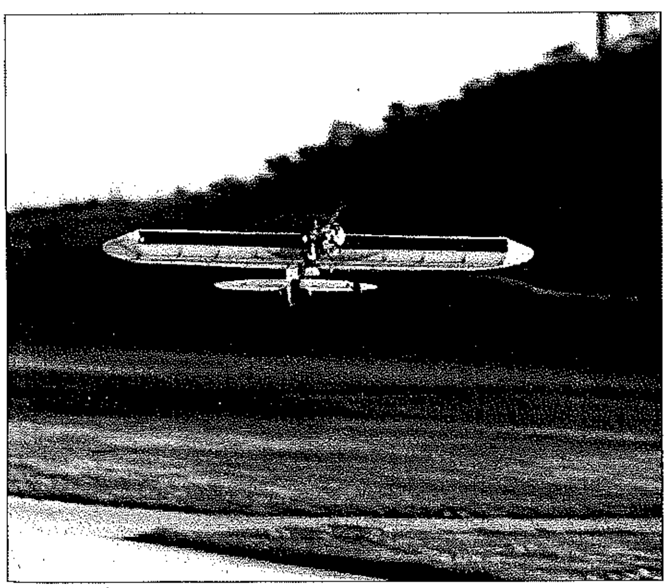
Neither confined areas nor weather extremes can faze this 15-size fun-fly design

by Joe Ball

Game

THE GAME TRACKER is a 15-size fun-fly airplane that has a wing loading of less than 7 ounces per square foot. It can be flown in a small space, handles wind well, and has unlimited performance. Its name comes from the arrow shaft I used on the first one.



On approach for a precision touch-and-go, it seems natural to keep the model in close and will sharpen your flying skills!

A carbon-fiber (CF) arrow shaft and 20-pound-test Dacron fly-line backing are the only unconventional materials you will need to build this airplane. I obtained several range-damaged arrow shafts from the local archery shop, all of which were broken within an inch or two of the tips.

The Game Tracker Carbon Express 400 and the Beman ISC 400 shafts work well. The number refers to the shaft's wall thickness. A 300 would be okay if you planned to use a .10-size engine, but you should use a 400 shaft with a .15 engine. Do not use a fiberglass fishing arrow or a kite spar; they are too heavy. A 5⁄16-inch-diameter CF arrow shaft cut to length will weigh approximately 18 grams.

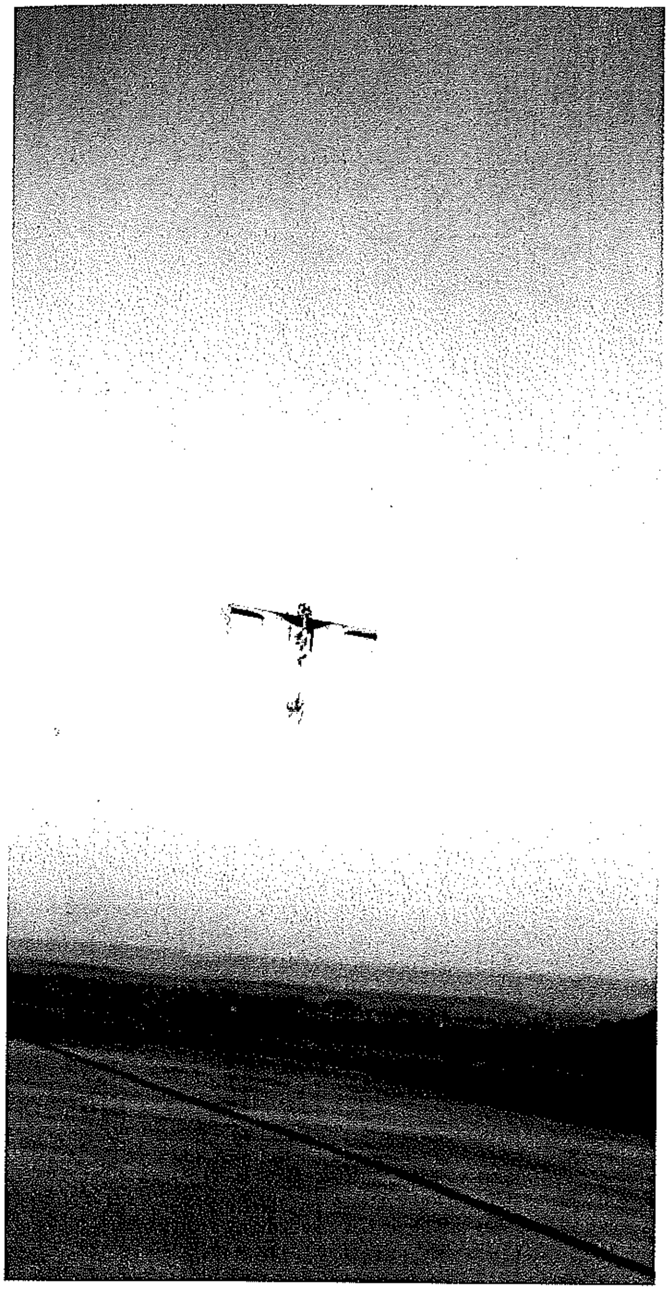
You can purchase Dacron fly-line backing at any store that carries fishing supplies. Do not use monofilament line because it tends to stretch. Do not use Kevlar line either; it tends to fray. The Dacron line works the best and doesn't fray.

The Game Tracker was built around the O.S. .15 FP engine and the fairly inexpensive microservos that are available these days. You will need five microservos; a submicroservo would be best for the throttle. The flight surfaces need something with 20-30 inch-ounce of torque, such as Hobbico's CS-12.

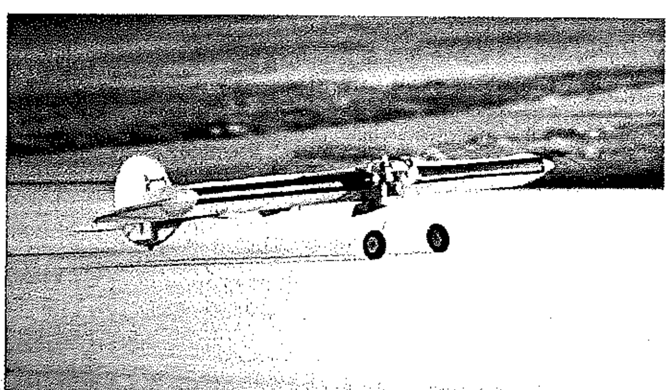
O.S. has replaced its FP engines with the LA line. The specifications are the same, and I have found that performance is too. My .15 FP turns an 8 x 4 APC propeller consistently near 14,500 rpm on 15% sport fuel and idles reliably at just less than 3,000 rpm. I have opened the baffle in the muffler and ground down the sharp edge at the tail-cone outlet. The engine weighs 6.25 ounces.

An FP or LA .10 would be good for a park flyer; it would be lighter and quieter, and still perform well. A .20 would be too heavy. Many of the hot ball-bearing-equipped .15 engines are high-strung and like to stay wound up at high rpm. Choose your engine based on idle quality and throttle response.

Photos by Bill Heinson, Debbie Munden, and the author



Vertical takeoffs and hovers are routine fare for this model. If you are really into hovering, you may want to add an inch to the boom length.



Ground handling is important in fun-fly events, and this design exhibits stable and predictable on-the-wheels habits.

This Game Tracker weighs 23 ounces with a standard receiver and a 270 mAh battery pack. The wingtips greatly improve the airplane's handling, especially in the wind, and the rudder and subfin keep control positive at slow speeds.

I use exponential on all flight-surface controls and approximately 50% flaperon. The model will loop and roll at dead-slow speeds or punch out more than 25 loops in 30 seconds. It can be hand launched vertically and flies circles around most Fazers and Uproars. It also fits into the car much better than the bigger one-piece airplanes.

You will have no problem making the target weight if you use light wood and only the materials and hardware specified. With a .10 engine and a light receiver, you could get extremely close to 20 ounces.

This design is the result of four prototypes, a few hundred flights, and considerable tinkering. All you have to do is build it as shown, and you will find that there is a new benchmark for small-airplane performance.

Game Tracker

Type: RC fun-fly

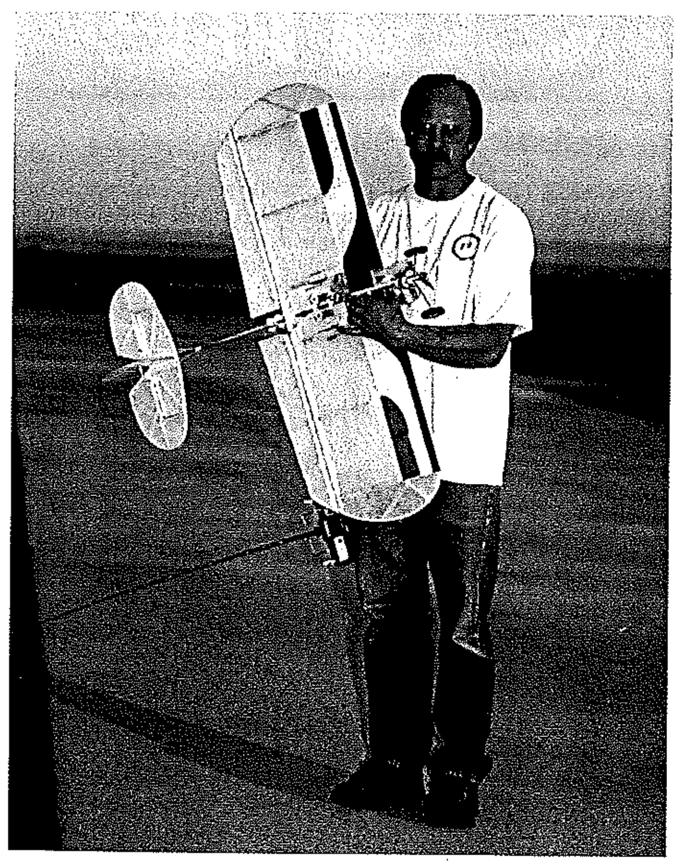
Wingspan: 40 inches

Engine: .10-.15 glow

Flying weight: 20-26 ounces

Construction: Balsa and plywood

Covering: Micafilm



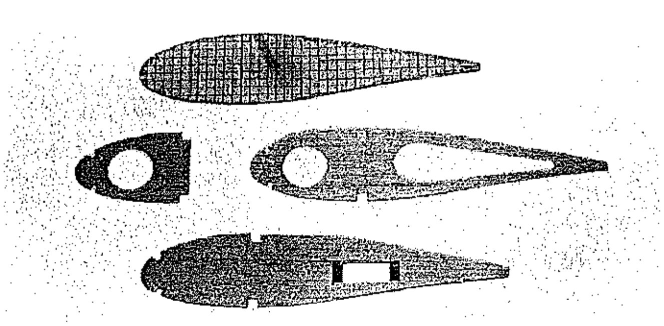
The author gives us a planform look at the latest version. It has a spartan appearance but is a tiger in the air.

Game Tracker Materials List

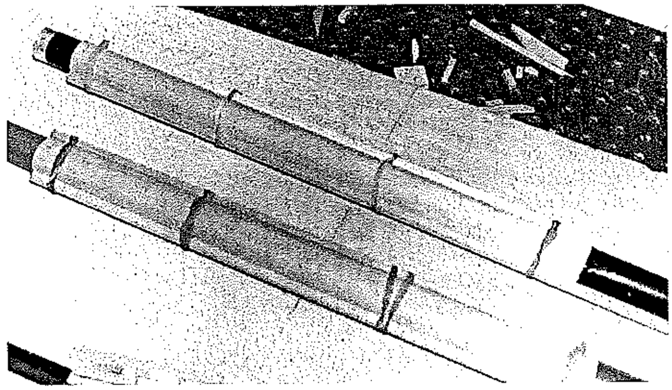
Materials Used	Quantity
1/16 x 3 x 36-inch sheet balsa, light grain	5
1/8 x 3 x 36-inch sheet balsa, light grain	1
1/4 square x 36-inch balsa sticks, light with straight grain	3
1/4 x 36-inch balsa triangle stock, light grain	2
3/16 square x 36-inch balsa sticks, firm grain	4
1/4 square x 36-inch spruce stick	1
1/8-inch birch dowel	1
1/32, 1/16, 1/8 aircraft plywood	1 each
3/32- and .047-inch music wire	1 each
Dave Brown Products 2-inch-diameter Lectra Lite wheels	2
1/2-inch Sullivan Products tail wheel	1
3/32-inch Du-Bro wheel collars	2
#2 x 1/2-inch Allen sheet-metal screws, washers	10 each
4-40 x 1/2-inch bolts, lock washers, blind nuts	4 each
2-56 threaded coupler, snap link	1 each
Covering material—clear Micafilm	1 roll
Sullivan 2-ounce flex oval fuel tank	1
Nylon tie	1

Additional Items Needed

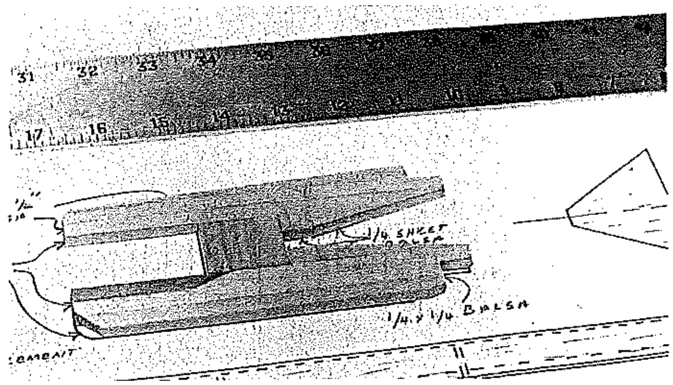
- Medium silicone fuel line
- 1/2-inch-wide fiberglass tape
- Cyanoacrylate EZ hinges
- Five microservos—20-30 inch-ounce of torque (four microservos, one submicroservos were used)
- Four-cell 270 mAh Ni-Cd battery pack
- Engine .10-.15 (O.S. .15 FP with APC 8 x 4 propeller used)
- CF 5/16-inch-diameter, 23½-inch-long arrow shaft—300-400
- 20-pound-test Dacron fly-line backing
- Plastic guides—sections of inner Nyrod work well
- Velcro
- Small amount of 1/4, 3/16 balsa sheet
- Aileron extension, connector lock
- Thin, medium, thick cyanoacrylate
- Elmer's white glue
- Blister pack
- Radio (Futaba Super 7, standard seven-channel receiver used)



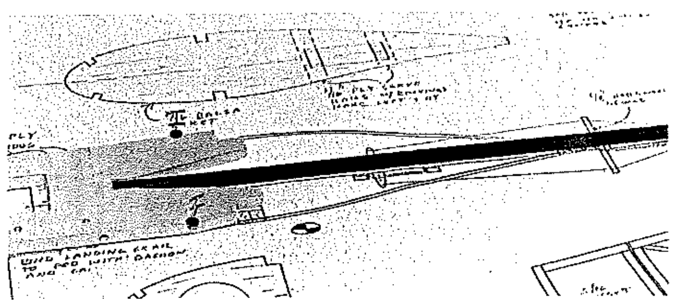
The airfoil on the ribs and subribs is not symmetrical. Mark the tops, and make a left and a right servo rib.



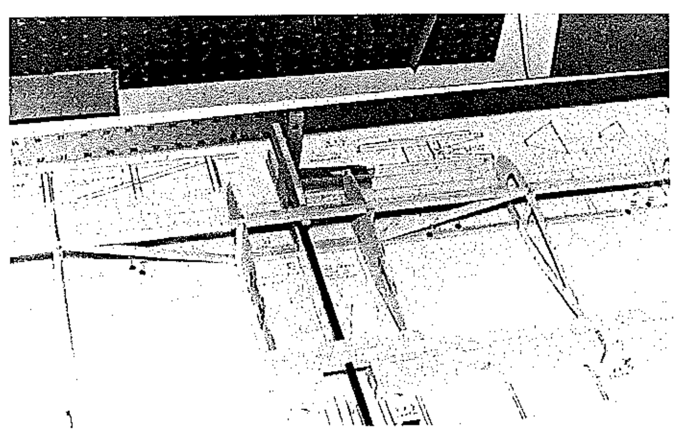
The rolled LE is lighter and easier than building one up. Molding balsa is a useful skill in building models.



The engine pod builds up from balsa, with spruce engine and landing-gear-mount beams—a light but robust unit.



Tack the boom in place over plans to assure alignment. Close pocket in with 3/4-inch square patch of 1/32 plywood on each side.

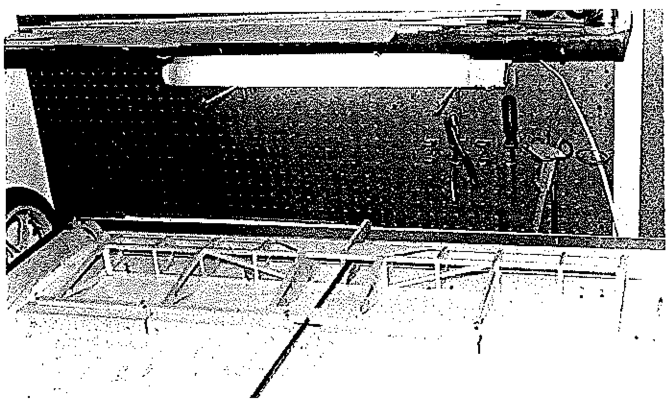


The pod-and-boom installation. This is a bottom view of the assembly because the model is built upside-down over the plans.

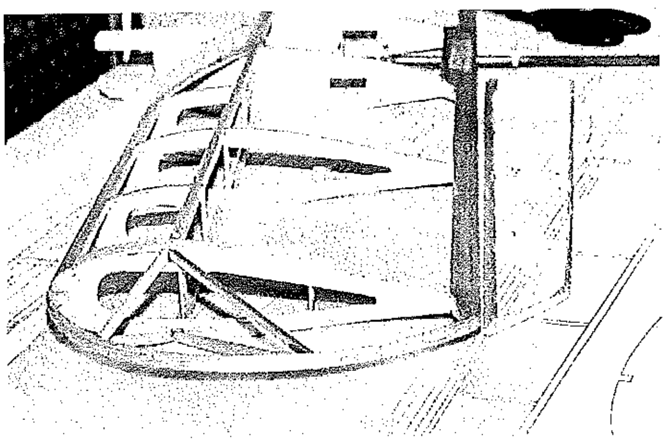
It is best to have the engine and servos on hand at the start of construction because they need to be fitted early in the process. The 3/16 square stock used in the tail and aileron TE should be medium or firm balsa, and the rest of the balsa should be light or contest grade.

CONSTRUCTION

Wing: Make a rib template, mark the main and subspar locations on it, cut six ribs from 1/16 sheet balsa, and cut four subribs. Pin these together into a stack, and lightly sand it uniform with a sanding block. Use the template to mark the spar locations, cut the main and subspar notches, then *mark the top of the stack with a felt-tip pen.*



At this point in assembly, the Game Tracker is ready to be turned over so that the top can be completed.



Servo rails and guides are installed. Note the gussets where the pod attaches to the spars, fuel-tank cutout, and spacer.

Separate two ribs from the stack and set them aside. Cut the lightening holes in the remaining ribs and subribs, but leave the area between the main spars intact. This makes the parts easier to handle. This section will be removed later in the building sequence. Set up the other two ribs for the servos you will use. Do not try to glue or tape down the servos; they all work hard in this airplane and need to be secured with screws.

Be sure to make a left and a right servo rib. Cut the servo openings in the ribs and make 3/8-inch-wide servo rails from 1/16 plywood. Glue these in place as shown. Add a small patch of 1/16 plywood to the back of each rail where the screw will go through, and drill the mounts for the servos.

It is easiest to cut all the strip material at the same time in 36-inch lengths. From 1/16 sheet, cut one 2-inch-wide strip, five 1/2-inch-wide strips, and five 1/4-inch-wide strips. For the laminates, cut an additional three strips 3/8-inch wide and six 3/16-inch wide. From 1/8 sheet, cut two 3/8-inch-wide strips, two 1/4-inch-wide strips, two 3/16-inch-wide strips, and two 1/8-inch-wide strips. Be sure to use light wood.

Cut the 2-inch LE strip in half and soak the pieces in water, and then form them around a roll of covering material, using rubber bands and sticks to hold them while they dry, as shown. Make the forms for the laminates. Almost anything will work, including foam board and craft board. I used two layers of cardboard on the model featured here.

Cover the edges of the forms with waxed paper so the part won't stick to the form. Soak the wood for the laminates in water and use rubber bands to hold the wood to the form. It helps to make the wood limber by pulling it around something before laying it on the form; an aerosol spray-paint can works well.

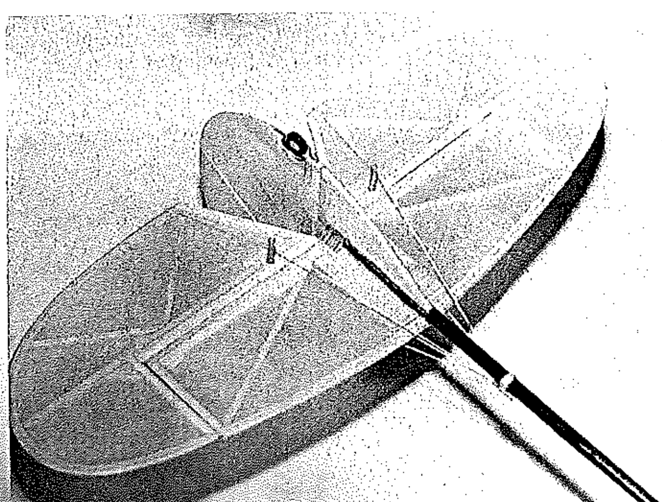
Thin some white glue, mix it 50/50 with water, pull the first strip around the form, and hold it in place with rubber bands. Paint the strip with the thinned glue. Repeat this process with the second layer, and then put on the third layer. Be certain to wipe off any excess glue.

The tailpieces will use full lengths. Cut the 3/8-inch wingtip strips in half. You can make two wingtip forms at one time or do them separately. Allow these pieces to dry. Remove them from the forms and dress them flat with a sanding block. The wingtips can be sanded to a radius at this time, but do not radius the tailpieces until after they are built up.

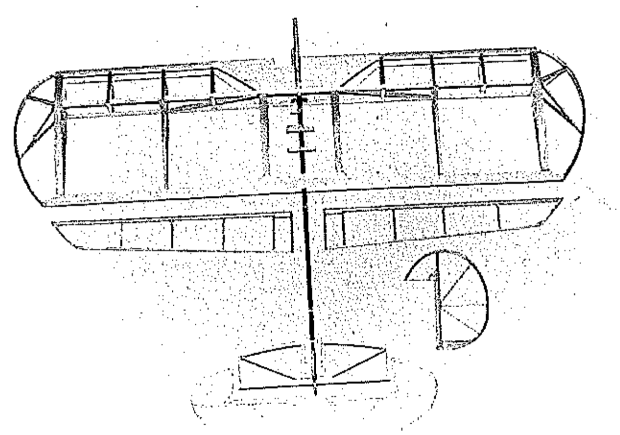
Cut the balsa and hardwood pieces for the engine pod. The engine-mount beams are left long to aid in balancing. If you will use a .10-size engine, lengthen the mount beams an additional 1/2 inch. The vertical-grain piece sets the engine-mount-beam spacing. Cut this to fit the engine used, and adjust the lower mount-beam position as necessary.

Build up the pod over the plans, and make sure the boom pocket is on center. Lay a rib over the pod, and make certain that the spar notches line up with both parts on center. The notches in the pod will be 1/4-inch farther forward to clear the doublers in the center of the main spars. Lift the pod from the plans and block-sand both sides smooth.

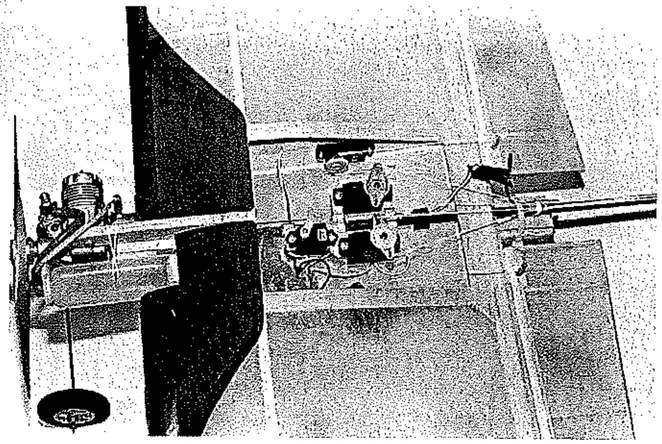
Trace the pod's outline onto 1/32 plywood. Cut out two pieces, and glue one to each side of the pod. Sand the edges smooth. Drill a 3/16-inch hole 1-inch deep into the bottom of the pod. Carve a shallow



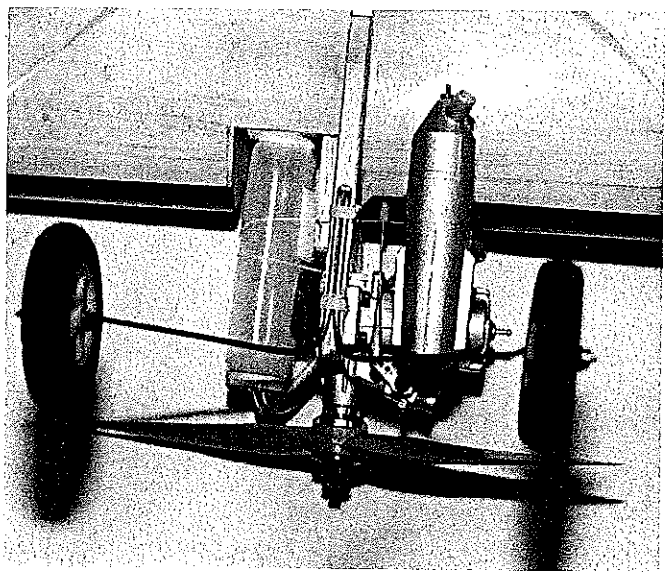
Rigging is fairly simple once you get the hang of it. Make sure that the tail wheel is in line with the rudder.



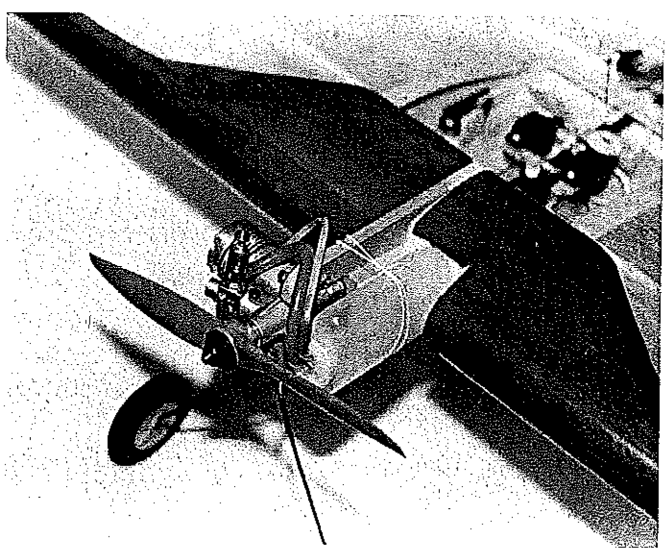
A look at the finished components, ready for covering. You can tell that this will be a lightweight model!



A standard receiver fits easily. Make sure elevator and rudder servos are far enough apart. Note that the antenna runs through the wing.



The radius at the front of the landing gear is far less prone to snap than a sharp bend. Tall, thin wheels taxi best in the grass.



Set the engine back as far as is practical, and then adjust the battery's placement for final balance.

groove forward of this hole to set the landing gear in, and then drill the two ⅛-inch holes for binding the landing gear on, as shown on the plans. Do not drill for engine-mounting yet.

Cut the arrow shaft to 23½ inches, and sand, with coarse paper, the end that will go into the pod. Set up the pod and boom over the side view, and make sure the boom and pocket are on center, the spar notches line up with the ribs you have made, and the engine-mount beams are at 0° incidence.

Tack-glue the boom into the pocket, remove from the plans, and close the pocket in with a small patch of 1/32 plywood on each side. Finish the joint with a few extra drops of thick cyanoacrylate glue.

The wing is ready to be framed up. You will build it upside down over the plans, but you will turn it over once you're in the process, so follow the steps closely.

Set a ¼-inch square balsa spar over the plans, add the ¼-inch square center-section doubler, and hold it in place with pins. Use a rib as a guide to set blocks or a spacer to hold the TE 1 inch off of the board. Secure these so they won't move around.

Lay a ½-inch-wide TE strip over the plans, and mark the rib locations and centerline on the strip. Remember that the TE extends 1 inch outboard of the ribs on each side. Set the TE strip up on the spacer. Use a small square to center it over the plans, use a rib to set it ⅛ inch past the end of the rib, and secure it in place with pins.

Place the ribs on the spar *upside down,* and use a small square to stand them up straight. Align the tip with the mark on the TE strip. Make sure the strip extends ⅛ inch past the tip of the rib, and tack-glue the ribs in place. Check to make sure that the center ribs will position the servos into the center compartment and that all six ribs are upside-down.

Add the top spar and its doubler. Make certain that the ribs remain square as you do this. Tack the spar in place.

Set the ⅛ x ¼-inch TE spar on the TE strip. It should extend 1 inch past the ribs, along with the strip. Glue the spar to the strip and to the ribs. Add the TE doubler, and finish the TE with another ½-inch-wide strip.

Cut two diagonal trusses from ¼ square balsa. Glue them in place as shown in the spar cutaway detail on the plans. Make sure the ribs stay square as you do this.

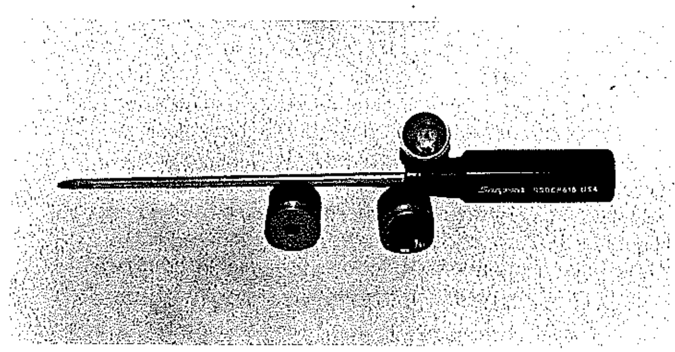
Cut a 5/16-inch-diameter hole in the TE for the boom to pass through. Use a sharpened piece of brass tubing for this, and start from the inside. Turn the tubing by hand. Take your time and cut a smooth, clean hole, making sure that it is on center.

Lightly sand the boom at the TE and servo-rail locations. Install the pod-and-boom assembly. Be sure it is *upside-down* and square with the wing and plans. Glue the pod in place, and then add a gusset to each side at both spars. Wick a few drops of thin cyanoacrylate into the TE joint from both sides.

Install the subribs and the ⅛-inch square subspars. Again, be sure the subribs are upside-down. Butt-glue the subspars to the pod, and use a small square to align the subribs.

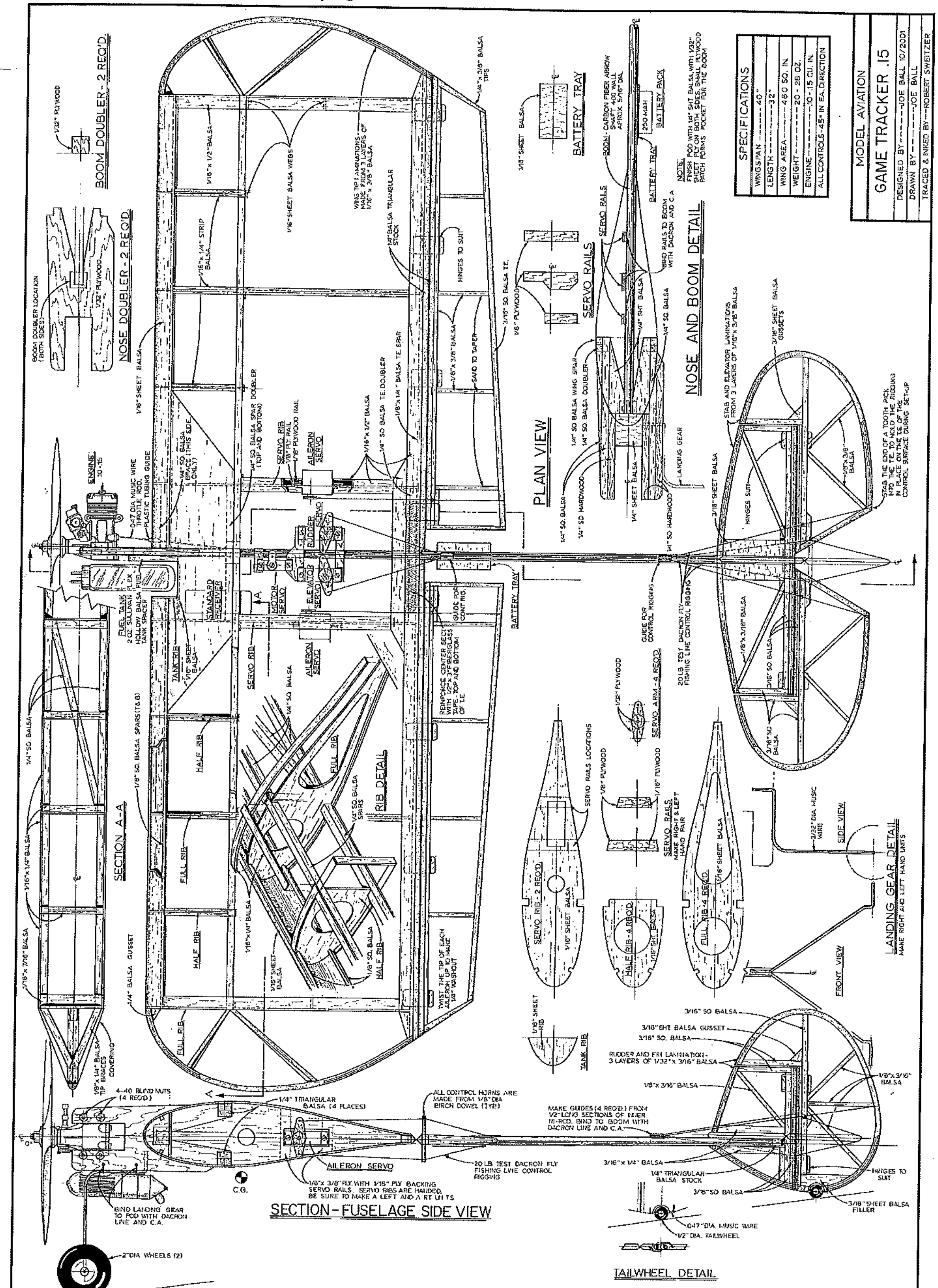
Add the shear webs to the spar as shown in the spar cutaway. Before placing each shear web, finish lightening the ribs and subribs by slicing along the grain to remove the area between the spars, and then glue the shear web in place. Fit the LE sheeting, make a good fit against the pod, and then add the capstrips, spar furring, and center-section sheeting.

Remove the wing from the plans. Place some ¼-inch shims on the plans along the spar, and then place the wing over the plans right side up. Once the wing is set, glue a piece of ¼ square balsa in the LE on the right side between the pod and the first subrib. On the left side, glue a 1/16-inch strip in for the fuel-tank cutout. Add the capstrips, furring, and



The baffle in the O.S. before and after opening it. The tail cone has a sharp edge at the outlet; radius it off with a small ball-shaped bit.

Full-Size Plans Available—see page 207



center-section sheeting. Add the vertical brace to the aft section of the tip ribs.

Trim and sand the spars and LE square with the tip ribs. Leave the TE; it should extend 1 inch past the rib and will support the wingtips. Trim the wingtip laminates to fit, and compare them to each other for symmetry. Tack the wingtips in place; they should be level with the wing and on the centerline. Glue in the 1/8 x 1/2-inch braces and the gussets at the LE.

Finish the wing by capping the TE with 1/4-inch triangle stock and making the cutout for the fuel tank. Box this in with 1/16 sheet. If you have made good joints, the wing shouldn't need much sanding. Clean up any rough spots with a sanding block.

Use a straight pin to perforate the area to be fiberglassed where the boom passes through the TE. Stick the pin through the sheeting into the spar so the glue can nail into the spar. Cyanoacrylate-glue a 1/2 x 3-inch strip of fiberglass cloth where shown on the top and bottom of the TE.

Set up the 1/8 x 3/8-inch LE and 3/16-inch square TE up over the aileron details. Fit the ribs and control-horn doubler. Match the tip to the wing contour, and then cap the LE with 1/4-inch triangle stock. Block-sand smooth and radius the TE.

Control Surfaces: Build the elevator and rudder in the same manner. Secure the elevator laminate over the plans, and build up the stabilizer and elevator together. Block-sand smooth and radius the edges.

Cut the elevators from the stabilizer, and sand a bevel into both sides of the hinge joint. All of the control surfaces must move at least 45% in each direction for good control at low speeds.

Cut the servo rails from 1/8 plywood, and tack them to the boom as shown. Make sure they are level, square, and spaced for the servos used. The servos must install far enough apart for the tiller arms to clear each other. Bind the rails to the boom with Dacron, set the bindings with cyanoacrylate glue, and drill for the servos.

Attach the stabilizer to the boom, and square it with the wing. Place a 3/8-inch section of 1/4-inch triangle stock as shown at the TE, and then wrap the bottom with a 3/8 x 3-inch section of fiberglass cloth and secure with cyanoacrylate. Install the fin and subfin.

Cut four 1/2-inch sections of inner plastic control rod, smooth the inside edges of both ends carefully so that there are no burrs, and bind two front and rear guides to the boom where shown. Secure them with cyanoacrylate. Check the fit of all control surfaces.

This finished airframe weighed 5.5 ounces bare, ready to cover.

Covering: Cover the airframe with something light. Clear Micafilm weighs 19 grams per square yard, and so far I have found nothing lighter. It is substantially tougher than all of the plastic films I have tested.

Micafilm is slightly harder to work with than plastic films because you must apply the adhesive. Don't be heavy-handed with the Balsarite; the material will attach to a light coat.

Best results come from covering the open structures with Micafilm and using transparent MonoKote for the sheeted areas and trimming.

The airframe weighed 6.75 ounces at this point.

Final Assembly: Mount the tail wheel in the rudder. This is not an easy bend to make. Use .047-inch music wire. It helps to take the tire off of the wheel while making the bends.

Cut some EZ hinges in half the long way. Each control horn should pass through a hinge; use two on each elevator half, three on the rudder, and four on each aileron. Make sure all surfaces have adequate travel, and then seal all hinge lines. Washout the tip of each aileron, twist the outboard tip up 1/4 inch, and reheat the covering to set the washout.

The pull-pull control system handles the big surfaces without heavy rods and arms. Mount all servos. Allen-head screws work best on the aileron servos, and you can use a ball driver to install them.

Make tiller arms from 1/32 plywood, and make sure the holes have smooth edges. The outside holes should be 1 1/4 inches apart. Glue these to the bottom of the servo disks.

Power up the radio set, zero all trims, and check the direction of travel and make sure all travel volumes are 100%. Install the aileron servo arms at 90° to the datum line. The elevator and rudder arms angle in toward each other a bit to keep the geometry right.

Make the control horns from 1/8 birch

dowel. Cut across each end halfway through with a razor saw for the control lines to set in. The cuts should be 1½ inches apart. Cut ⅛-inch holes for these with a sharpened piece of brass tubing.

Install the horns, and make sure the cuts in the dowel are centered and aligned properly and that the dowels are perpendicular to the surface to prevent unwanted differential. Glue these in place with cyanoacrylate.

Start the rigging with the ailerons. Cut two slots in the bottom of the center-section covering for the lower aileron control lines. Tie a section of Dacron to the lower end of the tiller. Make all knots ½ inch away from the end so the line can move freely as the tiller rotates, and be certain to tie these knots tightly.

Bring the line through the slot, around the aileron, and tie it loosely to the tiller. Do not glue the line to the control horn or surface yet. Adjust the knot to get the tension right. The lines should just have slight tension on them—not too tight.

After setting the tension for both ailerons, turn on the radio, center both ailerons on the boom, and, when satisfied, glue the line to the horns and TE. Glue the line aft of the horn with a drop of thick cyanoacrylate so it won't wick up the line.

Rig the tail in the same manner. Set the tension and turn on the radio. Center the surfaces, and then glue. Use a separate line for each elevator half, making certain that the elevator halves are on line with each other before gluing. Glue all of the knots.

You can leave some extra line off of the knots and make a short trim flight before gluing them. This will let you make adjustments. This won't be necessary if you have subtrims. Be careful not to glue the line to the tiller arm; the line should move freely on the tiller.

Make the landing gear from 3/32-inch music wire. The 1-inch radius at the front of the gear holds up much better than a sharper bend. Use light wheels.

Bind the gear to the bottom of the pod with Dacron and cyanoacrylate. Mount a ½-inch guide made from plastic tubing in the LE for the throttle rod.

Set up the fuel tank. Sullivan's 2-ounce-capacity oval flex tank is light and allows a longer clunk line than most. Use the supplied plastic tubing. It can be formed with a bit of heat and is lighter than brass and silicon tubing.

Arrange the engine, tank, battery, and receiver on the airplane to set the final balance. Wrap the receiver in blister pack and place it in the LE left of the pod. Determine the engine location and drill for mounting. Try to set it so that the model balances with the battery pack located between the ailerons. Trim off any extra mount beam, and seal the pod with thin cyanoacrylate.

Set four 4-40 blind nuts, mount the engine, set up the throttle linkage, and install the muffler and propeller. Mount the fuel tank with hook-and-loop fastener. Tie a couple loops of Dacron around the tank to hold it in place.

Locate the battery to achieve final balance, starting ½ inch behind the spar. Seal the mount plate with cyanoacrylate and glue it to the bottom of the boom. Mount the battery with hook-and-loop fastener, and secure it with a nylon tie. Be careful not to trap any control lines with the tie.

To save weight, no switch is used. Plug the battery into an extension, and use an Ernst connector lock to secure the connection. I have been leaving the equipment bay open on top. This doesn't seem to affect it in flight, and the LE makes a good grip with which to handle the airplane.

Flying: All control surfaces should move 40-45% in each direction. I use 60% exponential on the ailerons and 50% on the elevator and rudder, with 50% flaperon mixed to the elevator.

The Game Tracker taxies well and lifts off