AEROMODELLER ANNUAL 1959-60

A review of the year's aero-modelling throughout the world in theory and practice; together with useful data, contest results and authoritative articles, produced by staff and contributors of the *AEROMODELLER*

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acknowledges with thanks the undernoted sources, representing the cream of the world's aeromodelling literature.

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CONTENTS

Pat Wheeler of Capetown—who writes on Printed Circuits—finds his De Bolt Champion buzzing him a little too close for comfort during a radio control session in the shadow of Lion's Head near Table Mountain. So typical of modern really controlled radio control flying we found this picture impossible to resist.

INTRODUCTION

WONDERFUL 1959 !

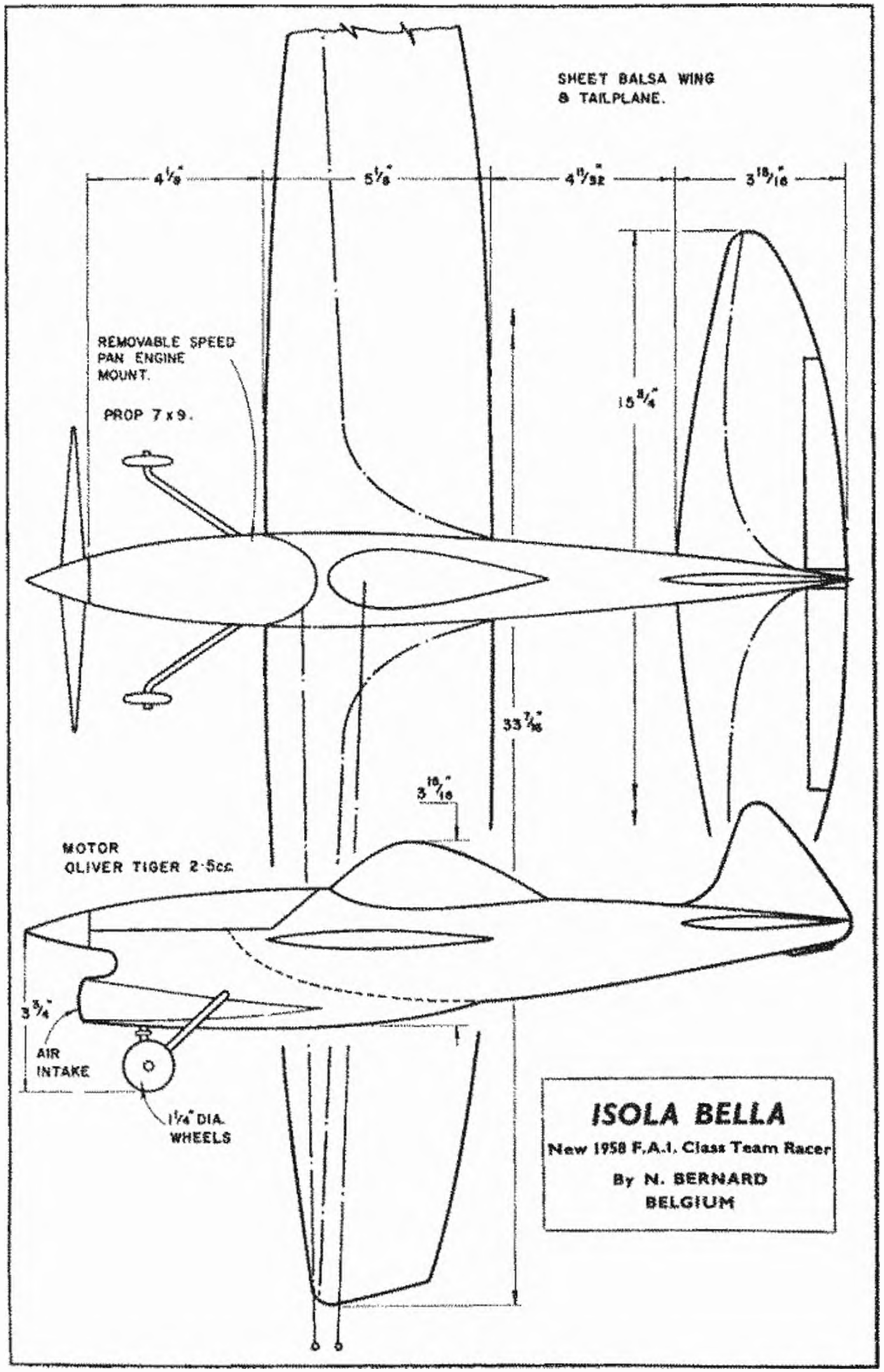
NO aeromodeller under eighty—and there can only be a handful of them over—can honestly claim to remember a summer like 1959, when glorious flying weather has been there for the taking for months on end. Apart from the continuing shortage of good flying grounds, gala and open day organisers have all had a wonderful time, and club coffers in general should be refreshingly heavier in consequence. International meetings too have enjoyed their share of the weather, with mass fly-offs to complete proceedings. Whether this will lead to amendment of rules governing such fly-offs remains to be seen. There is certainly room for some streamlining of arrangements to prevent any human skill—like timekeepers' eyesight—playing an exaggerated part in the final result; it is fair neither to the hardworking officials nor to entrants who may have come hundreds of miles to compete.

Perhaps the fine weather has something to do with the immensely improved quality of our native radio control flying. Some of our leading lights are now putting on shows week after week that would be praised even in top American circles. A growing trade interest has also helped with the supply of better equipment, which is able to command prices high enough to justify manufacture in comparatively small runs, and the tedium of import arrangements. We expect ever lighter equipment next year, wider use of transistors, and smaller, lighter more powerful power packs.

Another phase that we are watching with interest is the attempted comeback of the glowplug engine. This is not really a true "comeback" since glowplugs never established themselves here as they have done in America. British manufacturers, however, are now wise to the advantages of this type of motor, which can be manufactured at a price below a diesel engine of comparable power output. Plug manufacturers have devoted time and trouble to produce a reliable glowplug. It now remains to be seen if ordinary John Modeller can be weaned from his firmly established diesel Side by side with this has been the introduction of built-in engine starting devices which are likely to bring an influx of new enthusiasts (in the same way that the motor scooter has swept the transport field), by offering foolproof, painless power modelling to the masses. This wider appeal is also tied up with the new plastic shell almost-ready-to-fly models on offer, and completely ready-to-fly types in a higher price bracket that have been snapped up as fast as they have been imported.

Altogether it has been a fine year. Aeromodellers are happier than they have been for a long time with the weather, what the trade has given them, and what they hope to get in the months to come if all the backroom secrets prove founded on fact.

This, our 12th *Annual*, departs a little from its previous style, in that more drawings than ever before have been included. We hope the mixture pleases—it is based on what most of you have asked for—and would thank our very wide circle of contributors, known and unknown, for their assistance, and the aeromodelling press of the world from which we have garnered so much.

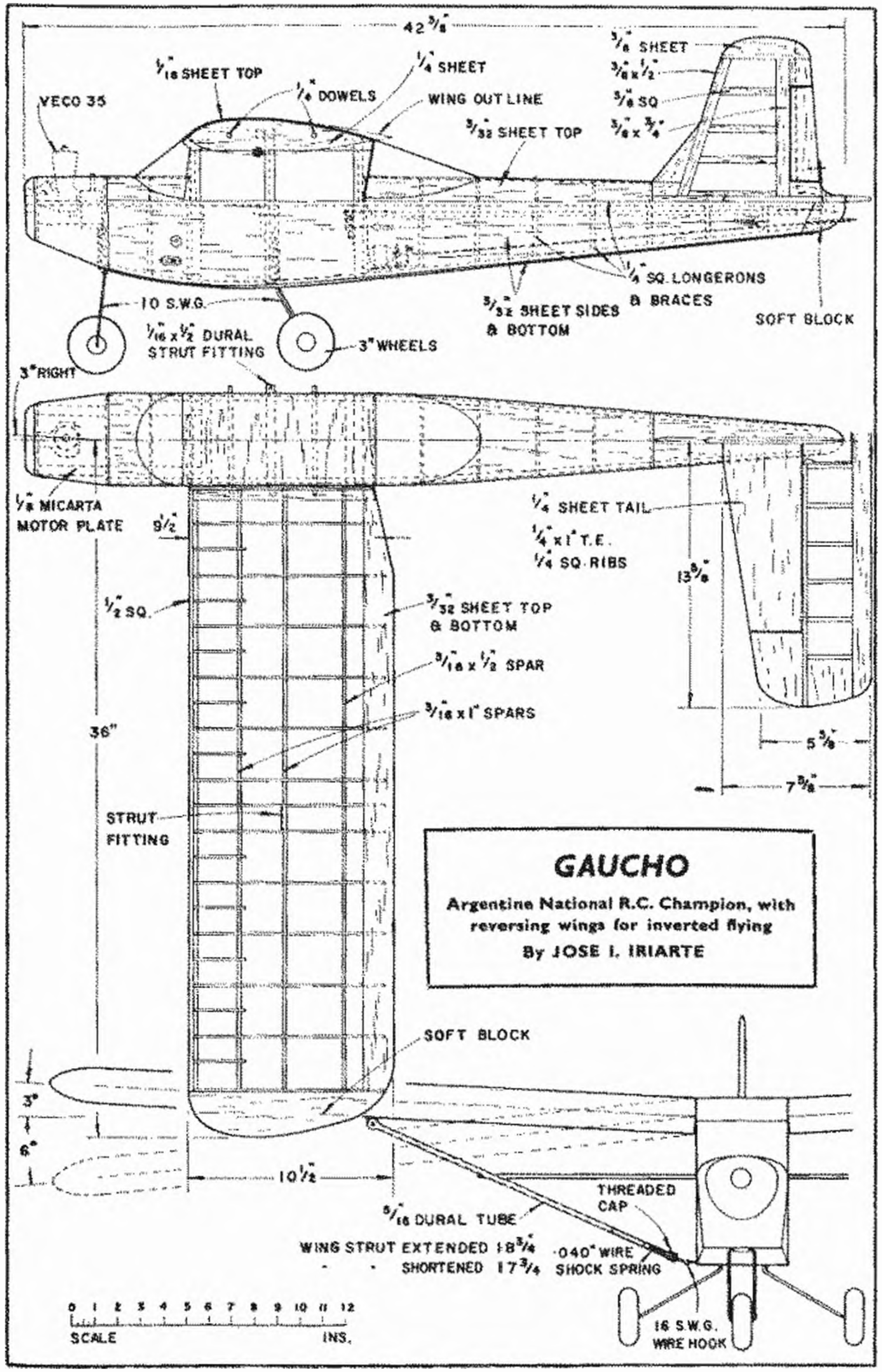


ISOLA BELLA

New 1958 F.A.I. Class Team Racer

By N. BERNARD
BELGIUM

MODEL-AVIA

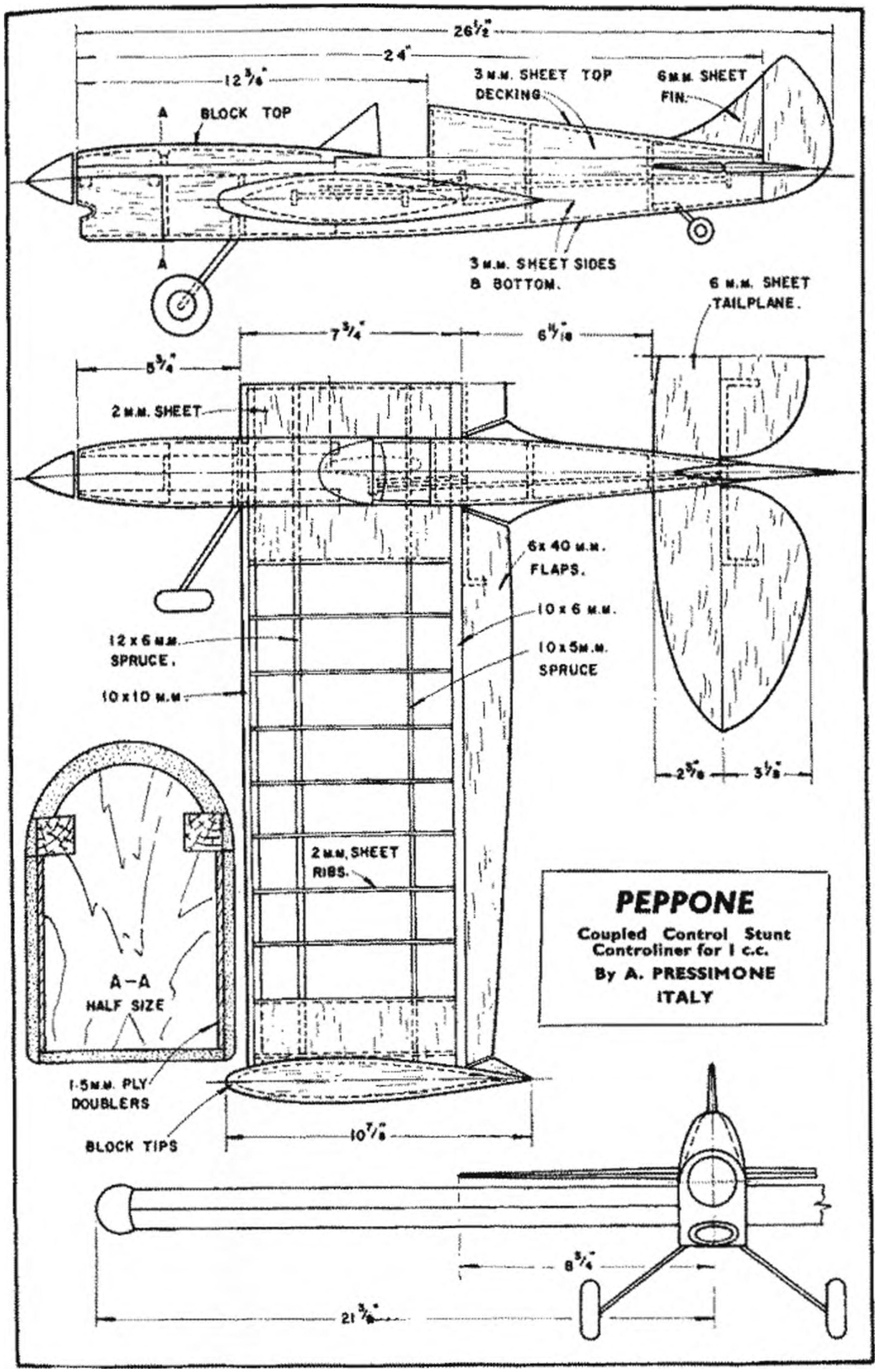


GAUCHO

Argentine National R.C. Champion, with reversing wings for inverted flying

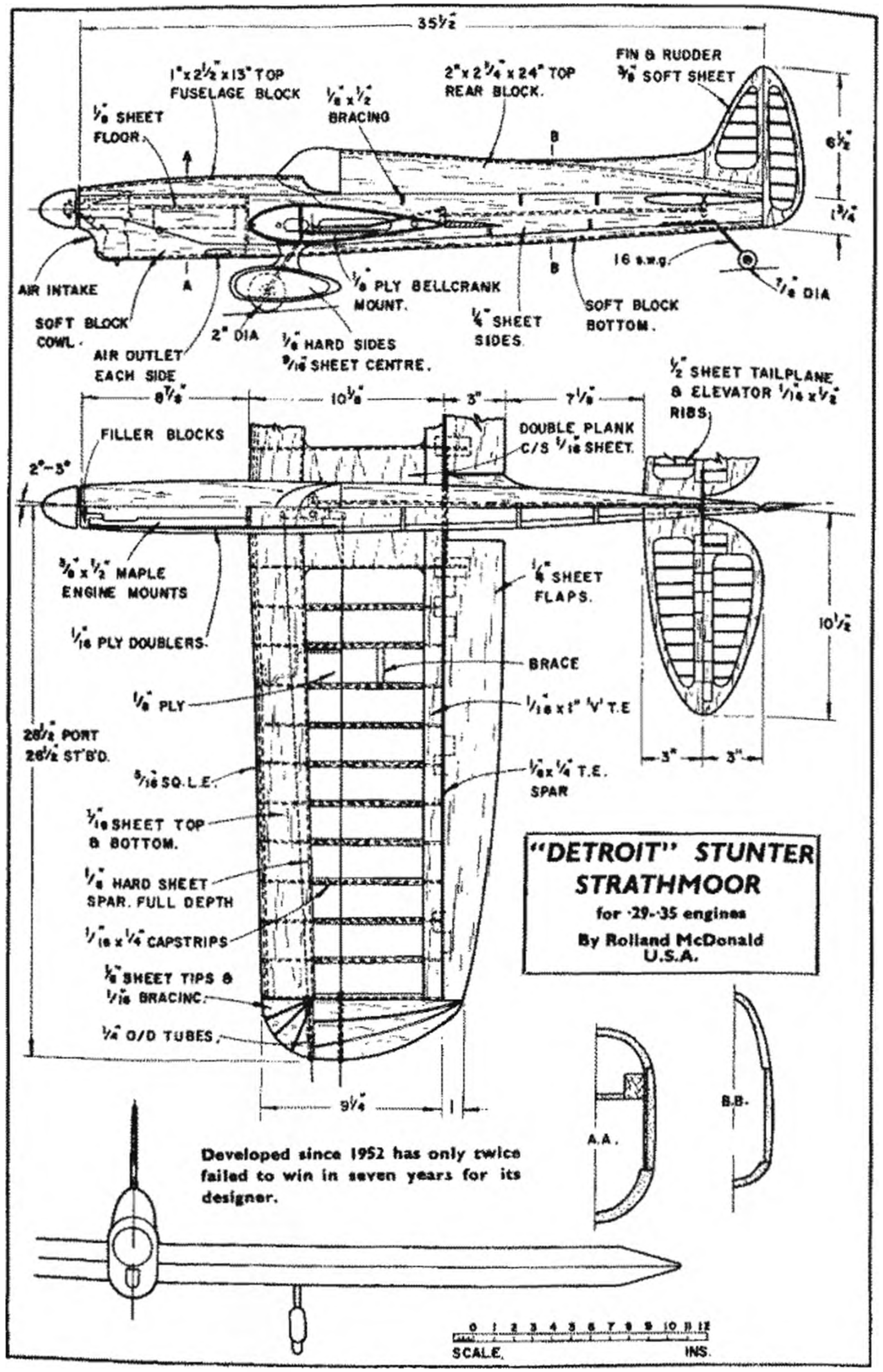
By JOSE I. IRIARTE

MODEL AIRPLANE NEWS



PEPPONE
Coupled Control Stunt Controliner for 1 c.c.
By A. PRESSIMONE
ITALY

MODELLISMO



"DETROIT" STUNTER STRATHMOOR
for ·29–·35 engines
By Rolland McDonald
U.S.A.

Developed since 1952 has only twice failed to win in seven years for its designer.

MODEL AIRPLANE NEWS

INDOOR AND SMALL SPACE RADIO CONTROL FLYING

By KEN WILLARD

With growing scarcity of flying fields, particularly in built-up areas, the idea of an indoor radio-controlled model has a lot of appeal. There are plenty of drill halls, gymnasiums, village halls and the like which would be excellent places to fly such models, that is, if you could make an R/C job which could fly safely within the space available.

Until recently, the idea was pretty far-fetched ; then along came the transistor with its lightweight and low drain features, and, suddenly, the lightweight radio was an actuality. Sure there are still some problems to be worked out, but the sets now becoming available are reliable enough and light enough to do some experimenting.

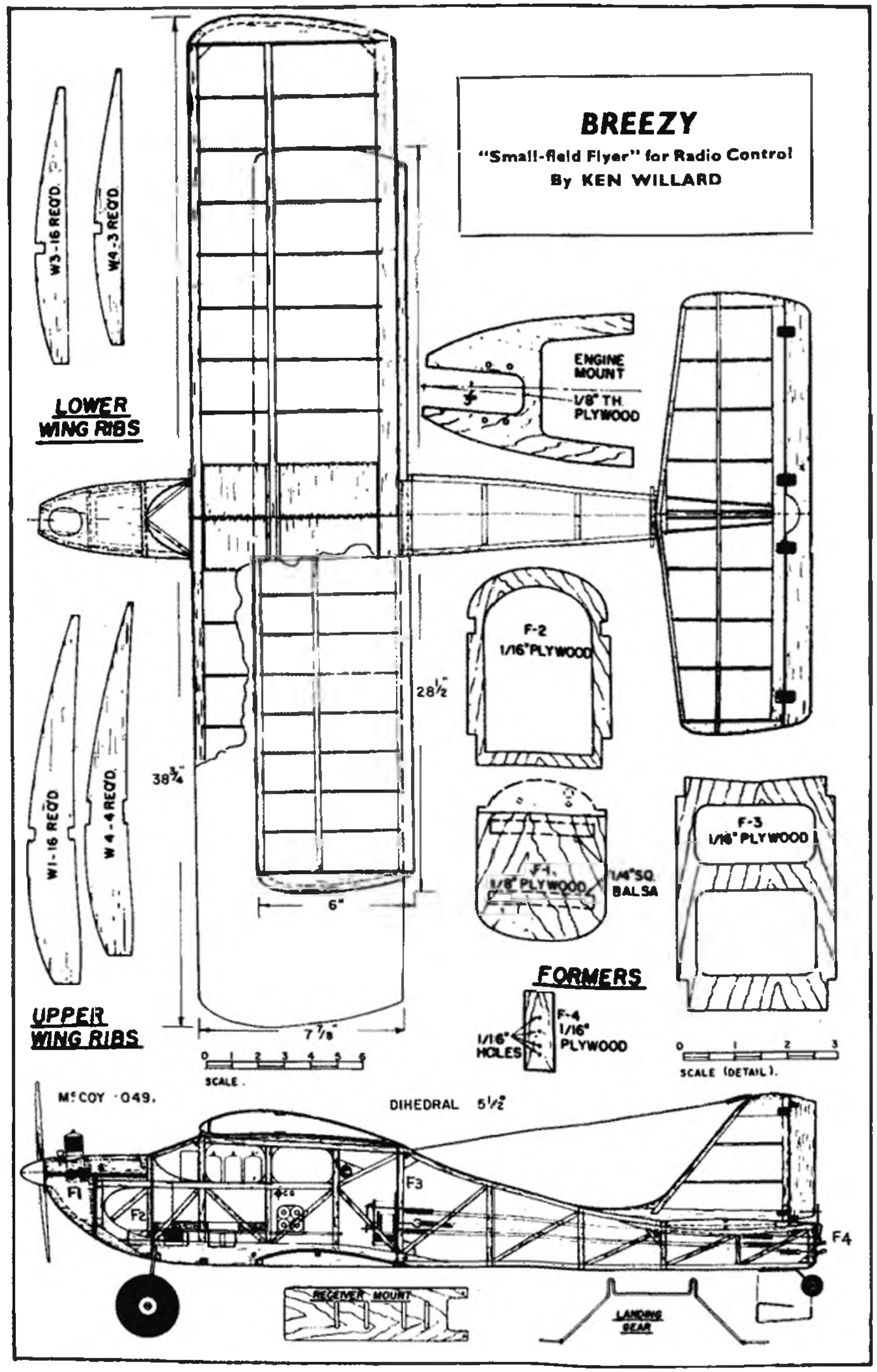
Actually, the indoor R/C job is nothing but a refinement of the small-field R/C model. I have been designing them for quite some time, starting with the little *Breezy* biplane which appeared in *Model Airplane News* a few years back (not to be confused with the commercially produced *Breezy* monoplane which came out a little later). The biplane has the basic characteristics of high manoeuvrability combined with the chance to get a low wing loading and a fairly small model. Therefore, it was logical that my first attempt at an outdoor job would be a biplane.

Since the small-field *Breezy* was designed, several new lightweight radios have appeared. So far, the lightest of the lot is C.G.'s all-transistorised receiver which even uses a power transistor in lieu of a relay. Also, it operates on three volts, and the small wafer cells which C.G. puts out are ample power. The limiting factor on this receiver is that it is designed with the Bonner SN escapement in the circuit, and if you use another escapement, your chances of success are marginal, because the magnetic efficiency and operating characteristics of the Bonner are different. However, this limitation is not serious, since the Bonner SN is very reliable ; the trouble that I have with it is not the escapement—it's my own inability to remember what's coming up. I finally had to give up and go to the Bonner compound—which uses the same coil, but is bigger and heavier. I saved some weight by cutting it down to a minimum size, and it has proven very successful in the indoor biplane. Another thing you have to do is to take receiver out of the case and use only the chassis. Lightweight is paramount, and you can't afford to carry a case around.

(EDITOR'S NOTE : British readers can use the Kraft receiver described on page 25 and following pages on Printed Circuits with the Rising Superlightweight Escapement.)

As for the engine, I tried several ideas. First was a rubber band motor. I gave it up because the motor run is too short. Next I tried an old Campus "B" CO_2 motor, but it didn't have enough poop. I finally settled on Cox's Pee-Wee ·020. It is far too powerful, but you can convert the power into just the right amount of thrust by making a small metal prop. to fit behind the regular prop., but bend it into reverse thrust—just enough to cut the total forward thrust into just what you want. But watch out for your fingers !

Now we've settled on a radio and an engine. What about the airplane ?



MODEL AIRPLANE NEWS

It should not only be light and manoeuvrable, it should also fly very slowly, both for ease of control in a limited space, and to keep damage down when you goof on the controls, which you will.

Two factors in wing design help to keep flying speed at a minimum; one is high aspect ratio, the other is high camber. The former has the drawback of reducing manoeuvrability so a compromise is necessary. But high undercamber has no drawback except perhaps a bad stall characteristic—and we can live with that. Generous dihedral is required so you can rock the model around in tight turns.

To fly at the minimum speed, a high angle of attack is required. This is achieved by using lots of downthrust on the motor together with pretty high angular difference between the wing and the tail. With this arrangement, the engine drags the plane through the air at a speed just above the stall speed associated with the high angle of attack. In fact, when the engine cuts, the plane picks up a little speed! This is because the glide is achieved at a slightly lower angle of attack.

From all the foregoing considerations, a variation of the *Breezy* biplane was designed. To keep weight down, a long narrow fuselage seemed logical, with the top wing up on cabane struts. The aspect ratio of the wings was increased, and the result was a long, thin biplane. This model flew fine—but it was too fast!

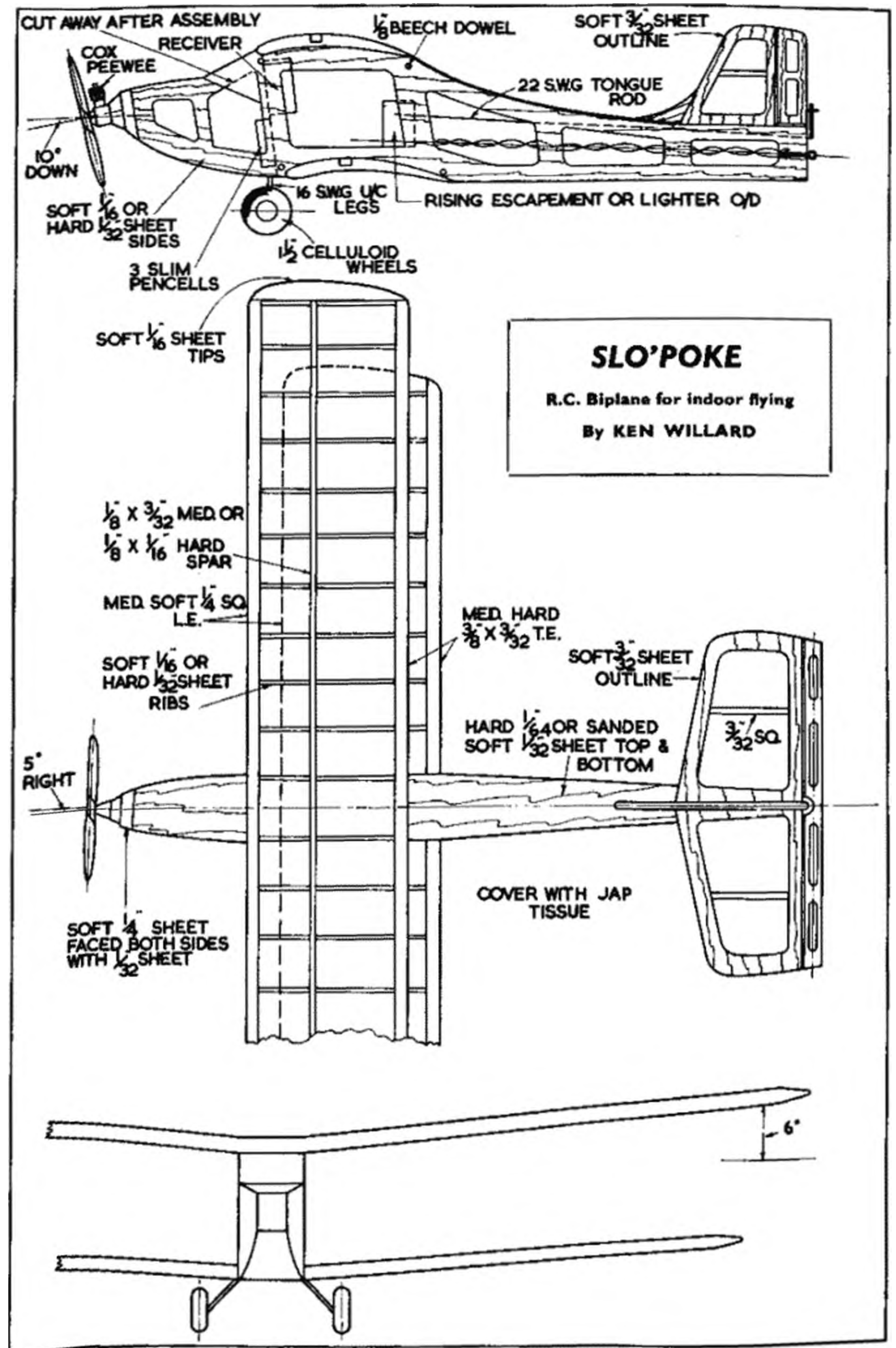
The next design went back to the cabin type fuselage, because of the higher frontal area and bigger drag. I used the same wings and tail, and found a definite improvement. This design, with a 33 in. wing span, weighed in at six ounces, and is still flying. However, it requires an area about 100 feet by 125 feet for safe manoeuvring, and this is still a little large.

While flying the little bipe, which Bob Bowen, editor of the Lark newsletter, christened the *Slo'poke*, I had another idea for a design which held promise. In the first place *Slo'poke* had the prop. out in front, which is a bit of a hazard to people who might be watching. It also had a landing gear, which added weight. How about a new concept—from an old one, of course—with the prop. in back and a skid to land on? I had also discovered that the Bipe is much stronger than is necessary when you get down to these lightweights—it even flew right into the trunk of my car one day, banging the structure in several places without damage.

Another point; with a pusher, the engine would be in back and forcing the exhaust back as well—so let's go to a profile job and let everything hang out in the breeze. Finally, let's go really indoor in the design concept, with a single-surface wing.

When the model was finished, I covered the wing with Jap tissue, and then made my mistake. I didn't plasticise the dope enough and when the covering dried after the first coat, the airplane was named *Warpy*. I should have used the same size wood for the leading and trailing edges, but I didn't and the trailing edge really warped up. This gave me a lot of washout—more than I wanted, but I figured it would be all right to experiment with, so I finished up the model, fuel proofed it, and took it out early one morning to test in calm air.

This model proved to be a truly named indoor job. It weighs $3\frac{3}{4}$ ounces, has a 33 in. span, 7 in. chord, and flies slowly enough so that you can run alongside of it. Don't try it, though, unless you've checked your transmitter-receiver



MODEL AIRPLANE NEWS

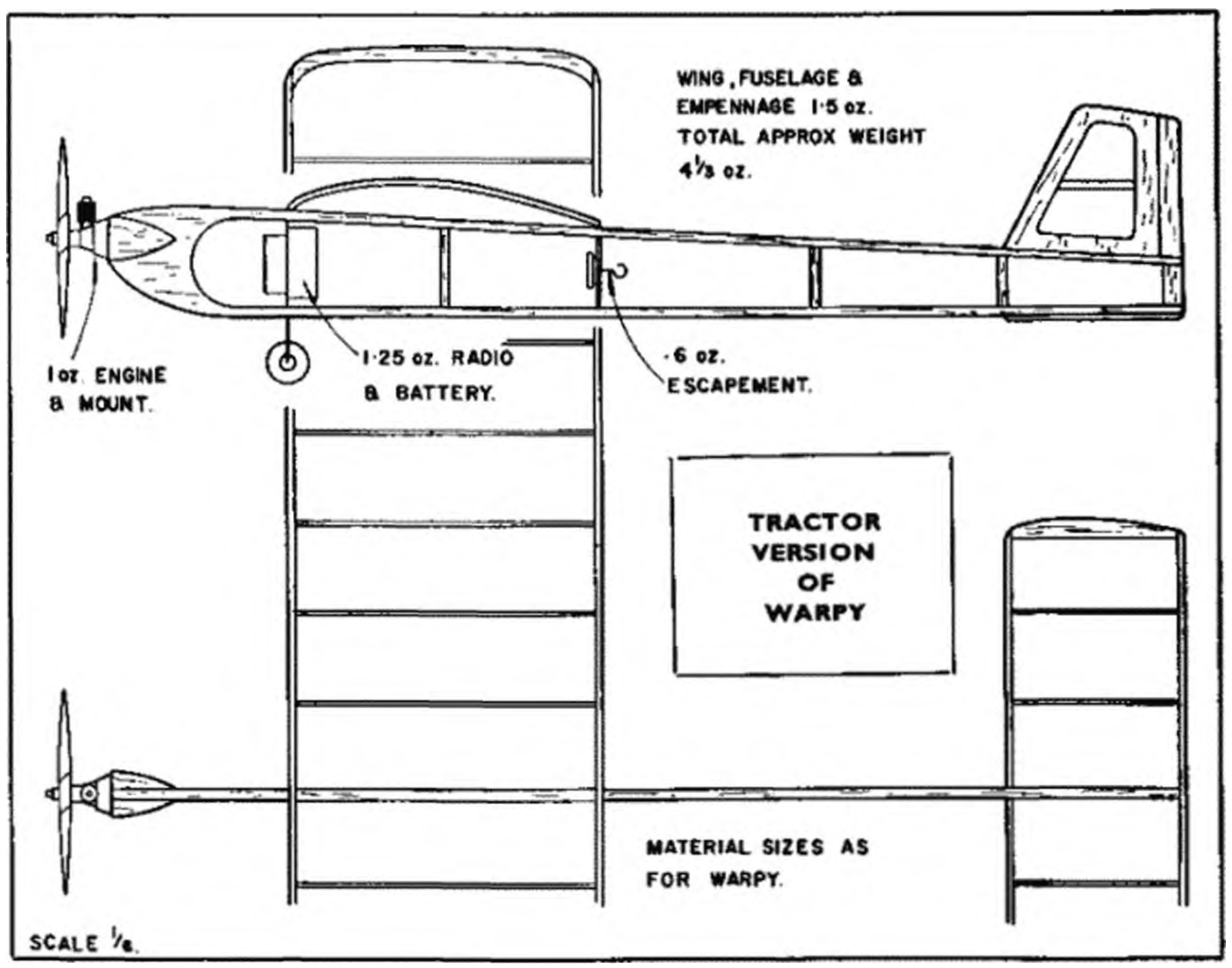
combination to be sure the receiver isn't swamped when the transmitter is too close. The model is adjusted to fly in a 30 ft. circle to the left. By pressing the button on the transmitter once, right rudder pulls the airplane slowly into straight flight and then into a gradual right turn.

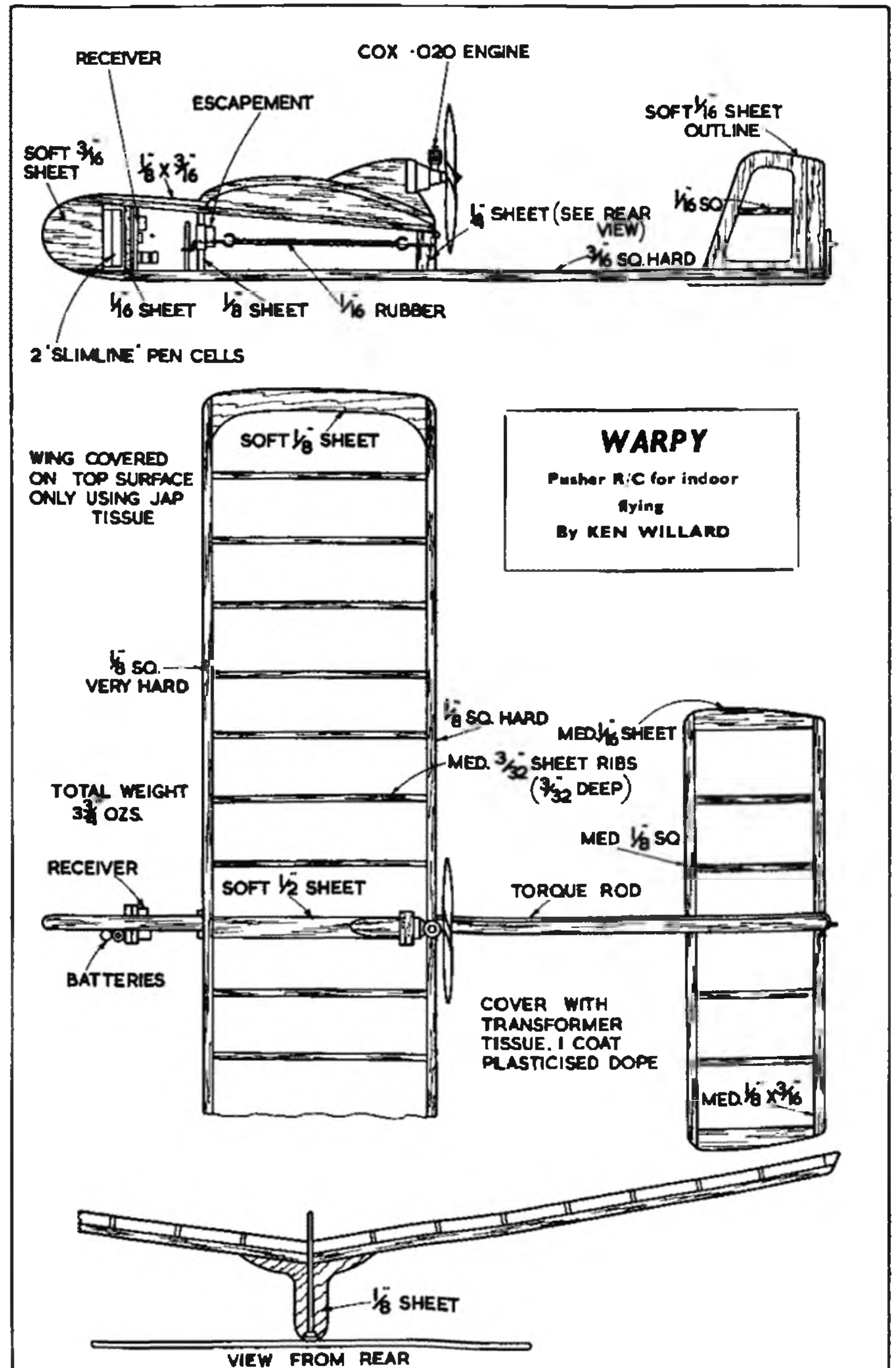
Warpy is what I would call a sort of "laboratory" model. It does the job, but it isn't much to look at. But it does point the way, and for you experimentally-minded modellers, it isn't too hard to make a few refinements to the design and come up with a really attractive indoor R/C job which you can fly in the local high school gymnasium (get the principal's permission first !). For example, make the boom hollow, and run the torque rod through it—maybe close in the cabin area with a light shell of balsa.

I have given some thought to another design. It's a variation of *Warpy* with tractor engine (easier to adjust for flight). Again, it's a rather ungainly and fragile design but I think it has possibilities. The open framework, single surface wing and lightweight radio are virtually mandatory for very small areas, since slow flight is a must, and that means ultra light wing loading. A couple of transverse balsa or thin plastic baffles (or "windscreen") in front of the radio and escapement will deflect the engine exhaust as well as create drag which is desirable.

You may have trouble equalling the weights which I have indicated. However, a *seven* ounce version of *Warpy*, which a friend of mine made, does a pretty fair job, although faster by about one-third. So there is some leeway.

You probably already have an idea or two of your own, so go to it, and let us hear how you make out.

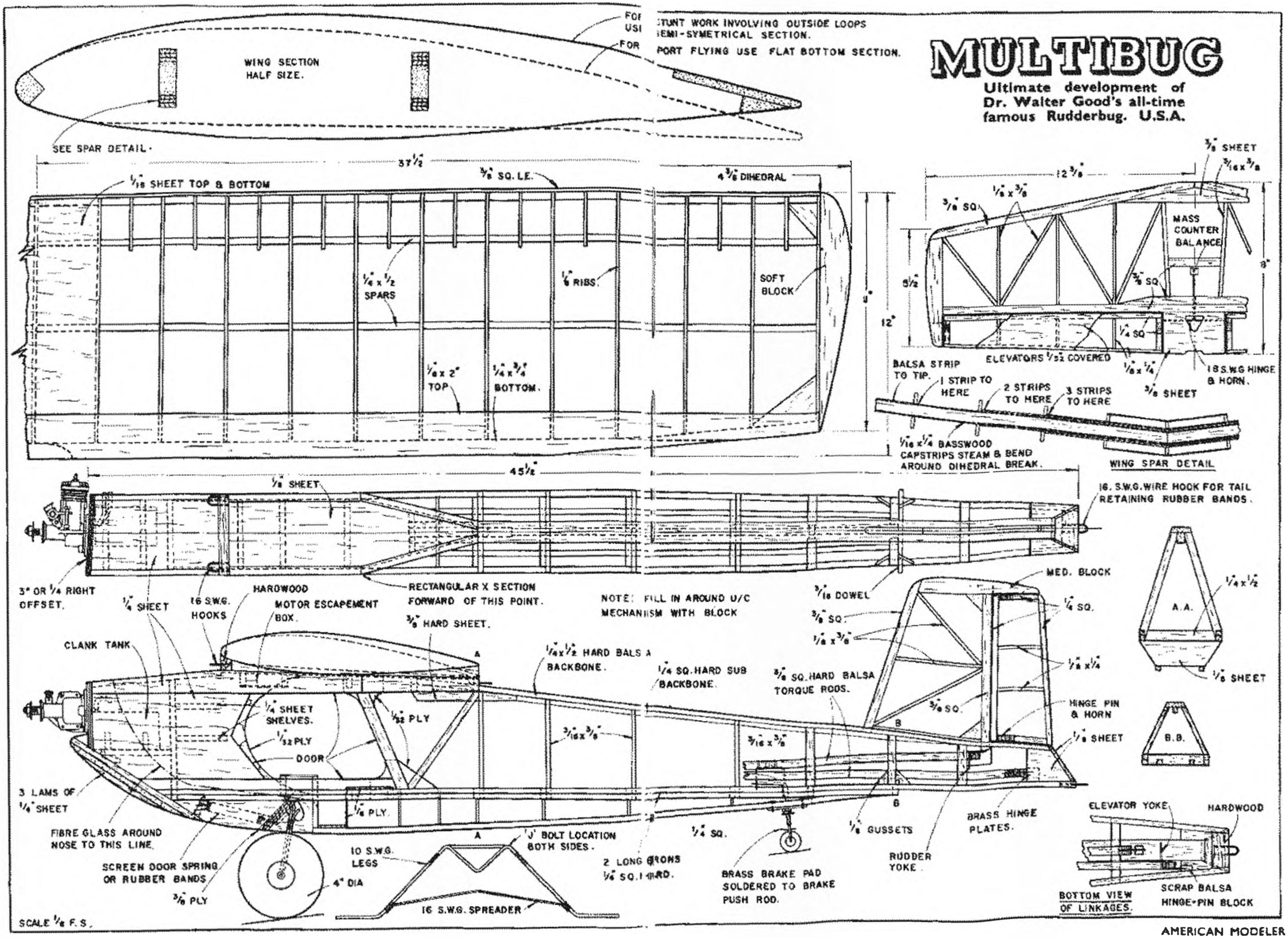




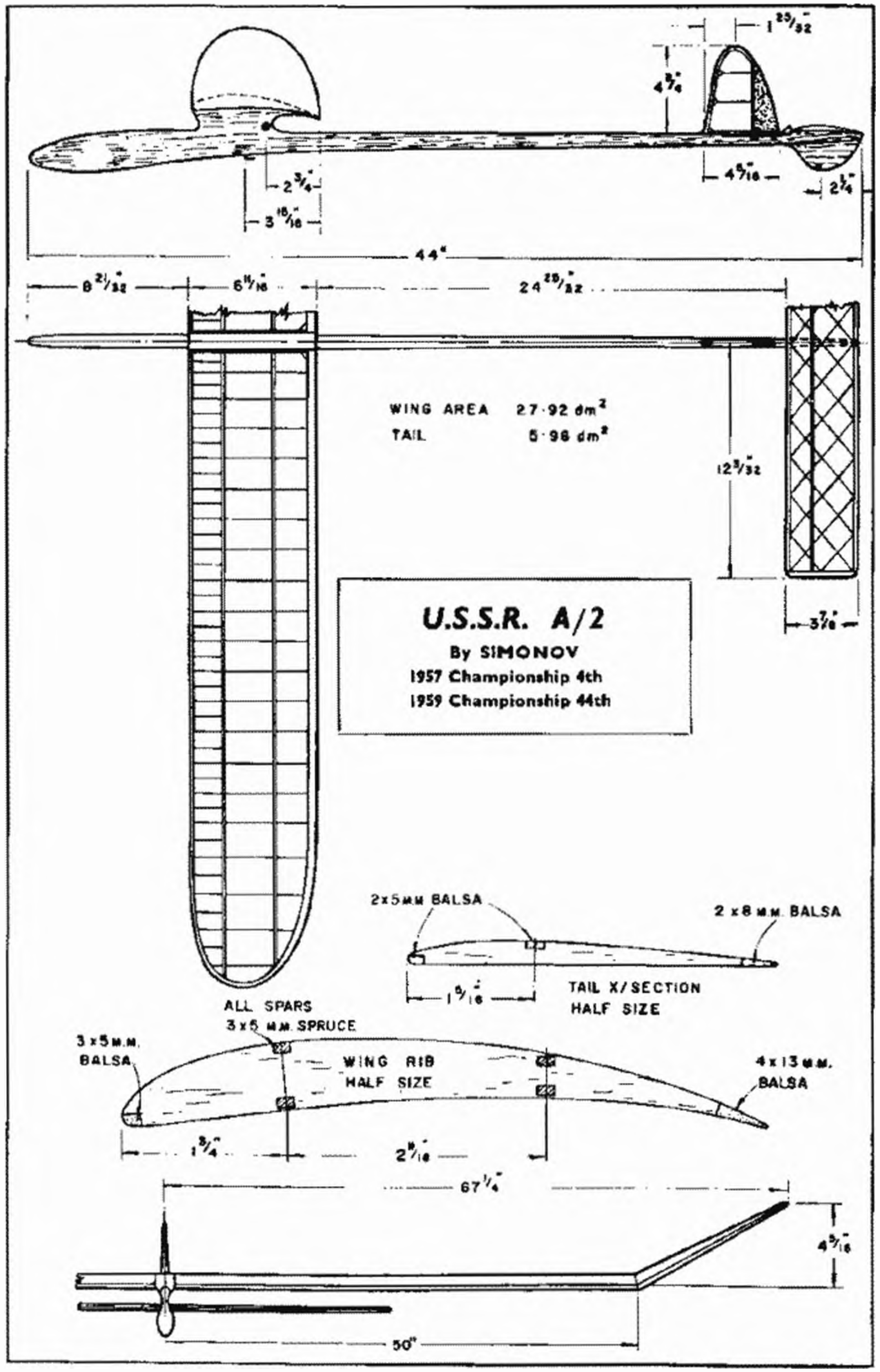
MODEL AIRPLANE NEWS

MULTIBUG

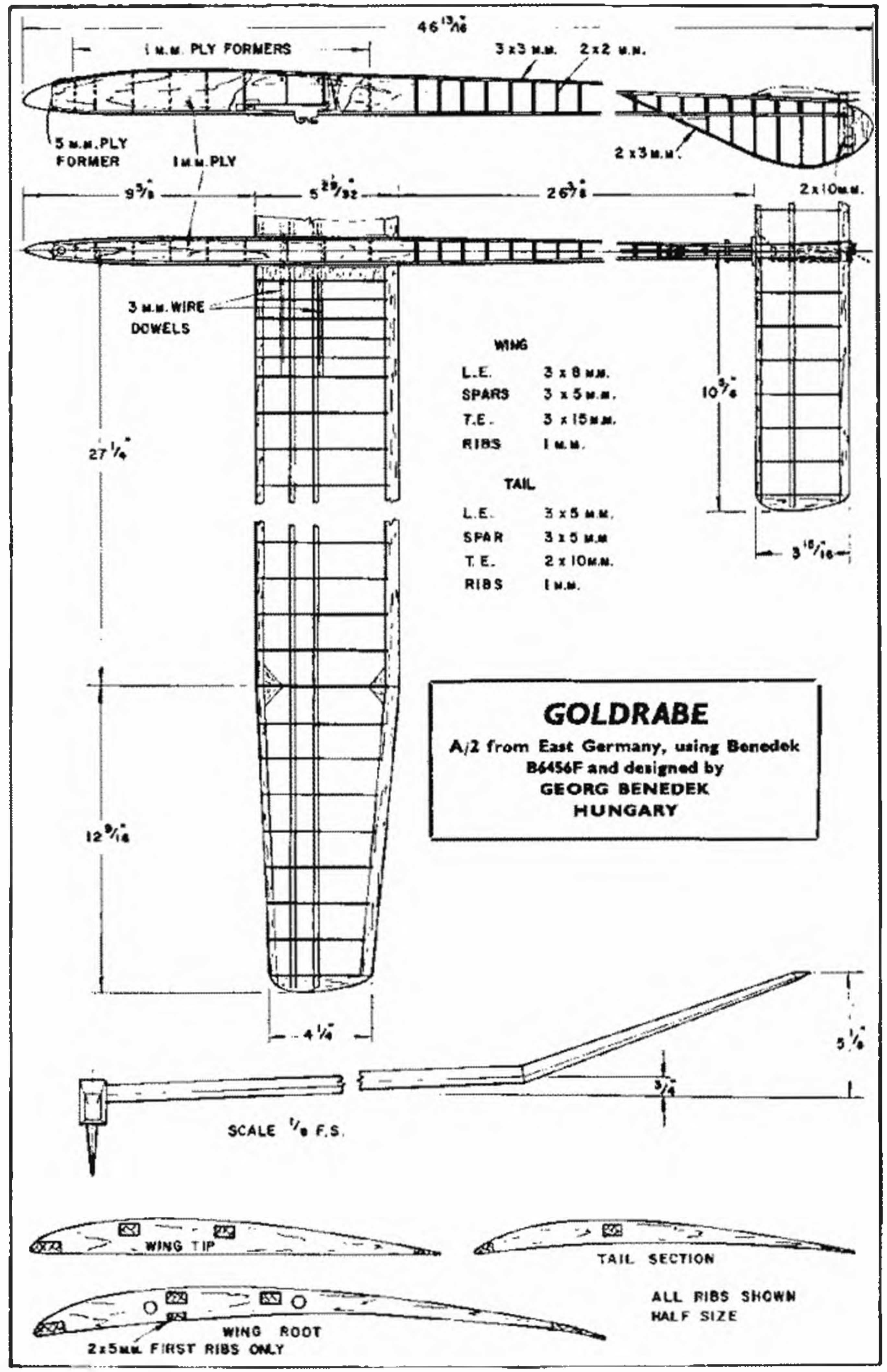
Ultimate development of Dr. Walter Good's all-time famous Rudderbug. U.S.A.



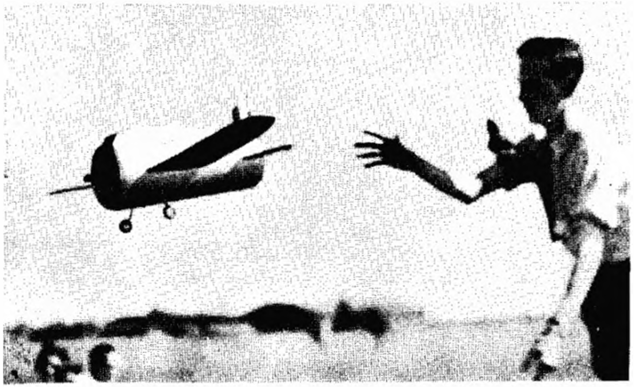
AMERICAN MODELER



LETECKY MODELAR



MODELLBAU & BASTELN



No! Not quite such a dreadful example as it looks! This annular fuselage is open at the ends, and, in theory at any rate, provides a comparatively drag-free entry, reminiscent of the Caproni Campini ducted fan full-size machine.

STREAMLINING

THE VIRTUES of streamlining in low-speed aerodynamics are highly debatable. In the older days when the unrestricted rubber Wakefield was the outstanding "performance" model the respective aerodynamic merits of the "slabsider" and "streamliner" were argued at length, usually missing the main point that the ultimate performance of these models was largely determined on the propeller-rubber motor combination and the ability of the individual flyer to achieve the optimum in trim. Yet according to the type of model and its function, drag is both extremely important and relatively unimportant. It is a matter of appreciation where drag effects are high, and where streamlining can usefully be employed.

Drag is most significant in the case of control line speed models—and almost equally significant with any type of control line model designed for maximum performance. Unfortunately, in this case by far the major proportion of the drag which ultimately limits the speed or performance of the model is line drag. About the only way in which drag can be reduced to show a measurable improvement is by using thinner lines, or a mono-line. Model drag is unimportant by comparison, and apart from the fact that close cowling on a high-speed model will reduce model drag to a minimum, the rest of the model shape is not all that important.

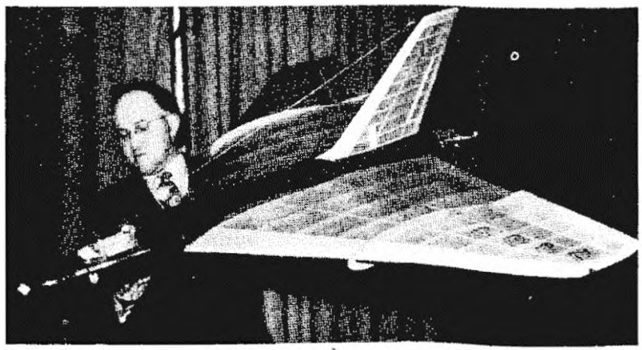
What remains as important on a high-speed model, however, is model *weight*. For a given wing area, the lighter the model the lower the angle of incidence needed to supply the required amount of lift and hence the lower the wing drag. Wing drag, as a single item, will be higher than the drag of the rest of the model, hence this feature of being able to operate at minimum incidence will be more significant than streamlining applied to the rest of the model.

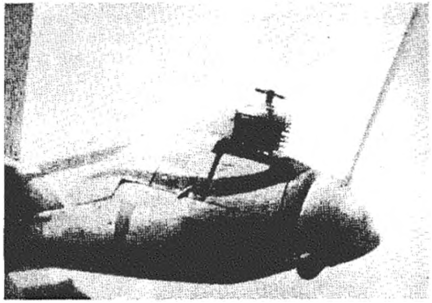
In particular, the importance of spinner shape is usually over-emphasised on speed models. Although a high-speed *model*, speed is still low in the aerodynamic scale and a relatively blunt entry is better from a streamlining point of view than a pointed or extended spinner. In fact, the main virtue of a spinner, apart from appearance, is usually in masking off any possible "air trap" offered by an open ended fuselage. At lower speeds, *e.g.*, on free flight models, a spinner is quite worthless from the aerodynamic point of view.

This also underlines the fact that "front end" streamlining is relatively unimportant, at the low to moderate speeds with which we are concerned in model design. Even a relatively large flat plate area offered to the airstream does not appear markedly to detract from performance. Thus, the flat front former, typical of the average free flight power duration design, is quite an acceptable feature with the engine mounted directly on it, or to bearers protruding from it. There appears to be no advantage at all in cowling in the engine, and several disadvantages. These include restricted accessibility and possible "fin effect" of a cowling affecting stability. About the only thing to avoid, in fact, is a "bucket shape" entry in which the airstream could be trapped and have to reverse its flow to escape. A cowling may well reproduce this condition accidentally, unless adequately vented.

The main requirement of good low-speed streamlining is a good *leaving* or *trailing* shape, drag being caused far more readily by the airstream eddying around a bluff trailing section and breaking up into a wide wake than in being disturbed by a bad entry. A fuselage which ended in a "flat plate" area, for example, would show a quite high drag, but this feature is relatively unknown since fuselages normally taper away to a thin section (vertically or horizontally) at the extreme rear. The same reasoning, however, argues in favour of "knife-edge" trailing edges for wings and tailplanes, rather than leaving these sections relatively blunt. A thick edge section may not *appear* to be a drag producer, but it does tend to increase the depth of the wake, and consequently the drag. A similar effect is realised when the trailing edge is canted to give a flap effect,

A radio-controlled delta wing model by A. S. Bailey of Cheadle, winner of *Aeromodeller* championship trophy at Northern Models Exhibition, which demonstrates a high degree of model streamlining in interesting form. (Photo: Arthur Hamer).





Something of a rarity! This continental contest power model "power egg" shows what can be done in streamlining a difficult subject. Builder has gone further than usual in that a single-bladed balanced prop. is used to cut down drag to the lowest possible amount.

but here there is also an aerodynamic gain in increased lift and the overall effect may be favourable, for certain applications, if not overdone.

As far as fuselage streamlining is concerned, the actual shape appears relatively unimportant. A rounded section, theoretically at least, involves less risk of eddies developing along the edges under the influence of a spiralling slipstream. As a concession to this possibility, box fuselages can have the edges of the longerons rounded off, but any difference between that and the performance of a cross section with sharp edges in normally undetectable. What is far more significant is the *wetted area* of fuselage involved. The smaller the area of fuselage surface over which the air has to pass, the smaller will be the resulting drag. This effect is appreciable right down to the lowest free flight speeds, althought the *principal* advantage of the "stick" type fuselage still remains in its simplified construction.

Despite the fact that drag effects, as so far discussed, appear relatively low, model drag is relatively high, compared with full-size practice, considering the speeds involved. That is to say the drag coefficients, derived by dividing drag by the square of the speed, are appreciably higher. And the major source of drag is again the wing. For higher speed flying it is essential to trim the model to operate at a low angle of attack; while at the other end of the scale for optimum glider performance the wing angle of attack must correspond very nearly to the stalling angle. The section chosen may have to be capable of coping with both extremes without introducing excessive instability problems.

The best low-drag sections for model work are relatively thin, drag also increasing with the amount of camber. The greater the amount of camber, as a general rule, the greater the instability of the section. Thus, if driven fast, the change in trim produced may be very difficult to control. A flat undersurfaced section on a power duration wing is generally easier to trim for power flight than a cambered undersurface wing. But the latter may have a better glide performance and, because it has better lift characteristics, develop the amount of lift required for "power on" flight at a lower angle of attack and less drag, if it can be controlled. Usually, however, the amount of undercamber, which can safely be incorporated on a modern power model wing, is strictly limited. Overall there is probably little to choose between the favoured sections from the point of view of drag saving.

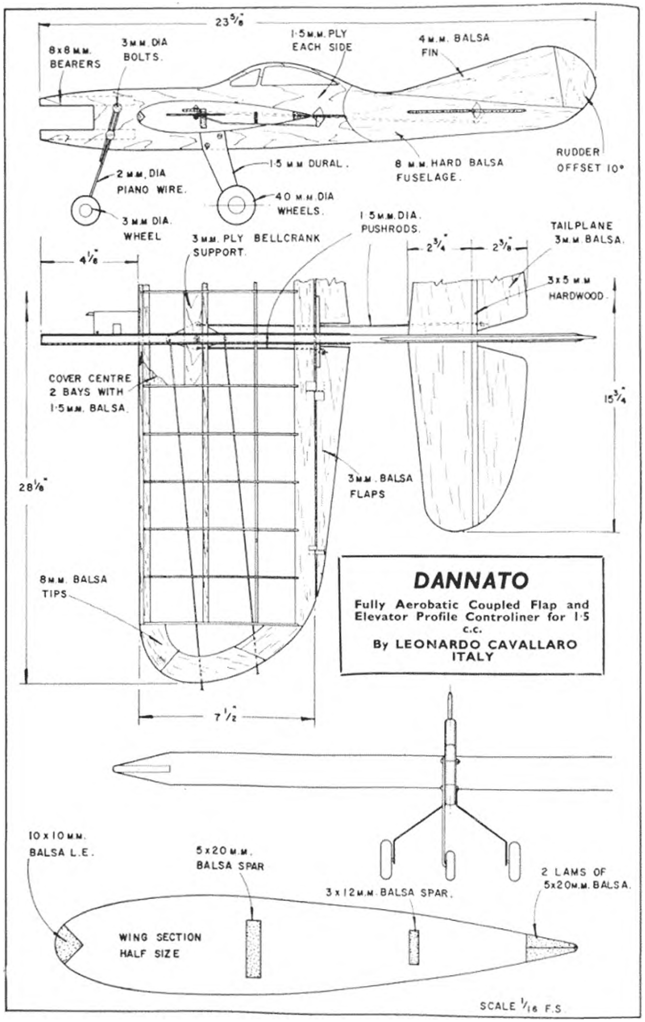
Next to the wing, the propeller is the major drag producer on the glide, even in the case of a power model where the propeller diameter may be relatively small. There is often a measurable difference in glide performance between a high pitch and low pitch propeller of the same diameter—the higher pitch giving less drag in the stopped position. A well-trimmed rubber model of Wakefield proportions with a *freewheeling* propeller can outperform a much larger (and therefore theoretically more efficient) power model on the glide.

With a propeller of the proportions common to rubber models (at least one-third of the span, ranging up to one-half the span), drag on the glide if the propeller is fixed is prohibitive. The methods of "streamlining" the propeller are to allow it to freewheel or fold, or to automatically feather the blades.

The latter method is logically the best, since it does not affect the trim of the wheel, but is relatively complicated to arrange. The folding propeller is almost universal on contest designs, but can involve trim changes. The freewheeling propeller is largely outdated for pure contest work, particularly with the favouring of very large diameter sizes on modern designs, but up to 18 in. in diameter would still hold its own for glide performance against models with "feathered" or "folded" propellers in anything but still air conditions, provided the model was trimmed out to its limit. The additional drag of a freewheeling propeller can, in fact, be an advantage in gusty conditions in dampening out accidental stalls.

None of these solutions is generally applicable to power model propellers, for reasons of practical limitations. Folding propellers have been used, and have been rejected for various reasons (not the least being a tendency to shed a blade under power due to the heavy stresses on the fixing pins). Feathering and freewheeling propellers have been similarly rejected for contest work as being too complicated mechanically. Yet this is about the only part of the modern free flight power duration model remaining which could benefit from "streamlining".

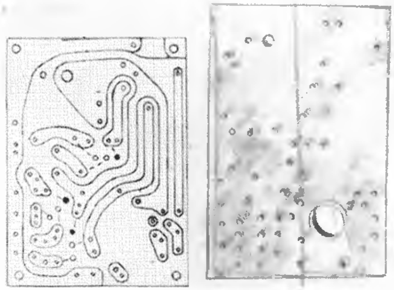
Magnificent Mercury! Noel Barker's model of this popular A.P.S. beauty demonstrates what is perhaps the highest degree of streamlining built into a sports power design. For the record: power unit is Forster 99; spinner and u/c fairings are fibreglass. Single-channel r/c is installed. All up weight is 9¾ lbs.



MODELLISMO

MAKE YOUR OWN PRINTED CIRCUIT

By PAT WHEELER



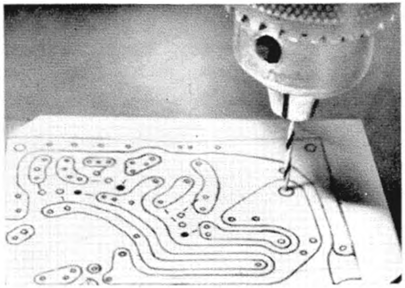
Layout drawing of circuit, size 2$\frac{3}{16}$ in. x 1$\frac{3}{8}$ ins. ; with, on right, mock-up board of perspex for trial assembly.

PRINTED CIRCUITS are useful to the modeller as well as the manufacturer ; they offer us extra strength, lightness, neatness and smaller size, all properties to be wooed. But how to make just one without going to great expense ?

This type of radio base-board is made by depositing a film of copper onto fibre-cum-phenolic resin or F.R.P. sheets and can be bought ready-made from radio parts suppliers, $\frac{1}{16}$ in. thick being the normal size for us to use. To turn it into our circuit we need a wax pencil of the glass or china writing variety, pure nitric acid, an eye-dropper for the acid, bicarbonate of soda in solution for neutralising same and good old soap and water.

If you are not merely copying a bought set, you will need to find out first if your proposed layout is going to work, so build a mock-up on $\frac{1}{16}$ in. Perspex using ordinary tinned wire where your etched copper circuit will be *on the lower side only*, remember, as your board is coated on one side only. Here you can drill away and move around to your heart's content without any expense, the beauty of this system being that you can see both sides at once and so will easily memorise the layout later. Connect it up to batteries, even install it in a plane, but do see that it does work *now*. If you find that it is essential to cross two insulated wires use a short jumper wire on the *top* side for one of them. Remember that in your printed circuit every wire from a component must have its own hole into which to fit, no sharing, so that every part is held rigid at both ends and can be removed without disturbing any other. Mounting all the parts upright close to the base and bending the other wire down to fit into a second connecting hole is the basis of the strength of the system ; anything that is longer than the height of the coil-former or the relay-reedbank will have to lie flat. The valve must be held down ; clips take valuable space so gluing is better, use a sliver of foam plastic or Elastoplast pliobonded both sides.

Once you are satisfied with the performance of the mock-up make an exact size drawing of the layout on paper showing the position of every hole clearly and allowing not less than $\frac{1}{16}$ in. width for each copper strip and a minimum gap also of $\frac{1}{16}$ in. between any two. As an example I have shown a Kraft type receiver ; everything is rigid and yet weighs 1$\frac{1}{2}$ ozs. with 24 SWG Alclad case. The mock-up looked horrible but worked.

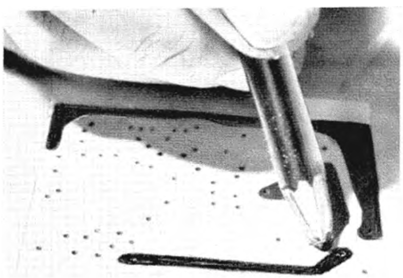


Cut your baseboard ½ in. larger (¼ in. all round) than the finished size, tape your drawing to the copper side and drill right through both with a No. 60 for all holes; larger ones are opened later. Remove drawing. Make a teaspoonful of 50-50 acid-water (add acid to water, *not* water to acid) and apply all over copper to remove all grease marks. Wash in running water, neutralise in bicarb. and re-wash, dry without touching. Throw acid down drain, rinse container.

Copy circuit onto board (copper side) with wax pencil building up a complete sharp-edged coat wherever you are to *retain* copper. This is the hardest part so persevere. Its quality determines the neatness of your job.

Now for the interesting part. Use the eye-dropper as a "pen" to draw acid onto the bare parts; it will fizz and turn blue. Adding further acid after the fizzing has stopped will do no good, so wash off the board by holding a corner with a pair of pliers and swishing in a basin of water as soon as all reaction stops. Shake off drops and dab dry with blotting paper. Repeat this process until all the copper visible is eaten away. The reason for adopting this method rather than immersing the whole board in acid and agitating is that the acid not in use stays in its glass-stoppered bottle with little chance of spilling, splashing or other worse accidental damage ; the acid is in the open for the minimum time and so hardly any fumes are given off. A ¼ oz. per board is all that is needed which is surely cheap enough.

As soon as the board is clean, neutralise by dipping and swirling thoroughly in the bicarb. solution ; a super-saturated solution (made with boiling water) can be re-made by adding more water as required. Wash the



Drilling through drawing taped on board. It is a moot point whether this should be done before or after etching.

Drilled baseboard being marked out with wax "chinagraph" pencil to form resist.

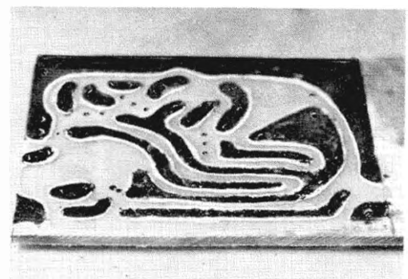
bicarb. off, then scrub off the wax pencil with a nail brush, soap and hot water. If the copper remaining appears stained, use more 50-50 acid-water mixture and re-wash in bicarb. and then fresh water. It takes longer to describe than to do.

An alternative system that you may find easier to use is to substitute beeswax for the wax pencil. Before attempting to mark out the circuit and after it has been drilled and cleaned, the whole of the copper surface must be coated with an even thickness of beeswax. This is best done by melting it in a dish or pan from which it is easy to pour, running the wax onto the board then tilting it so that any excess flows off one corner. Be sure that all the holes are well filled. Once again using the holes as a guide, scribe the actual pattern of the drawing as shown in the photo, through the wax with a fine rounded point such as the sharpened end of the back of a file or piece of thin wire. Carefully lift off any bits of wax that may lift up. When the drawing is complete take a round-bladed knife and scrape away all the wax covering the unwanted copper. Scrape until all this copper can be seen bright and clean.

Now you can go ahead with the etching as before. There is one thing to be cautious about though, make sure that no acid gets underneath the board as this may come *up* through the holes and take away the copper around them, just where you need it most.

Smear on a trace of resinflux all over board and tin copper at once. Discoloured parts of the resin board may be scraped with a razor-blade. This also gives a good "key" for Pliobond when needed. Drill out all larger holes,

Etching away with acid through eye-dropper on the bare copper. Board is beginning to show where acid has done its work.



Etching complete. Circuit now stands out and bears comparison with drawing.

saw and trim board to size, and you're ready to assemble. Unless you're going into even limited production, use the parts from your mock-up, it's safer. Work methodically from the coil-former to detector, amplifiers to relay reed bank. Take all transistor leads through separate holes, turn over to connecting strips, cut to length. Hold them tight with pliers or wide tweezers while soldering and until cool; they go in last.

Before installing in case, check that it works, then coat underneath with fuel-proofer, not against fuel but corrosion. A soldering iron will always burn through this layer in case of need, if ever. Either lay a piece of celluloid or cover with Scotch tape the inside of the tray of the case, glue to this short lengths of fuel tubing at the attachment holes to act as spacers; attach with screws. These combine to prevent shorts in the circuit due to dents or bumps. Make top of case a tight fit.

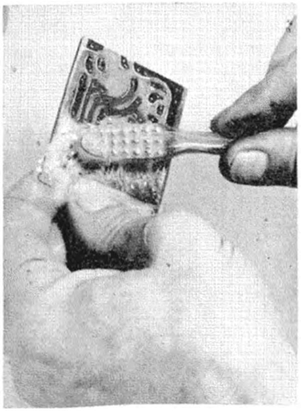
Summing up: Parts held at both ends won't move, greater stability. Upright parts give closer spacing, less base area, less weight, less size. Absolutely rigid "wires" mean no worries from shorts, all soldering easy to get at, neater job, quicker trouble-shooting.

PRINTED CIRCUIT WIRING FOR R.C. USE

Digested from an article by Ed Lorenz *in Paul Runge's American GRID LEAKS*

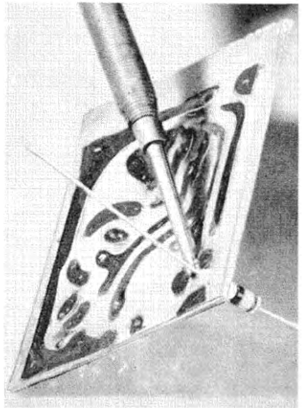
WHAT IS PRINTED, or more correctly as we will use it, etched wiring? It is a process for obtaining a predetermined electrically conductive circuit pattern on an insulated base. The insulating part of the base is generally a phenolic paper or epoxy glass laminate with copper foil bonded to one or both sides. Base thickness, for our purpose, is $\frac{1}{16}$ in.

Production of the etched circuit is straightforward. A pattern is placed on the surface to be etched using an acid resistant material. The exposed copper is then etched away using such chemicals as ferric chloride, nitric acid, ammonium persulphate, chromic sulphuric acid and copper chloride solutions. When unwanted copper is completely etched away, the resist material is cleaned off leaving a copper conductor pattern. Holes are then drilled, components inserted and soldered.



Scrubbing off wax pencil resist with an old toothbrush to expose copper circuit.

Some questions asked are: How much current will a narrow line carry? What wattage iron should be used? How is material cut and drilled? Using a ·0014 in. thick (1 oz.) copper, a $\frac{1}{32}$ in. line will carry about 3 amps, and *pro rata*. An iron with $\frac{1}{8}$ in. to $\frac{3}{16}$ in. diameter tip rated at from 25-35 watts is desirable. Ersin multicore 60 40 20 gauge solder is excellent. Drilling XXXP material can be done with high-speed drills. Keep drills sharp and use high-speed (3,4,000 r.p.m.). Cutting can be done with fine-tooth saw.

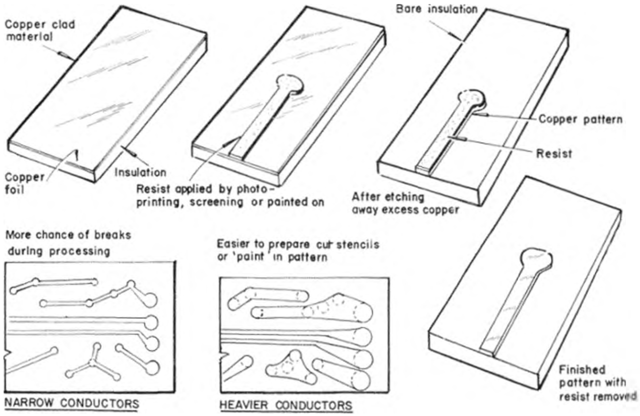


Tinned circuit on untrimmed board. First component is being soldered in place with small size of iron recommended. Note ease of access which is a feature of P.C. work.

Drawing (below) shows stages in P.C. production, with comparison of thick and thin line work.

To save etching solution and maintain adequate conductor bond it is desirable to keep conductors as wide as possible and fill in areas that are common to one another. This is dependent on the circuit, since large areas of copper act as "ground planes".

A small flat dish is required to hold etching solution in use—a pyrex baking dish or photo printing dish will do. Ferric chloride (the only solution we will discuss here) is made up of $4\frac{3}{4}$ lbs. per gallon of water plus 1 to 2 ozs. of muriatic acid per gallon. Smaller quantities *pro rata*. Dissolve in warm water at 100 deg. F., stirring until complete. Etching time will vary from



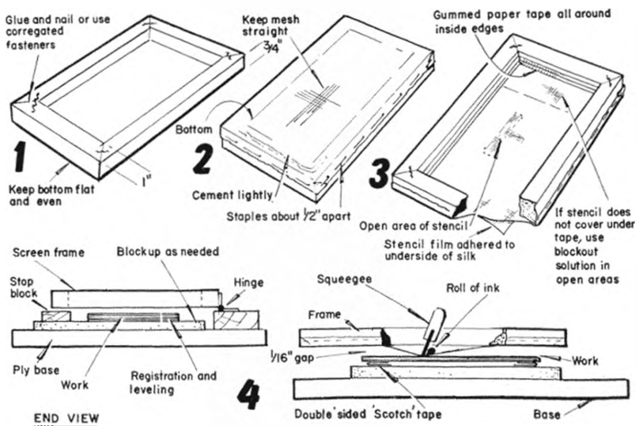
about 2-3 minutes to 20/25 min. for 1 oz. copper ; solution becomes depleted when 6-8 ozs. of copper have been dissolved in a gallon. Throw away solution outside in a hole in the ground—NOT down the drain as it will do the pipes no good.

Silk Screening Printed Circuit Boards

An elaboration of this method, very suitable for clubs use, involves construction of a simple silk screen printing frame and printing through a stencil. Here the ink (resist material) is forced through a silk screen on to the copper foil covered base.

Special stencil film can be obtained and pattern is cut on it with a razor blade or modelling knife, taking care not to cut right through the backing sheet. Pattern is then peeled off leaving background of the film on the backing. Stencil is then placed on several layers of newspaper, film side up and silk screen pressed on to it, and adhered by following instructions with the stencil film (this may be by adhering fluid or hot iron, according to type). Parts of frame not covered by stencil should be blocked out with special fluid, or simply filled in with paper. Tape in place as necessary with gummed paper tape, not cellophane tape as this is often soluble in inks used.

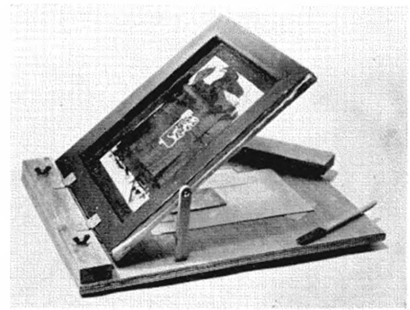
Base is jigged into position under the screen, and carefully inked through it with a flat type of rubber squeegee. Edge should be straight and sharp. Pull ink once across surface firmly and evenly. A few trial pulls are advised as screen printing is quite an art and requires practice. Do not be discouraged, therefore, if first efforts are less than perfect.



Opposite page: Construction and use of silk screen printing frame—which is "de luxe" approach to P.C.

The Editor's Reeves silk screen printing frame, with Profilm stencil cut and in place. P.C. board is located in place for stencilling. Note also squeegee at rear and small ink-mixing stick in foreground.

Details of Kraft receiver, offered as test piece for P.C. experiments appear on following page.



The Editor's Comments

Here are two "do-it-yourself" printed circuit methods that have been evolved quite independently of each other—one in America the other in South Africa. We were so intrigued by them that we have gone further into the matter and sorted out sources of supply in this country. There are doubtless many other sources and materials available.

A really informative work has just been published by Heywood & Co., entitled *Technology of Printed Circuits* by P. Eisler. It costs 60/-, but is undoubtedly the definitive work on the subject, and while aimed at commercial production is full of useful information for one-off enthusiasts.

We would also advise readers against using nitric acid as an etching medium if they can obtain ferric chloride, since the former is prone to gassing and gives off noxious fumes, so that use in confined spaces by unskilled operators would be unwise.

Suitable resists with which to draw circuit patterns include wax pencil (Chinagraph), ordinary model aircraft dopes and enamels, beeswax and turpentine, printers' ink.

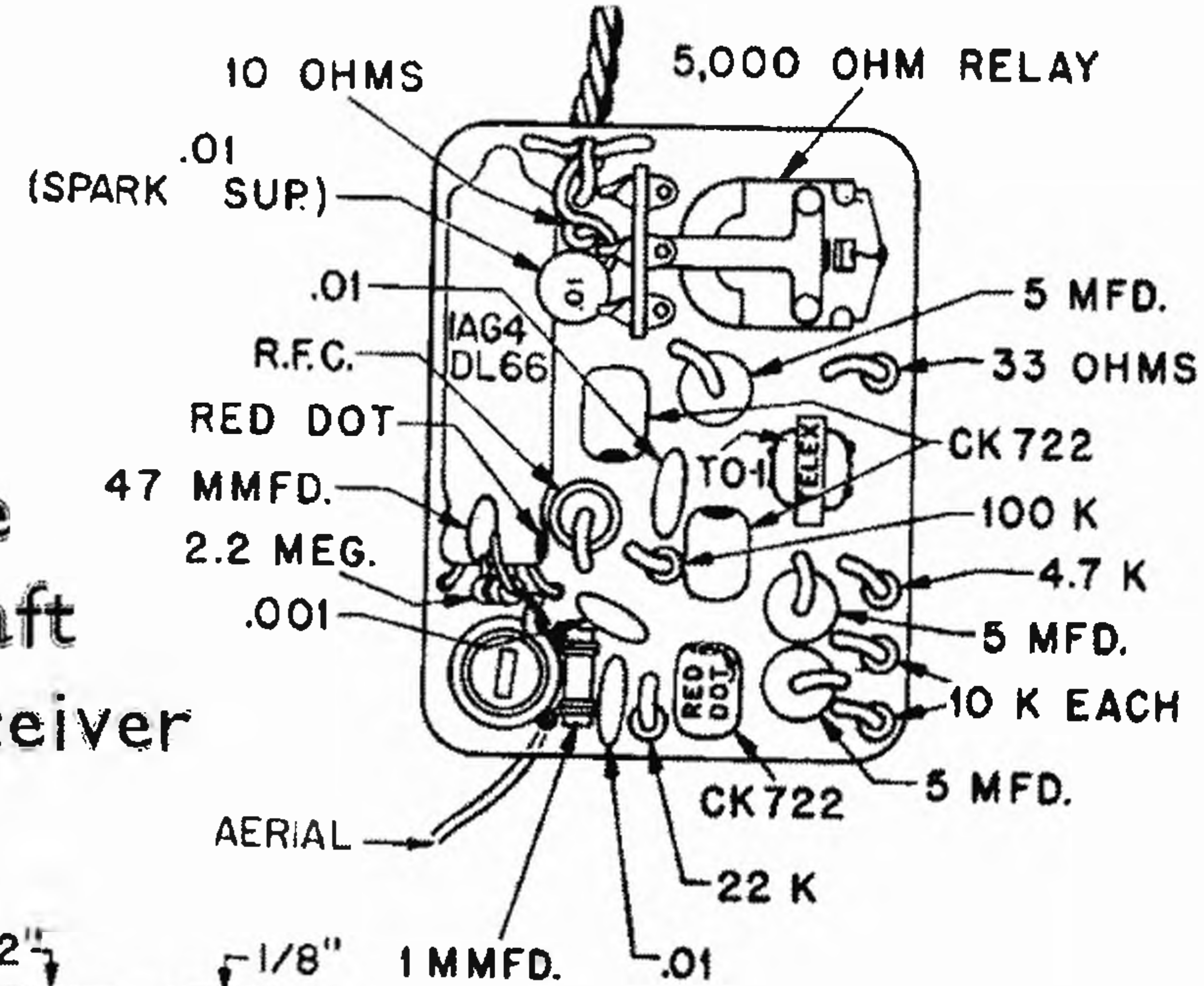
Pat Wheeler drills his holes before etching, but usual practice is to do after etching—there is then no danger of etching material undercutting copper adjacent to the holes where it is most needed.

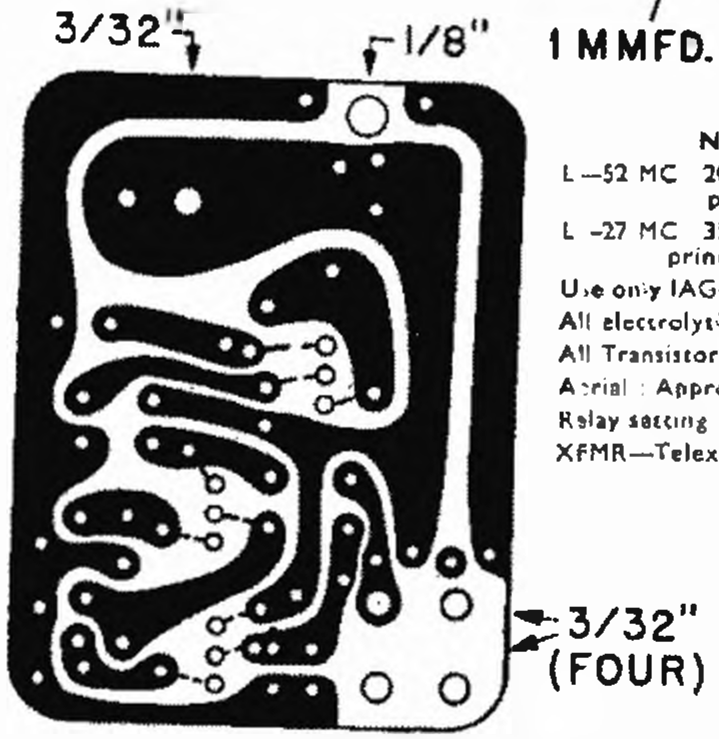
A silk screen printing frame is easy to make, or a ready-made one is available from artists' colourmen Reeves & Co., who also supply a stencil film called Profilm, which is just the job.

Suitable laminate with copper foil bonded to it of ·003 thickness (twice as thick as Ed. Lorenz uses) on $\frac{1}{16}$ in. thick laminate is available from Radio & Electronic Products Ltd. XXXP material referred to is official grade coding for phenolic paper, and is most widely used grade, with high insulation resistance. There are many other grades such as XXP, which has good punching properties, Epoxy glass, which is most widely used glass-base type and CE, phenolic cotton, with greater impact resistance than paper bases.

To round off the P.C. story we include printed circuit pattern, full-size, for the successful Kraft tone receiver, which is enjoying great popularity in America, and, incidentally, is that illustrating Pat Wheeler's article. Well . . . etching to go. . . .

The Kraft Receiver





NOTES ON COMPONENTS

L—52 MC 20 turns No. 26 enamelled wire on 3/16 in. i.d. printed circuit, slug tuned

L—27 MC 35 turns No. 30 enamelled wire on 3/16 in. i.d. printed circuit, slug tuned.

Use only IAG4 for 52 MC.

All electrolytic caps—5 mf/50v. (Sprague TE-1303).

All Transistors—CK 722 (Beta 20-30).

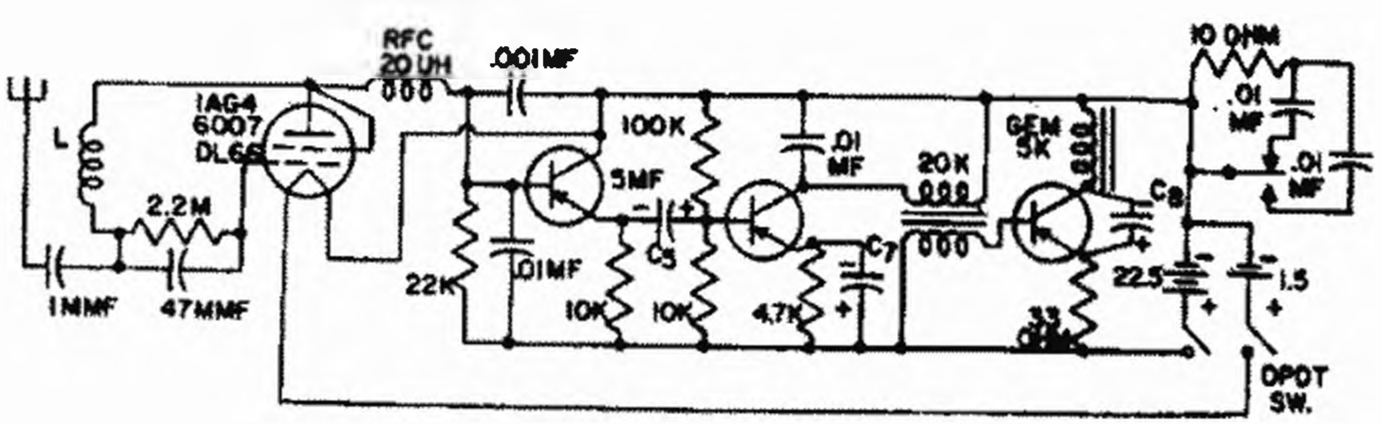
Aerial : Approximately 20 in.

Relay setting : Pull in 2.2 ma, Drop out 1.8 ma.

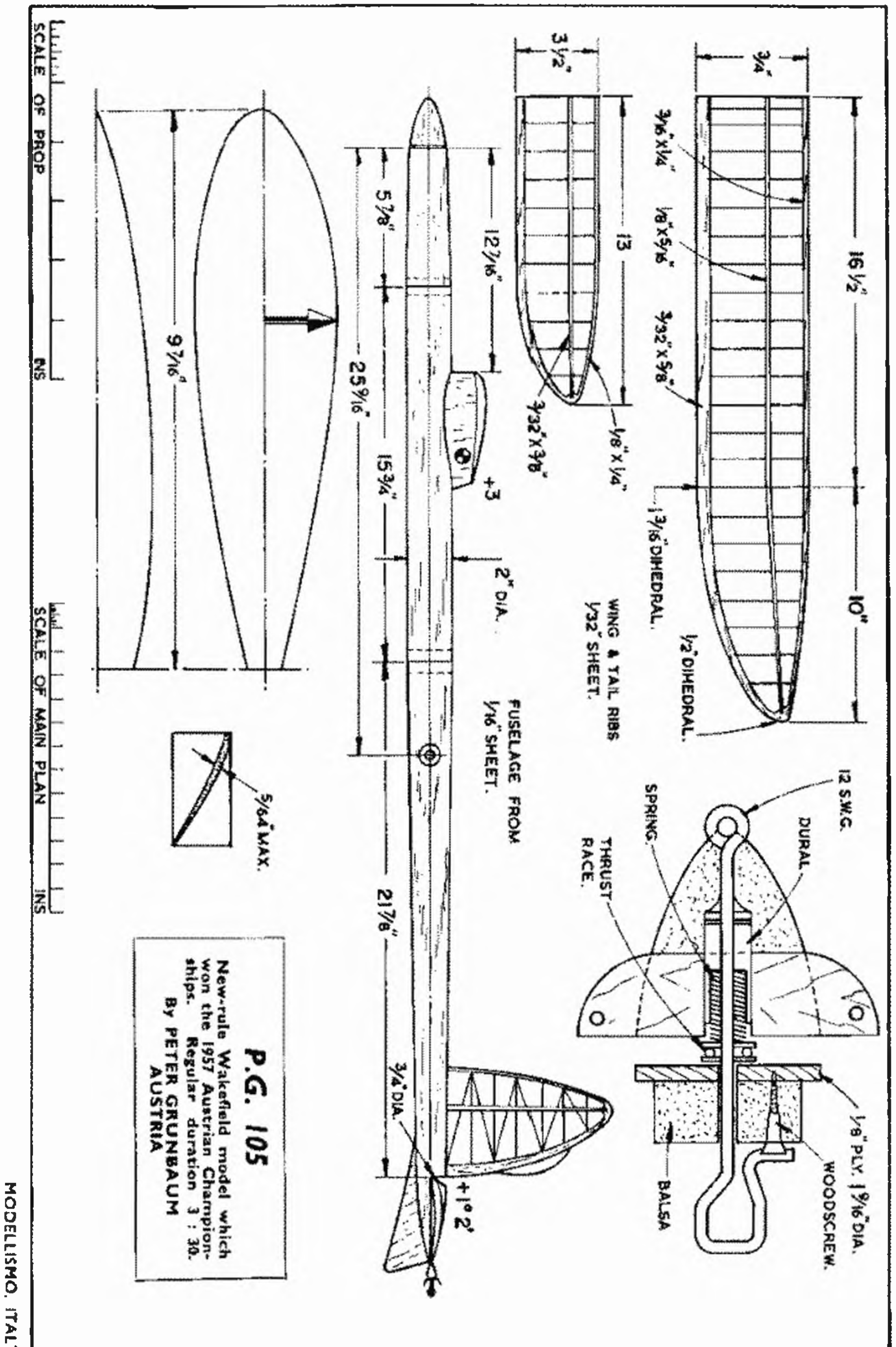
XFMR—Telex TO-1 or equivalent 20K—1K imp.

NOTES ON P.C. ASSEMBLY

Use No. 60 drill throughout, except as noted. Put transistor leads through holes and bend onto pattern. Hold leads with tweezers or long-nosed pliers to dissipate heat while soldering.



MODEL AIRPLANE NEWS

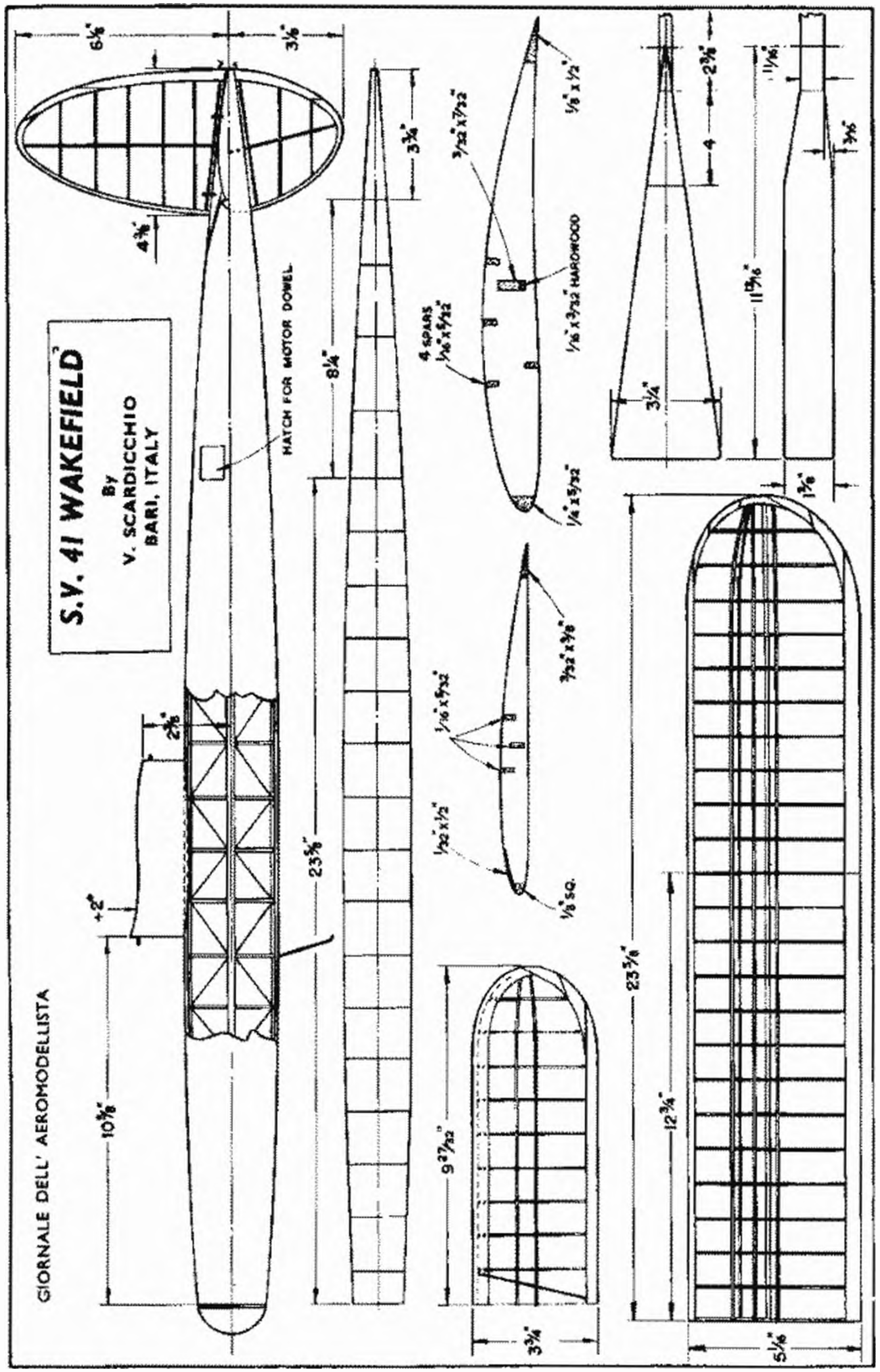


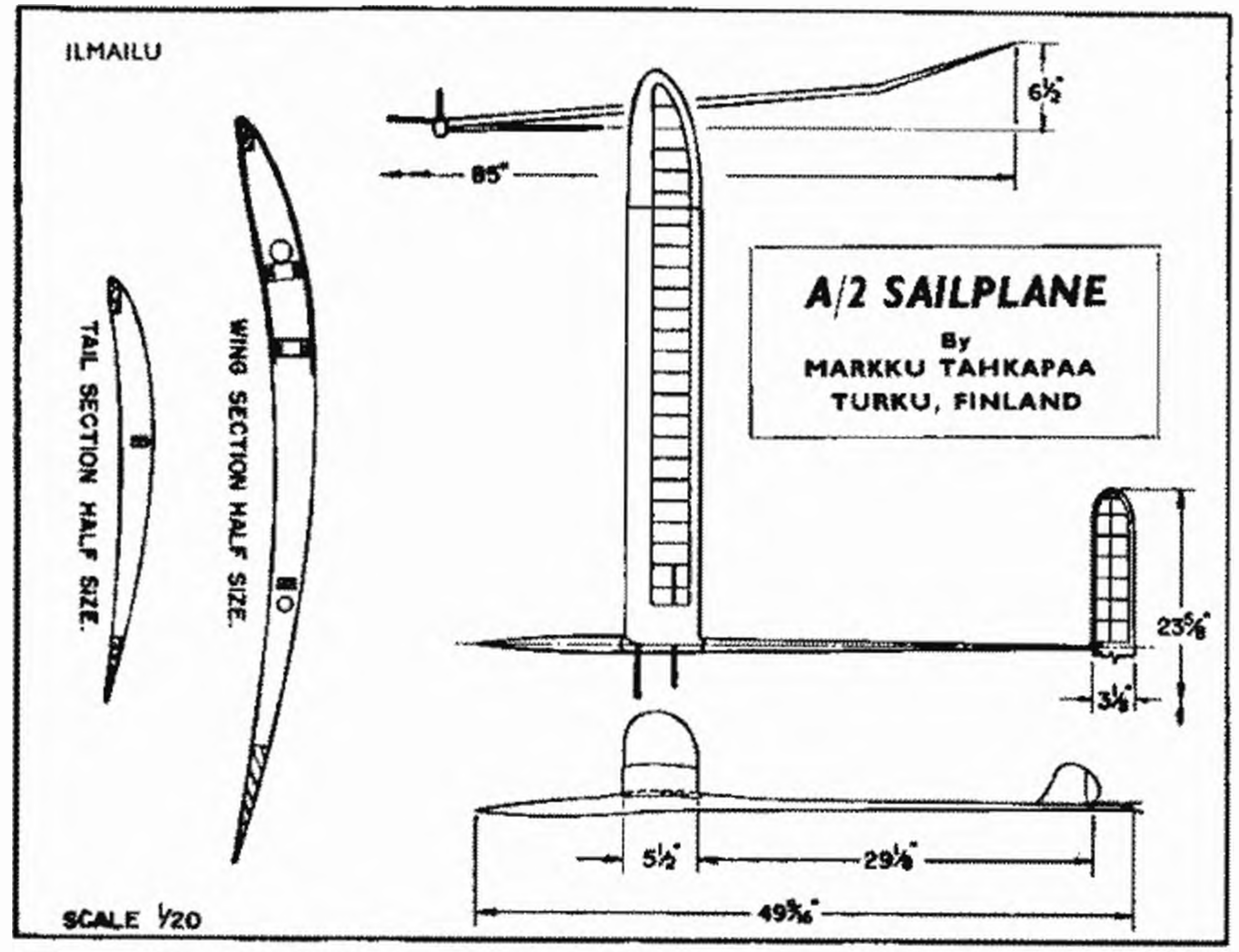
P.G. 105

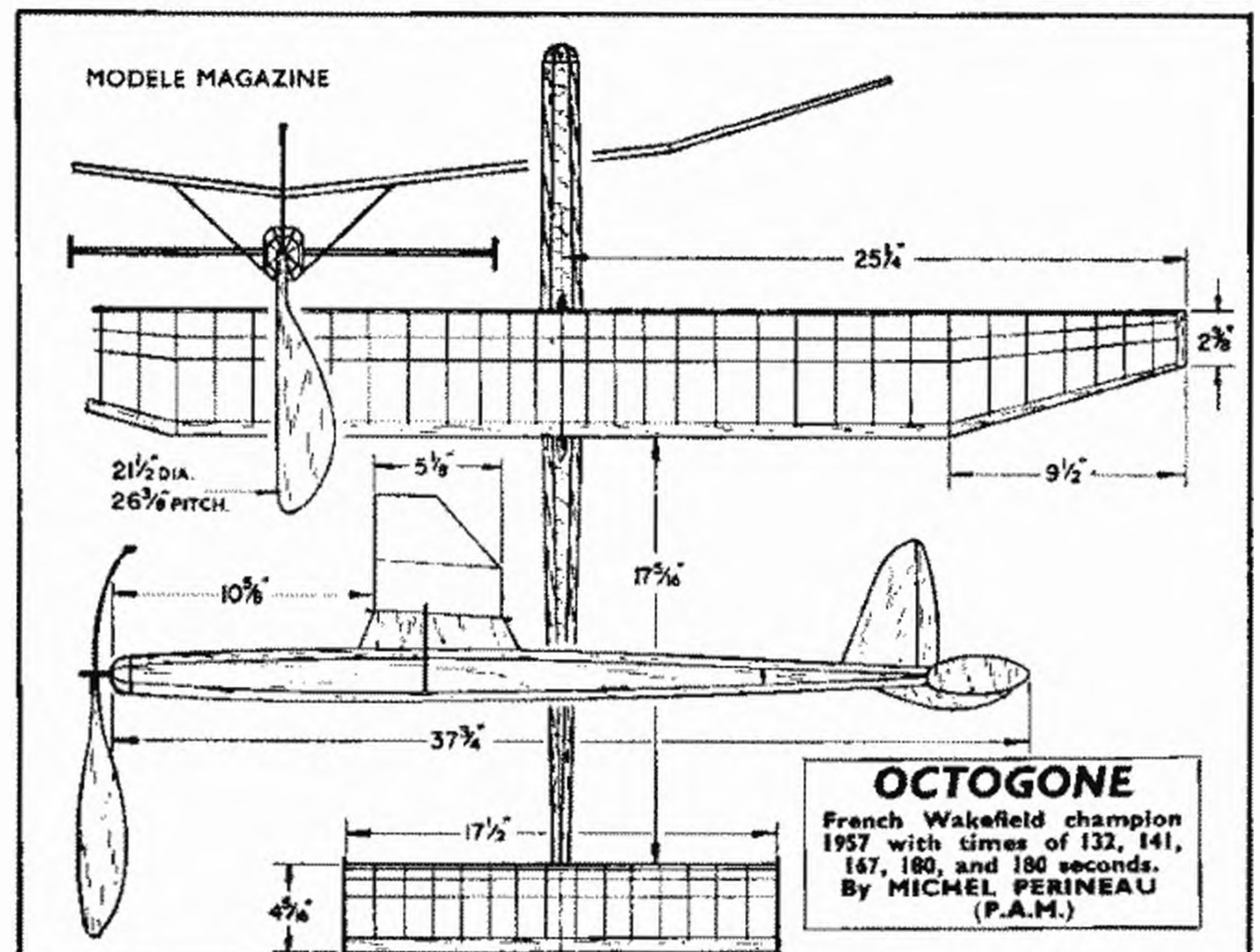
New-rule Wakefield model which won the 1957 Austrian Championships. Regular duration 3 : 30.

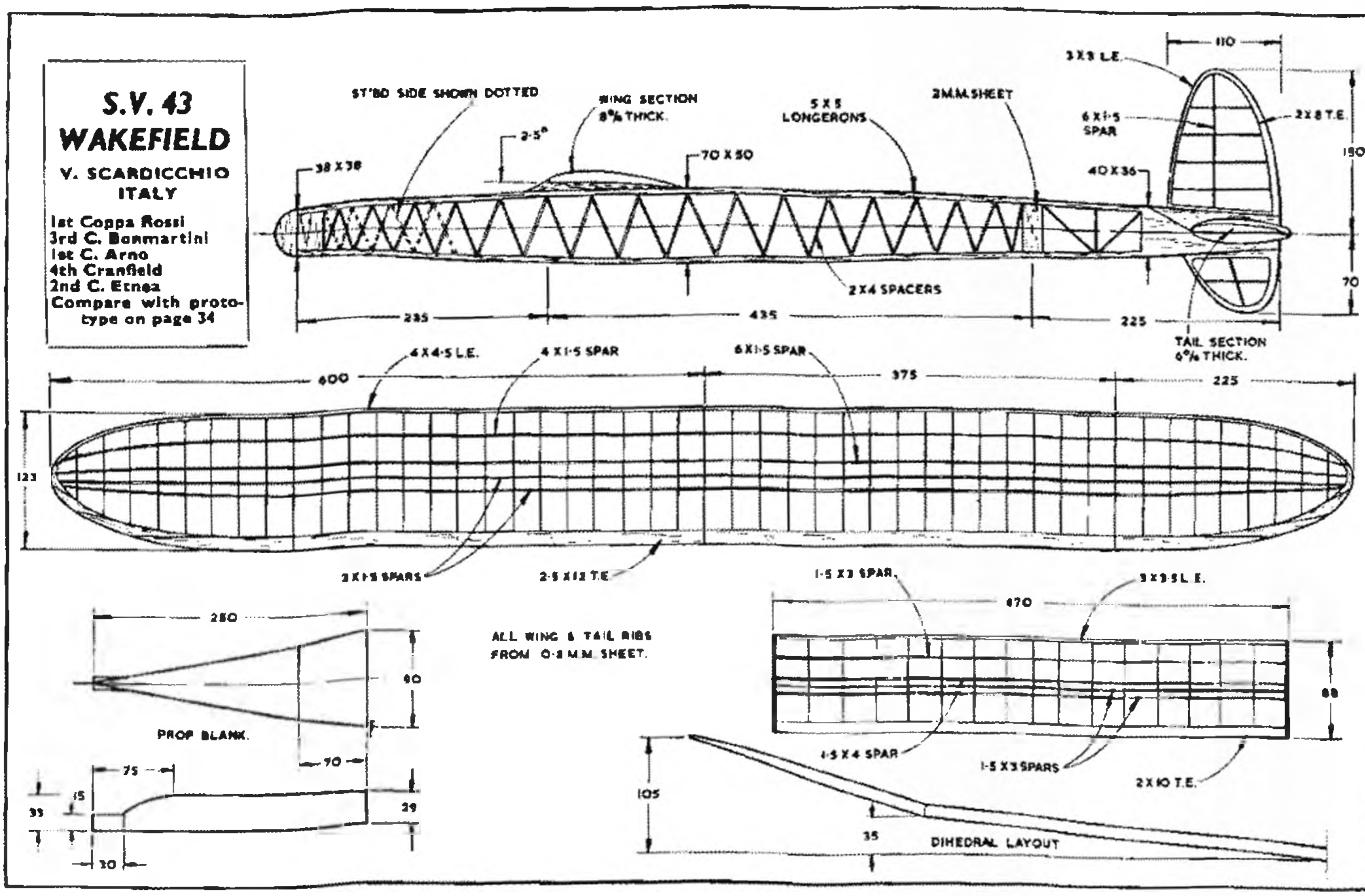
By PETER GRUNBAUM
AUSTRIA

MODELLISMO, ITALY

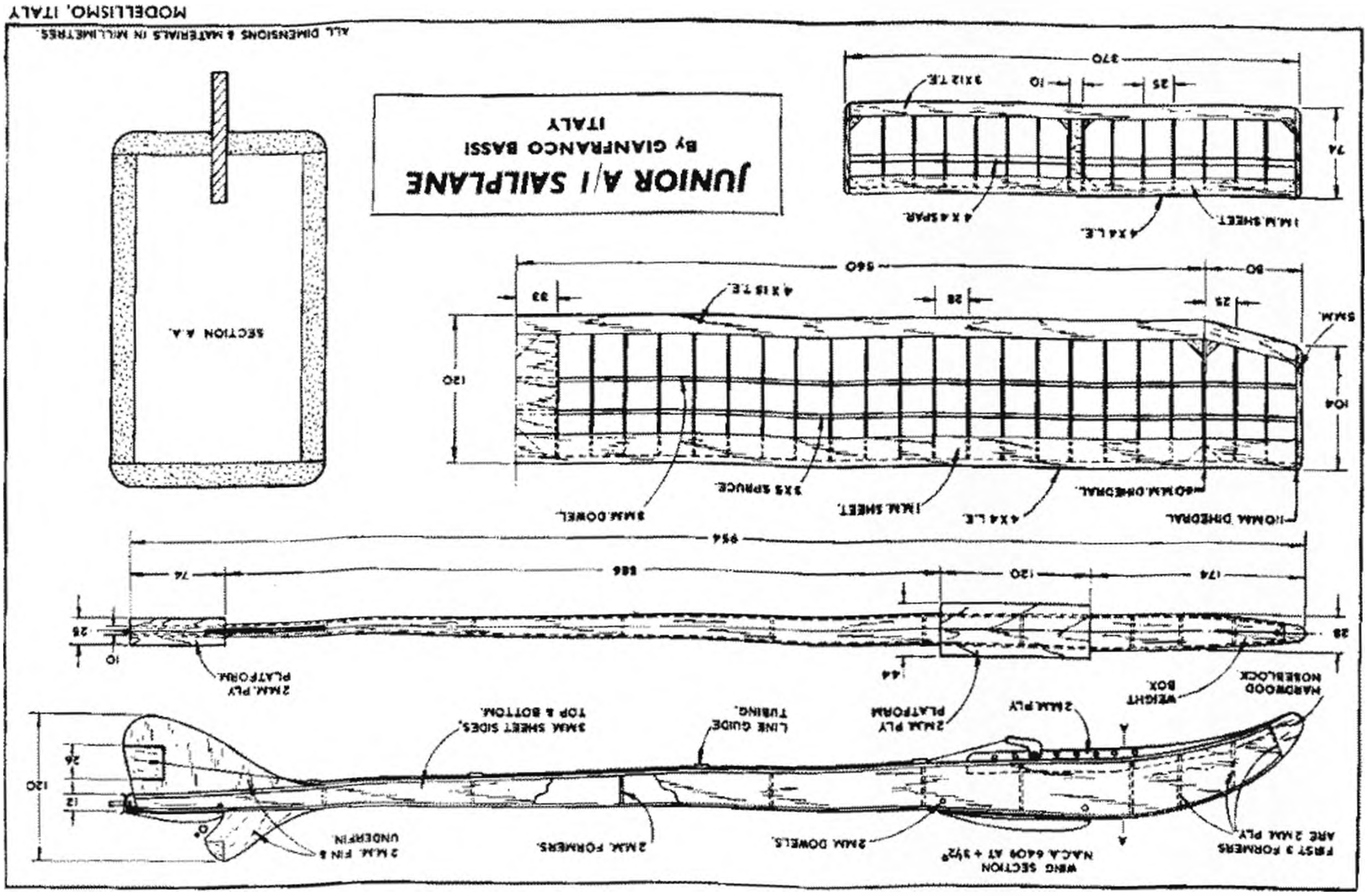

S.V. 41 WAKEFIELD
By
V. SCARDICCHIO
BARI, ITALY
GIORNALE DELL' AEROMODELLISTA
HATCH FOR MOTOR DOWEL
4 SPARS
1/16 x 3/32 HARDWOOD


ILMAILU
A/2 SAILPLANE
By
MARKKU TAHKAPAA
TURKU, FINLAND
TAIL SECTION HALF SIZE.
WING SECTION HALF SIZE.
SCALE 1/20

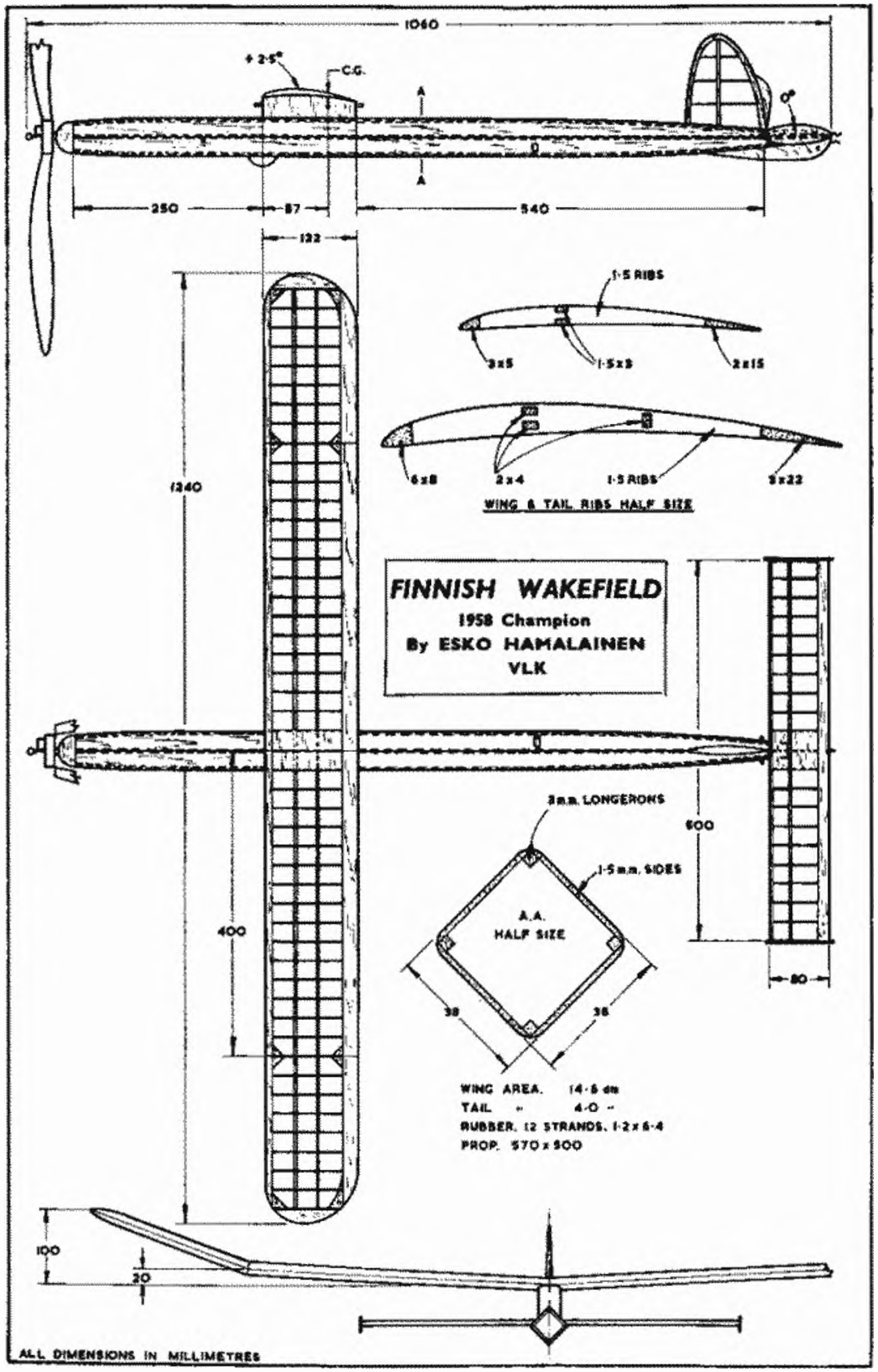

MODELE MAGAZINE
21½" DIA.
26⅜" PITCH.
OCTOGONE
French Wakefield champion 1957 with times of 132, 141, 167, 180, and 180 seconds.
By MICHEL PERINEAU
(P.A.M.)



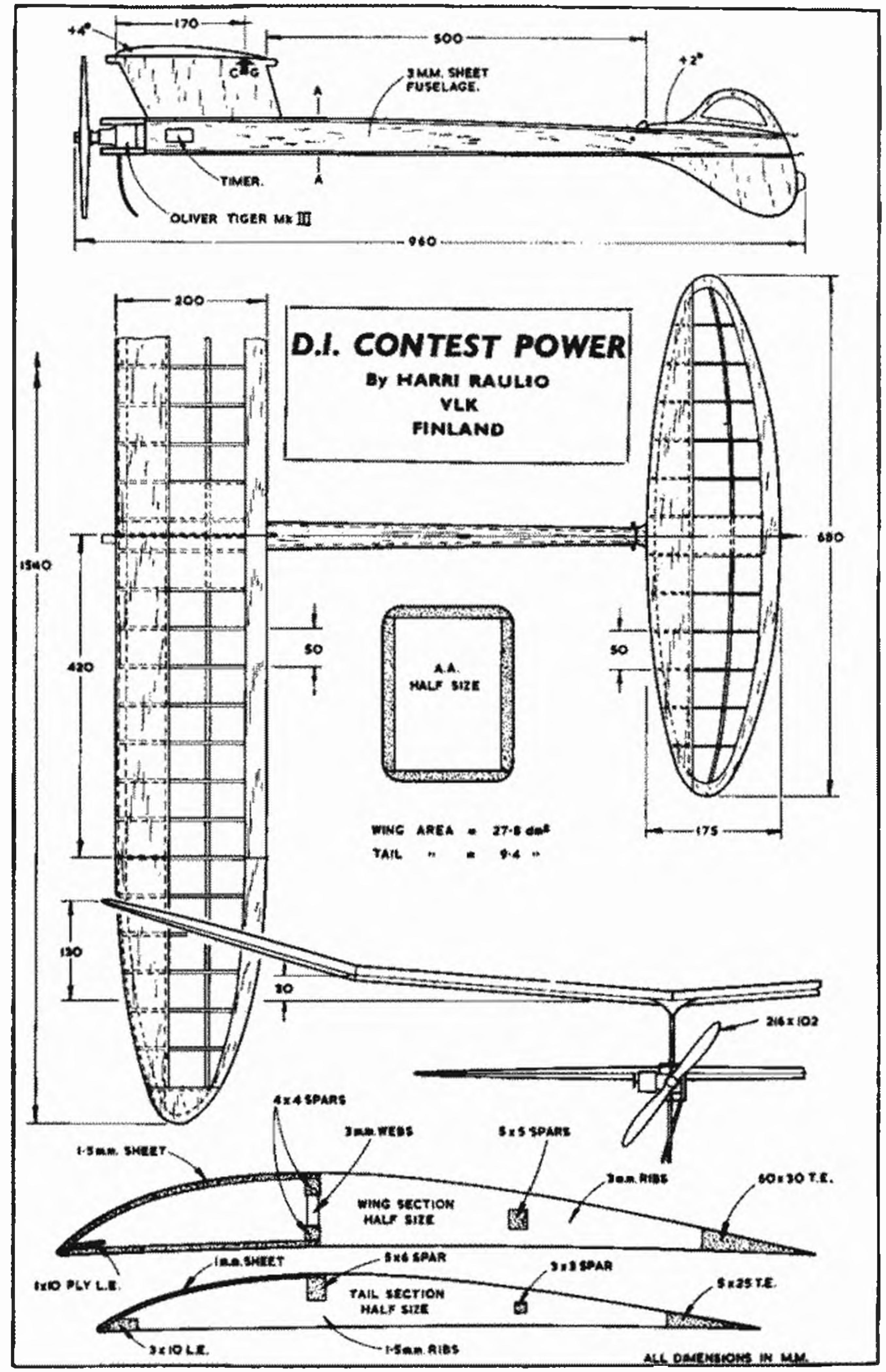
AEROMODELLISTA, ITALY



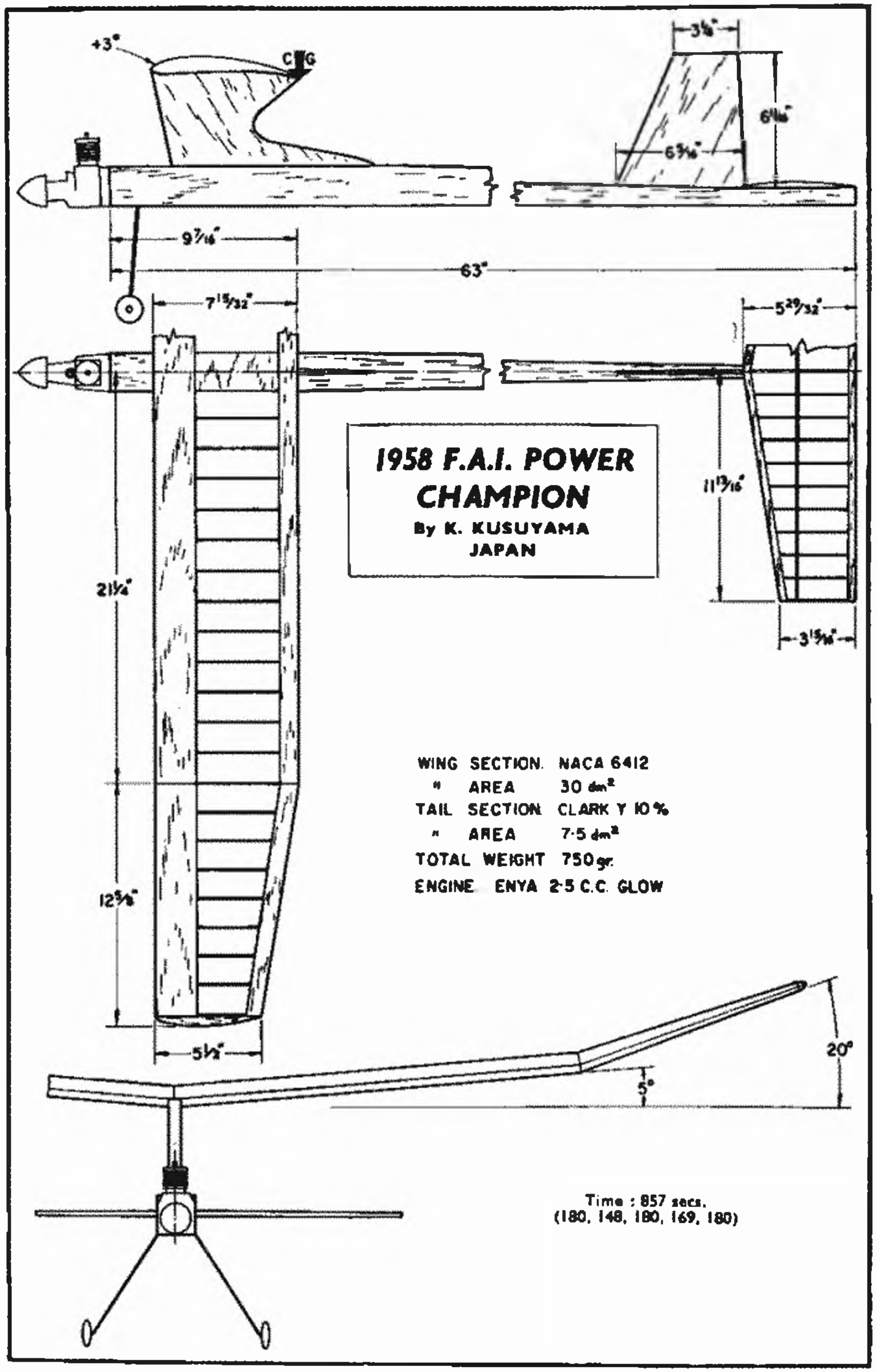
MODELLISMO, ITALY

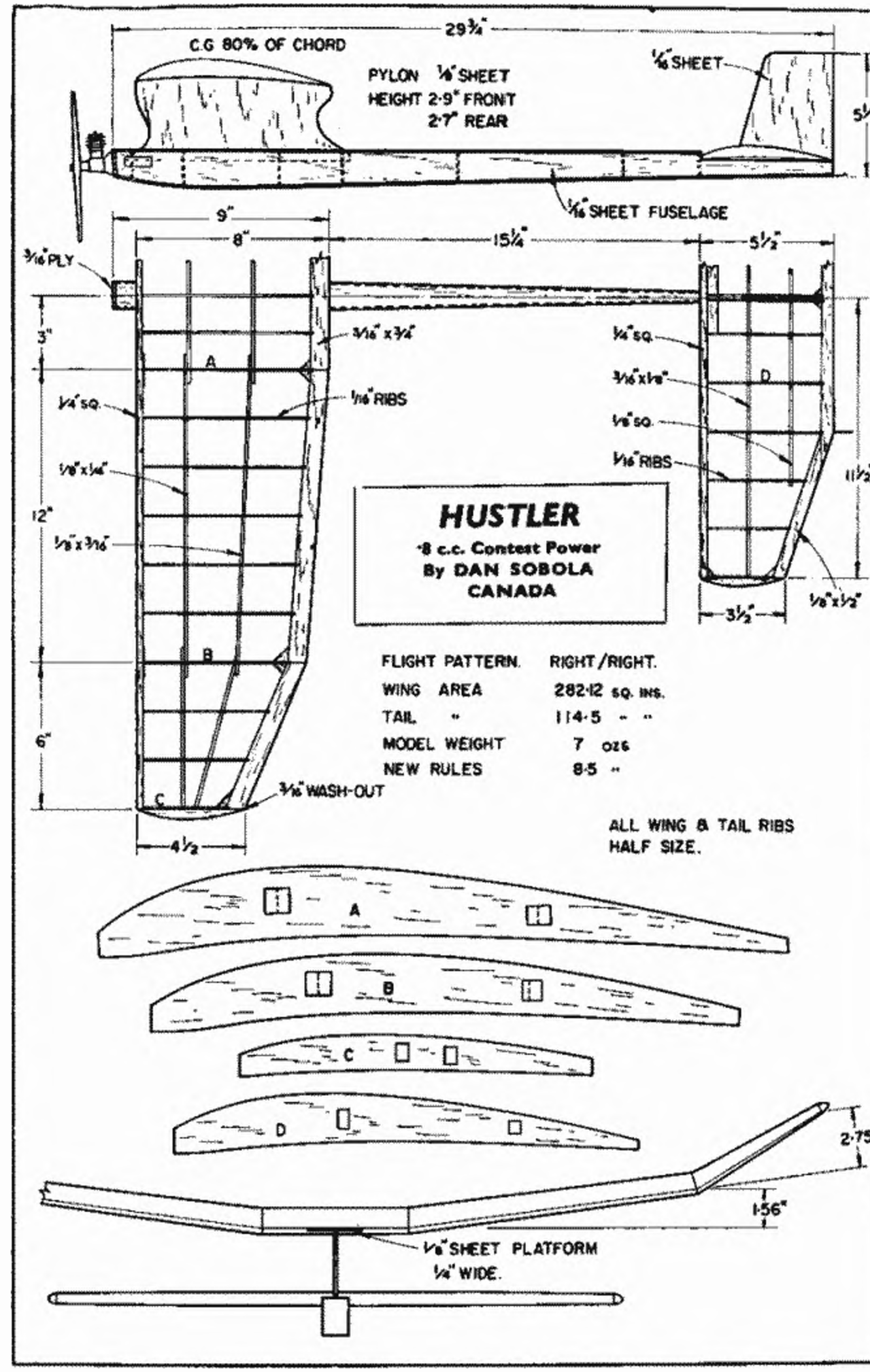


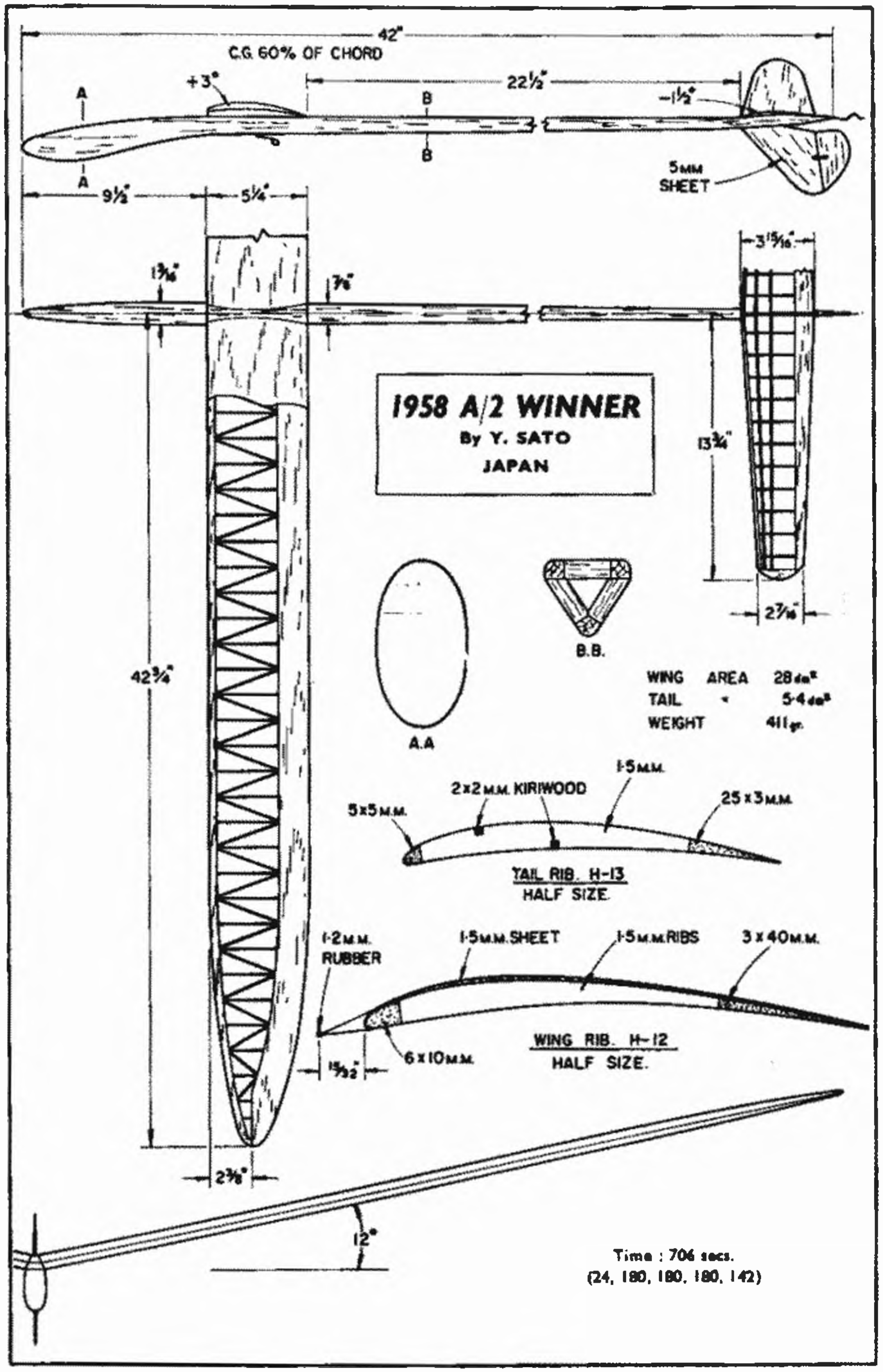
ILMAILU, FINLAND

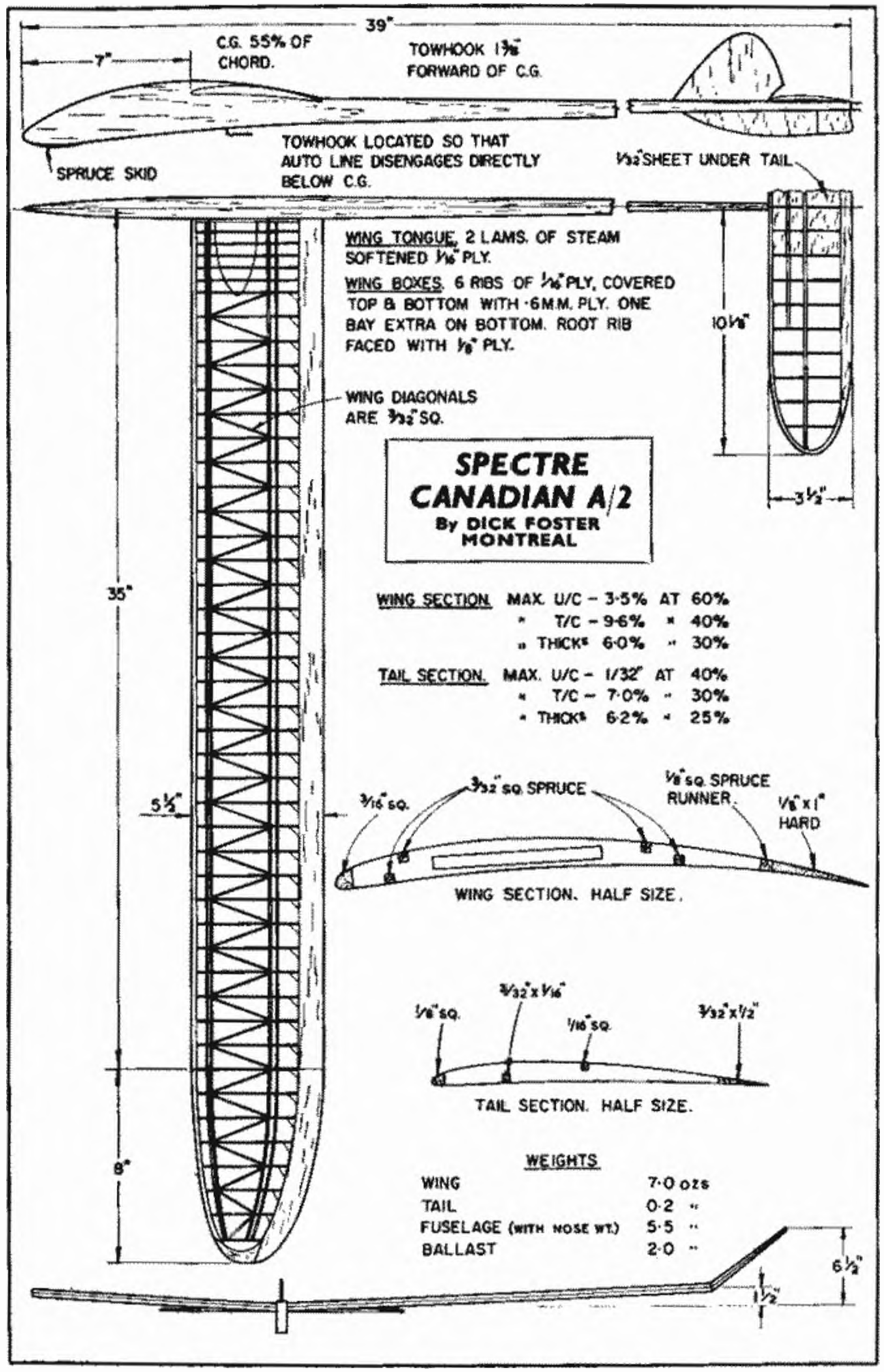


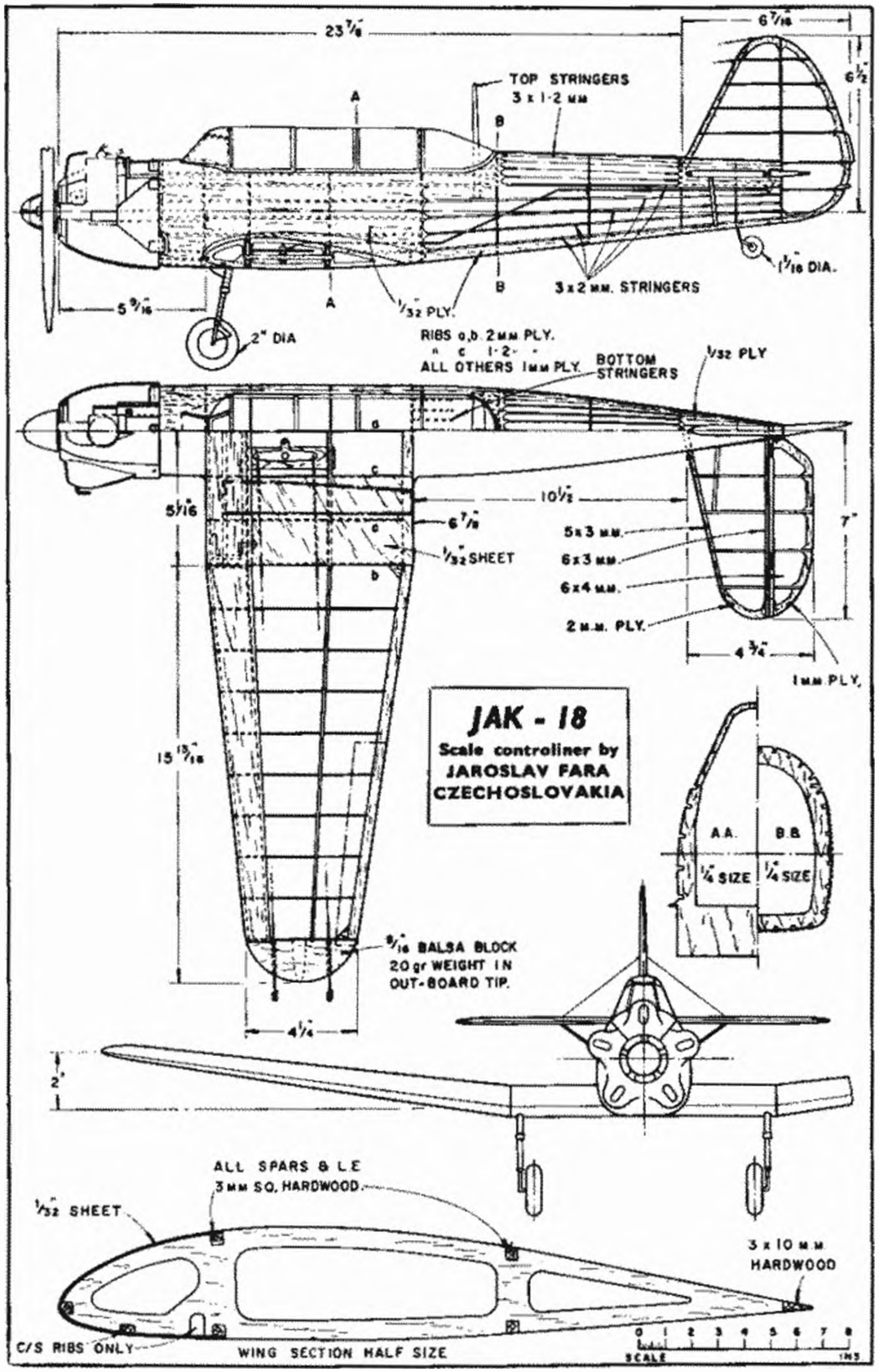
ILMAILU, FINLAND


+3°
C.G
3⅛"
6 11/16"
6 5/16"
9 7/16"
63"
7 15/32"
5 29/32"
11 13/16"
3 15/16"
21¼"
12⅝"
5½"
20°
5°
1958 F.A.I. POWER CHAMPION
By K. KUSUYAMA
JAPAN
WING SECTION NACA 6412
" AREA 30 dm²
TAIL SECTION CLARK Y 10%
" AREA 7·5 dm²
TOTAL WEIGHT 750 gr.
ENGINE ENYA 2·5 C.C. GLOW
Time: 857 secs.
(180, 148, 180, 169, 180)

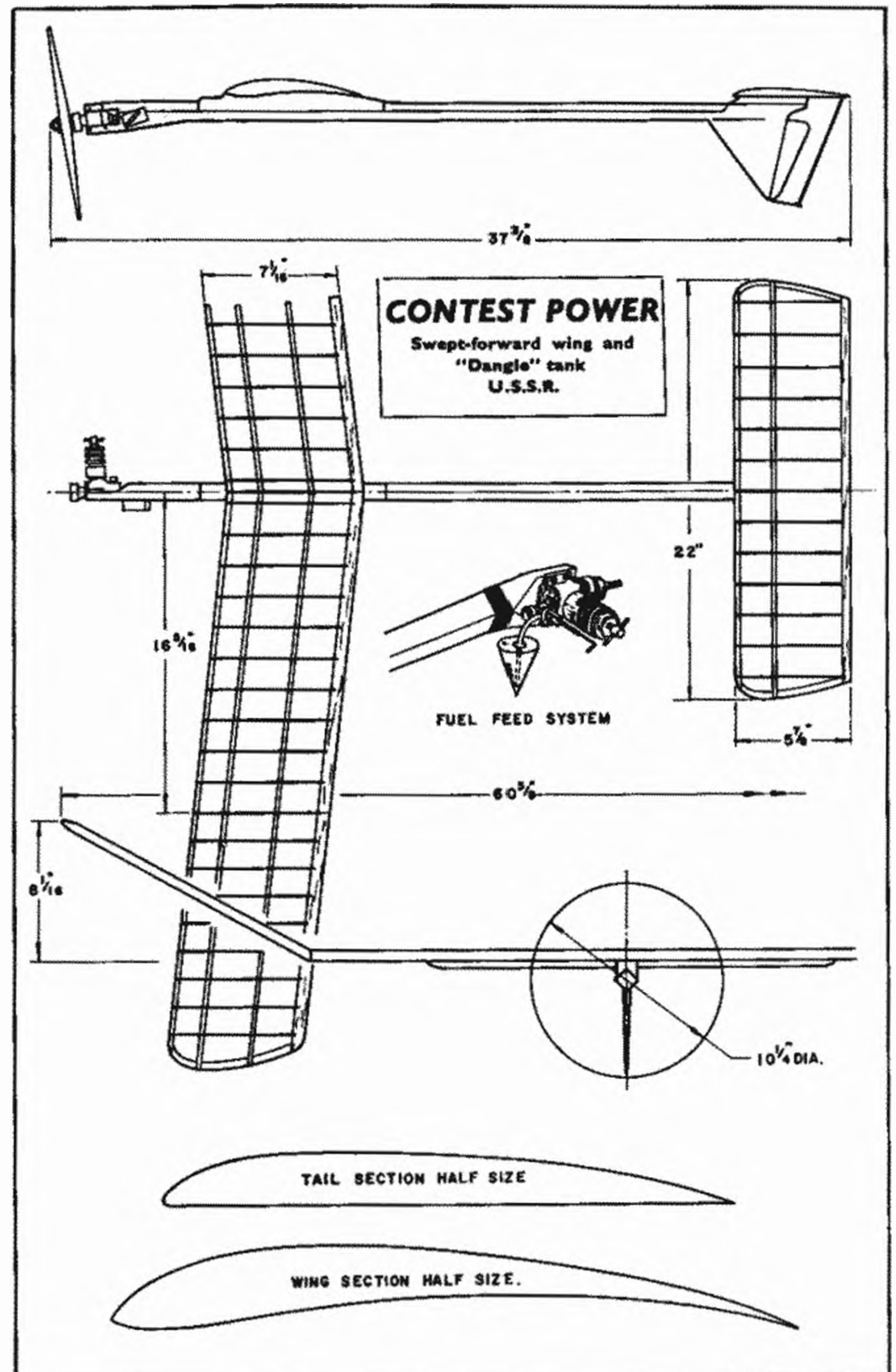

29¾"
C.G 80% OF CHORD
PYLON 1/8" SHEET
HEIGHT 2·9" FRONT
2·7" REAR
1/16" SHEET
5⅛"
1/16" SHEET FUSELAGE
9"
8"
15¼"
5½"
3/16" PLY
3/16" x 3/4"
1/16" RIBS
1/4" SQ.
1/8" x 1/4"
1/8" x 3/16"
3"
12"
6"
4½"
3/16" WASH-OUT
1/4" SQ.
3/16" x 1/8"
1/8" SQ.
1/16" RIBS
11½"
3½"
1/8" x 1/2"
HUSTLER
·8 c.c. Contest Power
By DAN SOBOLA
CANADA
FLIGHT PATTERN. RIGHT/RIGHT.
WING AREA 282·12 sq. ins.
TAIL " 114·5 " "
MODEL WEIGHT 7 ozs
NEW RULES 8·5 "
ALL WING & TAIL RIBS HALF SIZE.
A
B
C
D
2·75"
1·56"
1/8" SHEET PLATFORM
1/4" WIDE.

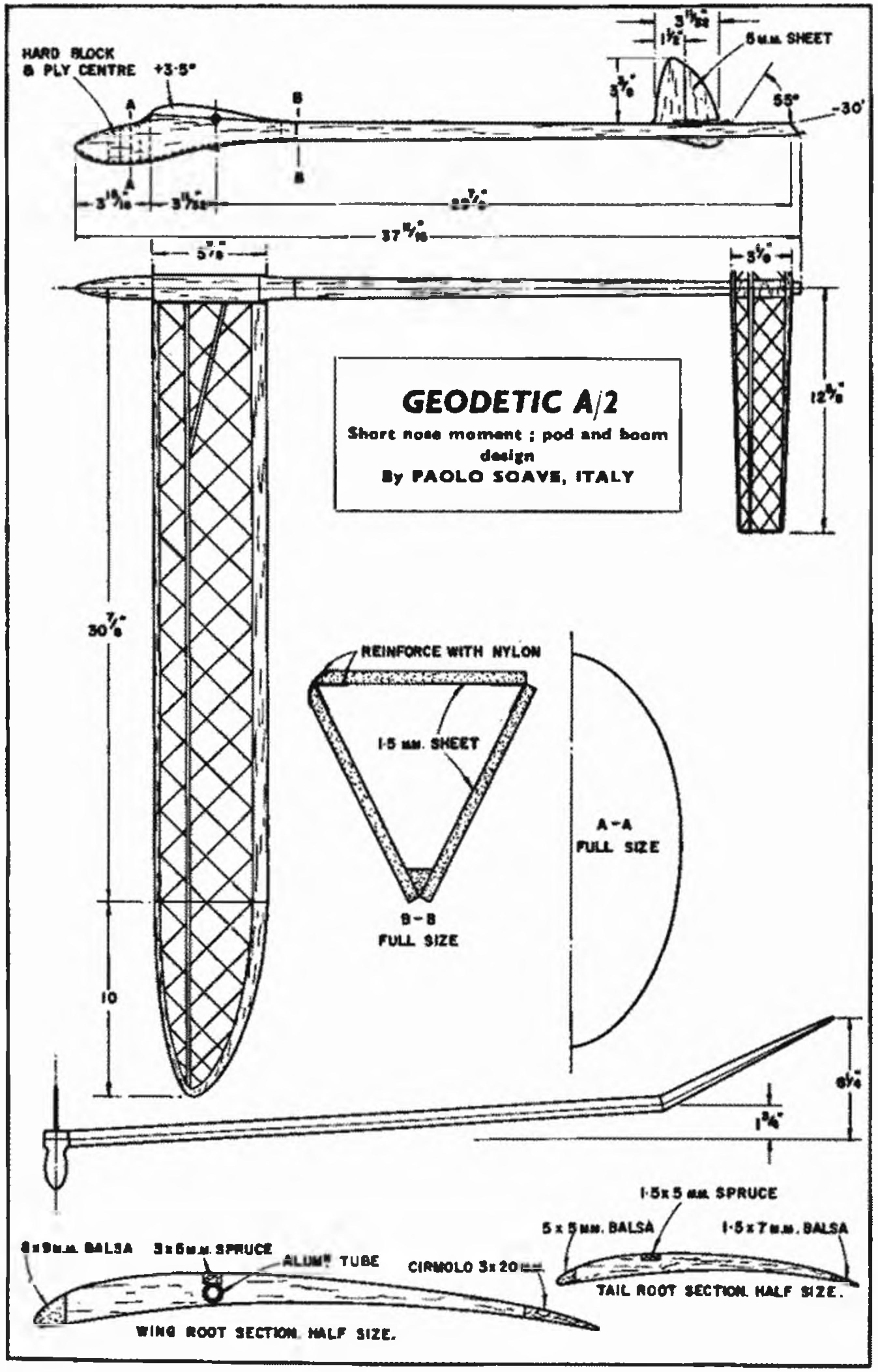

1958 A/2 WINNER
By Y. SATO
JAPAN
C.G. 60% OF CHORD
42"
+3°
22½"
-1½°
5MM SHEET
9½"
5¼"
3 15/16"
13¾"
2 7/16"
42¾"
2⅜"
B.B.
A.A
WING AREA 28dm²
TAIL " 5·4dm²
WEIGHT 411gr.
2x2MM. KIRIWOOD
1·5MM.
5x5MM.
25x3MM.
TAIL RIB. H-13
HALF SIZE.
1·2MM. RUBBER
1·5MM. SHEET
1·5MM. RIBS
3x40MM.
6x10MM.
WING RIB. H-12
HALF SIZE.
12°
Time : 706 secs.
(24, 180, 180, 180, 142)


SPECTRE
CANADIAN A/2
By DICK FOSTER
MONTREAL
39"
7"
C.G. 55% OF CHORD.
TOWHOOK 1⅜" FORWARD OF C.G.
SPRUCE SKID
TOWHOOK LOCATED SO THAT AUTO LINE DISENGAGES DIRECTLY BELOW C.G.
1/32" SHEET UNDER TAIL
WING TONGUE. 2 LAMS. OF STEAM SOFTENED 1/16" PLY.
WING BOXES. 6 RIBS OF 1/16" PLY, COVERED TOP & BOTTOM WITH ·6M.M. PLY. ONE BAY EXTRA ON BOTTOM. ROOT RIB FACED WITH 1/8" PLY.
WING DIAGONALS ARE 3/32" SQ.
10⅛"
3½"
35"
5½"
8"
WING SECTION. MAX. U/C - 3·5% AT 60%
" T/C - 9·6% " 40%
" THICK^S 6·0% " 30%
TAIL SECTION. MAX. U/C - 1/32" AT 40%
" T/C - 7·0% " 30%
" THICK^S 6·2% " 25%
3/16" SQ.
3/32" SQ. SPRUCE
1/8" SQ. SPRUCE RUNNER.
1/8" x 1" HARD
WING SECTION. HALF SIZE.
1/8" SQ.
3/32" x 1/16"
1/16" SQ.
3/32" x 1/2"
TAIL SECTION. HALF SIZE.
WEIGHTS
WING 7·0 ozs
TAIL 0·2 "
FUSELAGE (WITH NOSE WT.) 5·5 "
BALLAST 2·0 "
6½"
1½"

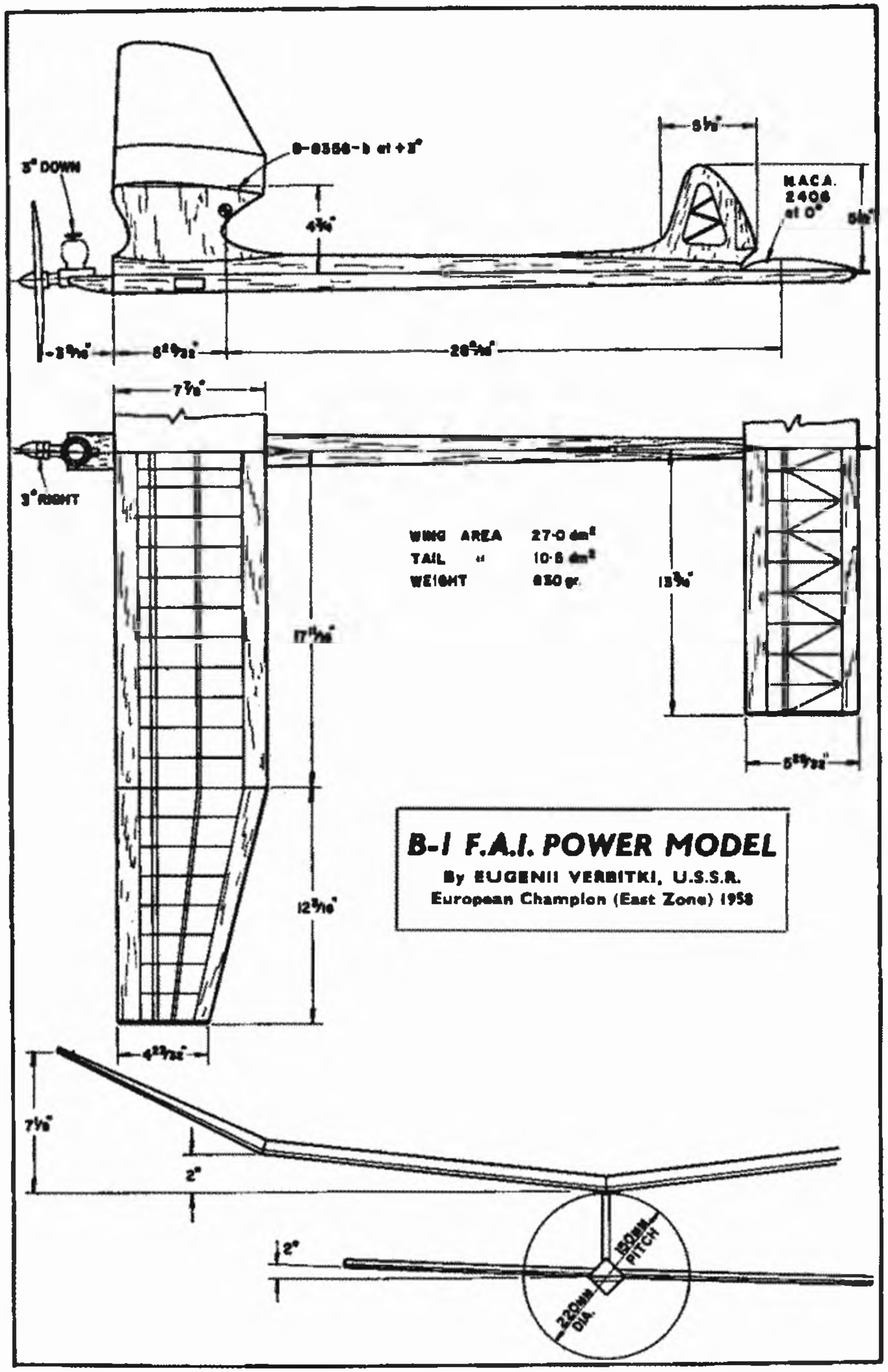


LETECKY MODELAR





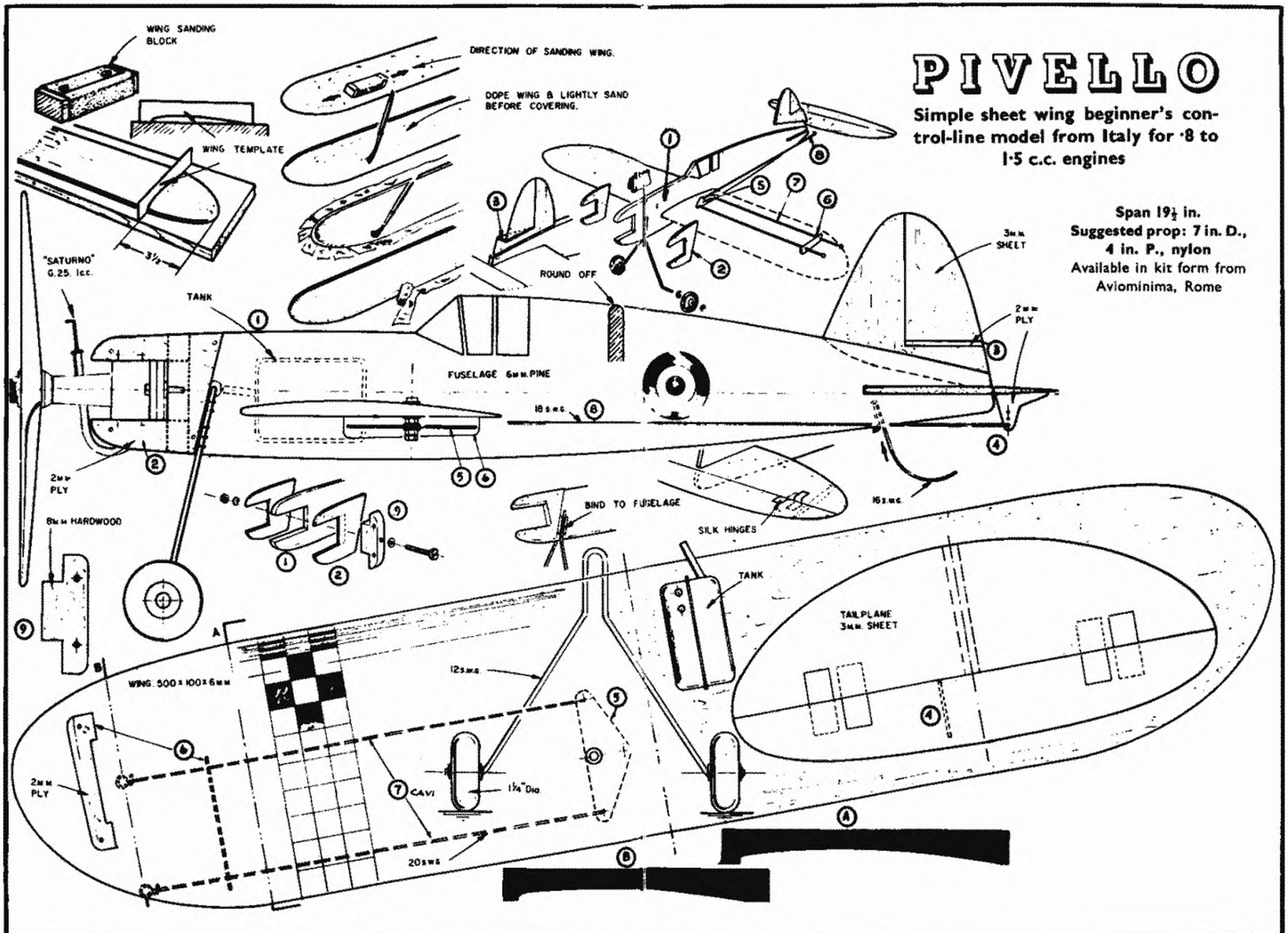
AEROMODELLISTA

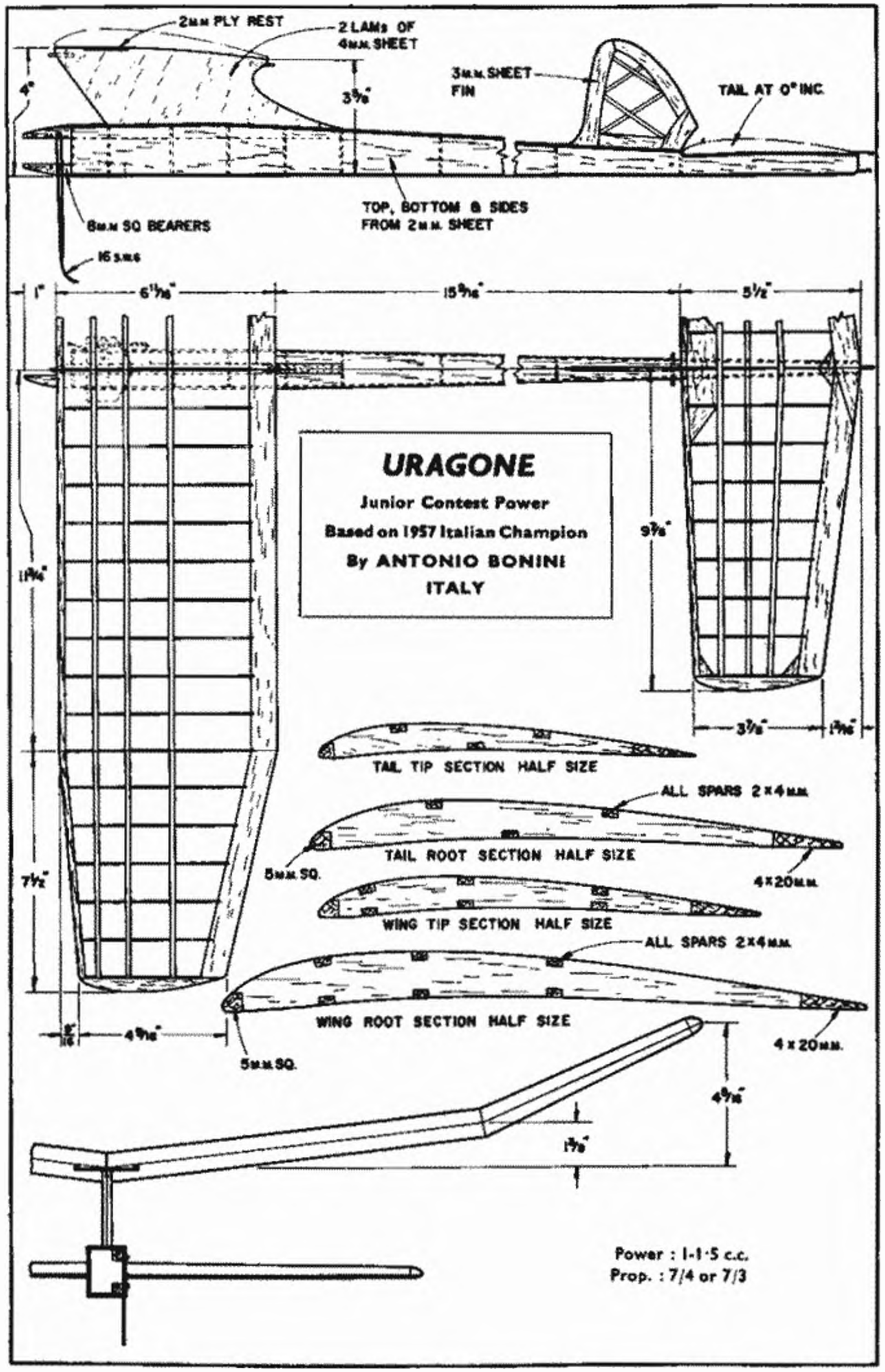


PIVELLO

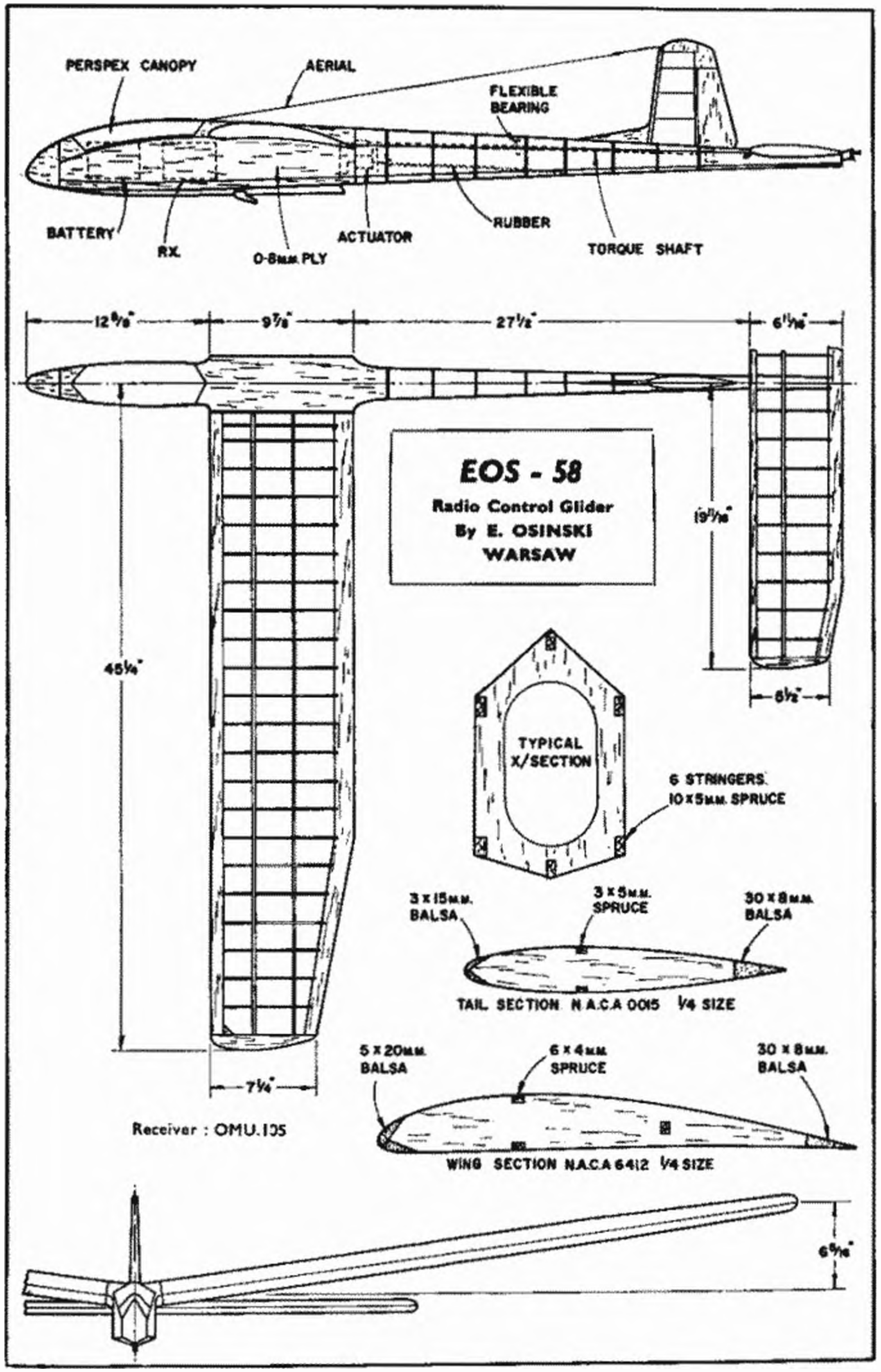
Simple sheet wing beginner's control-line model from Italy for ·8 to 1·5 c.c. engines

Span 19½ in.
Suggested prop: 7 in. D., 4 in. P., nylon
Available in kit form from Aviominima, Rome

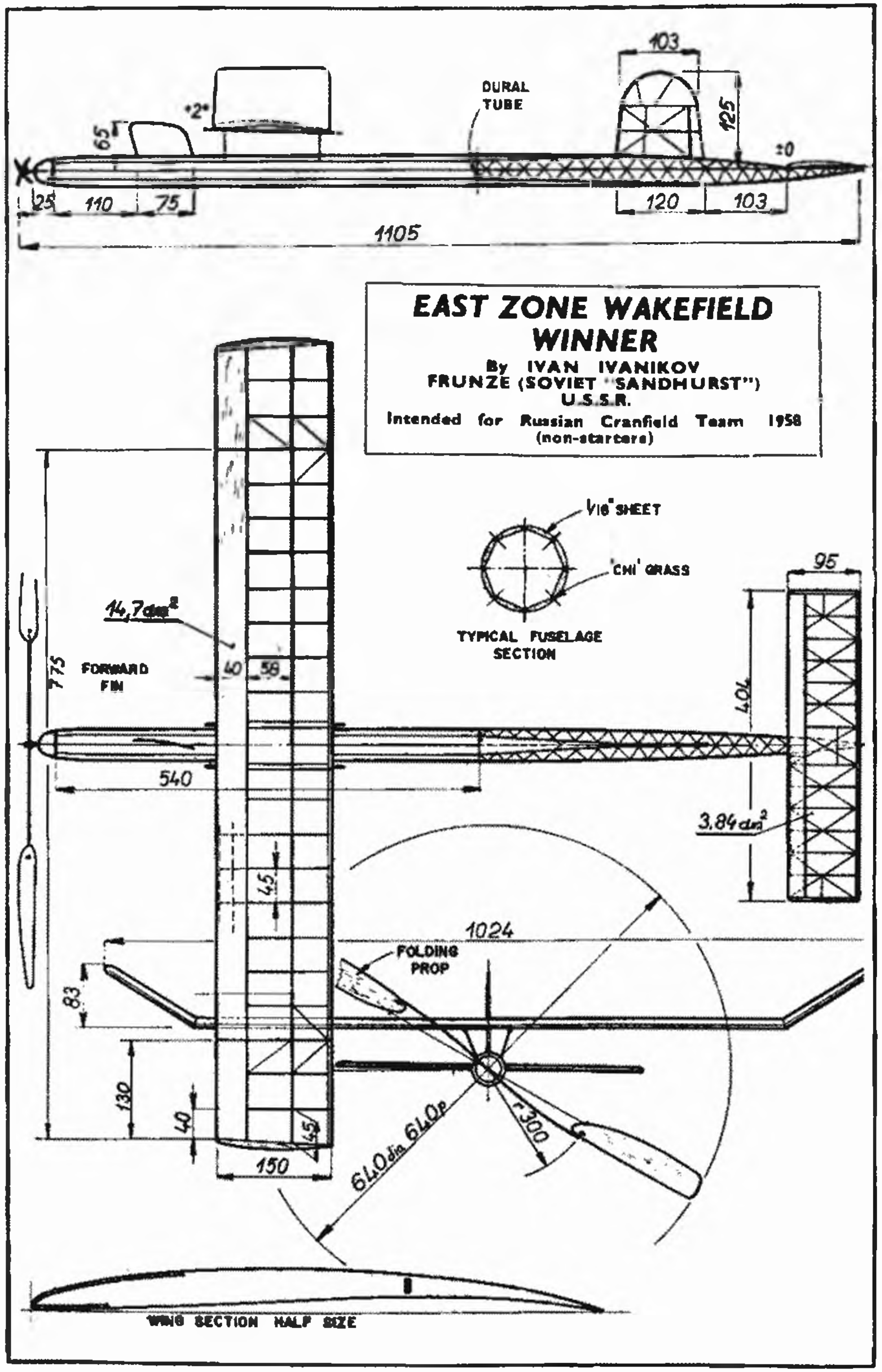




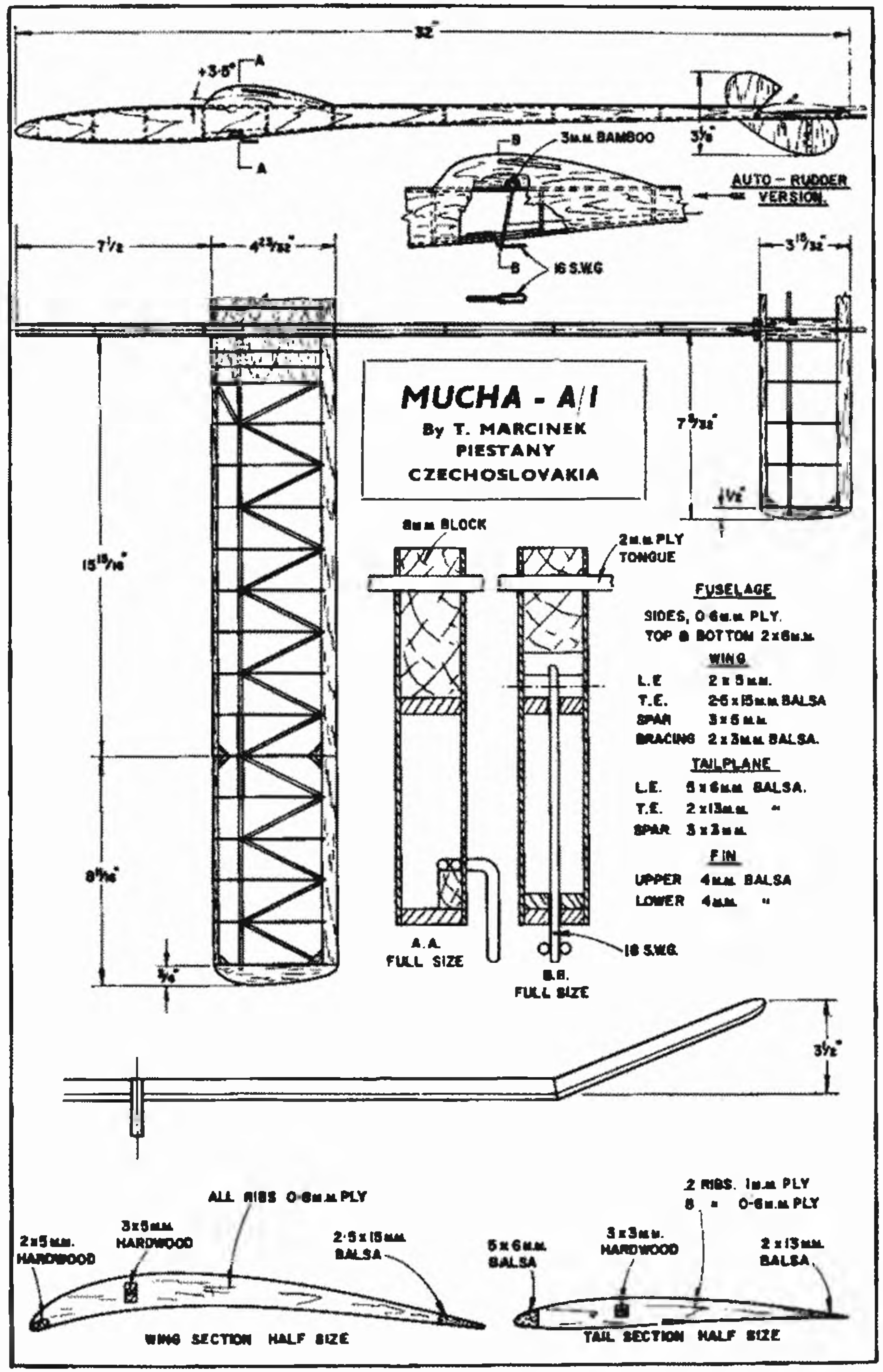
MODELLISMO



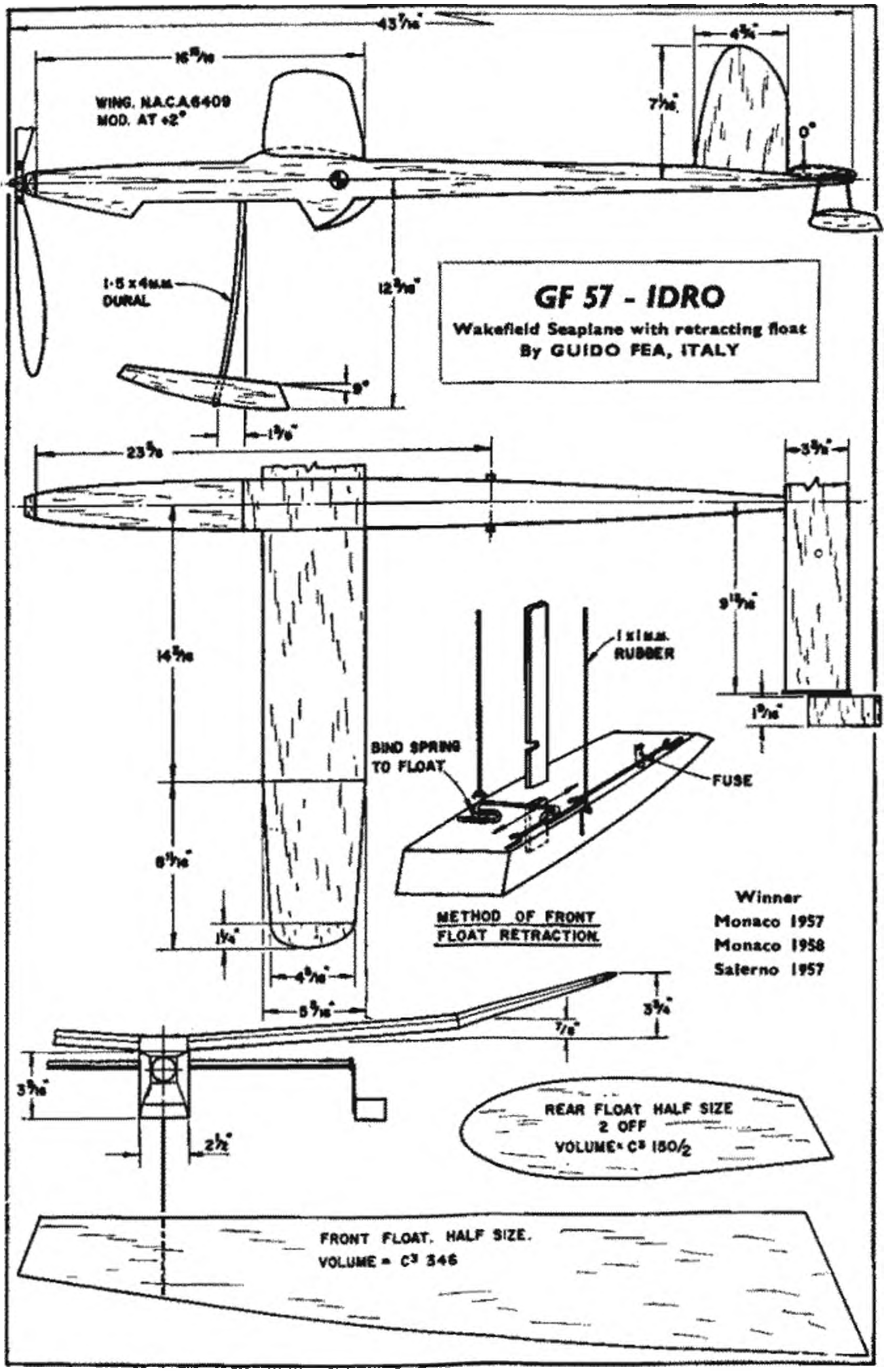
MODELARZ



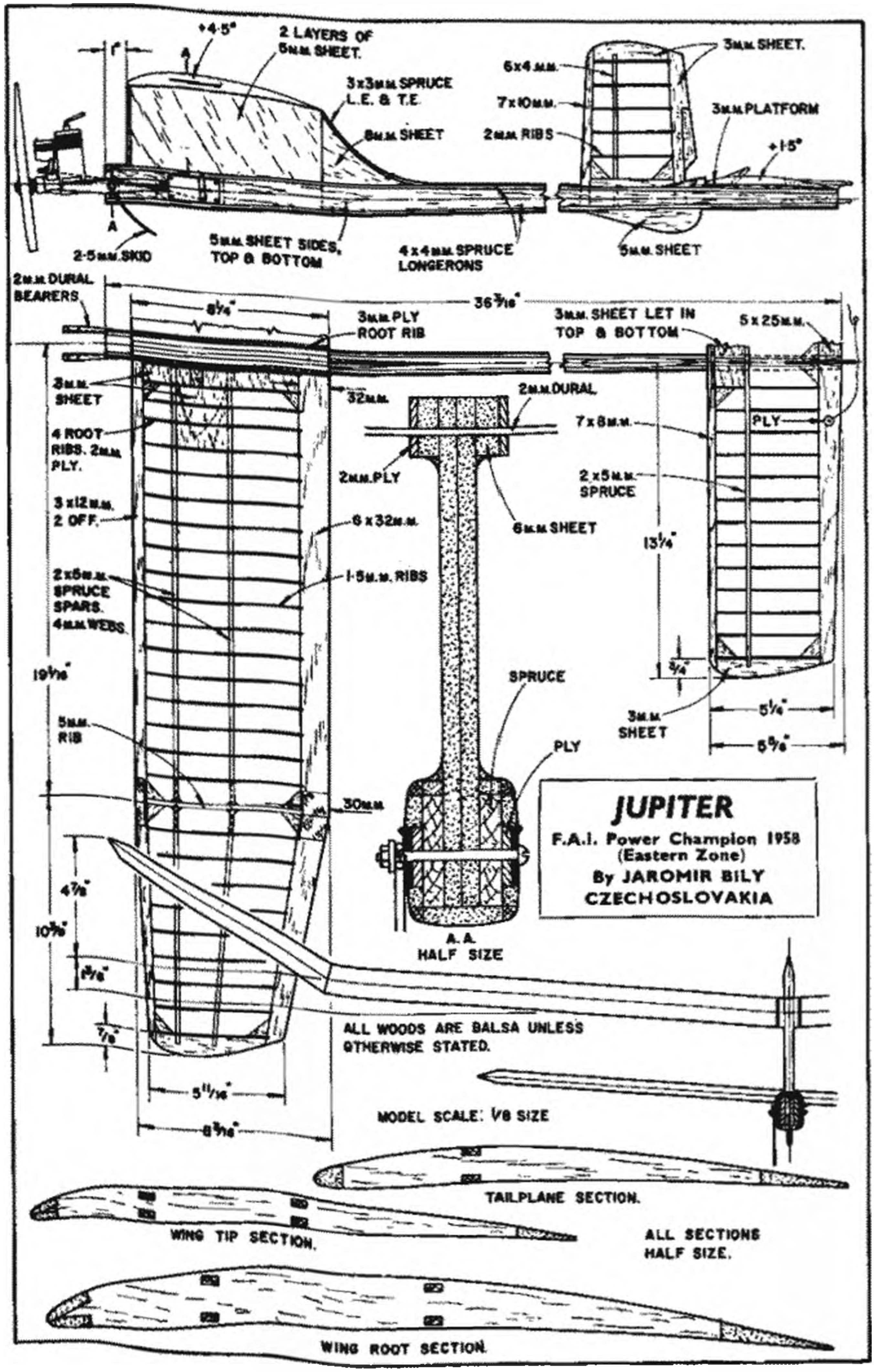
EAST ZONE WAKEFIELD WINNER
By IVAN IVANIKOV
FRUNZE (SOVIET "SANDHURST")
U.S.S.R.
Intended for Russian Cranfield Team 1958
(non-starters)
DURAL TUBE
103
125
65
+2°
±0
25
110
75
120
103
1105
1/16" SHEET
'CHI' GRASS
TYPICAL FUSELAGE SECTION
14,7dm²
FORWARD FIN
775
40
58
95
404
540
3.84dm²
45
1024
FOLDING PROP
83
130
40
45
150
r300
640dia 640p
WING SECTION HALF SIZE



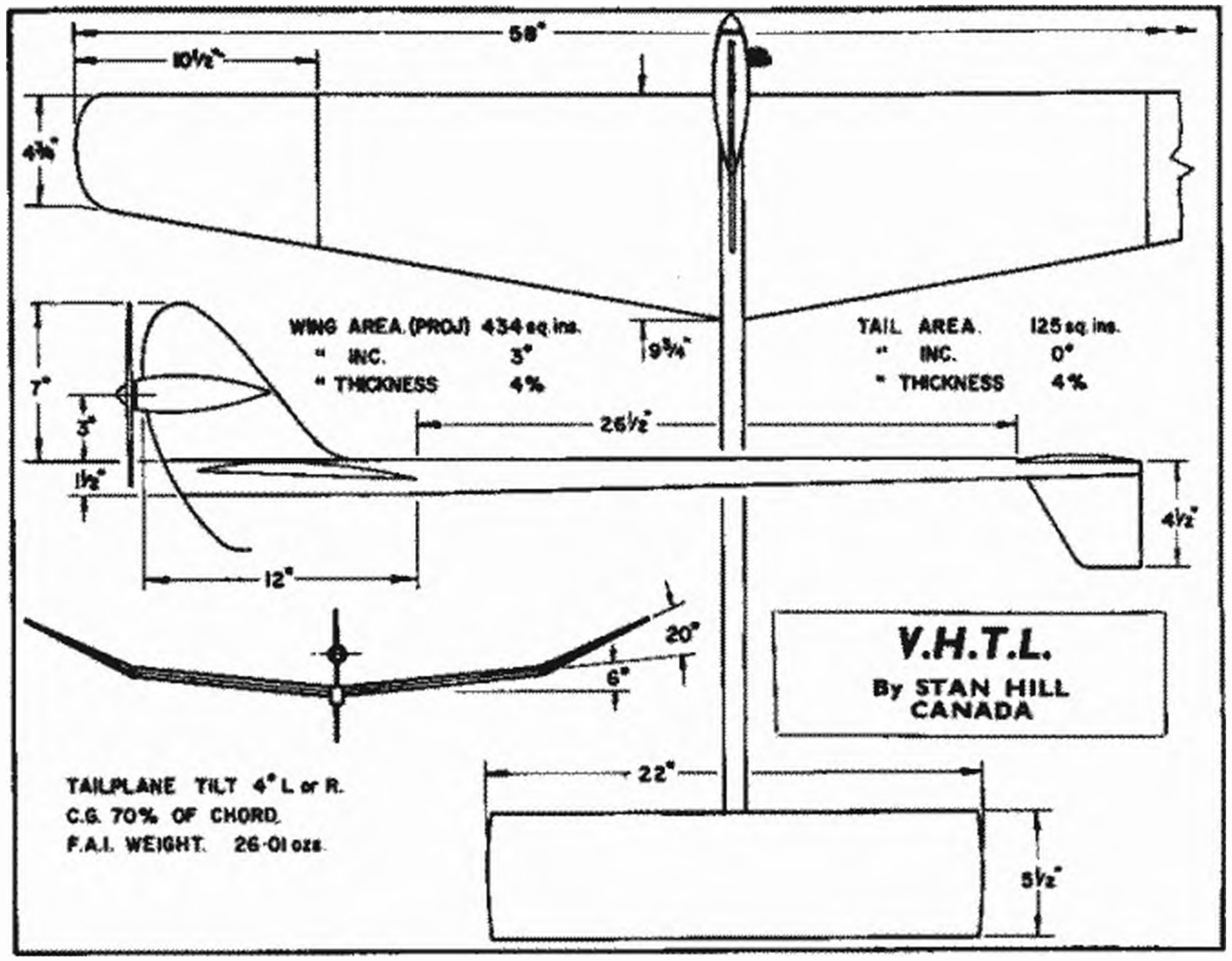
MUCHA - A/I
By T. MARCINEK
PIESTANY
CZECHOSLOVAKIA
32"
+3·5°
A
B
3MM BAMBOO
3½"
AUTO-RUDDER VERSION
16 S.W.G.
7½"
4 23/32"
3 15/32"
7 9/32"
1½"
15 15/16"
8 11/16"
¾"
8MM BLOCK
2MM PLY TONGUE
A.A. FULL SIZE
B.B. FULL SIZE
16 S.W.G.
FUSELAGE
SIDES, 0·6MM PLY.
TOP & BOTTOM 2x6MM
WING
L.E. 2 x 5MM.
T.E. 2·5 x 15MM BALSA
SPAR 3 x 5MM
BRACING 2 x 3MM BALSA.
TAILPLANE
L.E. 5 x 6MM BALSA.
T.E. 2 x 13MM "
SPAR 3 x 3MM
FIN
UPPER 4MM BALSA
LOWER 4MM "
3½"
ALL RIBS 0·8MM PLY
2x5MM. HARDWOOD
3x5MM HARDWOOD
2·5 x 15MM BALSA
WING SECTION HALF SIZE
2 RIBS. 1MM PLY
8 " 0·6MM PLY
5 x 6MM BALSA
3 x 3MM. HARDWOOD
2 x 13MM BALSA.
TAIL SECTION HALF SIZE

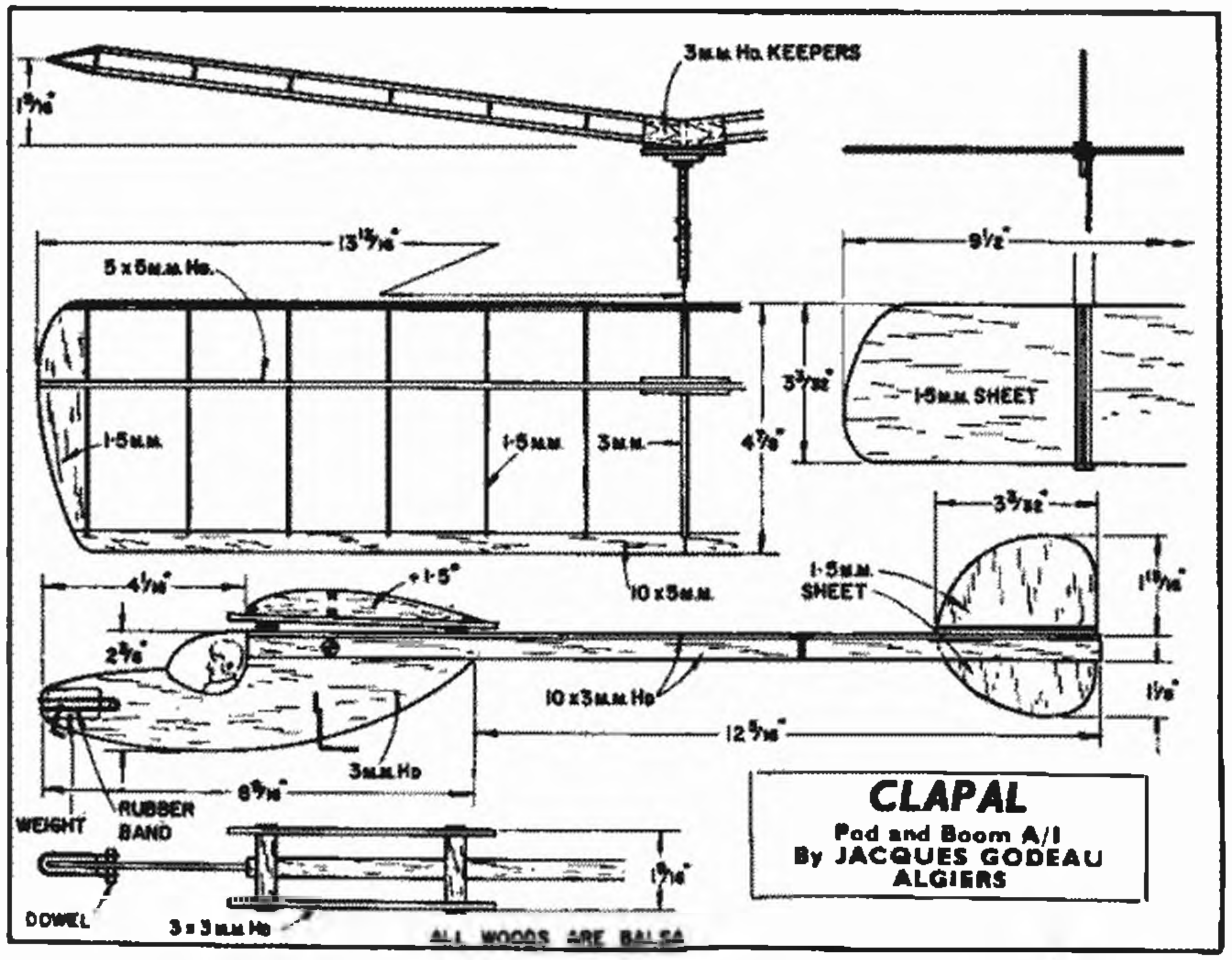


AEROMODELLISTA

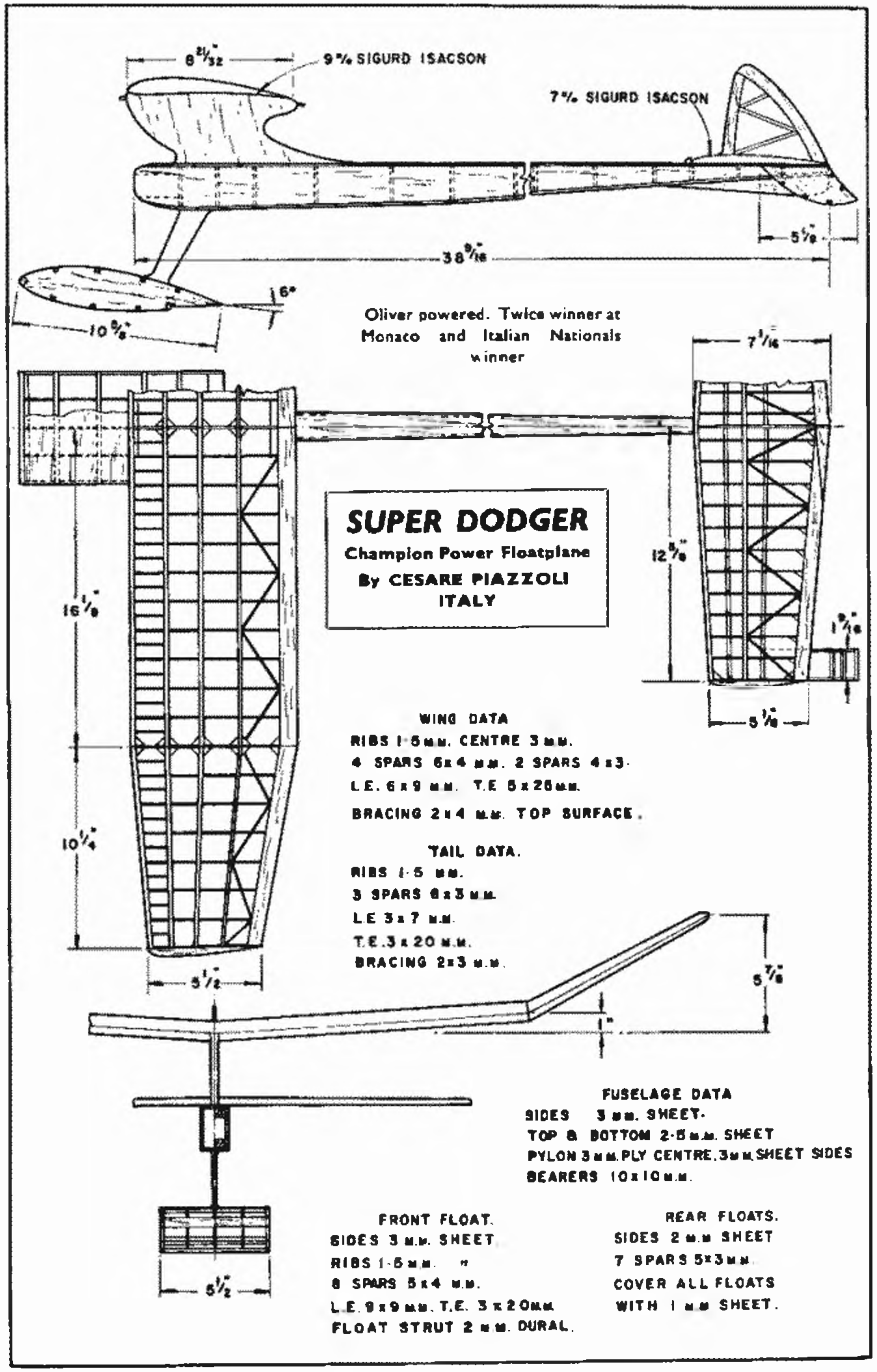


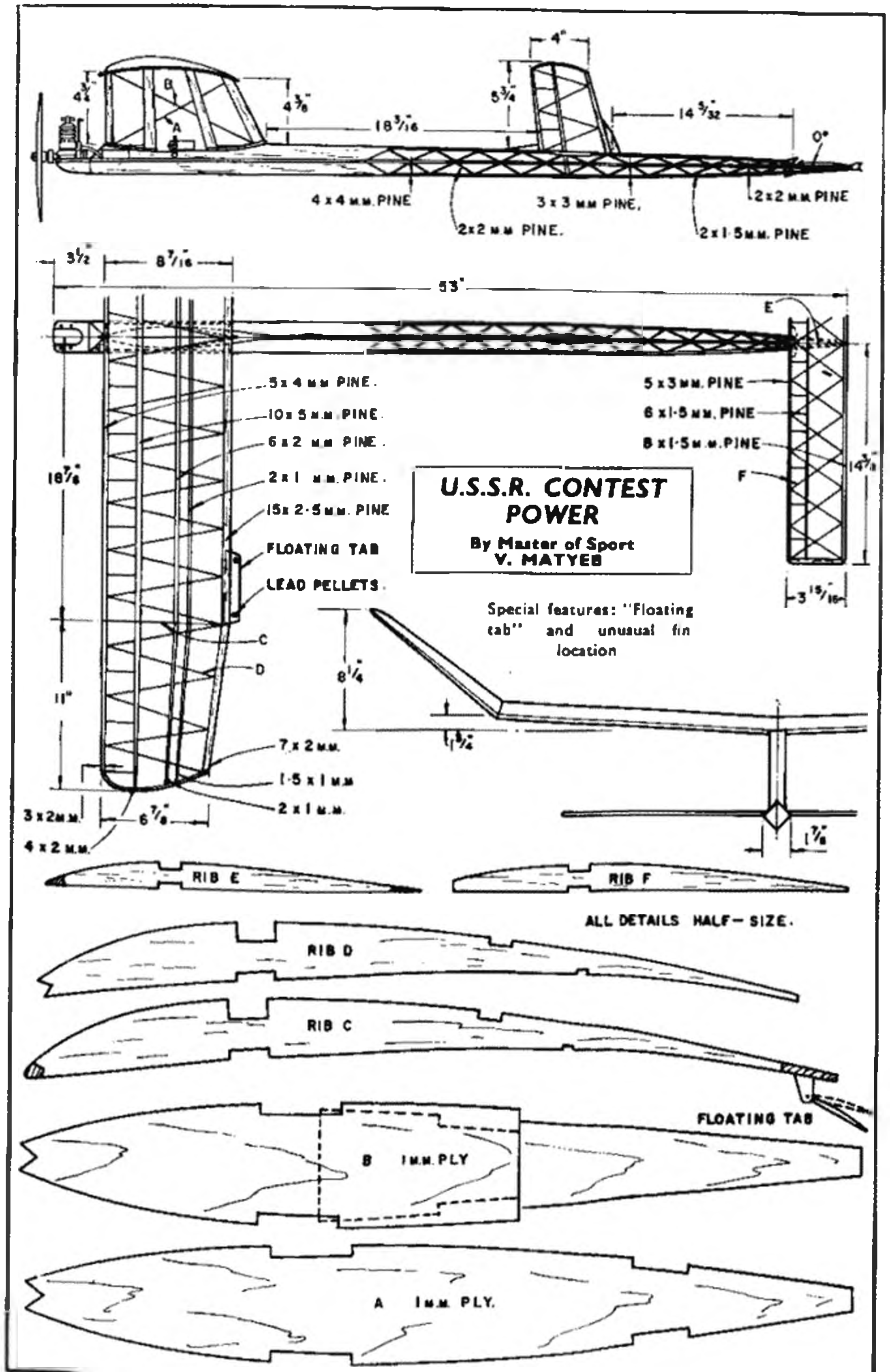
LETECKY MODELAR





MODELE MAGAZINE





"KNOW-HOW" ON ENGINE MATERIALS

THE USE of metals in aeromodelling is relatively limited, except they form the basis of all model aero engine assemblies. Here, basically, designers follow a more or less standard pattern for material selection, and some attempts at an "original" approach have been more noteworthy for their failure as a commercial proposition than anything else.

Shortly after World War II, for example, the American *Thor* engine appeared with an aluminium piston and cylinder, giving certain advantages, such as ease of production and equal expansion with good heat dissipation, but suffering from too many practical disadvantages to achieve any marked success. There is a distinct possibility that the "all aluminium" engine could now be made a success, with chrome plating or chrome diffusion now a practical proposition for producing a really hard-wearing surface on light alloys. This treatment is used for treating larger commercial aluminium cylinders for two-stroke engines—*e.g.*, the B.S.A. "Dandy" and N.S.U. "Quickly".

Basically, material selection is a compromise between production requirements and performance. Having arrived at a particular type of material, however, there is still the question of an exact specification. Cast iron as a particular material may be a logical choice for certain components, but there are literally thousands of different compositions of "cast iron" and good performance may depend entirely on choosing a particular specification or type. The days are past when engines were produced in small batches and stock for making the next batch was frequently purchased from the nearest scrap yard. "Majesco" engines, as a typical example—the first of the post-war engines to appear in Great Britain—were largely dependent on the acquisition of Austin Seven back axles for crankshaft stock, and sufficient old "Lo-Ex" pistons for castings.

Castings

Castings are applicable to parts which are not highly stressed and the material selected is invariably light alloy to minimise weight. Typical aluminium casting alloys contain between 2 and 13 per cent silicon, with or without other alloying elements. Silicon has the property of imparting excellent foundry characteristics to aluminium and so is always a constituent of a typical casting alloy. Although the tensile stress of such castings is low they maintain fair ductility and are not brittle.

Greater strength is achieved by a casting alloy containing magnesium, the full strength of such an alloy being realised by a heat treatment process. Aluminium-magnesium casting alloys, in general, are more difficult to cast but have greater strength and excellent resistance to sea water corrosion, besides having good machining properties. Silicon may or may not be used as a constituent to similar degrees in the alloy, but in the case of low magnesium casting alloys silicon must be present to produce effective response to heat treatment.

A limitation with an aluminium-silicon alloy casting is that it cannot be anodised and coloured satisfactorily. Anodising is basically a chemical treatment producing a durable, resistant oxide film on the surface of aluminium or an aluminium alloy, while colouring is imparted by a suitable dye. Where there is silicon present it tends to prevent proper and uniform penetration of the dye, giving a blotchy or uneven appearance.

Where an engine employs a cast head this has to be left plain, while a cylinder jacket (normally turned from dural or similar alloy) can be anodised successfully to improve the appearance of the engine. An alternative adopted in such cases is to paint the head with a suitable heat-resisting paint (*e.g.*, the K. & B. Torpedo), although this is far less durable than an anodic coating and usually discolours in service.

Similar limitations as regards anodising are also found with machining alloys. Here anodising may be quite practicable but some of the colours may lack clarity or consistency. The new Frog "100" affords a typical example where a gold anodised tone was chosen for the cylinder jacket but could not be applied to the spinner, which is blue. This is because the type of alloy which would "take" gold was too brittle to hold a thread on the blind bored hole in the spinner. Hence an alloy with better machining properties had to be used, with a restricted choice of anodised colours.

Most British engines specify an LAC type aluminium-silicon alloy for die-cast crankcases, and the Americans a similar United States specification. There are a whole variety of alloys in this group, but for the duty required choice is not at all critical. Alloys of this type are used for pressure die-castings, gravity die-castings and sand castings, although the latter are seldom used except for prototypes or short-run productions (see "Manufacture of Model Engines").

A lighter casting can be produced in magnesium alloy—*e.g.*, an "Elektron" type alloy which may contain up to 90 per cent magnesium (as distinct from aluminium-magnesium alloys which have a relatively low proportion of magnesium). Magnesium alloys formulated specifically for casting application have excellent foundry characteristics and can also be solution-treated or heat-treated to improve strength and ductility.

Such alloys are recognisable by a greenish colouration, although the finished casting may be chemically treated (chromated) to give a characteristic dull black finish—*e.g.*, the Mills ·75 and 1·3 and E.D. "Racer".

The smaller engines may have the crankcase unit machined from solid stock—*e.g.*, the American Cox engines are so produced ; also the first production batch of E.D. 3·46s had turned crankcases (in this instance because the die-castings had not come through in time). The choice of light alloy for turning may vary widely, depending on the requirements of the design, but logically would be special extruded bar with first-class machining properties. In this way consistency would be ensured.

About the only "working" part of the crankcase is the main bearing, which may be left plain, or sleeved, or the crankshaft carried on ball races. Design opinion has undergone a change during recent years in that plain bearings are now commonplace and generally accepted as giving an excellent performance, provided they are properly fitted and shaped initially. This is particularly true of the smaller engines although larger plain bearing engines (*e.g.*, 3·5 c.c. and above) are usually bushed.

Bearings

Choice of bushing material rests between cast iron, bronze and sintered semi-porous bronzes. White-metal bearings, as used on full-size internal-combustion engines, are quite unsuitable for models, since they fail quickly by cracking or crazing. Cast iron is an attractive material as far as performance is concerned, having very little wear and being easy to match to a good fit by honing or lapping. It is not so easy to machine as some of the bronzes although this is normally no restriction on its application. It must, however, be used with a really hard crankshaft, otherwise shaft wear will be high.

Bearing bronzes comprise a range of proprietary alloys combining good low friction properties with good machining qualities, and are a logical choice for bushings. There are a whole variety of such alloys readily available, any one of which would be a suitable choice. Merely specifying a "bronze", however, is not necessarily an automatic guarantee of the best bearing material. Phosphor bronze is not a good choice for, apart from being expensive, it is a very difficult metal to machine.

Sintered bronze bearings are usually manufactured in the form of flat steel strip coated with powdered bronze and sintered to form a permanently bonded laminate. The strip is then rolled into the form of a sleeve suitable for fitting and finished to bore size by normal techniques. The porous nature of a sintered bronze surface acts as an oil trap to improve lubrication along the length of the bearing. Further self-lubricating properties can be provided by introducing powdered graphite or similar impregnates in the bronze powder during fabrication.

The production of such bearing sleeves is a specialised job, manufacturers purchasing them ready-made for fitting in the form of complete sleeves. Extensive use is made of Vandervell bearings of this type in the range of Frog engines.

Crankshafts

Steel is the logical choice for the crankshaft, although again a wide variety of specifications may be applicable. The choice, basically, lies between mild steel, nickel steel and nickel-chrome steel, the material increasing both in strength and difficulty to machine in the same order.

Mild steel is very attractive from the production point of view, being very easy to machine. Ordinary mild steel would, however, be unsatisfactory in service, being too soft and wearing too rapidly (especially in a cast iron bush). Also ordinary mild steel covers a multitude of steels of varying properties, often lacking homogeneity. However, a leaded mild steel specified for machining is a different proposition, especially if the surface is toughened after finishing by case hardening. More and more manufacturers are turning from the tougher nickel steel to leaded steel crankshafts for easier production and producing suitable hardness and strength by heat treatment.

The type of hardening required is a surface hardness extending to a depth of some 10-15 thousandths of an inch. Hardening right through would be quite undesirable as the resulting shaft would be extremely brittle. After hardening, shafts are normally tempered to produce stress relief and avoid a brittle skin which could lead to cracks developing. In practice hardness is usually taken back to the extent that the metal will just mark with a file ; or even further so that the metal is not much *harder* than originally, but appreciably *stronger* as a result of the heat treatment.

Where an unhardened shaft is used, this is normally nickel steel or nickel-chrome steel for strength. American manufacturers favour an unhardened shaft, especially for their larger engines. In these cases bearing loads are lower and the design usually incorporates large bearing areas—*e.g.*, very large shaft diameters.

Unhardened shafts can bend without breaking in a crash—quite possibly ruining the engine by bending the main bearing also. A hardened shaft will normally fail by breaking without bending, depending on the degree of tempering. A shaft which breaks too readily may not be a material fault as much as a design fault or faulty hardening.

Cylinders

Choice of cylinder material lies broadly between a free cutting mild steel which can be surface hardened (or high-quality cast iron, such as Meehanite, which can be hardened by heat treatment), or a leaded mild steel which is used in the unhardened condition. The former is typical of British and Continental practice (virtually for all diesels), and the latter of American manufacturing practice. Apart from the fact that tolerances are not as critical on glow motors, a major reason for this different choice is a variance in manufacturing techniques. British and Continental cylinders are normally hand-honed to size ; most American cylinders are fully finished by machine tools. The former technique is suitable to a hardened surface and the latter more suited to a non-hard work surface.

This difference in technique is also expressed in the different external appearance of the finished engines. Americans widely employ cylinders with close-spaced integral fins of very thin section. If such a cylinder were hardened the fins would be extremely brittle and readily broken. Hence, relatively few British engines have appeared with integrally-finned cylinders and where they have the fins have been of generous thickness and more widely spaced.

Pistons ; Contra-Pistons ; Rings

The basic rule for matching cylinder-piston materials is "one hard and the other soft", so with a hardened cylinder one would select a soft piston (*e.g.*, cast iron or mild steel) ; and with a soft cylinder a hardened piston (case-hardening steel or heat-treatable cast iron). Some designers break the rule, but none with outstanding success. The J.-B. "Atom" featured a hardened cylinder and piston but if it erred slightly on the tight side when initially fitted it would literally have to wear out the other running parts of the engine before the piston-cylinder fit had worn loose. At the other extreme a soft piston in a soft cylinder usually means a short life engine, with high piston wear.

With a soft and a hard surface in rubbing contact wear is highest on the *harder* surface and so on this basis one would anticipate the cylinder on a conventional British engine to wear more than the piston ; and the piston to wear more rapidly than the cylinder on an American glow motor. The latter, it will be appreciated, yields the shorter engine life and the quickest loss of compression seal. This is more tolerable with a glow motor than with a diesel, hence the British way would appear the best for diesels and "long life" engines ; while the American choice is better suited to more fully automatic production techniques, especially the mass production of glow motors at a low unit cost. The Cox factory, it has been stated, has a production rate in excess of one thousand engines per day, on a battery of machines.

Cast iron (typically Meehanite) is a favourite choice for unhardened pistons in a hardened bore. A leaded soft steel is an alternative choice, mainly on account of being easier to fabricate. This usually produces a piston which is more prone to seize when the engine is new, but once properly run-in has a somewhat lower coefficient of friction than cast iron. Hardened pistons, where employed, may be of heat-treatable cast iron or steel. A hardened steel piston may be used in a hard or semi-hard cylinder on small diesels to maintain a good compression seal, but is normally employed with a soft cylinder.

In a larger size of engine—particularly glow engines—where piston rings become a practical proposition, the piston becomes a "carrier" rather than a sealing device. Hence, it can be made appreciably undersize relative to the bore, the degree of undersize tolerable being sufficient to accommodate the differential expansion of a light alloy compared with the steel cylinder. Hence, a light alloy becomes a logical choice for the piston, both to reduce the weight of this reciprocating component and also to accommodate any particular form of contoured head without complicated machining operations by casting the piston to shape. A typical low-expansion cylinder alloy would be the logical choice for a casting or, if machined from solid, extruded bar of similar specification, although the same alloy as that used for crankcases is commonly used.

Cast iron is the normal choice for piston rings, usually bought in standard sizes from specialist manufacturers. There is no reason, however, why hardened steel rings should not give equally good service, or even phosphor bronze rings (although the latter would be more tricky to fabricate).

The contra-piston—peculiar to the diesel—usually follows piston material choice, although not invariably. Much the same considerations apply. A cast iron contra-piston usually has the nicest "feel" and is easiest to size for the ideal smooth but tight fit. Since there is no "running-in" wear with a contra-piston a mild steel piston may have a tendency to seize when hot so that it will not follow the screw when the compression is backed off.

A hardened contra-piston approaches the ideal, provided the initial fit is correct. If not, then it will either remain consistently too loose or too tight.

Some Continental diesels employ a dural contra-piston, which is an unfortunate choice of material. The coefficient of expansion of light alloys is usually appreciably higher than that of steels, except for the specialised low-expansion light alloys. Hence, as the engine heats up the contra-piston tends to seize solid. The usual result is a contra-piston which is too loose to start with but completely seizes up as soon as the engine has run for a short period, making any further compression adjustment impossible.

Another solution is to provide the necessary seal by some other means—*e.g.*, an O-ring—when the contra-piston can have a generous clearance between the cylinder walls and hence virtually any material from soft aluminium up could be used. Practice has shown that contra-pistons with O-ring seals are quite effective in practice. They were first introduced in America on the O.K. diesel, followed by the McCoy ·049 diesel. The only British engine to employ an O-ringed contra-piston is the Frog "80". The chief attraction of this type of design is that the contra-piston can be a simple turning and does not have to be fitted to the cylinder, and is much cheaper to produce. The only disadvantage is that the "feel" of the contra-piston setting is completely destroyed, which makes it more difficult to establish the correct compression setting for starting. This lack of feel is partly due to the O-ring action (which has a varying seal force, depending on the pressure acting upon it), and the fact that an elastic friction lock or similar device has to be used on the head to provide effective locking of the compression screw at any particular setting.

Connecting Rods

The connecting rod, linking the piston to the crankshaft, is subject to very heavy loads in a diesel, demanding the use of a high-strength material. At the same time light weight is important to minimise inertia loads. For these reasons the first choice material is usually a high-strength light alloy of the aluminium-copper group where maximum strength is realised by heat treatment. The strongest form of this alloy is a forging which, by virtue of the metal being compressed to shape, results in the best grain flow pattern and maximum "column" strength.

Again this is a specialised production job and where a particular design is not felt to jusitfy the expense of a sub-contract order the rod may be machined from forged bar stock of similar specification (*e.g.*, RR 56) or turned from another high-strength light alloy, such as dural.

The strength of such alloys may be equivalent to that of steel, while a steel connecting rod of the same size would be appreciably heavier. Thus, to compare in weight the steel rod must be sectioned, or reduced in cross section and hardened to improve its strength. A hardened steel con. rod is not necessarily a solution since it may produce rapid wear at the crankpin and gudgeon pin.

Where the connecting rod is less heavily stressed, as in glow motors, light alloy machinings or even castings may be used or, on small engines again, soft steel. There is little risk of bending a soft steel con. rod on such engines for they are not liable to be turned over by hand in a "hydraulic-locked" condition, as often happens with diesels.

Miscellaneous Parts

Dealing briefly with the remaining components of the engine—the gudgeon pin is usually silver steel, principally because this is a suitable hard material readily available in a variety of stock sizes ground to close limits. As a material silver steel tends to be a little more brittle than nickel steel, calling for a slightly larger size of pin than would be adequate in this material.

For the disc valve in rotary induction engines, metal does not appear a good choice. Casting is a logical—and cheap—method of producing the disc in light alloy, but a cast or machined disc usually shows high wear on its mounting pin and subsequently leaks. Tufnol (a thermoset plastic laminate) is undoubtedly a better material.

Most of the other components called for are covered by a dural-type light alloy. Cylinder jackets are almost invariably turned from dural, which can be reduced to attractively thin fins (although not as thin as steel finning without being too weak and easily broken). Machined heads and crankcase backplates are also turned from dural.

The propeller driver is commonly dural again, machined to fit a taper on the shaft or a keyway, or splines. In the latter case a softer alloy may be preferred so that the splines cut into the driver when first fitted. A taper fit usually provides the most positive centering, and may be a pure friction fit or employ a brass split collet.

Brass is the common choice for spraybars and is also the easiest material for drilling a *straight* small diameter hole. The harder the brass the easier it is to drill an accurate hole, but at the same time the metal is more brittle. Dural is an alternative material, less easy to drill accurately but clean cutting for threads and less liable to corrosion with some of the more potent glow fuel mixtures.

For the same reason a fabricated brass tank is not always a wise choice, especially if buried in a control-line model installation. Tinplate seems to withstand fuel attack better. On a production basis, however, fabricated tanks are out as integral fittings with a commercial engine. The usual solution is a metal tank—cast, turned from solid, or spun, according to production facilities and capital investment available ; or a moulded plastic tank. In the latter case, only nylon has proved a suitable material for withstanding virtually all fuels without warping or becoming excessively brittle through contact with fuels.

STRESS AND STRAIN IN MODEL STRUCTURES

By M. S. Pressnell

PERHAPS the aeromodelling topic about which least is known is the behaviour of our model aeroplane structures. Balsa structures are very strong for their weight and hence ideal for their purpose. In fact the usual type of model structure leaves little to be desired, its design is fairly simple and its construction straightforward. However, for those whom this may interest, the following is a look at the load-carrying capabilities and behaviour of some of these structures.

Basically, we must understand three types of loading, and the resulting stresses and strains. These are bending, shearing, and twisting. Let's look at the way the first two occur in the case of an A/2 wing. Figure 1 shows a probable spanwise distribution of loading and its corresponding shear and bending moment diagrams. The shear and bending moment at any point is found by adding up these respective quantities outboard of the point in question. The most highly loaded point is, of course, the wing root. Here the shear will be about 7 ounces, *i.e.*, half the lift in flight. The root bending moment is 108 oz./in. To understand what this means suppose the bending moment is carried by four spars, two above and two below. Let the wing be about 0·5 in. thick. Then the compressive load in one of the upper spars is about 100 ozs.

In a sudden upgust these loads may be nearly doubled, and in the case of a fast tow and a sudden upgust a factor of six is not unlikely. The wing root is, then, a most important structure.

It can easily be seen that in bending a component one introduces compression in one side and tension in the other. The axis between the two along which no strain occurs is known as the neutral axis and passes through the centroid of the cross sectional area. Suppose we are considering a deep rectangular wing spar. Figure 2a shows the strain distribution through the depth, due to a bending

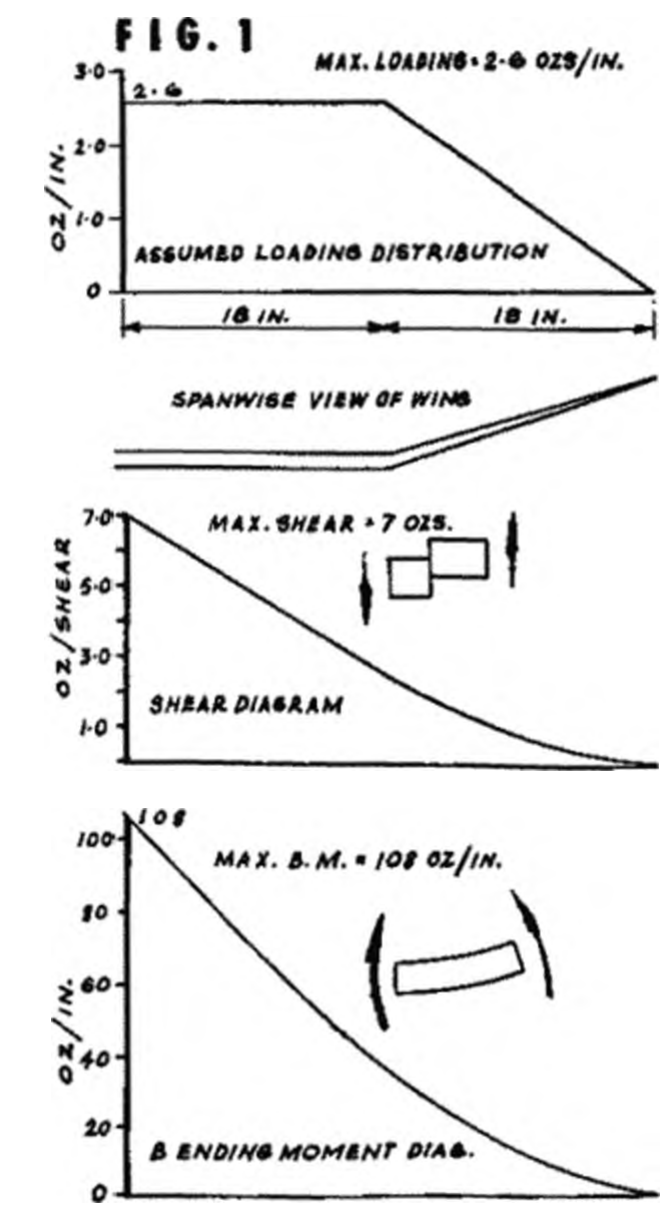


Fig. 1.—Assumed spanwise loading diagram and its corresponding shear and bending moment diagram. Notice how rapidly the loading increases towards the centre section.

FIG. 2

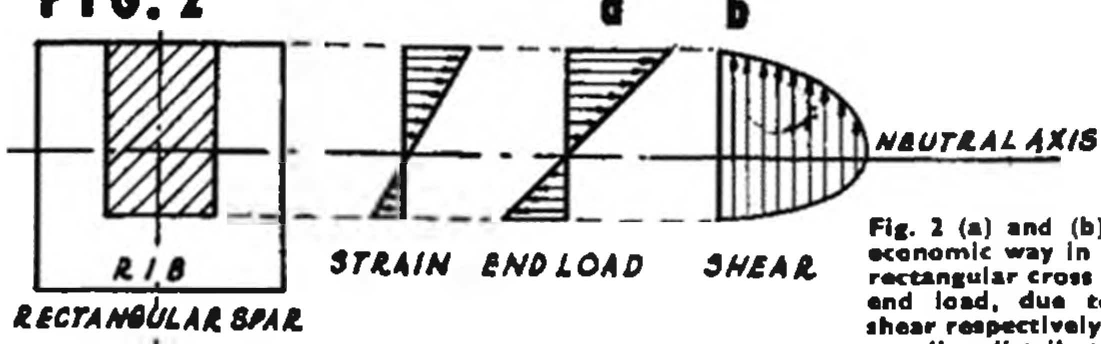


Fig. 2 (a) and (b) shows the uneconomic way in which a spar of rectangular cross section carries end load, due to bending and shear respectively. Loads are not equally distributed across the depth of the spar.

load. This is simply related to the diagram showing end load distributed through the depth. Near the neutral axis it is seen that the load carried is small. It may be concluded that the spar is being used uneconomically, since not all its depth is at the same high stress. This defect is largely overcome in the case of the "I" section spar which concentrates the timber in the region of biggest strain. See Fig. 3a. In this way most wood is carrying high loads, and it is quite remarkable the increase in bending stiffness which may be obtained by introducing flanged spars, without incurring any weight penalty. A secondary advantage is that without the deep notches otherwise necessary, the ribs are much stronger.

Consider the shear loads in the spars. For the rectangular spars, the stress distribution is shown in Fig. 2b. It is parabolic in shape, largest near the neutral axis and zero at the outside. Again this is an uneconomic distribution. Now consider the "I" section spar, as shown in Fig. 3b. The stress is greatest and nearly constant in the web. This is an economical state of affairs and hence the "I" spar provides the best way of carrying both bending and shear loads.

The web also stiffens, and prevents the upper flange from buckling under compression. Yet another function of the web is shown in Fig. 4. In (a) the flanges tend to bend separately and so distort and crack the ribs; (b) shows the effect of the web in causing the spar to bend as a whole. It is only in this latter case that the full bending stiffness of the "I" section is achieved.

The third type of loading to discuss is twisting. To illustrate certain results the following is an interesting experiment to carry out. Take a piece of card and fold it into any shape tube. A square tube is shown in Fig. 5a. Make a mark across the overlapping edges. Now twist the tube, noticing the movement of the marks, and feeling the rigidity of it. The stiffness is proportional to the perimeter of the tube and does not depend on the shape or cross sectional area, indeed the same stiffness would result by twisting the originally flat piece of card. This we refer to as an open tube or channel section. Next glue up the overlap and twist the tube again. You will find the stiffness to have considerably increased. The marks can no longer move relative to each other, and this closing

FIG. 3

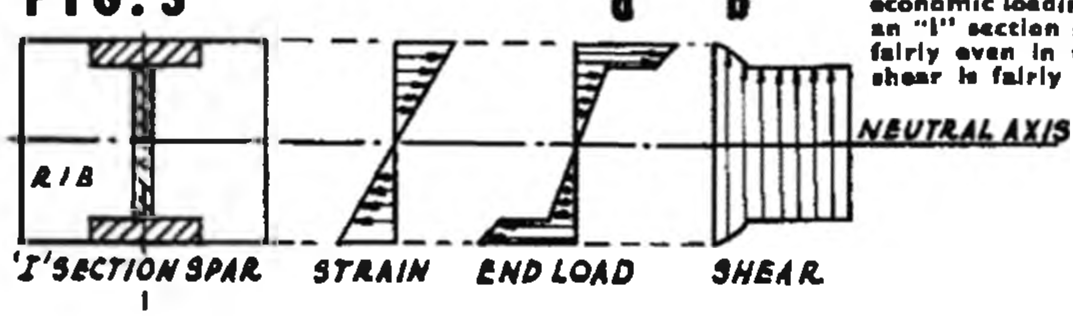


Fig. 3 (a) and (b).—The more economic loading distributions in an "I" section spar. End load is fairly even in the flanges, while shear is fairly even in the web.

FIG. 4a

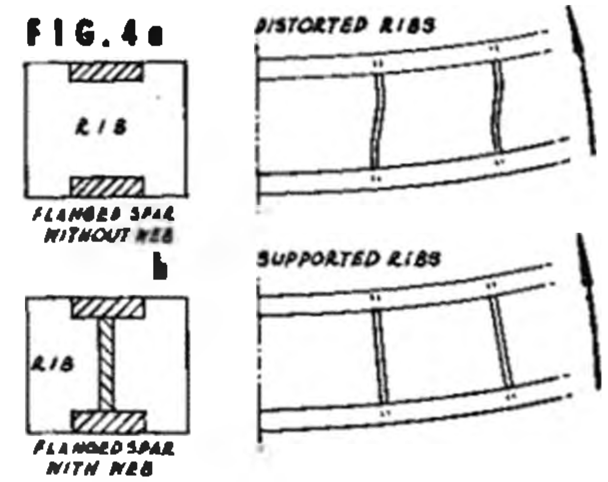


Fig. 4.—The effect of the web in supporting the ribs. In (a) the flanges bend separately, whereas in (b) the structure bends as a whole. Without a web the full stiffness attainable with an "I" section is not achieved.

FIG. 5

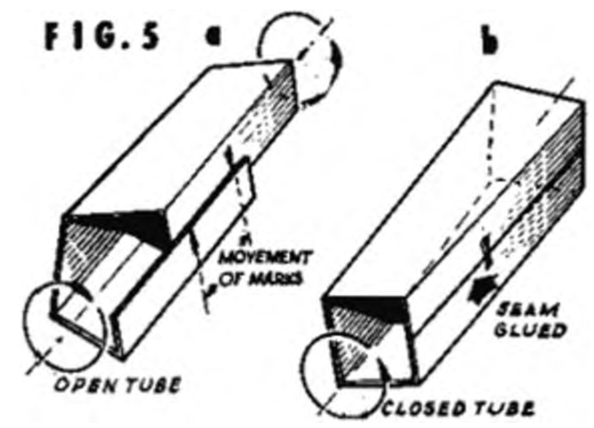


Fig. 5.—A simple experiment which may be carried out to demonstrate the rigidity of tubes in torsion.

of the tube enables a shear stress to be sustained running round the perimeter of the section, rather than through the thickness as in the previous case. This accounts for the increase in stiffness, which is now proportional to the enclosed area of the tube. If the tube, be it a wing or a fuselage, contains some lengthwise stringers its torsional rigidity may be further increased by the bending of these members. This is most important in the case of an open tube.

An example of the first case is a sheeted leading edge. The sheeting gives little torsional rigidity although it is useful in taking bending loads. If the weight may be permitted, the sheeting may be extended on the underside and the tube so formed closed by a web. This gives remarkable torsional rigidity without resorting to the complication of geodetic ribs.

A wing, when covered, is a closed tube and so falls into the second category described above. The tissue acts as shear panels and provides the majority of twisting stiffness. In a heavy landing the wing may be severely twisted and it is not uncommon for the tissue to fail in shear as a result. The failure occurs in the directions of greatest shear stress, *i.e.*, along the ribs or spars, and is often referred to as shock tearing.

Perhaps the best example of a torsion tube is a rubber model fuselage. This is also a strut since it is in compression due to the tension in the rubber motor. Torsion is applied to the fuselage at the rear motor peg, and in flight this is equilibriated by a slight asymmetric wing loading. It is then only the fuselage between the peg and wing mount that is in torsion. When you hold a wound rubber model on the ground prior to launching the torque is equilibriated at the place you hold the fuselage. It is therefore desirable to hold the model at the rear mount so that no part of the fuselage is strained before flight. In flight the shear stresses are greatest at the point of minimum cross section area, near the motor mount. This may be verified by twisting a fuselage, when it will be noticed that the tissue wrinkles or buckles first at the rear fuselage. Double covering or extra dope is recommended to give the additional strength required here. It is worth observing that any cut-out in a fuselage, such as hatches or an uncovered wing mount, makes the fuselage at that point into an open tube with the consequent stress concentrations and loss of stiffness. To overcome this a

FIG. 6

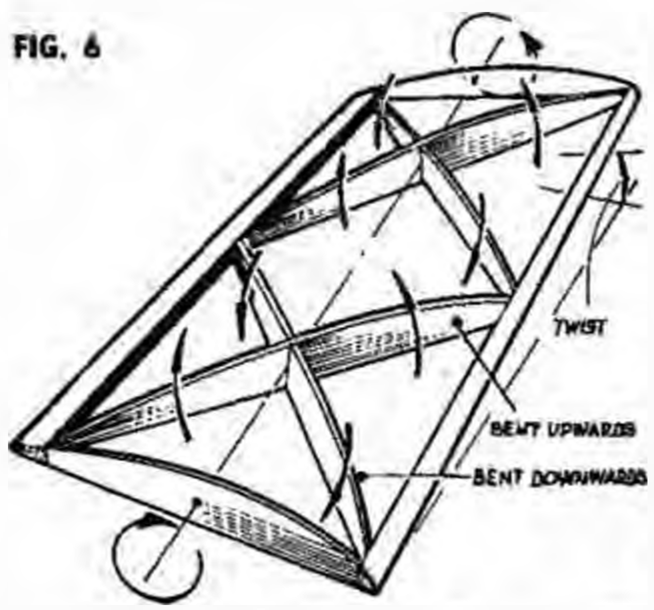


Fig. 6.—A twisted geodetic structure to an exaggerated scale. Ribs running in one direction are bent upwards while the remainder are bent downwards.

secondary, Warren Girder type, structure may be employed to replace the missing tissue.

Another method of providing torsional stiffness in wings is the use of geodetic ribs. A twisted geodetic structure is shown in Figure 6. It gains its strength from the fact that the ribs are put both in tension and compression. In fact, the ribs act as beams taking bending loads. Further improvement may be had by using capstrips which make the ribs into an "I" section. From a structural point of view the best angle for the ribs is at 55 deg. to the leading edge. In this way they carry the warping loads with the minimum distortion.

Failure in a model structure often occurs due to buckling or local crippling of some compression member suddenly overloaded. Spars and longerons are the usual victims. Buckling loads in such members are inversely proportional to the square of their lengths. In other words, doubling the distance between wing ribs, for instance, will reduce the buckling strength of the upper spars by about 75 per cent. There is good reason, then, to space ribs more closely towards the centre section of our wings, where the end load in the spars, which causes buckling, is greatest. The tissue tends to stabilise spars in the plane of the surface, and a web, if one is used, will stabilise the flanges perpendicularly to the surface.

Other failures occur as a result of inertia loads, most common in landing accidents . . . wings break in half, fuselages break at the back, undercarriages cave in, tailplane leading edges collapse . . .; in general, heavy components move forward on impact. It is difficult to avoid weight concentrations and the only cure seems to be the use of local stiffening. It is a wise precaution to support longerons just in front of wing mounts, especially in the case of diamond rubber job fuselages, where the single top longeron often fails in a crash. Another refinement is the use of diagonal struts in a fuselage nose or behind the undercarriage attachment. If longerons and struts are the same cross sectional area the struts give best results if placed at 60 deg. to the longerons. If the strut is to be half the cross section of the longeron an angle of 69 deg. is better.

In conclusion, concentrations of strength and weaknesses should be avoided at all costs and local bracing used sparingly, only at points where failure is most likely to occur. Think about how each component is loaded and try to make its size suit its load. Choose true, straight-grained timber for the main members, especially if made from spruce. Lastly, try to put balsa cement in the joints as well as around them.

CAPACITY CONVERSION TABLES

These tables enable rapid conversion from cubic centimetres (c.c.) into cu. in., the former being the standard for measurement of engine size in Britain and Continental Europe, while cubic inch units are used in America.

The bottom table gives instantaneous conversion of c.c. values given to one decimal place, by reading across from the "unit" value to the column under the appropriate decimal fraction, e.g., to find the cu. in. equivalent of 2·4 c.c. read across from the 2 c.c. line until under the ·4 column heading. Answer: ·146 cu. in.

The top table can be used for more precise conversion when the original figure for c.c. capacity contains two decimal figures. In this case the unit conversion is read from the second table and added to the fraction conversion obtained from the first table.

e.g., to find the cu. in. equivalent of 2·46 c.c.

From the second table ... ... 2 c.c. = ·122 cu. in.

From the first table ... ... ·46 c.c. = ·0281 cu. in.

Thus ... ... 2·46 c.c. = ·150 cu. in.

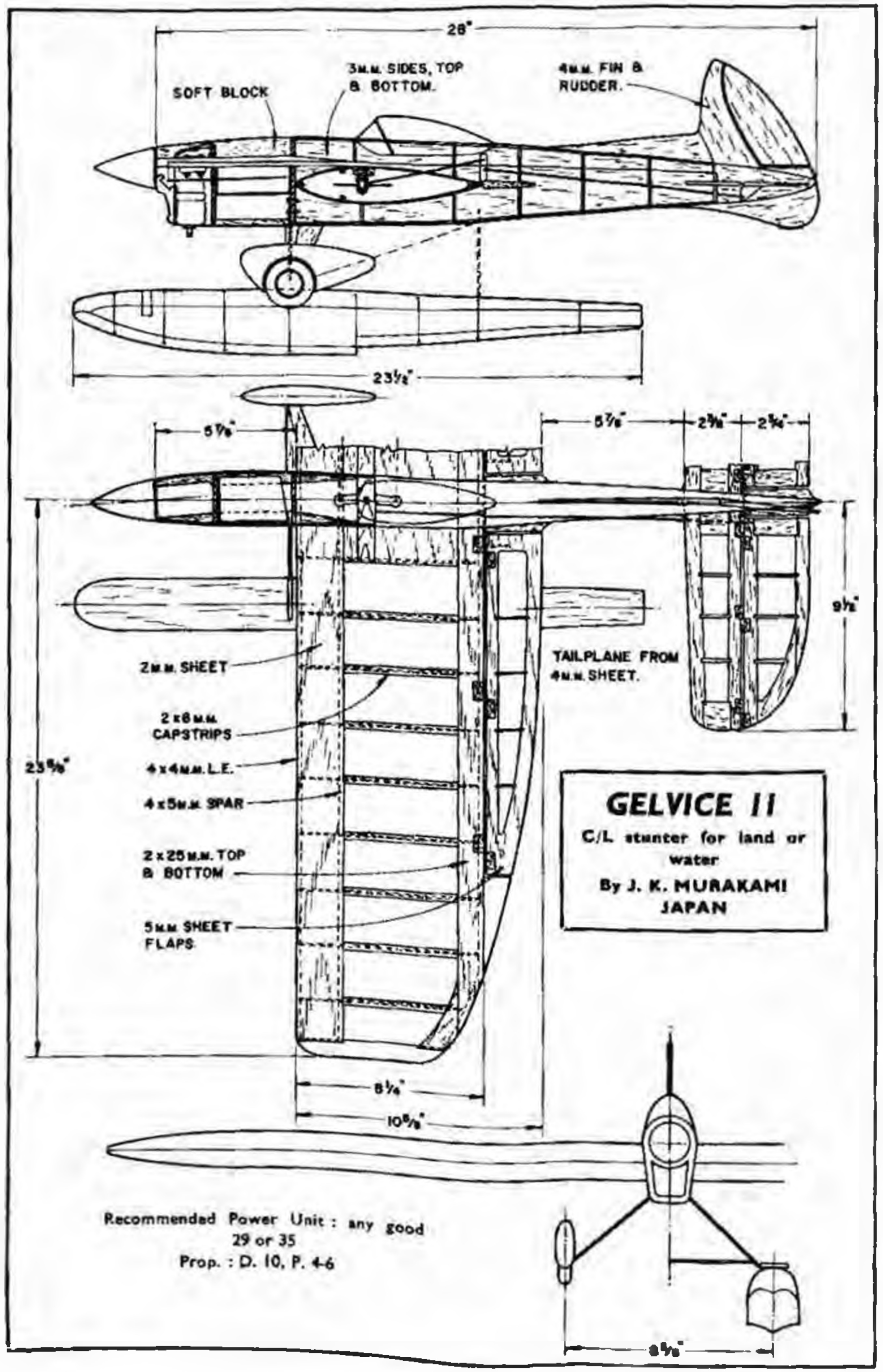
(Correct to three decimal places.)

CONVERSION TABLES—c.c. into cu. in.

c.c.	0	·01	·02	·03	·04	·05	·06	·07	·08	·09
0	—	·0006	·0012	·0018	·0024	·0031	·0037	·0043	·0049	·0055
·1	·0061	·0067	·0073	·0079	·0085	·0092	·0098	·0104	·0110	·0116
·2	·0122	·0128	·0134	·0140	·0146	·0153	·0159	·0165	·0171	·0177
·3	·0183	·0189	·0195	·0201	·0207	·0214	·0220	·0226	·0232	·0238
·4	·0244	·0250	·0256	·0262	·0269	·0275	·0281	·0287	·0293	·0299
·5	·0305	·0311	·0317	·0323	·0330	·0336	·0342	·0348	·0354	·0360
·6	·0366	·0372	·0378	·0384	·0391	·0397	·0403	·0409	·0415	·0421
·7	·0427	·0433	·0439	·0445	·0416	·0458	·0464	·0470	·0476	·0482
·8	·0488	·0494	·0500	·0507	·0513	·0519	·0525	·0531	·0537	·0543
·9	·0549	·0555	·0561	·0568	·0574	·0580	·0586	·0592	·0598	·0604

c.c.	0	·1	·2	·3	·4	·5	·6	·7	·8	·9
0	—	·006	·012	·018	·024	·031	·037	·043	·049	·055
1	·061	·067	·073	·079	·085	·092	·098	·104	·110	·116
2	·122	·128	·134	·140	·146	·153	·159	·165	·171	·177
3	·183	·189	·195	·201	·207	·214	·220	·226	·232	·238
4	·244	·250	·256	·262	·269	·275	·281	·287	·293	·299
5	·305	·311	·317	·323	·330	·336	·342	·348	·354	·360
6	·366	·372	·378	·384	·391	·397	·403	·409	·415	·421
7	·427	·433	·439	·445	·452	·458	·464	·470	·476	·482
8	·488	·494	·500	·507	·513	·519	·525	·531	·537	·543
9	·549	·555	·561	·568	·574	·580	·586	·592	·598	·604

10 c.c. = ·61024 cu. in.



KOKU FAN

DESIGN CHARTS

THESE CHARTS have been designed to give both a complete summary of National and International specifications covering different types of contest models, and major design features. Layouts are based on typical or average proportions of successful models in each of the categories dealt with. From these data it should be a relatively simple matter to draw up an original design conforming to any particular specification ; and also of satisfactory aerodynamic form. Where useful, nomograms have also been included on the design charts to give quick solutions to necessary calculations.

While the complete model must also be designed *structurally*, a suitable form for the latter, together with suitable wood sizes, can readily be obtained by studying plans of other models of similar type. Types of construction, spar sizes, etc., are generally fairly well standardised in each class or size of model.

Team Racers

The chart details the specifications for the three official classes, the design proportions for which can follow similar lines. It is important, of course, that for contest work the most suitable motor should be chosen in any particular class for top performance. This inevitably leads to a choice of diesel for Class ½A and Class A because of the favourable fuel consumption figure, compared with glow motors.

Combat

The all-wing design is usually favoured for simple, rugged construction and light weight. Suitable design layouts also include a wing planform with slight trailing edge taper with a root chord of approximately 20 per cent of the span. Sidewinder engine mounting is almost universal and again maximum performance comes from using the most powerful engine available. Fuel consumption is not critical since there is no limit to the size of tank which can be carried, but engine size is limited to a maximum of 3·5 c.c.

C/L Speed

Four official classes are recognised, with Class I also conforming to the F.A.I. World Championship specification. Models to Class I have, therefore, to conform to F.A.I. minimum total area and maximum weight rules. A nomogram is provided on the chart for finding these solutions, starting with the engine size. Because the model size called for is relatively large, it is best design practice to work to the minimum total area figure. The official course length for record purposes is one kilometer in all classes.

F.A.I. Power (Free Flight)

Design proportions given may be used for the layout of any size of free flight power duration model, but to conform to F.A.I. specifications must comply with the minimum weight and area rules. The nomograph provided enables these figures to be worked out readily from the engine size selected. For open contests it would be a distinct advantage to reduce the model weight and size and work to light loadings.

Wakefield

Design proportions given typify current trends. A critical factor is the propeller diameter and pitch, matched to the number of strands employed in the motor. A minimum power of 12 strands is suggested, with 14 strands as a maximum. Propeller size may range from 18 in. diameter by 30-33 in. pitch, up to 24 in. diameter sizes. With increasing diameter size it is generally advisable to reduce the pitch. A satisfactory pitch for a 24 in. diameter propeller would be 20-21 in. A folding propeller is almost universal, a two-blade folder being preferred to a single-blade unit. Most consistent results will normally be obtained with a power run of 40-45 seconds.

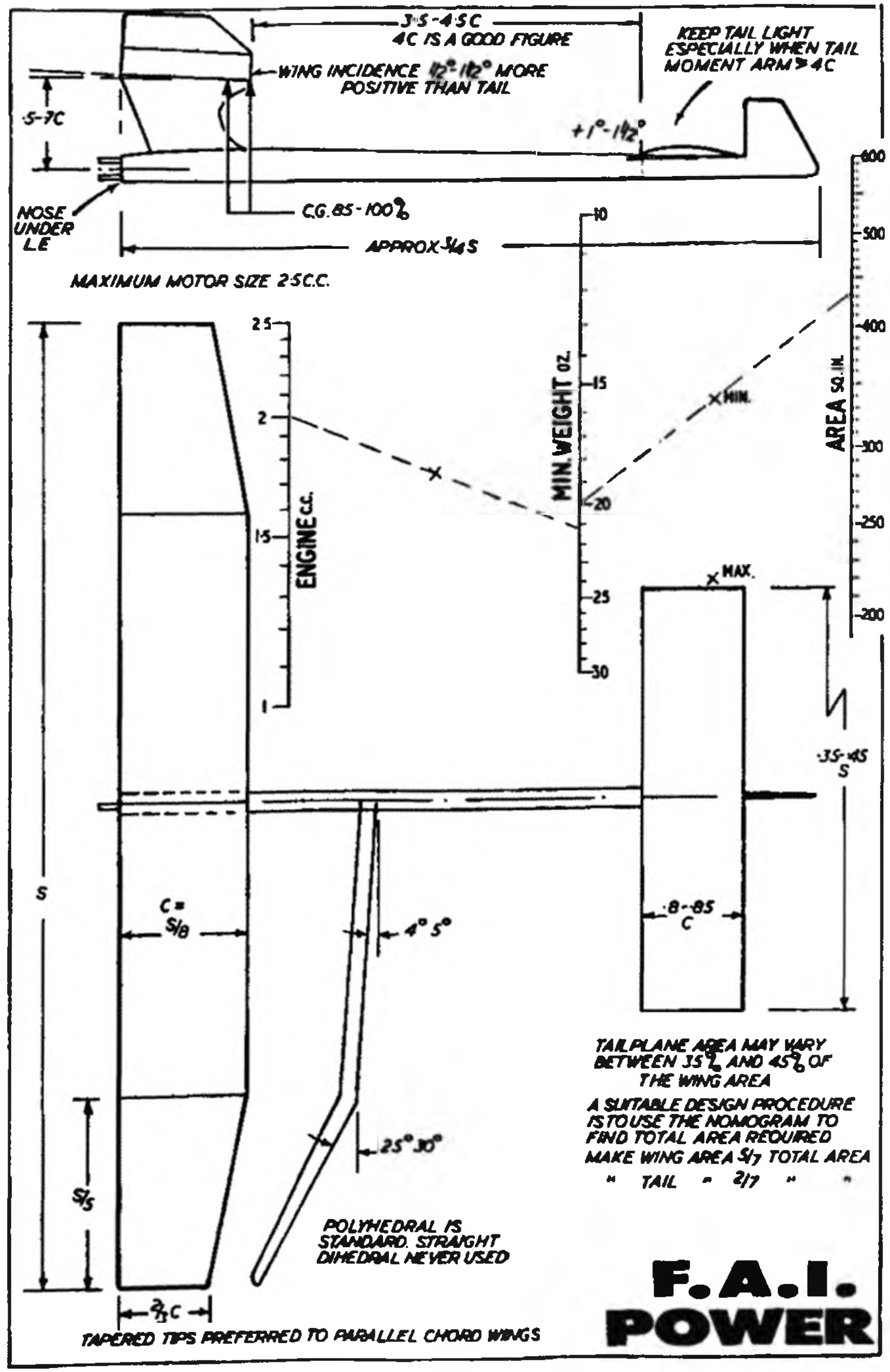
A/2 Glider

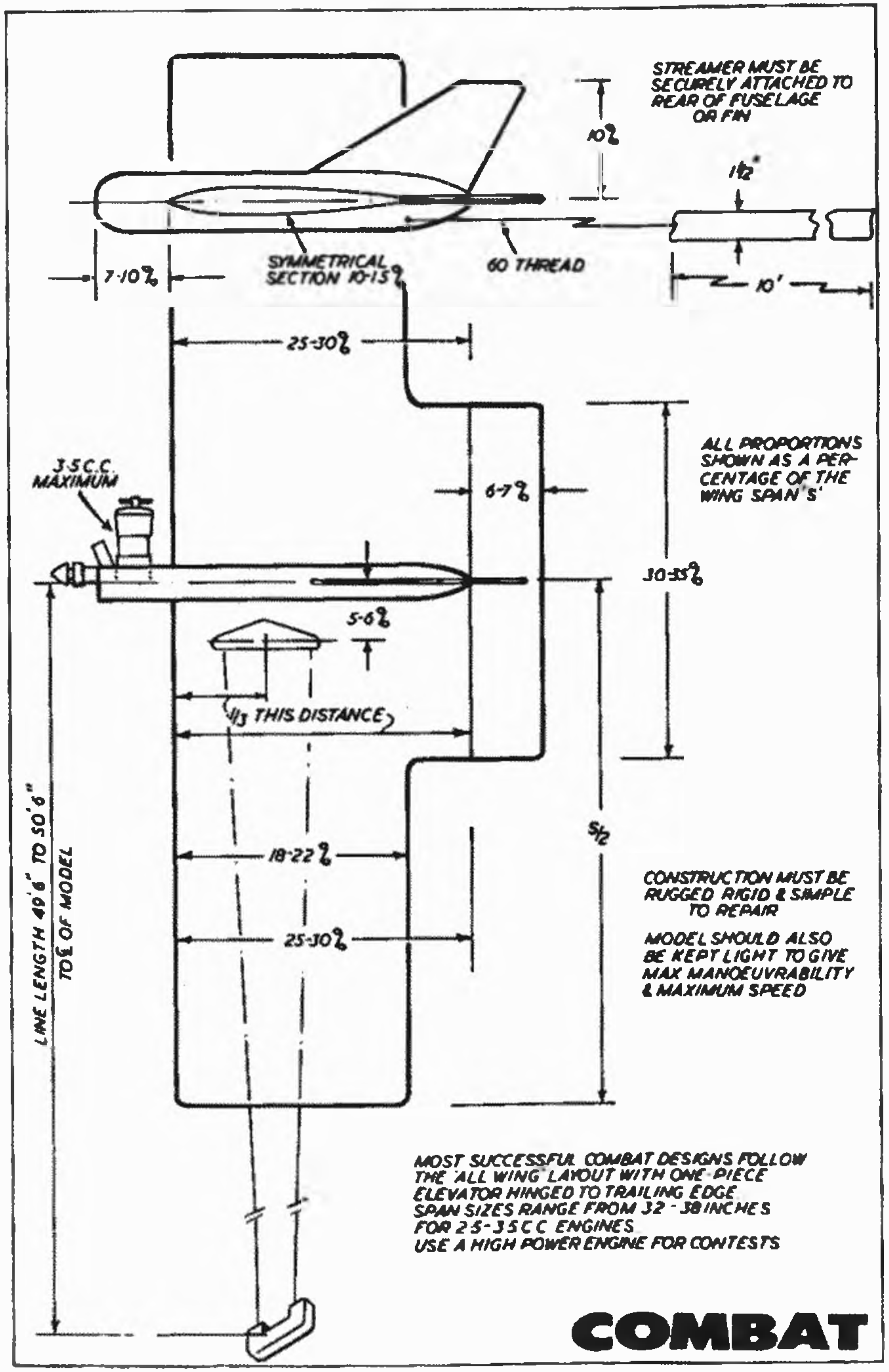
Design has become fairly well standardised with small area tailplanes, long moment arms and thin cambered sections for both the wing and tailplane. The table lists minimum and maximum wing and tail area combinations for minimum and maximum total area specifications, respectively. A maximum size tail can be used with a minimum size wing (this being simple equivalent to an increase in tailplane percentage area).

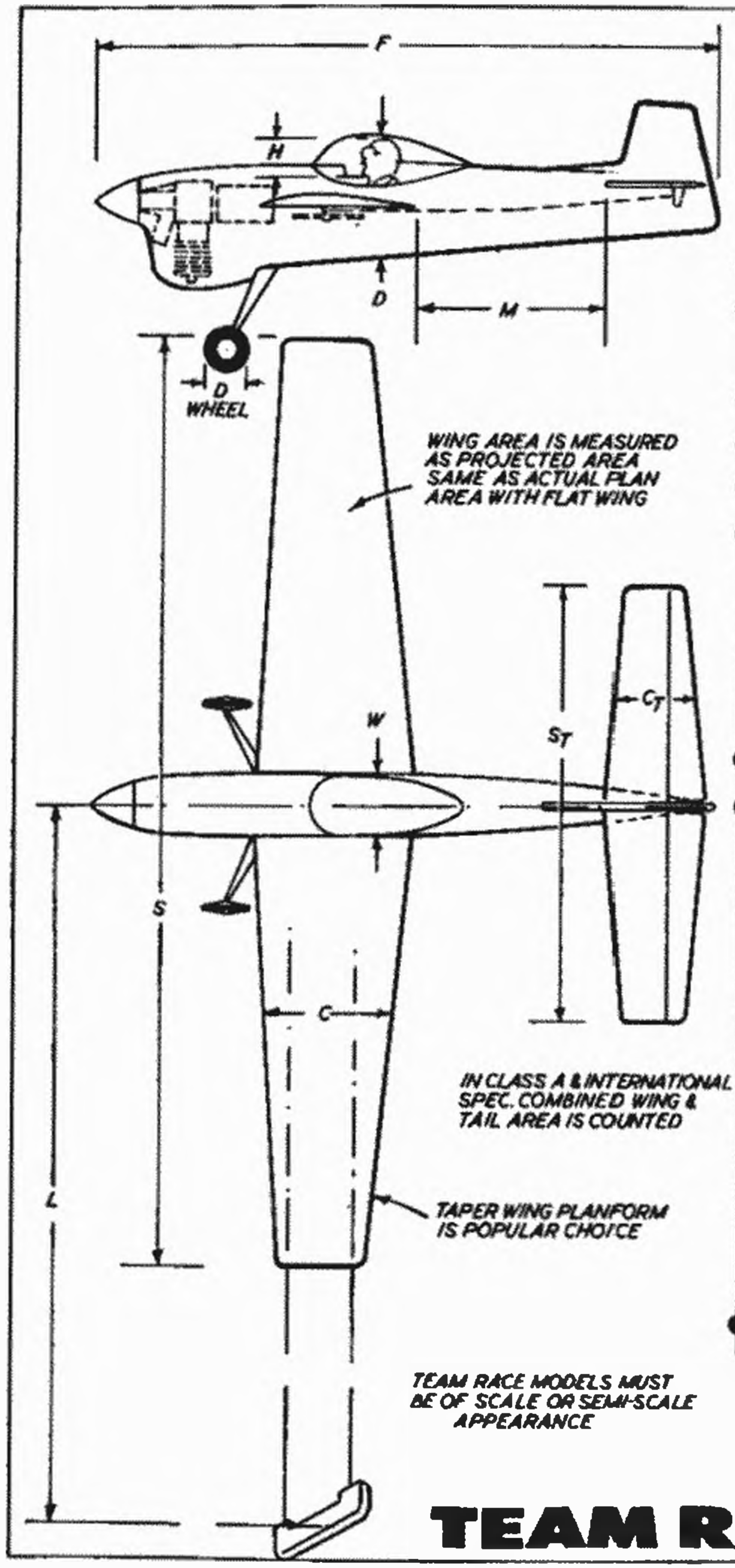
On many designs fuselage cross section is kept to a minimum to reduce wetted area ; others prefer a definite "profile" shape as an aid to stability. The nose should be kept relatively short and all structure aft of the wing as light as possible.

Paaload

Apart from the amount of payload to be carried for a given engine size (payload equals one dummy plus cargo deadweight), and a minimum total weight for the complete model without payload, design size is very open. The aim should be a wing loading consistent with a good duration glide performance without making the model so large that its climb is killed. The emphasis is on lightweight construction and the selection of an engine with the highest power/weight ratio, consistent with a high maximum B.H.P. figure. Fine pitch propellers should be used to operate the engine at peak r.p.m., but not at the expense of reducing diameter size. This will be found particularly significant with the smaller sizes of Paaload models and smaller engines.

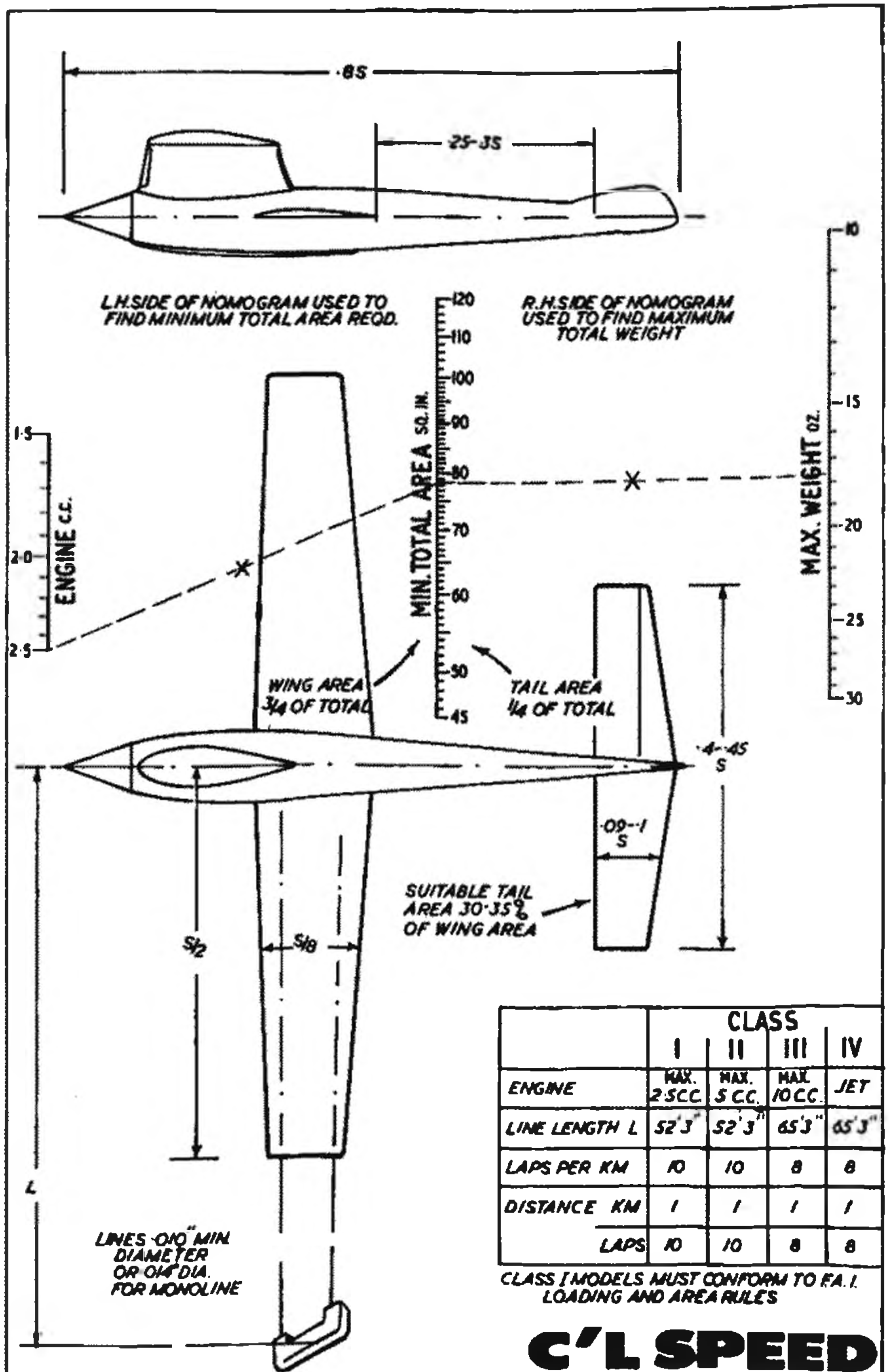






		CLASS ½A	CLASS A & INTERNATIONAL	CLASS B
● ENGINE		UP TO 1.5 C.C.	MAX. 2.5 C.C.	2.51-5 C.C.
PROP		6X6	7X8 7X9	8X9 8X8
● TANK		MAX. 10 C.C.	MAX. 10 C.C.	MAX. 30 C.C.
● WING AREA		MIN 75□"	MIN 186□"	MIN 133□"
TAIL %		25-35		25-35
● D		3"	3.94"	4"
● W		1.5"	1.97"	2"
● H		½"	7/8"	7/8"
● C		S/8 TO S/4		
S_T		35-45% S		
C_T		S_T/4 TO S_T/5		
M		AV. 1.5C		
F		60-70% S		
● D WHEEL		1.5"	1.5"	2"
● LINE LENGTH		42'6"	52'3"	60'
LAPS	MILE	20	–	14
	KM.	–	10	–
DISTANCE-HEATS	LAPS	100	100	70
	MILES	5	–	5
	KM.	–	10	–
DISTANCE-FINALS	LAPS	100	100	140
	MILES	5	–	10
	KM.	–	10	–
LINE DIA.	2-LINE		.010"	.010"
	MONO		.014"	
● MAX WT			24-69 OZ.	

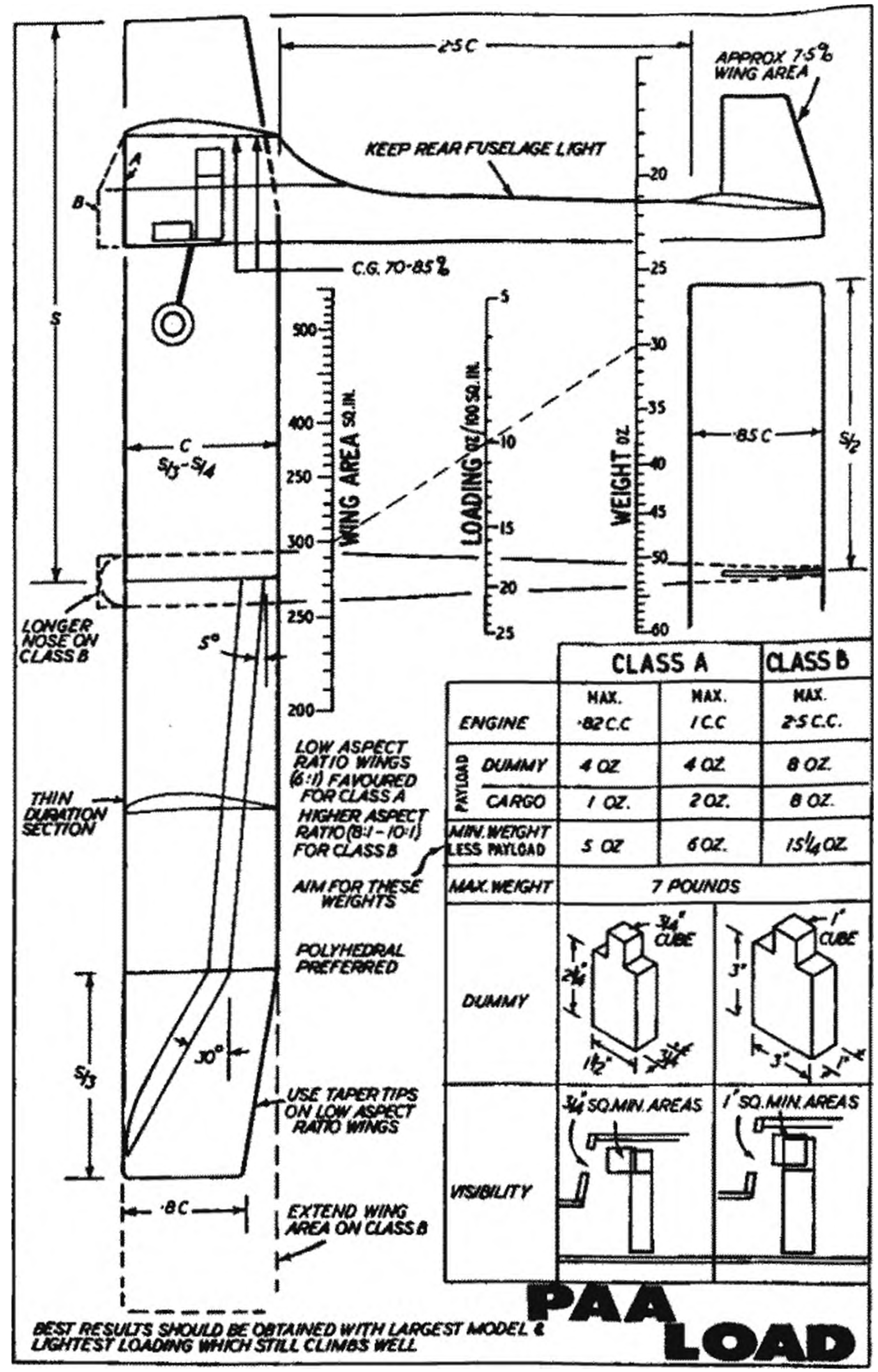
● CONTEST SPECIFIC'TNS. OTHER DATA TYPICAL OF CURRENT DESIGN PRACTICE



	CLASS I	CLASS II	CLASS III	CLASS IV
ENGINE	MAX. 2·5 C.C.	MAX. 5 C.C.	MAX. 10 C.C.	JET
LINE LENGTH L	52' 3"	52' 3"	65' 3"	65' 3"
LAPS PER KM	10	10	8	8
DISTANCE KM	1	1	1	1
LAPS	10	10	8	8

CLASS I MODELS MUST CONFORM TO F.A.I. LOADING AND AREA RULES

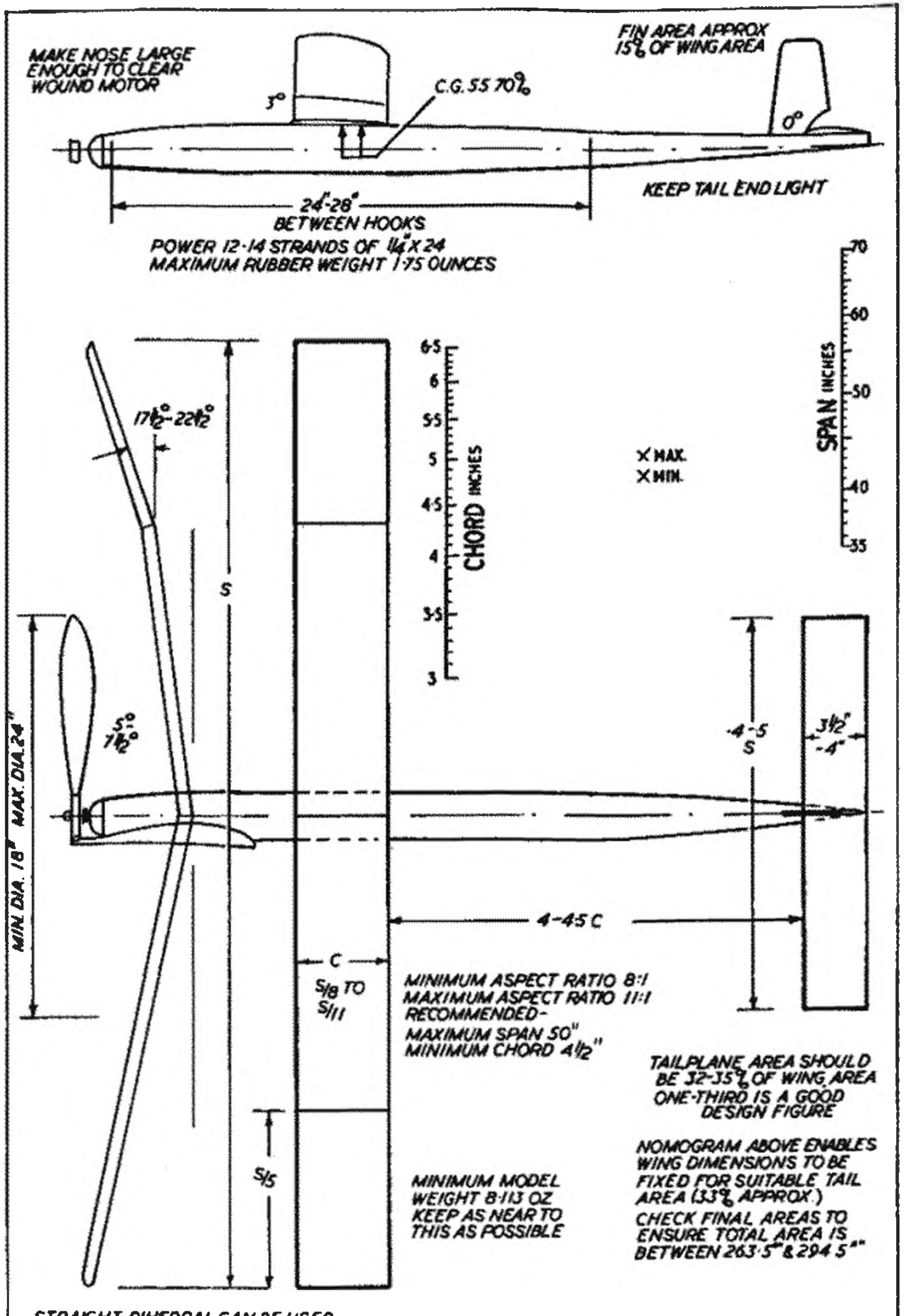
C/L SPEED



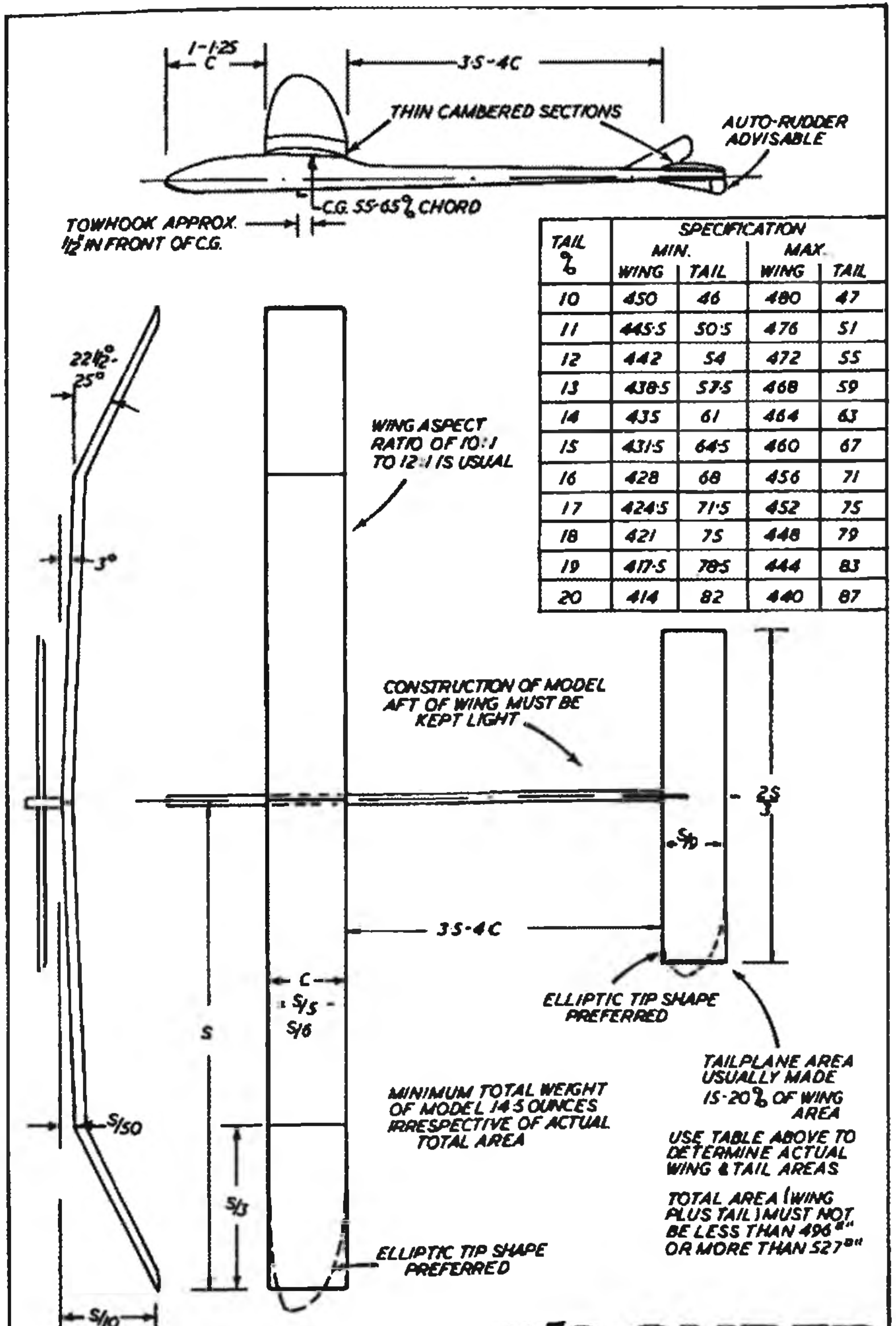
		CLASS A		CLASS B
ENGINE		MAX. ·82 C.C	MAX. 1 C.C	MAX. 2·5 C.C.
PAYLOAD	DUMMY	4 OZ	4 OZ	8 OZ.
PAYLOAD	CARGO	1 OZ.	2 OZ.	8 OZ.
MIN. WEIGHT LESS PAYLOAD		5 OZ	6 OZ.	15¼ OZ.
MAX. WEIGHT		7 POUNDS		
DUMMY		3/4" CUBE; 2¼"; 1½"; 3/4"		1" CUBE; 3"; 3"; 1"
VISIBILITY		3/4" SQ. MIN. AREAS		1" SQ. MIN. AREAS

BEST RESULTS SHOULD BE OBTAINED WITH LARGEST MODEL & LIGHTEST LOADING WHICH STILL CLIMBS WELL

PAA LOAD

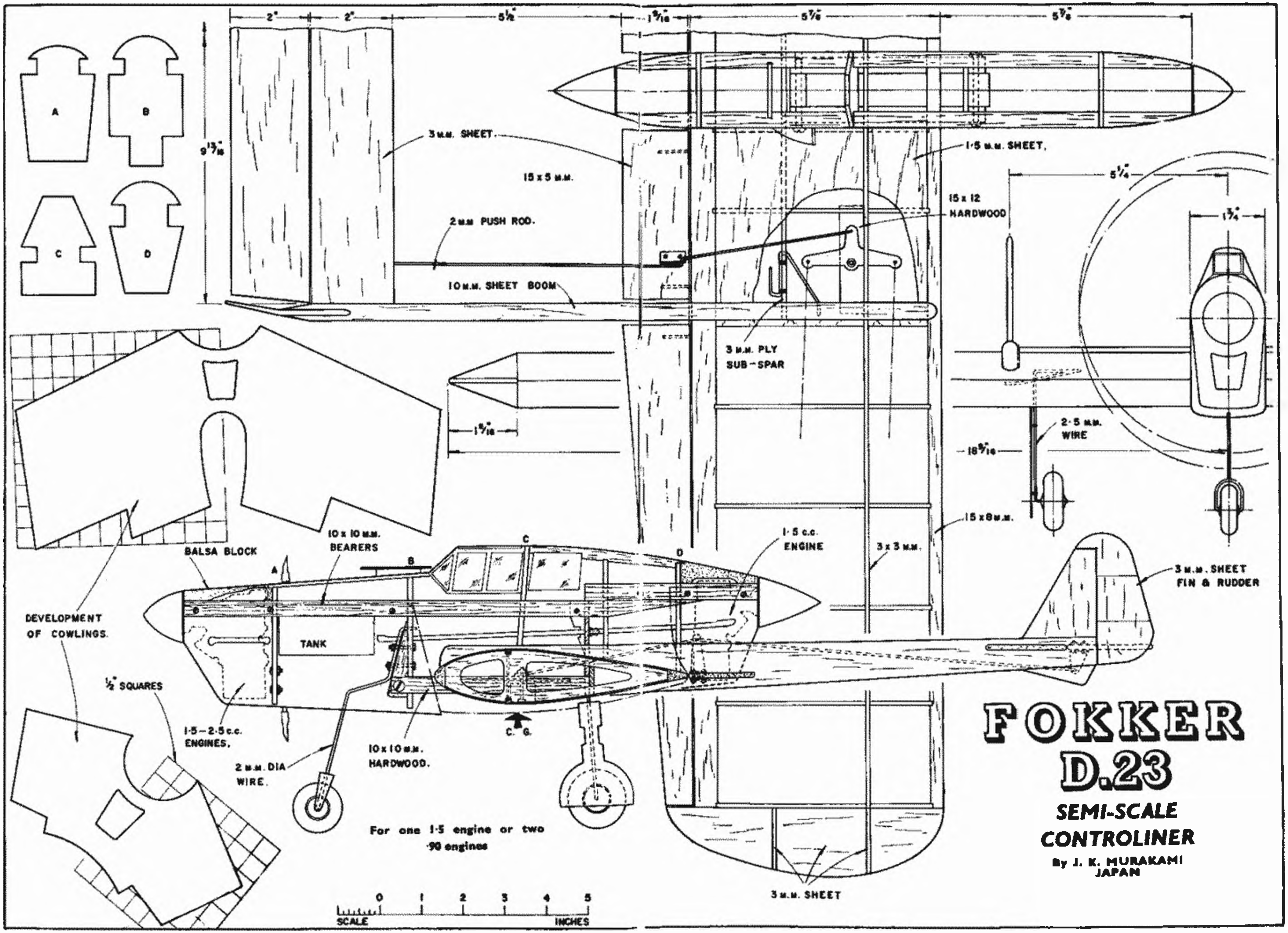


WAKEFIELD



TAIL %	SPECIFICATION MIN. WING	MIN. TAIL	MAX. WING	MAX. TAIL
10	450	46	480	47
11	445.5	50.5	476	51
12	442	54	472	55
13	438.5	57.5	468	59
14	435	61	464	63
15	431.5	64.5	460	67
16	428	68	456	71
17	424.5	71.5	452	75
18	421	75	448	79
19	417.5	78.5	444	83
20	414	82	440	87

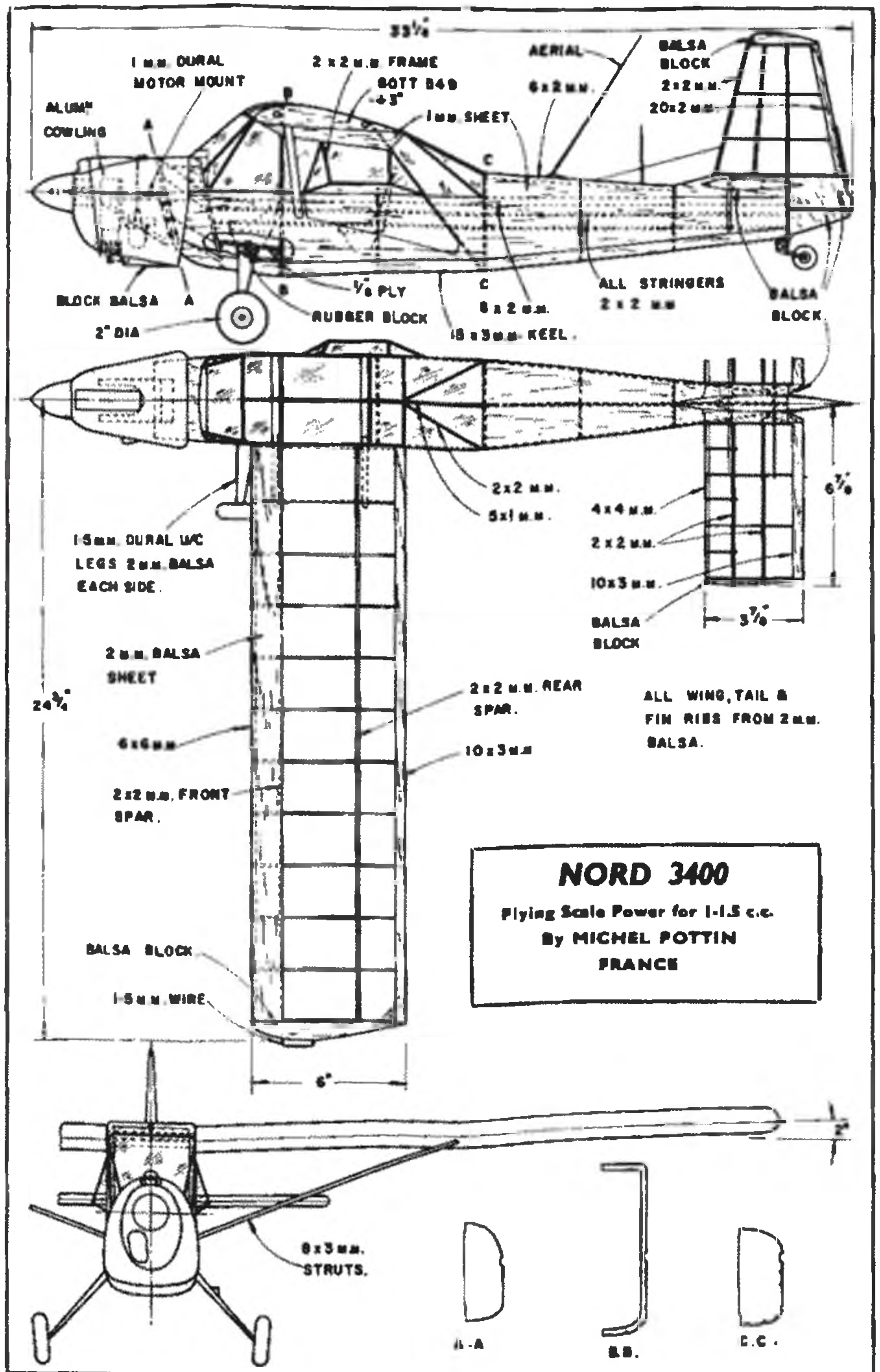
A/2 GLIDER



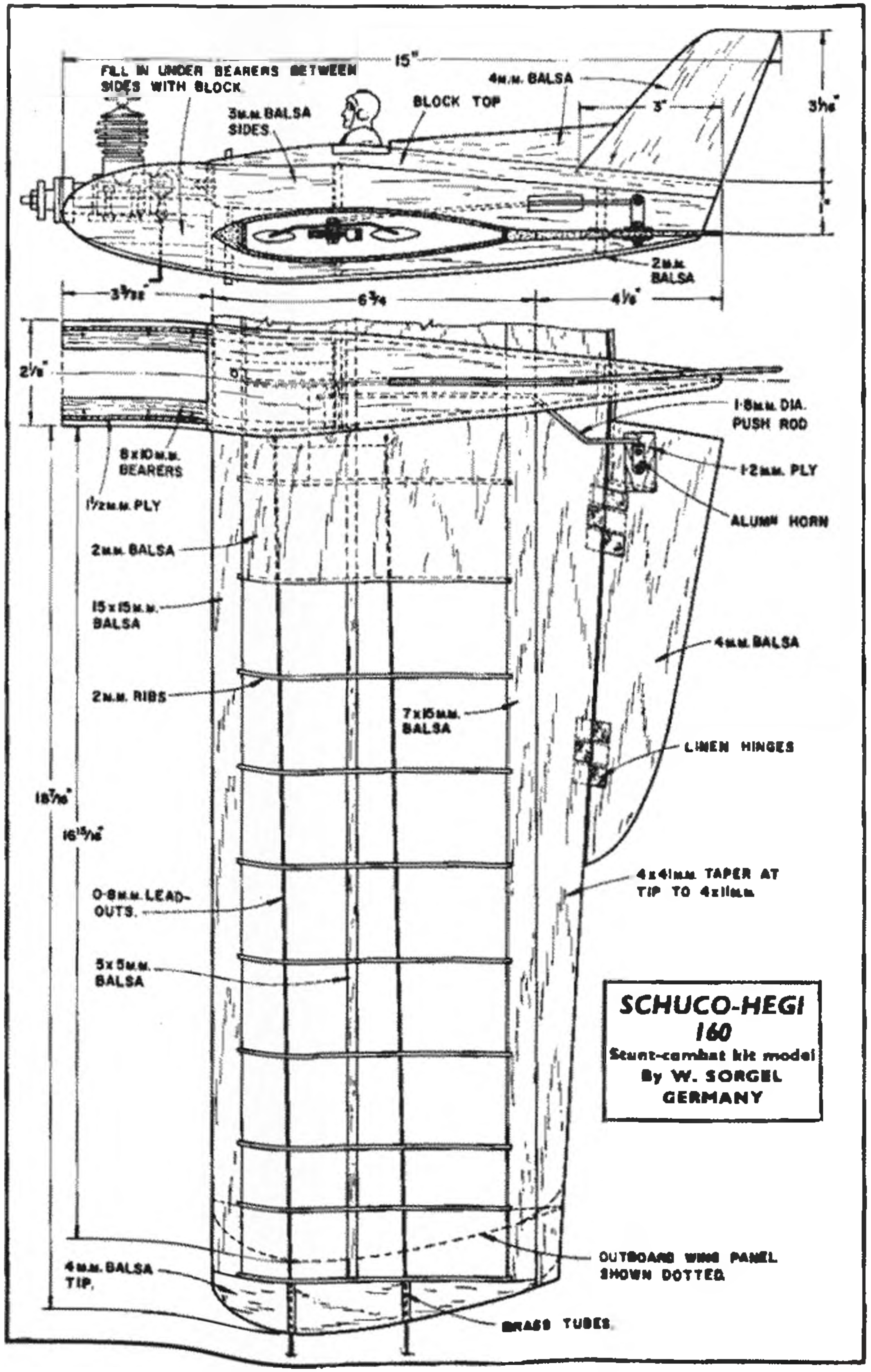
FOKKER D.23

SEMI-SCALE CONTROLINER

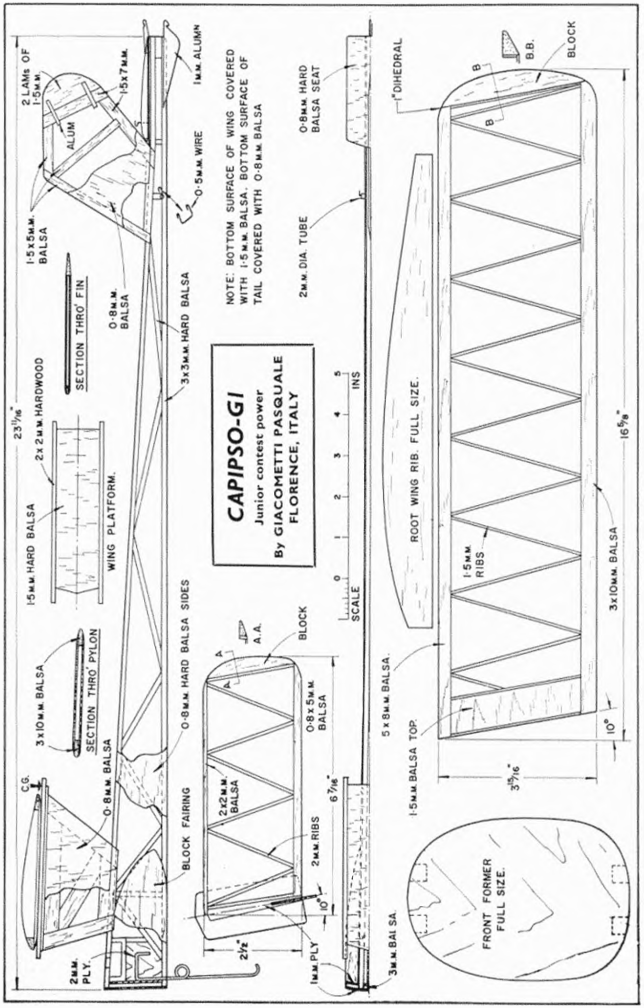
By J. K. MURAKAMI
JAPAN



MODÈLE REDUIT D'AVION



FLUG MODELL TECHNIK



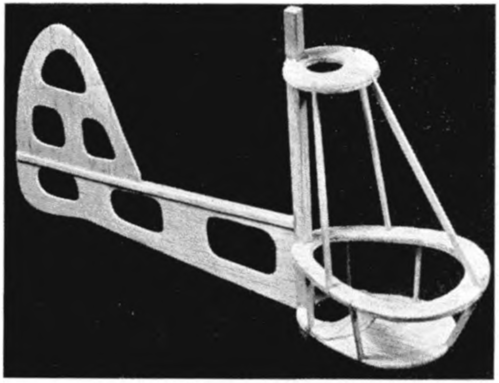
MACOPTER

D. McHard *is inspired by a Japanese Model Helicopter*

A LITTLE Japanese helicopter model originally inspired the construction of the two variants here described.

The Oriental version was built of a lightweight reed, similar to the type used for wickerwork basket-making. This substance lends itself well to the curvaceous nature of the model's front end, but western builders would probably find construction in this material difficult, even if the reed were readily available here. Modifying the structure presents some problems if the character of the model is to be retained.

Two solutions are presented, the one most nearly resembling the Japanese original is constructed of wound formers or elliptical hoops. The process of winding these hoops may be strange to modellers who have been reared since the days of streamlined Wakefields when wound formers were quite commonplace. There is nothing to it really, as you will discover upon boiling a kettle and holding a length of $\frac{1}{8}$ in. × $\frac{1}{32}$ in. medium balsa close to the spout and gently curving it as the steam softens the fibres. Quite sharp curves can be produced if the grade of wood is carefully selected. Medium hard straight-grained stock is the stuff to use. Buy a sheet and slice it into $\frac{1}{8}$ in. wide strips. You may ruin a few during the initial experiments, but the cost will be negligible. Cut out a $\frac{1}{8}$ in. thick former corresponding to the inner curve of the completed wound hoop and wind the $\frac{1}{32}$ strip twice around it overlapping the ends by 1 in., and

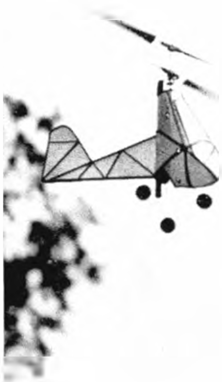


Fuselage of alternative sheet version. This is tricky to build down to weight but most impressive.

Below: Macopter in flight. It has a pleasing vertical climb, coupled with some uncertainty of ultimate direction.

tapering them off after sticking the layers together with a contact adhesive.

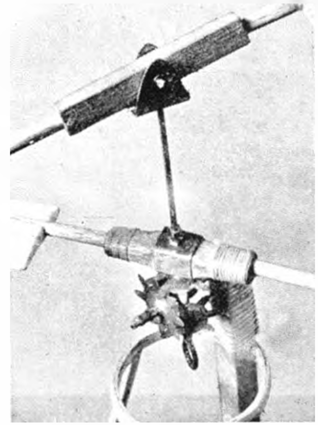
After producing all the laminated parts the $\frac{1}{4}$ in. sq. motor stick is notched on its rear face and the two complete hoops "A" and "B" are threaded on and cemented. Use pins to hold in position until dry. Next, the lower formers "C" and "D" are positioned with the aid of pins. Cement "E" to motor stick and add the three $\frac{1}{8}$ in. × $\frac{1}{16}$ in. upright members. Attach the lower curved keel.



The boom and fin are built on the full-size drawing and attached to the motor stick after preparing two $\frac{1}{16}$ in. deep slots to receive the forward ends.

The lower rubber hook and main U/C are bent up and both cemented and bound to the motor stick. Bind nosewheel leg in position.

The contra-rotating rotor mechanism is fully illustrated on the drawings and these explain far more than a bookful of words. Sufficient to say that great care should be taken to produce the best set of gears you possibly can! Time spent on this job will be well repaid by smooth running and low power losses. Cut out three discs of brass $\frac{1}{64}$ in. thick, drill or punch a small hole in the centre and sweat all three together. Trace out the gear onto the top washers, making certain all the centre holes *are* in the centre! Cut out carefully with a piercing saw and fine metal cutting blade—hold the blanks in a vice during this process and finally bring the gears to their completed shape with a needle file.

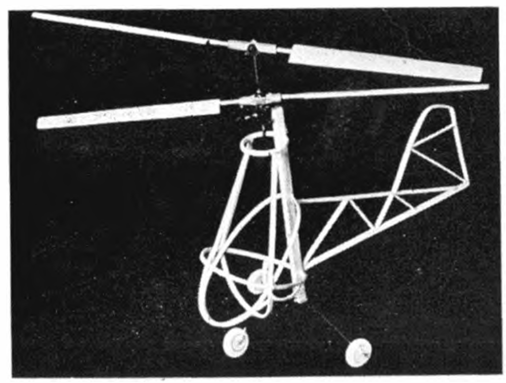


The rotor hubs are made from $\frac{3}{16}$ in. sq. spruce, the ends bound and then drilled to take the 1/[illegible] in. rotor dowels which should be a push fit. The upper rotor should be able to tilt 10° up and 10° down. Make certain the upper rotor cannot touch the lower one at the tips.

Cover the model with Jap tissue if possible. Do not dope. Cover the "windscreen" with cellophane. Balance at point shown on plan, this is very important. Wrong C.G. position will produce erratic flight.

Power required will depend upon the weight of the airframe. *Any* saving of weight, no matter how small, will considerably improve performance. Built as per instructions four strands of $\frac{1}{4}$ in. flat rubber were needed on our prototype, but with care and weight-watching it should be quite possible to get away with four strands of $\frac{3}{16}$ in. with a corresponding performance increase. Wind from the bottom using an "S" hook and handbrace winder. Details are also given of an alternative construction from *soft* $\frac{1}{16}$ in. sheet. This is easier to build, but not so strong as the wound former version. If the wood is not very carefully selected it could be much heavier, too heavy in fact. Skids can be used instead of wheels, if preferred. So, wind 'er up and mind them rotors!!

Above: Cut and filed gears and rotor hubs. These parts are the crux of the success or otherwise of the model.

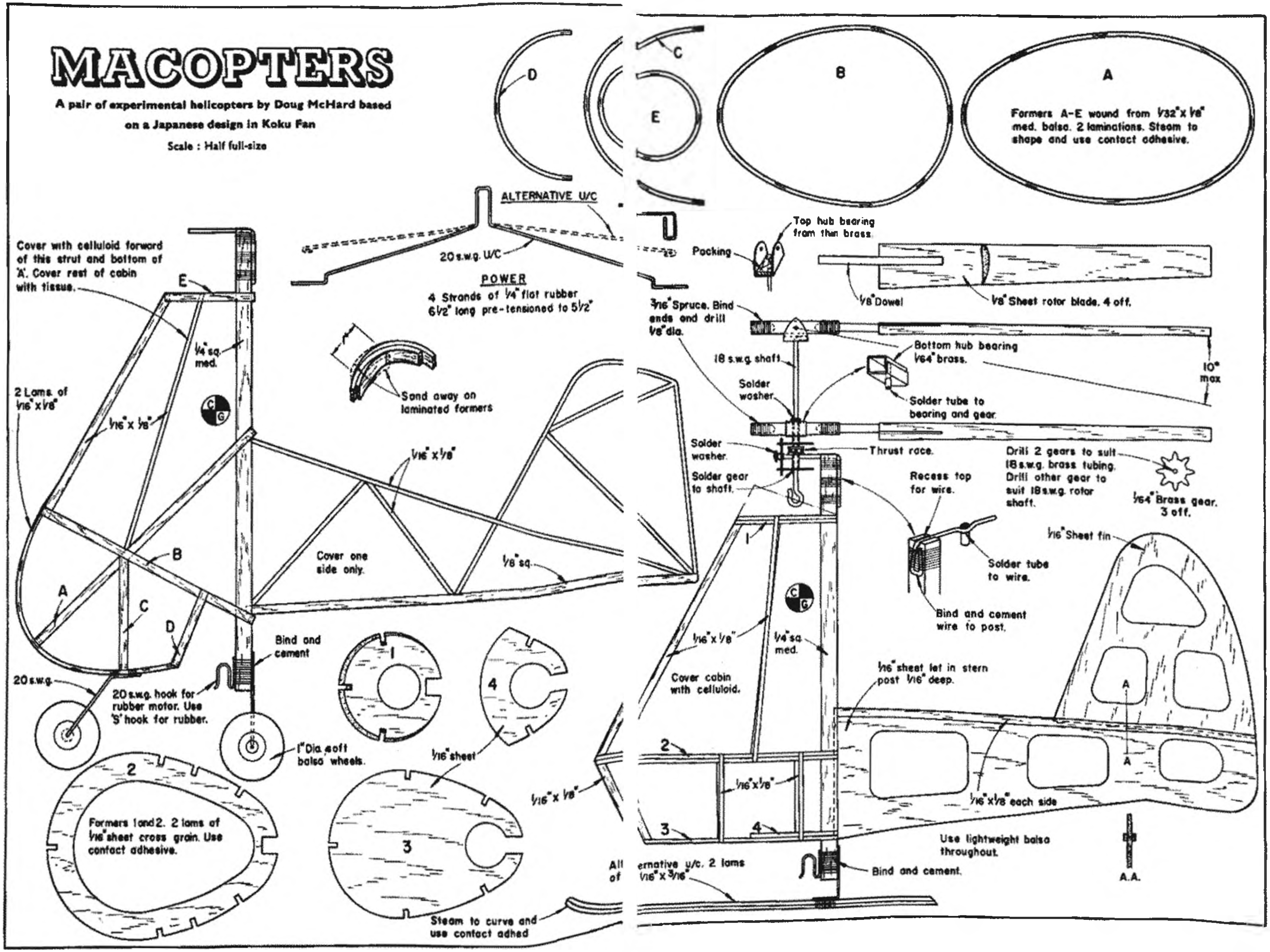


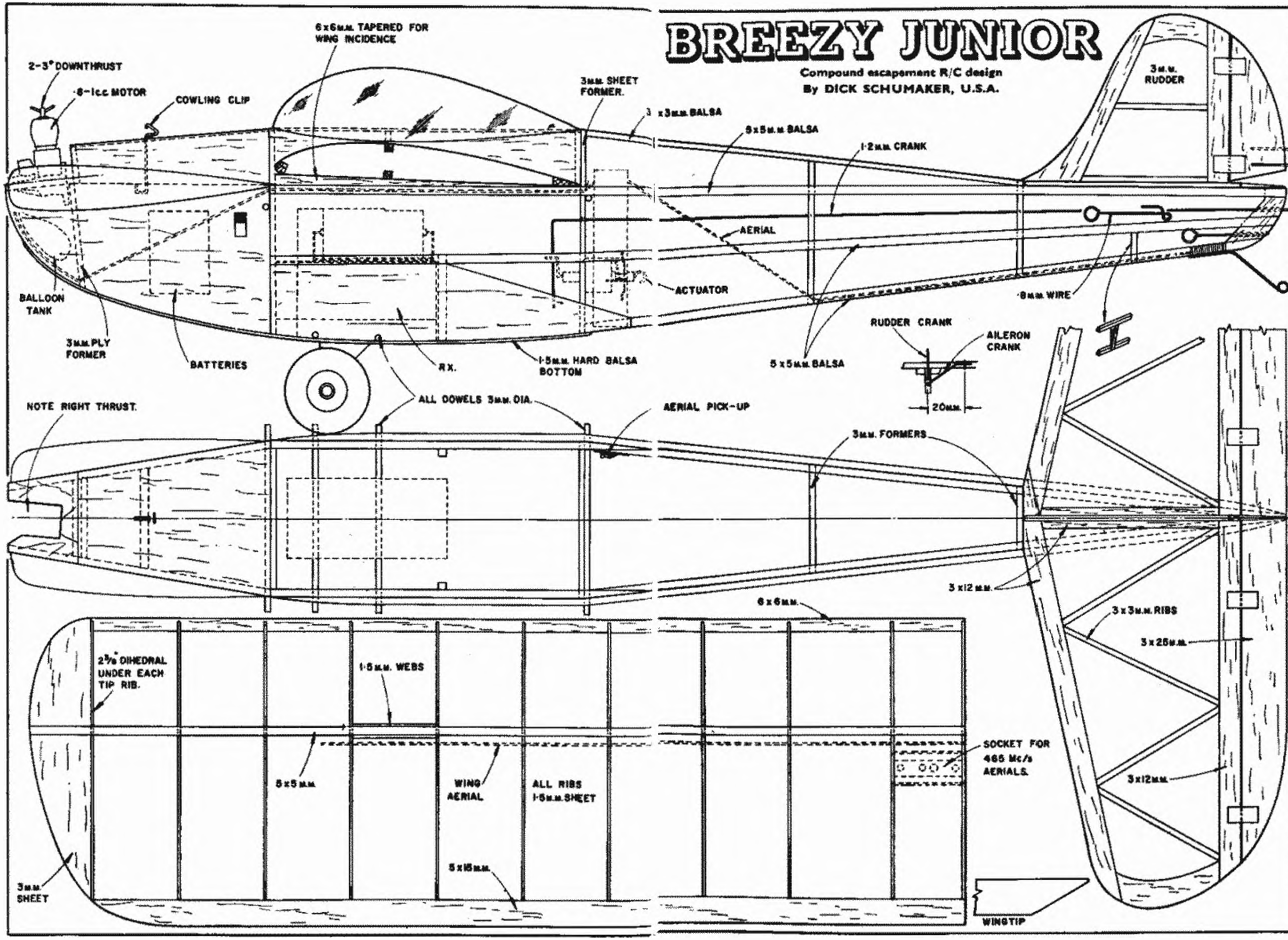
Right: Fuselage of the wound former version, which is recommended to those desiring a quick result and an easily responsive model.

MACOPTERS

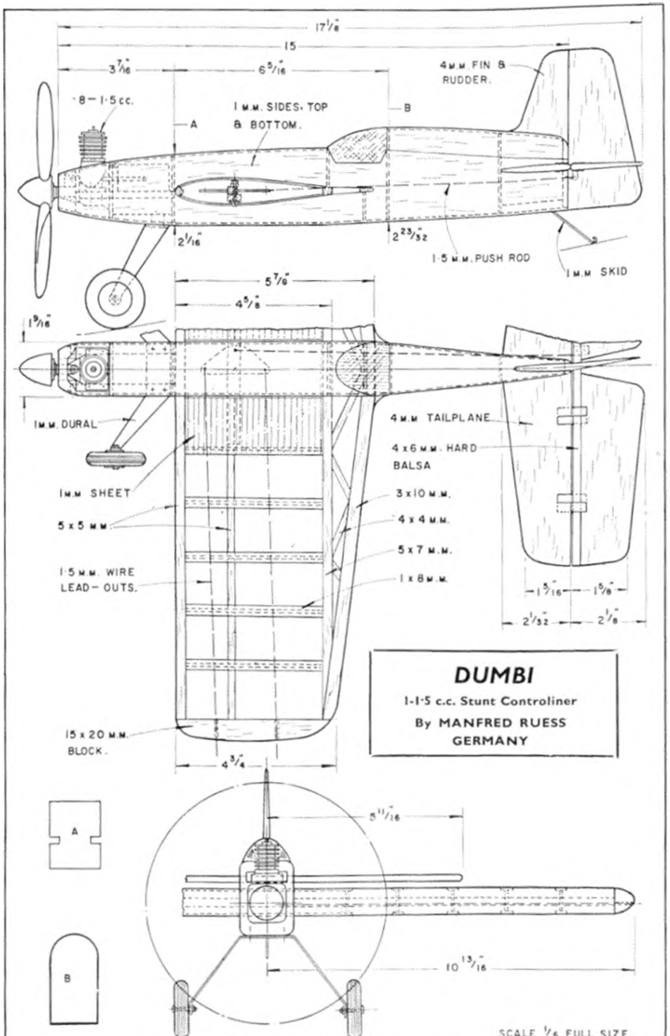
A pair of experimental helicopters by Doug McHard based on a Japanese design in Koku Fan

Scale : Half full-size





FLUG MODELL TECHNIK



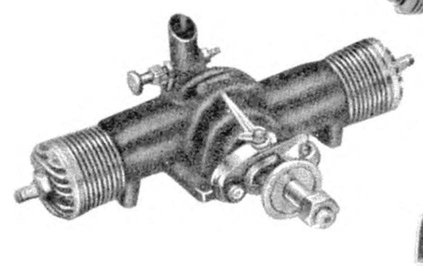
FLUG MODELL TECHNIK

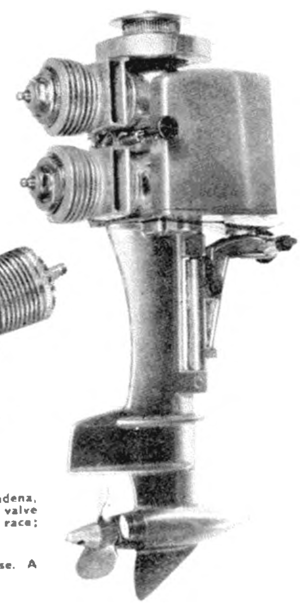
TWIN CYLINDERS

By Ron Moulton

WHY MAKE A TWIN? All the added complications of crankshaft alignment, frictional losses, bulk in design and symmetric induction seem hardly worth the bother when the end product is so rarely superior to its single cylinder counterpart. That may well be the first thought of any manufacturer proposing to enter the "twin" market. The problems *are* surmountable and performance can be turned to great advantage as recent introductions indicate, and for the rabid engine enthusiast, the charm of two "pots" in harmony outweighs any sacrifice that may be present at some stage of the engine's power range.

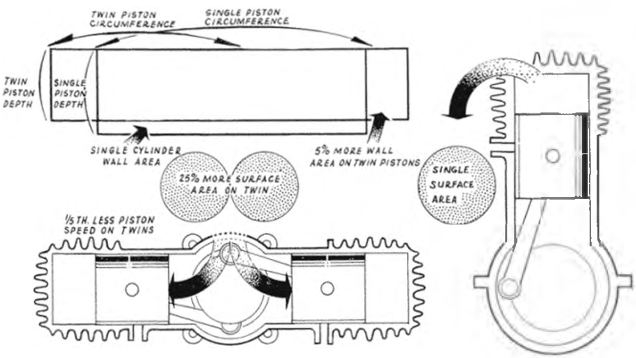
Twins are not new, they date back to pre-1909 model flying experiments and mass produced engines enjoyed great popularity in the U.S.A. in pre-1939 war years, notably the 20 c.c. O.K. twin, the small Elf twin and again in post-war years the Pal and Allyn twins have had moderate success. In Europe, the early Delmo diesel appeared as an awesome double-unit guaranteed to shatter any light airframe, Kemp had a "Black Devil" two-pot diesel, Eric Curwen produced another, and at some stage or other most manufacturers have dabbled with the idea of getting more out of existing components by doubling up.





Above: American Wasp twin by Micro Model Co., Pasadena, was 10 c.c., bore .74 in., stroke .702 in., with rear rotary valve induction. Shaft ran on two bearings with a ball thrust race; sold at 35 dollars in 1946.

Right: K. & B. Allyn twin, 2.5 c.c. version for marine use. A fine example of superior quality die castings.

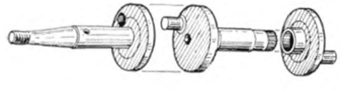


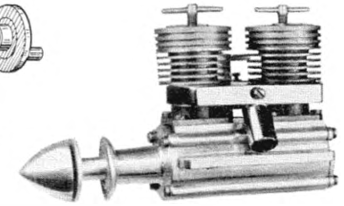
TWIN AND SINGLE CYLINDER ENGINES OF SAME CAPACITY

The main theory is that by dividing capacity into two cylinders, one gains 25 per cent additional piston head area for an increase of 5-8 per cent piston wall area (assuming near square bore stroke ratio). If extra piston area is employed efficiently, logic has it that extra power should be derived, and the chain of thought next turns to alternate firing cylinders so that power is continual on the shaft and smoother running occurs. There are many tunes to be played on the twin fiddle. They can be Vee, in-line, horizontally opposed, side-by-side, split cylinder or head-to-head. Not all of these are practical through their mechanical disadvantages, and it took a great designer like Edward Turner a long while to evolve a successful 500 c.c. side-by-side simultaneous moving, alternate firing four-stroke twin for the Triumph motor-cycle company. So it will be appreciated that only two layouts are really within the capabilities of miniature engine manufacturers. These are the horizontally opposed, and the in-line.

Before discussing the others, the split-single or divided cylinder "twin" is worthy of comment. This is an ingenious two-stroke arrangement with two rods and a common crankpin, or sometimes an articulated connecting rod. The pistons do not move in harmony as the radius of throw varies for the two pistons and so the out-of-phase motion is turned to advantage. During transfer, the faster piston on the downward stroke is used to induce an earlier charge and on the up-stroke the same piston rises faster to feed the other cylinder. Improved scavenging, the advantage of increased piston head area for capacity and only single-shaft bearing as in a single-cylinder engine are desirable features. Port control via the pistons is not the easiest of designing tasks and in the double-piston, split cylinder one has little encouragement to fabricate a long series of trial and error pots. In the motor-cycle world, the split single has achieved great merit, especially in German machines : but to date, no one has managed a successful miniature unit of less than 10 c.c.

Whether to use the two- or four-stroke principle is decided automatically by the size of the engine we want to use. Power to weight ratio is critical enough for aircraft use in the two-stroke twin. For any valved unit, the desirable ratio



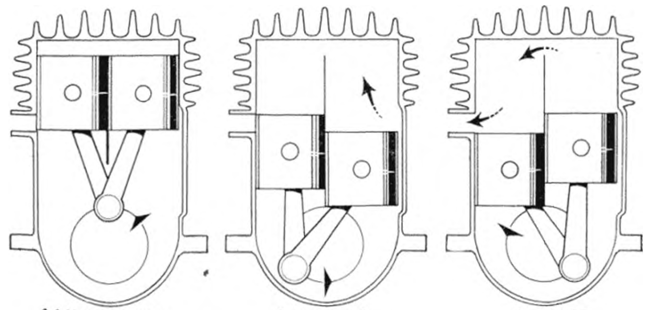


Col. Taplin's 7 c.c. twin is alternate firing and can employ common exhaust. Sketch shows press fit crankshaft assembly.

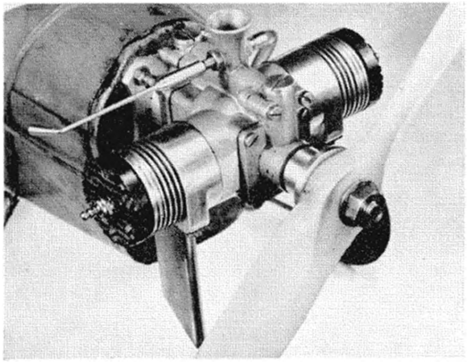
is virtually unattainable. The actual timing of the two-stroke twin is another matter. It could be argued that to use the extra piston area most effectively, it should be employed simultaneously, and since this common movement of the pistons can best be arranged in a horizontal layout, most simultaneous twins have a common crankcase with cylinders at 180°.

Conversely, the neatness of in-line design, with provision for a divided crankcase, alternate firing and subsequent smoother reaction from the firing strokes, has led to use of the upright twin. Colonel Taplin has for many years been a devotee of this type and following his success with a 7 c.c. unit using modified ED 3·46 components, he was encouraged to put the engine into production and its success as a "high-torque at low speeds" engine needs no enlargement. In marine and aircraft applications the Taplin Twin has established itself as the most flexible of all engines, with special advantages for radio control. In power development it rates no more in the graphs than a typical "19", but in the r.p.m. range from 600-9,000 it matches many single-cylinder units of slightly less capacity and throttles reliably to a tickover at the flick of a carburettor lever.

This engine uses side port induction from a common carburettor : actual intake areas are small, and induction periods short, the result being a docile, easy starter which is flexible in its control settings. To get the most out of a Taplin Twin, one has to adapt an "ear" for misfiring in either cylinder and



THE SPLIT-SINGLE 'TWIN'



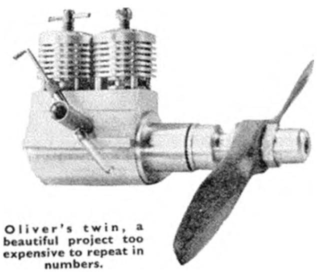
On test in a stunt controline design, the 5 c.c. D-C Tornado showed most useful power range and produced rapid increase in propeller r.p.m. as model became airborne. Has single carb for two valves.

adjust the individual compression screws according to symptoms. It is an art soon acquired, and once the technique is mastered, the "TT", as it has become known, is a first-time starter.

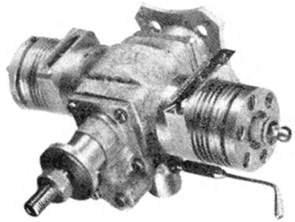
Constructionally, the alternate firing vertical twin can be a headache of major proportions. Crankshaft alignment is critical, crankcase seals must be good and the rotary valve, if used, must feed symmetrically to ensure maximum performance. A good twin could be rendered so ineffective by having to run rich on one pot for the sake of correct mixture in the other that the design effort simply is not worthwhile, especially with a diesel. Glowplug is more forgiving for there the "fire" disposes of any fuel excess. There have been many approaches to the problem (other than the simple Taplin way out with side-porting) and a particularly ingenious surface valve was used in the Oliver Twin.

This comprised a central flywheel with a radial port to its outer edge, feeding crankcases alternately. Though fits on such a system are at a premium, the Olivers made a fine job of it, and it would take a very large bag of gold to get them to part with their screaming pet.

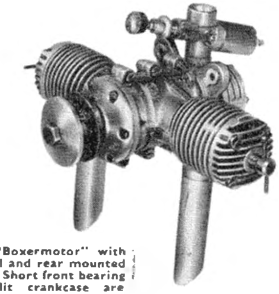
Allyn used a split main bearing between crankcases and a bolt-up assembly that invited trouble, yet, amazingly, rarely caused any bother. This 2·5 c.c. unit of diminutive proportions is a perfect example of the world's best in high pressure die casting and the simple assembly made almost a mockery of what we have said about critical fits, etc. As an aircraft unit, the Allyn (later, K. & B. Allyn) was by no means the expected success and it was not until the outboard marine power unit with flywheel for balance and starting appeared, that this twin became popular in great numbers.



Oliver's twin, a beautiful project too expensive to repeat in numbers.



Compare prototype D-C twin with production version opposite. Manufacturers have to build many experimental engines before finalising design.

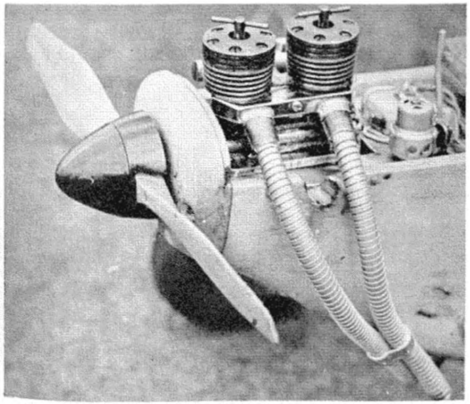


The Ruppert "Boxermotor" with throttle control and rear mounted vacuum pump. Short front bearing and small split crankcase are contributory to its lightness—and vulnerability.

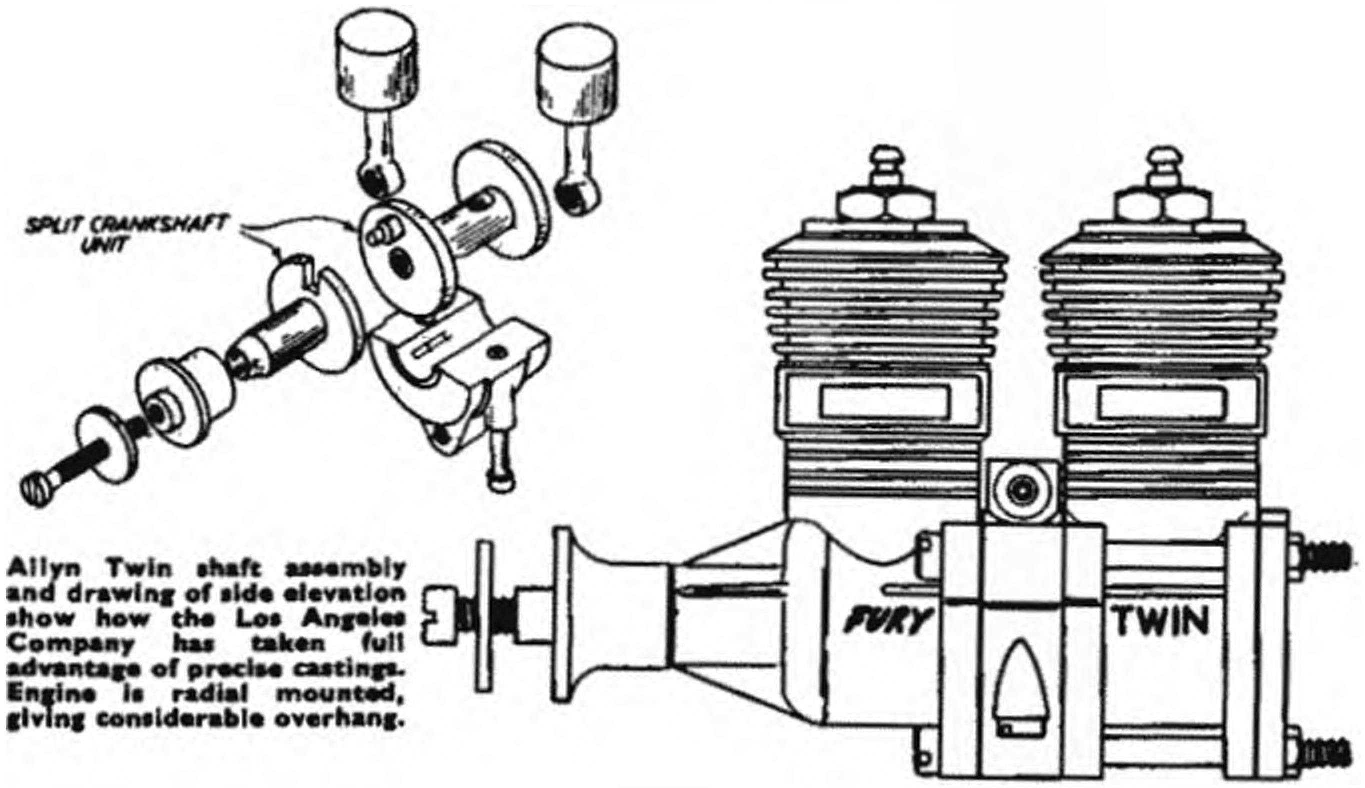
The sound of the alternate firing twin in full song at 12-15,000 r.p.m. is a joy indeed for those who like such amusement whereas the horizontal opposed twin is deceptively monotone.

Even 20 c.c.'s of OK Twin can be muted to low decibel level and yet its power has in our experience, lifted a 12 lb., 9 ft. model r.o.g., at 5,000 a.s.l. in sub-tropical conditions, and that takes some thrust ! It will drive props to 18 in. diameter, 8-10 in. pitch at constant revs. with (ignition permitting), moderate reliability. Many mourn the fact that such engines are no longer produced by the Herkimer factory. First counterpart to appear in European post-war skies was the Ruppert "Boxermotor" diesel of 8½ c.c., so-called because of the piston action resembling a pugilist at sideways jerks exercise.

The Ruppert is now reduced in capacity and produced by Webra in Berlin, complete with a vacuum pump driven off the rear shaft bearing (also



Taplin Twin belonging to Norman T. Jones of Crewe M.F.C. has flexible gas pipe twin exhausts. Motor speed control is actuated by Japanese KAKO motor with electric cigarette lighter accumulator for power. The neat aluminium top cowling has been removed in this photograph.



Allyn Twin shaft assembly and drawing of side elevation show how the Los Angeles Company has taken full advantage of precise castings. Engine is radial mounted, giving considerable overhang.

used for rotary induction), a very short front bearing and radial mounting. As a radio-model power unit, it has led the European contest sphere for several years and was in many ways influential in producing the D-C Tornado Twin of small 5 c.c. capacity.

Radio control modellers demanded a similar but smaller engine, not necessarily for vacuum servo gear ; but to develop peak power fairly low in the revolutions scale and still have a reserve of power for exhausting manoeuvres such as outside loops.

The Tornado is unusual in many respects, not the least being its two-shaft valves on a common crankcase and common needle jet. Bench work established this twin-valve system superior to the more simple direct induction, and the possibility remains that the valves with machining blank studs in convenient positions could be adapted for speed control. Flown in an aerobatic control-line model, the Tornado was most impressive, and the pick-up of revs. after take-off more noticeable than in *any other* engine of our experience—this on 6 in. pitch.

As with the Ruppert and full-size practice the D.C. twin is radially mounted and is vibration-free except when running on one cylinder and this coupled with a symptom of "drying up" as though running lean, is a warning that both pots are not firing.

Will the twin ever surpass "single" performance ? With all power units the answer to such a query depends on the ultimate purpose for which the engine is destined. For racing the answer is pretty certain to be NO. For slogging power in stunt models radio and control-line, development will bring a YES.

Remember that although old in conception the twin is young in heart and still needs a lot of fresh thought and engineering. Logic has it that the more surface area we can use to take the drive of a firing stroke, the more power should be transmitted to the shaft. Over-square bore/stroke ratios in single-cylinder engines do not offer ideal handling characteristics or show themselves generally superior, the answer must be to preserve the bore/stroke ratios, and increase piston area by dividing between two cylinders.

Come on the TWINS ! ! ! !

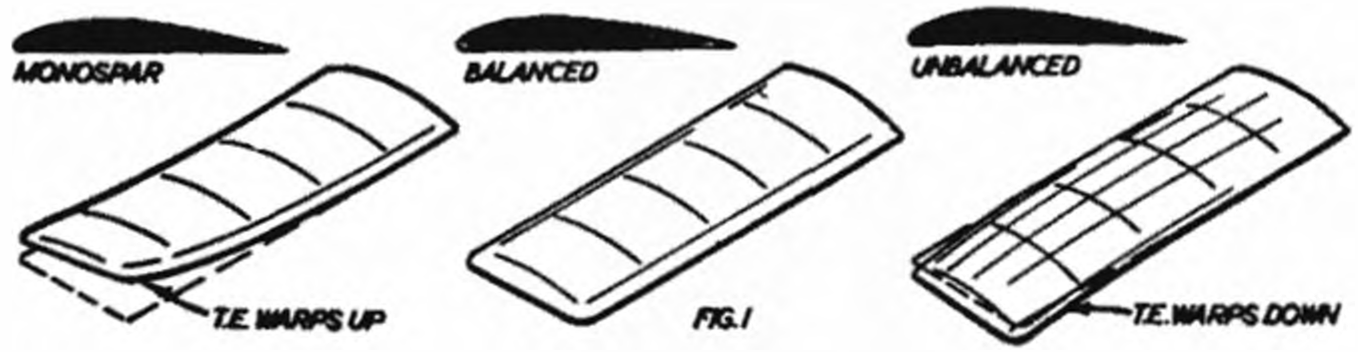
RIGGING FOR FLIGHT

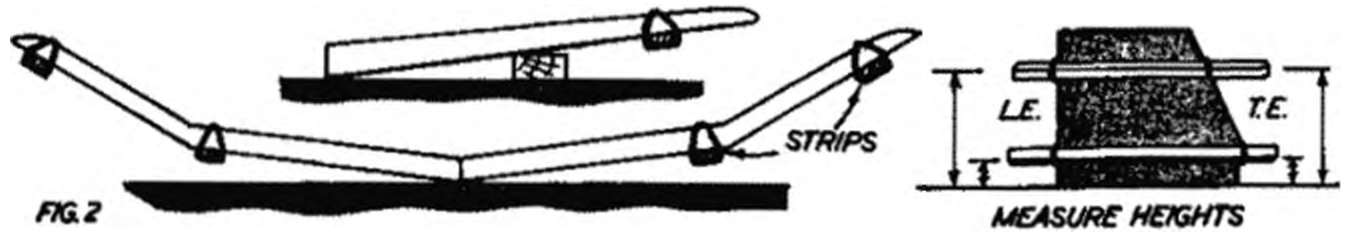
A RIGGING CHECK preparing a new model for its first flight should always be carried out thoroughly and accurately. Flight testing is the most critical period of the model's life and it is only common sense to make *sure* that the balance and trim is as near correct as it is possible to estimate.

For all free flight models employing tissue covered surfaces, best practice is to allow a period of "ageing" after covering and doping so that these surfaces will assume any permanent "set" they are likely to take up. Newly doped wings and tail surfaces tend to change their warps over a period of several days after the final coat of dope is dry and up to two weeks for final "ageing" is not excessive. It can then be safely assumed that (apart from prolonged exposure to extreme heat, or other adverse conditions) any small warps present are permanent and unlikely to change again and upset the trim.

The natural tendency for wings and tail surfaces to warp should also be appreciated. With conventional monospar construction there is a natural tendency for the trailing edge to warp upwards towards the tips, giving washout. If this is deliberately held out by pinning the surface down flat while drying, the natural warp will subsequently appear on ageing. Two-spar construction is less liable to this effect and with other forms, *e.g.* multi-spar, particularly where the spar distribution is unbalanced, the natural tendency to warp may have an opposite effect, *e.g.*, induce wash-in at the tips—see Fig. 1. Lightweight structures may also have a tendency to warp as a whole, *e.g.*, assume a slightly bowed dihedral (or a bowed anhedral with a badly unbalanced spar arrangement). Neither washout on wings or tailplanes, nor dihedral "bow" is harmful (provided it is not excessive) and may even be beneficial. Wash-in, on the other hand, is generally undesirable, except where deliberately used as a method of rigging a power model for torque control.

The main danger with a warp deliberately introduced for trimming purposes is its liability to change over a period of time. It must be built into the structure for a start, not warped in after covering and doping, if it is to have any chance of permanency. The only structures which are completely reliable and remain consistent, as built, are the recognised anti-warp forms, like geodetic. If properly proportioned and built, these should remain true after removing from the building board and subsequent covering, etc. The practice, often followed, of strapping conventional structure contest wings to a jig all the time they are not in use to "hold" put-in warps is far from being foolproof and consistent.



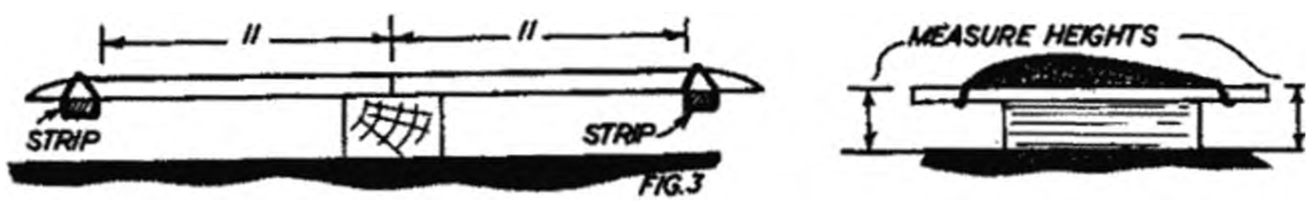


The simple, and direct, way of assessing a warp is to sight the wing from the rear with the trailing edge held at eye level and about an arm's length away. This gives a rough check of how much one wing is warped relative to the other panel, the degree of washout (or wash-in) which may have appeared and whether or not this is equal on both sides. More accurate determination involves measurement.

Rigging incidence is normally measured relative to a tangent to the lower surface of the aerofoil. If, therefore, lengths of rigid balsa strip are strapped to the wings with rubber bands, as in Fig 2, direct measurement of the incidence at these points can be undertaken. Simply mark a convenient length on each strip—say 5 in. or 10 in., depending on the chord of the wing—and then measure the height at the front mark and rear mark, respectively, on each strip or "rigging board" above a flat surface on which the wing is resting. Reference to Table 1 will then give the exact incidence at each point, determined by the difference between the front and rear heights.

Tip incidence on a plug-in or half wing is similarly measured, using a single rigging board strapped on near the tip. This method is more accurate than laying the wing on a flat surface and simply measuring trailing edge height above the surface since it compensates for any change in the remainder of the wing structure (*i.e.*, bowing of the mainspar and leading edge). The measurement of a single flat surface, such as a tailplane, can be done by supporting the centre on a parallel block and using rigging boards at each tip, as in Fig. 3.

To check fore and aft rigging, the model should be assembled and the fuselage suitably blocked up or otherwise supported on a flat surface so that the rigging datum line—such as the nominal fuselage centre line, or line from which the angles of incidence of wings and tail were originally laid out—is parallel to the surface. Direct measurement of the front and rear heights against "rigging boards", as before, this time near the wing and tail root, then determine the actual rigged incidences, using either Table 1 again, or Table 2.



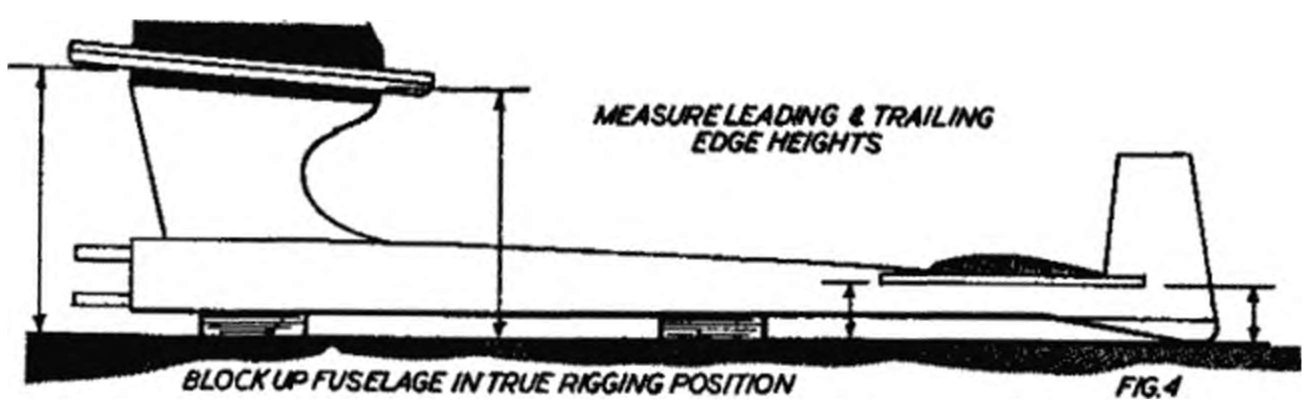


TABLE I - DEGREES EQUIVALENT ON 10" CHORD

DEGREES	1/2	1	1 1/2	2	2 1/2	3	3 1/2	4	4 1/2	5
DIFFERENCE	·087"	·175"	·262"	·349"	·436"	·523"	·616"	·698"	·785"	·872"
NEAREST FRACTION	5/64" 3/32"	11/64" 3/16"	17/64"	11/32"	7/16"	33/64" 17/32"	39/64"	45/64"	25/32"	7/8"

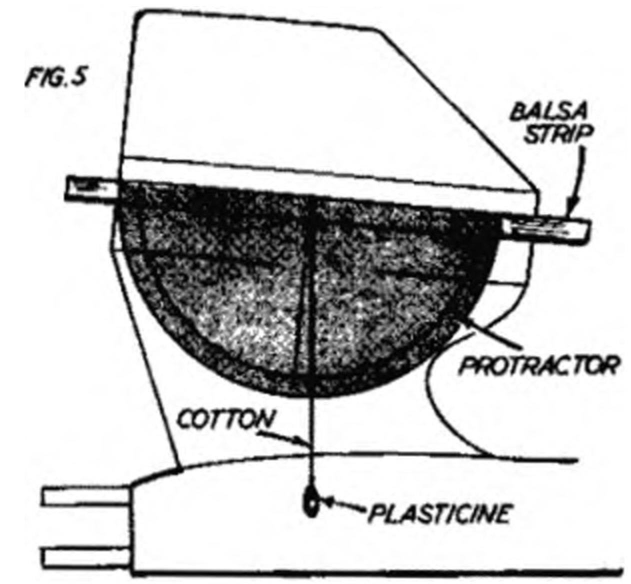


TABLE IA - CHORD LENGTH EQUIVALENTS

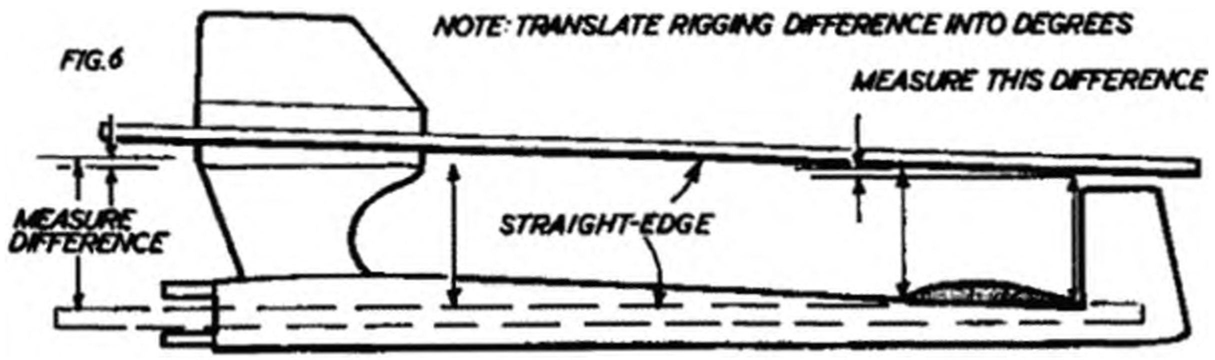
DIFF.	1/2°	1°	2°	3°	4°	5°
1/32"	3·6"	1·8"	·9"	—	—	—
1/16"	7·2"	3·6"	1·8"	1·2"	—	—
3/32"	10·8"	5·35"	2·7"	1·8"	—	—
1/8"	14·4"	7·15"	3·6"	2·4"	1·8"	—
3/16"	—	10·7"	5·4"	3·6"	2·7"	2·15"
1/4"	—	—	7·2"	4·8"	3·6"	2·9"

A positive difference between wing and tailplane rigging incidence is always called for on free flight models, and Table 2 can be used to decide what thickness of packing is required, if necessary, to adjust this difference in incidence (also known as longitudinal dihedral) to a specified amount.

Alternative methods which can be employed for a longitudinal rigging check include the use of a protractor and simple plumb bob (*e.g.*, small piece of plasticine on a cotton line) for direct measurement of rigging incidence in degrees, as in Fig. 5 ; or using a long strip of wood held flat under the wing and measuring the tailplane incidence relative to this—Fig. 6. Method 5, of course, can equally well be used to check the incidence along the whole length of the wing (simpler than the Fig. 2 method, but more liable to accidental error). The method of Fig. 6 measures only the *difference* in rigging incidence between wing and tailplane and not the actual rigging incidences. The latter, in fact, are of academic value only and it is this difference which is the important factor.

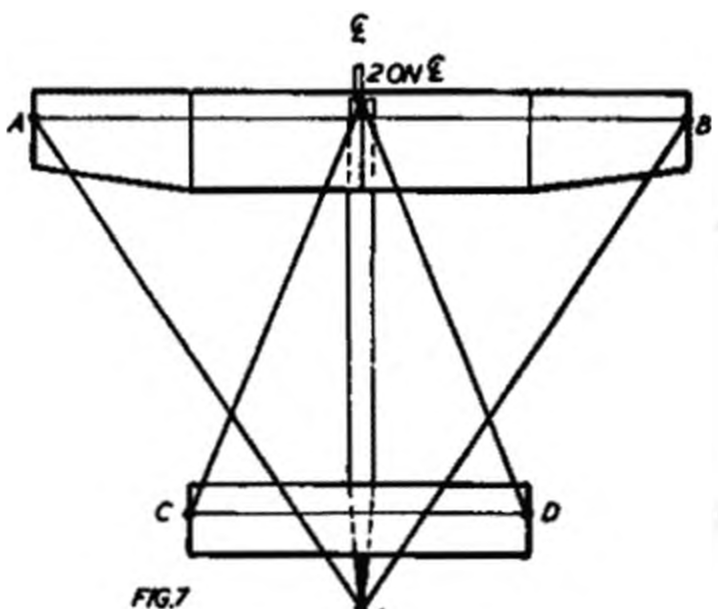
TABLE II. APPROXIMATE DEGREES EQUIVALENTS

CHORD → / ↓ DIFFERENCE	3"	3 1/2"	4"	4 1/2"	5"	5 1/2"	6"	7"	8"	9"	10"	11"	12"
1/32"	—	—	1/2	—	—	—	—	—	—	—	—	—	—
1/16"	1	1	1	—	—	—	—	1/2	—	—	—	—	—
3/32"	1/2	—	—	—	1	1	1	—	—	—	—	—	—
1/8"	—	1/2	—	—	—	—	—	1	1	—	—	—	—
3/16"	—	3	—	2 1/2	—	2	—	—	1 1/2	—	—	1	—
1/4"	—	4	—	—	3	—	2 1/2	—	2	—	1 1/2	—	—
3/8"	—	6	5 1/2	5	4 1/2	4	—	3	—	2 1/2	—	—	2
1/2"	9 1/2	8	7	6 1/2	6	5 1/2	5	4 1/2	4	3 1/2	3	—	2 1/2

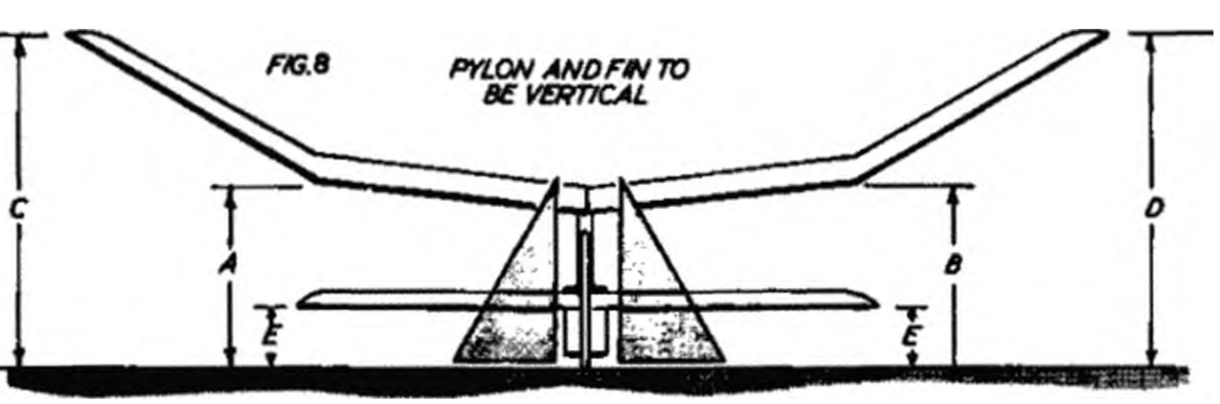


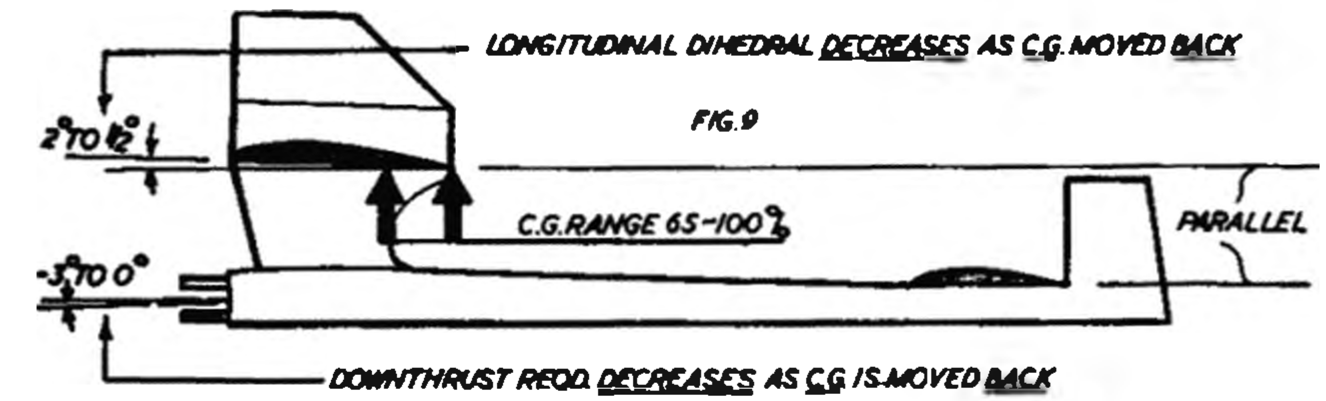
The alignment of the assembled model is best checked by direct measurement, as in Fig. 7, using a length of balsa strip or a length of cotton and a pin. Measure from point 1 at the extreme rear of the fuselage on the centre line (or datum line on an asymmetric fuselage) to points A and B on each wing tip, respectively. These points are, most conveniently, the mainspar or front spar position at the tips. The two measurements should agree closely—*e.g.*, to within $\frac{1}{4}$ in. on a 48 in. span model.

The tailplane is checked in a similar manner, measuring from point 2 on the centre line (or datum line) at the front of the fuselage to each tailplane tip point C and D. Again these measurements should agree, to the same order (*e.g.*, withint $\frac{1}{8}$ in. on 24 in. span).



Finally, alignment from the end-on aspect—Fig. 8. Logically, the model should be blocked up with the fin and fuselage vertical, but since there is the possibility of the fin leaning through an error in assembly the fuselage is aligned square (right angles to the surface) and the fin checked independently. Alternatively, if the model is a bit "out" and it is not advisable to alter the wing mount, "square" up the fuselage by aligning the wings with A and B equal, then align the fin accordingly. It is not so important in actual fact that the fuselage be truly square to everything, but it is important that the fin should be "square" with the wings. Further measurements C and D, made to the two wing tips, check that the tip dihedral is equal, where this applies.





Similarly, for the tailplane to be rigged "square", measurements see fig. 8 must coincide. This is not a necessity, however, for a tilted tailplane is often used for trimming for a turn. In this case the tailplane mount is deliberately adjusted to give a pronounced tilt—the effect being to make the model turn in the direction of the highest tailplane tip. In some cases, too, slewing the wing is sometimes recommended for adjusting turn, but this is not generally to be recommended and true rigging as determined by Fig. 7 is best practice.

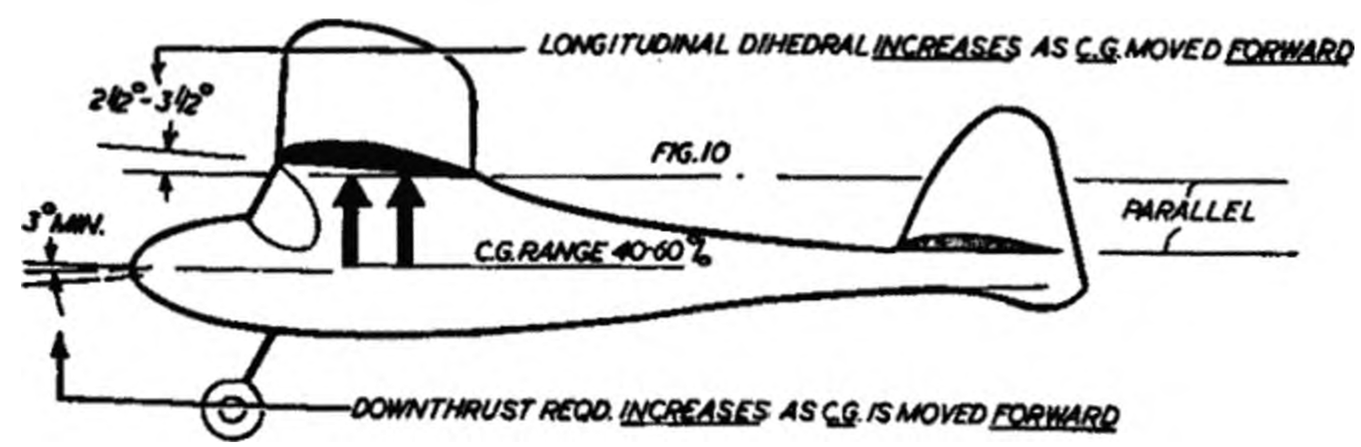
Finally, there is the question of balance and thrust line setting. The two are interrelated, and also dependent to a considerable extent on the design layout. Far from being the critical feature that many people imagine, the balance or centre of gravity position of the model can vary over a relatively wide range and the model still fly, *provided the rigging angles are adjusted accordingly*. Typically, however, individual types of models are rigged with the centre of gravity at a specific point. This corresponds to the rigging incidences of wings and tailplane, and the thrust line setting on which the original design was flown. Slight departûres from this given balance point require readjustment of rigging to compensate.

Generalisations which apply are, the farther *aft* the centre of gravity or balance point :

(*i*) The *less* the difference in rigging incidence between wing and tail (usually resolved as a reduction in wing rigging incidence).
(*ii*) The less the amount of downthrust required.
(*iii*) The more critical the model becomes on adjustment.
(*iv*) The greater the effect of a tilted tailplane as a measure of turn control.
(*v*) The less the power of recovery from a dive (*i.e.*, the longitudinal stability margin is reduced in consequence of the reduced longitudinal dihedral).
(*vi*) The more efficient the model as "duration" machine.

Conversely, the farther *forward* the centre of gravity :

(*i*) The greater the difference required in wing and tail rigging incidences (often to the point where the tailplane is rigged at negative incidence).



(*ii*) The greater the amount of downthrust required (so that the tailplane is always *positive* with respect to the thrust line).

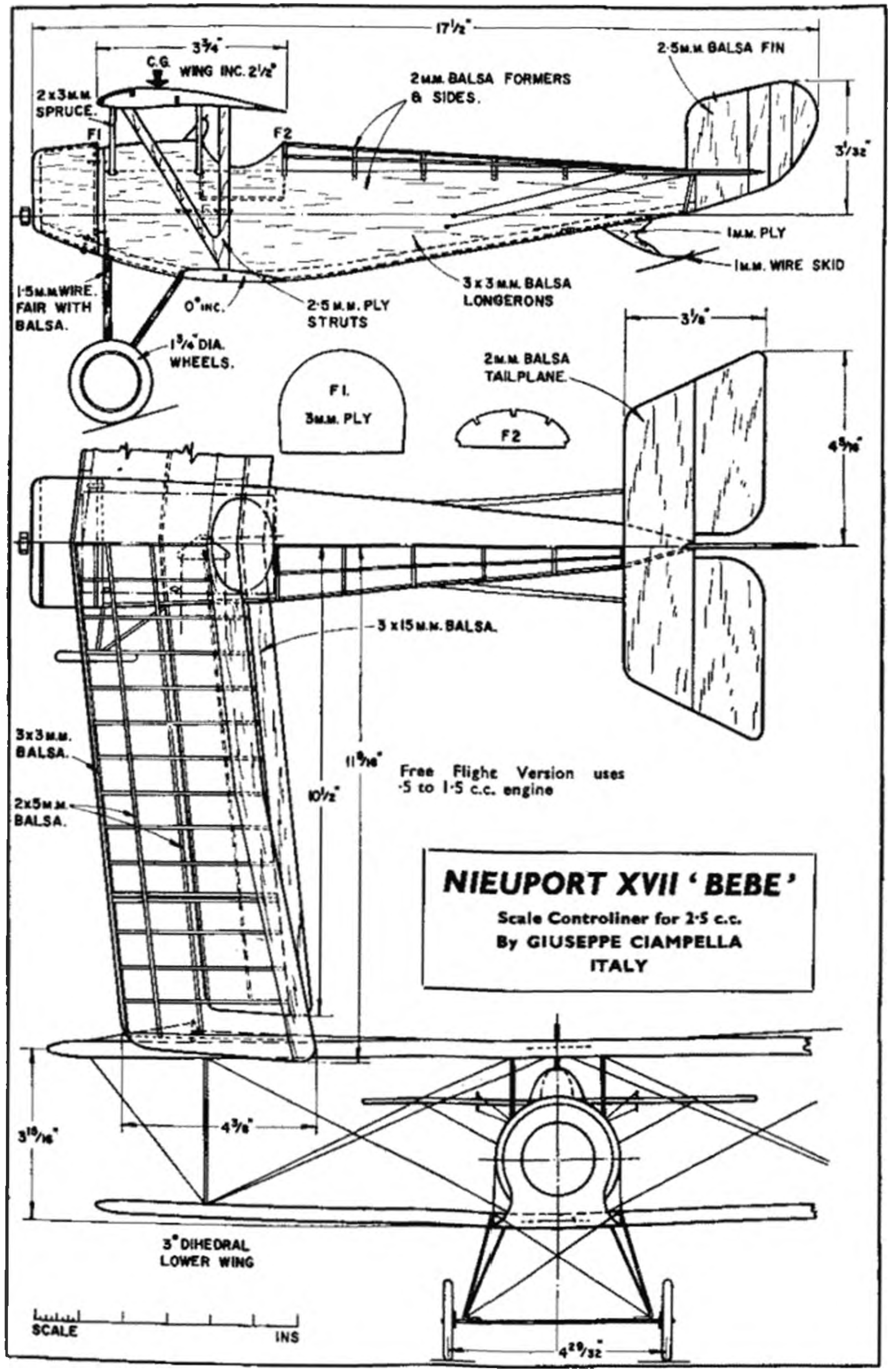
(*iii*) The greater the degree of freedom for adjusting to other balance points (with the limitation that a design proportioned for a fairly forward balance point (*e.g.*, 40-50 per cent of the chord) will not normally have satisfactory stability to be flown with a very rearward balance point).

Given a proven design, one therefore assumes that the limitations of the particular method of rigging adopted have been worked out and reduced to non-critical proportions. The farther aft the design centre of gravity, however, the more important it becomes to duplicate as near as possible the original design position unless drastic changes in rigging are to be adopted and the performance of the model affected in a similar degree.

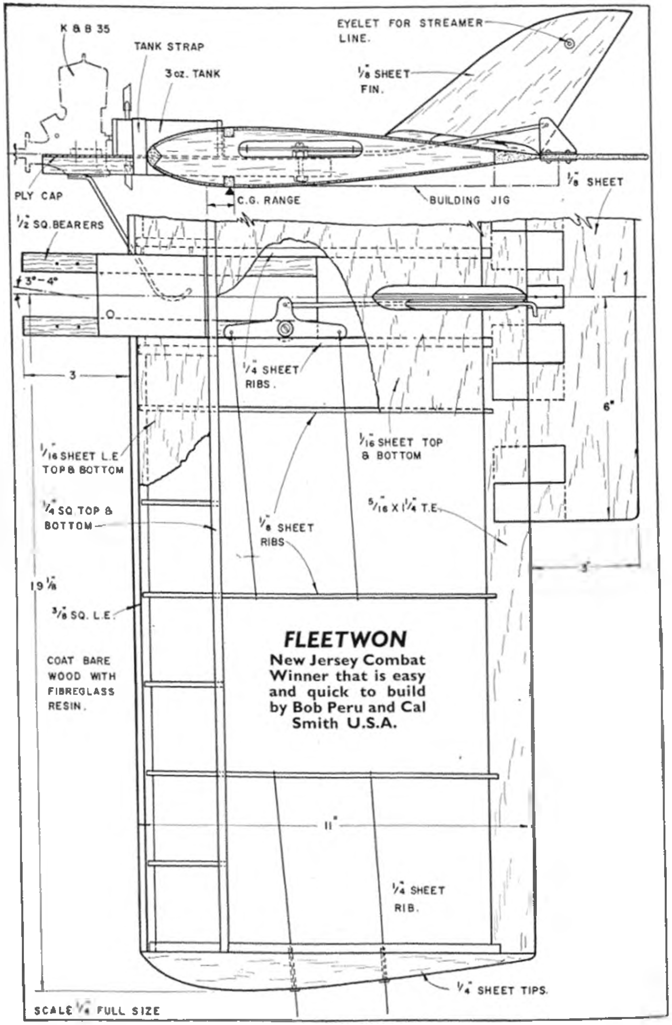
If, for example, the original design called for a balance point on the trailing edge and a "zero" thrust line setting; that model to fly balanced at, say, 60 per cent chord, may require double or treble the longitudinal dihedral angle and perhaps 10 degrees of downthrust. If the c.g. shift was brought about by using a heavier, more powerful engine, these trim changes may also take the model outside the stability limits of the design.

Given a model with a more forward design c.g. position, however, one could expect to accommodate a change in balance position without having greatly to alter the rigging set up to trim, or find critical stability introduced. Indeed a c.g. *range* may be indicated, leaving trimming to be done by adjusting tailplane incidence (and also downthrust, if necessary).

Failing a given balance point to work to (or a suitable given range), the centre of gravity is best positioned by experience *as suitable for that particular design layout and purpose*. Lacking personal experience in determining the set-up for a new design, simply analyse figures for other models of similar layout which have established proven practice. Rigging angles, naturally, are adjusted accordingly.



AEROMODELLISTA



AMERICAN MODELER

FIG I

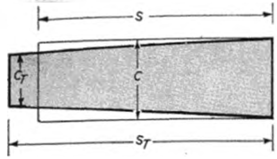


TABLE I

TAPER RATIO C_T/C_R	1	·9	·8	·7	·6	·5
$C_T = C_R$ X	1	·9	·8	·7	·6	·5
AVERAGE CHORD	C	·95C	·9C	·85C	·8C	·75C
S_T (SAME AREA) = S X	1	1·05	1·11	1·18	1·25	1·33
INCREASE IN SPAN	0	5%	11%	18%	25%	33%
ASPECT RATIO = S/C X	2	2·11	2·22	2·36	2·5	2·66
INCREASE IN A.R. %	—	10	23	39	56	76

PLOTTING TAPER WINGS

AERODYNAMICALLY and structurally a tapered wing is more efficient than a parallel chord wing. Many designs ignore this fact in favour of the simpler construction and the overall penalty is not large. Equally, too, the aerodynamic efficiency of a parallel chord wing may be increased by an increase in aspect ratio and there is probably very little difference, at model speeds, between the efficiency of a tapered wing and parallel chord wing of similar area and span.

However, the tapered wing is still superior structurally and allows a lighter wing to be built for the same area. While minimum structural weight is no longer a major consideration in modern contest designs, the fact remains that a light wing is usually a *better* wing (provided it remains strong enough), and weight-saving at the tips, in particular, contributes to better stability.

The design of an equivalent area taper wing with the same root chord automatically implies an increase in wing span, and therefore aspect ratio—Fig. 1. The increase in span follows from the taper ratio employed—see Table I.

The choice of taper ratio is largely arbitrary. It may be chosen purely on the score of appearance, or decided on aerodynamic or structural considerations. As far as aerodynamics is concerned a sharp taper (low taper ratio) is bad, leading to poor efficiency and poor airflow conditions over the tip. At model speeds, too, it is generally accepted that aerofoil sections with a chord of 3½ in. or less become very inefficient, which implies a practical limit on the value of C_T which can be employed to advantage. Hence taper ratios are generally kept to moderate values, *e.g.*, about ·7, and the tip chord given a value of at least 3·5 in. and preferably slightly more, even on small area wings.

There is no objection, however, to completing the extreme tip section with an elliptic planform as in Fig. 2. In fact, this will further increase aerodynamic efficiency, provided the tip is kept reasonably blunted, as opposed to pointed. This type of planform is, in fact, the most efficient of them all.

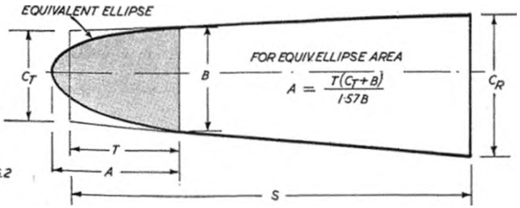


FIG.2

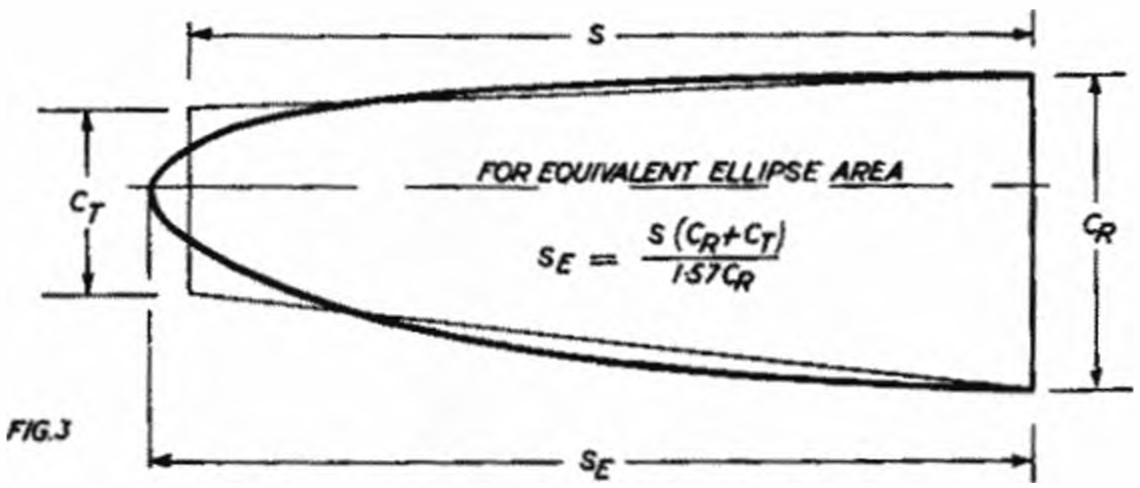


FIG.3

A very close approximation to a true elliptic planform can be reproduced with straight outlines, as in Fig. 3. The aerodynamic performance will be virtually identical at model speeds and although the appearance may not be as pleasing as a true elliptic outline, it is a very much simpler wing to build. The appearance may be improved by making the outer section of equivalent elliptic shape, as in Fig. 2, but the resulting increase in efficiency will be negligible.

Similarly, there will be very little difference in practical performance between the compound straight-tapered wing of Fig. 3 and the one employing a parallel inboard panel and tapered tips—Fig. 4. The tip taper must be pulled in slightly more, but the aerodynamic effect is substantially unaltered, particularly if the change in planform also coincides with a dihedral break. The spanwise proportions of such a wing, in fact, represent almost the ideal distribution of taper, although the point of change is far from critical.

The use of moderate taper ratios minimises structural problems, simply by keeping down the extra length of spars required. Since the taper wing implies an increase in span, structural weight will increase if the same spar sections are used—any saving in rib weight through reduction in chord being offset by the fact that more ribs are required. However, the loading on the spars is less, so spar section can be reduced and, ideally, tapered from root to tip, corresponding to an efficient distribution of loading. On this basis the taper wing can be made lighter, and particularly the tip areas of the wing lightened.

The layout of a taper wing on the lines of Fig. 1, however, may not be acceptable. For a reasonable taper ratio the tip chord may be reduced too much ; or the final aspect ratio may be too high. Although, theoretically at least, an increase in aspect ratio results in an increase in efficiency through reduced wing drag, this does not necessarily apply, without limit, in model sizes. Any gain in this respect may be more than offset by a reduction in efficiency of the aerofoil

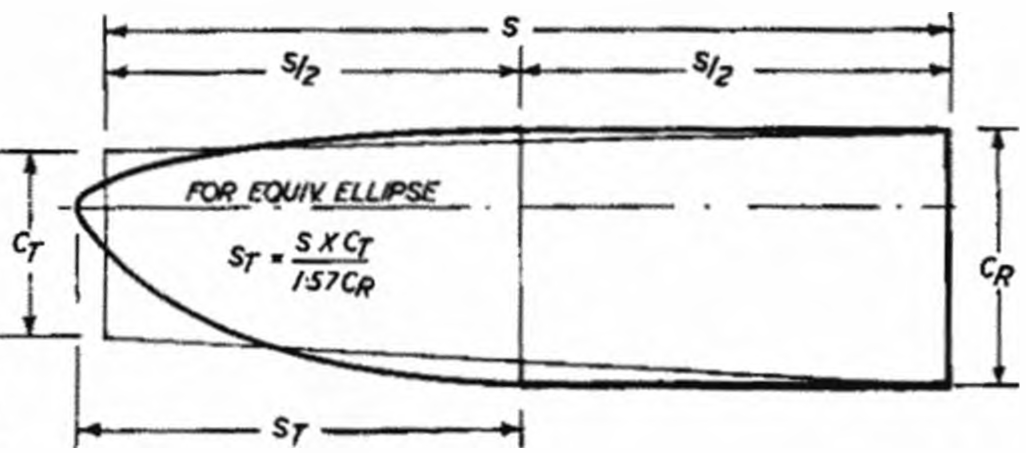


FIG 4

TABLE II. EQUIVALENT AREA WINGS OF EQUAL SPAN ($S_T = S$)

TAPER RATIO C_T/C_R	1	·9	·8	·7	·6	·5
ROOT CHORD $C_R = C \times$	1	1·05	1·11	1·18	1·25	1·33
TIP CHORD $C_T = C \times$	1	·95	·89	·82	·75	·67

section through the smaller chords employed. If a 3½ in. chord represents a minimum for the section to "work" at all efficiently, the larger the chord the more efficient it becomes at the same speed. The other objection to high aspect ratios is structural—the higher the aspect ratio the greater the problem of preventing the wing from twisting under flight loads, and the more difficult it is to make it strong and rigid enough without adding excessive weight to the structure.

Although numerous methods of calculating or arriving at the "optimum" aspect ratio for any design have been advanced, suitable values are usually arrived at by experience and a majority of successful designs in any one class or type usually conform to similar figures. Thus, for A2 gliders an aspect ratio of 9 or 10 : 1 up to 12 : 1 has become standard practice. For free flight power models it is lower at around 8 : 1 on average. For rubber models average values are between 9 and 10 : 1. There is no advantage to be gained in departing from proven figures since these have shown themselves to be best in practice.

Thus, the aspect ratio of a tapered wing is seldom made very much higher than that of an equivalent area parallel chord wing. It is usually a little higher, but seldom very much so. The equivalent planform is therefore based on a slight increase in root chord, as in Fig. 5, whence the increase in span is reduced proportionally. Table 2 details some typical design data.

In all the planforms so far described (Figs. 1 to 5) the taper has been plotted equally about a hypothetical datum line which, strictly speaking, should be the aerodynamic centre of the aerofoil section or say, approximately, 40 per cent of the chord. Plotting about any other datum will give the resulting wing either *sweepback* or *sweepforward*.

If the taper is confined entirely to the trailing edge, for example, as in Fig. 6, the wing is aerodynamically swept forward, the amount of sweep readily found by joining the 40 per cent chord points on the root and tip chords and measuring or calculating this angle relating to a line at right angles to the fuselage centre line. Similarly, if the taper is confined to the leading edge, as in Fig. 7, the wing has *sweepback*.

A small amount of aerodynamic sweep appears to have little effect. Sweepforward, generally, is not advisable for stability reasons, but most wings with parallel chord centre sections and tapered tips employ the method of Fig. 6

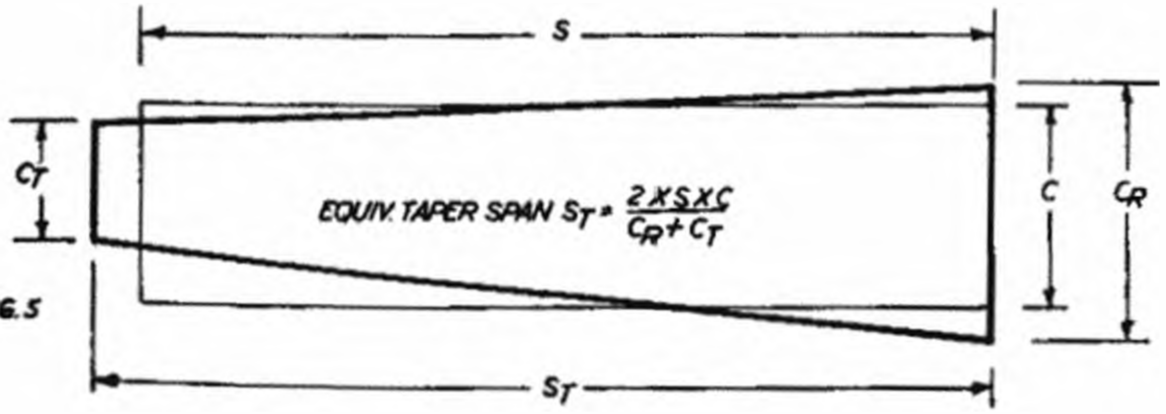
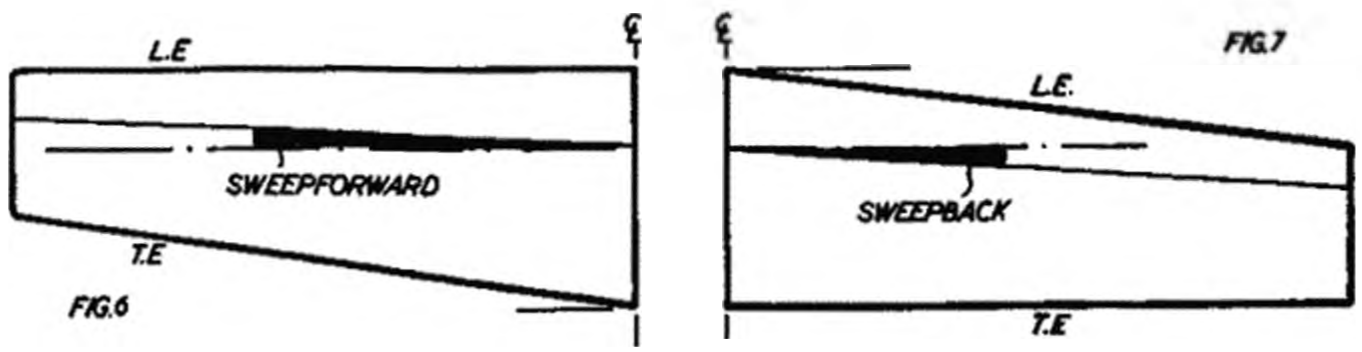


FIG. 5



for laying out the tip taper and do not appear to suffer any adverse effects. The tip sweep of Fig. 7 is theoretically better but is seldom employed and does not, in fact, look right.

In practice most model wings, when rigged, *do* have sweepback by virtue of being set at a positive angle of incidence. This canting of the whole wing results in a tilting back of the aerodynamic mean centre line, which may completely cancel out the forward sweep of the Fig. 6 layout ; add sweepback to a wing tapered about the aerodynamic centre line ; increase the sweepback of the Fig. 7 layout ; or cancel out the forward sweep on the tips of a rectangular planform with trailing edge taper on the tips—see Fig. 8.

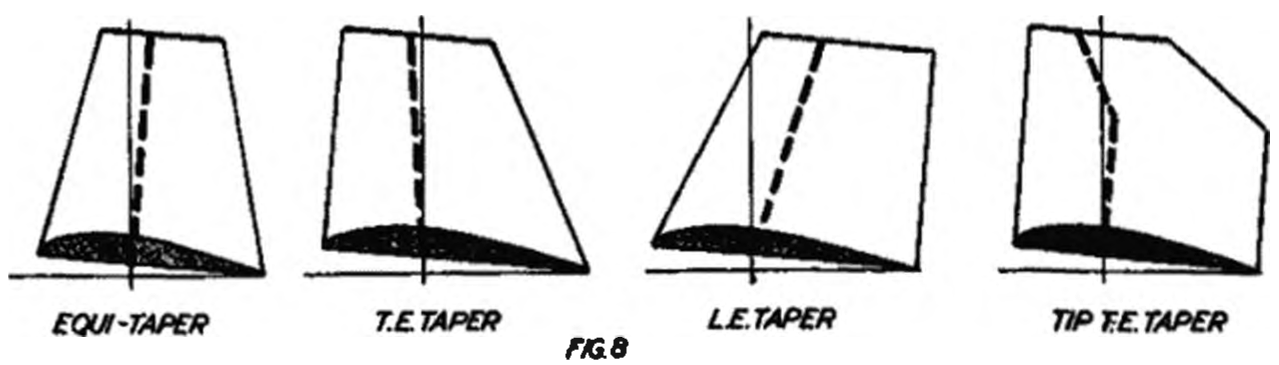


FIG.8

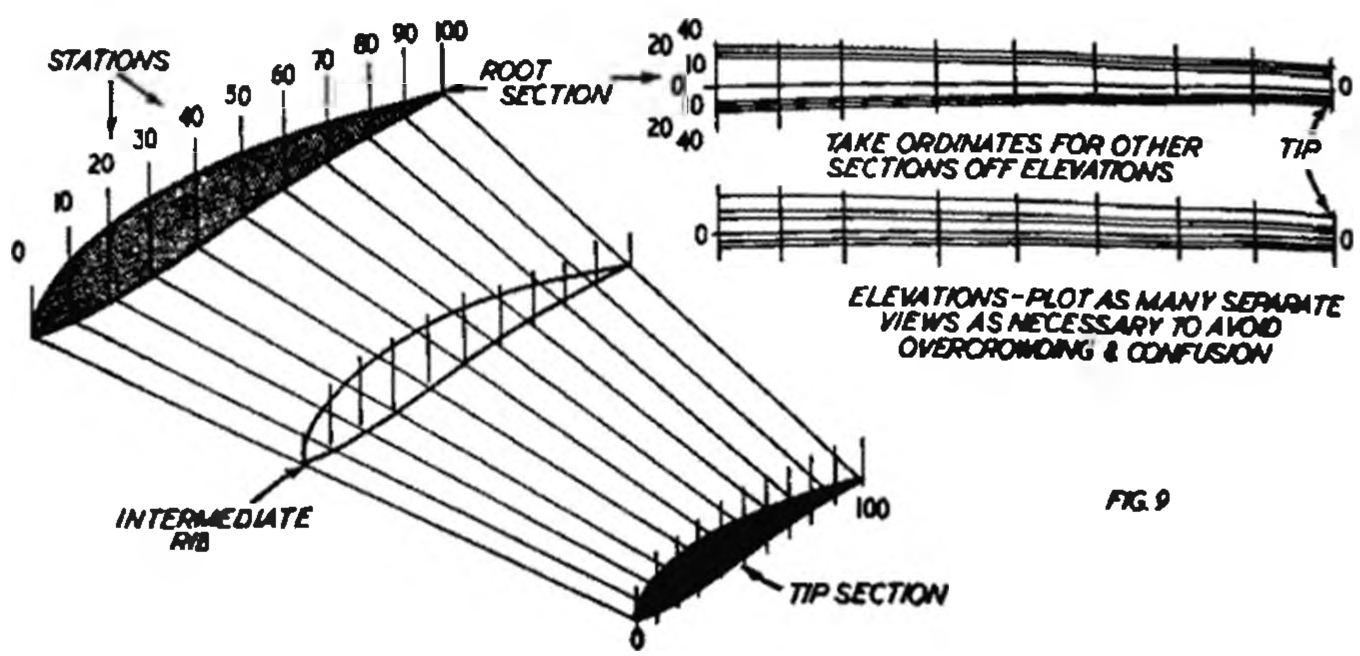
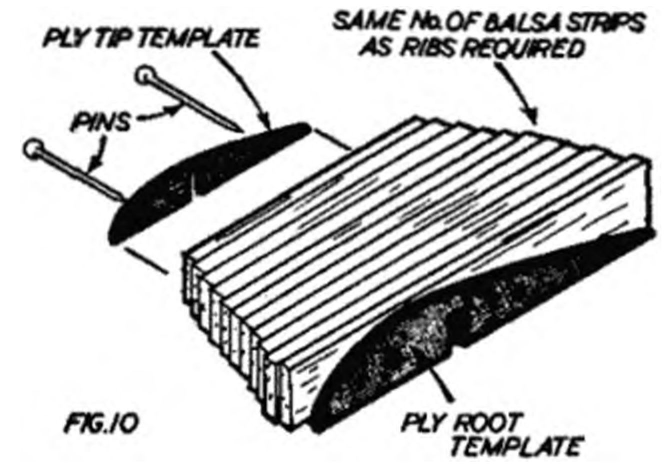
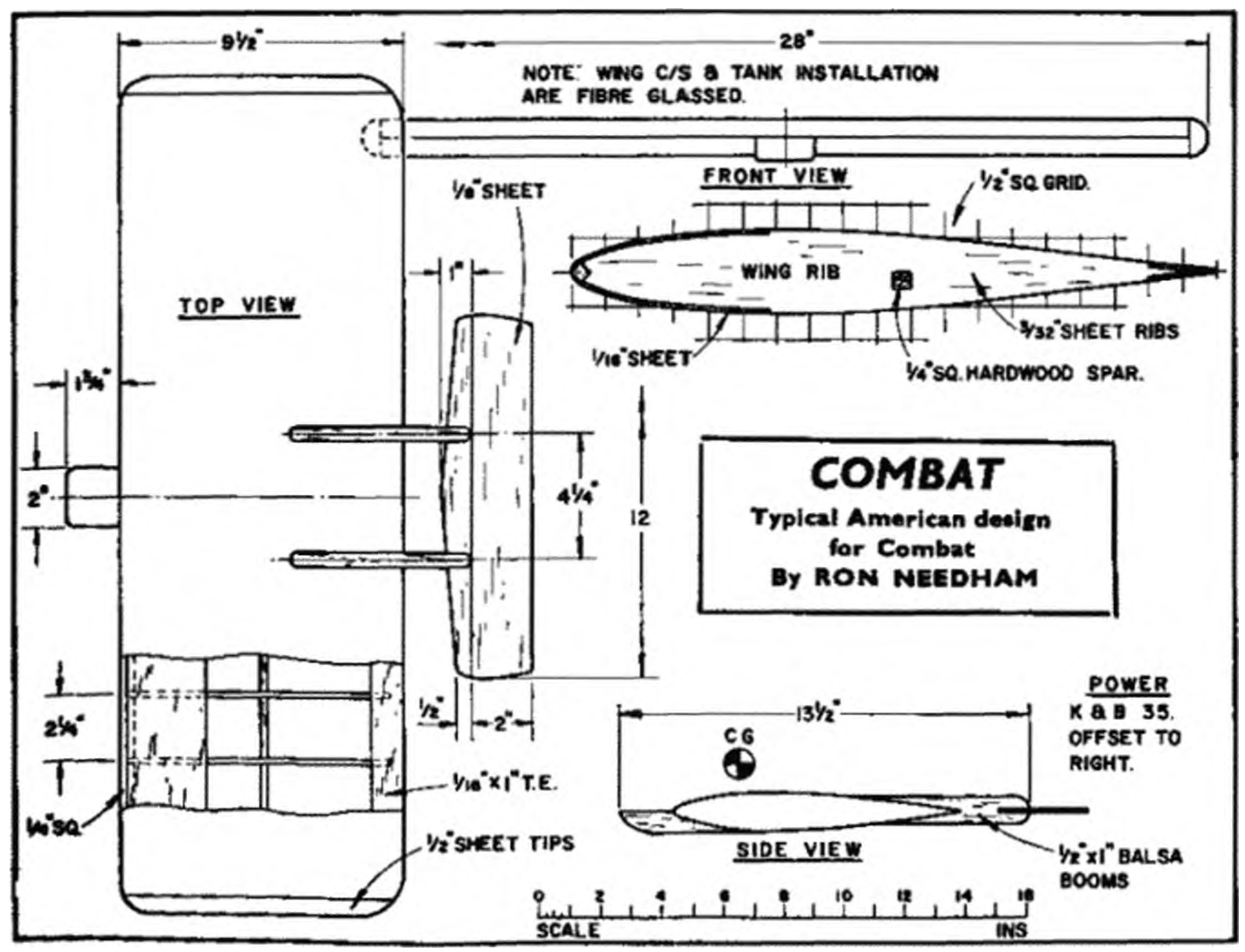


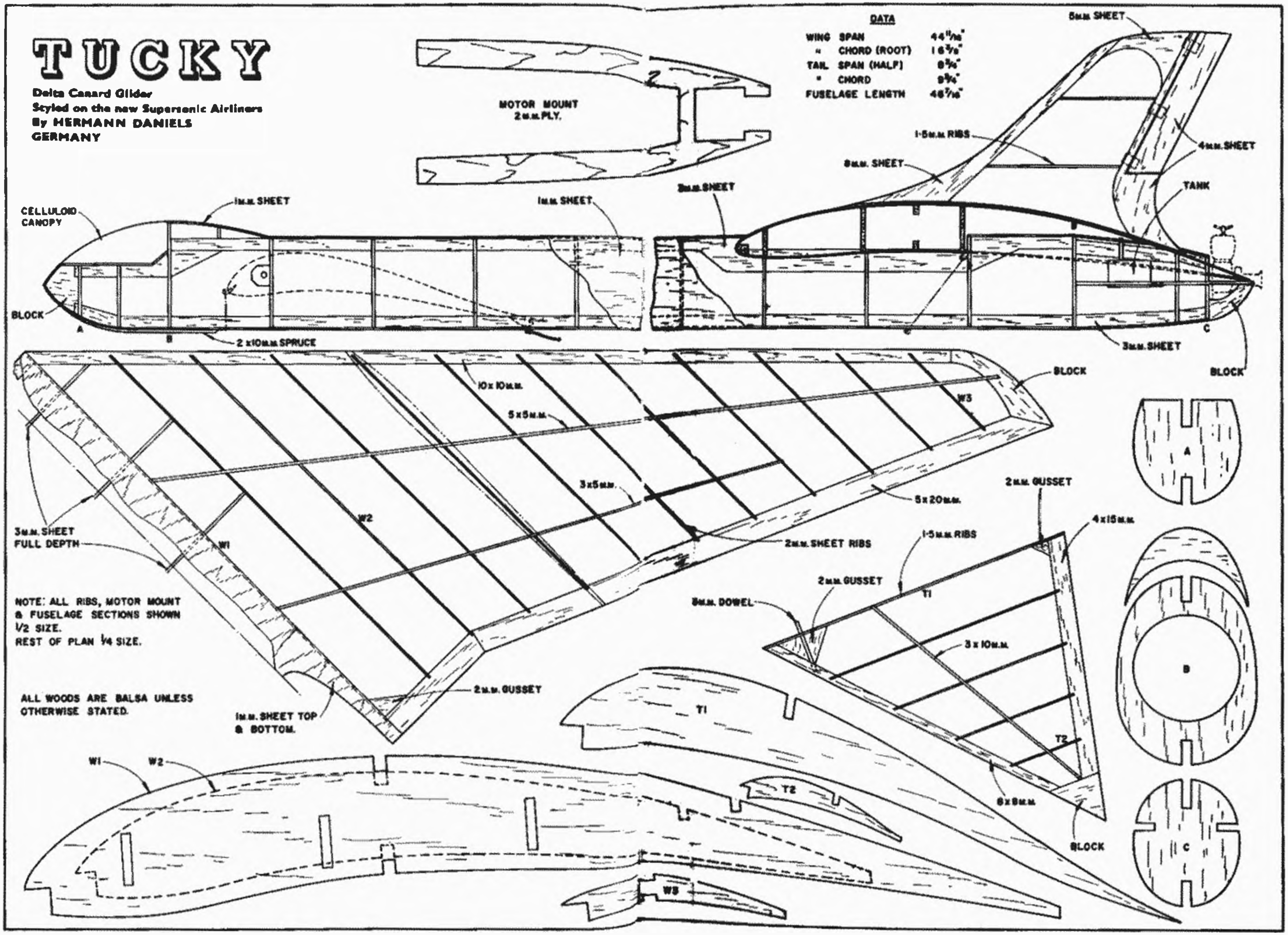
FIG.9

The other major aspect in plotting a taper wing is determining the individual chord sections at each rib station. These sections can readily be plotted, as shown in Fig. 9. Chord station ordinates are marked off for the root and tip sections and joined, as shown. Corresponding ordinates for any other rib station can then be measured off and the appropriate individual sections plotted. The method is exact and can accommodate a change of section, any type of taper, etc., but the method is tedious. In practice it is more usual to make two templates, one of the root rib and one of the tip rib, and sandwich between them rectangles of balsa equal in number to the number of ribs required. The templates are suitably aligned, preferably on the spar slot, the whole pinned together and then carved as a block. The resulting chamfer on the individual ribs is not consistent with the true taper, but this has no practical significance. Certainly a set of taper wing ribs made in this manner is usually more accurate than those plotted and then cut individually.

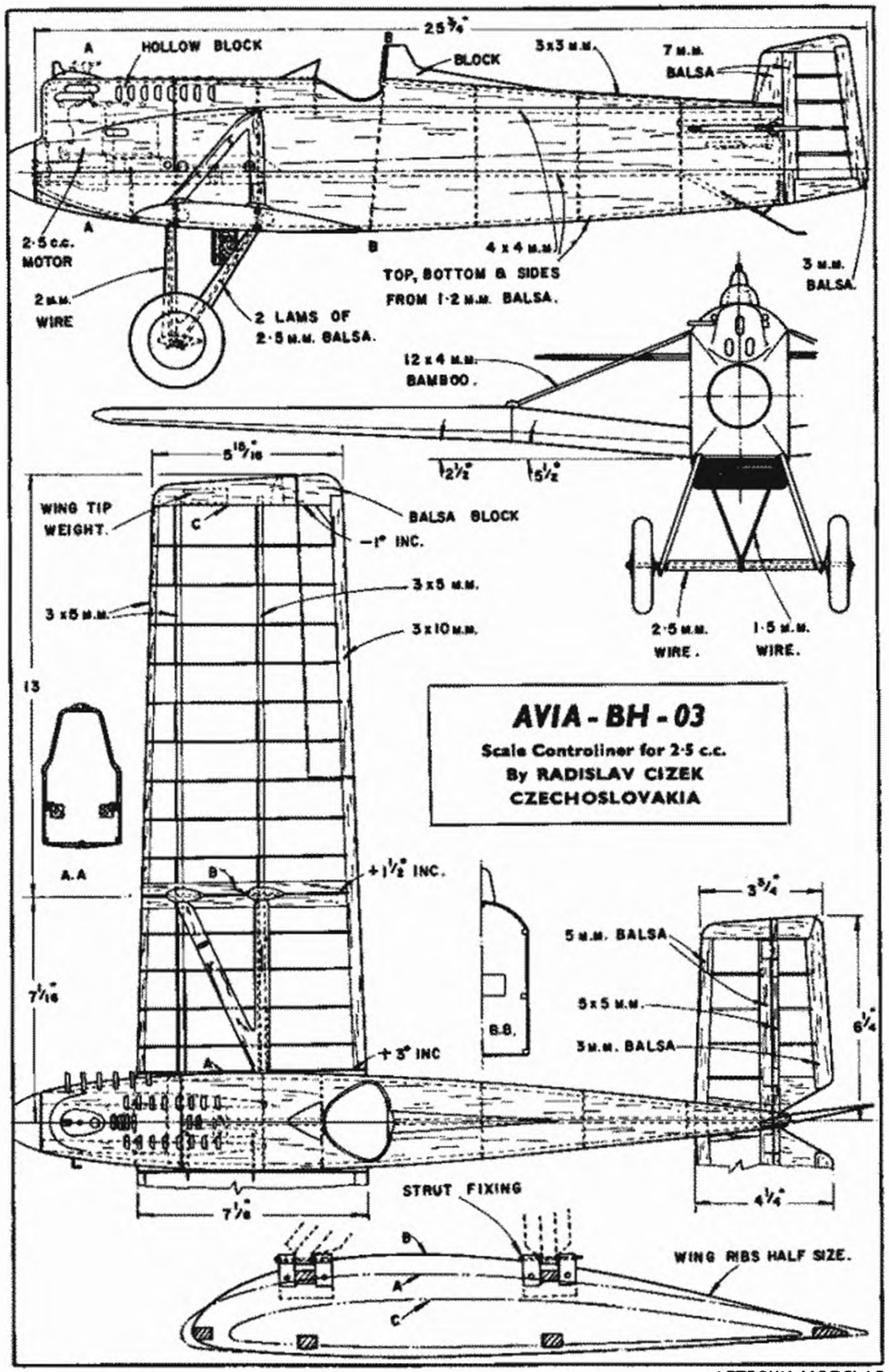




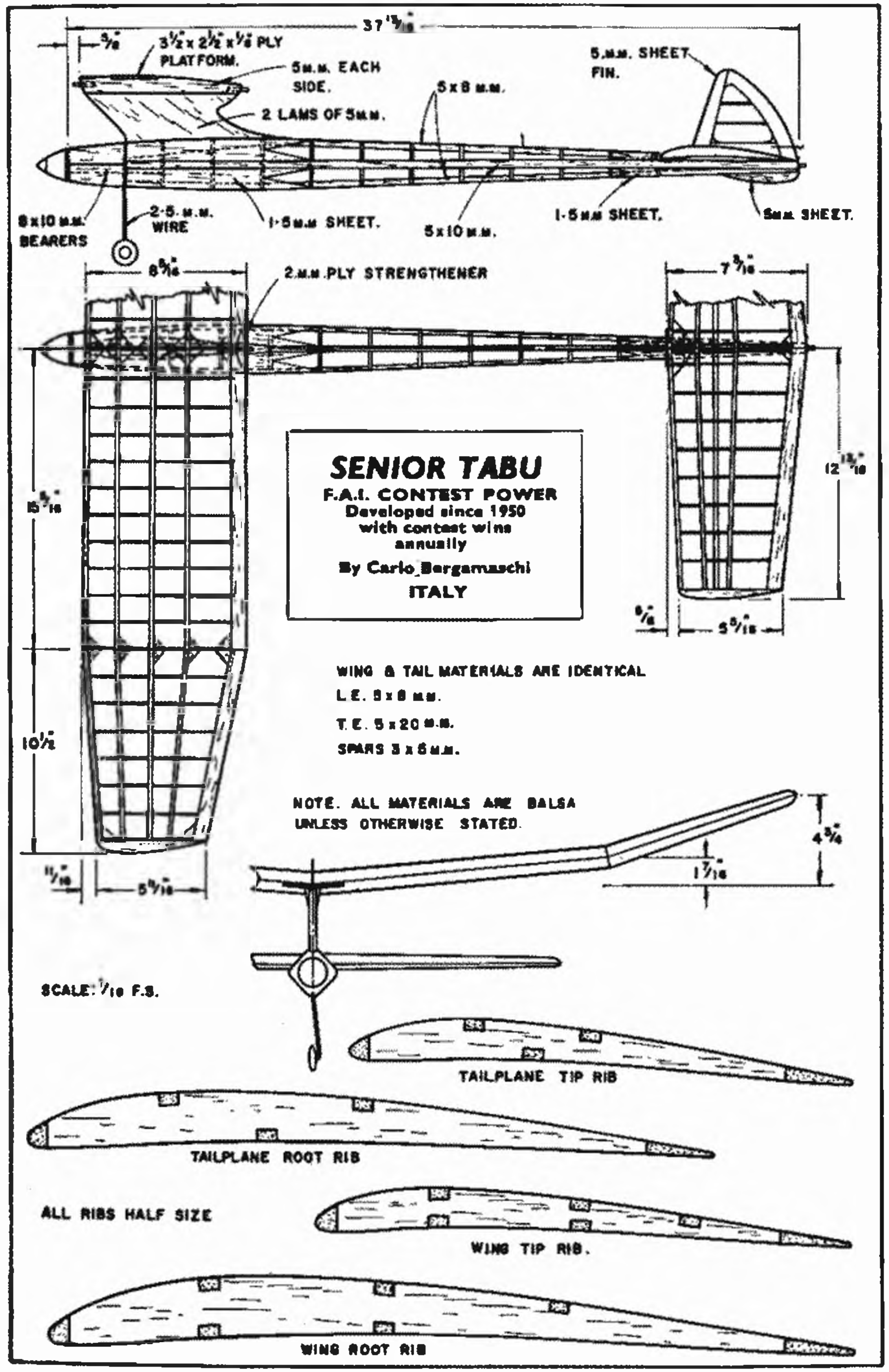
AMERICAN MODELER



FLUG MODELL-TECHNIK


AVIA - BH - 03
Scale Controliner for 2·5 c.c.
By RADISLAV CIZEK
CZECHOSLOVAKIA
HOLLOW BLOCK
BLOCK
3 x 3 M.M.
7 M.M. BALSA
2·5 c.c. MOTOR
2 M.M. WIRE
2 LAMS OF 2·5 M.M. BALSA.
4 x 4 M.M.
TOP, BOTTOM & SIDES FROM 1·2 M.M. BALSA.
3 M.M. BALSA.
12 x 4 M.M. BAMBOO.
WING TIP WEIGHT.
BALSA BLOCK
-1° INC.
3 x 5 M.M.
3 x 10 M.M.
2·5 M.M. WIRE.
1·5 M.M. WIRE.
+1½° INC.
+3° INC
5 M.M. BALSA
5 x 5 M.M.
3 M.M. BALSA
STRUT FIXING
WING RIBS HALF SIZE.

LETECKY MODELAR


SENIOR TABU
F.A.I. CONTEST POWER
Developed since 1950
with contest wins
annually
By Carlo Bergamaschi
ITALY
3½ x 2½ x ⅛ PLY PLATFORM.
5 M.M. EACH SIDE.
2 LAMS OF 5 M.M.
5 x 8 M.M.
5 M.M. SHEET FIN.
8 x 10 M.M. BEARERS
2·5 M.M. WIRE
1·5 M.M. SHEET.
5 x 10 M.M.
1·5 M.M. SHEET.
5 M.M. SHEET.
2 M.M. PLY STRENGTHENER
WING & TAIL MATERIALS ARE IDENTICAL
L.E. 5 x 8 M.M.
T.E. 5 x 20 M.M.
SPARS 3 x 6 M.M.
NOTE. ALL MATERIALS ARE BALSA
UNLESS OTHERWISE STATED.
SCALE: 1/16 F.S.
TAILPLANE TIP RIB
TAILPLANE ROOT RIB
ALL RIBS HALF SIZE
WING TIP RIB.
WING ROOT RIB

AEROMODELLISTA

TRIMMING CHECK CHARTS

POWER MODELS

FAULT	REMEDIES FOR MODEL RIGGED c.g. at 50-70 per cent chord	c.g. at 80-100 per cent chord
GLIDE: STALLING	(a) Increase tail positive incidence (b) Decrease wing incidence	(a) Add weight to nose (b) Increase tailplane positive incidence (c) Decrease wing incidence
DIVING	(a) Increase wing incidence (b) Add weight to tail (c) Decrease tail positive incidence	(a) Add weight to tail (b) Increase wing incidence
POWER: STALLING	(a) Add downthrust	(a) Trim for turn, e.g. with a little sidethrust
TOO SHARP A CIRCLE	(a) Check for warps (b) Check fin or tab offset (c) Reduce any sidethrust	(a) Check for warps (b) Check fin or tab offset (c) Add a little upthrust
POWER FLIGHT TOO STRAIGHT	(a) Trim for turn with a little sidethrust (pylon models adjust for r.h. circle; cabin models preferably l.h. circle)	(a) Try launching slightly cross wind. A straight climb is O.K. if model goes straight up with no tendency to loop
GLIDE TOO STRAIGHT	(a) Adjust rudder tab against power circle (b) Adjust for circle with tail tilt	(a) Adjust for circle with tail tilt (b) Use a floating tab on one wing
POOR CLIMB	(a) Check engine setting (b) Wrong prop—try finer pitch (c) Engine parts loose	(a) Check engine setting (b) Wrong prop—try smaller diameter or thinner blades (c) Engine parts loose
POOR GLIDE ...	(a) Model not trimmed near enough to stall (b) Glide circle too tight	(a) Model not trimmed near enough to stall (b) Glide circle too tight

Note: A change in propeller pitch may affect the direction of turn under power. This can also be used to adjust power circle. A propeller of coarser pitch will tend to induce a power turn to the left; and a finer pitch a turn to the right.

GLIDERS

FAULT	REMEDY	NOTES
STALLING	(a) Add more nose weight (b) Pack up tailplaine leading edge ($\frac{1}{16}$ in. at a time) (c) Give more turn (if stall is only moderate)	Optimum trim is with the model flying just below the stall. Trim until the model is just beginning to stall when gliding straight, then add a little turn to damp out the stall. This will give optimum trim
DIVING	(a) Pack up tailplane trailing edge (b) Pack up wing leading edge (c) Reduce nose weight	
DOES NOT TOW STRAIGHT (pulls off to one side)	(a) Correct with fin adjustment (b) Check for warps on wings or tail (c) Check wings for balance (one tip heavier than the other)	Normally, for straight tow and circling glide an auto-rudder device is advisable

(Continued next page)

GLIDERS—Continued

FAULT	REMEDY	NOTES
DOES NOT TOW STRAIGHT (contd.)	(d) Alter tow hook position (move forward) (e) Try re-trimming with c.g. farther forward	
MODEL WEAVES ON TOWLINE	(b), (c), (d) and (e) as above	May be a fault inherent in the design
MODEL DOES NOT TOW UP TO FULL HEIGHT OF LINE	Tow hook too far forward—move back	

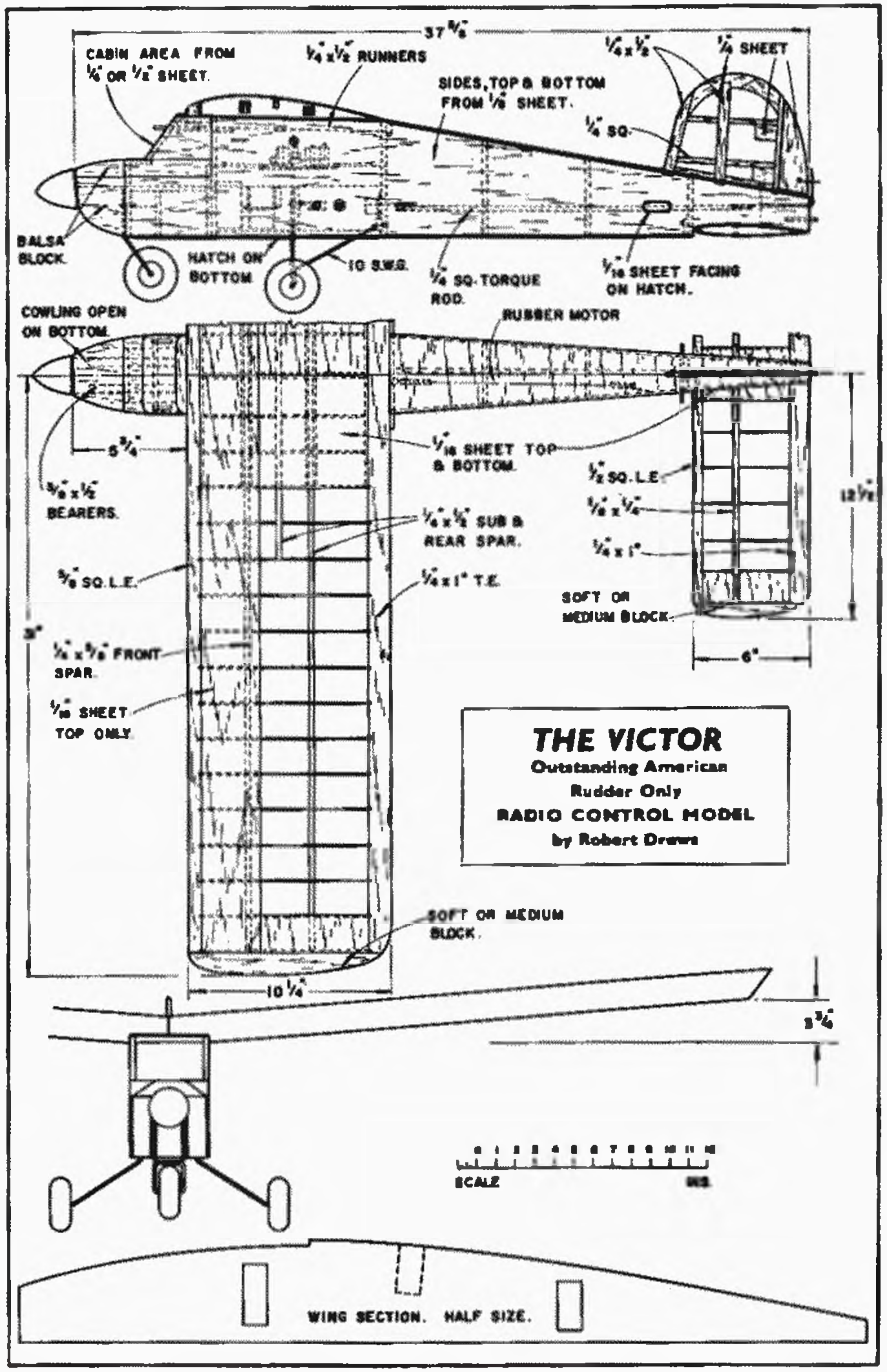
RUBBER MODELS

GLIDE TRIM.—Establish as for gliders, usually best with right-hand circle. Folding propeller models may have left-hand circle on the glide to provide compensating trim change (r.h. power circle, opening up straight, then l.h. glide circle).

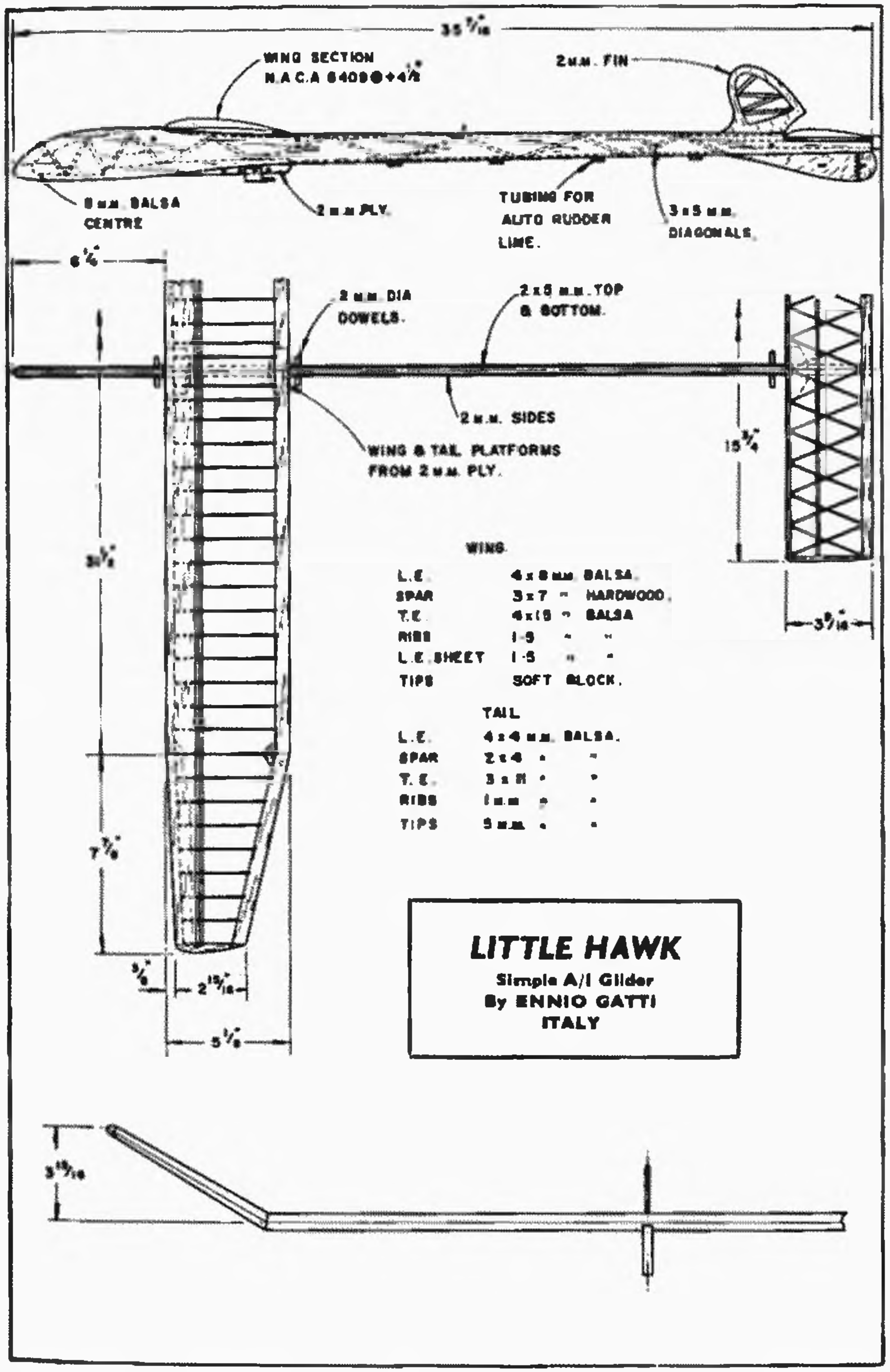
Glide trim may be established roughly by hand-launched tests, but fine adjustment can only be carried out from a height and following a suitable power run. Use about 30-40 per cent turns and work to establish optimum glide trim before proceeding further. As a safety measure, $\frac{1}{16}$ in. downthrust can be used temporarily to guard against stalling under power.

FAULT	REMEDY	NOTES
STALLS ON CLIMB ...	(a) Add downthrust (b) If flying straight, add a little right sidethrust	When adding sidethrust, reduce the amount of downthrust which may be present. Trim for right-hand circling climb (all rubber models)
FLIES FAST, DOES NOT GAIN HEIGHT	(a) Too much downthrust — decrease (b) Not enough wing incidence —increase (c) If circling tightly—reduce sidethrust	
FLIES SLOWLY, DOES NOT GAIN HEIGHT	(a) Not enough power—motor may be weak (more strands required), or propeller too large	Model should gain height and run out power in the air on 20 per cent maximum turns with optimum prop-power balance
TURNS VICIOUSLY TO RIGHT ON FULL TURNS	(a) Too much sidethrust—reduce (b) Excessive fin or fin tab offset—reduce	Rudder or tab offset used should be kept to a minimum. Tilting the tail is a safer method of trimming the glide circle
LOSES HEIGHT AT END OF POWER RUN	(a) Motor weak (b) Underpowered (motor needs more strands) (c) Change of trim with folding prop model	Trim for r.h. climb opening up to straight flight at end of power run
"WAGGLES" on glide (with feathering prop)	(a) Blades not feathering evenly	
HIGH SINKING SPEED	(a) Glide trim not adjusted near enough to stall	

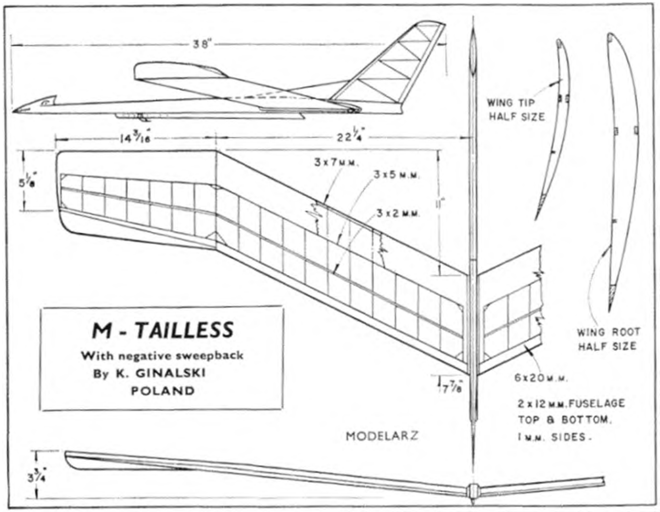
Note: Changes in sidethrust adjustment may also affect glide turn trim with freewheeling propellers

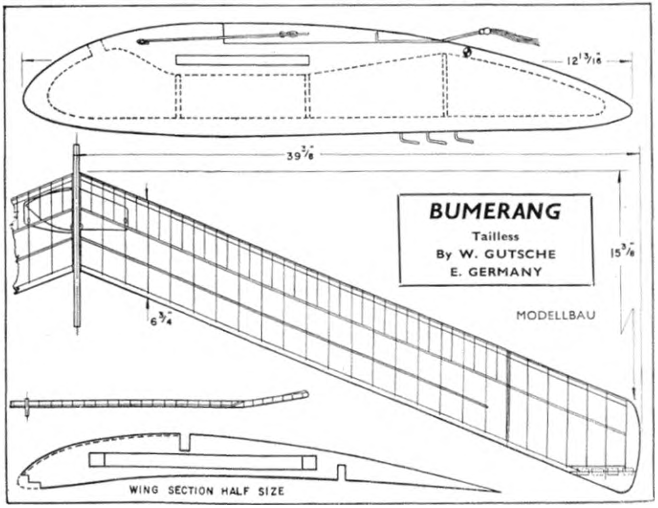


MODEL AIRPLANE NEWS



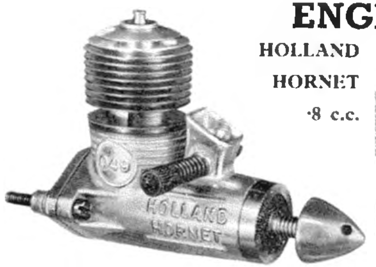
MODELLISMO

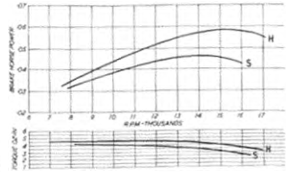




ENGINE ANALYSIS

HOLLAND HORNET ·8 c.c.





Specification

Displacement : ·795 c.c. (·04895 cu. in.)
Bore : ·422 in.
Stroke : ·350 in.
Bore stroke ratio : 1·2 : 1 ; weight : 2 ounces.
Max. B.H.P. :
(Hot head)—·058 at 15,500 r.p.m.
(Standard head)—·047 at 14,000 r.p.m.
Max. torque :
(Hot head)—4·5 ounce-inches at 9,000 r.p.m.
(Standard head)—4 ounce-inches at 9,000 r.p.m.
Power rating :
(Hot head)—·0725 b.h.p. per c.c.
(Standard head)—·059 b.h.p. per c.c.

Material Specification

Cylinder : leaded machine steel
Piston : carbo-nitrided steel
Con. rod : (ball and socket little-end) test aluminium alloy
Crankcase : light alloy die casting
Crankshaft : carbo-nitrited steel
Bearing : plain ; broached and carbide burnished
Spraybar : steel
Prop. shaft : American NF No. 8 thread
Cylinder head : aluminium (integral element)
Manufacturer:
HOLLAND ENG. CO.,
12929 Saticoy Street, North Hollywood, California
Price : $6·95 (not available in Great Britain)

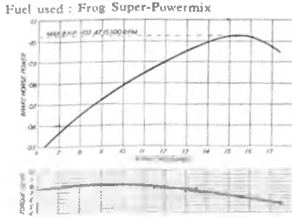
PROPELLER—R.P.M. FIGURES		
Propeller dia. · pitch	*Standard head r.p.m.*	*"Hot" head r.p.m.*
6 · 4 (Tornado)	11,500	12,400
6 · 3 (Tornado)	12,200	13,200
6 · 4 (Frog nylon)	11,600	12,600
5 · 3 (Trucut)	12,800	14,000
6 · 3 (Trucut)	10,000	11,000
5 · 6 (Frog plastic)	10,200	11,300
6 · 6 (Frog nylon)	9,000	9,800

Fuel used : Mercury No. 7

FROG 100 MK.II

PROPELLER—R.P.M. FIGURES	
Propeller dia. · pitch	*r.p.m.*
8 · 6 (Frog nylon)	6,000
8 · 4 (Frog nylon)	7,000
7 · 4 (Frog nylon)	12,400
6 · 4 (Frog nylon)	16,000 plus
8 · 3½ (Tiger)	11,000
8 · 4 (Tiger)	9,800
8 · 4 (Stant)	9,600
7 · 4 (Stant)	10,500
6 × 6 (Stant)	10,500
6 · 4 (Stant)	11,400
7 · 5 (Trucut)	9,000
7 · 4 (Trucut)	11,400
7 × 3 (Trucut)	13,000
6 · 4 (Trucut)	12,500
6 · 3 (Trucut)	13,600
5 · 3 (Trucut)	16,500

Fuel used : Frog Super-Powermix



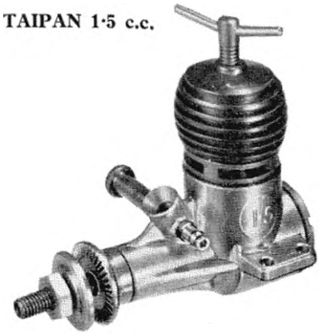
Specification

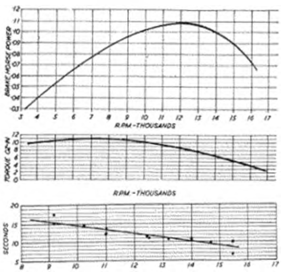
Displacement : 1·025 c.c. (·0625 cu. in.)
Bore : ·416 in.
Stroke : ·460 in.
Bore/stroke ratio : 0·9
Bare weight : 3 ounces (less tank and spinner
3¾ ounces (with tank, spinner and prop.)
Max. B.H.P. : ·103 at 15,500 r.p.m.
Max. torque : 8·2 ounce-inches at 9,000 r.p.m.
Power rating : 0·1 B.H.P. per c.c.
Power/weight ratio : ·034 B.H.P./ounce

Material Specification

Cylinder : leaded steel, hardened
Piston : cast iron
Contra piston : mild steel
Crankcase : light alloy pressure die casting
Crankshaft : leaded steel, case hardened and stress relieved
Connecting rod : light alloy forging
Cylinder jacket : dural (anodised gold)
Main bearing : Vandervell sintered bronze sleeve
Spinner : light alloy (anodised blue)
Spraybar : brass
Propeller nut : 2 B.A.
Tank : moulded nylon
Manufacturers-
INTERNATIONAL MODEL AIRCRAFT LTD.,
Morden Road, Merton
Retail price : 53/6

TAIPAN 1·5 c.c.





Specification

Displacement : 1·5 c.c. (·091 cu. in.)
Bore : ·511 in.
Stroke : ·453 in.
Bore stroke ratio : 1·16
Bare weight : 3·3/16 ounces
Max. B.H.P. : ·11 at 12,200 r.p.m.
Max. torque : 11·2 ounces-inches at 7,500 r.p.m.
Power rating : ·074 B.H.P. per c.c.
Power/weight ratio : ·0345 B.H.P./oz.

Material Specification

Cylinder : case hardened mild steel
Piston : Mechanite
Contra piston : Mechanite
Con. rod : dural
Cylinder jacket : dural (anodised red)
Crankcase : light alloy die casting L.33
Crankshaft : 3 per cent nickel steel, hardened
Back cover : dural (turned)
Bearing : plain (reamed and honed)
Spraybar and thimble : brass
Prop. driver and front washer : dural
Manufacturers :
GORDON BURFORD & Co.,
91 Beach Street, Grange, S. Australia
Retail price : £3/17/0

PROPELLER—R.P.M. FIGURES	
Propeller dia. × pitch	*r.p.m.*
12×4 (Trucut)	4,600
11×4 (Trucut)	5,400
10×4 (Trucut)	5,700
9×4 (Trucut)	8,000
8×4 (Trucut)	10,200
8×3 (Trucut)	10,750
7×6 (Trucut)	9,200
7×5 (Trucut)	10,000
7×4 (Trucut)	12,200
7×3 (Trucut)	14,000
6×4 (Trucut)	13,200
6×3 (Trucut)	14,500
5×3 (Trucut)	16,000
7×4 (Frog nylon)	11,200
6×4 (Frog nylon)	15,500
9×3 (Tiger)	9,000
8×3½ (Tiger)	11,400
6×9 (Tiger)	11,000

Fuel used : standard diesel mixture (1 : 1 : 1)

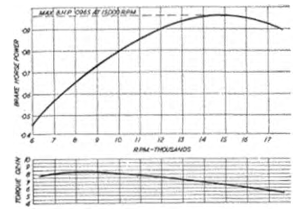
SUPER TIGER G-32

Specification

Displacement : ·9471 c.c. (·0578 cu. in.)
Bore : ·414 in.
Stroke : ·429 in.
Bore/stroke ratio : 1 : 1·0003
Bare weight : 3 ounces
Max. B.H.P. : ·0965 at 15,000 r.p.m.
Max. torque : 8·8 ounce-inches at 8,500 r.p.m.
Power rating : 1·02 B.H.P. per c.c.
Power/weight ratio : ·032 B.H.P. per ounce

Material Specification

Crankcase : light alloy pressure die casting
Cylinder : hardened steel
Cylinder jacket : turned aluminium alloy, anodised dark red
Piston : Mechanite
Contra piston : Mechanite
Crankshaft : hardened and tempered nickel chrome steel



Connecting rod : machined aluminium alloy
Main bearing : single ball race and cast iron bush
Drum valve : steel
Drum valve bearing : bronze bush
Spraybar : brass
Manufacturers:
MICROMECCANICA SATURNO,
Via Paolo Fabbri 4, Bologna, Italy
Retail price : 4,800 lire (not available in Great Britain)

PROPELLER—R.P.M. FIGURES	
Propeller dia. × pitch	*r.p.m.*
8×4 (Tiger)	9,500
8×3½ (Tiger)	10,000
6×4 (Frog nylon)	16,000 (max.)
9×4 (Trucut)	6,900
8×4 (Trucut)	8,800
8×3 (Trucut)	9,400
7×4 (Trucut)	11,200
7×3 (Trucut)	13,000
6×4 (Trucut)	12,500
5×3 (Trucut)	16,200
6×6 (Trucut)	10,700
8×4 (Stant)	9,200
7×4 (Stant)	10,600
6×4 (Stant)	12,800

Fuel : standard diesel mixture, 3 per cent amyl nitrate

SILVER STREAK 2·5 c.c.

Specification

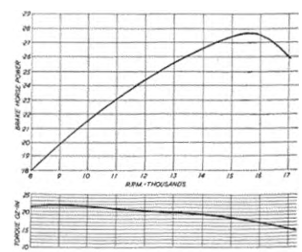
Displacement : 2·49 c.c. (·152 cu. in.)
Bore : ·5782 in.
Stroke : ·5782 in.
Bore/stroke ratio : 1·0
Bare weight : 5·6 ounces
Max. B.H.P. : ·277 B.H.P. at 15,800 r.p.m.
Max. torque : 22 ounce-inches at 8-9,000 r.p.m.
Power rating : ·11 B.H.P. per c.c. (1·83 B.H.P./cu. in.)
Power/weight ratio : ·049 B.H.P. per ounce

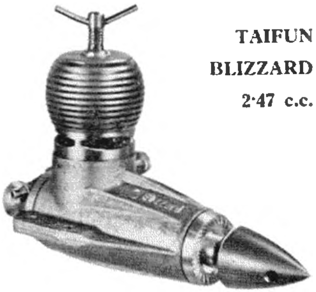
Material Specification

Crankcase : light alloy gravity die casting
Cylinder : hardened steel, stress relieved
Cylinder jacket : dural, turned
Piston : Mechanite, ground and honed
Contra-piston : Mechanite, ground and honed
Crankshaft : 85-ton steel, hardened on journals, tempered on crank pin and threaded length
Bearing sleeve : hardened steel
Bearings : rollers (sleeve and rollers forming an integral twin roller race assembly)
Connecting rod : DTD 363 dural
Spraybar assembly : brass, 4 B.A.
Prop. driver (hub) : machined from dural
Manufacturers :
A. E. RIVERS (SALES) LTD.,
15 Maswell Park Road, Hounslow, Middlesex
Retail price : £6/5/8

PROPELLER—R.P.M. FIGURES	
Propeller dia. × pitch	*r.p.m.*
10×6 (Frog nylon)	8,000
9×6 (Frog nylon)	10,600
9×6 (Tiger)	12,000
8×4 (Tiger)	14,500
7×3 (Trucut)	18,400
7×4 (Trucut)	16,000
7×5 (Trucut)	13,800
7×6 (Trucut)	12,300
8×4 (Trucut)	13,500
8×4 (Trucut)	10,200
8×8 (Trucut)	8,300
9×4 (Trucut)	10,800
9×6 (Trucut)	8,400
10×4 (Trucut)	8,000
9×4 (Stant)	11,000
8×4 (Stant)	14,200
8×6 (Stant)	12,700

Fuel used : Mercury No. 8

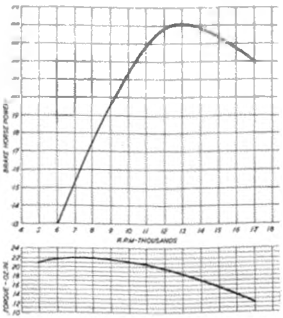




TAIFUN BLIZZARD 2·47 c.c.

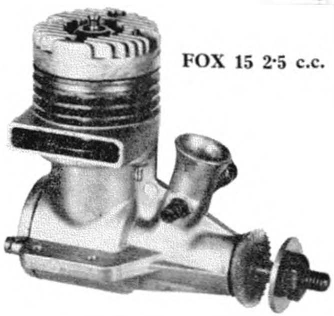
Specification

Displacement : 2·477 c.c. (·151 cu. in.)
Bore : ·593 in. (15·06 mm.)
Stroke : ·547 in. (13·9 mm.)
Bore/stroke ratio : 1·1
Weight : 6¼ ounces
Max. B.H.P. : ·242 at 13,000 r.p.m.
Max. torque : 22 ounce-inches at 8,000 r.p.m.
Power rating : ·098 B.H.P. per c.c.
Power/weight ratio : ·037 B.H.P. per ounce
Manufacturers :
J. Graupner,
Kirchheim/Teck, W. Germany



Propeller—R.P.M. Figures			
Propeller dia. × pitch	*r.p.m.*	*Propeller dia. × pitch*	*r.p.m.*
10 × 6 (Frog nylon)	8,400	9 × 3 (Tiger)	11,800
9 × 6 (Frog nylon)	10,800	8 × 4 (Tiger)	14,000
8 × 8 (Frog nylon)	7,400	8 × 3½ (Tiger)	14,600
11 × 4 (Trucut)	7,500	6 × 9 (Tiger)	14,150
10 × 4 (Trucut)	7,800	7 × 4 (Trucut)	15,200
9 × 6 (Trucut)	8,400	7 × 3 (Trucut)	17,000
8 × 8 (Trucut)	8,000	10 × 4 (Stant)	8,000
8 × 6 (Trucut)	10,100	9 × 5 (Stant)	10,200
8 × 4 (Trucut)	13,200	9 × 4 (Stant)	10,500
8 × 3 (Trucut)	13,700	8 × 6 (Stant)	11,200
7 × 9 (Trucut)	10,100	8 × 5 (Stant)	11,900
7 × 6 (Trucut)	11,500	8 × 4 (Stant)	13,500
		7 × 6 (Stant)	13,600

Fuel used : Mercury No. 8



FOX 15 2·5 c.c.

Specification
Technical Data

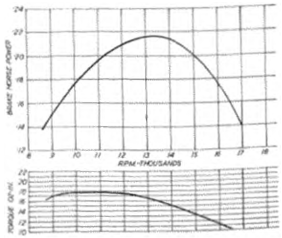
Displacement : 2·415 c.c. (·147 cu. in.)
Bore : ·591 in.
Stroke : ·537 in.
Bore/stroke ratio : 1 : ·908
Bare weight : 4 ounces
Max. power : ·218 B.H.P. at 13,500 r.p.m.
Max. torque : 18 ounce-inches at 11,000 r.p.m.
Power rating : ·09 B.H.P. per c.c.
Power/weight ratio : ·055 B.H.P. per ounce

Material Specification

Cylinder : mild steel
Piston : cast iron
Crankcase : light alloy die casting
Connecting rod : light alloy die casting
Cylinder head : Light alloy casting
Main bearing : hardened sleeve
Crankshaft : hardened steel
Propeller driver : light alloy casting

Propeller—R.P.M. Figures	
Propeller dia. × pitch	*r.p.m.*
7 × 4 (Frog nylon)	14,250
8 × 4 (Tiger)	13,200
9 × 4 (Trucut)	10,200
8 × 4 (Trucut)	12,800
8 × 3 (Trucut)	13,000
7 × 4 (Trucut)	14,600
7 × 3 (Trucut)	15,800
6 × 3 (Trucut)	16,500

Fuel used : Mercury No. 7



Spraybar : brass
Back cover : light alloy die casting
Glow Plug : standard KLG glow plug used for tests
Manufacturers :
Fox Manufacturing Company Inc.
Fort Smith, Arkansas, U.S.A.
Importers :
H. J. Nicholls Ltd.,
308 Holloway Road, London, N.7
Retail price : 70/6

GLO CHIEF 5 c.c.

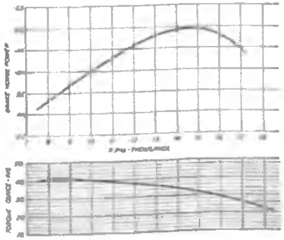
Specification

Displacement : 4·92 c.c. (·30 cu. in.)
Bore : ·739 in.
Stroke : ·700 in.
Compression : 8 : 1
Bore/stroke ratio : 1·04
Max. torque : 41 ounce-inches at 8,500 r.p.m.
Max. B.H.P. : ·495 at 14,600 r.p.m.
Power output : ·1 B.H.P. per c.c.
Power/weight ratio : ·065 B.H.P. per ounce
Bare weight : 7½ ounces

Material Specification

Cylinder : leaded mild steel
Piston : Meehanite
Crankshaft : hardened steel
Crankcase unit : light alloy gravity die casting
Cylinder head : machined alloy ; gold anodised
Back cover : die cast light alloy
Propeller driver : dural
Bearing : cast iron sleeve (plain)

Spraybar : brass
Glo plug : not specified, KLG plug used on test
Manufacturers :
Gordon Burford & Co. Ltd.,
Grange, South Australia
British Agent :
Performance Kits, Coventry
Retail price : £6/8/9

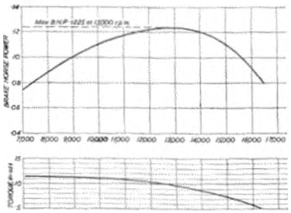


Propeller—R.P.M. Figures			
Propeller dia. × pitch	*r.p.m.*	*Propeller dia. × pitch*	*r.p.m.*
12 × 4 (Trucut)	8,500	9 × 3 (Tiger)	14,900
11 × 4 (Trucut)	9,900	8 × 3½ (Tiger)	18,000
10 × 6 (Trucut)	9,600	10 × 4 (Stant)	12,800
10 × 4 (Trucut)	10,100	9 × 9 (Stant TR)	10,000
9 × 6 (Trucut)	11,400	9 × 5 (Stant)	13,000
8 × 6 (Trucut)	13,000	9 × 4 (Stant)	13,800
8 × 5 (Trucut)	16,500	8 × 4 (Stant)	17,000
8 × 4 (Trucut)	17,000	8 × 6 (Stant)	13,900
7 × 6 (Trucut)	15,000	7 × 6 (Stant)	17,300
7 × 4 (Trucut)	19,000 plus	7 × 4 (Stant)	18,000
		10 × 6 (Frog nylon)	10,800
		9 × 6 (Frog nylon)	12,800

Fuel used : 25 per cent castor ; 55 per cent methanol ; 20 per cent nitromethane

ALAG X-4 2·5 c.c.

Stroke : ·449 in.
Bore/stroke ratio : 1·14
Bare weight : 2½ ounces
Max. B.H.P. : ·1225 at 14,000 r.p.m.
Max. torque : 11·4 ounce-inches at 8,000
Power output : ·081 B.H.P. per c.c.
Power/weight ratio : ·049 B.H.P. per oz.



Specification

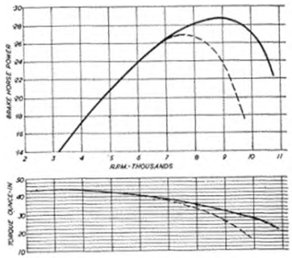
Displacement : 1·517 c.c. (·09245 cu. in.)
Bore : ·512 in.

Material Specification

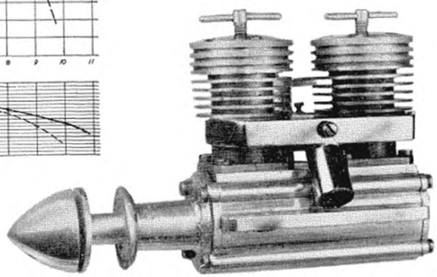
Crankcase : light alloy die casting
Cylinder : hardened steel
Piston : cast iron
Contra piston : cast iron
Crankshaft : hardened steel
Cylinder jacket : machined from light alloy, anodised red
Back cover : aluminium anodised red
Connecting rod : machined from dural
Intake tube venturi : thermoset plastic
Spraybar : brass
Trade Distributors in U.K. :
RELUM LTD.,
5 Chalk Farm Road,
London, N.W.1.
Price: 49/6

PROPELLER—R.P.M. FIGURES	
Propeller dia. pitch	*r.p.m.*
9 × 4 (Stant)	7,800
8 × 4 (Stant)	10,800
7 × 4 (Stant)	11,800
6 × 4 (Stant)	14,600
8 × 4 (Trucut)	10,000
8 × 3 (Trucut)	10,700
7 × 4 (Trucut)	12,500
7 × 3 (Trucut)	14,300
6 × 4 (Frog nylon)	15,750
8 × 3½ (Tiger)	12,300
8 × 4 (Tiger)	11,000
9 × 3 (Tiger)	9,000

Fuel used : Frog "Powamix" and Mercury No. 8



TAPLIN TWIN 7 c.c.



Specification

Displacement : 6·920 c.c. (·420 cu. in.)
Bore : ·656 in.
Stroke : ·621 in.
Bore/stroke ratio : 1·06
Weight : 15 ounces
Max. B.H.P. : ·29 B.H.P. at 9,000 r.p.m.
Max. torque: 44 ounce inches at 3,500 r.p.m.
Power rating: ·42 B.H.P. per c.c.
Power/Weight ratio ·0194 B.H.P. per ounce

Material Specification

Crankcase : light alloy gravity die casting
Cylinders : hardened steel
Pistons : cast iron
Connecting rods : dural forgings, bronze big end bush
Contra-pistons : cast iron
Crankshaft : hardened steel, split assembly, press fitted hardened steel front drive shaft
Bearings : main crankshaft—twin ball races
front drive shaft—one ball race, bronze bush at front
Carburettor : body—gravity die casting
fabricated components in dural and brass
Manufacturers :
THE BIRCHINGTON ENGINEERING CO. LTD.,
Albion Road, Birchington, Kent
Retail Price : £8/12/0

PROPELLER—R.P.M. FIGURES			
Propeller	*R.P.M.* (*full throttle*)	*R.P.M. idling (throttle closed)* *Minimum safe*	*Abs. minimum*
14 × 6 (Trucut)	5,600	1,750	1,500
13 × 8 (Trucut)	6,000	1,900	1,500
13 × 6 (Trucut)	6,500	1,900	1,550
12 × 6 (Trucut)	7,000	1,800	1,500
11 × 4 (Trucut)	9,400	2,200	1,700
10 × 8 (Trucut)	8,200	2,500	1,900
in. dia. Truflex	7,000	1,800	1,500
10 × 6 (Frog nylon)	9,600	2,400	1,900*
9 × 6 (Frog nylon)	10,500	3,000	2,400*

Fuel used : Mercury No. 8

**Engine backfires and starts to oscillate*

INTERNATIONAL TAILLESS MEETING

TERLET, HOLLAND, SEPTEMBER 12th 15th, 1958

GLIDER

No.	Name	Country	1	2	3	4	5
1	Zwilling, W.	Germany	158	139	88	117	160
2	Waldhauser, H. ...	Germany	66	178	143	59	180
3	Osborne, J.	Holland	50	180	72	73	101
4	Fiks, G.	Holland	180	71	72	100	43
5	Hack, W.	Germany	51	39	163	84	76
6	Nick, A.	Germany	67	97	77	33	70
7	Hedgeman, P. ...	Great Britain ...	80	55	42	108	46
8	ten Hagen, G. ...	Holland	47	109	58	35	77
9	Lust, P.	Holland	74	87	61	61	42
10	Marshall, J.	Great Britain ...	34	75	51	49	87
11	Smith, F. C.	Great Britain ...	48	42	56	59	39
12	Wilkins, P.	Great Britain ...	—	48	70	49	63

RUBBER

No.	Name	Country	1	2	3	4	5
1	Schubert, W.	Germany	180	180	84	92	69
2	Scheyde, H.	Holland	60	63	96	88	122
3	Marshall, J.	Great Britain ...	82	90	67	76	70

POWER

No.	Name	Country	1	2	3	4	5
1	Klinger, W.	Germany	180	24	21	103	22
2	Hedgeman, P. ...	Great Britain ...	—	39	62	25	97
3	Wassenaar, W. ...	Holland	81	58	74	—	—

INTERNATIONAL TAILLESS MEETING

KALTENKIRCHEN, GERMANY, JUNE 13th/14th, 1959

GLIDER

No.	Name	Country	1	2	3	4	5	Total
1	Zwilling, W. ...	Germany ...	118	42	180	180	80	600
2	Lust, P.	Holland ...	43	50	80	68	176	417
3	Muller, J.	Germany ...	86	42	49	61	122	360
4	Fiks, G.	Holland ...	81	52	78	56	51	318
5	Schwarze, P. ...	Germany ...	81	53	34	64	84	316
6	de Koning, H. ...	Holland ...	64	30	36	29	24	183
7	Kiesel, A.	Germany ...	—	—	24	—	—	24
8	Osborne, J.	Holland ...	8	—	—	—	—	8

POWER

No.	Name	Country	1	2	3	4	5	Total
1	Kilner, W.	Germany ...	67	40	128	123	180	538

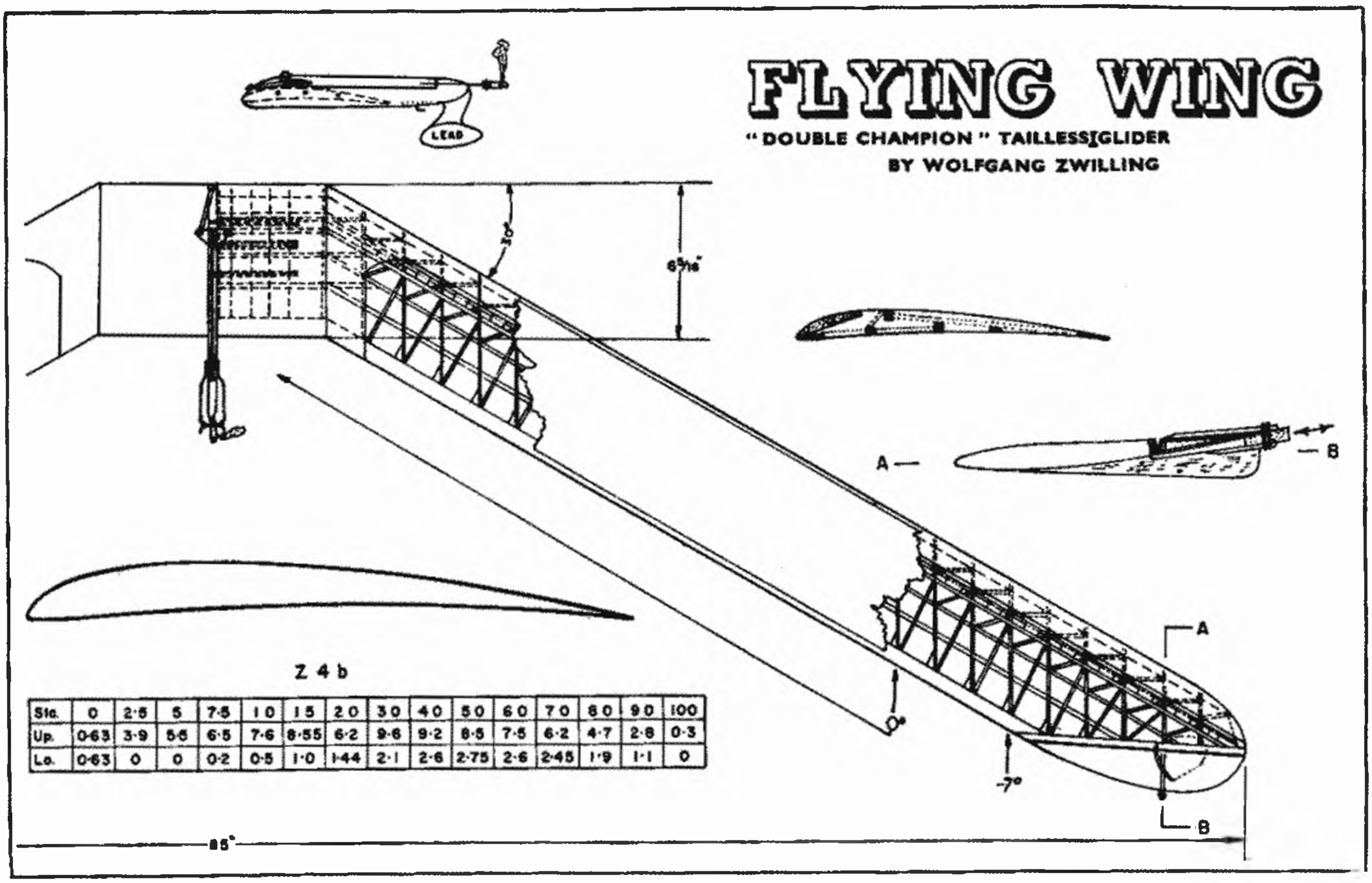
RUBBER

No.	Name	Country	1	2	3	4	5	Total
1	Schubert, W. ...	Germany ...	—	—	41	126	77	244

FLYING WING

"DOUBLE CHAMPION" TAILLESS GLIDER

BY WOLFGANG ZWILLING



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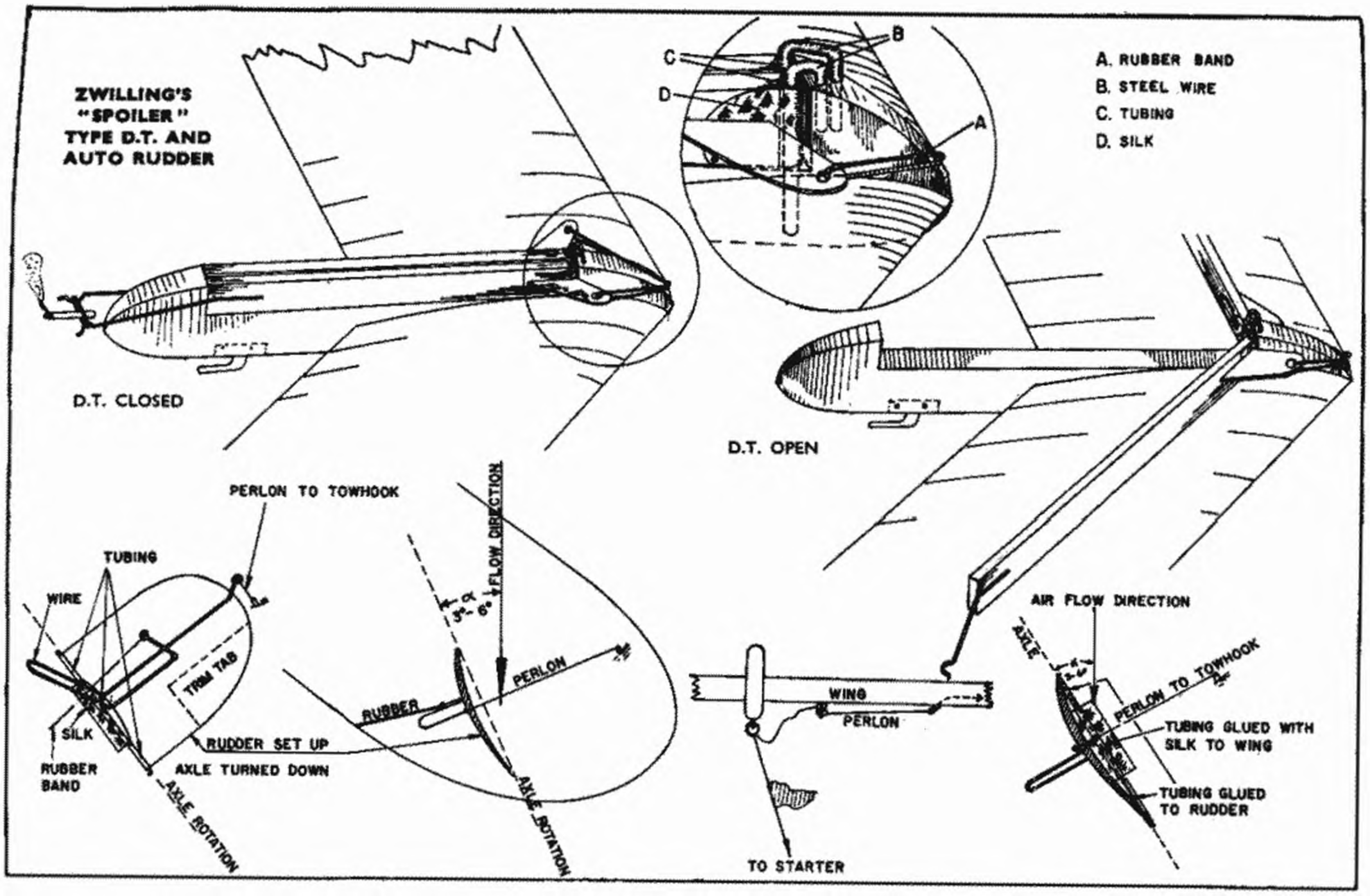
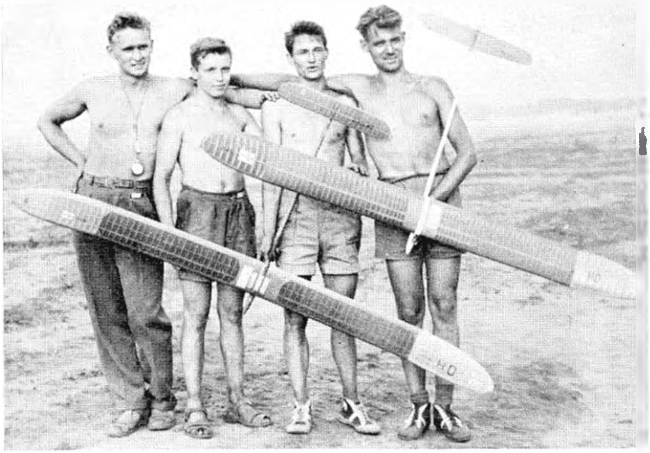
Sta.	0	2·5	5	7·5	10	15	20	30	40	50	60	70	80	90	100
Up.	0·63	3·9	5·6	6·5	7·6	8·55	6·2	9·6	9·2	8·5	7·5	6·2	4·7	2·8	0·3
Lo.	0·63	0	0	0·2	0·5	1·0	1·44	2·1	2·6	2·75	2·6	2·45	1·9	1·1	0





Victorious Finns. Winners of the team trophy at the 1959 World A 2 Glider Championships. The Finnish team of Reino Hyvarinen (Manager), Kekkonen, Ella and Tahkapaa were outstanding for their skills in tow launching and thermal detection.

WORLD GLIDER CHAMPIONSHIP FOR SWEDISH CUP
Held at Bourg-Leopold, Belgium, August 23rd, 1959

No.	Name	Country	1	2	3	4	5	Fly-off & Total
1	Ritz, G.	U.S.A. ...	180	180	180	180	180	900 · 401
2	Sokolov, J. ...	U.S.S.R. ...	180	180	180	180	180	900 · 329
3	Habib, H. M. ...	Pakistan ...	180	180	180	180	180	900 86
4	Tahkapaa, M. ...	Finland ...	180	180	180	180	180	900 · 71
5	Kekkonen, I. ...	Finland ...	180	180	180	180	180	900
6	Buiter, A.	Holland ...	180	180	164	160	180	864
7	Jansson, R.	Sweden ...	180	180	180	180	140	860
8	Bulgheroni, G. ...	Italy ...	180	180	126	180	176	842
9	Wagner, H. ...	Austria ...	110	180	180	180	180	830
10	Ella, P.	Finland ...	180	180	101	180	180	821
11	Nilsson, G. ...	Sweden ...	180	180	92	180	180	812
12	Babic, S.	Yugoslavia	180	180	180	180	90	810
13	MONKS, R. ...	*Great Britain*	180	108	180	180	160	808
14	Michalek, J. ...	Czechoslovakia	180	106	180	180	159	805
15	Taverna, G. ...	Italy ...	97	180	161	180	180	798
16	Hansen, B.	Denmark ...	180	75	180	180	180	795
17	Thomson, W. ...	Canada ...	180	180	180	180	70	790
18	Kunz, H.	Germany ...	145	180	180	96	180	781
19	Kool, P.	Holland ...	180	108	180	180	127	775
20	Horyna, V.	Czechoslovakia	180	164	180	180	69	773
21	Schnurer, H. ...	Austria ...	85	180	141	180	180	766
22	Petit, A.	Belgium ...	180	180	87	180	135	762
23	Kalen, G.	Sweden ...	180	41	180	180	180	761
24	Frygyes, E. ...	Hungary ...	180	77	180	125	180	742
25	Krook, R.	Holland ...	180	145	68	180	166	739
26	Radoczi, N. ...	Hungary ...	133	164	180	180	79	736
27	Hansen, H. ...	Denmark ...	180	180	123	71	180	734
28	Soave, P.	Italy ...	109	180	100	180	160	729
29	Marchand, P. ...	Belgium ...	180	82	105	180	180	727
30	Whiele, B.	U.S.A. ...	154	180	102	105	180	721
31	Wilson, R.	New Zealand	180	180	180	180	–	720
32	Feldleit, R.	Israel ...	87	180	180	180	88	715
33	BLACK, E. ...	*Great Britain*	180	147	77	125	180	711
34	Vuletic, M. ...	Yugoslavia	180	180	55	180	115	710
35	Braud, H.	France ...	180	71	180	86	180	697
36	Scheidler	Austria ...	87	180	180	62	180	689
37	Prohacka, O. ...	Czechoslovakia	180	112	180	50	164	686
38	Averyanov, A. ...	U.S.S.R. ...	180	180	87	55	180	682
39	Roser, O.	Hungary ...	159	180	66	180	92	677
40	Sifleet, B.	U.S.A. ...	60	77	180	180	180	677
41	Hauenstein, W. ...	Switzerland	62	63	180	180	171	676
42	Dreher, V.	Yugoslavia	85	179	103	180	128	675
43	Mahomedali, R. ...	Pakistan ...	180	–	180	180	121	661
44	Simonov, W. ...	U.S.S.R. ...	96	55	147	180	180	658
45	Caron, C.	France ...	68	49	180	180	180	657

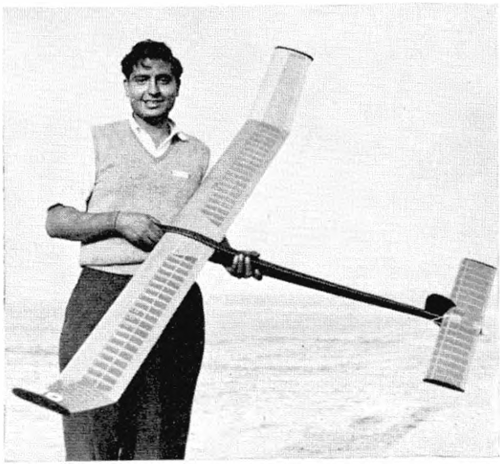
Left: Juri Sokolov from Moscow, and Right: Gerry Ritz of Chicago, final protagonists for top individual honours in the A 2. Models were evenly matched, but Gerry's upwind run of a quarter mile gave him the advantage in timekeepers visibility.

46	Hansen, A.	Denmark	180	–	180	179	116	655
47	Tuck, H.	Canada	67	180	94	125	177	643
48	Dawood, H.	Pakistan	31	66	180	180	180	637
49	SHIRT, E.	*Great Britain*	96	86	180	85	180	627
50	Scheu, G.	Switzerland	141	180	–	180	97	598
51	Foster, C.	Canada	171	70	50	142	161	594
52	Kiflawi, J.	Israel	79	51	98	180	180	588
53	Sheppard, J.	New Zealand	25	148	130	180	103	586
54	Beutler, W.	Switzerland	96	56	55	180	180	567
55	Benkert, L.	Germany	180	53	72	64	180	549
56	Ritchie, I.	New Zealand	180	50	85	166	61	542
57	Zimmerman, G.	Belgium	55	180	43	180	79	537
58	Magniette, R.	France	83	104	149	81	113	530
59	Kadmon, N.	Israel	–	180	36	180	102	498
60	Kalthoff, P.	Germany	140	27	71	175	77	490
		Maximums	(33)	(29)	(30)	(43)	(30)	

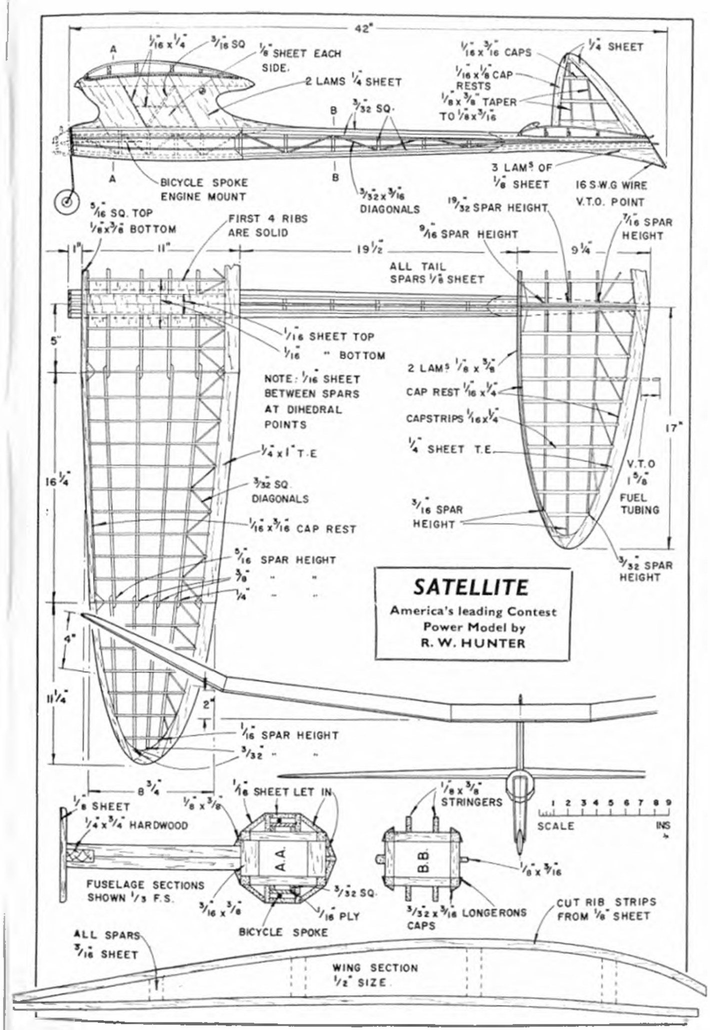
TEAM RESULTS

1	Finland	(14)	2,621	11	Denmark	(10)	2,184
2	Sweden	(12)	2,433	12	Hungary	(7)	2,155
3	Holland	(8)	2,378	13	**Great Britain**	(7)	2,146
4	Italy	(8)	2,369	14	Canada	(5)	2,027
5	U.S.A.	(10)	2,298	15	Belgium	(8)	2,026
6	Austria	(10)	2,285	16	France	(6)	1,884
7	Czechoslovakia	(8)	2,264	17	New Zealand	(6)	1,848
8	U.S.S.R.	(10)	2,240	18	Switzerland	(6)	1,841
9	Pakistan	(11)	2,198	19	Germany	(5)	1,820
10	Yugoslavia	(8)	2,195	20	Israel	(7)	1,801

Number of maximum flights per team in brackets.



Habib M. Habib, one of the world's keenest aeromodellers, who travelled from Pakistan to compete in the A 2 finals, convinced the F.A.I. that they should admit his entry though not a member country, had to pay 100 dollars to get his models through tough customs in Iran and finally wound up in the fly-off at third place. His efforts deserved such success. Model is modified APS Top-score design by John Hannay.

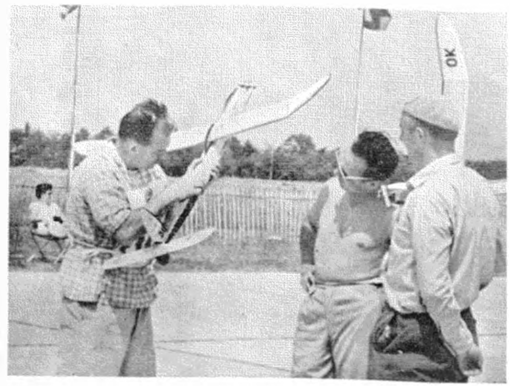


WAKEFIELD CUP (Individual)
Held at Brienne-le-Chateau, France, July 18th 19th, 1959

No.	Name	Country	1	2	3	4	5	Fly-off & Total
1	Dvorak, F.	Czechoslovakia	180	180	180	180	180	900 + 285
2	Hatschek, R. ...	U.S.A. ...	180	180	180	180	180	900 + 256
3	McGillivray, J. ...	Canada ...	180	180	180	180	180	900 + 245
4	Zurad, S.	Poland ...	180	180	180	180	180	900 + 230
5	Zapachny, V. ...	U.S.S.R. ...	180	180	180	180	180	900 + 198
6	Mackenzie, D. ...	Canada ...	180	180	180	180	180	900 + 184
7	Tysklind, L. ...	Sweden ...	180	180	180	180	180	900 + 121
8	Bilgri, J.	U.S.A. ...	180	180	180	180	163	883
9	Cardoro Sueno, A....	Portugal ...	155	180	180	180	180	875
10	Kothe, H.	U.S.A. ...	163	170	180	180	180	873
11	Petiot, J.	France ...	145	180	180	180	180	865
12	Hyvarinen, R. ...	Finland ...	180	180	180	147	160	847
13	Fea, G.	Italy ...	180	180	123	180	180	843
14	Meyer, J.	Switzerland	180	180	112	180	180	832
15	Schilling, H. ...	Germany ...	137	160	180	180	174	831
16	MONKS, R. ...	Great Britain	180	139	142	180	180	821
17	King, A.	Australia ...	180	180	180	180	97	817
18	Hamalainen, E. ...	Finland ...	164	180	180	110	180	814
19	Van Mellaert, J. ...	Belgium ...	143	180	130	180	180	813
20	Krizsma, G. ...	Hungary ...	180	180	180	130	138	808
21	Pla Ysas, M. ...	Spain ...	180	180	173	143	128	804

No.	Name	Country	1	2	3	4	5	Fly-off & Total
22	ROBERTS, G. L.	Great Britain	180	180	108	129	180	797
23	NORTH, R. J. ...	Great Britain	180	147	180	127	156	790
24	Kossowski, A. ...	Poland ...	180	180	180	88	159	787
25	Fullarton, J. (P) ...	Australia ...	180	180	83	180	158	781
26	Rupp, G.	Germany ...	91	180	180	148	180	779
27	Suter, H.	Switzerland	180	180	180	78	159	777
28	Benedek, G. ...	Hungary ...	136	180	180	97	180	773
29	Cooke, A. (P) ...	New Zealand	81	151	180	180	180	772
30	Sugden, D.	Canada ...	180	77	180	180	154	771
31	Taberna, S. ...	Italy ...	180	109	180	180	118	767
32	Johansson, R. ...	Sweden ...	56	180	178	180	170	764
33	Smolders, J. ...	Holland ...	180	138	76	180	180	754
34	Scardicchio, V. ...	Italy ...	180	76	180	180	132	748
35	Nimptsch, ...	Germany ...	150	180	105	180	132	747
36	Aalto, P.	Finland ...	108	180	120	180	157	745
37	Ivannikov, I. ...	U.S.S.R. ...	123	180	180	126	121	730
38	Da Fonseca e Sousa, M. ...	Portugal ...	96	118	180	180	140	714
39	Muzny, L.	Czechoslovakia	107	180	138	105	180	710
40	Carroll, J. (P) ...	Ireland ...	180	112	111	180	127	710
41	Mikkelsen, H. ...	Denmark ...	180	180	64	180	95	699
42	Kennedy, D. (P) ...	New Zealand	180	180	67	119	150	696
43	Terrazzoni, D. ...	France ...	109	110	140	180	151	690
44	Monturo Cavaco, M.	Portugal ...	78	180	106	178	144	686
45	Chabert, J.	France ...	105	123	106	169	180	683
46	Azor, L.	Hungary ...	113	180	167	111	105	676
47	Lust, P.	Holland ...	180	93	103	180	103	659
48	Van Mellaert, L. ...	Belgium ...	142	180	120	107	108	657

Opposite: Victorious American team of Joe Bilgri (8th), Herb Kothe (10th) and Bob Hatschek (2nd).



On right: Radoslav Cizek, designer of winning plane, makes ready under watchful eye of team-mate Frantisek Dvorak the winner (the torso).

49	Matveev, V.	U.S.S.R.	103	72	131	165	180	651
50	Kaufmann, B.	Switzerland	69	180	60	154	180	643
51	Baker, B.	Australia	99	152	90	139	159	639
52	Qvarnstrom, A.	Sweden	180	71	78	152	156	637
53	Balasse, E.	Belgium	138	80	134	132	142	626
54	Cizek, R.	Czechoslovakia	118	147	110	96	139	610
55	Reuser, B.	Holland	—	180	180	137	101	598
56	Merseburger Baldy, C.	Spain	137	144	89	75	102	547
57	Christensen, N.	Denmark	121	118	133	69	85	526
58	Clarke, A. (P)	New Zealand	65	56	180	109	113	523
59	Kosinski, J.	Poland	112	97	180	—	129	518
60	Nienstaedt, E.	Denmark	107	86	27	61	119	400
61	Navarro, G.	Morocco	12	39	48	44	—	143

PENAUD CUP (Team)

1	U.S.A.	2656	9	Portugal	2275	17	Holland	2011
2	Canada	2571	10	Hungary	2257	18	New Zealand	1991
3	Great Britain	2408	11	Switzerland	2252	19	Denmark	1625
4	Finland	2406	12	France	2238	20	Spain	1351
5	Italy	2358	13	Australia	2237	21	Ireland	710
6	Germany	2357	14	Czechoslovakia	2220	22	Morocco	143
7	Sweden	2301	15	Poland	2205			
8	U.S.S.R.	2281	16	Belgium	2096			

INTERNATIONAL RADIO CONTROL, DARMSTADT

SEPTEMBER 19th, 1958

6th KING OF THE BELGIANS TROPHY

Typical, rather ugly, high shoulder wing model of Karlheinz Stegmaier, Germany won 6th King of the Belgians Trophy at Darmstadt in 1958. Third man Helmut Bernhardt, however, undoubtedly flew the most beautiful machine at the meeting, and is seen on opposite page.

Category I—Multi-control Aircraft

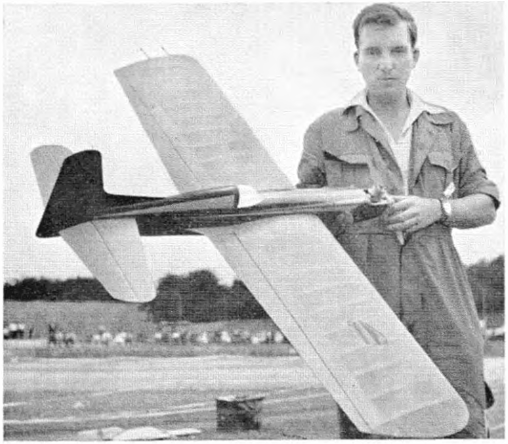
No.	Name	Country	1	2	Total
1	Stegmaier, Karlheinz	Germany	1,562	1,685	3,247
2	Gobeaux, Jean-Pierre	Belgium	1,597	1,648	3,245
3	Bernhardt, Helmut	Germany	287	1,667	1,854
4	Olsen, Christopher H.	Great Britain	625	776	1,401
5	Bickel, Alfred	Switzerland	528	666	1,194
6	Hetzel, Max	Switzerland	617	499	1,116
7	Uwins, Stewart	Great Britain	657	223	880
8	Johnson, John Edward	Great Britain	301	286	587
9	Higham, Richard	Great Britain	—	253	253
10	Veenhoven, Jan	Holland	73	162	235
11	Van der Hoek, Wim	Holland	72	—	72

Category II—Multi-control Gliders

No.	Name	Country	1	2	Total
1	Campolongo, Rolf	Switzerland	326	283	609
2	Lodiga, Rudi	Germany	302	298	600
3	Nettingsmeyer, Horst	Germany	37	262	399
4	Geraerts, Jean	Belgium	146	—	146

Category IV—Single-control Aircraft

No.	Name	Country	1	2	Total
1	Berglund, Eric	Sweden	376	336	712
2	Schoorel, C. Willem	Holland	327	389	706
3	Vandermeulen, Willem	Belgium	343	355	698
4	Huber, Bernhard	Switzerland	282	335	617
5	Dilot, Rolf	Sweden	205	362	567
6	Schumacher, Hans	Germany	268	287	555
7	Louis, Michael	Belgium	245	302	547
8	Strickland, Olie	U.S.A.	173	366	539
9	Setz, Eugen	Switzerland	270	264	534
10	Louis, Pierre	Belgium	275	232	507
11	Hart, Fred	Germany	281	—	281
12	Rolle, Roger	Belgium	33	232	265
13	Janse, Lambertus	Holland	229	—	229
14	Bossard, Henry	France	196	—	196
15	Boys, Arthur H.	Great Britain	30	100	130
16	Kreulen, Evert	Holland	—	—	—
16	Christiaanse, Cornelius	Holland	—	—	—



Josef Gabris of Bratislava, Czechoslovakia, who proved a comfortable stunt winner at the "Expo" International at Brussels.

BRUSSELS EXPO INTERNATIONAL, 1958

NINTH CRITERIUM OF EUROPE GRAND PRIX FOR VICTOR BOIN CHALLENGE TROPHY

		Speed	*Aerobatics*	*Team Racing*	*Total*
1	Hungary	1	3	4	8
2	Belgium	7	2	3	12
	Great Britain ...	5	6	1	12
	Italy	3	7	2	12
	Czechoslovakia ...	2	1	9	12
6	Spain	4	5	5	14
7	Germany	8	4	7	19
8	Sweden	6	8	8	22
9	Holland	9	9	6	24

TEAM RACING

Final

			mins.	*secs.*	
1	Edmonds	Great Britain	4	58	Oliver Tiger
2	Taddei	Italy	5	7	Oliver Tiger
3	Stouffs	Belgium	5	21	Oliver Tiger
4	Azor	Hungary	7	12	Oliver Tiger

Best Heat Times

1	Taddei	Italy	5	1
2	Edmonds	Great Britain	5	6
3	Stouffs	Belgium	5	8
4	De La Plaza	Spain	5	9
5	Azor	Hungary	5	33
6	Bernard	Belgium	5	34
7	Rossiu	Italy	5	42
8	Contini	Italy	5	44
9	Carasco	Spain	5	51
10	Vognalar	Holland	5	53
11	Lenssen	Germany	5	56
12	Yeldham	Great Britain	5	57

AEROBATICS

			Total best two flights	
1	Gabris, J.	Czechoslovakia	1764·6	M.V.V.S. 5·6
2	Stouffs, H.	Belgium	1681 3	Fox 35
3	Bene, P.	Hungary	1618·6	Fox 35
4	Sorgel, W.	Germany	1598·9	Fox 35
5	Macon, G.	Belgium	1585·3	Fox 35
6	Egervary, G.	Hungary	1577 9	McCoy 35
7	Rieger, H.	Germany	1558 6	O.S. 35
8	Roggl. G. ... ... —	Austria	1553 3	McCoy 35
9	Sirotkine	U.S.S.R.	1550 6	Kometa
10	Kondratenko	U.S.S.R.	1533·3	Kometa
11	Ordogh, L.	Hungary	1532 6	Fox 35
12	Battlo, F.	Spain	1521·2	O.S.35
13	Tcherbakov, V.	U.S.S.R.	1507·9	Kometa
14	Morley, W.	Great Britain	1478·4	Merco 35

Jet

Ivannikov	U.S.S.R.	276 Km.	RAM-2

Aerobatic Team Results

1	Hungary	4·727
2	Czechoslovakia	4·676
3	Belgium	4·622
4	Germany	4·590
5	U.S.S.R.	4·590
6	Austria	4·121
7	Spain	3·988
8	Great Britain	3·915
9	Italy	2 672
10	Sweden	1 351
11	Holland	1·319
12	Monaco	1·187

Speed Team Results

1	Hungary	627
2	Czechoslovakia	620
3	Italy	619
4	Spain	574
5	U.S.S.R.	570
6	Great Britain	535
7	Sweden	525
8	Finland	503
9	Belgium	446
10	Germany	338
11	Switzerland	163
12	Holland	135

SPEED

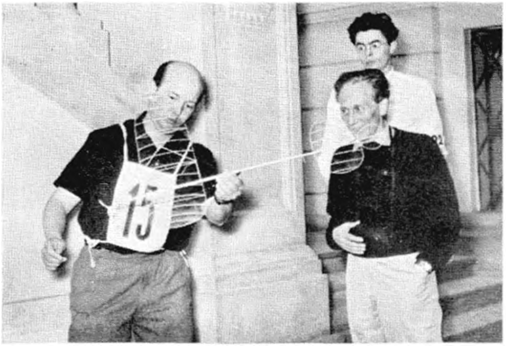
			k.p.h.	
1	Toth	Hungary	216	Moki
2	Beck	Hungary	214	Moki
3	Koci	Czechoslovakia	209	M.V.V.S. 58
4	Pastyrik	Czechoslovakia	206	M.V.V.S. 58
5	Sladky	Czechoslovakia	205	M.V.V.S. 58
6	Rossi, C.	Italy	204	Super Tigre G20V
7	Pezzi	Italy	203	Super Tigre G20V
	Vassiltchenko	U.S.S.R.	203	M.V.V.S.

Members of the U.S.S.R. team make ready for 300 k.p.h. record Jet flight in the hands of Master of Sport Ivannikov. Enthusiasm and friendliness of Iron Curtain competitors these last two seasons has been a specially welcome aspect of international aeromodelling.

9	Prati	Italy	202	Super Tigre G20V
10	Rossi, U.	Italy	198	Super Tigre G20V
11	Zatocil	Czechoslovakia	197	M.V.V.S. 58
	Krizma	Hungary	197	O/D
13	Gogorcena	Spain	194	Super Tigre G20V
14	Battlo	Spain	193	Super Tigre G20V
15	Gibbs	Great Britain	189	Carter
16	Fernandez	Spain	185	Super Tigre G20V
	Natalenko	U.S.S.R.	187	O/D
18	Azor	Hungary	185	B.R.W.M.
19	Rosenlund	Sweden	182	Super Tigre G20V
20	Grouchine	U.S.S.R.	180	O/D
	Bjork	Sweden	180	Super Tigre G20V
22	Deligne	Belgium	177	Super Tigre G20V
23	Gorziza	Spain	176	Barbini
	Kouznetov	U.S.S.R.	175	O/D
25	Page	Great Britain	173·9	M.V.V.S.
26	Hall	Great Britain	173	Oliver Tiger
27	Savolainen	Finland	170	Super Tigre G20
28	Valo	Finland	169	Super Tigre G20
29	Jaaskelainen	Finland	164	Super Tigre
30	Bengt Martinelli	Sweden	163	Vltavan
	Fawer	Switzerland	163	Barbini
32	Frolich	Germany	162	Super Tigre
33	Eifflaender	Great Britain	146	PAW 2·49
34	Godsiabois	Belgium	139	PAW 2·49
35	Vogelaar	Holland	138	Oliver Tiger
36	Deville	Belgium	128	Super Tigre

Combat

Kruck, D.	Germany		Webra Mach. 1



K. H. Rieke of Germany, winner of over 35 cm. span class at Debrecen.

INDOOR MODEL INTERNATIONAL

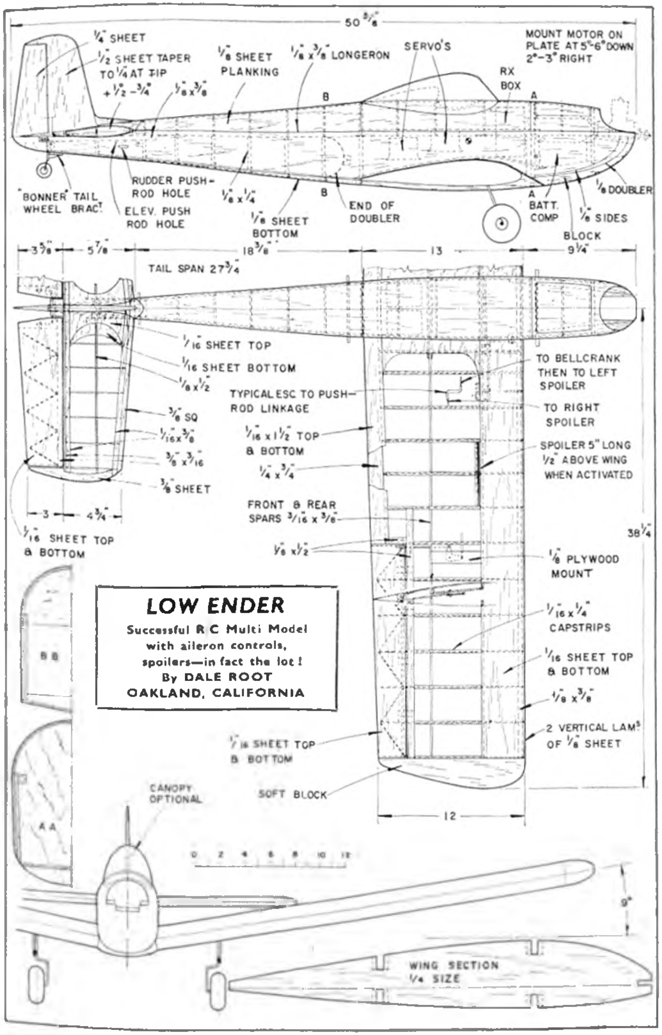
DEBRECEN, HUNGARY, MAY 17th, 1959

35 cm. Span

		min.	sec.
1	L. Englund—Finland	14	27
2	G. Varszegi—Hungary	12	36
3	O. Roser—Hungary	11	52
4	S. Niemela—Finland	11	49
5	S. Kujava—Poland	10	58
6	L. Hamalainen—Finland	10	57

Over 35 cm. Span

		min.	sec.
1	K. H. Rieke—Germany	22	05
2	S. Kujava—Poland	18	50
3	L. Englund—Finland	17	26
4	L. Hamalainen—Finland	16	49
5	Gy. Simon—Hungary	16	40
6	I. Antal—Hungary	15	04

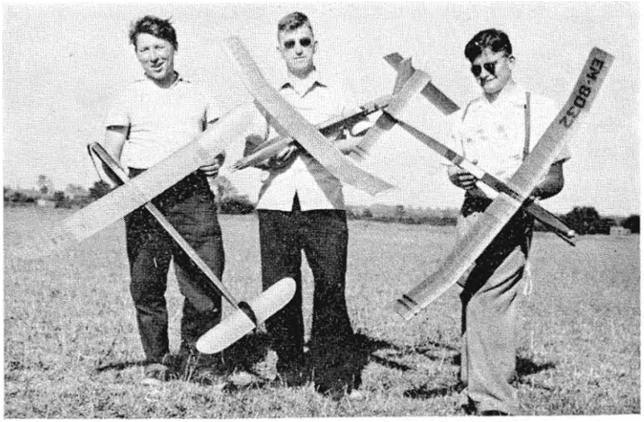


LOW ENDER

Successful R/C Multi Model with aileron controls, spoilers—in fact the lot!

By DALE ROOT
OAKLAND, CALIFORNIA

AMERICAN MODELER



British Wakefield Team 1959. Left to right: Ray Monks of Birmingham, Jack North, Croydon and Lew Roberts of Lincoln, top man in the trials. Brian Picken actually qualified, but had to withdraw, thus enabling Ray Monks to complete a praiseworthy double.

CONTEST RESULTS

Results of S.M.A.E. Contests for balance of 1958 season are included in this report to complete records. Those 1959 events which have been decided before going to press are also included and will be completed in next year's AEROMODELLER ANNUAL.

INTERNATIONAL TEAM TRIALS—July 20th, 1958—Cranfield.

Tailless Glider
1 Hedgeman, P. — Hayes — 7 : 04
2 Wilkins, P. — Southern Cross — 6 : 50
3 Donald, K. — Southern Cross — 6 : 06
4 Holland, W. P. — Apsley — 5 : 22
5 Marshall, J. — Hayes — 5 : 13
6 Smith, F. C. — Southern Cross — 4 : 36

GODALMING CONTROLINE RALLY — June 15th, 1958.

Class A Team Race
1 Hartwell, P. — Enfield — 9 : 56
2 Williams, J. — Wimbledon — 11 : 07
3 M. and J. Templeman — Sidcup — 11 : 13

Class B Team Race
1 Whitbread, T. — West Essex — 8 : 44
2 Walker Tuthill — Enfield — 8 : 45
3 Hartwell, P. — Enfield — 12 : 17

Combat
1 Burbridge, L. — Kenton

P.A.A. FESTIVAL—June 21st 22nd, 1958—R.N.A.S. Abbotsinch.

America Class P.A.A. load
1 Done, J. — Wallasey M.A.C. — 8 : 16
2 Collinson, A. R. — Baildon M. F. C. — 6 : 07
3 Aspinall, J. — Wigan M.A.C. — 5 : 53

International Class P.A.A. load
1 O'Donnell, J. — Whitefield M.A.C. — 7 : 38
2 Parsons, R. C. — Prestwick M.A.C. — 7 : 14
3 Aspinall, J. — Wigan M.A.C. — 6 : 21

Clipper Cargo Load Event
1 Collinson, A. R. — Baildon M.F.C. — 32½ oz.
2 Chrystal, W. — Glasgow Barnstormers — 30½ oz.

Free Flight Glider
1 Wood, S. — Wigan M.A.C. — 9 : 00 + 9·21
2 Picken, B. — Wigan M.A.C. — 9 : 00 + 6·24
3 McNulty, F. — Baildon M.F.C. — 9 : 00 + 2·26

Combat
1 Howie, I. — Glasgow Gremlins

Free-Flight Power
1 Collinson, A. R. — Baildon M.F.C. — 9 : 00 + 6·34
2 Lanfranchi, S. — Baildon M.F.C. — 9 : 00 + 5·28
3 O'Donnell, J. — Whitefield M.F.C. — 9 : 00 + 5·09

Free Flight Rubber
1 O'Donnell, J. — Whitefield M.F.C. — 9 : 00
2 Farrar, A. — Wakefield M.F.C. — 8 : 30
3 Black, E. — 8 : 18

Radio Control
1 Fraser, R. — Kirkcaldy

Team Race A
1 Long, K. — Wharfedale — 8 : 40

Team Race B
1 McFarlane, W. — Glasgow Barnstormers — 8 : 30

CLWYD SLOPE SOARING—June 22nd, 1958.

Gosling Trophy
Tipper, D. H. — St. Albans — 7 : 10

Open
Tipper, D. H. — St. Albans — 7 : 10

A/C
Filtness, C. R. — Chester — 6 : 43

Tailless
Edwards, D. — St. Albans — 2 : 37

Junior
Jenkins, E. — Chester — 4 : 3

Radio
Bailey, D. — Burton-on-Trent — 3 : 57

NORTHERN HEIGHTS GALA—June 29th, 1958—R.A.F. Station Halton.

The Queen Elizabeth Cup—A 2 Gliders (pts.)
1 Norris, R. — Surbiton — 1,013
2 Hinds, S. — Reading — 1,006
3 Amor, R. — East Essex — 881

Flight Cup—Open Glider
1 Tofield, B. — Watford — 8 : 00 + 9 : 10
2 Fuller, G. — St. Albans — 8 : 00 + 7 : 20
3 Wade, S. A. — C.M. — 8 : 00 + 2 : 25

Fairey Cup—Open Rubber
1 Lennox, R. — Birmingham — 8 : 00 + 5 : 15
2 Burwood, R. — 8 : 00 + 3 : 55
3 Barnacle, E. — Leamington — 8 : 00 + 3 : 44

De Havilland Trophy—Open Power
1 Fuller, G. — St. Albans — 8 : 00 + 4 : 10
2 Glynn, K. — Surbiton — 8 : 00 + 1 : 43
3 Gough, R. — Enfield — 8 : 00 + 1 : 25

Thurston Helicopter Trophy
1 Ingram, C. M. — Southampton — 564 pts

R.A.F. Flying Review Cup—R/C Spot Landing
1 Fox, J. — Hatfield — 22 ft.

Keil Combat Cup
1 Burbridge, L. — Kenton

"AEROMODELLER" Challenge Trophy—Gala Champion
Fuller, G. — St. Albans

ENFIELD C/L RALLY—July 13th, 1958.

Class A
1 Yeldham, G. — Belfairs

Class B
1 Winch, B. — West Essex

Stunt
1 Blundell, M. — Godalming

Combat
1 Copeman, G. — Kenton

SCOTTISH NATIONALS—June 8th, 1958—Abbotsinch.

Leask Cup—Glider
1 McNeil, J. — Glasgow Rebels — 4 16

Edinburgh Cup—Power
1 Ewing, W. — Paisley — 6 34

Rubber
1 Taylor, R. — Glasgow A.S. — 4 55

Allison Trophy—Best Junior
1 Black, E. — Glasgow A.S.

Combat
1 Irvine, R. — Perth

"A" Team Race
1 Forrest, R. — Barnstormers

"B" Team Race
1 Irvine, R. — Perth

Stunt
1 Grubb, C. — Kirkcaldy

SOUTH MIDLAND AREA RALLY, 1958—Cranfield.

Radio Control (19 *entries*)

Multi		Single	
1 Redlich, G. H.	65	1 Boys, H. ...	23
2 Unwins, S. ...	45	2 Robinson, J.	17½
3 Johnson, E. ...	33½	3 Airey, T. ...	9

Free Flight

Power (62 *entries*)
1 Bickerstaffe, J. — Rugby — 9 : 00
2 Draper, R. — Coventry — 9 : 00
3 Glynn, K. — Surbiton — 9 : 00

Rubber (30 *entries*)
1 Poole, D. — Birmingham — 12 : 09
2 Latter, D. — Men of Kent — 11 : 47
3 Elliott, N. — Men of Kent — 8 : 43

Glider (52 *entries*)
1 Varley, D. — Birmingham — 8 : 25
2 Abbey, R. T. — Coventry — 8 : 07
3 Wingate, J. — Cheadle — 7 : 28

Combat (62 *entries*)
1 Sadler — Derby
2 Tribe, P. — Northwood

Team Race

"A" (45 *entries*)
1 Dew/Bassett — Ecurie Endeavour — 8 : 50
2 Hartwell, P. — Enfield — 9 : 20
3 Kendrick, M. — W. Bromwich — 9 : 58

"B" (16 *entries*)
1 Baxter, F. — Wharfedale — 9 : 41
2 Winch, J. — W. Essex — 11 : 16
3 Davey, L. — Wharfedale — retired

Chuck Glider (24 *entries*) **best of 2 of 5 chucks.** (secs.)
1 Smith, M. — High Wycombe — 93·1
2 Simeons, G. — St. Albans — 76·8
3 Greaves, D. — Leamington — 74·8

CROYDON GALA—September 14th, 1958.

Rubber (48 *entries*)
1 Horry, K. — Bristol and West — 12 : 00 + 4 : 50
2 Poole, D. — Birmingham — 12 : 00 + 4 : 39
3 Barnacle, E. — Leamington — 12 : 00 + 4 : 38

Glider (76 *entries*)
1 Partridge, D. — Country Member — 12 : 00 + 2 : 58
2 Howell, D. — De Havilland (Hatfield) — 12 : 00 + 2 : 11
3 Dickson, M. — Leamington — 12 : 00 + 1 : 29

Power (57 *entries*)
1 Fuller, G. — St. Albans — 12 : 00 + 4 : 19
2 Glynn, K. — Surbiton — 12 : 00 + 4 : 10
3 Posner, D. — Surbiton — 12 : 00 + 3 : 54

Chuck Glider (19 *entries*)
1 Young, A. — Surbiton — 4 : 29
2 Lawson, J. — St. Albans — 2 : 06
3 Barker, J. — Surbiton — 1 : 29

Slope Soaring (34 *entries*)
1 Baguley, J. — Hayes — 3 : 46
2 Simeons, J. — St. Albans — 3 : 45
3 Cox, B. — St. Albans — 3 : 03

SCOTTISH GALA—August 24th, 1958.

Caton Trophy (U/R Rubber)
1 O'Donnell, J. — Whitefield — 12 : 00
2 Chambers, T. — Tees-side — 9 : 57
3 Rhead, T. — Wigan — 9 : 27

Open Glider
1 Sleight, R. — Prestwick — 9 : 00 + 5 : 58
2 Meechan, W. — Glasgow — 9 : 00 + 1 : 15
3 Rhead, T. — Wigan — 7 : 26

Astral Trophy (Power U/R)
1 O'Donnell, J. — Whitefield — 12 : 00 + 5 : 55
2 Talbot, B. — Wigan — 12 : 00 + 5 : 54
3 Smith, A. J. — Stranraer — 10 : 40

Taplin Trophy (Radio) (pts.)
1 Nield, W. S. — Cheadle — 44
2 Parkinson, G. W. — Kendal — 35
3 Fraser, R. — Kirkcaldy — 31

Team Racing "A"
Pasco, T. — Thornaby — 4 : 51

Team Racing "B"
Rhucroft, G. — Thornaby — 13 : 46

NORTHERN GALA

Flight Cup (U/R Rubber)
1 Poole, D. — Birmingham — 12 : 00
2 Barnacle, E. A. — Leamington — 10 : 31
3 Lennox, R. — Birmingham — 9 : 53

Frog Senior Cup (U/R Power)
1 Wilkes, T. H. — Sheffield — 11 : 55
2 Eckersley, T. S. — Baildon — 11 : 06
3 Glynn, K. — Surbiton — 11 : 04

Pan American Trophy (Payload)
1 Collinson, A. R. — Baildon — 6 : 01

2 Muller, P. Surbiton 5 : 18
3 Monks, R. C. Birmingham 5 : 02

"AEROMODELLER" Radio Control Trophy *pts.*
1 Nield, W. S. Cheadle 23
2 Parkinson, G. W. Kendal 18
3 Smith, H. B. Baildon 10
Team Race "A"
1 Davy, L. Wharfedale
Team Race "B"
1 Mitchell, D. W. Prestwick

NORTHERN GALA—September 7th, 1958—Linton-on-Ouse.
Open Glider
1 Dent, D. Scunthorpe 7 : 47
2 Southam, P. Chorlton 7 : 39
3 Ellison, I. English Electric 7 : 33
4 Spencer, B. Chorlton 7 : 30
5 Davies, E. Wallasey 7 : 19
6 Tyrrell, B. Leicester 7 : 13
"MODEL ENGINEER" CUP—September 21st, 1958. (48 *clubs.*)
1 Birmingham M.A.C. ... ... 30 : 17
2 Coventry D.M.A.C. ... ... 29 : 56
3 Leamington M.A.C. ... ... 29 : 42
4 Anglia M.A.C. ... ... 29 : 03
5 St. Albans M.A.C. ... ... 27 : 25
6 Teeside Group ... ... 27 : 16

HALFAX TROPHY—September 21st, 1958. (96 *entries.*)
1 Topham, D. Loughboro Coll. 12 : 00 + 4 : 30
2 Gaster, M. Surbiton 12 : 00
3 Roberts, G. L. Lincoln 11 : 48
4 Draper, R. Coventry 11 : 46
5 Hickmott, C. Hull 11 : 44
6 Monks, R. C. Birmingham 11 : 35

FROG JUNIOR (Rubber Glider)—October 26th. (14 *entries.*)
1 Smith, B. English Electric 7 : 40
2 Hosker, M. Wigan 7 : 06
3 Wigley, E. Brixton 6 : 32
4 Gambadella, B. Blackheath 6 : 16
5 Cooper, A. Thameside 6 : 14
6 Rees, S. Letchworth 6 : 13

HAMLEY TROPHY (Open Power)—October 26th, 1958. (87 *entries.*)
1 Farrar, A. Wakefield 12 : 00 + 11 : 47
2 Buskell, P. Surbiton 12 : 00 + 9 : 26
3 Gaster, M. Surbiton 12 : 00 + 8 : 36
4 Monks, R. Birmingham 12 : 00 + 8 : 26
5 Jays, V. Surbiton 12 : 00 + 8 : 22
6 Draper, R. Coventry 12 : 00 + 8 : 15
Sid Allen Memorial Trophy
Parkinson, G. W. Kendal
Senior Champion
O'Donnell, J. Whitefield
Farrow Shield (Team Rubber)—October 12th, 1958. (26 *Club entries.*)
pts.
1 Birmingham ... ... 47·55
2 Coventry ... ... 45·57
3 Leamington ... ... 43·10
4 Surbiton ... ... 42·47
Plugge Cup
1 Coventry ... ... 834·44
2 Birmingham ... ... 774·53
3 Surbiton ... ... 725·58
4 Wakefield ... ... 678·13
5 Baildon ... ... 670·39
6 Sheffield ... ... 654·86
S.M.A.E. Cup (A/2)—October 12th, 1958. (152 *entries.*)
1 Hinds, S. Wallasey 15 : 00 + 1 : 57
2 Wade, S. C.M. 14 : 31
3 Young, F. Birmingham 13 : 55
4 Abbey, R. Coventry 13 : 35
5 Amor, R. South Essex 13 : 15
6 Warburton, H. Derby 13 : 11

GAMAGE CUP (Open Rubber)—March 1st, 1959. *Decentralised.* (96*entries, four returned no score.*)
1 Morley, D. Lincoln 12·00 + 7·01
2 Barnacle, E. A. Leamington 12·00 + 6·49
3 Draper, R. Coventry 12·00 + 6·36
4 Fuller, G. St. Albans 12·00 + 5·37
5 Greaves, D. Leamington 12·00 + 5·04
6 Heywood, R. Coventry 12·00 + 4·36
HALFAX TROPHY (Open Power)—March 1st, 1959. *Decentralised.* (106 *entries, ten returned no score*).
1 Bainbridge, D. Foresters 12·00 + 8·20
2 Reid, D. Edinburgh 12·00 + 6·52
3 Jays, V. Surbiton 12·00 + 4·55
4 Shaw, J. R. C.M. 12·00 + 4·33
5 Green, M. Foresters 12·00 + 4·33
6 Wain, D. J. Oxford Martyrs 12·00 + 3·50

PILCHER CUP (Open Glider)—March 1st, 1959. *Decentralised.* (163 *competitors, twelve returned no score.*)
1 Partridge, D. A. Croydon 9·00 + 7·48
2 Perry, P. Birmingham 9·00 + 7·15
3 Allsop, C. M. Birmingham 9·00 + 6·50
4 Shirt, E. R. N. Sheffield 9·00 + 4·37
5 Hobson, E. N. Sheffield 9·00 + 3·46
6 Woodward, T. Foresters 9·00 + 2·30

GUTTERIDGE TROPHY (Wakefield)—March 8th, 1959. *Area.* (60 *competitors, five returned no score.*)
1 Roberts, L. G. Lincoln 13·04
2 Monks, R. Birmingham 12·57
3 Wilkes, T. L. Cheadle 12·55
4 Chambers, T. B. Teeside 12·22
5 O'Donnell, J. Whitefield 12·10
6 Wade, S. A. C.M. 12·09

K. & M.A.A. CUP (F.A.I. Glider)—March 8th, 1959. *Area.* (182 *competitors, five returned no score.*)
1 Helliwell, E. Sharston 13·07
2 Hinds, S. Wallasey 12·49
3 Stokoe, P. Wakefield 12·38
4 Farrar, A. Wakefield 12·10
5 Manville, J. H. Bournemouth 11·39
6 Rennison, P. Baildon 11·31

ASTRAL TROPHY (F.A.I. Power)—March 29th, 1959. *Area.* (39 *flew, 26 returned no score.*)
1 Manville, P. Bournemouth 15 : 00 + 4 : 10
2 Smith, T. W. English Electric 14 : 49
3 Faulkner, B. Cheadle 13 : 12
4 Hinds, S. Wallasey 12 : 40
5 Manville, J. H. Bournemouth 12 : 10
6 Fuller, G. St. Albans 11 : 58

S.M.A.E. CUP (F.A.I. Glider)—March 29th, 1959. *Area.* (62 *flew, 35 returned no score.*)
1 Barr, A. Coventry 11 : 49
2 Turner, M. Cheadle 10 : 26
3 Picken, B. Wigan 9 : 54
4 Wiggins, E. E. Leamington 9 : 44
5 Hinds, S. Wallasey 9 : 27
6 Spencer, D. Chester 9 : 19

WOMEN'S CUP (U/R Rubber)—March 29th, 1959. *Area.*
1 Mrs. O. L. Fuller St. Albans 3 : 45
2 Mrs. E. M. Filtness Chester 0 : 57

JETEX TROPHY—March 29th, 1959. *Area.* (*Only five entries.*)
ratio
1 O'Donnell, J. Whitefield 20 : 88
2 Presnell, M. S. Thameside 12 : 58
3 Roberts, R. Bolton 9 : 61

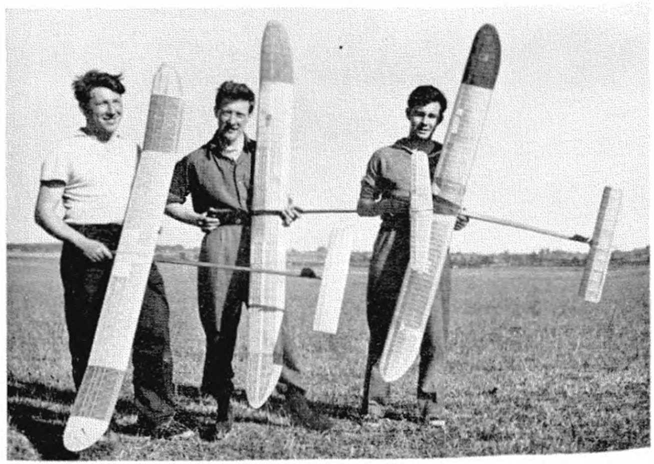
BRITISH NATIONALS—R.A.F. Scampton, near Lincoln—May 17th 18th, 1959.
Thurston Cup (Glider). (355 *entries.*)
1 Boxall, F. Brighton 9 : 00 + 1 : 58

2 Tideswell, G. Baildon 9 : 00 + 0 : 55
3 Foster, C. Sheffield 9 : 00 + 0 : 14
4 Waters, P. Port Talbot 9 : 00
Short Cup (P.A.A.). (26 *entries.*)
1 Collinson, A. Baildon 9 : 34
2 Sayers, J. Tees-side 7 : 34
3 O'Donnell, J. Whitefield 7 : 00
Gold Trophy (C/L Stunt). (41 *entries.*) *pts.*
1 Horrocks, B. Wolverhampton 444
2 Brown, R. Lee Bees 441
3 Day, D. Birmingham 384
Knokke No. 2 (C/L Scale). (21 *entries.*) *pts.*
1 Milani, C. Wayfarers 137½
2 Wheldon, C. B'Heath & Halesowen 110½
3 Moss, R. Eastbourne 81½
S.M.A.E. R/C (Multi). (43 *entries.*) *pts.*
1 Uwins, S. C/members 174
2 Olsen, C. C/member 145
3 Van den Bergh, F. Bromley 119·5
4 Dumble, J. A.R.C.C. 47
5 Haxton, F. C/member 43·5
6 Franklin, M. Leicester 38
Davies "A" (F.A.I. T/R). (98 *entries.*) 10 *kilometres.*
1 Edmonds, R. High Wycombe 6 : 2·3
2 Tyler, D. Feltham Eagles 6 : 16·2
3 Baxter, F. Wharfedale 6 : 27
4 Stephens, R. Belfairs 6 : 32
Davies "B" (5 c.c. T/R). (55 *entries.*) 10 *miles*
1 McNess, I. W. Essex 8 : 23
2 Walker, D. Enfield 8 : 35
3 Lang, K. Wharfedale 8 : 39
Ripmax Shield (R/C Rudder Engine only). (53 *entries.*) *pts.*
1 Scoles, E. N. Lincs 44·5
2 { Johnson, E. A.R.C.C. 24
{ Grocott, D. A.R.C.C. 24
3 Miller, S. Luton 23
4 Nixon, V. N. Lincs. 19·5
5 Dowker, P. Kendal 17

Super Scale Trophy (FF) (22 *entries.*) *pts.*
1 Partridge, D. Croydon 126
2 Bridgewood, J. Doncaster 110
3 Simmons, J. Northwood 107
4 Evans, H. Mill Hill 102½
Speed (2·5 c.c.) *m.p.h.*
1 Gibbs, R. Hornchurch 115·3
2 Hall, J. Belfairs 111·9
3 Irvine, R. Glasgow 99·87
Speed (5 c.c.) *m.p.h.*
1 Watson, J. Lomac 131·6
2 Roffey, I. Lomac 124·3
Speed (10 c.c.) *m.p.h.*
1 Drewell, P. Lomac 151·2
2 Howell, D. 142·5
3 Billington, M. Brixton 133·1
Combat (2·5 c.c.). (128 *entries.*)
1 Stevens, R. Northwood
2 Kendrick, M. W. Bromwich
Sir John Shelley (Power). (266 *entries.*)
1 French, G. Laindon 12 : 00
2 Talbot, B. Wigan 11 : 31
3 Smith, K. Croydon 11 : 03
Model Aircraft Trophy (Rubber). (169 *entries.*)
1 O'Donnell, J. Whitefield 12 : 00
2 Miller, C. P. Baildon 11 : 50
3 Barnacle, E. Leamington 11 : 26

1959 BRITISH INDOOR NATIONALS—February 15th, 1959—The Corn Exchange, Manchester. (17 *entries.*)
Micro Film
1 Read, P. Birmingham 12·05
2 Monks, R. Birmingham 10·10
Tissue Covered. (19 *entries.*)
1 O'Donnell, J. Whitefield 11·18
2 Barnacle, E. Leamington 11·02
Chuck Glider. (27 *entries.*)
1 Ellison, J. T. Whitefield 38·0
2 Freeston, G. Sheffield 37·0

Our A 2 Glider Team 1959. Once again we start with Ray Monks on the left and another Ray—Ray Shirt of North Sheffield centre, with 17-year-old Eddie Black of Glasgow, who hitch-hiked to and from the trials, a distance of about 250 miles each way !



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