibers in a ball turret, and two .50 calibers were mounted in the lower waist. The drawing shows these in socket fittings ahead of the "openable" panel, but they fire through the panels (as shown in the photo). For ground attack, a fixed, .50-caliber gun was installed inside the nose, and four others were added as "package guns" on the outside of the fuselage.

The normal gross weight of the B-26B increased to only 34,000 pounds, but the bomb load was reduced to 3,000 pounds. Overloads were common, however, and with a 5,200-pound bomb load, the gross weight rose to 36,500 pounds.

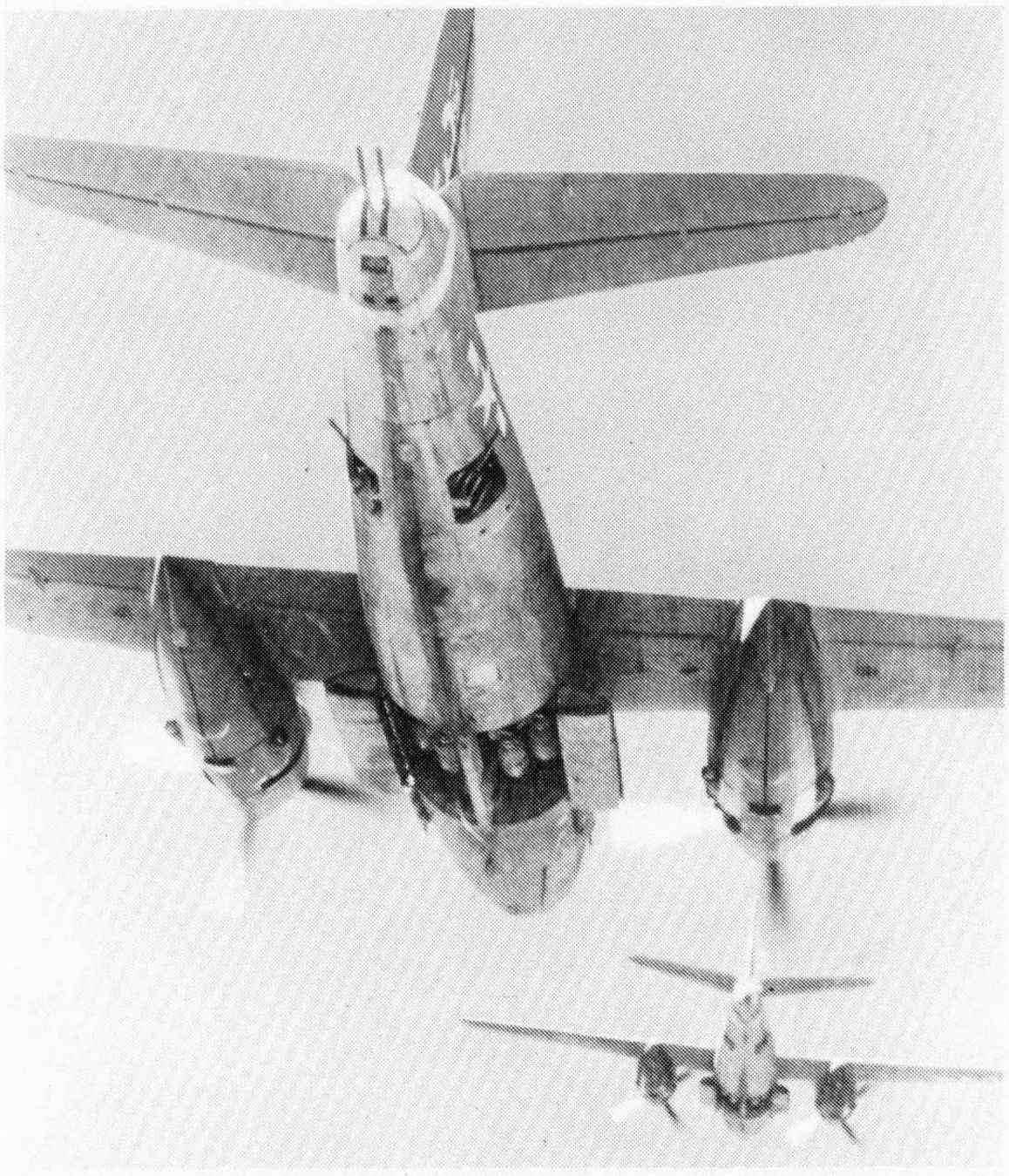
The tail number on the Wylam drawing is accurate for a B-26B-25-MA ("MA" identifies the main Martin plant in Baltimore).

B-26C—The 1,235 B-26Cs were similar to the B-26Bs except that they were built in a new Martin plant in Omaha, NE, where slightly different manufacturing methods were used. The designation became "B-26-MO." Gross weight increased to 38,200 pounds; the top speed dropped to 282mph.

B-26D and E—These two production B-26Bs were modified for experimental projects.

B-26F—The 300 B-26F-MAs were similar to the B and C models except that the angle of incidence of the wing was increased 3 1/2 degrees to further improve the takeoff and landing characteristics.

B-26G—The 893 B-26G-MAs were similar to the F model except that they had only 11 .50-caliber machine guns. A further 57 were built as unarmed crew trainers, and were designated "TB-26G."



This close-up flight view of the B-26B-30-MA shows the ball tail turret, waist gun ports with the guns extended, and the double-hinged doors of a bomb bay containing 500-pound bombs.

REDESIGNATED B-26s

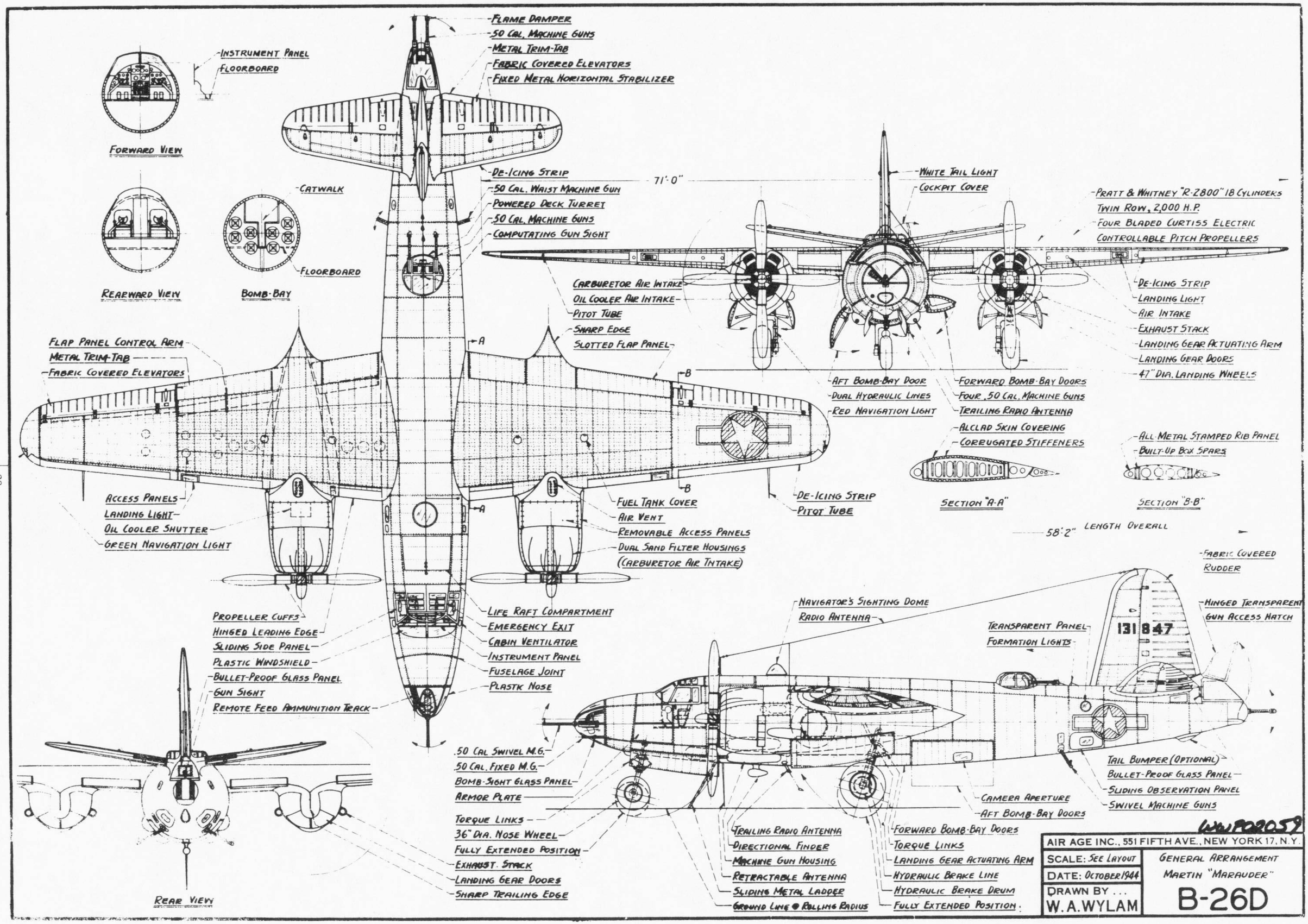
Some production Marauders were modified for use as crew trainers and redesignated: 208 former B-26Bs became "AT-23A Advanced Trainers," while 350 B-26Cs became "AT-23B." These were soon redesignated "TB-26B" and "C" after 203 of the AT-23Bs were transferred to the Navy as unarmed JM-1s ("J" for "Utility," "M" for "Martin"). The Navy also received 47 of the TB-26Gs as JM-2. The JMs were used primarily as tow-target tugs.

ROYAL AIR FORCE MARAUDERS

The R.A.F. received 544 B-26s under Lend-Lease as follows: 52 B-26As as Marauder I; a further 19 B-26As as Marauder IA; 123 B-26Cs as Marauder II; and a combination of 350 B-26Fs and Gs as Marauder III.

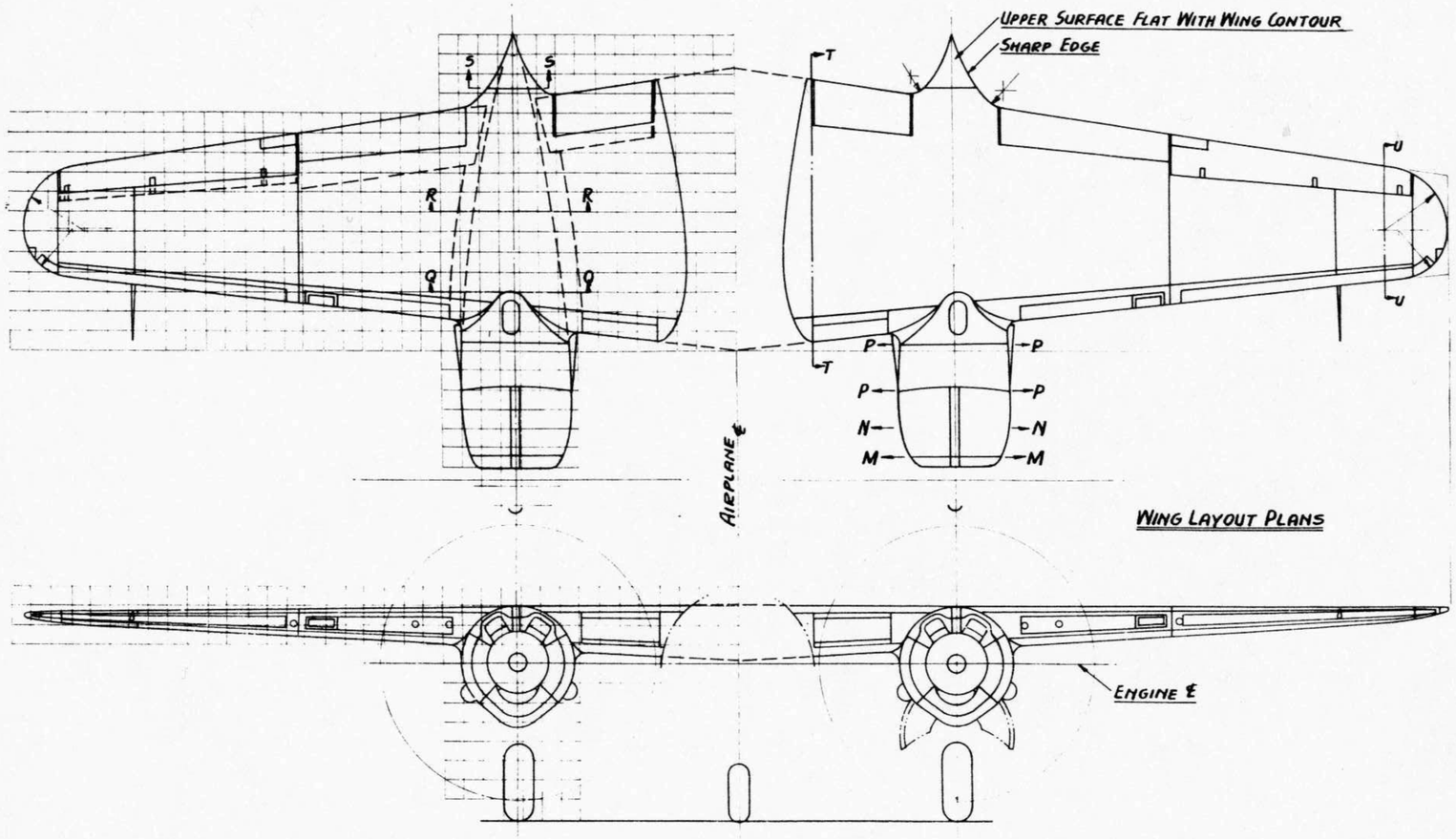
MARAUDERS IN ACTION

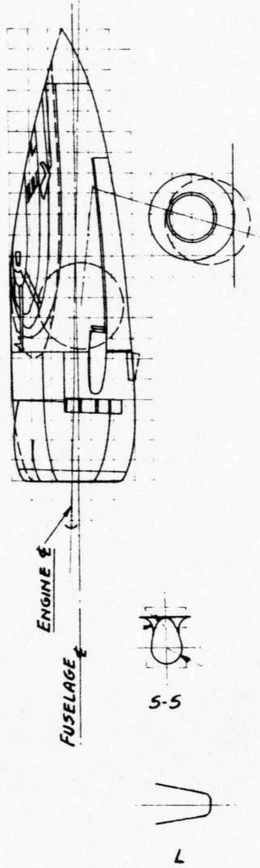
The first few B-26s were retained for testing, but the squadrons began to get B-26s in the spring of 1941. They served in every theater of U.S. Army Air Force operations, starting in New Guinea in April 1942, where the distance between targets and U.S. bases required a reduction of the bomb load because of the extra fuel tanks that were carried in the bomb bays. B-26As were used as torpedo planes in the Battle of Midway in June 1942.

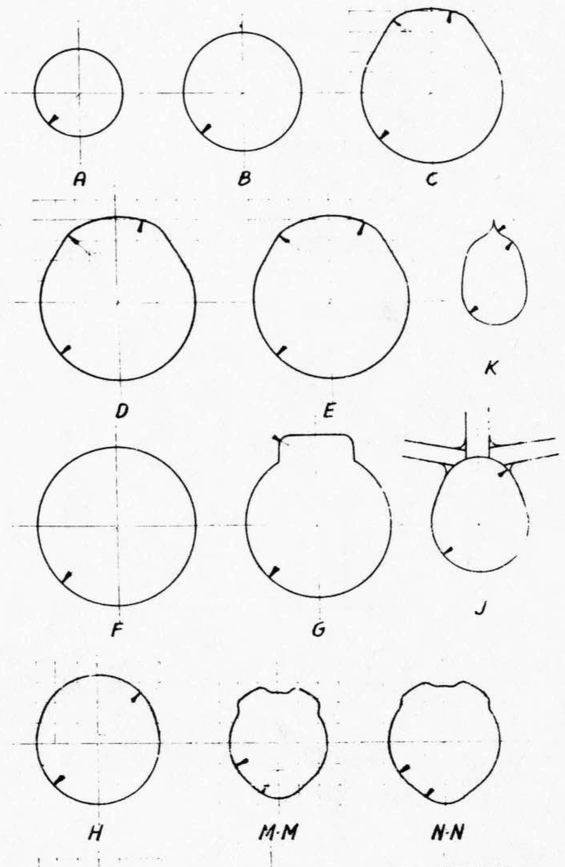


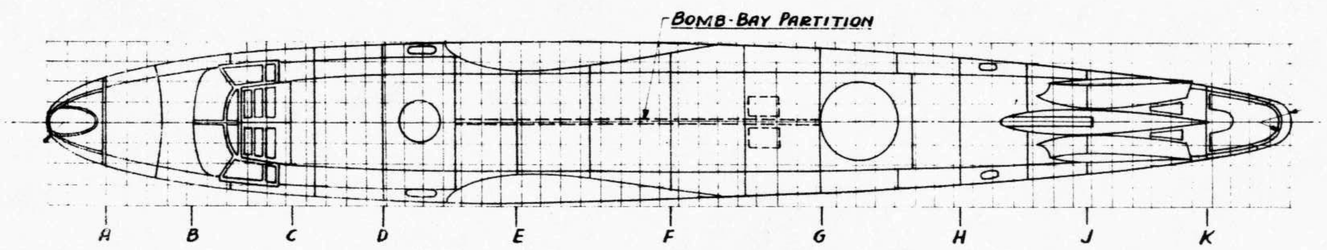
WA FD2059

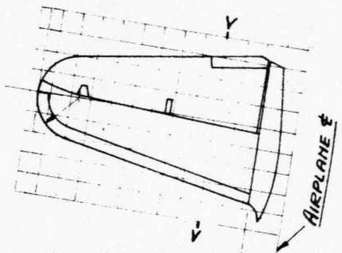
AIR AGE INC., 551 FIFTH AVE., NEW YORK 17, N.Y.	
SCALE: See Layout	General Arrangement
DATE: October 1944	Martin "Marauder"
DRAWN BY ... W. A. WYLAM	B-26D

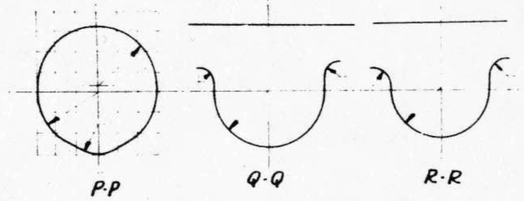


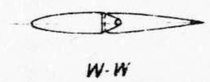


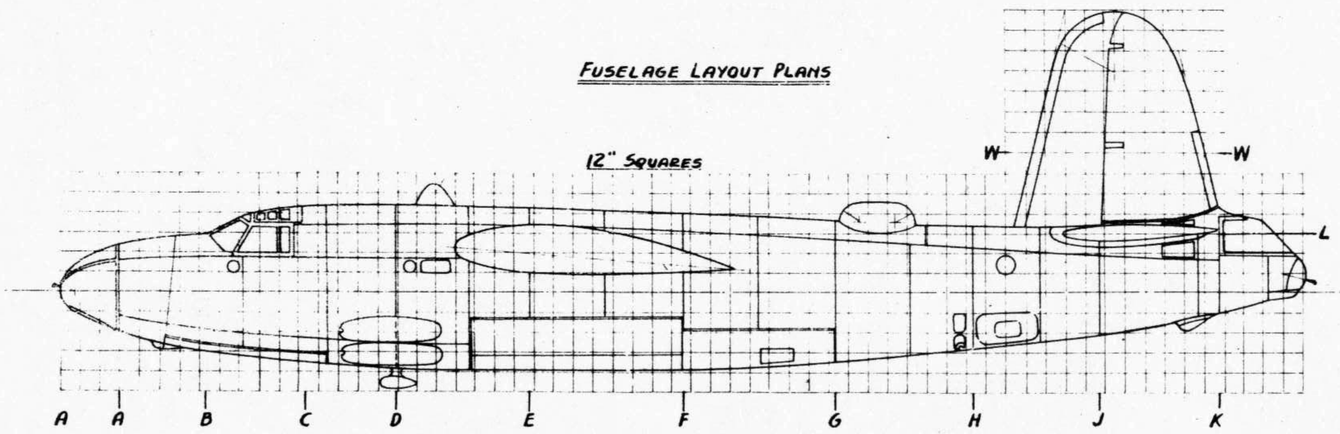


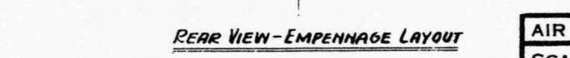












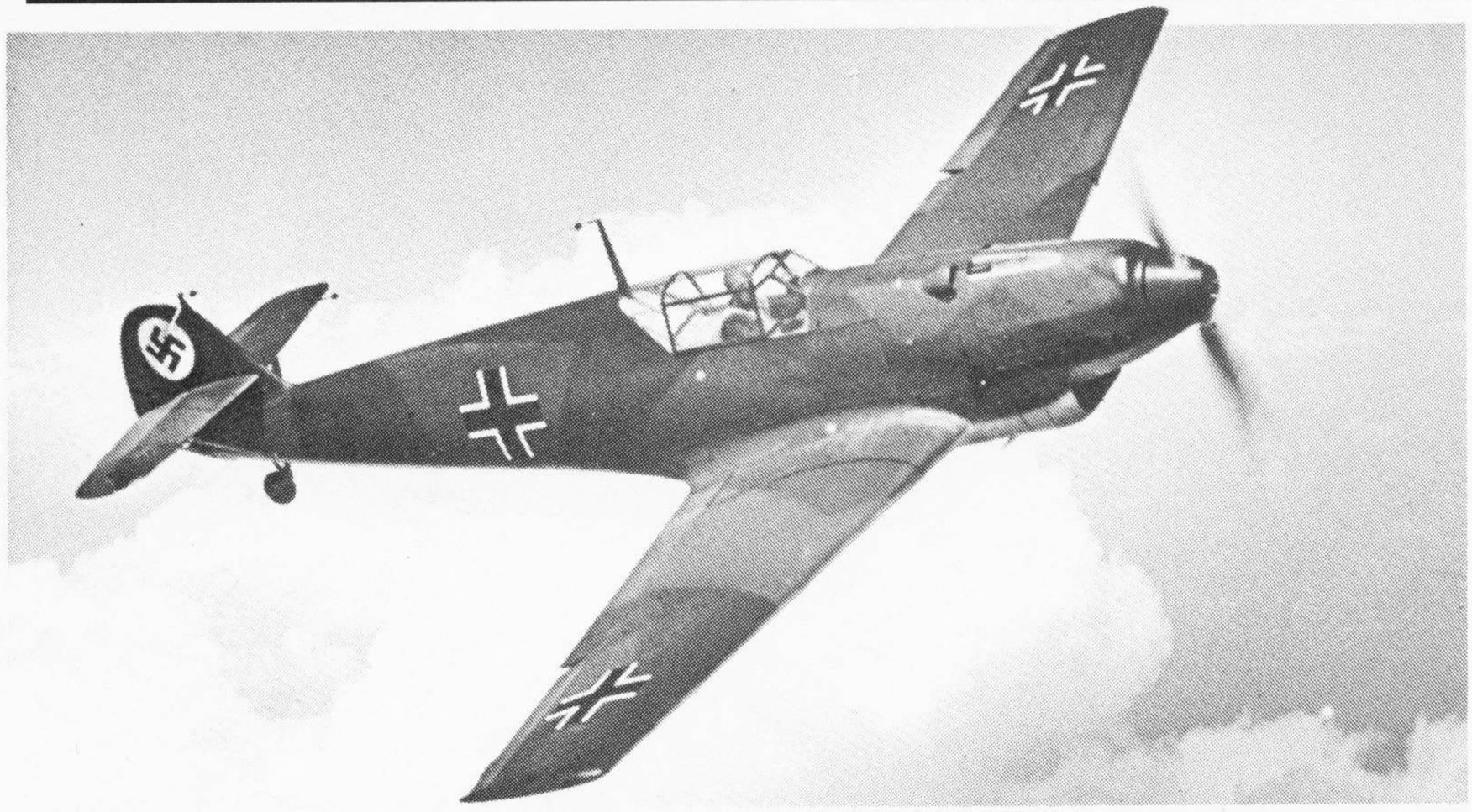
REAR VIEW-EMPENNAGE LAYOUT

WW II SCALE AIRCRAFT DRAWINGS

AIR AGE INC., 551 FIFTH AVE., NEW YORK 17, N.Y.	
SCALE: SEE ABOVE	LAYOUT PLANS & DETAILS
DATE: OCTOBER 1944	MARTIN "MARAUDER"
DRAWN BY ... W. A. WYLAM	B-26D

MARTIN B-26 MARAUDER

MESSERSCHMITT ME 109



An Me 109B-2 in 1938 camouflage and markings. Note the white circle around the swastikas, the narrow white borders for all crosses, and the wing crosses close to the wing tips.

The Me 109 was one of the world's great fighter planes and it enjoyed the distinction of having been built in greater numbers than any other—some 33,000 were built. It was mass-produced in Germany from 1936 through 1945 and it was built in other countries after the war, serving in Spain until 1967.

The Me 109 was designed in 1934 in a four-way design competition for a modern fighter to be used by the brand-new Luftwaffe. Although it was designed to use the new 610hp Junkers Jumo inverted V-12 engine, the Me 109V-1 prototype had to use an upright 625hp British Rolls-Royce Kestrel engine when it flew in September 1935. While it differed little in outline from the new monoplane fighters that were being developed in other countries, the Me 109 was almost revolutionary in its use of a greatly simplified, all-metal structure for mass production and ease of maintenance in the field.

The design was also suitable for "stretch"—the use of higher power, heavier armament and other state-of-the-art changes that kept it competitive with later Allied fighters until the war's end. About the only serious deficiency of the Me 109 was the design of the landing gear. The gear was on a narrow track and the wheels weren't 90 degrees to the ground. This often gave the pilots serious problems when they landed.

Note: The "Me 109J" designation that's used on the Wylam drawing never officially existed. It was an in-house designation used by Messerschmitt for some Me 109G models that were being built for Spain late in the war. The drawing shows the configuration of the prewar Me 109B through D models fitted with the three-blade propeller of the Me 109E. The markings are for early Me 109Bs as seen in 1938. The "J" was just a guess on Mr. Wylam's part, as accurate designations for many German aircraft weren't readily available to the Allies in 1940, when the drawing was made.

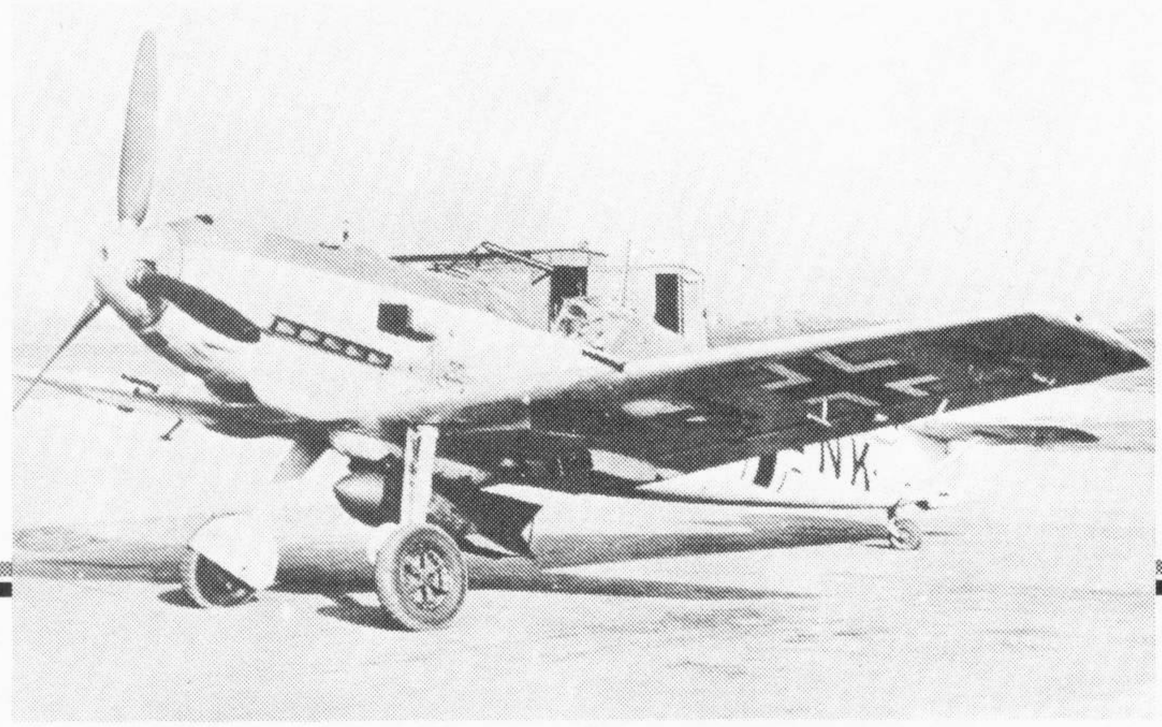
Also, note that the abbreviations "Bf" and "Me" are both used in reference to the Messerschmitt airplanes. Although the planes were designed by Willi Messerschmitt and were referred to as such, they were the product of the Bayersche Flugzeug Werke (Bavarian Airplane Works) of Augsburg and were officially designated "Bf." The name of the firm was changed to Messerschmitt in July 1938, so "Me" became the official abbreviation, but "Bf" also remained in use almost until the war's end. Because "Me" is the most commonly used term today, it's used here even for the early, "true" Bf models.

PROTOTYPES

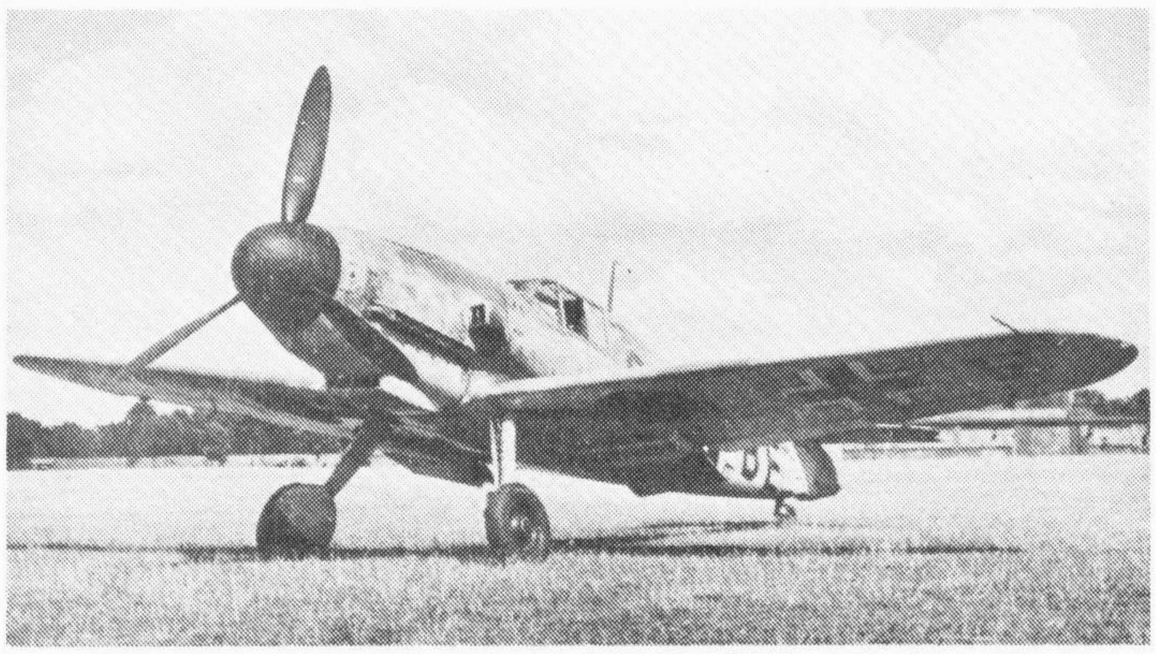
Three Me 109 prototypes were ordered in 1934 and designated "Me 109V-1" through "V-3" ("Versuchs," or "Experimental"). These were followed by 10 more prototypes mixed with pre-production Me 109B models. Designated V models continued to appear until late in the war (reaching V-55). Most of these were adapted from production models rather than built from scratch as experimental models.

Me 109B—This was the first production model because there was no Me 109A as such. It used the 635hp Jumo 210 engine and drove a fixed-pitch wooden propeller, which was later replaced by a two-blade metal controllable-pitch type. Its initial armament was a pair of 7.9mm machine guns that fired through the propeller, with a third gun that fired through the hollow propeller shaft. Early combat experience was gained by 45 109Bs that were sent to the German Condor Legion, which was fighting in the Spanish Civil War. The Me 109B's gross weight was 4,740 pounds and its top speed was 289mph at 13,120 feet (4,000 meters).

Me 109C—This model was outwardly similar to the B, but it had an improved Jumo 210C engine and two additional guns in the wings. Some Cs were used to test a 20mm cannon that fired through the propeller shaft, but this wasn't



An Me 109E-4/B, in 1940 coloring, carrying a 550-pound bomb. Note the wide white borders on the fuselage and the underwing crosses, and the wing crosses now located farther from the wing tip.



The major change in the appearance of the Me 109F resulted from the larger propeller spinner and round wing tips. Shown here is an early Me 109F-0.

The Me 109G was outwardly similar to the F model, except for the bulges for larger nose-gun ammunition drums located ahead of the cockpit (which started with the G-3). Shown here is an ME 109G-10/R1.

yet standard equipment.

Me 109D—The Me 109D, which kept the Jumo engine and two-blade propeller, was the first true mass-produced model, with several hundred built. Although it rapidly became obsolete, some D models saw action during the German invasion of Poland in September 1939. They were then "retired" to fighter-pilot schools.

Me 109E—A major change came with the Me 109E, which used the 960hp Daimler-Benz DB 600 engine, (an inverted V-12 like the Jumo) but had a three-blade propeller and a notably different radiator arrangement under the nose. Production Es with 1,100hp DB 600A engines entered service with the Luftwaffe early in 1939. A great variety of armament was incorporated in the E over its production life, and the nose-mounted cannon was standard equipment. Some other Es had cannon installed in the wings. Provision was also made for the installation of racks under the wings for bombs, and either a 300-liter drop tank or a 550-pound bomb could be carried under the fuselage.

In combat, the Me 109E was slightly superior to the British Hurricane I and far better than the Curtiss Kittyhawk. It was about even in performance with the early British Spitfires.

Me 109F—Major changes in appearance came in late 1940 with the Me 109F. Most notable were a greatly enlarged, nearly hemispherical propeller spinner, rounded (instead of squared) wing tips, and a horizontal cantilever tail that eliminated the bracing struts. From the F-3 model on, the engine used was the 1,350hp DB 601E. Its gross weight was 6,063 pounds and its high speed was 391mph at 19,680 feet (6,000 meters).

Me 109G—The Me 109G of 1942 was the most-produced model. Some featured cockpit pressurization (a new feature for fighters at the time), and from the G-3 on, the nose guns were 13mm. The larger ammunition drums required for these guns caused conspicuous bulges on each side of the fuselage ahead of the cockpit. Again, wing armament varied between cannons, extra machine guns and rockets. Its gross weight was 6,945 pounds; the high speed was 387mph at 22,967 feet (7,000 meters).

Me 109H, J—A small series of Me 109H prototypes (which were intended to be high-performance fighters) was started, using F-4 airframes for prototypes and G-5s for early production models. Only a few were delivered before the program was cancelled. The "J" designation was used by Messerschmitt as its own designation for 25 G airframes that were shipped to Spain without engines.

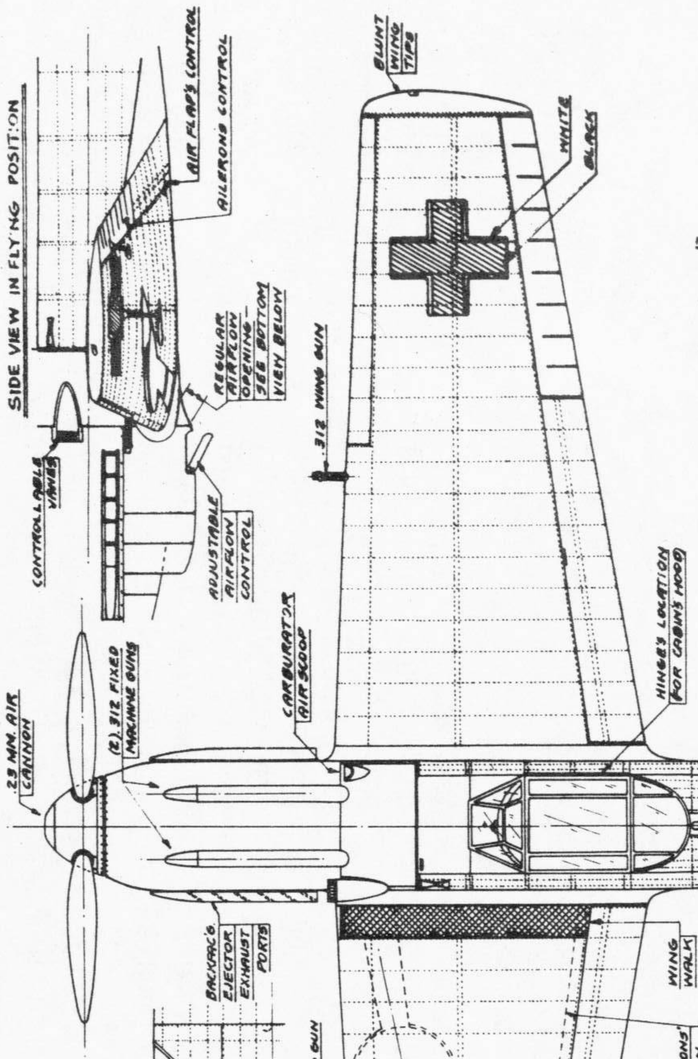
Me 109K—The final production model, which was similar to the late 109G, appeared late in 1944. The Me 109K used the 1,500hp DB 605L engine with a two-stage supercharger that could deliver up to 2,000hp for short dashes.

Its gross weight was 7,400 pounds, and its high speed was 452mph at 19,606 feet. These were figures that emphasized the ability of the 1934 design to grow and remain competitive with later fighter designs.

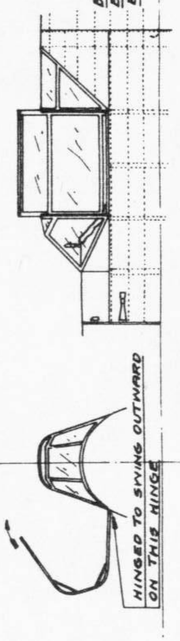
POSTWAR PRODUCTION

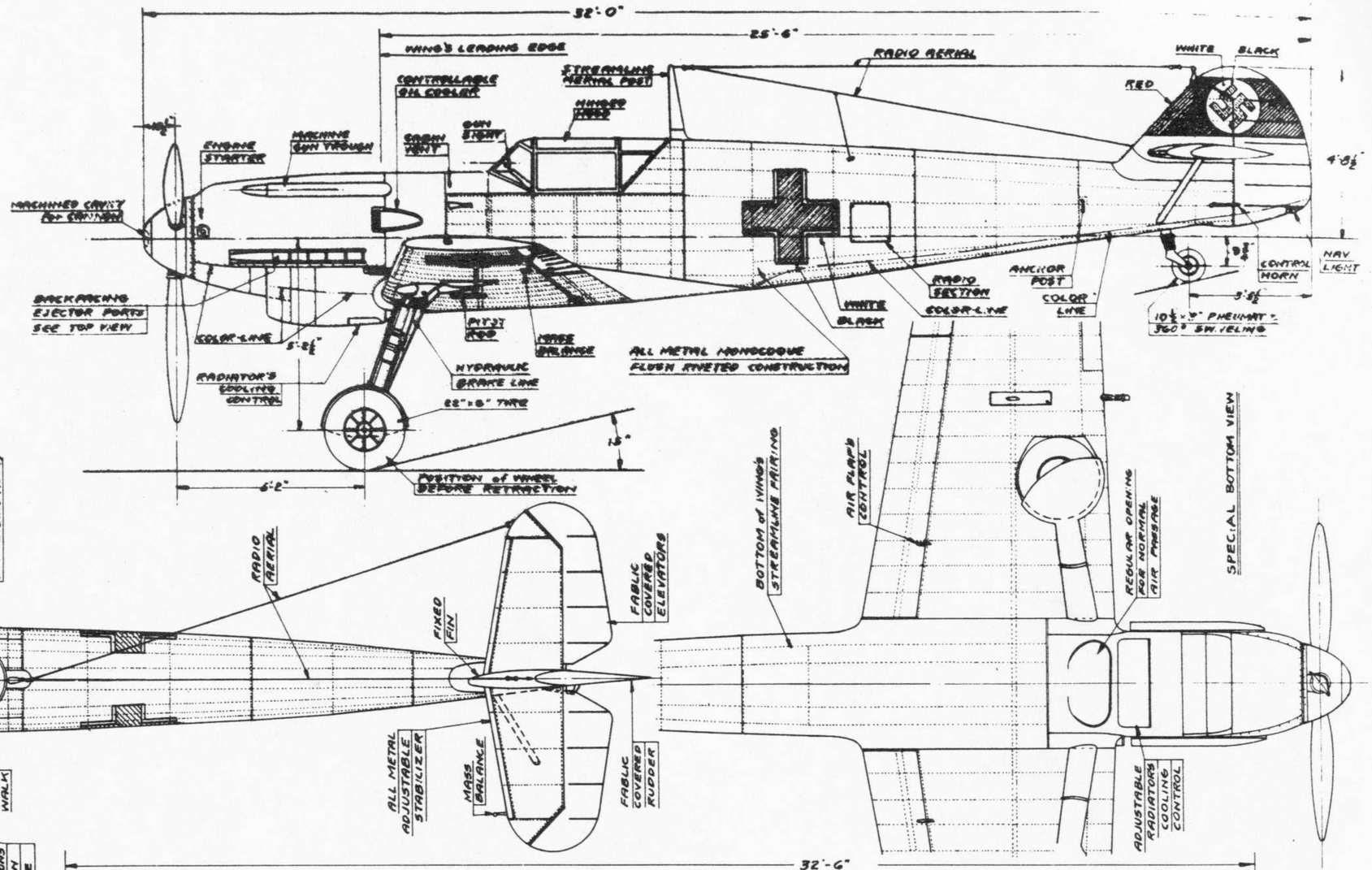
The Avia plant in Czechoslovakia had been building Me 109Gs, and after the war, it continued to build them for the new Czech Air Force, using both DB 605 and Jumo engines. Spain also built Me 109Gs after the war, using Hispano-Suiza engines, which were later replaced by British Rolls-Royce Merlins.

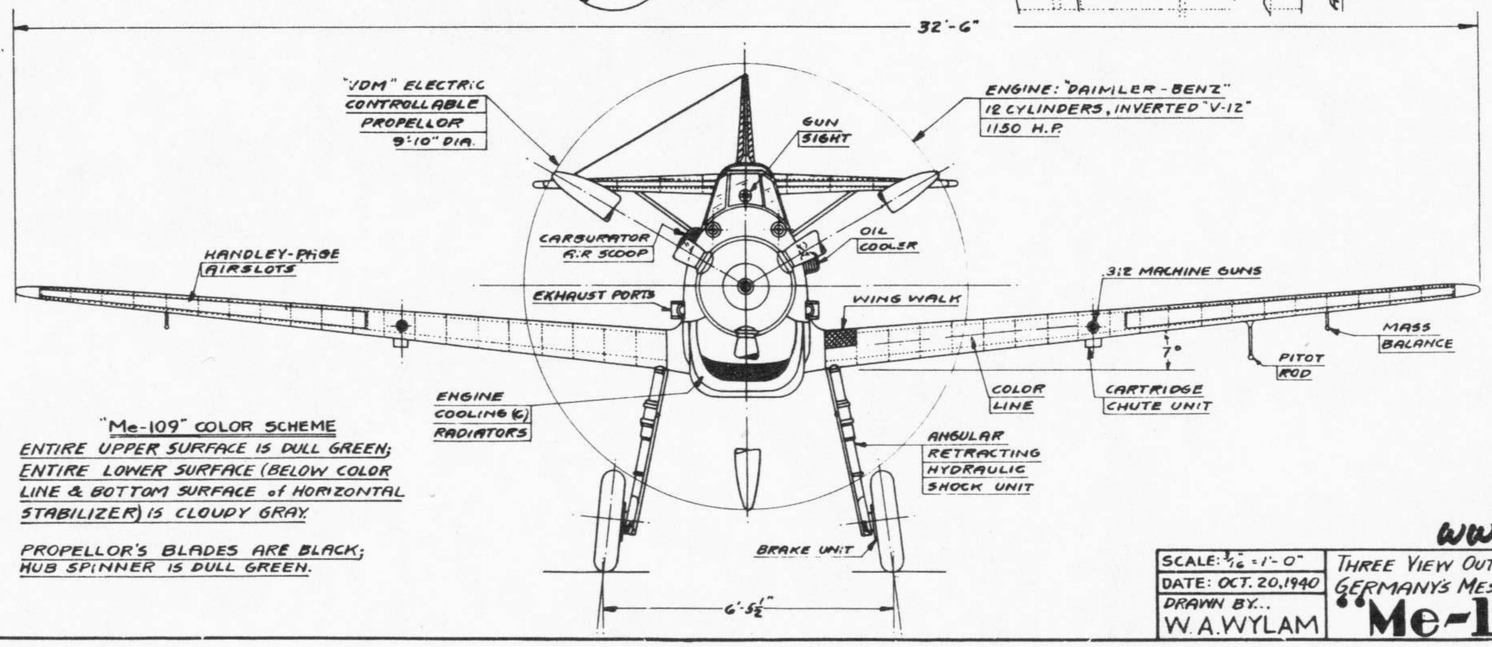
SIDE VIEW IN FLYING POSITION



FRONT & SIDE VIEWS' DETAILS of HINGED CABIN HOOD







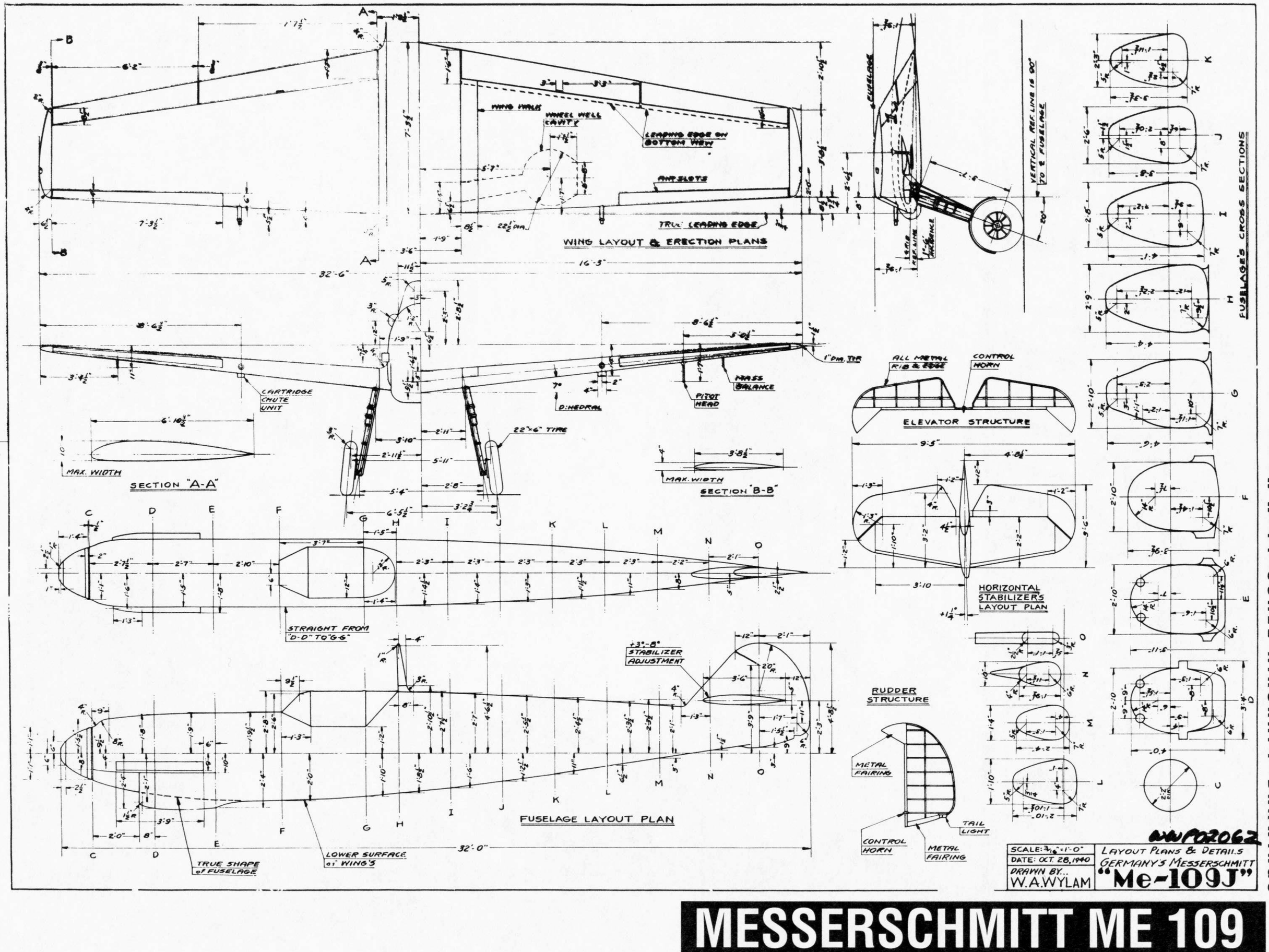
"Me-109" COLOR SCHEME

ENTIRE UPPER SURFACE IS DULL GREEN; ENTIRE LOWER SURFACE (BELOW COLOR LINE & BOTTOM SURFACE of HORIZONTAL STABILIZER) IS CLOUDY GRAY.

PROPELLOR'S BLADES ARE BLACK; HUB SPINNER IS DULL GREEN.

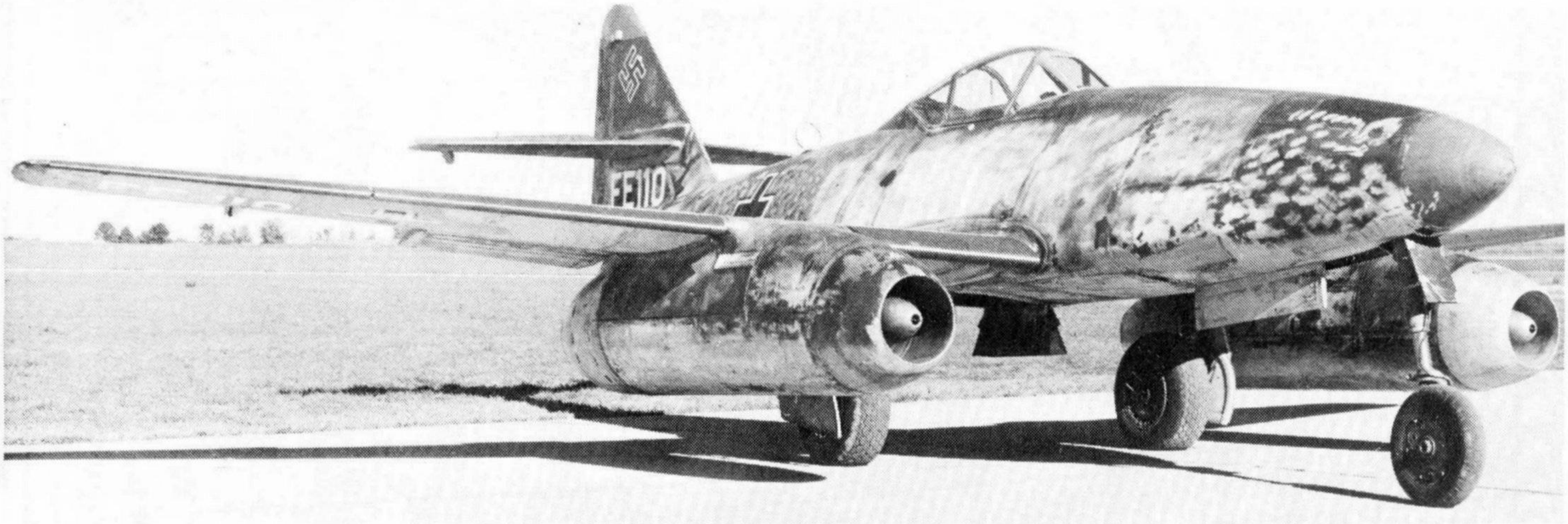
WWP02062

SCALE: 3/16 = 1'-0"	THREE VIEW OUTLINE & DETAILS
DATE: OCT. 20, 1940	GERMANY'S MESSERSCHMITT
DRAWN BY... W. A. WYLAM	"Me-109J"



MESSERSCHMITT ME 109

MESSERSCHMITT ME 262 SWALLOW



An Me 262A-1a tested in the U.S. after the war. The original German fuselage markings had been painted out, but erroneous crosses in WW I style were painted on later for publicity purposes.

THE German Messerschmitt Me 262 has the distinction of being the first turbojet airplane to see combat. It wasn't the first fighter without propellers to do so, however. That honor went to the Messerschmitt Me 162 Komet, which was powered by a liquid-fuel rocket engine and went into action on August 14, 1944. Although the Me 262 didn't go to war until October 3, 1944, its impact on aircraft design was great. Rocket propulsion wasn't adopted for subsequent fighters, but all of today's fighters are powered by turbojets.

It was fortunate for Allied air power that deployment of the Me 262 was held up, first by delays in jet-engine development and then by official indecision as to how it should be used. The initial planning for its use as a fighter was faulty, and then Adolph Hitler ordered that it be produced as a bomber rather than a fighter.

In 1938, the German Air Ministry encouraged the development of jet and rocket powerplants for military aircraft. As a result, the newly named Messerschmitt A.G. ("A.G." for "Aktien Geselleschaft," or Proprietary Company) was invited to design a jet-powered fighter. Messerschmitt's preliminary design study received the Ministry's Project No. P.1065, which appeared as a wooden mock-up in March 1940. Approval of this resulted in an order for three all-metal prototypes, designated "Me 262." The new fighter eventually received the name "Schwalbe" (Swallow).

As a fighter airframe, the Me 262 was a relatively conventional design, but it featured a slightly swept-back wing to reduce compressibility at high speeds. Two axial-flow turbojet engines were installed in nacelles on the underside of the wing, outboard of the inward-retracting landing gear. A detail new to fighters at the time, but soon to be widely adopted, was the use of a cockpit canopy that was entirely above the fuselage, not faired into it as on the Me 109 and its contemporaries.

The first four Me 262s (Me 262V-1 through V-4) featured conventional tail-wheel landing gear. This was quickly changed to the tricycle type, and for good reason. The jet blast hit the pavement, damaging it, and also bounced upward to scorch the tail surfaces while further damaging them with blown-up debris. Significantly, all subsequent jet airplanes used tricycle landing gear with their jets parallel to the ground (notable exceptions are latter-day vertical takeoff types such as the British Harrier).

Airframe development got far ahead of jet-engine development, so the Me 262V-1 was hurriedly fitted with a

Me 262A-1as in Germany. Note that the tail swastika is black with a white border, but that the fuselage cross consists only of a white outline over the fuselage camouflage pattern.

1,200hp Junkers Jumo piston engine in a modified nose. It made its first flight on April 18, 1941. Later attempts to fly it and other prototypes with early developmental jets failed because the engines weren't delivering sufficient thrust (1 pound of thrust equals 1hp at approximately 375mph; 1 pound of thrust equals more than 1hp above that speed and less below it).

Finally, powered by two 1,848-pound-thrust (static) Junkers 109-004A engines, the first all-jet Me 262 flight was made by the V-3 on July 18, 1941. Orders were then placed for production Me 262A-0 and -1 fighters, but for a while, it looked like they wouldn't be delivered as such. Hitler saw a demonstration flight of the Me 262V-6 in November 1943 and, impressed by its speed, decided that it was just the thing for hit-and-run bombing raids on England. He ordered that the new jets be built as bombers instead of fighters. A redesign program got under way, and the Me 262A-2 version could carry two 500kg (1,100-pound) bombs under the fuselage. The bomber version was named "Sturmvogel" (Storm Bird). Reason prevailed in the Air Ministry, however, and Hitler was persuaded to allow simultaneous production of both the Me 262 bomber and the fighter. The fighter was usually fitted with four 30mm cannon in the nose, but other armament arrangements were also used.

By April 1944, 12 prototypes and 10 Me-262A-0 preproduction models had been built. Initial production models went to fighter-pilot schools, not to the front, because considerable training was needed for experienced fighter pilots during their transition to the new jets. The first Me 262 combat mission against U.S. daylight bomber formations was on October 3, 1944.

The performance of the Me 262 handed the Allies a nasty surprise: it was more than 80mph faster than the best Allied fighters of the time. Its speed was an asset in hit-and-run attacks on the bomber streams and allowed it to avoid mixing with the defending fighters. The powered gun turrets of the bombers couldn't follow the Me 262's high-speed passes. Most of the Me 262s that were shot down were victims either of their own pilots' errors or of slowing down for more careful aim or for landing. Some Me 262s were designed with a single 50mm (2-inch) cannon in the nose to permit the Me 262s to attack the bombers while safely out of range of their .50-caliber guns. This version, however, was never produced.

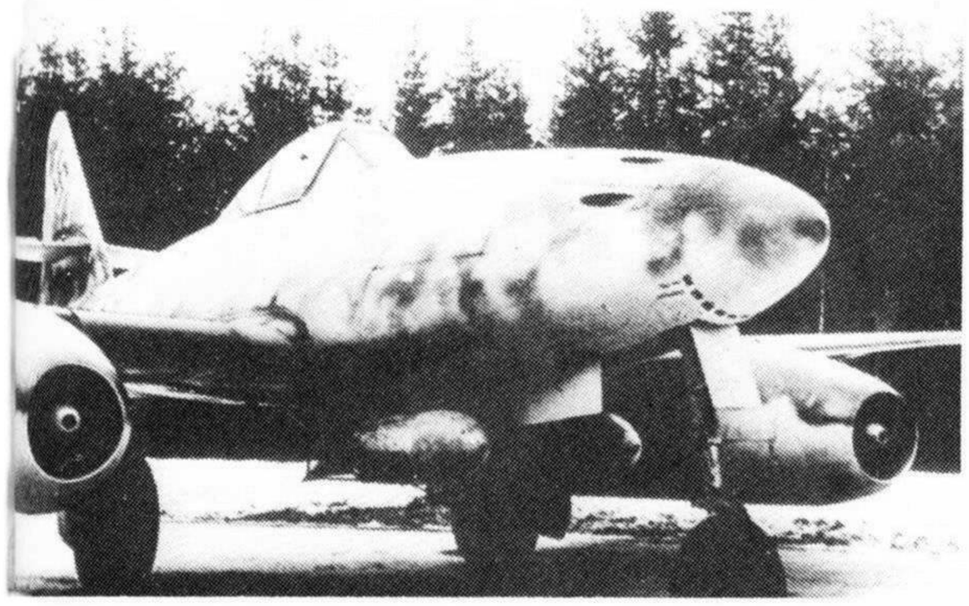
The increasing need for night fighters resulted in the installation of specialized night-fighting radar into some single-seat Me-262A-1s, complete with an impressive array of antennas on the nose. Two-seat Me 262Bs were developed specifically as night fighters.

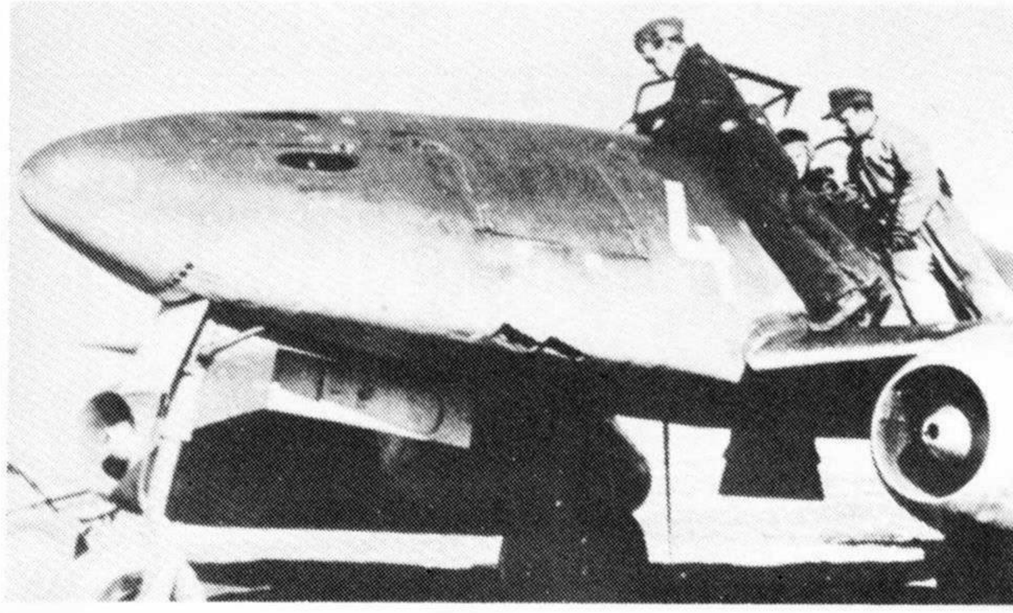
Altogether, 1,430 Me 262s were built out of thousands ordered, and then they were a classic example of too little, too late. Had they been available a year and half earlier (before long-range fighters began to accompany the bombers), the outcome of the Allied strategic bombing program might have been different.

A two-seat Me 262B-1a/U1 night fighter tested in the U.S. after the war. Note the nose radar antennas and the auxiliary fuel tanks where bombs were carried on the bomber versions.

☆ ☆ ☆

Note: The designations "FE" and "T2" on the rear fuselages of German aircraft photographed in the U.S. during and after the war aren't original German markings. "FE" means "Foreign Equipment," and "T2" is the number of the particular Technical Intelligence office that tested the aircraft.





Me 262 nose details. At left, an Me 262A-2a with two 250kg (550-pound) bombs under the fuselage. At right, an Me 262A-1a fighter. Note the ports for the 30mm cannon in the upper nose.

THE MESSERSCHMITT ME-262 WAS THE FIRST OPERATIONAL TURBO-JET FIGHTER DESIGNED AND BUILT BY MESSERSCHMITT A.G. 1433 PLANES OF THIS TYPE WERE MANUFACTURED AND 200 SAW ACTION IN WORLD WAR TWO. THE FOLLOWING IS A LIST OF THE VARIOUS MODELS:

ME-262 V1	PROTOTYPE.
ME-262 V3	PROTOTYPE.
ME-262 V4	
ME-262 V5	NOSE GEAR(FIXED).
ME-262 V6	RETR. NOSE GEAR.
ME-262 V7	PRESSURIZED.
ME-262 V8	ARMAMENT.
ME-262 V9	RADIO TEST.
ME-262 V10	STICK FORCE TEST.
ME-262 A-0	MASS PRODUCTION.
ME-262A-1a	SCHWALBE.
ME-262A-1a/U1	4-30MM CANNON.
ME-262A-1/U2	TACTICAL FIGHTER.
ME-262A-1b	FIGHTER.
ME-262A-2a	STORMVOGEL.
ME-262A-2a/U1	BOMB SIGHT.
ME-262A-2a/U2	BOMBER 2 PLACE.
ME-262A-3a	
ME-262A-5a	RECONNAISSANCE.
ME-262B-1a	NIGHT FIGHTER.
ME-262B-1a/U1	NIGHT FIGHTER.
ME-262B-2a	
ME-262C-1a	ROCKET ENGINE.
ME-262C-2b	
ME-262C-3	

THE GERMAN AIR FORCE USED THE ME-262 FOR TRAINING, INTERCEPTION, NIGHT FIGHTING, FIGHTER-BOMBER, FIGHTER RECONNAISSANCE GROUND ATTACK ETC. THE CONTRACT FOR THE PROTOTYPE WAS AWARDED IN 1938. THE FIRST OPERATIONAL FLIGHT ON TURBO-JET POWER WAS MADE IN JULY, 1942. THE FIGHTER SERIES WAS CALLED THE SWALLOW AND THE BOMBER PLANES WERE CALLED THE STORMBIRDS.

PRODUCTION BREAKDOWN

THE FOLLOWING IS THE PRODUCTION ASSEMBLY BREAKDOWN:

WING TIP(2).
OUTER WING PANELS(2).
OUTER LEADING EDGE SLATS(2).
INNER LEADING EDGE SLATS(2).
AILERONS(2).
AILERON TRIM TABS(2).
OUTER WING FLAPS(2).
INNER WING FLAPS(2).
WING-FUSELAGE LANDING GEAR BOXES.
TURBO-JET ENGINE NACELLES(2).
MAIN LANDING GEAR(2).
NOSE GEAR.
NOSE GEAR DOOR.
NOSE CONE.
NOSE REMOVABLE PANELS(2).
FUSELAGE NOSE ASSEMBLY.
FUSELAGE MID-SECTION.
MAIN LANDING GEAR DOORS(2).
MAIN LANDING GEAR FAIRINGS(2).
FUSELAGE FUEL CELLS.(4).
COCKPIT.
PILOT'S SEAT.
PILOT'S CANOPY.
WING-FUSELAGE FILLETS(2).
FUSELAGE AFT SECTION.
EMPENNAGE SECTION.
HORIZONTAL STABILIZER.
VERTICAL STABILIZER.
ELEVATORS(2).
ELEVATOR TRIM TABS(2).
RUDDER.
RUDDER TRIM TAB.
INSTRUMENT PANEL.
FLIGHT CONTROLS.
BOMB RACKS(2).
ARMAMENT.

DIMENSIONAL DATA

WING SPAN	40'-11.5"
OVERALL LENGTH	34'-9"
HEIGHT	12'-4"
WING AREA	270.00 SQ.FT.
CHORD(ROOT)	100"
CHORD(TIP)	33.75"
ASPECT RATIO	7.5
WING LOADING	44.5 LBS.
WEIGHT EMPTY	8,514 LBS.
USEFUL LOAD	7,106 LBS.
GROSS WEIGHT	15,620 LBS.
HIGH SPEED(RED LINE)	658 M.P.H.

DURATION 50-90 MINUTES AT 10,000 FT.
MAX. AIRFOIL THICKNESS 35% CHORD.
MAX. PERMISSIBLE C.G. 30% M.A.C.(AFT).
MAX. PERMISSIBLE C.G. 18.5% M.A.C.(FWD).

LANDING AND TAKE-OFF

ME-262A FUELED WITH 475 GALLONS: CONCRETE RUNWAY 3750-4350 FEET.
WITH 578 GALLONS ABOARD:
LANDING ROLL ..... <4350 TO 4950 FEET.
LANDING ROLL ..... 4350 TO 4950 FEET.

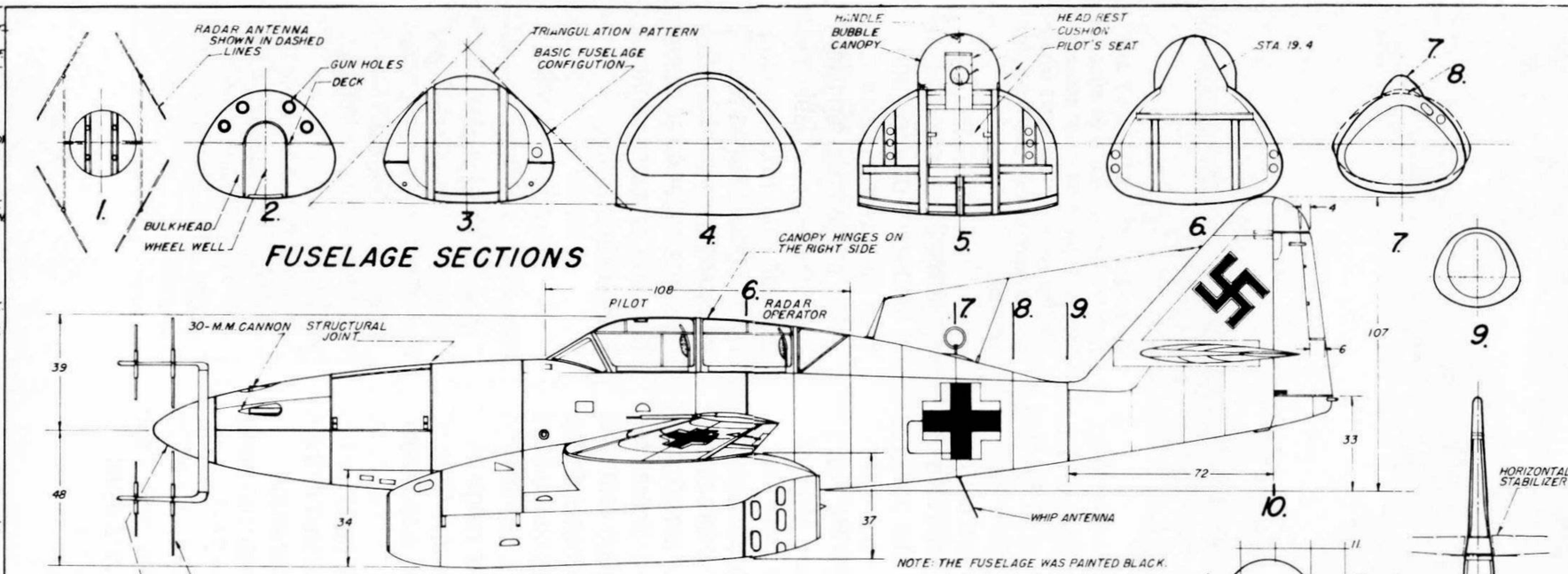
PERFORMANCE CLIMB

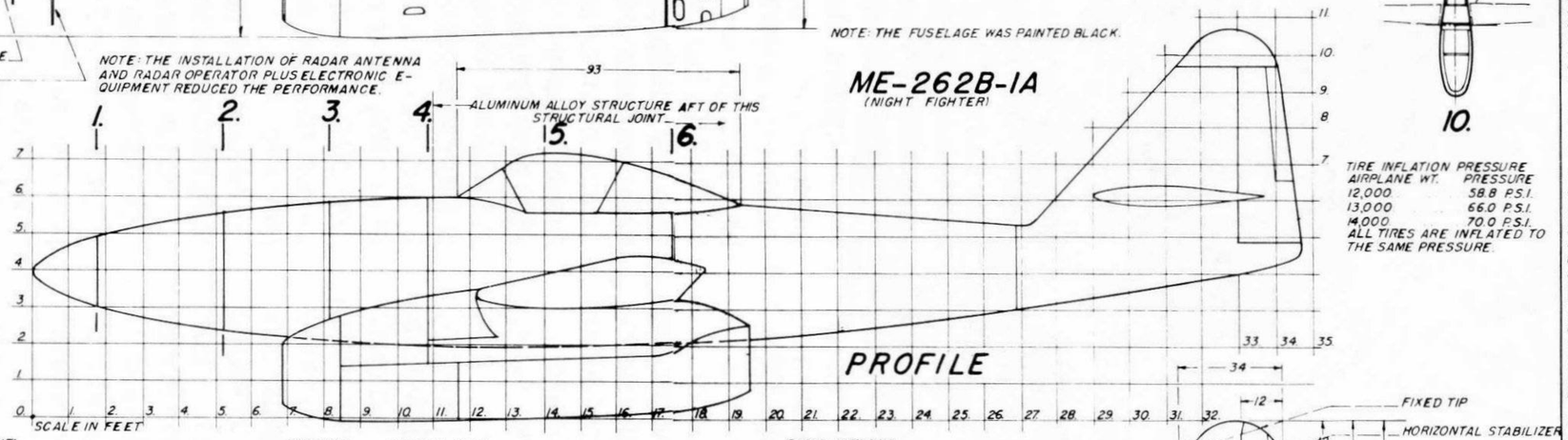
0 TO 13,000 FEET INDICATED CLIMBING SPEED ..... 279 M.P.H.

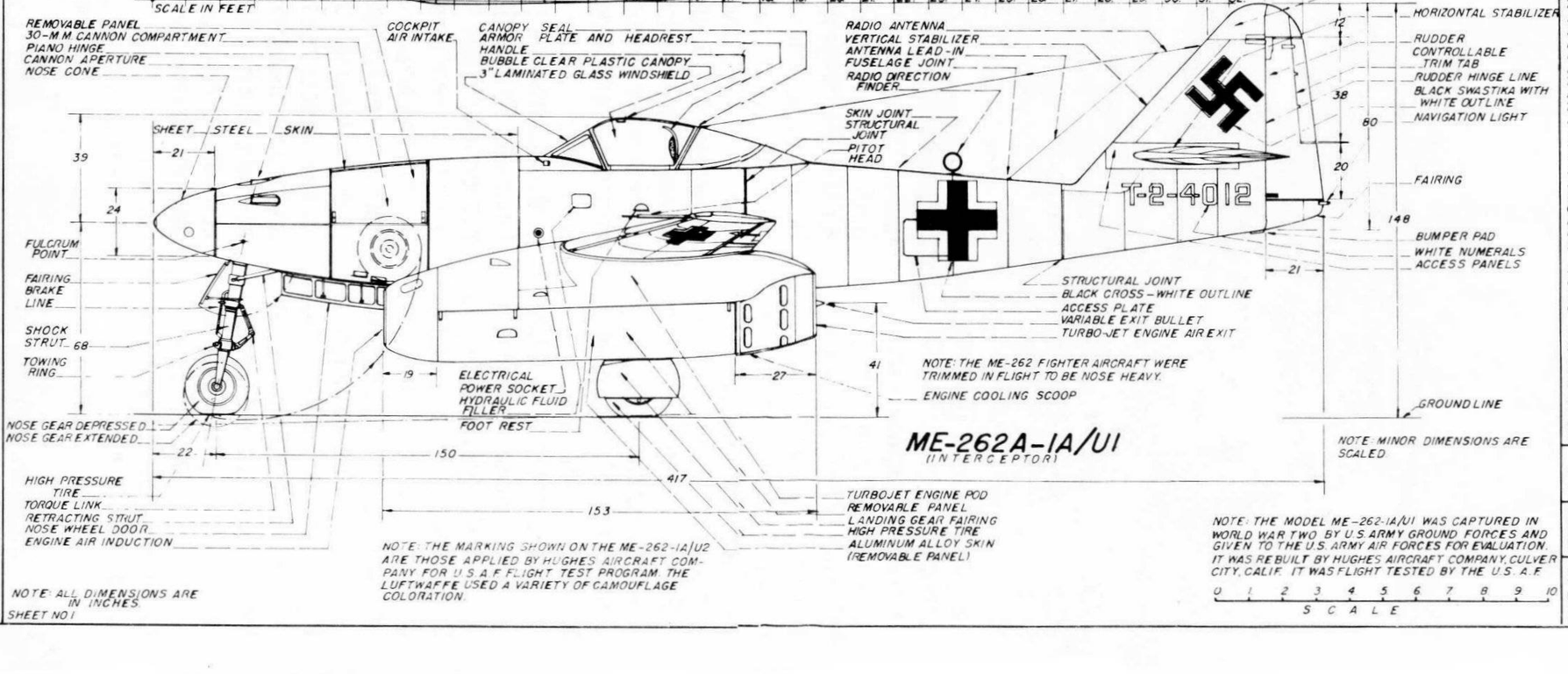
13,000-19,700 FEET ..... 310 M.P.H.
19,700-26,200 FEET ..... 342 M.P.H.
26,200-32,800 FEET ..... 372 TO 403 M.P.H.

STALLING SPEED

LANDING GEAR AND WING FLAPS DOWN. 126 M.P.H.







NOTE: ALL DIMENSIONS ARE IN INCHES.

NOTE: THE MARKING SHOWN ON THE ME-262-1A/U2 ARE THOSE APPLIED BY HUGHES AIRCRAFT COMPANY FOR U.S.A.F. FLIGHT TEST PROGRAM. THE LUFTWAFFE USED A VARIETY OF CAMOUFLAGE COLORATION.

NOTE: THE MODEL ME-262-1A/U1 WAS CAPTURED IN WORLD WAR TWO BY U.S. ARMY GROUND FORCES AND GIVEN TO THE U.S. ARMY AIR FORCES FOR EVALUATION. IT WAS REBUILT BY HUGHES AIRCRAFT COMPANY, CULVER CITY, CALIF. IT WAS FLIGHT TESTED BY THE U.S. A.F.

0 1 2 3 4 5 6 7 8 9 10
SCALE

PERFORMANCE DATA

SEA LEVEL MAXIMUM SPEED	500 M.P.H.
INITIAL RATE OF CLIMB	3937 FEET/MIN.
SERVICE CEILING	37,565 FEET.
RANGE AT SEA LEVEL	298 MILES.
RANGE AT 19,684 FEET	526 MILES.
RANGE AT 29,560 FEET	652 MILES.
TAKE-OFF RUN TO CLEAR 50FT OBSTACLE	3280 FEET.
TOUCH DOWN LANDING SPEED	108 M.P.H.

TURBO-JET ENGINES

THE TURBO-JET ENGINES WHICH POWERED THE ME-262A FIGHTER WERE DESIGNED AND BUILT BY JUNKERS FLUGZEUG UND MOTORENWERKE. THE ENGINES WHICH WERE INSTALLED IN THE FIGHTERS WERE MODEL JUMO 004. THE ENGINE IS 152" LONG AND A MAXIMUM DIAMETER OF 34".

GENERAL DATA

WEIGHT(WITHOUT THE COWL)	1669 LBS.
WEIGHT(WITH THE COWL)	1,775 LBS.
SPECIFIC WEIGHT	.85 LBS.
THRUST	1,980 LBS.
PRESSURE RATIO	3:1
FUEL CONSUMPTION PER HOUR	2,745 LBS.
SPECIFIC FUEL CONSUMPTION	1.39
MAXIMUM SPEED	8,700 R.P.M.
IDLING SPEED	3,080 R.P.M.
IDLING SPEED FUEL CONSUMPTION	61.4 LBS.
FRONTAL AREA	6.4 SQ.FT.

ENGINE ACCESSORIES

ENGINE OIL TANK. OIL PUMP ASSEMBLIES
FUEL PUMP, FUEL TANK.
GOVERNOR, OIL PUMP, SPILL AND THROTTLE (VALVES)
TACHOMETER.
AIR-OIL SEPARATOR.
ORIFICE CONTROL SERVO MOTOR
ORIFICE CONTROL DRIVE SHAFT.
FUEL FILTER.
FUEL NON-RETURN FUEL VALVES.
THROTTLE LINKAGE.
PIPING AND ATTACHMENTS.
ENGINE MOUNT BRACKETS.
ENGINE IGNITER COILS.
STARTER ENGINE (10 H.P. AT 6,000 R.P.M.)
FUEL TANK AND SUPPORTS.
ELECTRICAL GENERATOR.
HYDRAULIC FLUID PUMP.
MISCELLANEOUS ENGINE COWLING.

TWO KINDS OF FUEL ARE BURNED IN THIS JET ENGINE, AVIATION GASOLINE FOR STARTING AND KEROSENE FOR FLIGHT OPERATIONS. BOTH AIR AND LUBRICATING OIL ARE USED AS COOLING AGENTS. THERE ARE SIX COMBUSTION CHAMBERS. THREE CHAMBERS HAVE IGNITION PLUGS AND THREE HAVE INTERCONNECTORS. THE COMPRESSOR ROTOR IS COMPRISED OF EIGHT ROTOR DISKS. THE DIAMETER OF THE DISKS VARY FROM THE LOW TO HIGH PRESSURE ENDS. THE NUMBER OF BLADES ON THE ROTOR AND STATOR ALSO VARIES FROM THE LOW TO THE HIGH PRESSURE END. A VARIABLE EXHAUST CONE VARIES THE EXIT AREA. THIS CONE IS MECHANICALLY LINKED TO THE ENGINE THROTTLE.

THE JUMO-004 ENGINE HAD AN EIGHT STAGE AXIAL FLOW TURBO-JET, AND SIX STRAIGHT THROUGH COMBUSTION CHAMBERS. THE SINGLE STAGE TURBINE DISCHARGED THE COMPRESSED AND HEATED AIR INTO THE VARIABLE EXIT ORIFICE. THE ENGINE WAS COOLED BY AIR BLED OFF FROM THE COMPRESSOR FLOWING PAST THE COMBUSTION CHAMBER BY MEANS OF A DOUBLE SKIN DUCT. OTHER AIR WAS USED TO COOL THE TURBINE DISC AND ALSO TO COOL THE JET EFFLUX NOZZLE. AN INTERNAL COMBUSTION TYPE STARTING ENGINE IS MOUNTED IN THE INTAKE AIR DUCT. THE STARTING MOTOR HAS AN ELECTRIC STARTER. THE STARTING MOTOR IS 10 H.P. CAPACITY. THE STARTING MOTOR IMPARTS TORQUE TO THE ROTOR PROVISION IS ALSO MADE FOR MANUAL STARTING.

PROVISION IS MADE TO LUBRICATE AND TO COOL THE ANNULAR BEARING ASSEMBLIES BY LUBRICATING OIL AS WELL AS THE ENGINE ACCESSORY DRIVE.

THE ENGINE IS CONSTRUCTED OF HIGH STRENGTH ALUMINUM ALLOYS AND ALLOYED SHEET STEEL. THE MAIN BODY OF THE ENGINE CONSISTS OF A MASSIVE FRONT ALUMINUM ALLOY CASTING WHICH SUPPORTS THE ENTIRE ENGINE. THIS CASTING ALSO CARRIES THE MOUNTING POINTS FOR THE ENGINE. EXTENSIVE WELDING IS ALSO USED IN THE ENGINE.

ACKNOWLEGEMENT

ROYAL FREY, U.S.A.F. AIR MUSEUM.
JACK PIRELLA ..... A.A.H.S., I.P.M.S., C.B.C.
DON GARRETT ..... I.P.M.S.

ME-262A

GERMAN AIR FORCE WORLD WAR TWO.
TWIN TURBO-JET ENGINE FIGHTER PLANE.
DRAWN BY ..... WILLIS L. NYE, A.A.H.S.
FOR ..... MODEL AIRPLANE NEWS.
N.Y. NEW YORK CITY. ..... NEW YORK.

SHEET NO 1

WING STRUCTURE

THE WING STRUCTURE OF THE ME-262A IS CONSTRUCTED OF STEEL AND ALUMINUM ALLOY MATERIALS. IT HAS AN UNORTHODOX WING PLAN FORM. THE PRIMARY STRUCTURAL COMPONENT IS THE MAIN WING SPAR OF COMPOSITE CONSTRUCTION AND SWEPT BACK AT AN ANGLE OF 12° AT THE FUSELAGE. THE SPAR CONSISTS OF STEEL FLANGE ANGLES RIVETED TO AN ALUMINUM ALLOY WEB. THE ALUMINUM ALLOY WEB IS OF THE BUILT UP TYPE. THE WING SPAR TAPERS FROM 14.5" AT THE WING ROOT TO 3" AT THE WING TIP.

THE WING IS BUILT AROUND THE MAIN COMPOSITE "I" BEAM SPAR. THE SPAR BOOM CAPS ARE .75" THICK AT THE AIRPLANE CENTERLINE. THE UPPER CAP IS 4.25" WIDE AND THE LOWER IS 4.75". EACH WING PANEL IS AN INDIVIDUAL ASSEMBLY. THE MAIN SPAR IS SPLICED AT THE CENTERLINE. THE WEBS ARE FLANGED AND JOINED WITH BOLTS. STEEL SPLICE PLATES .75" THICK COVER THE TOP AND BOTTOM OF THE BOOM CAPS. THE PLATES ARE ATTACHED IN PLACE BY 6 THROUGH BOLTS, LOCATED ON EACH SIDE OF THE WEB. TAPERED WEDGES ARE PLACED BETWEEN THE SPLICE PLATES AND THE LOWER CAPS. THE WEB IN THIS AREA IS REINFORCED WITH STEEL HAT SECTION STIFFENERS. WHERE THE WING SWEEPBACK BEGINS, THE WEB IS REINFORCED WITH HAT SECTION ALUMINUM ALLOY STIFFENERS OUT TO THE WING TIP. THE WING SPAR IS LOCATED AT 35% OF THE M.A.C. HEAVY GAUGE ALUMINUM ALLOY NOSE RIBS VARY IN CONSTRUCTION DETAIL ALONGE OUTER WING SPAN. THE WING RIBS ARE FORMED AND FLANGED ALUMINUM ALLOY. THE COMPRESSION RIBS HAVE SHAPED STIFFENERS RIVETED TO THE WEB. TWO SPANWISE J-SECTION STRINGERS ARE LOCATED FORWARD OF THE MAIN SPAR. ANOTHER SIMILAR STRINGER IS LOCATED BETWEEN THE MAIN AND AUXILIARY SPARS.

THE AUXILIARY SPAR EXTENDS OUT TO THE WING TIP AND CARRIES THE WING FLAPS AND THE AILERONS. THIS SPAR IS LOCATED 38.5" AFT OF THE MAIN SPAR. ITS WEB IS 12" DEEP. THE SPAR SECTION IS CHANNEL SHAPED. THE WEB IS STIFFENED BY MEANS OF HAT SHAPED MEMBERS RIVETED TO IT.

THE TOP SURFACE OF THE WING HAS A THICKNESS OF .083" AT THE LEADING EDGE AND VARIES TO .080 AT THE TRAILING EDGE. FLUSH RIVETING IS USED TO ATTACH THE SKIN TO THE STRUCTURE.

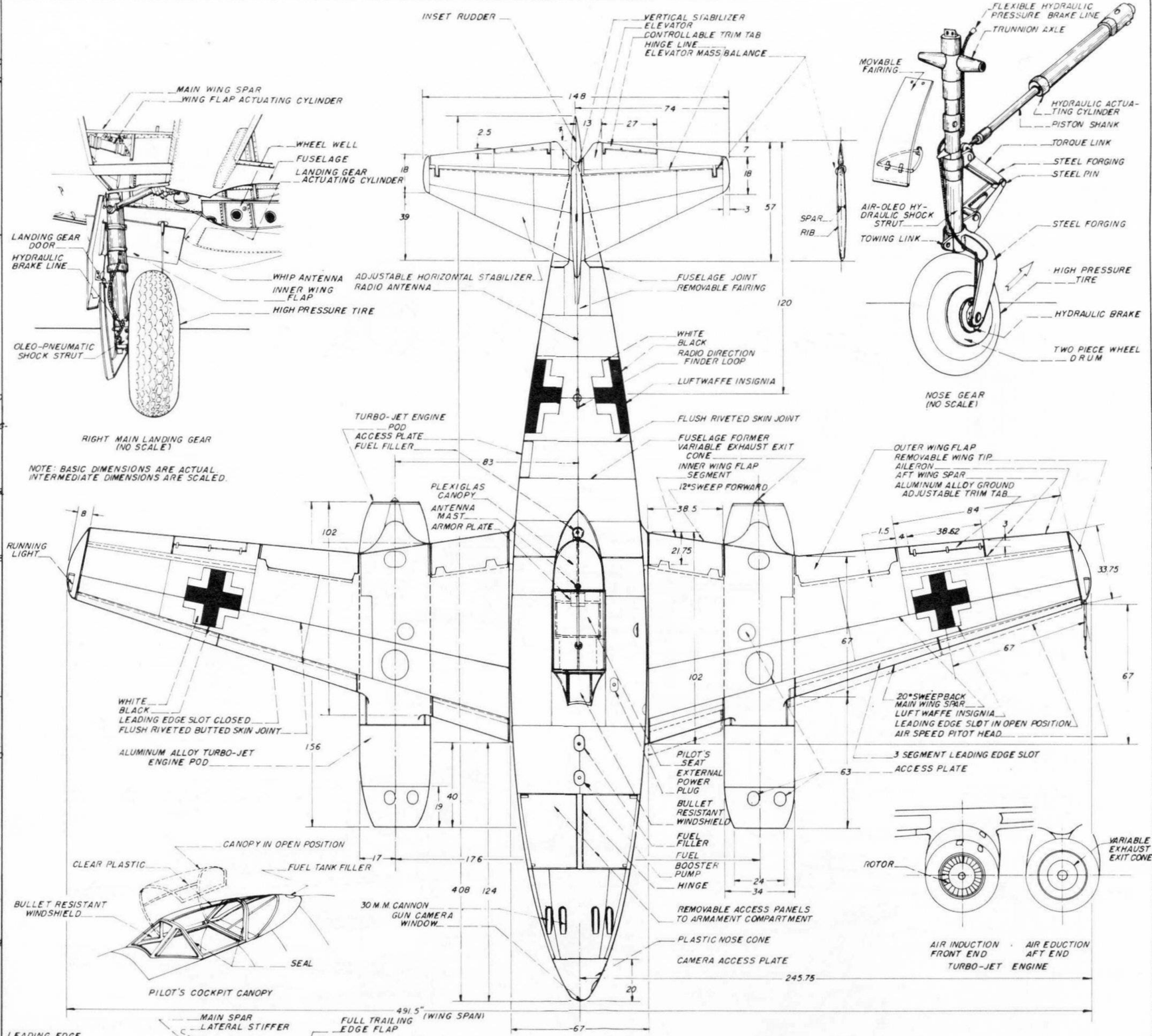
THE LEADING EDGE OF THE WING IS PROVIDED WITH A WING SLOT THAT OPENS AUTOMATICALLY IN A CLIMB AT 279 M.P.H. IN A GLIDE THE SLOT OPENS AT 186 M.P.H. THE SLOT AIRFOIL ASSEMBLY IS COVERED WITH .040 STEEL SKIN. THE FORMED AIRFOIL OF THE WING AFT OF THE SLOT IS MADE OF .010 SHEET STEEL. THE WING SLOT IS MADE IN 3 ASSEMBLIES, ONE BETWEEN THE FUSELAGE AND THE TURBO-JET ENGINE NACELLE AND BETWEEN THE NACELLE AND THE WING TIP. EACH WING FLAP ASSEMBLY IS ATTACHED TO TWO CURVED STEEL GUIDE TRACK WHICH SLIDE OVER BALL BEARING ROLLERS ATTACHED TO THE WING NOSE RIBS. RANGE OF MOVEMENT IS 6" AT THE INBOARD PORTION AND 2.62 AT THE WING TIP. THE WING TIP ASSEMBLY IS FABRICATED IN AND UPPER AND LOWER SUB-ASSEMBLY AND IS RIVETED TO THE OUTER WING STRUCTURE. THE SUB-ASSEMBLIES OF THE WING TIP ARE WELDED TOGETHER.

THE AILERONS ARE MADE OF ALUMINUM ALLOY. A CHANNEL SPAR, ROLLED SHEET ALUMINUM LEADING EDGE AND FORMED FLANGED RIBS. THE AILERONS ARE IN TWO SECTIONS OF 42" AND EACH SECTION IS INTERCONNECTED AT THE CENTER CONTROL BRACKET. SELF-ALIGNING BEARINGS ARE USED AT BRACKETS.

THE WING FLAP ASSEMBLIES ARE MADE IN TWO SECTIONS, THE INBOARD AND THE OUTER SECTION. THE WING FLAPS ARE MADE OF ALUMINUM ALLOY, SIMILAR TO THE AILERONS. IN OPERATION THE WING FLAPS MOVE AFT AND DOWN BY MEANS OF ROLLERS AND GUIDES WHICH SLANT DOWN. THE UPPER SKIN OF THE WING EXTENDS 1.5" OVER THE LEADING EDGE OF THE WING FLAP SO WHEN THE FLAP IS DEPRESSED THIS FUNCTIONS AS A SHROUD AND GUIDES THE AIRFLOW. THE FLAPS ARE ACTUATED BY HYDRAULIC ACTUATING CYLINDERS. THE WING FLAP POSITION INDICATOR IS MARKED AT 0, 10, 20, 30, 40 AND 50 DEGREES. THE WING FLAPS ARE INTERCONNECTED. THE WING FLAPS CANNOT BE OPERATED UNTIL THE LANDING GEAR HAS BEEN EXTENDED AND LOCKED IN POSITION. THE FLAP ACTUATING LINKAGES ARE A SYSTEM OF ALUMINUM ALLOY TUBES AND BELL-CRANKS.

RIGHT MAIN LANDING GEAR (NO SCALE)

NOTE: BASIC DIMENSIONS ARE ACTUAL. INTERMEDIATE DIMENSIONS ARE SCALED.



NOSE GEAR (NO SCALE)

TAIL SURFACE STRUCTURE

THE HORIZONTAL STABILIZER IS MADE OF ALUMINUM ALLOY AND FUNCTIONS AS A STRUCTURAL MEMBER TO JOIN THE FUSELAGE STRUCTURE AT THE EMPENNAGE. THE HORIZONTAL STABILIZER IS ADJUSTABLE BY MEANS OF AN ELECTRIC MOTOR SCREW JACK FOR VARIED SETTINGS OF INCIDENCE. THIS POWER UNIT IS INSIDE A FAIRING AT THE BASE OF THE VERTICAL STABILIZER.

THE HORIZONTAL STABILIZER IS CONSTRUCTED WITH A TOP AND BOTTOM HALF EACH BOLTED TOGETHER. ACCESS HOLES TO TIGHTEN THE BOLTS ARE PROVIDED IN THE SKIN. THESE HOLES ARE COVERED WITH FABRIC PATCHES.

THE HORIZONTAL STABILIZER HAS THE MAIN SPAR, A BUILT-UP I-BEAM, 24" FROM THE LEADING EDGE. IT IS ATTACHED TO THE FUSELAGE BY MEANS OF THROUGH BOLTS TO TWO STEEL FORGED FITTINGS SET IN BALL BEARINGS AT THE AXIS OF ANGLE ADJUSTMENT.

THE ELEVATORS ARE MADE OF ALUMINUM ALLOY. THE MAIN SPAR IS MADE OF A FORMED FLANGED SPAR. THE RIBS ARE PRESSED WEBS WITH FLANGES. SELF-ALIGNING BEARINGS AT THE TIPS AND THE CENTER HINGES ARE USED. A TRIM TAB WAS BUILT INTO THE TRAILING EDGE OF EACH ELEVATOR. THE ELEVATORS ARE MASS BALANCED.

THE VERTICAL STABILIZER IS MADE OF ALUMINUM ALLOY. THE ASSEMBLY IS CONSTRUCTED IN TWO HALVES JOINED TOGETHER BY BOLTS ON THE VERTICAL AXIS OF THE FUSELAGE. ACCESS HOLES ARE COVERED WITH FABRIC PATCHES. THE LEADING EDGE IS FAIRED WITH PLYWOOD. THE TIP CONSISTS OF TWO FORMED HALVES WELDED TOGETHER AND ATTACHED WITH SCREWS. THE VERTICAL STABILIZER IS PROVIDED WITH STEEL FITTINGS WHICH ARE BOLTED TO THE FUSELAGE. THE RIBS FOR THE FIXED TAIL AREAS ARE OF THE PRESSED TYPE WITH FLANGES. THE SKIN IS FLUSH RIVETED TO THE PRIMARY STRUCTURAL MEMBERS OF THE FIXED TAIL SURFACES.

THE CONSTRUCTION OF THE RUDDER IS SIMILAR TO THAT OF THE ELEVATOR. THE MAIN STRUCTURAL MEMBER IS THE D-SHAPE SPAR WHICH FITS INSIDE THE MAIN STRUCTURAL MEMBER OF THE VERTICAL STABILIZER. THE HINGES ARE ATTACHED TO THESE MEMBERS TO FACILITATE OPERATION. THE RIB CONSTRUCTION IS SIMILAR TO THE ELEVATOR. THE RUDDER IS MASS BALANCED. THE TIP IS ATTACHED BY SCREWS TO THE STRUCTURE ABOVE MASS BALANCE. THE TWO RUDDER HINGES ARE SELF-ALIGNING BALL BEARING TYPE. THE RUDDER IS PROVIDED WITH A COMBINATION SERVO AND TRIM TAB WHICH IS ALSO MASS BALANCED.

THE TAIL SURFACES INTERSECTION WITH THE FUSELAGE ARE FILLETED WITH FORMED ONE-PIECE ANGULAR FILLETS ATTACHED WITH SCREWS.

FLIGHT CONTROLS

THE FLIGHT CONTROLS ARE OF THE CONVENTIONAL TYPE WITH PISTOL GRIP TYPE JOYSTICK MANUALLY OPERATED BY THE PILOT. THE SYSTEM IS COMPOSED OF A CONFIGURATION OF PUSH-PULL TUBES WITH BALL BEARING ASSEMBLIES AND UNIVERSAL JOINTS BEING USED TO FACILITATE OPERATION. THE RUDDER PEDALS ARE OF THE STIRRUP TYPE. THE HYDRAULIC BRAKES OF THE LANDING GEAR ARE CONTROLLED BY THE ACTION OF THE RUDDER PEDALS BY MEANS OF A LINKAGE TO THE HYDRAULIC SYSTEM. THE FLIGHT CONTROLS HAVE ADJUSTABLE MASS BALANCES IN THE LINKAGE OF THE RUDDER AND THE ELEVATORS. THESE ARE IN ADDITION TO THE MASS BALANCES BUILT INTO THE MOVABLE SURFACES. THE AILERON AND ELEVATOR TRIM TABS ARE GROUND ADJUSTABLE ONLY. THE RUDDER TRIM TAB IS TUBE OPERATED BY TURNING THE CONTROL WHEEL LOCATED ON THE COCKPIT. THE MASS BALANCES TAKE THE PLACE OF HYDRAULIC BOOSTERS. THE TORSION TUBE ASSEMBLY FOR THE RUDDER TRIM TAB IS PROVIDED WITH BALL BEARING ASSEMBLIES, UNIVERSAL JOINTS AND LINK TUBES. THE ACTUATING MECHANISM FOR THE WING FLAPS CONSISTS OF A HYDRAULIC CYLINDER AND A SINGLE PUSH-PULL TUBE ASSEMBLY WHICH ACTUATES THE FOUR WING FLAP ASSEMBLIES SIMULTANEOUSLY. THE ACTUATING ASSEMBLY HAVE UNIVERSAL JOINTS BECAUSE OF WING DIHEDRAL ANGLE.

ME-262A

GERMAN AIR FORCE WORLD WAR TWO
TWIN TURBO-JET ENGINE FIGHTER PLANE
DRAWN BY: WILLIS L. NYE, A.A.H.S.
FOR: MODEL AIRPLANE NEWS
NEW YORK CITY, NEW YORK

SHEET NO 2

WW II SCALE AIRCRAFT DRAWINGS

MESSERSCHMITT ME 262 SWALLOW

LANDING GEAR

THE TRICYCLE LANDING GEAR IS FULLY RETRACTABLE BY MEANS OF HYDRAULIC ACTUATING CYLINDERS. THE MAIN LANDING GEAR ASSEMBLY IS HINGED TO A BUILT UP STEEL BOX STRUCTURE WHICH IS PART OF THE MAJOR WING ASSEMBLY. THE STEEL BOX STRUCTURE IS LOCATED BETWEEN THE MAIN AND AUXILIARY WING SPARS. THE MAIN WHEELS ROTATE UP AND INTO THE FUSELAGE BOTTOM. A VALVE IS ACTUATED AFTER THE WHEELS RETRACT WHICH CAUSES THE LANDING GEAR FAIRING DOORS TO CLOSE, FAIR THE WHEEL OPENING AND ALSO FUNCTION AS AN UP-LOCK. A SINGLE CANTILEVER SHOCK STRUT 26" LONG OF FORGED STEEL CARRIES EACH MAIN LANDING GEAR. A TORQUE LINK OF FORGED STEEL PERMITS 20" TRAVEL. A 1200 P.S.I HYDRAULIC SYSTEM ACTUATES THE LANDING GEAR. THE ACTUATING CYLINDER IS BOLTED TO A HINGED FITTING TO THE ROOT RIB AT THE END OF THE FRONT SPAR OF THE LANDING GEAR TORQUE BOX. THE PISTON OF THE ACTUATING CYLINDER IS ATTACHED TO THE FRONT OF THE SHOCK STRUT.

THE NOSE GEAR RETRACTS AFT AND UP INTO A WHEEL WELL COMPARTMENT. A LINKAGE CLOSES THE NOSE GEAR DOORS. EITHER A TORQUE LINK OR A SHIMMY DAMPER WAS PROVIDED TO ELIMINATE SHIMMY ACTION.

HYDRAULIC SYSTEM

THE HYDRAULIC SYSTEM IS A MEDIUM PRESSURE TYPE, BEING 1200 P.S.I. FOR NORMAL OPERATION. THE SYSTEM SUPPLIES MOTIVE FORCE TO OPERATE THE RETRACTABLE LANDING GEAR AND WING FLAPS. AN ENGINE-DRIVEN HYDRAULIC PRESSURE PUMP SUPPLIES THE HYDRAULIC POWER. THE WING FLAPS AND LANDING GEAR ARE OPERATIVE BY MEANS OF MANUALLY OPERATED POSITION SELECTOR VALVES. THE SYSTEM ALSO OPERATED THE HYDRAULIC BRAKES FITTED TO THE LANDING GEAR. A MANUALLY OPERATED HYDRAULIC BRAKE WAS FITTED TO THE NOSE GEAR. THE HYDRAULIC BRAKES ON THE MAIN LANDING GEAR OPERATED BY THE PILOT'S TOE ACTION OF THE RUDDER PEDALS. THE BRAKES MAY ALL BE APPLIED SIMULTANEOUSLY OR INDIVIDUALLY. THE INNER MAIN WHEEL WELL DOORS ARE ALSO OPERATED OFF THE HYDRAULIC SYSTEM. THE PRESSURE PUMP IS DRIVEN BY THE LEFT TURBO-JET ENGINE. THE PRESSURE IS MAINTAINED BY AN ELECTRIC-MAGNETIC PRESSURE REGULATOR.

EMERGENCY SYSTEM

EMERGENCY EXTENSION OF THE LANDING GEAR AND WING FLAPS IS ACCOMPLISHED BY MEANS OF A PNEUMATIC SYSTEM. AIR UNDER PRESSURE FUNCTIONS TO ENERGIZE THE SYSTEM. THE OPERATION IS CONTROLLED BY A MAGNETIC SOLENOID VALVE.

AIR INDUCTION SYSTEM

THE INDUCTED AIR FLOWS INTO THE NOSE COWLING OF EACH TURBO-JET ENGINE AND THEN INTO THE COMPRESSOR.

AIR EDUCTION SYSTEM

THE COMBUSTED AIR EXHAUST FLOWS FROM THE COMBUSTION CHAMBER THROUGH THE TURBINE AND EDUCTS FROM THE TAIL PIPE.

TURBO-JET ENGINE CONTROLS

THE AMOUNT OF THRUST ENERGY DEVELOPED BY THE TURBO-JET ENGINE IS IN DIRECT PROPORTION TO THE FUEL WHICH IS SUPPLIED TO THE BURNERS. THE ENGINE THROTTLES ARE MOUNTED ON THE LEFT SIDE OF THE COCKPIT. THE THROTTLE MOVEMENT IS FORE AND AFT, THE AFT POSITION SHUTTING OFF THE FUEL.

TURBO-JET ENGINE MOUNT

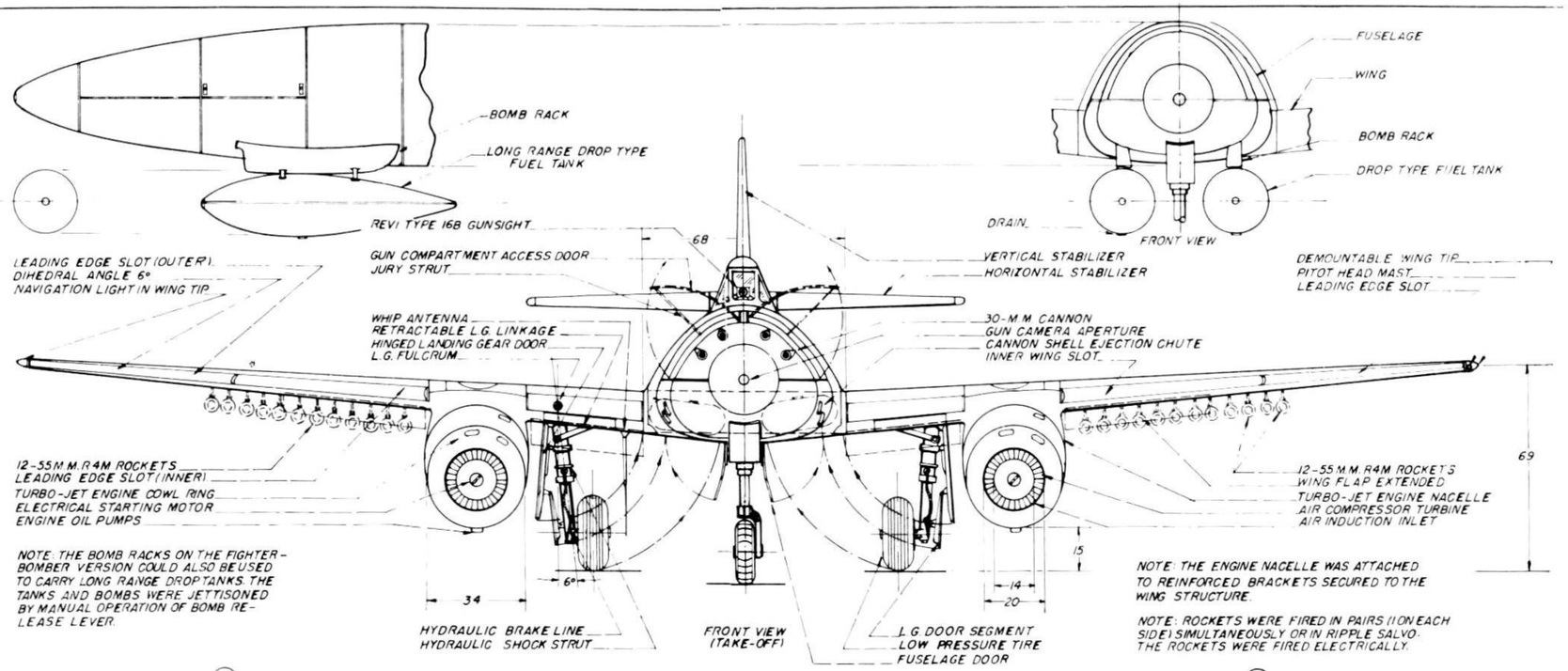
THE ENGINE IS MOUNTED ON THREE SHOCK ABSORBING FITTINGS. THE RIGHT AND LEFT FITTINGS ARE ATTACHED TO A STRUCTURAL HORIZONTAL MEMBER WHICH IN TURN IS ATTACHED TO STRUCTURAL NOSE RIBS IN THE LEADING EDGE OF THE WING. THE AFT MOUNTING IS ON THE FRONT WING SPAR.

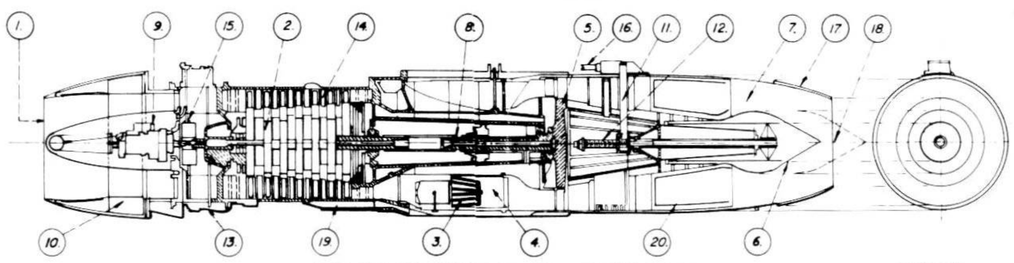
MAIN LANDING GEAR WHEELS

THE WHEEL ASSEMBLY CONSISTS OF AN 840 X 300 M.M. TIRE AND TUBE. THE WHEEL ASSEMBLY COMPRISES TWO PARTS WHICH ARE BOLTED TOGETHER TO FACILITATE QUICK TIRE CHANGING. THE BRAKES ARE AN EXPANDING BAND TYPE. THE WHEEL ASSEMBLY IS MOUNTED ON THE AXLE WITH A SET OF ROLLER BEARINGS ON EACH SIDE. THE TIRES ARE INFLATED TO 70 LBS. P.S.I. AND ARE A LOW PRESSURE TREADED CASING.

PARKING BRAKE

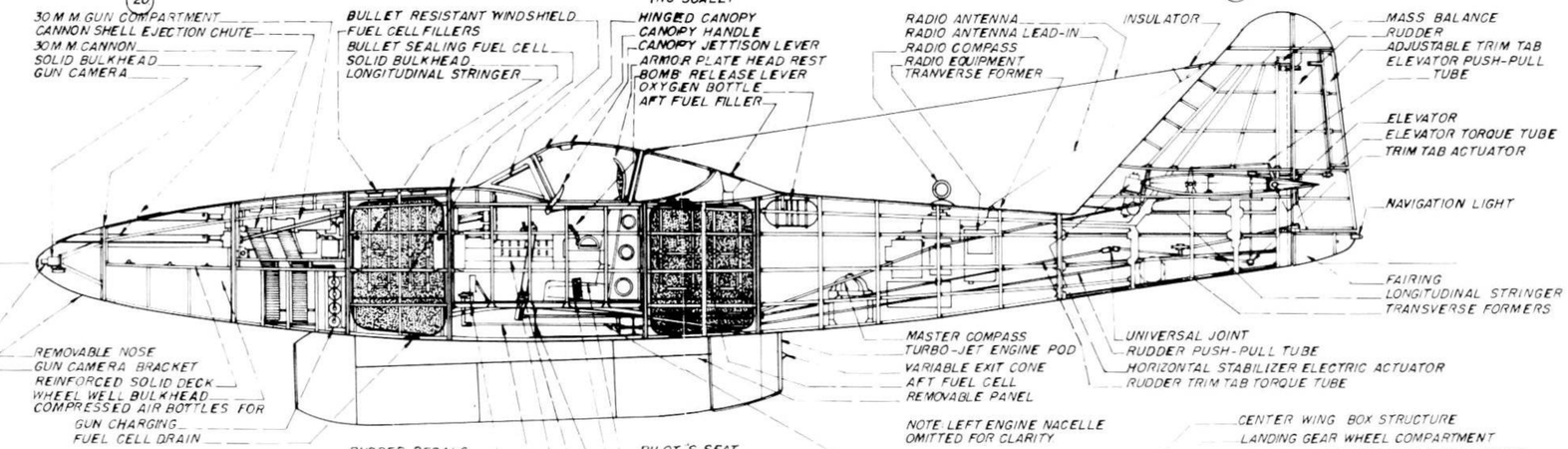
NO PARKING BRAKE OR TIE-DOWN FITTINGS ARE INSTALLED IN THIS AIRPLANE.

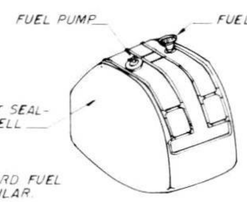


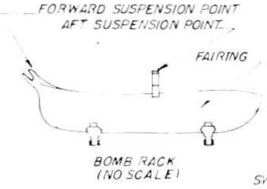


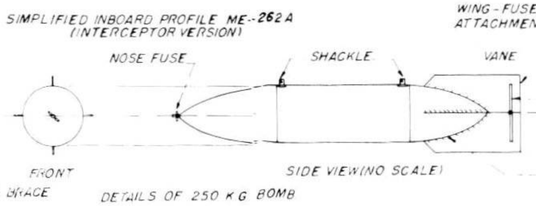
SIMPLIFIED LONGITUDINAL SECTION JUMO 004 ENGINE (NO SCALE)

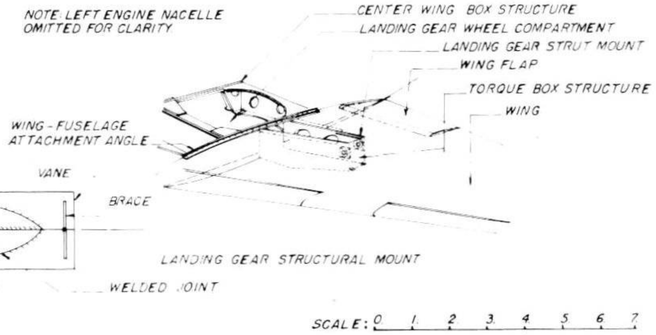
AFT VIEW











SCALE: 0 1 2 3 4 5 6 7

SHEET NO 3

FUEL SYSTEM

THE FUEL SYSTEM CONSISTS OF THE FOLLOWING MAJOR COMPONENTS:

FRONT MAIN CELL 240 GALLONS
REAR MAIN CELL 204 "
FRONT AUX CELL 53 "
REAR AUX CELL 158 "
ELECTRICAL FUEL PUMPS
FUEL LINES AND CHECK VALVES
FUEL SELECTOR VALVES
FUEL SHUT-OFF VALVE
FUEL QUANTITY INDICATORS
ELECTRICAL FUEL BOOSTER PUMPS

THE FUEL CELLS ARE SELF-SEALING. THE OUTER SHELL WAS A FIRE RESISTANT PLYWOOD. EACH FUEL CELL HAS TWO FUEL BOOSTER PUMPS. THE RESERVE FUEL CELL HAS ONE. BY MEANS OF THE FUEL SELECTOR VALVES, FUEL CAN BE PUMPED FROM ANY TANK TO EITHER ENGINE. FUEL CAN ALSO BE TRANSFERED FROM THE AFT CELLS TO THE FORWARD CELLS FOR PURPOSES OF LONGITUDINAL TRIM. ACCESS PANELS PERMIT THE FUEL CELLS TO BE MAINTAINED OR REPLACED. THE TWO FUEL VALVES CONTROLLING THE FUEL FLOW HAVE 3 SETTINGS ON A NOTCHED QUADRANT. TWO THROTTLE CONTROL ENGINE SPEED.

ENGINE OIL SYSTEM

AN ENGINE LUBRICATING OIL TANK OF 2.5 GALLON CAPACITY CARRIES THE OIL. TWO ENGINE-DRIVEN OIL PUMPS TRANSFER OIL TO THE COMPRESSOR BEARINGS, THE ACCESSORY DRIVE GEARS AND OTHER MOVING PARTS. A SEPARATE ELECTRICAL OIL PUMP SUPPLIED OIL TO THE AFT COMPRESSOR BEARINGS AND TURBINE BEARINGS.

INSTRUMENTATION

THE MAIN INSTRUMENT PANEL IS DIVIDED INTO TWO SECTIONS, THE FLIGHT INSTRUMENTS ARE LOCATED ON THE LEFT PANEL AND THE ENGINE INSTRUMENTS BEING LOCATED ON THE RIGHT PANEL.

FLIGHT INSTRUMENTS

ARTIFICIAL HORIZON.
BANK AND TURN INDICATOR.
AIR SPEED INDICATOR.
ALTIMETER.
RATE OF CLIMB INDICATOR.
REPEATER COMPASS.
BLIND APPROACH INDICATOR.
RADIO COMPASS.

ENGINE INSTRUMENTS

ENGINE TACHOMETERS (2).
TAIL PIPE GAS TEMPERATURE THERMOMETER.
FUEL INJECTION PRESSURE INDICATORS (2)
FUEL QUANTITY INDICATORS.
FUEL CONSUMPTION COUNTERS.
FREE AIR TEMPERATURE BULB SELECTOR.
FREE AIR TEMPERATURE THERMOMETER.
HYDRAULIC PRESSURE INDICATOR.

PILOT'S CONTROLS.

VENTILATION CONTROL.
BREATHING OXYGEN CONTROL VALVE.
BREATHING OXYGEN INDICATOR AND FLOWMETER.
FUEL SHUT-OFF AND SELECTOR VALVES.
ENGINE THROTTLES (2).
EMERGENCY LANDING GEAR CONTROL.
EMERGENCY WING FLAP CONTROL.
HORIZONTAL STABILIZER TRIM CONTROL.
RUDDER TRIM CONTROL.
CANOPY RELEASE CONTROL.
BOMB RELEASE.
NOSE WHEEL BRAKE AND WHEEL BRAKES.

POSITION INDICATORS.

HORIZONTAL STABILIZER TRIM.
LEFT MAIN LANDING GEAR.
RIGHT MAIN LANDING GEAR.
RUDDER TRIM TAB.

ELECTRICAL CONTROLS

FUEL TRANSFER PUMP (2).
RADIO - FU G-16.
RADIO - FU G-25A.
RECOGNITION LIGHTS.
PITOT HEATER.
HORIZONTAL STABILIZER TRIM.
INVERTER SWITCH.
RIGHT AND LEFT GENERATORS.
STORAGE BATTERY.
RIGHT AND LEFT FUEL MANIFOLD DRAINS.
RADIO CONTROL BOX.
RIGHT AND LEFT REIDEL STARTERS.
RIGHT AND LEFT TACHOMETER RANGE.
HEAD PHONE VOLUME CONTROL.
FLARE RELEASE.
WINDSHIELD HEATER SWITCH.
NAVIGATION LIGHTS.
DIRECTIONAL FINDER.
GUN CAMERA.
CANNON FIRING SWITCH.
THE MAIN ELECTRICAL SWITCH BOX WAS LOCATED ON LEFT SIDE OF THE PILOT'S COCKPIT.

ME-262A

GERMAN AIR FORCE. WORLD WAR TWO
TWIN TURBO-JET ENGINE FIGHTER PLANE.
DRAWN BY.....WILLIS L. NYE A.A.H.S.
FOR.....MODEL AIRPLANE NEWS
NEW YORK CITY.....NEW YORK

COMMUNICATION EQUIPMENT

THE RADIO COMMUNICATION EQUIPMENT CONSISTED OF THE FOLLOWING:

VHF RADIO TRANSMITTER.
RADIO DIRECTION FINDER
I.F.F.

RETRANSMISSION EQUIPMENT GROUND CONTROL STATION
ANTENNA.
MICROPHONE.
RADIO RECEIVER.

ARMAMENT INSTALLATION

THE ARMAMENT CONSISTS OF FOUR MK-108 30-MILLIMETER CANNON MOUNTED HIGH IN THE NOSE OF THE FUSELAGE. THE CANNON IS 42" LONG MAKING A COMPACT INSTALLATION. THE CANNON BARRELS WERE FITTED WITH BLAST TUBES. ACCESS TO THE ARMAMENT INSTALLATION IS ATTAINED BY LATCHED HINGED DOORS. THE EJECTOR CHUTES FOR SPENT PROTILE CARTRIDGES DISCHARGES THESE AT THE LOWER SIDE OF THE FUSELAGE. THE AMMUNITION IS FED TO THE GUNS IN DRUMS. THE GUNS ARE SIGHTED TO CONVERGE 450 METERS AHEAD OF THE AIRPLANE. THE UPPER GUNS HAVE 100 ROUNDS AND THE GUNS HAVE 80 ROUNDS OF AMMUNITION. EACH GUN CAN FIRE 600 OR MORE ROUNDS OF AMMO PER MINUTE. THE GUNS ARE FIRED ELECTRICALLY. THE PILOT FIRES THE GUNS ELECTRICALLY BY MEANS OF A TRIGGER SWITCH MOUNTED ON THE JOY STICK. THE MUZZLE VELOCITY WAS 1570 F.P.S. AND EACH GUN WEIGHED 134 POUNDS.

GUN CHARGERS

THE GUN CHARGERS WERE OPERATED BY A PNEUMATIC SYSTEM USING COMPRESSED AIR. THE AIR IS CONTAINED IN 8 AIR FLASKS IN THE ARMAMENT COMPARTMENT.

BOMB RACKS

TWO JETTISONABLE TYPE BOMB RACKS WERE INSTALLED EACH CAPABLE OF CARRYING A 550 POUND BOMB. THE SELECTOR AND FUSING SWITCHES WERE LOCATED ON A CENTRAL PANEL BENEATH THE MAIN INSTRUMENT PANEL. THE BOMB RELEASE LEVER WAS LOCATED ON THE RIGHT SIDE OF THE COCKPIT. THIS LEVER ALSO RELEASES THE BOMB RACKS.

ROCKET PROJECTILES

PROVISION WAS ALSO MADE TO CARRY 12 R4M 5CM. ROCKETS UNDER EACH WING. THE ROCKETS WERE FIRED ELECTRICALLY. THE ROCKETS COULD BE FIRED SINGLY OR IN RIPPLE SALVO.

GUN CAMERA

THE GUN CAMERA WAS INSTALLED IN THE NOSE CONE. THE SHUTTER SPEED WAS SYNCHRONIZED WITH THE FIRING RATE OF THE CANNON. OPERATION OF THE FIRING SWITCH TURNED ON THE CAMERA.

GUN SIGHT

A REVI TYPE GUN SIGHT IS MOUNTED ABOVE MAIN INSTRUMENT PANEL. IT IS IN THE PILOT'S LINE OF VISION BUT IT IS SWUNG TO THE RIGHT SIDE DURING TAKE-OFF AND LANDING OPERATIONS.

JACK POINTS

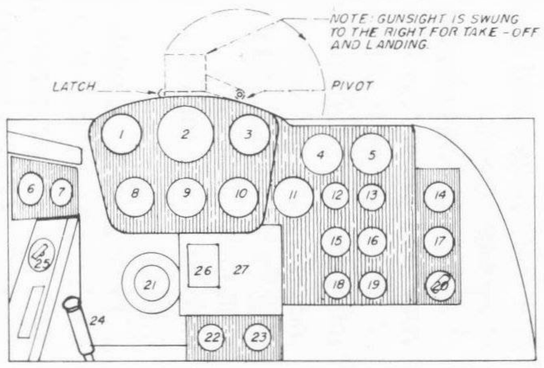
THE AIRPLANE IS JACKED AT FOUR PADS. TWO PADS ARE LOCATED ON THE UNDERSIDE OF EACH WING OUTBOARD OF THE ENGINE NACELLE. A PAD IS ALSO LOCATED ON THE UNDERSIDE OF THE FUSELAGE NEAR THE NOSE AND FORWARD OF THE LANDING GEAR AND AFT OF THE COCKPIT FORWARD OF THE TAIL SURFACE.

LANDING GEAR FAIRING

THE LANDING GEAR FAIRING FOR THE MAIN WHEELS AND STRUT ASSEMBLY IS BUILT IN TWO SECTIONS BOTH OF WHICH ARE DOUBLE-SKINNED FORMED GRID STRUCTURES. THE TOP ASSEMBLY IS HINGED TO THE WING TORQUE BOX STRUCTURE. THE LOWER FAIRING IS BOLTED TO A BRACKET WELDED TO THE OLEO PISTON ABOVE THE AXLE. THE FAIRING DOORS HINGED TO THE CENTERLINE OF FUSELAGE ARE ALSO A DOUBLE-SKIN GRID ASSEMBLY. THESE DOORS ARE ACTUATED BY HYDRAULIC POWER WHEN THE LANDING GEAR IS RETRACTED. THE FAIRING ON THE NOSE GEAR ASSEMBLY IS SIMILAR THOSE ON THE MAIN LANDING GEAR.

LANDING GEAR DOWNLOCKS

LANDING GEAR DOWNLOCKS ARE INCORPORATED IN THE HYDRAULIC ACTUATING CYLINDERS. PRESSURE ON THE PISTON HOLDS THE LANDING GEAR IN A FIXED POSITION. THE UP-LOCKS FUNCTION IN A SIMILAR MANNER. NO PARKING BRAKE IS PROVIDED. NO MEANS ARE PROVIDED TO THE PILOT FOR LOCKING THE CONTROL SURFACES. MANUALLY ATTACHED WOODEN CHOCKS ARE USED INSTEAD. NO TIE DOWN FITTINGS ARE PROVIDED.



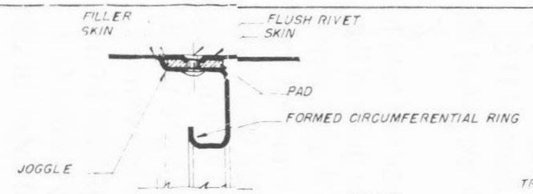
SIMPLIFIED VIEW OF INSTRUMENT PANEL

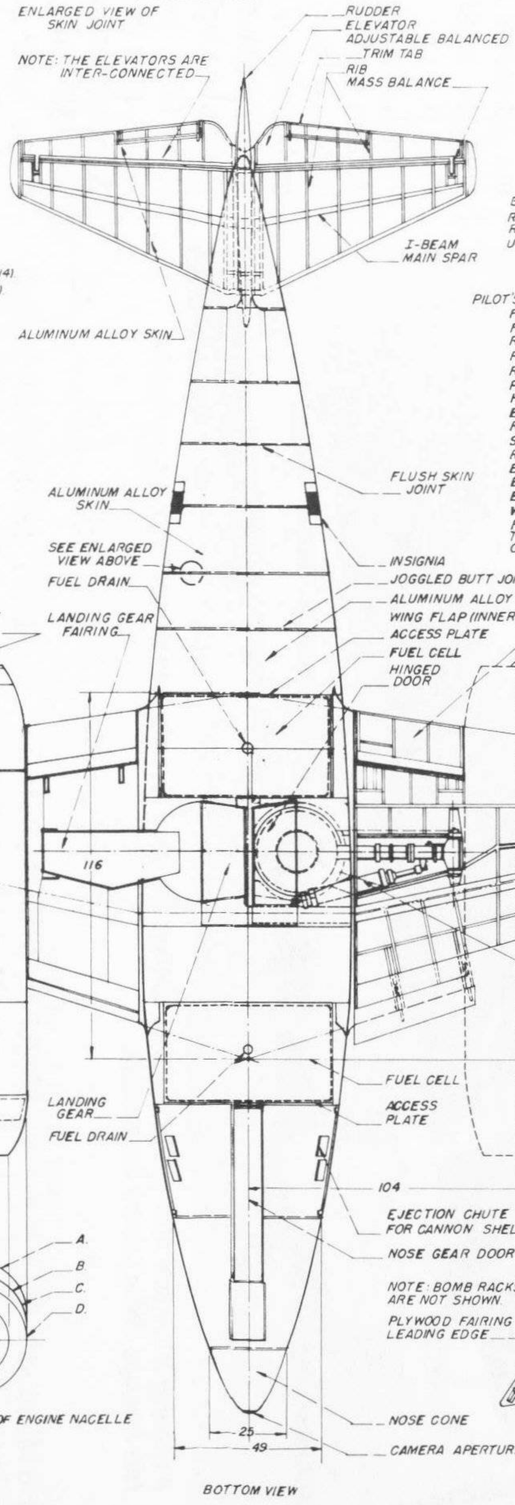
PILOT'S PRIMARY INSTRUMENTS

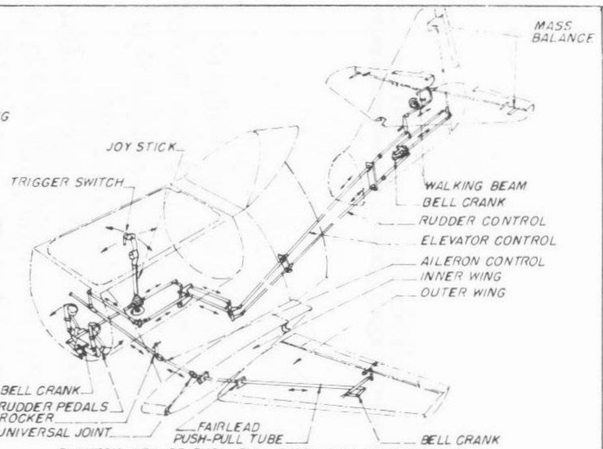
AIRSPEED INDICATOR(1).
FLIGHT INDICATOR(2).
RATE OF CLIMB INDICATOR(3).
ENGINE TACHOMETER(4).
ENGINE TACHOMETER(5).
OXYGEN PRESS INDICATOR(6).
OXYGEN FLOWMETER(7).
ANEROID ALTIMETER(8).
RADIO COMPASS(9).
BLIND APPROACH INDICATOR(10).
FREE AIR TEMP. BULB SELECTOR(11).
FUEL QUANTITY COUNTER(12).
FUEL QUANTITY COUNTER(13).
TAIL PIPE EXHAUST GAS TEMP. INDICATOR(14).
TAIL PIPE EXHAUST GAS TEMP. INDICATOR(17).
FUEL INJECTION PRESSURE INDICATOR(15).
FUEL INJECTION PRESSURE INDICATOR(16).
FUEL QUANTITY INDICATOR(18).
FUEL QUANTITY INDICATOR(19).
COCKPIT HEAT CONTROL(20).
HYDRAULIC PRESSURE INDICATOR(16).
NOSE WHEEL MANUAL BRAKE(24).
FREE AIR TEMP. INDICATOR(22).
UNKNOWN(23).
EMERGENCY LANDING GEAR CONTROL(25).
AMMUNITION COUNTER(26).

PILOT'S SECONDARY INSTRUMENTS

PITOT HEATER.
VERY SIGNAL PISTOL.
TACHOMETER LOW SPEED SELECTOR SWITCH.
LANDING GEAR POSITION INDICATOR.
WING FLAP POSITION INDICATOR.
HORIZONTAL STABILIZER ANGLE OF INCIDENCE INDICATOR.
MASTER COMPASS.
BOMB SWITCH PANEL(27).







PHANTOM VIEW OF PUSH-PULL TUBE SURFACE CONTROLS

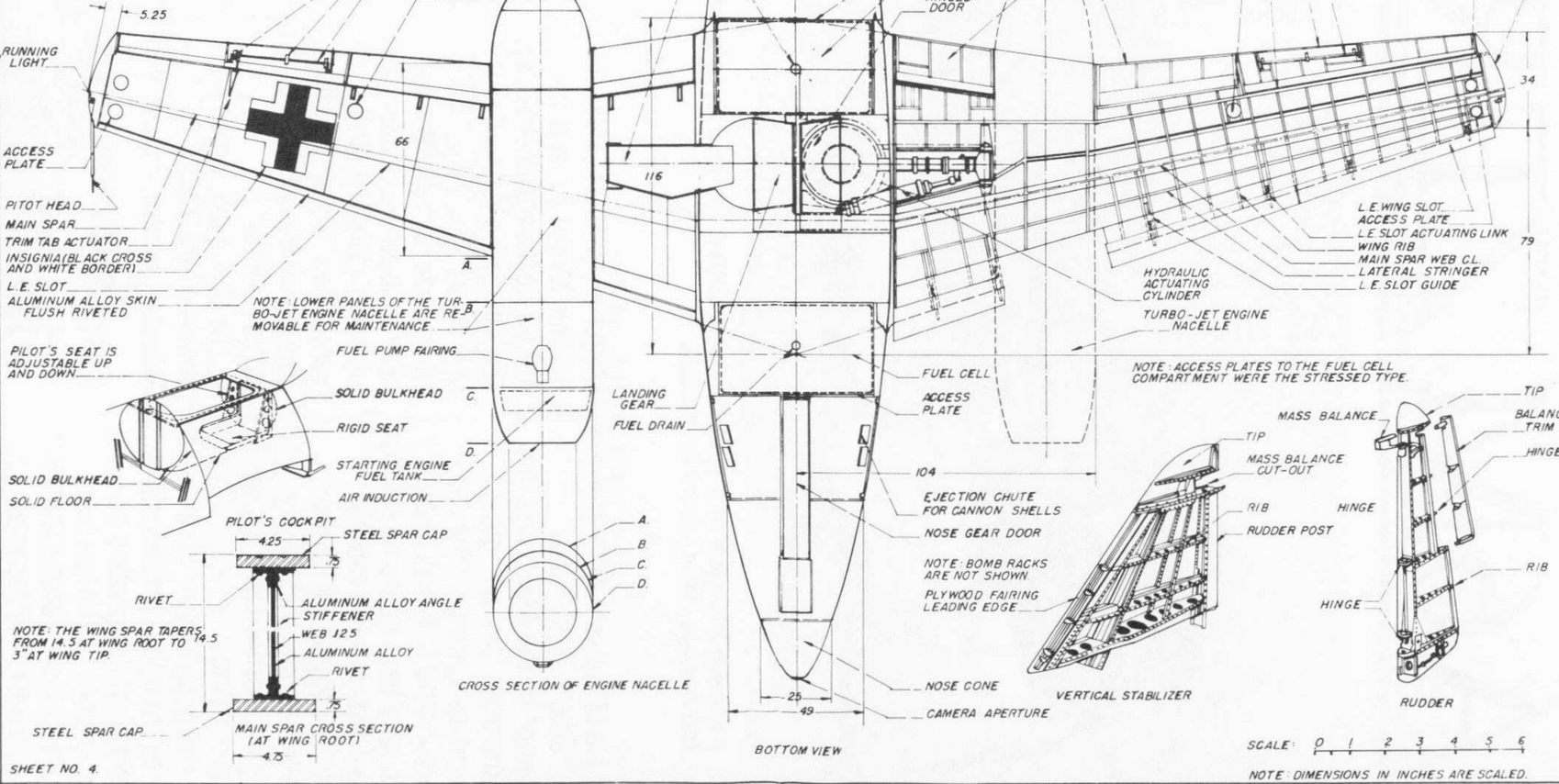
PILOT'S ELECTRICAL CONTROLS

FUEL TRANSFER SWITCH.
FUEL PUMP SWITCHES(2).
RADIO SWITCH FU-G16.
RADIO SWITCH FU-G25A.
RECOGNITION LIGHT SWITCH.
PITOT HEAT SWITCH.
HORIZONTAL STABILIZER CONTROL SWITCH.
ELECTRICAL INVERTER SWITCH.
RIGHT AND LEFT ENGINE GENERATOR SWITCHES.
STORAGE BATTERY SWITCH.
RADIO CONTROL BOX BC-602A.
ENGINE STARTER SWITCHES(2).
ENGINE TACHOMER RANGE BUTTONS(2).
EAR PHONE VOLUME CONTROL.
WINDSHIELD HEATER SWITCH.
FLARE RELEASE SWITCH.
TRIGGER SWITCH (CANNON)
GUN CAMERA SWITCH.

SECONDARY PILOT'S CONTROLS

CANOPY RELEASE LEVER.
BOMB RELEASE LEVER.
EMERGENCY LANDING GEAR.
EMERGENCY WING FLAP.
ENGINE THROTTLES(2).
FUEL SHUT-OFF AND SELECTOR VALVE.
RUDDER TRIM CONTROL.
HEATER CONTROL.
VENTILATOR CONTROL.
HORIZONTAL STABILIZER TRIM CONTROL.
RADIO FREQUENCY SELECTOR.
LANDING GEAR CONTROL.
WING FLAP CONTROL.
ROCKET FIRING SWITCH.
ELEVATOR TRIM TAB CONTROL.
JATO JETTISON RELEASE.
ELECTRICAL MASTER CUT-OFF SWITCH.

NOTE: THE TURBO-JET ENGINES WERE ATTACHED TO THE MAIN WING SPAR AND AFT WING SPAR.



FUSELAGE STRUCTURE

THE FUSELAGE STRUCTURE WAS CONSTRUCTED OF ALUMINUM ALLOY. A SEMI-MONOCOQUE CONFIGURATION IS USED. THE STRUCTURAL CONFIGURATION CONSISTS OF BULKHEADS, HOOP FRAMES, LONGERONS AND STRINGERS. THE ENTIRE STRUCTURE COMPRISES FOUR MAJOR SUB-ASSEMBLIES ALL OF WHICH ARE BOLTED TOGETHER. I.E. THE NOSE SECTION, PILOT'S COCKPIT, AFT SECTION, AND THE EMPENNAGE. THE NOSE SECTION IS DETACHABLE SO VARIOUS TYPES OF WEAPONRY MAY BE USED. THE TAIL CONE IS ALSO REMOVABLE. ALTHOUGH THE COCKPIT WAS DESIGNED FOR PRESSURIZATION, NO PRESSURIZATION WAS USED. NO FORE AND AFT ADJUSTMENT WAS POSSIBLE FOR THE PILOT'S SEAT OR RUDDER PEDALS. THE PILOT'S WINDSHIELD CONSISTED OF LAMINATED PLATE GLASS 3.5" THICK. THE COCKPIT CANOPY IS MADE OF CLEAR PLASTIC MOUNTED IN A FRAME. IT PIVOTS ON A FRAME ON THE RIGHT SIDE TO PERMIT ENTRY OR EXIT. THE CANOPY IS LOCKED BY THE PILOT ON THE INSIDE. A SEAL IS PROVIDED. FOR EMERGENCY PILOT BAIL-OUT, THE CANOPY WAS JETTISONED, FORE AND AFT OF THE COCKPIT. A 238 GALLON FUEL CELL IS INSTALLED. ACCESS TO THESE FUEL CELLS IS POSSIBLE BY REMOVABLE ACCESS PLATES ON THE UNDERSIDE OF THE FUSELAGE. THE FUSELAGE STRUCTURE HAS NO LONGERONS BUT LONGITUDINAL STRINGERS ARE USED TO STABILIZE THE SKIN STRUCTURE. THE TRANSVERSE FORMERS ARE AN INTEGRAL PART OF THE EXTERIOR SKIN SHEETS. THESE ARE JOGGLED TO THE THICKNESS OF METAL FOR LAP JOINT, THE FORMED INWARD TO MAKE A JAY OR CHANNEL SECTION. THE SKIN JOINTS AT THE JOGGLE WERE SMOOTHED WITH A FILLER MATERIAL. THE BULKHEADS WERE SHEET STEEL OR ALUMINUM ALLOY SHEET. SHEET STEEL SKIN .08" THICK WAS USED TO COVER THE ARMAMENT COMPARTMENT. THE FUSELAGE FUEL CELLS ARE ARMORED FORE AND AFT. THIS ARMOR ALSO FUNCTIONS TO PROTECT THE PILOT. THE COCKPIT WAS PROVIDED WITH A MANUALLY CONTROLLABLE FRESH AIR VENTILATOR.

CONTROL SURFACE MOVEMENT

THE CONTROL SURFACE MOVEMENTS ARE AS FOLLOWS:

AILERONS	20°
ELEVATORS	35°
ELEVATOR TRIM TAB	35°
RUDDER	30°
RUDDER TRIM TAB AT 30° DEFLECTION OF RUDDER	18°
RUDDER TRIM TAB AT 0° DEFLECTION OF RUDDER	20°
WING FLAPS	50° MAXIMUM.

OXYGEN EQUIPMENT

A LOW PRESSURE OXYGEN SYSTEM IS INSTALLED FOR USE OF THE PILOT.

MISCELLANEOUS EQUIPMENT

DATA CASE.
PILOT'S RELIEF TUBE.
VERY PISTOL AND CARTRIDGES.
SEAT TYPE PARACHUTE PACK.
SEAT BELT AND SHOULDER HARNESS.
MAP CASE.
HEADPHONES.
THROAT MICROPHONE.
OXYGEN MASK.

MISSLE ARMAMENT

THE MODEL ME-262A-1B WAS FITTED WITH 24 5CM TYPE R4M MISSLE. THE MISSLES WERE FIRED ELECTRICALLY. THE MISSLES HAD AN OPERATING RANGE GREATER THAN THE DEFENSIVE RANGE OF A 50 CALIBER MACHINE GUN ON B-17 AIRCRAFT. THE MISSILES WERE AIMED BY POINTING THE AIRPLANE AT THE TARGET. THE MISSILE WOULD EXPLODE ON CONTACT. THE MISSLES COULD BE FIRED IN PAIRS OR IN RIPPLE SALVO.

ROCKETS FOR TAKE-OFF

FOR SPECIALIZED MISSIONS, TWO 1100 POUND THRUST ROCKETS WERE FITTED TO ASSIST TAKE-OFF WITH A HEAVY BOMB LOAD.

FLIGHT CHARACTERISTICS

THE ME-262A WAS TRIMMED NOSE HEAVY IN FLIGHT. IT HAD GOOD STALL RECOVERY AND COULD BE SPUN AND RECOVERED HANDILY. THE PERFORMANCE IN HIGH SPEED TURNS WAS EXCELLENT. HOWEVER, IT SELDOM FOUGHT ABOVE 30,000 FEET BECAUSE THE POSSIBILITY OF ENGINE FLAMEOUT.

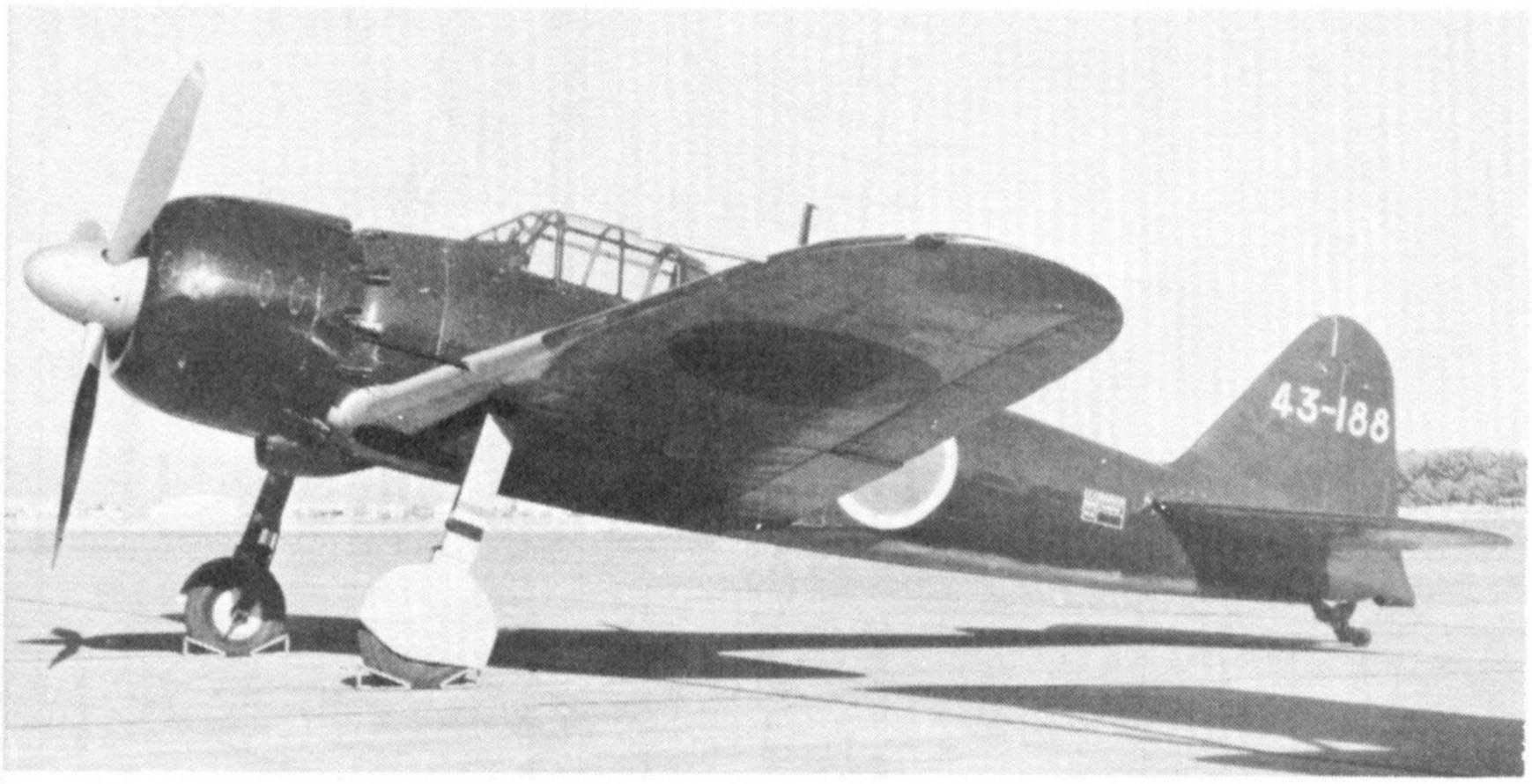
ME-262A

GERMAN AIR FORCE.....WORLD WAR TWO
TWIN TURBO-JET ENGINE FIGHTER PLANE
DRAWN BY:.....WILLIS L. NYE, A.A.H.S.
FOR:.....MODEL AIRPLANE NEWS
NEW YORK CITY.....NEW YORK

SHEET NO. 4.

MESSERSCHMITT ME 262 SWALLOW

MITSUBISHI A6M ZERO



A restored Mitsubishi A6M-5C Zeke 52. Its markings are more accurate than on most restorations, but the rear fuselage doesn't match the drawing.

THE Mitsubishi A6M, called "Zero", "Zeke" and "Hamp" by the Allies, was one of the major technological surprises sprung by the Japanese in WW II. Because they had long been contemptuously regarded as being capable only of copying foreign airplane designs, their highly original, carrier-based fighter was startling.

The designation "Zero" came from the Japanese Navy practice of designating airplane types by the last two digits of the Japanese Dynastic calendar. The Japanese year 2600 matched our calendar year 1940, so "00," was shortened to "Type 0" for the A6M, which was named "Raiden." The naval model designation of "A6M" reflected the sixth A-model built by Mitsubishi (M). The sub-designation for the A6M-1 was Model 11, while the A6M-2 became Model 21, and the A6M-3 became Model 32, etc. The Allies also referred to it broadly as "The Zero," but when code names were applied to Japanese military aircraft, the standard models were called "Zeke," and the short-wing Model 32 was called "Hamp."

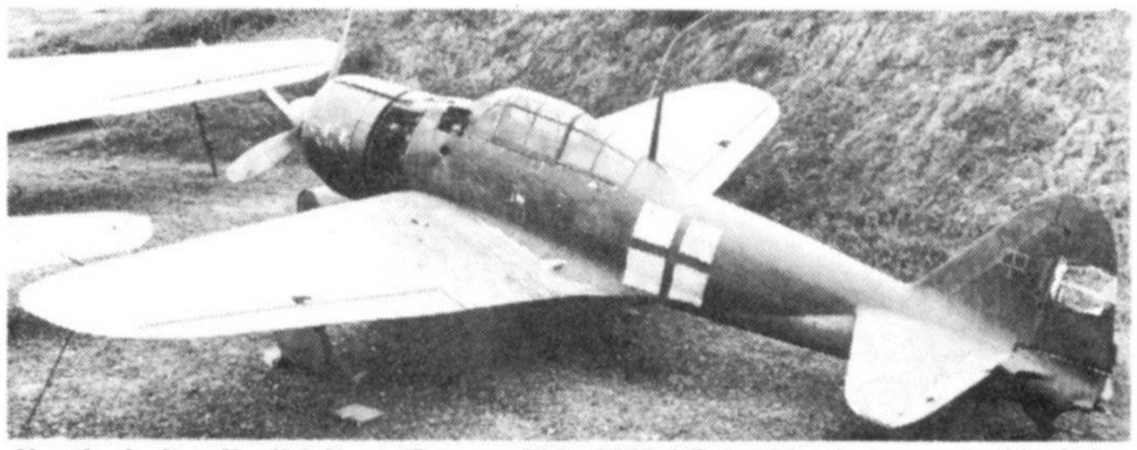
The prototype, which was powered by a 780hp Mitsubishi Zuisei engine, flew April 1, 1939, and was quickly ordered into production as Type 0 fighter Model 11. It entered combat in China in July 1940. Allied Intelligence reported on its capabilities, but the warnings were disregarded, which caused later regrets.

For two years, the Zero was superior to any plane it fought. It was fast and highly maneuverable and, thanks to its auxiliary fuel tanks, it had long range. Its shortcomings included a lack of armor protection for the pilot, a light structure and fuel tanks that weren't self-sealing. The Zero was also highly vulnerable to the .50-caliber guns of U.S. fighters—when they were able to hit it.

Its initial armament was two 7.7mm machine guns in the nose and two 20mm cannon in the wings. Armament varied during production to a maximum of a single 13.2mm gun in the nose, two more in the wings, plus the two cannon. Its bomb load ranged from two 132-pound bombs to a single 1,102-pounder, or up to eight 22-pounders. Late -6 and -8 versions could also be fitted with rockets.

Although it was obsolete by mid-1943, when new Allied fighters opposed it, the Zero remained in production until the end of the war, with 3,879 built by Mitsubishi and 6,570 built under license by Nakajima, for a total of 10,449.

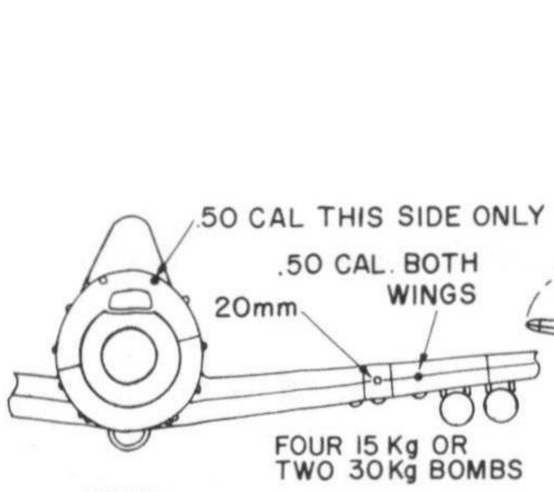
Most Zeroes—Models 11, 21, 52 and 64 (AM6-1, -2, -5 and -8)—had wingspans of 12 meters (39 feet, 4 inches), but Model 32 (A6M-3) had its span shortened by 1 meter to 36 feet. Other data for Zero Model 52 (A6M-5): powerplant: 1,130hp Nakajima Sakae 21; wing area: 229.27 square feet; empty weight: 4,136 pounds; gross weight: 6,025 pounds; high speed: 351mph at 19,685 feet.



No, the Luftwaffe didn't use Zeroes. This A6M-2 Zeke 21, photographed in China just after the war, carries the green cross on a white marking used by some of the Japanese airplanes that were allowed to continue flying during the surrender negotiations. Note that a souvenir hunter has cut the unit marking off the rudder.

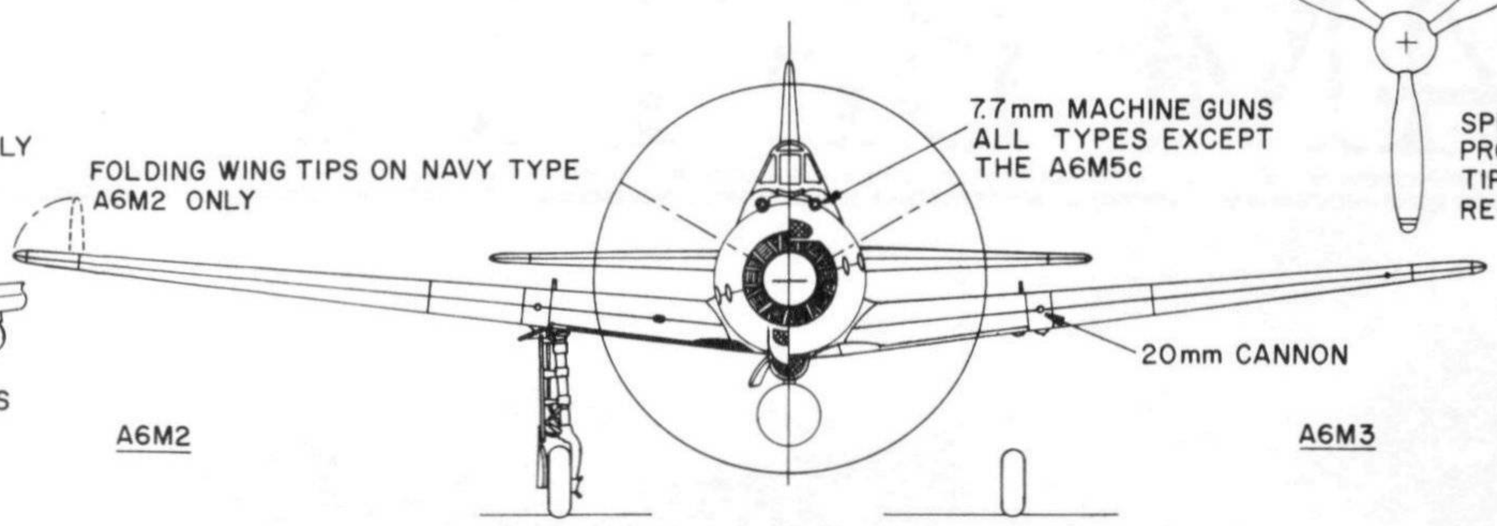
MITSUBISHI A6M ZERO

MODEL	ENGINE	H.P.	SPEED	AT ALTITUDE OF
A6M2	SAKAE 12 (Ha. 35/12)	925	317	16,400 FT.
A6M3	SAKAE 21 (Ha. 35/21)	1,130	341	20,500
A6M5	" "	"	358	22,000
A6M5c	" "	"	346	19,600

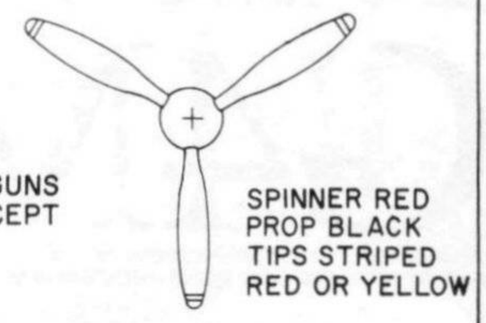


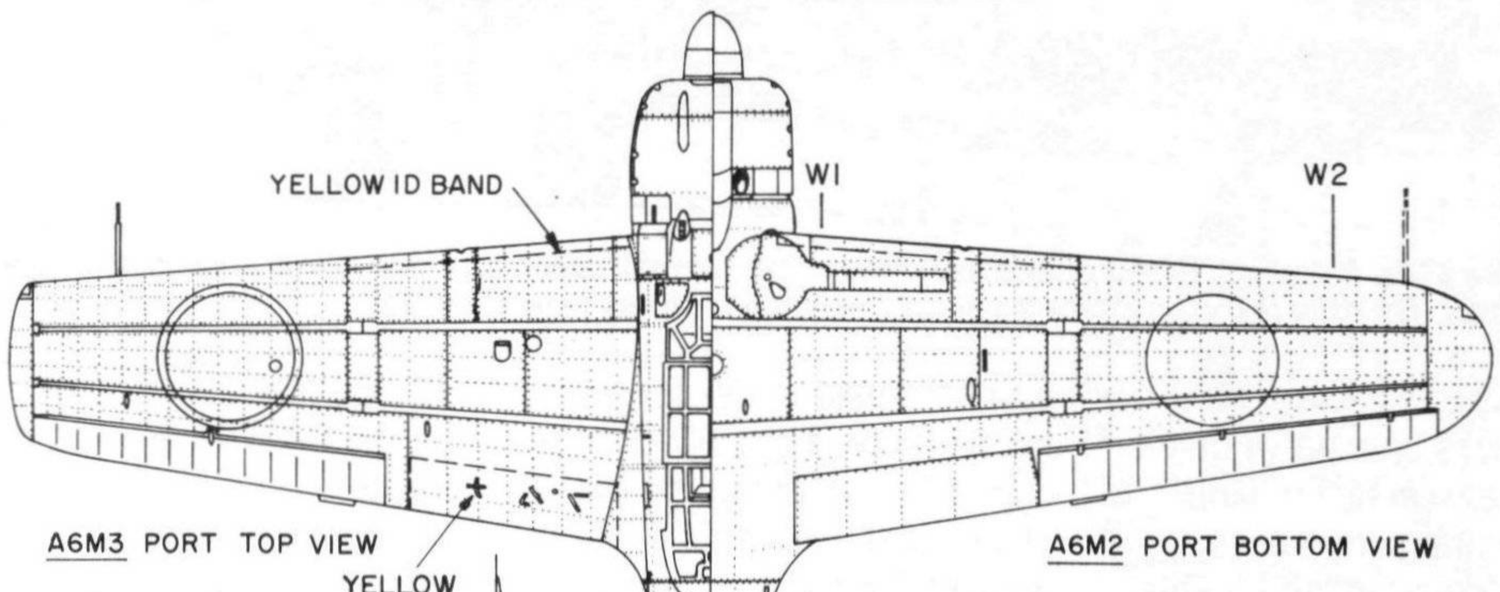
A6M5c

ONLY 99 A6M5c 'S WITH THE .50 CAL. GUNS WERE BUILT SINCE THE ADDITIONAL WEIGHT AFFECTED THE PERFORMANCE SO BADLY.



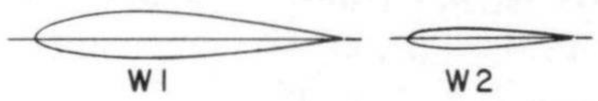
A6M2 A6M3

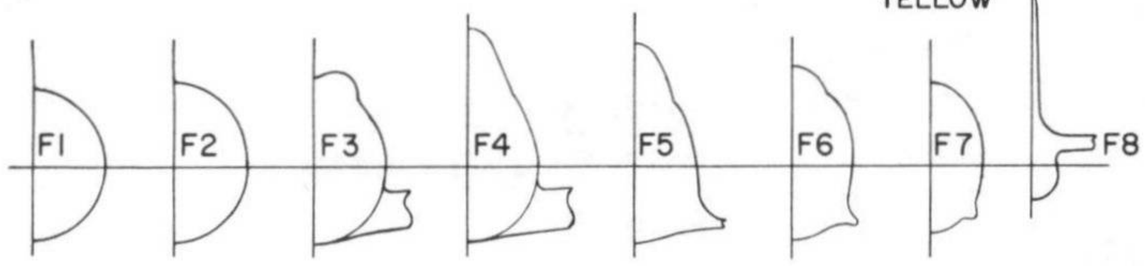




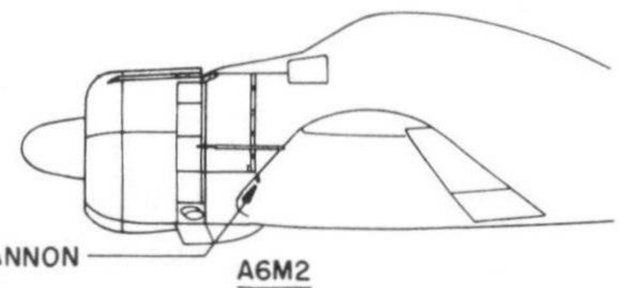
A6M3 PORT TOP VIEW

A6M2 PORT BOTTOM VIEW

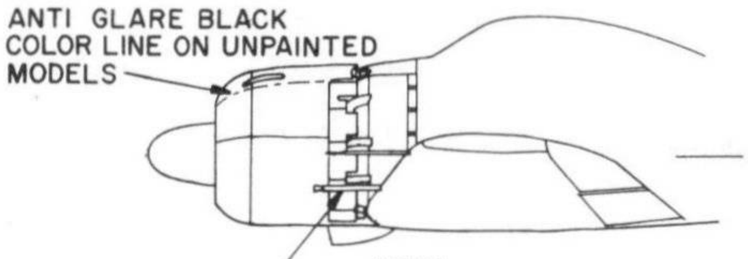




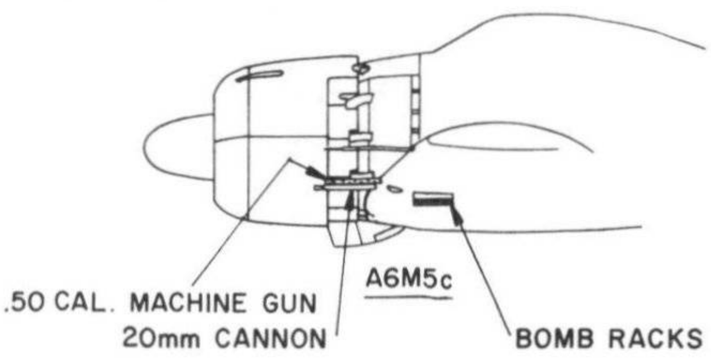
YELLOW



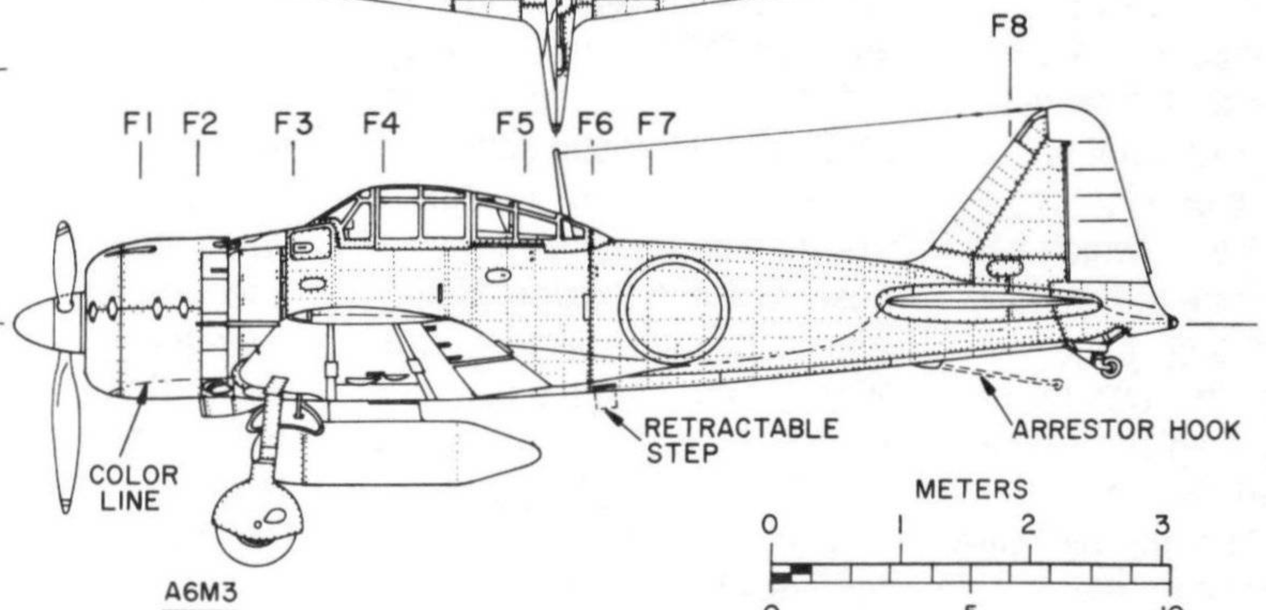
A6M2



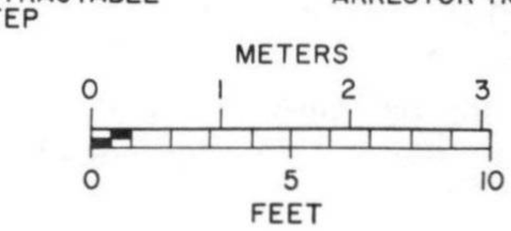
A6M5



A6M5c



A6M3



COLOR NOTE:

MOST WIDELY USED SCHEME, A BROWNISH OLIVE GREEN ON UPPER SURFACE WITH A WARM LIGHT GREY UNDER-SIDE.

Mitsubishi Type Zero or "Zeke"

A6M2, A6M3 "HAMP", A6M5, and A6M5c

SCALE 1/8" = 1'

Drawn by C. graham

MITSUBISHI G4M BETTY

This view of the Mitsubishi G4M-2 Betty bomber shows the powered upper turret and four-blade propellers added to this model. The color is dark green on the upper surfaces and silvery gray underneath.

THE Japanese Naval Air Arm was unusual in that it made extensive use of land-based bombers, and used them for long overland flights deep into enemy territory in what would usually be considered an Army-type operation.

The Mitsubishi G4M, code-named "Betty" by the Allies but not officially named in Japan, did acquire the unofficial nickname of "Hamaki," or "Cigar," in an obvious reference to the shape of its fuselage. The G4M prototype flew in September 1939, but its production was delayed in favor of the G6M-1, which had the same airframe but was equipped as a long-range escort fighter. This was necessary for raids deep into China, because Japan had no conventional fighters that were capable of escorting the bombers then in use for the full distance. The G6M-1 concept didn't work out, so the 30 planes that were built in 1940 were converted to trainers and transports.

Production Bettys, which were designated Navy Type 1 Attack Bomber Model 11 (G4M-1), were first delivered in April 1941. Its initial powerplants (contrary to the drawing) were 1,530hp Mitsubishi MK4A Kasei 11 engines; the bomb load was 1,764 pounds or one standard naval torpedo; defensive armament was four 7.7mm machine guns—one in the nose, one in a topside blister, one each in side blisters, and a 20mm cannon in the tail turret. The G4M-1's range was 3,256 nautical miles (3,749 statute miles), and its top speed was 266mph at 13,780 feet.

The G4M-1s enjoyed great success on raids into China as far inland as Chungking, and their lack of armor and heavy defensive armament wasn't a handicap when they faced the weak Chinese fighter resistance. It did, however, cause serious problems when they encountered even the second-rate but determined fighters that the U.S. and British defenses first put up against it.

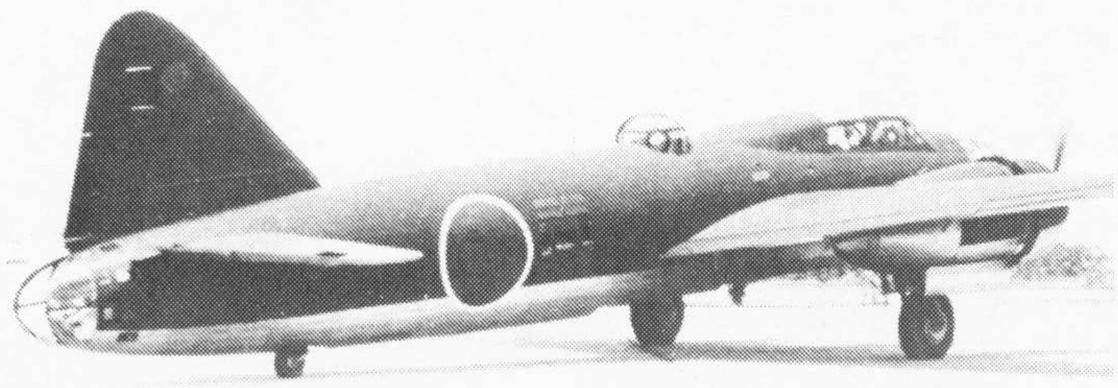
Improvements were made on the G4M-2 Model 22. The top blister was replaced with a powered turret that contained a 20mm cannon. The nose guns were doubled, the side blisters were removed and replaced with flat hatches (still containing 7.7mm guns), and a revised tail turret retained its 20mm cannon. Bomb load increased to 2,205 pounds, and power was increased to 1,800hp (takeoff), with Kasei 21 MK4P engines driving four-blade propellers (the G4M-1 had three-bladers). A new wing with laminar airfoil was used; gross weight increased to 27,588 pounds, but high speed increased to only 272mph at 15,090 feet. The final production version of the Betty was the G4M-3, which had a redesigned tail turret and dihedral in the horizontal tail.

Bettys were in production until the war's end, and they operated everywhere there were targets for land-based bombers (either land targets or ships at sea). An unusual conversion was made on the G4M-2e, which had its bomb bay modified to carry the MXY-7 Ohka ("Cherry Blossom," but called "Baka," or "Fool," by the Allies) single-seat suicide bomber. Carrying the Ohka greatly reduced the performance of the Betty, and made it an easy target for U.S. and British fighters. Sixteen were shot down during a single attack.

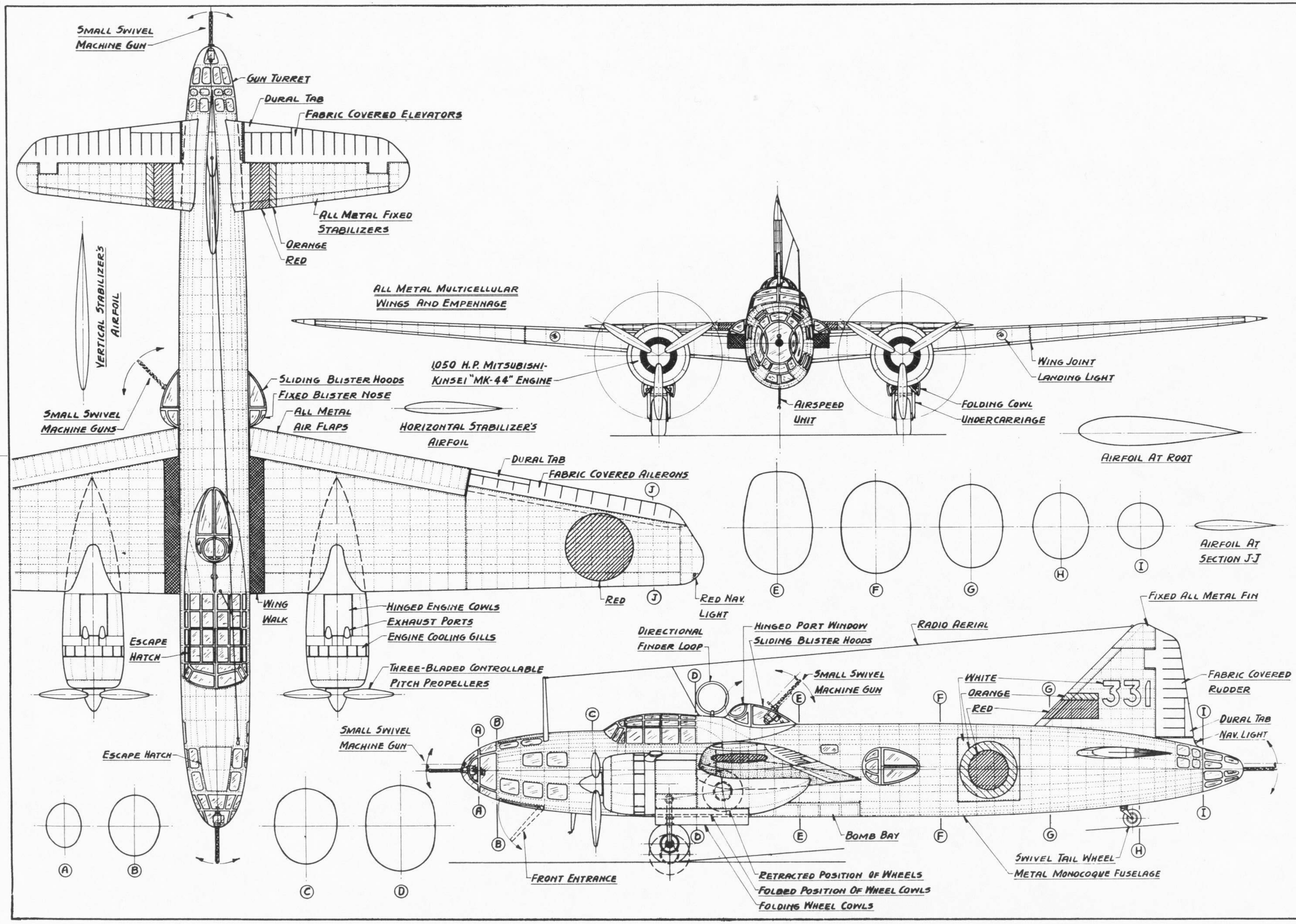
Altogether, 1,200 G4M-1s, 1,154 G4M-2s and 60 G4M-3s were built.

SPECIFICATIONS AND PERFORMANCE G4M-2

Wingspan	*82 ft., 1/4 in.*
Length	*65 ft., 7 in.*
Wing Area	*840.9 sq. ft.*
Empty Weight	*17,199 lbs.*
Gross Weight	*27,588 lbs.*
High Speed	*272mph at 15,090 ft.*
Range	*3,765 statute miles*

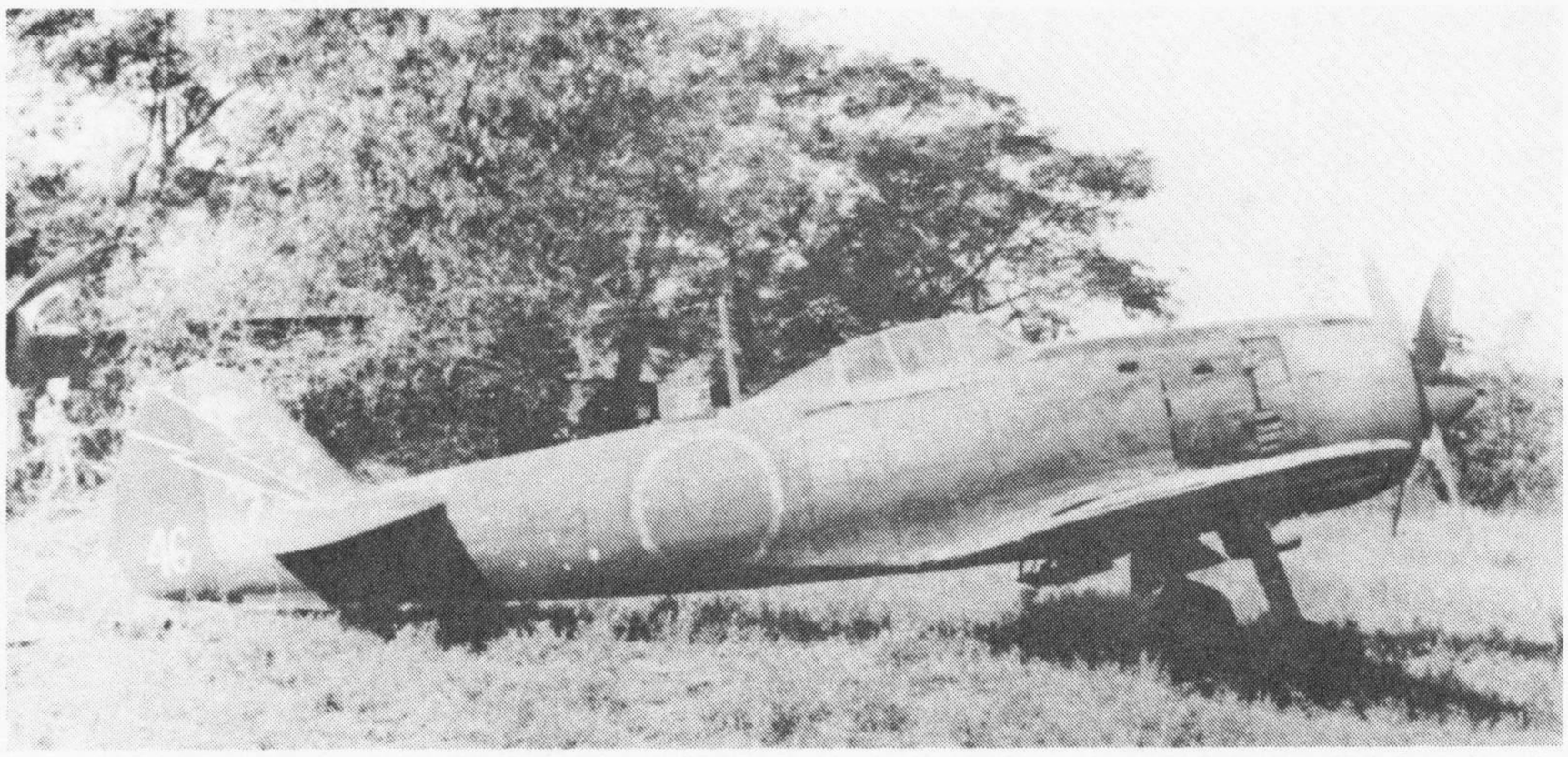


This view of the G4M-2 Betty bomber shows the flush hatches that replaced side machine gun blisters, and the tail turret redesigned with two vertically aligned transparent clam shells that opened to permit movement of the 20mm cannon.



MITSUBISHI G4M BETTY

NAKAJIMA KI-84 FRANK



A Nakajima Ki-84 "Frank" of the 11th Sentai (group), captured in the Philippines. Note the lightning-flash Sentai marking on the tail and the plane's well-worn appearance. The numeral "46" on the rudder is an allied inventory number for captured airplanes.

THE best all-around Japanese fighter developed in response to the new U.S. models was the Nakajima Ki-84 Hayate ("Gale"). It was code named "Frank" by the Allies, but its official designation was Type 4 (for the Japanese year 2604) Model 1A Fighter. It was designed and built by the Nakajima Aeroplane Company, Ltd.; the prototype flew in April 1943.

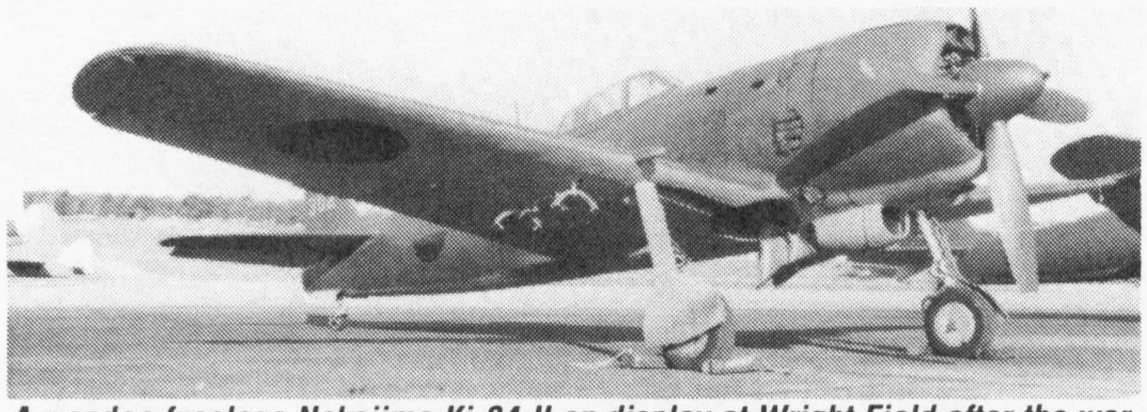
The engine was a 1,800hp Nakajima Ha-45 Type 11, and the airplane's lines were similar to Nakajima's Ki-43 "Oscar" and Ki-44 "Tojo".

The prototype had provision for a single drop-tank under the fuselage, but the production models could carry two 44-gallon tanks, or up to two 550-pound bombs under the wings. Its initial armament was a pair of 12.7mm machine guns in the nose and two 20mm cannon in the wings. The Ki-84 was up-to-date in its use of heavy armor and protection for the fuel tanks, and it featured special "Butterfly Flaps" that could be lowered to improve maneuverability in combat.

The Ki-84 wasn't quite as fast as the latest U.S. P-51s and P-47s, but it could outmaneuver and out-climb them.

"Franks" first went into combat against the U.S. 14th Air Force (the former Flying Tigers), in China in March 1944.

Soon after, 10 three-squadron fighter groups that were equipped with Franks were stationed in the Philippines to resist the impending Allied invasion. The Franks didn't live up to their potential there, because they were badly outnumbered, and also because they suffered from fuel and hydraulic-system malfunctions and the failure of less-than-standard landing gear.



A wooden-fuselage Nakajima Ki-84-II on display at Wright Field after the war. The coloring is standard U.S. Army olive drab and gray. Unbordered and undersized Hinomaru markings have been re-applied for display purposes.

SPECIFICATIONS AND PERFORMANCE KI-84-IA

Wingspan	*36 ft., 10 7/16 in.*
Length	*32 ft., 6 9/16 in.*
Wing Area	*226.04 sq. ft.*
Empty Weight	*5,864 lbs.*
Gross Weight	*7,955 lbs.*
Overload Weight	*8,576 lbs.*

Improved versions of the Ki-84 quickly followed the Ki-84-Ia. The Ki-84-Ib eliminated the two machine guns and used four cannon. The few Ki-84-Ics (specialized bomber interceptors) had two 20mm cannon and two 30mm cannon.

Because of the serious shortage of aluminum in Japan, wood was substituted for many parts of the Ki-84. The resulting composite model had a 1,990hp Ha-45 Type 23 engine and was designated the "Ki-84-II." Production was also seriously hampered by the B-29 raids on Japan, and an engine shortage after the engine factory was bombed.

As in Germany, much of Nakajima's fighter production was forced into underground factories.

Altogether, 3,509 Ki-84s were built (contrary to the drawing)—127 prototypes, service test and pre-production models; and 3,382 production Ki-84-Is and -IIs by Nakajima and the Mansyu Aeroplane Manufacturing Co. in Manchuria. The drawing total includes derivative designs with other designations, such as the Ki-87 variant with a turbo-supercharger and the lightweight Ki-116.

NAKAJIMA KI-84 FRANK

12.7mm MACHINE GUNS (2)

20mm CANNON(2)

WHEN TWO LONG RANGE TANKS WERE CARRIED IT'S RANGE WAS 1,815 MILES AT 173 M.P.H.

IN THE ROLE OF DIVE BOMBER IT CARRIED TWO BOMBS FROM 66 TO 550 LBS. APIECE

A NUMBER OF FRANKS WERE CONSTRUCTED WITH WOODEN PANELS IN ORDER TO SAVE WEIGHT & MATERIAL WITH NO SUCCESS. IT'S RUGGEDNESS, HOWEVER, MADE IT THE MOST VERSATILE ARMY FIGHTER OF THE TIME.

WING CENTER SECTION IS AN INTEGRAL PART OF THE FUSELAGE

W1 W2

W1 W2

NAKAJIMA BUTTERFLY TYPE COMBAT FLAPS

ENGINE	NAKAJIMA Ha. 45/11
H.P.	1,900
MAX. SPEED	388 M.P.H. AT 19,680 FT.
RANGE	1,025 MILES AT 178 M.P.H. ON INTERNAL FUEL
RATE OF CLIMB	5 MIN. 54 SEC. TO 16,400 FT. 11 MIN. 40 SEC. TO 26,240 FT.
CEILING	34,750 FT.
WEIGHT	5,864 EMPTY (LBS.) 7,965 NORMAL 9,194 MAX.

F1 F2 F3 F4 F5

DESIGN WORK BEGAN APRIL '42, THE PROTOTYPE FLEW IN FEB. '43, & IT WENT INTO COMBAT OVER CHINA IN AUG. '44. A VERY STURDY STRUCTURE, IT COMBINED THE BEST QUALITIES OF THE OSCAR & TOJO. THE FRANK WAS SLIGHTLY SLOWER THAN THE P-51H & P-47N, BUT COULD OUT-CLIMB & OUT-MANEUVER BOTH. HAD IT NOT BEEN PLAGUED WITH ENGINE, HYDRAULIC, FUEL & OIL PRESSURE, AND LANDING GEAR TROUBLES, IT WOULD EASILY BE RATED AMONG THE BEST OF WWII.

THE FRANK WAS FLOWN BY THE FOLLOWING SQUADRONS: THE 1st, 10th, 11th, 22nd, 51st, 52nd, & 200th. IN ALL 3,577 WERE BUILT

YELLOW

BLACK

BLACK

RED

ROYAL BLUE

RED

F1 F2 F3 F4 F5

OVERALL COLOR IS NATURAL ALUMINUM

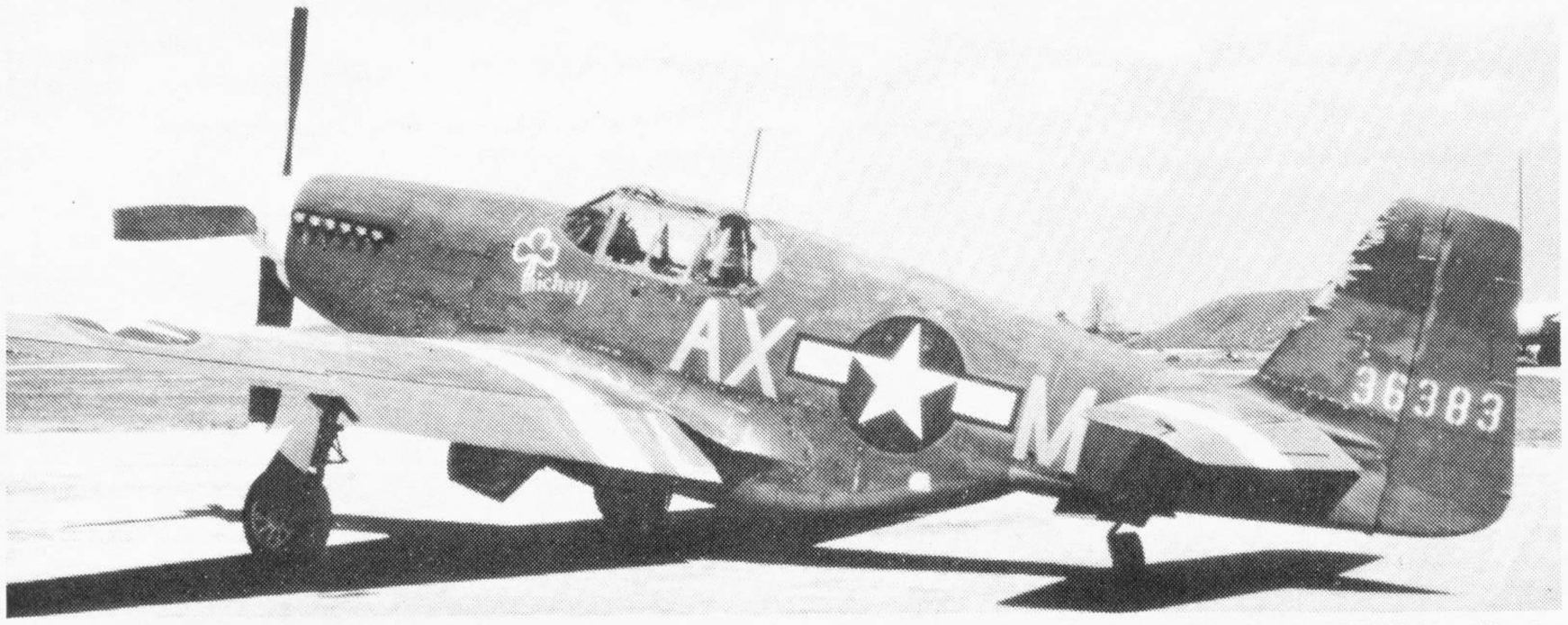
METERS 0 1 2 3

0 1 2 3 4 5 FEET 10

nakajima ki-84 "frank"

MODEL Ia DRAWN BY C. Graham SCALE: 5/32" = 1'

NORTH AMERICAN P-51B MUSTANG



A camouflaged P-51B-5-NA Mustang, photographed with the Ninth Air Force in England. The letters "AX" identify the 12th Squadron of the 67th Reconnaissance Group, identified by the letter "M."

IN 1940, the British Purchasing Commission (in the U.S.) wanted North American (NAA) of Inglewood, CA, to build the Curtiss P-40 under license. NAA engineers had been researching a new fighter design that would overcome some of the notorious deficiencies of the designs used early in the war. The design would also incorporate a new aerodynamic feature: the laminar-flow wing.

In 120 days, NAA built a prototype that used the same 1,100hp Allison V-1710-F3R engine then being used in the P-40. The first flight of the NA-73 (the company-funded prototype with civil registration NX19998) was made on October 25, 1940. Production models with British-specified armament of six .303-caliber guns were flying in May 1941. NAA had originally called it the "Apache," but this was soon changed to "Mustang." The initial British contract was for 320 Mustang Is, and this was soon increased by another 300. Some of these were acquired by the U.S. Army, but they weren't yet called P-51s.

The U.S. Army wasn't particularly interested in the new design, but it did direct that the fourth and tenth production Mustang Is be tested by the Army as "XP-51." Despite good maneuverability and high speed, the Army still wasn't interested in production. The 150 supplied to Britain as "Mustang IA" under Lend-Lease with four 20mm cannon were designated "P-51" though their armament and other details differed from the XP-51s. These carried both U.S. Army and British serial numbers.

The first Army order to NAA was for 500 examples of an odd type—a single-seat dive-bomber variant designated "A-36A." This had dive brakes, racks for two 500-pound bombs and an armament of six .50-caliber machine guns (four in the wings and two in the lower nose). The engine was the 1,325hp V-1710-87.

The A-36A first flew on September 21, 1942, and production models took part in the invasions of North Africa and Sicily. The dive-bombing tactic, however, was soon abandoned, and the dive brakes were wired shut.

The first Army fighter order was for 310 P-51As with 1,200hp V-1710-81 engines. Armament was four .50-caliber guns in the wings. Britain obtained 50 P-51As under Lend-Lease as "Mustang II." At this time, the Army didn't send P-51As overseas for combat.

The Mustang's only serious shortcoming was its lack of performance at altitude, which was attributable to the Allison engine. The British were sufficiently concerned about this to upgrade four Mustangs with Rolls-Royce Merlin engines. The performance gain was impressive, and the U.S. Army and NAA were encouraged to try Merlins in P-51s on their own. Two four-cannon P-51s were fitted with 1,380hp Packard-built V-1650-3 Merlins… and the rest is history.

Production orders followed for 1,998 P-51B-NAs at Inglewood and 1,750 similar P-51C-NTs from a new factory in Dallas, TX. Armament was the same as in the P-51A. The P-51Bs and Cs through B-10 and C-3 had 1,380hp V-1650-3 engines, while higher dash numbers of each had 1,490hp V-1650-7 engines.

The British designated their 275 P-51Bs "Mustang III," but they made no distinction for 636 P-51Cs, which carried the same name.

There were also camera-carrying versions of the P-51. Such P-51s were designated "F-6A"; P-51As became "F-6B"; and both P-51Bs and Cs became "F-6C."

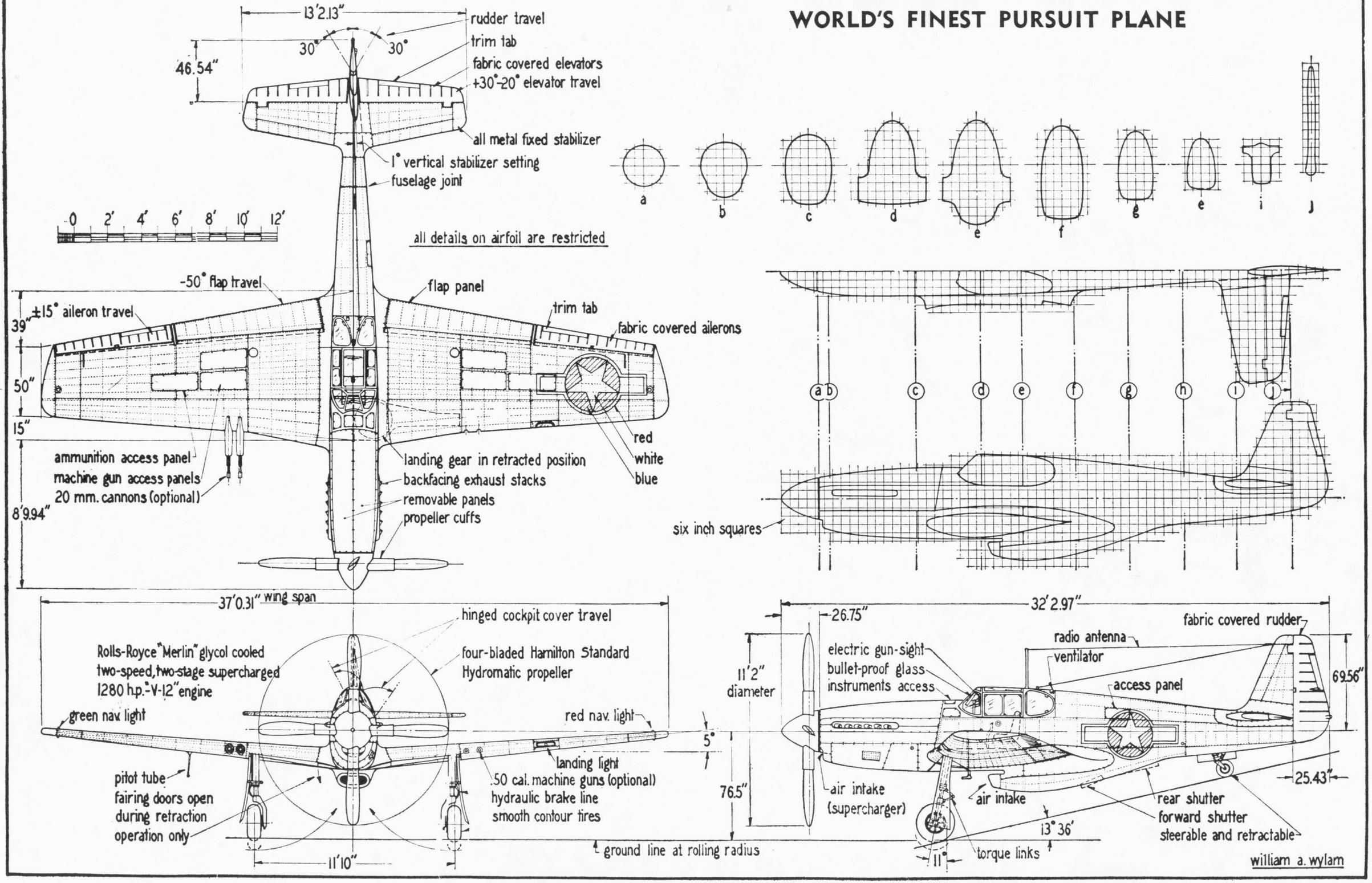
Because the Wylam drawing shows the P-51B with high turtle deck, the later bubble-canopy variants (P-51D through P-51K) won't be detailed here, but the British called them all "Mustang IV."

SPECIFICATIONS AND PERFORMANCE P-51 B

Wingspan	*37 ft.*
Length	*32 ft., 3 in.*
Wing Area	*237.7 sq. ft.*
Empty Weight	*17,199 lbs.*
Gross Weight	*11,000 lbs.*
High Speed	*440mph at 30,000 ft.*
Armament	*Four .50-caliber guns, plus two 1,000-lb. bombs*

NORTH AMERICAN MUSTANG P-51B

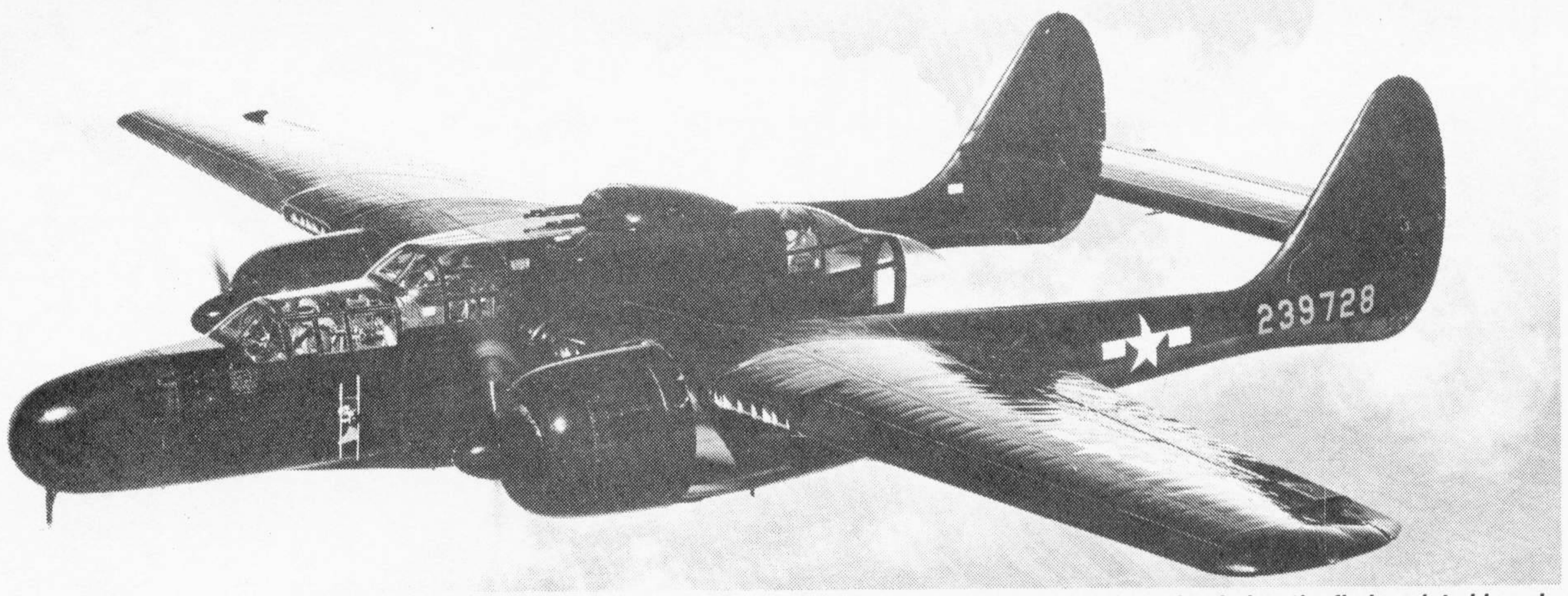
WORLD'S FINEST PURSUIT PLANE



william a. wylam

NORTH AMERICAN P-51B MUSTANG

NORTHROP P-61 BLACK WIDOW



The glossy black Northrop P-61B on a factory test flight. Note the radar antenna alongside the cockpit. The army serial number below the fin is painted in red, which is standard for black night fighters.

MOST of the night fighters used in the war were adapted from existing designs for a specific mission. The only fighter that was specifically designed for night missions was the three-seat, twin-engine Northrop P-61. It was named "The Black Widow" because of its overall glossy black coloring.

The U.S. Army became interested in specialized night fighters as a result of British experience with German night raiders in 1940. Northrop Aircraft, Inc., of Hawthorne, CA, responded to an Army request and submitted a design with four fixed, forward-firing, 20mm cannon in the belly; British-designed radar in the nose to detect and track the enemy; and four .50-caliber machine guns in a powered turret for defense.

The engines were 2,000hp Pratt & Whitney R-2800-10s. The plane's most unusual feature was its twin-boom layout, with the crew in a short pod rather than in a full-length fuselage. The radar operator sat alongside the pilot. Two XP-61 prototypes were ordered, followed by 13 YP-61 service test models.

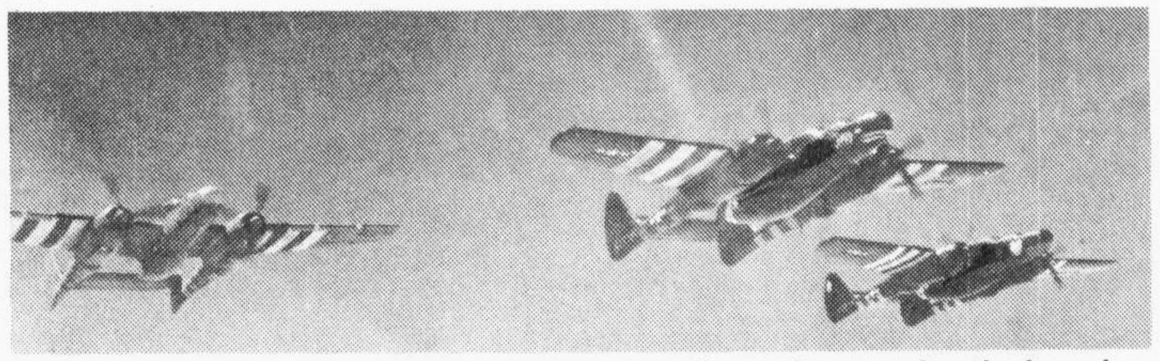
The first XP-61 had a matte-black finish and flew on May 26, 1942. Satisfactory tests resulted in an order for 200 production P-61As with glossy instead of dull paint, and deliveries began late in 1943. From the 38th aircraft on, the top turret was deleted in the belief that added speed was a better defense at night than manually aimed guns. The P-61As were sent to the Pacific and scored their first night victory on July 7, 1944. Others were sent to Europe and participated in the Normandy invasion.

The P-61As were followed by 450 improved P-61Bs in July 1944. Most of these restored the top turret and could carry either four 1,600-pound bombs or two 300 gallon drop tanks under their wings. Final production versions of the Black Widow were 41 P-61Cs with 2,800hp R-2800-77 engines.

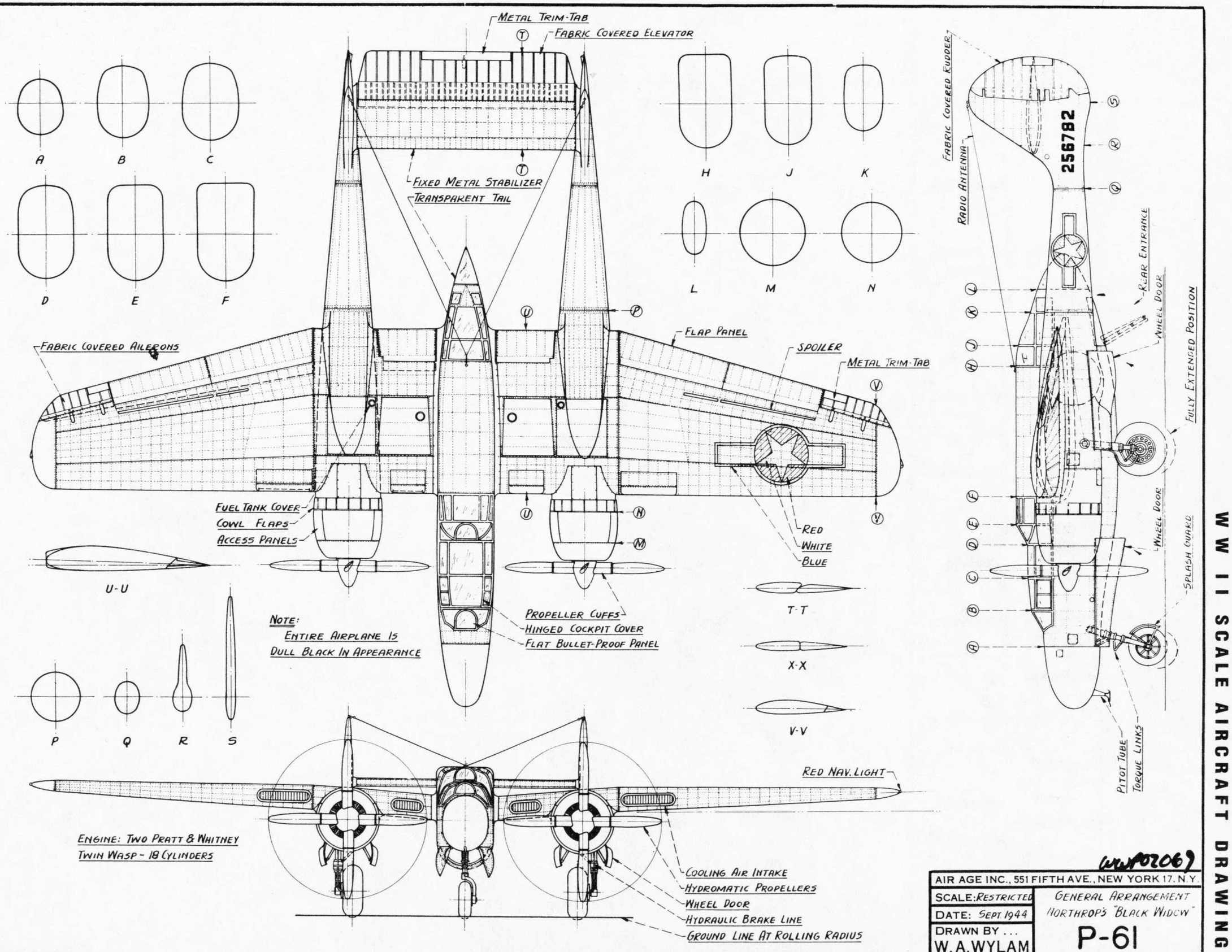
Subsequent P-61 designations were for conversions. Two XP-61Ds were former P-61As with R-2800-77 engines, and two XP-61Es were P-61Bs that were converted to day fighters with four cannons in the nose, no radar or top turret and the two-man crew seated in tandem under the longest one-piece bubble canopy built to that time. A P-61C conversion to XP-61F was cancelled. Sixteen P-61Bs were converted to unarmed P-61G Weather Reconnaissance planes. The first XP-61E was converted to the XF-15 "photo plane" with cameras in the nose, along with one P-61A that became the XF-15A. Thirty-six production F-15As followed, but they were out of service by 1952.

SPECIFICATIONS AND PERFORMANCE P-61 B

Wingspan	*66 ft.*
Length	*49 ft., 7 in.*
Wing Area	*664 sq. ft.*
Gross Weight	*29,700 lbs.*
High Speed	*366mph at 20,000 ft.*



P-61As (with black and white "Invasion Stripes") over Europe after the invasion of July 6, 1944. The wartime censor has left the serial numbers on the airplanes but has blacked out the radar antennas. Note the "Shark Face" painted on the nearest plane.



AIR AGE INC., 551 FIFTH AVE., NEW YORK 17, N.Y.

SCALE: RESTRICTED	GENERAL ARRANGEMENT NORTHROP'S "BLACK WIDOW"
DATE: SEPT 1944	P-61
DRAWN BY ... W. A. WYLAM	

WW P0206?

WW II SCALE AIRCRAFT DRAWINGS

NORTHROP P-61 BLACK WIDOW

REPUBLIC P-47 THUNDERBOLT

A Republic P-47D-25 in service with the Royal Air Force as "Thunderbolt II." The streamlined shape under the wing is a rack for either a drop tank or a 500- or 1,000-pound bomb. Note the absence of a dorsal fin.

THE Republic P-47 Thunderbolt, commonly called "The Jug," is an excellent example of a successful fighter that evolved through a series of designs from the same design team.

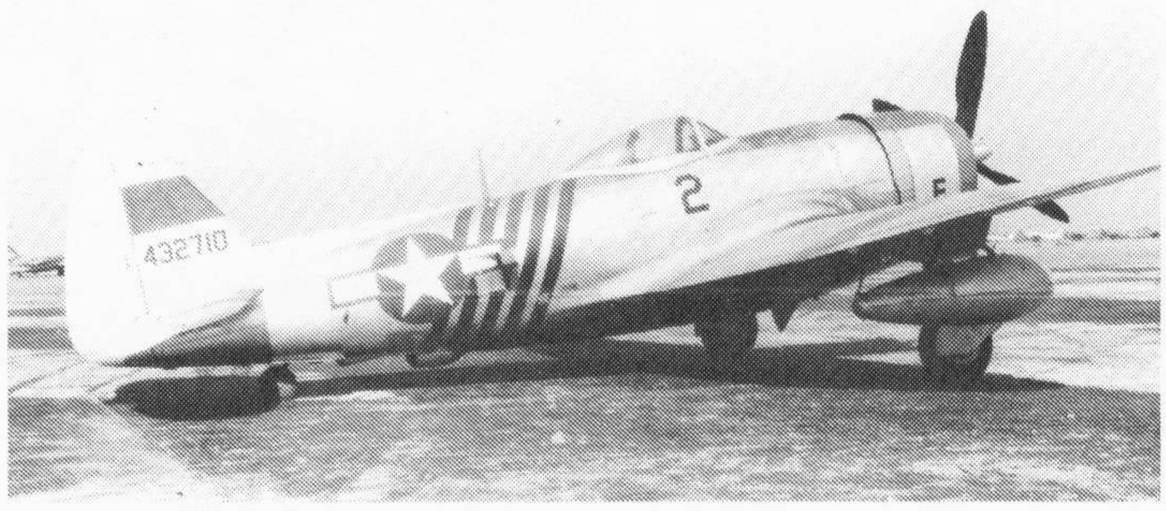
The Jug's distinctive configuration can be traced back to the 1933 appearance of the Seversky SEV-3 twin-float amphibian. The plane's distinctive features were its all-metal construction, its fuselage with a nearly circular cross-section, and its wing planform (straight sweepback on the leading edge and an elliptical trailing edge and wing tips). This trademark wing planform (shared with the Supermarine Spitfire) was retained for all subsequent Seversky and Republic fighters through the P-47 and some of its experimental derivatives.

Alexander Seversky, a former Imperial Russian Air Force pilot, didn't have a factory when he started business. His first airplane was built by Edo of College Point, NY, a famous builder of all-metal seaplane pontoons. Now, with a successful design to sell, Seversky established a factory in Farmingdale, Long Island, NY. The second Seversky airplane, which was similar to the first, was initially tested as a two-seat, land-plane fighter with fixed landing gear. It was soon modified (for a U.S. Army fly-off design competition) to a single-seater with an 850hp Pratt & Whitney R-1830 Twin Wasp engine and backward-retracting gear. Seversky won a production order for 77 P-35s with 950hp R-1830-9 engines, backward-retracting gear and an armament of one .30-caliber and one .50-caliber machine gun. Deliveries began in 1937, and the last production aircraft was fitted with a turbo-supercharger in the belly, and a new wing of the same span and area as the XP-41, but with a different center section and inward-retracting landing gear.

A P-47C shows off the sharp-topped fuselage structure behind the cockpit that earned models before the P-47D-25 the nickname "Razorback."

By that time, Seversky had been ousted, and the company was renamed "Republic." The new features of the XP-41 were incorporated into a new model, the P-43, which used the 1,200hp R-1830-35 engine and a standard armament of two .30-caliber and two .50-caliber machine guns. The fuselage had refined lines and was nearly 2 feet longer than the P-35/XP-41. There were 272 P-43s and P-43As built. Meanwhile, Republic had been selling export versions of the P-35. Of 120 ordered by Sweden, 60 were drafted by the U.S. after the Arms Embargo went into effect, and they were designated "P-35A." Most were shipped to the Philippines, where they soon fell victim to the Japanese Zero.

There was to have been a P-44—essentially the P-43 fitted with the new 1,850hp Pratt & Whitney R-2800 engine—but it was decided that the engine was too big for the existing airframe. A new Republic model that was then being designed (the light-



This P-47D-30 with a dorsal fin and 150-gallon drop tanks has the dark blue stripes of the First Air Commando Group, which was based in Southeast Asia in 1944-45.

weight XP-47) was cancelled, and the designation "XP-47B" was given to an enlarged development of the P-43 that would use a big engine and eight .50-caliber machine guns (the heaviest armament then fitted to a single-seat fighter). The XP-47B, with a 2,000hp XR-2800-21 engine, flew on May 6, 1941, and it was followed by P-47 production models through P-47N (to a total of 15,683 planes), which are detailed here.

P-47B—This was the first production model, and 171 were built. Deliveries started late in 1942, and some went into action in Europe on April 8, 1943. In combat, the P-47B-RE had inadequate climb and maneuverability, but it had plenty of speed and firepower. It also had excellent diving ability, and its heavy structure could absorb terrific punishment. Its wingspan was 40 feet, 9 inches; area, 300 square feet; gross weight, 13,360 pounds; high speed, 429mph at 27,800 feet.

P-47C—The 602 P-47Cs were refined P-47Bs that had their noses lengthened 13 inches and were equipped to carry a 200-gallon drop tank under the fuselage. Although it wasn't quite as fast as the P-47B, its greater range enabled it to be used on long-range escort missions.

P-47D—This model was the major production version, and 6,315 were built. The initial improvement was a water-injected version of the 2,000hp R-2800-21 engine, which gave it a top speed of 433mph at 30,000 feet. Provision was made for two 150-gallon drop tanks under the wings or a 250- to 1,000-pound bomb on the same streamlined rack, plus a 500-pound bomb under the fuselage. A new Republic plant was built in Evansville, IN, and 2,350 P-47D-RAs were built there.

There were two notable external changes during P-47D production: a cut-down rear fuselage and a bubble canopy (as tested on the XP-47K) became standard on the P-47D-25 and on, and a long, shallow dorsal fin was added to the P-47D-27 and on. Because of the two different fuselage configurations, the P-47 models prior to D-25 became known as "Razorbacks."

The P-47D proved to be more effective as a fighter-bomber than as an escort fighter, and from P-47D-30 on, provision was made for carrying 10 rockets under the wings in addition to the bombs. England received 240 Razorback P-47Ds as "Thunderbolt I," and 590 P-47D-25s and on as "Thunderbolt II." The gross weight of the P-47D-25 was 19,400 pounds; its high speed was 428mph at 30,000 feet.

XP-47E—The last P-47B tested with a pressurized cockpit.

XP-47F—One P-47B tested with a laminar-flow wing.

P-47G—Duplicates of the P-47B built by Curtiss to compensate for the cancelled P-60A contract.

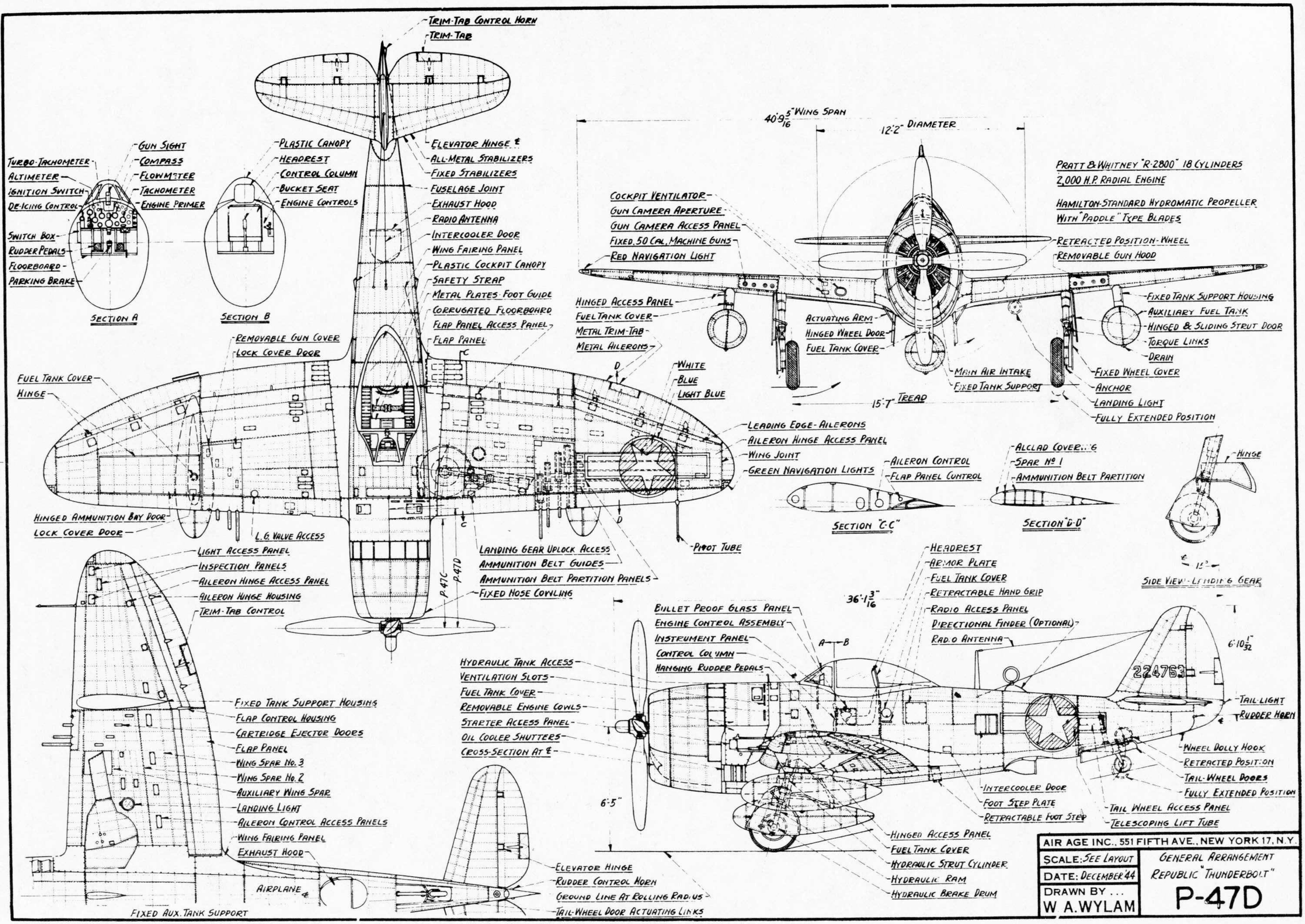
XP-47H, J, K and L—Experimental conversions which tested new features and equipment. The XP-47J tested a new, liquid-cooled, 2,300hp, 16-cylinder Chrysler XIV-2220-1 engine; the lightened XP-47J with a 2,100hp R-2800-61 engine became the first piston-engined plane to exceed 500mph; the XP-47K tested the bubble canopy; and the XP-47L had increased internal fuel capacity.

P-47M—A need for a fast, high-altitude fighter was met with the P-47M. Only 150 were built after three P-47Ds were modified as YP-47M prototypes. The bomb and rocket racks were deleted, and special 2,800hp R-2800-57 engines gave a top speed of 473mph at 32,500 feet. Most of the P-47Ms were in combat in Europe in the closing months of the war.

P-47N—The final production model, P-47, was produced solely for action in the Pacific. Its new wing had a span of 42 feet, 10 inches, an area of 322 square feet and squared-off wing tips. With additional internal fuel (as tested on the XP-47L), two 93-gallon drop tanks under the wings and a 100-gallon drop tank under the fuselage, the P-47N had a total fuel capacity of 1,266 gallons and a range of 2,350 miles, which was enough to enable it to escort B-29s to Japan in the last months of the war. With a 2,800hp R-2800-77 engine, the P-47N had a gross weight of 20,700 pounds and a high speed of 467mph at 32,500 feet.

Republic built 1,667 P-47Ns in Farmingdale and 149 in Evansville. A further 5,934 planes were cancelled. The P-47 was retired as a first-line fighter right after the war, but bubble-canopy P-47Ds and P-47Ns stayed in the reserve training squadrons until 1955.

This is the final "Jug" model, the P-47N, with a lengthened and square-tipped wing. This plane is in fighter-bomber configuration, with two 1,000-pound bombs and 10 rockets.



AIR AGE INC., 551 FIFTH AVE., NEW YORK 17, N.Y.

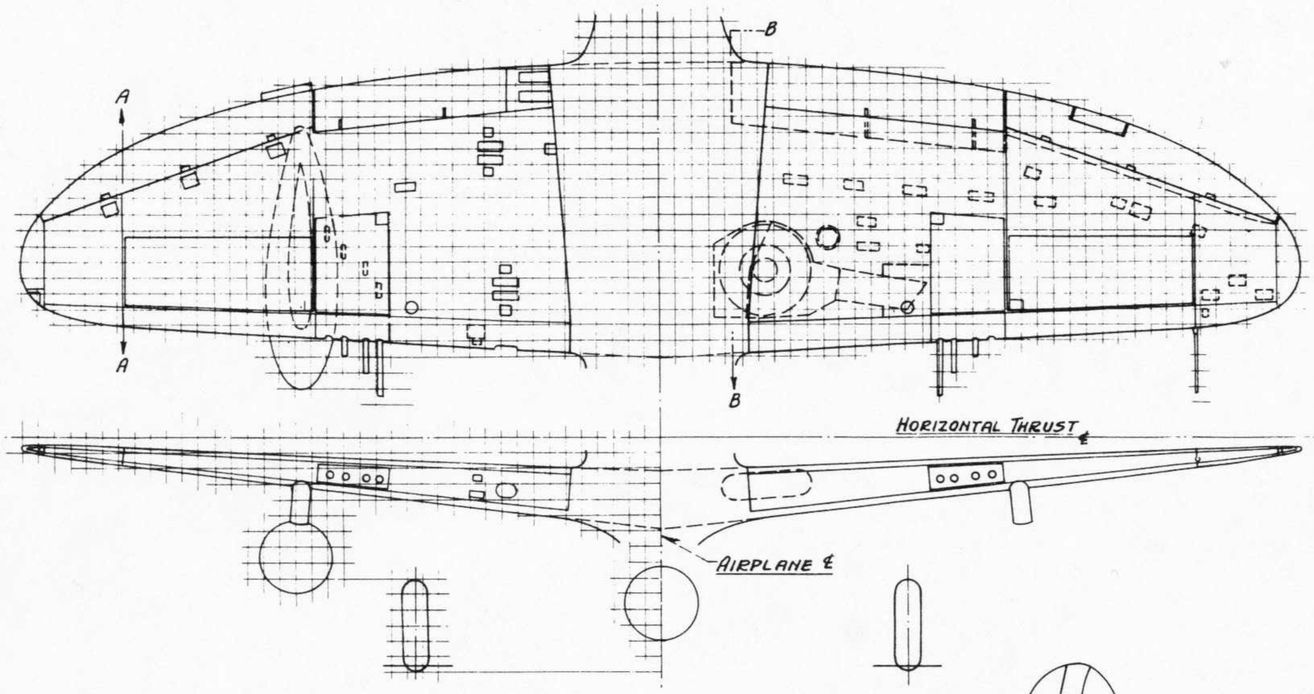
SCALE: See Layout

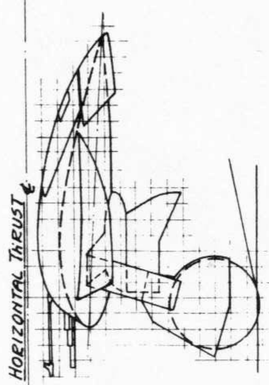
DATE: December '44

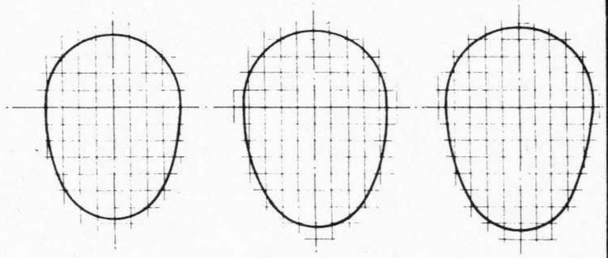
DRAWN BY ... W A. WYLAM

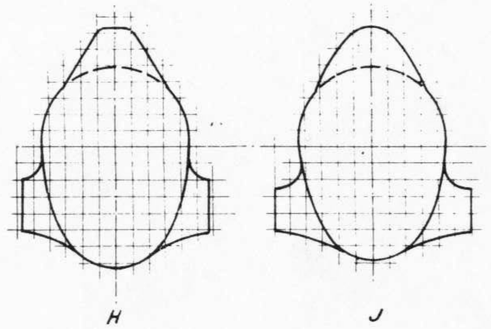
GENERAL ARRANGEMENT
REPUBLIC "THUNDERBOLT"

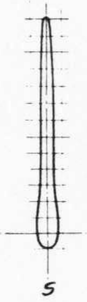
P-47D

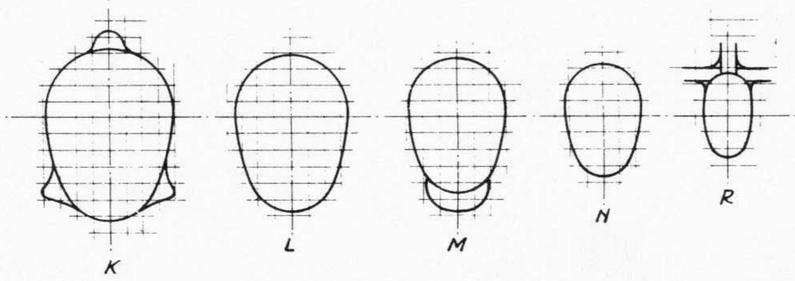


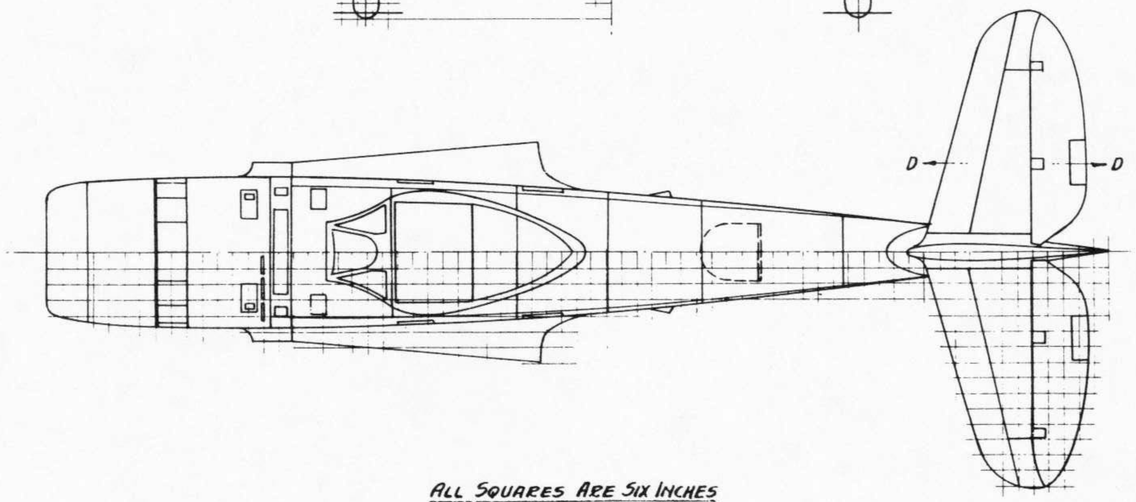


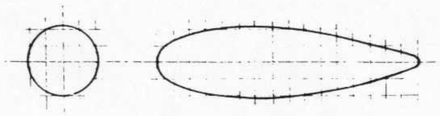




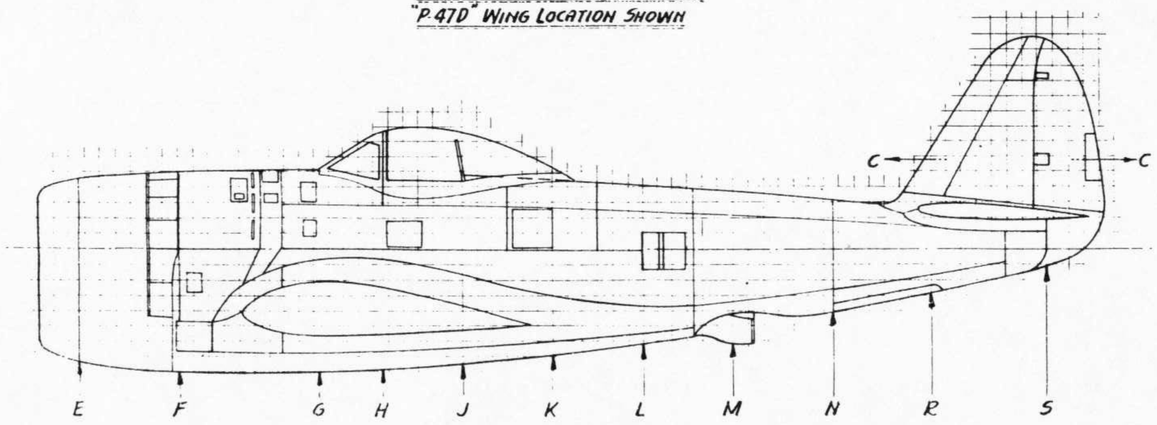




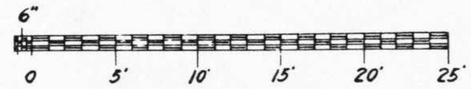




All Squares Are Six Inches
"P-47D" Wing Location Shown



Auxiliary Fuel Tank



Angular Movements

Rudder	± 28°
Rudder Trim-Tab	± 12°
Elevator	+30°-20°
Elevator Trim-Tab	+7°-8°

General Data And Specifications

Wing Incidence	+2½°	Span-Wings	40'-9 5/16"
Stabilizer Incidence	+2½°	Span-Tail	16'-0 3/32"
Fin Setting	0°	Height	13'-8 3/16"
Max. Chord-Wings	9'-2"	Tread	15'-7"
Max Chord-Horizon. Stab	5'-5 5/8"	Length (P-47C)	35'-5 3/16"
Max. Chord Vert. Stab.	6'-5"	Length (P-47D)	36'-1 3/16"
Dihedral-Wing	+6°	Propeller Dia.	12'-2"

AIR AGE INC., 551 FIFTH AVE., NEW YORK 17, N.Y.

SCALE: Above

DATE: December '44

DRAWN BY ... W. A. WYLAM

Layouts & Cross-Sections
Republic "Thunderbolt"
P-47D

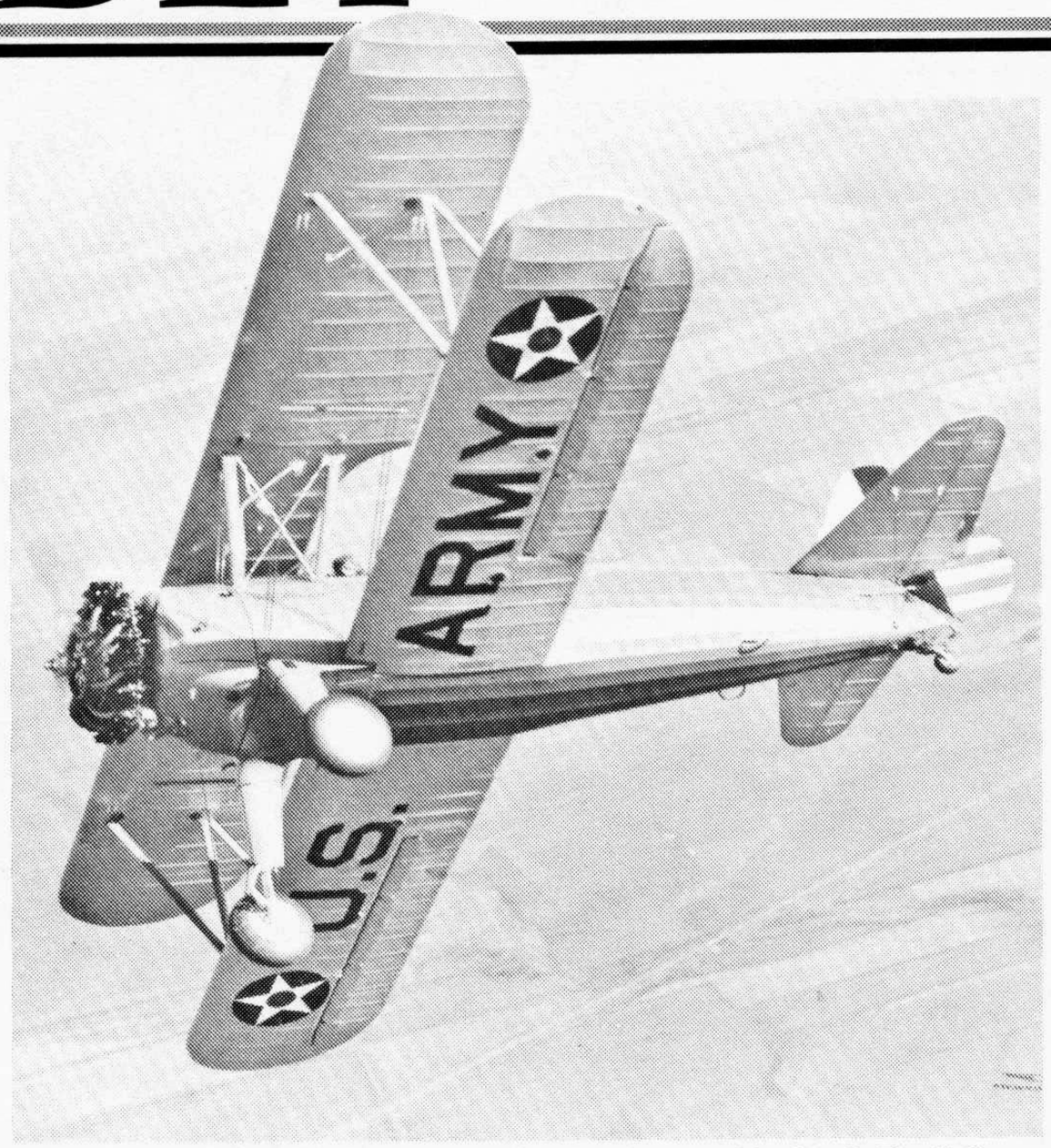
REPUBLIC P-47 THUNDERBOLT

STEARMAN KAYDET

THE Kaydet was the most used U.S. military primary trainer of WW II, but there's often confusion surrounding it because it had two builders' names—Stearman and Boeing. In 1934, after the breakup of the United Aircraft and Transport companies, the Stearman Aircraft Company of Wichita, KS became a wholly owned subsidiary of Boeing. It became Boeing's Stearman Division in 1938, and the Wichita Division of Boeing in 1941, when the airplanes officially became Boeings, even though the old Stearman model and serial numbers were continued. However, all those associated with the airplanes—builders and users alike—stubbornly continued to call the planes Stearmans, and today they're still referred to as such in the antique airplane movement.

In the case of the Stearman/Boeing Model 75, the use of the name "Kaydet" made it readily identifiable, even though there were eight manufacturers' sub-designations, four U.S. Army model designations and five U.S. Navy N2S series designations (see table).

The original Stearman Model 70 trainer, with a welded-steel tube fuselage and wooden-frame wings, flew late in 1933. The U.S. Navy bought 61 improved Model 73s in 1934 as NS-1 ("N" for trainer, "S" for Stearman) and had them fitted with 220hp Wright J-5 engines that had been out of production since 1929, but were still plentiful in Navy warehouses.



A Stearman PT-13A banked over to reveal the underside detail. The U.S. Army lettering is 24 inches high; the star insignia is 30 inches in diameter under the wing and 42 inches above.

Model 75, which was introduced in October, 1934, was similar to Model 73, but it used three different 220hp radial engines and won large orders from both the Army and the Navy. Altogether, 8,504 biplanes were built in the Model 70-76 series, with spare parts raising the widely publicized total to 10,346 (only the U.S. military Model 75s are shown in the table). Unit prices, less such government-furnished equipment (GFE) as engines and instruments, ranged from $7,713 to $10,412.

Until the spring of 1942, the Army Kaydets had colorful blue fuselages, chrome-yellow wing and tail surfaces, and the distinctive Army rudder stripes that had been used since 1926. Subsequent Army deliveries were all silver and without stripes. The winterized PT-27s supplied to Canada under Lend-Lease were all yellow, and some had cockpit canopies. Early Navy Kaydets were all yellow. Most of the later models were all silver, but a few were delivered all yellow.

Before inter-service standardization with the E-75 model, the Army and Navy frequently exchanged their Kaydets. Oddly, the different Navy dash numbers weren't equally significant; the difference between the N2S-1 and -2 was the same as between the Army PT-17 and PT-13, with entirely different engines, while the N2S-1, -3 and -4 differed only in the dash numbers of the same Continental R-670 engine.

Stearman Model	U.S. Army Designation	U.S. Navy Designation	Engine	No. Built
75	PT-13	-	Lycoming R-680	26
A75	PT-13A, B	-	Lycoming R-680	268
A75J-1	PT-18	-	Jacobs R-755	150
A75N-1	PT-17, 17A	N2S-1, -4	Continental R-670	3,769
B75	-	N2S-2	Lycoming R-680	125
B75N-1	-	N2S-3	Continental R-670	1,875
D75N-1	PT-27	-	Continental R-670	300
E75	PT-13D	N2S-5	Lycoming R-680	1,786

WINGS AND CONTROL SURFACES ARE SPRUCE - FABRIC COVERED

STEEL WELDED FUSELAGE - FABRIC COVERED.

POWER PLANT
ONE 7-CYL. 220-HP CONTINENTAL W-670 ENGINE.

HAND GRIP

- BLUE
- WHITE
- RED

LIFT WIRES

LANDING WIRES

YELLOW WINGS AND TAILS

OLIVE DRAB FUSELAGE AND WING STRUTS

EXHAUST COLLECTOR RING

LUGGAGE HATCH

AIR SCOOP

AILERONS

HAMILTON STANDARD PROPELLER

CARBURATOR

EXHAUST STACK

BLACK LETTERS

HAND GRIP

A B C D

TYPICAL AIRFOIL

RED BLUE WHITE

D C B A

AIR SCOOP

HAND GRIP

WHITE LETTERS

CARBURATOR

WHITE LETTERS

TWIN LIFT WIRES

SINGLE LANDING WIRES

AIR SPEED TUBE DETAIL

PT-17	BOEING-STEARMAN PT-17 KAYDET
SCALE: 3/16"-1'0"	DRAWN BY: BJORN THORLIKSEN-56

STEARMAN KAYDET

SUPERMARINE SPITFIRE

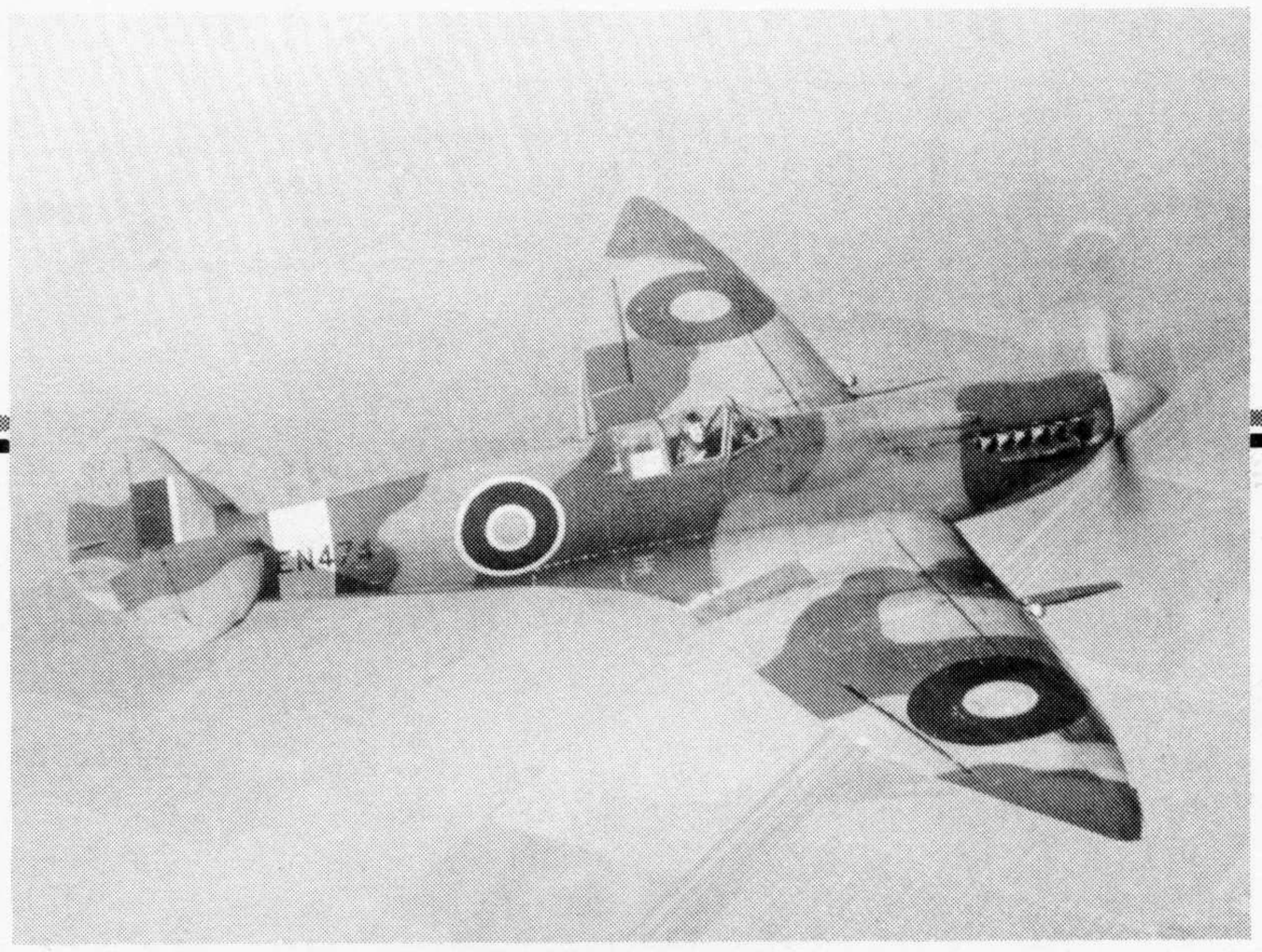
THE British Supermarine "Spitfire" was one of the greatest all-around fighters of the war. Its lines and performance, however, weren't the result of a long line of pedigreed fighters, in the way that the Hawker Hurricane evolved from Hawker and Sopwith fighters dating back to WW I. Rather, the Spitfire evolved from a line of monoplane seaplane racers that was started by designer Reginald J. Mitchell in 1925. His S-4 model changed the development of high-speed aircraft from biplanes to low-wing monoplanes. Later S-models set new speed records. The S-6B of 1931 retired the Schneider Trophy with a speed of 340.8mph around a triangular course, and it later set a new absolute speed record of 407.5mph.

An early Spitfire I with a fixed-pitch wooden propeller and a straight top canopy. Note the Type A roundel under the wing and the Type A.1 roundel on the fuselage.

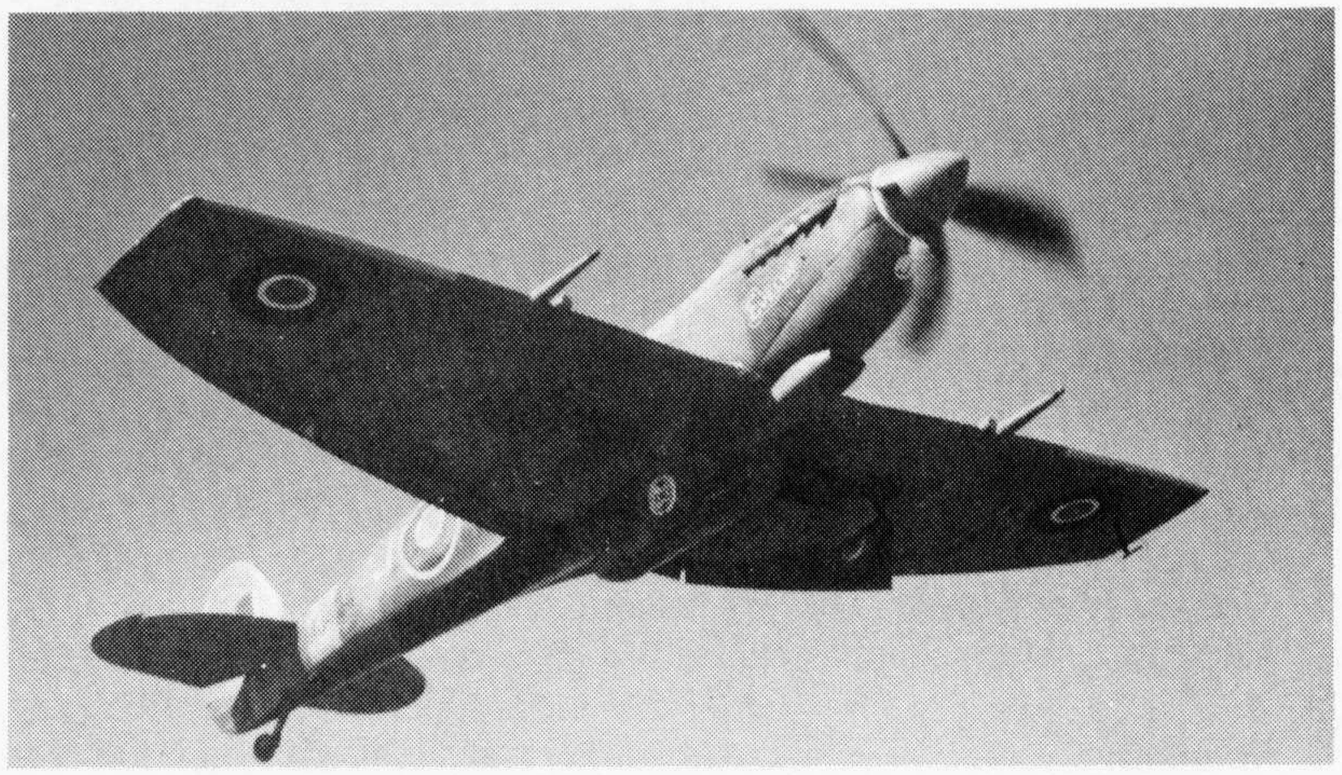
Mitchell's racers were masterpieces in the way they fit the slimmest possible fuselage around a pilot and a liquid-cooled engine. This practice continued with the Spitfire, which was built in response to a 1934 Air Ministry request for an eight-gun fighter. The prototype used a 990hp Rolls-Royce Merlin C engine, and featured an elliptical wing planform for maximum aerodynamic efficiency, which was supposed to offset the handicap of added structural complexity. The narrow landing gear retracted outward into the wing, which, in its initial form, contained eight .303-caliber machine guns. The semi-monocoque metal fuselage was so narrow at the pilot's shoulder level that it was necessary to install a hinge-down door on the left side for access.

The prototype flew on March 5, 1936, and production orders soon followed. Spitfire Is with 1,030hp Merlins driving fixed-pitch, wooden two-blade propellers began to reach the squadrons

A Mk V Spitfire with a fin flash and an A.1 roundel on the fuselage, as used from December 1940 through June 1942. The Type B roundel was retained on the wings almost until the war's end. Note the rear-view mirror above the windshield and the tape over the gun muzzles.



A Spitfire H.F.VII with extended triangular wing tips (above) and a Spitfire VB with clipped wing tips (below).



in May 1938. Later articles featured three-blade, controllable-pitch metal propellers. Nine squadrons of Spitfires were in service by the start of the war, and 19 were in service when the Battle of Britain started in August 1940. Spitfires fought in all theaters where the R.A.F. operated.

The early Spitfires were slightly superior to the German Me 109E in speed and maneuverability, but the Me 109 could out-climb and out-dive them, and its guns had greater range. To meet the competition, the Spitfire was continually improved throughout the war years, using two different engines and a variety of wing planforms and structures to accommodate varying armament. It also used different fuselages and tail shapes.

In 1940, three of the famous Eagle Squadrons, manned by American volunteer pilots, flew Spitfires. Because of the shortage of American fighters in 1943, the British provided two U.S. Army Air Force fighter groups in England with Spitfires.

Altogether, the U.S. obtained 600 Spitfires under Reverse Lend-Lease out of the 21,767 built. These weren't given standard U.S. Army designations or serial numbers. Instead, they flew with British designations, serial numbers, equipment and coloring, with only the U.S. star insignia to identify them as being operated by the USAAF.

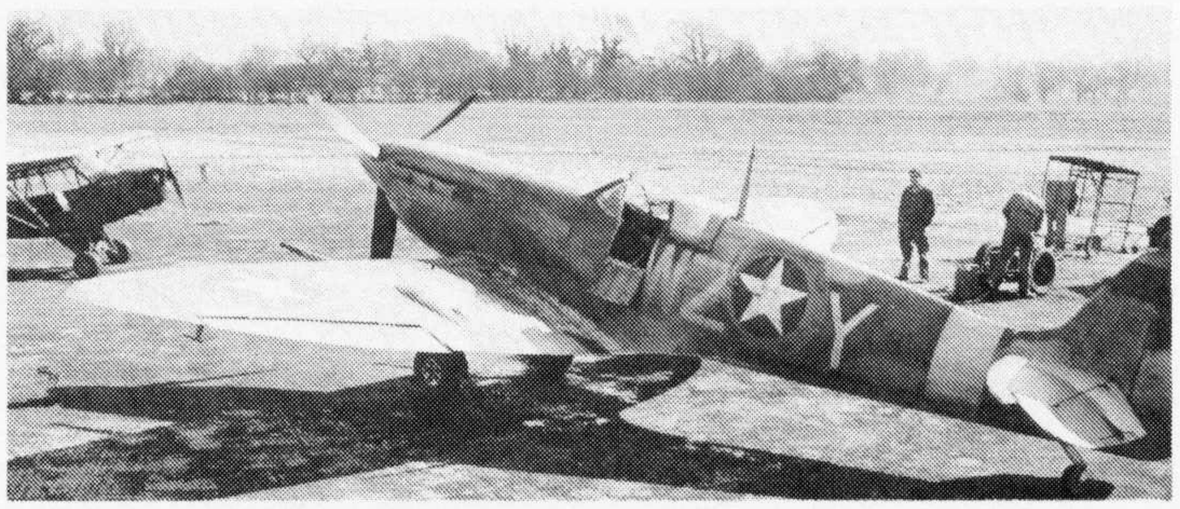
Although the accompanying drawings show the Spitfire V with the standard wing and fuselage, the following text and photos cover all of the variants through the postwar Spitfire 24, and identify the significant configuration changes. The higher Mark (Mk) numbers are out of sequence because the Spitfires with Merlin engines are grouped separately from those with Griffon engines. It should be noted that Spitfires through Mk XX were identified by Roman numerals, while later ones were identified with Arabic figures.

SEA-GOING SPITFIRES

It was inevitable that a successful land-based fighter would be considered for use on aircraft carriers. This was done with the Spitfire, which then became the "Seafire." (The basic Seafire and its variants are described following the Griffon Spitfire write-ups.)

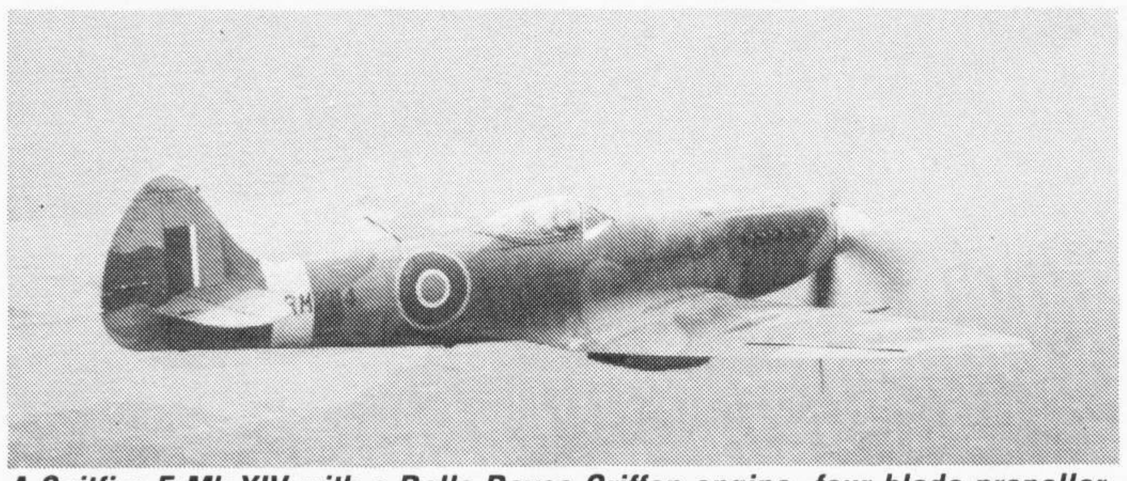
SPITFIRE WINGS

The basic Spitfire wing had an elliptical planform, a span of 36 feet, 10 inches and an area of 242 square feet. It was built in three types: A, B and C. The A-Wing had provision for four or eight .303-caliber machine guns entirely enclosed within it. The B-Wing had provision for two 20mm cannon in place of two machine guns. The C-Wing was called the "Universal Wing," and it could carry two 20mm cannons and either two or four .303 guns. The final wing was the E-Wing, which had only 1 inch more span but 2 feet more area, because of its different root and tip shapes. This wing was fitted with four 20mm cannons.



A Spitfire Mk VB of the 309th Fighter Squadron, 31st Fighter Group, with U.S. insignia. Note the bulge on the wing over the cannon breech and the hinge-down door necessary for pilot access to the narrow cockpit.

SUPERMARINE SPITFIRE



A Spitfire F.Mk XIV with a Rolls-Royce Griffon engine, four-blade propeller, cut-down rear fuselage with bubble canopy, and an enlarged vertical tail.

In all cases, the structure of the A-, B- and C-wings allowed for planform variations. The wing-tip panels could be removed and the ends covered to produce a "clipped wing" with a 32-foot, 7-inch span. The span could also be increased to 40 feet, 2 inches by adding new triangular tips in place of the ellipticals. These span changes could be made within the various Spitfire Marks without affecting the Mark numbers. Some of the Spitfire Mark numbers mentioned below were assigned to Seafires.

MERLIN-POWERED SPITFIRES

Mark I—This was the initial production model, with a 1,030hp Merlin II engine and a non-retractable tail wheel. The early straight-top canopy changed to the bulged type to increase the pilot's headroom and visibility. There were four .303 guns in the Mk I because of a shortage; but there were eight in the Mk IA. It had no protective armor. The Mk 1B had a B-Wing.

Mark II—This was just like the Mk I but had a 1,050hp Merlin XII engine and 73 pounds of armor. The Mk IIB had two 20mm cannons and four .303 guns in the B-Wing. A few flew in the Battle of Britain, and some were later converted to Mk V with more armor and a Merlin 45 engine.

Mark III—This was a single prototype, strengthened to take the two-stage Merlin XX engine that delivered 1,280hp for takeoff and 1,480hp at 12,250 feet. It had additional armor, a strengthened structure, a retractable tail wheel and clipped wings. The 1,000 production versions ordered were completed as "Mks V" and "IX," and a further 120 were cancelled.

P.R. Mark III—Unrelated to the Mk III prototype, many Mks I and II were fitted with cameras in the fuselage and redesignated "P.R. Mk III" (for "Photoreconnaissance").

P.R. Mark IV—This unarmed photoreconnaissance variant appeared in September 1941. Extra range was obtained by building fuel tanks into the leading edge of the wing, thereby eliminating the guns. Various cameras were in the fuselage, as they were on the P.R. Mk III.

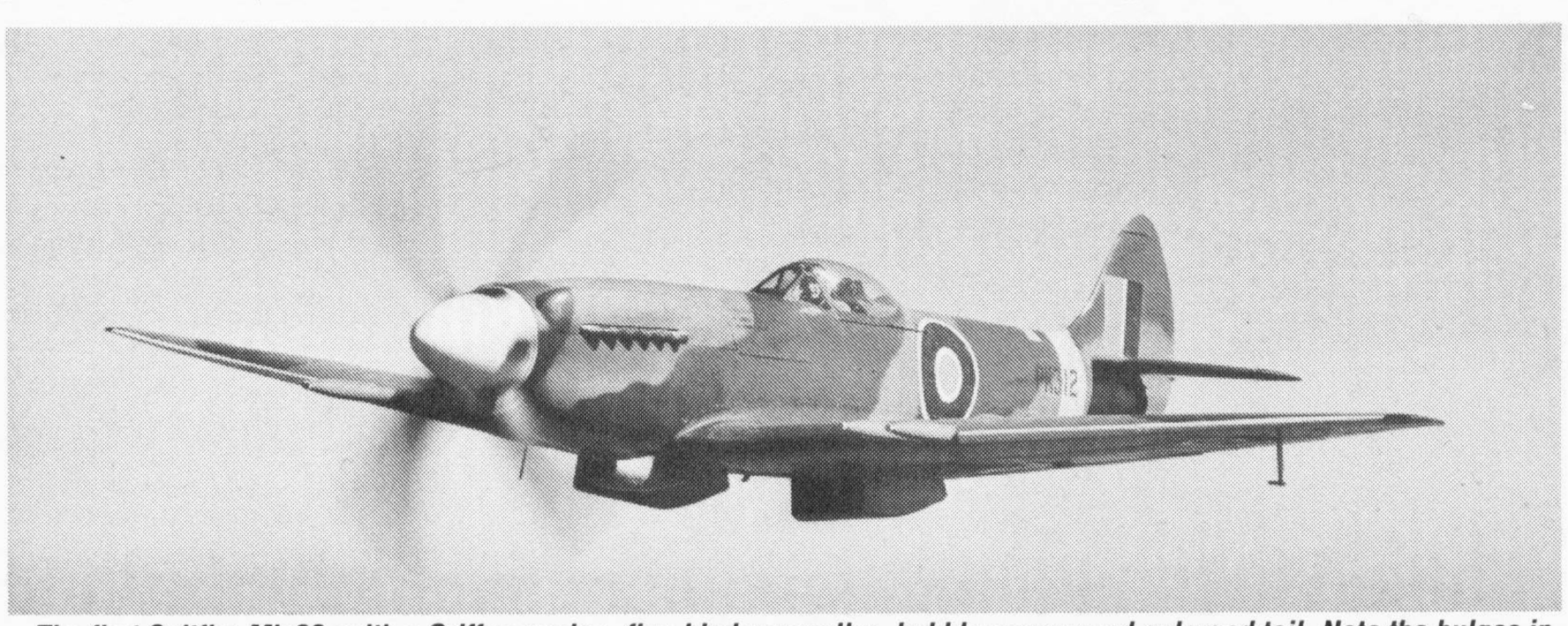
Mark V—A major advance, using the Merlin 45, 50, or 50A (1,470hp at 9,250 feet), or the -46 engine that delivered 1,415hp at 14,000 feet. Mks VB and VC could carry 115 or 175 Imperial gallon auxiliary tanks under the fuselage and either two 250- or one 500-pound bomb. The Mk VC introduced the C-Wing and entered service in March 1941. Some were modified for low-altitude work with 1,585hp Merlin 45M, 50M, or 55M engines, and were redesignated "L.F. Mk V" (for "Low-Altitude Fighter").

Mark VI—This high-altitude fighter with a pressurized cockpit and 1,415hp Merlin 47 engine was developed from the Mk VB. This model introduced the extended, pointed wing tips. Gross weight: 7,178 pounds; high speed: 364mph at 22,000 feet.

Mark VII—A designed-for-the-purpose high-altitude fighter with a two-stage, 1,710hp Merlin 64 engine, a C-Wing and a retractable tail wheel. It was delivered in April 1942. Gross weight: 7,875 pounds; high speed: 408mph at 25,000 feet.

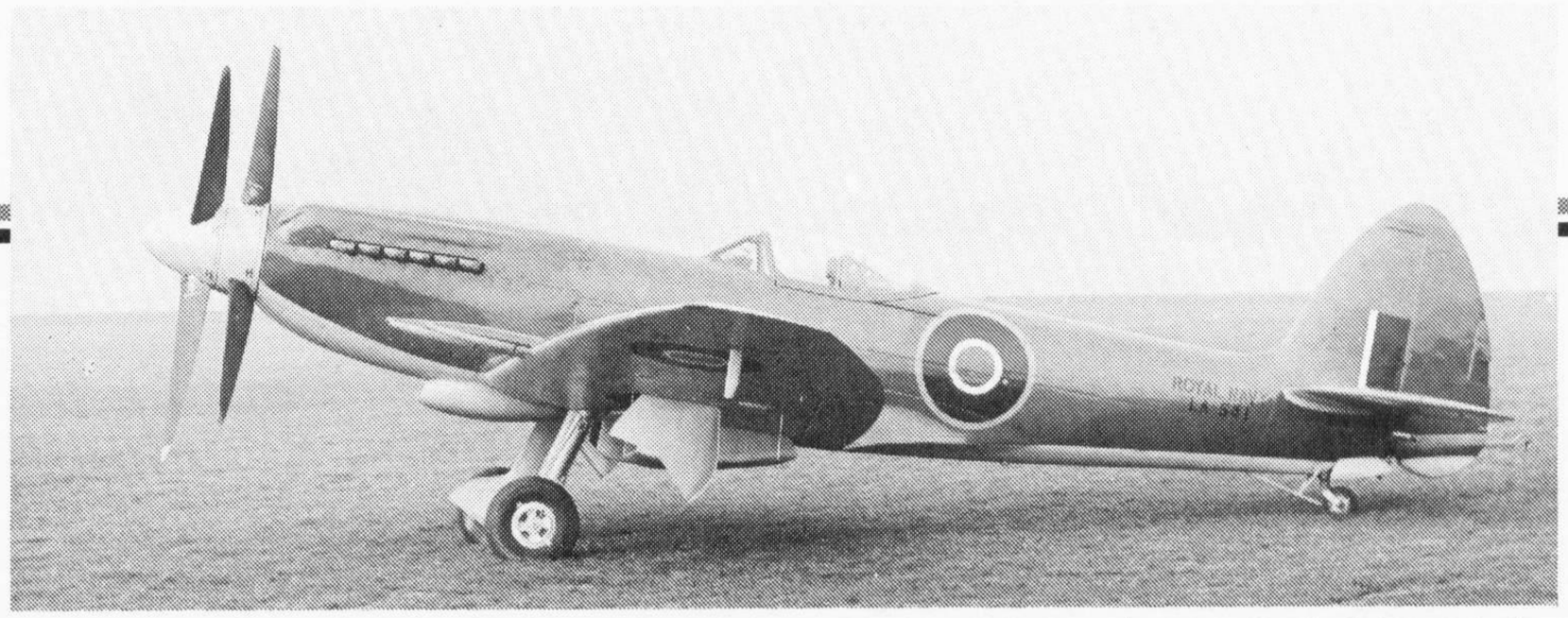
F. Mark VIII—This was similar to the Mk VII, but didn't have the pressurization. The high-altitude version with an extended wing was designated "H.F. Mk VIII"; the low-altitude version with clipped wings was designated "L.F. Mk VIII." Several Mk VIIIs were used for experimental modifications, but retained their "Mk VIII" designation.

Mark IX—With the Mk V outclassed by later Me 109s and the new Focke-Wulf Fw 190, Mk V airframes were refitted with 1,720hp Merlin 66 engines and redesignated "Mk IX." There were three versions—standard F, H.F. and L.F.—all with the Mk V's fixed tail wheel. Deliveries began in July 1942. H.F. Mk IX gross weight: 7,500 pounds; high



The first Spitfire Mk 22, with a Griffon engine, five-blade propeller, bubble canopy and enlarged tail. Note the bulges in the nose to cover the cylinder banks of the larger engine.

The final variant of the Spitfire line: the Seafire Mk 46 with contra-rotating propellers. Note the extension of the rudder carried by the stinger-type arrester hook. The later Mk 47 was very similar, except for its greater fuel capacity and folding wings.



speed: 416mph at 27,500 feet.

P.R. Mark X—A pressurized photo-reconnaissance version of the Mk IX.

P.R. Mark XI—Just like the P.R. Mk X but without pressurization. It was delivered in 1942.

Mark XVI—Similar to the Mk IX; some had a C-Wing, and later versions had an E-Wing and an enlarged vertical tail. Others had a cut-down rear fuselage and a bubble canopy. It was delivered in 1944 with a low-altitude, American-built Packard Merlin engine.

GRIFFON-POWERED SPITFIRES

The need for greater performance resulted in the installation of the 1,735-2,050hp Rolls-Royce Griffon engine. This was larger than the Merlin (2,240-cubic-inch displacement vs. 1,650). The larger size resulted in prominent bulges in the longer nose to cover the cylinder banks. Four- and five-blade propellers were used, and some variants used two three-blade counter-rotating propellers. Altogether, 2,053 Spitfires were delivered with Griffon engines.

Mark IV—The Griffon prototype, with a 1,735hp engine, a four-blade propeller and an extensively reinforced structure. A mock-up wing was fitted with six 20mm cannon, but no six-cannon Spitfire was ever produced. To avoid confusion with the Merlin-powered P.R. Mk IV, the Mk IV prototype was redesignated "Mk XX."

Mark XII—Built in two versions: a strengthened Mk VC airframe for low-altitude fighting with a fixed tail wheel; and a Mk VIII airframe with retractable tail wheels. All entered service early in 1943 and had larger vertical tails and four-blade propellers. Gross weight: 7,400 pounds; high speed: 393mph at 18,000 feet.

Mark XIV— These had Mk VIII airframes with five-blade propellers. Some late articles had cut-down rear fuselages and bubble canopies. The F.R. Mk XIVE was a fighter-reconnaissance variant with fuselage cameras and a 2,050hp Griffon 65 engine. Gross weight: 8,500 pounds; high speed: 448mph at 26,000 feet.

Mark XVIII—Built from scratch in two versions: the F.Mk XVIII fighters and the F.R. Mk XVIII fighter-reconnaissance planes. Both versions had a reinforced fuselage and wing, and carried additional fuel. They were delivered too late to serve in the war.

P.R. Mark XIX—Unarmed Mk XIV airframes with a Mk VC wing. The first 20 weren't pressurized, but the final 225 were. They were operational in the closing months of the war.

Mark XX—The Mk IV prototype redesignated.

Mark 21—A major redesign with new E-Wing and fuselage structure but old-style cockpit canopy. Its powerplant was a 2,050hp Griffon 61 engine driving a five-blade propeller. It had four-cannon armament. This design was made too late for combat; only 122 of the 1,500 Mk 21s ordered were built. Gross weight: 9,200 pounds; high speed: 454mph at 26,000 feet.

Mark 22—This was similar to the Mk 22, except for its cut-down rear fuselage and bubble canopy. Some had contra-rotating propellers.

Mark 24—The last of 21,767 Spitfires and Seafires built was the Mk 24, which was similar to the Mk 22, but had increased fuel capacity. The last one was delivered to the R.A.F. in October 1947.

SEAFIRES

Mark IB—This was a conversion of A-Wing Mk VB Spitfires with A-frame arrester hooks (see "Hawker Sea Hurricane"). They were put into service in June 1942. Seafires participated in the invasion of North Africa in November 1942.

Mark IIC—These were built as new airframes similar to the Mk VC Spitfires with C-Wings. It came in two versions, the F. Mk IIC and the L.F. Mk IIC; the latter had a 1,645hp Merlin 32 engine and four-blade propeller. Some L.F. IICs were fitted with cameras and operated as "P.R. Mk IIC."

Mark III—A disadvantage of the early Seafires was their lack of folding wings for shipboard storage. On the designed-for-the-purpose Mk III, the outer wing panels folded upward near the root, and the tips folded downward to reduce the height and clear the ceiling of the below-deck hangars. Its armament was two 20mm cannon and four .303 guns. The fuselage was reinforced for catapult launching, and up to 500 pounds of bombs could be carried. Variants were the L.F. Mk III and F.R. Mk III. Engine: 1,470hp Merlin 55; gross weight: 7,100 pounds; high speed: 352mph at 12,250 feet.

Mark XV—This was essentially a sea-going variant of the Mk XII Spitfire, with a 1,850hp Griffon VI engine and a four-blade propeller. After the first 50, the arrester hook was changed from the A-frame type to a stinger type below the rudder which was fitted with a fairing that continued the rudder contour. Gross weight: 8,000 pounds; high speed: 383mph at 13,500 feet.

Mark XVII—Similar to the Mk XV except for the bubble canopy.

Mark 45—The postwar equivalent of the Spitfire Mk 22, with non-folding wings and a Griffon 61 engine with a five-blade propeller.

Mark 46—Similar to the Mk 45, except that it was powered by a Griffon 87 engine driving co-axial propellers. Also, it had the fuselage structure and bubble canopy of the Spitfire Mk 22.

Mark 47—Similar to the Mk 46, except that its wings folded upward outboard of the cannon, and it wasn't necessary to fold the wing tips.

GROUND TRANSPORT

THE SPITFIRE MK.Vb FIGHTER IS TRANSPORTABLE ON THE GROUND BY DISASSEMBLY INTO FOUR COMPONENTS:

COMPONENT NO.1.
- MAIN FUSELAGE.
- ENGINE MOUNT.
- ENGINE OIL TANK.
- FUEL TANKS.
- FLIGHT CONTROLS.
- PILOT'S EQUIPMENT.
- HYDRAULIC COMPONENTS.

COMPONENT NO.2.
- MAIN PLANE.
- LANDING GEAR.
- WING FLAPS.
- AILERON AND WING FLAP CONTROLS.
- LANDING LIGHTS.
- ARMAMENT.

COMPONENT NO.3.
- EMPENNAGE AND TAIL PLANE CONTROL COUNTER SHAFT.
- TAIL WHEEL.

COMPONENT NENT NO. 4.
- ENGINE AND ACCESSORIES.
- COOLANT HEADER TANK.
- FRONT COWLING RING.

ENGINE INSTALLATION

THIS PLANE CAN BE EQUIPPED WITH SEVERAL VERSIONS OF THE ROLLS ROYCE MERLIN 12-CYLINDER VEE TYPE ENGINES. THE ENGINES ARE LIQUID COOLED AND SUPERCHARGED. THE ENGINE DRIVES A THREE BLADE CONTROLLABLE PITCH PROPELLER.

TROPICAL USE

FOR TROPICAL USE, A HOT AND COLD AIR INDUCTION SYSTEM IS INSTALLED WHICH HAS AN AIR FILTER, A LARGER ENGINE OIL TANK, A LARGER RADIATOR, AND A LARGER ENGINE OIL COOLER OIL DUCT OUTLET.

ENGINE ACCESSORIES

AIR COMPRESSOR.
ENGINE-DRIVEN GENERATOR(12-VOLT).
PROPELLER CONSTANT SPEED UNIT.
VACUUM PUMP.
ENGINE OIL DILUTION VALVE.
HYDRAULIC FLUID PUMP.
ENGINE COOLANT PUMP.
ENGINE OIL PUMP.
MANUAL FUEL PRIMER AND ENGINE FUEL PUMP.
ENGINE STARTER (ELECTRIC TYPE).
CARBURETOR.
MAGNETOS.

ENGINE MOUNT

THE ENGINE MOUNT IS A RIVETED TUBULAR STEEL STRUCTURAL CONFIGURATION. IT IS ATTACHED BY MEANS OF TAPERED BOLTS PASSING THROUGH LUGS ATTACHED TO THE FUSELAGE FIREWALL. A BUILT-UP U-SHAPE MEMBER IS PART OF THE MOUNT AND HAS BLOCKS TO WHICH THE ENGINE MOUNTING LUGS ARE ATTACHED. BRACKETS AND CLIPS ARE RIVETED TO THE TUBULAR MEMBERS FOR SECURING SUPPLY PIPES, LINES, ACTUATING PUSH-PULL TUBES, HOSES, ETC.

ENGINE CONTROLS

THE THROTTLE AND FUEL MIXTURE CONTROLS ARE HOUSED IN A QUADRANT ON THE LEFT SIDE OF THE COCKPIT. POSITION OF EACH LEVER IS MAINTAINED BY FRICTION PLATES. A SLOT IS PROVIDED FOR EACH LEVER AND A GATE FOR THE THROTTLE IN THE TAKE-OFF POSITION. THE FUEL MIXTURE LEVER CAN ONLY BE SET IN THE WEAK AND RICH POSITIONS. AN AUXILIARY CONTROL IS PROVIDED TO OVER-RIDE THE ENGINE AUTOMATIC BOOST CONTROL IN AN EMERGENCY.

PROPELLER CONTROL

THIS CONTROL IS MOUNTED ON THE ENGINE CONTROL QUADRANT (MANUALLY OPERABLE)

LDG. GR. POSITION INDICATOR SWITCH

A SWITCH FOR THE LANDING GEAR POSITION INDICATOR IS MOUNTED ON THE AFT PORTION OF THE ENGINE CONTROL QUADRANT AND IS OPERATED BY A STRIKER ON THE THROTTLE LEVER.

SLOW RUNNING CUT-OUT CONTROL

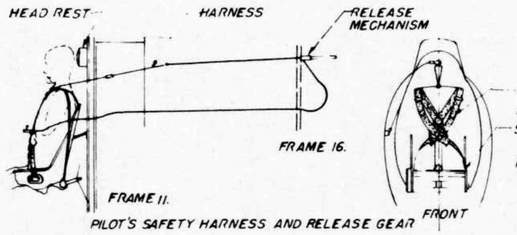
THE ENGINE IS EQUIPPED WITH A SLOW-RUNNING CUT-OUT CONTROL ON THE CARBURETOR WHEN STOPPING THE ENGINE. THIS CONTROL IS ACTUATED BY A PULL-RING ON THE INSTRUMENT PANEL.

ENGINE COOLANT RADIATOR

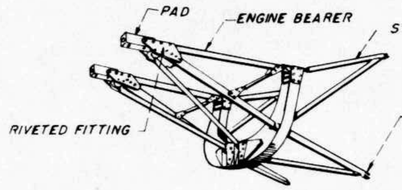
THE COOLANT RADIATOR IS MOUNTED UNDERSIDE OF THE RIGHT WING. IT IS ENCLOSED IN A FAIRING OPEN AT THE FRONT AND REAR. A COOLING FLAP IS PROVIDED TO REGULATE THE VOLUME OF AIR FLOWING THROUGH THE CORE AND THUS THE RATE OF COOLING. THE FLAP IS MANUALLY CONTROLLABLE.

ENGINE COOLANT

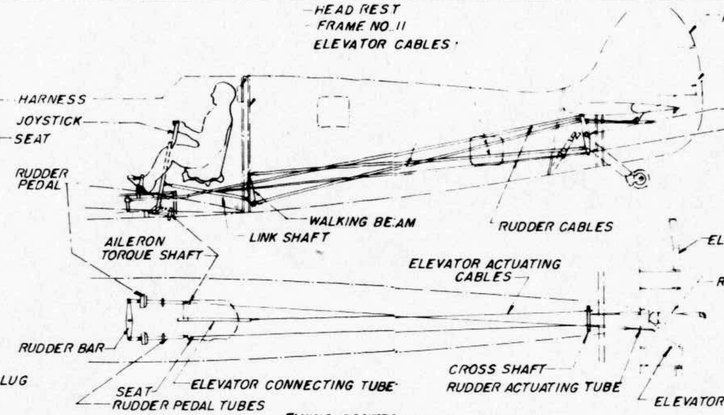
THE LIQUID COOLANT USED IN THE COOLANT SYSTEM IS A MIXTURE OF 70% DISTILLED WATER AND 30% ETHYLENE GLYCOL. THE ENGINE COOLANT TEMPERATURE IS CONTROLLED BY A THERMOSTAT.



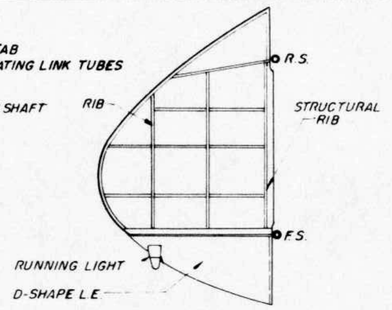
PILOT'S SAFETY HARNESS AND RELEASE GEAR



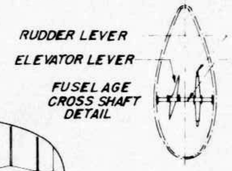
PERSPECTIVE DRAWING OF ENGINE MOUNT

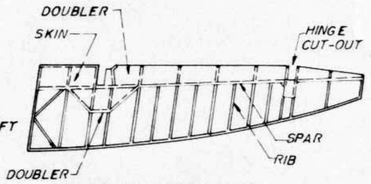


FLYING CONTROLS IN THE FUSELAGE



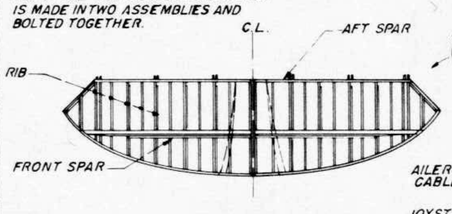
WING TIP - SKIN REMOVED SHOWING STRUCTURE





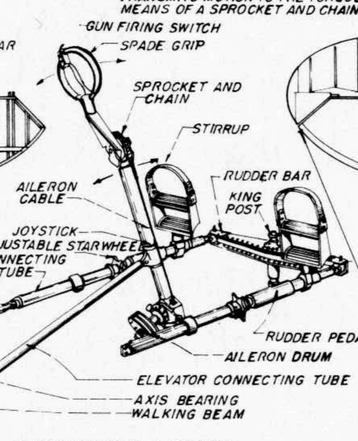
AILERON STRUCTURE
(SKIN PARTIALLY REMOVED)
NOTE: R.H. AND L.H. ARE SIMILAR IN CONSTRUCTION.

NOTE: THE HORIZONTAL STABILIZER IS MADE IN TWO ASSEMBLIES AND BOLTED TOGETHER.



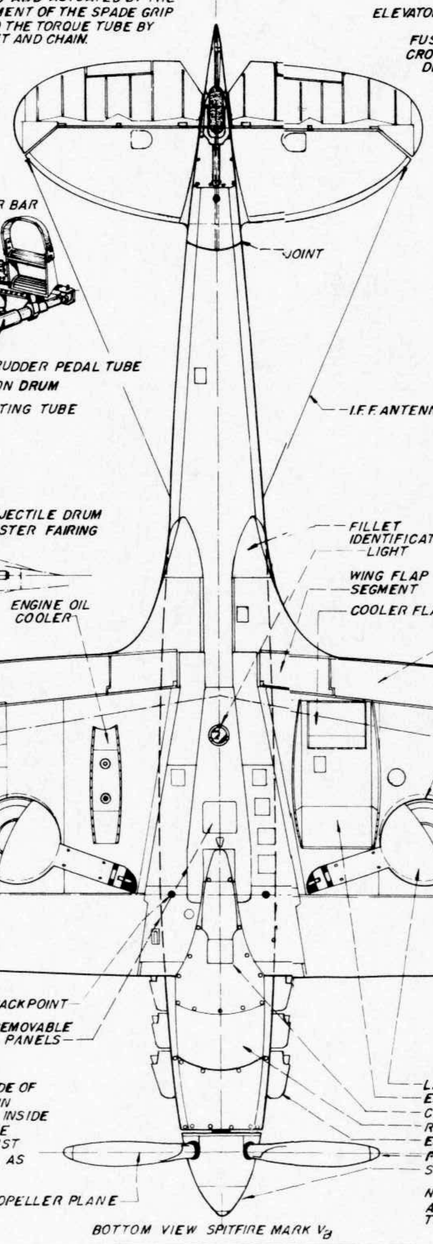
MK.Vb HORIZONTAL STABILIZER (SKIN REMOVED)

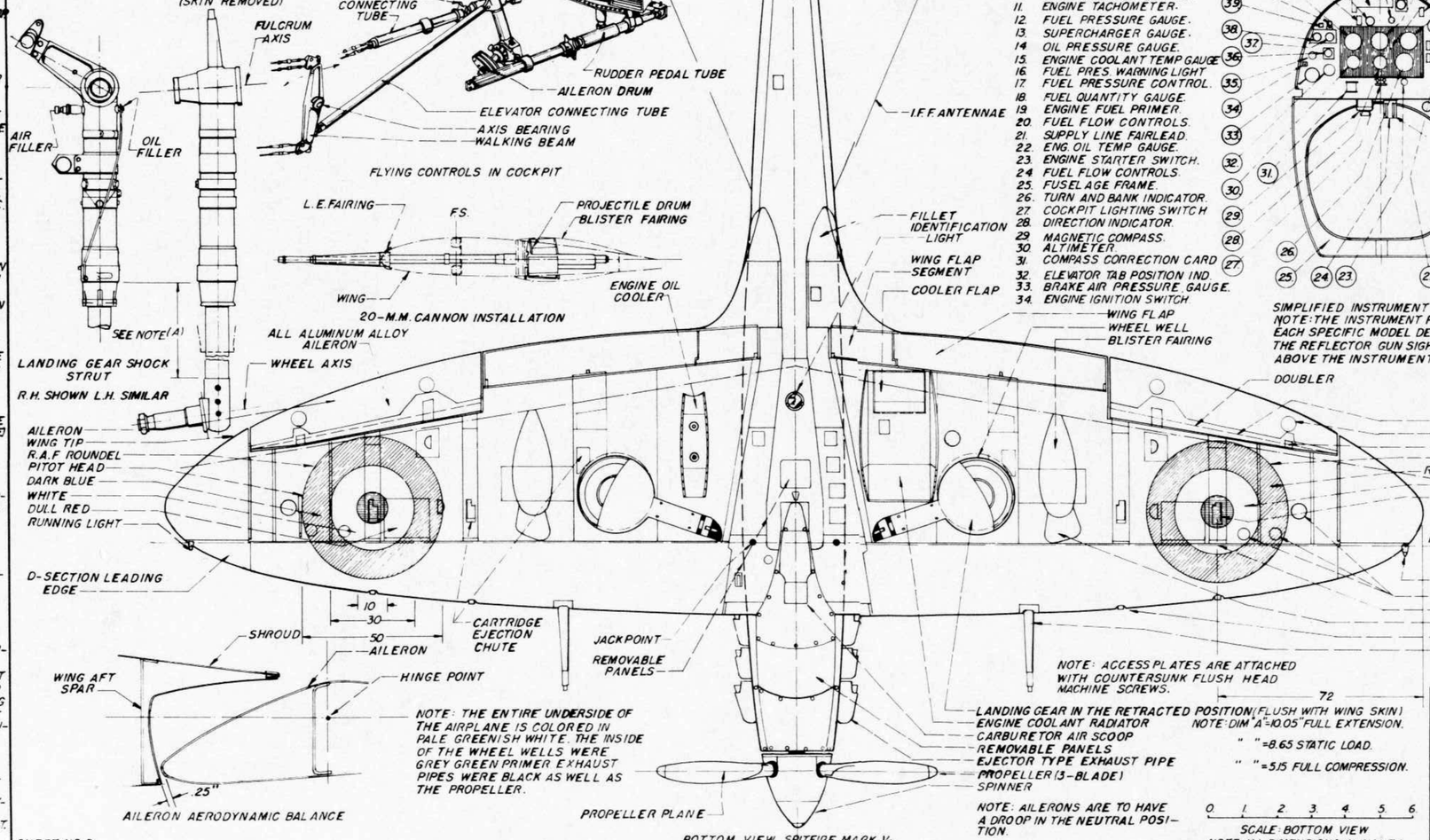
NOTE: THE AILERONS ARE CABLE ACTUATED. THE CABLES ARE WRAPPED ABOUT THE DRUM WHICH IS ATTACHED TO AND ACTUATED BY THE TORQUE TUBE. MOVEMENT OF THE SPADE GRIP TRANSMITS MOTION TO THE TORQUE TUBE BY MEANS OF A SPROCKET AND CHAIN.



FLYING CONTROLS IN COCKPIT

20-M.M. CANNON INSTALLATION

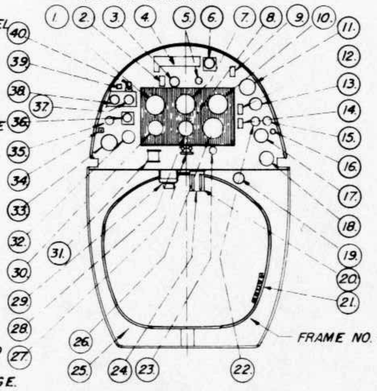




BOTTOM VIEW SPITFIRE MARK Vb

PILOT'S INSTRUMENT PANEL CALL-OUTS

1. AIRSPEED INDICATOR.
2. REFLECTING GUN SIGHT SWITCH.
3. SWITCH.
4. SUN SCREEN.
5. SWITCH.
6. VOLTMETER.
7. ARTIFICIAL HORIZON.
8. STANDARD INSTRUMENT PANEL.
9. SWITCH.
10. RATE OF CLIMB INDICATOR.
11. ENGINE TACHOMETER.
12. FUEL PRESSURE GAUGE.
13. SUPERCHARGER GAUGE.
14. OIL PRESSURE GAUGE.
15. ENGINE COOLANT TEMP GAUGE.
16. FUEL PRES. WARNING LIGHT.
17. FUEL PRESSURE CONTROL.
18. FUEL QUANTITY GAUGE.
19. ENGINE FUEL PRIMER.
20. FUEL FLOW CONTROLS.
21. SUPPLY LINE FAIRLEAD.
22. ENG. OIL TEMP GAUGE.
23. ENGINE STARTER SWITCH.
24. FUEL FLOW CONTROLS.
25. FUSELAGE FRAME.
26. TURN AND BANK INDICATOR.
27. COCKPIT LIGHTING SWITCH
28. DIRECTION INDICATOR.
29. MAGNETIC COMPASS.
30. ALTIMETER
31. COMPASS CORRECTION CARD
32. ELEVATOR TAB POSITION IND.
33. BRAKE AIR PRESSURE GAUGE.
34. ENGINE IGNITION SWITCH.
35. CLOCK.
36. LANDING GEAR POSITION INDICATOR.
37. OXYGEN FLOW INDICATOR.
38. OXYGEN GAUGE.
39. LANDING LIGHT SWITCH.
40. WING FLAP CONTROL.



SIMPLIFIED INSTRUMENT PANEL
NOTE: THE INSTRUMENT PANEL VARIED WITH EACH SPECIFIC MODEL DESIGNATION. THE REFLECTOR GUN SIGHT WAS INSTALLED ABOVE THE INSTRUMENT PANEL.

ENGINE COOLANT HEADER TANK

THE LIQUID COOLANT HEADER TANK IS PRIMARILY AN EXPANSION SPACE FOR THE COOLANT AFTER IT REACHES OPERATING TEMPERATURE. IT IS PROVIDED WITH A PRESSURE RELIEF VALVE WHICH FUNCTIONS AT 2.5 P.S.I. ABOVE SEA LEVEL ATMOSPHERIC PRESSURE. THE PRESSURE VALVE IS THERMOSTATICALLY CONTROLLED.

GUN HEATERS

THE COOLING FLAP IS OPERABLE THROUGH SEVERAL SETTINGS. AT HIGH ALTITUDES THE FLAP IS CLOSED. IN THIS POSITION THE WARM AIR FLOWING THROUGH THE RADIATOR IS DIVERTED INTO WARM AIR DUCTS INTO THE GUN POSITIONS TO KEEP THE GUNS OPERATIVE.

FUEL SYSTEM

THE FUEL SYSTEM OBTAINS THE SUPPLY FROM TWO FUEL TANKS LOCATED IN THE FUSELAGE AFT OF THE FIREWALL BULKHEAD. THE 37 GALLON TANK IS MOUNTED IN THE BOTTOM OF THE FUSELAGE AND THE 48 GALLON TANK IS MOUNTED ABOVE IT. BOTH TANKS ARE INTERCONNECTED A REMOTE CONTROL FUEL COCK CONTROLS THE FUEL SUPPLY. REMOTE INDICATING FUEL QUANTITY GAUGE IS INSTALLED. FUEL FLOW TO THE CARBURETOR IS PUMPED BY AN ENGINE-DRIVEN FUEL PUMP. AN IMMERSED ELECTRICALLY-DRIVEN FUEL BOOSTER PUMP IS FITTED IN THE LOWER TANK. THIS PUMP IS OPERATED BY SWITCH IN THE COCKPIT FOR HIGH ALTITUDE OPERATION.

FUEL INDUCTION PRIMING SYSTEM

A MANUALLY OPERATED FUEL PRIMING SYSTEM PUMP IS USED TO PRIME THE FUEL INDUCTION PIPES WHEN STARTING THE ENGINE.

LONG RANGE DROP TANKS

FOR LONG RANGE OPERATIONS, A 170 GALLON DROP TANK IS FITTED TO THE FUSELAGE. THE FUEL TANK IN THE FUSELAGE BEHIND THE PILOT'S COCKPIT IS USED IN CONJUNCTION WITH THE LONG RANGE TANK. A MANUAL RELEASE PERMITS THE PILOT TO JETTISON THE TANK IN FLIGHT.

ENGINE OIL SYSTEM

THE ENGINE OIL TANK HOLDS 8.5 GALLONS AND 2.6 GALLONS EXPANSION SPACE. FOR LONG RANGE OR TROPICAL OPERATIONS, A 17 GALLON OIL TANK IS FITTED. THE TANK IS ATTACHED TO THE UNDERSIDE OF THE ENGINE MOUNT.

ENGINE OIL DILUTION SYSTEM

TO FACILITATE FAST ENGINE STARTS, AN ELECTRICALLY OPERATED SOLENOID FUEL VALVE, ALLOWS ENGINE FUEL TO FLOW INTO THE OIL TANK AND DILUTE THE ENGINE OIL. (OPERABLE BY THE PILOT).

ENGINE OIL COOLERS

THE TWO ENGINE OIL COOLERS ARE MOUNTED IN TANDEM ON THE UNDERSIDE OF LEFT WING AND SECURED IN A CRADLE. EACH COOLER HAS A DRAIN PLUG AND A BY-PASS VALVE. THE OIL COOLERS ARE ENCLOSED IN A FAIRING.

ENGINE OIL TANK

THE OIL TANK FILLER IS LOCATED LEFT SIDE OF THE FUSELAGE AND ITS POSITION DETERMINES THE CORRECT LEVEL OF OIL IN THE TANK WHEN THE PLANE IS IN THE TAIL DOWN POSITION. THE INTERIOR OF THE TANK IS FITTED WITH BAFFLES TO ASSURE PROPER MIXING OF HEATED RETURN OIL FROM THE ENGINE WITH THE REST OF THE OIL IN THE TANK. THE CONTOUR OF THE TANK CONFORMS TO THE FUSELAGE.

ENGINE HAND TURNING GEAR.

A MANUAL STARTER IS NOT PROVIDED BUT A HANDLE IS PROVIDED TO TURN THE ENGINE CRANKSHAFT FOR MAINTENANCE FUNCTIONS.

ELECTRICAL ENGINE STARTER

THE ENGINE IS STARTED BY MEANS OF AN ELECTRICAL ENGINE STARTER. IT IS ENERGIZED BY A STARTING SWITCH OPERABLE BY THE PILOT. 12-VOLT ELECTRICAL ENERGY IS SUPPLIED BY A STORAGE BATTERY. PROVISION IS ALSO MADE FOR STARTING BY MEANS OF EXTERNAL POWER. THE STARTER MOTOR IS FITTED TO THE RIGHT SIDE OF THE ENGINE. A STARTING BOOSTER COIL IS MOUNTED ON THE RIGHT SIDE OF THE ENGINE FIREWALL BULKHEAD.

SPITFIRE

FIGHTER-INTERCEPTER ROYAL AIR FORCE 1939-1945

BUILT BY: SUPERMARINE (VICKERS ARMSTRONG - WHITWORTH)

DRAWN BY: WILLIS L. NYE A.A.H.S. FOR MODEL AIRPLANE NEWS

ELECTRICAL SYSTEM

THE ELECTRICAL EQUIPMENT PROVIDES ENERGY FOR LIGHTING, NAVIGATION, IDENTIFICATION LIGHTS, COMMUNICATION, HEATING, ENGINE STARTING, GUN SIGHT, LANDING WARNING AND POSITION INDICATOR, ENGINE OIL DILUTION VALVE, FUEL PRESSURE INDICATOR, FUEL QUANTITY INDICATOR AND GUN CAMERA.

FUSED CIRCUITS

THE ELECTRICAL SYSTEM CIRCUITRY CONSISTS OF THE FOLLOWING:

- TWO SPARE CIRCUITS.
- NAVIGATION LIGHTS.
- LANDING LIGHT(LEFT) AND GUNSIGHT.
- RIGHT LANDING LIGHT.
- IDENTIFICATION LIGHTS AND THE FUEL QUANTITY INDICATOR.
- LANDING GEAR POSITION INDICATOR.
- LANDING GEAR WARNING HORN.
- GUN CAMERA.
- HEATED PITOT HEAD.
- ENGINE STARTER.
- RADIO CONTACTOR.
- RADIO EQUIPMENT A.R.I.-5000.
- ENGINE-DRIVEN GENERATOR CONTROL.
- ENGINE OIL DILUTION VALVE.
- HEATED CLOTHING.
- A.R.I. DESTRUCTOR.
- RADIO T.R.1133

STORAGE BATTERY

DURING FLIGHT, THE ENGINE-DRIVEN GENERATOR CHARGES A 12-VOLT STORAGE BATTERY. THE CIRCUIT IS SHIELDED TO SUPPRESS RADIO INTERFERENCE. A VOLTAGE REGULATOR MAINTAINS CONSTANT VOLTAGE. 750 WATT POWER SYSTEM.

BONDING AND SHIELDING

THE ENTIRE AIRPLANE STRUCTURE IS BONDED AND SHIELDED TO PREVENT INTERFERENCE WITH RADIO OPERATION.

AIRPLANE LIGHTS

- INSTRUMENT LIGHTS (2).
- LANDING LIGHTS (2).
- IDENTIFICATION LIGHTS (3).
- REFLECTOR GUN SIGHT LIGHT.

IDENTIFICATION LAMPS CAN BE CODED BY MEANS OF A MORSE KEY SWITCH. LANDING LIGHTS ARE RETRACTABLE. REFLECTOR GUN SIGHT HAS AN "OFF" AND A NIGHT AND DAY SWITCH.

COMMUNICATION EQUIPMENT

AN A.R.I. RADIO INSTALLATION FOR COMMUNICATION IS INSTALLED IN THE FUSELAGE AFT OF THE PILOT'S COCKPIT. POWER FOR OPERATION IS DERIVED FROM THE PRIME POWER SUPPLY. THE INSTALLATION CONSISTS OF THE FOLLOWING:

- TRANSMITTER.
- RECEIVER.
- ELECTRICAL CONTROL UNIT.
- ANTENNAE.
- REMOTE CONTROLS.
- JUNCTION BOX.
- POWER UNIT.
- RADIO BEAM EQUIPMENT.
- ELECTRICAL HARNESS.
- I.F.F. EQUIPMENT.
- HYDRAULIC SYSTEM

THE HYDRAULIC SYSTEM CONSISTS OF THE FOLLOWING:

- HYDRAULIC FLUID RESERVOIR.
- ENGINE-DRIVEN HYDRAULIC PUMP.
- POSITION SELECTOR VALVE.
- PRESSURE RELIEF VALVE.
- ACTUATING CYLINDERS.
- CHECK VALVES.
- SHUTTLE VALVES.
- FLUID SUPPLY LINES.

THE HYDRAULIC SYSTEM IS USED TO RETRACT AND EXTEND THE LANDING GEAR. ACTUATING CYLINDERS FUNCTION IN A LINKAGE ASSEMBLY TO OPERATE THE LANDING GEAR. THE FLUID UNDER PRESSURE FLOWS THROUGH THE SUPPLY LINES TO THE MANUALLY OPERATED CONTROL VALVE.

L.G. EMERGENCY EXTENSION SYSTEM

IF THE HYDRAULIC SYSTEM FAILS, A CYLYNDER OF COMPRESSED CARBON-DIOXIDE GAS IS PROVIDED. THIS GAS IS RELEASED IN AN EMERGENCY BY THE PILOT AND FLOWS INTO THE ACTUATING CYLINDER BY MEANS OF THE SHUTTLE VALVES WHICH SEAL OFF THE NORMAL SYSTEM WHEN EMERGENCY ACTION IS MANDATORY. A SPECIAL CONTROL LEVER IS PROVIDED FOR THE PILOT'S EMERGENCY USE.

PNEUMATIC SYSTEM

COMPRESSED AIR FOR THIS SYSTEM IS OBTAINED FROM AN ENGINE-DRIVEN AIR COMPRESSOR. AIR UNDER PRESSURE IS STORED IN TWO PRESSURE BOTTLES. THE FOLLOWING ARE OPERABLE:

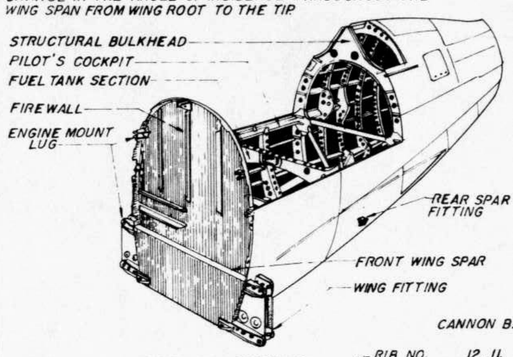
- CAMERA GUN.
- TRAILING EDGE WING FLAPS(2).
- LANDING GEAR BRAKES(2).
- GUN CHARGERS(4).
- AIR CONTROL VALVES.
- LANDING LIGHTS (2).
- WING FLAP ACTUATING CYLINDERS(2).
- RESTRICTOR VALVES.
- GUN FIRING.

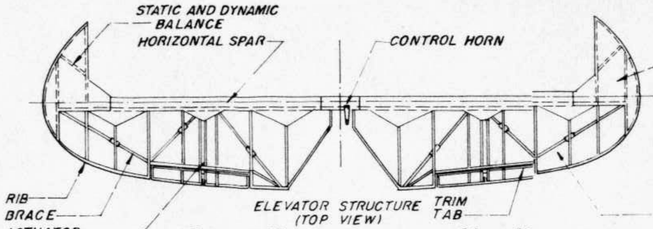
NOTE: THE MAIN PLANES EACH COMPRIZE A LEADING EDGE D-SPAR, AN AUXILIARY AFT SPAR AND VARIOUS PLATE RIBS, THE WHOLE BEING COVERED WITH ALCLAD AND DURALUMIN SHEET. STRUCTURAL MEMBERS ARE FITTED AT THE WHEEL WELL, GUN BAYS AND MAGAZINE BAYS. WINGS HAD A CHANGE IN THE ANGLE OF INCIDENCE THROUGHOUT THE WING SPAN FROM WING ROOT TO THE TIP.

WING

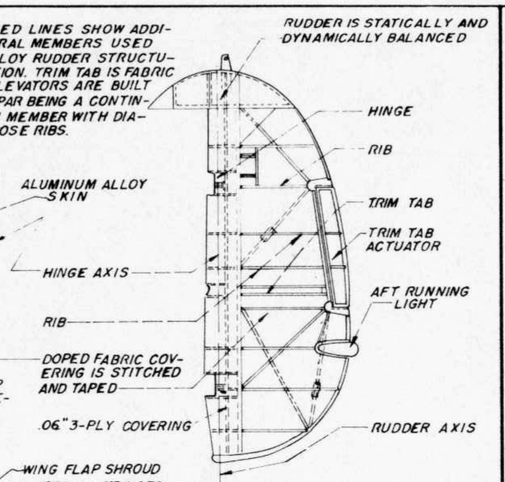
RIB	ANGLE OF INCIDENCE
2	2°-0°
3	1°-57'
4	1°-52'
5	1°-46'
6	1°-38'
7	1°-31'
8	1°-24'
9	1°-17'
10	1°-11'
11	1°-4'
12	0°-58'
13	0°-51'
14	0°-45'
15	0°-38'
16	0°-30'
17	0°-22'
18	0°-15'
19	0°-7'
20	0°-0'
21	0°-8'

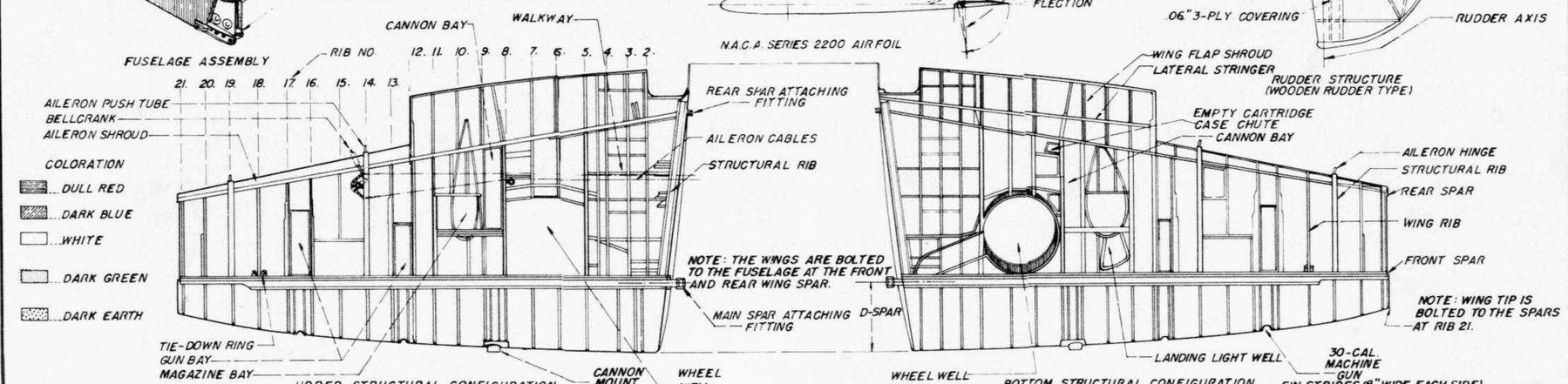
NOTE: THE TOP AND BOTTOM WING LEADING EDGE TOP AND BOTTOM SKIN FROM THE D-SPAR FORWARD WERE ATTACHED WITH FLUSH RIVETS WITH POLISHED AND FILLED HEADS. FLUSH RIVETS WITH UNFILLED HEADS WERE USED AFT OF WING SPAR, TAIL PLANE AND VERTICAL STABILIZER.





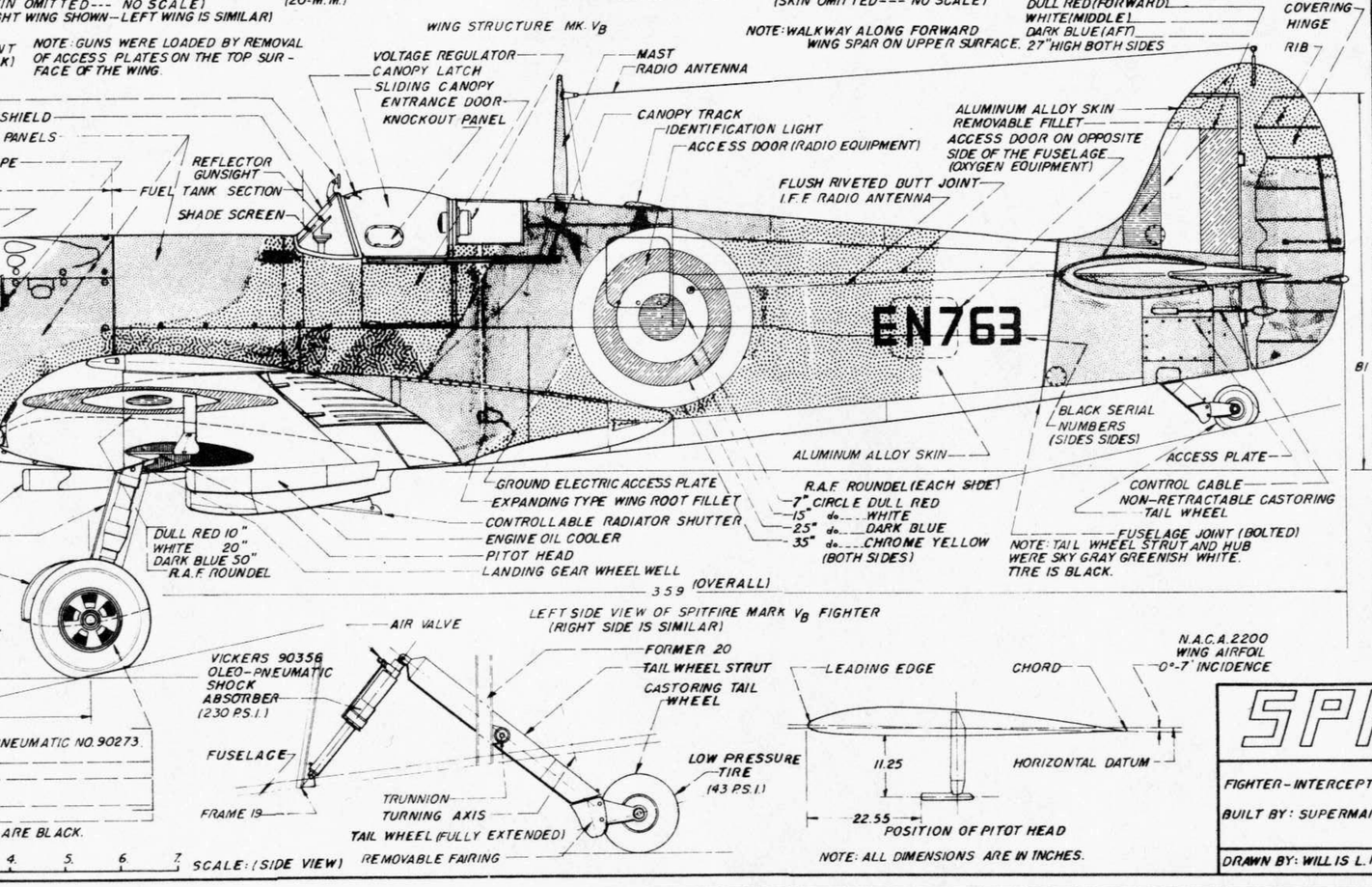
NOTE: THE DASHED LINES SHOW ADDITIONAL STRUCTURAL MEMBERS USED IN ALUMINUM ALLOY RUDDER STRUCTURAL CONFIGURATION. TRIM TAB IS FABRIC COVERED. THE ELEVATORS ARE BUILT AS A UNIT. THE SPAR BEING A CONTINUOUS "D" SECTION MEMBER WITH DIAPHRAGM TYPE NOSE RIBS.





NOTE: GUNS WERE LOADED BY REMOVAL OF ACCESS PLATES ON THE TOP SURFACE OF THE WING.

NOTE: WALKWAY ALONG FORWARD WING SPAR ON UPPER SURFACE. 27" HIGH BOTH SIDES



SHOCK ABSORBER STRUTS -- VICKERS OLEO-PNEUMATIC NO. 90273
AIR INFLATION PRESSURE -- 455 P.S.I.
WHEELS -- DUNLOP A.H. 2061
TIRES -- 11.12
AIR INFLATION PRESSURE -- 55 P.S.I.
PNEUMATIC BRAKES
L.G. COLORATION IS SILVER (WHEEL HUB). TIRES ARE BLACK.
* TAIL DOWN POSITION.

SHEET NO. 4

SCALE: (SIDE VIEW) 0 1 2 3 4 5 6 7

NOTE: ALL DIMENSIONS ARE IN INCHES.

ARMAMENT

ALL ARMAMENT IS FITTED WITHIN THE WING. THE OPERATIONAL EQUIPMENT INCLUDES THE FOLLOWING:

- CAMERA GUN.
- RECONNAISSANCE FLARE TUBE.
- COMMUNICATION EQUIPMENT.
- TWO LANDING LIGHTS.
- OXYGEN SYSTEM.
- NAVIGATION LIGHTS.
- IDENTIFICATION LIGHTS.
- SIGNAL DISCHARGER.
- WINDSHIELD DEICING.
- BROWNING .303 GUNS. (4).
- HISPANO 20-M.M. CANNON (2).
- GUN MOUNTS.
- AMMUNITION BOXES.
- GUN HEATERS.
- GUN CHARGERS.
- GUN BLAST TUBES.

THE FOUR BROWNING .303 MACHINE GUNS ARE MOUNTED AFT OF MAIN WING SPAR AND FIRE THROUGH TUNNELS IN THE WING LEADING EDGE. THE TWO HISPANO 20-M.M. ARE MOUNTED ON THEIR SIDES OUTBOARD OF THE UNDERCARRIAGE WING RECESS. THE GUNS ARE SUPPORTED AT THE LEADING EDGE AND ON RIB NO.8. THE FORWARD MOUNT ABSORBS RECOIL LOADS. SIXTY ROUND DRUM TYPE MAGAZINES ARE FITTED TO THE CANNONS. ALL GUNS ARE ADJUSTABLE IN THEIR MOUNTS FOR HARMONIZING AND BORE SIGHTING. AMMUNITION BOXES ARE MOUNTED LATERALLY BETWEEN THE GUNS. FOR THE CANNON A MAGAZINE IS MOUNTED ON IT. EACH CYLINDER MAGAZINE CONTAINS 60 PROJECTILES AND EACH AMMO BOX 350 CARTRIDGES. THE GUNS ARE HEATED BY WARM AIR FLOWING THROUGH DUCTS BLEEDING HEATED AIR AFT OF THE ENGINE COOLANT RADIATOR. AMMO BOXES AND MAGAZINE ARE REPLENISHED BY REMOVAL OF ACCESS PLATES IN THE TOP SURFACE OF THE WING. EACH GUN IS FIRED BY PNEUMATIC MEANS.

ARMOR PLATE

ARMOR PLATE IS LOCATED AS FOLLOWS:

- HEAD REST FOR PILOT.
- FRONT OF UPPER FUEL TANK.
- FRONT OF HEADER TANK.
- PILOT'S SEAT (BACK AND BOTTOM)
- AMMO BOXES (FRONT, TOP, BOTTOM).

SIGNAL DISCHARGER

A 1.5" SIGNAL DISCHARGER IS MOUNTED IN THE REAR OF THE FUSELAGE BETWEEN FRAMES 16 AND 17 AND FIRE OUT OF THE TOP OF THE FUSELAGE. THE MANUAL FIRE CONTROL IS LOCATED IN THE PILOT'S COCKPIT.

OXYGEN SYSTEM

TWO 750 LITER CYLINDERS SUPPLY OXYGEN TO THE PILOT. THE CYLINDERS ARE INSTALLED IN THE FUSELAGE AFT OF THE PILOT. THE OXYGEN SYSTEM HAS A REGULATOR UNIT AND AN ECOMIZER DEVICE.

WINDSHIELD DE-ICING SYSTEM

FOR CLEANING THE WINDSHIELD IN FROST CONDITIONS AT ALTITUDE, A MIXTURE OF DISTILLED WATER AND ETHYLENE GLYCOL IN EQUAL QUANTITIES CAN BE SPRAYED ON THE WINDSHIELD BY THE PILOT. A HAND PUMP OPERATED BY THE PILOT SPRAYS THE LIQUID AS REQUIRED. A NEEDLE VALVE REGULATES THE FLOW AND DIFFUSION OF THE FLUID.

REFLECTOR GUN SIGHT

THE REFLECTOR TYPE GUN SIGHT IS MOUNTED ON A BRACKET ABOVE THE INSTRUMENT PANEL. THE LIGHT IN THE SIGHT HAS 3-POSITION DIMMER SWITCH.

LANDING GEAR BRAKES

THE BRAKES ARE ACTUATED BY PNEUMATIC PRESSURE. THE BRAKE RELAY VALVE IS OPERATED BY A LEVER ON THE CONTROL STICK WHICH IS CONNECTED TO THE BRAKES. MOVEMENT OF THE LEVER APPLIES THE BRAKES. MOVEMENT OF THE RUDDER BAR WHEN THE BRAKES ARE APPLIED PROVIDES DIFFERENTIAL ACTION.

COLOR PATTERNS

R.A.F. COLOR PATTERNS WERE SIMILAR FOR ALL SPITFIRES IN WAR PERIOD. HOWEVER, FOR SPECIFIC MISSIONS, PLANES DIFFERENT COLORATION. AT THE BATTLE OF BRITAIN COLORATION WAS USED AS SHOWN. COLORATION WAS INTENDED FOR CAMOUFLAGE AND IDENTIFICATION.

SPITFIRE

FIGHTER-INTERCEPTER ROYAL AIR FORCE 1939-1945

BUILT BY: SUPERMARINE (VICKERS ARMSTRONG-WHITWORTH)

DRAWN BY: WILLIS L. NYE, A.A.H.S., FOR MODEL AIRPLANE NEWS

SUPERMARINE SPITFIRE

SUPERMARINE SPITFIRE

THE SUPERMARINE SPITFIRE IS ONE OF THE GREAT AIRPLANES OF ALL TIME. A TOTAL OF 20,351 PLANES OF THIS TYPE WERE BUILT OF 18 DISTINCT MARKS AND HUNDREDS OF VARIANTS. SPITFIRES WERE BUILT BY THE SUPERMARINE, CASTLE BROMWICH AND WESTLAND FACTORIES. THESE FIGHTERS WERE FLOWN BY R.A.F, U.S.A.A.F AND OTHER ALLIED NATIONS IN WORLD WAR II. NAVAL VERSIONS OF THE SPITFIRE WERE KNOWN AS THE SEAFIRE OF WHICH 2,408 WERE BUILT.

SPITFIRE PRODUCTION SUMMARY

MARK NO.	NO OF PLANES
I	1,583
II	920
IV	229
V	6,479
VI	100
VII	140
VIII	1,658
IX	5,665
X	16
XI	471
XII	100
XIV	957
XVI	1,054
XVIII	300
XIX	225
21	122
22	278
24	54

SEAFIRES

II	372
II/III	30
III	1220
XV	340
XVII	232
45	50
46	24
47	90

LEADING PARTICULARS

NAME ..... SPITFIRE FVB.
TYPE ..... FIGHTER SINGLE SEAT.
WING SPAN ..... 36'-10"
LENGTH ..... 29'-11"
HEIGHT TO PROPELLER TIP 11'-5"
GROUND TO C.L. THRUST LINE 6'-1"
LANDING ANGLE STATIC LOAD 11.5°
MEAN AERODYNAMIC CHORD 7'-1"
TAIL SURFACE SPAN ..... 10'-6"
AIR FOIL ..... N.A.C.A. 2200
WING ANGLE OF INCIDENCE ..... 2°
WING DIHEDRAL ANGLE ..... 6°
WING AREA ..... 242 SQ.FT.
AILERONS ..... 18.9 SQ.FT.
WING FLAPS ..... 15.6 SQ.FT.
TAIL PLANE ANGLE OF INCIDENCE 2°
TAIL PLANE AREA ..... 31.46 SQ.FT.
ELEVATOR AREA ..... 13.26 SQ.FT.
TRIM TABS ..... 0.76 SQ.FT.
VERTICAL STABILIZER ..... 4.61 SQ.FT.
RUDDER ..... 8.23 SQ.FT.

CONTROL SURFACE MOVEMENT

AILERONS UP 26° ..... DOWN 19°
AILERON DROOP ..... 3/8 INCH.
ELEVATOR UP 28° ..... DOWN 23°
ELEVATOR TRIM TABS. UP 20° DOWN 7°
RUDDER 28° RIGHT OR LEFT.
RUDDER TRIM TAB RIGHT 6° LEFT 18°
WING FLAPS ..... DOWN 85°

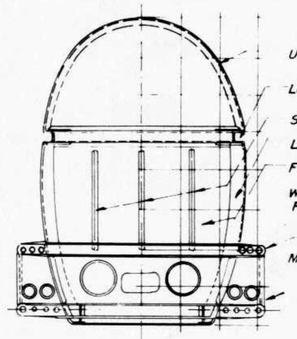
SPITFIRE MK. V

THE SPITFIRE MK. V TYPES VA, VB AND VC ARE SINGLE PLACE FIGHTERS, LOW WING MONOPLANES, POWERED BY ROLLS-ROYCE MERLIN ENGINES (45, 46, 50 AND 50A ON "F" VERSION PLANES). "F" VERSION PLANES ARE HIGH ALTITUDE FIGHTERS WHEREAS "LF" PLANES ARE POWERED WITH ROLLS-ROYCE MERLIN 45M, 50M OR 55M ENGINES. SPITFIRE VA AND VB DIFFER ONLY IN ARMAMENT, THIS CHANGE BEING MADE BY USE OF DIFFERENT MAIN PLANES. THE VC TYPE COULD ACCOMMODATE ANY OF THE THE ARMAMENT INSTALLATIONS.

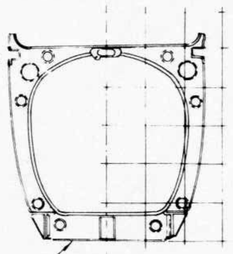
THE SPITFIRE FIGHTER WAS THE DESIGN CREATION OF R.J. MITCHELL, CHIEF ENGINEER OF THE SUPERMARINE WORKS OF VICKERS—ARMSTRONG IN RESPONSE TO THE AIR MINISTRY SPECIFICATION F37/34 ISSUED IN 1935. THE FIRST PROTOTYPE K5054 FLEW AT R.A.F PAGEANT AT HENDON IN 1936. THE FIRST PRODUCTION PLANE, K9787, WAS COMPLETED IN 1938. PLANE K9789 WAS THE FIRST PLANE TO ENTER SQUADRON SERVICE OF THE R.A.F IN 1938.

R.A.F SQUADRONS 71, 121 AND 133 WERE EAGLE SQUADRONS AND LATER WERE TRANSFERED TO 4TH FIGHTER GROUP OF U.S. A.A.F 8TH AIR FORCE. 600 SPITFIRES WERE DIVERTED TO U.S.A.A.F. BY THE END OF 1943. THE 31ST FIGHTER GROUP OF THE U.S.A.A.F. THE FIRST AMERICAN AIR COMBAT UNIT IN EUROPE IN 1942, WAS EQUIPPED WITH SPITFIRES.

BRITAIN SUPPLIED 1331 SPITFIRES TO THE RUSSIAN AIR FORCE IN WORLD WAR II PLUS MANY OTHERS TO ALLIED NATIONS.



FRAME 5.

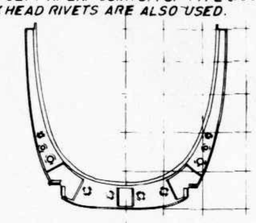


FRAME 8.

NOTE: FRAMES 6 TO 10 ARE SIMILAR IN DIMENSION AND GEOMETRICAL CONFIGURATION.

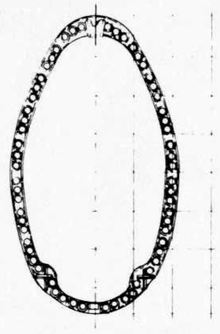
NOTE: THE WING PANELS ARE ATTACHED TO THE FUSELAGE AT THE MAIN SPAR BY MEANS OF THREADED BOLTS SECURED BY SAFETIED NUTS. CONTROL CABLES, SUPPLY LINES AND ELECTRIC WIRES HAVE DISCONNECT FITTINGS AT THE WING ROOTS.

NOTE: ALL OF THE RIVETS USED TO ATTACH THE SKIN PLATING TO THE UNDER SIDE OF THE FUSELAGE, SIDE PLATING THROUGH THE FRAMES, LONGERONS AND INTERCOSTALS FORWARD OF FRAME 11 TO FRAME 5 ARE LIGHT ALLOY COUNTERSUNK HEAD TYPE AFT OF FRAME 11, DE BERGUE LIGHT ALLOY RIVETS ARE USED EXCEPT AT LAP JOINTS. POP TYPE COUNTERSUNK HEAD RIVETS ARE ALSO USED.



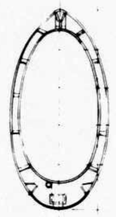
FRAME 10.

NOTE: LIGHTENING HOLES ARE BEADED AROUND THE EDGES FOR STRENGTH.



FRAMES 13 TO 18.

NOTE: FRAMES 13 TO 18 ARE SIMILAR EXCEPT IN GEOMETRICAL DIMENSIONS.

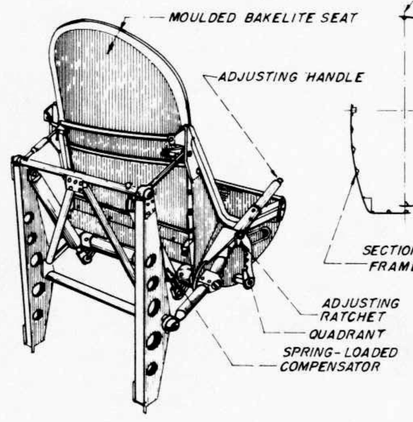


FRAME 19 (FORWARD).

FRAME 19 (AFT).

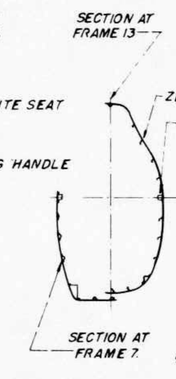
NOTE: EACH HALF OF FRAME 19 IS BOLTED TOGETHER.

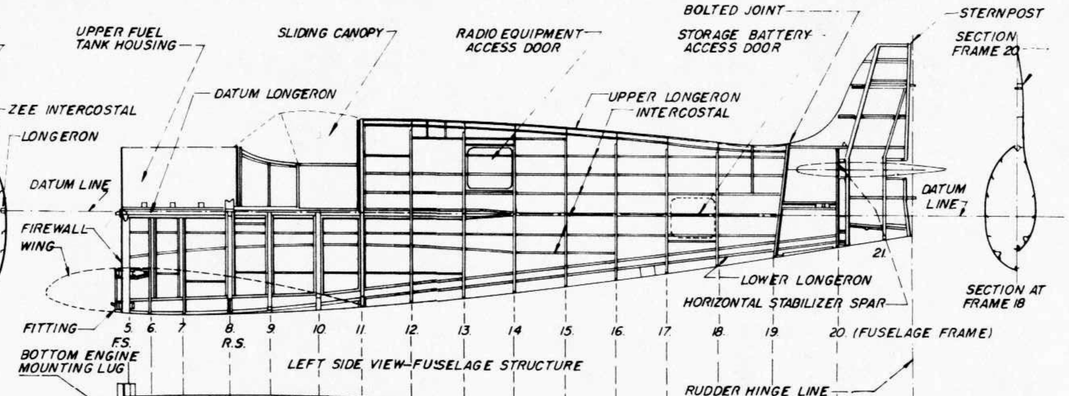
NOTE: EACH FUSELAGE FRAME IS OF CHANNEL SECTION.

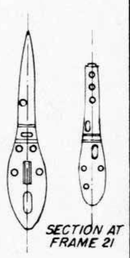


PILOT'S SEAT FRAME

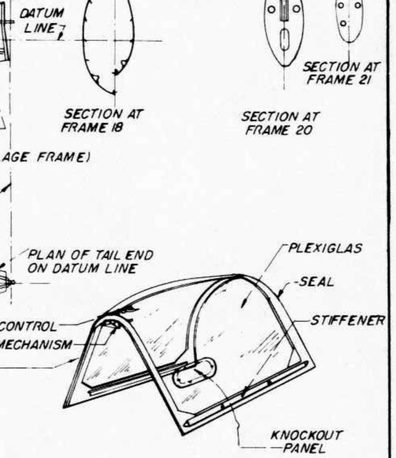
NOTE: ARMOR PLATE IS ATTACHED TO THE BRACKETS AT THE BACK OF THE SEAT.



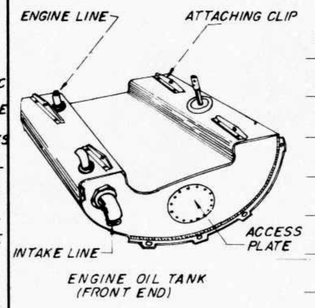




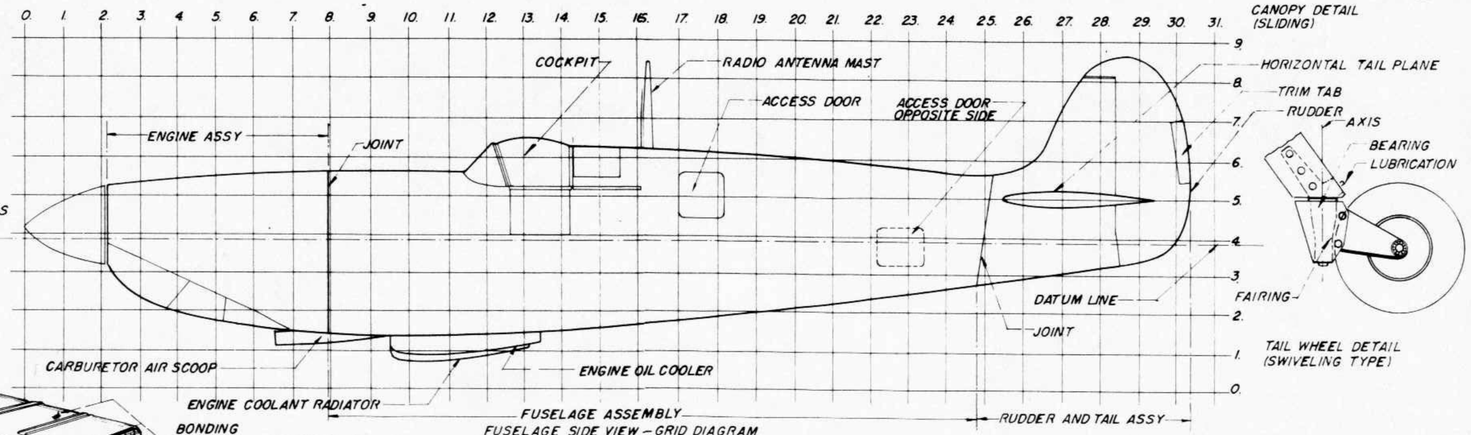
SECTION AT FRAME 18



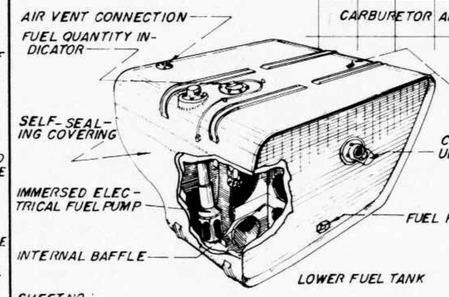
CANOPY DETAIL (SLIDING)



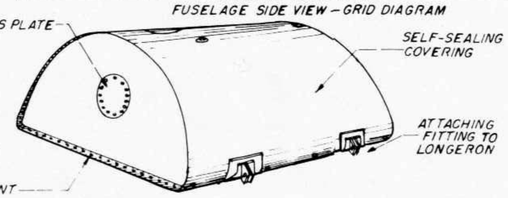
ENGINE OIL TANK (FRONT END)



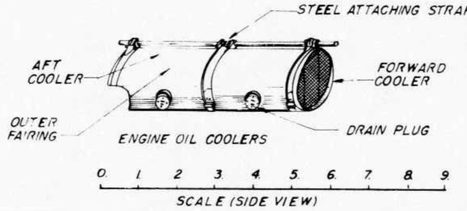
TAIL WHEEL DETAIL (SWIVELING TYPE)



LOWER FUEL TANK



UPPER FUEL TANK



ENGINE OIL COOLERS

0 1 2 3 4 5 6 7 8 9
SCALE (SIDE VIEW)

SHEET NO.:

MAJOR ASSEMBLIES OF SPITFIRE

WING TIPS (RIGHT-LEFT).
AILERONS (RIGHT-LEFT).
MAIN PLANES (RIGHT-LEFT)
HEADER TANK.
ROLLS-ROYCE MERLIN ENGINE.
ENGINE EXHAUST MANIFOLDS (2)
ENGINE-DRIVEN GENERATOR.
UPPER FUEL TANK.
LOWER FUEL TANK.
ENGINE BRACE STRUTS.
FIREPROOF FUSELAGE BULKHEAD.
WINDSHIELD.
JETTISONABLE HOOD.
INSTRUMENT PANEL.
PILOT'S ACCESS DOOR.
RADIO COMPARTMENT ACCESS DOOR.
HORIZONTAL STABILIZER (RIGHT-LEFT).
ELEVATORS (RIGHT-LEFT).
VERTICAL STABILIZER.
RUDDER.
RUDDER TRIM TAB.
ELEVATOR TRIM TAB (RIGHT-LEFT).
TAIL WHEEL STRUT.
AFT PORTION WING-FUSELAGE FILLET.
MAIN PLANE AFT SPAR FITTING (2).
20 M.M. GUN BAY (2).
AMMUNITION MAGAZINE DOOR (2).
MAIN LANDING GEAR (RIGHT-LEFT).
LANDING GEAR SHOCK STRUT (RIGHT-LEFT)
20 M.M. CANNON FAIRING (2).
20 M.M. CANNON (2)
LANDING GEAR SHOCK STRUT FAIRING (2).
20 M.M. CANNON ADJUSTING RING (2).
MAIN WING SPAR (2).
DROP TYPE FUEL TANK.
FRONT SPAR WING ROOT (2).
ENGINE MOUNT.
SUPPRESSOR.
ENGINE OIL TANK.
PROPELLER.
SPINNER.
FRONT COWLING RING.
MAIN FUSELAGE ASSEMBLY.
HYDRAULIC ACTUATING CYLINDERS.
PILOT'S SEAT.
WING FLAPS (RIGHT AND LEFT).
LANDING LIGHTS (2).
TAIL WHEEL.
MAIN LANDING WHEELS (2).
FLIGHT CONTROLS.
TAIL CONTROL COUNTERSHAFT.
ENGINE OIL TANK.
ARMAMENT, AMMO MAGAZINES.
RADIO EQUIPMENT.
MAIN PLANE FILLETS.
RADIATOR.
ENGINE OIL COOLERS (2).
BOMB CARRIER.
MAIN PLANE LEADING EDGE (2).

PILOT'S CONTROLS

FLIGHT CONTROLS.
FLIGHT CONTROLS LOCK.
ELEVATOR TRIM TAB.
RUDDER TRIM TAB.
LANDING GEAR OPERATION.
LANDING EMERGENCY EXTENSION
WING FLAPS.
THROTTLE AND FUEL MIXTURE.
FUEL MANAGEMENT.
PROPELLER GOVERNOR.
RADIATOR SHUTTER.
ENGINE BOOST EMERGENCY CUT-OUT.
ENGINE IDLING CUT-OUT CONTROL.
ENGINE OIL DILUTION.
ENGINE FUEL PRIMER.
ENGINE STARTER.
CANOPY CONTROL.
PILOT'S SEAT ADJUSTMENT.
COCKPIT DOOR.
BRAKE CONTROL.
GUN CHARGERS.
GUN FIRING.
REFLECTOR GUN SIGHT.
LANDING LIGHTS
COCKPIT LIGHTS.
NAVIGATION LIGHTS.
WINDSHIELD DE-ICER.
PITOT HEATER.
IDENTIFICATION LIGHTS.
SIGNAL DISCHARGER.
RADIO EQUIPMENT.
BOMB RELEASE.
PARACHUTE FLARE RELEASE.
BREATHING OXYGEN.
ENGINE IGNITION.

ACKNOWLEDGEMENT

THANKS TO P.D. CAMPBELL OF KAPUSKASING, ONTARIO, CANADA WHO PROVIDED THE TECHNICAL DATA WHICH MADE THESE DRAWINGS POSSIBLE.

SPITFIRE

FIGHTER-INTERCEPTER ROYAL AIR FORCE 1939-1945.

BUILT BY: SUPERMARINE (VICKERS ARMSTRONG-WHITWORTH)

DRAWN BY: WILLIS L. NYE A.A.H.S. FOR MODEL AIRPLANE NEWS

FUSELAGE

THE FUSELAGE IS ALL-METAL, STRESSED SKIN CONSTRUCTION. IT IS MADE IN THREE SUB-ASSEMBLIES, FORWARD, MAIN AND TAIL. THE STRUCTURE IS HIGH STRENGTH ALUMINUM ALLOY ACCESS PLATES AND INSPECTION PANELS ARE FITTED WHERE NECESSARY. FITTINGS FOR THE VARIOUS CONTROLS AND EQUIPMENT ARE ATTACHED INTERNALLY AT VARIOUS PARTS OF THE STRUCTURE. FORMED IN THE BOTTOM OF THE FIREPROOF BULKHEAD IS A STUB SPAR FOR THE ATTACHMENT OF THE OUTER WING PANELS.

BASIC CONSTRUCTION OF THE FUSELAGE STRUCTURE CONSISTS OF FOUR MAIN LONGERONS, IN ADDITION, IS CHANNEL-SECTION FRAMES OF CIRCULAR OR U-SHAPE. THE TOP LONGERONS ARE FITTED ALONG THE DATUM LINE OF THE AIRPLANE. THE FRAME NUMBERS RANE FROM 5 TO 19 FROM FRONT TO REAR. THE U-SHAPE FRAMES BEING FOR WARD OF FRAME 11. THE ALCLAD SKIN COVERING IS FLUSH RIVETED TO THE STRUCTURE. THE FORWARD FUSELAGE ASSEMBLY CONTAINS THE FIREWALL, PILOT'S COCKPIT, FLIGHT CONTROLS, ETC. THE MAIN ASSEMBLY IS PRIMARILY A STRUCTURAL ASSEMBLY BUT WHICH CONTAINS NECESSARY EQUIPMENT AND TO WHICH THE VERTICAL INTEGRAL STABILIZER IS ATTACHED. THE AFT PORTION CONTAINS THE RUDDER POST, HORIZONTAL STABILIZER SPAR AND HORIZONTAL RIBS WHICH SHAPE THE VERTICAL STABILIZER. ALL ASSEMBLIES OF THE FUSELAGE ARE JOINED BY BOLTS AND STUDS.

THE PILOT'S COCKPIT IS PROVIDED WITH A SLIDING TRANSPARENT CANOPY. IT CAN BE ADJUSTED FOR POSITION BY A SPRING-LOADED LOCK DEVICE. A DIMMING SCREEN IS PROVIDED TO REDUCE GLARE. THE CANOPY IS AIRTIGHT WHEN CLOSED.

THE SEAT IS MADE OF MOULDED PLASTIC AND IS ADJUSTABLE FOR HEIGHT. A PARACHUTE WELL IS PROVIDED IN THE SEAT BOTTOM. A MANUAL DEVICE ALLOWS THE SEAT TO BE RAISED OR LOWERED. A SUTTON TYPE HARNESS HOLDS THE PILOT SECURELY IN THE SEAT. A RELEASE DEVICE PERMITS FORWARD MOTION. A PADDED HEADREST IS PROVIDED.

WINGS

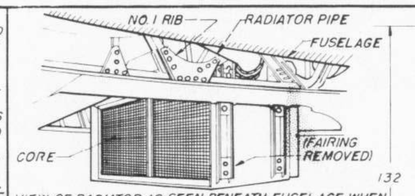
THE WING STRUCTURE CONSISTS OF TWO SEPARATE STRESSED-SKIN OUTER PANELS OF ALUMINUM ALLOY WHICH ARE BOLTED TO THE FUSELAGE STUB SPAR. THE UNDERSIDE OF OUTER WING PANELS BEING CONTINUOUS WITH UNDERSIDE OF THE FUSELAGE. ALUMINUM ALLOY FRISE TYPE AILERONS ARE FITTED TO THE OUTBOARD REAR WING SPARS. SPLIT TRAILING EDGE WING FLAPS ARE FITTED TO THE INBOARD PORTION OF THE WING PANELS AND ARE PNEUMATICALLY OPERATED.

THE LANDING GEAR STRUTS ARE ATTACHED TO THE FRONT WING SPARS AND FOLD OUTWARD AND UPWARD INTO THE FORMED RECESSES INTO THE UNDERSURFACE OF THE WING. FOR THE SPITFIRE VB ACCOMMODATION IS MADE IN EACH WING PANEL FOR TWO BROWNING 303 INCH MACHINE GUNS AND ONE HISPANO 20 M.M. GUN. THE GUNS ARE HEATED BY WARM AIR CARRIED IN AIR DUCTS FROM THE AFT SIDE OF THE ENGINE COOLANT RADIATOR FOR THE 20 M.M. CANNON, AND FROM THE ENGINE EXHAUST MANIFOLD FOR THE 303 INCH MACHINE GUNS. A GUN CAMERA IS FITTED INSIDE THE LEADING EDGE OF THE LEFT WING NEAR THE WING ROOT.

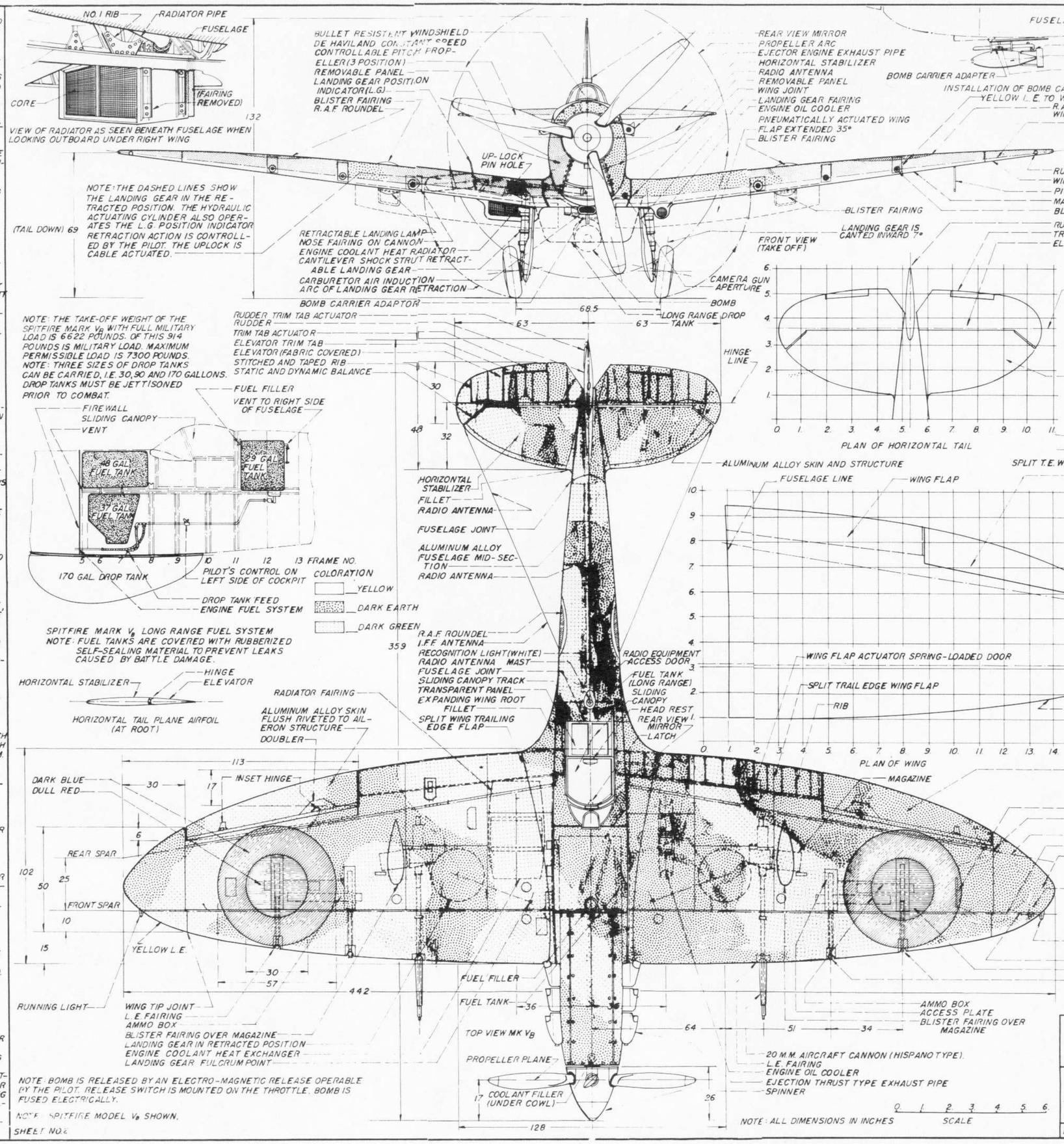
THE RIGHT WING CARRIES THE ENGINE COOLANT RADIATOR. TWO ENGINE OIL COOLERS ARE FITTED IN TANDEM UNDER THE LEFT WING. THE PITOT HEAD IS FITTED TO THE LEFT WING. A PNEUMATICALLY OPERATED RETRACTABLE LANDING LAMP IS FITTED INTO THE UNDERSIDE OF EACH WING.

THE MAIN SPAR AND FORMED LEADING EDGE OF EACH WING IS CONSTRUCTED AS A SUB-ASSEMBLY AND TO WHICH THE AFT SECTION OF THE WING IS ATTACHED. THE ENTIRE WING IS BUILT OF ALUMINUM ALLOY, AND ALCLAD SKIN COVERING.

THE RECESSES FORMED IN THE LOWER SURFACE OF THE WING FOR THE LANDING GEAR ARE SEALED FROM THE INTERIOR STRUCTURE. AT THE RADIATOR THE UNDERSURFACE IS RECESSED FOR FITTING OF THE RADIATOR AND A FAIRING TO FORM AN AIR COOLING DUCT. AFT OF THIS AIR DUCT AN OPERABLE FLAP IS ATTACHED TO CONTROL THE VOLUME OF AIR FLOWING THROUGH THE CORE. A FAIRING ALSO ENCLOSES THE ENGINE OIL COOLERS. THE WING TIPS ARE DETACHABLE. THE LEADING EDGE HOUSES THE NAVIGATION LIGHT.



VIEW OF RADIATOR AS SEEN BENEATH FUSELAGE WHEN LOOKING OUTBOARD UNDER RIGHT WING



NOTE: THE TAKE-OFF WEIGHT OF THE SPITFIRE MARK Vb WITH FULL MILITARY LOAD IS 6622 POUNDS. OF THIS 914 POUNDS IS MILITARY LOAD. MAXIMUM PERMISSIBLE LOAD IS 7300 POUNDS. NOTE: THREE SIZES OF DROP TANKS CAN BE CARRIED, I.E. 30, 90 AND 170 GALLONS. DROP TANKS MUST BE JETTISONED PRIOR TO COMBAT.

WING (CONT'D)

THE AILERONS ARE BUILT OF ALUMINUM ALLOY AND COVERED WITH ALCLAD SHEET. THE AILERON IS MASS BALANCED.

THE SPLIT TRAILING EDGE WING FLAPS ARE MADE IN TWO ASSEMBLIES. THIS TYPE OF CONSTRUCTION IS NECESSARY BECAUSE OF THE SWEEP-UP OF THE LOWER SURFACE OF THE WING AT THE WING ROOT AS THE TWO PORTIONS OF FLAP SEPARATE WHEN THE FLAP IS LOWERED. BOTH WING FLAP ASSEMBLIES HAVE A TUBULAR SPAR AND ZEE-SECTION PLATE RIBS AND ARE COVERED ON ONE SIDE WITH ALCLAD SHEET.

TAIL SURFACES

THE VERTICAL STABILIZER IS INTEGRAL WITH AFT FUSELAGE.

THE CANTILEVER HORIZONTAL STABILIZER IS MADE OF ALUMINUM ALLOY AND IS A STRESSED-SKIN TYPE OF STRUCTURE. IT IS MADE IN HALVES AND BOLTED INSIDE THE AFT END OF THE FUSELAGE. THE ROOT END OF THE HORIZONTAL STABILIZER IS FAIRED BY MEANS OF A REMOVABLE FILLET.

THE ELEVATORS ARE MADE OF ALUMINUM ALLOY AND ARE COVERED WITH FABRIC. EACH ELEVATOR IS FITTED WITH A METAL TRIM TAB. THE ELEVATORS COMPRISE A SINGLE ASSEMBLY.

THE MOVABLE SURFACES ARE STATICALLY AND DYNAMICALLY BALANCED.

FLYING CONTROLS

THE PRIMARY FLYING CONTROLS ARE OPERATED BY CABLES AND TUBES ATTACHED TO THE CONTROL COLUMN AND RUDDER BAR. THE RUDDER AND ELEVATOR TRIM TABS ARE OPERATED BY CABLES AND CHAINS FROM MANUALLY OPERATED HANDWHEELS ON THE LEFT SIDE OF THE COCKPIT.

THE CONTROL COLUMN IS A SINGLE TUBE WITH A HOUSING AT THE UPPER END WHICH HAS BALL BEARINGS ON WHICH PIVOTS A SPADE GRIP WHICH ROTATES RIGHT OR LEFT FOR AILERON OPERATION. A SPROCKET TRANSMITS THE MOVEMENT OF THE SPADE GRIP BY MEANS OF ANOTHER SPROCKET IN A HOUSING AT THE LOWER END OF THE CONTROL COLUMN. THE TWO SPROCKETS ARE CONNECTED BY A LINKAGE. RUDDER AND ELEVATOR CABLES ARE DOUBLE. THE AILERON CABLES ARE SINGLE.

THE SPADE GRIP IS FITTED WITH A GUN OR CAMERA FIRING BUTTON, WHICH IN TURN IS CONNECTED TO THE PNEUMATIC SYSTEM BY MEANS OF FLEXIBLE LINES. A BRAKE OPERATING LEVER AND A PARKING BRAKE ARE FITTED TO THE CONTROL COLUMN. THE PARKING BRAKE PERMITS THE BRAKES TO BE LEFT APPLIED WHEN THE AIRPLANE IS AT REST ON THE GROUND.

THE ELEVATOR CONNECTING ROD ON THE CONTROL COLUMN IS CONNECTED TO THE LOWER END OF A LEVER MOUNTED ON A CROSS-SHAFT AT THE BOTTOM OF FRAME NO. 11. THE ELEVATOR CABLES ARE ATTACHED TO THIS LEVER. TO GIVE THE ELEVATORS CORRECT MOVEMENT, RELATIVE TO THE CONTROL COLUMN, THE CABLES ARE CROSSED.

THE RUDDER IS CONTROLLED BY FOOT PEDALS MOUNTED ON TUBES SLIDING IN SPHERICAL BEARINGS AND CONNECTED AT THE FORWARD END TO A RUDDER BAR AND AT THE AFT END TO THE OPERATING CABLES. THE RUDDER PEDALS ARE ADJUSTABLE THROUGH A 4 INCH RANGE. HEEL PLATES ARE PROVIDED.

THE ELEVATOR TRIM TABS ARE ACTUATED BY CABLES WHICH IN TURN ROTATE A SCREW JACK LINKAGE ATTACHED TO THE TRIM TAB AND MOVE IT FORE AND AFT TO THE AIRPLANE AS REQUIRED. THE HAND WHEEL IS PROVIDED WITH A POSITION MARKER. NO SERVO ACTION IS OBTAINED.

THE RUDDER TRIM TAB IS ACTUATED BY CABLES WHICH OPERATE A SCREW JACK LINKAGE ATTACHED TO THE TRIM TAB WHICH MOVE IT RIGHT OR LEFT.

A LOCKING DEVICE IS FITTED TO THE CONTROL COLUMN WHEN THE PLANE IS AT REST ON THE GROUND.

SPITFIRE

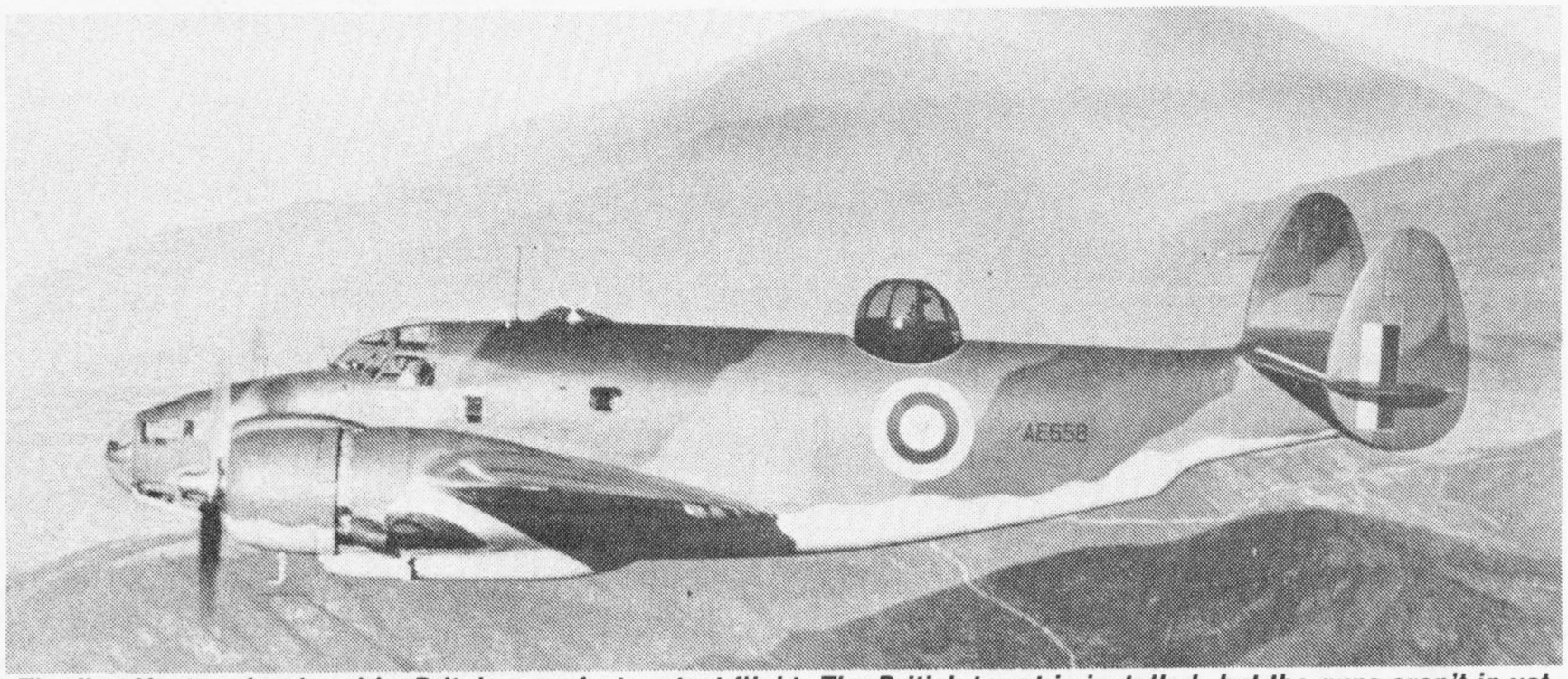
FIGHTER-INTERCEPTER ROYAL AIR FORCE 1939-1945.

BUILT BY: SUPERMARINE (VICKERS ARMSTRONG-WHITWORTH)

DRAWN BY: WILLIS L. NYE A.A.H.S. FOR MODEL AIRPLANE NEWS

SUPERMARINE SPITFIRE

THE VEGA VENTURA



The first Ventura I ordered by Britain on a factory test flight. The British turret is installed, but the guns aren't in yet. Note the step-up forward of the tail for the ventral gunner's station.

IN 1938, Lockheed introduced an improved version of its Model 14 airliner as the "Model 18 Lodestar." The British were pleased with the Hudson bomber conversion of the Model 14, and they asked Lockheed to do the same with the Model 18, but with more major changes.

The principal change was the use of the new 1,850hp Pratt & Whitney S1A4-G (R-2800) Double Wasp engine in place of the 875 to 1,200hp airliner powerplants. The R-2800s used wide-blade, or "paddle," propellers because the location of the engine nacelles on the Lodestar wing precluded larger diameters, and four-blade units weren't desirable. A bomber nose and a bomb bay similar to those on the Hudson were fitted, but the lower rear fuselage was modified to accommodate a ventral gunner's station, which resulted in a distinctive upward step toward the tail. A powered dorsal turret was installed farther forward than the one on the Hudson.

Lockheed gave the new bomber a new model number (37), and the British, after placing an initial order for 300 in May 1940, named it "Ventura." A further 375 were ordered later that year, and its first flight was on July 31, 1941.

The Venturas weren't built in Lockheed's Burbank plant, or even by Lockheed as such. Vega Aircraft Corp., a wholly-owned subsidiary with a factory adjacent to the Lockheed-owned Union Air Terminal in Burbank, was selected to build the Ventura, hence its identity as a Vega rather than a Lockheed product. On November 30, 1943, Vega was absorbed by Lockheed, and the factory, where 2,750 Boeing B-17s were also being produced, became "Lockheed Plant 1A." Some Ventura variants for the U.S. Army were built in the main Lockheed plant.

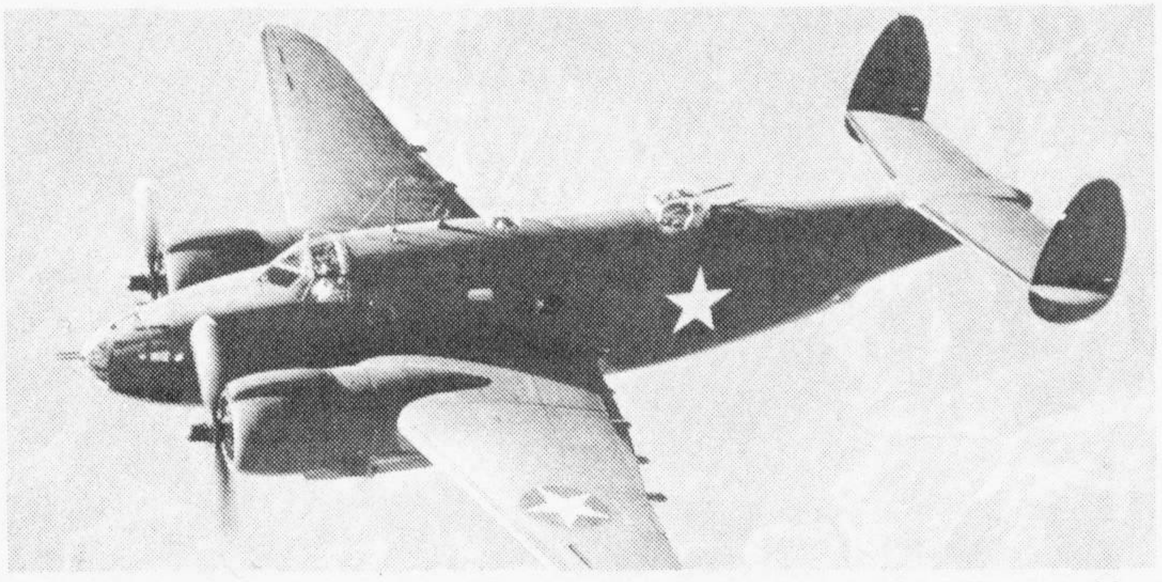
Ventura I—These had armament of two fixed and two flexible .303-caliber machine guns in the nose; two or four more in the dorsal turret; two in the waist positions; and two in the ventral station. The Ventura I could also carry 2,500 pounds of bombs. The first Mark Is were powered with 1,850hp civil engines. Deliveries began in September 1941, and Venturas were in service by November.

Ventura II—The 487 Ventura IIs carried more fuel, 3,000 pounds of bombs and four guns in the turret, and they were powered with 2,000hp U.S. Army R-2800-31 engines.

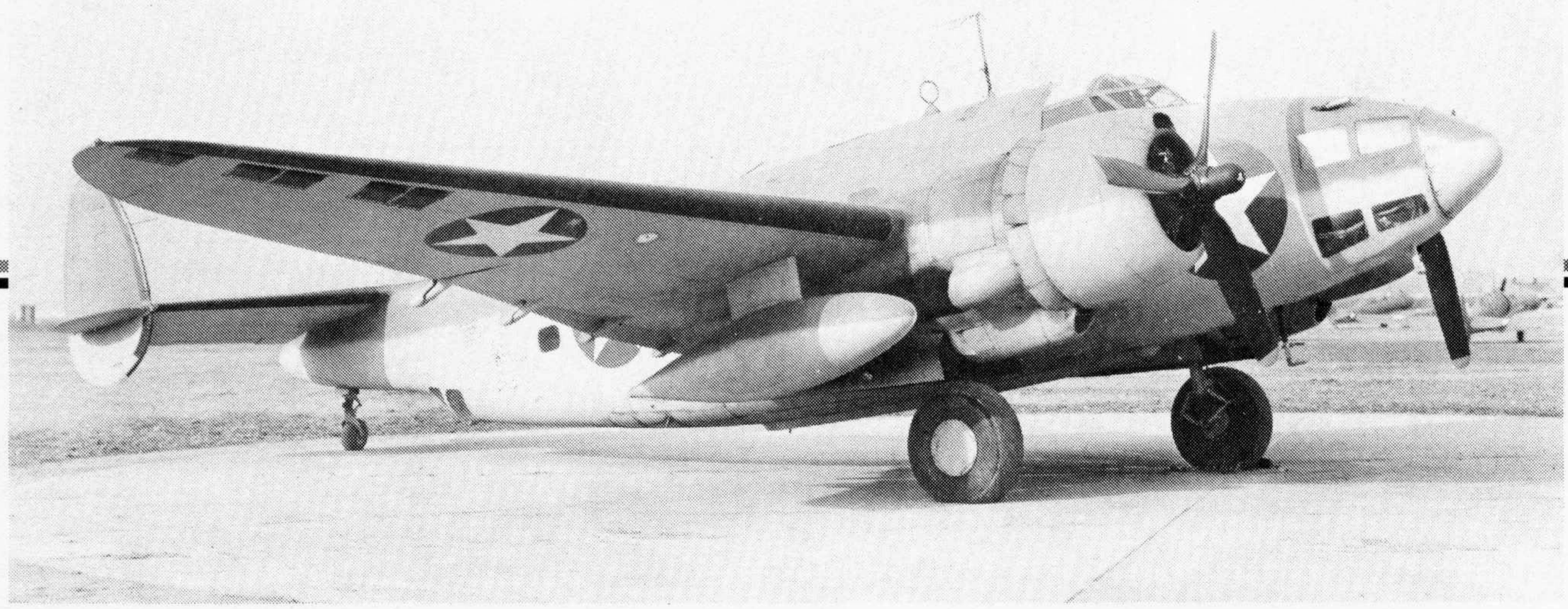
Ventura IIA—These were 200 planes originally ordered for Britain under Lend-Lease that carried the U.S. Army designation "B-34." Only 25 were sent to the R.A.F.; others went to other Empire forces—20 to Australia, 25 to Canada with R.A.F. serial numbers, and 23 to New Zealand. The rest remained in the U.S. and were soon designated "RB-34," since they weren't considered suitable for combat missions. Most were used as trainers and for utility work.

Ventura III and IV—The Ventura III was to have been an R.A.F. version of the U.S. Army O-56 (later the B-37), but none of them were procured. No "Ventura IV" designation was assigned.

Ventura V—These were "navalized" versions of the Ventura supplied under Lend-Lease by the U.S. Navy from PV-1 orders. British forces acquired 388, and many were diverted to Australia, Canada, New Zealand and South Africa.



View from above of a U.S. Army Vega B-34, with two fixed .50-caliber machine guns and two flexible .30-caliber guns in the nose; .50-caliber guns are in the Martin powered turret and the ventral gun station.



Long-range reconnaissance version of the U.S. Navy Vega PV-1 with 155-gallon drop tanks. Note the painted-over (once transparent) bomber nose, and the oddity of the star insignia on both the nose and the aft fuselage.

The prefix "G.R." was given to reconnaissance versions as in "G.R. Mark V."

American Venturas—The U.S. Army took over some of the British-contract Ventura Is, and then provided others to the R.A.F. and its own squadrons from later B-34 contracts. The Army, however, called its B-34s "Lexington" rather than "Ventura." The U.S. Navy became the major user of Venturas as "PV-1" and "PV-3," still using the British name.

Model 37—Because the drafted Ventura Is didn't meet U.S. Army specifications, they couldn't be given Army designations or serial numbers. Instead, the Army simply called them "Model 37." These became "R Model 37" in October 1942. This resulted in an interesting bit of confusion by some when they misunderstood the spoken letter "R" to mean "Our Model 37," as compared with the British Model 37.

B-34—The first 200 Lend-Lease Venturas were designated "B-34," and only 24 went to the U.S. Army. Major changes included an American Martin turret and American equipment and armament, including .50-caliber machine guns.

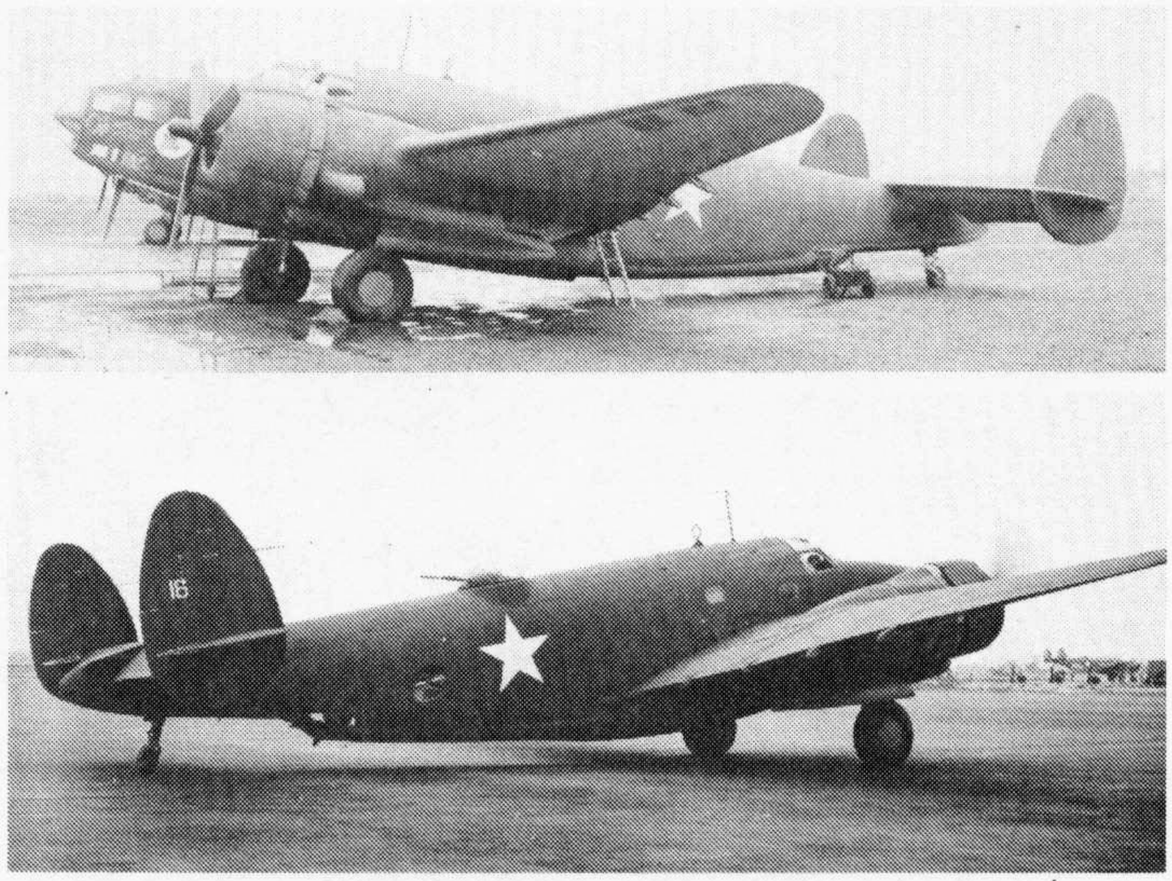
B-34A—A further 211 B-34s: 66 went to Britain and the others went to the U.S. Army as follows: 101 B-34A-2 bomber trainers, 28 B-34A-3 gunnery trainers and 16 B-34A-4 target tugs.

B-37—The Army ordered 550 armed reconnaissance/observation versions of the Ventura under the designation "O-56." Before they were completed, however, the Army discontinued the "O for Observation" category and redesignated the O-56s as bombers, since they fit that category and could still carry 2,000 pounds of bombs. The designation "B-34B" was to have been assigned, but because the planes had 1,700hp Wright R-2600-13 Double Cyclone engines instead of Pratt & Whitneys, they were given the new bomber designation "B-37." Production was in the main Lockheed plant, but because the space was needed for other projects, the contract was cut short. Only 18 B-37s were built, and they were used as trainers.

PV-1—The U.S. Navy, with 1,600 PV-1 variants ordered as "PV-1" ("P" for Patrol; "V" for Vega), was the major Ventura user. These carried additional internal fuel, plus two 155-gallon drop tanks and fittings for 10 5-inch rockets, and they could carry up to 3,000 pounds of bombs, depth charges, or a torpedo in the bomb bay. The Navy used its Venturas widely in the Pacific and in Alaska from early 1943 until the end of the war. Armament varied greatly according to the mission, including night fighters for the U.S. Marines with three-man crews, six fixed nose guns and British night-intercept radar. Some photographic conversions were designated "PV-1P."

PV-2—A greatly revised Ventura with longer wings, larger tail surfaces and extensive internal and armament changes was ordered in 1943. The revisions justified its new name, "Harpoon," and made this plane too different from the basic Ventura to be called such. Harpoons did see action late in the war.

PV-3—To get Venturas into its inventory before the PV-1s on order could be built, the U.S. Navy took the last 27 of the British Ventura IIs and designated them "PV-3" in October 1942.



Top photo: an unarmed U.S. Army Ventura I that had been drafted from the British order and redesignated "Lockheed Model 37." Above: one of the 18 U.S. Army Lexingtons that had been ordered as O-56 observation planes, but were delivered as B-37 bombers.

INSTRUMENTS

INSTRUMENTS FOR FLIGHT AND ENGINE OPERATION ARE PROVIDED FOR THE PILOT AND AIRCREW. THE INDICATING INSTRUMENTS ARE PNEUMATICALLY, HYDRAULICALLY OR ELECTRICALLY OPERATED. INSTRUMENTS ARE AS FOLLOWS:

AIR AND ENGINE OIL TEMPERATURE INDICATORS.
ENGINE MANIFOLD PRESSURE INDICATORS.
AIR SPEED INDICATORS.
ENGINE REVOLUTION INDICATORS.
FUEL QUANTITY INDICATORS.
FUEL PRESSURE INDICATORS.
FUEL FLOW METERS.
HYDRAULIC PRESSURE INDICATORS.
DE-ICER AIR PRESSURE INDICATOR.
ALTIMETER.
MAGNETIC COMPASS.
DIRECTIONAL GYRO. GYRO HORIZON.
RATE OF CLIMB INDICATOR.
OXYGEN PRESSURE INDICATOR.
ANTI-ICER FLUID QUANTITY INDICATOR.
BATTERY AMMETERS.
AUTO-PILOT.
EMERGENCY BRAKE AIR PRESSURE INDICATOR.
CLOCK.
WING FLAP POSITION INDICATOR.
LANDING GEAR POSITION INDICATOR.
TRIM TAB POSITION INDICATORS.
STEERING INDICATOR.
TURN AND BANK INDICATOR.
CARBURETOR AIR TEMPERATURE INDICATOR.
ENGINE OIL COOLER SHUTTER POSITION INDICATOR.
VACUUM INDICATOR.

NAVIGATION INSTRUMENTS

CLOCK.
AIR SPEED INDICATOR.
ALTIMETER.
AIR TEMPERATURE INDICATOR.

BOMBARDMENT INSTRUMENTS

BOMB SIGHT PLUG.
CAMERA PLUG.
BOMB SELECTOR KEYS.
FUSING SWITCH.
BOMB APPROACH DIRECTOR SWITCH.
INTERVALOMETER SWITCH.
FLEXIBLE LIGHT RHEOSTAT.
FLIGHT INSTRUMENT RHEOSTAT.
DRIFT SIGHT RHEOSTAT.
BOMB RELAY RESET SWITCH.
INDICATOR LIGHTS.
BOMB RELEASE RELAY FUSE PANEL.

VENTILATION SYSTEM

FRESH AIR IS INDUCTED INTO THE FUSELAGE THROUGH 5 ADJUSTABLE AIR VENT INTAKE ASSEMBLIES. THE VOLUME OF INDUCTED AIR IS MANUALLY CONTROLLED. FOUL AIR IS EXHAUSTED FROM OUTLETS IN THE FUSELAGE SKIN.

LANDING GEAR

THE LANDING GEAR IS OF THE HYDRAULICALLY OPERATED, RETRACTABLE TYPE, AND RETRACTS COMPLETELY WITHIN THE ENGINE NACELLES. THE OPENINGS IN THE BOTTOM OF EACH NACELLE ARE PROVIDED WITH DOORS THAT OPEN AND CLOSE WITH THE OPERATION OF THE LANDING GEAR. WHEN THE LANDING GEAR IS EXTENDED, THE OLEO-PNEUMATIC SHOCK ABSORBER STRUTS ARE PERPENDICULAR TO THE THRUST LINE. THE PILOT OPERATES A CONTROL ON THE ENGINE CONTROL PEDESTAL TO RETRACT THE LANDING GEAR.

PHOTOGRAPHIC EQUIPMENT

AN AERIAL CAMERA IS MOUNTED ON THE LEFT SIDE OF THE FUSELAGE ADJACENT TO THE ENTRANCE DOOR. THE CAMERA CAN BE USED FOR VERTICAL OR OBLIQUE PHOTOGRAPHY. THE CAMERA MAY BE OPERATED WITH AN 8, 10 OR 14" LENS. THE CAMERA IS ELECTRICALLY OPERATED AND CAN TAKE A TIMED SEQUENCE OF PHOTOS BY INCLUDING THE INTERVALOMETER INTO THE CAMERA CIRCUIT.

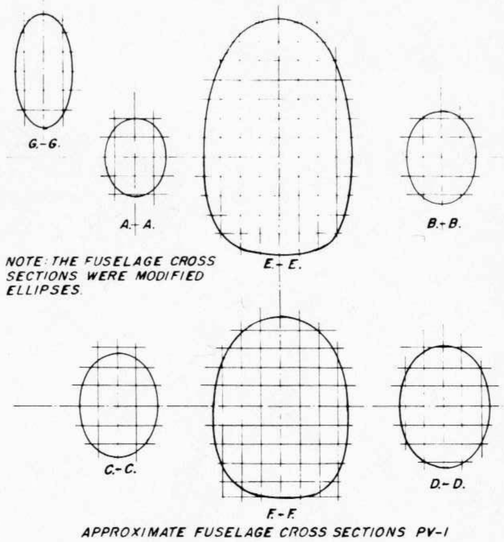
AIRCREW SURVIVAL

EACH CREW MEMBER HAS A PERSONAL FLOTATION JACKET AND SURVIVAL KIT, FIRST-AID KIT.

STOWAGE ITEMS

THE FOLLOWING ITEMS ARE STOWED ABOARD FOR AIRCREW USE:

GROUND-TO-AIR SIGNAL CARD INDEX.
TWO POUND FIREMAN'S AXE.
BOMB HOIST MECHANISM.
RUBBER MAT TO COVER BOMBARDIER'S WINDOW.
ADJUSTABLE AERIAL WINCH.
FLASHLIGHTS FOR AIRCREW.
TOOL KIT (AIRFRAME AND ENGINE).
FOUR ONE PINT VACUUM FLASKS.
PORTABLE FIRE EXTINGUISHERS.
WALK-AROUND OXYGEN BOTTLES.
MARINE DISTRESS SIGNALS.
DRAFTING MACHINE ON BOMBARDIER'S TABLE.
FLOTATION TYPE SEAT CUSHIONS.
TO PUBLICATIONS.
WEIGHT AND BALANCE MANUAL.
PILOT'S CHECK-OFF CARD.
CHEMICAL TOILET.
RUBBER FLOOR MAT AT CREW STATIONS.
PLANE FLIGHT RECORDS.
VERY PISTOL AND CARTRIDGES.
SPARE ELECTRICAL FUSES AND LAMPS.
SPARE ELECTRONIC TUBES.
SEA MARKERS.
FLOATING SURVIVAL CONTAINER.
FLOAT LIGHTS.
GUN TURRET AND ASTRODOME COVERS.
CREW RATIONS.

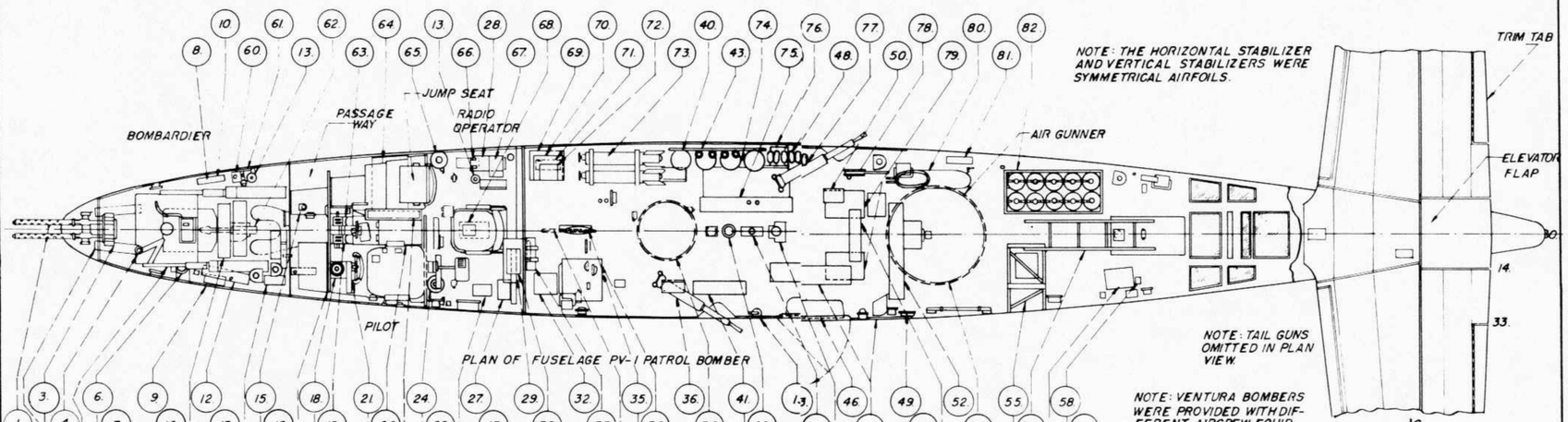


NOTE: THE FUSELAGE CROSS SECTIONS WERE MODIFIED ELLIPSES.

APPROXIMATE FUSELAGE CROSS SECTIONS PV-1

CALL-OUT NOMENCLATURE

1. NOSE GUNS.
2. NOSE GUNS AMMUNITION BOXES.
3. NAVIGATOR'S REMOTE INDICATING COMPASS.
4. VARD AIRCRAFT PLOTTER.
5. FIXED NOSE GUNS (NO LATERAL MOVEMENT).
6. ASTRO COMPASS.
7. ASTROGRAPH.
8. MN26C REMOTE COMPASS.
9. NAVIGATOR'S INSTRUMENT PANEL.
10. AZIMUTH INDICATOR.
11. FIXED NOSE GUNS AMMUNITION BOXES.
12. BOMBARDIER'S ELECTRIC SWITCH PANEL.
13. HAND FIRE EXTINGUISHER.
14. INTERVALOMETER.
15. FIRE EXTINGUISHER IMPACT ACTUATOR.
16. SPERRY AUTOMATIC PILOT.
17. PILOT'S INSTRUMENT PANEL.
18. 1826-1 PILOT'S COMPASS.
19. PROPELLER CONTROL BOX.
20. PILOT'S REMOTE INDICATING COMPASS.
21. CONTROL COLUMN.
22. AUXILIARY CONTROL COLUMN.
23. MAIN ELECTRICAL CONTROL BOX.
24. MAIN HYDRAULIC FLUID RESERVOIR.
25. AIRCREW FLASHLIGHTS.
26. A1134 AMPLIFIER.
27. INTERPHONE AMPLIFIER.
28. BLIND LANDING APPROACH RECEIVER.
29. ONE GALLON THERMOS.
30. RADIO OPERATOR'S AND INTERPHONE EQUIPMENT.
31. RADIO ANTENNA TRANSFER RELAY.
32. DYNAMOTOR.
33. 2-VOLT BATTERY CONTAINERS.
34. RADIO LOOP ANTENNA.
35. RADIO COMPASS RECEIVER.
36. CHEMICAL TOILET.
37. EMERGENCY ESCAPE EXIT.
38. LEFT HAND SIDE GUN (30-CAL.)
39. ASTRO HATCH.
40. DRINKING WATER CANTEENS.
41. L.H. SIDE GUN AMMO BOX.
42. UPPER RECOGNITION LIGHT.
43. VACUUM THERMOS FLASKS.
44. VERY PISTOL SOCKET.
45. REMOTE INDICATING COMPASS TRANSMITTER.
46. FUSELAGE ENTRANCE DOOR WITH DINGHY.
47. PARACHUTE STOWAGE RACK.
48. MARINE DISTRESS FLARES.
49. EXTERNAL BATTERY CART PLUG.
50. FIRST AID KIT.
51. R.H. SIDE GUN AMMO BOX.
52. DINGHY RADIO TRANSMITTER AND ACCESSORY CASE.
53. GUN TURRET (MARTIN TYPE).
54. TWIN TURRET GUNS (50-CAL.)
55. CAMERA MOUNT.
56. LADDER STOWAGE.
57. RADIO RECEIVER.
58. IMPACT DESTRUCTOR.
59. RADIO ANTENNA.
60. BOMBARDIER'S WINDOW ANTI-ICER TANK.
61. DRIFT RECORDER.
62. BOMB SIGHT.
63. ENGINE CONTROL STAND.
64. BATTERY COMPARTMENT.
65. EMERGENCY LANDING GEAR EXTENSION UNIT.
66. BLIND APPROACH JUNCTION BOX.
67. BLIND APPROACH DYNAMOTOR.
68. AUTOMATIC SERVO UNIT.
69. RADIO RECEIVER.
70. RADIO TRANSMITTER.
71. RADIO JUNCTION BOX.
72. ANTENNA LOADING UNIT.
73. RECONNAISCANCE FLARES.
74. TOOL AND ACCESSORY STORAGE BOX.
75. FLIGHT RATIONS CONTAINER.
76. INTER-AIRCRAFT CONTROL LAMP.
77. RIGHT HAND SIDE GUN (30-CAL.)
78. TRAILING ANTENNA REEL.
79. EMERGENCY RATION CONTAINER.
80. FLARE CHUTE.
81. BLIND APPROACH RADIO RECEIVER.
82. OXYGEN FLASKS.
83. RUDDER PEDAL ASSEMBLY.
84. IMMERSION SWITCH.
85. PITOT MAST.
86. DOWNWARD IDENTIFICATION LIGHTS.
87. RADIO ANTENNA.
88. BOMB RACKS.
89. FUEL JETTISON VALVE.
90. WING FLAP POSITION INDICATOR TRANSMITTER.
91. BOMB BAY DOOR HYDRAULIC ACTUATING CYLINDER.
92. WING FLAP HYDRAULIC ACTUATING CYLINDER.
93. VERY PISTOL CARTRIDGE BOX.
94. VERY PISTOL.
95. DI-POLE RADIO ANTENNA.
96. TUNNEL GUNS (30-CAL.)
97. TUNNEL GUNS AMMO BOXES.
98. TAIL WHEEL POSITION INDICATOR TRANSMITTER.

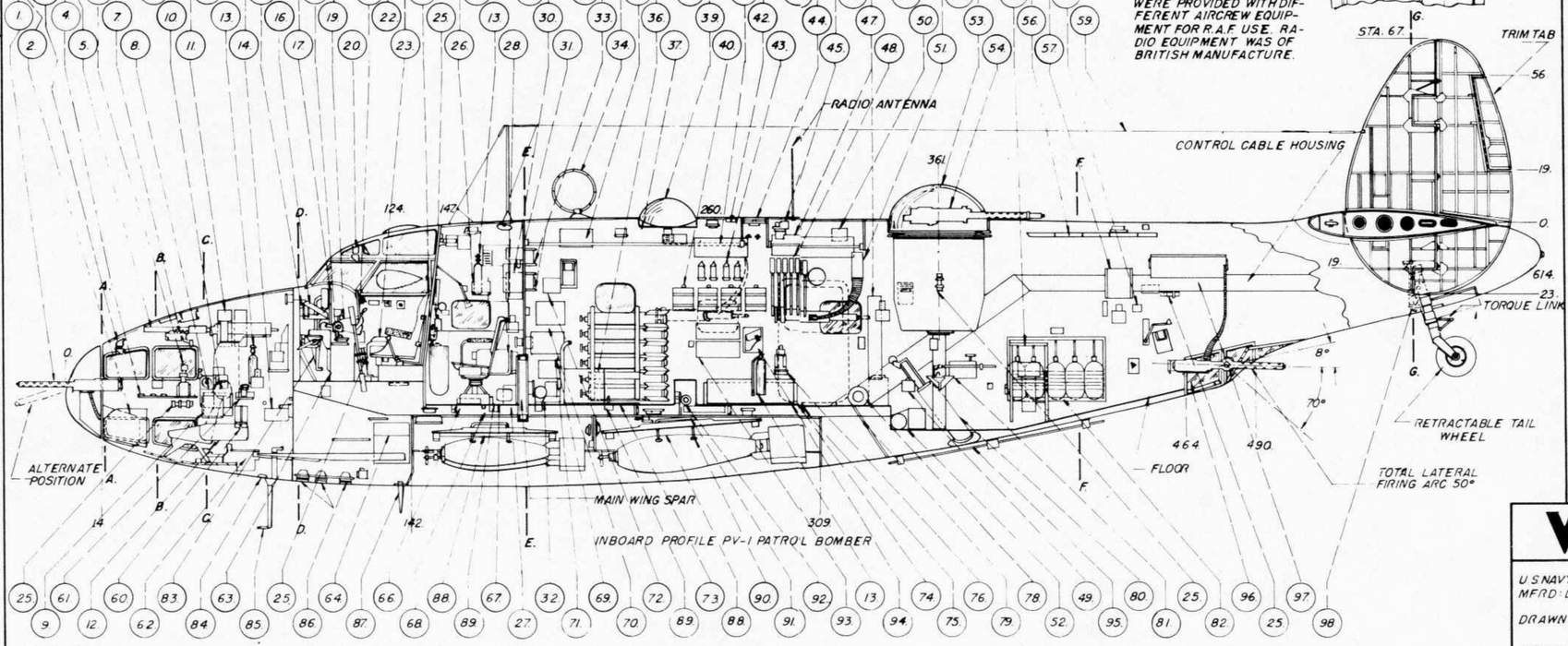


PLAN OF FUSELAGE PV-1 PATROL BOMBER

NOTE: THE HORIZONTAL STABILIZER AND VERTICAL STABILIZERS WERE SYMMETRICAL AIRFOILS.

NOTE: TAIL GUNS OMITTED IN PLAN VIEW.

NOTE: VENTURA BOMBERS WERE PROVIDED WITH DIFFERENT AIRCREW EQUIPMENT FOR R.A.F. USE. RADIO EQUIPMENT WAS OF BRITISH MANUFACTURE.



INBOARD PROFILE PV-1 PATROL BOMBER

SHEET NO. 3

NIGHT FIGHTER

THE PV-1 COULD BE CONVERTED TO THE ROLE OF A NIGHT FIGHTER BY MODIFICATION OF THE FORWARD NOSE GUNS AND BOMBARDIER'S COMPARTMENT. THE RADAR EQUIPMENT IS FITTED INTO THIS COMPARTMENT AND A PLASTIC NOSE FOR THE RADAR ANTENNA. THE PV-1 MADE ITS FIRST NIGHT FIGHTER KILL AT TOROKINA, SOLOMON ISLANDS, NOVEMBER, 1943. AN AIRCREW OF THREE WAS CARRIED ON NIGHT FIGHTING MISSIONS. PILOT CAN FIRE THE FORWARD 50-CAL. GUNS BY PRESSING BUTTON ON THE CONTROL COLUMN.

SURFACE CONTROLS

THE SURFACE CONTROLS ARE ACTUATED BY MEANS OF CABLES, PUSH-PULL TUBES, BELL CRANKS AND CABLE SECTORS. THEY ARE CONTROLLED FROM THE FLIGHT STATION BY THE CONTROL WHEEL, CONTROL COLUMN AND RUDDER PEDALS. STOPS ARE PROVIDED TO LIMIT MOVEMENT AND INTERFERENCE WITH THE ADJACENT STRUCTURE.

TRIM AND BALANCE TABS

COMBINATION TRIM AND BALANCE TABS ARE ATTACHED TO THE MOVABLE PORTIONS OF THE CONTROL SURFACES, WITH THE EXCEPTION OF THE RIGHT AILERON. THIS TAB FUNCTIONS AS A BALANCE TAB ONLY. THE AMOUNT OF TRIM REQUIRED IS MADE EVIDENT TO THE PILOT BY INDICATORS ON THE CONTROLS IN THE FLIGHT STATION.

LANDING GEAR SHOCK STRUTS

THE SHOCK STRUTS EMPLOY A COMBINATION HYDRAULIC AND PNEUMATIC ACTION TO ABSORB LANDING LOADS. IMPACT LOADS ARE ABSORBED BY HYDRAULIC ACTION. TAXYING LOADS ARE ABSORBED BY THE PNEUMATIC AIR CUSHION.

LANDING GEAR WHEELS

THESE WHEELS ARE CAST FROM MAGNESIUM ALLOY, 15 X 16 IN SIZE, AND ARE FITTED WITH TAPERED ROLLER BEARINGS. THE TAIL WHEEL IS ALSO MADE OF MAGNESIUM AND IS 18 INCH STREAMLINE TYPE. TIRES ARE 16.00 X 16.00 HEAVY DUTY, 10-PLY, INNER TUBE TYPE. TAIL WHEEL TIRE IS 18-INCH STREAMLINE TYPE. TAIL WHEEL HAS A CABLE OPERATED CENTERING LOCK.

LANDING GEAR BRAKES

THE HYDRAULIC BRAKES ARE TOE OPERATED BY THE PILOT BY MEANS OF INDIVIDUAL BRAKE VALVES ACTING ON EACH RUDDER PEDAL. EACH BRAKE CAN BE INDIVIDUALLY CONTROLLED. MULTIPLE DISC TYPE BRAKES ARE USED. A PARKING BRAKE IS ALSO INSTALLED.

SAFETY DEVICES

THESE DEVICES CONSIST OF LANDING GEAR WARNING HORN, ELECTRICALLY OPERATED CONTROL LEVER LATCH, AN UPLOCK AND THE HYDRAULICALLY OPERATED DOWNLOCK.

L.G. EMERGENCY EXTENSION

THIS IS ACCOMPLISHED BY MEANS OF AN INDEPENDENT HYDRAULIC SYSTEM OPERATED BY THE PILOT AFTER RELEASE OF THE MECHANICAL UPLOCK.

HYDRAULIC SYSTEM

THE HYDRAULIC PRESSURE SYSTEM OPERATES THE FOLLOWING COMPONENTS:

LANDING GEAR.
TAIL WHEEL.
LANDING GEAR BRAKES.
BOMB BAY DOORS.
GUN CHARGERS.
FOWLER TYPE WING FLAPS.

HYDRAULIC PRESSURE IS SUPPLIED BY TWO ENGINE-DRIVEN PUMPS. NORMAL OPERATING PRESSURE IS 650-750 P.S.I. 2.07 GALLONS ARE CONTAINED IN THE FLUID RESERVOIR. AN AIR-BALLASTED PRESSURE ACCUMULATOR MAINTAINS PRESSURE IN THE SYSTEM UNDER LOAD IN CONJUNCTION WITH THE HYDRAULIC FLUID PRESSURE REGULATOR.

TAIL EMERGENCY EXTENSION

IF THE MAIN HYDRAULIC SYSTEM FAILS, THE TAIL WHEEL CAN BE EXTENDED BY MANUAL OPERATION BY MEANS OF A CABLE EXTENSION SYSTEM.

PLANE DEVELOPEMENT

THE PV-1, WHILE SIMILAR IN APPEARANCE TO THE LOCKHEED LODESTAR, WAS A COMPLETELY DIFFERENT PLANE. IT WAS ENGINEERED AROUND A BASIC LOCKHEED CONFIGURATION, THE WEIGHT WAS INCREASED, FLIGHT RANGE INCREASED, PERFORMANCE IMPROVED ETC. THE STRUCTURE WAS STRENGTHENED FOR MILITARY PERFORMANCE. BASIC DIMENSIONS REMAINED THE SAME EXCEPT THE WING CENTER SECTION WHICH WAS INCREASED IN SPAN.

VENTURA

U.S.NAVY PATROL BOMBER PV-1 WORLD WAR 1939-1945.
MFRD: LOCKHEED AIRCRAFT CORPORATION AT BURBANK, CALIFORNIA
DRAWN BY: WILLIS L. NYE, A.A.H.S.
FOR
MODEL AIRPLANE NEWS NEW YORK CITY, N.Y.

ARMAMENT

THE NOSE GUNS ARE TWO-POSITION FIXED 30-CALIBER BROWNING M-2 TYPE. THEY ARE LOCKED TO FIRE STRAIGHT FORWARD OR CAN BE DEPRESSED 25° DOWNWARD. THE GUNS ARE MANUALLY CHARGED BY THE BOMBARDIER AND ELECTRICALLY FIRED BY THE PILOT. 375 ROUNDS OF AMMO ARE CARRIED. THE FIXED 50-CAL. FORWARD FUSELAGE GUNS ARE ARRANGED TO FIRE FORWARD AND ARE CHARGED HYDRAULICALLY. THE GUNS ARE FIRED ELECTRICALLY BY THE PILOT. 125 ROUNDS OF AMMO ARE CARRIED. THE SPENT CARTRIDGES ARE EJECTED INTO CANVAS BAGS ADJACENT TO THE NOSE GUNS AND FIXED FORWARD GUNS. PROVISION IS MADE TO CARRY EXTRA AMMO. TWO MACHINE GUNS ARE ALSO MOUNTED IN THE AFT VENTRAL POSITION. THE 30-CAL. TYPE M-2 GUNS ARE FLEXIBLE IN OPERATION. THE GUNS FIRE 8° UPWARD AND 70 DEGREES DOWNWARD. LATERAL TRAVERSE IS 25° EACH SIDE OF THE CENTERLINE OF THE AIRPLANE. 500 ROUNDS OF AMMO ARE CARRIED. AMMO IS SUPPLIED FROM FLEXIBLE CHUTES TO EACH GUN. 500 EXTRA ROUNDS PER GUN CAN BE CARRIED. LINKS AND SPENT CARTRIDGES ARE EJECTED OUTSIDE THE FUSELAGE. THE GUNS ARE FIRED AND CHARGED MANUALLY. SIDE 30-CAL. FLEXIBLE GUNS MAY BE MOUNTED IN THE WINDOWS OF THE FUSELAGE. BALL SOCKET MOUNTS ARE USED. GUNS ARE SUPPLIED WITH AMMO BY MEANS OF FLEXIBLE CARTRIDGE CHUTES. MANUAL CHARGING AND FIRING ARE USED. INTERRUPTERS PREVENT THE GUNS FROM FIRING INTO THE STRUCTURE.

ARMOR PLATE

ALL SEATS FOR THE AIRCREW ARE PROTECTED BY ARMOR PLATE EXCEPT THE RADIO OPERATOR'S SWIVEL SEAT. THE RECONNAISSANCE FLARES AND INSTRUMENT PANEL ARE ALSO PROTECTED BY ARMOR PLATE.

BOMBING COMPONENTS

ADAPTERS TO CARRY BOMBS IN A UNIVERSAL BOMB CARRIER.
BOMB RELEASE SWITCHES.
PILOT'S BOMB RELEASE AND BOMB BAY DOOR OPERATING SWITCH.
BOMB JETTISON RELEASE SWITCH.
BOMB ARMING SWITCH (PILOT AND BOMBARDIER).
MANUAL BOMB HOIST.
HYDRAULIC CONTROL VALVES.

BOMB LOAD

THE FOLLOWING BOMB LOAD CAN BE STOWED IN THE BOMB BAY:
6 300 LB. BOMBS OR 1 500 LB. BOMB.
7 300 LB. BOMBS OR 6 350 LB. DEPTH CHARGES
1 2000 LB. TORPEDO AND TORPEDO RACK.

BOMB SIGHT

A TYPE D-8 BOMB SIGHT IS INSTALLED IN THE BOMBARDIER'S COMPARTMENT. THE BOMBARDIER'S WINDOW FOR AIMING THE BOMBS IS PROVIDED WITH AN ANTI-ICING PUMP, TANK AND SPRAY NOZZLE.

BOMB BAY ADAPTERS

BRACKETS ARE INSTALLED FOR HOLDING SEVEN BOMB ADAPTERS IN THE BOMB BAY. SWAY BRACES ARE PROVIDED TO PREVENT ROLLING OF THE BOMBS.

BOMB BAY DOORS

BOMB BAY DOORS CONSIST OF FOUR ASSEMBLIES DIVIDED LONGITUDINALLY AND ARRANGED IN GROUPS OF TWO PANELS HINGED TO EACH OTHER AND TO THE FUSELAGE BELOW THE FLOOR. THE BOMB BAY DOORS OPERATE SWITCHES TO ENERGIZE INDICATOR LIGHTS IN THE FLIGHT AND BOMBARDIER'S STATIONS, AND WHICH ALSO PREVENT RELEASE OF THE BOMBS UNLESS THE DOORS ARE OPEN.

BOMB LOADING

BOMBS ARE HOISTED TO THE ADAPTERS BY MEANS OF A GEARED MANUALLY OPERATED HOIST.

INTERVALOMETER

AN ELECTRICALLY OPERATED INTERVALOMETER DISTRIBUTES THE BOMBS AS TO TIMING THE RELEASE.

BOMB RELEASE SYSTEM

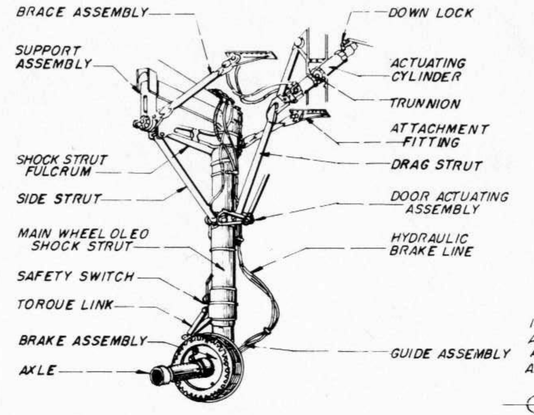
THE BOMB RELEASE SYSTEM IS OPERATIVE AFTER THE BOMB DOORS HAVE BEEN OPENED. THE BOMB RELEASE SYSTEM IS ELECTRICALLY CONTROLLED BY SWITCHES ON THE MAIN ELECTRICAL PANEL.

BOMBARDIER'S OPERATIONS

THE BOMBARDIER MAY SELECT ANY NUMBER OF BOMBS AND RELEASE THEM IN A UNIFORMLY SPACED SERIES AT A MINIMUM RATE OF 2 BOMBS PER SECOND AND A MAXIMUM RATE OF 20 BOMBS PER SECOND BY MEANS OF THE INTERVALOMETER. THE BOMBS MAY ALSO BE RELEASED SINGLY. THE ENTIRE BOMB LOAD MAY ALSO BE RELEASED SIMULTANEOUSLY. THE PILOT CAN ALSO RELEASE THE BOMBS.

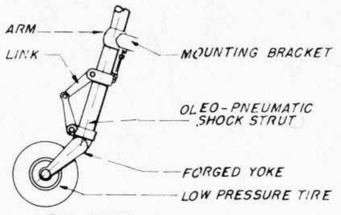
PYROTECHNICS

A FLARE CHUTE IS LOCATED IN THE AFT RIGHT SIDE OF THE FUSELAGE. FLARES ARE MANUALLY LOADED AND RELEASABLE BY THE PILOT. MARINE DISTRESS SIGNALS ARE ALSO CARRIED IN A RACK. A VERY PISTOL IS PROVIDED TO FIRE THE SIGNALS. 12 DISTRESS SIGNALS ARE CARRIED.

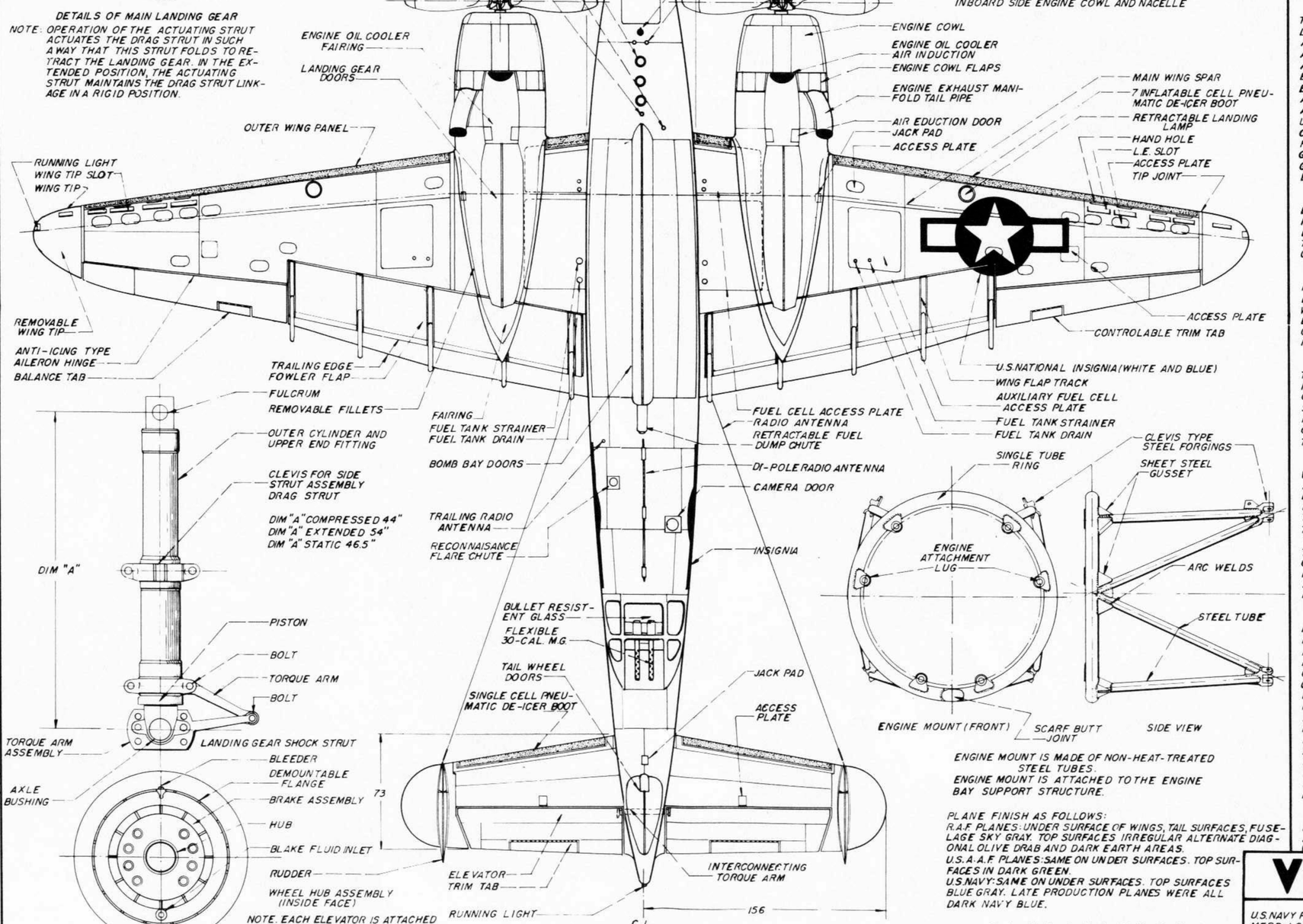


DETAILS OF MAIN LANDING GEAR

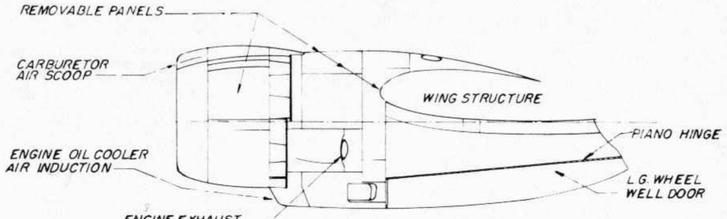
NOTE: OPERATION OF THE ACTUATING STRUT ACTUATES THE DRAG STRUT IN SUCH A WAY THAT THIS STRUT FOLDS TO RETRACT THE LANDING GEAR. IN THE EXTENDED POSITION, THE ACTUATING STRUT MAINTAINS THE DRAG STRUT LINKAGE IN A RIGID POSITION.



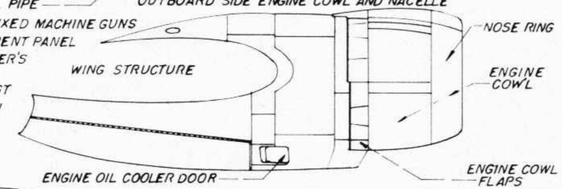
TAIL WHEEL STRUT (RETRACTABLE)



NOTE: EACH ELEVATOR IS ATTACHED TO THE HORIZONTAL STABILIZER BY 6 BALL BEARING HINGES.



OUTBOARD SIDE ENGINE COWL AND NACELLE



INBOARD SIDE ENGINE COWL AND NACELLE

ENGINE MOUNT IS MADE OF NON-HEAT-TREATED STEEL TUBES.
ENGINE MOUNT IS ATTACHED TO THE ENGINE BAY SUPPORT STRUCTURE.

PLANE FINISH AS FOLLOWS:
R.A.F. PLANES: UNDER SURFACE OF WINGS, TAIL SURFACES, FUSELAGE SKY GRAY. TOP SURFACES IRREGULAR ALTERNATE DIAGONAL OLIVE DRAB AND DARK EARTH AREAS.
U.S.A.A.F. PLANES: SAME ON UNDER SURFACES. TOP SURFACES IN DARK GREEN.
U.S. NAVY: SAME ON UNDER SURFACES. TOP SURFACES BLUE GRAY. LATE PRODUCTION PLANES WERE ALL DARK NAVY BLUE.

0 1 2 3 4 5 6 7 8 9 10

DRAWING SCALE (PLAN ONLY)
NOTE: ALL DIMENSIONS IN INCHES.

POWER-DRIVEN GUN TURRET

A MARTIN TYPE GUN TURRET WITH 2 FLEXIBLE BROWNING M-2 MACHINE GUNS IS MOUNTED ON THE TOP SIDE OF THE FUSELAGE. A MOUNTING RING AND ATTACHMENT TO THE FUSELAGE ARE PROVIDED. THE TURRET IS SELF-CONTAINED WITH AMMO BOXES, GUNNER'S SEAT AND OTHER ACCESSORIES. THE GUN TURRET CARRIES 400 ROUNDS OF AMMO FOR EACH GUN. THE GUN TURRET IS ELECTRICALLY DRIVEN. GUNS MOVE THROUGH A VERTICAL ANGLE OF 75°. GUNS ARE ELECTRICALLY FIRED AND OPTICALLY SIGHTED.

FIXED GUN SIGHTS

FORWARD FIXED GUNS ARE AIMED BY MEANS OF FIXED RING AND BEAD SIGHTS.

AERIAL TORPEDO

THE NAVAL VERSION PV-1 AND PV-3 COULD BE EQUIPPED TO CARRY AERIAL TORPEDOES DEPENDING ON THE COMBAT MISSION. SPECIAL MOUNTING EQUIPMENT MUST BE MOUNTED IN THE BOMB BAY. SPECIAL ELECTRICAL CIRCUITRY, RANGE COMPUTING AND AIMING DEVICES MUST ALSO BE INSTALLED. THE TORPEDO IS ELECTRICALLY ENERGIZED AND RELEASED AFTER THE BOMB BAY DOORS HAVE BEEN OPENED. BOMB BAY DOORS REQUIRE MODIFICATION FOR USE WITH A TORPEDO.

ELECTRICAL SYSTEM

THE B-34 IS EQUIPPED WITH A 24-30 VOLT DIRECT CURRENT, SINGLE WIRE, SHIELDED AND BONDED ELECTRICAL SYSTEM. THE NEGATIVE TERMINAL OF THE STORAGE BATTERY AND THE NEGATIVE SIDE OF CIRCUIT IS GROUNDED TO THE AIRFRAME. CURRENT IS SUPPLIED BY TWO ENGINE-DRIVEN GENERATORS, RATED AT 200 AMPERES EACH AND A 24-VOLT STORAGE BATTERY. ALL WIRING IS CARRIED IN ALUMINUM CONDUIT. EXTERNAL GROUND POWER CAN BE SUPPLIED TO A RECEPTACLE IN THE FUSELAGE WHEN THE PLANE IS ON THE GROUND. ALL CIRCUITS ARE PROTECTED AGAINST OVERLOADS BY FUSES OR CIRCUIT BREAKERS.

ENGINE IGNITION

ENGINE IGNITION IS ENERGIZED BY DUAL MAGNETOS AND DUAL DISTRIBUTORS SEPARATELY MOUNTED ON THE FRONT OF EACH ENGINE. THE CONTROL SWITCH IS MOUNTED ON THE ENGINE CONTROL PEDESTAL.

STORAGE BATTERY

RESERVE ELECTRICAL POWER IS SUPPLIED BY A 12-CELL, 24-VOLT, STORAGE BATTERY WITH A 51-AMPERE HOUR CAPACITY. SURPLUS ELECTRICAL POWER GENERATED BY THE ENGINE-DRIVEN GENERATORS MAIN THE BATTERY IN A CHARGED CONDITION.

ELECTRICAL CIRCUITRY

THERE ARE 70 INDIVIDUAL ELECTRICAL CIRCUITS FOR THE OPERATION OF THE B-34. THESE CIRCUITS ENERGIZE THE ENGINE IGNITION, INSTRUMENTATION, ARMAMENT, COMMUNICATIONS, NAVIGATION, FLIGHT ACCESSORIES, FUEL AND OIL SYSTEMS, ETC. LIGHTING, ACCESSORY MOTORS, POSITION INDICATORS.

LONG RANGE FLIGHT

WHEN A LONG RANGE FLIGHT IS TO BE MADE IN ACCESS OF THE NORMAL RANGE, A 200 GALLON FUEL IS INSTALLED IN THE FORWARD BOMB BAY, A 290 GALLON FUEL TANK IS INSTALLED IN THE AFT BOMB BAY, AND 2 277 GALLON FUEL TANKS ARE INSTALLED IN THE CABIN. AN OIL TANK IS ALSO STOWED IN THE CABIN. A SET OF TEMPORARY FLOORING IS INSTALLED IN THE CABIN AREA. CERTAIN MODIFICATIONS ARE MADE IN THE CABIN. IN ADDITION, SEA MARKERS ARE CARRIED, FLOAT LIGHTS AND A SURVIVAL KIT ETC.

ELECTRICAL LIGHTS

FOLLOWING LIGHTS ARE ON THIS PLANE:
RETRACTABLE LANDING LIGHTS. (2).
NAVIGATOR'S LIGHT. (1).
BOMB BAY LIGHTS. (2)
CABIN DOME LIGHT. (1)
CABIN NIGHT LIGHTS.
FUEL PRESSURE WARNING LIGHTS. (2)
RUNNING LIGHTS. (2)
FLIGHT INSTRUMENT LIGHTS.
RECOGNITION LIGHTS. (3)
RADIO OPERATOR'S LIGHT. (1).
TORPEDO SIGHT LIGHT. (1)
TAIL GUNNER'S DOME LIGHT. (1).
ASTRODOME LIGHT (1).
SWITCH PANEL EMERGENCY LIGHT (1).
LIGHT INTENSITY IS CONTROLED BY RHEOSTATS.

ACKNOWLEDGEMENT

PUBLIC RELATIONS DEPARTMENT OF LOCKHEED AIRCRAFT CORPORATION FOR PHOTOGRAPHS.
GUNNERY SGT. FRITZ GEMEINHARDT U.S.M.C.

VENTURA

U.S. NAVY PATROL BOMBER PV-1 WORLD WAR 1939-1945.
MFRD: LOCKHEED AIRCRAFT CORPORATION AT BURBANK, CALIFORNIA

DRAWN BY: WILLIS L. NYE, A.A.H.S.
FOR
MODEL AIRPLANE NEWS NEW YORK CITY, N.Y.

WW II SCALE AIRCRAFT DRAWINGS
THE VEGA VENTURA

LOCKHEED U.S. NAVY PV-1

THE LOCKHEED U.S. NAVY PV-1 "VENTURA" IS A MODIFICATION OF THE LOCKHEED "LODESTAR," WHICH IN TURN WAS DEVELOPED FROM THE AIR TRANSPORT MODEL 14, "SUPER ELECTRA," FIRST FLOWN IN JULY, 1937. THE FIRST TEST FLIGHT OF THE VENTURA (MEANING LUCKY STAR) WAS MADE IN JULY, 1940. ORIGINALLY, THE BRITISH AIR COMMISSION, PLACED AN INITIAL CONTRACT FOR 375 PLANES AND A SECOND CONTRACT FOR AN ADDITIONAL 300 PLANES. AT THE OUTSET OF WAR IN 1941, ALL OF THESE PLANES WERE ACQUIRED BY THE U.S. GOVERNMENT. 200 BECAME B-34 AND 333 OTHERS WERE CONVERTED TO THE B-34A CONFIGURATION. VENTURAS SERVED IN THE R.A.F. AND R.C.A.F. THE PV SERIES WAS ASSIGNED TO THE U.S. NAVY BECAUSE OF ITS SPEED, MANEUVERABILITY, AND RANGE. IT HAS BEEN USED ON ANTI-SUBMARINE PATROLS, AS A BOMBER, PHOTO RECONNAISSANCE AND TACTICAL MISSIONS. 2162 PV SERIES PLANES PROCURED. ALTHOUGH IT WAS USED BY THE U.S.A.A.F. IN THE U.S.A., IT WAS NOT USED IN COMBAT BY THEM. THE U.S. NAVY USED IT AS A LAND BASED COMBAT AIRPLANE. IT WAS EMPLOYED ON LOW ALTITUDE, MEDIUM RANGE MISSIONS.

PRODUCTION BREAKDOWN

1. ENGINE COWL COOLING FLAP RING.(2).
2. ENGINE COWL WELL.(2).
3. ENGINE MOUNT(2).
4. NACELLE FIREWALL(2).
5. ENGINE SUPPORT BAY STRUCTURE(2)
6. LANDING GEAR(2).
7. LANDING GEAR DOOR(2).
8. OUTER WING TIP(2).
9. AILERON(2).
10. AILERON TRIM TAB(2).
11. OUTER WING PANEL AFT SECTION(2).
12. WING FLAP(2).
13. WING FLAP TRAILING EDGE EXTENSION(2).
14. WING CENTER SECTION AFT SECTION(2).
15. WING CENTER SECTION CENTER SECTION.
16. WING CENTER SECTION FORWARD SECTION.
17. WING CENTER SECTION MAIN SPAR.
18. AFT FUSELAGE FLOOR.
19. FUSELAGE DOOR.
20. FUSELAGE MID SECTION.
21. FUSELAGE AFT SECTION.
22. TAIL WHEEL.
23. TAIL CONE.
24. HORIZONTAL STABILIZER CENTER SECTION.
25. HORIZONTAL STABILIZER LEADING EDGE.
26. VERTICAL STABILIZER LOWER ASSEMBLY(2).
27. RUDDER LOWER ASSEMBLY(2).
28. HORIZONTAL STABILIZER TIP(2).
29. HORIZONTAL STABILIZER OUTER PANEL(2).
30. ELEVATOR(2).
31. UPPER VERTICAL STABILIZER(2).
32. UPPER RUDDER ASSEMBLY(2).
33. RUDDER TRIM TAB(2).
34. ELEVATOR TRIM TAB(2).
35. ELEVATOR FLAP.
36. GUN TURRET FOUNDATION.
37. UPPER FUSELAGE ASSEMBLY.
38. CANOPY.
39. WING SECTION LEADING EDGE.
40. LOWER ENGINE NACELLE ASSEMBLY(2).
41. UPPER ENGINE NACELLE ASSEMBLY(2).
42. ENGINE COWL(2).
43. MAIN WING SPAR.
44. WING LEADING EDGE.(2).
45. FUSELAGE NOSE.
46. FUSELAGE NOSE ASSEMBLY.
47. PILOT STATION.
48. FORWARD FUSELAGE FLOOR.
49. UPPER BOMB BAY DOOR ASSEMBLY (2).
50. LOWER BOMB BAY DOOR ASSEMBLY (2).

MODEL DESIGNATION

PV-1	U.S. NAVY	(VEGA MODEL 37)
PV-2	D°	(ENLARGED PV-1) HARPOON
PV-2C	D°	D° D°
PV-2D	D°	D° D°
PV-3	D°	D° D°
B-34	U.S. ARMY	(200) SAME AS PV-1
B-34A	D°	(333)
B-34B	D°	(117)
B-37	D°	(18) FORMERLY O-56.

AERODYNAMIC AREAS

TOTAL WING AREA	551.00 SQ.FT.
AILERONS AREA	34.90
WING FLAPS	107.50
HORIZONTAL STABILIZER	88.33
ELEVATORS	40.60
ELEVATOR TRIM TABS	4.03
VERTICAL STABILIZERS	29.28
RUDDERS	34.83
RUDDER TRIM TABS	3.81
ELEVATOR FLAP	5.25

TANK CAPACITIES

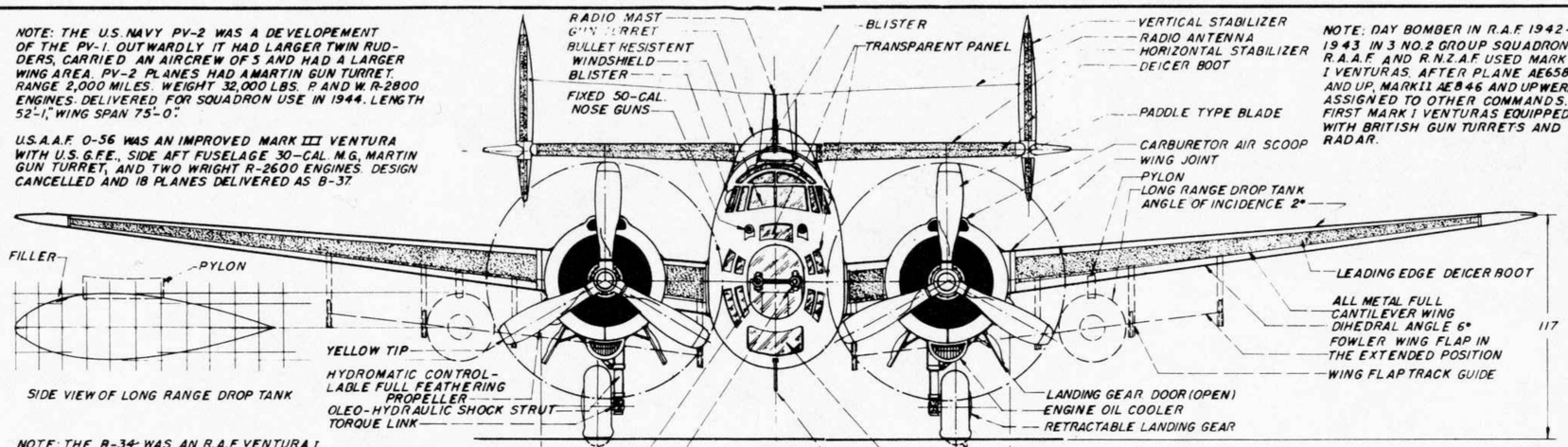
CENTER SECTION FUEL TANKS	494 U.S. GALS.
AUXILIARY FUEL TANKS (2)	82 "
ENGINE OIL TANKS	32 "
HYDRAULIC FLUID RESERVOIR	2 "

PROPELLERS

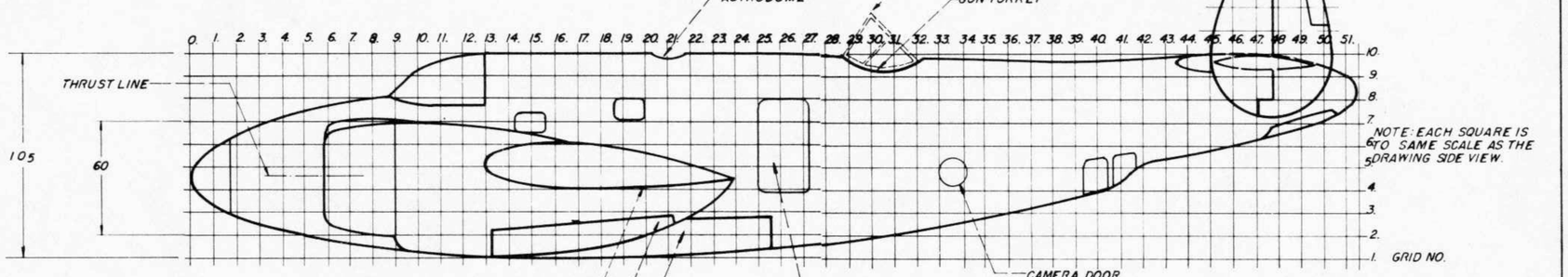
HAMILTON STANDARD HYDROMATIC.
HUB NO. 23E50-287.
BLADES (3) NO. 6477A-12.
QUICK FEATHERING CONSTANT SPEED.
PITCH LIMITS 0° TO 88°
DIAMETER 126"

NOTE: THE U.S. NAVY PV-2 WAS A DEVELOPEMENT OF THE PV-1. OUTWARDLY IT HAD LARGER TWIN RUDDERS, CARRIED AN AIRCREW OF 5 AND HAD A LARGER WING AREA. PV-2 PLANES HAD A MARTIN GUN TURRET. RANGE 2,000 MILES. WEIGHT 32,000 LBS. P AND W. R-2800 ENGINES. DELIVERED FOR SQUADRON USE IN 1944. LENGTH 52'-1," WING SPAN 75'-0".

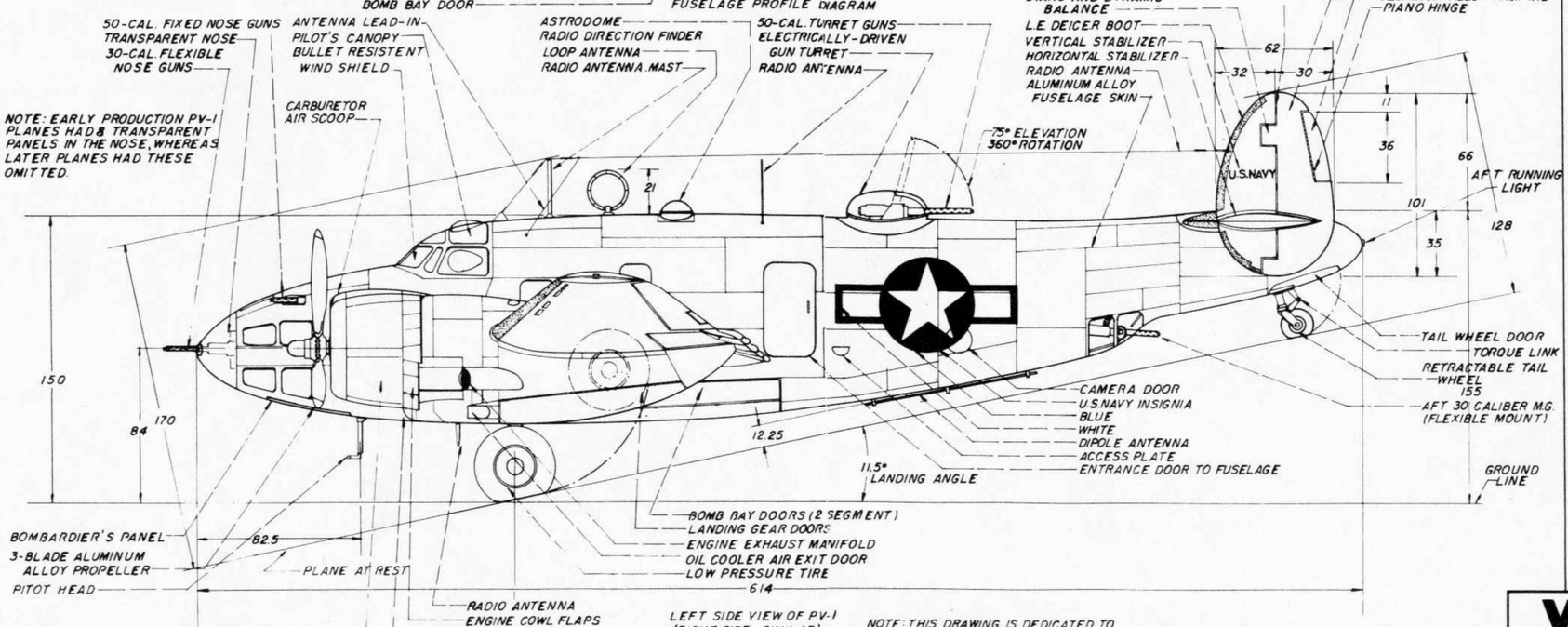
U.S.A.A.F. O-56 WAS AN IMPROVED MARK III VENTURA WITH U.S. G.F.E., SIDE AFT FUSELAGE .30-CAL. M.G., MARTIN GUN TURRET, AND TWO WRIGHT R-2600 ENGINES. DESIGN CANCELLED AND 18 PLANES DELIVERED AS B-37.



NOTE: THE B-34 WAS AN R.A.F. VENTURA I EXCEPT IT HAD U.S.A.A.F. G.F.E. IN LIEU OF BRITISH G.F.E. IT HAD AN AFT PAIR OF FLEXIBLE 50-CAL. GUNS IN LIEU OF A GUN TURRET. THE B-34 WAS USED FOR TRAINING FUNCTIONS BY U.S.A.A.F. THE EXTERNAL FINISH WAS IN BRITISH CAMOUFLAGE PATTERN. U.S. NAVY PV-1 PLANES WERE EQUIPPED WITH MARTIN GUN TURRETS.



FUSELAGE PROFILE DIAGRAM



NOTE: EARLY PRODUCTION PV-1 PLANES HAD 8 TRANSPARENT PANELS IN THE NOSE, WHEREAS LATER PLANES HAD THESE OMITTED.

LEFT SIDE VIEW OF PV-1 (RIGHT SIDE-SIMILAR)

NOTE: U.S.M.C. USED PV-1 MODIFIED FOR NIGHT FIGHTER OPERATIONS IN THE SOUTH PACIFIC IN 1943. VMF(N-531) RECORDED THE FIRST KILL AT TOROKINA POINT, SOLOMON ISLANDS, NOVEMBER, 1943.

NOTE: THIS DRAWING IS DEDICATED TO MARK CAMPBELL, PIONEER FLYER, MEMBER OF EARLY BIRDS, A.A.H.S., SILVER WINGS, C.A.P., ENGINEERING DEPARTMENT, LOCKHEED AIRCRAFT CORPORATION FOR 25 YEARS AND PIONEER PLANE BUILDER. THE AUTHOR WORKED WITH HIM AT LOCKHEED WHILE THE VENTURA WAS BEING DESIGNED.

0 1 2 3 4 5 6 7 8 9 10.
DRAWING SCALE
NOTE: ALL DIMENSIONS IN INCHES.

NOTE: DAY BOMBER IN R.A.F. 1942-1943 IN 3 NO. 2 GROUP SQUADRONS, R.A.A.F. AND R.N.Z.A.F. USED MARK I VENTURAS. AFTER PLANE AE658 AND UP, MARK II AE846 AND UP WERE ASSIGNED TO OTHER COMMANDS. FIRST MARK I VENTURAS EQUIPPED WITH BRITISH GUN TURRETS AND RADAR.

TABLE OF WEIGHTS

WEIGHT EMPTY	18,525.00 LBS.
PILOT	200
BOMBARDIER	200
RADIO OPERATOR	200
TURRET GUNNER	200
GUNNER'S PARACHUTE	40
FRONT MAIN TANKS (228 GAL)	1,368
REAR MAIN TANKS (266 GAL)	1,596
AUX. WING TANKS (82 GAL)	492
TRAPPED FUEL	14.5
ENGINE OIL TANKS (32 GAL)	240
TRAPPED OIL	91.1
NOSE M.G.	473
AMMO (1500 RDS)	105
BOW M.G.	140.2
AMMO (500 RDS)	155.6
SIDE M.G.	50.2
AMMO	1,200
TURRET GUNS	130
AMMO (800 RDS)	249
TUNNEL GUNS	65.5
AMMO	140
BOMBSIGHT	14.4
3-500 LB. BOMBS	1,500
4-250 LB. BOMBS	1,000
MISC. BOMB CARRIERS	1393
PYROTECHNICS	21
SIGNAL PISTOL AND AMMO	9.4
FLARES (RECCO)	285
FUSE CAPSULES	3.0
MISC. NAVIGATION EQUIPMENT	2.0
EMERGENCY EQUIPMENT	42.0
SURVIVAL EQUIPMENT	91.0
CAMERA AND CONTROLS	41.0
OXYGEN FLASKS	180.6

NOTE: THE ABOVE ITEMS ARE REMOVABLE LOAD AND VARY, DEPENDING ON THE MISSION.

WEIGHT EMPTY INCLUDES:	
GUN TURRET AND MOUNT	463 LBS.
M.G. MOUNTS	212.6
FIXED BOMB & FUSING GEAR	130
FIXED PYROTECHNIC EQUIPMENT	21.7
HYDRAULIC & ANTI-ICING FLUID	137.2
ARMOR PLATE	316.
BULLETPROOF GLASS	57.9
DESIGN GROSS LOAD	22,500 LBS.
DESIGN OVERLOAD	26,500 "

COMMUNICATION EQUIPMENT

BLIND LANDING APPROACH EQUIPMENT.
TRANSMITTERS. TA-12B.
CONTROL UNIT. MR-98 & 3616B.
MORSE KEY. MT-11B.
ANTENNA LOADING COIL MT-53B.
TRAILING ANTENNA REEL MT-5E.
FIXED ANTENNAE.
ELECTRICAL JUNCTION BOXES. 3507.
RECEIVERS. RA-10B.
AMPLIFIERS. 3611.
STATION BOXES. 3620.
AZIMUTH INDICATOR. MN-22A.
RELAY UNITS. MT-53B.
COMMAND EQUIPMENT.
D.C. DYNAMOTORS.
LOOP ANTENNA MN-20A.
MICROPHONES AND HEAD SETS.
INTERPHONE.

AUTOMATIC PILOT

A SPERRY TYPE A-3 AUTOMATIC PILOT IS INSTALLED TO MECHANICALLY CONTROL THE PLANE. IT IS CONTROLLED BY THE PILOT.

HEATING SYSTEM

FIVE STEWART WARNER ARE INSTALLED IN THE FUSELAGE TO SUPPLY WARM AIR TO THE AIRCREW. HEATERS ARE INDIVIDUALLY CONTROLLABLE. THE HEATERS ARE GASOLINE FIRED AND ELECTRICALLY IGNITED.

SURVIVAL EQUIPMENT

4 HALF GALLON WATER FLASKS.
4 RATION CONTAINERS.
4 EMERGENCY RATION CONTAINERS.
1 GALLON THERMOS BOTTLE.

SOUND INSULATION

SOUND DEADENING MATERIAL IS CEMENTED TO THE INSIDE OF THE FUSELAGE SKIN IN THE FLIGHT STATION, BOMBARDIER STATION AND THE RADIO OPERATOR'S STATION.

CENTER OF GRAVITY

THE LIMITS OF POSSIBLE C.OF G. TRAVEL ARE 182.97" TO 194.09 INCHES AFT OF THE AXIS OF REFERENCE (23.5% TO 33.1% OF THE MEAN CHORD. THE AXIS OF REFERENCE IS AT STRUCTURAL STATION "0". THE LEADING EDGE OF THE MEAN CHORD IS 155.75 INCHES AFT OF THE AXIS OF REFERENCE. LENGTH OF MEAN CHORD IS 115.84".

VENTURA

U.S. NAVY PATROL BOMBER PV-1 WORLD WAR 1939-1945
MFRD. LOCKHEED AIRCRAFT CORPORATION AT BURBANK, CALIFORNIA

DRAWN BY: WILLIS L. NYE A.A.H.S.
FOR
MODEL AIRPLANE NEWS NEW YORK CITY 10, N.Y.

ENGINES

THE PV-1 VENTURA IS POWERED BY TWO PRATT AND WHITNEY TWIN ROW, RADIAL, 18 CYLINDER, AIR-COOLED, R-2800-2 SBG, SUPERCHARGED, SINGLE STAGE TWO SPEED ENGINES (2,000 H.P. RATING)

BORE	5.75"
STROKE	6.00"
CUBIC DISPLACEMENT	2804"
DRY WEIGHT	2305 LBS.
COMPRESSION RATIO	6.1 TO 1.00
LOW BLOWER RATIO	7.6 : 1
HIGH BLOWER RATIO	9.9 : 1
ENGINE OVERALL DIAMETER	52.5"

ENGINE ACCESSORIES

EACH ENGINE HAS A DIRECT CRANKING INERTIA ENGINE STARTER. PROVISION IS ALSO MADE FOR MANUAL STARTING BY MEANS OF A CRANK. PROPELLER GOVERNORS ARE MANUALLY CONTROLLABLE BY MEANS OF CABLES RUNNING FROM THE ENGINE CONTROL PEDESTAL. PROPELLER FEATHERING PUMPS OPERATE OFF 24-VOLT STORAGE BATTERY.
ENGINE-DRIVEN GENERATORS ARE 30-VOLT, 50-AMPERE 1500 WATT CAPACITY.
AUXILIARY FUEL PUMPS ARE ELECTRICALLY DRIVEN AND CONTROLLED BY THE PILOT.
ENGINE PRIMERS ARE ELECTRICALLY OPERATED.
CARBURETOR HEAT IS OBTAINED FROM A MUFF INSTALLED AROUND THE ENGINE EXHAUST MANIFOLD. HEAT FLOWS INTO THE CARBURETOR AIR INDUCTION SYSTEM BY MEANS OF A MANUALLY CONTROLLABLE HINGED DOOR.
PROPELLERS ARE AUTOMATIC IN PITCH AND BLADE ANGLE SETTING. GOVERNORS ARE ENGINE-DRIVEN.
EACH ENGINE IS BOLTED TO A WELDED STEEL TUBULAR TYPE ENGINE MOUNT THROUGH VIBRATION ABSORBING BUSHED MOUNTINGS.
THE ENGINE FIREWALL BULKHEAD IS CORROSION RESISTANT STEEL SHEET.
EACH ENGINE AND THE ACCESSORY COMPONENTS IS REMOVABLE AS A UNIT AT THE FIREWALL AND IS INTERCHANGEABLE.
ENGINE-DRIVEN VACUUM PUMPS ENERGIZE THE FLIGHT INSTRUMENTS AND THE DE-ICER BOOTS.
ENGINE-DRIVEN HYDRAULIC PUMPS ENERGIZE THE HYDRAULIC PRESSURE SYSTEM.
AN ENGINE-DRIVEN FUEL PUMP SUPPLIES FUEL UNDER PRESSURE TO THE FUEL SYSTEM.
AN ENGINE-DRIVEN OIL PUMP SUPPLIES LUBRICATING OIL TO THE ENGINE.
AN ENGINE-DRIVEN TACHOMETER GENERATOR ENERGIZES THE TACHOMETER.

ENGINE OIL SYSTEM

EACH ENGINE IS PROVIDED WITH AN OIL SYSTEM WHICH IS LOCATED IN EACH ENGINE NACELLE. MANUAL AND AUTOMATIC OIL PRESSURE CONTROLS ARE PROVIDED. EACH ENGINE OIL TANK HAS A 16 GALLON CAPACITY. OIL COOLERS PROVIDE TEMPERATURE REGULATION. EACH ENGINE HAS AN OIL DILUTION SYSTEM TO ASSIST IN STARTING THE ENGINE IN COLD WEATHER.

ENGINE CONTROL PEDESTAL

THE PEDESTAL, LOCATED IN THE FLIGHT COMPARTMENT, CONTAINS THE FOLLOWING CONTROLS:
RIGHT AND LEFT ENGINE THROTTLES.
D. D. D. D. FUEL MIXTURES.
D. D. D. PROPELLER GOVERNORS.
D. D. D. ENGINE SUPERCHARGERS.
D. D. D. CARBURETOR AIR TEMPERATURE BOMB BAY DOORS.
AUTOMATIC PILOT.
TAIL WHEEL CENTERING LOCK.
ALL OF THESE CONTROLS ARE CABLE ACTUATED

ENGINE OIL COOLERS

THE FLOW OF OIL THROUGH THE COOLER IS CONTROLLED THERMOSTATICALLY. THE OIL TEMPERATURE IS REGULATED TO COMPENSATE FOR CHANGES IN AIR TEMPERATURE AND ENGINE OPERATING CONDITIONS. THIS IS DONE BY CONTROLLING THE VOLUME OF AIR FLOWING THROUGH THE COOLER. ELECTRICALLY OPERATED DOORS, CONTROLLED BY THE PILOT, REGULATE THE VOLUME OF AIR FLOWING THROUGH THE COOLING AIR DUCT.

ENGINE EXHAUST MANIFOLD

THE ENGINE EXHAUST MANIFOLD CONSISTS OF EIGHT TUBULAR SEGMENTS CLAMPED TOGETHER TO COMPRISE A MANIFOLD.

ENGINE SUPPORT STRUCTURE

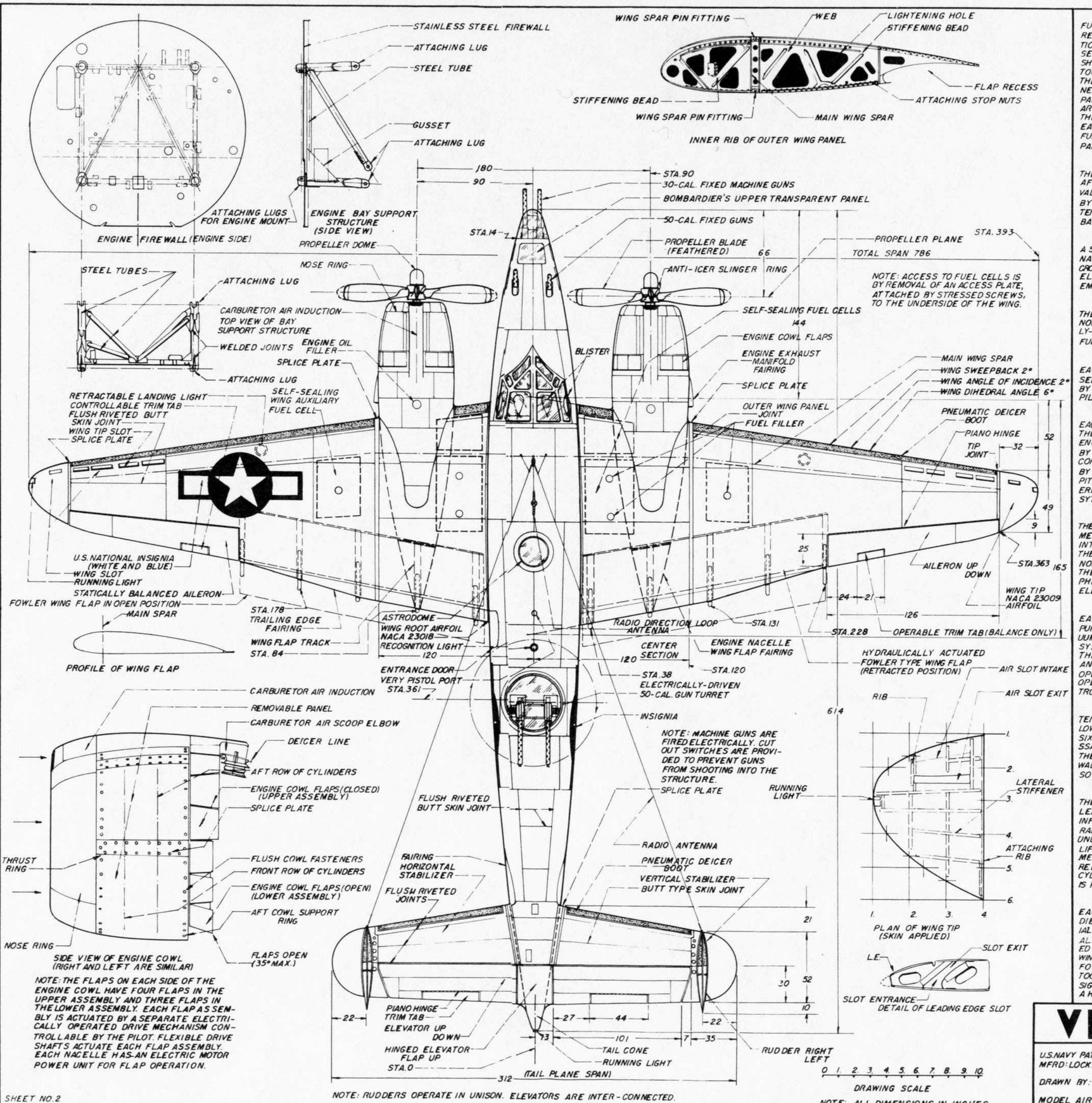
THE TUBULAR STEEL TRIANGULAR BRACED STRUCTURES ARE ATTACHED TO THE FRONT WING SPAR IN THE ENGINE NACELLE. THE ENGINE MOUNTS ARE ATTACHED TO THESE STRUCTURES.

ENGINE FUEL SPECIFICATION

100 OCTANE SPEC. AN-VV-F-781.

ENGINE FIRE EXTINGUISHER

THE ENGINE INSTALLATION IS PROTECTED BY A FIRE EXTINGUISHING SYSTEM WHICH USES CARBON-DIOXIDE UNDER PRESSURE. BOTH IMPACT AND THERMAL ACTUATORS AUTOMATICALLY ACTIVATE THE SYSTEM. MANUAL OPERATING CONTROLS ARE ALSO INSTALLED. THE SYSTEM IS OPERABLE ON THE GROUND OR IN FLIGHT. A TUBULAR MANIFOLD DISTRIBUTES THE CARBON-DIOXIDE UNDER PRESSURE TO THE ENGINE.



SHEET NO. 2

FUEL CELLS

FUEL CELLS ARE SELF-SEALING, AROMATIC RESISTANT, SYNTHETIC MATERIAL CONSTRUCTION. THE CELL MATERIAL IS COMPOSED OF SEVERAL LAMINATED SYNTHETIC RUBBER SHEETS AND LAMINATE RUBBER CEMENTED TOGETHER AND COVERED WITH PLIOFORM. THE SHEETS VARY IN COMPOSITION AND THICKNESS. ALL FITTINGS ARE BUILT AS AN INTEGRAL PART OF THE FUEL CELL. FOUR FUEL CELLS ARE LOCATED IN THE WING CENTER SECTION. THE FUEL CELLS ARE INTERCONNECTED ON EACH SIDE OF THE FUSELAGE. AN AUXILIARY FUEL CELL IS LOCATED IN EACH OUTER WING PANEL.

FUEL JETTISON SYSTEM

THE FUEL OF THE FOUR FORWARD AND THE TWO AFT CELLS ARE EQUIPPED WITH JETTISON VALVES. THE CONTROL IS MANUALLY OPERABLE BY THE PILOT. THE CHUTE IN OPERATION EXTENDS BELOW THE FUSELAGE AFT OF THE BOMB-BAY DOORS.

FUEL SYSTEM

A SEPARATE FUEL SYSTEM, LOCATED IN EACH NACELLE, FUNCTIONS FOR EACH ENGINE. A CROSS FEED FUEL VALVE, LOCATED IN THE FUSELAGE CONNECTS BOTH FUEL SYSTEMS IN AN EMERGENCY.

ENGINE-DRIVEN FUEL PUMP

THE ENGINE-DRIVEN FUEL PUMP IS USED IN NORMAL FLIGHT OPERATION. THE ELECTRICALLY-DRIVEN FUEL PUMP IS USED FOR GROUND FUELING OR IN AN EMERGENCY CONDITION.

FUEL TANK SELECTOR VALVES

EACH ENGINE NACELLE HOUSES TWO FOUR-WAY SELECTOR VALVES MANUALLY CONTROLLABLE BY CABLES AND A TORQUE SHAFT FROM THE PILOT'S COMPARTMENT.

PROPELLER OPERATION

EACH PROPELLER GOVERNOR IS OPERATED OFF THE ENGINE OIL SYSTEM FOR THE RESPECTIVE ENGINE. THE DESIRED PITCH SETTING IS MA... BY THE PILOT. THE FEATHERING PUMPS AR... CONTROLABLE BY MEANS SWITCHES OPERA... BY THE PILOT. PROPELLERS ARE AUTOMATIC... PITCH AND BLADE ANGLE SETTING. THE FE... ERING PUMP RUNS AN AUXILIARY HIGH PRE... SYTEM TO FEATHER THE BLADES.

ENGINE COWL

THE ENGINE CONSISTS OF A NOSE RING, IN... MEDIATE COWL PANELS AND COWL FLAPS. ... INTERMEDIATE COWL PANELS ARE REMOVA... THE CARBURETOR AIR SCOOP CONSISTS OF ... NOSE, INTERMEDIATE AND ELBOW SECTION... THE COWL FLAPS EXTEND AROUND THE PE... PHERY OF EACH ENGINE. THE COWL FLAPS ... ELECTRICALLY OPERATED.

PNEUMATIC SYSTEM

EACH ENGINE DRIVES A ROTARY VANE TYP... PUMP WHICH TRANSFERS AIR FROM THE V... UUM LINES TO THE PRESSURE LINES OF TH... SYSTEM. THE PNEUMATIC SYSTEM OPERA... THE GYRO HORIZON, AUTOMATIC PILOT AND ... AND BANK INDICATOR. THE DE-ICER BOOTS ... OPERATE OFF THE PNEUMATIC SYSTEM. T... OPERATION OF THE PNEUMATIC SYSTEM IS ... TROLED BY MANUAL OPERATION OF A VALVE

OXYGEN SYSTEM

TEN CYLINDRICAL OXYGEN FLASKS, CHARGED TO LOW PRESSURE, AN OXYGEN FLOW REGULATOR, SIX FLOW METERS, SEVEN OUTLETS AND NECESSARY SUPPLY LINES COMPRISE THE SYSTEM. THE FLASKS ARE CHARGED TO 1800 P.S.I. WALK AROUND FLASKS AND FACE MASKS ARE ALSO PROVIDED FOR THE AIRCREW.

FUSELAGE ENTRANCE DOOR

THE ENTRANCE DOOR SWINGS ON SPECIAL RELEASE HINGES. WITHIN THE DOOR SHELL, AN INFLATABLE LIFE RAFT IS INSTALLED. THE LIFE RAFT IS AUTOMATICALLY INFLATABLE BY CO_2 UNDER PRESSURE IN A FLASK ATTACHED TO THE LIFE RAFT. THE DOOR HAS A QUICK RELEASE MECHANISM WHICH ALLOWS THE DOOR TO BE RELEASED WITH LIFE RAFT AND INFLATION CYLINDER. THE DOOR IS MADE AS WATERTIGHT AS IS PRACTICABLE.

MISCELLANEOUS EQUIPMENT

EACH SEAT HAS A SAFETY BELT. THE BOMBARDIER AND AFT GUNNER POSITIONS HAVE SPECIAL SAFETY BELTS. AN INTERIOR HAND RAIL IS ALSO INSTALLED. A BOMB HOIST IS ALSO STOWED IN THE FUSELAGE. AN ADJUSTABLE AERIAL WINCH IS ALSO STOWED IN THE FUSELAGE. FOUR VACUUM TYPE FLASKS ARE CARRIED. A TOOL KIT IS ALSO CARRIED. GROUND-TO-AIR SIGNAL INDEX CARD HOLDER IS ALSO CARRIED. A HAND AXE IS ALSO CARRIED.

VENTURA

U.S. NAVY PATROL BOMBER PV-1 WORLD WAR 1939-1945
MFRD: LOCKHEED AIRCRAFT CORPORATION AT BURBANK, CALIFORNIA

DRAWN BY: WILLIS L. NYE, A.A.H.S.
FOR
MODEL AIRPLANE NEWS NEW YORK CITY, N.Y.

THE VEGA VENTURA

VOUGHT SB2U CHESAPEAKE / VINDICATOR

An SB2U-3 in the overall light gray adopted for tactical U.S. Navy planes in February 1941. This is Airplane No. 16 of the Marine Scouting Squadron One (VMS-1).

☆ ☆ ☆

STARTING in the early 1920s, the Chance Vought Corporation of Long Island City, NY (later of East Hartford, CT), was the major supplier of scouting and observation planes to the U.S. Navy. Until 1934, scouting, light bombing and observation were considered separate missions, and the airplanes used separate "S," "B" and "O" designations. In 1934, some missions and designations were combined; e.g., "SB" for Scout-Bombers and "OS" for Observation-Scouts.

Vought entered the dual-designation era with the SBU-1 biplane, which started as the XF3U-1 two-seat fighter. The 124 SBU-1s and -2s were Vought's last biplanes. Changing requirements and the Navy's final acceptance of monoplanes for use on aircraft carriers resulted in subsequent Navy monoplane designs .

Vought responded to a U.S. Navy requirement for a folding-wing monoplane scout-bomber, and they received a contract for one XSB2U-1 on October 11, 1934. Like the Hawker Hurricane, the SB2U (Vought's Model 156) carried traditional Vought tube-and-fabric structure into the monoplane age. The SBU fuselage construction and tail shape were adapted to a new, metal-frame, low-cantilever wing that contained retractable landing gear. The wing had a single spar, a closed aluminum D-tube from the spar forward for torsional strength, and it was fabric-covered aft of the spar. The wing folded upward outboard of the flat center section by means of a manually operated screw jack that was secured to fittings on the wing and fuselage.

Its armament was two .30- or .50-caliber machine guns in the wings, and a single, flexible, .30-caliber gun in the rear cockpit. A single 500- or 1,000-pound bomb was carried on an ejector rack under the belly. Because the SB2U was a vertical dive bomber, this device was necessary to swing the bomb clear of the propeller. Two 100-pound bombs could be carried on racks under the wing. The powerplant for the production SB2U-1s was the 825hp Pratt & Whitney R-1535-96, and 54 planes were ordered in October 1936. An odd feature (compared with previous scout models) was the great distance between the cockpits.

The SB2U-1s entered

The following figures compare the weight and performance of the SB2U-1 and the SB2U-3:

Empty Weight .. 5,049/5,620 lbs.

Gross Weight .. 7,888/8,900 lbs.

Rate of Climb ..... 1,220/1,051 ft./min.

Service Ceiling ..... 26,400/22,000 ft.

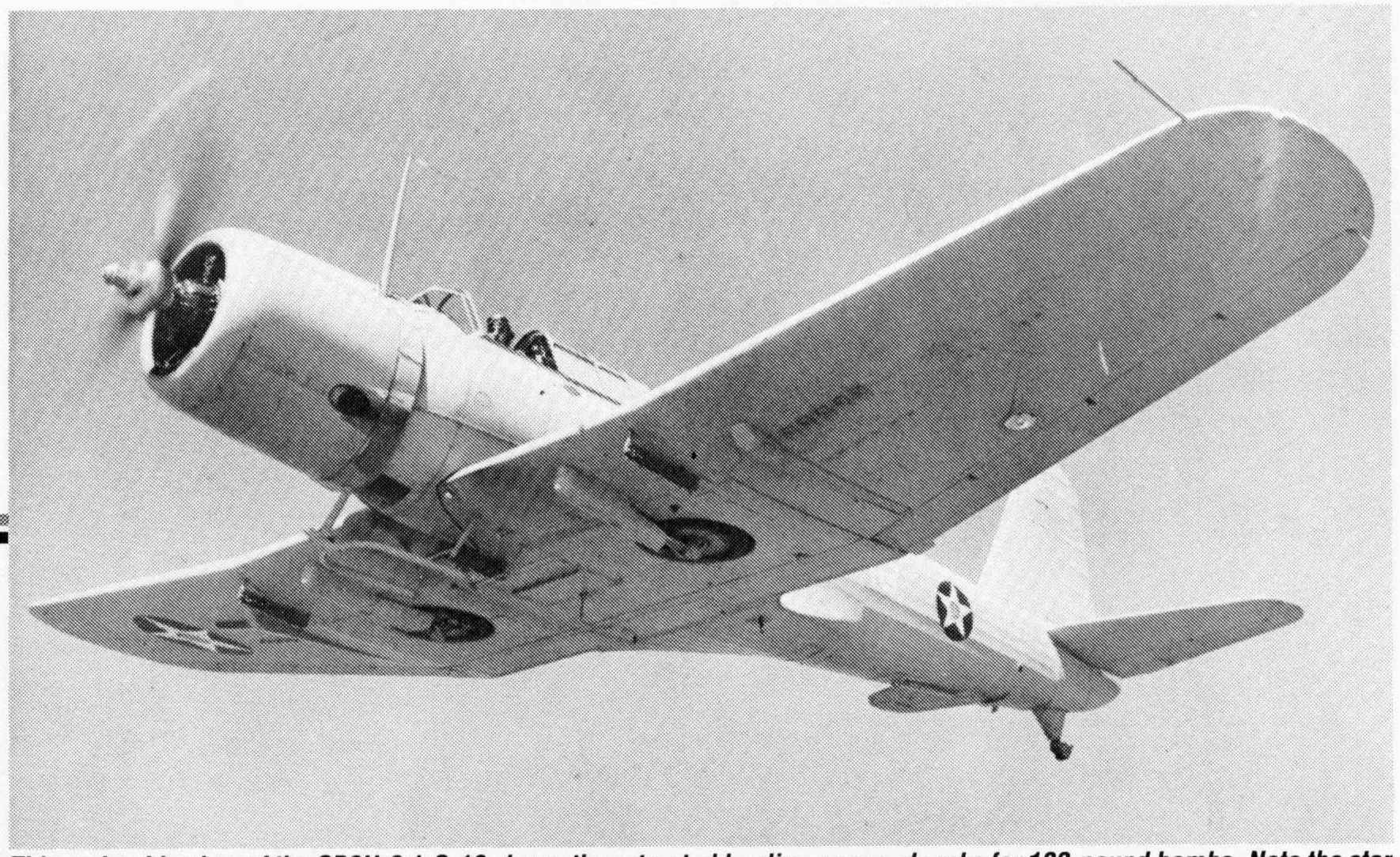
*Fuel ..... 690/2,766 lbs.**

High Speed ..... 250/221mph (at 9,500 ft.)

Range ..... 1,120/2,640 statute miles

*Navy specification tables for 1941 give pounds instead of gallons.

A Vought V-156F of the French Navy. Note the red, white and blue stripes on the elevators and the rudder, and the dive brakes on the wing (a feature not used on the U.S. Navy/Marine SB2Us).



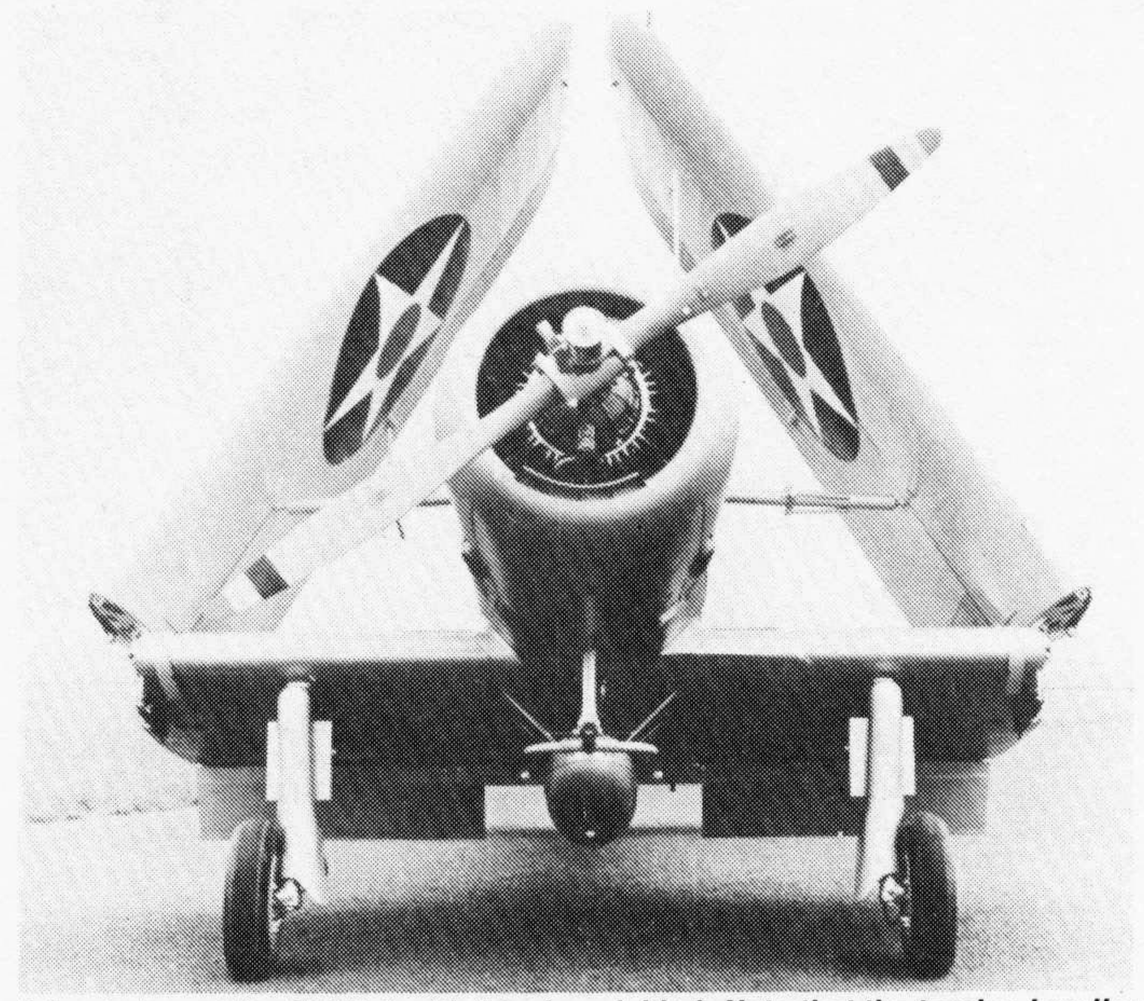
This underside view of the SB2U-3 1-S-16 shows the retracted landing gear and racks for 100-pound bombs. Note the star on the lower right wing.

service in December 1937, and they were followed by 58 improved SB2U-2s that were ordered in January 1938. The final order was for 57 SB2U-3s that were delivered to the U.S. Marine Corps late in 1940. The -3s were heavier because of their increased fuel and armor and their two additional wing guns.

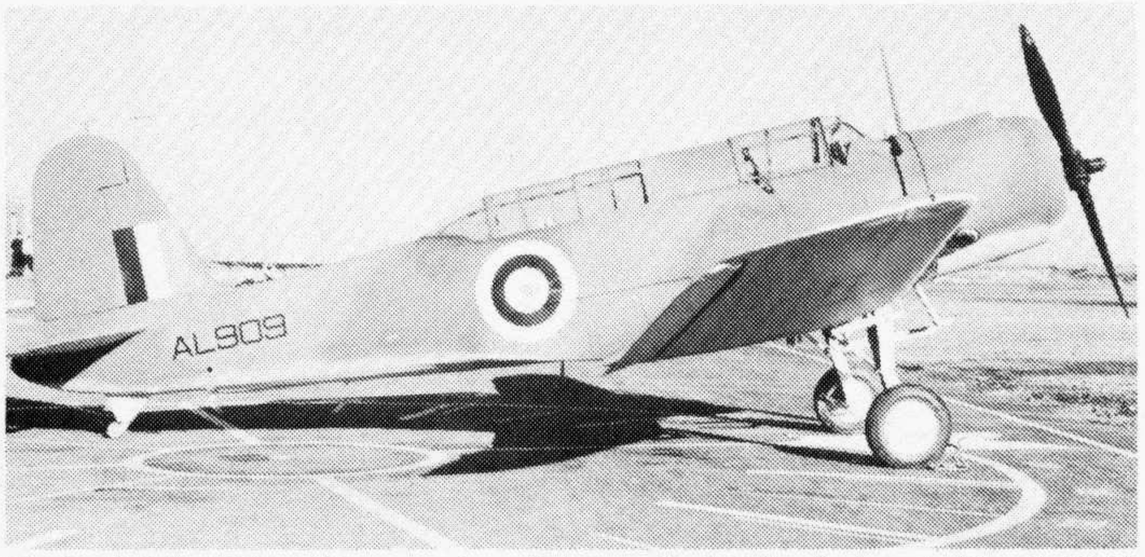
In 1938, the Navy allowed Vought to build 40 SB2U-2s for the French Navy as "V-156F" ("F" for France). These planes were equipped to French requirements, including the novel reverse-action French throttles that pulled back to increase power. French armament was installed in France. The V-156Fs served on French aircraft carriers and with shore-based squadrons, and they were the only SB2U types to go on the offensive (some made bombing raids from southern France into northern Italy in 1940). After the fall of France, England took over a second French contract for 50 V-156Fs, and named them "Chesapeake." Vought designated them "V-156B-1" ("B" for Britain).

The U.S. didn't adopt the British name, as it did with some other U.S. models in British service. When U.S. military planes were given "popular" names in October 1941, the SB2Us were named "Vindicator."

When the planes were re-equipped to British standards (including forward-open throttles and extra armor), the Chesapeakes were too heavy to operate from the small British carriers to which they had been assigned. As a result, they were reassigned to secondary shore duty and didn't see combat. It has been stated, but not verified, that the Germans used captured V-156Fs for scouting missions along the English coast.



A front view of the SB2U-2 with its wings folded. Note that the turning handles on the right-hand jack are extended, and that those on the left jack are folded.



The British V-156B-1 Chesapeake, photographed at the factory in March 1941.

By the middle of 1940, SB2U-1s and -2s were flying with seven U.S. Navy squadrons from four of the Navy's six big carriers. By the end of 1941, there were only four squadrons aboard two carriers. The U.S. Marines had all of their SB2U-3s at shore bases. Some of the carrier-based SB2Us that were at Pearl Harbor on December 7, 1941, were destroyed on the ground by the Japanese. Later Marine SB2U-3s were ferried to Midway Island, where they attacked Japanese ships during the Battle of Midway in June 1942.

Four SB2U squadrons served on the carriers "Wasp" and "Ranger" in the Atlantic until the end of 1942. They finished their service as trainers.

In 1939, the United Aircraft Corporation, the parent firm of both Vought and Sikorsky, merged the two into a single entity: the Vought-Sikorsky Division of United. The Vought factory was moved from East Hartford into the Sikorsky plant in Stratford, CT. The SB2U-3s that were then being built technically became "Vought-Sikorskys" instead of "Chance Voughts."

WING'S LAYOUT PLANS & ERECTION DETAILS

FUSELAGE'S STRUCTURE AND BODY LAYOUT PLANS

HORIZONTAL STABILIZER LAYOUT PLAN

VERTICAL STABILIZER LAYOUT PLAN

REDRAWN MAY-1940

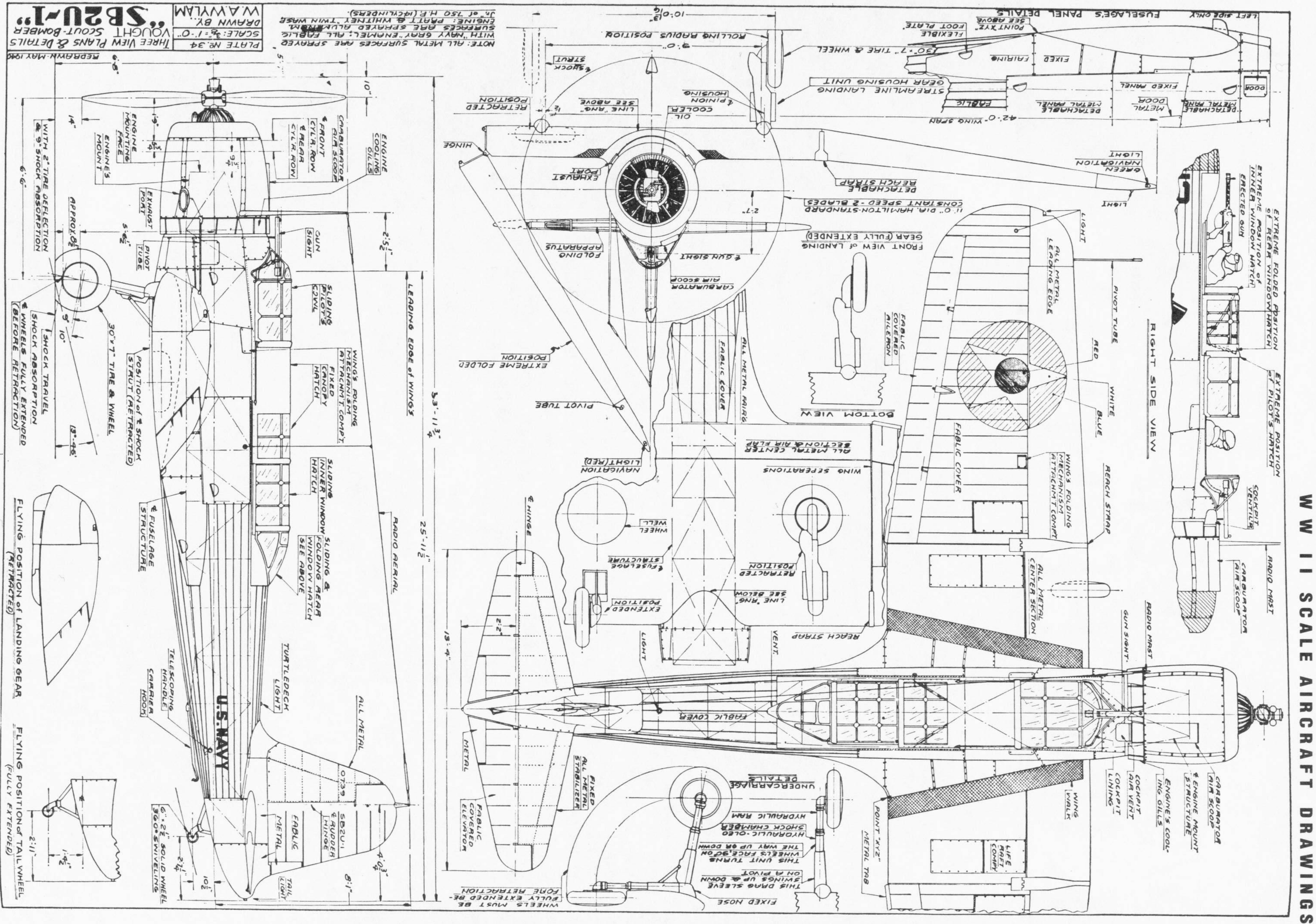
FUSELAGE BODY'S CROSS SECTIONS

VERTICAL STABILIZER CROSS SECTION

HORIZONTAL STABILIZER CROSS SECTION

PLATE Nº. 35	LAYOUT PLANS & DETAILS
SCALE: 3/8" : 1'-0"	VOUGHT SCOUT BOMBER
DRAWN BY.. W.A.WYLAM	"SB2U-1"

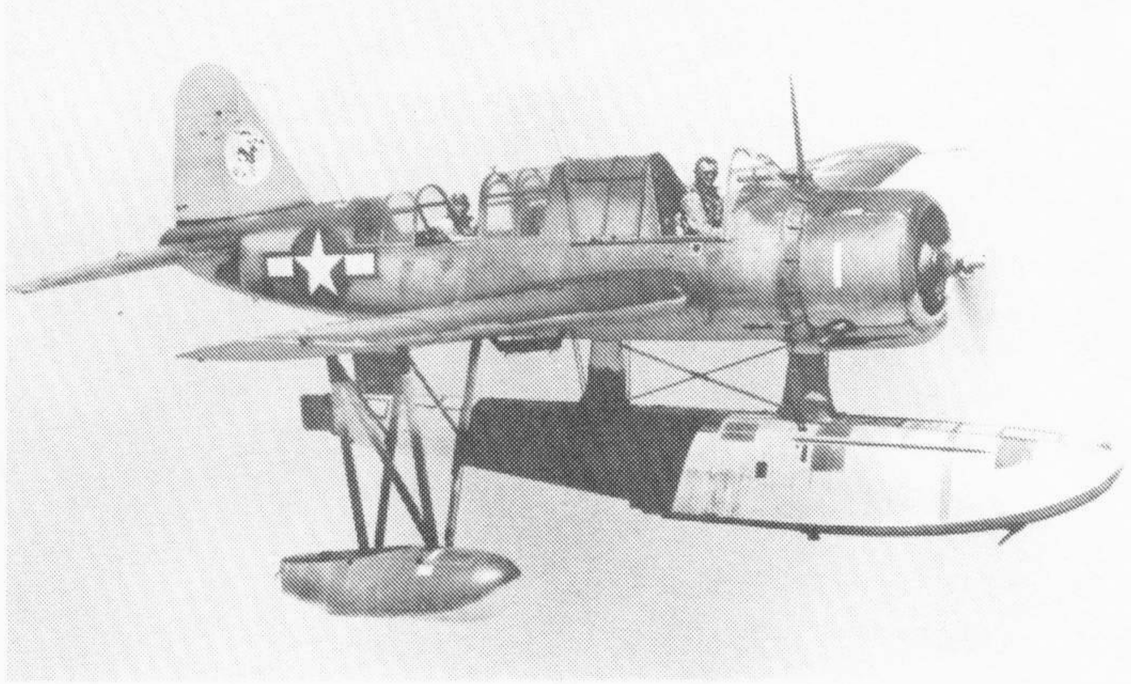
VOUGHT SB2U CHESAPEAKE/VINDICATOR



VOUGHT OS2U KINGFISHER

THE Vought OS2U Kingfisher was the most widely used U.S. Navy shipboard catapult plane of the war. On March 22, 1937, the Chance Vought Company (then of East Hartford, CT) received a contract for a single XOS2U-1, which was intended as a replacement for older Vought and Curtiss biplanes that were still serving the fleet. The prototype first flew on July 20, 1938, and an order for 54 production OS2U-1s followed. The first examples, which were mostly seaplanes, reached the fleet in August 1940, while others equipped with wheels were assigned to naval air stations and reserve training bases around the country.

As an airplane, the Kingfisher had little in common with previous Vought designs, other than the SBU-SB2U tail shape. It was an all-metal monoplane with a 450hp Pratt & Whitney R-985-48 Twin Wasp Jr. engine. The distance between the pilot and the observer/gunner was unusual, even when it was compared with the SB2U. A structural innovation for a production airplane was the spot-welding (rather than riveting) of sheet aluminum.



A Vought OS2U-3 Kingfisher seaplane, with 1943-44 dark blue-gray camouflage on the upper surfaces graduating to white undersides. The hook under the float was used to snag a retrieval net before the seaplane was hoisted aboard the mother ship.

The seaplane version used a single main float and wing-tip floats. Early floats were made by Vought, but the majority of them were built on a separate Navy contract by the Edo Corporation of College Point, Long Island, NY. The airplanes were flown from the new Vought-Sikorsky plant in Stratford, CT, to naval air stations, where the floats were installed in Navy shops.

SPECIFICATIONS AND PERFORMANCE OS2U-3

Powerplant	*Pratt & Whitney R-198-AN-2 or -8:450hp*
Wingspan	*35ft., 10 7/8 in.*
Wing Area	*262 sq. ft.*
Gross Weight	*6,000 lbs.*
High Speed	*165mph at 5,500 ft.*

The Navy was also involved in the manufacture of the Kingfisher. After Vought delivered 158 improved OS2U-2s with R-985-50 engines, and was working on 1,006 longer-range OS2U-3s, the U.S. Naval Aircraft factory in Philadelphia, PA, built 300 OS2U-3s as "OS2N-1" (the Navy had built a single XOSN-1 biplane of its own design there in 1938; hence the "OS2N-1" designation).

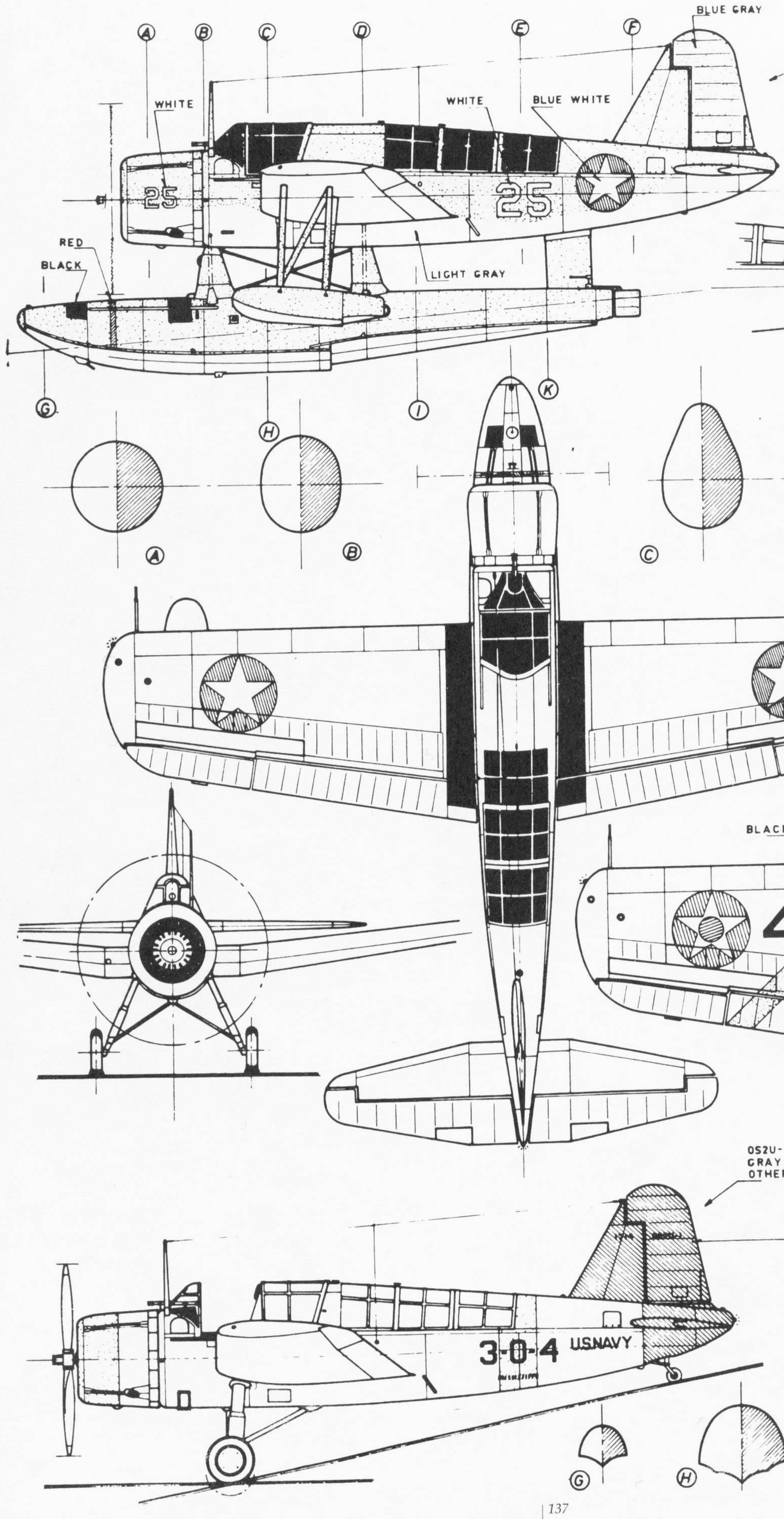
British forces received 100 OS2U-3s in 1942, and kept the name "Kingfisher." In the U.S., Kingfishers (on wheels and on floats) served with the Inshore Patrol Squadrons. In the fleet, they operated on wheels from aircraft carriers, and catapult seaplane versions served on battleships and cruisers until the end of the war.

Although they were usually low-performance scouts and observers that were lightly armed (two .30-caliber machine guns and two 325-pound depth charges), Kingfishers earned great fame for numerous rescue missions, where they picked up downed air crews from under the guns of Japanese shore batteries, and found lost personnel. The most famous of these missions was the successful 22-day search for Captain Eddie Rickenbacker, America's WWI Ace, who was forced down in the Pacific with a B-17 crew in November 1943.

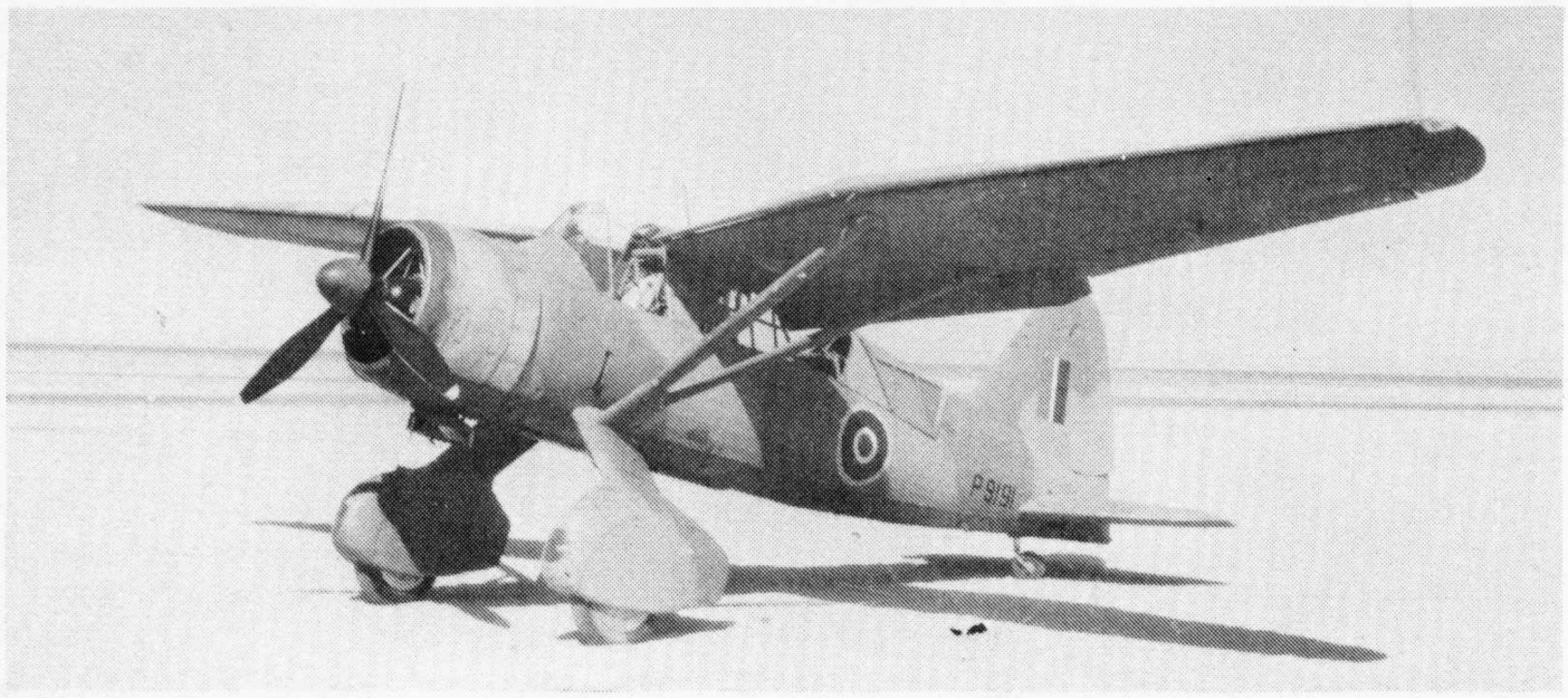
☆ ☆ ☆

An OS2U-3 ashore on its fixed landing gear. This is airplane no. 6 of Scouting Squadron Six, in the dark blue-gray top and side camouflage, and light gray underside camouflage, of 1942-43.

VOUGHT OS2U KINGFISHER



WESTLAND LYSANDER



A Westland Lysander II photographed at Kabrit, Egypt, in 1943. Note the lowered wing flaps and the very large pants (spats) over the wheels.

THE British Westland "Lysander" was developed in 1935 by Westland Aircraft, Ltd., of Yeovil, England. Westland applied latter-day technology to the traditional "Army Cooperation" airplane, which had been standardized by the major air powers as a large, versatile, open-cockpit biplane. Its mission was to work with the ground forces through observation and reconnaissance; photography; light bombing; and ground attack with machine guns. In pre-radio days, such planes could also pick up messages from ground points and drop them (and small quantities of supplies) to remote outposts.

The metal-framed Lysander retained all of the required Army Cooperation qualities, despite such major changes as a high monoplane wing, and a closed cabin in which the gunner/observer sat far to the rear, separated from the pilot by the fuel tank.

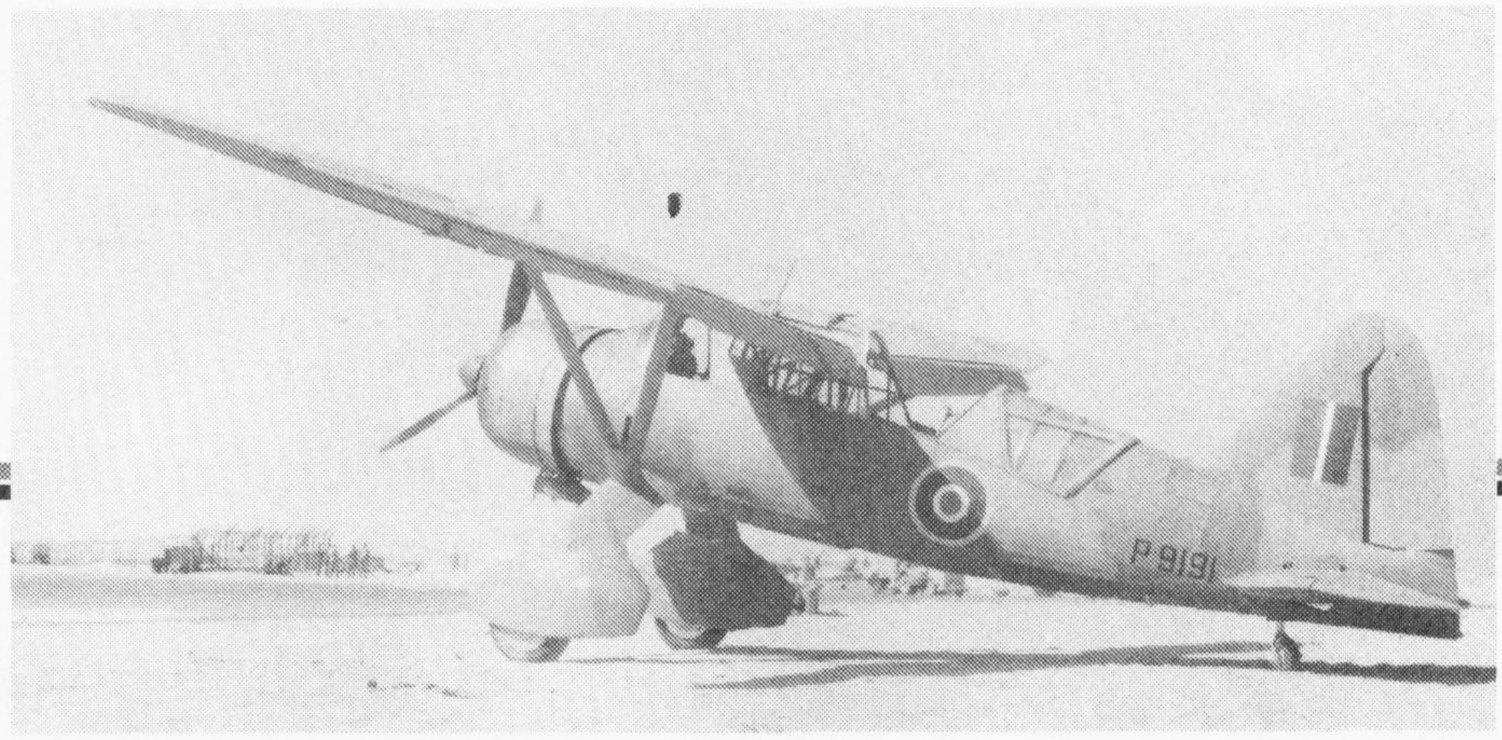
The single-wing design was much more than a simple deletion of the lower wing of a traditional biplane in the interest of improved crew visibility and streamlining. The odd planform (see photos and drawings) resulted in an overall aerodynamic forward sweep of the wing—an innovation that was many years ahead of its time. It also featured large trailing-edge flaps, and full-span, automatic, leading-edge slats that opened for slow-speed flight. Both features were relatively new to military aircraft, and they gave the Lysander unprecedented short takeoff and landing (STOL) performance.

Its initial powerplant was the 890hp Bristol Mercury XII radial engine; it had the unique Bristol-type cowling in which the leading edge of the cowling was also the collector ring for the engine exhaust. The single exhaust stack was at the lower right side. The Lysander's initial armament was a pair of forward-firing, .303-caliber machine guns in the wheel fairings outboard of the propeller arc, and a single WW I vintage, .303-caliber Lewis machine gun in the rear cockpit. Using both belly racks and racks on winglets, sixteen 20-pound bombs, four 216-pound bombs or two 250-pound bombs could be carried. Other stores, such as flares, smoke generators, supply cannisters and auxiliary fuel tanks, could also be

Lysander IIs with stub wings in place on the landing gear; the wheel covers have been removed. Note the far-aft location of the fuselage bomb racks and the early form of the narrow fin flash that was adopted in mid-1940.

SPECS AND PERFORMANCE
LYSANDER III

Powerplant	*870hp Bristol Mercury XX or 30*
Empty Weight	*4,365 lbs.*
Gross Weight	*6,318 lbs.*
High Speed	*209mph at sea level; 196mph at 15,000 ft.*
Minimum Speed (at gross weight)	*56mph*
Takeoff Run (to clear 50-foot obstacle)	*930 ft.*
Landing Run (over 50-foot obstacle)	*1,020 ft.*



Side view of the Lysander II. Note how the rear portion of the cabin enclosure slides straight aft.

carried by the versatile Lysander.

Another innovative Lysander feature was the single-leg landing gear, which was designed for high-impact short and hard landings. It had large spats over the wheels, and it could be fitted with stub wings, called "winglets," that served as mounts for bomb racks, rescue equipment and miscellaneous supplies. Later, a large cylindrical cargo container or auxiliary fuel tank was fitted under the belly. The first flight of the prototype was on June 15, 1936.

Lysander I—Successful tests of two prototypes resulted in an order for 169 Lysander Is, and production was completed in 1939. Gross weight was 4,065 pounds.

Lysander II—This was similar to the Mk I, except for a change to a 905hp Bristol Perseus XII sleeve-valve engine. Because of size and detail differences, this wasn't interchangeable with the Mercury engine. Westland built 442 Mk IIs, and a further 75 were built in Canada. Gross weight was 6,015 pounds.

Lysander III—This plane "reverted" to an 870hp Mercury XX engine; 250 were built in Yeovil, and another 17 were built in a new Westland plant in Doncaster. The armament was increased to two flexible machine guns.

Lysander IIIA—These were improved Mk IIIs with 870hp Mercury 30 engines; 370 were built. A further 100 were completed as unarmed T.T. Mk III target tugs.

The R.A.F. had seven squadrons of Lysanders in service when the war started, and six were sent to France. Their role was traditional as long as the front remained stable in the "Sitzkrieg." When the "Blitzkrieg" began on May 10, 1940, the old Army Cooperation role was shattered; the Lysander and similar types were unable to operate in the old way. Their own troops were hard to follow in the rapidly changing scene; enemy armored columns were impervious to light machine-gun attacks and even to light bombs, and they possessed formidable firepower that was deadly to slow, low-flying aircraft. Further, the overwhelming German air power shot down many Lysanders, and destroyed others on their airfields. Of 174 Lysanders sent to France, only 50 were able to return to England—88 were lost in combat, and 36 were either destroyed on the ground or abandoned by their retreating squadrons.

Many British-based Lysanders were lost in the Battle of France, when they flew across the Channel to drop supplies to surrounded Allied troops and were hit by German ground fire.

The Army Cooperation role continued in modified form in other theaters of the war—notably in North Africa, were Lysanders had been sent before the war. After the war began, Lysanders also served in Greece, Palestine and India. The Lysanders' most famous operation—and the one best suited to their STOL characteristics—was the nighttime shuttling of French Resistance and other agents (and supplies) into and out of occupied France. Between August 1941 and late 1944, some 400 such sorties were made, with nearly 300 people flown in and 500 brought out. For this clandestine work, the Lysanders were painted overall matte black.

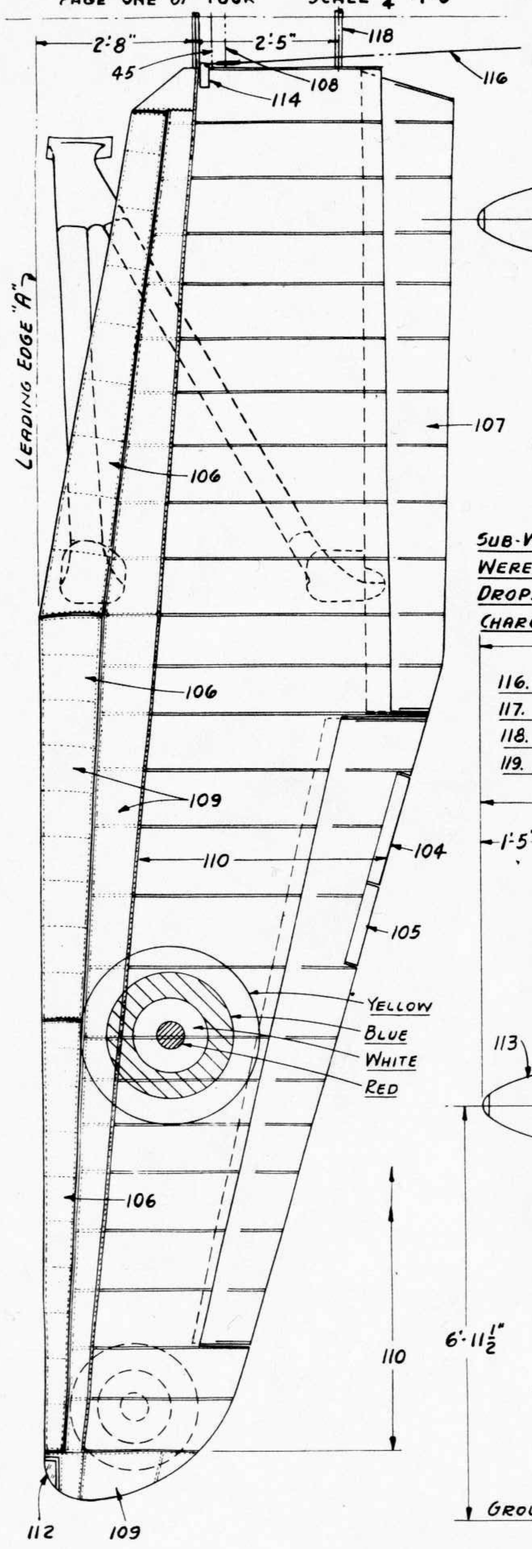
This view of a Lysander III with a belly-mounted auxiliary fuel tank shows the full-span wing slats open during a landing approach.

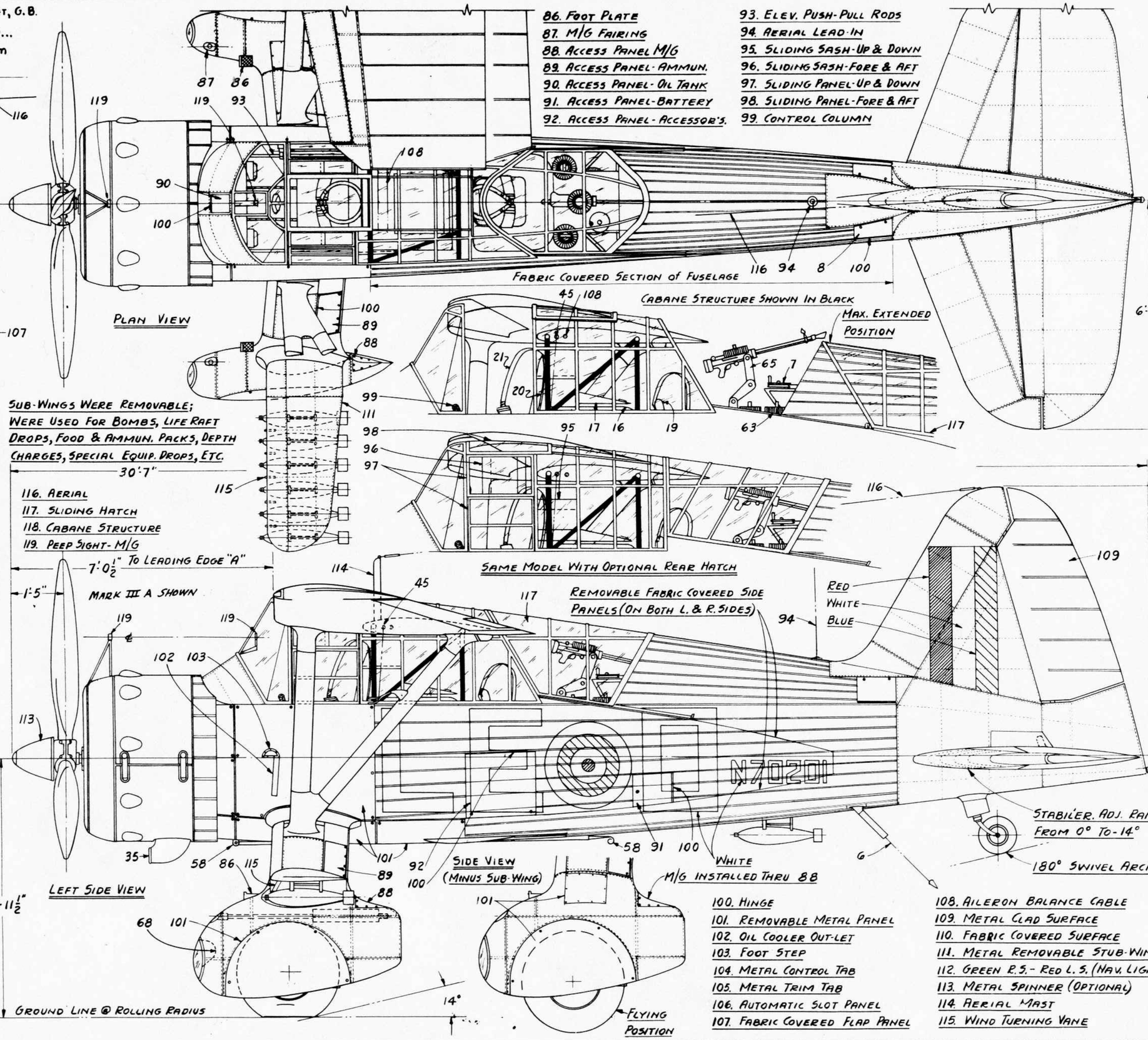
WESTLAND AIRCRAFT LIMITED · YEOVIL, SOMERSET, G.B.

LYSANDER

drawn by... W.A. Wylam

PAGE ONE of FOUR SCALE $\frac{1}{4}$" = 1'-0"





86. FOOT PLATE
87. M/G FAIRING
88. ACCESS PANEL M/G
89. ACCESS PANEL - AMMUN.
90. ACCESS PANEL - OIL TANK
91. ACCESS PANEL - BATTERY
92. ACCESS PANEL - ACCESSOR'S.
93. ELEV. PUSH-PULL RODS
94. AERIAL LEAD-IN
95. SLIDING SASH - UP & DOWN
96. SLIDING SASH - FORE & AFT
97. SLIDING PANEL - UP & DOWN
98. SLIDING PANEL - FORE & AFT
99. CONTROL COLUMN

SUB-WINGS WERE REMOVABLE; WERE USED FOR BOMBS, LIFE RAFT DROPS, FOOD & AMMUN. PACKS, DEPTH CHARGES, SPECIAL EQUIP. DROPS, ETC.

116. AERIAL
117. SLIDING HATCH
118. CABANE STRUCTURE
119. PEEP SIGHT - M/G

100. HINGE
101. REMOVABLE METAL PANEL
102. OIL COOLER OUT-LET
103. FOOT STEP
104. METAL CONTROL TAB
105. METAL TRIM TAB
106. AUTOMATIC SLOT PANEL
107. FABRIC COVERED FLAP PANEL
108. AILERON BALANCE CABLE
109. METAL CLAD SURFACE
110. FABRIC COVERED SURFACE
111. METAL REMOVABLE STUB-WING
112. GREEN P.S. - RED L.S. (NAV. LIGHTS)
113. METAL SPINNER (OPTIONAL)
114. AERIAL MAST
115. WIND TURNING VANE

ALL METAL FIXED FIN

FABRIC COVERED RUDDER

1. RUDDER HORN
2. ELEV. HORN
3. STAB. ADJ. SCREW
4. ENDLESS CHAIN
5. PARACHUTE FLARES
6. TRAILING AERIAL
7. AERIAL WINCH
8. START'G. CRANK STOR'E.
9. STAB. HINGE POST
10. TORQUE STRUT
11. BATTERY
12. CAMERA
13. RADIO
14. TAIL LIGHT
15. METAL SHELF
16. FUEL TANK
17. CHART TABLE
18. PULLEY

19. SWIVEL ADJ. SEAT
20. ADJ. HT. SEAT
21. SHOULDER STRAP
22. STABIL. ADJUST.
23. ENGINE CONTROL
24. INSTRUM'T. PANEL
25. OIL TANK
26. OIL COOLER
27. FLOORBOARD
28. SEAT ADJ.
29. EXHAUST COLL'R RING
30. EXHAUST OUTLET
31. EXHAUST SUPPORT
32. EXHAUST STACK
33. OIL SUMP
34. ADJ. COOLING GILLS
35. CARB. AIR INTAKE
36. IGNITION & PLUGS
37. FIREWALL
38. SNAP FASTENER

EXHAUST COLLECTOR SUPPORT (VIEW 'A')

DE HAVILLAND CONSTANT SPEED STEEL PROPELLER

FRONT VIEW-HUB (MINUS SPINNER)

BRISTOL "MERCURY XX" (VIEW 'B')

RIGHT SIDE VIEW

RIGHT SIDE VIEW - COWLING

DOWTY SELF-CASTORING INTERNALLY SPRUNG T.W.

PUSH-PULL RODS (46) WERE HELD TO FUSELAGE CURVATURE BY CAPITIVE ROLLER BEARINGS

39. MAIN BEARING
40. TORQUE TUBE
41. ELEV. SHAFT
42. BALL SOCKET
43. UNIVERSAL
44. PIVOT ℄
45. AILERON CABLE
46. FLEXIBLE PUSH-PULL
47. BRAKE PAD
48. M/G CHARGING
49. BOMB RELEASE
50. COUNTER-M/G
51. ELEC. SWITCH
52. REAR BOMB RELEASE
53. INDICATOR LIGHTS
54. M/G & BOMB CONTROL
55. METAL HOOD
56. SLIDING LADDER & DOOR
57. JACK-KNIFE BRACE
58. MESSAGE PICK-UP HOOK
59. MESSAGE HOOK WENCH
60. SLIDING PANEL

61. LEWIS .303 CAL SWIVEL M/G
62. BROWNING .303 FIXED M/G
63. AMMUNITION DRUM
64. AMMUNITION TRAY
65. FOLDING GUN MOUNT
66. FIXED GUN MOUNT
67. EMPTY SHELL CHUTE
68. LANDING LIGHT REFLECTOR
69. REINFORCED STRUCTURE
70. TORQUE LEVER

DOWTY INTERNALLY SPRUNG (SHOCK ABSORBING) WHEELS

INBOARD VIEW of WHEEL FAIRING

FLIGHT CONTROLS (SCHEMATIC)

AUX. BOMB RACK

FABRIC COVERED SECTION OF FUSELAGE

BOTTOM VIEW

ALL METAL ELEV. & STABILIZER

ALL METAL FUSELAGE TAIL SECTION

CABANE STRUCTURE SHOWN IN BLACK

SPRUCE FAIRING STRIPS MOUNTED ON WOODEN FORMERS

"F"

"E"

"D"

71. OIL GAGE
72. OIL PRESS.
73. OIL TEMP.
74. VOLTMETER
75. CLOCK
76. ALTIMETER
77. BANK & TURN
78. INCLINOMETER
79. TACHOMETER
80. AIR SPEED
81. ENGINE TEMP.
82. IGNITION
83. DASH LIGHT
84. PROP. SETT'G. CONTROL
85. FLAP CONTROL LEVER

SECTION @ "C"

ONE PIECE, FIXED LENGTH, 2½" SQ. STEEL TUBING LANDING GEAR STRUT WITH STREAMLINE HOUSING

WESTLAND AIRCRAFT LIMITED

LYSANDER

PAGE TWO of FOUR

W. A. Wylam

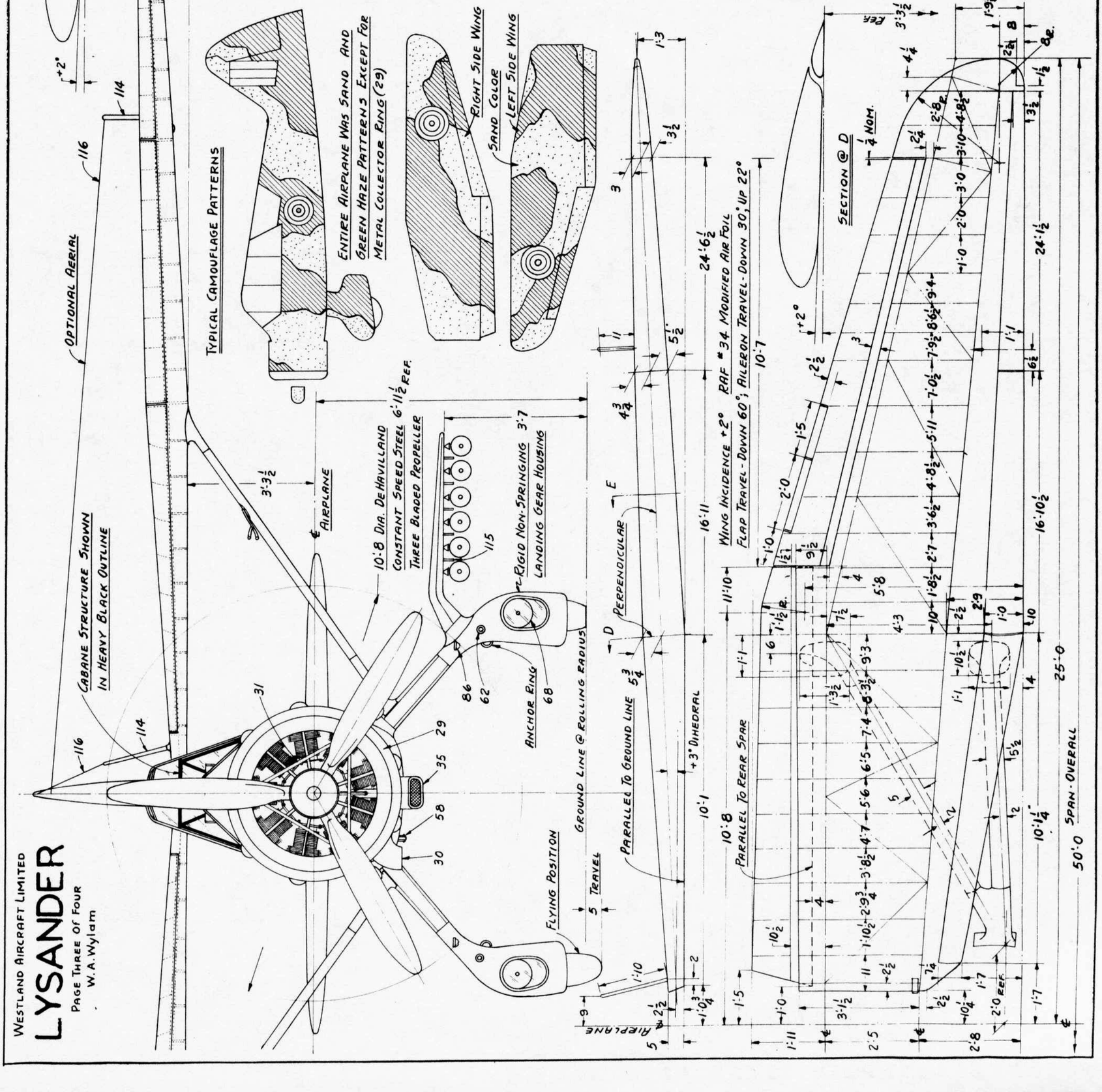
WESTLAND LYSANDER

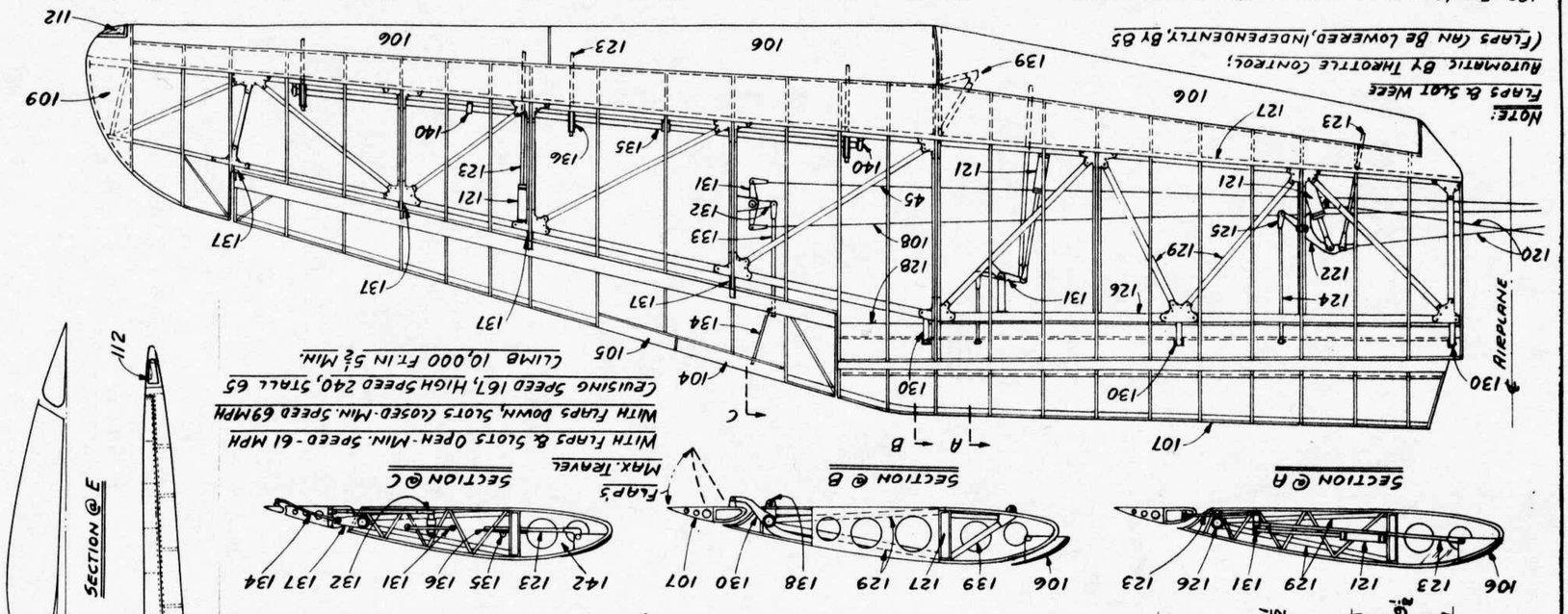
WESTLAND AIRCRAFT LIMITED

LYSANDER

PAGE THREE OF FOUR

W.A. Wylam





120. FLAP/SLOT BRACKET (GABLES)
121. HYDRAULIC CYLINDER
122. THREE POINT BELL CRANK
123. SLOT THRUST ROD
124. FLAP THRUST ROD
125. LEVERS & PIN
126. TUBULAR REAR SPAR
127. BUILT-UP METAL SPAR
128. METAL FAIRING PANEL
129. SQUARE TUBE DRAG STRUT
130. FLAP HINGE BRACKET
131. TWO POINT BELL CRANK
132. ONE POINT BELL CRANK
133. AILERON THRUST ROD
134. TAB CONTROL
135. CONTROL SHAFT (SLOTS)
136. RACK & PINION
137. AILERON HINGE
138. WING STRUT LUGS
139. SUPER-STRUCTURE (WING STRUTS)
140. BEARINGS
141. GUSSET PLATES
142. METAL NOSE RIB

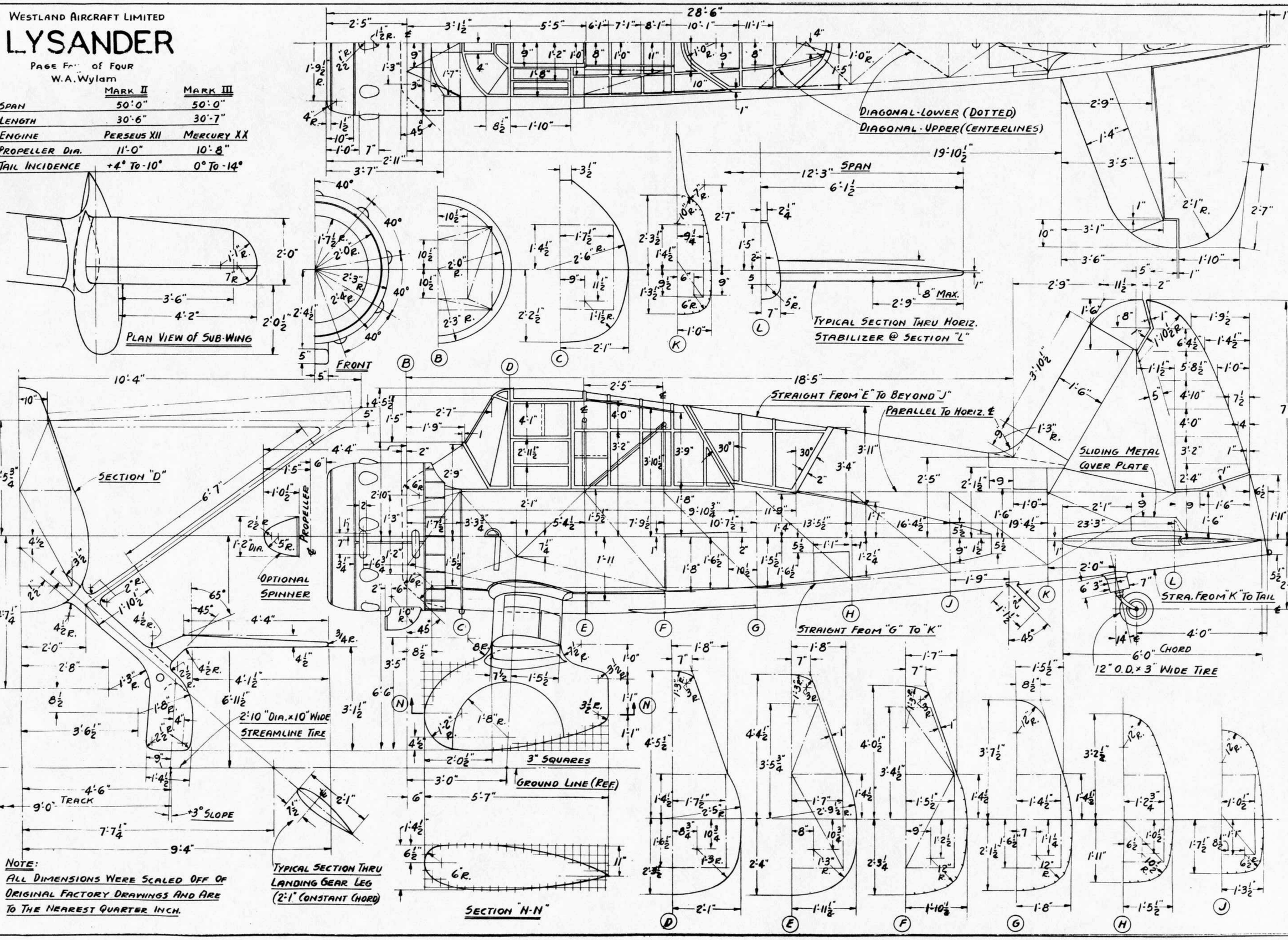
WESTLAND AIRCRAFT LIMITED

LYSANDER

PAGE FOUR OF FOUR

W.A. Wylam

	MARK II	MARK III
SPAN	50'-0"	50'-0"
LENGTH	30'-6"	30'-7"
ENGINE	PERSEUS XII	MERCURY XX
PROPELLER DIA.	11'-0"	10'-8"
TAIL INCIDENCE	+4° TO -10°	0° TO -14°



NOTE:
ALL DIMENSIONS WERE SCALED OFF OF ORIGINAL FACTORY DRAWINGS AND ARE TO THE NEAREST QUARTER INCH.

WESTLAND LYSANDER

THE WESTLAND WHIRLWIND

Only 12 Westland Whirlwinds were built after this P7110. Note the four-cannon armament and the "bullet" at the fin-stabilizer intersection that wasn't on the two prototypes.

THE British Westland Whirlwind was the world's first production twin-engine, single-seat fighter that was designed as such. The prototype flew on October 11, 1938, beating the American Lockheed XP-38 by three months. The Whirlwinds saw extensive action in Europe during the war, but they weren't built in great numbers. There were two prototypes, and only 144 production models that equipped two fighter squadrons.

Design of the Whirlwind began in 1936, in response to an Air Ministry request for a twin-engine, single-seat fighter. Westland beat proposals from Bristol and Hawker, and received a contract for two prototypes in February 1937. The Whirlwind airframe was, in effect, a scaling-down of conventional twin-engine transports and bombers; it had a shorter nose, engines in nacelles on the wing, and landing gear that retracted into the nacelles. This led to odd proportions, because the single-seat airframe was relatively small, but the nacelles,

This view from above shows engine and radiator air intakes, located in the leading edge of the wing, between the fuselage and the nacelles. Note the 1940 Sand and Spinach camouflage, the Type A.1 roundels on the fuselage and the Type B roundels on the upper wing surface.

SPECIFICATIONS AND PERFORMANCE: WHIRLWIND

Powerplant ..... Rolls-Royce Peregrine, 860hp at 2,850rpm at 13,500 ft.; 885hp at 3,000 rpm at 15,000 ft.

Wingspan ..... 45 ft.

Length ..... 32 ft., 3 in.

Wing Area ..... 250 sq. ft.

Empty Weight ..... 8,310 lbs.

Gross Weight ..... 10,356 lbs. (fighter); 11,388 lbs. (bomber with two 500-lb. bombs).

High Speed ..... 315mph at 5,000 ft.; 360mph at 15,000 ft.; 270mph at 15,000 ft. with two 500-lb. bombs.

with their standard-size engines, had to be as big as those on much larger aircraft.

The structure was all metal, including even the covering of the control surfaces. Its powerplants were 885hp Rolls-Royce Peregrines, which were developments of the earlier Rolls-Royce Kestrel that preceded the famous Merlin. The Whirlwind was the only airplane to use this engine, and troubles with the Peregrine hindered Whirlwind production and operations. Armament was the heaviest of any British fighter of the time; it had a battery of four 20mm cannons in the nose.

An initial order for 200 Whirlwinds was soon followed by an order for 200 more. Production began in Westland's Yeovil plant, but it suffered from the higher priority that was given to the Lysander program, and the first production Whirlwind didn't fly until May 1940. Two Whirlwinds, plus the second prototype, were assigned to No. 25 Fighter Squadron, but they were withdrawn when that unit was re-equipped with Bristol Beaufighters. The three, and other Whirlwinds, were then assigned to No. 253 Squadron, but because there were so few of them, they didn't participate in the Battle of Britain. Whirlwinds didn't engage the enemy until January 12, 1941, when two were sent up to intercept a lone German bomber over England. They scored a "probable"; and the first confirmed victory came on February 8, when a German Arado 196 seaplane was shot down.

The Whirlwind was kept secret from the public until February 1942. The Germans, however, knew of it much earlier; they had accurate silhouettes of the Whirlwind in their aircraft recognition manuals.

The short range of the Whirlwind precluded its use as an escort on long-distance bomb raids, but it did conduct escorts as far as Holland. Although it could hold its own against the Messerschmitt 109, the Whirlwind lacked high-altitude capability—a feature that wasn't considered important in a fighter when it was designed, but became very important after the war started. Whirlwinds equipped a second squadron (No. 137), and participated in low-altitude missions. They took part in attacks on German airfields and military installations in western France from their bases in England.

Bombing was added to the Whirlwind's activity in mid-1942, when racks for two 250-pound or two 500-pound bombs were added to the wings outboard of the nacelles. This version was named the "Whirlibomber."

The Whirlwind was already suffering from low priorities in its own factory, and production suffered further setbacks when the new Ministry of Aircraft Production decided to cancel Peregrine engine production in favor of increased Merlin production. As a result, the second order for 200 Whirlwinds was cancelled, and only 144 on the first order were completed. Westland then converted the Whirlwind production line to licensed production of Supermarine Spitfires.

The delivered airplanes were now "orphaned," with little support from the factory or the engine manufacturer; and the operational Whirlwinds were withdrawn from service. No. 263 Squadron was the last to use them, and 12 Whirlwinds made a spectacular attack on Cherbourg Harbor in France on October 22, 1943.

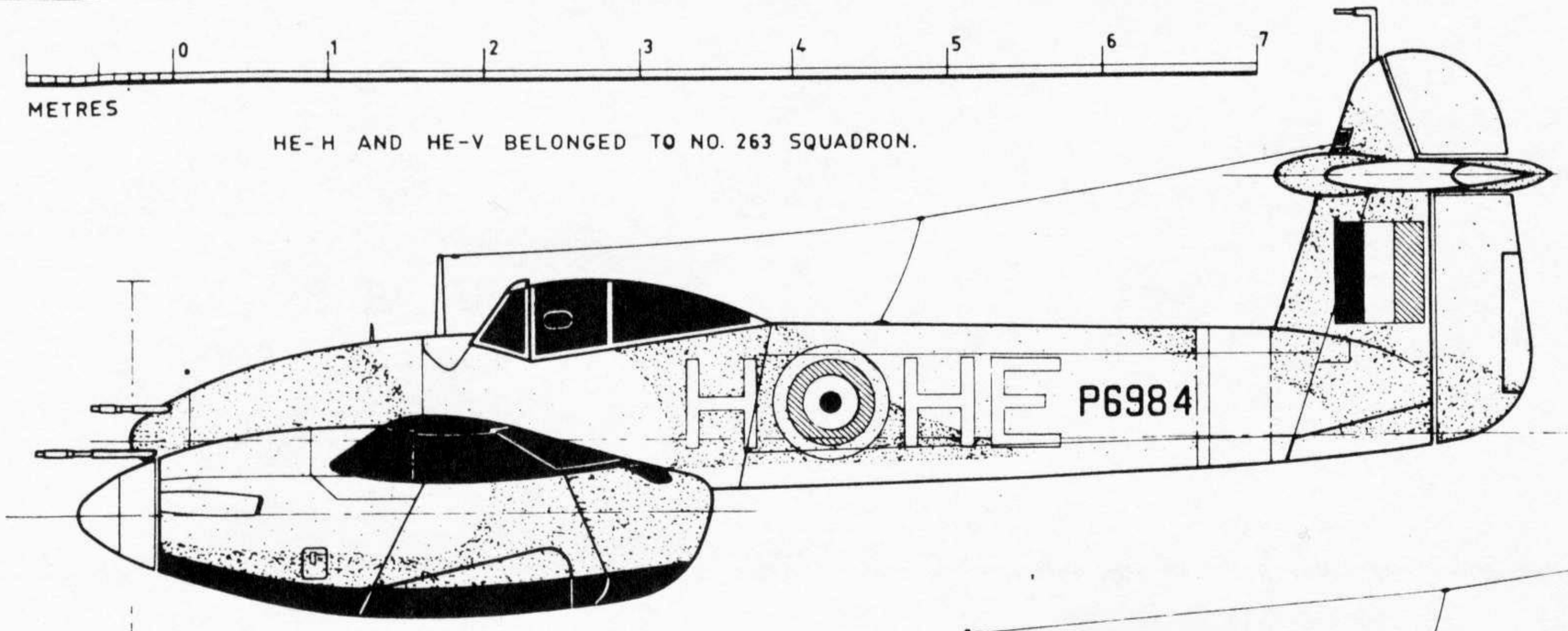
A variety of British colors and markings were used during the career of the Whirlwind. The first prototype was painted overall red with white letters and Type A roundels all over. The second prototype was all silver, again with Type A roundels. The odd arrangement of a black underside for the left wing, with a Type A.1 roundel matching a Type A roundel under the duck-egg blue right wing, is correct. This arrangement was also used by some other British fighters in 1940. Type C roundels were used on the fuselage and under the wings from July 1942 on.

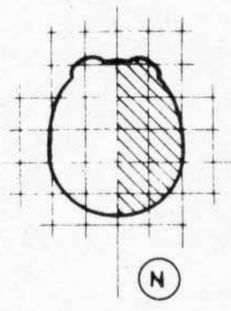
This underside view of the Whirlwind shows the landing gear completely enclosed in nacelles, and Type A roundels under the wing.

0 1 2 3 4 5 6 7

METRES

HE-H AND HE-V BELONGED TO NO. 263 SQUADRON.



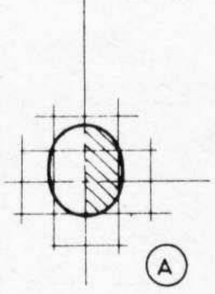


ENGINES:
TWO 885 HP ROLLS-ROYCE "PEREGRINE" 12-CYL. LIQUID COOLED SUPERCHARGED ENGINES

CASE BOX

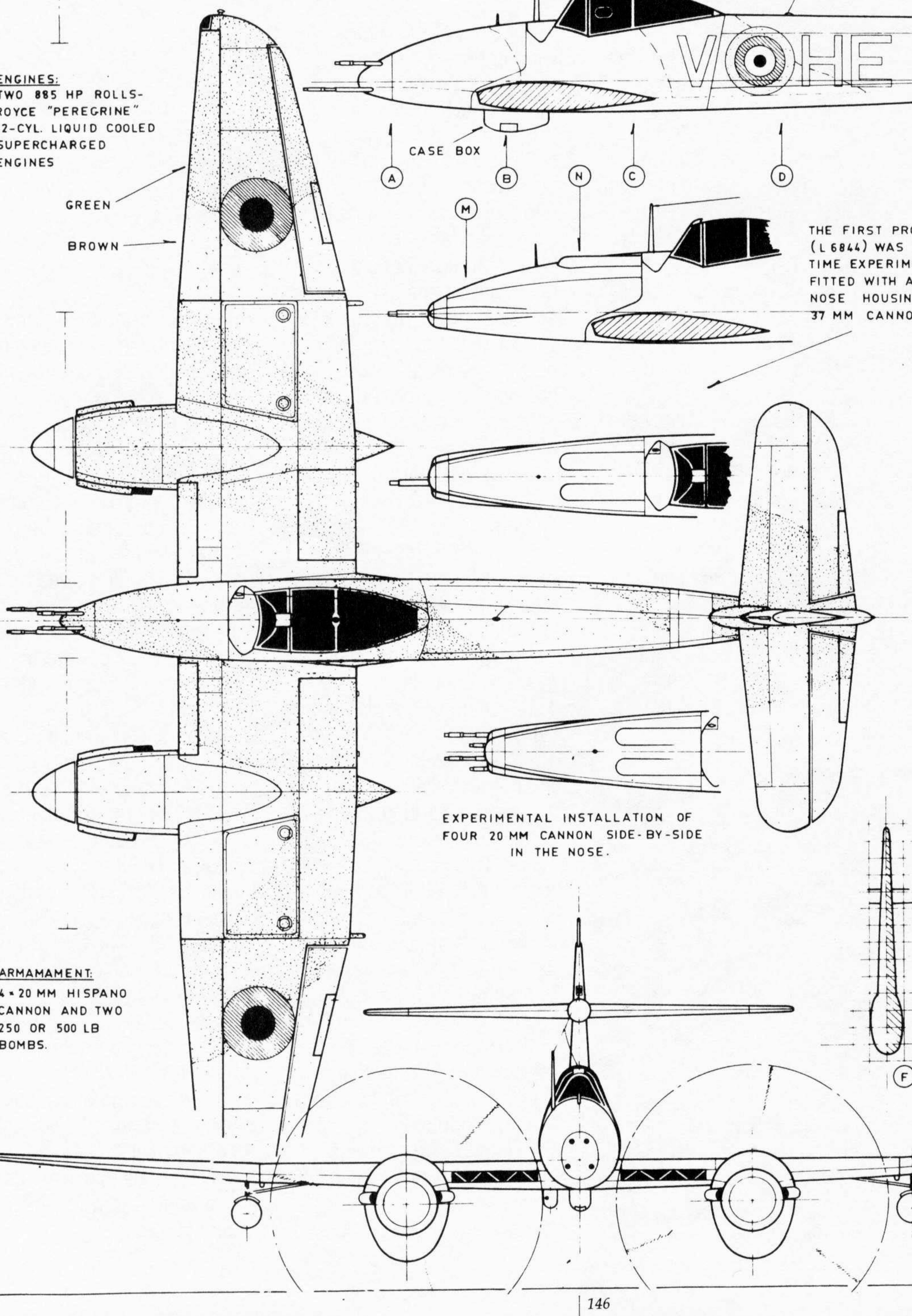
A B N C D E F

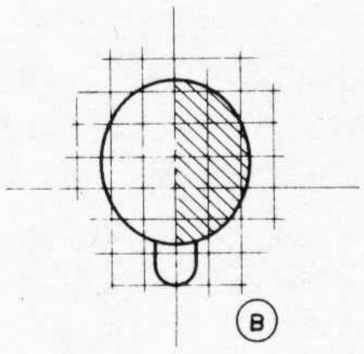
THE FIRST PROTOTYPE (L 6844) WAS FOR A TIME EXPERIMENTALLY FITTED WITH A SPECIAL NOSE HOUSING A 37 MM CANNON.

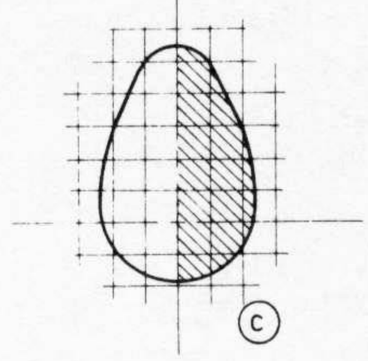


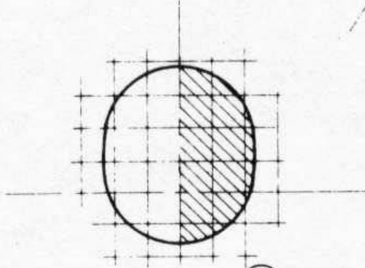
GREEN

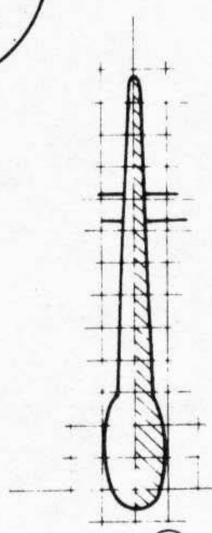
BROWN

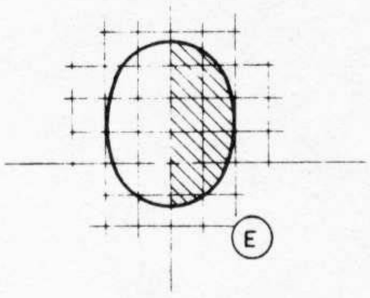












EXPERIMENTAL INSTALLATION OF FOUR 20 MM CANNON SIDE-BY-SIDE IN THE NOSE.

ARMAMAMENT:
4 × 20 MM HISPANO CANNON AND TWO 250 OR 500 LB BOMBS.

WESTLAND WHIRLWIND

COLOUR SCHEME:

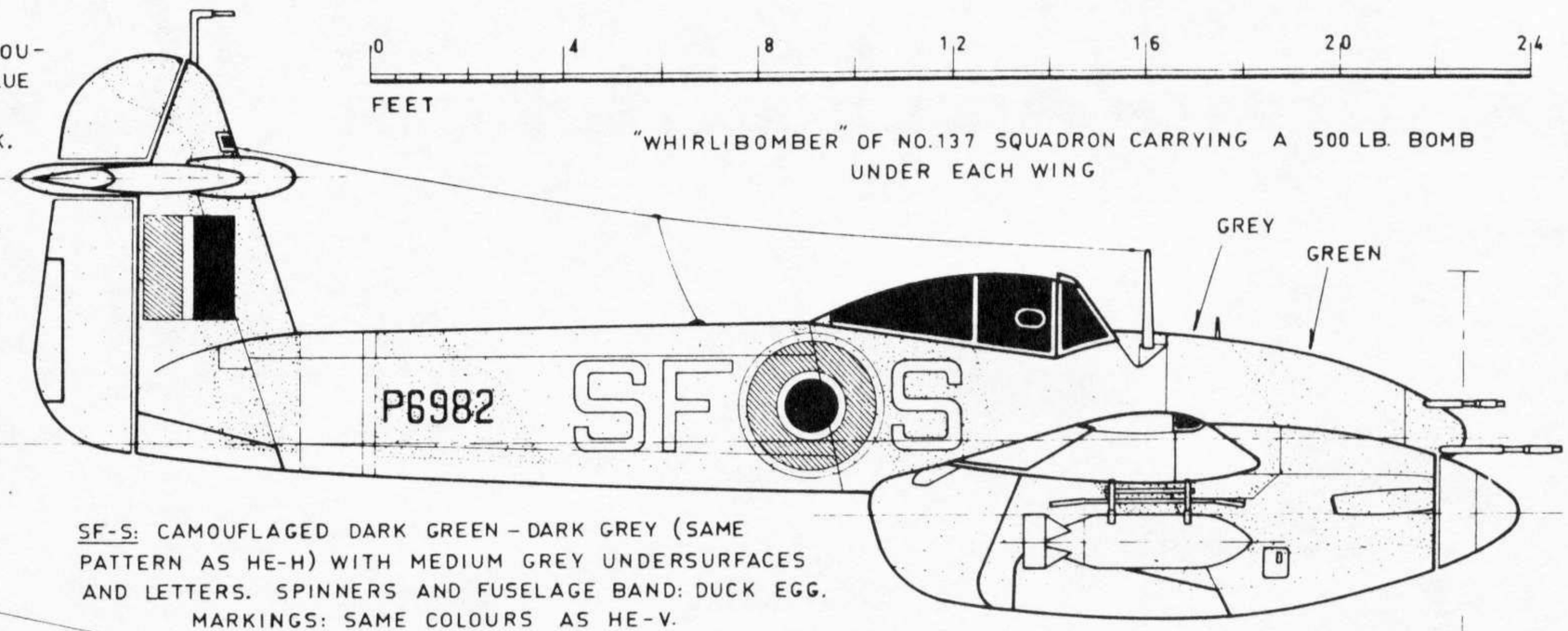
HE-H: DARK GREEN - DARK BROWN CAMOUFLAGE. UNDERSURFACES: DUCK-EGG BLUE (VERY PALE GREEN) EXCEPT FOR PORT WING & NACELLE, WHICH WERE BLACK. SPINNERS & FUSELAGE BAND: DUCK-EGG. MEDIUM GREY SQUADRON LETTERS. FUSELAGE ROUNDELS: RED-WHITE-BLUE-YELLOW (RED CENTER). WING ROUNDELS, UPPER: RED-BLUE, LOWER: RED-WHITE-BLUE WITH AN EXTRA YELLOW RING ON PORT WING. FIN FLASH: RED-WHITE-BLUE.

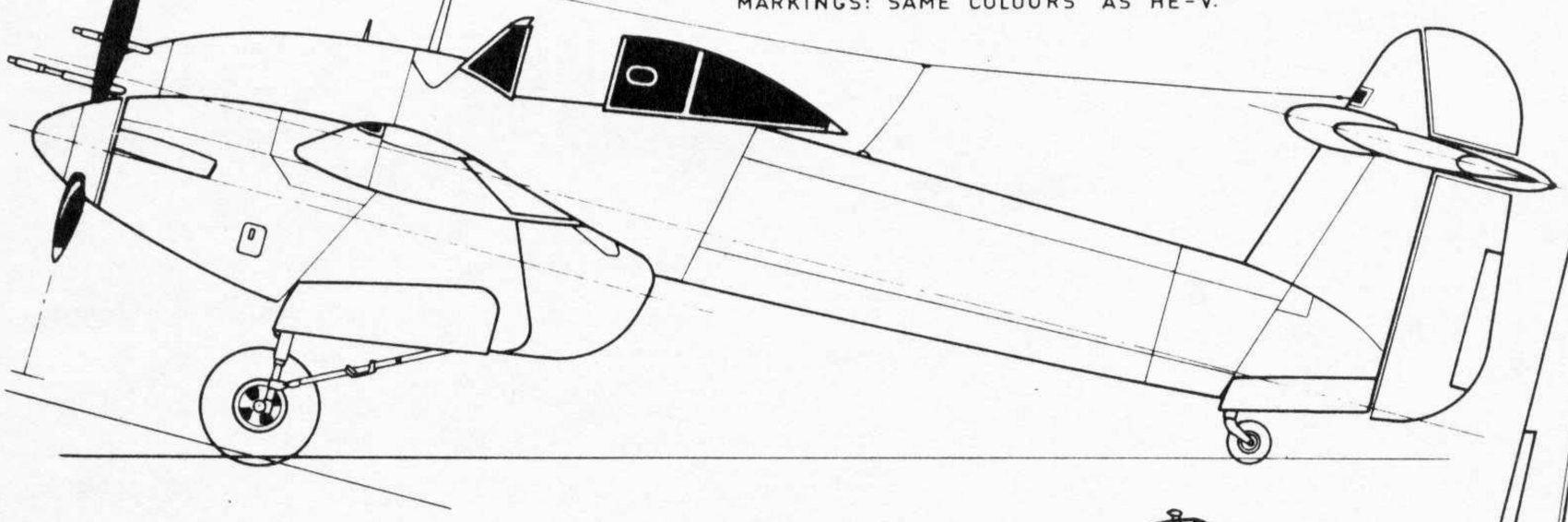
HE-V: AS HE-H BUT WITHOUT BLACK PORT WING AND WITH RED-WHITE-BLUE ROUNDEL UNDER BOTH WINGS.

SF-S: CAMOUFLAGED DARK GREEN - DARK GREY (SAME PATTERN AS HE-H) WITH MEDIUM GREY UNDERSURFACES AND LETTERS. SPINNERS AND FUSELAGE BAND: DUCK EGG. MARKINGS: SAME COLOURS AS HE-V.

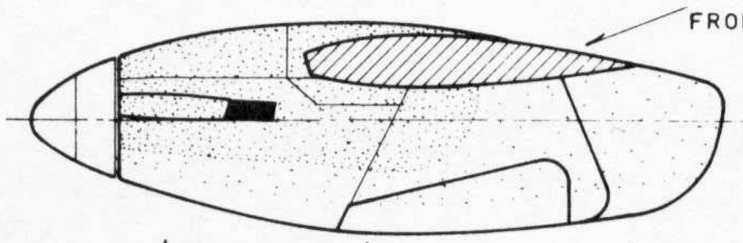
0 4 8 12 16 20 24
FEET

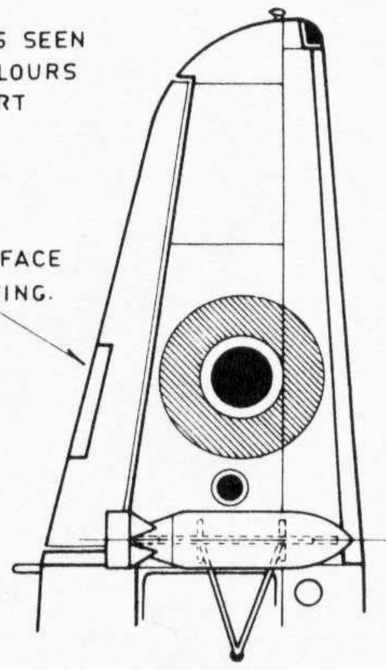
"WHIRLIBOMBER" OF NO.137 SQUADRON CARRYING A 500 LB. BOMB UNDER EACH WING



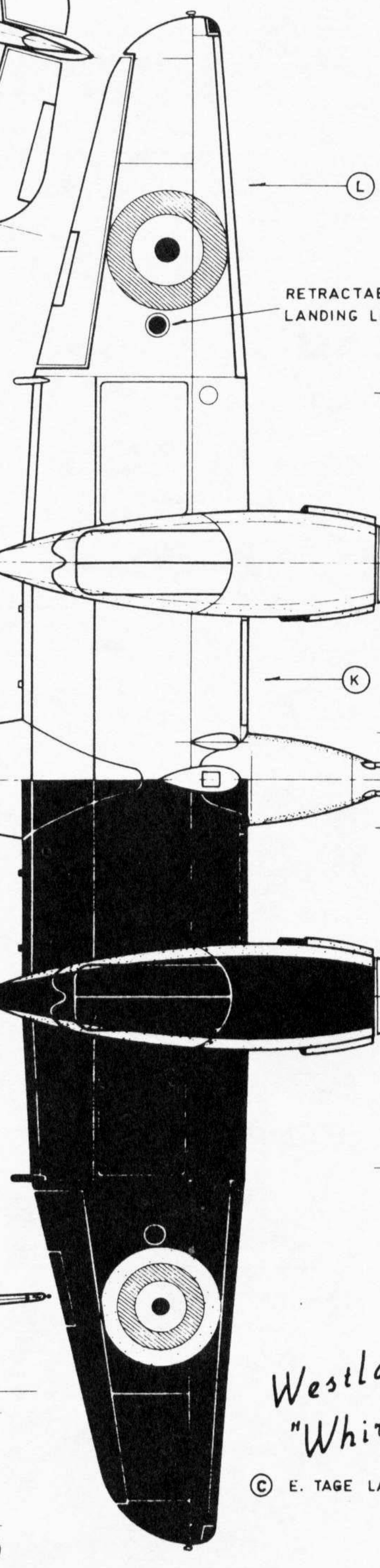


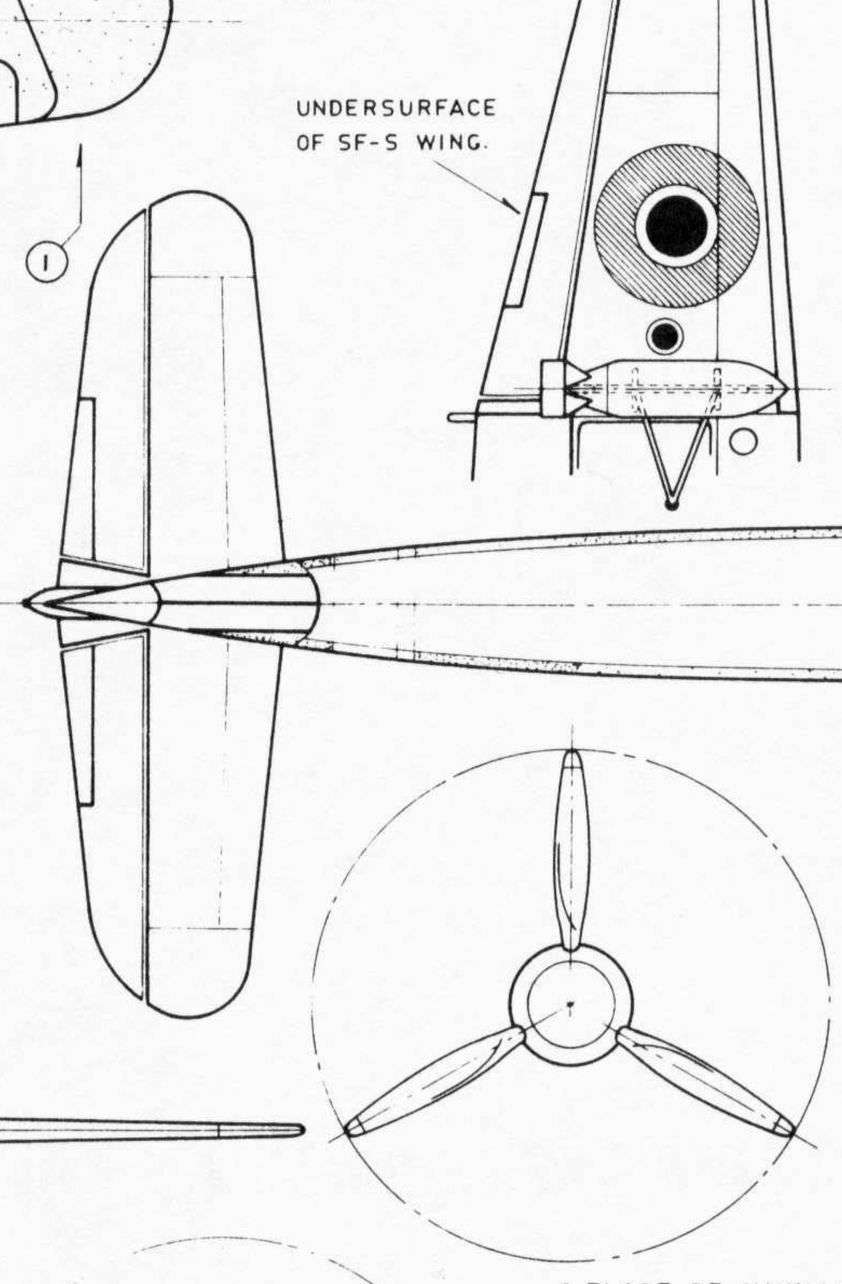
STARBOARD ENGINE AS SEEN FROM FUSELAGE. (COLOURS REVERSED ON PORT ENGINE).



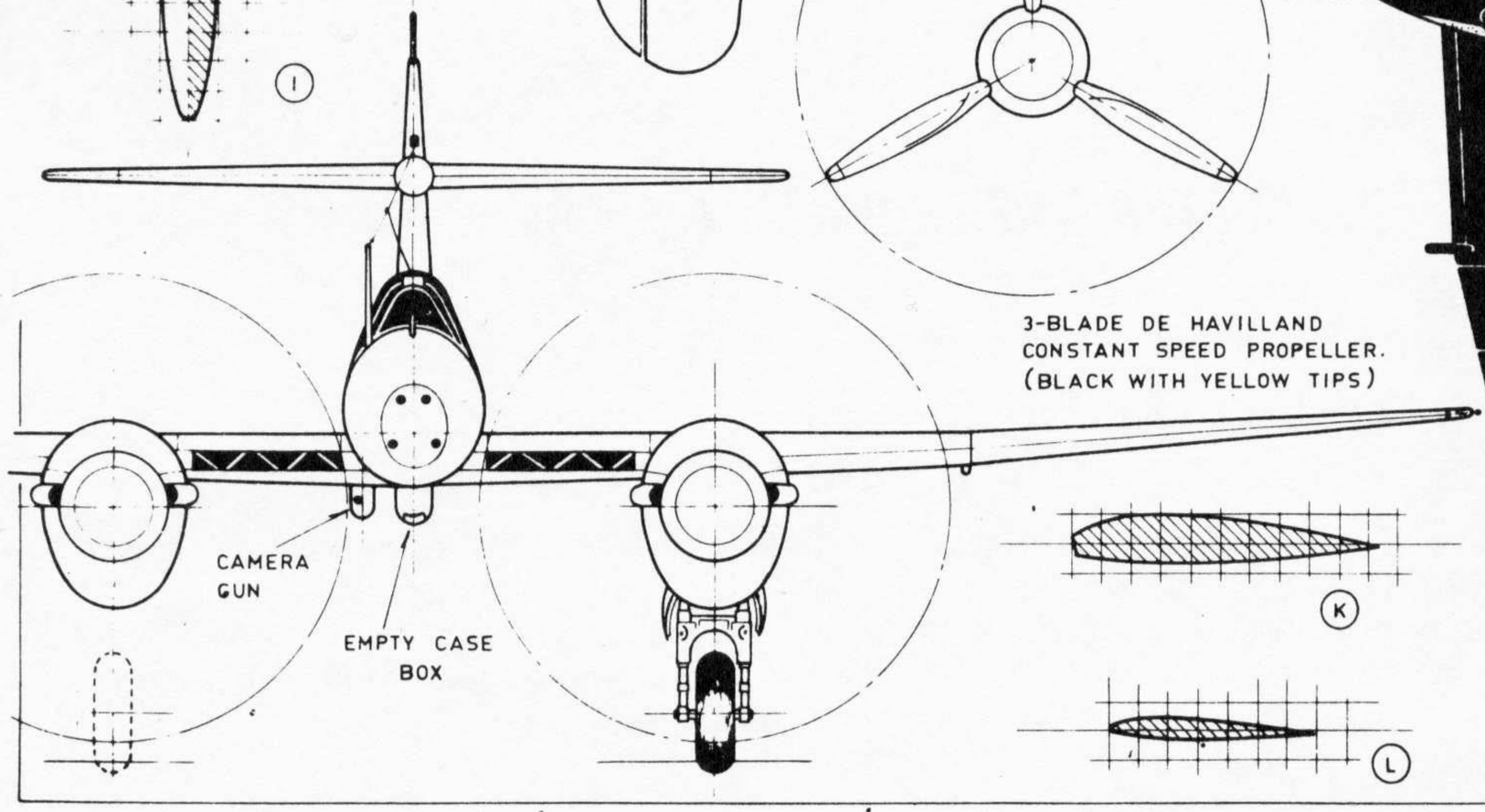


UNDERSURFACE OF SF-S WING.





3-BLADE DE HAVILLAND CONSTANT SPEED PROPELLER. (BLACK WITH YELLOW TIPS)



Westland "Whirlwind"

© E. TAGE LARSEN, OCT.-68

Tage

AIR AGE, INC.

Aviation Magazine and Book Publishers since 1929

ISBN: 0-911295-14-3 $12.95

AIR AGE, INC.

**Aviation Magazine and Book
Publishers since 1929**