'G-ERUP'

by NORMAN WARNER

OVER many years I have found that most people regard aeromodellers as mild eccentrics; but if one delves deeper, one finds that there are sub orders of eccentricity within the main order. Take, for example, those chaps who manage to flatten a few atoms of matter into sheets of shimmering gossamer and apply these to a nearly non-existent framework of braced spiders' webs, to make an aircraft that drifts around the room at a quarter of a mile per year. Then there is the other chap, who lovingly builds a most advanced free-flight model, powers it with a highly expensive, highly tuned engine, then launches it for its first flight—which is very often a very fast but incomplete loop.

I could go on, but it is time to arrive at the sub order of Radio Control, and it is probably not surprising to find that within the sub order, there are different species of Radio Control modellers. The chap dreamily in love with high floating thermal soarer seems very different to the masochist driving his racer around the pylons, and these are just two out of many.

My own fetish within this spectacle is concerned with S.T.O.L. aircraft, and my early experiments with this type, evolved a highly satisfactory aircraft, fitted with leading edge slats, large Fowler flaps, a very resilient undercart, and all summing up to a scale-looking, high wing aircraft, which gave me hours of fun. There was, however, one slight deficiency, and that was its disinclination to perform aerobatics. But, after all, that was in keeping with its character.

This aircraft, enjoyed a long and active life but finally, due to increasing weight and decreasing vigor, was quietly retired, to be supplanted by a much more elegant bird, the subject matter from hereon.

A low wing, scale looking, aircraft with minimal wing loading coupled with high lift and anti-stall devices. To elaborate on the major points. . .

1. *Low wing and scale appearance.*
The low wing position is chosen simply to give neutral stability to improve aerobatic performance.
Scale appearance, obviously because it looks better, but it can involve weight penalty, hence structure is kept to the minimum of material.
The undercart is very important on this type of aircraft and is rather long so as to give a high attack angle on take off. It also gets some very rough treatment on slow landings, so great resiliency is required.

2. *Low wing loading.*
Obtained by building lightly and having a large wing area. (Attempts at "beefing up" should be avoided).

3. *High reserve of power.*
The motor used is a .61 of modest performance, so some of the current 40's would be adequate. This model flies happily on very reduced power and would probably fly on a good .29. However, when taking off with lots of flap and with high power, the slow—nearly vertical—climb is very impressive.

4. *High lift devices.*
This basically is a slotted flap for 50 per cent of the wingspan. It is a one-piece device and hence is continuous where it crosses under the fuselage. This gives, at certain flap and power settings, a "blown flap" effect, and thus very low flying speeds.

To maintain adequate control at these very low air speeds, the control surfaces of the aircraft are very large in area. Because of this large control area, care should be taken to ensure that control hinging and servo linkages have minimum flop or backlash. This is not so important at low flying speeds, but becomes very critical at high speeds.

CONSTRUCTION

I tend to use balsa cement on the joints involving heavy and stiff material, and P.V.A. glue where lightweight sections and thin sheets are used. As this airframe is very lightly constructed, it can be quite fragile until the final covering is in place. Attempts to "beef it up" will only involve extra weight and loss of performance, and in many instances concentrates stress into small areas, with consequent risk of structure failure.

Fuselage

The side sheets of $\frac{1}{8}$in. and $\frac{1}{16}$in. balsa are joined on the plan and the main and subsidiary longerons added. It is easier to start by building the right-hand side first and then use it as a pattern for the left-hand side. Both sides are joined at the rudder post, and then the various bulkheads are built in. The front plywood bulkheads are filleted to the side members.

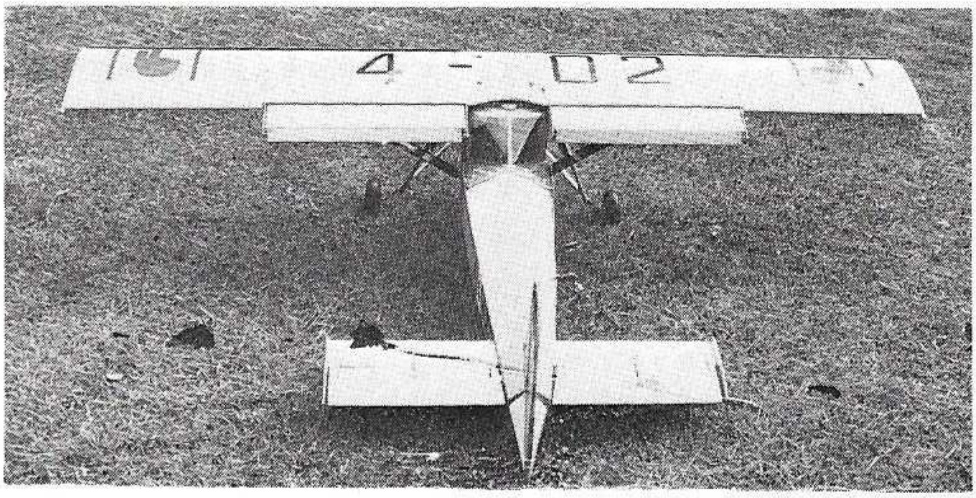
The $\frac{1}{8}$in. square "A" frames behind the canopy are next. Starting with the one immediately behind and adding at the same time, the spinal longeron that defines the length of the following frames. Follow this with the rudder outline structure, but add no skin at this juncture. Next construct the complete horizontal tailplane, which includes the elevator and hinges. Fit this into the fuselage, and add the rudder and elevator control linkage before fitting the remaining fuselage side skins. At this point, I delay fitting the servos and receiver until the aircraft structure is fairly advanced. The reason is to use the gear stowage for adjusting the centre of gravity position, and avoid having to carry unnecessary ballast. The canopy is now fitted, but the fuselage forward of bulkhead C is left open at the top.

Temporarily fit the motor and fuel tank, and fill in the fuselage around the motor with soft block. The removable top front of the fuselage is now constructed. Finally, cover the fuselage in lightweight tissue and paint finish. It can be covered in film, but the tissue-and-paint finish is far more oil-proof. The horizontal fin and elevator is film covered, which offers the right amount of lightness and flexibility for the structure. The motor and tank may be finally fitted after the varnishing is finished.

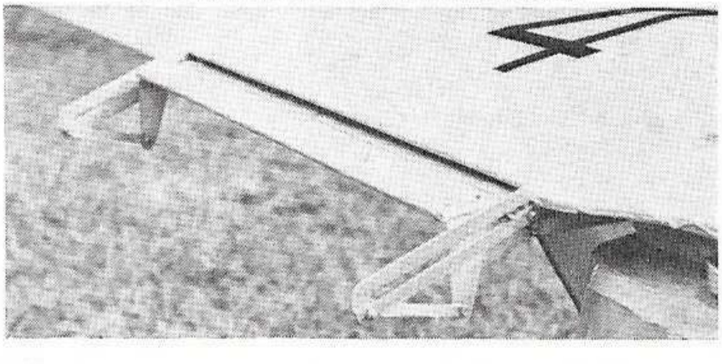
Wings

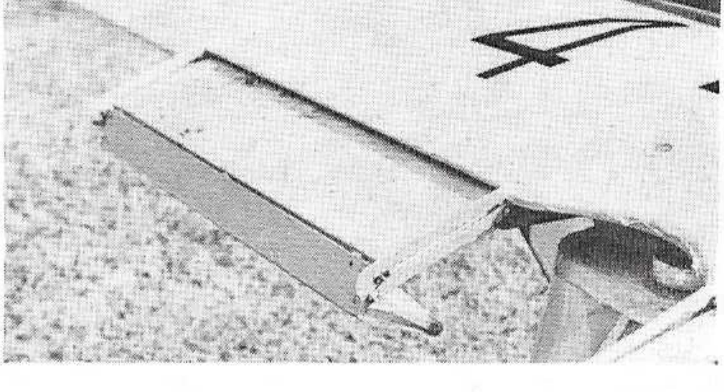
The wings do a lot of work on this model, and the centre section particularly takes much punishment from the undercart. Consequently the plywood section's glued and screwed joints should be taken seriously.

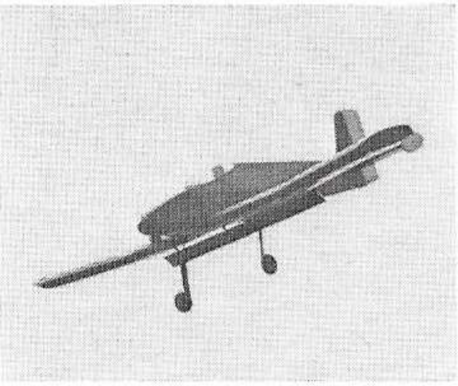
The flap and its wing socket should be a snug fit and, accordingly, it is a good practice to check the flap fit in the wing-socket progressively as construction proceeds. The ply flap hinges have large inboard areas

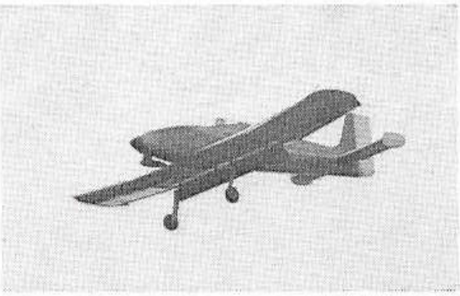


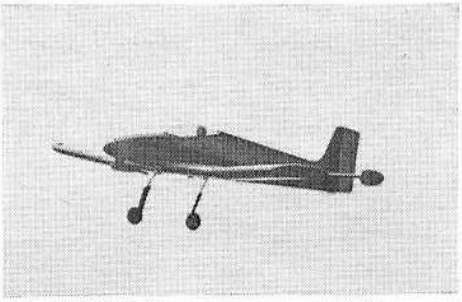
The original pseudo-scale model, on which the writer tried out STOL effects. It incorporated leading edge slats and the very large Fowler flaps shown in close-up in the lower photos.











to ensure good gluing surfaces, and are joined together with 10 B.A. nuts and bolts.

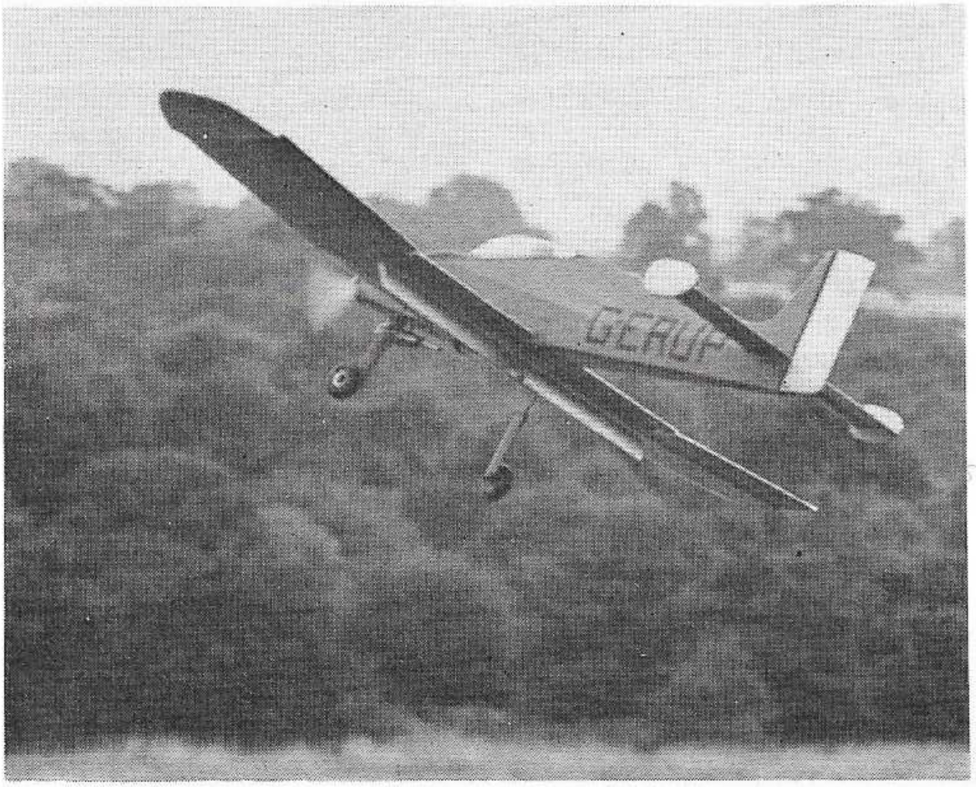
At this stage, a note about the flap servo. The long operating arm is chosen so that the flap extension angle is approximately 60 deg. I originally used a standard servo, favouring the quick action that this facilitates. Unfortunately in practice the following phenomena occurred: the aircraft was throttled back for landing and full down-flap selected. Push down elevator and a steep but slow approach initiated. As the back pressure built up on the flap, the servo yielded its position and the flap began to retract. Immediately the dive and speed began to increase and the correcting action was up to elevator, which slowed the aircraft by lifting up the nose, which relieved the pressure on the flap, which tended to lift the nose higher. Hence a highly unstable, violently undulating approach. The immediate cure for this was to substitute a retract servo for flap operation.

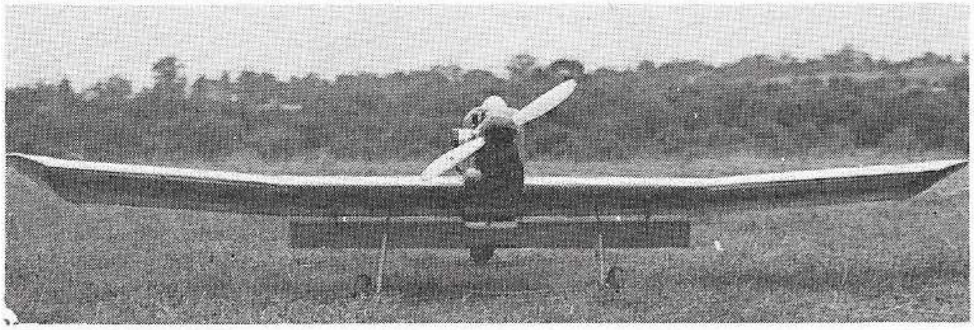
The outboard wing panels are very light for rapid manoeuvring, and much of their strength is in the main spars which must be hard balsa. When these panels are joined to the centre section, the main spars after cementing are bound to each other with thin thread. This is very important as balsa wood parts quite easily under alternating shear loads, but binding keeps the fibre layers together. Film cover the wing and complete it before fitting the leading edge slats. These slats can be constructed against the leading edge to ensure the shape.

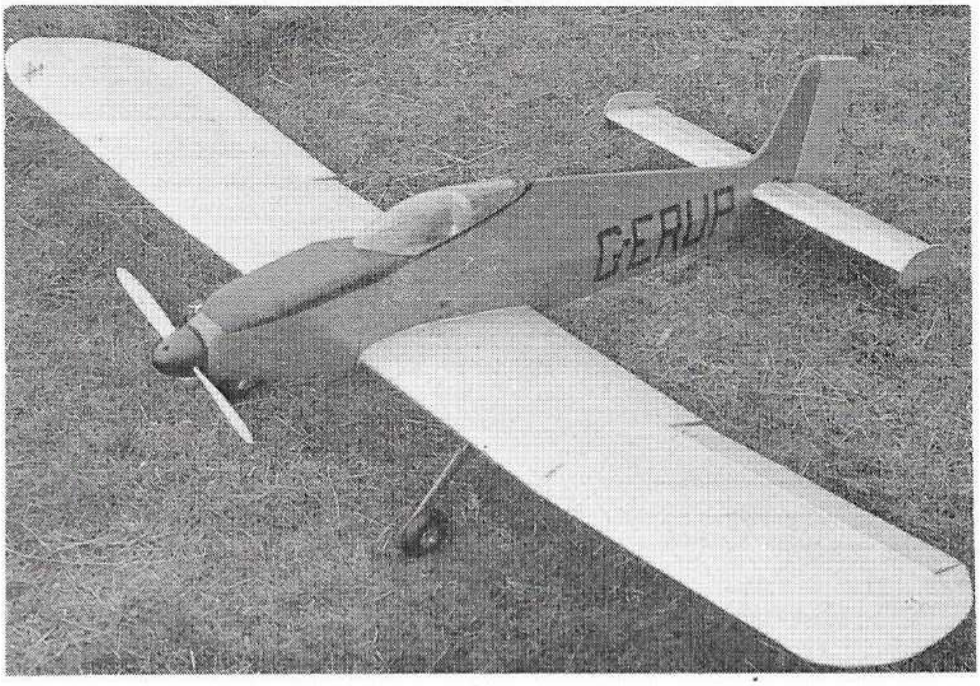
The control movements, measured at the trailing edges of such surface, are as follows: *Aileron*—up 1.4cm down 1.2cm. *Elevator*—× 1cm *Rudder*—× 1.8cm. The Final weight without fuel should be close to 6lb. 2oz.

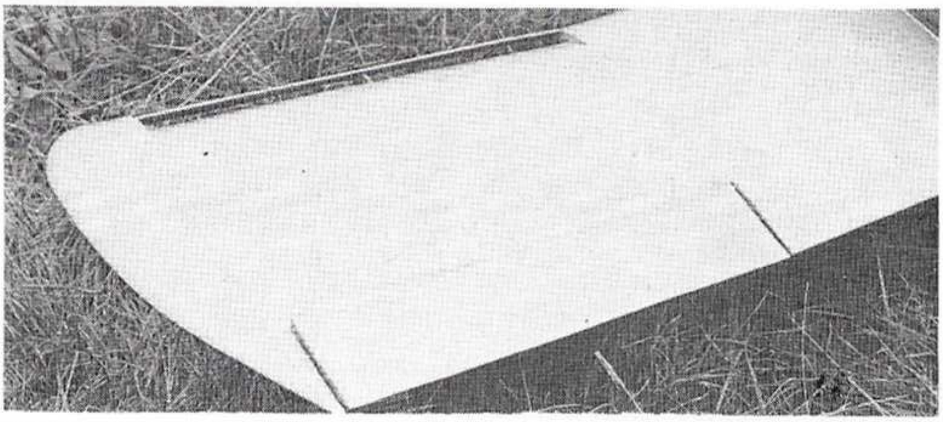
FLYING—theory

Before getting to the real flying, the various parts of the aircraft and their signifiance to the flight patterns should be understood. First, however, it must be stressed that

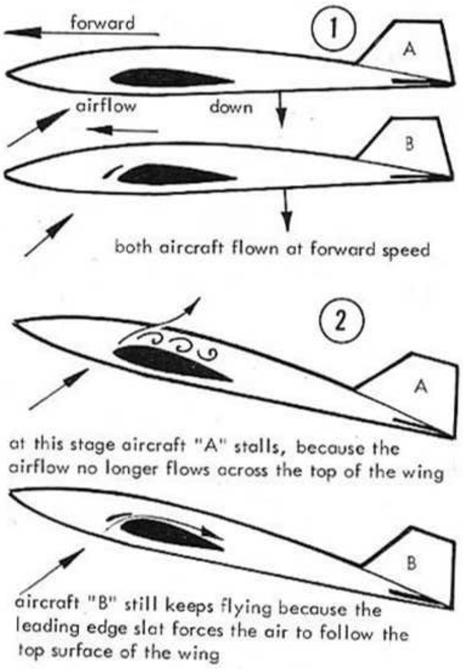








The leading edge slat, which forms the "slot", is clearly seen in this close-up of the model's wing. In the photo below, designer Norman Warner holds G-ERUP so that the control surfaces and auxilliary surfaces may be clearly seen.



if one desires tight manoeuvres, then *low wing-loading is essential*, so keep the weight down.

Anti-stall devices. The functions of these are shown by the diagrams in Fig. 1. Aircraft **A** and **B** are identical in all aspects, including weight, except that **B** has leading edge slats. Both are being flown at a forward speed which is just below that needed to maintain height. The elevators are positioned so as to keep the aircraft in a level attitude. Both aircraft will therefore be moving forward but at the same time descending, and the airflow hitting the wings will be angled up towards the leading edges from beneath.

If the forward speed is reduced even more, the lift diminishes further and a faster descent rate ensues. This in turn makes the airflow hit the leading edges even further from beneath.

At this stage, aircraft **A** stalls, (Fig. 2) because the air will no longer flow across the top surface of the wing, but aircraft **B** continues to fly because its leading-edge slats force the air to maintain its passage over the wing. However, now that **A** has stalled, **B** will follow suit if the airspeed is further reduced to a point where even the slats are not effective.

By fitting slats to the wingtips only, a controlled, nominal stall characteristic can be achieved whereby the centre of the wing stalls before the tips and the consequent reduction of lift causes the aircraft's nose to drop. The effect of this is to increase the airspeed and hence achieve stall recovery.

Flaps. The manipulation of these is a fairly precise business. For a given airspeed, small angles of flap extension can increase lift considerably without too much increase in drag, but further extension—although increasing the lift—does begin to create disproportionately high drag, until such a point is reached where the flap virtually becomes an air brake.

By having a flap that is continuous across the centre section, slip stream from the airscrew can be diverted downwards to give extra lift—useful, particularly at low airspeeds. But to be able to achieve slow flight with the flap and the slats, the c.g. position is critical.

FLYING—practice

Ignore the flaps for the first flights, and fly as a straightforward low wing aircraft. Due to its light weight, a well tuned .61 will give a sparkling acceleration from rest, but for the first flights a reduction in power is recommended. At reduced power the aircraft is fully aerobatic, and very gentle and forgiving in its flying characteristics. Explore its turn and loop ability, and its stall recovery. When reasonably happy start exploring the *flap performance*.

Start at fairly high altitude and try 50 per cent flap with about 30 per cent motor setting. There will be a tendency for the nose to pitch up, and I recommend full down-elevator trim for all flap extensions. Even at this there is a modicum of down-elevator needed for level flight. With

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practice, by using full flap plus the right power setting, *very* slow flight can be achieved and in a stiff breeze it is possible to hover. Often when friends' models are dashing about the sky like skittering sparrows, one can sit at reduced power, almost silently hovering, like some watchful hawk.

Of course, there is a difference in control response between high and low speeds. For example straight level flight at high speeds, requires only minimal control movements, whereas at the very slow end of the range to obtain quick response, the controls have to be slammed temporarily to extreme positions. Rather similar to a glider when the flying speed is low.

Landings with full flap tend to fall into several categories. If there is a stiffish breeze blowing, then at altitude and facing into wind, with a critical motor setting, the aircraft can be held in a slight nose-up attitude, whilst moving forward and sinking slowly. The other method is to throttle back to tick-over, and then dive at approx. 30 deg.

The first method is slow (but entertaining), and the second requires very precise flare-out, and for these reasons a combination of the two is probably the most professional, with a steep, almost powerless approach changing into a powered flare out. But it does take practice.

Should the motor cut when the flap is out, do not worry, as the aircraft glides very well in this condition, but does lack penetration. Take offs with full flap need some care because the acceleration seems deceptively sluggish, and accordingly one at first is unprepared for the vertical jump off following the very short run. It follows that for flap take off's, a succession of these, each with increased flap extension is recommended.

To sum up; experience has shown that this model is ideal for small fields, with its ability to leap up out of long grass, and to be aerobatic in a restricted space. This aerobatic space can be reduced by flying with 40-50 per cent flap, (even though some of the manoeuvres are a bit peculia). *Its ability to fly at reduced power makes it very quite.* Then, to return to earth from almost dead overhead by sideslipping, diving and general waffling, completes the performance. Once you become proficient with this aircraft, perhaps, like me, you will see in every small space, a potential flying site!