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FORMATION...

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ON THE COVER

Distinctive aircraft shapes stick in the mind. Pure elegance of line is not necessarily the trigger although in some cases, one might conclude that a particular aircraft type in so ugly, it's beautiful!

The Fairey Flycather's shape is certainly 'distinctive' and has been well captured by Ken Dallow in his 1:40 scale model, reviewed in this issue.

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CONTACT

Scale sailplanes are very much a niche-interest branch of our hobby and one that FSM is delighted to support on a bi-monthly basis under the guidance of our columnist Chris Williams.

Part of the reason that this side of our hobby tends to be it's own 'specialist interest' is perhaps the unique requisites for getting involved. For example, to fly a scale R/C sailplane alone, or at least unaided, requires its own type of flying site, i.e. a suitable hill ridge from which to sustain flight on the updraft ... slope soaring.

The alternative, on a flat-field flying site, is to tow the sailplane aloft behind a suitable powered model aircraft. That takes two - glider pilot and tug pilot, so it's a collective affair between like-minded enthusiasts and, in most cases, very much a collaborative club orientated operation. Scale sailplanes have been part of my own participation in our hobby, periodically, from a long way back - most of it in terms of air time from a slope soaring site, but I found that getting a sailplane aloft from a flat field site, by Aerotow to be much more exhilarating as a prelude to 'cheating gravity' by thermal hunting.

So, to temp those who think they might like to explore this branch of our hobby, but who have held back, this month's FSM starts a two-part feature covering the basic requirements and techniques required for the thoroughly rewarding discipline of Aerotowing, together with a construction feature for a really elegant quarter scale sailplane.

CESSNA 165

A sport-scale model designed by Peter Rake, with the prototype model built by Vicky Young

Before I get in too deeply here, let me explain the reasoning behind this model. As anyone familiar with my designs will know, Cessna types aren't my usual fare. They have too few wings and nowhere near enough rigging! So, while looking for a really simple model, one that might very well appeal to a novice builder, this nicely boxy Cessna caught my eye. Boxy, but not without interest.

However, there were certain aspects of it that might not prove that easy to build if this was to be your first scale (ish) model. This is why I only describe this as a very sport-scale version of the type, because I've modified it slightly to produce what is intended to be an easier-to build-model. It still retains most of the character of the original, but is a little fatter in the fuselage, the idea being that by extending the flat sides to the rear of the wing, this deviation would allow for a much simpler wing-to-fuselage join. The fact that it also allows more room inside the fuselage for installing the radio gear is just a happy coincidence.

The design was inspired by a rubber power model and, throughout the structure, I've tried to retain that simplicity, but tied in with my usual style of construction to make the model both relatively easy to build and sturdy enough to survive those less than perfect landings to be expected from novice pilots.

THE BUILDER

Now I'm sure that Vicky won't be too offended if I start out by mentioning that she isn't the world's most experienced model builder; a competent enough pilot, but still quite new to building models from plans. As such, she has done a bit of experimenting with techniques as the build progressed. Some worked well, while others are still under discussion as regards their effectiveness.

Along the way, she also discovered some tasks that gave her problems. That would not have been the case for anyone used to building this style of model, but I remember only too well having just those same problems when I first started building models.

That being so, I'll pay particular attention to these areas as we come to them. Regardless of what problems were encountered along the way, the important thing is that Vicky enjoyed the build (when she wasn't cursing said problem areas) and ended up with an attractive model at the end of the adventure.

BACK TO THE MODEL

Okay then, let's take a closer look at getting this model built. Because of its relatively simple nature I won't attempt a

Here you can see just how visible the colour scheme worked out.

blow by blow description of how it goes together. Instead I'll restrict my input to describing basic techniques required and highlighting those areas that gave Vicky problems. Believe me, as long as you study the plan, think through each stage and don't be in too much of a rush to get the model built it isn't a complicated build at all. If you do still need step-by-step guidance, I would, without being insulting in any way, suggest that you build a few more kits before tackling a plan-only build. Until you understand the basic techniques involved, or are prepared to read up on such building tasks, building kits with full instructions is the best way to learn. Once you find yourself relying less and less on those instructions, and finding many tasks to be second nature, THEN you are definitely ready to tackle more complicated, plan only builds.

Vicky is a novice builder (albeit with a more experienced modeller husband to query about build techniques), but she demonstrates admirably that the model can be built if you are prepared to take your time and think through each stage of construction. If in doubt about any point ask somebody who has more building experience.

There are plenty of on-line forums around and if that fails, I'm never more than an e-mail away. Mind you, if I'm your only hope you really are in dire straits. The one thing I would recommend is that you purchase the set of laser cut parts from the publisher. That in itself will remove one of the biggest hardships from plan building, and ensure that all the parts will fit as intended.

So, with all that rambling on out of the way, let's get on with building a miniature Cessna.

TAIL SURFACES

Since these are definitely the simplest parts of the model this seems as good a place as any to ease you into plan building.

Although the actual build of the tail surfaces is very straightforward, they also involve a task that gives many builders problems - the dreaded laminated outline. At least with this model there are no tight bends to worry about so it shouldn't cause you too many problems. Personally I don't understand why so many people have trouble with the process, it really isn't that hard to do. However, since these may well be your first set of laminated outlines, I'll attempt to walk you through the process.

Begin by slicing your strips of 1/16" balsa. These don't need to be from particularly hard balsa, just as long as they aren't soft, spongy wood. The laminating process provides surprisingly strong outlines for the weight of wood involved, so please don't discount it out of hand. Strips may be a little wider than 1/8" (the finished structure will get sanded), but avoid making them any narrower or you'll end up with a surface that is impossible to sand smooth without making the tail surfaces much thinner than they are supposed to be.

Next, soak your strips in warm water for about half an hour. This will make them nice and pliable for when we do start the laminating process. While they're soaking cut out some templates to the inner line of the outlines shown on the plan and tape the edges to prevent the glue sticking. A beautifully laminated outline is no use at all if you can't get it off the template without breaking it. Pin down these templates (which should be at least as thick as the strips are wide) onto a polythene protected, flat board.

Now, glue (PVA, not CA) together the required number of still dripping wet strips of balsa and, while they are still soggy and pliable, secure one end firmly against your template. I like to use a scrap piece of balsa pinned to the board for this because it avoids a pin creasing any of the balsa strips.

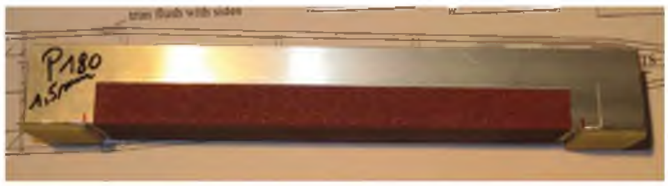
Gradually pull your glued (and still soggy) strips around the template using further pieces of scrap balsa pinned in place to ensure all the strips remain in close contact with each other and with the template. Once you've worked the strips into place all the way round the templates, leave them to dry thoroughly before attempting to remove the outlines from the board.

Once you have your outlines it's just a case of pinning them over the plan and gluing in place all the cut parts and strip that make up the tail surfaces. Allow to dry, sand overall and round off the edges as shown on the drawings.

Finally, with both elevators

Although I don't advocate the pin 'fence' method (see text) this is how the laminated outlines are built into the tail surfaces. In this case, one elevator.

The tailplane all sanded and with the edges rounded off.



Not from Vicky's build but a useful example of a simple tool to ensure you don't sand the tail surfaces too thin.

As you can see, there's nothing overly complicated about the wing panels. Just see the text about spar material.

The basic forward fuselage box provides a solid base around which everything else fits.

How the cowl is planked and sanded to shape.

The simple mould Vicky made for producing the cowl blisters.

drilled and grooved for the joiner wire, pin them back onto the plan and bend up the joiner to match the holes. Then epoxy the joiner into the elevators.

Note that the rudder leading edge should be drilled and grooved for the tail wheel leg, but do this after the rudder is covered or the wire will only get in the way.

Okay, so maybe that took a long while to explain for such a simple task but it does get better from here on in.

WINGS

Building the wing panels really is pretty simple stuff. However, don't be even slightly tempted to use anything less than bass for the spars. They are what take the flight loads, so anything less simply won't be up to the task. Spruce is fine if you can't get bass but hard balsa definitely isn't.

You'll notice that the trailing edge pieces are quite thick for such a small model. This is to allow for the taper from the relatively thick root section to the much slimmer tip. Don't taper them until you have the wings built and can carefully plane (You do own a razor plane? If not I would strongly advise you to get one. Once you've used it you'll wonder how you ever managed without.) them down to match the wing ribs and wing section.

Similarly, laminate the wing tip parts and build them into the wings, but don't shape them until the wings are complete.

The final point of note here involves the root rib angle. The section through the spar shown on the plan is full size, and shows the correct dihedral angle. Use this drawing to mark your spars with the angle at which the root rib should be glued into position when actually building the wing panels.

COWLING

I'll deal with this as a separate item since it's one of the areas that gave Vicky a little trouble; not so much with building the cowl, but more to do with shaping, smoothing and adding the cowl blisters - nothing major, just things related to the learning curve that is scale modelling. In the early days the curve is quite steep but levels out the more building and experimenting, you do. No matter how many models you build, there's always something new to learn, so don't be put off if initially things don't quite turn out as you'd have liked.

As you'll see from the photo of Vicky's cowl, it's planked and sanded to shape before having the cowl blisters applied. Unfortunately Vicky applied the blisters and then attempted to smooth out the cowl. It would have made her life a lot easier if the cowl had been smoothed, sealed, primed and sanded completely smooth before adding the blisters. The blisters are such a prominent feature of the original aircraft that they really have to be included on the model but it's just a

All in all, a very attractive little model.

If you're going to use snakes instead of pushrods make sure they're supported along their length, as Vicky has.

matter of thinking through each stage before diving in with the glue..

Vicky actually moulded her cowl blisters in resin (a master pressed into modelling clay multiple times after whiuch the resin was poured into the depressions and allowed to set - a brilliant idea for achieving uniformity of same, but resin tends to be somewhat harder than balsa when it becomes time for sanding smooth.

FUSELAGE

Yes, I've left the biggest lump of model until last. Well, no point building the fuselage until you're sure you have everything else built successfully. Although it is the biggest part, there aren't really too many points to raise here.

Most important point is probably to ensure that you use the hardest balsa you can get for the longerons, and to make sure that all four are of equal flexibility. If they aren't, you'll have problems producing a straight fuselage when you gather the longerons in the tail.

Now, as it happens, Vicky had just such a problem. After a few attempts, which all failed to achieve the desired result, she approached the task from a slightly `outside the box' angle. Since the longerons are just straight pieces of strip when viewed from the side, why not build a top and bottom frame over the plan and then join them with uprights which are just more straight pieces of balsa? No reason at all apparently because that is precisely what she did in order to arrive at a straight fuselage, with both sides curving in evenly to the tail. As soon as I saw it, it reminded me of doing something very similar in the dim and distant past. Just make sure that, if using this technique, you don't alter the incidence angle of the tailplane in the process.

Another point of interest is that you must pay careful attention to accurately installing the F4/F4A assembly. If that assembly isn't installed accurately you won't get even dihedral when you glue the wing panels in place.

Unless approached in the correct way the nose section of the fuselage could prove problematic. Where those sides angle in sharply, make a score on the inside of each fuselage side, immediately in front of where former F3 will go. Gently crack the sides along the score lines and work glue into the score before pulling the sides in to fit into F1.

The side blocks are more easily shaped if cut as wedges - make one and then cut it in half diagonally across the top. Then, regardless of them being over thick at the front end, they will automatically feather neatly into the fuselage sides at F3. Make sure all the nose blocks (the two wedges and the lower section) form a complete rectangle for you to trim down to shape. Since the lower section will ultimately be the removable battery hatch it's probably easiest if the side wedges end level with the bottom edge of the fuselage sides and the hatch piece runs the full width.. Similarly, the belly block should be full width too. As you may guess, from the inverted servos, at least a portion of the belly block needs to be removable for access to the radio gear. However, since you shouldn't need regular access, it may be tack glued in place once the gear is installed and the model covered.

Other than these points, building the fuselage is all pretty straightforward stuff. Take your time, think through how you intend to go about it and check that your idea actually works before applying the

ABOVE: Although a little battle scarred, and here minus the spats, the little Cessna is all set for yet another attempt at flight. Successfully so this time.

LEFT: Vicky poses with her creation and has every right to look pleased with herself.

glue. I seldom use CA when building fuselages. I like PVA for balsa-to-balsa joints and five-minute epoxy for gluing in stressed formers and motor mounts. CA is too brittle for these tasks and the last thing you need is a motor that changes its' thrust lines every time you have a slightly heavy landing.

COVERING AND ASSEMBLY

Covering is always going to be a personal preference sort of thing. Tissue, Litespan, So-Lite, even Solarfilm are all viable options. Being in experimenting mode, however, Vicky opted for document laminating film and paint. Yes, I know it's very green, but it is the scheme used on an actual full size example of the Cessna 165. At least Vicky was able to avoid her daughters' choice of sparkly pink!

Assembling the model is pretty simple stuff really. Because the F4/F4A former assembly sets the dihedral and the locating dowels ensure the wings go on at the correct incidence angle it's simply a case of gluing the wing panels to the fuselage sides and the spar extensions to the step in F4/F4A. Make sure those spar stubs are securely glued in place because they are really what's holding the wings on. The tail surfaces now have a guide to alignment as you glue them in place.

As regards the cowl, since there's ample motor access through the front, that can be simply glued in place.

FLYING

Now, while it would be very nice to be able to say that the maiden flight went smoothly and the model proved a superb flyer, that notion would be stretching the truth slightly. Okay, it would be downright lies, since the maiden flight was actually something of a disaster. We never really discovered quite why that was so, but possibilities included a sticking elevator servo, broken servo mount and lack of down thrust. Whatever the cause, the model climbed violently, stalled and headed straight for a field of what looks to be Rape. Yes, a green and yellow model hiding in a green and yellow crop.

Repairs were minimal, but took time before a second attempt at flight could be made. Once again, it didn't go quite as well as we would have liked. Possibly because of the tapered wing, but also possibly because the model was rushed into the air, it tip-stalled and dislodged the motor.

Next time out Vicky was taking no chances. Heavy wheels and spats were replaced by lighter ones, down thrust was increased slightly and the wings had a little wash-out warped into them. Balance was left exactly as before, which is to say with the model hanging slightly nose low at the point shown on the plan. The result, SUCCESS!!!!

Because the supposedly steerable tail wheel had become non-steerable somewhere along the line the model required a lot of rudder on the ground, but not much while flying. Power was just about right and the model proved nice and stable.

The best way to steer it proved to be small 'dabs' of rudder with counter 'dabs' to cancel the turn. If you didn't counter the turn, the model just carried on turning. There isn't a huge amount of dihedral, so it's never going to be as self-righting as a trainer. The landing was uneventful.

For flying control throws were 13 mm on rudder and 11 mm on elevator, but more rudder was required for ground handling.

My thanks to Vicky for both building the model, and persevering to arrive at a model that actually flies well. I really didn't expect that green colour scheme to work, but there's no denying it results in a rather attractive model. Certainly one that is easy to see in the air, even if not in a field of Rape. ■

AEROTOWING FOR

PART 1: For those who have never tried it, the aerotow launched scale sailplane is a branch of our hob scale glider master deigner, the late Cliff Charlesworth

The exercise of getting a model glider, either Scale or otherwise, into the air can be achieved in any of four ways. The most obvious is that the model can be launched from a hill/ridge site into the prevailing wind of `instant lift', which can be particularly useful as a `least hazardous' means of initial air testing. The three others are, or have at one time or other, been used to get a glider to useable height from a flat-field flying site. Of these, bungee chord launch and power-winch launch are mentioned here merely for historical reasons, since neither now have very much relevance today,

Ali Machinchy's Super Decathon tows a 3rd scale Habicht at Middle Wallop. ***(PHOTO: Chris Williams)***

SCALE SAILPLANES

by, not to be missed. This two-part feature is based on the teachings of

having been bypassed universally in favour of Aerotowing, behind a suitable, powered model.

Aerotowing provides the means of reliably getting a scale R/C sailplane to the required altitude for sustained flight via thermal hunting. It is, in effect, also 'more scale-like', particularly if the powered aero tug is also a scale model - although any model with the requisite size, power and general layout, will do the job - all of which we will explore in this two-part feature. Aerotowing has its own specialist techniques, which will be covered in this two part feature.

FIG.1.

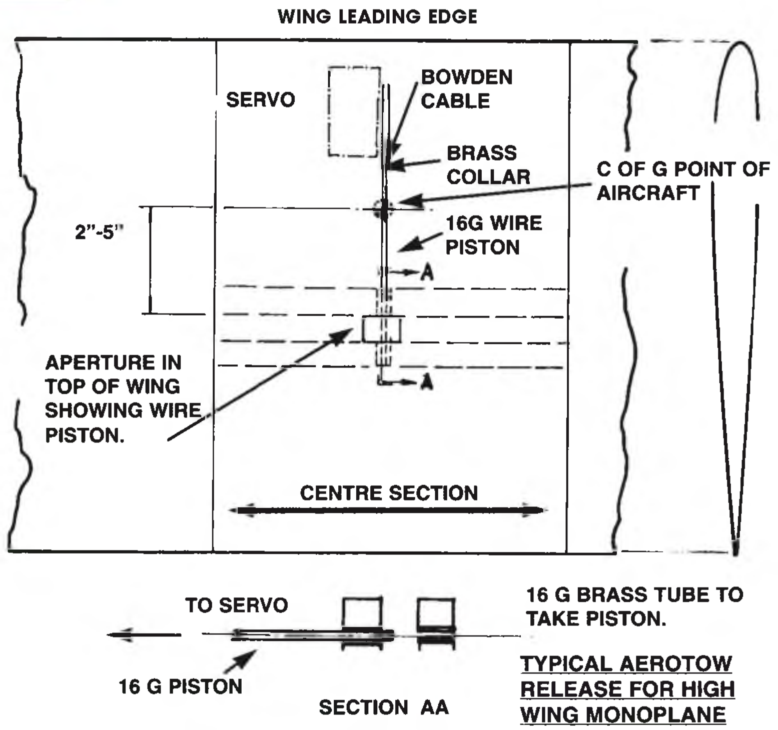


FIG.2.

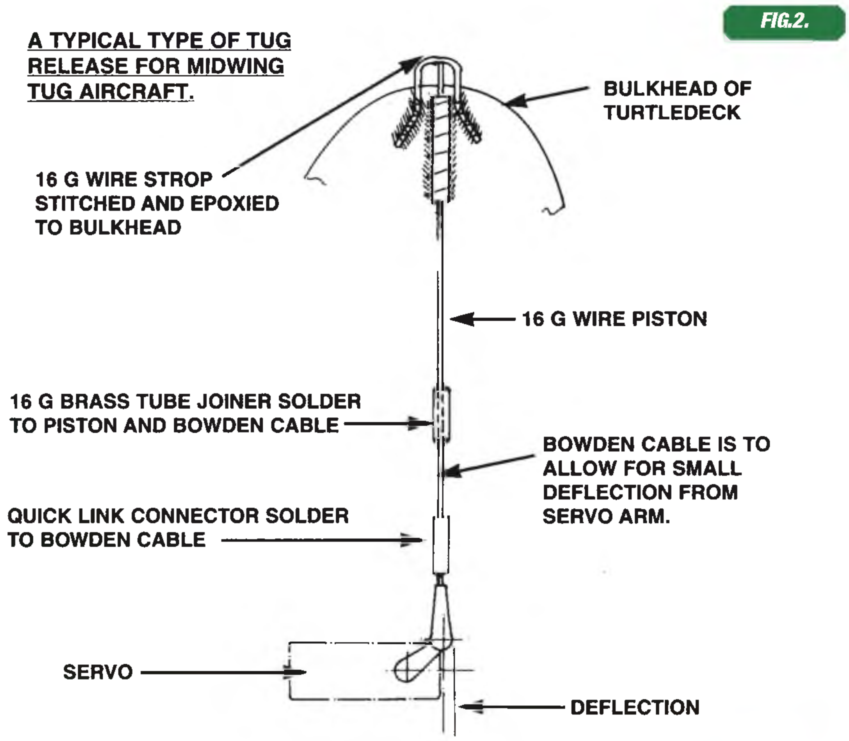
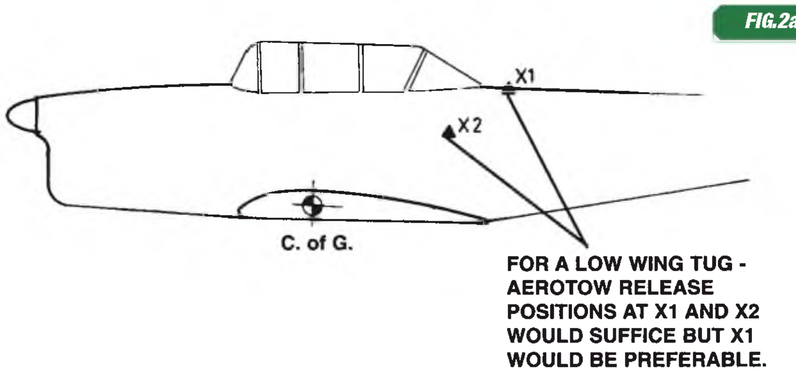


FIG.2a.



The basic equipment required for towing a glider aloft is: -

i) A suitable powered model aircraft fitted with a tow line that can be released by radio control and which has an engine sufficiently powerful to tow the largest scale gliders, which can weigh up to 20lb, or maybe even more.

ii) A Courlene towline with loops at either end to take whatever fittings are required by either the tug or the glider. (Courlene is crab fishing line 1/16" diameter, orange in colour, with a breaking strain of 25 lb approx.)

(iii) A 1/5th, 1/4 or even a 1/3rd scale glider, or indeed a non-scale glider, with a wingspan ranging from 2.5m to maybe 6m, fitted with a suitable tow release arrangement in the nose that can be released by radio control.

MORE ABOUT THE TUG AIRCRAFT

Now let us go into more detail about the tug aircraft and its equipment. In this two-part series we are, of course, talking in general terms about basic aerotowing techniques that apply to both scale and non-scale aircraft. Because of the very nature of the work requirement of the tug, it needs to be built extremely well. Its engine, radio, servos and ancillary equipment need to be the best you can buy. In other words, it has to be 100% reliable and capable of providing aerotug servises typically throughout a full flying day. Naturally there is no vital need for the tug aircraft to be a scale model at all, just one with the requisite characteristics to provide to the performance that will get the glider 'upstairs'.

A single tug aircraft will, if maintained and looked after properly, serve a Club for a long time and is quite capable of launching a number of gliders in a short space of time so that it is possible to have, say, six or even gliders soaring simultaneously depending on how active the thermal activity may be, in which case the tug can be temporarily on stand down.

Aerodynamic stability and the requisite towing power are the basic requirements, so set out below are typical examples of aircraft that, at the appropriate scale model size, adapt well as scale glider towing tugs. There are of course, many more:-

(High Wing)
- Piper J-3 Cub
- Piper Super Cub
- Christen Husky
- Aeronca Citabria

(Low Wing)
- SOCATA Rallye 3000
- DHC-1 Chipmunk

There are of course a wide range of other full size aircraft that have similar characteristics that can be modelled and used as tug aircraft. All the above aircraft have sufficient wing area and carry a suitable wing section i.e. Clark Y or a modified RAF 32 section that will give good lift at moderate speeds. A tug that flies fast is definitely a 'no-go' subject, especially when you are trying to tow a

20lb vintage glider. In a case such as this, a tug aircraft with a high wing loading would run the risk of stalling on the tow, so stay away from aircraft that carry fully symmetrical wing sections and which are short on wing area. All the controls on the tug need to be driven via heavy duty control rods, so could be carbon fibre tubes with 3mm metal end fittings at both ends.

Do not use plastic control horns. Nylon or metal types are much more durable and there are some really good options available, particularly those used for the big scale aerobatic model aircraft. If you cannot find them in the shops, buy some dural sheet and make them. The controls on your tug aircraft need to be positive in action and free moving. Whatever you do, don't end up with 'humming' servos, otherwise you are going to run your receiver batteries low prematurely during a day's aerotowing operation. If you intend to be top of the stack as a tug pilot, then your tug equipment has to be the tops to give you 100% reliability.

A good airborne power pack set-up might be two 2200mAh receiver batteries linked to an electronic battery backer.

The battery backer will switch over to the auxiliary pack when the main battery gets low. When this happens, the LED on the battery backer will illuminate, so the backer needs to be installed in a position where the LED is immediately visible.

LINK-UP AND RELEASE FOR THE TUG

The tug aerotow release mechanism MUST be simple and 100% reliable. The tow wire MUST also be releasable at BOTH ENDS, to cope with any emergency during the tow. The position of the release on the tug aircraft should be 2" - 5" rearward of the fore/aft balance point (C.G.). On a high wing aircraft similar to the Piper J-3 Cub, Piper Super Cub Aeronca Citabria etc., the servo and release mechanism can be installed very neatly in the centre section. See **Fig. 1**. The same type of release can be made to suit many aircraft.

However, in the case of a tug with low wing configuration, the situation is a little more difficult as the release has to come out on the side or the top of the fuselage within the rearward location stated from the C of G. See **Fig. 2** and **Fig 2A**.

The reason for putting the tug release within these constraints is to limit the adverse flight effects that the glider can have on the tug during towing. If the release were to be placed further rearward behind the balance point (say14" - 18") and the glider were to climb very steeply or run sharply to either left or right, then the pull of the glider would interfere with the flight direction of the tug.

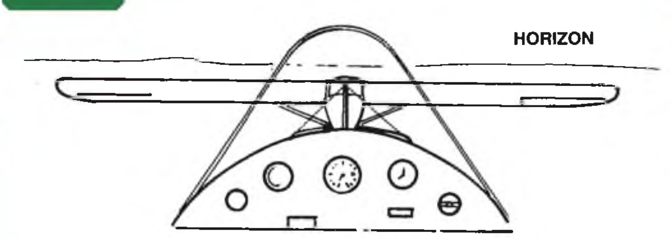
In a full-size aerotow situation, things are different. When you are in a glider behind the tug, you are able to view the position of your glider relative to the tug, controlling your climbing attitude and any yaw from left to right to hold correct station relative to the tug aircraft, thus minimising any effect on the tug. See **Fig.3**, which is a typical view seen from the cockpit of a full size glider.

When simulating this in model form, if the tug aircraft towline hook-up position is too far rearwards, the situation gets harder to follow and control as the tug and the glider get further away from you. If the model towline release is within the rearward limits stated here, you can allow the glider a fair degree of latitude without affecting the flight path of the tug.

WHAT MOTOR?

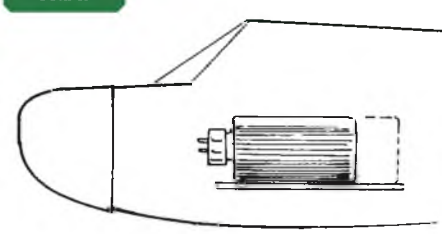
Now let us deal with the power plant for the tug aircraft. Reliability is the key here, so ease of starting and reliable tick-over are most important. If your tug is, for example, to quater-scale and, say, around 105" to 120" wingspan, the approximate weight should be between 20 - 26lbs. To tow large-scale gliders that can weigh anything from 8 -20 lbs. dependent upon the subject, an engine that can deliver plenty of 'oomph' at the right moments is needed. This is because

FIG.3.



THE VIEW FORWARD AS SEEN FROM THE COCKPIT OF A FULL SIZE GLIDER ON AER0TOW. THE GLIDER IS AT THE RIGHT ATTITUDE TO THE TUG.

FIG.4.



FUEL TANK INSTALLED REARWARDS ON PETROL POWERED TUGS TO ASSIST C OF G POSITION THIS IS TO AVOID ADDING DEAD WEIGHT TO THE AIRCRAFT.

Does this prove that queuing is what the British do best? Glider pilots await their turns with the most popular man of the day! *(PHOTO: Chris Williams)*

FIG.5.

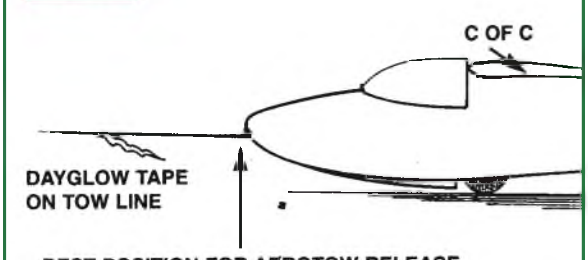
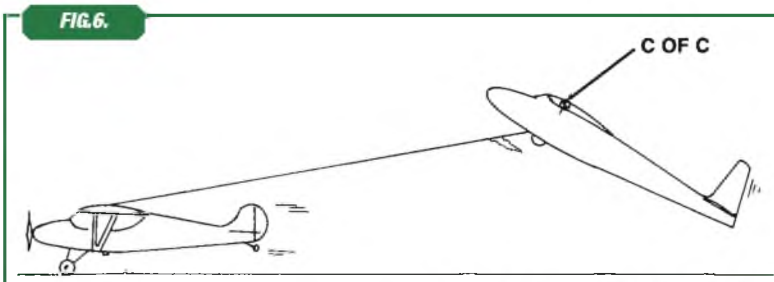


FIG.6.



there will be times during towing when tug and glider will climb out through rough turbulent air and it is these situations that require all the power that is available.

Petrol engines of 38cc to 70cc are suitable for towing, with the former really the minimum; units of around the 45-60cc mark are preferable. Petrol fuel is also the least expensive - with glow engines, the fuel costs would be much higher. In the case of glow-plug engines, batteries are required for starting and, invariably, these do not have any fuel pumping facility attached to them, which will tend to dictate the position of the fuel tank.

With a petrol engine, for example a Zenoah 45 or 62, fuel pumping facilities are built into the unit, so a large capacity fuel tank can be installed in the belly of the aircraft in a position that assists in balancing the aircraft correctly. There is no sensitivity to position of the fuel tank in relation to the engine carburettor. See **Fig. 4**.

Towing with smaller sized power units is possible, but there will be less power to spare if there is a problem during the climb-out when power is low. In good conditions with a 30cc unit, the tow can last up to 3.5 - 4.5 minutes, dependent upon the release height you intended. Compare this to a 60cc unit and you are looking at tow times of around 1 - 2 minutes. If you were doing an aerotow for scale effect, then of course, the lower powered machine would be adequate. For general towing, it is certainly worth going for the larger petrol units; after all, throttle setting can be retarded if required.

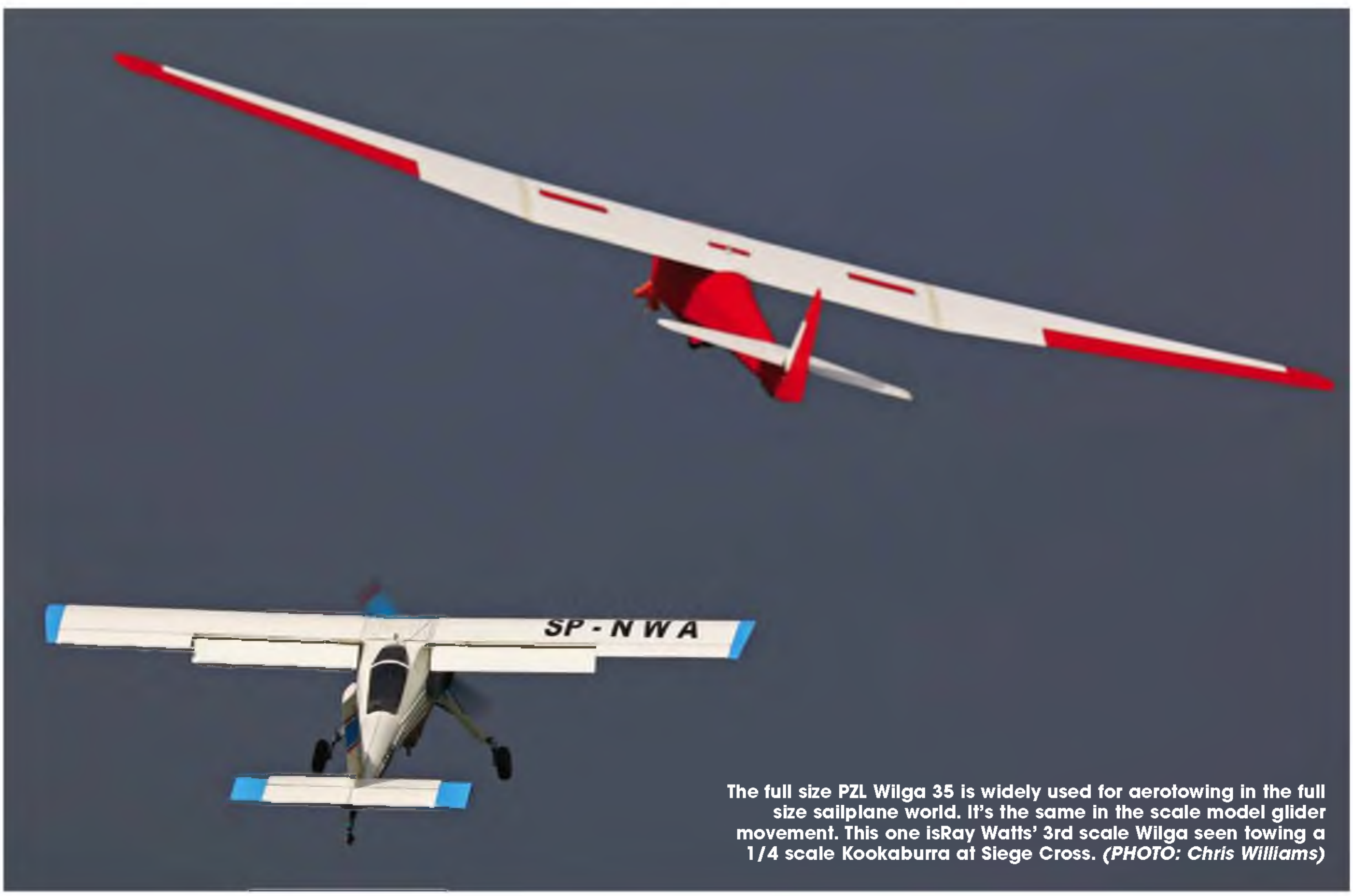
One final point to consider when putting your tug together is the undercarriage and the steerable tailwheel. Both of these items are going to come in for a hammering, so wire joints need to be silver soldered, with spreader bar bungees used to control the track width. Good quality air wheels should be used and kept at the correct pressure.

There are many steerable tail unit assemblies on the market, so buy a heavy-duty type, which will serve your tug well. The Dubro Cub type, or similar, is strong and will give you good service.

Finally, if you do choose to use a large petrol engine in the tug, then use a wooden prop, but ensure it is perfectly balanced to minimise any vibration. Before every flying session, always examine your prop for damage. Throwing a prop blade during a tow can result in disaster for both tug and glider. Above all, always carry a spare, just in case you pick up debris on the take off or when taxiing.

LINK AND RELEASE FOR THE GLIDER

The only special piece of equipment that you need on your glider for aerotowing is a towline hook-up mechanism that can be released by radio control. This is



The full size PZL Wilga 35 is widely used for aerotowing in the full size sailplane world. It's the same in the scale model glider movement. This one isRay Watts' 3rd scale Wilga seen towing a 1/4 scale Kookaburra at Siege Cross. *(PHOTO: Chris Williams)*

positioned right in the nose of the aircraft. See **Fig. 5**.

On some of the old (vintage) full size gliders, the hook used for aerotowing was basically in the same position as the winch launch tow point. However, sense has prevailed and many of them have been modified to bring the tow hook into the nose area, so if there are modellers about who have gliders with a winch hook fitted, do not use it for aerotow unless you want a hair-raising ride. Here is the reason.

When you try to tow a glider up with a rear mounted hook as in **Fig.6**, the glider will always try to zoom up at a steep angle of climb well above the tug and if a tow continues, the glider may start to wander side-to-side to such an extent that it would end up almost alongside the tug. See **Fig. 7**.

It may be of historical interest for know that there have in the past, been a small number of fatal full size accidents when aero towing with the old hook position.

The towline anchor point needs to be fixed very strongly to be able to withstand snatch loads sometimes experienced on tow when the line goes slack.

There are a range of basic types of towline release that are simple in operation. Some are commercial items, while it is also possible to develop you own, best suited to your model. Typical of the commercial items that have been available is what can be termed the ball-end-and-wedge-plug as shown in **Fig.8**. It works for some, but others have found it not entirely reliable.

In **Fig.9** is shown one type of hook you can make yourself quite simply from 16g wire and tube and a little piece of brass strip. The later has proven reliable over many years, with never a failure! It requires only a I" split steel ring on the end of the tow line so that, If the towline does get lost, which happens sometimes, you haven't lost a precious ball-end fitting, only a small split ring which can be obtained from a fishing tackle shop a dozen at a time. If you happen to be building a modem glass sailplane there is another cheap reliable release that you can install that doesn't require any end fittings on the towline. Fig.l0 shows how.

The released illustrated in **Figs 8**, **9** and **10** all rely on a rearward withdrawal release action.

An alternative is shown in **Fig 11**. Here, the mechanism consists of a long guide tube set into the extreme nose of the aircraft. The rear end is anchored inside the nose section alongside which a release servo is installed. The servo drives a release pin that is withdrawn sideways. The towline end is simply a long narrow loop fed along the tube. For the link-up, the servo drives the release pin home through holes either side of the guide tube. Upon release command, the servo withdraws the release rod to release the tow line.

Whatever the towline release mechanism chosen, it is vital that it must be to be fixed very strongly, to be able to withstand snatch loads sometimes experienced on tow when the line goes slack.

Release at both tug and glider ends of the towline is essential as insurance against release hang-up at either end.

FIG.7.

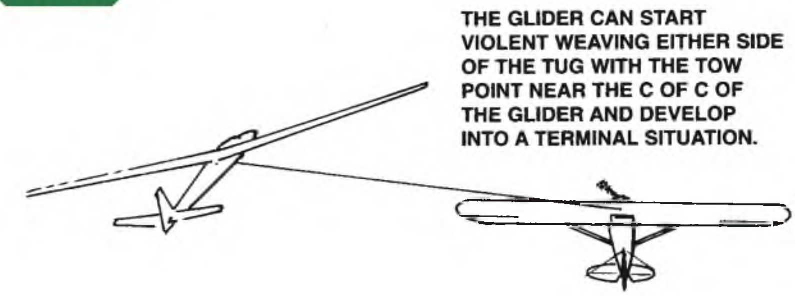


FIG.8.

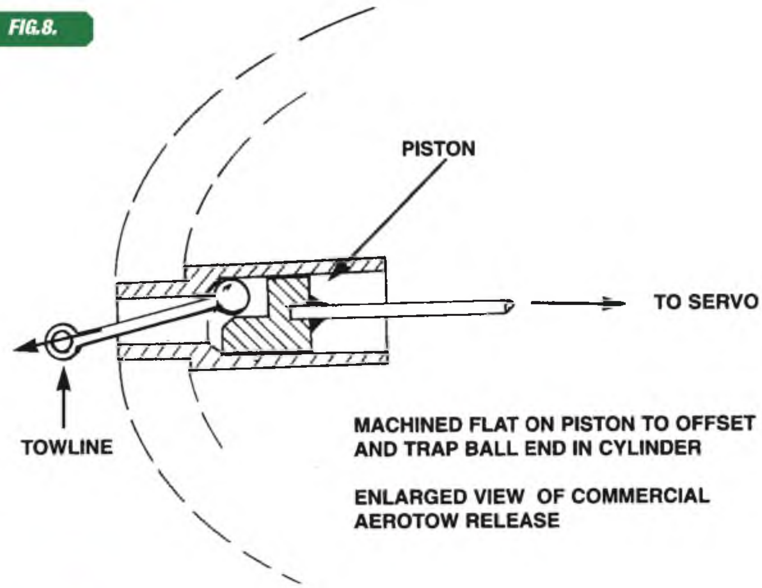
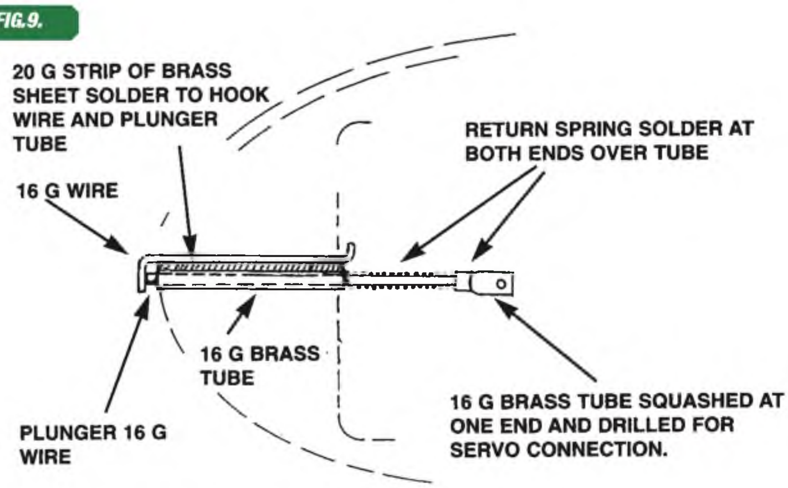
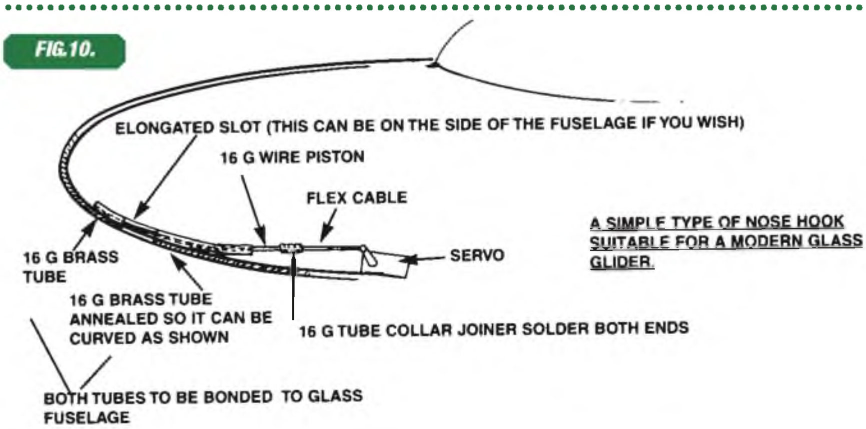


FIG.9.



AEROTOW NOSE HOOK EASY TO MAKE SIMPLE TO OPERATE

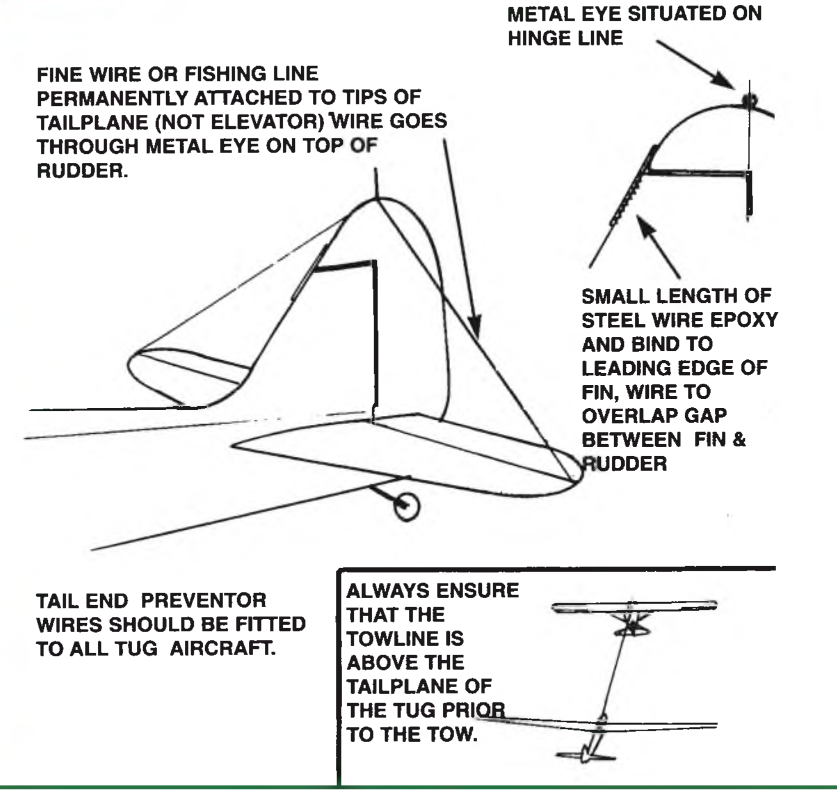
FIG.10.



Piper Super Cub offers ideal characteristics for a scale model tug aircraft. This quarter-scale example sen at the old TVSA site, Siege Cross Farm. *(PHOTO: Chris Williams)*

These days, model glider tugs are not limited to internal combustion engine power. This is Gordon Tarling with his electric powered Pilatus Porter, the ultimate in fuel economy! *(PHOTO: Chris Williams)*

FIG.12.



Whichever style of towline release is selected, reliability and compatibility is vital - and you should always have a spare hook-up line available just in case the tug pilot has to dump the towline in an emergency.

NO SNAGS PLEASE

To avoid the towline from becoming snagged on the tug's tailplane, it is essential to fit a guide-wire fender on the leading edge of the fin to run across the gap created by the balanced rudder and to fit a wire from the tip of the tailplane over the top of the rudder at its hinge line and down again to the opposite tip of the tail plane. These wires are permanently fitted and obviate completely any possibility of the towline becoming jammed in the tailplane. Prior to the commencement of any tow, always make sure the towline is coming from the top of the aircraft, then over the top of the tail on one side or the other. See **Fig.12**. ■

FIG.11.

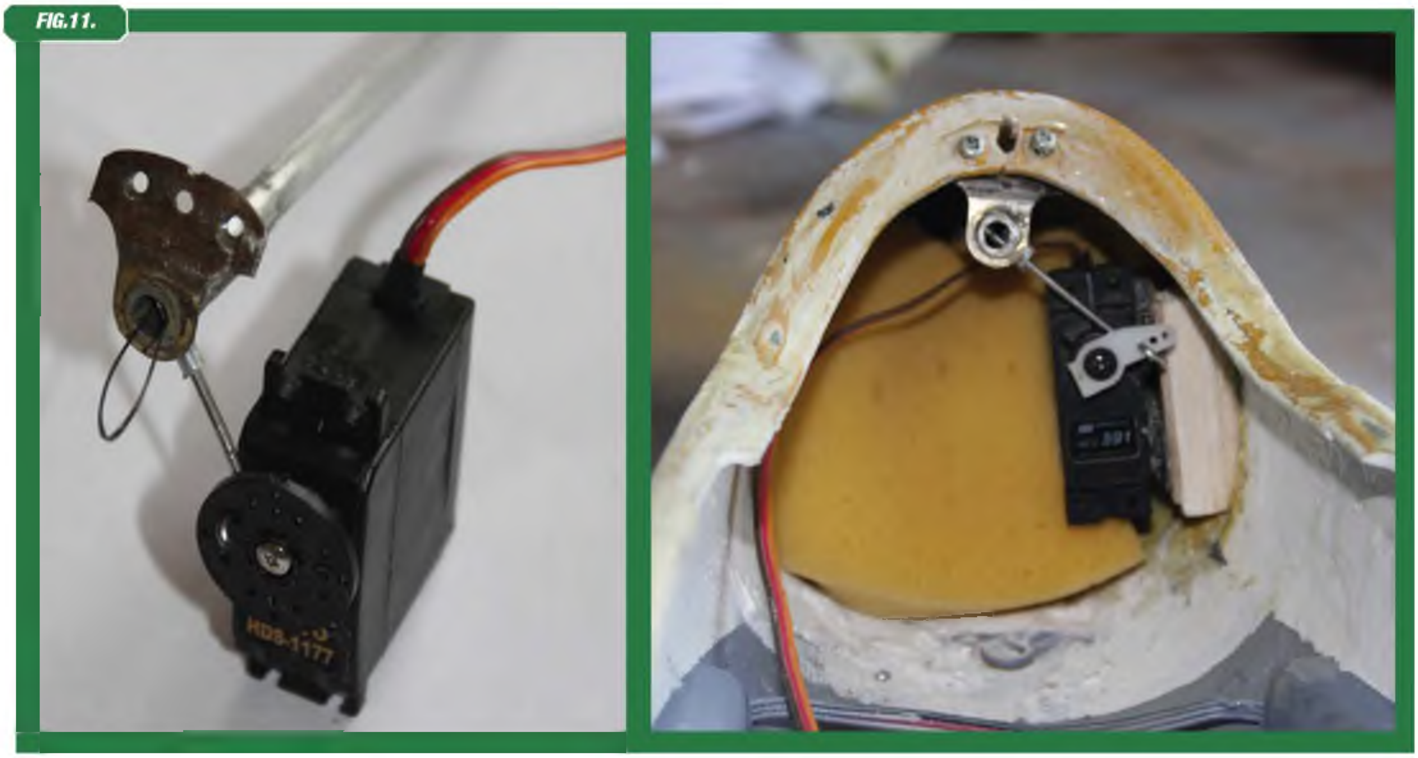


Fig.11: This towline release comprises a length of tube, buried in the fuselage nose. The towline link at the glider end has a long, slim loop, which is fed up the tube to the inside end. The servo mounted on the fuselage side withdraws the piano wire lock/release pin sideways across the fuselage at 90 deg. to the line of flight.

FAIREY FLYCA

ATCHER

The quirky little aircraft that advanced British naval aviation

Ken Dallow is a noted scale modeller, and Large Model Association pilot, who built a smaller Flycatcher some years ago. He was pleased with the performance of that model, but craved a larger version. Ken's latest Fltcatcher is entirely scratch-built. (He has a well-appointed shed). The model is built to 1/4 scale which gives a wingspan of 87". and is powered by a magnificent Saito 36cc four stroke petrol engine driving an 18"x10" Falcon wooden two-bladed propeller. The Fairey Flycatcher weighs in at 26lbs.

1: Centre section and cockpit very neatly executed.

2: Ken used the three layer sandwich method for the dashboard. Brass bezels from live steam hobby sources.

3: Hatch, hinge, and foot well detailing is convincing. Note also rivets and lacing.

4: Simple but effective windscreen detailing.

Plan

Ken drew up his own plans. To ensure accuracy, he based on these on the original 1/48th scale factory blueprint sourced from Fairey Aviation archives via Westland Helicopters, as long ago as 1969.

Documentation

Ken used Profile Publications No: 56 Monograph: "The Fairey Flycatcher" supplement by further detail gleaned from the book: "British Naval Aircraft since 1912", by Owen Thetford.

Ken's Flycatcher is modelled on an example from 406 Group operating from HMS Glorious in 1931.

Construction

Ken is a traditional builder, so his model is mostly constructed from balsa, birch ply, lite ply, cyparis, and spruce. The model was bult over a five year period, with interruptions when Ken's centre of attention moved to other projects.

Fuselage

The fuselage is built up from birch and lite ply formers and doublers. The forward cockpit area is made from 1/8" balsa planking for the top, with sheet balsa sides. The rear fuselage employs balsa

A pleasantly quirky fuselage design, but a fine flyer.

The rigging is complicated, with lots of flying wires.

stringers over cyparis longerons, and the underlying balsa framework.

Wings

Each of the wings is a one-piece structure These were constructed with cyparis for the for spars, balsa and lite ply ribs and riblets, and 1/32" balsa capstrips. The centre sections are sheeted in 3/32" balsa.

Centre section stuttery

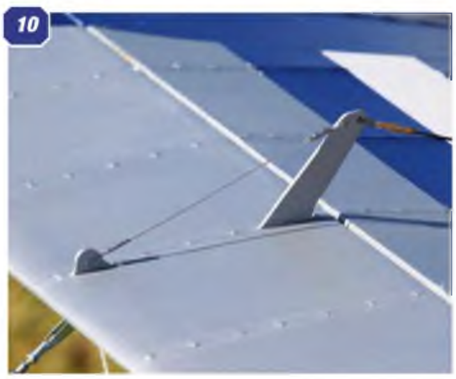
The centre section struts are a key part of any such scale biplane. On Ken's model, the top wing underside is bolted to plywood transverse supports on the 5/32" piano wire strut cores, with balsa fairings in the prevalent manner for scale model biplanes.

Tail

The tail is a conventional built-up structure constructed from spruce spars with balsa ribs. The tailplane is not fixed to the fuselage, but is mounted on a hinge and jack system which allows the incidence to be adjusted. The four struts are made from carbon with machined aluminium ends, which are adjustable.

Dummy engine

Because the fully exposed Armstrong Siddely Jaguar IV of the full size Flycatcher is such a prominent feature of the aircfact, any model of the aircraft will stand or fall in this significant area. Ken's example contains over 600 hand-crafted



5: The rear fuselage is full of character. 6: Fuselage tape and lacing detailing is all present. 7: Rear fuselage is top is stringered. 8 & 9: Rib tapes and stitching faithfully simulated on the wings. 10: Scale aileron horn and anchor points.

11: Ken has achieved a realistic patina on his (Williams Brothers)Vickers machine gun kit. 12: Forward fuselage is doped tissue, painted; rear is painted and sealed Solartex. 13: Note interplane strut detail. 14: Adjustable tailplane supported on carbon fibre struts with turned aluminium terminations. 15: Ken built the wooden tail skid from hardwood.

parts and in order to accurately replicate this prominent feature Ken visited the Science Museum in London to photograph the last extant example.

For Ken's 1/4 scale dummy, the crankcase is made from a blue foam mould which was machined to size on his lathe, and from which the 1/4 scale crankcase was then cast in fibreglass. The rest of the individual engine components were fashioned from balsa and birch ply, with aluminium pushrods, and dummy spark plugs.

Overall, Ken spent two months on the dummy engine, and used 5 square feet of 1/64" ply wood to make up the many cooling fins.

Engine

Ken selected a new Saito 36cc four stroke petrol engine.

Exhaust

The Flycatcher uses the standard Saito exhaust system supplied, which fits behind the dummy engine.

Prop

Flying prop chosen initially is an 18"x10" Falcon wooden item. When fully run in,

The Flycatcher could be airborne in fifty yards.

Ken expects the Saito to turn a 20"x12" prop.

Undercarriage
It comprises a frame support, with swinging arm rear section, and is fitted with working shrouded oleos. Wheels are6" diameter Williams commercial items.

Covering
The forward fuselage section employs doped tissue covering, sanded smooth. The remainder is covered in natural Solartex.

Painting
The front of the fuselage to the rear of the cockpit is painted with Halfords Aluminium car paint. It was then given top coats of matching gloss lacquer to simulate the alloy finish found on the full size example. The remainder of the model was given a coat of non-shrinking dope, followed by a layer of silver base coat, topped off with satin lacquer. The dummy engine was painted in Humbrol enamels.

Legending and Decals
The roundels were accomplished in the traditional manner with a draughtsman's pen and compasses, using Flair Spectrum Paints. Other stripes were hand painted using Humbrol enamels. The small numerals and masks were supplied by Flightline Graphics.

Cockpit details
The dummy Vickers machine gun is a Williams Brothers 1/4 scale commercial item, while the 'man in the office' is a Mick Reeves Models / Jim Reeves "special".

The cockpit instrument panel was done on the traditional 'three layer' method: base layer with dials, sandwiched layer of transparent plastic for the instrument glasses, top layer wood-grained dashboard. He also used some "live steam" hobbyist brass items for instrument bezels.

Ken also added a working throttle quadrant. He also used some "live steam" hobbyist brass items for instrument bezels.

Aldis Gunsight
Ken machined this up on the lathe from some acetal, and then added some litho plate support brackets.

Other little touches
The rib taping was done with torn strips of Solartex, while rivets were simulated by applying PVA "spots" with pin or a hypodermic.

Flying Notes
The model is as yet unflown. I shall return with flying shots just as soon as she makes her proving flights. ■

SPECIFICATIONS:
Fairey Flycatcher Mk 1

Scale:	1:4
Span:	87"
Weight:	26lbs
Engine:	Saito 36cc four stroke petrol
Propeller:	18"x10" Falcon wood

16: From this view, it is obvious why Ken had to get the dummy engine convincing. Look closely for the Saito. 17: Hand crafted dummy engine took two months to complete. 18: Dummy engine "cone" was moulded from a blue foam plug turned on the lathe. 19: The model uses Williams Brothers 6" diameter wheels. 20: Undercarriage struts and wires are carefuly terminated. 21: The Flycatcher's working "sprung and oleo'd" undercarriage is complex. 22: Two wings and a round engine: a scale model formula that never fails.

FAIREY FLYC

The world's first purpose-designed naval fighter aircra

In the early hours of July 9th, 1918, seven Sopwith Camels, manned by pilots from the Royal Navel Air Service and Royal Air Force, were launched from the forward deck of the H.M.S. Furious. The Furious had originally been conceived as a Battlecruiser, but had been modified during construction with a forward deck for aircraft take-off and a rear deck for aircraft recovery.

The target for the seven specially navalised versions of the Camel, (designated 2F) was the Zeppelin sheds at Tondern in the northern German area of Schleswig-Holstein, which had previously been part of Denmark and which would, post-WW1, again be restored as part of Denmark.

Two of the three sheds were successfully bombed, the largest containing the Imperial German Naval Air Division's airships L.54 and L.60, both of which were destroyed. Thus, it was world's first air strike delivered from a dedicated aircraft carrier and, at least, a planned recovery to the launch ship.

After the attack, of the seven attack aircraft, all but one were lost at sea due to failure to rondesvous for the recovery journey as planned, engine failure or premature fuel exhaustion.

The only one that managed to return to Furious ditched in the sea close by. However, a new branch of aerial warfare had been successfully demonstrated.

THE FIRST DEDICATED FLEET FLIGHTER

After the WW1 Armistice in 1918, economy became the watchword in all official policies concerning military aviation and nowhere was this more apparent than in naval flying. By the end of 1919, British strength in naval aviation had shrunk to a token force of one spotter-reconnaissance squadron, half a torpedo squadron, one fighter flight, one seaplane flight and one flying-boat flight. From 1919 until 1922 there was only one aircraft carrier in commission (H.M.S. Argus) and the handful of aeroplanes then employed on deck-flying duties, such as the Sopwith Cuckoo, Parnall Panther, Nieuport Nightjar and Westland Walrus had either originated during W.W.1 or had been developed from types of that wartime period. Indeed. There were a few examples of the veteran Sopwith Camel still flying from the deck of HMS Argus as late as 1920.

It was against this situation that, in 1922, the Air Ministry (to which by then, matters of naval aviation had been delegated) issued Specification 6/22 calling for a single-seat fighter capable of operating from carrier decks, on floats, or as an amphibian and powered by either the Bristol Jupiter or Armstrong Siddeley Jaguar radial engines. Just as the the Jaguar-engined Armstrong Whitworth Siskin and Gloster Grebe were to supersede the wartime rotary-engined Sopwith Snipe in the land-based fighter squadrons of the Royal Air Force, so also so did the naval fighters produced to Spec. 6/22 replace the rotary-engined Nieuport Nightjar on the carrier deck, to become the first examples of the post-war generation of fighters.

TWO TO TRY

The Fairey Flycatcher was one of two designs produced to Spec. 6/22, the other,

Flycatchers ranged on the flight deck of HMS Glorious, ready for launch. The three aircraft at the rear are Fairey IIIFs.

ATCHER

aft. It was no beauty but it did eveythiong that was asked of it

and far less successful, being the Parnall Plover. The Plover offered a comparable performance but lacked the rugged strength of its rival (it was of all-wooden construction whereas the Flycatcher had a mixed metal and wooden fuselage) and thus the Plover enjoyed only a very brief Service life commencing in 1923. But when joined by production Flycatchers in 1924, the superiority of the Fairey aircraft soon became clear and the Plovers faded quickly from the scene.

The prototype Flycatcher, fitted with a 400-h.p. Jaguar III engine first flew in 1922, and went on board H.M.S. Argus in early 1923 for deck handling trials. For this purpose, steel jaws were fitted on the undercarriage spreader bar to engage the fore-and-aft deck arrester wires then in use. This type of arrester gear remained standard on Flycatchers until the fore-and-aft wires were abandoned in 1926. Thereafter, landings were made without any form of arrester device, and by the time that transverse wires had been standardised in 1933, the Flycatcher had been largely supplanted by the Hawker Nimrod and Hawker Osprey.

A PILOT'S AEROPLANE

From the outset, the Flycatcher made an enduring and endearing impression on all who flew it. It was comfortable to fly, superb for aerobatics and had all of the characteristics required of a carrier-borne aircraft for ease of handling. Its strongly individual appearance was derived from the marked dihedral only on the upper wings with zero dihedral on the lower wings; pronounced wing stagger; ungainly undercarriage; plus a fuselage which, with an oddly shaped fin and rudder, gave the impression of being 'cocked-up' at the rear end.

The Flycatcher shared with other Fairey types such as the Hamble Baby and the Fairey IIID and IIIF, the patented aerofoil camber-changing mechanism on the wings. This involved flaps that ran along the enties trailing edges of both upper and lower wings which could be lowered for landing and take-off, but split into two separate sections for each wing panel, so that the outer sections served also as ailerons. This steepened the glide path and shortened both landing and take-off runs, with obvious advantages for deck-flying operations.

Service testing proved the Flycatcher to be highly satisfactory from a deck-landing point of view. Stability was good, neither too light nor too heavy on the controls, with no dangerous peculiarities and the majority of pilots had no difficulty in flying the type.

Another fascinating feature was that, to aid stowage on board ship and in the absence of folding wings, the entire airframe was designed and constructed in such a way that it could be dismantled, so that no section exceeded 13 ft. 6 in. in length. Another practical feature was that its wing span of 29 ft. enabled it to go up and down the hangar deck lift without wing folding.

INTO SERVICE

Full-scale production of the Flycatcher was started by the Fairey factory at Hayes in 1923, and the first Flycatchers entered service with the R.A.F. when No. 402 Flight received the type. During the following year,

Neat and tight formation of Flycatchers airborne from HMS Glorious.

Flycatcher landing on HMS Glorious. Note the lack of arrestment wires, either longitudinally along the length of the deck, or transverse across it.

WHEELS AND FLOATS TOGETHER: In amphibian configuration, the Flycatcher had barely visible wheels let into the planing undersides of the floats and presented an odd sight when taxiing at a shore base. Note also the propeller spinner, olnly occasionally applied.

A Mk.2 development of the Fairey Flycatcher was proposed, and a prototype built. It was far more elegant than the Mk.1, but progressed no further that the prototype stage.

with the gradual build-up of Flycatcher strength, the type was also issued to No. 401 Flight, replacing Nightjars, and to Nos. 403 and 404 Flights where they supplanted Parnall Plovers.

Although its primary role was that of a Fleet fighter, the Flycatcher was also equipped to carry four 20-lb. bombs on racks below the lower wings and, in accordance with official Fleet Air Arm policy which was continued in its successors the Hawker Nimrod and the Blackburn Skua, operated as a dive-bomber. Such was the strength of the Flycatcher's airframe that it could be dived vertically with its Jaguar engine at full throttle until it reached its terminal velocity. it was the first aircraft to be required to undergo such a stringent test by the Air Ministry.

Demonstrations of the Fleet Air Arm's proficiency in dive-bombing tactics made Flycatchers of No. 405 Flight the star turn at the R.A.F. Hendon Displays of 1928 and 1929. The famous 'Blue Note' of the engine in a dive delighted the spectators during the converging bombing displays in which three Flycatchers attacked the same target simultaneously by diving from 2,000 ft. from three different sides of the aerodrome.

As late as September 1932, Flycatchers were still in service with Nos. 401 to 407 Flights, but had been replaced by the first of the new Hawker Nimrods in No. 408 Flight, H.M.S. Glorious. By that time, in April 1933, Fleet Air Arm Flights began to be merged into squadrons by Air Ministry Order; the Nimrod and Osprey now predominated, but Flycatchers remained for a while alongside Nimrods in the new No. 801 Squadron (formerly No. 401 Flight) in H.M.S. Furious.

Flycatchers also continued to serve with No. 403 Flight on the far eastern 'China Station' and with No. 406 Flight of the East Indies Squadron. The latter two units were catapult flights operating from battleships and cruisers of the Royal Navy and such units retained flight status until 1939. The five Flycatchers of No. 403 Flight and the two of No. 406 Flight were finally replaced by Osprey seaplanes in June 1934.

EVER ADDAPTABLE

The Flycatcher's versatility ensured that it could operate from aircraft carriers with or without arrester gear; from the surface of the sea with twin floats, or from land or water as an amphibian. It could also be fitted with skis. It was the first Fleet Air Arm fighter to be stressed for catapulting from the deck of a ship, permitting operation as a seaplane from Cruisers and other warships as well as Carriers and was the last to be flown from a platform mounted above the gun turret of a Battleship. This latter technique was first developed by the R.N.A.S. in W.W.I, using Sopwith 1.1/2 Strutters and Pups, but eventually fell into disuse with the development of a successful catapult.

As a twin-float seaplane, the Flycatcher retained all the lively aerobatic qualities of its landplane counterpart. The lengthy 'boat-built' floats provided sufficient stability on the water to enable the traditional third float beneath the tail to be deleted.

PIRATE PATROL

The collapse of the Qing Dynasty in China in 1911, led to the progressive disintegration of central authority there, the political vacuum being filled by regional Warlords. One of the consequences of this was a lengthy period of piratical hi-jacking of ships, their crews and passengers. As part of the operation to counter the threat to 'British Interests' in the region, in the late 1920s, Flycatcher seaplanes of No. 403 Flight were very active against Chinese pirates raiding coastal shipping at Hong Kong.

SLIPPERY STUFF!

No account of the Flycatcher would be

complete without a reference to the spectacular operations of the 'slip-flights' serving in the carriers Furious, Courageous and Glorious. In these ships it was customary to house six Flycatchers in a forward hangar, below the main flying deck, from which the fighters took off from a 60 ft. tapered 'runway', straight out of their hangar and over the bows. As the engines were run up to full power inside the confines of the small hangar the noise must have been excruciating.

Flycatchers of the 'slip-flights' invariably dropped out of sight below the bows and almost touched the water before commencing their climb-out. Meanwhile, other aircraft were being flown off from the main carrier deck above.

Recovery of Flycatchers on the main deck was effected with equal dash and verve. As the aircraft came in line astern at approximately one minute intervals they were immediately taken down the lift and the skill of the deck-handlers was such that six Flycatchers were once landed on board and stowed in their hangar in the astonishingly short time of 4 min. 20 sec. It was, incidentally, a Flycatcher that made the first successful night landing on a carrier deck by a single-seat fighter. This was on board H.M.S. Courageous on 26th November 1929, the Flycatcher having flown from Hal Far in Malta.

The Flycatcher was built exclusively for the Fleet Air Arm and none were ever sold to a foreign country. The type was finally declared obsolete by the Air Ministry in April 1935 and with its passing what was probably the most romantic era of British naval aviation came to an end. ■

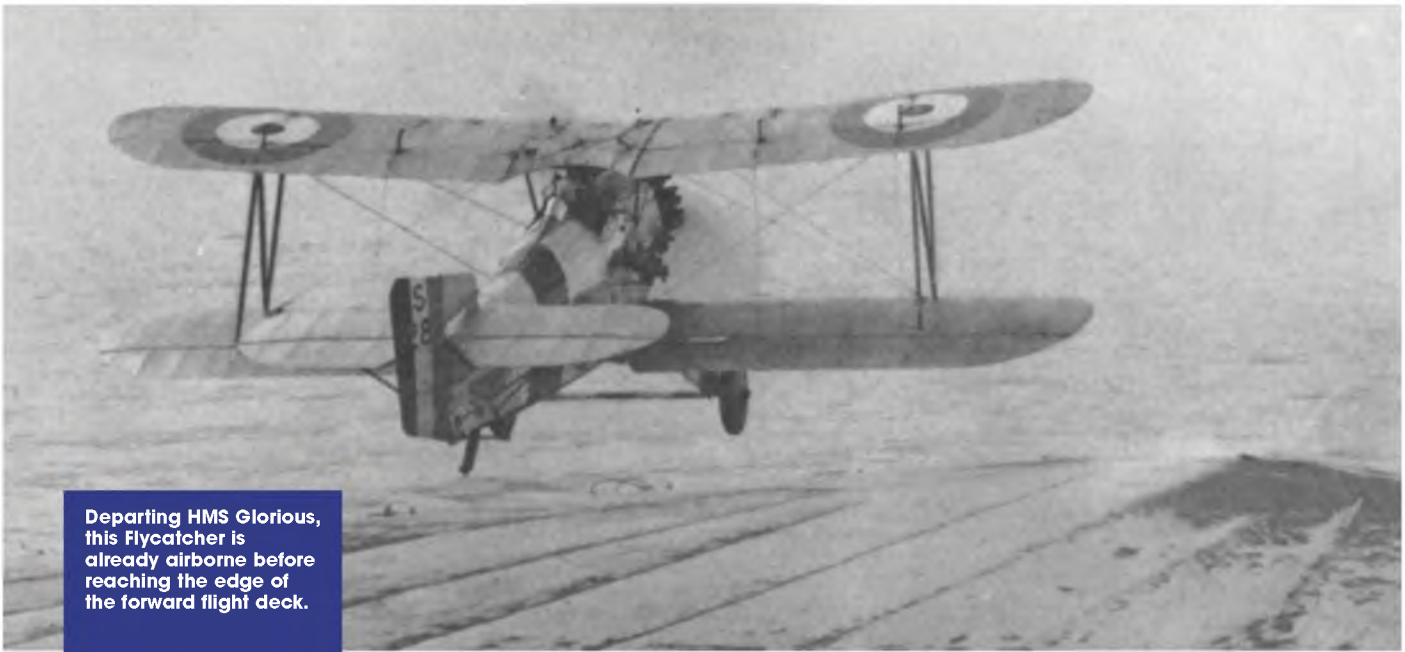
With engine already running, a Flycatcher emerges from the forward hangar to the forward flight deck of HMS Glorious. The noise in the hangar must have been excruciating!

Catapult launch of a Flycatcher in floatplane configuration. Recovery on return was by crane.

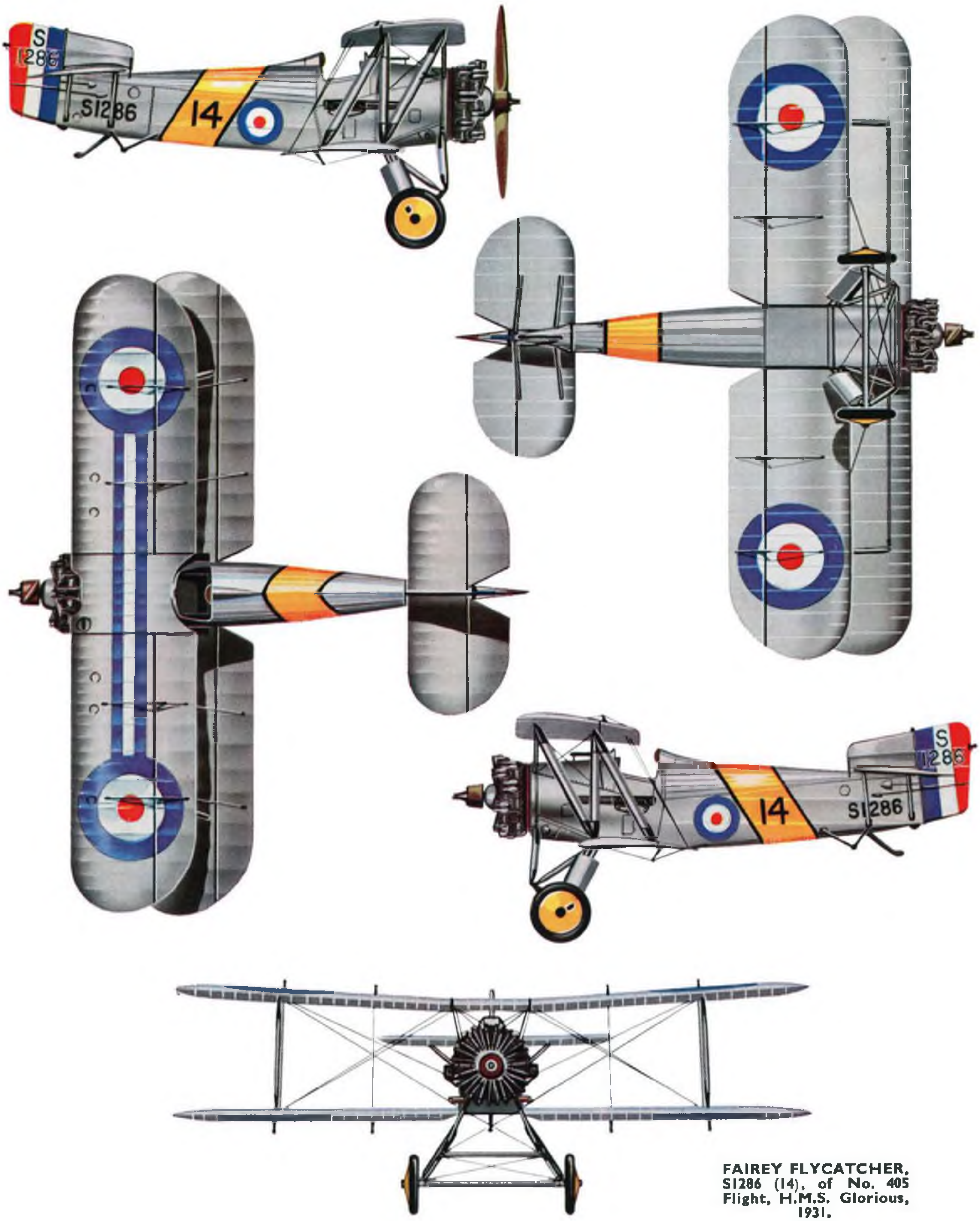
A Flycatcher emerges from the hangar of HMS Glorious. With a wingspan of just 29ft., no wing-fold was required.

WHERE TO SEE ONE NOW

No genuine example has survived, but at the Fleet Air Arm Museum, Somerset, there is Flycatcher replica G-BEYB. Constructed by Robinson Aircraft at Blackbushe, in was first registered in 1977 to John Fairey, the second son of Sir Charles Richard Fairey, founder of the Fairey Aviation Company, but remained unflown until 1979 whereafter it appeared at a few public air displays. It was sold to the Fleet Air Arm Museum in 1995 where it remains, but now rather hidden away in the FAAM Reserve Collection where it can be viewed during the Museum's periodic 'open days'.



Departing HMS Glorious, this Flycatcher is already airborne before reaching the edge of the forward flight deck.



FAIREY FLYCATCHER, S1286 (14), of No. 405 Flight, H.M.S. Glorious, 1931.

Flycatcher, No. 403 Flight, H.M.S. *Eagle*.

Flycatcher, No. 405 Flight, H.M.S. *Furious*.

Flycatcher, No. 404 Flight, H.M.S. *Courageous*.

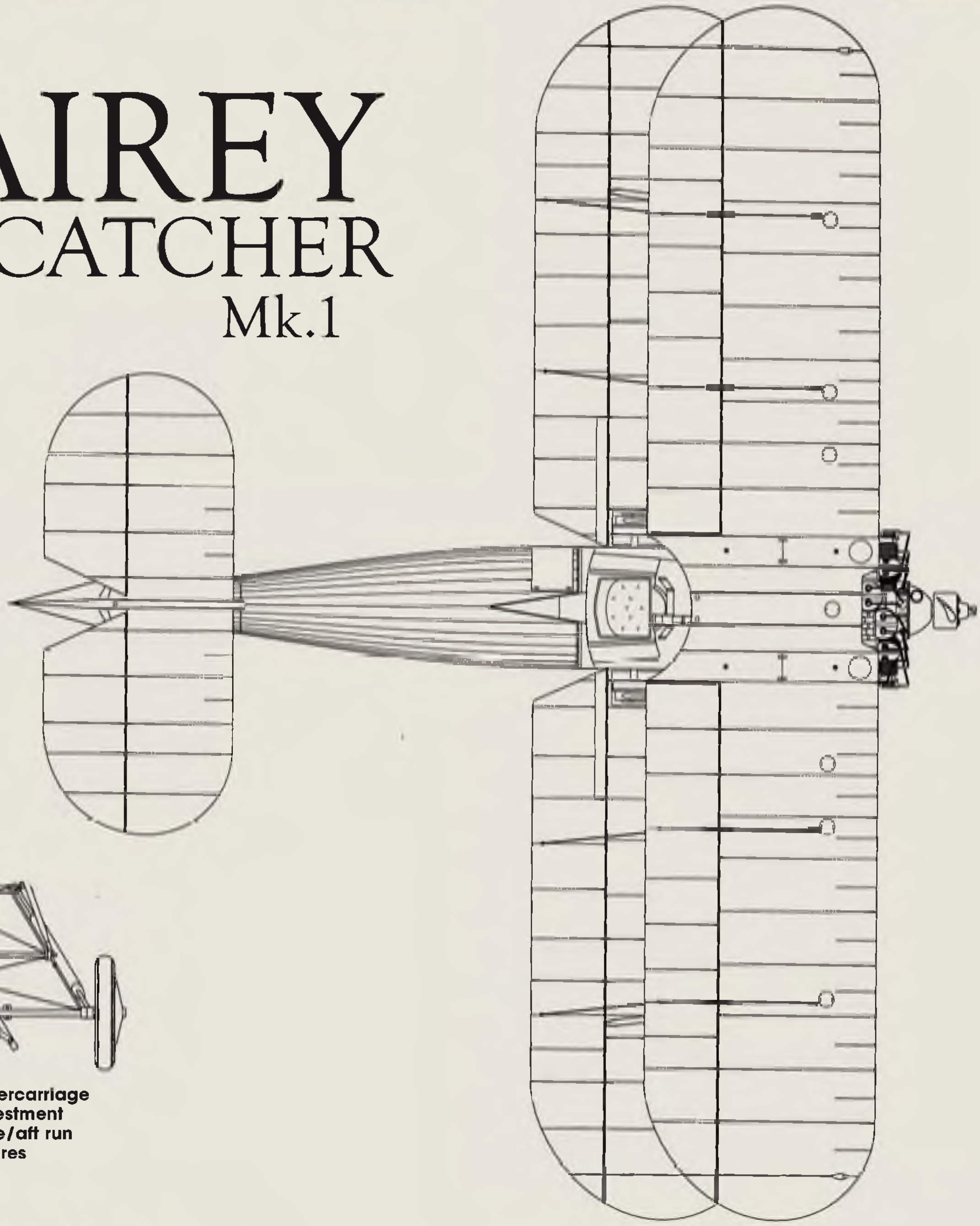
Flycatcher, No. 405 Flight,
H.M.S. *Glorious*
with Command pennants.

Flycatcher, showing fuselage stencil details.
Manufacturer's serial number F 474.

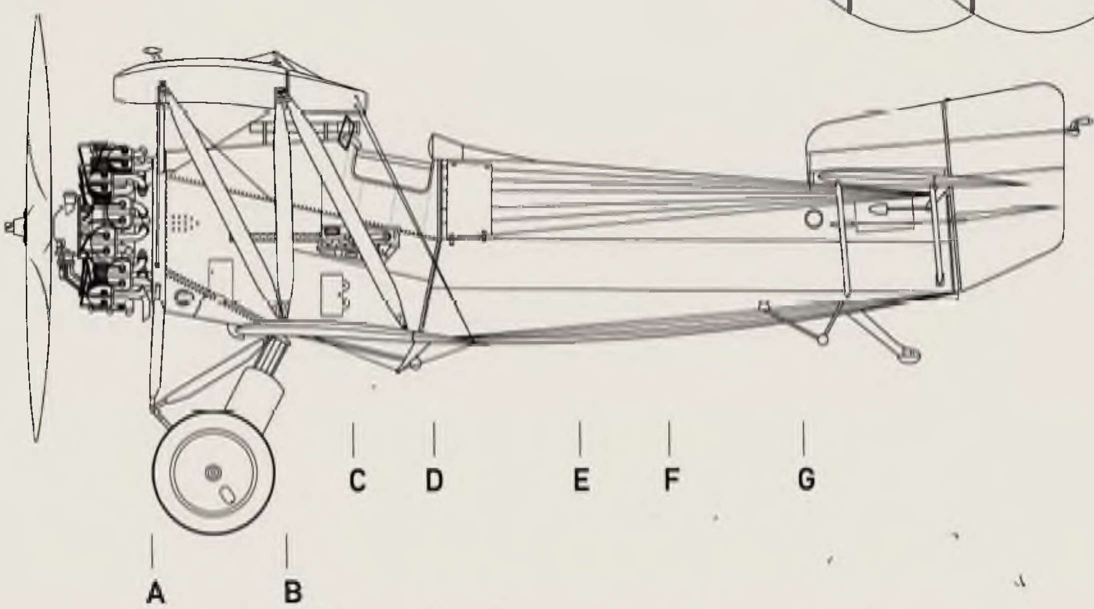
Flycatcher floatplane version.

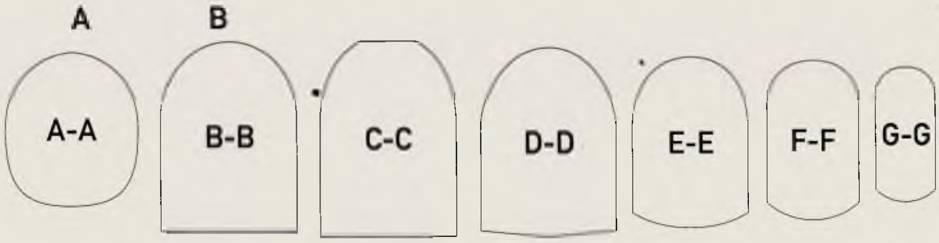
SCALE 1:50

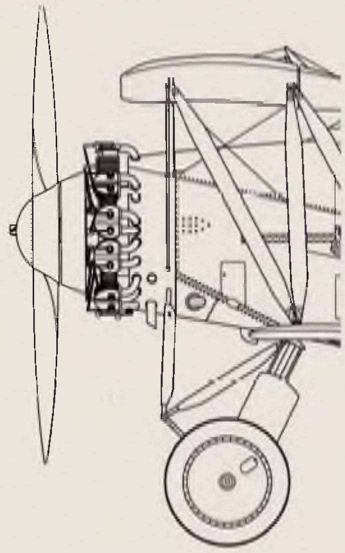
FAIREY FLYCATCHER
Mk.1

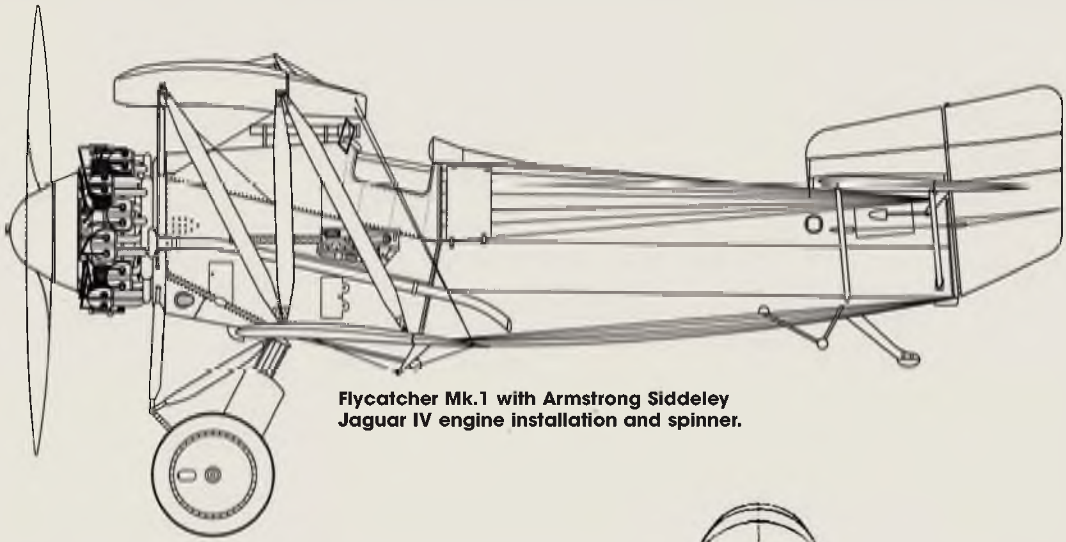


Flycatcher Mk.1 undercarriage showing earlt arrestment mechanism for fore/aft run arrestment wires



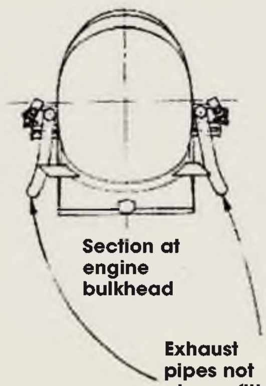


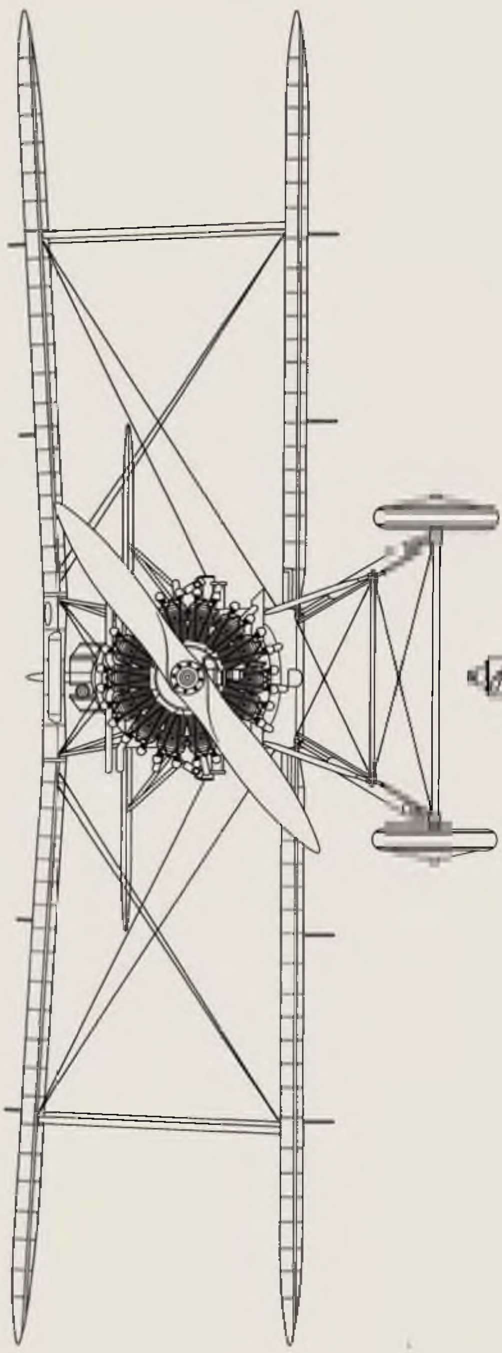


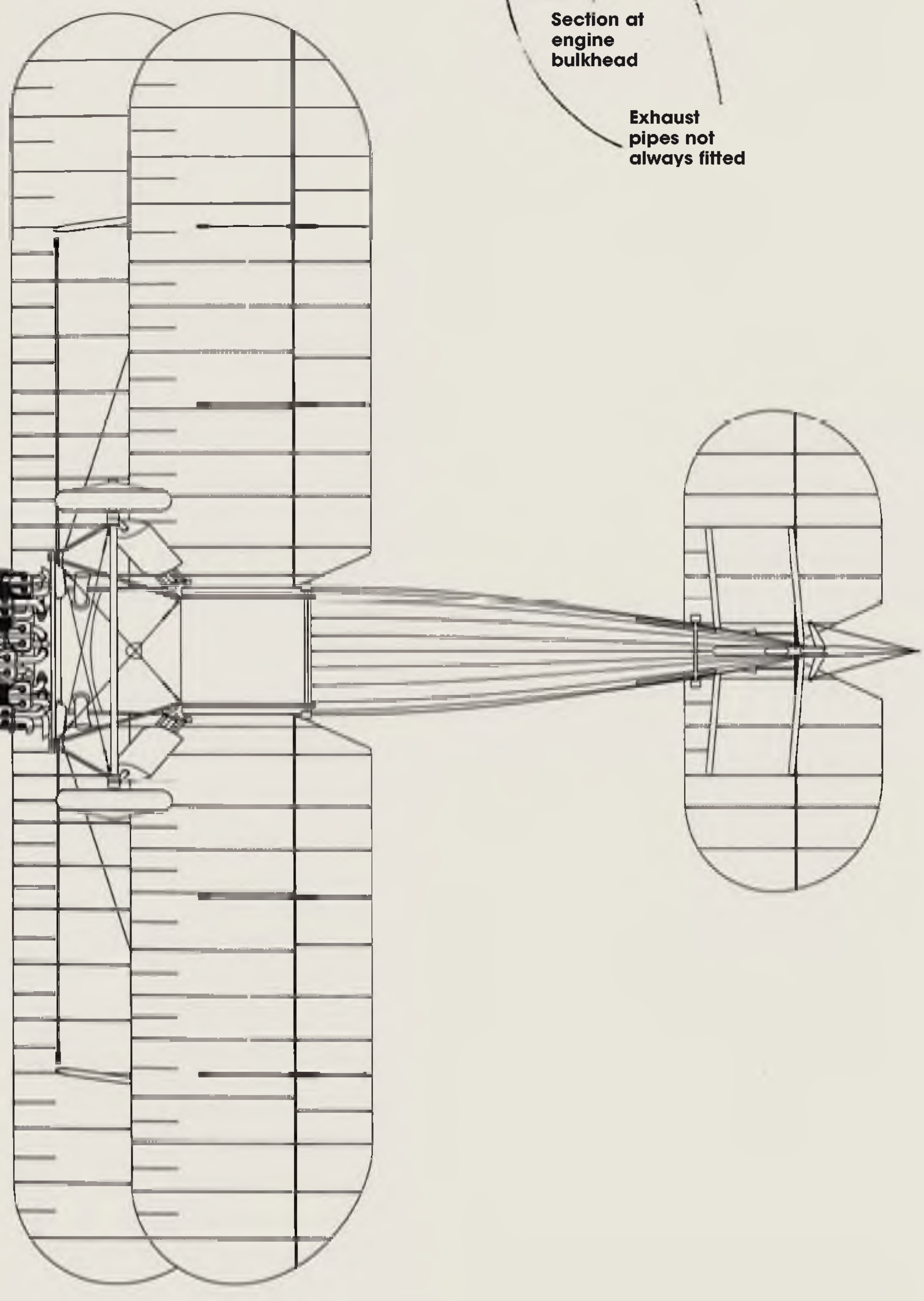


Flycatcher Mk.1 with Armstrong Siddeley Jaguar IV engine installation and spinner.

Flycatcher Mk.1 with Bristol Jupiter nine-cylinder single row engine installation and spinner.







Stinson L-5 Sentinel

A 36" wingspan 1/12th scale model of the WW2 era light Liason and Observation aircraft for either free flight or lightweight radio control, for engines of 0.75 - 1cc, or electric power, designed by JOHN WATTERS

In the summer of 1940, the Stinson Aircraft Division of the Aviation Manufacturing Corporation was takenover by Vultee, to become the Stinson Aircraft division of Vultee Aircraft Inc. At the time, the popular three-seat Stinson 105 Voyager was adapted for obseravtion duties and ordered into production for the US Army Air Corps as the L-5 Sentinal. It was one of severall designs competing designs of which the Stinson design was successful, alongside Piper's revision of their well know J-3 Cub, the military vesrsionof whicg was designated L-4.

Evenyually, total of 1.731 L-5s were manufactured, for Coast Guard and air ambulance duties under designations L-5a & B, while further production variats evolved. culminating in the L-5E. In all, a total of 3.590 Sentinals were manufactured up until 1945, including examples for the US Navy, US Marines and 100 examples for the Rotal Air force.

THE MODEL

Athough the full-size Sentinal had a wingspan is 34 feet, to get a fully enclosed motor, I increased the scale of Athe model slightly from 1/12th scale, which produced a wingspan of 36" and thus, a bit more wing area. Having previously built the model of the Stinson 105 Voyager, initially as free flight, but later converted to radio control, this time I set out to install lightweight R/C from the construction stage. This is an option you may wish to consider; the cockpit area has ample space to hide any small R/C system equipment.

Fuselage

This is not a difficult model to construct, but probably not one you should tackle as

Passing overhead the EP Sentinel is a very attractive scale type.

The wings are removable for easy transport, although in fully assembled state it will easily fit into the smallest of cars.

The top clear-vision hatch is hinged for access to the receiver, servos and power pack.

The tail could be a bit tidier, but the radio system and associated control linkages are a retro-fit after initial free flight activity.

Detail of the cabin side windows. One side is hinged for switch access - don't forget to fit a pilot!

a first scale model project. We will take for granted that at whatever stage you build any of this model, allowance will be made for the parts to set after gluing.

You will see from the plan that the hatched areas form the basis for the fuselage side frames. These are built up from hard strips of 1/8"sq. balsa. Construct two of these identical side frames. As the fuselage from former F1 to F12 is a basic 'box construction', all the formers in this range can be glued to one of the side frames. The other side frame can then be attached on to these formers. Parts RR and R1 F for the wing attachment can be positioned onto F5 and F12. Make sure that these pieces are vertical to the fuselage. A simple progression of the other formers will quickly build up the fuselage shape. Note, that former F7 should already have the undercarriage wire attached. The engine bearers can now be glued into the front formers. These have been deliberately spaced wider than the motor mounts, so that a 1/8" motor mount plate can be used. This plate will have to be cut to suit whatever motor you are using (the prototype used a Mills 1 cc diesel).

Sheeting can now be added to the top of the nose cowl and the stringers added to the rear and bottom of the fuselage. Glue on the nose block and with the bottom formers positioned for the motor cowl, build up the bottom cowling from block and sheet. Remember that this has to be detachable to allow engine access. I went a bit over the top in this area and thought it would be a good idea to strengthen up the cowl. This I did by adding a layer of fibreglass to the inside. Looking back now it was not necessary - it also added unnecessary weight.

Add any sheeting to the required areas and the fin locating plate TB. The tail block can be tack glued in place and roughly carved to shape; this will be finally fitted after the tailplane has been constructed. Any other pieces not detailed here should be added to the fuselage structure and the whole thing given a fine sanding. The wire wing dowels should be looked at from the front of the model to see that they are in-line and true. Cardboard templates are good for checking this; in fact templates should be used whenever you are not sure of any fit or shape. When all the parts have been assembled, check that all the glued joints are good and that the structure is straight and true.

Any cockpit detail you may wish to add could be done at this stage. As the wings are detachable and the cockpit area top does not come off with the wings, so I had to find a way to give access to get at the radio bits. My first effort was to make the top glazing area completely detachable, this caused problems and did come off when flying. I finally hit on the idea to make it hinged, via small pins passed through the wing support sides and the hatch. This works very well and gives adequate area to fit everything in - neither does it fly off!

WINGS

All the ribs should be cut from quarter-grain firm balsa. The rib section is as applied to the full-size and does not detract in any way from the model's performance. If you wish to change this to a flat bottom section (typically Clark Y) then you will have to make sure it fits at the cockpit.

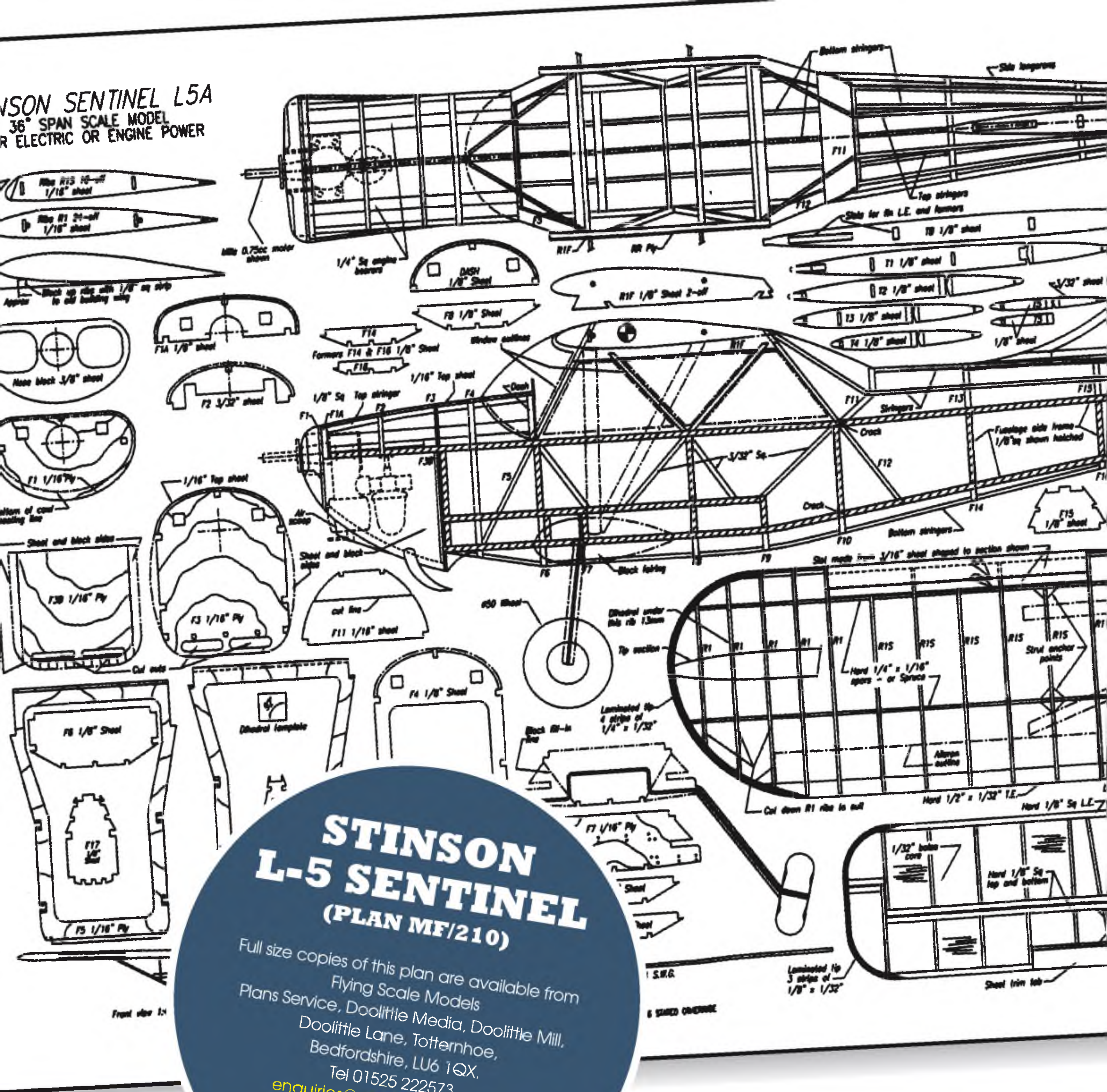
You will see from the plan that to build the wing with the scale rib section, requires the ribs to be blocked up to keep the trailing edge straight and flat. After cutting out all the ribs (a pair of thin plywood ribs can be used as templates, they can then be cut down and used as the end ribs on the wing), form block of ribs pinned together and cut the two spar slots through them, making sure that the spars do pass easily through the ribs, but not too slack.

The assembling of this type of wing construction is quite straightforward. Begin by threading all the ribs for one wing onto the spars and roughly space them out. This ladder of ribs can then be positioned at the correct spacing over the pinned down trailing edge, with the 1/8" packing in place at the front of the wing, not forgetting to set the inner rib RR to the correct dihedral angle. Glue all the ribs, spars and trailing edge together and then add the leading edge.

The pre-formed laminated tips can then be added to the structure - this will require the tip ribs cut to size to match with the tip outline. Add in all the other parts to complete the wing along with the tubes for the dihedral wires, which should be bound and glued to the spars.

Finish the wing panel by sanding to shape with the tip ribs thinned down to follow the tip profile.

You can decide as to whether or not to add the leading edge slots, or just mark them on after covering. If you decide to add them, you will need to remove the



STINSON L-5 SENTINEL (PLAN MF/210)

Full size copies of this plan are available from Flying Scale Models Plans Service, Doolittle Media, Doolittle Mill, Doolittle Lane, Totternhoe, Bedfordshire, LU6 1QX. Tel 01525 222573 enquiries@doolittlemedia.com Price £9.95 plus p&p (U.K £2.50; Europe £4.00; Rest or World £6.00.

front part of the ribs in the slot area and replace them with the sheet strips, shaped to the slot sections as shown. There are two inter ribs in the slot area. When you are satisfied with the wing panel and its fit onto the fuselage wing dowels, the same COnstruction can be followed to build the other wing panel.

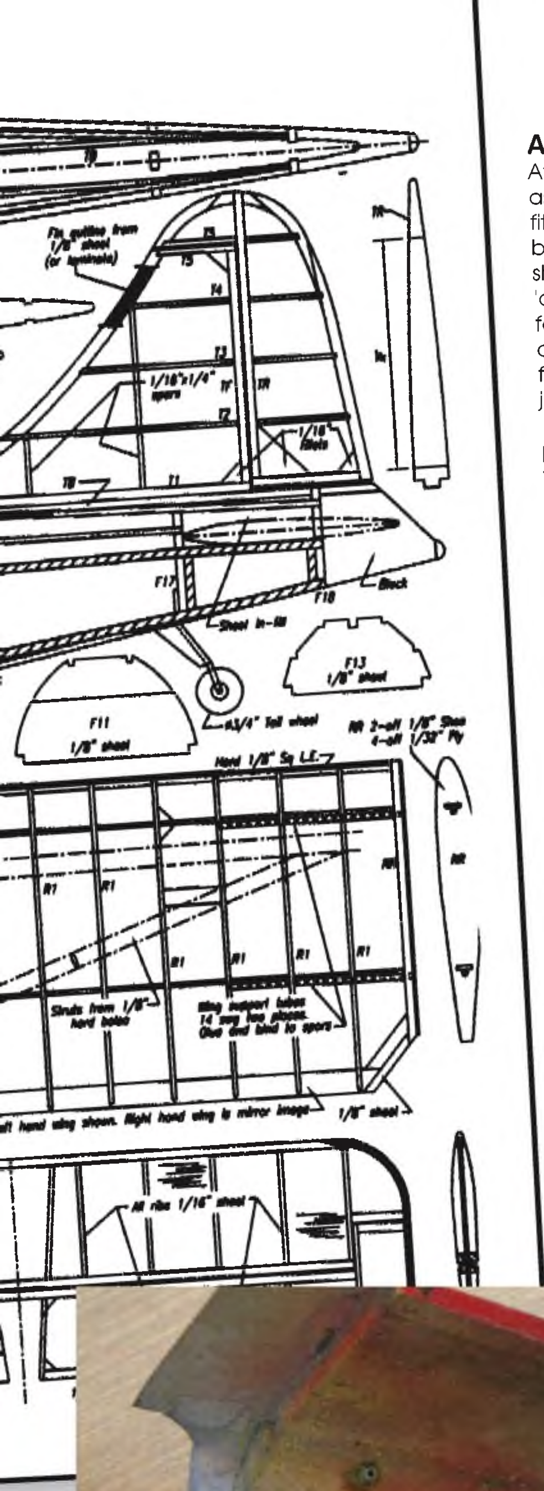
TAILPLANE

The basis for the tailplane is a piece of stiff 1/32" sheet balsa that forms a flat-plate the central core onto which are glued the 1/16" ribs, top and bottom. Forming the outline and elevator joint are strips of 1/8"sq. balsa with additional laminated tips. You will need to block up the first side of this construction to centrally position the leading and trailing edge strips onto the core. Completion of the second side is then just a matter of turning it over and adding the other ribs. The small sheet trim tab is an additional scale detail this could be left off and drawn on if required. Sanding the tail to the section shown is then all that is required to complete.

FIN

Typically of a number of American aircraft from this era, the fin has a relatively thick section. To build this I used a method that worked well for me, but you may decide to use another method. All the parts for the fin outline were glued together, over the plan and lightly marked where all the ribs are located.

Part T1 was then pinned down with the rudder section packed up 1/16". Pieces TF and TR are then glued vertically into position on T1, again having marked the positions for the ribs. The outline is then added to these parts, checking that all are true and vertical. The remaining ribs can then be added along with the fillets. Having completed the fin the remaining central spar can be threaded through the ribs, the structure can then be sanded smooth and checked for accuracy.



ASSEMBLY AND FINISHING

At this stage, all the parts can be assembled together and any required fitting carried out. The wing struts can now be corrected to length and the tail cone shaped to the correct size. I went a little bit 'over the top' with the strut connections by following the fullsize method of clevises and small bolts, a simple tube through the fuselage and banded on struts will work just as well.

For covering, I decided on a two stage process, first with an under-layer of five thou Mylar, then lightweight tissue on top. This works very well, but is a bit of an art to get it right. If you have not tried this method of covering then do have a go; you will be amazed at the strength that results with minimal weight gain, particularly if you are using an all-over colour scheme.

The colour schemes for this aircraft type are many and varied. Further research via the Internet has shown up quite a number of other colour schemes and markings, but some nice possibles are shown elsewhere in this issue. As this particular aircraft had a lot of glazing, it looked wrong not to put in a pilot. For this scale of model it is difficult to find a commercial pilot that suits the period, so the only option was to carve one from balsa. I used the Doug McHard pilot shown and described way, way back in a 1957 copy of AeroModeller (that shows you how old I am, but it's good to). Although this pilot is for a WWI aircraft, a bit of modification produced a pilot that suited and a bit of paper to make a hat finished it off.

RECOMMENDED PRE-FLIGHT CHECKS

As with any model, the first thing is to check the balance position and adjust as necessary. My model came out slightly nose heavy, which I deemed OK for testing, seeing that I had some control over the models flight pattern. I am sure that with a bit of careful covering and a simple balsa cowl, weight could be reduced. The recommended (but difficult to find) long grass field was chosen and I did not spend a lot of time on hand launch glide trimming, other than to make sure that the model flew straight. With a cowled-in motor, I usually leave it off for initial flying.

This being the case, the tank was filled and motor fired up. From a straight launch it could be seen that this model was going to my fast. Initial slight tum to gain height proved that the control surfaces are quite powerful requiring little stick movement. Nothing untoward was noticed during the flight other than a throttle would have been useful. The glide was fast, requiring us to allow the model to come down near enough to a selected landing point, which it did requiring quite a bit of flare out. As is said - "better a walk than a wreck". As ever, this model has now been electrified, giving me the throttle advantage, but with a weight increase.

Weight with electric power and battery came out at about 560g, that's llb. 40z. in old money. Now in this electric power age, there is nothing to stop this model being powered with a brushless motor and lipo batteries. These give greater power and longer duration and less weight, but do come at a cost.

The Sentinel flies well and had a fairly decent glide.Whichever power source you use, you should get good results from this model. ■

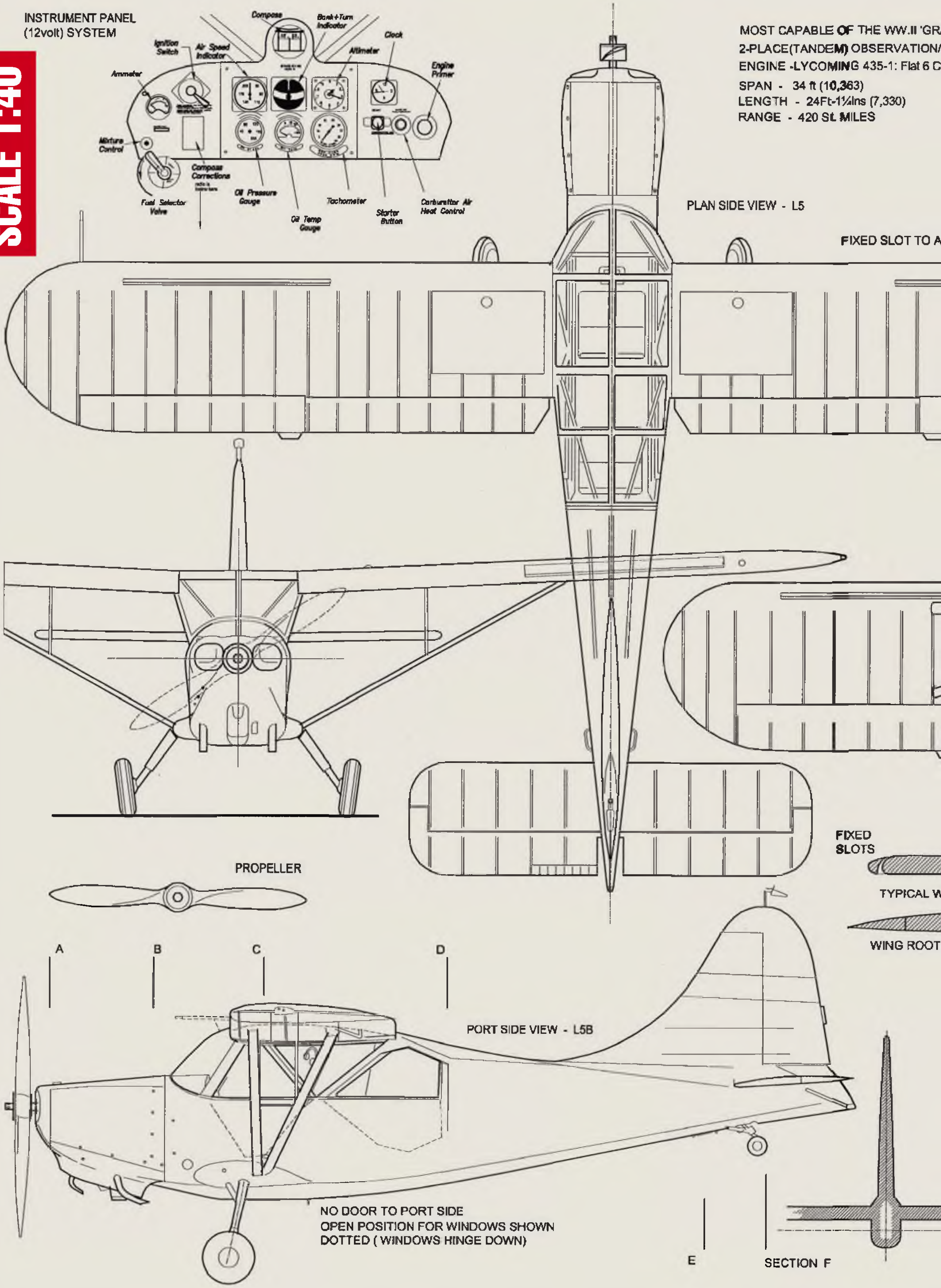
John's original cowl is a bit over-engineered for EP. It could be made lighter.

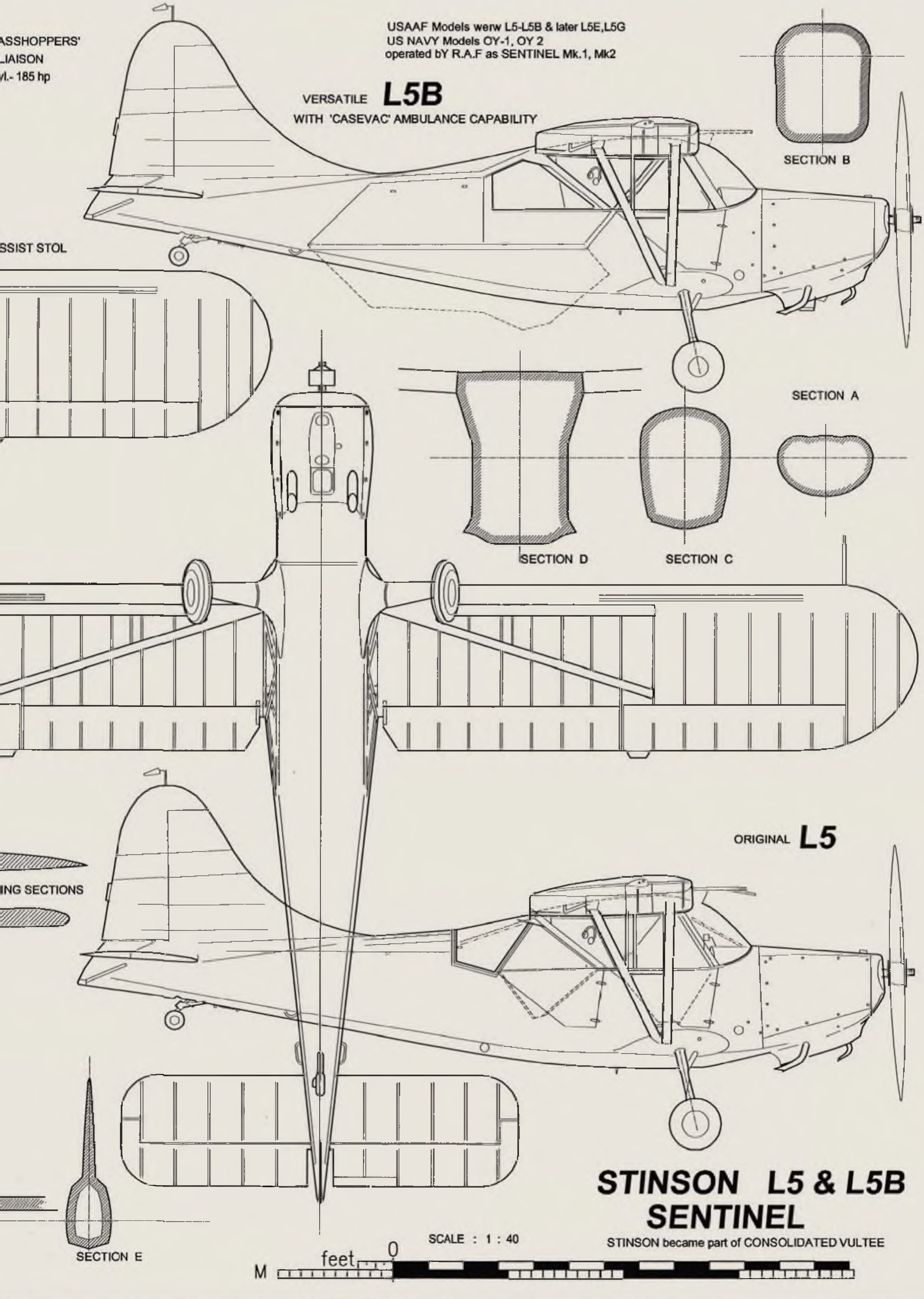
The under view of the cowl and 'exhaust' stacks, showing the original Mills exhaust exit slots under the rear edge.

John built in fixed slats on the wing LE just like the full size - easy to do and certainly adds to the 'look'.

The strut attachments are bolted in the manner of the full-size - could be made a lot simpler and more 'arrival' resistant, if building for free flight.

SCALE 1:40

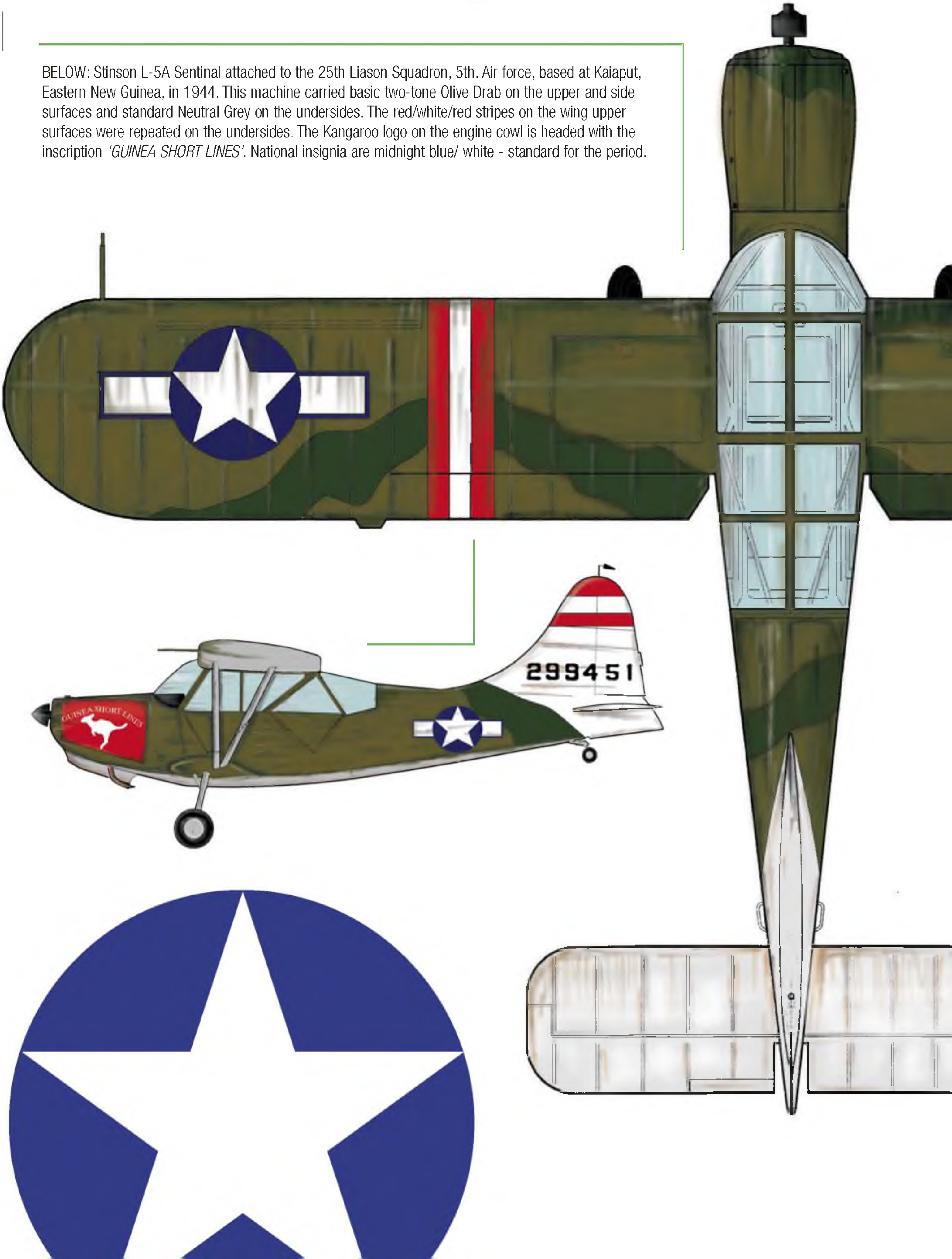

INSTRUMENT PANEL
(12volt) SYSTEM
Compass
Bank+Turn Indicator
Clock
Ignition Switch
Air Speed Indicator
Altimeter
Ammeter
Engine Primer
Mixture Control
Compass Corrections
Fuel Selector Valve
Oil Pressure Gauge
Tachometer
Oil Temp Gauge
Starter Button
Carburettor Air Heat Control
MOST CAPABLE OF THE WW.II 'GR
2-PLACE(TANDEM) OBSERVATION/
ENGINE -LYCOMING 435-1: Flat 6 C
SPAN - 34 ft (10,363)
LENGTH - 24Ft-1¼Ins (7,330)
RANGE - 420 St. MILES
PLAN SIDE VIEW - L5
FIXED SLOT TO A
PROPELLER
FIXED SLOTS
TYPICAL W
WING ROOT
A
B
C
D
PORT SIDE VIEW - L5B
NO DOOR TO PORT SIDE
OPEN POSITION FOR WINDOWS SHOWN
DOTTED (WINDOWS HINGE DOWN)
E
SECTION F

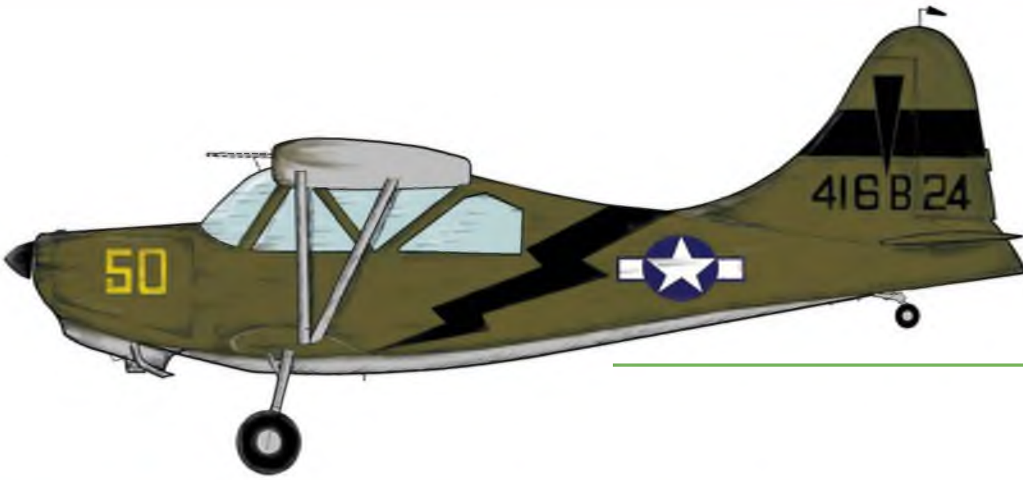


STINSON L5 & L5B SENTINEL

STINSON became part of CONSOLIDATED VULTEE

BELOW: Stinson L-5A Sentinal attached to the 25th Liason Squadron, 5th. Air force, based at Kaiaput, Eastern New Guinea, in 1944. This machine carried basic two-tone Olive Drab on the upper and side surfaces and standard Neutral Grey on the undersides. The red/white/red stripes on the wing upper surfaces were repeated on the undersides. The Kangaroo logo on the engine cowl is headed with the inscription *'GUINEA SHORT LINES'*. National insignia are midnight blue/ white - standard for the period.

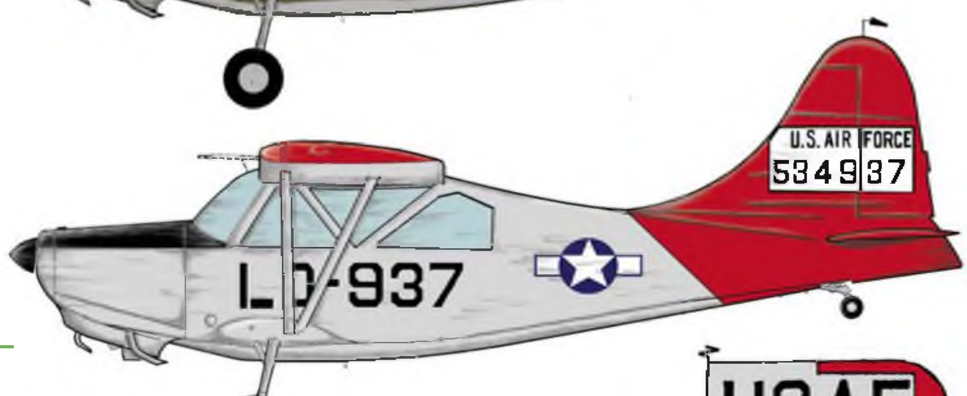




L-5B model operated by the 2nd Air Commando in the China-Burma-India combat theatre.This machine had single-tone standard Olive Drab upper and side surfaces and standard Neutral Grey undersides.

Stinson L-5A operated by a unit of the USAAF 9th Air Force liaison squadron in Europe. Two-tone Olive Drab upper surfaces. Invasion stripes applied to lower fuselage only and to lower suface of both wings.

Stinson L-5G operated, post WW2, by USAF in Arctic markings of mid-1950s. Basic silver dope finish with Dayglow Red applied to wings, rear fuselage, fin/rudder and horizontal taiplane. Anti-glare matt black panel ahead of cockpit and national insignia red/white/blue.



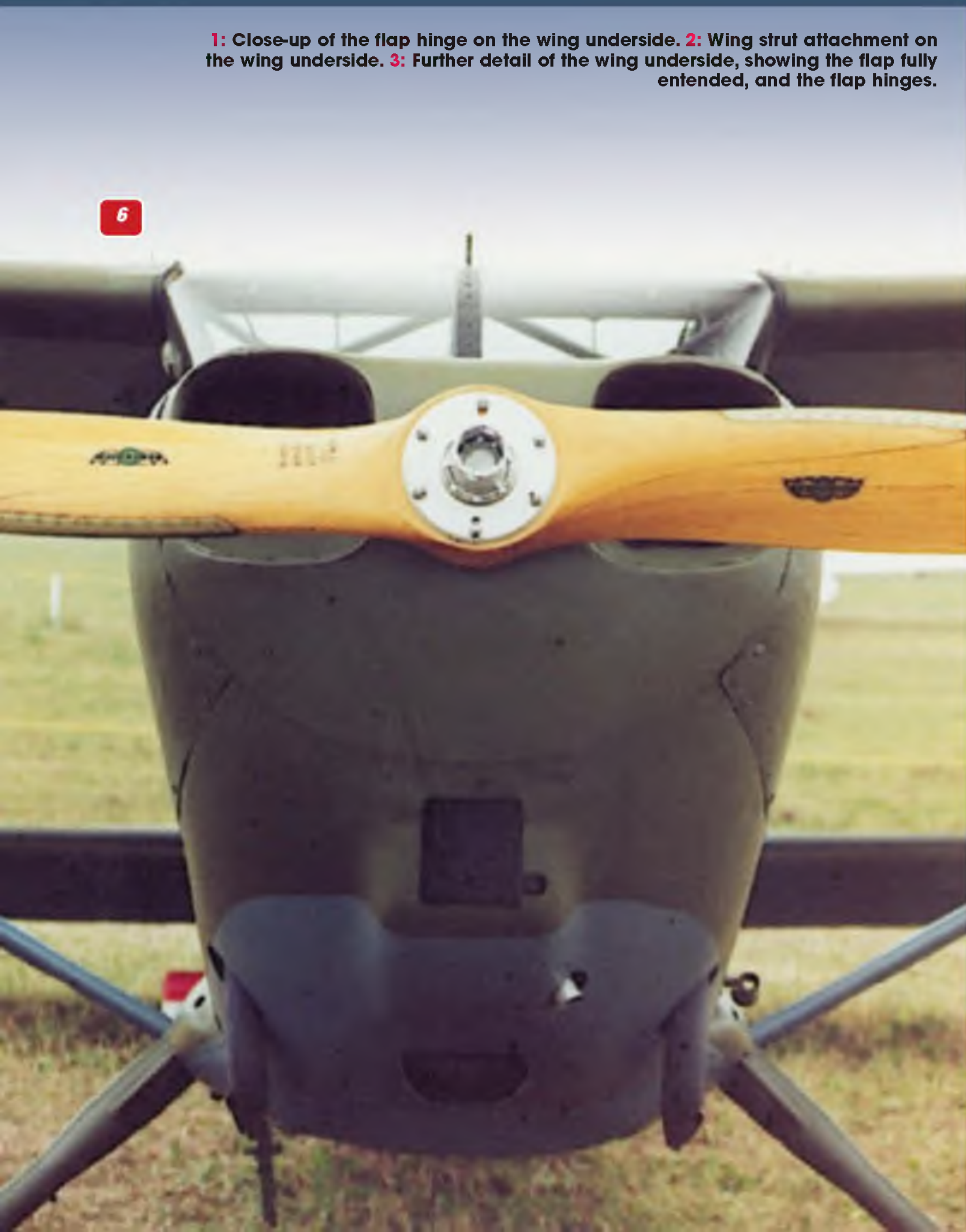
The U.S. Marines operated the Sentinal as the OY-2. This machine is shown in livery circa 1951, finished in overall dark sea gloss with white lettering and codes.

Stinson L-5 Sentinel

LESS WELL KNOWN THAT ITS WW2 COMPATRIATE THE PIPER L-4, THE SENTINAL WAS EVERY BIT AS MUCH OF A WORKHORSE

1: Close-up of the flap hinge on the wing underside. **2:** Wing strut attachment on the wing underside. **3:** Further detail of the wing underside, showing the flap fully entended, and the flap hinges.

6



1

2

3

4

5

4: Full frontal, showing the air intakes and the propeller blade shape.

5: Side view of the engine cowl revealing the curve of the air intakes.

6: Further full frontal with the propeller in horizontal positiion to show the under-cowl air scoop and the exhaust pipes.

7

8

7: View of lower cowl, showing the shape of the exhaust stacks and relief of lower cowling.

8: Lower fuselage at the cockpit area showing the unfaired undercarriage leg and the anchor point for the wing struts.

9: The main undercarriage and lower wing wing strut anchor point. Also shows the fairing bulge below the cabin door.

10: View from the rear reveals the constant chord tailplane/elevator and the upper cockpit clear vision screens.

9

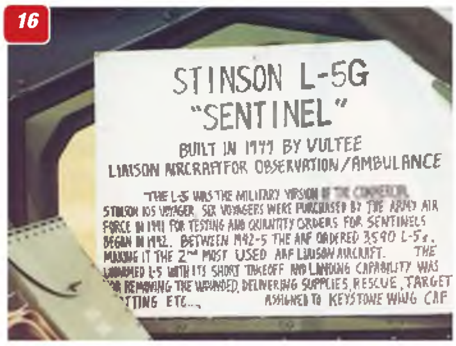
10

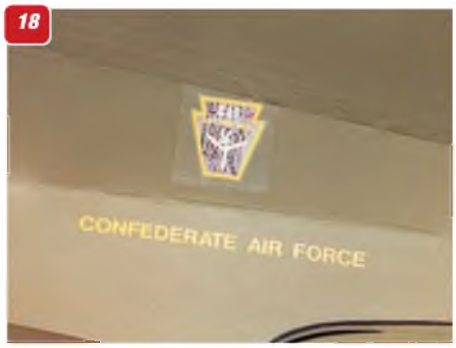
11: Further view of the flaps and the glass-house cockpit area.

12: Tyres, showing the rib pattern. Note the bulged fairing where the undercarriage leg meets the fuselage.

13: View under the fuselage shows the exhaust stack shape, air scoop and the wheel hub.

14: Left hand side of the rear cockpit. **15:** The instrument panel and control column.





16: A little bit of history! **17 & 18:** Rear fuselage detail just ahead of the tailcone. **19:** Tailpane, showing the aerodynamic ballance at the tip. **20:** The cabin showing the full run of the clear side panels. **21 & 22:** Two views of the fuselage rear showing markings. **23:** Front cockpit showing the windscreen and the mass of fully visible structural members. **24:** The cockpit area, with the crew access panels folded down. **25:** Further view of the cockpit windscreen revealing the double curvature of the clear screen.

KAISER Ka-2b

The late Cliff Charlesworth produced many highly successful scale R/C sailplane designs, among them this 1/4 scale,157.5" (4000mm) span sailplane for slope soaring or aerotow

Not all these construction photos depict the Ka-2b, but all are representative of the general construction techniques involved in the structure of the KA-2b fuselage. It pays to work out the control system installation and servo-to-control surface links before skinning.

Design work on this Kaiser Ka-2b began with the acquisition of a full set of works drawings for the full size Ka-2b that I had been able to borrow – an ideal starting point for the project. Having now amassed all the main drawings of the glider's structure, I commenced the lengthy job of sorting out a suitable construction drawing for building the prototype of this 1:4 scale model.

The Ka-2b is very similar in its make up of Alexander Kaiser's subsequent Ka-7 (of which I had already desinged a model), the basic difference being in the fuselage. The Ka-7 has an angular fuselage made up from 12.5 mm steel tube, while the Ka-2b featured a wooden monocoque fuselage. Wings and tailplane units of the two designs are identical, so basically, all that was needed, was to design the fuselage. I tried, where possible, to simulate the full size structure and, drawn to 1/4 full size, the model worked out to 4000mm (157.5") wingspan with a wing area of 11.32 sq.ft. This imparts a wing loading of 16 oz. per square foot which is reasonable for general thermal soaring.

The wing section used on the model is

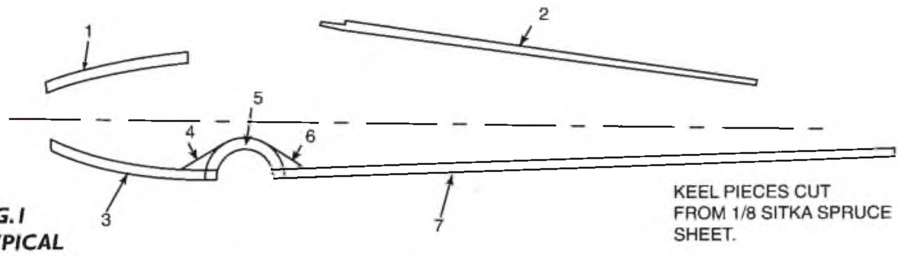


FIG. 1 TYPICAL LAYOUT OF FUSELAGE KEEL

FIG. 2A EXAMPLE OF FUSELAGE SKIN PANEL

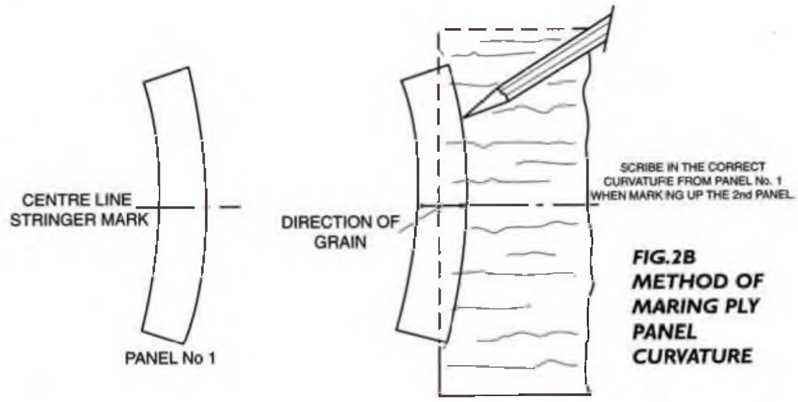


FIG.2B METHOD OF MARING PLY PANEL CURVATURE

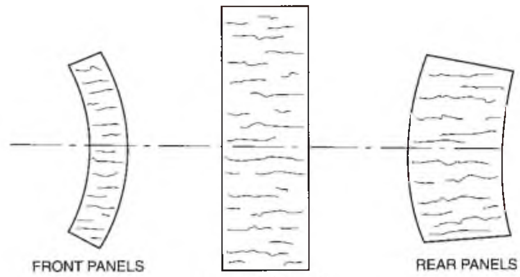


FIG 3: TYPICAL SHAPES OF PLYWOOD PANELS FROM FRONT TO REAR OF FUSELAGE

The start of the fuselage surface panelling, with panels covering the forward nose section.

Here the entire nose section of the fuselage is fully surface panelled and the servo tray and servos are installed.

Typical servo installation showing the elevator and rudder servos with remote bellcrank line to the closed loop rudder linkage.

G0533 throughout, which has been used in preference to the G0535 and 549 applied on the full size as these sections, combined, tend to be too draggy on a model of this size.

Construction of the Ka-2b fuselage follows in similar method as used in my previous designs of the Olympia 2b, LO 100, and Ka-6e. The fuselage formers of the Ka-2 are made up in two layers, one part is 1/16" ply while the other is 1/8" balsa.

The basic structure is formed around two keel pieces (see **Fig.1**), which are shaped to conform to the outside profile of the fuselage. These keel pieces are laid flat over the plan and pinned or weighted in place. Having cut all the half-formers out, we now stick them onto the top and bottom keel pieces, starting from the front of the fuselage. The two layers that make up the formers provide sufficient thickness for the plywood panels to be stuck on later in the process.

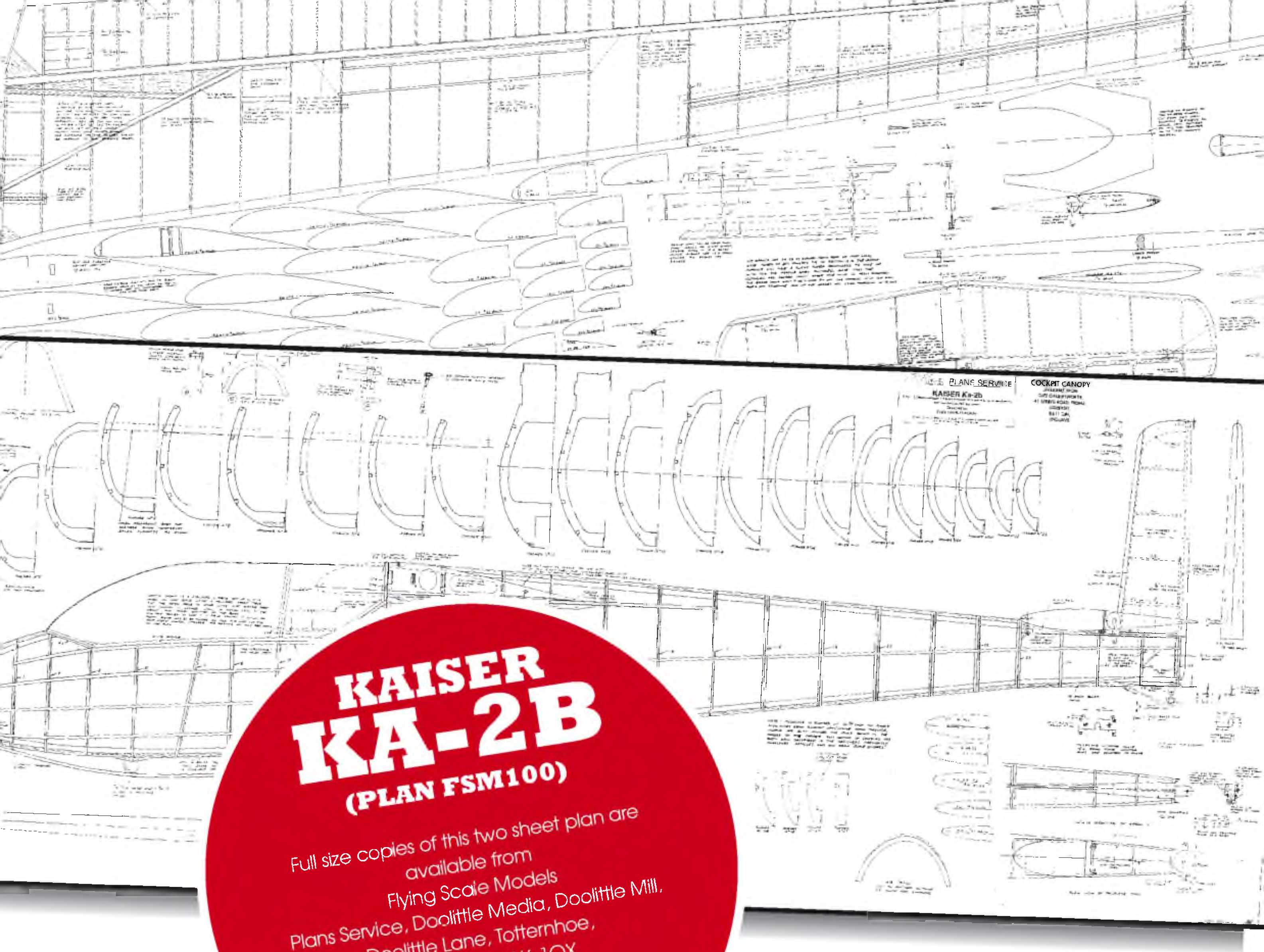
Prior to sticking the formers to the keel pieces, they must be bevelled to suit the fuselage contour. When sticking the formers to the keel, it is best to use a small set square to ensure that the formers are at right angles to the workbench. With all the half-formers now in place it is time to add the stringers, providing we have no humps and hollows in the fuselage contours. If any such imperfections do exist, you have to get rid of them now, before the stringers go in.

After the stringers are applied, you can now add the balsa infill pieces at the top and bottom locations of the formers). When all these are in place, they need to be faired off in line with the fuselage contour. You can now add the root centre

Detail of the metal wing joiners that slot into the wing. Extension leads for the aileron and spoiler servos hand ready.

Screwdrivers hold the rubber band wing retainers ready for hook-up to the wing root hooks.

Detail of one of the elevator hinges in the elevator-to-tailplane cuff.



KAISER KA-2B

(PLAN FSM100)

Full size copies of this two sheet plan are available from
Flying Scale Models
Plans Service, Doolittle Media, Doolittle Mill,
Doolittle Lane, Totternhoe,
Bedfordshire, LU6 1QX.
Tel 01525 222573
enquiries@doolittlemedia.com
Price £20.00 plus p&p (U.K £2.50;
Europe £4.00;
Rest or World £6.00.

section rib and the surrounding pieces to complete one vertical half, which now looks a bit like a boat upside down.

The final operation is to panel the entire half with 0.4mm plywood. Beginning at the front, the first panel starts flush with former No.1 and ends at the mid-point of former No.2. It wraps all the way round from the top keel to the bottom keel piece.

Before you start hacking plywood about and wasting it, practice cutting panel pieces out from thin card. Once you have the right curvature on the panel of card, you will be able to wrap it round the nose and check that the right hand side of the panel matches the middle of former No.2 from top to bottom. **(See Fig.2A, Fig. 2B & Fig.3)**

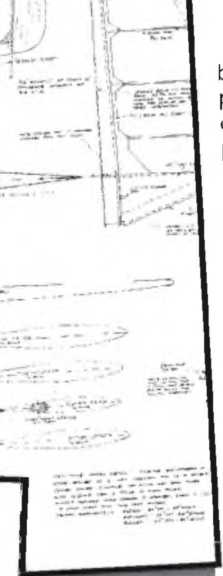
From here on, it all becomes simpler. The left hand side of panel No.2 has the same contour as the right hand side of panel No.1 and so on. Practice two or three panels in thin card - it will pay off. When it comes to cutting panels in ply, make sure the outer grain is running along the fuselage, it bends better that way.

Working your way along the fuselage, you will notice the curves on the side of the panels start to diminish until you get to the centre section, where the sides will be straight. Rearward from the centre section, the panel edges curve only slightly and because of the gentle taper of the fuselage, wider panels covering two to three formers can be used. To glue the panels to the structure, I always use contact adhesive. Over the years, I have found this to be very reliable. Once you have reached this stage, you can remove the half fuselage from the building

The tailplane leading edge locator pins inserted into their mounting lugs.

Detail of the centre line elevator horn and centre line hinge, all cut from sheet metal. Note also the hole for the tailplane retainer bolt.

Rear fuselage showing the tailplane seat, retainer bolt and access hatch to the elevator control horn.



board.Repeat the procedure of assembly and panelling on the right hand side.

Once the panelling is complete, the next stage is to fair the entire fuselage off from front to rear. If you look at the plan view of the fuselage, especially at the front, you will notice that you have a series of flats created by the panel widths. We have to fair over these flats by using a sand-able filler paste (micro balloons & finishing resin for example). The area requiring this treatment will be from the nose to the rear of the centre section.

WINGS

The wings of the Ka-2b are identical in concept to the later Ka-7. There is a high degree of forward sweep on the leading edge which dictates that items like wing joiner tubes are housed in an auxiliary spar. In turn, this is grafted onto the main spar. Double wing joiner blades are employed because of the large area of the wings. This is a precautionary item to accommodate any high G forces experienced in tight manoeuvres.

Ailerons are top hinged using tape top and bottom, a method which has been proven over the years, so why change it. On the prototype model, a one-piece canopy was made up which is scale for the early Ka-2, while later versions had a two-piece canopy similar to the Ka-7.

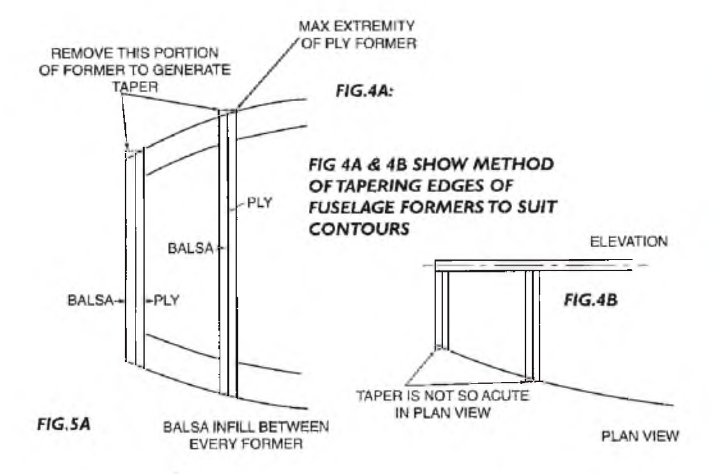
The hardest items to do on the canopy are the small winglets that blend with the angled wing root rib. You have to practice with thin card until you get the shape just right, then you can cut the glazing material.

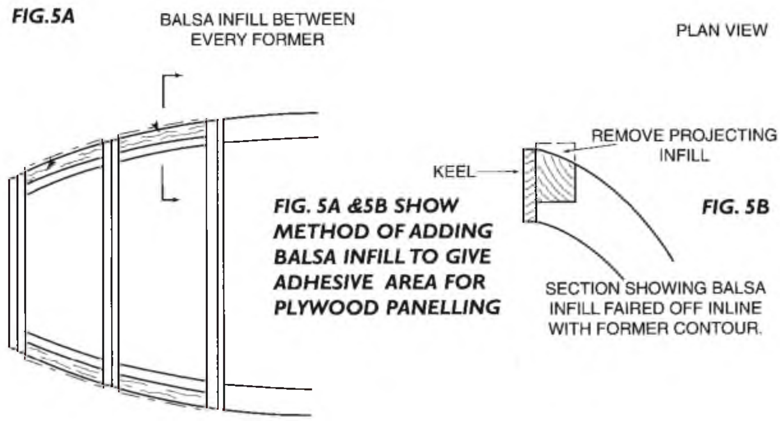
TAILCONE

The vertical and horizontal tail surfaces on the Ka-2b should be built as light as possible to keep the ballast in the nose to a minimum, so the rudder and taiplane components follow full size practice, i.e: the leading edges of both rudder, taiplane and elevator follow full size practice, i.e. the leading edges of both rudder and elevator are made from rolled 0.4 mm ply and the other general wood sizes are minimal. Because the Ka-2b has a relatively long fuselage, building light at the rear end pays off.

The prototype model was covered in *Solartex* material and given two coats of thinned non-shrink dope, then finished to the full size colour scheme with car cellulose.

The lower hinge point of the rudder, pivots on this piano wire pin located on metal bracket screwed to the bottom of the fin tailpost.





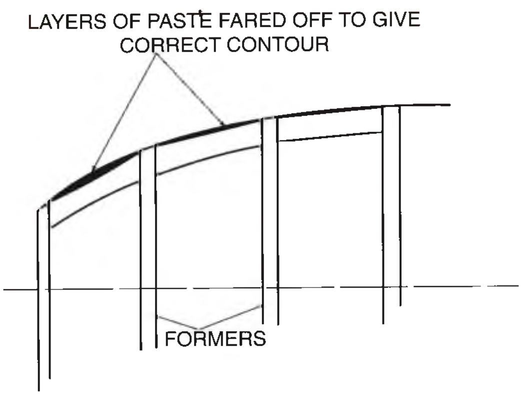


FIG.6: METHOD OF FAIRING OFF PASTE OR FILLER ON PLY PANELS IN ACUTE CONTOUR AREAS

Tongue-and-slot mounting of the tail fin allows it to be removable for transport if required.

Removable panel in fuselage rear under the tailplane, allows access to the elevator horn for adjustment.

Normally a model of this type initial flight testing is best flown from a slope flying site, but at the time if testing the prototype Ka2b model, weather conditions were super calm, hot weather, so it was a case of an Aerotow-start or nothing.

One sometimes has little niggling doubts about incidence settings, so it was with a little hesitation that an *"All Out"* command was given to the tug pilot and away she went.

On this initial tow, a fair degree of up trim was required to keep the glider above the tug and on release from the tow, the model still had a tendency to dip her nose, so the last remaining bit of up elevator trim was used to bring her straight

One of the spoilers let into the upper surface of one of the wing panels.

The single fixed centre-line undercarriage wheel.

The cockpit canopy and its fairing into the wing centre section leading edge.

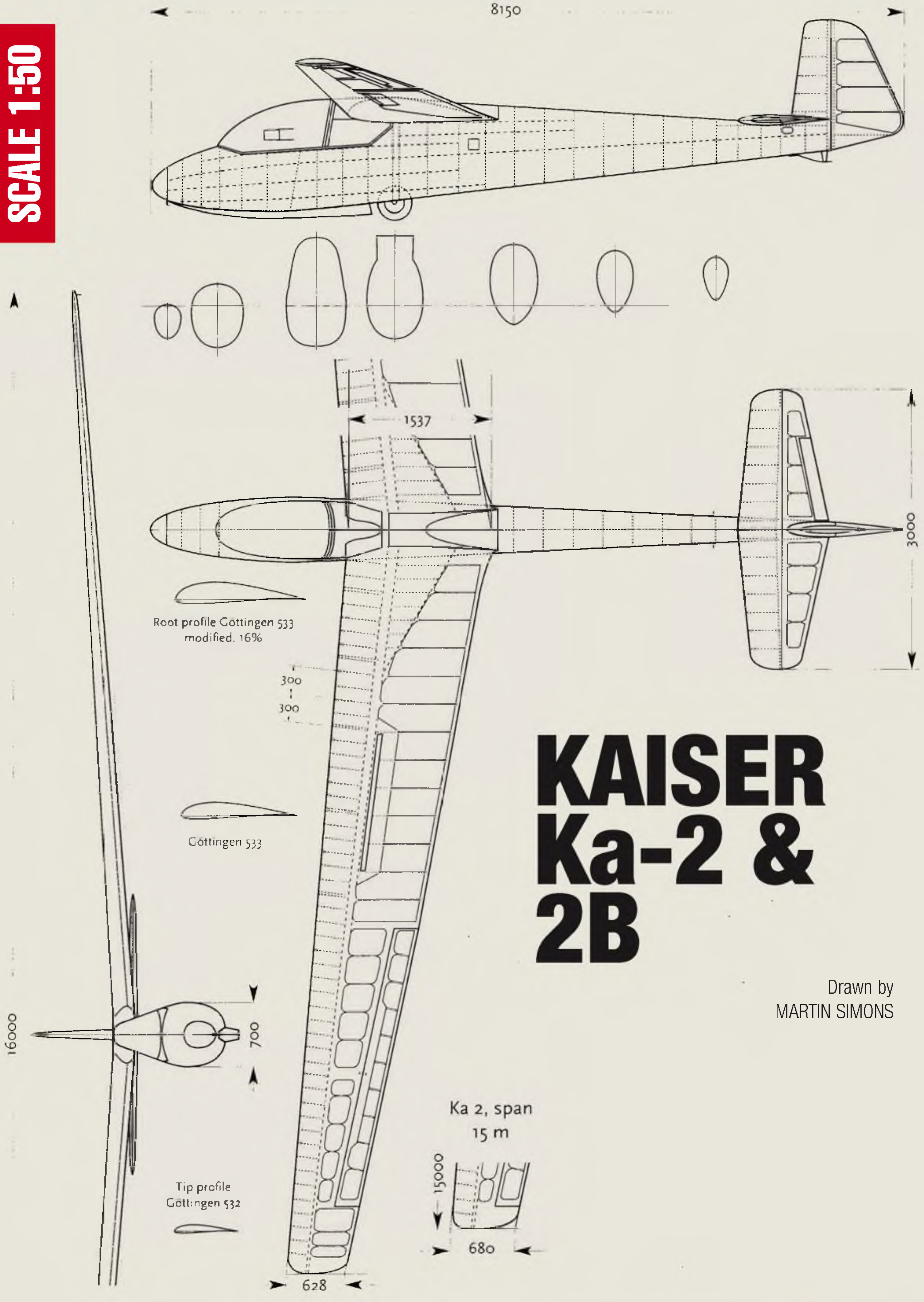
The final finishing touch – a fully furnished cockpit in quater-scale. There's nothing worse that a gaping void under that big cockpit canopy.

The forward sweep of the wing planform is well illustated here.

SCALE 1:50

KAISER Ka-2 & 2B

Drawn by
MARTIN SIMONS



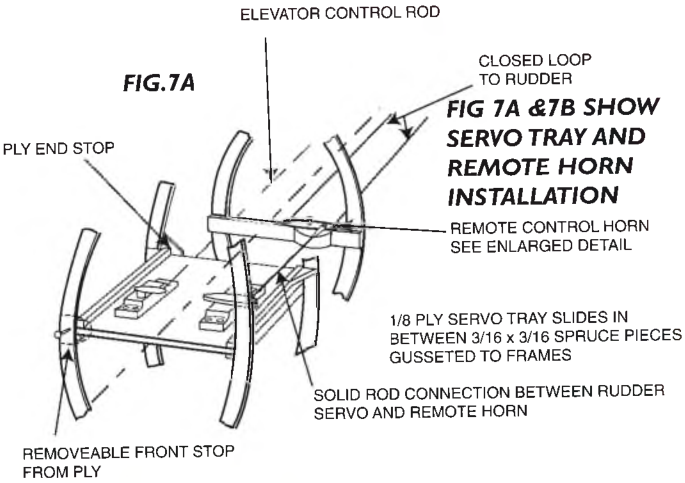
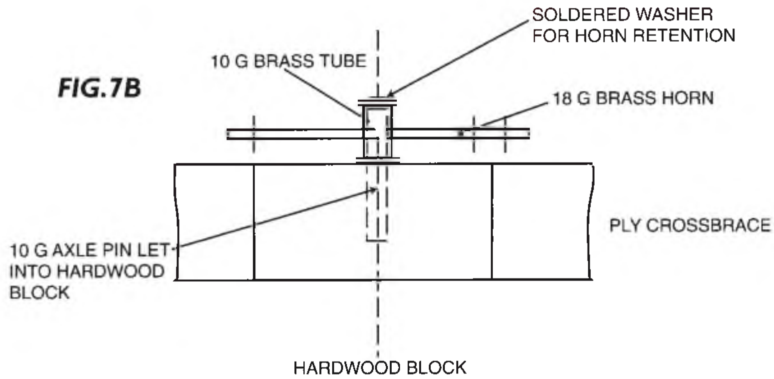


FIG 7A &7B SHOW SERVO TRAY AND REMOTE HORN INSTALLATION



REMOTE HORN FOR RUDDER CONTROL

SERVO TRAY AND REMOTE HORN INSTALLATION

and level.

Following this first test flight some five ounces of ballast was removed from its position in the nose and an increase to the incidence on the tailplane was applied.

On the second tow, she was very docile and, on release from the tow, she started to thermal soar like a good 'un.

Well that's it really, an enjoyable project, a very nice looking glider, and most of all its a delight to fly. ■

NOTE: Unless there is some form of take-off dolly available, a 'wing-man' is needed to keep the wings level during the first few metres of tow as the model gathers pace and controls become effective. Tug and glider pilots stand close to each other during the launch for communication purposes.

SCALE BIPLANES - MY WAY

PART 4: MARTIN FARDELL gets to the heart of it - wings, struts and rigging...

Getting to the heart of it - wings, struts and rigging...I wonder how many of you out there reading this are actually building your own models from the real living balsa. Not very many, I suspect.

In these days of mass ARTFs, there is a big danger that all those traditional building skills will be lost for ever, which is one reason why I wanted to write this series; if the accumulated ideas of a generation of scale modellers are written down, then the information will still be there when the world comes to its senses! One day we will all go back to the pleasures of creating our own models, instead of just bolting the wings on.

Actually, if you want a big, slow scale biplane you may well have to build it yourself anyway as, for some reason, the ARTF merchants don't offer very much in that line!

Wings, wings!

Firstly this month, we are looking at wings - the most important bit of any aeroplane. Those of us who are scratch-building scale biplanes have all more or less standardized on the same wing construction, which actually follows the full size structure of 1930s biplanes quite closely.

All my models have plug-in wing panels (top and bottom wings together), with no strength in the actual joint at the wing root. Forget dihedral braces, mighty steel rods in aluminium tubes and all the rest; the flight loads are entirely taken on the bracing wires. This requires a leap of faith for most of us - over the years we have gradually enlarged the construction methods used on 24" rubber models; OK for small models, but not the best way for a 100", 10kg aeroplane.

Pete McDermott's DH 9A. One of the best scale models ever.

The cockpit of the Pete McDermott's DH 9A. Unbelievable! But don't let this put you off the whole idea - you don't have to go to this level of detail - unless you want to be World Champion!

We need to work from the other end - start from the full-size and scale it down a bit! **Fig.1** shows a typical chord-wise section at a wing rib. The spars, leading edge and trailing edge are all spruce, and the ribs are 3/32" balsa. The spars are webbed with balsa (grain vertical), which gives a useful increase in strength for virtually no weight penalty, and also prevents the ribs crushing in a vertical direction. This gives a very strong wing, probably a lot stronger than we need in order to take normal flight loads. Once the bracing wires are in place, the whole biplane wing assembly is immensely strong, and I have never seen a wing built using this system to fail, except when a bracing wire attachment has been faulty.

The spars are reinforced at the strut attachment points and at the wing roots, and **fig.2** shows this.

Complications!

The wing structure is made quite a bit more complicated by the need to maintain reasonable scale appearance. The spars need to be below the surface so that they do not show through the covering, and the leading edge will be of quite small cross section. The trailing edge is always difficult; in most cases, on the full-size, it would be wire, or small section steel tube, with the necessary stiffness coming mostly from the wing ribs and not from the trailing edge itself.

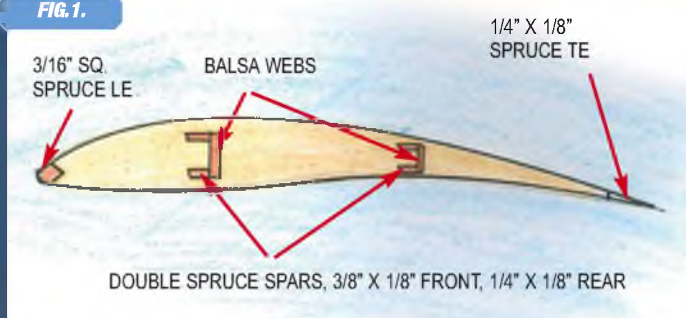
For a model of such and aircraft type, it is very nearly impossible to make the trailing edge stiff enough this way. Even carbon rod will tend to allow warps when the covering is applied. I have successfully used carbon tows to stiffen up the ribs behind the rear spar, and this helps quite a bit (**fig.3**). For his Blackburn Blackburd, Terry Manley cleverly incorporated a triangular box spar into the very long ailerons on this aircraft. **Fig.4** shows the general idea, and the resulting ailerons are amazingly stiff and show no tendency to bend or twist.

Ribs, Ribs and - more Ribs...

All those wing ribs need to be cut before construction starts. I make a ply template and cut them by hand with a sharp knife, using a pointed scalpel blade for the spar slots. The sheet balsa can be quite soft, so the job is pleasant enough, if a bit time-consuming. A glass of wine to hand helps.

Alternatively, you can order them up from one of the firms doing laser cutting - all they need is an accurate drawing of your wing ribs. One important point to note is that the ribs should be cut slightly deeper than necessary at the leading and trailing edges, to allow them to be sanded to blend perfectly with the leading and trailing edge sections. Nothing looks worse than the edge of the 3/16" spruce leading edge sticking up above the wing ribs (**fig. 5**). The root ribs need to be as stiff as you can make them, as these always tend to pull in under the tension of the covering. I usually make them of 1/4" balsa with a layer of glass cloth on each face. Cut the ribs out first and then lay up the glass-balsa-glass

FIG.1.



STANDARD BIPLANE WING CONSTRUCTION

FIG.2.

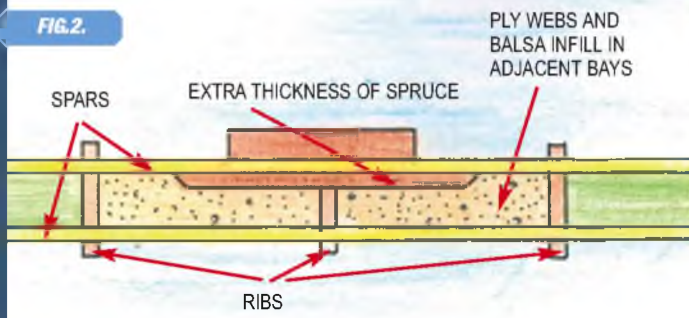


FIG. 2 - SPAR REINFORCEMENT AT STRUT/RIGGING ATTACHMENT POINTS.

FIG.3.

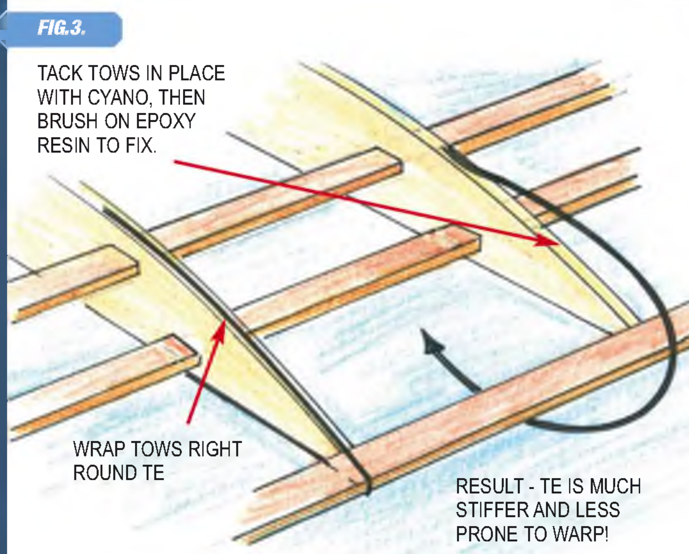


FIG. 3 - WING RIB/TE REINFORCEMENT USING CARBON TOWS.

FIG.4.

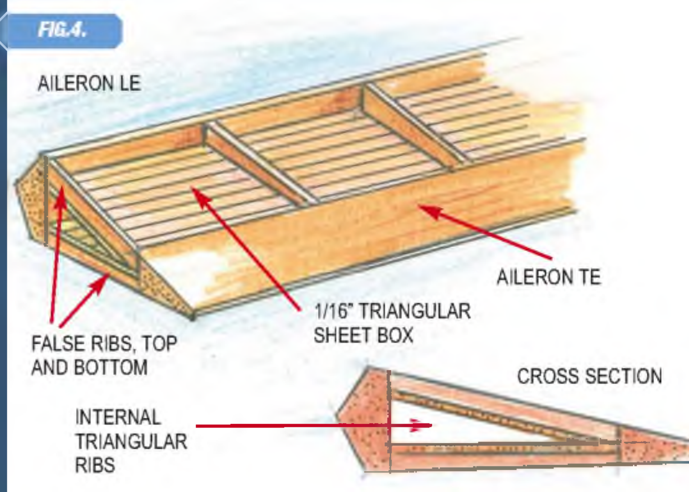


FIG. 4 - TERRY MANLEY'S METHOD FOR WARP-FREE AILERONS.

PARADISE!. A gathering of biplane nuts on a windless summer's day. We allow monoplanes in if they are De Havillands! (Ian Bryant's lovely Puss Moth on the left).

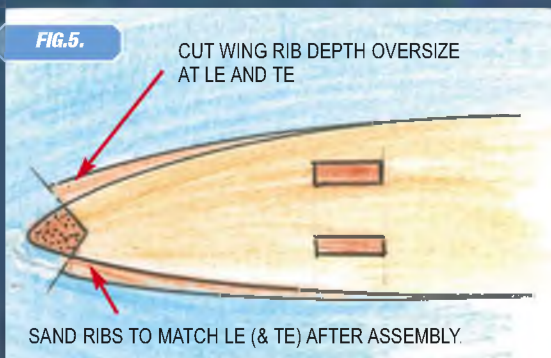


FIG. 5 - SHAPING RIB LE/TE TO MATCH LE/TE STRIP SECTION.

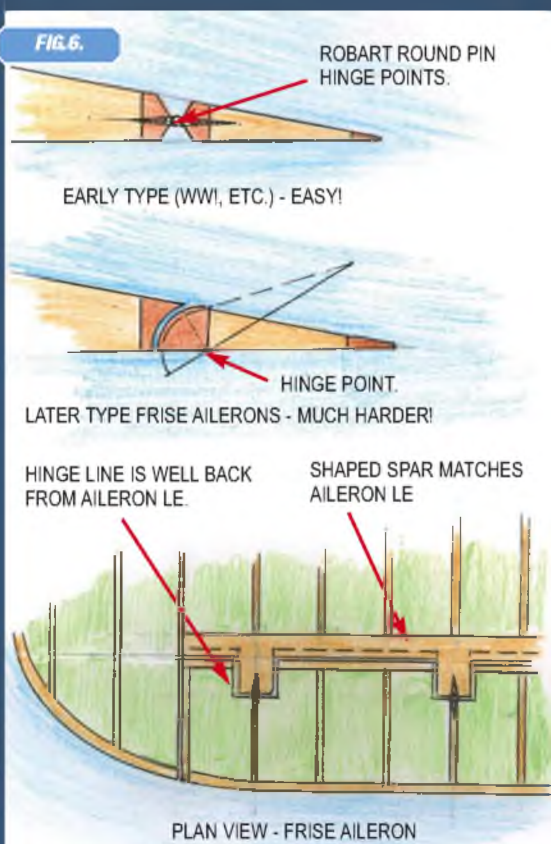


FIG. 6 - AILERON HINGING - EARLY AND LATE PERIODS.

sandwich and cure between two sheets of glass. Trimming off the surplus glass cloth is easier if you catch it just before it's fully cured.

Spruce is usually supplied in 3ft lengths; the spars will need to be scarf jointed for larger models.

Construction at last!

Once you have all the bits ready, assembling the wing is easy enough, if a bit repetitive. I try and build the four wing panels in parallel, otherwise after hours of work and one wing is finished you have that dreadful "one down, three to go" feeling!

Rule lines on the building board to give the correct rib spacing, and then thread all the ribs onto the four spruce spars. Space the ribs out to roughly the right spacing, but don't worry about tips or root rib at this stage.

Pin or tack glue the two end ribs to the building board in exactly the right place and then accurately position all the other ribs. When all is in place, squeeze white glue on all sides of all the joints that you can reach. Add spruce leading and trailing edges, shaped to correct cross section. When the glue is dry, turn the wing over and glue all the rib-spar joints from the underside.

Root ribs come next; these must be positioned as accurately as possible as any error will be greatly magnified at the wing tip.

Tips on Tips

The wing tips are important. Not only must they be the right shape, but also they must not look too heavy or lumpy. Real biplanes were surprisingly delicate beasts and nasty thick wing tips can really spoil a model. I have found that the easiest way to get the necessary strength into the wing tips is to laminate them from layers of 1/32" ply. This may sound complicated, but is actually dead easy to do.

Mark out the shape accurately on thick cardboard (old packing boxes), cut out 1/4" undersize, and fix to a board. Cut strips of 1/32" ply about 1/4" wide (grain lengthwise) and assemble an eight-layer sandwich with plenty of white glue. Wrap round the card template and allow the glue to dry overnight. Sanding the laminated tips to section can be hard work and some sort of power sander is a great help. They need to be shaped to a nice fine cross section, and also reduced in depth towards the trailing edge, so quite a lot of wood has to be sanded off.

Once the tips are in place and the last three or four ribs have been glued in, the whole wing tip area can be sanded to a nice smooth contour. The lower two spruce spars can probably continue right to the tip, but the top spars will need to be cut and angled downwards so that they remain below the covering. The photo shows a typical finished wing tip. At this stage, the balsa webs can be added to the spars and the reinforcement at strut attachment points built up, as in **fig.2**.

The end is nigh...

Nearly there now! The final stage is to create the ailerons. Mark the position of the aileron leading edge, and carefully remove a section from each wing rib to allow both the aileron leading edge, and the aileron spar on the wing, to be dropped in. Constructing the ailerons integrally with the wing in this way ensures that each aileron exactly matches its wing. The part ribs at the ends of the ailerons are again very liable to pull out of shape as the covering tightens, so these need to be as stiff as possible.

Hinging arrangements vary from aircraft to aircraft. If you are lucky, the ailerons will be hinged on the centre of their leading edge; the worst to do are Frise ailerons, where the hinge line is well back from the aileron leading edge. (**Fig.6**) I always use Robart round hinge points (with metal pins); these are much easier to install than flat hinges. Final stages include the addition ofleading edge riblets (if any) and arranging the servos to drive the ailerons. Nobody uses a single servo and bell cranks these days; a servo in each wing is much

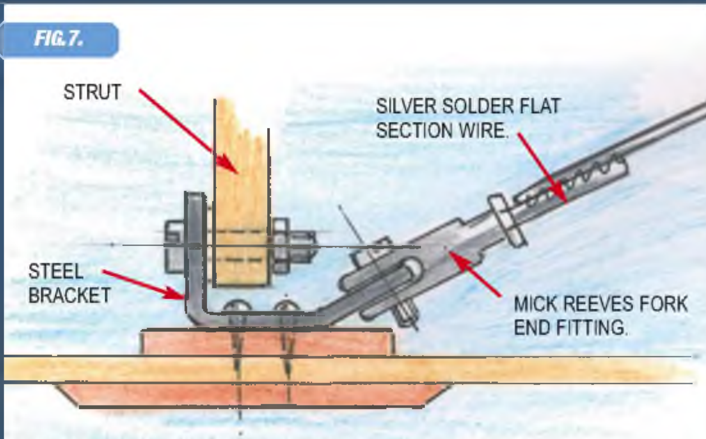


FIG. 7 - RIGGING WIRE ATTACHMENT METHOD.


This is why we do it. Bringing my Loening in for a touch and go at Barkston Heath.

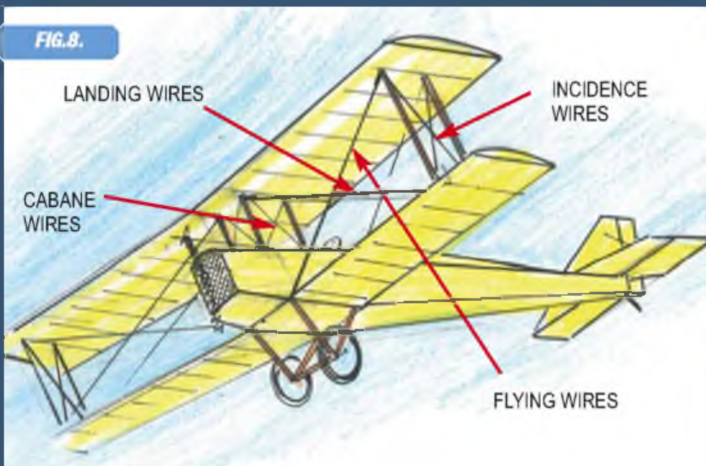


FIG. 8 - NAMING THE RIGGING WIRES


A birds nest of wires! The earlier the aeroplane, the worse was the tangle of wires. This is my RE8.

easier and it is usually possible to bury a standard size servo within the wing. Even if it slightly protrudes on the underside it will hardly show. It is usual to drive the lower ailerons direct from their servos, and connect to the upper ailerons with pushrods in the scale position.

Wind in the wires...

If you have not made a big biplane before, this will be unfamiliar territory. Over the years there has been much pooling of ideas and I will describe how I do the struts and wires on my models. You will see other models where the rigging is much closer to exact scale, but my way is not far wrong, quite quick to do, and well up to our notional stand-off scale standard. The struts are balsa, cored with carbon and glass skin, the wires are flat section stainless steel from Mick Reeves, the adjustable end fittings also from Mick. The wires and struts go to brackets made from thin steel or brass sheet. **Fig.7** shows the general idea, also have a look at the photo. Not perfect scale, but not too far off! **Fig.8** shows the correct names for each set of wires. Each top and bottom wing pair is removed as a unit for transport - all the struts and wires remain in place. Single bay biplanes need jury struts to support the wing roots once the wings are removed.

Struts made easy

For years we made all struts, undercarriage, interplane, cabane, out of piano wire with balsa fairings to get the shape right. This is hard work and time consuming. Not only that; after the slightest mishap the wire bends and is almost impossible to straighten without wrecking the strut. The way I make all the struts now - with a balsa core and carbon skin - was invented by Pete McDermott and is easy to do. You end up with struts that are very stiff and light. They will break if there is a bad accident, but a replacement can easily be made.

Start by shaping the strut out of balsa. Let in the strengthening pieces at each end as in **Fig.9** (epoxy glass board or Tufnol). Cover one side with carbon fibre cloth and then a layer of 100 gramme


All the RAF biplane fighters from 1918 to 1939 are very appealing. This is Pete McDermott's Snipe in WW1 colours. I believe he is now recovering it in a 1920's silver scheme.


Richard Crapp has taken his Swordfish all over the world, with great success.

FIG.9.

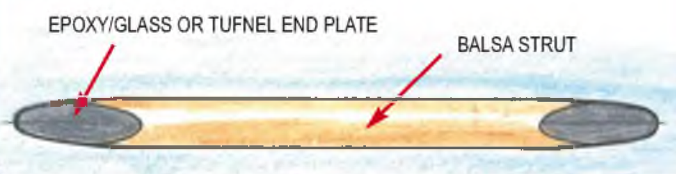


FIG. 9 - FIG. 6 - INTERPLANE STRUT CONSTRUCTION.

Double bay wing panels can be removed fully rigged for transport. Single bay wings need an end plate jig to hold the panels rigid.

glass cloth over that. Free Flight Supplies web site has a very good selection of carbon and glass cloths in various weights. I use the Russian unidirectional carbon cloth for the struts as it is a good bit cheaper than most carbon cloth, and gives the strength along the length of the strut, where it is needed. Let the cloth hang down over the sides of the strut if you can.

Polyester resin is entirely adequate for this job; although possibly not quite as strong as epoxy, it is less critical to mix, cheaper, easier to sand off any excess - and quicker to cure. Trim off the surplus cloth when nearly cured, turn over, and repeat on the other side. The glass cloth is there mainly to give a smooth finish over the carbon, as well as some of extra strength. The edges may need a bit of tidying up with filler and then just a light scraping of lightweight filler over the strut surface will fill the cloth weave ready for painting.

Fittings

The fittings to attach the struts and wires are easily made from thin brass or steel sheet. Fix in place with small self-tap screws into the reinforced spars with a dab of epoxy, after covering. At the wing roots we need to accurately locate the wings using tapered steel pins into brass tubes, and also devise a way of holding the wings in, i.e. preventing them sliding outwards. **Fig.10** shows this. Note that there is no bend strength built into the root joint - everything depends on the wires!

Which brings us to the most crucial bits on the whole model...

They must not fail!

On a biplane you can stand a few minor structural failures - spars cracking, wires becoming detached, etc. There is usually enough strength remaining to get the model down safely. There are two exceptions. The flying wires, from the root of the lower wing to the top of the first set of struts, must never fail. This means that the fittings at the end of these wires must be bolted through the spars; you just can't take the risk of a screwed fitting

FIG.10.

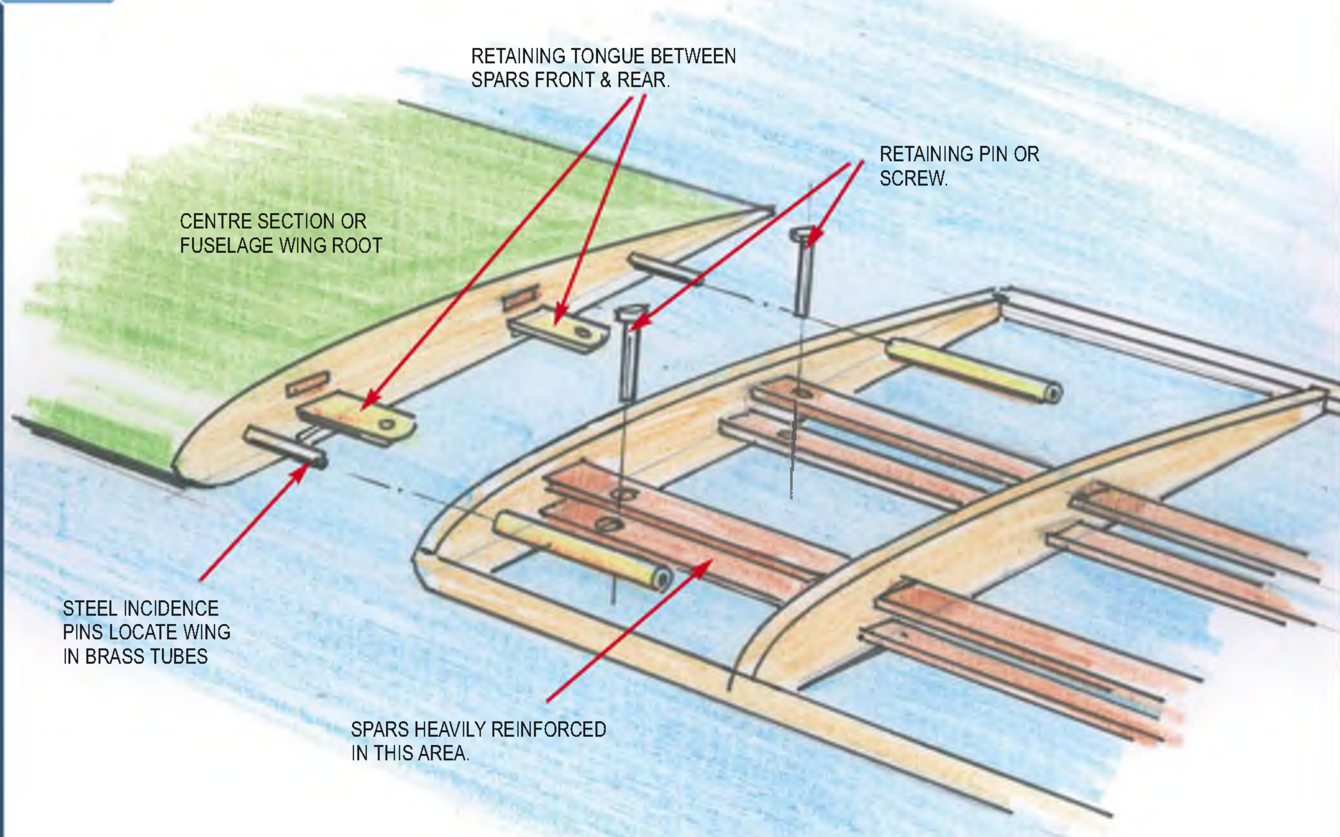
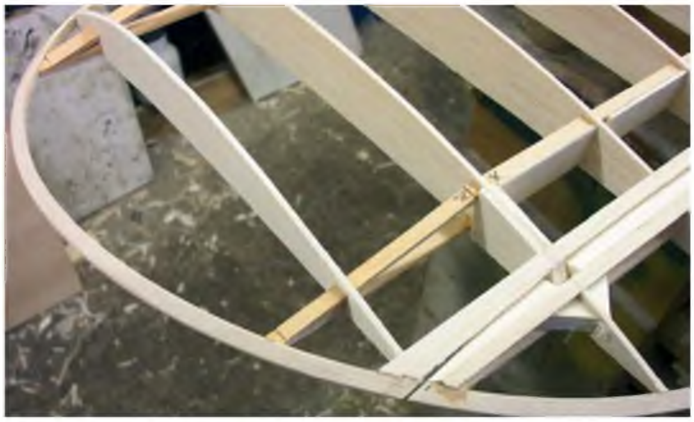


FIG. 10 - RETAINING THE WINGS AT FUSELAGE/CENTRE SECTION.

Alex Kennedy and his Tiger Moth, in jazzy Swedish colour scheme.



Laminated wing tip. See text.

Close up of strut end and wire termination, including the Mick Reeves adjustable end fittings.

Covering the balsa strut with carbon and glass cloth.

working loose.

I have never had a screwed fitting (as described above) come out, but take no chances with the flying wires and bolt right through the spars. Secondly, not so obvious, is the retaining system for the lower wing. Under normal flight loads, all the 'g' forces on the wings are tending to pull the lower wings outwards, away from the fuselage. This tension force needs to be taken by the retaining system, and this means a metal or epoxy glass strap right through the fuselage. **Fig.10** shows these two critical areas. The alternative is to take the flying wires to the fuselage instead of the wing root (usually the full-size method), which means you have to disconnect the wires to remove the wings. However, whichever way you do it, there must be no chance of failure in this area!

At the centre of the upper wing, normal flight loads will produce a compression force (unless you intend to fly inverted) and this will not be a problem on a model; we normally have strength in hand as far as compression forces are concerned.

Rigging the model

We have not talked about covering and painting the airframe, but this seems the logical place to deal with rigging - that is connecting all the struts and wires to produce a complete aeroplane! Rigging was a skilled trade in the RAF in the biplane era. The exact sequence of adjusting all the wires was carefully followed; errors in rigging would affect flight performance. It's not so difficult with a model, as you can assemble the complete airframe without wires first, using piles of books and suchlike to prop up the wings in roughly their right positions.

The wires can then be added one by one, making fine adjustments as you go along. An incidence gauge is almost essential, not only for checking incidence along each wing, but also for getting the dihedral correct. With these big models it is impossible to stand back far enough to check the rigging angles by eye, so you have to rely on measuring.

The Mick Reeves fork ends for the wires are straightforward to use. There is threaded adjustment at one end, and a swivel at the other, to allow adjustment by turning the wire. Being stainless steel, they silver solder easily to the flat wire. 3/32" is the correct size of wire for all but the very largest models. Once all the wires are in place and you start to make final adjustments, you find that they are all inter-related.

Tighten an incidence wire and the stagger changes. Tighten a landing wire and the incidence changes! If your airframe was accurately built, it will all come together correctly, maybe after a bit of fiddling; if the airframe was not accurate, then some compromises will be necessary! However, I very much doubt whether small errors in rigging angles are noticeable when we fly our models.

'N'-struts

When I started to set about rigging my Loening amphibian, I fully expected it to be a load of trouble; a two-bay biplane, eight struts and about 30 or 40 wires to adjust.

In practice, it was dead easy. The reason: "N" struts. Like most US biplanes, the Loening has "N " struts between the wings, instead of two separate struts and incidence wires. These make the rigging much easier, as the incidences and alignment of the wings are automatically fixed. The routine is as follows. Once the centre section and cabane struts are in place, take accurate measurements at the wing roots of the top and bottom spar attachment points. Then make four identical "N" struts as accurately as possible, using the same method detailed above for single struts. If the struts are right at the wing roots, then they will be right at the tips. Screw the four struts in place, and Bingo! The wings are correctly aligned. This made such a difference that I will always use this method in future. Even on types which have separate interplane struts, it would be well worth while making dummy "N" struts out of ply and then replacing them one by one when the wings are all aligned. ■

NEXT MONTH

As a change from all this construction nitty-gritty, we are going to look at operating and flying these big beasts.

THE QUIET ZONE

R/C SCALE ELECTRICS WITH PETER RAKE

Yes, here we go again with yet more electric flight meanderings. By now you're all fairly familiar with the way this goes, I waffle on a lot, throw in some electric flight stuff and generally attempt to keep you entertained for a few minutes. Silly, isn't it? Still, just think how much more boring life would be without it.

So, what have we lined up for you this month? Well, to be perfectly honest, when I sat down to write this I hadn't the faintest idea what it would be about. Okay, maybe a vague idea, but not what form it would take. If truth be known, I still don't really know how this will play out. It's obviously going to be something of a mystery tour for both of us (all of us if there's more than one person that actually reads this).

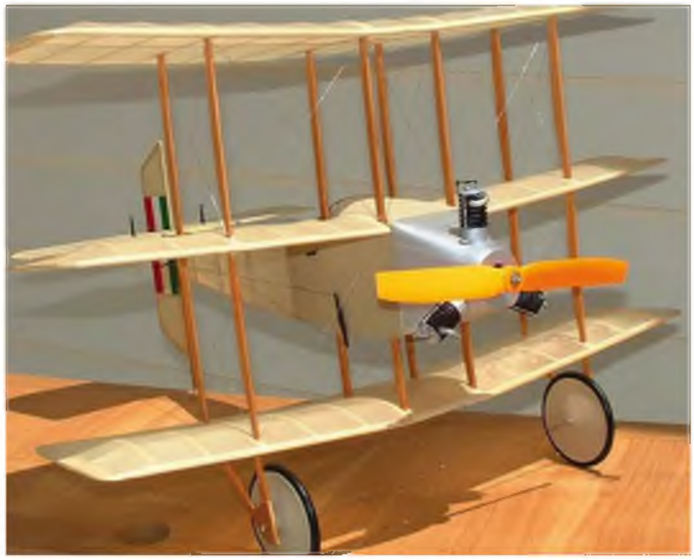
Over the past months we've looked at small models, converted rubber power models and profile scale foam models. The only thing they had in common (apart from the fact it was me writing about them) was that they were electric powered. This set me thinking. Yes, I know it's hard to believe but that does happen if I'm not careful.

WHY ELECTRIC

A question I've asked myself many times over the years, especially in those early days when about the only power source available (at my local model shop and long before I owned a computer) were

Models don't have to be small these days. This 67" Brisfit proves the point.

Built years ago, and not actually a scale model, this 56" span monoplane was powered by a geared 600 brushed motor and 7 or 8 Ni-Cad cells. Flew really well.



With that slim nose and all that rigging this type of model lends itself admirably to electric power.

Not this particular model but a 45" Stahlwerk was a nice flyer at around 24 ounces and powered by a geared 400.

Even floatplanes, like this Besson that will be next month's free plan, are feasible as long as you keep water out of the model.

various winds of 540 sized brushed motors and ex-buggy battery packs. Let me assure those of you who have been fortunate enough to avoid such cumbersome and marginally powered set-ups that you haven't missed a thing. Believe me, they were truly horrendous to use but, since there was very little else to be had, did the job to one extent or another.

Remember that I'm talking late 1980s/early 1990s here and electric flight was far from a main line proposition - it was necessary to cobble together whatever equipment looked as if it might do the job - without weighing so much that the model could carry it all.

Given this, you might be wondering why anybody in their right mind would even consider electric power, and in so wondering, then answer your own question nicely - nobody ever said I was firing on all cylinders. Maybe that should have been with all armatures fully functioning, considering what we're discussing!

To be honest, in my case it was that I'd tried rubber power and free-flight models and enjoyed both, but was down right sick of having to chase the beggars. Radio control went some way to solving that issue and I'd gone through the trainer, aileron trainer, scale model initiation, designed my own sort of route and it was all becoming a bit 'old hat'; not that I'd come even close to exhausting the possibilities, or become a wonderful pilot, but it had taken me as far as I wanted to go along those lines.

Just as an aside; I clearly remember my first low wing model (a Mini Stuntman) which also, as it happens, was my first aileron model. You know how it goes, you learn to fly a couple of trainers and instantly think you can take on anything - THINK YOU CAN!!! So, there I was, never having flown an aileron model and never flown a low wing model. Sounds a recipe for disaster, doesn't it? Looking back I'll never know how I got away with it. S

So, I pointed the thing into wind, opened the throttle and hauled the thing off the ground before it ran into the heather at the edge of our tiny patch. Surprise, surprise, the little model leapt into the air and proceeded to climb away nicely. Then it occurred to me that I had to turn the stupid b****y thing - PANIC!!!! Typical of me; never picked the easy route. I had no idea how much bank was required or how the model would respond so my solution was to half loop the model and do a half roll off the top. Problem solved, the model was now heading back again. The even greater surprising was that I actually landed it back on the patch at the end of the flight. No mean feat in itself considering how small that patch was.

Sorry about that, you know how we old beggars wander from time to time. Having gone as far as I wanted (at that time) with wet and smelly models, an idea that had been nagging away in the back of my brain (you see, I do have one) began to take hold. Knowing that electric models needed to be built lightly, and since I thoroughly enjoyed the rubber power/free-flight style of building, I began to consider the possibilities of electric flight. I wasn't interested in powered glider style models, or the few trainer style kits that were around at the time so, armed with the ubiquitous direct-drive 540 motor and six-cell Ni-Cad pack (all I could obtain easily and without spending too much on something I might not like), I set about drawing up a model I did want to build.

The result was a simple, shoulder wing monoplane with an open cockpit of about 45" span. Controls were just rudder, elevator and motor - no throttle, just a simple on/off arrangement - it was all very crude in those days.

Anyway, the upshot of all this was that the model actually flew, and flew rather well too. Being shoulder wing battery access was through the lower fuselage, immediately behind the undercarriage and the pack was retained with Velcro. Connectors were those awful Tamiya buggy style things, but that actually proved just as well during one loop. For the uninitiated, Tamiya connectors clip together and since Velcro isn't overly fond of having eight ounces of battery pack put through high G manoeuvres, the battery pack attempted to part company with the model. Trust me, it looked really strange flying around (battery sensibly (by luck) located directly below the balance point) with the pack dangling out of the fuselage. It made landing interesting I can tell you.

Inspired by such success, when the model finally met its demise, I experimented with other models using similar power. The one thing I can tell you, and the thing that killed my otherwise successful model, is that unless your landings are smooth, and on the strip, every time that model is going to stop suddenly at some point, the model itself may well stop suddenly, but the battery pack tends to carry on going for a bit further. That 'bit further' usually takes the battery through the nose of the model, which does the model no good at all.

While still experimenting, I came across an Olympus belt drive. Having seen that these will fly a 40" biplane I quickly converted my DB Moth 20 to electric power. Absolutely outstanding - NOT!!!! All the poor overburdened thing could manage, on the only motors and battery packs I had, was a sedate waddle across the strip; no accelleration, no attempting to lift on and not really very much of anything else either.

Totally disheartened I went back to the dark side and continued to fly my own-design, four-stroke powered models.

BUT IT'S STILL NIGGLING

By now my models were getting better and my pilot skills improved, but there was still something that was not quite right (no, I most emphatically do not mean me - although some might argue that point). There was still this strange urge to fly quiet, clean, electric powered models; the sort of model I'd flown rubber power, or dreamed of flying free-flight. Small, lightweight, scale models. Sopwiths, Fokkers and Nieuports, that sort of thing - the type of model I'd always envisioned cruising sedately around the local sports field, but without annoying the neighbours with noisy, smelly engines - I had done far too much of that in my misspent youth. Believe me, a 56" control-line model powered by an unsilenced (Silencers; what are they for?) Merco .35 is not the most neighbour friendly model imaginable.

So, reading through the electric flight articles in the modelling press, I could see that the availability of practical electric power items had improved considerably. People were successfully flying precisely the type of model I had always lusted after thanks to this wonderful device known as a geared Speed 400. Motor weight was greatly reduced, battery weight had come down to around five ounces and models that weighed little more than a pound were flying well. That was it, the die was cast, I simply HAD to own just such a power unit.

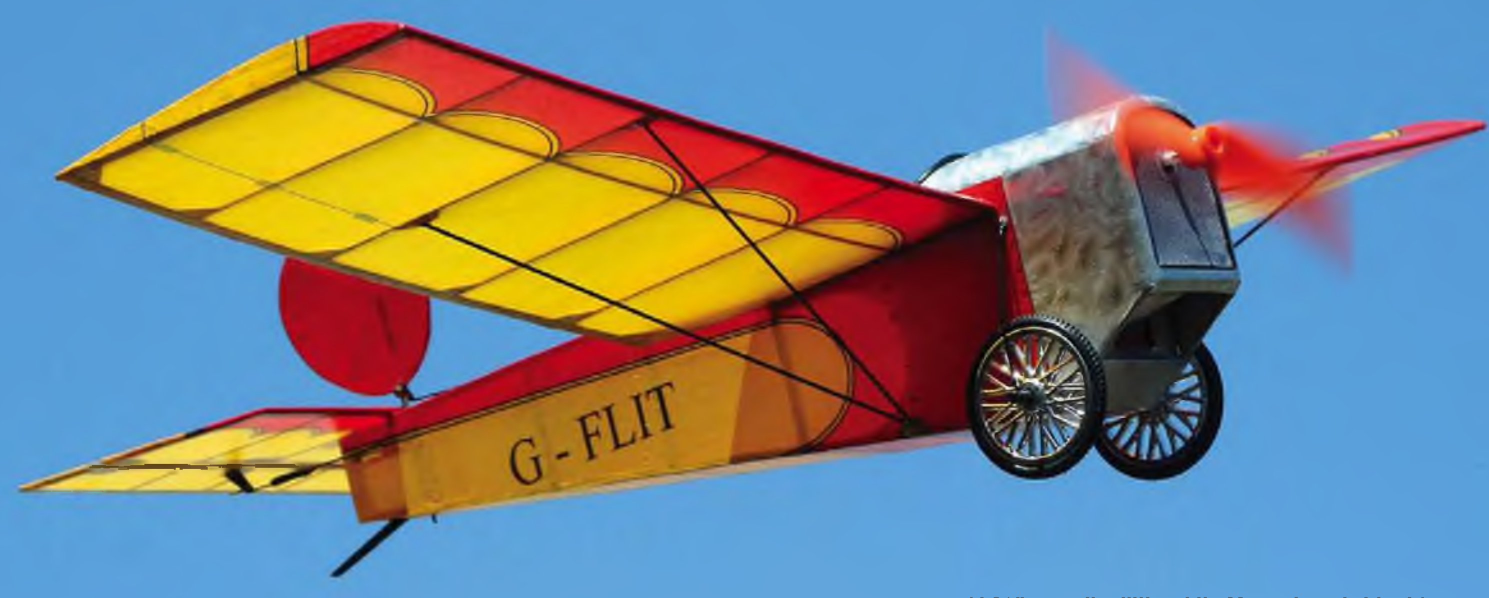
Having stumped up my hard earned cash and bought myself a Speedgear 400 (in-line 4:1 gearbox fitted to a 7.2 volt Speed 400 controlller), seven cell 600 AR (THE one to have) battery pack - that's Ni-Cad cells- and a suitable speed control, a model was drawn up and built.

Inspired by a Walt Mooney rubber power plan I had from years before, a 45" span Chiribiri N5 took shape; with boxy fuselage, skidded landing gear and more rigging than you can shake a stick at, I loved it. It was just what I'd dreamed of being able to fly. What was more, it actually did fly, looked great, flew great and had me truly hooked. In fact, that was the first design I ever had published. I liked it, but wasn't sure it was good enough for publication. Imagine my surprise when Ken Sheppard snapped it up for dear old Radio Modeller (alas, no more). It might have appeared in AMI, but Tony (our beloved editor) was just too slow getting back to me. Perhaps I should have described him as long suffering. After all, this was back in 1995 and he's had to put up with me ever since. The patience of a saint that chap must have.

When the next few electric models worked out just as well, and I'd discovered that the Olympus belt drive does work well with the right motor and batteries (I was flying 45 and 50" biplanes using one), I knew I had found my niche. At this point I sold all my engines (only four-strokes by then) and went over to solely electric powered models. I haven't built a non-electric model since, just quiet, clean and highly civilised types. Yes, I know some of you wish I hadn't designed anything since, but tough luck.

OKAY, SO WHY

I know that last section ran on a bit and highlighted far more reasons why NOT to build electric models than it did reasons to build them (back then), but it served to illustrate what electric flight was like back in those days. Motors were basic, battery packs came in far fewer forms than now and speed controls were given that designation somewhat optimistically.



At 18" span the little white Monoplane is ideal for indoor, or calm outdoor flying.

Don't get me wrong, most worked well but there were still some hanging around that were somewhat less reliable. I still carry the scars from just such a speed control that armed before it was supposed to. A geared 600 motor on seven or eight cells (around 9 volts) doesn't slow up very much as the prop slices through flesh; nothing deep, fortunately, but that didn't stop it b****y well hurting. But it does teach you, the hard way, to keep your arms out of the prop arc while messing about with things though.

These days, selecting a suitable power train is relatively easy. Probably the hardest parts are choosing which brand of components to use, or deciphering exactly what all those brushless motor numbers mean.

As to the actual why of it, well it no longer has to mean you're slightly strange and actually makes a lot of sense for certain types of model. Add in that it's quiet, and opens up the possible use of small playing fields as flying sites without annoying anybody with the noise - and it becomes clear that it has a lot going for it. I

ndoor flying, in all it's forms are now easily possible without the need for ear plugs and with no build up of noxious fumes. Big models, small models and absolutely minuscule models are all perfectly viable. Even models that can be flown in your living room are now no longer about to get you banished to the garden shed for life.

For me personally, as it has from the very early days (eventually), it means that I can fly precisely the type of model I want, built in the way I prefer and at the size I want to build it. The model can have as much, or as little, detail as I feel like incorporating without having to worry about it getting covered in oil. Flying sessions no longer need as much ancillary equipment dragged along and end by simply putting the models onto the back seat of the car - without spoiling the seats.

In these days of unlimited types of brushless motors and lightweight, high capacity battery packs pretty much any model that can be powered by a wet and smelly could just as easily be electric powered - and possibly work out a little lighter. Short flight duration is no longer the issue it once used to be. Instead of the five to eight minutes duration to be expected from a geared 400/Ni-Cad arrangement, flight of well over 20 minutes are now easily within our grasp.

To my mind (addled as it may have been by dope fumes) electric flight simply HAS to be the way to go. Just look at the way it opened up the field as far as model helicopters are concerned. Combined with advances in gyro technology helicopter flying is now almost as easy as falling off a log. So easy, in fact, that many now fly flybarless models to actually make it more difficult. That's probably not why they say they do it, but it is basically the case.

There you go then, another visit to the asylum over with. If you'd like to contact me for any reason you'll find me at PETERRAKE@aol.com ■

This 32" model demonstrates, through the doculam covering, my favoured reinforced rubber power style of construction.

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Luton Minor CD68
Just one example of this light aircraft, to which the owner has added many mods and variations. (32 images)

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Kawasaki Ki100 CD66
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Junkers Ju87G-2 Stuka CD65
The aircraft that defined the term

Hawker Typhoon CD109
The Hawker Typhoon was a British single-seat fighter bomber, produced by Hawker Aircraft. While the Typhoon was designed to be a medium-high altitude interceptor. 117 images

Hawker Tomtit CD64
Mid 1930s RAF biplane trainer aircraft, from the era open cockpits of silver dope and polished metal. (140 images)

Hawker Tempest Mk 2 CD63
The final development of Hawker

Hawker Sea Fury FB XI CD62
Hottest of all the piston-engine fighter aircraft, the carrier-bourne Sea Fury is also admired for its elegant profile. (140 images)

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Hawker Hart & Hind CD60
A combo collection featuring the RAF Museam's Hart bomber and Hart Trainer, plus Shuttleworth's Hind . (115 images)

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No authentic example now exists, but the accurate replica photographed in extensive detail in this collection is as good a guide as can be found of this elegant 1930s RAF fighter. Includes some general arrangement pictures authentic to the period. (55 Images)

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Grumman F8F Bearcat CD57
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Grumman F7F Tigercat CD56
The awesome twin engine long range fighter of the late WW2 era operated by US Navy and US Marines. (60 Images)

Grumman F6F Hellcat CD55
The US Navy's most important, and most successful fighter of WW2, photographed, close-up, from nose to tail and wing tip to wing tip. Example shown is part of The Fighter Collection, based at Duxford. (90 images)

Grumman F3F CD54
A study of the faithfully replicated example of the 1930s U.S. Navy biplane as seen at the 2001 Flying Legends Show. (34 images)

Gloster Gladiator CD53
The Royal Air Force's last biplane fighter, star of late 1930s air shows and flown in combat during early WW2, including Battle of France, Battle of Britain, Mediterranean operations and North Africa. (50 images)

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The Fantasy of Flight Museum's example of the late WW1 Imperial German Air Service monoplane fighter, in full detail. (69 images)

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The most famous of all the German fighter aircraft of WW1. The collection depicts the RAF Museum, Hendon's authentic, restored example. (44 images)

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