U.S.A. NAVY F-5-L FLYING BOAT*

THE F-5-L boat seaplane is a twin-motored tractor biplane, having a total flying weight of nearly 7 tons, a cruising radius of 10½ hours as a fighter, or 8½ hours as a bomber. It carries a military load of over 1,400 lb., with a crew of four men. This machine is a formidable engine in naval war craft, and it is so designed that it may be quickly and efficiently made under war conditions.

In the case of this machine the United States Navy, as did the Army, took a foreign design and modified it to meet American production methods. It is interesting to note, however, that in this particular case the English design had been based upon an American model, the large Curtiss flying-boat—the H 12—which was the forerunner of both the H-16 and the F-5-L.

The F-5-L is a somewhat larger machine than either the H-12 or the H-16, and is capable of carrying a greater useful load. It was originally developed at Felixstowe, and the name "F-5" was chosen to denote the English experimental seaplane factory at Felixstowe ("F"), and the model number design in machine ("5"). The United States Navy added the letter 'L," indicating that, as built in U.S.A., it is driven by Liberty engines.

The lines, overall dimensions and main constructional features were worked out in England, and an experimental plane was constructed there. The details with many modifications were worked out at the Naval Aircraft Factory, Philadelphia, to correspond to its production methods. The planes were then put into production at that and other factories, such changes from the first drawings being made as they were found necessary by tests.

Fundamentally the plane is similar to the American Curtiss flying-boats—particularly the H-16 model. But in size and details it is quite different, being larger and better fitted to emergency production. For example, with few exceptions, the fittings are soft sheet steel, cut from flat patterns and bent to shape. This obviated the necessity of dies and drop forgings, which are particularly difficult to obtain under war conditions. The struts, likewise, are uniform sections, that is, not tapered, so that they can be shaped with a minimum of hand labour. Throughout, the parts are such that duplication is easy, production methods possible, and readily available equipment suitable

The most noticeable feature in the F-5-L is the degree to which the hull or boat has been streamlined. The hull cover sweeps aft, broken only by the cockpit openings. From an aerodynamic standpoint this is more efficient than the construction of the H-16, where a raised cabin is used. On this model, as on the H-16, the fin edges are continued aft, and join into the lower *longeron*, giving a much stronger and better streamline form. Another feature in the hull construction that is noteworthy is the use of veneer instead of linen doped and painted on the after hull sides. It was found in practice that the linen failed in heavy seas or on a bad landing, but this failure was obviated by the use of veneer.

The specifications herewith will give some idea of the size and capacity of this seaplane. It will be noted that the lift, per square foot of surface is from 9.3 to 9.5 lb. per sq. ft., and is somewhat greater than land practice.

Overall span (top plane)	103 ft. 9½ ins.
Overall span (lower plane) ..	74 ft. 4 ins.
Overall length	49 ft. 3 11/16 ins.
Overall height	18 ft. 9½ ins.
Hull beam	10 ft. 1¼ in.
Chord (H-12 curve)	8 ft.
Gap	8 ft. 10½ ins.
Angle of incidence	3° 40′
Dihedral	1° 30′
Angle of incidence of tail ..	2° 30′
Areas	
Top plane (including *ailerons*) ..	848 sq. ft.
Lower plane	546 sq. ft.
Ailerons (two)	118 sq. ft.
Total of main planes	1,394 sq. ft.
Main plane fins	30 sq. ft.
Gross weight	13,659.5 lb.
Useful load (1,405 lb. military load)	5,224 lb.
Loading per sq. ft.	9·5
Power plant	Two 330 h.p. Liberties.
Speed range	57-90 m.p.h.
Climb	2,600 ft./10 mins.

With few exceptions, all large seaplanes have been previously built with unbalanced control surfaces. However, on the F-5-L both the *ailerons* and rudder are balanced. The purpose is, of course, to increase the controllability of the unit, and in the case of the *aileron* control the result is as anticipated. Differing from the usual control surface balance construction, the balance on these *ailerons* is cambered so that it has a positive lift. By this construction the *ailerons* tend to be more sensitive in their action and to operate with less difficulty and with less balance surface.

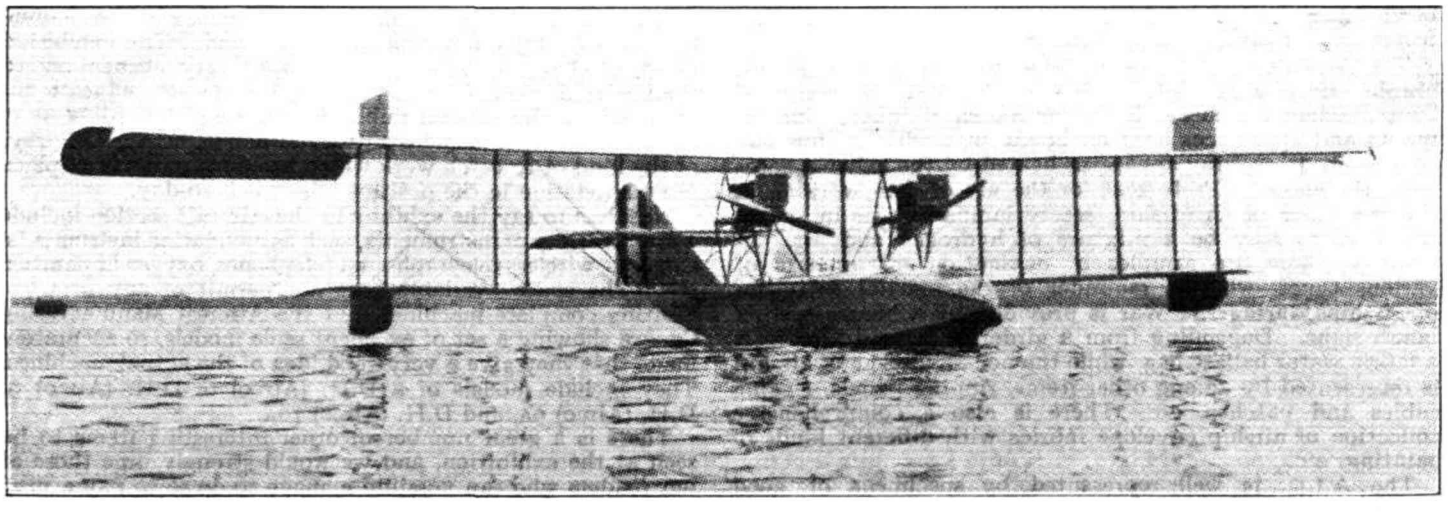
The planing action is increased by the use of vents extending through the hull aft of the rear steps. Although the cabin top over the pilot's cockpit is eliminated, a certain amount of protection is afforded the pilot by small adjustable windshields.

The whole lay-out of the machine is such that the duties of the crew may be most readily carried out. The observer's cockpit is in the nose of the machine, and from it the widest range of vision is possible. At the bow is mounted the bomb sight, and adjacent to it are the bomb-release pulls, ammunition racks, signal pistols, binoculars, etc. A machine-gun turret is mounted on the scarf-ring of the forward cock-pit.

The pilot's cockpit is just aft the observer's cockpit, and may be readily reached from it when the machine is in operation. The pilots are seated on comfortable seats, hinged on a bulkhead and attached to a transverse tube by means of a snap-catch that may be instantly released. This permits the observer to pass aft at will without disturbing the pilot.

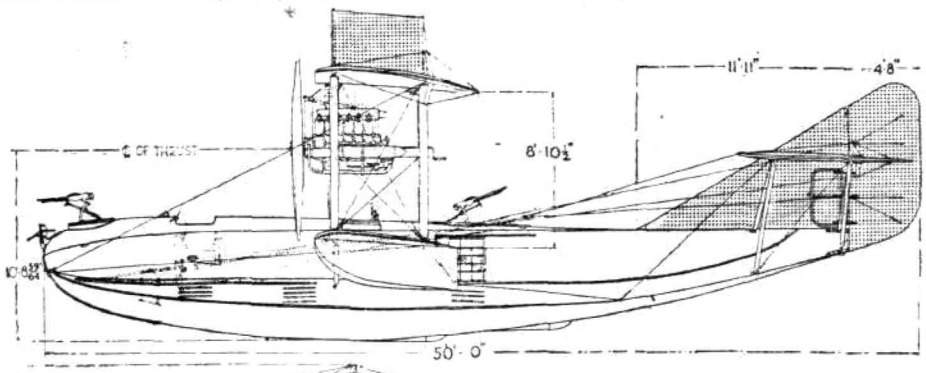
A wheel control of the dual type is used. It comprises a laminated ash yoke on which are mounted the two *aileron*

* Extracts from an article by S. T. Williams, Chief Engineer, U.S. Naval Aircraft Factory, appearing in *Automotive Industries* (U.S.A.).



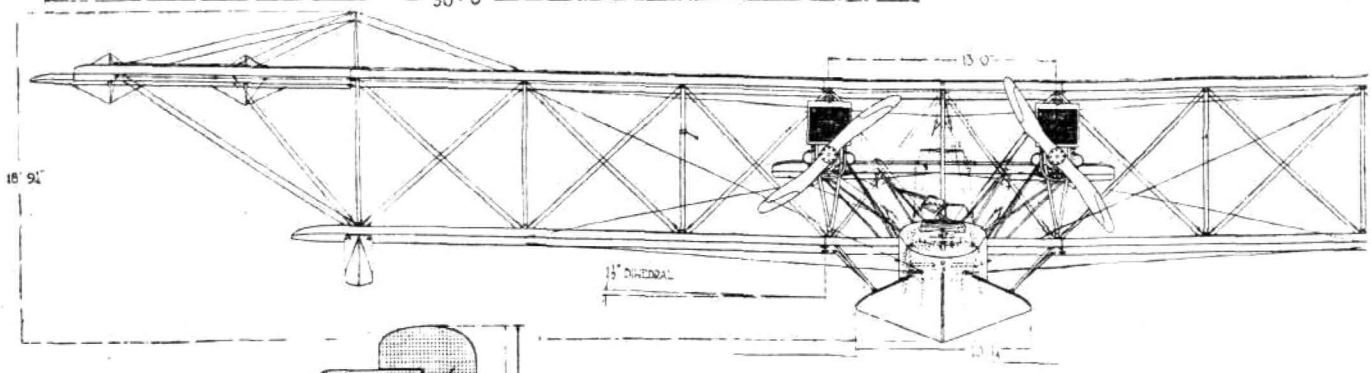
Three-quarter front view of the U.S.A. Navy F-5-L flying-boat

FLIGHT
AIRCRAFT ENGINEER AIRSHIPS



AREA OF FIN
35 SQ. FT.

AREA OF RUDDER
33 SQ FT

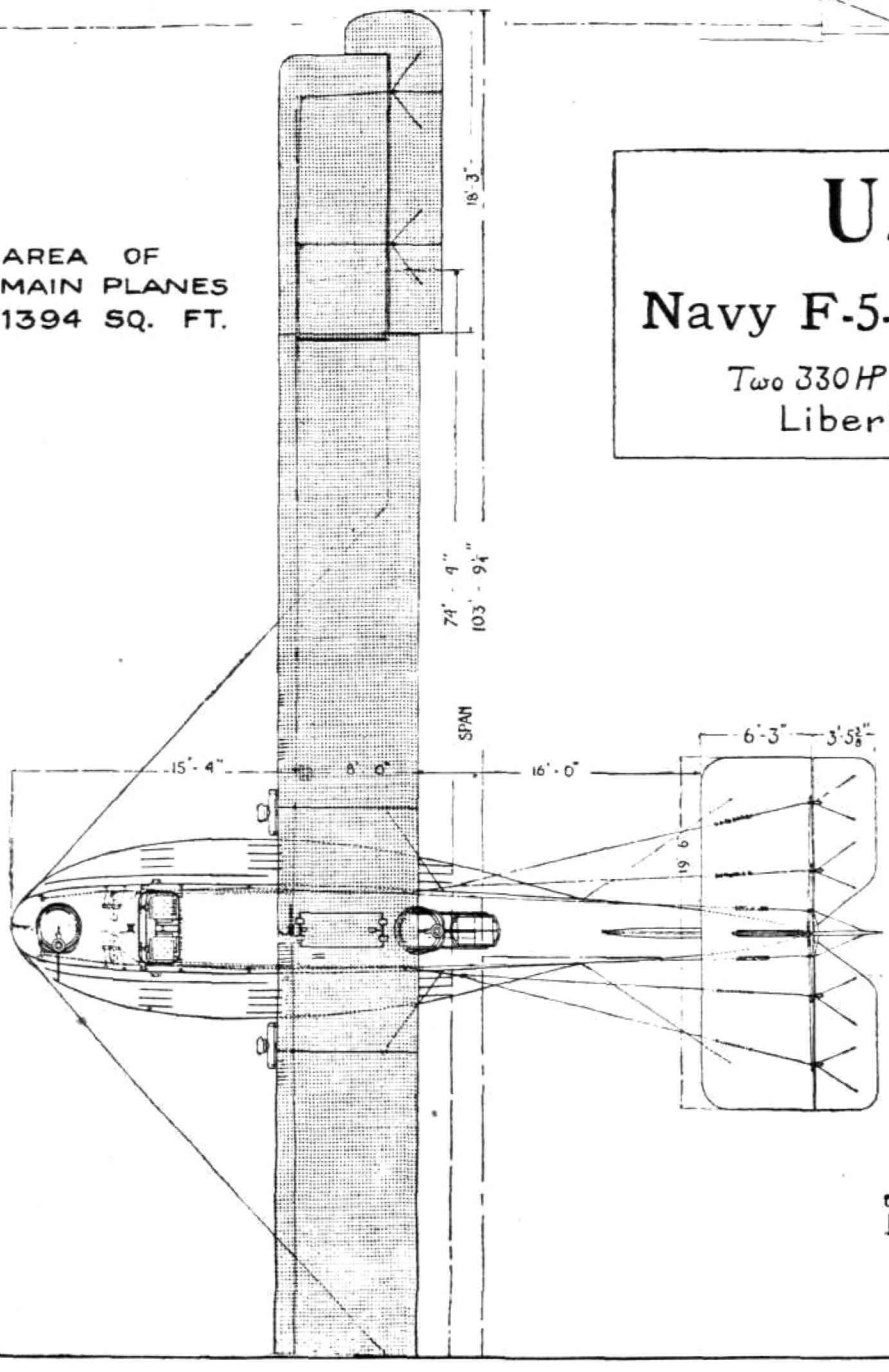


U.S.A.

Navy F-5-L Flying Boat

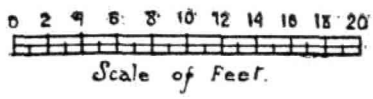
Two 330 HP Low-compression
Liberty Engines

AREA OF
MAIN PLANES
1394 SQ. FT.

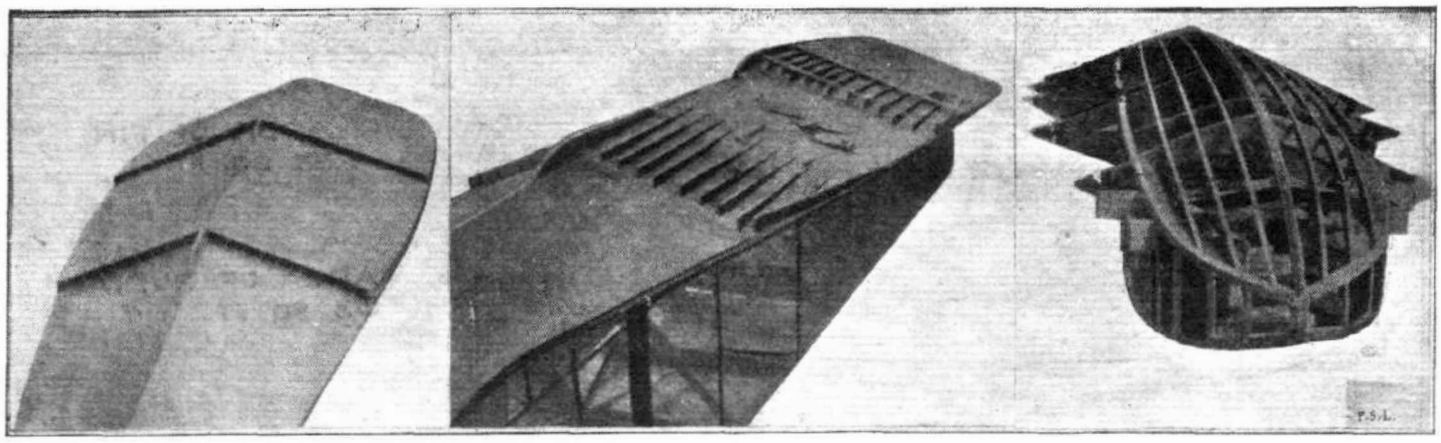


AREA OF TAIL PLANE
121 SQ. FT.

AREA OF ELEVATORS
56 SQ. FT.



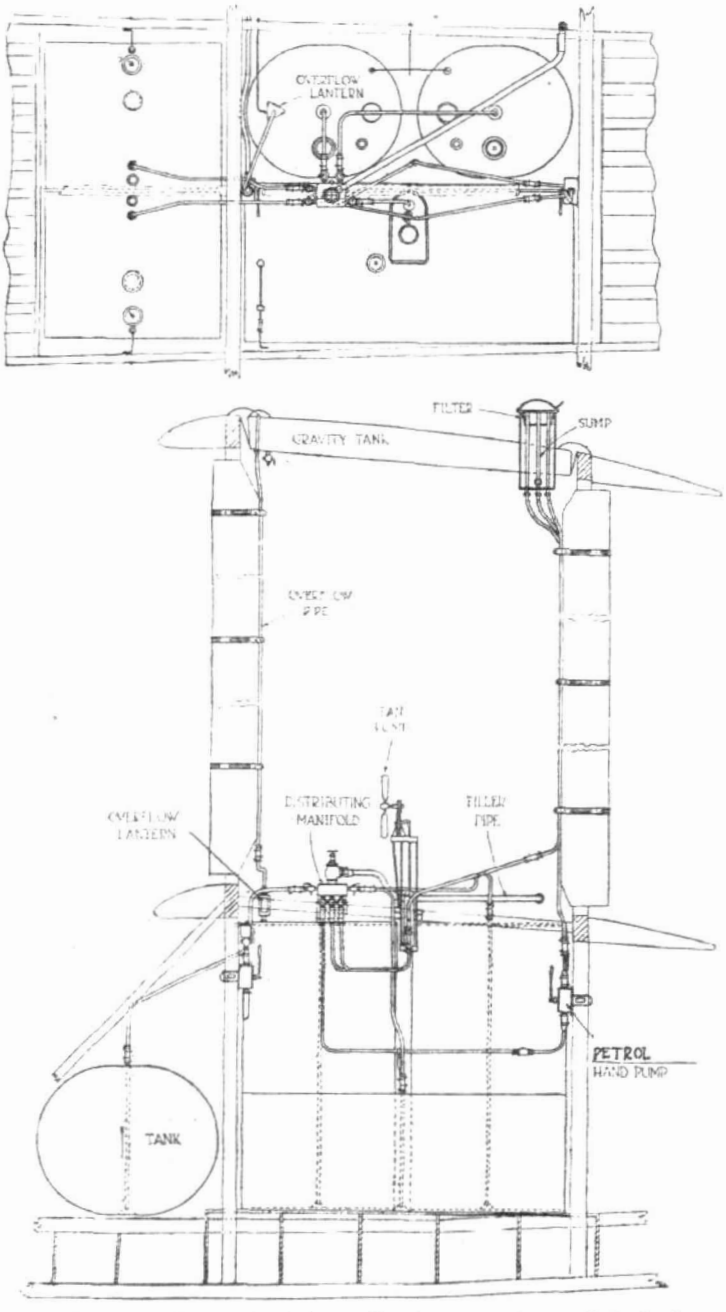
THE U.S.A. NAVY F-5-L FLYING-BOAT. Plan, front and side elevations to scale



Three views showing the construction of the hull of the F-5-L flying-boat

wheels connected by an endless chain. An instrument-board, containing tachometers, alimeters, air-speed indicator, oil-pressure indicators, inclinometer, and pilot-directing bomb sight is mounted directly in front of the pilot.

On the starboard side of the hull are the individual engine switches, ammeters and emergency switches, together with the circuit breakers. The two compasses are mounted at some distance apart, so that they cannot interfere with each other. One is on the deck and the other on the floor. All instruments are self-luminous, but instrument-board lights are provided. The spark controls are at the starboard side of the starboard pilot's seat, but the throttle controls are between the two pilots, so that either may operate them. Fire extinguishers are placed conveniently at each station, those in the pilot's cockpit being attached to the bulkhead beneath the seat. The wireless operator's station is on the starboard side, just aft the pilots. The equipment is mounted on a small veneer table, and used in conjunction with a telescopic mast that is carried in the stern. A celluloid window in the hull side provides necessary light. The mechanics' station is amidships by the petrol tanks and pumps, and their main duty is to see that the plane is "trimmed" by pumping petrol from the tanks alternately; to see that the engines do not overheat, and that all parts function properly. The water and oil thermometer are mounted on the sidewalk beam adjacent to the mechanics' station.



Diagrams of the fuel installation on the F-5-L flying-boat

Aft the mechanics' station, or wing section, is the rear gunner's cockpit. Three guns are accessible from this station, and it also provides a good point of observation or position for aerial photography. All machines are equipped with inter-communicating telephones, the receivers being incorporated in the helmets and connection effected by terminal boxes at each station. It is thus possible for all members of the crew to be in constant communication. In addition to the equipment indicated, the following are some of the miscellaneous items usually carried: tool kits, water buckets, range and running lights, pigeons, emergency rations, drinking water, medicine chest, sea anchor, chart board, mud anchor, anchor rope, heaving lines, signal lamp, binoculars, Very's pistol, ammunition, life jackets, and possibly electric warmers. Included also are the priming cans, drinking cups and usually several personal items. All this is exclusive of the ordnance equipment of bombs, machine guns, etc.

Considering the size of the machine and the amount of material carried, the performance is quite remarkable. In fact, it compares very favourably with the performance of land planes having the same specifications and not hampered by the heavy boat construction. The time required to get the machine from the water varies with the wind velocity, but with a 15-mile wind and the plane fully loaded, from 30 to 40 sec. is required. The speed at take-off is about 47 knots on the air-speed indicator, and a machine of this design has made a climb of 4,200 ft. in 10 mins. A horizontal speed of from 85 to 90 m.p.h. is attained, but on patrol duty they are generally flown at a more economical speed, such as 70 m.p.h. When geared Libertys were tried out in one of these machines a speed of 102 m.p.h. was attained, but this was a special power-plant equipment. The engine revolutions are about 1,500, though this, of course, varies with the types of propeller used. At full speed the petrol consumption is about 65 galls. per hour, and the oil consumption about 2.6 galls. per hour. By throttling down the engine to 1,350 r.p.m., or to a speed of about 60 knots, the petrol consumption per hour is reduced to 44 galls., the oil consumption remaining the same. This gives a maximum cruising time of 10.6 hours with a light machine, or 8½ hours fully loaded. The cruising time at full speed is 7.3 hours and 5.9 hours respectively.

The advantages of operating at cruising speed are many, and it is at this speed that the plane is chiefly operated. Among the advantages are increased engine life, greater ease of control, longer cruising radius, less strain on plane parts, and time for more extended observation. When running at full speed, control is not particularly easy, though under normal conditions one pilot can operate the machine without difficulty. However, the reserve control is necessary to lift the machine from the water, and in cases of emergency, though not ordinarily used.

(To be concluded.)