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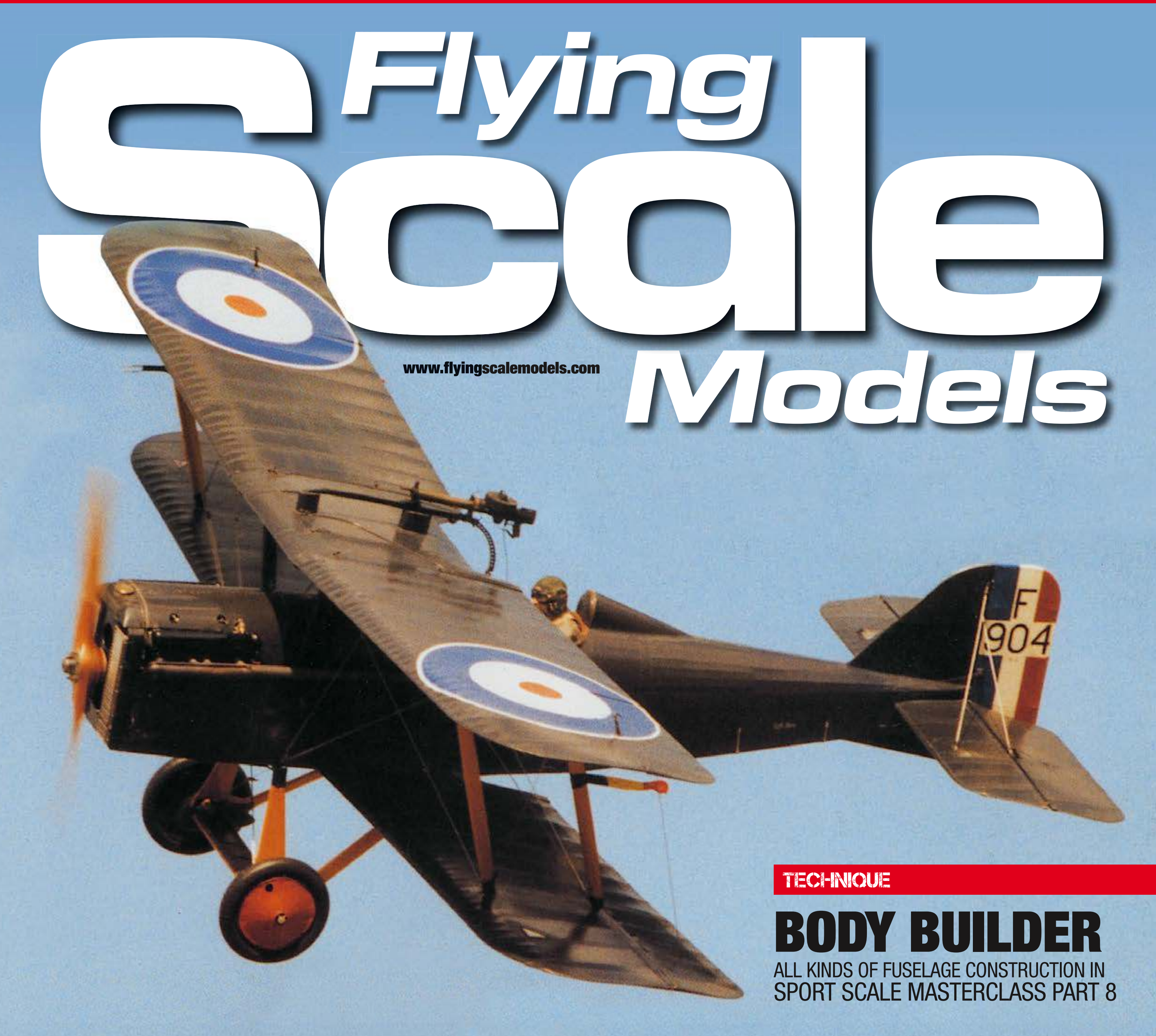

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52

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ON THE COVER

The Royal Aircraft Factory's S.E.5a has aslways been a firm favoutite among scale modellers, from the smallest indoor flying miniatures, through free flight and control line, to the largest in R/C scale. This month's issue presents two fine examples in free flight and R/C.

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TOP OF THE POPS

This month, we deal with two of the most notable British warbirds since the dawn of aviation, both of which were key fighter aircraft in their respective era.

Similarly the pair are, arguably, two of the most modelled types among aeromodellers and there must be few of us who have not built models of the two types during our years in pursuit of our hobby sometime between school-age, at the time of the Keil Kraft rubber powered range, to many times larger, more complicated and more 'flyable' replicas.

Those K.K. miniatures were built from indifferent, wildly variable quality and hardness balsa, the shapes needing to be cut out, often using one broken-off side of a double-edge razor blade; not good, but a useful exercise in youthful perseverance training!

The Royal Aircraft Factory's Scout Experiment Type 5 and Type 5a was/were an outstanding success in stark contrast to some of the other 'flying machines' with which brave and often unsuspecting young men were required to face the foe all those years ago. The reputation of a good aeroplane endures and in scale model form, the 'S.E.' makes a fine and very flyable model.

So this month, we present this outstanding WW1 era warbird in construction features for both a 1/12th scale free-flighter and a 1/5th scale R/C model. For anyone looking to build one rather larger, the Denis Bryant 1/4 scale 80" wingspan design would be a good bet. It ioncorporates an ingenious fuselage front/rear split of easy transport.

Fast forward only two decades and the Supermarine Spitfire was, arguably, the best known aircraft of an equally desperate conflict and one at least equally popular with scale modellers. But whereas the S.E.5/5a remained little changed in the two years from inception to the end of service, Spitfire development ran through 24 different variants over a full decade, the last emerging as a very different aeroplane from the first.

For all that though, the original Spitfire Mk.1 can be looked upon as arguably the prettiest and it this month's *'Subjects for Scale'*. For anyone looking to build a model, then Brian Taylor's 69" wingspan 1:6.4 scale plans are perhaps the most accurate, and can easily be scaled to a larger size.

Both the Bryant S.E.5a and the Taylor Spitfire Mk1a plans are available from Sarik Hobbies.

Doug McHard's last model...

Doug McHard's 1/12th scale free flight scale model of the S.E.5a first appeared in Aeromodeller December 1957 issue. Nearly half a century later, the author built another superb example - his last' yet it endures as fine example of free flight scale design

Before starting any assembly, carefully mark and cut out all fuselage parts, then commence by gluing the wire fittings and 3/32″ sq. cross pieces to the formers where indicated on the plan.

Shape the wire for the struts and undercarriage and then commence assembly of the fuselage by binding and soldering together the undercarriage and front centre section (cabane) struts using fuse wire binding. This unit is now bound securely to the front (ply) face of bulkhead F3. Coat with thick cyano and block up the binding holes to prevent fuel seepage from the engine bearers, align carefully and glue firmly in place.

Bind the rear centre section struts to the engine bearers (see plan view) and then glue bulkhead F4 in position. This stage of assembly is shown in **Fig. 1.**

The 3/32″ medium grade sheet balsa

Doug McHard's last model was finished in the colours of A/8918 which initially served with No.56 Sqdn, then went to No.60 Sqdn until it was captured, reasonably intact on September 17th 1917. The pilot, Lt.H.T. Hammond was made prisoner of war and a German photograph recorded the markings.

1-3: **Three detail pictures of the S.E.5a reveal the cockpit and the Lewis gun. Doug always had a scale pilot in his cockpits, in this case to cover a shut-off timer to control the power run of the Mills .75 diesel.**

fuselage sides should be carefully scored at bulkhead station F8 and bent slightly inwards aft of this point (see plan view). Seal the grain at the crack thoroughly with cyano inside and outside and allow to dry before proceeding further.

Add the 3/32″ sheet doubler reinforcements between bulkhead positions F1 and F2 and at the lower wing attachment point (see side view). Glue the already assembled bulkheads to the starboard fuselage side and affix bulkheads F1 to F12 and the lower wing attachment tubes as shown in **Fig. 2.**

Attach the port fuselage side, the lower nose reinforcement, nose block (lower part), tailblock, tailskid and bulkhead F6. This stage is illustrated in **Fig. 3.** Now glue the 1/8″ x l/16″ stringers to the rear fuselage, (**Fig. 4**). Cut away the stringers immediately behind the cockpit so that the rear edge of the 1/16″ nose sheeting lies flush with the stringer surface (see side view).

Cover the fuselage decking ahead of cockpit with softish 1/16″ sheet balsa one side at a time. Moisten the outside surface of the sheet before gluing it in place, this will pre-curve the balsa and considerably simplify the operation; see **Fig. 5.**

Cover the underside of the fuselage with 1/16″ soft sheet balsa with grain running across the fuselage (**Fig. 6**).

ENGINE COWL

The removable top of the engine cowling which runs from the nose back to former F3a is next to be built. Glue the two 1/8″ dowels into the top nose block, plug this into the lower nose block. Add the 1/4″ balsa bulkhead 1A to the rear of the nose block, position the two 3/32″ square hard balsa reinforcing side strips and glue these to bulkhead 1A. Then, glue bulkheads F2A and F3A to the side strips. Bulkhead F2A should have the 20 S.W.G. retaining hooks already fitted and secured in place.

Now, cover the top of the cowling with 1/16″ medium sheet balsa, pre-curving as previously described, for the cockpit decking. When dry, remove the top cowling which should now appear as in **Fig. 7.** This image also shows the engine in position. The original prototype model used an Albon Merlin, but the final example built used a Mills 75 for power. Note the needle valve hole, which must be cut to suit the particular engine chosen. The engine thrust line should be corrected for side thrust at this stage and the mounting bolt holes drilled in the bearers. After checking, remove motor until the model is complete and fuel proofed.

TAILPLANE

Cut out the tailplane, fin and rudder from soft 1/8″ balsa sheet (the plan shows the scale outline in addition to that used for the examples built. The horizontal

FIG. 1.

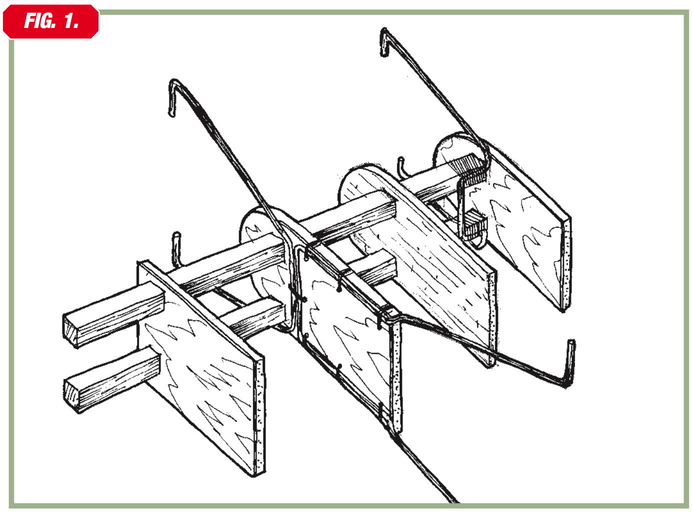


FIG. 2.

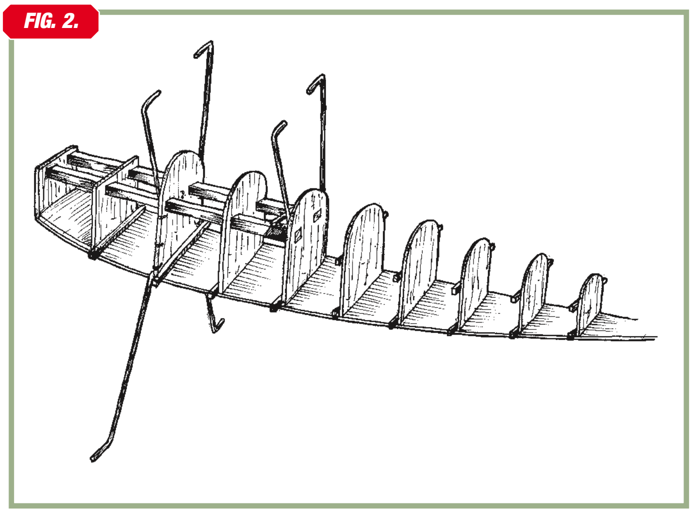


FIG. 3.

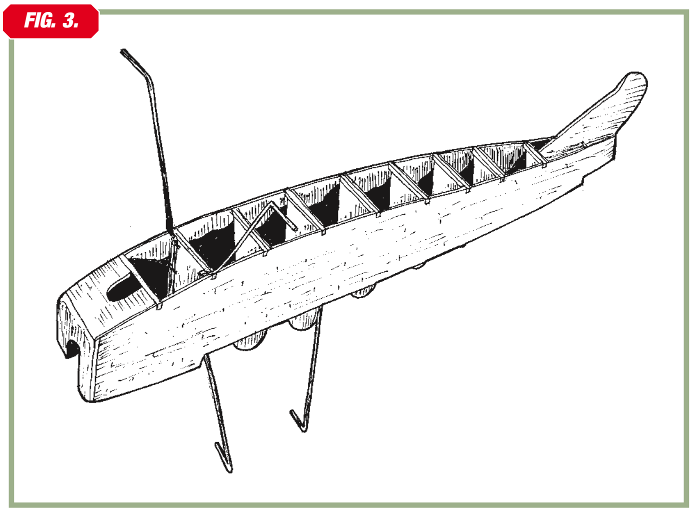
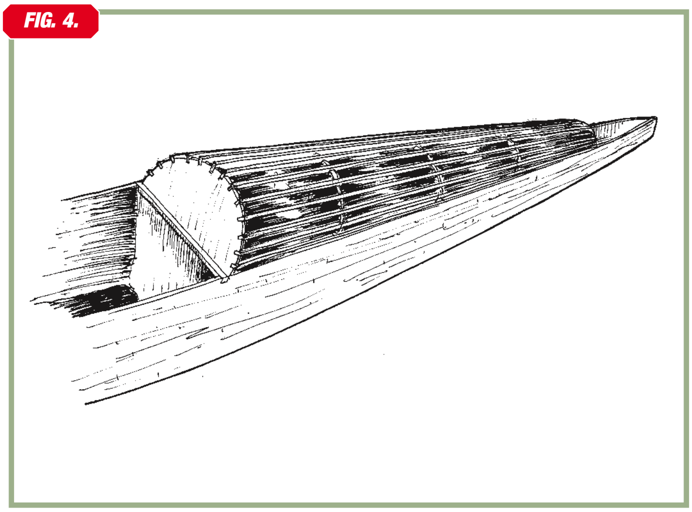


FIG. 4.



4: Components of the fuselage ready for assembly, complete with wire cabane struts and undercarriage. 5: Don't stint on the stringers over the upper rear fuselage to get a realistic effect after covering. 6: One each of the wing panels, with near-to-scale aerofoil section and thick tips to take care of ground scrapes. 7: Piano wire locating pins bound to the spars engage in 18 swg brass tubes in the fuselage for the lower wings as here with one root shaped, the other showing two layers of 1/4in balsa fairing.

tailplane is too broad to be cut from the standard 3" wide sheet, so the join should be made along the leading edge, using a strip of hard balsa ahead of the joint. Glue former F13 (1 m/m ply) to the recess in the tailplane leading edge and glue the 1/8" hardwood locating dowel in place.

Glue the 20 swg. tail unit fixing hooks to the upper surface of the stabiliser trailing edge (see side view). Glue the fin and rudder unit to the stabiliser upper surface and square up with the soft balsa fairing blocks at each side making certain the fin/rudder is exactly upright. To the underside of the stabiliaer glue the 1/8" sheet balsa locating piece making certain that the rudder is truly straight fore and aft. Cement the celluloid rigging washers to the tailplane in the positions shown. A dotted line on the plan indicatos the true scale stabiliser outline. The model will fly with a true scale stabiliser but is more sensitive and needs very careful, trimming.

TOP WING CENTRE SECTION

Next, bind with fuse wire and solder, the 18 swg. tubes to the upper ends of the cabano struts. Place the fuselage exactly over the side view on the plan and make certain the ends of the tubes come in the correct position as shown, before proceeding further. Make adjustments if necessary. Sight the tubes from the front to ensure that they are both in line.

The upper wing centre section is now

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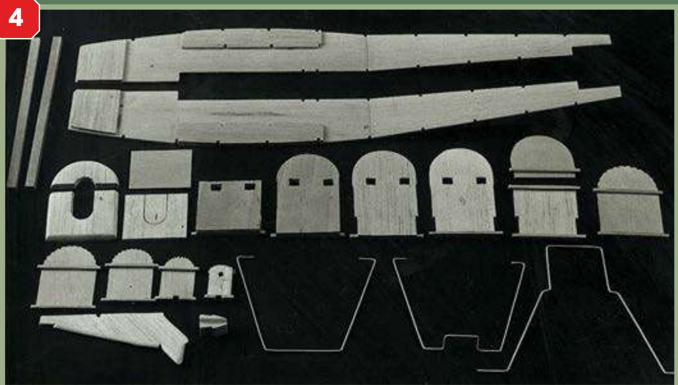

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FIG. 1.

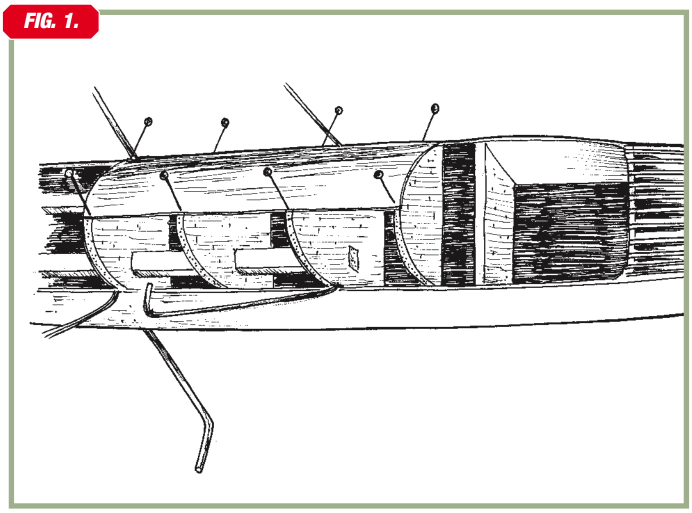


FIG. 2.

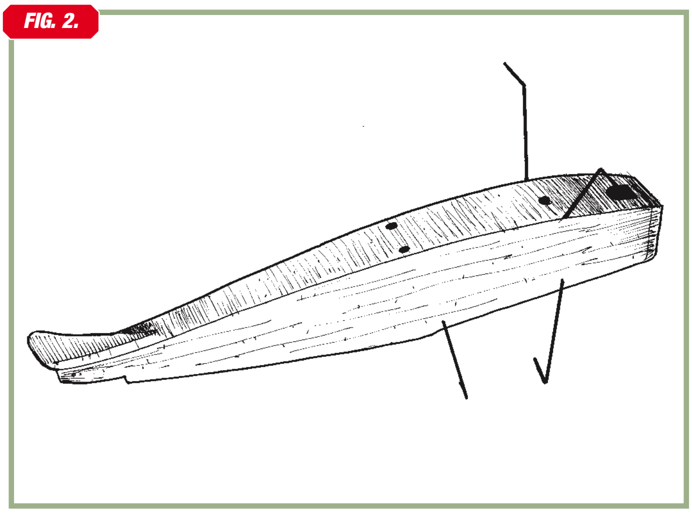


FIG. 3.

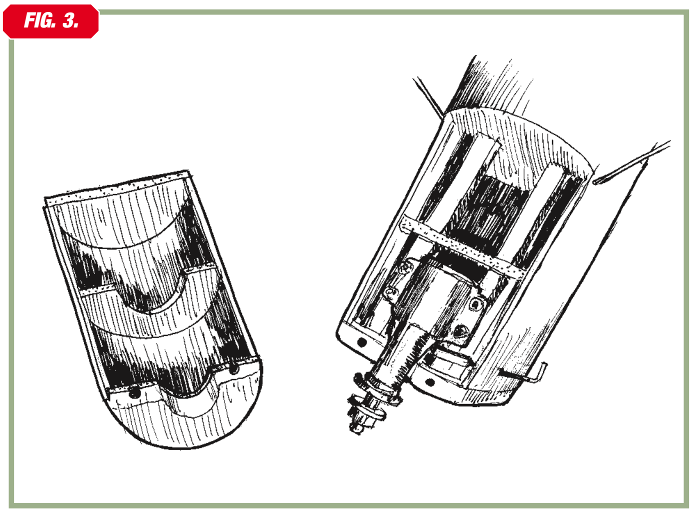
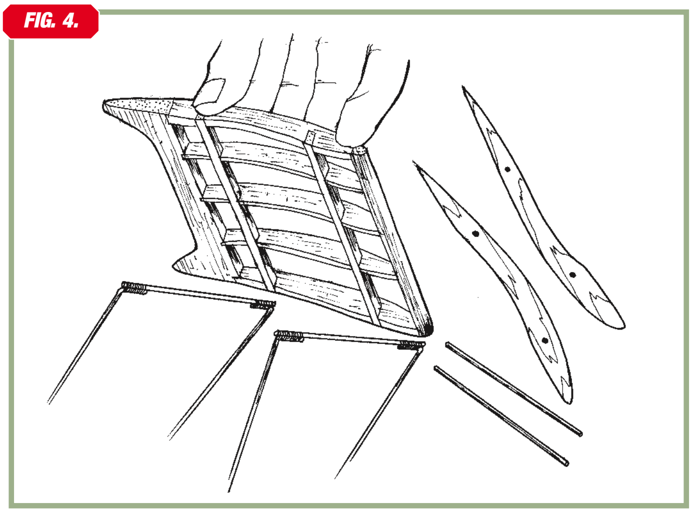


FIG. 4.



built flat on the plan. Do not glue the 1mm ply facing ribs to the structure at this stage. When dry, remove from the plan and secure to the fuselage cabane struts (see note and exploded view on plan). Glue the rigging hooks firmly in position.

The strut fairings should be sanded to a streamline section and bound and glued in position, the double coverrd with lightweight tissue, glued on (**Fig. 8**).

Undercarraige

The main undercarraige leg fairings are bound to the leg from top to bottom with strong thread and then covered with tissue. They are not glue to the fuselage at the top end. The rear undercarriage struts are made up, the lower ends threaded over the axles and the top ends allowed to travel freely back and forth in the slots cut in the 1/16" sheet under-fuselage covering. Spring the spreader bar into place.

WINGS

The upper and lower wings are identical, except for the roots of the lower panels which have an extra rib and are cut away at the trailing edge. This is clearly shown on the plan. Incidentally, if those seeking exact scale findelity, this last rib space should have no dihedral, although this is almost unnoticeable in practice and the extra complication involved in construction was not considered worthwhile on this essentially straight-forward model. The only other differences between the upper and lower wing panels lies in the 20 swg. strut fixings and rigging hooks. The positioning of these is clearly shown on the plan.

Before commencing wing construction, cut all spars to correct size and bind the 18 S.W.G. wing attachment wires in position. Shape the leading and trailing edges to correct sections and cut the rib notches in them where indicated.

Pin down the trailing edges and hold the spars in the correct position with pins on either side. Now, glue the ribs in place and then attach the leading edge. The soft belsa 1/4" sheet tips should be fitted, but the necessary carving to section should be left until the structure is lifted from the plan. When dry, the remaining

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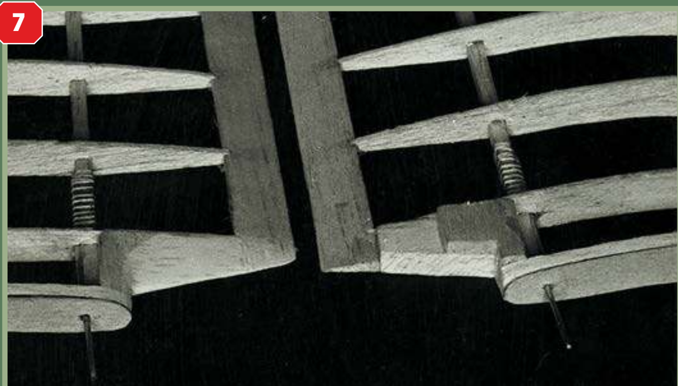


8: View, showing the full upper wing surface markings on Doug McHard's model. Note that the wing roundels are postioned at mid-span on each of the outer wing panels.
9: The rear fuselage and tailplane, showing markings and the dummy tailplane struts.
10: Another rear fuselage detail, showing the simulated fabric inspection panel lacing.

wire fittings should be bound in place and the wing sanded smooth with very fine sandpaper.

The wing interplane struts are now made. These should be a sliding fit over the 20 S.W.G. wing fittings.

ASSEMBLY AND RIGGING

Assemble the wings and struts. The wing root attachment wires should be a smooth sliding fit in their tubes and they should be adjusted to give 1" dihedral under each wing tip. The rigging "wires" are reproduced with grey, shirring elastic thread and four pieces are required each 14" long and fitted with small 20 swg. rings at each end.

One length of elastic thread is taken from the front rigging hook 3" out from the root of the upper wing, down and around the top of the main undercarriage leg and up to the top of the front interplane stut. The elastic is taken outside the struts and thus prevents them from falling off. From the top of the front strut, the rigging goes down to the bottom end of the rear strut and terminates at the rigging hook near the rear cabane strut.

The second rigging thread starts at the front cabane strut hook and terminates at the rear rigging hook on the top wing underside, after passing around the interplane strut and over the fuselage rigging hook. This completes the rigging on one side, the reverse procedure is followed for the opposite side.

Cover all surfaces with lightweight tissue, apply one coat of clear and two of colour dope.

DETAILS

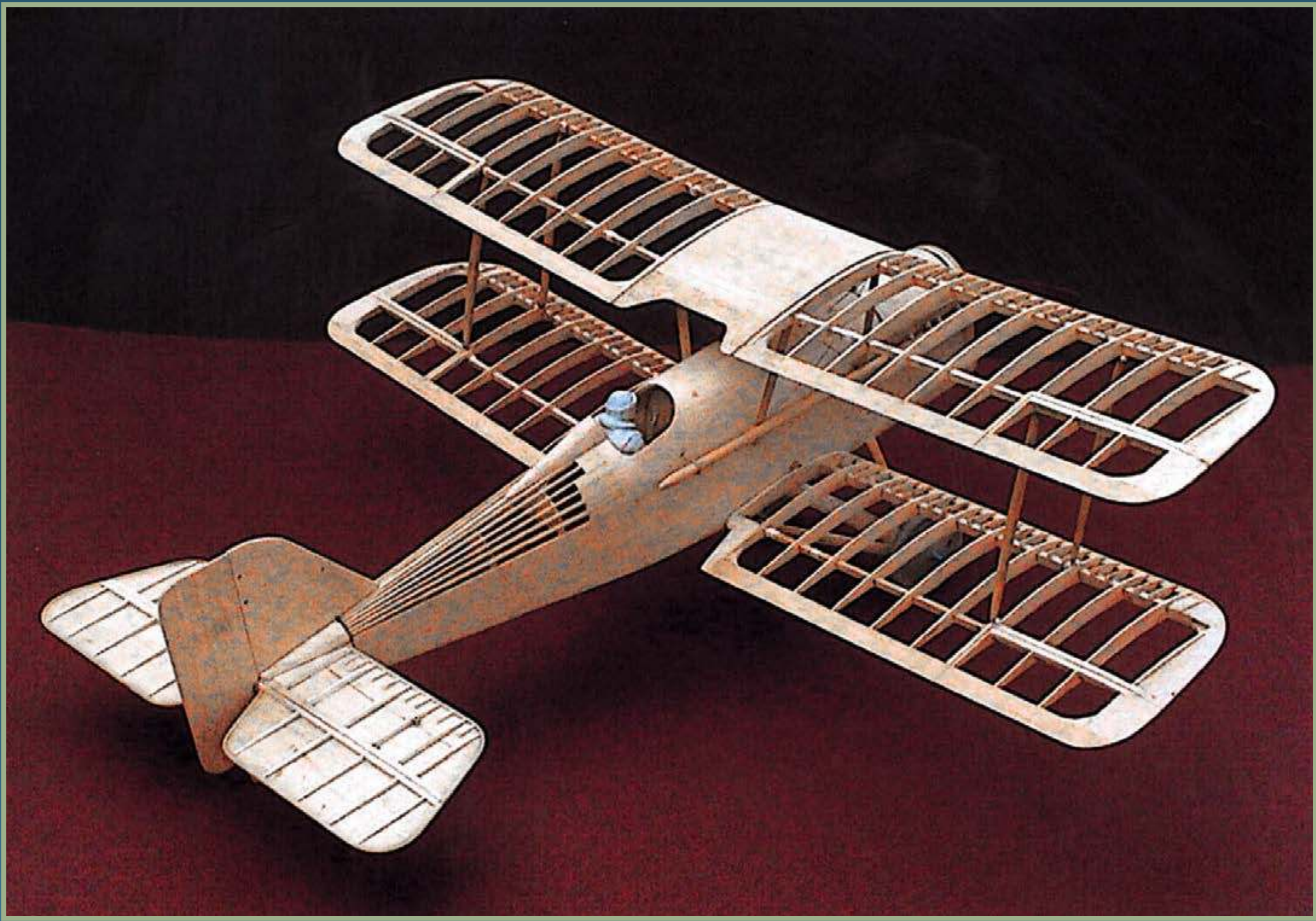
Fit wheels, radiator strips, engine cylinder blocks and gun. The two exhaust pipes are made fram 1/4" dia balsa dowel and covered with tissue. They are attached by gluing and binding to the cabane struts. They are not glued to the engine cylinder block.

Add roundels and insignia and fuel proof the entire aircraft, paying particular attention to the engine compartment and the nose area generally. All-up weight should be between 8 and 9 ounces.

The modol should balance horizontally when supported by finger tips under the top wing centre section at the point shown on the plan. If necessary, add weight to the nose or tail until correct balance is achieved.

Glide test over long grass under calm conditions, launch level at model's flying speed, into wind and note the descent. If the model dives, add weight tothe tail. If it first climbs and then dives, add weight to the nose, until a steady, controlled glide results.

The first power flight should be made with the engine running very slowly. Thereafter, gradually build up revs making



The completed airframe ready for covering. Note the method of constructing the taiplane unit over a flat sheet balsa centre plate.

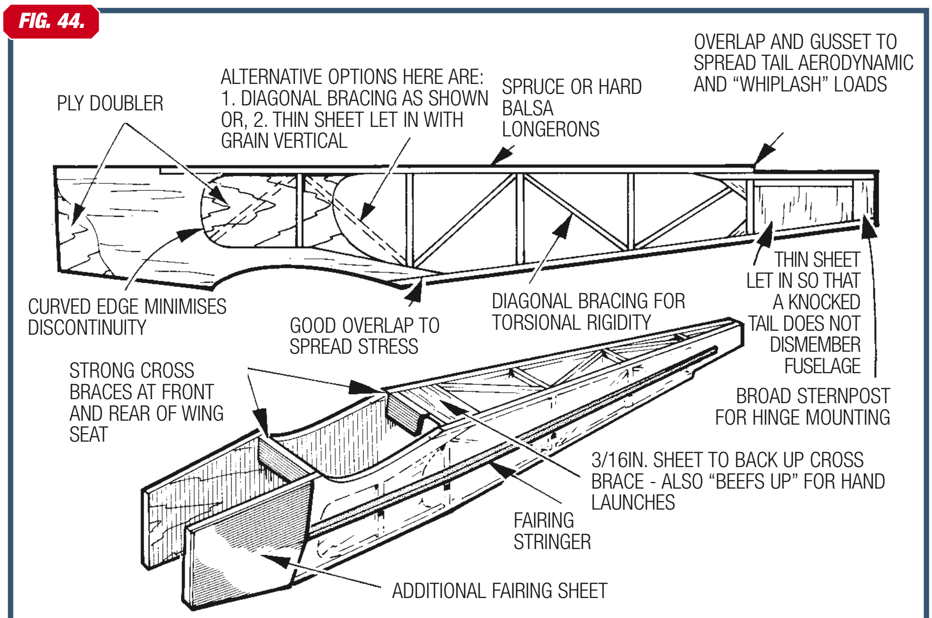
any necessary thrust line adjustments on the way, to correct turning or erratic power flight, until the model safely handles full power.

Trim for a large radius left-hand turn under power by adjusting the engine side thrust. The rudder may be warped slightly right to keep the nose up in sharp left turns under power. Never turn the rudder over to the left and DON'T try right-hand circuits under power, until you know the model's characteristics. ■

SPORT SCALE MASTERCLASS

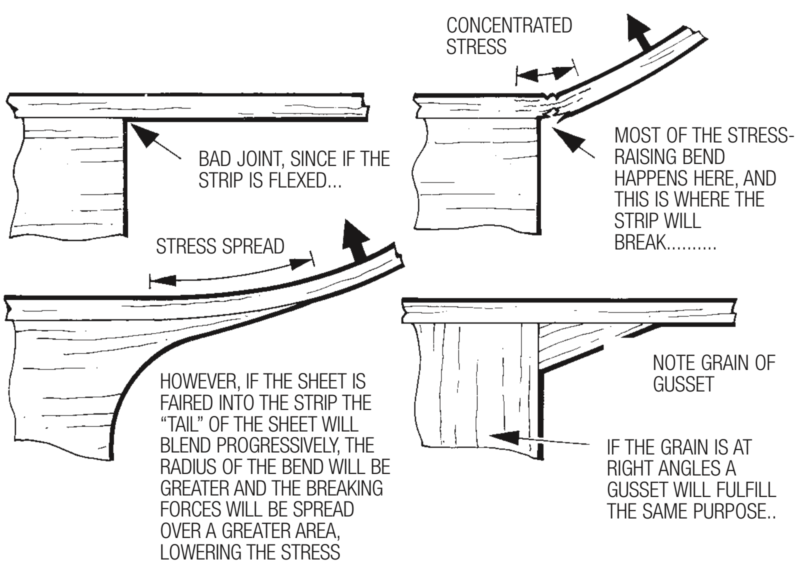
PART 8: FUSELAGE STRUCTURES

FIG. 44.



TYPICAL BOX FUSELAGE LAYOUT

FIG. 45a.



OPEN FRAMEWORK BOX FUSELAGE

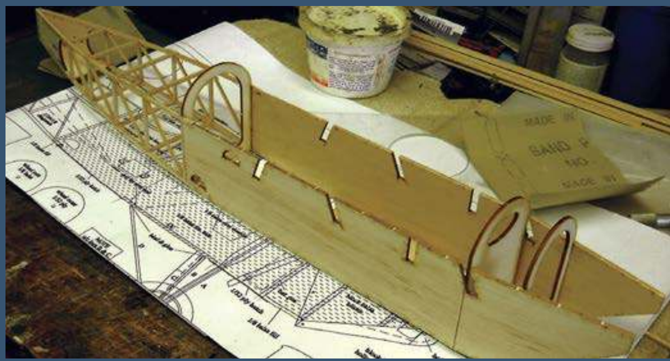
If the aircraft being modelled features a flat, slab sided box-style fuselage, one has the option of either employing solid sheet sides, or a framework constructed from strip wood. Although the open framework fuselage used on, for example, the SE5a and some of the Austers etc. could be represented by sheet slab-sides, the writer feels that one cannot do better than to copy the full-size framework fairly closely, especially if longerons and spacers are shown on the three-view scale drawing.

Because of engine and wing mount considerations, the front part of the fuselage can be made from sheet of the same thickness as the longerons and spacers, with ply doublers strategically incorporated to strengthen the assembly at the engine mount, wing cut-out and cockpit area. Fig. 44 shows points to aim for in providing strong joints and stiffness in an openwork fuselage side.

Diagonal bracing has the task of endowing the finished fuselage with torsional rigidity and by changing the lengths of some of the diagonals, we can true up the finished framework if it is discovered to be slightly distorted from true. Note the overlaps of longerons and front sheeting and the way that the fuselage front side and ply doubler curves into line with the longerons to prevent the generation of stress-raising discontinuities.

The principle of 'blending' stress points is shown in Fig. 45a. Basically, sharp corners look ugly, and are mechanically poor, though where such a shape is essential - the Armstrong Whitworth Siskin IIIa fighter biplane for example - gussets should be used to spread the load, as shown in Fig. 45b.

Suitable wood sizes for open framework fuselage construction (Fig. 46) are shown in Table 4. Longerons will normally need to be of hard material, but the remaining balsa can be of medium grade, since highly stressed areas are doubled or gusseted. This basic box fuselage often has a stringer placed about half way



The Westland Widgeon III is an example of the 'basic-box-plus-rounded-top-deck. In this example the rear, open-fame structure is build separately from the balsa sheet, flat-sided assembly.

down, as on the De Havilland DH 82 Tiger Moth. We can fair this in at the nose with an overlay of sheeting, shaped as shown in Fig. 44.

Commonly, the top of the fuselage is a curved decking, sheeted at the forward part of the fuselage and with fabric covered stringers aft. People often plank the forward decking, but I recommend the use of wrapped sheet for this purpose as shown later in Fig 50.

SHEETED BOX FUSELAGE

Sheet box fuselages might be regarded as simple enough not to require any description, but I would like to discuss a few points here. The normal kit-built non-scale sport or aerobatic model generally uses l/8" sheet balsa sides for .20-power size models, and 3/16" and l/4" sheet sides for .40s and .60s. By using a little imagination, we can halve these thicknesses, saving weight and cost, as the only strength considerations we have are for 'finger-proofing'. The box structure is in itself a very rigid arrangement, not needing excessively thick wooden sides.

My method is to make the fuselage sides in one piece, splicing the sheet together if necessary. I then build a simple structure similar to the box girder just described (though without the diagonals) onto the inner sides. I then add doublers as needed, joining the sides with bulkheads and cross-braces. Fig. 47 shows the principle. A fuselage built that way will be significantly lighter than a thick sheet structure, especially where excess weight is a consideration - at the tail end. Table 5 details suitable wood sizes.

One could employ a hard sheet balsa doubler in place of the thin ply one, provided one did not have to add undercarriage or centre-section (cabane) anchorage points as on Fig 47. Balsa doublers of 1/8" thickness would be suitable on smaller models, 3/16" on larger examples. The reason for using a thin-sided strut-braced arrangement is that our scale fuselages are often deeper and wider than for the usual slim-line sport model. We have to prevent 'weight growth' at the expense of the slight added complexity of internal bracing, which is there to prevent the sides from sagging inwards.

BULKHEAD DESIGN

On most models, we will use ply or built-up balsa bulkheads around the widest part of

FIG. 45b.

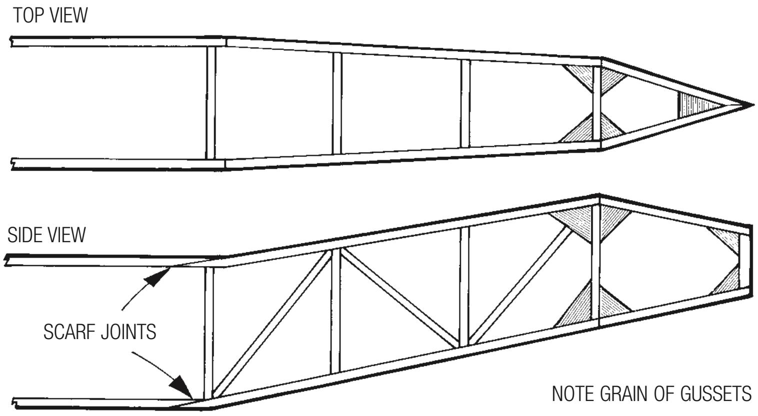


FIG. 45b.

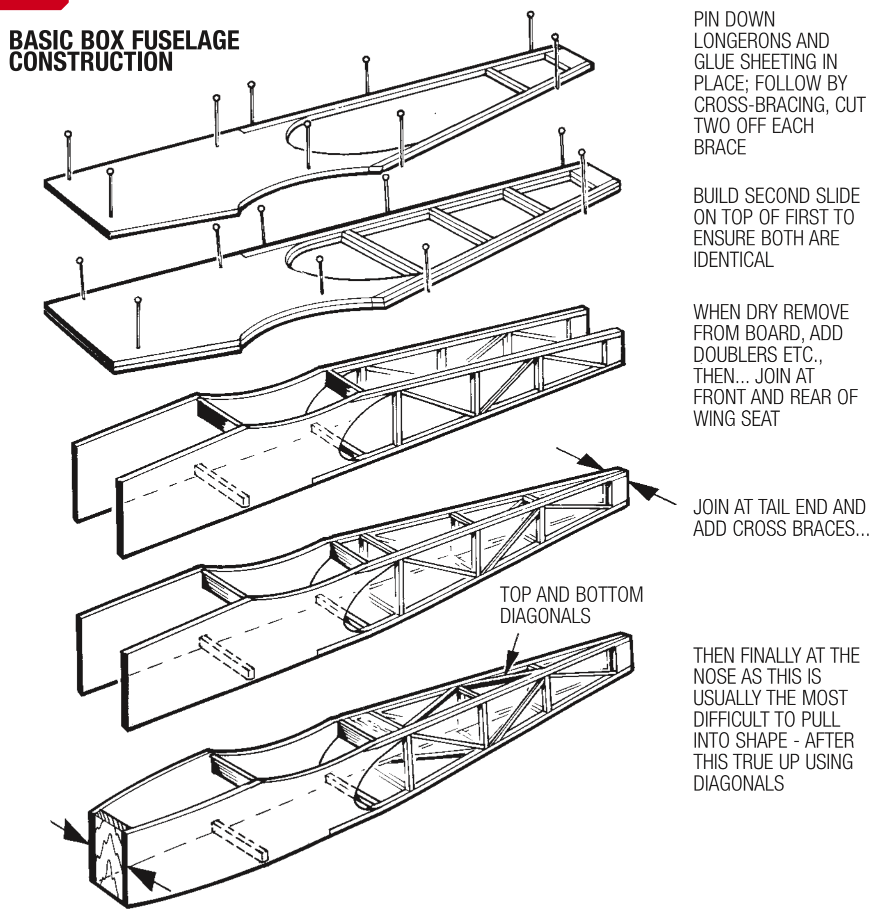


TABLE 4.

SUITABLE WOOD SIZES FOR COMPONENTS OF OPEN BOX FUSELAGE

ITEM	.15-.19	.20-.35	.40-.61
NOSE SHEETING	3/16 BALSA MED.	3/16 BALSA MED.	1/4 BALSA MED.
PLY DOUBLER	1MM	1MM	2MM
LONGERONS AND UPRIGHTS	3/16IN.SQ. HARD BALSA	3/16IN.SQ. SPRUCE	3/16IN.SQ. SPRUCE OR 1/4IN.SQ BALSA
DIAGONAL BRACING	3/16 X 1/8IN. MED.BALSA	3/16 X 1/8IN. MED. BALSA	1/8 X 1/4IN. MED. BALSA
GUSSETS	1/8IN. MED. SHEET BALSA	1/8IN. MED. SHEET BALSA	3/16IN. MED. SHEET BALSA
TAIL BAY SHEET	1/16IN. MED. SHEET BALSA	3/32IN. MED. SHEET BALSA	1/8IN. MED. SHEET BALSA
WING SEAT CROSSPIECE	3/16IN. HARD BALSA	1/8IN. SHEET SPRUCE OR PLY	3/16IN. SHEET SPRUCE OR PLY

TABLE 5.

WOOD SIZES FOR SHEETED BRACED BOX FUSELAGE

ITEM	.15-.19	.20-.35	.40-.61
BALSA SIDE SHEETING (MED).	1/16IN.	3/32IN.	3/32 OR 1/8IN.
LONGERONS AND UPRIGHTS (MED).	1/8 X 3/16IN.	1/8 X 3/16IN.	3/16 X 3/16IN.
PLY DOUBLERS	1/32IN.	1/32IN.	1/16IN.
PLY ANCHORAGE DOUBLERS	3/32-1/8IN.	1/8IN.	1/8IN.

the fuselage, which is normally at the front and rear ends of the wing seat or cabane strut anchorages. These two formers are the whole key to producing an accurately aligned structure. When designing bulkheads, those around the engine bay and at the wing and undercarriage attachment points need to be beefy, but all the others will not have quite as much strain on them, and can be of thinner stock and usually of balsa. See Fig. 48.

UPPER AND UNDERSURFACE SHEETING

If the top and bottom panels of the fuselage are of flat sheet, then this sheeting is best applied with its grain cross-wise, remembering the tensile and compressive loading caused by the fuselage sides; see Fig 49. If the fuselage top is curved then, of course, the grain will have to run lengthwise to achieve the curvature. In the latter case, the formers and spacers will provide the required cross-wise strength, with their wood grain running transversely. It is best to avoid planking with strips of wood for single-curvature deckings as it is hard to remove all trace of the glue lines, whilst wrapped sheeting is easier and neater, needing less sanding.

First, we cut a piece of paper oversize (newspaper will suffice) and wrap it over the decking formers in the area to be sheeted. Now we run our fingers round the extremities of the sheeted area so that the edges of the existing structure crease the paper. Using the creases as a guide, we cut the paper to an exact size template. The next step is to edge-join the balsa sheet (which should be flexible across the grain) to the required width, then lay it on a flat surface and, using fine grit paper, sand the side which will then become the outer surface, making it nice and smooth. Take care here to avoid dinging it during subsequent handling.

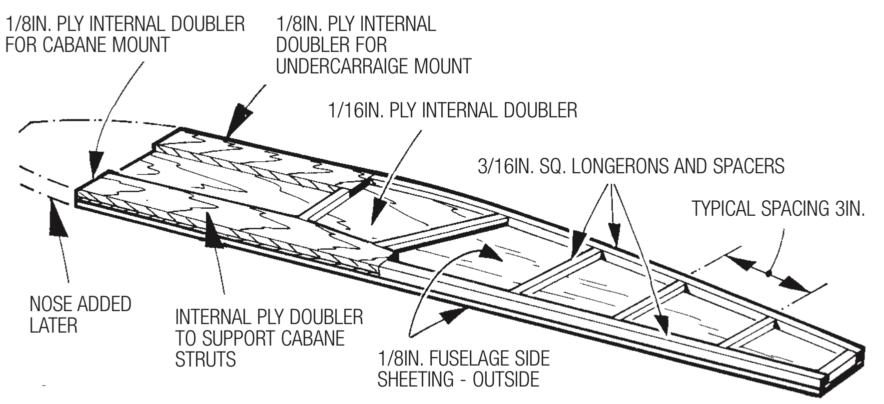
Next, cut the prepared sheet to size round the paper template. Dampen one side of the sheet with a moist cloth to assist the necessary curl over the formers, before gluing it in place, holding it with pins and elastic bands or maybe masking tape. The sheet should not be soaked or it will swell too much, and when the wood dries out it will shrink and sag inwards between the formers.

This Auster J/5 Adventurer is an example of the not-quite-flat-sided rear fuselage shape in which fore/aft stringers have been applied over the flat balsa sheet sides to get to the right, scale, fuselage section.

If the sheet you have chosen is too stiff to form the required shape without risk of cracking along the grain, brush household ammonia over the outer surface and wait a short while, flexing the wood periodically (taking care to avoid splitting) until it will form the required curve. The ammonia reacts with and softens the wood fibres, making the sheet far more flexible, yet when it dries out, the wood regains its previous stiffness whilst retaining its new shape. If using ammonia, be sure to read and obey the safety instructions on the bottle and only perform this operation outdoors in the open air.

When the sheet has become flexible, secure it over the decking formers with pins to locate it, and with masking tape wrapped all round the fuselage to make it conform to the required shape. When the ammonia has dried, it will leave the sheet moulded to the required decking curvature, and you can then pin and glue the sheet in place. Ammonia will soften quite hard sheet, sufficiently for it to be wrapped all the way round a wing

FIG. 47.



The Piper J-3 Cub fuselage rear section is close to, but not quite flat sided, in which side stringers are applied to the upright spacers of the open box structure to achieve the true-scale fuselage cress section

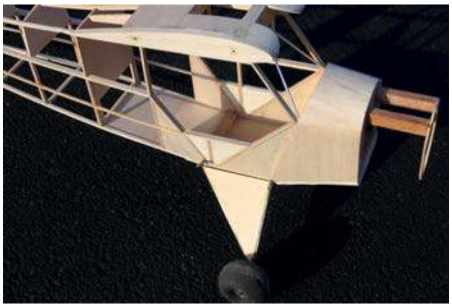
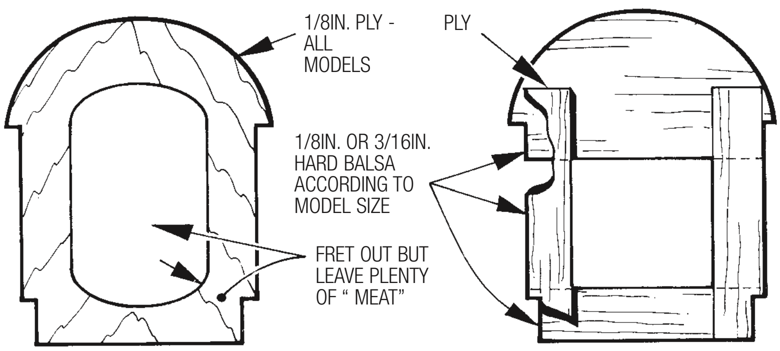
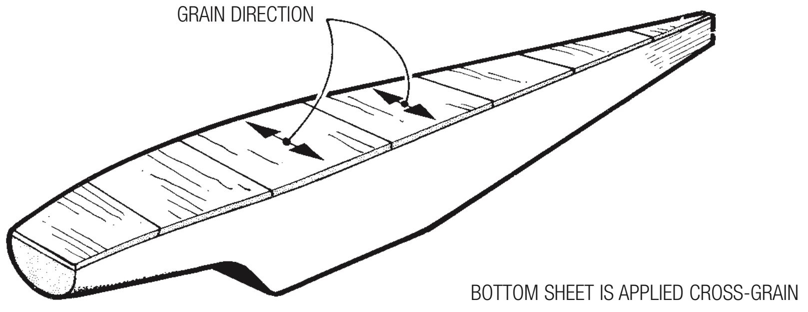


FIG. 48.



"KEY BULKHEADS" FOR JOINING SIDES

FIG. 49.



leading edge from the front upper spar, round the leading-edge of the ribs which need no actual leading edge member, and ending at the front lower spar, thus forming the leading edge 'D'-box in one piece; just like on the real Fokker Dr.1 and D.VII. Note that quarter-grain sheet has the wrong grain structure for this treatment, so should be retained for ribs and formers as normal.

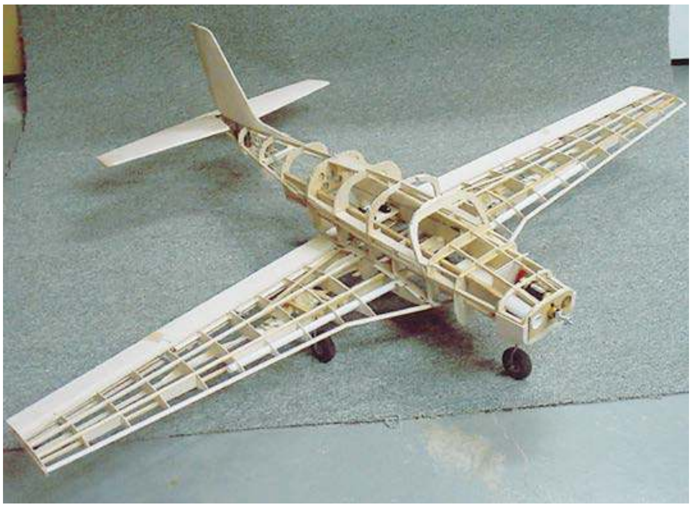
On small models l/16" or 3/32" light sheet will work fine, but on larger models, with greater bulkhead spacing, one will need to use light 1/8" sheet - see Fig. 50.

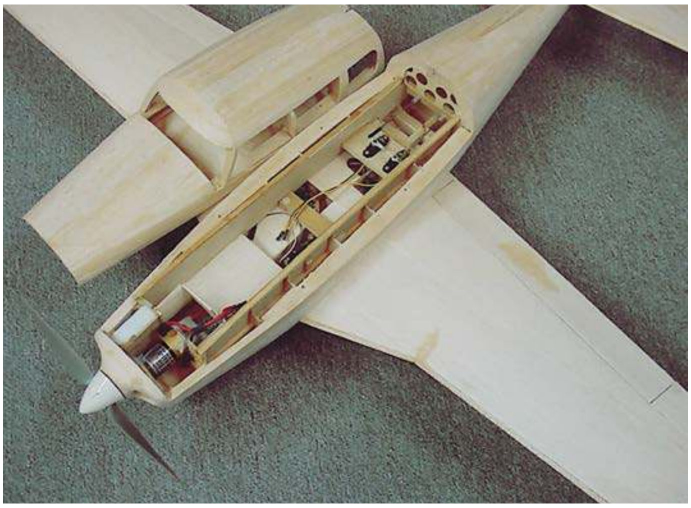
COCKPITS AND CABINS

When making open-cockpit sport-scale subjects, the cockpit recess is a source of crash-susceptible weakness, which I have learnt to overcome by gluing in a rectangle of sheet level with the upper longeron, with its grain cross-wise. This is the reason that I rarely add cockpit detail on a sport model. This sheet filler is also a convenient base on which to mount a head-and-shoulders pilot.

A high-wing cabin model will usually employ one of the two basic fuselage assemblies described, but achieving a strong and unobtrusive wing seat can be a headache on a fully glazed type like the Cessna L-19 Bird Dog or Westland Lysander. Here we can use a couple of fretted-out ply bulkheads, located at

Chris McHugh's Bucker Jungmeister displays a typical lightweight biplane fuselage structure with open-frame rear.





Dave Gamblin's delightful electric powered Piper Commanche features both planked and sheeted covering over a light framework.

window frame or doorframe positions, to carry the loads from wing to main fuselage structure, and vice-versa. On a subject like the Fieseler Storch, a celluloid-glazed piano wire 'cabane' may be preferable. In the latter case, the full size aircraft had a mass of tubes inside the driver's compartment anyway and the piano wire could simulate this arrangement, perhaps with stub ends on which to plug the separate wing panels.

STREAMLINED, STRINGERED FUSELAGES

The earliest streamlined fuselages such as the early-WW1 era Morane type 'N' and the Bristol M.1 Scout monoplanes were in fact open box girder fuselages faired around with stringers carried on segment-shaped formers. Depending upon how nearly circular or elliptical the streamline cross-section is, we have two ways of simulating this shape.

For the near circular fuselage, typified by those examples quoted, and also the later Bristol Bulldog and Gloster Gladiator fighter biplanes, we first create the largest cross-sectioned box girder that will fit inside all the fuselage formers. We then make up the open box framework, with sheet nose insert and ply doublers as before, then add the half formers and segments to build up the scale cross-section. The fuselage is then completed by the addition of stringers, nose panel sheeting and block where necessary (Fig. 51). The box wood sizes are as previously advised and suitable stringer sizes are 3/32" x 3/16" balsa for up to .35 size engines and 1/8" x 3/16" for up to .61 power, the stringers being on edge in relation to the covering to resist sagging. Spruce wood is more sag-proof than balsa in this application and we could use thinner material, but maintaining depth. Since the stringers share fuselage loads, we could use medium/hard balsa longerons and spacers in place of spruce with no strength penalty, but with a bonus in rear end lightness fore/aft balance (C.G.).

The second method is applicable to near-square streamlines, as exemplified by the Hawker series of biplanes. Here one uses tapered stringers of varying widths glued directly to the box girder framework along the sides, with conventional formers and stringers on the turtle deck (Fig. 52). This approach also suits aircraft with only a few side stringers such as the Bucker Bu 133 Jungmeister and various other lightplanes. Once again the stringers help to strengthen the fuselage, and medium grade longerons may be used. Suitable wood thicknesses are 3/32" and 1/8" on small and large models respectively.

An alternative way of producing a stringered streamline is to employ the method used in the kits for small rubber powered models. Here, a vertical outline centre 'crutch' pinned to the building board, to which fuselage formers are added, followed by stringers to form a vertical half-shell. However, to complete the opposite half shell, the first has to be removed from the building board and the

FIG. 50.

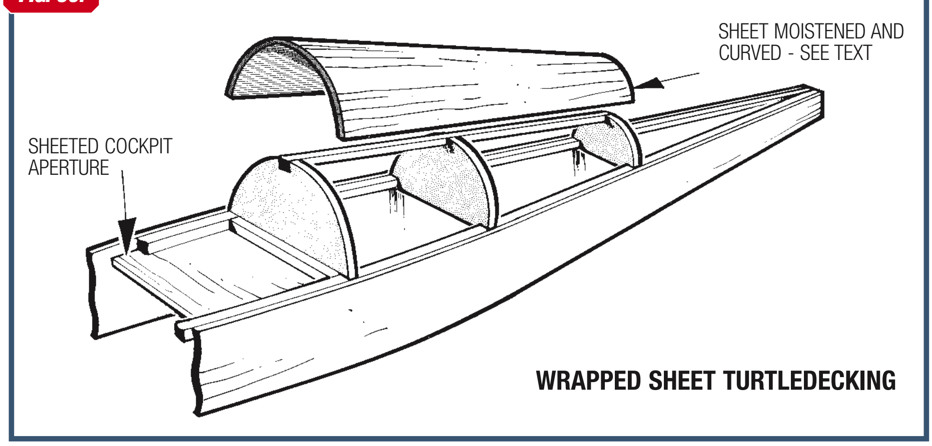


FIG. 51.

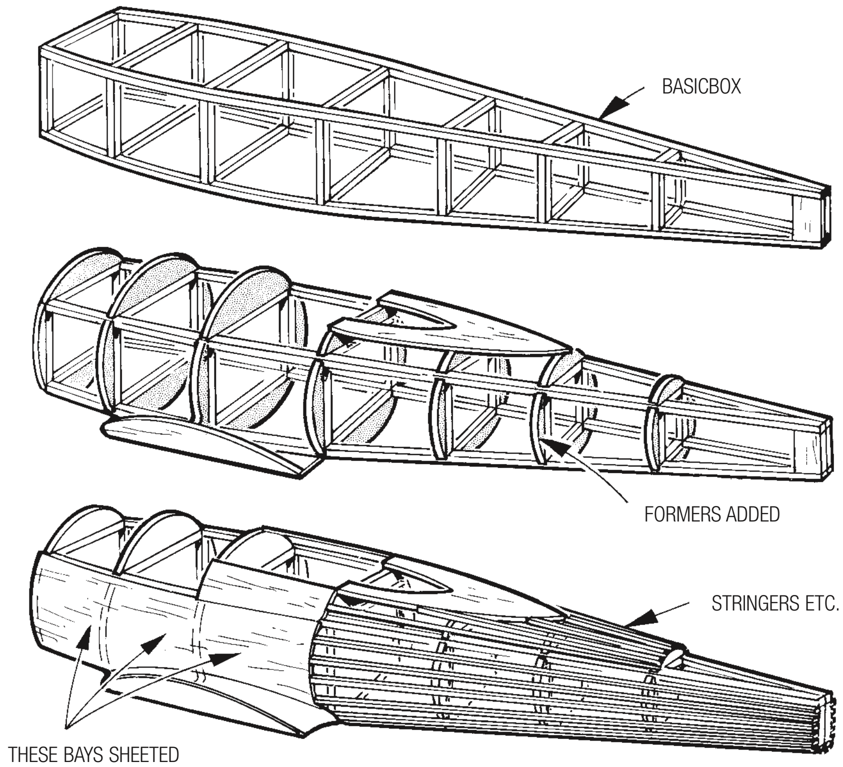
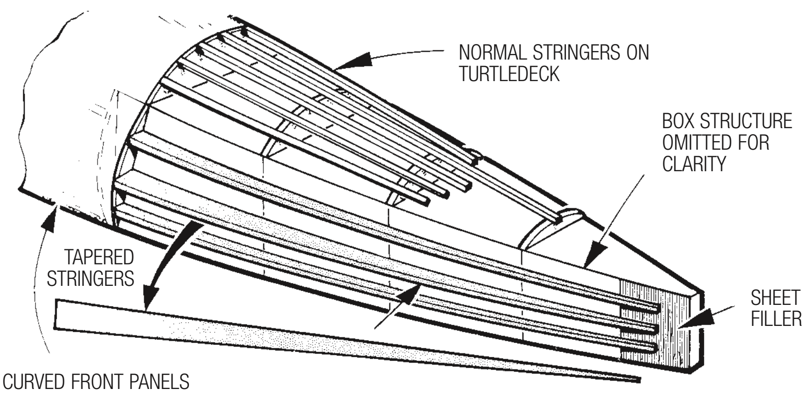
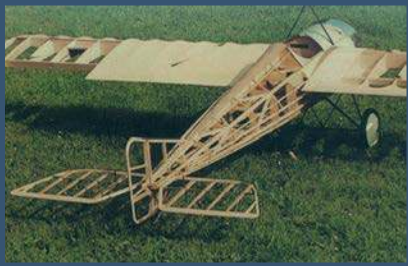


FIG. 52.





The early WW1-era Moraine Saulnier Type N fighter/scout was an early attempt at a streamlined fuselage. Illustrated here is a finished airframe in which a basic square box is rounded to profile with circular sub-formers applied around the box structure uprights.

A different approach to 'rounding out' a circular fuselage over a basic square box structure is this example on a WW1 Nieuport 28 in which balsa strips, all of the same width have been applied of the basic box structure uprights and then tapered along their length to get the final final external profile.

opposite side assembled and glued 'in mid-air' so to speak without the benefit of the flat building board surface and great care has to be used to ensure a true fuselage, especially if it is long, say over 40". Once assembled, with stringers glued in place and with built-in 'banana effect', one cannot straighten it.

A simple strip-wood box girder is easy to align, and subsequently straighten by using diagonal inserts, (Fig. 53) and is also a better structure on which to mount centre-section cabanes, undercarriages and engine bearers. Suitable sheet thicknesses for nose panelling and decking on the fuselages just described are 1/16" on small models and 3/32" on large ones, with judicious use of soft 1/2" sheet and block balsa for carving to the compound curves at the nose.

STREAMLINED MONOCOQUE FUSELAGES

There are many avenues open to us here, depending upon the size of the model and the ovality of the fuselage. In all cases, the sides will be fully planked or sheeted to simulate the metal of the full-size machine.

The first example is the slab-sider with rounded top and undersides. We can either wrap sheet round the top and bottom of the fuselage, or if the curvature is too sharp, use triangular-sectioned corner pieces and a thick sheet spine, carving the corners to section (Fig. 54). Both methods, as extensions of our basic sheet slab-sider, should use similar wood

FIG. 53.

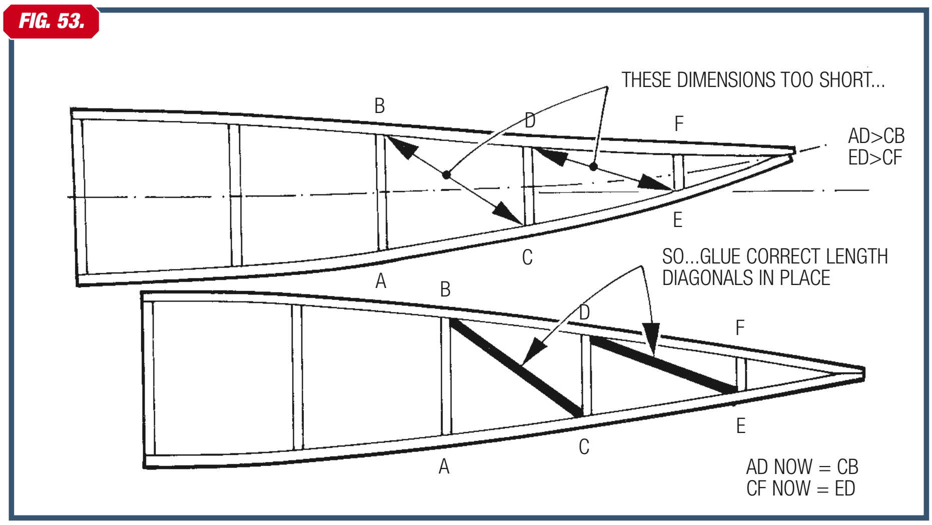


FIG. 54.

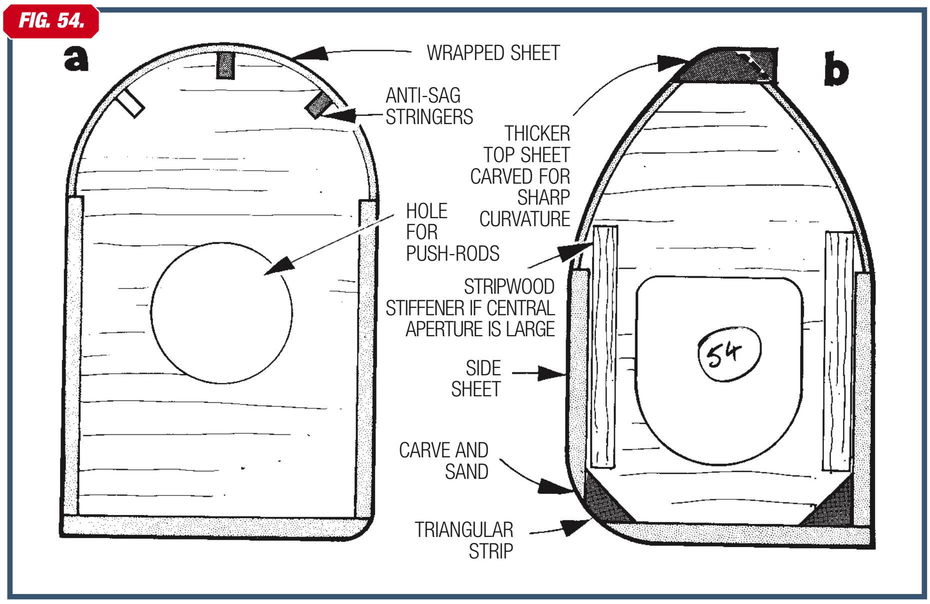
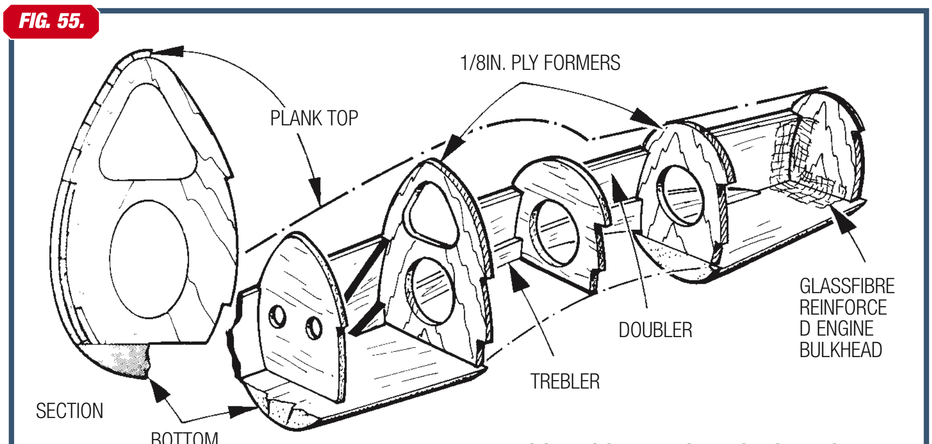


FIG. 55.



COMPOSITE FUSELAGE STRUCTURE

sizes, the medium/soft triangular and spine sizes being chosen to suit the application.

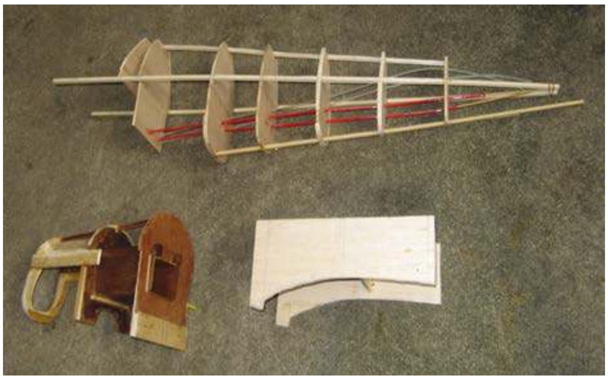
The fully elliptical or circular section fuselage can be assembled in a similar way to that just described, or carved from a box fabricated from thick sheet, or else built on a crutch and planked. The method used is determined by the size of the model, the amount of curvature needed in the sides, and in the wing position. The first method, illustrated in Fig. 55, is acceptable for low wing or shoulder-wing set-ups and all engine capacities, and requires complete fuselage sides cutting from 3/32"or 1/8" sheet - depending on engine size - with selective damping to achieve the curvature.

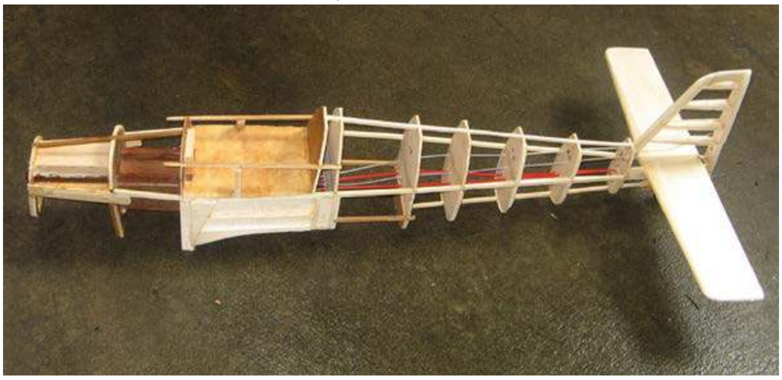
Internal doublers of the same thickness as the outer surface sides should be incorporated from the engine bulkhead to aft of the wing trailing edge, with a "trebler" at the wing seat. Once the curvature has been induced, the two sides are joined to the formers as for a flat-sider and the top decking planked or wrapped with sheet, the bottom being thicker carved sheet. This technique will produce a light model, provided you use medium weight wood sheet. The two plywood formers are used for wing anchorage with the bolt-and-peg method. Note that when you dampen the sheet, it actually bellies out in a three-dimensional double curvature and, as previously mentioned, over-soaking the wood will cause sagging between formers when the wood dries.

The next choice is, effectively, to carve the fuselage from the solid. To do this, we first assemble a box of thick sheet with formers and corner gussets, identical in shape to the plan and elevation of the model. After marking the centre-line on the top and bottom surfaces, and the location along the sides of the points at which the elliptical cross-section is widest, we carve away the unwanted wood, using card templates to define the sections at the appropriate stations along the fuselage length. (Fig 56).

Suitable principally for small models, because of the vast quantities of weight generating wood left in place (and the vast quantity of waste wood thrown in the bin!), the idea is to design for a

Something a bit different here! Dr. Mike Hawkins built the fuselage of his Bucker Bu 182 Kornet as three separate sub-assemblies (nose section, centre and rear) then put the three together and applied wrap-around balsa skin over the rather minimal basic rear structure.





reasonably constant skin thickness all the way round the cross-section. A related method is to carve the fuselage from a large block (actually two blocks tacked together along the centre-line) then split the carving into halves and hollow out internally as appropriate. In fact, many modellers use this method with blue or pink builders' insulation foam instead of wood and with a suitable surface finish, the method is cheap and fairly easy to do, although disposing of the by-product of lots of pink or blue foam chips and dust can be a chore, because the stuff can get everywhere!

In both these methods of construction, we will need to put doublers at the wing saddle. The important point is to extend the doublers well forward and well aft of the aperture normally covered by the wing, to eliminate stress-raising discontinuities. (Fig. 57).

CRUTCH SYSTEMS

The final standard streamlined fuselage structure employs the crutch system and is very suitable for all models sizes. For a mid-winged aeroplane such as a Brewster Buffalo, or even a low-wing such as the Republic P-47 Thunderbolt where there is an under-pan centreline fairing on the wing centreline undersurface, the horizontal crutch is hard to beat, as it can give automatic alignment of formers; also there is no chance of building in a 'banana effect', because the plan view is already 'built in'. Fig. 58 shows the system in use on a sport-scale P-47 Thunderbolt.

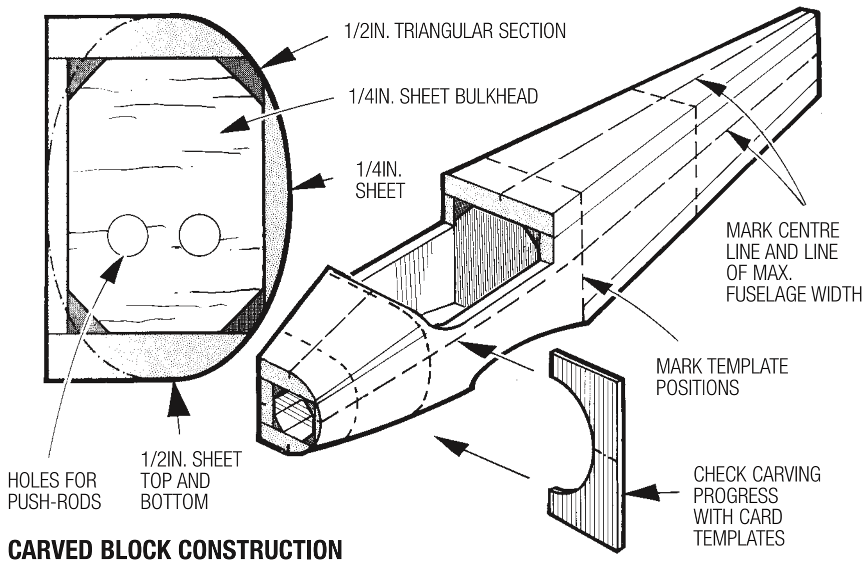
A variation of this system is to build and plank both top and bottom halves of the fuselage separately, each on its horizontal crutch - Fig. 59. The upper and lower shells are then joined. This method allows us to get to grips with the wing seat doubler, as it is useful to have the fuselage firmly jigged to the board whilst trying to curve a piece of sheet perhaps 3/16" thick into place

For circular sectioned fuselages, we can erect ply-faced balsa webs to carry the wing attachment points and the engine and radio gear as shown in Fig. 60. For a mid-winged aeroplane, the crutch would need to be of deeper and thicker material than hitherto considered, to allow for carving to fuselage cross-section and also for the wing saddle cutout. Fig. 61 illustrates the principle. Quarter-inch sheet is ideal and the overall depth from nose, to wing trailing edge, should be about 1.1/4" tapering aft to about 1/2" depth at the tail. The reason for this deeper crutch is to keep some strength in the fuselage when you have taken that enormous bite out of it to allow for the wing to be removable. The remainder of the fuselage is planked.

The second type of crutch employs our friend from earlier in these pages, the open box girder, which is suitable for use with small or large models. Design the crutch framework exactly as for the stringered circular-section fuselage shown earlier, only this time plank the exterior to simulate a metal-clad skin. Suitable sizes for the crutch are 3/16" light balsa for .40 motors and 1/4" light balsa for .60s.

Why only light? Well, we are going to plank the whole fuselage with 3/32" or 1/8" balsa, and this in itself will be strong

FIG. 56.



CARVED BLOCK CONSTRUCTION

FIG. 57.

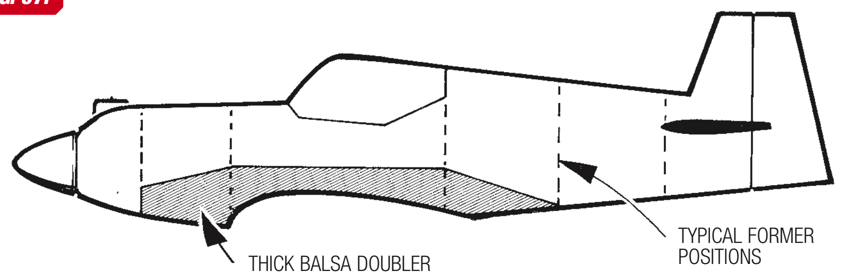


FIG. 58.

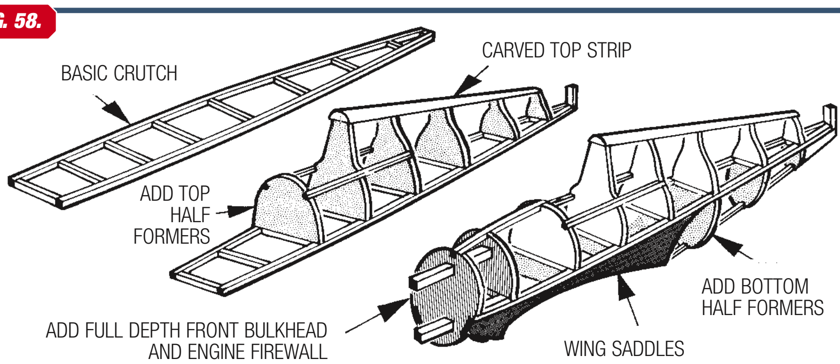


FIG. 59.

SPLIT HALF SHELLS USING CRUTCH - ELLIPTICAL FUSELAGES

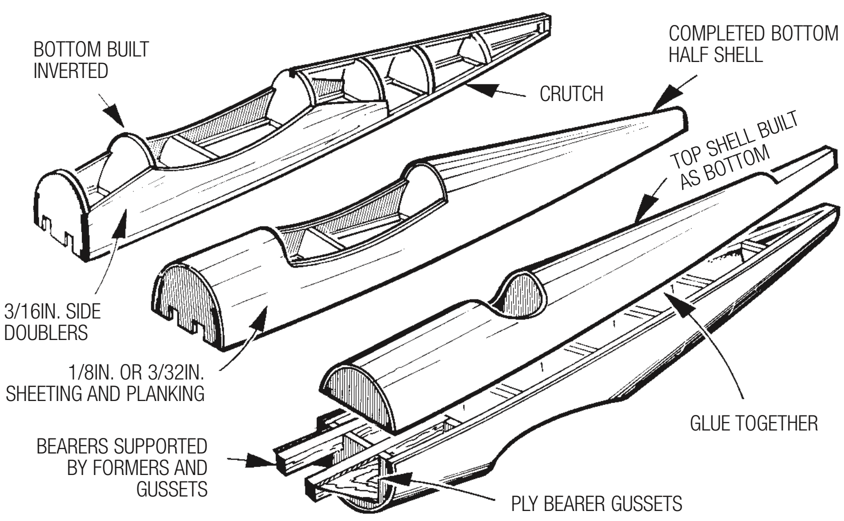
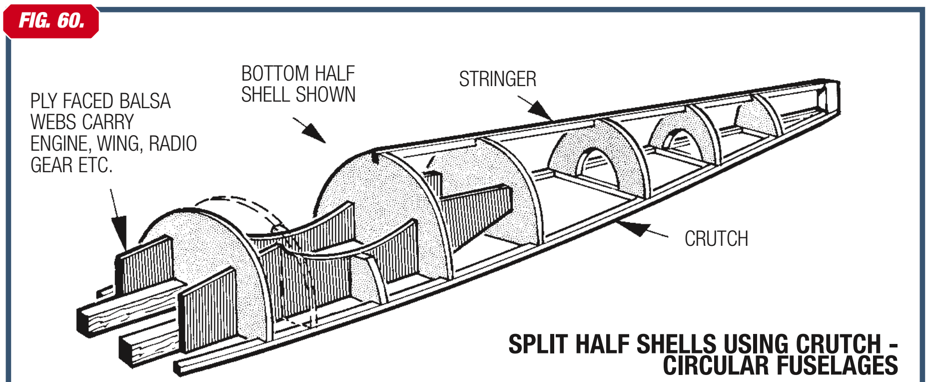


FIG. 60.



SPLIT HALF SHELLS USING CRUTCH - CIRCULAR FUSELAGES

enough for flight loads without the crutch, which is really an assembly aid, taken along for the ride, so to speak. The nose needs to be strong enough to carry the engine, however, the strength here being achieved by using ply doublers on the forward balsa sheet part of the crutch.

In all cases when planking, one should use light flexible wood, avoiding too much weight growth, especially from the use of excessive glue.

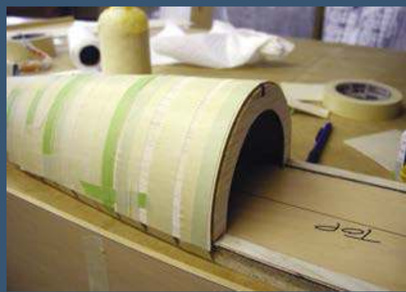
An interesting point gleaned from reading a 1917 issue of 'Flight', magazine is that the Albatros WW1-era series of streamlined Scout biplanes were actually covered in flat panels of wood, there being no double-curvature present except that produced by optical illusion. Since a basic Albatros structure was similar to the box-crutch just described, with extra stringers running along the centre-line and datum lines, it would be entirely possible to replicate the full-size technique using a thin spruce box framework, fretted out spruce formers, and 1/64in. ply panel covering.

The Pfalz D.III (also WW1-era) was a true streamline, so anyone planning to build a model of a Pfalz type will have no alternative available but to keep on planking.

The Windsock Datafiles by Albatros Productions on these aircraft are valuable references regarding how the Pfalz fuselages were actually assembled, whilst World War One Aero magazine, issue No 84 (dated April 1981) showed how to replicate the diagonal planking used on the Pfalz, as in Fig 61a1. The method employed involved making a scale fuselage skeleton using the formers and stringers of the full-size Pfalz, gently pressing blocks of white foam into all the spaces, and then carving and sanding the foam to the correct streamlined shape using the fuselage framework as a guide. The result was a fuselage plug over which the stressed skin could be moulded. The plug was diagonally planked with strips of plywood in three layers as per the full size, and then the foam blocks were poked out from inside with a length of piano wire, leaving the planked shell. In fact the full size Pfalz fuselages were assembled from left and right-hand half-shells, the planking being laid down on large moulds, with a layer of fabric between each plywood layer. When the glue was dry, each half-shell would be taken and nailed to the pre-assembled fuselage internal structure, with strips of reinforcing fabric being doped over the top and underside join lines.

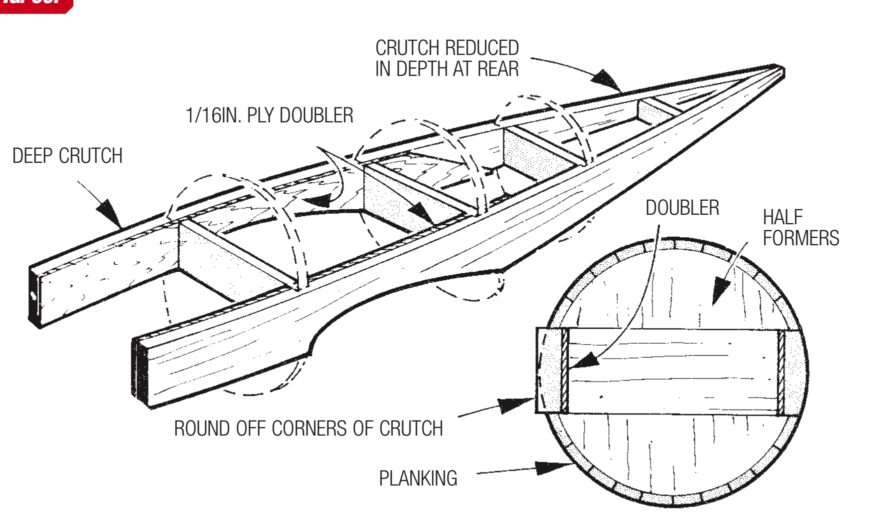
This half-shell method would make replicating the Pfalz structure easier and would also reduce the chance of distortion in the final product. One could make left and right-hand frameworks, each side being firmly pinned to the building board before fitting and shaping the foam blocks. On lifting each planked shell from the bench, the foam blocks would be easily accessible for removal, and then the two sides would be joined along their centre-line as per the full size.

Apparently, the Albatros fuselage skins were also pre-assembled on moulds, with full-length side, top and bottom skins being assembled separately, before being mated together on the pre-assembled framework. The edges of the individual ply sheets were chamfered to provide a generous overlap where they were joined.



This sequence is a good example of a rounded fuselage built as two half-shells, top and bottom, in which the balsa surface skin is applied to each of the shells before joining. The aircraft being modelled here is the Albatros D5a late WW1 fighter type.

FIG. 60.



HORIZONTAL CRUTCH FOR MID-WINGED AEROPLANE - BREWSTER BUFFALO ETC.

MOULDING BALSA FUSELAGES

Though planking is the usual way of reproducing the stressed skin of a fuselage that has areas of double-curvature, one can mould balsa sheet if one is prepared to first make a plug, out of wood or blue foam - see Fig 61a. The plug is mounted on a scrap-wood plinth to allow an overlap so that the edges of the final moulding can be trimmed back neatly. Plastic food wrap covers the plug to enable easy separation of the moulded item when the glue finally dries.

GETTING REALLY AMBITIOUS NOW! Another example of upper and lower half shell fuselage shell construction is this twin engine Bristol Beaufighter, with the added complication of a nose section/cockpit sub-assembly.

FIG. 61a.

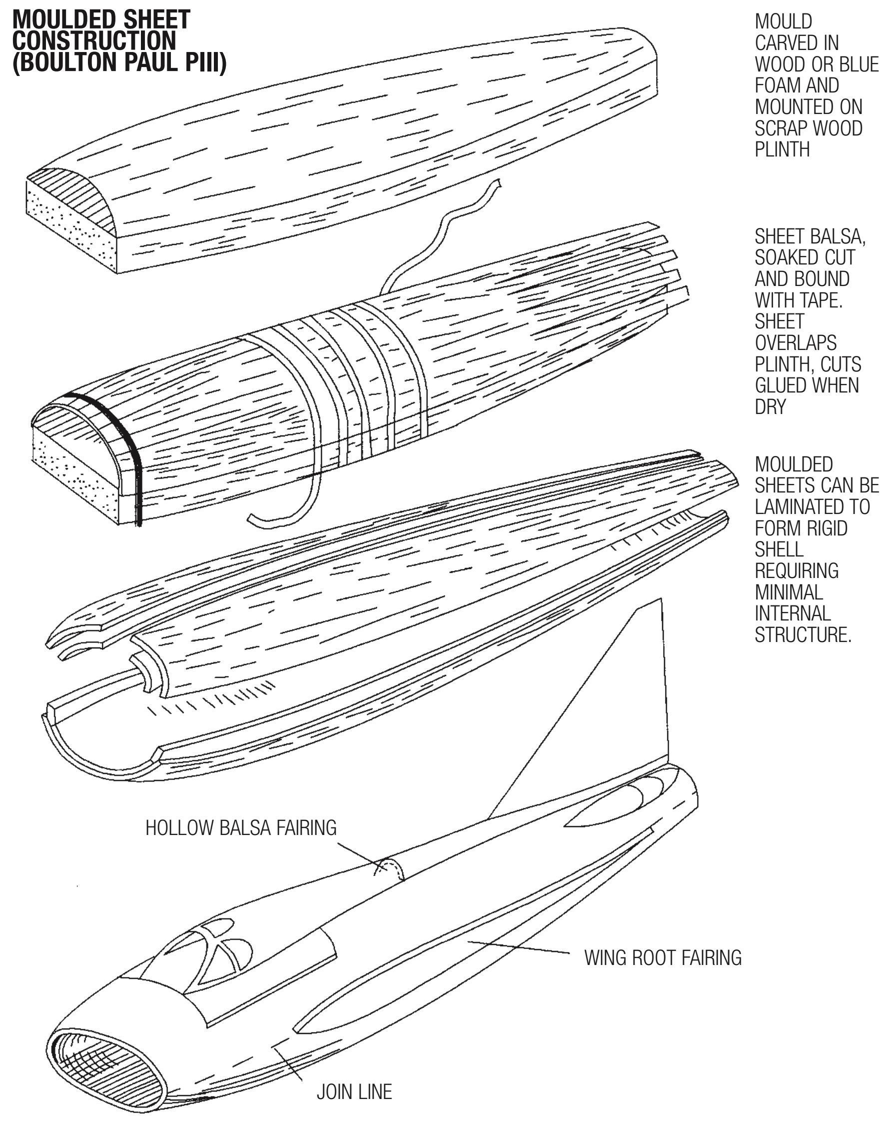
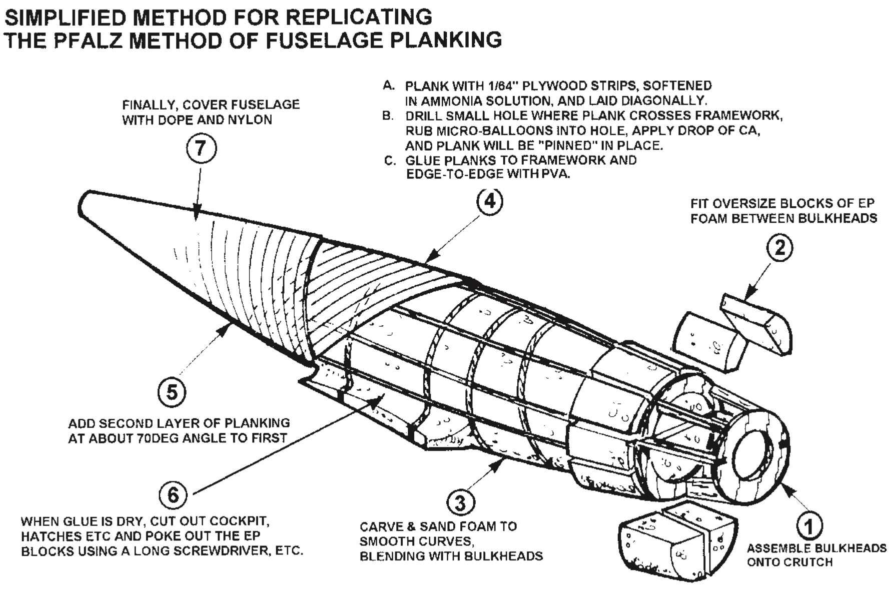


FIG. 61a1.



If necessary, household ammonia can be used to soften the sheeting as described earlier.

You start with a plug which is undersize by the final thickness of the skin, say 1/8”, and then wrap a piece of well-dampened straight-grained soft 1/16” balsa round the plug at the largest cross-section, pinning and binding it in place. You then pleat the sheet by making out a series of long Vee-cuts and pull the edges together so that eventually the 1/16” balsa is as close as possible to the surface of the plug. The next stage is identical, except that the Vee-cuts are made in a different position so they overlay on wood, and the sheet is tailored to fit and partially dried.

Then, the first moulding is liberally smeared with glue (PVA white-glue or even slow CA), and the outer skin is pinned and bound in place. Any deformities on the outer surface can be filled with balsa scraps or lightweight filler and after surface finishing, the shell is then ready for assembly onto the fuselage sub-structure. The method is suitable for complete fuselages, cowlings, or for sections such as the front fuselage decking on the DH 88 Comet, which was actually a plywood shell, formed by diagonal planking in similar fashion to the Pfalz fuselage just described. ■

SE5a

1/5TH SCALE, 64" (1626mm) WINGSPAN MODEL FOR FOUR FUNCTION R/C AND .90 CU.IN. FOUR-STROKE ENG1NES AND BASED ON THE DESIGN BY THE LATE GARY SUNDERLAND

First, we should explain the term *"based on Gary Sunderland's design"*.. Gary had, on more than one occasion, been a member of the Australian World R/C Scale Championship team and was a very competent and practical scale modeller, incorporating lessons learned over many years of scale modeling, all of which were progressively incorporated into the extensive series of scale model design that have featured in FSM over the years. Gary was a great all-rounder scale modeller, flying both indoor and free flight scale in addition to radio control and he also participated in full size glider flying.

By his own admission his SE5a, when originally designed was, by later standards, rather more of a 'Stand-Off-Scale' replica, but was indeed a first class flier. However, by reference to the three-view scale drawings presented elsewhere in this issue is has been possible to tailor Gary's original plans of his model as close to true scale as possible. This entailed a few modifications, including a revised wing section and structure.

So, the construction plans offered with this feature show the 'corrected' outlines and sections but have also included Gary's original and proven structure.

This is not a model for the beginner in terms of building and finishing, although it is not difficult to fly. You will have to study the plan drawings carefully to understand the structure and it may well be that you will want to incorporate some of your own methods.

How much surface detail to incorporate is a matter of personal preference. There are plenty of references work to aid in surface detailing the S.E.5a one of which is the *Albatros Productions Datafile* of the subject, now well out of print, but regularly to be found on EBay or with second hand book dealers, such as *The Aviation Bookshop* at Tunbridge Wells (Tel: 01892 539284)

Gary's following notes are fairly brief but, as we said, this is not a building project for the novice.

THE BUILD

My subject aircraft was the direct-drive Wolsey Viper version of the aircraft (as opposed to the Hispano-Suiza engine variant, the Viper engine being substituted to alleviate the scarcity of the H-S engine at the time when the SE5a was greatly in demand in frontline service. The other difference with the Viper powered variant was the wooden undercarriage, also applied to this model.

At 1/5th scale, the size is nicely manageable and at 13lbs. (6kg) all-up weight, is good for an O.S. 91 four-stroke engine, or maybe a Laser 90, the extra power of which could be useful at 'critical moments'.

The particular individual aircraft modeled was flown by No.2 Squadron, Australian Flying Corps and differs from the featured model on the plans by having the headrest fairing removed and an extra bracing wire to the fin.

Study the aircraft carefully and decide on the methods you are going to use; understand all areas before commencing construction. The basic structure is straightforward so that most of the effort goes into adding the fittings, rigging and surface detail.

Start with the fuselage box structure. The lower wing is bolted into the fuselage in six places. First there are two bolts near the leading edge of the centre section lower wing (I only used one centre bolt to the 1/2in.sq. pine cross-piece, but a bolt each side will leave more room for access to the front bracing clip). With the lower wing in position, the aluminium underpan is fitted and this mounts the undercarriage. All bolts used on the original were Du-bro 4-40 cap head screws with blind nuts into the 1/2in.sq. Pine corner blocks.

For aeromodellers in Australia there is the doubtful pleasure of being able to purchase modelling wood in both metric and imperial sizes. Thus, this model uses

5mm.sq. balsa strip for the basic fuselage structure whereas most U.K. modellers would be use 3/16in.sq. balsawood, but with 5mm plywood! And just to be more perverse, Ozzie modellers use piano wire in fractions of an inch diameter whereas in any U.K. model shop piano wire comes in S.WG. (Standard Wire Gauge) sizes, so that centre section (cabane) struts at 3/32in.dia. are approx. 13swg, or 2.4mm - take your pick')

Fully detail the cockpit and the instrument dash at this point, before you add the top formers. Glue in the cabane (centre section) pick up wires and do not add any top sheeting at this time, but the rear formers and stringers can be added.

Most builders who model the SE5a get the radiator cap wrong. It is almost flush, not stuck up in the breeze! This is how to do it: -

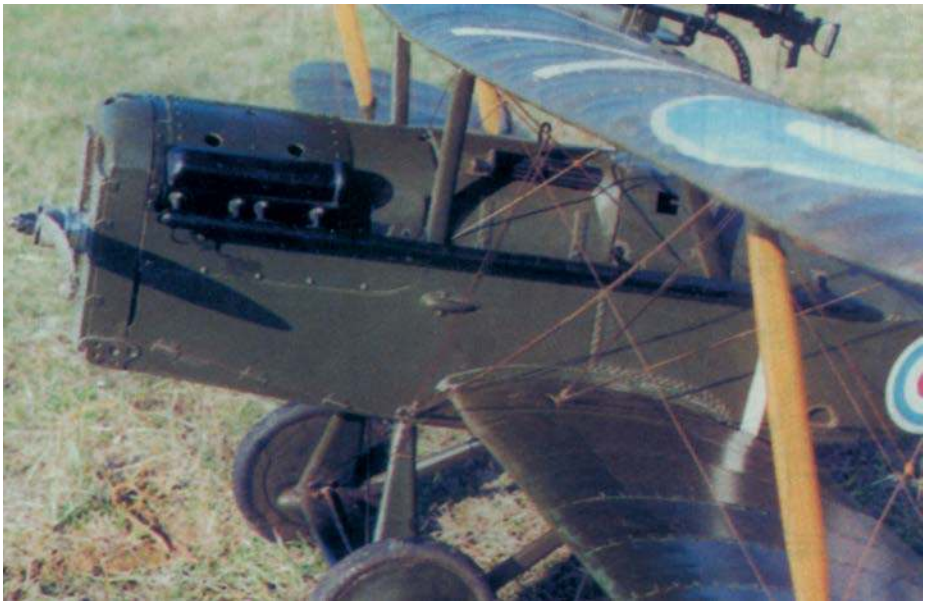
Cover the top balsa nose block with fibreglass and epoxy. (Also at this time, resin coat inside the engine compartment.) Carve out an access hole, circular in plan view, and make up a cap from scrap dowel and epoxy it in. Paint the inside a `Humbrol' copper colour then carve away at the rear, to provide clearance for the O.S. engine tappet cover.

Build the top wing and then draw the interplane struts out on scrap plywood. Make two (bind and solder) identical sets of interplane struts. Then assemble the wings to the wing struts and fuselage, and bind and solder the centre section together, checking incidence, gap and stagger at every stage.

The fuselage dummy fuel tank is made removable, and includes the forward part of the Vickers machine gun. The front cross bracing wires screw into the tank.

Next, cover the top decking with balsa and 0.4mm ply, and fabric the rear fuselage top and sides, leaving the bottom open for the moment. One point needs to be made here about covering. The forward side fabric on an SE5a often appeared wrinkled and slack, something which was the result of the aircraft being left out in the open, coupled with the manner in which the fabric side panels were secured in place with lengths of

Gary's dismantled prototype model reveals the individual component parts, and provides a good idea of how it assembled. The interplane struts have wire pegs top and bottom to locate into the upper surfaces of the lower wings, and lower surfaces of the top wings. Note the static display scale propeller.



Lumps, bumps, bolts and fittings are very much the character of the SE5a, which the model should reflect. Our 'In-Detail' photo study in this issue is a useful reference for this.

lacing that were there to be undone for service access to the internal airframe structure. That can be simulated by beads of glue, applied before you add the fabric. Balsa cement can be used for this wrinkling process ... if you can find some these days!

TAILSURFACES

Build the tailplane, cover and hinge it. Cut away the rear fuselage and slot it for the tailplane. Check that the incidence angle is 3° to 4°. There should be a gap of about 1/16in. between the sides of the fuselage and the first tailplane rib. Check that the tailplane is level (horizontal to the fuselage) in the front view and if it's right, glue in the tailplane and connect the elevator drive.

Cover in the underside and add the tailskid. The model has a fixed skid, whereas the SE5a had a steerable assembly. In practice it was found that a steerable skid was not necessary on the model saving a lot of weight and complication, so was left fixed.

Make the fin and rudder at any time, but do not attach it until after final painting. Epoxy in the brass tubes at all rigging points on the tail surfaces, plus 'dummy controls'.

COVERING

Cover the undersides of the wing. I used *Sig Koverall* on this model, but but the iron-on fabric substitutes for (regrettably no longer available) *Solartex* are alternatives. Because of the undercamber, all of the lower fabric must be stitched to the ribs, at least in the undercambered part. Use linen thread at 3/8in. pitch, then add the top fabric and hinge the ailerons.

Epoxy in the aileron control horns. The SE5a ailerons had a plywood gap seal, which is added after covering. Make this from 1mm ply, glue over the fabric and tissue over. Also add the 'inspection panels' to the top of the tailplane and bottom of the wings.

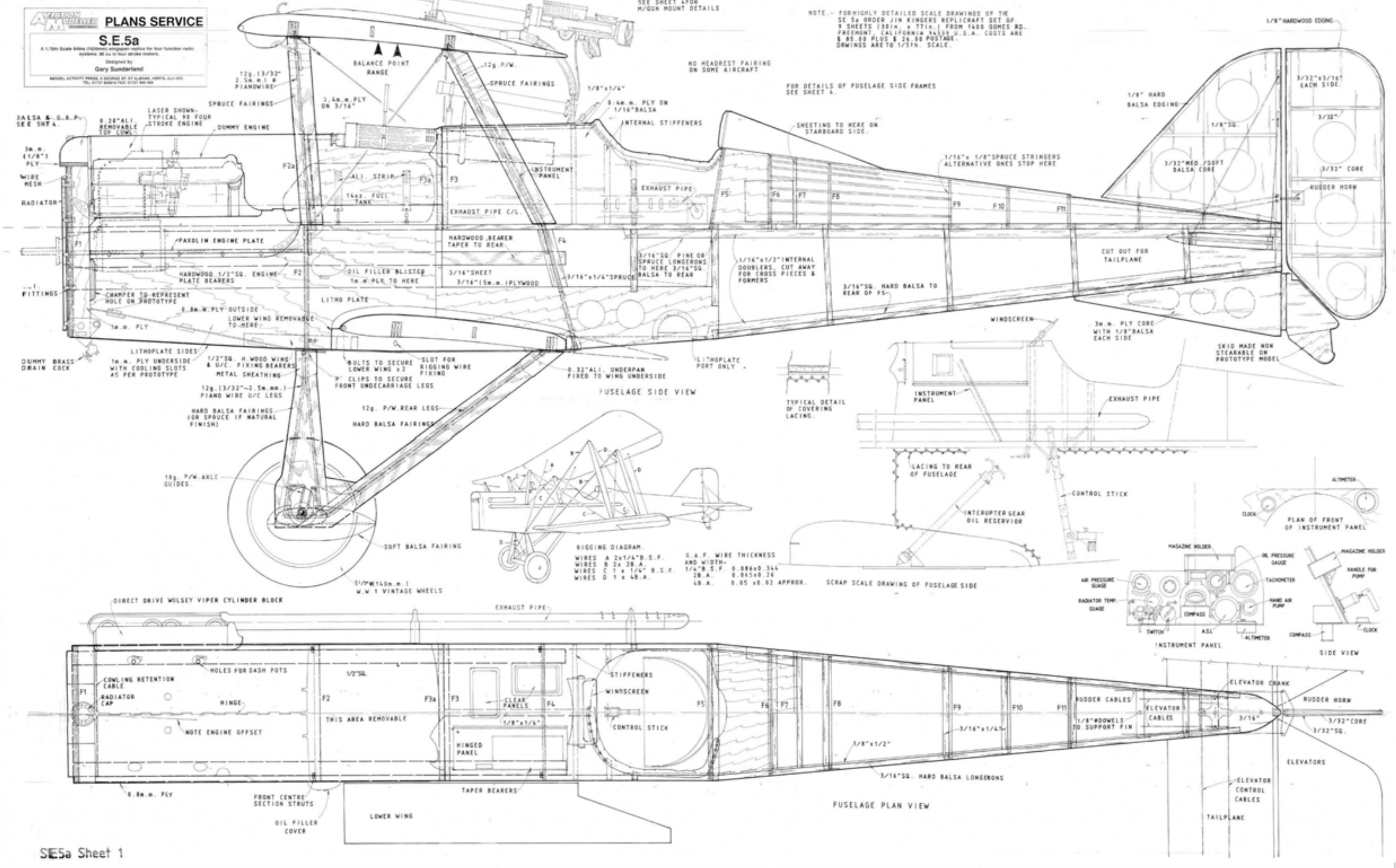
Rib stitching was very pronounced on 1918 British aeroplanes like the SE5a, and shows up in most photographs. Make up strips of 'rib tapes' on a frame and glue these strips to all rib positions, wing and tail surfaces. Structural fittings, for wire attachments, were made from .040 inch Dural. Alternatively, mild steel strapping (container packaging) is an excellent substitute, and costs nothing if you can lay you hands on some!

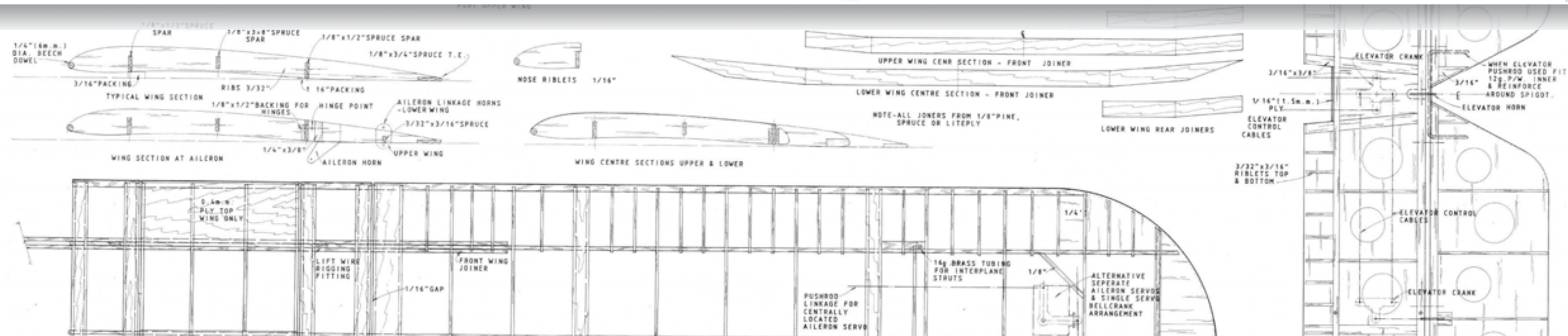
Make and attach all the wing rigging fittings, including those inside the fuselage. The entire wing rigging is from 0.032in. (21swg) piano wire, doubled for flying wires. Do not over-tension the wires, and check the incidences before and after rigging.

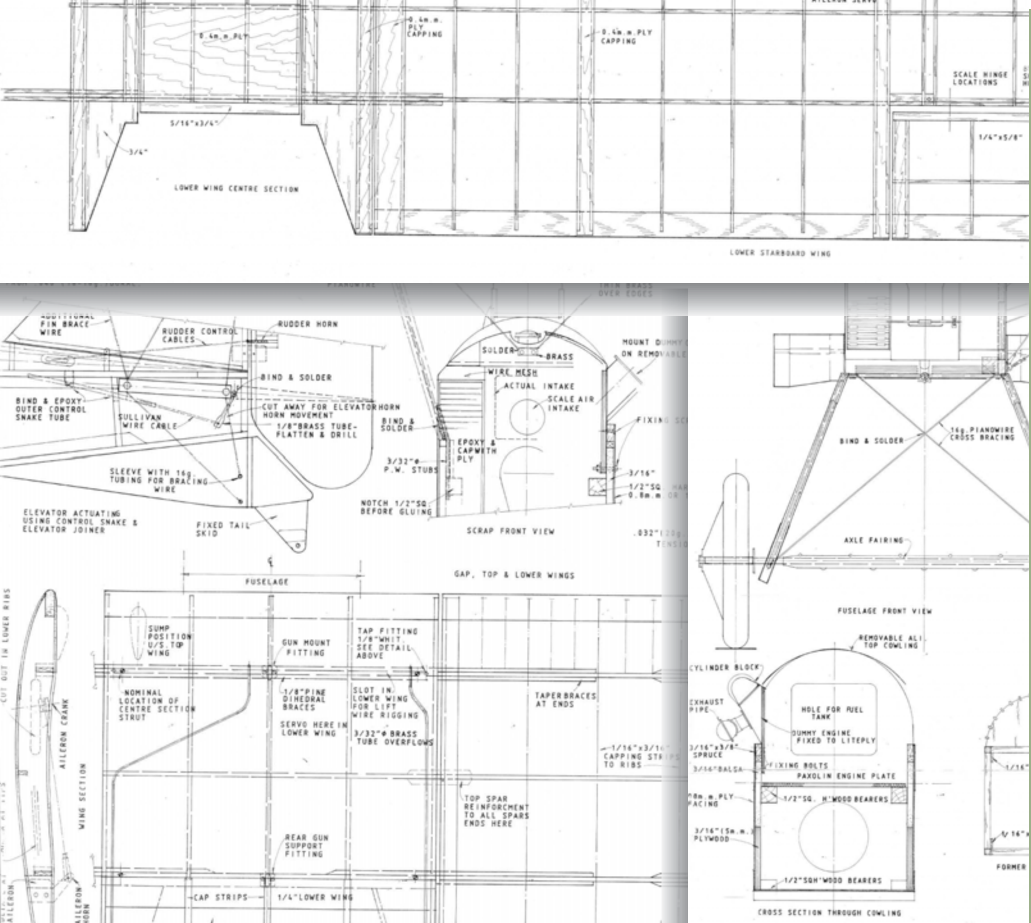
The undercarriage is built onto the detachable under fuselage plate made from 0.032in. Aluminium, or Dural for preference. This is patterned from the original SE5a belly pan and attached with cap-head screws. There is a clearance hole at the wing attach bolt. The 3/16in. wire axle is bound and soldered at the centre and is sprung by one loop of 1/8in.dia. rubber shock cord each side.

FINALISING

The dummy Wolseley Viper engine,







SE5a

Full size copies of this four sheet plan are available from Flying Scale Models Plans Service,
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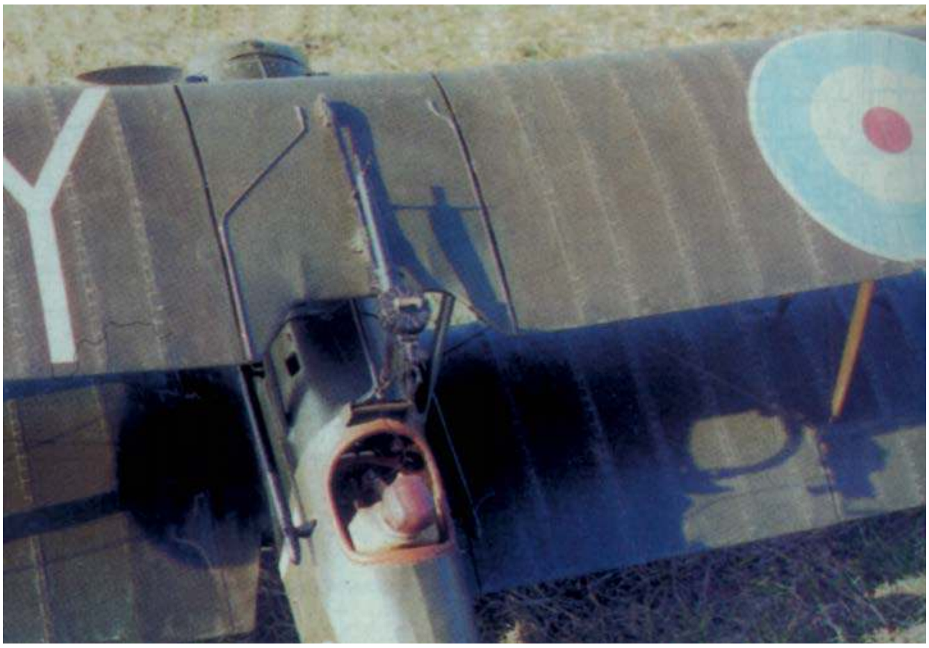


How much detail you add to the model is a matter of personal preference. Little of it can be seen when the model is airborne, but on the ground, close up, it makes all the difference.

At 1/5th scale there is really no need for separate left and tight wing panels and the model will easily fit into a modestly sized vehicle for transport. Assembly is therefore quick.

The plans include full details of the structure but the three-view scale drawings and 'In-Detail photo study both in this issue are also an aid to construction and surface detail.

exhaust stack and Lewis machine gun are all made from plywood and balsa, and attached with brass and aluminium fittings. After final painting, the fin and rudder are attached. Note that there is also a small gap beneath the fin. The rigging wires are all very much structural on the SE5a, particularly on the tail surfaces.

The completed model should weigh just under 6kg (13.2 lbs) and balance somewhere near the top wing middle spar. (Incidentally do not leave out this extra spar, otherwise you may develop 'bandy-wings', due to fabric tension warping the structure). Adjust all the controls to zero deflection.

FLYING

All controls pre-take off checked (?) - so let it fly off in the two-point attitude, just like the real SE5a. It is very stable in all axes (which is unusual for a WW1 Scout) and the SE5a is best left alone to fly itself most of the time.

You will find the 'barn door' aileron only moderately effective, with lots of aileron drag, particularly at high angles of attack. The elevators are relatively sensitive and the rudder is very sensitive at all speeds. The prototype model had as much aileron as could obtained, while the elevators were adjusted to +/- 1/2 inch and the rudder at +/- 3/8 inch.

Try not to use the rudder during takeoff and landings which, incidently, should (must!) always be straight into wind.

In the air you really need to use rudder in combination with ailerons all the times to overcome the aileron drag, even for normal turns. Don't try to use radio mixing, as the amount of rudder required varies with the speed, angle of attack and 'g' load - and the day of the month! In other words, learn to use both sticks (fingers) to get the best out of the aircraft. As you master the SE5a it really becomes fun to fly - just like the real thing.

Loops and stall turns are straightforward. An axial roll is beyond me, but the SE5a does a beautiful barrel roll with the help of a jab of rudder and aileron together (which is just as it should be). Rudder is also necessary when rolling into a 'Split S'. The stall is docile and the prototype model SE5a would not spin.

Back in 1918 the SE5a had a reputation for being difficult to land. I cannot imagine why, because the model sits down nicely, into wind. A spritely performance is achieved with the O.S. Surpass engine and it is fun to fly, even on a windy day. Beware of the Hun in the sun!

ADDITIONAL BUILDING NOTES

Gary was not at all keen on the elevator control linkage system shown on the revised plan and prefers his Sullivan outer tube (blue) wire internal cable, to a brass tube horn on the piano wire elevator joiner method. However, to use this method and obtain sufficient up elevator motion it may be necessary to position the tailplane a little forward of the scale location.

Gary also preferred his original wing construction system which is certainly easier to make and stronger, but the airfoil profile was less scale. However, you must take particular care to rub the top of the centre spar with a candle to prevent the covering from sticking to the spar.

Whichever way you decide to build and detail your SE5a we hope you enjoy the building and flying. Don't forget to send some photographs - and don't forget the man in the office ... there were no Drones back in 1918 (unless some highly informed aviation historian out there can prove otherwise!

So get ready for the Dawn Patrol.

The prototype model, O.S. 91 Surpass powered, gave designer Gary Sunderland long and faithful service.

With dummy pilot on board, the prototype model is ready for action.

THE ROYAL AIRCRAFT FACTORY S.E.5 & 5a

FAMILY PORTRAIT!

Flying personnel and ground crew of an RFC Squadron in France with their S.E.5a aircraft … together with much mud, it appears! Squadron codes have been obscured by the Censor.

In the Royal Aircraft Factory at Farnboough desined two single seat fighters, each to be powered by the 150 h.p. Hispano-Suiza inline engine. Only one of these was to go further that the project stage and that was H.P. Follan's S.E.5.

Three prototype aircraft were ordered in September 1916 and this decision was quickly followed by another order of 24 aircraft in an initial production batch. The first prototype was completed by November 1916 and on 21 November it underwent its final inspection before performing its maiden flight the next day when Major Frank Gooden, took the aircraft into the air 20 minutes initial test flight. On the following day Capt. Albert Ball, who at the time was considered to be the most brilliant and daring pilot of the Royal Flying Corps (RFC), took the S.E.5 up for a trial flight. Landing back after not more than 10 minutes he immediately pronounced his poor opinion of the aircraft.

In hindsight one might consider this to have been an unfair judgment. Chroniclers speculate that his opinion was biased as he had only recently set down his own basic requirements for a single-seat fighter. Fortunately it would appear that Ball's opinion did not have any effect on the aircraft's fortunes as the project continued unaffected and a second prototype took to the air on December 4th.

Gooden took the aircraft to France for further evaluation in an operational environment, but on 28 January 1917 but subsequwntly was killed while flying the third prototype, which broke up in the air, and the next recorded flight of any S.E.5 did not take place until four months later. Production of the initial batch was completed by March 1917.

Deliveries of the S.E.5 began on 13 March 1917 and by April 56th No. 56 Squadron had been fully equipped with

An early Wolsey Viper engine installation on an S.E.5. The top of the radiator differs from the shape that became standard, while the nose section underfairing is more shallow than on Viper powered production aircraft.

This S.E.5a passed its final inspection for service use at the end of September 1918, surviving the end of WW1 so become a test bed for a variable-pitch propeller experiment at the Royal Aircraft Establishment during February 1919.

the type. Three days later the squadron went to France with its new mount ... with the exception that Capt. Ball decided to retain a Nieuport that had been acquired by the unit, as his personal mount!

On 22 April No. 56 became fully operational from Vert Galand and the following day Ball scored its first victory, again flying the Nieuport. This famous pilot's apparent prejudice towards the S.E.5 during this initial period seems to have taken a turn when on that same day he flew such a machine and scored another victory when he shot down an Albatros. Ball was killed on 7 May by which time the S.E.5 had earned the respect of the squadron's pilots and, spurred by Ball's fighting spirit, had become an elite unit within the RFC. At the end of May No. 56 moved north for the Battle of Messines where it was also heavily engaged on ground strafing missions, before returning to England in June for Home Defense Duties.

IMPROVING THE BREED

The third prototype (A4563) was fitted with a 200 h.p. Hispano-Suiza engine and to all intents and purposes it can be regarded as the prototype of the S.E.5a. It had wings of reduced span, its engine drove a four-blade propeller, and the gravity petrol tank and the water header tank were fitted into the leading edge of the upper wing centre section.

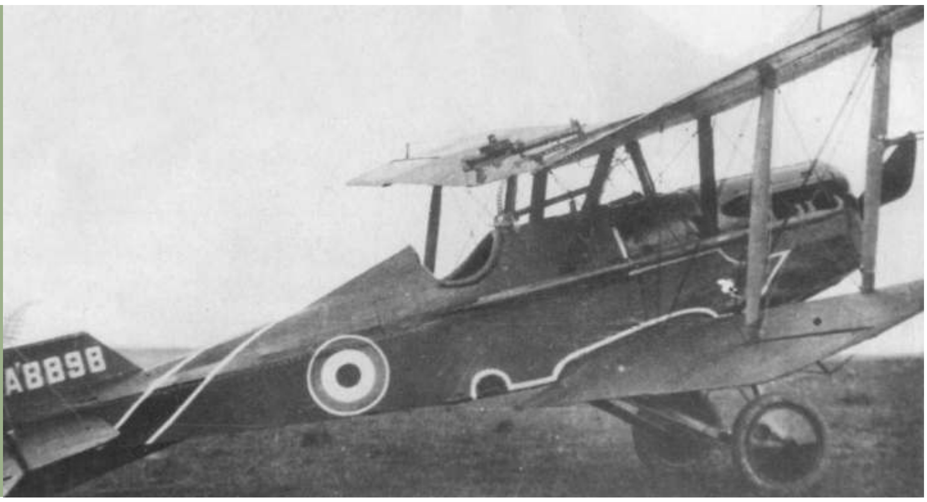
The report on the S.E.5a stated that its flying qualities were good and that its lateral control was better than that of the S.E.5. By 1917 standards, the S.E.5a had passed the test and the first aircraft of the production batch was delivered to No. 56 Squadron in June 1917. No sooner had the unit re-equipped with the new version than it was again sent to France for the Third Battle of Ypres, where it had among its pilots Capt. J.B. McCudden, a subsequent V.C.

Production S.E.5as were generally similar to the prototype, having lengthened horizontal exhaust pipes, the addition of a head fairing behind the cockpit and a straight top line; the nose under-fairing was likewise given a straight-line profile.

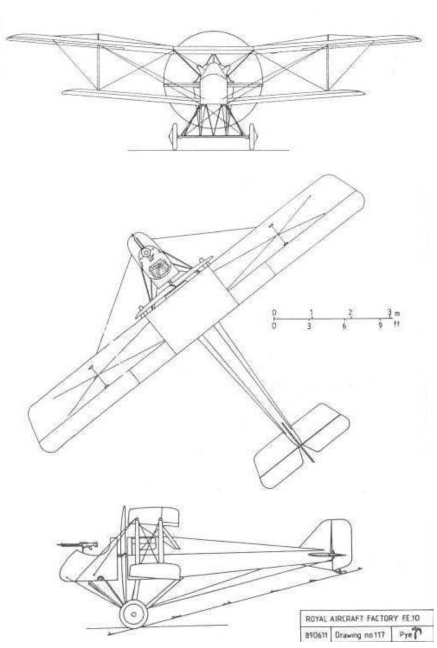
ENGINE SUPPLY BOTTLENECK

As the summer of 1917 advanced, production increased steadily. To add to the initial order of 400 aircraft, an additional order for 850 was placed in July and by the end of that same month a further 1,300 had been ordered. Further large orders continued to be placed throughout 1917.

By the end of 1917 over 800 S.E.5s and



One of the Hispano-Suiza powered S.E.5s issued to No.60 Squadron R.F.C. that, for a short time at least, carried colourful fuselage trim. A8898's was red and white, while A48853 of No.56 Squadron's was of a similar pattern in blue and white.



AN UNGAINLY BIRD INDEED!
The Royal Aircraft Factory F.E.10 parallelled the S.E.5 and was designed by the same team. The pilot's nacelle, ahead of the propeller and engine was suspended on struts and rigging.

S.E.5a types had been built, yet only five squadrons were operating these in France. The reason for this delay was the difficulty that were being experienced in the supply of the 200hp Hispano-Suiza engines. It was unquestionably the best engine available at the time on the Allied side of the warring nations, and enormous demand from aircraft manufacturers in Britain, France, Italy, Spain, Russia, the United States and Japan.

The British concessionaries, Wolseley Motors of Birmingham, had begun to deliver small numbers of the 150hp engine early in 1917. The Admiralty had, with admirable foresight, ordered 8,000 engines from France in 1916, but delivery of these did not begin until early the following year. By the autumn of 1917 the general engine supply situation was critical so that in January 1918, something like 400 new S.E.5a airframes were in store without engines and it was only the delivery, starting at about that time, of the 8,000 French-built engines that enabled squadrons to be equipped and new units to go to France.

The Wolseley version of the 150hp Hispano-Suiza, known as the 'Adder', differed in some ways from the original. It had a higher induction system and different reduction gear and compression ratio. It also suffered from lubrication problems and crankshaft failures. Moreover, the different gear system adopted by Wolseley rendered original Hispano-Suiza spares inadequate and, therefore, created difficulties for maintenance crews.

During the first half of 1917 the Sunbeam Arab engine had been ordered into large-scale production and in an effort to ease the engine supply problem when the Hispano-Suiza crisis arose, this powerplant was considered as a possible alternative engine. In November, therefore, an aircraft was fitted with an Arab I engine, but it was dogged by endless troubles and the engine was never adopted.

Wolseley had, meanwhile, embarked on its own engine programme, based on the 200hp Hispano-Suiza, called the 'Viper'. This engine used a direct drive to the propeller, eliminating the troublesome gear system, which thus solved most of the problems previously experienced. One of these new engines was fitted to an S.E.5a in August 1917 and the aircraft underwent tests at Martlesham Heath the following month. A second Viper installation was tested in December and although only a marginal improvement in performance had been registered, RFC officials were impressed enough to order Wolseley's new engine as the standard powerplant for the S.E.5a. although delays again set in and it was not before well into 1918 that the Viper became available in significant numbers.

Apart from the redesign of the nose area to accommodate the new engine, the S.E.5a went through some other important modifications, some of which were the result of reports of aircraft shedding wing panels during steep dives, occurrences of which became more frequent, especially during the early months of 1918.

A conference held at Farnborough during February tackled this problem and requested a number of modifications to

The significance of this picture, at least for scale modellers, is that it reveals the wrinkles in the rear fuselage side panel fabric that regularly appeared, caused by outdoor exposure, after the inspection panel had been laced back in place. The point is alluded to by Gary Sunderland in the construction feature for his 1/5th scale model elsewhere in this issue.

A post WW-1 experiment applied to this S.E.5a was this variable pitch propeller, undertaken during 1920.

An S.E.5a in American service markings as seen at Quantico, Virginia in mid 1921. The nose underfairing has been deleted and the structure under the lower wing between the undercarriage legs may be some kind of bomb rack.

the wing structure of the aircraft, with stiffening of the ribs behind the rear spar, strengthening of the compression ribs, lengthening of the front spar of the box rib by the aileron cut-out, and omission of the spindling of the rear spar for the last six inches of the box rib length.

FIGHTER SUPREME

With these modifications in place on the production line, the S.E.5a's structure ceased to be of concern to its pilots. Its Viper engine also contributed to the making of a superb fighting machine, respected by both friend and foe.

After the US entered the war a vast scheme for mass-production of aircraft was drawn up and it was inevitable that the S.E.5a be included. During the first months of 1918 there was some confusion within the American Expeditionary Force (AEF) regarding the equipment required. At first, an order for 1,000 SPADs had been communicated by General Foulois in Europe on 10 February, claiming that these would be built in the USA. It would appear that this was overtaken by something that happened later, as by April it was the S.E.5a that was being recommended for mass production in the US for the American Expeditionary Force (AEF).

Negotiations with the Curtiss Aeroplane & Motor Company resulted in an order for 600 S.E.5 and 1,000 S.E.5a fighters to be built powered by the 180 Hispano-Suiza engine. The reply that arrived in Europe in May disapproved of S.E.5 production and recommended their acquisition from Europe.

This confusing situation was finally settled when, in May, the Director of Aircraft Production notified the AEF that the Air Division in the US had just ordered 1,000 S.E.5s powered by the 180hp Hispano-Suiza engines to be built by Curtiss.

Quick off the mark, the first Curtiss-built machine was delivered by early August, but during the tests held that month, its engine overheated. This led to the extension of the S.E.5a's cooling surfaces and further tests conducted in September led to the approval of its production, which was confirmed to Curtiss in early October, This, however, was only five

This Hispano-Suiza powered S.E.5a was the personal mount of 57 aerial victory ace Major James McCudden. Most of McCudden's victories occurred while servicing with No.56 Squadron RFC and all but five while flying the S.E.5a. The spinner applied over the four blade propeller boss on MuCudden's aircraft was a non-standard application of a victory trophy from an LVG C.V.

THE NOSE KNOWS...

A comparison of the radiators of the S.E.5a. On the left is that of the Hispano-Suiza engine example at the R.A.F. Museum, Hendon. On the right is the Shuttleworth Collection's Wolseley Viper powered aircraft.

weeks before the Armistice, which brought with it the cancellation of the programme.

Meantime, the American Expeditionary Force (AEF) acquired 38 Austin-built examples of the S.E.5a from Britain during 1918 for use by the United States Air Service (USAS). The majority of these aircraft were passed on to the 25th Aero Squadron at Toul around the beginning of November 1918, with which the unit performed two limited patrols before the Armistice, without seeing any combat action, but by the end of that month the unit had been completely S.E.5a equipped.

Some of these aircraft went back to the USA after the war and saw limited service there during the first years of the 1920s. Curtiss assembled a number of British airframes during that period, using American engines although only 56 such aircraft were assembled and these were later rebuilt to serve as trainers, redesignated S.E.5e.

At the end of the war, the RAF had fourteen S.E.5a squadrons in France where they were joined by No.2 Squadron of the Australian Flying Corps. The type was also used in Palestine, in Macedonia and Mesopotamia. In 1919 it was suggested that the S.E.5a could be re-engined with the ABC Dragonfly radial but this engine proved to be such a catastrophic failure that it was never installed.

There was only one major derivative of the basic S.E.5 design, which appeared in early April 1918 under the designation S.E.5b. The new aircraft used the fuselage and tail unit of the S.E.5a. but with extensive structural changes that included a sesquiplane wing planform that greatly altered aircraft's appearance. It never went into production.

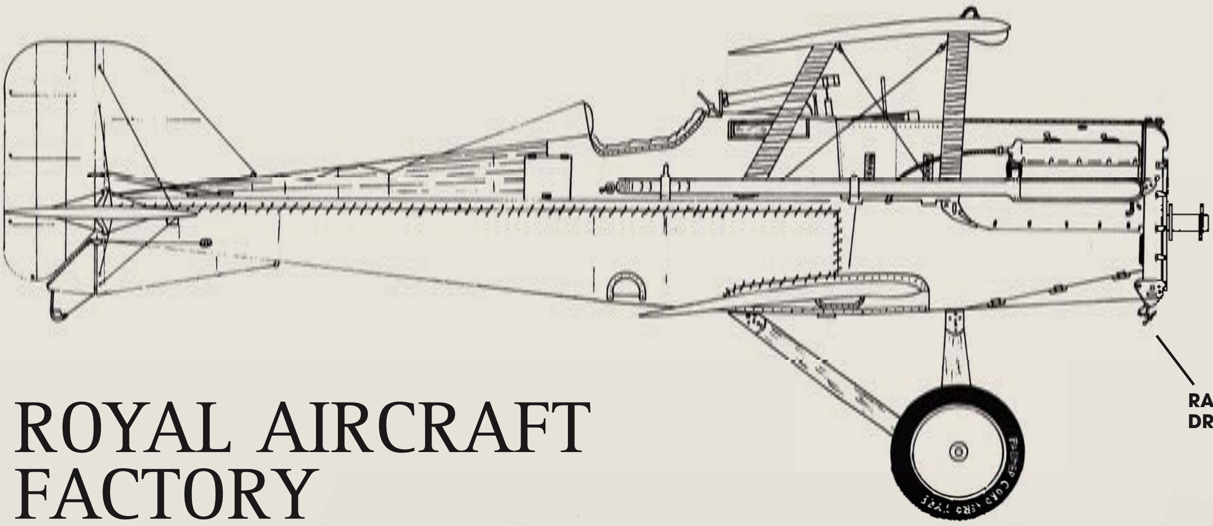
Although the S.E.5a did not long survive in service after the armistice, modest numbers lingered on in official service use for a few years and at one time a formation of five gave a remarkable display a formation aerobatics.

Australia, Canada and South Africa received numbers of the S.E.5a as part of an Imperial Gift Scheme where this old warrior continued to be used for some years. A few S.E.5s were sent to Poland and were flown on the Ukrainian front against the Bolsheviks, while another donation by the British gave 25 examples of the S.E.5a to the White Russian Government. Six examples are known to have been delivered to Chile serving with the 1st Aviation Company mainly as weapons trainers.

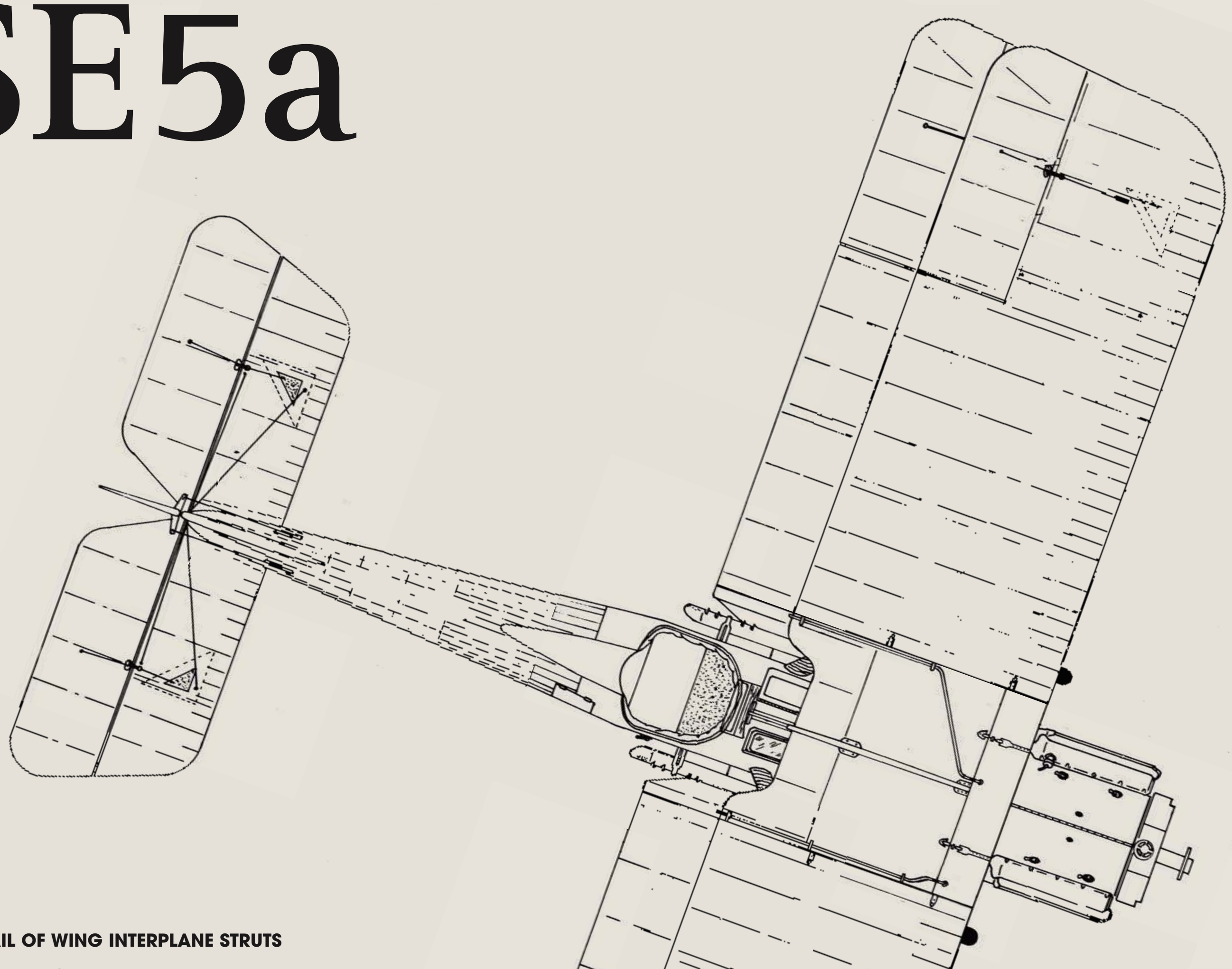
WRITING IT LARGE

Fifty S.E.5as acquired civil identities on the British register and some of these acquired distinctly non-standard engines. Best known were the 33 examples acquired by Major John Clifford 'Jack' Savage for his *Savage Skywriting Co Ltd* fleet. Most of these were suitably modified in having extended, lagged asbestos exhaust pipes extending to the tail end where they were joined into one by a 'Y' section that required the division of the rudder into two sections, while a tank for the liquid to generate smoke replaced the fuselage mount for the Vickers gun.

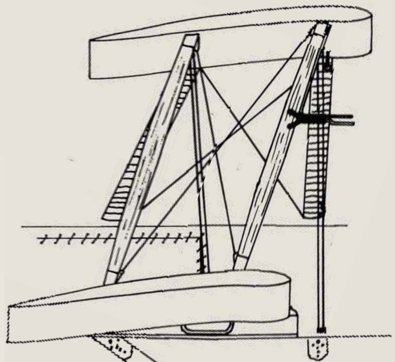
Skywriting was a real novelty of the time and few of the civilian population who looked up at the heavens could have realized these aircraft had, in their time, been one of the major instruments of victory in a long and bloody conflict. ■



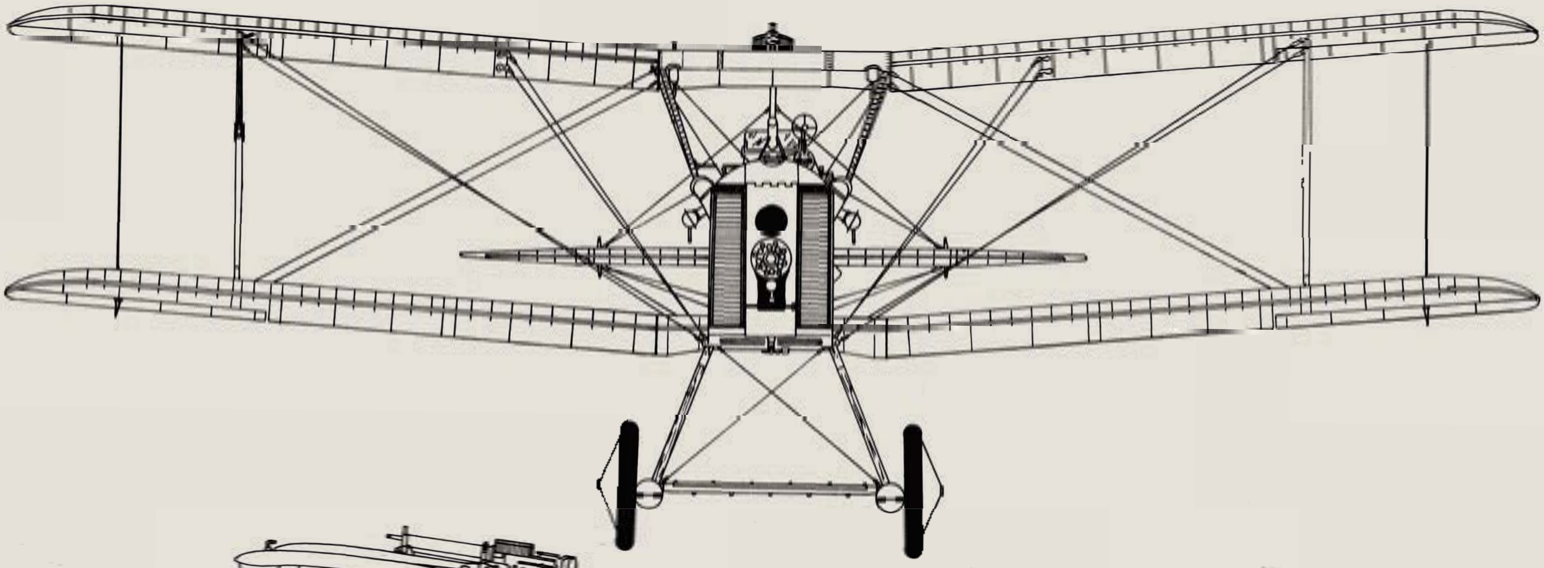
ROYAL AIRCRAFT FACTORY
SE5a

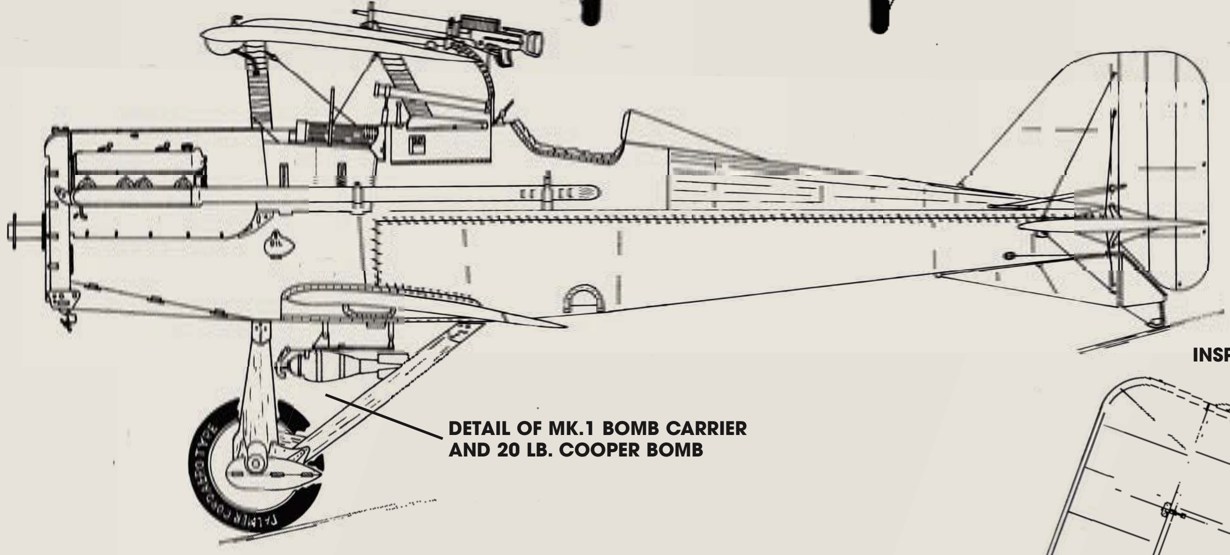


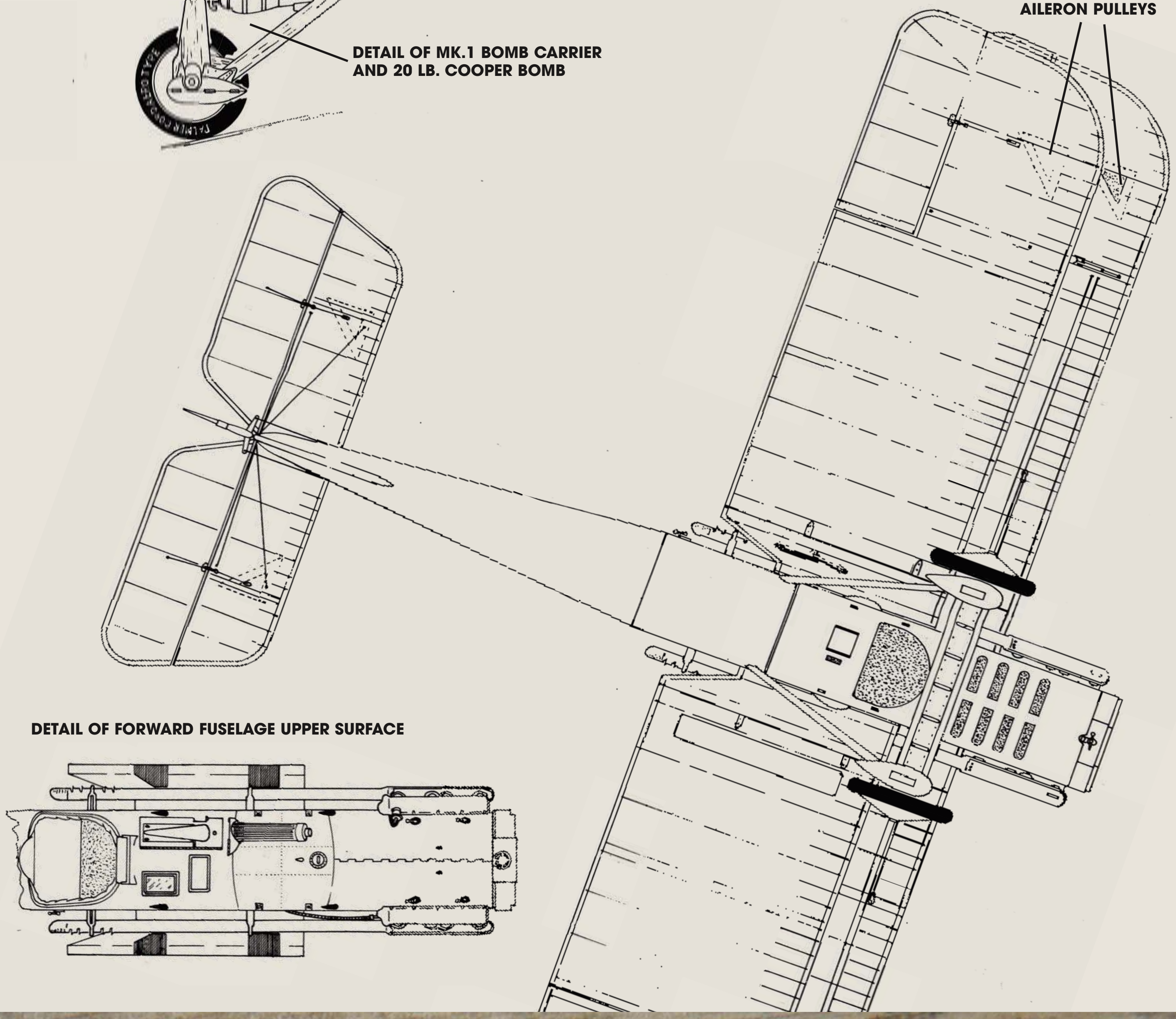
DETAIL OF WING INTERPLANE STRUTS

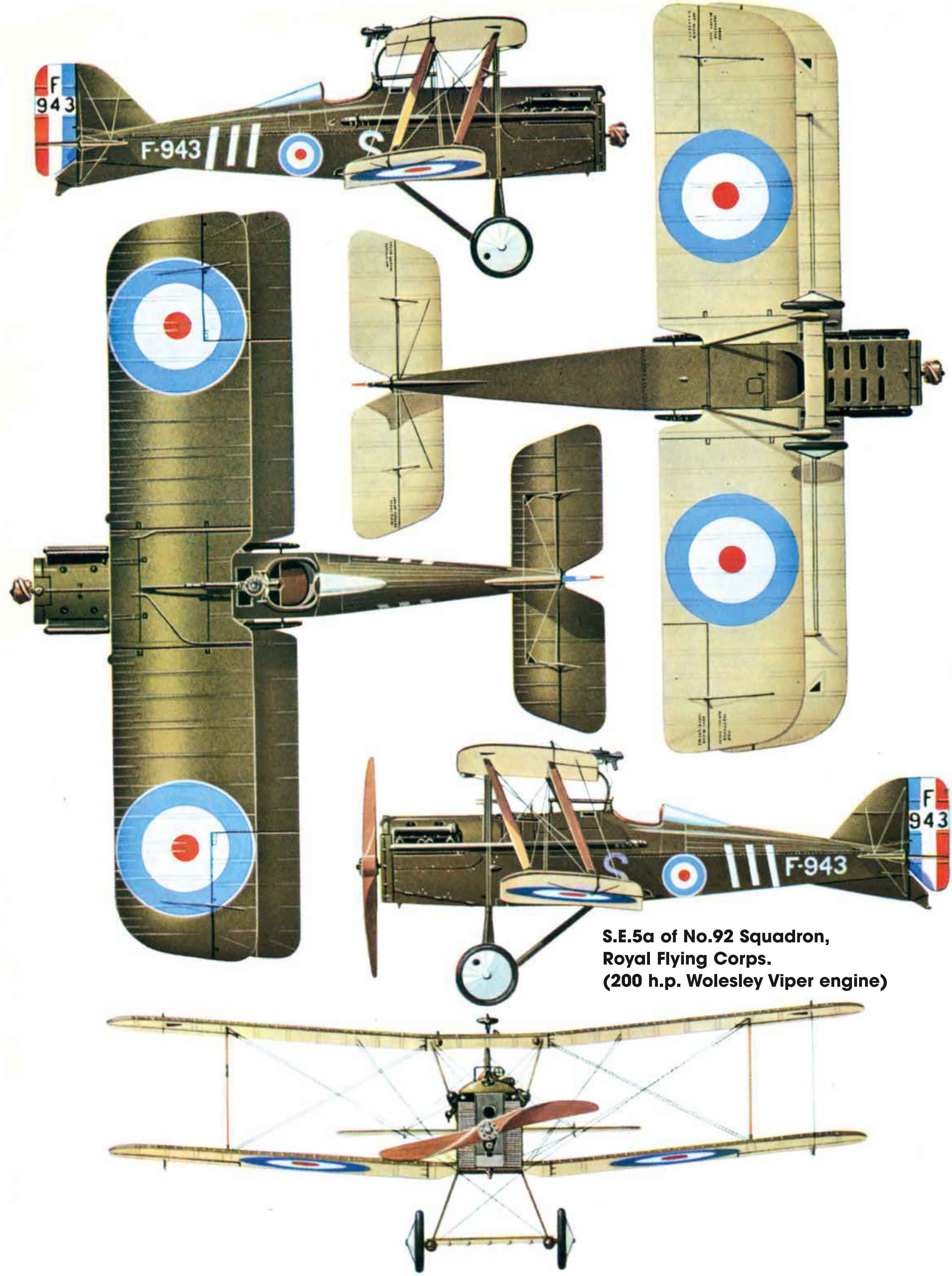


SCALE 1:40




DETAIL OF MK.1 BOMB CARRIER
AND 20 LB. COOPER BOMB

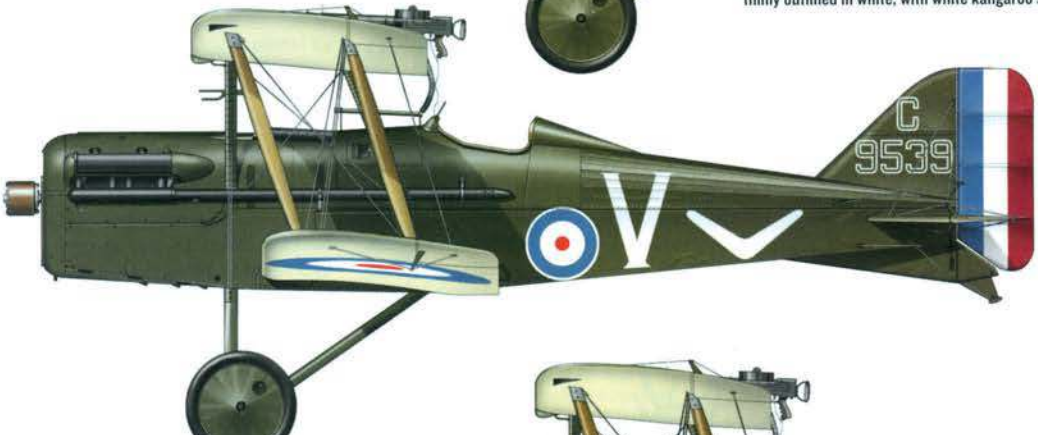

INSPECTION PANELS TO
AILERON PULLEYS
DETAIL OF FORWARD FUSELAGE UPPER SURFACE



S.E.5a of No.92 Squadron,
Royal Flying Corps.
(200 h.p. Wolesley Viper engine)

Above: S.E.5a (Hispano-Suiza), D276, flown by 'Mick' Mannock, No.74 Squadron RAF, France, April 1918. PC-10 overall except for undersides of wings and tailplane which are clear doped; white code, serial and bar on fuselage sides. 'A' repeated in white above top wing, to starboard of centre section, and in black below port wing, between roundel and wingtip

S.E.5a (Hispano-Suiza) D351/4, Australian Flying Corps, Minchinhampton. PC-10 overall with clear doped linen below wings, tailplane and underside of rear fuselage; red band, thinly outlined in white, with white kangaroo superimposed. Serial and code in white



S.E.5a (Hispano-Suiza), C9539/V, flown by Capt. H.G. Forrest (leader 'C' Flight), No.2 Squadron Royal Australian Flying Corps, Savy (France), March 1918. PC-10 overall with undersides of wings, tailplane and rear fuselage clear doped linen; all lettering in white

S.E.5a (Wolseley Viper), C1096/3, flown by Lt H.J. 'Hank' Burden, No.56 Squadron RAF, 1918. PC-10 overall with clear doped linen undersides of wings, tailplane and rear fuselage; all lettering in white (including 'Maybe?' on engine cowling). '3' repeated in white above top wing, inboard of starboard roundel, and in black (some sources quote blue) below starboard wing, inboard of roundel. Blue/white wheel covers; note shortened exhaust pipe

S.E.5a (Wolseley Viper), C1904/Z, No.85 Squadron RAF, St Omer (France), June 1918. PC-10 overall with clear doped linen undersides of wings, rear fuselage and tailplane; all markings and lettering in white. 'Z' repeated in white above top wing, inboard of staboard roundel

S.E.5a (Wolseley Viper), F943, No. 2 Squadron, France, 1918. PC-10 overall with clear doped linen undersides of wings, tailplane and rear fuselage; lettering and markings on fuselage in white. Serial repeated in black on rudder; white wheel covers and headrest fairing

S.E.5a (Wolseley Viper), E5750, No.84 Squadron, Bickendorff, summer 1919. PC-10 overall with clear doped linen undersides of wings, tailplane and rear fuselage; white markings flanking fuselage roundels. White serial on fuselage, black on fin (over white background)

Above: S.E.5a, F8038/15, flown by Lt Guy M. Baldwin, 25th Aero Squadron, United States Air Service, Toul (France), November 1918. PC-10 overall with clear doped linen undersides of wings and tailplane; white radiator frame, wheel covers, ventral and dorsal fins. White serial on fuselage, code and name 'Tunis' on nose; black serial on rudder. '15' repeated in black below lower port wing and in white above top wing, both inboard of roundels. Unit badge on both sides of fuselage (handed)

S.E.5a (Hispano-Suiza, four-bladed prop), 4th Corps Aviation Section, 1st Battle Air Group, Soviet Air Force (commanded by Ivan Pavlov), South-West Front, August 1920. PC-10 overall with clear doped linen below wings, rear fuselage and tailplane; red star markings in six positions over white disks. Red rudder with white marking over vertical tail surfaces; original RAF serial overpainted in a darker colour on fuselage sides

S.E.5a (Wolseley Viper), A2-33, Royal Australian Air Force, Point Cook, July 1926. Aluminium dope overall with roundels in six positions; black serial. Note wheel covers still in Khaki

S.E.5a (Wolseley Viper), 66/Maule, Chilean Air Force. Aluminium dope overall with polished natural metal engine panels; black lettering and radiator frame. Blue rudder with white star; national marking in four wing positions

S.E.5a, White 13, 94th Squadron (Pursuit), United States Air Service, Texas, 1920. PC-10 overall with clear doped linen undersides of wings and tailplane; red/white radiator sides and wheel covers. White code on fuselage sides; US star markings with white outline in six positions. 'Hat in Ring' emblem on a light blue patch on fuselage sides; note fairings removed from front mainwheel struts

S.E.5a, F8157/9, 95th Aero Squadron ('Kicking Mule'), United States Air Service, 1919. PC-10 overall with clear doped linen undersides to wings, tailplane and rear fuselage; white radiator frame, wheel covers, ventral and dorsal fins. Serial F.8157 in white on fuselage sides, repeated in black on rudder; white '9' on fuselage sides which appears to have been darkened roughly using either black or dark blue. Unit badge on both sides of fuselage

S.E.5a (180hp Wright Martin), AC-22-235/16 (unarmed training aircraft) United States Army Air Corps. PC-10 overall with Chrome Yellow wings, tailplane, dorsal and ventral fins; US national markings in four wing positions. Black lettering; blue/white/red striping on rudder

S.E.5a, 320, South African Air Force, 1921. Aluminium dope overall with black radiator front, wing struts and undercarriage legs; serial '320' in black. Wheel covers appear to be a dark grey

SE5a

The Shutleworth Collection's airworthy example is the subject of this detail study

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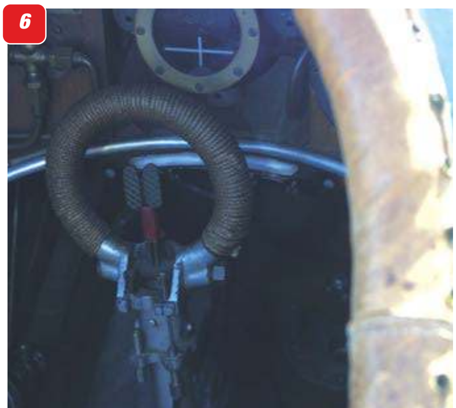

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1-6: Detal of the forward cockpit, showing instruments. Note that the cluster of four dials at the top of the panel are modern items installed by Shuttleworth.
7: The rudder bar in the cockpit floor.
8: Pilot seat and the starter magneto installed on the right fuselage side.
9: Rear cockpit left side, showing map pocket. **10:** Radiator drain tap at bottom of the radiator fron face. **11:** The nose undertray, showing the pull-release pins that hold it in place. **12:** Panel detail on side of nose section. **13:** Rear of rocker box cover on right side of engine bay.
14: Further view of the engine rocker-box on the right fuselage side. **15:** View of the upper engine cowl showing panel detail, also seen in **16**. Note the lack of close fit between the radiator and the front of the upper cowl cover behind it. **17:** View showing the full run of the long exhaust stack on the right fuselage side (left similar). **18:** The end of the exhaust stack, showing the shape of the exhaust orifices and the upper mounting bracket.
19: Further view of the exhaust stack end and the lower mounting bracket.

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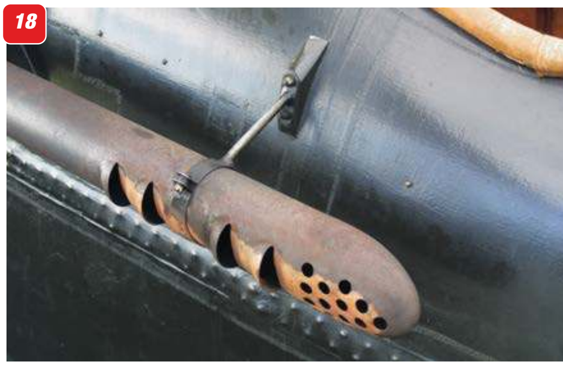

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20: The exhaust manifold mated to one bank of the engine cylinders, also reveals the shape of the rocker cover. **21:** The anchor points of the fin/tailplane bracing wires, showing the end-links at the rudder post end. Tailplane anchor points similar. **22:** Fin is anchored to the fuselage by metal brackets at base. **23:** Close-up of fin mounting bracket at fin leading edge. **24:** View over the top of the fuselage upper deck looking rearward from the nose. **25:** The opposite view looking forward from the cockpit position, shows the Vickers gun and upper fuselage metal panel detail. **26:** Upper fuselage ahead of the cockpit shopwing the filler cap to the main fuel tank. **27:** Detail of right fuselage upper decking, showing the windscreen and gun sight tube. The slightly warped panel nearest to the windscreen is clear-vision.

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28: Panel line detail on the left fuselage side level with the Vickers gun installation. **29:** More panel detail, further back. Note the fairing around the Vickers gun. **30:** Hinged hatch on tthe right fuselage side just behind the cockpit. **31:** More panel detail. Note also the binding on the cabane struts. **32:** The starter magneto winding handle on the right fuselage side, just below the cockpit coaming. **33:** Rear fuselage at the rudder post, showing the rudder horn and dual control cables. **34:** The cockpit step at the bottom of the left fuselage side. **35:** View rearwards on the right side reveals the somewhat irregular stitching to the fabric inspection panel that runs the length of the rear fuselage. **36:** The Underfin and the tailskid, which, unusually for a WW1 type, is steerable .

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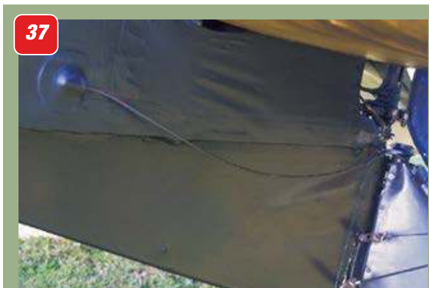

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37: Tailpost, viewed from ynder the tailplane **38:** The Lewis gun installation - gun slides back and down on curved rail. **39:** The gun sight tube, showing front mounting and panels. **40:** The rail for the Lewis gun mounting is secured to the upper wind centre section by two faired mounting blocks. **41:** Business end of the left fuselage mounted 0.303" calibre Lewis, fixed-mounted under fairing. Also shows the ring sight. and chamber mounted ring sight.

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42 & 43: Two views of the cockpit windscreen. Note also the anchor bracket to the Lewis gun rail. **44-47:** The radiator and propeller hub. Note that **46** shows the pulley type control to the radiator shutters. **48:** Upper engine cowling, with air gaps between panels. **49:** Radiator filler cap. Note the lack of fit between the radiator rear and the front of the cowl panel behind it. **50:** Anchor point for bracing wires at lower fuselage, just above rear undercarriage attachment. **51 & 52:** Fuel line from emergency tank in wing centre section. Note cabane strut binding. **53:** Cabane strut atttachment to wing upper centre section. **54:** Flying wire anchor, under upper wing.

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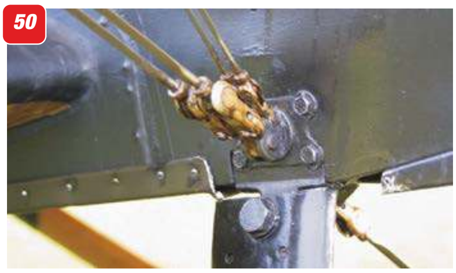

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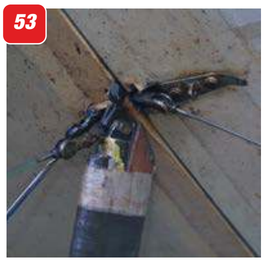

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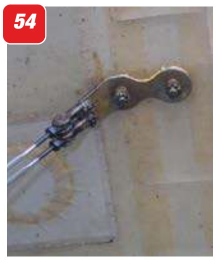

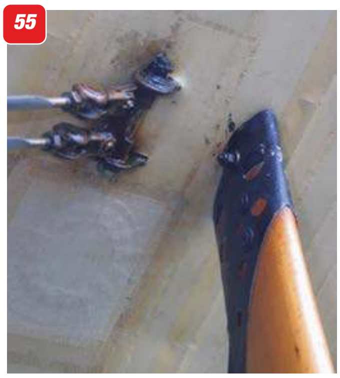

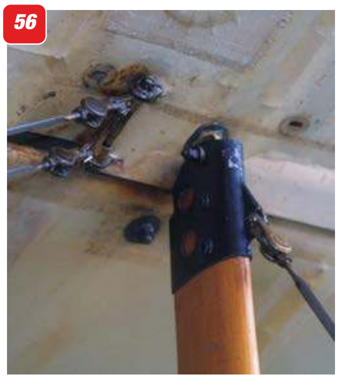

55: Front strut attachment under upper wing. 56: Rear strut anchor point under upper wing. 57: Centre section (cabane) struts. 58: Rea rinterplane strut anchor on lower wing. 59: Similar for front strut. 60: Pitot head. 61: The right side cabane struts. 62: General arrangement of interplane struts.

63: Anchor points for tailplane bracing. Note clear vision inspection panel to aileron cable pulley. 64: Elevator control wire run to elevator horn also showing clear inspection panel. 65: Simple metal elevator hinge. 66: Eleevator horn.

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69


67 & 68: Underside of tailplane and elevator, showing bracing wires and clear vision inspection panel. 69: Wing entre section inspection panel on Shuttleworth machine, non-standard. 70: Lower left wing centre section showing tread plates and bracing wire anchors. 71: Close up of rear tread plate at wing root. Note also the release tab for the wing panel. 72: Wing panel release tab on lower wing root underside. 73: Aileron, showing hinge line. 74: Lower centre section front tread plate and brace wire anchor point 75: Upper wing centre section showing the overflow pipes and the faired attachment points for the Lewis gun rail. 76: Clear vision panel, upper wing tip underside. 77 & 78: The steerable tail skid, also showing the bracing wires to the tailplane underside and the steering horn for the tailskid. 79: Lower wing underside, showing the aileron and the control horn.

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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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BE COOL!

NOTHING SPOILS A SCALE MODEL OF A FULL SIZE IN-LINE CYLINDER LIQUID COOLED ENGINED TYPE MORE THAN AN ENGINE CYLINDER HEAD 'OUT IN THE BREEZE'. BASIL LOCKWOOD-GOOSE DEVISED A SYSTEM TO KEEP A FULLY COWLED ENGINE COOLED

I have seen many superb scale models of 1930s and WW2 era fighter aircraft ruined by a protruding engine cylinder head and muffler and I was determined to avoid this disfigurement on any model that I attempted. In fact it is possible to completely 'bury' the engine yet provide adequate cooling, by determination, using ingenuity and by carefully planning an air ducting system prior to commencement of constructing the model and then building that ducting into the airframe as construction progresses. This has been achieved on scale models such as of the Hawker Hart

1: Spinner is used as a centrifuge to extract air out of the cowling. 2: View into the front of the cowl shows exhaust stack outlets which are made from metal tube and used for additional heated air extraction. 3: This view shows the rear induction, rear exhaust Webra 61 geared engine used on the Spitfire Mk.XIV model, mounted on the firewall fuselage former. Note the large hole that allows the cooling air, channelled forward to pass into the fuselage nose section. The engine has been fitted with a helicopter type heat sink clamped over the cylinder head as an aid to heat dissipation. Heat sink helps to keep the engine cool while the model is on the ground and before the ram-air takes effect as it moves forward. 4: Diagramatic view of the engine bay assembly prior to incorporation into the model, demonstrates the forward flow of the cooling air and counter-flow rearward. Tuned pipe exhaust is housed in a plywood tube and cooling air is extracted rearward past the pipe, to exhaust on the underside of the rear of the radiators. All possible inlet and outlet positions should be used and the inlet/outlet areas segregated and sealed as effectively as possible to minimise any cross flow.

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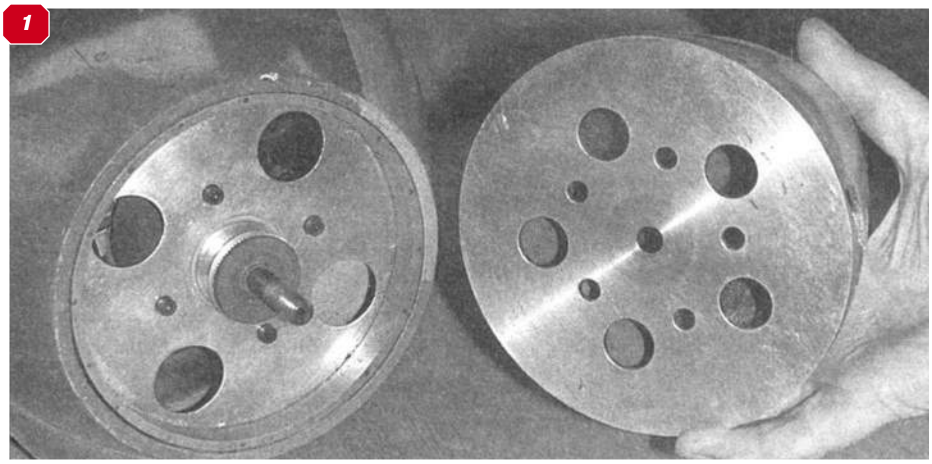

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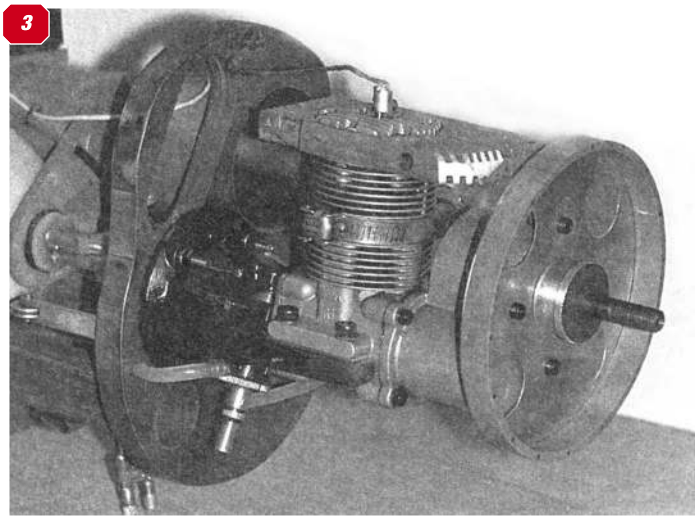

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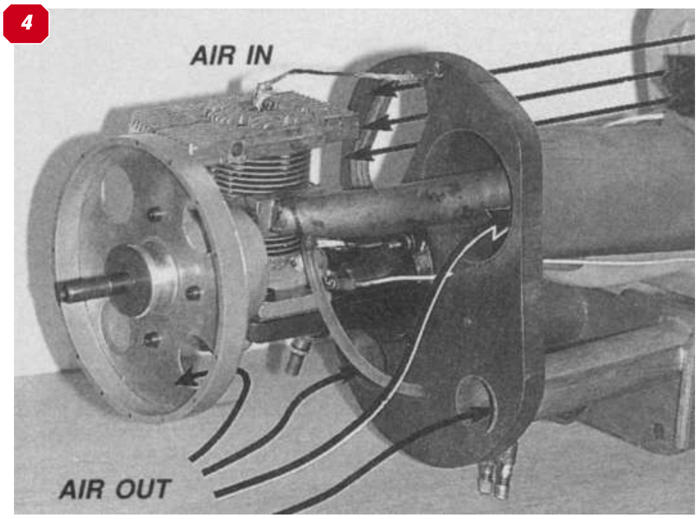
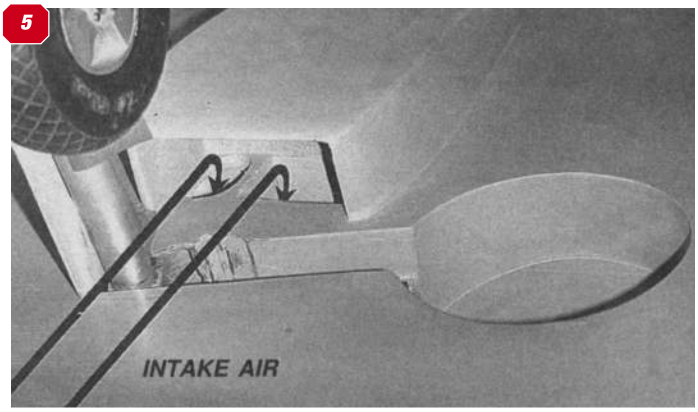
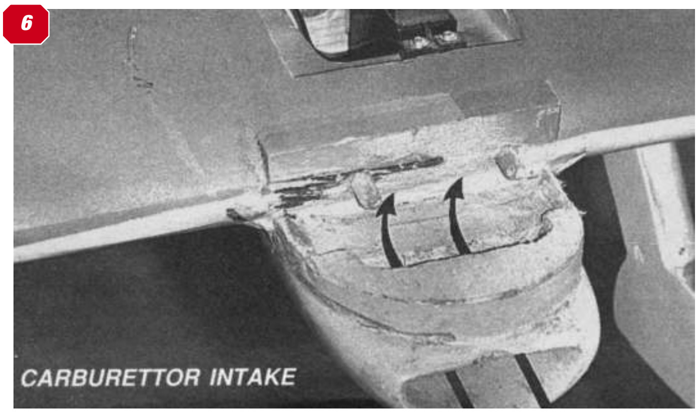






5: Underside view of the Spitfire wing demonstrating the intake flow of air at the front of one of the radiator air scoop. 6: Carburettor air intake scoops like this one on the Spitfire nose underside may be usefully used to supplement the intake of cooling air. 7 to 9: Wing ducts are divided with inlet air from radiators at the front and outlet air to the rear of the radiators (centrally divided with a baffle) behind the main spar. Note the electric retract motors on the illustration on the left. Rolled plywood tube cooling ducts are obvious, below, the airtight bulkhead dividing the inlet and outlet areas can also be seen.

and Fury, Supermarine Spitfire and Hawker Hurricane, which I have made.

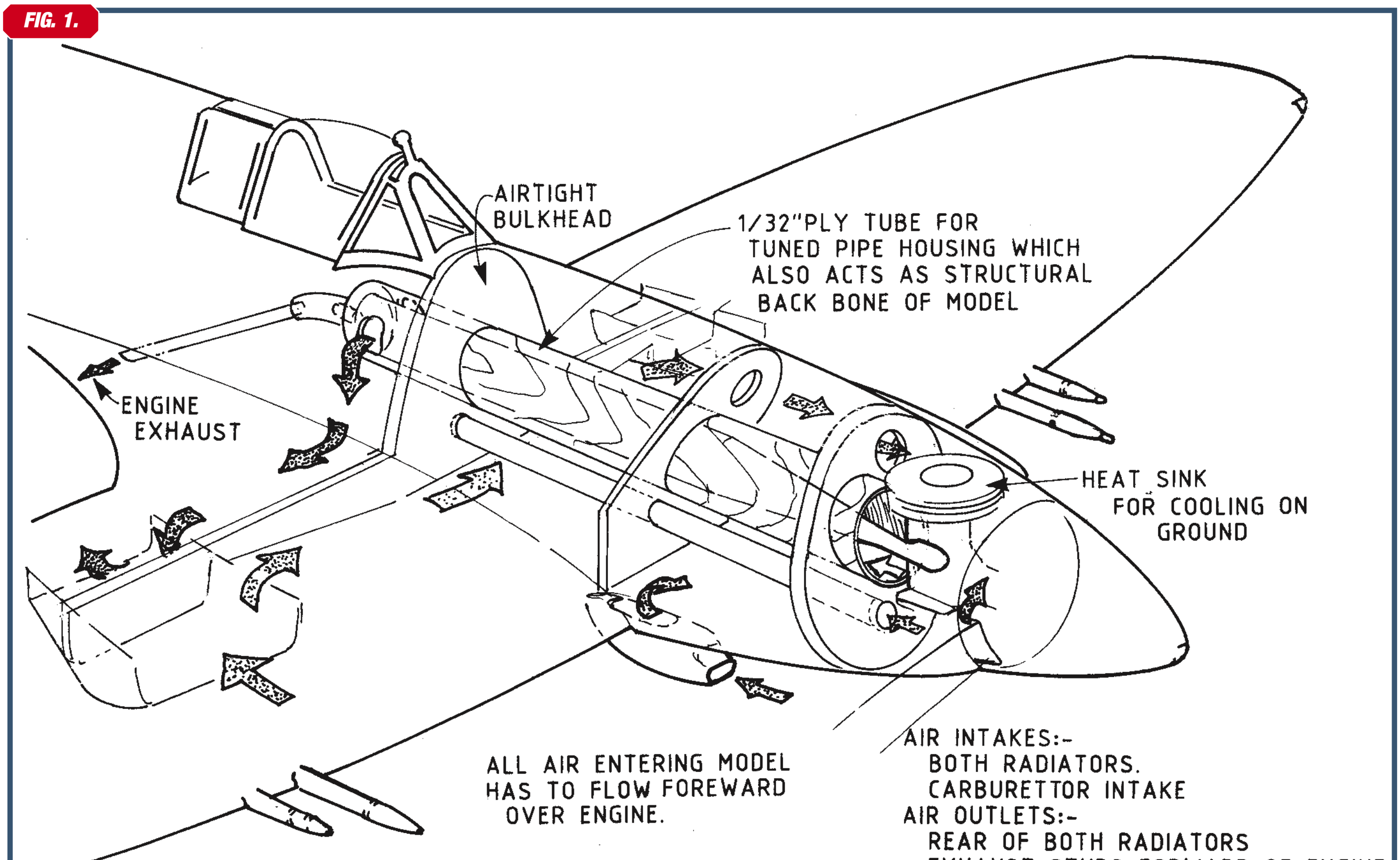
The secret of successful cooling is not only to get adequate air to the engine but, far more importantly to get the cooling flow of air efficiently around the engine and away. As air is warmed it expands and therefore requires more space; so as a general rule: -

1. Make sure that the air inlet area is at least equivalent to the frontal area of the engine cylinder.
2. Then, make sure that the air outlet area is 150% of the inlet area.

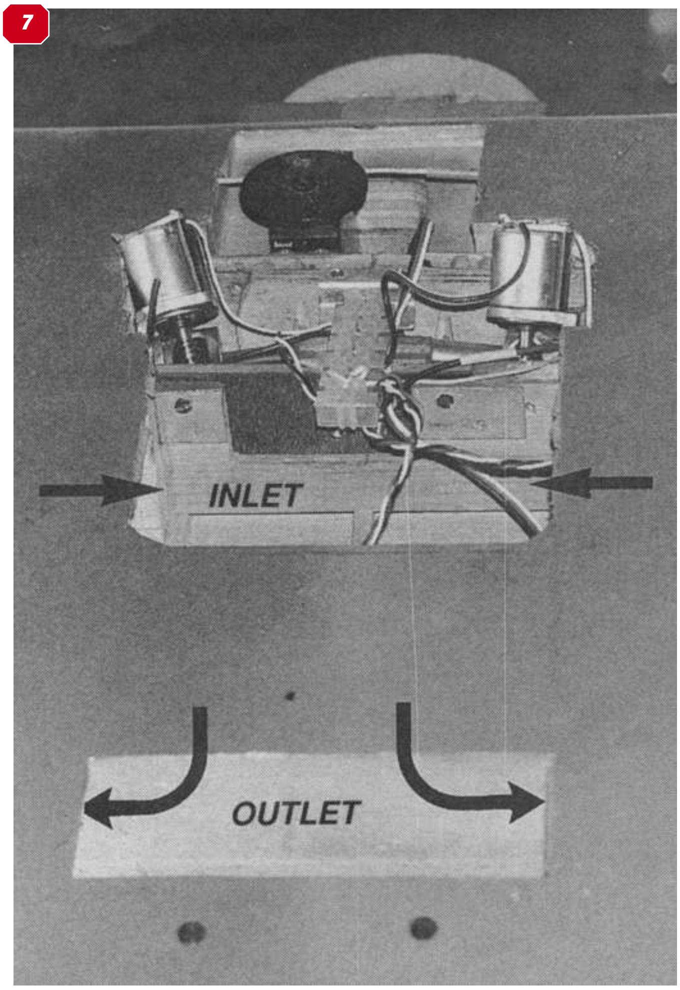
This is not difficult to achieve on models of aircraft that had liquid cooled engines, as the radiator and carburettor inlet area meet the first requirement and the radiator outlet, exhaust stubs and spinner outlet areas can be combined to meet the second requirement.

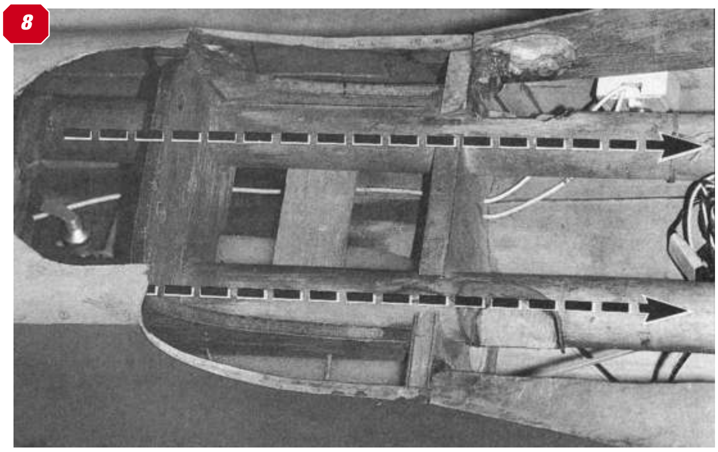
This method of cooling is particularly relevant if used in conjunction with a geared engine fitted with a tuned pipe. For the Spitfire and Hart I used geared Webra 61s and for the Hurricane the

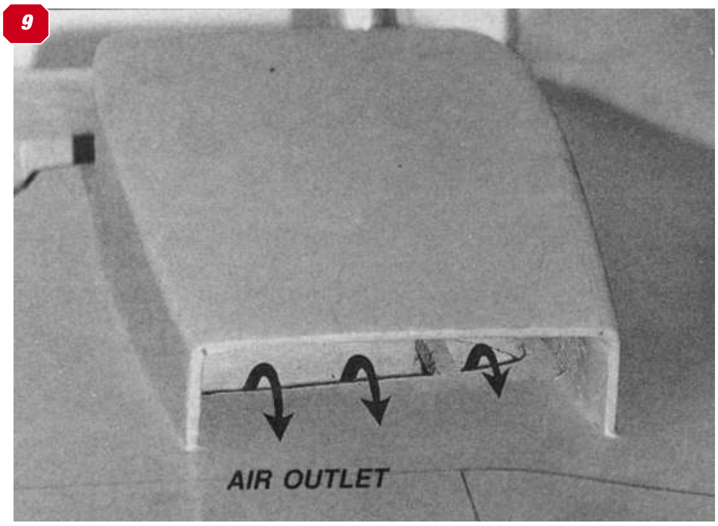
FIG. 1.



Diagrammatic view showing the principles of the 'reverse' cooling system where the cooling is brought forward from the radiators to the engine. Positions of radiators and ducts will vary with different aircraft types.





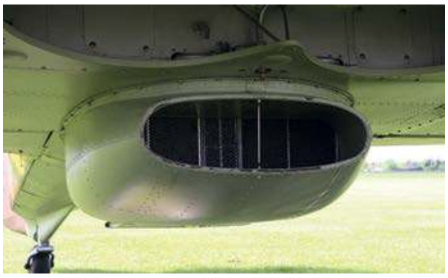


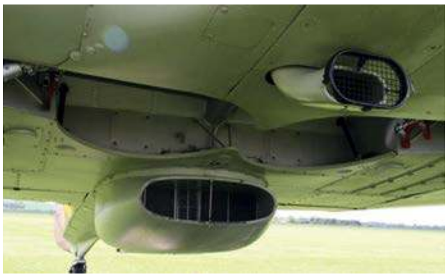
7-9: Wing ducts are divided with inlet air from radiators at the front and outlet air to the rear of the radiators (centrally divided with a baffle) behind the main spar. Note the electric retract motors on the illustration on the left. Rolled plywood tube cooling ducts are obvious, below, the airtight bulkhead dividing the inlet and outlet areas can also be seen.

superb geared O.S. 61.

The geared engine gives a double advantage of being able to use a larger and more efficient propeller and also makes for easy installation because of the high propeller shaft line. A heat sink head is used on the engine to assist cooling whilst the model is on the ground, when ram air is not great. In the air, always a cool sweet running engine. ■

From the Mk.IX onward, Supermarine Spitfires had two large radiators mounted one under each wing which could be used as airscoops/ warm air outlet ducts as illustrated in Fig.1. The centrally mounted nose underside mounted carburettor air intake can also be used for air ducting.





The Hawker Hurricane had one large fuselage-mounted radiator installed on the centreline on the wing underside. Front and rear views here illustrate the front intake and the rear air outlet. Doubtful if the rather small centreline carburettor intake scoop, forward of the radiator, would be worth adapting for cooling purpose. Much effort for little gain!

SLIPPING THE SURLY BONDS OF EARTH.

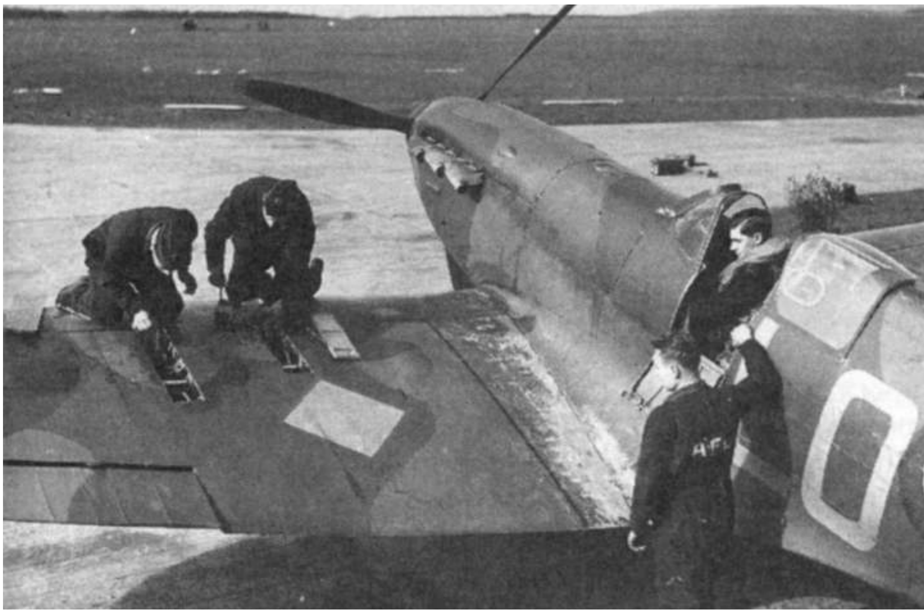
A 'Vic' of three Mk.1 Spitfires formate between a low cloud base and a much higher cloud formation as they curve past the camera lens somehow affected by the sun's rays. Shutter speed has almost 'stopped' the two-blade propellers which indicates these as very early Spits.

SUPERMARINE SPITFIRE

MKs I & II

Through 24 variants by the end of which it was, both in airframe structure and shape, an entirely different aeroplane, the first two define the classic Spitfire shape and arguably the prettiest

Early Mk.1s on the final assembly line on Supermarine's Eastleigh, Southampton production line. So close to the U.K. south coast, this factory received early attention from the Luftwaffe, after the debacle in France, in June 1940.



Armourers at work rearming a Mk.1. Worth noting here is the diamond shaped gas-warning panel on the wing and also the early flat-sided cockpit canopy side panels. Judging by the well-worn pain finish at the wing root, the aircraft had seen a lot of work.

By the early 1930s, the comfortable sense of security and the expectation of undisturbed peace that characterised the 1920s decade was rapidly disappearing. The first rumblings of the coming storm came from the Far East where the Japanese military aggression in Manchuria, then into China, soon flamed into a regular war.

The shock of the Japanese action was still echoing in the British press when, in July 1932, the Nazi party achieved their biggest election success, becoming the largest political force in the Reichstag and thus an obvious influential component of subsequent German governments. In only six months, on 30th January 1933, Adolf Hitler was sworn in as Chancellor leading rapidly to the establishment of a system of dictatorship and totalitarian control in Germany.

In the face of all this meanwhile, the League of Nations Disarmament Conferences that dragged on from 1932 to 1934 finally broke up, leaving participating governments to face an uncertain future and a general movement toward strengthening defenses albeit, at first, halting.

In Great Britain the Royal Air Force was, in both numerical and equipment terms, in a parlous state. Nevertheless, among those of talent in both the British aviation industry and in R.A.F. higher command, there was an awareness of the need for fighter aircraft of performance beyond what could be expected from four wing panels and a couple of machine guns, and such luminaries were at the forefront of specifying new aircraft within the bounds of what was possible, given the financial restrictions of the day.

BENT WINGS AND BAGGY TROUSERS

A new 'wish-list' for a fighter requirement for the R.A.F. became cristallised in Air Ministry specification F.7/30, issued to the aircraft industry toward the end of 1931. This envisaged a day and night fighter with a maximum speed of 250 mph, carrying an armament of four machine guns. The Rolls Royce Goshawk V-12 air-cooled engine was envisaged to power the aircraft.

Unsurprisingly, at a time when military aircraft procurement numbers were fairly close to that of hens' teeth there were wide ranging tenders among British aircraft manufacturers; Blackburns with their F.3, Bristol Aircraft's Type 123, Gloster's F5/34 and Westlands's PV-4. All were biplanes.

At the Supermarine Aviation Works, newly absorbed into the Vickers-Armstrong industrial conglomerate, chief designer Reginald J. Mitchell had gained a wealth of knowledge and experience of high performance aircraft design as head of the team that created the Supermarine S.4, S5, S.6 and S.6B series of high-speed floatplanes which, between 1927 and 1931 dominated the Schneider Trophy Race series. Mitchell's proposal for Spec F.7/30 was the Supermarine Type 224, a monoplane with low, 'inverted gull' wing, open cockpit and a shape dominated by a fixed undercarriage enclosed in bulky trouser fairings.

Looking rather more 'modern' than competitor proposals, the Type 224, nonetheless failed to deliver the anticipated performance when, after lengthy delays, it flew for the first time February 1934.

All five of the Spec F.7/30 proposals received a prototype contract from which Gloster's SS.37 design, received the production order, to become, as the Gladiator, the RAF's last biplane fighter.

BACK TO THE DRAWING BOARD

Supermarine's Type 224 was unsuccessful mainly due to the tightly drawn specification that required use of the Rolls Royce Goshawk 600 hp steam cooled engine, but even before the Type 224 flew, Mitchell had already initiated further design studies based on experience with Supermarine's Schneider Trophy aircraft which, by stages, led to incorporation of enclosed cockpit, retracting main undercarriage and, finally, the Rolls Royce's private venture PV-12 liquid cooled engine that was also an extension of the engine development progress gained from involvement with the Schneider Trophy events and which became the Merlin.

By then, the R.A.F had revised its fighter requirements, all of which Mitchell's design projections exceeded in the Supermarine Type 300, a nice round number for one of aviation's most iconic aircraft, the Spitfire.

FROM PROTOTYPE TO PRODUCTION

Thus, on 1 December 1934, the Air Ministry issued contract AM 361140/34, providing £10,000 for the construction of Mitchell's further refined Type 300, design, formalised the following month in a contract with a new specification, F10/35, written around the aircraft.

On 5 March 1936, the prototype (K5054) took off on its first flight from Eastleigh Aerodrome (later Southampton Airport). At the controls was Captain Joseph 'Mutt'

QJ-S serial R6923 was one of the earliest Mk.1 Spitfires converted to twin 20mm Hispano cannon armament, retaining four 0.303" machine guns.

Summers, chief test pilot for Vickers who, upon landing the aircraft, is quoted as saying *"...don't touch anything..."*.

This eight-minute flight came four months after the maiden flight of the contemporary Hawker Hurricane and on March 10th Summers was airborne again in K5054 equipped with a new propeller for a first flight with undercarriage retracted. Top speed attained then, was just 330 mph which was little faster that the prototype Hurricane, but two months later, with a further propeller substitution, the figure was raised to 348 mph.

A month before K5054's first test flights, the parent company Vickers-Armstrong had guaranteed production of five aircraft a week, beginning 15 months after an order was placed and in June that year, the Air Ministry placed an order for 310 aircraft, at a cost of £1,395,000 (£4,500 apiece).

Full-scale production was supposed to begin immediately, but numerous problems ensued. Supermarine was a small company, already busy building Walrus and Stranraer flying boats, and parent group Vickers was busy building Wellington bombers, so the Spitfire order clearly could not be completed in the 15 months promised and the first production Spitfire, K9787, did not roll off the Woolston, Southampton assembly line until mid-1938.

To get things moving, the initial solution was to subcontract the work, but although outside contractors were supposed to be involved in manufacturing many important Spitfire components, especially the wings, Vickers-Armstrong was reluctant to see the Spitfire being manufactured by outside concerns, and was slow to release the necessary blueprints and sub-contracts.

As a result of the delays in getting the Spitfire into full production, the Air Ministry put forward a plan that Spitfire production be stopped after the initial order for 310, after which Supermarine would build Bristol Beaufighters. However, the managements at Supermarine and Vickers were able to convince the Air Ministry that production problems could be overcome and a further order was placed for 200 Spitfires on 24 March 1938.

Thus it was not until mid-1938 that the first production Spitfire rolled off the assembly line, almost 24 months after the initial order. The final cost of the first 310 aircraft, after delays and increased program costs, came to £1,870,242, more than £1,500 per aircraft than originally estimated - a 34% overrun!

THE CASTLE BROMWICH EXPERIENCE

As far back as 1935, the Air Ministry had approached Morris Motors Ltd to ask how quickly their Cowley, Oxfordshire plant could be turned to aircraft production and the following year, that general enquiry was formalized into what became the Shadow Factory Plan, to boost British aircraft production capacity by building

nine new factories, and to supplement the British car manufacturing industry by either adding to overall capacity or increasing the potential for reorganisation to produce aircraft and their engines.

In 1938, construction began on the Castle Bromwich Aircraft Factory at Solihull next to the airfield. Such was the urgency that Installation of manufacturing wherewithal began only two months after work started on the site and although Morris Motors, under Lord Nuffield, managed and equipped the factory, it was government funded. Even as the first Spitfires were being built there in June 1940, the factory was still incomplete, and suffering from personnel problems. The Spitfire's stressed-skin construction required precision engineering skills and techniques that were beyond the capabilities of the local labour force, and some time was required for retraining.

Difficulties were also created by management, who ignored Supermarine's tooling and drawings in favour of their own working practises and technique, while the workforce continually threatened strikes or "go-slows" until their demands for higher wages were met.

In spite of promises that the factory would be producing 60 per week starting in April, by May 1940 Castle Bromwich had not yet built its first Spitfire, prompting the Minister of Aircraft Production, Lord Beaverbrook, to summarily take control of the Castle Bromwich plant under his Ministry, immediately sending in experienced management staff and workers from Supermarine, with administration of the factory delegated to Vickers-Armstrong.

SPITFIRE FORERUNNER.
The Rolls Royce Goshawk II powered Supermarine Type 224 heading to the New Type parking area during the 1934 R.A.F. Display at Hendon on June 30th. The biplane with the 'gull' shaped upper wing following in the background is the Westland F.7/30, also making its first public appearance at the event.

While resolving the problems took time, by June 1940, ten Mk.II Spitfires were built; 23 rolled out in July, 37 in August, and 56 in September. The shake-up clearly worked because by the time production ended at Castle Bromwich in June 1945, a total of 12,129 Spitfires of all marks from the Mk.II onward had been built, at a maximum rate of 320 per month, making CBAF the largest Spitfire factory in the UK and the largest and most successful plant of its type during the 1939-45 conflict. That's just short of 60% of all Spitfires, of all marques built!

INTO SERVICE

The very first Spitfire Mk.Is off the production line were little different from the prototype, fitted wit the original flat top, flat side paneled style cockpit canopy and with fixed pitch two blade wooden propellers. The prototype's semi circular lower ends of the undercarriage fairings that assumed a horizontal position with the legs lowered, were deleted, the engine exhaust manifolds were revised, and it was in that state that No.19 Squadron based at Duxford, near Cambridge received the first of the type on August 4th 1938, followed two weeks later by another.

The trickle continued, but No.19 Sqn. did not have a full complement until December, a clear indication of production difficulties

Previously, No.19 had been equipped with the Gloster Gauntlet that delivered a top speed of just 220 mph, so that the squadron went from flying the slowest front line type in Fighter Command, to the fastest, in on leap!

Once the initial production difficulties began to be alleviated, supply of Mk.1 Spitfires gathered pace, so that by the outbreak of WW2 in September 1939, nine squadrons of Fighter Command were fully so equipped, with another two working up.

Further performance improvement

SPITFIRES ON PARADE!
A total of sixteen Mk.1 Spitfires at Fighter Comand11Group airfield R.A.F. Hornchurch on June 8th 1939. All have three-blade de Havilland twin-pitch propellers.

coincided with the 175th aircraft with Rolls Royce Merlin III installed, to which either de Havilland or Rotol three blade constant speed airscrews could be applied and de Havilland service engineers installed the new propeller units to aircraft in service, moving from airfield to airfield.

FIRST COMBAT

Shortly after the declaration of war in September 1939, the British Expeditionary Force, with its Air Component was established in France. But the fighter aircraft complement was made up largely of Hawker Hurricanes, which were better suited to the primitive servicing facilities and poor airfield conditions in France with which the wide-track Hurricane undercarriage could better cope. Thus, Spitfires were reserved for home defense.

Only six weeks later though Spitfire Mk.1s of Nos.602 and 603 Auxilliary Air Force Squadrons based at Drem, East Lothian, in Scotland were scrambled to intercept an incoming raid of Junkers Ju88 bombers heading for the naval anchorage in the First of Forth. Each Squadron downrd one of the attackers which fell into the sea.

Ten days later, aircraft of the same squadrons were vectored to 'trade' consisting of Heinkel He 111s, one of which became the first Luftwaffe aircraft to fall on British soil.

CANNON ARMAMENT AND THE SPITFIRE MK.II

From the outset, the firepower of the Mk.I Spitfire had been a battery of eight wing mounted Browning 0.303" caliber machine guns, but the possibility of alternative firepower

THE HIGH SPEED SPITFIRE.
Mk.1 K9834 was modified as Supermarine N.17 for a prospective world speed record attempt. The airframe was 'cleaned up, with a modified cockpit canopy, special 2,160 hp Rolls Royce Merlin III engine driving a four blade propeller, enlarged radiator intake and carefully surface-filled skin panels. However, the required performance was not achieved and the aircraft was rebuilt to Mk.II photoreconnaissance standard and camouflage overpainted, through which the gold-coloured fuselage flash eventually showed.

A Spitfire Mk.1 with Rotol three-blade propeller and with an early flat sided cockpit canopy.

ROYAL INSPECTION.
King Edward VIII (standing on wing) inspects Spitfire prototype K5054 at the Aeroplane & Armament Experimental Establishment, Martlesham Heath, Suffolk. Given that the first flight of K5054 took place on March 5th 1936, and that the King abdicated on December 11th, the visit must have been sometime during the summer of that year.

BAGS OF SWANK LADS!

Formation of No.65 Squadron Mk.1 Spitfires. FZ-I in the foreground is flown by Ace-to-be Robert Stanford Tuck.

was also considered, including a battery of six 0.5" machine guns, or cannon.

The light caliber explosive-round automatic cannon was in fact nothing new, having been first developed in Germany as a 20mm weapon for aircraft installation as far back as the WW1 years, and by the 1930s the concept had been further developed by others including the Swiss Oelikon Company and also the Spanish/Swiss/French Hispano Suiza group.

By 1939, the Luftwaffe already had their Messerschmitt Bf109 with two 20mm MG FF cannon (a development of the Oerlikon), wing mounted outside the propeller arc. Cannon installation in Spitfire wings had been under consideration as far back as 1936, with Supermarine receiving instruction to prepare an installation design at the end of 1938. The 5th production Mk.1 was duly used as a mock-up trials airframe, while a further aircraft received a 'live' installation of two cannon, one in each wing in place of the eight machine guns.

This Spitfire was then passed around various trails establishments from March 1939 onward until taken on charge for operation trials at Drem, Scotland, where on January 13th, Pilot Officer Proudman attacked and downed a Heinkel He 111 with 43 rounds out of 120 (60 round per gun) before the guns jammed.

Before then, Supermarine had already received instruction for conversion of 30 Spitfires to a configuration of two cannon, replacing the eight machine guns and by July 1940 No.19 Squadron at Duxford became fully equipped with cannon armed Spitfires and others went to front line Squadrons from August onward. But there was no great success with this early cannon armament when, as pilots moved in for the kill, their cannon jammed solid after just a few rounds had been fired.

Further work to cure the problem led to structural stiffening of the wing and a composite two cannon/four 0.303 machine gun armament with the two cannon inboard, and this configuration became the 'B-wing', which greatly reduced the stoppages. Retrospectively, wings with eight Browning machine guns became the 'A-wing'.

The Spitfire Mk.II was, effectively a collective upgrading of all the piecemeal improvements, revisions and additions that had been applied to the basic Mk.1 during the time from the type's first introduction to service and its 'finest hour' of those tense, momentous months in the summer and autumn of 1940.

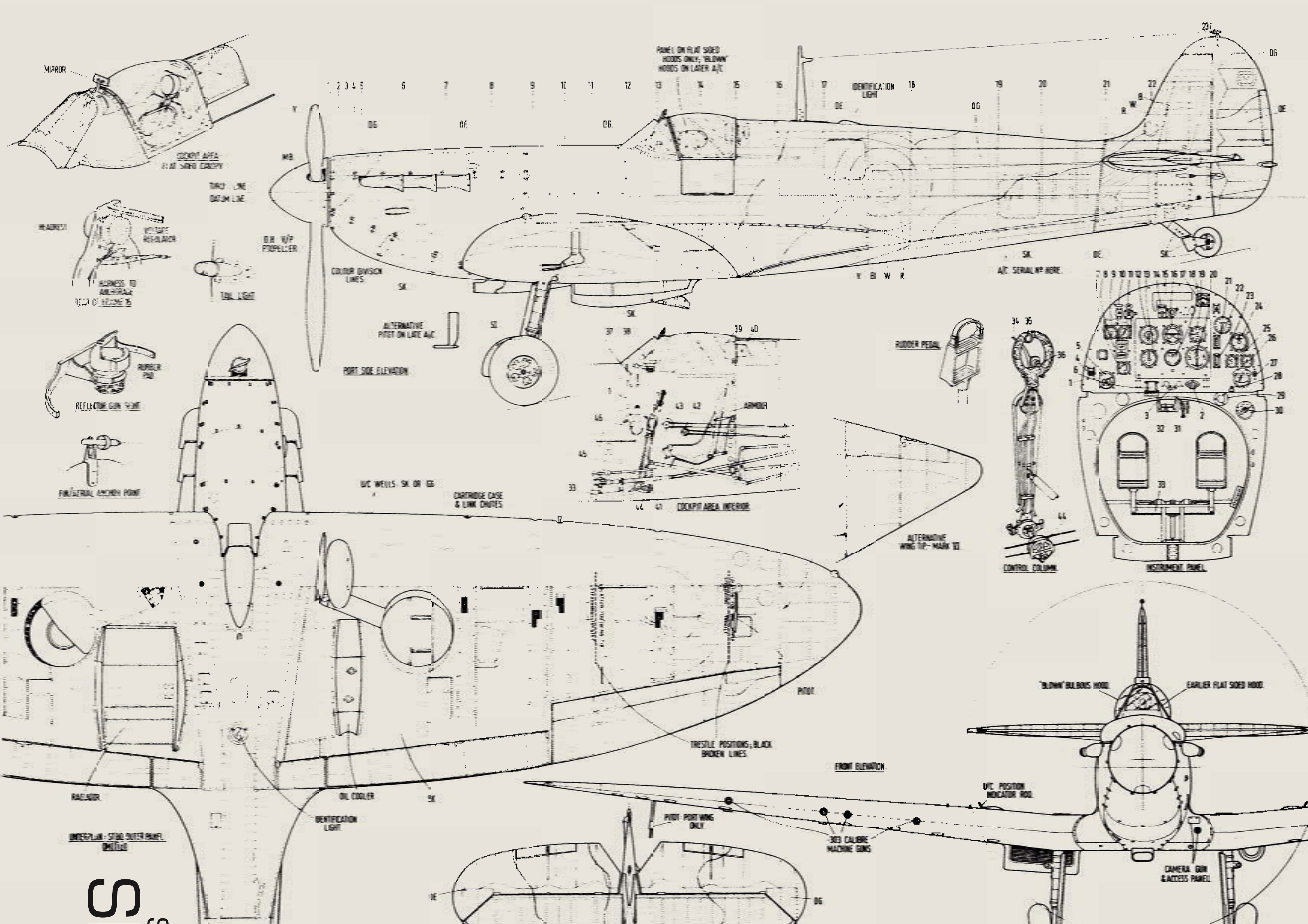
The Mk.II had the more powerful 1,175 hp. Merlin XII engine fitted, with a Coffman starter and ran on 100-octane fuel, incorporating as standard those additions often hurriedly applied to the Mk.Is at their airfields such as armoured windscreen and 73 lbs of armour plate protection behind the pilot's seat and headrest, plus vital forward fuselage protection for the coolant header tank and top fuel tank.

No.611 Squadron at Digby received its first Spitfire Mk.IIs in August 1940, in time for the Battle of Britain.

The Mk.II, produced in relatively small numbers by 'Spitfire standards' overall, was a product entirely of the Castle Bromwich factory which turned out a total of 920, the larger proportion of which, 750, were Mk.IIa. ■

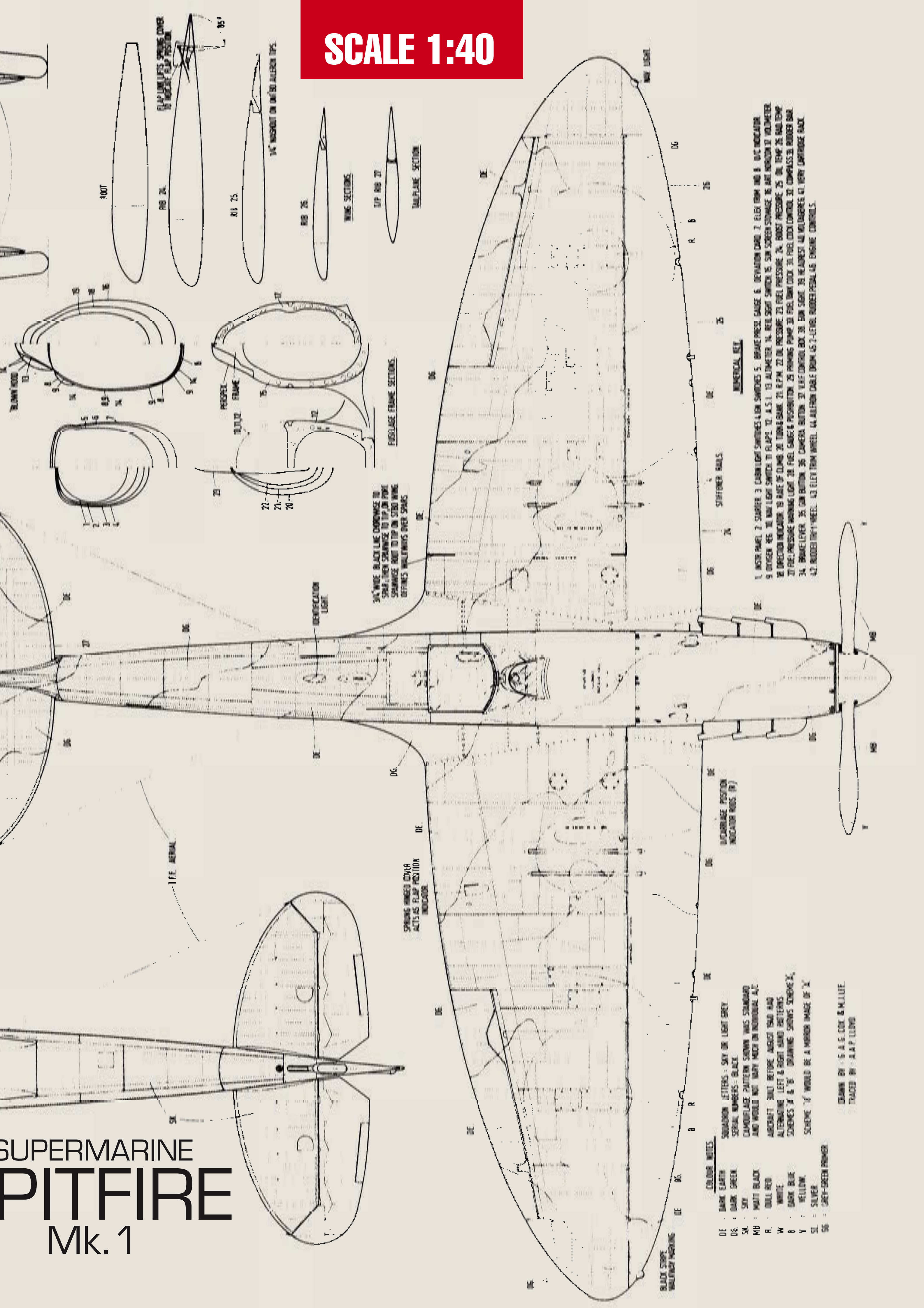
POSERS!

First to receive the Spitfire was No.19 Squadron at Duxford, the first of a trickle arriving in early 1939 August. This eleven aircraft line-up is seen at home-base on May 4th 1939. The one foreground has the domed cockpit canopy, but the rest seem all to have the original flat top.



MIRROR
COCKPIT AREA FLAT SIDED CANOPY
THRU LINE
DATUM LINE
HEADREST
VOLTAGE REGULATOR
HARNESS TO AIRFRAME
TAIL LIGHT
D.H. V/P PROPELLER
COLOUR DIVISION LINES
PANEL ON FLAT SIDED HOODS ONLY; 'BLOWN' HOODS ON LATER A/C
IDENTIFICATION LIGHT
A/C SERIAL Nº HERE.
Y B W R
ALTERNATIVE PITOT ON LATE A/C
PORT SIDE ELEVATION
RUDDER PAD
REFLECTOR GUN SIGHT
RUDDER PEDAL
ARMOUR
COCKPIT AREA INTERIOR
FIN/AERIAL ANCHOR POINT
U/C WELLS - SK OR GG
CARTRIDGE CASE & LINK CHUTES
ALTERNATIVE WING TIP - MARK III
CONTROL COLUMN
INSTRUMENT PANEL
PITOT
TRESTLE POSITIONS; BLACK BROKEN LINES.
FRONT ELEVATION.
'BLOWN' BULBOUS HOOD.
EARLIER FLAT SIDED HOOD.
RADIATOR
OIL COOLER
IDENTIFICATION LIGHT
UNDERPLAN - STBD OUTER PANEL OMITTED
PITOT - PORT WING ONLY
·303 CALIBRE MACHINE GUNS
U/C POSITION INDICATOR ROD.
CAMERA GUN & ACCESS PANEL

SCALE 1:40



SUPERMARINE SPITFIRE Mk. 1

SUPERMARINE SPITFIRE MK.1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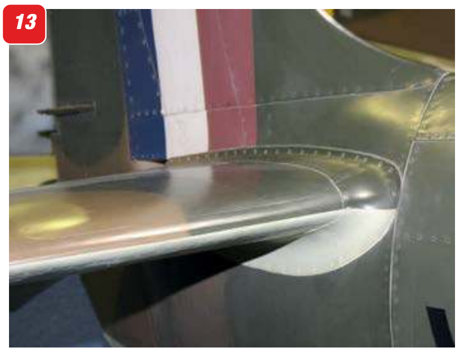
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1-4: Cockpit canopy and front windscreen. The canopy on this example of the Mk.1 Spitfire is the 'full blown' style with 'balooned' sides, so is not really repesentative of the Mk.1. **5-9:** The shape of the exhaust manifolds. **10 & 11:** The tailplane and elevator, showing the cuffed hange line. **12:** Elevator trim tap and faired drive rod. **13:** Tailplane-to fuselage join, showing the pressed metal fairing panel. **14:** Rudder horn and drive rod (left side only), also showing the tail light. **15:** Fuselage access panel, lower fuselage, just ahead of the tailplane.


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16 & 17: Two views of the main undercarriage wells. Note the stiffeners. **18:** Wing underside, showing access panels to the guns and the spent rounds exits. **19:** Rearward view of the fuselage/wingroot underside. Note the "gull' shape of the fairing panel at the wing trailing edge. **20:** Fin and rudder. Tapes and stitching to the fabric of the rudder are prominent, also seen in **21**. **22:** The rudder trim tab and drive, right side only. **23:** Carburettor air intake, placed at the wing/fuselage underside centre line. **25 & 26:** The radiator, right wing underside. **27:** Further view of the radiator, from the rear. Note also the prominent "gull' shape of the wing-to-fuselage fairing trailing edge.

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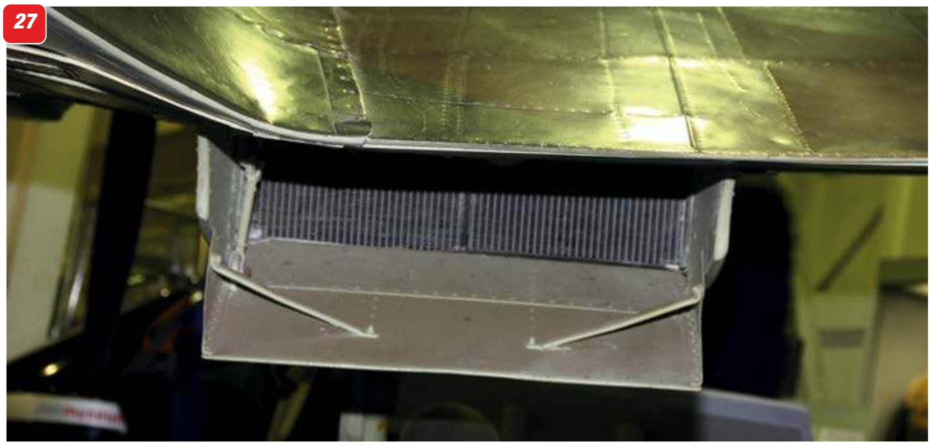
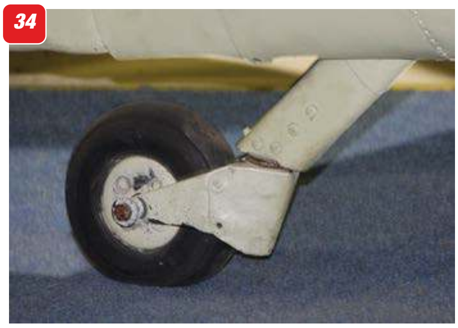


28: Nose section and spinner. Someone should point out to the RAF Museum, Hendon, that few Spifires ever went into combat with a spinner held in place by Duck Tape!

29 - 31: Deails of surface panelling on the nose section.

32 & 33: Nose section underside, again a glorious advert for Duck Tape!

34 & 35: Two views of the non-retractable, castoring tailwheel.



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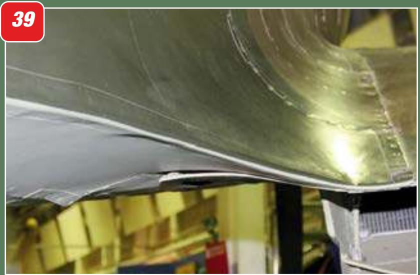

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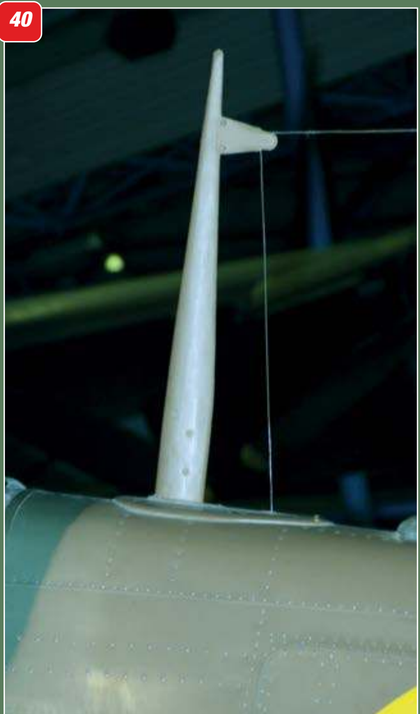

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36: The cockpit access door, left fuselage side only. **37:** Close-up of the door, showing the stowed crow bar provided to force exit if needed. **38:** The long leading-edge-to-trailing-edge wing-to-fuselage fairing is a prominend feature of the Spitfire. **39:** The "gull" shape of the wing fairing at the trailing edge is a prominent feature that needs to be done correctly on a model. **40:** Radio mast just rear of the cockpit canopy. **41 & 42:** Main undercarriage and door fairings. **43 & 44:** Surface panel stiffeners on the wing upper sides of the left and right wing panels. **45:** Wing tip light. **46:** Surface panel detail, right wing leading edge. **47:** Detail of the cuffed aileron hinge line. **48:** Small pop-up hatch indicator on wing top surface to confirm flaps down.

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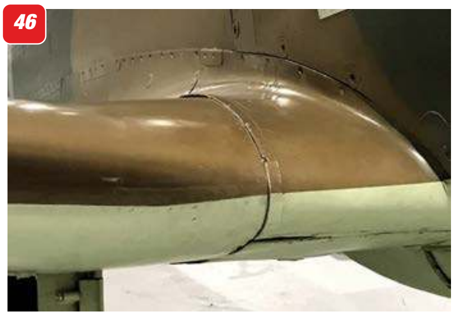

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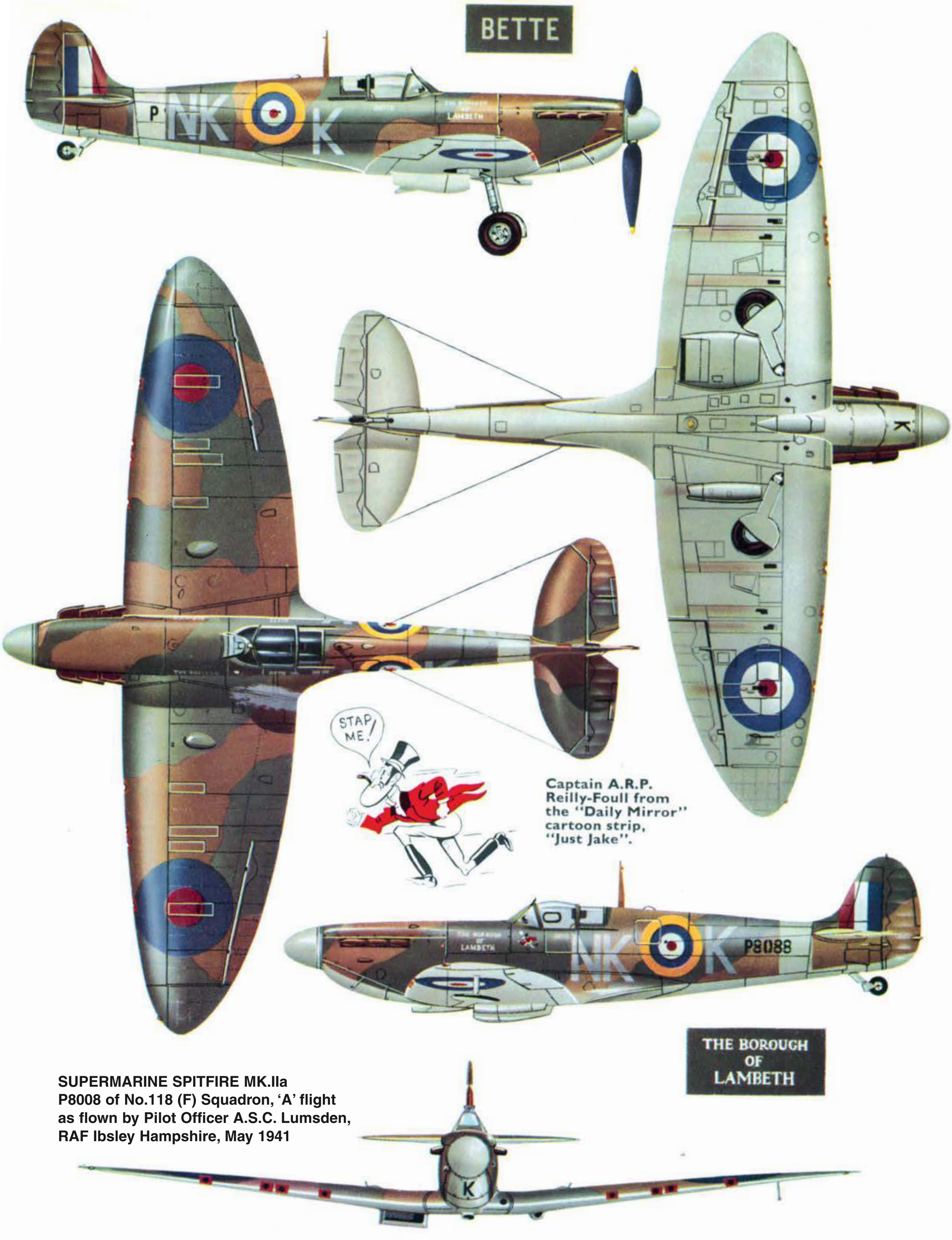
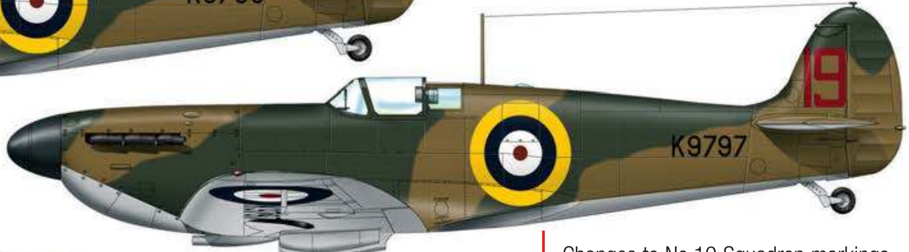


SUPERMARINE SPITFIRE MK.IIa
P8008 of No.118 (F) Squadron, 'A' flight
as flown by Pilot Officer A.S.C. Lumsden,
RAF Ibsley Hampshire, May 1941

SPITFIRE MK.1 & MK.IIA FLYING COLOURS

Spitfire Mk.1 K9789, the first delivered to No.19 Squadron, first to convert to the type August 1938. Undersides finished aluminium, remainder dark earth/dark green.



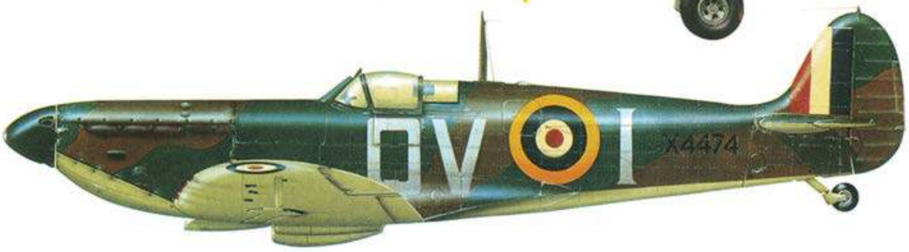
Changes to No.19 Squadron markings between September 1938 and mid-1939. Spitfire Mk.1.

Spitfire Mk.1 WZ-S of No.19 Squadron, Duxford. Undersides in matte Night (black)/white on centre-line left/right split with black to the left.

Spitfire Mk.1 K9987 of No.66 Squadron, Duxford, early 1939. Night/White undersides and standard dark earth/dark green top and side surfaces.

Spitfire Mk.1 SD-H of No.72 Squadron, Church Fenton 1939. Night/White (left/right)split finish undersurfaces.

Spitfire Mk.1 DW-K serial N3289 of No.610 (County of Chester) Squadron, operating from Biggin Hill in 1940. (Note: the ‘thumbnail’ detail ‘D’ is that which is obscured by the open cockpit entry door.



Spitfire Mk.1 QV-I serial X4474 of No.19 Squadron operating from Duxford, September 1940

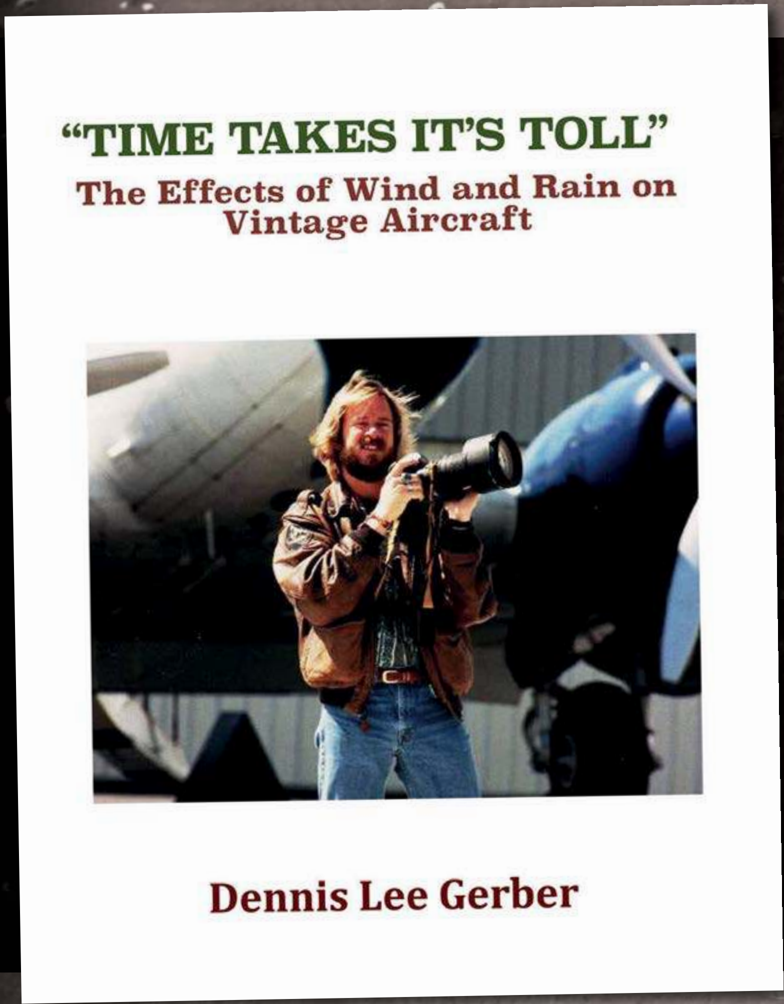
Spitfire Mk.1 AZ-H serial N3277 of No.334 Squadron operating from Middle Wallop, 1940.

Spitfire Mk.1 LZ-F serial X4321 of No.66 Squadron operating from Coltishaw, 1940.

Classifieds

TIME TAKES IT'S TOLL

by Dennis Lee Gerber



THE EFFECTS OF WIND AND RAIN ON VINTAGE AIRCRAFT

"Time Takes It's Toll" is not just another Aviation photo book. Most books show shiny refurbished examples housed in indoor museums. This book features hundreds of photos of aircraft that have been parked outside for years out in the elements exposed to the hot sun, wind and rain. They take on a character and beautiful patina that is stunningly amazing in all their faded glory. This book also features some one off examples of aircraft that are the last ones is in existence. It includes propeller and jet engine aircraft and some vintage helicopters. Aircraft enthusiasts and modellers alike will enjoy ***"Time Takes It's Toll"***, a very unique book with some truly amazing photographs along with descriptions of each aircraft.

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