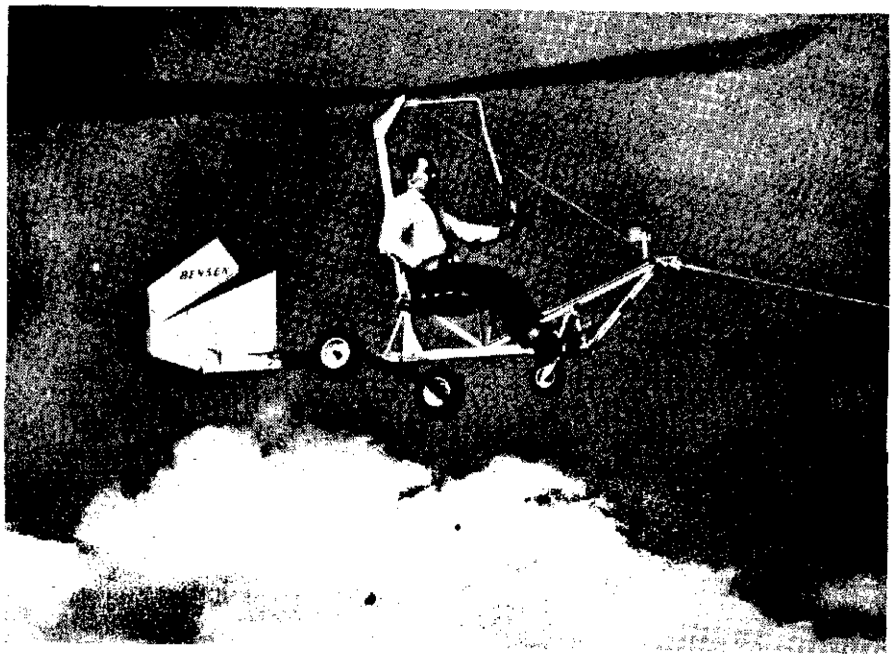
BENSEN

GYRO-GLIDER

BENSEN MODEL B-8



BUILDING AND OPERATING MANUAL

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BENSEN AIRCRAFT CORPORATION

RALEIGH-DURHAM AIRPORT

RALEIGH, NORTH CAROLINA, 27612, U. S. A.

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GYRO - GLIDER

MODEL B-8

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IMPORTANT: READ CAREFULLY

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Anyone operating or handling the equipment described herein must first read, understand and agree to comply with the instructions contained in this and other applicable Bensen Manuals. The operator will hold and save harmless its present or previous owner, Bensen, its employees and dealers from damage claims, and the owner agrees to prevent others from handling and operating this aircraft if they have not complied with the above requirement.

Xxx

TABLE OF CONTENTS

Bensen Model B-8 Gyroglider Manuals

Xxx

FOREWORD

You have just purchased here the Aircraft Plans which are a compliment to your sound judgment and good taste. We believe that Bensen Plans are the finest aircraft plans produced anywhere, handsomely illustrated and thoroughly explained in every detail. Meticulous workmanship both in the preparation of these Plans and in complete material lists, as well as quality of Bensen hardware will reward your unerring good judgment in selecting Bensen — world's first manufacturer of one-man rotorcraft.

Thanks to continuous research at Bensen factory since 1953 and tests after tests of every piece of material in Bensen machines, they will outperform all others in durability, reliability and performance. You will be proud to be the leader in Gyro circles with your machine, if it is a "Bensen all the way", without any changes or modifications.

The Bensen Gyro-glider is a real man-size flying machine. It is not a toy, although it is a lot of fun to fly. Your safety and the safety of your friends will be in your hands when you fly it, so follow the instructions carefully, and when you are ready to fly, don't take unnecessary chances.

We are very much interested in hearing about your success, or problems, in building and flying your Gyro-glider. Write us when you have anything interesting or valuable to report, send snapshots, etc. The Company awards prizes for the most interesting and inspiring stories, accompanied by photographs, sent in by Gyro-glider owners. So, be sure to send us your photos with stories, for you might win a valuable prize.

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Fig. 1—Gyroglider flying can be a lot of fun when giving rides to your friends in the dual-seat convers can also make money for you as an ideal vehicle for flight instruction. This particular Gyroglider is equip pilot training with both types of control stick—overhead and joystick. The machine is so easy to fly, and so that it flies hands-off all by itself.

GENERAL INFORMATION

The Gyro-glider is not an entirely new type of flying machine, although it was never before manufactured in the United States. The German Navy used them during the last World War, towing them high in the air behind the submarines to increase the range of vision for their observers. The British Royal Air Force used them as gliders to drop men and equipment behind the enemy lines.

Bensen Aircraft Corporation is the first and only manufacturer of Gyro-gliders in the United States, having produced and sold them since 1953. Thousands have been built by flying fans all over the world from Alaska to New Zealand. Even the U. S. Air Force and the Army had procured Bensen Gyro-gliders for military uses.

The Gyro-gliders have attracted world-wide attention because of certain inherent advantages which are not matched by any other type of aircraft:

First, their helicopter-like rotors will not stall, nor go into "spin" dives under any circumstances, regardless of how slowly the craft flies. The rotor is always under full control of the pilot. The machine can even descend vertically downward, without its rotor losing lift or control.

Second, Gyro-gliders are remarkably simple, light, and inexpensive. Three girls put one together and flew it in just 3 days during a recent PRA Fly-In.

Third, the Gyro-glider is a true Mighty Mite. Small enough to fit in any garage and weighing only 100 pounds, it can lift with ease an additional load of 500 pounds. No other flying machine has so much lifting capacity. Its ratio of payload to empty weight of 5:1 is simply unheard of in any other aircraft. The standard B-8 Model described here lifted three people weighing together 500 pounds during engineering tests.

Fourth, because of its ability to fly slowly without stalling or loss of control, the Gyro-glider can land in very small spaces, often without any ground roll at all. Little space is also required for its take-off.

Finally, the Gyro-glider has a truly outstanding safety record. Not one single in-flight structural failure has been reported to us over a period of years by owners of Gyro-gliders built by Bensen. Its low landing speed has only one-tenth the kinetic energy of fixed-wing gliders and airplanes. With such gentle landing qualities, this type of aircraft sets a new standard of safety not approached by any other flying vehicle.

DESIGN INFORMATION

The Bensen Model B-8 Gyro-glider was designed primarly to be built by an individual builder from materials and kits consisting of simple shapes easily bolted together like an erector set. Unlike its predecessor, Model B-7, the Model B-8 described here was specifically designed for high strength demanded by its possible future conversion for self-powered operation by a powerful 72 horsepower engine. The airframe was also designed to carry two people, if necessary, for instruction purposes as shown in Figure 1.

Since the greatest cost of manufactured goods today is in labor, you will save money if you can do some fabrication work yourself. In fact, you can fabricate the entire Gyro-glider yourself and procure your own raw materials. But you will save much time and possible risk of making mistakes if you order Bensen's new material packs. They contain all correct materials and hardware and are approved by Bensen engineers. Not only that, they also are so designed that you can build the entire Gyro-glider using only simple standard hand tools.

Very few people realize that the selection of materials for rotary-wing aircraft is far more critical than for any other vehicle, including the airplane. This is because structural vibrations, which are generated by the rotor can easily lead to destructive fatigue failures if materials chosen by the builder deviate even slightly from the prescribed strength, elasticity, section modulus and mass. Notice, we didn't say strength alone. Other mechanical properties are just as important and are beyond the average hobbyist's knowledge to tamper with without assuming serious risks.

Although some illustrations in this Instruction Book show earlier or different models of Gyro-gliders, this should not be regarded by you as an encouragement to deviate from the B-8 plans. On the contrary, you must constantly keep in mind that the new B-8 model represents the latest word in Gyro-glider engineering, rendering all other models obsolete. If you are determined to try some design ideas of your own, you should first build the B-8 in its exact standard form, learn to fly it well, and only then proceed to make your own modifications. You will then become your own design engineer and must assume the responsibility for any and all danger or risks of the modified machine. You must understand also that the Gyro-glider is not a high-performance soaring plane. It was not designed for high soaring performance or aerial acrobatics, but for simplicity and the greatest enjoyment of flying at lowest possible cost.

Conversion Plans and Kits are available to homebuilders who wish to put their Gyro-glider on skis, or floats, or motorize it with an engine. The water-based Model is known as the HYDRO-GLIDER, while the engine-powered Model was named the GYROCOPTER. The Plans you have here are a part of Hydro-glider and Gyrocopter Construction Plans, because certain parts of all three models are identical. Hydro-glider Float plans and Engine Conversion Plans can be ordered separately. Those pilots who wish to rig their machines with the conventional airplane type "joystick" control column, can also order the Joystick Plans. Pre-fabricated kits of joystick components are available from the factory and are recommended to fixed-wing pilots. Only Bensen-built factory furnished components, such as all metal rotor blades, Gimbal Control Head etc. have been tested to be compatible with homebuilt design. Rotors and other components of non-Bensen origin may develop dangerous vibrations, adverse control responses etc. and should be avoided.

The machine you will be building from these Plans has a fabulous background. Its first prototype, Model B-6, is now exhibited at the Smithsonian National Air Museum in Washington together with world's first airplane built by Wright Brothers, Lindbergh's "Spirit of St. Louis", and other world famous flying machines. Its engine-powered version, named "Spirit of Kitty Hawk" gyrocopter set 12 official world records in speed, altitude and distance for autogyros and is also exhibited at the Smithsonian. It set more world records than any other non-military rotorcraft in the United States. It is a pedigree you will be proud of when you fly your own Bensen.

You will be pleased to learn that the Gyro-glider can make some money for you and even pay for itself in short time if you are interested in using it to derive revenue. Thus, with the dual seat modification you can give rides to people on weekends or at various fairs. (We heard of rates varying from $.50 to $2.00 for a ride.) Dual seater can be also used for flight instruction at $10.00 to $15.00 per hour. Considering today's cost of flight training in helicopters of $60.00 per hour, many people will take your rate as a real bargain and will thank you for it. Exhibition flights of Gyro-gliders and Gyro-copters are also much in demand at air shows, bringing anywhere from $100.00 to $500.00 per show. Construction Kits with Detailed Plans for the Dual Seat conversion and the Training Trailer may be ordered from the factory.

The Bensen Model B-8 Gyro was designed by professional helicopter engineers with many years of aircraft experience. The fact that the Gyro-glider has been accepted by the Air Force attests that it is not the work of amateurs. Every bolt and nut has been carefully analyzed for its function and strength. Complete Drawings and strength data of all materials used in the B-8 design have been supplied to the FAA headquarters in Washington. These data are available to any FAA agent, whom in future you may ask to license your bird. Thus you won't go wrong if you follow this Instruction Book and the Drawings down to the finest detail. Use only materials and parts supplied in Bensen Kits. If you do, your Gyro will give you many years of reliable, trouble-free operation. So, roll up your sleeves now and let's see how well you can do!

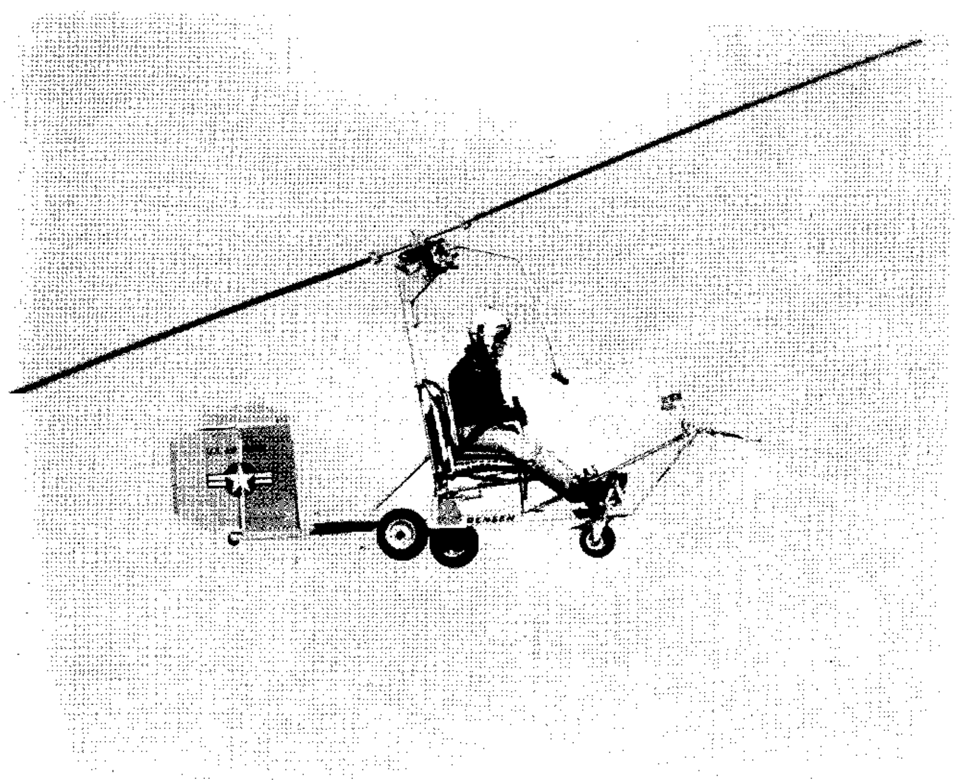

Fig. 2—Bensen Gyroglider has been officially accepted and designated by the U. S. Air Force as the X-25B. Here it is flown by the professional Air Force test pilot who was checked out at Bensen factory. The machine is entirely factory-built, including all-metal tail surfaces, all-metal rotor blades and the pre-rotator, all of which are available to you, too.

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CONSTRUCTION MANUAL

BUILDING INSTRUCTIONS

The Gyro-glider consists of three parts: 1. The Airframe, 2. The Rotor Head and 3. The Rotor.

Only the Rotor Head requires accurate machining, because it contains ball bearings, which must be carefully mounted for perfect operation. The rest can be built with hand-tools and the usual hobby-shop equipment.

These Building Instructions show you, step-by-step, how to shape, assemble and test your Gyro-glider. If you have had only little previous shop experience, by all means, have your work checked by a skilled supervisor. Most people will be only too glad to help you on a project like this free of charge. Before starting to build, call your local FAA inspector and tell him about your project. He is an experienced aviation man and can give you much valuable free advice that might save you trouble later. The chances are that he has licensed many other Gyros before you and will advise you how to steer away from mistakes.

In any event, you will be wise to form a team of two or three men right from the start and work together, because it will take teamwork later when you begin to fly. Look up the addresses of the nearest Bensen dealer and of nearby members of the Popular Rotorcraft Association who may give you a hand on your project with much enthusiasm. Be sure that all members of your team have read and fully comprehend this Instruction Book. Do not scale off the drawings because shrinkage of paper and revisions may give you wrong readings. Use the dimensions shown to lay out parts.

It took two men two weeks to build the first Gyro-glider from the Plans you have here. If you study the Drawings carefully and plan your work efficiently, you might be able to improve on this time, but don't hurry; it is better to take your time and do it right than to hurry and have to do it over. Even if it takes a year, it is worth the time to have the comfort of knowing that every fine detail was skillfully and accurately executed. Start with the Airframe; the Rotor and the Rotor Head may be worked on at the same time later.

If you intend to fly your Gyro later in free flight, it must be licensed by FAA. Instructions for construction and licensing are in FAA's Advisory Circular 20-27A obtainable from your local FAA office

1. THE AIRFRAME

See Drawing No. 8-104-100 (Sheets 1 thru 4)

Study the contents of this chapter and the drawings carefully before starting to build. Be sure that you understand all instructions and drawings completely. If not, do not hesitate to inquire with your Bensen dealer or the factory. Lay out carefully all parts on the supplied materials and double-check their dimensions before starting to cut.

The importance of your following the Bensen design to the letter cannot be overemphasized. Extensive professional engineering time was spent in design simplification and flight testing of this machine to assure you of the safest, most enjoyable, and trouble-free operation. You cannot begin to improve on it without assuming risk of making serious mistakes. Also remember the basic aviation motto "PAY ATTENTION TO DETAILS." Don't take any short-cuts and short-change yourself on safety.

For your convenience and accuracy of building this craft, a step-by-step procedure for construction was worked out. Included in the airframe kit #83PB are additional construction aids, such as (1) a transfer punch fixture, (2) a set of transfer punches, (3) a center drill, and (4) the materials necessary to build a special tool or clinching aircraft type Nicopress cable sleeves. Instructions on the use of the special tools are described later in this chapter and are shown on the drawings.

The materials supplied in Kit #83PB can be identified from the packing slip by description and part numbers, which coincide with part numbers on the Drawings #8-104-100. Check the packing slip and materials in the kit carefully before starting construction. A method of positive identification, as construction progresses, would be to mark materials with the proper part or detail numbers.

Packing lists supplied with the kits should be taken as the latest authority as to what should be included in the material list. They supersede all previous information since they represent the latest state of engineering development. Of course, if you trust yourself as a skilled craftsman and have built a homebuilt aircraft previously, then you can order all raw (bulk) materials either from Bensen or from other sources, using the Material Specifications list supplied with these Plans.

Two spaces are provided against each numbered step for the builder to initial and fill in with the completion date to assure that each operation was completed. If you plan at any time in the future to license your Gyro as a home-built Gyro-copter, a third space is provided for local F. A. A. Inspector's signature to certify that he has approved the construction of your craft. These signatures and dates, like pilot's check lists, are an essential method of safety control that you must follow. F. A. A. Inspector's signatures are equally essential: until he inspects your machine and signs in the places provided, your machine must be presumed to be unsafe to fly. This record in your Manual should be preserved with your packing slips which will bear evidence that you per-

STEP 7

Cut 9 degree bevel on bottom of —3 mast, as shown. Lay keel piece and mast on flat surface. Measure 46 ⅛" along the keel from left end on #1 side, scribe a line with pencil. Cut from a scrap piece of lumber, a strip long enough to drill two ¼" holes 74 ⅝" between centers. These holes must be plumb and square and should be drilled on a drill press, not by a hand drill. Use this strip to locate top of mast by inserting a ¼" bolt through strip into the keel tube hole that attaches the —14 angle, and the other ¼" bolt through strip into lower rear hole for head plate attachment to mast. Place #3 side of mast against previously drawn 46 ⅛" line on keel tube. This gives proper location of mast to keel tube, and the angle between them will be 81 degrees.

Builder's Signature .... Date of Completion ....

STEP 8

Slide one cluster plate under keel and mast junction, position by pre-drilled hole in plate and keel. Align with bottom edge of keel, clamp in position. (Note: plate overhangs keel tube ⅛" to assure adequate hole edge distance). Transfer-punch through four pre-drilled mast holes and two remaining keel holes. Remove plate and center-drill. Align on top of other cluster plate by the use of one ¼" predrilled hole, and drill remaining six ¼" holes through both plates simultaneously. Bolt cluster plates into position, forming a permanent junction between mast and keel. (Note: if you do not use transfer fixture, lay out the holes carefully to avoid scoring inside walls of the tube with the drill, which may weaken it dangerously.)

Builder's Signature .... Date of Completion ....

STEP 9

Repeat a like procedure with head plates previously cut and location hole drilled. (Note: Top edges of head plates are at right angle to mast). Make four spacers —5B, transfer through plate attachment holes, two holes in each, and drill. Bolt head plate and spacer assembly into position on mast.

Builder's Signature .... Date of Completion ....

STEP 10

Lay out seat-back upper attachment angle —6, drill two 3/16" holes for seat-back attachment (and two ¼" holes for future engine mount installation, if one is planned). Note that —6 angle should be centered on the mast. Dimension from the face of mast to the center of 3/16 holes should be ⅝. Clamp one angle in position on mast, transfer-punch through two pre-drilled holes, center drill, and drill. Clamp the two —6 angles back-to-back, and transfer the two ¼" holes from one to the other, prime, paint, and install on mast.

Builder's Signature .... Date of Completion ....

STEP 11

Lay out seat-bottom attachment angle —7, drill two ¼" holes for seat-bottom attachment. Clamp in position on mast, check for symmetry and right-angle alignment, clamp and transfer-punch, center drill, and drill. Prime, paint and bolt into position.

Builder's Signature .... Date of Completion ....

STEP 12

Machine —10 B Block, and mount the tow-hitch —10A. Lubricate pivot bolt and hitch face.

Builder's Signature .... Date of Completion ....

STEP 13

To make angles —11, cut length ¼" longer than shown on the drawing. Lay out and finish one end on each as detailed. Locate fabricated end in place with bolt, center other end of angle over frame hole, clamp and transfer-punch. Remove, complete the end and install bolt, **mast end only.**

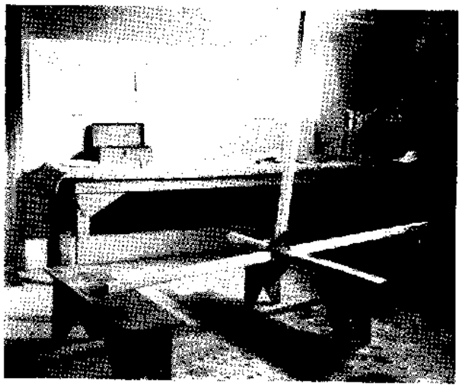

Fig. 3–The basic frame: Mast, Keel and Axle.

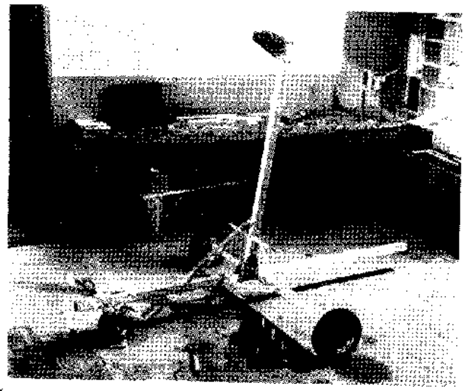

Fig. 4–Wheels and cross-braces added.

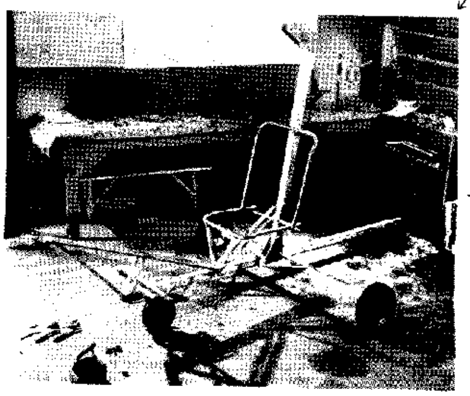

Fig. 5–Seat frame and tow boom added.

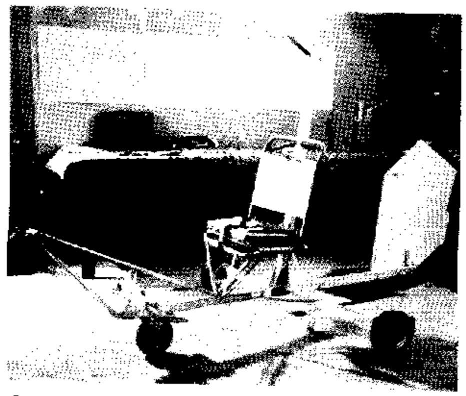

Fig. 6–Airframe nearly completed.

NOTE: These photos show an earlier design with mast-to-keel brace going forward. In the present design this brace is to the rear of the mast.

NOTES ON AIRFRAME FABRICATION

It is important that the bolts going through main 2-inch tubes hug the walls of adjacent sides, which will allow them to be properly tightened. If the holes are too far away from the walls, tube flats will cave in under bolt tension, will become loose, and may lead to fatigue failure later. On the other hand, drilling the holes too close to the edge may scratch up and score the inside wall enough to render the tube unsafe. This is the big reason for using the transfer jig fixture, which guides the drill very accurately exactly where the hole ought to be. The purpose of the transfer punch is only to mark the location of holes accurately. It is made of soft steel and should not be hit hard by the hammer because it is NOT intended to be used as a centerpunch.

Wherever edges of gusset plates parallel the tubes, they overhang tube edges by ⅛" to assure proper edge distance for bolt holes.

The term "grip" refers to the unthreaded length of the bolt between its head and the start of the thread. Aviation practice requires that only he grip portion of the bolt go through the structure. Thus shear loads must never be carried by the threads. Bolts that are used as pivots or are subject to heavy vibration must have their nuts secured by cotter pins or safety wires. All other nuts must be self-locking type that will not unscrew themselves. Machine or automotive types of screws and nuts must be avoided. A cadmium-plated washer at least 0.060" thick must be placed under each nut.

One washer is essential under each nut. Do not use spring washers. If the bolt is too long, more washers may be added under the bolt head. This will assure intended tight compression of the structure and will avoid jamming the nut on the unthreaded part of the bolt.

Good construction practice requires that there should be no slop of the bolt in the hole. The AN-3, 4 and 6 bolts used in gyro construction are nominally 2 to 3 thousands of an inch undersized, depending on the manufacturer and lot. If you use standard ¼ and 3/16 inch drills, make sure their tips are ground symmetrically, and they don't "walk" during drilling thereby producing oversize holes. Use slightly undersize drills if you can find them to obtain a closer fit. Don't be a "sledge-hammer" mechanic, don't pound the bolts in with steel hammers. The fit must be a light push, not "interference" fit. Also, don't be tempted to weld or braze AN bolts, as heat ruins the temper of steel and weakens the metal. A cadmium or chromium "embrittlement" may also result.

If you intend to use pre-fabricated rotor and rotor head, remember that FAA won't license the machine in "amateur-built" category unless you fabricate yourself other components constituting a "major portion" of the construction. Also, we have heard that an FAA inspector did not approve the use of 6063-T5 aluminum for the Keel, Mast and Axle even though an aluminum company salesman assured the builder that it would be okay. Bensen specifications call for 6061-T6 for these members, and the FAA man was absolutely right.

Use a good quality torque wrench to tighten all nuts. If you don't have one, buy one, it's a good investment. Turn the nut, not the bolt. Overtorquing of nuts can readily lead to: (1) stripping of threads, or (2) crushing of tubes, or (3) imbedding of washers into metal or wood with dangerous stress concentrations. It should be avoided like poison.

RECOMMENDED TORQUE VALUES

	Bolts in Shear	Bolts in Tension
3/16" bolts	20-25 inch lb	40 inch lb
¼" bolts	50-70 inch lb	100 inch lb
3/8" bolts	160-190 inch lb	390 inch lb

The above torque values must be modified to accomodate the structure through which the fastener passes. A sharp eye must be maintained to avoid deformation of tublar structures, crushing of wood, or imbedding of washers into metal or wood with dangerous stress concentrations.

Whenever you don't use the torque wrench, in the field, use short-length ¼" drive rachet or 4"-6" spanner wrenches on 3/16" and ¼" bolts. Short arms of these wrenches will help prevent accidental over-torquing.

Lead weights on the rudder are counterbalances which prevent tail flutter. Their total weight is 24 oz. for the shape of tail shown. If you change the shape of your tail (which is not recommended because it will change yaw stability and controllability by some unknown amount), you will also have to change the counterbalance weight.

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Double-check that the wheels have rim-to-hub bolts tightened correctly. Do not assume that all is right, unless you have installed and re-checked each nut yourself.

Remember, flying safety is manufactured in the workshop, assured during installation in the hangar, and confirmed in your pre-flight inspection.

STEP 28

Airspeed indicator bracket —24 is fabricated as shown. Install on —13A plate, with machine screws. Test for rise of red ball, by blowing into cupped hand to deflect air into the bottom inlet holes of indicator.

.... Builder's Signature .... Date of Completion

STEP 29

Cable —25 is installed next. Make two —25A spacers as detailed. (Clinching tool BT8-104-132 must be made, as detailed, from the materials supplied). Fabricate one end of cable as detailed, using tool to clinch sleeve. Be positive that tool is fully closed when ⅝" nuts are tightened. Fasten one end of cable in position, and string other end around thimble and through sleeve. Load the seat of the craft to approximately 300 lbs. with sandbags or two men to deflect the airframe. With airframe deflected, tighten cable and clinch with tool. Cut off excess cable. (Be sure tow-hitch attachment bolt has castellated nut and cotter key).

.... Builder's Signature .... Date of Completion

STEP 30

Spring clips —19E are made, drilled and mounted in position on top of — 12 angle. Springs should be attached to clips in a just slack condition with the nosewheel adjusted in center position.

Airframe assembly should now be complete, with the exception of tail group and control cable.

.... Builder's Signature .... Date of Completion

STEP 31

Tail surfaces are made from a good grade of ¼" marine plywood, 3 or 5-ply, whichever is available in your area. Saw the horizontal tail —28A, fin —27A, and rudder —27B, to shape. (Observe the direction of wood grain on drawing). Sand edges straight and faces smooth. Seal with three coats of a good wood sealer.

Reinforcing strips are cut to length, rivet pattern laid out, and riveted in place with rivets provided. (Be sure surfaces are flat when strips are drilled and riveted).

Rudder is attached to fin by three hinges. Make sure hinge wires are bent over on both ends to prevent their falling out. (Note the reinforcing strips —27 on the reverse side under hinge rivets).

Rudder horn brackets —27F are cut from the templates on drawing 8-104-100, drilled, and bent. They are bolted in position on top of attached reinforcing strips.

Clamp the fin and rudder assembly in position on the keel tube, transfer attachment holes, remove, and drill.

Surfaces can now be finish-sanded, spot-filled, and painted desired color with a good grade of exterior enamel. The horizontal stabilizer and strap are fabricated and installed by inserting the ends of the —11 angles through the slots and bolting stabilizer to keel. The —11 angles are then bolted to keel.

.... Builder's Signature .... Date of Completion

STEP 32

Two brace brackets —27M and N are made and bent to shape. Clamp in position on keel, transfer attaching holes, remove, and drill. Replace in position, push through bolts, slide fin and rudder assembly on other side, and install washers and nuts. Make sure the fin is vertical; clamp brace brackets in position, and drill attaching holes with hand drill. (See Section BB on detail —27). Install bolts, washers and nuts. (Note: All washers used on wood surfaces, are large diameter "crush" type washers BA 1183).

.... Builder's Signature .... Date of Completion

STEP 33

Four cable guides —22 and —23 are now made as detailed on drawing and mounted in proper position. (Note slot on both —22 and —23 is on the bottom of guides).

Builder's Signature .... Date of Completion ....

STEP 34

Fabricate four —21J spacers as detailed.

String 1/16" cable through guides. With clinching tool, fabricate rudder pedal end of cable, and install. Adjust cables on the rudder horn end to permit rudder to swing 30 degrees side to side, and when rudder is in neutral, pedals should be even. Be sure rudder pedal pivot bolts and rudder horn cable bolts are cotter-keyed. (Note that when engine is installed in gyrocopter conversion one cable is longer than the other so that rudder is deflected 10° to the right when pedals are neutral).

Builder's Signature .... Date of Completion ....

FINAL INSPECTION

STEP 35

This completes the construction of your basic B-8 airframe. Before you take it out for a test run, give it an overall "pre-flight inspection" from stem to stern. Check over carefully every junction now and every time you fly. Remember this: if you take good care of it, it will take good care of you. Be sure to sign and date the spaces below to record the date when you have completed the final assembly inspection.

Builder's Signature .... Date of Completion .... F.A.A. Inspector's Signature ....

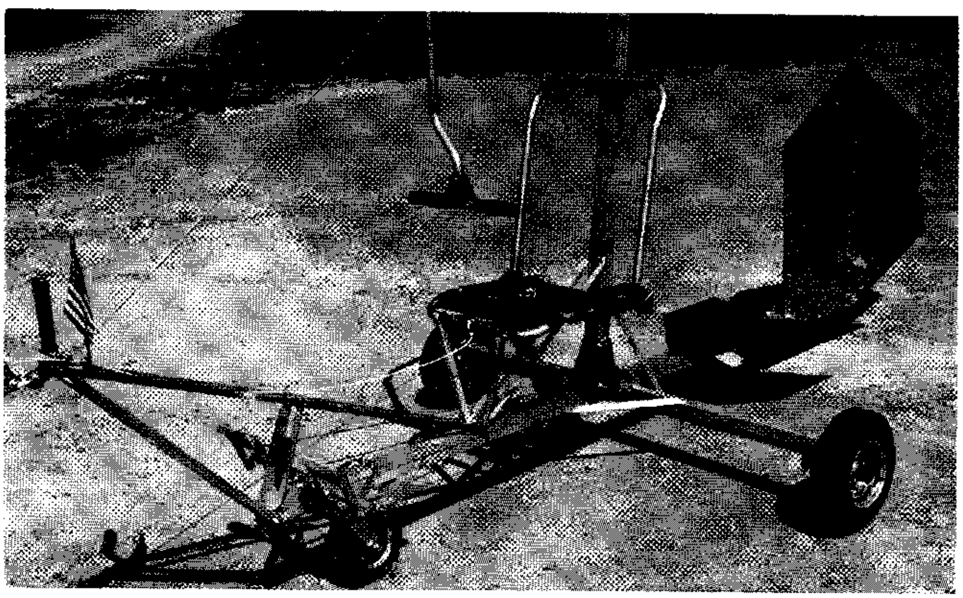

Fig. 7—Standard B-8 Airframe, fully assembled. Seat back and cushion omitted for clarity.

TESTING THE AIRFRAME

STEP 36

At this point it will be assumed that all your hardware has been properly assembled and double-checked for correctness. Now comes a series of tests to prove that everything is also functioning properly.

First, sit on the seat cushion and observe if your feet reach the pedals and the brake comfortably. If not, slip an extra cushion behind your back to move yourself forward.

Bounce up and down on the seat. Your seat cushion should be strapped under the rubber strips as to be free of interference with the aluminum frame. If not, shift the cushion around until a smooth, free cushioning action is obtained.

Push the nosewheel foot bar back and forth and see if the springs return it to neutral. Neutral in this case means to steer straight ahead. Be sure that the springs are NOT stretched in neutral position, nor slack. They are intended to stretch one at a time, but not both at the same time. However, they should be pulled up snug, allowing no looseness or play in steering.

Now take the Gyro airframe on the road for a "taxi" run. When towing it on public roads with motor vehicle traffic, do not exceed 10 mph and use a tow rope no longer than 15 feet. Warn the driver not to apply brakes suddenly and to slow down on turns.

When you come out to your "testing grounds," which may be any reasonably flat area where you can have complete privacy (an airport runway, a football field, an abandoned country road, etc.), increase the towline length to 30 feet. Take your heels off the steering bar and see if the craft will steer straight. If not, adjust the position of the tracking springs BA-12-2S until it does. Tracking springs must be just snug, so one goes slack as soon as the other begins to expand.

Learn to trip the two-hitch release with a quick, positive motion until it becomes a reflex.

Note that for correct towhitch closure, the triangular rubber stop must be compressed all the way to allow the engagement of the tongue by the peg nearest to the pivot. It will take a lot of push on the new towhitch, but it will become softer with use.

Learn to steer the craft with your heels, at about 10-15 mph. Observe how much more sensitive steering becomes at higher speeds; also how much faster your ground speed becomes if you follow the car on the outside of the curve. Conversely, how the craft slows down when you cut on the inside of the curve. Knowledge of this observation will be important to you later when you will be doing the same thing in the air.

Avoid taxiing faster than 20 mph, as beyond this speed you will have difficulty steering accurately and applying brakes without swerving.

This is also a good time to check (professional word is to "calibrate") your Airspeed Indicator. If wind is calm, your ASI should read exactly as the speedometer of the towing car. If the day is windy, take the average reading going up and down wind, while the tow car maintains constant ground speed. To double-check the reading, install another airspeed indicator above the hood of your car.

For best riding and cushioning action, deflate the tires so that they are about one-third compressed when you are in the seat.

If the nosewheel develops a shimmy at higher towing speeds, eliminate it by tightening the swivel nut. Any addition of friction to the swivel pivot will help control shimmy.

See also the MAINTENANCE MANUAL for further tips on how to care for the airframe.

2. THE ROTOR HEAD

See Drawing No. 8-102-100

The Rotor Head is the only part of the Gyro-glider where accurate machining is required. However, the design is so simple, all metal parts can be machined on a standard lathe and a drill press. No special tool bits or cutters are required.

Pilots with airplane stick time, who prefer to use the conventional between-the-knees type control stick, can obtain detailed Joystick Plans from the factory. Although the Rotor Head is essentially the same in both types of controls, additional braces, pushrods, links, etc., have to be fabricated to complete the joystick control. Kits of materials and hardware for home construction, as well as ready-to-use joystick controls, are available from the factory. (See price list for details).

Drawings of the Rotor Head have been so prepared that you can take them to your local machine shop and have the pieces made for you directly from the plans.

To further simplify construction, the rotor head system was grouped into three basic units as follows:

Unit 1. Rotor hub —2, pillow block —1, and spindle —3.

Unit 2. Upper housing assembly, consisting of housing 5, top cover —4, and lower cover —6.

Unit 3. Lower housing assembly, consisting of housing —11, top cover 12, lower cover —13, and plate 16.

A step-by-step procedure for construction follows:

STEP 1

Spindle —3 is machined from 1¼" round "Fatigue-Proof" steel.

Chuck in a lathe, and indicate O.D. of round to locate its center accurately. Center-drill to provide a true turning center on both ends. Workpiece can now be turned on centers to desired dimensions. A light push fit in both bearing diameters is desired.

Note that .030" and .060" Radii in fillets between turned shoulders and straight diameter are a MUST. A polished scratch-free surface finish in fillet area is also a MUST. Otherwise the spindle may fail in fatigue later.

Chase the ½ x 20 thread on the lathe; check with BA 310-8 nut to assure a true fit.

The two flats are now milled on the 1¼ round to obtain the 1.000 dimension on upper portions of the spindle. Care must be used to insure that flats are parallel to center line of spindle and are equally distant from center line.

The .375 reamed hole is now machined. Use care in the setup to assure that the hole is on center of, and at right angles to, the center line of the spindle.

Builder's Signature .... Date of Completion ....

STEP 2

Cut —1 pillow block to length. Lay out ¼" and ⅜" hole centers. (It is suggested that bottom surface of pillow blocks be checked for squareness; if not square, correct it. Use a locating straight edge on drill press set up to assure 1½" centers of ⅜" holes are exactly the same on both pillow blocks).

Builder's Signature .... Date of Completion ....

STEP 3

Mill, or drill and saw, clearance cutout in —2 rotor hub.

Builder's Signature .... Date of Completion ....

STEP 4

Using —3 spindle as a 1" spacer, bolt pillow blocks together. Center this sub-assembly carefully on hub —2. Clamp when in position. Drill the four ¼" mounting holes on assembly. This completes Unit 1.

Builder's Signature .... Date of Completion ....

STEP 5

On —6 cover, lay out the center, four mounting holes, and 3/8" slot location. Drill a 1/4" hole in center only. Mill, or drill and saw, the 3/8" slot. (Use care to maintain tolerance of slot width). File bevel on corners of cover, and de-burr.

Builder's Signature .... Date of Completion ....

STEP 6

Locate carefully the center of —5 housing, scribe with dividers 4 1/2 Dia circle segment to be sawed after drilling all holes. Center-drill 1/4 hole in block center. Locate center for 3/4 clearance hole, center drill, and drill 3/4 hole.

Locate carefully the center of —4 cover, center-punch, and scribe a 4 1/2" diameter circle. Drill a 1/4" hole in located center.

Bolt together cover —4, housing —5, and cover —6, with a 1/4" bolt. Align carefully edges of —5 housing with —6 cover. Tighten 1/4" bolt to clamp in position. Mark parts to index them so that they may be later assembled in the same order. Drill on assembly the four laid out 1/4" holes. Disassemble and remove all burrs.

Builder's Signature .... Date of Completion ....

STEP 7

Cover —4 is now completed by chucking in lathe, and centering on 1/4" drilled hole. Bore center clearance hole to 1 1/4" diameter. Re-chuck on I. D. of 1 1/4" hole, and turn O. D. to 4 1/2" diameter. Remove and countersink the four 1/4" holes to allow BA-509-416 bolt head to be flush with cover. De-burr, prime, and paint with enamel.

Builder's Signature .... Date of Completion ....

STEP 8

Use 1/4" pre-drilled hole to center the —5 housing. Bore I.D. to close tolerance dimension, to give light press fit on BA-A8A bearing. Lay out, drill, and tap the hole for grease fitting. After —5 housing is bored to fit A8A bearing and grease fitting is installed, saw 1/2 wide slot into 3/4 clearance hole.

Clamp the block in position on the head plate assembly of airframe. (Let head plates overhang 1/8" on front for hole edge distance). Top of the block must be flush with —5A head plates. Transfer-punch through two 1/4" pre-drilled holes in head plates. Remove the block, set it up carefully on a drill press, making sure its face is parallel with spindle, pick up holes with a center drill, and drill 1/4" through holes. Relocate block on head plates by using clamps and locating the holes with two 1/4" bolts. Clamp tightly in this position. Removing one bolt at a time, use a hand-drill through the other head plate, using drilled holes in housing as a guide.

Builder's Signature .... Date of Completion ....

STEP 9

Bore 1 1/4" hole in —6 cover, centering on 1/4" pre-drilled hole. De-burr, clean, prime, and paint with enamel.

Builder's Signature .... Date of Completion ....

STEP 10

Place BA-A8A bearing on base of an arbor press, supported by its inner race only. Insert tool and apply pressure until inner sleeve is moved about 1/8". Set up the bearing on a drill press or lathe, and chamfer 1/16" exposed I.D. of bearing top to assure clearance for fillet radius on spindle shoulder. Replace bearing on arbor press, supported by its inner race, insert tool and press out the sleeve. Let bearing sit undisturbed on press and insert—3 spindle. Press in spindle until its shoulder is against inner race of bearing. (See notes 8 and 9 on drawing for detailed instructions). Open hole in the cover plate from 1 1/4 to 1 7/16 to allow square spindle to pass through.

Builder's Signature .... Date of Completion ....

STEP 11

To assemble unit 2, bearing BA-A8A and spindle sub-assembly are pressed into—5 housing. (Be sure to apply pressure on the outer race of bearing only. Top cover—4, and lower cover—6, can now be bolted into place on —5 housing.

Builder's Signature .... Date of Completion ....

STEP 12

Locate the center line of —12 cover. On the center line, lay out two $^{3}/_{16}$" holes for stick attachment.

Locate center line on —13 cover. On the center line, lay out location of the center ¾" hole, and the center of ¼" hole for —15 spacer. Locate four ¼" attachment bolt hole centers.

Stack —13 on top of —12 cover, flush sides, and ends where —15 spacer hole is located. Clamp these plates together and drill ¼" hole on ¾" center, and a ¼" hole on —15 spacer hole center.

Locate center of —16 plate and drill ¼" hole in this center.

Cut covers —12 and —13 to final dimensioned shape.

Builder's Signature **Date of Completion**

STEP 13

Locate center of —11 housing and drill ¼" hole. Bolt —16 plate, —12 cover, —11 housing and —13 cover together with a ¼" bolt through their centers. Cut —15 spacer to 1" length, insert between covers and anchor in place with a ¼" bolt. Align sides of —11 housing, flush with sides of covers. Tighten ¼" bolt to clamp in position. Drill four 3/16" attachment bolt holes.

Builder's Signature **Date of Completion**

STEP 14

Braze —17 tube to —16 plate. Straighten plate to lie flat if warped from heat of brazing. Chuck **and face assembly to 7/16 dimension. (Be sure plate is chucked true). Bore a 1" hole on ¼" hole** center, and remove. De-burr, prime, and paint with enamel.

Builder's Signature **Date of Completion**

STEP 15

Use ¼" hole to locate center in housing —11. Bore to close tolerance dimension for light press fit of two BA-S5KDD bearings.

Builder's Signature **Date of Completion**

STEP 16

Spacer—8 is machined as detailed. (See Note 3 on drawing). Two BA-S5KDD bearings are pressed into —11 housing by their outer races only. (Be sure —8 spacer is in place between the two bearings).

Builder's Signature **Date of Completion**

STEP 17

The center holes of covers —12 and —13 are machined to ¾" diameter. Unit 3 is assembled as follows: Bolt together —16 plate assembly, —12 cover, —11 housing, and —13 cover.

Builder's Signature **Date of Completion**

STEP 18

Cut to dimension the handle bar —26B and two plates —26C. Lay out four 3/16" holes on plates —17. (These parts are detailed on airframe drawing 8-104-100). Clamp handle bar, two plates, and stick —26A together. (Be sure handle is at right angles to center line of stick). Drill 3/16" holes on assembly and bolt together. Slide stick assembly in position between —12 and —13 covers. Check carefully to align lower unit assembly of stick: when handle bar is level, lower unit should be also level, and be straight with center line of stick. Clamp in this position, drill two 3/16" holes, and bolt assembly together.

Frank Aller 4-8-75 2hrs

Builder's Signature **Date of Completion**

STEP 19

Remaining spacers —7, —9, and —14 are now made. Spacer —7 should be machined to .590" length; this will match control stop assembly dimension to assure control motion is 9 to 9½ degrees in all quadrants.

Builder's Signature **Date of Completion**

STEP 20

Control head is now ready for final assembly:

(a) Unit 1 is clamped in vise by sides of spindle, with threaded end up. Be sure vise has smooth or soft jaws to avoid damage to the spindle.
(b) Slide —7 spacer in place.
(c) Install —14 spacer on bolt BA-4-27, and put in position in ⅜" slot.
(d) Slide or press lower unit bearing assembly on spindle and BA-4-27 bolt. If any push pressure must be applied, be sure to push on the inner races of bearings, **not** on the outer housing.
(e) Slide —9 spacer in place.
(f) Slide BA-960-8 washer in place.
(g) Screw on BA-310-8 nut and tighten securely. Check to see if BA-A8A bearing is tight against spindle shoulder. Housing assemblies should turn free on spindle.
(h) Drill hole in spindle with hand drill to receive 3/32" cotter key.
(i) Screw nut on BA-4-27 bolt and tighten.
(j) Apply a film of grease on spacer —14, on faces of pillow blocks, spindle faces, and teeter bolt.

Builder's Signature	Date of Completion

STEP 21

This completes the assembly of the Rotor Head. Mount it on the airframe as shown on the drawings and bolt it with two ¼" bolts provided. Give it its final "pre-flight" inspection and enter its completion date in the box above.

DO NOT DRILL ⅜" blade retention holes through the Hub Plate 8-102-102 until you are ready to assemble the blades. This operation is described later. When the Head is assembled, be sure the main BA-310-8 nut does not rub against the bearing retention plate. This is very important, because if it does, it might unscrew itself in flight. Also, after both bearings are correctly assembled, be sure to insert the cotter pin in the nut, as shown.

The good thing about this rotor head design is that nearly everything can be readily inspected because you can see all vital parts. The main thrust bearing is pre-lubricated at the factory, so you will not have to worry about its maintenance for a long time. Small bearings in the control stick housing should be packed with light bearing grease, if they come dry from the factory.

The teeter-bolt must fit into the spindle quite snugly. If there is too much play, the rotor will vibrate and may become difficult to control, like a car with worn steering wheel mechanism. The nut of the teeter bolt should be always secured with a cotter pin, or a regulation safety pin. **Do not tighten the teeter bolt** so the hub cannot pivot on the spindle. It is intended to serve as a hinge. Make it snug to eliminate all loose play, but not too tight.

Builder's Signature	Date of Completion

STEP 22

Stick stops were designed to limit motion of the rotor shaft to + or −9 degrees in all directions. Don't exceed these limits, because otherwise the spherical main bearing will operate beyond its normal limit of travel, and may be caused to fail. Do not limit the travel to less than 9 degrees either, because this would reduce the amount of control motion needed by the pilot. Check with the bubble protractor, or the Bensen Pitch Meter, BT-8-102-103, that your stick travel is symmetrical on either side of the "neutral," which is measured on the spindle as 0 degrees (perfectly vertical) in lateral plane and 9 degrees rearward tilt in longitudinal plane when mounted on the airframe (See Fig. 8.) The total travel of the control motion of plus or minus 9 degrees **should be checked from time to time as it tends to increase from wear of the stops. To restore correct travel** insert slotted shims of required thickness between —16 contol stop and —12 cover.

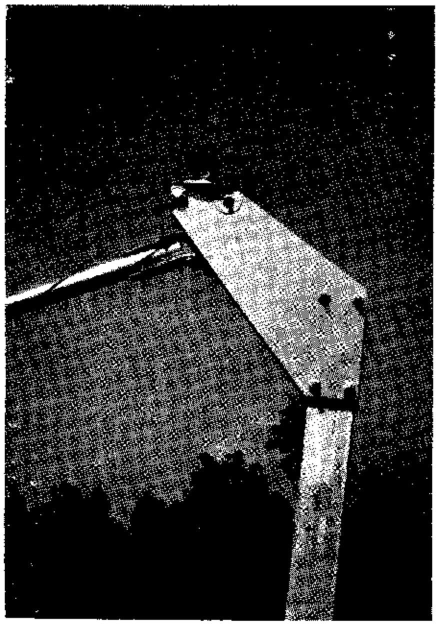

Fig. 8–Rotor Head assembled on the Airframe. With the stick hanging freely against its rear stop, the Spindle is exactly vertical when all 3 main wheels of the craft rest on level ground.

Sit in the pilot's seat and check if your hands reach easily the limits of control stick motion. If not, bend the stick as needed to manipulate the stick comfortably through its entire motion.

Now remove the Hub Plate —2 and suspend the craft by the teeter bolt from an overhead beam, a tree branch, or any other high solid object (See Fig. 12). Climb into the seat and hold the stick neutral (do not wiggle the stick unnecessarily, as without rotation of the spindle, side motion may damage the main bearing). Measure the angle of the Cover Plate —4 to the horizontal with a bubble protractor or the Pitch Meter. The angle should read two (2°) to six (6°) degrees nosedown, the ideal being four (4°) degrees. This test is known as the "weight-and-balance," or "hang test" and is a **must** before you can begin flying. If Cover Plate tilt angle falls outside of prescribed limits, you must either shift pilot's position, or add lead weights to the tail until proper tilt is obtained. **This test must be repeated every time you change the weight of the craft in any way.** In extreme cases of unusually large changes, such as excessive pilot weight (over 230 lbs.), or addition of the engine, a new set of Head Plates 8-104-105A, with shifted Head position may be required.

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Builder's Signature

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Date

STEP 23

Next, test the strength of your construction. With the craft still suspended by the teeter bolt, attach the towline to the tow hitch and pull on it 300 lbs. after loading the seat with sandbags weighing 300 lbs. Everything in the frame must be snug and solid. After the load is removed, there should be no evidence of bending, buckling, or any other permanent deformation.

Finally, climb into the pilot's seat and raise the craft by the teeter bolt until its lowest point is 8 inches above the ground. Assume normal position with your feet on rudder pedals and stick neutral. Then make the machine drop freely to the ground by suddenly cutting or releasing the suspension. Again, there should be no visible deformation anywhere in the airframe after this drop test. If you have any doubt, disassemble the suspicious member, inspect it, and if damaged, replace it with a stronger one.

The standard B-8 Airframe, properly assembled, withstood a drop test twice as severe as the one described here, which is well in excess of minimum safe standards prescribed by the F. A. A. Yours should do as well if you used specified materials and construction procedures.

See the MAINTENANCE MANUAL for further instructions on lubrication and care of the Rotor Head.

Ready-made Rotor Heads are also available from the factory for those who want assured top performance.

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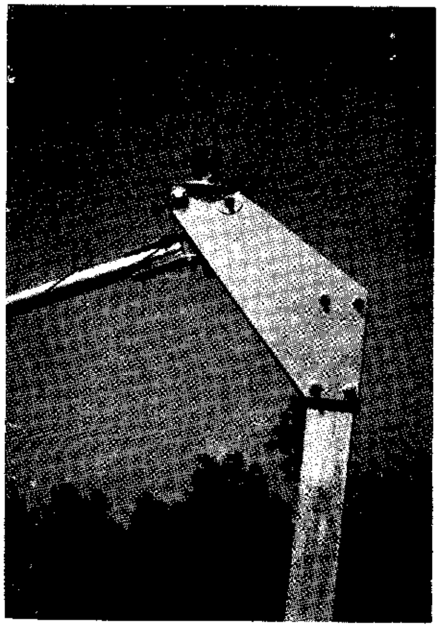
Builder's Signature	**Date of Completion**	**F.A.A. Inspector's Signature**



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Date

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Builder's Signature	**Date of Completion**	**F.A.A. Inspector's Signature**

3. THE ROTOR BLADE

See Drawing No. 8-103-100

Now you come to the heart of your whirlybird: the Rotor. The Rotor consists of two (2) rotor blades joined together by the Hub Plate 8-102-102. The two blades are identical, therefore it is sufficient to describe the procedure of building one rotor blade.

The importance of following this design and construction technique to the letter cannot be overemphasized. There have been many hours of professional engineering talent spent on the design and flight testing of these rotors, to insure that they would give you satisfactory flight performance under all possible flight conditions. These blades were produced by the hundreds at the Bensen factory exactly as detailed on your drawings. They were sold and used in the field; not one single failure or complaint about their performance was recorded over a period of years; thus they are of proven and experience-tested design. Beware of imitations or substitutions. You should not entrust your life and safety to cheaper or inferior materials which are not approved by the Bensen factory.

For your convenience, the construction will be laid out step by step as before. Note the signatures and date-of-completion space provided for each step. This is still a MUST to assure safety.

The step-by-step procedure follows:

STEP 1

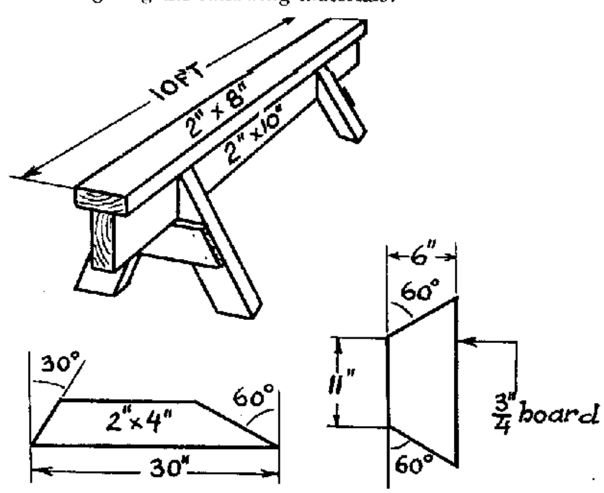
A clean area to work in, where the temperature can be maintained above 75 degrees during gluing operation and for eight hours following, is a "must" to insure full glue strength.

A "T" bench must be built to be used as a Blade Work Bench (see Sketch 1). When the Bench is completed, it must be carefully leveled in all directions by the use of shims under the legs. Check the Work Bench carefully with a level and a string or a straight edge, to see that it has no twist or bow. The surface must be planed or sanded until perfectly flat or true (remember your blades will be only as straight and true as your Work Bench).

Two straight strips of wood 2" x 2" x 10 Ft. are required for gluing pressure pads.

You must have a minimum of 16 6-inch "C" clamps to apply proper pressure while gluing.

Have on hand before gluing the following materials:



SKETCH 1

(a) A fresh 1 lb. can of urea resin glue. (Powder type, to be mixed with water just before gluing). In U.S. the suitable glue is Weldwood, Fed. Spec. MMM-A Type II (unextended), available in all good lumber yards and boat stores (it's waterproof after setting).

(b) Half a pound of No. 6 finishing nails.

(c) A roll of wax paper (household grade).

(d) Twelve No. 8 by 2" wood screws with flat washers.

(e) One gross of ¾" by 18 gauge wire brads.

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Builder's Signature	**Date of Completion**

STEP 2

Tapered steel spars #8-103-001 are now prepared. Draw a straight line on the edge of Work Bench, using a stretched string as a guide. Check edge of spar to straight line, bend cold if necessary to straighten. When spars are straight, lay out, drill, and countersink holes, as detailed on drawing. (Note that the locating hole for noseweight is **not** countersunk; also that ¼" holes for upper retention strap and ⅜" attachment holes are **not** drilled).

Bend 3" of butt end of spar up 4 degrees. This gives the proper pre-cone angle.

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Builder's Signature	**Date of Completion**

STEP 3

Prepare Leading Edge Strips #8-103-004. Select side to glue, check for straightness, plane to a smooth and flush surface. Lay out hole locations for #20 holes on ¾" face of strip. Locate holes approximately on 12" centers; end holes should be inset 2" from ends. Drill holes through leading edge of strip to size. These holes are clearance holes for No. 8 screws used to apply pressure for gluing leading edge to wood spar assembly. Later they will become 3/16" holes for hardwood dowel inserts.

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Builder's Signature	**Date of Completion**

STEP 4: Dry Run

Materials are now prepared for a **dry run** before gluing, in the following manner:

(a) Beveled wood spar #8-103-003 is prepared for use by planing front edge smooth and straight. Cut the taper span-wise from 2½" width at butt end, to 1" width at —115 5/8".

(b) Cut 7 degree bevel on tip and butt wood filler blocks, Nos. 8-103-008 and 8-103-009 respectively. Leave full width, as they will be fitted later.

(c) Front edge of upper skin #8-103-005 is cut to a "chalk line" (a painter's tool used to mark straight lines with a chalked string) and planed smooth and straight. The rear edge is cut to proper width, parallel, with front edge. A 7 degree bevel is cut on the rear edge and planed to a smooth feathered edge. NOTE: Steel spars and leading edge stips are paired for balance in the kits, but the skins are not.

(d) Lower skin #8-103-006 is chalk-lined and cut, removing a tapered strip 1½" wide on butt end to nothing on tip end.

(e) Unroll a strip of wax paper full length of bench and cut off. (This is used to prevent glue from sticking to bench).

(f) Place leading edge strip on top of wax paper, flush with edge of bench, with edge selected to be glued to the inside. Align inside edge with a tight string to insure straightness, tack in position with a few finishing nails.

(g) Slide prepared steel spar **under** the wax paper, with countersunk side down, and flush with leading edge strip span-wise. Drive several finishing nails through drilled holes in spar, flush with top to hold spar in position. Fold wax paper down, flush with rear of steel spar.

(h) Place lower skin in position on **top** of wax paper, against rear edge of steel spar. Plane its edge if necessary, to match edge of spar. The gap between the skin and spar should not exceed 1/16". Do not force the skin into alignment with the spar, as it will try to spring back after gluing and will warp the airfoil. Nail it in position to bench with several wire brads, cut off their heads so that they may be pulled through the skin later. (Blade will be cut to final width and bevel-cut on reflex **after** gluing operation).

(i) Lay wood spar in position against the leading edge strip, and slide root filler block under it. When the feather edge of the filler block lines up with the front junction line between upper and lower skins, scribe a line along the rear edge of the wood spar on to the block. Remove and cut block on scribed line, also cut bevel on inboard end. Place block into position against the spar, their top surfaces to flush.
Use the same procedure with the tip filler block.

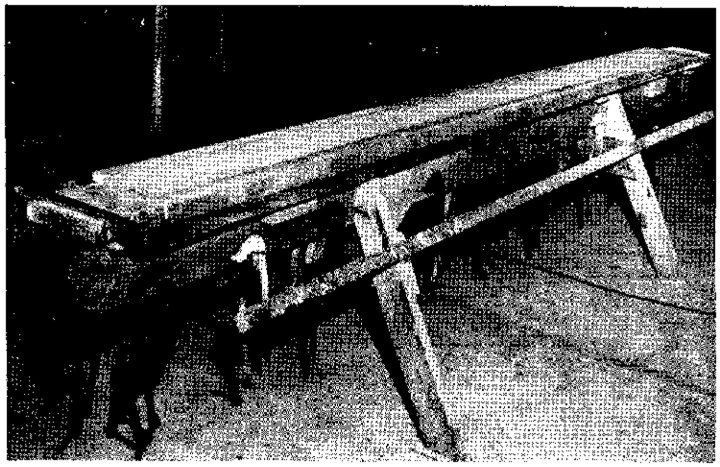


Fig. 9—BLADE WORK BENCH. Note the handy way of storing "C" clamps and pressure strips. Waxed paper in place, the blade is ready for gluing.

(j) Lay top skin in position, check all points for a close fit, correct wherever necessary. Cover top skin with a strip of wax paper. Lay the 2" x 2" pressure pads in position on top skin. The front pad should be 1/16" to rear of leading edge, and the rear pad should be flush, or slightly ahead of, the rear edge of the top skin. Adjust "C" clamps. Place at even intervals, with 8 or more clamps on each side, and tighten lightly. Check carefully to see if all parts fit well under pressure. Be sure "C" clamps are clear of the leading edge strip, to permit its removal while clamps are in position. Mark the position of each clamp and pressure pad. Remove and hang on nails driven under the work bench (see Fig. 9).

This completes the dry run on one blade. You are now ready to start gluing.

.... Builder's Signature

.... Date of Completion

NOTE: If it becomes necessary for you to use spliced plywood for skins, scarfed joints should be placed closer to the blade tips. Glue bevel of scarf joints should be not less than 10 to 1.

STEP 5

The gluing operation is performed in the following manner:

(a) First read instructions carefully on the glue can for mixing the glue. Have a proper container for mixed glue; about 1½ pint of dry glue powder is required for each blade. Have a fairly stiff 1" brush to spread glue. Have a good supply of rags or paper towels; also a bucket of clean water to wash off excess glue. Have all tools ready, such as: a tack hammer, diagonal cutters to remove bent nails and to cut off nail heads, and a screwdriver to tighten pressure screws on the leading edge strip.

Be sure all parts are clean and well fitted, and that you have your procedure down pat. With glue room temperature in the 80 degree range to obtain maximum glue strength, gluing operation should be completed within 45 minutes after the glue is mixed.

(b) Mix the glue according to manufacturer's directions; it should have the consistency of a thick cream. Glue should be spread smooth in a thin coat. All parts to be glued should be completely covered. When proper amount of glue is applied, it will have a smooth, rich brown look like melted chocolate.

(c) Spread glue full length of wood spar, on rear ½" of bottom side and on joining surface of lower skin. Push spar in position against leading edge and anchor with several brads through spar into lower skin.

(d) Spread glue on bottom of root and tip filler blocks, and joining surfaces of lower skin, anchor in position with several small brads.

(e) Spread glue on top of wood spar, root and tip filler blocks, and full length of lower skin where 1" bevel of trailing edge of top cover joins. Spread glue on all joining surfaces on top skin, lay in position, anchor with several small brads,

(f) Cover with wax paper strip, lay the 2" x 2" pressure pads into position, and clamp as previously marked. (Note how glue squeezes out at joints. Tighten clamps evenly; if they are over-tightened, crushing of wood will result).

(g) Wipe off and wash off promptly all excess glue. Squeeze water out of wipers well, so that wood will not become soaked nor glue diluted with water.

Remove leading edge strip, clean off all excess glue from strip and blade spar.

(h) Spread glue on the prepared surface of the leading edge strip, coat wood spar and top skin edge. Place leading edge into position, insert screws and washers, tighten to provide gluing pressure. Wipe and wash off excess glue.

Clean out the glue container, tools and brush promptly with water. Allow the blade to **set under clamp pressure for at least 10 hours. Don't forget, keep that temperature over 75 degrees day or night. If you cannot do it, wrap the blade in the electric blanket and set it to 90 degree F (or 32°C).**

....
Builder's Signature **Date of Completion**

STEP 6

(a) After 10 hours remove blade from bench and cut off all protruding nails; they can be filed flush with skin surfaces now.

(b) Remove screws from the leading edge and redrill holes 2" deep with 3/16" drill.

(c) Cut upper retention filler pad #8-103-007 to dimension, and fit to contour of top skin, locate carefully and mark its position.

(d) Clean excess glue out of steel spar recess, to be sure that spar will lay flat and flush with skin.

(e) Mix a small batch of glue, spread on lower surface of retention filler pad and the joining surface on top skin. Tack into position with brads. Clamp with two "C" clamps, using two short lengths of 1" x 4" board for pressure pads.

Fill dowel holes with glue, insert 3/16" dowel pins. Wash and clean off all excess glue.

....
Builder's Signature **Date of Completion**

STEP 7

Prepare and finish the other blade in the same manner as just described. Attempt to make both blades as near alike as possible.

....
Builder's Signature **Date of Completion**

STEP 8

After blades are thoroughly dry, steel spars are installed. Drill 1/16" lead holes for screws, about ¼" deep. Insert screws and tighten. An Epoxy type of adhesive may be used under spar to insure a better bond with wood, but it is not absolutely necessary.

....
Builder's Signature **Date of Completion**

STEP 9

Root and tip ends are now cut and sanded to shape. Excess pieces sawed off at the ends are used as glue test samples. Break them at glue joints; all joints should pull wood. If they part at glue surfaces, the blade may be unsound mechanically and should be either rebuilt or discarded. Save a sample of a glued joint from each blade to preserve the record of your work.

Use the leading edge as your guide to saw the trailing edge to proper width. Then bank the blade on the trailing edge and saw the seven-degree reflex bevel on the botom of the trailing edge.

Now shape the leading edge by planing and sanding, or by multiple-step saw cuts, or both. Make an airfoil template from the Drawing #8-103-100 to constantly check the airfoil contour. Remember, round leading edges, sharp trailing edges and smo-ooth surfaces are essential to good aerodynamic performance. It may require a considerable amount of filing or sanding to obtain smooth continuous surfaces.

....
Builder's Signature **Date of Completion**

Step 10

Fill large depressions, cracks and openings around the steel spar with a mixture of plastic wood with primer-surfacer. Use a sanding block rather than free hand for all contour sanding. Blades should then be sealed with three coats of half-and-half thinned mixture of good quality wood sealer and turpentine.

....
Builder's Signature **Date of Completion**

Step 11

Clamp the upper retention strap in place. Be sure the distance between the spar and the strap is exactly ¾", and the ends are parallel. This is quite important, because the hub plate is also a ¾" thick piece, and the steel straps must go from wood to hub plate without wedging or pinching. Drill six ¼" holes on a drill press, and bolt together as shown on the print.

....
Builder's Signature **Date of Completion**

Step 12

Your are now ready to install the nose weight and the trim tab.

The nose weight consists of a steel strip bent in U-shape, filled with plumber's solder (lead alloy) and attached to the leading edge of the blade. Use the drawing as your template for the shape of the steel strip. Weld or braze ⅛" rods in place as retention posts to hold the lead firmly in place. After they are filled with lead, the weights should weigh exactly 34 ounces apiece. Use the 9th hole from the tip in the steel spar to locate your first inboard hole in the nose weight. The other two holes will straddle the 8th hole. Drill through with 3/16" drill on a drill press, and use bolts BA23-19 to clamp the weight on the blade. Nuts may be covered with streamlined balsa caps, but the rotor will fly with the bolts unfaired.

The main purpose of nose weights is to prevent flutter. They do it by shifting forward the chordwise center of gravity of the airfoil. Heavier blades require heavier nose weights and vice-versa.

The trim tab is made of thin aluminum sheet cut 1½" x 6" and located near the tip of the blade. One half of its width overhangs the trailing edge of the blade and is bent up or down as required by tracking (see Chapter 5). To insure a better bond, glue it on with Epoxy cement and secure it with five staggered rivets. Trim tabs operate in reverse of the ailerons, i.e., bending the tab down decreases the lift of the blade and vice-versa.

Bending of the trim tabs must be done flush with the blade trailing edge. Do not bend them more than 20 degrees at any time, as beyond this angle they will begin to act as lift spoilers. One builder reported endless trouble with a "rough" rotor that kept going out of track, until he discovered that his trim tabs became loose from handling and changed position in flight. Be sure your trim tabs are always firmly held against the blade.

....
Builder's Signature **Date of Completion**

Step 13

Finally, sand down the blade thoroughly with fine paper, leaving no ridges, nor depressions, especially on the upper surface, round off the tip smoothly as shown on the drawing, and cover the blade with the primer-surfacer. When completely dry, sand down with block and fine sandpaper. fill all imperfections, and cover again with the primer-surfacer. After another thorough sanding, paint it with two coats of hard-gloss exterior synthetic enamel.

Vinyl adhesive tape three inches wide should be applied in U-shape over the leading edge from nose weights to the tips to prevent abrasion from dust, pebbles and water spray. School supply houses carry this type of tape.

....
Builder's Signature **Date of Completion**

Step 14

Your rotor blade is now ready for assembly. If it was correctly built, it will weigh 15 pounds fully assembled, and its center of gravity will be at the station 57 (meaning 57 inches from the center of the rotor).

Notice that the inboard ends of steel straps have not been drilled yet. They will be drilled "on assembly" later, when attached to the rotor hub.

If you made any mistakes on one blade, which might affect its weight distribution, or stiffness, you must repeat them exactly on the second blade, or else start anew. It is very important that the two blades are exactly alike, as you will see from the instructions on "Rotor Tracking." The better work you do when building the blades, the fewer problems you will have when you start flying.

One last word of caution. Take good care of your rotor blades, because they are what holds you up in the air. Keep them out of rain, snow, and sandstorms. Suspend or support them by the nose weights to keep them straight when not flying, or remove them from the Gyro altogether and lay them down flat. When storing them for a long time, leave them lying flat on the work bench in a dry cool place. Watch for signs of rusting or severe warping, which usually come from excessive humidity or dryness.

Remember, rotor blades are your wings. Protect them as you would your own arms and legs. If you do, they will give you many years of efficient and trouble-free service.

....
Builder's Signature **Date of Completion** **F.A.A. Inspector's Signature**

4. ROTOR ASSEMBLY

The assembly of rotor blades onto the hub plate will require an accurate alignment of the blade tips across the center of rotation to obtain good balance. This operation will require making of a jig setup, because it is next to impossible to do it by eye. So, proceed as follows:

(1) Mark and center-punch the upper steel straps of both blades for 3/8" holes, as shown on the assembly drawing.

(2) Your Work-Bench will serve as the base for the jig shown in the Sketch 2. First, nail or screw two pieces of 1"x4" board on the side of the bench nearest to you, one (A) flush with the end, the other (B) exactly 49" from the end of the bench. Add also the pitch board (C) on the end, as shown. Its purpose is to hold the coning angle to four degrees and the pitch angle to zero degrees during the assembly. Check its upper surface with a carpenter's level to be straight and level. If you want to build a quicker starting rotor, the board (C) may be set at —1° to —2° (nose-down) to give the blade a slightly negative pitch.

(3) Take a piece of 1/4"x6"x12" plywood and make a spacer pad (D) out of it, as shown, boring out clearance holes for the bolt heads holding the pillow blocks. Remove burrs and nail it onto the bench in position. Lay the Rotor Hub on it with pillow blocks up, spacing it 1/2" from the front edge of the bench with a spacer board (E) and flush with the edge of the board (B).

(4) Apply pressure with one or two "C" clamps and check the Rotor Hub to be level in all directions.

(5) Now place the first blade on the bench as shown, with its short steel strap facing up. Line up its inboard end exactly with the edge of the guide board (B). Place an 1/8" shim plate under the spar end. Double-check with a level its pitch to be 0°. Press the blade leading edge against the guide-boards (A) and (B) and clamp lightly against the bench.

(6) Next, make two 3" wide metal straps (F), which have 3/8" holes reamed for the teeter shaft and three or four holes drilled for husky wood screws. Slipping a close-fitting 3/8" shaft through the pillow blocks, slide the uprights (F) from either side until they touch the bench. Screw down the uprights onto the sides of the bench in that position, making certain that the shaft can be easily withdrawn (without jamming or cocking) when the Hub Plate rests firmly on the spacer pad.

(7) Bring the Drill Press over to the Work Bench, swing the drill table out of the way, lower the head and drill the two 3/8" holes through the entire assembly. Use cutting oil and raise the drill often when drilling through the second layer of steel to prevent steel chips from damaging the hole in aluminum. It would be desirable to use a slightly undersize drill and then ream to assure a snug fit (hand push) between the hole and the bolt you intend to use. Do not allow the drill to chatter. De-burr the holes after drilling.

(8) Make light center-punch or file-marks on the Hub Plate and on the upper steel strap close-by, so you will recognize them as mating parts later. Remove the blade No. 1. **Do not disturb** the setting of the uprights (F).

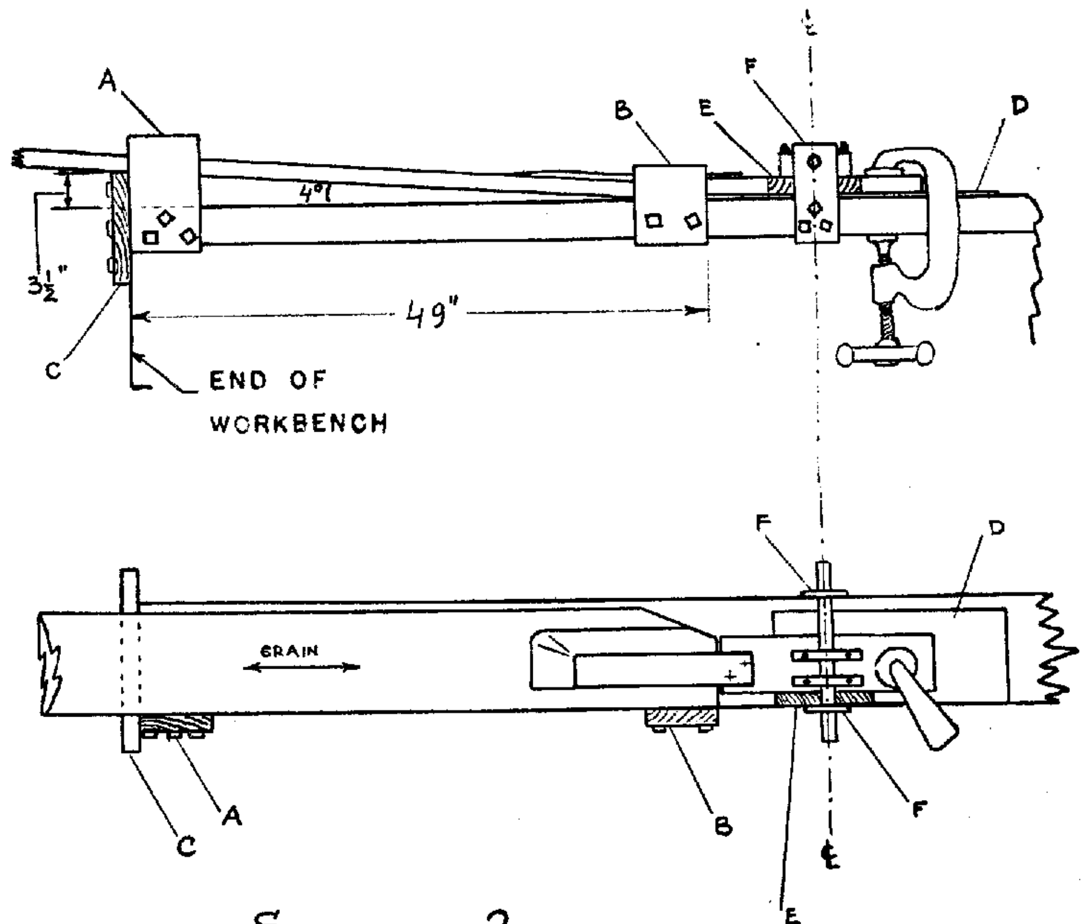
(9) Pull out the 3/8" shaft from the asembly, lift up the Hub Plate and turn it end for end, or 180 degrees.

(10) Insert the 3/8" shaft again through the uprights and the pillow blocks. Bring the Blade No. 2 and set it up against the guide boards (A) and (B) as before. Be sure to clean metal chips off the bench when you put the blade down. Clamp as in Operation 5, double-check the pitch to be 0° and proceed as with the Blade No. 1.

(11) Finally, put double marks on the blade-end and the Hub Plate as in Step (8) to identify the mating ends of the blade No. 2.

ROTOR ASSEMBLY

JIG



SKETCH 2

NOT TO SCALE

...

Your Rotor is now ready to be mounted on the Rotor Head.

CHECK: To be doubly sure that you followed the procedure correctly, bolt both blades onto the Hub Plate, stretch a light string from one tip to the other, from leading edge to leading edge, then the string should pass right over the center of the Hub Plate. Maximum permissible "out of pattern" misalignment is about 1/8". Beyond that the rotor will begin to feel "rough" in the air.

If the alignment is good, this completes the assembly of your rotor, and you may proceed to mount it on the Rotor Head. This is done merely by inserting the 5/8" bolt through the teetering hinge and securing it with a cotter pin. Remember, don't make it so tight that it would not hinge, nor so loose that it would rattle.

Proceed to balance the rotor by drilling out some solder from inside of the Nose Weight of the heavier blade. Always start with the Hub Plate level and then watch which blade goes down. You may shake the stick lightly during this test to minimize friction. Good enough balance must be

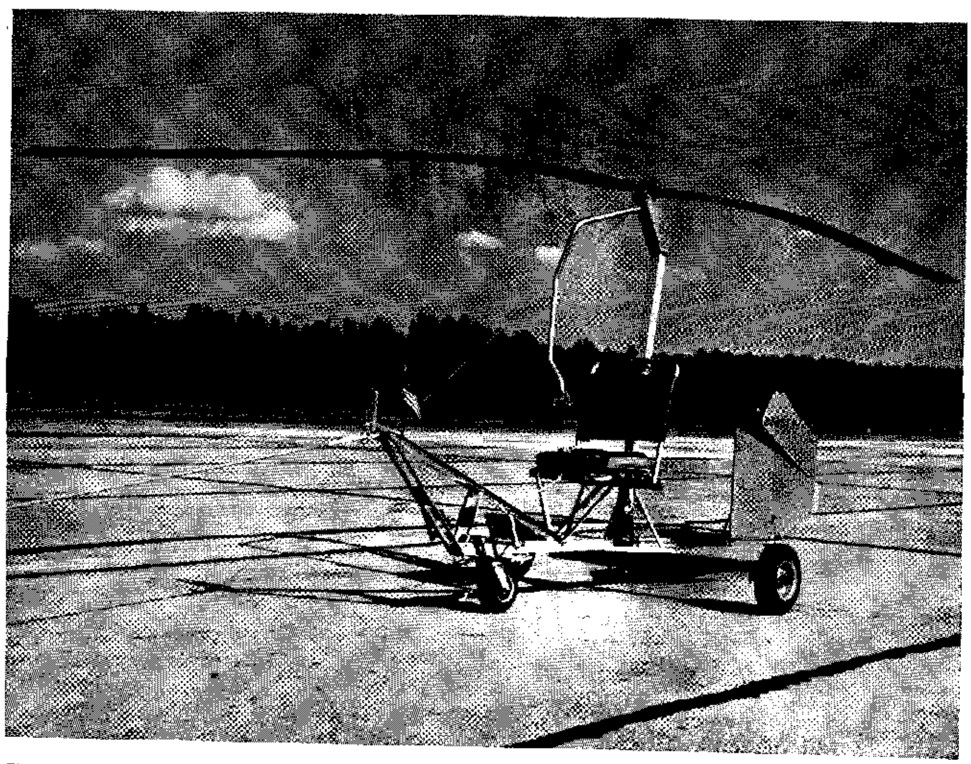


Fig. 10—Completed B-8 Gyro-glider, ready to fly. Note its neat and functional lines. There are no frills, no tinsel, not one ounce of unnecessary weight. It's crisp and solid. Every inch a flying machine.

obtained, so a penny placed on the nose-weight of either blade would make that blade go down. No more than two ounces may be removed from the noseweight. If the rotor is still out of balance, the lighter blade must be made heavier by drilling 3/8" holes, as many as needed, about 3" apart starting from the tip, and filling them with lead. Their centers should be 1¾" from the leading edge, which will put them through approximately the thickest section of the airfoil.

After you are satisfied that your rotor is "in balance" and "in pattern", all that remains to be done before flying it is to put it "in track." This completes your shop work, because rotor tracking is done outdoors.

Your Gyro-glider is now ready for its first spin.

One last word before you rush off to your nearest airport to test-hop your bird. Stop for a while and give it a slow and thoughtful inspection. Ask yourself a question: "Is it built exactly as Bensen Drawings and Manual specify?" If you have installed any hardware NOT as specified by Bensen, then YOU have become responsible for its design and must accept the consequences if anything goes wrong. This is because as soon as you change any part of the design, or materials, or method of fabrication, or even one single bolt, YOU become the "aircraft's designer", and engineering responsibility for the entire craft becomes yours. If you have done this, ask yourself: how do you, or men who advised you to make the changes, rate as aircraft designers? How much do you know about aeronautical engineering? Remember, your safety will depend on your answers.

Whatever you decide, if you have deviated from the Bensen design, then it is no longer a Bensen Gyro, but YOUR Gyro, designed by YOU.

It is not too late at this stage to remove all "modifications" and return the machine to all-Bensen design. It will pay big dividends in the peace of mind of knowing that 19 years of Bensen rotorcraft experience will be backing you up when you are up in the air.

5. ROTOR TRACKING

Although the Gyro-glider is a very simple machine, in many respects simpler than a bicycle (it has fewer bearings and moving parts, for instance), there are certain things you must learn about it that are quite different from earthbound machines you may be familiar with. The main difference, of course, is that you don't roll on wheels, but fly on wings. Furthermore, the wings spin around with

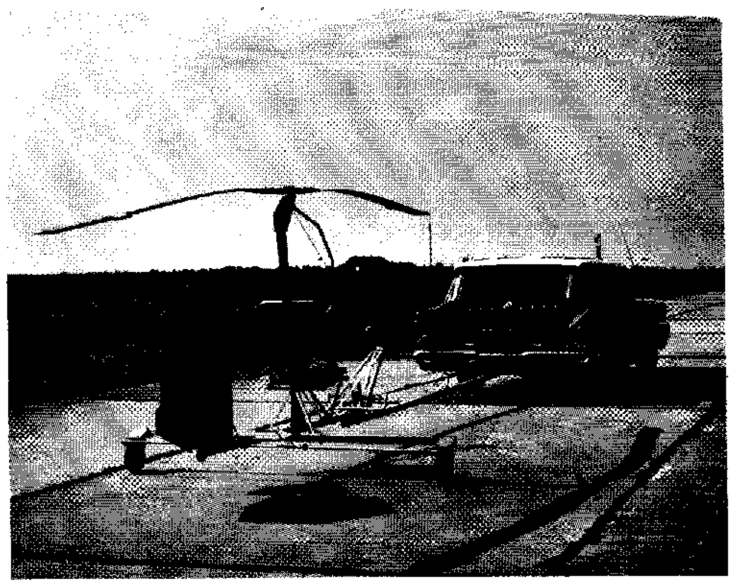


Fig. 11 Rotor tracking may be conveniently done on the B-8 modified into the Training Trailer shown here. (See Pilot's Manual). Note long rigid boom replacing the nosewheel, safety cable, castored main wheels.

their tips traveling at some 250 miles per hour, and they are what holds you up in the air. This is why it is said that the Gyro-glider belongs to the family of "rotary-wing aircraft." Just as with the bicycle however, whose wheels are liable to be out-of-round and have a "figure 8" in them when first put together, you will probably find the rotor "out of track" when you first spin it in the breeze. This is quite to be expected. A certain amount of trial and error experimentation will be necessary to obtain good operation of the rotor.

First, paste a 6" length of white or silver plastic tape on the leading edge of the blade No. 1, ending it at the very tip. Paste another 6" length of the same tape on the blade No. 2, but ending 6" short of the tip. This is done to help distinguish one blade from the other when they spin at high speed. Painting entire blade tips different colors, light and dark, may also give satisfactory distinction.

Now you are ready for tracking. On a windy day, choose a clearing or a hill where the breeze blows steadily, about 20 mph (bring your -24A wind-meter to check it), and face the Gyro-glider into the wind. Tie the tow-rope to a post or a heavy stake in the ground some 10 feet in front of the ship. Remember, the tow rope may pull as hard as 250 pounds; make certain by testing it that your stake and rope can hold it. Certified rope strength should be 1000 pounds or stronger..

The table below gives the strength of various types and sizes of rope. Manila or Linen rope are preferred because they have a minimum of "rebound stretch" (see p. 42 of Pilot's Manual on "rope buffeting.")

STRENGTH OF ROPES

Size (in)	Manila Min. Tensile Strength	Nylon Min. Tensile Strength	Dacron Twist Min. Tensile Strength	Dacron Braid Min. Tensile Strength	Yellow Polypropylene Twist Min. Tensile Strength	Yellow Polypropylene Braid Min. Tensile Strength
¼	....	1500	1440	....	1300	1100
5/16	1000	2400	2220	1650	1900	1375
⅜	1350	3400	3120	2300	2750	2025
7/16	1750	4800	4500	2900	....	....
½	2650	6200	5500	3800	4200	3800

Strap yourself into the seat. Slide the ship back to put tension on the rope. Check the control stick motion to be free from binding or jamming. Proceed as follows:

(1) Spin the rotor with your right hand as fast as you can while holding the rotor nearly level by holding the stick all the way against your chest with the left hand. Have your assistants watch the blade tips from the side. Allow the rotor to pick up speed by gradually tilting the rotor backwards. Do not move the stick forward too soon, while the rotor is still accelerating, because if the wind is strong, it will pick up the slowly rotating front blade and force the rear blade to strike the -4 cover plate, slowing down the rotation and causing unnecessary wear. It might even strike the tail if you let it go too far back. Unpitch the rotor forward as soon as you feel the teeter stops contacting the plate. If the two lengths of white tape seem to form a straight line to the observers outside at 200-250 rpm, your blades are in track at slow speed. CAUTION: Do not pull down on the rotor blade when starting or stopping the rotor. It may force the blade tip to hook the tow rope, or wind gust may break it in droop.

(2) Rotor speed will continue to pick up until the blades turn so fast you cannot see their tips. But your assistants still will be able to tell if it remains in track. If it goes out of track, you will know it by noticing an increasingly stronger shaking of the hub. It may become so strong, if badly out of track (tips a foot apart or so), you would be wise to pitch the rotor forward again to unload the lift and slow down the rotation. About 2" out-of-track is considered flyable, but of course, the better the track, the smoother the rotor will fly. More than 2" out of track is considered unsafe for flight. Vibration level of the rotor must be low, otherwise you may do "fatigue" damage to the airframe, that is liable to be followed by sudden structural failures.

(3) As the rotor continues to pick up lift, the craft will rock on its tail, which will further increase its lift and speed. This is the "high-speed" condition for tracking, and you must be careful now not to take-off inadvertently. Leave your feet on the ground, and if you feel the main wheels lifting off the ground, dump the stick immediately and unload the rotor. You are not quite ready to fly yet.

If you observe your rotor to be out of track, bend up the trim tab of the lower blade. As a rule, it takes about 3 degrees of trim tab bending to correct for one inch of out-of-track distance between the blade tips. Bend down the trim tab of the high blade. Tab should be bent flush with the trailing edge of the blade.

The Trim Tabs are not effective at low speeds, but have a powerful action at high speeds. They also have strong influence on the speed of the rotor, which should be maintained between 340 and 360 rpm in normal level flight. Bending of the trim tabs down speeds up the rotor, bending them up, slows it down. Under no condition bend the tabs more than 20 degrees either up or down, because they will begin to lose their effectiveness and will act as drag plates, producing erractic action.

Sometimes it helps to bend both trim tabs up or down to speed up or slow down the rotor away from a "rough" range.

If your rotor refuses to pick up speed in presence of 12-15 mph wind after sustained vigorous acceleration by hand, double-check its pitch to be 0 degrees especially in the vicinity of the nose weights and see that trim tabs are not bent excessively. Furthermore, be sure that the upper surfaces of the blades have no ridges, steps, nor any protrusions, because they would act as spoilers and will interfere with free rotation. You may reduce the pitch to -1 degree, or even -2 degrees, if you wish to have a quick starting rotor, but then your takeoff speed will be higher, too.

If the rotor spins too fast, again check the pitch angle, and if it is low, slow it down by bending the trim tabs up until a speed of about 350 rpm is obtained, or else by turning up the pitch a degree or so. One way you will know that the rotor turns too fast after you start flying, will be by unduly high take-off speed. The craft should become fully airborne at about 20-25 mph, if the rotor speed is right.

Be sure your tabs do not become loose on the blade, or else the blades will go in and out of track erratically. Peen over the rivets gently or cement them on the blade at the first sign of looseness.

You are now ready for your first lesson in Gyro flying.

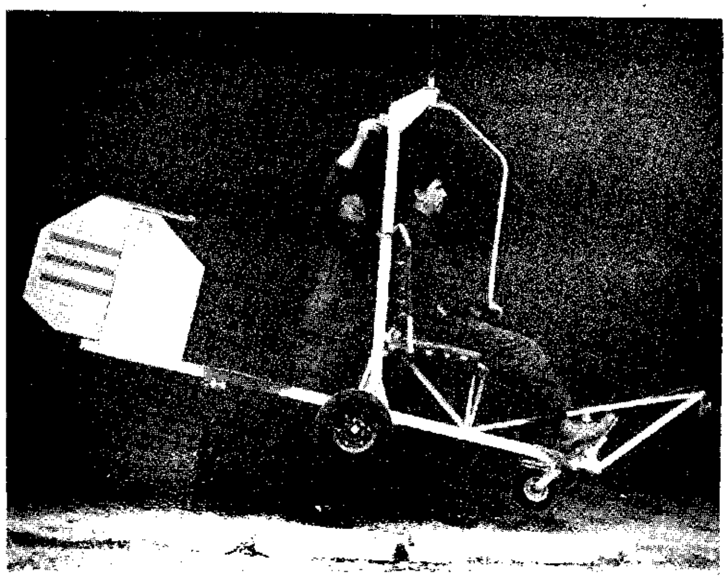


Fig. 12—Hang Test is a MUST before the Gyro is flown. Note that the mast is tilted down from the vertical and its angle is measured by the pitch meter placed just under the rotor head. The stick is held neutral.

Fig. 13—A closeup of the approved towhitch and the rope fastening. It is important that the tension end of the rope go directly over the solid bar without kinks or knots.

PILOT'S MANUAL

and

OPERATING INSTRUCTIONS

For Bensen Model B-8 Gyro-glider

IF YOU CAN ride a bicycle, you can learn to fly the Gyro-glider. It is that simple to control. However, you shouldn't expect to fly the Gyro-glider on the first try, no more than you could ride the bike on the first try. It takes a little learning. As in learning to ride a bike, if too hasty in getting off the ground, you might get mixed up and take a spill. Unlike taking a spill on a bike, which you can right up and try again, a spill on a Gyro-glider might result in a damaged rotor. So, take your time, advance in your flying skills gradually, getting the "feel" of the control action so pat at each step, that your reactions will become "reflexes," before advancing to the next step.

Whether you have a pilot's license or not, chances are this is your first acquaintance with lightweight rotary-wing aircraft. Fixed-wing pilots are especially prone to get themselves into trouble during early stages of flying the Gyro through overconfidence and disregard of these Instructions. In some helicopter schools it takes 25 hours of flight instruction before even licensed fixed-wing pilots with commercial ratings are considered checked out. Some never make the grade. If you are an airplane pilot, take notice.

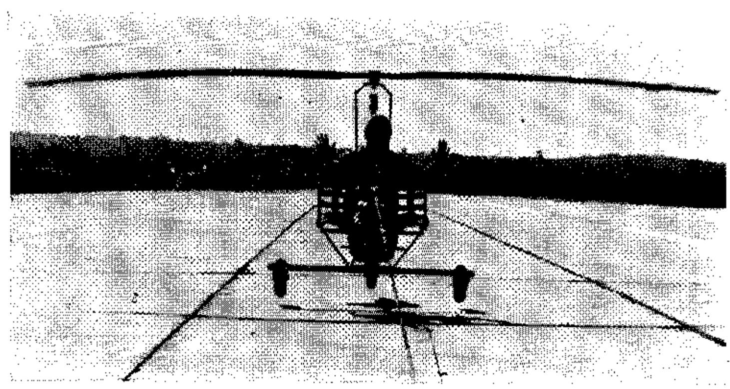


Fig. 14—Gyro-glider is so stable and easy to fly, it flies itself, hands-off.

The Gyro-glider is actually easier to fly than helicopters. While some exceptional students succeeded in soloing it in as little as 10 minutes, our experience shows that, on the average, whether you are licensed pilot or not, it will take about three hours of practice for a new man before he should safely venture to altitudes above 1-2 feet. This should be normally spread over six half-hour periods, morning and afternoon, on three different days. So, don't rush it, take your time and be safe.

While you are still building the rotor and the rotor head, you can use your airframe as a static flight trainer similar to the Link Trainer for airplanes. It will teach you correct hand movements and reactions which you will later use in flight. A similar static training rig is used at Bensen plant to check out control reactions of all would-be Gyro pilots. This is an indoor rig. It consists of a standard automotive universal joint clamped under the Front Keel tube, directly under the center of gravity, the lower part of which is bolted onto an automobile brake drum. The drum rests on the ground while the Gyro-glider is thus propped about 3" off the ground and can swivel freely around the universal joint. An overhead beam or a tripod is mounted above the pilot's head ending about 6" above and in front of the point where the teeter bolt would be. A rope, chain or cable is suspended from this point ending with a pair of handle-bars removed from the control stick. When the "pilot" sits in the machine, position of handle-bars is exactly as in the real cockpit. The craft will first rest on two wheels in a lopsided position, as he climbs in it.

The checkout procedure is done in three stages. First, leaving the nosewheel on the ground, the pilot masters only the lateral control by maintaining lateral equilibrium. This he does by applying steady downward pressure on the hand-grips and deflecting them sideways until both main wheels are off the ground. He should be able to maintain the axle horizontal for at least two minutes before proceeding to the next step. He should sit erect in the seat, his back resting firmly against the back-rest.

The next stage gives practice in longitudinal control. Leaving, say, left wheel on the ground, the pilot pushes forward on the handlebars until the nosewheel lifts up in the air. The stick is then returned to neutral and the pilot strives to maintain equilibrium by keeping the nose and tail-wheels off the ground. This, too, he should be able to do for at least two minutes. Make sure you apply steady, light pressure on the handlebars, using hand movements rather than pressure to maintain equilibrium.

The final stage requires the pilot to lift and hold all four wheels off the ground maintaining equilibrium "on the point" in all directions for at least five minutes. This he should be able to do completely relaxed, looking around and making conversation with people deliberately distracting his attention. Downward pressure on the handle-bars should be light and steady. Control corrections should be made mostly by moving hands rather than by varying the pressure. The pilot should be able to let go of the grips altogether for an instant without losing equilibrium.

An "instructor" standing behind the pilot might deliberately produce "gust loads" by pushing on the frame to see how quickly does the pupil respond with corrective action.

A successful checkout on this "Point Trainer" is mandatory before anyone should try to fly the Gyro-glider for the first time.

Trained airplane pilots who wish to use the "joystick" type of control stick, unfortunately, cannot use this static trainer because of its overhead nature, and must advance directly to the actual "on the point" pre-flight training with the Rotor and Rotor Head mounted on the Gyro-glider. You can begin this training at the same time you do your rotor tracking.

The idea of "practicing on the point" boils down to balancing the Gyro-glider on a single point under the pilot's seat with all wheels about 3" off the ground. The same universal joint and brake drum described above can be used as a pivot point (see Fig. 15). The purpose of this practice is to let yourself become accustomed to the speed of rotor response to control motions, both sideways and fore-and-aft. First let your feet rest on the ground. Then tilt the stick sideways and feel how the rotor follows the stick motion. Do it many times until you can lift your feet off the ground and balance yourself on the point indefinitely, using only the rotor for control. Repeat the exercise with fore-and-aft stick motion. After you have learned the longitudinal motion, combine the two and practice keeping all wheels off the ground until you can do it easily and comfortably. DO NOT ATTEMPT TO FLY until you can do this whether you fly the overhead stick or joystick.

Here is how the founder of one of the first "Gyro-Glider Clubs" in America admonishes young members of his Club, who are about ready to start flying:

"You have spent hours building your Gyro-glider — and money as well — do not under any circumstances try to fly your glider until you have spent hours practicing 'on the point'. Hold

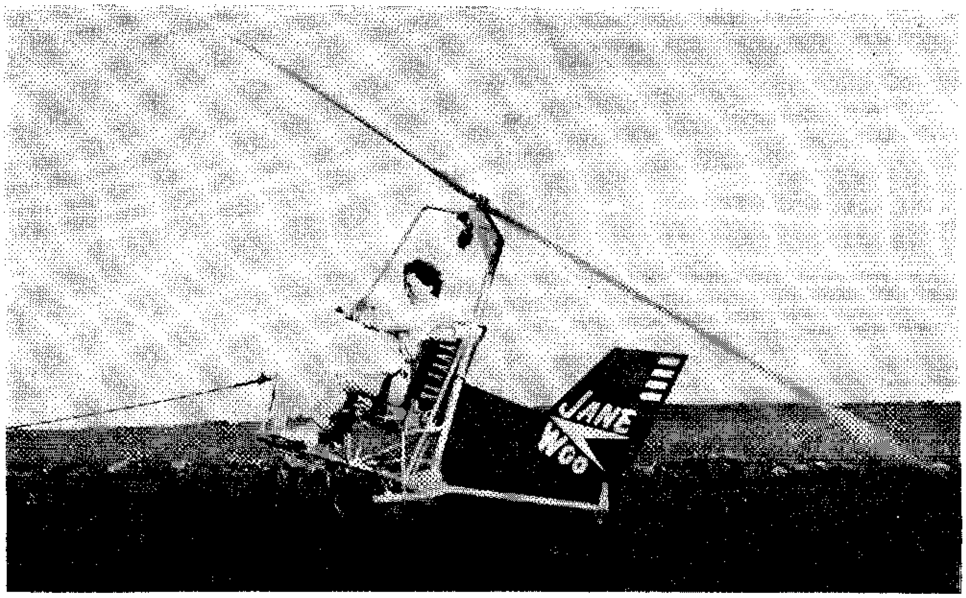


Fig. 15—Practicing in the wind "on the Point." Notice all main wheels are off the ground.

yourself back — I know you are enthusiastic, can't wait, want to take a chance — but don't do it! Spend hours in the seat . . . It's still fun practicing 'on the point'. Everyone of the successful flyers of the Gyro-glider have proven the value of practice 'on the point' ".

To which we say: AMEN. You won't regret this advice from a man who successfully flew himself and taught some 30 members of his Club to fly.

If you don't have much wind in your area, you would be wise to convert your Gyro-glider into a Flying Trailer shown in Figs. 11 and 16. This configuration is used in Bensen plant to check out all new Gyro-glider pilots before they are advanced to flying on the towline. This is the only safe way to learn to fly alone if you cannot get dual-seat training from a Bensen dealer. It does not matter if you have pilot license in any other type of aircraft — it is a lot cheaper to convert your Gyro temporarily into a Flying Trailer than to have to replace a broken rotor.

The Flying Trailer consists essentially of the same B-8 Airframe as you just built except for the following changes:

1. The nosewheel is replaced by a rigid boom which is attached by a ball hitch to the car.
2. The main axle is removed and replaced by a wider axle (8 feet) with castored wheels on its ends.

The wheels are synchronized by a tie-rod and preloaded to steer straight by centering springs.

The most gratifying thing about the Flying Trailer is its inherent safety — it will not fly higher than 2 - 3 feet no matter how hard you try to go higher. If the pilot gets himself in any sort of trouble, all the driver of the car has to do is slow down and the craft will settle down safely.

Another virtue of the Flying Trailer is its tolerance to landing in a crab. While the pilot should strive to always land directly behind the centerline of the car, his failure to do so would not be followed by capsizing, as it would in most other aircraft. An airplane, for instance, would do a "ground loop" if landed in a crab. In this respect, the Flying Trailer may be said to have a cross-wind landing gear which is immune to "crab".

Rotor tracking and all preliminary flight training may be done with your Gyro converted into the Flying Trailer. (Drawings and kits of correct conversion of the B-8 into a Flying Trailer are available from the factory). Normal airspeed during trailer training **should not exceed 35 mph.**

The Flying Trailer gives you an extra bonus which a stationary "point" does not: it teaches you that tilting of the craft is accompanied by drifting. This is an important association to learn early

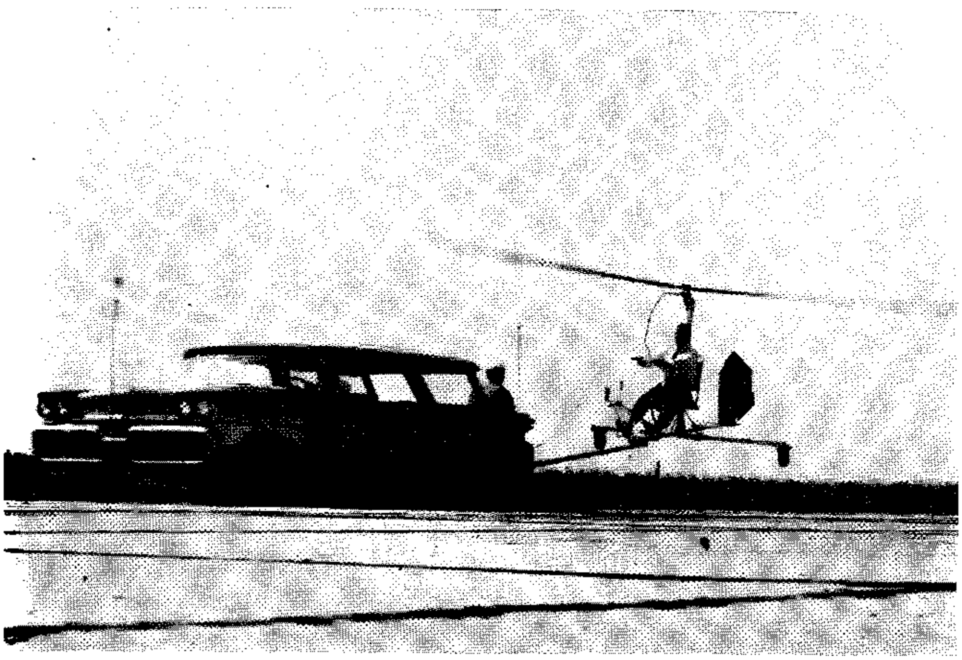


Fig. 16—The Gyro-glider modified into the flying Trailer in full flight at its maximum altitude. Note the safety man facing rearwardly. Also the Airspeed Indicator and flag mounted above the hood of the car.

in the game. Thus, if you tilt the rotor to the right, the machine will soon drift to the right of the car, and vice-versa. The pilot thus can practice the art of "anticipation", leading with the control of tilt (or "bank"), to produce the desired drift effect. There is usually a second or two of delay between the two. The same thing applies to the use of the up-and-down control. There is no substitute in convenience for this type of solo flight training, considering its safety and independence from wind conditions.

If you do not wish to go into the expense of adding a wider axle with castored wheels, you may be able to retain the standard B-8 axle, but must not attempt to fly from hard pavement. The best surface in this case would be slick grass or hard sand, which permit considerable skidding in crab without "digging in", which would cause ground looping. However you will still need the boom and the extra safety cable. These are readily available from the Bensen factory.

It is suggested that if you expect someone else ever to fly your Gyro-glider you should definitely check him out first "on the boom" in the Flying Trailer with yourself driving the car. This way you will be always in command of the situation while testing the new man's skill under safe conditions.

1. FIRST SOLO

Finally, the great moment comes and you are ready to "solo" in your Gyro. This is an exciting moment of your life that you will never forget. There are no instructors to help you correct your mistakes. Like a young bird making its first flight, you are entirely on your own. You are about to fulfill man's age-old dream—fly like a bird, all by yourself.

First, choose a windy hill with wind blowing steadily 25-30 mph and start your flying career by flying your Gyro as a KITE! Proceed as you did for rotor tracking on page 30.

This time wear goggles and a hard helmet for greater safety. These safety aids, like the safety belt, are rapidly becoming popular in all sport activities including such innocent ones as go-karting and motor-scooting. They are inexpensive and are designed to protect you. Use them.

Using a short rope not longer than 20 feet with tested strength of 1000 lbs. or more (see p. 31), tilt the rotor all the way back, gradually making it gain full speed. Suddenly the Gyro-glider rocks on its tail and in another instant the main wheels leave the ground. Quickly reduce the stick position to neutral and do not permit the machine to rise more than a few inches. This is important, because if you don't, you might find yourself sitting some 10 feet up in the air without any visible means of support and might get excited. Wisely, you stay close to the ground no higher than one or two feet above the ground, during all your early flights. Practice at low altitude as long as necessary until you relax and gain complete confidence in your ability to handle the ship. Then, only then, do you climb to altitude above one or two feet. As you leave the ground, you will notice that the air becomes smoother higher up, as you climb out of the "ground turbulence", and at altitudes above 15 feet flying becomes so easy you can take time to look around and enjoy the scenery of the world below you.

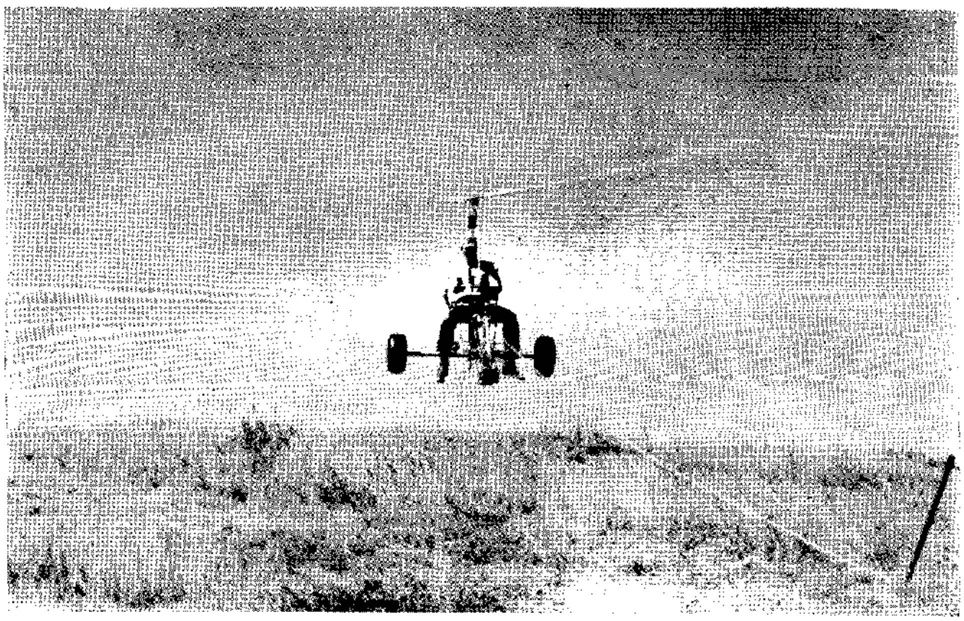


Fig. 17—Kiting in the wind. This home-built Gyro has Piper Cub wheels. Stake in the ground on the right holds full towline pull. Pilot is relaxed enough to fly with one hand.

Don't overdo it the first day. Practice for 15-20 minutes or so at a time, two or three times and then stop. Whether you know it or not, it will take a lot out of you to fly your first "solo." The excitement will tire you sooner than you realize it, and your reflexes may slow down to the point where you might do something wrong.

After you have practiced KITING in the wind long enough to gain confidence in yourself, you may tow the Gyro-glider behind a car. Any reasonably smooth field 1000 feet or more long, an old road, a race track, a runway at the airport, or a taxi strip—all are suitable to fly your Gyro-glider. All early training flights should be made into the wind. Avoid flying during training period when gusts or crosswind exceed 5 mph. Even when you become proficient in Gyro piloting, avoid flying when gusts exceed 10 mph.

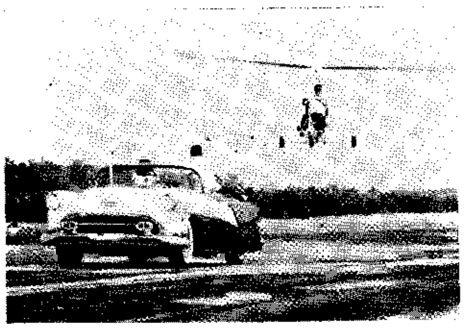


Fig. 18—A 16 year old high school boy and his chums built this Gyro and soloed after 4 hours of practice.

Use a short length of rope at first, no longer than 30 feet, so you can shout and be heard by the driver (see Fig. 18). Position yourself downwind from the car and pull back hard on the line to test its strength. Have at least one man in the car face back at all times to watch your signals: (1) "Thumb up", meaning "go ahead" or "go faster", (2) "Thumb down" meaning "slow down", and (3) "Cut" motioning across your throat, meaning "stop quickly". If only two men go out, you must have a wide-angle rear view mirror and a radio intercom installed, so the driver can always see and hear the pilot. A wind meter should be installed on the car, which the driver must learn to watch instead of the speedometer, (see Fig. 16). There should be no one sitting next to the driver, to avoid his being distracted by conversation.

Repeat the taxiing exercise without the rotor; learn to operate the steering bar and the brake with your heels until it, too, becomes a reflex. Taxi speeds in excess of 20 mph without the rotor are dangerous and should be avoided. Learn to release the tow hitch. You should know exactly where the tow hitch cord is and reach for it automatically without looking at it.

Next, make more taxi runs with the rotor turning, but at low speed. If the rotor seems to be slow in picking up speed, give it an extra strong push as fast as your hand can follow it, driving no faster than 15 mph. Rotor should be turning at about 250-300 rpm during these taxi tests. Observe now how the rotor responds to your stick motions. Do not exceed at any time the air speed of about 20 mph (meaning that if the wind is, say, eight mph, your ground speed should be no greater than 12 mph). Practice tilting the rotor back, but not allowing it to strike the head plate. You will soon learn that there are two stages in bringing the rotor up to speed: first stage is under 15 mph when the rotor accelerates from very slow speed to intermediate speed, and second stage up to 20 mph when it accelerates to full flying speed. Don't try to go faster than 15 mph when the rotor is still turning slowly, because you will find that it will refuse to speed up and will bang hard against the head plate and may hit the tail. So, slow down and give the rotor a chance to accelerate.

It is important that the driver of the car understands the operation of the Gyro-glider and works closely as an active member of the team. For instance, if the agreement is that the pilot intends to stay close to the ground and the driver sees the craft suddenly rise into the sky, he must know enough to slow down at once, decreasing the flying speed, and thus preventing further gain of altitude. Conversely, if the driver sees the glider settling down rapidly, he should increase his speed at once to prevent a possible hard landing. Another common fault of some drivers is that unconsciously they tend to accelerate to higher speeds after the Gyro-glider becomes airborne. Driver must make a determined mental effort to hold his air speed constant at all times and not get too absorbed in the excitement of flying. This vigilance will become less important after the pilot becomes more proficient in his skill of flying, but during the learning stages a good teamwork between the pilot and the driver is essential. The driver certainly must be asked to read this chapter of the Instruction Book and the Driver's Check List, whether the pilot is a beginner, or an expert. Wind Meters installed on the hood of the tow car and above the tow hitch on the glider must be used to maintain constant air speed. Remember, air speed is what is important, not ground speed.

If you are a light-weight man, the Gyro-glider might become airborne even below 20 mph, so watch out if it starts heading for the sky. Be on the ball with your control stick and don't allow it to rise more than one or two feet, and set it down quickly.

Now pick up more speed until the machine rocks on its tail, which indicates that it is about ready to take off. Lean firmly against the back-rest. Without increasing the air speed, pull back on the stick and rock the craft back on its nose-wheel. Then push the stick forward again and rock it back on its tail. Then use this 'rock-and-roll' practice to keep both front and tail wheels off the ground. This should be reminiscent of your earlier "on-the-point" exercises. The purpose of this practice is to make you attitude-conscious and give you an idea how quickly the rotor responds to your control commands when it is nearly airborne. Keep your heels off the steering bars to avoid inadvertent swerving when nosewheel touches the ground.

After you are satisfied that your hands acquired sufficient skill to keep both front and tail wheels off the ground at will, then you can proceed to make short gentle flights. Increase the air speed slightly (no more than 25 mph) and push forward on the stick enough so the nosewheel is up, but the tailwheel is just barely off the ground, too. Do not deflect the stick laterally when main wheels are still on the ground even if the craft does not steer straight. The latter may be caused by a slight dissymmetry of the landing gear, or a crosswind; tilting the rotor to the side will not correct the resulting crab while the craft is on the ground, but might cause the craft to leap sideways on take-off. So, make a special effort and watch yourself to keep the stick laterally neutral (or vertical) as you manipulate it longitudinally during take-off until after the main wheels have left the ground. As soon as the main wheels leave the ground, neutralize the stick promptly to prevent further tilting back. As soon as the machine becomes fully airborne, reduce the rotor tilt and land again. Learn to "leap frog" like this, striving to accomplish very smooth, gentle touchdowns, with barely a few seconds in the air. This exercise will teach you the amount of longitudinal stick motion required to obtain precision control. Watch your lateral control, too, and keep the craft always level during landings. Above all, keep the craft from drifting sideways. Land promptly if you drift more than 5 feet to either side of the center line of the tow car.

Remember, it is a known psychological fact that the shortest possible time in which a man can count on acquiring a new reflex is about 20 minutes of sustained practice, which must involve a minimum of seven repetitions of the desired operation. Thus, for your own safety, make at least SEVEN full-length runs with a total time of not less than, say, half-hour before venturing to altitude above 2-3 feet. This is absolutely a "must" in training, unless you deliberately wish to risk a chance of cracking up. Your patience will be well rewarded by skillful and sure handling of your craft later.

After you master the "leap-frogging," you may spend a little more time aloft during each leap, lingering at a two to three-foot altitude a little longer and striving to maintain that exact altitude, no higher and no lower. Use lateral motions of the stick to fly directly behind the car. Do not allow the glider to drift sideways and above all, never land in a crab. While crabbing in the air is quite harmless, touching the ground in a sideways attitude is something else. When you are still learning to fly, a good rule should be to avoid side drifting, period. Stay directly behind the car. This is your most important learning period in acquiring good flying habits and developing precision of control. Resist the temptation to climb to higher altitudes until you can fly 10 times full length of the runway at 2-3 feet without coming down from beginning to end. This applies especially to pilots with previous training in airplanes, who are likely to become over-confident after a few successful passes. These pilots must constantly remind themselves that rotorcraft are entirely different type of flying machines from airplanes. This is true whether you fly a standard helicopter, or a Gyro-glider, an overhead stick, or a "joystick," it makes no difference. The entire lifting surface of the rotor craft is tilted when the control stick is deflected. Only small surfaces (ailerons and elevators) are deflected in airplanes. Therefore, a trained fixed-wing pilot will tend to "overcontrol" by excessive stick motions. This leads to "porpoising" type of overcontrol, both up and down and sideways, which may be dangerous if allowed to persist. While wing of an airplane is fixed to the airframe, rotor of the helicopter is free to hinge on the spindle. Thus the pilot, who flies by watching tilting motions of the airframe, must learn to anticipate the delayed action of the rotor tilt-ing, as contrasted from an instant tilt action he gets from the rigid wing. A fixed-wing pilot must therefore make a special effort and take time to practice as instructed at a safe low altitude, to eradicate, or overcome, all conflicting notions and reflexes he learned while flying the airplanes. To do otherwise would be wilful negligence of these Instructions and may lead to accidents later.

Be careful not to over-run the tow rope, or allow it to go slack, as you depend on it to maintain steady heading. Do not release the tow hitch in mid-air under any circumstances. Do not shift your feet from the footrest to the steering bars until nosewheel drops to the ground itself with rotor fully tilted back after landing. Keep the rotor spinning at intermediate speed and tilted back during taxiing, or bring it to a complete stop.

Make ten full length passes at low altitude and air speed of 30 mph to become completely familiar with the response of control. Look only forward during takeoffs. Do not watch main wheels to determine moment of takeoff as it may upset your equilibrium. Keep your eyes fixed on the horizon when flying rather than on the tow car. Then take a half-hour break to exchange notes with the car crew and to rest your nerves. You may drive the car for a while, perhaps, while one of your partners goes through the preliminary flying routine you just completed.

Repeat the low-altitude practice three or four times, preferably in the morning and afternoon on different days.

Finally, the time comes for you to "climb to altitude." First, make two low-altitude passes full length of the runway at an air speed of about 35 mph. You will notice that the controls will become somewhat more sensitive at higher speeds, yet the Gyro-glider will seem to become more stable and easier to control. Suddenly you will be able to relax and let your hands handle the controls almost automatically. This is the first sign that you "got it" and you have reached the point of flying it as automatically as riding a bicycle. Now you are ready for altitude. Gradually ease forward on the stick and let the ship float up higher and higher until the car seems to be almost below you. This is the moment of a great thrill. You feel as if you, yourself, are flying like a bird. Soon you can begin to make deliberate maneuvers, gently banking to the right, then to the left,

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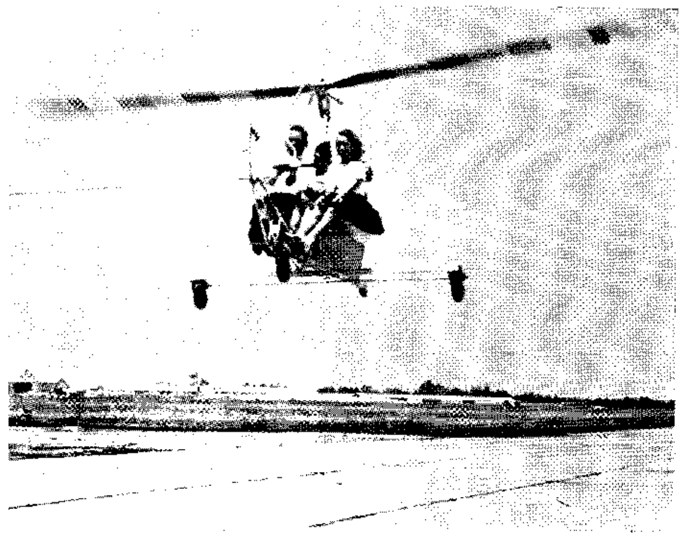


Fig. 19—A 45-year-old instructor teaches a boy, 11, and a girl, 14 to fly the dual-seat gyroglider, with all three flying at the same time.

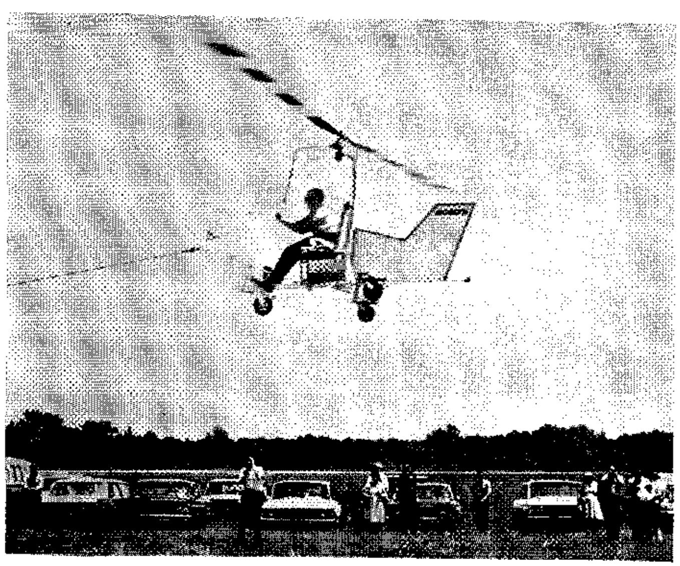


Fig. 20—An 11-year-old-boy soloes the gyroglider in front of several hundred spectators during an International Fly-In of the Popular Rotorcraft Association. Flying a dual-seat trainer, he not only flew himself, he also taught many adults how to fly. No license is needed to fly the gyroglider.

in graceful S-curves, like on water skis. This is known as "coordination exercises" in the art of piloting. Increase the air speed gradually to 40-45 mph. After you have mastered the S-curves, start going up and down like a roller-coaster, first gently, then steeper and steeper, still at 40 mph. Be sure your car crew maintains constant air speed of 40 mph regardless of what you do. It won't be long before you will observe that on the "downhill" glide the tow rope will become slack and you will begin to catch up with the car. Be careful at this point to avoid jerky pulling on the line, for the rope may snap if you make it pull too hard. When the line goes slack, you are in effect in free flight, gliding independently from the car. During these exercises, or even earlier, you may encounter a phenomenon which is known as "rope buffeting." It is usually caused by a periodic stretch of the rope, like a rubber band, resulting in jerky snatching of the line. The remedy is simple: change the length, or the size of the rope. When it happens for the first time, unload the rotor each time just before the line jerks to minimize the severity of oscillation, unload the towline and land. Do not continue to fly when buffeting occurs. It is easy enough to get rid of it, but if you persist, sharp towline snatching may overstress the aircraft and put undue strain on the pilot to the point where he may do something wrong.

Now increase the airspeed up to 60 mph in steps of 5 mph, but decrease the altitude to 5 feet, and study the "feel" of your machine at higher speeds. Coordinate your landings with the driver to always land at airspeed not exceeding 20 mph. Avoid high-speed landings, being especially careful not to land on the nose-wheel first.

In general, you will be pleased to find that the Gyro-glider is much more forgiving of mistakes than an airplane in case you don't execute some maneuvers exactly as prescribed.

2. TYPICAL FLIGHT

A typical well executed flight goes about as follows:

After a thorough pre-flight inspection, (see p. 56) the Gyro and its tow car are lined up directly into the wind some 100 feet apart. An observer in the car faces backward to watch pilot's signals at all times. The pilot checks the strength of the towline and the tow-hitch by rolling the craft back as hard as he can, snapping hard the towline.

Satisfied that everything is **OK,** the pilot begins to spin the rotor with his right hand, **holding the stick in "neutral" position with his left hand. When the rotor reaches maximum speed that the pilot** can physically reach (about 30 rpm), he gives the "thumb up" signal to the driver. The driver, watching his Wind Meter, accelerates the car quickly to the airspeed of 12 mph and holds it there. The pilot in the meantime continues to spin the rotor as hard as he can, gradually advancing the stick all the way forward, until it spins faster than 60 rpm. All the time he is careful not to allow the blades to hit the head plate in the rear by easing back on the stick whenever the blades flap too much.

As the blade-tips begin to make a swishing noise, the pilot makes a second "thumb up" signal and the driver accelerates to 20-22 mph. The rotor continues to spin faster until suddenly the Gyro rocks on its tail. The pilot continues to hold the stick forward for 2-3 seconds, then brings it back to neutral, with his tail-wheel kept just off the ground, and gives his third "thumb up" signal.

The pilot does nothing else and waits until the driver promptly accelerates to 30 mph. The craft then makes a neat take-off at 25 mph. The pilot immediately tilts the rotor forward and holds the altitude not higher than 2-3 feet until the car accelerates to full flying speed. The driver advances the speed further to about 40 mph to give the pilot enough "reserve speed" for maneuvering. Unless requested otherwise by the pilot, the driver strives to maintain a steady airspeed of 40 mph during the entire flight by watching the Wind Meter (not speedometer). Avoid flying downwind or crosswind if wind is in excess of 8 mph.

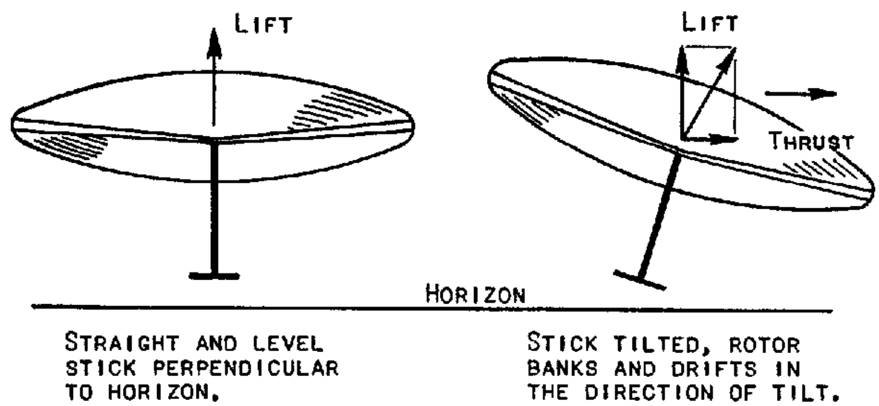
When the pilot is ready to land, he first brings his craft down to about one (1) foot off the **ground. He then makes a motion "thumb down" to the driver to slow down.**

As the car decelerates, the pilot maintains one-foot altitude by gradually pushing the stick forward until the speed is too slow to continue flying. As its stick reaches full forward position and the airspeed drops to about 19 mph, the Gyro touches the ground with its tail-wheel. Seconds later the main wheels settle down, and as the pilot neutralizes the stick, the craft rocks on its nosewheel. Airspeed at this moment is no more than 7 mph. The pilot manipulates the stick to prevent ballooning up in the air again, as well as keeping the towline from going slack. As the forward roll **of the landing is dissipated, the pilot, if he wishes to fly again, pushes the stick all the way forward to keep the rotor turning while taxiing.**

3. DIRECT INSTRUCTIONS

In every flight training the student pilot hears his instructor give him countless "man to man" talks, sometimes prodding, sometimes scolding, but always with sympathetic concern for the student's safety. The student learns to remember his instructor's pet sayings and explanations that cut deeply into his memory, forming a solid framework of his future safe flying habits. Here is a sample of instructor's "direct talk" that you would be apt to hear if you took dual instruction at Bensen factory. Here is hoping it will get coined into your memory, too.

YOUR BEST FRIEND--THE OVERHEAD STICK



SKETCH 3

1. In helicopters it is the **rotor** that flies; the rotor is **hinged** on the airframe. In airplanes it is the **wing** that flies. The wing is **rigidly** attached to the airframe.
2. Rotor is **always** perpendicular to the stick.
3. If the stick is held vertical to the **horizon,** the craft will **always** fly level.
4. When you see the stick tilted with respect to the horizon, it tells you that the rotor is banked.
5. If you want to fly level, hold the stick vertical with respect to the **horizon,** regardless of what the airframe is doing.

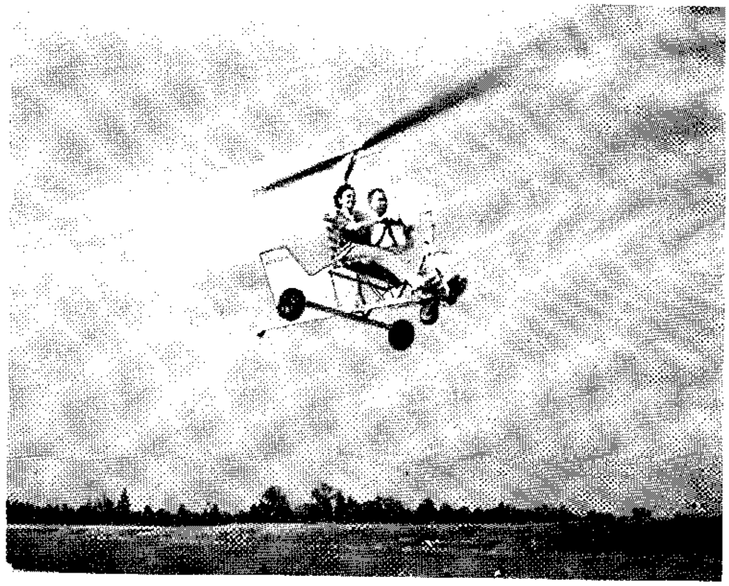


Fig. 21—The B-8 Gyro-glider modified with a dual seat, lifts easily two people. Dual instruction can be profitable for both the student and the instructor, can be a lot of fun, too.

—"Start up the rotor with your right hand. Stop it with left hand. Work it closer to the hub where it travels slower. Hold the rotor level when first starting and stopping the blades, especially in the wind. If we had a power pre-rotator, all this would be done automatically."

—"Give me 15!" (To the driver of the car, meaning 15 mph airspeed, to accelerate the rotor).

—"Your rotor is banging on the head plate. Unpitch the stick a little until it picks up some speed."

—"Go, man, go! . . ." (Motioning thumb-up to the driver, to accelerate to takeoff speed). [illegible] rotor all the way back now. Hold it there for a moment. Give the rotor a chance to speed up.

—"Hold the stick lightly. Don't grip it like a sledge hammer. Try holding it with three fingers. See? That's all the force it needs. Don't squeeze it any harder than a ripe peach."

—"Follow through now. Watch the nosewheel lift off the ground. Let the rotor pick up some more speed. Now watch it. Main wheels leave the ground. Quickly neutralize the stick. Don't let it zoom up for you. Hold this low altitude.

"Leave the stick motionless for 2-3 seconds at a time. Just hold it steady. Don't wiggle it. Every time you wiggle it, the Gyro wiggles. This is what they call 'pilot induced oscillation.' This machine can fly without any help from you, hands off. So, don't mess it up."

—"Stick motions are always short. This is where a helicopter is different from the airplane. In airplanes only the ailerons and elevators move. They are only a small portion of lifting surfaces. In helicopters the entire lifting surface—the rotor—moves. No wonder they seem to be more sensitive."

—"Control with short jabbing motions. Ever watch boxing? Remember how the boxers jab? They push the fist, and pull it right back. You do the same thing here. Don't linger on the end of the stroke, pull it instantly back to neutral. If you didn't produce enough effect, jab again 2-3 seconds later. But always return that stick and hold it motionless in neutral between the jabs."

—"Better make several short jabs in succession, no longer than 2-3 inches, rather than one big one."

—"I can see that you flew airplanes before. You deflect the stick and hold it there. That's a NO-NO for rotorcraft. You would have even harder time with regular helicopters. They are more sensitive to 'overcontrol' than Gyros. This comes from holding the stick deflected. Pull back to neutral. Jab it, and pull back at once."

—"The reason for this "overcontrol" is because rotor is hinged on the airframe. There is a time lag between rotor deflection and airframe deflection. You must practice to anticipate this time lag."

—"ANTICIPATE!" — That's the key word in the art of helicopter piloting. Think ahead.

—"This 'pilot induced oscillation' comes from the fact that reaction time of a man is about the same as helicopter response to control. You are bound to get into a resonance if you just follow your natural reflexes. This is why you must work either faster — by jabbing, or slower — by holding the stick in neutral and shifting it slowly."

—"Neither Gyros, nor other commercial helicopters are designed for aerial acrobatics and won't fly inverted. It is dangerous to exceed rotor tilt of 30° to horizontal and should be avoided. Should this "pilot induced oscillation", or porpoising, ever occur, slow down immediately, and and stop flying for a while, because it means that pilot is too tense and is overcontrolling."

—"Is Gyro-glider a helicopter? Yes, it qualifies under that name. The meaning of the word comes from Greek "Helix" for screw and "Pteron" for wing. In translation, rotating wing."

—"Yes, there is a basic difference between helicopters and Gyros. In powered-rotor helicopters the air flows through the rotor from above **downward.** In Gyros it flows through the rotor from below **upward.** Rotors of Gyros are self-driven by this upward air flow. That's where the name "autorotation" comes from. That's why there is no torque on the airframe and no tail rotors are needed to counteract it."

— Procedures we teach you here are the only ones that are normal and proper. We can teach one right way, but cannot think up all the wrong ways that would be improper. There are millions of wrong ways, but only one right way. Make sure you coin this in your memory. You must assume that any and all procedures not taught here are improper and are at operator's own risk.

— If you let anyone else fly your machine, be sure to let them first sign a "Hold Harmless" release (you can get a copy from Bensen or PRA) in case he cracks up and then sues you for damages. In these days of rampant "consumerism", lawyers are on the prowl to make hay with just such cases. In the eyes of the law, a Gyro is "a think of danger" and like other aircraft, invites lawsuits. Don't let it happen to you.

—"Let's get ready to land now. Are you headed into the wind? Don't be a birdbrain — always land into the wind. Even "birdbrained" birds know enough to always land into the wind. Watch them sometime. They take off into the wind, too."

—"Ease down closer to the ground. Closer. About 2 feet. No, you are balooning up again. This comes from the "ground cushion". It bounces you back up in the air when you get close to the ground. ANTICIPATE it. Be ready for it. Try again."

—"Watch that drift! . . . Don't forget it. Get directly behind the car! OK, you are doing fine now. Hold that one-foot altitude. Signal the driver to slow down now.

—"Start tilting the rotor back as he slows down. Don't let it settle any lower. As the nose goes up the tail goes down. Rotor all the way back now. Here comes the landing. The tailwheel touches the ground first. Main wheels squeel as they touch next. You made a perfect landing."

—"Wasn't it fun? This is the nearest thing to your flying like a bird. So smooth and graceful. And, really, quite simple.

—"Unpitch the rotor by moving the stick to neutral. You don't want to baloon up in the air again. Once you touched the ground, stay down."

—"Watch that towline! . . . Don't let it drag on the ground. Leave just enough rearward rotor tilt to keep the line taught."

—"When you taxi 10-15 mph, leave the rotor tilted back all the way to keep it turning. It will give you a shorter run on the next take-off and keeps the towline from dragging. Keep a respectable distance from spectators and kids. If you can't control them, better stop the rotor."

—"That's all there is to it. If you make 10 take-offs and landings like this, I will let you solo. Let's see if you can do it again. Remember, jab, shift the neutral slowly, and ANTICIPATE!"

4. TEN GYRO COMMANDMENTS

We described the "correct" typical flight procedure here on purpose to keep you and your driver from making an inadvertent mistake. It is easier to describe one "right" way than to warn against countless possible "wrong" ways. Nevertheless it may be worthwhile to review several important "don'ts" to give you a better understanding of Gyro flying.

(1) Don't land in crab or in a turn. Always land directly behind the tow car.

(2) Don't let the driver slam on the brakes, or slow down for any reason, when the machine is high in the air.

(3) Don't use old or weak tow rope of questionable strength. Certified rope strength should be 1000 pounds or higher. A new 3/8" manila or 1/4" nylon rope is recommended. Even a new rope can be easily cut by sharp edges of car bumper. Don't wrap the rope around bumpers. Use a standard trailer ball hitch attached to the frame of the car (for example Draw-Tite type), not to the bumper. See Fig 13 for approved method. Don't use old rope that may be rotten.

(4) Don't fly without wearing goggles and safety helmet, during the learning period and when trying out unfamiliar equipment, location, personnel or maneuver.

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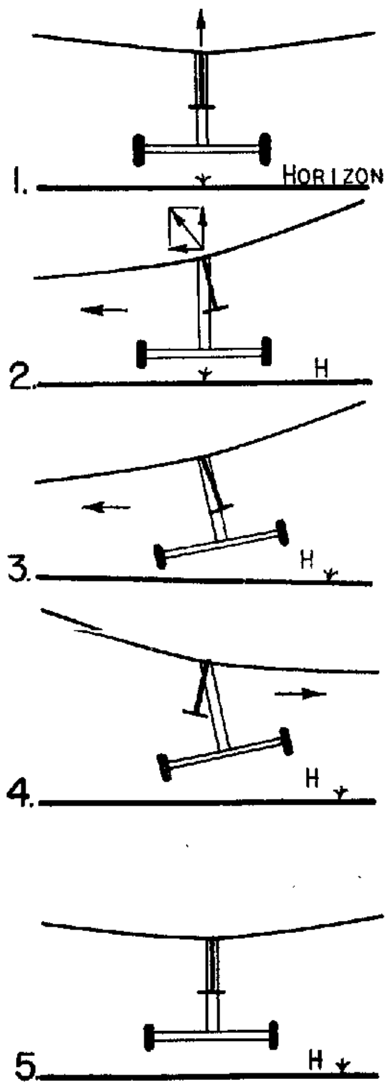
FLY THE ROTOR, NOT THE AIRFRAME



1. STRAIGHT AND LEVEL FLIGHT.

2. LEFT BANK AND DRIFT INITIATED. FOR A WHILE THE AIRFRAME REMAINS LEVEL, BUT THE ROTOR FLIES TO THE LEFT.

3. STEADY STATE DRIFT TO THE LEFT. NOTE THAT THE ROTOR AND THE STICK HAVE THE SAME TILT TO THE HORIZON, BUT THE PILOT MUST MOVE THE STICK CLOSER TO THE CENTER OF THE AIRFRAME AS THE AIRFRAME TILTS.

4. TO STOP THE BANK AND DRIFT, TILT THE STICK TO THE RIGHT. ROTOR FOLLOWS ALMOST INSTANTLY. NOTE THAT THE AIRFRAME LAGS AND IS STILL TILTED TO THE LEFT.

5. ANTICIPATE PENDULAR SWINGS OF THE AIRFRAME. PREVENT THE OVERSHOOT OF THE CONTROL BY REMOVING THE STICK DEFLECTION AS THE AIRFRAME FOLLOWS.

SKETCH 4

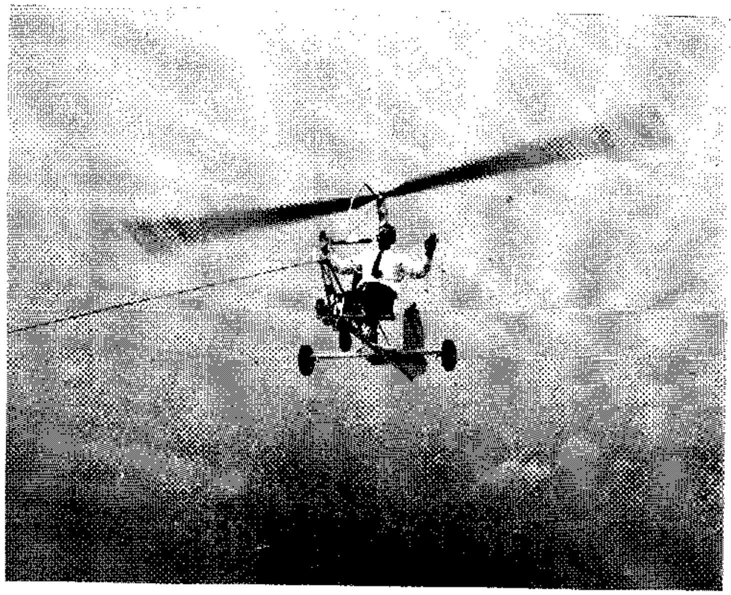


Fig. 22—Gyro-glider is so stable, it can be flown hands off. During tests at the factory the B-8 Gyro took off, flew full length of the runway and landed—all by itself, without its stick being touched through the entire flight. The driver held the airspeed at 35 mph for takeoff and flight, and slowed down for landing.

(5) Don't permit anyone except the pilot under the whirling rotor even when it turns very slowly. Keep especially children and dogs at a respectable distance. STOP THE ROTOR COMPLETELY before allowing anyone to approach the craft or getting out of the pilot's seat. Never, NEVER, allow the rotor to turn in the wind without pilot in the seat. Rotor MUST be tied and its rotation prevented, — and control stick secured by the seat belt — when there is no one in the seat.

(6) Don't climb above 1-2 ft. during your early flights. This applies especially to fixed-wing pilots who are trained to feel "safe" at higher altitudes because of stalling characteristics of airplanes. Gyros don't stall; thus "leap-frogging" is by far the safest method of learning to fly them. If a new pilot does not have enough sense to stay 1 - 2 feet above the ground the driver should slow down, and by reducing the airspeed, keep him from climbing higher.

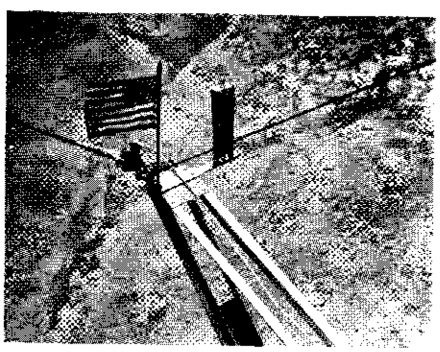


Fig. 23—Approved rope attachment to the tow-hitch. Steel thimble lines the inside of the rope loop. Loose end is spliced back into the rope and taped tightly to prevent abrasion and fraying. See Drawing for improved mounting of Airspeed Indicator.

(7) Don't forget to see to it that your driver has read this Instruction Book. This is a must. Don't let an inexperienced driver spill you.

(8) Don't loan your Gyro to other people who have not read this Instruction Book, or whom you have not personally seen fly before a Gyro exactly like yours. Experience shows that owners very seldom crack up their ships, but second or third man to fly the craft is more likely to goof through over-confidence and unfamiliarity.

(9) Don't fly fast (above 50 mph) at high rope angle. Towline pull increases at high air speeds, that may lead to buffeting and porpoising which overstress the structure.

10) Don't make landings at high speed. Tail must always touch the ground first. If your driver doesn't know enough to slow down when you get into landing position, 1 foot above the ground, just sit there and wait. He is bound to slow down sooner or later. If he doesn't, trip the line and land straight ahead.

Here are some of the reasons why these 10 COMMANDMENTS must be followed to the letter.

Landing in crab produces the same action of wheels against the ground as wheels of a car in a :id. It is an unstable condition; on hard dry pavement it may cause the machine to roll over.

The second "don't" is the condition of the tow car slowing down below the minimum flying eed for level flight. Your first reaction would be to try to maintain altitude by tilting the rotor ckward. In fact, once off the ground, you might fly indefinitely at speeds as low as 15 mph with e rotor tilted all the way back. But when the glider settles down close to the ground in this steep titude, the rotor will be liable to hit the ground. The right thing to do, if the tow-car slows wn for any reason, or there is a sudden drop of wind velocity, or if the towline breaks, is to tilt the tor forward. Only when the craft is about 2 - 3 feet off the ground should the pilot ease off on e stick, tilting the rotor all the way backwards. This will produce a "flareout" type of landg, which is in fact a standard landing procedure for all Gyros, powered and unpowered. In exeting a flareout one must bear in mind that the airframe, swinging from the teeter bolt like a penlum, applies as much control to the rotor as the stick. At times you have to undo with the stick me of the control motion applied by the rapidly tilting airframe to keep the flareout from coming too abrupt. A little practice with the "roller coaster" type of exercise will give you a feel the right amount of stick control for a perfect flareout. In all cases, the tail-wheel should always uch the ground first, before the main wheels do. Tilting of the rotor rearwardly should be adual rather than abrupt. Wait until all forward usable speed is consumed, holding the craft a few ches above the ground, before forcing the tailwheel to touch the ground. If you yank on the stick ruptly before all forward speed is consumed, the machine will nose up sharply and may hit the ound with the rotor.

On windy days, the machine can be landed vertically, without any forward roll at all. When such ndings are made, you must not forget to "dump" the lift by tilting the rotor all the way forward imediately after landing, because otherwise the machine might start rolling backwards.

Other Commandments are self-explanatory. They are not difficult to abide by and will soon beme your second nature, if you start following them to the letter from the beginning. They are elled out here for just one purpose - your safety. If you violate them, as when violating The Great n Commandments, you must be prepared to face harsh consequences and will have no one to ame but yourself. These instructions cannot possibly foresee all the wrong and foolish things a man n do when he takes a notion to do things his own way. So, please, don't be neglectful or foolhardy, r we can't be there to hold your hand when something goes wrong.

The final achievement of your flight training will be to master the Proficiency Test in the Gyroider which every student must pass at Bensen Aircraft before he is permitted to advance to free ghts in the Gyro-glider and to Gyro-copter flying. This Flight Test has been recommended also the FAA officials in Washington as a standard test of proficiency qualifying the pilot for a solo dorsement on his Student Pilot license in the Gyrocopter. Practice it until you can perform it flawssly every time you are asked to.

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5. PROFICIENCY TEST FOR SOLO FLIGHT IN THE GYRO-GLIDER

1. Proficiency of ground handling: Taxiing up to 20 mph, turning, stopping, tripping the tow hitch, braking to full stop without swerving, with rotor stopped, and rotor turning.
2. Starting the rotor (not exceeding IAS of 15 mph), take-off, straight and level flight at 5 ft. altitude and 30-40-50-60 mph IAS, holding that altitude within plus or minus 2 feet. Airspeed indicators in good working order must be installed on both the gyro-glider and the towing vehicle. Landing touchdowns within 50 feet of predetermined spot. Four (4) flights. Two (2) flights should be under crosswind conditions (less than 10 mph).
3. Climb and descent: Using a 75 foot length of towline, and holding the position of the craft directly behind the towing vehicle, climb to maximum altitude. pause; then descend to within 5 feet of the ground. Repeat four times. Airspeed 40 mph.
4. Bank and Drift: Holding a steady altitude of 5 feet, swing 25 feet to the right of towing vehicle, pause; return to the centerline of the track, pause; swing 25 feet to the left of the towing vehicle, pause; return to the point of departure. Repeat three times. Airspeed 40 mph.
5. Coordination proficiency ("ferris wheel") maneuver: Starting at 5 ft. altitude, make a climing bank to the right on a circular path, reaching maximum width at 20 ft. altitude; then returning to the centerline of the track at the peak of the climb, descending to the left of the centerline, reaching maximum width at 20 ft. altitude, and returning to the centerline of the track at 5 ft. altitude. Repeat this maneuver in clockwise (reverse) direction. Properly executed, a nearly circular (helical) path will be obtained in the air. Airspeed 40 mph.
6. Solo permit may be issued to the applicant if all the above maneuvers are executed with confidence and precision. All landings must be gentle and directly behind the towing vehicle in wind and crosswind. The examiner will either ride in the towing vehicle, or follow in his own vehicle to better observe the execution of maneuvers.
7. Before endorsing the student certificate, the examiner must assure himself that: (1) the applicant is in possession of the latest Pilot's Manual for his craft, describing in detail recommended free-flight procedures; (2) his craft is equipped with an airspeed indicator functioning adequately in the range of 20-60 mph.

If you have any plans to convert your machine to engine power, or to carry two people at a later date, you must not forget to test the rotor for its lifting performance at higher gross weights and speeds. It must remain acceptably smooth, have low stick forces and unimpaired response to control commands when loaded to 600 lb. gross weight and flown in towed flight at low altitude at airspeeds up to 70 mph. Load up the machine with sand bags for this purpose and be extra cautious during the tests. These tests are a must for safety, and failure to make them would be a negligent disregard of safety. Make a record of completing these tests in your logbook.

6. VOICE OF EXPERIENCE

Most people stop their flight training at this point and enjoy flying in towed flights only, occasionally adding another seat to their Gyros so they can give rides to their friends. Others convert their machines into Gyrocopters by installing an engine, or advance to free flights in gliders with towline cast off.

Much valuable experience has been accumulated by successful pilots of Gyrogliders all over the world, and they cared enough about you, the new pilot, to pass along their comments for your better safety. We heartily share their advices and reprint them here as an integral portion of these Instructions.

—"Please pass along the warning to other Gyro fans not to tow the Gyro-glider at high speed and high altitude. We had a fatal accident here where a fellow would climb as high as his towline would permit at 70 mph and then cut loose. It gave him some kind of a special thrill. Well, stresses on the rotor were too great and he must have hit a strong gust that was just too much for his machine. Anyway, his rotor chopped off the tail last time he cut loose (he always balooned when he tripped the hitch) and he lost control of his rig. The result — another statistic. We warned him not to do it, but he just wouldn't listen" . . .

—"All Gyro builders should be required to determine and mark their Airspeed Indicators with VNE (never exceed speed). Every flying machine has a VNE, including airships and space rockets, and Gyros are no exception. It's actually easy to obtain. Here is what you do. Load up your Gyro with sandbags or lead to its maximum expected gross weight, including yourself, get a long runway and tow it at 5-ft altitude. Start at 50 mph and make a flight full length of the runway. On the way make short sharp control movements fore-and aft to see that all responses of the machine dump out and result in no unusual vibrations. Then increase the airspeed to 55 mph and repeat the test. If all is OK, go to 60, 65, 70 etc. making a full-length pass at each speed. You must be able to maintain easily 5 feet altitude within plus or minus one foot. Sooner or later either your controls will become too sensitive, or your machine will develop a heavy vibration, or a diving and/or climbing instability that would be too much for comfort. Stop the test immediately when it happens and go no further. Then mark your Airspeed Indicator (ASI) with red line 10 percent below the maximum speed tested. Thus, if you stopped the test at 70 mph, then your VNE would be red-marked at 70— 7 =63 mph. After that, religiously avoid exceeding this speed and tell all other pilots flying your Gyro to do likewise. Don't fail to do this. I should add that this VNE is applicable to this particular rotor. A different rotor would have different VNE, as would the same rotor mounted on a different machine. So make sure you determine your VNE for each rotor flown on your Gyro. Repeat the test periodically to check VNE and don't assume that it will always be the same."

"There is no excuse in anyone flying his rotor out of track more than 1 inch. It is so easy to track it that it amazes me when I see some fellows allow their machines to shake like in St. Vitus dance and do nothing about it. Apart from being uncomfortable, out-of-track vibration can build up dangerous fatigue damage in the structure, which might let go at some future time. Here is how I track my rotor — and it takes no more than 15 minutes. I tow my Gyro at about 30-35 mph and look at the tips at about 60 degrees to the right. In this position your eyes can actually see from the pilot's seat how much the blade tips are out of track. If they are, say, one inch out of track, with my rotor it requires differential tab setting of 2° on one blade and minus 2° on the other blade. Since I don't know which blade is high, I make an intelligent guess after stopping the rotor and lining up visually the blade tips with the horizon. If the first blade was set at 0°, and the tip of the second blade appears to be negative (without changing stick position), then the lower pitch blade has its trim tab bent up 2° and the other down 2°.

Then I rev-up the rotor and fly again. In 95 percent of the cases that brings the rotor into track and your Gyro flies smooth as silk. In remaining 5 percent of cases the blade tips "cross over" and out-of-track gets worse instead of better. All you do then is stop the rotor and reverse your trim tab adjustments, and you are back in business. That's all there is to it. I can do it all alone without any help from outside.

—"Perhaps I should mention that what I described above is "differential" tab adjustment, which affects only the track. There is also a "collective" tab adjustment which affects the speed of the rotor. If for instance my tab setting after tracking above are +2° and —2°, then my "collective" setting is the mean value, or 0°. This may give me rotor RPM of 360 rpm. Since this is a bit fast for Gyro-glider, I might want to slow it down. So I bend both tabs up, say, 3° and end up with +5° and +1°, and rotor RPM of 330 rpm, which is just right. Note that my differential tab settings are still 4 degrees apart and consequently the rotor will still be in track. So, unless you want to change the speed (RPM) of your rotor, always bend the tabs differentially. Conversely, if you bend one tab at a time during tracking, you should expepct to have rotor speed change as well."

—"Get a pilot Log Book and log ALL your flying hours. It is especially important during your early training period and will be needed by FAA later when they issue your Pilot's License."

—"We had an accident during a recent PRA Fly-In which could have been easily avoided. An experienced pilot was giving rides in his dual-seat Gyro-glider to a lot of spectators during the first day, without any trouble. The second day he loaned his machine to another man with much less stick time, and his driver, to continue giving rides. The result — you guessed it — splat! Luckily no one got hurt, but the Gyro was washed out, and no insurance. The owner did not take the precaution of checking out the second man and his driver in a dual-seat check ride and paid dearly for his blind confidence. Don't let it happen to you!"

—"Never exceed the airspeed of 15 mph when starting the rotor by hand. Never exceed ground speed of 30 mph whether the rotor is turning or not. If it is not turning at all, or turning too slowly, steering becomes too touchy for safety beyond 20 mph. If it is turning fast enough to lift, then you should be airborne well below 30 mph. If it won't fly below 30 mph, then your rotor is sick and needs adjustment by someone who knows what he is doing."

. . .

—"Don't ever fail to make pre-flight and post-flight inspections of your Gyro. They are simple and practical enough, and with ordinary care will discover practically any defects in your machine. It cost one man the price of a rotor once when he neglected to "pre-flight" his machine. His assistant forgot to insert the teeter bolt, and when his rotor gathered enough speed, it simply flew off by itself, leaving the embarrassed pilot sitting on the ground and poorer by quite a few dollars.

—"Some fellows still have problems with tow-rope buffeting. The Manual gives instructions on what to do, but for some reason they either don't read or don't remember that section. Any jerking or snatching of the tow-rope should be avoided like poison. If and when it happens, the remedies are always simple: change the length, or the diameter, or the material, of the rope to get away from the resonance. That's all the buffeting is — the resonance either with the Gyro's or the pilot's response rates."

—Don't buy second-hand gyrogliders. The chances are its previous owner did not build it in accordance with the Manuals and is now too chicken to fly it. Even if he has a proof that he flew it, this is no assurance that the machine will hang togtther for long if he built it incorrectly. Should you be unable to resist the bargain and buy someone else's gyro, do as follows:

1. Get the Manuals from which it was built.
2. Obtain the complete record of time flown and data on crackups, if any.
3. Disassemble the machine completely, part-by-part and bolt-by-bolt.
4. Obtain the latest Bensen Plans and Catalog.
5. Throw away all parts that do not conform to the drawings, are bent, cracked, with elongated holes etc., and replace them with new Bensen parts.
6. Then re-assemble the machine slowly and carefully, following the latest Bensen Manual exactly to the letter.

It goes without saying, that your flight training should also go exactly "by the book". Remember, it's your neck you will be protecting. This is no place to be juvenile and take chances.

—Be careful about flying downwind, or downhill (or both). Your touchdown speed after landing can be high enough to give you trouble in applying the brake without swerving. It is a good policy not to fly downwind, or downhill, if your ground speed on touchdown is 25 mph or more. Always land on the tailwheel and keep the rotor tilted back until the nosewheel drops down before applying the brake.

—"I would recommend that any time there is a group of Gyro fans getting together, they should have at least one dual-seat Gyro-glider available to all members of the group for flight training. It makes for quicker and safer training and allows wives and girl friends to take a ride in them, too, so they can see for themselves how safe they are. Many a woman has kept a man from flying by unfounded fears of flying machines. Gyros are safer than either the airplanes or helicopters and certainly safer than cars on the highways. A ride in the dual-seat glider is undoubtedly the safest way to partake in the pleasures of flying".

7. FREE FLIGHTS

The top achievement in your Gyro-glider flying would be to set your bird free by casting off the towline. First, of course, you must obtain licenses for yourself and the craft, because in the eyes of the U. S. Law, your Gyro-glider in free flight becomes an "aircraft" and you become a "pilot". See page 63 for further details about licensing. You should have logged not less than 25 hours before attempting free flights.

To practice free flights with complete safety, do what the Wright Brothers did as well as other aviation pioneers, including yourself. Start by making short leap-frogging flights at low altitude. With the tow-car driving at airspeed of 45 mph directly into the wind, maintain the altitude of 2-3 feet and then trip the tow release. Notice how long the machine 'floats' before landing. Use rudder pedals to keep the craft pointed directly forward. Keep your feet off the steering bar during landings. The steering bar was made extra narrow on purpose to prevent your heels from hitting it accidentally during landings. Do not take the liberty of tying-in the steering bar with the rudder pedals. At times you may have to hold full rudder during the landing, if some crosswind component is present, but you certainly wouldn't want the nosewheel to steer hard off to the side when it contacts the ground. Avoid making zero speed "pancake" landings, allow little extra ground speed at the moment of touchdown. It is better to "wheel in" the Gyro from a free flight with some forward speed than to come in at slow speed if there is some crosswind component present.

Make 10-15 landings casting off at 45 mph. Then increase the speed to 50 mph, make ten more landings, then up to 60 mph and again 10 more landings, all from an altitude of 2-3 feet. Notice how much longer the craft floats at higher airspeeds. Watch the airspeed indicator during glides and be sure the tailwheel always touches the ground first.

Now, using no more than 75 feet of rope, climb to, say, 30 feet, while the car drives at an airspeed of 45 mph. Initiate the dive as in the "roller coaster" exercise, until the towline becomes slack.

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GYROGLIDER IN FREE FLIGHT

Fig. 24—FREE GLIDES from altitudes as high as 1500 feet have been made in the gyroglider after the towline was cast off. A typical flight is shown on the right. A small parachute is attached to the end of the tow cable to keep it from coiling up and tangling after it drops to the ground. Note that the machine displays FAA license numbers on the tail.

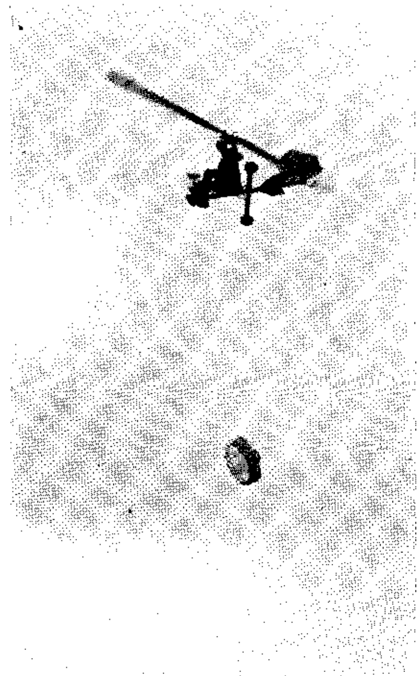


Fig. 25—TYPICAL ATTITUDE of the gyroglider in free flight. Study especially the angle of the rotor and the Mast to the horizontal. Helicopters, when landing power-off in "autorotation", must fly the same way. This particular craft is using the Joystick and the Gimbal rotor head.

Then trip the tow hitch release. Maintain constant airspeed of 45 mph during the glide by watching your ASI and a constant heading by operating the rudder pedals. When about 5 feet off the ground, initiate the "flareout" and land tail first, but with some forward speed.

The crowning point of your flying the Gyro-glider would be to use a much longer tow-line—some 300 to 1000 feet, climb to the highest attainable altitude, release the line and glide freely to any point of your choosing. If you learn to pick out the 'thermals", or updrafts over hot surfaces, you might even soar to still higher altitudes, just as the soaring pilots do.

Do not trip the tow release when the rope is tight. To properly release the towline, the craft must be first put into a slight dive until the rope goes slack. Only then should the towhitch be tripped. If this is not done, the craft will pitch up momentarily and will execute a mid-air flare, losing precious forward speed. Even if your towline breaks, or the towing vehicle stalls, your first instinct should be to get the nose of the craft down to maintain horizontal speed of 45 mph by promptly tilting the rotor all the way forward. Only when you are 3-5 feet off the ground should the stick be pushed forward to initiate the landing flare.

One word of caution about the legal situation: Before you may cast off the tow-line, you must secure FAA licenses for the glider and yourself. Don't let this discourage you, though. Both licenses can be easily obtained if you demonstrate your skill of flying the Gyro-glider to the local FAA inspector (look under U. S. Government in the telephone book). As "amateur-built" aircraft, your glider will be issued an "experimental" license and you will receive a "Student Gyroplane Pilot" license. All you have to do is to fly the machine towed behind the car and show him that you know how to control it. You should find him cooperative and eager to help you. He is a public servant on the public payroll, whose job, given to him by the Congress, is to "encourage and develop civil aeronautics" activities such as yours.

Flying is a great sport that requires plenty of skill and courage. It is a sport for "men", not for "mice". And you can learn it all by yourself, a feat accomplished only by true pioneers of the air. Your friends will be proud and thrilled to know that you "earned your wings" in the flying machine you built yourself. Others will envy your spirit of daring and adventure.

And so, good luck, have fun, and HAPPY LANDINGS! . . . . . .

Fig. 26—Whose Gyro takes off quicker? . . . Climbs to 50-foot altitude faster? . . . A friendly "sky-race" is being held here to see whose Gyro has better performance.

MAINTENANCE

The Gyro-glider was designed to require a minimum amount of maintenance. All important bearings are of anti-friction type, packed with grease at the factory or during the assembly. Occassional oiling, or greasing is required as follows.

If the craft is called to do much taxiing, re-grease the wheel bearings every 50 hours, or oftener, if extreme dust or sand conditions prevail. A few drops of oil occasionally on rudder pedal pivots, rudder hinge, rudder horn, and tow-hitch pivots, are required. Dust rudder cables, where they pass through cable guides, with dry graphite. If oily, wipe them dry first.

Do not allow the Blades to hang in droop position for days and weeks. If they are left on the airframe, prop them up under the nose weights, so they are nearly straight. For long periods of storage the rotor blades should be removed and laid flat in a dry place. Inspect periodically their leading edges. Fill promptly all scratches and nicks as soon as they are discovered. If the machine is flown from gravel-type pavement, or water, the pebbles and water spray would cause less abrasion if the leading edges are covered by a smooth vinyl adhesive tape sold in school supply stores. The tape can be replaced periodically. A smooth, clean rotor is your best insurance for quick starts and high lifting capacity. Small wheel fenders will also effectively prevent rocks from being thrown by wheels into the rotor.

Inspect all aluminum angles and tubes periodically. Road bumps, when carrying the Gyro-glider on highways on the trailer, as well as hard landings, or rough terrain, might eventually cause fatigue strains in the corners. Do NOT continue to fly if ANY part of your Gyro is bent, cracked, visibly worn, loose, not safetied or in any way does not correspond to the Drawings. Replace it, or repair it at once before your next flight. Until then—hang a red tag or flag on it and don't let anyone fly it, including yourself.

Hinge action of the Teeter Hinge must be checked during the "pre-flight inspection", which means before each flight. Sand and grit particles sometimes manage to work themselves into the grease between the Spindle and Pillow Blocks, which subsequently results in galling of rubbing surfaces and eventually tightening of the fit. Wipe off the old grease occasionally and if galling marks appear, file them flat promptly. Re-grease the main bearing BA-A8A every 25 hours.

Put a fresh dab of grease on the teeter bolt and cover plate -4 every time the rotor is replaced on the Spindle. Watch for wear between the teeter bolt and the Spindle. If the hole wears elliptical from lack of lubrication, the rotor will become "rough" and almost impossible to track. This can be checked by holding the stick tight and rocking the Hub Plate around feathering (pitch) axis.

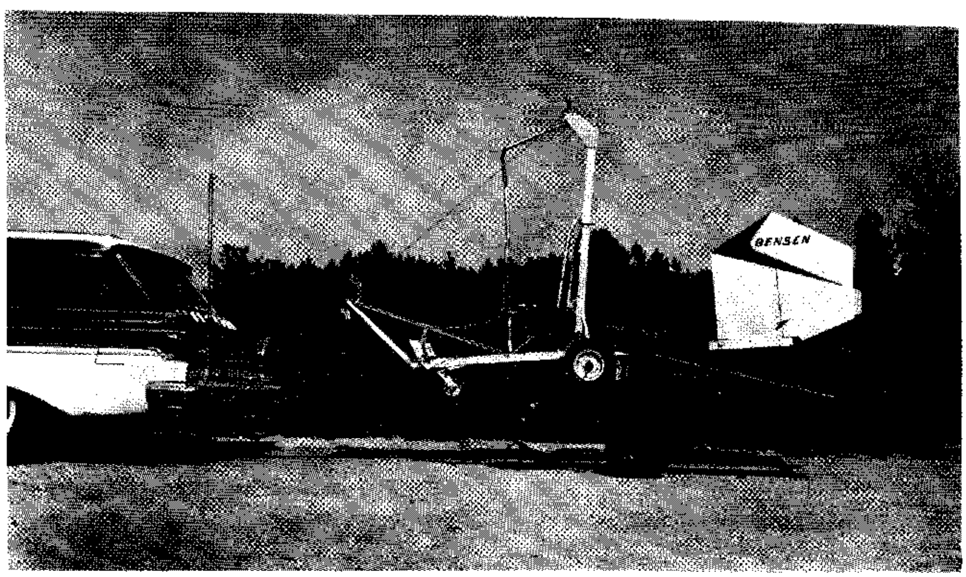


Fig 27—Approved method of ground transportation over long distances. The rotor is secured inside the long water-tight box below the airframe. The modified small boat trailer has springs and shock absorbers to assure a soft ride. Control stick is tied down to prevent wear.

If you feel a definite play, your blades will change pitch at random in flight; this must be remedied by reaming out the Spindle to a next larger round hole and replacing the old teeter bolt with a closer fitting larger one. Check on every pre-flight inspection if the spindle, teeter bolt, and blade retention bolts are cotter-keyed.

Inspect also periodically all bolts and nuts for tightness. Although the FlexLok nuts are not likely to back off after having been tightened properly, minute motions at a joint might produce enough wear in time to loosen the fit. So tighten them up again before backlash motions ruin the holes. This type of maintenance is standard routine on all aircraft, and, if you are not accustomed to it already, this is a good time to begin developing this good habit.

Any damaged or worn parts you cannot rebuild or replace yourself may be obtained from your nearest Bensen dealer. Write for Parts List Catalog, or order them directly, using part numbers specified in the Drawings. Keep a Maintenance logbook and make records in it of all services and changes made to your Gyro.

2. INSPECTION

PRE-FLIGHT CAR INSPECTION:

A. The car bumper and trailer ball hitch to which tow line is fastened must be inspected for mechanical soundness. Check that ball hitch has a mechanical draw-bar link to both bumper and car frame. Check that ball is of the correct size and that it is secured with a castellated nut and cotter pin rather than just an ordinary automotive lock washer. Be sure the coupling ball is cleaned and lightly oiled or greased for best operation.

B. Be safer by using Bensen approved BAC-TLH tow hitch with aluminum rope attaching spacer. Visually check that this hitch has no dents in the area fitting over the coupling ball; otherwise, it will have an undersirable slack fit. Also examine attaching spacer for nicks.

C. Cinch down the tow-line hitch on the coupling making sure the locking rachet is functioning. You'll hear it clicking as you rotate the tightening knob clockwise. When the unit is cinched properly, no "play" will exist and you should be able to swing it easily from side-to-side through an arc of 180 degrees.

D. Check that you tie your tow line to the attaching spacer in the correct manner. It's a fail-safe method utilizing a bight and two half hitches with the remaining loop thrown over the cinching knob. This tie must always pass over the top of the attaching spacer rather than underneath. It allows the standing part of the tow line freedom to float without abraison on the upper periphery of the aluminum attaching spacer. Seat the tied assembly by giving a strong, steady pull on the standing line. As an extra safety measure, tie any leftover running end of rope to some other part of the car. This will act as an extra fail-safe device, if necessary.

E. Your tow line should be 3/8" approved manila of whatever length is best suited to your ability and environmental conditions. Before flying, rope should be safety checked. This is best done by grasping rope in hand and walking from car to the thimble end. "Feel" and "see" any rope damage. Double test your tow line at the thimble end by giving a husky pull, followed through with your body weight for added strain.

F. Examine the rope thimble and eye splice for "fit" and "wear". Make sure rope cannot slip out of the thimble, or else it may be cut by sharp projections of the hitch.

G. Repair or replace any part of the entire towing unit which you find in a doubtful state. It's more than just a rope . . . it's your "life line."

PRE-FLIGHT GYROGLIDER INSPECTION:

Before inspecting and flying your rotorcraft, get your safety helmet and place it on your head or on the seat of your craft. This way, it will not be forgotten when you're ready to fly. While you are inspecting your craft, it is wise to ask spectators politely not to distract you in conversation unil you have completed the job properly. Inspecting your gyroglider requires undivided attention to details. Now make your inspection either right around or left around using the suggested steps. Examine all points with infinite care.

STEP 1

Place the thimble end of the rope on the lower jaw of the tow hitch and latch the upper jaw into closed position. Grasp the taut rope and pull the tow hitch in all four directions. Unit must respond by moving easily, up-down-left and right. Loosen the fit, or purge and relubricate to obtain this free movement. Check that vertical and horizontal cotter pins are installed properly. Check that -12 angles are not deeply galled by abnormal block chafing. Check that lanyard cannot trip the tow hitch accidentally. Move hitch to all conceivable positions. Trip the hitch with the lanyard to ensure effortless release whenever desired.

STEP 2

Examine the yaw flag, airspeed indicator, and mounting bracket for looseness. No part must be allowed to come adrift in the air. You might also blow in the orifice of the A.S.I. to check that pith ball is free floating. Also make sure the lower venturi screw is tight. Strum the front guy cable to reveal tone tension. Improper tension can cause problems. Too much will twist and distort the tow boom; too little will result in improper support to the mast under tow conditions. Make sure it is right. It must be just snug with the pilot in the seat: neither loose, nor tight.

STEP 3

Grasp the tow boom from the front end, placing a hand on both sides and applying pressure downwards. You can then check two things simultaneously:

A. Structural integrity and side play of the entire boom end. (Check for loose bolts and rivets).
B. The nosewheel resting on the ground should swivel and easily return, without sticking, to the neutral position when side thrust is firmly applied and then released. The nosewheel must pass this free castoring test in order to be safe. Correct, if necessary, by adjustment of its spindle bolt, or cleaning and regreasing base plate and fork assembly bearing surfaces. NOTE: While your weight is on the front end, tire pressure can be visually checked by noting deflation level, which should be one-third depressed.

STEP 4

Bend down and examine brake board. Feel for wear underneath and check that return springs bring it against stops automatically. It should be free of undesirable drag on the tire when not in use. Be certain all springs are adjusted in accordance with this Manual and that they are moused with safety wire. Grasp the rudder pedals and see that they have proper movement and stopping action. Check all bolts, rivets, thimbles, sleeves and cotter pins for security. Look along and underneath the craft. Check that keel and axle are not bent. It's easy to see from this vantage point.

STEP 5

Next check the seat throughout for cracks and looseness. Grasp it firmly and attempt to move it in various directions.

STEP 6

Check your Overhead stick for cracks in the bends and no-play fit to the control head. Check anti-rotation bolt for looseness and test control limits. If your craft has a Joystick type control, bend down and examine all parts under the seat for security. Hold the stick at the junction of the forward gussets and feel for excessive play sideways in the pivot sections. Play should be less than ⅛ inch.

Grasp the stick by the handle and move it throughout its full cyclic movement. Check visually that the control head follows suit. There must be no binding nor hesitation in control movements. Be certain that stick touches the rubber keel bumper in the full forward position . . . and the —7, rear seat stick stop angle, in the full rearward position. Check that the rear end of the joystick assembly is not scoring the front face of the mast tube just above the cluster plates. Also the [illegible] on the back of the seat mounting angle. Also check that the —IE arms are not touching the lower push rod end nuts. Push rods must be allowed freedom of movement all times without binding.

Check the rudder cables for wear and fraying at the guide block junctures when you look under the seat.

STEP 7 Control head check list

The control head is the heart of your gyroglider and must be examined with loving care and close attention to all details.

1. Check that the control head is clean, free of rust, and that it has adequate lubrication on all moving parts.
2. Check that all parts are free of deep score marks, deflection, galling, squashing, and yielding of metal out of its correct shape. All welds must be examined for proper bond and cracks.
3. Check that all mounting bolts, washers, nuts and cotter pins are correctly fastened. Make certain the teeter bolt cotter pin is in place. If you have a spindle type head, double check the castellated nut and cotter pin.
4. Check that the rotor hub teeters easily with light pressure applied by two fingers. Also examine it for excessive side play and vertical play. Do this by putting both hands on the hub while holding stick fixed, applying pressure in all directions, and "feeling" for backlash. Ten thousands of play in either direction should be the limit.
5. Move control stick through all control positions making certain that control stops are functional in all directions.
6. Check that all return springs are in proper tension.
7. Check the Joystick push rods by putting a finger and thumb on each one and feeling for freedom of rotation. They both must be free to move without binding in all control positions. Their lock nuts must be tight.

STEP 8

Check the main wheels for free rotation and tire inflation. Tires should depress by one-third when your weight is on the axle tube directly over each wheel. Examine each wheel for side play, binding and lubrication. Check tires for wear and sidewall cracks. All bolts must be tight, especially machine bolts holding two halves of the hub together.

Also, look at the tail wheel for wear and cracks which may have developed in the small hub portion.

STEP 9

The stabilizer should be checked for rigidity. Apply hand pressure on it up and down. Look for possible migrating cracks around the four mounting bolts. Move the rudder sideways checking for full control swing without binding. You should be able to move it more to the right than to the left side for prop torque compensation.

Look at all mounting bolts, hinges, rivets, braces, cables, and cable ends. Be certain everything is ship-shape. Check control surfaces for cracks. Double check rudder horn radii and rudder counter-weight bolt for security.

STEP 10

While you're at the aft end of the craft, it's a good point to check the rear rotor blade.

Look at the tip and leading edge for abrasions. Check the trim tab for rivet fit and undersirable looseness. If the trim tab has been improperly installed in a too tight or pre-loaded state, it will be apt to "oil can" and cause change of track in flight. Trailing edge of the tab must be "straight" along its entire length. (Since Bensen **metal blades** use neither noseweights, nor trim tabs, you may delete this part of the inspection if your craft utilitzes this type.)

Bring the blade to waist level and view the entire **upper** surface along its length for cracks in the wood, especially chordwise, glue separation, nicks, abrasion etc. Raise the blade over your head and examine it in the same manner along its lower surface. Walk along the leading edge "feeling" and "looking" for any damage. Double check at the hub to see if all bolts and nuts are in place and cotter pinned.

Walk to the front of your craft and repeat the same procedure on the forward rotor blade.

Turn the rotor cross ways on the craft and back off twenty feet or so, viewing the entire rotor for **equal droop** on each blade. If one blade has visibly greater or different droop than the other, it may be damaged and should not be flown.

STEP 11

Finish your inspection by getting into the seat and becoming comfortable. Bounce up and down a couple of times in the seat and see to it that your seat cushion sinks past the seat frame on the down stroke. Also double-check the latching action of the seat belt. Dry **run all controls for proper movement**: control stick, nosewheel, brake, and rudder pedals should be reached and operated comfortably. Pre-rotate the blades facing the wind . . . and you're ready to go.

POST-FLIGHT INSPECTION

Your "post-flight" inspection begins "in the air"! By your awareness of abormalities revealed "in flight" through your senses of sight-sound-and-feel you can know in advance what to look for when back on the ground again. The visual-audio-vibratory language is subtle, but your alertness to its messages can help you decipher by association, and translate them into early maintenance action. For example, you can easily "see" a one-per-rev. vibration of the rotor wiggle the tow line by making it "wag" like a dogs' tail. You can "hear" the screech of the foot brake wearing wood and rubber. It may need attention soon! And of course, you can "feel" airframe vibrations coming through your body just like a sounding board. By paying attention, you will know when something is out of vibratory "tune". It can help you detect a snapped brace, or a more important part, early enough to prevent catastrophic failure later.

Train yourself to use these human aids! The cost is small . . . only intelligence, and alertness. The bonus will be extra safety, and a more meaningful post-flight inspection.

CHECK LIST AFTER FLIGHT:

1. The rotor blade tips and leading edges should be closely checked for any abrasion caused by ground debris being sucked up into the rotor. Check along trailing edges for possible separation. Examine the blades especially at each root section for flapping damage caused by improper rotor starting . . . or rough taxiing, and hard landings.
2. Check the control head visually for any signs of deformation or fatigue of critical parts.
3. Check the seat area and mast bottom for looseness, fatigue cracks, or any snapped angle braces. Deflect the mast tube sideways, examining closely for any "working" or looseness between seat back mounting angles and the mast tube. Check axle tube for bending and the tail wheel for runway wear.
4. Check tail braces for bending and fatigue cracks.

5. Re-examine the tow rope for runway abraisions and signs of fraying. Don't forget to secure the blades from free rotation before leaving your craft unattended. It only takes a minute, but it could save the rotor from damage. Also wrap the safety belt around the stick to keep the rotor head from flapping around in the wind.

3. PILOT'S CHECK LIST

If you are already a licensed pilot, you know about the "walk-around preflight inspection". If you are not, now is the time for you to learn this time-honored standard routine of inspecting your craft before getting into the pilot's seat. Don't fail to do it every time you fly.

The usual procedure is to start from one end of your machine, say, from the front, and slowly walk around clockwise until full circuit is completed. While doing it, look at, touch and wiggle every part of the craft in front of you that should be inspected. Actually, just about everything should be inspected, but some parts may be more critical or vulnerable to damage than others and might require extra scrutiny. Above all, don't be superficial. Inspect as if someone would give you a great reward for every flaw you find. When you find them, don't fly until they are corrected.

Specifically, don't miss the following inspection checks:

1. Tow hitch swivels freely in all directions. Cotter pins in place on pivot bolts. Release lever and latch neither too loose, nor too tight. Towline has a steel thimble where it engages the hook. Rope is not frayed anywhere. Attachement bolts to keel tube all tight. No looseness in the framework.

2. Flag and airspeed indicator are in place and work.

3. Foot rest is bolted tightly. Caster pivot neither too loose, nor too tight. Brake in working order. Tire not deflated (stand on the foot bar). Steering springs and chains just loose and safetied.

4. Seat attachments to frame sound and not loose. No bent or cracked frame members under and behind the seat. Check safety belt attachement.

5. Nothing loose, bent or cracked in mast-to-rotor-head attachment. Rotation stopper bolt tight and freshly greased in the slot. Head plate greased and not bent. Teeter hinge freshly greased, neither tight, nor loose. No "feathering" play in the hub plate. Spindle (shaft) turns freely. Cotter pins in place in: teeter bolt, spindle, blade grips. Control limit stops greased and not worn out, operating properly. Control stick attachments tight.

6. Main wheels one-third deflated, with equal deflection (step on axle), turn freely. No excessive end-play, interference or looseness. Rudder cables not wedging or frayed on guides, or worn out on pivots. Clevis pins have cotter keys.

7. Tail surfaces tightly bolted. No cracks in metal struts and hinges. Hinge pivot wires secured in place. Rudder moves to full control limits. Tail wheel core not cracked and free to turn; its axle bolt tight.

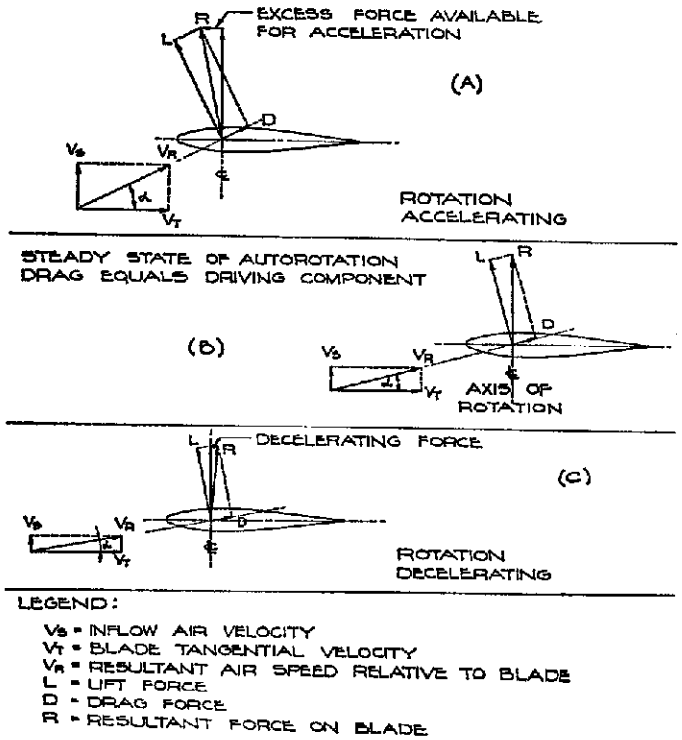
8. Rotor blades have no cracks, nicks, or loose hardware. Trim tabs and noseweights tight. Clearance to the vertical fin and ground adequate.

9. Repeat the procedure in reverse on the left side of the craft walking slowly from the tail to the tow hitch.

10. After the craft is fully inspected examine also the tow rope and its attachment to the tow car. All kinks, cuts and sharp projections are taboo and must be eliminated before flight.

Last but not least, examine yourself and your tow driver. Are you both alert, thoroughly familiar with your equipment, mature, unhurried and unstrained? Do you understand each other quickly and trust the soundness of the other man's judgment? If the answer to any of the above check points is NO, **refuse to fly.** The cost of carelessness and negligence is much too high to take chances with your safety. Take pride in saying, as so many ace pilots do, "I don't care to be the boldest pilot. I would rather be the oldest".

OPERATION OF THE ROTOR



AUTOROTATION

Fig. 28—Diagrams above show what turns the rotor of a gyroglider. Although the airfoil pitch is set at zero and may be even at a slight positive pitch, air forces on the airfoil are such that they drive it forward around the axis, as in diagram "A". As the rotor accelerates to higher speed the airfoil incidence angle (alpha) becomes shallower, and the resultant force R tilts rearwardly, as in "B" until equilibrium is reached, and rotor RPM reaches a steady state.

Finally, when the rotor speeds up from a momentary excess load, angle alpha becomes still shallower, which tilts R further aft and produces the deceleration force, which slows down the rotor. Thus rotor speed (RPM) of an autorotating rotor is self-governed at a constant speed by the aerodynamics of the airfoil itself. Rotor would autorotate with positive pitch angles as high as plus 6 degrees, but would be turning slower than at lower pitch angles.

Rotor speed is also dependent on the total lift produced by it. The higher the lift, the higher the RPM. Thus, if your gyroglider rotor turns at, say, 325 RPM at a gross weight of 300 lb., the same rotor would turn at 375 RPM when converted to a gyrocopter weighing 500 lb.

For the same reason, when you pull up on the rotor, as in a flare during landing, the rotor speeds up because it produces greater than normal lift. Conversely, it slows down when you make a "pushover" maneuver by nosing down the gyro from a level flight.

4. DRIVER'S CHECK LIST

(Cut this page out, slip it inside a transparent plastic envelope and give it to each driver to read before he starts towing. Don't lose it).

(1) Check over the car. Does it have enough gas? Is the motor in perfect running order? Does it have rear-view mirror where you can see the glider at all times? Do you have a safety rider facing rearwardly to watch the glider?

(2) Did you read and understand the Flying Instructions in this book?

(3) Are you positive the towline is capable of holding the pull of 1000 pounds without breaking? Does it have a metal thimble inserted in the loop where it attaches to the tow-hitch on the glider? (See Fig. 23). Did you examine the rope for breaks of strands, kinks, cuts, fraying, weak spots? Is the attachment to the car as shown in Fig. 13? Is the ball of the draw-bar attached to the frame of the car and not just to the bumper?

(4) Is there an Airspeed Indicator and a flag mounted on the hood of your car? Are both in good working order? Will you always remember to hold the airspeed at 35-40 mph, or more, so long as the Gyro-glider is more than 2 feet above the ground?

(5) Are you aware that you must watch the Airspeed Indicator and **not** the speedometer?

(6) Do you know enough not to exceed, under any circumstances, the airspeed of 30 mph unless the Gyro-glider is fully airborne?

(7) Did you check the terrain over which you will travel to be free of rocks, ruts, soft spots, or any other obstacles that may cause you to slow down or stop unexpectedly?

(8) Do you have a set of wrenches, hand tools, cotter pins, spare nuts, washers, safety wire, grease, etc., handy in the car in case you have to do incidental maintenance work in the field?

(9) Have you practiced receiving and understanding clearly the pilot's hand signals while he sits in the gyro-glider? Have you made sure that no one will distract you with conversation while you do the towing?

(10) If this is your first towing experience, is your pilot an experienced Gyro flier in whom you have complete confidence?

(11) Does your pilot know enough to get into the landing position well before you run out of towing space?

(12) Are you aware that you should: not apply brakes abruptly regardless whether taxiing, flying, or towing the Flying Trailer? . . . never let the towline go slack on the ground? . . . take turns and curves slowly when taxiing?

If the answer to any of the above Check Points is NO, refuse to drive. Remember the old aviation motto, "IF IN DOUBT—DON'T FLY". As the tow-car driver, you are an important member of the flying team. Your responsibility on the team is equal to the pilot's. Don't goof it.

5. INSURANCE

There are a number of companies underwriting insurance of home-built aircraft, which include Gyro-gliders and Gyro-copters. Among them are:

Crump London Underwriters, Inc.
Indemnity Marine Assurance Co.
Cornhill Insurance Co.
London & Scottish Assurance Corp.
The British Aviation Insurance Co.

National Insurance Underwriters
Bowes & Co., Inc., 135 So. LaSalle, Chicago, Ill.
The Aviation and General Insurance Co.
OMNI Insurance Company
Van Nuys, California

As in automobile insurance, the rates vary depending on the age, experience, etc., of the operator. To obtain exact quotation for your case, write directly to the above companies, submitting the following information:

(1) Type of aircraft.
(2) Approximate initial cost.
(3) Rotor Diameter.
(4) Cruising speed, towed and/or in free flight.
(5) Gross weight.
(6) A photograph of your craft in flight operated by you.
(7) Your age.
(8) Your total flying hours.
(9) Flying hours in the craft similar to one to be insured.

6. FINANCING

If you wish to finance the purchase of your Gyro-glider, you may secure the help of financing companies who specialize in purchases of aircraft. You can find their advertisements in aviation magazines such as FLYING, TRADE-A-PLANE, AOPA PILOT, etc. The following companies specialize in individual financing requiring 25% down, balance up to 36 months to pay:

W. D. Owens & Associates
Investment Company
A-110 Petroleum Center
San Antonio 4, Texas

Air-Credit Sales Co.
Torrence Airport, Calif.

Of course, you can buy the Gyro-glider in separate kits one at a time, which is equivalent of installment buying, or buy any of the "KC" kits on an installment plan.

Finally, if you are in industrial business and need the Gyro-glider or Gyro-copter for business purposes, you can get it on a "lease-purchase plan" through companies that specialize in this type of service. It resembles installment buying, although the payments are tax deductible as "rent" fees. You may obtain more details about this form of financing from the following company:

American Industrial Leasing Co.
509 Madison Avenue
New York 22, New York

7. FAA REGULATIONS

Applicable to Gyro-Glider

If you don't intend to fly your Gyro-glider in free flight, nor to convert it later to engine-powered Gyrocopter, then you don't need any licenses for either your machine, or yourself. You can learn to fly in complete privacy without any red tape at any time and anywhere you want.

Well, almost anywhere. FAA lists Gyro-gliders officially as "Kites", and the rules governing the kites apply to Gyro-gliders. The FAA Advisory Circular No. 20-27B spells out these rules as follows:

1. No notice or approval from FAA is needed if you fly below 150 ft. altitude outside of a 5-mile radius from the nearest airport. That covers more than 99 percent of this country's territory.
2. If you want to fly higher, say between 150 and 500 feet, then you must send a notice to your local FAA office at least one day before you go up that high. One notice is enough.
3. If you want to fly above 500 feet, or within 5 miles of an active airport, then you can apply, and FAA will issue to you a "certificate of waiver" to do so, on a "Form 663", valid for one year. This way they can alert other pilots of airplanes in your area to be on the lookout for you, and especially for your towline, which is difficult to see from far away.

The Advisory Circular 20-27B also spells out what needs to be done if you wish to license your Gyroglider in "amateur-built" category. This Circular applies to all homebuilt aircraft including airplanes, and is too long to be reprinted here in full. To get the latest information on licensing, write to Washington (FAA, Flight Standards Service, 800 Independence Ave., S. W., Washington, D. C.) for the Advisory Circular 20-27B or its latest replacement.

Licensed amateur-built flying machines are permitted to fly anywhere in U. S. except over thickly populated areas and in areas with congested air traffic.

All things considered, FAA's job is to protect public safety in the air just as highway patrol protects the safety on the highway. Licenses are issued to protect you from screwballs who are either too ignorant or unfit to operate their vehicles safely. Cooperate with FAA. They have licensed many Gyro-gliders and Gyrocopters before you. They are public servants paid by tax money, and their services to you are free. In addition to protecting the public from unsafe operation of any aircraft, Congress charged FAA also with promotion and encouragement of aviation in all its phases. This includes your activity, therefore you should find FAA personnel friendly and eager to help with all your problems.

8. LIST OF DRAWINGS

The following Drawings are integral part of this Manual:

	Dwg. No.
Airframe Assembly, Sheet #1	8-104-100-1
Airframe Assembly, Sheet #2	8-104-100-2
Airframe Assembly, Sheet #3	8-104-100-3
Airframe Details, Sheet #4	8-104-100-4
Rotor Head	8-102-100
Rotor Blade	8-103-100

The following additional optional drawings are applicable to Gyro-glider, but are not a part of this set of Plans:

Joystick	8-105-100
Floats Sheets 1# & #2	F-P
Dual-Seat and Training Trailer	8-107-100

These Drawings can be ordered separately, together with their applicable Manuals, directly from the factory. See Catalog for prices.

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9. READING REFERENCES

If you wish to learn more about the designs and theory of helicopters, you will enjoy studying the following books and publications:

*1. "The Story of the Helicopter" — by Devon Francis, 1946, Coward-McCann, Inc., New York.

†2. "Aerodynamics of the Helicopter" — by A. Gessow and G. C. Myers, 1952, MacMillan Co., New York.

†3. "Elements of Propeller and Helicopter Aerodynamics" — by D. O. Dommasch, 1953, Pitman Publishing Corp., New York.

†4. "Rotating Wing Activities in Germany During the Period 1939-1945" — British Intelligence Report No. 8, H. M. Stationery Office, London, 1948.

*5. "The Story of the Winged-S" — by Igor I. Sikorsky, 1941, Dodd, Mead & Co., New York.

*6. "Anything a Horse Can Do" — by H. F. Gregory, Reynall Hitchcock, 1944, New York.

‡7. "Introduction to Helicopter Aerodynamics" — by W. F. Stepniewski, 1950. Rotorcraft Publishing Committee, Morton, Pa.

‡8. "Typical Helicopter Performance Calculation" — by R. Harris, L. Sloan and K. Ulrich, 1952, Rotorcraft Publishing Committee, Morton, Pa.

†9. "Helicopter Rating" — By Charles A. Zweng, Pan American Aviation Service, 12021 Ventura Blvd., North Hollywood, Calif.

†10. POPULAR ROTORCRAFT FLYING — Official organ of the Popular Rotorcraft Association, P. O. Box 2772, Raleigh, North Carolina.

†11. "The Helicopter" — by Jacob Shapiro, 1958, Macmillan Co., New York.

12. Federal Aviation Administration regulation 43.13 and Advisory Circular AC 20-27B.

13. Experimental Aircraft Association's aircraft Building Manuals.

†14. "Proceedings of Annual Forums"—by American Helicopter Society, 10 books, 2 East 64th Street, New York 21, N. Y.

*15. "Helicopters" — by D. N. Ahnstrom, 1954, World Publishing Co., Cleveland, Ohio.

*16. "Pioneering the Helicopter" — by C. L. Morris, 1945, McGraw Hill, New York.

*17. "Helicopter Guide" — by C. L. Morris, 1955, Helicopter Utilities, New York.

†18. "Principles of Helicopter Engineering" — by J. Shapiro, McGraw Hill Book Co., New York 36, N. Y.

†19. "Rotorcraft" — by R. N. Liptrot and J. D. Woods, Butterworths Scientific Publications, London W. C. 2, England.

†20. "Handbooks of Rotary Wing Aircraft" — 18 volumes, The Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C.

†21. "Helicopter Dynamics and Aerodynamics" — by P. R. Payne, MacMillan Co., 1960, N. Y.

*22. "Helicopters and Autogiros of the World" — by P. Lambermont and A. Pirie, 1960, Philosophical Library, Inc., 15 East 40th Street, New York 16, N. Y.

*23. "Complete Book of Helicopters"—by Ahmstrom, Aero Publishers, Los Angeles, Calif.

*24. "Civil Air Regulations & Flight Standards for Pilots" by Aero Publishers, Inc., Los Angeles, Calif.

*25. "Straight Up" by Hubler, Aero Publishers, Inc., Los Angeles, Calif.

†26. "Helicopter Design Data Book" — by Stanley Dzick, Hector Servantes, Inc. P. O. Box 5544, Milwaukee, Wisc. 53211

*27. "Helicopters Work Like This"—by Basil Arkell and J. W. R. Taylor. Phenix House, 1963. Order from Air Age Publications, Ltd. 1, Temple chambers, Temple Avenue, London E. C. 4.

*28. "Vertical Flight Aircraft of the World," by F. G. Swansborough, 1964, Aero Publishers, Inc. Los Angeles, California.

†29. "Flight Test Guide" — Gyroplane Private Pilot and Gyroplane Commercial Pilot, Federal Aviation Agency publication, 1961, U. S. Government Printing Office, Washington, D. C.

*30. "Log Books" for Pilots, Aircraft and Engines, Aero Publishers, Inc., Los Angeles, Calif.

*31. "Flying Windmills" — Ross, Aero-Publishers, Los Angeles, Calif.

*32. "The Helicopter and How it Flies"— by Fay, Aero Publishers, Los Angeles, Calif.

*33. "Helicopters that Made History" — by Cooke, Aero Publishers, Los Angeles, Calif.

*34. "Helicopters in Action" — by Bergaust, Aero Publishers, Los Angeles, Calif.

*35. "Helicopters"—by Kenneth Munson (*Blandford Press*) -Air Age Publications Ltd., 1 Temple Chambers, Temple Avenue, London, E.C.4.

*36. "Helicopters & Autogiros"—by Charles Gablehouse (Muller)—Air Age Publications Ltd., 1 Temple Chambers, Temple Avenue, London, E.C.4.

*** Non Technical**
† Technical
‡ Highly Technical

OTHER BENSEN GYROS

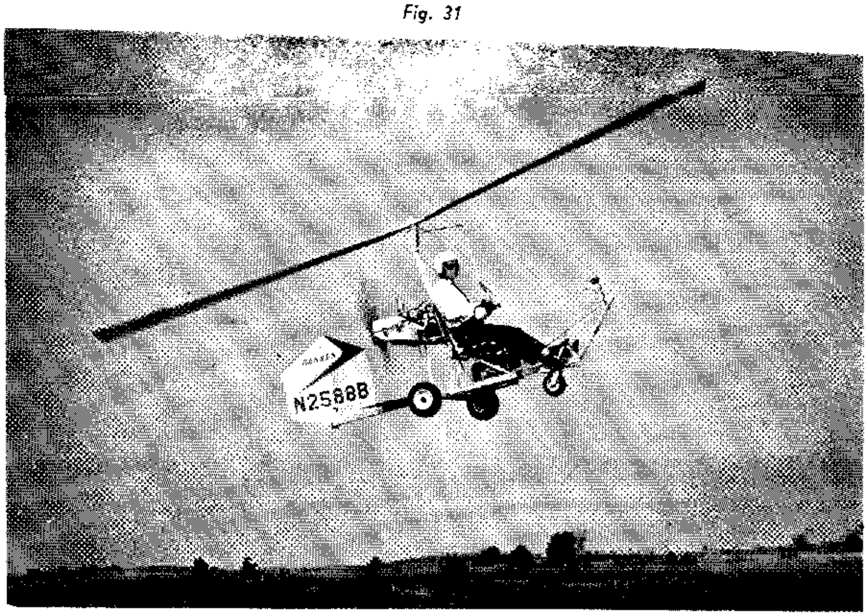
Fig. 29

HYDRO-GLIDER
For Fun on Water . . .

Fig. 30

GYRO-BOAT AND HYDRO-COPTER
Fly With Freedom of a Seagull . . .

Fig. 31



GYROCOPTER
Personal Size Flying Scooter . . .