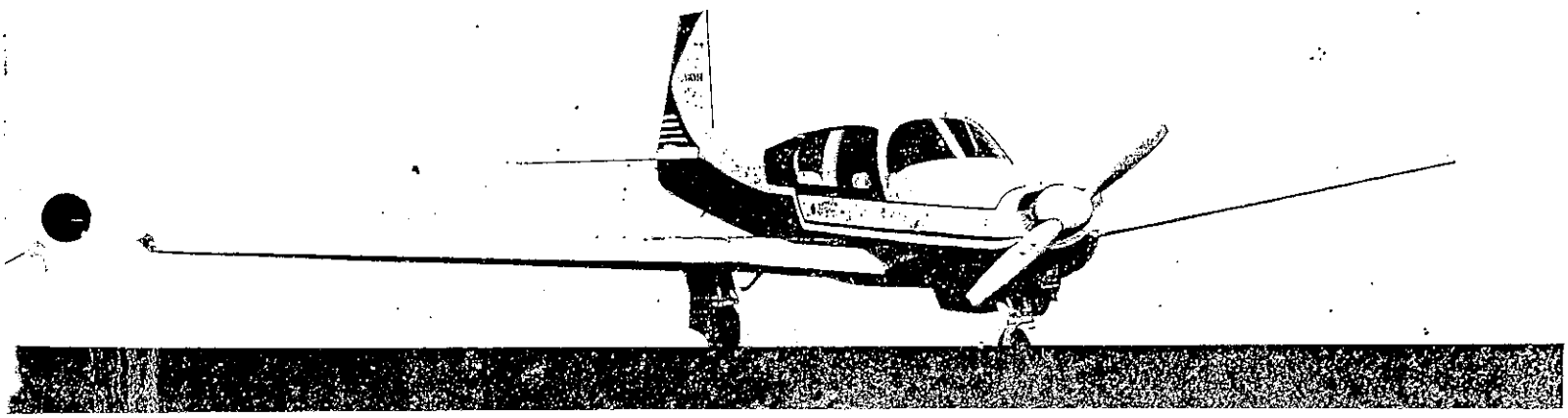
welcome aboard!

MOONEY
MARK 21
OWNER'S MANUAL



INTRODUCTION

The jet-age realm of flight can be introduced to the aircraftsman no more glamourously, nor luxuriously, than in the all-new, high performance Mooney Mark 21. Years of design experience have embodied in this fine airplane jet-age features that mark it as the best business aircraft in its class on the market today.

Outwardly, the sleek, new Mark 21 presents a picture of symmetrical beauty, poised to slash through the air at its master's command, effortlessly and smoothly. Inwardly, the Mark 21 represents a marvel of craftsmanship and design, expertly built to provide many thousands of miles of pleasurable, swift travel at an amazingly low cost.

Here, we are sure, you will be interested in taking a look at how, and of what, the new Mark 21 is made. You will be pleased to learn of the airplane's fine construction and, perhaps, surprised at the superior quality of the materials used in an airplane of this price category. But then you will begin to see shy Mooney proudly proclaims that the Mark 21 is the World's best single-engine business aircraft!

THE MARK 21 PILOT'S HANDBOOK

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PART I

THE 1961 MOONEY MARK 21

In the following pages we would like to remove the cowling and inspection plates on the Mark 21 and observe some of the more technical features of this plane. This will provide a better understanding of the airplane and will enable you, as the pilot and owner, to obtain the maximum in efficiency and performance.

THE MARK 21 ENGINE

The Mark 21 is powered by the famous Lycoming 0-360 A-1-A, high-compression engine. It is rated at 180 HP and uses dynafocal engine mounts to dynamically balance the engine in flight and to reduce the transmission of vibration to the cabin.

If you look at the base of the cylinders, you will note a wide, blue band painted around them. This denotes that it is the newest version of the 0-360 A-1-A engine with the following improvements:

1. New-type cylinders which have tapered bores and are nitrided for extra hardness.

2. New pistons, compression, and oil-scraper rings for longer engine life.

3. 180-degree oil temperature thermostat to provide optimum oil temperatures in all conditions of flight and to give better vaporization of the fuel-air mixture in the intake manifold.

The Lycoming 0-360 A-1-A engine is FAA approved for a 750-hour normal overhaul life; however with a mechanic's approval it may be flown to 1,125 hours before overhaul becomes necessary.

ENGINE IGNITION

This engine utilizes the very latest ignition system which gives quicker, easier starts and longer ignition life. It consists of:

1. Two Bendix magnetos, the left magneto being equipped with a set of retard breaker points.

2. A starting vibrator, located on the upper fire wall, and which furnishes a shower of sparks for starting.

3. A switch which combines both ignition and starting functions.

4. Shielded spark plugs and ignition harness to suppress radio noises.

When the starter switch is turned to the "start" position, the starter vibrator sends an interrupted current through the retard-breaker points while the right magneto is grounded out. The left magneto then provides a shower of sparks to each cylinder after the piston has reached top dead center on the compression stroke. The engine starts sooner and easier because of this system.

A switch is provided on the upper fire wall adjacent to the starter vibrator to disconnect the starter, should it be necessary to manually start the engine.

ENGINE OIL SYSTEM

The Lycoming 0-360 A-1-A engine has a pressure-type, wet-sump lubrication system. It has an eight-quart capacity, but will operate safely with as little as two quarts; however as a general rule, when the oil level drops below six quarts, one quart is added. This will maintain the oil level between the six-quart and seven-quart level.

NOTE: Lycoming recommends the use of the following grade oil for outside air temperatures:

Above 40° F.	(4°C.)	SAE 50
Below 40° F.	(4°C.)	SAE 30
Below 10° F.	(-12°C.)	SAE 20

An oil temperature thermostat, set for 180 degrees, is located in the oil reservoir to assure warm oil for all operations, while an oil cooler, mounted on the lower left section of the front cowling, keeps the oil from getting too warm. Stratoflex hoses, triple-lined for extra safety, feed the oil from the oil reservoir to the cooler, then back to the reservoir.

ENGINE FUEL SYSTEM

Fuel for the engine is fed to the float-type carburetor by an engine-driven, diaphram-type fuel pump mounted on the accessory section of the engine. The Lycoming 0-360 A-1-A engine is designed for 91-98 octane aviation grade fuel; however 100-130 octane aviation grade fuel

is preferable, if available, because of its lower lead content.

WARNING!

Under no circumstances should aviation fuel of a lower grade than 91-09 octane be used in this engine.

Aviation fuels may be distinguished by their color. Remember that 80 octane is RED; 91 octane is BLUE; 100 octane is GREEN.

ENGINE ACCESSORIES

The Lycoming 0-360 A-1-A engine is equipped with the following accessories:

Generator	-	Delco-Remy 50 ampere output
Starter	-	Delco-Remy 12 volt type
Magnetos	-	Bendix S-200 (left magneto equipped with retard breaker points)
Fuel Pump	-	AC Diaphram-type
Carburetor	-	Marvel MA4-5 float-type
Spark Plug	-	AC SR-88D
Oil Radiator	-	Harrison Model APO7AUO603
Battery	-	Rebat R-33, 33 amperes
Vacuum Pump	-	Airborne Mechanism's Dry-Type, Model 113

THE MARK 21 PROPELLER

The Mark 21 utilizes a McCauley Constant Speed propeller. The blades have a high-aspect ratio and a diameter of 74 inches. They are constructed of aluminum alloy and are annodized, as well as painted, for protection. Operation of this propeller is completely automatic. Once the desired propeller speed is established by the pilot, the blades automatically change their pitch to maintain a constant engine speed.

The hub of the propeller contains a completely sealed, pitch actuating unit. All materials of this unit have been specifically chosen for their resistance to wear and are fully protected against weathering. Grease and oil seals are made of synthetic rubber of high durability. All aluminum alloy parts are annodized. All steel parts are suitably plated. The blade actuating pins are chrome-plated, not only for protection, but

to provide low friction and wear-resistant surfaces for better operation. Other steel members are cadmium-plated.

PROPELLER OPERATION

The McCauley propeller utilized engine oil pressure to change from low to high pitch. The oil comes from the engine lubrication system; however, since the propeller's oil pressure requirements are greater than the engine's, the oil pressure is boosted by a geared pump in the Woodward governor before it is delivered to the propeller. A strong spring, aided by the blade's centrifugal force, changes the pitch of the propeller from high to low pitch. This force is always present in the propeller and is counter-balanced by the oil pressure.

THE PROPELLER GOVERNOR

The Woodward propeller governor, which is mounted on the accessory section of the engine, controls the speed of the propeller and the engine by decreasing the oil pressure when the RPM is too low. This allows the spring and the centrifugal force to change the propeller pitch so that it takes a smaller "bite" and thus speeds up. The governor increases the oil pressure to the propeller when the RPM is too high. The extra oil pressure overcomes the force of the spring and the centrifugal force and changes the propeller pitch so that it takes a larger "bite" and thus slows down.

PRE-FLIGHT INSPECTION

Before each flight the propeller blades should be checked for any nicks, cracks, or signs of other damage.

NOTE: It is not unusual for the propeller to have a certain amount of end-play. This is a result of manufacturing tolerances in the parts. Small differences at the blade root are magnified many times at the tip. This end-play has no adverse effect on the performance or operation of the propeller. As soon as the propeller begins to rotate, the centrifugal force of the blades seats them positively and rigidly against the bearing.

HUNTING OR SURGING

Sometimes it may be noted that the tachometer needle wavers in straight and level flight. If it is excessive, it may be further checked to determine if the problem lies in the propeller governor system or in the tachometer by doing the following:

1. Increase the propeller control to the "high RPM" position. The RPM should go to 2700.

2. Reduce the manifold pressure control until the RPM is below 2700. At this time, the propeller will be in fixed pitch.

If the tachometer needle continues to waver, the problem lies in the tachometer and cable system, itself. If the tachometer needle stabilizes, then the problem lies in the governor and propeller system. To eliminate this condition, have your mechanic purge, or clean the propeller system.

If surging of the propeller occurs during takeoff or climb out, it may be caused by air in the system of foreign matter in the governor passages. If, after the system has been purged, surging persists, the condition may be cured by adjusting the carburetor.

THE MARK 21 FUSELAGE

THE CABIN SECTION

The forward section of the fuselage is composed of a truss-type welded steel frame covered with aluminum skin. A stainless steel fire wall separates the cabin from the engine compartment. Generous use of sound-deadening lead tape and fiber glass soundproofing makes the cabin "whisper quiet." Three-sixteenth inch tinted glass on the side windows, and one-fourth inch tinted glass on the front windshield add greater comfort and safety. Fiber glass window frames are painted to harmonize with the decor of the luxurious interior fabrics.

Cabin seats are constructed of welded steel frames, and the two front seats recline for greater comfort on long trips. All seats incorporate "no-sag" springs overlaid with poly-foam rubber cushions and covered with expensive and tastefully chosen fabrics for maximum comfort and beauty. The interior styling is by Fred M. Gore, noted industrial designer.

The cabin door is stamped from heat-treated aluminum and has a three-way, positive-locking latch, and is tightly sealed so that there are no air leaks. A heavy piano-type hinge is used to secure the door to the fuselage. The three-way latch mechanism has a safety latch, a lock pin, and a latch hook to hold the door positively and securely in place. A heavy, chrome-plated steel door handle actuates the latching mechanism.

LUGGAGE COMPARTMENT

The extra-large luggage compartment is easily accessible from inside or out. The door is made both air and water tight by a full length piano hinge, rounded corners and rubber mounding. Location of the compartment makes the loading and unloading of baggage easy and convenient.

THE FUSELAGE TAIL CONE SECTION

The fuselage tail cone section is of monocoque construction. Aluminum skin, dipped in zinc-chromate primer for corrosion protection, is riveted to heat-treated aluminum bulkheads to form the tail cone section. Extruded aluminum stringers add longitudinal strength to the tail cone.

An access opening is located on the left side of the tail cone section of the fuselage for easier access to the tail. This greatly facilitates the installation of radio power packs and inspection of the tail cone.

A spring-steel tail skid and tie down ring are attached to the lower section of the tail cone rear bulkhead. This is to protect the tail from damage in the event of an extreme nose-high landing and to provide a tie-down ring for parking.

Tail empennage attaching hinges are locked to the fuselage tail cone through a reinforced multiple-bulkhead system, which distributes all tail empennage loads into the tail cone structure. These hinges are constructed of heavy, machined metal and are attached to the tail cone by Huck bolts, Hi-Shear rivets, and Hi-Lock fasteners--all proved by extensive use with the military and the airlines to be superior locking devices.

THE TAIL TRIM ACTUATING MECHANISM

The tail trim actuating mechanism is built into the multiple-bulkhead system, also. A screw-jack, operated by a torque tube running from the pilot's trim wheel to the tail cone rear bulkhead, trims the aircraft by moging the entire tail empennage. A short-coupled, piano-type hinge (the lower tail attaching hinge) absorbs the effects of any unsymmetrical tail loads caused by air gusts, and allows the trim screw-jack to operate completely free of any side loads. The tail-attaching hinges and bolts

are reamed to close tolerances and to give the tail empennage free movement without excess end play.

All structural members of the tail cone and trim actuating system are specially "Turco-treated" against corrosion.

THE MARK 21 WING

THE LAMINAR-FLOW WING

The Mark 21 uses a laminar-flow wing. This wing reduces drag, improves aerodynamic efficiency over standard airfoils, and yet retains very docile slow-flight and stall characteristics. Through the use of the laminar-flow wing, the Mark 21 has achieved almost unbelievable performance for its horsepower.

THE MARK 21 WING CONSTRUCTION

The Mark 21 wing is all metal and is constructed in one piece, incorporating a single main spar of rugged "Z"-type construction. Every bulkhead in the wing forms a torsion box which distributes the wing loads evenly over the entire wing.

The wing skin is attached to the wing utilizing a new "wrap-around" technique that eliminates any skin laps in a span-wise direction, thus contributing to a smoother wing surface. The skin is pre-stretched and is flush-riveted from the leading edge rearward on the wing surface to a point where rivet-head drag is at a minimum.

The main spar is constructed in one piece. All spar caps are extruded from 7075 T-6 aluminum alloy and are assembled in such a manner as to form a "Z" cross-section. High-strength fasteners, such as Huck bolts, Hi-shear rivets, and AD rivets insure maximum structural integrety.

The wing is built on six assembly jigs and then each assembly is transferred to one wing-final-assembly jig for completion. These jigs are optically leveled and aligned to insure a high degree of uniformity. This results in a truer airfoil, better appearance, and closer tolerance fit of all parts.

The wing is attached to the fuselage by thirty-four attaching bolts. Aileron and flap hinges are machined from extrusions. All structural members of the wing are "Turco-treated" against corrosion, and the main spar receives further corrosion protection in the form of a coating of zinc-chromate primer.

THE MARK 21 TAIL EMPENNAGE

The tail empennage is constructed in the same manner as the wing. Optically aligned jigs insure uniformity and close tolerance fit of all parts. The same "wrap-around" skin construction and use of flush riveting eliminates high-drag skin laps.

The rear spars on both the horizontal and vertical stabilizer are made from extrusions, as are all control hinge fittings. A metal gap strip attached to the aft side of the stabilizers effectively stops drag-producing air flow between the empennage and the control surfaces.

THE MARK 21's NEW-TYPE PAINT

All exterior metal parts of the Mark 21 are painted with a new type acrylic-base enamel. This enamel is non-porous and leaves a plastic-like covering over the metal parts. The advantages are:

1. A higher gloss finish.
2. A finish that is easier to maintain, since it requires no waxing.
3. A finish that has greater resistance to oxidation and thus will stand up longer under adverse-weather conditions.
4. A finish that retains its resiliency almost indefinitely, and resists chipping or rain-chaffing.
5. Greater re-sale value of the airplane.

THE MARK 21 LANDING GEAR

The Mark 21 landing gear is unique in that it is manually retracted by the pilot. Gear-assist springs in the wings, aided by bungee-type springs in the fuselage, make the manual operation of the gear quite simple. New overcenter-lock springs positively force the down-locking mechanism into place when the gear is lowered.

GEAR CONSTRUCTION

The landing gear is constructed of heavy, chrome-molybdenum tubular steel, heat-treated for greater strength and resistance to wear. Neoprene rubber discs of great resiliency absorb the shock of normal taxiing and landing. The Cleveland wheels are made of magnesium castings and the six-ply tires are made by Goodyear. The main gear has a nine-foot tread, which makes taxiing a simple operation; and because of the wide gear-tread and the aircraft's low center of gravity, taxiing or landing in strong cross-winds presents no problem, even to the novice pilot. The attaching points of the main gear are in metal bushings embedded in a gear-mounting box and attached to the spars. The nose wheel is mounted to the cabin's tutular-steel frame instead of to the engine mount. Tire pressures are as follows:

Nose wheel tire	24 to 30 pounds
Main wheel tires	24 to 30 pounds

THE MARK 21

MISCELLANEOUS INSTALLATIONS

THE INSTRUMENT PANEL

The instrument panel has been scientifically designed to provide functional location of all flight, radio, and engine instrument groupings.

All flight instruments are grouped on a shock-mounted panel directly in front of the pilot. They are located in such a manner as to provide maximum efficiency for the instrument cross-check, a most important item for good IFR flying.

The radio panel is located in the center of the instrument panel and has sufficient room for two modern radios. A sub-radio panel is located on the far right side of the panel, should a third radio be desired. All of the engine instruments are grouped on the co-pilot's panel. A brief glance tells the whole story on engine operation, since all the engine instruments are in one location.

The electrical panel is divided into two parts:

A. The electrical toggle switches, which are lower left side of the pilot's panel. They are (from left to right):

1. The main fuel gauge selector.
2. The electric fuel pump.
3. Space for an optional equipment switch.
4. The pitot heat (if ordered).
5. The rotating beacon (if ordered).
6. The navigation lights.
7. The landing light.

B. The breaker switches, or fuses, which are located on the lower right side of the co-pilot's panel, and are covered by a special breaker-switch cover. These switches are of the push to re-set type.

The push-pull controls are located on the lower right side of the pilot's panel. These operate (from left to right):

1. The parking brakes.
2. The cabin heat.
3. The cold air.
4. The carburetor heat.

The carburetor heat control is located just to the left of the throttle for convenience and safety. It has a serrated shaft to reduce "creeping" of the control when partially on.

THE MARK 21 CONTROLS

The ailerons, elevator, and rudder on the Mark 21 are of all-metal construction. They are jig-built, using hinges of machined extrusions. The elevator and rudder incorporate an unusual method of construction. The leading-edge spar of these controls consists of a specially designed extrusion that allows flush attachment of the skin.

The control system for the Mark 21 requires very little maintenance and provides superior control-feel because torque tubes, rather than the conventional cable system, are used to actuate the controls. The fact that this control system provides unsurpassed control pressure and response through the elimination of slack in the system, and the fact that it provides a more durable and lower maintenance system, are reasons why the Mark 21 has attained such popularity in such a short period of time. HEIM bearings are used throughout the control system. These bearings are permanently lubricated and require no maintenance.

The control wheel is designed to give maximum visibility to the instrument panel and to provide just the right control feel; and because of the differential travel of the ailerons, very little rudder is needed in flight to coordinate turns. This makes in-flight co-ordination in the Mark 21 quite simple and easy.

THE ELECTRICAL SYSTEM

The Mark 21 uses a twelve-volt electrical system. A fifty amp, heavy-duty generator provides plenty of current so that, even if a high electrical load is placed on the system by multiple radios, a rotating beacon, and navigation lights, the heavy-duty, thirty-three amp battery will remain at full charge.

The battery is located on the forward left-hand side of the fire-wall. It is sufficiently close to the engine, so that there is very little voltage drop and more electric power is available for cold weather starting. Since it is located in the engine compartment, engine heat tends to keep the battery warm for best performance.

IMPORTANT

The battery should be serviced every thirty days, or every twenty-five hours of flight, whichever comes first.

Breaker switches, designed to relieve the electrical system of any over-loads, are located on the lower right-hand side of the co-pilot's instrument panel. If a circuit breaker pops out continuously, its circuit is overloaded, and should be checked for a short.

The Master Switch Control for the electrical system is located at the top right-hand side of the radio instrument panel. The electrical system operates all of the electrical accessories listed below:

1. Radios.
2. Engine starter.
3. Starter vibrator.
4. Engine generator.
5. Navigation lights.
6. Landing light.
7. Rotating beacon (if installed).
8. Heated pitot (if installed).
9. Turn and bank (if installed).
10. Electric auto pilot (if installed).
11. Fuel gauges.
12. Electric fuel pump.
13. Stall warning horn.

NOTE: The engine has its own separate electrical system and will continue to run, even though the Master Switch has been turned off; or even though the accessory electrical system should fail.

THE FUEL SYSTEM

The Mark 21 has a forty-eight gallon fuel capacity, using two integral fuel cells. These cells are formed by sealing off, through the use of a special sealing compound, a portion of the wing. These cells are located on the forward section of the wing near the root and hold twenty-four gallons each.

Aluminum fuel lines feed the fuel from the cells to a two-way, positive-setting selector valve on the floor beneath the pilot's seat. The selector valve is made by Republic Products and uses a teflon core, which not only provides greater resistance to wear, but also eliminates the tendency to "freeze" up that is prevalent in brass valves. The selector valve feeds fuel from one of the cells at a time, and also has an "off" position for extended periods of storage or for emergency use.

Fuel is then routed from the fuel selector, through the Bendix electric fuel pump up to the gascolator, or sediment bowl, by aluminum fuel lines. From the gascolator it passes through the fire wall to the engine-driven pump, and from there to the carburetor.

For normal operation, the engine-driven fuel pump has adequate capacity to pump fuel from the fuel cells to the carburetor; but to insure an adequate supply of fuel for take-off and landing, and to preclude engine fuel pump failure, it is recommended that the electric fuel-boost pump be used for these operations.

There are three flush-type quick drains located in the fuel system: one at the lowest point of each fuel cell, and one beneath the fuel selector. Use the drain cup provided to test for water or sediment after each re-fueling or prior to each flight.

THE BRAKE SYSTEM

The Mark 21 uses Cleveland disc-type hydraulic brakes. Each main gear is equipped with a disc brake, and each brake is actuated individually by brake pedals located on the pilot's rudder pedals. The brake disc is bolted to the inner rim of the wheel instead of being held in place by brake clips. The brake linings are held in place by three rivets and can easily be replaced. The brake disc, itself, is exposed to the air for extra cooling.

The hydraulic reservoir is located on the cabin side of the fire wall, just aft of the battery. It is easily accessible by removing the left-side access panel, just forward of the pilot's windshield.

NOTE: The Mark 21's brakes have synthetic seals which require a petroleum-base brake fluid. Texaco "A" Aircraft Hydraulic Fluid is recommended; however should it become necessary to add brake fluid to the reservoir, be sure to use a brake fluid which conforms to Military Specifications 0-5606A. This brake fluid is Red in color.

The brake master cylinders are located under the left-hand side of the fuselage and are easily accessible by removing the access cover.

THE MARK 21

MISCELLANEOUS ACCESSORIES

THE MANUALLY OPERATED STEP

A manually retracted step is provided to make it easier to enter the cabin. The step is constructed of heavy-gauge, welded steel, and is chrome-plated for better appearance and protection.

The step-retraction crank is located on the left side panel by the pilot's left knee. Two and one-half turns of the crank in a clockwise direction retract the step fully into the wing-root fairing. Rotating the crank in a counter-clockwise direction lowers the step.

NOTE: Failure to retract the step will result in the loss of five miles per hour air-speed.

THE OVERHEAD VENT SYSTEM

Four individual airline-type adjustable vents are located in the center of the cabin roof to provide fresh air for each passenger. Air is forced through a retractable scoop in the top of the fuselage when it is opened by turning the overhead control for the vent system 180 degrees in a clockwise direction. Each passenger may adjust the desired amount of air by turning his individual vent clockwise for more air and counter-clockwise for less air, and may adjust the the direction of air by swiveling the vent.

THE FORWARD VENT SYSTEM

Two vents under the instrument panel provide a second source of fresh air to the cabin. When the cold air control is pulled to the "on" position, fresh air is forced through a scoop on the side of the fuselage into a mixing box and then into the vent tubes under the instrument panel. Deflectors force the air either downward toward the pilot's and co-pilot's feet or upward, as may be desired.

THE HEATER AND DEFROSTER SYSTEM

Cabin heat is supplied by a heater muff which transmits air heated by conduction from the engine exhaust manifold. The hot air is piped to the cabin air mixing box where it is then directed through the pilot's and co-pilot's air vent system.

To operate the heater, pull the heat control to the "on" position. Adjustment of the air deflector will force the warm air downward toward the floor or upward, as desired. When the air deflector is in the neutral position, air is forced into the window defroster system.

THE FLAP SYSTEM

The flaps are of all-metal construction and span seventy percent of the wing trailing edge. They are primarily drag flaps, but do also give a slight increase in lift when in the "down" position. The flap handle is located on the right side of the gear handle and has three positions:

1. The "up" position when the handle is full forward.

2. The "take-off" position when the handle is in the middle notch.

3. The "down" position when the handle is in the full back position.

To actuate the flaps, pull the flap handle downward until the lock pin is clear of the notch and then pull the handle to the desired position and lock by pushing the lock pin into the notch.

NOTE: Do not actuate the flaps above 100 miles per hour indicated air speed.

THE INSTRUMENT LIGHTS

Two instrument lights are located on the forward, center overhead panel. They are manually adjustable to provide a beam of light anywhere on the instrument panel. Screw adjustments on the rear side of each light are provided to focus the beam of light for smaller or greater surface coverage. A rheostat control is located to the right of the lights and when turned clockwise dims the lights; then when turned counter-clockwise, brightens the instrument lights. It is also the "on-off" switch for the instrument lights. A courtesy light under the pilot's panel is wired in conjunction with the instrument lights. This light illuminates the fuel selector. When not in use, it can be shaded by turning the cover in a clockwise direction.

THE TRIM SYSTEM

The Mark 21 uses a unique trim system. The entire tail empennage moves when the trim wheel is actuated. The use of this system of trimming eliminates the drag of the standard trim tab. It also keeps the vertical stabilizer perpendicular to the line of flight at all angles of attack and keeps the horizontal stabilizer lined up with the line of flight. Not only is this system more efficient, but it also gives more positive rudder and elevator control right through the stalling speed range. Rolling the trim wheel in a rearward direction increases the back pressure on the elevator controls through the assistance of elevator bungees.

THE COWL FLAPS

The cowl flap control is located under the instrument panel, just beneath the throttle. As a general rule, it should be used whenever you have a high power setting and a low airspeed, or when the cylinder head temperature is above 450 degrees Fahrenheit in level flight.

Normally, cowl flaps are used for climb-out. In the winter time, the cylinder head temperature may run low, even during climb- out. Should this occur, it would be advisable to climb with the cowl flaps closed.

NOTE: For best cooling during the summer, climb with the cowl flaps open and 120 IAS.

PART II

THE MARK 21 FLIGHT PROCEDURES

PRE-FLIGHT INSPECTION

A thorough pre-flight inspection is a necessity for safe operation of any aircraft. Use the following check list as a guide to insure that your Mark 21 is ready to fly:

1. Check all switches off.
2. Check the propeller blades for nicks or cracks.
3. Check the oil level to six quarts or above.
4. Inspect the cowling for loose screws.
5. Inspect the tires for proper inflation.
6. Inspect the carburetor air filter for cleanliness.
7. Using the fuel cup, drain the fuel sump on the left forward bottom of the fuselage.
8. Check the left tank for fuel level.
9. Check the left aileron for proper travel and smooth operation.
10. Inspect the left flap.
11. Check the horizontal stabilizer for end play.
12. Inspect the elevator and rudder hinges.
13. Inspect the right flap.
14. Inspect the right aileron for proper travel and smooth operation.
15. Check the right fuel tank for fuel level.

LOADING PASSENGERS

For easiest loading of passengers, use the following procedures. With both front seats all the way to the rear, the pilot should climb into the left front seat first. Placing his right hand on the steel cross-bar

under the instrument panel and his left hand on the seat adjustment lever beneath the left front seat, he should slide the seat forward to a comfortable position.

NOTE: The further forward the pilot sits, the better his visibility will be over the nose and over the leading edge of the wing.

When the pilot is comfortably seated with his seat properly adjusted, he should then slide the right front seat all the way forward and allow his two rear-seat passengers to enter. After they are seated, the pilot should slide the right front seat back to the last notch and, while holding the control wheel full-forward, allow his front-seat passenger to enter. When the last passenger is seated, he should slide the right front seat forward to a comfortable position.

To close the door, grasp the door-pull strap and press the door in tightly against the seal.

NOTE: Do not slam the door. Slamming the door is likely to damage the latching mechanism and put the door out of adjustment.

Holding the door tight against the seal, rotate the door handle full-forward until the latch locks into position.

STARTING THE ENGINE

There are five pre-starting items to cover below the instrument panel. They are as follows:

1. Adjust the trim to "take-off" position.
2. Place the fuel selector on the "left" or "right" main tank.
3. Roll the step to the "up" position.
4. Pull the cowl flaps to the "open" position.
5. Place the flaps in the "take-off" position.

Now, going to the lower left side of the pilot's panel:

6. Place the main fuel gauge switch on the tank corresponding to the tank on which the fuel selector is placed.
7. Place the electric fuel pump switch to the "on" position.

STARTING THE ENGINE (CONT'D)

8. Check all other electrical switches to the "off" position.
9. Set the parking brake by pulling brake control and simultaneously depressing the brake pedals. For greater braking pressure, repeat this procedure.
10. Check the cabin heater, cabin vent, and carburetor heat controls in the "off" position.
11. Check the throttle in the "closed" position.
12. Check the propeller control in the "full increase" RPM position (full forward).
13. Check all breaker switches "closed".
14. Check all radios in the "off" position.
15. Push the mixture control to the "full rich" position.
16. Call "clear", and pull the master switch to the "on" position.
17. Depress the throttle button and pump the throttle twice to prime the engine.
18. Set the throttle approximately 1/4" open.
19. Turn the magneto switch to the "start" position.
20. After the engine starts, adjust the throttle for 800 RPM and check the engine oil pressure.

STARTING IN COLD TEMPERATURES

For cold weather starting, when temperatures drop below 32 degrees Fahrenheit, add the following procedure to the starting procedures:

17A. At step 17 above, depress the throttle button and pump the throttle four times. This gives the engine the extra prime necessary for cold weather starting.

For extremely cold weather starting, temperatures below 15 degrees Fahrenheit, add the following procedures to the starting procedures:

17B. At step 17 above, depress the throttle button and pump the throttle six to eight times.

17C. After priming the engine, check the magneto and master switches in the "off" position, and then manually pull the propeller through at least four revolutions. (This sucks the raw fuel from the intake manifold into the compression chamber so that less battery energy is needed for starting.) After pulling the propeller through,

STARTING IN COLD TEMPERATURES (CONT'D)

17C. (Cont'd)
place the magneto and master switches in the "on" position once again and continue with the starting procedures listed above, starting with item 18.

MANUALLY STARTING THE ENGINE

In the event that it becomes necessary to start the engine with a low battery and no external battery source is available, use the following procedures:

19A. At step 19 above, reach behind the instrument panel and turn the "starter disconnect switch" to the "off" position. This switch is located just to the right of the starter vibrator and is mounted behind the instrument panel on the upper center part of the fire wall. It disconnects the starter so that when the starter switch is turned to the "start" position, only the starter vibrator operates.

19B. As the engine is manually "propped", hold the starter switch in the "start" position. This operates the starter vibrator and furnishes the retarded spark to the engine. When the engine starts, release the switch and place the "starter disconnect switch" in the "on" position.

TAXIING PROCEDURES

Any tricycle gear aircraft is easy to taxi. The Mark 21 is particularly easy to taxi for several reasons:

1. It has a nine-foot tread between main gears.
2. It has an exceptionally low center of gravity.
3. It has direct linkage from the rudder pedal to the nose wheel. This gives positive control with a minimum of rudder movement.

For these reasons, ground operation of the Mark 21 is simple. Cross-wind landings are as easy as normal landings and taxiing in a cross-wind is a cinch.

A word of caution: The propeller of the Mark 21 has eleven inches ground clearance. It is recommended that minimum power be used for starting to taxi on sod or gravel fields. Too much power will cause the prop blast to suck up stones and thus nick the propeller. It is a good idea to use the vernier operation of the throttle only for taxiing. This will help to avoid inadvertent use of excessive power.

RUN-UP PROCEDURES

When in the run-up position (on gravel fields, it is recommended that the run-up be made while taxiing to avoid nicking the propeller), make the run-up in the following manner:

1. Adjust the RPM to 1700.
2. Check the ammeter for positive charge.
3. Check the magnetos for smooth operation and maximum drop-off of 100 RPM.

   NOTE: If one magneto runs rough, turn the switch back to the "both" position and reduce the power to 800 RPM. Allow the engine to run for a minute and then slowly increase the power to 1700 RPM and recheck the magnetos. This operation will usually burn out the carbon deposits and allow the magnetos to check properly.

4. Exercise the propeller by pulling the propeller control to the "full-out" position. After the tachometer has shown a drop-off of 100 RPM, push the propeller control to the "full-in" position.
5. Pull the carburetor heat control to the "hot" position and check the tachometer for approximately fifty of 100 RPM drop. Push the carburetor heat control to the "cold" position.
6. Check the cylinder head temperature. If it reads 250 degrees Fahrenheit or more, the engine is warm enough for take-off.

   NOTE: Lycoming recommends a maximum ground run of four minutes in cold weather and two minutes in temperatures above 70 degrees Fahrenheit.

NORMAL TAKE-OFF AND CLIMB PROCEDURES

NORMAL TAKE-OFF

After the run-up procedures have been completed, line the Mark 21 up with the runway. Move your feet to the lower part of the brake pedals and away from the brakes. Twist the throttle vernier to increase the power and then squeeze the throttle botton and smoothly apply full throttle. Maintain directional control by application of pressures on the rudder pedals rather than movements. Allow the aircraft to accelerate to between 65 and 75 miles per hour. When the aircraft has attained this speed, smoothly apply elevator back pressure to lift it from the runway.

NOTE: When back elevator pressure is applied, the nose wheel will lift from the ground and shortly thereafter, the aircraft will break ground. As the nose wheel lifts from the ground, increase right rudder pressure to provide the torque control that the nose wheel can no longer give.

When the Mark 21 breaks ground, it will tend to "rock" into a nose-high attitude. To compensate for this tendency, relax some of the elevator back pressure as the nose-wheel leave the ground. For best results and a smoother take-off, do not allow the nose of the Mark 21 to lift above the horizon during take-off. After some practice, you will find that you can make your smoothest take-offs by applying elevator back pressure as flying speed is approached and then slowly reducing the back pressure as you feel the nose wheel lifting from the ground. This will allow the aircraft to fly smoothly from the runway without any abrupt change in pitch attitude.

As soon as the Mark 21 is airborne and under good control, perform the following procedures:

1. Retract the gear (see gear operation below).
2. Reduce the propeller RPM to 2550-2600.
3. Retract the flaps (if used).
4. Establish climb-out attitude.
5. Turn electric fuel pump to the "off" position.

GEAR OPERATION

To retract the gear, slide the gear handle from the down-lock detent and move the handle rapidly to the floor between the seats. Slide the gear handle into the up-lock detent and the operation is complete. The more rapid the movement of the gear handle, the easier it is to retract the gear. The gear retracts easiest at low airspeeds as air pressure on the gear fairing doors helps push it up.

To lower the gear, slide the gear handle from the up-lock detent and move the handle forward to the instrument panel. Slide the gear handle into the down-lock detent and check the gear warning light for a gear-down indication (a green light).

NOTE: Your aircraft is equipped with the safest retractable mechanism available. It is just as safe as the operator of the aircraft, since the proper operation is completely dependent on the pilot. If you have not flown a retractable gear airplane before, you should become acquainted with proper procedures of any aircraft with retractable gear.

If you will follow the following rules of safety, you will not experience an expensive, unwarrented gear retraction:

1. Upon entering your Mark 21, be sure the gear handle is properly secured in the "gear-down" position. Do not use the gear retracting handle as an assist when moving your seat to a forward position. Use the steel tubular frame under the instrument panel.

2. After turning on the master switch, be sure that your green light indicates "down and locked" before proceeding with your check list.

3. If you are operating from muddy fields or under slush-ice conditions, be sure your landing gear mechanism is free of all foreign matter before taking off. Ice and mud can be thrown upon the retraction mechanism and freeze solid, making it impossible to operate the landing gear. This situation can occur on any retractable gear aircraft almost, regardless of size or operating

3. (Cont'd)
complexity. If during take-off, you notice an unusual force required to operate the gear, immediately return it to the down and locked position and land to investigate.

4. On take-off, do not touch the handle preparatory to retracting the main gear until you have a safe airspeed and are sufficiently high above the runway to avoid sinking back to the ground.

5. Make a practice of checking the land gear handle for down and locked while on final approach. Check the gear warning light for GREEN condition.

NOTE: Do not lower the gear above 120 MPH.

NORMAL CLIMB

Initial climb-out can be made at an indicated speed of 96 MPH (minimum cooling speed), until leaving the traffic pattern. For best results in the climb after leaving traffic, it is recommended that 115-120 MPH be used. This climb attitude will give excellent visibility and an efficient rate-of-climb.

When the throttle is in the "full-open" position, an automatic enrichment valve opens in the carburetor to give extra fuel for cooling the engine. The automatic enrichment valve is provided so that it is possible to climb out with the throttle in the "full-open" position; however if you desire to climb at a lower power setting, it is recommended that you use twenty-five inches of manifold pressure and 2500 RPM.

SHORT FIELD TAKE-OFF

If it should become necessary to make a short field or high altitude field take-off, the following procedures are recommended:

1. Roll the trim tab back until the indicator is half way between the "normal take-off" position and the "full-back" position.

2. Place the flaps in the "fully-retracted" position.

3. Hold the brakes and increase the throttle to the "full-open" position.

CAUTION: If on a gravel strip, eliminate this procedure unless absolutely necessary.

SHORT FIELD TAKE-OFF (CONT'D)

4. Release the brakes and allow the aircraft to accelerate to 60 MPH.

5. Upon reaching 60 MPH, extend full flaps and simultaneously add sufficient elevator back-pressure to pull the aircraft smoothly from the ground.

6. When airborne, retract the gear.

7. For maximum angle of climb to clear an obstacle, use one notch of flaps and climb at 70 to 80 MPH IAS.

8. When clear of the obstacle, allow the airspeed to increase to 90 MPH and retract the flaps to the "full-up" position.

9. Reduce the RPM for normal climb-out and establish a normal climb.

HIGH ALTITUDE CLIMB

On a hot day and with a heavily loaded airplane, maximum altitude can be attained by trimming the aircraft for a 120-125 MPH IAS climb. The wing's efficiency is at its best within this speed range, and the Mark 21 will climb at altitudes where most other airplanes in its category will not.

CRUISE PROCEDURES

LEVEL-OFF PROCEDURES

In order to accelerate to cruising speed, it is recommended that you allow the aircraft to climb 200 feet above cruising altitude prior to beginning the level off. Use the following level-off procedures:

1. Close the cowl flaps.
2. Trim the nose downward to the level flight altitude.

   NOTE: As the nose drops, the aircraft will lose the extra 200 feet and thus will accelerate more rapidly to cruise speed.

LEVEL-OFF PROCEDURES (CONT'D)

3. Reduce the manifold pressure and RPM to desired cruise setting.

4. Learn the mixture for smooth operation (reference Lycoming's Operators Manual, page 32-33).

5. Retrim to maintain altitude.

CRUISE CHARTS

The following cruise charts are provided to enable you to choose the altitudes and power settings which will give the best performance. Please keep in mind the following information:

1. When the throttle is in the "full-in" position, the automatic enrichment valve in the carburetor is open. The power settings in the normal cruise and performance charts include the symbol "FT". It means full throttle but retarded sufficiently to close the automatic enrichment valve.

2. The indicated airspeed column in the normal cruise and performance cruise charts contains a low and a high speed range because the airspeed will vary with temperature changes. In summer, it will read on the low side; in winter, it will read on the high side.

3. The "range" column in all three charts does not take into consideration the extra fuel used for take-off and climb-out. The average fuel consumption in a climb from sea level to 10,000 feet is 14.0 GPH. During fifteen minutes of climb, the engine will consume 3.5 gallons of fuel. Assuming that one-half gallon was used for taxiing, then forty-four gallons remain for cruise after level-off.

Referring to the "Fuel Consumption" column for your power setting, the remaining range in hours may be determined by dividing the fuel consumption per hour into forty-four gallons.

PERFORMANCE CRUISE CHART

Altitudes	Power Settings RPM	Manifold Pressure	% Power	Fuel Cons.	Indicated Airspeed** S. - W.	True Airspeed	Range (No Reserve)***
1,000	2450	24"	77	10.7	160-168 mph	168 mph	4 Hrs. 36 Min.
2,000	2450	24"	78	10.9	160-168 "	171 "	4 Hrs. 30 min.
3,000	2450	24"	78	11.0	160-167 "	173 "	4 Hrs. 28 min.
4,000	2450	24"	79	11.1	160-167 "	175 "	4 Hrs. 24 min.
5,000	2450	24"	81	11.3	159-165 "	176 "	4 Hrs. 20 min.
6,0	2450	FT*	78	11.0	157-164 "	179 "	4 Hrs. 28 min.
7,000	2450	FT	78	10.9	155-160 "	177 "	4 Hrs. 30 min.
8,000	2450	FT	72	10.1	150-155 "	175 "	4 Hrs. 51 Min.
9,000	2450	FT	70	9.8	145-150 "	173 "	5 Hrs. 00 Min.
0,000	2450	FT	67	9.3	142-146 "	171 "	5 Hrs. 18 Min.

Above fuel consumption figures are based on rich mixture -- fuel consumption may be reduced by proper leaning.

* See "Cruise Procedures", Page 25
** See "Cruise Charts", Page 26
*** See Page 26

S. = Summer

W. = Winter

NORMAL CRUISE CHART

Altitude	Power RPM	Settings Manifold Pressure	% Power	Fuel Cons.	Indicated Airspeed** S. - W.	True Airspeed	Range (No Reserve)***
1,000	2300	23	70	9.8	152-163 mph	160 mph	5 Hrs. 00 Min.
2,000	2300	23	71	9.8	152-163 "	163 "	5 Hrs. 00 Min.
3,000	2300	23	71	9.8	152-162 "	165 "	5 Hrs. 00 Min.
4,000	2300	23	72	9.9	152-162 "	167 "	4 Hrs. 57 Min.
5,000	2300	23	73	10.0	151-160 "	170 "	4 Hrs. 54 Min.
6,000	2300	23	73	10.1	151-160 "	171 "	4 Hrs. 51 min.
7,000	2300	FT*	74	10.2	150-159 "	174 "	4 Hrs. 48 Min.
8,000	2300	FT	69	9.6	148-152 "	172 "	5 Hrs. 06 Min.
9,000	2300	FT	67	9.3	143-148 "	170 "	5 Hrs. 18 Min.
10,000	2300	FT	64	8.9	139-143 "	169 "	5 Hrs. 30 Min.
11,000	2300	FT	63	8.7	138-142 "	169 "	5 Hrs. 36 Min.
12,000	2300	FT	62	8.5	137-142 "	168 "	5 Hrs. 48 Min.

Above fuel consumption figures are based on rich mixture -- fuel consumption may be reduced by proper leaning.

* See "Cruise Procedures", Page 25
** See "Cruise Charts", Page 26
*** See Page 26

S. = Summer

W. = Winter

MAXIMUM ENDURANCE CRUISE

There may be times when you will wish to get maximum distance with your fuel supply. To do this, climb your Mark 21 to an altitude between 9000 and 13,000 feet. This is the most efficient altitude range for fuel economy. Refer to the cruise chart below for proper power settings. Establish the power settings as follows:

1. Reduce the RPM to 2200.
2. Adjust the manifold pressure to maintain 120 MPH (this is the Mark 21's most efficient airspeed). Ordinarily 16.5 inches of manifold pressure is sufficient to maintain 120 IAS; however this setting may vary slightly depending upon whether the aircraft is loaded or light.
3. Lean the mixture by moving the mixture control smoothly (and not too slowly) toward the lean position and noting the tachometer for a slight increase and then drop-off of RPM. Push the mixture control toward the "rich" position, again observing the tachometer for the slight surge in RPM. The mixture is properly leaned when:

   A. Further leaning causes rough engine operation.
   B. The cylinder head temperature is at or below 450 degrees Fahrenheit.

ENDURANCE CRUISE CHART

Altitude	Power Setting RPM	Manifold Pressure	% Power	Fuel Cons.	Indicated Airspeed	True Airspeed	Range (No Reserve)
9,000	2200	16.5"	45	6.3 gph	120 mph	140 mph	7 Hrs. 48 Min.
10,000	2200	16.5	45	6.3 gph	120 mph	143 mph	7 Hrs. 48 Min.
11,000	2200	16.5	45	6.3 gph	120 mph	146 mph	7 Hrs. 48 Min.
12,000	2200	16.5	46	6.4 gph	120 mph	148 mph	7 Hrs. 42 Min.
13,000	2200	16.5	48	6.5 gph	120 mph	151 mph	7 Hrs. 36 Min.

Make your take-off and climb out on the left tank. When the level-off has been completed, check your time and switch to the right tank. Use the right tank for one hour. Switch back to the left tank and use it for one hour. Use another hour out of the right tank, and then switch back to the left tank and run it dry. You should then be able to fly an equivalent time off the right tank and still have a thirty minute reserve for landing.

LET-DOWN PROCEDURES

It is recommended that power let-downs be made in order to keep the engine from cooling too rapidly. By reducing the manifold pressure to some figure below cruise setting and then retaining cruise speed, a let-down can be made without excessive cooling of the engine. Do not open the cowl flaps for let-down.

LANDING PROCEDURES

PRELANDING CHECK

The prelanding check is normally performed while on the downwind leg; however it may be made at the pilot's discretion prior to landing. The following prelanding check is recommended:

"GUMPS" CHECK

1. G as on fuller tank. Electric fuel pump on.
2. U ndercarriage down and locked. (below 120 MPH)
3. M ixture in the "full rich" position.
4. P ropeller control in "full-increase" position.
5. S afety belts fastened.

NORMAL APPROACH

It is recommended that the base leg be flown at 90 MPH. Upon turning final, or sooner if necessary, extend full flaps. Flap speed is 100 MPH. As the flaps are extended, the aircraft will become nose heavy. Roll the trim back so that the aircraft will glide hands off at 80 MPH. The addition of a slight amount of power will flatten out the glide considerably. Use your power as needed.

NORMAL LANDING

Begin your flare-out for landing closer to the ground than you ordinarily would. This is done for two reasons:

NORMAL LANDING (CONT'D)

1. The Mark 21 sits lower to the ground than most aircraft.
2. The Mark 21 requires very little altitude to make a transition from a glide to a landing attitude. A slight addition of back pressure is sufficient to stop the rate-of-descent.

Most Mark 21 pilots use full flaps on all landings because of the added visibility over the nose that it affords. The best landings are made when the trim tab is rolled well back and the aircraft is held off the ground as long as possible. As the Mark 21 decelerates, it becomes nose heavy. A corresponding increase of back pressure throughout the deceleration period is then necessary to hold the Mark 21 off the ground. You know you have made a good landing when you can touch down gently on the main gear only, holding the nose wheel clear of the ground for a few hundred feet of the landing roll.

SHORT-FIELD APPROACH AND LANDING

If it should become necessary that you make a landing in a very short field, make your approach as follows: After making your pre-landing check, extend your base leg slightly so that you can make a power approach. If the terrain permits, use a low, power approach to the field with full flaps and the trim rolled well back. Use a safe approach speed for the aircraft loading and to compensate for air turbulence. This speed should range from 65 MPH in smooth air to 75 MPH in turbulence. Remember, the higher your speed, the sooner you will have to cut your power in order to hit a spot of intended landing. At 65 MPH, the aircraft will settle in within fifty feet or so after the power is cut. By hard application of brakes, it is possible to stop within 400 to 600 feet from the point of touchdown.

CAUTION: Do not attempt to make a short field landing until you have sufficient flying time and experience in the Mark 21 to know its best approach speeds.

STOPPING THE ENGINE

Stop the engine in the following manner:

1. Idle the engine at 1,000 to 1,200 RPM.

STOPPING THE ENGINE (CONT'D)

2. Pull the mixture control to the "idle cutoff" position.
3. As the engine stops firing, twist the throttle all the way out to eliminate engine vibration.
4. When the propeller stops, turn the magneto and master switches to the "off" position.
5. Place the flaps in the "down" position. (When the flaps are down, they are less likely to be stepped upon.)
6. Roll the step to the "down" position.

UNLOADING THE MARK 21

For best results in unloading your passengers, use the following sequence:

1. Unload the right front seat by sliding the seat back to the last notch and allowing your right front seat passenger to step out. Hold the control wheel forward to give him more room.

2. Now slide the right front seat all the way forward and allow the two rear passengers to debark.

3. Then slide both front seats all the way back and, placing your right hand on the back of the right front seat and placing your right foot on the right front cabin floor, step toward the door and out of the cabin.

4. Close the door and latch it.

PART III

MAINTENANCE AND CARE OF THE MARK 21

A service and maintenance manual is furnished with every new Mark 21. This manual covers in detail instructions on how to properly maintain the Mark 21. You will find that this manual will be of great assistance in your getting to know your airplane better.

MAINTENANCE AND CARE OF THE MARK 21 (CONT'D)

In the back of the service and maintenance manual, are a series of inspection guides covering recommended twenty-five, fifty, and 100 inspections. These three inspections are the key to getting the service that you expect from your Mark 21. May we recommend that you have your local shop perform these inspections on your aircraft. It will pay dividends in increased service life, greater resale value, and the peace-of-mind that comes from knowing that your plane is properly maintained.