CHAPTER 6

THE "FULL-HOUSE" AEROBATIC MODEL

Three function control

THE term "full house,'" as applied to model gliders, generally means the use of three radio functions for the primary controls, elevator, aileron and rudder. There are additional refinements such as flaps, spoilers and even variable-camber aerofoils, but these do not come into the basics of flying, as such, and will, therefore, be dealt with later on in another chapter. From the point of view of flying characteristics and potential, we can divide the full-house models into two main categories—the aerobatic model and the semi-scale or so-called "sport" model. (The scale model proper, from the point of view of our generalisation, as far as flying is concerned, may be grouped with the semi-scale models.) Let us first look at the difference between the intermediate and the full-house model. That difference is, primarily, *ailerons.*

Aileron control

Here, for the first time, we have proper control over the *roll* axis of the model. In the intermediate model we produced our turns and our rolls by using the rudder, which first *yawed* the model, then the dihedral effect took over to produce a bank—or a roll, depending on how long we held the rudder over. With ailerons, however, we now have direct control of the roll axis.

Ailerons are coupled to the servo in such a way that when one moves upwards, the other moves downwards. Fig. 54 shows the way in which, when the stick is moved to the left, the left aileron moves up, so pushing that wing down. At the same time the right aileron moves down, moving the right wing up. This, then, produces the rolling action, around the longitudinal axis of the model.

Little or no dihedral is used on models which have ailerons, since they are not required to be auto-stable, laterally, as are the intermediate types. Because of this absence of dihedral the rudder now has its true *yaw* effect; it does not bank or turn the model but simply skids it sideways, and it soon resumes its former course, or almost, when the rudder is centred. Fig. 55 shows the skidding action termed yaw. *We must now forget about the rudder* for turning our model, and concentrate on ailerons and elevator. The rudder will now only be used for stall turns (which, as we have seen, require the yaw action) and spins. (There are other more advanced stages where all three controls are used simultaneously, but we will not concern ourselves with such refinements at this stage.)

Fig. 54

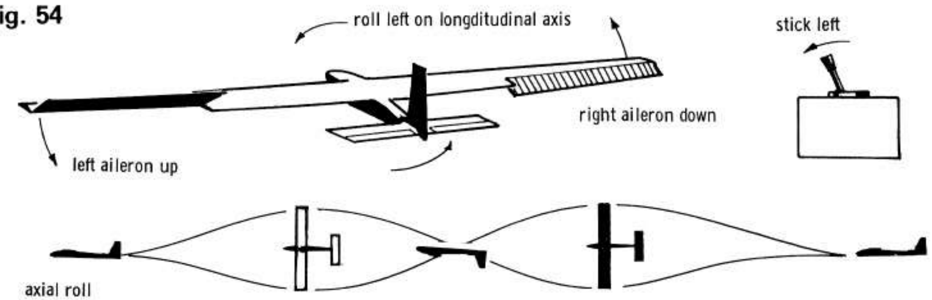
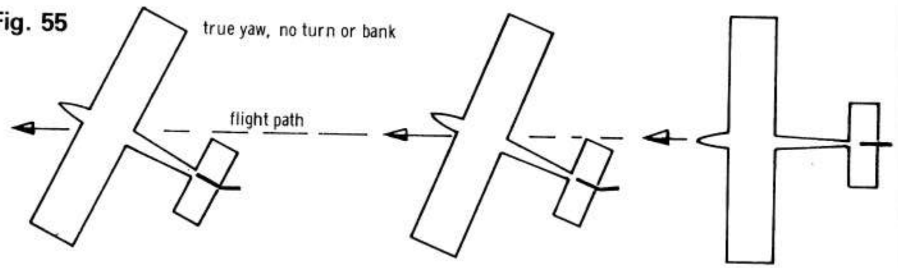
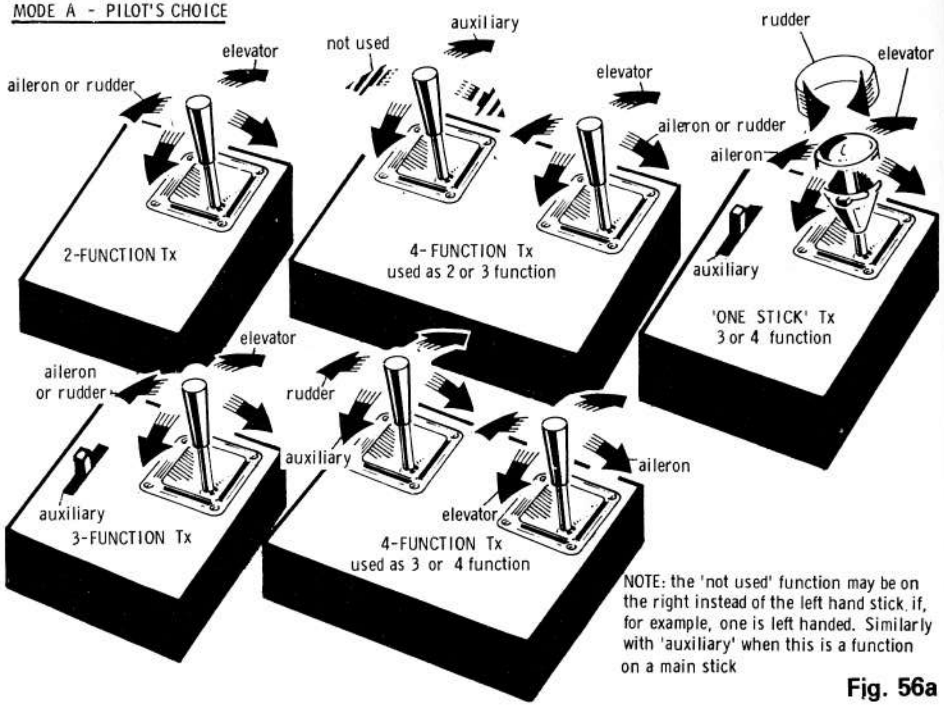


Fig. 55



Prime functions

At this point, a word or two about transmitter "modes" is appropriate. If you have read *The R.M. Propo Book* you will recall that we have two main modes of placing the controls on two-stick transmitters*. Mode A has ailerons and elevator on the right-hand stick, and rudder and throttle on the left. Mode B has elevator and rudder on the left-hand stick, and ailerons and throttle on the right. This is illustrated in Fig. 56a and b.



NOTE: the 'not used' function may be on the right instead of the left hand stick, if, for example, one is left handed. Similarly with 'auxiliary' when this is a function on a main stick

Fig. 56a

*The two control modes used when flying proportional have, not surprisingly, become known as Mode 1 and Mode 2. However, confusion exists as to which is which and we have decided to denote them as Mode A and Mode B so that at least it will be clear to which mode *we* refer! Mode A (referred to in *The Propo Book* as Mode 1) is where the two primary controls are operated by one stick, with the secondary controls on the other stick. Mode B (referred to in *The Propo Book* as Mode 2) is where there is one primary control on each stick. To be clear, the primary controls are elevator and rudder *or* aileron. On an aeroplane without aileron control, elevator and rudder are the primaries. On an aircraft with ailerons, it is usual for these, together with elevator, to be the primary controls and rudder the secondary control. However, as aileron control can, sometimes, prove to be less effective than rudder, in such a case one would retain the latter as the primary control. In the case of the "One Stick" transmitter (Fig. 56a) the "twist" control is always reserved for the secondary function.

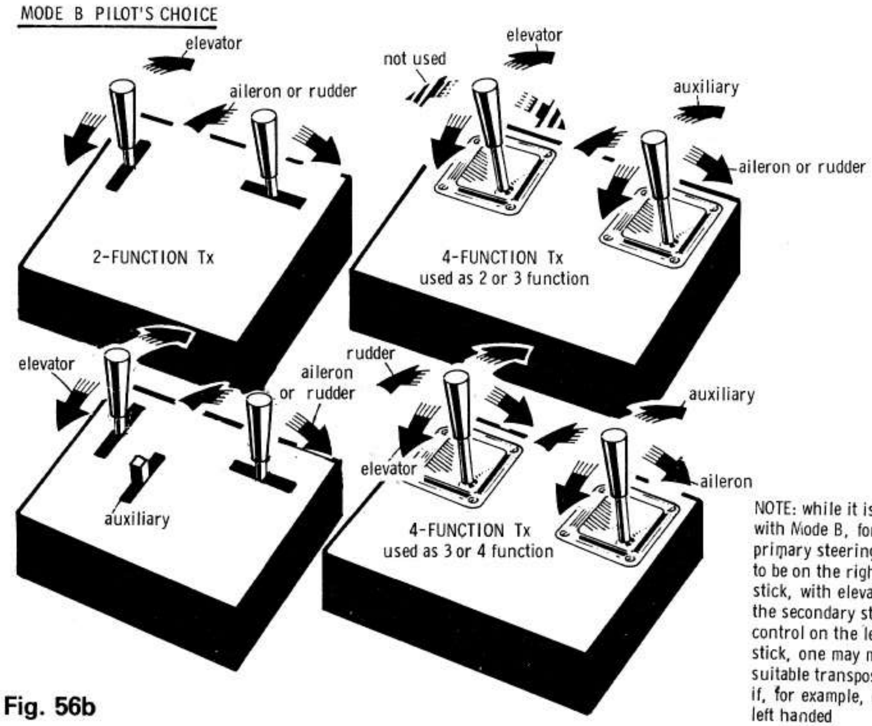
Now, we should always have our prime functions in the same place. That is to say, if we fly Mode A, with intermediate models we have been using rudder and elevator on the right-hand stick, but when we change to full-house, we now have *ailerons* and elevator on that stick, with rudder (now subsidiary) on the left. In the same way, if we fly Mode B, with intermediate we had elevator on the left and rudder on the right. Changing over to full-house it's *ailerons* on the right and elevator still on the left, plus rudder. The rudder has ceased to be the prime function (steering) and is replaced by ailerons—*which are now moved by the same stick movement we used for rudder on intermediate models.*

We have met people who, flying intermediate, have used rudder on the left and elevator on the right. On querying this, it was explained to us that they were "saving" the right-hand stick's remaining axis for ailerons, when they took up full-house flying! This is a curious piece of logic, and will be anything but helpful when they come to change over. Having learned to fly this way, they would be better advised to have *ailerons* on the left, when they add them. However, one would certainly pity any other flier taking over the controls with this bizarre layout!

To sum it up, then, whatever one *steers* with (rudder on intermediate; ailerons with full-house) should be on that right-hand stick, irrespective of which stick works the elevator. Similarly, those with single stick outfits should use the left/right stick movement for rudder when flying intermediate, and for ailerons when flying full-house, with the rudder then transferred to the twisting top of the stick.

Turns

Having said that we must forget about rudder, how do we go about making a turn with our full-house model? To all intents and purposes, the stick movements are the same.



NOTE: while it is usual, with Mode B, for the primary steering control to be on the right hand stick, with elevator and the secondary steering control on the left hand stick, one may make suitable transpositions if, for example, one is left handed

Fig. 56b

However, instead of yawing and banking (and thus also partly turning) as it did with rudder, the bank the model goes into when aileron is applied is *pure* bank. With the intermediate model's rudder, acting with its dihedral, it is possible to turn without using elevator (like the rudder-only model) but, with the full-house aerobatic model, if we only apply bank (aileron) then the model simply tends to fly one wing low. It does not turn until we apply up-elevator. The radius of the turn is, of course, determined by the amount of control movement applied. Many beginners making the change from intermediate flying, we have noticed, tend to be a little too tentative with their control applications. We must bear in mind that if only a small amount of bank is applied, then only a small amount of elevator is required—and a wide, sweeping, almost flat turn, results. If the model is travelling particularly fast (say downwind) when this command is given, it can skid out of its track, sideways. So the faster the model is flying, the more acutely it should be banked—rather like a cornering motor-cyclist.

If a large amount of elevator is given after only a small amount of bank, this will not tighten the turn so much as lift the nose and cause the model to try to do a stall turn or, more likely, simply a stall with one wing low. If, on the other hand, too little up-elevator is applied after a generous amount of bank, the model will not turn tightly enough and its nose will drop. If not corrected quickly, the whole model will begin to drop, in a sort of sideslip action.

At this point, some people may be wondering if it is worth their while changing over to ailerons! If that is so, then we have—in the interests of thoroughness—made the whole thing sound a lot more complicated than in fact it is. The intermediate flier will already have a feeling for the co-ordination between the two controls, and most fliers very quickly develop an instinct for the relationship between aileron and elevator, and their common relationship to the speed and attitude of the model.

The sequence for a turn, then, is as follows: (1) Maintain sufficient speed, (2) Apply bank (say 45°), (3) Centralise ailerons and pull up-elevator simultaneously, holding elevator until the desired heading is reached. (4) Give opposite aileron for long enough to bring the wings level and, simultaneously, a touch of down elevator to prevent the nose rising.

A little practice doing turns, like this, and the co-ordination will become so natural that all you have to think is "I'm going to turn"—and it happens.

There is no doubt at all that the addition of aileron control makes as great a difference to our flying as did the addition of elevator when we changed to intermediate from rudder-only. It makes models vastly more manoeuvrable and adds considerably to the number of figures they can perform. For landing, especially in awkward or restricted spaces, or in turbulent conditions, ailerons enable a wing to be picked up immediately, instead of having to go through the sequence of yawing first, and so pushing forward—towards the ground—that very wing we wish to lift up. Is aileron flying really *so* much superior, for slope soaring? many people will ask. Well, while it might be putting it a little strongly to say that full-house is "the only way to fly," we do not know of anyone who has once used ailerons, ever to go back to regularly flying rudder/elevator again. This is not to say, of course, that everyone's aim is flying aerobatic models. Far from it! But, while there are many semi-scale sport models flying on rudder/elevator, genuine *scale* models, by definition, must have the controls that their full-size counterparts have. Not only is it scale—it also makes them easier to fly! But we will be looking at semi-scale and scale models later on. Let us now look at some further manoeuvres, noting the differences, when we have ailerons, as applied to the aerobatic model.

The loop

Nothing very different about this one, of course, except that ailerons are used to correct any "skewing out" caused by the wind. This could not be done to any extent with the intermediate model because of the turning effect of rudder-yaw.

The roll

As we have seen, in Fig. 54, the roll can now be virtually completely axial. We dive, as usual, for speed, then briefly straighten up before applying aileron and holding it on. As the wings pass the vertical position, ease in some down-elevator—just enough to keep the nose

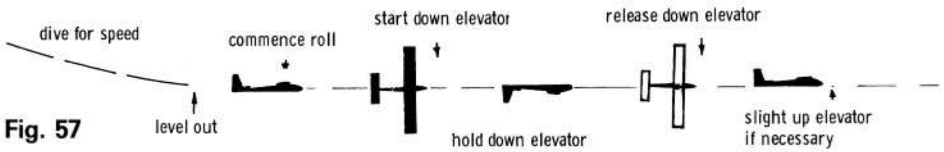


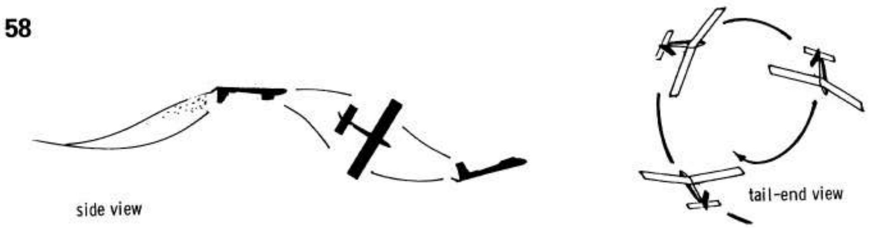
Fig. 57

on the same level—and, as the wings again reach the vertical position, take off the down-elevator and put in a small amount of up-elevator, if necessary, to keep the nose level. As the wings come to the horizontal once more, with the model again upright, neutralise the ailerons. See Fig. 57.

In multiple rolls, one holds in aileron, while using a sort of pumping action, giving first down, then up, then down, then up-elevator—to keep the roll as near axial as possible. The reason for having to give these elevator movements is because the model is rigged to fly upright, and will normally not fly so efficiently inverted. Because of the use of different airfoil sections—some more nearly fully symmetrical than others—different models will have different characteristics in this respect, some of the more highly bred contest machines requiring very little change in trim for inverted flying, and very little indeed for the short period they are inverted during a roll.

In particularly strong winds, it is often possible to make one's model perform a continuous roll without any progress forwards over the ground. It is amusing to see how many "rolls on the spot" it is possible to perform before the concentration weakens and the co-ordination of the elevator gets out of step!

Fig. 58



The barrel roll

With the intermediate model, even our best rolls were of rather a barrel roll nature. Doing a barrel roll with a full-house model, however, calls for it to be made purposely "barrelly." This is achieved (after first attaining some speed) by putting *and holding* on a little up-elevator at the same time as we apply aileron, so that the whole model flies round, corkscrew fashion, instead of on its own axis.

Only a very small amount of elevator must be used, of course, or the model will try to do an upward roll—not what we intended. Fig. 58 shows the barrel roll as performed by our full-house aerobatic glider.

Immelman turn

This is a simple method of reversing direction of flight. It consists of a half-loop followed by a half-roll (Fig. 59). As with most manoeuvres, first we dive for speed. Next level

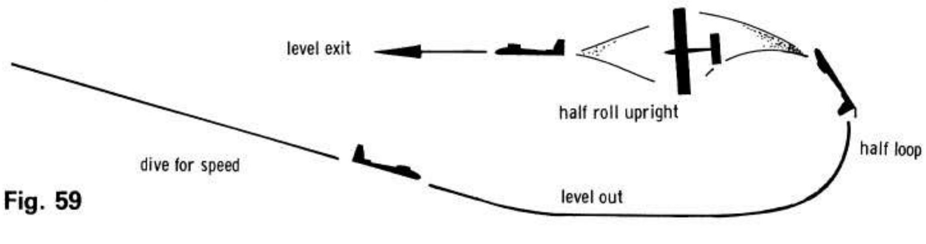


Fig. 59

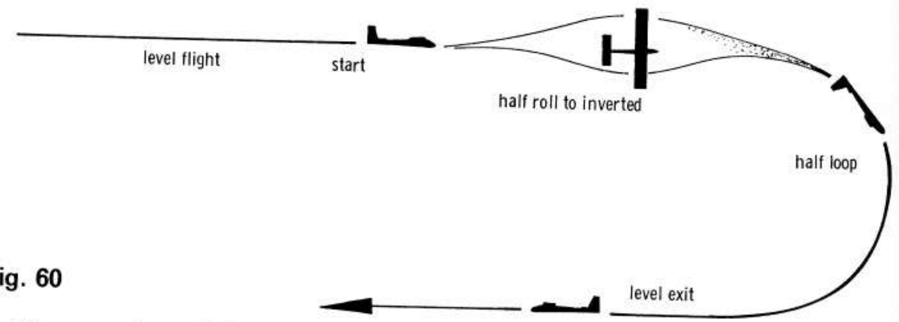


Fig. 60

out for a second or so before starting a loop. When the model is inverted, at the "top" of the loop, we half-roll it back to the upright position and resume level flight.

Reversal

Virtually an Immelman in reverse, (Fig. 60). From level flight, half-roll the model inverted, then pull it round in a half loop to resume level flight. This manoeuvre builds up considerable excess speed and is, therefore, a useful starting point from which to go into other manoeuvres when doing a series of them as a "pattern." It does have the disadvantage of having its exit considerably lower than its entry, of course.

Stall turns

The rudder is used for this manoeuvre—not ailerons. You may find it difficult to force yourself to do this, at first—with your left hand, not your right, but a little practice will see that left hand trained! At first we can do stall turns away from the slope, into wind (as we have seen, in Fig. 46, with the intermediate model), but later we should try doing them parallel with the slope. Thus we can judge the model's angle better—and also enlist a little help from the wind, to tip it over for us, making the manoeuvre much more positive. (Fig. 61).

Spins

These are performed in a very similar manner to that in which we did them with the rudder/elevator model (Fig. 47) except that *some* full-house models (usually those with no dihedral at all) also need to have aileron applied, in the same direction and at the same time as rudder—*i.e.* just after the model has stalled. Most models stop spinning when the

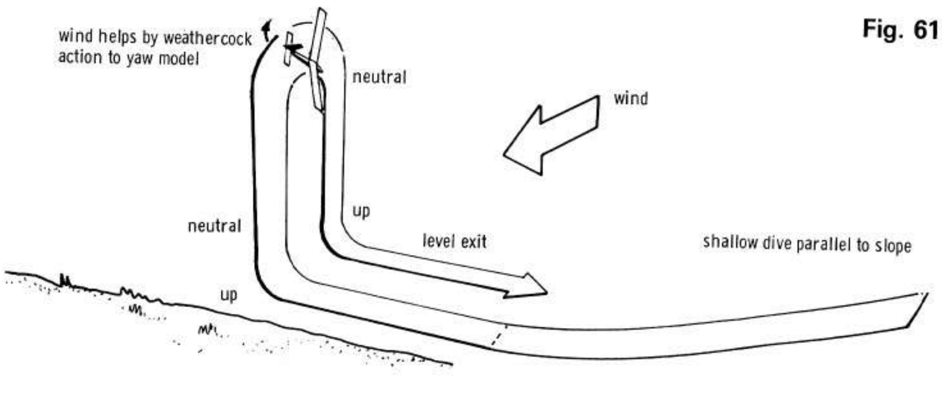


Fig. 61

controls are centred—most easily achieved by momentarily letting go of the sticks—and we have already seen (Chapter 5) how it is best to familiarise oneself with the period (measured in turns, or fractions of a turn) that a particular model takes to do so.

Inverted flying

We may have found our attempts at flying our intermediate model inverted somewhat less than rewarding, meeting with only partial, if any, success. With the full-house model, however, we have an aircraft that was designed for this sort of thing. A symmetrical, or nearly symmetrical wing section does not mind too much which way is "up," and we have ailerons for lateral control. Because of the wing section, not nearly so much down-elevator is required to keep the model's nose level and, of course, the ailerons work in the same "sense" whatever the model's position.

To try some inverted flight, then, first position the model well out from the slope, and at sufficient height to allow plenty of room for mistakes. (It is surprising how quickly height can be used up by a few unintentional "up-elevators" when the model is inverted!) Now, put on a little speed by slight forward pressure on the stick, level out and then apply aileron (either way—whichever side seems natural) when the model will roll. Neutralise the ailerons just a *fraction* before the wings reach the horizontal position with the model on its back and, at the same instant, apply a little down-elevator (Fig. 62), to keep the nose from dropping, which it would otherwise try to do.

Fig. 62

It will be necessary to experiment in order to find the exact amount of down-elevator to put in at this particular roll-over point, as each model will have different requirements. If anything, err on the mean side, since too little will cause the model to gain speed—which is always safe—whereas too much could stall it. Once the flight path is more or less stabilised, the speed can be controlled by the use of the elevator in the usual way—apart from having to "think upside-down."

Persuading the model to take up the inverted position, then, is simply a matter of going through the actions of the first half of a roll. *Flying* it inverted takes rather more concentration. The elevator has now changed 'senses' and, to put the model's nose up, we have to give a stick movement corresponding to "down-elevator," and vice versa. Most people develop their own aids to this mental transposition, while learning, but one of the best methods is *not* to think in terms of your own "up" or "down" but in terms of the model's—*relative to the model itself*, not to the ground.

As we have said, the ailerons work the same way whichever way up the model is (they have to, if we think about it, or we could not perform a roll), so we use them normally to correct any wing-low tendencies. When you have had as much of this rather tantalising "inverted elevator" as you can stand, for the moment, bring the model back upright. The correct way is to roll back to the upright position, but it is a great temptation to the novice simply to pull back on the stick and half-loop out. This is in order, provided there is still sufficient height, for the first few tentative attempts (and admittedly it seems the easiest thing to do, at the time!—what a relief to relax from that intense concentration!). But do try to start to *roll* out, as soon as you feel you have sufficient confidence.

When you find yourself able to keep the model inverted for a reasonable time (say, 10 seconds), the next thing to do is to try some turns. Build up a little speed first, by easing off some of the down-elevator, then apply bank and tighten the turn by means of elevator in the normal way—*except* that it is down-elevator that we increase to tighten the turn, not up.

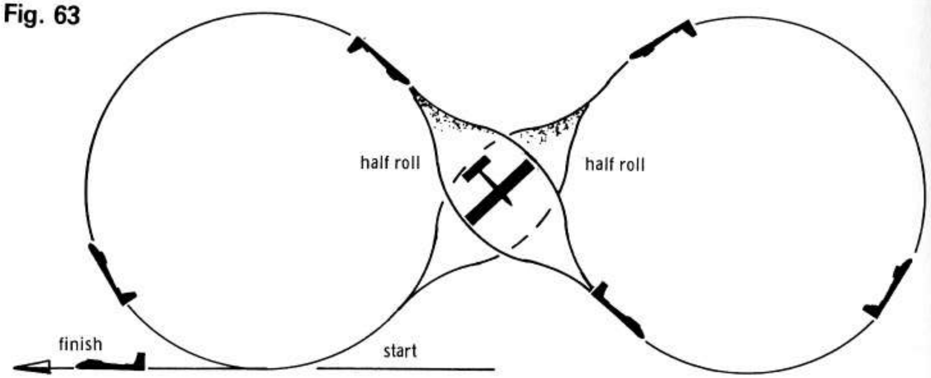
When you eventually get the feel of this, you will want to try prolonged inverted flying, and figures like inverted circles or eights.

Inverted spins

While you are practising your inverted flight and generally familiarising yourself with your model's inverted characteristics, you may like to try an inverted spin. You will probably already have stalled the model inverted, through putting in too much 'down.' For the spin, of course, we first need just this inverted stall. From level inverted flight, into wind, ease in all the 'down' available, so that the model stalls positively. Then, as the nose drops—and keeping in full down-elevator—put in full rudder (and ailerons, if they were necessary for a normal spin). The model should now perform an inverted spin.

Recovery from an inverted spin should, by rights, be back to inverted flight. You will no doubt be glad enough to have the model recover any old how at first—while you yourself recover!—but it should be borne in mind, for later on, that that is how it should be done. Start inverted; finish inverted, and on the same heading (*i.e.* pointing in the same direction).

Fig. 63



Cuban eight

If you can loop and roll your model, then you have the basis of a Cuban eight. The actual execution of this figure, however, calls for a well-developed sense of timing. It consists of two interconnected loops, the model performing a half-roll, to the upright position, at the intersections, on each pass, as shown in Fig. 63.

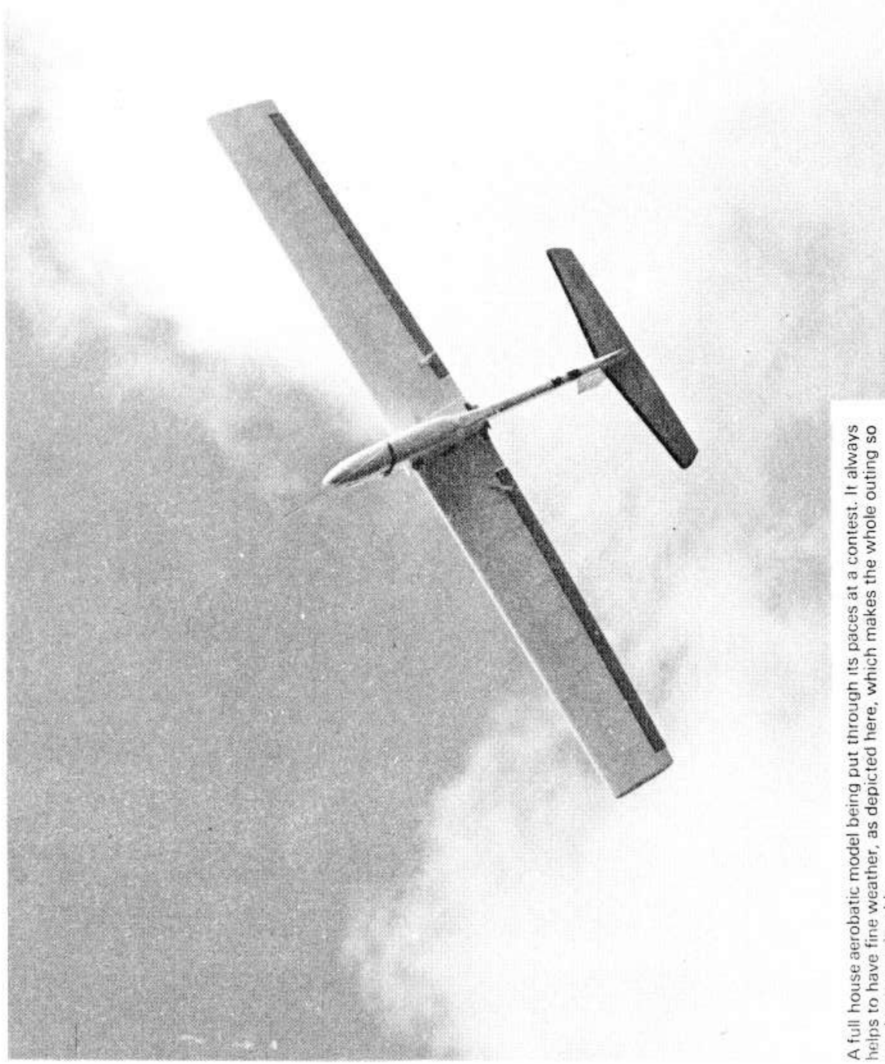
Dive the model as for a loop, commence the loop and then, at the "two o'clock" position—when the model is inverted and diving at about 45°, make a half-roll to the upright position—still at the same angle of dive—and then continue with another loop, again half-rolling at the intersection. Pull round to the bottom of the loop, and level out.

In words, it sounds complicated, but in practice it is not too difficult to do a recognisable Cuban eight. What *is* difficult is to position the loops properly relative to one another, and to make them nicely circular and of the same size.

Outside loop

This is one of the manoeuvres that really started the model designers working overtime, and has resulted in some of the highly developed aerobatic gliders we have today. With a power model, it is relatively easy to execute an outside loop, with a powerful motor pulling the model all the way. With a glider, however, it is a different matter, and both aerodynamic design and flying technique come much more into the picture.

Plenty of initial speed is needed for the outside loop, so it should be commenced from as high as is reasonably possible. Now dive for speed and, just before you intend to commence the manoeuvre proper, level the model out briefly, then ease in the down-elevator to make



A full house aerobatic model being put through its paces at a contest. It always helps to have fine weather, as depicted here, which makes the whole outing so much more enjoyable.

Start of an aerobatic contest flight. You have to be something of a showman to be at your best at times like this. The challenge (and the spectators!) bring out the best in some fliers, while others go to pieces. It's all a matter of temperament.

the model arc downwards and "tuck under" the bottom of the loop, (Fig. 64), easing in still more down until you have in almost full travel at the "ten o'clock" position—pushing in the remaining amount between this point and the top. If the model is a good one, it may actually speed up over this last part, but if it is not, it may slow down alarmingly, and even stall, flopping over either forwards or on its back.

As with all other manoeuvres, much practice is necessary to achieve anything like the correct shape, so try varying the amounts of down-elevator at different points in the loop and you will find how your particular model needs to be flown round it. Probably the most crucial part (though it varies) is the "7 o'clock" to "9 o'clock" one and, if the model has not sufficient speed, this is where it will show up. When attempting an outside loop for the first time, therefore, be ready to roll out or—if the model is almost vertical—simply let it stall and recover in the normal way.

We have described the correct way of performing an outside loop. Another way, often seen, is to start from level flight at normal speed, and gradually increase the down-elevator until the model goes round in an increasingly tight curve. This way, the manoeuvre has no definite beginning (Fig. 65a) and is usually elliptical rather than circular, with the exit much lower than the entry point. Not really ideal but easier, perhaps, to start with than the "classic" one shown in Fig. 64.

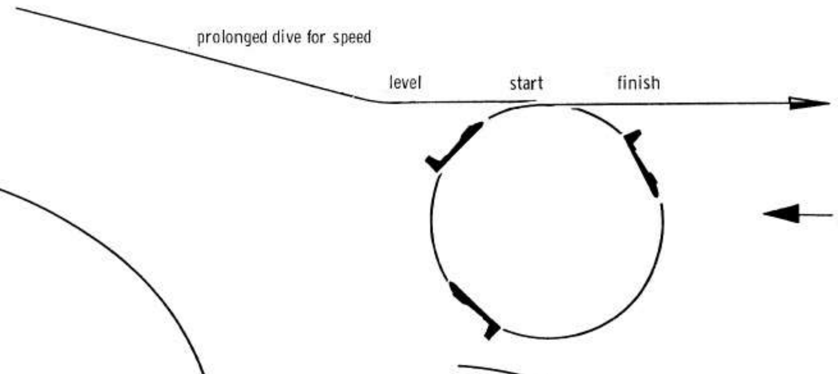
If all your model can manage is something like that shown in Fig. 65b, then either the model itself is not very suitable (wing section not symmetrical enough? Model too heavy?) or else you are not putting in enough down-elevator at point 1, and too much at point 2. Aim all the time for as nearly a circular track as possible.

All in a row . . .

Not content with "improving" the breed to the extent that all aerobatic gliders worthy of the name can do a "bunt" (as it is—incorrectly—nicknamed), some of the contest organisers are now demanding two, and even three consecutive outside loops, so it behoves the would-be contest goer to make sure he can do at least two!

There are, of course, ways of executing and presenting all manoeuvres to score high

Fig. 64



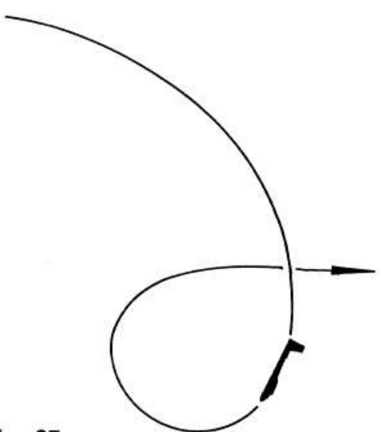


Fig. 65a

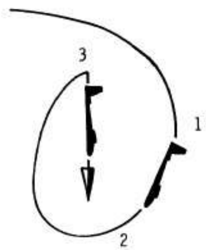
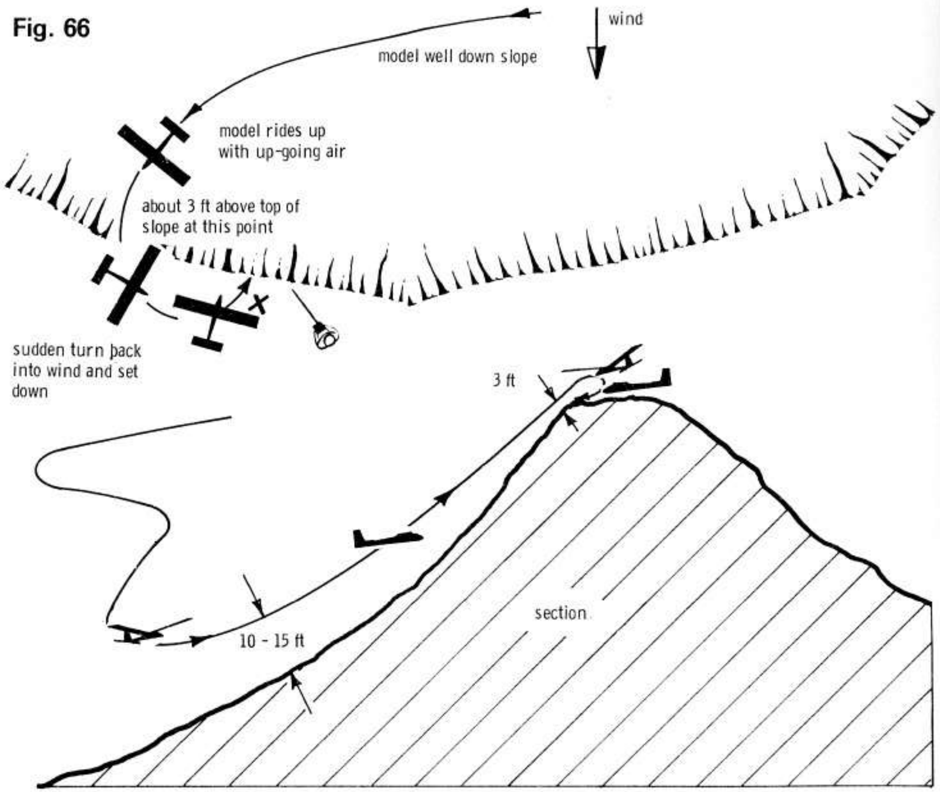


Fig. 65b

Fig. 66



marks, and some of these are explained by our guest writer, Ken Binks, in the chapter "Approach to Contest Flying," a little later on.

General flying

A mistake many newcomers to full-house aerobatic soaring make, after graduating from the more sedate intermediate model, is to fly their models *too slowly.* They then complain that the model is unresponsive and "mushy." The aerobatic model needs *speed* for correct performance and should not be cruised about like a "floater" or it will be near its stalling speed all the time, when its control surfaces cannot be expected to be very effective.

Landing

With full-house, landings become yet another stage easier, simply because one has control of the model's movement in all three axes—pitch, roll and yaw. In a sense, of course, this means that it can also be more complicated, because there are more controls to operate. For most purposes, however, we continue to use only elevator and ailerons.

Depending on the terrain we are flying from, landings may be made in any of the ways described in previous chapters, with the added advantage of being able to *pick up a wing, quickly,* perhaps at the last instant, without having first to make the model yaw, and push forward—towards the ground—that very wing we want to lift clear.

It will be found that ailerons give the model such great near-the-ground agility (as long as the proper flying speed is maintained) that you become more and more able to control

precisely the spot at which it lands, instead of being glad to get it down safely anywhere within 50 yards! When you can land the model within six feet of yourself, *every* time, then you can claim to have perfected your landing technique. (If you have not achieved this after a year or two's flying, don't worry too much—there are probably only a dozen people in the country who can do it, anyway!)

A handy way of landing, for most places where there is no flat landing area available, is what we can call the "quick about-face" method. First determine the spot at which it is proposed to set the model down (say, about 6ft. to your left, at the lip of a bowl). Now lose some height, so that the model is some way below you, but do it in such a way that it does not build up too much speed. With the model pointing towards the slope (Fig. 66) and perhaps ten or fifteen feet away from it, *let it ride up the slope with the upgoing air* until it is at the crest, when you turn it quickly back into wind. This sudden into-wind turn gives the model more effective airspeed, which reduces its actual ground speed to virtually zero. At this point, it is only two or three feet from the ground, so ease in the down-elevator to bring it forward, steering the model to the predetermined spot—or as near as you safely can.

The main thing, in doing this type of landing, is not to let the model get too high as it comes up to the lip of the slope or, by the time you ease it down (and thus forward)—it will have gone out away from the slope again! If you start the turn—a steeply banked, tight one—as the model passes over the lip of the slope, it should be facing back into wind and two or three feet up, some six feet back from the lip. This is the general idea but, of course, the wind velocity, type of model and type of slope will all play a part in modifying the details.

A variation of this technique has the refinement of using rudder, as well as ailerons, for the final stages, and is used by the most advanced fliers, who have no trouble in co-ordinating the three controls simultaneously. This is done as follows. . . .

Again position the model well down the slope, and 10 or 15ft. away from it, flying parallel with it. Now turn in towards the slope face, but do not point the model directly at it; an angle of about 45° would be about right (Fig. 67 shows this). Now let it ride up the hill with the rising air, as before, while it is coming towards you, but turn it back into wind while it is still some way down the slope and "crab" it sideways towards you, using the rudder to keep the nose pointed into wind, whilst using the ailerons in the usual way and the elevators to control the height and speed. The last few yards will be covered with the model only two or three feet from the ground, so one needs a steady, reliable breeze for this sort of landing, especially when trying it for the first few times.

Fig. 67

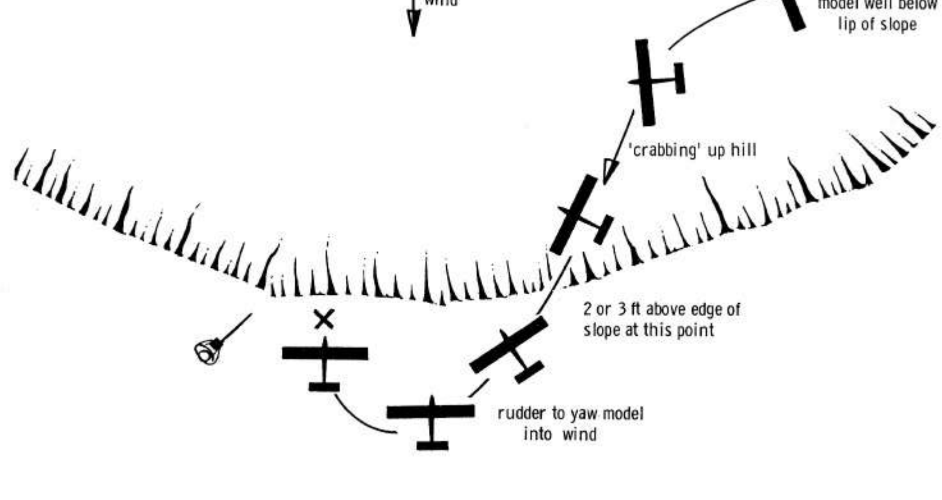
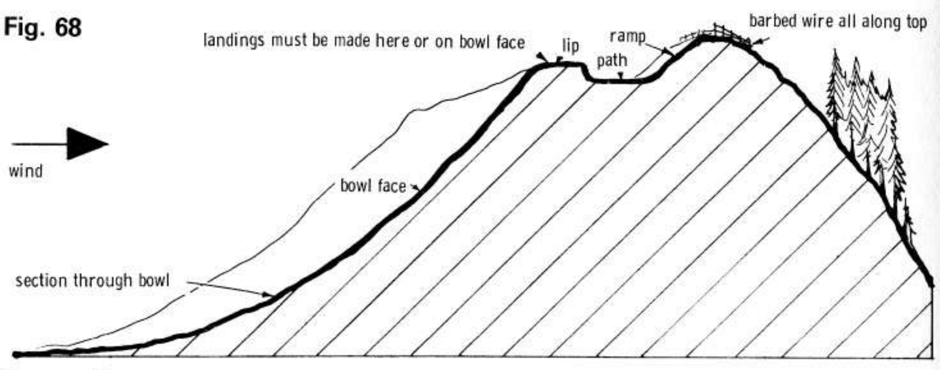


Fig. 68



Be versatile

If you happen to fly regularly from a site with the "classic" plateau top, affording a "sink" area and plenty of nearly flat landing space, then you could well find yourself at quite a disadvantage when faced, perhaps at a contest, with a very different type of site. A bowl, perhaps, with a very narrow lip—say about 5ft. wide—behind which is a path, some 6ft. lower and about 10ft. wide, and then a ramp, topped by a barbed wire fence, beyond which the hill slopes away sharply downwind. Fig. 68 shows the sort of thing. We are not dreaming this up as an extreme case, either—it is based on a well-known contest venue! (Little wonder the local soarers are such expert fliers—their environment encourages it!)

To attempt a square landing approach at this sort of site could be hazardous, as you will readily see. Too far back and the model is in turbulence and sinking air. Turning earlier, and aiming to set down on the lip, could mean the model either hitting the barbed wire fence or, if it clears that, to drop into the downwash coming from the lip—and fall onto the path. If it is high enough to clear all these hazards, it will not be low enough to land on the lip, so unless able to do a "sidle up and sit," the only remaining option for the pilot is to do a slope-side landing somewhere on the curved face of the bowl. From this you will appreciate that it pays to be able to land in quite a number of different ways.

It is very beneficial, not to mention enjoyable, to travel around the country, either to contests or simply trying out new and different sites (take a model on holiday!). This way, you will be landing in all sorts of unfamiliar surroundings, and have to adapt to them. It must not be expected that any single one of all the landing methods described will apply specifically; the combinations of different site configurations are too great. Having become familiar with the kinds of approach, however, it will be possible to combine parts of two or three of the approaches described, and create your own landing technique for any given set of conditions.

Climate makes the model?

Britain seems to have made the aerobatic slope soarer its own. In nearly all other countries of the world, slope soaring gliders still look like full-size sailplanes(!) with high aspect-ratios and slender lines. Mostly these are without ailerons, and so with little, if any, rolling or inverted flight capability. However, the aerobatic lead set by British modellers is spreading. British designed soarers are being flown in South Africa, New Zealand and Australia, and in Germany models are appearing with ailerons—although maintaining their high aspect-ratios and elegant "sailplane" appearance. with correspondingly limited potential in the "extreme" performance range required for outside or inverted manoeuvres.

The British aerobatic soarer is capable of handling almost anything that the weather here can hand out, from 10 to 50 m.p.h., steady or turbulent, and the British weather could well be the reason why our models have developed, as they have, into a quite unique position in the world of r/c gliding.

CHAPTER 7

FULL-HOUSE SPORT AND SEMI-SCALE SOARERS

HAVING dwelt on the nature and flying of the full-house aerobatic glider at some length, we now turn to the so called "sport" and semi-scale models.

There are many modellers—indeed they undoubtedly form the vast majority—to whom contest flying (and thus the specialised contest aerobatic model) is of no interest. In fact, they cannot understand why anyone should make a round trip of anything up to 400 miles just for two five-minute flights, when they could be flying the whole day long at their home slopes! It is to these modellers, who enjoy slope soaring purely for its own sake, rather than as an outlet for an urge to prove themselves better, in some way, than the next man, that the sport and semi-scale models appeal. They can be extremely elegant, and are often very efficient, rising to much greater heights than their "compact" aerobatic cousins. The sight of a near-scale *Skylark* or *Kestrel* circling gracefully aloft is very satisfying indeed.

From the flying aspect, these models, with their high aspect-ratios and resulting large wingspans, simply take up more room to manoeuvre than do the aerobatic contest jobs. They have more mass-inertia and their large spans tend to make them slow to roll, even with ailerons. These characteristics give them an air of majestic serenity—even though they may actually be travelling quite fast. A sort of "scale effect," one might say, which really befits their appearance.

As a general rule, flying this type of model, one must not slow it up too much or a tip stall* and incipient spin can result. While this is usually controllable, sorting it out takes up room, as it were, so a tip stall near the slope or on the landing approach is very much to be avoided. The semi-scale or near-scale model is more prone to tip stalling then is its "free-lance" counterpart because the latter will often have a lower aspect-ratio and probably ample washout at the wing tips, thus being very stable and docile, if not perhaps so sleekly elegant in appearance.

Launching the large model

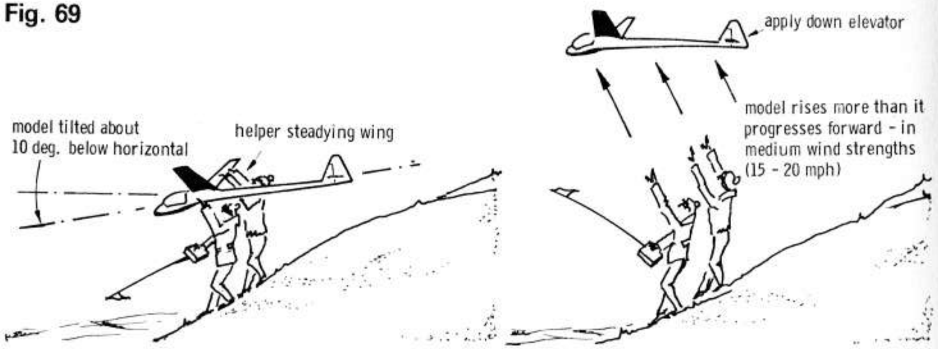
For its first launch, the large sport or semi-scale model is best held, not by the pilot, but by a helper, with possibly—if the wind is at all blustery—a second helper steadying one wing. The nose should be tipped slightly downwards—about 10° from the horizontal (Fig. 69) and the model launched, straight into wind, with a smooth, follow-through action. Note that *straight into wind.* The wind is not always blowing at right angles to the slope; sometimes it is at a relatively acute angle to it, so do not then launch the model straight out from the slope (superfluous advice, one may feel, but we have seen this mistake made, again and again!) but obliquely from the slope and *directly into the wind.* (Fig. 70).

As always, we must be ready to put in some down elevator as soon as the model is launched, and aim to keep the nose a little below the horizon until some headway has been made, out and away from the hillside. If the lift is good, it is quite possible that the model will start to ride up bodily—even though the nose is pointing well down from the horizontal. It often happens that the movement of air upwards is greater than the model's progress

***A "tip stall" is when the tip of the wing stalls first, rather than the whole wing stalling at once, causing that tip to drop sharply. This can be very vicious on high aspect-ratio models with tapered wings, where the chord at the tips is often very small. When the stalled tip drops, the model will often begin to spin of its own volition—very dangerous if it happens near the ground.**

To help reduce this undesirable characteristic, it is common practice to introduce "aerodynamic twist" to the wing—known to modellers as "washout"—whereby the angle of attack at the tips is reduced, or even becomes negative. Thus the tips become the last part of the wing to stall, so ensuring a "straight" stall.

Fig. 69



forwards (as depicted in Fig. 69), and we have to apply even more down elevator to gain "penetration" into the wind and out from the slope.

"Penetration"

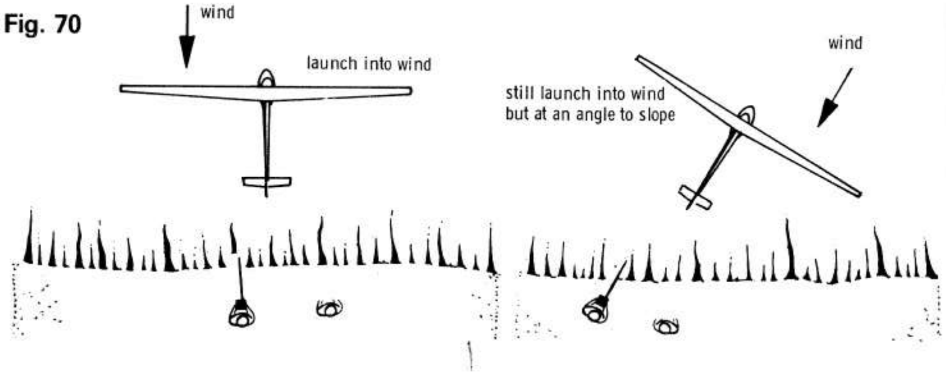
Some models have better penetration in these conditions than others. A higher wing loading will usually make for better penetration, and thin wings will often have a similar effect. The right combination of both will produce a model with very good penetration. Of course, we must be prepared for such models to fly unusually fast when the wind is not blowing so hard. The docile sportster will have a medium wing loading of around 10-16oz./sq.ft. and a fairly thick wing. The near-scale type will, of necessity, have a quite thin wing and, depending upon its construction, a loading of between 10 and 18oz/sq.ft. At the lower end of this range it will usually have fairly pleasant handling characteristics, which become more "interesting" as the weight goes up. (For "interesting" read "exciting"—or even downright hair-raising. It depends very much on the combination of wing-loading, configuration and general design.)

High speed landings

The higher the wing loading, as we have seen, the better the penetration, and we then have to pay the penalty of the resulting high landing speed. One must not attempt to slow these models down too much on the landing approach or, despite washout, one can engender a tip stall, which can result in a spectacular flick-roll at 6ft. altitude—not good practice unless one prefers building to flying. We must allow the model to come in at its natural flying speed, and only ease back the stick at the very last moment when it is within an inch or two of the ground.

Coming in fast, like this, it is desirable that our landing area is as smooth as possible

Fig. 70



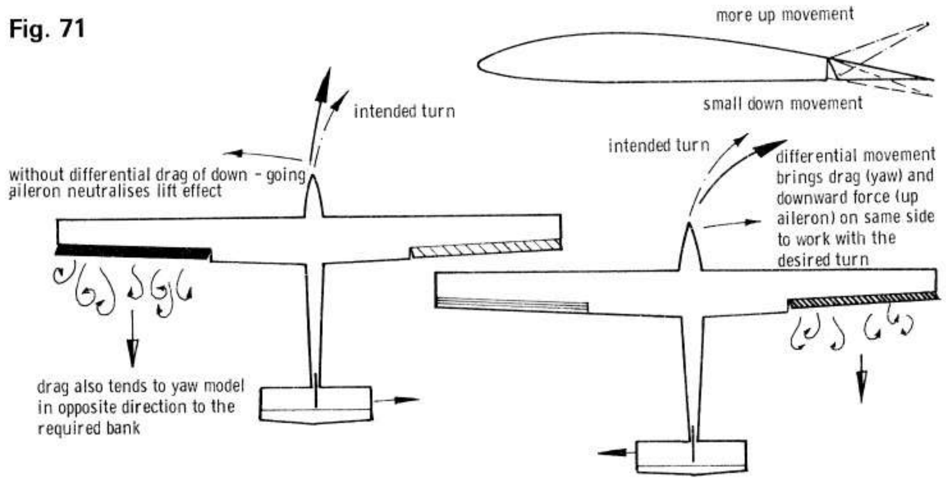
and free from large bumps or tufts which could catch a wingtip or hit the tail. (When flying near-scale or scale gliders, it is a pity that we cannot all fly from a site near a golf course, where we could land on the green in virtually "scale" conditions! As it is, most of us have to set our models down in the scale equivalent of a forest of 4ft. high fir trees!) However, for our landing with the full-house sport or near-scale model, we can at least "pick up a wing" with our ailerons, much quicker and easier than we could with that rudder/elevator sport model, and thus can keep the wings lined up and level, and out of the way of any nasty looking tufts we may see looming up in the landing path.

Ailerons and rudder

In turns, for general flying, it is usually preferable to use ailerons and rudder together, in a co-ordinated manner, just as in full-size gliding. While some high aspect-ratio near-scale types will turn well enough on aileron alone, much smoother and realistic turns can usually be effected by using both controls—plus, of course, elevator to keep the nose up and to tighten the turns in the usual way.

Many fliers find it difficult to co-ordinate the controls properly at first. It is not the sort

Fig. 71



of thing one has to do in flying any other kind of model, except perhaps the powered scale model. To most, the knack comes, after practice. To some it never seems to quite "click." These will often prefer to have it done "automatically" for them, by means of "CAR" (coupled aileron and rudder) and more information, together with a typical linkage for this sort of system, is given in a later chapter. It is also suitable, of course, for those who only have two-function equipment, enabling them to operate three control functions. If at all possible, however, it is infinitely preferable to keep the control functions operating separately, and learn to co-ordinate them. To have ailerons and rudder coupled all the time *can* be an embarrassment, as the reader will realise, on mentally going through some manoeuvres.

We find some odd effects with ailerons, on high aspect-ratio wings. If we have equal "throw" on these control surfaces (that is, the same amount of movement, upwards, as downwards), they may not have the effect we require. In fact, it is possible to have an aerodynamic reversal of the ailerons' effect. (Nothing to do with fitting the servo in the wrong way, either!)

What happens is this. The down-going aileron has more drag effect than the up-going one, so this tends to (a) neutralise its lifting effect and (b) to yaw the model to that side—*i.e.*

out of the intended turn. On moving the stick, say, to the right, we see a momentary yaw to the left, followed by nothing very much. Or we may come across a condition worse than this, where the wing with the down-going aileron stalls, and drops. That is to say, we move our stick to the right—and the left wing drops!

What we have to do to correct this rather alarming fault is to incorporate a differential movement of the ailerons, so that they move at least twice as far in an upward direction as they do downwards. A 3 : 1 differential is better still, if it is mechanically possible. Some designs even use a system whereby the ailerons move upwards only, alternately, thereby having the downward force and all the drag on the same side—the inside wing in the turn—so helping the turn rather than hindering it. Fig. 71 shows the differential aileron effect. (Details of the geometry and mechanics for obtaining differential movement will be found in *The Radio Control Guide.)*

As we said earlier, the sort of models we have been talking about in this chapter are usually very "clean," aerodynamically, and highly efficient, being capable in fair conditions of being flown to almost "out of sight" heights. Flying one of these graceful creations, well up into the blue, it is easy to have it mistaken (if only momentarily) by an onlooker, for the "real thing"—and on such occasions who will not forgive us if we indulge in a satisfied chuckle?

CHAPTER 8

THE PYLON RACING SOARER

FROM the "non-competitive" pleasure-flying model, we now turn to a type of slope soarer that has been evolved for the sole purpose—as its names implies—of competitive flying. (Why build a racer if not to race?)

Strictly speaking, most pylon racers could come under our "intermediate" category, in that they require only two controls. However, we have seen that the recognised intermediate controls are rudder and elevator, whereas *most* pylon racers, being largely derived from aerobatic models, use *aileron and elevator.* Indeed, the specialised pylon race soarer is one of the most recent developments in slope soaring and although, naturally, it is possible to fly an "ordinary" aerobatic model in a pylon race, the trend towards specialised designs means that, if one is to be competitive, then one must virtually rule out-of-the-running any compromise designs or dual purpose models.

Speed is the prime requirement here, with turning ability a close second. As we have seen, rudder is not required (this usually only being used for stall turns and spins with aerobatic models, not for turns). Neither are outside loops or inverted flying, so we see a return to the semi-symmetrical aerofoil section and, in many cases, to the flat-bottomed one. For a given area, the wing with the flat-bottom section generates more lift and, when "held down," as it were, by the pilot, that excess lift seems to result in increased forward speed instead of climb. We will not attempt, here, to discuss the reasons for this—though the more technically inclined reader may see some clues in Fred Duedney's technical section, later on—but if our description sounds too "un-aerodynamical" for you, then perhaps it will be more acceptable put another way. Let us say, then, that one can put the nose down further (thus increasing the speed) on the model with the more efficient (lift-producing) wing section, *without loss of height.*

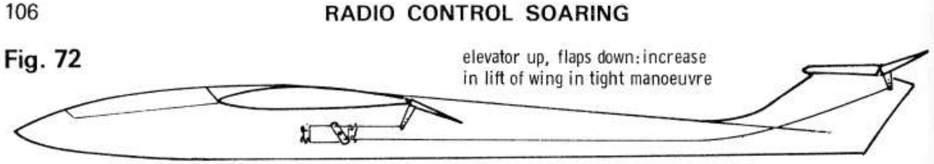
The wings will, however, tend to be *thin,* for low frontal area and low drag characteristics. Spans tend to be a little greater than the average aerobatic model, because aspect-ratios become higher (again, for greater efficiency, since rolling—at any rate past the vertical position!—is not required). The whole model is generally more sleek and cleaned up than the majority of aerobatic models, an increasingly common feature being the use of "V" or "butterfly" tail units, to give reduced wetted and frontal area (and being conveniently less complex, mechanically, for not having to incorporate a "rudder" action).

Perhaps not surprisingly, when one considers their clean lines, high aspect-ratios, and thin, flat-bottomed section wings, some true (that is rudder/elevator) intermediate models—notably the *Cirrus,* a near-scale type based on the full-size sailplane of that name—can be made to fly extremely fast, especially when their wing-loading is increased by ballasting, often making up in sheer speed any loss incurred in having to make wider turns.

Usually, the pylon racing models are constructed rather more solidly than their aerobatic counterparts, the higher wing loading increasing the flying speed (though this, as always, is a compromise, since the heavier models will not turn so tightly). Tightness of turn being a prime requirement, we also find models using the coupled-flap-and-elevator set-up that we described briefly when first mentioning the pylon racing model in Chapter 3.

This system was originally evolved by the control-line stunt fliers, in the 1950's, when their schedules started to demand very sudden changes in direction—square outside loops and so on. The flaps, at the trailing edges of the wings, are coupled to the elevator push-rod

Fig. 72



in such a way that when the elevator is made to go up, the flaps will go down (Fig. 72). Thus, at the very moment when most demand is put on the lifting ability of the wing, extra lift reserves are provided, to enable it to pull round those 'square' manoeuvres or, in our case, the very tight pylon turns, with little loss of speed.

There are a number of variations of the coupled flaps idea; some feature separate flaps, along the inboard half of each wing panel, while others utilise what have come to be known as "flaperons"—a combined flap and aileron. This, by means of one of a number of possible mechanical linkage systems, enables the aileron to act also as a flap (by drooping but still retaining its aileron action) and still be coupled to the elevator push-rod in its flap capacity. Such a system is shown in Fig. 73, which has the added attraction of a "knock-off" crash-proofing feature, so as not to damage the servos in the event of a crash or "heavy landing."

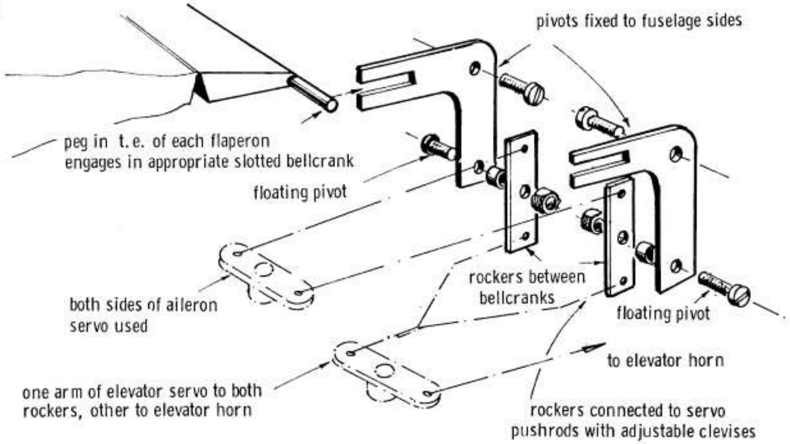
We have seen that some designers go to great lengths to produce aerodynamically "clean" models (no external rubber bands, or even control horns, in some cases), but the question of whether or not a very high surface finish helps does not really seem to have been resolved. We have known modellers produce a really beautiful mirror finish by spraying and rubbing down—and then polish the model with furniture polish, but turn in only a mediocre performance. The winning models, on the other hand, on many occasions have had only a mediocre finish—but a startling turn of speed. On the whole, we think it is probably the general configuration of the model, and the way in which it is flown, that count more than elbow grease at the workbench.

Pylon race flying

In slope soaring pylon races there are usually only two pylons, rather than the three used in powered racing. This, of course, is dictated by the fact that the course must be along the face of the ridge in order that the models can fly continuously in slope lift. The models race to and fro, and turn as they *pass* the pylons, *not* turning around them as in powered pylon racing. See Fig. 74.

There are differences in detail, around the country, some dictated by the nature of the

Fig. 73



slope (it's not possible to arrive at a standardised length of lap, as no two sites are the same) and others by the ideas of the organising club but, in general, the soaring pylon race is something like this. The two "pylons" each consist of two flags, forming two parallel lines, some 200 or 300ft. apart. A race is usually either six or ten "laps" (12 or 20 "legs"). With the flying start, one minute is given for the models to gain height, the last ten seconds of this being counted down (by the official starter or contest director) to zero. All the models must, at this instant, still be on the start side of the line. Any model having anticipated, even by half a second, the "zero," must turn back and re-cross the line.

The "flying start" or "sail boat start" is the better and more correct way, but some organisers use a simultaneous launch (which can be rather hair-raising) or else a staggered launch, whereby models are launched one second apart (a better compromise). The flying start, however, is certainly more exciting and satisfying to pilots and spectators alike.

A "flagman" is stationed at the far "pylon" for each model taking part (usually three, but sometimes four in finals), and the pilots must first "identify" their models to their particular flagmen (noting the colour of the flag waved in response) by holding them up aloft, showing top and bottom surfaces, especially if these are coloured differently, or have some particular identifying mark. The winner of each heat goes forward to the next race until the final is reached, which decides first, second and third places.

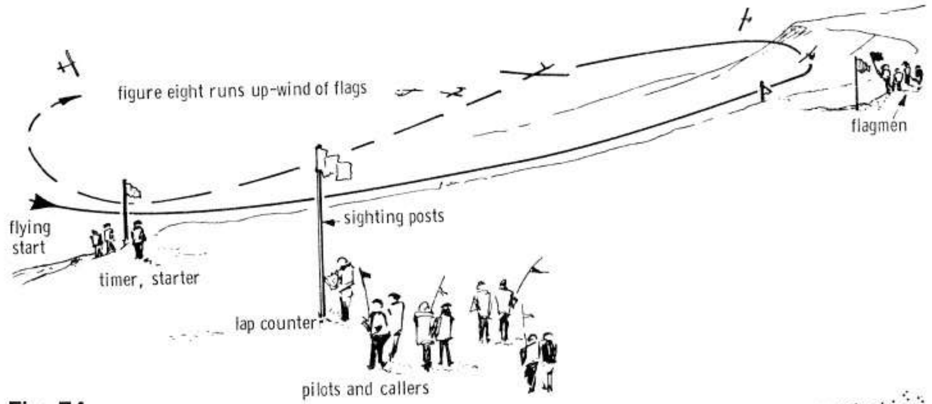


Fig. 74

After you have flown in one or two pylon races you will begin to develop your own technique, but for those just beginning, some general words of guidance. After the launch, search for the best lift and get your model as high as possible in the first fifty seconds. In the last ten seconds before the whistle, position the model somewhere near the start line (though, of course, a lot higher). At about three or four seconds from zero, start a near vertical dive to gain speed, keeping on the start side of the line, of course; if you go over it you must loop or otherwise manoeuvre to bring the model back and recross it.

Now fly straight to the far "pylon," with only the smallest possible control movements—we do not want the model swooping and swerving all over the place, or it will have to travel further. Have a caller by your side, ready to call out when the flag at the far pylon is raised. *You* will be far too busy concentrating on flying the model to notice this. Immediately he calls, do a very quick turn (a near vertical bank, followed by pulling in almost full up-elevator) and fly the model straight back to the "pylon" at your own end, then turn again when called. This is a lap, and is repeated six times (or whatever the particular organisers have decided).

Slight advantages can sometimes be gained by climbing in the turns and diving on the "legs," and it is possible to get into a certain rhythm of doing this—if not baulked and forced to take avoiding action by the proximity of another model. Avoid flying the model too close to the hillside as this tends to make it "crab" along (try to point into the wind), which induces drag and makes the model slower in response. Finally, be on the lookout for those other models; they can come "out of nowhere," and the risk of mid-air collision is very high in pylon racing, where the models are all racing up and down virtually the same narrow corridor of air in front of the ridge.

CHAPTER 9

TYPES OF CONTEST

THE newcomers to slope soaring will have seen references to a number of different types of competition, and will probably be wondering just how many kinds there are. The answer—in one sense—could be "infinite," since there are no standardised rules for slope soaring contests, and each organiser tends to improvise, depending often upon prevailing conditions, the type of ridge available and so on.

The contests, though varying in detail, do fall into a number of definite categories, however, and a list of these, with a general description of each, is given here.

Rudder only

Usually simply a "speed" event, with one model in the air at a time, flying along a slope face between two markers. The greatest number of passes wins the event. Sometimes this event is combined with points for a spot landing (landing nearest to a marked spot).

It must be noted that, with the now almost universal use of proportional radio control (and usually 2 or 4 functions), rudder-only as a competition class, has virtually died out.

Intermediate

This usually consists of a schedule of simple aerobatics, for the rudder/elevator type of model. It may include loops, spins and possibly rolls, with a "nominated manoeuvre" to gain points. (That is, some manoeuvre other than those laid down, but nominated in advance by the competitor.)

Full-house aerobatics

The schedules for this type of event are about as numerous as the events themselves. Sometimes the more "difficult" manoeuvres are given a higher possible score; on other occasions all are marked out of the same possible maximum.

Sometimes—usually as a second round of the same event—there may be a "lucky draw." In this, the pilot, while cruising his model to and fro to gain height, picks a sealed envelope from a pack and is then obliged to perform the four or five manoeuvres written on the card from the envelope. This can be very amusing—at any rate for the other competitors and spectators—as they hear the pilot's howls of anguish when the manoeuvres he has drawn are read out to him.

The other type of aerobatic contest is the "freestyle" event, where the pilot is asked to fly any number of manoeuvres of his own choosing, strung together in a smooth and flowing pattern, with each manoeuvre being called before it is performed. This is where "opportunism" and presence of mind count a great deal. Regular and continuous practice is, of course, required to achieve any degree of accomplishment in this or any other type of aerobatic event.

Aerobatics from the flat

This event really originated at the slope, when the bungee (catapult) launch was used because of completely calm conditions. With a bungee "Hi-start" launch (described fully in the Thermal Soaring section) it is possible to do a limited number of manoeuvres before the model is back to start level.

The idea has now been carried a stage further, to become an event in its own right, with the slope soaring type models being launched from a flat field, either by means of bungee catapult or electric—or even petrol driven—winches. This sort of contest has the attraction that it is completely independent of both wind speed and direction and, given suitable "tasks" in addition to manoeuvres, can be a most interesting and "different" event.

Pylon racing

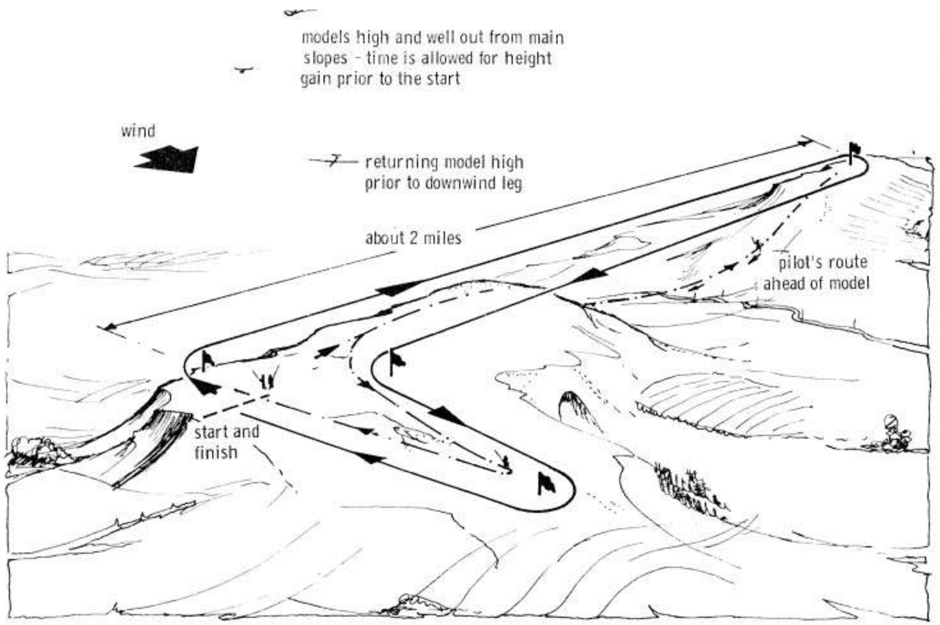
This type of competition has already been described in the chapter concerning pylon racing models. It is claiming more and more devotees so that, instead of being a secondary event to an aerobatic contest, as used to be the case, some organisers are now setting aside a complete day for slope pylon racing.

Cross country events

This comparatively recent addition to the contest calendar has lately been proving the most well supported event of all, with almost double the number of participants of other contests. Probably the reason for its general popularity is that it does not demand a specialised type of model. In fact, the specialised aerobatic or pylon models will generally be at a disadvantage. The cross country event favours glider models that look more like they did before specialisation became rife—fairly large, high aspect-ratio sailplanes, often of the semi-scale type, that are aerodynamically efficient and will gain height easily and maintain it. The sort of model favoured by the "sport" fliers, in fact. So, in many cases, the soarer who never dreams of entering any other sort of contest will take part in a cross country event. Added to this, there is the fact that, apart from the initial cruising about to gain height, most of the activity is carried on well away from the crowds of competitors and spectators, not under the spotlight of their gaze.

Bascially a cross country soaring event requires the model to be flown over a course of perhaps two miles or so and, if possible, return to base. This is similar to what the full size gliding people call "goal and return."there will be a checkpoint—perhaps several—which

Fig. 75



the model has to pass over or turn at, to establish that it has been over the course. Fig. 75 shows a typical course. Each pilot is accompanied by a "co-pilot" or helper, to guide him over rough terrain (the pilot, remember, is trotting along while squinting upwards or over his shoulder to keep the model in sight!) or who is allowed, if circumstances demand, to take over the transmitter while the pilot jumps a ditch or negotiates a stile. The helper may also urge on the pilot with words of encouragement and advice, which are always a comfort during what may be quite an arduous journey! In fact, this type of event can be a test of physical fitness as well as piloting ability. Following by vehicle is not permitted, nor is this practical.

Often the nature of the conditions will mean that modèls are virtually "thermal soaring from a hillside" but, of course, the wind may increase in velocity at any time, so the genuine "paper bag" thermal soarer, which is likely to do well in near-calm conditions, might well be put out of the running by its lack of sufficient flying speed, or "penetration."

Another of the attractions of the cross country event is that anything up to six models may be airborne together, and have up to 90 minutes flying time each—plus, perhaps, a fly-off if two or more complete the course. For the average r/c soaring modeller, such an event represents a most enjoyable day out and a chance to see, and talk to the owners of, many interesting models which would never appear at any other sort of meeting.

Scale

Competitions for scale model gliders and sailplanes have not exactly caught on like wildfire in this country—probably the world's leading proponent of the r/c scale power model. A very gradual increase in the numbers of those interested, over the past few years, however, shows that such events may well have a future, though they will certainly never have the mass appeal of the cross country.

So far the rules for static judging have been anything but stringent—in order to encourage a larger entry—the models being judged from a set distance (usually 10ft.). This is commonly known as "Eyeball" or "Standoff" scale, though published 3-view drawings of the prototype, and usually an authenticating photograph (for colour scheme and markings) are generally asked for. Some events add to their criteria "Workmanship and finish," though one could not be blamed for wondering how this is to be assessed at a distance of ten feet.

In flight, realism is the criterion, and models are usually required to perform a few basic manoeuvres in a "scale" manner. A demonstration of the effectiveness of each individual control function is sometimes also required.

There now only remain what we call the "novelty" events, for want of a better term. These are usually held after a main event, if there is sufficient time and daylight remaining. Also called "fun" events, it seems implicit that these events are organised and participated in purely for amusement, rather than any real means of competition and, although small trophies are often awarded, they represent no real "kudos" for the regular contest goers. We will outline them briefly so that our resumé of types of contest will be complete.

Limbo

The name is taken from the West Indian dance "contest" whereby the dancer manages to get under a tape, suspended between two poles, which is progressively lowered each time he or she performs the feat.

In the model flying world, the poles are much the same, the "tape" is usually a light wool or narrow crepe paper streamer—and it is the model which has to be flown under it. (Wits have, of course, suggested that the pilots should keep their models hovering while they themselves scrambled under the tape—something that the rest of us feel the wits ought to be made to try).

At one time, the tape used to be lowered progressively, between rounds, in the manner of the dance. It sometimes still is done this way, but it is more usual to have a set height for the tape with the winner the one who can make the greatest number of clear passes under it with his model in, say, two minutes—instead of the one whose model "survives" through the narrowest gap. All good clean fun—unless your model hits the pole. Depth perception can play a considerable part in this, as may be imagined.

Spot-landing—at "start" level

This is, as its name implies, a landing as near as possible to a predetermined spot on the ground, at the top of the hill, somewhere near the launching point. The spot is usually marked by a coloured disc or similar device, which will not damage the model should the landing be really "spot" on. This type of event is usually combined with a "spot time," so that the contestant has to gauge both speed and distance to a nicety on his landing approach.

Spot-landing—foot of the slope

As may perhaps be imagined, this is usually a "desperation" event, improvised by contest organisers when there is insufficient lift for anything else of a competitive nature to be practical. However, it can be very interesting as, once below the pilot, the actual height of the model from the ground below it can be very difficult indeed to judge, especially if there is no sun to provide a tell-tale shadow. Models will appear to "stop" when one thought they must be at least 30ft. from the ground—or, on the other hand, may keep going long after one thought they must be at ground level. There can be a risk of damage to models, of course, through "flying into the ground" in this way from, perhaps, a considerable distance away.

Most spins

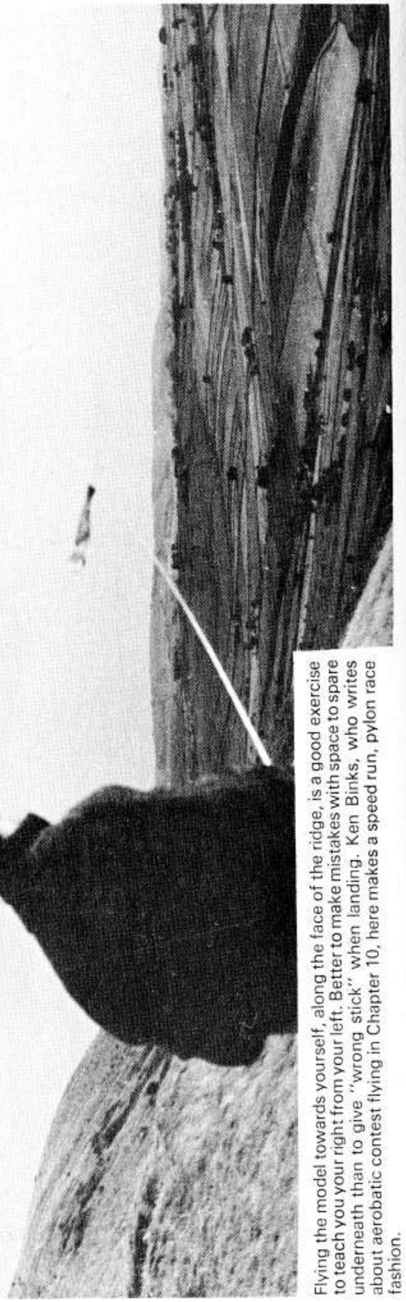
This is fairly explanatory, and can sometimes be even more hair-raising than limbo flying. The contestant is given a specified time (usually one minute, depending on conditions) to gain height, then, at the given word or blast of the whistle, he spins his model and keeps it spinning as long as he dares. The one to do the most spins, without writing off his model, is the winner. Normally the winner, and many other competitors, are obliged to land their models at the foot of the slope, having flown below the lift area, or "point of no return," and it could well be for this reason that events of this nature are usually scheduled as the last of the day.

One piece of "gamesmanship" that can often work to the pilot's advantage (there do not seem to be any rules for "Most spins"!) is for him to go down to the foot of the slope first, then have a helper launch his model, and also call "go" when he is to start spinning it. This way he can much more easily judge when to pull out of the spin, as it will by then be very close to him, and of course, he will be able to land it safely, too.

Advance notice

If you are thinking about attending soaring contests, you should keep a close watch on the "For Your Diary" feature which appears monthly (from February to October) in Radio Modeller magazine. This will give the dates and venues of the meetings, and often also the addresses to which to send for entry forms and contest details. Many contests are becoming so popular that pre-entry is necessary (*i.e.* entry details and fee sent some time in advance of the actual contest) and, when this is the case, again details are given.

With a large entry, slope pylon races can run on until late in the day, as in the case pictured here. The flag man signals that the model has passed the line, when its pilot banks it vertically ("pylon turn") and sends it speeding back to the other end of the course. Another model may be seen, tail towards us, on the horizon line, also banked almost vertically.



Flying the model towards yourself, along the face of the ridge, is a good exercise to teach you your right from your left. Better to make mistakes with space to spare underneath than to give "wrong stick" when landing. Ken Binks, who writes about aerobatic contest flying in Chapter 10, here makes a speed run, pylon race fashion.

CHAPTER 10

APPROACH TO AEROBATIC CONTEST FLYING

By KEN BINKS

IF you attend any slope soaring competition around Great Britain, you will find a really friendly crowd who are really there for the flying and the chat, as much as for the contest itself. The competitive spirit is there, but without the ill-feeling and cut-throat undertones that one seems to find at power competitions. I really enjoy competitions at the slope, not only for themselves but because they present the opportunity, like nothing else does, to meet fellow enthusiasts from other parts of the country, and to see their models, discuss new projects and so on. It has always been like this, right from the very early days of r/c slope soaring, and I hope it always will be. It is aerobatic competitions that have come to be the major part of the British slope soaring scene, and I hope here to be able to give a few pointers to those who are thinking of joining in.

The model

Competitions tend to design models. That is to say, the increasing demands made by the "thinkers-up" of schedules have tended to reduce model design criteria to a fairly narrow spectrum. There was a time (it seems long ago now, though it is only a very few years!) when any soaring competition could be won with a rudder/elevator model; not any more. The 2-point and 4-point rolls, prolonged inverted flying, and so on, have demanded aileron control, so for "multi" competitions, 3-function equipment is necessary—and perhaps 4-function (for variable section, or flaps). We still have "intermediate" contests for the two-function model, but these are usually restricted to the beginner.

Once you have graduated from the beginner's model, then, you should, if you are intent upon flying in aerobatic contests, build one of the currently popular full-house aerobatic designs. (I will not name any names because, apart from its being too much of a temptation to name one's favourite (ahem!), books are made to last a few years, and model designs change almost monthly!) Build a proven design and, provided your model is warp free and trimmed out properly, with aerobatic practice you can be with the winners.

Practice

Now obviously you must practice your general flying and your aerobatics and, on this point, I would mention that it is amazing the number of people one sees letting the model "fly them," instead of controlling its flight path. One idea, to help you maintain strict control is, when you are doing your landings, do a nice rectangular approach and land on a pre-determined spot. Practice this all the time, so that you get used to putting you model just where you want to. Your approach does not always have to be right-handed or left-handed, but from either side, so that you can land in any situation of slope, on whatever sort of site you may be called upon to fly.

There is no standardised schedule for slope soaring aerobatics. This is a deliberate decision on the part of the various organisers, who maintain that, by not having a set pattern to practice at, the most versatile and adaptable fliers will do best. It certainly makes for more interesting competitions. Some schedules are published in advance, and you may find one or two in the monthly magazines to practice.

Firstly you can practice each manoeuvre on its own and, when you are proficient at these, try stringing them together. For instance a typical run of manoeuvres could be . . . loop, roll, stall-turn, reversal, 4-point roll, stall-turn, outside loop, reversal, half-roll, inverted circle, half-roll . . . followed by an approach and landing. Now, just bend down and switch the model off. Or, of course, "back to the drawing board." Well, it's not that bad, really! This stringing together of manoeuvres is the sort of thing that is required for what is called "freestyle" aerobatics. They should not follow one another in lightning succession, however—the judges must have time to write down the marks!

The contest

After putting in plenty of practice, it's time for your first competition—and there's no practice like the real thing. When you decide to go to a contest, make sure you know where the site is, so that you will be able to arrive on time or, preferably, a little early. When you get there, talk to the local lads, find out what the slope is like, see where the best lift is (you'll be able to try it out for yourself, if you arrive early enough), and what prospects the landing area holds. See where you will be flying from, and where the judges will be positioned in relation to the sun, and the slope, so that when you come to do your manoeuvres they are not too high, or in the sun.

If the judges cannot see your manoeuvres, they will score "0," so do them at head height in front of them; if a judge has to crank his head about too much or crane his neck, you must expect to get less points. If there is a choice of manoeuvres, make sure the judges know the ones you are going to perform. Before you go into each manoeuvre call it out, loud and clear. If, for some reason, a particular manoeuvre goes wrong, you must go on to the next one—no second attempts are permitted. Provided you had no spectacular failures, the overall impression of a flight counts as well. The placing of manoeuvres, the smoothness of in-between flying, how square your approach is—and, by now, you ought to be able to land it at your feet. It always gives a good impression if you only have to bend down and switch it off, instead of disappearing over the back of the ridge to find out where it has gone!

All the foregoing has assumed that conditions are perfect, or at any rate, good. If the lift is poor, you should pick the manoeuvres which are rated the highest, even if it means giving a very high powered launch and flying straight out over the valley, using all the height you have got to do the highest pointed manoeuvres, even though you have to land at the bottom of the slope. If, with generally poor lift, the odd thermal or two comes along, you may be very lucky to catch one and can utilise this to gain height to do, perhaps, the whole schedule on the way down. With practice there is no reason why you should not soon be picking up some of the prizes. Even if you don't, you will find you have had such an enjoyable day that you will come again, and keep coming, once you have been "bitten."

As this is essentially a beginner's article, I think it might be an idea to explain the way to perform and present some of the manoeuvres, with special regard to encouraging the judges to give you good marks.

The loop. First gain some speed with a shallow dive and then pull on up-elevator gradually. As you get to the top, reduce the elevator movement so that it flattens out slightly, then as it starts to dive, pull out more sharply and finish on the same level as you started. This way you will get a nice round loop. Now, for consecutive loops, since it is a glider, you have keep the speed up. So, in the downward part of the loop, *i.e.* the second half, you must allow the model to dive slightly to gain speed, then you can use this speed to do the next loop—and so on. This way, with practice, you will be able to superimpose your consecutive loops. Present them sideways on, to the judges, so that they can see how round they are, even though this is cross-wind.

The roll. This, again, is best started with a fair reserve of speed. From a shallow dive, pull up just past the horizontal and apply full aileron. As the model rolls towards the inverted position, apply slight down elevator to keep it flat. Then, as it reaches the vertical position again, let the elevator off, keeping full aileron on all the while. When the model has nearly reached the horizontal, release the aileron, finishing nice and level, fore and aft as well as laterally. This is standard practice for an axial roll.

For consecutive rolls this procedure is repeated, but obviously you must keep the speed up or the model will tend to wander. So you must start with more speed, because there is no way of keeping the speed up in horizontal rolls. It is sometimes an advantage to apply slightly more down in the inverted position so that the nose is raised, and thus your consecutive rolls will maintain a level attitude, instead of being all slightly "downhill." Do not overdo this, of course, as it can easily reduce that all-important speed. As with loops, the rolls should, ideally, be presented going *past* the judges, not away from them, even though it does mean doing them cross wind. We all do rolls *into* wind to start with, because it seems the natural way. But practice doing them along the length of the slope, and you will find, after a while, that this is not so difficult as you thought. It will certainly give you an advantage when you start flying for the judges.

Inverted straight flight. First half-roll to the inverted position and apply some down elevator to maintain level flight—not too much or you will stall the model—and keep it going nice and straight for, say, the 15 seconds that is usually required in competitions. Either the organisers will provide a counter, or you can have a helper who will call off the seconds. Sometimes, even, the judge will do this. When the time is up, half-roll out, rolling the same way that you entered the manoeuvre. (That is to say, if you half-rolled to the right to go inverted, do another half-roll to the right, to recover at the finish.)

Which way this manoeuvre is presented can depend a lot on the particular site. To do it along the ridge can mean that the model is going quite fast—and can cover a lot of ground in 15 seconds, so, if you do not feel there is enough room, then do it into wind. What the judges are looking for here is simply straight flight, directionally, with not too much swerving about, and with the wings level.

Inverted circle. This should be started in front of the judge, with a half-roll. Then, keeping on an angle of bank, do a round circle, using down elevator to maintain a level height. When you reach the entry point you must roll out in the direction of bank. This is obviously your shortest path back to an upright position.

Inverted eight. This is usually started at the intersection point, with a half roll to an angle of bank. Complete as if doing an inverted circle and, as you get the model back to the intersection point, aileron is applied *opposite* to the bank until a bank to the other side is started. When you have completed this circle, roll out the *same* way as your bank to complete the manoeuvre back at the intersection point. This sounds complicated on paper. It's not really all that complicated, but it does take a great deal of practice to produce anything like a recognisable inverted eight—let alone one that the judges are going to approve of. So get practising.

Outside loop. This should be started with plenty of height, then applying increasing amounts of down-elevator so as to build up speed in the first part of the loop. Then, as you start to climb back up the other side, gradually increase the amount of down-elevator all the time so as to level out at the point of entry. This manoeuvre relies on the fact that you *gradually* increase the down-elevator so as to maintain the speed for the last quarter, which is the usual point of trouble with the outside loop.

Again, as with loops, this manoeuvre should be done—when you can manage it—sideways on to the judges, to show them how nice and round you can make the manoeuvre.

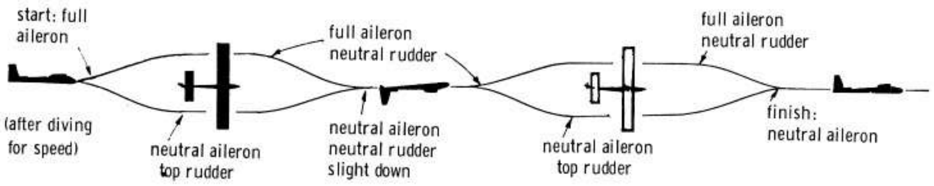
Three turn spin. This, it goes without saying, has to be started with a fair amount of height. Sometimes, if the lift is not good, and competitors can select the order in which they do their manoeuvres, it is as well to make this the last one, so that you can spin down below "the point of no return" and land at the bottom of the slope. (Only do this, however, if it will gain you more points than you could have scored with your approach and landing.)

The model is gradually stalled by applying up-elevator; as you see it drop a wing, apply full up and full left (or right) rudder. This will start the spin. On some models ailerons might be required to keep the model spinning. When you wish to stop the model spinning, release all controls. Usually it will then stop its spin, taking half to three-quarters of a turn to do so. If it doesn't—apply full *down* elevator, to unstall the wing, and then recover in the normal way. This tendency to continue spinning could be due to the c.g. being too far back, or to warped flying surfaces.

Presentation-wise, there is not a great deal one can do with the spin, to please the judges. The main thing is to do *precisely* three turns, and finish on exactly the same heading as you started, coming out of it nice and level, without any zooming.

Stall turn. Start with some excess speed and, from level flight, pull up until the model is vertical, then allow it to continue until nearly all the speed has gone, then apply full rudder to kick the model over. Sometimes ailerons are needed in the same direction to keep the model in the one plane. As the model comes back down, gradually apply up-elevator, pulling out at the same height as your entry.

Reversal. This is a half-roll followed by a half-loop. From level flight apply aileron to complete the half-roll. (This must be accurately done because, when the half-loop is executed, the model will not return on the same path, unless the inverted position was exactly horizontal.) Now pull on up-elevator to complete the half-loop. That's all there is to this manoeuvre.



Four point roll. This is an axial roll with hesitations at 90° stations. To perform it, we once again need excess speed, from a shallow dive. Then lift the nose, apply ailerons then release, apply top rudder*, release, apply ailerons, release, down-elevator and hold level, release, apply ailerons, release, apply top rudder, release and finally apply ailerons to return to level flight. Phew! you will really have to practise this one—study the illustration!

I have not attempted to cover all possible manoeuvres here, but I think the foregoing will give you a good basis for stick stirring, while bearing in mind what judges will most likely be looking for. Experience is a dear teacher but I don't think anyone has found a better one, so let us see you on the slope!

Unless you live only a very few miles from suitable slopes, so that you can practise in the evenings as well as weekends, and do so regularly, you cannot really expect to attain the high degree of precision now demanded to place high in these contests. Nevertheless, it is good experience to practise for contests, and certainly helps you to achieve disciplined, purposeful flying, instead of random, haphazard manoeuvres. Once you have got to this stage, then it is only a short step to getting into active competition soaring.

* Top rudder is the term used when rudder is applied with the aircraft in a vertical or near vertical bank, when the rudder actually acts as an elevator. For instance, if we bank to the left, into a vertical bank, we then apply *right rudder* which helps to keep the nose up. As will be seen, the application of "Top Rudder" is called for twice during a four point roll. Without it, the model would describe a steadily descending path, due to the brief periods spent on its side, when the nose would go down quite steeply. The co-ordination of hand and eye required for the correct application of top rudder (also used during a slow roll) is of a very high order.

CHAPTER 11

KEEPING UP WITH THE BIRDS

There's more to it than a 15 knot wind and a good slope, say – PAT TEAKLE and TONY ELLS

IF you go to the slope in marginal lift conditions, you will often find that less experienced pilots have much more difficulty in keeping their models airborne than the older hands. The design of the model obviously plays an important part in success, but the model trim, piloting technique, and a general feel for "sloping," also have an important contribution to make.

Most clubs have a few members with "built-in lift," but you ask these chaps the secret and they will have genuine difficulty in explaining judgements and actions that, after a time, have become almost instinctive. Pat and I thought that, by putting a few thoughts on paper, ideas that have been slowly and painfully crystallised over several seasons' flying, these might provide a short cut for a few, provoke heated argument with most, and possibly bring back a few really worthwhile ideas.

We were originally asked to write an article on "where to look for lift" but we found this impossible to do, because the "where" is so much tied up with the "how." Therefore, we are going to put our heads on the chopping block and talk firstly about model trim. Most of this stuff will be obvious to you but, nevertheless, will, we are sure, bring a great many unwritten thoughts and prejudices into the open.

Model trim and flying technique

Before advantage can be taken of any light lift, the pilot must be thoroughly familiar with his glider's flight characteristics. Principally, he must be able to recognise the onset of the stall, which must not be too sharp. The minimum sink speed of the glider will be very slightly above the stall, whereas the minimum glide path angle will occur at a speed which is a fair margin faster again. It is this minimum glide path angle that you need, to move from a dead lift area to a possible lift area, with the minimum height loss. If you are lucky enough to find some lift, then you will settle back to minimum sink speed. The most common trap beginners fall into is to fly the model a crack too slow, even for minimum sink, and only speed up if they want to lose height. To their surprise, up to a certain speed, this is the very last thing that happens. With a draggy box plus wings, this minimum glide path angle will not be very far above the stall but, with a clean, reasonably high aspect-ratio model, this speed margin is much greater.

To achieve an accurate flying speed, apart from knowing the model like you know the back of your hand, you must have precise pitch control. Now pitch response is, to a certain extent, a matter of personal choice, but too forward a c.g. will result in excessive static pitch stability, and the model will "balloon" up with variations in windspeed. The fight is on, and you will not be as one with the model. The "feel" can be lost to such an extent that it could become impossible to hold the model on a smooth flight path.

In all light wind conditions one should use the minimum control surface movements consistent with the desired flight path—it can be likened to milking a mouse! A sneaky comment here about design. The incremental increase in drag, due to control surface deflections, may be further minimised by having very large control surfaces moving through small angles, with the model neutral trim carefully set so that the rudder and elevator are at zero deflection.

Turns are much more efficiently executed with some attempt at a co-ordinated rudder-and-aileron turn, to minimise the drag. This does not mean coupled aileron/rudder controls, as aileron is nominally used only to set up the bank angle and to terminate the turn, while the rudder is used throughout the turn, theoretically maintaining zero side-slip. As small slip angles are impossible to detect with models, the right order of rudder can only be found by trial and error, but it is quite small. Just a suspicion of rudder will enable you to execute the same rate turn with less bank angle than is required with the aileron-only turn. In light slope lift, entry into and exit from the turns, must be anticipated by using control movements and allowing time for their full effect to develop. Remember, of course, that the stalling speed in a turn will be slightly higher than in normal straight and level flight.

Where is the lift?

Naturally you should choose, if possible, a site with the wind drift normal to the slope and a long, open, windward approach. A preliminary assessment of the situation should be made, and this is best done as follows:

(a) Preferably watching models already struggling.
(b) Looking for any birds circling in thermal lift, or holding height on ridge lift.
(c) Looking for possible sources of thermals: ploughed fields, stretches of concrete, large groups of trees, broken terrain.
(d) Looking for those wonderful cumulus clouds building up.
(e) Using small bowls within the main slope, which may produce localised areas of stronger lift; keeping close to the hill contours for maximum advantage.

To make a practical assessment of the situation, it is best to have an assistant with a true and mighty heave. A single exploratory circuit-and-land can then be made, with only fifteen or twenty feet height loss. Several of these single circuits are a better investment for finding lift than over-optimistically hanging on, finally finishing up way down the hill. Not only can this result in a hazardous landing, not infrequently of the tent-peg variety, due to bad visibility, or stalling—or both, but also recovery of the model can be very exhausting. Nevertheless, a delicate touch and caution are required for these single circuits, otherwise damage to the model can easily be caused.

When the time is your own, you can often wait for weak thermals to come through. These may be detected by slight rises in temperature, which you can sense on your face, and they are often accompanied by a decrease in the air movement.

Flying the model near lift can cause an upset in the lateral trim. Advantage may quickly be taken of this situation by holding down the rising wing and gently turning into the disturbance. Thermal activity naturally gives turbulent conditions and often, prior to getting the lift, the model will fly into a small downdraught. This kind of situation makes it more efficient, overall, to increase the speed slightly so that an incipient stall is avoided.

One can spend many pleasant hours searching out lift, in this way, from the slopes, and it really does improve one's flying ability. After all, anything, and almost anyone, can fly a slope soarer indefinitely with a 15-knot wind up the slope. Don't be discouraged, therefore, if you reach your hill site to find hardly a breath of wind. This is the time when there is some real challenge!

The really gratifying proof of your having learned something about the business may come one day—when the gulls begin to follow and formate onto your model, instead of the other way about!

CHAPTER 12

CREATIVE SOARER DESIGN
By CHRIS FOSS

THE creative aspects of life give possibly the greatest pleasure of all, whether they are of a musical, artistic, literary or practical nature. The latter I would describe as including all those creations that can ultimately be put to some use, or made to perform a function, and this must surely cover, in principle, this hobby or pastime of ours.

The vast majority of us create or construct our own flying machines, if only from a box of pre-shaped parts which has been prepared for us. But how much more satisfying it would be to create our own model, right from its origin; to be our own master throughout, making our own decisions from start to finish.

The thought of designing a model from "scratch" is, I know, a daunting one for many, but no model is truly designed from so-called scratch. There is so much reliable and proven information already at our fingertips, and there are numerous magazines full of photographs of other designs that we can use for reference. We must all have had the opportunity, too, to study detailed constructional plans from time to time.

We therefore have a fair idea of what a model glider is, yet the biggest drawback, when it actually comes to producing a design of our own, is the lack of practical information to guide us along the correct path, which is so necessary if we are to be guaranteed a good degree of success.

In these following pages, I intend to lay out a path, commencing at the basic elements, running right through the various design stages and finally leading up to the building board, a path which can be used with some measure of confidence by any progressive modeller who has, up till now, been waiting for the opportunity to "go it alone," or whose past experience may lie completely with power models, and who wishes to explore this, yet another, branch of the sport.

One's powers of creativity are readily affected by numerous factors, not the least being one's particular frame of mind. Inspirations cannot be made to happen, they occur when they are ready, and impatience is the worst deterrent. Be prepared to produce a dozen futile designs for every one that possesses a glimmer of hope, and only be satisfied when one has come as near to the ultimate as is personally considered possible.

Basic components

In approaching any new skill that has to be acquired, one is always told not to try and run before one can walk. So, in the same context, and with the help of the imagination, there is no point in rushing off to design something if we do not know what we are to design. Now that makes sense, doesn't it?

Before gathering together paper and pencil, therefore, we should firstly try to visualise the general overall picture of the model we wish to design and, at the same time, consider the role that it should, or must, fulfil. We must ask ourselves whether we want a simple and stable soarer for fair weather flying, a high speed pylon racer, or a versatile aerobatic contest machine. In doing this we should bear in mind the type, size and weight of the radio control system to be used, and fully appreciate any limitations it may impose on the scope of the design. Quite obviously it is pointless to rush off and proceed with a sophisticated full-house soarer, if the only radio available is a set of two-function equipment!

The vast majority of potential designers are probably fully experienced in building models from kits or from plans, but are at a complete loss when confronted with a blank sheet of paper. Therefore, what would be valuable, at this stage, is a complete analysis of the individual components and their recommended values, to act as a foundation on which to base our design. Such material may also be of use in clearing away any doubts over particular items (and will, without doubt, spark off criticism and laughter from the "experts" who should not need to read this chapter anyway!).

The wing

1. Span. More often than not, practicalities take priority over all other considerations, and the wing span may simply be determined by the size of the car boot! Practical implications aside, however, it is a generally accepted view that, whilst the smaller and more compact model has a greater chance of surviving the occasional (or continual) mishap, the larger model is invariably much smoother and more pleasant to fly, being less affected by irregularities in the airstream (another way of saying turbulence!).

The resulting influence of these factors has been a slow, but continual, reduction in the extremes of model sizes, until the situation has now been reached where, upon carrying out a survey of all the most popular and successful designs at present being flown throughout this country, it would be the exception rather than the rule to find many soarers smaller than 4ft.6in., or larger than 6ft. in span. Four-feet-six, because models much smaller tend to find themselves bounced about in anything other than ideal conditions, and six feet probably because that is the length of two 3ft. pieces of wood!

Popular opinion and choice being the most reliable, it makes good sense to point our design somewhere between these two figures.

2. Aspect-ratio. If we want, basically, a good stable performer with pleasant flying characteristics, then we cannot hope to achieve aspect-ratios comparable with those of full-size sailplanes. Although scale models with 1 : 20 or 1 : 25 aspect-ratio wings will fly and, indeed, have flown, they are invariably plagued with the unpleasant vice of tip stalling*, or flick rolling, at the slightest provocation, a characteristic which is further accentuated by the use of a sharply tapered wing. It must be remembered that a soarer has no source of power on which to rely in order to maintain a safe flying speed, but is required to fly in a varied range of conditions at a similarly varied range of air speeds and, at times, often very near the stall.

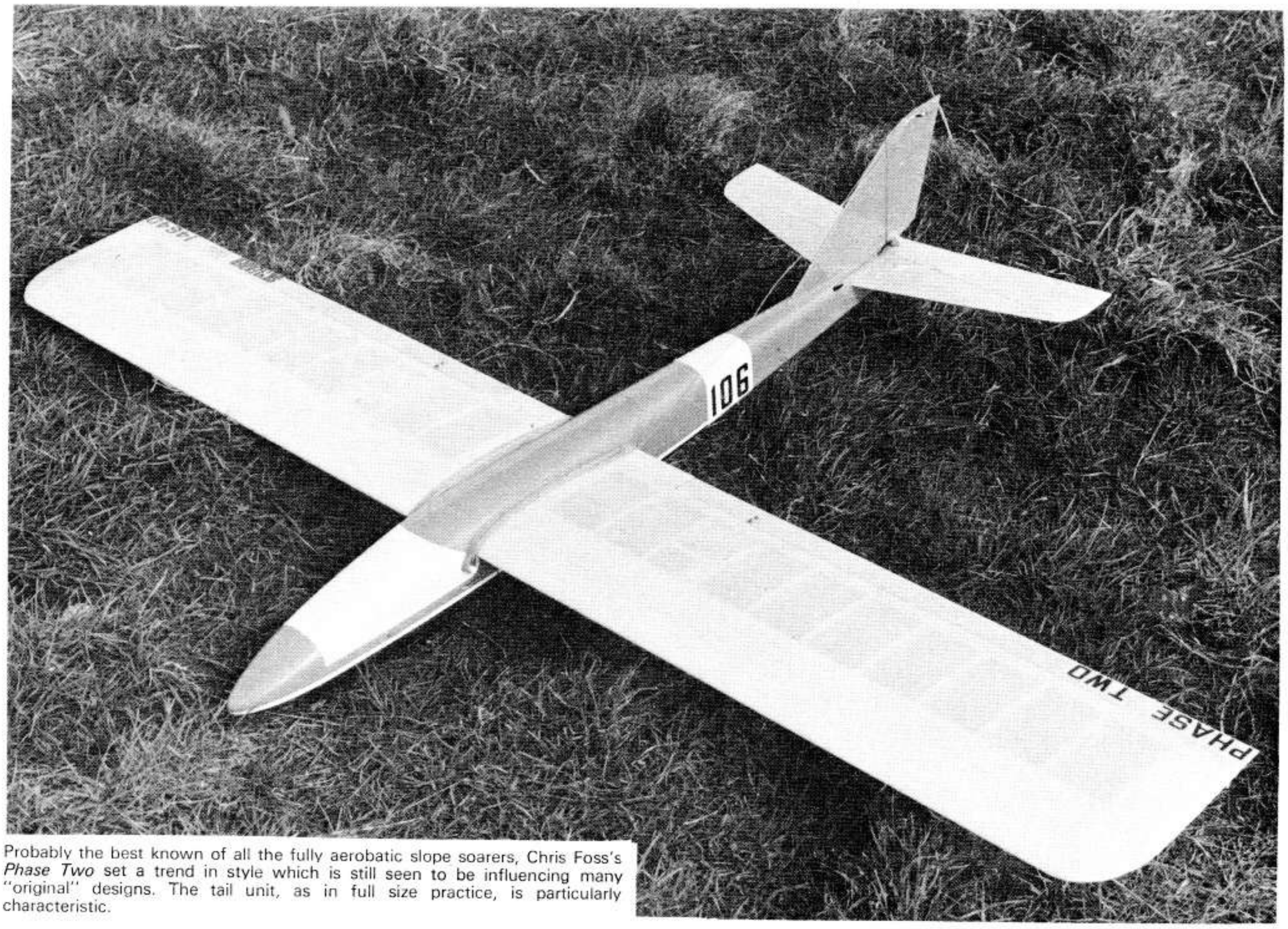
However, if we are interested in maintaining a semi-scale appearance, we could aim for an aspect-ratio around 1 : 12 to 1 : 14, remembering that, if ailerons are to be used, the control response will become comparatively poor and, indeed, "aileron reversal" may be experienced at times.

On the other hand, if less importance is attached to producing a model resembling a full-size machine, the aspect-ratio can be reduced to a more practical level of between 1 : 7 and 1 : 10. Certainly the trend in aerobatic contest soarers, where a good rate of roll and crisp levelling qualities are essential, is towards this more compact wing form. However, criticism is often levelled at this modern breed of soarer, insofar as they no longer resemble gliders. Using the same argument, it can be said that the typical competition class aerobatic power model bears little resemblance to anything one might expect to see at the local aerodrome! Such models are designed for a specific purpose—to perform the functions required of them in a particular type of contest, and perform them as effectively and efficiently as possible. They should be regarded solely as model aeroplanes and viewed comparatively with one another, rather than with full-size machines. However, I am not condemning any attempts to add a degree of realism to a design, far from it, for what I have just said only applies to thoroughbred contest models, where flying performance is the chief factor.

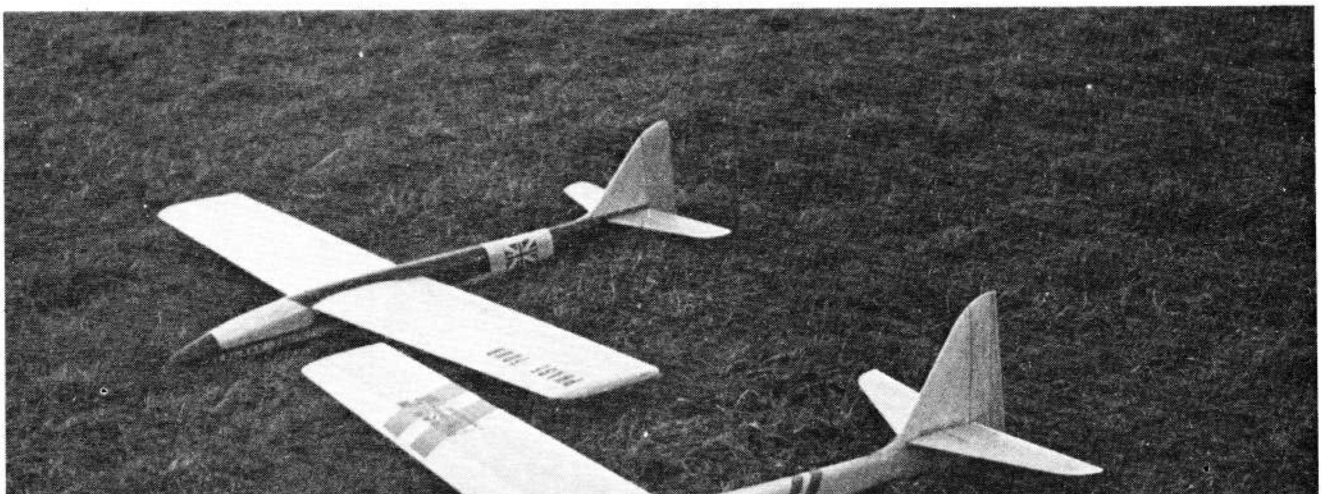
3. Wing loading and wing area. Before a final decision can be made on the span and

* Here some "washout" at the wingtips, as described in an earlier chapter, can be helpful, but it will not altogether prevent the tip-stalling tendency in models with *very* high aspect-ratios and *very* tapered wings. One low aspect-ratio aerobatic soarers, of course, it is neither necessary nor desirable since, when the model is flown inverted, it would have the opposite effect to that intended.

Quite a breakthrough in design concept for rudder-only models (previously often "boxes with wings") Chris Foss's *Force Four* showed early evidence of a keen eye for line and form, as well as a firm grip of the practical essentials. The model has a thin wing for good penetration, and an adjustable semi-elevator.



Probably the best known of all the fully aerobatic slope soarers, Chris Foss's *Phase Two* set a trend in style which is still seen to be influencing many "original" designs. The tail unit, as in full size practice, is particularly characteristic.



Two of Chris Foss's most recent developments in specialised aerobatic slope soarer design – *Phase Four* and *Phase Five* – the latter being in the foreground. *Phase Four* features coupled elevator/flaps/ailerons, and *Phase Five* has this system too, with the added refinement that the outer ailerons operate in conjunction with the inner surfaces (flaps), which have just half the travel. *Phase Four* has a wing span of 67in. while *Phase Five* spans 73in., with 1in. less chord, giving it a higher aspect-ratio.

Elegance and efficiency are the keynotes of *Phase Lift*, Chris Foss's high aspect-ratio design for cross-country slope work and flat field thermal soaring. It features ailerons, plus a variable camber aerofoil ("trimmable trailing edge") which affords a wide range of speeds—desirable in both these aspects of soaring.

aspect-ratio, consideration must be given to the wing area we require, as well as the wing loading we may hope to achieve. The latter is a factor, the importance of which is not perhaps fully appreciated in the world of slope soaring, and it can quite often be the sole factor determining the success or failure of a given design.

As a fairly broad statement, I would suggest that the wing loading of the typical all-weather soarer, with which we are mainly concerned in this article, should be somewhere between 10 and 18 ozs./sq.ft. A fairly wide variation indeed but, in fact, it can be narrowed down at a later date, when we know the type of aerofoil to be used, a topic that will be explained in detail in the aerofoil department. It is not to say I am suggesting that models with loadings outside these limits are impractical, for soarers over 20 oz/sq.ft. are fine, provided that the wind is blowing well, and the models of the thermal soarer variety with 4 or 6 oz loadings are quite happy on days when there is just sufficient breeze to move the grass. As it is our aim to concentrate on designing one model and not two, then we must produce one that will operate in the widest range of wind speeds possible.

Returning to the question of wing area, bearing in mind what I have just said, and being consistent with the previous material, I would suggest setting 2½sq.ft. as a minimum and 4½ as a maximum.

The tailplane

The general shape and aspect-ratio of the tailplane seems to be a matter of personal choice, rather than of any real aerodynamic value but, what is of vital importance, is the area in relation to that of the wing. An unnecessarily large tailplane is perfectly all right from an aerodynamic point of view, but may spoil the appearance of the model, whereas an undersized tail will certainly impair the longitudinal stability of the model, even to the extent where controlled level flight is impossible, however skilful the pilot.

Ideally, the tailplane should be just sufficiently large to provide a safe margin of stability, as a surplus of area will only create unnecessary drag and weight. As a general rule, on a conventional and sensibly proportioned layout, the overall tail area should be 15%-20% of the wing area.

Nose and tail moments

The nose moment, measured from the tip of the nose to the leading edge of the wing, should, ideally, be sufficiently long to accommodate the bulk of the radio equipment, so as to virtually, or entirely, eliminate the need for nose ballast, therefore reducing any unnecessary dead weight. On both practical and aesthetic grounds, a nose length of between 1 and 1½ wing chords seems most desirable.

The tail moment, or the "moment arm" as it is more commonly known is, in simple terms, the distance between the trailing edge of the wing and the leading edge of the tail, and is quite often referred to in terms of so many wing chords. The moment arm and tail area are inversely proportional to one another—a larger moment arm requires less tail area than a shorter moment arm, to provide the same degree of stability.

In practice, the moment arm may often be decided on the "if it looks right, it is right" principle and, if viewed in conjunction with the tailplane area and relative to the wing, can frequently lead to the most satisfactory result. However, for the purpose of this design exercise, it is not going to be a great deal of help to simply state "design it to look right" as most of us have differing standards of what is "right"!

Therefore, to conform with the tail area already specified, we should aim for a moment arm of between 2 and 3½ wing chords, and bear in mind the relationship with the tail area, as already stated, when determining the final length.

Dihedral

On a model using rudder as the only directional control surface, a fair amount of dihedral, in the region of 5°-8°, is required under each wing panel, to provide an adequate degree of control response. Alternatively, to save messing with protractors and adjustable set squares, it could be stated as 1in. of dihedral at each tip for every foot of span.

Reducing the angle also reduces the effectiveness of the rudder, until we reach the completely flat wing, where the rudder becomes entirely useless for normal flight. Conversely, an unnecessary amount of dihedral, whilst increasing rudder response, will also result in the model wallowing, or "Dutch rolling," as it is sometimes known, when rudder is applied, thus giving a rather unattractive flight pattern.

With ailerons as the major control, the less dihedral the better. A completely flat wing is most desirable on a fully aerobatic soarer, thus giving equal stability (or lack of it!) both upright and inverted. However, criticism is often levelled, from some quarters, at the "droopy" appearance of a non-dihedral layout, so it is quite in order to add a degree or two to eliminate what is purely an optical illusion.

To relieve the need for the reader to refer back through the foregoing material I will now set out a summary of the recommended values relating to the basic components:

Wing span:	54″—72″
Aspect-ratio:	1:7—1:14 (up to 1:10 max. for aerobatic soarers)
Wing loading:	10—18 ozs./sq.ft.
Wing area:	2½—4½sq.ft. (360-648 sq.ins.)
Tail area:	15%—20% of wing area
Nose moment:	1—1½ wing chords
Tail moment:	2—3½ wing chords
Dihedral—rudder only:	5°—8° under each panel
Dihedral—aileron:	no dihedral necessary

AEROFOIL SECTIONS

Before we all go racing off to the drawing board, there is a little more reading to be done, for it would be as well, at this stage in the proceedings, to run briefly through the types of aerofoil sections, noting their suitability for our particular application. There are two ways of approaching this subject—armed with either (a) a library of technical information, or (b) a shoe and a pencil. The latter method seems to be by far the most popular!

Seriously though, I admit to being rather ignorant on the theory of aerofoils—I get up and leave the room when the discussion turns to Reynolds Numbers and lift coefficients—so the following is written in plain and simple language.

Wing sections

1. Undercambered. This is most suited to a lightly loaded model and produces good lift at slow speeds. As the flying speed is increased, so is the drag, and the net result is that you get nowhere fast! Such models are normally more suited to thermal soaring, although they can be valuable on those few calm days when the grass is barely moving, and most of the models are rapidly descending to the foot of the hill. Conclusion—*not* suitable for the average slope soarer.

2. Flat bottom. Any section, based on the well-known *Clark Y*, with a maximum thickness of between 10% and 12%, will perform well in a varied wind range, although there are definite limitations in its use in the higher wind speeds that are quite often experienced in this country. It is invariably the wing loading of the model that determines the actual upper operating limits (sheer weight and brute force!) and a fairly high loading of around 16 to 18 ozs/sq.ft. is desirable, if one intends to fly in winds much over 20 m.p.h., without the constant threat of "losing it over the back," whilst still permitting a useful performance in marginal conditions due to the excellent lifting qualities of this type of section.

As regards rigging angles, it is most common to set the underside of the wing at 0°, and rely on the slight upsweep or radius at the leading edge to produce an *actual* incidence angle of one or two degrees.

Conclusion—most suitable for all slope soarers that are not required to achieve "fully aerobatic" status. However, it has not been completely unknown for some models to have

performed quite satisfactory bunts and limited inverted flight using this type of section, although I suspect there have been other important, but subtle, factors involved to have permitted such antics!

3. Semi and fully symmetrical. These are an essential ingredient for all fully aerobatic soarers, and can be remarkably efficient at low speed in marginal conditions, whilst, at the same time, capable of clocking up a fair rate of knots when required to do so in strong winds. The semi-symmetrical *Eppler 374* section has become a favourite amongst contest fliers in recent years, although increasing use is now being made of fully symmetrical wing sections, as practical experience has shown they have a comparable performance to the semi's, even in marginal lift, whilst offering superior aerobatic capabilities. In contrast to the flat bottom wing, which, as mentioned, requires a substantial loading to cope in high winds, it is advantageous to keep the loading down to 10 or 12 ozs/sq.ft. if possible, as this will ensure a good "marginal" performance, whilst relying on a clean low drag design to fight the gales.

The recommended longitudinal dihedral is 0°, relying on a small degree of "up" trim on the elevator for normal upright flight, therefore only requiring a similar amount of "down" when inverted.

Tail section

There is little that need be said about this—after all the tailplane is only there to keep the fuselage level in flight!—other than that the simplest and most popular section is a flat plate, with a radiused leading edge and a tapered trailing edge, or elevator. An elaborate built-up tailplane, using a "proper" aerofoil, seems to offer no significant advantage.

Initial design work.

The enthusiastic readers who have thoroughly read and inwardly digested all of the foregoing material should now have a clearer picture of what should, and what should not, be incorporated in the design of a slope soarer. Having reached this stage, it is not completely unknown for some modellers to actually start building. No pencil and paper or nicely thought out plans to work from, just a few random lines scratched on to the building board, and they are away! Needless to say, more often than not their method of approach is borne out in the end product. The darn' annoying part of it is when a model produced in this manner actually flies, although apparently most things will fly after a fashion, even bricks.

If any of the readers are "cut and hope" modellers, then may I politely suggest they turn quickly to the next chapter, as the following material is going to be of no use to them whatsoever!

Right, with the room now two-thirds empty, I shall continue and try to explain the most satisfactory procedure to adopt in tackling actual design work. Unlike the previous sections in this chapter, where it only entailed commenting on specific items and recommending maximum and minimum values for the various components, the task I am now faced with is somewhat more complex.

The plan form or layout

The first and relatively painless step is to gather together a pile of scrap paper and a newly sharpened pencil. Proceed to sketch out, in freehand and roughly to size, ¼ or ⅛th scale plan views using all the previous data as a basic guide, bearing in mind any individual requirements, and the rôle we wish the model to fulfil, particularly when determining the aspect-ratio. Don't be afraid of wasting paper; cast aside the designs that are leading to nothing, for a lot of time can be wasted labouring heavily over one poor drawing, rubbing out, re-drawing and so on until a hole eventually appears in the paper. The secret of success is to explore every possibility, to sketch away furiously at all conceivable variations and combinations of shapes—try a tapered wing, possibly with the taper on the leading edge, then try it with the taper on the trailing edge, do the same with the tailplane, and vary its aspect-ratio as this can have an interesting effect on the overall appearance; juggle with the moment arm and, in fact, try everything!

There is nothing to lose in doing this, apart from paper and pencil lead. As the pile of

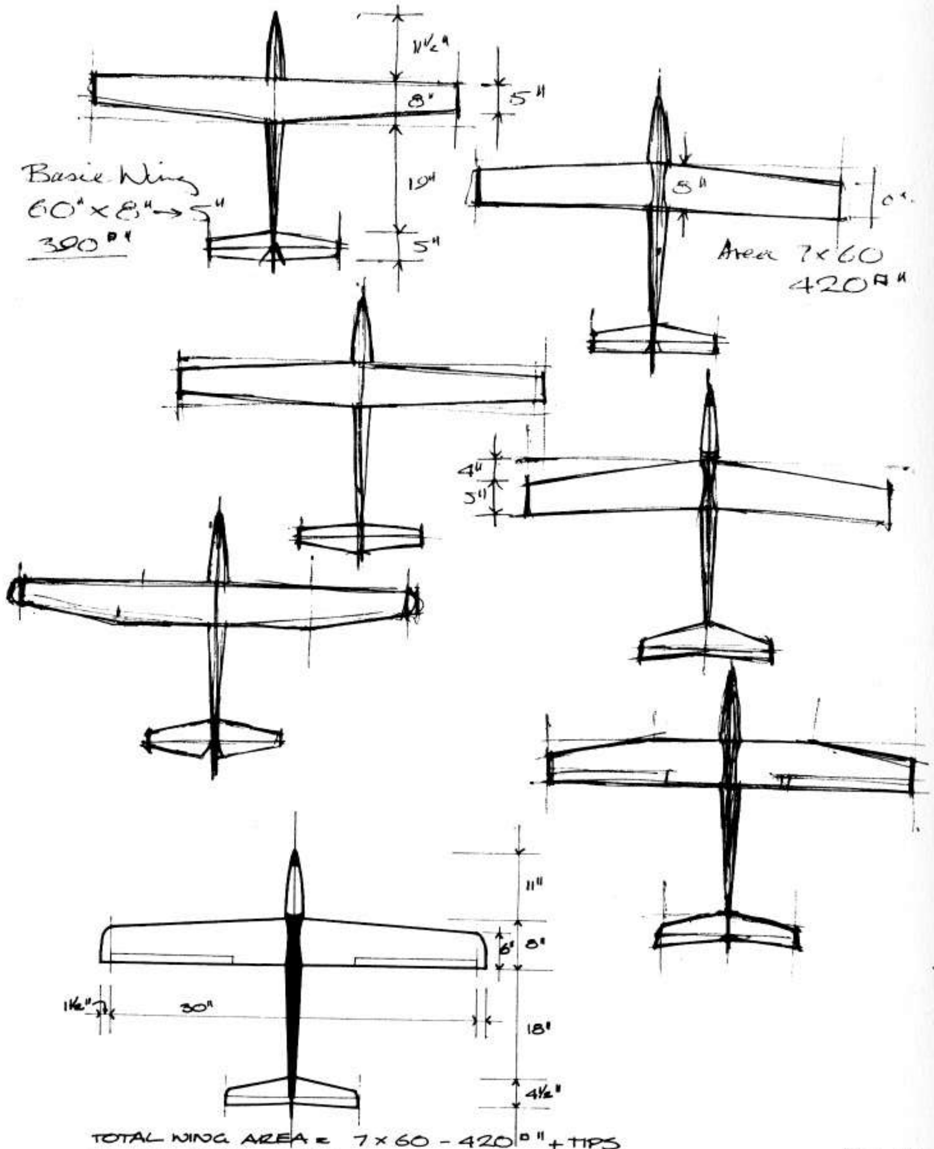


Fig. 76

sketches increases in volume, we will, or should, begin to pick out certain features which are particularly to our liking, so that we can then bring them together on one drawing, thus producing the final layout sketch on which to base the remainder of the design work.

Although I should stress the importance of making full use of the "Basic Components" data, even doing so religiously does not necessarily guarantee that the result will be a winner.

On the contrary, it would be quite an easy matter to create an absolute freak, whilst still working within the suggested limits! This statement is not intended to shatter the confidence as much as to warn of the possibilities.

By far the greatest asset one can possess is an "eye" for the right shapes—all my own designing is basically carried out on the "what *looks* right must *be* right" principle. This is something that can only be acquired through experience, by observing other designs, looking at photographs in magazines, studying plans, and watching and relating the performances of other models in action. When we observe a particular model performing significantly well, or maybe badly, an impression is created in our mind, and a detailed picture of the model is "filed" away subconsciously, together with any favourable or unfavourable impressions that it has created. As time goes on, we enlarge our "library," until it is sufficiently well equipped to enable us to use it as a reference in order to produce a design of our own, which we are confident will fly and fly well.

Let us now assume that we have finalised our sketch plan view, so the next step is to work it up to an accuratge scale drawing to which can be added a few detail items such as rib-spacing, spar positions, areas of sheeting, and the outlines of the horizontal control surfaces. The whole operation of working up the basic plan-form of a design is summarised briefly as a series of illustrations, in Fig. 76. Let us now proceed to the question of tapered flying surfaces.

Wing taper

A wing which tapers in plan form towards the tip is considerably more acceptable, from the visual angle, than a constant chord wing. There is, however, a certain constructional drawback, insofar as all of the wing ribs are slightly different in size. The small degree of additional effort involved is often the reason why there are so many parallel chord wings in evidence these days! From a flying point of view, provided the taper is reasonably gentle—the tip chord is no less than ⅔ rds of the root chord—there is little harm to be done. If one tries tapering the wing to the extent that the chord at the tip is reduced to ½ or less than that at the root, the same unpleasant characteristics, in the form of tip-stalling or even, in a more violent form, flick-rolling, will quite probably occur. Sharply tapered wings can be, and have been, quite acceptable on power models, but we must remember that a slope soarer is a different kettle of fish, as it does not rely upon an engine to provide adequate flying speed at all times.

Tailplane taper

As most tailplanes on slope soarers are of the simple flat plate variety, the actual shape does not normally present any constructional or, for that matter, aerodynamic, problems. In fact, there are few models possessing tailplanes that are not tapered, and the way the taper is handled can have a considerable bearing upon the overall visual effect. A carefully proportioned tapered tail can do a great deal to offset the plain look often afforded by a constant chord wing, as is shown in Fig. 77.

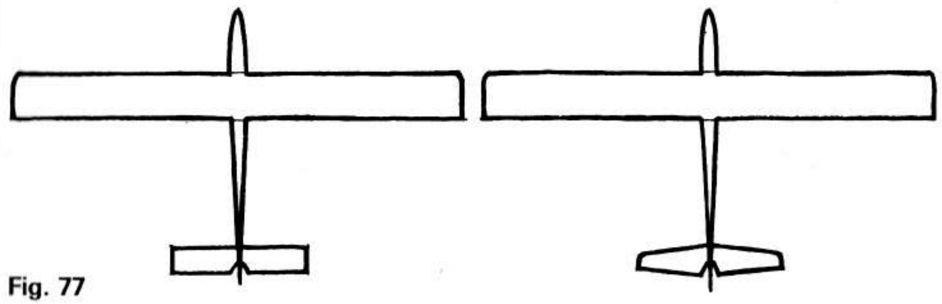


Fig. 77

The fuselage profile

With the plan form of our model finalised and, thus, the major factors of aerodynamic and performance value determined, we can now concentrate on producing an attractive fuselage profile, a task which, unlike the previous operation, has few significant restrictions. Now is the time to let our hair down and allow the imagination to run wild. Sounds great, doesn't it!

The idea is to produce a shape that is personally satisfying, which is worth admiring, has character, clean flowing but purposeful lines, and all that. It is a great mistake to sit down and simply plot methodically and with great accuracy a side view of the fuselage, for the chances are the result would show little inspiration and appear quite insignificant "in the flesh," as it were.

What we must do is to set to with a big soft pencil and some large white paper and eagerly sketch out the wildest variations of shapes that the mind is capable of conceiving. As I suggested when tackling the plan view, explore every possibility. Leave no stone unturned, and do not be afraid of consuming large quantities of paper. Fig. 78 shows the sort of sketches that I mean. The chances of finally obtaining a shape with some interest and character, that is a step above the rest, are substantially greater by aiming the sights high and then "watering down" the design into a practical proposition later, than by starting with a "tame" and mediocre shape that results in a nonentity.

It is so easy to picture in our mind the ultimate design, yet it is another matter to be able to convert it, with the aid of pencil and paper, into reality. However, by making a concentrated effort to investigate every possibility, we should sooner or later strike a "theme" that is to our liking. It can be a long and sometimes frustrating process but, when the lines begin to fall into place and we see at last some of our dream model appearing in black and white, then the sense of satisfaction and achievement is ample reward.

Before going any deeper, I must point out that we should not completely lose sight of the planform of the model which has already been established. Sooner or later the fuselage has to be mated with the wing and tail, so consideration must be given to the compatibility of these items. There are obvious cases where models possess the influence of one designer throughout, whereas others give the impression that the wing, tail and fuselage were each the work of separate individuals.

Once we have found the "shape" that, in our opinion, is compatible with the overall planform, the next step is to relate it dimensionally to this. This is best achieved by setting up a "grid" consisting of a horizontal datum line, crossed by verticals which indicate, to scale, the nose length, wing chord, moment arm and tail position. The idea now is to transfer our shape onto this grid, to produce an accurate scale fuselage profile that can then be enlarged to produce the full size drawing. It may be found that, in redrawing, some of the character or meaning is lost, and the shape may become distorted as a result of making it conform with the dimensions already fixed. For example, the rear of the fuselage may become disproportionate to the whole, or the nose a little deeper than expected in order to accommodate the radio equipment. Don't despair, for it is quite probable that the layout will tolerate a small amount of pushing and pulling along the fuselage to help rectify any discrepancies that have appeared.

With the layout and the fuselage profile drawn accurately to scale, the basic design is complete, so the scaling-up process can now commence to produce the final full-size "shapes" into which we can begin to work the construction. And this is where we might begin to regret some of the fancy ideas. . . .

Detail design

With the basic overall design put to bed, the time is now ripe to investigate and consider carefully the small details, the finishing touches if you like, that can have a considerable influence on the final product. By small details, I mean such items as the tip shapes, fairings, canopy, and rear-end treatment. In practice, these are the items often given little or no prior consideration and which only come to light as the balsa knife is travelling through

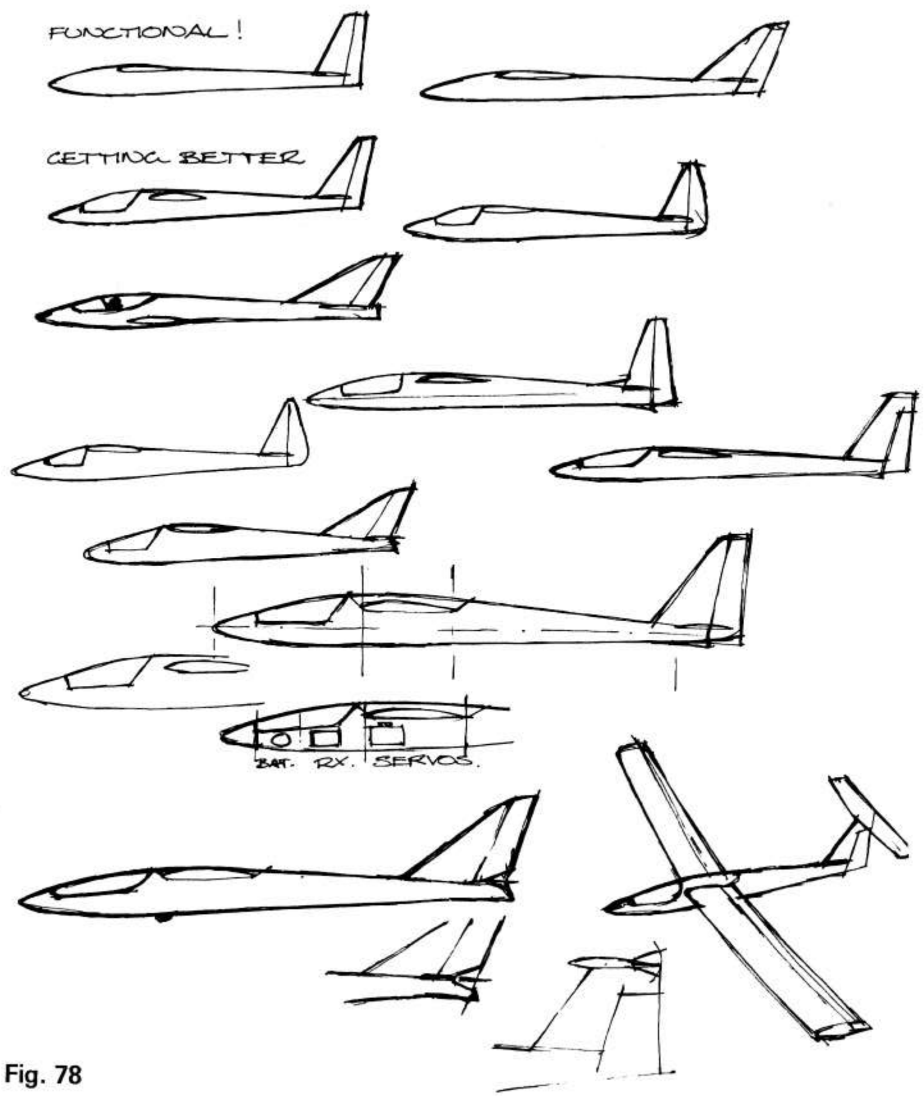


Fig. 78

the wood! Just to illustrate what I am driving at, I have made a couple of sketches (Fig. 79) showing a simple design before and after the "treatment." Let us now take a look at each of these items in turn. . . .

Tip shapes

Remembering my remarks earlier about some models giving the impression of being designed by three individuals rather than by one, the wing, tail and fin extremities should be related to one another in order to provide some continuity, throughout the model. With that in mind I have made another group of sketches, together with appropriate comments, which may provide some food for thought. (Fig. 80).

I read somewhere that the elliptical wing-tip shape is aerodynamically superior to all others but, to be quite honest, such theories are difficult to prove in practice, particularly on slope soarers, where ultimate efficiency is never the prime factor, so the choice of tip shape can be left entirely to the individual.

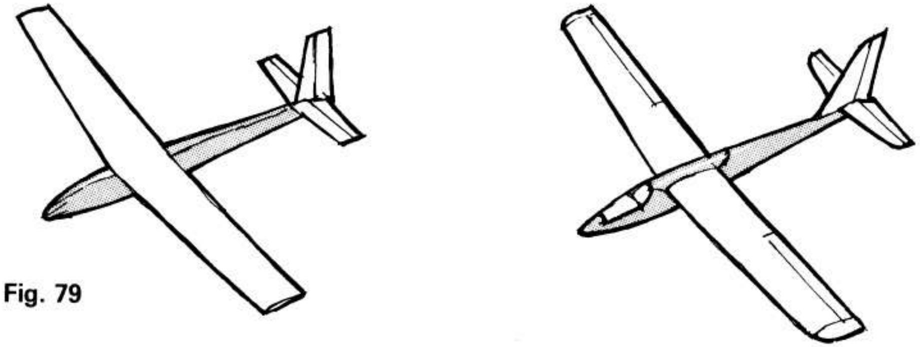


Fig. 79

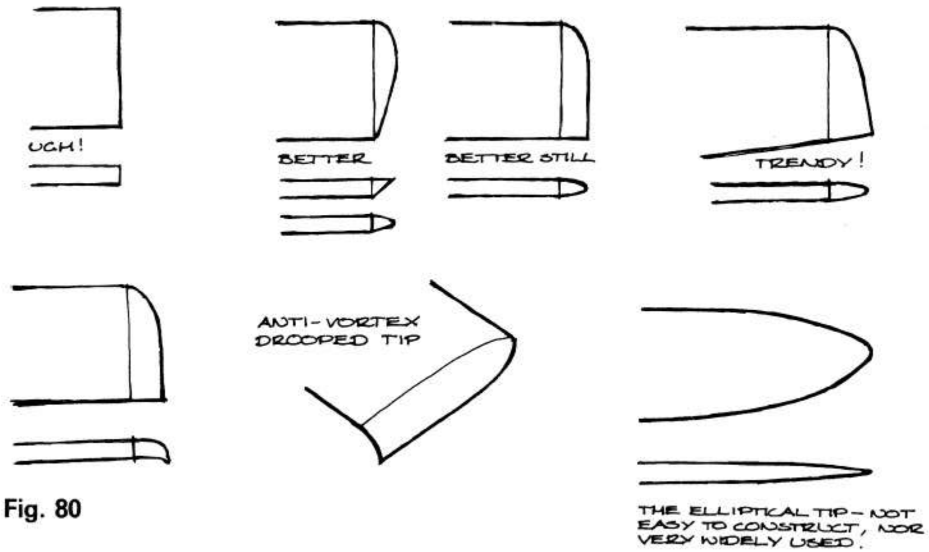


Fig. 80

Front-end treatment

You get blunt noses and pointed noses on people—and the same applies to slope soarers. The choice is up to you, whether you like your model to bounce or stick in! What does enhance a model more than any other individual feature is a cockpit canopy, preferably transparent but, if all else fails, at least a painted area to suggest where the canopy should be! Break off for a quick illustration. (Fig. 81).

The main problems with a transparent canopy, if it is other than the pimple variety, perched on top of the nose, are that it invariably exposes a tangle of wires and electrical workings that are not very pretty to look at and, being a fairly large non-structural com-

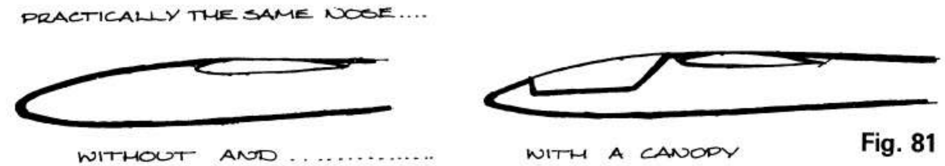


Fig. 81

ponent, can cause a weak nose just where additional strength is required. The above is, of course, most apparent on the smaller variety of soarers, with slim minimum area fuselages of just sufficient volume to accommodate the radio equipment. On the larger models, the radio can easily be tucked away, thus allowing considerably more scope in positioning the canopy.

Also under this heading, wing fairings deserve a mention. The simplest way of positioning a wing is simply to strap it to the top of the fuselage, which can give the appearance of the whole thing's being an accident. With a little more imagination and effort, we can set the wing down into the fuselage and continue the top of the fuselage over the wing, in the form of a fairing, thus creating the impression that the wing and fuselage actually came together by design. Incidentally, wing fairings serve a practical use, indicating whether the wing is correctly aligned with the fuselage—a useful check to make before "chucking off."

With the wing secured by the time-honoured rubber band method, it should be free to knock off cleanly in the event of an accident and, therefore, we should be certain to ensure the wing fairing does not foul the proceedings. Just how many models have you seen with a vertical bulkhead directly in front of, or behind, the wing? Quite a few, I bet, and I need not explain about what happens in a crash. One should always provide an angle no steeper than about 30°, in front of the wing so that, if the model does have an argument with the hillside, the wing is free to shoot forward without taking pieces of the fuselage with it. (Fig. 82). The angle at the trailing edge is not so critical, but it should ideally be 45° or less, thus allowing the wing to slew round should one attempt to land "one wing low" (there, somewhere, is the beginning of a joke about a Chinese pilot.)

Rear-end treatment

However painful the heading may seem, the relationship of tailplane to fin and the associated details, deserve considerably more thought than is often given. Firstly, we must decide whether the tailplane is to be detachable or not—if it is, then the fin must be kept clear of it. A detachable tail is preferable, if one's piloting skill gives cause for concern, but it is rather prone to be knocked and misplaced, causing an elevator trim change and, in addition, limits the design possibilities around the tail feathers. The sketches will, I hope, speak for themselves. (Fig. 83).

Constructive suggestions

Having spent so much time expounding upon the techniques and procedures involved in designing a slope soarer, to conclude at this stage would leave the story incomplete, for there ought to be some mention of how to construct the thing once it has been designed.

Here then, is a brief, and I mean brief, run through of the popular and proven constructional methods widely used on slope soarers.

Wing

Foam wings aside, a sheeted leading edge is considered most advisable, preferably top and bottom and, together with vertical main spar webbing, forms a "D" shaped box section.

Fig. 82

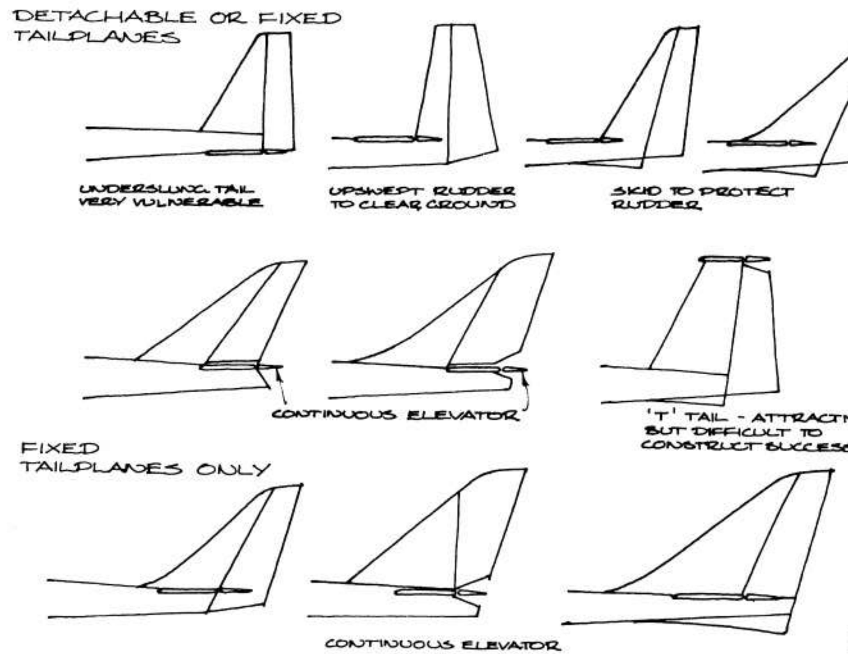


Fig. 83

which is very resistant to torsional loads. Spruce main spars are widely used, although hard balsa can be considered quite adequate, if using the type of construction outlined above. In the interests of economy, weight, and ease of repairing, an open structure behind the spar is recommended, using capping strips over the ribs to provide extra strength with negligible weight penalty.

Ailerons can be dealt with in two different ways, depending on the type used. Strip ailerons are the simplest, and also seem the most effective, as they do not affect the basic wing construction, and can simply be cut from solid wood. If inset ailerons are used, it is most satisfactory to build them in with the wing and cut them away when the basic wing structure is complete.

Fuselage

My own preference is to use fairly generous quantities of light wood, rather than thin and hard material, using 3/16in. sheet for the fuselage sides and underside with triangular longerons in the lower corners, and a fairly generous 1/2in. block top, again with longerons if desired. With this type of construction a fair amount of wood can be removed from the corners to produce an attractive near-round cross section and, when covered in nylon, which I thoroughly recommend if one intends to keep the model, produces a very strong but reasonably light structure.

If the wing is to be faired into the fuselage, 1/16in. ply facings should be used on both the fairing and fuselage where the join occurs, to provide protection when the wing shifts. It is worth while to add a small amount of fibreglass reinforcement around the inside of the nose, mainly in the form of corner fillets, to strengthen the joints between the formers and the fuselage sides, preventing the nose from "spreading" upon heavy impact.

"Tail feathers"

The tailplane and fin, together with the elevator and rudder can be straightforward,

3/16in. or 1/4in. sheet balsa, although one may experience some weakness in the tailplane, if it is permanently fixed, unless great care is taken over wood selection. If a fixed tailplane is contemplated, I would play safe and use a built-up structure, consisting of a basic 1/8in. by 3/8in. or so framework, with perhaps a small amount of spruce reinforcement around the centre, covered both sides with 1/16in. sheet. The result is still a 1/4in. thick tailplane, but one which is many times stronger than the solid version.

Now that I have reached a convenient clearing in the woods, it is an opportune moment for me to draw this chapter to a close. I hope I have covered the important aspects in sufficient detail—any obvious holes in the text are either an oversight on my part, or the result of the editor being over enthusiastic in his editing! If this article fulfils the task that I hope it will, then we should soon be witnessing some new and enterprising soarers on our slopes.

CHAPTER 13

T-TAILS, V-TAILS – AND DETAILS – including all-flying tails, coupled flaps, flaperons, variable camber aerofoils, airbrakes and spoilers

THERE are certain configurations used on gliders which are not commonly found on any other type of model. For this reason and because, therefore, one is unlikely to come across them in any other volume on modelling, we are going to look at some of these here. The idea of this is simply to familiarise ourselves with them, and "what's the object" of them, which is what most newcomers to this branch of the hobby ask.

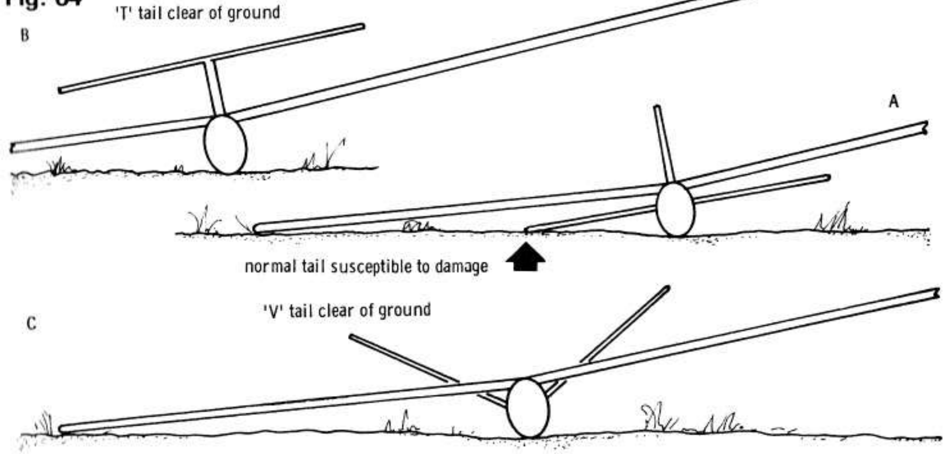
It is not intended to show in detail how to build or install such items—the former will come under the scope of another book, some other time, and the latter is dealt with exhaustively elsewhere*—but simply to show the sort of innovations that are made by r/c modellers, soarers in particular, with various specific aspects of their models in mind.

Ground clearance!

Many gliders, but especially slope soarers, use either a "T" tail—where the tailplane is mounted on top of the fin—or a "V" tail, instead of the usual configuration. No matter how one's aesthetic or aerodynamic senses may be offended, let us be clear that the main reason for this is to keep the tailplane clear of tufts and stones which are a common cause of damage every time the model lands—Fig. 84. The tail is also kept clear of the ground when the model is at rest.

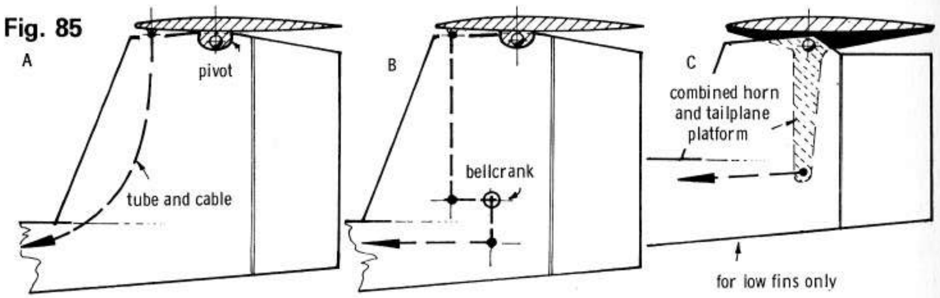
There may be an aerodynamic bonus and there certainly is artistic satisfaction to be obtained from such layouts but, nonetheless, the main reason for their use is practical!

Fig. 84



* **THE RADIO CONTROL GUIDE**—this publication has already been mentioned several times but it should again be emphasised that studying it closely will provide all the answers about installing equipment, linking up to control surfaces—including "T" and "V" tails and so on—that are not dealt with in detail in this book. As a bonus, the *Radio Control Guide* also advises on the choice of equipment at the outset, and how to maintain it in first class condition throughout its life.

Fig. 85



All-flying "T" tail

The "all-flying" or "all-moving" tailplane is one that does not have elevators. The whole tailplane changes its angle of attack instead. Theoretically, this is a more efficient way of doing things, of course, and undoubtedly is so in terms of "full-size" gliders. There is some doubt about there being any real aerodynamic advantage in model sizes. However, it is an interesting way of producing a tail unit and, of course, necessary on some scale subjects.

Probably the most commonly used all-flying tail configuration is in conjunction with a T-tail layout where it is probably easier to produce than an elevator version *provided the mechanics of the pivot and the linkage are properly and accurately made.* Many modellers do seem to have difficulty in producing accurate and slop-free tail-assemblies, however, and this is probably the main reason why, after enjoying an initial vogue, the all-flying tail has rather fallen out of favour with slope soarers. Unless properly made, an all-moving tail can develop "flutter" when the model is subjected to steep dives and other violent aerobatics. Such tails have even been known to lock in a "down" position, through poor geometry of the linkage arrangement. (Thermal soarers, on the other hand, are not subjected to such extreme aerodynamic pressures—not intentionally, at any rate—and the all-moving tail has therefore become quite widely used on these more sedate fliers.)

Fig. 85 shows some examples of T-tail layouts. The variations on this theme are numerous, of course, but about the most extreme version we have seen is that of one kit manufacturer, who has arranged for the whole fin and rudder to pivot and lean backwards or forwards in the fuselage, to provide the change of elevation. It works very well.

Fig. 86

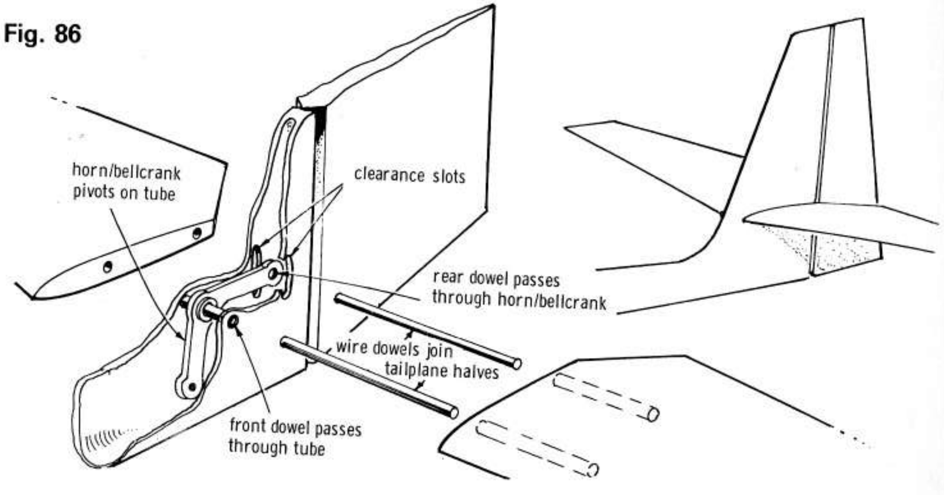
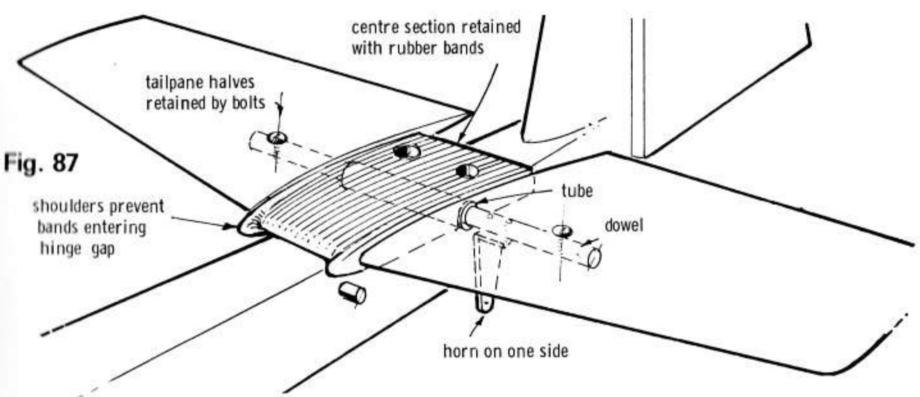


Fig. 87



All-moving semi-T tail

This tailplane is situated lower down the fin, and is usually in two halves, threaded onto each side of the fin with a wire support. One of the wires—the front one—simply rotates in a metal tube or bearing, and the rear one passes through one end of a bellcrank located inside the fin. Fig. 86 shows this arrangement.

All-moving tail on fuselage

These are most common as a modification to an existing design, when the simplest method is to have a separate centre-section through which the bearer rod goes to mount the tailplane panels. They are a good tight push fit. One of the tailplane panels (whichever side is convenient) has an ordinary elevator control horn mounted in a suitable position, and operated by a push rod in the normal way—Fig. 87.

Another method, rather more elegant, and likely to be used in a new design rather than as a modification—uses a bellcrank inside the fuselage with the tailplane (or "stabilator" as an all-flying tailplane is called) panels fitting each side in the manner of the "Semi-T"—Fig. 86—except that the panels are, in fact, fitted to each side of the fuselage.

V-tails

The V-tail, like the T-tail, is another way of keeping the tail out of harm's way. This time, however, we go one better, from the point of view of "cleaning up" the design, in that we dispense with the fin and rudder. The "V" angle formed by the tailplane is itself

Fig. 88

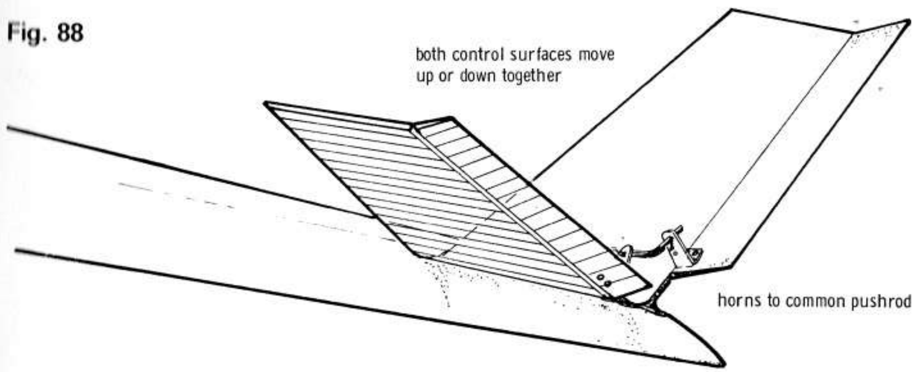
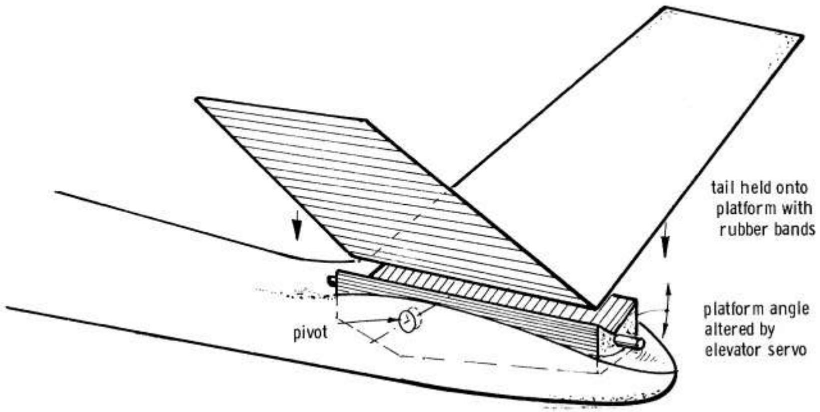


Fig. 89



presenting enough side area to make up for this. The V-tail is sometimes called the "butterfly" tail—a name, of course, derived from its appearance.

The simplest version of the V-tail is one whose control surfaces have elevator action alone. This is the sort of tail used on pylon racing soarers, that only require elevator and aileron action for all the manoeuvres and tight turns they may be called upon to make during the course of racing. Fig. 88 shows this type of V-tail.

An all-flying V-tail can be simple and elegant. As will be seen from Fig. 89, it can be of the knock-off variety—a good idea when used with pylon racers! The tailplane seats in a moving block which is pivoted in the fuselage and connected to the elevator push-rod.

Interesting things begin to happen, however, when modellers start to work on methods of achieving *rudder and elevator* effect with a V-tail! Fig. 90 shows the general principle but there seems to be no limit to the mechanical variations dreamed up to achieve the correct action and each modeller will, no doubt, choose the one that best suits his particular model, equipment or workshop.

Fig. 90

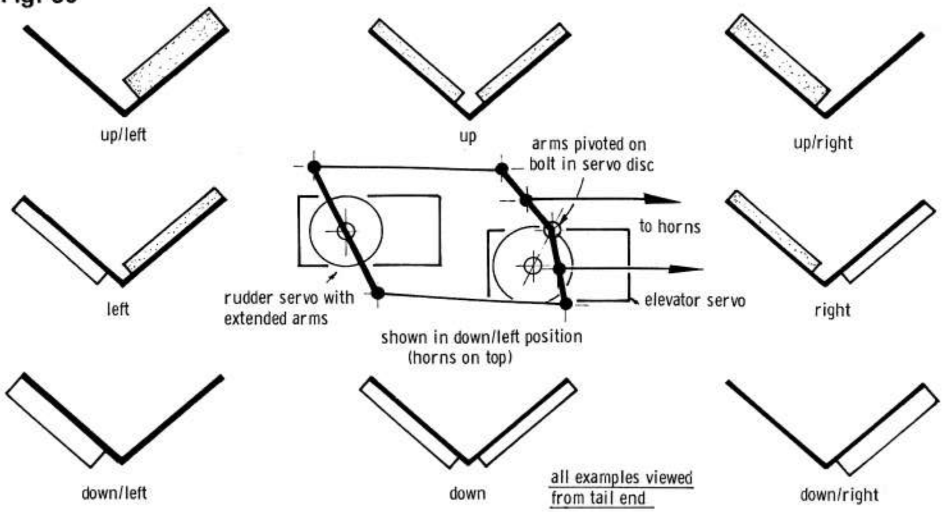
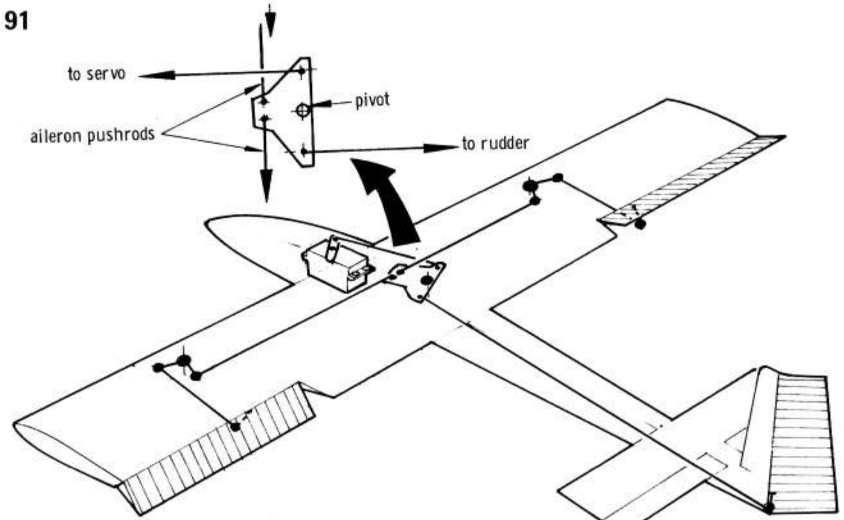


Fig. 91



C.A.R.—coupled ailerons and rudder

This is not exactly a part of a model's "configuration"—to look at a model one would not know it was being used—but more a "configuration of control."

As we have seen in the earlier chapters, some models—usually the scale or semi-scale type—perform best with rudder *and* ailerons. While this is no problem to those of us with "full-house" outfits, many soarers normally use only two-function equipment. To get the best out of these more sophisticated models, therefore, it is necessary to make a mechanical coupling, as in Fig. 91, so that both rudder and ailerons may be operated by just one servo.

The best proportion that the rudder should move in relation to the ailerons will only be found, on each individual model, by trial and error but, as a rule, it is necessary for the rudder to have considerably more travel than the ailerons. For instance, one model we know of, has "normal" aileron movement ($\frac{5}{16}$in. "up" and $\frac{3}{16}$ in. "down") and the rudder deflection is some 40° to tie in with this, for nicely co-ordinated turns. Each model varies, however, and trial and error is the only sure way.

We have heard of C.A.R. being used by full-house fliers who could not seem to manage

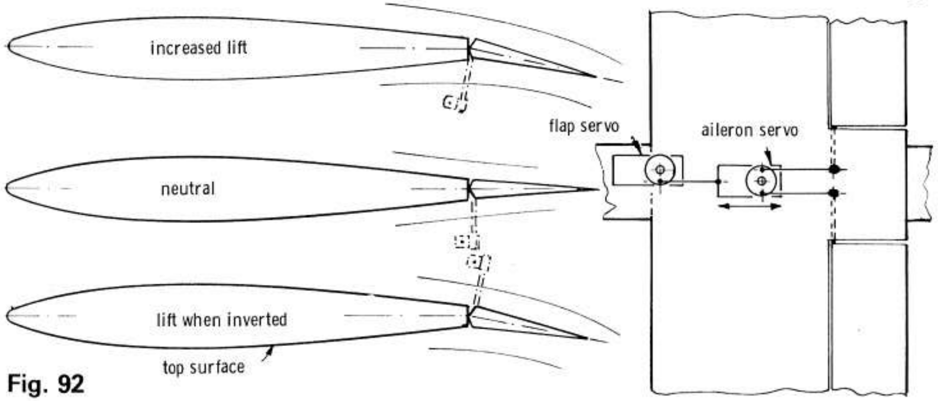


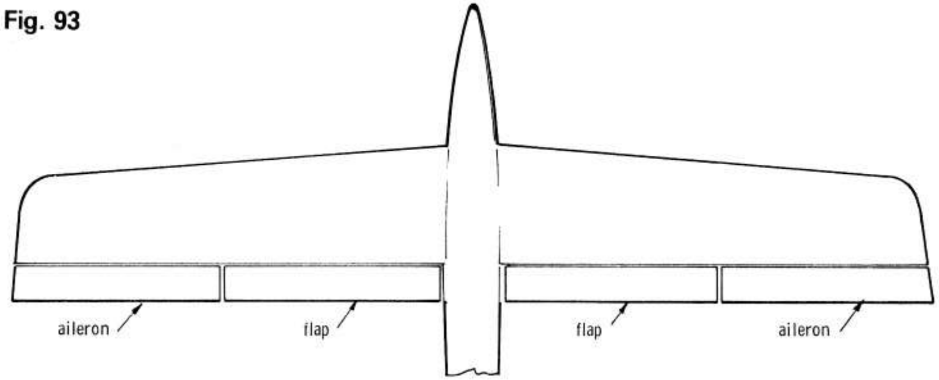
Fig. 92

the correct co-ordination of rudder, aileron and elevator. By coupling rudder and aileron, they say, they can at least be sure that all the controls go in the right direction! Usually, on a model with a relatively small ("scale type") dihedral, quite a large degree of rudder movement will be required.

Flaperons

The word "flaperon" is a composite of "flap" and "aileron" and it means, naturally enough, part flaps and part strip-aileron. The idea of an aileron usable as a flap is twofold. The flaperons can be drooped so as to give the trailing edge of the wing a downward curve, thus giving the wing an increased lift coefficient, in order to maintain—or gain—height. They can then be neutralised for general aerobatic flying, or *raised,* to once again increase the model's lifting properties—*when inverted.* Fig. 92 shows this, and also that two servos are required—one operating the ailerons in the normal manner, and the other driving the first so as to effect flap control. This is achieved with a similar servo link-up to that shown in Fig. 90. The flap and aileron controls operate independently and simultaneously.

Fig. 93



Flaps/ailerons

Another practice is to use wider control surfaces, and to arrange the outboard part as ailerons and the inboard part as flaps. This probably has advantages in that the effectiveness of the ailerons is in no way impaired, and the increase in overall lift coefficient will probably be greater than with flaperons. Fig. 93 shows roughly the proportions of flap and aileron used.

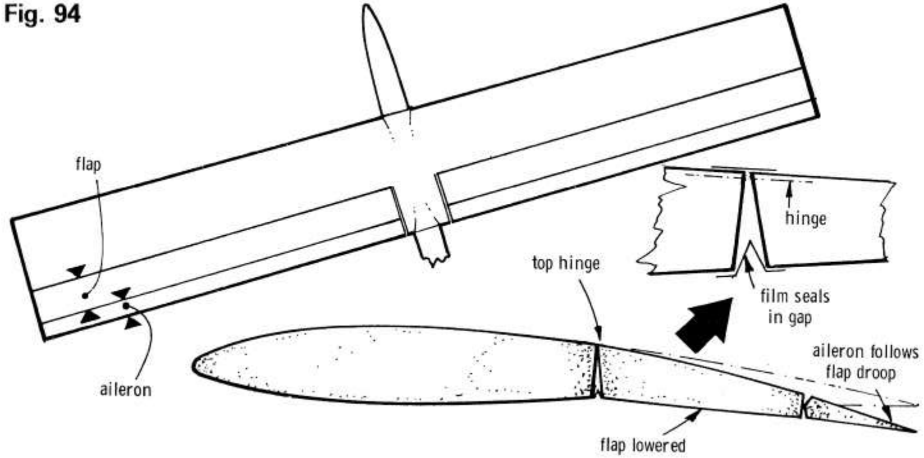
Variable camber aerofoils

Following on from "flaperon" the logical development was a really variable geometry wing section. Not many have so far been produced in this country—only those by the more dedicated contest protagonists. They require a great deal of painstaking care and attention and much experimentation.

Those systems tried so far have been of two types. First, the definite two-stage, changing-section wing, then the less complicated "wide flap" type. As seen in Fig. 94 the two-stage type changes its section from about one-third of the wing chord. It involves considerable mechanics for the linkages—and big problems arise with the necessity to seal the gap on the undersurface of the wing. Without sealing, serious vibration problems develop, due to turbulence around the edges of the gap. Power to move it becomes the problem with the seal in place, however!

Whereas it seems necessary to seal the gap which occurs, in the two-stage unit, at some one-third of the chord, there seems no such necessity to seal that on the "wide flap" unit, which occupies something less than a quarter of the chord—not really such a great deal more than the normal strip aileron, as seen in Fig. 95. Instead of sealing, a knuckle hinge is

Fig. 94



used for the flaps and ailerons, which allows a very close fit. This type of variable section has proved very effective in marginal wind conditions, but seems to have little if any advantage in "good" contest weather.

Coupled flaps/elevators

This system, whereby the flaps go down when the elevator goes up—and vice versa—gives a greater coefficient of lift to the wings at just the moment this is required—that is, in tight turns. The subject has been more fully dealt with in the chapter on Pylon Racing models, since it has been developed specifically with pylon racing in mind.

Spoilers

Many of the larger and more efficient models find difficulty "losing" height for landing. In fact, on some sites where one is obliged to land *into* lift they can pose definite

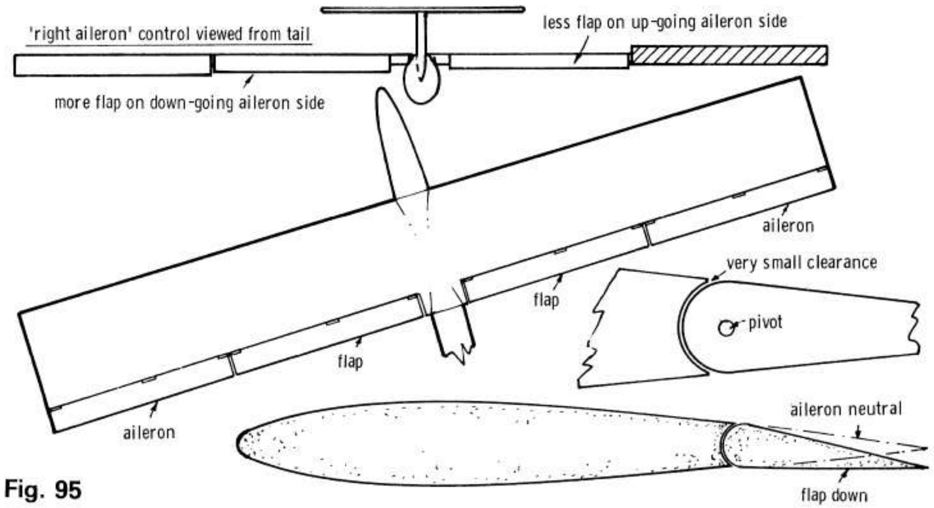
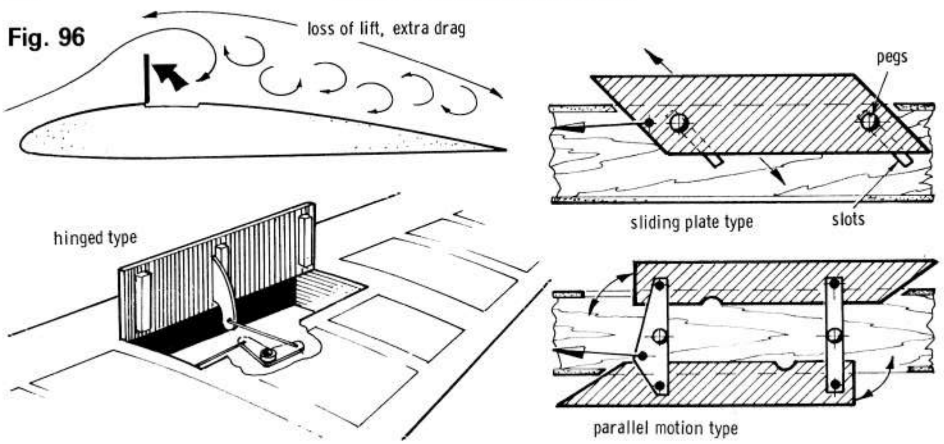


Fig. 95

Fig. 96



problems, unless some sort of lift "spoiling" device is fitted, so that they can make a steep approach without too much build-up forward of speed.

Mechanically, spoilers take a number of forms and, as always, the modeller will select that best adapted to his particular model. Fig. 96 shows a few of the variations. Choice could depend on the spar depth, or even the type of output of the servo it is planned to use. The position of the spoilers, chordwise, is usually at the maximum depth point, for both efficiency and structural reasons. Spanwise, they should not be sited too near inboard, as the turbulent airflow caused by them could reduce the effectiveness of elevator control, as shown in Fig. 97.

No one seems to have arrived at a formula for determining the appropriate size for spoilers on any particular model. In most cases it seems that a strip of material roughly ½ × 6in. long, placed at about the main spar position (maximum thickness of the wing) and parallel with the spar, will have the desired effect! These are often made from thin ply, but tend to warp, so Paxolin or Formica have been more often used.

If you have fully proportional control on the spoiler servo, then so much the better, as it may be raised by degrees, noting the effect, and correcting as you proceed. As a rule, when the spoilers are raised a little, the nose of the model drops slightly. One corrects this with a little back stick and the model starts to sink. More spoilers, more nose-down pitch . . . more

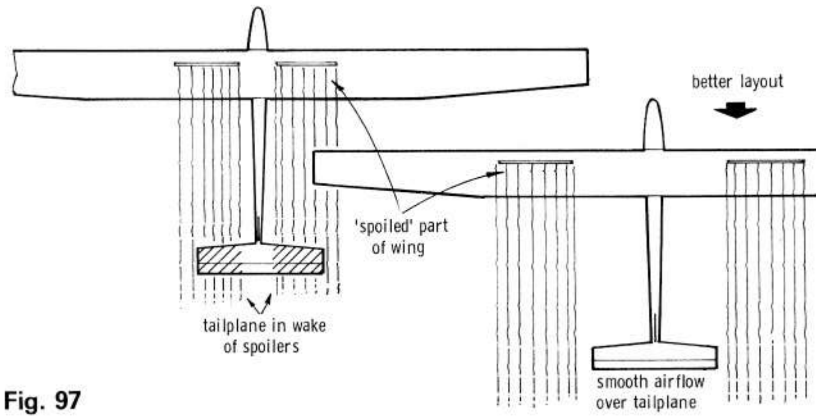
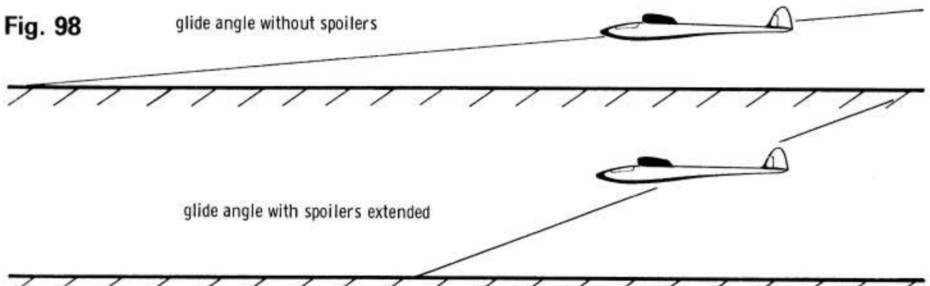


Fig. 97

Fig. 98



back stick . . . more sink—and so on. So, in fact, the approach may be steepened considerably without increasing the forward speed because we are, in fact, now only using some three-quarters of the wing, having "spoilt" the lift on the other quarter or so. Fig. 98 shows the effect on the glide angle.

Some modellers, who do not have extra servos available, operate a "once only" system, whereby the spoilers are fully extended by a take-off from the extreme position of one of the other controls. For instance, the spoilers could be actuated by rubber bands, but held closed by a pin which was pulled by a thread attached to the servo output, in such a way that it would not operate unless "full down" were applied—very briefly, one should add. The brief moment of down-elevator will hardly affect the model's equilibrium, but sufficient movement has been given by the servo to pull out its locking pin and release the spoilers. Crude, perhaps, but effective—and certainly light.

However effective the "once only" system may be (it is probably ideal for thermal soarers) it is really best to have a separate servo for the job. In this way, not only is it possible to "inch" the spoilers up, by degrees, but also to retract them fully and "go round again," should your approach not have been shaping up to your liking.

It is usually the larger types of semi-scale or sport models that benefit by being fitted with spoilers. The smaller aerobatic models are generally manoeuvrable enough to be able to land in confined spaces without such aids.

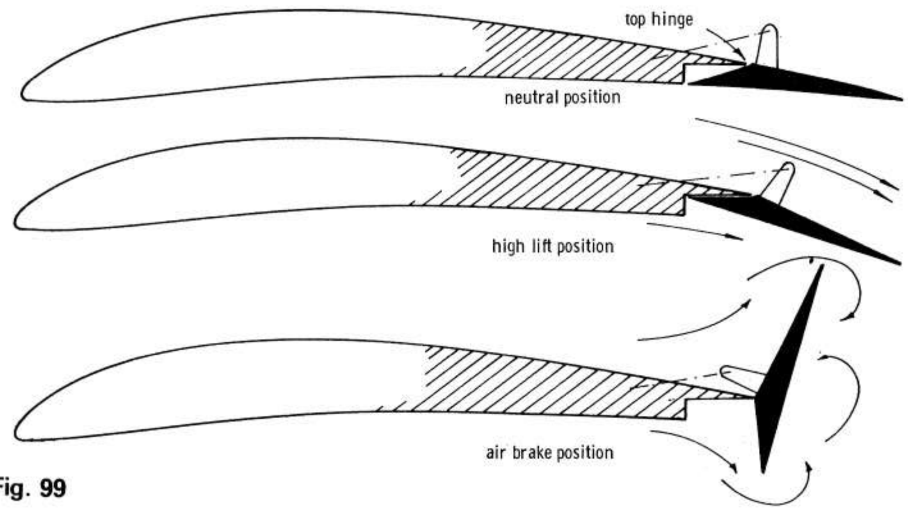
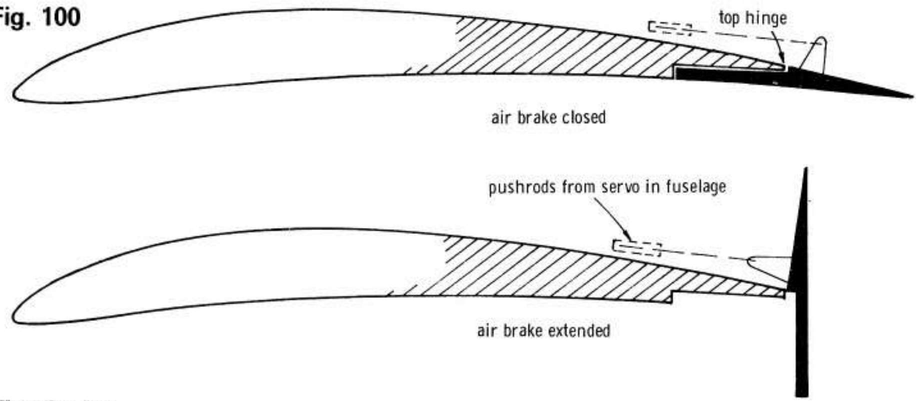


Fig. 99

Fig. 100



Flap/brakes

An unusual and ingenious idea from Norway, shown in Fig. 99, is that of dual-purpose flaps-cum-brakes. Bear in mind, however, that the sort of models flown there are more like the "thermal soaring from the slope" models seen in Germany and the rest of the Continent—not like our own slope models, which are more often of the aerobatic type.

The idea behind these devices is to have a flap which may be used as a lifting surface for slow flight and, using the same servo, with the secondary rôle of serving as an effective airbrake/spoiler. The diagram shows how the system works in theory, but it will need careful structural design to give the necessary strength and rigidity in practice.

Although we have not yet seen these interesting devices in operation on a model in this country (and they could well be more suited to thermal soarers than slope soarers) the Norwegians claim many advantages. These include a much lower landing speed, steeper descent at lower speeds, increased longitudinal stability (as compared with ordinary brakes), improved thermalling performance, permitting safe turns of much smaller diameter without stalling—and improved efficiency, by virtue of the elimination of air leakage and contour breakaway at a critical location on the wing.

Trailing-edge airbrakes

The trailing-edge flaps, as used in Germany, are really a simplification of the Norwegian idea, dispensing with the higher lift position, as will be seen from Fig. 100. Again, these will have a wider application on thermal soarers, but could be used, with advantage, on slope soarers which have to be landed in confined spaces, into lift. When they are deployed, the model may be pointed at the ground, at something like 60° to 70° and will lose height at something less than its normal flying speed. Any tendency to "float" on the landing approach can be killed, and excess height can be lost at the correct moment, by their adroit use.

There are many refinements, both in configuration and in mechanical detail, that have been—and will be—devised by the keen and ingenious soaring modeller. The foregoing, however, are probably the most significant, and are certainly those which seem to puzzle the newcomer most, as to their whys and wherefores.

SECTION TWO

THERMAL SOARING