Hi-Fin with Fox .25 installation and 'Sunday-flier' rudder/fin combination. Also the wing, with flat tip plates, is shown in this photograph.

HI-FIN...'64

By HARRISON MORGAN . . . CLASS ONE WINNER BY ONE OF THE COUNTRY'S TOP RUDDER-ONLY MEN. DESIGNED FOR PERFORMANCE, HI-FIN CAN PUT IN WINNER'S CIRCLE.

Daughter Margo holds Harrison's Hi-Fin with K&B 35 engine. Wing with shaped wing tips is seen in this photo. In foreground, are the trophies for the 1964 winning season with his contestable plane.

► Hi-Fin was completed early in 1964 and entered in six contests during that contest season. It won five first places and one close second. Weather conditions varied widely from no wind at all at the New England R/C Championships, moderate winds at the Lids and Littleton N.H., to high winds at Endicott and Rochester, N.Y.

Hi-Fin is basically designed with more built-in stability than the average 'hot' rudder-only plane. It handles well both on the ground and in the air. How 'hot' it will be, depends directly on how much you are willing to bend the rudder. Therefore everyone from the sport flyer to the contest flyer should find this airplane interesting.

The plans show installations for both .19 and .35 engines. All of the contests entered were flown with a Fox .25 with the exception of Rochester, N.Y. where a K&B .35 (plugged down) was used for power. A .19 to .25 engine is all you will need even on hard-top runways. The .35 will make for more positive ROGs from grass strip. If you are of the rudder-only school that believes that you can just glide around and not attempt maneuvers, you will find a .15 engine satisfactory, and you will also be better off with a glider type airplane as the high aspect ratio is more suited for this style of flight.

Hi-Fin is designed for multi equipment permitted in Class I by the new AMA rules. For an escapement airplane to be highly maneuverable, the tail moment should be rather short and the rudder must be aerodynamically balanced

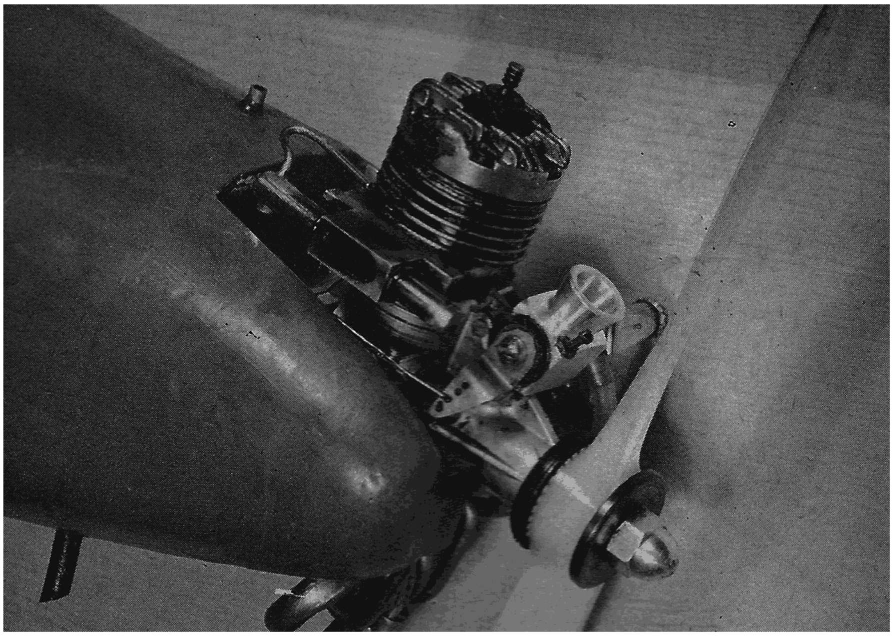
HI-FIN . . . Continued

since the available power from the escapement is very low. (About less than 2 inch ounces.) This calls for a design that will 'crank' around with a minimum of power. On the other hand with servos, since there are 2 to 3 pounds of power available, so why not take advantage of this power, build more stability into the airplane and let the servos do the work? Therefore the tail moment is longer (better grooving in straight flight); the tail is higher (better tracking in loops); and the stab is nearer in line with the wing (greater pitch stability).

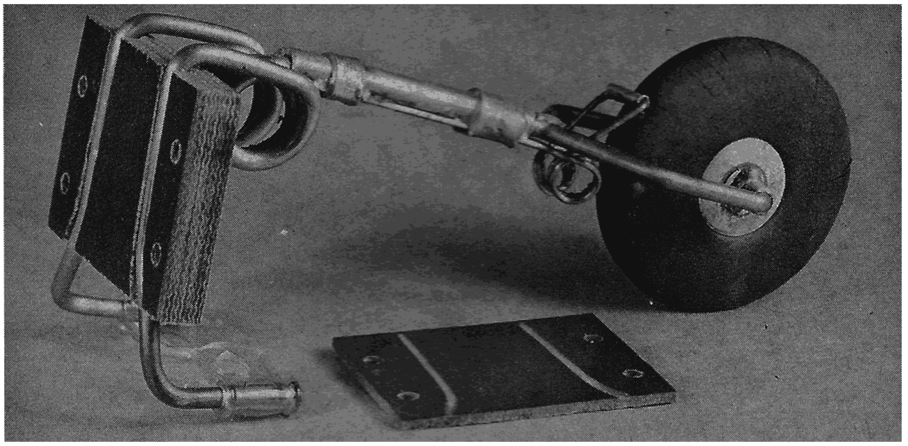
A long tail moment dictates smaller fin and stab areas. Most hot rudder jobs are strong on stab area and short on fin area. Stab area was found to be best at around 27%, as shown on plans, however, the fin area was kept on the generous side in the interest of stability. Four rudder-fin combinations were tried on Hi-Fin. The one shown seems to be about the best compromise between stability and maneuverability. The 'Cool-Sunday-Flyer' rudder and fin combination, as shown, will do most of the maneuvers but they will be somewhat opened. Although the rather high placement of the rudder-fin combination along with the long tail moment, tend to give greater stability, they also tend to distract from rudder effectiveness, the rudder movement must therefore be on the generous side. I use normal servo throw and the inside hole of a Top Flite rudder horn, and find this set up satisfactory for all maneuvers.

Wing is basically straight with some built-in washout at the tips, which helps take out any ballooning tendency and gives a smoother sink rate. The slight notch at the trailing edge center section makes for a thicker section at this point where the wing comes to rest on the fuselage back stop. The wing's aspect ratio is lower than five to one which is better for rolling than higher ratios. The roll rate of a Class One airplane is most important as so many of the maneuvers depend on this action. The sink rate is further enhanced by the small spoilers. With this set-up, you can get an engine idle with a 5,000 rpm on a 9-4 prop, although a lower one is desirable. The round wing tips shown are excellent for ground handling and for rolling. Flat tip plates give more stability in the air but a cross wind will get under them easier when on the ground. Also they roll slower upstairs. Total dihedral for the wing is 140° and this seems right for contest work. This minimum amount is required as the fuselage is only 4" deep giving less stability from pendulum effect.

The shallow fuselage brings the CG down close to the ground and along with good

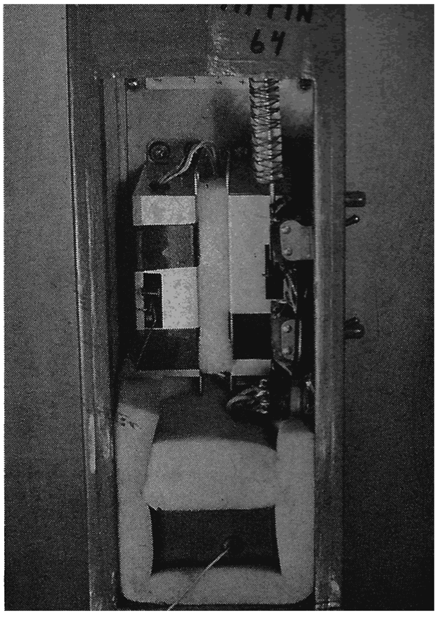


Close-up of Hi-Fin with Fox .25 installation. Intake throttle is a K&B and coupled with exhaust throttle. 1.5 ounce weight, used with Fox engine, is visible here looped in landing gear spring.

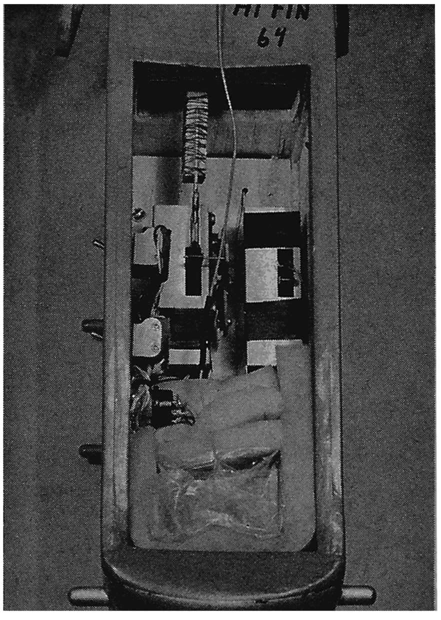


Close-up of the nose gear assembly. ¼" micarta block and ⅛" cable clamps are shown in position.

Drag brake installation is made of .050 piano wire. 1/16" micarta in foreground fits on top ¼" section.



Servo installation as used with the Fox .25 engine. Receiver wrapped in foam is at the bottom of pic.



Servo installation as used with K&B .35 engine. Plastic bag keeps dirt out of the receiver.

spacing of the wheels, the airplane has unusually good ground handling characteristics.

Most Class I fliers prefer the thrust adjusted so that the airplane will pull up sharp when the 'coal' is poured on. The amount of 'up thrust' varies with several factors such as the power loading, angular difference, air airfool section and nose moment. The 3° of down thrust, shown on the plans, will give a sharp pull up with full power. Don't take it out or you will loop on takeoff and dive into the pavement.

Probably the greatest problem affecting a trike gear on a Class One airplane, is that of a nose wheel which not only works well but will 'take it' without folding or breaking the airplane. Without an elevator button to hold up the nose, the rudder ship is subjected to an occasional 'prang' on the nose gear taking most of the punishment. The nose gear will take many such 'prangs' with no dammage to it. The nose gear, as seen in the photographs, has been on two airplanes, it has made hundreds of flights, including hundreds of touch and goes. Only maintenance has been to twice replace the tire and axle. (Tire was cut and axle worn out.) Nose gear is placed as far forward as practical, giving greatest stability to ship during ground maneuvers along with maximum protection to propeller. A distance of ¾" or more should be maintained between wheel and propeller to prevent the prop from being struck by the nose wheel, when it springs back.

Construction: Both Ambroid and white glue are used: white glue on all hardwood joints, Ambroid on all joints where a lot of sanding is to be done, such as on fuselage longerons and leading edge of wing, as it leaves a smoother joint. Be sure to double glue all joints where Ambroid is applied.

When cutting balsa to size, be sure all joints fit well. (Use a small band saw.) This is especially important where blocks are used. Use clamps and pressure on as many joints as possible, it will pay off.

Although I tend to be a heavy builder, a serious attempt is made to keep this airplane light. Special attention should be given to keep tail section light, especially if a .19 size engine is used. All-up weight is 4.5 lbs., with 500-square inch wing, loading is 21 ounces per sq. ft. If the plane is heavier than this, add an inch or two to wingspan. CG is at the point indicated on the plans with the .35 engine. For the .25 engine, a 1.5 ounce weight is added to nose. (Use a piece of auto body solder hooked around the spring in the landing gear.)

Fuselage: I prefer to begin construction with fuselage as it is most time consuming. Fuselage is straight forward construction. The tail section is unusually simple, yet it is strong, light and goes together fast.

Glue F-3 to the ⅛" x ½" former doublers. Set these aside to dry. The fuselage sides are built from two pieces of ⅛" x 4" x 36" sheet stock. Draw the side view, minus the top and bottom sheeting, on one of the sheets: pin other sheet to bottom and saw them together. This will insure that both sides are similar. Assemble sides to F-3 and F-4 and its doublers; add the ⅛" by 13" doublers, balsa block bottom of battery pack area, F-5 and the ⅛" x 3¼" x 8½" sheet bottom. When dry, pull sides together and glue tail block. Install the ¼" square longerons with Ambroid glue, use clothespins to dry. Install the 1/32" ply stab doublers. Install the ½" tapered top block to F-5 and the ¼" longerons.

Use a good flat block and #120 paper to sand lightly top and bottom of fuselage, this will assure good glue joints for the 1/32" top and bottom sheeting, and for the hardwood landing gear block and the ⅜" bottom sheeet, which are next assembled.

Before gluing F-1 in place, be sure motor mounts, fuel tank and motor all fit in place. The motor mounts behind F-1 are cut away until the top of fuel tank is even with top of F-1. After F-1 is glued, install motor mounts, fuel tanks and F-2. Line them up and glue, when dry add the ¼" motor mounts braces and the 1" x ½" corner blocks. Install windshield block and rear platform wing trailing edge. Sand top and bottom of nose section and add top and bottom sheeting. Now add nose-cheek. Install the rear 1/32" ply tip piece, the ⅛" x ½" spruce barces and the 3/16" x ¾" trailing edge stock. Form the front of wing platform by filling in space back of F-3 with scrap stock.

Before installing the fin sand the entire fuselage to shape with #50 paper on a sanding block. Smooth up with #120 paper. Note that the corners of the rear section of the fuselage are sanded down to the ¼" longerons, thus giving excellent round corners as shown in section "DD."

The fin is made of medium light 'C' grain stock. When installing it, use a 36" straight edge so that it is properly aligned with the fuselage. After the fin is dry, install the triangle fin supports.

The dowels are not put up until fuselage is covered and two coats of dope applied. However, the dowels are made and fitted to fuselage before covering. Install servo rails before drilling holes for landing gear dowels.

Sand fuselage with #120 and #400 paper; give it three coats of dope, sanding lightly between them. Cover entire fuselage with heavy silk, except for the fin which is not covered. Apply two coats of dope, sanding lightly between each. Cut the fabric at the dowel holes and install the dowels, gluing them. Apply four more coats of dope, sanding lightly each time, add trim colored dope and apply two additional coats of clear dope. This will give a good finish. Sanding with #400 paper between coats will make for a smooth finish.

Wing: Take 3 pieces of 3/32" x 3" x 36" sheet stock and saw them into 18 pieces of 12" x 1½" stock. Stack them up and drive four common pins from each side of the stack. Draw the W-1 wing rib plan on top of stack and saw whole stack at once. Touch up with #120 paper, pull the pins and you will have 18 ribs ready to go——all similar size. Fifteen of these will be used in the wing; three spares can be used for repairs or for templates for another wing. The bottom of two ribs are trimmed to make the W-2s and two more are used to make the W-3s. Rest of the ribs are used as is, with the exception of three center ribs which have to be cut for dihedral braces.

Wing is built on a flat surface except for built-in washout caused by W-2 and W-3. A 3/16" shim is placed under trailing edge of the W-3 rib to give correct washout. Trailing edge sheeting is held flat up to third rib from the tip, washout is from this point to tip of wing. Spruce spars are strongly recommended for the wing. The 3/32" sheet webbing between the trailing edge sheeting is important. None is used at the main spars. Tips are hollowed for lightness. When completed, wing is sanded with #120 and #400 paper. Cover and dope.

Dope 'run through' is a problem with the wing. Dope one panel; turn wing over and dope other side. When this panel is completed, go over the first side doped—which is now up-side-down, the dope has now run through to the outside, where it can be spread around again. Turn the wing over and dope the third panel,etc. This controls the "run-through" problem quite well.

Stab: Stab ribs are built in the same manner as the wing ribs. The three center ribs must be cut down 1/16" for sheeting. All light wood is used in stab to keep its finished weight to 2.5 ounces.

Build it on a flat surface where bottom spar is fastened directly. Use scrap stock to 'jig' up leading and trailing edges, so that they are at an equal distance from the flat surface.

Stab is covered and doped. Tips are hollowed out for lightness.

Landing gear: Main gear is made from .090, 6061 T-4 stock. This makes quite a rugged gear, yet can be bent cross grain with no danger of breaking. A deBolt heavy duty gear can be used.

The nose wheel gear is from ⅛" music wire and a piece of ¼" brass tube. It is held in place with the ¼" and 1/16" Micarta blocks which are in turn secured by the motor mount bolts.

Take a piece of ⅛" music wire, 36" long, and clean it with a piece of #400 paper. Grind it to two 18" pieces. Wind a two turn coil in the center of each piece around a ⅜" rod. (Note that one is wound to the right, and the other to the left.) Cut the ¼" brass tube to length and clean it well, inside and out, so that it will take the solder well. Squeeze the ¼" tube just enough so that it will slide over the two ⅛" wires. Line up the coils so that they are square with the brass tube and each other. Using a heavy iron, feed in enough solder so that the entire space between wire and tube is filled. Bend both ⅛" wires straight back at the dotted lines as shown on plans. Fan out the wires after going back about 1" so that when the final bend is made, the two wires will end up in the corners between cheek blocks and F-1. The last bend is critical as it will determine whether or not gear will be square with fuselage. Make a fork of the lower end of the ⅛" wires (as shown) to accept the nose wheel and axle. Make last two bends before cutting the wire. Using a slight radius here will prevent the wire from breaking. The double 5/32"—3/16" axle is strongly recommended as it will last longer than a single one.

Wheel and axle are installed by springing the ⅛" wire fork apart. Wheel is not soldered in place as it has never jumped out—even during a rib splitting 'prang'.

The nose gear is now put in place and the ¼" micarta block-marked for routing. A Dremel tool with a ⅛" round bit is used to rout out the Micarta so that the ⅛" wire fits tightly down into it to within .005" of the top. The compression between the 1/16" micarta and ¼" Micarta will keep the wire tightly in place.

Holes are drilled in motor mounts to accept engine, then the holes are continued down through the migarta pieces. They should be held in place with nose wheel assembly when marked for drilling.

Assemble nose gear and Micarta blocks with 4-40 x ½" bolts with the heads on bottom. Set engine in place on top of mounts. Complete assembly is then tightened. Use Dynamic engine mount plates, instead of nuts. ⅛" cable clamps are used to secure the end of the ⅛" wire to F-1 and are held in place with #6 x ⅜" sheet metal screws.

Drag brake is added after the unit is assemblied and adjusted for proper tension at the flying field.

Pre Flight: With complete airplane assembled and equipment installed, check CG. It should be within 1/4" of that shown on the plans. Add ballast to bring within these limits if necessary. Check side and down thrust. Check neutral position of rudder. Check alignment of wing and stab with relation to the fuselage. Put a 1/16" shim under trailing edge of the stab. Check operation of equipment with engine running—at a distance.

If all the above items check out, you are ready for the first flight. I'd suggest a hand-launch for the first one as it will eliminate the ground handling problems. If using a .35 engine, be sure to plug it down, and pull throttle back a couple notches prior to launching.

At full power with the CG and thrust positions (as shown on plans), climb will be quite steep. Medium speed will give a good level flight and low speed will give a good sink rate. Left or right turning tendencies can be taken out with small adjustments of the rudder neutral position. Shims up to 3/16" can be added during windy weather with good maneuvering still possible.

Ground Control: Except for straight take-offs and landings into the wind, ground control of Class I airplanes must be limited to times when there is little or no wind. At the 1964 N.E. R/C Championships, there was little wind and all flights had proto take-offs. Proto returns were completed on two flights.

With CG and landing gear positioned as shown, note that nose wheel is lightly loaded. The lighter the load, the easier it is to turn as the rudder doesn't nose so much wheel pressure to overcome. Nose wheel is adjusted so that when rolling the airplane on the ground, without the engine running, the airplane will track slightly to the right, with neutral rudder. With engine running, torque will try to pull plane to the left; however, at slow speeds the right wheel will take over, especially when helped with right rudder. With left rudder at slow speeds, the airplane will track straight. At higher speeds and left rudder. the airplane will track to the left.

As mentioned, little or no wind is needed for a good ground control. Turning out of a down wind attitude is most difficult. here depend on casters of nose wheel. In some cross-wind positions, crossing the controls will aid turning. (I.e. left rudder for a right turn etc.) With much wind it is very difficult, much more so than in Class II and III where there are steerable wheels and brakes. Class I airplane would be as good on the ground as the other classes if were allowed.

Drag brake should be adjusted so that at idle speed the airplane will come to a stop, at a reasonable distance.

If you build Hi-Fin, I'm sure you'll be pleased. It is a pleasure to handle both on the ground and in the air.