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No. 76

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THE FOKKER "TRIMOTOR F VII" COMMERCIAL TRANSPORT MONOPLANE

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NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS.

AIRCRAFT CIRCULAR NO 76.

THE FOKKER "TRIMOTOR F. VII" COMMERCIAL TRANSPORT MONOPLANE.\*

The Fokker Trimotor is directly developed from the single-engined type F VII ten-passenger monoplanes which are the new standard equipment of the K.L.M. (Royal Dutch) airlines on the Amsterdam-London and Amsterdam-Paris routes. The first Trimotor was brought out in August, 1925 and competed in the Ford Reliability Tour, October, 1925.

In its general construction and use of materials, the Fokker Trimotor F VII follows closely the highly successful features of the long line of Fokker commercial aircraft which have preceded it.

W i n g s

The wings embody the Fokker all-wood, veneer-covered construction. For eight years now this form of construction has been standard on all Fokker monoplanes and has proven so satisfactory in service that it is this part of the airplane that has undergone the least change during this long period.

A most important feature of the wooden wing is also its flexibility, which permits deflection under overload without permanent deformation; no rivets or connections can be strained, as the wings form one continuous, unbroken structure.

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\*From a circular issued by the Atlantic Aircraft Corporation.

The wing spars are built up of box section, with heavy laminated spruce upper and lower flanges and birch veneer plywood walls, suitably blocked where necessary. The ribs are built up of birch plywood with spruce cap strips and stiffeners and the entire structure is both covered and solidly bound by the complete birch plywood covering, which is glued, nailed, and screwed on. The result is a wing which is not very light in weight but will stand both regular use under all weather conditions and collisions, with a minimum of deterioration.

#### Power Plants

The three Wright "Whirlwind" air-cooled radial engines of 200 HP. contribute greatly to the commercial utility of the Fokker Trimotor. The average fuel consumption on the Fokker Trimotor in normal commercial operation is only about 39 gallons per hour, for the three engines. Oil consumption averages below 9 quarts per hour; several brands of heavy oil, commercially easily obtainable, are suitable. The center engine is bolted to the nose of the fuselage, while the two side engines are mounted on well designed tubular steel nacelles suspended below the wing and attached thereto by three bolts.

The design of the exhaust manifolds is also the result of much experience and testing. They consist of a system of short lengths of flexible metallic tubing clamped to rigid joints. Replacements are, therefore, very cheap and quick to make. All

possibility of straining the cylinders is avoided and individual cylinders can be removed quickly without detaching the manifold. The exhaust of the side engines is taken up over the top of the wing, and that of the center engine under the floor of the cabin, with connection to the cabin heating installation. The result is an unusually quiet cabin, a point of the greatest importance in passenger traffic.

The power plant installations are most carefully designed and have thoroughly proven their reliability, both under intensive operation and in long-distance flights. Pipe lines are of large diameter and very carefully laid. No rubber joints are used in the fuel lines. Strainers are placed in the line at each engine, addition to screens over the tank outlets. Gravity feed only is used, avoiding all complications in the way of pumps and their accessories. In the standard installation, two gasoline tanks, of 95 gallons each, are placed in the center section of the wings, between the enormous wing spars; this is undoubtedly the most protected position conceivable on any aircraft. Provision is made in the wing structure for installation of a third tank when desired. Each tank feeds the fuel system independently, through a shut-off cock. These cocks form part of a manifold installation on which the three individual feeds to the engines are also each controlled by separate cocks. On top of this manifold, which is mounted right next to the two pilot's seats and in full view, boiler type glass tube stand

pipe level gauges are provided for each tank. They are calibrated and marked both for standing and flying positions of the airplane and are provided with shut-off cocks, in case of breakage; this is unlikely as the gauges are protected by a transparent pyralin box.

Each engine mount carries its own oil tank, the total oil capacity being 21 gallons.

Drainplugs are fitted in readily accessible positions.

Each engine is fitted with tachometer, oil pressure gauge and oil thermometer. For starting, primers are provided, operated from the pilot's seat. Combined hand crank and booster magneto starters are the standard equipment, but allowance is made in the installations to permit the fitting of electric, hand-operated inertia or electric inertia starters.

The engine controls are of the bell crank and push and pull tube type; the tubes are of large diameter and very rigid. The levers are centrally located and conveniently placed for both pilots, as are also the individual switches and master switch.

The cowling incorporates the results of much experience in operation and is consequently exceptionally durable and rigid, while at the same time quickly removable, as a whole and in individual pieces independently of the rest. The entire cowling lies behind the cylinders, the engines thus remaining completely accessible for inspection and maintenance work.

## Cockpit and Cabin

The cockpit for the two pilots is roomy and conveniently arranged. The three-piece glass windscreen gives such protection that, except in extreme weather, flying clothes and goggles are unnecessary. At the same time, the sides are open, so that it is possible to look forward outside the screen when necessary, and also backwards along the sides of the fuselage, which is cut away at an angle behind the cockpit to improve this view. Windshield wipers are fitted. The view as a whole is exceptionally good for accurate navigation and the dash is large enough for any special navigating instruments desired. The standard equipment includes: altimeter, clock, magnetic compass, air-speed indicator, and the engine instruments already noted.

The cockpit is entered from the cabin through a large door, fitted with a window.

The passenger cabin is 10 feet long, 5 feet wide and 5 feet, 10 inches high. This height, which enables the average person to walk about upright, is a feature which is valued highly on the most experienced and best patronized passenger lines. Eight comfortable and specially designed wicker armchairs are provided. They are to a certain extent movable, but anchored down against tipping. Racks for light hand baggage are fitted overhead along each side. The glass windows run the entire

length of the cabin and can be slid open; the result is a very light and pleasant interior with ample ventilation. Provision is made for heating the cabin by means of an adjustable register connecting through the floor with a sleeve around the exhaust pipe. This system has been thoroughly tested and provides a comfortable temperature under all conditions. The standard finish is Spanish leather below the window line and Duco finished fabric on the upper part of the walls and ceiling. The floor is covered either with carpet or linoleum, as desired. At the rear of the cabin another doorway leads into the entrance way, off which the completely equipped washroom and toilet is also located. The main access door, in the side of the fuselage, is entered by way of one step, directly from the ground. This door is 4 feet, 5 inches high by 2 feet, 6 inches wide.

#### Baggage and Freight Compartments

Rear of the cabin there is an entirely separate baggage or freight compartment, of which the dimensions are 5 feet, 4 inches high by 4 feet, 7 inches long by 2 feet wide. The door to this is 4 feet, 3 inches high by 2 feet, 6 inches wide, and is located on the opposite side to the cabin door; loading and unloading baggage or freight thus in no way interferes with the convenience of passengers. Forward of the cabin, below the floor of the pilot's cockpit, there is another baggage or freight compartment, 4 feet, 6 inches by 1 foot by 4 feet, ac-

cess to which is gained through a trap door in the right-hand side of the fuselage. This is a very convenient mail pit.

All floors and walls are planked with veneer and amply strong and rigid. They are built up as separate panels, bolted in place as units and removable. This feature permits of the hoisting of very large objects, such as engines or other machinery, into the fuselage when desired.

The total cabin and freight space available in the standard arrangement is approximately 500 cubic feet.

#### Controls and Control Surfaces

Complete dual controls, of the wheel and column type and built entirely of non-magnetic materials to avoid compass interference, are fitted. Control pulleys are all of large diameter and carefully guarded. The tail control cables all run entirely outside the fuselage and through guides of special design which have proved to give maximum durability to the cables. Through this arrangement the routine inspection of control cables is much facilitated.

The tail surfaces are all built of steel tube, fabric-covered; the hinges are fitted with large diameter bronze pins, to prevent rusting and freezing. The stabilizer is adjustable in flight by means of a worm gear, operated by means of a universal jointed shaft and crank from the pilot's cockpit. Elevators and rudder are balanced, exceptionally light in operation

and completely and instantly effective at all speeds.

The ailerons are of wood construction, veneer covered like the wings, unbalanced but light and completely effective in operation; the directional stability of the Fokker Trimotor is such that the airplane can be steered by the ailerons alone, without the rudder, an unusual safety factor. The lightness of the controls relieves the pilot from strain on long flights.

#### Tail Skid

Great attention has been paid to the design of the tail skid which is of the latest Fokker rotating type. The skid itself is made of nickel steel tube, heat-treated and fitted with a quickly replaceable manganese steel shoe. The tail skid suspension consists of rubber rings, of which the tension is adjustable by means of a nut. These rings form quickly replaceable units but have great durability on account of the large size of the pins on which they are hung. The tail skid is steered by rotation, the operation being effected by short cables, incorporating springs, which are connected to the rudder control.

#### Landing Gear

The landing gear of the Fokker Trimotor is of novel design and has proven extremely satisfactory in service. It has an exceptionally wide wheel track, 15 feet, of which the advantages are obvious. Each half of the landing gear consists of an axle

and radius rod hinged to the lower longeron of the fuselage, and a vertical shock absorbing strut abutting at the top directly on the side engine nacelle. In landing, the entire weight of the side engines is thus borne directly by the landing gear instead of through the wing structure. The shock absorbing strut itself is the product of a great deal of experience; especially, in passenger traffic, perfect shock absorption, not only in landing but particularly in taxiing, is of the greatest influence on the comfort of the passengers. The shock absorbing elements themselves are horizontally suspended individual rubber rings which allow a very long stroke, both in taxiing and landing. The action is extremely soft and causes no tendency to bounce. The quickly and individually replaceable rings are a valuable maintenance feature.

44-inch by 10-inch wheels with straight side tires and detachable edge rims are fitted. Brakes of special design are installed, by means of which the roll after landing can be reduced to a very short distance by the pilot or his assistant in case of an emergency landing in a very small field.

The mud guards are attached to the vertical struts, so that they do not have to be touched when removing wheels.

S p e c i f i c a t i o n

Fokker "Trimotor F VII" Commercial Airplane Fitted  
with Three 200 HP. Wright "Whirlwind" Engines

Dimensions

Span .....	63 ft. 4 in.
Length .....	49 " 2 "
Height .....	12 " 9 "
Track of landing gear .....	15 "

Disposable Load

Alternative Dispositions:

Fuel and Oil (5 hours) .....	1,300 lb.	
Crew (2) .....	360 "	
Passengers (10) .....	1,800 "	} Pay load 2,340 lb.
Baggage .....	540 "	
Total .....	4,000 "	

Or

Fuel and Oil (7 hours) .....	1,820 "	
Crew (2) .....	360 "	
Passengers (8) .....	1,440 "	} Pay load 1,820 lb.
Baggage .....	380 "	
Total .....	4,000 "	

Performance

Climb

Official U.S. Government Tests

Military Disposable Load	Commercial Disposable Load
2,975 lb.	4,000 lb.
Rate of climb at ground level ..... 860 ft./min.	Rate of climb at ground level ..... 720 ft./min.
5,000 ft. .... 6.9 "	5,000 ft. .... 8.6 "
10,000 " ..... 17.5 "	10,000 " ..... 24.2 "
15,000 " ..... 42.1 "	Ceiling .... 13,950 ft.
Ceiling .... 16,950 ft.	

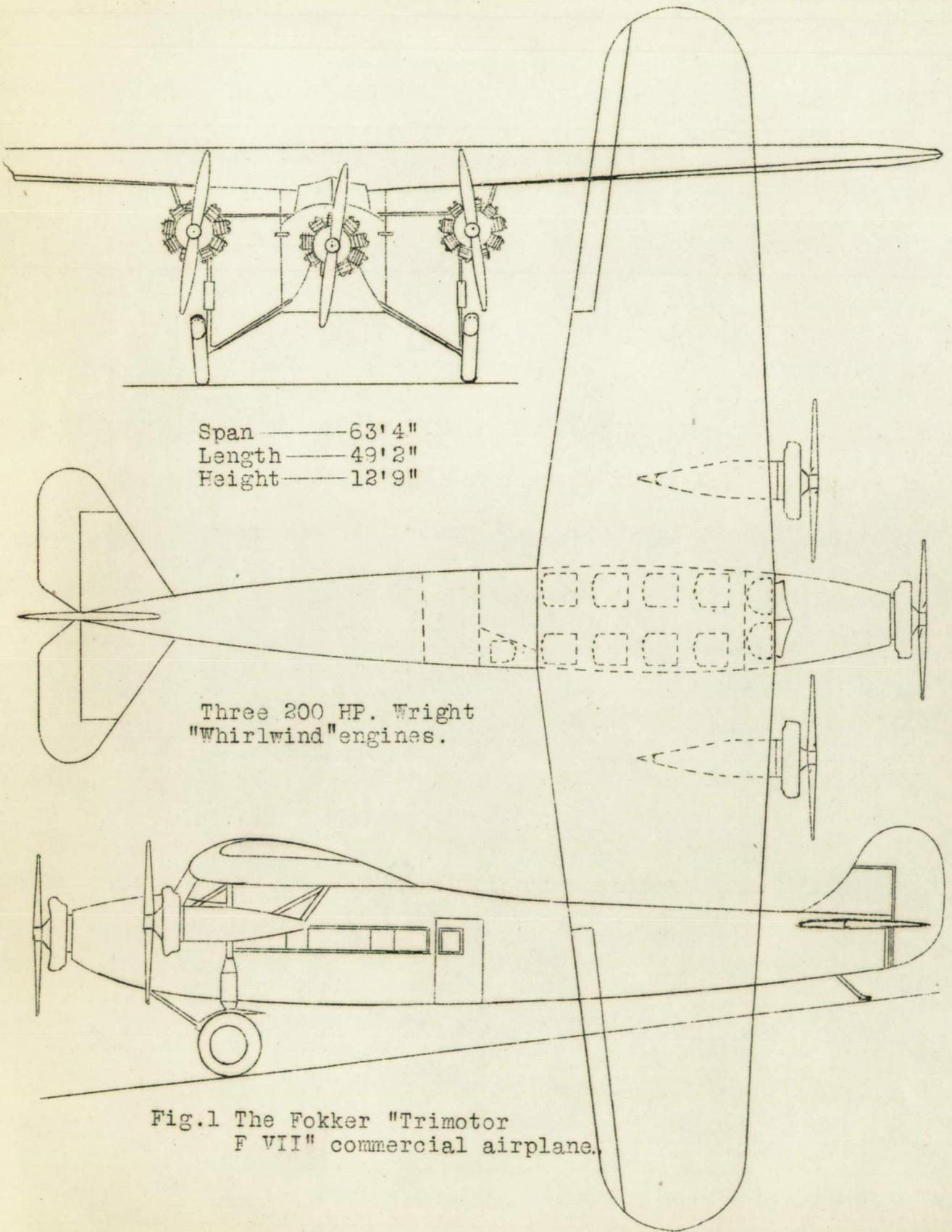
On Two Engines Only

Rate of climb at ground level ..... 530 ft./min.	Rate of climb at ground level ..... 343 ft./min.
Ceiling ... 11,000 ft.	Ceiling .... 7,000 ft.

S p e e d

Manufacturers' Tests

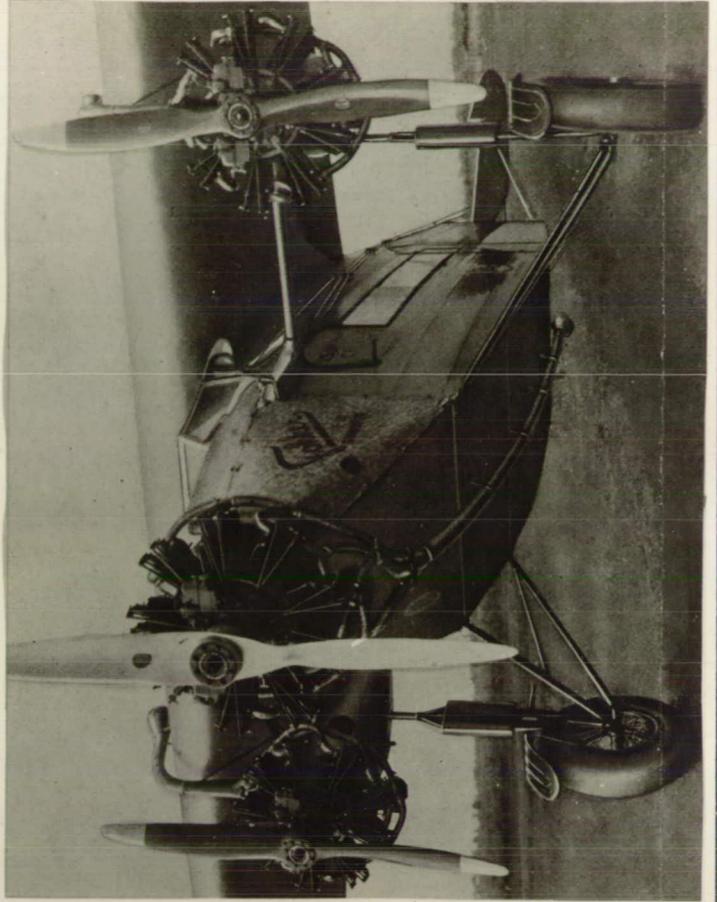
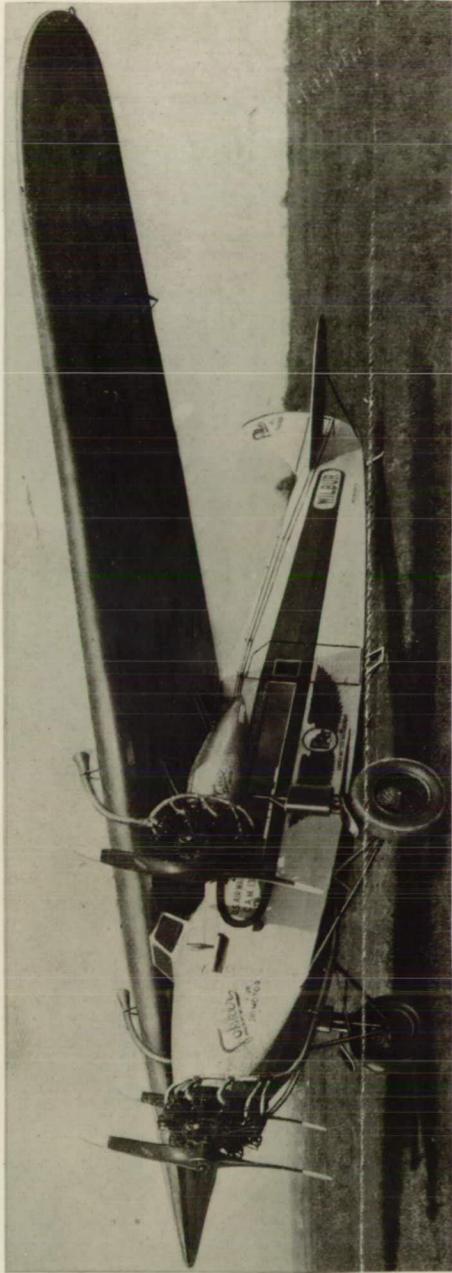
High speed at ground level .....	122 M.P.H.
Average cruising speed .....	100 "



Span ———— 63' 4"  
Length ———— 49' 2"  
Height ———— 12' 9"

Three 200 HP. Wright  
"Whirlwind" engines.

Fig.1 The Fokker "Trimotor  
F VII" commercial airplane.

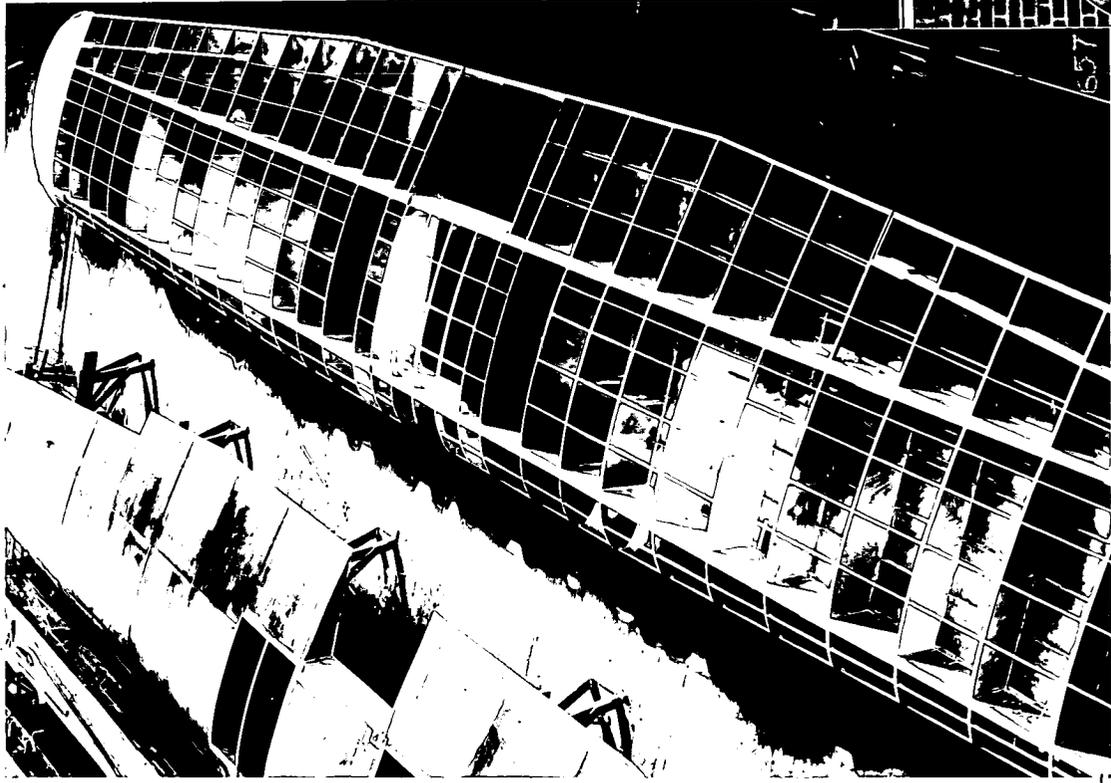
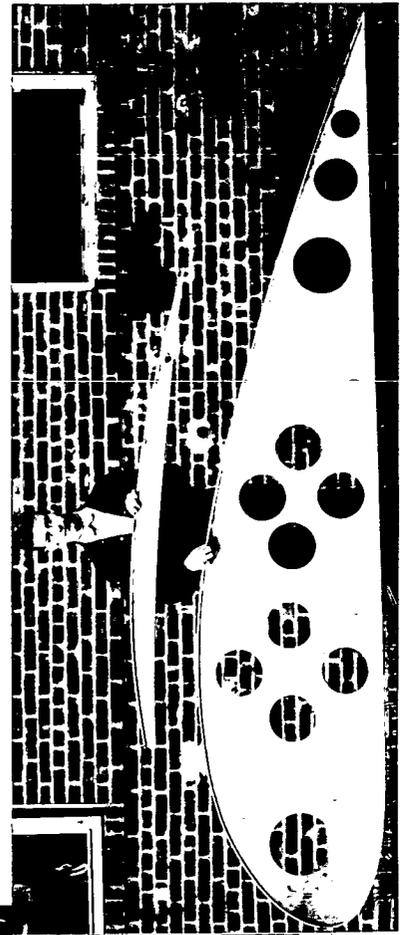
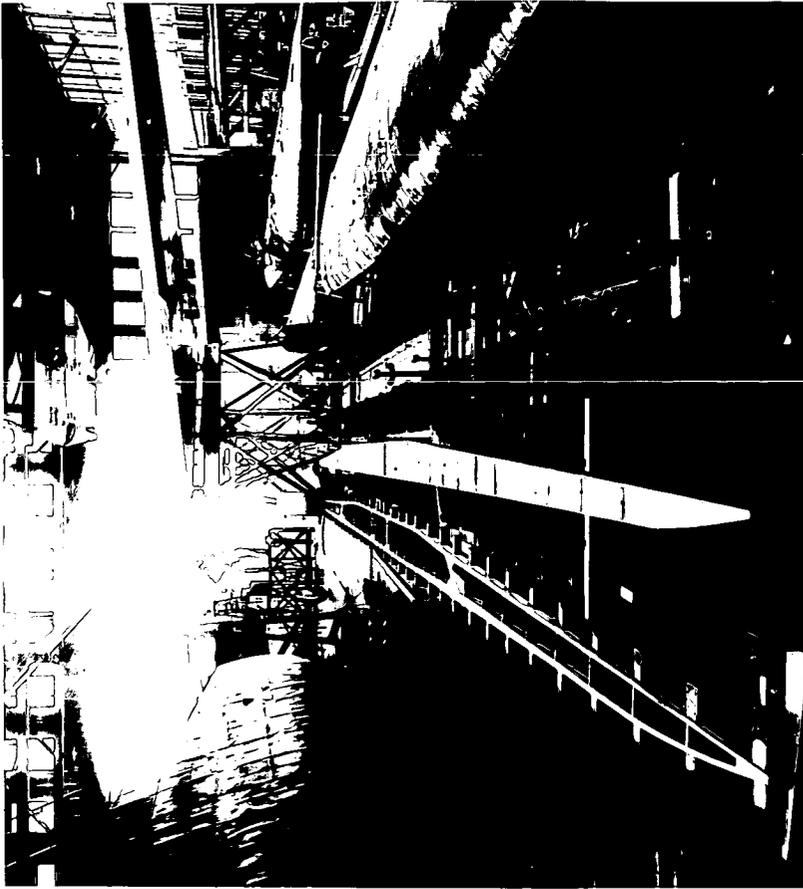


Figs. 2, 3 & 4

Views of the Fokker  
"Trimotor" commercial  
airplane.

The standard fin-  
ished cabin to the  
right, showing arrange-  
ment of seats and  
racks over head for  
light baggage.





Figs. 5, 6 & 7 Views of the Fokker airplane wings, showing construction of spars, ribs and assembly without the veneer covering. The completed wings are also shown