10 feet of "Thermal Hopper"

A spoiler equipped super floater from Old England. It hand-tows aloft to hunt for lift, a servo actuated lock on the hook. 6th at the 1971 International Soaring Competition at Doylestown, Pa. Hard to find a fault with it!

by Geoff Dallimer

6th at the International Soaring Competition, Doylestown, Sept. 1971. Weather was sullen.

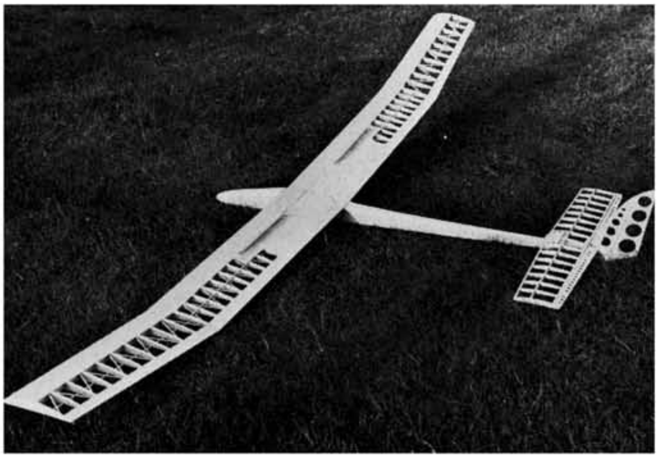
Photo by Don McGovern

During the 1971 R/C World Championship meeting at Doylestown, U.S.A., your editor Don McGovern asked me if I would do a feature article on the R/C Thermal Soarer I was flying in the contest. Little did I imagine that I would be writing by the light of two home made oil lamps! Indeed it is in quite a 'Pickwickian' atmosphere that I am writing, and one could well be in the 17th century England, instead of the 20th. Not 200 yards from where I sit, stands an old coachhouse inn reputed to have an underground passage used by the celebrated highwayman Dick Turpin, well known by ill-repute! This particular inn is known as the "Roebuck" and lies just south of Stevenage on the Roman Great North Road.

Of course little of the above has any connection with Thermal Soaring—except perhaps the heat from the oil lamps! The reminiscence is brought about by Great Britain being hit by a nationwide electricity crisis due to industrial problems—hence the need for oil lamps! However perhaps my model does have something of an English flavour since the building methods I use are simple and indeed the construction is very similar to A/2 models I built a decade ago. Nevertheless, considerable development has gone into the model beneath its modest tissue covering, and *"Thermal Hopper"* is a well bred competition model.

I first started building R/C thermal soarers some four years back, and after a year of experimentation, started a series of "thermal" models. First design was *Thermal Rider* of 8 foot span and was published during 1969. The design was scaled up to 12 foot span for the second model in the series known as *Thermal Hunter,* but I have settled back to a 10 foot span for the current model. This is considered to be an optimum size of model for competitive flying. Larger models may appear more efficient but become un-manageable on the ground in windy weather. Here in Great Britain conditions are usually "breezy" if not always "windy." Thermals appear to be smaller in area and less strong than those we found during our short stay in Pennsylvania, and certainly not like those we read about in California and Texas!

When the possibility of coming across to fly in the U.S.A. first arose, my colleague —Dave Dyer—and myself spent some time wondering what sort of weather to expect, since having a model to suit the conditions is of prime importance in thermal soaring.



It frames out easily, but prime wood is important. The slender wings of a glider call for straight, true lumber to start off. Note lightening holes.

It's a ship to sense out the slightest of lift. Agile enough for towing by hand, which Geoff much prefers. Sunlight through structure is a "memory."

Between us, Dave and myself had won quite a few events in Great Britain and we particularly wanted to do well at an International event. An English ex-Stevenage Club member now living in Philadelphia gave us a "long range" weather forecast and this proved reasonably accurate—except for the rain storms preceding the meeting at Doylestown! In fact both Dave and myself were surprised just how similar conditions were to those we experience at home.

In fact in these conditions I would have expected to do better than sixth place—especially since I finished ahead of Dave in every other event during 1971! Perhaps if the contest had run to another (third) round! Incidently it was *very* disappointing for competitors who, after travelling many thousand miles, had the contest cut short after only two rounds. If another International Event is ever held in the U.S.A. I trust more democratic contest direction will be provided. Prematurely terminating an event to enable a trade display to start was unforgivable by European standards.

Hey—have just improved the oil lamps! Found D.T. fuse makes a great lamp wick! Have now got D.T. fuse threaded through a piece of 1/8" balsa floating in a jam jar full of cooking oil! Full constructional details next month!

Well now back to the *"Thermal Hopper"*—as I previously mentioned this is the third of a series using similar constructions, but differing wingspan. Apart from the obvious differences in wingspan there has been a steady refinement of detail to improve the design. I originally used an "all flying" tailplane for elevator control which enabled me to have a tip up tailplane dethermalizer, and avoided the losses of an elevator hinge. However I found that a conventional elevator seemed more effective, with a more rapid response to stick movements, especially when killing a stall. I attach great importance to having a model that has good inherent stability and thus needs a minimum of control. Every movement of a control surface causes drag and lowers the models efficiency. Following these ideas of stability brought about the outcrop of lightening holes in the tailplane and fin. This is aimed at keeping the extremities light so that the pitching moment of inertia is as low as possible. The wing tips must also be kept light and this is achieved by the selection of a light grade of balsa. Choosing the right wood—long grain harder grades for the heavily loaded parts of the model, and lighter wood at the extremities, is part of the hidden "know how" that results in improved contest models. This is not always apparent on a drawing, and of course there is no point in using light wood for the tailplane and then fitting heavy moulded hinges and metal "kwik links" etc. Keep it simple, keep it light, and keep it strong is the motto!

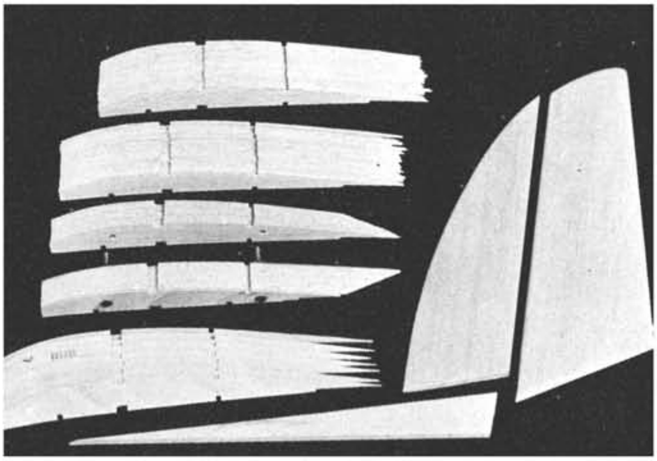
Photos by the Author

Geoff found Doylestown's lift strong by English standards, but as this writer recalls, it was about as weak as lift in the U.S. can be. A good "boomer" Kansas style takes model, house and workbench OOS.

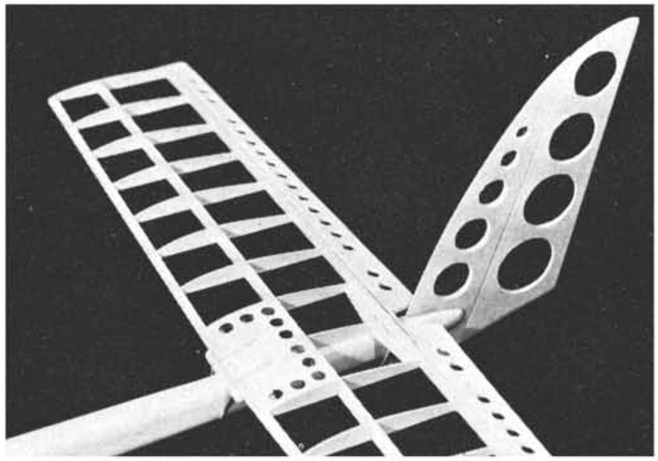
This is the first of my models to feature lift spoilers and these have proved very helpful in hitting the landing target area. I have often overshot the square through approaching too high—under these circumstances down elevator doesn't help much since you only fly past faster! Unless it flies into the ground! On the other hand if you undershoot, spoilers are useless! Spoilers have the effect of increasing the model's wing loading and also its drag. When you open them you will find the nose drops quite sharply and if uncorrected the model speeds up into a dive. However pulling back on the stick keeps the nose level and the model settles into a normal attitude with a fairly fast rate of sink.

Although simple to make, the spoilers shown could perhaps be improved. Since they are positioned at a critical point of the wing section they must be a good fit to avoid inefficiency—their size is about right, but I think I shall try a different method of construction next time—you may care to do the same.

The spoilers are operated from the same servo as the towhook release. This has the advantage of saving the weight and cost of an extra servo, and since the spoilers are opened just before the line is released, the tendency for the glider to "balloon" up into a stall is removed. Remember to shut them again after the first line is released though! The release mechanism for the towhook has proved very successful and was easy to make, very little load is plac-



The rib blanks can be stacked, drilled, pinned together, carved in groups. A once-over with sanding block takes care of remaining bevel, easy method.



Holes weigh very little. Dead weight removed here in effort to lighten up surfaces. Fin, stab, elevators visible, wing and spoilers in foreground.

ed on the servo, since towing towing loads are directed onto the latch pivot point.

Construction

Basically the structure is very simple and should present no difficulty. The wing is the most important part of the model and should receive most care, particularly avoiding warps and the like! I usually prepare a metal template of the wing section so that the ribs can be cut accurately. Notches in the ribs are produced with a small file to avoid cutting 'knicks' that would otherwise weaken them. Check that the spars are a nice fit, with all the ribs held together in a block. Incidentally I always strip my balsa spars from sheet so that they can be matched for weight and stiffness.

The ribs for the outer tapered wing panels are produced by the "sandwich" method, i.e. blank pieces of wood are sandwiched together into a block between templates of the root and tip sections. The sandwich is held together by two bolts, whilst the block is carved to match the two templates. After separation the slight taper on the edge of each rib is removed by a light sanding.

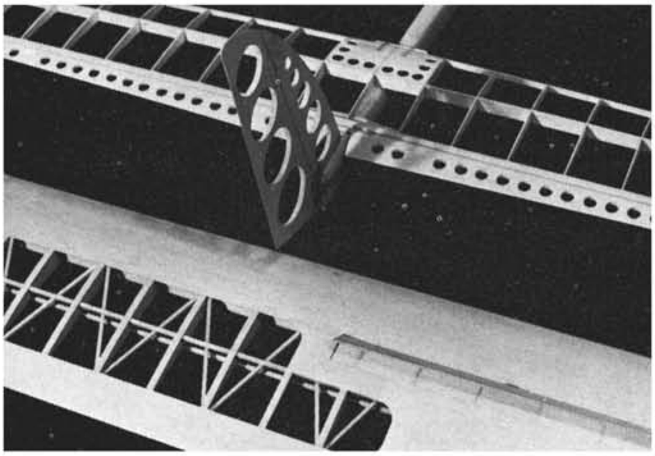
Construction of the wing is commenced by pinning down the 1/2" sq. leading edge straight and true. Position a strip of 1/32" balsa just behind it to pack up the ribs at their foremost point. Pin down the lower trailing edge strip, again using a strip to pack it up to match the lower airfoil contour, in fact I usually pack in a little extra "droop" to the trailing edge to allow for distortion during subsequent doping. Put in all the ribs and the top mainspar and rear sub-spar, cut the trailing edge webbing from strip and fit in position before adding the upper strip. When dry, lift off the building board and turn the wing over. Add the lower sub-spars and the mainspar webbing—finally the lower mainspar. Fill in lower center section sheeting out to position marked on the plan. Turn the wing back to its original position and pin down again. Install wing dowel tubes with generous amounts of epoxy. Fit stiffening and "load spreading" pieces around tubes etc., and then the top surface sheeting and rib capping. Finally fit in the diagonal spars and shape the leading edge section.

The outer panels are butt jointed to the center panels at the correct dihedral angle. When the adhesive is dry, cement or epoxy on a 1/2" wide strip of fibreglass across the joint. Carve the wing tip block to a pleasing shape and add the 1/32" ply facing rib. Clean up carefully and cover with heavyweight modelspan tissue or light nylon, plus three or four coats of thinned, plasticised dope. I wouldn't advise 'MonoKote' or 'Solarfilm' on a glider wing for a number of reasons—starting with the cost! More important these plastic films don't have the rigidity of a dope tightened covering and can lead to wing flutter. Leave wings to one side to 'weather' whilst the tailplane (alright then—stabilizer!) and fuselage is built.

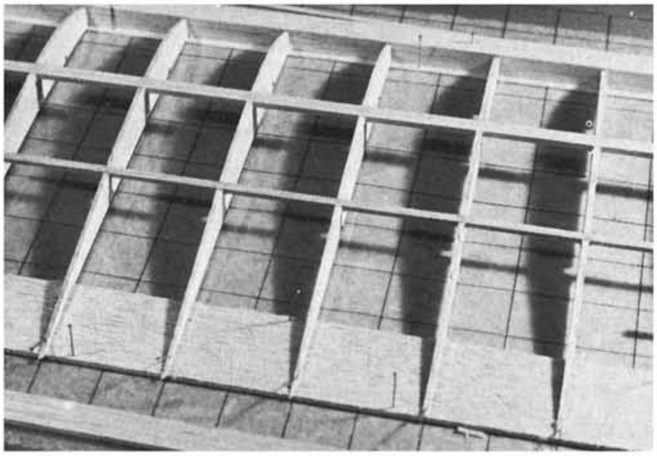
The tailplane/stabilizer is straight forward in construction, but again take care to select a light grade of wood and avoid building in warps. These are usually caused by pushing parts together that don't really fit! I usually use a PVA adhesive on all wing and tailplane joints—except the wing diagonal spars, and other small items that need a quick drying cement to hold them in position. The lightening holes are cut with a 1/2" diameter tube sharpened at one end and at which notches are filed to act as teeth. This is then pressed into position and gently rotated. The elevator is sewn on after the covering and doping has been completed, as are the light 1/32" thick fiber horns that are epoxied in position.

Fuselage construction commences with the cutting of two sides from hard 1/8" balsa—take care to cut along the right lines as shown on the fuselage side view—these will be found to be three straight lines plus the wing mounting curve. In fact these lines can be marked out direct on the sheet without using the plan—this would save cutting up the drawing. The 1/32" ply doublers are then cut and bonded to the fuselage sides with contact adhesive—take care not to make two left sides! I have not drawn a top view of the fuselage since there was not room, and anyway it

The ship rises smoothly on the line, holds on the hook till opportunity knocks. It's moderate size for soaring, practical to tote around, handle in the wind. Plug-in panels, follows proven concept.



The tailplane arrangement gives the greatest degree of reaction to rudder. Slow speeds of soarers make adequate rudder response a marginal com-



Before you start, make sure the building surface is true. A neat snug fit of ribs to spars discourages warps. Ample ribs to hold airfoil sections.

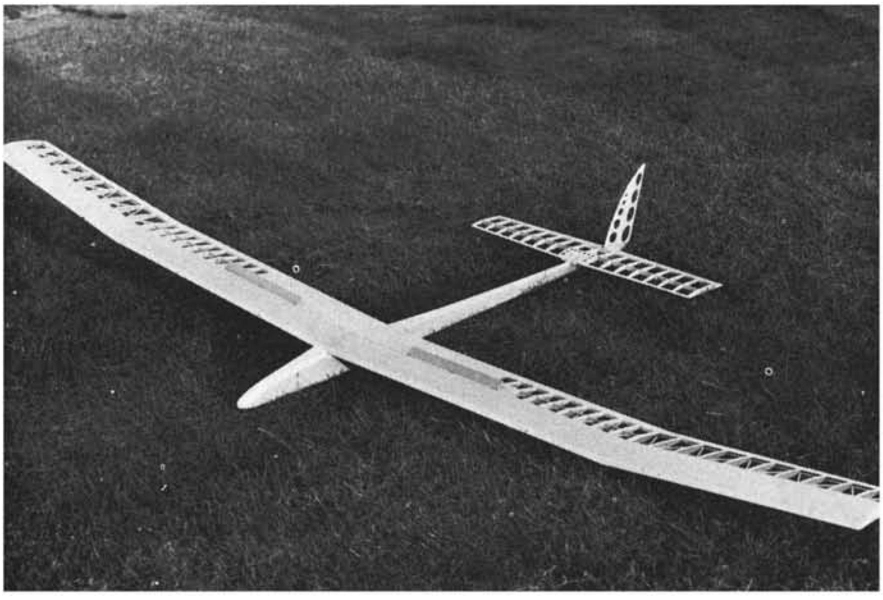
is not necessary. Once the bulkhead formers have been glued in position to produce the basic fuselage box, the aft end can be pulled together and the fuselage will assume its correct shape. Fit in the 1/8" ply floor and triangular section longerons, followed by the top and bottom sheeting. The nose block can be made by laminating sheet together (mine has a 1/16" ply laminate at the center) and then glue in position. When the glue has hardened the corners of the fuselage can be carved and sanded to generous radii and blended into the nose-block.

Add the stiffening around the wing mounting and tailplane mounting etc., slot the rear end of the fuselage and glue in the fin ensuring it is upright and straight (like any Englishman!). When the fuselage is complete, the false bulkhead can be removed and the towhook and servo's etc., fitted. Note that the towhook should be carefully made, the latch lever and hook being a close fit in the 'U' housing. The latch must be notched to fit the hook so that the harder the towline pulls, the tighter the latch grips. Trim the wing mounting until the wing fits snugly and fit the small fairings along the angled wing "knockoff" feature. Cover fuselage with silk at the front end and tissue all over.

Fit in your radio to suit yourself and link the servos to flying surfaces using balsa pushrods or snakes. Keep them light at the back end though! So now you're ready to fly!

Thermal Hopping

Check the model to see it balances correctly and that flying surfaces are correctly aligned. Have plenty of rudder and elevator movement—30° of travel each way is not too much. Try a few test glides over long grass with the radio on. The model will almost certainly stall—trim 1/32" off the rear tailplane mount and try again—repeat until the glide looks reasonable. My tailplane mount was cut down to 1/16" thick. Now try a hand tow on a short towline and get the model flying straight and level on the transmitter trims. After landing these can be returned to neutral and the adjustment made on the kwiklink connectors. I prefer to finish up with the elevator slightly below neutral when in normal glide trim. This in effect produces an undercambered tailplane section and helps to improve stall damping.



1/16" plywood spoilers rise along the wing, aid in a smooth off-line transition, spill altitude for landing, chickening out of downwind-bound lift. Every piece in framework for a purpose.

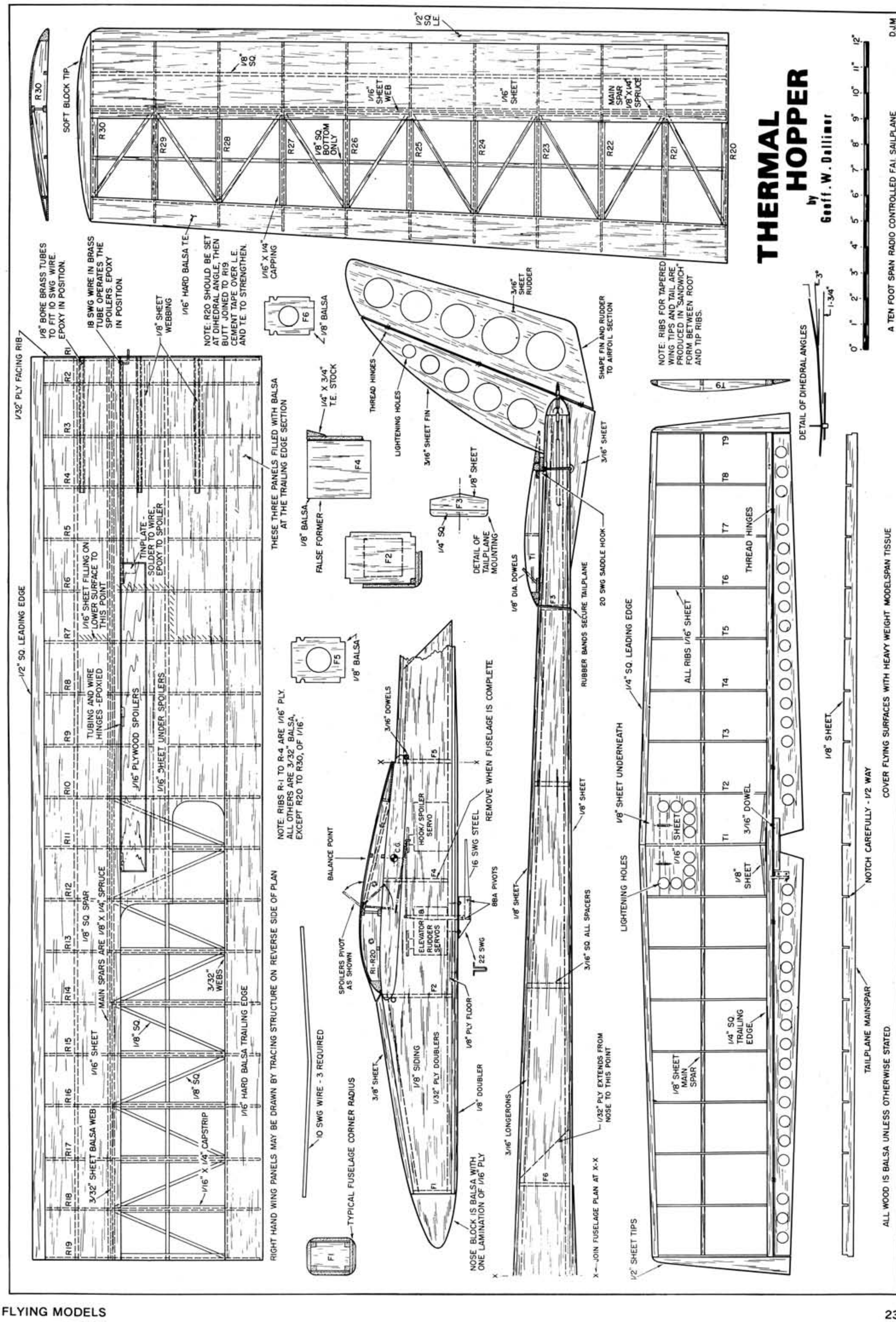
The thermal flying technique usually used here in Great Britain is to keep the model facing upwind and then "tacking" from side to side until lift is found. Only occasionally does it pay to circle in lift—that is when the thermal is strong and there is not too much wind drift. In the U.S.A. you may well find circling in lift the best way, however whichever way you do it, try and avoid letting the model come directly overhead. In this position not only do you get a stiff neck—but it is also very difficult to judge the models pitch attitude, so height can be wasted with the model stalling or diving unnoticed.

I have always used hand towing simply because it so obviously is better than mechanical winches. Not only does one get more height but one can feel and launch the model into lift at the start of the flight. This makes the contest more skillful and reduces the luck element. Hand towing doesn't need the excessively long 300 meter towline—most of which finishes up on the power winch drum! Of course if you are feeling your age and getting short of breath—power winches are just the thing!

Finally a word on wing loading. If one wants to fly faster into wind, (or 'penetrate' as it is occasionally called), then it is necessary to increase the wing loading. This is the major variable—changing the airfoil section makes a little difference, but not much. Wing loading is most important. Down elevator will speed up the model, but also loses height more rapidly. To get a large change in flying speed however one needs an awful lot of ballast in the model, so we have to compromise—mostly ballast but a little down elevator when necessary as well!

The existing model is around 7-1/2 ounces per sq. foot. If you feel you want to fly regularly at 8 or 9 ounces per sq. foot then put the extra weight into the structure. Use more and harder wood in the wing center panels and use 1/16" ply doublers in the fuselage. Finally add any lead needed at the C.G. It will still pay to keep the wing tips and tailplane light.

Well the oil lamps are burning low now and I hear the King's men at the door, so I just have to go... Good flying!



FULL SIZE PLAN AVAILABLE THROUGH CARSTENS FLYING PLANS