Typical American Speed model in the intermediate class. Uncowled engine suggests that top speed is unlikely to exceed 90—100 m.p.h. Note the absence of fin, and elevator movement on one side of tail only. Spinner appears to have built-in metal ring for flywheel effect.

CHAPTER SEVEN

# EMPENNAGES

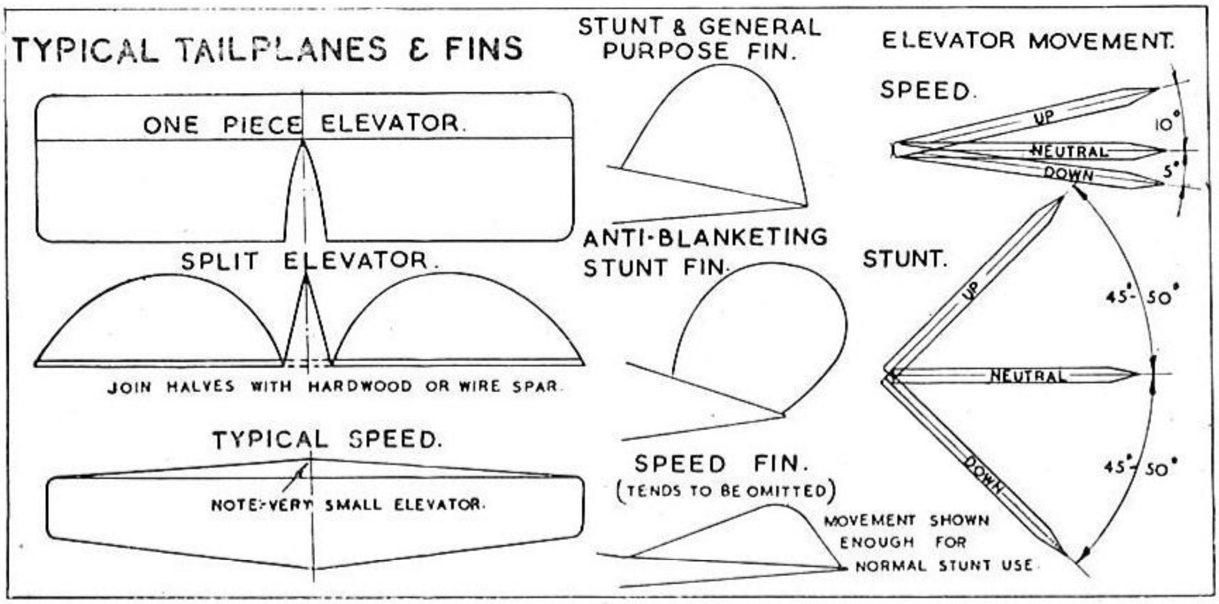
So far, beyond locating the tail movement arm and discussing elevator hinges, we have hardly considered the empennage at all. There are several general points to be discussed before coming down to precise cases. What material shall we use for the tailplane ? What is the best shape ? What relation in size does it bear to the mainplane ? How much of it should be elevator, and how much movement should there be in the elevator ? Should it be set at an angle of incidence ? On fins, we must consider material, size, and offset—fixed, adjustable, or automatic, and, coming into more advanced realms, whether we even need a fin at all.

In the early days tailplanes were frequently built up, just as in normal freeflight models, but more recently the tendency has been all for simple sheet balsa or three-ply fabrication. This is easily worked, can be readily shaped to a flat plate symmetrical airfoil shape, and its strength can be widely varied by variations in hardness of the wood. Hardwood strips can be added to hinge edges of tail and elevator if additional local strength is needed, or the elevator itself can be three-ply and tail balsa. The only exception to this solid technique is in the case of large lightweight stunt models where tail lightness is essential, when a large tailplane can be lightly constructed of say 3/16th in. square, and tissue covered. It will have little strength and but a short life, but some enthusiasts consider it justifies these disadvantages.

The simplest shape is always the best. Most stunt models employ a rectangular tailplane, with single piece elevator stretching the full span, and projecting beyond the fin for ease of uninterrupted movement. This can be made more elegant by a slight sweepback to the leading edge, and by rounding off the corners, but generally this is the basic shape that will be found most useful.

In the speed department this rounding off of corners will be carried still further to produce an elliptical tailplane, but still using solid construction. Ply will be more popular here in the need for extra rigidity and a firm fixing for elevator hinges.

Relation between mainplane area and tailplane will vary according to the type of model. Though we have seen a figure as high as 35% quoted by an authority, we consider that this is far larger than will ever be necessary with a long moment type speed model. For speed it is more usual to find this area reduced to from 15%-20% of mainplane area, which will give sufficient control, and involve no particular structural problems. For stunt models, again, a practical minimum is 20%, increasing to 30% with short moment arm designs. For biplanes




the relation is judged from the total area of the two mainplanes, and the low limit size chosen, unless the model is of unusual proportions. For extremes of moment arm the figures given can be slightly increased or reduced, if considered essential to good design, but less trouble is likely to be experienced if they are adhered to rigidly.

Most scope is offered in deciding the proportion of the tailplane that is to be elevator. As we have seen in the design section, this figure can rise as high as 60% (which is latest American figure) for stunt models, but the comparative beginner will be best served by keeping within the 50% margin, which gives an immense amount of control, well able to manage the most ambitious flight pattern. Just as stunters see how much they can move, so speed fliers must see how little. It should never be necessary to have more than 20% of the tailplane devoted to movable elevator ; in fact, it is far better to think in terms of 10% as a normal maximum, and consider very carefully before increasing it. The speed model will be flown in constant height flight circles and the only trim required is in keeping the job level in a wind, and in take-off and landing. The least that will do this work should be chosen. To give some idea of just how little will do for speed flying, a number of modellers have flown their models with fixed controls R.T.P., and a number of designs have been published for this kind of flying. When there is no wind it should be possible to fly any *well designed* speed model like this.

How much movement should we incorporate in the elevator ? For speed models a total range from full up to full down should not normally exceed 15°, with up having 10° and down 5°. Always give more up than down so that response is quicker in emergency ; it will be easier to keep out of trouble in an upwards direction than downwards, and it is comforting to feel that a quick flip will correct an unwitting dive in time to avoid a prang. For stunt models we can really put in some movement ; 90° full range is quite a good normal maximum to bear in mind, with the movement split equally between up and down, for the model will be flown, we trust, as much inverted as right way up. We have seen even more movement allowed, but the elevator is then becoming virtually a wind brake, and may well cause mushing and even stalls if given full movement except at top speed.

There can seldom be any reason to set the elevator at any angle of incidence : it will be hard to go astray if always placed at 0°, as nearly as possible on the thrust line in the case of both speed and stunt models. There will be occasions with speed designs where its location can be defended elsewhere on structural grounds, for example, to avoid damage in a belly landing, or to permit all enclosed control operation.

Whilst accepting the single straight through type of elevator as the most desirable, there will be occasions where a split type will be required. This applies mainly to speed models, as the divided type permits easy installation of all enclosed elevator horn and connecting rod. Care should then be taken to be sure the two parts are strongly attached in the same plane. This can be accomplished either by a hardwood strip cemented to the edges of the two halves, or by a steel wire joining brace. The latter is stronger, but more inclined to buckle. The hardwood or dowel attachment is more rigid, but will break off under strain. Some very fast models get over the problem by having a movable elevator on only *one side* of the tailplane. As the model cannot get out of the circle it does not matter if the elevator movement tends to pull it out on the wires. For other than fast models, with a high degree of centrifugal pull, this practice is not recommended.

Another recent innovation, pioneered by Garami, is to have a fixed tailplane on speed models and secure control by movable ailerons in the trailing edge of the mainplane. This permits shorter connecting rod, and smoother response, though not so positive as in conventional layouts. It also spoils, to some extent, the smooth sweep of the mainplane. We have not heard of it being fitted to any really successful design, so must consider it experimental only for the present.

There can be no reason whatever for a detachable tail unit in a model designed for exclusive control line use. There are one or two so-called combination kits on the market with interchangeable free flight and control line empennages, where loose fitting is necessary, but such models are compromise designs at best. No matter how well secured there is the probability of movement in flight with jamming of controls, plus flight to flight changes of tail trim through casual assembly.

The fin enjoys a dual function on control line models. By sturdy construction it can protect a comparatively vulnerable tailplane from damage in a noseover landing, and in flight by offsetting it can maintain line tension. Area should be 10% to 15% of mainplane, reducing to 5% or less with speed models.

For the former reason the trend is now to a solid fin, though not quite so general as the solid tailplane. If a built-up fin is decided upon it is a good practice to see that it has a sturdy vertical mainspar to take any unwanted landing shocks. By far the greater number of models use the fin to keep the model constantly trying to turn out of the circle, thus preventing that horrible feeling of helplessness when an unruly plane is coming in on the line faster than the operator can step back and control it again. The slower the model the more offsetting will be required, but it is not necessary to offset the whole of the fin. About one-third only at the rear can be offset to turn the plane out of the circle, according to rotation of flight. It should be offset anything from 5° to 15°—finding by experiment the least offset that will do the job efficiently. Too much makes the machine crab, and with speed models materially reduces speed. If the whole fin is turned—and this will be usual with built up fins—then amount of offset can be reduced to as little as 5° with good results.

For small scale models where an offset fin would destroy something of the scalishness we have found cambering of the fin to a Clark-Y or similar airfoil does the trick very well. It does not seem very efficient, however, with the larger engines and heavier models.

Modellers flying their own designs will probably favour an adjustable fin, at any rate in their prototype trials. Hinges should be stout enough to resist the airstream striving to straighten them in flight, and owing to greater speed must be stiffer than similar free flight hinges. Tincan metal or brass wire will be found simple and practical. When the ideal setting is found, cement the offset, and carefully measure angle for future reference.

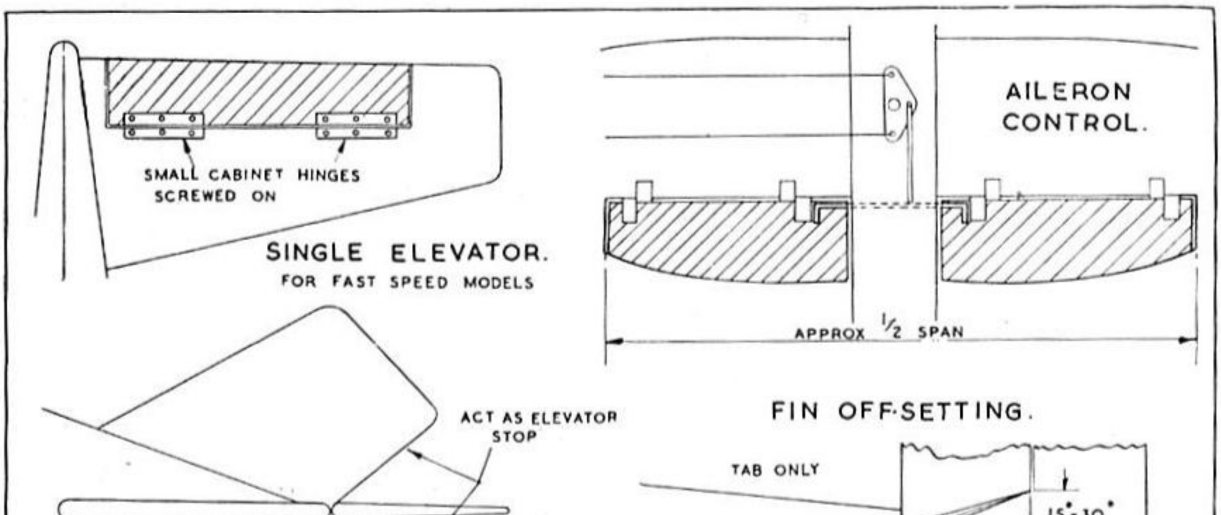
As the offset fin is only necessary to prevent the model coming in on the line, some ingenious builders have experimented with an automatic rudder, which only turns when the lines slacken. This is effected by having a sliding control plate, normally held in a central position by the pull of the lines. If the pull slackens then elastic bands act on the plate, which in turn allows the spring loaded rubber to swing over. As the lines take up the strain again, the control plate centralises and the rudder returns to neutral. For the gadget-minded it is worth trying, but seems an unnecessary complication to a simple model and an insecure one to a really fast machine.

High speed devotees have considered this fin bogey very thoroughly, and decided to do away with it altogether. They reason that at speed the centrifugal pull on the lines will keep a properly designed model taut, so the problem only applies to slower take off and landing speeds. With a really stable dolly designed to carry the model until it is well up to its flying speed before release, the take off problem is solved, while the machine can be whipped to keep control in a dead engine landing. Hence a number of dolly type speed models will be seen to lack any fin. To a practised flier there are no particular flying headaches, whilst perhaps as much as 5 m.p.h. has been added to top speed by removal of an undesired piece of drag.

Fin shapes are usually conventional and unimaginative, taking the most practical lines suited to the design. Thus we find them practically straight on the leading edge, and gently curving into the lines of the tail at the rear, with a convenient sweep joining the two parts. Or, more utilitarian, with all lines straight and only the corners slightly rounded off. An exception to this was noted in Pete Cock's 1948 Gold Trophy winner, which had a distinctive bowed trailing edge. In conversation with this acknowledged low power stunter, he claimed that such a shape prevented any blanketing effect when in the transition position between upright and inverted. We later had occasion to try the idea on a small Mills powered model and found it much happier at the controls, so offer it to all small slow-flying model designers.

Some models, particularly with twin boom layouts, have incorporated twin fins. This is doubling up on a nuisance and suggests that twin booms are bad design, except in scale models. With such a layout flying is more by instinct than eye, for it is quite impossible to see the elevator unless it is big enough to project beyond the fins. This twin boom idea appears in one of the A.P.S. designs, the Tyro Trainer, and we were puzzled for some time as to why the designer had used it, for it is not a twin boom job, and it seemed to have no logical place. On test the model justified its design : the twin fins added to directional stability, and steady pull on the lines, while the inability to see elevator encouraged instinctive control and smooth movement. As the design is a speed *trainer* this forcing of the pilot to act instinctively and not watch the controls—which can hardly be seen that clearly at speed anyway !—warrants further investigation of beginners' designs to make them do the right thing because they have to, instead of just telling them.

Carrying this analogy a step further, it remains to consider whether the recommended practice of painting the elevator a bright colour so that it can be seen is good advice. Frankly, the only time when seeing it matters is at take-off testing, and the helper can surely be relied upon to give the cautionary, full up, full down, as the pilot waggles. At slow speed the elevator can certainly be seen, and its position checked visually, but most reactions become purely instinctive, and it is a poor flyer who does not know where his controls are at any given moment. We have decided against the practice, and confine ourselves to a bright colour for the whole aircraft, with a contrasting underside in the case of models intended for extensive stunting, for one can almost forget which way up the machine should be and attempt an upside down three pointer.



Speed model mounted on dolly. Features to note are wide spacing of front wheel section intended for concrete or tarmac take off, and simplest possible bracing compatible with strength.

CHAPTER EIGHT

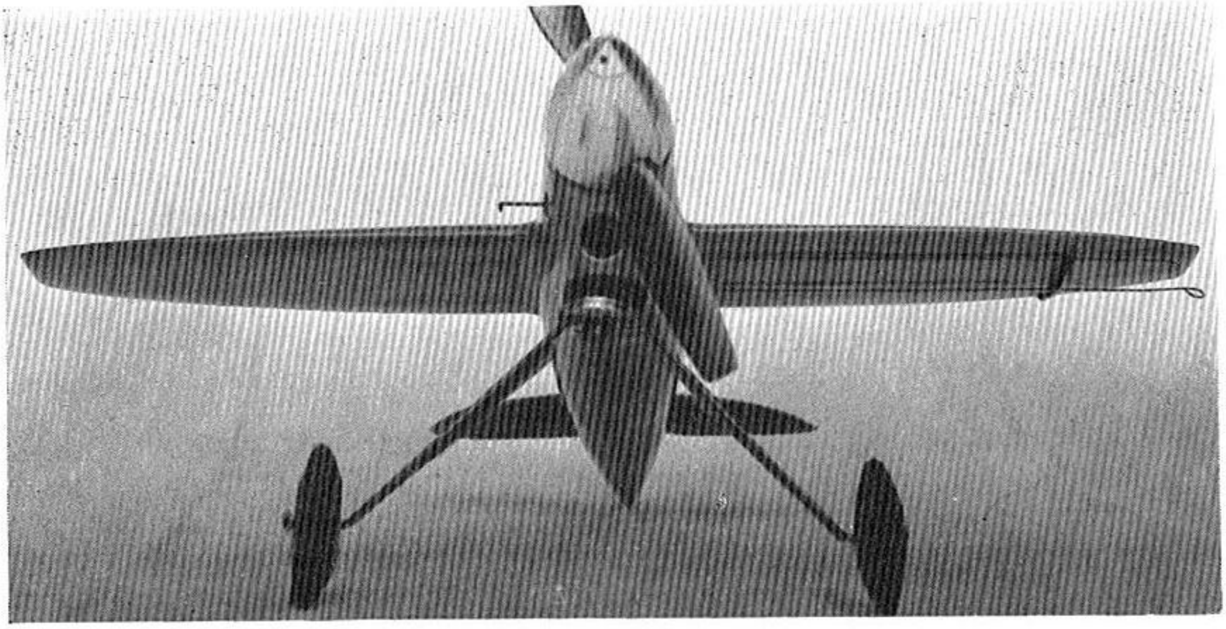
# UNDERCARRIAGES AND DOLLIES

As most control line models are functional rather than beautiful, it follows that undercarriage arrangements will be such as to do the job required and no more. The obvious reasons for an undercarriage at all are to give the model some means of running along the ground until flying speed is reached, and to serve the same purpose in reverse when landing. To these may be added the need to protect the propeller at all stages when the model is not in the air, added side area low down provided by the wheels, and added pendulum stability added by the weight of wheels and wire structure.

There are certain differences between the design of a control line undercarriage and that of a free flight model. In the latter case there is usually a secondary attachment to the fuselage behind the main legs to even out the backward landing stresses, when the machine must land unassisted by a pilot and with engine off. A control-liner is, normally, landed smoothly by an experienced or lucky pilot, or simply whanged into the ground. No harm is done in the first instance, but in the second legs are invariably bent for all their inherent springiness, and any wood fairings damaged. These are therefore usually omitted and we have instead a stark single wire leg without any secondary attachments, which are more trouble than they are worth. A bent leg is no worry on the field as the wire can be straightened in the hands and all is well. Any complications make for trouble and are best left off.

As a single wire only is used it follows that it must be stout, of 3/32nd or 1/8th in. diameter best piano steel. It is bent in a single piece with a V or U shaped portion at the centre for attachment to a bulkhead in the fuselage. This bulkhead must be of ply, not less than 1/8th in. thick, and the wire firmly bound to it with fuse wire and the joint soldered over. Thread binding will be strong enough only for the smaller models of up to 2 c.c. capacity. A simpler and equally effective method is to use J-bolts, either bent up and threaded by the builder, or bought at the model shop for a few pence. Again a strip of tincan metal can be cut and bolted to the bulkhead to make a firm fixing.

We have recently made full use of small bonded paxolin boxes available to take the more popular wire gauges. These are so strong and afford so firm a fixing that they have often survived to play a useful part in several models when all else has gone. The undercarriage need not be bolted in, but is simply sprung in place. In the case of bad bending it can therefore easily be removed for more extensive straightening than the usual hand bending back.



A simple training model that is nevertheless quite graceful and finished with such refinements as enclosed engine and prop spinner. Simple unbraced undercarriages of adequate thickness are the general practice for this class of model.

Legs should be bent slightly forward, with the attachment bulkhead just forward of the C.G., or even actually on it, and be long enough to give, say, up to one inch clearance for the airscrew when the model is in its normal posture just prior to becoming airborne. Their track should be about 80% of the airscrew diameter. Too wide a track should be avoided, as it provides an unnecessarily large turning moment where one wheel is out of line.

With scale or semi-scale models builders will wish to follow the prototype undercarriage arrangements, and in this case some fairing-in will be necessary, but should be so carried out as to allow the maximum possible springiness in the steel wire to be retained. Added strength will be given to legs normally located outboard of the fuselage in the underside of wings if they are still bent up in one piece with the connecting wire running through the fuselage, and firmly bound or clamped to a ply mainspar. Advanced builders have developed clever retracting mechanisms that work both up and down by means of a third line, and these certainly add to the realism of scale model flying. They have no justification, however, in any other phase of design.

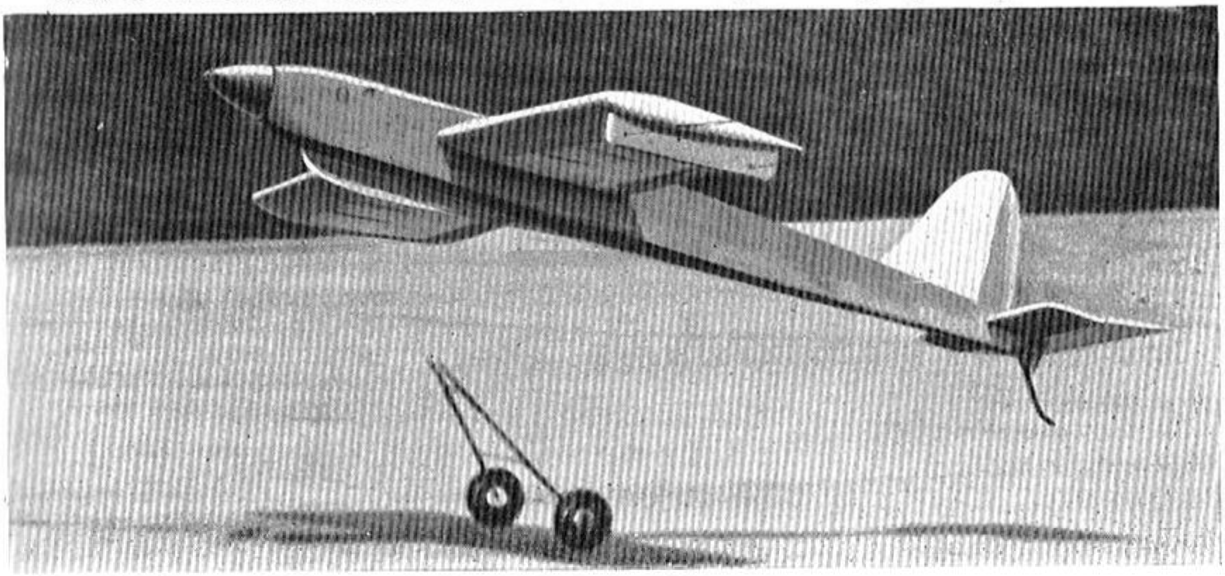
The uses of a fixed undercarriage cease, except for its stabilising value, once a model is airborne, and builders have been quick to seize on this aspect. Nearly all contest type speed models and some stunters are designed to have either a drop-off undercarriage, or to take off from a three- or four-wheeled "dolly," which can best be described as a "take-off truck." At the end of the flight the model must, perforce, make a belly landing, but in reasonably skilled hands this will not do any damage. The underside of the fuselage is suitably reinforced in some cases with a wire or metal skid, metal sheathing, or simply a piece of hardwood strip let into the surface. The airscrew has been previously fixed on the shaft so that when the engine cuts it will lie horizontal, that is, in line with the wings. For added protection some airscrews even have folding blades, a refinement that saves much extra work or expense. This lack of damage presupposes that landings are made on turf or dirt surfaces ; concrete or tarmac will score even metal protectors.

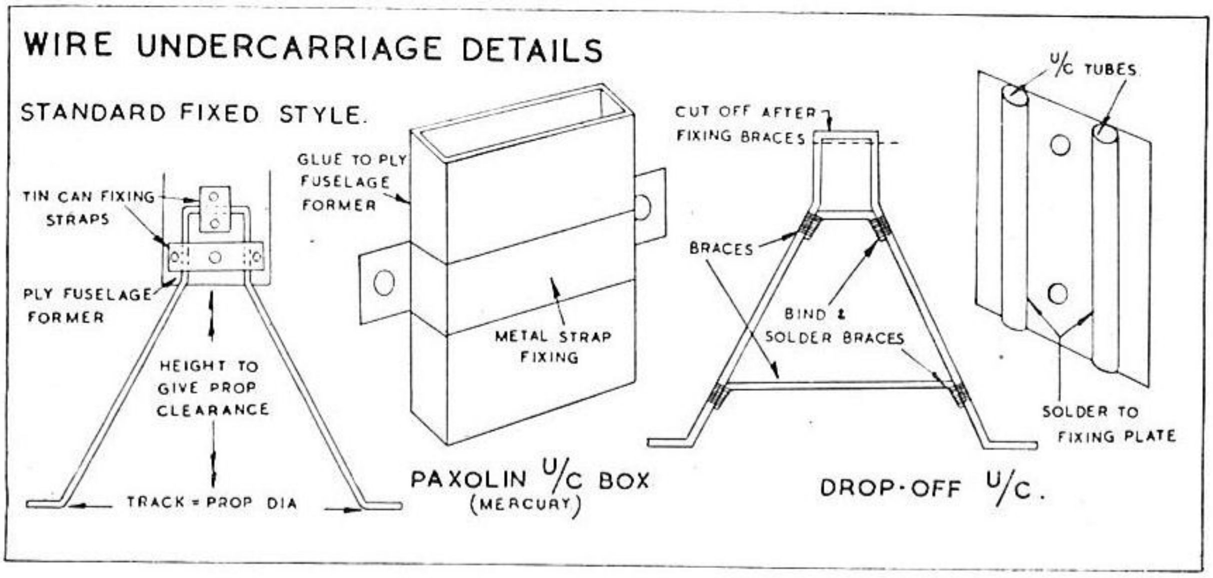
As a first essay at detachable undercarriages, the beginner is urged to try the two-wheel drop-off type. He may find this so satisfactory that he will not want to try any other method, though there are disadvantages and risk of a noseover when fitted to a very fast model, that requires high take-off speed, operating from somewhat bumpy ground, such as usually seems to be the venue of the average contest occasion. The construction of such a unit is very simple. If the paxolin box already mentioned is used, it is only necessary to bend in the U-shaped retaining portion of the undercarriage to make it a drop-off fit in the box. Immediately the model becomes airborne it will drop off.

Care should be taken when first trying such a modified take-off, for the removal of the weight of wheels and wire, probably from a point not exactly on the C.G., will give the machine a violent up surge, and over-correction at this point must be guarded against. Where models have been specifically designed for such tactics the undercarriage should be located exactly on the C.G., thus avoiding this violent change of trim. All that will then be noted will be an immediate increase in speed.

Most varieties of this technique embody two separate prongs in place of the U-shaped tongue of wire. The legs should be bent up in one piece as for a conventional undercarriage, and two cross pieces bound and soldered in place. The bar of the U can then be cut away and the prongs finished smooth with a file and emery paper. Brass tubes that provide a free sliding fit should next be cut to slip over the prongs, and, using them as locating guides, the tubes should be soldered to a flat metal plate for attachment to the appropriate bulkhead. When finished they will probably be found to work very well tested manually, but apt to stick in actual operation. This fault can be cured by steadily filing away at the prongs until, if the model is held in the hand and thrust forward quickly in a flying attitude, the legs will then freely detach themselves. Before flying both the tubes and prongs should be oiled to assist free detachment. It will be noted that expert flyers are most particular about this, oiling the undercarriage as often as they fill the fuel tank, and testing legs before every flight.

Drop-off undercarriage coming away from *Aeromodeller* design Crackerjack, during its test flights.






Some experts have devised a light spring wire " whisker " which they locate on the leg cross-bar which has the effect of forcing out the prongs on the model becoming airborne. This seems to be only a complicated way of curing a fault that should surely not have been allowed to arise for long. However, as experts have used it, we offer it for what it is worth.

So far we have not considered the type of wheels that are to be used with these undercarriages. Many firms have now produced excellent streamlined rubber wheels in the more popular sizes, bushed with brass or dural hubs. There is little to choose between the makes offered—all seem good value for the money. The better wheels have firmer attachment of rubber to hub and are less likely to strip off in use. With all types it is essential to see that they not only run freely and true, but are firmly attached. A washer should be pushed on to the axle before the wheel and firmly soldered in place, binding behind it with fusewire to give soldering area. The axle must be well cleaned with file and emery paper until it shines, and the wheel then slid in place. A further washer, again reinforced with a little fusewire then locks it in place when soldered. Steel is much easier to solder when using an acid agent such as Baker's Fluid, but to avoid rust the soldered joint must be thoroughly washed with warm soapy water or soda water to act as a balancing alkali to the acid. This prevents rust that will otherwise quickly appear. The soldered joints are finally finished off neatly with a file, a drop of oil added to the axle, and the job is ready for use.

Some of the smaller kits provide hardwood or even metal wheels in place of rubber. There is nothing really wrong with their use, except that the wood may split, and the paint on the metal soon wears off, making the model look somewhat shoddy. For initial flights they will serve well enough.

We have spoken so far of solid rubber wheels only. Air wheels are not looked upon with favour by the best people for fixed or drop-off undercarriages, as variations of inflation may destroy tracking at take-off, they have much more drag in the air, and their natural bounce may turn a nice three point landing into an ignominious somersault. There are occasions when their use is justified, such as where take-offs are contemplated from rough and grassy areas, and their added cross-sectional area will help to flatten the surface and prevent take-off noseovers.

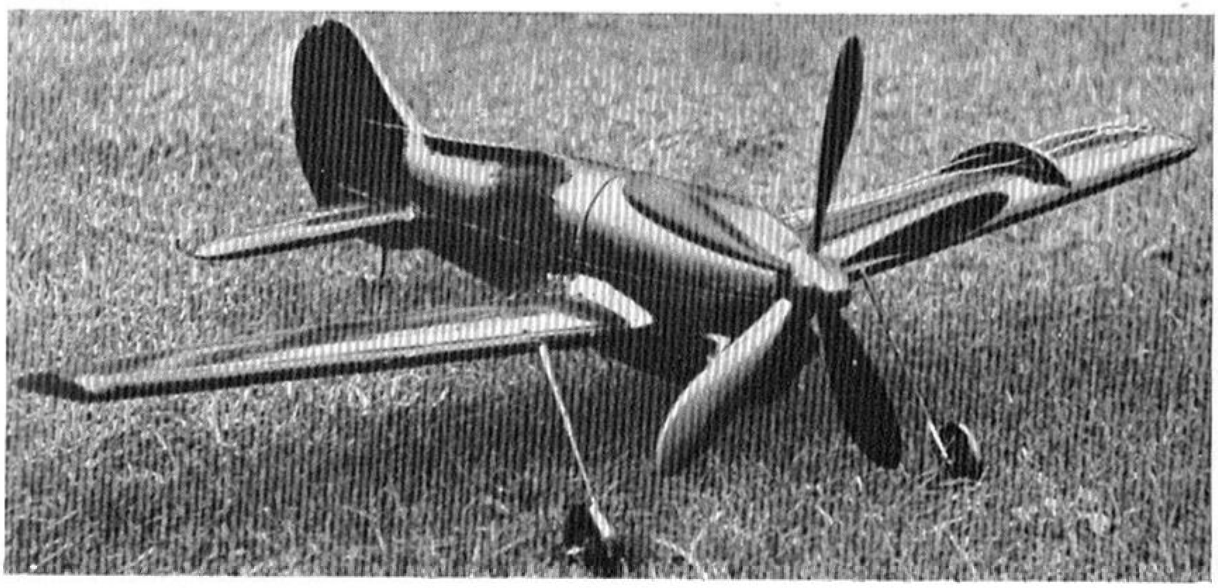
Finally, we come to the dolly. Here good strong construction is possible, and airwheels of ample size come into their own, for most speed flying will take place from turf, where landings can be gentler. They are equally good on concrete and tarmac surfaces.

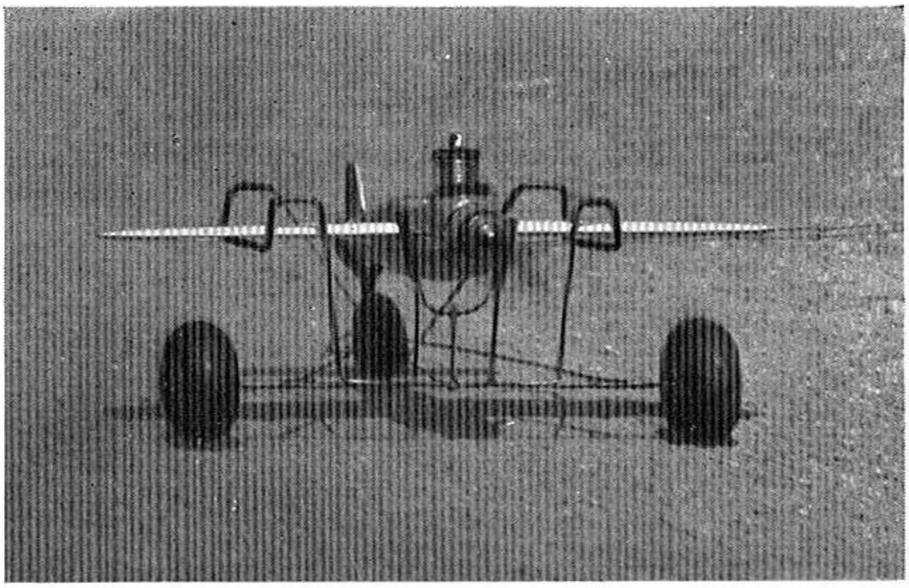
Dollies are usually three wheeled, with two wheels in front and one behind, though four wheeled dollies are also used sometimes. Apart from the wheels they complete their truck nature by a cradle for the fuselage, and extension pieces supporting the wings. In some designs the fuselage cradle is omitted in favour of prongs entering the underside, which makes for more positive location. It is important that their construction is such as to retain the model securely on its bed without shifting, in spite of bumps on uneven ground, until sufficient speed has been attained for it to fly off safely. Only too often we have seen good models damaged by a premature departure from a poorly designed dolly.

It is not good enough to proceed with construction on the lines of a rather elaborate undercarriage. Such a procedure will soon land the builder with what looks like a tangle of steel wire knitting ! The whole job must be carefully planned : the separate parts required carefully bent to size, and matched with any opposite part. Assembly is virtually impossible without some form of simple jig. We have found a short length of planking about six inches wide by an inch thick most useful in this connection. Assemblies can be pinned to it with ordinary carpenter's staples where they are perfectly secure during the binding and soldering operation. A right-angled joint can be well supported on the surface of the plank, with the upright part stapled to the side, whilst a holding jig for any other angle can be made in a few moments with a plane on any other side.

In the effort to be symmetrical some dolly designers fix the rear wheel in a U-bent axle. This is always difficult to bend, as the wheel must be slipped in place before the second bend is made, and never

Outboard wire undercarriage on model of semi scale appearance. Whilst essential in true scale models there seems little justification for its location in this instance.



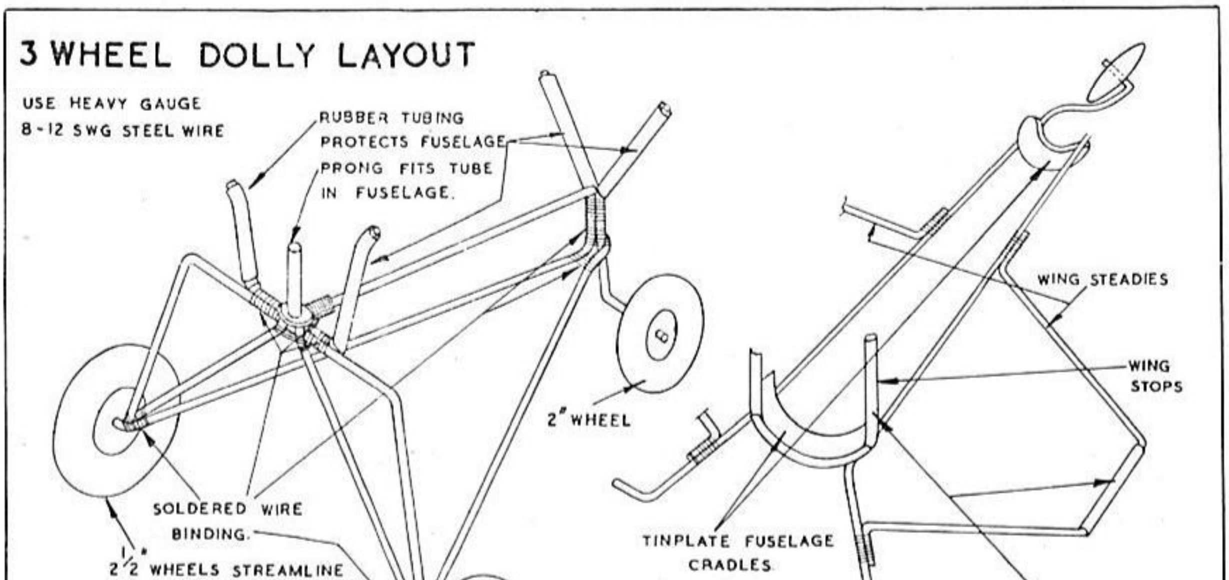


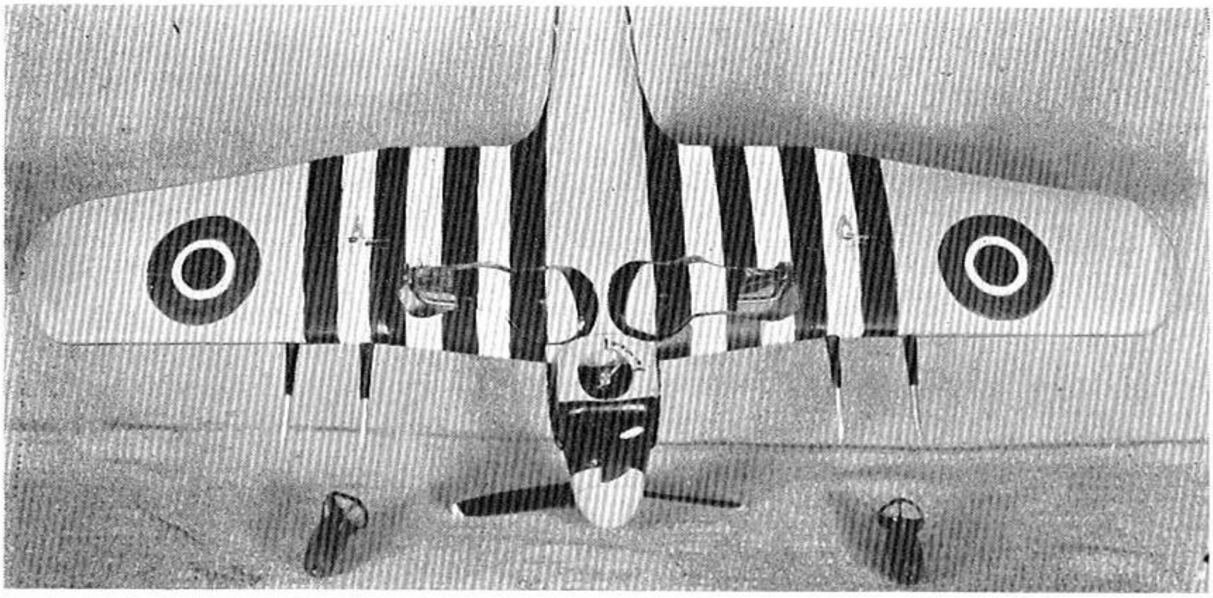
Tricycle dolly fitted with airwheels for grass or rough ground take-off. Compare the more complicated bracing here with the simplicity shown on page 66.

A scale dream! Fully retracting undercarriage and drop-off bombs featured in one of F. B. Thomas's models. This degree of realism is at present beyond the average British control line enthusiast.

seems to track up without immense trouble. It is better to have an open-ended rear axle, similar to the normal front axle, as all bends can be made *and adjusted* before slipping the wheel in place.

It may be thought that binding of say three 1/8th in. wires together at a junction will make an ugly bulky joint. It will be bulky, but need not be unsightly if the fusewire binding is laid on neatly, and a restrained use of solder made. After a joint is effected between the surfaces concerned no amount of extra solder makes it any stronger, so that nothing is gained by slapping it on. We have found that 15 amp. fusewire is the best for dolly use as it is thicker and pleasanter to handle than the lighter 5 and 10 amp. grades which do so well for binding control wire loops.



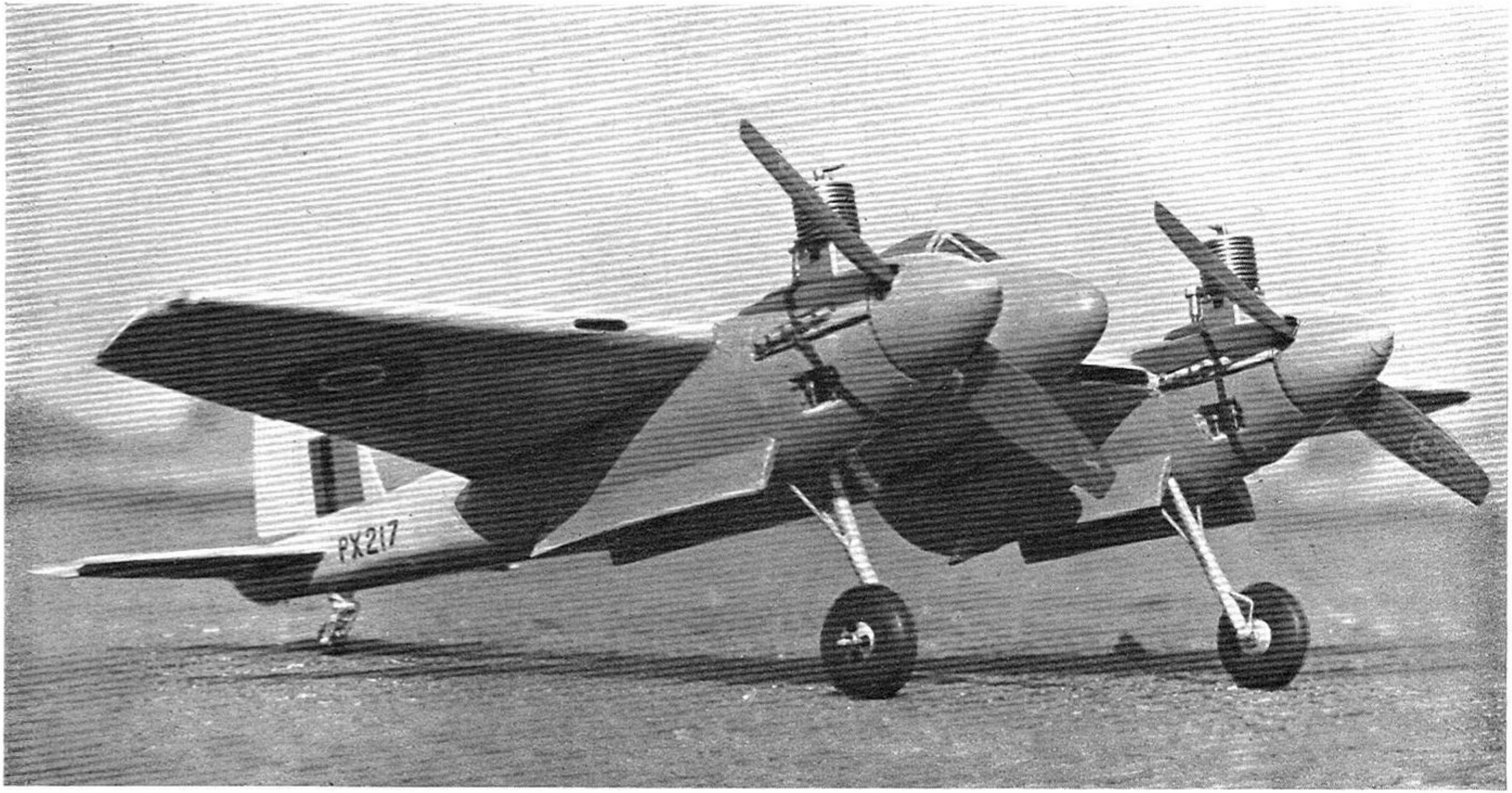


When the dolly is finished it will be necessary to bind the parts touching the model with rubber or similar material to prevent scratching the highly polished surface. In some cases it may be possible to have slipped bicycle valve rubber in place prior to closing access by a soldered joint; other parts, such as the wing locating pieces, will still offer convenient slide-on points. Where it is not easy or possible to have rubber tubing in place, a neat and efficient covering can be given with quarter-inch rubber strip wound round in spirals. The beginning and end can be touched with rubber solution to hold in place, and really painstaking builders may even rubber solution the spiral edges. For final security a neat thread binding at each end finishes off the job. Binding with insulating tape, old bits of rag, and so on, such as we have seen, is slovenly and adds nothing to the flyer's reputation. Remember, the dolly is on the ground most of the time, and spectators can inspect it more carefully even than your model; moreover, it will have no performance figures to give the lie to unsightly finish!

All drop-off undercarriages and dollies should be attached by a third thread line to the pilot to avoid injury to spectators. Although not so necessary to do this when flying without a crowd, it is a good habit to acquire. Should you decide not to bother, do remember to paint the drop-off parts with a vivid splash of red or other bright colour. We have spent twenty minutes or so trying to find a drop-off undercarriage not so coloured in the grass—and then did not find it.

The practice of fitting rear skids would appear to have only the practical value of protecting tail and underfin from wear on a hard take-off strip. In use they are more trouble than they are worth, catching in grass and interfering with proper tracking. Except, therefore, when they are essential for protective or mechanical reasons they may best be omitted.

Before leaving the subject of undercarriages, we should mention in passing the omission of any undercarriage at all. The model is then hand launched by a helper as described in the flying chapter. Such simplification is usually found with the smaller sizes of stunt model, or where access to decent take-off surfaces is impractical.



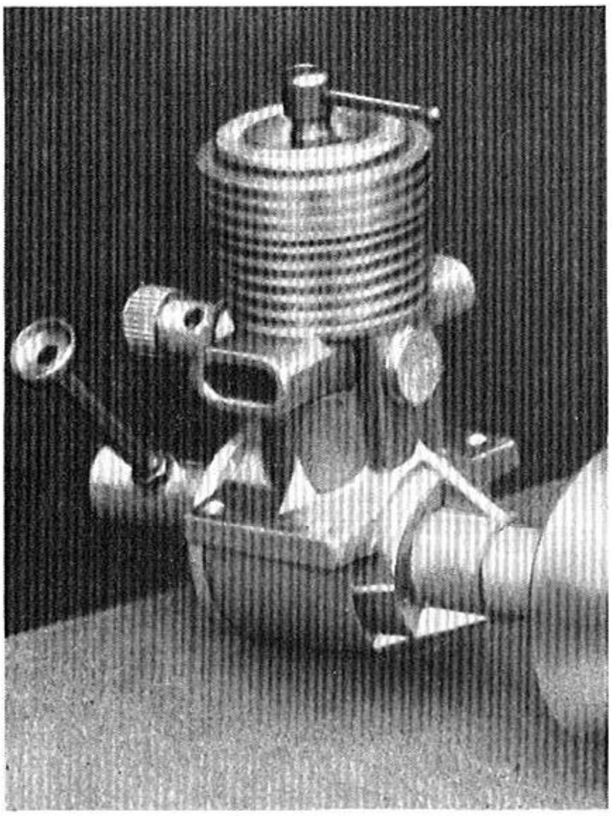

A control line model of the D.H. Hornet. While this machine's scale appearance is marred by the protruding cylinder heads—which would have been far less obtrusive if inverted—and the ugly exposed fixing bolts, it is nevertheless a very praiseworthy and successful effort to produce a *flying* twin engined job. Later versions will no doubt devote more attention to scale looks.

CHAPTER NINE

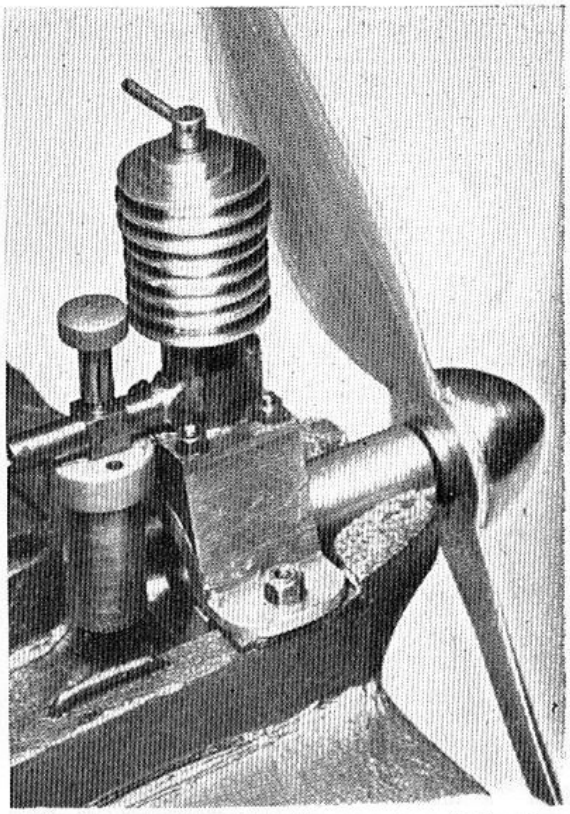
# ENGINES, COWLS, TANKS, FUEL AND STARTERS

WHILE design of airframe and engine as an integral unit is essential to really high performance, this is sometimes a counsel of perfection, impossible both in full-scale and model projects. There is no need, however, to despair ; in the full-size world, for instance, the German FockeWulf 190 will long remain a classic example of the unsuitable, or even somewhat outmoded, engine so brilliantly incorporated into an airframe design that it equalled and often surpassed contemporary designs that had suffered from no such handicap. The model builder will, of course, always endeavour to match engine to airframe to come as near this ideal as possible, but, unless he is able to own a number of engines, there must be a degree of compromise if he takes an interest in both speed and aerobatic flying. Most heart-burning will come where, for example, some attractive American design is built, but no equally attractive hot engine is available. Frankly, this is bad planning—first have your engine, then, even if you do not propose to design an aircraft for yourself, you can at least secure plans or a kit specifically produced for that power unit. Only in that way will the best be got from both. Whilst on the subject of one engine or many—obviously it is better to have several power units if the pocket permits, but never quantity at the expense of quality ! If you can afford two average engines or one really good one, our advice is go for the good one. Though we hasten to qualify that advice by adding, provided you can guarantee it " a good home." In the novice state it is perhaps provident to have the eggs in more than one basket—then later on sell these engines and get the very best you can buy.

What constitutes a good engine ? Literally every engine on the market has had one or more models designed round it, and manages to fly them—but that does not necessarily make them " good " for control line flying. We must necessarily mention a number of engines, but this by no means implies that they are the only ones suitable, or even that they are more suitable than those unmentioned—engines are popping up faster than anyone can keep track of them, let alone give them a thorough testing for suitability. First question on engines must be—what size ? We have already noted that large engines generally provide easier flying than small, enable more liberties to be taken by the unskilled, and give more flying days in the year when smaller jobs would be grounded. But the choice is limited at present, they are often harder to start, though not always, and they hit the ground much harder when they do. If there is a background of experience of general



Popular Italian 5.65 Super Tigre diesel that is equally at home on a stunt or speed model. This firm have just announced a 10 c.c. diesel version that should prove interesting.



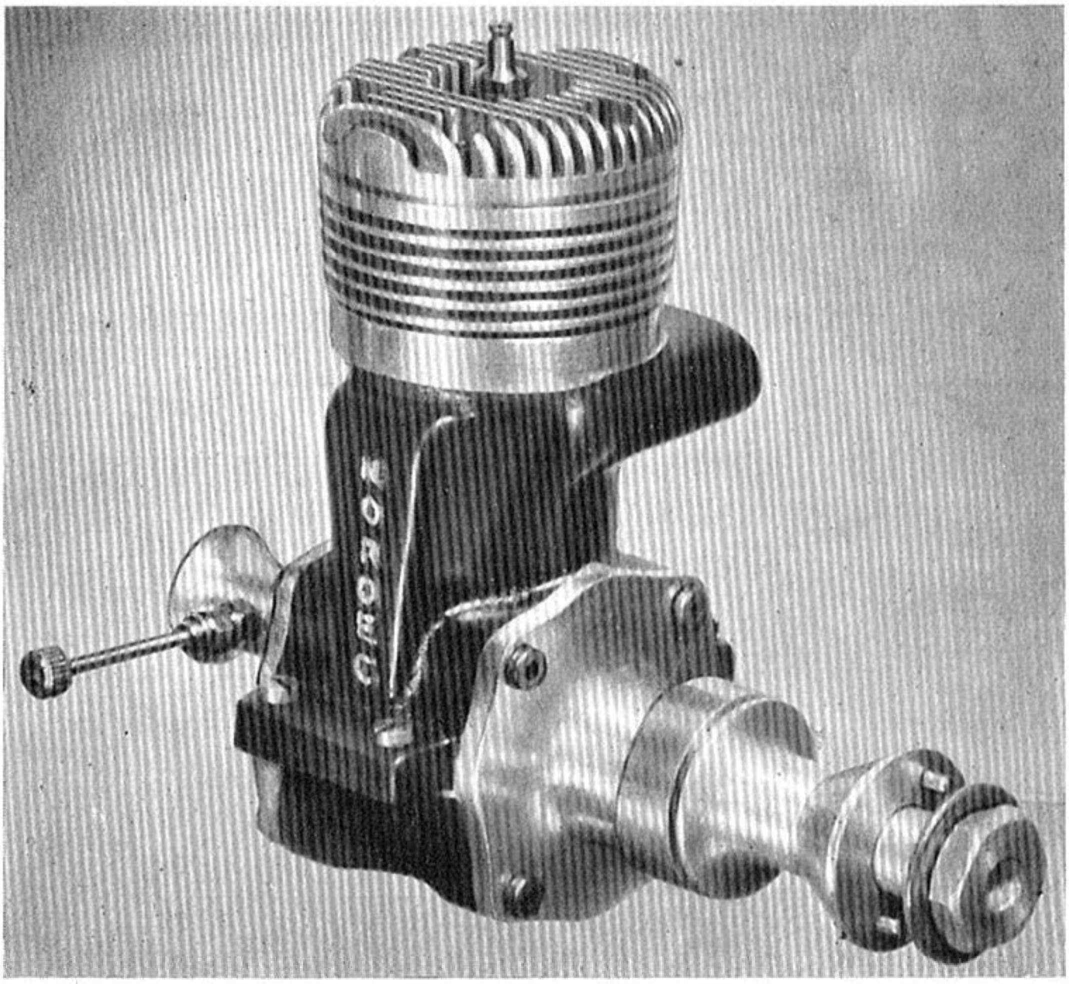
Simple mounting of an " under 1 c.c." diesel direct to the hollowed out fuselage. Metal airscrew fitted will be no trouble in this size, but frequent fill-up necessary with the tank shown.

power flying then go for one of the British " big stuff " motors, such as the Nordec ; or, if some cunning exchange can be arranged, obtain an American in the same power class. We have found American " pen friends " very helpful in providing engines on a non-commercial " swop " basis—gift for a gift, though we are not quite sure just how " legal " this is. There are a number of good American engines in the country already and club members should have no real difficulty in getting one if they set their hearts on it. Do, however, remember that American manufacture does not make it good ; there are some " duds " amongst them, both worn out good motors, and never-been good motors. By sticking to the better known makes it is easier to avoid such pitfalls. " Good " Americans include Arden, Dooling, Forster, Fox, Hornet, Madewell, McCoy, Ohlsson, OK, Super Cyclone—but the list could be much longer, and newcomers are legion. Of British engines it is not so necessary to speak as monthly tests appear in the *Aeromodeller*, and are systematically covering the field.

There is no need to be hypnotised into the belief that only an American job will do—in the small size field there is nothing to equal British manufactures in general, with one or two outstanding Continentals to add. Three years ago this was not the case, but to-day our native product in the diesel field can beat the world, size for size. Of present day Continental engines that can be recommended we would list Supertigre 5.65 c.c. and its smaller brother the Supertigre 3 c.c. (actual 2.8), this latter engine has recently flown a speed model at over 105 m.p.h. It comes, incidentally, from Italy. Another Italian that should appeal is the Movo 10 c.c.—the biggest standard diesel size in commercial production that we know. Of French designs there is the Super Delmo 5 c.c. This is a powerful job, but some users have found it of over light construction to stand up to really hard knocks. Of two that we had, one took any amount of punishment, but the other was far weaker. An unusual Delmo version is the same motor linked up to another to make 10 c.c. with a single crankshaft going right through. It is spectacular, but *not* twice as good as the 5 c.c. Micron have now produced their glowplug 60 of 10 c.c., which is a masterly product, and for a high revving " American " type starts quite easily by hand. The Meteore 5 c.c. may prove in the " recommended " class, but has, as yet, insufficient case history to justify unqualified support. No other Continental, though there are quite a lot of good ones, can be classed as outstanding.

In selecting an engine the choice is now between spark ignition, glowplug, or diesel. All have their partisans. Those who have never—and there are many like this—had any experience of spark ignition, may tend to shy off from the complications of coil, condenser, and batteries. But it is not really as bad as all that. There is an excellent literature on petrol engines, and a good many years' background. A week-end spent bench running will cure any of these nervous types, particularly if a friend who knows all about it can be roped in to help. Advice here, for complete satisfaction, is to choose your helper as carefully as you

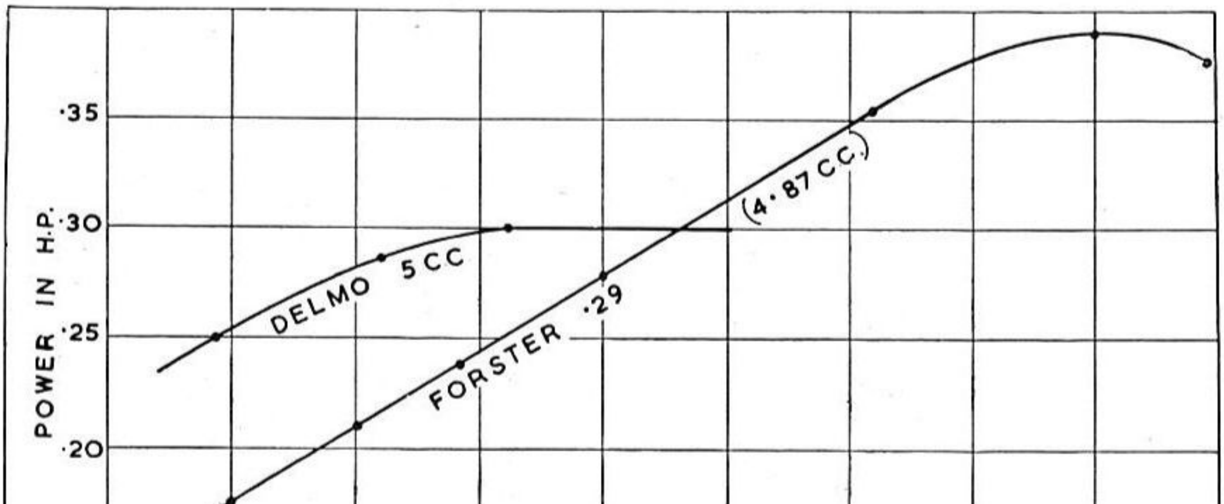
Nordec 10 c.c. engine in its glowplug form. This is the first serious rival on the home market to the wide range of " hot " American motors.



selected the engine. From a performance point of view there is something quite in a class of its own about the crackle of a " happy " spark ignition job, and its powerful response when called upon, that can never, to our mind, be quite equalled by the maid-of-all-work diesel with its constant power output. Such an engine is essential for those who intend to go in for niceties like engine control, single-handed flying, and taxi-ing in.

The new glowplug engines give a happy medium in performance, with the performance of spark ignition jobs and almost the carefree starting of the diesels, but have certain disadvantages in allegedly quick wear, and occasional trouble with the hotwire department. Whether these disadvantages are real or fancied it is too early to state definitely. We will quote from the experience of one user who sent his compressionless engine in for servicing in the belief a rebore at least was necessary, to be informed by the repairers that his glowplug required screwing down ! ! The quick-wear bogey had convinced him untested—it will be a long time before he is allowed to live that one down !

There remains the diesel, which will probably be the choice of the greatest number. Here an absence of etceteras may be claimed to outweigh other advantages. Nevertheless there are certain losses that must be considered. The diesel gives its power comparatively low down in the scale of revs., and though most engines can be persuaded to go well up the power curve there is a flattening off rather sooner than with a comparative spark ignition engine. We give relative power curves of the Delmo 5 c.c. and the Forster 29 (4.8 c.c.) which shows that up to 9,500 r.p.m. the diesel is better, but the petrol job then continues improving up to 13,000 r.p.m., when it is about 25% better. Such an improvement will be found in most comparative tests. But there is a nigger in this particular woodpile ! It is not possible always to get this improved performance with an *airscrew* ; The Forster, for example, will not thus transfer its power at over 10/11,000 r.p.m., when it is not

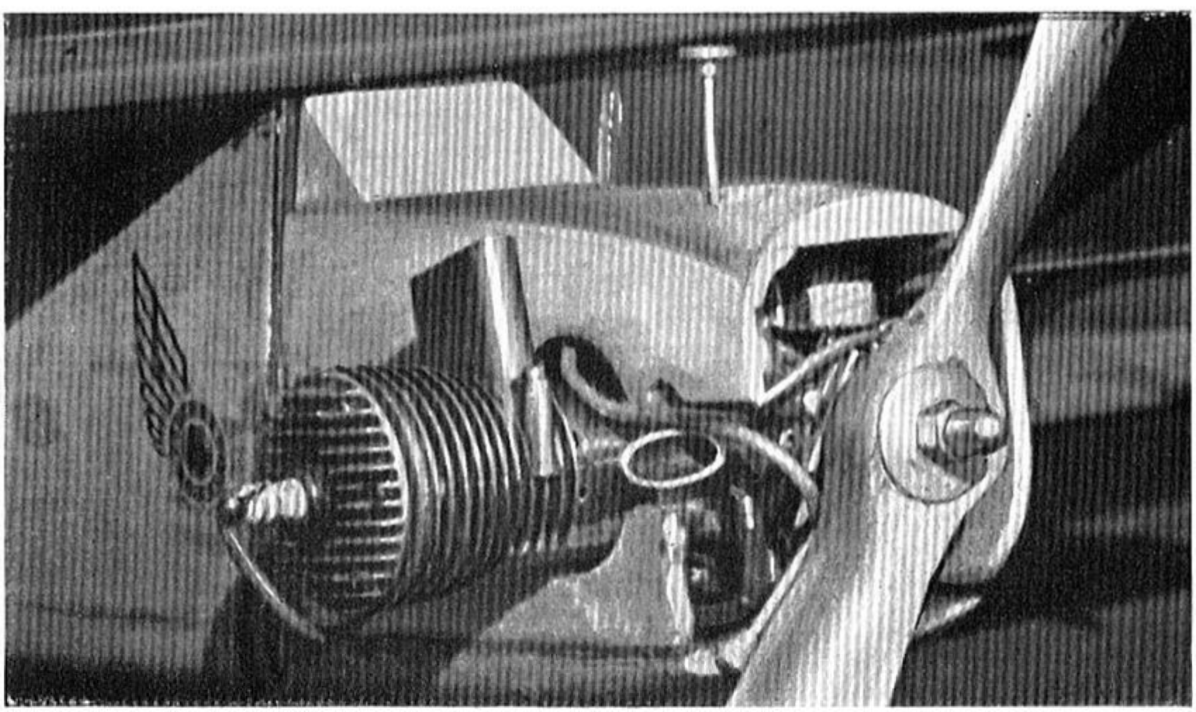


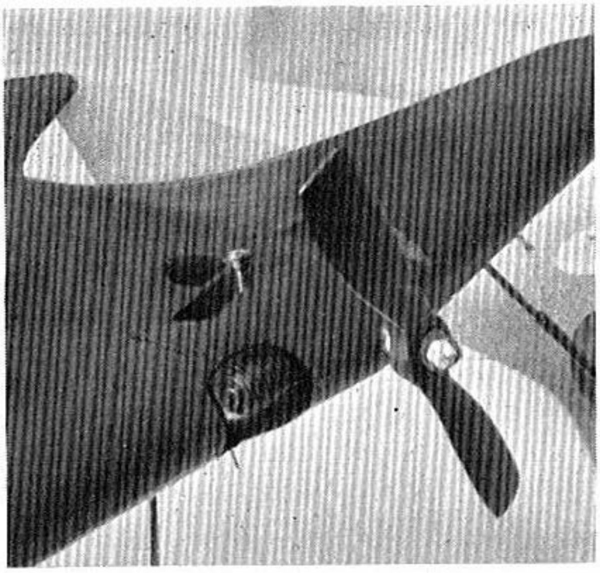
so very much better than the diesel. If it is ultimately possible to design an airscrew to absorb the potential power then the answer is obvious. Nevertheless, the Forster *has* a definite advantage of about 2,000 r.p.m. even as things stand at present.

Diesel enthusiasts may take heart, however, from the thought that spark ignition motors have been steadily developing since Maxwell Bassett first introduced the Brown Jnr. to aeromodellers and may be said to be approaching its peak ; the diesel, on the other hand, is a growing youngster and may well outstrip the longer-known engine. Those who like to dabble have far more chance of making headway, then, with diesels than with any other internal combustion power form.

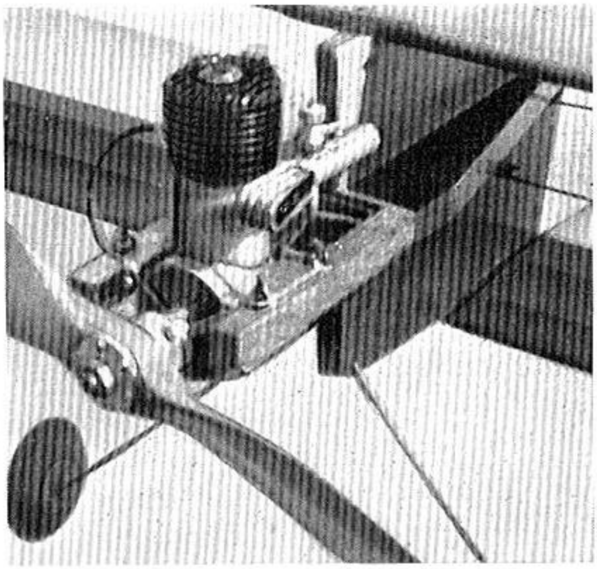
Next consideration in choice of the most suitable engine is basic design. Comparison with early engines will show one significant change at least. They are growing down. The long piston, small bore pre-war engine has changed to a squat, square workmanlike shape with almost equal bore and stroke. In fact, many of the latest designs have greater bore than stroke. This involves, of course, far more accurate construction, as chances of power losses through piston leakages are much increased. In line with this change has come increased attention to porting, and exhaust scavenging. Exhaust ports in some engines are now so vast as almost to encircle the head, and one is led to wonder if those small pieces of metal will really hold it on ! Compression ratios have increased until 6 : 1 is normal, and many engines offer much more up to Hornet 12 : 1 and Hassad 13¾ : 1. Rotary valve admission has become usual, and most of the more successful engines feature it. These improvements in performance have not been obtained without certain disadvantages. It is virtually impossible to start a really hot motor without the aid of some form of mechanical starter. Revs. have risen to such an extent that airscrews will shatter at speed purely by their own vibratory impulses, if fractionally out of balance. To sum up these super efficient

Sidewinder mounting in one of Henry J. Nicholls' machines. Intended as a stunter, controls are easily accessible ; note transparent filler and air vent to fuel tank facilitating replenishment.





A neat effort to overcome drag by mounting engine in the thickness of the wing of this unusual model.



" Flatfish " fuselage with motor mount brackets for normal upright or inverted engine installation.

spark and glowplug engines we would say that they are mainly of interest to the mechanically minded with sufficient skill to operate them, and sufficient knowledge to avoid taking undue risks. They are *not* for beginners. On the other hand, the opportunity of handling such little engineering masterpieces has tended to attract a new class of aeromodeller to the ranks of control line flying, whose interest can only be beneficial to the hobby. We speak of that class of model engineer whose interests have until now been centred on such branches of model building as racing hydroplanes and cars. They bring a high degree of technical skill to the power unit side, with, to experienced aeromodellers, a woefully deficient knowledge of the airframe aspect. Their presence in clubs will, however, do much to " improve the breed," and there is no doubt that the particular skill they bring will be as welcome to their fellow clubmen as the aeronautical angle will be to the newcomers.

Diesel engines, too, are showing radical changes since their first introduction to British enthusiasts. Here, again, there is a growing down tendency ; attention to porting ; increased use of rotary valve admission ; and a general refining of design. In common with other internal combustion classes the more expensive makes are fitting ball bearings ; taking greater care in the selection of exactly suitable materials for the various parts, and making all that progress which an ever widening demand renders possible to commercial firms.

For general all round use our own suggestion to newcomers is a diesel engine of medium power, say between 2-3.5 c.c., choosing if possible an engine that offers conversion heads for occasional glowplug use. Later, they will probably feel an urge to go in for something bigger—perhaps change over entirely to petrol operation.

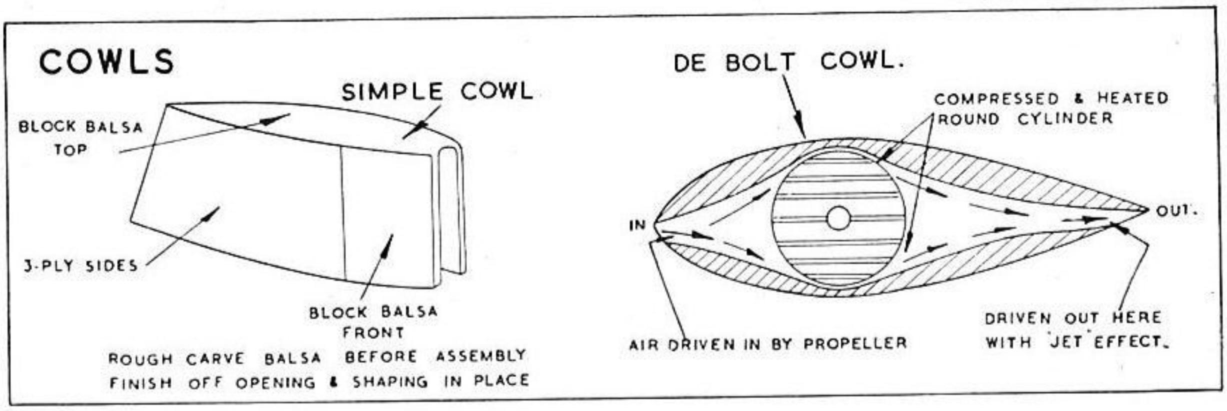
Some—a minority—will step down in size to the true miniature class of 1 c.c. and under. This is excellent in its way, rendering any number of scale and even indoor projects possible with a minimum expenditure of time and money.

We must not forget some mention of jet propulsion, particularly as the S.M.A.E. have now wisely limited its use entirely to control line, and at least one British manufacturer has commenced to market an imitation of a successful American design. Frankly, the noise is terrific, the performance startling, if not to say frightening, and the application of the jet limited to speed and scale-type speed flying. Except as a sensational finale to a meeting, or an interlude for the benefit of there-to-be-thrilled spectators, we doubt its useful and permanent place in our scheme of things. But, then, we have so often had doubts like that, in common with the large majority of aeromodellers. We doubted pylon contest models, we doubted flying wings, we even doubted control line flying! and we were wrong every time! We shall certainly be in the front line of spectators when first we hear its unmistakable wee-woof-woomph starting up!

Having selected our engine, there remain several questions regarding its use. Shall it be mounted upright, inverted or sidewinder? What sort of—if any—cowling shall be put round it? Beam mounting or radial?

Except in scale or semi-scale designs the general practice seems to lie between upright mounting or sidewinder. Any model that lands without undercarriage must of necessity conform to this style. For aerobatic models a sidewinder with head facing out of the circle seems the obvious answer, as there will then be no chance of a change in the fuel feed when flying inverted, and the natural leaning out tendency of the mixture will assist operations. For all outline fuselage models the sidewinder again is obviously the right mounting. With more normal fuselages there is no particular structural difficulty in fixing the motor mounts one above the other rather than side by side. At the design stage it is necessary to remind readers that they will usually have to lay these mounts over to allow the thrust line to come over the centre line; though nothing catastrophic is likely to happen if this is neglected. With radial mounted engines the problem of where to put the mounts does not arise, and the engine can even be tilted at 45° between upright and sidewinder if the designer can think of a good reason for so doing. Few British engines seem to favour radial mounting, and not very many foreigners for that matter. Certain American engines will be found with both beam and radial mounting arrangements. To our mind, beam mounting is to be preferred as it enables a somewhat larger gluing area to be offered to the fuselage; we cannot recollect a beam coming unstuck, but have several times in various sized engines had the mounting plate of a radial engine come adrift. Where any form of knock-off mounting is favoured then such objections to beam mounting do not apply. The method used on some of the Frog kits for knock-off mounts is very practical though anti-rubber-band fiends will deplore it. The real answer is—it works!

Cowling of engines is a matter on which a lot must be said. First of all, from a streamlining point of view there is no particular advantage gained until speeds are nearing the three figure mark. To be more precise, its benefit exists in some degree lower down the scale, but the added frontal area of the cowl, as opposed to the engine alone cancels out the advantage. It is fair to say, then, that a cowled engine of 2 c.c. and under may look the prettier for it, but gains little or nothing on the score of streamlining.




Of equal importance, or some claim greater value, is the use of the cowl to control engine temperature. Some engines, particularly the larger super-efficient Americans, perform best at a heat just below pre-ignition point. Flying without cowls they are cooled below this point and fail to give of their best. The cowl must not only have an entry for the air, but also a way out ; this has sometimes been missed by designers intent on looks above everything. The size of the entry and exit will control the amount of air entering, and the manner of its exit and thus the degree of cooling obtained. The exit must be larger than the entry unless special precautions are taken, otherwise there will be a definite retarding effect like flying a drogue if all the air cannot easily escape. As the inside of the cowl is in contact with the air it must be just as well finished as the outside or drag will be increased. Its inside shape must also be given some thought. When these items have been satisfactorily checked, extra speed may often be obtained by varying the size of inlet and egress openings. As a start, inlet should be about the height of the fins and head and about a quarter inch wide, with exit slightly larger. This should suit the average engine.

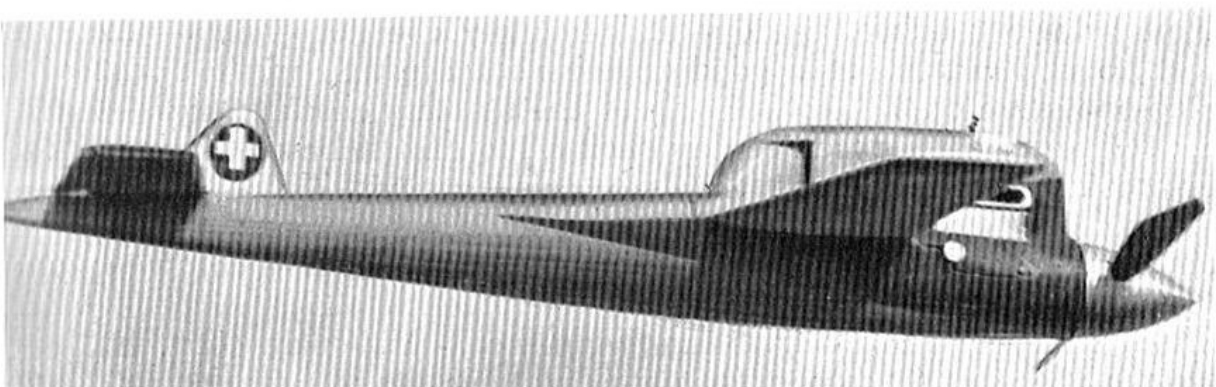
That famous record breaker and designer Henry deBolt, having exhausted the usual means of going faster, spent some time on cowl design, and we cannot do better than quote him on the subject : " Good cowl design will also afford a little additional boost from the hot air that is pumped from the rear outlet. For a cowl to do this it must be properly designed (*see above*). The final cowl design is such that air enters from the side so that it may be forced in, to some extent, by the swirl of the propeller's slipstream (side must be changed if prop is rotating in the opposite direction). Then it is baffled so it flows smoothly through the engine fins only, where it picks up the required heat to cool the engine and provide the boost. After passing the fins it is condensed to its original volume and this time it comes out with the boost we are looking for. For this to work properly the curves must be smooth and there must be nothing to create back pressure such as square corners. That is deBolt's theory, and he claims it works at high speeds ; we, alas, have not achieved anything in his speed class so cannot confirm or deny it.

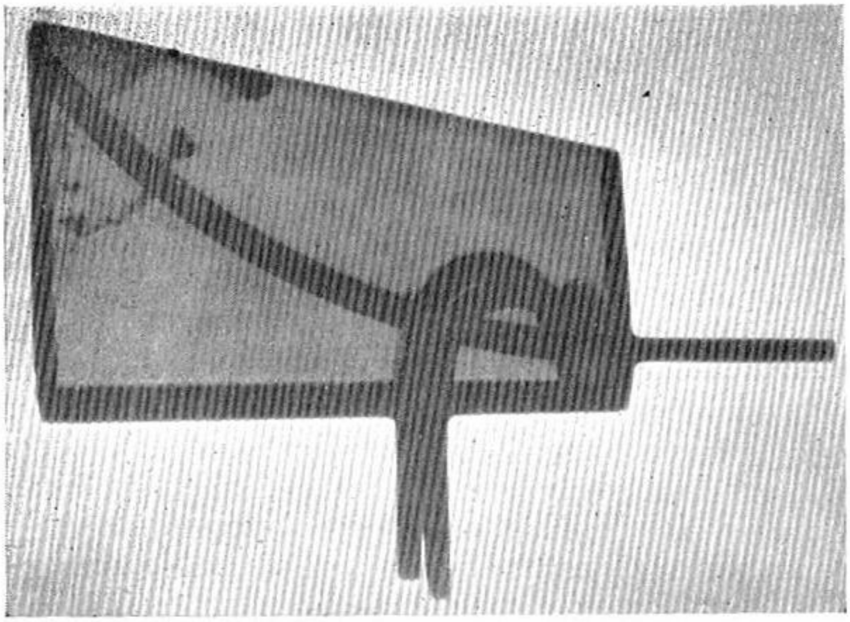
Another point with the fitting of cowls is that they increase the amount of side area forward of the control plate and C.G., so that crabbing may ensue, and crabbing with a speed model will undo all the extra m.p.h. theoretically gained. This can be corrected by moving the pivot point forward, but this will probably bring one control wire out of the wing where it was nicely tucked away—so the wing comes forward as well. There is now a risk of horizontal instability. Again, returning to our mentor Henry deBolt, we find he cures this problem by placing the pivot point exactly on the C.G. instead of slightly behind it, as generally recommended. This cures the trouble. But readers should be cautious of trying out this "expert" solution until they have completely mastered flying on the more normal techniques.

Faced with the problem of fitting a cowl and yet adding the least possible amount of extra frontal area, builders may like to try out the papier mâché type cowl, on much the same lines as wheels and other accessories to scale models have long been made by Rupert Moore. A shaped former is first made slightly undersize from balsa or pine, greased with candle wax or vaseline, then successive layers of paper—newspaper will do—are laid in small strips, each layer being cemented in place, until a thickness of about twelve layers has been built up. This is allowed to dry thoroughly, and may then be sanded to a smooth surface and treated for finish as wood. Any necessary holes for plug, air intake and outlet may be cut with a razor blade. The resulting cowl is quite strong, smooth and good for all but the hardest usage, and should be substantially smaller than an equivalent cowl of wood. To get extra strength, top and bottom layers could be of nun's veiling—a stiff muslin obtainable from your local drapers'. Those anxious to have the truest possible shape may elaborate this method by using a female mould pressed out of plaster of paris or its dental equivalent with the male former previously mentioned. When sticking the finished cowl to the fuselage it may be desirable to obtain a larger cementing surface by sticking square section strip balsa round the gluing edges, which when dry should be sanded round as fairings. Col. Bowden's favourite standby, plastic wood, should also be remembered in this connection.

For aerobatic flying and speed work it will soon be found that the average fuel tank provided, apart from being much too small, though recently makers have been providing larger ones in many cases, is not designed to give continuous feed when flying in abnormal attitudes, or thrown right back in the container by the forward speed of the model.

Swiss speed model by Arnold Degen. The 10 c.c. engine is completely cowled, with adequate exit for cooling airflow. The fuselage and wings are made of thin pine planking—only the cowl itself being of balsa.





An X-ray photograph of a proprietary stunt tank, which clearly shows how the feed pipe takes fuel from the far corner where it is thrown by centrifugal force when in motion.

Simple and portable mechanical starter in use. Spinner is pressed into rubber hose which is clamped to the starter shaft with a jubilee clip. Large spring hinged switch-on flap can be seen just below the shaft.

A number of excellent commercial tanks have been devised to get over this problem. For everyday use, where normal fuel mixtures suffice, transparent tanks will appeal as they do show how the fuel level is, if they are located in sight. Generally they will not, however, stand up to " hot " mixtures and metal tanks are desirable for these. Several shapes have appeared, mainly based on a wedge principle, with internal feed pipes extending to the very back of the container. Sizes are varied and one should not be hard to find to suit the particular engine used. It may be more difficult to find one that fits the fuselage conveniently, and for this reason many more advanced flyers build up their own from shim brass. By so doing a shape that fits internal dimensions exactly may be made. Ordinary " tincan " metal can be used in place of brass shim if preferred, though there must be a greater risk of impurities in the fuel, and the action of hot fuel on the tinning.

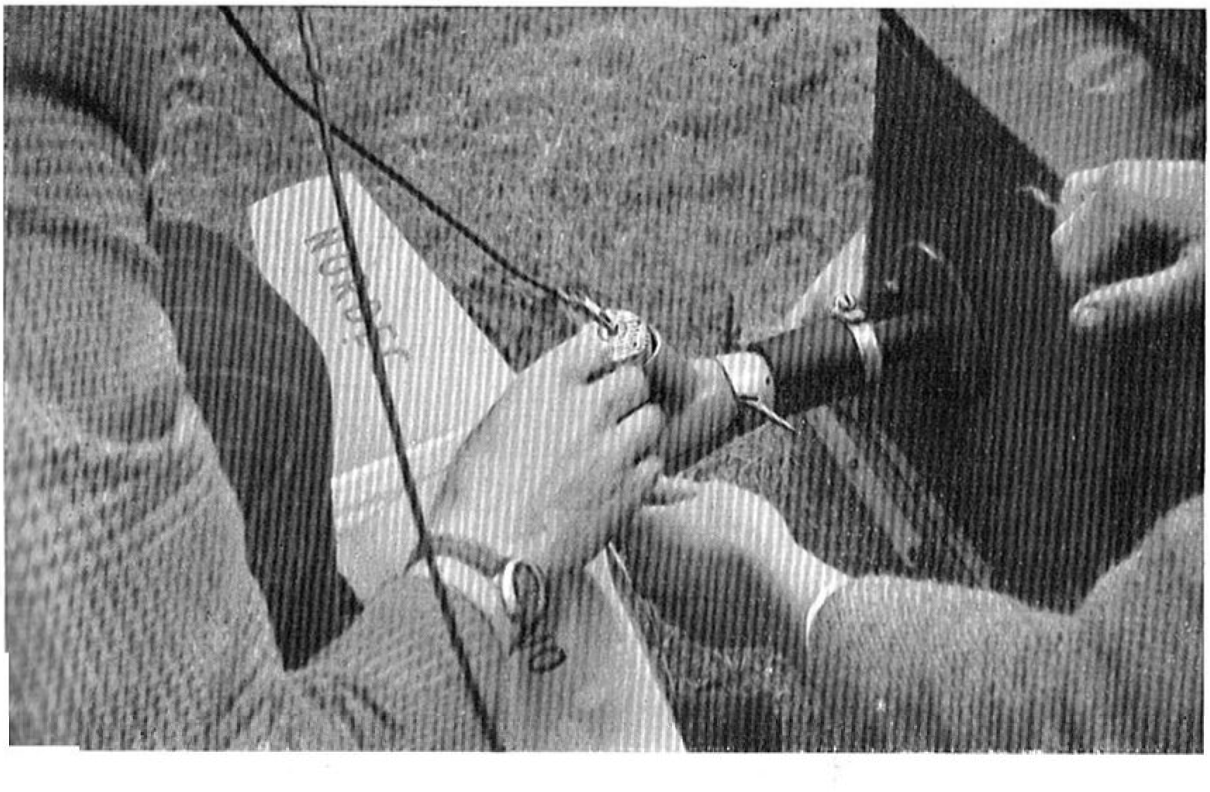
The development of highly efficient engines of fairly high power has produced another headache for control line flyers—the problem of starting them. With one or two rare exceptions such engines when fitted with high speed tooth-pick type airscrews cannot be turned over by hand at a fast enough rate to get them popping. Moreover, if a sufficiently vigorous spin is given there is considerable risk of a backfire, when such an airscrew can be quite damaging.

Mechanical starters have therefore been devised which take all the hard work out of the operation. They are not cheap—probable cost about the same as a good engine—but are well worth making as a co-operative club effort. Basis of the starting mechanism is an old car starter motor. Even to-day such a motor can be obtained from a carbreaker's yard for a pound or two. This is connected up to an accumulator of suitable size—either 6 or 12 volt, according to starter motor obtained—with a foot-operated spring-loaded make and break switch. The whole machine is mounted on a convenient stand, preferably with wheels for ease of bringing to the flying area. When the foot switch is pressed the starter motor spins over and turns its central shaft at high speed. To this shaft is fastened a short length of rubber pipe, garden hose, or similar stout material. To start the engine the airscrew spinner is pressed against the hose bore, and the engine thus turned over. Both hands are free owing to foot switch, and the hose has sufficient bite to grip the spinner enough to turn the engine, without any harm coming from a backfire, when the hose will just be thrust back. The spring loaded switch will prevent undue waste of accumulator which must, of course, be freshly charged for important meetings. The whole gear will go on the luggage carrier of someone's car for transport.

A simpler version of this idea is the invention of Bill Warne, who has mounted a sturdy ex-grinding wheel on a suitable stand with grinding wheel removed and the usual hose attachment for grasping the spinner. Procedure here is that owner manipulates the model while helper, brought along or conscripted on the field, turns the handle like mad. It works well and if helpers hold out, certainly saves expense of the more elaborate installation.

Fuels for internal combustion engines have come to be highly specialised, though for a very long time the model trade seemed ignorant of it in this country. Happily now blends of everyday hot and extra hot fuels can be bought at any model shop, which tends to discourage individual experiment. Most engines have a mixture that is best suited to their requirements, though this may not be the mixture recommended by the makers.

One fruitful source of enquiry that has been entirely neglected in this country, but is now engaging serious attention in America is the preparation of " climatised " fuels, that is, fuels that have been specially blended to give their best performance at the usual temperature and humidity of the district where flying is done. Thus a fuel might be suitable for a temperature of 65° and a humidity content of 60%. Research on these lines may well provide the answer and the antidote to the old problem of why a 120 m.p.h. American engine will only give a maximum of 95/100 m.p.h. when brought over here.



CHAPTER TEN

# AIRSCREWS—PRACTICAL AND THEORETICAL

## PART I.—PRACTICAL ASPECTS.

WE offer no apology for putting the practical cart so firmly before the theoretical horse. This is the usual approach by modellers everywhere, to have tried a number of airscrews, and flown quite a few models, before beginning to wonder why one airscrew should be better than another. So, in our case we are sure that control line flyers will turn first to commercial products before thinking of carving their own.

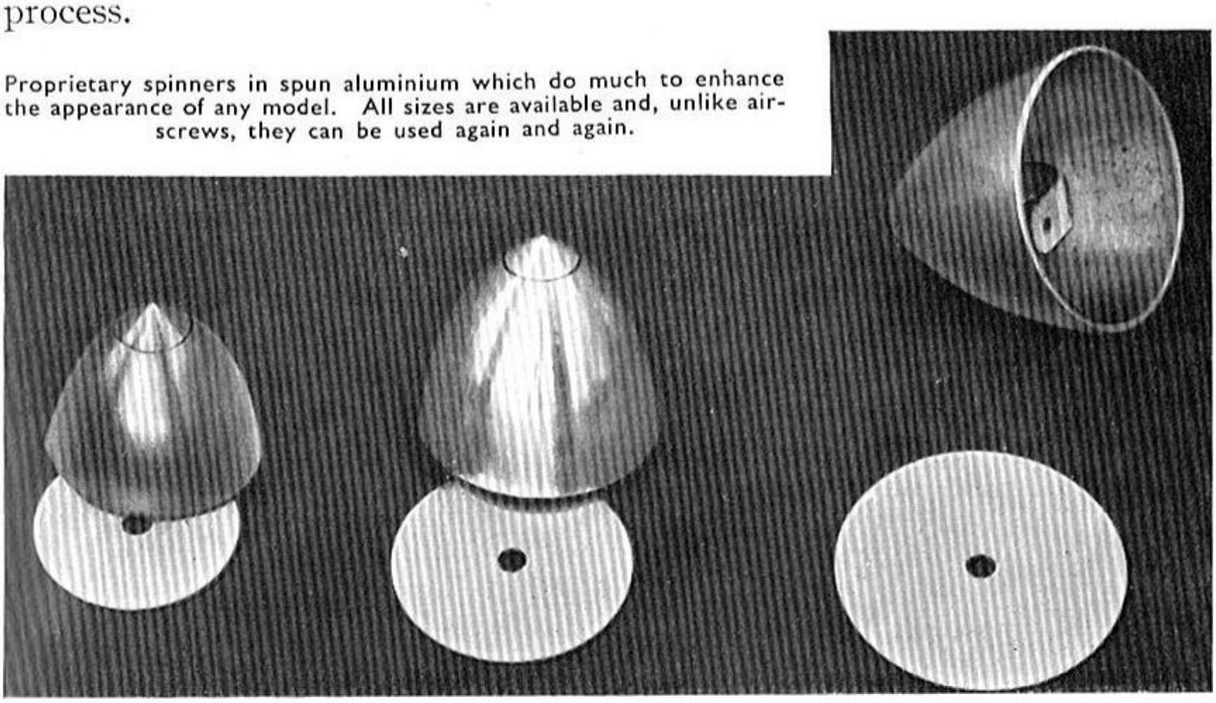
Sooner or later we are certain home production will be considered, for the life of an airscrew is limited even in skilled hands. The experts, along with the novices, bring a goodly store of spares to the flying field. We well remember being present in a model shop while the proprietor sold a customer his first control line kit. He was loaded up with rubber wheels, a spinner, control handle, thread lines, and all that was necessary in the way of extras, and finally sold *one* airscrew. We suggested, when the laden customer had departed, that this was rather slipping up on the job: surely three props at least were necessary? "Oh no, indeed," replied the dealer, "that would have frightened him off for good"! The dealer was right; it would have done just that. It really is amazing how many otherwise skilled aeromodellers have never made their own power props, yet would never think of buying one for their rubber model. The bogey of hardwood carving is frightening them off. Yet, given a little practice and the right approach, hardwood power props are easier to carve than balsa ones. One well-known modeller told us recently that he could easily carve and finish half a dozen power props in an evening provided the blanks were cut out beforehand; and that sitting comfortably at his work table near the fire.

Before branching out on a carving programme, however, the newcomer is advised to try one or two commercial designs to see what he fancies. Nowadays nearly every manufacturer publishes suitable pitch and diameter figures for use with his engine as a control line power unit. The larger model shops normally carry in stock over a hundred different combinations of pitch and diameter so that it should not be hard to find the right one for your model. Once that decision is made, carefully measure up the airscrew, make templates for front and side and you can have as many duplicates as you fancy.

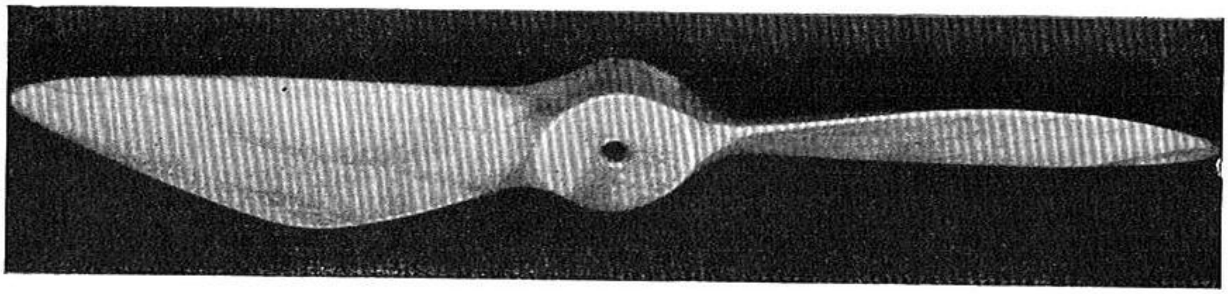
Beyond reminding would-be carvers that their best friend is a good coarse rasp, we do not propose to cover the physical business of propeller carving. It is adequately described in the *Aeromodeller Annual*, apart from several other standard articles and books on the subject. What may be something of a problem these days is getting the right sort of hardwood. Only small pieces are required that would normally be thrown away by craftsmen using hardwood in bulk. It is sound policy, therefore, to make friends with some such user in your locality. Jobbing furniture repairers and undertakers are potential sources of supply; small builders and house decorators use wood, too, and will be willing to hand over offcuts for a copper or so, or even give them away. The lazy, and farseeing, man will not leave it at that, but pursue the friendship still further, for such workers have power tools, including a bandsaw, and can be persuaded to cut out a few blanks to a favourite shape. Possible woods for use are beech, birch, ash, spruce, walnut, and mahogany, though other less used woods such as pear and the Australian timbers can be used as well.

Fainthearts may still feel disinclined to embark on home prop production, but there is still a way that they, too, can save money on the prop side. In nearly every prang one blade only will be damaged. If all the props are the same make, pitch and diameter, a good one can be made from every two damaged ones, by halving the boss and joining them together. Pressure of the locking nut on the crankshaft will hold them securely in place. Again, there is no need to discard an airscrew that has lost only an inch at the tip, for a new tip can be simply mortised in position, made either from a salvaged tip, or carved anew from any scrap of wood suitable. Care should be taken to start the engine on the sounder blade and it will fly the model as well as ever a new one did.

We have also recently tried a new metal airscrew marketed for the smaller engines. Such an airscrew is not permitted in contest flying, but is a very practical moneysaver for training flights. It is just as well to start up with a gloved hand, but, contrary to our expectation, even quite a hard slap did not do the damage we had expected. They should not be used, however, on larger engines of 5 c.c. and upwards. Using a metal-bladed airscrew we have dived into concrete, wrapping the blades round the nose like banana skins, but have straightened them out and flown again. As a rough guide the usual blade will take at least six or seven such bashings before breaking off in the straightening process.



Proprietary spinners in spun aluminium which do much to enhance the appearance of any model. All sizes are available and, unlike airscrews, they can be used again and again.



Typical proprietary airscrew (Hi-Thrust) designed for control line use, with straight leading edge and boldly curved trailing edge, coming to a sharp point at the tip.

We noticed several of our Continental visitors had salvaged single blades from their airscrews and balanced them up for use as single-bladers, with a wire arm and a lead balance weight. This, too, could be followed, though there will be some loss of power if fitted to an engine normally flown on twice the blade area. They can be stepped down to a smaller engine, pre-supposing the flyer has more than one.

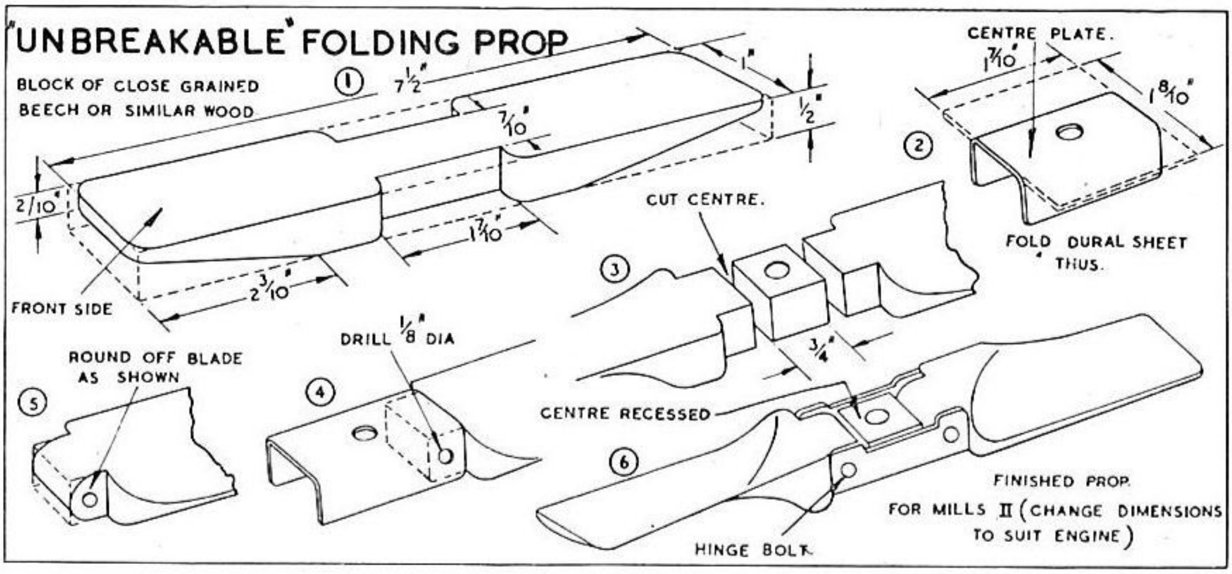
A welcome sign amongst control line models has been the growing popularity of the spinner. A large variety of shapes and sizes and fitting devices have appeared on the market, made of light alloy or hardened rubber. They are little trouble to fit, and besides improving the appearance of the model, reduce drag quite considerably. On speed machines they are virtually a necessity. In any event the airscrew round the hub does no useful work, and performance may well be improved by streamlining this part, extending up to a fifth of the airscrew diameter.

## PART II.—THEORETICAL ASPECT.

We are indebted to P. R. Payne for much of the theoretical aspects in this section, and whilst by no means claiming that his views are necessarily the only ones, would point out that, carefully followed, his style of airscrew gives excellent results, if, in the eyes of many, a rather ugly duckling, with its parallel blades and square tips.

The airscrew can make or mar the performance of any model aircraft, and nowhere more so than with control line models. In free flight models slow speed flying is usual, and the normal inefficiency of standard designs has a relatively small effect. With control line models, all but the very slowest are flying faster than the fastest free flight power model. A badly designed prop here can lower flying speed by as much as 20 m.p.h., or more, with speed models, because of its low practical efficiency.

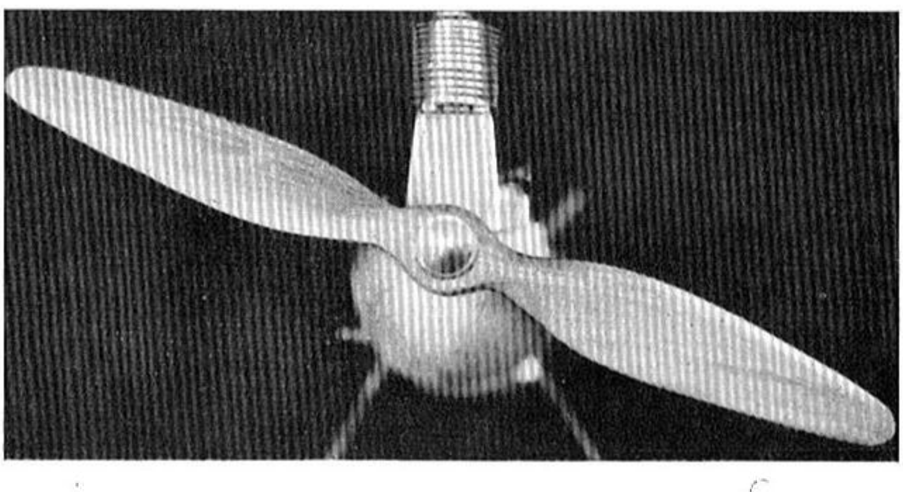
Until fairly recently the customary British practice was to use helical, or constant pitch airscrews. The pitch on such airscrews is constant all along the blade, blade angle being varied from hub to tip in such a way that all the blade elements move forward the same distance in one revolution. Thus, we speak of ten-inch pitch, meaning that the whole airscrew would move forward ten inches if it were rotated once in some solid medium. Most airscrews obtainable to-day are of this type, though happily some of the more progressive makers are now offering a better design of which we shall speak. It is, therefore, somewhat surprising to note that a constant pitch is by no means the most efficient for model use !



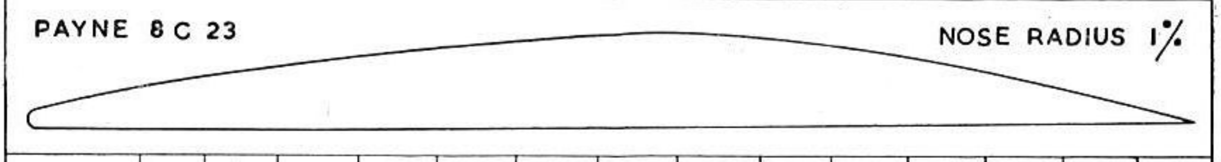

This fact was first publicised by D. A. Russell in his *Design and Construction of Flying Model Aircraft*, as a result of an exhaustive series of experiments. He maintained that the tip-pitch should be 10% greater than that at a position seven-tenths of the radius out from the hub. Owing to the war, and consequent neglect of power modelling, the initial interest in this matter cooled and other events took pride of place. It was not until 1943 that L.S.A.R.A. Director N. K. Walker approached the subject, and, in the November, 1943, *Aeromodeller* covered the theoretical ground in some detail. Unfortunately for the general aeromodeller his article was couched in highly technical terms and thus made no particular impression. It was, however, responsible for one notable contribution—it gave the new form of airscrew a name—non-helical pitch airscrew—which it has retained.

It was left to P. R. Payne, therefore, to make use of this theory and apply it to practical use, producing a series of airscrews that show a 50% increase in efficiency over the more usual constant pitch type. As noted above a number of manufacturers are now availing themselves of this knowledge and producing commercial props embodying the non-helical pitch principle.

Apart from his researches in blade angle theory Payne has produced his own typical parallel chord blade shape. This is ugly in appearance, but, at low speeds anyway, such a shape is more efficient.



Experimental Payne type airscrew fitted to a small diesel. Manufacturers have been very co-operative in providing additional facilities for control line airscrew tests for the benefit of all concerned.



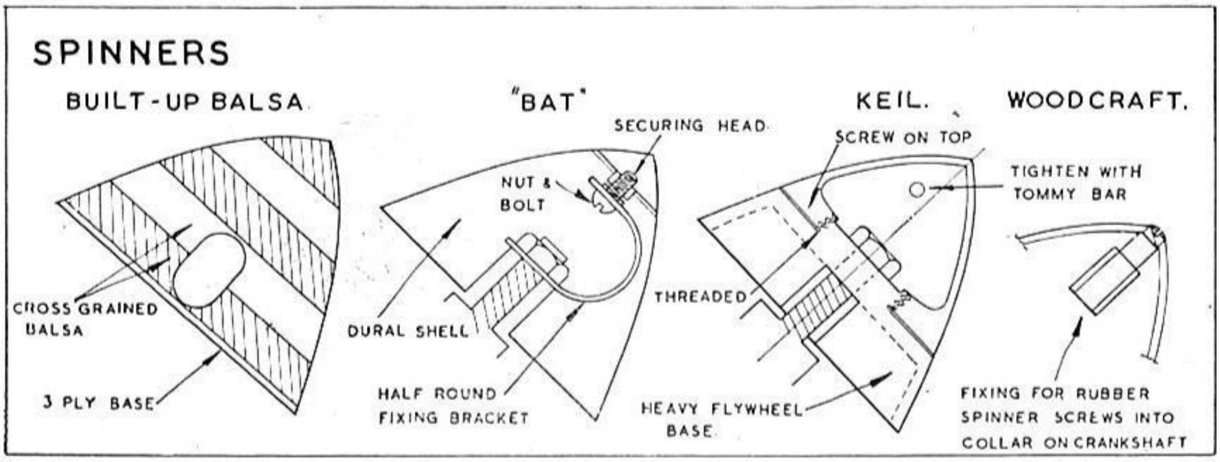

| STATION | 0 | 1 | 5 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 95 | 100 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| UPPER | 0 | 1·1 | 2·2 | 3·4 | 5·3 | 6·7 | 7·4 | 7·8 | 7·3 | 6·4 | 4·8 | 2·7 | 1·3 | 0 |
| LOWER | 0 | -1·0 | -1·0 | -0·9 | -0·8 | -0·7 | -0·6 | -0·5 | -0·4 | -0·3 | -0·2 | -0·1 | -0·05 | 0 |

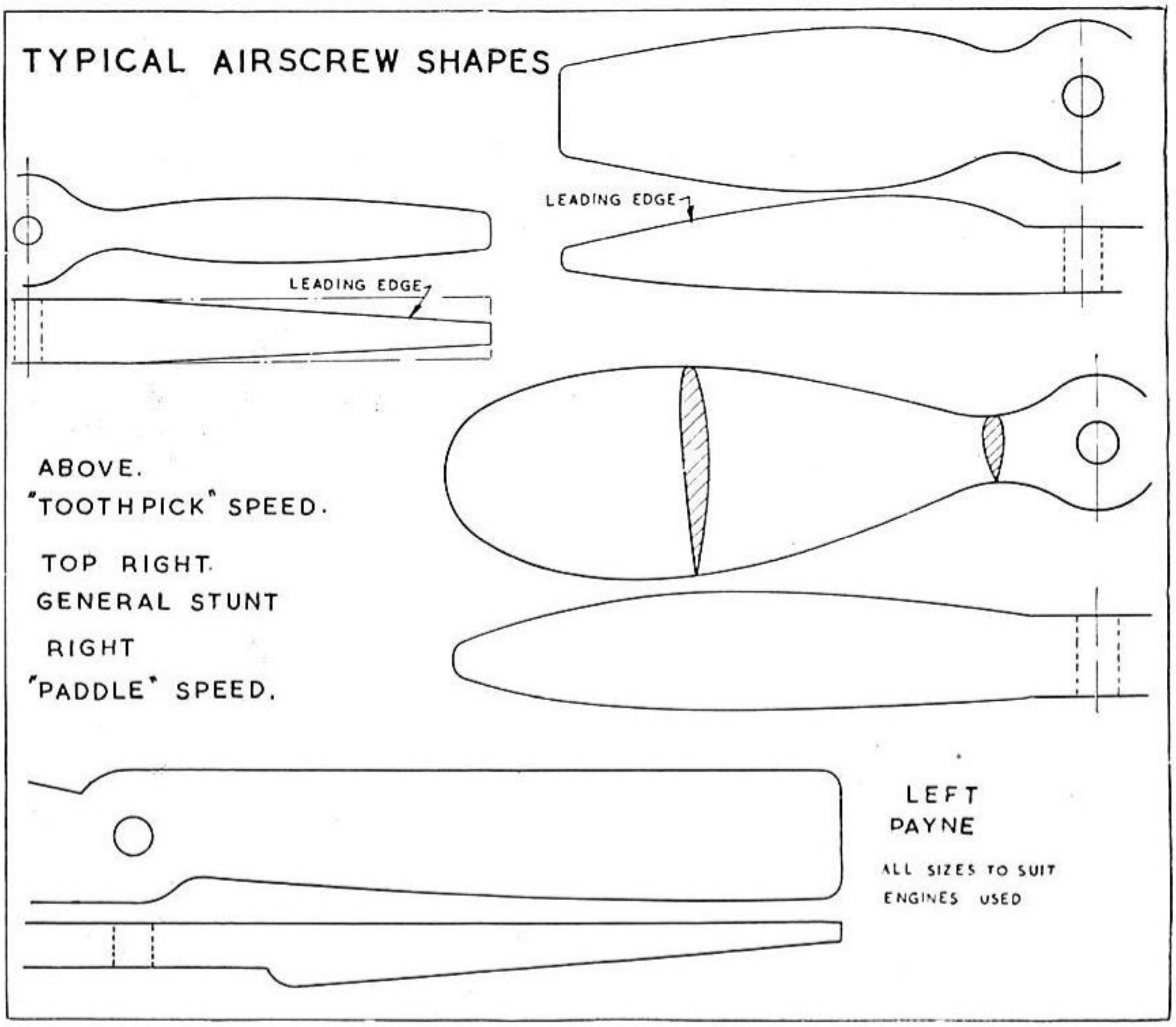
Its advantages at high speeds are more problematical, and no claims can be made without considerable additional research.

Not content with the standard Clark-Y type of blade section, Payne has produced his own turbulent flow section, which gives considerably improved results. Thickness should remain constant from the tip down to a point four-tenths of the radius from the hub, when it may be thickened and faired into the hub. Extreme accuracy in carving is necessary to secure the maximum benefit from the design.

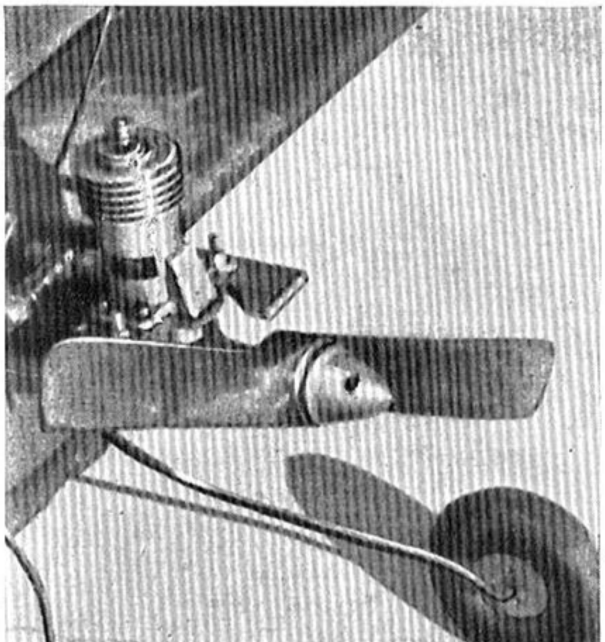
Those who hope to capture and hold speed records against a growing challenge will find airscrew design a necessary part of their work. Unlike the stunt or general flyer who will be satisfied to match engine and airscrew without particularly considering the airframe, speed models should be designed as a complete unit. Their first thoughts will tend towards the American " tooth pick " type of prop, with its thin blades and reduced frontal area. These can increase revs. to almost fantastic heights, though whether they are the most efficient type it is possible to design is a debatable point. To assist starting and running such blades have frequently a loaded hub to produce sufficient flywheel effect. This can be most conveniently concealed in the inevitable spinner. A word of warning is necessary when using such thin props. At high revs they reach a " fragmentation " point and shatter spontaneously; similarly, if out of balance they can set up this shattering effect at lower speeds. It is inadvisable therefore to linger near them in " the line of fire " longer than needful, and to be wary of following round a dolly until under way, as we have seen done, apparently without knowledge of unpleasant possibilities.

Our Italian friends have taken to an almost paddle like airscrew for some speed models, and have even added a lump of lead to *one* blade, presumably for flywheel effect. Recent designs have, however, featured the typical toothpick, so we must assume the future of paddle blades is limited.

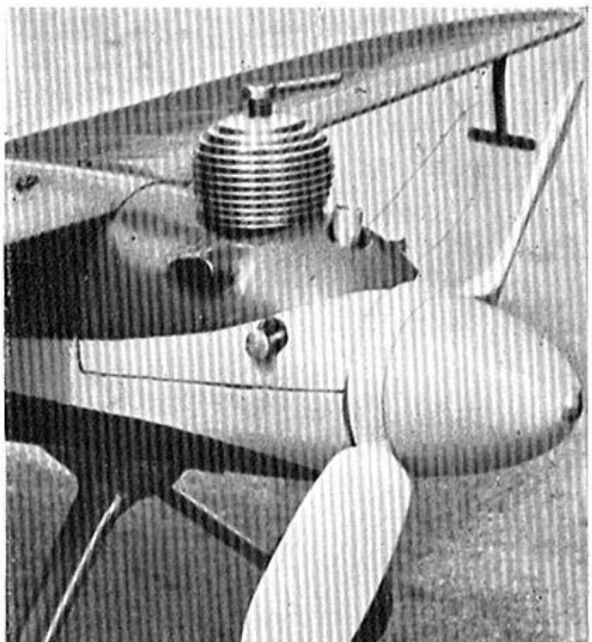


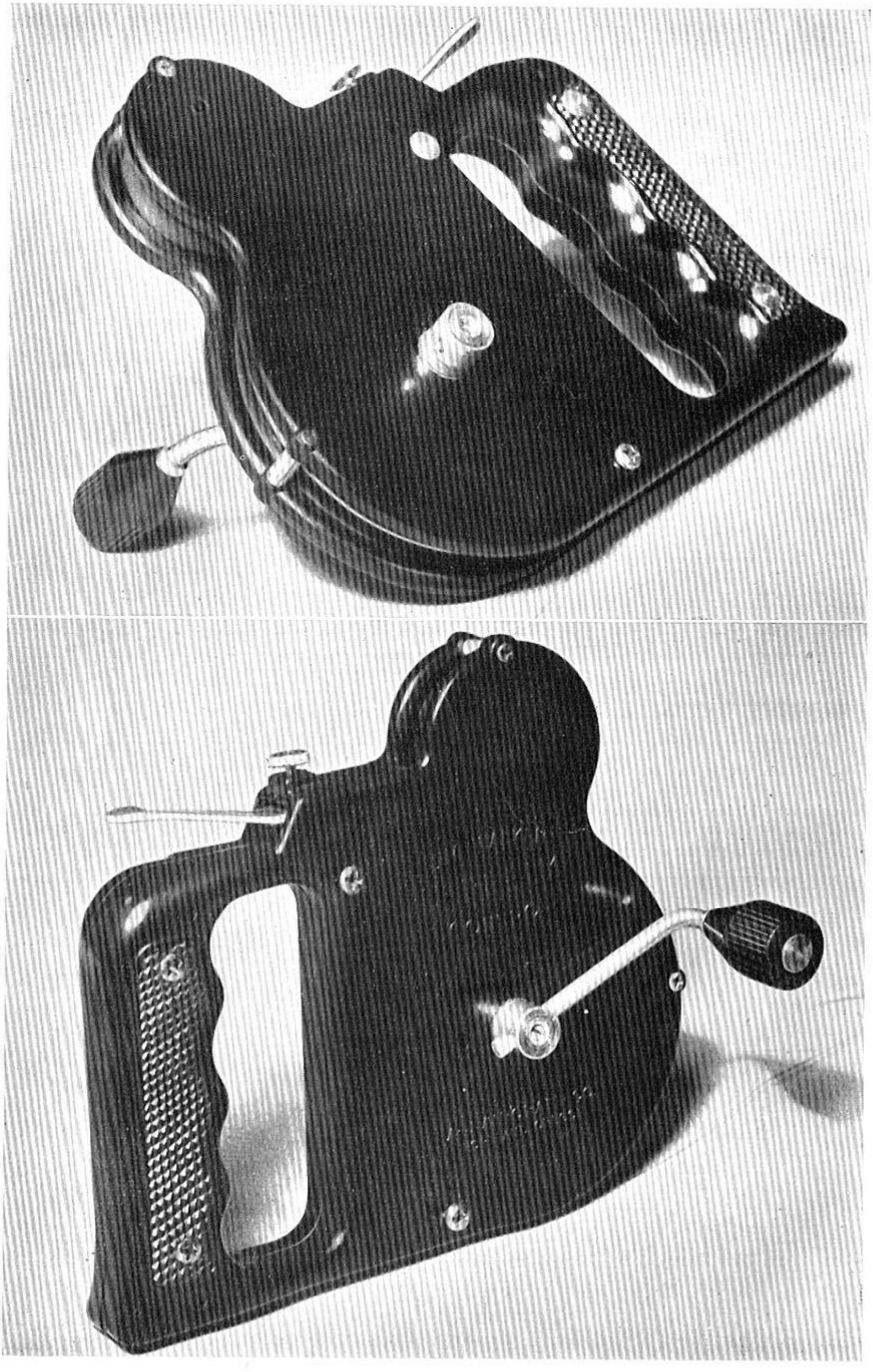



Experimental biplane design with Payne airscrew specially designed for Delmo 5 c.c. In spite of its ugly lines it is extremely efficient.



Italian "paddle" type airscrew in an intermediate speed machine. This airscrew has lead inserted in one blade for flywheel effect.





Two views of the justly famous Jim Walker U-Reely handle—a commercial version of which will be welcome in this country.

CHAPTER ELEVEN

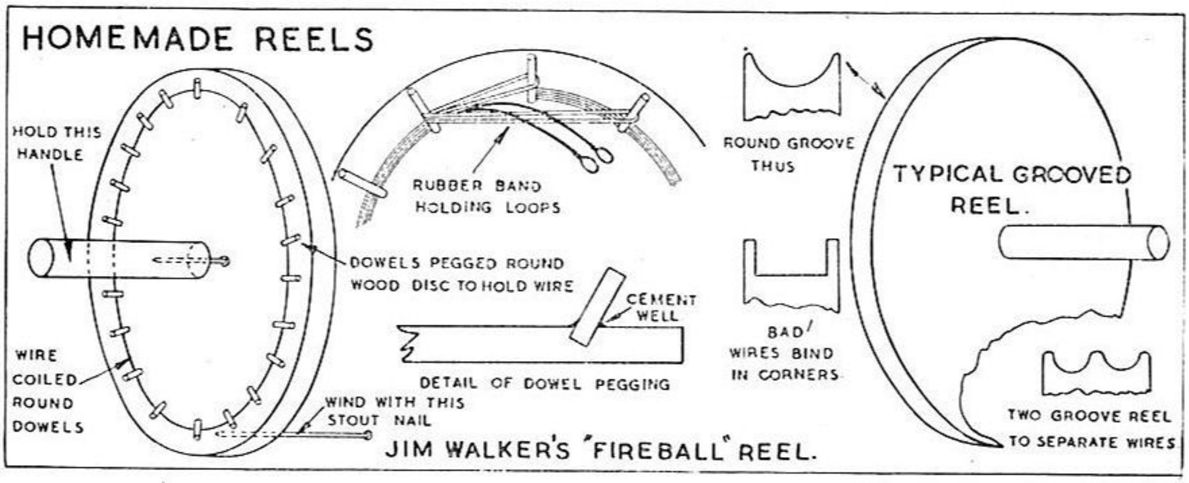
# CONTROL LINES, REELS AND HANDLES

WHATEVER form of control line flying is taken up, it is certain that a large part of its continuing success will depend on a proper selection of lines, carrying reel and handle. Unlike fishing, where sometimes the best catch falls to a lad with a bent pin hook and a piece of string, attention to tackle is desirable from the very beginning. We have seen models flying on what looked like furry parcel string, with copious knots along its length, but the model at the end usually looked even worse, if that were possible.

First comes the question of thread lines or wire? For the man who is often going to be without an intelligent helper, for the younger beginner, and the casual interest merchant, we would suggest thread for a start. It will stand more abuse than wire, can be unravelled more easily, and requires less maintenance. There is no need to be high-class in buying it. We tried some of the very best quality silk fishing line and found it absolutely useless. The stuff stretched abominably, which would have been just the thing with a large carp at the other end, but not so clever with a model, for the controls refused to answer without a prodigious tug. With ordinary carpet thread, or the cheaper types of linen thread at 6d. to 8d. per hank, we found an immediate positive response, and a substantial cash saving on the better grade. Thread has more drag than wire, and the line will bow quite alarmingly sometimes, giving the impression of considerably whipping by the flyer, but it does its job with the smaller lighter models within its breaking strain. Then, when flying is over, it can be simply wound round the control handle without a care in the world. There is not much that need be said on its maintenance, beyond keeping it as free of fuel, oil, grease and other rotting agents as possible, and seeing that knots are firm. When it begins to fray and look perished, throw it away and get some more.

All serious flying involves the use of steel wire, of an appropriate thickness to suit the model to be flown. Drag and dead weight varies considerably between the thinnest and the thickest. If the frontal area is bulked it will be appreciated that even a thin line represents the equivalent area of a penny flying round midway between model and pilot, and thick line something about the size of a small cocoa tin lid! Do not, therefore, play unduly safe with a hawserlike wire when it is not necessary.

Wire is sold in reels of approximately 200 feet, in both plated and unplated qualities. The plated sort is better as it is more rust resistant,




but the plain type is just as strong though it must be inspected more carefully for defects. The tyro often gets in a tangle unwinding his first reel, and may, through ignorance, spoil the coil before having a flight. Before touching any of the wraps procure a helper and some temporary holder, such as a thick cardboard tube, a broom handle or similar, having length though not necessarily thickness. The coil may then have its wraps unloosened. The individual turns will then spring open, half way up the broom handle, but this does not matter as they cannot tangle about themselves. An end is then taken and firmly wound on to the carrying reel, which may be an empty cocoa tin ; or a dried milk tin, large size, makes a good carrier for a start. Once firmly wound on, a small loop is made in the free end hooked over a conveniently placed nail, and the length of the line paced out. For accuracy, such as when making up lines for speed work, this length should have been carefully measured and marked previous to this. Cut the line with pliers (not scissors !) leaving ample to make a further loop, which when made should be hooked over another nail. In the open this may present difficulties, but a screwdriver stuck point down in the ground will make an effective substitute. Repeat the process for the other line, and the job is done. To keep the line tight on the improvised tincan reel, a short length of adhesive plaster tape is excellent. Lines should on no account be allowed to lie loose and sloppy on the reel.

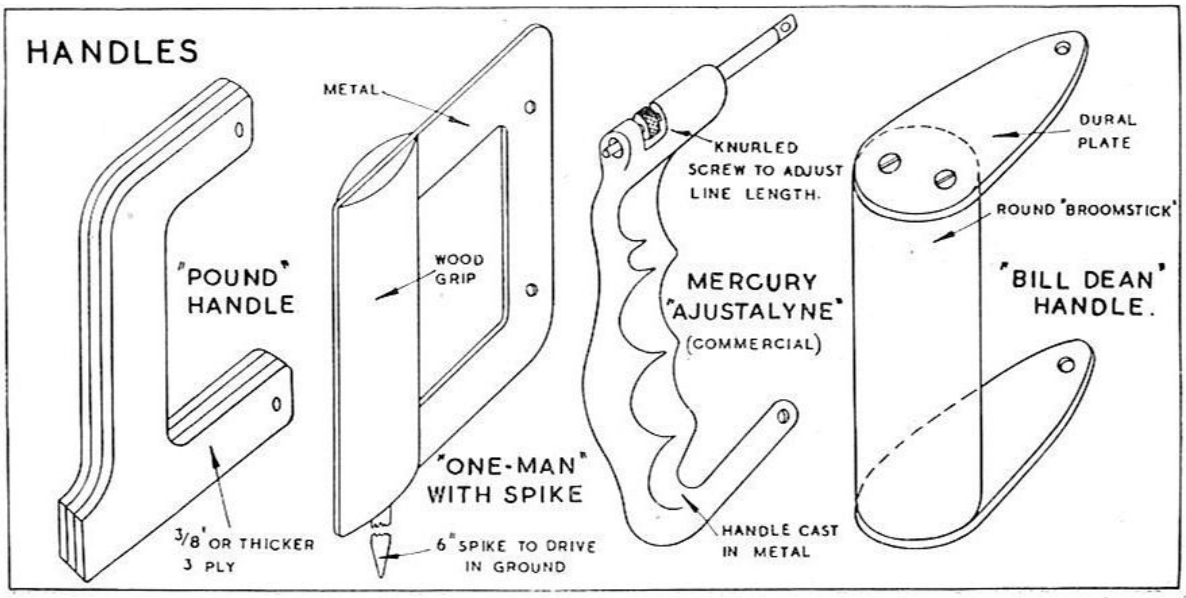
Although a number of quite expert flyers have been content with such a reel, it is not the best by any means. Better by far to make up Jim Walker's own original reel, first produced in 1940 and still used by experts. Here a circular piece of thick three-ply or planking is cut out about 10 in. in diameter. A circle is marked with a compass one inch in (8 in. diameter) and on this line at intervals of about an inch a series of $\frac{1}{4}$-in. holes are drilled at an angle inclined outwards at about 60°. Short lengths of dowel are driven into these holes with a dab of cement. A short length of broom handle is fixed in the centre for a hand grip, and another piece of dowelling or a nail driven in the other side towards the edge to make a winding grip. Just inside the circle of dowels two small nails or screws are driven in to take the line loops, and the line is then wound round the dowels. A small elastic band goes through the loops at the other end and is hooked over the most convenient dowel. Nothing could be simpler or more practical.

Some fliers like to keep their two lines separate on the reel, and for them we suggest a double grooved reel, using inset screws to take the loops, and again hooking the loose ends up with an elastic band to a conveniently placed nail. There are any number of elaborations to these ideas that are limited only by the materials and resourcefulness of the maker.

It should be emphasised that it is better to detach lines altogether from the handle when not in use, though many do not follow this advice. If they do not propose to do this, then by all means let the handle dangle at one end ; but do not say you were not warned when kinks quickly develop, and a snapped line spoils your latest brain child !

In the early days of control line flying it seemed that any old piece of wood that could be held in the hand was good enough for a handle. Now the better kits contain a suitable piece of wood with instructions for shaping the handle. We have found the best home-made handle is one shaped like a £ sign, curved at the top, and with a projection like the base of the sign. This is always held £-up, with the up-line attached at the top. Thus, however hastily it is grabbed for a flight there can be no risk of picking it up upside down as it will not feel right. This is best made of a scrap of heavy 5/8th or thicker ply for strength and to give some feeling of weight in the hand. We have found thin lightweight handles give little sense of control, though we agree this is a personal feeling, and may not apply to everybody. There are any number of alternative shapes, all with their following. Where a symmetrical shape is used mark top with a dash of paint.

Lines are attached to the handle via a short securing hook, which, as noted for control leads in the appropriate section, should be so designed as to avoid twisting the control lines. A paper-clip style of fixing made from steel wire of 16 or 18 s.w.g. is as good as anything. For speed flying and advanced control work it is a safety precaution to have about two feet of line at the handle end made of thicker multi-stranded wire. Then, if by some mischance the wire becomes twisted round the hand, there will be no harm done. The line fixing loops are then attached to the end of this safety line.

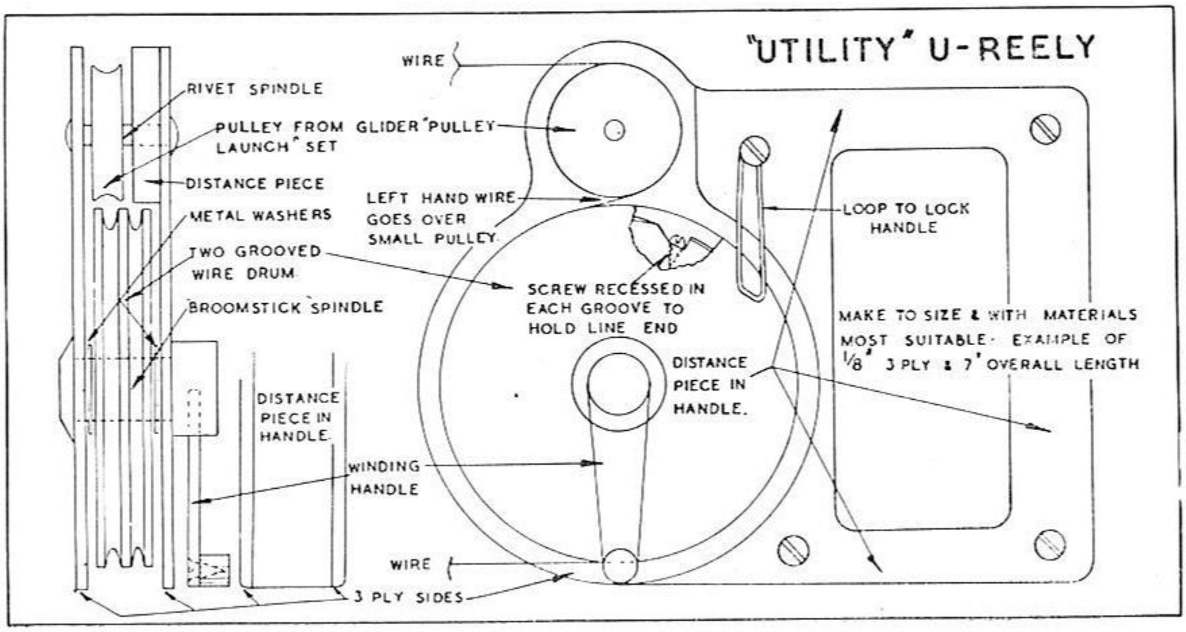


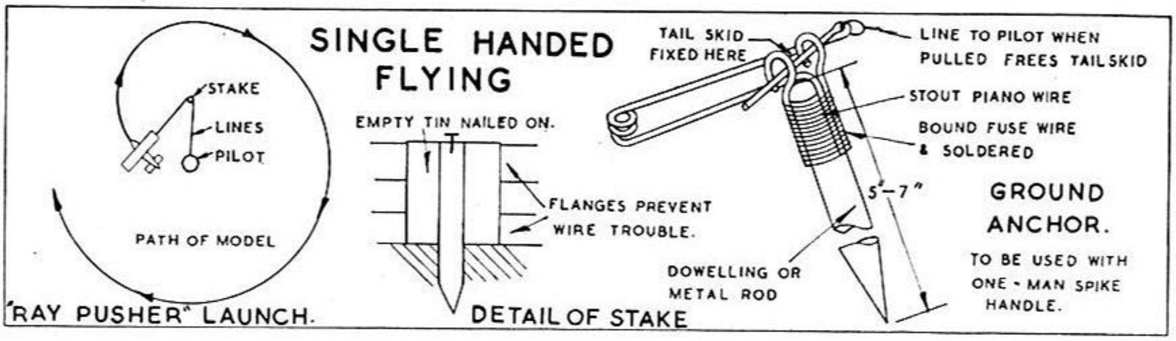
For those who desire the strength of wire lines with the non-kink virtues of thread the trade have conveniently catered with multi-stranded lines. These are naturally thicker, and with more drag, than single lines, but, if not entirely kink-proof, are at any rate kink resisting. For small models, however, their weight and drag is such as to interfere to a noticeable extent with flying, and even make models impossible to fly.

As usual, the trade have rallied round with a number of medium priced handles which will solve the problem for those who require a ready made job. Of these we have found the Mercu y Ajustalyne the best, as it is conveniently grooved for the fingers, and has top and bottom different to give the advantages of our own £-handle. In addition there is a short length of screwed rod, adjustable by a knurled ring to balance any slight inequalities of line length. It is heavier than the usual wooden handle and gives a good feeling of control. We understand that a British version of the famous Jim Walker U-Reely line, combining reel and handle, will soon be available. Such an accessory renders possible stunts like unassisted take-off, variation of line length in flight, and, with the electric version, engine control of a spark ignition motor. So far we have not even seen enamelled control line wire in this country, so the prospect of such control may still be distant.

We have made up a variety of the U-Reely line in wood, using a wheel from a pulley-launch rig which may be of interest for those wishing to try out this style of handle-reel before spending money on one.

Before flying, the pilot should get into the habit of regular line drill. Once laid out the lines should be passed through the hands slowly and each length examined for rust spots, kinks, or other weaknesses. Then with helper holding the model, the handles should be pulled firmly with a pressure of up to forty pounds according to the size of model. Joints should be carefully scrutinised at the same time, as rust at soldered wraps is very prevalent, owing to inefficient cleaning of acid fluxes.

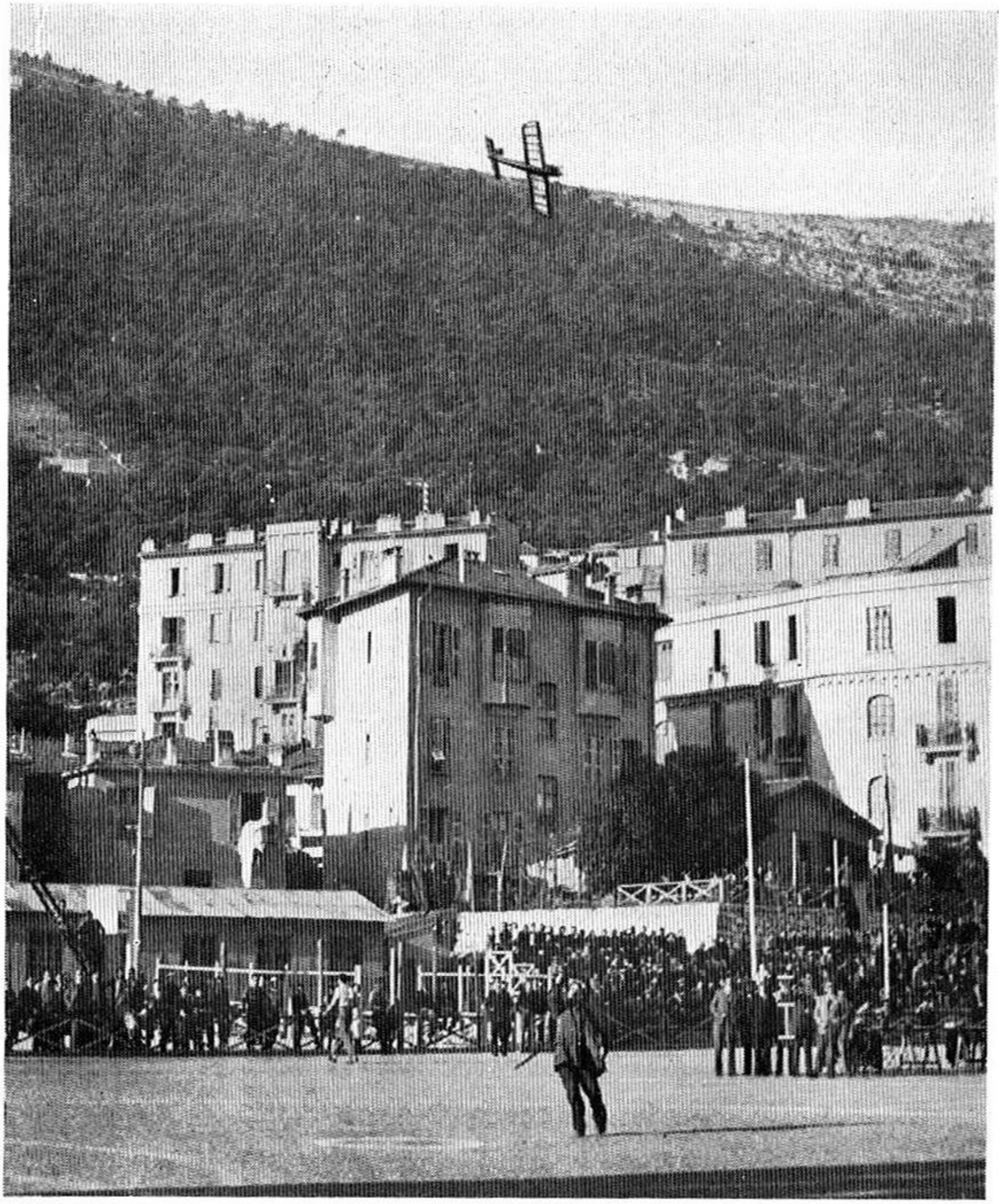





For this reason some flyers will have nothing to do with soldered wraps, but rely entirely on the strength of the twisted wire. If properly done it should be enough ; this is another of those controversial points where the individual will choose his own side.

Those who cannot always secure the services of a willing—or even unwilling—helper will find F. B. Thomas's spiked control handle, and skid-release of practical value. Here the handle is stuck in the ground at the centre of circle, the lone flyer starts up the engine, having previously locked the skid in place on the holding device. He then proceeds to the centre of the circle, grasps the handle and pulls out the release pin with a thread third line, allowing the model to circle free. In reasonable weather conditions this works very well, and certainly permits private training. Very powerful models with large engines will tend to vibrate free or noseover on release so that the method should be restricted to smaller sizes unless specially designed for this type of release. An alternative one-man flight that we favour is the idea of Ray Rusher, a well-known American gadgeteer. This also requires reasonably calm weather, but enables a spectacular release, without any movement from the centre of the circle by the pilot. The principle of this is to double the lines back round a peg, reducing the initial take-off circle ; the model gains speed from the pilot's hands, turns about the pivot of the peg, and is then running in its true circle, and takes off normally. An extensible line is an advantage here, but it can be accomplished without it. For initial experiments thread lines should be used in case of tangles and, of course, an old and not too treasured model.

We have left the subject of multi-line controls until the end as there seems a marked indifference towards them as yet. These are used to actuate either engine control, via the ignition switch or a simple on-off engine shut off, bomb dropping, undercarriage retraction, or similar stunts. The addition of a third loose line to the two flying controls will be found rather an embarrassment to beginners, and will get in the way of stunters, but for those reasonably skilled who desire to work accessories on the model it is almost essential. A delayed action timer type of accessory control has been suggested, but is not very sound, as things being what they are, the release invariably comes at just the wrong moment—such as undercarriage retraction in advance of schedule, with model still grounded ! The American method of control through enamelled control wires carrying current from a substantial battery in the pocket of the flyer has many advantages, but must await stocks of suitable wire.



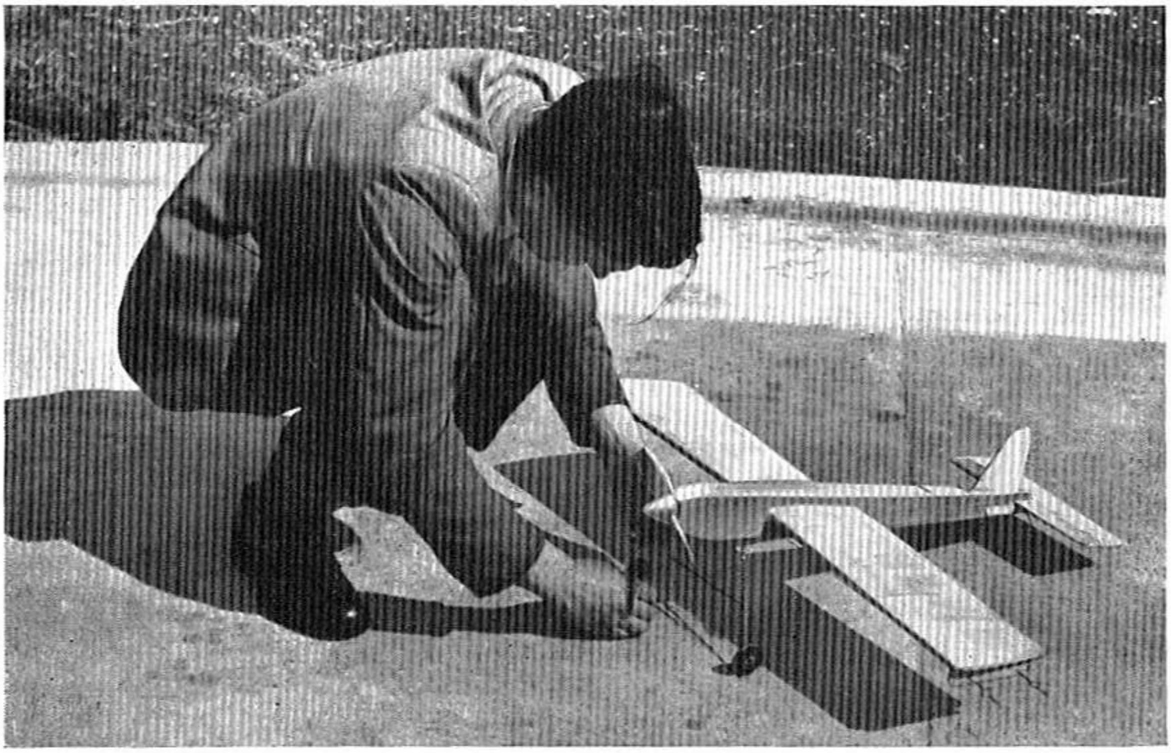
Spectator control is most important if completely carefree flying is desired. This shot of a competitor performing a wingover comes from Monaco where the club makes use of a local football and sports ground for their meetings. Keen club secretaries should be able to make similar arrangements for their members by a little judicious "lobbying" of Councillors and other V.I.P.s.

CHAPTER TWELVE

# ELEMENTARY FLYING

CLUB members will have a great advantage over "lone hands" in that their control line adventures can be mutually shared and some mistakes avoided, even if none of them has ever flown before. This may sound strange, but is perfectly true. By watching one or two others do the wrong thing there is a chance you may be able to avoid it when your turn comes. But don't rely too much on this. We learned the hard way without a control-liner amongst us, and listened very patiently to the advice of one kindly soul who was determined to be last in the air. He was: and made all the mistakes we had all made! It is a strange thing that in our own little group of seven or eight learners everyone of us made the same basic mistakes in roughly the same order—even though we all knew what we were trying to avoid, and had any amount of encouragement from outside the circle. Of course, the ideal is to get elementary training from someone who already flies reasonably well, although here there is the risk that the instructor will tend to give plenty of demonstrations and not too much of the actual flying instruction.

Happily it is not necessary for a model to be particularly well built for it to fly quite successfully; but it is necessary that certain parts at least are strongly built. Wings and tail unit should be firmly secured in place. It is a good general rule for beginners that these surfaces should be glued and not attached with rubber bands, though we have seen a few kits, designedly for novices, where this precaution is not taken. There is little more embarrassing than to have mainplane lifting up and down in flight or tailplane wobbling from side to side. If these items are secure there remain controls to be checked. Control-plate is a frequent source of breakdown in flight, especially if pivoted on a threaded bolt and secured by nuts only. These usually work loose and at the most awkward moment the whole plate comes off the pivot! It is important that the securing nuts be soldered in place. If you are not an enthusiastic solderer wind a little cotton round that part of the bolt standing up above the nut and flood it generously with balsa cement taking care to keep it from sticking to the plate. This is not as permanent as soldering, but will do the job quite well. Next comes attention to wheels; these should track properly in line, any tendency from a straight path should always be out of the circle rather than in. Washers or other wheel retaining device should be checked as the loss of a wheel will often mean at least loss of a prop—and these can be lost easily enough without additional methods. Finally engine mounting should be checked to see that holding-down bolts are secure and that



Assistant Editor Hundleby practises what we preach by a careful check over of drop-off undercarriage fitting before starting up for a flight.

any offsetting is towards the outside of the circle. Airscrew should be adjusted to stop in a horizontal position to minimise risk of breakage on landing, and should be tested for ground clearance with tail held up parallel with datum line. About one inch between prop tip and ground will allow enough for average surface bumps. Next drill is to make sure the controls operate freely without binding anywhere, and that there is no way of them over-running and becoming jammed. Lines can then be attached, and must be checked to make sure that held in a normal position with the handle upright they are exactly the same length. With the thumb at the top of the control handle it should be pulled with a twisting motion towards the body to give " up " and away from the body to give " down." Until a reasonable proficiency is obtained no such wrist movements should be attempted, however, but the arm held out quite straight and raised or lowered for up and down movement of elevators. Lines being laid out on the ground, checked for twists and snags, should again be tested on controls to make certain handle is held right way up, and that controls are still free. It is a good idea to have a handle so shaped that one side is the obvious right way up, and so avoid any accidental change when taking off. We use a handle shaped rather like a £ sign—which must be held " pound way up " but many of the proprietary handles also have basic differences which will help the novice.

There are still one or two points to consider before actually flying. There is the question of lines : whether to use wire or thread lines or one of the multi-strand non-kink lines. If the model is in the under 2.5 c.c. category, then we suggest thread for the first flights—though it will not satisfy once some proficiency is gained. It is less liable to snags and kinks and so gives one less initial worry, but certainly adds quite a bit of drag to the model. Multi-strand non-kink should not be used for anything under 5 c.c., it is too heavy and too thick and may so seriously impede flight as to hazard the machine in unskilled hands. Again, if wire is to be used, check the wire table and do not use any that is too thick—weight and drag soon builds up.

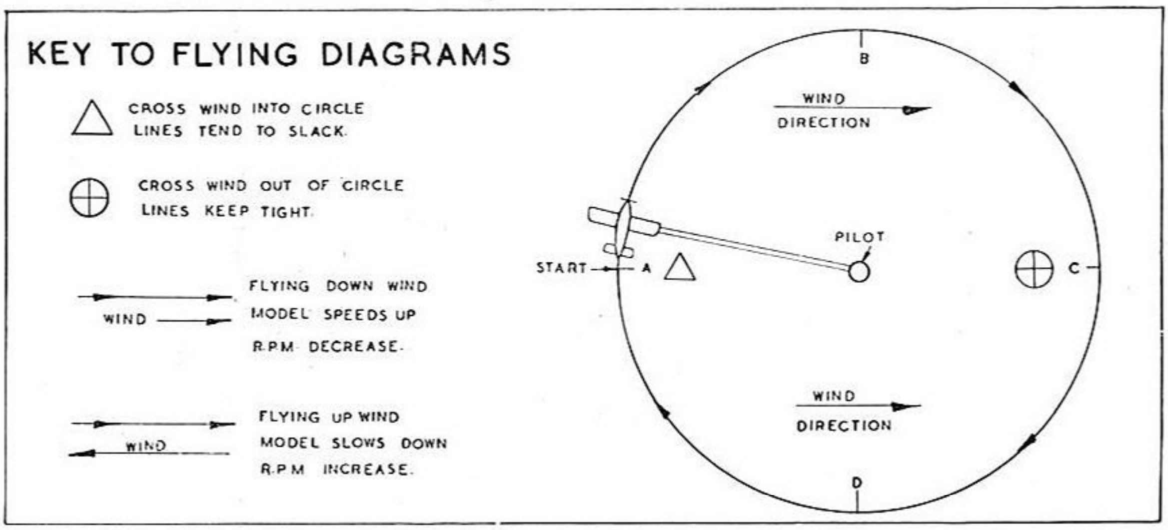
Next point is—do be patient. If it is windy pack up the box and go home again, otherwise there may not be much left worth packing. Wind up to 8 m.p.h. (Beaufort Scale 2-3) is quite safe for first hops, but if there is the slightest breath be sure that a start is made *down wind*—that is to say, in the opposite direction to which you would launch a free flight model. Model should be placed so that it travels about one-eighth of a lap before coming directly down wind. It should then be airborne before it comes into the wind, that is in not more than half a lap.

Let us get you back on the tarmac ; ready to take off after a final briefing. First and most important point to get very firmly fixed in the mind is that *the model cannot prang when it is going up*. Very few flyers appreciate this light-hearted comment at its real worth. But it is very true. We need only start to worry when the machine is coming down. For that reason do not be too long about letting the model take off. Give your assistant the signal to let go, *step back to keep lines taut* and you are away, with the model rolling nicely on tarmac, tail off the ground running fast down wind, and you wondering about when it should be airborne. But do not be too eager about it either. This is an equally common fault—giving full up, and as our American

Not everyone will be lucky enough to have a hangar like this for flying, which makes any meeting independent of the weather. Local drill halls, however, make a good substitute.

friends so succinctly put it, "flying to the end of the lines." What happens with full up is that the model either goes straight up, loses forward flying speed, and stalls or is frantically over-corrected by the horrified pilot and hits the ground with a bang. A third alternative is that, having plenty of power in hand it does not stall, but continues up and up until it is vertically overhead in the beginning of a wing over that he would dearly like to produce in his later more skilled period, but which now does nothing but embarrass him. Well, we warned you! *It need not be disastrous* if you keep your head! Step back smartly, neutralise the controls and *watch the model*. As it comes right over your head and starts on its downward path, keep stepping back, and give up control, which should bring the model on to an even keel and start it on a rational circuit. The object of stepping back is two-fold. First, in an involuntary wingover like this it is possible the model will go over behind your head and thus become unsighted when you will have not the faintest idea what is happening at all until you hear the clunk! Again, in its initial burst of freedom it may have become inverted, in which case, if you see this, give it *down control* as it comes out from its overhead swing. You will probably have given it up instinctively already before noticing its inverted position, which means the model will now be hurtling earthwards in a vertical dive. By giving it down at the last moment (which, of course, with an inverted machine is really up!) it is unlikely that you will avoid a prang altogether, but should get away with a broken prop and perhaps a bent fin.

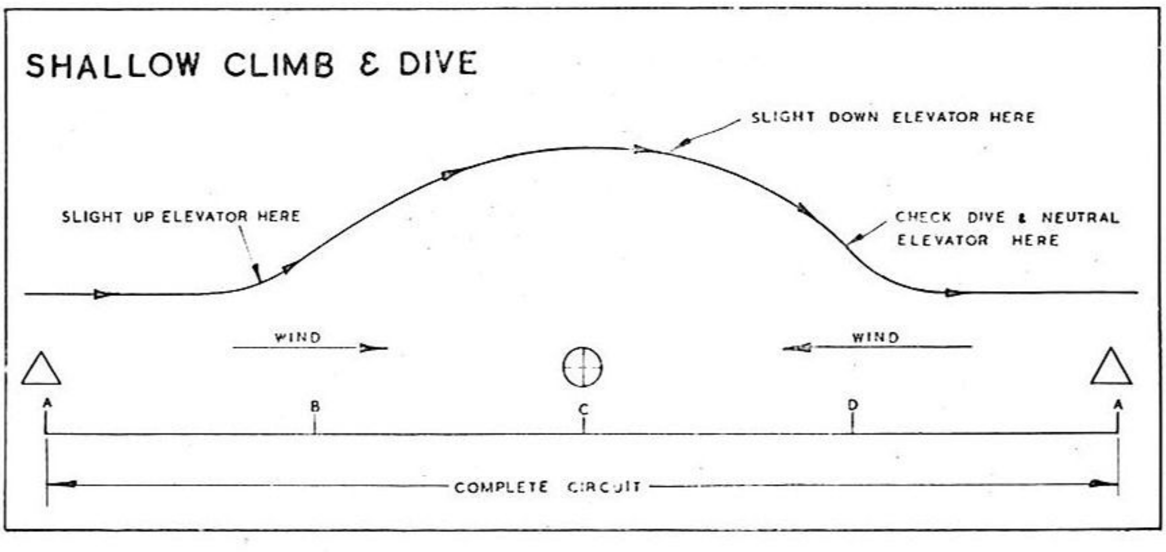
But none of this alarming picture need happen if you don't give full up at the take-off. With an engine well matched to the aircraft it should be possible to take-off in under half a lap without giving any appreciable up elevator. In other words, *let the machine fly itself off the ground*! Allowing for those weaknesses common to all of us, we cannot expect you to leave well alone to that extent, and your probable first take-off will be somewhere between the dreadful example and the perfect job—you will undoubtedly give too much up, but not so much, we hope, as to be painful. The model then will fly upwards—though happily in a circular path—far more steeply than you had bargained for. Your immediate instinct is to give lots of down, and then the ground is

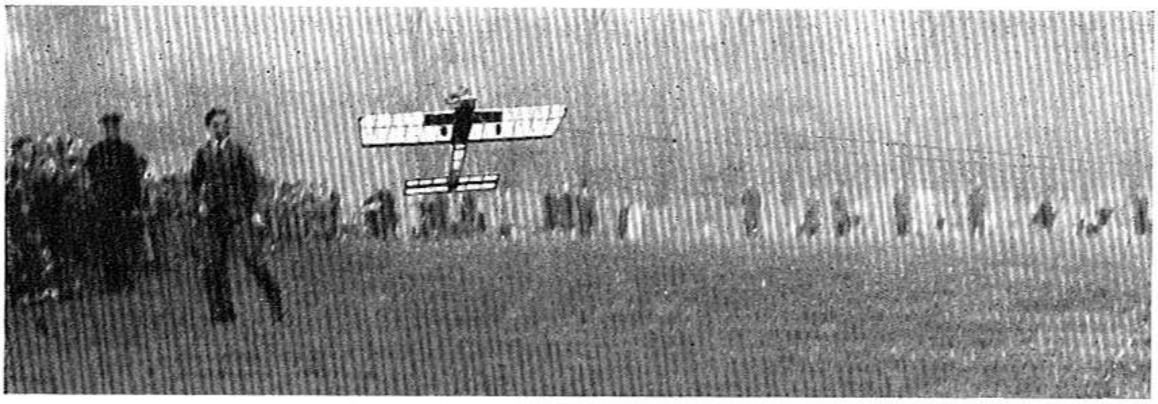


coming uncomfortably close in a dive, and up you go again. With luck, little wind, and a good model, you should be able to flatten out these extremes in a few circuits and eventually get in a few laps of fairly level flying.

If your nerves are strong enough, however, it is better to ease out that terrifying initial climb more gradually, levelling it off with the lines and the ground making an angle of about 45°. Fly round at this height and then gently lower your outstretched arm which will bring the model lower and lower. After a few laps you will appreciate how little control is necessary to make the model rise or climb gently, but for your first flight or two do not attempt anything more ambitious than level flight at various heights. You will notice, even if the wind is very slight, that the model tends to climb as it comes into wind, which, as in a free flight model, is what you would expect. To preserve complete control then, you should dive slightly into wind—just enough to maintain your height without climbing, and then climb slightly on the downwind part of the circuit. This should become second nature to you, for, later on, when you try stunting, all your manœuvres will take place on the downwind side of the circle.

Until you have had quite a number of flights you will find the business makes you quite giddy—short lines more so than long ones. A lot of this dizziness can be overcome by watching the model and not the background, and in time you will not notice the feeling at all. Just at first, however, it is unwise to try and fly with too full a tank of fuel—some of the special control-line tanks have enough for anything up to 15 minutes' flying ! As you will not—we hope—be trying any stunts immediately there is no reason why the standard tank as fitted to your engine for free flight should not be used. Most free flight tanks have a capacity of not more than two minutes—and this will be quite long enough for a start, even allowing a good half minute starting and warming up. You will be surprised how long it seems until the motor starts to splutter and you know the flight is nearly over. And so are your troubles for the time being. As the motor cuts, consider quickly just where you are in relation to wind. It is much better if there is any wind to bring it in on the downwind side—just as you started from there—





Take off from rough grass. Helper on left has just released model which is already well airborne. Such a take-off is quite easy with the larger sizes of engine.

as your lines will remain taut and you have a good chance of landing on the wheels. If you have some way still to go try to pull the model round with a " whipping " motion, keeping the controls so that it is gliding steadily earthwards ; then just before it touches down, give it full up, which should help towards a three-pointer. Quite a number of props get broken in landing, even when the engine has cut, so it pays to take care. Just the weight of the model tipping over on to its prop can easily break it—which, of course, is where the advice on adjusting prop position to stop horizontally proves its worth. As it comes in be sure to step back a pace or two thus helping to keep full control, which you will only have just so long as the lines are taut. This is a point worth emphasis—*you can only control the model with taut lines*. As soon as they go slack, as, for example, when you come into wind and the machine is blown in towards you a little, you lose control and until the lines tighten again there is nothing you can do to change its flight path. Moral of this is *don't let the lines get slack*. If you feel them going slack step back at once until you get positive control again. This should not be much of a problem for beginners flying in calm weather, but just as soon as you get ambitious and try a model out on a bad day you will learn all about slack lines in next to no time.

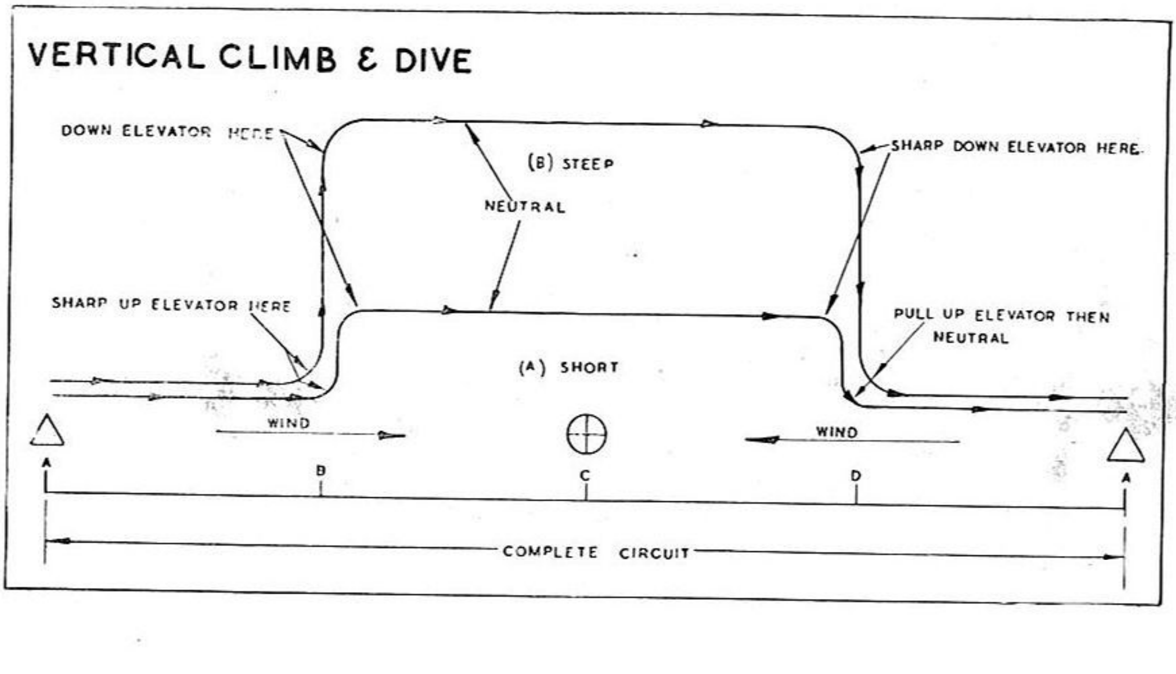
So far we have spoken only of what the pilot should do on his first outing. Nearly as important is the conduct of the mechanic, if we may so describe the assistant charged with letting go the model at the appropriate time. It is a help—and evens out the work—if the assistant can do the actual starting of the engine himself. Otherwise there is that rush down the lines with the engine going splendidly, a hasty grab at the handle, and the wretched engine peters out again. After doing this two or three times it is small wonder the pilot is a little flustered and unable to give of his best, or even picks up the handle upside down ! No ! if possible the assistant should do the actual starting, with the pilot already at the handle end ready to take off quietly and without fuss when the model is ready to go.

Having started the engine satisfactorily the assistant should not release it until he receives a signal from the pilot. This is important. If he just lets go when he is ready the man at the other end may well be caught napping and have to make a very flurried take-off. Note also that we say *release* the model. There is a school of thought that says a gentle push is to be recommended, but we have not found the advantages anything like up to the disadvantages of a push. Sometimes it is too vigorous and puts the model over on to its nose ; at other times it sends the model rolling into the circle with slack lines. All things considered it is better to let the model go without pushing—then whatever happens is in the hands of the pilot. The only exception to this, we would say, is in the case of speed models on a dolly where a *skilled* helper can do a lot to assist take-off by running round steadying the outside wing-tip until a fair speed has been got up. But this should hardly affect the novice flyer.

Elementary flight technique can then be summed up as follows :

(1) Check model including control plate, wheels and engine.
(2) Check lines for snags and free up and down movement.
(3) Start engine ; check " up " *is* up and " down " *is* down !
(4) Signal release of model.
(5) Keep lines taut, stepping back if necessary.
(6) Let model take itself off with only very slight elevator up assistance.
(7) Correct too much up elevator.
(8) Fly level.
(9) Climb down wind ; dive up wind.
(10) Remember to keep lines taut always by stepping back.
(11) When engine cuts try to bring model in downwind by whipping if necessary.
(12) Give up elevator immediately before wheels touch down.

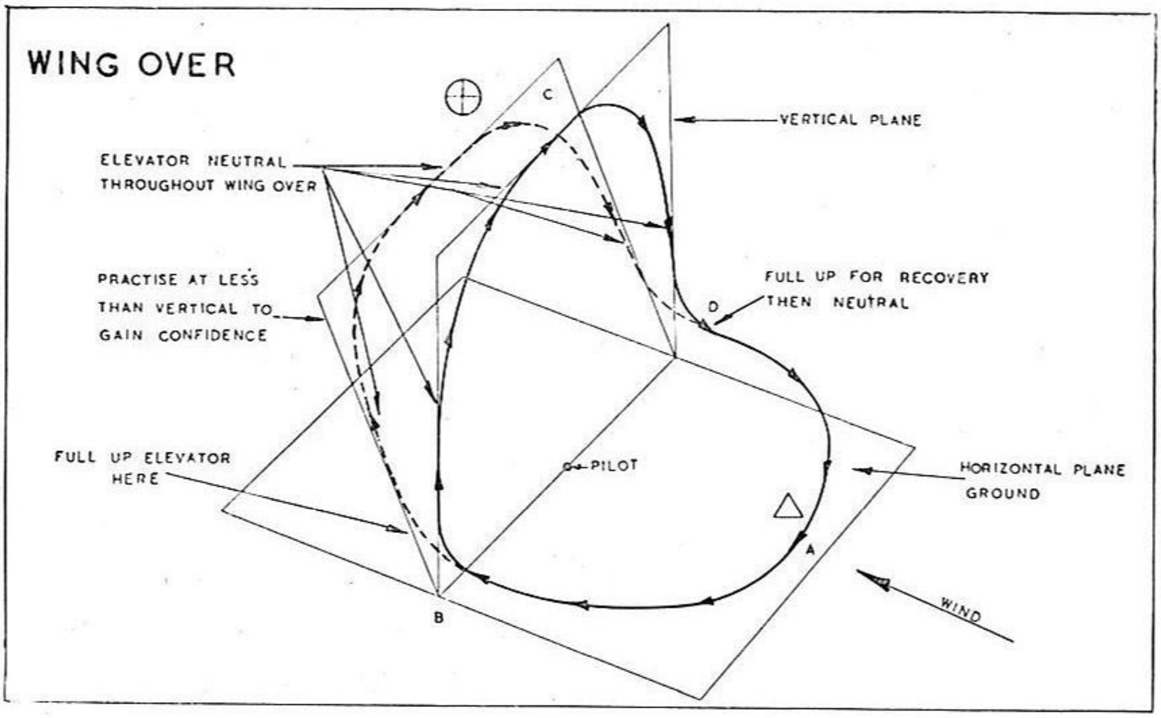
One of the beauties of control line flying is that flights can be made almost anywhere. But that does not mean some places are not better than others. If any choice exists it is as well to have the most suitable. Best of all is a nice smooth hard tarmac or concrete surface for the take-off and soft turf for landing. Such conditions will be found on a full size aerodrome, where take off can be made from the runway, and then stepping back down wind the model can alight on a grassy portion



of the airfield. Such conditions will not be available to many, and so a compromise must be sought. A large school playground wants quite a lot of beating for smoothness—though it is a little hard for heavy landings. A hard tennis court, preferably of the asphalt kind, is good. The loose dirt sort that requires watering is bad for the engine and we doubt if control line models would be popular with the groundsman! Cricket pitches are good for an all grass take-off, but unfortunately the same remarks on groundsmen apply; so enthusiasts had better be content with some smoother part of the outfield and not desecrate the actual wicket. Housing estate roads, where building has not caught up with the road, make good take-off spots. For small—1 c.c. and under—models there is little to beat an indoor flight in a fair-sized gymnasium or badminton hall. For the sake of repeat performances, however, do take care to lay down a sheet of felt or lino where engine starting and tank filling takes place—people are quite touchy about their floors!

We have assumed so far that the novice flyer has brought a typical trainer along for his first flights. Such a machine will be moderately powered with an engine of sufficient size but nothing special to make it "a hot ship." In the same way elevators will be of moderate size only, with comparatively small up and down movement. In other words, everything possible will have been done to save the beginner from himself. With the worst will in the world it would be impossible to break speed records with such a model or put it through many of the stunts in the book. At any rate this is what we hope has been brought along. It is foolhardy, to say the least, to start flying with some super speed design or highly sensitive stunt job—it will be smashed up before you have ever had a chance to fly it properly. The beginner cannot do better than make up any of the better "trainer" kits advertised, choosing one to suit his engine. In this early stage the qualifying flights will be the same whether it is intended to specialise in stunt or speed. First step is to become completely confident in the handling of the machine. This may come if you are a thoroughly adaptable type of the "born pilot" class after only one or two flights. More likely, if you are average—or a bit above average—it will take half a dozen or more flights to begin to get the feel. This is the time to beware. Over confidence will put you back if you are not very careful. By now you will have quite got the idea of take-off and landing, and each flight will be quite a

**Heading for disaster! Flyer can be seen running hard in an endeavour to regain control of his model coming in on a slack line.**

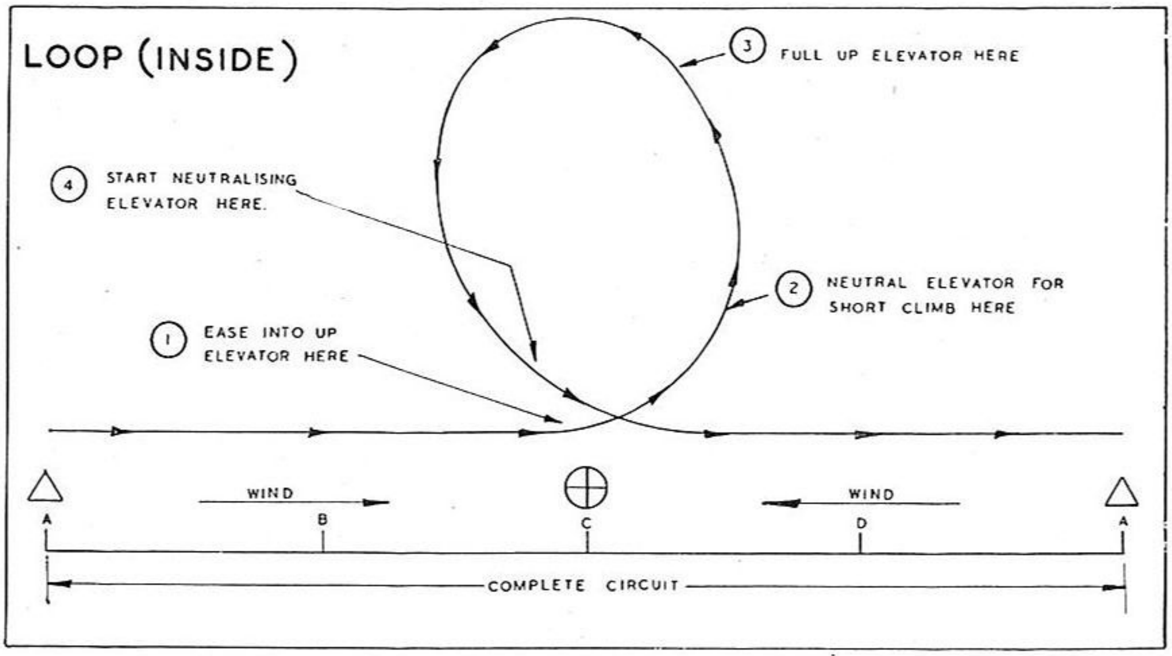



pleasant pattern of climbs and dives, which you can now produce at will—not spend a couple of laps levelling off ! Now for a nice loop or awing over you say, and, hey presto, it must be recorded that the first three-quarters of the manœuvre were perfect, if only you had started higher up ! Over confidence may have laid you low even before this stage, as you try just how close you can skim the grass, and find it too close by several inches. Can we be thoroughly practical ? Try to make up your mind, and keep to it, to put in one hour—sixty minutes' solid flying before you attempt anything more than simple dives and climbs. With the average standard tank this means about thirty flights, or say two afternoons out. During this time you will probably, indeed, almost certainly, have broken several props, dented several parts of the model, and done all the things we have warned you against at least once, but you will have got the hang of flying without thinking consciously of what you are doing all the time. Then and only then is it safe to embark on more ambitious work.

A wingover can be your first effort. Don't try to get a perfectly vertical climb right overhead for a start. Make a few pecks at it first, bringing the model up into a climb *downwind* over at about 60° and so nicely levelled off before you get upwind again. Then again just a little steeper, about 5° at a time until suddenly you find the man on the outside of the circle applauding a really good effort. Just between ourselves, the wingover is one of the hardest manoeuvres to do really well, in fact even the experts do not always produce a true " vertical " whatever they may think themselves ! Having mastered the wingover—or shall we say the " near wing over," next stunt might well be the loop—simple outside loop executed on the climb. Secret here is to *consciously feel the loop all the way*. Give it good firm up elevator until it is past the vertical and coming over, then ease the controls a little to give an opportunity to pick up speed for the downward rush, then full up elevator again until you see it is coming out with enough air in hand—and lo! and behold! you have done your first successful loop. Or have you? Running out of air is the most common trouble with first loops. Either it has been commenced too near the ground, or controls have not been really felt all the way. It is surprising how that ground does loom up—usually just enough to catch the undercarriage and mean one more prop. But persevere, and do make the first effort over turf if you can, it is so much softer than concrete! This mainly applies to the smaller sizes of engine where there is not enough margin of power to really whip off the loops. With a good 5 c.c. diesel or 10 c.c. petrol engine nicely tuned it seems so much simpler—though the damage is proportionately greater if things do go wrong!

Speed merchants will wish to progress after their apprenticeship to the take-off dolly; which is also quite a good thing for stunt merchants—then you don't (theoretically) catch the undercarriage at the end of the first loop. There are two types in general use: the three-wheeler tricycle on which the wing and fuselage belly rests, and the two-wheel type with one or two prongs fitting into holes in the fuselage. The latter is probably better for first attempts provided they are being made from comparatively smooth ground. On rough ground the three-wheel dolly with good large airwheels is the better choice. The model will career round with its take-off apparatus and become airborne still carrying it. The tricky moment is when it falls, for there will be an immediate surge of power by the lighter wingloading, which will tend to give a nose up effect to the model.

Another trouble with dollies is that bumpy ground may tend to dislodge the model before it is going fast enough to become airborne. This usually means another prop. There is no magic word to avoid it. The secret here is in the design of an efficient dolly. Some experts recommend that the wings and fuselage merely rest on a shaped trough, becoming airborne as soon as it has lifted clear of the retaining arms holding the wing leading edges from sliding forward. Better, perhaps, is



Well cut grass and adequate crowd control make this flyer's lot a happy one. Whitewash circle, in which he stands, gives him an idea of relative distances. He is flying right handed in an anti-clockwise direction across the body, which we recommend as the more comfortable method.

the method where the dolly is equipped with prongs, like the two-wheel drop-off undercarriage, as this seems to give more positive fixing until the two parts are really ready to separate. A disinclination of the dolly to drop away can sometimes be cured by weighting it with solder or the like, but this somewhat retrograde step should not be taken until free movement from any pronged fittings has been checked. It is a lesson in itself to watch the speed experts setting up their models on a dolly—everything is carefully tested for each flight, and the oil-can ever ready to ease any recalcitrant part.

Our advice on first steps to flying should be enough to set the complete novice on his way without undue heartburning or the destruction of more than a normal number of props and odd parts. If he is fortunate enough to have a skilled friend willing to assist then his task will be that much lighter. Nothing that we have said need be unlearned or ignored. The skilled friend *may* be able to help his take-off with a knowing push—that is up to him ; he may, equally well, pass the novice on to more ambitious manœuvres before completing his one hour solo—that again is up to him. But he will never be able to fly for him—that the novice must learn himself. The double ended control handle may prove useful in nearly flying for him, but hints on its use are superfluous as the skilled helper will know best how he likes things.

One last point before passing on—are you left handed ? This is quite a point. We are, and found our own mortality rate far lower when flying in a clockwise direction than anti-clockwise ; whilst colleagues who were right-handed found anti-clockwise the happier direction. It seems easier to follow the model round in a forwards direction, that is with it flying across the front of the body, than to be turning round backwards with the model always about to disappear round the back of the head. Provision for the way round must be made quite early in building—and there is no reason why this should not be changed, if necessary, to suit the individual. There are plenty of arguments in favour of flying with and against torque ; choose those that enable you to fly your own " natural way."

We have refrained from giving advice on advanced flying. When pilots reach such a stage they require only two things—courage to try, and opportunity for regular practice. Included in the appendix are details of the usual flight patterns possible, which are all elaborations and variations on the standard themes of flying normally and flying inverted and the process of changing from one stage to the other. Speed flying requires less practice, perhaps, on the field, but certainly much more work at home perfecting the model for its flight.

In conclusion, may we wish all our readers the best of luck in their flying—sweet revving motors and happy landings !

The flying diagrams used in this chapter are based on *Mercury Magnette* instruction leaflet by Henry J. Nicholls, to whom grateful acknowledgment is made.

THE END

# INDEX

# APPENDIX I

## SPEED TABLE

**Half Mile Distance**

| Time | Speed m.p.h. | Time | Speed m.p.h. | Time | Speed m.p.h. | Time | Speed m.p.h. | Time | Speed m.p.h. |
|---|---|---|---|---|---|---|---|---|---|
| 12.0 | 150.00 | 15.5 | 116.15 | 19.0 | 94.74 | 22.5 | 80.00 | 26.0 | 69.23 |
| 1 | 148.76 | 6 | 115.4 | 1 | 94.24 | 6 | 79.65 | 1 | 68.97 |
| 2 | 147.5 | 7 | 114.65 | 2 | 93.73 | 7 | 79.3 | 2 | 68.71 |
| 3 | 146.3 | 8 | 113.9 | 3 | 93.24 | 8 | 78.95 | 3 | 68.46 |
| 4 | 145.1 | 9 | 113.2 | 4 | 92.75 | 9 | 78.59 | 4 | 68.18 |
| 12.5 | 143.95 | 16.0 | 112.5 | 19.5 | 92.27 | 23.0 | 78.24 | 26.5 | 67.92 |
| 6 | 142.9 | 1 | 111.8 | 6 | 91.78 | 1 | 77.9 | 6 | 67.66 |
| 7 | 141.75 | 2 | 111.1 | 7 | 91.35 | 2 | 77.56 | 7 | 67.4 |
| 8 | 140.62 | 3 | 110.45 | 8 | 90.91 | 3 | 77.24 | 8 | 67.15 |
| 9 | 139.55 | 4 | 109.8 | 9 | 90.46 | 4 | 76.92 | 9 | 66.9 |
| 13.0 | 138.5 | 16.5 | 109.15 | 20.0 | 90.0 | 23.5 | 76.6 | 27.0 | 66.67 |
| 1 | 137.4 | 6 | 108.5 | 1 | 89.56 | 6 | 76.28 | 1 | 66.43 |
| 2 | 136.3 | 7 | 107.85 | 2 | 89.12 | 7 | 75.96 | 2 | 66.18 |
| 3 | 135.3 | 8 | 107.2 | 3 | 88.67 | 8 | 75.64 | 3 | 65.94 |
| 4 | 134.3 | 9 | 106.55 | 4 | 88.23 | 9 | 75.32 | 4 | 65.70 |
| 13.5 | 133.35 | 17.0 | 105.9 | 20.5 | 88.81 | 24.0 | 75.0 | 27.5 | 65.46 |
| 6 | 132.4 | 1 | 105.26 | 6 | 87.39 | 1 | 74.7 | 6 | 65.22 |
| 7 | 131.4 | 2 | 104.6 | 7 | 86.97 | 2 | 74.41 | 7 | 64.98 |
| 8 | 130.4 | 3 | 104.05 | 8 | 86.54 | 3 | 74.09 | 8 | 64.78 |
| 9 | 129.49 | 4 | 103.4 | 9 | 86.12 | 4 | 73.77 | 9 | 64.54 |
| 14.0 | 128.57 | 17.5 | 102.85 | 21.0 | 85.71 | 24.5 | 73.47 | 28.0 | 64.29 |
| 1 | 127.68 | 6 | 102.3 | 1 | 85.29 | 6 | 73.17 | 1 | 64.05 |
| 2 | 126.8 | 7 | 101.7 | 2 | 84.87 | 7 | 72.87 | 2 | 63.82 |
| 3 | 125.9 | 8 | 101.1 | 3 | 84.48 | 8 | 72.58 | 3 | 63.59 |
| 4 | 125.0 | 9 | 100.55 | 4 | 84.08 | 9 | 72.29 | 4 | 63.37 |
| 14.5 | 124.15 | 18.0 | 100.0 | 21.5 | 83.71 | 25.0 | 72.0 | 28.5 | 63.15 |
| 6 | 123.3 | 1 | 99.46 | 6 | 83.34 | 1 | 71.76 | 6 | 62.92 |
| 7 | 122.46 | 2 | 98.91 | 7 | 82.96 | 2 | 71.43 | 7 | 62.71 |
| 8 | 121.62 | 3 | 98.37 | 8 | 82.57 | 3 | 71.18 | 8 | 62.5 |
| 9 | 120.81 | 4 | 97.84 | 9 | 82.19 | 4 | 70.92 | 9 | 62.29 |
| 15.0 | 120.0 | 18.5 | 97.32 | 22.0 | 81.82 | 25.5 | 70.61 | 29.0 | 62.07 |
| 1 | 119.2 | 6 | 96.79 | 1 | 81.45 | 6 | 70.31 | 1 | 61.86 |
| 2 | 118.42 | 7 | 96.27 | 2 | 81.09 | 7 | 70.04 | 2 | 61.65 |
| 3 | 117.66 | 8 | 95.75 | 3 | 80.78 | 8 | 69.77 | 3 | 61.44 |
| 4 | 116.9 | 9 | 95.25 | 4 | 80.36 | 9 | 69.5 | 4 | 61.23 |

**ACKNOWLEDGMENT :** *Appendices giving S.M.A.E. Control Line Regulations, Schedule, and Draft Rules are reprinted from the S.M.A.E. Handbook, 1949, to which due acknowledgment is made.*

# APPENDIX II

## S.M.A.E. AEROBATIC CONTEST SCORING SCHEDULE

| *Manoeuvre* : | *Grade* | *Points* | *Max. Poss.* |
|---|---|---|---|
| (*a*) Starting (take-off within 1 min.) ... ... ... ... | | 5 | 5 |
| (*b*) Take-off ... ... ... ... ... ... ... | Good | 5 | |
| | Rough | 3 | 5 |
| | Poor | 1 | |
| (*c*) Level flight (Two laps at 6ft. alt.) ... ... ... | Level | 5 | |
| | Wavy | 3 | 5 |
| | Poor | 1 | |
| (*d*) Climb (to be through 15ft.) ... ... ... ... | Vertical | 10 | |
| | Steep | 7 | 10 |
| | Shallow | 3 | |
| (*e*) Dive (to be through 15ft.) ... ... ... ... | Vertical | 10 | |
| | Steep | 7 | 10 |
| | Shallow | 3 | |
| (*f*) Wingover (Bisecting circuit vertically over pilot) ... | Vertical | 15 | |
| | Steep | 10 | 15 |
| | Shallow | 5 | |
| (*g*) Consecutive Inside Loops (entire series to be completed within ¼ lap, line angle not to exceed 60°. Shaky loops 2 points each.) ... ... ... ... ... ... | 1 Loop | 3 | |
| | 2 ,, | 7 | |
| | 3 ,, | 12 | 25 |
| | 4 ,, | 18 | |
| | 5 ,, | 25 | |
| (*h*) Consecutive Outside Loops (as above. May be entered from normal or inverted position.) ... ... ... | 1 Loop | 25 | |
| | 2 Loops | 30 | |
| | 3 ,, | 35 | 45 |
| | 4 ,, | 40 | |
| | 5 ,, | 45 | |
| (*i*) Inverted Flight ... ... ... ... ... ... | 1 lap level | 10 | |
| | 1 lap wavy | 7 | |
| | 2 laps level | 15 | 25 |
| | 2 laps wavy | 10 | |
| | Smooth recovery | 10 | |
| | Rough ,, | 7 | |
| (*j*) Horizontal Figure Eight (within ½ lap, shaky manoeuvres lose 3 points each) ... ... ... ... ... | One | 25 | |
| | Two | 30 | 35 |
| | Three (Max.) | 35 | |
| (*k*) Vertical Figure Eight ... ... ... ... ... | Good | 30 | 30 |
| | Rough | 20 | |
| (*l*) Overhead Figure Eight (centre of "8" must be overhead of pilot.) ... ... ... ... ... ... | Good | 30 | 30 |
| | Rough | 20 | |
| (*m*) Square Loop (horizontal portions of loop to be ½ lap) ... | Good | 30 | 30 |
| | Rough | 20 | |
| (*n*) Special Manoeuvre (must be fully specified in flight pattern sheet) ... ... ... ... ... ... | Best man (Others graded accordingly) | 15 | 15 |
| (*o*) Landing (to be judged by approach if over bad ground) | Good | 10 | |
| | Rough | 7 | 10 |
| | Poor | 1 | |
| | Maximum possible | | 295 points |

# APPENDIX III

## TYPICAL CONTINENTAL AEROBATIC CONTEST RULES AND SCORING SCHEDULE

1. During each flight (of 3) the entrant may execute the manoeuvres set out in the rules, but he may not repeat the same figure more than three times during the meeting. The selected manoeuvres will qualify for points only if carried out during the first twenty laps of each flight.

2. The meeting will begin with the allocation of numbers. A corresponding number will be carried on the back of each concurrent, who will not be permitted to start without such designation. A draw will be made for order of flying.

3. Motors must be started by hand by the flyer of the model.

4. In the case of a tie, the entrant with the higher number of points for appearance will be judged the winner.

5. The organisers decline any responsibility for accidents to flyers and spectators if such are caused by other than their members.

6. The meeting will only be stopped for bad weather on a vote by the judges.

7. Before flying the entrant shall submit a list of figures he will execute in the order given in the schedule.

8. Schedule of points.

| | | | | *Total possible* |
|---|---|---|---|---|
| (A) | *Appearance* | | ... ... ... ... ... ... ... ... ... | 100 |
| (B) | *Dexterity* | (i) | Take off from a nominated spot (4 pts. penalty for each metre of error) ... ... ... ... ... ... ... ... | 20 |
| | | (ii) | Passing between two points 1.25m.—1.75m. from the ground | 10 |
| | | (iii) | Passing between ground and a point .75m. above ... ... | 20 |
| | | (iv) | Landing on a nominated spot (8 pts. penalty for each metre of error) ... ... ... ... ... ... ... ... | 40 |
| | (Any model touching ground with its wheels will be considered to have "landed.") | | | |
| (C) | *Originality.* | (i) | Trailing of ribbons or flags in flight ... ... ... ... | 20 |
| | | (ii) | Dropping of single or groups of objects ... ... ... | 20 |
| | | (iii) | Glider towing ... ... ... ... ... ... ... ... | 30 |
| | | (iv) | Emission of smoke trails for at least 1 lap ... ... ... | 40 |
| | | (v) | Pick-up of objects from the ground in flight ... ... | 50 |
| (D) | *Aerobatics.* | (i) | Dive ... ... ... ... ... ... ... ... ... | 5 |
| | | (ii) | Climb (min. 3 metres) ... ... ... ... ... | 10 |
| | | (iii) | Vertical climb ... ... ... ... ... ... ... ... | 20 |
| | | (iv) | Touch down for ½ lap (after at least 1 lap flying) ... | 20 |
| | | (v) | Dive, touchdown and vertical climb ... ... ... | 30 |
| | | (vi) | Wingover (vertical over pilot) ... ... ... ... | 30 |
| | | (vii) | Vertical S ... ... ... ... ... ... ... ... | 50 |
| | | (viii) | Single loop (inside or outside) ... ... ... ... | 50 |
| | | (ix) | Multiple loops (each) ... ... ... ... ... ... | 60 |
| | | (x) | Inverted flying (min. 1 lap) with recovery ... ... | 100 |
| | | (xi) | Horizontal 8 ... ... ... ... ... ... ... | 150 |
| | | (xii) | Vertical 8 ... ... ... ... ... ... ... | 200 |
| | | (xiii) | Humorous or crazy flying (20 laps) ... ... ... | 150 |
| (E) | *Team Flying.* | (i) | Two flyers. Simultaneous take-off on opposite sides of circle (20 laps with at least 2 passings) each flyer ... ... | 100 |
| | | (ii) | Three flyers. Simultaneous take-off from equally spaced stations on circle. (20 laps and 2 passings minimum) to each flyer ... ... ... ... ... ... ... | 150 |

# APPENDIX IV

## S.M.A.E. RULES GOVERNING CONTROL LINE FLYING

### General

1. No model shall be flown on any ground unless suitable arrangements are made for the protection and control of spectators.

2. Spectators shall remain at least 25 feet outside the flight path of the model/s.

3. In the event of flight conditions becoming unsafe, the flyer shall immediately cease flying until such time as the situation has been remedied.

4. Before each flight the pilot shall examine his equipment for kinks, wear, etc., and submit the controls to test by exerting a pull on the handle with an assistant holding the model.

5. Flying lines and handles shall conform to the following breaking strain specification :—

| | | |
|---|---|---|
| Classes I and II | ... | 15 lb. minimum |
| Class III | ... ... | 25 lb. ,, |
| Classes IV and V | ... | 40 lb. ,, |

6. No model shall be flown having a total weight of over 4 lb. or an engine capacity above 15 cc. (Capacity=.7854 × Bore² × Stroke).

7. The General Rules governing the flying of Power-Driven models shall apply.

### Speed

8. For contest and record purposes, speed control line models are graded according to engine capacity, and flown on standard line lengths as follows :—

| | | | | |
|---|---|---|---|---|
| Class I | ... | 0.00-1.5 c.c. | ... | 35 feet |
| Class II | ... | 1.51-2.5 c.c. | ... | 35 ,, |
| Class III | ... | 2.51-5.0 c.c. | ... | 52½ ,, |
| Class IV | ... | 5.01-8.5 c.c. | ... | 70 ,, |
| Class V | ... | 8.51-15 c.c. | ... | 70 ,, |
| Class VI | ... | Jet or Rocket | ... | 70 ,, |

(Line shall be measured from centre of handle to centre of model, this measurement to be taken as radius and used to calculate speed.)

9. In cases where longer lines than standard are used, speed shall be calculated from the standard line lengths for the particular class, and that figure only recorded.

10. No attempt on Speed Records shall be made without obtaining the sanction of the S.M.A.E., who shall decide if the conditions are suitable.

11. No speed model shall be flown without the use of an Anti-whip Yoke Pylon.

12. Models shall not exceed an altitude of 10 feet during a record attempt.

### Timing

13. (*a*) All contest or Record attempts shall be times over a minimum course of half a mile.

(*b*) Timing shall commence on receipt of a signal from the pilot.

(*c*) At least two (for record attempts three) stop watches calibrated in 1/10th seconds shall be employed.

(*d*) Any time variation over 1/5th second shall render the flight null and void.

14. At all speed events, all equipment shall be checked for strength and serviceability by an officer delegated for that purpose, and who shall have authority to refuse permission to fly in cases where the required standards of safety are not met.

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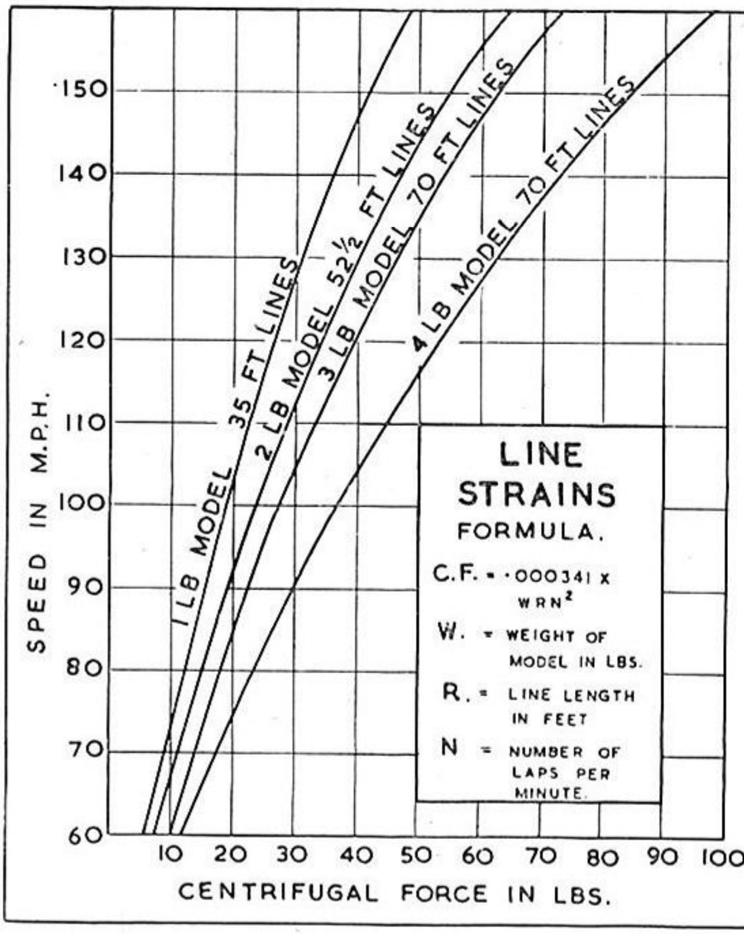
## APPENDIX V

### WIRE BREAKING STRAINS




**BREAKING STRENGTH**

| S.W.G. | DIA. IN INS. | BREAKING. |
|---|---|---|
| 31 | ·011 | 25 LBS |
| 29 | ·013 | 40 " |
| 27 | ·016 | 60 " |
| 26 | ·013 | 80 " |
| 25 | ·020 | 100 " |
| 24 | ·022 | 120 " |
| 23 | ·024 | 140 " |
| 22 | ·028 | 180 " |

GIVEN FOR ONE LINE ONLY
SAFETY FACTOR ALLOWED

# APPENDIX VI

## S.M.A.E. DRAFT RULES FOR FLYING SCALE CONTROL LINE MODELS

Aware of the increasing interest being shown in Flying Scale control line models, the S.M.A.E. Council present the following initial Rules and Schedule for this class of contest, and trust that many members will try them out during the 1949 season, and forward their opinions gained from experience.

All recommendations received will be carefully reviewed by a special Committee set up to consider the inclusion of this type of contest in the National programme for 1950.

---

1. The General Rules governing the flying of Power-Driven models shall apply.

2. Entrants shall supply full working drawings, together with full measurement specification of the model prototype.

3. Points will be awarded in each of seven sections as follows :

| | | |
|---|---|---|
| Absolute scale ... | 20 points | Total possible 280 pts. |
| Approximate scale ... | 10 ,, | |
| Excellent workmanship | 20 ,, | |
| Good ,, | 15 ,, | |
| Fair ,, | 10 ,, | |

4. The seven sections in which the above points will be awarded are :—

   (*a*) General appearance
   (*b*) Fuselage
   (*c*) Wing
   (*d*) Empennage
   (*e*) Landing gear
   (*f*) Motor mount and cowl
   (*g*) Colour and markings.

5. Once judged for scale and workmanship the model must not be altered in any way before flight.

6. All models **must fly** for inclusion in the contest.

7. Models may be flown in either or both Speed or Aerobatic classifications.

8. Points awarded for Aerobatic flying will be made using the standard Aerobatic Schedule, half the points so gained being added to the Scale/Workmanship total, maximum gross total thus being $427\frac{1}{2}$ points.

9. Points awarded for Speed flying will comprise one point for each mile per hour recorded, this figure being added to the Scale/Workmanship total.

# APPENDIX VII

## F.A.I. RULES FOR CONTROL LINE SPEED RECORDS, 1949

**Speed records in a circular course**

1. Two types of speed records in a circular course are recognised :—

Records for machines driven by mechanical motors.
Records for machines driven by reaction motors.

2. In the case of machines driven by mechanical motors—and solely for records in a circular course—three classes are instituted according to cylinder capacity.

(i) from 0.01 c.c. to 2.50 c.c.

(ii) from 2.51 c.c. to 5.00 c.c.

(iii) from 5.01 c.c. to 10.00 c.c.

3. In the case of machines driven by reaction motors the following rules apply :—

Maximum weight of the bare reaction motor : 500 grammes.

Minimum weight of the aircraft in flying order, complete with fuel, four times the weight of the bare reaction motor.

4. Either hand control or tethering to a pylon will be permitted in speed records in a circular course.

5. In the case of machines controlled by hand, the wrist of the competing modeller, must during the duration of the flight submitted as a record, rest on a central support terminating in a fork and pivoted on a rigid mast.

6. The speed will be timed over a minimum distance of 1 kilometre.

7. Before timing commences the modeller will be permitted a sufficient number of laps to allow the machine to attain its full speed.

8. The radius of the flight circle is left to the choice of the modellist with the following minimum radii :—

Class I—(Cylinder capacity 0.01 to 2.5 c.c.) 11 metres—37 cms. 14 circuits to the kilometre.

Class II—(Cylinder capacity 2.51 c.c. to 5.00 c.c.) 13 metres—27 cms. 12 circuits per kilometre.

Class III—Cylinder capacity 5.01 c.c. to 10.00 c.c.) 15 metres—92 cms. 10 circuits per kilometre.

It is suggested in order to facilitate timing to adopt the above radii or the larger radius of 19 metres 99 cms., giving 8 circuits to the kilometre or 26 metres 53 cms. giving 6 circuits to the kilometre.

9. The length of the line shall be measured from the axis of the supporting mast or tethering pylon to the axis of the propeller or reaction motor.

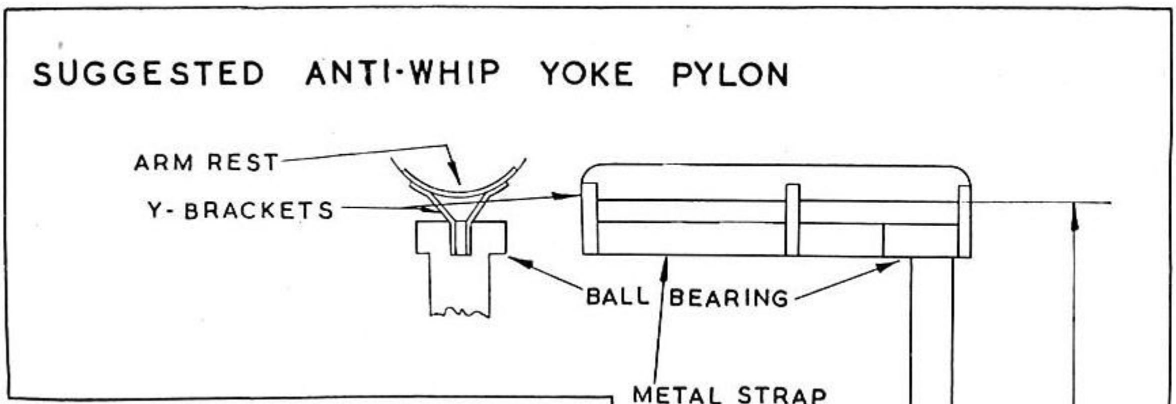
10. In the case when two propellers or two reaction motors with their axes parallel are employed, the axis of symmetry will be taken as the datum line.

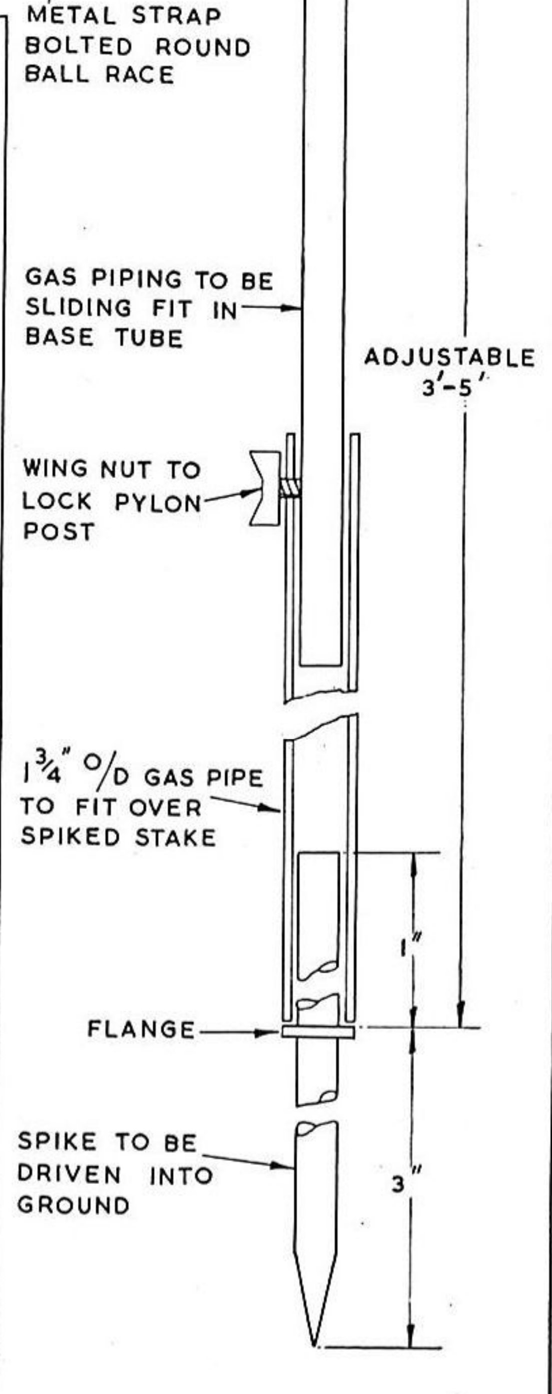
11. During the duration of the flight submitted as a record, the machine must always remain above the horizontal plane passing through the central point of attachment.

12. A speed record in a circular course cannot be beaten except by a flight exceeding the existing record by 10 kilometres per hour.

# APPENDIX VIII

## ANTI-WHIP YOKE PYLON




In their 1949 Handbook the S.M.A.E. refers to the use of an Anti-Whip Yoke Pylon for speed flying without definition. This is a deliberate ambiguity in order to give clubs an opportunity of testing various forms of pylon. We have endeavoured to give a lead in the right direction with the suggested pylon illustrated, which is based on one that has proved successful over several years for racing model cars.

As most flying will be on ground not permanently or exclusively available for model flying, the base part is intended to be driven into the ground with a sledge hammer, and the pylon proper dropped over the part remaining above ground. When flying from concrete or other hard surface, it should be possible to obtain permission to fix a permanent socket to take the pylon, using gas piping of sufficient diameter to be a rigid fit. A hinged lid is recommended when not in use to prevent dirt and leaves blowing in and filling the hole.

It will be noticed that height can be adjusted by means of a wing nut. This is no luxury, but almost essential when flyers may vary in height from four to six feet or more, and it is virtually impossible to fix on a satisfactory " average aeromodeller."

The flyer will normally take off without putting an arm on the rest, then, when he is ready, and the model under perfect control, he will place his arm in position, and, grasping the pylon upright in his other hand, gyrate round it as fast as may be necessary.

Ingenious timekeepers may wish to instal some form of electric switch to the pylon which will cause a bell to ring or a light to flash if the flyer removes his arm from the rest. With a spring loaded arm this should not be difficult.

# APPENDIX IX

## TYPICAL COMMERCIAL KITS

Following have been submitted to *Aeromodeller* staff for test and inspection and their published gradings (which apply to kit and materials only and not flying characteristics) are given below.

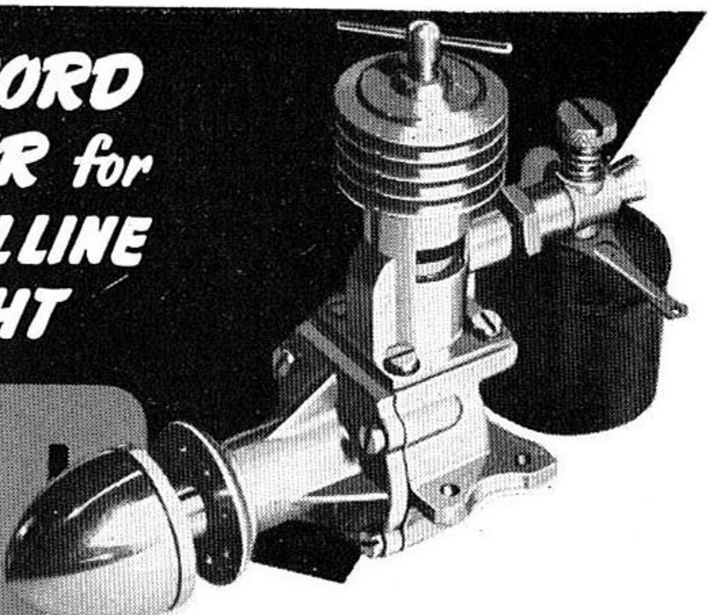
| *Aero-modeller* Rating | Name | Span in ins. | Type | Maker | Price |
|---|---|---|---|---|---|
| ***** | Cessna Airmaster | 25 | Scale ... | Modelair Control Liners ... | 17/6 |
| ***** | Magnette ... | 24 | Inter Stunt Trainer | H. J. Nicholls, Ltd. ... | 25/- |
| ***** | Nancy ... ... | 18 | Stunt Trainer | J's Model Centre ... ... | 14/6 |
| ***** | Radius ... ... | 22 | Sports ... | International Model Aircraft | 17/6 |
| ***** | Rival ... ... | 22 | Stunt Trainer | Don Models ... ... | — |
| **** | Monarch ... | 26¼ | Sport Speed | Worcraft Products ... | 17/6 |
| **** | Nieuport 17C ... | 20½ | Spt. Scale Bipe | Modelair Control Liners ... | 19/6 |
| **** | Phantom ... | 21 | Sport Trainer | Keil ... ... ... | 18/6 |
| **** | Sabre ... ... | 18 | Adv. Trainer | Halfax ... ... ... | 16/6 |
| **** | Speedee... ... | 24 | Sports ... | Model Aircraft (B'mouth) | 17/6 |
| **** | Stunter... ... | 24 | Spts. Biplane | Ditto ditto | 19/6 |
| *** | Copperhead ... | 32 | Sports ... | Astral ... ... ... | 23/6 |
| *** | Goblin ... ... | 24 | Sport/Speed | Shaws M.A. Supplies ... | 15/- |
| *** | Martinet ... | 36 | CL/FF Goat | Model Aircraft (B'mouth) | 21/- |
| *** | Mew Gull ... | 24 | Semiscale ... | Modelair Control Liners ... | 19/6 |
| *** | Nipper ... ... | 17 | Trainer ... | Model Aircraft (B'mouth) | 9/6 |
| ** | Trainer ... | 32 | Sport Trainer | Halfax ... ... ... | 20/- |
| * | Hall Racer ... | 30 | Scale Gull Wing | Astral ... ... ... | 84/- |
| * | Orbit ... ... | 17 | Speed ... | Law and Sons ... ... | 18/6 |

Following have either not been submitted for test or are at present awaiting test by *Aeromodeller* staff and no comment is therefore made. (*Listed Alphabetically*.)

| Name | Span in ins. | Type | Maker | Price |
|---|---|---|---|---|
| Anita ... ... | 30 | Flying Wing ... | J's Model Centre ... ... | 19/6 |
| Flapjack ... ... | 11 | All Wing/Saucer | Astral ... ... ... ... ... | — |
| Flying Wing ... | 30 | Sports ... ... | Skyleada ... ... ... | 25/- |
| Goshawk ... ... | 45 | Sports ... ... | Model Aircraft (Bournemouth) | 79/6 |
| Hornet ... ... | 28 | Adv. Trainer Speed | Kiel ... ... ... ... | 45/- |
| Kan-Doo ... ... | 29 | Stunt Winner ... | Kandoo Products ... ... | 25/- |
| Mamba ... ... | 28 | Stunt ... ... | Powakits... ... ... ... | 15/6 |
| Phantom Mite ... | 16 | Trainer ... ... | Keil ... ... ... ... | 11/6 |
| Playboy ... ... | 30 | Inter. Stunt ... | Precision ... ... ... | 17/6 |
| Pusher Pup ... | 18 | Twin Boom Sports | Don Models ... ... ... | 19/6 |
| Ringmaster III ... | 23½ | Stunt Biplane ... | Normans ... ... ... | 25/- |
| Scout Biplane ... | 20 | Trainer Biplane | Keil ... ... ... ... | 22/6 |
| Sea Fury X ... | 25½ | Scale Stunt ... | Model Aircraft (Bournemouth) | 22/6 |
| Shufti ... ... | 28 | "Flatfish" Stunt | Astral ... ... ... ... | 10/6 |
| Silver Ray... ... | 27 | Inter. Stunt ... | Model and Air Sports ... ... | 22/6 |
| Stuntmaster ... | 30 | " Flatfish " Stunt | Keil ... ... ... ... | 19/6 |
| Supalupa ... ... | 28½ | Stunt Sidewinder | Aeromodels ... ... ... | 25/- |
| Thunderbird ... | 29 | Semiscale Stunt | Skyleada ... ... ... | 22/6 |
| Tiger Moth ... | 30 | Scale ... ... | Royles ... ... ... ... | 21/- |
| Vandiver ... ... | 26 | Stunt ... ... | International Model Aircraft ... | 13/6 |

**Note.**—These lists do not claim to cover more than some of the more popular kits. These are being added to month by month.

# The RECORD HOLDER for CONTROLLINE FLIGHT

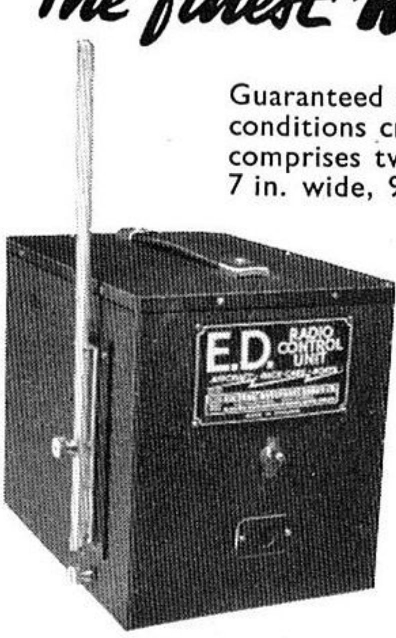


# E.D. 2 C.C. COMPETITION SPECIAL

The wonderful little engine which beat craft fitted with engines five times its cubic capacity ! Holder of British Speed Record for power units up to 5 c.c. for control line (89.95 m.p.h. !). Winner of 1948 British Nationals Gold Cup. See the amazing E.D. Competition Special at your Model Shop. **Price £3/17/6**

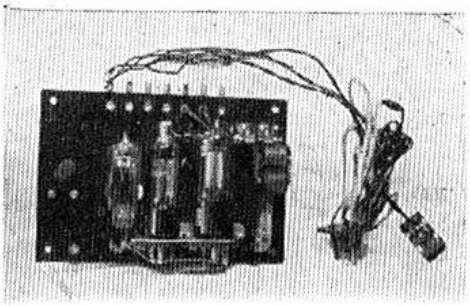
## The finest RADIO CONTROL UNIT

Guaranteed range of control 1,000 yards, but under test and severe conditions craft has been controlled at much longer ranges. Unit comprises two-valve battery operated Transmitter, size 8 in. high, 7 in. wide, 9¾ in. deep, a three-valve circuit Receiver with single tuning control, and a clockwork Servo. Ask your Model Shop for details.




*The Transmitter*

**Complete Unit, Less Batteries £14.10.0**



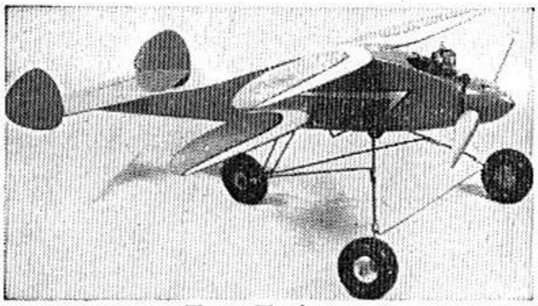
*A view of the Receiver*

**E.D. ELECTRONIC DEVELOPMENTS (SURREY) LTD.**

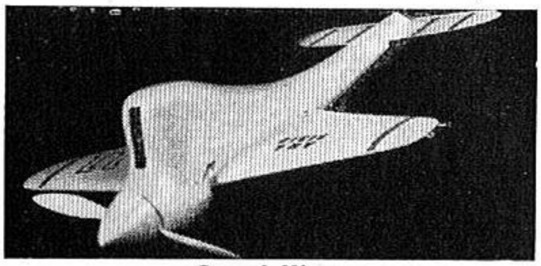
DEVELOPMENT ENGINEERS

KINGSTON-ON-THAMES 1223 18, VILLIERS ROAD, KINGSTON-ON-THAMES, SURREY, ENGLAND.

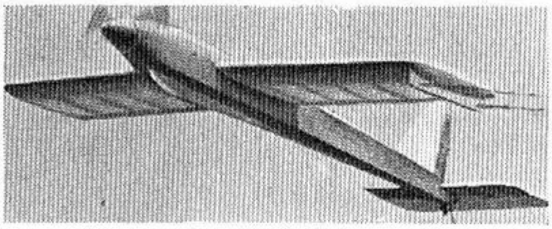
# CONTROL LINE PLANS



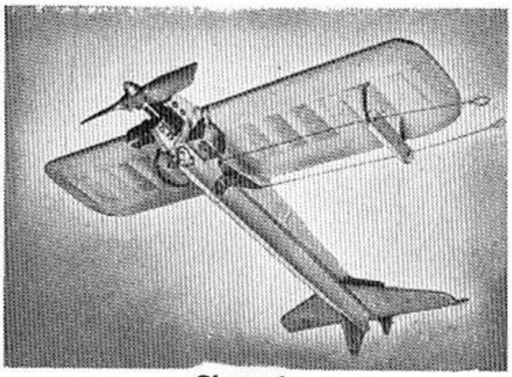
Tyro Trainer



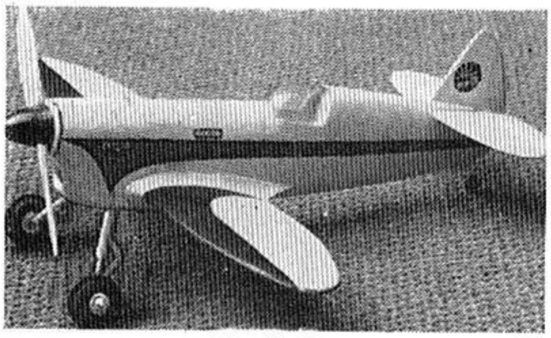
Speed King



Crackerjack



Cheetah



Candy II

*Send 2½ stamp for our full Flying Plans list containing over 200 proven designs for Power, Rubber, Glider, Scale and Indoor models.*

CL/269. **CANDY II.** By F. B. Thomas. A simple sports trainer model suitable for the beginner who requires looks as well as performance. Low elliptic wing, turtle back slabsider. For engines up to 2.5 c.c. diesel, 5 c.c. petrol. 38 in. span. **5/-**

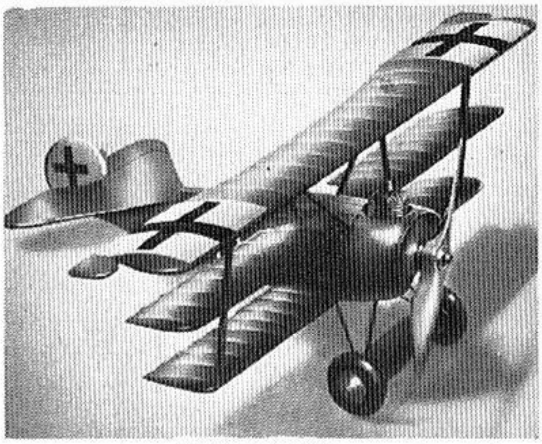
CL/284. **SPEED KING.** By Walter Musciano. Streamlined speed design by U.S. ace, in latest "no-fin" style. Dolly take-off, high performance 100 m.p.h. plus machine. For 6/10 c.c. engines. 19 in. span. **3/-**

CL/295. **TYRO TRAINER.** By Walter Musciano. Unstrutted Biplane speed trainer. Sheet fuselage, solid wings, twin fin tail. Take-off dolly or fixed undercarriage. For 3.5-5 c.c. diesels. Speed up to 80 m.p.h. 22½ in. span. **2/-**

CL/303. **CRACKERJACK.** By *Aeromodeller* design staff. Midwing sidewinder in the U.S. style, with drop-off undercarriage. Simple to build stunt machine that will go through "the book." For 2/3½ c.c. diesel or glowplug. 32 in. span. **3/-**

CL/307. **FOKKER TRIPE.** By Walter Musciano. Scale "old timer" triplane with a performance as good as its looks. Simple foolproof line-up strutting for wings. For 2/3½ c.c. diesel or glowplug engine. 23½ in. span. **3/-**

CL/313. **CHEETAH.** By E. Wiggall. "Flatfish" sidewinder stunt machine up to all the tricks. Anti-blanketing tail, stout construction, "unbreakable" folding prop. For 1/1.5 c.c. diesels. 23 in. span. **2/-**



Fokker Tripe

*"By return" post free postal service, or may be obtained from your local model shop.*