LOCKHEED P-38 LIGHTNING

By Gordon E. Whitehead

The P-38 must have inspired more daydreams and fired more aeromodelling imaginations than almost any other twin engined aeroplane. The ship has been on my hit list for 30 years, and you've no idea how much pleasure it gives me to present here in RCM a really practical small scale model of the aptly named Lightning.

There are two features of the real P-38 which indicate its potential as a good R/C sport scale model. First, it is a well-known fact that many P-38s returned home from missions with one engine stopped, sometimes having flown hundreds of miles in this condition. Some pilots even managed to outfly the opposition whilst only on one engine. Therefore, the Lightning's single engined behaviour must have been pretty good.

Secondly, there are many photos shown in the various books written about the Lightning which depict successfully belly-landed machines, surely an indication of the design's stability in a wheels-up landing. This quality enables us to do away with the landing gear to save weight and drag, and to go for a hand launched model.

Of course, what really makes the ship a **must** for R/C enthusiasts is the large variety of brilliant colour schemes available to adorn its wickedly irresistible and

LOCKHEED P-38 LIGHTNING

Designed By:
Gordon E. Whitehead

TYPE AIRCRAFT
Fun Scale

WINGSPAN
52 Inches

WING CHORD
Root: 9⅞" — Tip 3½"

TOTAL WING AREA
325 Sq. In.

WING LOCATION
Shoulder on Booms

AIRFOIL
Eppler 205 Mod

WING PLANFORM
Double Tapered

DIHEDRAL EACH TIP
2¼ Inches

O.A. FUSELAGE LENGTH
38 Inches

RADIO COMPARTMENT SIZE
Distributed

STABILIZER SPAN
21¾ Inches

STABILIZER CHORD (incl. elev.)
4 Inches

STABILIZER AREA
80 Sq. In.

STAB AIRFOIL SECTION
Symmetrical

STABILIZER LOCATION
Between Booms

VERTICAL FIN HEIGHT
7 Inches

VERTICAL FIN WIDTH (incl. rud.)
4½ Inches

REC. ENGINE SIZE
(2) .15s

FUEL TANK SIZE
(2) 4 Oz.

LANDING GEAR
With or without
Tricycle Gear

REC. NO. OF CHANNELS
4

CONTROL FUNCTIONS
Rud., Elev., Throt., Ail.

BASIC MATERIALS USED IN CONSTRUCTION

Fuselage ..... Balsa & Ply
Wing ..... Balsa & Spruce
Empennage ..... Balsa & Ply
Wt. Ready To Fly ..... 4½ Lbs. (72 Oz.)
Wing Loading ..... 32 Oz./Sq. Ft.

unconventional configuration. There is a whole raft of references available on the Lightning, and I've listed the ones I've seen at the end of this article.

I must confess that my model had a rather turbulent start to its career, and I hand launched it into the ground three times before applying a common sense modification in the form of little finger grips on the cockpit nacelle. These accidents showed that the model was repairable and, at the same time, highlighted a potentially hazardous flight characteristic, caused by the quite generous dihedral angle on the Lightning; I'll explain this fully later. Two of the prangs cracked a boom. The third broke the wing and both booms. This model hates cartwheels!

To aid those who are not confident with hand launches, I've shown a suggested fixed landing gear on the plan.

It is worth commenting here that I never photograph a model intended for publication in its finished state until after it's been properly test flown and had all the bugs ironed out. I'm not interested in pictures of unsuccessful models. That way, you get what you see, and I get the material for the flying section of my plan features. What you see here is a thrice repaired P-38 which has had over 50 flights, and which won a scale competition on its first public outing, beating off six or eight other models, including a pair of well-built large scale ships.

The lessons I've learned from this P-38 will be passed on to you in the flying section. So, let's proceed with the construction.

Build a pocket sized version of Lockheed's charismatic fighter, and celebrate 50 years of exciting twins.

CONSTRUCTION

Wing:

The sequence of wing assembly is illustrated on the plan, and is a little unusual in that the lower spar is added **after** the ribs have been glued to the lower skin.

Make up the lower and upper wing skins. Do not cut out the LE and TE recesses for the booms yet. Mark the rib positions and aileron hinge line on the lower skins. Now add the 1/8" sheet false LE, all the ribs, and the lower spar in the order shown on the plans. The spar doublers are glued to the spars before insertion into the ribs. Next add the aileron hinge spar and the aileron LE, and the LE and TE reinforcement between W4 and W5. Also add the skin doublers between W1 and W2, and between W4 and W5, using white glue such as Pic "rigid white" glue.

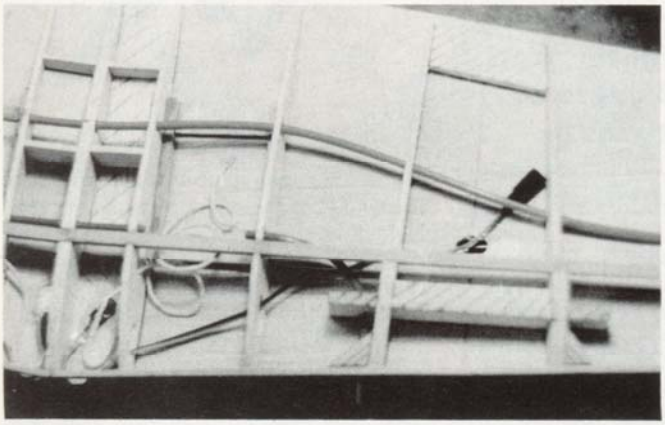
At this stage, you should glue the wing halves together.

Decide where the throttle and aileron servos will fit when they're servo-taped to the upper wing skins, and arrange the two sets of Ny-Rods®

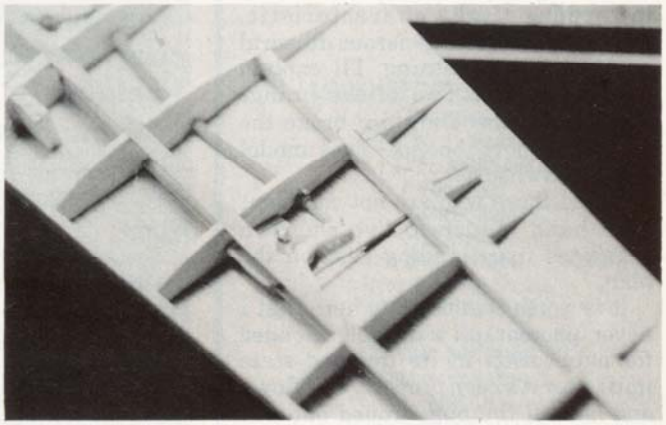
to exit at the correct heights within the ribs. Note that for the throttle linkage, one Ny-Rod® will be near the top skin and one near the bottom, as the inners need connecting to opposite ends of the servo arm. The aileron Ny-Rods® will both be located near, say, the upper skin, since both inners need to be connected to the same end of the servo arm. Draw the position of the servo hatches on the undersurface of the wing, but don't cut them out until after covering the wing. (The corners can be defined initially by pushing a pin through from inside the wing.)

Pre-bend the throttle cable outer, using a heat gun to assist the process. Slide some scrap inner up the tube to prevent the outer collapsing under the heat treatment. Then install the throttle cable outers. Make up and install the aileron Ny-Rods® and bellcrank linkage. Fit the aileron horn dry to check the exit pushrod length. Then remove the horns from the ailerons and the clevises from the ferrules, and tuck the outer linkage up inside the wing, making sure that you can tug it out again using a hook on the end of a piece of thin gauge wire.

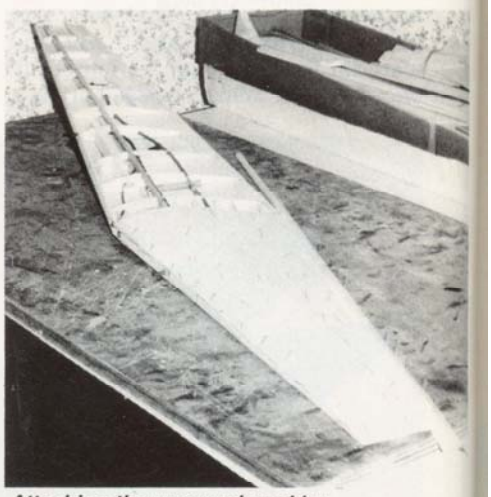
Mark with a pin, and draw on the wing undersurface, the position of the aileron separation lines, and the cut-outs in the LE and TE where the booms engage on the wing. Cut the holes in the undersurface and at the LE root for the servo leads, and also in the ribs. Install pull-strings, using Scotch Tape, to prevent the ends getting lost, so that you can pull the wing mounted servos' leads through the wing when you insert the servos. Install extension leads for the boom mounted servos, Scotch Taping these in place so as to be accessible for pulling out through the holes at the LE root and in the undersurface when needed. Have a little practice, and make sure that you can extract the required leads through the appropriate holes before fitting the top wing skin, which comes next. Then tuck the strings and leads back in until all carving, sanding, and



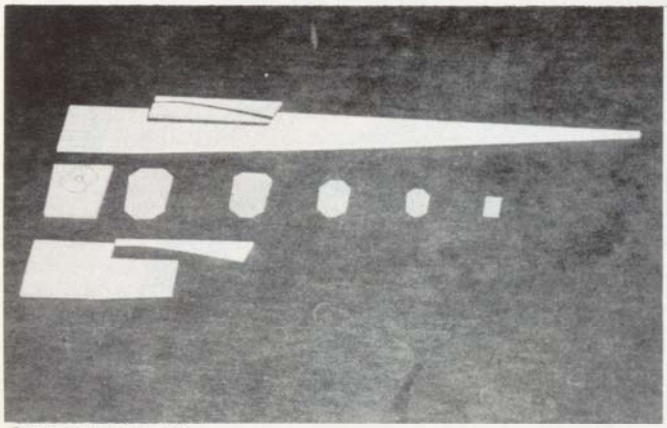
Interior of wing panel showing the routing of the servo extensions and nylon pushrods.



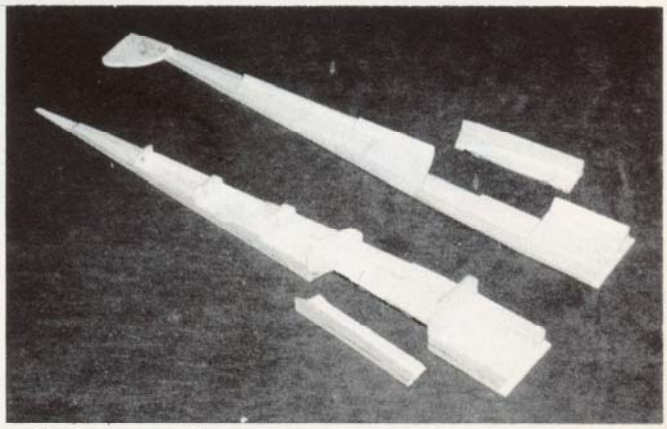
Aileron bellcrank assembly. Pushrod tucked up into wing.



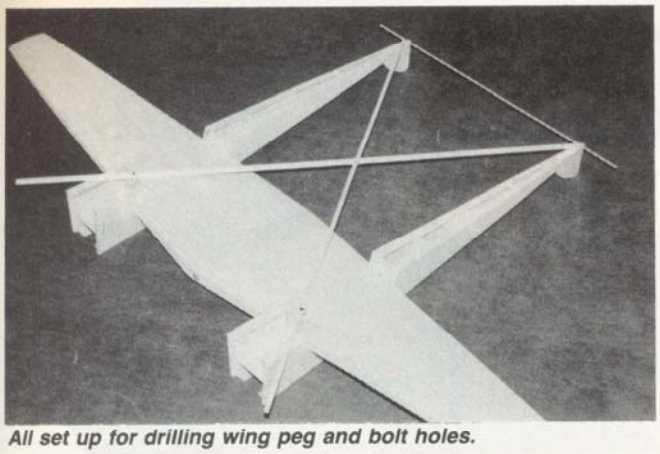
Attaching the upper wing skins.



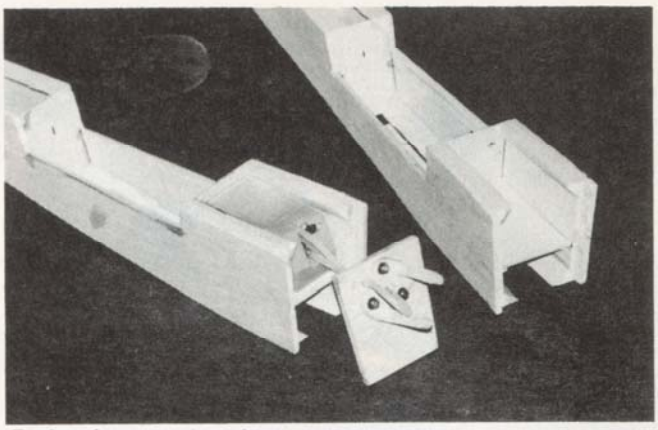
Set of boom parts.



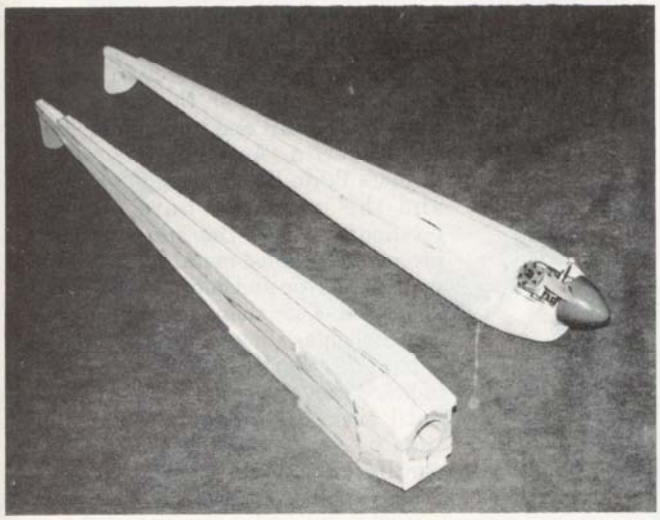
Initial make-up of boom sides.



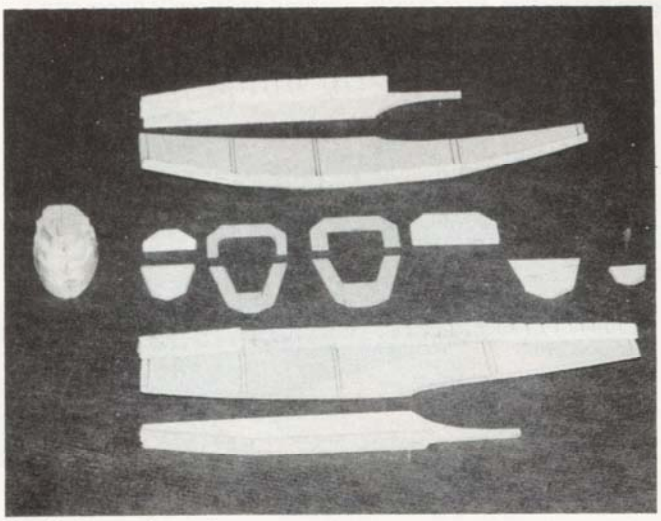
All set up for drilling wing peg and bolt holes.



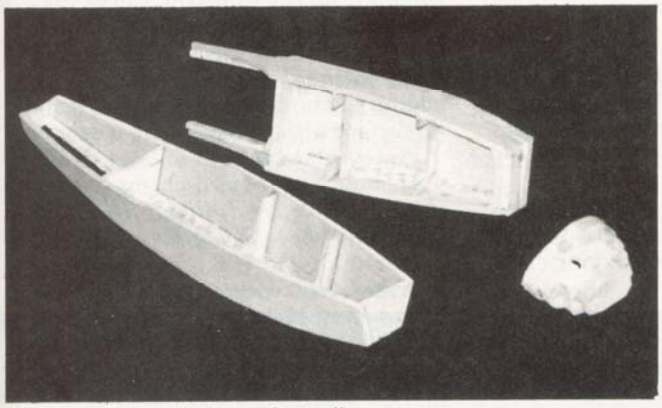
Fuel tank compartment.



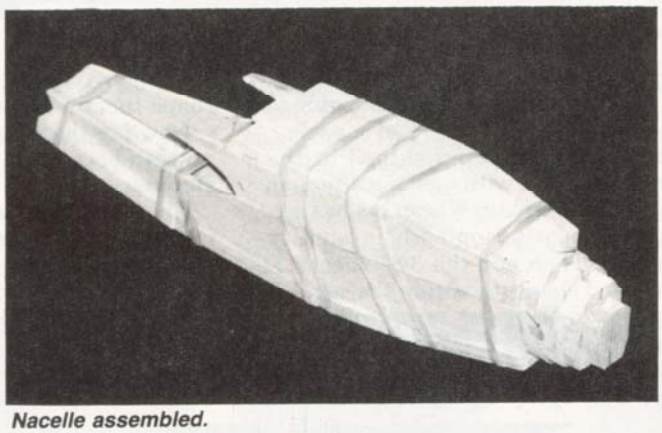
A before and after view of the booms.



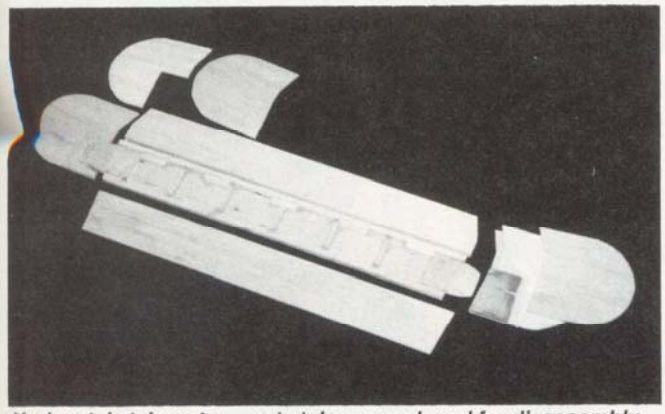
Cockpit nacelle parts.



Upper and lower halves of nacelle.



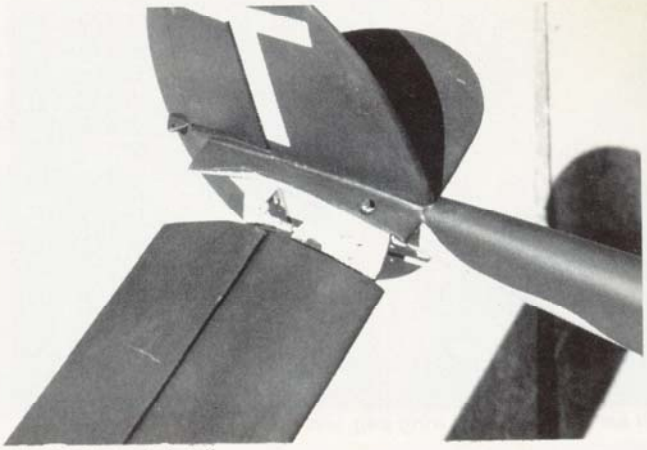
Nacelle assembled.



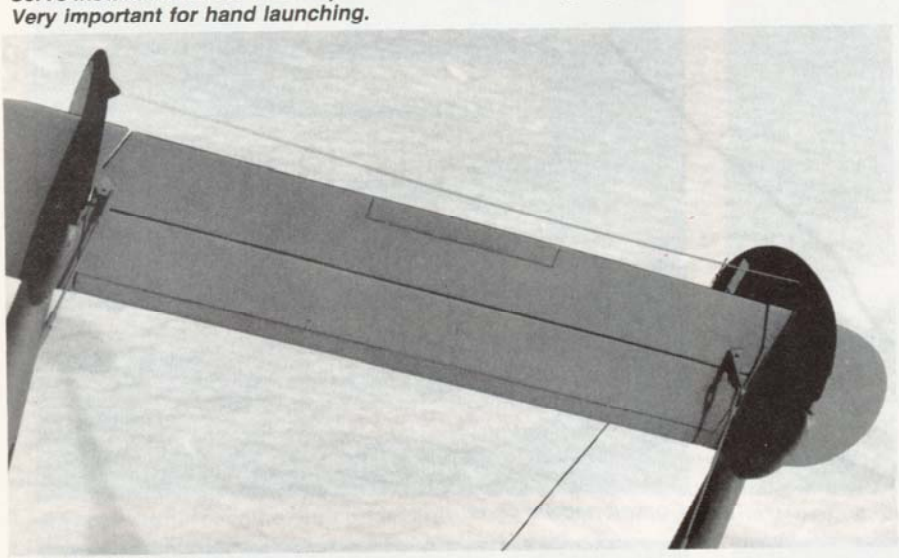
Horizontal stab parts — note tabs on each end for disassembly.

Detail of wing/nacelle assembly.

Servo installation. Note throttle pushrod and nacelle finger grip. Very important for hand launching.



Tail attachment detail.



Rudder cross link.

covering are finished.

Apply a liberal coat of white glue to the ribs, spars, LE and TE of one wing, and fit the top wing skin. Pin the assembly down with washout shims as shown on the plan. When this has set, fit the opposite top skin in similar fashion. Then add the 3/8" sheet LE strip and shape it, cutting the root LE servo lead holes out as well. Remove the cut-outs for the booms, and face them with 1/32" ply. Separate the ailerons. Epoxy a strip of glass cloth over the root joint. Add the tips and shape them to the outline on plans.

Now lay the wing aside, and make up both booms.

Booms:

Choose light springy stock for these items. I used cyanoacrylate for all assembly excepting the epoxying of B1 and the wing bolt plate.

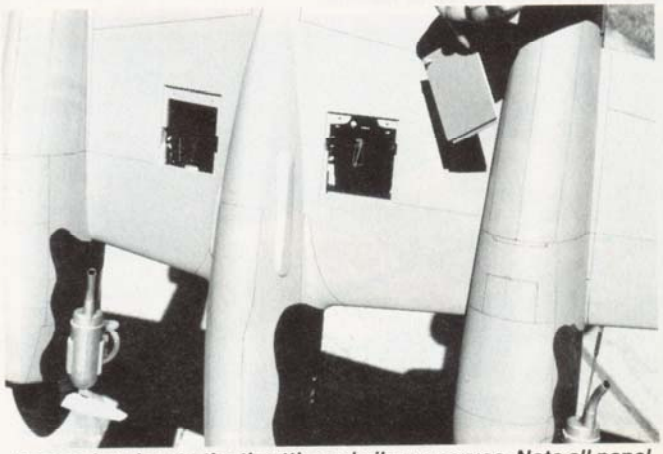
Stick the doublers to the sides. Neatly remove the two pieces which form the wing aperture and fairing. Stain the edges of these pieces with ink, and put them aside for later.

Add the triangular section corner pieces, and chamfer the inner side away at the tail end to accommodate the underfin. Assemble the sides, formers B2 to B7, the wing bolt plate and the underfin. Bore out the Ny-Rod® hole at the stern using a piece of sharpened metal tubing. True up the open top and bottom faces of the booms, and set them parallel on the workbench as shown in the photo and in the sketch on the plan. Lay the wing in place and trim or pack the wing sets until each fits perfectly. Take your time --- you want the booms to be parallel in both plan and elevation.

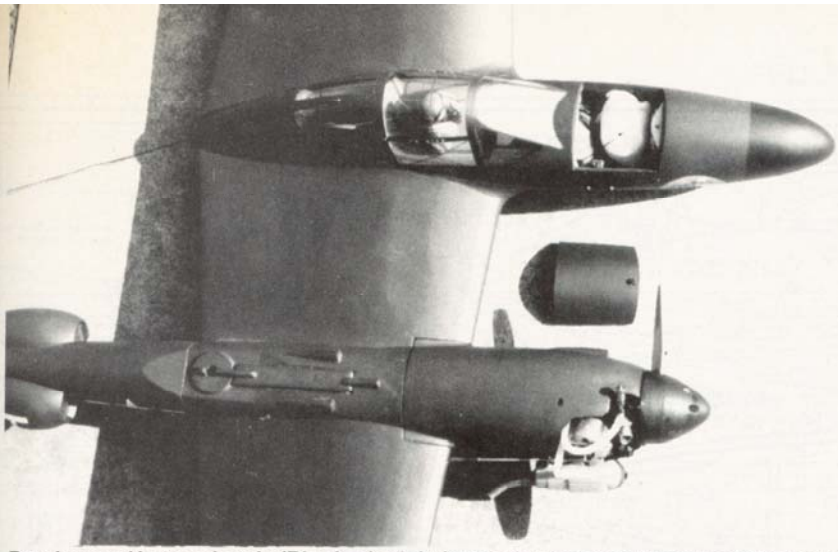
Now drill the holes in B2 for the wing dowels, and through the TE and bolt plate for the wing bolt. Check that the wing and booms can be bolted together without misalignment, and then continue with boom assembly by adding the tank bay floor and coating its surface with balsa cement or epoxy.

Prepare the tanks as follows. SLEC 4 oz. tanks were used on my model. *(Editor's Note: A Sullivan SS-4 will work fine. The tank Gordon used is not available in the U.S.)* Block off one overflow vent with a blob of silicone tub sealant. Make sure that the clunk weight doesn't slip off its tube by securing it with a twist of copper wire, and cyanoacrylate. You'll fill the tank

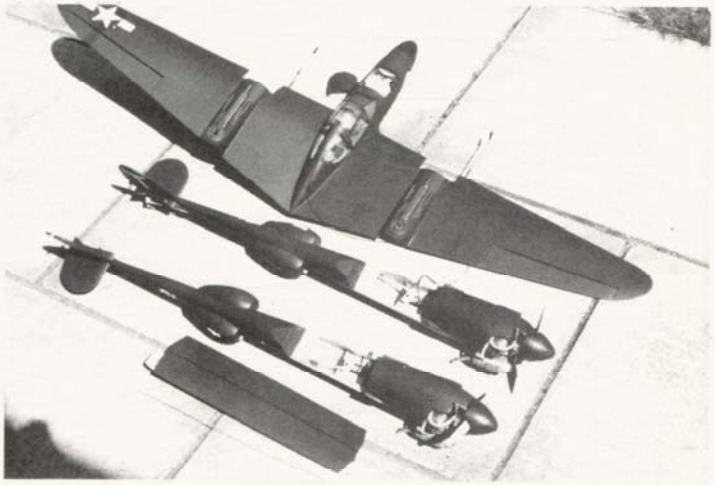
Close-up of the two O.S. 15's.



Access hatches to the throttle and aileron servos. Note all panel lines drawn with a draftsman's pen.



Receiver and battery hatch. (Ripples in right hand wing between boom and nacelle reflect a poor repair job after the 3rd cartwheel.)



Photos show how model can be broken down for transporting.

via the carburetor feed line, and the overflow will double as the muffler pressure line. Fit the silicone feed and overflow lines, securing with silicone tub sealant. Secure the tank to its base with servo tape. Feed the fuel lines through B1, which is now glued in place and has had the engine mount fitted previously.

Tack glue the wing aperture pieces back in place, noting their stained edges will aid you to cut them out again when necessary later. Add the top and bottom sheeting, and the cowling pieces. Carve and sand the booms to an oval cross section. Don't be afraid to remove wood — you'll be amazed how much has to be removed.

Remove the wing aperture pieces, refit the wing, and then trim the overwing fairings to fit, but don't glue them in place yet.

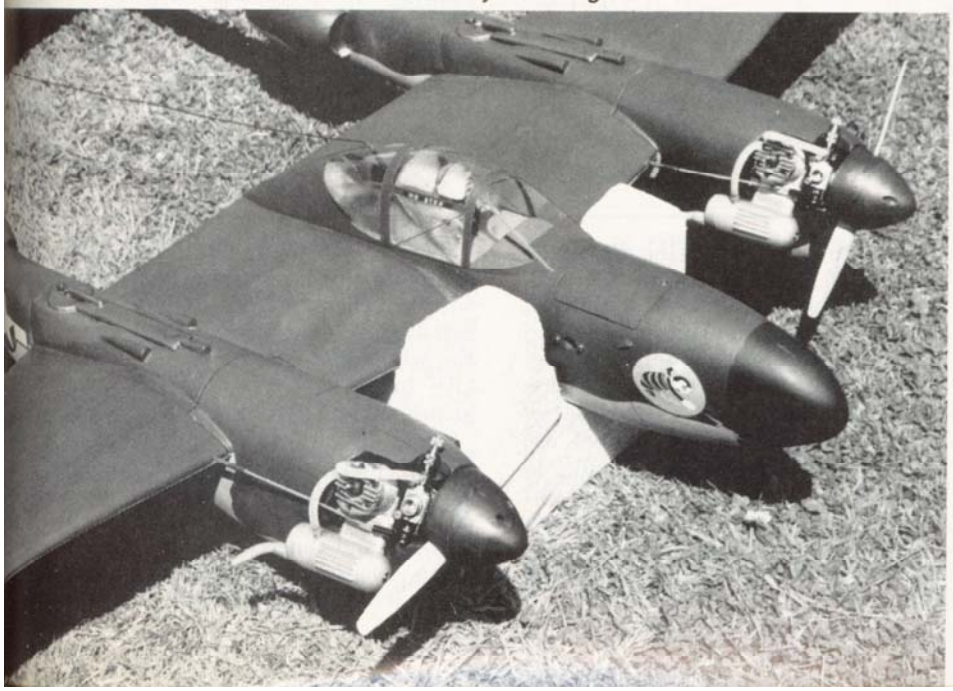
Tail:

The tail assembly has more to it than many of us are used to. The centre plane contains tongues which plug into boxes built into the stab tips. The tips are glued permanently on the boom. A sheet metal screw through each tongue and box prevents any kind of movement that would change the rudder alignment. When you've made the tail group, assemble the stab and tips, put the booms and wing back together and epoxy the stab tips onto the booms. Then you can glue the fins in place and trial fit the rudders.

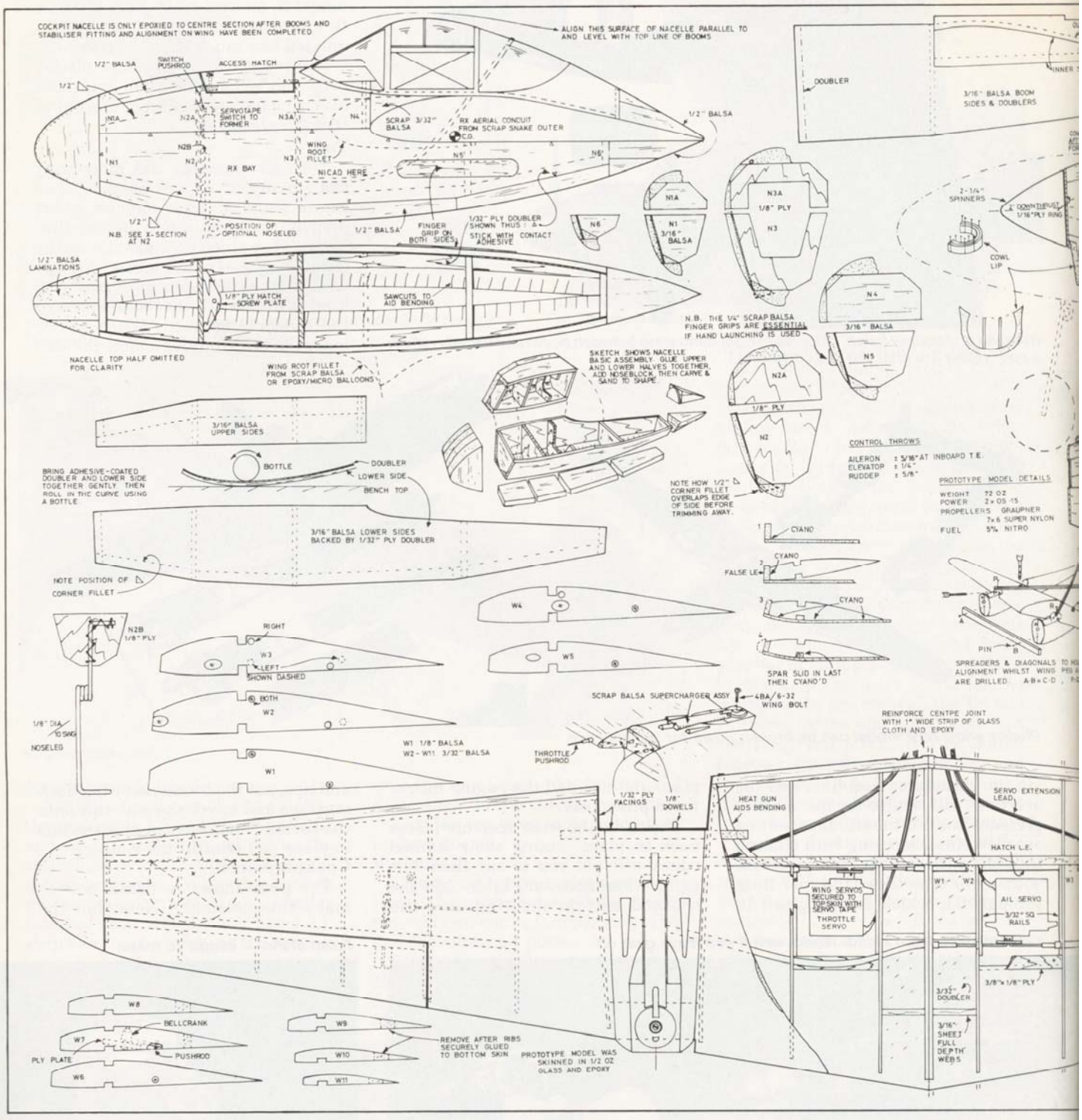
Cockpit Nacelle:

The plan shows in detail how to make this assembly. Note that the

Custom made foam stand. Works well if you leave gear off.



Foam stand — simple to make.



bottom triangular corner pieces protrude below the bottom edge of the lower sides, and are trimmed away just before fitting the bottom sheet. The upper and lower assemblies are built separately, then they are glued together and the noseblock added before carving the nacelle to shape. Do a preliminary trial fit of the nacelle at its position on the wing, and trim and pack the wing seating until satisfied. Don't glue the nacelle in place yet.

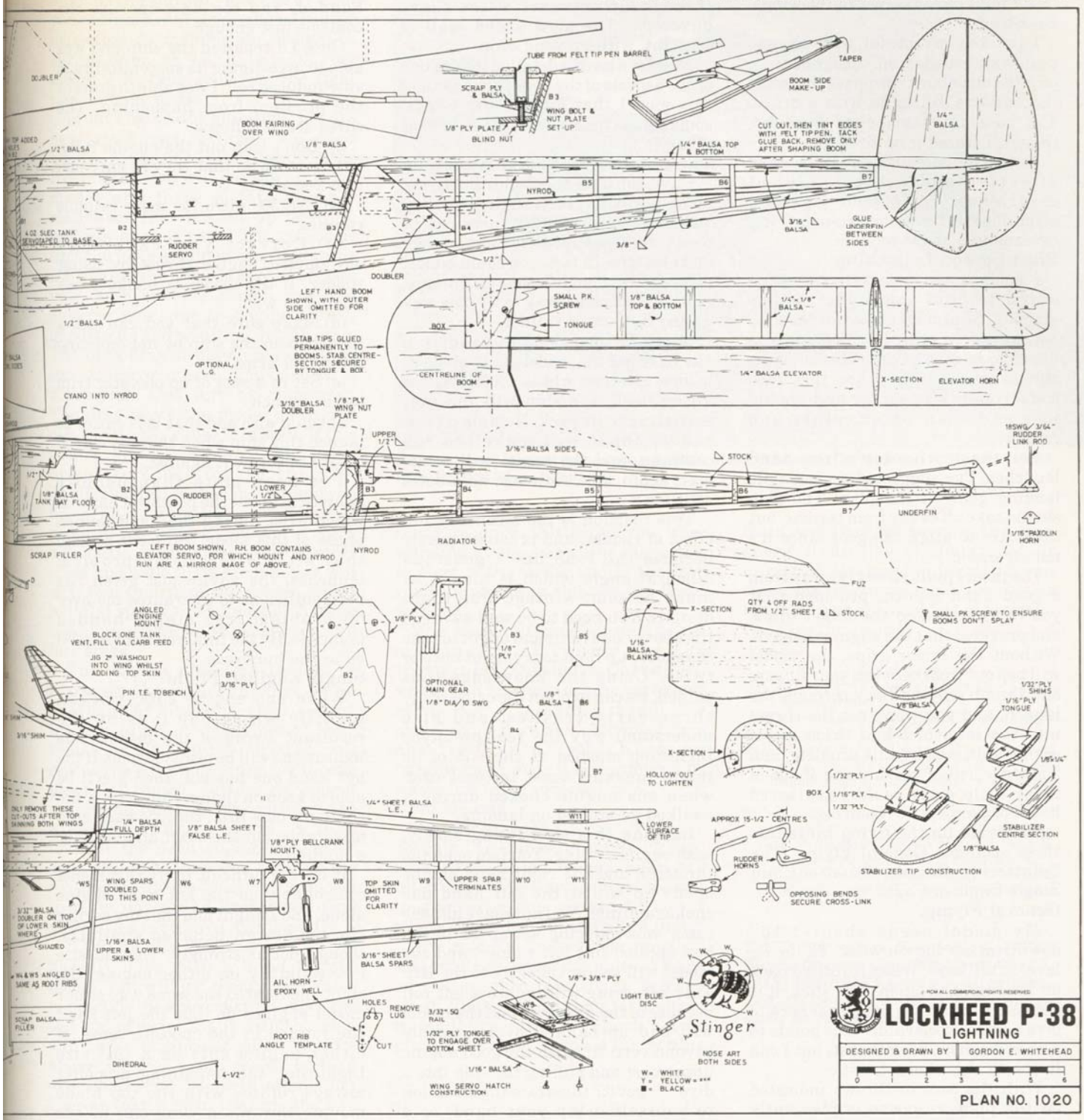
Covering:

I skinned my prototype in 1/2 oz. glass cloth and epoxy, using #80 grade production paper for smoothing it off. In brief, the technique uses thinned 75:25 epoxy/isopropyl alcohol brushed through the cloth. When the first application has set, trim off excess cloth and brush on a second coat of thinned epoxy. When this has set, use the coarse production paper gently to smooth down the epoxy without sanding through the glass cloth. Cover all items, i.e., nacelle, booms, wings, tail, control surfaces, and boom radiators.

When all is sanded smooth, assemble the booms and tail to the wings, recheck alignment, and when satisfied, glue the overwing fairings to the wings and sand them flush with the booms. Cover them with glass/epoxy after removing the booms.

Cut out the wing servo access hatches and add the various bits of ply and stripwood. Glue 2" square pieces of 1/32" ply to the inner top skin surface, and tape the wing servos in place. Use the drawstrings to pull the servo leads right through, and also

FULL SIZE PLANS AVAILABLE — SEE PAGE 306



extract the root ends of the extension leads.

Glue the nacelle in place, add the remaining balsa fairings and the epoxy and micro-balloon root fillet. Cut out the Rx/battery access hatch. Note that my Rx has fly-leads, so if yours uses an integral block connector, you'll probably need more extension leads as the free length of those already installed is only short.

Detailing:

I fitted a pilot, an armoured backplate from ply, a couple of balsa blocks to simulate RT equipment, superchargers, and boom radiators. The boom radiators look prominent, but hardly show up in flight, and neither do the engines and mufflers. I omitted the guns as I consider these to be fiddly breakable items which don't enhance my perception of this model as a fighter anyway.

Installation Notes:

Most of the installation has already been done. Note that the throttle arm is rotated 180° to normal, and the pushrod passes over the top of the muffler stub, terminating in a ball and socket link. This link separates when the booms are removed from the wings during normal dismantling.

The rudder cross linkage shown allows both rudders to work from one servo, and is essential. If you don't trust the natty joggles on the ends of the cross link, use clevises.

Paint the cockpit interior, add the antenna feed through tube, secure the pilot and then contact glue the canopy in place.

The drawing fully explains the

prototype's radio installation, except that I used linear servos in the wings.

Painting:

I painted my model with enamel that was brushed on. Insignia were painted on using a ruling pen to define the outlines, filling in with a brush. The nose art was applied freehand, though I traced it on first.

Note the camouflage. It is **very** effective and can cause pilot disorientation in poor lighting conditions. If I ever do a re-paint, it'll be done in a silver scheme.

Start Up and Launching:

I made a handy foam polystyrene stand to hold the model whilst starting. Minimum power for the ship is two good .15's turning 7 x 6 props on 5% nitro juice. The engines should be set up so that they are just into comfortable 2-stroking, and should idle and open up smoothly and reliably.

For those who don't like hand launches, I've suggested a near scale landing gear on the plan. The ship should take off easily from tarmac, but take care to align the gear since it's not steerable.

The model pulls strongly away from a good hand launch, provided that you've incorporated the finger grips, and provided that the engines behave. Without the finger grips, the model will pop out from between your fingers and thumb only halfway through the launch, and you won't get the thrust into the launch. I had three major prangs initiated by this problem, and 2 cents worth of wood in the shape of those little grips could have saved hours of pain spent repairing.

I'll divide up the flying hints into three sections: General Flying; The Spluttering Engine Situation; and Single Engined Flight.

General Flying:

My model needs about 1/16" downtrim at the elevator TE to fly level at full bore. When throttled back for landing, and when dead stick, it is necessary to pull the trim lever back to give a little up elevator. This points to a need for more downthrust, but I can live with this characteristic.

With the control throws indicated on the plan, response is pleasantly crisp, and she handles like any sport aerobatic ship. You can horse her around with abandon in inside and outside loops, slow and point rolls, steep turns, inverted flight, spins, and terminal velocity dives where the musical duet provided by those little OS's sends shivers down your spine.

She's highly stable about the roll axis because of the dihedral. If you bank her and neutralize the aileron, she'll level out. When you use rudder during maneuvers, you will find that the yaw will be accompanied by a strong secondary roll effect.

There is no tip stall evident throughout any part of the flight envelope. The slow speed stall is straight, with no wing drop.

Now let's have a detailed look at one of the aspects of the flight behaviour of this model that I know has caused some folks trouble with other models of the P-38.

The Spluttering Engine Situation:

First, consider the Lightning flying along normally, both engines pulling well. You will find that turns can be made very easily using just rudder and elevator. In fact, you could almost get away without ailerons on the ship, and she's quite as easy to fly this way as any 3-function trainer.

Going further along these lines, if you have got the model going along as before, and then whack on full rudder all by itself, the ship will roll over smartly onto its back. Holding on this rudder input will make the roll continue, and the model will rotate erect again, albeit in a very nose-down attitude.

This reaction is the secondary roll effect of rudder, and is caused purely because the P-38 has a generous dihedral angle which is almost as much as some vintage free flight designs. You need to be well aware of the above behaviour and ought to take the model up high to try it out once or twice. Using the knowledge thus gained, we can explain the cause of my three early crashes, and also understand why the real prototype Lightning crashed at the end of its record breaking coast to coast dash when one engine choked during a baulked go-around on landing.

Imagine this ship flying slowly, with engines idling. You jam open the throttles, and the right hand engine opens up whilst the left hand one chokes and dies. You now have just the same yaw-inducing set-up as if you had applied full left rudder, and the model will swing violently to the left. This left swing will induce a left roll because of the dihedral, and the model will end up banked over, possibly beyond vertical, with the good engine uppermost and pulling the ship into a dive . . . got it? Illustrate the situation to yourself using your hand, or a plastic model kit.

Now let's prolong this nightmare a little. Your helper launches the ship, but fails to give it a fast launch. At the moment of release, the left engine starves and almost cuts due to being too lean. We now have a repeat of the situation just described, i.e., a slow flying Lightning with one engine singing, the other dying. If fast corrective control is not applied, the model will bank steeply left, dive slightly, dig in a wing, and cartwheel. This scenario happened to me three times at the start of the model's life. I was launching the model single handed, and couldn't operate the controls fast enough.

Once I'd repaired the ship and was able to investigate its susceptibility to yaw-induced roll, I was able to prevent the problem from happening. The cures are as follows:

(a) Don't lean out the engine fully. Set them up so that they're only just into 2-stroking.

(b) Use 5% nitro for more reliable running.

(c) Correct yaw caused by asymmetric engine thrust by using rudder. If the model is banked, use aileron as well.

(d) Make sure that you can get a firm grip on the ship by not omitting the finger grips.

(e) Set in a spot of up elevator trim before launch.

I should also add that it is easier to launch this ship when there is a good breeze to throw it against.

I've been more than usually analytical about the potential hazards which exist during the hand launch phase of this model. So let it be said that after a few early problem launches, the advice just given has been sufficient to guarantee me over 50 problem free single handed launches. By the time you read this I'll be in the hundreds.

Single Engined Flight:

When one engine cuts, you can identify which one it is by the resultant swing of the model. The indications will be pretty strong. If the left hand one has cut, then you'll be able to keep on flying. However, if the right one cuts first, throttle back and, preferably, cut the other and head for a landing.

It is very difficult to fly this model controllably on the left hand engine alone, and I might add that my earlier Hornet design behaved similarly, though not as strongly. The full size P-38 could fly on either engine; the right one rotated the same way as our model engines do, but the left hand one rotated in the opposite sense. If either engine cuts on a full size Lightning, the remaining propeller always rotates with the top blade moving towards a wing tip. In our model's case, this situation does not apply, and that's the root cause of the difference in engine-out flyability between the full size P-38 and our model. It is well worth sucking back a drop of juice from the left hand tank to ensure that the left hand unit stops first. When you've got a few flights under your belt, get the model to a good height having arranged throttles or fuel contents to produce a right hand cut, and see what you think!

The procedure used in single engined flight is to apply sufficient rudder input to balance out the yaw

induced by the engine, and then to use ailerons and elevator, assisted by a tad of coordinated extra or reduced rudder deflection as appropriate to help in turns. Even at 4½ lb. weight, my model will climb gently on the right hand engine alone.

In an engine-out situation, always perform turns towards the dead engine, since in turning towards the live engine, you will have to fight the model and force it into doing a maneuver that it's set up badly to perform at that time. The reason is that the force set-up in a turn towards the live engine is one of severe adverse yaw, with adverse aileron yaw and adverse yaw, due to engine thrust, ganging up and resulting in high drag. The high drag situation is caused by the excessive control inputs needed to accomplish this turning maneuver. The drag slows the model down and can eventually cause it to stall. If this occurs, you get a power spin in an opposite direction to the now ineffectual full control inputs, and you have no corrective control power remaining. Unless you are a keen aerobatic enthusiast, which most sport and scale fliers are not, you will now lose control of the model, and it will flat spin into Mother Earth, even if you remember to throttle back at a late stage.

The correct direction to turn is towards the dead engine. If an overbanked situation then occurs, leading to an incipient power spin, then a simple reduction in power will rescue the situation, since you'll have plenty of control surface movement remaining to establish control of the airplane. Furthermore, a turn towards the dead engine is a lower drag situation than one towards the live one, so the tendency for the model to slow down and create piloting difficulties is reduced significantly.

If you fly it to the bitter end, as one usually does with a hand launch model, you will get plenty of chances to practice the above dictum, since the tail end of every flight with this ship will be an engine-out situation. The above advice is the result of long experience, and it's worth adding that I never turn a twin towards the live engine unless I want to demonstrate to someone just how darned difficult the maneuver is to accomplish.

Whilst on the right hand engine alone, the P-38 will loop and roll quite well. You need to enter the loop fast, and to keep it quite tight. If you perform a slack loop on one engine, then at the top of the loop, where low airspeed reduces rudder authority, the model will swing through 90° in heading due to the asymmetric thrust. The second half of the loop will then be performed at right angles to the original heading, and you'll have to be ready to duck. Although you were standing at one side of the maneuver to start with, at the end of the loop you'll be standing right in the flight path.

Gordon's pair of great flying twins. In back of the P-38 is his DeHavilland 103 Hornet, RCM Plan No. 933 (two .10's).

The most outstanding engine-out maneuver, of course, is the spectacular Zurabatic Cartwheel, where you let the machine cartwheel at the top of a hammerhead. The model exits from the cartwheel in a positive spin, which is an improvement over the Hornet which comes out in an inverted spin.

Conclusions:

As with most of my previous designs, I've learned about flying from this little ship. It has been my intention in this warts and all account to give everyone a headstart over where I was at the model's first flight.

The model is an entirely practical sport scale design and is quite at home on cow pasture type flying fields. I must thank my clubmate Richard Spreadbury for the superb action photos. We had enormous fun getting them and, besides proving the slow speed flyability of the model, it verified Richard's fortitude in standing his ground to get the shot as it buzzed past within 6 feet of his head. Good on yer, sport!

References

1. Lockheed P-38 Lightning by Roy Cross. Kookaburra.
2. The P-38 Lightning by Gene Gurney. Arco.
3. Lockheed P-38 Lightning. Aircam No. 10.
4. Lockheed P-38, F-4 and F-5 Lightning USAAF, ETO & MTO 1942-1945. Camouflage & Markings No. 18. Published by Ducimus Books.
5. P-38 Lightning in Action. Squadron/Signal No. 25.
6. Aces of the South West Pacific by Gene B. Stafford. Squadron/Signal Publications.
7. Modelaid International No. 10. Maltese Magazine obtainable via Bill Dean Books.

T & D Fiberglass Specialties, 30925 Block, Garden City, Michigan 48135, (313) 421-6358 has cowls, oil coolers, and canopy for P-38. T & D carries many RCM plan parts.