RAT RACING is the ultimate of all racing events. To achieve success, you must be willing to spend endless hours of hard work. A person who is willing to dedicate himself will be rewarded with success.

Rat has developed from four men in a circle with 90-mph airplanes to two men with 150-mph-plus airplanes. To fly one of these beasts takes a lot of flying experience. This is not to say that with practice you can't learn to fly one.

Here are a few essential items a good rat pilot must have. Peripheral vision, to know where the other plane is at all times and for spotting signals from your pit man. You also need fast reflexes, for split-second decisions. At the speed they are traveling, there isn't any time for errors. Top physical condition with a strong flying arm; 140 laps at 150 mph will whip most pilots. It sometimes feels like it will stretch your arm about two inches. Even if you have all the essentials to be a pilot, you must have a good flying airplane. A bad flying airplane will make the best pilot look bad. This article is designed to go beyond any previous article on model design, engine and equipment.

The "Snake" is an original design that has shown superior flying characteristics, speed and strength, all of which are necessary for a consistent winning rat.

Before construction is started, you must decide if you are going to use internal or external leadouts, round or conventional bellcrank and wash-out. Internal connected lines realize about 2% decrease in drag compared to external leadouts. This is about 3 to 4 mph increase. A round bellcrank is much stronger, smoother and has more travel; if you decide to use a conventional bellcrank see note on plans. Wash-out on a rat allows the plane to land faster, eliminating ballooning during pit-stops.

Construction

If you have problems in obtaining special parts, materials and service required in the building or flying of this aircraft, the following sources will be helpful. For the fiberglass top, basswood and other supplies: Art's Hobby Shop, 10234 Atlantic Blvd., Jacksonville, FL 32211; for engine rework, and other supplies: Aldrich Products, Inc., P.O. Box 1426, Mission, TX 78572.

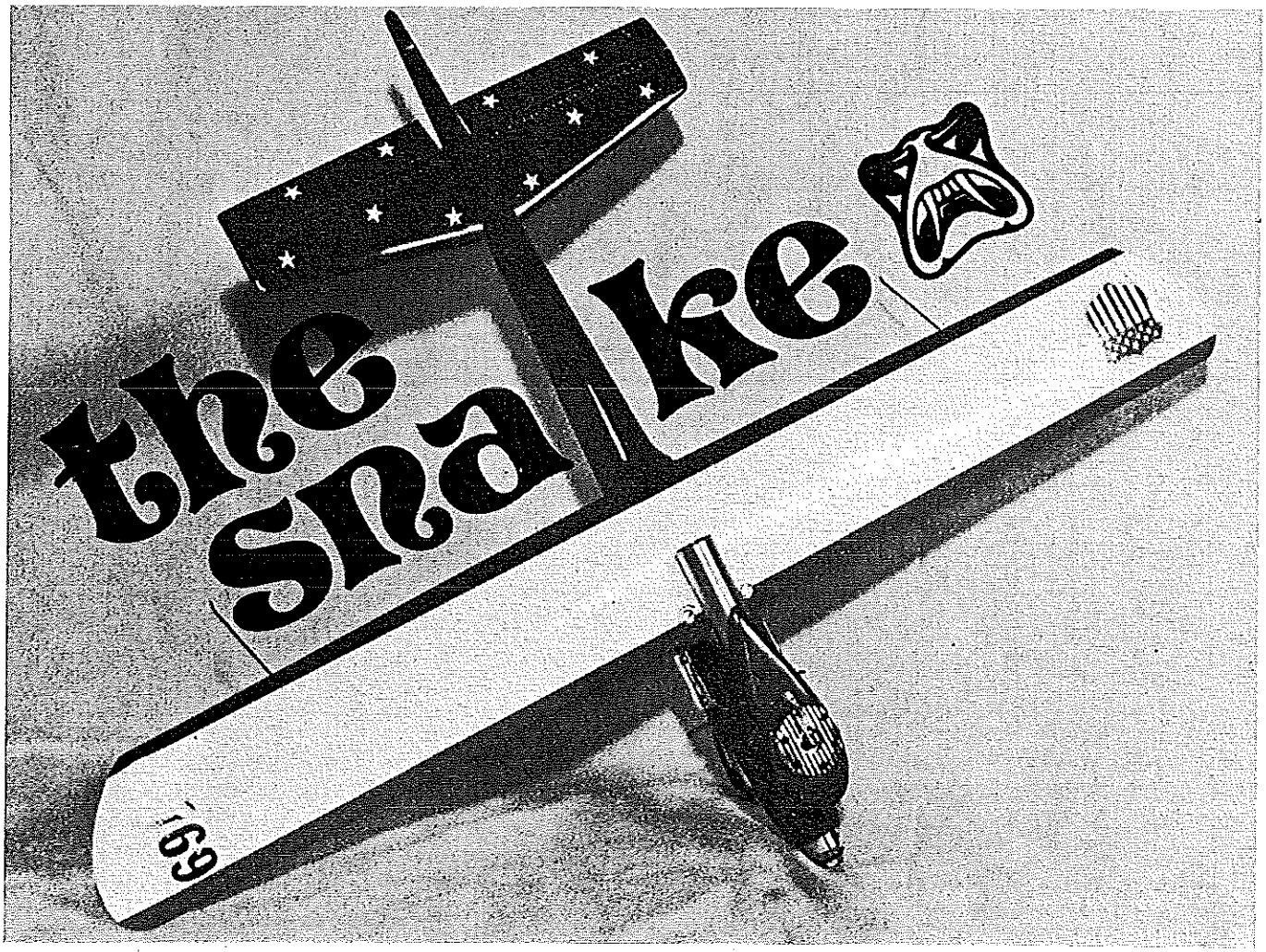
Into Rat Racing? Then fly the best. This article and design go beyond anything previously published on the subject.

Dick Lambert

The wing configuration is cut from a piece of 5/16 × 3½ × 28" basswood. Rout out a ⅛" deep bellcrank hole, a ⅛" deep wing weight pocket and 3/16" deep button grooves. Imbed 2 pieces of ⅛" aluminum tubing for leadouts on bottom of wing. Turn the wing over and shape the airfoil. Use a razor plane to rough it out, tapering as you go. Be careful not to over taper and cut into the button grooves. Finish shaping with 100-grit sandpaper. Drill holes and mount wing skids and bellcrank blind nuts.

Turn the wing back over and temporarily mount the bellcrank, check for freedom of movement; eliminate any surface drag. Remove bellcrank and epoxy lead weight. Sand in the wash-out as shown on plans; and flatten a piece of 3/16" brass tubing and epoxy in wing tip. Rout out a .030" deep pocket for the cover plate and mount (3) 2-56 blind nuts for hold downs.

Epoxy wing in fuselage and fill rear 1" portion of fuselage with epoxy to anchor rear hold-down tubing. Location of wing is



The K&B 6.5 fits nicely with very little modification. Finishing includes two coats of Hobbypoxy "Stuff" over basswood, and two or three coats of Hobbypoxy clear over the entire airplane. Finish is wet sanded, rubbed out, compounded and waxed. Sanding details given in text.

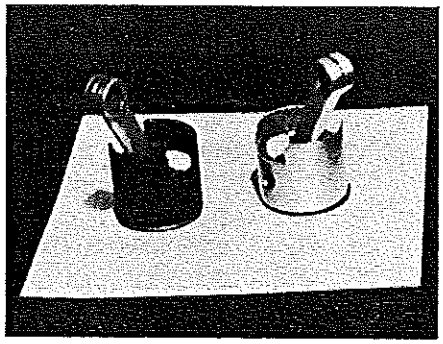
very critical (5⅛" from leading edge to nose of fuselage or 2-15/16" to engine center) as per plans.

Drill holes and insert 5/32" brass tubing for hold-down bolts at front and rear of fuselage as detailed on plans. The front tubing should be reinforced with heavy fiberglass cloth or blocks of hardwood.

Grind and shape the front of a Harter's Rat pan to fit a HP 40 RRV. Mark, drill and tap for 4-40 engine bolts; also, mark drill and tap for 6-32 hold down fuselage bolts—two front, one rear as per plans.

The method used for mounting the landing gear and tail skid is somewhat different than most. All that is needed extra is a 6-32 die. Cut about ½" of threads on two pieces of ⅛ × 6" piano wire. Drill and tap pan with 6-32 tap as per plan. Screw both pieces of wire into tapped holes. Bend rear wire to touch forward leg, wrap with copper wire and fill with solder. Cut to length, bend and install 1¼" Don's wheel.

For tail skid, cut about ¼" of threads on a ⅛ × 1½" piano wire. Drill vertically and tap pan with 6-32 tap; caution must be taken not to drill through the pan. Screw skid into pan (use Loctite), tighten and bend.



Impreglon piston left; the stock piston right. Impregnation actually penetrates the metal. In authors' HP engines a 300 to 1000 rpm increase is realized along with longer engine life.

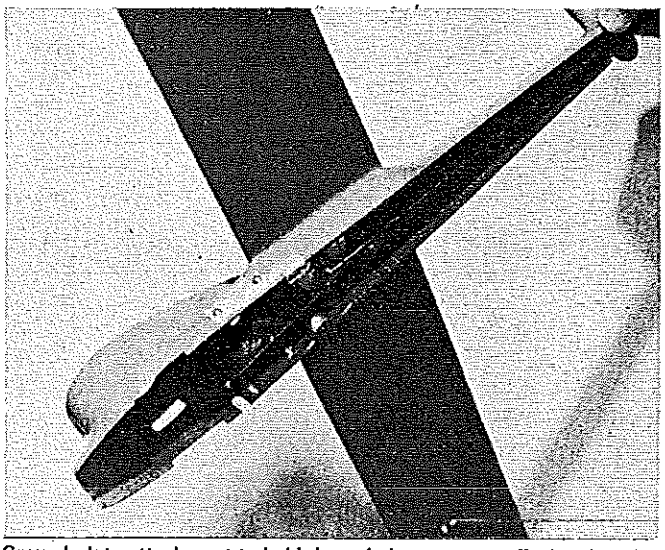
The stabilizer is made from a 3/16" piece of basswood. Mount crank horn, shape airfoil. Drill hinge holes and sew in nylon hinges. Shape a piece of hardwood as a key-way to fit bottom of pan and epoxy to bottom of stabilizer. See detail on plans. Drill (4) 5/64" holes in the pan and mount the stabilizer with (4) no. 2 ⅜" wood screws. Mounting stabilizer in this manner avoids pan breaking on hard landings.

The fuel tank is a 4-oz. Don's Rat tank extended to 5 oz. Mount the tank in pan with silicone rubber cement, base and sides. Drill hole in pan just in front of the tank for fuel overflow drain.

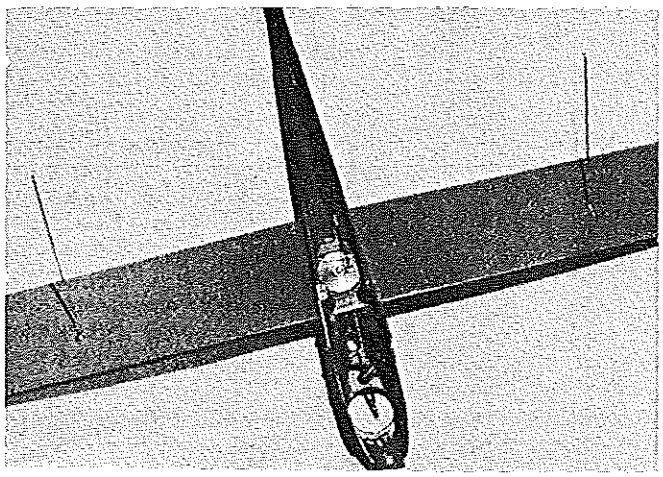
A vertical shut-off is used instead of a horizontal, because we find it faster and definitely works better for us. Drill and tap (2) 4-40 holes and mount the shut-off. To apply more tension, bend the wire where it mounts on the shut-off.

Mount engine and cut openings in fiberglass top (head opening, exhaust opening, engine mount opening, air intake, air outlet, shut-off opening, tank fill opening and clearance around stabilizer). Install bellcrank, pushrod, kwik-link and leadout wires; hook up the control system and make sure it works smoothly, then install the buttons.

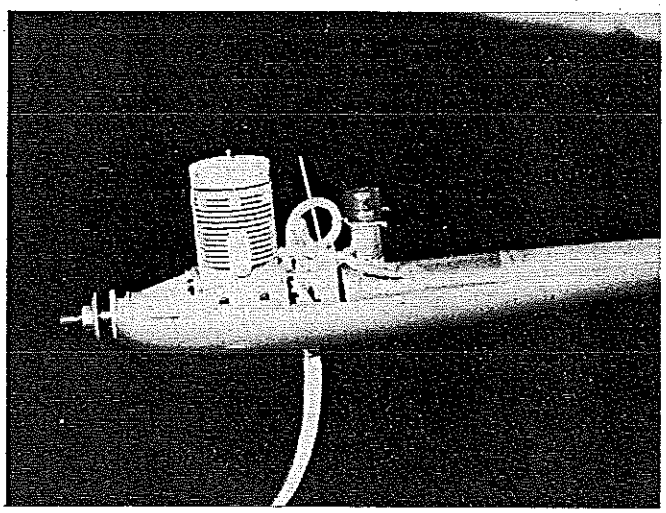
The buttons are made from brass and have been tested to 300 lbs.; so there isn't any danger in breaking. A lathe is necessary to make the buttons. If you do not have one, your local machine shop will make them for a small fee. Install buttons as you would eyelets, wrapping leadouts with copper wire and soldering. Install aluminum plate and work controls back and forth with elevator. Make certain there isn't any drag. The .018" control line ends



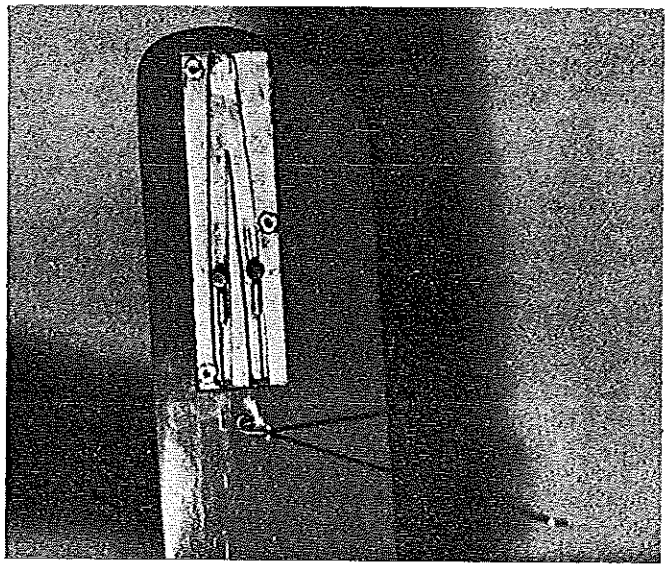
Ground plate attachment to hold-down bolt—note cut-off trip wire. Hot plate is located on other side of fuselage as shown on plans.



The brass button-type bellcrank is turned on a lathe, has been tested to 300 pounds. Round bellcrank stronger, smoother, more travel.



Method used for routing tubing through cut-off; excess tubing used to eliminate kinks. Fuel tank is 4-oz. Don's Rat extended to 5 in.



Internally connected lines realize about a 2 percent drag decrease compared to external leadouts. Yields speed increase of 3 to 4 mph.

are made up for buttons as found in general section in AMA Rule Book.

The shut-off trip wire is .018" braided wire with a small eyelet soldered on one end. Connect the other end to pushrod 1½" from bellcrank by wrapping with copper wire and soldering. Place eyelet over cut off wire and adjust to correct length by moving solder joint on pushrod back and forth. Fine adjustments in shut-off are made by turning kwik-link in or out.

Finish: Two coats of Hobbypoxy "Stuff" are applied to the basswood, sanding with 320-grit sandpaper between coats. Finish sanding entire plane with 360-grit sandpaper. Apply two or three coats of Hobbypoxy color of your choice to the entire plane and let dry. Wet sand with 500-grit sandpaper, rub out entire plane with compound, and wax. Install wing skids, mount hot plate and ground plate (location being convenient for your pitman).

Engine: HP 40 RRV is chosen because of its superior contest success, past and present. There are many factors involved in making this engine run; I will try to explain most of them.

Front End: The front end should spin freely. If there is any sign of drag, replace the bearings. I use Class 5 bearings, which are obtainable from most bearing supply stores. These bearings are hard to find at times, so stock or K&B bearings work just as well.

Timing: The intake and exhaust timings are stock. I have tried many variations with no improvement.

Liner and Ring: Remove liner by heating case to about 350-400 degrees. Grip one motor mount lug with pliers, tap outside top edge of case against soft wood and the liner will slide out. Be careful not to overheat and distort case or liner. The ideal way of obtaining a good ring is to take the liner to a hobby shop and, if the owner will allow you to try several rings in your liner, picking the best fit. If you have no way of doing this, buy two or three rings and pick the best. The first step in picking a good ring is to gently push ring together and check ends, making sure they are square. Second, take ring and insert into top of liner, using unringed piston to push ring down into liner. Hold liner up to bright light, look for any light between liner wall and ring. If you do not see any light the ring is round. Third, leave ring in liner, using a feeler gauge check for end gap: .002", .004" is acceptable.

Head: A double squishband high-compression head is good for about 1000 rpm over a stock head. George Aldrich makes a good head and will fit one to your engine for a small fee. We run .015" head clearance.

Piston: A good straight and square piston is hard to find. The problem with most is the wrist pin hole milled crooked. Check by measuring from top of piston to top of wrist pin hole; the measurement should not vary more than .001", .002".

Rod: The connecting rod should be matched to piston and stroke of crankshaft. This means when the engine is at bottom dead center, the top of the piston should be flush with bottom of exhaust port. Rods will vary in length up to .010".

Optional: Fluoropolymer metal impregnation, better known as Teflon impregnation, is the best thing that could have happened to an HP. Impreglon #218 is not a surface coating. Actual penetration of the surface occurs during the process. Penetration from .093", .125" is possible on aluminum; #218 provides superior protection and friction reduction characteristics for metal-to-metal frictional bearing surfaces. What it actually does for a HP is increase rpm from 300 to 1000 and improve engine

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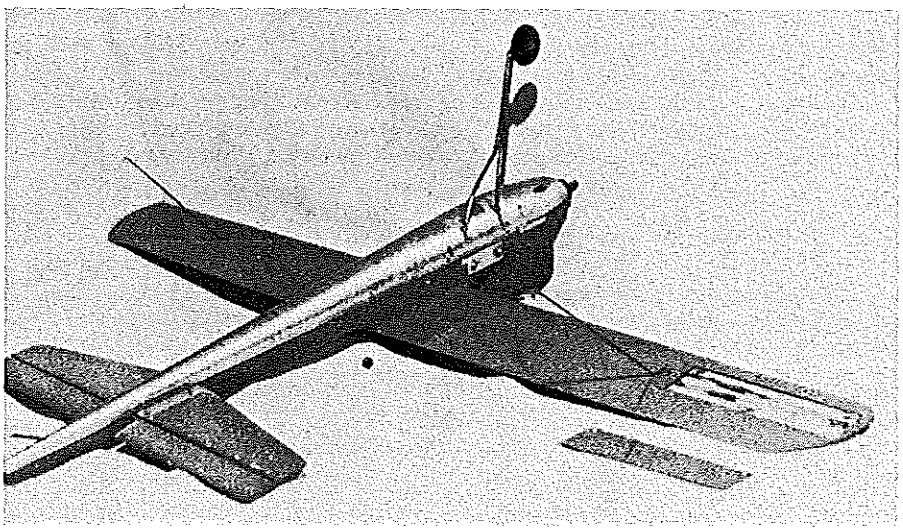
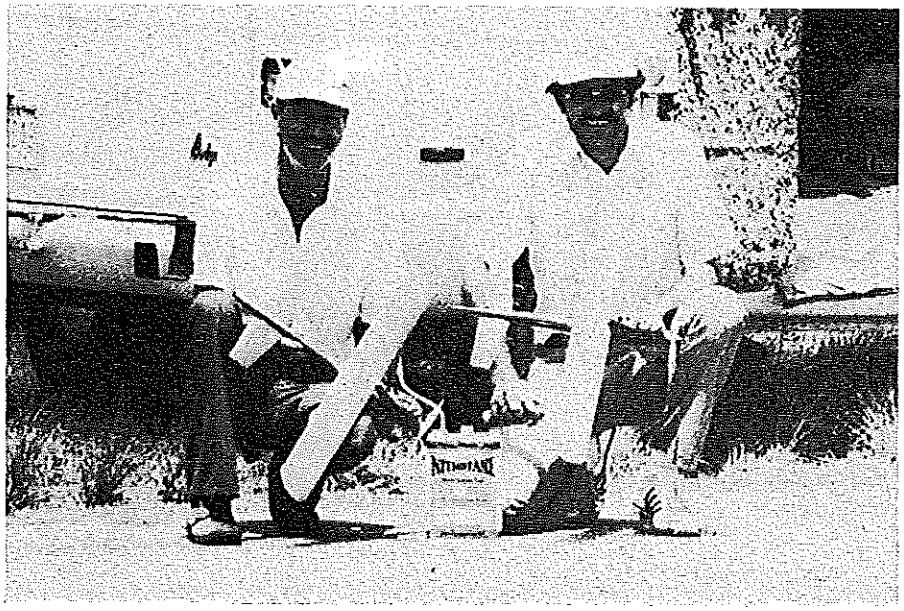
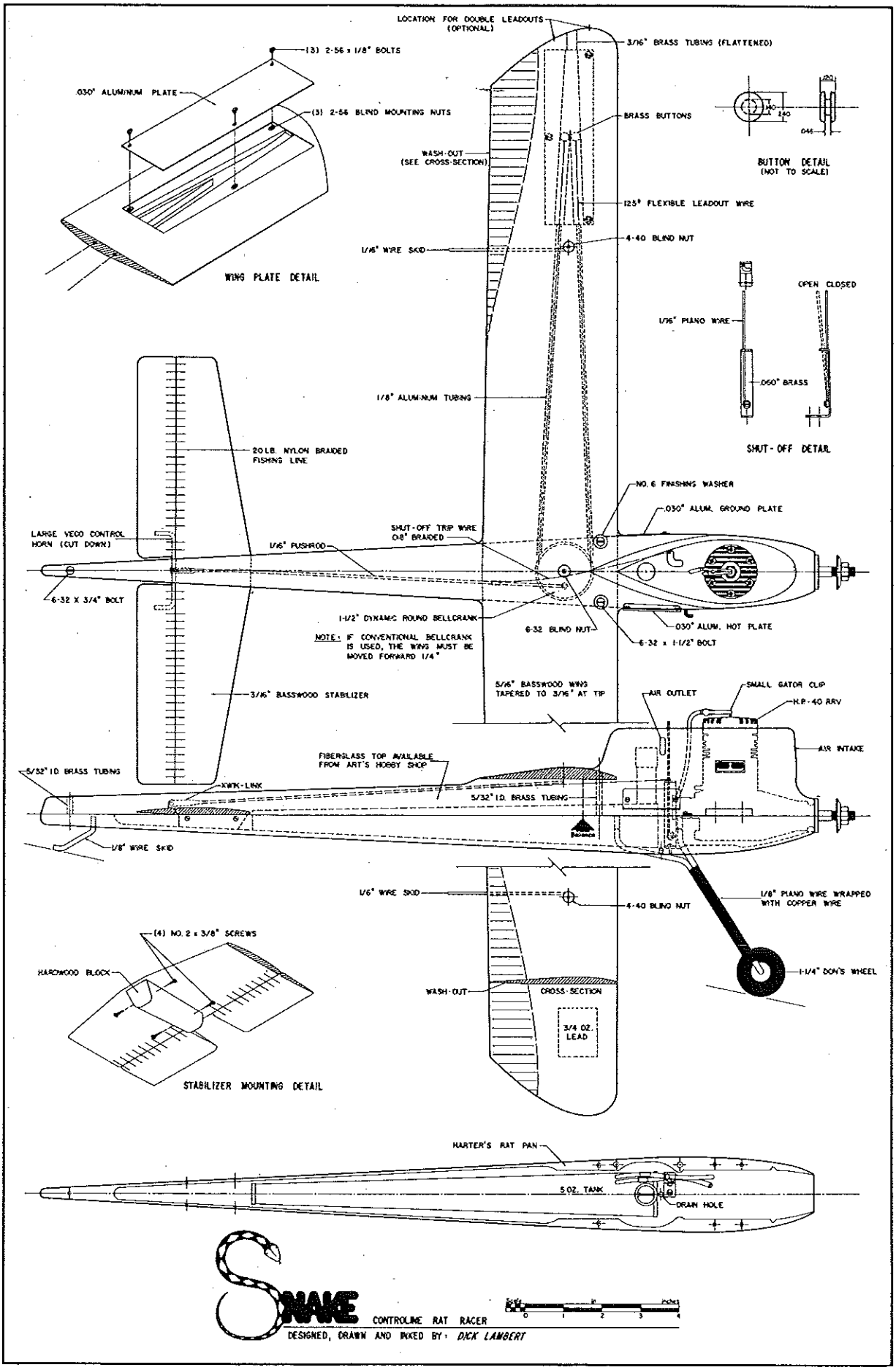
1st and 2nd place '75 Eagle-Beagle, Time 4:48
1st and 3rd place '75 Rebel Rally, Time 4:52
1st and 4th place '75 National, Time 4:35
1st and 3rd place '75 KOI, Time 4:34
1st and 3rd place '76 Eagle-Beagle, Time 4:46
1st and 2nd place '76 Southeastern Championships, Time 4:42
2nd place '76 Nationals, Time 4:44
1st place '76 District 5 Championships, Time 4:36



A Harters Rat pan is ground and shaped to fit the HP 40RRV. The single strut landing gear is exceptionally strong. Note landing gear wire skids attached to wing and leadout plate cover.



Harold Lambert, left, and Dick Lambert. Model has superior flight characteristics and speed.



FULL-SIZE PLANS AVAILABLE . . . . SEE PAGE 104

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nuts and secure with 4 × 40 Allen bolts. Now place cabin top in place and secure in normal manner. The cabin top can now be removed without disturbing the former 9 to make any needed adjustments. The radio receiver can be mounted in the area ahead of the aluminum bearing box, which eliminates the need for servo extensions.

Next month's column will cover the external needle-valve extension, glow-plug connectors, landing-gear improvements, and head modifications.

I have had a complaint about the way that I end my column. It is not intended to be a smart remark but rather a word of encouragement. I have yet to see a person fail to learn to fly when they put their mind to it. So as a word of encouragement, I say, "If you're not flying, it's because you are not trying hard enough."

Walt Schoonard, 2080 Sharon Rd., Winter Park, FL 32789.

Snake/Lambert

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life. My best HP has every moving part impregnated.

Assembly: Special care should be taken when installing ring. Do not distort or bend. Make sure boost and transfer ports in case and liner match. Always use new gaskets; and do not over tighten bolts.

Prop: Bartel 8 × 8 Tornado type is what we use, varying the pitch with each engine. A good rule of thumb is to use a stroke-prop relation; stock cranks will vary up to .010".

stroke .728"-.730", 6¾—7 pitch
stroke .732"-.734", 7¼—7½ pitch
stroke .735"-.737", 7½—8 pitch

Fuel: 55% nitro, 25% methanol, 15% MA 2270 and 5% castor oil is an ideal mixture. Good commercially available fuels are Nitrotane and Magnum.

Plugs: Fireball Cool (with seal epoxied), or Glo-bee.

Flying: On takeoff, slight down elevator and leading the plane should be applied. Caution should be taken as to wind direction—always takoff down wind or cross wind.

If you have any questions, please contact me. Address: 718 Boston Ave., South Daytona, FL 32019.

CL Racing/Lee

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Speed in kilometers/hour—3600/T
Speed in miles/hour —2237/T

"T, in the formula above, is the time in seconds to fly ten laps. The reason for using this as the speed is that it is the only one we can measure easily, and it is the only thing that really counts.

"Now that this person is assumed to be out there flying, let us perform some experiments to determine the relation between speed and technique.

"The easiest effects to understand are those that occur when the plane is flying a circular path—no "yo-yo" (e.g., pulling the arm in to suddenly reduce the flying circle radius), and no wind. If the pilot is leading or holding back on the airplane, he does so continually, not just for a fraction of a lap. The handle and the airplane will both move in a circle at a steady rate. In short, what is called "steady state operation" is established. Under these conditions there are two kinds of effects: those due to changed flying radius and those attributable to power added (subtracted) by leading (holding back) on the plane.

"For discussion purposes, say that the speed achieved when flown from an FAI pylon is the standard. Compared to flying from a speed pylon, if the plane is flown according to the new Team Race rules (center of rotation, handle, plane all in a line), the line length is effectively increased. Except for a tiny increase in line drag, the true air speed will not change. The speed (based on time per lap) goes down because the aircraft flies further than 100 meters per lap. If the pilot's hand moves in a one-foot (.3 meter) radius circle, for example, and the handle is between the airplane and the center of rotation, there is about a 2% decrease in timed speed (see Fig. 1 and Table I). If the pilot gets way "behind the plane" the lines pass over the left shoulder (center of rotation between the handle and plane) and the effect is reversed (see Fig. 2). Most of us thought this latter position is where Herb Stocton flies; Herb was probably just setting up for a pass.

"Note from Fig. 2 that shortening the radius means the pilot must lean toward the plane while he flies and the lines will come off his left shoulder. Increasing the radius just reverses things. Note that the net change is .86 seconds in the time to fly ten laps and neither pilot is "whipping."

"The discussion above illustrated apparent speed change by changing the flying radius without whipping. Before discussing the most general case, two more special cases will be discussed. These two cases will be maintaining the same flying radius (approximately), but changing speed by leading or lagging, one might call it the "pure whipping case." The first one, shown in Fig. 4, is the natural flying posture most beginners and sport fliers assume without being instructed. The pilot walks around in a circle with the lines perpendicular to his shoulders. In Fig. 3, the pilot walks backward as you might right after a pass in AMA competition (not *legally*; it's whipping!—W.R.L.) or, as some stunt fliers do, between maneuvers to get high maneuver entry speeds. By calculation for an example world-class racer, the speed lost is 5 mi./hr. in Fig. 4 and in Fig. 3 the speed gained is 6 mi./hr. The reason the gain is more than the loss is