AVRO 504K

By Gordon E. Whitehead

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Designed By: Gordon E. Whitehead

TYPE AIRCRAFT
1/9 Sport Scale
WINGSPAN
48 Inches
WING CHORD
6½ Inches
TOTAL WING AREA
585 Sq. In.
WING LOCATION
Biplane
AIRFOIL
Flat Bottom
WING PLANFORM
Constant Chord
DIHEDRAL EACH TIP
4 Chan. 1¼", 3 Chan. 2¼"
O.A. FUSELAGE LENGTH
39½ Inches
RADIO COMPARTMENT AREA
(L) 9" x (W)2¾" x (H)3"
STABILIZER SPAN
13¼ Inches
STABILIZER CHORD (incl. elev.)
6½ Inches
STABILIZER AREA
80 Sq. In.
STAB. AIRFOIL SECTION
Flat
STABILIZER LOCATION
Mid-Fuselage
VERTICAL FIN HEIGHT
6¼ Inches
VERTICAL FIN WIDTH (incl. rudder)
6 Inches
REC. ENGINE SIZE
.20-.30 Cu. In.
FUEL TANK SIZE
2-4 Oz.
LANDING GEAR
Conventional
REC. NO. OF CHANNELS
3-4
CONTROL FUNCTIONS
Rud., Elev., Throt.,(Ail.)
BASIC MATERIALS USED IN CONSTRUCTION
Fuselage ..... Balsa, Ply and Spruce
Wing ..... Balsa and Spruce
Empennage ..... Balsa
Wt. Ready To Fly ..... 64 Oz.
Wing Loading ..... 15.75 Oz./Sq. Ft.

This ship caused me some gray hairs! For years I'd wanted to build the Avro 504K --- "the classic trainer" --- "the ideal scale model" --- the world's first true "buddy box" system. So what was it that prematurely aged me? The first flight of the ship — that's what! As I'd successfully flown most of my ships straight off the board, and as this one was only finished hours before the annual "Old Warden All-Scale Meeting," I decided to test fly her at the venue.

So, I get to the meeting, my flight slot arrives, the H.B. 20 fires first go, and she's off! Trundle, trundle, bonk, bonk, and with a last little jig, she's airborne. But what's this? The ailerons don't work! You can see 'em flapping like paddles in response to my frantic stick stirring, but the ship just seems oblivious to my demands. In a gentle left turn, she banks inexorably towards a ukie circle and, steepening the bank, she joins a circulating Hawker Fury for half a lap. Inexplicably, as if sensing danger, she gently lands next to the u/c pilot, whose adrenalin has by now begun to spout out of his ears!

A serious thinking session ensues, while I wait for my next flight slot. A friend who's recently been flying a 6' Avro (on T.V.) recommends a spot of nose weight, as undeniably she was twitchy on elevator. So on goes three ounces of lead, and the next flight eventually takes place . . . with the same flight pattern, only the ukie fans are resting this one out.

Home we go, and a few taxi runs in the garden to produce one reason for poor performance flying-wise — a leaky plug causing loss of power after about twenty seconds. Now we know we can concentrate on the trimming, and the moral here is to test fly without the cacophony of sound present when all six frequencies are in use! At the

Revel in the thrill of piloting your own model of the R.A.F.'s immortal first dual-control trainer — or at the very least, read this guff and digest a few handy trimming tips.

strip, she bounds into the air. She answers to aileron deflection but seems to want to turn in the wrong direction even though the controls are hooked up correctly. However, she is well up and going strong and then I really lose all aileron control. I fly her a while on rudder-elevator, and on landing (after a few practice approaches), I discover that the aileron servo has gone kaput.

The next time out, the RX battery goes flat in mid-flight, all controls go to the stops, and she spins in splitting her seams and busting her wings. By now my dear wife had adrenalin coming out of **her** ears since the house needs painting, the garden needs weeding, and here's me waging a full scale battle against the aeronautical intransigence of a historically proven natural flier.

So how come I'm presenting Avro as a plan for the whole of the world to build? Well, having been repaired, she now handles well and has even been successful in competition both for appearance and handling. At our club, we had a club contest to see who could perform the most take-offs and landings in five minutes (from a standing start each time) and me and my friend (the Avro!) won with ten complete take-off & landings. Next came a .40 powered pattern ship with 10 take-offs and 9 landings. Conditions included a 10 knot gusty breeze & a cow pasture strip!

I'll reveal my trimming secrets later, along with comprehensive flying notes, but now let's see how to build her. By the way, the house and garden are doing fine!

CONSTRUCTION

General:

The only tough parts on the slender box-girder fuselage are the landing gear and tail skid --- more about this later. The flat bottomed section wings use thick top spars to resist compressive bending loads in high-g maneuvers. At last I've discovered a method of getting inter-plane struts the exact length with minimum work, and the method of linking the quadruple ailerons is just a variation of what the ukie boys have been doing for years with their pushrods.

Fuselage:

Make the sides, including the 3/16" nose and lower wing seat sheeting. Add ply doublers, and then join the sides from F-1 back to the last F-2, taking care to get the down and side thrust angles correct. Join the tail end, then glue the cross braces, landing gear mount, skid front strut blocks, cabane mounts, top decking, cowl sheeting, stern sheeting and stringers. Whew! Check how the cabane struts define the wing incidence, before binding in place and soldering up. As regards to the cockpits, I decided at an early stage on the joy-ride version, but the military cockpits are shown as well.

Landing Gear:

The sprung gear is a worthwhile project and combines vertical springing and torsion bar action. The 1/8" wire is amply strong enough, since even crashes only happen slowly with this ship! You can leave the legs solid, but the sprung version goes together as follows: Make the 5/64" lower legs, not forgetting the axle bearing, and solder the two brass retainers in place. Then wind the spring about 1/4" too long, put the spring, stop, and 1/8" wire top leg in place and solder the stop to the 1/8" leg. Yes, it's that quick! Tin the edges of the retainers, bend and tin the oleo fairing and solder this in place. Use a hot iron quickly at this point, or

the whole assembly will disintegrate as the solder melts and the spring activates. After making the other leg, drill the landing gear mount, observing the slight off-set relationship between opposite holes, to ensure that the legs exit the sides truly opposite each other. Secure the legs to the fuselage with tin plate saddles, then solder the axle in place. You will see now that when you press each wheel independently, the little tube bearing plays its part in removing stress at the bottom joint.

By now you should be in the mood for wire bending, so make the rear skid, though don't glue the ply plate to the fuselage until just before painting. Leave the front skid assembly until you've made the bottom wing, and have the rear leg retaining spurs secured in the center section.

Stabilizer:

Join 1/32'' balsa edgewise, and cut out the entire stab outline. Build the structures successively on each side, sand the edges round, then separate the elevators which are then joined and hinged. Choose light stiff sheet for the rudder. Use a Robart hinge point for the top rudder hinge, but any old pinned hinge will suffice for all the other hinge stations.

Wings:

Only the center sections differ, both in shape and width. I used bolt-on wings and these look realistic, but the arrangement can be unforgiving in rough landings --- so you may choose to secure the wings with elastic bands. I cut the front cabane lugs from a large nylon horn, but aluminum or paxolin would be suitable. As usual, I built the ailerons integrally with the wing panels, and separated them when needed. When setting up the ailerons, you'll find the link wires sufficiently rigid as there are two per aileron, and the angled stubs retain them positively. Use a sharpened piece of 1/32'' wire to drill the lugs, and open the holes slightly with a needle file. Make the wires slightly too long, and adjust them for final

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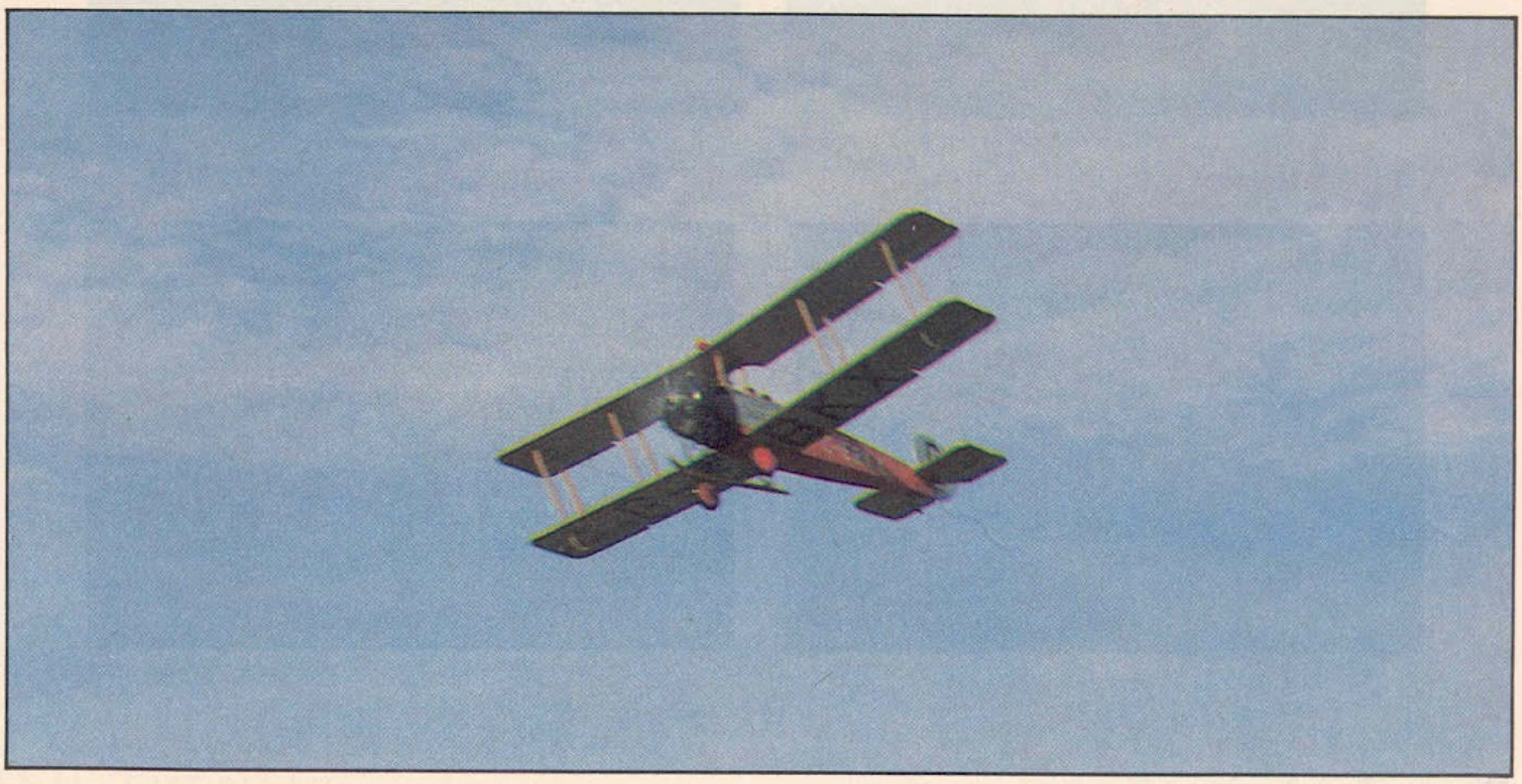
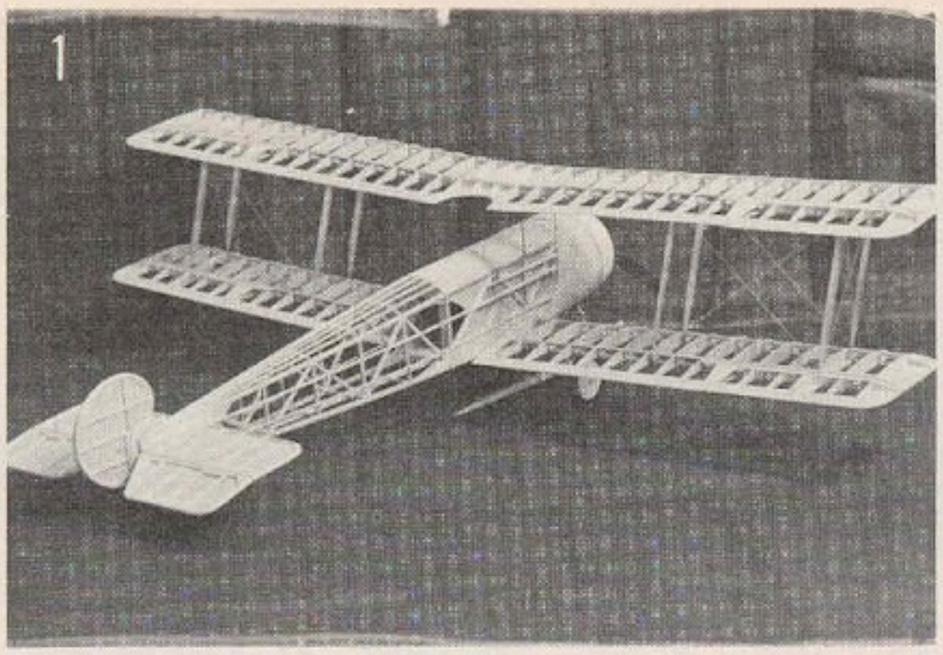
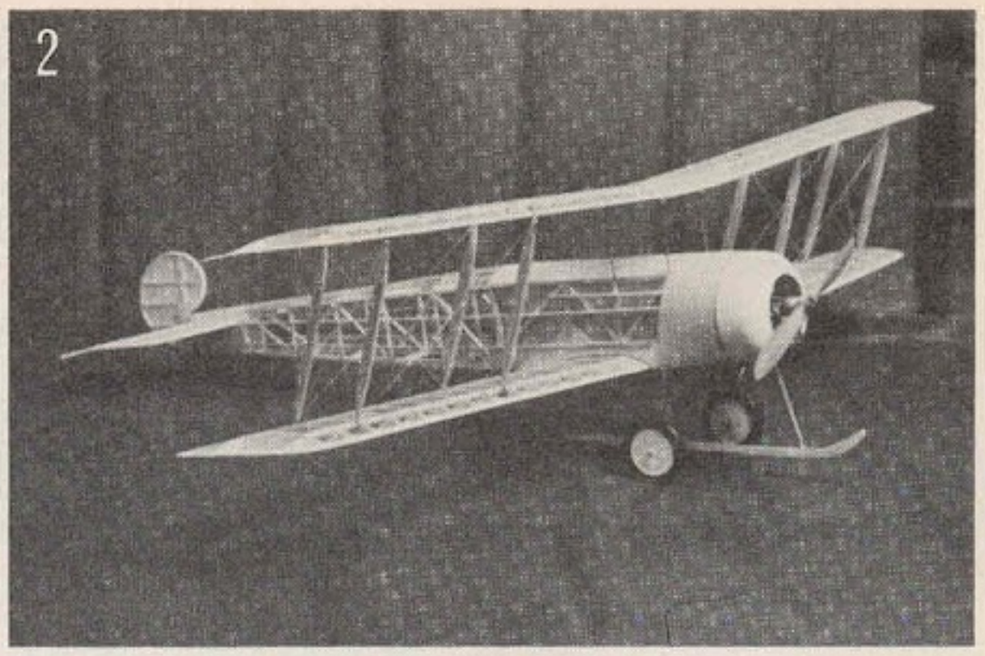
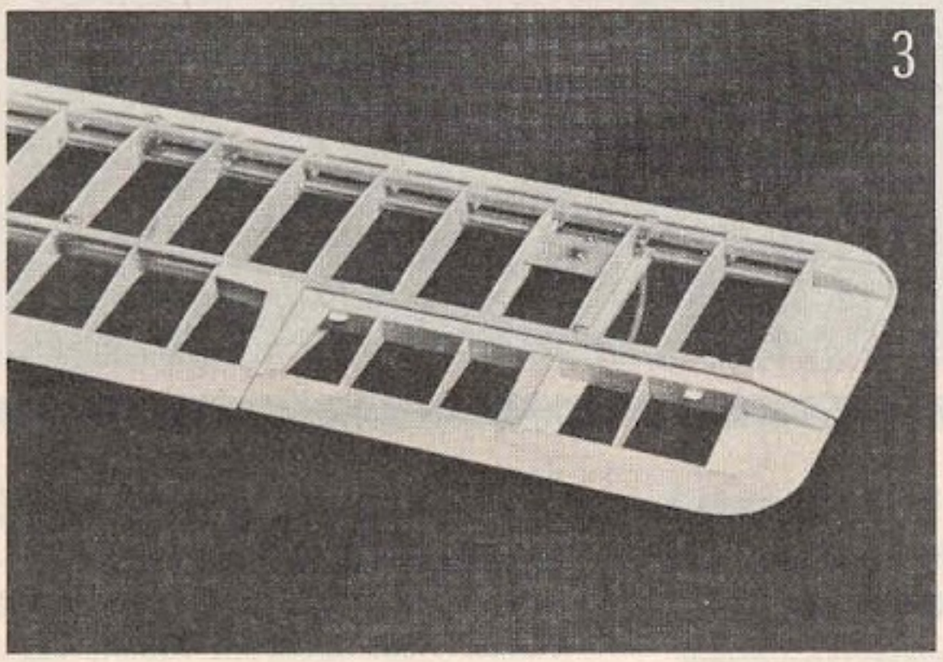
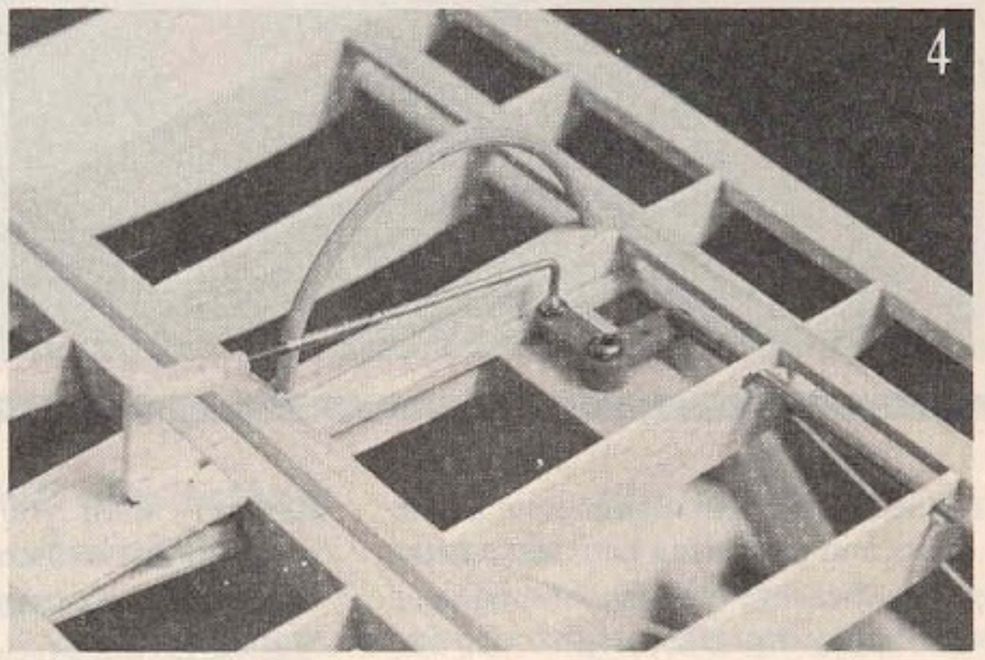
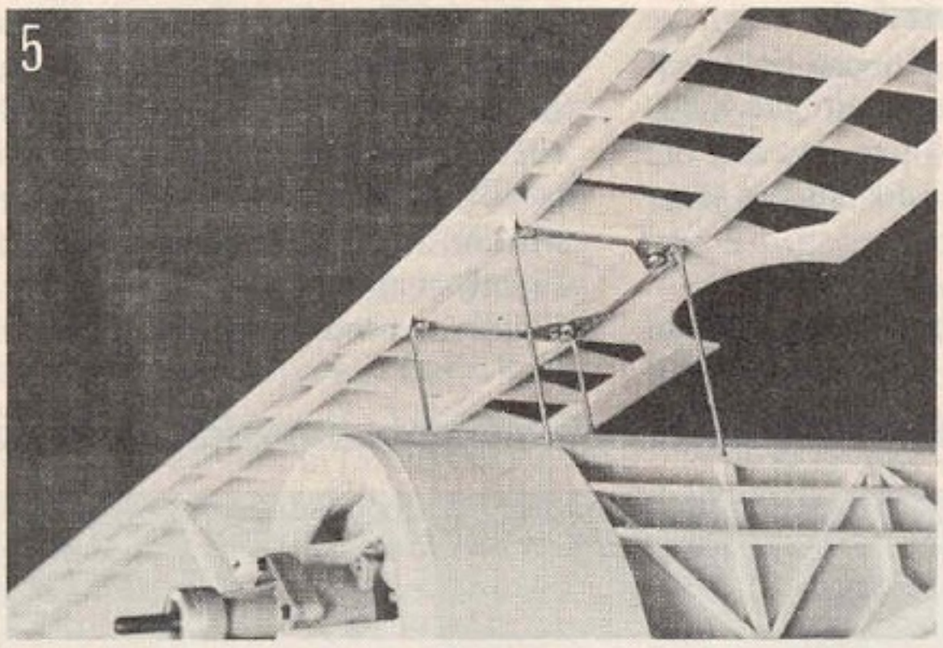


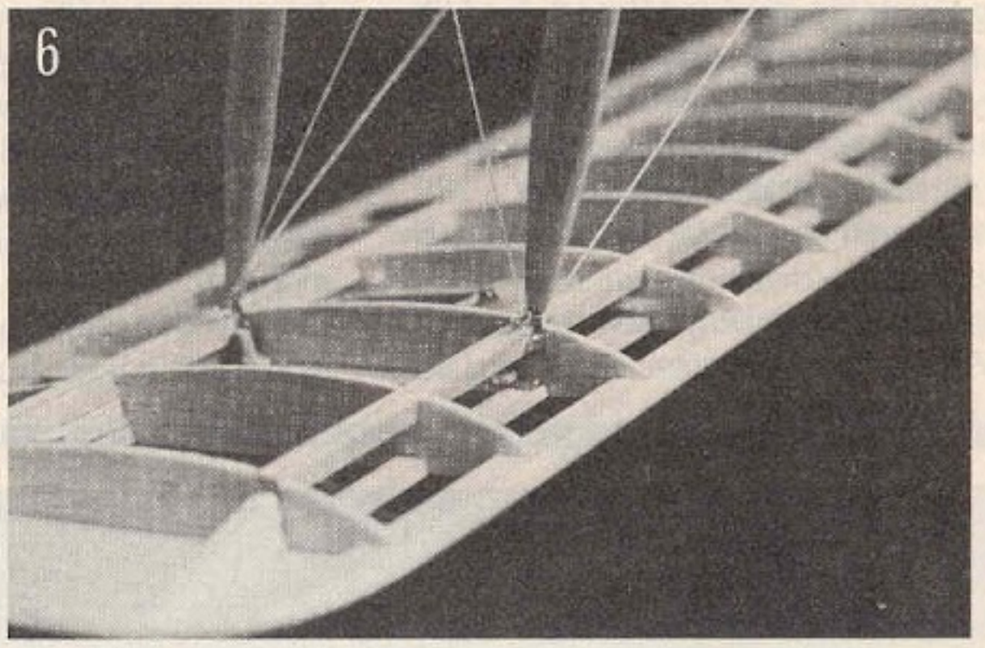


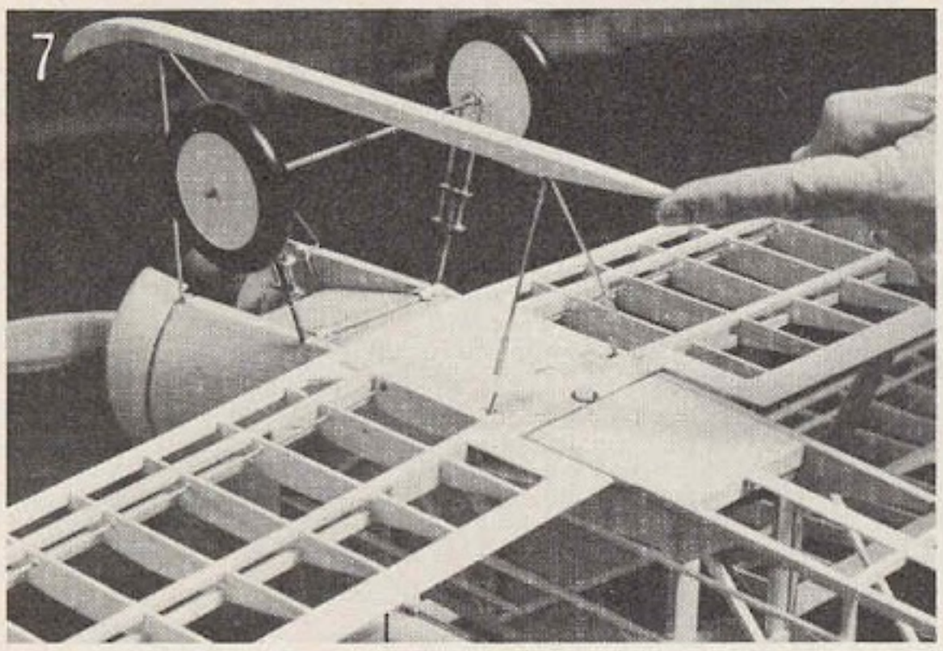






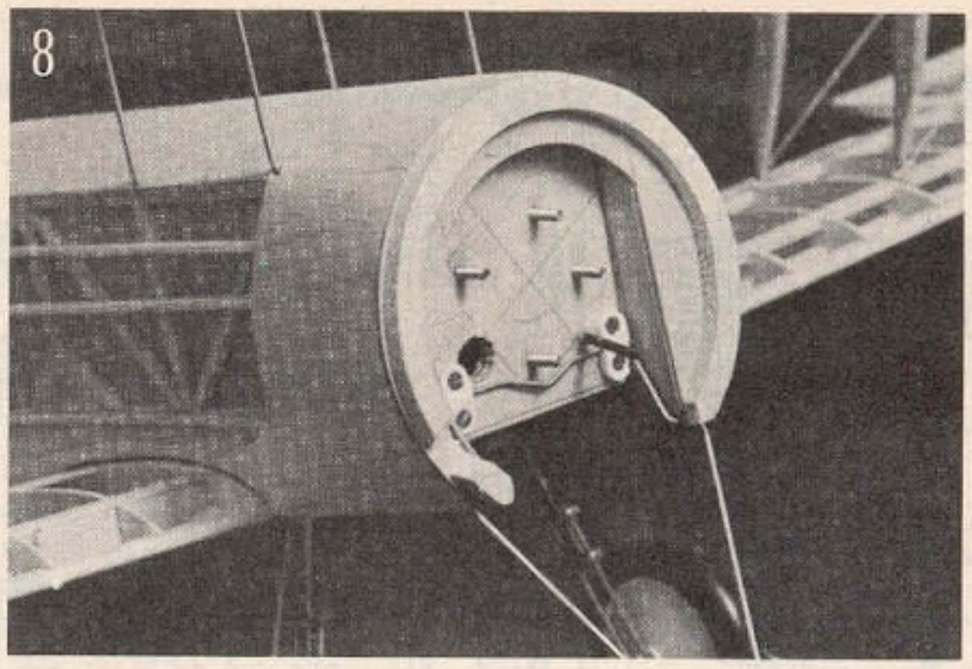






(1) Rear view of uncovered Avro. (2) Another view from the front. Skid keeps the nose-overs to a minimum. (3) Aileron detail viewed from the top. (4) Tip skid shown along with aileron set-up. This gives slight but not noticeable differential action. (5) Bolt-on center section arrangement on top wing. (6) Struts are retained on hooks by elastic thread which wraps around hook. (7) Rear skid struts engage on angled prongs projecting from lower wing center section.

(8) This view shows front skid clamps. (9) Angled engine mounting. A car-type muffler was used. (10) Compressed main landing gear springs. (11) Tailskid assembly before epoxying in place. (12) The Avro 504K lifts gently into the air. (13) A low fly-by. Bright disc in center is sun's reflection on muffler. (14) The end of another perfect flight.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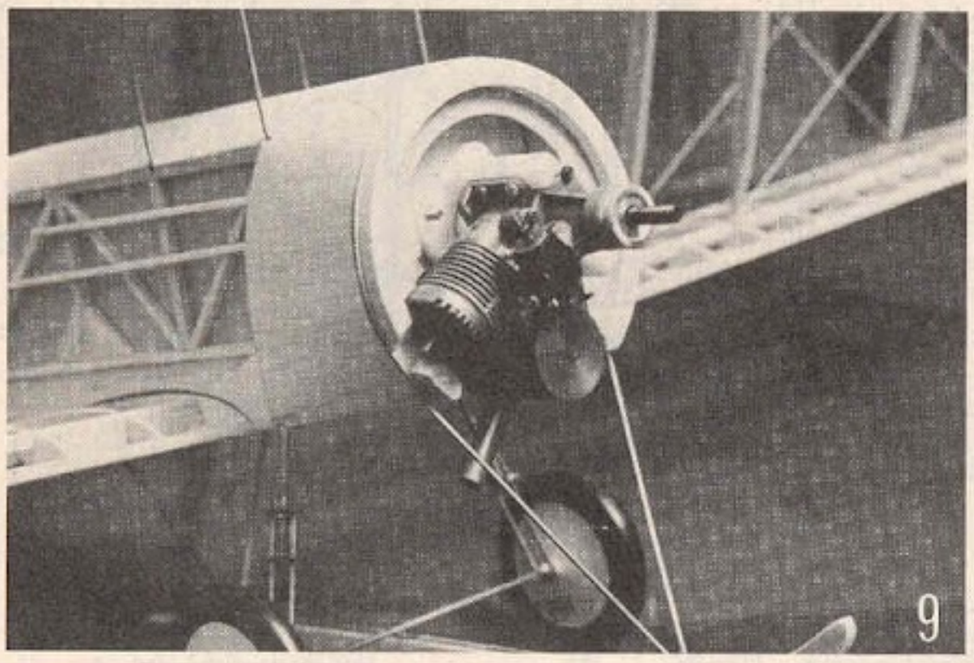
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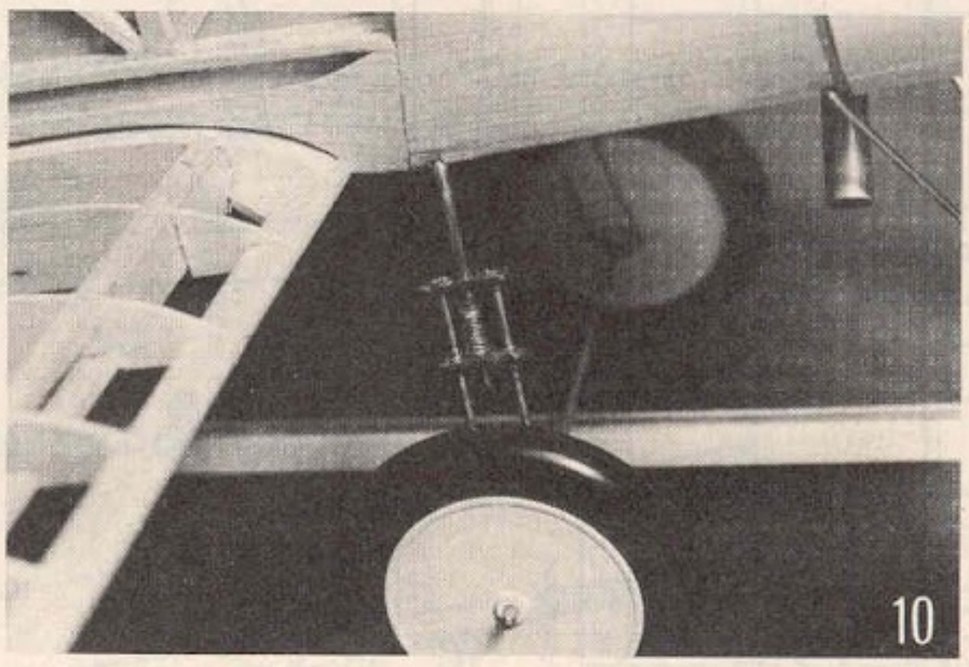
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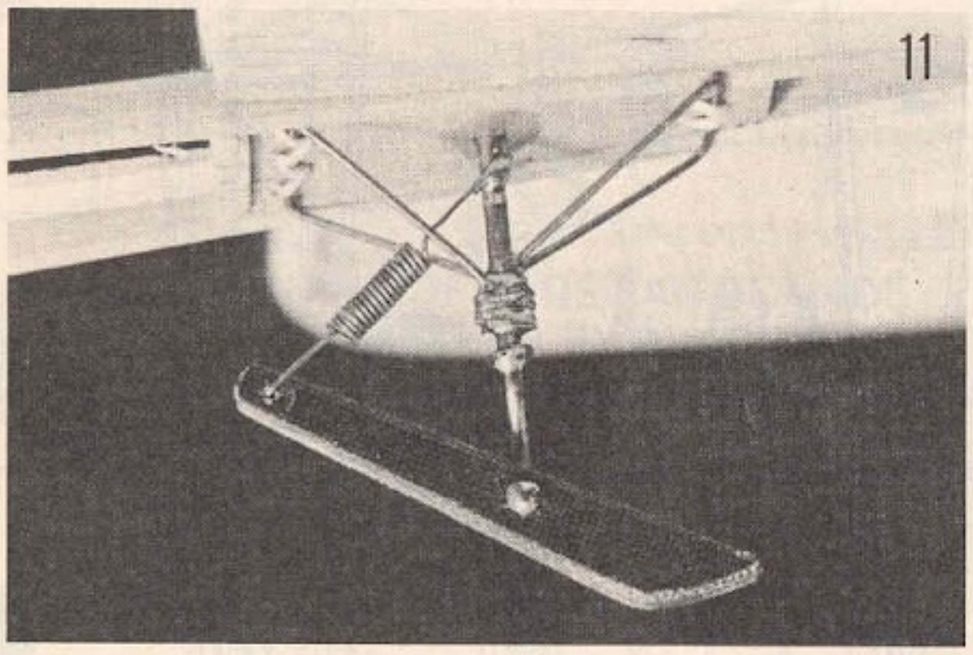
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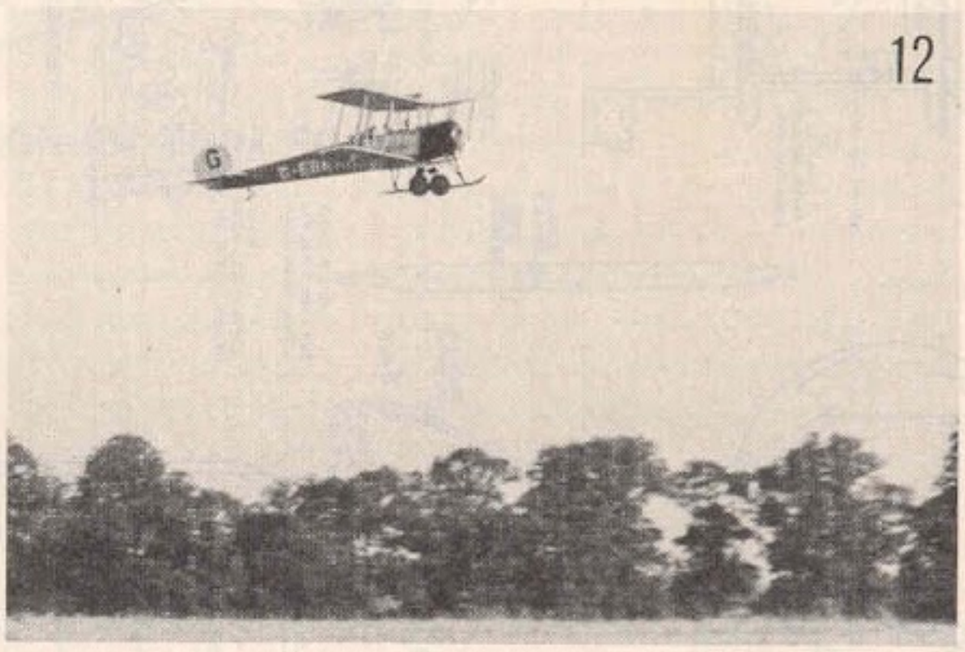
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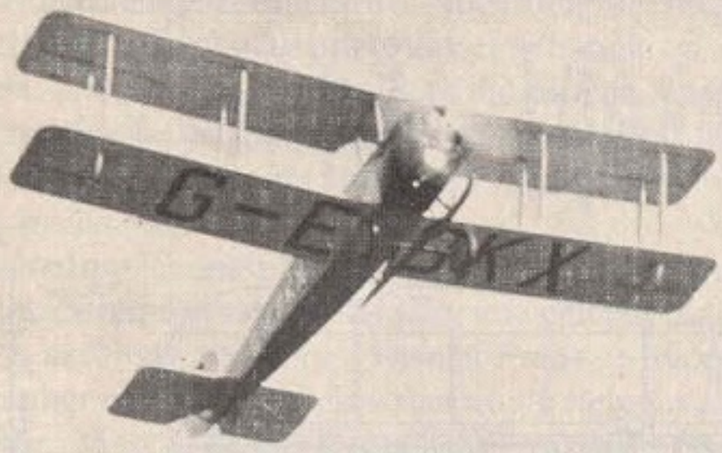

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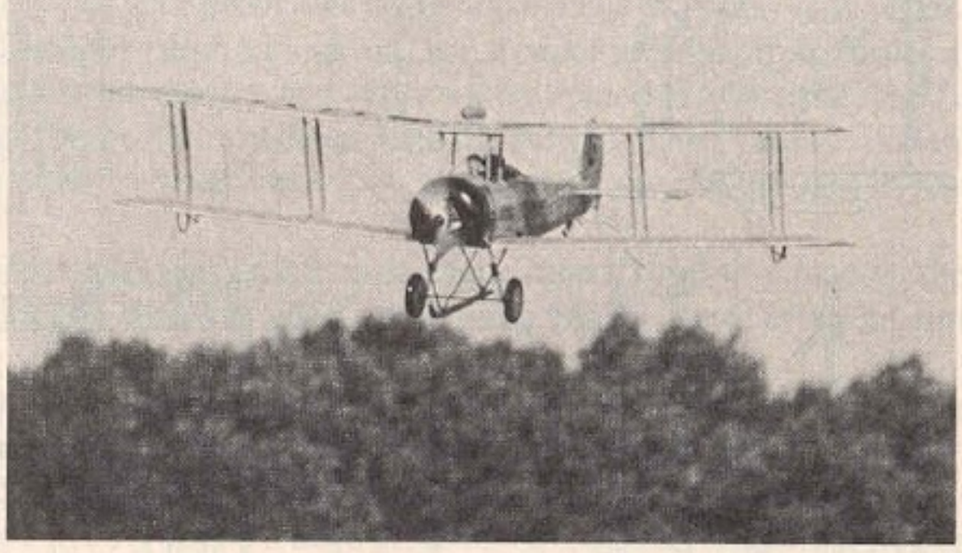

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length by kinking one end as shown on the plan. Arrange the angled stubs so that you have to twist the wire to get the stub in place.

A collegue made a 3 channel REM version and his model flies very well — so if you prefer aileron-less flight, don't despair!

The strut ends allow you to adjust the struts to accurate length while the epoxy dries. However, number the struts according to position so you don't have to fit them by trial and error after disassembly. For the rigging, eight 20'' long pieces of elasticated thread are needed, with loops tied in the ends.

Engine Installation:

I used a racing car silencer, but the cylinder inclination chosen enables a standard silencer to exit below the front fuselage. Nowadays I always try to arrange the tailpipe so it ejects goop away from the model so as to reduce the amount of cleaning needed. With this ship, a brief wipe with a wet sponge on the undersurfaces is all that is needed after a five flight session!

Covering and Finishing:

I experimented with silk over tissue on this model. After doing a tissue and dope job, cut a piece of silk about 1'' oversize and iron flat with a cool iron. Lay the silk in place and, using a soft brush, apply thinned dope at the center of the area to be silked. Working towards the edges, swab the dope through the cloth, taking care to avoid air bubbles. Practice on the tail-plane first. When dry, apply a final coat of dope to fill the weave. I would like to have tried Coverite, but it is hard to get this in the U.K.

Paneled areas were sealed and sanded.

completely. 3 channel jobs will have no problems on this score, of course, assuming a REM set-up is used.

Take-Offs:

Open up, and let her fly herself. She needs slight right rudder to track straight, and climb-out is gentle though faster than scale.

Landings:

Since she is quite unstreamlined, with stacks of wires and struts, approach at a fast idle to maintain headway, chopping the throttle on landing. This ship will 3-point, as there is plenty of elevator authority. On grass, she lands straight, but on asphalt she may ground-loop since the skid doesn't bite.

Maneuvers:

She'll trim out for free-flight in left turns, and loop, roll, stall-turn, split "S" and spin (left) with ease. The full size Avro's roll was very slow, so I wired a roll-rate switch on my TX, using full throw for general flying, and 2/3 throw for slow, staggery, vintage rolls!

For spins, one needs as much rudder as possible, but then you must go easy on the rudder stick in other situations — perhaps a rudder dual-rate switch would be useful. This is the only model I've had which would perform a falling leaf; probably because the large moments of inertia and drag slow her down to my reaction speed! A falling leaf is a series of incipient spins, each checked instantly, to have the direction reverse, and is a vintage maneuver almost as old as the airplane itself. Position the ship downwind pointing towards you so that you can see the maneuver's shape best. Engine rotation tends to make movement faster to the model's left, and you have to watch out for snap rolls in this direction!

Throttle back, stall gently, and holding full up all the while from now on, feed in right rudder. As the wing drops, bang in left rudder. She will slow her turn, then flick the other way. You immediately reverse rudder direction, repeating the successive opposite rudder commands until you chicken-out. I suggest you start high and finish high. This maneuver is much prettier than a spin and you will have great fun trying to make it symmetrical. Strictly speaking, one should feed in down elevator at each reversal of direction as part of the normal spin exit procedure. However, I always find I nearly drop the transmitter at this point so I have given up playing with the elevator.

She looks most distinctive in the air, and that prominent skid really sets her off, besides reducing nose-over tendencies on the ground. Perhaps surprisingly, the landing gear is very durable, so don't let its apparent complexity put you off building an otherwise straightforward and very satisfying design.

Conclusion:

Well people, this ship really furthered my education and, since I know from experience that her early behavior is exhibited in varying degrees by many bipes, I hope that in spilling the beans I've done a little more to improve your knowledge of

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Hinged panels were simulated with polycard contact-glued in place.

My chosen color scheme is that of a joy-ride operator and was an interesting and fulfilling exercise in research. I lettered the fuselege by first spraying it silver, masking off the registration with fablon letters and spraying the red. I masked off the wing registration letters using Scotch Tape, brushing the lettering. The owner's nameplate I marked out in soft pencil then painted with a No. 0 brush and one hour's patience. A soft rubber eraser subsequently removes pencil marks. I still find nitrate cellulose the best color medium, followed by a thin coat of eggshell polyurethane clear household paint which is fuelproof.

FLYING

General:

Leave off the front skid for first flights, and get the C.G. right. I use 3 oz. of lead screwed to the engine mount. The total weight is 64 oz. with a 2 oz. tank, H.B. 20, and 1 lb. of old Futaba radio gear. I use 5% nitro fuel. The wing loading is average at 16 oz./sq. ft., but don't use less than a .19, because of the high drag factor. The engine run is over ten minutes, as you will use half throttle for much of each flight. I originally fitted a T-F 10/3½ wooden prop, but the Graupner 10/3 glass filled nylon is better for aerobatics, again because of the high drag; the finer pitch allows more revs from the engine.

My first flights were hairy because the model totally lacked in directional stability around the yaw axis. The scale sized rudder I had fitted was too small, and she would fly crab-wise after a turn. Furthermore, aileron adverse yaw was so great that on applying right aileron slowly to full extent, she would perform 360° left turns ad infinitum! This really got me all crossed up when landing towards myself, as the correct aileron deflection always produced the wrong response! I discovered that to minimize adverse yaw, I needed to double fin area; this was first done experimentally by taping huge chunks of 1/32'' plywood to the rudder. Previous experiments using differential aileron throws were unsuccessful; the differential made the model wallow alarmingly and did not help at all.

I now had a new problem in that her behavior in turns was inconsistent. To the left, she performed aileron turns very well, but to the right, she dragged around, tail hanging low, and she fought against the turn all the way. She needed a fair amount of coordinated right rudder. The effect was caused by insufficient right side thrust. The phenomenal amount shown on the plan produces reasonable right turns on aileron/elevator only, except at very low speed when she needs a tad of rudder. Please note that I've not described the above details just to frighten people off Avro 504's! My experience should help readers to identify and cure similar symptoms in many other models, e.g., Curtiss Jennys. Slight adverse yaw is still present, but by feeding in a touch of coordinated rudder, the effect disappears