

*Major K. M. Beaumont, D.S. O.  
Director.*

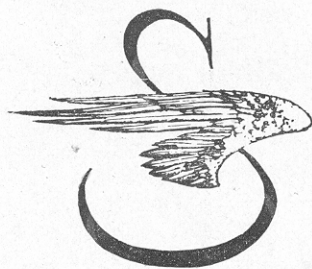
*Imperial Airways (Africa) Limited.  
Airway Terminus,  
Victoria Station. (Continental Departures)  
London, S.W. 1.*



INSTRUCTIONS  
for the maintenance and care  
of the  
SIKORSKY AMPHIBION  
TYPE S-38

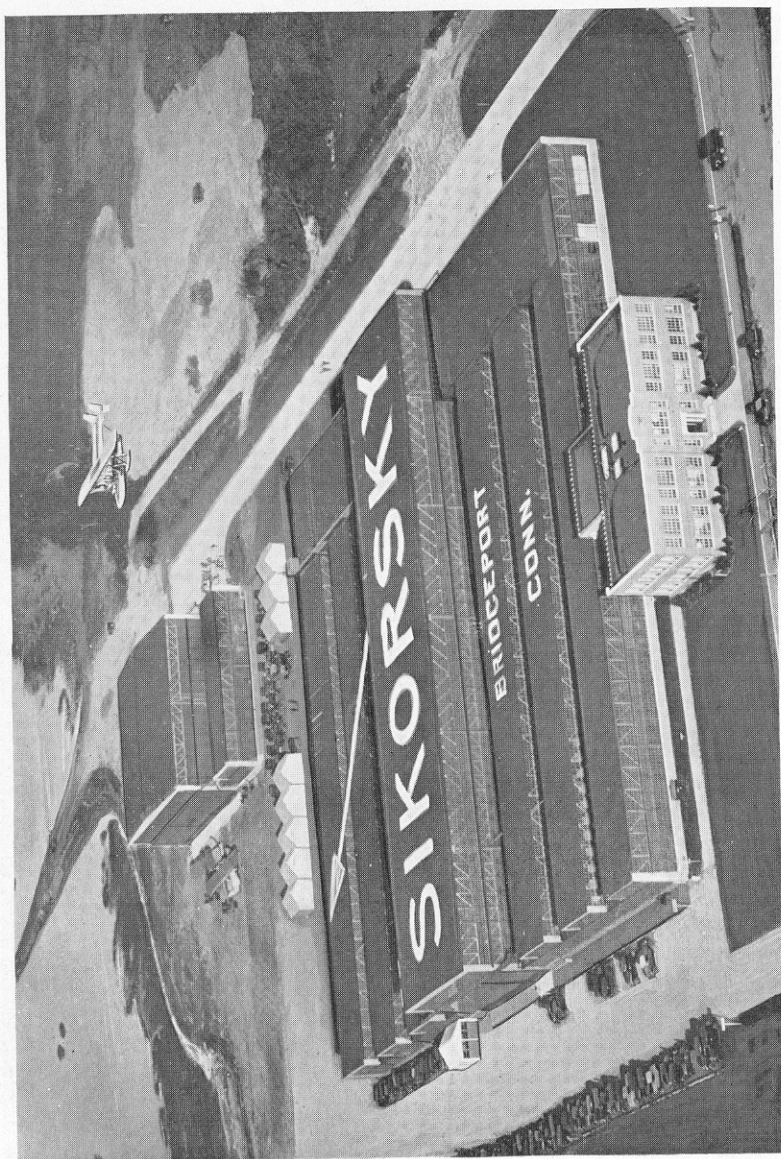


INSTRUCTIONS  
*for the*  
MAINTENANCE AND CARE  
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*Type S-38*



THE SIKORSKY AVIATION CORPORATION  
BRIDGEPORT, CONNECTICUT  
U. S. A.





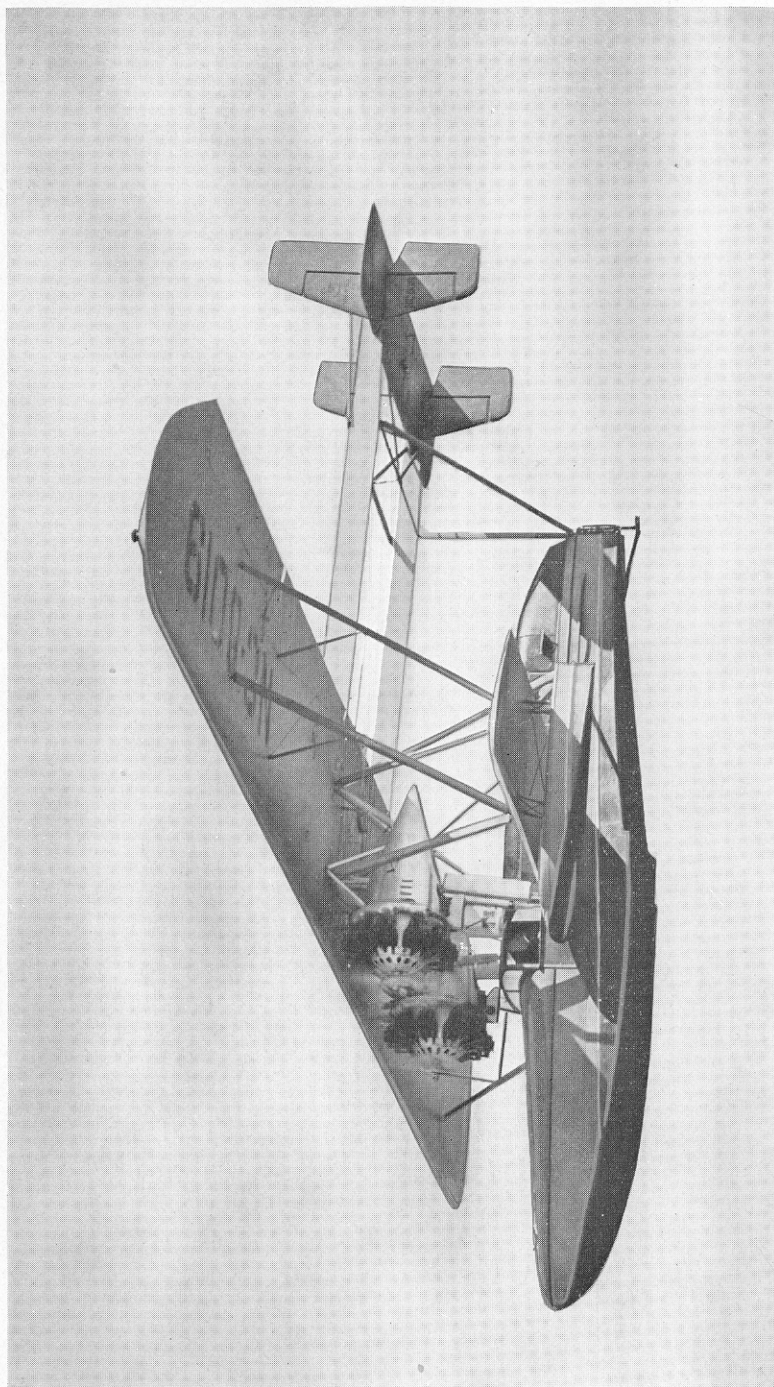
THE HOME OF THE SIKORSKY AVIATION CORPORATION IN BRIDGEPORT, CONNECTICUT



The Sikorsky Aviation Corporation  
extends to all users of its products  
an invitation to visit the plant at  
Bridgeport, Conn. Please remem-  
ber that we are ready and desir-  
ous of hearing your comments  
and suggestions and that we  
are anxious to assist you  
in every way possible.







SIKORSKY AMPHIBION IN FLIGHT



## Performances

All performance data was obtained from flight tests. (The setting of propellers remained the same during all tests.)

### WITH USEFUL LOAD OF 3800 LBS.

High speed over .....	125 m.p.h.
Stalling speed .....	55 m.p.h.
Cruising speed at sea level at 1750 r.p.m. ....	110 m.p.h.
Initial Climb .....	750 ft. p.m.
Ceiling .....	18,000 ft.
Takeoff time from land .....	12 sec.
Takeoff time from water .....	18 sec.

### DISTRIBUTION OF LOAD FOR A FLYING RANGE OF ABOUT 600 MILES

Ship empty .....	6500 lbs.
Gas for 6 hours at cruising speed—264 gals. ....	1584 lbs.
Oil for 6 hours at cruising speed— 16 gals. ....	120 lbs.
Eight passengers } .....	1700 lbs.
Two crew } .....	
Standard and extra equipment of boat and passenger luggage .....	576 lbs.

### GROSS WEIGHT AS PER DEPARTMENT OF COMMERCE

CERTIFICATE No. 126 .....	10,480 lbs.
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## Specifications

Power plant, 2 Pratt & Whitney motors, 420 h.p. each at 2000 r.p.m. ....	840 h.p.
Weight of plane empty .....	6500 lbs.
Weight per sq. ft. with 3800 lbs. useful load .....	14.3 lbs.
Weight per h.p. with 3800 lbs. useful load .....	12.3 lbs.

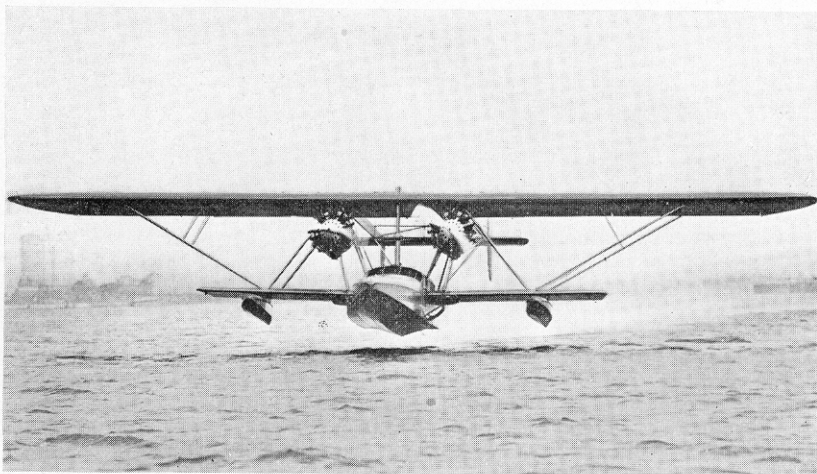
### DIMENSIONS

Span .....	71 ft. 8 in.
Length overall .....	40 ft. 3 in.
Height .....	13 ft. 10 in.
Width of tread .....	9 ft. 8 1/4 in.
Span of upper wing .....	71 ft. 8 in.
Span of lower wing .....	36 ft. 0 in.
Chord upper wing .....	100 in.
Chord lower wing .....	59 in.
Dihedral upper wing .....	0°
Dihedral lower wing .....	1°
Gap .....	95.3 in.
Stagger .....	4.5°
Area upper wing (including 42.2 sq. ft. for ailerons) .....	574 sq. ft.
Area lower wing .....	146 sq. ft.
Total wing area .....	720 sq. ft.
Area stabilizer .....	51.4 sq. ft.
Area elevator .....	35.5 sq. ft.
Area fins .....	15 sq. ft.
Area rudders .....	20 sq. ft.

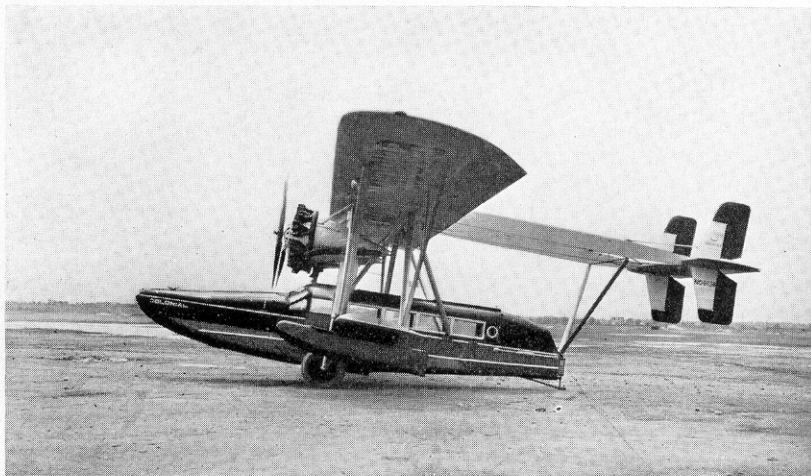
### U. S. GOVERNMENT CERTIFICATION

*Fully complies with the Department of Commerce regulations for landplanes and for seaplanes and has been granted Approved Type Certificate No. 126.*





THE S-38 TAKING OFF FROM THE WATER



THE S-38 ON LAND

## Foreword

To derive the maximum value from your purchase of this plane, it is necessary to observe a strict routine regarding its upkeep and maintenance. All airplanes are subjected to very severe operating conditions and while the Sikorsky Amphibion S-38 is designed with a very wide factor of safety to meet these requirements, without proper maintenance, the safety of the ship is materially lessened.

The Sikorsky Amphibion S-38 represents a substantial investment and in order to insure the greatest return we strongly recommend that the one in charge of this plane become thoroughly familiar with all its characteristics as outlined in these instructions and follow the recommendations herein for its care and maintenance.

Ignoring the cost factor, it must be realized that this is an airplane and for safety, maintenance is very important. This plane is constructed of the best materials and the workmanship is of the highest quality. It was thoroughly inspected before it was delivered. The Sikorsky Amphibion S-38, by virtue of its size, two motor installation and reserve power, together with its amphibion characteristics and the reserve strength of the all metal framework of the wings, outriggers and tail surfaces represents the strongest and safest type of plane in the world. It can maintain flight on one motor, and alight on and take off from either land or water.

Barring acts of God and improper piloting, it will never go wrong provided you give it one thing, **proper maintenance.**

## Service Department

For the purpose of making repairs and alterations, and furnishing repair parts for all ships that have been delivered by the factory, the Sikorsky Aviation Corporation maintains a special Service Department. This department is in full charge of making all repairs, alterations, and the furnishing of parts to ships after their delivery to customers. Mechanics trained in the Sikorsky plant are specialized men on this type of plane and your work will be performed by them.

## Ordering Parts

In ordering parts by mail or telegram, give manufacturer's plane number and Government identification mark; name of part; or precise description of it.

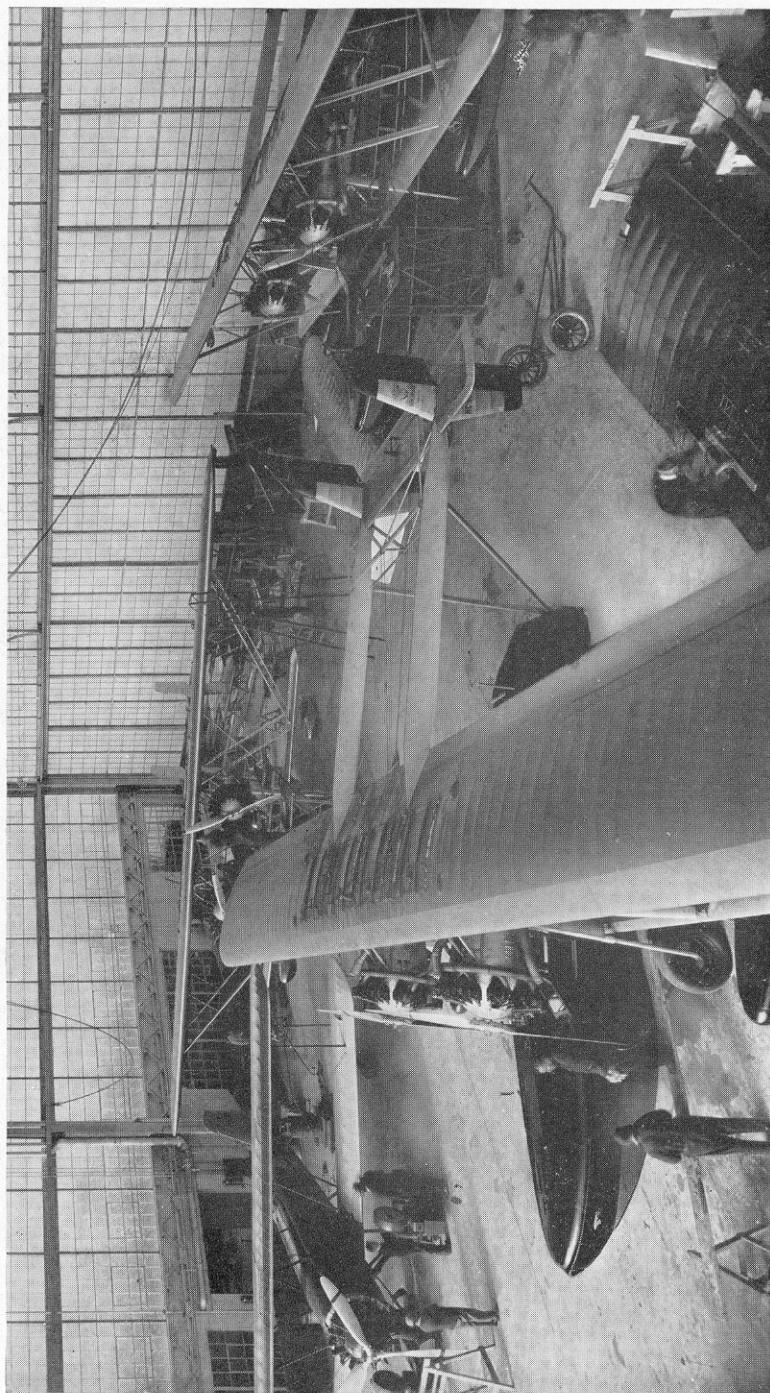
For example: Plane 214-4, NC—9106.—Strut No. 6.

Also give exact shipping instructions with full address, and whether shipment is to be by freight, express, air express, parcel post or mail.

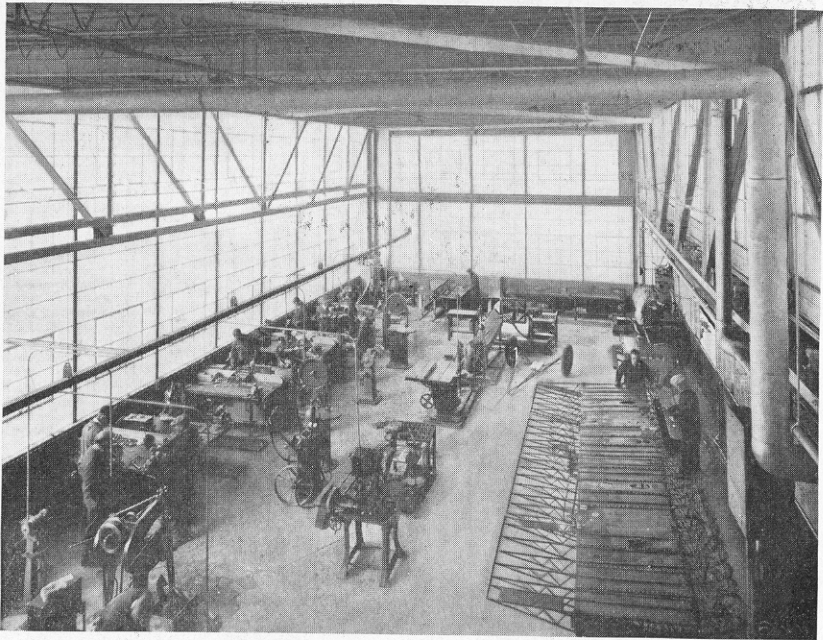
## Sending Ship to Sikorsky Service Department for repairs or alterations

For repairs or alterations to ships by the Sikorsky Aviation





INTERIOR OF SERVICE BUILDING WHICH IS FULLY EQUIPPED TO TAKE CARE OF ANY REPAIRS OR ALTERATIONS ON THE S-33



PART OF MACHINE SHOP IN THE SERVICE DEPARTMENT

Corporation Service Department, it is necessary that you furnish the following data:

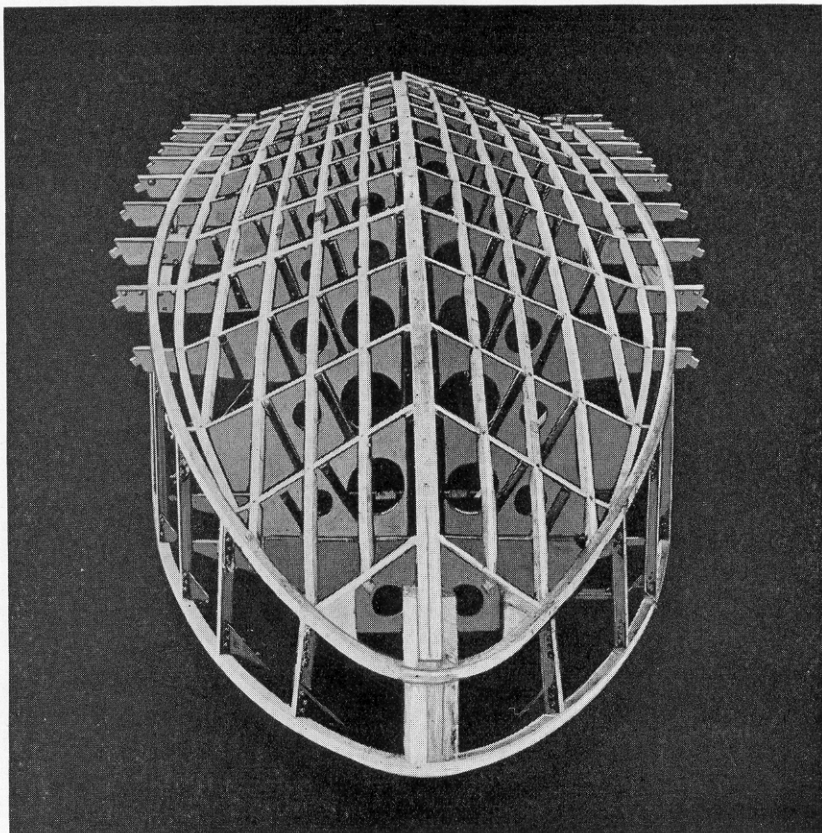
1. A complete detailed list of repairs and alterations.
2. If non-standard articles are requested which have to be manufactured, they should be described in detail and accompanied by a precise sketch.
3. Give approximate date when ship will be available for these repairs and alterations.

The above data should reach the Service Department office, if possible, a week before the date that the ship will be sent for repairs.

4. On turning ship over, have pilot and mechanic report to the Service Department Office to verify above list of repairs and alterations and sign the repair order.

If you will comply with the above, it will avoid misunderstanding, shorten the period of work, avoid delay in performing the work after the delivery of the ship and enable the Sikorsky Service Department to give you at once an approximate estimate of the cost.





SKETCH SHOWING THE FRAMEWORK OF THE HULL

## Hull

The hull is 30 feet long with a 62 inch beam which is increased at the bottom to 82 inches by means of large sponsons. It is streamlined and of composite construction, the frame work being of ash reinforced with Alclad plates and covered with heavy gauge non-corrosive Alclad sheets. These sheets are riveted together and screwed and bolted to the frame with dural wood screws and bolts. In order to prevent direct contact between the wood frame and the metal skin, wooden members are wrapped with fabric where they touch the metal. This fabric is doped and treated with XXXXXXXXXX marine glue.

The landing gear fittings and supports consisting of T & L riveted dural sections running across the hull to the sponsons are built integral with the hull.

Upon completion each hull is filled with water and tested for possible leaks before going into the assembly line.

## Wing Sections

The Sikorsky type and design of wing section composed of an all metal interior structure with fabric covering has proved its superiority under many years of test and under all climatic conditions.

The interior structure consists briefly of two I-beam spars with tension bracing, and compression members. On these spars are riveted ribs built of drawn dural channel sections. The entire structure is of dural except for chrome molybdenum steel fittings and is of rivet and bolt construction, no welding being used in the process.

Taking each part of this structure in detail.

The spars are built up I-beams, Warren truss construction consisting of extruded dural bulb T for top and bottom members with gussets and extruded channel sections for connecting members. All fittings are bolted or riveted directly to these spars.

The compression members of which there are five in each section of the upper wing and tail surfaces are built up of double angles. The diagonals are dural channel sections.

Steel tension tie-rods are used between all compression members except in the center section of the upper wing where the gasoline and oil tanks are located. Here the tie-rods are replaced with plates of Alclad riveted to the front and rear spars which not only gives the necessary bracing but also acts as a bed plate for the gas and oil tanks. These plates are further reinforced by extruded T sections riveted to the bottom of the sheet.

In figuring the drag stress on the wings it is of interest to note that the ribs are not considered, the spars and compression members alone taking care of all stresses with a wide margin of safety.

The entire leading edge of all wing surfaces is covered with sheets of Alclad which insures a smoother entering edge.

In the upper wing is installed the double aileron control system operating on ball bearings at four stations, two in the center section and one in each outer section. Inspection windows are provided at each station.

All interplane wing-strut fittings are of chrome molybdenum steel. All wing hinge fittings are of dural.

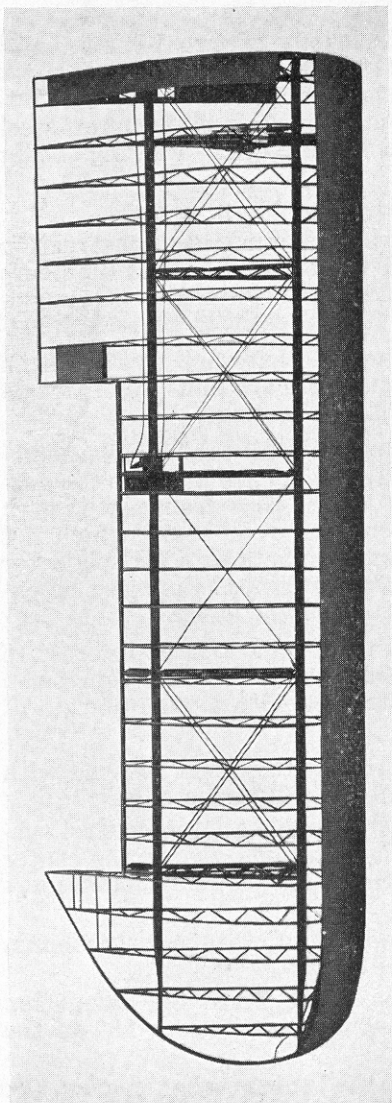
The upper wing and tail surfaces are wired for navigation and riding lights, shielded wires being bonded every 18" to the wing ribs.

A painted section on top of the upper wing marks the walk-way for mechanics when filling gasoline and oil tanks. This walk-way is supported beneath the fabric covering by special reinforcement angles fastened to the ribs and front spar, covered with heavy dural sheets.

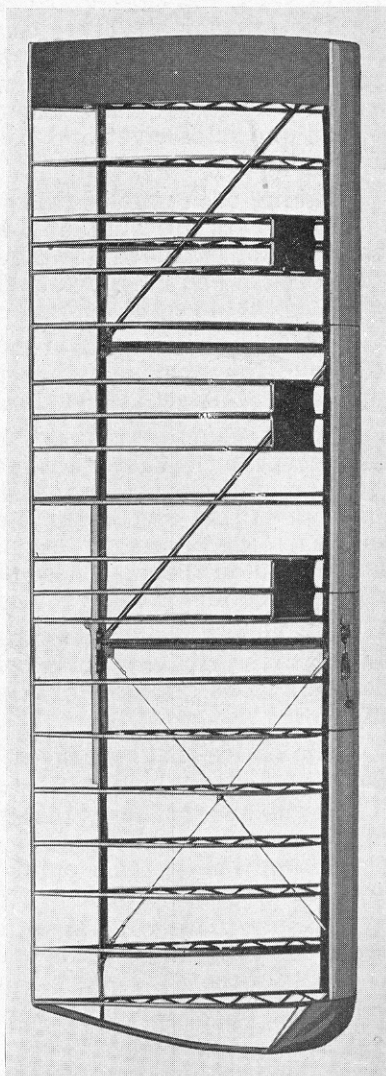
In the lower wings the spars are extruded channel sections



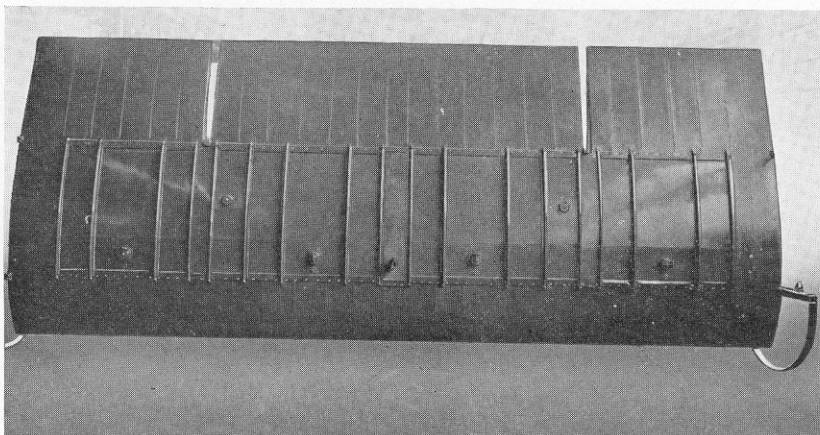
PHOTOS SHOWING ALL METAL STRUCTURE OF WINGS



OUTER WING SECTION



LOWER WING



CENTRAL WING SECTION SHOWING TANKS

and the compression members are of dural tubing, otherwise the construction is the same as that in the upper wing. In the lower left wing the air speed indicator tubing, fastened to the ribs runs to strut No. 1. See strut diagram No. 2, page 35. Between the pilot's cabin and the trailing edge of the lower wing reinforced walk-ways are provided for the mechanics' use. Also a reinforced walk-way to each pontoon is provided. **It is important that mechanics keep closely to the walkways to avoid unnecessary damage to the wing covering.**

### Outriggers

The outriggers consist of two metal fabric covered spars of the same construction as those used in the upper wing. These are bolted to the rear spar of the center section and the spar of the stabilizer. Their position is well above water and keeps the rudders in the slipstream of the propellers. The outriggers are kept rigid by means of eight streamline wires and struts No. 24 to the stern of the boat. This arrangement forms a modified box truss.

### Struts

All major struts are of dural streamline sections except strut No. 2, 3 and 4. No. 2 is of round dural tubing with metal fairing. No. 3 and 4 are of round chrome molybdenum steel with metal fairing. All non-adjustable strut ends are machined from forged dural bars. All adjustable ends are machined from chrome molybdenum steel. No welding whatsoever is used, thus eliminating the strength uncertainty which is always present in welded construction. All engine mounting and pontoon struts and fittings are of chrome molybdenum steel. Interplane wires are of standard streamline sections.

### Engines

The S-38 is powered with two Pratt & Whitney 420 H. P. (commercial rating) Wasp motors.



### **Cowling**

The engine cowling is of burnished aluminum, arranged in sections, which do not overlap; this makes each section easily removable. These sections are fastened by cowling studs and aero-plane safety pins.

### **Engine Nacelle**

The engine nacelles are constructed of bolted dural angles and consist of engine mounting rings, necessary connections and bracing for strut attachments, together with supports for streamline engine cowling.

### **Engine Exhaust Ring**

This is an exclusive Sikorsky product. It is made from "Armco" iron. It is constructed in 12 sections, each section being fastened rigidly to its corresponding cylinder exhaust, yet the whole is free to expand or telescope within itself. The vacuum created at the end of the exhaust amounts to a height of  $6\frac{1}{2}$ " of water, therefore there is no back pressure on the motors. This exhaust also reduces the noise of the engines, making the ship much quieter and pleasanter in which to travel.

### **Propellers**

The S-38 is equipped with Hamilton metal propellers set at the most efficient angle at the 42" station. Standard Steel metal propellers will be furnished at the request of the customer at an extra charge.

### **Fuel System**

The Sikorsky fuel system is gravity feed. While the total capacity of each tank is  $82\frac{1}{2}$  gallons, this capacity unless otherwise specified has been cut down to 66 gallons by means of a skirt on the filler cap, and by lowering the vent pipe. This arrangement was found desirable, to meet varying requirements of pay load capacity.

By removing the filler cap skirt and cutting down the vent pipe the capacity of each tank may be increased. Bear in mind, however, that by increasing your fuel capacity you decrease your pay load. Four  $82\frac{1}{2}$  gallon tanks are located in the center section of the upper wing. These tanks are constructed of duralumin, all parts being riveted. The top, bottom, front and rear are of one sheet with one seam on top. The ends are fitted in, riveted and flanged over. The seams are kept tight by a special compound insoluble in gasoline or benzol thereby preventing leakage. The tanks are equipped with two longitudinal and two cross splash baffles. The two inner gas tanks are equipped with dump valves which allow them to be emptied instantaneously in case of emergency. All tanks are readily accessible and can be easily removed by taking out six bolts and removing the T-braces on top which hold them in place. It will first be necessary to remove the gasoline gauges. A walk-way is provided on the upper wing for servicing the tanks. When working on or removing the tanks it is

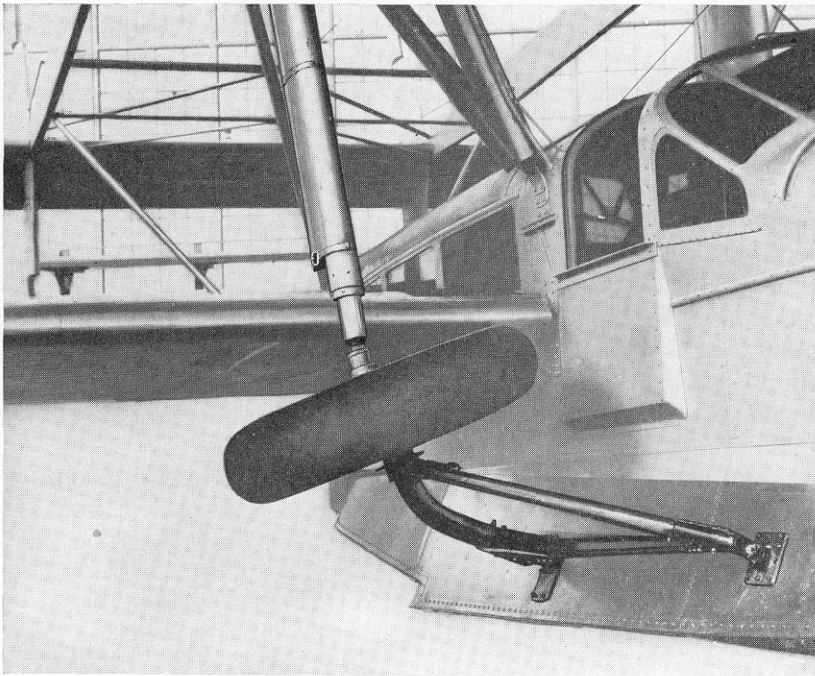
advisable to place boards over the tank braces to form a platform upon which to work. The tanks on each side of the center line of the ship are paired together through a valve with the engine on their side. Handles from these valves enter the cockpit in line with struts No. 3 and have control handles over the pilots' compartment. These valves are so arranged that either engine may run on any one or more tanks or all tanks may be cut off. Connecting the tanks of either side is an equalizing line with a shut-off directly over the center of the cockpit. These three valves give the pilot complete control of the gasoline tanks and lines. At the same time there is no gasoline stored in, nor gasoline entering the hull or cabin. Neither is any gasoline stored in engine nacelles or near the engines. This eliminates all danger of fire while flying and allows smoking in the cabin.

Handles for dump valves on gasoline tanks mentioned above are placed in paper covered boxes within easy reach and just above the pilot's head. To operate—break covering and pull handle.

All tanks are equipped with "Protecto Seal" special fire-proof filler caps and are tested at 2 lbs. pressure at the factory.

### Oil System

The Sikorsky system operates by gravity and consists of two tanks of 14 gallon oil capacity, plus a five gallon expansion capacity making a total of 19 gallons capacity each. The construction of the tanks is the same as that of the gasoline tanks previously described. They are piped directly to and from the engines. This constitutes a draining unit.



LANDING GEAR WITH WHEEL PARTLY RAISED

### Landing Gear

The landing gear is an exclusive Sikorsky development, consisting of two sturdy, rubber-tired, bronze bearing wheels mounted on axles and equipped with a special Sikorsky wheel brake. The axle is hinged to the ship and fitting on the outer end to a hydraulic gear. This gear consists of two steel tubes, one inside the other, the inside or smaller tube being fitted at its upper end with dural plunger and washers just fitting the inside of the larger or outside tube. The larger tube has two openings connected to an oil pump, one at the top and one at the bottom. See diagram on page 28.

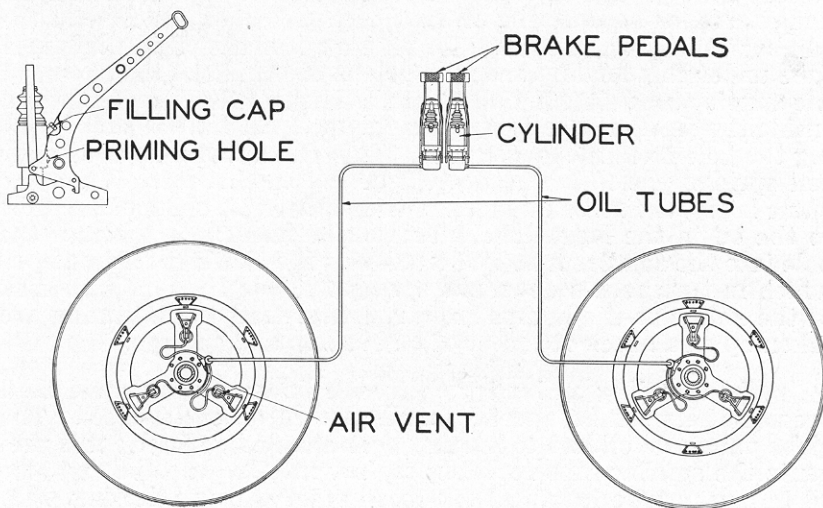
To raise the landing gear, oil is pumped into the bottom opening of the large tube pressing up on the washers attached to the top of the smaller tube, pushing it up and telescoping it into the larger tube. This raises or retracts the wheels, bringing them up into a position parallel with the wings which is their correct position when flying or landing on water.

To lower the wheels, reverse the pump line valves and pump oil into the top of the larger tube forcing the smaller tube down.

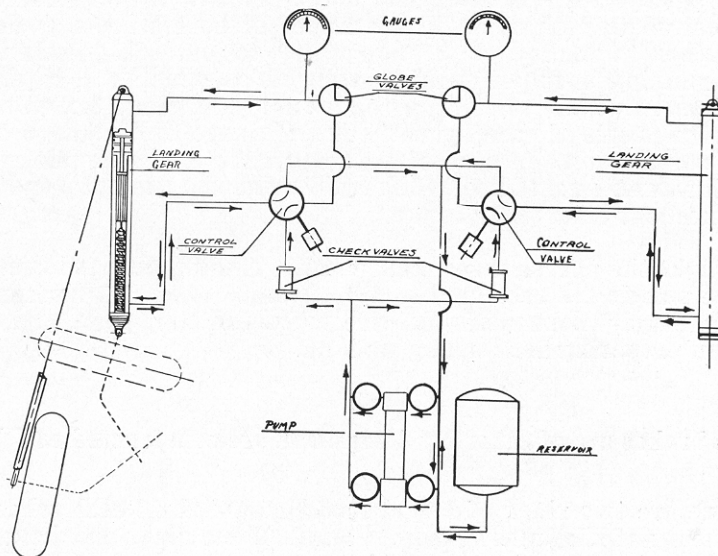
To prevent leakage of oil, the larger tube is fitted at its lower end with a packing box. To prevent smaller tube being forced out of larger one a spacer is placed in the cylinder of the larger one.



# DIAGRAM OF SIKORSKY \* 4 BRAKE



## PIPING DIAGRAM OF HYDRAULIC LANDING GEAR



Another feature of this landing gear is its shock absorbing quality when landing on land. The shock of the wheels striking the ground is transmitted directly up the smaller tubes and cushioned against the oil in the larger tubes which hold the smaller tube down. To allow for an escape of the oil in the larger tube under this landing shock, a hole is bored in the top center of the smaller tube allowing oil from the larger tube to enter into it. Inside the smaller tube is a piston facing up against the oil entering the hole from the larger tube. This piston rests on two heavy coil springs placed in the bottom of the small tube. When the plane lands, the force or shock is transmitted up the smaller tube to the oil in the large tube. This oil in turn flows through the hole into the smaller tube and transmits the shock to the plunger, which in turn forces down the springs. Thus the landing shock of the ship also the bumps from rough ground while taxiing are taken up on a shock absorber of oil cushion and springs.

When landing on land with wheels down, there should be a pressure between 25 and 50 pounds shown on each wheel. The globe valves on oil line to landing gear should be closed; this prevents the smaller tube recoiling too far into larger tube and also oil in larger tube leaking back to oil reservoir and letting ship slowly down on the ground. When wheels are up no pressure is needed to keep them there and the use of pressure only strains packing in system, and gives dangerous loading on strut No. 3.

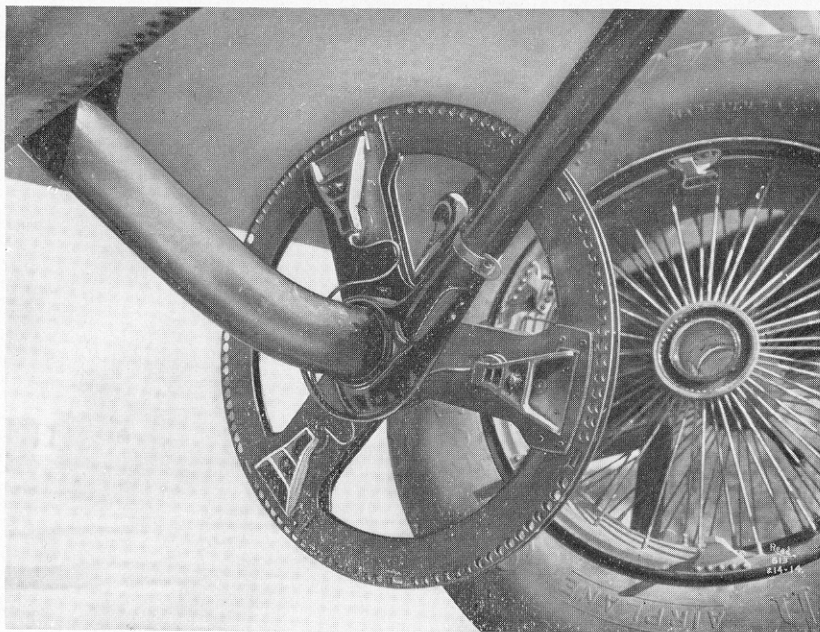
The hydraulic control for each wheel of the landing gear is independent. This allows the following to be done: When taxiing on water with one motor, lower the wheel under the working motor to give water resistance and make machine maneuverable. When desired to jack up ship, use either or both wheels as desired. When in shallow or strange water, lower both wheels to prevent running aground on hidden obstacles which will injure hull. When in water, wheels may be lowered and plane taxied up on beach or prepared runway without assistance to discharge or take on passengers. In case of an emergency it allows pilot to quickly lower ship to its keel while running on the ground providing an excellent emergency brake.

In flight the parasitic resistance of the landing gear is lowest when the wheels are retracted to a position 8" from the horizontal. Accordingly most pilots fly with wheels in that position except when preparing for landing on land.

### **Brakes**

The brakes are of Sikorsky design and are constructed as follows:

There are two rings of monel metal mounted on each wheel rim by means of six fingers made of dural. These rings are drilled around the outer edges in order to decrease their weight and radiate heat generated by friction.

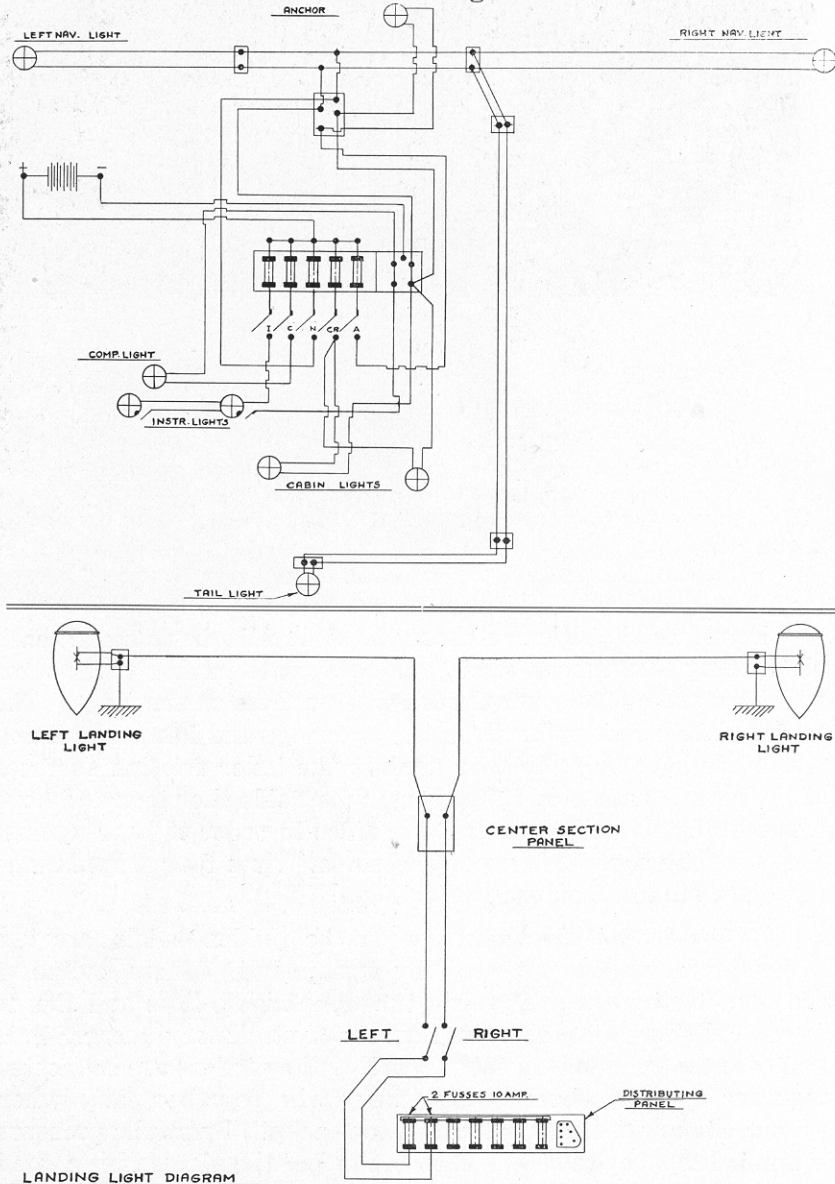


Bolted to the axle are three plates of Allegheny metal, each plate being .062 inches thick, and each plate having three arms which extend out to cover the friction surfaces on the rings. The center plate comes up between the two rings and has brake lining riveted to both sides to bear against the inner friction surfaces of the rings. The outer plates come up outside the rings and have brake lining riveted to their inner sides in order to bear against the outer friction surfaces of the rings. Thus four friction surfaces are obtained on each wheel.

In the cockpit, located between the rudder pedals, are two hydraulic cylinders operated by foot pedals. These cylinders are connected down to the axle through flexible hose and thence to one cylinder in each of the six sets of stationary arms. This makes three cylinders to each wheel. All cylinders are connected together on each wheel so that they work together, and when pressure is applied to the pedal in the cockpit, hydraulic pressure is applied to all cylinders on each brake and the pistons are caused to travel outward. Each cylinder and piston is connected up through rocking levers so that the outward force of the cylinders and pistons results in an inward pressure, tending to clamp the three stationary arms and the two rotating rings together. This sets up great pressure on the friction surfaces and gives the desired braking effect.



## Electrical Diagrams

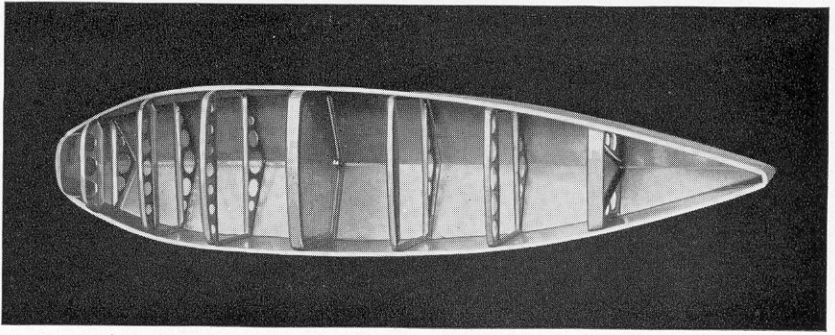


LANDING LIGHT DIAGRAM

## Electric Wiring

All electric wiring used in the Sikorsky S-38 is of Army and Navy specifications. All wiring is shielded and electrically bonded according to Army and Navy specifications.

On the upright section of the instrument board, directly behind the switches will be found the fuses for each individual switch.



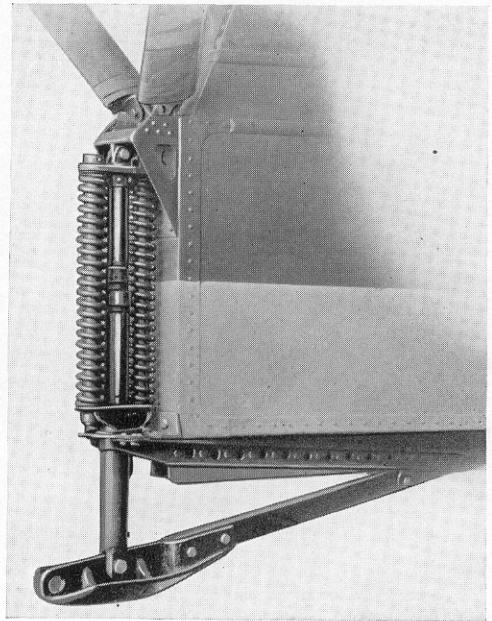
### Pontoons

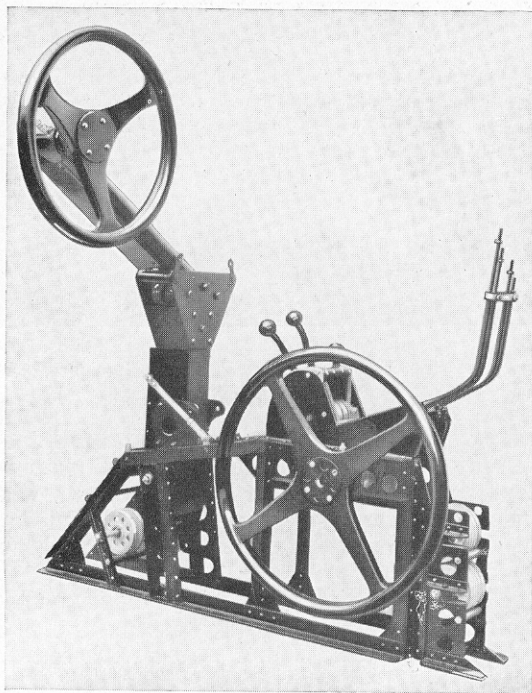
Pontoons are of Sikorsky special design, Alclad riveted construction, heavily reinforced inside. They are of approved streamline form divided into two water tight sections with nose cap. Both water tight sections are equipped with hand hole covers, and the rear one with drain plug. All strut fittings are of chrome molybdenum steel.

They are located on the lower wings close to the hull to overcome any tendency to list insuring seaworthiness and allowing turns to be made while taxiing on water with but small angle of heel.

### Tail Skid

The tail skid is of oleo and spring combination consisting of tail skid proper, tail skid shoe, oleo chamber and two springs. The oleo chamber takes care of the first heavy jolt when landing. After that the springs take care of the bumping along the ground.





CONTROL BOX

### Controls

All controls except the rudder control are assembled in a single control box mounted between the pilots' seats, readily accessible from either seat.

Pivoted to the front of the control box is a column with hinged wheel which may be swung in front of either pilot, where it automatically locks in place. The elevator controls are fastened to and worked by the backward and forward motion of this column, while the aileron controls are operated by a sprocket and chain from the wheel.

The stabilizer adjustment wheel is mounted on the left side of the control box. The stabilizer is mechanically self locking, consisting of sprocket, chain and worm gears.

The rudder control is worked by four pedals connected in pairs. Those for left seat are equipped with comfortable foot rests for long flights.

Installed on the floor on the right side of the control box so that the handle can be operated from either seat is the hydraulic pump for operating the landing gear. Between the backs of the seats are located the master valves and two globe valves for the control of the hydraulic pressure on the respective landing gears.



The motor controls consisting of throttle and mixture controls are mounted in a quadrant on top of the control box conveniently placed to the pilot's hand from either seat. They are connected to the engines by a system of rigid push rods, elbows, and bell crank levers.

All controls leave the pilot's cockpit through a vertical control strut. Three feet above the roof of the cabin on line with the engines, two horizontal control struts lead to the two respective engines carrying the engine controls, ignition wiring, hydraulic landing gear lines, and instrument connections.

The other control wires follow up the vertical strut to a pulley box under the upper wing from which they go, supported by guides and pulleys, direct to their various horn attachments.

The aileron, rudder and elevator control cranks are mounted on ball bearings to insure ease in operation. The aileron controls in the interior of the upper wing are of rigid tubing except for the connections where the outer wing sections are joined to the center section; here short control cables are used for connection.

### Instruments

The list of instruments furnished with the standard S-38, located on the instrument board is as follows:

Number	Name of Instrument	Maker of Instrument		
2	Tachometers	Pioneer Instrument Co.		
2	Oil temperature gauges	"	"	"
2	Oil pressure gauges	"	"	"
2	Landing gear pressure gauges	"	"	"
1	Altimeter	"	"	"
1	Magnetic Compass	"	"	"
1	Turn and bank indicator	"	"	"
1	Air Speed Indicator	"	"	"
1	Waltham 8-day clock	Waltham		
1	Inclinometer	Pioneer Instrument Co.		
	Located in gas tank in upper center wing:			
2	Triumph Magnetic gas gauges	Boston Auto Gauge Co.		

On the instrument board the landing gear pressure gauges, oil pressure gauges, oil temperature gauges, tachometers, and switches are arranged in two columns in the center, the left column contains the instrument for the left engine and landing gear and the right column those for the right side. The flight instruments are grouped in front of the left seat from which the piloting is normally done, but can be easily read from the right side.

### Pilots' Seats

Seats are of duralumin construction with cushions in seat and back. By means of a handle on the outer side of the seat, they are easily and quickly adjustable for height while occupied. Safety belts provided for the pilots are fastened to these seats, allowing adjustment of the pilot's position without interference from the belt. The seats in turn are securely fastened to the hull of the ship.

## **PAINTING AND DOPING**

### **Wings**

1. All interior structural members of the upper wing, outriggers and tail sections are thoroughly scoured and cleaned and then given two coats of red oxide primer, one by dipping and one by spraying.

2. All interior structural members of the lower wing are given two coats of red oxide primer, one by dipping and one by spraying. This is followed by two coats of special paint.

3. The surfaces of the wings, outriggers and tail are given two coats of clear dope followed by two coats of pigmented dope and one coat of gloss.

### **Hull and Pontoons**

The hull and deck are given inside a coat of red oxide primer and two coats of bitumastic; outside bottom one coat of red oxide primer followed by two coats of bitumastic. Outside surface above water line receives one coat of red oxide primer followed by surfacer and two coats of lacquer. Wooden members of hull are specially treated in heated bitumastic.

### **Struts**

Struts are given one coat of red oxide primer followed by three coats of silver lacquer.

### **Cowling**

Cowling inside is given one coat of red oxide primer and outside two coats of clear varnish.

### **Exhausts**

Exhausts are given one coat of heat resistant paint.

#### **General Instructions For Mechanics**

Due to the size and cost of the Sikorsky Amphibion S-38, it is strongly recommended that a mechanic be employed and kept on the ship at all times both when the ship is in the hangar and on flights. To keep the ship clean and in proper condition, it will require the full time of at least one man.

It is also recommended that if possible, a good mechanic be chosen prior to the delivery of the ship and sent to the Sikorsky factory to take a short course with our Service Dept. and then watch the final assembly of his ship to familiarize himself with its construction and assembly.

When a mechanic has been assigned to the ship and becomes familiar with it, he should not be transferred except for a very good reason. An average mechanic who is conscientious and knows the ship, is much better than a mechanic unfamiliar with the ship,—no matter how great his skill.

(b) On land

*Tanks should be filled up to the level of the filler cap flange.*

### Preparing Ship for Flight

1. Inspect engines (see P. & W. hand book for detailed list of inspection).
  2. Check oil. *on water*
    - (a) Tanks should be filled to overflow cock under the wing (they hold 14 gallons and have space for 5 gallons expansion.)  
Use oil as recommended by engine manufacturer or consult a reputable oil refiner making sure to get oil according to engine manufacturer's specifications.
  3. Check Gasoline.
    - (a) Tanks should be filled at the end of each flight.
    - (b) In filling tanks keep funnel in constant metallic contact with tank filler neck to prevent fire from static electricity.
    - (c) Always use chamois strainer when filling tanks.
    - (d) For proper grade of gasoline—See Pratt & Whitney hand-book.
  4. Check landing gear.
    - (a) Test air pressure in tires (correct pressure 65 lbs.)
    - (b) Remove grease from polished surfaces on landing gear tube as grease collects dirt which damages the gland packing.
  5. Check controls.
    - (a) Remove all locks from controls.
    - (b) Test controls for free operation. If in any way defective or stiff, rectify before flight.
  6. Unlock doors.
  7. Inspect wing surfaces for wrinkles.
  8. Start Motors.  
Be sure that spark is  $\frac{1}{3}$  retarded when starting motors, using either, hand inertia or electric inertia, starter.
  9. Stand by ship whenever motors are running to keep people away from the propellers.
  10. Warm up motors by taxiing if on water.
  11. Run up motors after the oil temperature registers 40°C. and check on individual magnetos.
- When all the above is satisfactory, hand over ship to pilot as O. K.

### Taking Off and During Flight

1. In taking off, check positively that hydraulic globe valves are closed.
2.
  - (a) Keep close watch for airplanes in flight and on field.
  - (b) If on water for rocks or floating obstacles.
3. Raise or lower landing gear when pilot directs.



### **To Raise Landing Gear**

- (a) Open globe valves.
- (b) Pull master handles up.
- (c) Manipulate pump, located between the seats, until wheels are all the way up.
- (d) **Do not pump any pressure.** Watch landing gear pressure gauges.
4. Keep sharp watch on all gauges and indicators.
5. Observe performance and listen to motors.
6. Check gasoline supply on gas gauges.
7. Keep accurate position on map at all times.
8. If oil (during summer) shows a gradual heating up, notify pilot.
9. Check hydraulic gauges to see that there is no pressure on hydraulic landing gear.

Note: In case of one or more helpers on a flight, Flight Mechanic is in charge of such helpers.

### **Landing on Land**

1. When directed by the pilot, pump down landing gear, closing globe valves unless an emergency landing in a short field is being made, in which case leave them open so that pilot may quickly lower ship on to keel if necessary.

### **To Lower Landing Gear**

- (a) Pull master handles down.
- (b) Manipulate pump until wheels are all the way down and the pressure rises to about 50 pounds.
- (c) Close globe valves securely.
2. As soon as ship is stopped, get out and run to front of ship and keep all persons away from the ship while propellers are turning.
3. When stopping engines, shut off your fuel supply and let engines die out on lowest speed. Turn the switches off after engines have stalled. This will prevent the oil from being diluted with gasoline and the lower cylinders from being flooded over night with oil, which in turn will save the rudders and struts from being smeared with oil the next time the engines are run.

### **Landing on Water**

1. Never land on water with the wheels down.
2. After landing, crawl through bulkhead to anchor compartment.
3. Get anchor ready to drop or rope ready to tie to buoy.

### **Anchoring at Night**

1. Observe regulations for anchor lights.
2. Lock controls and cover motors.
3. Be sure to moor to heavy buoy; the anchor on the ship will not be sufficient in case of a squall or high wind.
4. Lock all doors.

### **Leaving Ship on Field at Night**

1. Tie ship down from No. 1 strut fitting on upper wing to suitable deadmen.
2. Place suitable support under front of hull at point marked (Block here).
3. Grease the polished surface of landing gear tube, and hinges.
4. Lock controls and cover ship and motors.
5. Lock doors.
6. If landing gear columns have a slight leak, block under step to prevent damage to pontoons in case of the plane settling down.

### **Log Books**

1. Log books are to be carried on ship.
2. Enter all motor time on ground and in flight in log book.
3. At end of each day's operations, enter motor time on ground and flight time, repairs, adjustments, etc.

### **On Returning to Base After Flight**

1. Grease landing gear (outside).
2. Fill gasoline and oil tanks.
3. Clean motors and nacelles.
4. Clean gasoline strainers.
5. Make thorough general inspection of ship and enter inspection report in plane log book.
6. Clean cabin, toilet, pilots' cockpit and compartments thoroughly.
7. Open hand hole covers to ventilate thoroughly compartments under floor and in pontoons. To prevent corrosion of the metal skin it is important that moisture be kept out.
8. Carry out routine adjustment of motors.

## Suggestions For Making Common Repairs

### To Change Tire

1. Check and record the pressure on each wheel guage for future reference.

2. Carry a 2½ ton "Ever-ready" jack in equipment of ship.

3. Place jack under lower end of Hydr. strut fitting on axle of damaged tire or wheel and hoist ship.

4. Block hull immediately in front of step on sponson then release jack, block under jack and repeat until ship is high enough.

5. Remove bolt holding Hydr. strut to axle and remove wheel.

6. Use tire levers to remove tire by usual methods and reverse operations for refitting to ship.

7. Pump pressure up to amount recorded under paragraph No. 1.

### To Change Landing Gear Cups

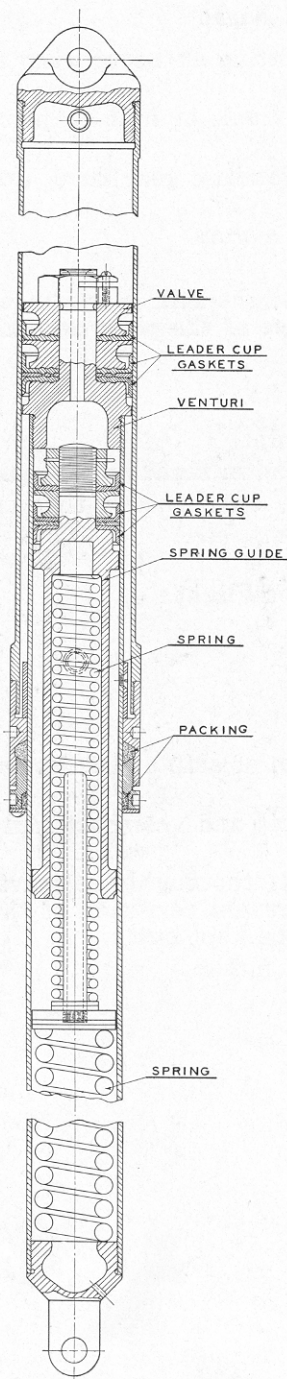
1. Block under sponson at step immediately in front.

2. Remove bolt connecting Hydr. strut to axle and disconnect and pump all the way up.

3. Disconnect upper flexible connection and pull gear down by hand after putting control handle in down position.

4. Disconnect other flexible connection and main bolt holding gear to upper strut in motor nacelle.

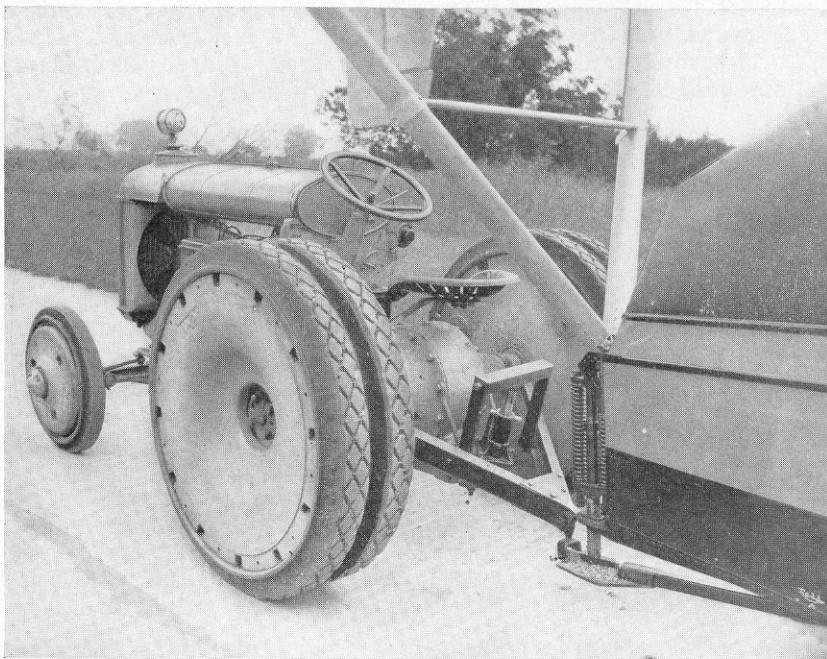
5. Unscrew bronze fitting complete on strut end (do not unscrew packing nut).



LANDING GEAR PLUNGERS



6. Pull out the inner cylinder and unscrew the large plunger with leather cups.
  7. Pull out the small inner plunger.
  8. Change leather cups on either plunger by first taking out the set screw or pin and then disassembling it.
  9. Reverse operations for reassembly to ship. No. 1-5.
- 



METHOD OF MOVING SHIPS USED AT THE FACTORY. NOTE THE HYDRAULIC JACK AND THE WAY THE TAIL SKID IS ATTACHED TO THE TRACTOR.

### Jack Up Ship

1. Use  $2\frac{1}{2}$  ton jack immediately in front of step on one side using wood blocking. Pump up, pump landing gear down on that side, transfer jack to other side and repeat. Continue this operation until the ship is in normal position.

2. In case a  $2\frac{1}{2}$  ton jack is not available, use following method: Block under step on side to be raised, raise wheel 3 or 4 inches from the ground. Block up under wheel and pump gear down, rocking the plane laterally by taking hold of pontoons and not the trailing edge or tip of lower wing. Repeat this operation until high enough. See that the tires are inflated to about 50 lbs., otherwise this method tends to pull the tire off the rim.

## MAINTENANCE

### Hull

1. Open all hand holes in the cabin flooring for ventilation whenever possible. Keep inside of hull dry. Ventilation of all sections below flooring is very important to prevent corrosion.
2. Retouch with bitumastic or paint any spot of exposed metal.
3. In case of damage to the skin of the hull where it is necessary to replace screws or bolts to the frame, hot galvanized steel screws or bolts only should be used for a permanent repair, if dural screws or bolts cannot be obtained. These screws and bolts should be dipped in marine glue before using.
4. Marine glue should be used in all repairs to the metal skin. Where the metal touches wood use a fabric insulator.
5. Keep leather cabin top clean. If it begins to lose some of its lustre give it a thorough washing and apply Duco No. 7 dressing according to the directions on the can.
6. If corrosion starts, clean affected part thoroughly with steel wool, wash with a weak solution of washing soda; dry thoroughly and repaint with bitumastic.

### Pontoons

Hand hole covers should be removed at every opportunity and interior ventilated. If ship is used on salt water, interior must be flushed out every two weeks with fresh water. The importance of this is very plain when one realizes that due to evaporation, the salt content of moisture inside the pontoon may become fifty or sixty percent within a short time, and unless the pontoon is flushed out, this will cause extreme corrosion.

If on inspection any traces of corrosion are found inside the pontoons, use method referred to in ¶6 above. After rinsing with fresh water, thoroughly dry and paint all exposed parts with bitumastic.

If any leaks occur in seams, apply No. 7 Marine glue to the seams, using a mildly hot soldering iron. Do not hammer seams to close leaks as it is more apt to make new leaks than close the existing ones. In some cases, it is possible to head rivets up tighter to stop leaks.

Dents in pontoons may be hammered out as long as they do not require hammering on a seam.

Wash all outside exposed metal with fresh water and retouch with paint.

Examine stay wires for correct tension, keep them taut.  
Keep all fittings well greased.

## Wing Sections

Wash the fabric covering with pure soap and warm water to remove oil and exhaust stains.

Don't use gasoline, as it may affect dope or paint.

Inspect wing covering regularly for wrinkles. Wrinkles on the fabric indicate structural distortion.

If these appear the plane should be immediately brought to Sikorsky Service Department for inspection and repair.

If however, the plane is too far away to make this practical—open the fabric, inspect the extent of damage, and order all necessary parts to make the repair on the spot.

It is much better to replace damaged members than to try to straighten them out as this method is bound to weaken the metal.

Any signs of fabric damage should be immediately repaired. "A stitch in time saves nine".— See page 33, Paragraph 2, under Painting and Doping.

Inspect from time to time all fittings for corrosion, and keep all fittings greased, especially on the lower wing.

Be sure fabric is water-tight around all fittings.

When ship is used on salt water, wash all fittings in fresh water and repaint any exposed metal after removing all signs of corrosion by method referred to above.

Although the Sikorsky wing structure is protected from corrosion by the best known methods, it is advisable, however, if the plane is operating from salt water, every three months to open covering of both the lower wings at five points; (1) at the fitting on the rear spar where struts 6 and 7 are attached to wing, inspecting fitting and front side of spar at that point. (2) At point on front spar where struts 1 and 2 are attached. (3) Hinge bolt front spar. (4) Hinge bolt rear spar. (5) Rib joints of trailing edge.

If corrosion is found, it is advisable to remove wing covering and remove all traces of corrosion using above method and repaint using two coats of red oxide primer and one outside coat of Goodrich Acid Seal No. 1011.

## Adjustment

To correct the angle of incidence, adjustment can be made by the use of adjustment fittings on end of No. 5 struts. Wing can also be leveled by same method.

To adjust outer sections of upper wing for angle of incidence ( $21\frac{1}{2}^\circ$ ), place support under upper fitting of Strut No. 7, remove cotter pin and release bolt on lower fitting of strut No. 7, turn fitting on strut for necessary adjustment and refasten strut in position.

Never adjust interplane wires when on water.

## Outriggers

1. Keep streamline wires taut and inspect their intersection for wear and rust.
2. Inspect attachment bolts frequently.
3. Inspect fabric frequently.



### **Struts**

1. Keep all fittings greased.
2. Keep equal tension on cabane wires at all times.
3. See that streamline wires bracing struts Nos. 1 and 7 are just taut.

### **Engines**

For descriptive assembly and maintenance of engines see Handbook furnished by the Pratt & Whitney Corporation, the manufacturer. Two of these books are included in the list of standard equipment of each ship.

### **Cowling**

After every fifty hours of flight, remove cotter pins from engine bed bolts, tighten nuts if slack. Check all bolts on motor mounts, fittings, etc. after every long flight or every ten hours. Keep engine mounting clean from all dirt and oil.

### **Exhaust Rings**

Keep exhaust rings coated with heat resisting paint to prevent unnecessary rusting.

### **Propellers**

When not in use, keep surfaces coated with grease to prevent corrosion. Salt spray has a tendency to roughen the blades and after landing they should be carefully cleaned with fine steel wool. If they become deeply pitted they will be thrown out of balance and will have to be replaced.

For maintenance and adjustment see Maker's Handbook.

### **Fuel System**

1. Refill gasoline tanks at the end of each flight.
2. Use care when filling tanks not to stand or walk on leading edge of upper wing but use the walk-way provided. This is very important as walking on the leading edge will dangerously damage the ribs and may cause an accident.
3. In filling gasoline tanks keep funnel in constant metallic contact with tank filler neck to prevent fire from static electricity. Due to fire proof filler caps, gasoline inside the tank is free from fire danger, but gasoline spilled around the mouth of the filling holes or on the wings can burn, setting fire to the plane.
4. When refueling the ship on water great care must be used. Any gasoline on the water surface creates a serious fire hazard.

### **Oil System**

1. Fill oil tanks at the end of each flight.
2. Always have at least  $9\frac{1}{2}$  gallons of oil per motor.

### **Landing Gear**

Every week check oil in tank. There should never be less than two inches nor more than 7 inches of oil in tank when wheels are down.

For filling tank (ordinary weather) any high grade light cylinder oil may be used.

Hot climates, when landing gear leaks, use medium heavy oil.

Keep polished surfaces of smaller tube on landing gear greased at all times except when in flight. When preparing for

flight, remove grease as it collects dirt which damages the gland packings.

If oleo gear leaks consistently at the lower end of the plunger at the axle, the small washers on the shock absorbing device inside of the plunger have deteriorated and should be replaced. As shown on page 28. Keep all joints well greased.

### **Tail Skid**

Be sure to keep the proper amount of oil in the oleo chamber. Fill up to over-flow hole which is about 3" from the top of the tube. Use the same oil as is used in the hydraulic landing gear. Never fill with grease.

In case the shoe on the skid becomes worn or broken, replace with new shoe.

### **Controls**

Examine all pipes and cables for rust or corrosion. Every two weeks grease control pulleys, cables and horn connections. Frequently examine cables for wear over pulleys or where they pass near other cables, cross wires, or struts. In case any strands are broken, fit new cables.

### **Instruments**

For description, maintenance and care of instruments, see handbooks of instrument manufacturers.

It is important however, that you note and remember the following points:

1. After magnetic compass has been adjusted, no metal part or attachment should be moved or added to ship. For example, if a galvanized iron anchor is used, its movement from one location to another would affect the compass. If metal parts are changed or new ones added, be sure and have compass compensated before next flight.

2. Have turn and bank indicator oiled regularly every month by the Pioneer Instrument Company mechanic. Never try to do this yourself.

In blind flying, your safety will depend on these two instruments.

### **Pilots' Seats**

Oil adjusting device frequently.

### **Painting and Doping**

1. Retouch any spot of exposed metal no matter how small.
2. Repair at once any torn fabric. To do this stitch together with coarse cotton thread the sides of torn fabric. Take a piece of fabric about three times the size of the hole and fray all edges about 1/2" wide. Dope around the hole, place patch in position and give four coats of dope, allowing each coat to dry thoroughly. This patch should last as long as the undamaged fabric.

3. Make frequent inspections of all fabric as well as metal fittings both inside and outside of hull.

## GENERAL ASSEMBLY

1. Assemble all tail surfaces, stabilizer, fins, rudders, elevator and center section on the ground. This will be found much more convenient than in making the assembly at a height of 13 feet.

(a) Tail Surface.

1. Bolt elevator to stabilizer.
2. Bolt fins to stabilizer.
3. Fasten rudder to fins and connect control lines.
4. Attach and adjust stabilizer control arms.

2. Bolt outrigger to the center section of the upper wing, supporting the loose ends on horses.

3. Attach stabilizer to the outrigger.

4. Attach the four stabilizer adjustment struts Nos. 25 and 26. Ill. No. 1.

5. Attach the four inter-outrigger struts Nos. 27 and 28.

6. Attach upright strut No. 33. Ill. No. 1.

7. Attach and make taut the eight streamline wires of this unit.

8. Raise this whole unit up over hull by means of a hoisting sling.

9. Attach struts No. 3 and 24; then No. 4 and 5.

10. Attach engines with exhaust to engine mounts. This operation can more easily be done on the ground.

11. Install on the engine mounts struts Nos. 17, 18, 19, 20, 21, 22 and 23.

12. Raise these units into position under the center wing section and attach same to engine mount fittings.

13. Install vertical and horizontal control columns.

14. Connect all gas and oil lines from tanks to motors as well as gas and mixture controls running from the engines to the boat.

15. Attach landing gear columns and hinge fittings in center wing section and at wheel axle. Attach landing gear to boat fittings.

16. Attach cowlings and install propellers.

17. Attach rudder, elevator, and stabilizer to control wires.

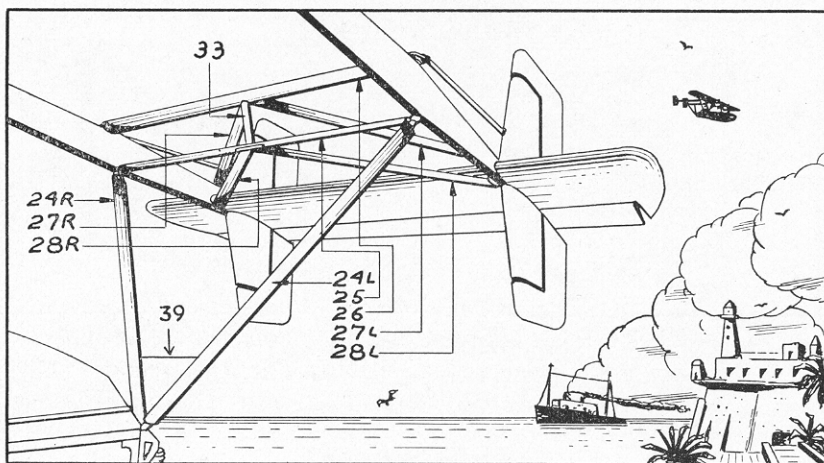
18. Attach upper wing outer sections. Use special built-in wing fittings for hoisting. Bolt hinge fittings.

19. Connect aileron cables and navigation light wires at wing connections through inspection windows.

20. Attach connecting strip to fabric at wing connections. Also the streamline for hinge fittings.

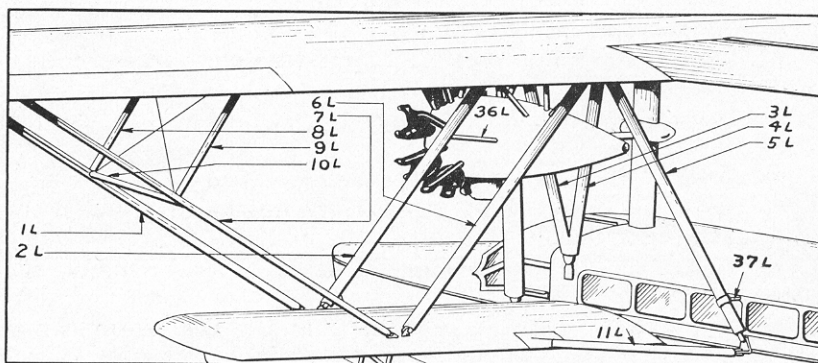
21. Attach pontoons to lower wings with struts Nos. 12, 13, 14, 15 and 16 and diagonal tierods. (Illustration No. 4)





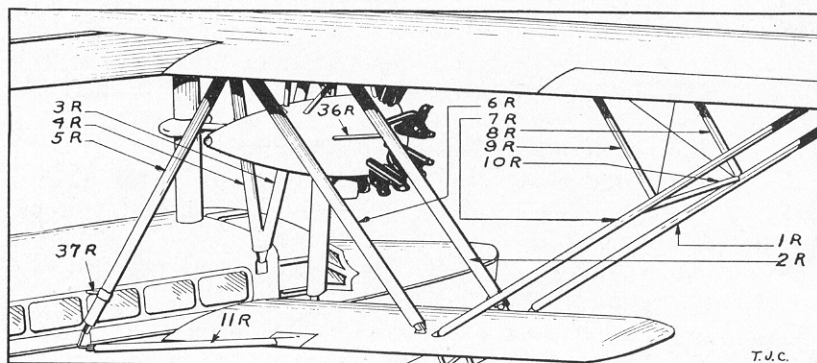
NO. 1

# TAIL GROUP STRUT DIAGRAM



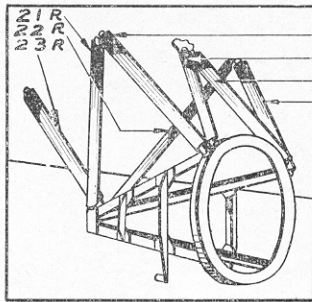
NO. 2

# LEFT WING

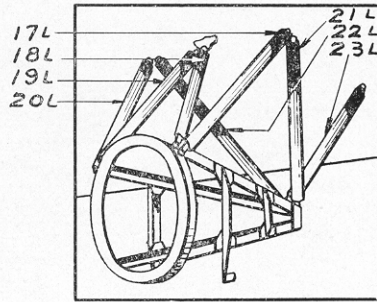


NO. 3

# RIGHT WING

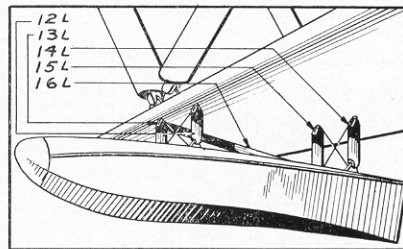
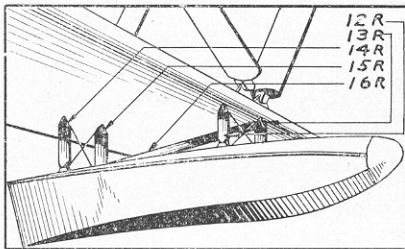


ENGINE MOUNTS



NO. 4

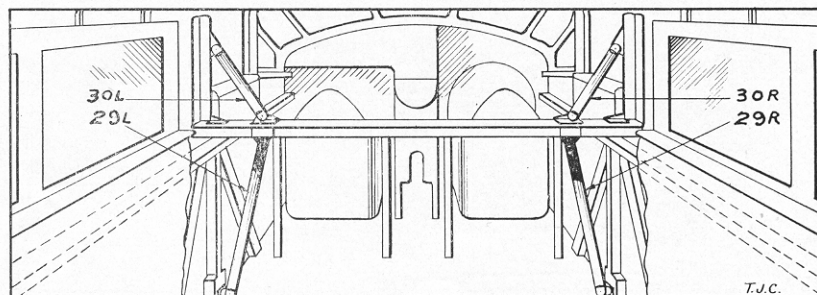
NO. 5



PONTOONS

NO. 6

NO. 7



INTERIOR CABIN BRACING

NO. 8

22. Raise lower wings into position and attach root bolts.
  23. Install struts No. 1, 7, 2, 6, 8, 9, 10 and streamline wires between struts 8 and 9. Illustration No. 2. Be sure struts 8, 9 and 10 are installed before releasing weight of the wing from scaffold, as long struts No. 1 and 7 are designed to be supported in the middle and will be sprung if overloaded.
  24. Remove wing scaffold.
  25. Check over all controls making sure that stabilizer is in neutral position.
- Disassembly will be made much easier if the order of the above list is reversed.

### Landing Gear

Support the hull in a cradle or on blocks placed with one support just in front of the step and the other support near bow where marked "Block here".

1. Assemble axles to hull.
  2. Assemble wheels and brakes to axle. (See description brakes.)
  3. Attach top hinge joint of large tube.
  4. Pull down inner tube completely.
  5. Connect axle hinge joint.
  6. Connect lower oil line from pump.
  7. With master handles down, globe valves open, pump up completely.
  8. Connect upper oil line from pump.
  9. With master handles up, globe valves open, pump down completely.
  10. See that all air is out of line. To do this, pump wheels up and down three times, then check oil in tank with wheels down. There should be at least 2" of oil in the tank.
- Note: Rocking ship back and forth is helpful while pumping.
11. Support hull only at points marked "Block Here".

### OPERATION IN COLD CLIMATE

1. When using a Sikorsky in a cold climate, if it is found that the landing gear works so stiffly that it requires more than a minute and a half to either lower or raise it, the oil in the hydraulic tank should be drained and replaced with light oil.
2. Motor oil for use in cold climate (See recommendation engine manufacturer.)
3. Immediately after flight drain all oil from motors, opening drain plug at lowest point in line. Leave this drain plug out after all oil has been drained off. (If ship is being kept, however, in a heated hangar, the above is not necessary.)
4. In preparing for flight refill motors with heated oil. The best method for doing this has been found to place the cans of oil in a container of hot water for the purpose of heating.



5. In very severe climates application should be made to the Sikorsky Aviation Corporation for special coverings for motors to be used in starting up motors.

6. Landing on snow in an emergency, wheels should be pumped up so that the bottom of the tread is between 3" and 5" below the keel line of the ship. (To tell when wheels are in correct position, 3" to 5" below keel, ship should be lowered on wheels until in correct position and then small tube of landing gear should be marked with paint so as to be discernable from cockpit. As the paint will rub off it will have to be renewed from time to time.) This allows the ship to land on its keel and still retain its balance. In landing on ice the same method is advised unless one is positive that the ice is heavy enough to sustain a real landing. With the wheels in this position even if the ship should break through the ice there is no danger of its nosing over.

7. Watch Air Speed Indicator to see that the same does not get water in it. In case water does get into the instrument line disconnect the lines from the instrument and blow line out with air pump. This prevents freezing and cracking the line.

8. At all times keep snow and ice off the lifting and control surfaces as too much weight would tend to warp surfaces.

9. Check ship carefully before starting flight for ice on control cables, pulleys and control surfaces. Be sure that all control movements are free. In no case should ice be broken by moving the controls. Instead warm water or a tool should be used directly on the ice to free the control cables and surfaces.

10. After landing check boat and pontoons carefully to be certain that they are dry inside. This prevents freezing and opening of seams.

## Standard Equipment

2—Wheels with Brakes	2—Dome Lights in Cabin
2—Propellers, Hamilton Metal	6—Ash Receivers for Cabin
2—Hand Inertia Starters	1—Aerokit
1—Magnetic Compass	1—Seat Cushion (extra)
1—Altimeter	1—Toilet
1—Air Speed Indicator	1—Anchor
1—Bank & Turn Indicator	150'—Manila floating rope
2—Oil Pressure Gauges	50'—Heaving Line
2—L. G. Oil Pressure Gauges	1—Portable Bilge Pump
2—Oil Thermometers	1—TB Boat Hook
1—Inclimeter	2—Canvas Fenders
1—8-Day Clock	1—Raw Hide Bow Fender
2—Tachometer	1—Canvas water bucket
2—Magnetic Fuel Gauges	1—Towing Sling
1—Set (3) Navigation Lights	1—Mooring Sling
1—Riding Light	1—Hand Stroke Air Pump
5—Light Switches for Instrument Board	1—Tire Valve Extension
1—Master Switch	1—Toolbox, With Tools
2—Scintilla Engine Switches	1—Toolkit
2—Hot Shot Batteries	1—Engine Instruction Book
2—Hand Fire Extinguishers in Cockpit	1—*Engine Instruction Book
2—Hand Fire Extinguishers in Cabin	1—*Toolkit
2—Windshield Wipers	1—Airplane Instruction Book
8—Passenger Seats	2—Engine Log Books in Bag
2—Pilot's Seats with Cushions	1—Airplane Log Book
8—Passenger Safety Belts	2—Engine Covers
2—Pilot's Safety Belts	1—Two-piece Hull Cover

\*In package for ground service only.



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