Structural details of B-314.

AIR POWER

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THE BOEING CLIPPERS
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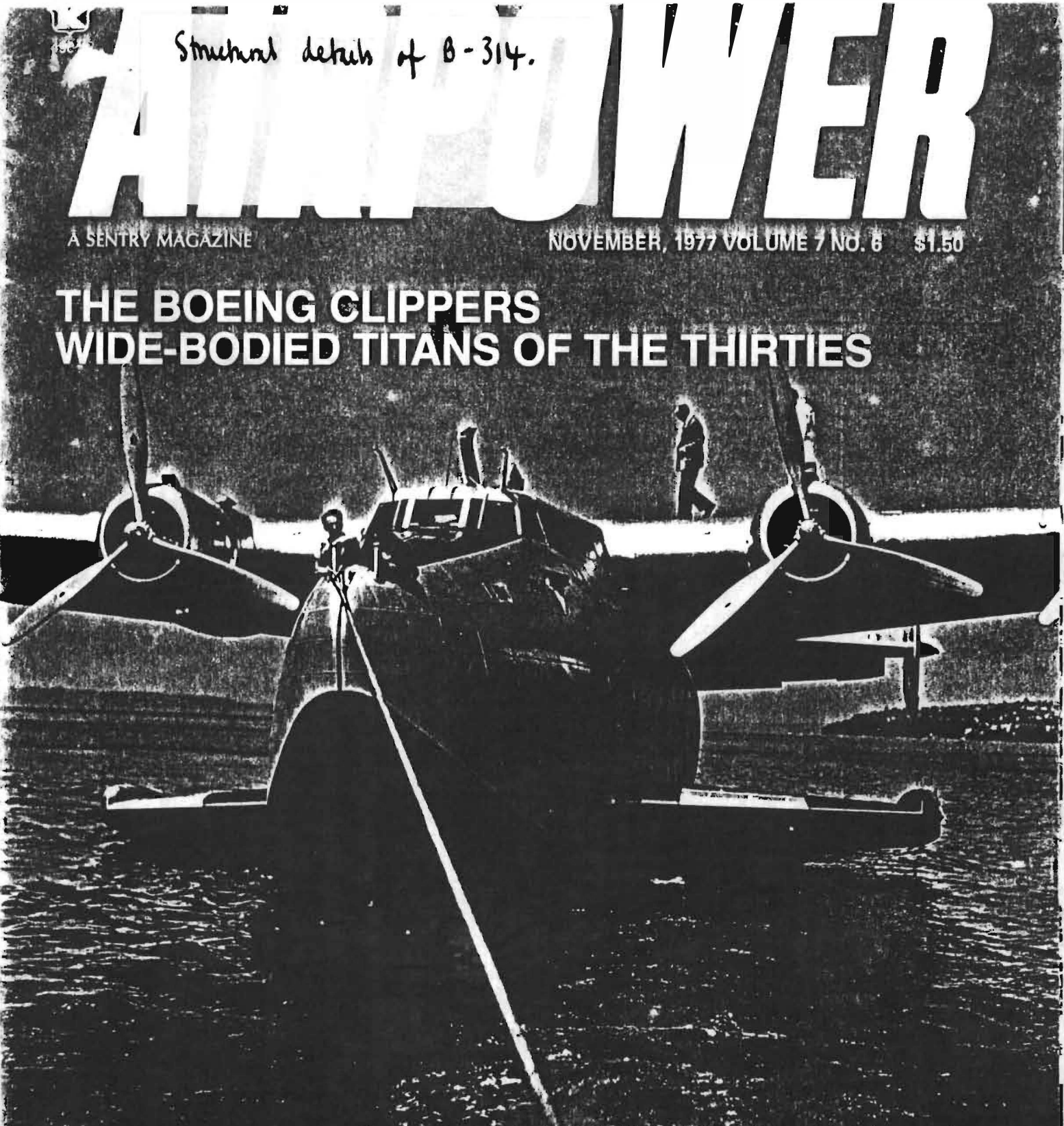

FIAT'S G.50 FIGHTER—BOMBER
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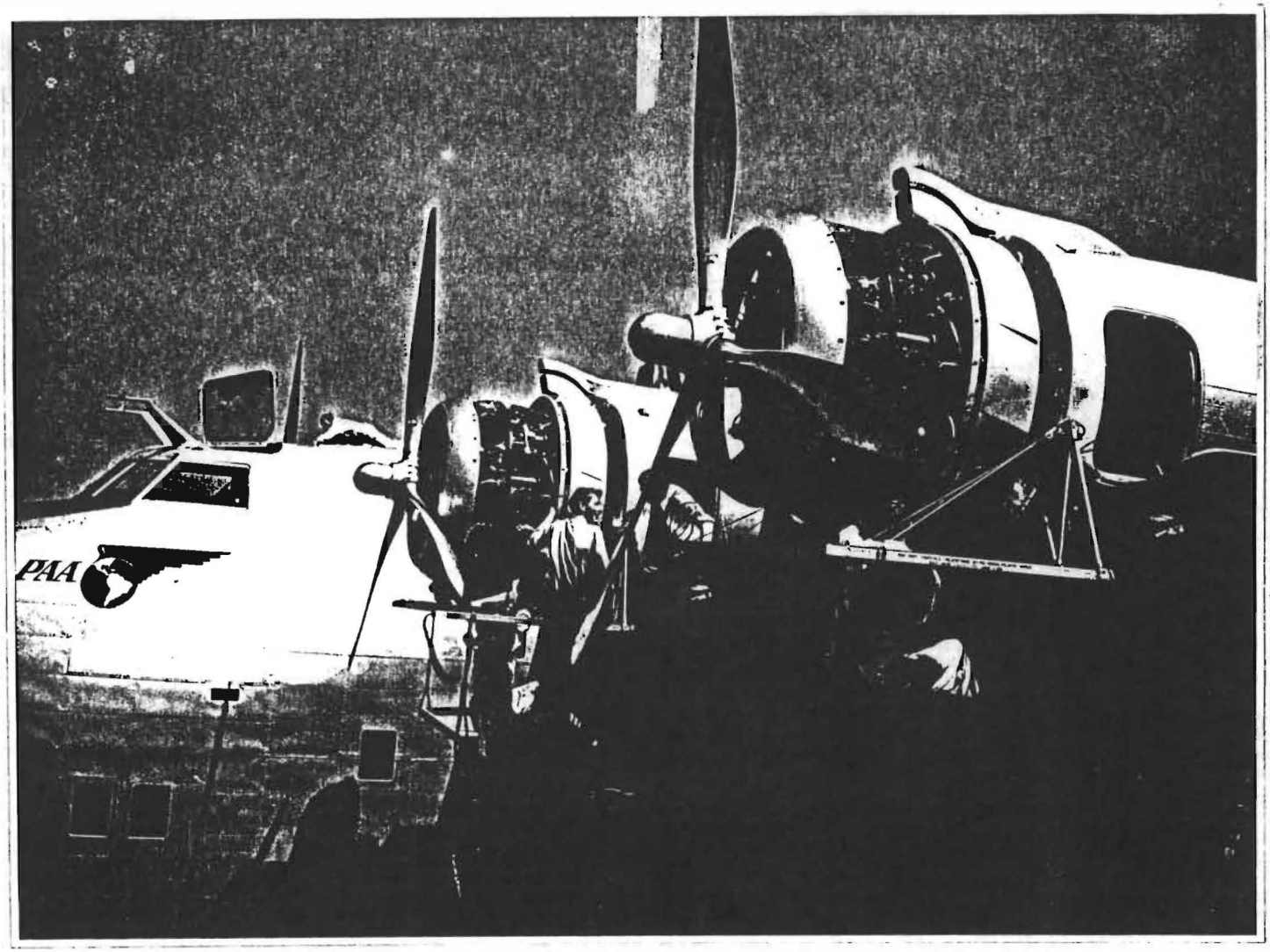


THE GREAT CLIPPERS

The Boeing 314 Clipper was a marvelous machine even by today's standards. She was big, comfortable and very dependable. At 84,000 lbs. gross weight, with 10 degrees of flap and no wind, she used 3,200 ft. to take off, leaving the water in 47 seconds. At 70,000 lbs. with 20 degrees of flap and a 30 knot headwind, she was off in just 240 ft., leaving the water in only eight seconds. At left are the new Wright 579CI 4AC1 14 cylinder twin row radial engines which developed 1,600 hp. for take off, a refinement of the basic R-2600-A2 Double Cyclones which powered the first six machines and generated 1,500 hp. for take off. Hamilton-Standard three-bladed propellers, were full-feathering, constant speed types, measuring 14 ft. nine inches in diameter. They, as well as the new engines were retrofitted to older models to bring them up to 314A standards. At right, the Anzac Clipper (NC18611) undergoing tests at Boeing. She was scrapped in 1950. Bottom: Artist's rendition of NC18603 (Yankee Clipper) which crashed on landing in Lisbon harbor Feb. 23, 1943.

beginning as "The Boeing Clipper", the word was not a Boeing model name like "Flying Fortress" (Model 299) or "Stratoliner" (Model 307). The word "Clipper", made famous by the famous line of fast, square-rigged sailing ships developed by Donald McKay in the late 1840s, was actually owned by Pan American. After applying it as part of the names on individual airplanes, as "China Clipper", "Clipper America", etc., the airline got a copyright on the word and subsequently became very possessive over its use. It is reported to have had injuncions issued against Packard for use of the work "Clipper" as the name of a car series and against Piper Aircraft for its use on the Piper "Clipper" airplane. Pan Am's use of the name continues into the jet age and the latest Boeing 747SPs delivered in 1976. The same names are frequently used again on new models as old ones are retired. "American Clipper" (or "Clipper America") has been used on Sikorsky S-40, Boeing 314, Lockheed 049 "Constellation", Boeing 377 "Stratocruiser", two Boeing 707s, and the Boeing 747.

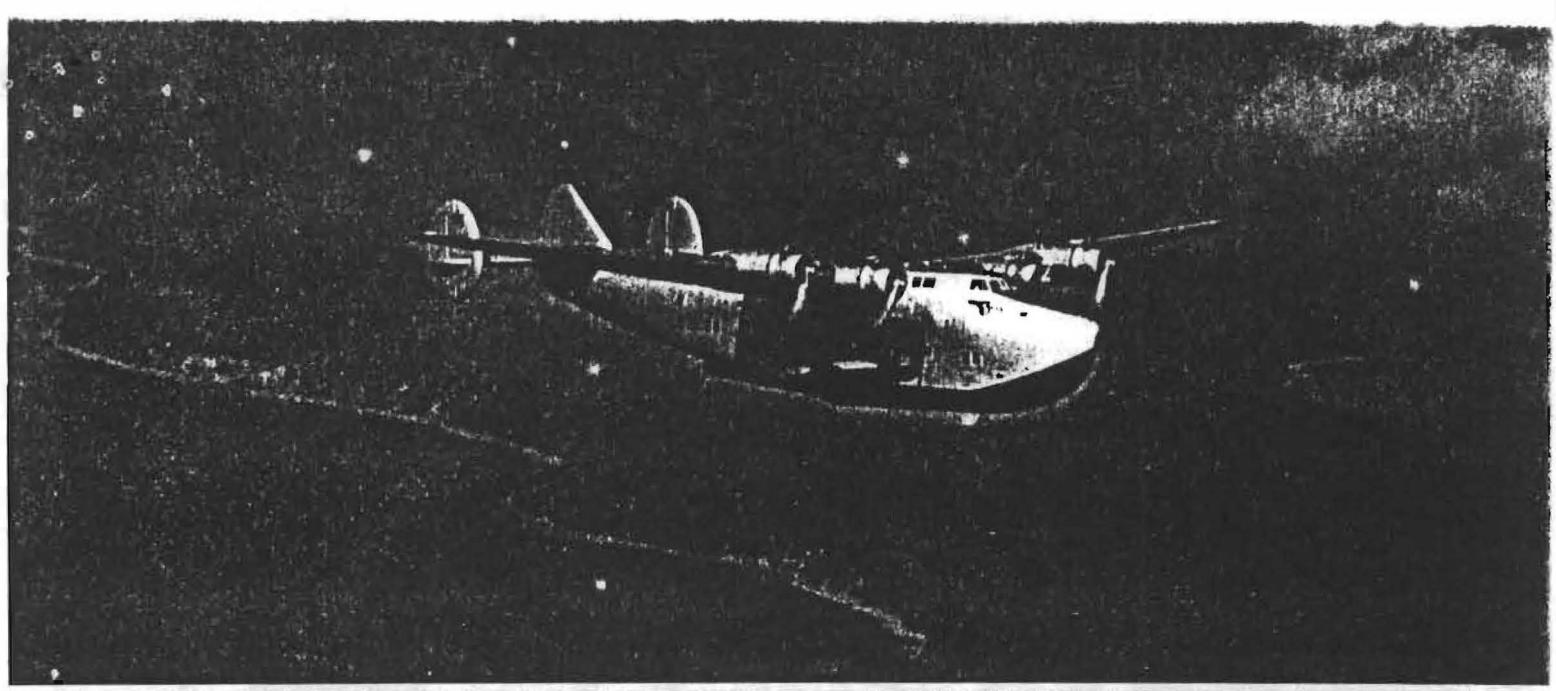
Boeing's Bid

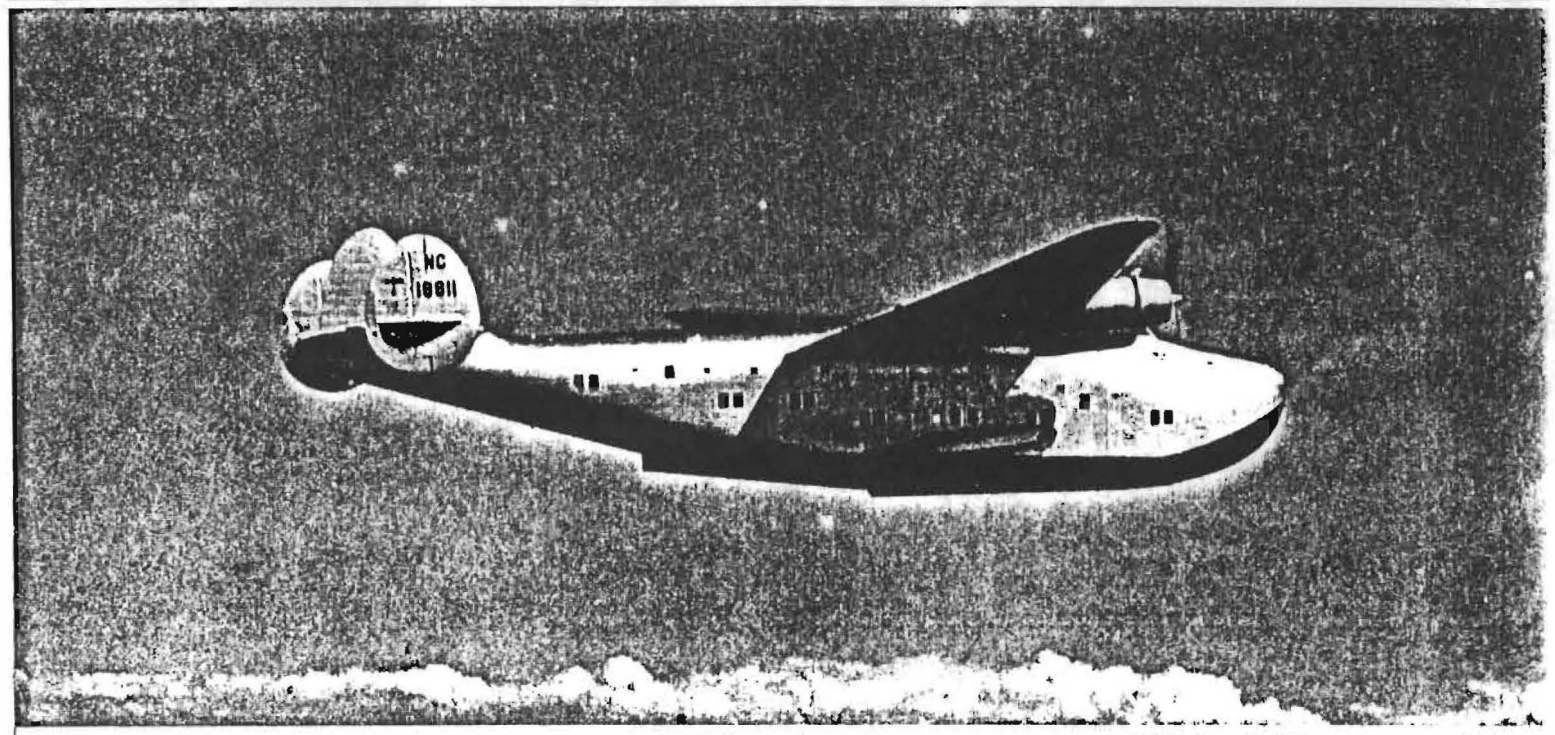
Boeing very nearly passed up Pan Am's request for a design study. Actually, it did. Starting in mid-1934, the engineering resources of the company had been stretched thin by the simultaneous development of Model 294, the Air Corps "Project X" that was to become the XB-15, the Model 299 that was the ill-fated prototype of the B-17, and was currently continuing XB-15 work and redesigning the B-17 for production when the Pan Am request was received on February 28, 1936. With so much already in the works, it was felt that the company couldn't divert the engineering manpower needed for still another big project.

The deadline for response had passed when Wellwood E. Beall, an engineer diverted to sales and service work, returned from a trip to China to deliver 10 Boeing 281s, the export version of the Army's P-26A "Peashooter". When informed of the Pan Am request and the passing of the deadline, he immediately got excited over the possibilities of such a project.

With no authorization for such activity on company time, he worked feverishly at home evenings to rough out a design that would meet the requirements. What he turned out was a cross between a preliminary design study and a sales brochure; his wife was an interior decorator and made up color paintings of appealing cabin interiors.

A major part of the design work, it turned out, had already been done. Consideration had already been given to using the XB-15 wing on any design that might

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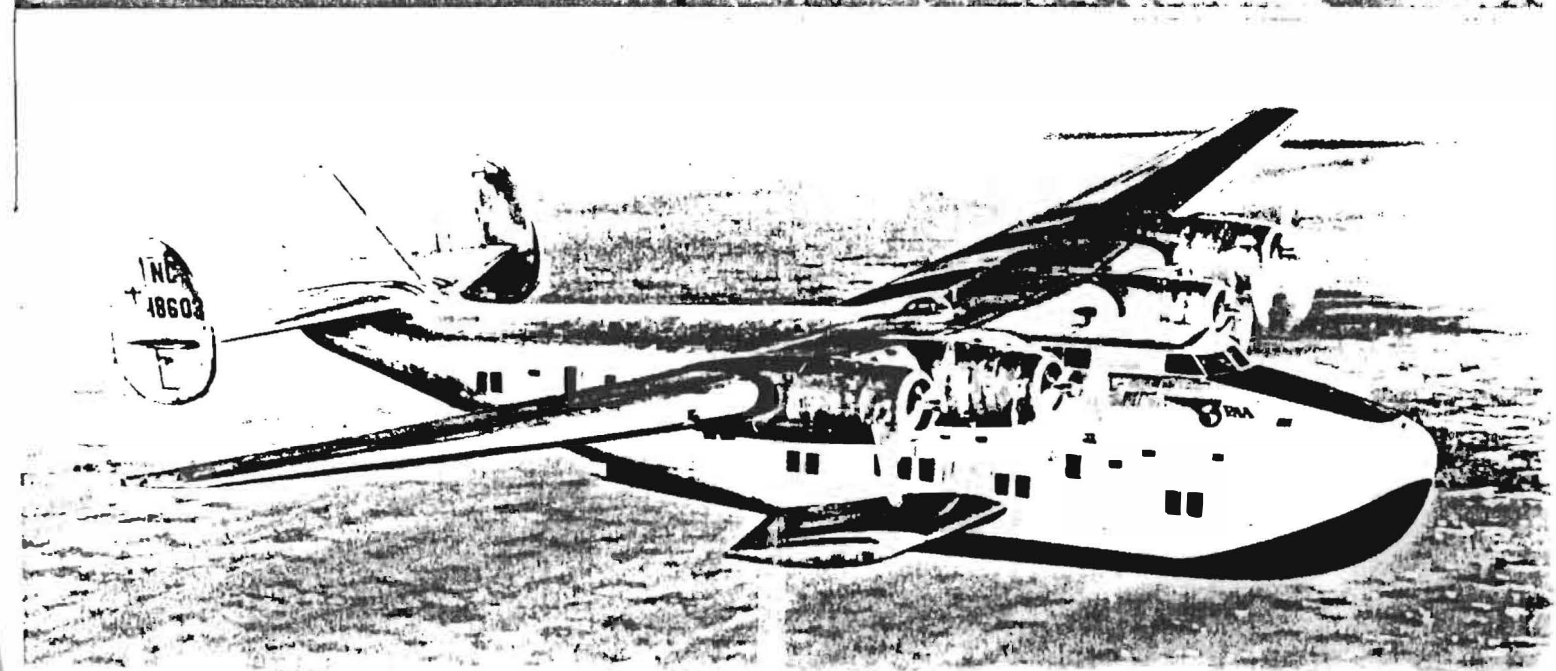
19811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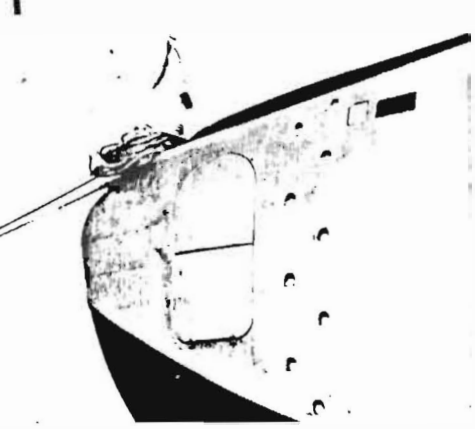
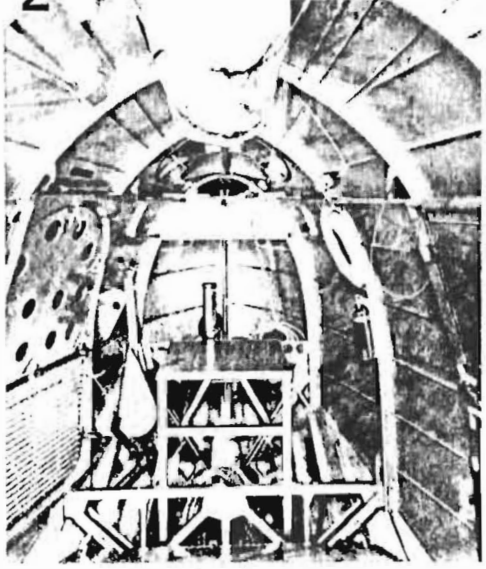
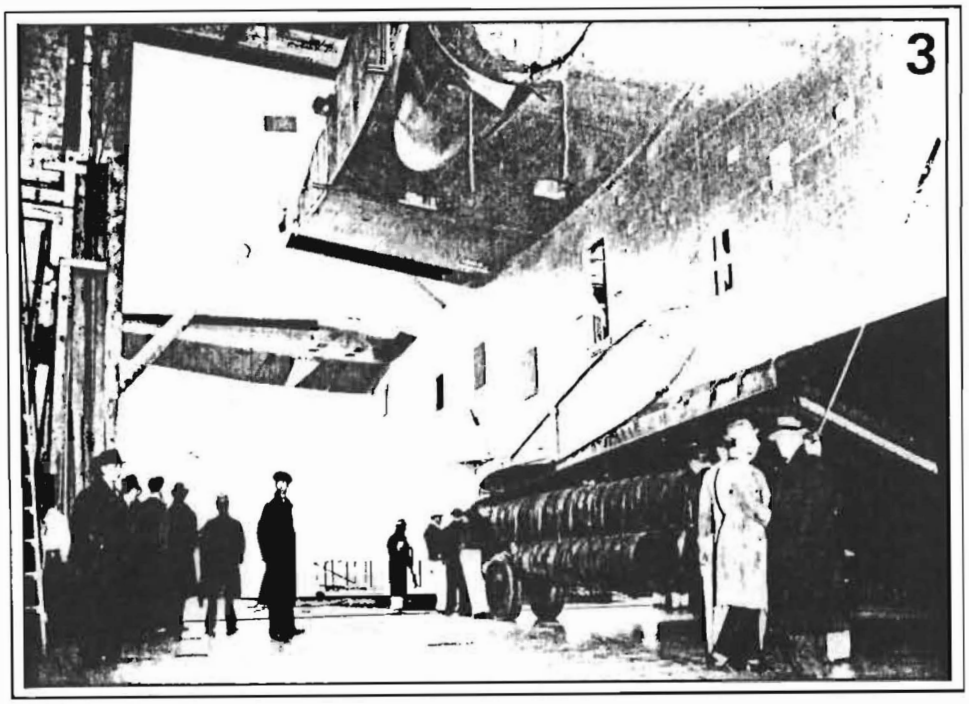
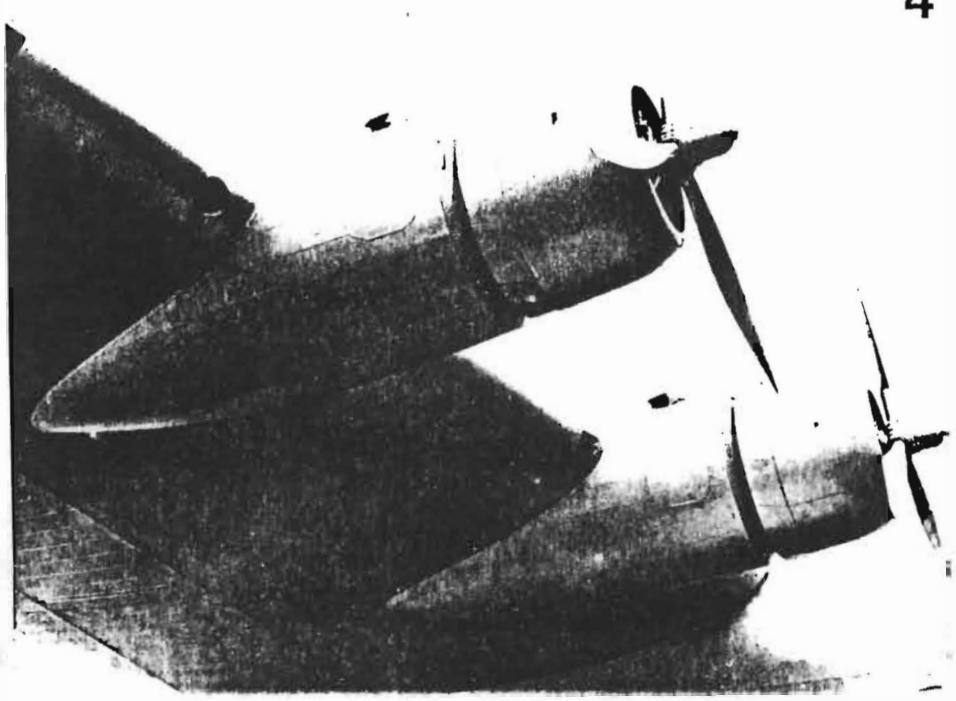


1. External view of clipper bow showing two-section side door, mooring-towing posts, and the recessed steps that were to be found only on the first six Clippers. They were deleted when they were converted to the later A-314 configuration.







be developed under the Pan Am request. Further, the airline had already specified the engines and propellers to be used. Beall's main task, then, was to match those to a suitable hull, tail assembly, and auxiliary flotation system.

After showing his idea to top management and convincing them that engineering could handle the job, Beall got authorization to contact Pan Am to request an extension of the deadline. The request was granted.

Engineering officially got under way on Boeing Model 314 after Beall was relieved of his sales and service duties and given a group of 11 engineers for the new project.

Beall, aerodynamicist Ralph Cram, and company president Clair Egtvedt left Seattle for New York on May 9, 1936, with their proposal. Pan Am reviewed it, liked it, and awarded a contract for six 314s, with an option for six more, on July 31, 1936. Unit prices worked out to $618,908 per airplane with an additional $756,450 for engines and airplane spares. An amendment to the contract on January 20, 1937, extended the specified delivery dates for the six units by three months, but there were to be other schedule slides later.

Design Requirements

Boeing engineers led by Beall, who had been assigned as Project Engineer for the 314, laid down four primary design requirements for the flying boat. These were:

1. To fulfill the airline's requirement for a 10,00-pound payload to be carried for 2400 miles (San Francisco-Honolulu distance) against a 30-mile headwind at a cruising speed of 150 m.p.h. at 10,000 feet.

2. To permit efficient operation with a minimum of crew fatigue (such a flight would take a minimum of 16 hours).

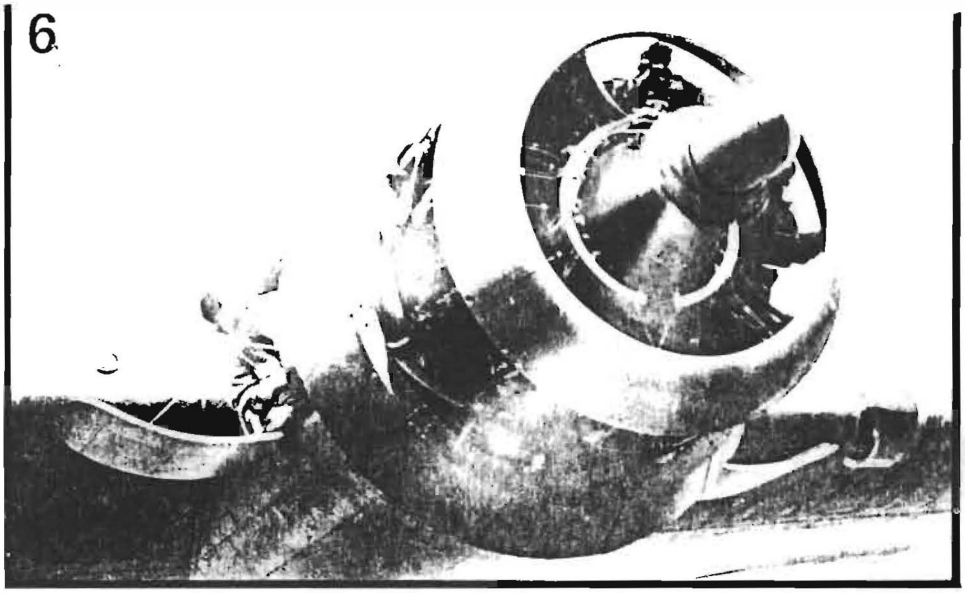
3. To efficiently provide unprecedented comfort, spaciousness, and luxury for the passengers.

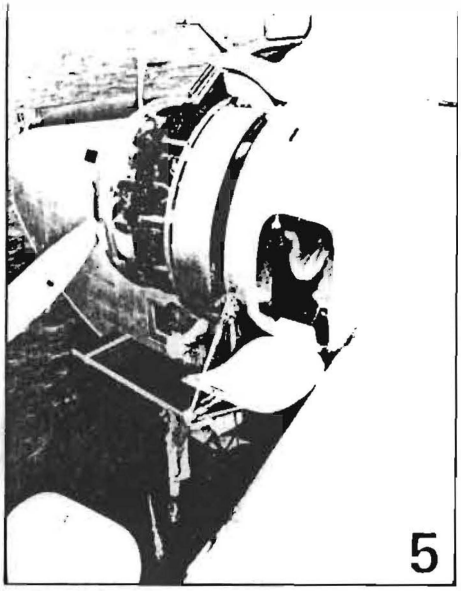
2. Details of bow compartment ahead of the water-tight forward bulkhead in a completed Clipper hull. Post-like object in center is one of two that were installed in sockets in the bow to secure towing and mooring lines. Small hatch is at top, larger two-section door at left.

3. Fully-assembled hull was mounted on a launching dolly, after which Clipper's stern was moved outside hangar door so that tail surfaces could be attached. Attach point for planing hydrostabilizers or sponsons can be seen on hull's side. These carried four of clipper's six fuel tanks, two in each sponson.

4. Underside view of Clipper engine nacelles showing clean lines and smooth intersection with the thick wing. The were almost exact duplicates of those on XB-15, as was Clipper's wing.

5&6. The four engine nacelles were large enough for mechanics to work in and their side access doors could also be used as work platforms. Easily attached work stands were carried on the airplane for engine repair ahead of the firewall.

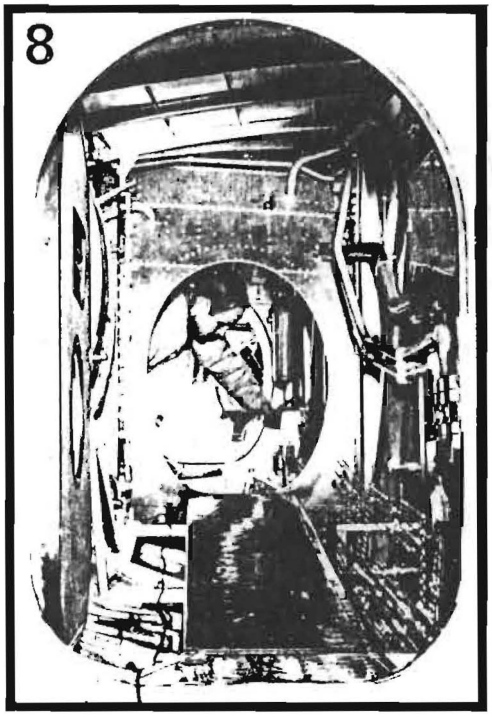


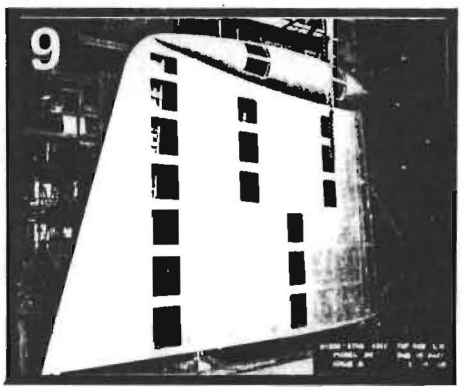


4. To make the airplane as safe as possible within the existing knowledge of materials, equipment, and the science of aviation (called state-of-the-art today).

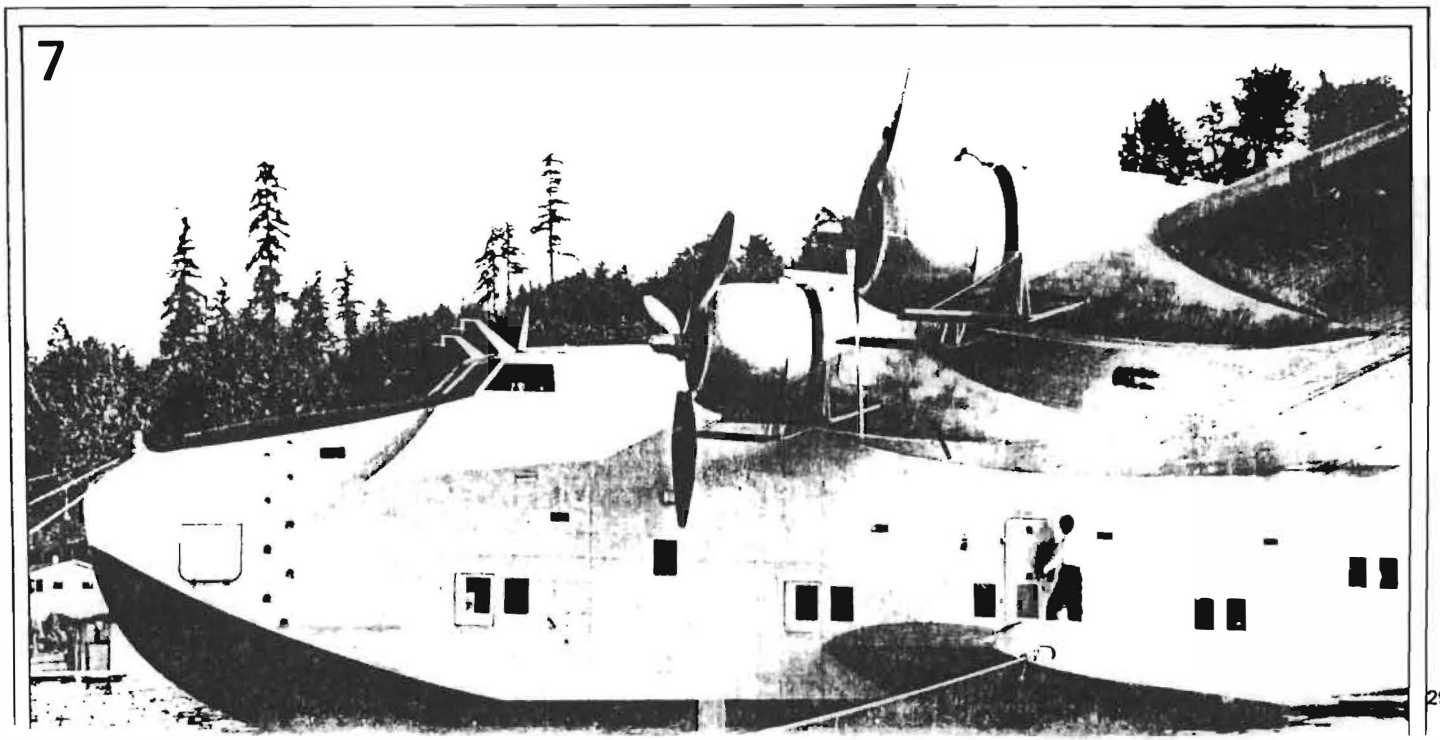
Working from the predetermined payload and the fuel required to go the distance, plus crew weight, the engineers quickly established an approximate gross weight from the prevailing and realatively constant ratio of airplane empty weight to disposable load. This worked out to slightly over 80,000 pounds, nearly 10,000 pounds above that of the partially-completed XB-15 bomber. Although the use of the existing bomber wing on the flying boat would result in a wing loading increase from 25 pounds per square foot to 28, it would be handled by the bigger engines to be installed in the boat.

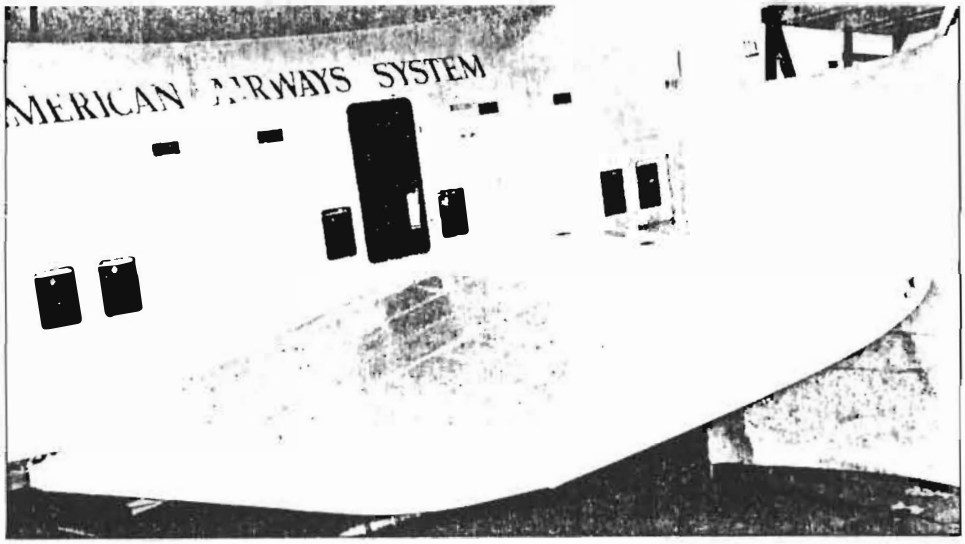
With the wing/engine details established, the job boiled down to designing the most efficient hull possible to carry the crew and passengers, mate it to the wing, and resolve the million and one trade-offs between the weight, manufac-





7. The first Clipper afloat, showing the height of the nacelles and propellers above the water and on-board work platforms on both sides of the nacelles. Compare shape of air intakes with those of later model in photo 5. Clipper hull drew four feet of water.
8. Interior view of wing crawlway with mechanic working inside one of the nacelles.
9. Top view of left-hand hydrostabilizer with access covers removed prior to installation on the airplane.



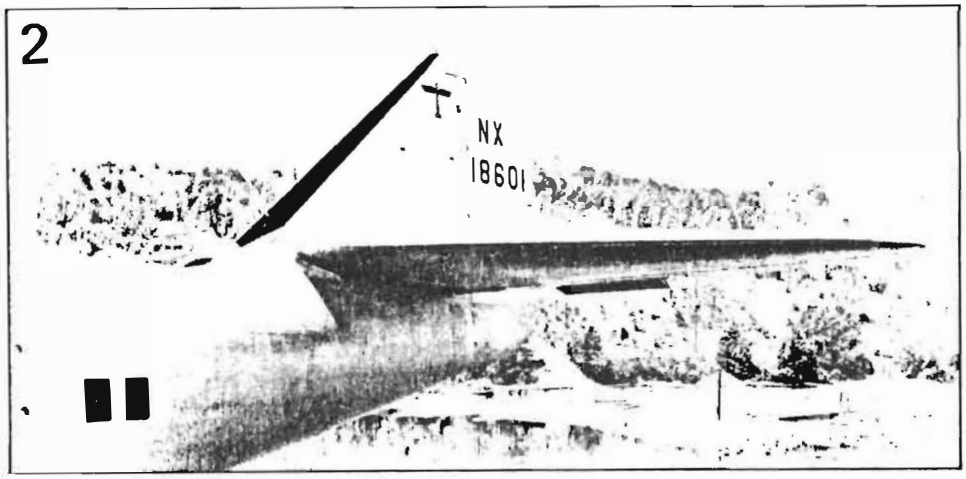


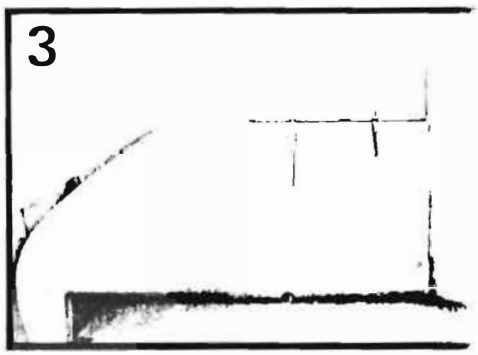
1. Right-hand hydrostabilizer installed on the first clipper. Note the bulbous tip and the squared-off trailing edge. Hydrostabilizer made an excellent loading platform for passengers and crew.

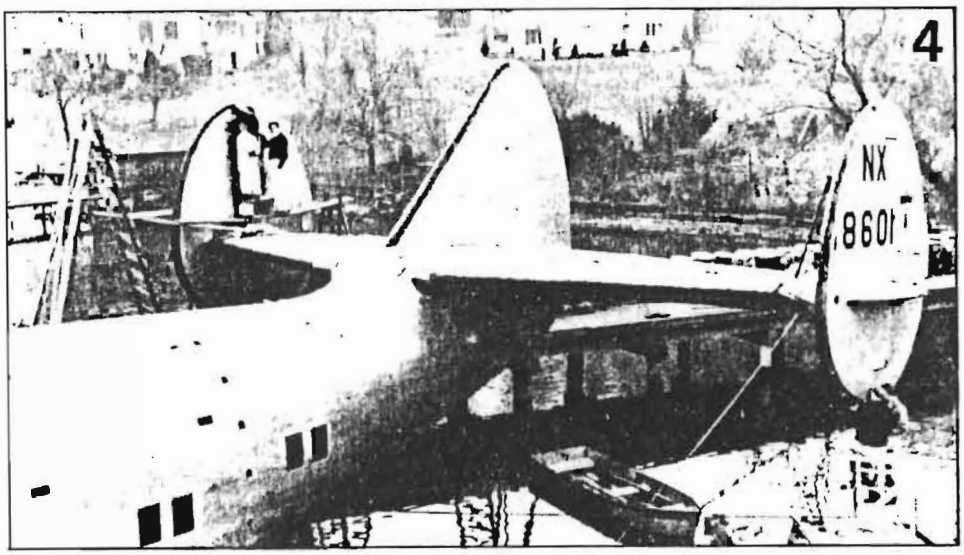
2. The first Clipper was designed and flown with the small single fin and rudder assembly shown, which proved to be inadequate. Note recessed steps in hull at left and how the bottom of the rudder is bulged to fair with the cross-section of the hull at the rudder post. Photo taken May 25, 1938.

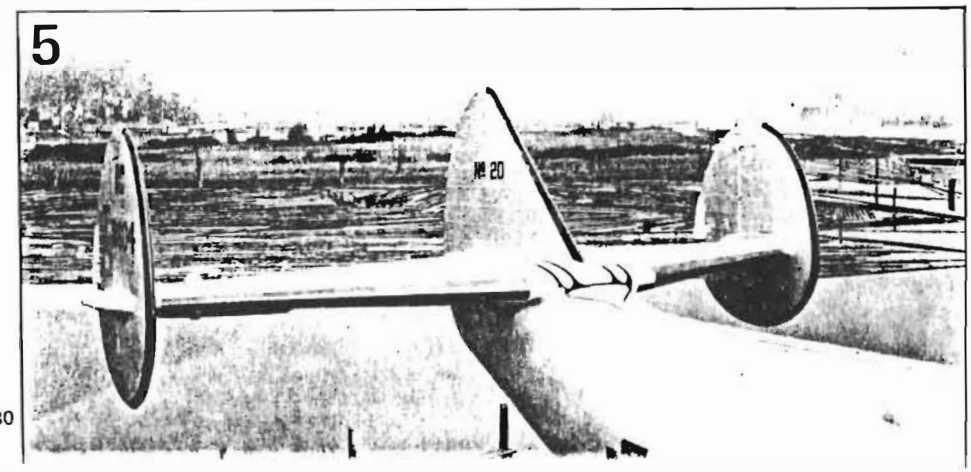
3. Closeup of the original single rudder. It is equipped with double tabs, one for control, one for trim.

4&5. An intermediate form of the Clipper tail used two outboard fins and rudders as on the B-24, but the final form used the outboard rudders with a central fin as shown in these photos.









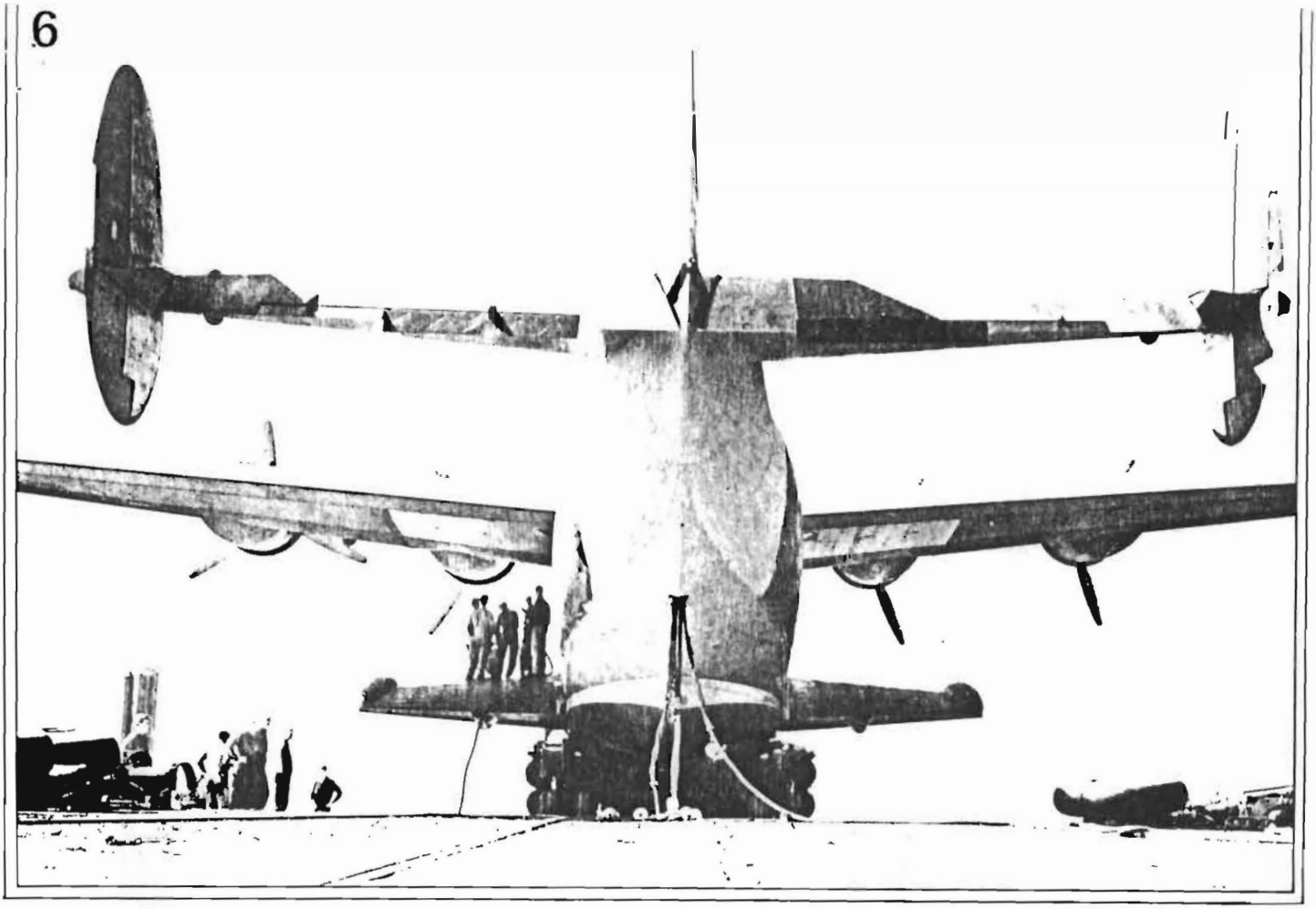
turing cost, and function of each item. The basic choice between a full-cantilever wing or a lighter strut-braced structure with attendant drag penalty was resolved by the availability of the cantilever bomber wing. While earlier flying boats like the Martin 130 and the Consolidated PBY did have cantilever wings, they were raised above a realtively broad but shallow hull to give the propellers, which were in line with the wing chord plane, adequate water clearance. This required the use of struts to stabilize the wings, plus a superstructure between the hulls and the wings that was mainly a substitute for the old center section struts. A wing directly on the hull offered far less drag, but decreased the essential water clearance of the propellers. Earlier and smaller flush-wing boats like the Douglas "Dolphin" had their engines mounted *above* the wing on struts. The state-of-the-art was moving toward higher but narrower hulls, and Boeing followed designs already under way in other plants, the Sikorsky XPBS-1 and the Consolidated XPB2Y-1, in using a deep hull with the wing directly on top of the primary structure and faired into the top superstructure, yet with the engine nacelles on the wing leading edge.

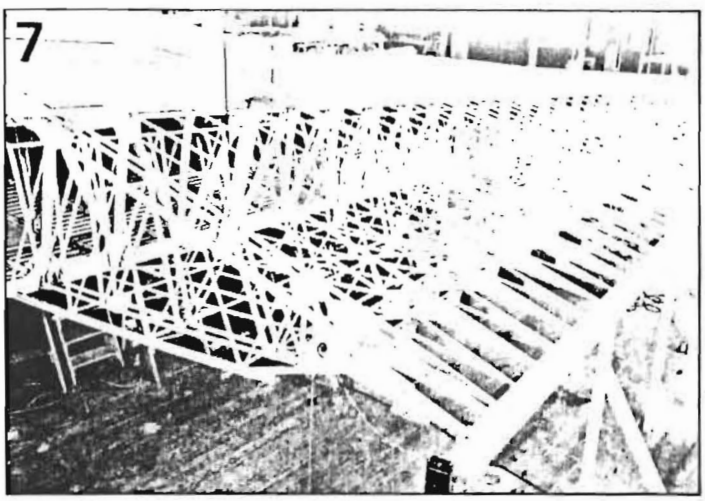
Design Details

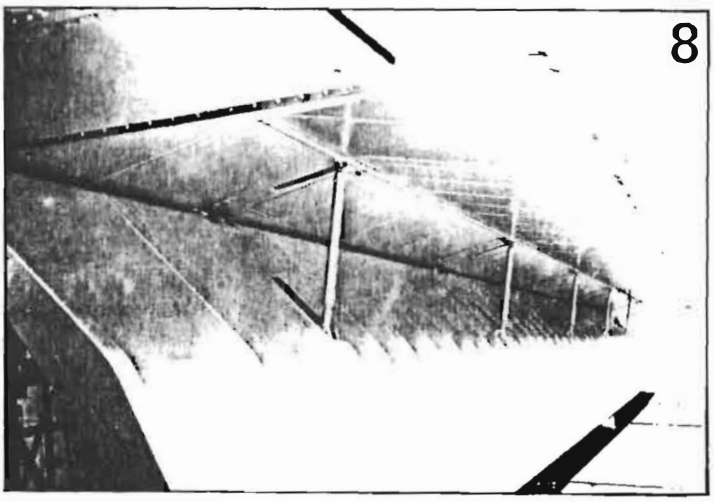
Much of the interior and equipment detail for the Clipper was spelled out by Pan Am in its original specification for the airplane, and other specifics were ordered later. The principal design and structural features of the big Boeing boat are detailed in the following paragraphs.

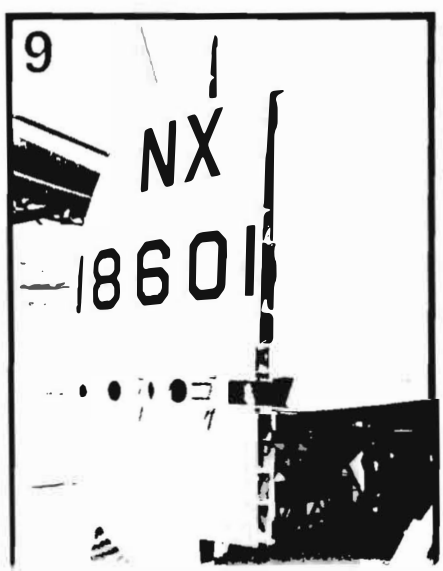
Powerplant

The engines, new 14-cylinder twin-row

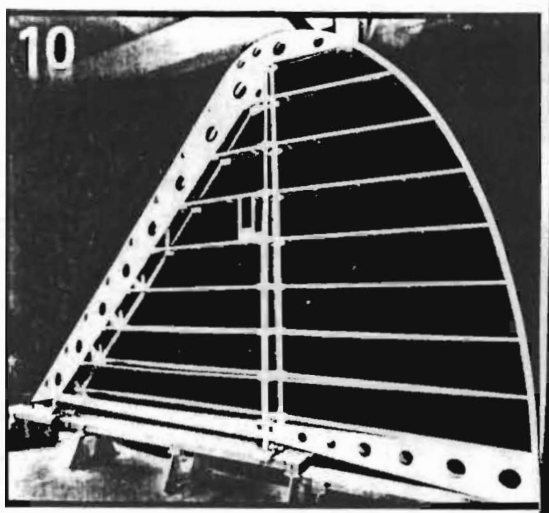








6. Rear view of complete empennage of three-tailed Clipper showing elevator tabs and method of fairing elevators to hull for level flight. Dolly is supporting just under 25 tons, empty weight.
7. The Clipper wing duplicated the construction of the XB-15 wing in using bolted square aluminum tube trusses for the spars and aluminum tubes and channels for the wing ribs.
8. Closeup of exceptional workmanship. Left-hand split trailing edge flap in full down position. Note how upper surface of flap fits into matching underside of trailing edge.
9. Closeup of the outboard fin that was added to the Clipper after its first test flight. Note the attach fittings for extensions of the shortened stabilizer.
10. Clipper's center fin was a single fabric-covered unit having the same outline as the original single fin-and-rudder combination.



THE GREAT CLIPPERS

Wright R-2600-A2 "Double Cyclones" were specified by Pan Am when its proposal was issued to the industry. In a way, this 1200 h.p. engine, delivering 1500 h.p. for takeoff, was the only feature of the Boeing 314 that could be regarded as a gamble or an unknown factor. Experimental versions of the engine had been flown in military airplanes but no production versions had been built or installed. Pan Am gambled on Wright's reputation when it specified the R-2600. Actually, it had no choice; it needed an engine more powerful than any then in service, and the Wright was the only one available. The Boeing XB-15 was severely handicapped by having to use the "small" Pratt & Whitney R-1830s when it was designed to use the V-3420 Allison; had the R-2600 been a lemon, the 314 program would have been a disaster.

As it turned out, the R-2600 was one of the most efficient transport plane engines of its day, with the lowest specific fuel consumption (in pounds per horsepower hour) of the models then in service. It was also the first commercial engine to use 100 octane gasoline.

Another innovation in the powerplant department was the use of full-feathering propellers for the first time on an airliner. Variable-pitch propellers had been in use for serveral years, but had a disadvantage in case of engine failure. The propeller would "windmill" in the airstream, often damaging the engine. Some airliners were fitted with propeller brakes to stop this rotation, but with full-feathering, the blades could be brought edgewise to the airframe and the propeller rotation stopped. This also reduced drag, a critical item to the continued flight of a one engine-out airplane, particularly over the ocean.

The Hamilton Standard Propeller Company announced the availability of this new feature at the time Pan Am was drawing up its specifications, and the airline specified it.

Structure

In keeping with current design trends, it was specified that the structure of the 314 be all metal, although with some areas of fabric covering. Details of specific structural components are presented below.

Wing - The three-piece wing was an almost exact duplicate of that on the XB-15, including the symmetrical NACA airfoil that tapered from an 0018 at the root to 0010 at the tip. The center section to a point outboard of the inboard nacelles was built integral with the hull while the outer panels were separate removeable units.

The wing used two main Pratt-truss num tubing. Ribs were both square tubing and channel. Covering was sheet aluminum from the rear spar forward and fabric from that point aft. As a safety feature (which paid off handsomely in early taxi testing), the outer ends of the wing were built as water-tight flotation compartments in case the ship heeled far enough to dig in a wingtip.

Two fuel tanks, plus mail and cargo compartments, were built into each side of the wing center section and heavy cargo was loaded through a hatch in the center of the wing right at the airplane center of gravity. This same hinged hatch also contained an astral sighting blister for the navigator.

Hull - The all-metal hull introduced some innovations in flying boat practice. First, it was not built up full-length in a jig and then mated to the wing. The portion under the main wing spars was built as an intergral unit with the center section and inboard nacelles. The other hull sections, built separately, were then added.

The traditional longitudinal division of the hull into a number of separate watertight compartments was unsuitable for a passenger plane and was deleted in favor of a compartmented "Double Bottom" based on ship construction. There were only two full-depth water-tight bulkheads - a "collision bulkhead" ahead of the instrument panel to prevent hull flooding if the bow was crushed and one between the passenger compartment and the tail.

The great depth of the hull made separate levels for the passenger and crew areas a logical choice. Because of the upward slope of the bottom of the hull aft of the step, the floor levels of the aft passenger compartments were progressively raised. As on all seaplanes, the 314 had a transverse hydroplane step slightly aft of the center of gravity with a second step, essential to large flying boats, farther aft. the aft step was pointed to reduce aerodynamic drag and terminated at the water rudder.

While the dimensions of the 314 did not approach those of the German Dornier DO-X of 1929, the 12½-foot width of the hull made it the first production "wide body" transport 30 years before the advent of the Boeing 747, which coined the term. The nearest previous American approach was the Fokker F-32 of 1930 with an eight-foot ten-inch wide cabin. The Boeing 707, with 12 feet, was still 20 years in the future.

Empennage - This term usually applies to the whole tail assembly, but will be limited here to the stabilizer and fins. The rudders and elevators are described under *Control Surfaces.*

- Stabilizer - The full-cantilever horizontal stabilizer was built as a single unit and was metal-skinned. It bolted directly to the top of the primary hull structure; the top of the hull directly ahead of it was built up to form a streamline fairing for it. The span of the basic stabilizer structure was shortened when the outboard fins were by bolting new detachable tips to the outboard side of the fins.

- Vertical Fins - The original single vertical fin was like the stabilizer, a metal-skinned cantilever unit that bolted to the top of the stabilizer, not to the hull. This was replaced by a fabric-covered unit that duplicated the shape of the original fin-rudder combination. The outboard fins were also full-cantilever units bolted to the squared-off ends of the shortened stabilizer.

Nacelles - The nacelles were another direct inheritance from the XB-15, which had been designed to use four-bank 14-cylinder liquid-cooled Allison engines that never materialized. The R-2600s of the 314 were bigger than the Pratt & Whitney R-1830s forced on the B-15 and fitted easily into the big nacelles.

A novel feature, never used before or since on any U.S. transport, was the provision for in-flight engine maintenance. The bomber wing was thick enough to allow personnel to crawl to the engines and the nacelles were large enough to permit them to work. The stainless steel firewall was made in two removeable sections so that the back of the engine could be serviced in flight. In addition, each nacelle had an access door on each side for maintenance on the surface. When lowered, these could be used as work platforms. Other work platforms carried on the airplane could be attached to the nacelles for work ahead of the firewall.

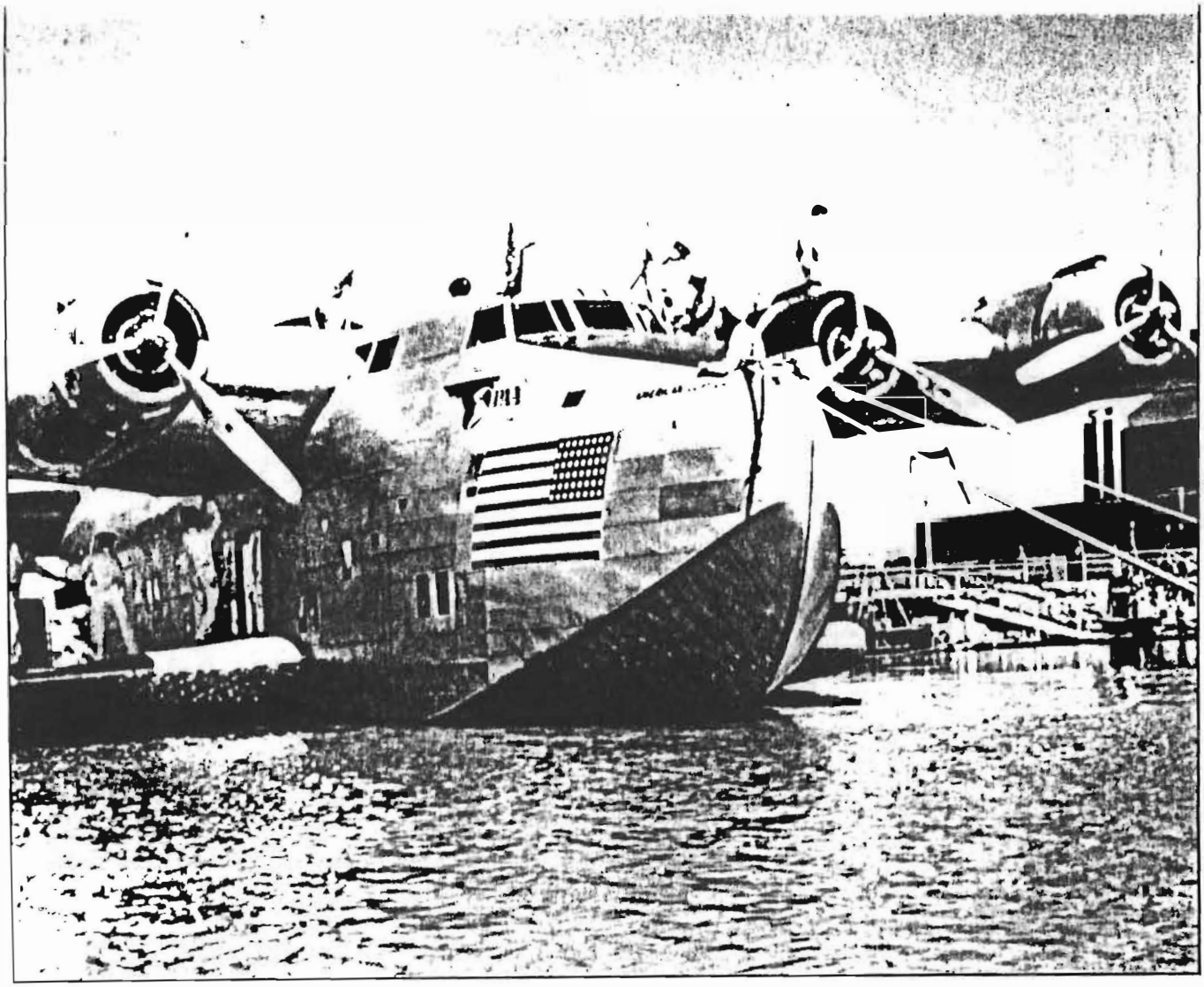
Hydrostabilizers - One distinctive feature of the 314 was the use of hydrostabilizers, also known as sponsons, instead of wing-mounted floats for lateral stability on the water. These originated with Dornier in Germany in 1918. Known then as "Flossenstummel", they were virtually a Dornier exclusive until the Martin 130 appeared in 1934. Because of the "cube law", their buoyancy increased as the cube of the dimension, making them much more efficient for large flying boats than for small.

The Boeing versions were divided into five compartments, two of which served as fuel tanks. Reserve buoyancy was such that stability would still be maintained if one of the empty compartments ruptured and filled with water. The hydrostabilizers made excellent loading platforms, the passengers and crew stepping directly from them through the entry doors on either side of the hull.

Control Surfaces

All moveable control surfaces shared the common features of aluminum tube-and-channel construction with fabric covering.

- Ailerons - The metal-frame ailerons were Frieze type with static and aerodynamic balance area ahead of the hinge line. These operated differentially; that is, with more up travel than down to reduce aileron yaw. Each aileron had one trim tab and was divided into two separate units to reduce hinge binding when the wing flexed under load.



NC18606 (American Clipper) prior to a 1941 flight. She was scrapped in 1950. Boeing 314A Clipper performance was exceptional for its time. Lift-off speed was 95 knots. Cruise at 11,000 ft. 140 knots. Top cruise was 155 knots. "Never-exceed" redline was 184 knots. Stall speed at 84,000 lb. maximum gross load with flaps down and power on was 55 knots. Approach was flown at 90 knots with 40 degrees of flap, with touch-down at 80 knots (70 knots in rough water). Optimum climb speed with one outboard engine out was 103 knots. Maximum swell height for take off and landing was 2½ ft. Operational ceiling was 16,000 ft. Range without headwind in terry condition was 30 hours and 3,700 nautical miles. Absoute ferry was 32 hours.

- Elevators - The fabric-covered elevators were so large and heavy that they required something new in transport plane control. The surfaces were fitted with two tabs on each side, one for control and one for trim. The control tab had twice the effectiveness of the trim tab. The elevators themselves were connected to the pilot's controls only through springs. The controls moved the tabs, which in turn moved the elevators. The springs gave a degree of "feel" proportional to surface movement. At high angles of displacement the spring links became rigid and further elevator movement was directly from the control column.

The elevators were statically balanced to 85% by a single counterweight in the hull and by smaller weights at the outboard ends. These were on arms projecting into the stabilizer; the full travel of the weights accommodated by adding aluminum "blisters" to the top and bottom surfaces of the stabilizer. There was no aerodynamic balance.

- Rudders - The rudders used the same tab-and-spring control system as the elevators and incorporated a small degree of aerodynamic balance. The outboard rudders incorporated slots to allow movement over the outboard portions of the stabilizer that were located aft of the rudder hinge line.

- Flaps - The metal-frame, fabric-covered flaps were known as the "split"type since they were fitted under the wing trailing edge, which stayed in place when the flaps were lowered. Full flap deflection of 60 degrees was normally used for landing while 20 degrees were used for takeoff.

Originally, the 314s were equipped with water rudders fitted to the pointed end of the rear step. These were not on the later A-314s and were deleted from the earlier models; for it was easier to steer on the water by using asymmetric power on the engines.

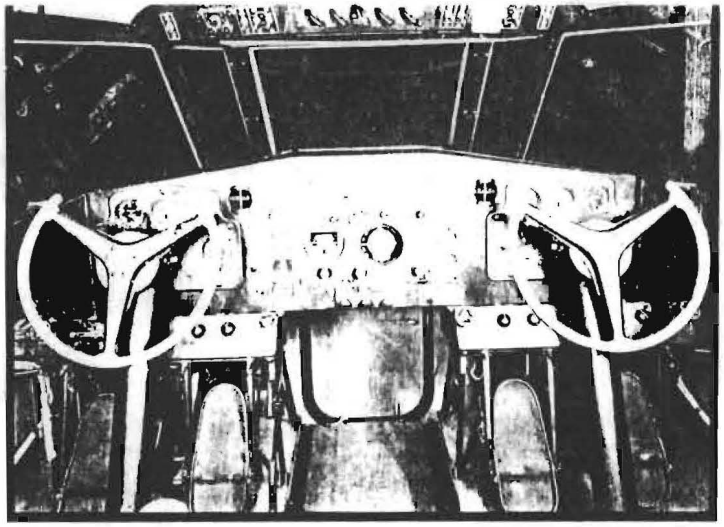
Crew Accommodation

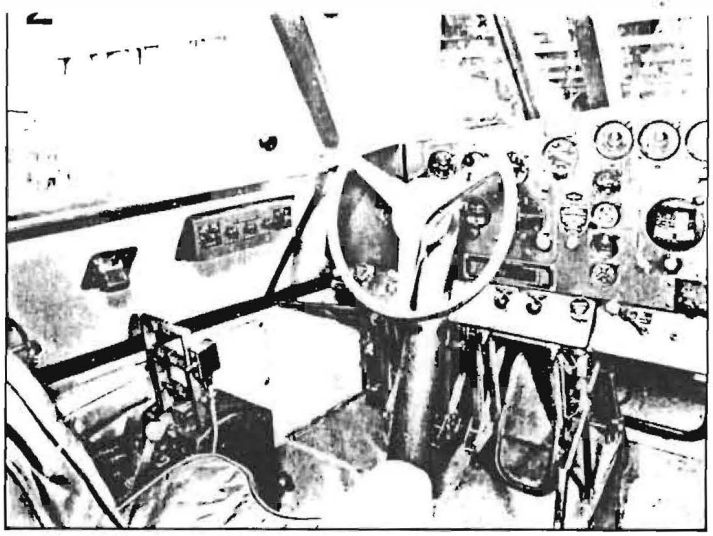
The non-stop routes to be flown by the 314 were so long that it was necessary to have two crews working in shifts; the facilities that Boeing provided for them were a real revolution. The upper deck for crew, communication gear and cargo was nine feet six inches wide by 21 feet four inches long and was six feet 1½ inches from ceiling to floor.

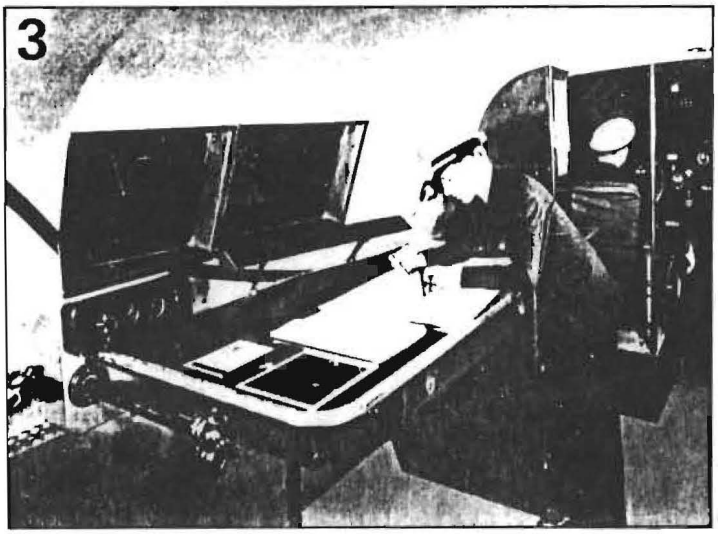
Normal flight crew was six - Pilot, Co-pilot, Navigator, Radioman, and the new positions of flight engineer and "master" or Watch Officer. The "master" was, in the tradition of the sea, captain of the Clipper, although he did not fly her. Add two cabin attendants to make eight, then double it for two shifts and you have a total of 16. *

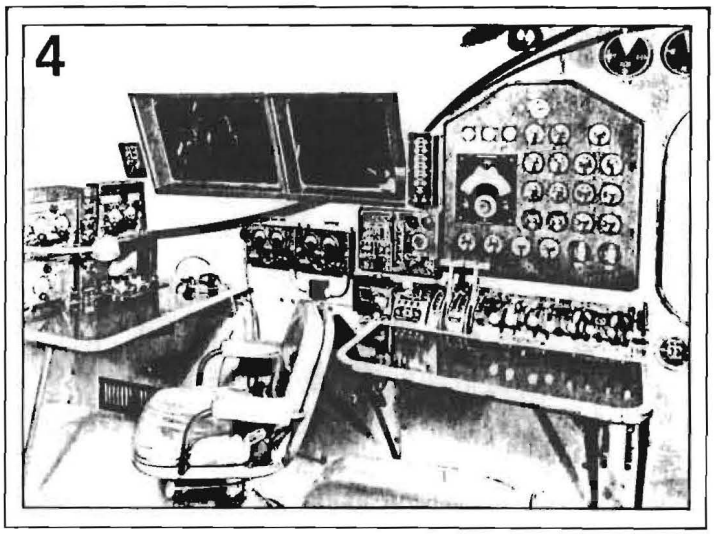
For the size of the airplane, the pilots sat at a remarkably clean panel. Many of the traditional instruments, plus some new ones, were now on the new flight engineer's panel on the right side of the cabin behind the radioman. The pilot had engine, propeller, and trim tab controls on a stand to the left of his two-movement (plus tilting) seat, while the copilot had a

* This is wrong. See interviews.









1. Clipper's instrument panel looks very bare compared to even a small twin-engine type today, but much of the pilots' powerplant responsibilities were taken over by the new member of the crew, the Flight Engineer, who monitored instrument panel located at right rear of spacious 21 ft. long flight deck.

2. Pilot's side of the control cabin. Notice the unique form of the throttles, which make it possible to operate the two inboards, the two outboards, or all four engines with one hand. This same throttle configuration was used on the B-17, but was mounted on a central aisle stand instead of being duplicated for pilot and copilot. Note large Boeing nameplate just to the right of the wheel.

duplicate set on his right. The pilots used their throttles mainly for maneuvering on the water - the engineer took care of them most of the time, along with propeller control, engine cowl flap settings, fuel flow, and airplane air conditioning.

The navigator sat at a large chart table in front of a panel containing the essential navigation instruments. There were also two drift sight stations in the wing roots, accessible from the cabin, and a celestial observation dome. This was located right over the airplane center of gravity to minimize movement in rough air.

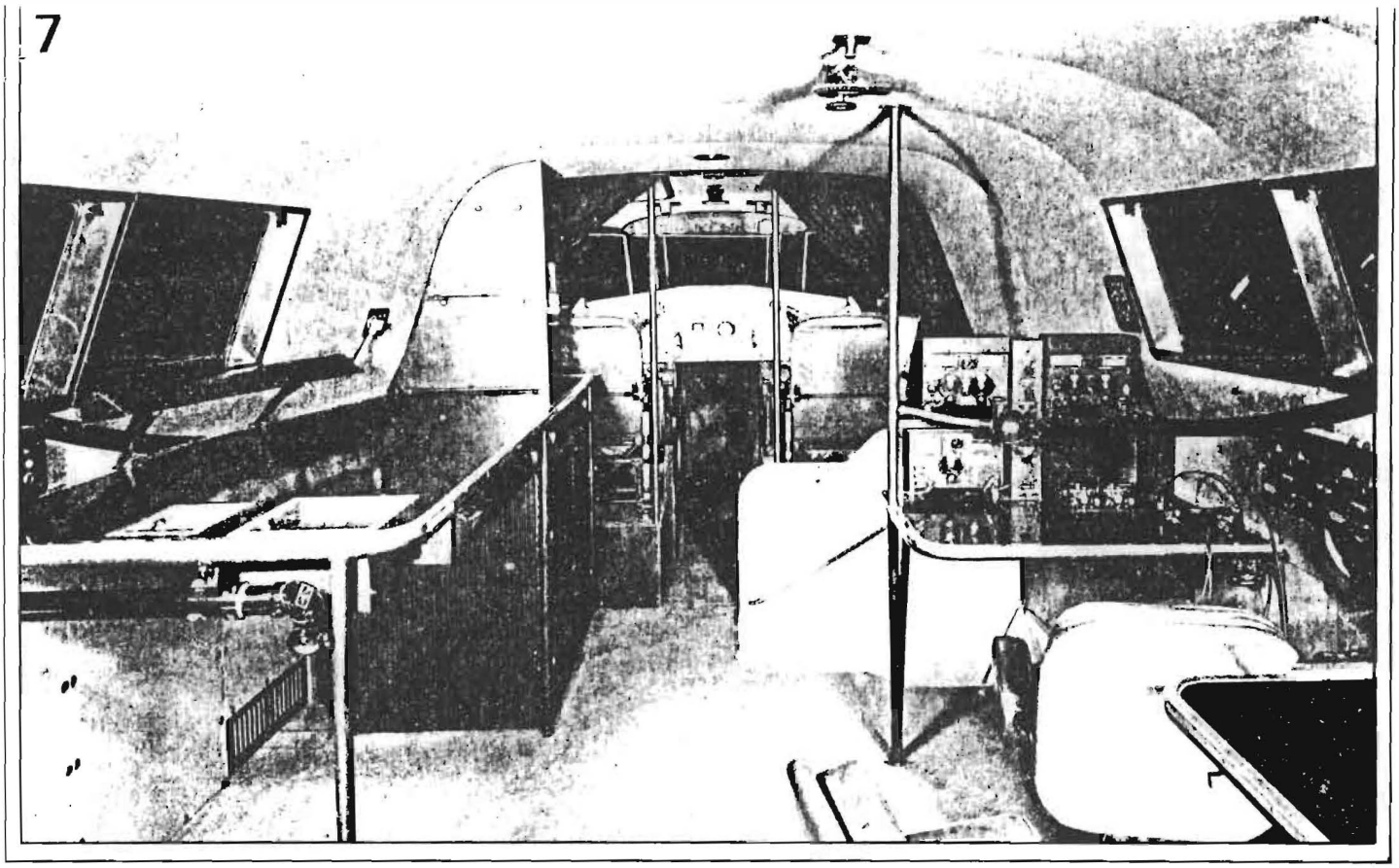
The "Master" had an uninstrumented station at the left rear of the cabin with a table for data and an extra chair for conferences, etc.

Seven tube-and-canvas bunks were provided for crew rest, three in the rear of the cargo area and four that folded up against the walls in the bow compartment, ahead of the collision bulkhead.

Passenger Accommodation And Payload

Boeing went all-out to make the 314 the most luxuriously appointed airliner of its time - there was no coach or economy air travel then - everything was first class, plus.

For short day flights, the 314 could carry up to 74 passengers. For sleeper flights, the passenger capacity was 34.



3. Navigator's Chart Table on the left side of the Clipper flight deck, behind pilot's station.
4. Details of the Radioman's station at the left and the Flight Engineer's station at the right. Oval-shaped door at right opens into the wing passageway to the engine nacelles.
5. Exterior view of pilot's and copilot's windshields and the pitot masts. Spotlight on viewer's left retracted into top of cabin.
6. Crew members at their stations. Free-lance test pilot Eddie Allen is in the pilot's seat.
7. View looking forward inside the flight deck of the Boeing Clipper. Curtains behind the pilots' seats can be closed to allow other cabin lights to be on during night flight.
8. Flight deck layout.
9. The Navigator also did business at the astral sighting hatch that was built into the top deck cargo hatch.
10. View toward rear of flight deck, with Radio and Flight Engineer stations to the viewer's left, then the Captain's or "Master's" Table, and the Navigator's table. Door leads into nacelles via wing passages.

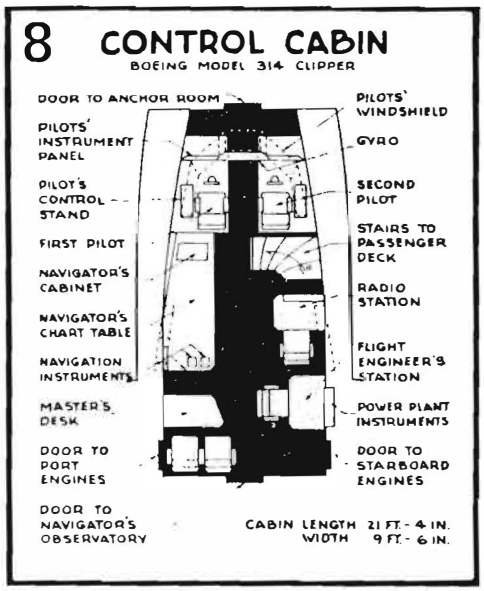
Actually, payload was an inverse function of the distance to be flown, as follows:

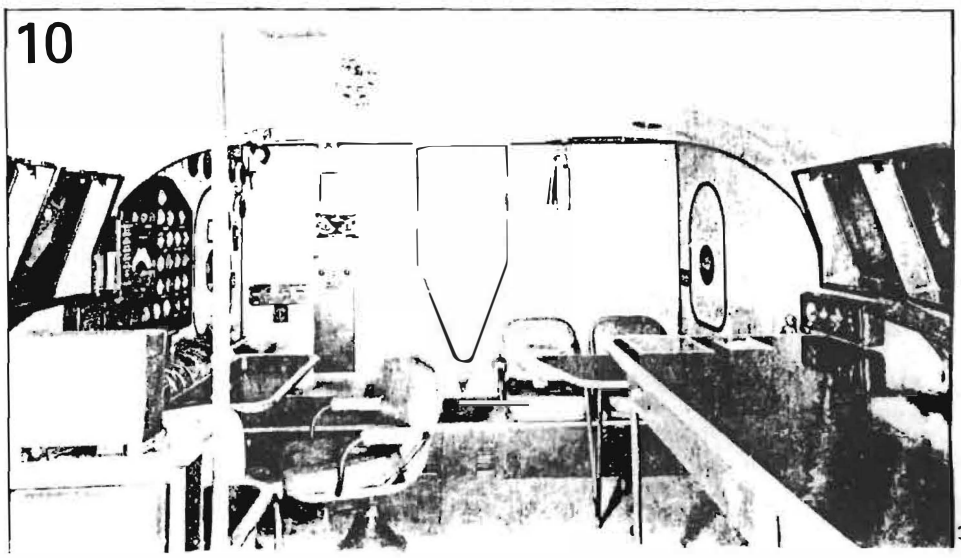
Distance	Payload
1,000 Nautical Miles	21,000 lbs.
1,750 Nautical Miles	15,000 lbs.
2,500 Nautical Miles	9,000 lbs.

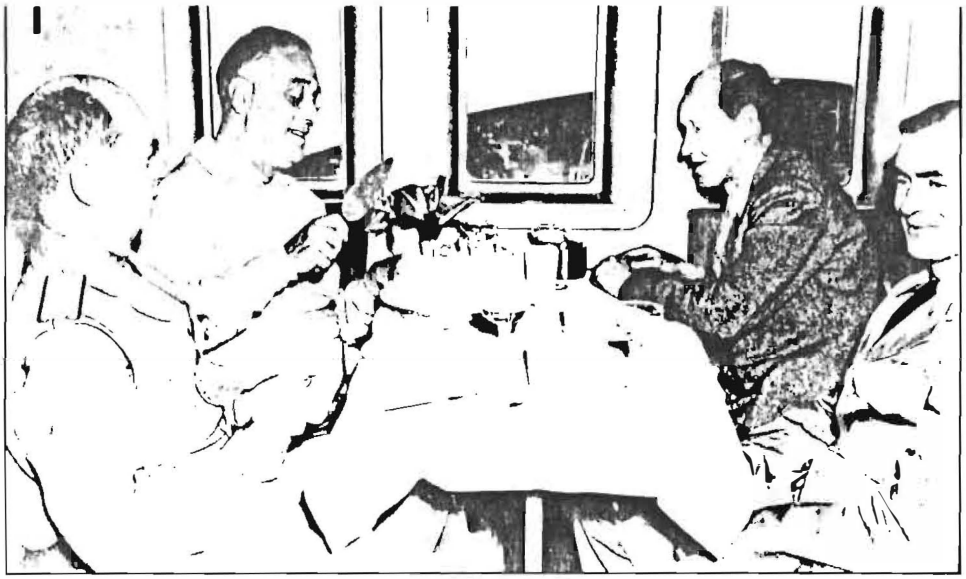
For the 2,500-mile San Francisco-Honolulu run, the passenger load was limited to 30.

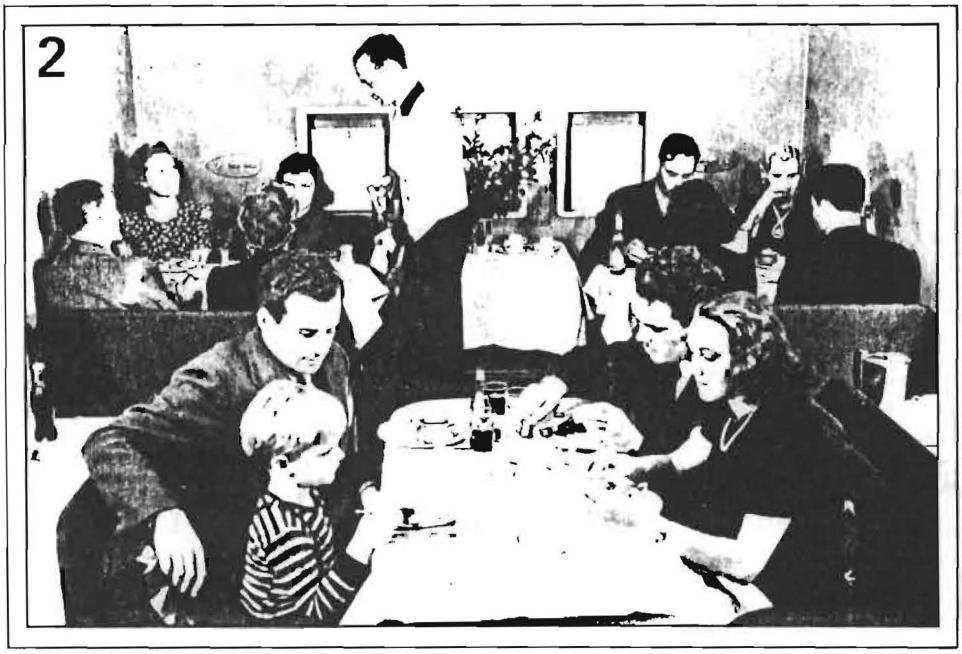
The passenger deck was divided into eleven sections; five standard compartments seating 10 or sleeping six, one special compartment seating four or sleeping two, one deluxe compartment seating six or sleeping two, plus a "Dining Salon" seating 14 at five tables. The dining furniture could be stowed quickly and replaced by lounge furniture seating eleven by day or sleeping six by night.

The three remaining sections were oc-

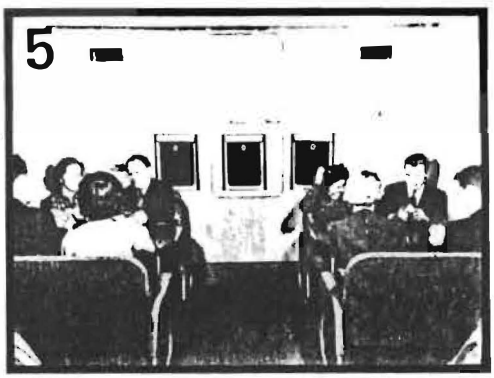


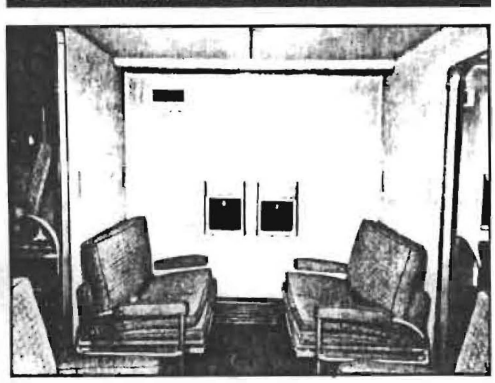






THE GREAT CLIPPERS





cupied by the galley and the men's and women's rooms, not counting three lavatories. These had both hot and cold running water. Pan Am designed and built the galley, which contained a steam table, refrigerator, and a bar. For an average flight, approximately 250 pounds of food and galley supplies were put aboard.

Heat And Power

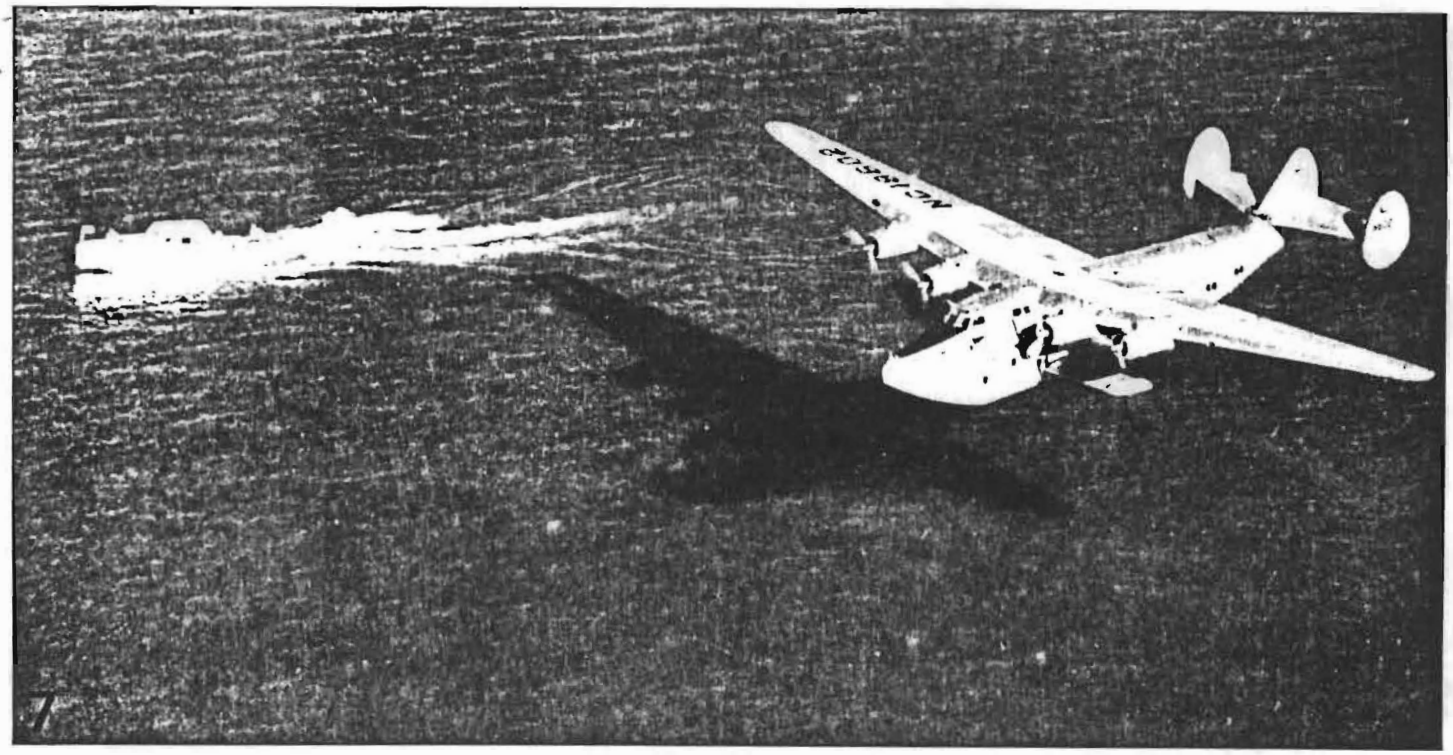
The cabins and cargo area were heated by air drawn from manifolds around the engine exhaust stacks. These could deliver 360,000 BTUs per hour and a volume of 170,000 cubic feet of air an hour. As a safety precaution, the system was fitted with a carbon dioxide (CO_2) analyzer to detect any leaks of exhaust gasses into the ventilating system. Electrical power was supplied by a 12-24 volt direct-current system from two 80-ampere 15-volt generators and two 12-volt batteries.

Emergency Equipment

The 314 set new standards of passenger safety. In addition to the regular doors and hatches, each standard passenger compartment had two emergency exit panels while the deluxe compartment had one. Altogether, there were 15 ways to leave the airplane in a hurry. The only structural doors (necessary for safe operation) were the fuel tank access doors. The others could be open or missing without structurally jeopardizing the aircraft.

Equipment consisted of eight 10-man life rafts, four of which were accessible from outside the plane. Each passenger seat was provided with a life jacket and a supply of ring-type life preservers, signal lights, flare pistol, bucket, axes, and rope was carried.

As a precaution against localized damage, the radio equipment was located in



three separate areas, and a gas-engine generator was carried to provide power for the radios in case of battery failure. To reduce fire hazard, all upholstery was fireproofed for the first time in an airliner.

For rough-water landings, not necessarily emergencies, the Clipper carried a 91-pound anchor with 150 feet of line, a six-foot sea anchor and two sway buckets that could be rigged to hang in the water from points half-way from the hull to the wingtips. There was even a tank of special oil to pour on rough seas!

The service life and character of the Boeing 314 will be described in part II of this article, appearing in December, 1977 *Wings*.

1. President Roosevelt made several trips in Boeing Clippers during WW II. Here he is celebrating his 61st birthday aboard NC18605, the "Dixie Clipper" while returning from the famous Casablanca Conference of January, 1943.
2. Dinner is now being served in the dining room. Note the real china cups in those pre-plastic days and the added touch of real flowers. Clipper's fuselage was wider than that of a Boeing 707.
3. Pan Am stewardess shows how easy it is to step from the cabin of the Clipper onto the hydrostabilizer. Note the rubber matting laid down for use while the plane is loading and unloading.
4. Doors in every compartment made possible a corridor for the full length of the Clipper cabin, which was divided into nine passenger sections, including lounge, galley and lavatories.
5. The main lounge could also be used as a dining room (Photo 2) following a change of furniture. When Boeing needed "People Pictures" back in the Clipper days, it didn't go out and hire professional models as is done today; it just rounded up available employees and had them make like passengers for the camera. That's Project Engineer Wellwood Beall at the left with the moustache.
6. One of five "standard" passenger compartments that could seat 10 passengers by day or make up six berths for night use.
7. NC18602 (California Clipper) coming in for a landing. Photographers on power boat are ready to catch the moment of touchdown of second 314 built.