CONTROL-LINE SCALE MODELS

Part I

Clive Hall describes basic methods of construction and presents the plans for his own—

HAWKER *HART*

The writer with his scale Ju 88. Twin engined models will be dealt with next month.

THE construction of C/L scale models can be comparatively complex but, if approached in a systematic manner, a pattern of construction emerges which, with slight adaptation, can be employed for virtually any prototype. In this series, I have set out the various basic essentials of construction which I have successfully employed with my own models and, in the side view sketches, show how the same basic methods can be applied to numerous different aircraft. For the benefit of newcomers to C/L scale modelling I have started with the basic requirements, before going on to more specific design aspects.

There are three obvious units into which design is divided and they in turn are further sub-divided:—

Wings

1. Built up, tissue covered—mainly for biplanes.
2. Simple basic structure sheet covered—more modern aircraft.

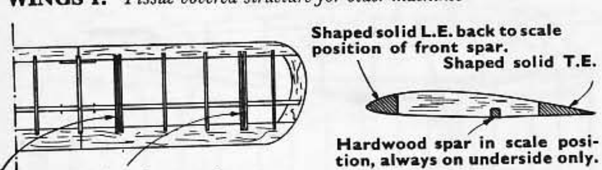
Fuselage

1. Profile and halved formers.
2. (a) Sheet sides and full formers.
   (b) Sheet part-sides (sometimes sloping) and full formers.

Tail

Cut from sheet balsa in most cases.

WINGS 1. *Tissue covered structure for older machines*

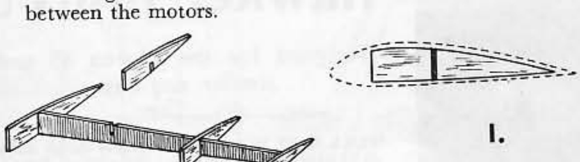


The lower wing centre section needs to be very strongly sheeted as it will, later, be cemented to the fuselage by its upper surface. The underside of the centre section may need reinforcement, if it is to carry part of the undercarriage.

WINGS 2. *Sheet covered structure to represent metal covered wings*

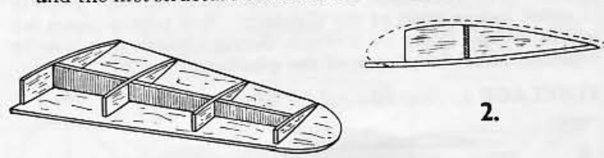
The wing is made in five steps:

1. Simple monospar structure with a few ribs—in the case of multi-engined machines a second spar may be added between the motors.



1.

2. The undersurface is cut to shape from $\frac{1}{16}$ in. balsa sheet and the first structure cemented down onto it.

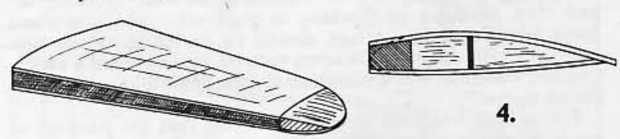


2.

3. The solid balsa leading edge is cemented on and partially shaped. At this stage, undercarriage components may be added, i.e. the entire installation for a fixed u/c, or the tubes for a drop-out u/c.

3.

4. The upper surface is attached—if balsa cement dries too rapidly, Durofix or P.V.A. does not. Balsa block is added to complete the wing tip.



4.

5. The leading and trailing edges are shaped and the wing sanded smooth.

5.

The mainspar position in such a wing may be anywhere between 25 and 50 per cent. of the chord from the L.E. The depth of the L.E. must be such that there is still enough wood to hold down the upper surface after stage 5.

All wings should be made in one piece for maximum strength, which means incorporating ply dihedral braces—in stage 1 for the spar and in stage 3 for the L.E., and bandage support for the wing sheet joins, inside the underside at stage 3 and on the upper surface at stage 5.

It is important to avoid chordwise cuts in the wing sheeting at all times. Spanwise cuts only are safe, making little difference to the structure's ability to resist bending stresses.

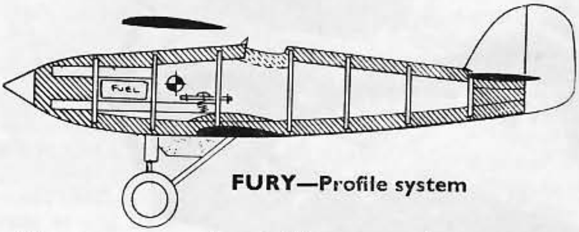
FUSELAGE

The basic sheet side structure is for prototypes with flat sides in cross-section, such as the Bristol *Fighter*. This is modified for aircraft with part of the side flat, or near-flat and perhaps sloping, such as the F.W.190D.

The profile and halved former method is for aircraft which cannot be made by the other method, such as the *Thunderbolt*.

Aircraft of any period can be found which will fit one structure—some, such as the *Fury*, could be made easily by either.

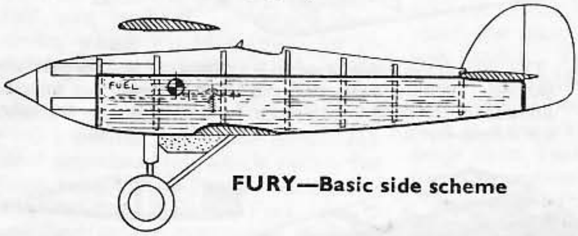
FUSELAGE 1. *Profile and halved formers*



FURY—Profile system

All parts are cut out first: half formers, profile pieces, motor bearers. The motor bearers and profile pieces are assembled direct on the plan, then one set of half formers is attached. This unit is then removed from the plan and the remaining half formers are attached. Then fuel and control systems are installed and the fuselage planked. Block balsa may be useful in places, usually for the motor cowling and aft of the last former. The nosewheel for a tricycle undercarriage must be installed before most of the planking. Any profile pieces left in the cockpit space for strength during construction, can be removed after completion of the planking.

FUSELAGE 2. *Sheet sides and full formers*

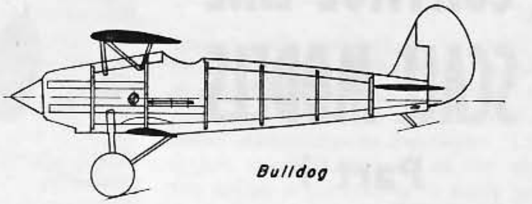


FURY—Basic side scheme

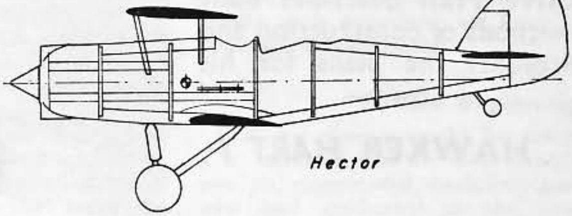
Again parts are cut out first: formers, sheet sides, motor bearers. The motor bearers are assembled and carefully aligned in as many formers as are needed, usually three. This assembly must contain also the fuel and control systems. Then the sheet sides are cemented to the assembly. The fuselage is completed by inserting the remaining formers, working aft and then planking or blocking as required. The nosewheel for a tricycle undercarriage should be included in the first assembly with the motor bearers, etc., or, in the case of a multi-engined machine, it is a substitute for the bearers in making the initial assembly.

For a multi-engined aircraft it follows that the fuselage is made in one of these forms, leaving out whatever is not required; motor bearers and fuel. The engine nacelles in turn are treated as small fuselages which do not contain controls, but may have U.C. legs attached in a similar manner to the tricycle nosewheel leg in a fuselage.

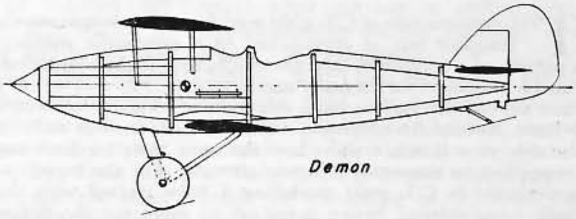
The profile system of fuselage construction applied to a selection of suitable prototypes



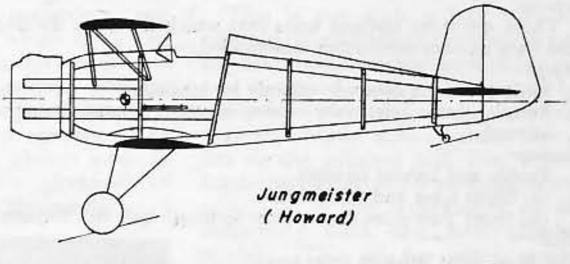
Bulldog



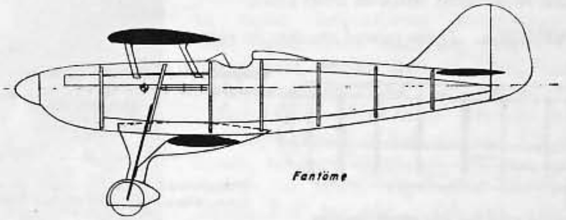
Hector



Demon



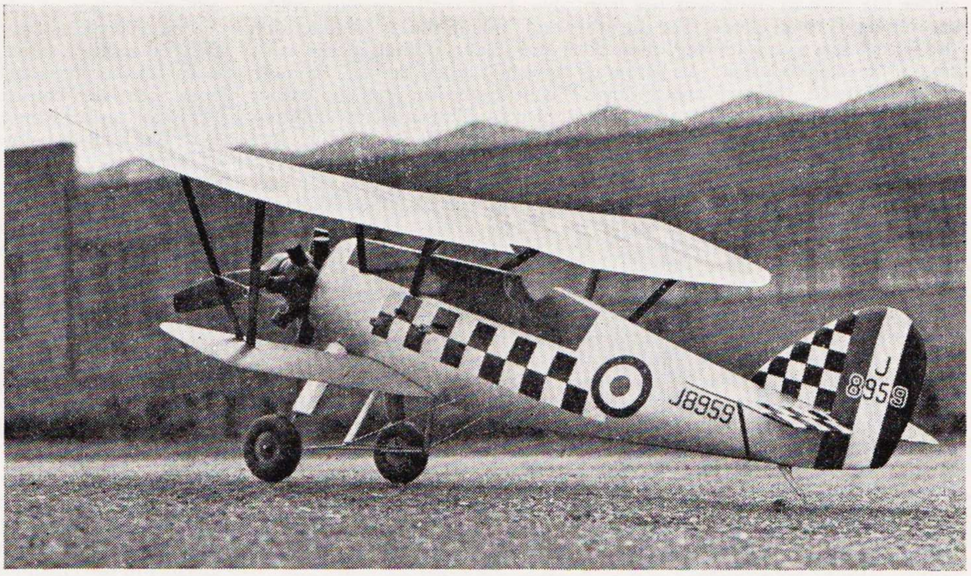
Jungmeister (Howard)



Fantôme

CONTINUED NEXT MONTH

CONTROL-LINE SCALE MODELS



Concluding this two part series in which **CLIVE HALL** describes basic methods of construction

Wing Attachment

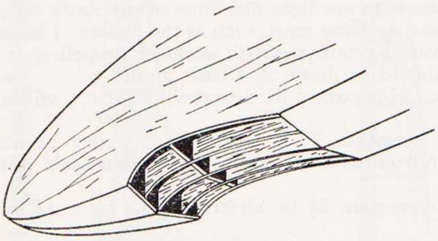
From the structural point of view this can be considered to fall in three main positions.

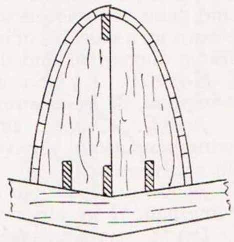
1. *Low Wing* (including shoulder wing, being the same thing inverted).
2. *Mid Wing.*
3. *Parasol Wing* (including upper wings of biplanes).

1 and 2 may need attention in the case of multi-engined aircraft to give extra strength.

Low Wings

With these, the profiles or sheet sides are left with provision for wing fitting and all that is necessary is to cut away the fuselage planking. The wing is made first, so that the fuselage can be cut to an exact fit and the wing centre section sheet is cemented to the edges of the fuselage sides, the bottom of one former and the centre profile which, for sheet side models, can be fitted for the purpose in slots in the bottoms of three formers.





Mid Wings

(a) *With profile fuselage*

Start fuselage in normal way, but plank only on one side of the wing position—above or below whichever is larger. The wing is fitted in position by resting it in hollows cut in the edges of the planking, after the removal of profile pieces and the upper or lower halves of any obstructing formers. The fuselage is completed when the wing is in position by replacing the removed parts and continuing the planking, allowing it to butt against the wing surface. The controls may be fitted into the fuselage before the wing; or to the wing or fuselage after the wing is in place. It is important always to keep as much fuselage planking as possible in long unbroken pieces.

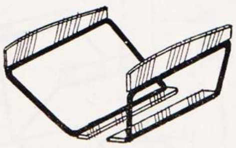
(b) *With sheet sides*

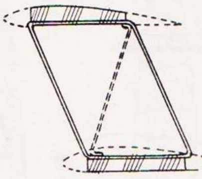
If parts of formers are cemented above and below the wing surfaces and wing-root cut-outs are made in the sheet sides, the latter may slide over the wings from the tips and be cemented in place to give the basis of the fuselage construction, rather than the motor bearer assembly. In such a case the bearer assembly is put in next and all that remains to be done is the addition of tail formers and planking.

Parasol Wings

These are mounted on struts and the construction is designed to accommodate the strut fixings. The struts are bound with strong thread to ply pieces which are inserted with cement into the spaces between double ribs. Interplane struts passing from slot to slot in two wings are bent from wire; the upper and lower bars being the parts to which the ply inserts are bound. There may be an extra piece necessary in the case of " N " struts. For scale appearance nearly all wire struts need to be " built up " by the addition of balsa fairing strips.

Cabane struts attach to the upper wing in just the same manner and are fitted to the fuselage similarly, except that the ply inserts are turned horizontally and pass into narrow slots cut for the purpose in the sides of the fuselage.





Bracing

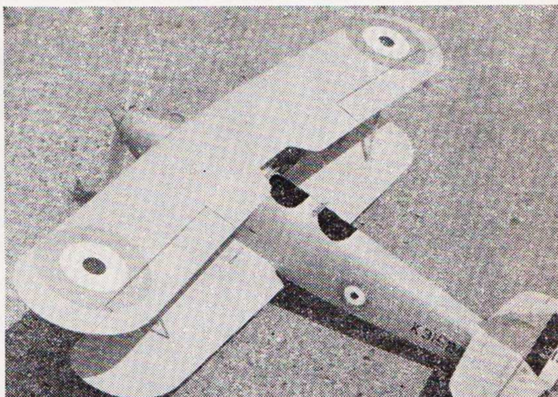
Some form of bracing is necessary to keep the weight of a biplane down to suitable limits. Excess weight in struts, etc., can be avoided if flying and landing wires hold the upper wing against lateral movements and remove torsional strains from strut attachments. Cross wires between cabane struts and also between interplane struts, are needed (except with " N " struts) to prevent longitudinal vibration of the upper wing. Bracing wires are needed to eliminate lateral undercarriage wobble on pre-1937 designs.

Use control line wire soldered to strut ends, or special bracing wire holders. A convenient form of fitting for holding bracing wires is 22 g.

wire, bent and bound to a small slat of thin ply cemented to a wing rib, or cemented inside the fuselage during planking, sandwiching the wire between the ply and balsa structure.

To attach the wire ends, bend the wire and leave plenty of excess to grip with pliers, then hook the wire over the loop on the airframe. Spot

Heading photo shows the author's Armstrong Whitworth "Siskin" IIIa in a realistic setting.



Right: Clive Hall's very fine model Hawker "Hart," the two-sheet plans for which appeared in our December issue, together with the first part of this feature. The plans (M.A.374) cost 7s. 6d. post free from 19-20, Noel Street, London, W.1.

solder the wire to itself near the loop, then bind with fuse wire, solder securely and cut off excess. For the other end, pull on the excess to tension the wire when spot soldering, then bind and solder, pulling at the same time to keep the tension. *Do not cut off the surplus at this end yet.* As more wires are fitted the airframe " moves " a little and some of the earlier wires may slacken. They can be re-tensioned by placing a hot soldering iron to the end and pulling the wire " tail " again. The rigging is complete when all wires twang when plucked and corresponding wires on each side emit a similar note showing that the tension is the same on either side which gives the airframe symmetrical trueness. Last of all, cut off excess " tails " of wire.

Tail Units

These are nearly always cut out from sheet balsa. Thick parts such as the fin on a Me.109 or *Gannet* can be made with a solid L.E. and a few ribs, with a cover of 1/32 in. sheet balsa, in the same way as the wing of a modern aircraft. Elevator linkage should be with a square strip of obechi, which suffers far less from torsion than does a wire link.

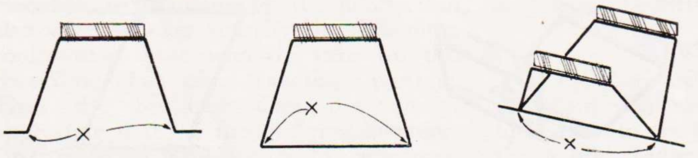
The tailplane is first attached to the tail-block or sheet sides, or made to fit into a slot saw-cut into same. An extra block on top of the tailplane may sometimes be required. The fin is put on after.

Pushrod Linkage

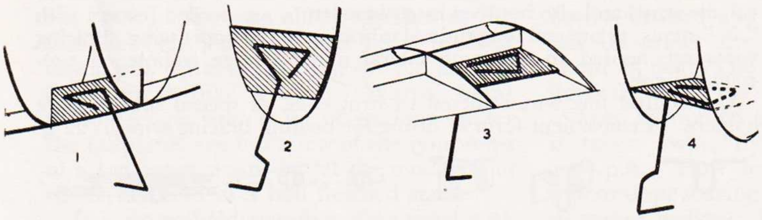
The pushrod emerges from the fuselage through a narrow slot and operates an external elevator horn. Accurate connection to horn is made by leaving excess length on pushrod until tail unit is fitted. Use a small bulldog clip to hold the lead-outs at fuselage side with controls neutral, use another to hold elevators neutral, then bend end of pushrod to fit elevator horn and cut off excess.

Undercarriages

(a) On older machines with fixed undercarriage, two legs and an axle, or simple extension of this pattern, is normally required. This type of u/c is made in two pieces.



The upper bars are bound to ply inserts, as in the case of struts, and are let into slots cut across the underside of the fuselage and sometimes in the undersurface of the lower wing. The undercarriage is completed when the two parts are pulled together and bound and soldered at the points marked " X."

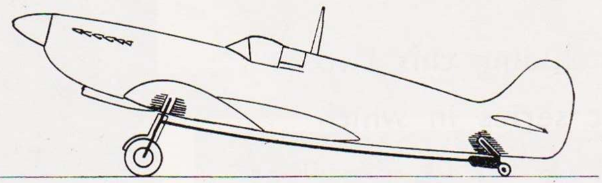


(b) On more recent designs with retracting undercarriages, the model may have a fixed or a dropout u/c.

Fixed. If mounted in the fuselage the leg can be bound to ply and then the ply slotted vertically between formers (1), or cemented against the face of a former (2). In a wing let the leg project down from a wire triangle bound to a horizontal plate (3), this arrangement can also be used inside a fuselage.

In (1) the ply is faced against a profile piece; (2) is the method used with sheet side construction, unless a small profile is specially added; (3) is for an all wing mounted u/c; (4) is for use where space is limited, with block fill-in below ply, it is useful for engine nacelles.

Dropout u/c. Tricycle type may plug in simply in three loose holes, as there is little chance of nosing over, but for a tailwheel u/c, the rear wheel needs to be on a peg at an angle in the fuselage, with a lead weight added. Nose-over is not then possible as the tail cannot rise until the wings are airborne.



Pre-finishing

Elaborate decoration on some aircraft, notably colourful biplanes, is more easily done and gives much cleaner results if components are completely finished before assembly. Assembly then requires only that surfaces to be cemented are cleaned to bare wood and that the cementing be cleanly done. A small amount of gap filling may be required in places and a few joints may need touching up with dope, but the main benefit is a good light finish on parts which become inaccessible after assembly. If the model is to be put together thus, it is important that the painting order be studied before commencing work.

Appearance may be better if fuel proofer is not used, which means that the engine must run on fuel containing only ether, paraffin and mineral oil (Mercury No. 6 meets these requirements). Unfortunately most engines misfire badly unless the fuel contains added ingredients, which attack unprotected dope. The D.C. Sabre 1.5 c.c. and E.D. Racer 2.5 c.c. are two engines which I have used and which run smoothly without additives. If glow engines are used, fuel-proofing is essential.

Propellers and Prototypes

The smallest size of airframe, which can accommodate an airscrew on which the motor is well behaved, must be safe to fly on the power available, if that aircraft be suitable for modelling. The aircraft which create the most problems are the single motor light machines of the *Auster* type and twins with motors set near the wing roots, such as the *Dakota*. I have drawn up a short list of interesting prototypes with workable propeller/airframe dimensions and this should be useful as a basic guide.

Firefly IV. 1.5 c.c.: 22 in. wingspan, 7 in. airscrew; 2.5 c.c.: 26 in. wingspan, $8\frac{1}{2}$ in. airscrew.

Ju.87D. 1.5 c.c.: 22 in. wingspan, $6\frac{1}{2}$ in. airscrew; 2.5 c.c.: 27 in. wingspan, $7\frac{1}{2}$ in. airscrew (airscrews are slightly larger than scale but fit easily enough).

Ju.88c. 1.5 c.c.: 36 in. wingspan, $6\frac{1}{2}$ in. airscrews; 2.5 c.c.: 44 in. wingspan, $7\frac{1}{2}$ in. airscrews.

Do17z. 1.5 c.c.: $34\frac{1}{2}$ in. wingspan, 7 in. airscrews; 2.5 c.c.: 39 in. wingspan, 8 in. airscrews.

Wellington. 1.5 c.c.: insufficient airscrew clearance on small airframe; 2.5 c.c.: 45 in. wingspan, 7 in. airscrews.

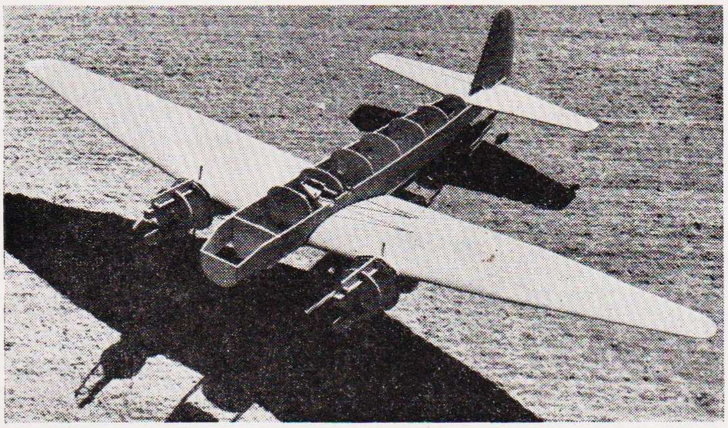
Clockwise Flying Circle

Nearly everyone flies anti-clockwise. If a model loses line tension it becomes, for a moment, an unstable free-flighter, even with a wingtip weight and if the motor is at moderate speed the torque which will be near maximum, will cause a left bank. The lines would not have slackened if the model did not already have an inherent, left turning tendency which will now become worse. The gyroscopic effect of a left turn will pull the nose up, losing airspeed thus further aggravating the situation, which all happens very rapidly usually ending in a crash near the pilot, after a near-wingover.

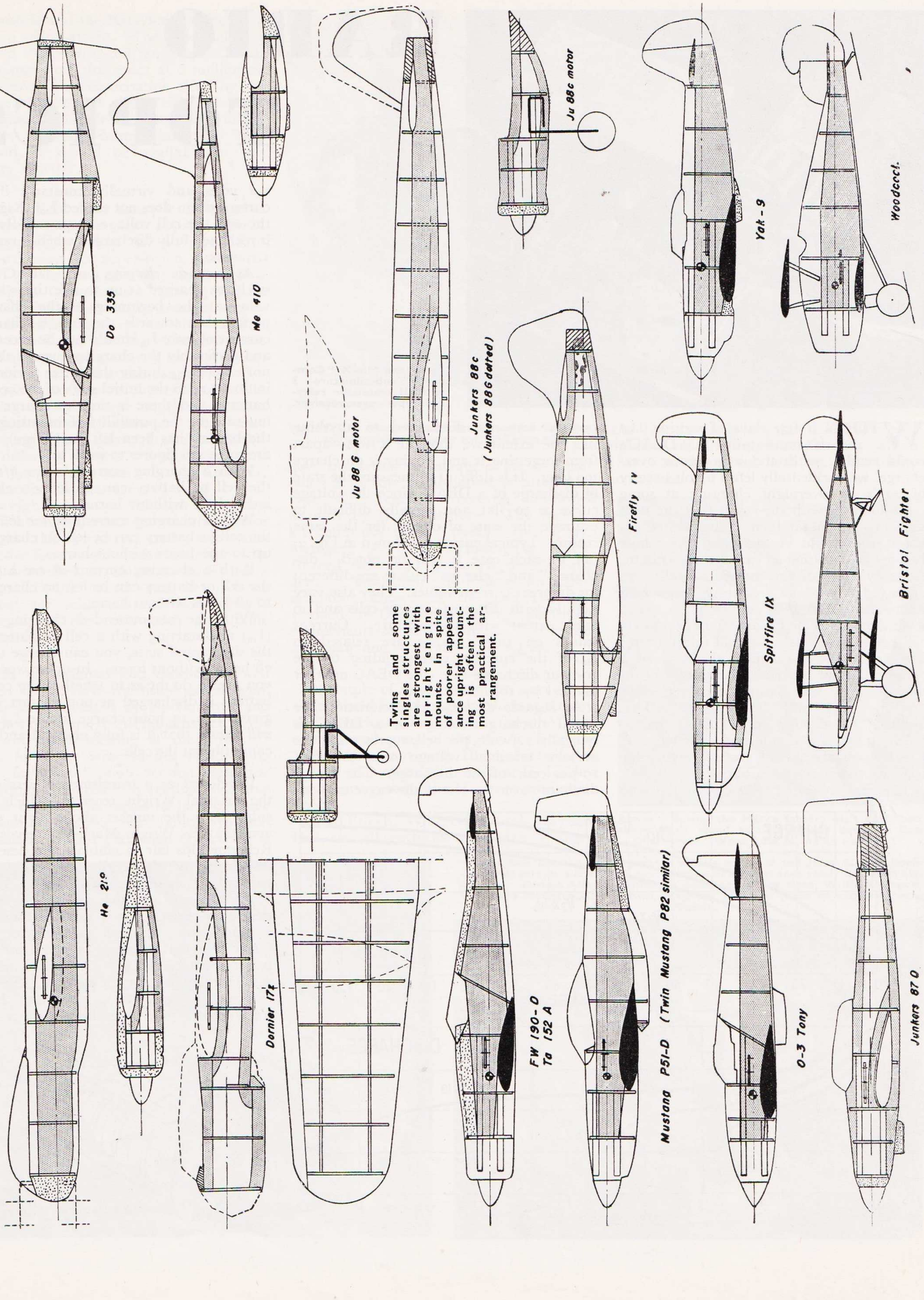
Consider a model flying clockwise under the same conditions of losing line tension and coming towards the pilot. Any tendency to bank towards him is countered by the torque which opposes the left bank, tending to level the model. If the torque is not enough and the model keeps turning right, the gyroscopic effects will put the nose down and with the dive the speed will increase, throwing the model away from the pilot.

Hence there is an increased margin of safety from loss of control for a model if it is flown in a clockwise circle. Stunt pilots, by flying normally anti-clockwise, reserve the extra safety for their inverted manoeuvres, but sport models, which are not intended to go inverted, are likely to find clockwise circuits safer, also it seems sensible to make the motor torque oppose the weight of the lines. This applies particularly to scale model biplanes which, with their extra drag and lower airspeeds, are, more than any other types, susceptible to cross winds.

Below : the author's Ju 88c clearly showing the fuselage and nacelle construction. A photo of the completed model appeared last month.



Some interesting prototypes with suggested methods of construction



Twins and some singles structures are strongest with upright engine mounts. In spite of poorer appearance upright mounting is often the most practical arrangement.