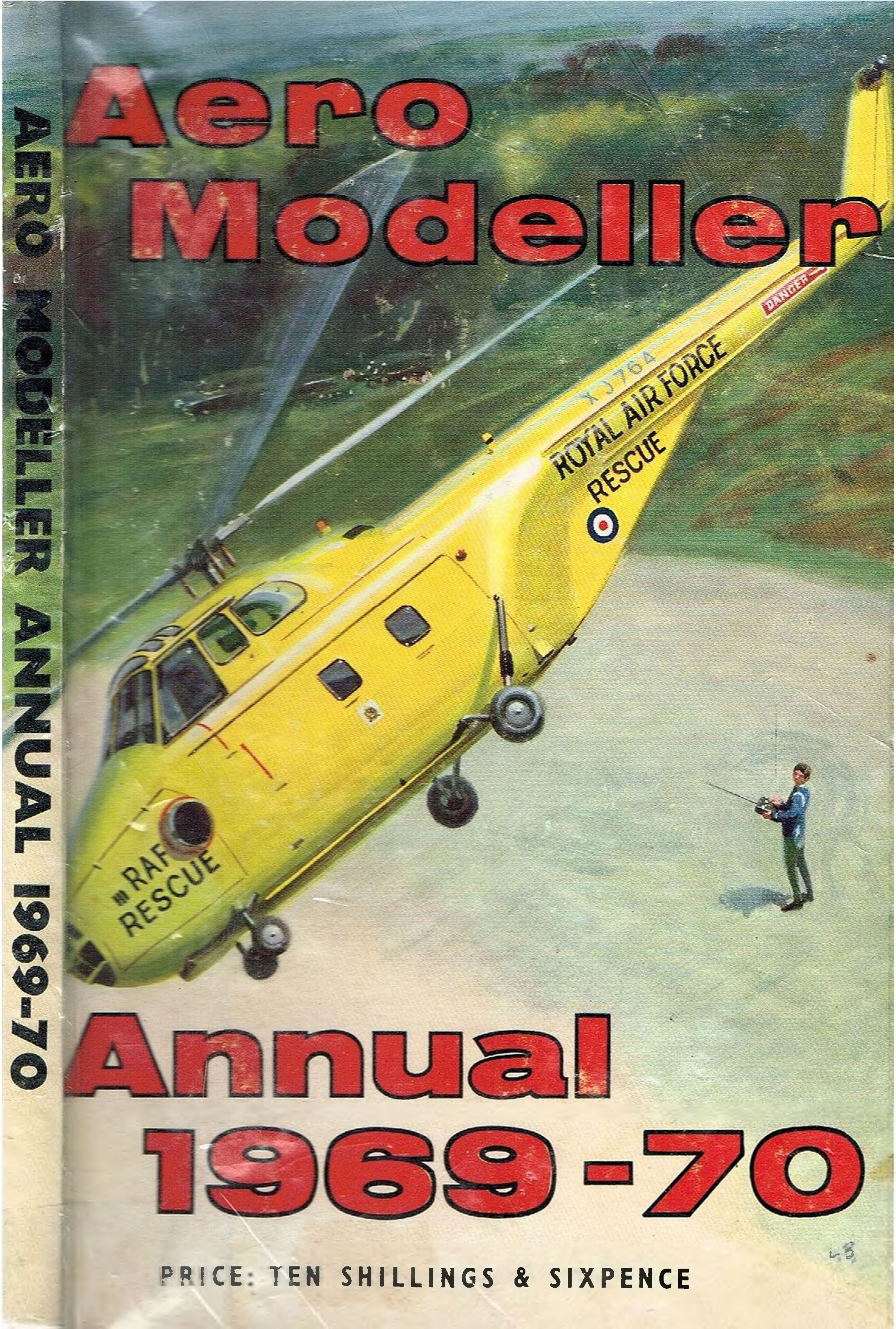
Aero Modeller



Annual 1969-70

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AERO MODELLER ANNUAL 1969-70

AEROMODELLER ANNUAL 1969-70

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

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AEROMODELLER ANNUAL 1969-70

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INTRODUCTION

WITHOUT doubt 1969 will go down in the annals (and ANNUALS!) as a truly vintage year in the history of aeromodelling. It has seen tremendous advances in the development of radio-controlled scale models, leading up to a climax with all-British victories in each of the two international contests at Metz and Bremen. No longer is the true scale model an "impossible" project. The old problems attached to small tail areas, bulky fuselages and radial engine cowlings have melted away with the arrival of almost infallible proportional radio control and powerful engines. Such is the degree of industry applied to the more expertly produced scale models that they reproduce every inscription on each instrument, and fly with exactly the same characteristics as their full-size counterparts.

Aside from this "new" facet—in reality the culmination of many years of perseverance—there is also a change of atmosphere in the free-flight contest field. Attendance at the Nationals was slightly less; but the quality infinitely higher than ever before. The trials to select the British team to go to the World Champs at Wiener Neustadt in Austria were the most demanding ever—and the most debated. Tactics have become a paramount issue. One has to be a thermal sensor as well as a model-trimming expert to succeed these days.

What finer reward could there have been for Bristol's Elton Drew than his absolute victory in the World Glider Championships following on from his excellent series of design development articles which appeared in AEROMODELLER at the turn of the year. To be the only competitor with perfect score among 84 of the World's best from 30 nations is a magnificent distinction.

In the Control Line field there is less to report. Team Race records continue to fall progressively, but not with new models or radical changes in design. Only the Speed class and a revival of interest in aerobatics indicate any degree of new-born enthusiasm, and the adoption of the fiendish Rat Racer by the hitherto Class B team race fraternity offers the only evidence of extra keenness. Of course, the combateers carry on (and *how*!) but they are fewer in number though astonishingly proficient. Quite how some of the aces manage to think so quickly astounds us at each control line rally.

Radio-controlled aerobatics was attracting far less attention at the 1969 Nats than before. Perhaps this is due to the operation of several take-off points—where models were judged simultaneously, or to the very sameness of the flight patterns. The British team—Mike Birch, Stewart Foster and Denis Hammant—acquitted themselves well wherever they went, especially at the World Championships in Bremen; but they would be the first to admit that a certain staleness had crept into British R/C model flying. Any cobwebs will be swiftly swept aside when these three and the dozens of British supporters from Bremen apply the techniques observed in the World Champs.

Rarely before has there been so clear-cut a victory as that by the young Swiss, Bruno Giezendanner, of Pfaffikon. This likable personality, so ably guided by that doyen of team managers Arnold Degen, and looked after by the precise Albert Frei, who made all his radio equipment, was universally acclaimed the greatest R/C pilot yet, at Bremen. Anyone who can use engine throttle to open up or tighten manoeuvres, a retracting undercarriage to act as an airbrake for the evasive tailslide, or can do a complete figure eight on just two bursts of throttle, collects our accolade too!

Bruno Giezendanner was not the only Radio Control pilot using such techniques at Bremen. He was the better exponent of what is the "new" European school from Germany, France, Liechtenstein and Switzerland. It is a school the British modellers cannot afford to ignore. Our more exploring personalities will have to go out into the European contests to make their mark and pick up the trends which go to win contests.

It is also significant that our two visits to German manufacturers during the years have left a strong impression of well being. We're not so sure that the attitude to the Press is healthy over there; but for logical trade development, wise capital investment, capacity to manufacture and enterprise in producing revolutionary new items, we doff our hats to the German model trade.

And what of our fare in this Annual? For one thing we have more plans than ever before. A round figure of fifty, each selected to offer variety and attractive techniques. The Radio Controlled subjects appear in our companion *Radio Control Manual—3*, to give the reader another thirty-eight inspirations. Production of eighty-eight drawings culled from the World's Model Press has not been an easy task—but we are sure that the result will be appreciated. Our thanks go to the many fellow Editors who give us this opportunity to accumulate so fine a selection each year.

We close with the hope that the feature on Helicopters serves to encourage the experimentally minded. Here is the greatest challenge of all time. Manufacturers of full-size Helicopters have never succeeded in producing a successfully remote controlled, self-contained model Helicopter, despite vast expenditure. Here's your chance, modellers, to prove where they went wrong!

Author's winning entry at 1st Helicopter International, Harsewinkel, Germany. Four-blade, main rotor is 47½ in. dia. Super Tigre G60 R.C. engine.

MODEL HELICOPTER TECHNOLOGY

by Dieter Schlueter, Engineer,

winner of the first R/C Helicopter Contest September 14/15th, 1968; translated by permission of "MODELL", Germany.

A helicopter operated in the same manner as a conventional radio-controlled model aircraft—that must be the dream of many modellers and whenever this subject is raised, there are endless discussions. It would be marvellous to be able to let such a plane take off right by one's front door. There would be no more flying space problems! Who has *not* dreamt of this before? But the word "*dream*" is the key which immediately brings one back to earth. As far as I know, there is as yet no model helicopter which, when radio-controlled, comes anywhere near to these expectations.

From the numerous discussions on this subject one realises how many people who are involved with building helicopters do not fully understand the technology. Theories which lack any fundamental technical knowledge are postulated and these are doomed to failure from the beginning. Nobody would think of building a model aircraft without having at least some idea why such an aircraft flies at all—today there is such wide knowledge in building conventional models that their construction can be based on long experience.

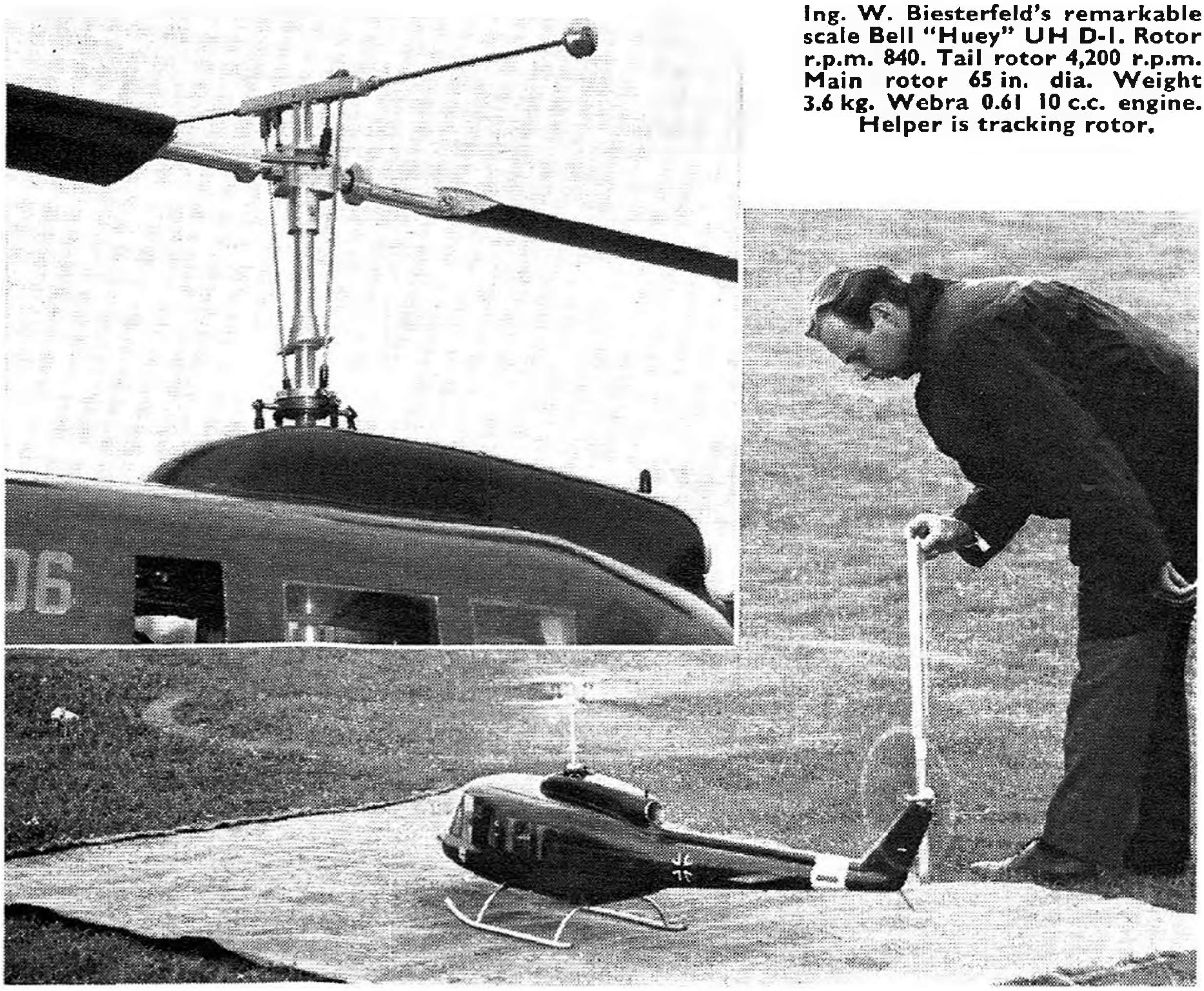
Builders of model helicopters face new frontiers and virtually have to design, test and build every part themselves. A certain measure of imitation of real helicopters is, therefore, unavoidable, at least in the beginning.

What then is a helicopter and why does it fly? Let us start with the main rotor. Mounted on the rotor head are the rotor blades. These are long and slender blades, mostly there are at least two, often more. As a result of their rotation, due to profile and angle of incidence, they create lift.

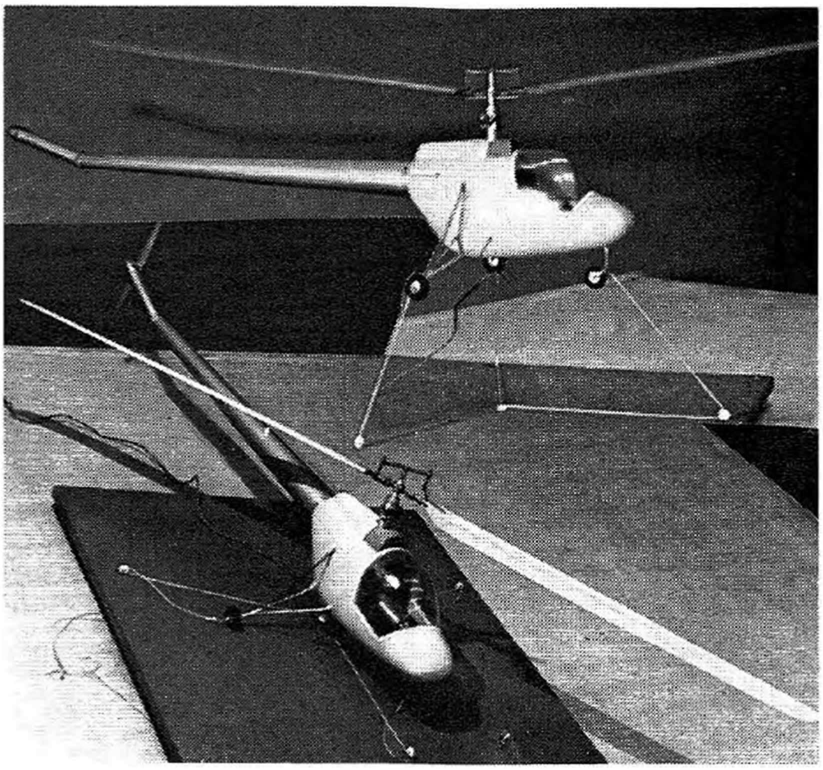
Here we meet the first problem because the blades near the rotor hub move very slowly into the air, whilst at their tips they move quickly. This is the big disadvantage of the helicopter in general, since the speed at the far tips of the blades is, of course, limited. The ideal rotor blade would therefore be constructed

in such a way as to give maximum lift everywhere. This is done partly by differing profiles and a decalage of the blade (or rotary bending). Since this has its limitations, some designers completely do away with the profile at the rotor disc and start the actual lifting surface approximately halfway along the blade. These considerations are only applicable to a helicopter hovering in the air. If the helicopter moves forward (or sideways or backwards), air flow by the forward movement is added to the actual speed of the rotor blade at the end of the blade. The advancing blade receives additional air flow so that this blade is under even higher strain. This is also the reason why helicopters are restricted in speed. Attention has to be paid to a far more important factor which raises considerable problems, even at low flying speed. The airstream does not only blow onto the blade when it is advancing, but also when the blade is retreating, and this happens with every rotation. Each blade, in the course of rotation, works alternatively with head and tailwinds. The result of this is that the blade turning against air-stream derives more lift than the one working with tailwind, so the lift is unequally distributed over the rotor disc area.

This explains the many failures of models with a simple rigid rotor head. Those who do not pay attention to this will notice that their helicopter may lift vertically, but as soon as it gathers speed it drops to one side. This could be averted by a controlling movement but in practice it is impossible since other control movements have to be applied as well. Besides, there is the additional factor regarding lack of experience in controlling a new model. These very problems also relate to real helicopters and one cannot, therefore, avoid building a complicated rotor head to eliminate the problem.



Ing. W. Biesterfeld's remarkable scale Bell "Huey" UH D-I. Rotor r.p.m. 840. Tail rotor 4,200 r.p.m. Main rotor 65 in. dia. Weight 3.6 kg. Webra 0.61 10 c.c. engine. Helper is tracking rotor.



Electric drive from external source on A. Kouznetzov's (Leningrad) experiment. Main rotor is 43.2 in. dia., 1,800 r.p.m. Tail rotor, 4¾ in. dia., 11,000 r.p.m. Weighs 1 lb.

Flapping hinges

The rotor head is not only equipped with a device for the adjustment of the angle of incidence of the blades but also with an additional linkage called the flapping hinge, which allows each blade to incline. The blade is not rigidly fastened to the hub but can move upwards, to 30 degrees and more. Weight of the blade and the speed of rotation result in a considerable centrifugal force which prevents the blade from completely "flying" upwards. Consequently the blades, depending on the ratio of lift and centrifugal force, form a kind of V-shape known as the cone angle. In the case of real helicopters, this is between 3 degrees to 7 degrees and is comparable to the dihedral on the wings of model aircraft. This, however, is not to be confused with stabilising model aircraft by means of dihedral. The success of the flapping hinge on the rotor hub is due to the fact that the blade turning against the wind does not transfer extra lift as torque direct onto the rotor head and consequently onto the model, but flexes upwards. It is only kept reasonably straight by centrifugal force. On the other hand, the blade with tailwind has less lift and flex downwards. Therefore the rotor head—and consequently the model plane—is not centrally suspended by the blades. Besides, the flexing of the blades results in a change of the angle of incidence, and of course places a considerable strain on the flapping hinges. This explains the problems of the head construction. If you listen carefully to a real helicopter, you will be able to hear the flexing movements very clearly. Since the flapping hinges give the rotor blades greater flexibility, there are, as a result, very undesirable and strong esonance effects which have to be compensated by shock absorbers.

Blade lag

The flexing movement of the blades has a very undesirable effect. We have all seen a skater performing a pirouette. He accomplishes this pirouette by turning and slowly bringing his arms towards his body. He is, in fact, bringing the weight of his arms towards the centre. The same applies to the rotor blades. Due to the upward and downward flexing of the blades the centre of gravity comes either nearer to, or moves away from, the rotor axis. This results in an acceleration or

deceleration of the speed of rotation about the rotor axis. The upward-flexing blade, therefore, tends to turn more quickly, whereas the downward-flexing blade wants to turn more slowly. The blades, therefore, counteract each other in their rotation about the rotor axis. This, in its turn, results in an enormous additional strain on the rotor head and the flapping hinges. For this reason a blade lag is built in which makes it possible for the blades to move forwards or backwards. Through this blade lag movement, one accomplishes—in addition to the flapping movement—a better distribution of lift when it is windy or during forward flight. The blade turning into airstream has to overcome greater resistance than the blade working with wind. By means of the blade lags, it can, therefore, lag slightly behind the rotation movement. This means that for this particular part of the rotation, it becomes slower and produces less lift. Once it has overcome headwind, the blade stretches out again, becomes quicker, moves forwards into the direction of rotation of the rotor hub and, so to speak, overtakes the rotor hub. During the out-of-wind phase the blade is momentarily quicker than the rotor hub and consequently compensates the tailwind slightly. I am not sure myself if blade lags are necessary for model helicopters. I built them into my last model (which flew at Harsewinkel) and have had favourable results.

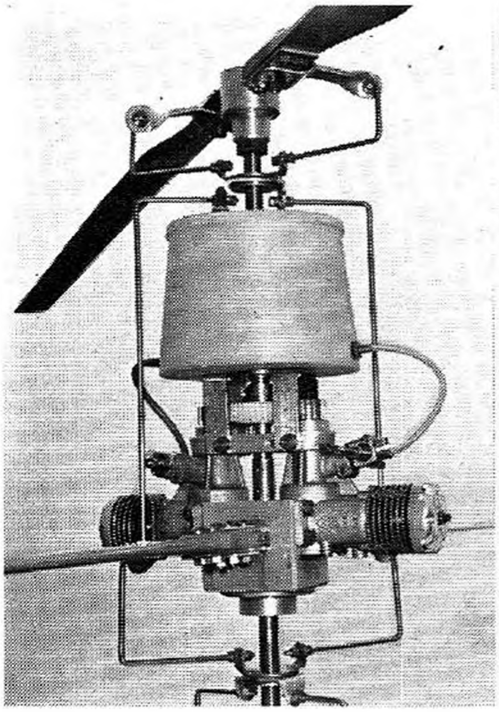
Thus, the main rotor consists of the actual hub, the flapping hinges and blade lags with shock absorbers. The blade linkages in their turn, must be rotating in order that the angle of the blades during rotation of the head can be adjusted. The blade connections end at the angles of adjustment which are connected to push rods. These have to rotate as well. Due to the fact that the blade connections adjust not only as far as the angle of incidence is concerned but, by means of flapping hinge and blade lag movements, execute very complicated manoeuvres; the push rod connections are not simple either. This is a factor which causes great difficulties in building a model.

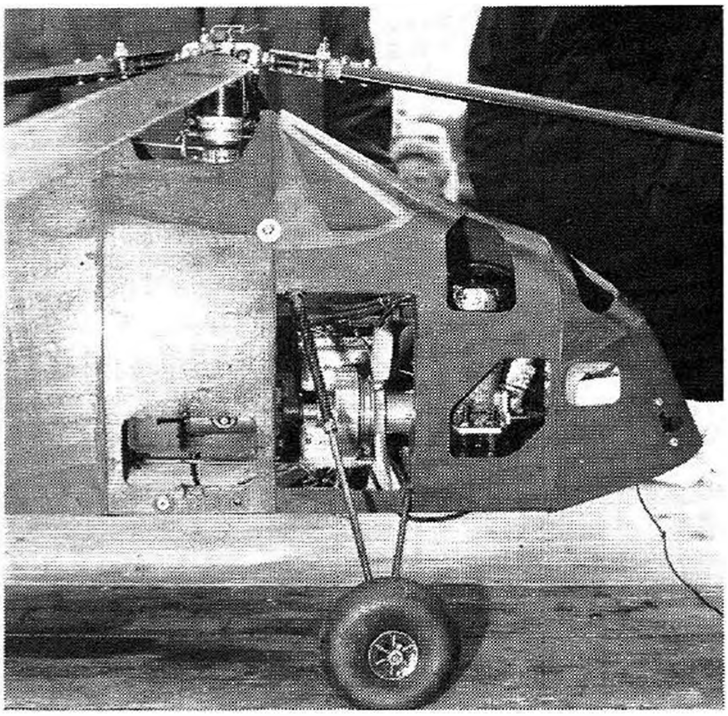
Blade Control

In order to effect a forward, sideway, backward, upward or downward movement of the helicopter, an adjustment of the blade angle is necessary. Firstly let

Above, right: Author's Sikorsky S.58 nose. Shows Super Tigre installed, weight 9 lb. Above, left: Contra-rotating rotor by Ing. J. Stehr, two Super Tigre G. 21/46 engines, 78 in. rotors, weight 8½ lb.

Left: Ing. J. Berkenkotter's tri-bladed 52-in. diameter model is 9 lb.; used Super Tigre G. 60 engine, 700 r.p.m. main rotor, 3,500 r.p.m. tail rotor.



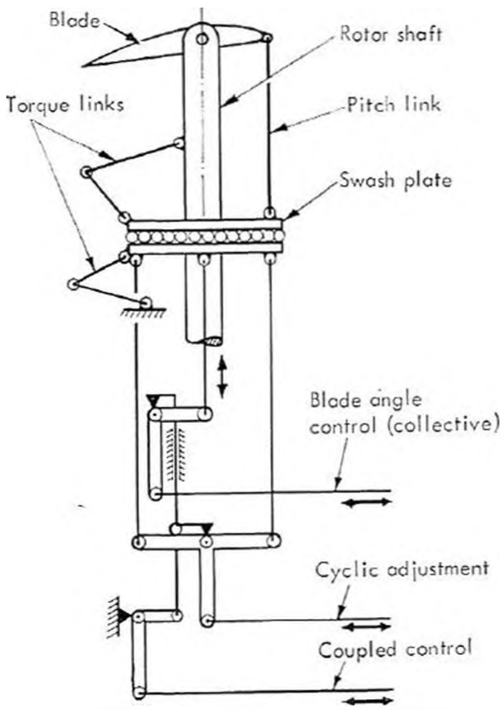


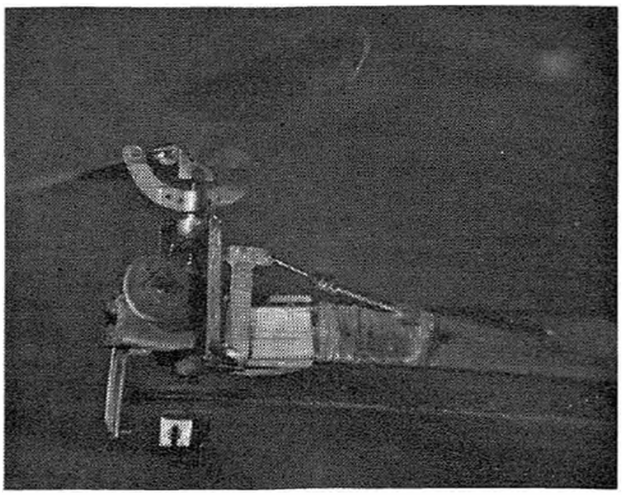
us consider the blade adjustment necessary for upward and downward movement. This is achieved by a so-called "simultaneous blade adjustment". Let us assume that the blades are in rotation. For the time being let us ignore the question of power. Initially the blades turn at a definite speed of rotation. If the angle of incidence of all rotor blades is changed, the strength of lift is altered. As the angle of incidence of the blades is slowly increased lift increases, until the point where the helicopter hovers in the air is reached. Under the rotor there is an air cushion which supports it above the ground. This is the so-called "ground effect". The helicopter rests on this cushion, and in order to free itself from the ground effect slightly more lift is required—which means that the angle of incidence has to be increased further.

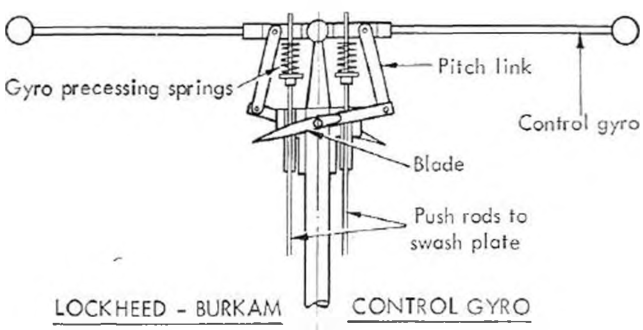
The helicopter now rises upwards and can be kept hovering if, by means of carefully calculated adjustments to the angle of incidence, lift is kept the same as the weight of the helicopter. The first essential requirement for vertical lift and descent is, of course, that the centre of gravity of the helicopter lies exactly in the rotor axis. If this is not the case, the helicopter will incline according to the position of the centre of gravity, and there would be a shifting movement around the centre of gravity. With this, we have arrived at the first possibility of controlling forward, backward and sideway flying of the helicopter—controlling the centre of gravity. This kind of control is, however, not used on helicopters —at least not on real ones.

Centre of gravity control

Let us assume that the centre of gravity of the helicopter is exactly in the plane of the rotor hub and that there are no other external influences. By making an appropriate blade adjustment, the helicopter takes off vertically. If the centre of gravity is changed the helicopter will incline. The plane of the rotating blades will now incline as well, and the pull of the rotor blades is not just vertical but also towards the C.G. displacement. This will result in a corresponding movement. For this, however, the angle of incidence of the blades has to be adjusted since a small part of the former lift will now be used for movement. The centre of gravity control is not suitable for effecting sudden movements of the helicopter.







Above: Diagram of basic controls as advised and described.

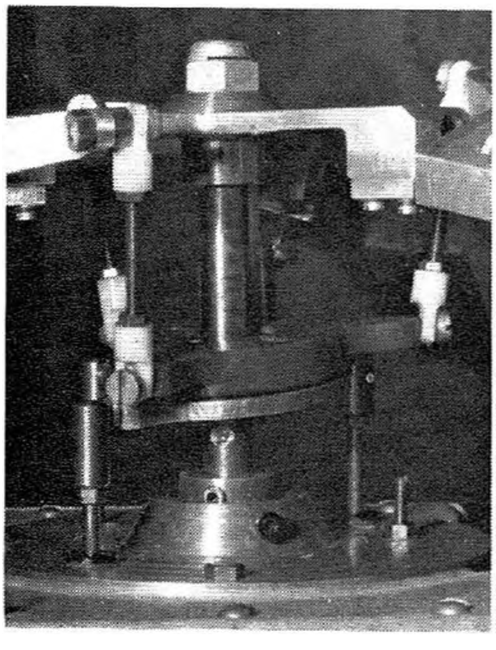
Burkam system of rotor control at right.

Rotor head control.

The rotor head control is an addition to the centre of gravity control. In this case there is no shift of weight in the helicopter, but the rotor head is adjustable, which means that the centre of gravity in relation to the rotor axis can be moved.

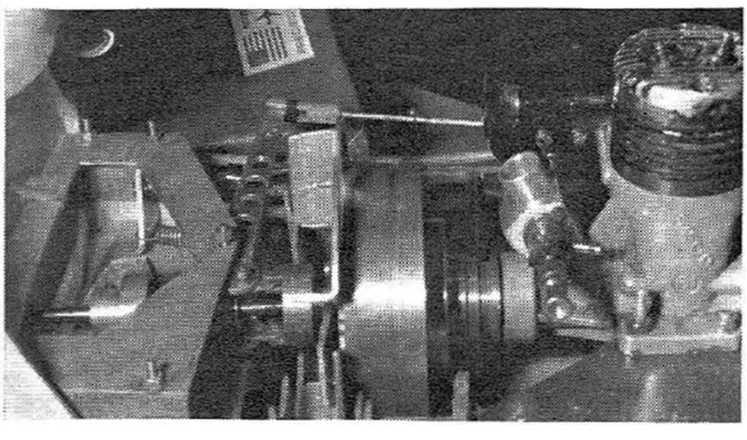
Head tilt control.

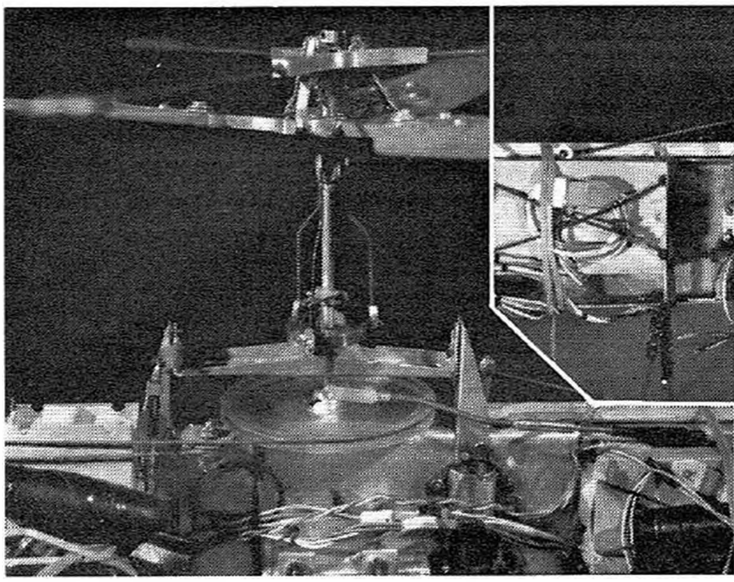
In this case, the rotor head can be tilted in relation to the fuselage and the rotor disc inclined. A series of earlier helicopters were controlled in this way, and this especially applies to "Autogiros", which have no rotor drive. This kind of control is, however, very costly for powered rotors since the drive and all the other controls have to be flexible. This control can still be found today on small

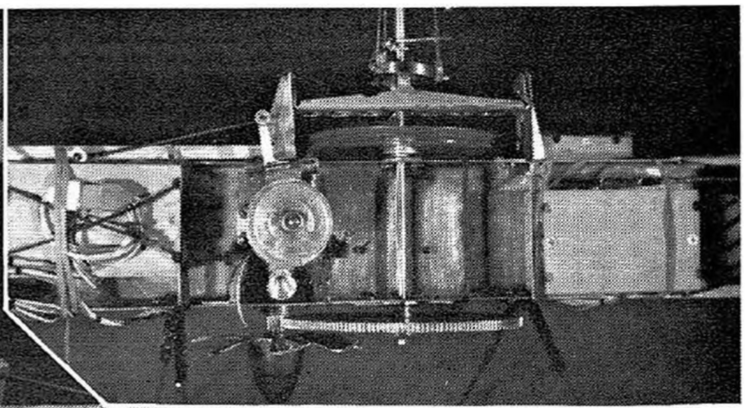


Top: "Super Susie" tail rotor and controls. Yoke connects with pitch arms on the blades and controls collective pitch.

Left and below: Keith Plested's Merco installation and rotor head on semi-scale Westland Whirlwind, which has passed initial tests satisfactorily.

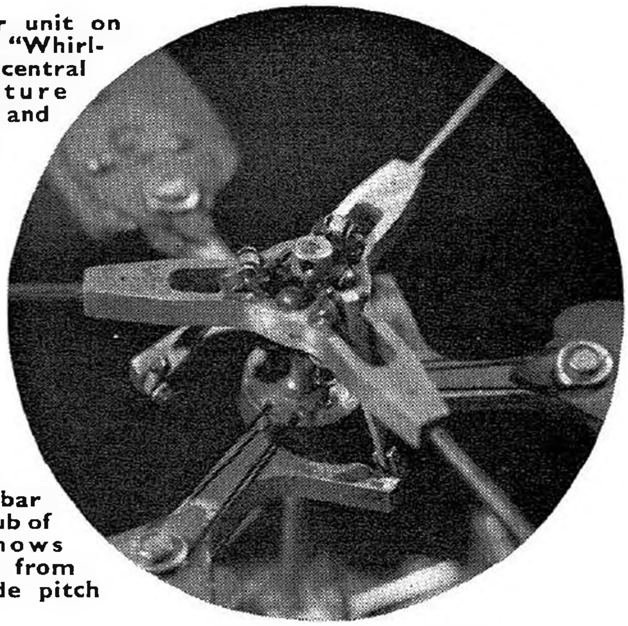






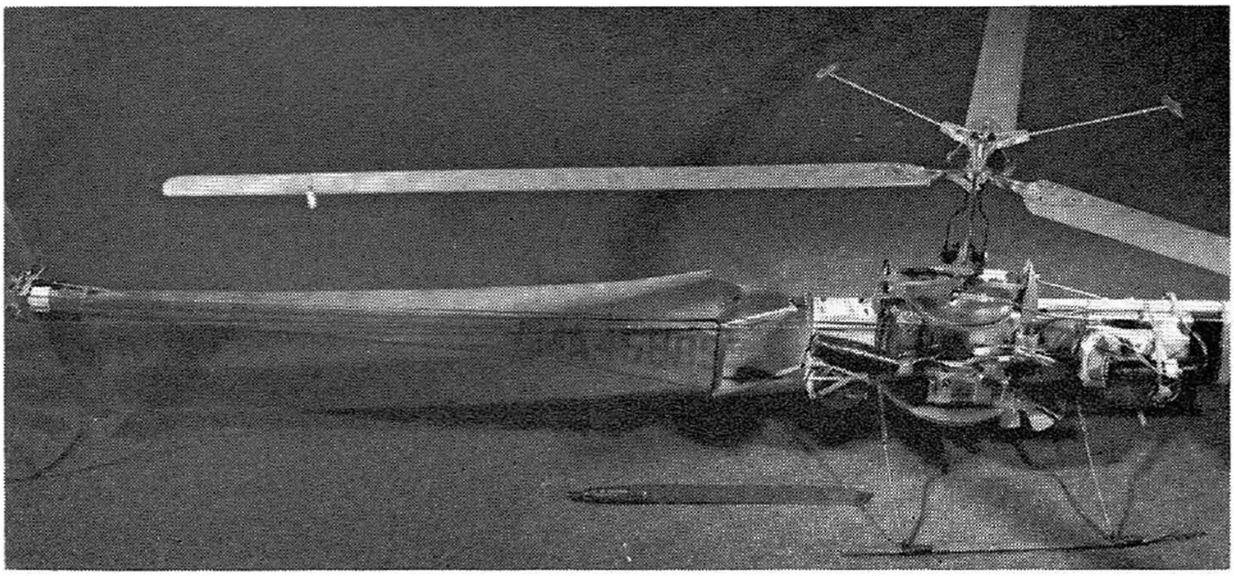
Detail of Burkam "Super Susie". Shows T.D. 0.049, fan/flywheel gearing, throttle servo and rotor drive.

Left: Power unit on the Plested "Whirlwind" with central box structure housing R/C and rotor drive.



Right: Gyro bar and rotor hub of "Susie" shows pitch links from bar to blade pitch arms.

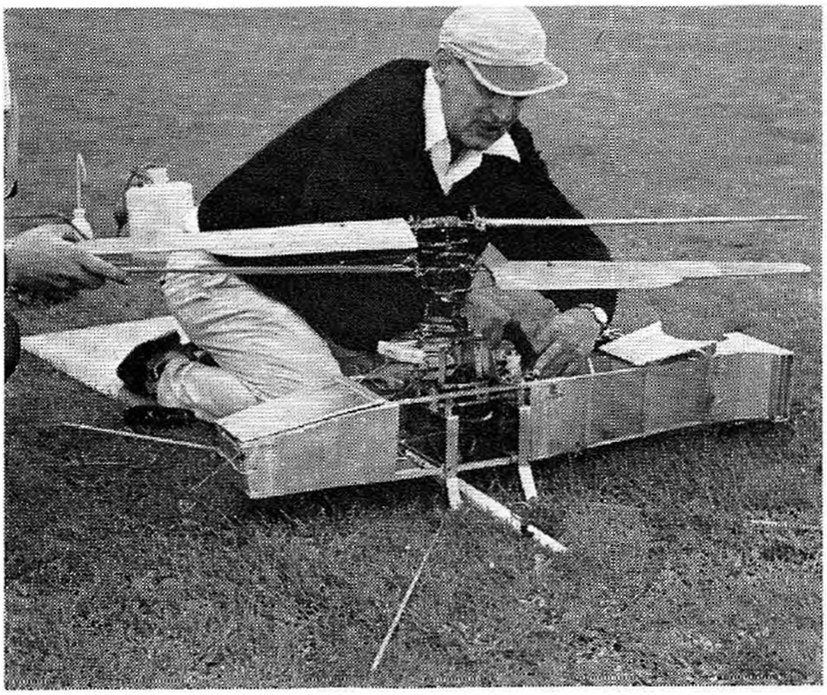
Below: John Burkam's (U.S.A.) "Super Susie" tri-blade rotor has 32 oz. thrust, carried four servos. Fuselage is open channel 0.32 in. alum. Gross weight 29 oz.



helicopters. In most cases, a hand-operated control lever is connected direct to the rotor tilt link. All three types of control mentioned virtually have a rigid rotor head. The additional disadvantage is that there is no precise means of control. A rigid rotor behaves like a spinning top. If the position of a spinning top is altered by an external force, it will be displaced. This means that the top will try to move away at an angle of 90 degrees. This is, of course, highly undesirable in the case of rotor control.

Cyclic blade control

The varying air speeds of the individual rotor blades in horizontal flight necessitate the use of flapping hinges—as already explained. One utilises the hinges by producing an additional flapping movement of the blades through *cyclic* blade adjustment. If a forward movement is desired, the individual rotor blades are controlled in such a way that, when in forward flight, the blade seen at the back lifts, whereas the front blade drops. This results in an inclination toward the front and consequently the addition to actual vertical lift of a forward component. The aircraft will move forward and the fuselage leans forward. Blade adjustment is no longer affected and all blades take up the same angle of incidence. If one wishes to change this, the angle of incidence of the individual blades has to be adjusted in such a way as to lift the front blade and lower the rear one, until there is no forward flight. The helicopter now has to be controlled at an even angle of incidence so that it will hover. Analogous with this forward and backward movement, movement to the left and right is possible as well as every combination of forward and backward flying. There is also periodic blade adjustment. Imagine you are looking from the top onto the rotor disc and this would be divided into a numbered clock face. The blades turn clockwise. On purely vertical take-off the blades have the same angle of incidence in relation to every clock reading, say 10 degrees. We now want the helicopter to fly forward, i.e. in the direction of 12 o'clock. The rotor circle plane, therefore, has to be tilted forward by periodic blade adjustment at the rotor head. Now let us follow the movement of any blade and start at 12 o'clock, i.e. at the beginning. The blade is now set at 10 degrees. It begins to move from 1 o'clock over to 2 o'clock to 3 o'clock and is meant to be higher at the rear (6 o'clock) than at the front. This is done by,



H. Deu with contra-rotating 55 in. dia. entry; flew 3 secs. Enya 60 engine, weight 11 lb.

E. Deittrich has "normal" torque reaction 59 in. helicopter with MicroMax electric drive to tail rotor. Webra 61 engine on rotor shaft, weight 8½ lb.

beginning at 1 o'clock, slowly increasing the angle of incidence of the blade, which, at 3 o'clock is no longer at 10 degrees, but, let us say, at 11 degrees. Owing to its increased angle of incidence, the blade is inclined to lift (which it does). It lifts and while continuing to rotate over 4, 5 to 6 o'clock, the angle of incidence decreases again to 10 degrees. The blade, however, is now higher at the rear—in other words, it has been lifted by the flapping hinges. It now runs through 7 o'clock, 8 o'clock, during which time the angle of incidence decreases to 9 degrees.The blade, therefore, moves down and recovers its original 10 degrees Then the cycle starts again for each blade in turn. It might be difficult to understand that the adjustment of the angle of incidence occurs at 90 degrees at 3 and 9 o'clock and that the effect only becomes apparent at 12 and 6 o'clock respectively. One has to understand that, through the flapping hinges, the rotor system is not rigid but quite flexible. The periodic or cyclic blade adjustment is not in any way parallel with the aileron of a conventional model aircraft since that is a rigid system. Unfortunately the cyclic blade adjustment interferes with the flapping movement when it is windy or at increasing speed. If, in our example, the rotor turns clockwise and the blades meet the wind, the retreating blade will drop at 3 o'clock whereas the one advancing with "head" wind will lift at 9 o'clock. This results in a slanting position to the right of the rotor which will interfere with the forward tilting. The helicopter will, therefore, no longer fly straight forward in the direction of 12 o'clock but more in the direction of 1 o'clock. This can, of course, be compensated by moving the cyclic blade adjustment slightly more to the left, i.e. largest angle (11 degrees) at 2 o'clock and smallest (9 degrees) at 8 o'clock. Together with the flying speed or head wind, this produces a straight flight towards 12 o'clock. If the speed is decreased, the cyclic blade adjustment is altered accordingly. It will be appreciated that this is quite a complicated affair and these problems apply to real, as well as to model, helicopters. It is maddening if one wants to fly forward and the helicopter starts altering its course since, apart from this, attention has to be paid to the attitude at which the model is flying, the torque compensation and the engine control. One's hands are very full!

Rotor head controls

How then is the cyclic adjustment of the angle of incidence effected? There are two possibilities, by means of the spider or the swash plate. They differ purely in

construction but not in their effect. I had better start by explaining the swash plate which is the more frequently used one of the two. The swash plate is suspended under the rotor head, which means it can be swivelled in any direction. The upper part of this plate is turned by means of the rotor head. The lower part remains rigid and is connected to the rotating part by a large ball bearing around the rotor shaft. The leverage from the joystick ends at the rigid part of the swash plate. The joystick is a conventional part and can be moved in all directions. By pressing it forward, the rotor blades drop towards the front. This means forward flying. A transverse movement effects flight to the right or the left. The joystick movements are transmitted to the rigid part of the wobble plate, which will then incline accordingly. Due to the bearing, the rotating upper part of the swash plate moves in the same way. The push rods controlling adjustment of the individual blades are connected to this upper part. Apart from the fact that the swash plate tilts, it can also be moved up and down. This is achieved by the blade adjustment lever which is positioned by the side of the pilot, like the handbrake on many cars. If this blade adjustment lever is pulled up the swash plate moves upward for higher angle of incidence. This corresponds to the vertical take-off of a helicopter, providing that the wobble plate is horizontal. If one now tilts the swash plate it means that the blade adjustment linkage periodically runs upward on the one side of the tilted plate (depending on rotation of the rotor) and downward again on the other side. When running upward the angle of incidence increases and when running downward it decreases. This produces the cyclic blade adjustment and, according to the magnitude and direction of the tilting movement of the swash plate, also an inclination of the rotor disc and the direction of movement of the helicopter. This, not very simple, blade control has the advantage that it is extremely precise and sensitive and the helicopter responds quickly since only relatively small parts of the blades have to be moved and not the whole rotor head. The pilot requires only relatively little strength to operate the joystick, and no auxiliary devices are necessary for this, up to medium-sized helicopters. This would also benefit radio-control since our little servos are also limited in power and by the time it has reached the rotor blades a lot of the power has been lost in leverage.

And now, briefly, to the "spider". The effect is the same as that of the wobble plate, with the difference that the spider consists of a thin lever which runs right through the hollow rotor shaft. It comes over the rotor head and is positioned there in a sphere. On this lever are the spider arms, one for each blade. A leverage connects the spider arms to the blade for adjustment. If one lifts and lowers the spider this results in simultaneous blade adjustment; if one lowers it, it results in cyclic blade adjustment.

John Burkam, *U.S. Model R/C Helicopter exponent, who has written a revealing address, reprinted in the 1969 D.C.R.C. Symposium papers, has the following comments:—*

The Germans have done marvellously well in the short time they probably have been working on the problem. And they probably don't have a helicopter, or even an aeronautical background. Dr. Schlueter, at least, is finding out that model helicopters with no stability augmentation are just too fast at turning over for a human pilot to keep up with, even if there were no time lag in the radio control system. Ing. F.W. Biesterfeld with his Bell Huey and its stabiliser bar at least has a chance, if the bar is hooked up right and has enough inertia.

The side-by-side or the tandem rotor helicopters are very difficult to

Heinemann Bros.' test rig for 63 in. dia. Super Tigre 60 powered entry, 1,200 r.p.m., weight 9 lb.

stabilise. The moment that one rotor moves into the area previously occupied by the other rotor, the still-down-moving air causes a decrease in lift of the following rotor. That side (or end) will drop causing the model to start moving the other way and the process repeats, only worse. I've had a tandem rotor rubber powered helicopter turn over in just one oscillation—*end over end*! The single main rotor and tail rotor configuration, or the co-axial rotor helicopter has the best chance of success. Even the co-axial has some sticky control problems, but stability can be achieved by a stabiliser bar on the top rotor, just like a single rotor machine.

Flying a full scale machine is not going to help a model "pilot" much, unless it is done by radio control while sitting on the ground! I let a full scale helicopter pilot who is also an expert R/C airplane pilot try to fly my model helicopter several times. He got crossed up in the controls worse than I did. That was in hovering. Maybe in forward flight it would have been a different story. Another licensed helicopter pilot tells me that the seat of the pants feel and the view out the window are everything. He and another pilot could both fly a moving base flight simulator but when they stopped the motion and gave the the visual display only, neither one could fly it! I still think my method of starting out with the model tied to the end of a counterbalanced boom is best. Practise flying on the boom until it gets automatic, then go to free flight, possibly with someone else helping on the controls at first.

A word about different kinds of rotors. Some kind of stability device is a *must* on any kind of rotor, to slow its response time down to a human pilot's capability and hopefully to make the helicopter stable by itself. The Bell, the Hiller, the Lockheed type gyros will work on models, provided they are used with the type rotor they were designed for; that is, teetering or hingeless. The Bell and Hiller are probably the most stable but the model is prone to tipping over on any but the best landings. The tip weight and servo tab system used by most builders of the actionless co-axial helicopter on their large rotor would work on R/C helicopters if one could figure out how to put cyclic control into the blades, or out to the trailing edge servo tabs.

Any rotor with lag hinges which allow the blades to lead and lag in the plane of rotation like some full scale helicopter blades do, is liable to encounter ground resonance which will destroy the helicopter (like some full scale helicopters do). Even if the blades do not have any lag hinges but are flexible in the

lead-lag direction (like Dr. Lee Taylor's 1967 and 1968 Nats. model) they are likely to encounter ground resonance. The rule of thumb to use here is if the sum of the *blade lead-lag frequency* (while rotating) plus the *pylon* (shaft) *natural frequency* equals *rotor speed* then ground resonance will develop very quickly. This appears as a circular motion of the rotor centre together with a sequential lead-lag motion of all the blades, which in two or three seconds builds up to damaging amplitudes.

Another recommendation which Ray Jaworski and I heartily endorse is to use either very durable and indestructible gears in the transmission or use gears that are readily obtainable and easily replaceable. These one-cylinder motors pound heck out of 'em in a very short time!

Don't waste time on an overrunning clutch and pitch change device for autorotation. Those can be added later after you've spent hours and hours flying close to the ground learning to fly the darned thing. You'll probably want to build a much better or larger model soon anyway. That's another point; start with rubber powered models to learn about the stability problem, work up through small free flight engine powered 'copters to learn about transmissions and cooling and starting problems, then go on to R/C, and lots of luck!

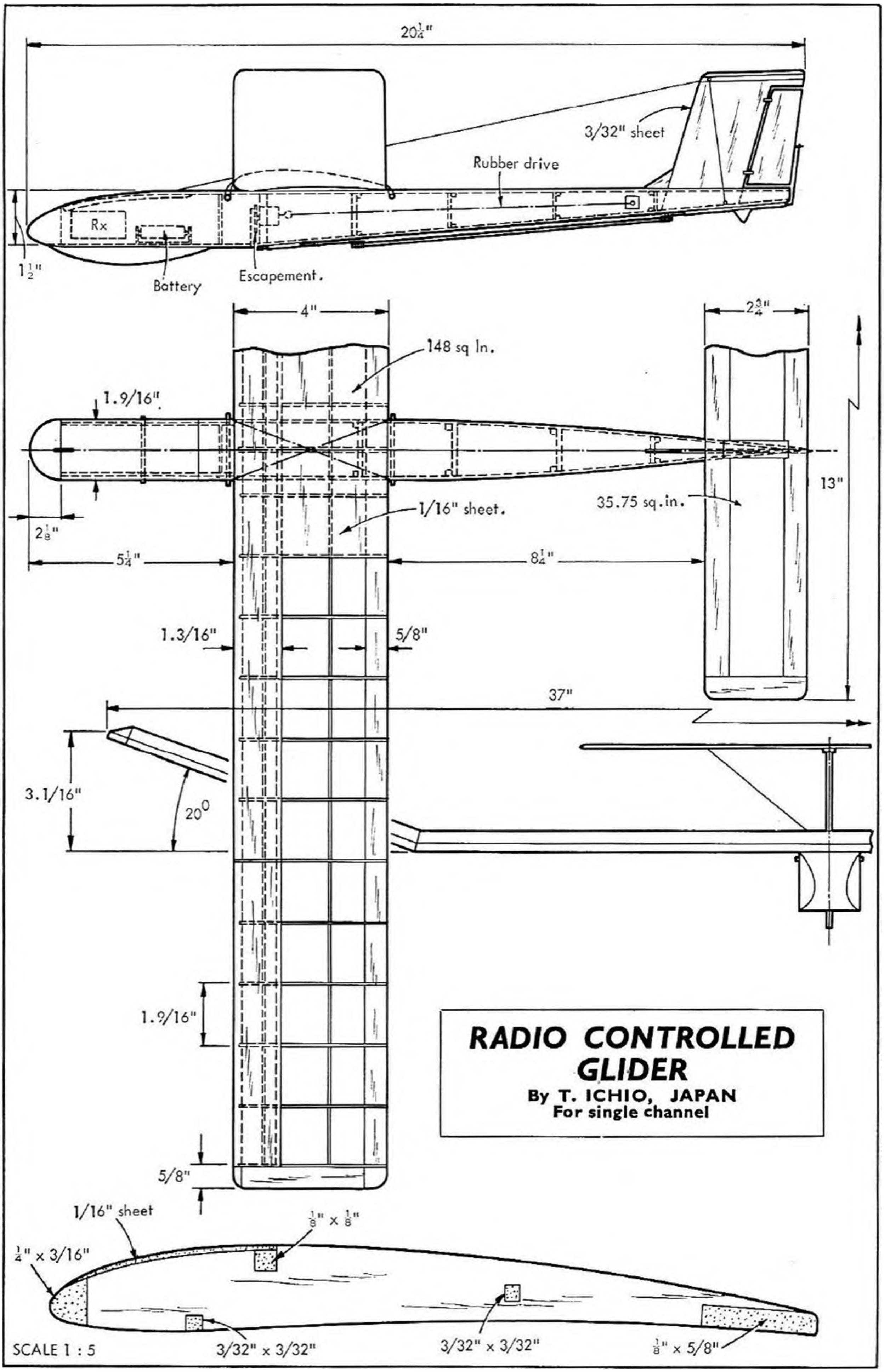
1st International R/C Helicopter Contest, Harsewinkel, West Germany,
14th and 15th September 1968

Credit for the initiative in running this contest must go to Walter Claas, owner of the firm of SIMPROP-Electronic in Harsewinkel. Specs were for a helicopter with a fuselage. Models were required to hover and fly in all four directions without turning the fuselage. Not one of the 13 entries flew in this manner. Some models had made some hops before at home—that was all.

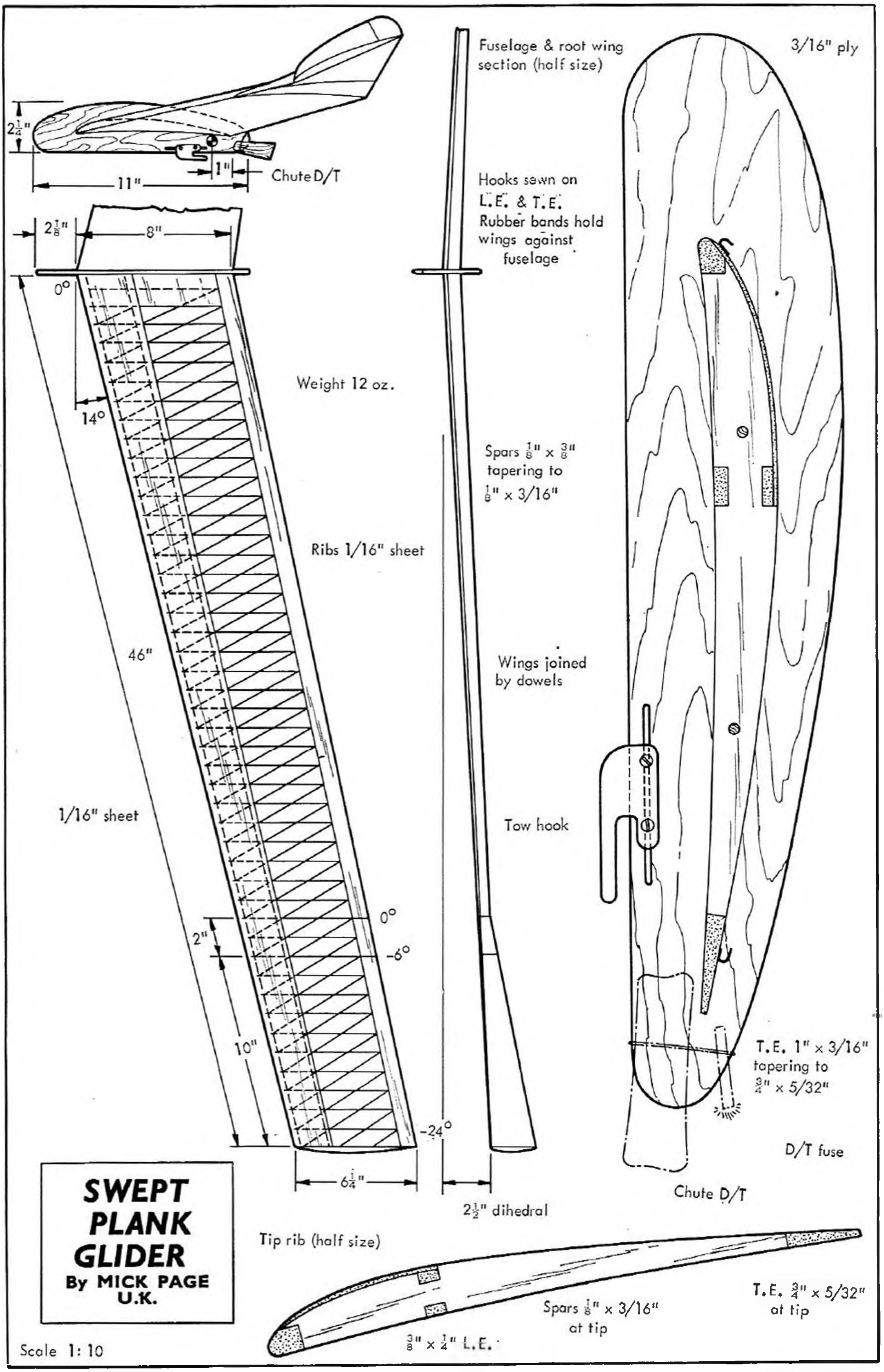
Most models were designed with the main rotor over the c.g. and a rear rotor to control torque. Some had contra-rotating rotors, or one rotor with contra-rotating engine with an airscrew like the well known free flight helicopters.

Most precise in starting was Ing. F. W. Biesterfeld with his well made Bell UH D-1, an excellent replica of this type. He lifted the model only a few millimeters with both skids sliding on the earth. He then turned the fuselage in both directions by altering the pitch of the rear rotor. But when he gave some more pitch to lift the Bell, at same time the fuselage turned clockwise round the rotor-axis. The torque came so suddenly and as it seemed powerfully that the human reflex of counteracting controls was too slow, even by one so long experienced with experiments as Herr Biesterfeld, the well known Delta flyer.

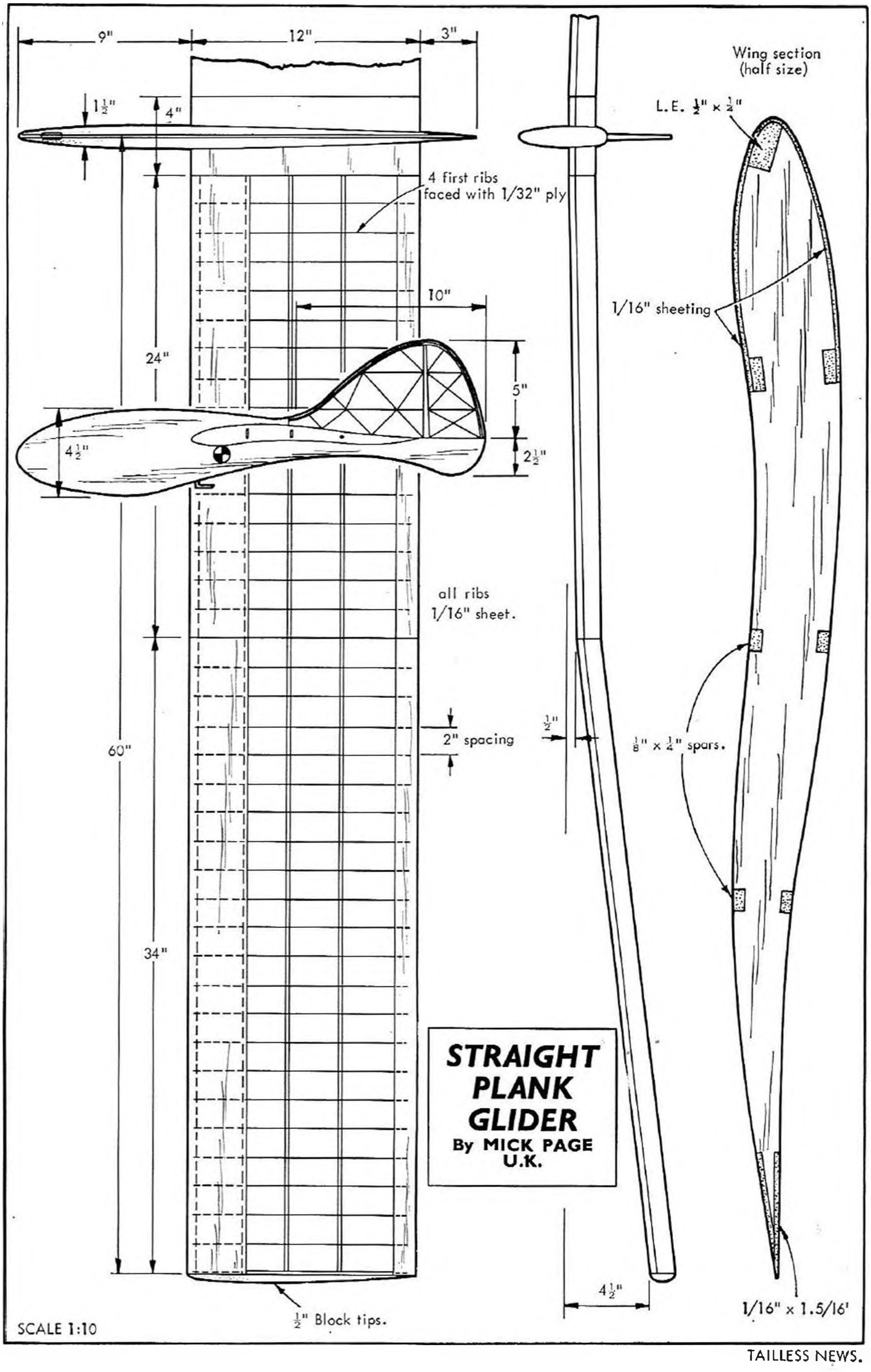
Biesterfeld received the 1st prize for design (and styling) and a special prize of £50. from Gunther, Count of Hardenberg, who is the owner of the firm Motorflug Ltd., the German importers of Bell helicopters. For his flying Biesterfeld received the 2nd prize, after Ing. Dieter Schulter with a model of the Sikorsky S.58. Also a well-made machine, similarly without luck at flying. At first attempt the model lifted nearly 6 feet, the fuselage turned around the axis of the main rotor, then rolled to the left and crashed. Time was a mere 3 seconds, rotor blades were broken but gear and motor safe. After some hours of repair, the model flew again. Perhaps a second longer—2 or 3 feet higher but now the fuselage turning clockwise and then rolling the fuselage to the right—more crashed blades! These two flights were the longest and it won the 1st prize for flying of £150. £1,330 unawarded prize money will be paid at the next international R/C Helicopter Contest, perhaps, in 1970.



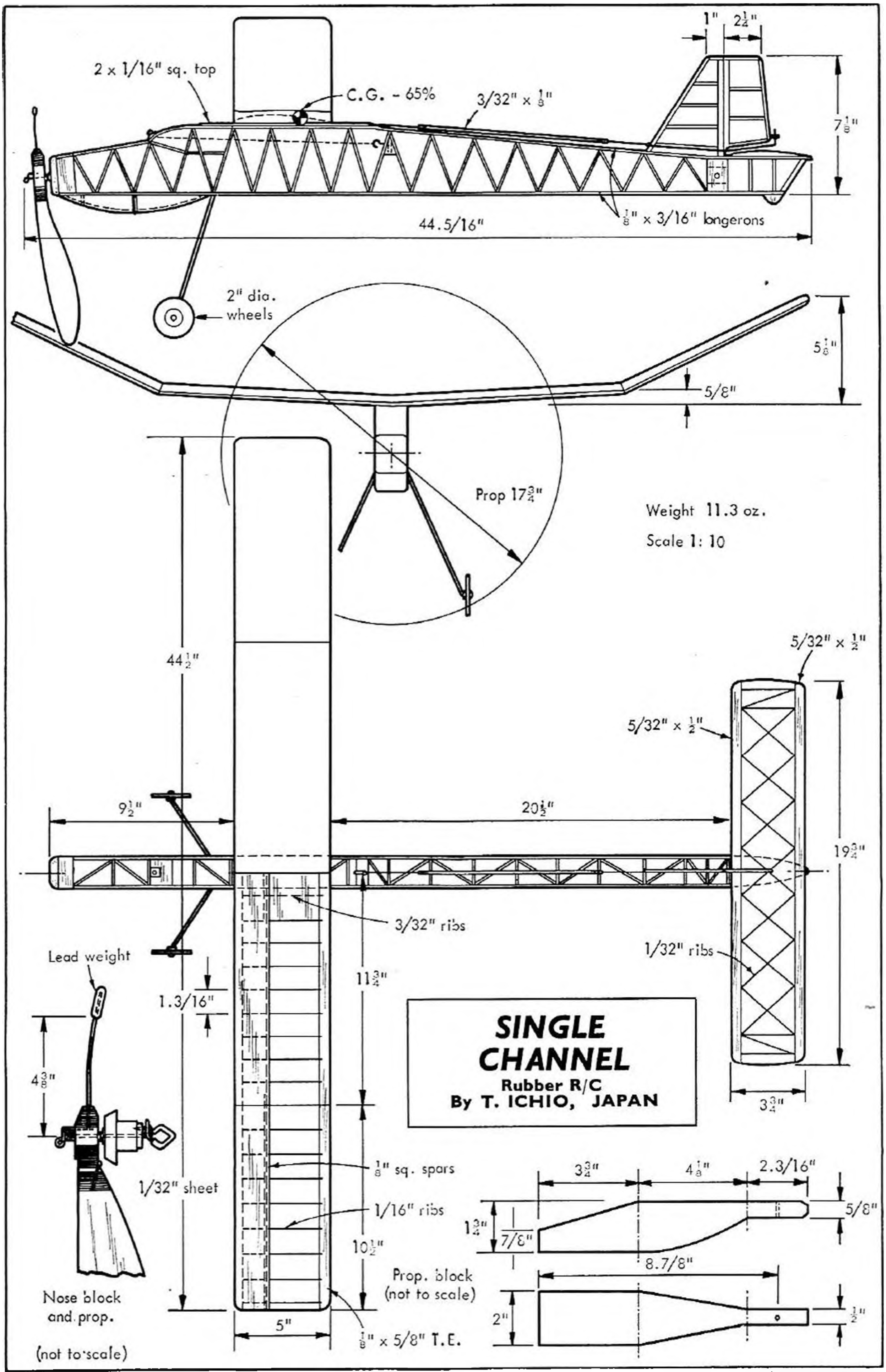
RADIO CONTROL TECHNIQUE.

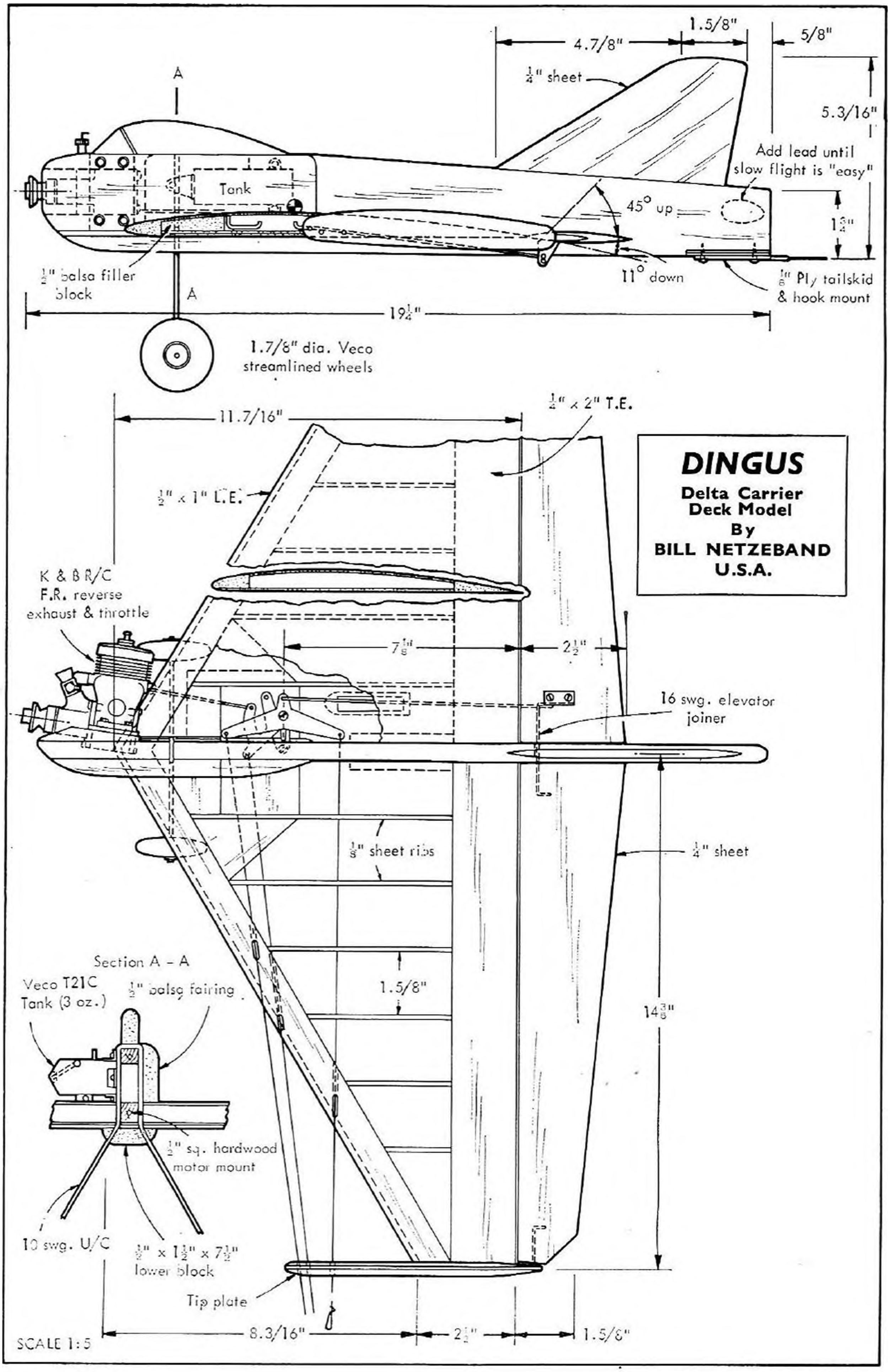


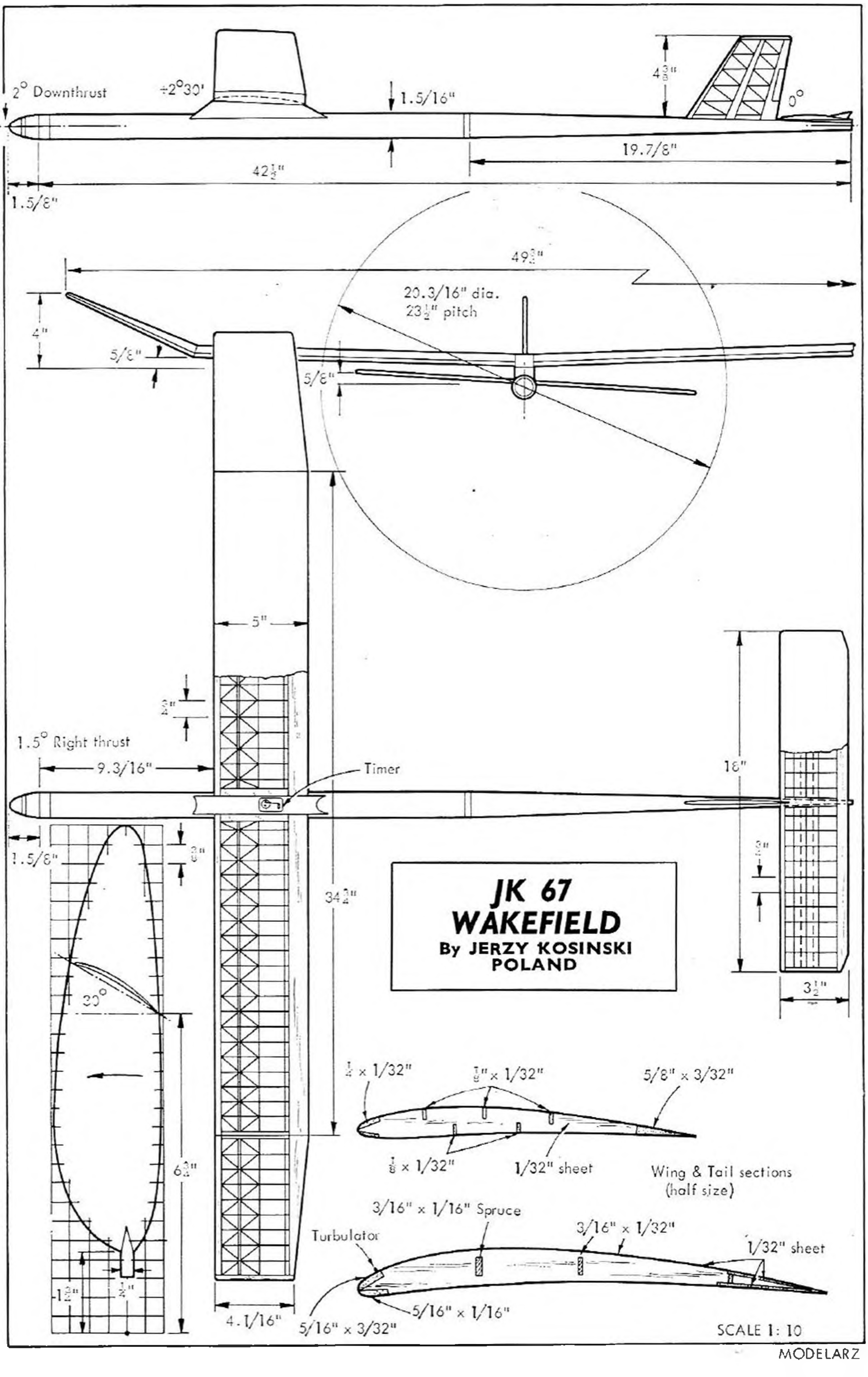
TAILLESS NEWS



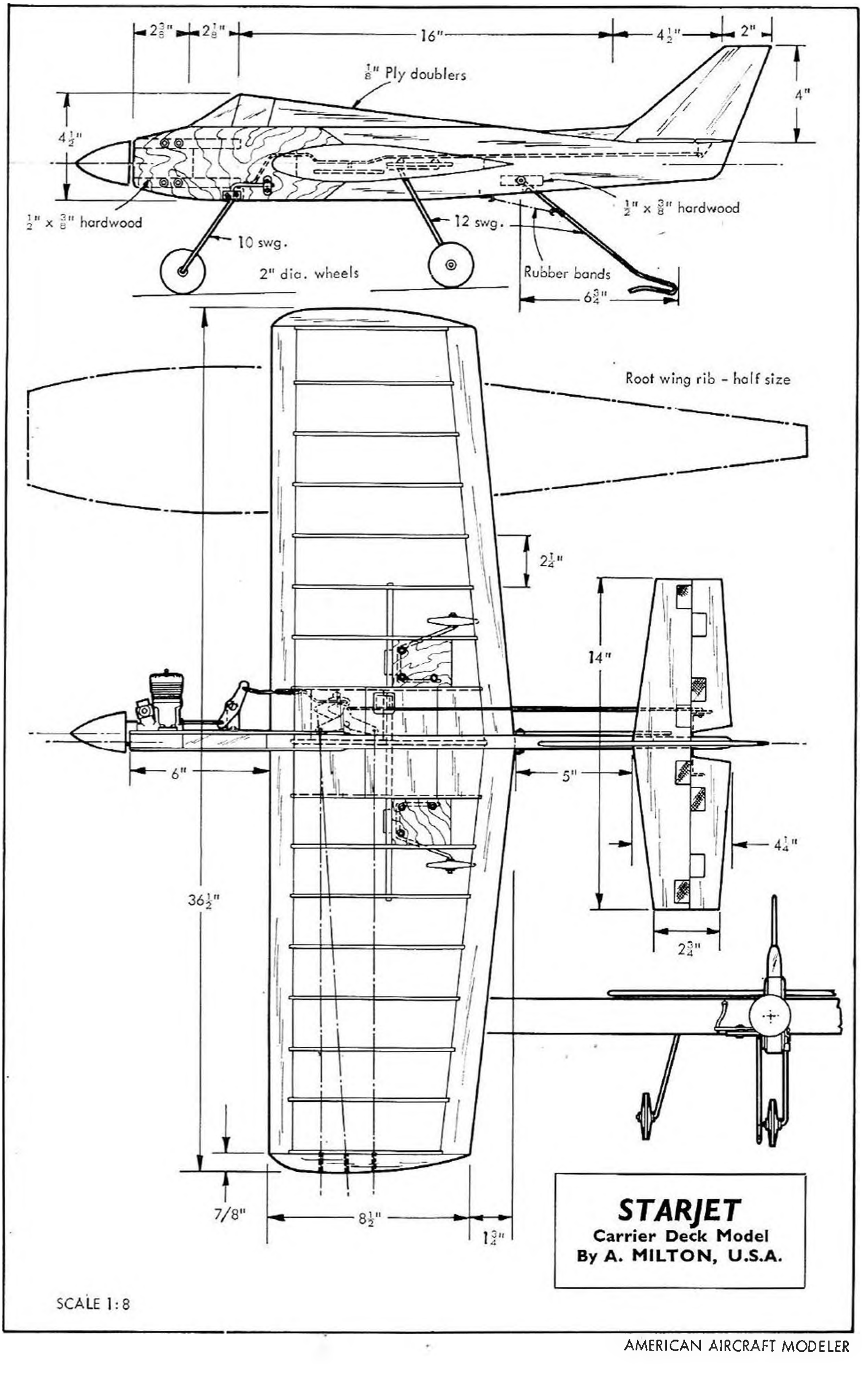
TAILLESS NEWS.


2 x 1/16" sq. top
C.G. - 65%
3/32" x 1/8"
1" 2¼"
7⅛"
44.5/16"
1/8" x 3/16" longerons
2" dia. wheels
5⅛"
5/8"
Prop 17¾"
Weight 11.3 oz.
Scale 1: 10
44½"
5/32" x ½"
5/32" x ½"
9½"
20½"
19¾"
3/32" ribs
1/32" ribs
Lead weight
1.3/16"
11¾"
SINGLE CHANNEL
Rubber R/C
By T. ICHIO, JAPAN
4⅜"
3¾"
1/8" sq. spars
1/32" sheet
1/16" ribs
3¾"
4⅛"
2.3/16"
5/8"
1¾"
7/8"
8.7/8"
10½"
Prop. block (not to scale)
2"
½"
Nose block and prop.
(not to scale)
5"
1/8" x 5/8" T.E.


1.5/8"
4.7/8"
5/8"
¼" sheet
A
5.3/16"
Add lead until slow flight is "easy"
Tank
45° up
1¾"
½" balsa filler block
A
11° down
⅛" Ply tailskid & hook mount
19¼"
1.7/8" dia. Veco streamlined wheels
11.7/16"
½" x 2" T.E.
½" x 1" L.E.
DINGUS
Delta Carrier Deck Model
By
BILL NETZEBAND
U.S.A.
K & B R/C F.R. reverse exhaust & throttle
7⅛"
2½"
16 swg. elevator joiner
⅛" sheet ribs
¼" sheet
Section A – A
Veco T21C Tank (3 oz.)
½" balsa fairing
1.5/8"
14⅜"
½" sq. hardwood motor mount
10 swg. U/C
½" x 1½" x 7½" lower block
Tip plate
SCALE 1:5
8.3/16"
2½"
1.5/8"


2° Downthrust
+2°30'
1.5/16"
0°
19.7/8"
1.5/8"
20.3/16" dia.
5/8"
5/8"
5"
1.5° Right thrust
9.3/16"
Timer
1.5/8"
30°
JK 67
WAKEFIELD
By JERZY KOSINSKI
POLAND
1/32" sheet
Wing & Tail sections
(half size)
3/16" x 1/16" Spruce
Turbulator
3/16" x 1/32"
1/32" sheet
5/16" x 1/16"
5/16" x 3/32"
4.1/16"
SCALE 1: 10

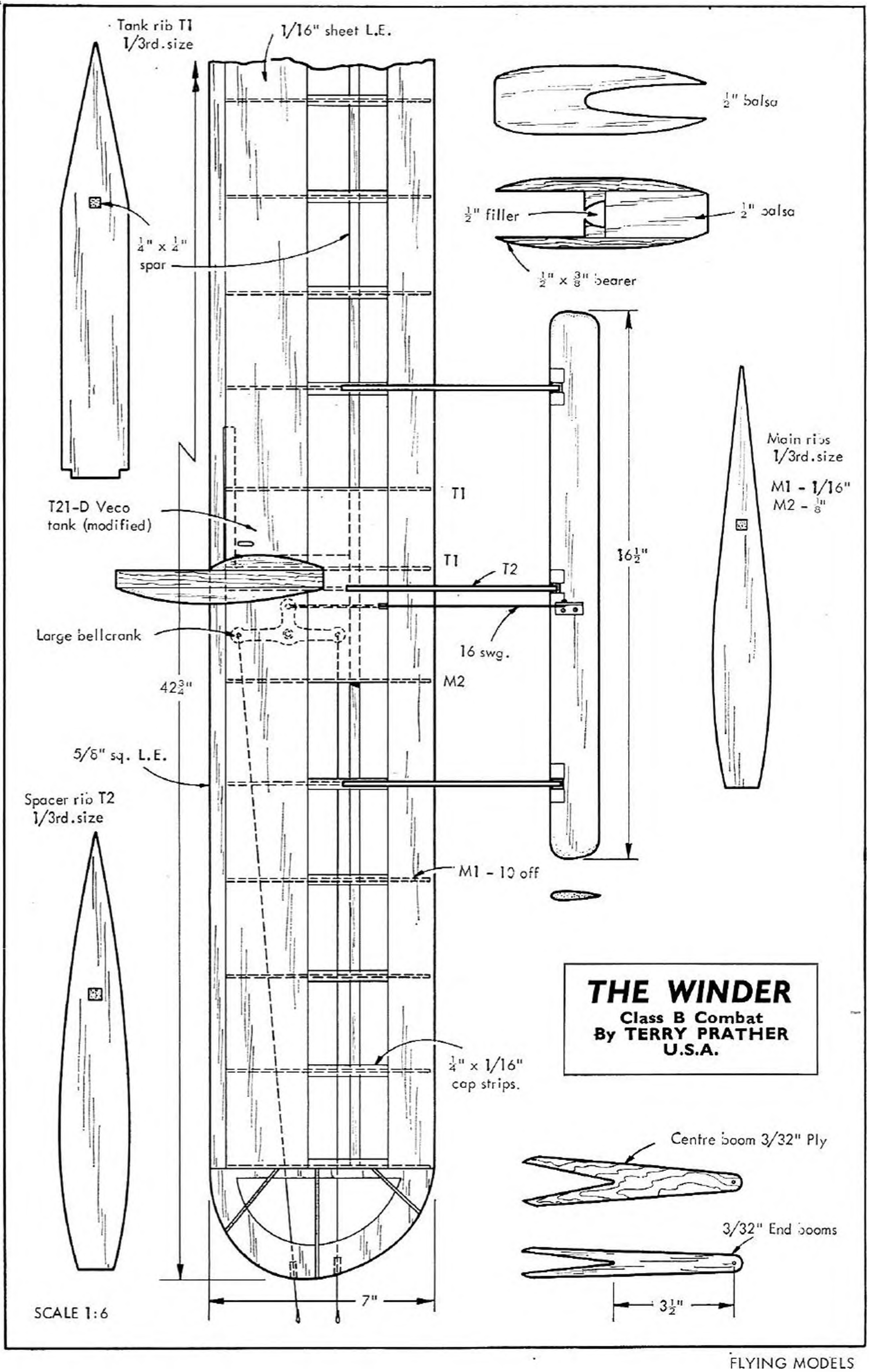
MODELARZ



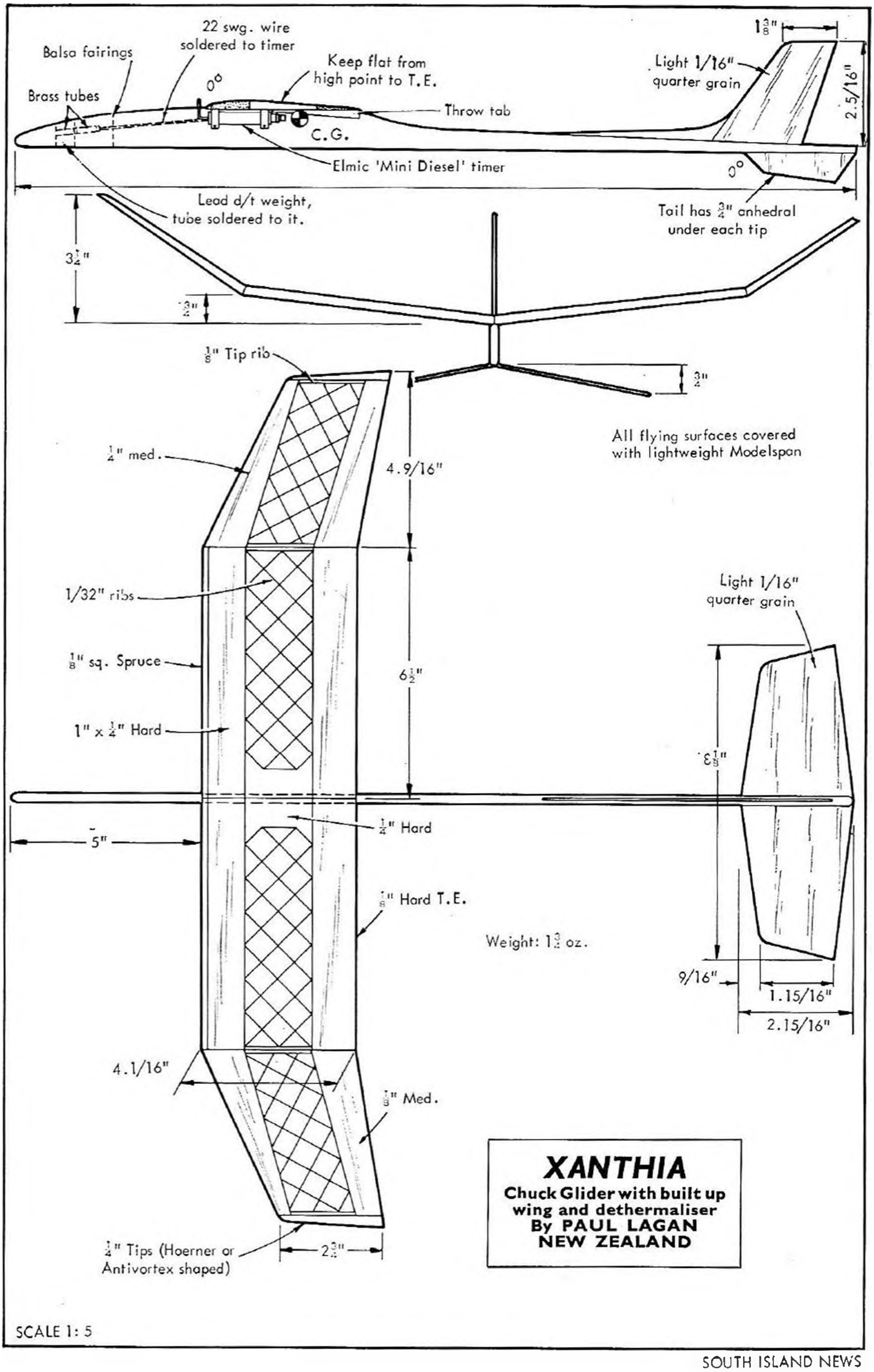
STARJET
Carrier Deck Model
By A. MILTON, U.S.A.

SCALE 1:8

AMERICAN AIRCRAFT MODELER



Tank rib T1
1/3rd.size
1/16" sheet L.E.
½" balsa
½" filler
½" balsa
½" x ⅜" bearer
¼" x ¼"
spar
Main ribs
1/3rd.size
M1 - 1/16"
M2 - ⅛"
T1
T21-D Veco
tank (modified)
T1
T2
16½"
Large bellcrank
16 swg.
M2
42¾"
5/8" sq. L.E.
Spacer rib T2
1/3rd.size
M1 - 10 off
THE WINDER
Class B Combat
By TERRY PRATHER
U.S.A.
¼" x 1/16"
cap strips.
Centre boom 3/32" Ply
3/32" End booms
7"
3½"
SCALE 1:6



XANTHIA

Chuck Glider with built up wing and dethermaliser
By PAUL LAGAN
NEW ZEALAND

SOUTH ISLAND NEWS

TUBULAR FUSELAGES FROM BALSA

by Trevor Faulkner

ALTHOUGH a great deal of writing on this subject can be found, I know of no attempt that has been made to evaluate or list the details of the main variations of the method. In addition, I am unaware of any account published of the technique of making wound laminated tubes.

Having made more tubular fuselages than I wish to recall, I *do* remember that it was only after a number of attempts that the procedural bugs were finally ironed out sufficiently to please me. My mistakes were caused by ignorance and lack of anticipation of the behaviour of balsa, glues and dopes. Perhaps the time "finding out" can best be justified if others may avoid its duplication.

There is little doubt of the "mechanical" efficiency of the tube as a structure: it simply does "more for less" than equivalent alternatives. Its reduced surface area by comparison with that of a rectangle of similar width allows either a weight reduction or greater strength with equal weight to be achieved.

Given this paragon of shapes, what are the snags—why are many builders reluctant to employ rolled tubes as fuselages?

I think the answer is threefold: first, a suitable former is necessary; second, modellers tend to stick to quick, familiar methods, using the limitations of the available sheet and strip shapes; third, the alignment of components (wings, tail, etc.) is more difficult as no flat surfaces exist to act as datum planes.

Let us deal with the problem of formers: in my living room I can see tapered legs on several pieces of furniture, left-overs from the "contemporary" 'fifties; throughout the house are broom handles, rakes, hoes, winding tubes, etc., all of which, singly or in combination, may be pressed into service. Martin Dilly suggested using the billiard cue (I got two damaged cues from a local billiard hall for free!), and most of us know friends or tradesmen with access to wood-turning lathes. In the last resort, a tapered form can be hand-planed, then rasped and sanded true enough to work.

Planning the Fuselage

The builder usually has a number of fixed factors which are going to dictate his design; for the rubber model, the space required by the *knotted* rubber motor must be adequately allowed for. Bobbins and winding tubes (if used) must be catered for if individual fittings are not going to need duplication.

A motor tube can be parallel throughout its length, the boom aft of this being of a suitable taper according to what formers are available.

The A/1 or A/2 model usually needs a long slender boom, and here the pool cue is hard to beat. If the finished fuselage can be made in two pieces, so much the better; the shock-absorbing elastic joints of some Continental A/2 models allow $\frac{1}{32}$ in. booms to be employed.

Having completed the outline planning of our fuselage, the next consideration concerns the technique to be used. A number of points require

attention, rather like variables in some design equation, and the usual antagonists appear—strength v. weight; stiffness v. flexibility.

The simplest technique is the single sheet roll; after this, the parallel-grain laminated sheet tube, finally, the wound (spiral) lamination.

Perhaps examples could be quoted to encourage anyone not having used tubes before.

1. *Single Sheet:* $\frac{1}{32}$ in. tube, tissue-covered outside, doped inside, will handle 12-strand "Open" motors, but will need local strengthening for handling areas and will not withstand a bursting motor; $\frac{1}{8}$ in. soft sheet can be rolled to $1\frac{1}{4}$ in. o.d. for Wakefields; $\frac{1}{16}$ in. medium sheet can also serve for "Formula" models, but should be silk or nylon wrapped to deal with 16-strand motors.

Booms can use either $\frac{1}{32}$ in. medium or $\frac{1}{16}$ in. soft timber to taper down to $\frac{1}{4}$ in. i.d.

2. *Laminated, parallel grain:* Very forgiving method; with care, the softest sheet and smallest diameter tubes can be made (within practical strength limits) by this method; upper limits need not worry us. The article by Mr. Dilly on his "Cue Dot" glider gives clear and full instructions for this technique (*Aeromodeller*, June 1966). Strong, simple, and widely adaptable with more laminations.

3. *Laminated Spiral:* Very strong, but most difficult technique; this produces a tube very resistant to longitudinal splitting at a slight weight penalty; one replaces the doped inside surface with an intermediate glue-line, in effect.

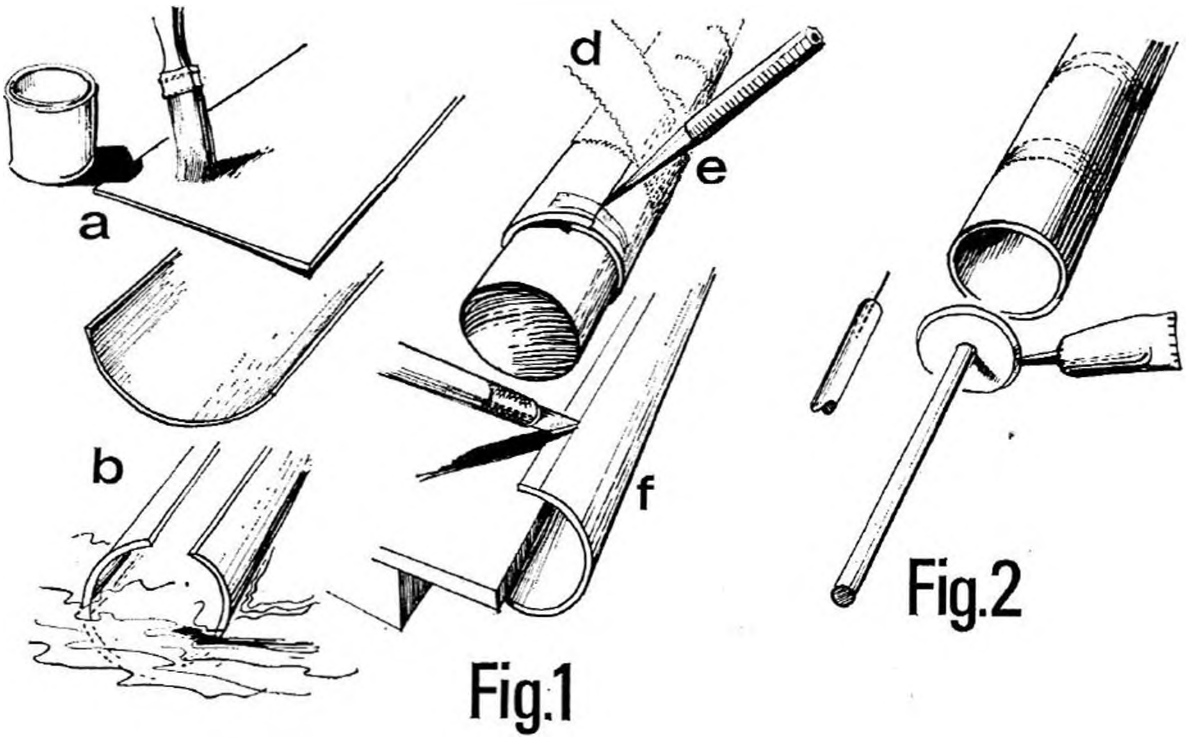
As all modellers of some experience know, balsa varies enormously in its physical characteristics: for our purposes tangent cut ("straight grain") medium to soft balsa is necessary. The softer varieties curve most easily, *but* they absorb most dope. A slightly harder piece of wood can under certain conditions produce a lighter finished piece of work. Wood of constant thickness and quality must be chosen for best results, unless a uniform decrease in thickness is desirable to achieve the smaller diameter curve on a tapered form.

Allow a little extra for trimming sheets to size after they have been formed: the shrinkage factors of individual pieces of timber vary quite significantly.

Method 1 (Single Sheet)

After determining the size of the required blank (plus $\frac{1}{4}$ in. allowance), proceed as follows (Fig. 1):

(*a*) Dope one side with two or three coats of full strength dope. Allow to dry and curl.
(*b*) Place the sheet in water: this exaggerates the curl.
(*c*) Place wet blank on former, and bind with crepe bandage. ("Persuade" rather than force the wood.) Allow 24 hours to "set".
(*d*) Remove bandage and balsa tube from former. Check exact position required on a tapered former, mark this, and replace balsa tube.
(*e*) With a sharp pencil, mark the overlap resulting from the allowance on the blank.
(*f*) Supporting the wood as shown, cut off waste with a sharp knife and steel edge.
(*g*) Wax the former well. If the wood is porous, warm it before applying the wax. A varnished former need not be warmed.



(*h*) Cement the raw edges of the tube: hold them together with Sellotape; using a dowel, remove any cement blobs on the inside of the seam.

(*i*) When the cement is almost dry, place the balsa tube back on the former. Run a block of balsa along the seam to press the edges exactly together. Allow to dry completely.

(*j*) Ease the tube from the former either by (i) striking the narrow end of the former sharply with a mallet, or (ii) revolving and pulling the former (in the case of a parallel tube).

(*k*) Replace tube on former (but not so tightly, if tapered), and wrap with tissue, nylon or silk. Polycell is the ideal adhesive for *all* these materials as it will allow the penetration of enough dope to bond it to the balsa without *your* becoming doped!

Leave the work to set on its former.

It may be felt that circular discs of balsa, acting as fuselage formers, would strengthen certain components such as light booms. These are manipulated as shown in Fig. 2, pre-cemented, into place; a trickle of dope redissolves the cement, and fuses it to the doped interior of the tube.

Joints

In order to join two-part fuselages satisfactorily, only a little patience and a flat abrasive surface are needed. Glue some medium glasspaper to a piece of flat timber about 4 in. square. Hold one component vertically, and rub gently in a circular direction on the abrasive (Fig. 3).

Repeat this with the other mating part, then hold them together, sight down their combined length, and adjust, if necessary, by further sanding (Fig. 4).

The reinforcing of joint (or noseblock) areas is simple: one or two layers of $\frac{1}{32}$ in. balsa are cemented inside the tube where required, any overlap being removed before the cement sets.

Ply faces are roughly cut, and double-cemented to the tubes' prepared ends. Final passing to shape is carried out until a minimum of waste remains to be sanded away.

The plug and dowel parts are self explanatory; the plug may be of ply *or* seamless aluminium tube.

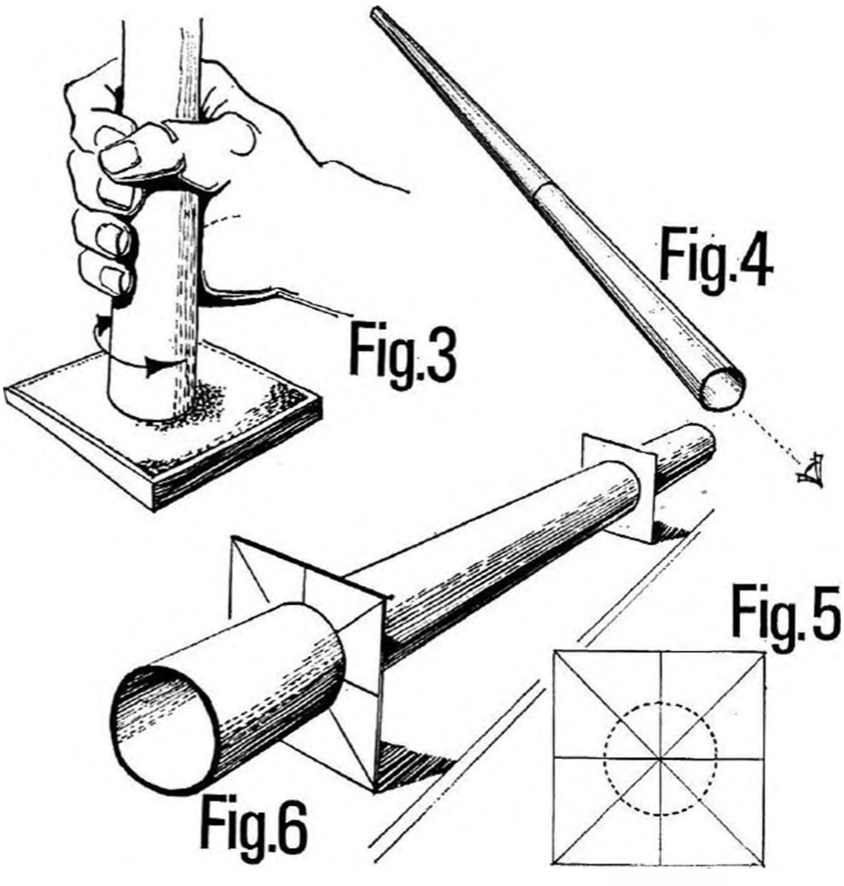
Alignment of Surfaces

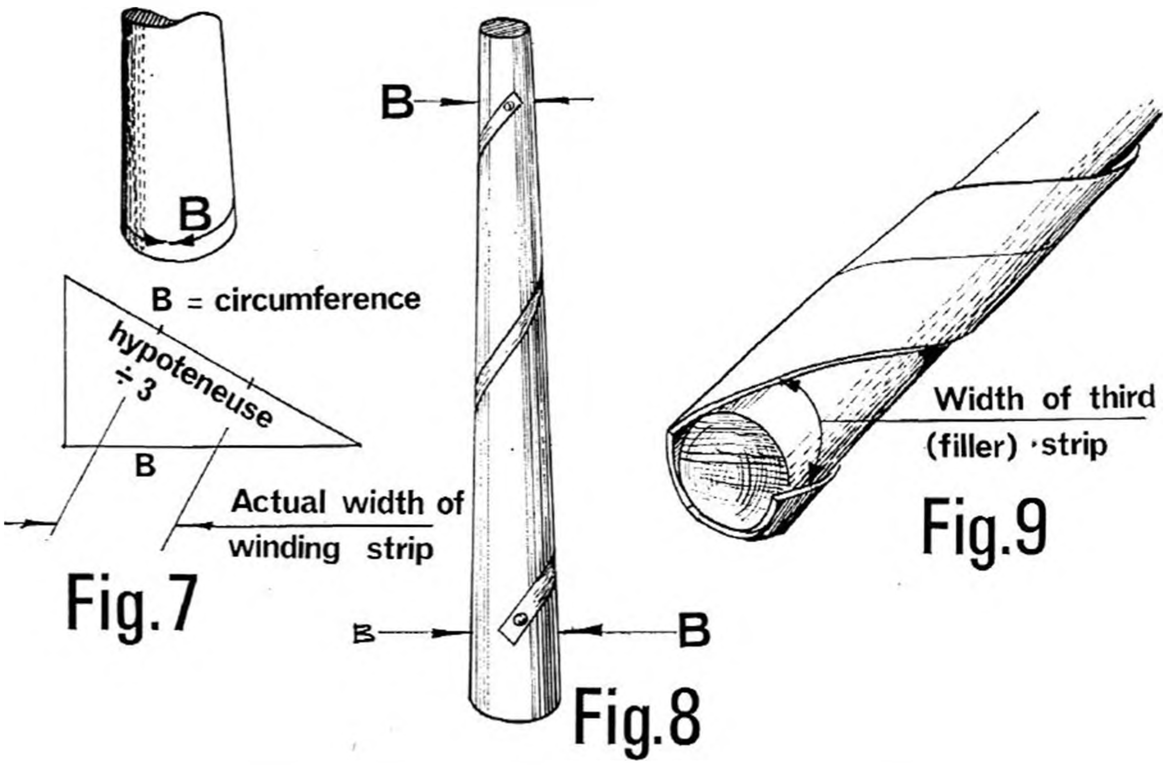
Two or more cardboard squares are cut out and marked as shown. The circle is removed from each (Fig. 5). Tubes may then be threaded through these template squares, and can be marked radially, or alternately, sighted fittings of flying surface mounts, etc., can be made using the top edges of the squares (Fig. 6).

Method 2: Spiral Wound Tubes.

This method is not much used by British model fliers, but enjoys Continental popularity. My personal procedure has evolved through trial and error (as always), without any help from existing users. It is, therefore, more than likely that some readers may improve the process. (For instance, the shape of the final blanks has been found in a rule-of-thumb way; it works, but would probably make a sheet-metalworker shudder!)

There is no problem with a parallel tube – so here is the more complex method for making a tapered job (Fig. 7).





(i) Measure the maximum circumference required: construct a 60°, 30° triangle with this distance as base. The hypotenuse is then measured and divided by 3 to give the maximum width of each of the three winding strips of $\frac{1}{32}$ in. balsa.

(ii) A strip of paper equal in length to the balsa strip blanks to be used is wound around the former at 30° to its axis. (This determines how far "up" the strips will cover (Fig. 8).

(iii) Repeat (i). This time with the circumference at the point reached by the paper. This gives the width of the other end of the balsa strips (in theory).

(iv) Two strips are cut to the dimensions established, soaked for 10 minutes in hot water and then wound and bound in the 30° spiral around the mandrel. After drying, their ends are held in place with Sellotape.

(v) The *actual* space, top and bottom, is measured at 90° between the edges of pieces 1 and 2. A third balsa strip is then cut and wrapped (wet) in position, and allowed to dry (Fig. 9). When dry begin partial removal of the bandage.

(vi) The first layer (of three tapering strips) is held rather more permanently by $\frac{1}{4}$ in. wide strips of tissue using Polycell paste. All Sellotape must be removed (if it has been used). When these tissue strips are dry, a further three lines of tissue strips are pasted along the joint lines. (*Note:* The strips in the same layer are only held together by paper.) The last spiral of paper prevents the laminating glue from getting on to the waxed former.

(vii) Tap the former out of the tube, wrapping it with three more strips approximately $\frac{3}{16}$ in. wider than the originals and starting lower down

the former to allow for the eventual increase in circumference. These strips are, of course, applied wet, and allowed to dry.

(viii) Remove "new strips", replace the balsa tube and brush on a coat o "Cascamite" glue. Wrap and bandage the outer strips in position, easing them gently for the best fit. Do this work in a cool room to avoid rapid setting of the synthetic resin glue (Fig. 10).

(ix) Having bandaged the full tube, begin (at the starting end) removing the bandage and replacing it by bands of Sellotape spaced at 2 in. or 3 in. intervals. This allows overlaps and gaps in or between the balsa strips to be seen and remedied by cutting or inlaying, whilst preventing the bandage sticking to the finished job. (A supply of $\frac{1}{32}$ in. soft sheet slivers saves time when strips don't fit perfectly.) Joint edges may be lightly burnished with a spoon handle to get the final close fit.

(x) Remove the Sellotape when the glue has dried. Sand all joint edges, wrap with tissue and/or dope as required.

As a guide to weight, a 40 in. × $1\frac{1}{4}$ in. × $\frac{3}{4}$ in. tube weighed 1·75 oz. before doping. This used medium hard balsa (harder than usually employed), and is larger in girth than a typical A/2 boom, which should scale some 1–$1\frac{1}{4}$ oz. only.

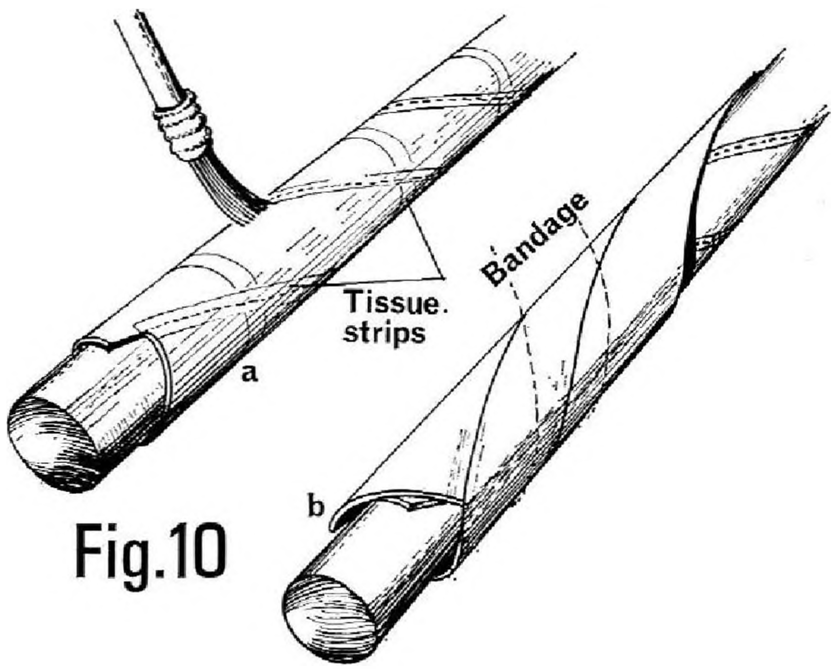
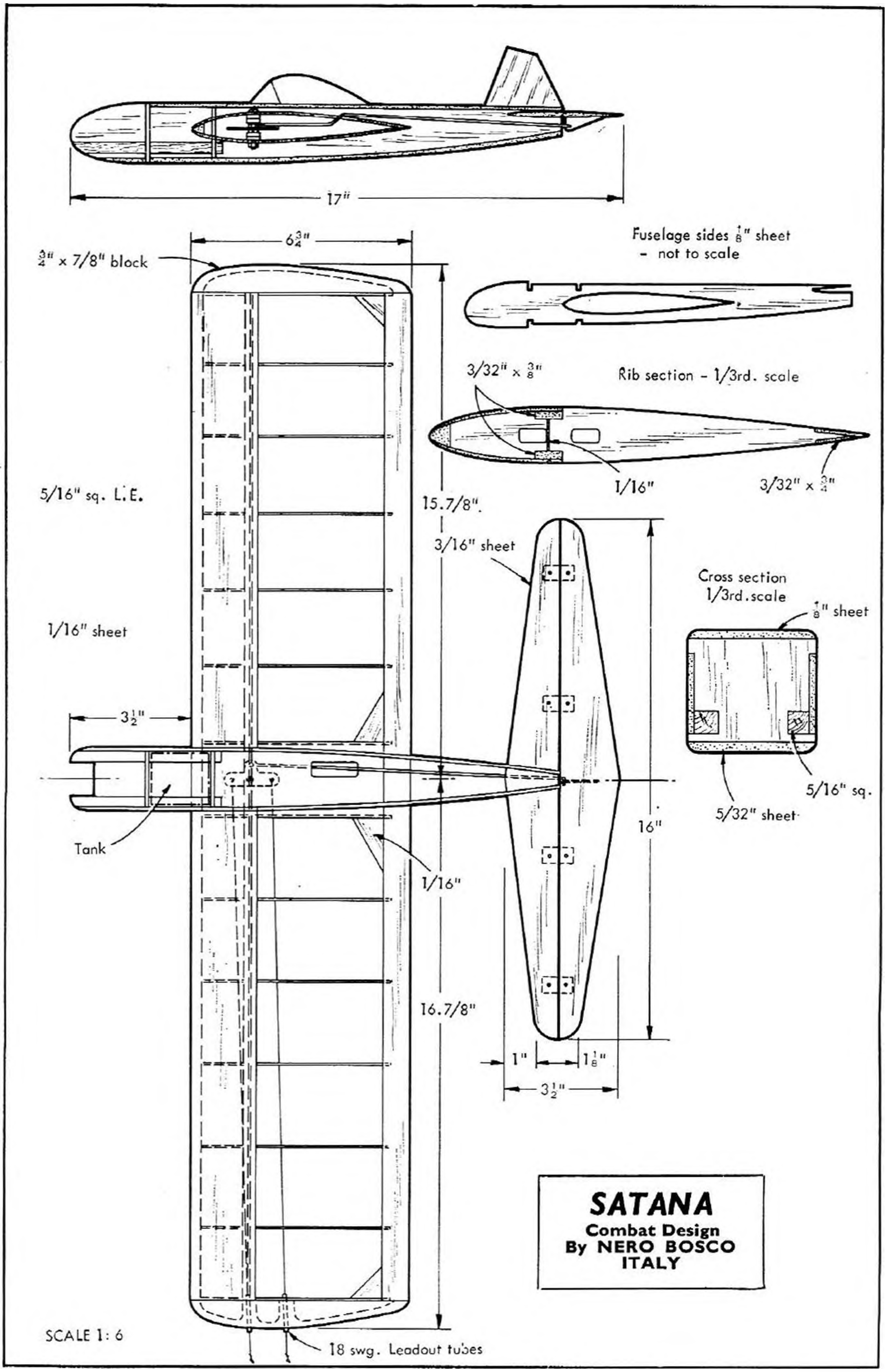
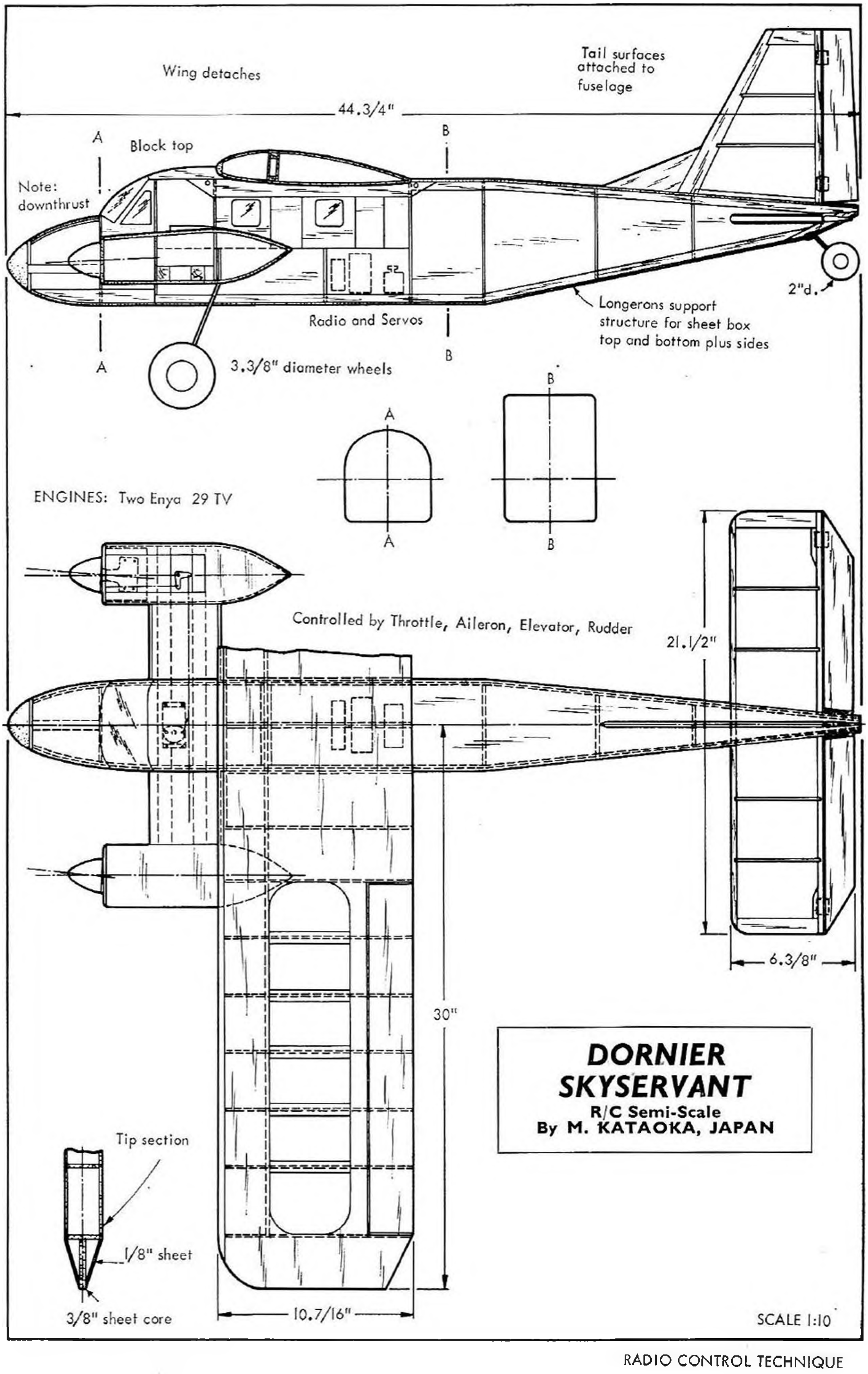


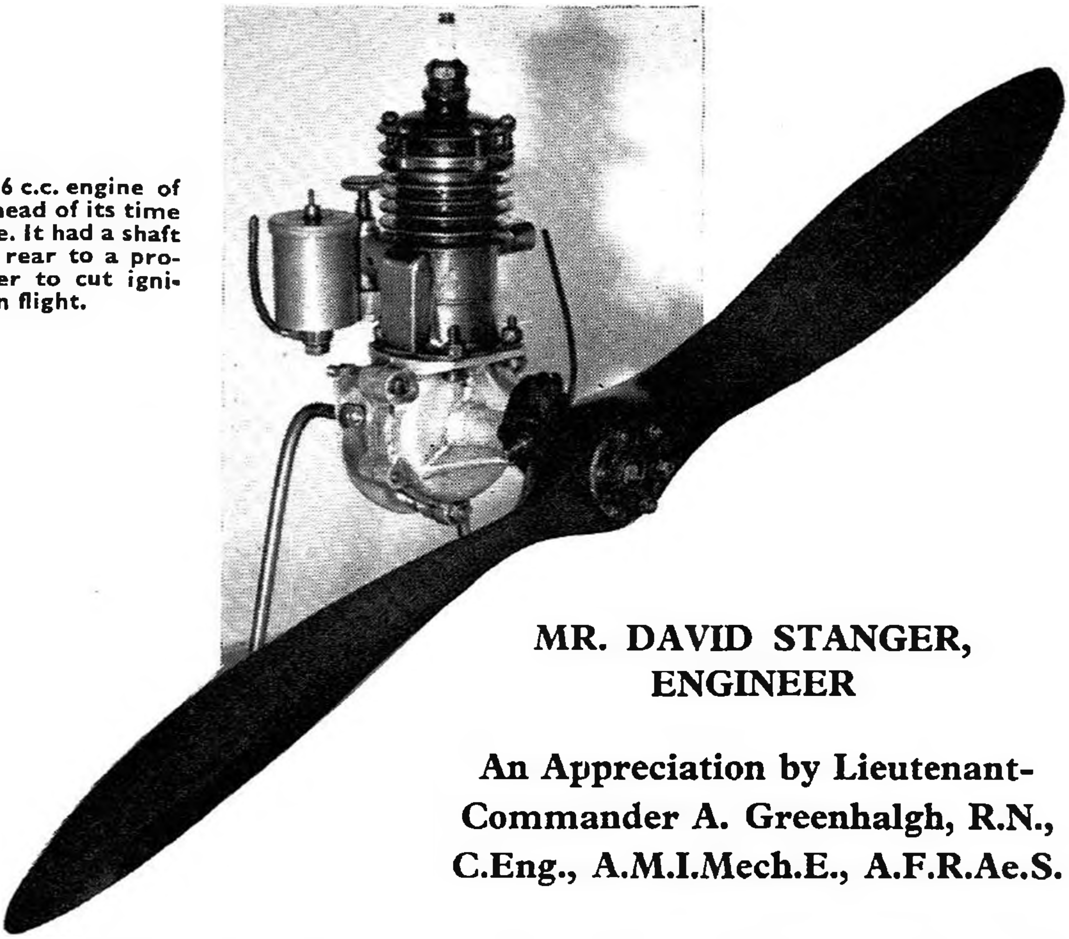
Fig.10



17"
6¾"
¾" x 7/8" block
Fuselage sides ⅛" sheet
- not to scale
3/32" x ⅜"
Rib section - 1/3rd. scale
1/16"
3/32" x ¾"
5/16" sq. L.E.
15.7/8"
3/16" sheet
Cross section
1/3rd. scale
⅛" sheet
1/16" sheet
3½"
Tank
1/16"
16"
5/32" sheet
5/16" sq.
16.7/8"
1"
1⅛"
3½"
SATANA
Combat Design
By NERO BOSCO
ITALY
SCALE 1: 6
18 swg. Leadout tubes

MODELLI


Wing detaches
Tail surfaces attached to fuselage
44.3/4"
A
B
Block top
Note: downthrust
Radio and Servos
3.3/8" diameter wheels
2"d.
Longerons support structure for sheet box top and bottom plus sides
ENGINES: Two Enya 29 TV
Controlled by Throttle, Aileron, Elevator, Rudder
21.1/2"
6.3/8"
30"
DORNIER SKYSERVANT
R/C Semi-Scale
By M. KATAOKA, JAPAN
Tip section
1/8" sheet
3/8" sheet core
10.7/16"
SCALE 1:10



The Stanger 6 c.c. engine of 1925, years ahead of its time in appearance. It had a shaft extension at rear to a progressive timer to cut ignition in flight.

MR. DAVID STANGER, ENGINEER

An Appreciation by Lieutenant-Commander A. Greenhalgh, R.N., C.Eng., A.M.I.Mech.E., A.F.R.Ae.S.

THE first petrol-driven model aircraft to fly successfully was built by David Stanger in 1908. It may be thought by some that Professor S. P. Langley was the first to achieve this distinction, but as his aircraft was a quarter-size version of the unsuccessful "Aerodrome" and was built under U.S. Government auspices, it cannot be considered to be a model in the accepted sense of the word.

The first petrol engine to be built by Mr. Stanger was an air-cooled four-stroke, four-cylinder "V" type, of $1\frac{1}{4}$ in. bore and $1\frac{3}{8}$ in. stroke. The power developed was in the order of $1\frac{1}{4}$ h.p. at 1,300 r.p.m. when driving a 28-in. diameter propeller of 30-in. pitch. The engine weighed $5\frac{1}{2}$ lb. and had a cast aluminium crankcase and cast iron cylinders and pistons. It was designed in 1905 and built in 1906. When considering this engine, it is important to relate the date of design to other events aeronautical. It lies but eighteen months after the first manned aeroplane flew, and four years before Bleriot flew across the Channel. That Mr. Stanger designed and built an engine of such small dimensions which operated with a high degree of efficiency can only reflect on his great appreciation of I.C. engine principles and design at a time when knowledge was confined mainly to the few who had attempted to build full-sized engines.

A biplane of 8 ft. 2 in. wingspan and 6 ft. 10 in. long was designed in 1907 and built in 1908. It was powered by the 1906 engine and weighed 21 lb. This aircraft was the first true petrol-driven model to fly successfully. During the next two years, minor modifications were embodied as experience and knowledge of the model were gained. The result was a most reliable and stable aircraft. Demonstrations were made in the London area and Yorkshire.

The second engine to be built was an air-cooled, twin-cylinder, four-stroke "V" type of $1\frac{1}{4}$ in. bore and $1\frac{3}{8}$ in. stroke. Lessons learnt from the first engine were considered in the design of the second, and the power-weight ratio was

vastly improved. This engine was designed in 1912 and built in 1913. It was fitted in a "Canard" type biplane of 7 ft. wingspan, and drove a 22 in. diameter propeller of 18 in. pitch at 2,000 r.p.m. This aircraft weighed 10¾ lb., of which engine weight was 2¾ lb. The flying speed was about 20 m.p.h. On Sunday, April 19th, 1914, this aircraft established the first endurance record for petrol-driven models of 51 sec o.o.s. at Hendon during the International Aero Exhibition. This record stood undefeated until Whit Monday, 1932.

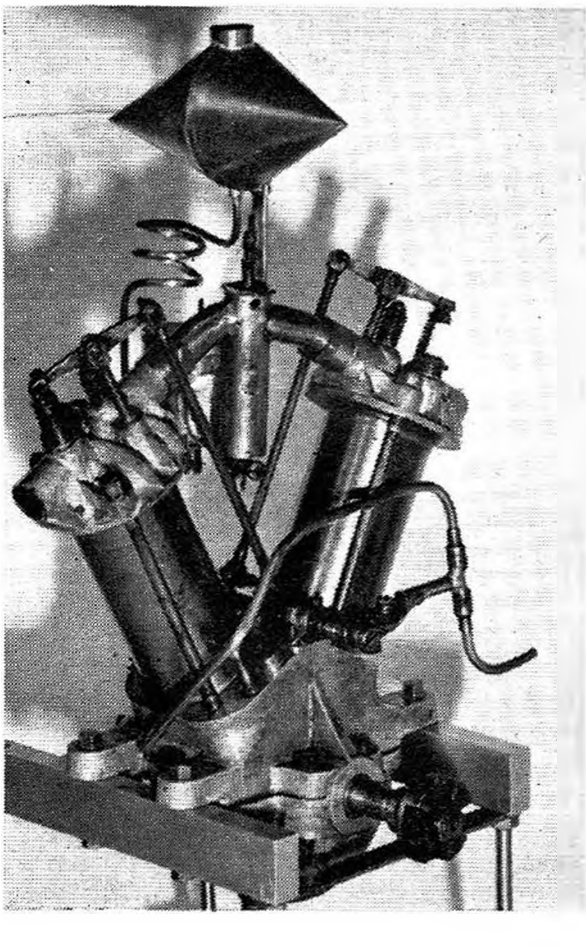
These first two engines had automatic inlet valves and mechanically operated exhaust valves. Mechanically driven oil pumps were fitted, and float type carburettors dealt with the fuel mixture.

The third model aero-engine was built in about 1925 and was a three-cylinder four stroke, in-line, air-cooled type. This engine had mechanically operated inlet and exhaust valves. The high finish and lightness of this engine was remarkable for its day, and the float-type carburettor was one of the smallest ever made. The next engine was again a three cylinder in-line type, but was a two stroke unit. The engine had a three-division crankcase and was fitted with a twin-choke carburettor supplied by a single float chamber.

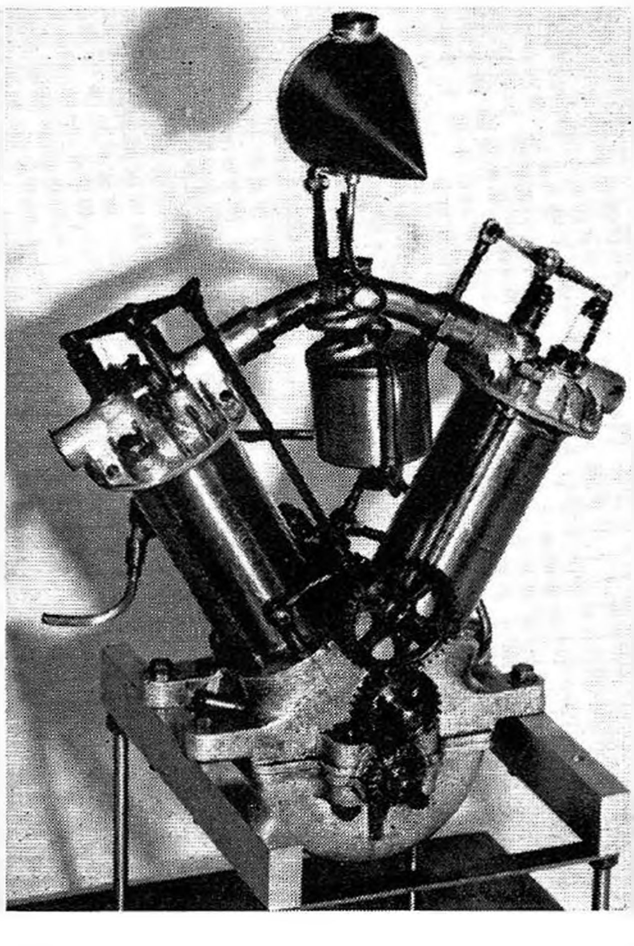
Up to this time, the spark plugs, ignition equipment and accumulator were all made by Mr. Stanger, no mean feat in itself.

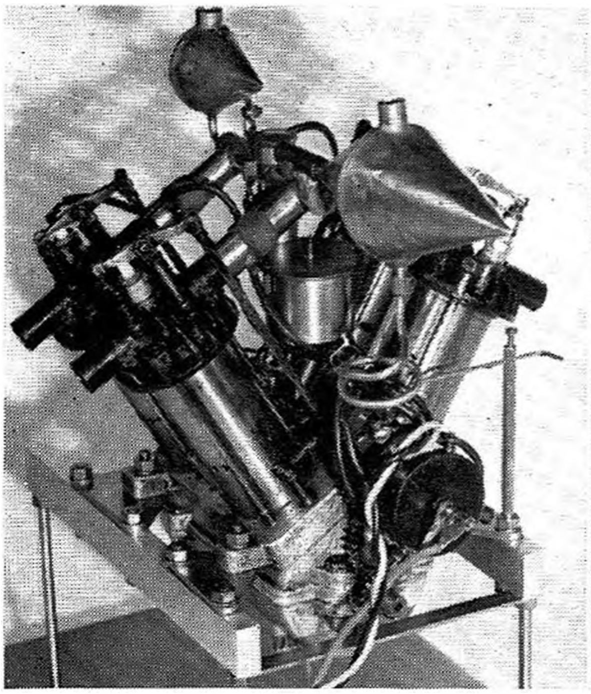
Several single cylinder air-cooled two-stroke petrol engines were built during the mid-1920s. Included in this series was one of about 1 c.c. capacity which ran very well indeed. This engine was only surpassed in size and efficiency when the small commercially built diesel engine appeared in the 1950s. During

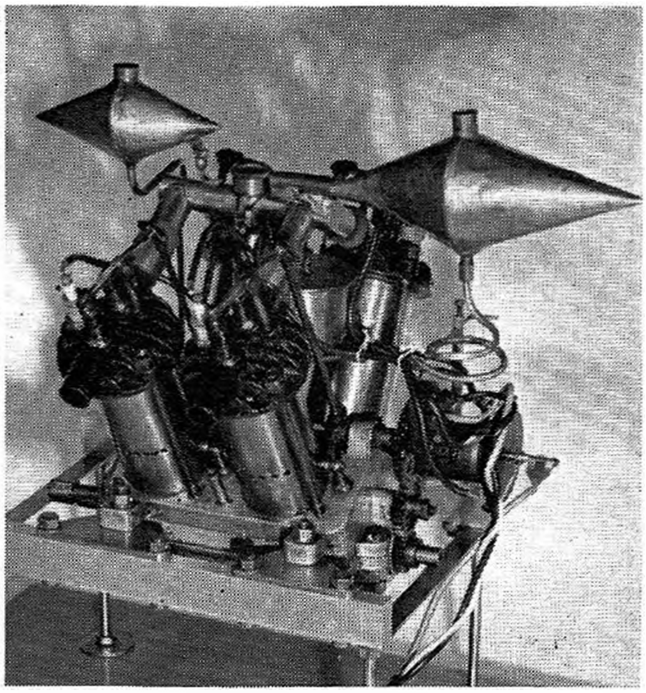
Twin cylinder 4-stroke of 1¼" bore, 1⅜" stroke designed in 1912, made in 1913, air cooled and fitted in Canard biplane to create world's first petrol driven model duration record.



Rear view, same Vee/twin engine. Weighed 2¾ lb., drove 18 in. pitch prop, 22 in. diameter, flying a 10¾ lb. model at 2000 r.p.m.! Has automatic inlet, and mechanical exhaust valves.







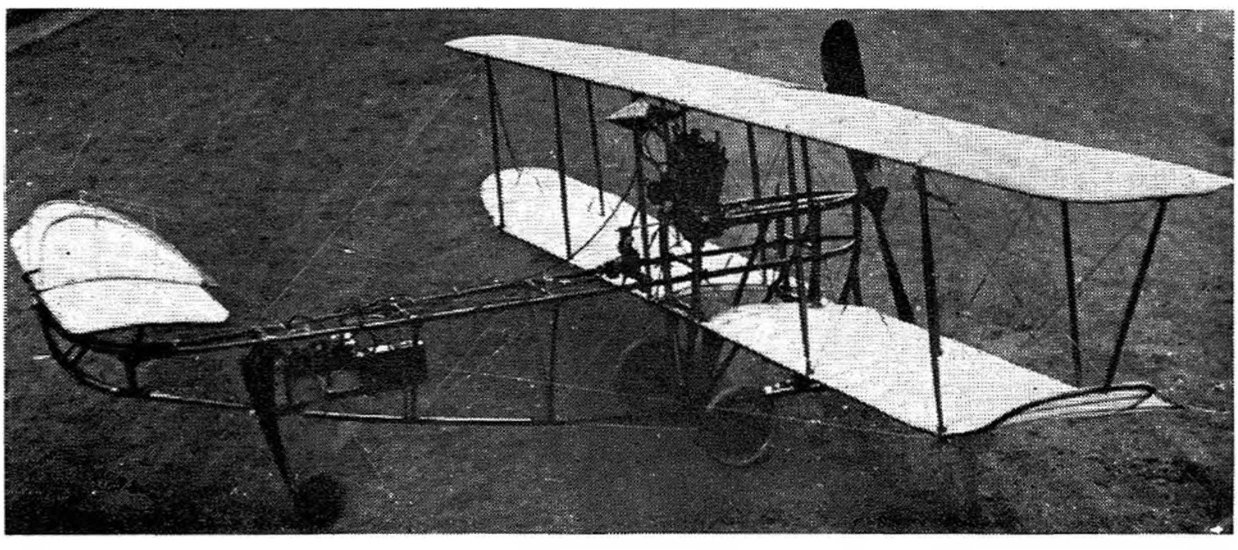
Two views of remarkable Stanger 1908, 4-cycle, 4-stroke, 1½ h.p. at 1,300 r.p.m. on 28 in. dia. prop!

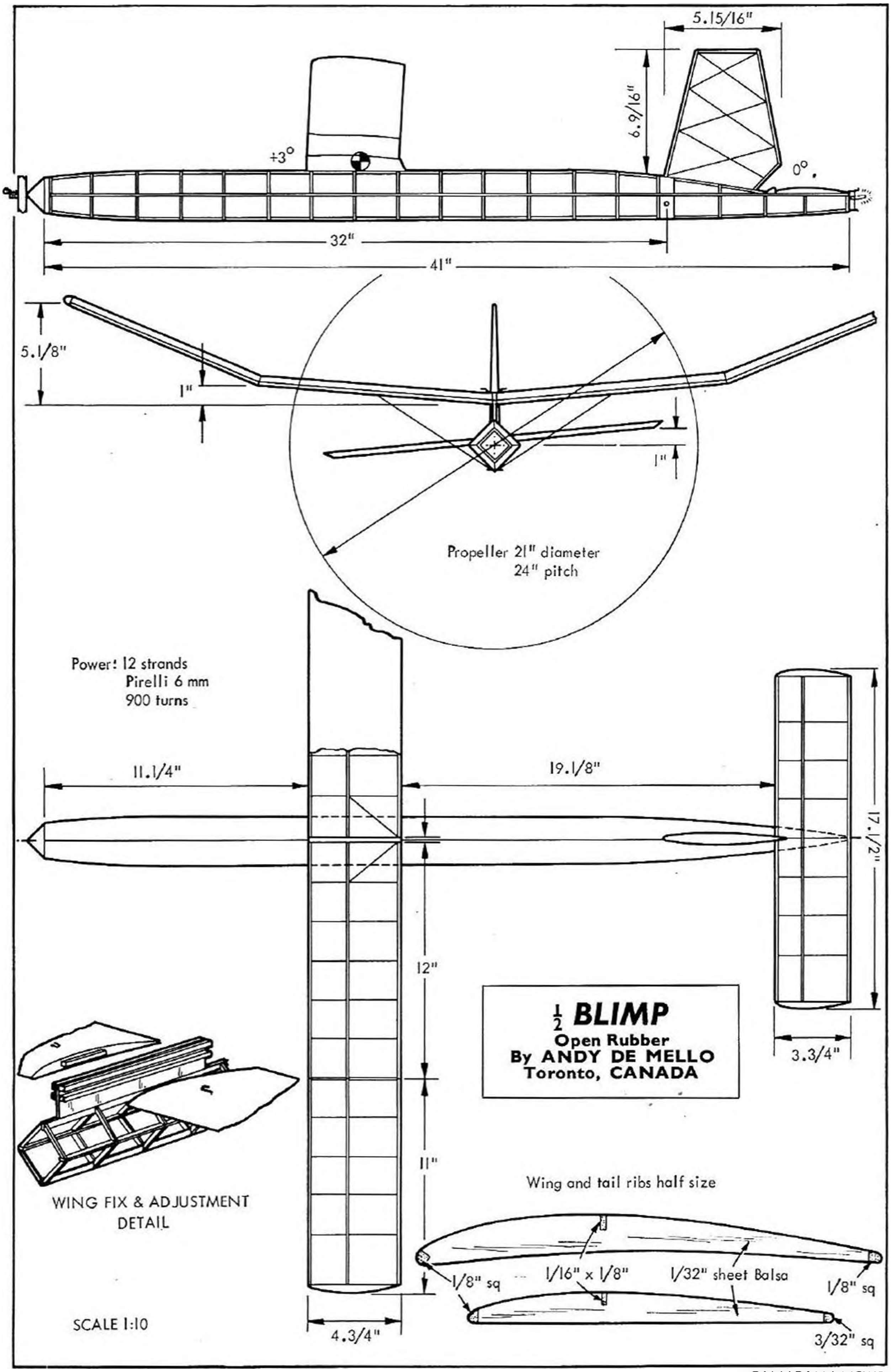
Canard biplane below, first petrol engined model to fly successfully for any duration, created a record in 1914.

this period several model biplanes and monoplanes were designed and built. The biplanes no doubt influenced other builders.

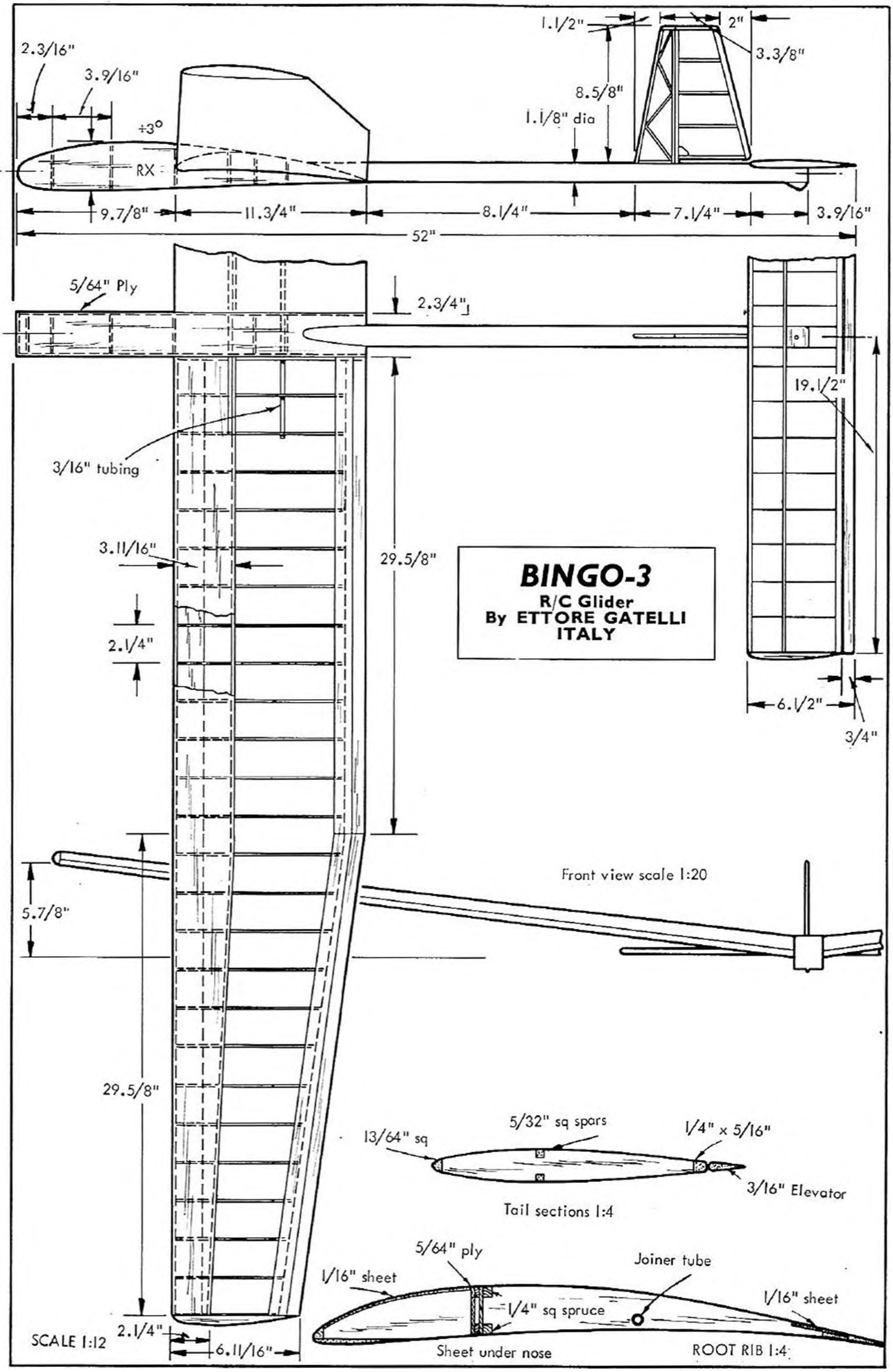
Mr. Stanger had other engineering interests. In 1901 he built his own motor car, which was well in advance of its day. In about 1920 he built a 5 h.p. two-stroke motorcycle which was used extensively and most successfully on trials. Further evidence of his versatility is the set of dining chairs still in use today. There is also in existence a beautifully proportioned aluminium statuette, which amply demonstrates his outstanding command of moulding and casting techniques. He constructed his own screw-cutting lathe by means of which his engines were built, his own micrometer (used by Mr. John Stanger until his retirement in 1958), protractor, iron plane, and most of the tools for his work.

The foregoing has been written so that the achievements of David Stanger may be properly recognised and made more widely known. He was a pioneer whose creations were enormously successful, and were due entirely to his own efforts, working from basic principles.



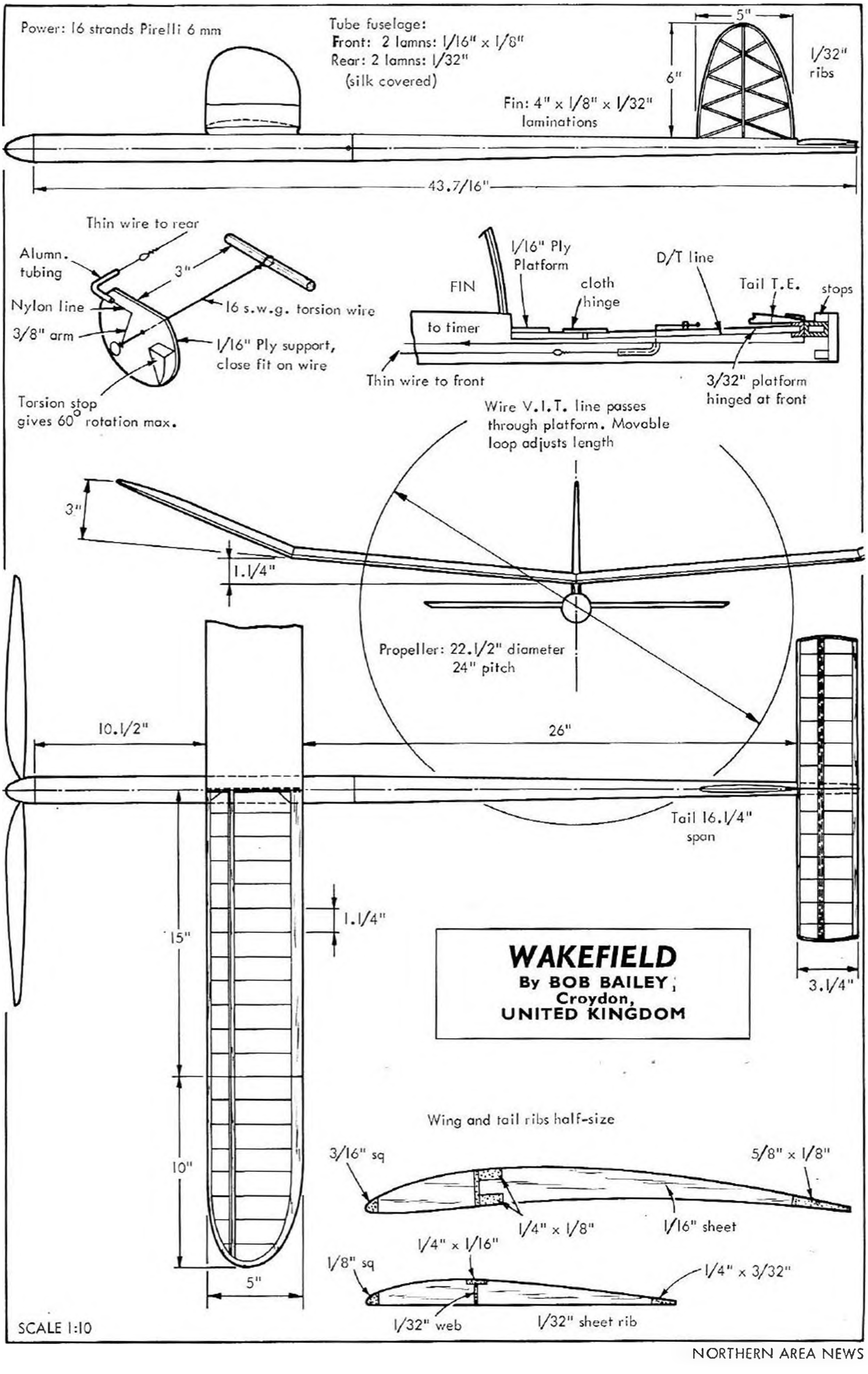


CANADIAN NEWS

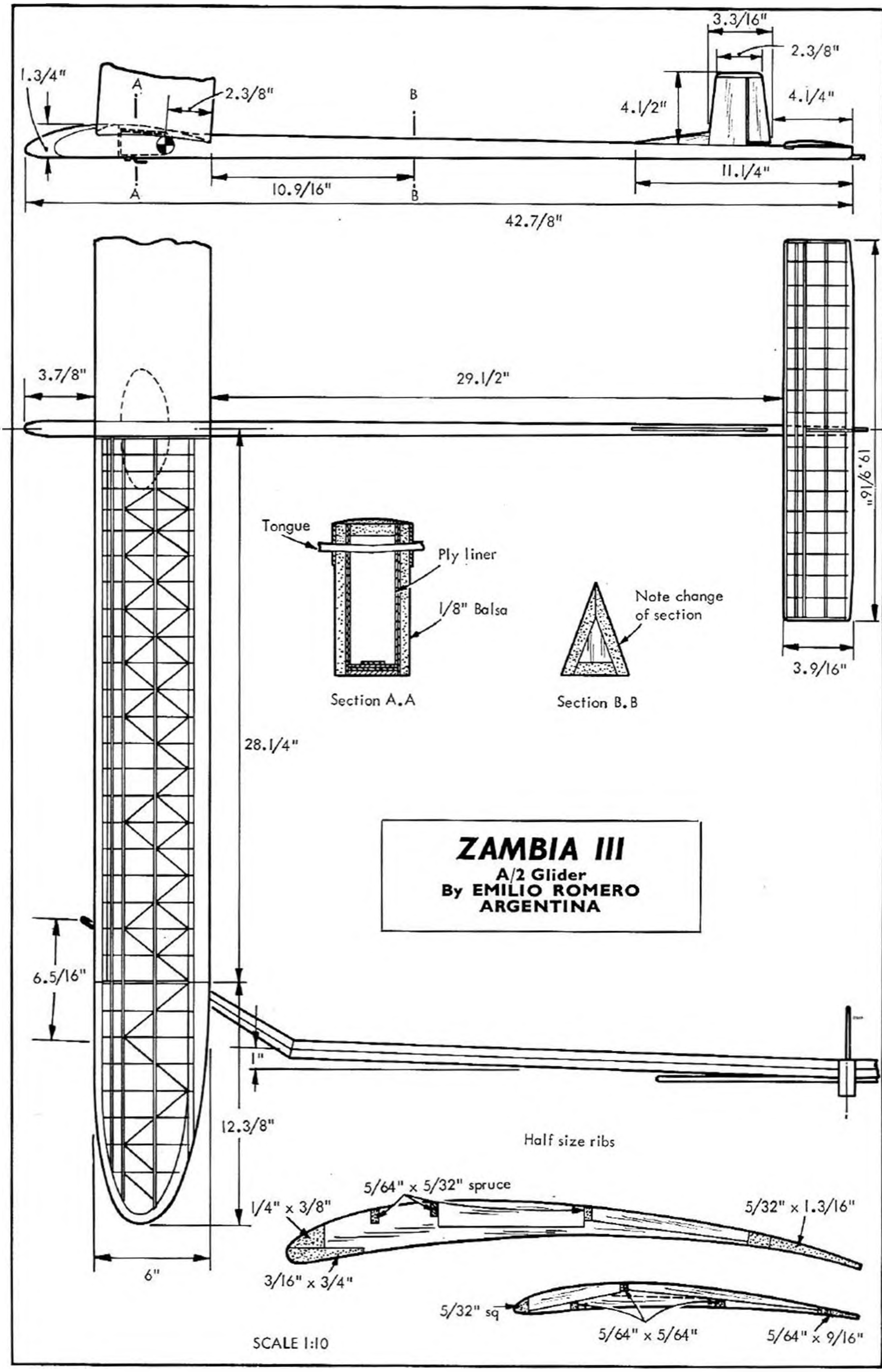


BINGO-3
R/C Glider
By ETTORE GATELLI
ITALY
2.3/16"
3.9/16"
+3°
RX
1.1/2"
2"
3.3/8"
8.5/8"
1.1/8" dia
9.7/8"
11.3/4"
8.1/4"
7.1/4"
3.9/16"
52"
5/64" Ply
2.3/4"
19.1/2"
3/16" tubing
3.11/16"
29.5/8"
2.1/4"
6.1/2"
3/4"
Front view scale 1:20
5.7/8"
29.5/8"
13/64" sq
5/32" sq spars
1/4" x 5/16"
3/16" Elevator
Tail sections 1:4
5/64" ply
1/16" sheet
Joiner tube
1/4" sq spruce
1/16" sheet
Sheet under nose
ROOT RIB 1:4
SCALE 1:12
2.1/4"
6.11/16"

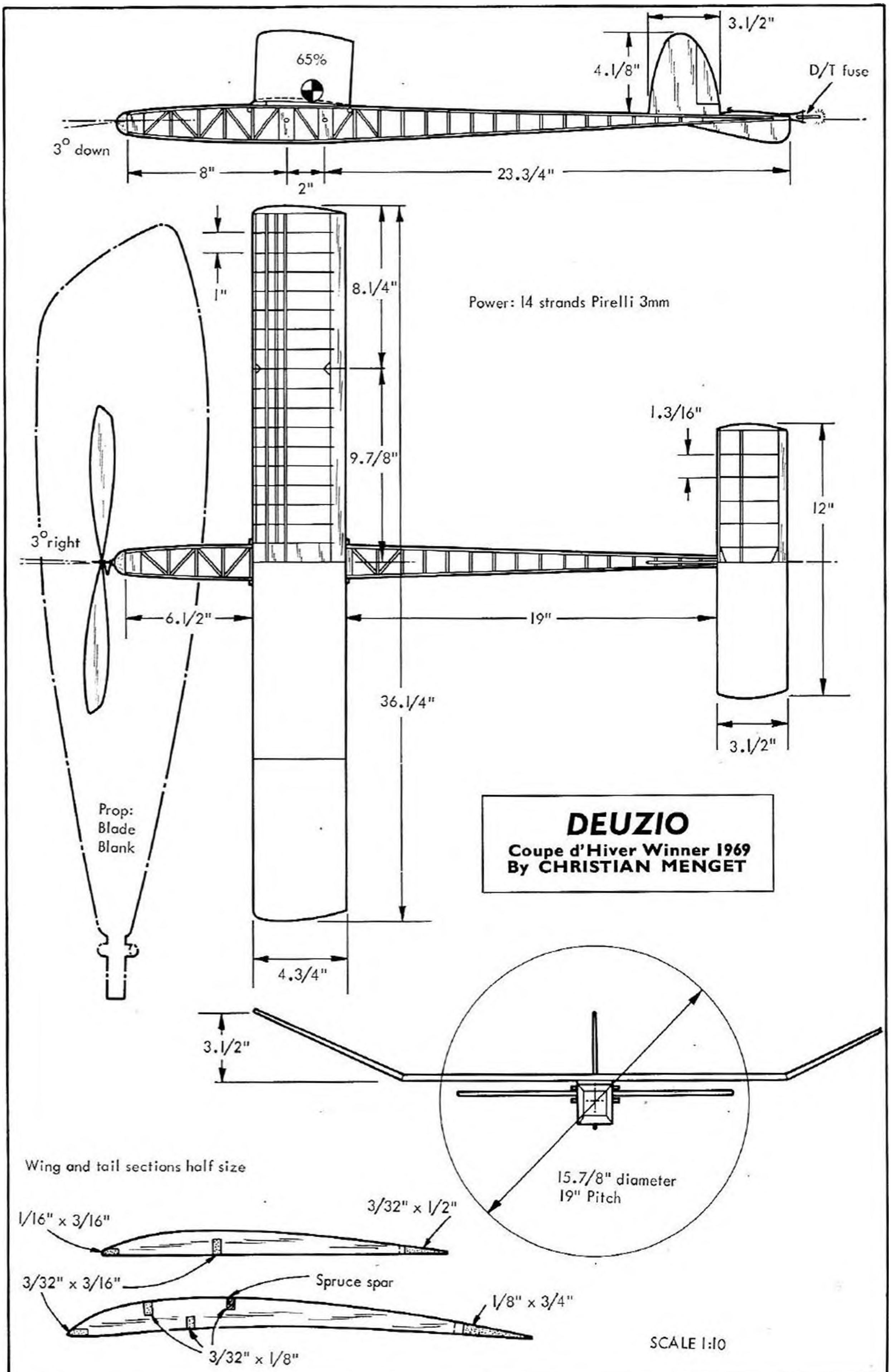
MODELLI



NORTHERN AREA NEWS

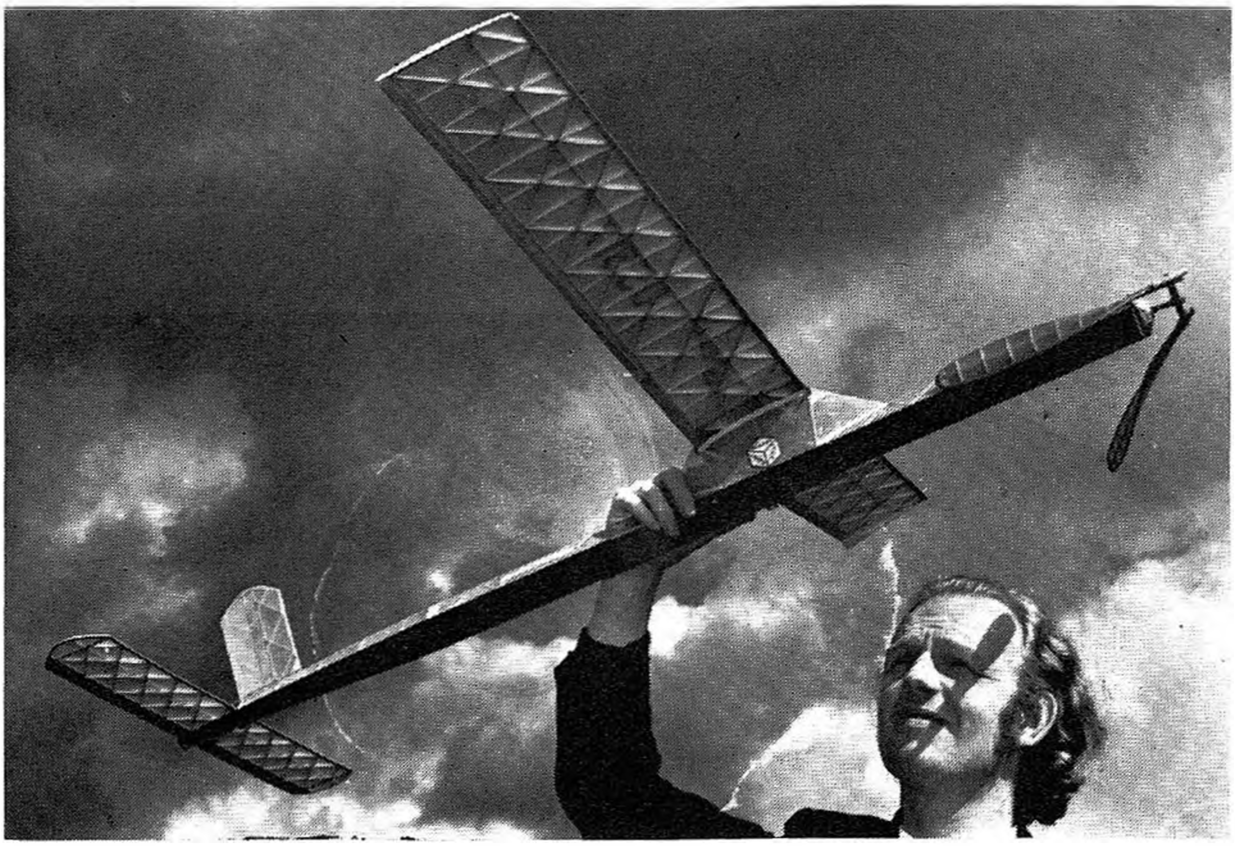


SPORT MODELLISMO



3.1/2"
4.1/8"
65%
D/T fuse
3° down
8"
2"
23.3/4"
1"
8.1/4"
Power: 14 strands Pirelli 3mm
1.3/16"
9.7/8"
12"
3° right
6.1/2"
19"
36.1/4"
3.1/2"
Prop: Blade Blank
DEUZIO
Coupe d'Hiver Winner 1969
By CHRISTIAN MENGET
4.3/4"
3.1/2"
Wing and tail sections half size
15.7/8" diameter
19" Pitch
3/32" x 1/2"
1/16" x 3/16"
3/32" x 3/16"
Spruce spar
1/8" x 3/4"
3/32" x 1/8"
SCALE 1:10

MODELE



CONTEST MODEL PERFORMANCE PREDICTION

by P. Beer

Summary

SIMPLE formulae have been empirically derived which provide good prediction of performance achievable with modern contest models. The effect of sinking speed is clearly shown. The resulting predictions obtained are in good agreement with practice. Conclusions are drawn pointing to possible improvements.

Symbols

CL	lift coefficients of airfoil section
E	energy stored in wound rubber motor (lb./ft.)
wr	weight of rubber motor
wa	weight of airframe
w	weight of model (oz.)
ehm	energy height of model (ft.)
U	sinking speed (ft./sec.)
V	gliding speed (ft./sec.)
W	area loading (oz./100 sq. in.)
t	engine or motor run (sec.)
d	propeller diameter (in.)
r	radius of inactive portion of propeller
ST	total flying surface area (sq. in.)
q	"fiddle factor" for power props: 0.6 app. for nylon props; 0.8 app. for shop bought wooden props
x	"fiddle factor" for rubber props: 0.8 app. for carved wood props; 0.9 app. for laminated/built-up props; 1.0 app. for variable pitch props
y	"fiddle factor" for rubber models: t/120 for open models; t/25 for Wakefield models; t/20 for Coupe d'Hiver models
z	"pusher factor": 1.6 app. when airframe clear of slipstream; 1.0 for tractors

Glide

The key to high performance lies in the glide. The best obtainable glide performance presently known is given by A/2 gliders. Maximum still air time appears to be 160 sec., which, allowing for 8 ft. stretch from the pilot giving 172 ft. altitude, indicates a sinking speed of 1·05 ft./sec. It is doubtful that either power or rubber models, both of which tend to have high parasitic drag, can improve on this.

Gliding and Sinking Speeds

Gliding speed V can be estimated from:

$$V = 8{\cdot}65\sqrt{\frac{W}{CL}}$$

A plot is given for CL = 1, obtainable from most airfoils, and 1·4 is possible from sections such as Eppler E58.

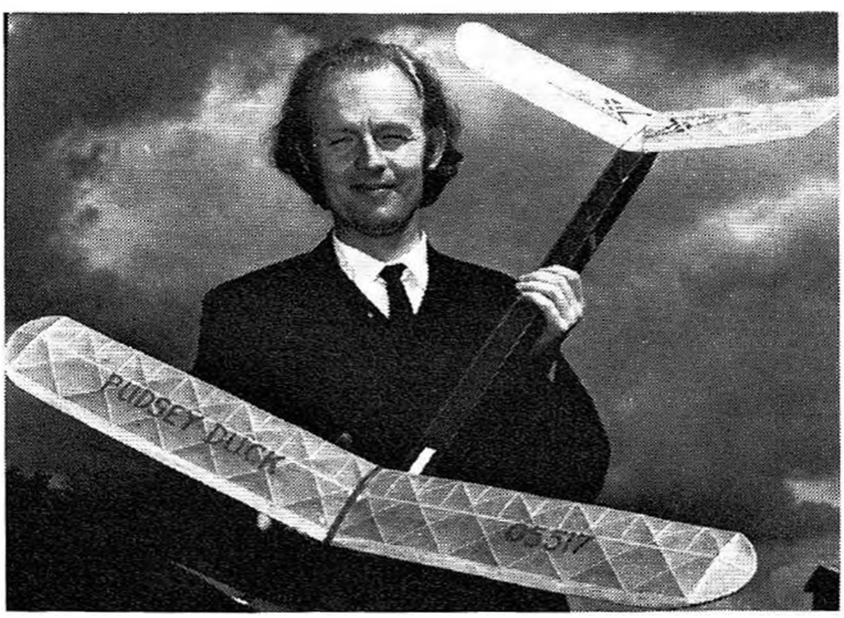
Sinking speed U tends to be incalculable and is best obtained by towing to a known height and timing several glides. (The results of such an exercise can be very demoralising—especially with power models.)

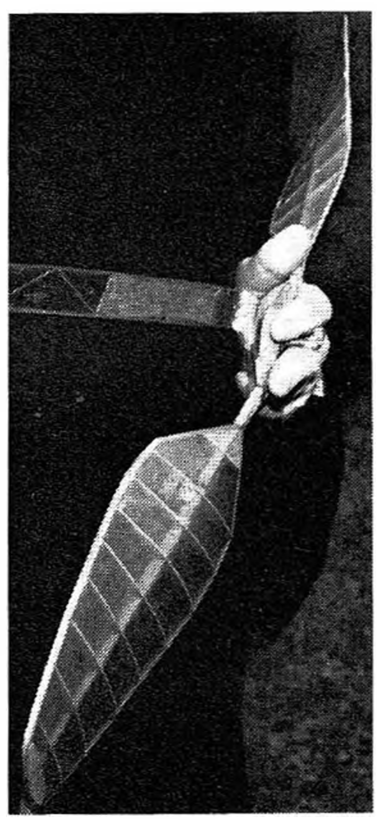
It will be noticed that the factor U/V appears in the equations following; the relationship between lift/drag ratio and U,V, is as follows: lift/drag ratio $= \frac{U}{\sqrt{V^2 - U^2}}$. This is very close to U/V when this factor is 1/10 or smaller.

Energy Height

The two methods of gaining altitude by mechanical means are distinctly different. The energy required to lift a rubber model is wound into it before the model leaves the ground and is released in an exponential manner, whilst a

Opposite, Author shows "Union Jack" type structure on surface of his lightweight design, with built-up folding propeller. Below, his "Pudsey Duck" canard pusher and right, close-up of "Unipitch" built-up folding propeller. Red-head Peter Beer has been engaged in this private research into measurement of performance for three years.





Selection of Peter Beer's props at left includes balsa one for pusher and two built up tractor types.

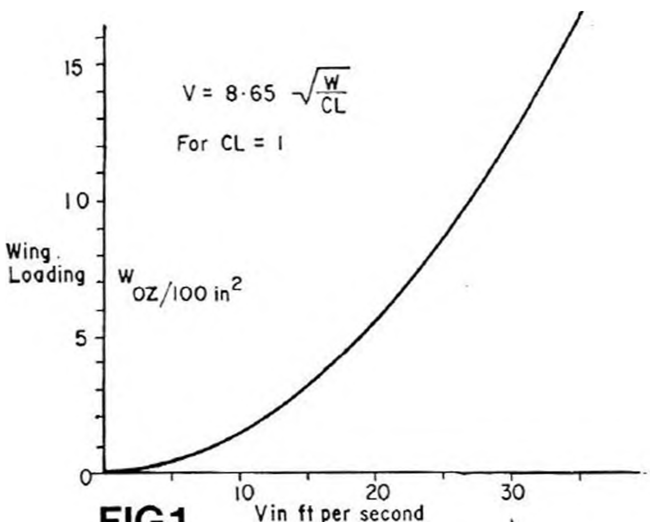


FIG1

Three figures to emphasis the author's controversia views on model performanc prediction. Factors x, w, y, in formulae are criticall decisive.

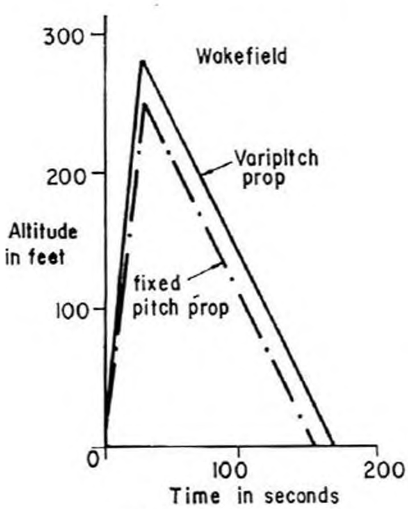


FIG 2

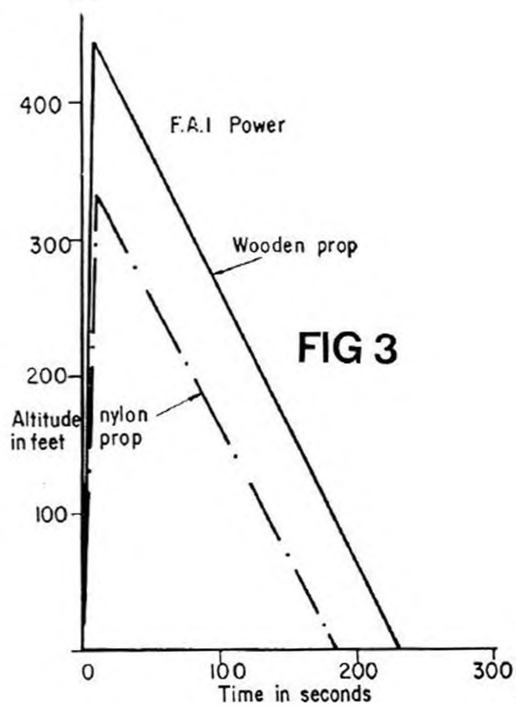
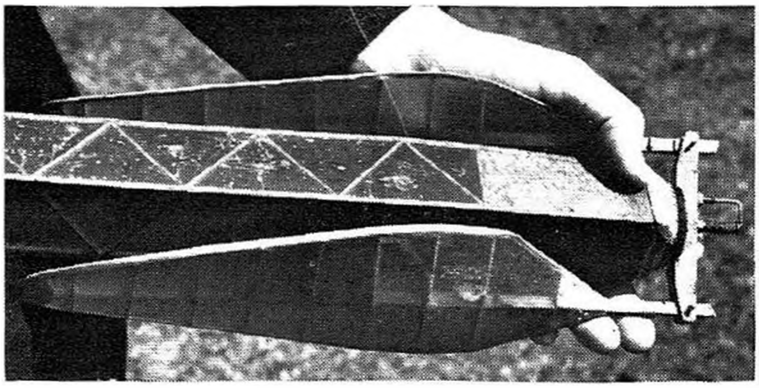
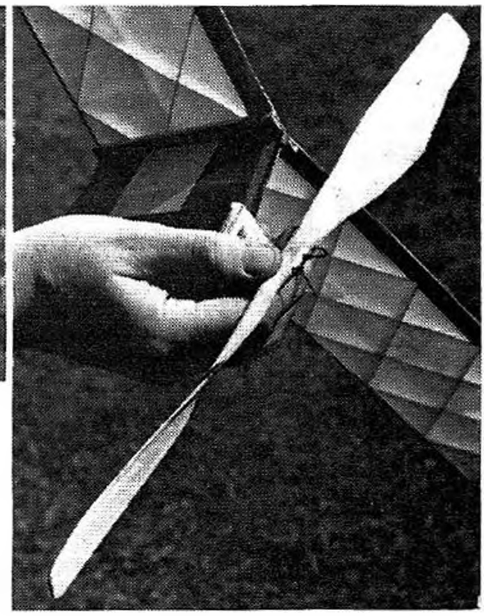


FIG 3





Built up prop for "Tinibini" folded against fuselage sides. Note twist in blades from root to tip. At right is the Canard pusher "Pudsey Duck" propeller non-folding and freewheeling.

power model manufactures its energy as it climbs in a linear manner. Both methods are of variable quality and dependent on atmospheric conditions to some extent, i.e., the energy storable in a rubber motor is proportional to the absolute temperature in the ratio $\frac{273+T}{273}$ (where T is the temperature in degrees Centigrade), whereas the energy manufactured by a power model is inversely proportional to the absolute temperature in the ratio 273/273+T.

If E be the energy stored in a rubber motor, then the height to which it will lift its own weight is E/wr. For average rubber wound to 90% of breaking turns E/wr is 3,300 ft.

It therefore follows that the energy height of the model

$$\text{ehm} = E/\text{wr}+\text{wa}$$

$$\text{ehm}(\text{wr}+\text{wa}) = E$$

$$\text{ehm}(1+\text{wr}/\text{wa}) = E/\text{wr} = 3{,}300 \text{ ft.} \qquad \text{dividing by wr}$$

so that

$$\text{ehm} = \frac{3{,}300}{1+\frac{\text{wa}}{\text{wr}}} \text{ ft.}$$

For power models $\text{ehm} = 8{,}800\cdot\frac{\text{b.h.p.}}{\text{w}}\cdot t$ ft.

Practical Height

The practical height achievable is basically dependent on the propeller disc loading modified by the U/V ratio:

For rubber models, the energy conversion factor.

$$\text{ECF} = \frac{d^2-4r^2}{4ST}\cdot(1-U/V)x\cdot y\cdot z \text{ ft.}$$

Hence the practical height for rubber driven models is:

$$\frac{3{,}300}{1+\frac{wa}{wr}}\cdot\frac{d^2-4r^2}{4ST}\cdot(1-U/V)x\cdot y\cdot z\text{ ft.}$$

And for power models:

$$ECF=\frac{\sqrt{w}}{b.h.p.}\cdot\frac{d^2}{16\cdot 8}\cdot(1-U/V)q\cdot z$$

Thus the practical height is:

$$\frac{8{,}800}{\sqrt{w}}\cdot\frac{d^2}{16\cdot 8}\cdot t\cdot(1-U/V)q\cdot z$$

Climbing Angles

Theoretical derivation of climbing angle is possible but tedious and liable to error due to lack of precise information. Practical experiment is quicker and more productive of success. However, some guidance can be given.

Propeller efficiency for a given disc loading is dependent on throughput of air—the greater the better. In a vertical climb, the propeller has not only to lift the weight of the model but to overcome the effects of the slipstream on the fuselage, causing high drag force. (Slipstream velocity increases and propeller efficiency decreases as the model slows down.) So unless the velocity along the thrustline is at least five times the gliding speed an oblique climb is more productive of altitude. With power the method is simple, provided the timers are reliable, by allowing about five seconds or so for the model to settle down at the end of the climb, operating the dethermaliser, and timing the descent. A variable incidence tailplane will be invaluable for this. Rubber models are a vastly more difficult proposition and the best advice is to avoid power stalls—just! Nevertheless an initial angle of about 50 degrees to the horizontal is best.

Finally, for both F.A.I. power and Wakefield a hearty bung at launch can be worth up to 15 seconds, as less power need be expended accelerating the model to climbing speed.

Aids to Better Performance

For models with restricted rubber content the following points should be borne in mind:

1. Variable pitch propellers are essential and are much simpler to make than recent literature might suggest.

2. Motor runs should be adjusted so that the model climbs all the way: Towards this end:

3. Freewheeling folders with fully counterbalanced blades obviating CG shift from glide trim will assist and prevent the loss of altitude associated with other methods at end of climb.

4. Torque-controlled variable incidence tailplanes (*not* tension controlled) will help with the initial climb. Note that it is doubtful whether any of these methods are suitable for Open models due to the weight penalty.

5. Use laminated or built-up blades with flat-bottomed or minimal undercambered sections for best overall speed performance (the old Clark Y is an excellent choice).

For all types of models:

6. Avoid differential twisting of the wing. This definitely deteriorates glide performance.

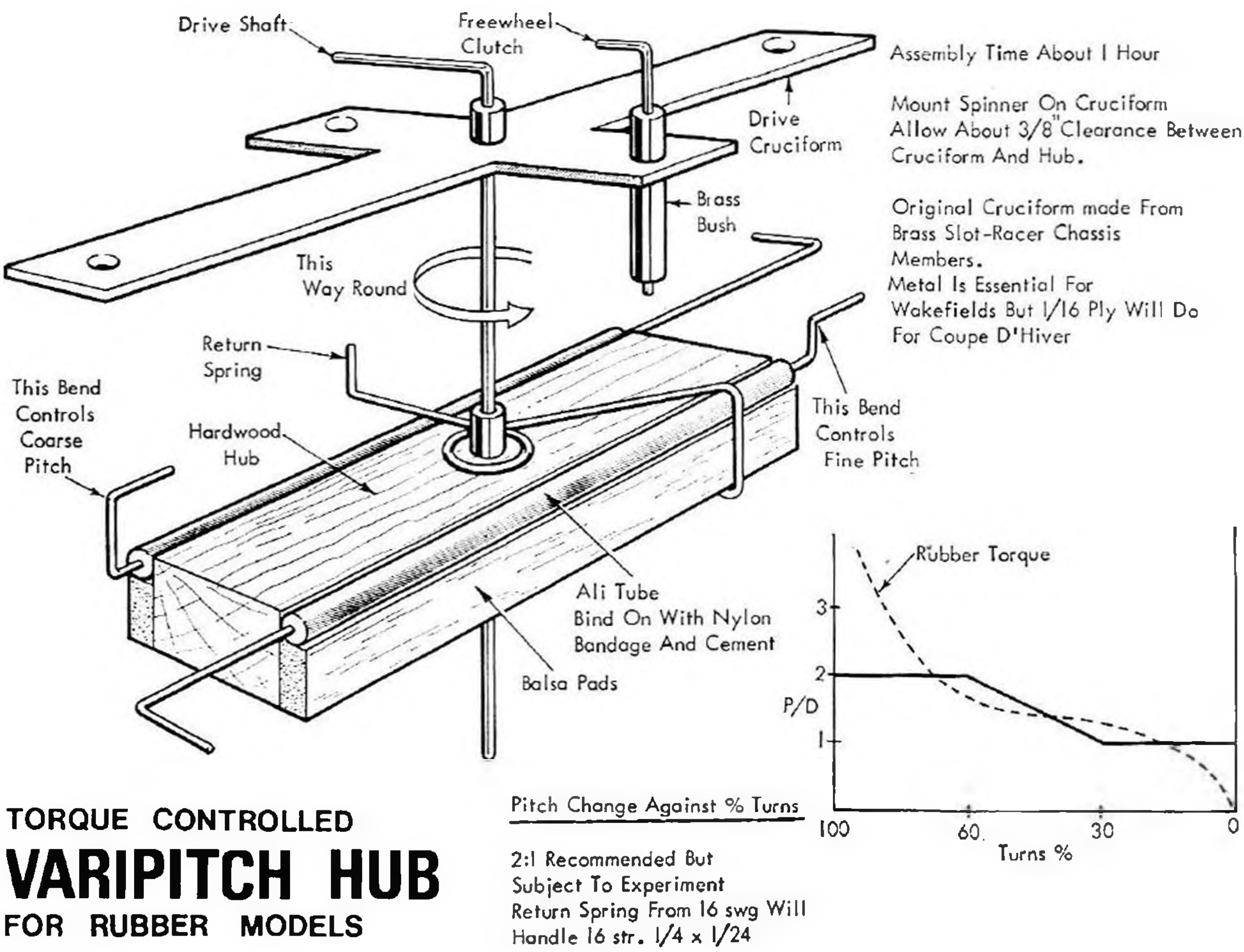
7. Use structures which are resistant to deformation due to aerodynamic forces, temperature and humidity changes. "Union Jack"-type structures are quite good in this respect but full geodetic are much superior.

The effects of humidity changes can be minimised by sealing the covering with banana oil. It may not be generally realised that this substance provides the best protection against the ingress of water vapour known, being at least twice as good as epoxy resins and very much better than any polyurethane formulation.

8. It is the writer's opinion that non-helical pitch propellers offer better performance than true helical. A very interesting experiment would be to use the 8×3 n.h.p. propeller designed by P. R. Payne for the E.D. Competition Special and published by *Aeromodeller* some time during 1949 on an F.A.I. model powered by a Super Tigre.

9. For F.A.I. power models in particular, it would seem essential to use an airfoil section which maintains a low profile drag at small angles of attack. Most do not. Flat bottom sections tend to be short of lift. However, a slope soaring section such as the Eppler 387 would fit the bill nicely.

10. The use of one of the very good 2·5 c.c. diesels at present available should result in improvements in duration as they are able to swing a larger diameter propeller than the very high revving glow motors which are so popular.



Sample Calculations

Wakefield:

CL	1·0	
wr	40 gm.	
wa	190 gm.	
U	2 ft./sec.	
V	16 ft./sec.	
t	30 sec.	
d	24 in.	
r	3 in.	
ST	290 sq. in.	
w	8·1 oz.	
x1	0·9	unipitch (fixed pitch) prop
x2	1·0	varipitch prop

$$\text{ehm} = \frac{3{,}300}{1+\frac{190}{40}} = \frac{3{,}300}{5{\cdot}75} = 574 \text{ ft.}$$

$$\text{ECF} = \frac{24\times 24-36}{4\times 290}\,(1-\tfrac{1}{8})\cdot\frac{30}{25}\cdot \text{x}$$

$$= 0{\cdot}465\times\tfrac{7}{8}\times 30/25\cdot \text{x}$$

$$= 0{\cdot}487\text{q}$$

practical height, x = 1: 574×0·487 = 280 ft., duration = 30+140 sec. = 2 min. 50 seconds.

practical height, x = 0·9: 574×0·487×0·9 = 252 ft., duration = 30+126 sec. = 2 min 36 seconds..

F.A.I. power

CL	1·0	
w	26·5 oz.	
U	2 ft./sec.	
V	21 ft./sec.	
t	9·5 sec.	
d	8 in.	
q1	0·6	nylon prop
q2	0·8	wooden prop

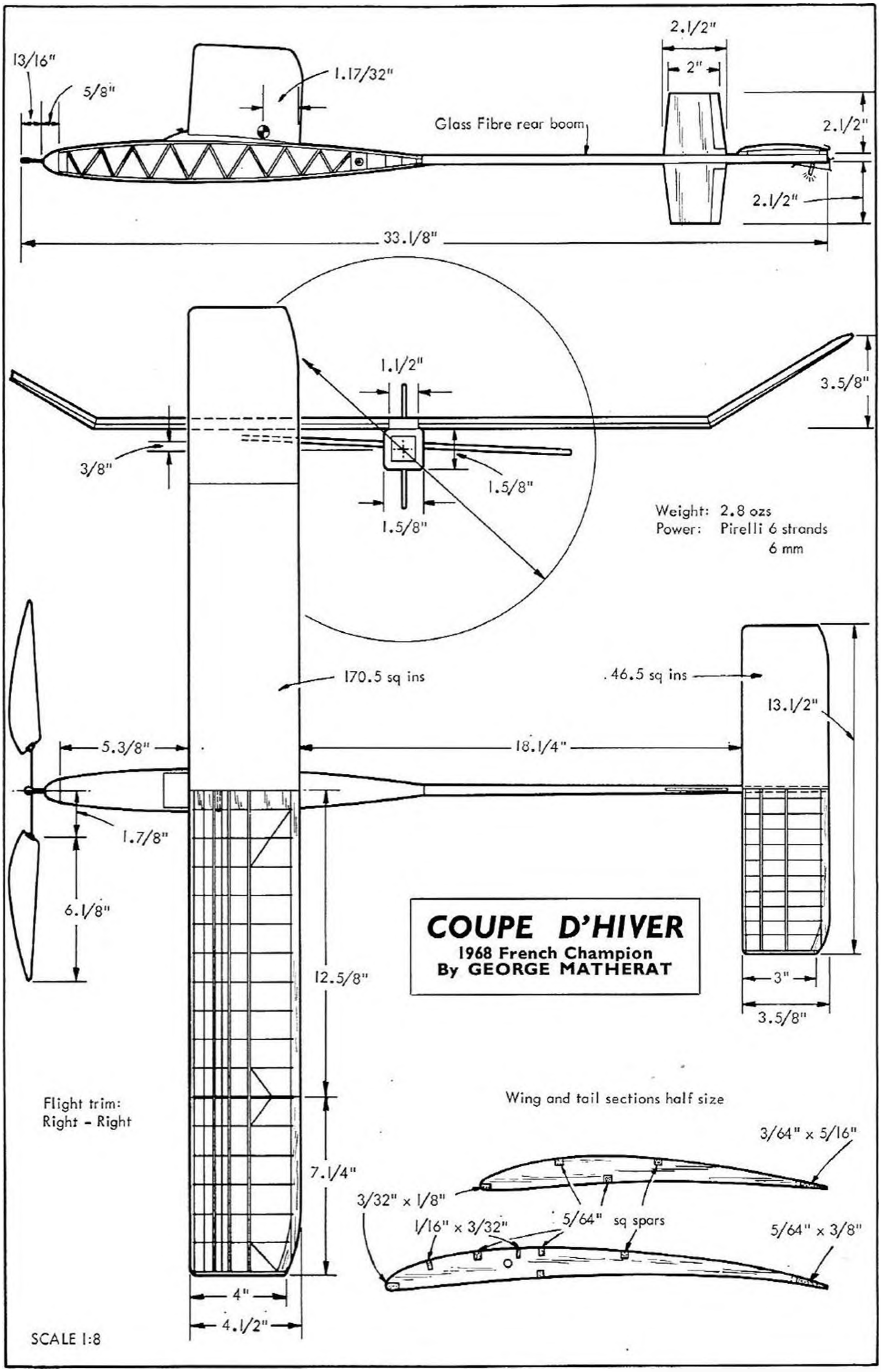
$$\text{ehm} = \frac{8{,}800\times 0{\cdot}7\times 9{\cdot}5}{26{\cdot}5} = 2{,}200 \text{ ft.}$$

$$\text{ECF} = \frac{5{\cdot}15}{0{\cdot}7}\times\frac{64}{16{\cdot}8}\times(1-\frac{2}{21})\cdot \text{q} = 0{\cdot}2539$$

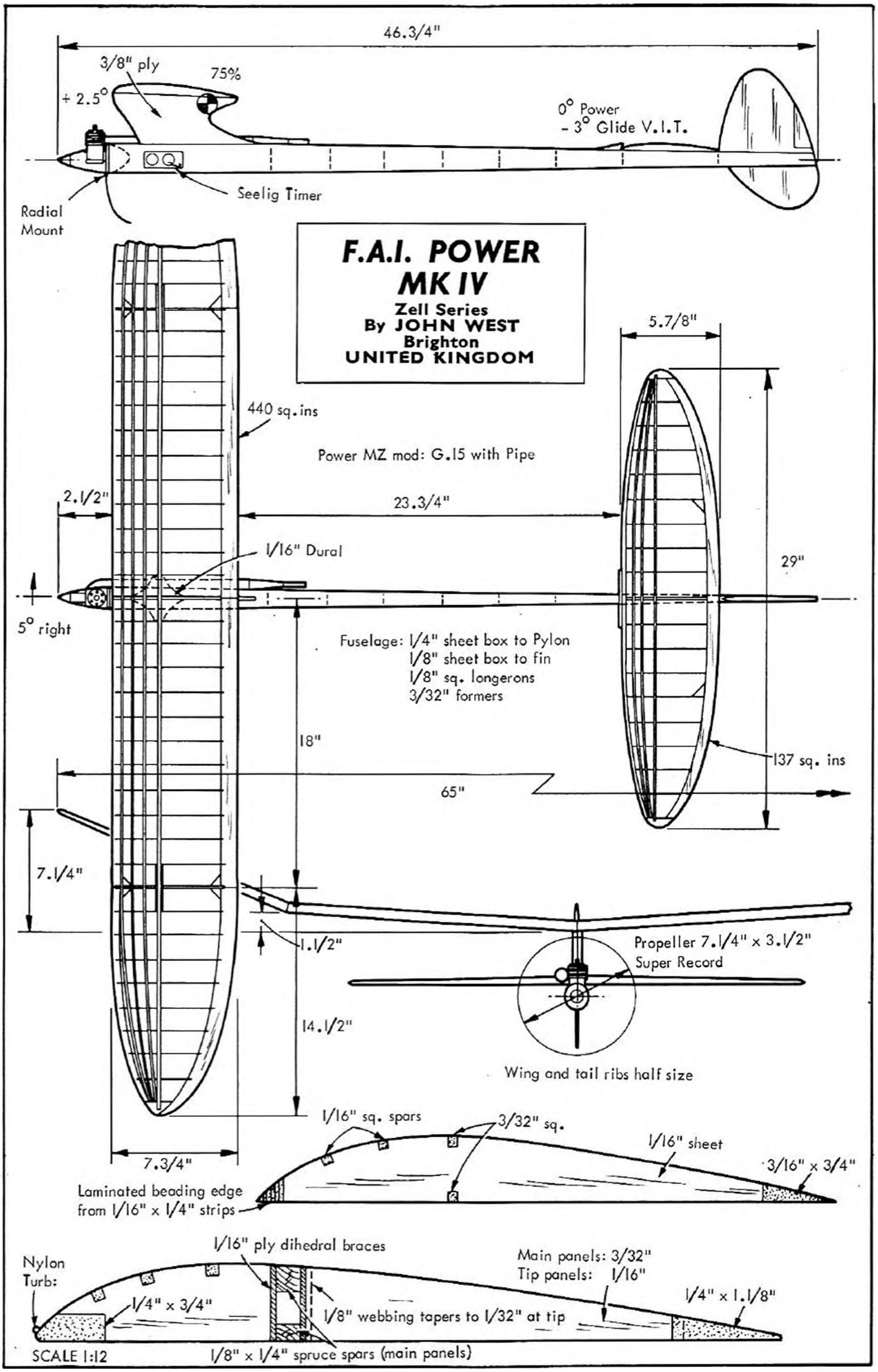
practical height, q = 0·6: 2,200×0·253×0·6 = 334 ft., duration = 9·5+167 = 2 min. 56.5 seconds.

practical height, q = 0·6: 2,200×0·253×0·8 = 444 ft., duration = 9·5+222 = 3 min. 52 seconds.

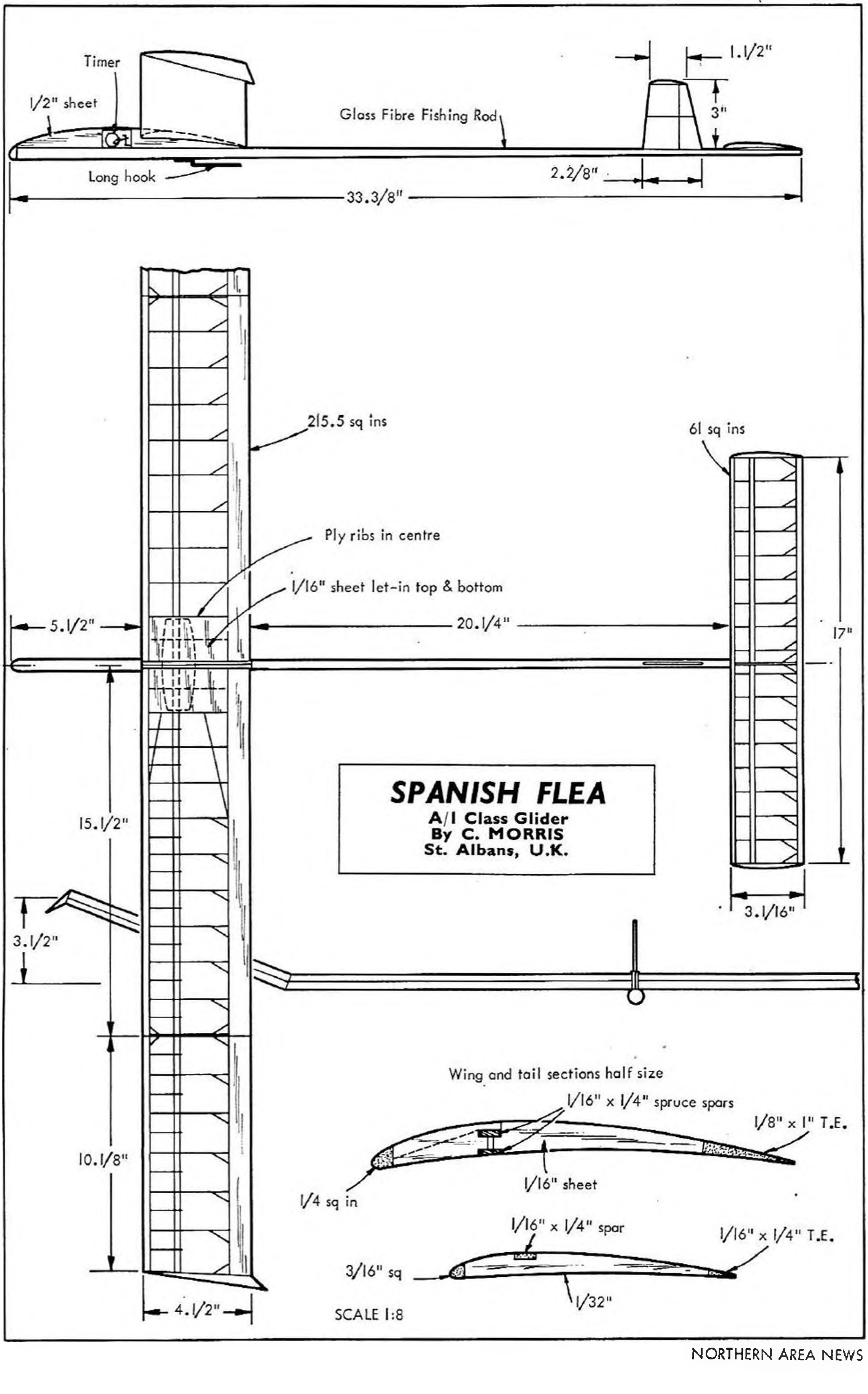
(WHICH ONLY GOES TO SHOW ONE CAN PROVE *ANYTHING* WITH FIGURES—Ed.)



LE MODELE REDUIT D'AVION

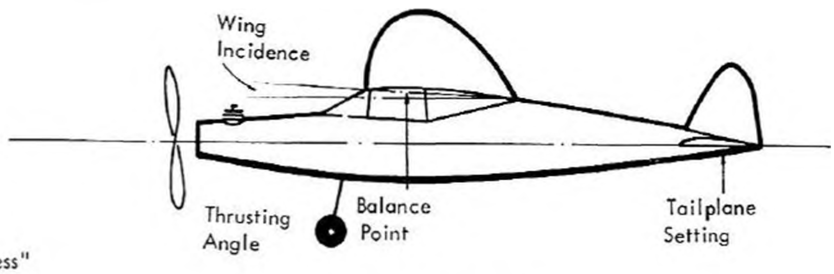

46.3/4"
3/8" ply
75%
+ 2.5°
0° Power
- 3° Glide V.I.T.
Seelig Timer
Radial Mount
F.A.I. POWER
MK IV
Zell Series
By JOHN WEST
Brighton
UNITED KINGDOM
5.7/8"
440 sq. ins
Power MZ mod: G.15 with Pipe
2.1/2"
23.3/4"
1/16" Dural
29"
5° right
Fuselage: 1/4" sheet box to Pylon
1/8" sheet box to fin
1/8" sq. longerons
3/32" formers
18"
137 sq. ins
65"
7.1/4"
1.1/2"
Propeller 7.1/4" x 3.1/2"
Super Record
14.1/2"
Wing and tail ribs half size
1/16" sq. spars
3/32" sq.
1/16" sheet
3/16" x 3/4"
7.3/4"
Laminated beading edge from 1/16" x 1/4" strips
1/16" ply dihedral braces
Main panels: 3/32"
Tip panels: 1/16"
Nylon Turb:
1/4" x 3/4"
1/4" x 1.1/8"
1/8" webbing tapers to 1/32" at tip
SCALE 1:12
1/8" x 1/4" spruce spars (main panels)

SEADOG

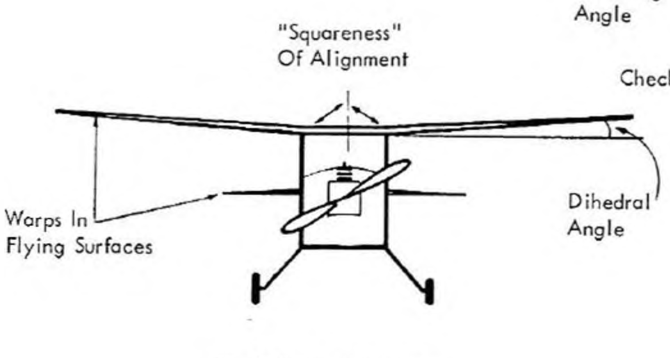


SPANISH FLEA

A/1 Class Glider
By C. MORRIS
St. Albans, U.K.



Check These Points As Per Plan



Check These Points Also.

BEGINNERS ONLY, PLEASE

by L. Ranson

Often when I see a beginner's model paraded on the local common I say to myself, "Here is a model that could do with a spot of trim, if not a short back and sides". And I don't always mean the surplus bits of tissue left hanging about; rather am I thinking of the model's performance, or rather lack of it.

Now I don't blame the beginner for his chuck-it-and-hope philosophy. After all, who ever heard of a model plane that didn't fly? Certainly none of the comic characters encounter any difficulty. Porky the Pig and Sammy the Skunk enjoy the most advanced aerobatic sorties over jam tart teas without lifting so much as a finger, even if they had one. But be warned! The model plane is a three-dimensional animal, capable of an infinite variety of maladjusted manoeuvres. If you do wish to suspend it in mid-air with only the support you build into it you need to know a few magic tricks.

One not so magic, but very important trick, is to secure the flying surfaces to the fuselage with something more than one timorous rubber band. If you want to keep your wing, and tail, in the style they should be accustomed to, try three or four bands together to give a firm, but not disabling tension. It's surprising how many otherwise flyable models are racked to pieces by wobbly wings and teetering tails.

Now to that first flight. Well, forget it, at least for the time being. Instead, try launching the model gently from shoulder height into long grass. Make sure, though, that there are no hidden obstacles—they sometimes object. If you can't get the model to glide in a nice aeroplany sort of way there may be lots of treacherous reasons why, but at least see that you are launching it straight into whatever wind there is, and there shouldn't be much on that first outing, and that you are giving it just the right amount of oomph.

Models have a curious way of coming out nose heavy, and this in spite of the fact that you've done your darnedest to match it up to the balance point shown on the plan. This could be due to leaving too much meat on the propeller blades or jamming an oversize engine on the nose. It could be that the wing

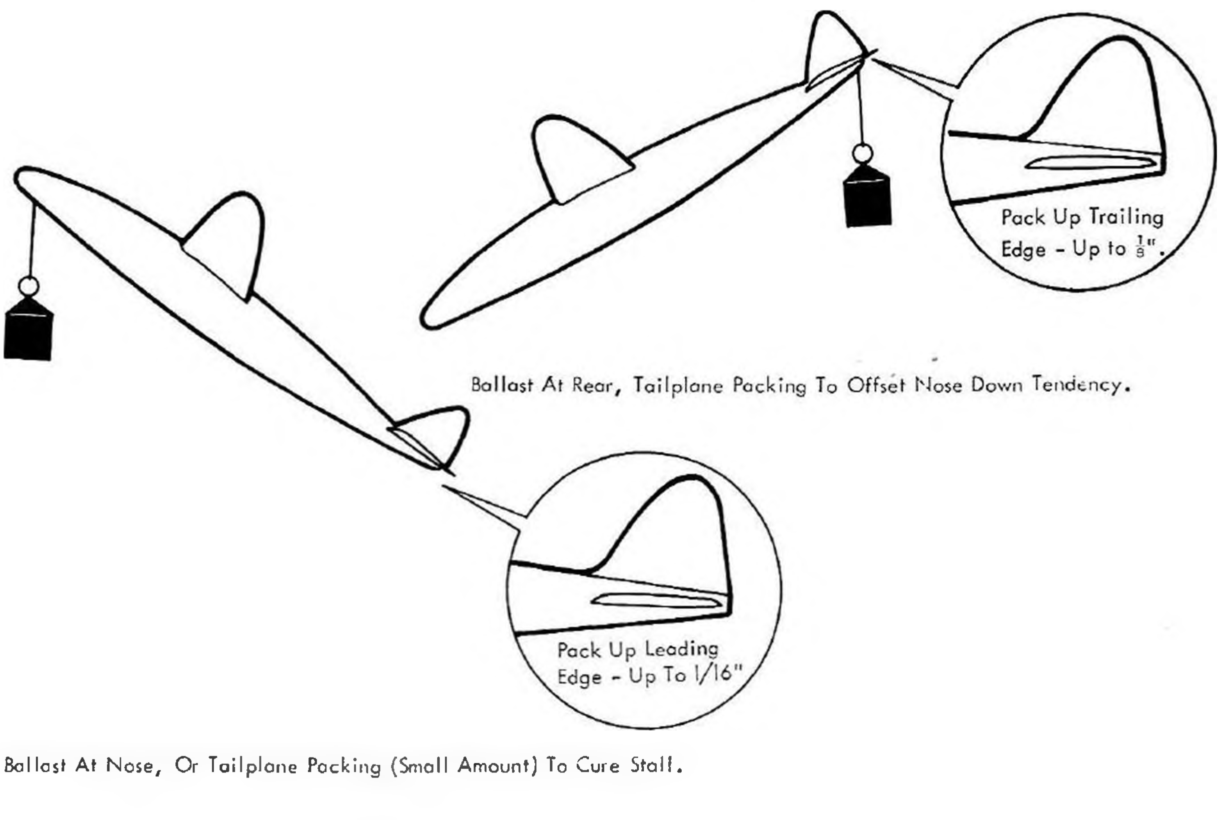
hasn't been rigged to the correct incidence. Most wings require the leading edge to be raised several degrees to give the requisite "angle of attack", whilst tailplanes are generally mounted flat to the fuselage centreline (invariably shown on the plan). If all such systems seem to be at go then the nose must be "elevated" by one fell device or another. Most commonly prescribed is a spot of ballast at the tail end. Plasticene is an ideal corrective.

You may, of course, have built one of those old-fashioned models which allow of wing movement along the fuselage. If so, the remedy is simple: just move the wing forward. By doing this you take the weight off the nose and push it towards the tail. But be warned, none of these adjustments should be too violent; just a little at a time until you get what appears to be a reasonable sort of glide.

If the model doesn't drop its nose down, then you might be sure it will poke it up—it's that sort of perverse world. In this case you reverse the procedure; that is, you move the weight into the nose either by forward ballasting or moving the wing backwards.

Going back to nose-down tendencies for a moment. The biggest weight item on a power model is the engine unit. See that the engine you intend to use is suited to the model. It's no use sticking a 5 c.c. racing engine on to a 30 in. span unless you seriously want to take up ploughing. Even so, an off-balance power model usually requires quite a bit of corrective ballast to get it on an even keel, unless the engine can be moved along the bearers. This is why I don't go much on the stubby sort of sports model sometimes offered to the beginner. The rangy model, with plenty of distance between wing and tailplane, known as "tail moment", is a better bet, easier to balance and safer to fly. Again, short coupled, or stumpy models—and many scale jobs come into this category—don't take too kindly to hand glide tests, and special "expert only" trimming procedures are required for any sort of success.

Back to the hand launch. If you are getting a stall, that is the nose rearing



Ballast At Rear, Tailplane Packing To Offset Nose Down Tendency.

Ballast At Nose, Or Tailplane Packing (Small Amount) To Cure Stall.

up, make sure that it is not due to too hearty a chuck. Correct launching is a matter of feel, acquired only with some practice.

The ups and downs of model flying are not the only things sent to plague us. Quite apart from diving and stalling your model may also veer sharply to right or left. Check, though, that you are launching into wind; a sudden veer may be due to a crosswind launch. If, however, you seem positively to have a nasty inbuilt turn, first check for general alignment and fixity of flying surfaces. And what about warps? Most models finish up with a few slight character forming buckles here and there, but if your wing has the sort of twist you find in a propeller blade I suggest you get off home to a steaming party before going on to the next lesson.

Which way should the model turn, though? Well, it's usual for power models to fly in left-hand circles and rubber powered models in right-hand circles—gliders can please themselves. The type of power model I refer to is, of course, a sports model; beginners are advised to stay well clear of the fiery duration model. The turn to the left is a natural turn, in that it is induced by the airscrew rotation. A right turn under power can be dangerous in that, for inscrutable gyroscopic reasons, a nasty spin can result.

Important thing to note at this point though is the necessity to get as straight a trim on the hand glide as possible. Thus, if your engine is aligned correctly the model should describe a wide, sweeping circle under power. But this is perhaps a sweeping statement; the flight pattern will vary from model to model, and is very much affected by warps which increase in effect with increase in speed. With luck, however, and it is always advisable to take some of this commodity with you, you should get some sort of not-too-destructive flight.

Two very important musts, though, before that first heart-in-mouth power-on launch: get the engine running at half throttle—full power can be disastrous—and see that you only leave a 10–15 second residue of fuel in the tank; there are more beginners' models lost upwards than downwards.

Rubber models do not fly well with torque. There are many reasons why, one being the variable thrust output, from fully wound to the last weak turns, and this means that a right-hand trim is indicated. Models, incidentally, should never be trimmed to fly straight. Apart from anything else it can be very trying on the legs. Given that you have incorporated the requisite amount of side thrust as indicated on the plan a small amount of right veer on hand glide is to be desired. Unless a rubber model does turn under power it will invariably stall, and the amount of turn is very important; too little will produce stalls and wallowing, whilst too much will spin the model in. Thus, although rubber models are often considered the basic model they can be tricky to fly, which is why they still present a challenge to the expert.

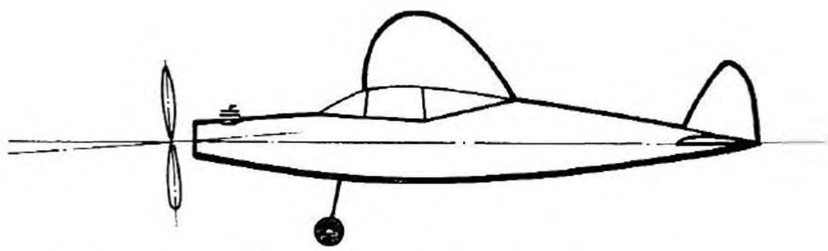
The art of trimming lies in matching the power flight to that of the glide. It is little use having one without the other, although having hit upon a good power flight pattern it is frustrating to have to mess it up because the model is gliding like a brick. If yours is an engine powered model it is essential that you have lined up the engine as per plan. Often the difference between a successful model and a crashing failure is a very minute difference in the way the engine, that is the thrustline, is pointing. Most power models require downthrust to stop the nose rearing up. Check this against the plan. Also check if some right thrust is called for. A well prepared model is most often a successful one. The expert is an expert because of this. It was said earlier that sports models usually fly to the

left, but check the plan for flight pattern instructions before taking my word for it.

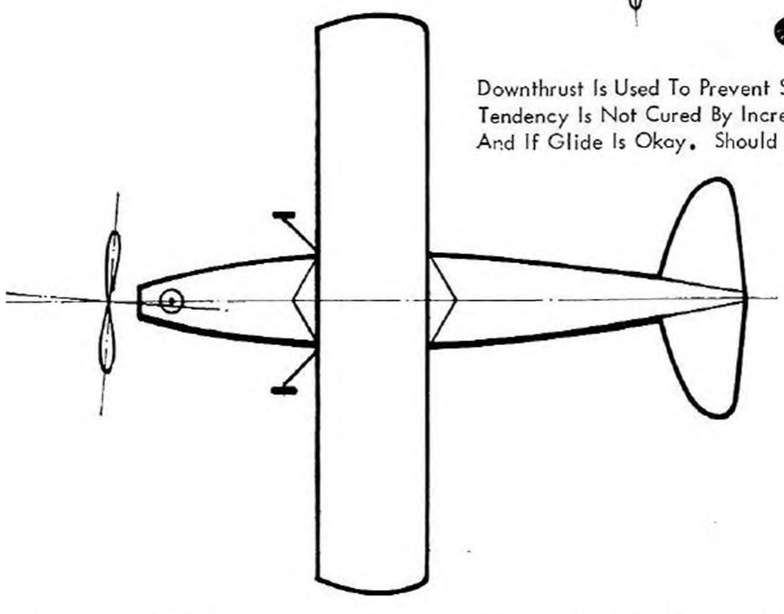
The trouble with model flying is that learning the techniques can be expensive on model craft. Launching is a case in point. You must launch smoothly, but with a certain amount of vigour. Not jerkily, though, as this can result in the engine cutting and the model falling plop to earth. Another worrying thing is that whatever happens to your model may be a combination of faults, and unless you study carefully what happens and think about it you will merely repeat the errors.

Take it that the model stalls, violent enough to pitch the model into the ground. First check that you put in the right amount of downthrust. Try another hand glide to see that it is not too flotatious. If that seems okay try a spot more downthrust and at the same time apply a little left rudder. But again it is very difficult to be hard and fast in these matters; whereas rudder offset might effect a cure on one model it will be insufficient alone on another. Trimming is, after all, a matter of trial and error, even though you can't afford to be generous with the error factor.

Horrid to say, but it is possible your model won't even make a flight—well, not a noticeable one. It may pull sharply into the deck either one way or another. The only immediate and hopeful remedy is to put on opposite rudder. It may well be that the fault is in the thrust alignment, and this will indicate itself if you manage to get a fair power flight but a poor glide. Oddly enough, one of the commonest faults to be seen in sports model flying is the model spiralling in to the right on glide. The short stubby models are terrors for this sort of thing. Often the cure is to increase left rudder turn, but sometimes right thrust, or more right thrust, is necessary to offset the effect this has on the power flight.



Downthrust Is Used To Prevent Stalling Under Power. Use Only If Stalling Tendency Is Not Cured By Increasing The Turn (But Do Not Overtighten Turn) And If Glide Is Okay. Should Initially Be Incorporated If Indicated On Plan.



Use Sidethrust To Vary Turn Under Power. Right Thrust Is Definitely Required On Rubber Powered Models. On Engine Powered Models Sidethrust Is Used To Match Power Flight To Glide Flight.

The spiralling may also be a sign of under elevation, and again, if the power flight is okay, the glide corrective you apply must be countered by an increase in downthrust.

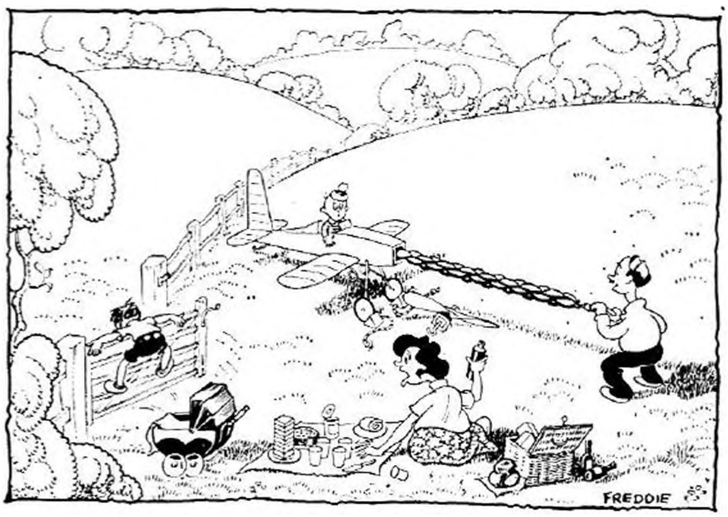
As you can see, matching the power flight to that of the glide can be a painstaking business, with a multiplicity of combinations to be encountered and overcome. However, it comes easier if you think about it. You can alter the power trim without altering the glide, but if you wish to alter the glide you will alter the power trim. For this reason it is desirable to see what sort of glide you've got, and why a series of preliminary hand launches are so necessary. Once you have a reasonable glide then power flight is a matter of correct thrustline adjustment. But, of course, a glide may be a good one yet be turning the wrong way for a suitable power trim to be applied to it. Say you have a good left-hand glide, but the model flies in tight, non-climbing circles to the left under power even though you have exhausted the amount of right thrust adjustment, then you must alter the glide pattern, and your model may well be gliding to the right before you open up the left turn circle to a safe climbing sweep.

This sounds complicated, and worse than that, it *is* complicated. Aircraft behaviour is only predictable up to a point; beyond that point you need the services of a test pilot, or, in our case, a rather elaborate trimming technique. But, nevertheless, you can get your first model flying reasonably well if you follow the basic rules of the trimming game, which is a little know-how and a lot of common sense. The little know-how amounts to this:

Fore-and-Aft Trim: Obtain glide by altering weight balance along fuselage. A small degree of tailplane adjustment is also permissible—a $\frac{1}{16}$ in. sliver under the leading edge to cure a stall, and the same under the trailing edge to increase elevation. Give downthrust to cure a stall on power and reduce same to increase elevation.

Directional Trim: Left or right rudder to adjust glide. Offset thrustline to vary turn under power.

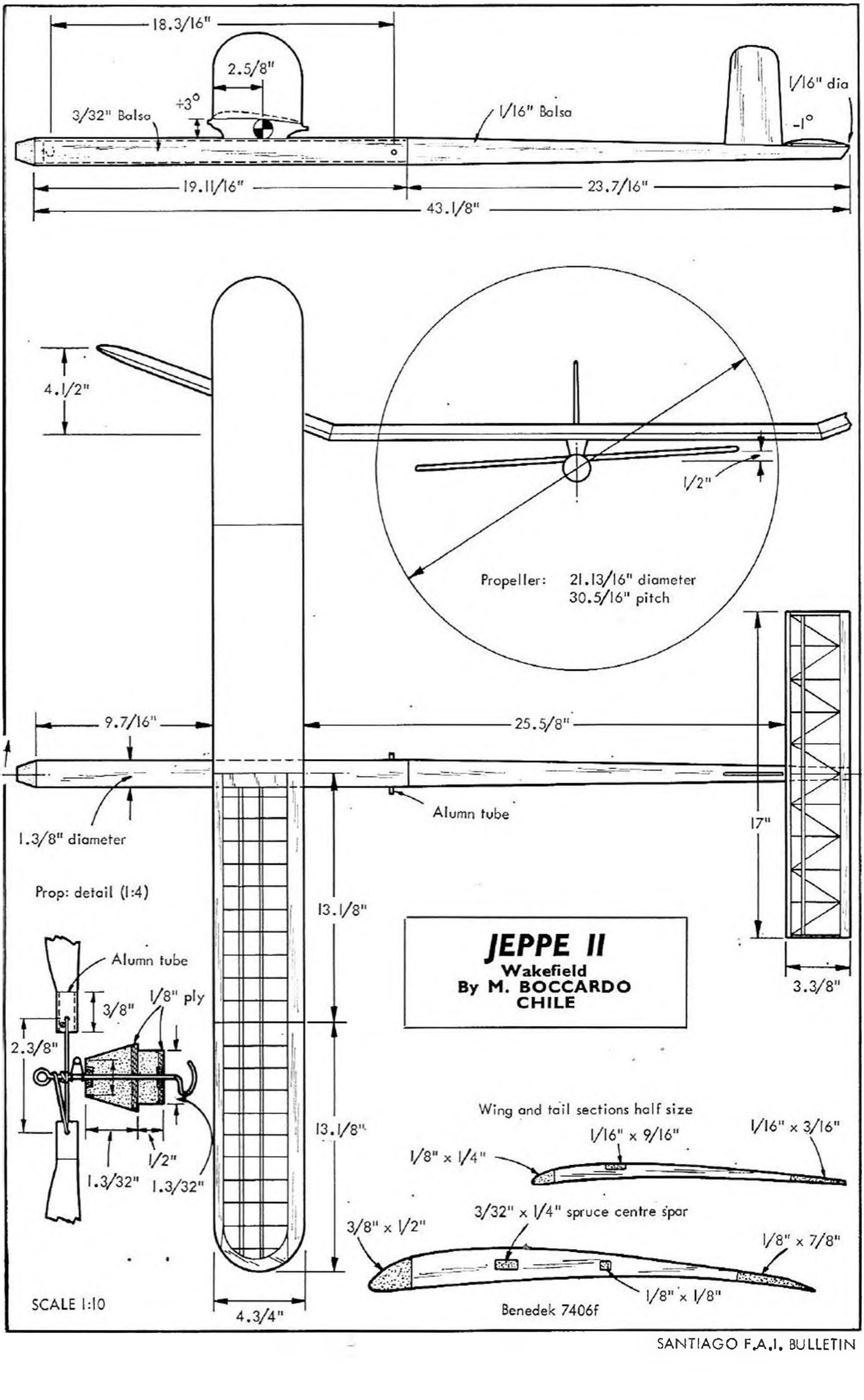
The common sense comes in working out the possible combinations of power and glide patterns and how to adjust one to the other. Some idea of how to go about this has been given in the article, but there are many pitfalls, such as poorly designed models, models unsuitable for beginners, and models built more in haste than expectation. Best bet is to get advice from an experienced modeller on the choice of suitable kit or plan. Better still you could write to the Aeromodeller, and to "Golden Wings Club" in particular if you are a Junior.



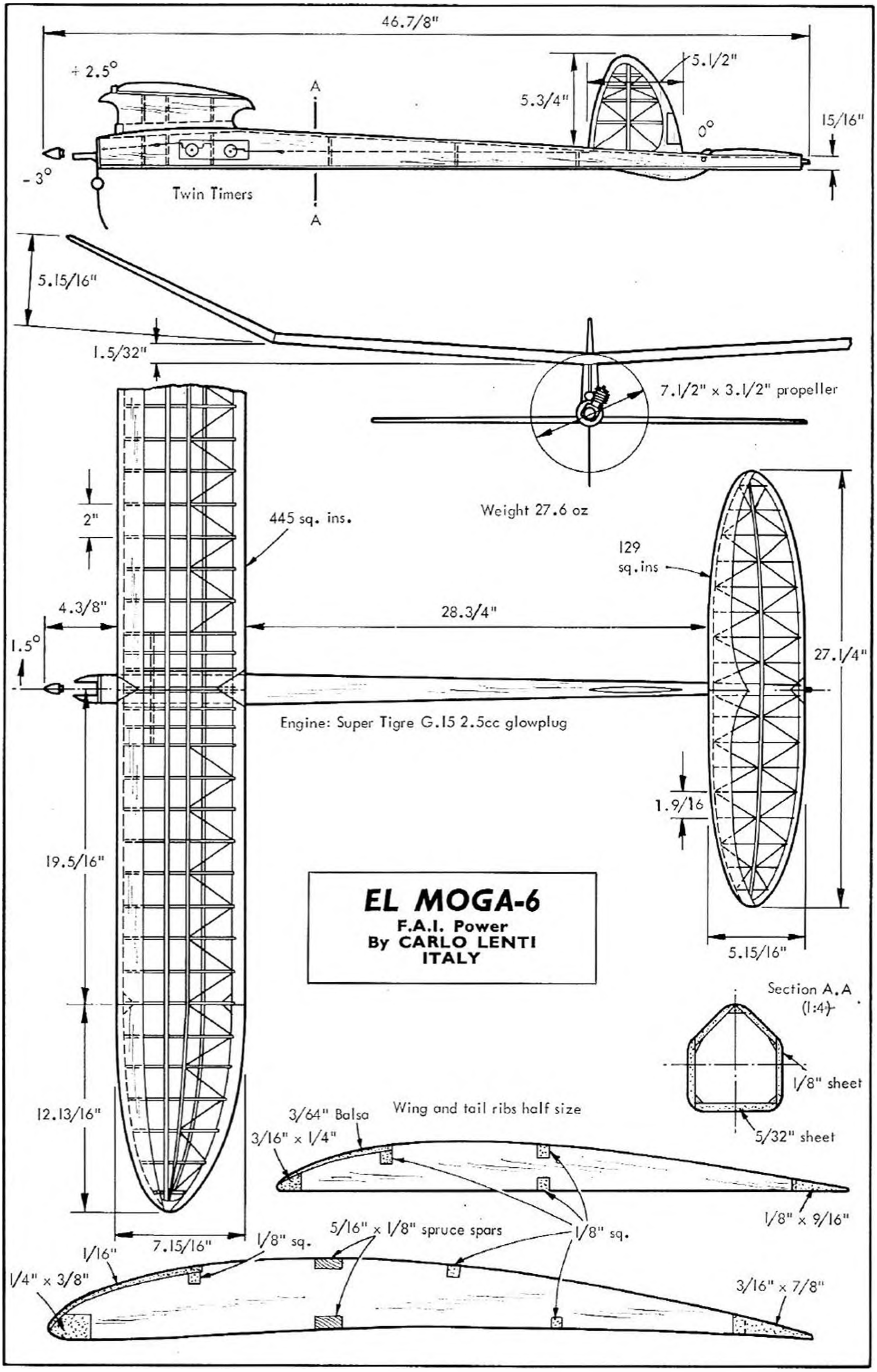
Vintage 'Freddy' cartoon from Aeromodeller 30 years ago

. . . .

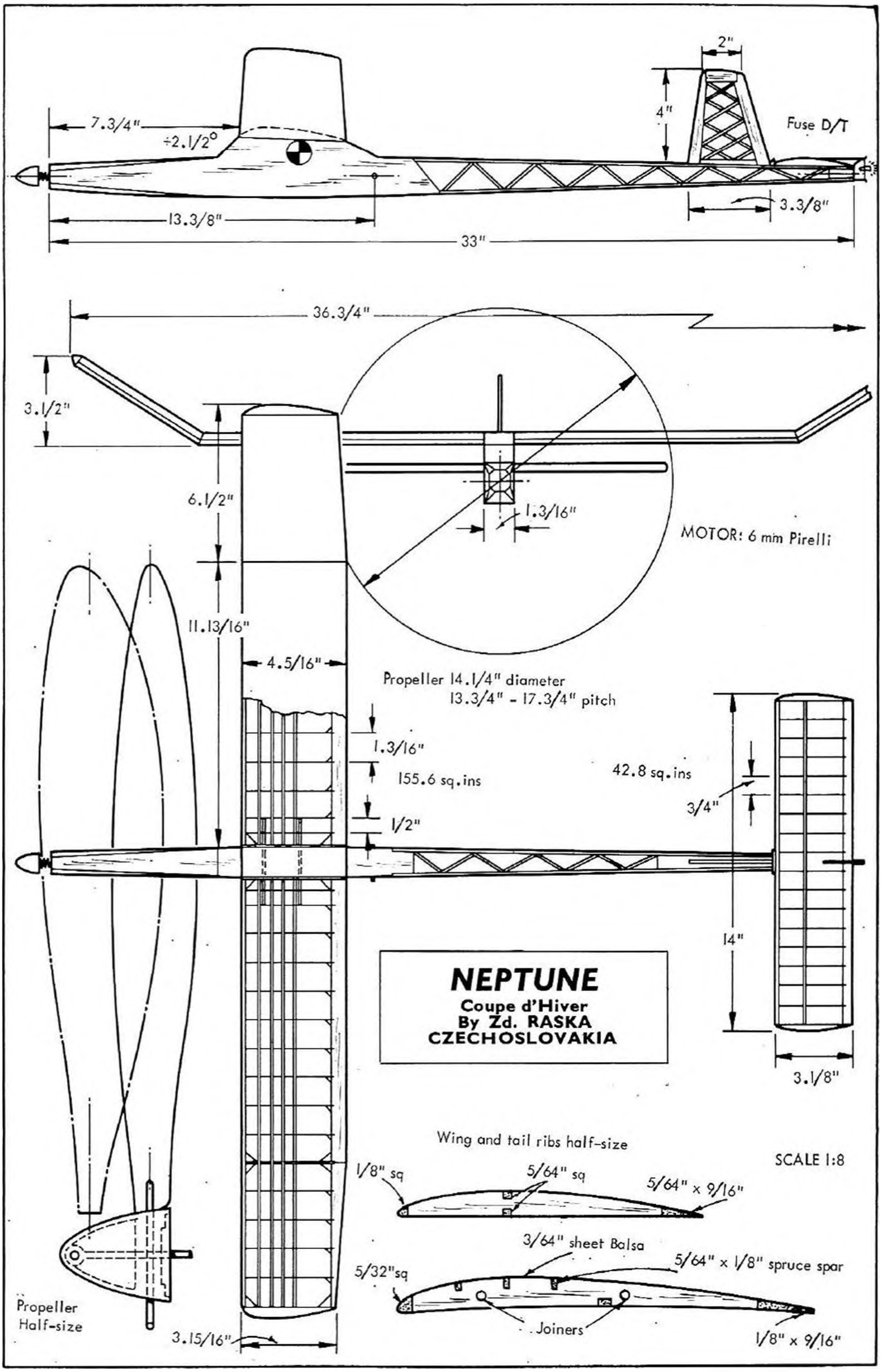
"Ernie, stop swinging on that gate, you'll break your neck!"



SANTIAGO F.A.I. BULLETIN



MODELLISTICA



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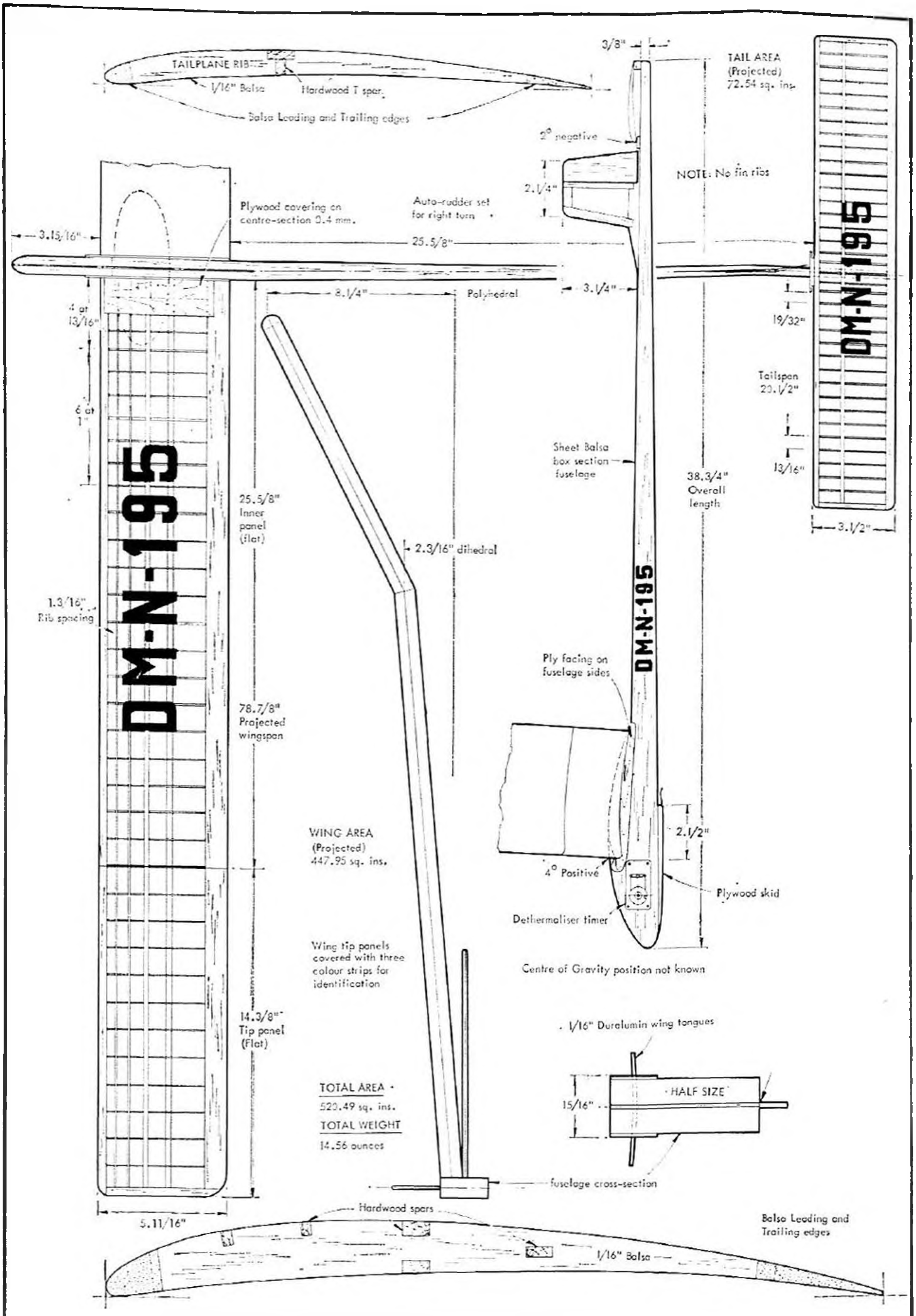
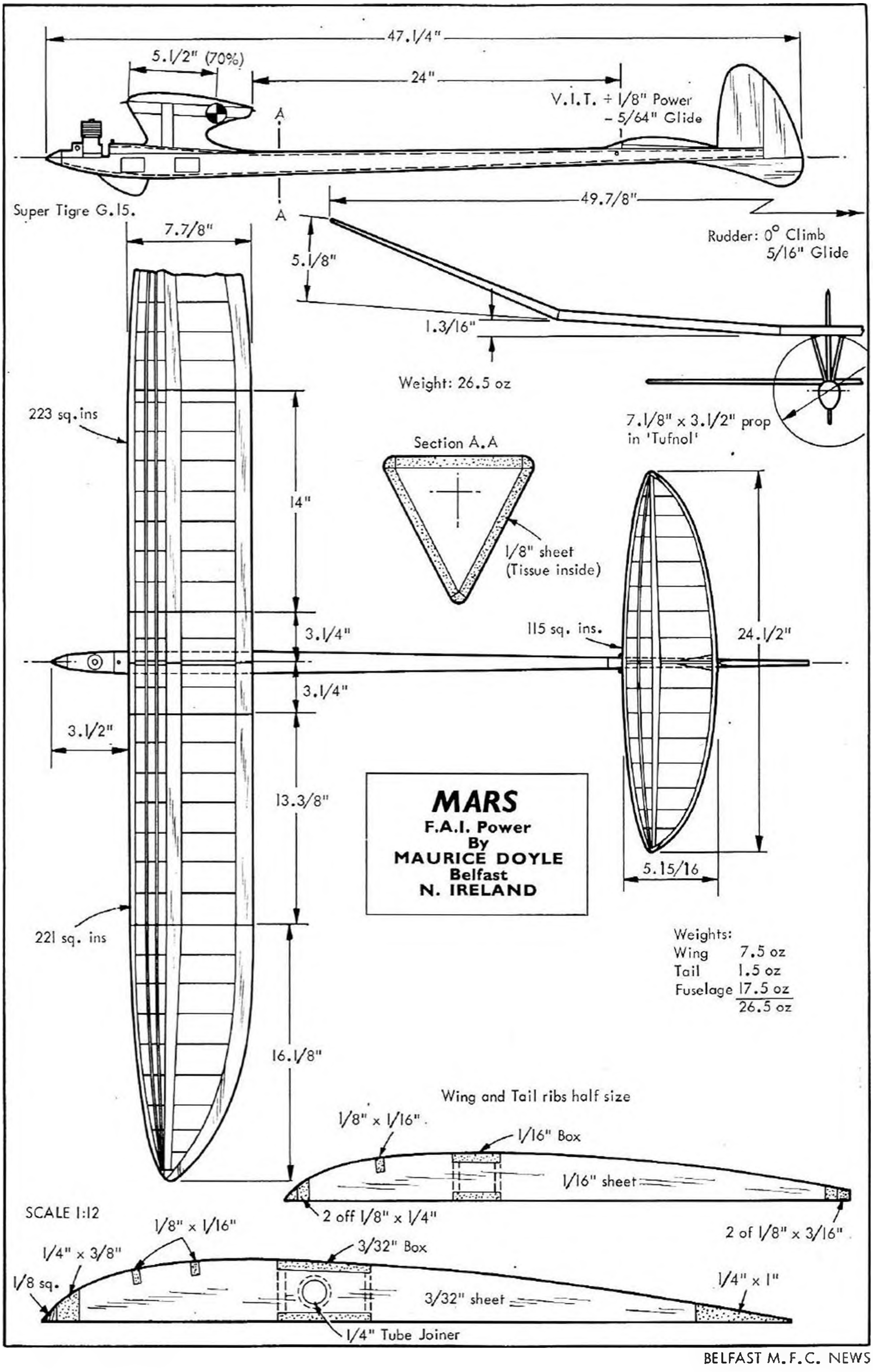
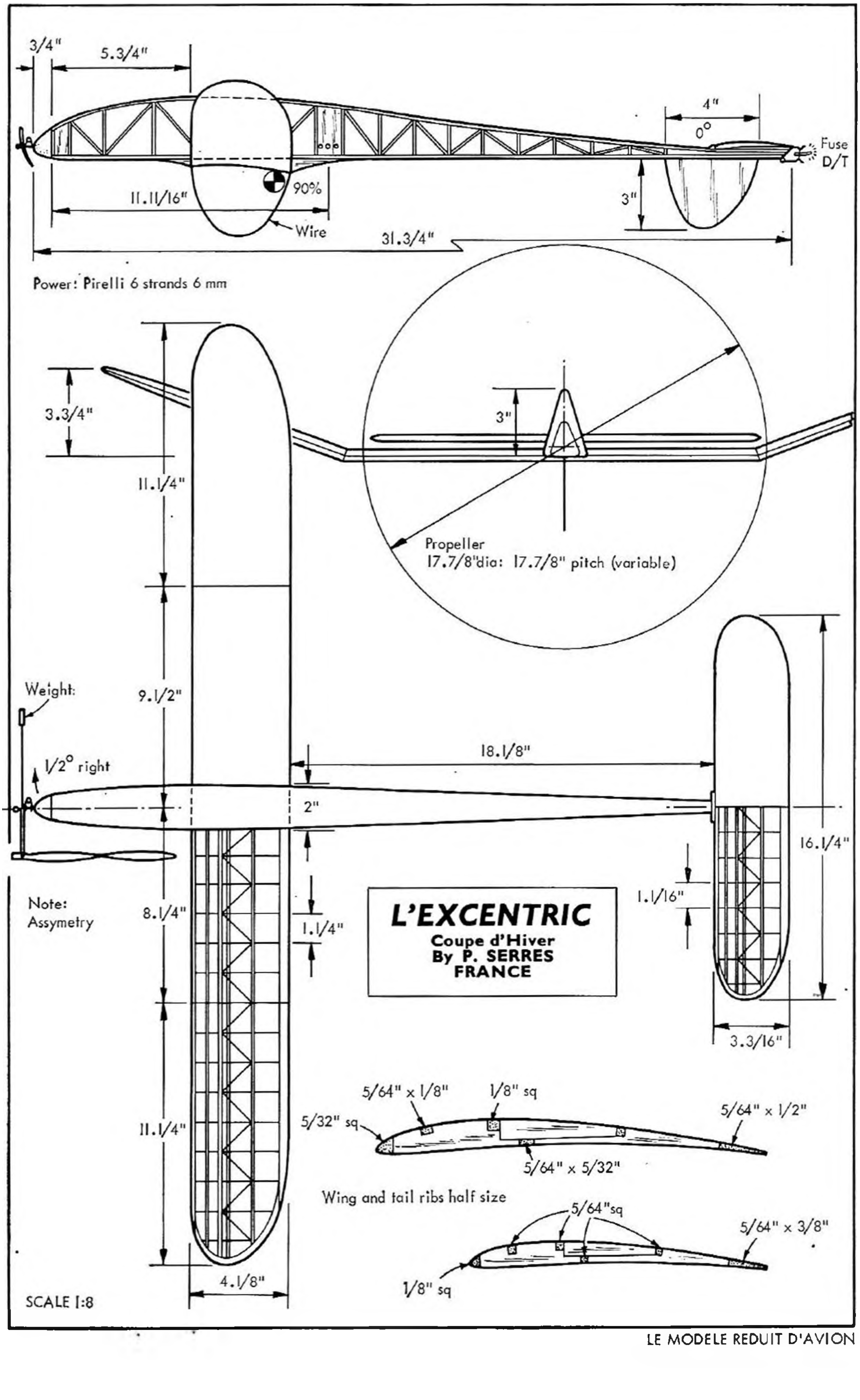


WORLD CHAMPION A/2 GLIDER 1967

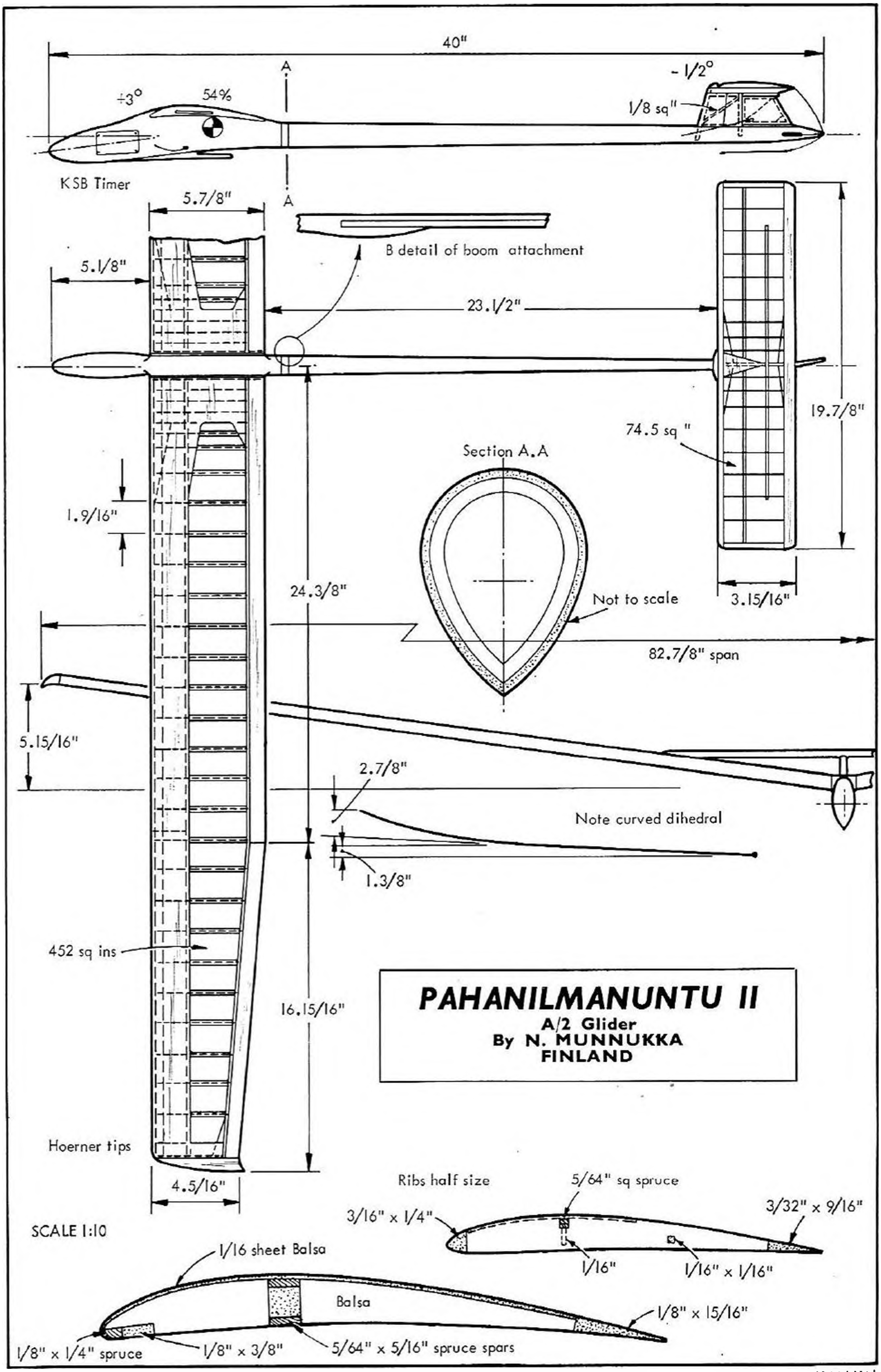
By MATTHIAS HIRSCHEL, EAST GERMANY



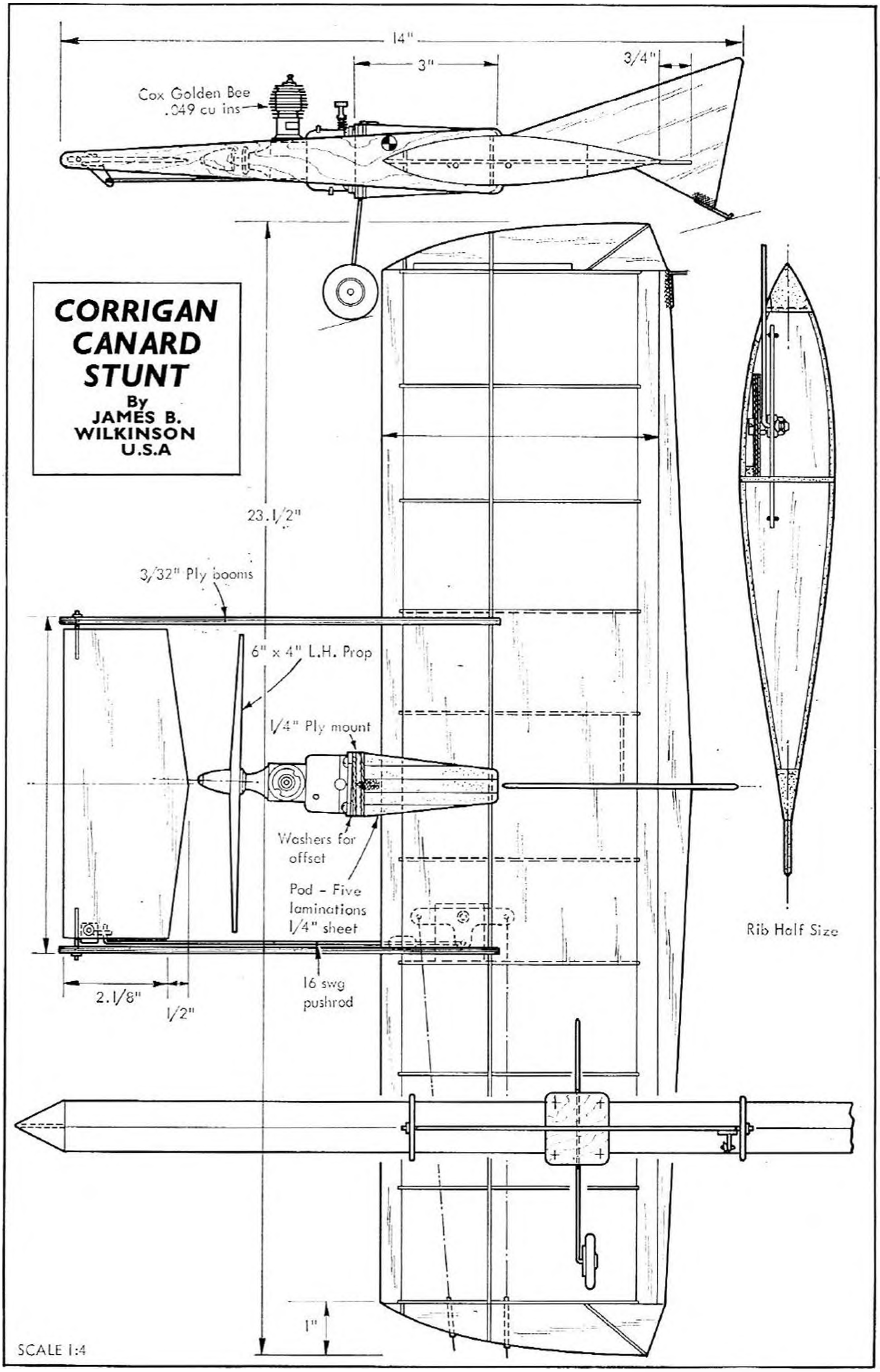
BELFAST M.F.C. NEWS

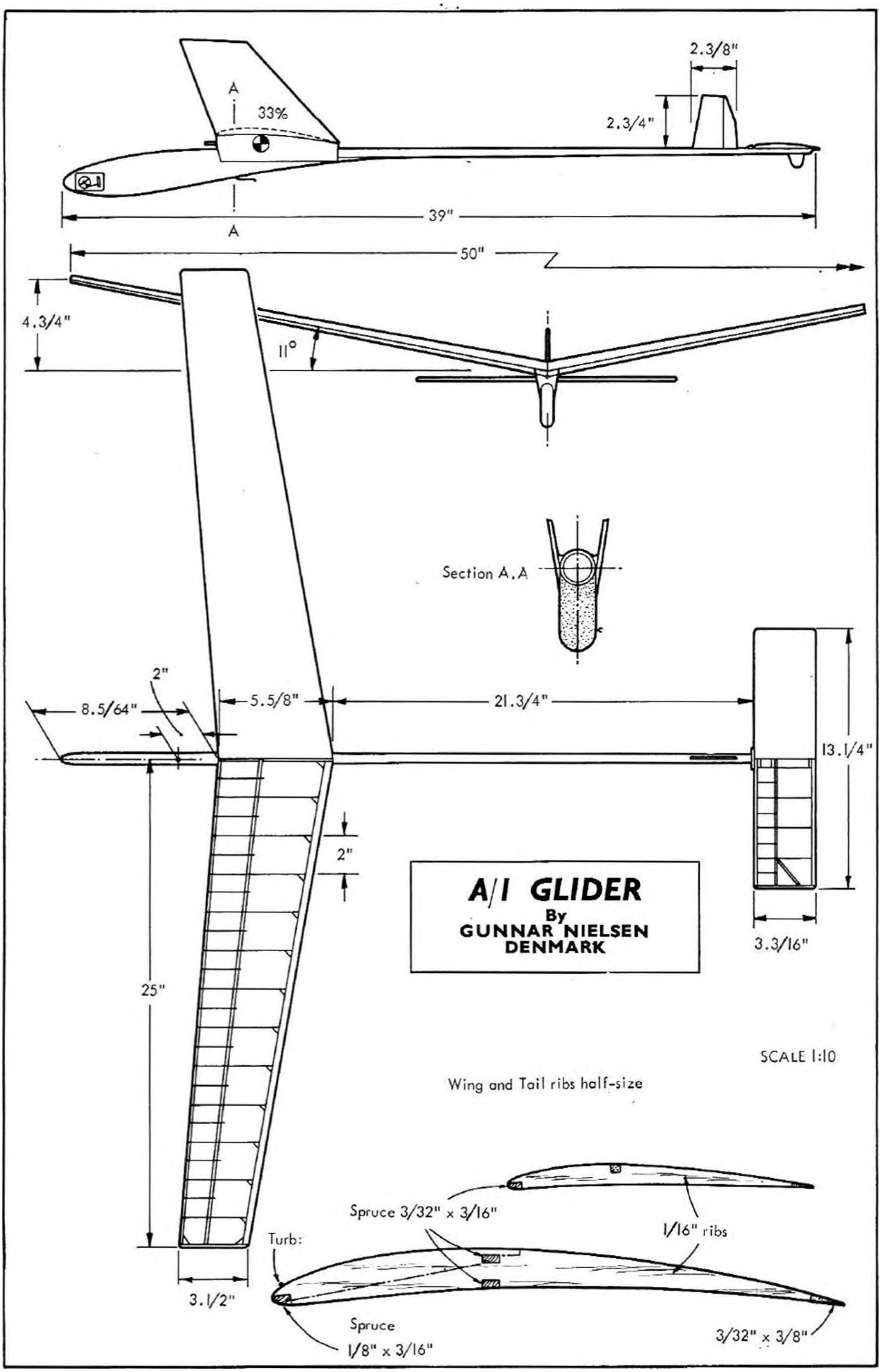


LE MODELE REDUIT D'AVION

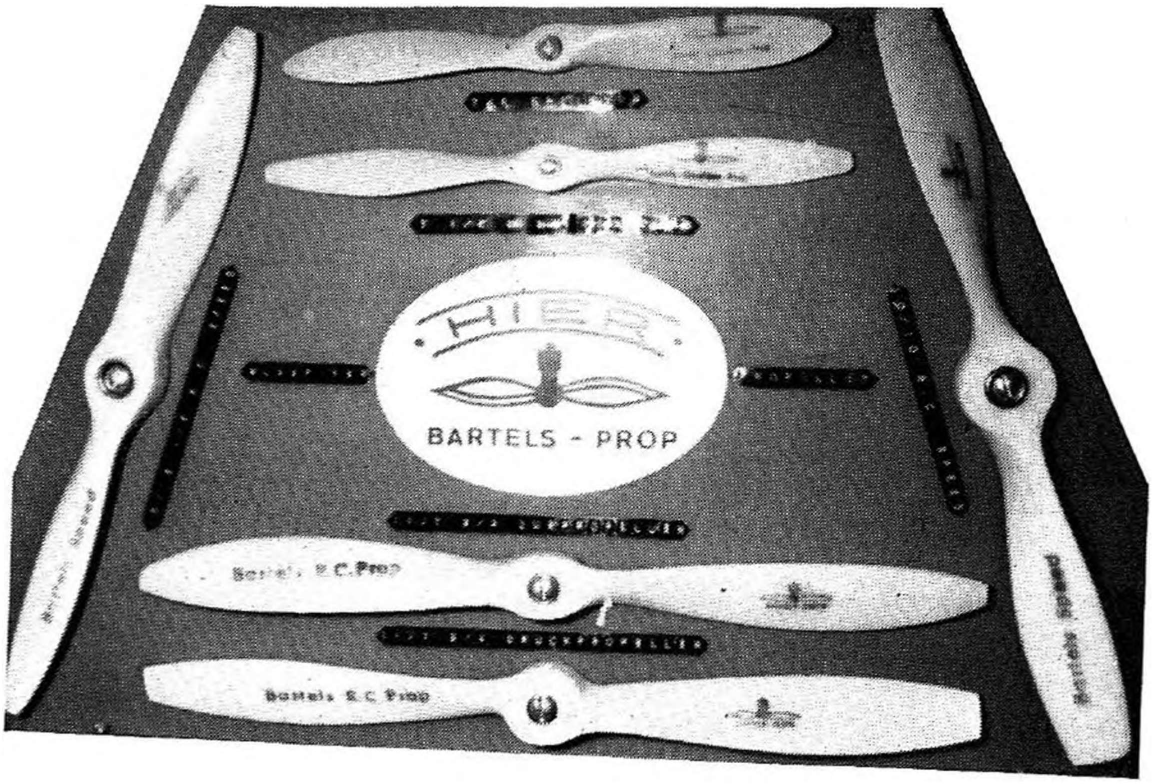

40"
A
- 1/2°
+3°
54%
1/8 sq"
KSB Timer
5.7/8"
A
B detail of boom attachment
5.1/8"
23.1/2"
19.7/8"
74.5 sq "
Section A.A
1.9/16"
24.3/8"
Not to scale
3.15/16"
82.7/8" span
5.15/16"
2.7/8"
Note curved dihedral
1.3/8"
452 sq ins
16.15/16"
PAHANILMANUNTU II
A/2 Glider
By N. MUNNUKKA
FINLAND
Hoerner tips
4.5/16"
Ribs half size
5/64" sq spruce
3/16" x 1/4"
3/32" x 9/16"
SCALE 1:10
1/16"
1/16" x 1/16"
1/16 sheet Balsa
Balsa
1/8" x 15/16"
1/8" x 1/4" spruce
1/8" x 3/8"
5/64" x 5/16" spruce spars

ILMAILU


14"
3"
3/4"
Cox Golden Bee
.049 cu ins
CORRIGAN
CANARD
STUNT
By
JAMES B.
WILKINSON
U.S.A
23.1/2"
3/32" Ply booms
6" x 4" L.H. Prop
1/4" Ply mount
Washers for
offset
Pod - Five
laminations
1/4" sheet
Rib Half Size
2.1/8"
1/2"
16 swg
pushrod
1"
SCALE 1:4


2.3/8"
A
33%
2.3/4"
39"
A
50"
4.3/4"
11°
Section A.A
2"
8.5/64"
5.5/8"
21.3/4"
13.1/4"
2"
A/I GLIDER
By
GUNNAR NIELSEN
DENMARK
3.3/16"
25"
SCALE 1:10
Wing and Tail ribs half-size
Spruce 3/32" x 3/16"
1/16" ribs
Turb:
3.1/2"
Spruce
1/8" x 3/16"
3/32" x 3/8"

· FLYV



FACTS ABOUT PROPELLERS

No practical aeromodeller needs to be told that the propeller can make all the difference to performance. In the case of a rubber model, however, the propeller size and proportions are normally selected on the basis of experience, or convention, and if any subsequent "adjustment" is needed this can most conveniently be done by altering the number of strands or cross-section of the motor.

Mention can be made, however, of a technique which worked well in the days when freewheeling propellers were still commonly used on duration rubber models. This was to carve the propeller blades separately with a reinforced cylindrical root to fit into a tubular hub. The blade was then locked to the hub by pinning, but at the same time adjustment of pitch could be made by removing the pin, turning the blades in the hub to a new pitch angle and repinning.

This proved a very effective method of "matching" the propeller to a given motor size—the technique generally being to establish the highest pitch angle which the propeller would take before the climb performance began to taper off. Once found, this optimum pitch was then fixed, as any further change would have affected trim. In other words a simple form of adjustable pitch propeller was an additional tool for establishing initial trim. The same method can be used on modern folding propellers by bending the hinge.

It is interesting to recall that other methods of adjusting the propeller characteristics have been applied from time to time to rubber powered models—aimed not so much at establishing trim but in "balancing" propeller performance against the continually changing power output of a rubber motor. The most popular solution was the automatic variable pitch propeller with the pitch angle controlled by motor torque. The other was the expanding diameter propeller—the diameter increasing to a maximum on full turns and then gradually con-

tracting as the torque diminished. The original aim was a constant speed propeller (or near constant speed), and thus a more or less constant propeller efficiency. Neither achieved particular distinction nor operational efficiency, and best results were invariably achieved either by using as high a pitch as possible on a moderately large propeller diameter; or a very large diameter propeller with a moderate to low pitch. Ultimately, however, top performance with all rubber models depends on using a quality of rubber strip with favourable torque characteristics.

In the case of power models propeller selection is usually very much easier. For a start, it is a simple matter to select an "optimum" propeller on a trial-and-error basis, and the propeller should have a constant efficiency since it is driven at constant speed by the engine. This "constant speed", however, will be different in flight to what it is on the ground, and will also vary with flight attitude and flight speed. In practice, therefore, it will be a constant only with one attitude of flight—and the r.p.m. achieved will be peculiar to that particular propeller.

The aim, logically, is to use a propeller size which represents an "in flight" load on the engine equivalent to the torque developed at peak r.p.m. The engine will then operate at peak r.p.m. and thus deliver its maximum power. This has certain limitations—notably in the difficulty of deciding when the motor is actually "peaking" in flight—and undoubtedly the majority of power models are operated with "oversize" propellers which never allow an engine to achieve its maximum performance—except perhaps in a dive where peak power is least required!

Basically, for any given power model-engine combination, there will be one particular propeller which will give the best performance. This can be a critical problem, as in the case of control line speed and team racers; fairly critical as in the case of power duration and radio control; and almost completely non-critical in the case of free flight sports models. The only time propeller selection tends to become really critical in the latter case is with the smallest sizes of engines (usually under 0·5 c.c.) where it may well be that only one size of propeller will fly the model at all. This is because the power available is marginal and thus a reasonable propeller efficiency is necessary in order to get a suitable amount of thrust. The only way to get reasonable propeller efficiency is to match it to the engine performance—and if possible further improve the efficiency of the propeller form. In the case of tiny glow engines, for example, propeller *balance* can be critical. An unbalanced propeller can waste so much power through vibration (since the generation of vibration *absorbs* power) that there is not enough left to fly the model. With the propeller properly balanced, the difference can be quite remarkable.

Propeller selection can be done, and usually is carried out, on a purely trial-and-error basis. Having arrived at an optimum size, it may then be possible further to improve performance by reworking the propeller itself. This is a particularly effective method where results achieved can be directly observed and *measured*, as in the case of control line speed, for example. It is a less exact method where results can only be observed but not measured, as with free flight models. It also demands some knowledge, at least, of what factors affect propeller performance and efficiency.

Basically the engine and propeller characteristics are affected by so many variables that it is useless to attempt any exact analysis of test data. However, we can use basic theory as a guide, the chief propeller characteristics being thrust,

torque and power absorbed. The following relationships then apply:

Thrust is proportional to $(\text{r.p.m.})^2 \times (\text{diameter})^4$
Torque is proportional to $(\text{r.p.m.})^2 \times (\text{diameter})^5$
Power absorbed is proportional to $(\text{r.p.m.})^3 \times (\text{diameter})^5$

From the above it is obvious that diameter has the major effect of any of the characteristics on propeller performance. Thus the effect on thrust of doubling the diameter, for example, would be the same as that produced by increasing r.p.m. fourfold with the original diameter. For practical purposes, however, we are concerned with what diameter size can be driven at a suitable r.p.m. figure by the available power.

Thus for any propeller we can express the "power absorption" characteristics either in terms of *torque* absorbed or *power* absorbed by the following equations:

$$\text{Torque absorbed} = C_q \times (\text{r.p.m.})^2 \times (\text{diameter})^5$$
$$\text{Power absorbed} = C_p \times (\text{r.p.m.})^3 \times (\text{diameter})^5$$

where C_q = the torque coefficient and C_p = the power coefficient of that particular propeller.

Theoretically, at least, C_q and C_p are constant values for any particular propeller. Thus giving one accurate set of test measurements for torque absorbed against r.p.m. the torque coefficient (C_q) can be calculated for that propeller and will hold for other combinations of torque and r.p.m.—i.e., insertion in the formula will give torque absorbed at any other r.p.m.; or r.p.m. given by any other torque value. Exactly the same applies to the power coefficient (C_p) and power formula. It depends whether you prefer to work with torque curves or power curves.

For a particular diameter of propeller we can go further than this and incorporate the diameter factor in the coefficient, viz.:

$$\text{Torque absorbed} = C_{q'} \times (\text{r.p.m.})^2$$
$$\text{Power absorbed} = C_{p'} \times (\text{r.p.m.})^3$$

Having found Cq, or Cp, by test we can then calculate torque or power absorbed over a range of r.p.m. These curves can be related to corresponding curves of torque or power developed by an engine and the working point of that propeller with that engine found—Fig. 1 and Fig. 2.

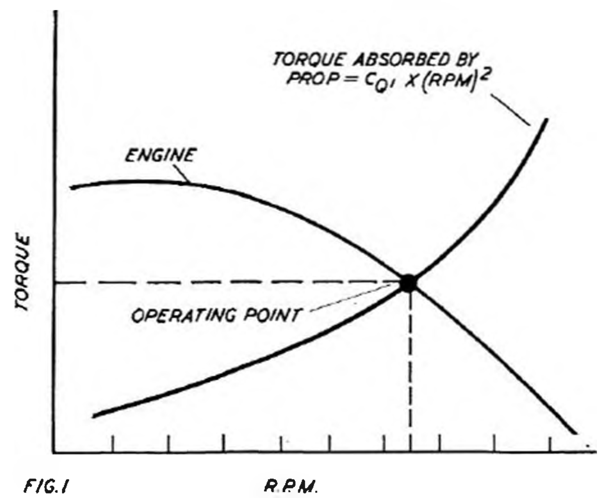


FIG. 1

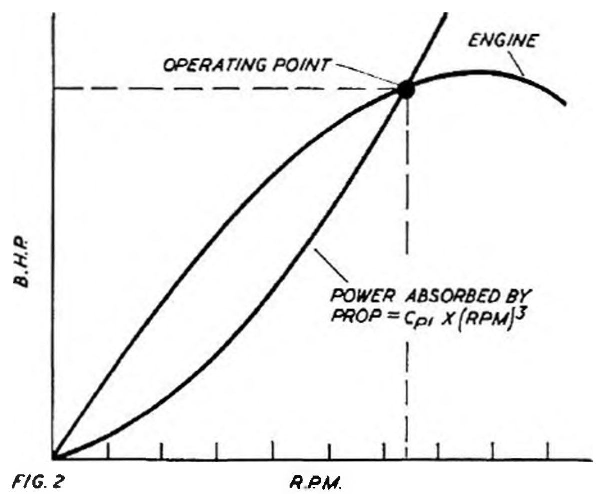


FIG. 2

On the same basis any other propeller can be "calibrated" in the same way, each having its specific value of C_q or C_p. The actual values will be specific to diameter plus the other geometric characteristics of the propeller—pitch, blade area and shape, and blade section.

In practice these coefficients will not necessarily be constant, due to "scale effect" operating at different speeds (i.e., widely different r.p.m.); and also to the effect that pitch has. Logically, the higher the pitch angle the more "drag" the blades will have and thus the higher the torque coefficient for a given diameter size. Under static conditions, too, the higher the pitch the more "stalled" the blades are. In the air, however, the blades become increasingly "unloaded" and its torque coefficient (and power coefficient) will substantially decrease. With pitch *properly selected* to match the flying speed, in fact, the pitch factor in affecting the value of C_q or C_p should be the *same for any pitch* with a particular shape of propeller.

There is thus a discrepancy between "in flight" and "static" values of C_q and C_p which increases with the geometric pitch. This also justifies the "control line" method of selecting a propeller on the basis of the *pitch* required to match a selected engine operating r.p.m. and then adjusting the *diameter* or *blade thickness* as a method of arriving at that r.p.m. It will fall down only if the available engine torque is not sufficiently high to achieve the design operating r.p.m. without having to reduce the diameter to such a value that the *thrust* produced at that r.p.m. is insufficient for the thrust requirement to fly the model at the corresponding design speed. The chart given in Fig. 3 is a reasonably accurate guide, although the actual performance achieved will be very dependent on the geometry of the propeller. Thus although pitch is second only to diameter in importance as far as propeller performance is concerned, the finer variations are concerned with blade shape and section.

Practical results have shown that for best performance model propeller blades need to be thin, especially towards the tips, which have the highest velocity. Some designs aim to get the same effect of reducing tip drag by using narrow blade widths towards the tips and compensate with additional area near the roots. This can set problems of blade strength at the wide chord sections. The result is all too often a propeller which is either too thick, but strong enough; or too thin and so weak that it is prone to shatter on starting.

Test results would also appear to indicate that an increase in area and particularly blade width tends to produce a propeller with slightly lower efficiency and a more marked tendency for blades to stall. Narrow blades, in particular, do not appear to stall so early as conventional aerofoils and so seem best suited to the higher pitches. Blade *area*, in fact, seems the least effective of the possible geometric "variables", except in the wrong way. It is all too easy to use too much blade area in an attempt to produce more "lift" (i.e., thrust), only to find that the increased drag pulls down the r.p.m. and thus the thrust.

There is also evidence which indicates that trimming the diameter of a propeller by cutting off the tips tends to decrease the efficiency somewhat. The loss is not great—about 2·5% efficiency loss for each 10% of diameter dropped. It can be recovered by reshaping and thinning the tips; or by increasing the pitch very slightly (e.g., by about 2% for each 10% reduction in diameter). On this latter basis trimming the diameter is a good answer to a propeller which is slightly over-pitched to start with.

Blade section thickness appears to have a far greater effect than blade area. The thinner the section, in general, the better the results, accompanied by

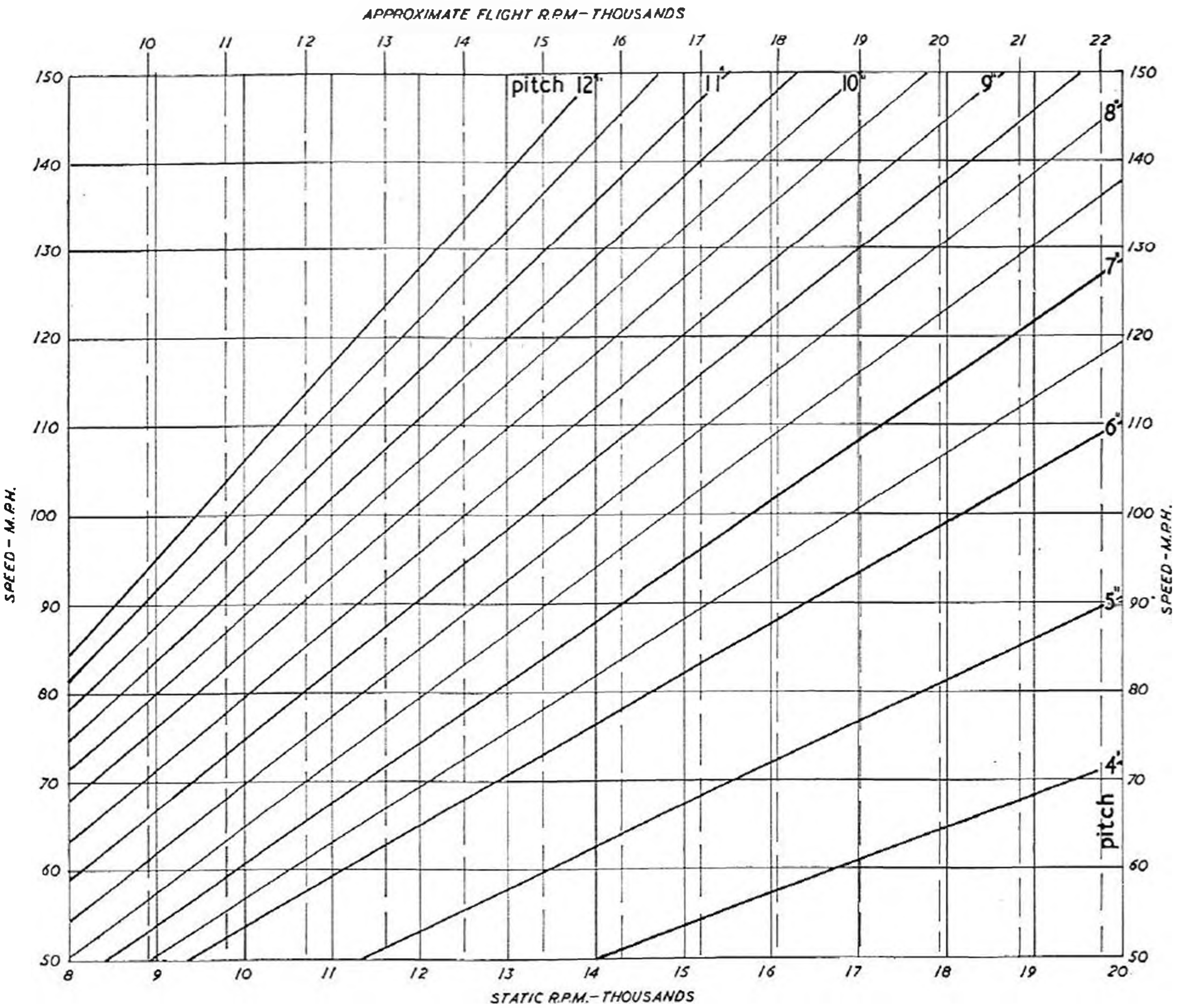
FIG. 3. PROPELLER SELECTION CHART

This chart can be used to select a suitable propeller pitch consistent with a specific design speed; or find maximum speed for different combinations of propeller pitch and static r.p.m. achieved with that propeller. The top scale gives approximate equivalent in-flight r.p.m. for the static r.p.m. figure(s) achieved. This is useful in assessing whether or not the selected propeller allows the engine to deliver peak r.p.m.

Example: Suppose the engine used peaks at 16,000 r.p.m. and the design speed is 100 m.p.h. Relating 16,000 r.p.m. on the top (flight r.p.m.) scale to 100 m.p.h. gives a required pitch of a little under 8 in. Logical choice would therefore be an 8 in. pitch prop.

Using the bottom scale and the 8 in. pitch diagonal it can be found that to achieve 100 m.p.h. with this pitch of propeller the static r.p.m. required is just under 14,000. This will correspond to an in-flight r.p.m. of 15,700 to 15,800 or just below the engine peak. Provided the 8 in. propeller will *give* 14,000 r.p.m. static the design performance should be achieved, provided that the diameter is adequate to provide the necessary thrust. If the static r.p.m. is below the required chart figure, then either the diameter will have to be trimmed (with the proviso above) or blade thickness; or a lower pitch used.

However, in this case, using a 7 in. pitch propeller would give approximately 16,700 r.p.m. at 100 m.p.h. in the air, or higher than the engine peak r.p.m. This will result in a loss of power and possibly insufficient thrust.



a sharp leading edge free from "notching". Irregular or blunted leading edges are poor. The actual section does not appear to be at all critical, although most experts aim to rework a propeller to a nominal aerofoil shape. As a matter of principle they usually also rework the trailing edge, if blunt to start with, but this is less important. The main difficulty in reworking is the weakening induced in the blades, plus the potential danger of knife edges on the blade for hand starting.

Blade symmetry—each blade being identical—is, strangely enough, far less important than *balance.* Commercial moulded plastic propellers are frequently asymmetric, and in some cases one blade is measurably longer than the other. They can still be quite efficient propellers, provided they are properly balanced.

The degree of balance with a moulded plastic propeller is usually nominal and based on the assumption that the pattern is absolutely true (which is only likely to be the case if the die is made from a single-blade pattern), injection of the plastic is uniform, and that the moulded material is not subject to dimensional changes when removed from the mould. Some commercial propellers are quite good in these respects, others are very poor. All would pay for at least checking for balance, and the majority will need at least some degree of reworking in order to achieve the degree of balance necessary to give optimum performance. Starting with the assumption that the propeller will probably have to be reworked to balance anyway, there is no reason why one should not go on to thin the blades and clean up the leading edge and tips. This can only do good as far as propeller performance is concerned.

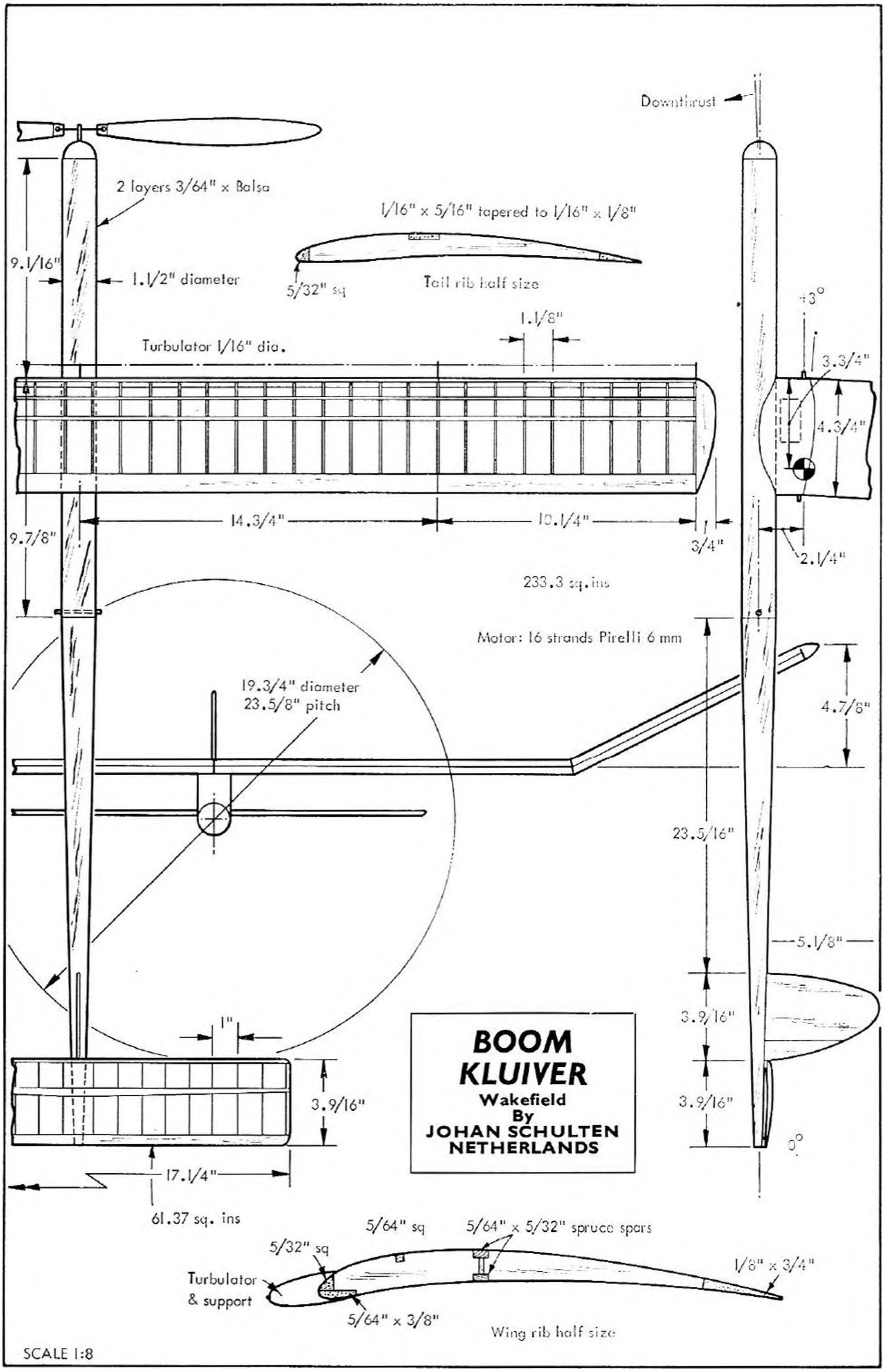
SIMPLE PROP CHECK

Here's a simple method of comparing "efficiencies" of different makes of the same size prop where *measured* performance is possible—e.g., with a Team Racer. This is done by multiplying speed by distance. The prop with the highest figure is then rated "100" and the others as a corresponding percentage.

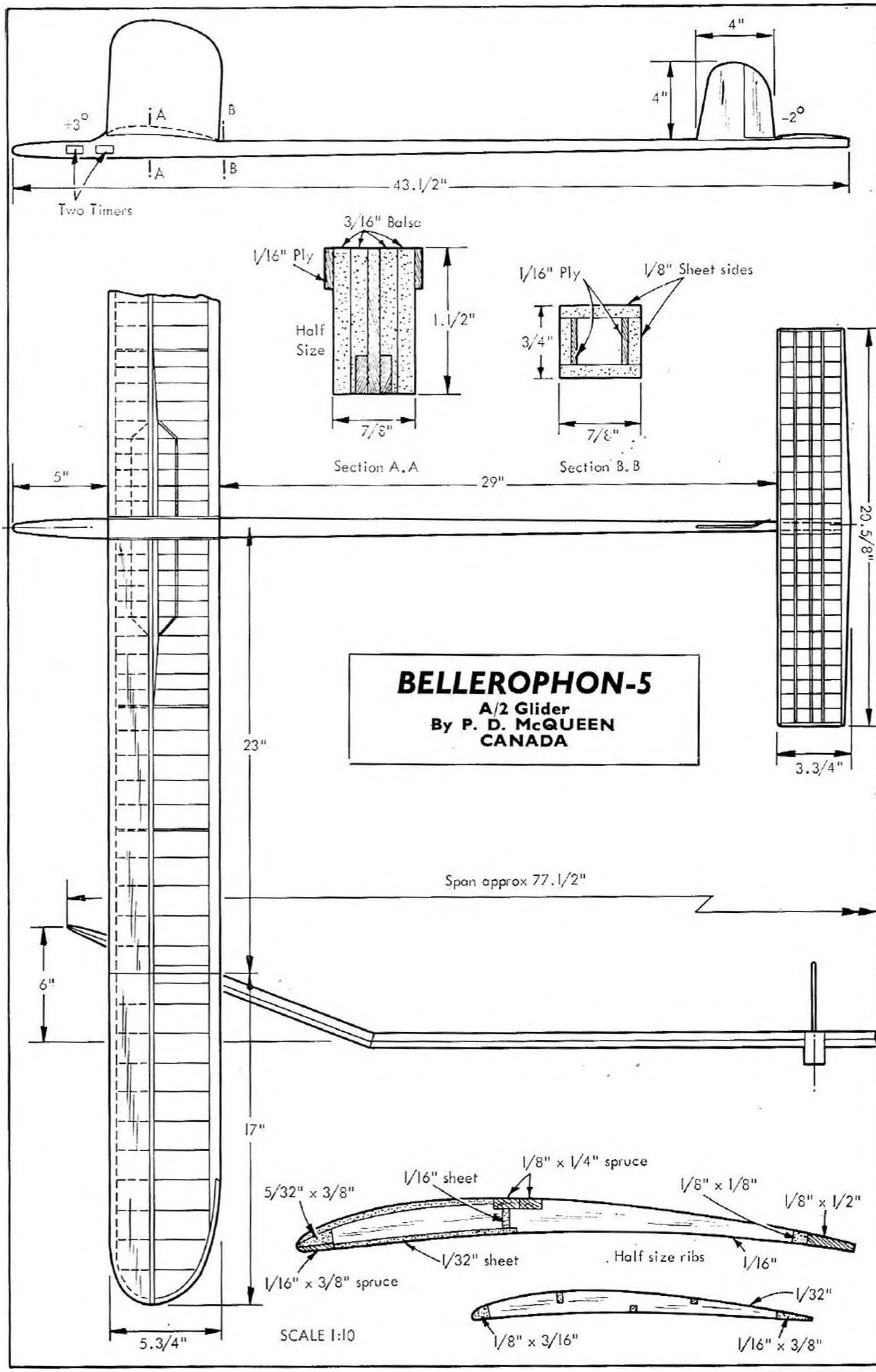
Using the prop test figures referring to seven samples of 7 × 8 props tested, the following figures result:

Prop	*Speed, m.p.h.*	*Laps*	*Speed × distance*	*Relative "efficiencies"*
A	101	35	3·54	94
B	95	36	3·42	91
C	94	40	3·76	100
D	90	35	3·15	83·7
E	88	33	2·90	77·0
F	86	31	2·66	70·6
G	82	45	3·69	98

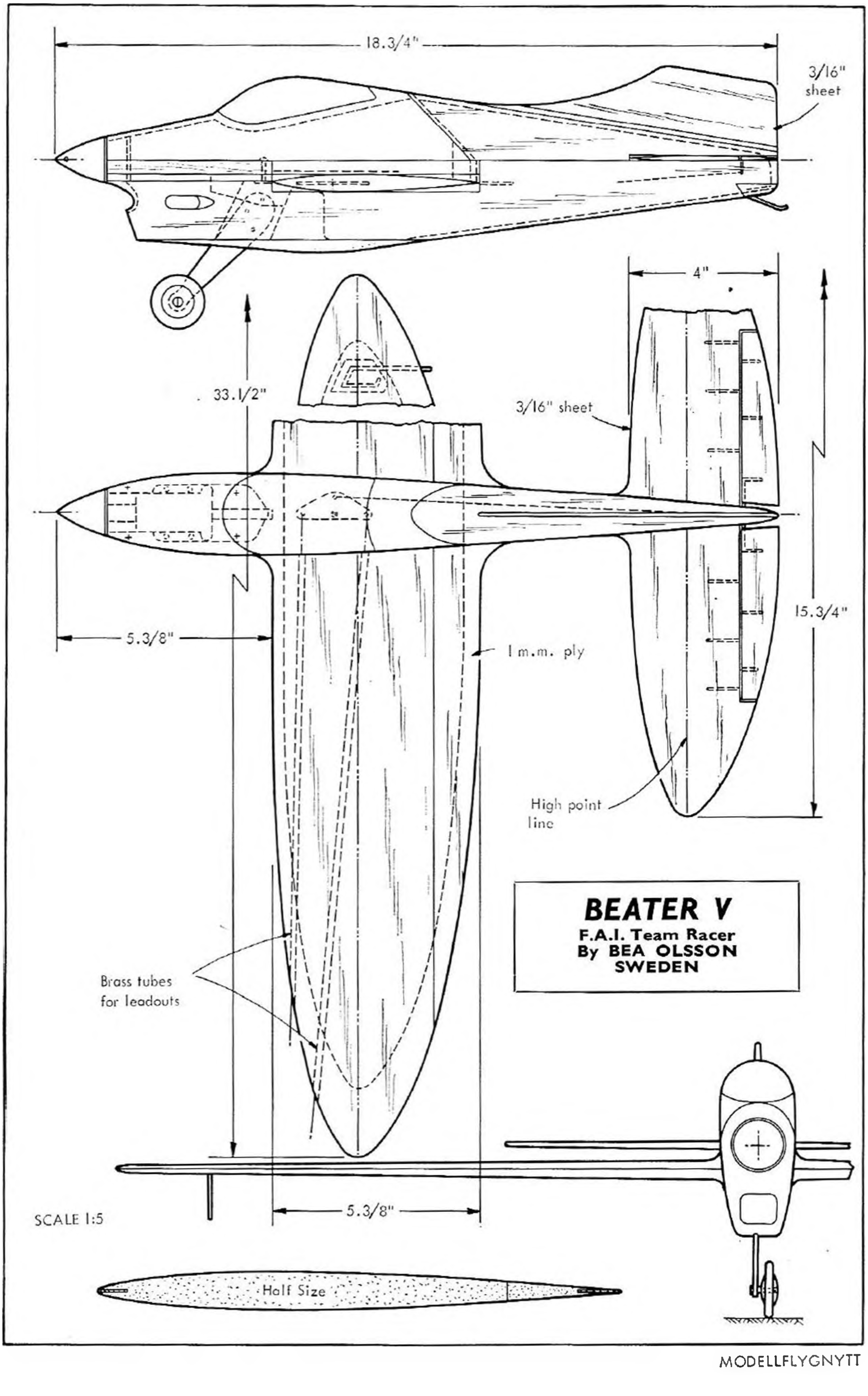
Note that this is a rough evaluation of "overall efficiency" only. In a particular application outright performance in terms of speed may outweigh nominal "efficiency" factors. Equally, the efficiency of the poorer examples may well be improved by reworking.


Downthrust
2 layers 3/64" x Balsa
1/16" x 5/16" tapered to 1/16" x 1/8"
9.1/16"
1.1/2" diameter
5/32" sq
Tail rib half size
+3°
1.1/8"
Turbulator 1/16" dia.
3.3/4"
4.3/4"
14.3/4"
10.1/4"
3/4"
9.7/8"
2.1/4"
233.3 sq. ins
Motor: 16 strands Pirelli 6 mm
19.3/4" diameter
23.5/8" pitch
4.7/8"
23.5/16"
5.1/8"
3.9/16"
1"
BOOM KLUIVER
Wakefield
By
JOHAN SCHULTEN
NETHERLANDS
3.9/16"
3.9/16"
0°
17.1/4"
61.37 sq. ins
5/64" sq
5/64" x 5/32" spruce spars
5/32" sq
1/8" x 3/4"
Turbulator & support
5/64" x 3/8"
Wing rib half size
SCALE 1:8

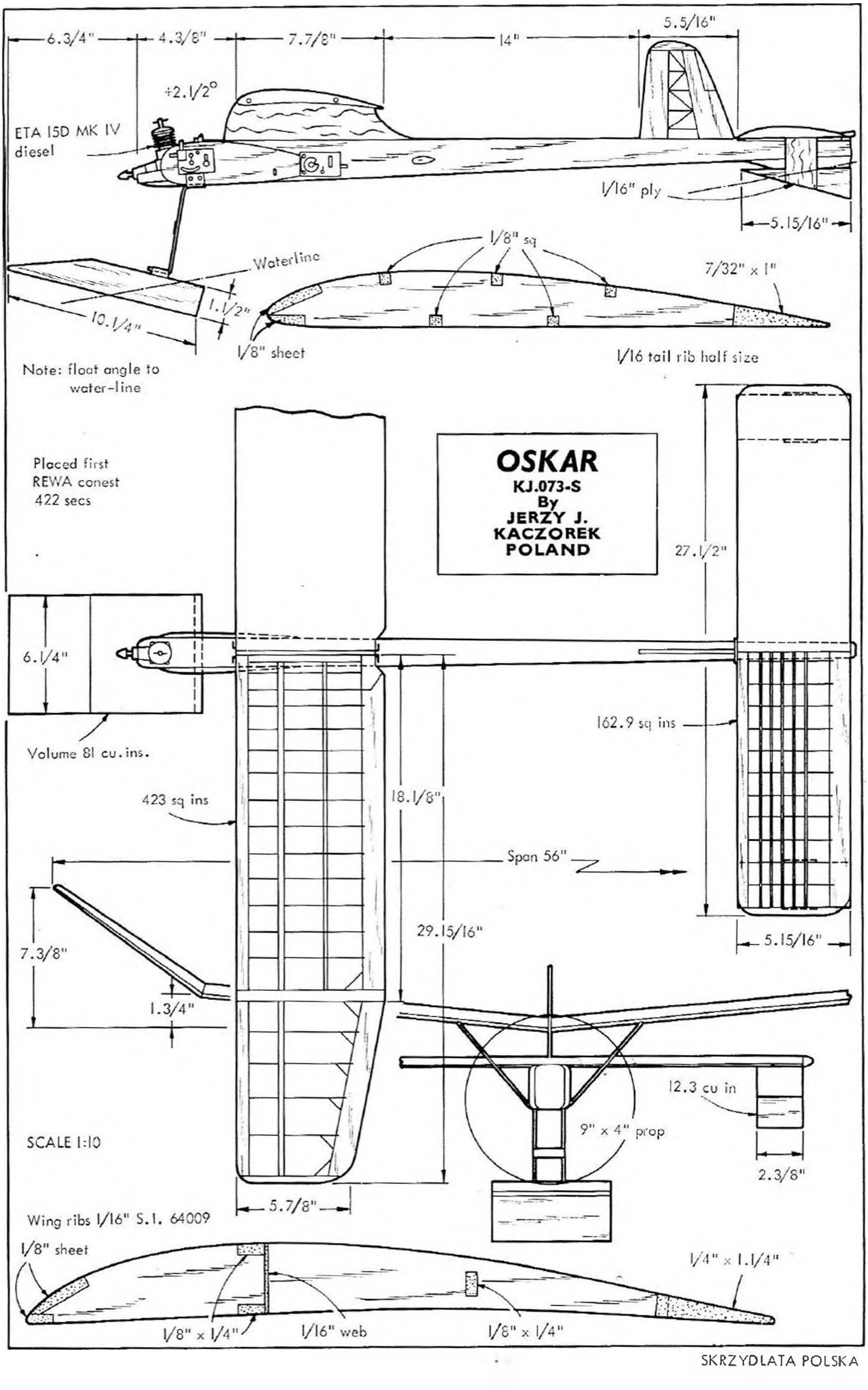
MODELLI



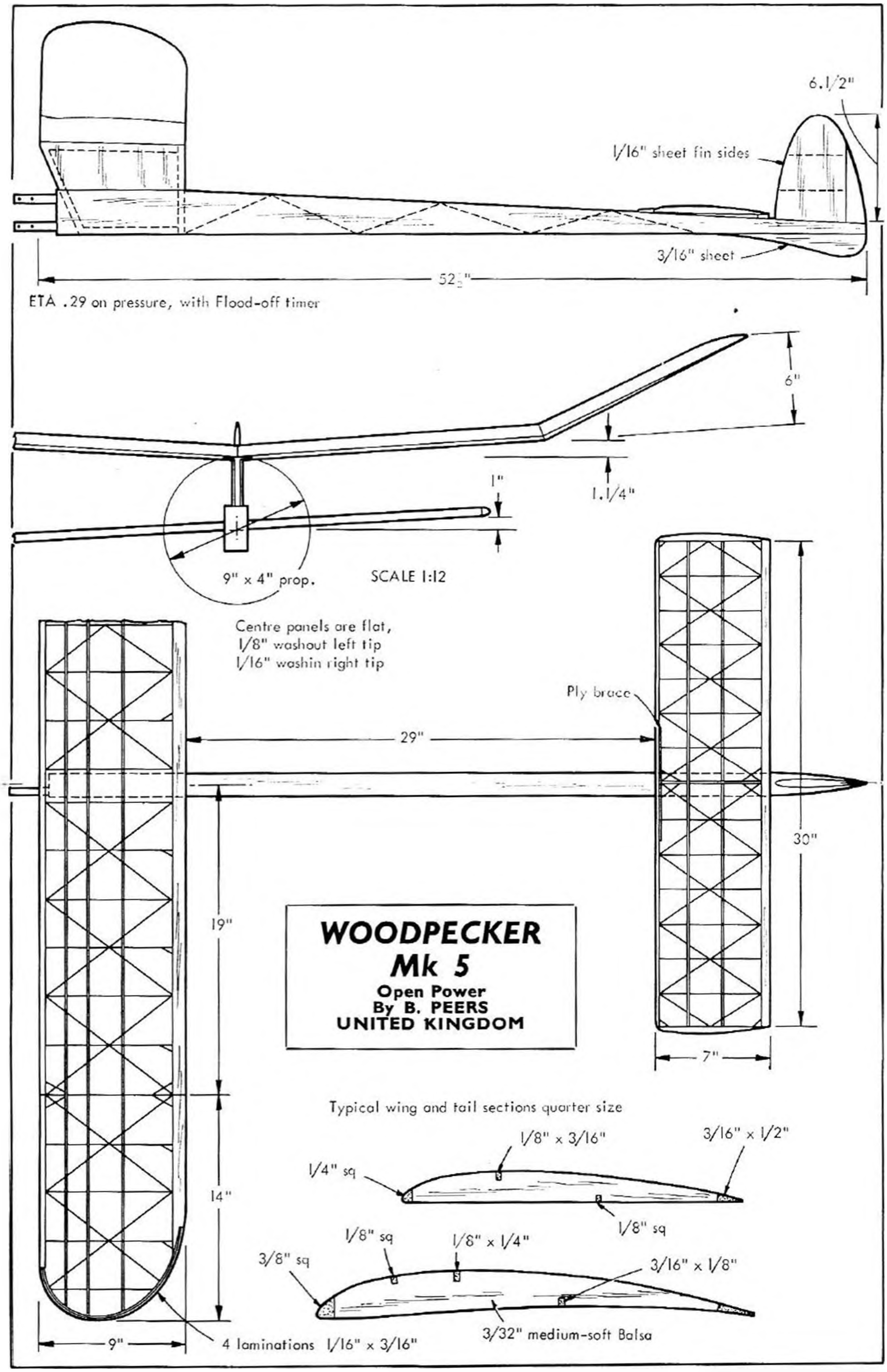
CANADIAN NEWS



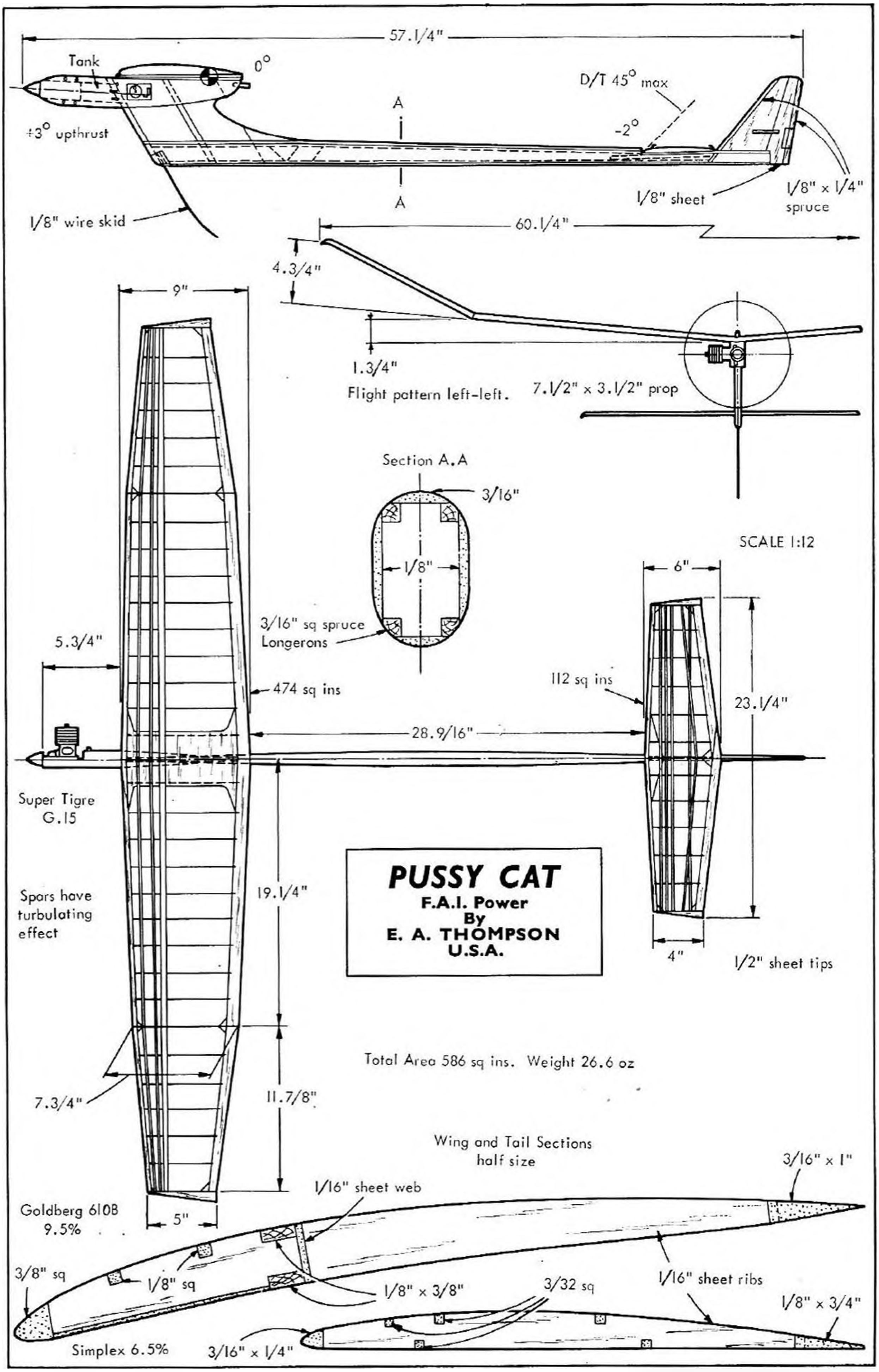
MODELLFLYGNYTT



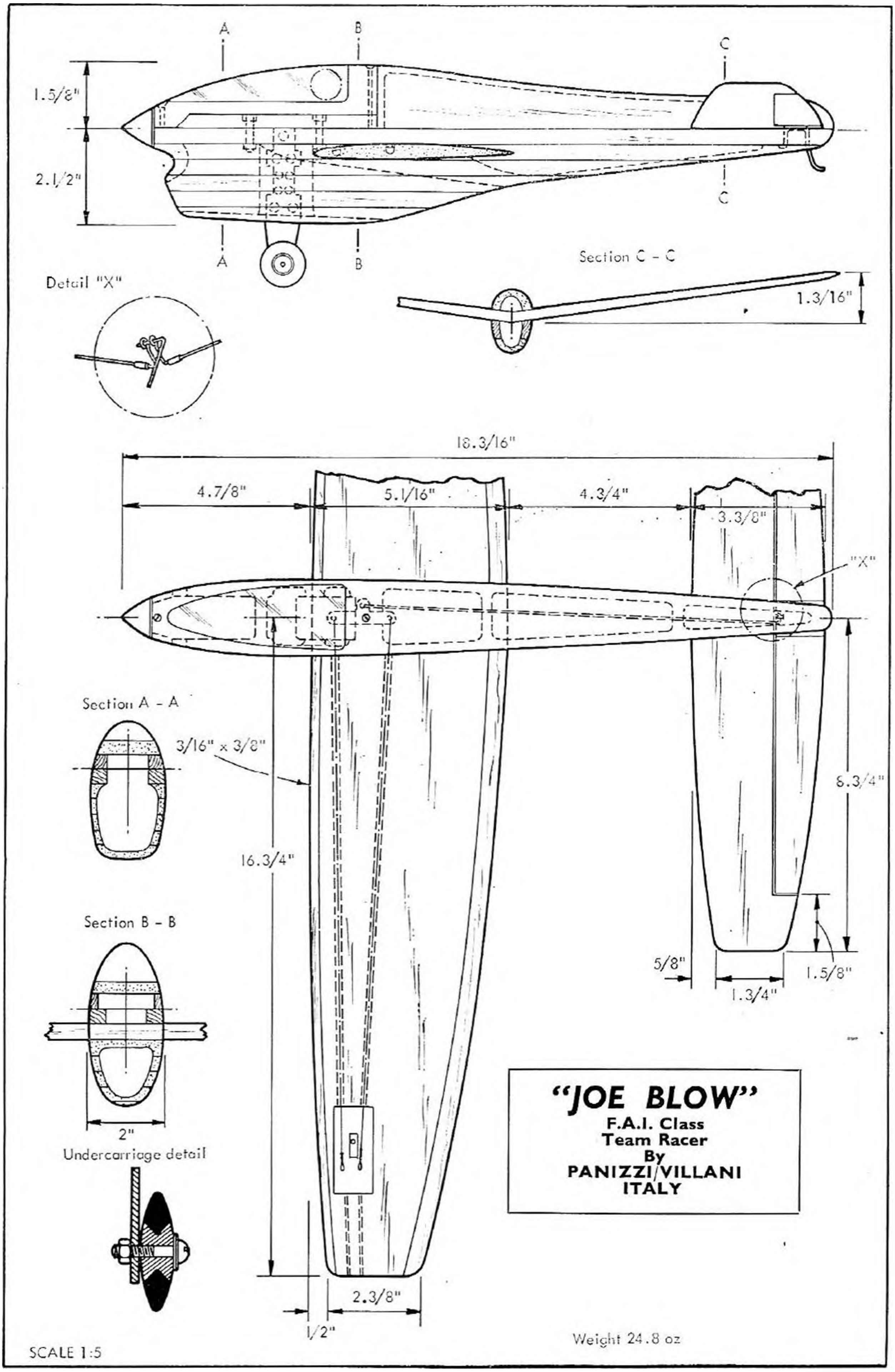
SKRZYDLATA POLSKA



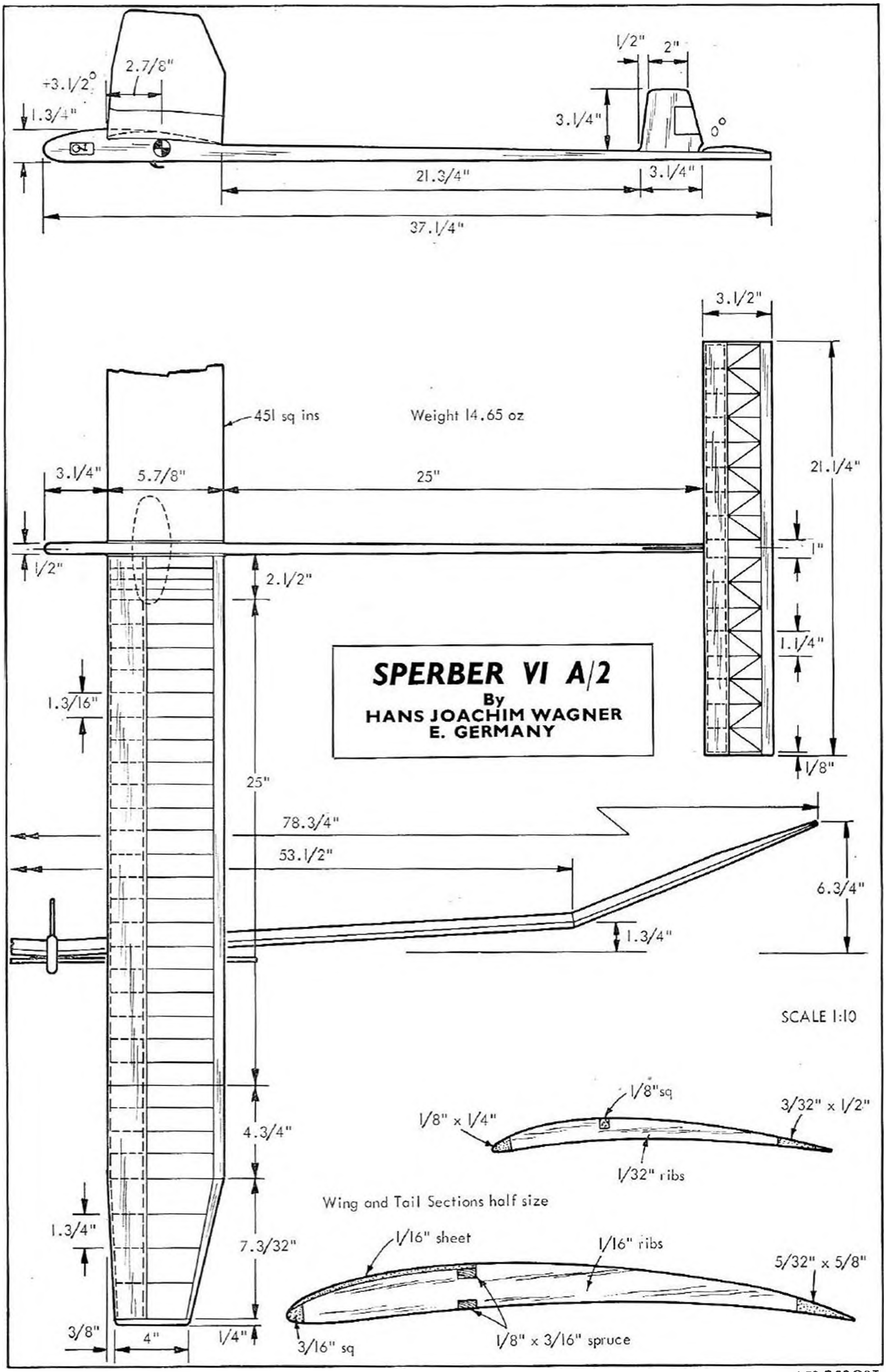
NORTHERN AREA NEWS



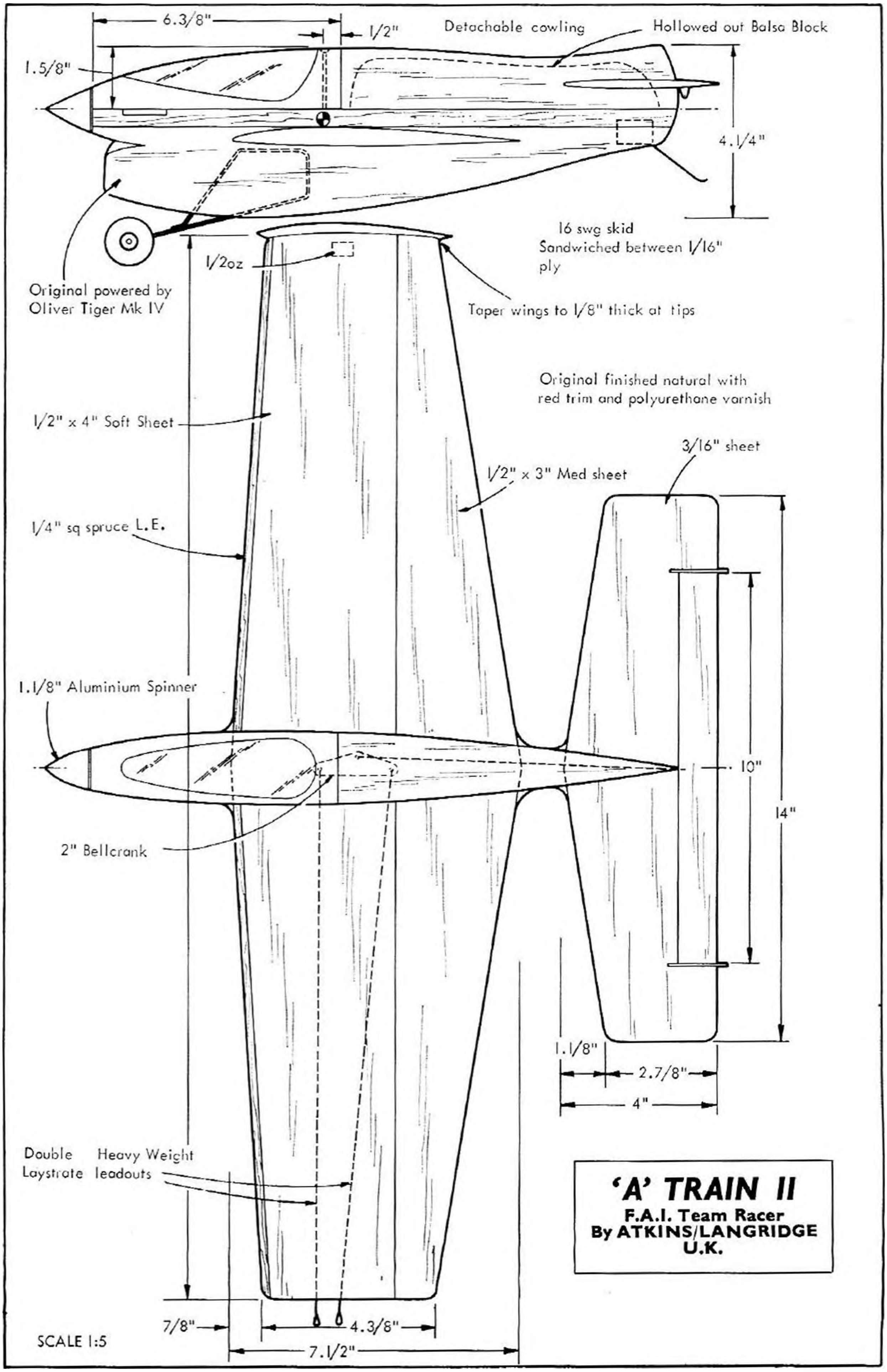
AMERICAN AIRCRAFT MODELER


A
B
C
1.5/8"
2.1/2"
Section C - C
1.3/16"
Detail "X"
18.3/16"
4.7/8"
5.1/16"
4.3/4"
3.3/8"
"X"
Section A - A
3/16" x 3/8"
16.3/4"
8.3/4"
Section B - B
5/8"
1.3/4"
1.5/8"
"JOE BLOW"
F.A.I. Class
Team Racer
By
PANIZZI/VILLANI
ITALY
2"
Undercarriage detail
2.3/8"
1/2"
Weight 24.8 oz
SCALE 1:5

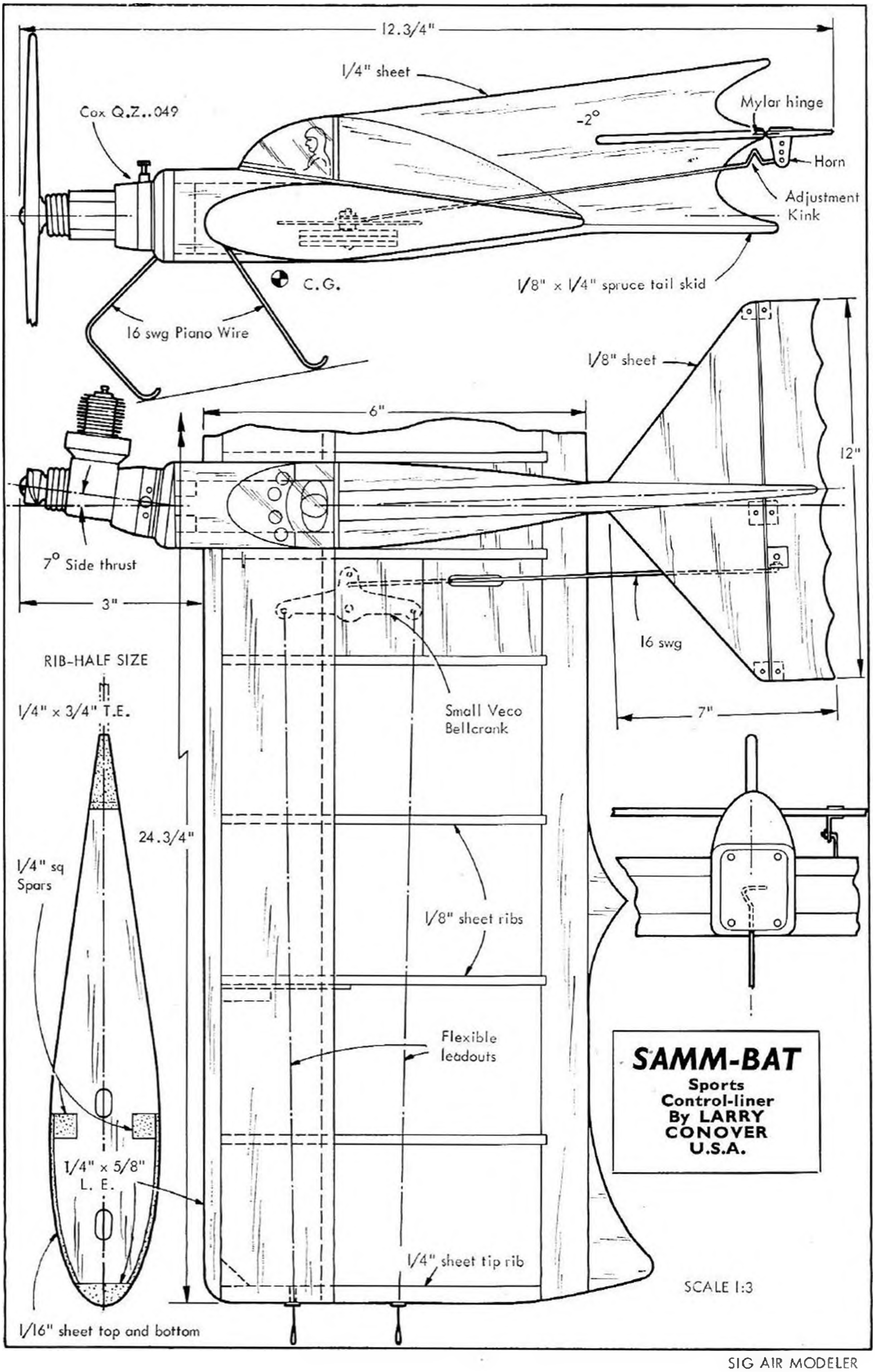
MODELLI


SPERBER VI A/2
By
HANS JOACHIM WAGNER
E. GERMANY
451 sq ins
Weight 14.65 oz
SCALE 1:10
Wing and Tail Sections half size
+3.1/2°
2.7/8"
1.3/4"
1/2"
2"
3.1/4"
0°
21.3/4"
3.1/4"
37.1/4"
3.1/2"
21.1/4"
3.1/4"
5.7/8"
25"
1"
1/2"
2.1/2"
1.1/4"
1.3/16"
1/8"
25"
78.3/4"
53.1/2"
6.3/4"
1.3/4"
4.3/4"
1.3/4"
7.3/32"
3/8"
4"
1/4"
1/8"sq
1/8" x 1/4"
3/32" x 1/2"
1/32" ribs
1/16" sheet
1/16" ribs
5/32" x 5/8"
3/16" sq
1/8" x 3/16" spruce

AEROSPORT

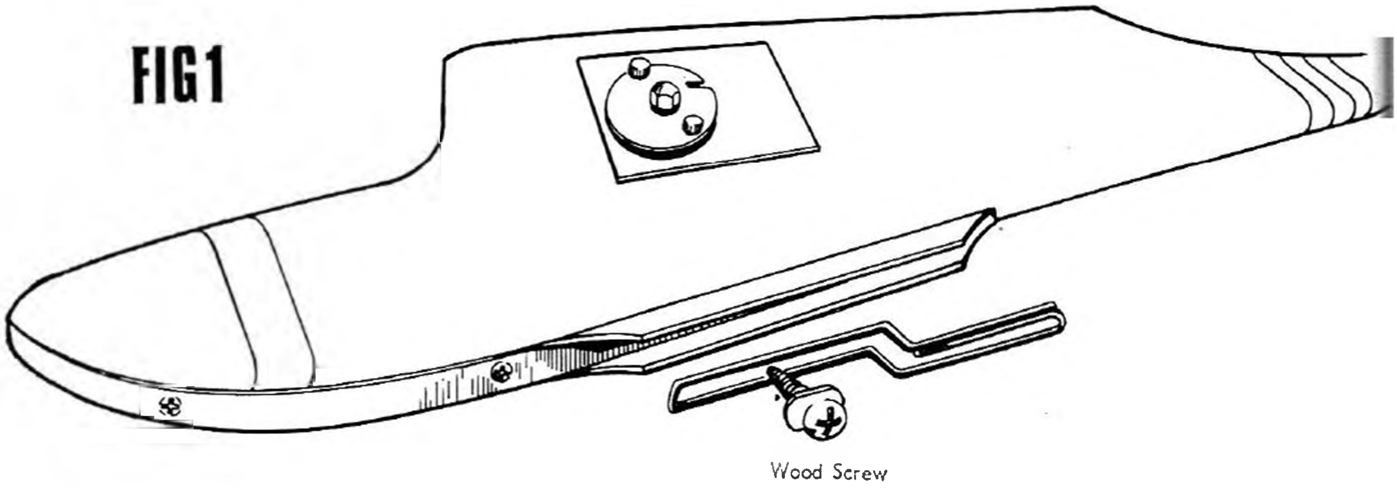

6.3/8"
1/2"
Detachable cowling
Hollowed out Balsa Block
1.5/8"
4.1/4"
16 swg skid
Sandwiched between 1/16" ply
1/2oz
Original powered by
Oliver Tiger Mk IV
Taper wings to 1/8" thick at tips
Original finished natural with
red trim and polyurethane varnish
1/2" x 4" Soft Sheet
3/16" sheet
1/2" x 3" Med sheet
1/4" sq spruce L.E.
1.1/8" Aluminium Spinner
10"
14"
2" Bellcrank
1.1/8"
2.7/8"
4"
Double Heavy Weight
Laystrate leadouts
'A' TRAIN II
F.A.I. Team Racer
By ATKINS/LANGRIDGE
U.K.
7/8"
4.3/8"
7.1/2"
SCALE 1:5

CIRCUIT



SIG AIR MODELER

FIG 1



GLIDER CONSTRUCTION SUGGESTIONS

by Trevor Faulkner

Diagram Details

1. Adjustable towhook and skid. Aluminium skid bent to channel section and fitted to shape shown. The advantage is that a curved shape can accommodate the skid and still allow adjustments ordinarily associated with flat fuselage undersides.

Fig. 1 illustrates a version of the adjustable towhook: its main advantage is that construction of this component takes place independently of fuselage construction, the skid and hook-screw being fastened to a section of hardwood reinforcing the lower fuselage.

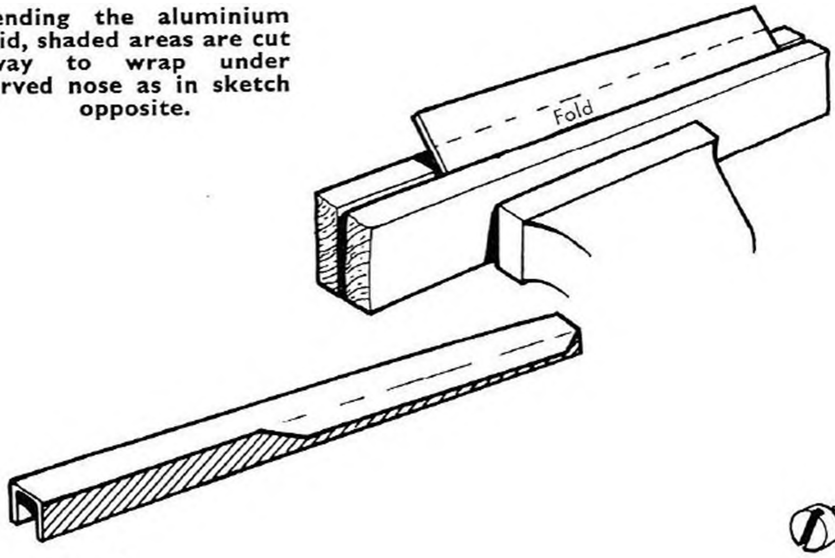
The alloy is bent around a section of material equal in width to the towhook and this ensures a snug fit. The projecting flanges are filed down until they barely shroud the towhook screw and washer. Marks filed on the flanges show graded positions for varying wind speeds.

2. Micro-adjustments for rudder horns using $\frac{1}{8}$ in. $\times$ $\frac{1}{4}$ in. spruce section with polyester resin "cast" of 10 B.A. screws at extremities. Thread loops hold screws whilst resin is applied: silk reinforcement can be incorporated in the resin. Screws are *lightly* oiled and cleaned before casting and will unscrew when resin is cured. The unit is rubbed smooth and profiled on a fine sandpaper and cemented into the fin in the usual way. (A version of this technique can be used for three-point nose noseblock adjustments of rubber models.)

In (2) the illustrations show how internal threads may be "cut" without a tap. The success of this method is based on the simple fact that polyester resins do *not* adhere to metal. The oil acts as a separator and assists the removal of the screw.

3. "Liquid ballast": polyester resin with lead powder incorporated can be brushed or poured as suitable nose weight, etc., glass mat or cloth can be used to reinforce this area. Lead filler is available from many fine art casters or from Tiranti Ltd., Charlotte Street, London. Clean brushes in meths immediately. *Note:* Lead accelerated curing of resins: add lead to resin before adding hardener.

Bending the aluminium skid, shaded areas are cut away to wrap under curved nose as in sketch opposite.



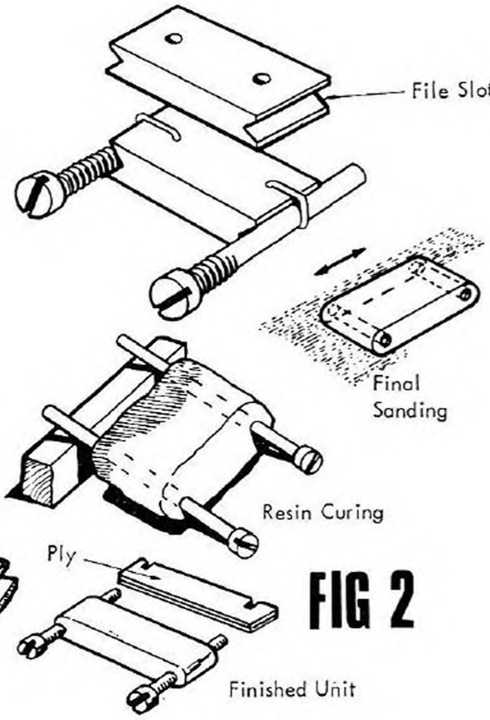


FIG 2

FIG 3

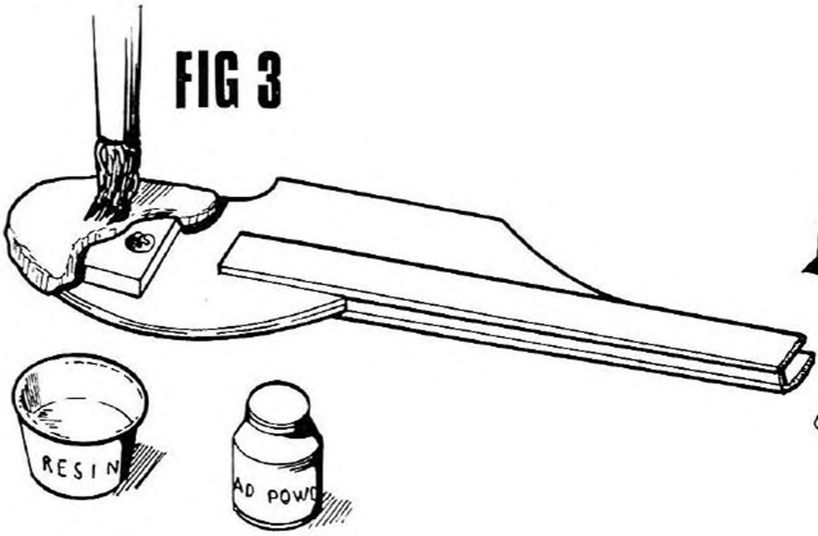


FIG 4

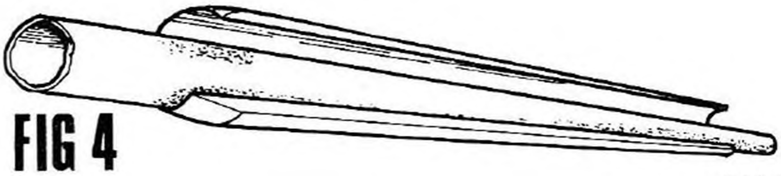


FIG 5

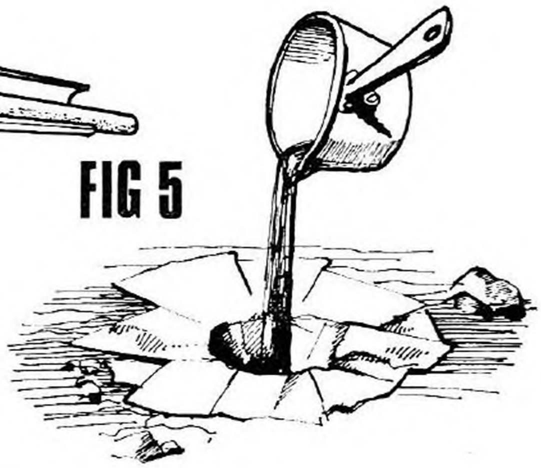
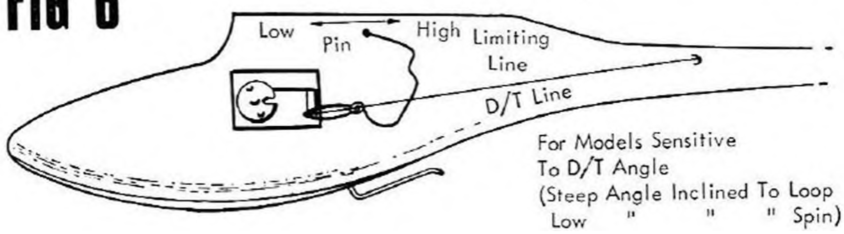


FIG 6



Nose weight or ballast in the form of reinforcement is always attractive and the incorporation of lead powder in a resin mix has these dual advantages. The mixture may be poured into a built-in ballast box and will occupy less space than an equivalent weight of lead shot. In Fig. 3 the resin mix is shown being applied by brush: if this method is used, additional hardener can be added to speed up setting time while the ballast is being built up. (Please note that personal cleanliness is very necessary when powdered lead is used.)

4. To avoid the need to epoxy mounting units to glass fibre rod fuselages, wrap the rod with soft $\frac{1}{32}$ in. sheet secured with an impact adhesive; small radius is no obstacle and added weight is negligible.

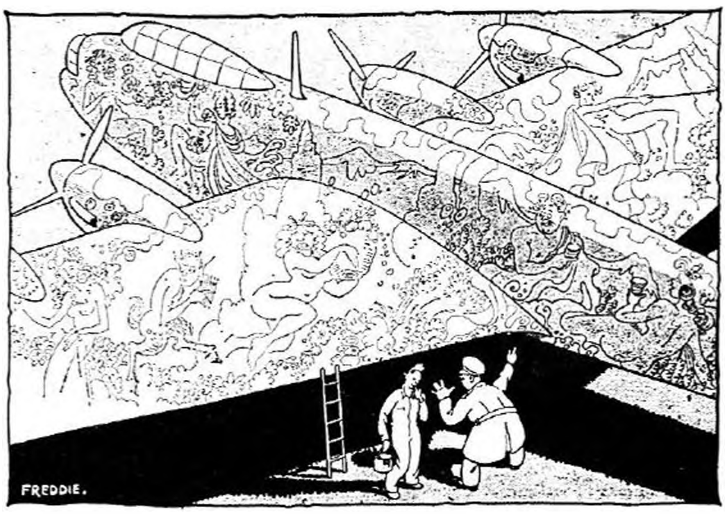
For some instinctive reason I am wary of fixing components to a flexible fibreglass fishing rod by means of epoxy resin which sets rock hard. The suggestion in (4) allows flexibility of the adhesive layer to be used and further saves the time required by epoxy resins to cure fully. Balsa cement can be used for the subsequent building procedure.

5. Lead casting in a wet mould can be *very* dangerous: for simple shapes try pressing aluminium foil to the required (negative) profile in a suitable piece of ground. Pour the lead and file and/or beat to the finished shape.

Finally, I have found a variety in D/T behaviour amongst my stable of models. Usually, Wakefields, U/R rubber models and Coupe d'Hiver give no trouble. Low aspect ratio wings combined with large stabiliser areas seem to represent simplicity in this respect, but my two A/2s are decidedly fickle. With aspect ratios of 14 and small tail areas (65°) the angle of tilt is very critical. The models alternated between spinning and stalling and to arrive at the most suitable adjustment the fixing shown in (5) was used.

As can be seen, the pin may be moved to allow very minute controlled adjustments to be made. The time saved when compared with the shortening or lengthening procedure necessary with a typical restrainer band is considerable, particularly on a cold, windy day!

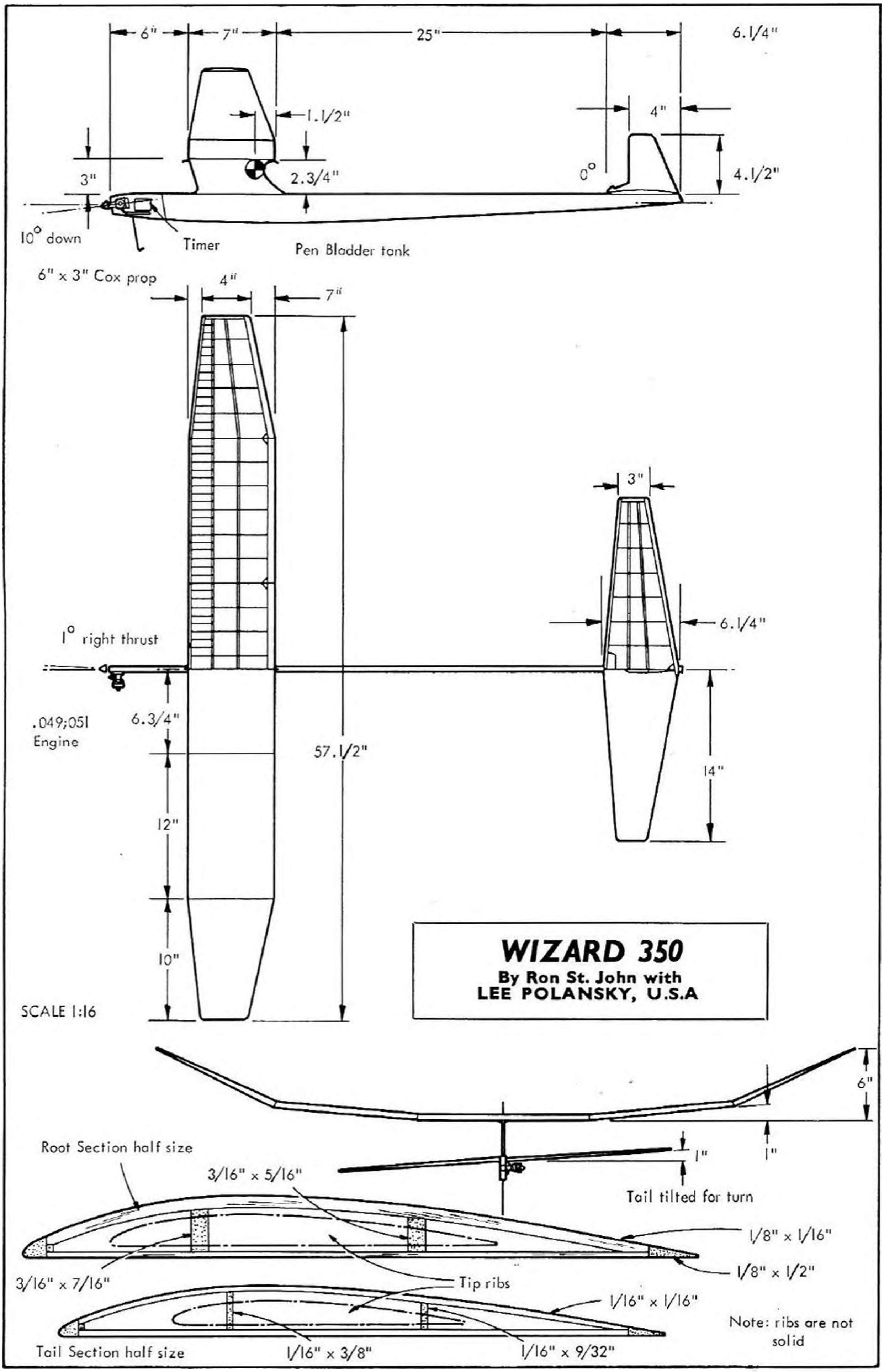
One of the fascinating aspects of aeromodelling is the seemingly limitless number of modifications and alterations which can take place in the detailed construction of the average model. Because of this I decided to place on record the innovations which have become part of my building methods during the past six months (the time limit during which I have built and flown a couple of A/2 gliders, a very limited programme indeed).



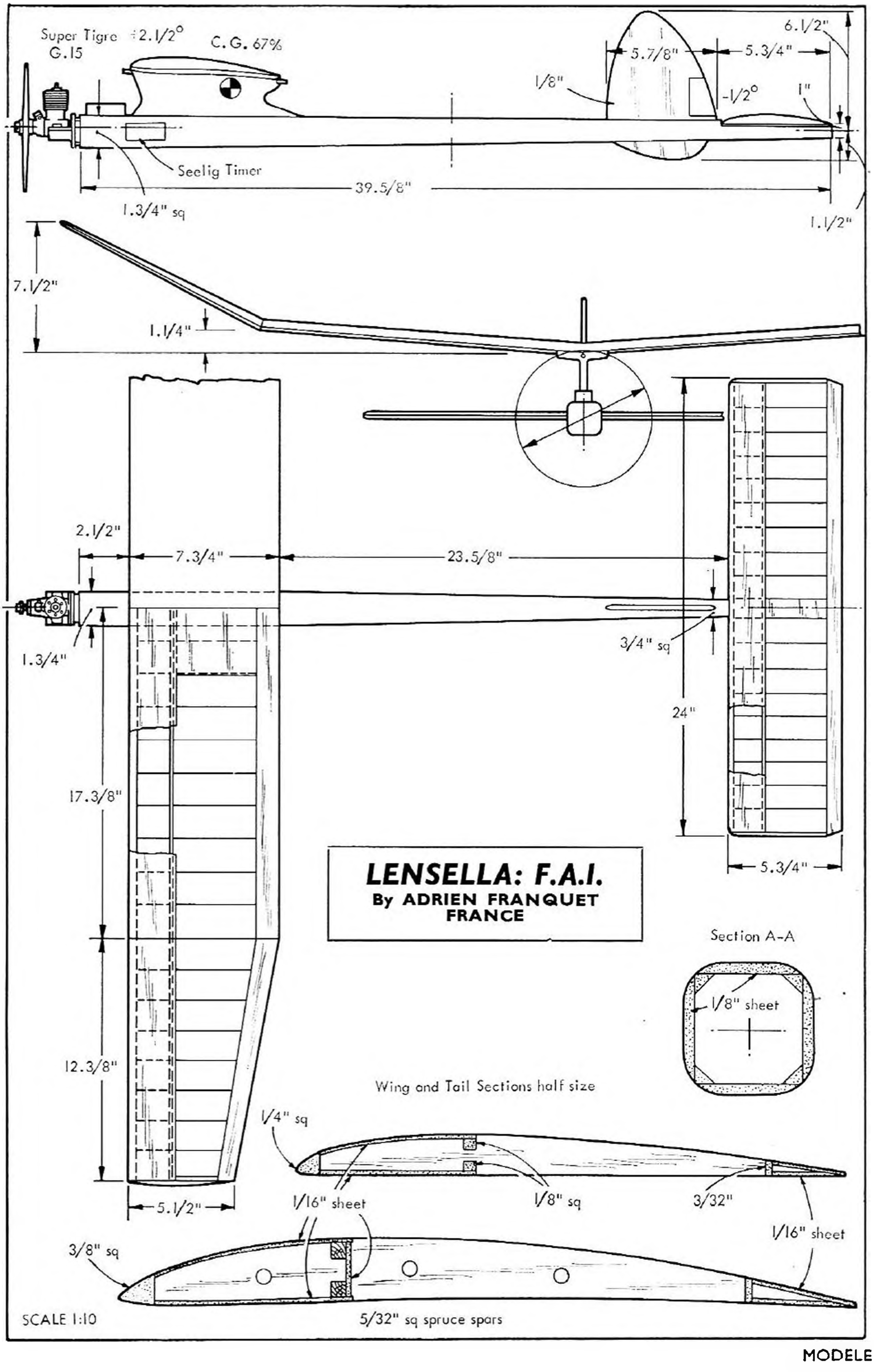
Vintage 'Freddy' cartoon from Aeromodeller 30 years ago

. . . .

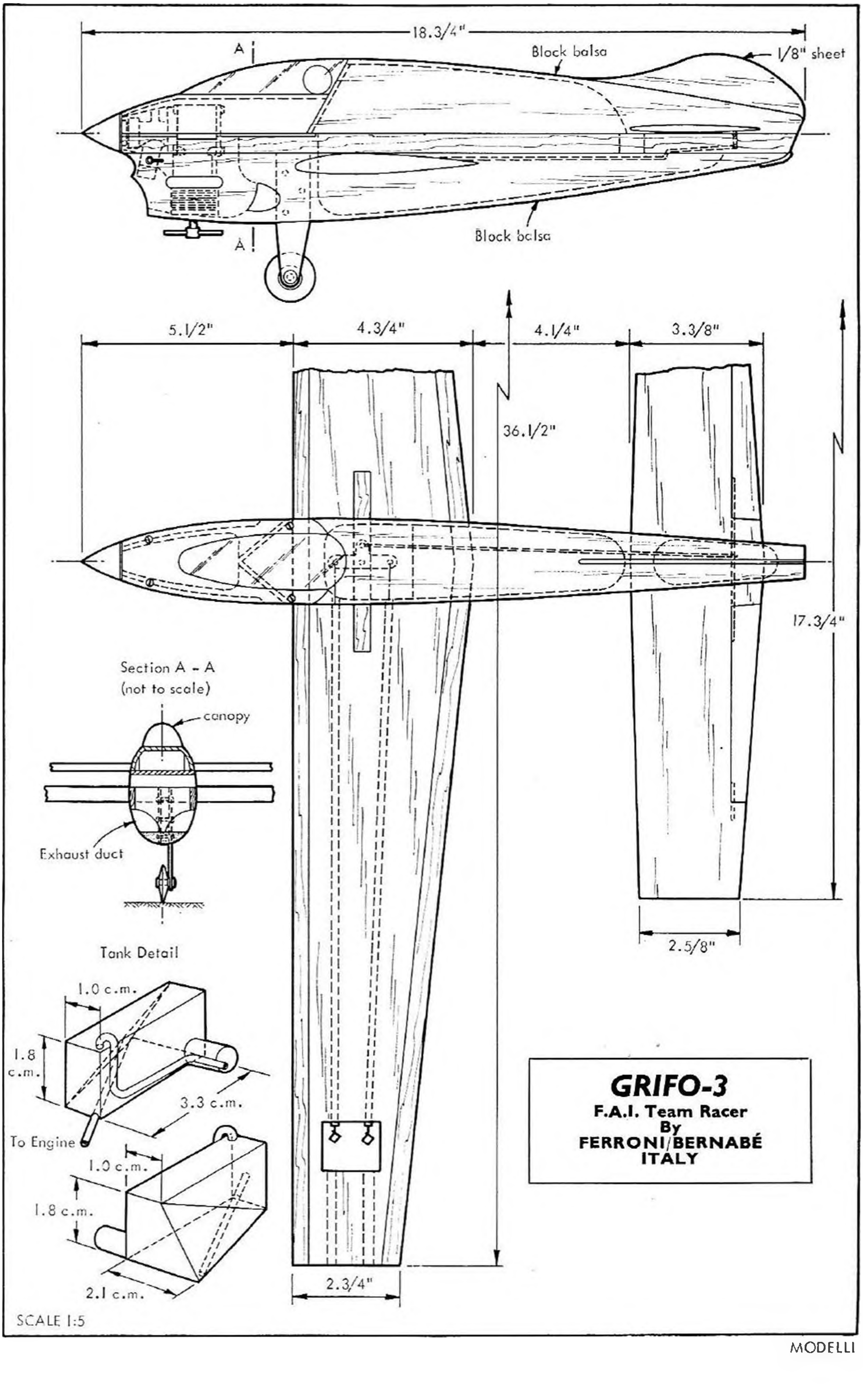
"I'm sorry Sir, I got carried away!"


6"
7"
25"
6.1/4"
1.1/2"
4"
3"
2.3/4"
0°
4.1/2"
10° down
Timer
Pen Bladder tank
6" x 3" Cox prop
4"
7"
3"
1° right thrust
6.1/4"
.049;051
Engine
6.3/4"
57.1/2"
14"
12"
10"
WIZARD 350
By Ron St. John with
LEE POLANSKY, U.S.A
SCALE 1:16
6"
1"
1"
Tail tilted for turn
Root Section half size
3/16" x 5/16"
1/8" x 1/16"
1/8" x 1/2"
3/16" x 7/16"
Tip ribs
1/16" x 1/16"
Note: ribs are not solid
Tail Section half size
1/16" x 3/8"
1/16" x 9/32"

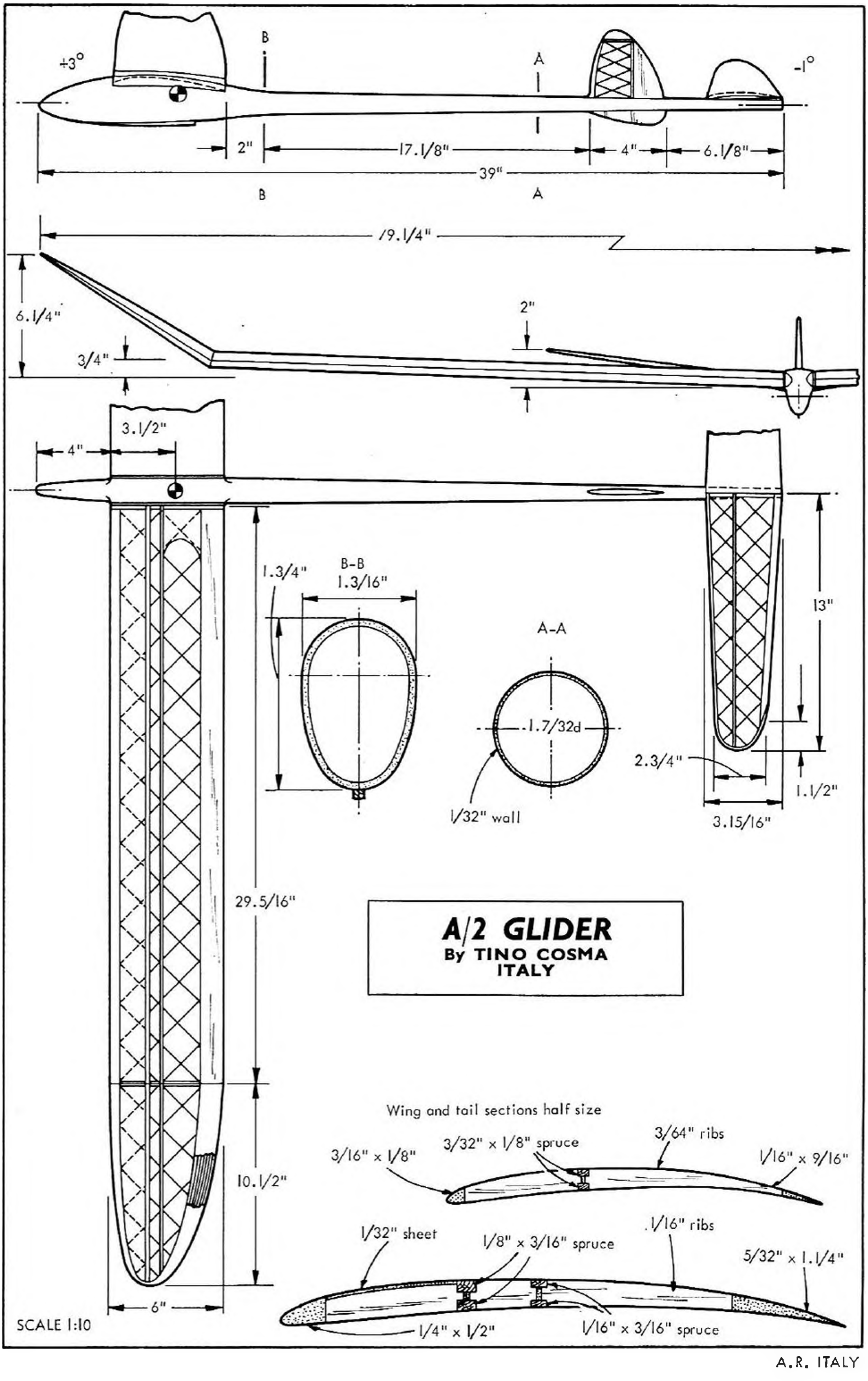
SATELLITE


Super Tigre G.15
+2.1/2°
C.G. 67%
5.7/8"
5.3/4"
6.1/2"
1/8"
-1/2°
1"
Seelig Timer
39.5/8"
1.3/4" sq
1.1/2"
7.1/2"
1.1/4"
2.1/2"
7.3/4"
23.5/8"
1.3/4"
3/4" sq
24"
17.3/8"
12.3/8"
5.1/2"
5.3/4"
LENSELLA: F.A.I.
By ADRIEN FRANQUET
FRANCE
Section A-A
1/8" sheet
Wing and Tail Sections half size
1/4" sq
1/8" sq
3/32"
1/16" sheet
1/16" sheet
3/8" sq
SCALE 1:10
5/32" sq spruce spars

MODELE

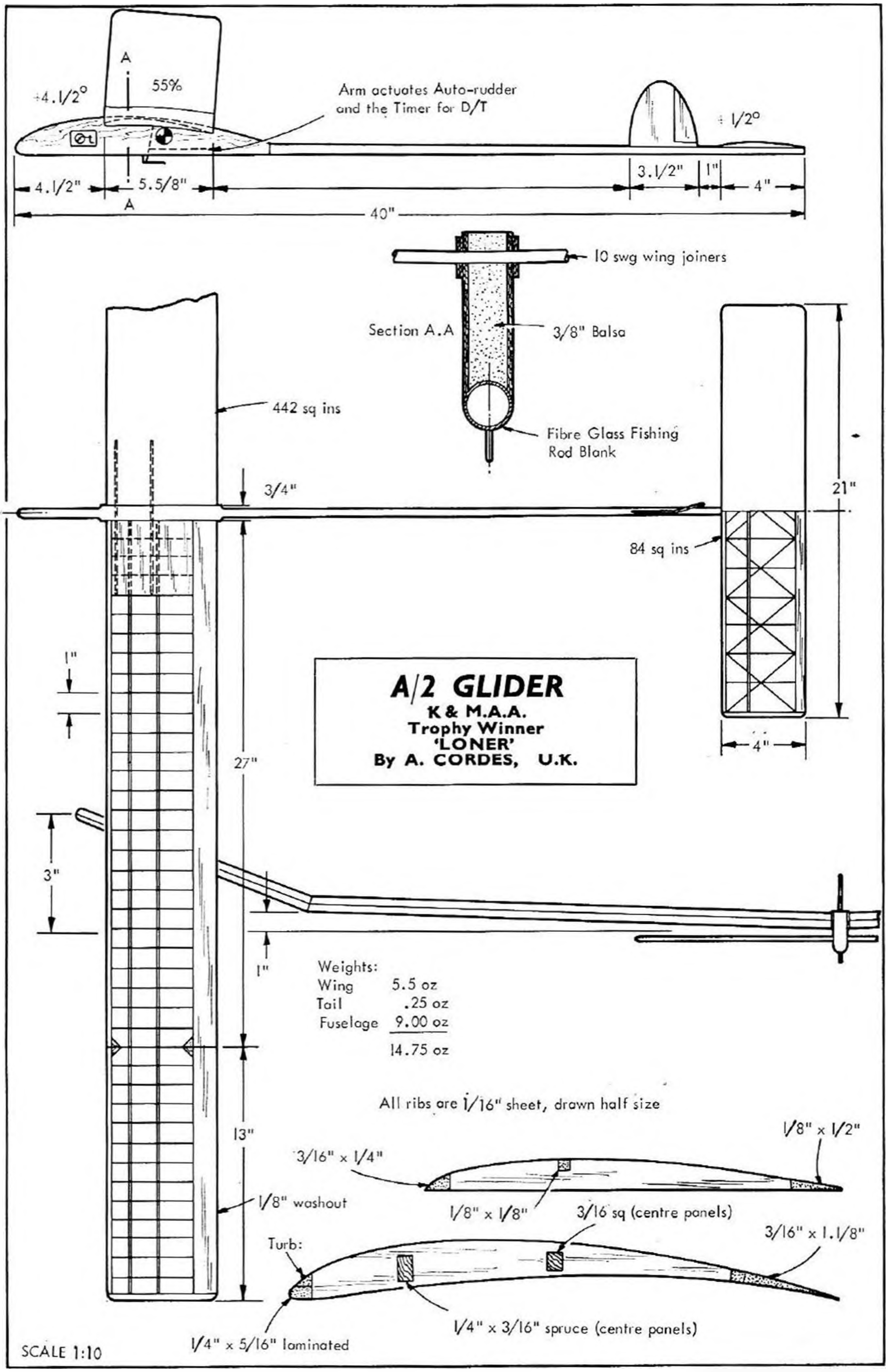

18.3/4"
A
Block balsa
1/8" sheet
A
Block balsa
5.1/2"
4.3/4"
4.1/4"
3.3/8"
36.1/2"
17.3/4"
Section A - A
(not to scale)
canopy
Exhaust duct
2.5/8"
Tank Detail
1.0 c.m.
1.8 c.m.
3.3 c.m.
To Engine
1.0 c.m.
1.8 c.m.
2.1 c.m.
2.3/4"
GRIFO-3
F.A.I. Team Racer
By
FERRONI/BERNABÉ
ITALY
SCALE 1:5

MODELLI

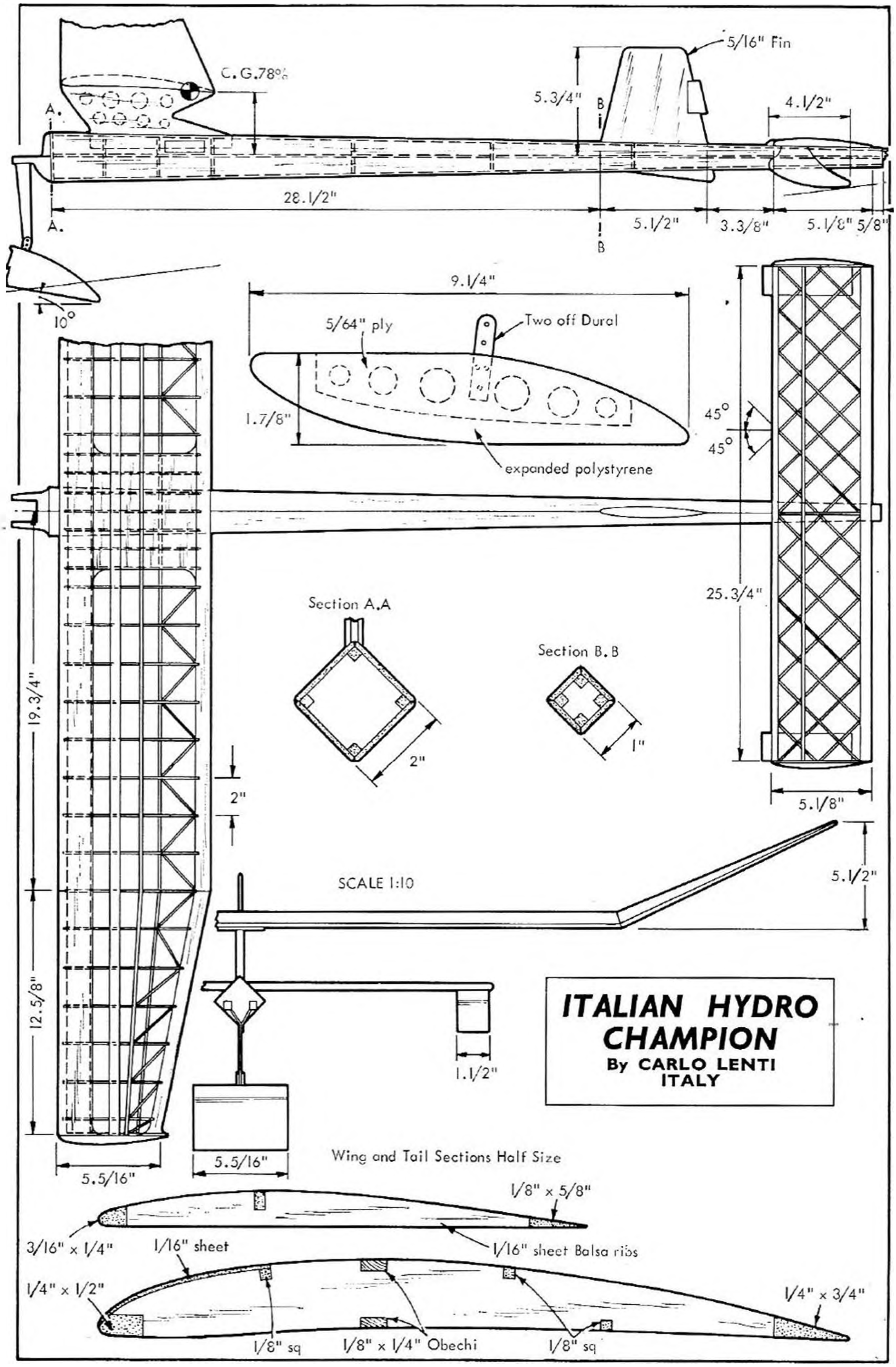


+3°
B
A
-1°
2"
17.1/8"
4"
6.1/8"
39"
B
A
19.1/4"
6.1/4"
3/4"
2"
3.1/2"
4"
1.3/4"
B-B
1.3/16"
A-A
1.7/32d
1/32" wall
13"
2.3/4"
1.1/2"
3.15/16"
29.5/16"
A/2 GLIDER
By TINO COSMA
ITALY
Wing and tail sections half size
3/32" x 1/8" spruce
3/64" ribs
3/16" x 1/8"
1/16" x 9/16"
10.1/2"
1/32" sheet
1/8" x 3/16" spruce
1/16" ribs
5/32" x 1.1/4"
6"
SCALE 1:10
1/4" x 1/2"
1/16" x 3/16" spruce

A.R. ITALY



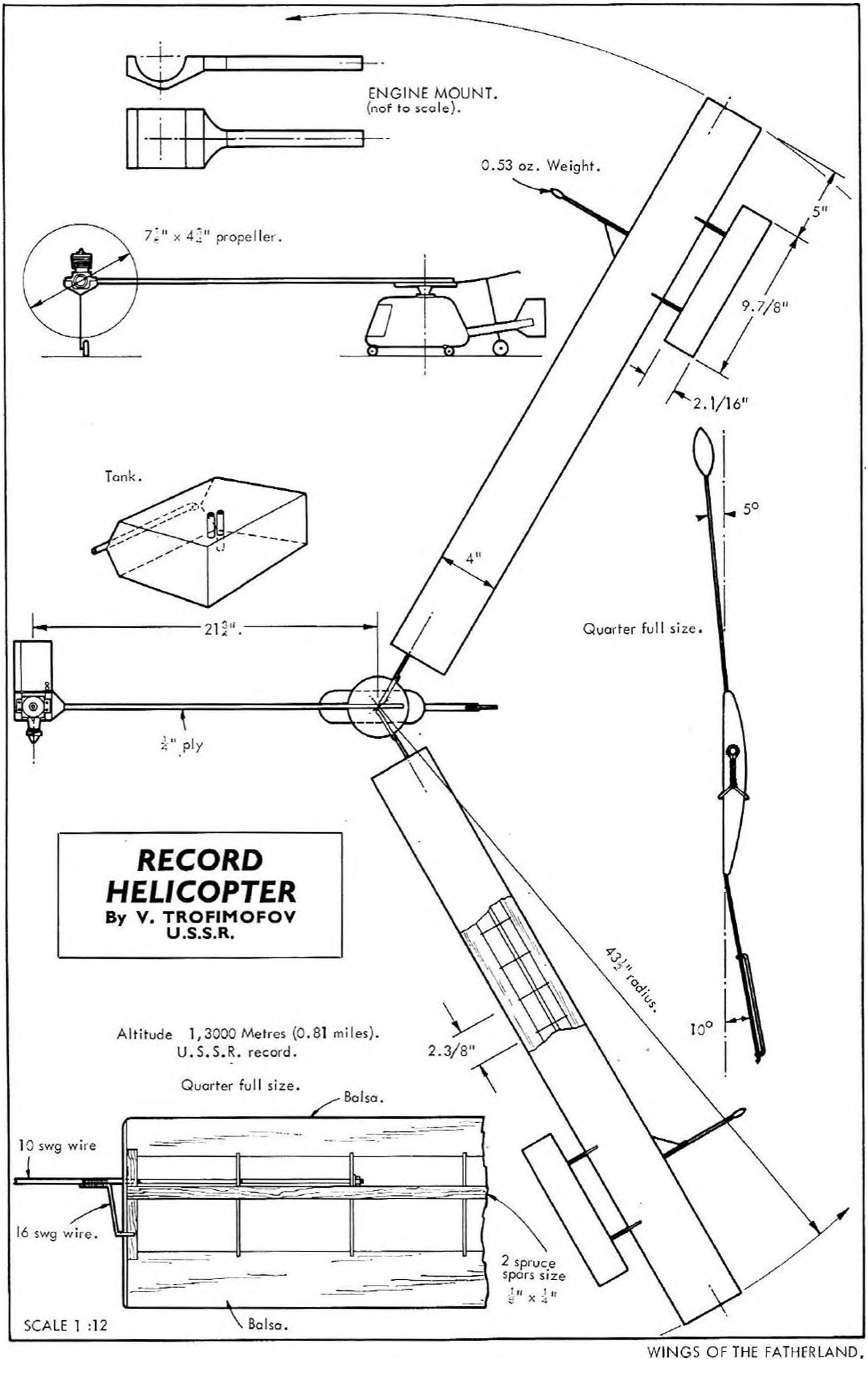
NORTHERN AREA NEWS



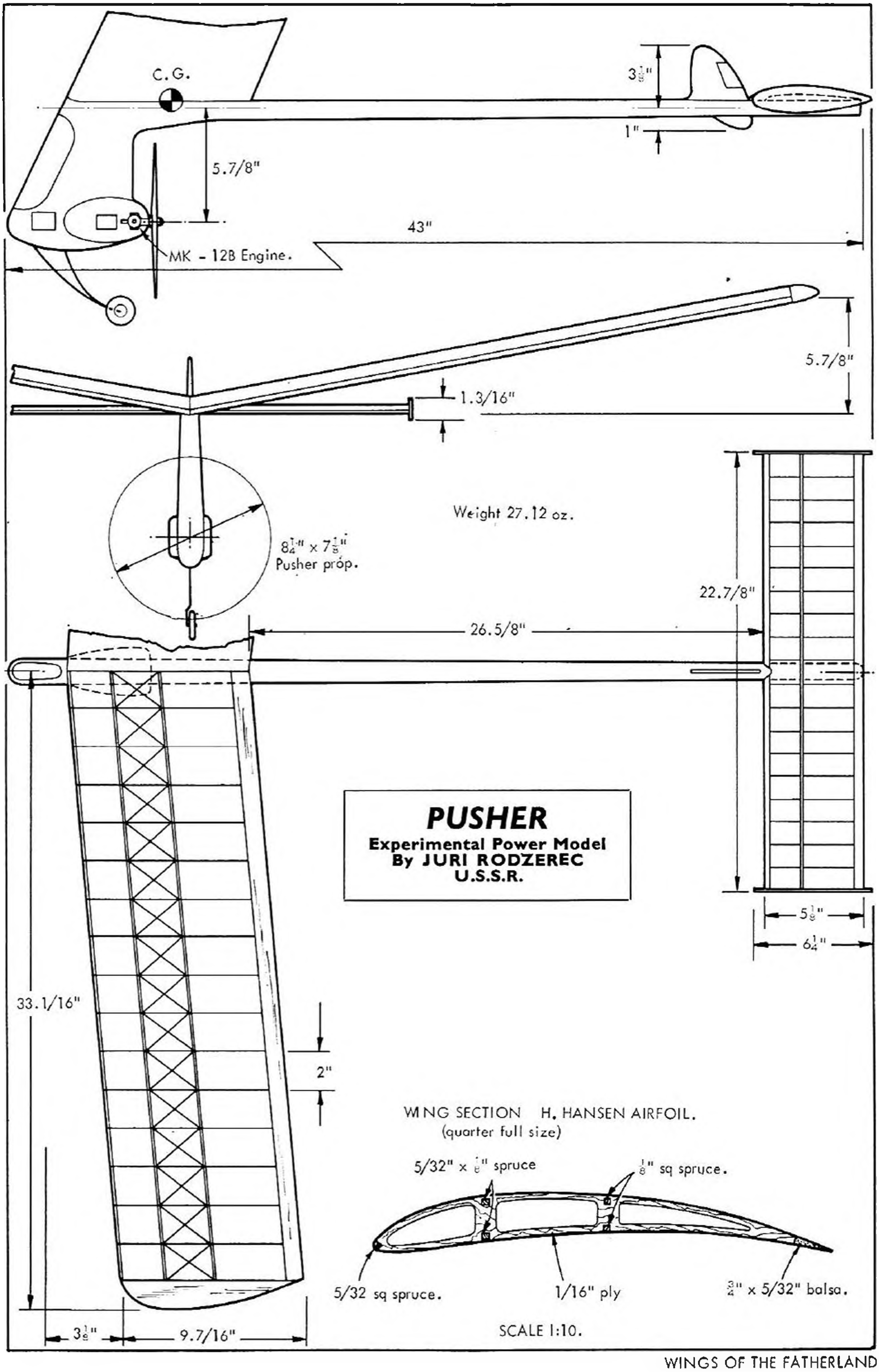
ITALIAN HYDRO CHAMPION

By CARLO LENTI ITALY

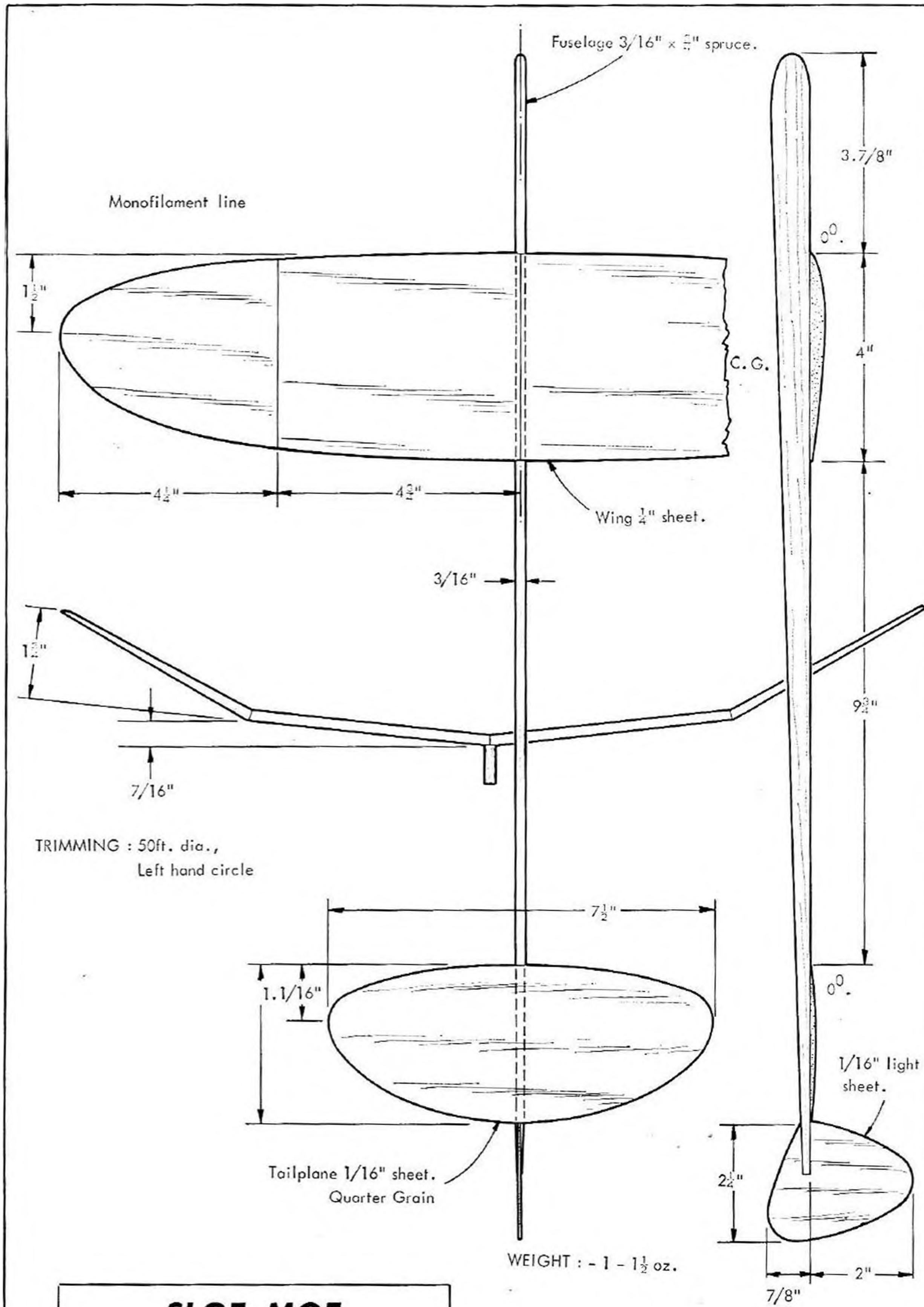
MODELLI



WINGS OF THE FATHERLAND.



WINGS OF THE FATHERLAND

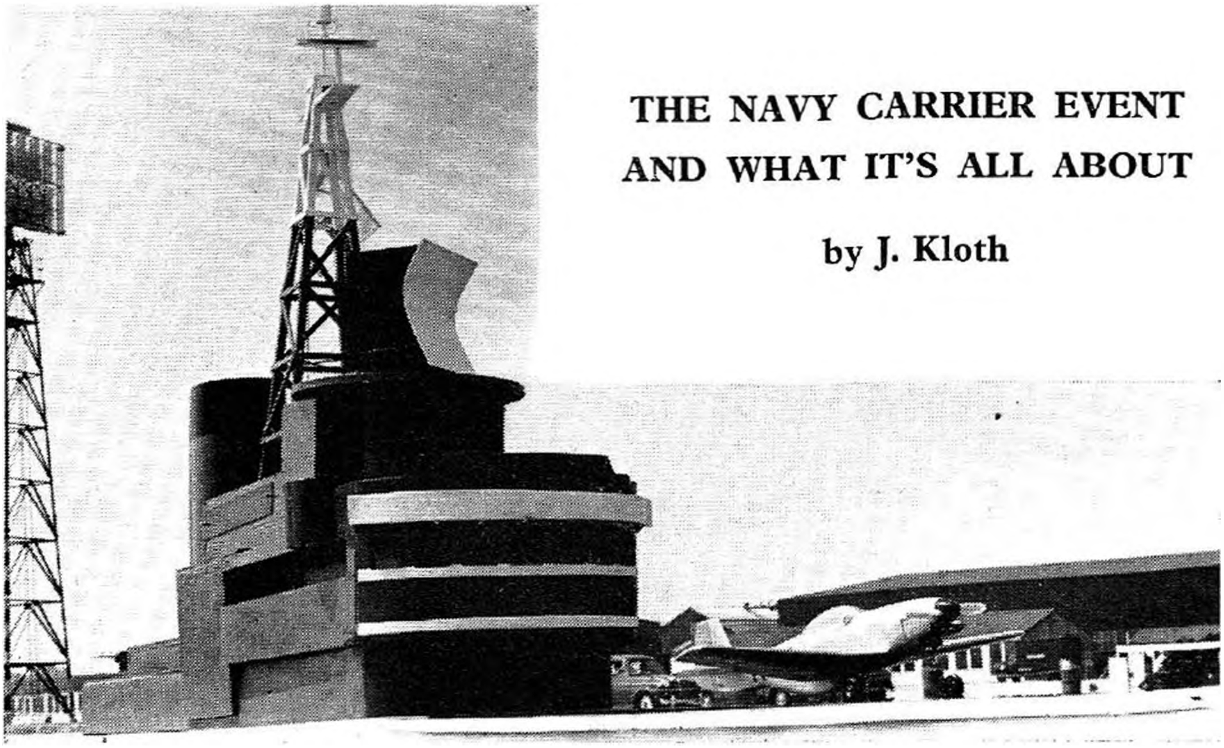


SLOE MOE

Canadian Nats Chuck Glider Winner
By RON HIGGS, CANADA

SCALE 1": 4.

CANADIAN NEWSLETTER.



THE NAVY CARRIER EVENT AND WHAT IT'S ALL ABOUT

by J. Kloth

NAVY Carrier is probably the most challenging and, therefore, the most enjoyable, control-line event on the contest schedule. It requires skills from almost all of the other control-line events plus a few peculiar to itself. It draws hot engines, hot fuel and high performance from the speed events. It demands a good bit of the precise flying ability of stunt. The realism and gadgetry are drawn from the scale event without the tediousness of reproducing the ultra-fine detail. The carrier take-offs and landings give further excitement to contestant and spectator alike. The thrill of a recognisable aeroplane rocketing off a replica carrier deck; booming through its high-speed run; realistically throttling back, hook, flaps and sometimes landing gear appearing; the agonising slow flight building up to the final approach to the deck; and Bam! you're down with the hook engaging one of the wires (you hope), adds up to a most satisfying endeavour.

The full competition Class II model appearing in most American contests is a complex and awe-inspiring sight to a novice or spectator. However, when it is broken down to its basic parts and viewed as a goal instead of an immediate necessity, the difficulties no longer seem so insurmountable. Even the smaller Class I size model can involve a good deal of time, effort and money. Reverting to the old adage of, "You must walk before you can run", there is much that one can do to get started and even become competitive with a relatively small investment of time and money.

There is such a large group of people now enjoying the flying of the Navy Carrier event, though unwilling, unable or uninterested in the scale aspect, to cause serious consideration of adding a non-scale Class I event to the A.M.A. contest schedule. This type of event previously had been limited to juniors only. This class would provide an ideal starting ground and hopefully would promote greater participation in the two scale-type classes. It would give the beginner a place to try out his flying and linkage engineering ability in competition without forcing him into the added work of a scale aeroplane. There are quite a few good kits available which can and have been converted to carrier use rather easily. The Sterling Skyshark was designed with just this purpose in mind. Some of the

others, such as Ringmasters, Magicians, and Sterling Mustangs, have also been modified to resemble carrier-based aircraft and retain some of the scale-like appearances.

The two most important components of any carrier-type aeroplane are the control system and the engine. Let's look at the control system first. Many methods of adding throttle and other accessory control to the standard two-line system have been tried. Few have been able to do the job adequately. The best method, tried and proven over many years, is the J. Roberts system now produced by Sturdi-Built. This system utilises a balance between the normal two flying lines and a third line. The effect of shortening the two flying wires and lengthening the third for high speed and reversing the procedure for low is accomplished by a lever system in the patented handle. This motion is then translated into a fore-and-aft motion by an auxiliary bellcrank beneath and interconnected with the usual one. The centrifugal pull of the model is divided equally by the three lines and this balance allows small, precise, and quick throttle changes. Sturdi-Built has recently improved the design of the plane units for greater strength. Custom plane units of Sturdi-Built parts are hand assembled by Bill M. Johnson (more about Bill later) and give even greater strength and improved action through a few of his little tricks.

The use of this fore-and-aft motion is up to the individual. Each aeroplane seems to present uniquely different conditions which need to be met. The motion is aft for high speed and forward for low. The travel is about $\frac{3}{4}$ in. Appropriate additional bellcranks, push-rods, links and levers must be fitted to provide the necessary directional travels and distances to operate the throttle, flap and hook release devices properly. One method is to connect the auxiliary bellcrank to a shaft fitted crossways in the fuselage. Additional levers can then be fastened to the cross-shaft with the proper moment arms, above or below centre, to provide the needed motion, direction and distance. (See Fig. 1.) Some of the R/C control linkage parts, such as the Dubro Quik-Link, are useful to make up whatever pushrods or arms are needed and allow a certain amount of fine adjustment. These have proved very helpful since wire bends need no longer be so precise. "Nyrod" seems as though it should be extremely useful too, though I have not yet tried it.

H.M.S. "Flycatcher", generous gift of the Royal Navy to the S.M.A.E. has imposing superstructure, seen with marinated Mustang "on deck" at R.N.A.S. Yeovilton in heading opposite.

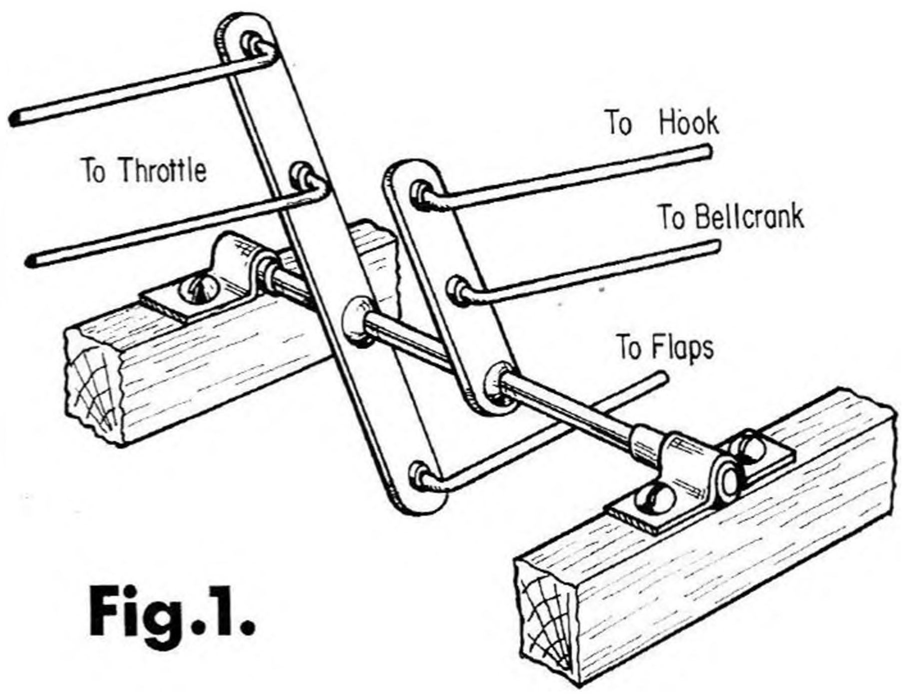


Fig.1.

Layshaft diagram for variation of control throw from levers to various functions in Carrier Deck models.

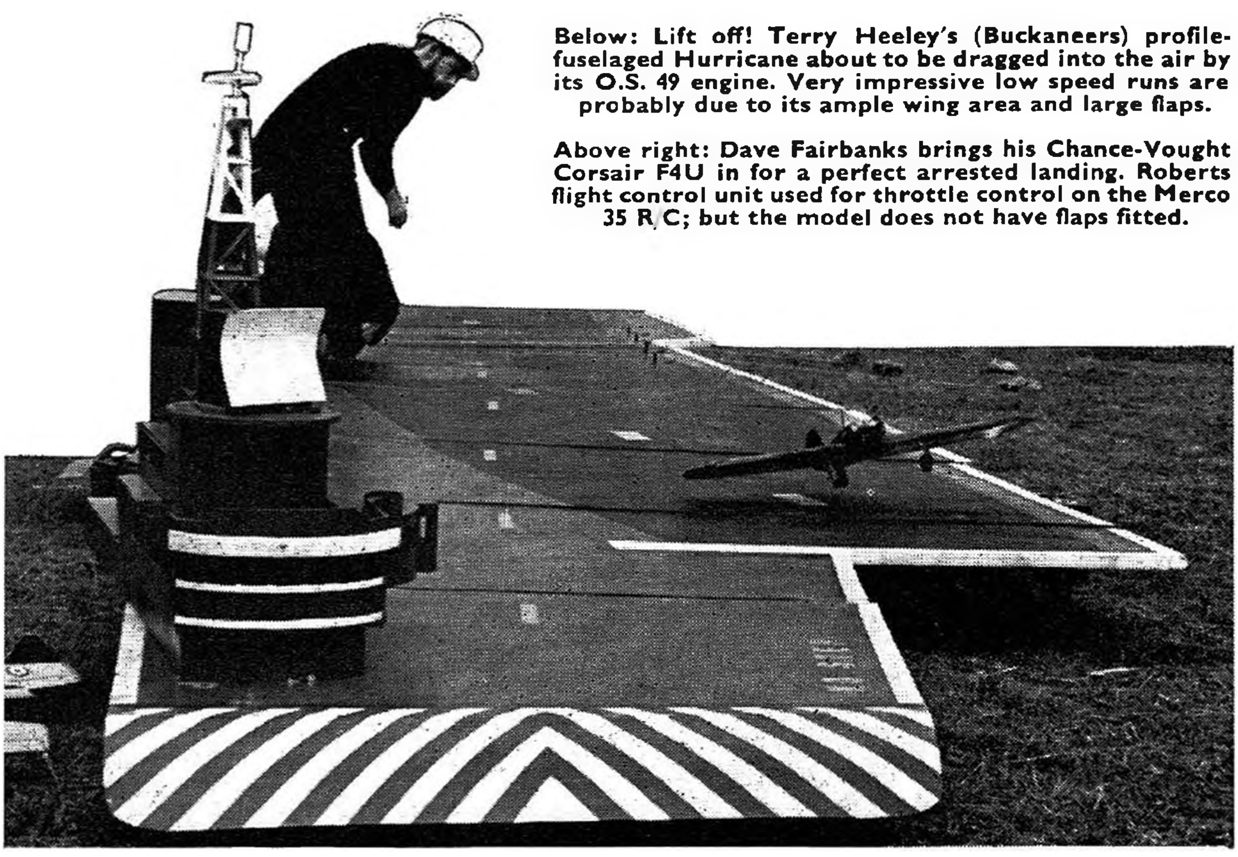
Great care must be exercised in the development of the linkage system. Most important, *the system must operate smoothly and freely with no binds and little looseness in the pivot points.* Short lengths of brass tubing make ideal bearings when positioned properly and soldered to sheet metal levers. Apply a dab of "Lubrosil" or some similar compound at the pivot points to ensure permanent lubrication. It is best to install all linkages and thoroughly check them for proper operation before closing up the fuselage. Checking is best done by hooking the J. Roberts control handle to the leadouts and operating the handle.

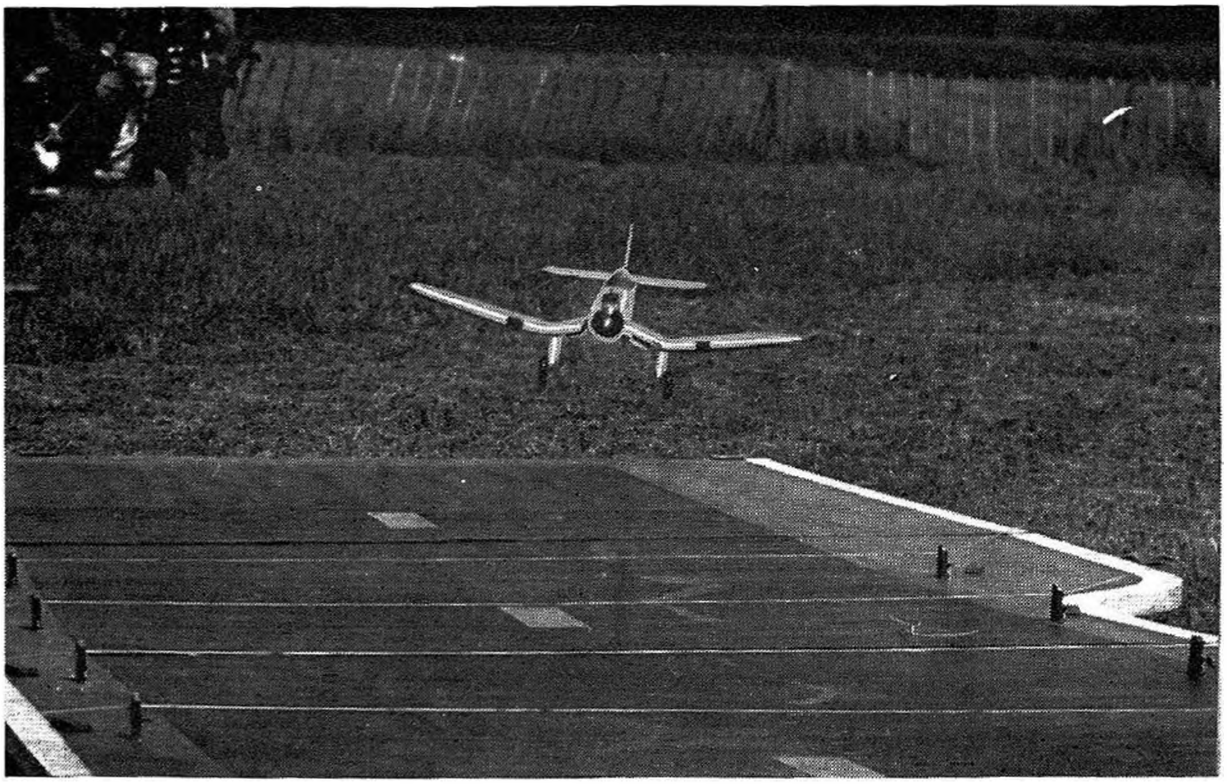
The choice of engine is the second most important point. Carrier aeroplanes represent a good deal of work and it can be heartbreaking to find you've chosen an engine which is not suited to the event. There are many good R/C engines available in both the ·40 and ·60 size which would be suitable for the beginner. Primary concern should be adequate power and smooth, effective throttling. The R/C-style engines are more docile and easier to handle, so give fewer problems while learning the other facets of the event. Later, hotter engines and other throttle systems can be tried. The first engine can be chosen with an eye to conversion later on.

The ultimate in competition carrier throttle systems at this time is produced by Bill M. Johnson, 6328 Jackson, Berkeley, Missouri, 63134, U.S.A., a tool and die maker for McDonnell Aircraft. It consists of an exhaust slide coupled to Bill's own "Fuel Control". This allows the use of huge intake venturis by throttling the pressurised fuel supply ahead of the needle valve. Now the wildest of the ·60 racing engines and ·40 Rat Race engines can be used, coupled with the high nitro fuel blends. Performance during the high-speed run skyrockets yet the engine will still throttle back to a slow, smooth idle for slow speed and landing. The throttle response is immediate when the Fuel Control is properly adjusted. Minute throttle changes can be made and quick, full-throttle

Below: Lift off! Terry Heeley's (Buckaneers) profile-fuselaged Hurricane about to be dragged into the air by its O.S. 49 engine. Very impressive low speed runs are probably due to its ample wing area and large flaps.

Above right: Dave Fairbanks brings his Chance-Vought Corsair F4U in for a perfect arrested landing. Roberts flight control unit used for throttle control on the Merco 35 R/C; but the model does not have flaps fitted.





bursts can save you from falling into the drink. The return to low throttle is immediate so that little is lost during the low-speed portion. I have used these throttles very successfully for a number of years. They have been fitted to Fox 36X, Supertigre G 21/40, Front Rotary, K. & B. 40RR, McCoy 60 and Rossi 60 engines and, once tuned according to instructions, the performance of all has been phenomenal. There are a number of other engines which could similarly be altered for better performance. The Bill Johnson throttle system is the only way to go for all-out carrier competition.

Flaps, hook, rudder and retractable landing gear can be classed as flight accessories. The arresting hook is the only required accessory. The others can be used at the builders' option. The hook should be at least $\frac{1}{8}$ in. dia. wire and the arresting end shaped as shown in Fig. 2. This type provides a wide entry to funnel the arresting wire into the small end loop. The small end serves two purposes. It tends to keep the arresting wire from sneaking back out after the initial shock and also concentrates the forces at the apex to prevent the hook from straightening out. Some builders even add an anti-release wire as shown in Fig. 2A. The other end of the hook must be ruggedly mounted in the fuselage to prevent everything from being torn out by the roots. Fuselage doublers are a good way to gain added support and distribute the shock load over a greater area. Needless to say, the whole assembly should be cemented together with epoxy. A plywood mount is a must. A light mousetrap-type spring should be fitted to hold the hook down in landing position. This prevents the airstream from partially retracting the hook and not presenting the widest aperture to the landing wire. It also assures that the hook is well out in the airstream for added drag during the low-speed portion of the flight.

The rudder must be fixed in a right turn position or made movable so to be in this position to assure line tension during low speed and landings. The advent of more powerful engines has demanded torque compensation right rudder for the take-off, too. A fixed rudder will cause higher centrifugal loads

Left: A fine Douglas SBD Dauntless by B. Pope does a fly past over H.M.S. Flycatcher during a low speed run. Power is supplied by a Merco 61 R/C, which is excellent for precise throttle control.

Below right: Not the most perfect landing technique, demonstrated by Mick Reeves as he "arrives" with his 3lb 6oz model of a Short Seamew, snagging second or third line with a quick "round-out" as the tail is brought down.

and a subsequent lowering of the speed during the high speed run. A simple method of having right rudder when you need it but not when you don't is shown in Fig. 3. The spring force should be adjusted so that the airstream will return the rudder to approximate neutral during high speed.

Flaps can be a problem. The linkages required in some scale-type planes can cause many hours of head scratching and "cut and try" before a suitably functioning mechanism is developed. Larger wing areas often will not require the extra lift at low speed so the extra work can be avoided. Small wings will not allow as slow a low speed flight and the extra lift and drag are a necessity. The builder must choose how close to the ultimate in performance he seeks and whether he is willing to undertake the extra work. There is much research still to be done in the area of flap efficiency on model aeroplanes with respect to angle, style and gap between flap and wing. Flaps can be made to release along with the hook or be proportional with the throttle. The latter method has a drawback in that airloads on the flaps will open the throttle on the upwind side of the circle unless the linkage is designed to prevent it. Control will become erratic and sometimes hair-raising when the throttle is opened with the flaps extended rigidly. A good compromise would be a spring loading of the flaps, like the rudder, so that increased air speed will tend to retract them. Care must be taken on these spring-loaded accessories to avoid an excess of drag or binding on the throttle controls.

Fig.2.

Hook end diagrams, left and right are advised by author who has long experience in U.S. Carrier Deck contests.

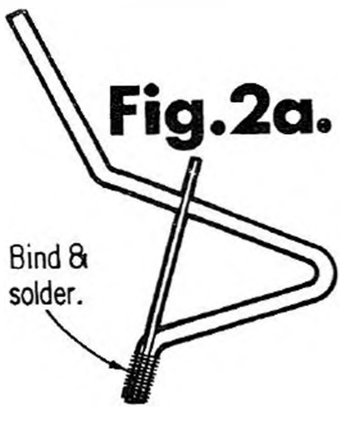


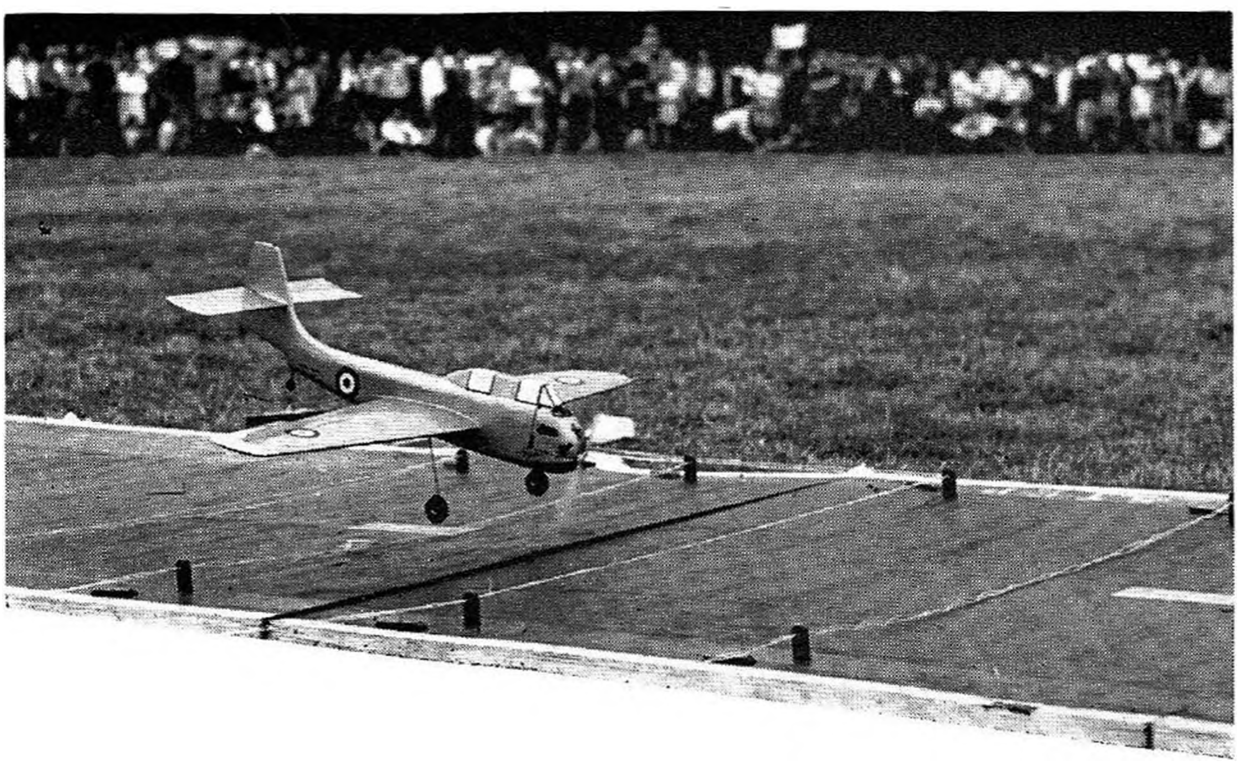
Fig.2a.

A relatively simple retractable landing gear is now practical for control-line models. The "Centrak", a unit produced by Bill M. Johnson (there's that man again) makes use of centrifugal force to operate the system. The unit mounts between the bellcrank and the model and features a spring to hold the gear down for take-off, slow speed and landing. The spring is adjusted so that line tension, in the form of centrifugal force, causes the gear to retract. The builder must provide his own linkage between the "Centrak" and the landing gear to accomplish the proper retraction. The "Centrak" also has a third arm which may be utilised to retract the tail wheel, operate the rudder or some other accessory.

While the non-scale event allows most anything, the scale carrier events do not allow too much leeway in the choice of a subject to model. Liquid cooled engine powered carrier-based planes were rarities in the U.S. Navy. The *Mustang* and *Airabonita* were single prototypes and many U.S. carrier flyers are using them because of their small frontal area advantage. Almost all of the more recent carrier-based planes featured huge radial engines and rather small wings. The *Martin Mauler* is about the only exception. These others not only had the large frontal areas but the whole fuselage became huge when scaled to get a decent wing area. Look back to the era around the beginning of the second world war. Engines were not so big then and larger wings were needed to get them off the decks. The ill-fated *Douglas TBD*-1 *Devastator* falls into this category. Lesser known ships were the *Vultee Vengeance*, *Vought-Sikorsky Vindicator* or the *SBD*-1 *and SBD*-2 versions of the *Douglas Dauntless*. Others could probably be turned up by researching old books and magazines.

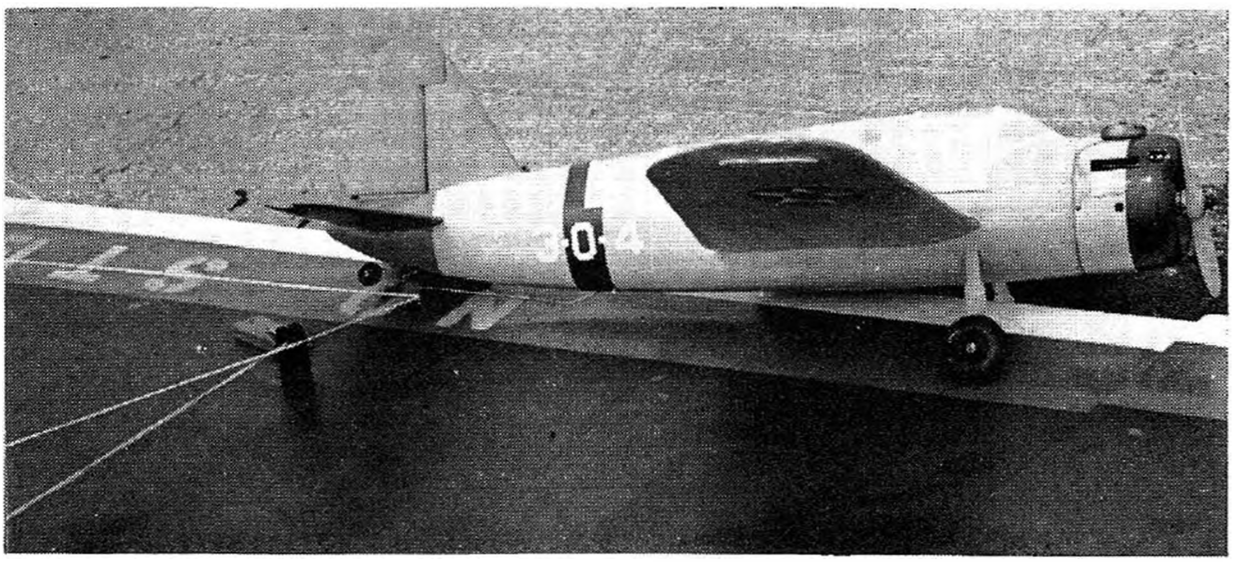
If you've read this far, you must be hooked on carrier flying. So—"Welcome aboard" for flight training and combat (contest) tactics.

Carrier contest flying requires a good deal of skill. Fortunately it is a skill that can be acquired through practice. The great differences in the speeds necessitates two different styles of flying. The high-speed run is timed from release of the model. This means that the take-off should be smooth, the model "grooved" as quickly as possible and held there for the whole first seven laps.



The model can't be making forward progress if it is constantly going up and down. The take-off portion of the deck looks so short that it causes a natural tendency to yank or jump the model into the air too quickly. This usually causes it to hang on the prop and sometimes even stall. This hesitation delays the natural acceleration and loses precious time. Worse yet, a model with a powerful engine will usually choose this moment to demonstrate its tremendous torque and try to pay you a visit in the centre of the circle. Not much good can come from such a situation. Once you are assured that the model will fly, handle properly and throttle correctly, practise smooth take-offs. Step off a distance equal to the take-off portion of the deck and mark it with a fuel can or tool box placed outside of the circle. This allows you to judge if you are getting airborne in time and avoiding the previously mentioned problems.

The high-speed run should be made with the handle pulled back as close to your body as is comfortable. Your lines should already have been measured for length and the speed is calculated on the basis of their length, not on their length plus the length of your arms. It is also better to fly with both hands on the handle. The more powerful engines exert a good bit of pull and you will want the safety of two-handed flying. Practise this way now so that you will already be accustomed when it becomes a necessity. I also use a parachute cord safety loop between the handle and my right wrist to ensure that the model will not get away and injure someone if the handle slips out of my oily hands. The two-handed method also affords another advantage with the J. Roberts handle. The right hand grips the handle in the normal fashion with the index finger pulling on the enclosed trigger. The left hand is wrapped around the front of the handle with the third line existing between the middle and ring fingers. The left thumb is positioned against the upper portion of the trigger and exerts a slight pressure toward low speed. The throttle is now controlled by opposite pressures of finger and thumb. Throttle change is effected by increasing and decreasing pressures in the appropriate direction. This allows immediate throttle change rather than a delay while switching from pulling to pushing with the right index finger. The trigger loop is larger than the finger so there is a lag before throttle changes are actually made. This also is less natural a motion than pulling with the index finger and pushing with the thumb. Minute throttle changes can now be made by lightly varying the pressures. This will allow you to vary engine speed by only a few hundred r.p.m. with ease.



Below left: B. Perry's Merco 35 powered Vought Sikorsky Kingfisher, arrested just before it fell into the "drink", a case of short radius on the lines?

Korean action Fairey Firefly has plenty of glamour in its dazzling markings; note the flaps and long arrester hook. Made by Alan Dorrell for Veco 35.

The slow-speed portion of the flight is the area where few have ever had much experience prior to taking up carrier flying. There seems to be a built-in fear of ultra-slow speeds even among experienced control-line flyers. Line tension drops way down and an alarm bell starts ringing in the pilot's head, warning of an imminent loss of control. It often takes a good bit of practice flying at slow speeds to overcome this previously developed attitude. The pilot should continue to gradually slow the aeroplane more and more until finally it does stall and drop out of the air. Now a reference has been established of how the engine sounds right down to the stalling point of the aeroplane. This is a practice for your ear as well as your hand and eye. Slower speeds can be attained by establishing a 10–15° nose-up attitude and maintaining it by small throttle changes. This is where the precise control of the throttle pays off.

The circular flight path seems a straight line when you are in the centre of the circle and turning with the model. Not so! The true airspeed of the model is constantly changing as it completes a full lap. The relative wind felt by the model is considerably less when it is on the downwind portion of the circle, requiring a little more throttle to maintain the necessary lift. Conversely, the upwind portion needs less throttle to keep the model airborne.

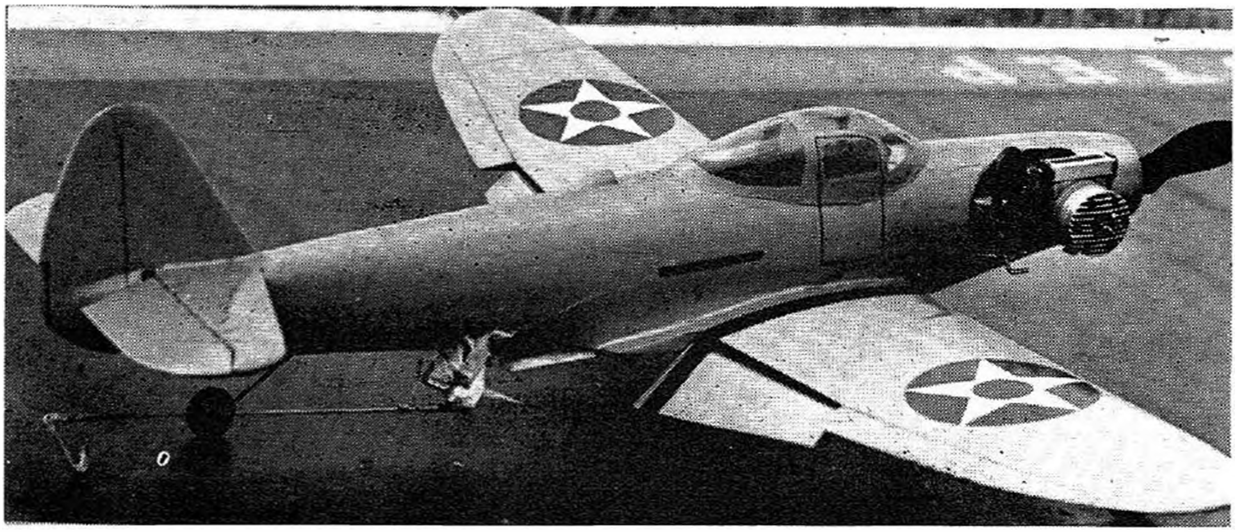
I always build large fuel tanks in my models to allow lengthy practice flights. This applies particularly to landings. A good landing is worth 100 points and a poor landing can easily spoil a flight which had good high and low speeds. Carrier contests are too often won by the guy who gets his proper landing, though his speeds might not at all approach some of the other contestants'. A deck isn't required for landing practice, only a decent flying surface. My system is to place a fuel can outside the circle and shoot touch and go landings to this point until I can set it in on that spot every time. A model with well constructed landing gear and adequate prop clearance to permit touch and go will certainly engage an arresting wire when you have learned to aim for a certain point rather than the whole landing area. Most of my pre-contest practice is directed at this one goal. I've found it necessary to brush up on my technique and reaffirm the proper throttle settings and glide path for the particular models which I intend to use in competition. Different and/or gusty winds on the day of the contest

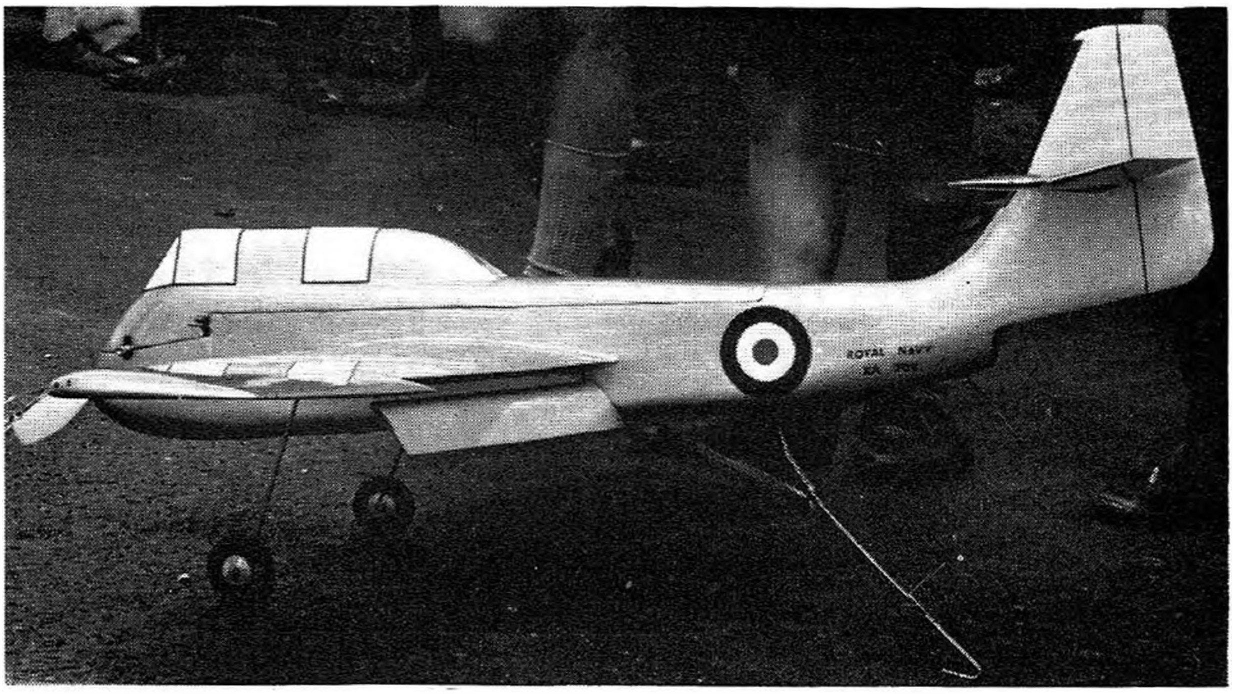
may cause a variation in your predetermined approach but familiarity with your model will make your adjustment to conditions far simpler. Confidence in yourself and your model can only be gained by a good deal of practice. My own contest scores are a good gauge of whether I was able to practise the weekend before and how many practice flights I was able to make.

Competition is the culmination of all of your work and preparation—and preparation is the secret to contest success. A quick and easy way to judge your opposition is to observe the pit area. The entrants who are constantly running engines, checking throttle and accessory action and rushing back and forth from the model to the toolbox will not cause you much worry. They must get lucky to turn a decent score. Beware of the contestant who appears unobtrusively, quietly hooks up lines and flies with an atmosphere of calm purposefulness. He was ready. He already knows, within a few points, what his score would be for he has done his homework. He may not win every time but will *always* score well. Carrier is an event that demands full attention through the whole flight when everything is working right. The untried unknowns can put you in the drink too quickly. This is not to say you shouldn't enter a model which hasn't been completely debugged for, after all, this is a sport and hobby which is supposed to be fun. Treat this type of entry as a practice session and do not expect too much. Next time you will be fully prepared.

There is one simple trick which eases many of the problems of making a contest flight. Do not depend on the other contestants or the officials to mark the centre of the circle for you. Obtain a small flat object (I use a flattened regular size beer can—king size and pop or soda cans just don't work for me) with which to mark your particular circle centre. Place the model in the centre of the landing area, then with the handle held as you would for landing, sight down the forward and aft boundaries of the landing area. Move so that these are both radial lines to you and place the marker under your right toe. This is the exact position you should be in for your landing. Now you will not need anyone outside the circle to direct you into alignment with the deck. This is normally a trying point in the flight. Directions are made inaudible by other contest noises and often improper or confusing anyway.

Below: Bell XFL1 "Airabonita" by Alan Woodrow of Hatfield Deltas, uses a K&B 40 RV rat-racing engine on pressure feed, and has fantastic acceleration, due to its light weight and "clean" aerodynamic shape. Note also how a rapid "arrest" has torn the hook away from its moorings in the fuselage.





Another view of Mick Reeves' successful 44" span Merco 61 powered Seamew, clearly illustrates the flaps and lowered arrester hook.

Arrange to have your helper signal you loudly at the completion of your high-speed run and count loudly each completed slow-speed lap. This will reduce the number of things you must do and enable you better to concentrate on the flying. Agree on a definite signal for release so that you will not be caught unawares.

Now that you are ready for the big flight, let's make one together. Move your model to the aftermost position allowed on the take-off portion of the deck. Fill the fuel tank and wipe off any spilled fuel or accumulated oil so that your helper can get a secure grip. Hook up the battery and start it up. Allow the engine to warm up before making the final needle valve setting then *walk* out to the handle, wiping any oil off your hands on the way. Pick up the handle, make sure that the lines are clear and take a stance aimed about one-eighth of a lap ahead of the model. When you are all set, give the release signal. Groove the flight path with your hands pulled in to your body as quickly as possible after the smooth take-off that you have been practising. Concentrate on the grooved pattern until you hear the signal at the end of the high-speed run. Take several laps to slow down, extend your arms to lengthen the lines and check for any odd air currents before you signal for the start of the slow-speed run. Now the tedious part begins. Concentrate only on the model and hang it out there as slow as you can. Be ready to make any quick throttle changes as it progresses around the circle. Anticipate those trouble spots which you checked for on the slow-down laps. The time seems interminable and you think that you will never hear the last lap called off. It does end though. Clear out the engine with several full-throttle laps, come back to about half throttle and look around for your centre marker. Move to a position a step to the left and slightly behind it, reduce power more and make a low slow lap over the deck to make sure all is well. Signal your landing intentions and move to your marker about 180° from the deck. Line up your glide path, get your toe on the marker and set it down right on the spot

Ray Willman. Three times U.S. National Winner-1st place at both 1965 and 1966 Nats. 2nd place at 1967 Nats. Set 6 different A.M.A. Records in Class II Open Carrier with Johnson exhaust slide throttle and fuel control combo, using pressure flown over 1 year without any adjustment of idle. 10x8 Rev-up prop,—Fireball Reg—plug—Fuel Brand X, J. Roberts Bellcrank, 3 oz. Veco tank.

Danny Johnson, winner of Class II Jr. Carrier at 1966 Nats. set Jr. A.M.A. Record same year. Uses pressure feed. Shown with Sterling Guardian with Rossi 60 slide and fuel control combo. Tank used was only 2½ oz. perfect tank. Danny won 2nd place in Class I in Sr. Carrier at '67 Nats.

you've chosen. Be ready to apply full power for another go round in case the wire is not hooked or the approach goes astray. A reduced point landing for a wave-off is better than no points at all. All that's left to do now is shut down the engine, clear the hook from the wire, move off the circle and collapse. Tension can really build during a competition flight. However, this is the time when all of the work and practice most seems worthwhile, so it is an enjoyable tiredness.

There are a few other bits of strategy worth passing on. Do not go all out on your first flight, rather concentrate on posting a good, but complete, score. Chances are you won't even need your second flight when the others fall victim to poorer preparation. Use the second attempt for your maximum effort to overtake higher-scoring competitors. You can better afford to take chances with a good score already posted. Make your Class I flights first if you enter both classes. The much greater speed and pull of the Class II tends to make you over-control when going back to the lighter handling Class I.

Choice of competition fuels and props are mostly governed by temperature, altitude and humidity. Missile Mist seems to be a good all-round fuel with or without pressure. Higher compression ratios and pressure fuel systems allow use of fuels with a higher nitro content. No commercial fuel seems adequate but various blendings of a speed fuel and a stunt fuel will enable you to improve your high speed and still retain good low speed throttle settings. Higher nitro content may require switching to an idle bar or R/C plug for good low-speed performance. The higher the nitro the shorter the plug life, though.

Class II propellers seem restricted to the 10×8 size Top-Flite or Rev-Up for Rossi's and Power Prop for McCoy 60's. Class I has a broader choice of 9×6, 9×7 and 9×8 in the various brands. Some flyers have had good success with the 8×6 and 8×8 Tornado Nylon three blade. Don't be afraid to experiment to find the best combination for your particular engine, model and climate.

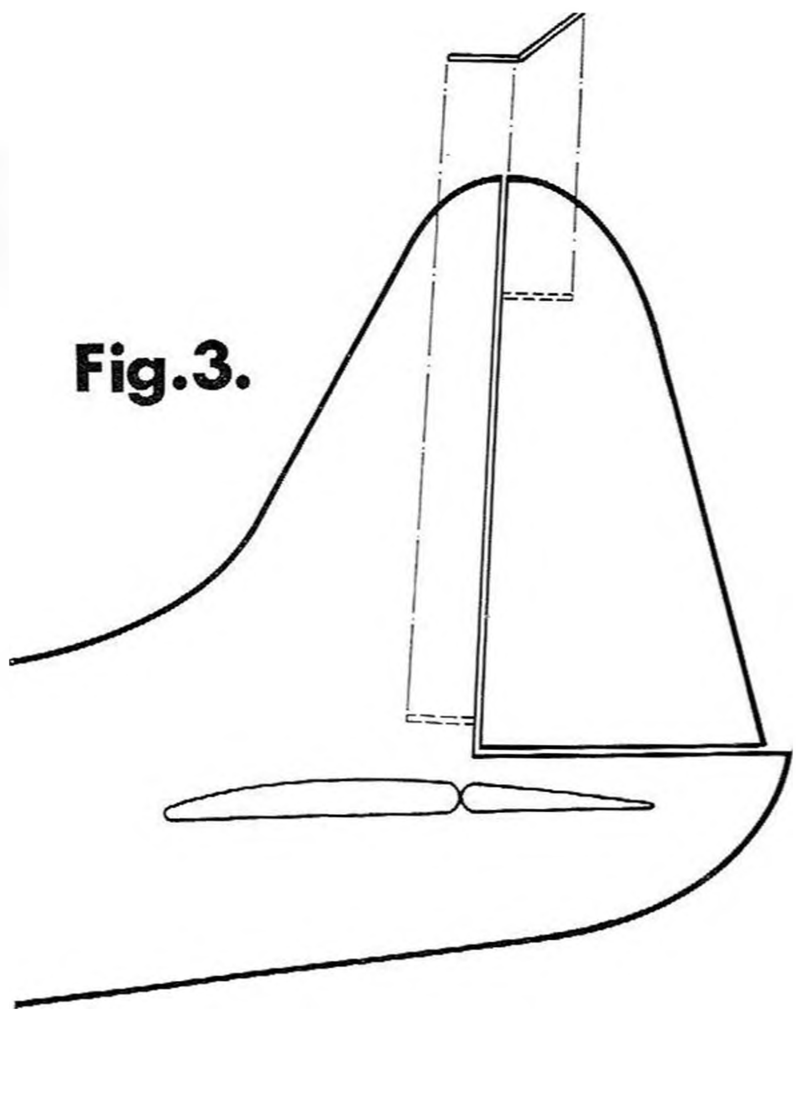
The rules are written so as to place greater emphasis on high speed. A 1 m.p.h. increase is worth four more points, three for the high-low differential plus one for the increase in top speed. A 1 m.p.h. decrease in low speed gains only the three differential points. This is the reason for the trend toward engines of greater power. The greater top speed is beneficial only when added to the scores for the other portions of the flight. The importance of full scale and landing points cannot be ignored. A 30 m.p.h. low speed is not hard to attain and could be established as a norm. Calm winds will allow lower speeds, but since they are rare on contest days, high speed is the area to improve when looking for better scores.

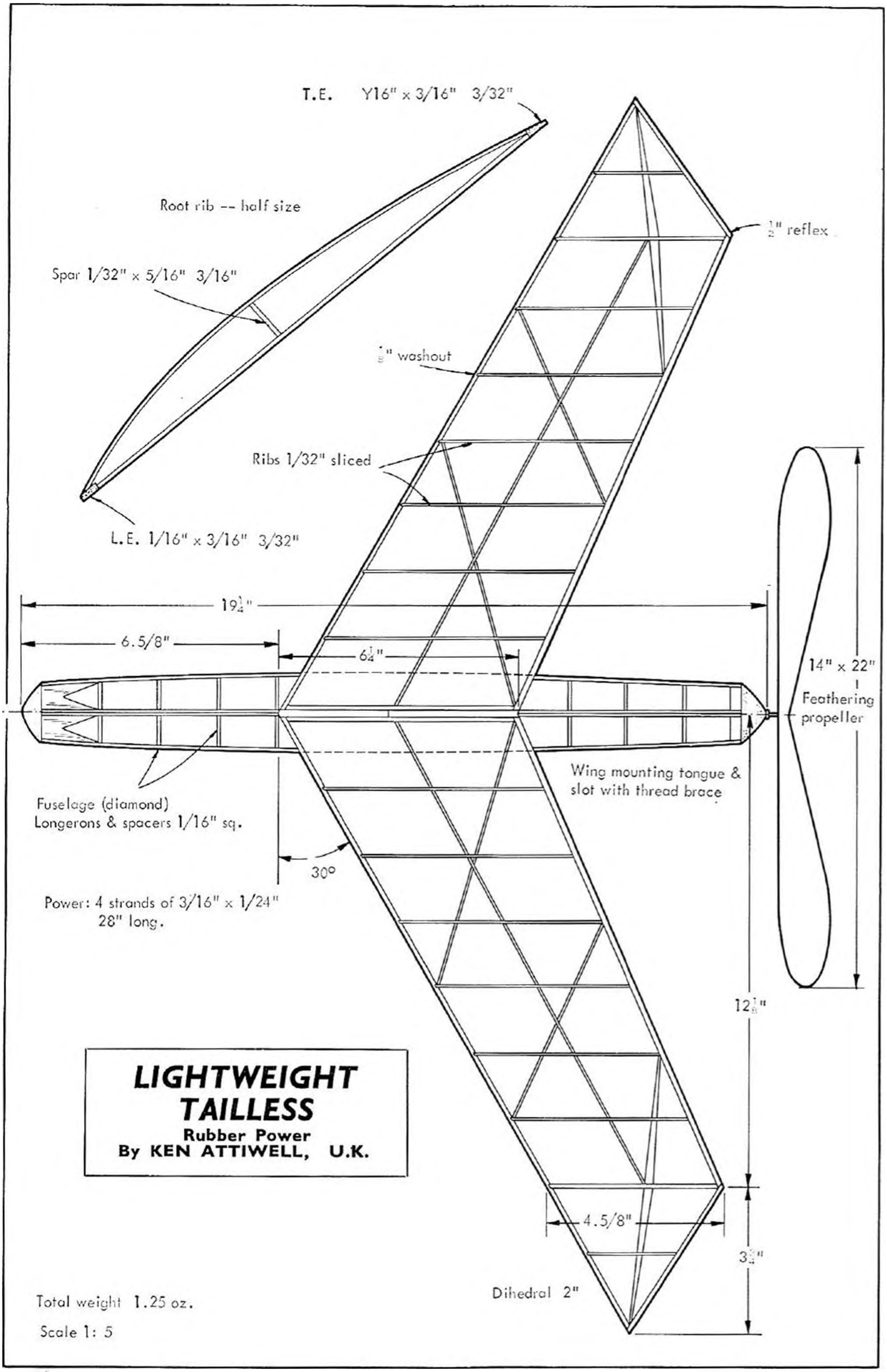
Present-day performances show high speeds in the 70–80 m.p.h. bracket for R/C throttled Class I engines; 80–90 m.p.h. for R/C Class IIs; 85–100 m.p.h. for hot Class Is and 90–105 for the wild Class IIs. Highs of 110 in Class I and 120 in Class II have been recorded by the hot shots on ideal days. Still, points drawn from all phases of the flight comprise the total score and this total is what wins. Start slowly and gradually build up the high speed points on a firm foundation of the other scores.

Flight training is over now so, "*Go get 'em, Tiger, and Happy* (100 *point*) *Landings.*"

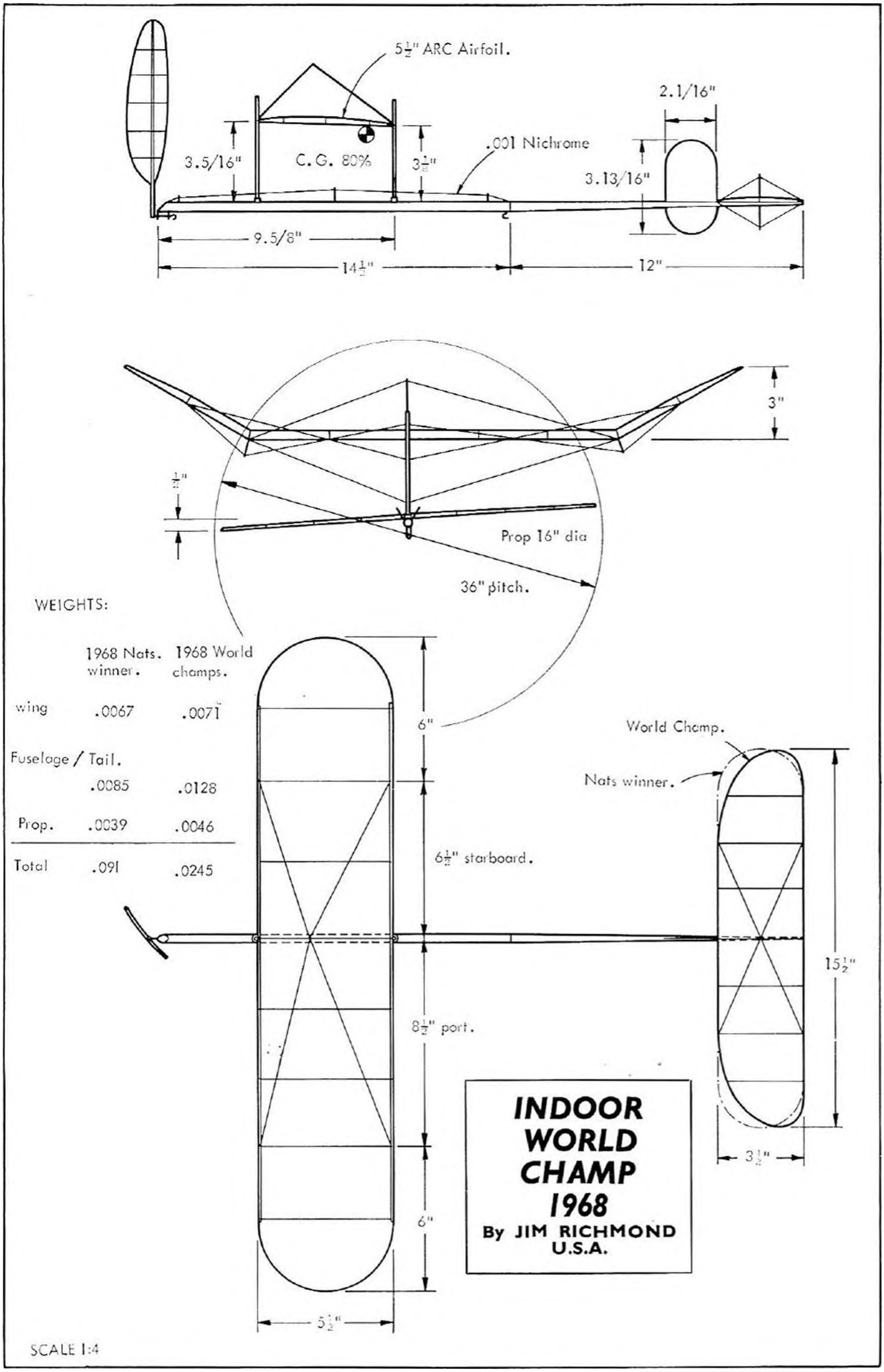
Author's advised method of spring effecting a rudder deflection is to use the torque of a length of piano wire embedded at each end into the fin and rudder, but with its "free" length along the hinge line to be used as a torque bar.

Fig.3.

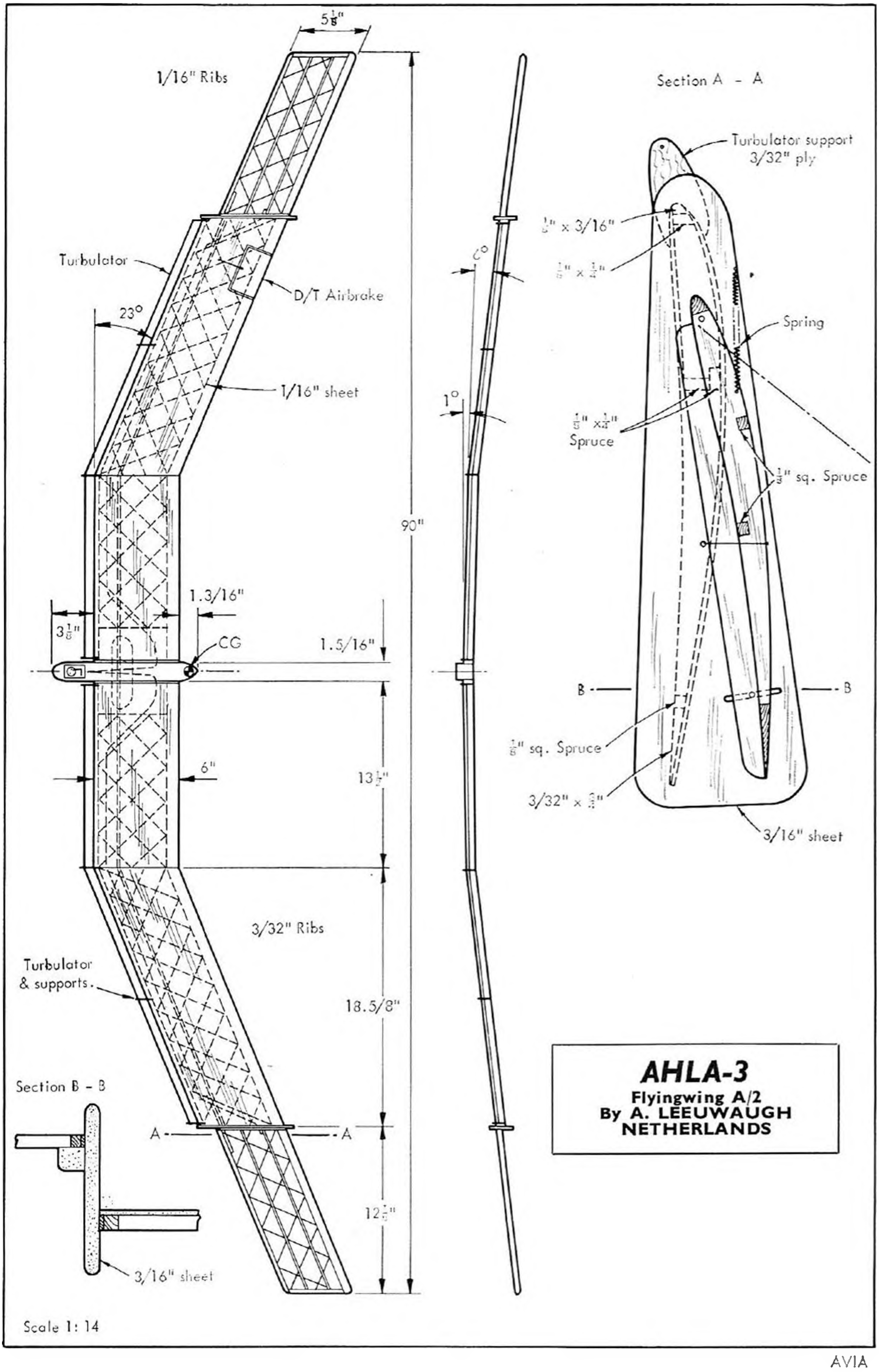




NORTHERN AREA NEWS



INDOOR NEWS AND VIEWS.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D/T Airbrake
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1/16" sheet
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CG
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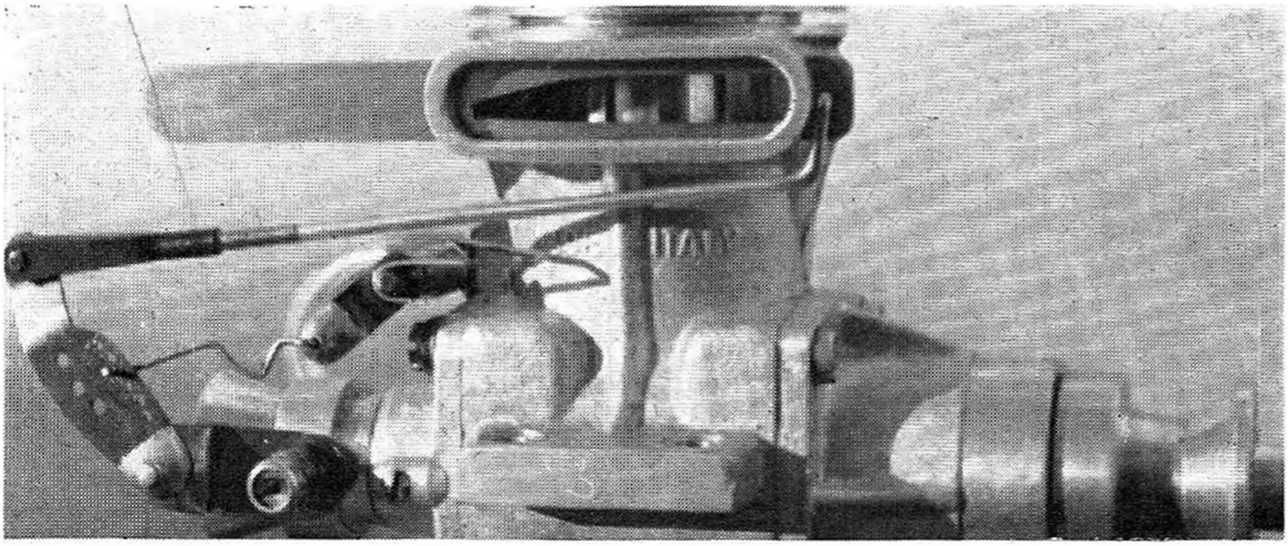
6"
90"
3/32" Ribs
Turbulator & supports.
Section B - B
3/16" sheet
Scale 1: 14
Section A - A
Turbulator support 3/32" ply
Spring
Spruce
sq. Spruce
3/16" sheet
1°
A
B

AVIA



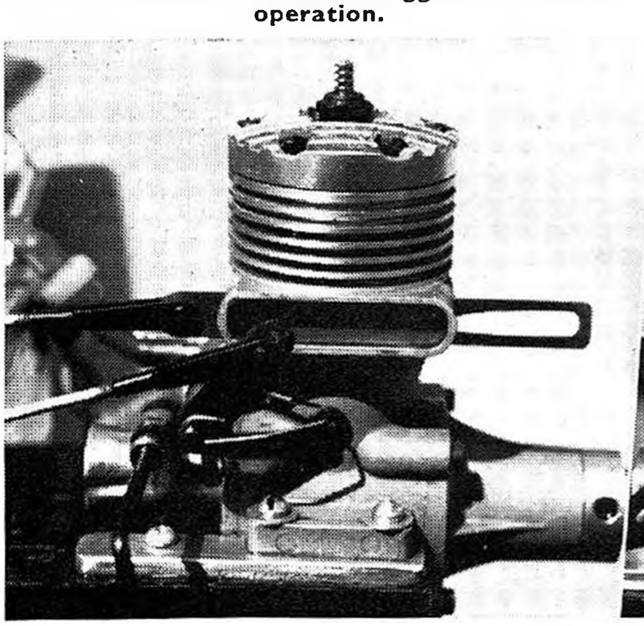
Racing Rossi .60 shown with Fuel Control, exhaust slide and extra throw and common linkage. Note Quick-link for fine adjustment of slide throttle; also note the small V wire can be moved up or down on holes to find best throw of Fuel Control.

FUEL CONTROL

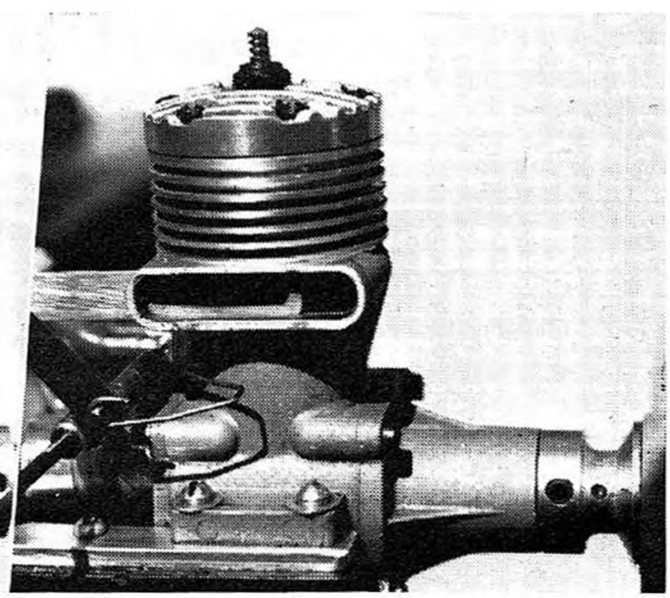
by Bill M. Johnson, Throttle Specialist

SINCE Navy Carrier and R/C Goodyear Pylon Racing are two events that require maximum engine performance during high speed, it is necessary to use pressure fuel feed, so that intake restriction can be reduced to a minimum. However, this usually results in flooding during the low speed and the engine either quits or gives very poor idling. Tests have proved, when using pressure feed, the larger the intake opening the more flooding effect can be expected, even to the point that all racing engines are considered a bad direction to go for good throttling, and this *was* true in the past.

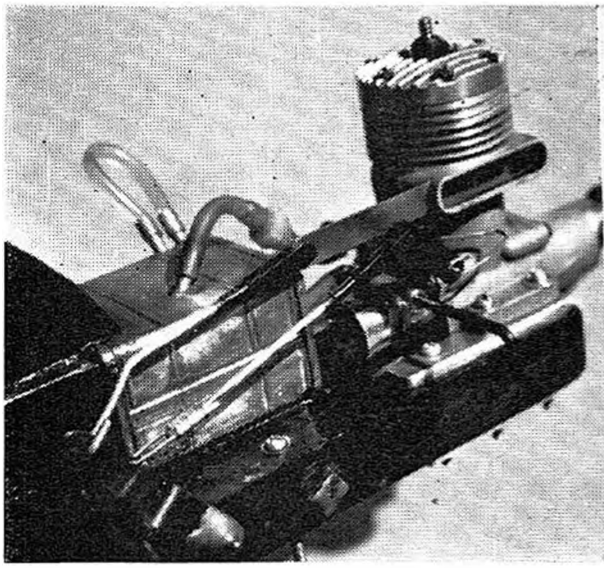
One type of method to permit pressure during high power and no pressure during low power is a system called *On–Off Pressure*, which has its problems, too! I developed the first On–Off Pressure System to be used in the



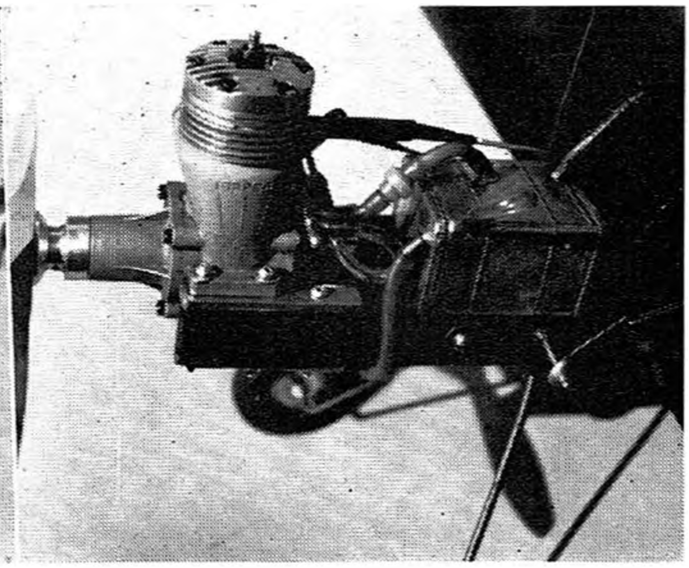
K.&.B 40 rear rotor exhaust slide and fuel control—shown in idle position. Has very good idle. Fireball reg. plug. Hot fuel. Model shown used for non-scale Class I Carrier has done 22 m.p.h. low. It is a Guillow III trainer rigged for carrier operation.



Shown in open position, slide withdrawn to ensure full r.p.m. of rat racer engine. Model can be landed and taxied, stopped and taken off again. Idle is very good and smooth.



Open position shown. Du-Bro Kwik-links used to slide and to Fuel Control. Note. Tap off line on 2 oz. Perfect tank for pressure operation. Shows fuel filter inserted in fuel feed line.



Good view of plumbing. Note line giong under pressure line. Had to install this tubing in corner of tank. Also note Fuel Filter between the tank and the Fuel Control.

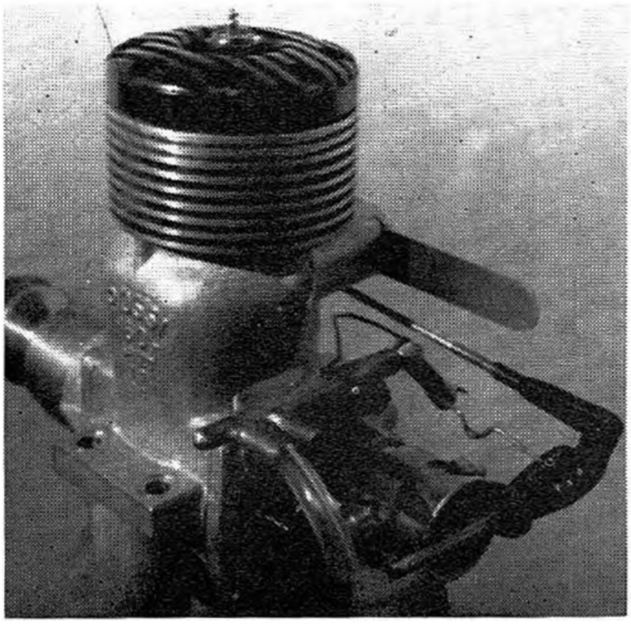
St. Louis area and have stopped making them since testing my new design, which I named *Fuel Control* (Fuel Metering Valve), which sets a new standard of throttling.

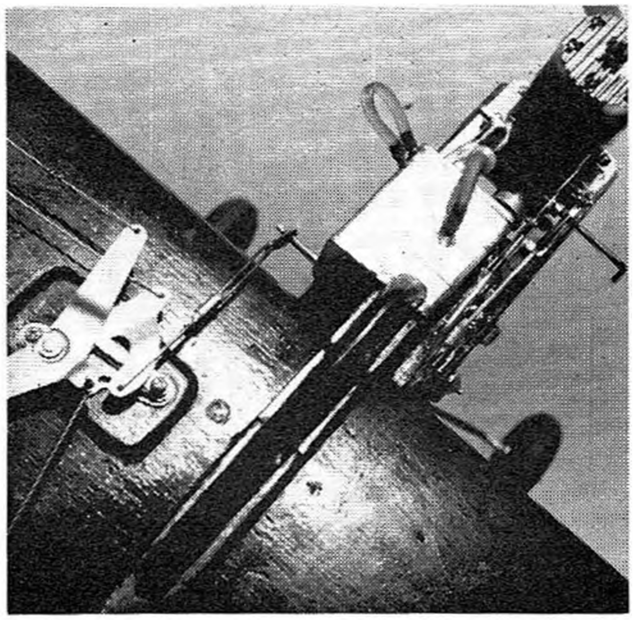
Fuel Control (Fuel Metering Valve) permits using pressure during both high and low speed (even those using maximum intake opening) by metering the fuel in the correct proportion to the amount of throttle being used, improving idling and in some cases to permit idling. Standard engines give higher r.p.m. than those that are sold as R/C engines since their internal parts are made to perform at higher r.p.m. Some engine manufacturers have made their R/C engines with different port and crankshaft timing in order to make them idle better with their throttle arrangement, and idle bar plugs are used, but many of them varnish up very badly due to excess amount of fuel entering the engine on low speed.

The metering of fuel is not a new idea; it has been around many years—what is new is my design that permits no restriction of the intake and far better control of the fuel. It can be adjusted (by extra throw and/or filing to suit) to suit engine being used, giving you no flooding action during any part of throttled flight, even when using pressure. In fact, I now prefer using the pressure system due to *Fuel Control* giving better idling which is smoother and more reliable due to tank location not being as critical when using pressure. Can use hot plugs, hot fuel, hopped-up engines and fast prop with no real problems on the low end when using my *Fuel Control.* I have the Ross ·60, Fox ·40 BB, K. & B. 40RR, etc., idling smoothly and very reliable (on pressure) when using *Fuel Control* in conjunction with my own throttle set-up. Extra benefits: save fuel during low speed; instant throttle response; the best throttling possible.

Smooth, reliable idling is simple when using a very good exhaust throttle as the main throttle (a built-in custom exhaust throttle or an exhaust throttle and intake throttle can be ordered direct), *Fuel Control* and pressure fuel feed. In some cases an intake choke (throttle) is needed to help lower the r.p.m. *Fuel Control* permits the proper amount of fuel during throttling, even to the point that no idle bar plug is needed.

Price $6, *Fuel Control* can be ordered from Bill M. Johnson, Throttle Specialist, 6328 Jackson, Berkeley, Mo., Zip Code 63134, U.S.A.





Back view of Racing Rossi 60. Extra throw is held on only by carburettor collet and grooves in throat. Note spring holding control rod to make good contact against tube of the same diameter inside the Fuel Control—this gives good end seal.

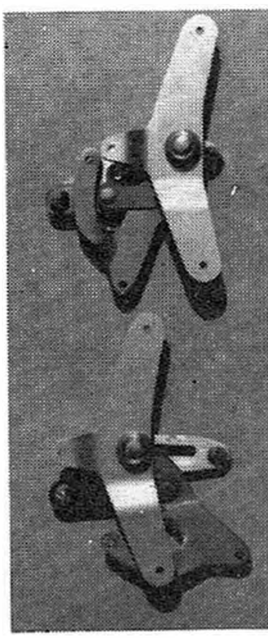
Above right, top view of linkages, tank location and "Custom Assembled" new heavy duty J. Roberts bellcrank. Fill and overflow tubes are capped off with fuel line.

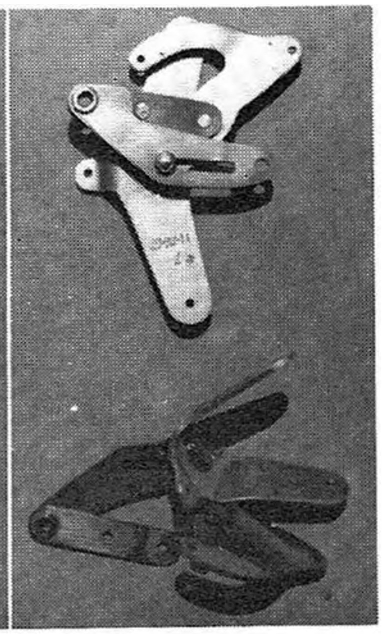
Strong bellcranks made up for Bill Johnson's models (near right).

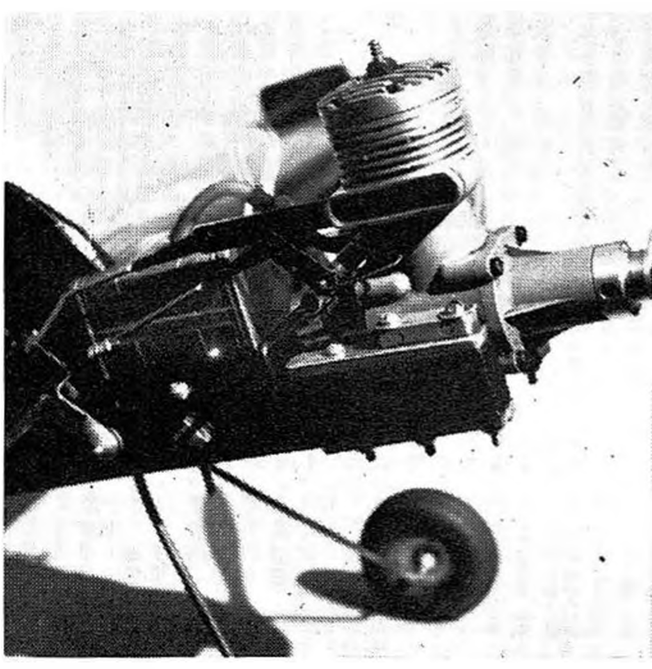
Far right is Roberts super bellcrank for large scale models; unit below broke when pull tested beyond 200 lbs.

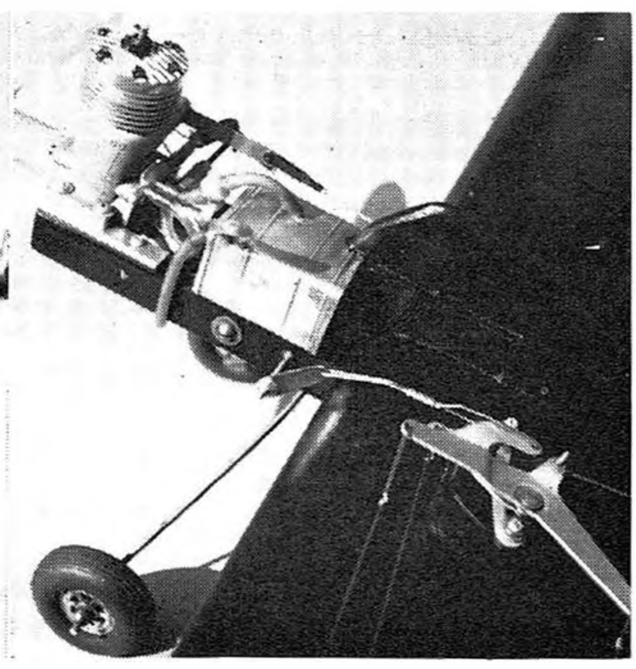
Below left, K&B. set-up; in full open position. Extra throw near wing is bent to bring throw in line with slide throttle and fuel control arm. Slide is rigged to travel $1\frac{3}{16}$ in. to $1\frac{1}{4}$ in. and fuel control has $\frac{3}{4}$ in. travel.

Below right is port side view showing the connection to layshaft from bellcrank arm.









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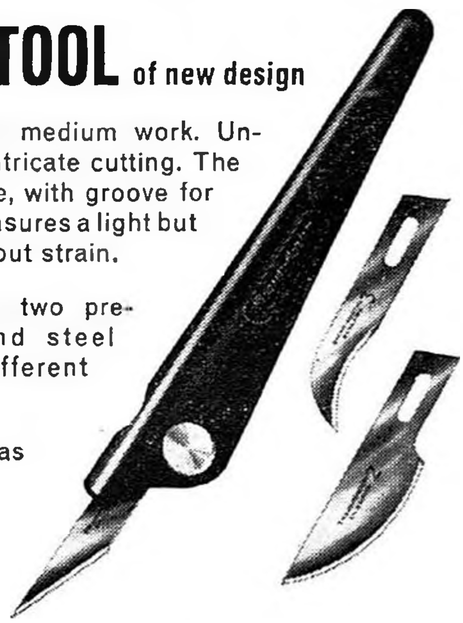

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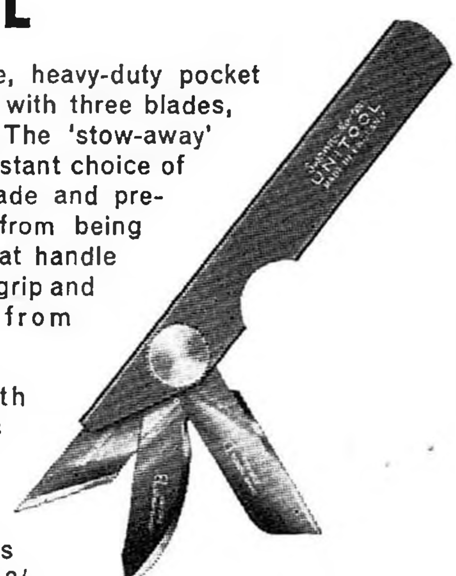

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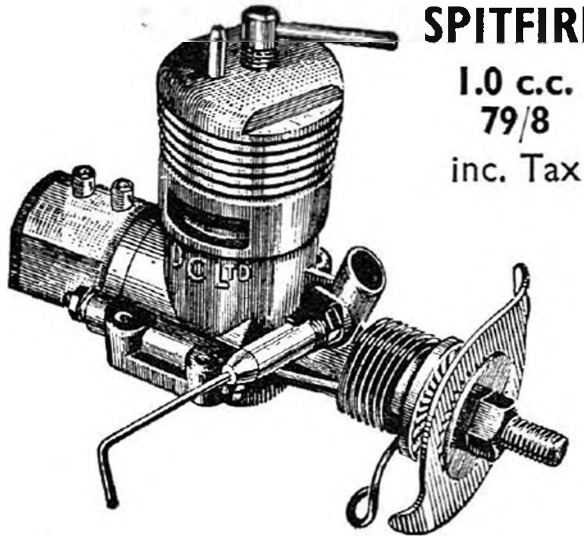

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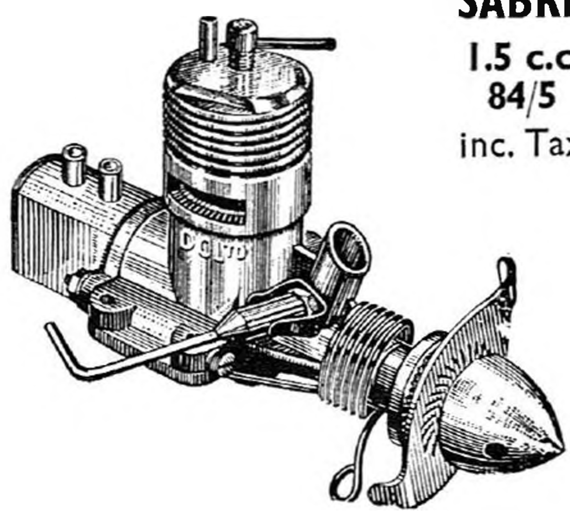

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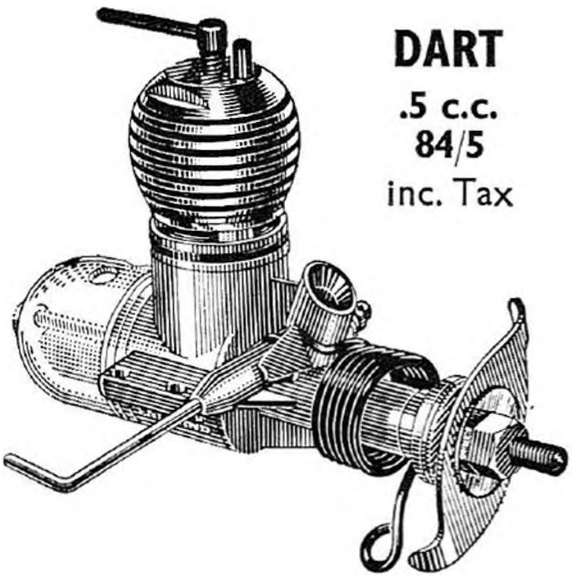

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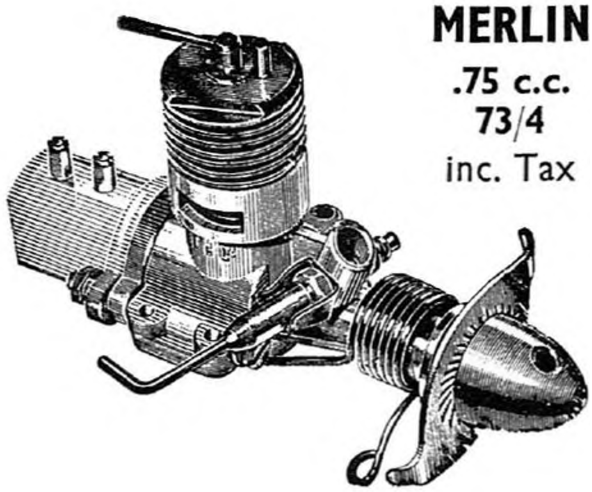

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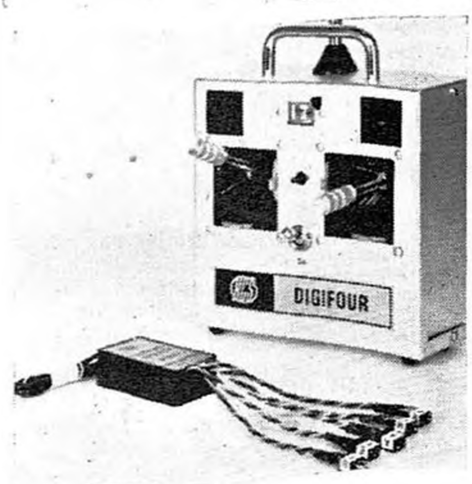

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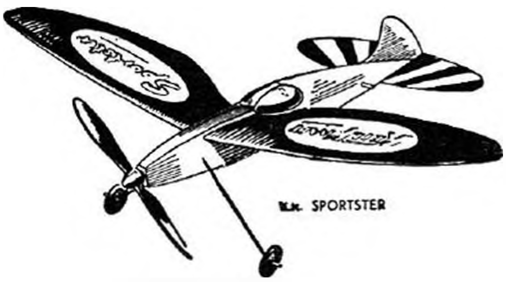

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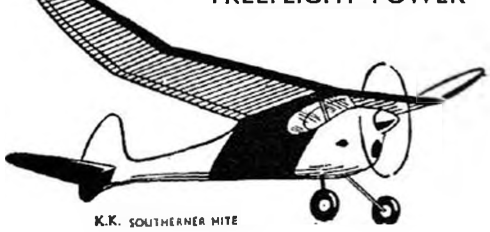

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