GRUMMAN AO-1 MOHAWK

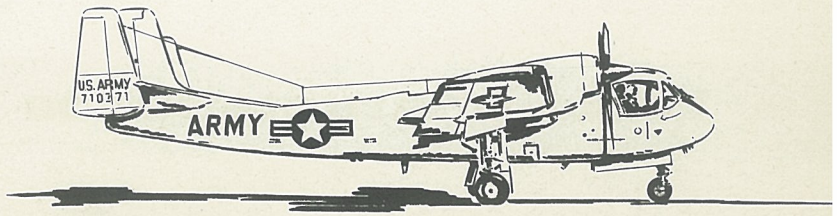
MORIARTY

introduction

The Grumman AO-1 Mohawk is an all-weather, twin turbo-prop aircraft designed to operate from small, unimproved fields for purposes of tactical observation.

The mid-wing, three-tail airplane utilizes Lycoming T-53-L-3 engines mounted in nacelles above the wing. Propellers are three bladed, full feathering, with reversible pitch. Primary control surfaces are conventional manually-operated ailerons, elevators and rudders. Provisions are made for carrying external 150-gallon drop tanks and supply containers. The latest photographic and electronics surveillance equipments are installed or may be accommodated.

The first flight of a prototype YAO-1 Mohawk was in April 1959. A total of nine prototypes have made possible an accelerated test program and early delivery of production airplanes. In addition to the basic visual-photographic Mohawk, other production versions are proposed which differ mainly in the electronics installations. Each version is described fully, together with comparisons of equipment and performance, in the supplemental section on Mohawk AO-1 configurations.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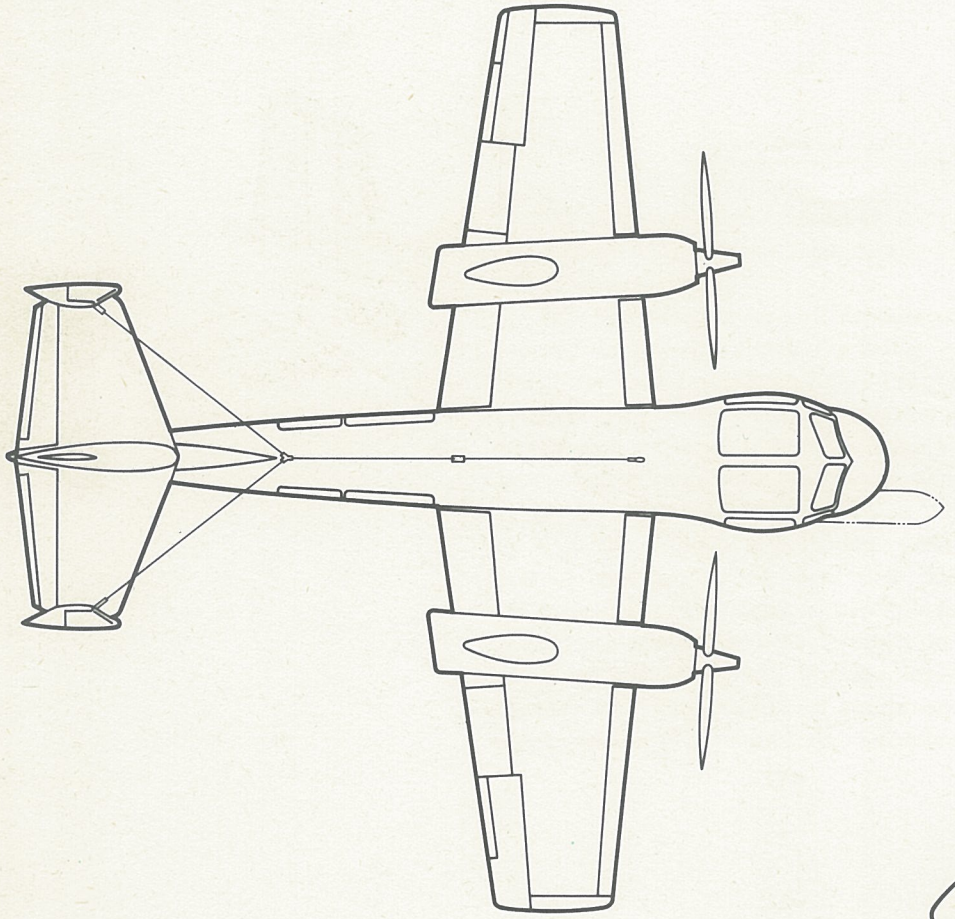
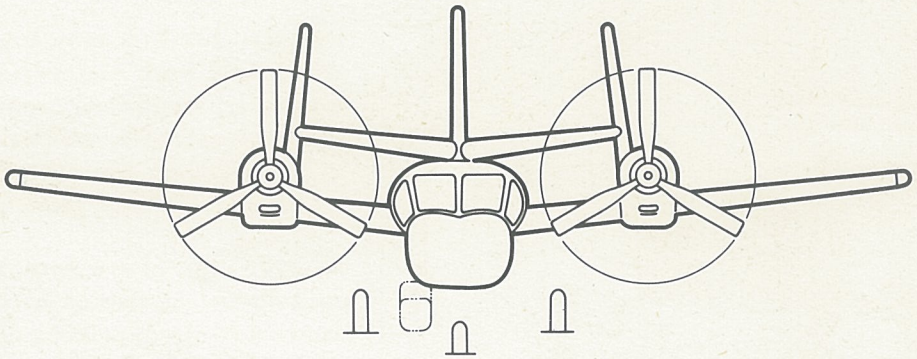
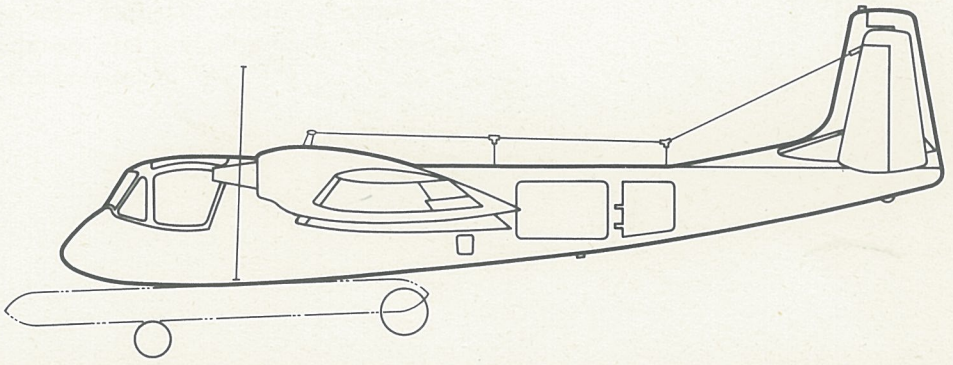
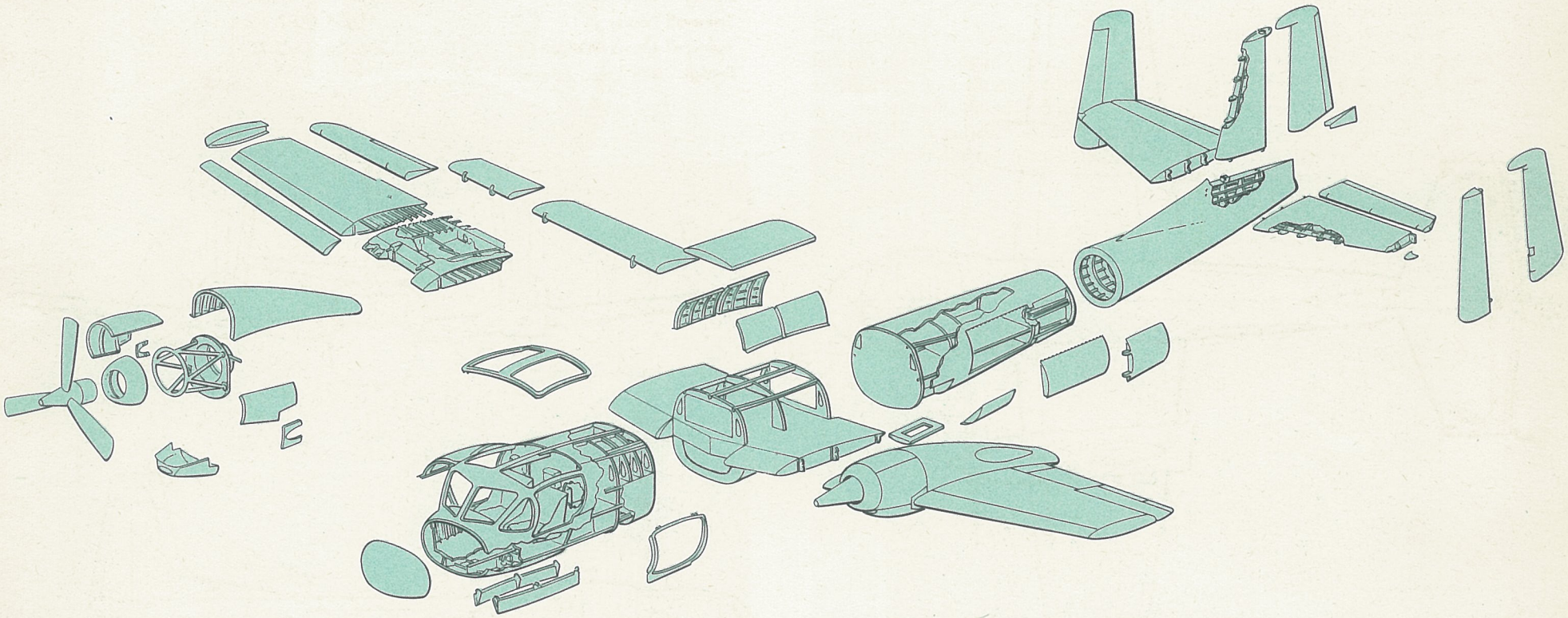
Wing Span	42′ 0″
Overall Length	41′0″
Tail Height	12′ 8″
Wing Area	330 sq. ft.
Aspect Ratio	5.35
Fuel Capacity	Up to 1930 lbs.
Power Plants (2)	Lycoming T-53-L-3
Take-off Power	1005 ESHP each
Take-off Gross Weight	12,236 lbs. (AO-1AF)
Design Limit Load Factor	+5.0







basic characteristics

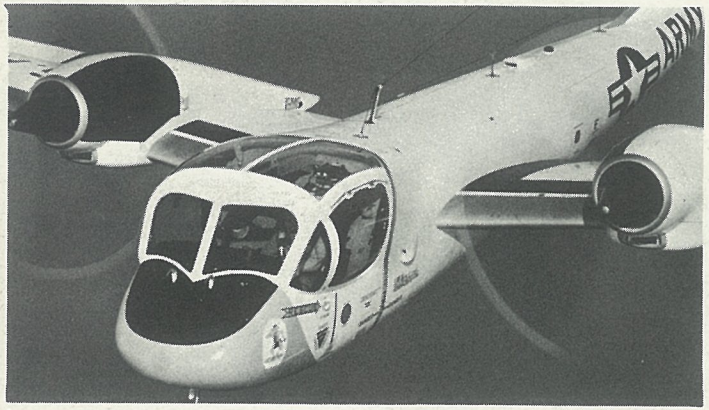


structural arrangement

observation

The principal function of the Mohawk is observation. Maximum visibility has been achieved by use of a bubble-type canopy. Either crewman has unobstructed vision 20° down over the nose of the aircraft along the centerline of the seats. By moving the line of vision outboard, the visibility afforded the pilot and observer is expanded as shown in the accompanying photographs. The resulting increase in the downward visibility over the nose is due to the employment of a low instrument panel and a nose section which falls away at a sharp angle.

Maximum side and rearward visibility is afforded by bubbled side hatches and a low main supporting longeron. The bubbled side hatches increase downward visibility to such an extent that the lines of sight of the pilot and observer converge at a point thirty-six feet below the aircraft. A transparent hatch permits complete vision directly overhead. It can be jettisoned if desired to provide an unobstructed path for ejection.



photography

The Mohawk photographic installation consists of a remote control system to operate a KA-30 camera located in the fuselage mid-section. The photographic control system includes a cockpit console control panel, exposure control panel, flare reset panel, system control unit, actuator control unit and flare detector unit.

The control panel is available to both the pilot and observer and includes camera position and flare control. By means of manual controls on the panel, altitude and speed data are furnished to the image motion compensation and pulse circuits. These circuits transmit signals to the camera control system to provide the desired overlap of vertical photographs. The photographic panel also incorporates indicators to show the proper operation of the cameras, amount of film and flares remaining, film failure, mount position, flares ready and end of flares.

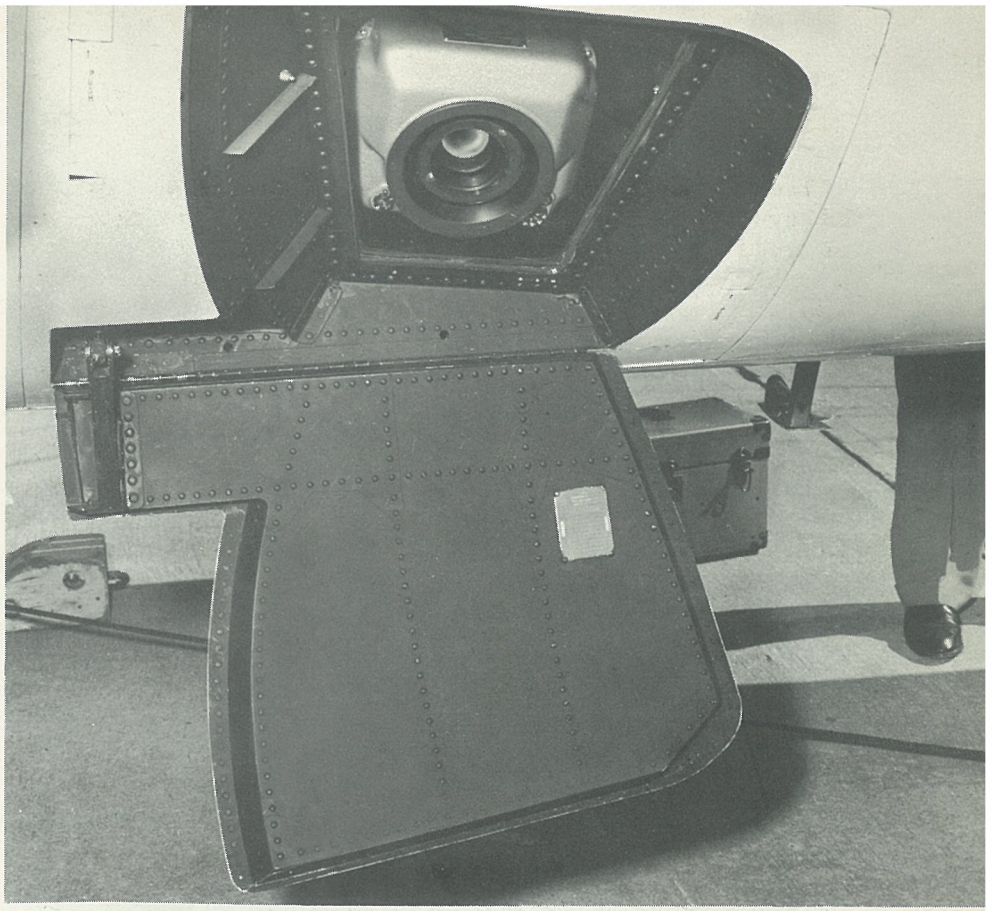
The camera can operate by either the console operate switch or the auto-operate stick switch on the pilot's control column. A second stick switch is also installed to manually pulse the cameras for day photography and to pulse individual flares for night photography. One hundred and four photo flares are carried in two removable pods. The flare pods are upward-firing, wing-root mounted.

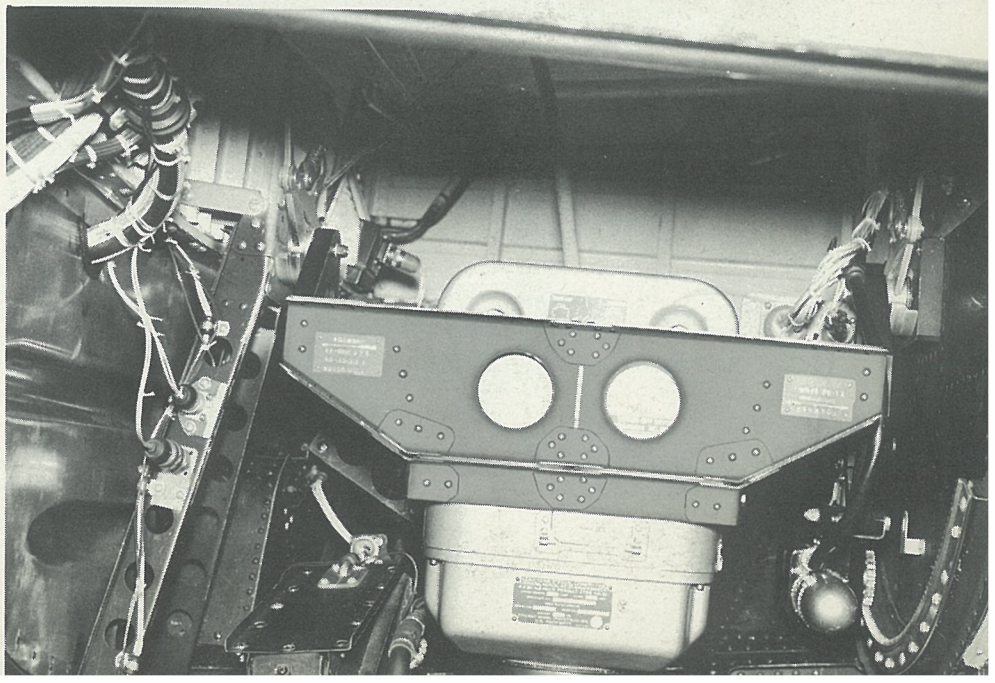
The camera mount can be rotated remotely to left or right, 15° or 30° oblique and vertical positions, by means of the control panel mount selector switch. Any one of the camera options indicated may be installed without adapters.

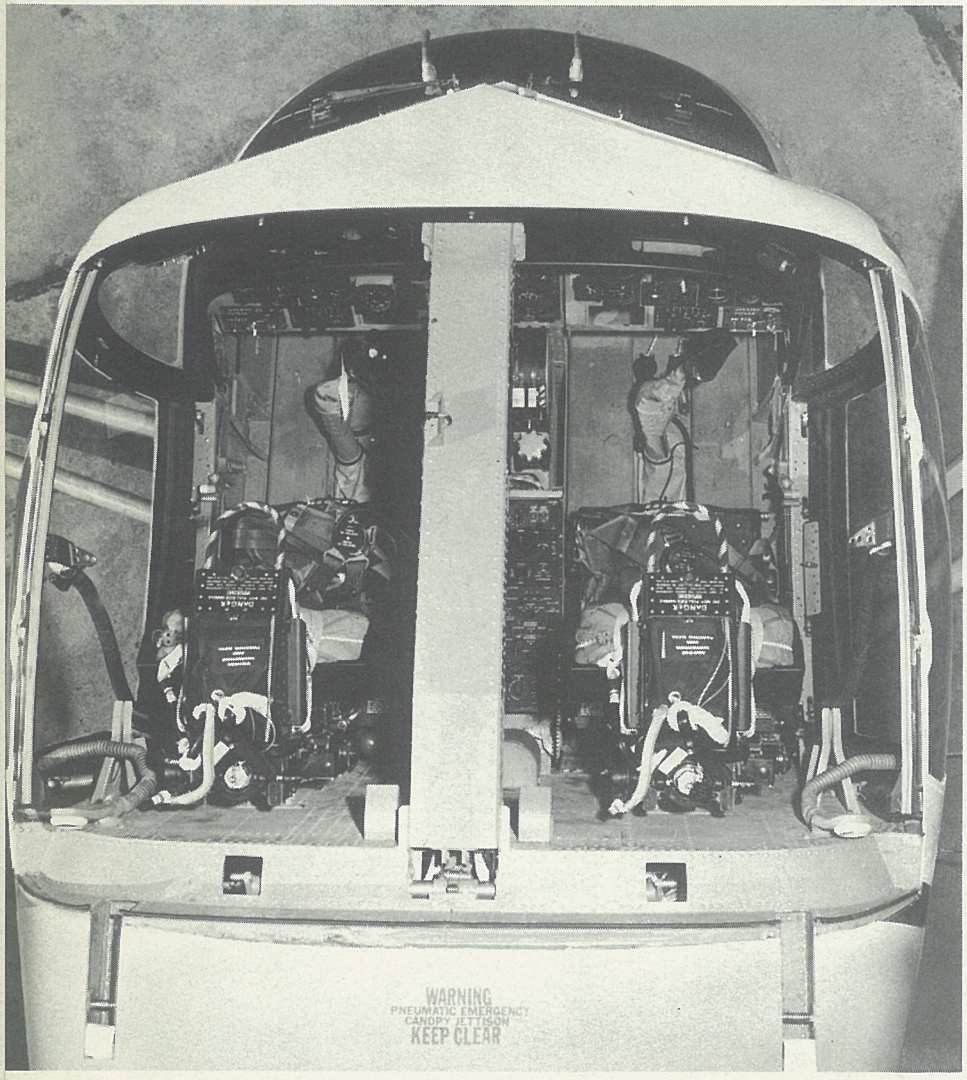
The left, right and vertical camera window doors open only when the corresponding mount position is selected.

CAMERA ALTERNATIVES

CAMERA	LENS CONE	MAGAZINE CAPACITY
KA-30	3"	100 ft or 250 ft
KA-30	6"	100 ft or 250 ft
KA-30	12"	100 ft or 250 ft







crew compartment

Maximum utilization of available cockpit space in the Mohawk is the result of adherence to recommended human factor considerations for both efficiency and comfort.

In conformance with accepted practice, the pilot is seated on the left and the observer on the right. All instrumentation and controls are located convenient to the pilot and visible to the observer. A low profile instrument panel is sloped 15° forward of the vertical. This eliminates partial blocking of the instruments by their own bezels and improves pilot instrument visibility. Instrumentation has been arranged to conform to recommendations of the Army Aviation Board. Specific details of instrumentation and the control consoles are shown in the section on Mohawk AO-1 configurations.

The observer's position is designed to accept electronic surveillance equipments where required. Control sticks and rudder pedals are installed at both pilot's and observer's positions. The observer's controls are removed when the electronic surveillance equipments are installed.

Regulators for the gaseous oxygen system are located on the outboard side of both the pilot's and observer's instrument panels. This system is composed of two 514 cu. in. O_2 bottles and the two instrument panel regulators with their associated piping.

A central pedestal provides one set of control levers equally accessible to both pilot and observer. The location of the levers permits a man of any stature down to the 5 percentile man, as defined in WADC TR52-321, to reach them comfortably. All trim controls may be reached readily by either the pilot or observer.

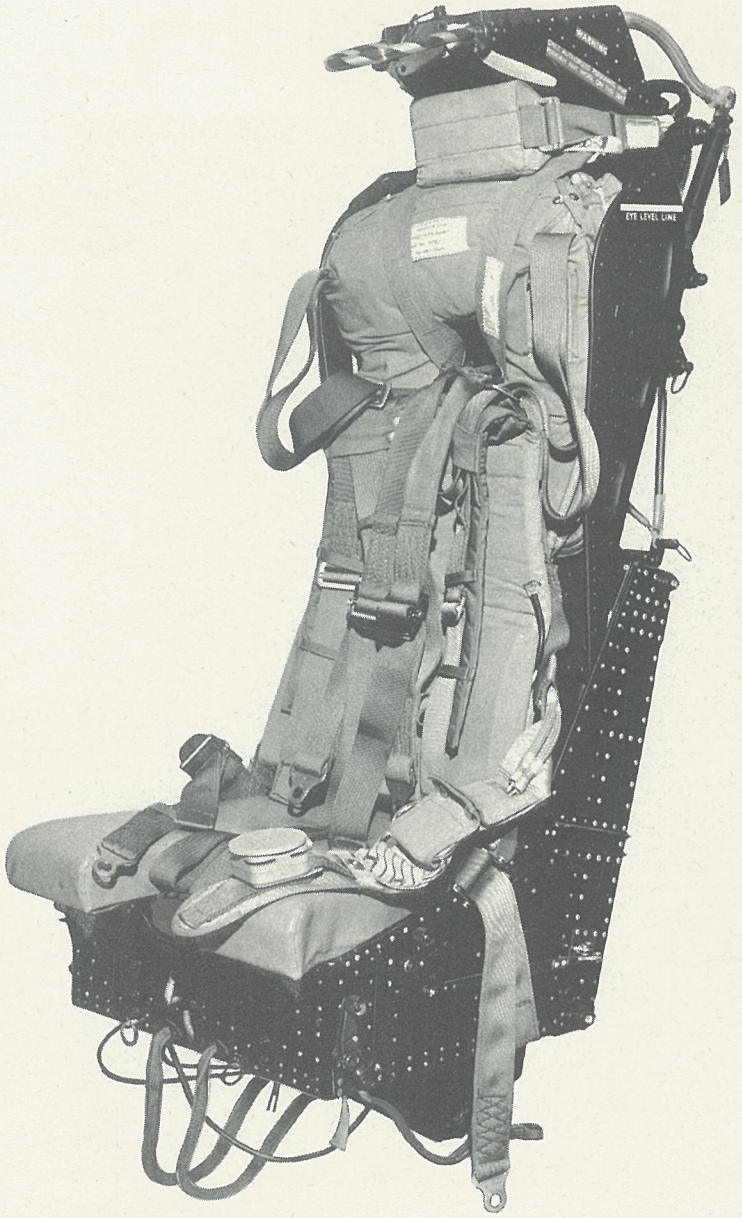
A double width lower console between the pilot and observer houses the communications, navigation and photographic panels. A single width overhead console between the pilot and observer houses the IFF, air conditioning and lighting panels. "Eye brow" panels above the windshield accommodate the engine, fuel and electrical master panels.

A circuit breaker panel, first aid kit, binoculars and fire extinguisher are located on the sloping bulkhead aft of the crew.

ejection seat

A Martin-Baker ejection seat provides safe escape at all altitudes within range of the aircraft and at speeds ranging from 60 to 450 knots.

To eject, the occupant pulls either the face curtain or the secondary firing handle on the leading edge of the seat bucket. Primary ejection is through the overhead hatch. If time permits, the hatch may be jettisoned prior to ejection. After ejection, the main parachute, stowed on the seat behind the occupant's shoulders, is deployed automatically, thereby separating the occupant from his seat. A barostat delays deployment of the parachute if ejection is initiated at high altitude, or a "G" limiter will delay it if ejecting at very high speeds. A seat-mounted bail-out oxygen system is automatically actuated upon ejection. The seat bucket is designed to accept an energy-absorbing type seat cushion and a survival equipment container. An electrical actuator provides 5 inches of vertical seat adjustment.



protection

The design philosophy incorporated in the Mohawk airplane assures maximum protection from ground fire. Principal factors are:

1. 246 pounds of armor protection surround the crew compartment:
   - 1″-thick flak and bullet-resistant windshield for pilot and observer.
   - 1/4″-thick dural cockpit floor.
   - Removable flak curtains on the fore and aft cockpit bulkheads in the area above the floor.
2. The basic configuration utilizes structural members to protect critical items on the airplane.
   - Self-sealing fuel cell is mounted above the wing structure.
   - Engines are located above the wing.
3. The longitudinal control system incorporates dual control runs separated as widely as possible.

Bullet Resistant Windshield

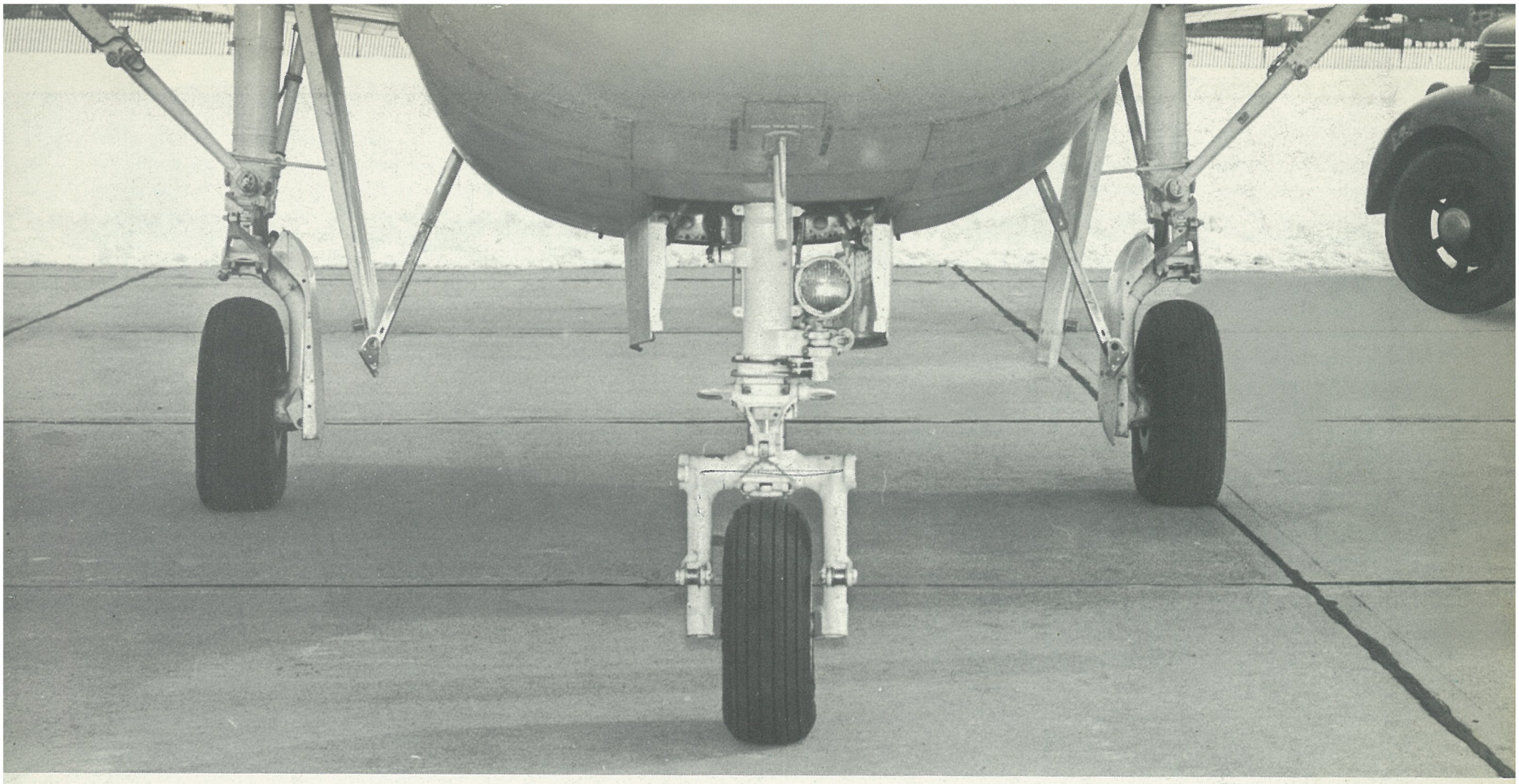
Flak Curtain

Armor Plate

systems and equipment

All versions of the AO-1 Mohawk have the same basic systems and equipment as described on these pages.

Any exceptions—primarily in electronics installations—are described in the supplemental section on Mohawk AO-1 Configurations.



alighting gear

The Mohawk airplane incorporates a conventional tricycle landing gear and auxiliary tail bumper designed for a limit sink speed of 17 feet per second. Pneudraulic shock struts are used at each wheel. The main gear consists of a simple cantilevered shock strut supported between rear and center beams of the wing center section. Both left- and right-hand struts are interchangeable. An oleo shrink rod serves to shorten the gear during retraction, thus permitting the gear to be housed within the wing in the engine nacelle. The nose wheel is mounted on a fork and spindle and incorporates nose wheel steering to facilitate ground handling. Both nose and main gear are retracted and extended hydraulically with mechanical up and down locks.

Both nose and main gear struts are fitted with low pressure tires to provide acceptable ground flotation characteristics.

Both nose and main landing gear have provisions for mounting skis which permit operation from snow, ice, mud and soft natural terrain as well as prepared runways.

flight controls

Directional

Conventional pedals at the pilot's and observer's stations control the rudders through a simple mechanical system consisting mainly of cables used as tension members between cranks. Each set of pedals incorporates a mechanism for adjusting both pedals simultaneously.

Trim control is accomplished through a manual cable and drum system controlling a tab on the center rudder. In addition, the tab is geared to deflect with rudder position.

A built-in gust lock system is controlled by a lever in the cockpit. When engaged, the handle blocks the throttle levers to prevent take-off with the gust lock engaged. Locking is effected at the rudder torque tube by means of a latch which engages a pin on the torque tube arm. Duplicate safety springs will disengage the latch in the event of failure of any system component.

Lateral

Control sticks at the pilot's and observer's stations are mechanically connected to aileron spring tabs. A pushrod system provides direct mechanical connection between both ailerons.

Separate auxiliary surfaces (inboard ailerons) on each wing are used when additional lateral control is required for slow speed flight conditions. Irreversible power systems are used to drive these surfaces, and are linked to the basic control system only when the flaps are extended. Flap motion mechanically shifts these power systems out of the basic control system when the flaps retract. Failure of the power actuators does not limit aileron motion.

Trim control is accomplished through a manual cable and drum system controlling a tab on the right aileron only.

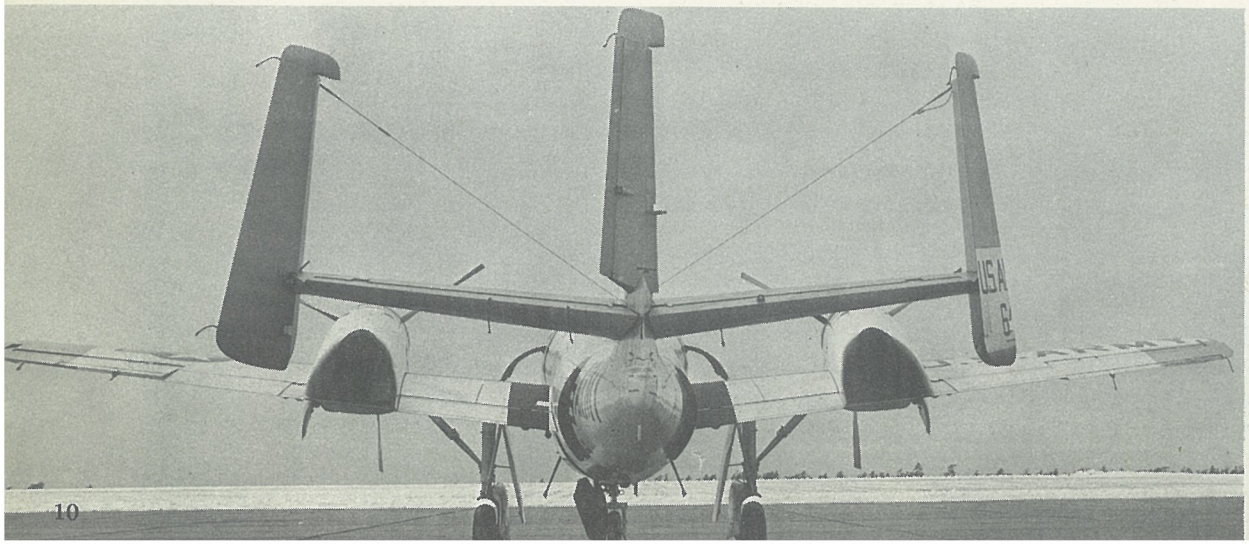
A built-in gust lock is provided and is similar to the one for directional controls.

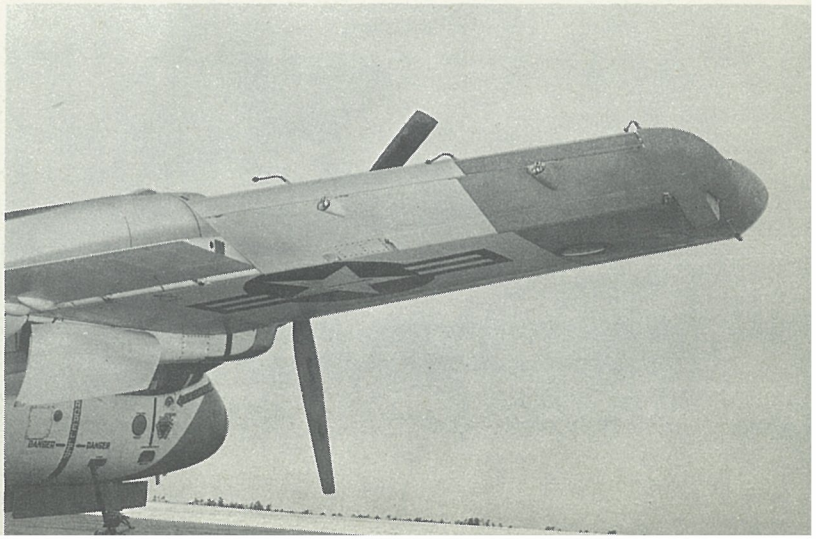
Longitudinal

Conventional control stick(s) actuate the elevators through a simple mechanical system, consisting mainly of cables used as tension members between cranks. Pulleys and sectors have been avoided to keep friction to a minimum. Two independent systems run the full length of the fuselage.

Trim control is accomplished through a manual cable and drum system controlling the neutral position of the geared tab.

A built-in gust lock similar to that of the directional system locks the longitudinal control system at the aft end of the fuselage.





auxiliary flight controls

Wing Slat Actuating Mechanism

The wing slats are arranged in a mechanically actuated section along the outer wing span. Equipped with integral tracks, the slats move on fixed supporting rollers in the wing. A hydraulically actuated mechanical linkage, located along the forward wing beam, transmits motion through right angle gear boxes. These are located at rack stations near the slat inboard and outboard ends.

Control for the slats is integral with the wing flap control. The slats are operated through their full range of motion with flap travel from 0° to 15°.

Wing Flap Actuating Mechanism

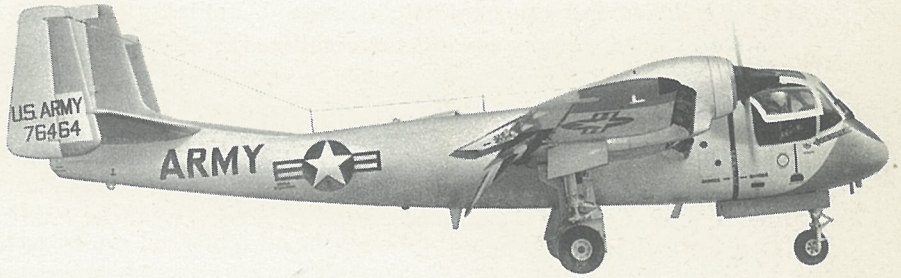
Each flap is supported and guided by two pairs of swing links situated near the flap ends. Motion is imparted to one inboard flap link by a hydraulically actuated linkage in the fuselage. This linkage both drives and interconnects the flaps.

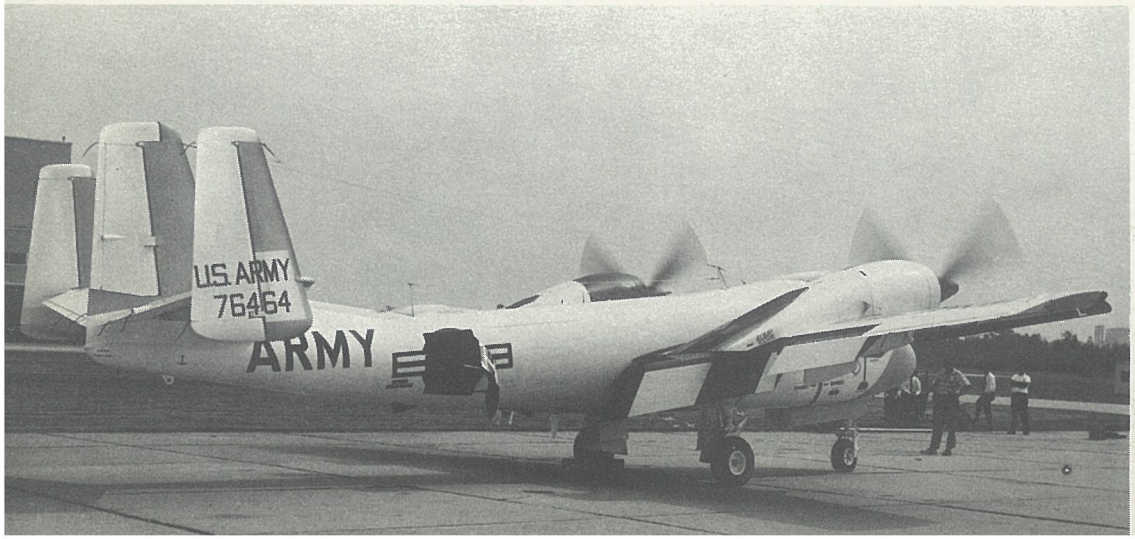
A pushrod is attached at the outboard end of each flap to operate the inboard aileron shift mechanism.

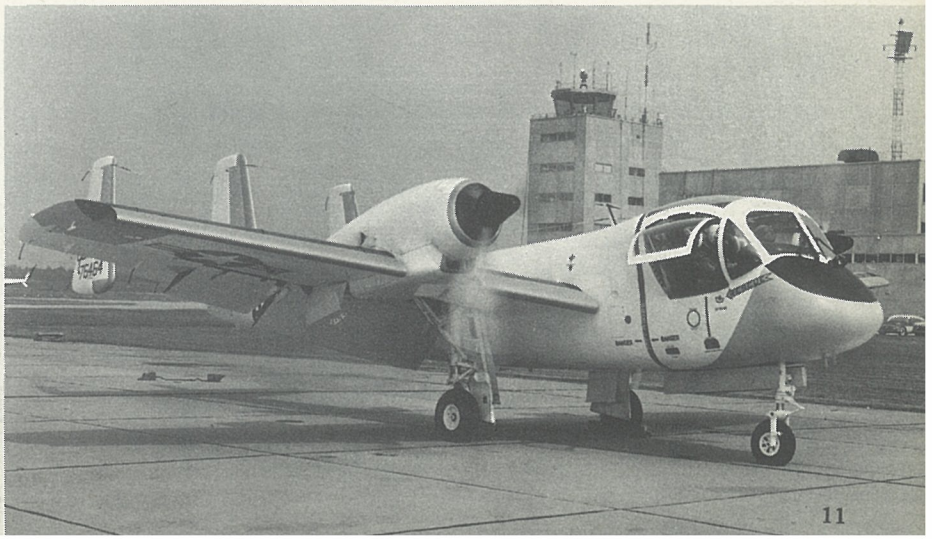
Three positions of flap extension may be selected through a follow-up system between the pilot's control and actuating cylinder. A lock for the 0° position is incorporated in the cylinder.

Speed Brake Actuating Mechanism

Two speed brakes are located on the sides of the fuselage in the aft section. They swing about vertical hinge lines. Each is extended and retracted by its own hydraulic cylinder mounted between the brake and fuselage structure. The two brakes are synchronized aerodynamically with a 5% maximum error in synchronization.







power plant

The Mohawk airplane is powered by two Lycoming T-53-L-3 turboprop engines installed in nacelles above the wings.

This engine features a single stage free-type power turbine, combination axial-centrifugal compressor driven by a single stage turbine, and an external annular vaporizing combuster.

Propellers are Hamilton Standard hydromatic, 10 feet in diameter. They incorporate variable pitch, full feathering, reverse pitch, synchronizing and synchrophasing.

The engines develop 960 shaft horsepower at take-off and produce 100 pounds of jet thrust at a gas producer speed of 25,240 rpm and a propeller shaft speed of 1700 rpm. The gear ratio between the power turbine and propeller drive is 12.40:1.

Anti-icing of the power plant is accomplished by electrically heating the propeller blades and spinner and the engine inlet cowling and by air heating the engine inlet struts.

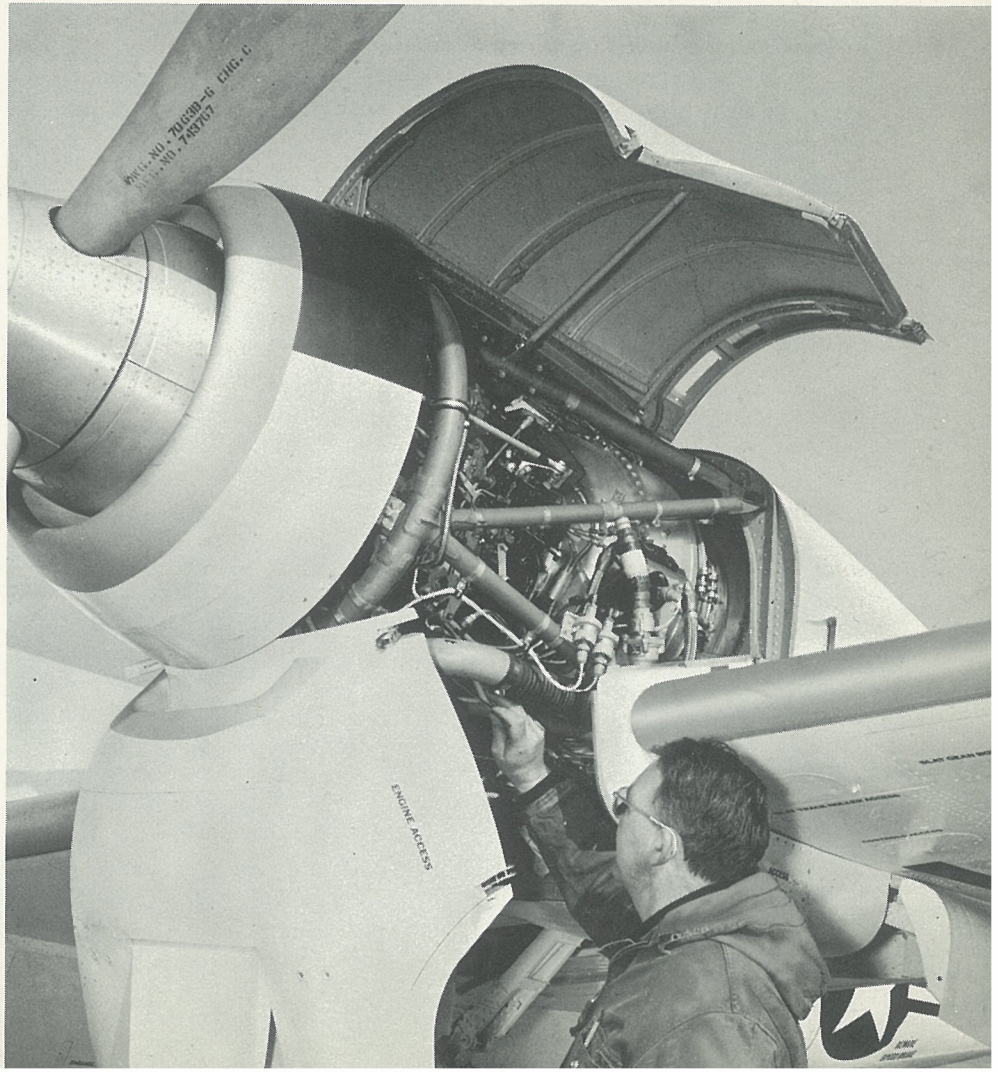
The engine nacelle allows easy access to the engine, controls and accessories. The two side panels are hinged at the top and swing upward; the lower panel is hinged at the forward end and swings down to provide 360° of accessibility. The lower panel contains the oil cooler, oil cooler ducts and the oil cooler flap.

All fuel control adjustments are easily accessible for servicing. The entire power plant package including propeller, engine accessories and engine mount with vibration isolators may be removed as one assembly and is interchangeable with the package on the opposite side.

In addition to the gearbox, which mounts a starter-generator on the lower portion of the engine, a contractor-furnished gearbox on the upper right hand side of the engine accommodates the hydraulic pump and an AC generator for anti-icing purposes.

Starter

A combination starter-generator is employed for all starting requirements, both air and ground. An external power receptacle at the aft equipment compartment makes it possible to start the engines on external power when desired.



fuel system

The Mohawk fuel system is simple and reliable. All fuel is contained in one internal self sealing 297 gallon tank and two external Douglas 150 gallon tanks.

All tanks may be fueled through 3 inch gravity filler units, one at each tank, or by single point pressure fueling. Complete operation of the pressure fueling system, including selective filling or shut-off pre-check on all tanks, can be accomplished at the pressure fueling station. Float switches in the drop tanks and a pilot valve in the main tank control automatic shut-off in all tanks. Defueling of all tanks may be accomplished at the pressure fueling adapter, the drop tank fuel first being transferred to the main tank.

Fuel feed to both engines is provided by two centrifugal pumps one forward and the other aft, in the main tank. The fore and aft pumps provide positive fuel flow for all conditions of aircraft attitude and fuel quantity. A secondary ejector type pump is provided in the forward part of the fuel cell as a back-up for the forward centrifugal pump. Both fuel pumps charge the main fuel line that feeds both engines. Two electric motor-driven vane-type pumps in the wings provide fuel transfer from the drop tanks to the main tank. The pilot and shut-off valves in the main tank control the flow of fuel from the wing tanks.

Cockpit control of the fuel system is provided by left and right engine master switches controlling the fuel gate valves. A fuel master switch arms the main tank fuel pump switch and energizes the drop tank transfer system. Fuel pumps and drop tank transfer switches are also provided.

Warning lights show: low pressure entering the engine high pressure pumps; impending by-pass of either fuel strainer; high pressure across each engine fuel pump indicating pump element failure. When the transfer switch is on, a warning light indicates zero transfer fuel flow. Additional warning lights indicate manual operation of the engine fuel control.

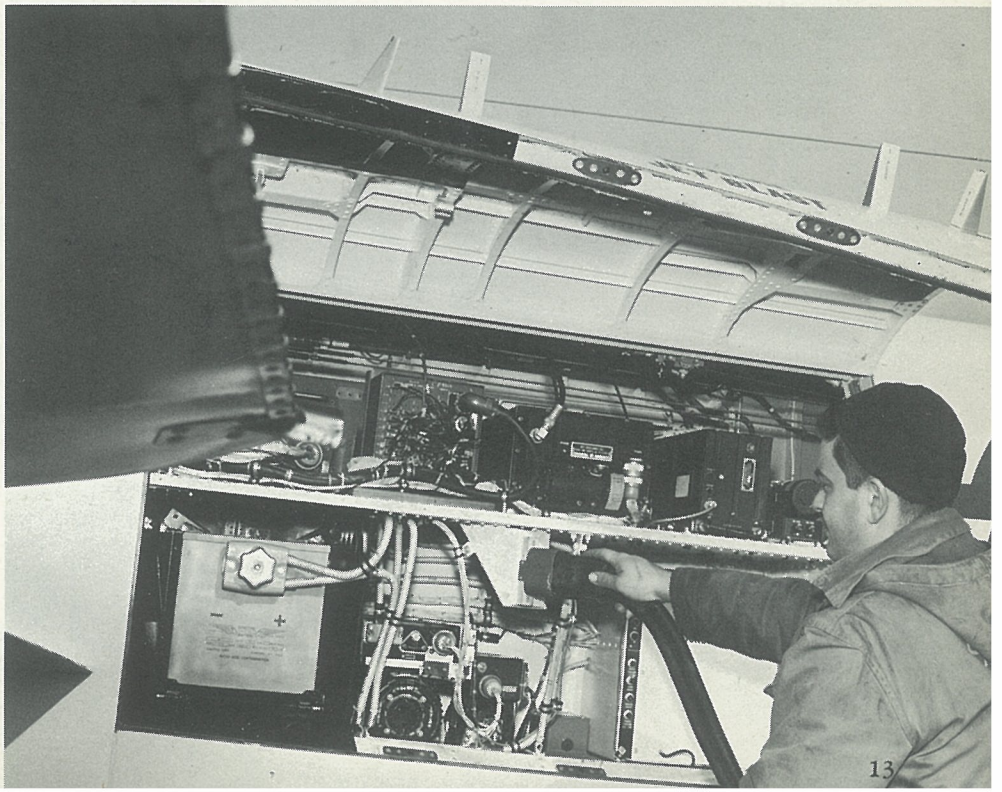
Fuel quantity is measured by a capacitance-type system that indicates total fuel or fuel in each individual tank. Flow meters indicate the rate of fuel flow to each engine. A warning light indicates low fuel level in the main tank.

electrical system

A 28 volt D.C. electrical system is provided. There are two parallel-connected 400 amp starter-generators (1 per engine), two voltage regulators, two reverse current cut-outs, two over-voltage and field relay assemblies, a 24 volt 34 ampere-hour nickel-cadmium battery and assorted relays and switches. An external D.C. power receptacle with reverse polarity protection is also included. The battery provides emergency power in the event of a double generator failure as well as providing power for engine starting.

A 115/200 volt, 400 cycle A.C. electrical system is supplied by 2 inverters. For normal operation, the instruments are supplied by a 750 VA inverter. The other A.C. is supplied by a 2500 VA inverter. If the 750 VA machine should fail, instrument power is supplied by the 2500 VA inverter.

Two 115 volt, 400 cycle 6.5 KVA generators (1 per engine) provide electrical power for power plant anti-icing.



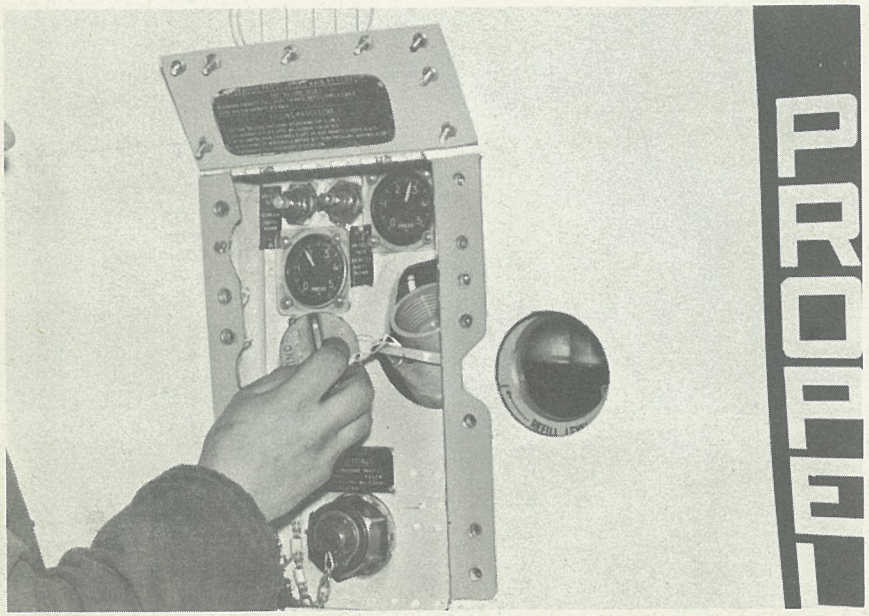
hydraulic system

The hydraulic system is a Type I, 3000 psi variable volume pump system designed in accordance with Specification MIL-H-5440B.

The hydraulic system provides power for normal operation of the following sub-systems:

1. Alighting gear.
2. Ski retraction and extension.
3. Speed brakes.
4. Inboard aileron (landing and take-off only).
5. Slats.
6. Flaps.
7. Windshield wipers.
8. Wheel brakes.

Hydraulic power is supplied by two engine-driven variable volume pumps, one per engine, drawing fluid from a common reservoir located in the fuselage. The reservoir is pressurized by engine bleed air to maintain proper pump inlet pressure at higher altitude. Emergency gear extension is accomplished by a single shot, stored air system.



heating and ventilation

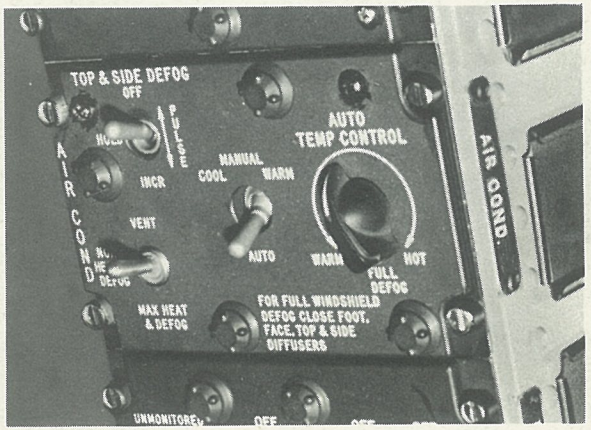
The Mohawk heating and ventilating system provides for cockpit heating and ventilating, air blast defogging of all transparent areas, camera compartment heating and ram air cooling of the electronic compartments.

The cockpit is heated by introducing engine bleed air which is first cooled in a heat exchanger located in the nose wheel equipment compartment. Ventilation is provided by diverting to the cabin air distribution system the ram air used to cool engine bleed air. The cockpit air distribution system includes defogging nozzles for transparent areas, together with foot air diffusers and face nozzles for each crewman. A control panel located in the overhead console permits selection of various heating, venting and defogging combinations together with automatic control of the heating and defogging air temperature. There are controls to shut off any or all air diffusers. A cabin temperature sensing thermostat is used.

A separate automatic temperature sensing control system is provided for the camera compartment. The system regulates the flow of bleed air to the camera window defogging nozzles.

The electronics equipment compartments are cooled by means of ram air.

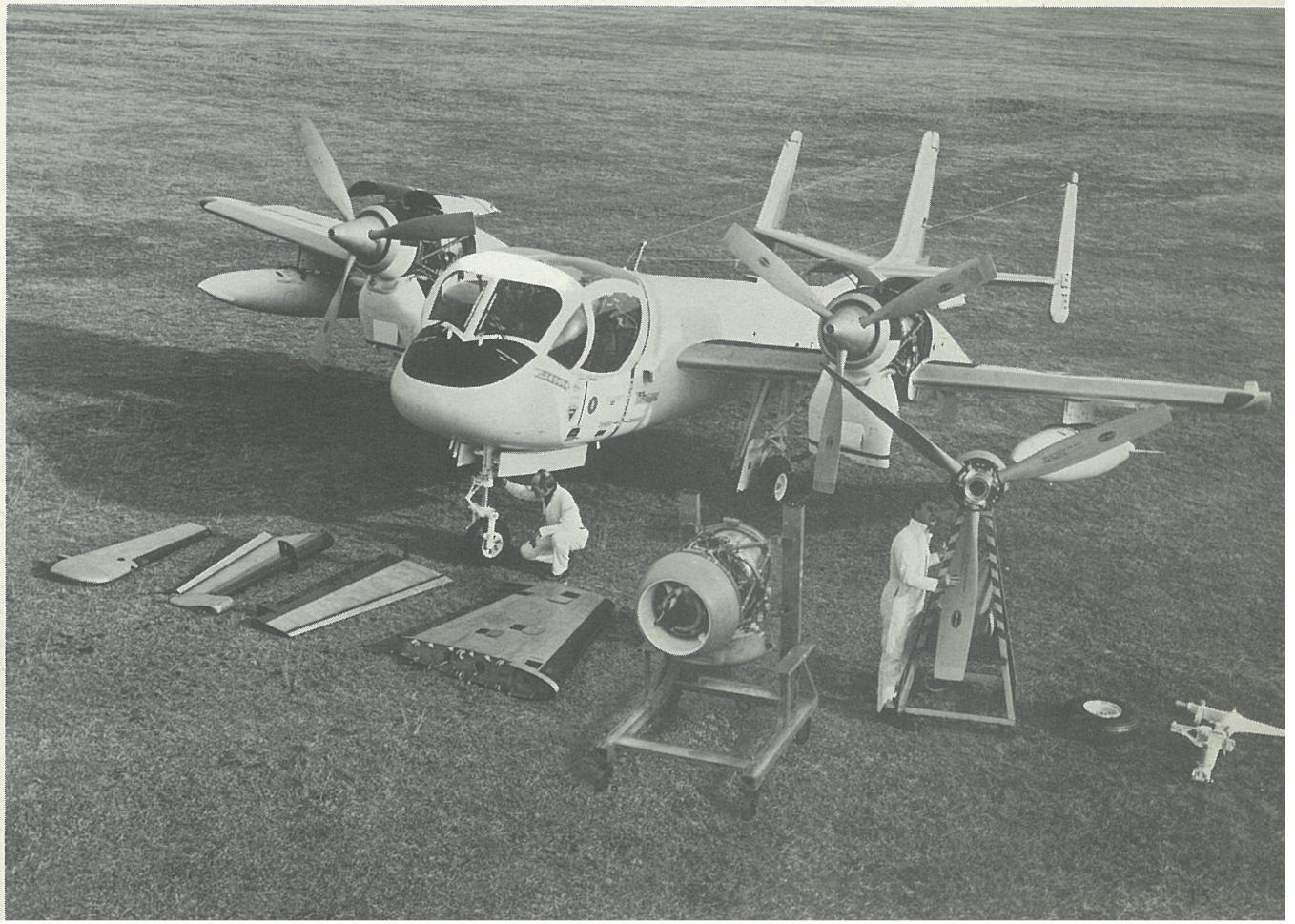
The windshield anti-icing and washing system has a capacity of six quarts. The tank filler is located in the nose of the airplane.

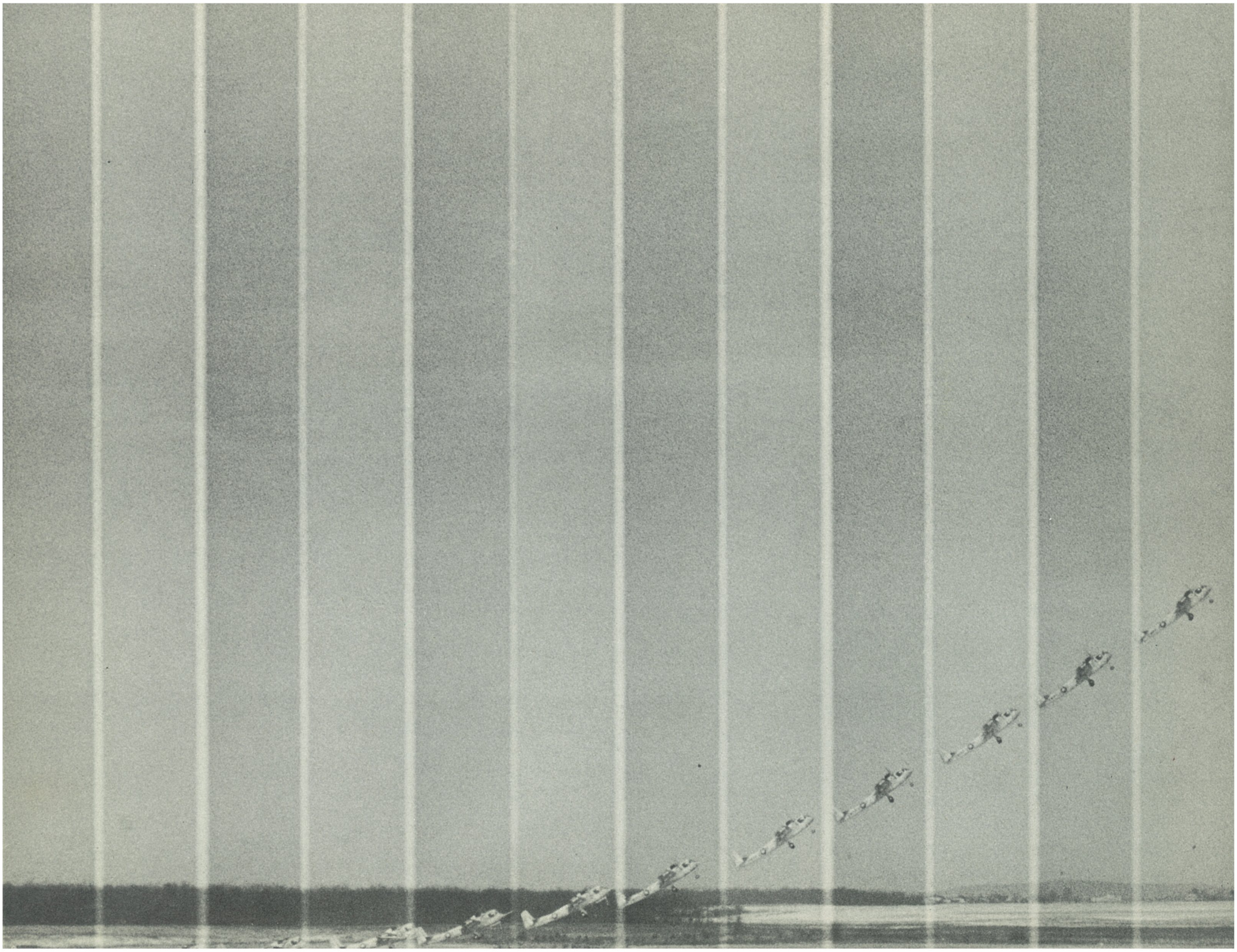


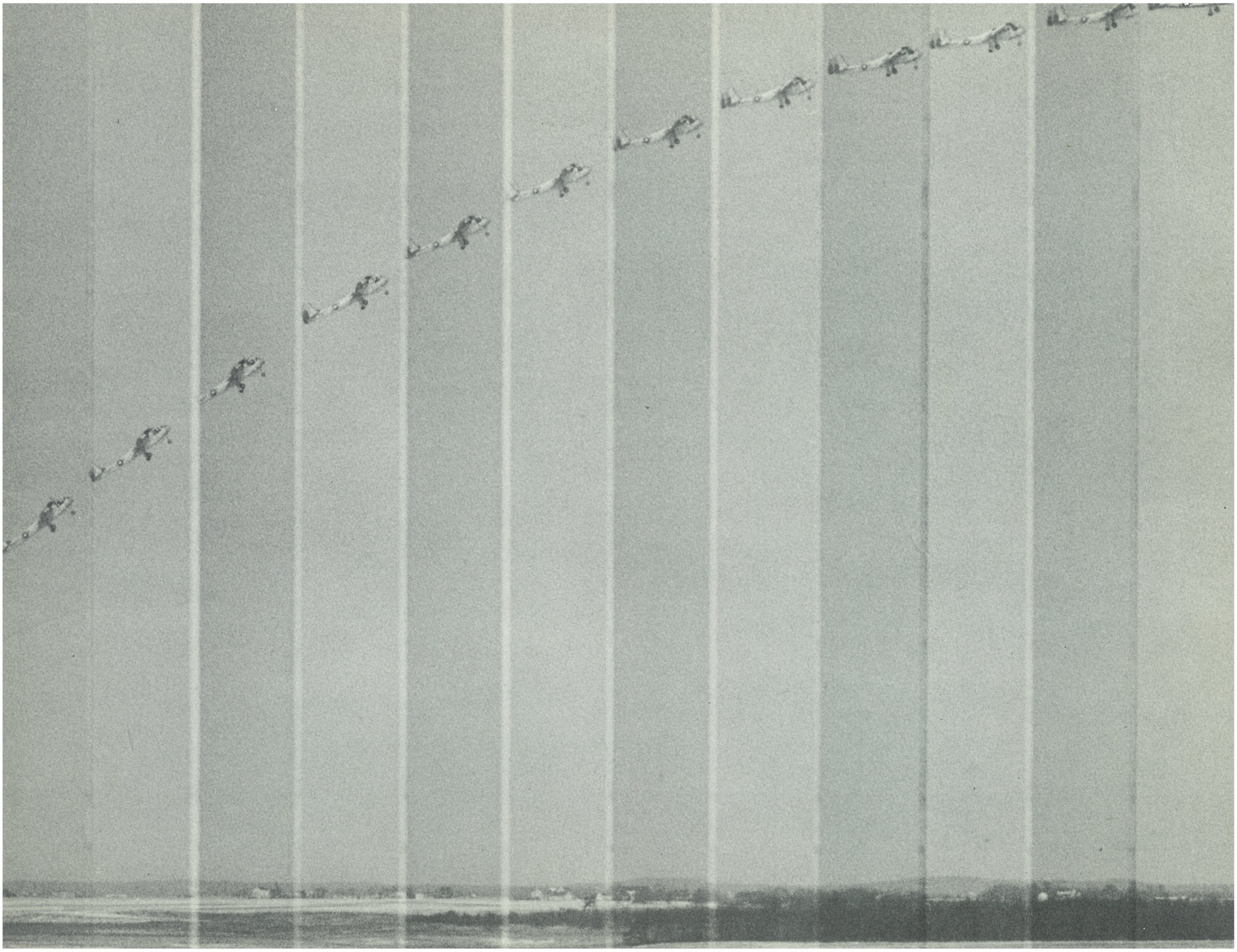
serviceability

For maximum serviceability, quick access is provided to all equipment items in the airplane. Wherever possible, access is obtained directly from the ground with a minimum use of work stands. Access to the No. 1 equipment compartment is through the nose wheel doors; to the No. 2 equipment compartment under the wing through a door on the left side of the fuselage; and to the No. 4 equipment compartment through doors on either side of the airplane. Access to the camera compartment is directly from the ground through the two camera doors. The single fuel cell is readily replaceable through the two removable panels on the top of the fuselage. Additional access panels are provided for servicing as required.

In addition to providing easy access, all major assemblies have been made interchangeable. The power plant assemblies will fit either wing. The left and right members of major landing gear components, stabilizers, elevators, outboard fins and rudders are interchangeable. The complete wing panel, including nacelle, is quickly replaceable. The wing tips, horizontal and vertical tails, and fuselage nose and tail sections are all readily replaceable as units.







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