AEROMODELLER ANNUAL 1960

AEROMODELLER ANNUAL 1960-61

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

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

AEROMODELLISTA	*Italy*
AMERICAN MODELER	*U.S.A.*
DER MODELLBAUER	*Germany*
FLUG MODELLTECHNIK	*Germany*
FLYING MODELS	*U.S.A.*
GRID LEAKS	*U.S.A.*
ILMAILLU	*Finland*
LETECKY MODELAR	*Czechoslovakia*
MECHANIKUS	*Germany*
MODEL AIRPLANE NEWS	*U.S.A.*
MODELARZ	*Poland*
MODEL-AVIA	*Belgium*
MODELE MAGAZINE	*France*
MODELE REDUIT D'AVION	*France*
MODELL	*Germany*
MODELLBAU UND BASTELN	*Germany*
MODELLEZES	*Hungary*
MODELLISMO	*Italy*

Frontispiece picture shows Arthur Evans of Mill Hill with his delightful model of a 1909 Valkyrie, taken at the British Nationals at R.A.F. Scampton.
Power unit is a Cox Space Hopper, cunningly hidden as one of the seven cylinders in the dummy engine.

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INTRODUCTION

MODEL FLYING TODAY

FOR THE FIRST TIME for a great many years the British market has been really open for the importation of almost unlimited supplies of American aeromodelling products, together with an ever increasing flow of the best of Continental goods. Only a short time ago we should have expected such an influx to have a marked effect on the pattern of our hobby. In fact, the impact has been of only limited force, due, in part, to some reduction in free spending money, but mainly, we think to the solid worth of the home produced article, which can now in very many cases stand on its merits against anything manufactured anywhere in the world.

Radio control enthusiasts have benefited most from this freedom in buying, with—if they can afford it—some of the most famous American names to choose from—but their choice has more often been angled towards such items as compound actuators and the like, where no strong native source has developed. Japanese engines have commanded a live interest, as have some of the smaller American types, and of course the more finely produced kits. In contrast, British engines have achieved a degree of perfection almost beyond our hopes, and only in those sizes not as yet adequately covered at home has there been a significant foreign growth. The glow plug revival has continued and new British motors of the "middle" capacity range have received a hearty and appreciative welcome.

In the contest field, another Nationals at Scampton produced exceptionally large entries, high quality flying, and enjoyed one of the finest weekends of a poor summer.

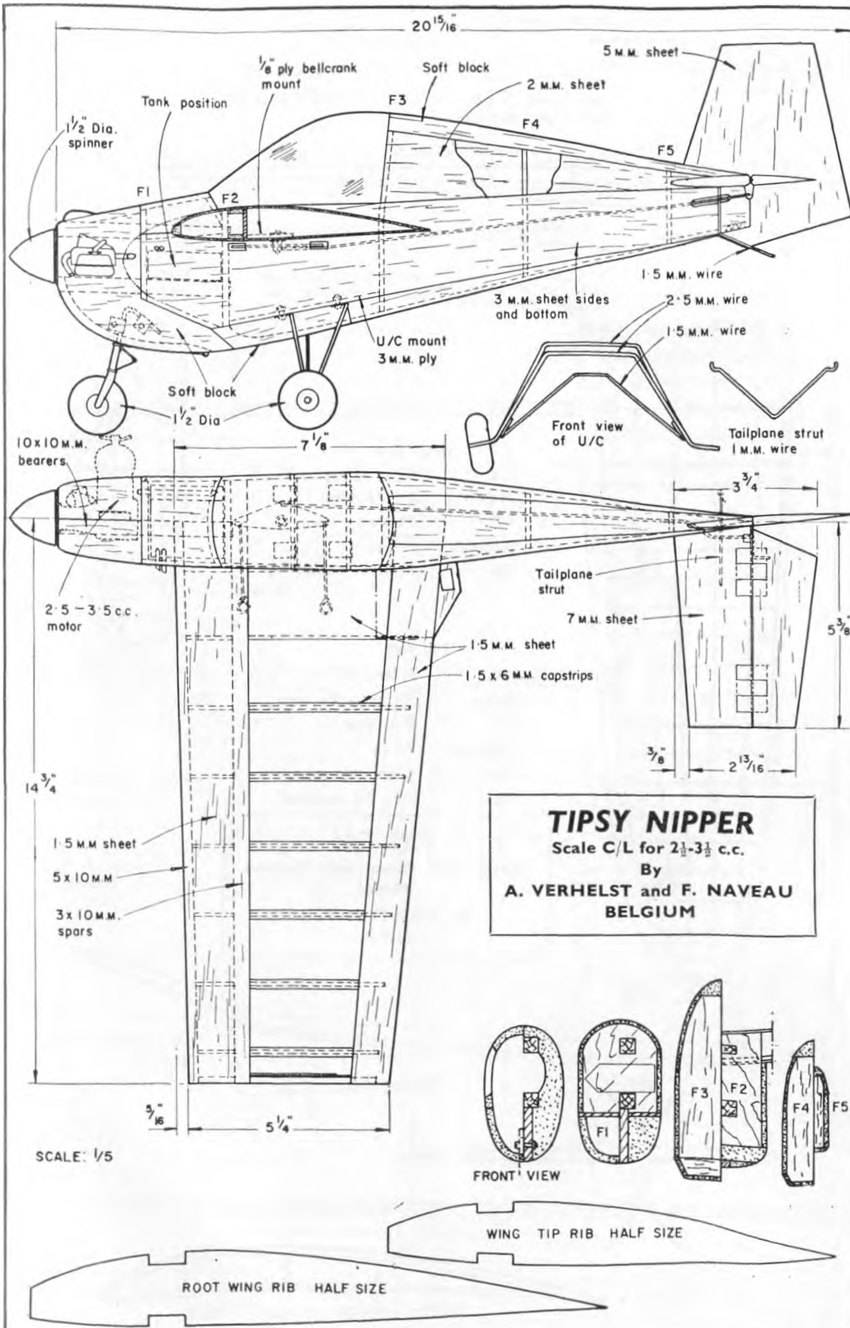
Internationally, we were hosts at Cranfield again for the World Free Flight Power Championships, which will be remembered for all time on account of the marathon fly-off, when after no less than seventeen maxs., five flyers were still undefeated. This is a matter for urgent revision of F.A.I. rules—but is an event we would certainly not have missed for anything.

The first F.A.I. sponsored World Radio Control Championships took place near Zurich, when, as rather expected a U.S. entrant proved the victor. Our British team nevertheless secured the team award, which is a tribute to the strides radio control has been making these past few years. We have felt sufficient confidence in its future to launch a magazine, *Radio Control Models and Electronics*, during the year devoted entirely to this aspect of modelling which has met with a substantial welcome.

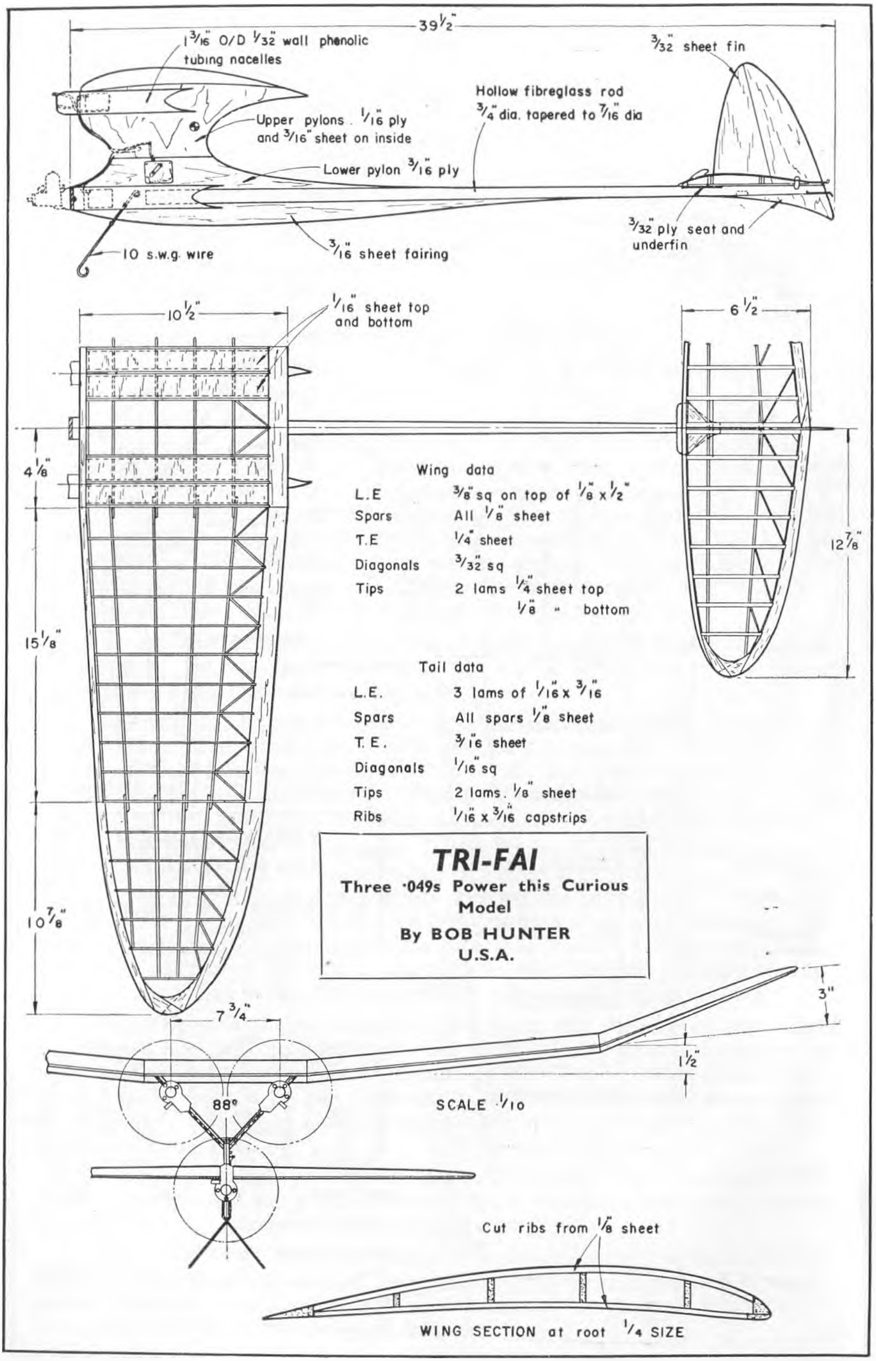
Significant amongst legislation has been the passing of the Noise Abatement Bill and manufacturers will have to give special attention to silencing devices on their motors if more of our already scanty flying fields are not to be barred to us, particularly in view of the somewhat higher scream of the glow plug motor as against the more restrained noise of the slower revving diesel.

If not a vintage year, 1960 has, nevertheless, been remarkable for steady progress, and the advancement of trade enterprise ready and capable of combating any foreign invasion in a free market.

Once again, we offer our year's collection to readers with confidence and hope the mixture pleases. Comments, suggestions and contributions are always welcome, and particularly information of activities in areas as vet new to us in the aeromodelling scheme of things.


TIPSY NIPPER
Scale C/L for 2½-3½ c.c.
By
A. VERHELST and F. NAVEAU
BELGIUM
20 15/16"
5 M.M. sheet
1/8" ply bellcrank mount
Soft block
2 M.M. sheet
Tank position
1½" Dia. spinner
F1
F2
F3
F4
F5
1·5 M.M. wire
3 M.M. sheet sides and bottom
2·5 M.M. wire
1·5 M.M. wire
U/C mount 3 M.M. ply
Soft block
1½" Dia
Front view of U/C
Tailplane strut 1 M.M. wire
10 x 10 M.M. bearers
7 1/8"
3 3/4"
Tailplane strut
7 M.M. sheet
5 3/8"
2·5 – 3·5 c.c. motor
1·5 M.M. sheet
1·5 x 6 M.M. capstrips
3/8"
2 13/16"
14 3/4"
1·5 M.M sheet
5 x 10 M.M
3 x 10 M.M. spars
5/16"
5 1/4"
SCALE: 1/5
FRONT VIEW
WING TIP RIB HALF SIZE
ROOT WING RIB HALF SIZE

MODEL AVIA

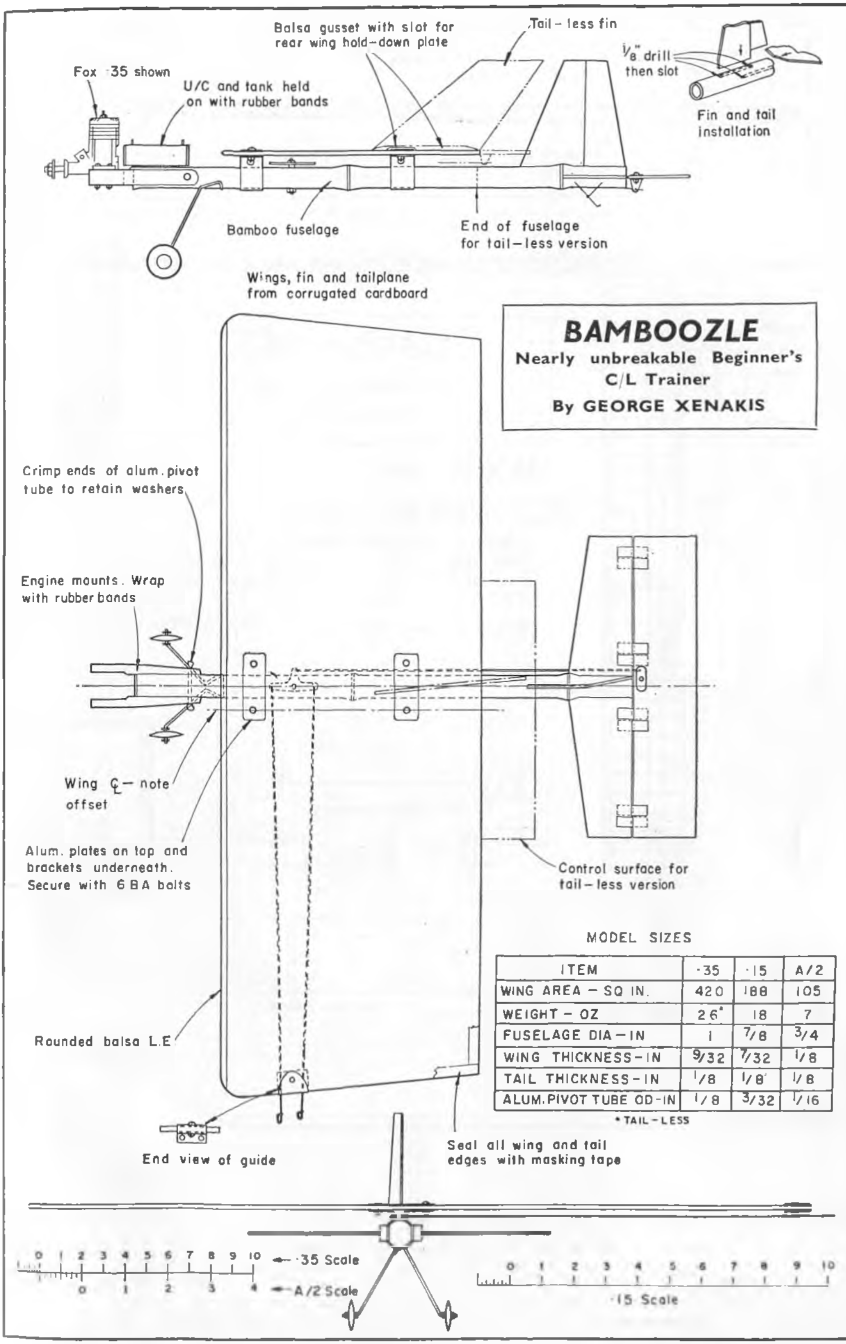


FLYING MODELS

BAMBOOZLE

Nearly unbreakable Beginner's C/L Trainer

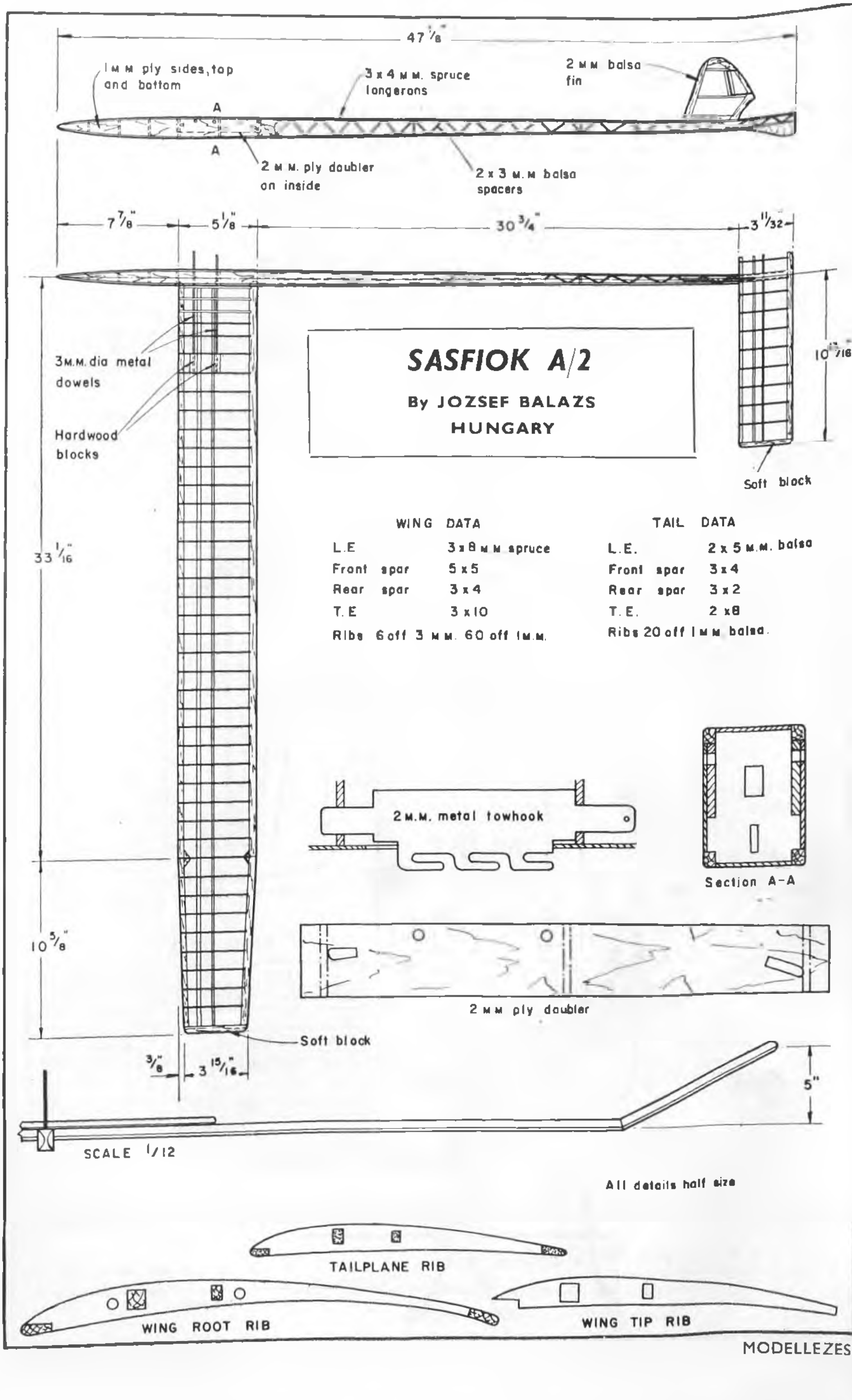
By GEORGE XENAKIS



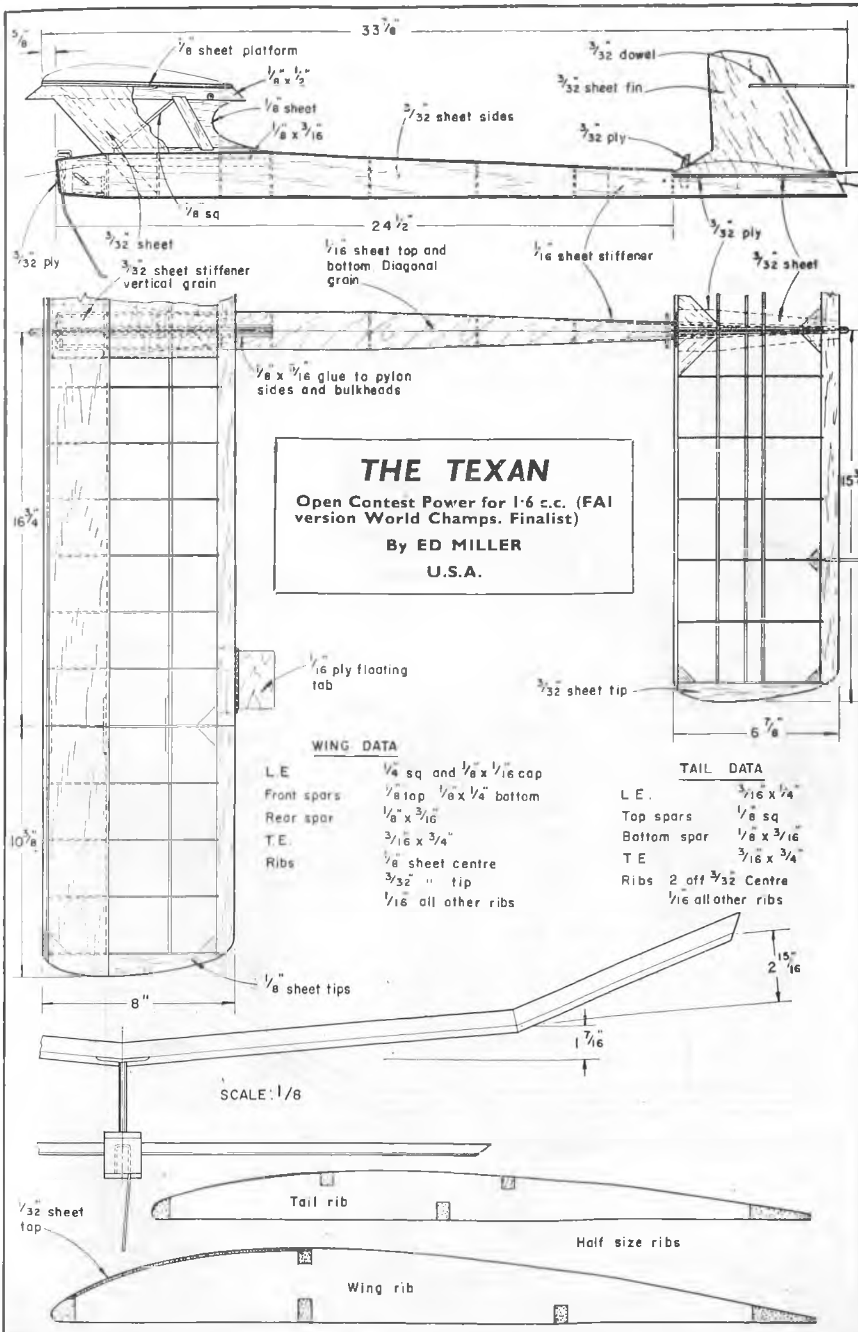
MODEL SIZES

ITEM	·35	·15	A/2
WING AREA – SQ IN.	420	188	105
WEIGHT – OZ	26*	18	7
FUSELAGE DIA – IN	1	7/8	3/4
WING THICKNESS – IN	9/32	7/32	1/8
TAIL THICKNESS – IN	1/8	1/8	1/8
ALUM. PIVOT TUBE OD – IN	1/8	3/32	1/16

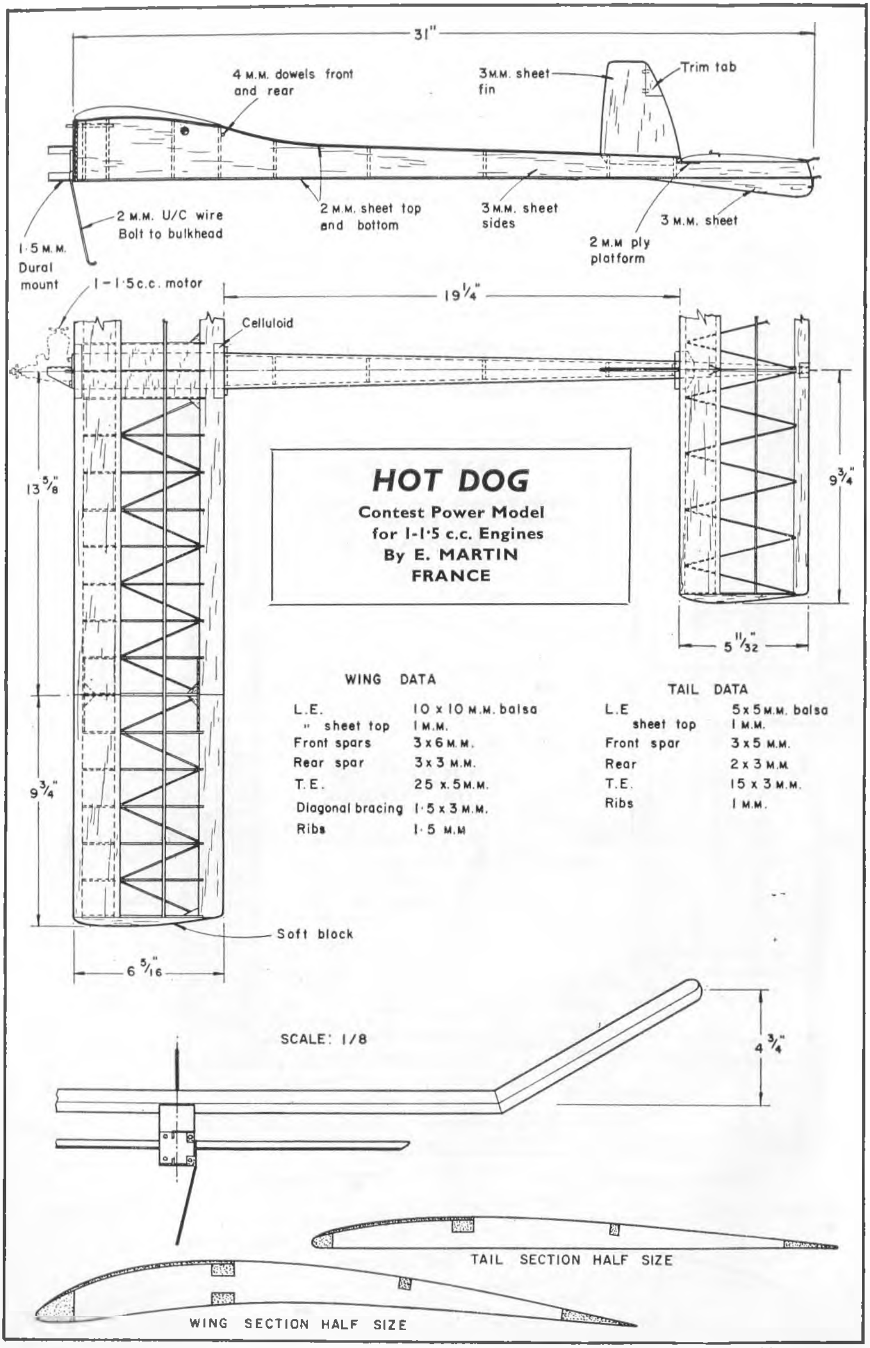
* TAIL-LESS


SASFIOK A/2
By JOZSEF BALAZS
HUNGARY
47 7/8"
1 M.M. ply sides, top and bottom
3 x 4 M.M. spruce longerons
2 M.M. balsa fin
A
A
2 M.M. ply doubler on inside
2 x 3 M.M. balsa spacers
7 7/8"
5 1/8"
30 3/4"
3 11/32"
10 7/16"
3M.M. dia metal dowels
Hardwood blocks
Soft block
33 1/16"
10 5/8"
3/8"
3 15/16"
Soft block
WING DATA
L.E. 3 x 8 M.M. spruce
Front spar 5 x 5
Rear spar 3 x 4
T.E. 3 x 10
Ribs 6 off 3 M.M. 60 off 1 M.M.
TAIL DATA
L.E. 2 x 5 M.M. balsa
Front spar 3 x 4
Rear spar 3 x 2
T.E. 2 x 8
Ribs 20 off 1 M.M. balsa.
2 M.M. metal towhook
Section A-A
2 M.M. ply doubler
5"
SCALE 1/12
All details half size
TAILPLANE RIB
WING ROOT RIB
WING TIP RIB

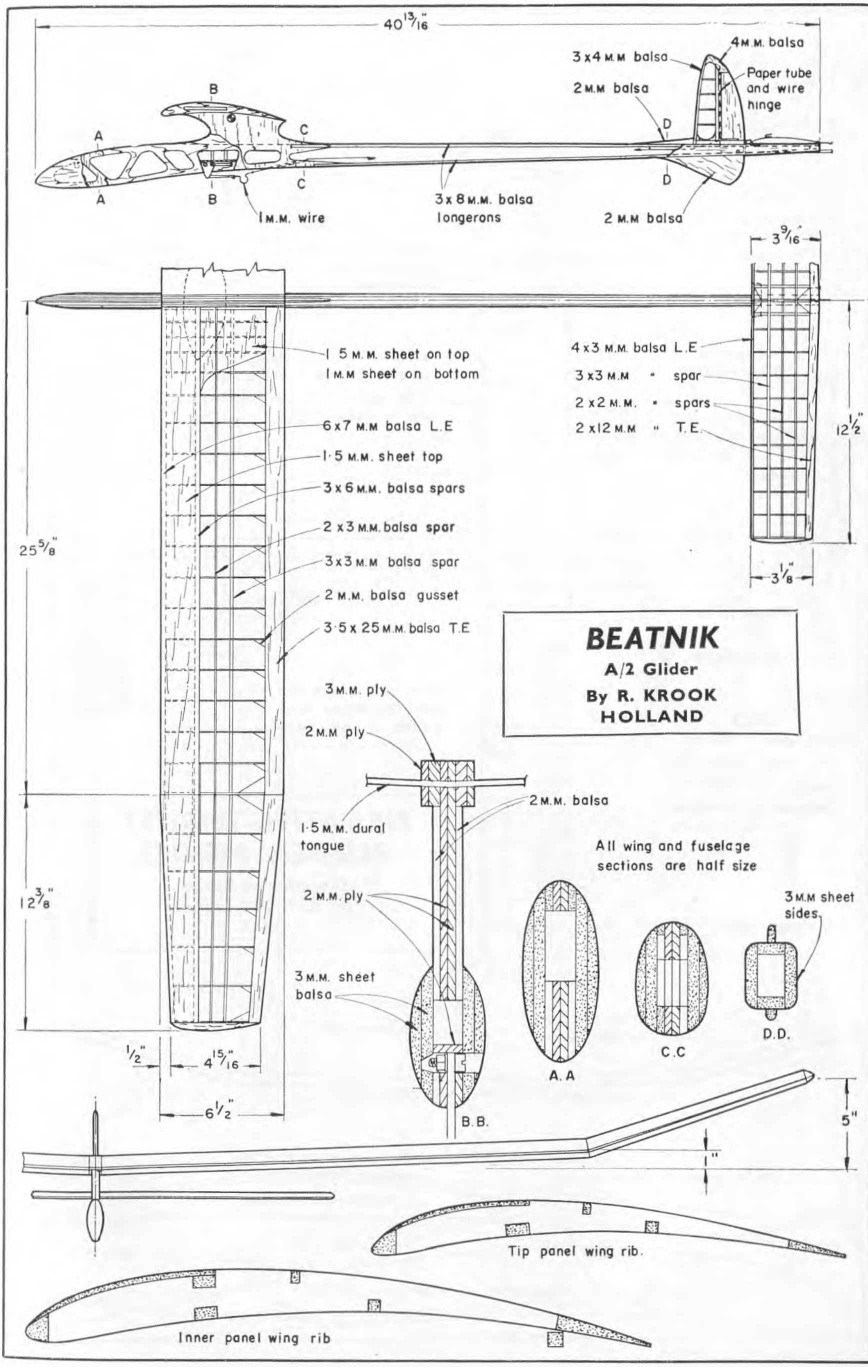
MODELLEZES



AMERICAN MODELER

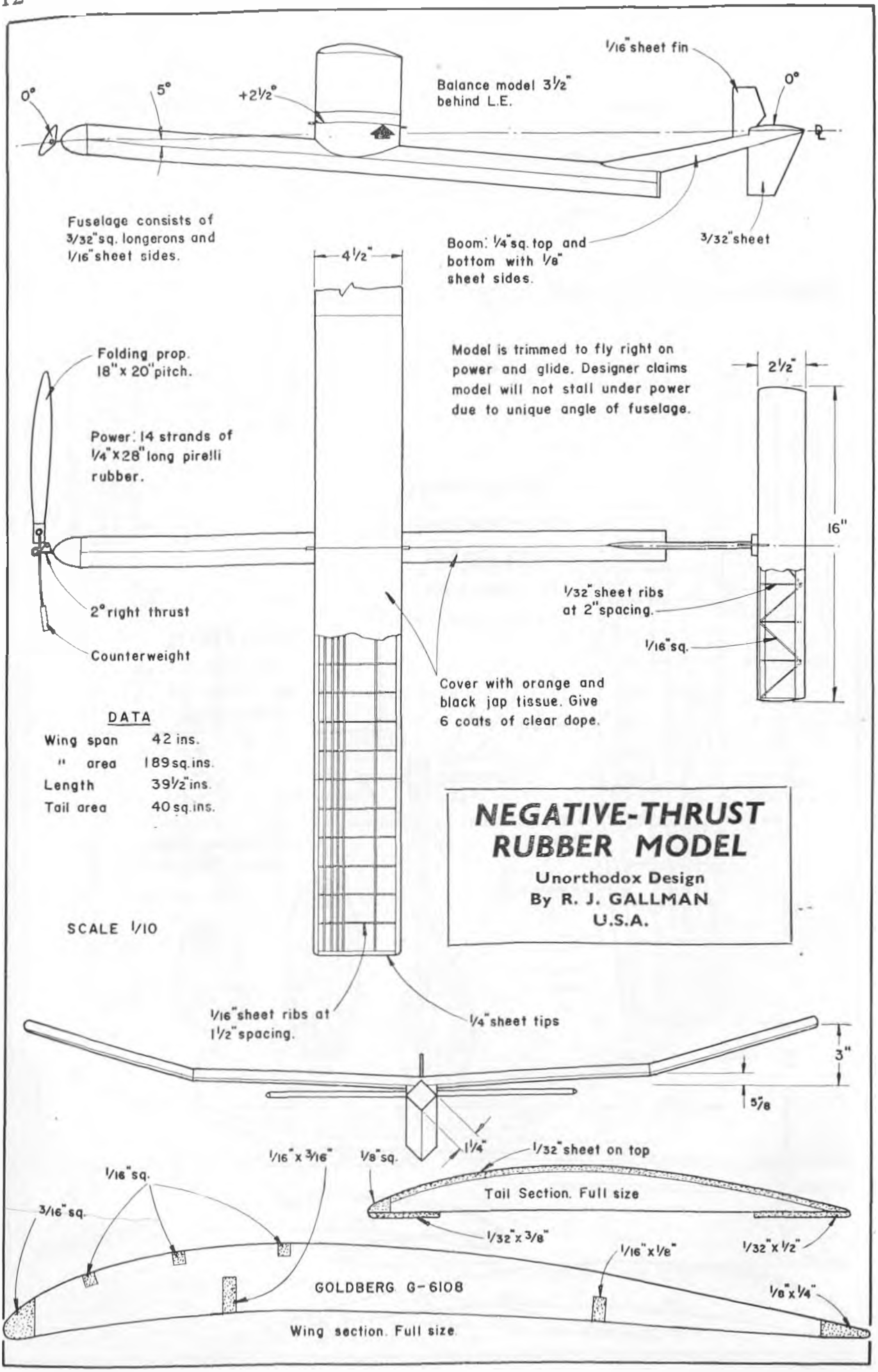

31"
4 M.M. dowels front and rear
3 M.M. sheet fin
Trim tab
2 M.M. U/C wire Bolt to bulkhead
2 M.M. sheet top and bottom
3 M.M. sheet sides
3 M.M. sheet
2 M.M ply platform
1·5 M.M. Dural mount
1 – 1·5 c.c. motor
19¼"
Celluloid
13⅝"
9¾"
HOT DOG
Contest Power Model for 1-1·5 c.c. Engines
By E. MARTIN
FRANCE
9¾"
5 11/32"
WING DATA
L.E. 10 x 10 M.M. balsa
" sheet top 1 M.M.
Front spars 3 x 6 M.M.
Rear spar 3 x 3 M.M.
T.E. 25 x .5 M.M.
Diagonal bracing 1·5 x 3 M.M.
Ribs 1·5 M.M
TAIL DATA
L.E 5 x 5 M.M. balsa
sheet top 1 M.M.
Front spar 3 x 5 M.M.
Rear 2 x 3 M.M
T.E. 15 x 3 M.M.
Ribs 1 M.M.
Soft block
6 5/16"
SCALE: 1/8
4¾"
TAIL SECTION HALF SIZE
WING SECTION HALF SIZE

MODEL AVIA

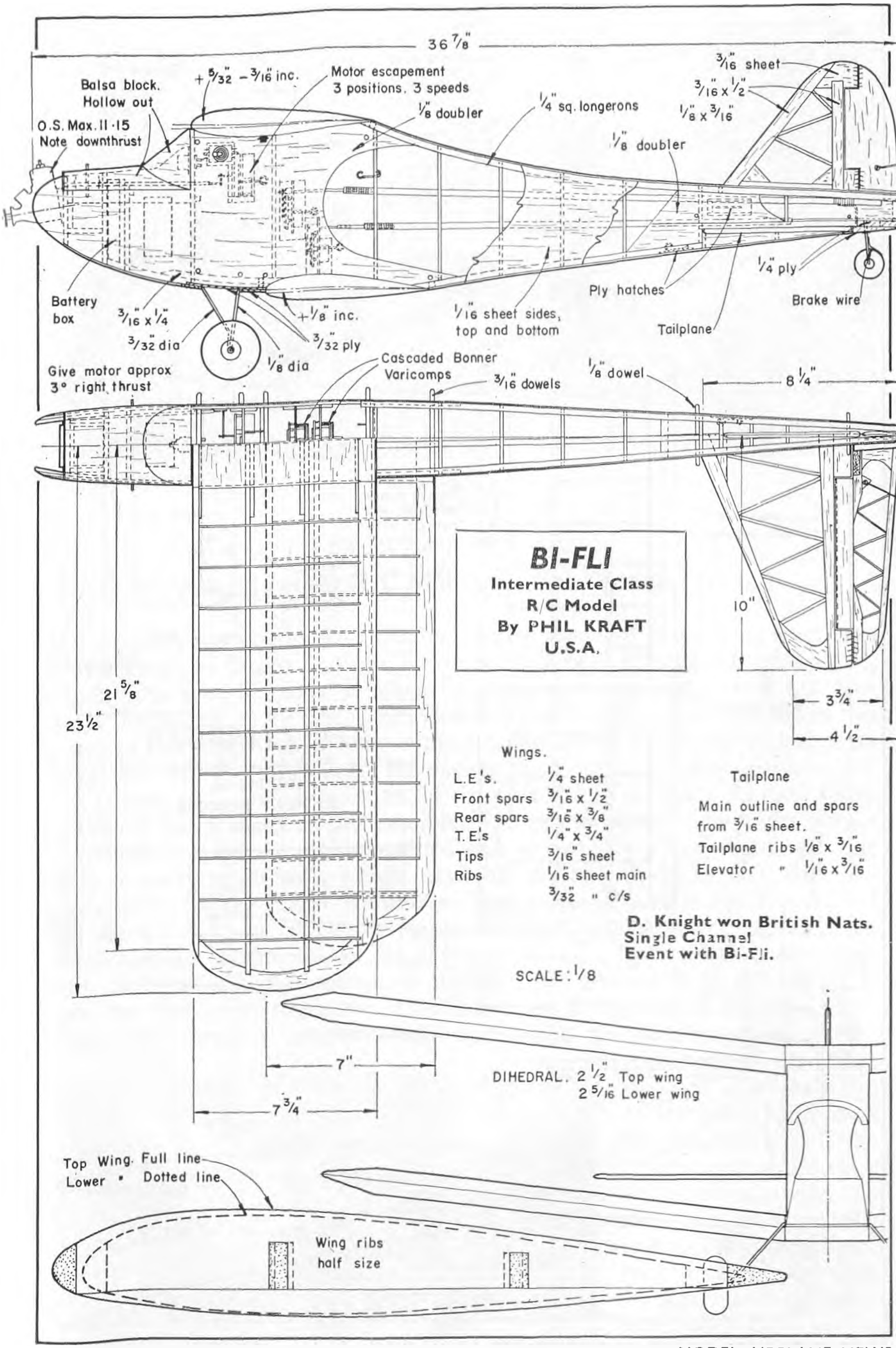


40 13/16"
4 M.M. balsa
3 x 4 M.M balsa
Paper tube and wire hinge
2 M.M balsa
B
A
C
D
A
B
C
D
I M.M. wire
3 x 8 M.M. balsa longerons
2 M.M balsa
3 9/16"
1 5 M.M. sheet on top
I M.M sheet on bottom
4 x 3 M.M. balsa L.E
3 x 3 M.M " spar
2 x 2 M.M. " spars
2 x 12 M.M " T.E.
12 1/2"
6 x 7 M.M balsa L.E
1·5 M.M. sheet top
3 x 6 M.M. balsa spars
2 x 3 M.M. balsa spar
3 x 3 M.M balsa spar
25 5/8"
2 M.M. balsa gusset
3 1/8"
3·5 x 25 M.M. balsa T.E
BEATNIK
A/2 Glider
By R. KROOK
HOLLAND
3 M.M. ply
2 M.M ply
2 M.M. balsa
1·5 M.M. dural tongue
All wing and fuselage sections are half size
12 3/8"
2 M.M. ply
3 M.M sheet sides
3 M.M. sheet balsa
A.A
C.C
D.D
1/2"
4 15/16"
6 1/2"
B.B.
5"
1"
Tip panel wing rib.
Inner panel wing rib

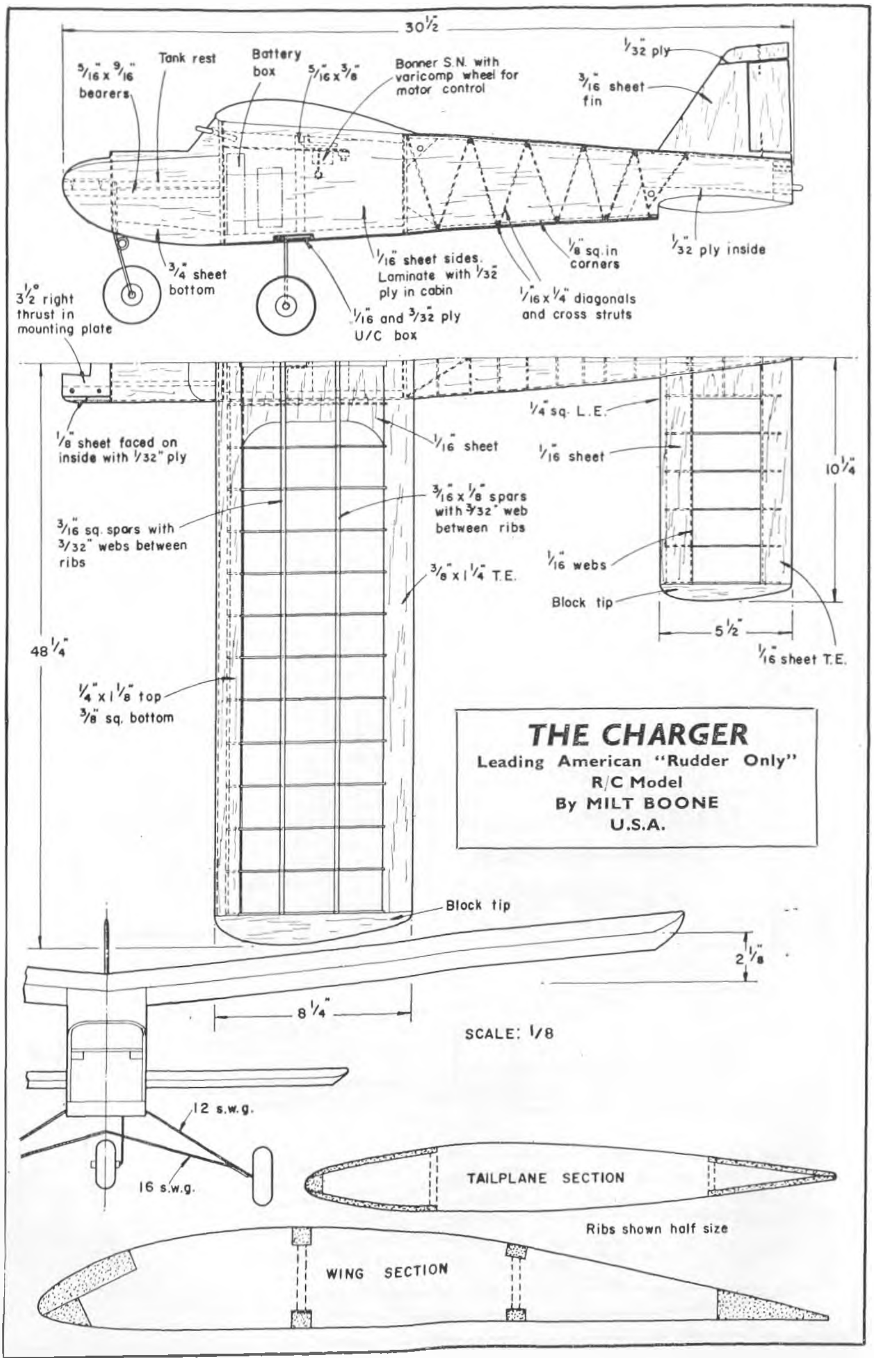
MODEL AVIA



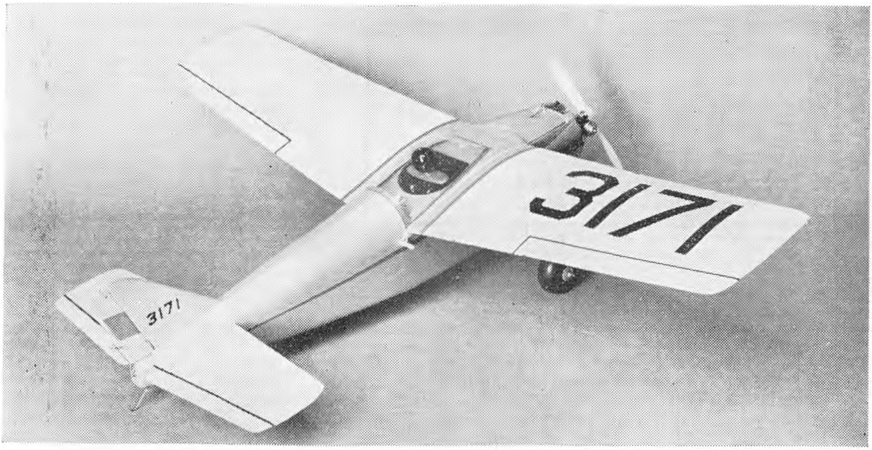
AMERICAN MODELER



MODEL AIRPLANE NEWS



AMERICAN MODELER



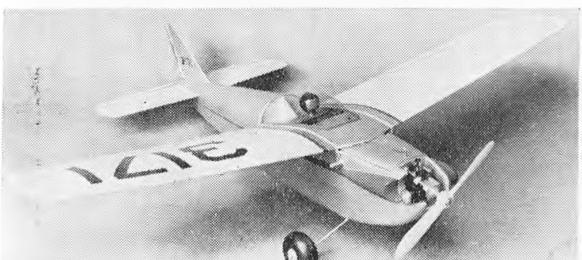
MINNIE

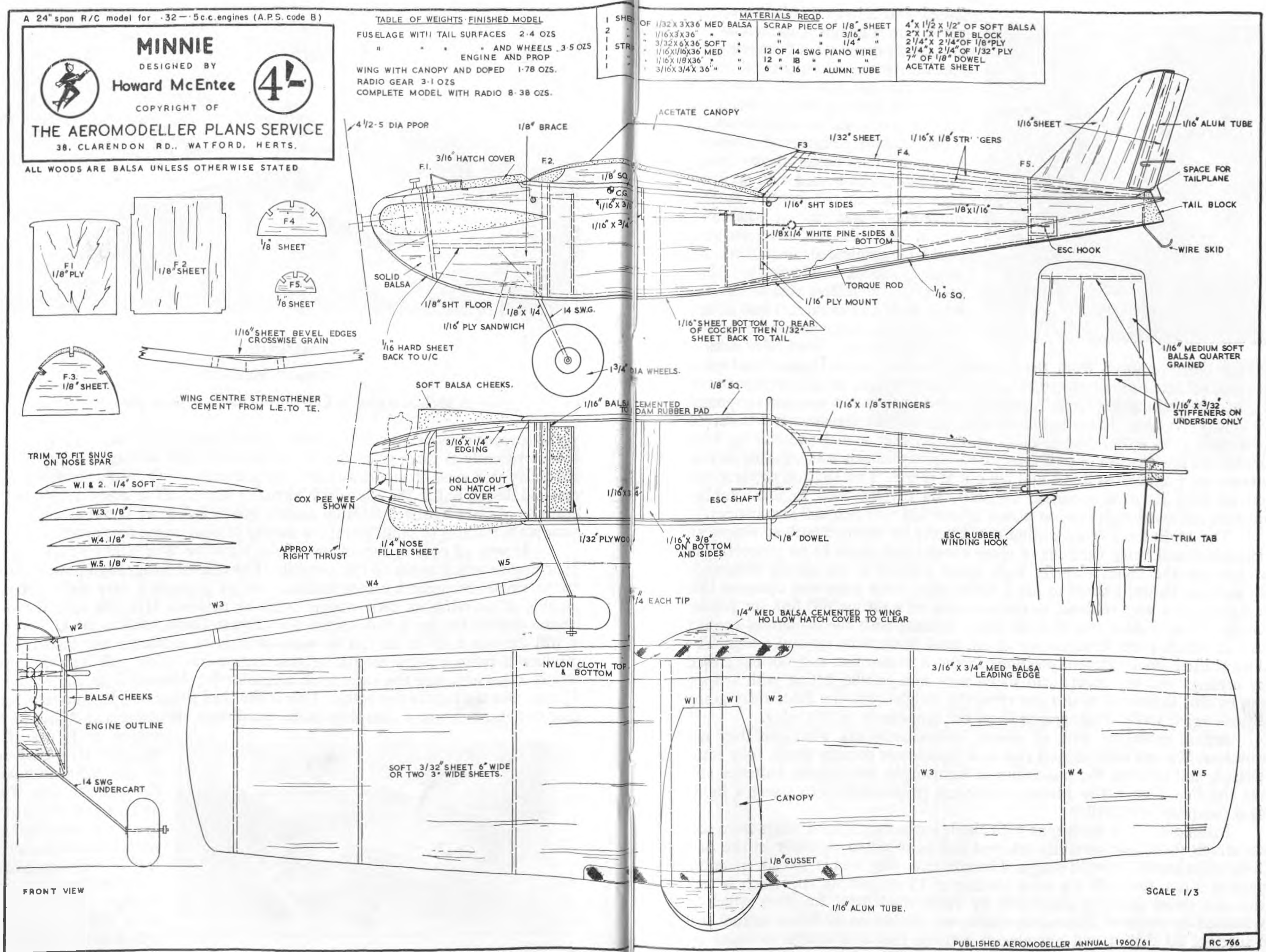
By HOWARD MCENTEE

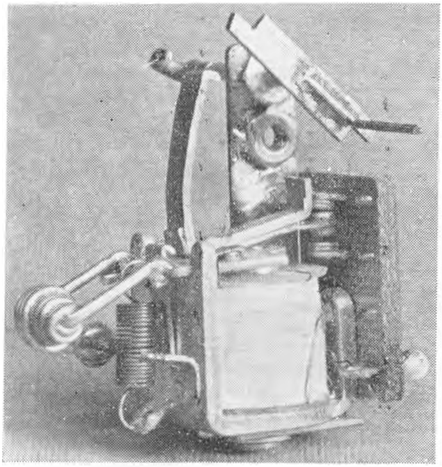
A lightweight R/C Model for Pee Wee power

HAD anyone considered a 9 oz. Radio Control model of 24 in. wing span even as recently as three years ago, he would have been tackling the impossible; but today this type of model is taken for granted. Mac's Minnie is now a two-year-old design but as the one which virtually started off so many people in this business of ultra lightweight radio control model flying we feel it is ideal as an example for others to build using the variety of equipment now available.

It was, of course, the advent of the Cox Pee Wee ·020 (·32 c.c.) Glow Plug Engine which made all this possible. The extraordinary high power output for so small and light a motor enabled one to produce a very light airframe capable of carrying its own weight again in payload. It is, in fact, the only engine eligible for the P.A.A. events for Clipper Cargo, *etc.*, in the U.S.A. and it will drive a 5×3 in. as fast as many motors of much greater capacity. To produce a radio control model for this engine one must still be very much weight conscious and the maximum tolerance for Minnie is in the region of $9\frac{3}{4}$ ozs., but the lighter the better. This is the final flying weight, and to achieve that one must devise a complete radio installation weighing something in the region of $3\frac{1}{2}$ ozs. This in itself is a challenge to the radio enthusiast for it means that if the standard actuator system is employed one must use miniature cells and a fully transistorised receiver on low voltage. Such is possible with the circuits which have been pub-




A 24" span R/C model for ·32—·5c.c. engines (A.P.S. code B)
MINNIE
DESIGNED BY
Howard McEntee
COPYRIGHT OF
THE AEROMODELLER PLANS SERVICE
38, CLARENDON RD., WATFORD, HERTS.
ALL WOODS ARE BALSA UNLESS OTHERWISE STATED
TABLE OF WEIGHTS · FINISHED MODEL
FUSELAGE WITH TAIL SURFACES 2·4 OZS
" " " AND WHEELS, ENGINE AND PROP 3·5 OZS
WING WITH CANOPY AND DOPED 1·78 OZS.
RADIO GEAR 3·1 OZS
COMPLETE MODEL WITH RADIO 8·38 OZS.
MATERIALS REQD.
1/32 x 3 x 36 MED BALSA
1/16 x 3 x 36
3/32 x 6 x 36 SOFT
1/16 x 1/16 x 36 MED
1/16 x 1/8 x 36
3/16 x 3/4 x 36
SCRAP PIECE OF 1/8" SHEET
3/16"
1/4"
12 OF 14 SWG PIANO WIRE
12 " 18
6 " 16 " ALUMN. TUBE
4" x 1 1/2 x 1/2" OF SOFT BALSA
2" x 1" x 1" MED BLOCK
2 1/4" x 2 1/4" OF 1/8" PLY
2 1/4" x 2 1/4" OF 1/32" PLY
7" OF 1/8" DOWEL
ACETATE SHEET
F1 1/8" PLY
F2 1/8" SHEET
F4 1/8" SHEET
F5. 1/8" SHEET
F3. 1/8" SHEET.
4 1/2-5 DIA PROP
1/8" BRACE
3/16" HATCH COVER
F.1.
F.2.
SOLID BALSA
1/8" SHT FLOOR
1/8" x 1/4
1/16" PLY SANDWICH
14 SWG.
1/16" SHEET BEVEL EDGES CROSSWISE GRAIN
1/16 HARD SHEET BACK TO U/C
WING CENTRE STRENGTHENER CEMENT FROM L.E. TO T.E.
1 3/4" DIA WHEELS.
SOFT BALSA CHEEKS.
TRIM TO FIT SNUG ON NOSE SPAR
W.1 & 2. 1/4" SOFT
W.3. 1/8"
W.4. 1/8"
W.5. 1/8"
3/16" x 1/4" EDGING
HOLLOW OUT ON HATCH COVER
COX PEE WEE SHOWN
1/4" NOSE FILLER SHEET
APPROX RIGHT THRUST
1/32" PLYWOOD
W5
W4
W3
W2
BALSA CHEEKS
ENGINE OUTLINE
14 SWG UNDERCART
FRONT VIEW
SOFT 3/32" SHEET 6" WIDE OR TWO 3" WIDE SHEETS.
NYLON CLOTH TOP & BOTTOM
ACETATE CANOPY
1/32" SHEET
1/16" x 1/8" STRINGERS
F3
F4
F5.
1/8" SQ.
C.G.
1/16" x 3/4"
1/16" SHT SIDES
1/8" x 1/16"
1/8" x 1/4 WHITE PINE - SIDES & BOTTOM
TORQUE ROD
1/16" PLY MOUNT
1/16" SHEET BOTTOM TO REAR OF COCKPIT THEN 1/32" SHEET BACK TO TAIL
1/16 SQ.
1/16" SHEET
1/16" ALUM TUBE
SPACE FOR TAILPLANE
TAIL BLOCK
ESC. HOOK
WIRE SKID
1/16" BALSA CEMENTED TO FOAM RUBBER PAD
1/8" SQ.
1/16" x 1/8" STRINGERS
ESC SHAFT
1/16" x 3/8" ON BOTTOM AND SIDES
1/8" DOWEL
ESC RUBBER WINDING HOOK
1/16" MEDIUM SOFT BALSA QUARTER GRAINED
1/16" x 3/32 STIFFENERS ON UNDERSIDE ONLY
TRIM TAB
1/4 EACH TIP
1/4" MED BALSA CEMENTED TO WING HOLLOW HATCH COVER TO CLEAR
3/16" x 3/4" MED BALSA LEADING EDGE
W1
W1
W 2
W 3
W 4
W 5
CANOPY
1/8" GUSSET
1/16" ALUM TUBE.
SCALE 1/3
PUBLISHED AEROMODELLER ANNUAL 1960/61
RC 766

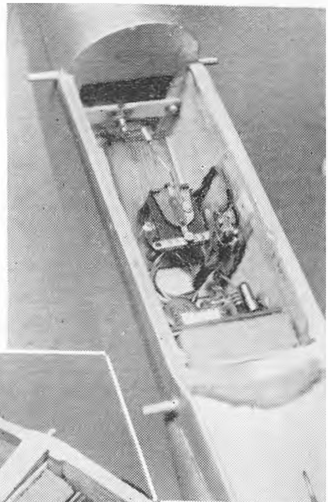


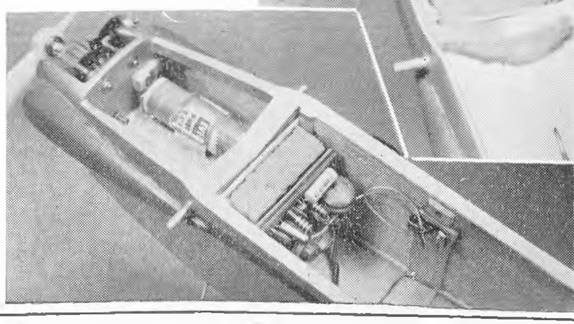
lished but Howard McEntee employed a standard commercial set and tried several ways of moving the rudder. In the first place one must realise that the amount of power required to move a small rudder on models of this size is very low indeed. The standard commercial actuators are generally employed in rudder only models as a means of applying high power to the control surface movement, and it is, therefore, logical that the actuator as such could be eliminated altogether in a small model. Howard's first approach, therefore, was to use the relay itself and convert it into a high resistance actuator as can be seen in the photograph. The relay was a standard Gem removed from the Deltron receiver. An L-shaped steel pawl catch was soldered to the armature and a counter weight added to balance out the otherwise unbalanced Gem. A simple 2-pawl escapement arm was supported by a vertical frame and thus the Gem relay became the actuator. It was driven by no more than a thin rubber band on the original model and this in itself indicates the low amount of power required. Spring tension was adjusted so that the armature pulled in at 2 mA and fell out at ·8 mA. The Deltron receiver was removed from its case, mounted vertically on ply attached to foam rubber insulation and used high tension power of one $22\frac{1}{2}$ volt pen cell size battery.

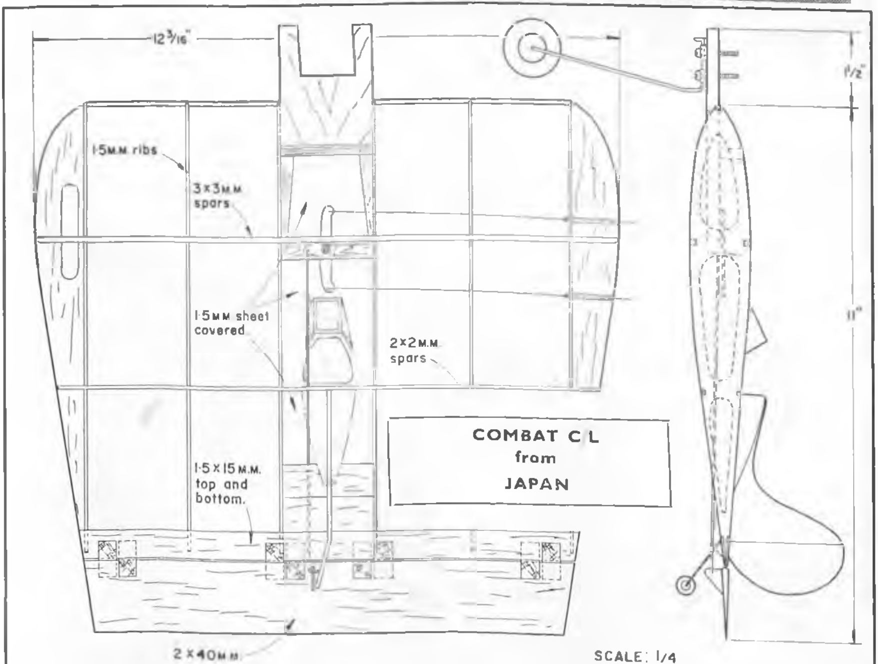
The McEntee inventive mind could never be satisfied with so simple an arrangement and being desirous of more control feel chose to go proportional. One can use the Gem relay for high speed pulsing if the spring tension is tightened up. Howard chose to use a 5,000 ohm. Price relay and operated this direct through a wire soldered to the armature to a torque rod link for rudder operation. The rudder was thus in direct contact with the armature, contact points of which were arranged for $\frac{1}{16}$ in. total movement up and down. The rudder shifted from extreme positions in the normal open and normal closed relay settings and the result said to be very nice rudder action with snappy flying by this little mid-wing racer type, the weight with the Price relay going to $9\frac{3}{4}$ ozs. ready to fly. Photographs show the installation of this relay.

British modellers will, of course, immediately ask what can they use themselves. We can only suggest that new equipment coming along, fully transistorised, and offering the possibility of lightweight low voltage batteries still make the Pee Wee Radio Model a practical proposition even using a lightweight escapement as well.

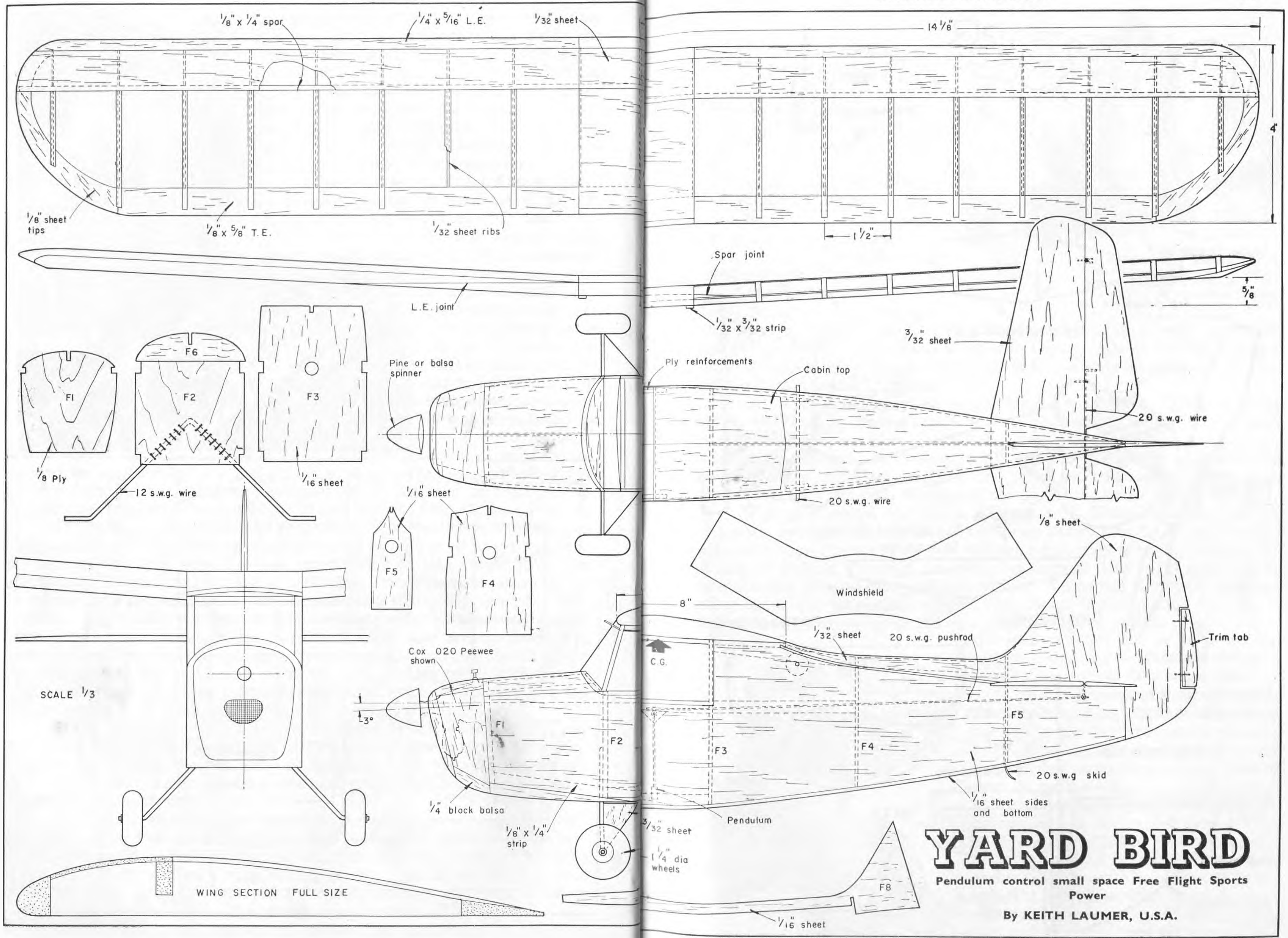
Minnie is an all-sheet type with single surface cambered wings from soft sheet which should be carefully selected and butt-joined carefully in the case of 3-in. wide sheets to avoid warps. The effective wing area is 100 sq. in. and a weight of 9 ozs. thus offers a wing loading of 13 oz. per sq. ft., which is well within the usual category employed by radio modellers. An item which is emphasised by designer Howard is that every precaution be taken to fuel seal the fuselage so that it will not absorb exhaust fuel and sludge to build up undesirable weight. On the original, lightweight glass fibre was wrapped around the nose as a strengthener. The weight of the airframe without radio gear and wiring should be in the region of 5¾ ozs. complete with motor, that is if the two-minute run offered by the standard Pee Wee tank is enough for you. An extra tank will add weight and in any case the shorter fuel run is a good safeguard for it's quite surprising how soon such a little model will disappear out of sight. Being sheet covered throughout it is a strong and durable model that will withstand many a knock. Because of its small size it introduces a problem in that some receivers need at least 24 in. of aerial and on the prototype a solution was found by having a wire running from tip to tip, taped to the under surface, and tapped off at the centre.



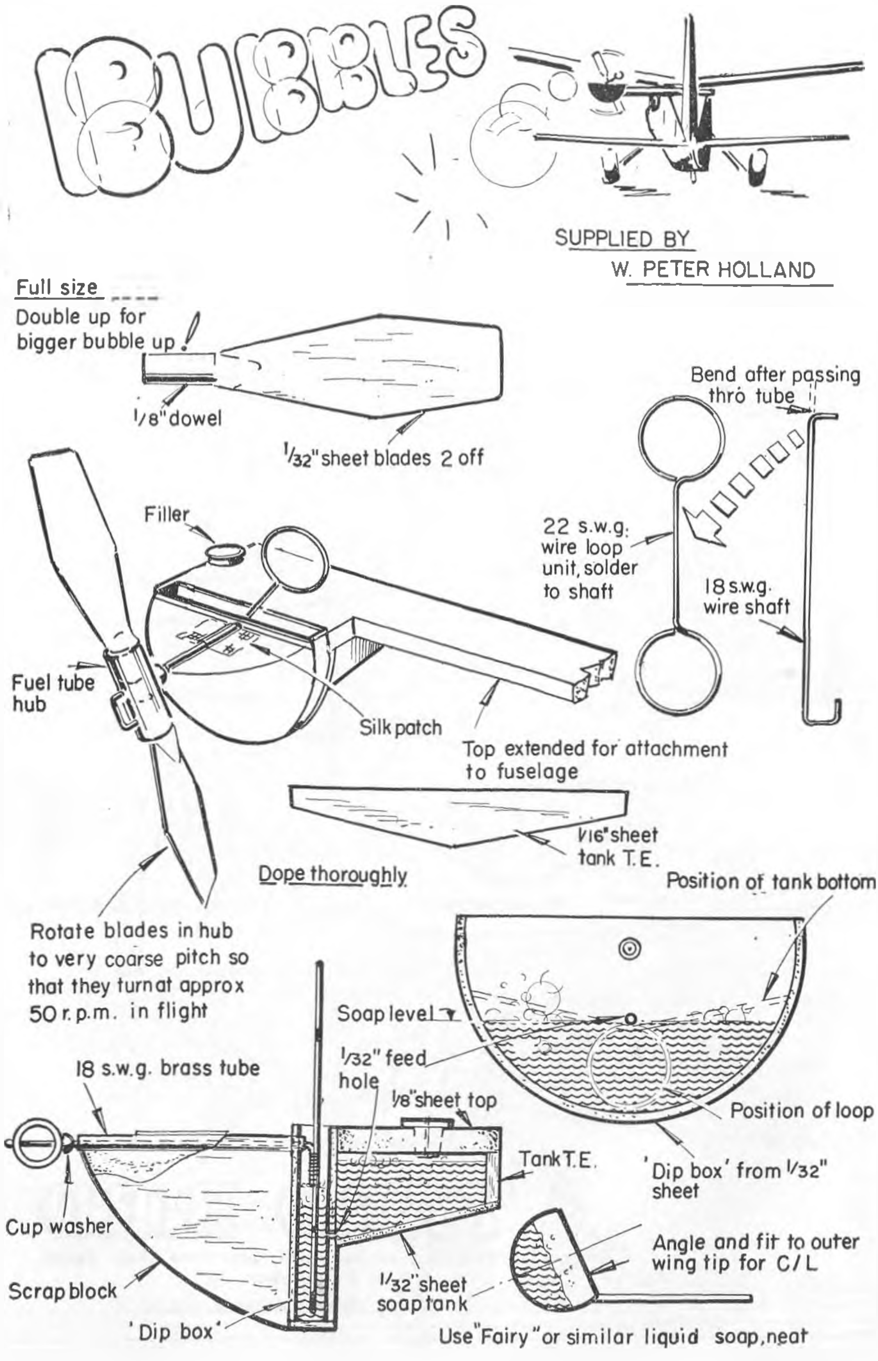




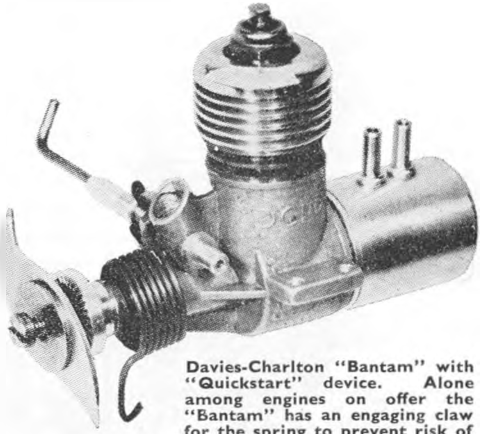
FLUG MODELL-TECHNIK



1/8" x 1/4" spar
1/4" x 5/16" L.E.
1/32" sheet
1/8" sheet tips
1/8" x 5/8" T.E.
1/32" sheet ribs
14 1/8"
4"
1 1/2"
L.E. joint
Spar joint
5/8"
1/32" x 3/32" strip
3/32" sheet
F1
F2
F3
F6
1/8 Ply
12 s.w.g. wire
1/16 sheet
Pine or balsa spinner
Ply reinforcements
Cabin top
20 s.w.g. wire
20 s.w.g. wire
1/16 sheet
F5
F4
1/8" sheet
Windshield
8"
1/32" sheet
20 s.w.g. pushrod
Trim tab
C.G.
Cox 020 Peewee shown
3°
SCALE 1/3
F1
F2
F3
F4
F5
20 s.w.g skid
1/16" sheet sides and bottom
1/4 block balsa
1/8" x 1/4" strip
3/32" sheet
Pendulum
1 1/4" dia wheels
F8
1/16" sheet
WING SECTION FULL SIZE
YARD BIRD
Pendulum control small space Free Flight Sports Power
By KEITH LAUMER, U.S.A.


BUBBLES
SUPPLIED BY
W. PETER HOLLAND
Full size
Double up for bigger bubble up
1/8" dowel
1/32" sheet blades 2 off
Bend after passing thro tube
22 s.w.g. wire loop unit, solder to shaft
18 s.w.g. wire shaft
Filler
Fuel tube hub
Silk patch
Top extended for attachment to fuselage
1/16" sheet tank T.E.
Dope thoroughly
Position of tank bottom
Rotate blades in hub to very coarse pitch so that they turn at approx 50 r.p.m. in flight
Soap level
1/32" feed hole
18 s.w.g. brass tube
1/8" sheet top
Position of loop
Tank T.E.
'Dip box' from 1/32" sheet
Cup washer
Angle and fit to outer wing tip for C/L
Scrap block
1/32" sheet soap tank
'Dip box'
Use "Fairy" or similar liquid soap, neat

SPRING STARTERS

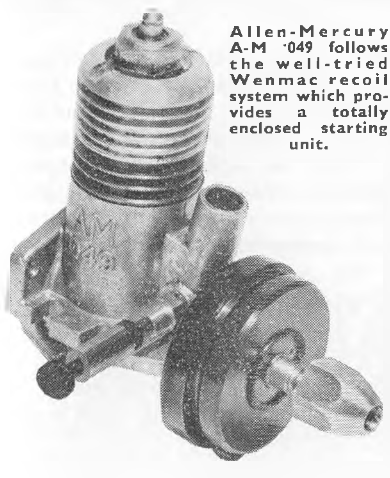


Davies-Charlton "Bantam" with "Quickstart" device. Alone among engines on offer the "Bantam" has an engaging claw for the spring to prevent risk of propeller damage.

It is something of an anomaly that glow motors, which are normally easier starters than diesels, are a logical subject for spring starting devices, whereas diesels are not. This is not simply because the higher compression ratios achieved by diesels make a starter ineffective, but also the fact that a diesel is best adjusted for starting by "feel". Make starting a purely mechanical process and that "feel" is absent and starting is no longer so positive with two controls to set. Diesels fitted with O-ring seals on the contra-piston also tend to lack this desirable "feel" and require a little longer to get familiar with their starting characteristics.

Basically, therefore, there is not much advantage in fitting a spring starter to a diesel. It can work quite well on smaller sizes (up to 1·5 c.c.), provided the engine is not allowed to develop a hydraulic lock through flooding—in which case it could do damage to the engine if the spring were powerful enough (but no more, and probably less, than the ham-fisted beginner with conventional flick starting). But it does not necessarily make starting easier.

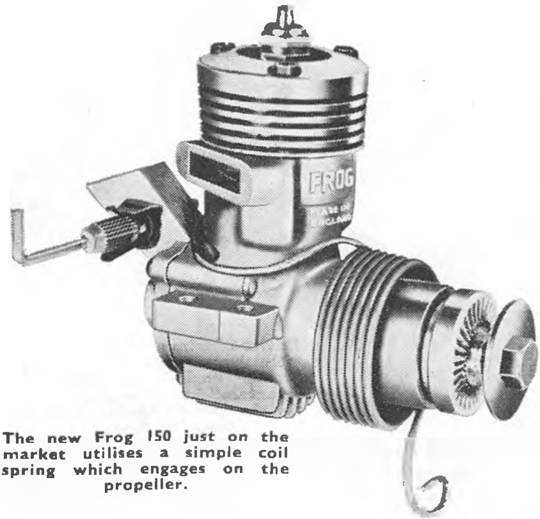
With glow motors it is quite a different story. There is only one control, for a start, governing the amount of fuel being drawn into the cylinder during each revolution. The necessary rich mixture for starting is readily achieved by priming or choking. Provided the glow plug element is the right temperature, starting is then purely a matter of rapid rotation of the shaft. A properly designed spring can do this *better* than a finger flick. Apart from replacing the manual effort required, the spring should be capable of storing enough energy to spin the shaft through four or more revolutions and thus make for more favourable starting conditions.



Allen-Mercury A-M ·049 follows the well-tried Wenmac recoil system which provides a totally enclosed starting unit.

Apart from various recoil starters fitted to model engineering products in the 1930's, the first attempts to produce a practical model aero-engine starter concentrated on external devices. One of the most notable—the American "Spring-It" starter—simply consisted of a cylinder housing a coil spring which could be wound up and locked with the spring energy stored. A suitable fitting then enabled the starter to be offered up to the hub of the propeller, locating on the shaft and against the propeller. When triggered, the spring energy rapidly rotated the propeller for engine starting—this in the days of spark - ignition engines.

With the advent of glow motors as the main commercial type in America, and diesels in Europe, little further consideration was given to starter devices until comparatively recently. Then the immense sale of the "049" size of glow motor in the States, and its adaptation to powering ready-to-go models with a wide toyshop sales appeal (and thus distribution to an essentially non-technical or non-skilled customer), brought a definite call for assisted starting.



The new Frog 150 just on the market utilises a simple coil spring which engages on the propeller.

The first of these were simple "pull cord" starters with a recoil action—a simplified version of the standard outboard motor type of starter. They worked reasonably well, with the particular limitation that the starting cord was a weak point. Not only was it possible to foul the propeller with it but the point of emergence from the starter unit remained a source of fraying and quick wear. Other weaknesses also showed up in "miniaturising" a basically sound "full-size" starter principle. As a consequence this type of starter has never offered very great advantages—only novelty appeal.

The logical development is more ingenious, using an enclosed clock-type spring to promote the recoil action which is automatically engaged when the propeller is turned backwards. The whole unit is then completely enclosed, compact and foolproof—within the limits of the mechanical design and material specification. The "Wenmac" starter is typical of this form of unit, as seen in this country on the A-M "049".

The principle limitation with this type of starter is that the spring is heavily stressed and can readily be overworked. Then it simply breaks. There just is not the space available—without making the starter excessively bulky—to accommodate a suitable size of spring to ensure operation under reasonable stress conditions and unlimited spring life. With the smaller spring, spring material specification and heat treatment become critical factors, and small variations can lead to a major crop of spring breakages—especially as the natural user reaction is to wind the spring—in fact *any* spring starter—back as far as it will go "to get more urge".

The coil spring starter, much simpler and certainly more "agricultural" in appearance, is a much better engineering design. Here spring size is not limited by the geometry of a casing into which it has to fit, spring length can be increased by increasing the number of coils, and fitting is a simple matter. It does, however, have to be engaged manually for each start and so is a less "complete" unit in this respect.

The Japanese appear to have been the first to use the external coil spring starter on a commercial engine—the Fuji diesel. Since then it has come into use in America (on the Cox "Olympic") and, of course, in this country with the Davies-Charlton "Quickstart" applied to their range of smaller engines, both diesel and glow, and the new Frog "150" glow motor.

Action of such a starter is too obvious to need description, but again the same basic limitation applies that with a spring of relatively small wire section it is readily possible to overstress the material by winding it up too tightly. Users will always ignore manufacturer's recommendations on any product—and inevitably pay the consequence, as a result. The smaller section spring, more than adequate for the job used *within the limit of winding turns recommended* can be permanently stretched and weakened by abuse. Once overstressed in this manner it loses some of its initial power and may fail to "return" safely free of the propeller.

This would appear to indicate that the desirable type of coil spring starter is one of generous diameter and length, using wire of fairly thick cross section. This will be capable of giving far more turning power than is ever required and although it may look clumsier is less likely to get overstressed by abuse. One point to watch here is that the stronger the spring is made the greater the liability for a finger to be rapped by the propeller blade once released. One has to be pretty quick, with most powerful spring starters, to hold the propeller blade by the extreme tip and withdraw the fingers smartly !

For the mathematically minded, the design of such a torsion spring follows from standard formulas. The basic formulas involved are:

$$a=\frac{366S\ PRDN}{Ed_4}$$

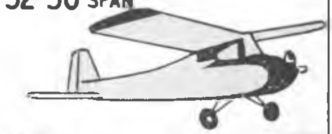
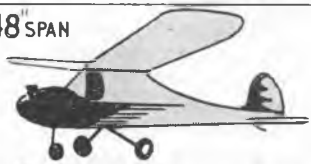
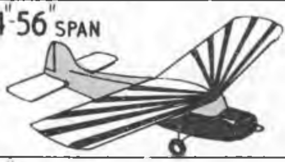
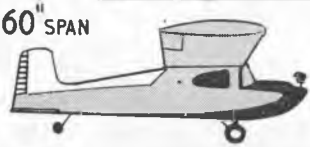
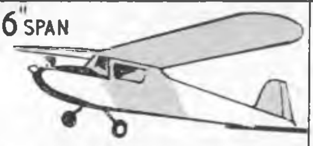
$$S=\frac{10{\cdot}18\ PRK}{d_3}$$

Where d=wire diameter
D=mean diameter of spring coils
A=free angle (degrees)
a=angular deflection required (degrees)
P=force in pounds to be exerted at radius R
N=number of coils
E=Youngs Modulus for the spring material
S=stress
K=correction factor for wire curvature

$$=\frac{4C=1}{4C=4}$$

$$\text{where } C=\frac{D}{d}$$

Minimum mean diameter is fixed by the necessity of accommodating the spring over the front bearing, but preferably making it a reasonably close fit both from the point of view of performance and end support. The spring geometry should then be chosen so that the spring stress comes within the safe working stress for the spring material—about 150,000 lbs. per sq. in. for good quality spring steel wire. Performance can be investigated in various diameter sizes to arrive at a suitable wire size—or wire diameter determined from limiting stress and performance requirements and the nearest (next size up) standard wire gauge used.

MODEL SIZE	WEIGHT OZS.	WING AREA	POWER	*CONTROLS*
32"-36" SPAN 	16-20	220 SQ.IN.	*·049-·075* ------ ·5-·8	RUDDER
42" SPAN 	18-26	270-300 SQ.IN.	*·075-·09* ------ ·8-1·0	RUDDER
48" SPAN 	40-48	400-450 SQ.IN.	*·09-·15* ------ 1·0-1·5	1. RUDDER 2. RUDDER/MOTOR
54"-56" SPAN 	50-60	550-600 SQ.IN.	*·15-·19* ------ 2·5-3·5	1. RUDDER/MOTOR 2. RUDDER/MOTOR/ ELEVATOR
60" SPAN 	60-72	600 SQ.IN.	*·29-·35* ------ 3·5	1. RUDDER/MOTOR 2. RUDDER/ELEVATOR 3. RUDDER/ELEVATOR/ MOTOR
66" SPAN 	80-96	750-800 SQ.IN.	*·29-·35* ------ 3·5	1. RUDDER/MOTOR 2. RUDDER/ELEVATOR/ MOTOR 3. RUDDER/ELEVATOR/ AILERONS
72" SPAN 	80-112	850 SQ.IN.	*·35-·45* ------ —	1. RUDDER/ELEVATOR/ AILERONS 2. RUDDER/ELEVATOR/ AILERONS/MOTOR 3. AS 2 PLUS ELEVATOR TRIM
78" SPAN 	96-112	800-1000 SQ.IN.	*·45* ------ —	1. RUDDER/ELEVATOR/ AILERONS/MOTOR 2. RUDDER/ELEVATOR/ AILERONS/MOTOR/ ELEVATOR TRIM

RADIO CONTROL MODEL SIZES

32-36 in. Span

This represents the minimum practical size and such models have definite limitations. They are essentially for calm air flying, suitable for rudder-only control and usually follow normal free flight sports design layout. Lightweight (transistorised) receivers are essential to save weight. Also the lightest rubber-driven escapements should be used. Excessive weight results in excessive flying speed which makes the model tend to be *too* responsive to rudder and difficult to control smoothly.

42 in. Span

The increased wing area enables more weight to be carried, but again transistorised receivers are to be preferred. "049" glow power is no longer suitable but diesels up to 1 c.c. will cope (larger diesels can also be used). Again the size of model is really suited to rudder only, although motor control may be added.

48 in. Span

Generally accepted as an ideal "trainer" size for rudder-only flying, these models can take up to 2·5 c.c. diesels for livelier performance—but start on low power first (*e.g.*, not larger than ·09 glow or 1·5 c.c. diesel). Rudder and motor control is a good set-up since this can be obtained with single-channel equipment. The motor control is useful in bringing the model down in a "powered glide" when penetration proves inadequate.

54-56 in. Span

This is a "marginal" size—more than big enough for rudder only but a little too small for ambitious "multi". Rudder and motor control is a minimum requirement. Rudder, motor and elevator control is to be preferred. Regard this as a good "trainer" size for multi, where you can start with four-channel equipment to save expense.

60 in. Span

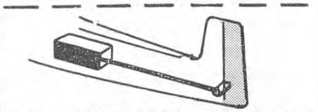
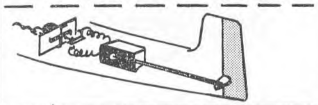
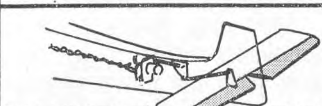
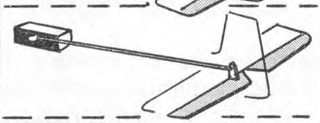
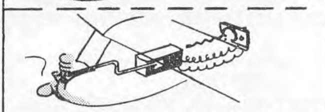
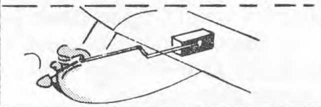
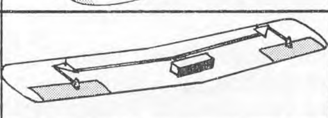
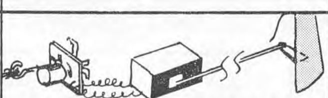
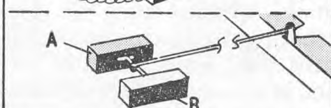
This is about the smallest size for advanced multi, although with more than six channels and attendant servos and batteries weight again tends to rise too high. Performance, in general, will not be as smooth and consistent as the larger models, but it is a particularly good size for four-channel equipment where you can use up to 3·5 c.c. diesels or the larger glow motors.

66 in. Span

A little "marginal" in size again for full eight-channel "multi", but if you want a fast flying model which is not too bulky, this is a good choice. The glow motor will be a logical choice for reduced vibration and greater flexibility during manoeuvres. Ideal size for six-channel and you could squeeze in those extra two later.

72 in. Span

Regarded as the "optimum" size for multi, whether using six channels or eight. Scheme 1 is adequate for most manoeuvres (six channels), but the addition of motor control is wise. Alternatively, omit aileron control for six-channel work. This size of model also lends itself to ten-channel operation where the extra "trim" control will be invaluable for smooth flying.

CONTROL MOVEMENT		ACTUATOR(S)	SELECTION	RADIO
RUDDER		ESCAPEMENT	SEQUENCE OR SELECTIVE	SINGLE-CHANNEL
		SERVO	SELECTIVE	MULTI-CHANNEL
		ESCAPEMENT/ SERVO	SELECTIVE	SINGLE-CHANNEL
ELEVATOR		ESCAPEMENT	SEQUENCE OR SELECTIVE	SINGLE-CHANNEL
		SERVO	SELECTIVE	MULTI-CHANNEL
		ESCAPEMENT/ SERVO	SELECTIVE	SINGLE-CHANNEL
MOTOR		ESCAPEMENT	SEQUENCE OR SELECTIVE	SINGLE-CHANNEL
		ESCAPEMENT/ SERVO	SELECTIVE/ SEQUENCE	SINGLE-CHANNEL
		SERVO	SELECTIVE	MULTI-CHANNEL
AILERON		SERVO	SELECTIVE	MULTI-CHANNEL
TRIM		ESCAPEMENT/ SERVO	SELECTIVE/ SEQUENCE	SINGLE-CHANNEL
		SERVO	SELECTIVE	MULTI-CHANNEL

78 in. Span

No need to go larger, in fact, anything bigger runs out of suitable engine power. The "35" is hardly man enough for this type of model, but you could get by with it. With a properly developed design you should get the edge over the 6 ft. model with either eight- or ten-channel—and the extra expense attendant on obtaining elevator trim is more than worthwhile.

Note: Span sizes are largely arbitrary but provide a useful criterion for conventional design layouts. Similarly, wing areas are nominal for the span size indicated. The "power" column lists glow motors in italics (specified in cu. in. sizes) and diesels underneath (in c.c. sizes).

RADIO CONTROL SYSTEMS

Rudder

For straightforward operation a simple escapement-type actuator is more than adequate with the advantages of saving weight and space and also having a very rapid transit time. If the escapement is mounted in the rear of the fuselage, choose a lightweight type. Otherwise locate in the centre of the fuselage and drive via balsa strip links with bound-on wire fittings.

A motor-driven servo offers more power but a slower transit time. This latter can be a failing with rudder-only systems, especially on small models which are particularly sensitive to rudder action.

Escapement/servo system employs the escapement as a switch to control the servo, making it possible to use a "multi" servo on single channel with little complication. Selective-type escapement should be used providing the necessary electrical switching.

Elevator

Simple escapement is not generally adequate for elevator since it cannot generate enough power—hence is liable to "skip" or lock on. It does, however, provide a solution for elevator control on single-channel systems via "cascade" escapements and similar.

Servo power is ideally suited to elevator movement, with transit time of the order of ·5 seconds adequate. Self-neutralising servo hook-up is safest. With progressive control movement you can get into serious trouble unless movement is restricted to below that required for "aerobatics".

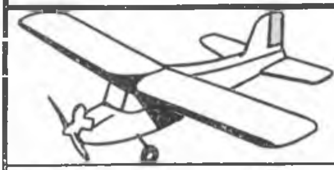
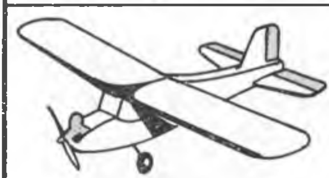
Escapement/servo combination is a solution again, desirable on single channel to utilise the extra power and safety factor of the motorised servo drive.

Motor

An escapement can either operate a mechanical linkage to close and open the throttle (and/or exhaust slide) or operate on the fuel supply. In the latter case twin feed pipes are used to separate spraybars and the escapement action switches from one to the other in sequence.

Escapement/servo linkage is better, since it provides more positive power for operating mechanical linkage. It is possible to operate the servo off a switching position on the rudder escapement, thus providing a basically straightforward system which is selective, but with the extra control (motor) following sequence.

Servo operation of the motor control (throttle and/or exhaust slide) is

CONTROL HOOK-UP	MOVEMENT	ACTUATOR	RADIO
	RUDDER	ESCAPEMENT SEQUENCE OR SELECTIVE	SINGLE-CHANNEL
	RUDDER PLUS MOTOR	ESCAPEMENT SELECTIVE SEPARATE SERVO OR ESCAPEMENT	SINGLE-CHANNEL
	RUDDER PLUS ELEVATOR	ESCAPEMENT OR SERVO ESCAPEMENT OR SERVO	SINGLE-CHANNEL WITH SELECTIVE SWITCHING OR MULTI-CHANNEL USING SERVOS
	RUDDER PLUS ELEVATOR PLUS MOTOR	ESCAPEMENT OR SERVO ESCAPEMENT OR SERVO ESCAPEMENT OR SERVO	SINGLE-CHANNEL WITH SELECTIVE SWITCHING OR MULTI-CHANNEL USING SERVOS
	RUDDER PLUS ELEVATOR PLUS AILERONS	SERVO SERVO SERVO	MULTI-CHANNEL 6 CHANNEL
	RUDDER PLUS ELEVATOR PLUS AILERONS PLUS MOTOR	SERVO SERVO SERVO SERVO	MULTI-CHANNEL 8 CHANNEL
	RUDDER PLUS ELEVATOR PLUS AILERONS PLUS MOTOR PLUS ELEVATOR TRIM	SERVO SERVO SERVO SERVO SERVO	MULTI-CHANNEL 10 CHANNEL

the only choice for "multi" and should be connected to act progressively. Then you have intermediate motor positions at will.

Ailerons

The only satisfactory way of operating ailerons is via multi-channel systems with a servo unit mounted in the wing and coupled to the ailerons by suitable wire linkage. Bellcranks provide the necessary change of motion at the aileron positions.

Trim

An escapement (separate from the main escapement) can be used as a switching control for progressive operation of a servo, thus providing a trimming action on a single-channel system. On aircraft, however, this can be worrying as the trim control, basically, has to be selected on a sequence basis.

For "foolproof" trim control, which is selective, an additional servo working the control surface over a small movement is the best and simplest choice. Thus servo "A" provides the main movement and servo "B" is effectively varying the "neutral" or trimmed position of the control surface. Servo "B" calls for an additional two channels to control. Connect the servo "progressively", then trim can be inched on and off, as required.

Note: This table is concerned with basic systems only. There are many electrical and electro-mechanical variations whereby "multi" control responses are obtained from single units.

CHOICE OF CONTROLS

Rudder

Rudder control is an essential feature of all single-channel systems. Simple escapements provide sequence rudder positions—right-neutral-left-neutral—with rapid transit time. This form of control is readily mastered. Selective-type escapement work on the same basic system but provide "selection" by the number of keying movements (*e.g.*, one for "right", two for "left"), again self-neutralising on release. Use of anything but *self-neutralising* escapements (or servos) on rudder-only systems is asking for trouble, unless you are a very experienced flyer.

Rudder plus Motor

Selective type escapements may provide a third position which can be used for controlling either a second escapement or a separate servo for motor speed control, off single-channel equipment. This is a worthwhile addition, especially as the second control is not critical.

Rudder plus Elevator

This is a workable system off single-channel equipment through "cascade" escapements, but essentially follows a sequence system. Hence it is possible to lose control and get out of step. Multi-channel operation is positive and selective and much to be preferred. This system requires four channels.

Rudder plus Elevator plus Motor

About the limit which can be attempted with single-channel equipment, with similar limitations to the above. Multi-channel operation is much to be preferred, using either five- or six-channels. In the former case motor control is operated via one channel only and is a sequence control. With six channels, the motor control is selective and by connecting the servo "progressively" can be made fully variable. Because it is a non-critical control the scope offered by the extra channel is well worthwhile and represents no hazard.

Elevator plus Rudder plus Ailerons

This system gives a fully aerobatic model (with the exception of true spins) available from six-channel equipment. Aileron control is very desirable since many extra manoeuvres can be performed with it and most of the turns done on ailerons—the rudder becoming something of a luxury, although still necessary. It gives you more in the manner of "flyability" for six channels, but you lack that useful "motor cut" for getting down out of trouble and have to rely on a spiral dive instead.

Rudder plus Elevator plus Ailerons plus Motor

This system gives you the fully aerobatic model. How well it performs all the possible manoeuvres is then a matter of practice, within any limitations offered by the design layout and trim. It is for multi-channel operation only and requires eight channels, four servos, attendant batteries and wiring, *etc.* Thus it becomes a relatively complicated and expensive system—but worth it.

Rudder plus Elevator plus Ailerons plus Motor plus Elevator Trim

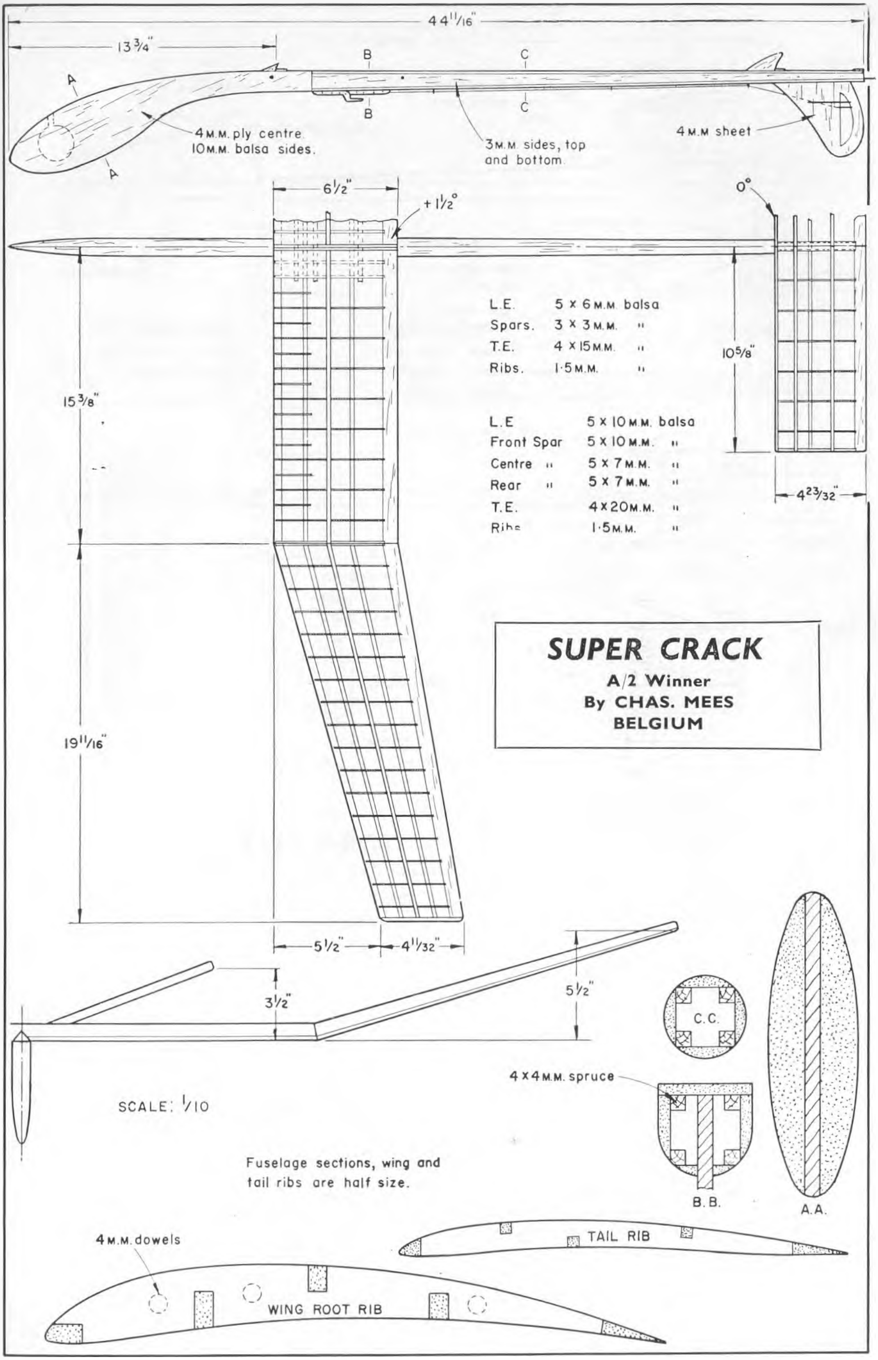
The addition of elevator trim takes the "steps" out of flying with self-neutralising controls and represents the ultimate, to present standards, in aerobatic flying requirements. The additional weight and expense is not too significant on a model of this size and type. Note: This table again only deals with "basic" systems and there are many possible variations offered by special servos and actuators, *etc.* Control movements are also assumed to be self-neutralising (except where noted), as this is the safest method. Fully proportional controls, where offering similar reliability, dispense with the necessity of a separate trimming control (two extra channels).

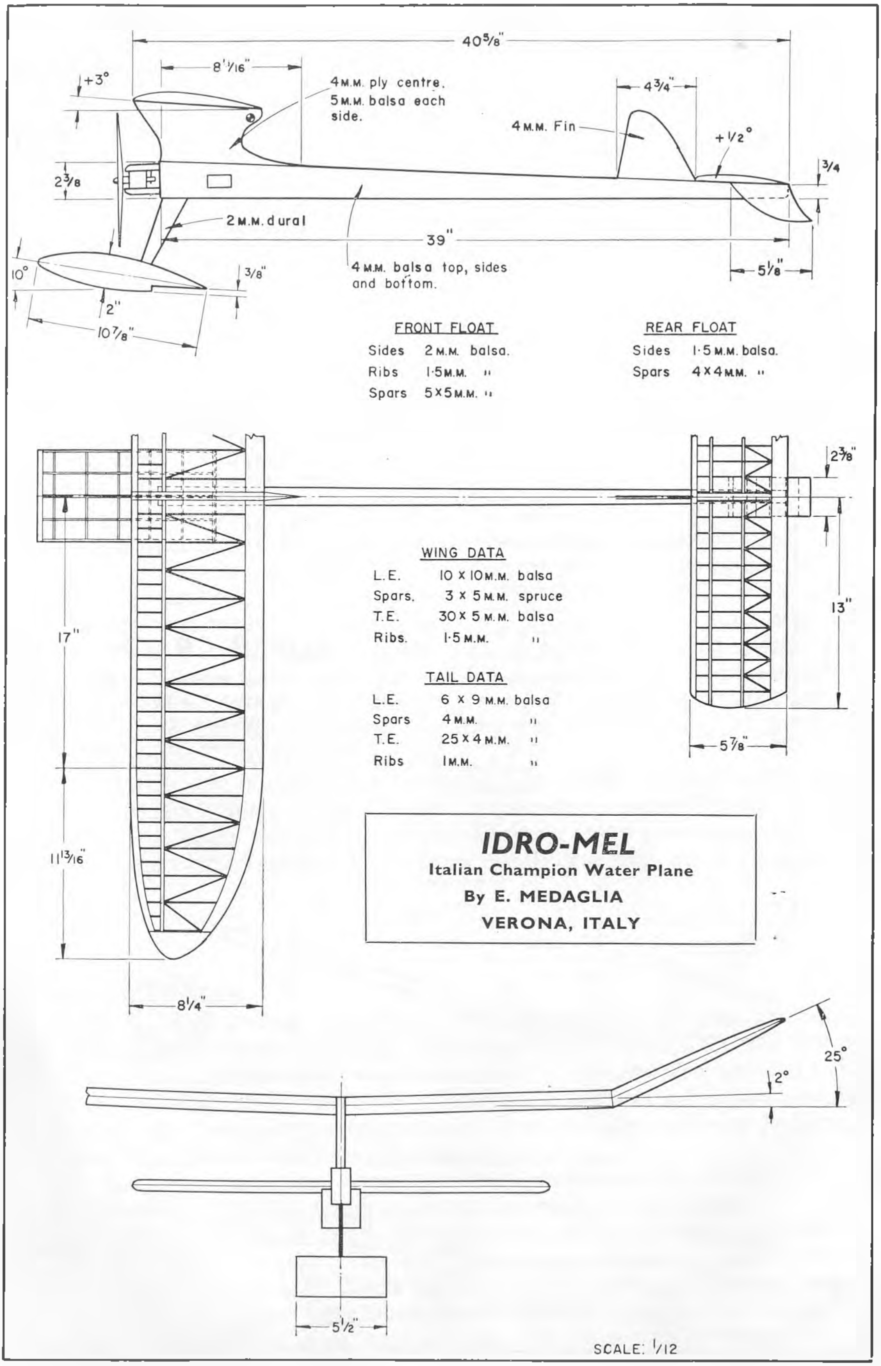
The survey is also based on producing a fully manoeuvrable model designed with a "contest" type aerobatic performance in mind. Quite obviously individual modellers may prefer to use additional control channels differently, *e.g.*, to operate wheel brakes, lower flaps, bomb dropping, aerial photography, *etc.*

WING RUBBERS

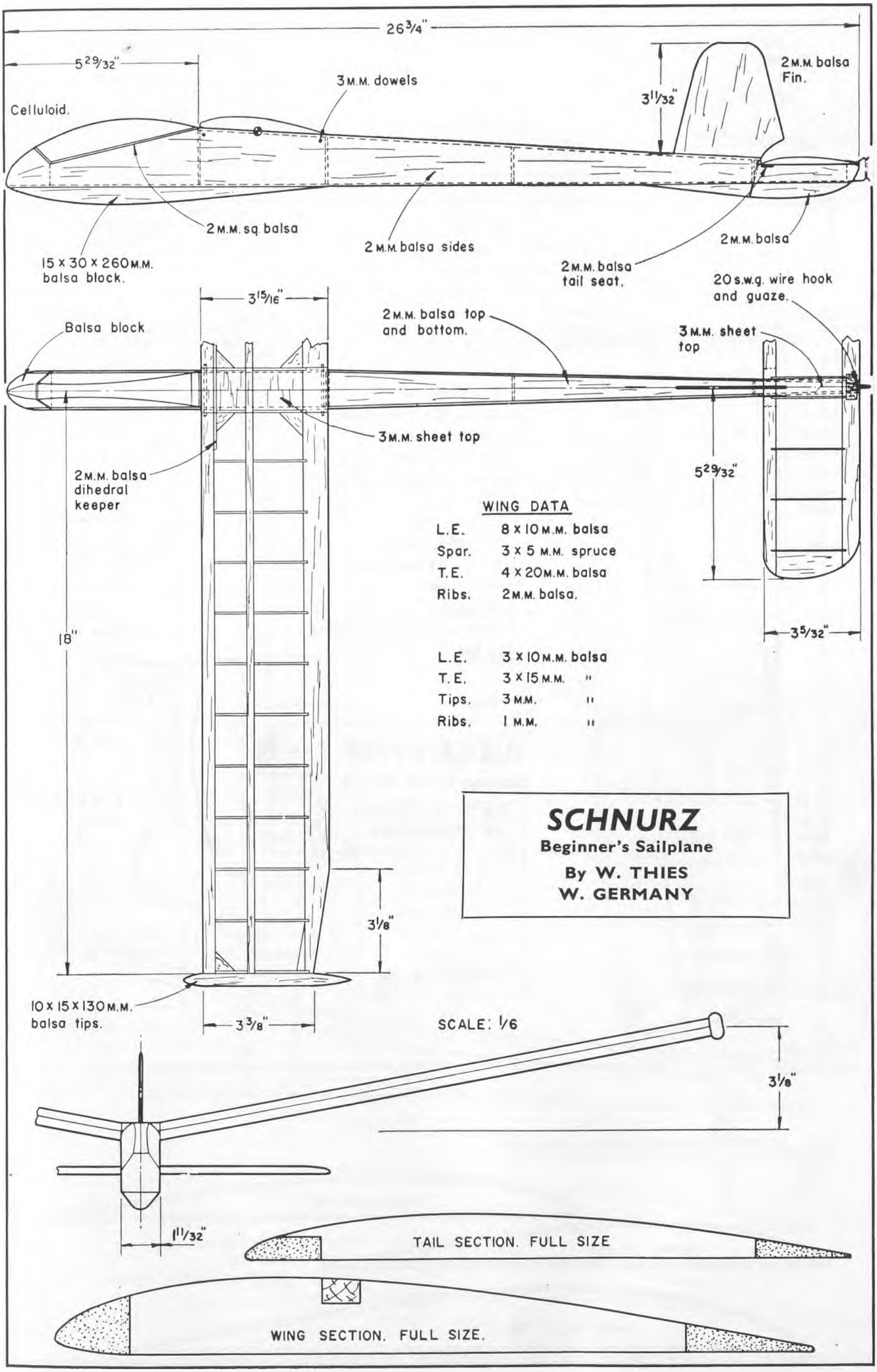
Holding on a wing with rubber bands of rubber strip is still the simplest and most foolproof method of wing mounting. Points to watch are that the wing leading edge and wing trailing edge (especially) are locally strengthened to take the bands without being damaged. A binding of gauze or glass tape cemented on is generally satisfactory reinforcement. A short length of wire let into the spar and taped over is better on large wings.

Bands must be strong enough to hold the wing firmly. A simple check is to lift the model up by the wings and see if the fixing is really secure. Too much rubber—literally yards of strip sometimes—makes it difficult for a wing to knock off without damage. The best technique is to use a number of thin bands stretched *really tight.* These hold very firmly and break immediately on a crash landing to let the wing fly off. Band length is chosen so that the stretch to get them in position is *at least six times* the unstretched length.

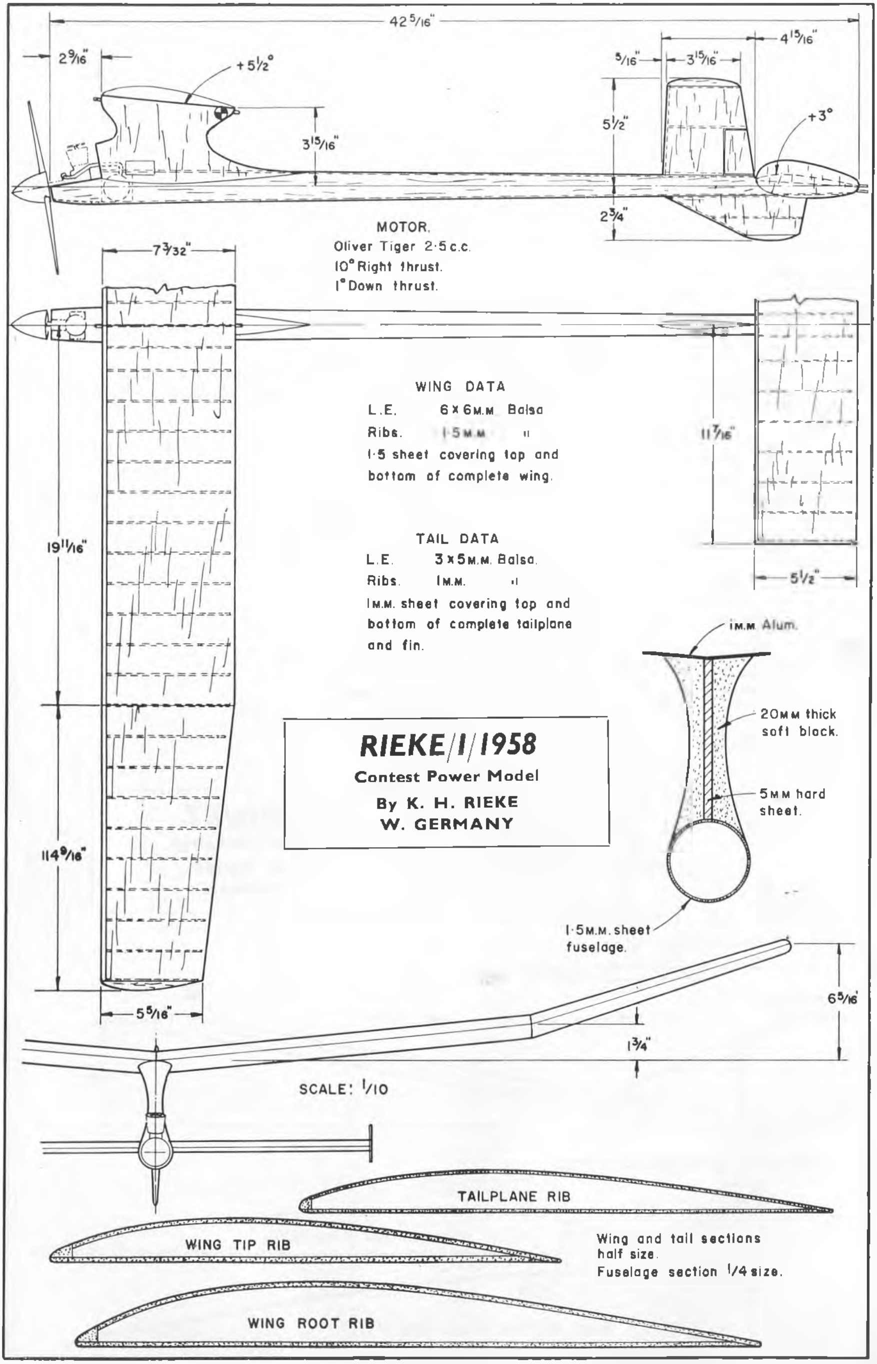

SUPER CRACK
A/2 Winner
By CHAS. MEES
BELGIUM
4 M.M. ply centre.
10 M.M. balsa sides.
3 M.M. sides, top and bottom.
4 M.M sheet
L.E. 5 x 6 M.M. balsa
Spars. 3 x 3 M.M. "
T.E. 4 x 15 M.M. "
Ribs. 1·5 M.M. "
L.E 5 x 10 M.M. balsa
Front Spar 5 x 10 M.M. "
Centre " 5 x 7 M.M. "
Rear " 5 x 7 M.M. "
T.E. 4 x 20 M.M. "
Ribs 1·5 M.M. "
SCALE: 1/10
Fuselage sections, wing and tail ribs are half size.
4 x 4 M.M. spruce
C.C.
B.B.
A.A.
TAIL RIB
4 M.M. dowels
WING ROOT RIB



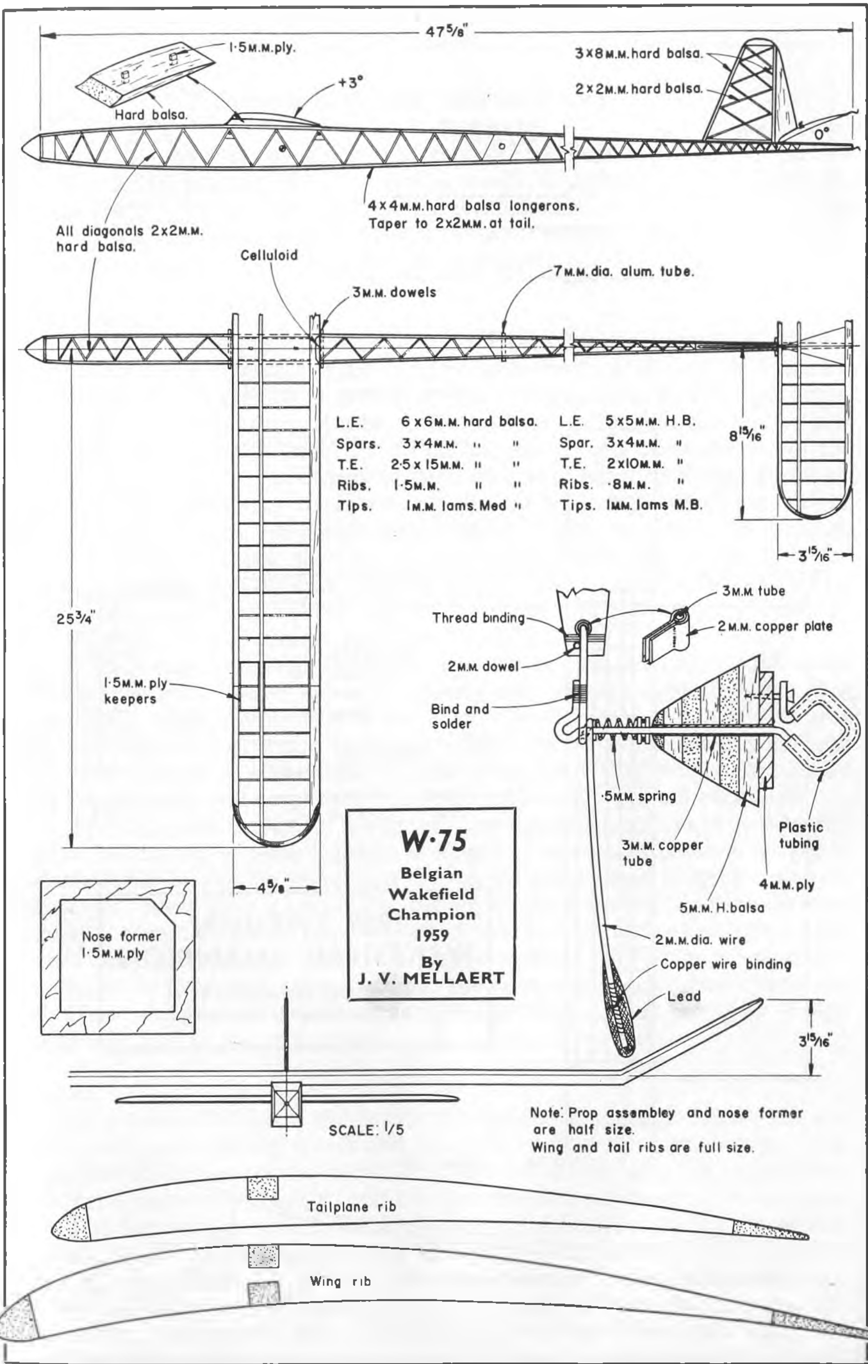
AEROMODELLISTA

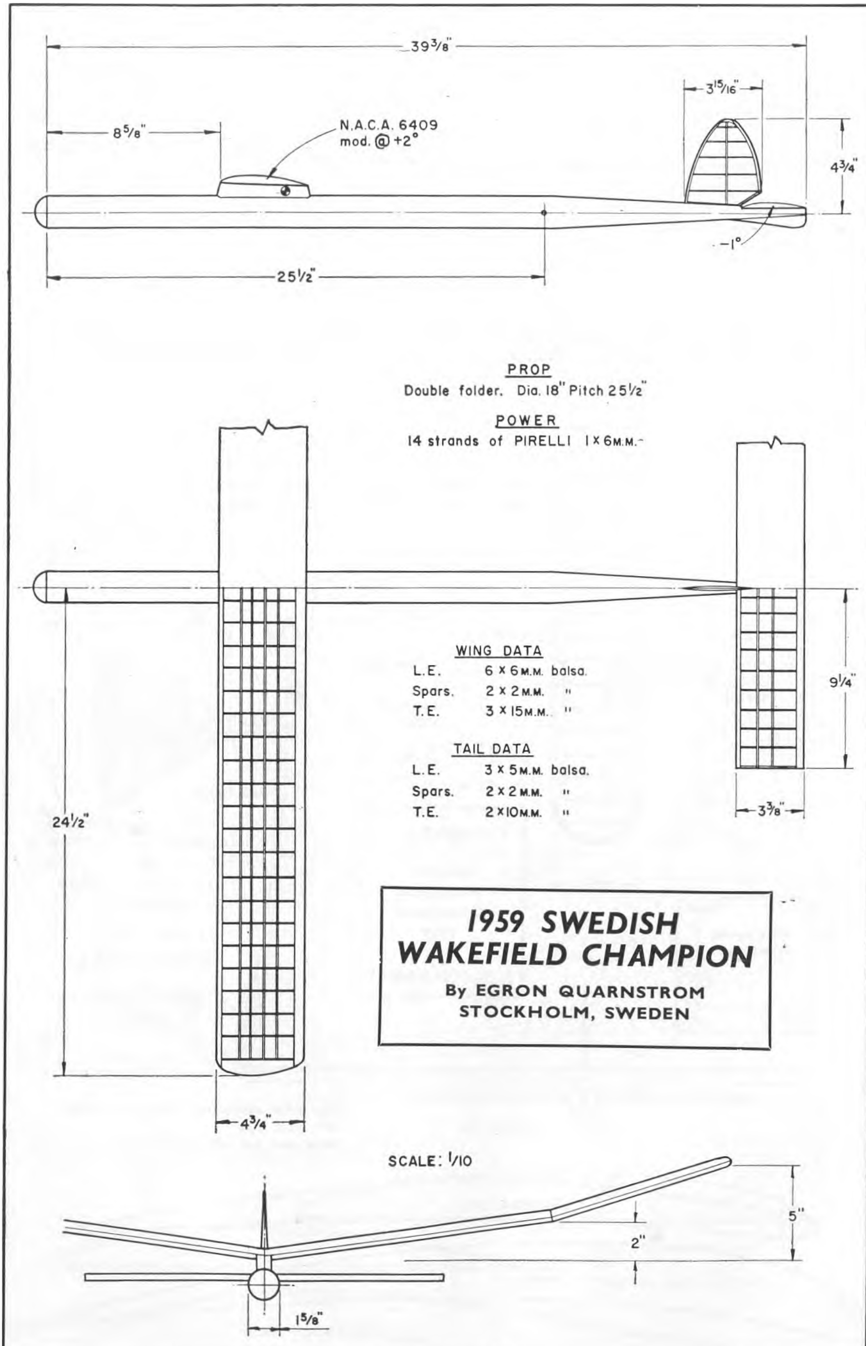

26¾"
5 29/32"
3 M.M. dowels
3 11/32"
2 M.M. balsa Fin.
Celluloid.
2 M.M. sq balsa
2 M.M. balsa sides
2 M.M. balsa
15 x 30 x 260 M.M. balsa block.
2 M.M. balsa tail seat.
20 s.w.g. wire hook and guaze.
3 15/16"
2 M.M. balsa top and bottom.
Balsa block
3 M.M. sheet top
3 M.M. sheet top
2 M.M. balsa dihedral keeper
5 29/32"
WING DATA
L.E. 8 x 10 M.M. balsa
Spar. 3 x 5 M.M. spruce
T.E. 4 x 20 M.M. balsa
Ribs. 2 M.M. balsa.
18"
3 5/32"
L.E. 3 x 10 M.M. balsa
T.E. 3 x 15 M.M. "
Tips. 3 M.M. "
Ribs. 1 M.M. "
SCHNURZ
Beginner's Sailplane
By W. THIES
W. GERMANY
3⅛"
10 x 15 x 130 M.M. balsa tips.
3⅜"
SCALE: 1/6
3⅛"
1 11/32"
TAIL SECTION. FULL SIZE
WING SECTION. FULL SIZE.

MECHANIKUS


42 5/16"
2 9/16"
+5½°
3 15/16"
5/16"
3 15/16"
4 15/16"
5½"
+3°
2¾"
MOTOR.
Oliver Tiger 2·5 c.c.
10° Right thrust.
1° Down thrust.
7 3/32"
WING DATA
L.E. 6 x 6 M.M. Balsa
Ribs. 1·5 M.M. "
1·5 sheet covering top and bottom of complete wing.
TAIL DATA
L.E. 3 x 5 M.M. Balsa.
Ribs. 1 M.M. "
1 M.M. sheet covering top and bottom of complete tailplane and fin.
11 7/16"
5½"
19 11/16"
1 M.M. Alum.
20 M.M. thick soft block.
5 M.M. hard sheet.
RIEKE/1/1958
Contest Power Model
By K. H. RIEKE
W. GERMANY
114 9/16"
1·5 M.M. sheet fuselage.
5 5/16"
6 5/16"
1¾"
SCALE: 1/10
TAILPLANE RIB
WING TIP RIB
Wing and tail sections half size.
Fuselage section 1/4 size.
WING ROOT RIB

MODELL


47⅝"
1·5 M.M. ply.
Hard balsa.
+3°
3×8 M.M. hard balsa.
2×2 M.M. hard balsa.
0°
4×4 M.M. hard balsa longerons.
Taper to 2x2 M.M. at tail.
All diagonals 2x2 M.M.
hard balsa.
Celluloid
3 M.M. dowels
7 M.M. dia. alum. tube.
L.E. 6 x 6 M.M. hard balsa.
Spars. 3 x 4 M.M. " "
T.E. 2·5 x 15 M.M. " "
Ribs. 1·5 M.M. " "
Tips. 1 M.M. lams. Med "
L.E. 5 x 5 M.M. H.B.
Spar. 3x4 M.M. "
T.E. 2x10 M.M. "
Ribs. ·8 M.M. "
Tips. 1 M.M. lams M.B.
8 15/16"
3 15/16"
25¾"
1·5 M.M. ply
keepers
4⅝"
Thread binding
2 M.M. dowel
Bind and
solder
3 M.M. tube
2 M.M. copper plate
·5 M.M. spring
3 M.M. copper
tube
Plastic
tubing
4 M.M. ply
5 M.M. H. balsa
2 M.M. dia. wire
Copper wire binding
Lead
W·75
Belgian
Wakefield
Champion
1959
By
J. V. MELLAERT
Nose former
1·5 M.M. ply
3 15/16"
SCALE: 1/5
Note: Prop assembley and nose former
are half size.
Wing and tail ribs are full size.
Tailplane rib
Wing rib



39 3/8"
3 15/16"
8 5/8"
N.A.C.A. 6409
mod. @ +2°
4 3/4"
-1°
25 1/2"
PROP
Double folder. Dia. 18" Pitch 25 1/2"
POWER
14 strands of PIRELLI 1 x 6 M.M.
WING DATA
L.E. 6 x 6 M.M. balsa.
Spars. 2 x 2 M.M. "
T.E. 3 x 15 M.M. "
TAIL DATA
L.E. 3 x 5 M.M. balsa.
Spars. 2 x 2 M.M. "
T.E. 2 x 10 M.M. "
9 1/4"
3 3/8"
24 1/2"
4 3/4"
1959 SWEDISH WAKEFIELD CHAMPION
By EGRON QUARNSTROM
STOCKHOLM, SWEDEN
SCALE: 1/10
5"
2"
1 5/8"

WEIGHT IS STILL IMPORTANT

DESPITE the fact that the majority of contest specifications no longer place a premium on lightweight construction, weight is still the enemy of performance. At the same time we have the apparent anomaly that an increase in total weight for a given model size does not necessarily reduce performance, but can even improve it if that extra weight is used properly.

Rubber Models

Nearly a quarter of a century ago, the Wakefield specification called for a minimum total model weight of 4 ounces and a majority of the top class models were built down to near this figure. When the 1937 rules doubled the minimum weight, the first thought was that performance must suffer, but the reverse was proved true. Performance, in fact, went on increasing right up to the end of the "unrestricted rubber" rules largely because designers found that they could go on increasing performance by increasing the rubber weight or power/weight ratio. The last of these truly high-performance models exceeded the 8 ounce minimum simply to pack in some 6 ounces of rubber, consistent with the theoretical analysis that optimum performance from a rubber model should be realised with a 66 per cent rubber weight. *Structural* weight, therefore, remained a vital factor in order to achieve this power/weight ratio.

The interesting fact also emerged that for a given amount of rubber the lightweight airframe loaded up with concentrated dead weight to arrive at a certain total weight, performed better than a model with the whole of this additional weight incorporated in the airframe—a point which has largely been absorbed in present day Wakefield design in concentrating weight in a really strong fuselage and still employing relatively light wings and tail surfaces.

The fact remains that for maximum performance from a rubber-powered model, a balance of one-third airframe weight to two-thirds rubber weight is required. At the end of the power run the rubber weight then becomes so much dead weight, demanding a minimum loading for maximum glide performance. Essentially, then, the *lightest airframe*, which can be built for *any* given size and preserve this power/weight ratio will give maximum performance—provided the airframe is rigid and strong enough for consistent performance; and the aerodynamic design capable of efficient, stable flight, with propeller design correctly matched to power available.

Gliders

On a theoretical basis, the lighter the loading for a given model size, the lower the ultimate sinking speed and hence the better the performance. The ultra-lightweight gliders of the mid-1940's flown off 300 ft. lines had outstanding still air performances—4 ft., 5 ft. and 6 ft. span models weighing 2¼ to 4 ounces.

The lightweight model, however, is never so happy in turbulent air and with modern rules restricting towline length, the chances of launching in smooth air are less. Also making a lightweight model strong enough to withstand tow-launching strains in windy conditions is a severe structural problem. And the more heavily-loaded model with higher flying speed has better penetration.

A peculiar feature of the large ultra-lightweight glider, too, was that it could be made to fly *too* slowly where, it seems, the Reynolds Number of flow was so low as to make the wing very inefficient. Hence its gliding angle became relatively steep, and its sinking speed high. It would still better the best of present day A2's, however, in *dead still air* when trimmed out to the limit, its sinking speed being of the order of 6 inches per second, although its performance from height was not always consistent with this figure. Certainly the more heavily-loaded modern design is a better proposition for all-weather flying—and probably also a better thermal catcher. But again the evidence points to the best performance coming from a design with light wings and tail surfaces, concentrating the necessary additional weight elsewhere (preferably around the centre of gravity in structure or even dead weight).

Power Models

Bounded by the international specification, and with modern engines capable of developing more power than can often be controlled, total model weight is perhaps not all that important, compared with other vital design factors. Again, however, the advantages of concentrating the bulk of the weight around the pylon area are very real. In particular, really light tailplanes and reasonably light wings (particularly the outboard panels) are desirable, consistent with sufficient strength to withstand tip-over and dethermalised landings.

Radio Control

The most misunderstood feature of radio model design is getting the "penetration" required. A heavily-loaded model which inherently flies fast is not the answer to getting "penetration" under windy conditions. The answer is elevator control when, for any given size, the *lighter the model the faster it can be flown* and hence the better its ability to battle upwind.

This is mainly a matter of wing drag. The lower the weight of the model, the lower need be the operating angle of attack of the wing to produce the necessary lift *at the same speed.* There is appreciably lower wing drag at this speed because of the reduced flying incidence—hence there is a balance of thrust available still further to increase speed, implying an even lower operating angle of incidence for the same amount of lift until the balancing condition is reached. With elevator control, therefore, the model can be trimmed out to maximum flight speed, which will be highest on the model with the lightest wing loading (for same thrust and same design layout). Equally, without elevator control, the model could be trimmed to fly at maximum speed, with the same results. It would not be a happy trim, however, on which to attempt manoeuvres by rudder action only.

The other outstanding feature of the lightly loaded radio model is that it must be more manoeuvrable and require *less power* to complete its manoeuvres. Within structural limitations, therefore, it appears that the lighter the radio control model the better, provided it is fitted with elevator control. A major limitation with a considerable number of inherently manoeuvrable r/c models is lack of power due to the relatively high loadings at which they are flying; whereas at lighter loadings the power available might be quite adequate.

Control Line Stunt

Again similar considerations apply—the lighter the loading the less power the model requires for manoeuvres and, usually, the tighter these manoeuvres can be performed. The first models to appear in this country which were truly aerobatic were very lightly loaded and the difference in performance between the hitherto single loops and rather staid inverted flight attempts was almost revolutionary. Since that time, engine power available, for a given engine size, has been increased considerably and minimum weight is not *essential* for full manoeuvrability. Nevertheless, the fact remains that the smoothest control line stunt flying usually comes from the larger sizes of models which are relatively lightly built and lightly loaded.

Control Line Speed

Weight is important in an identical manner to that discussed under the radio control heading. The lighter model can fly at a lower wing incidence, hence generating less drag. Although wing drag may only be a small proportion of the total drag—line drag is by far the biggest factor limiting speed—drag saving here can add those few vital m.p.h. to the flight speed. The ultimate performance, is, however, almost entirely controlled by the engine-propeller combination—and the size of the lines which the flyer is prepared to risk. (Note: for current national and international contest work, minimum line size specified is:

2·5 c.c. Class

When 2 cables used minimum diameter=0·25 mm.
When 1 cable used minimum diameter=0·35 mm.
(With a tolerance of 1 per cent)

SELF-TAPPING SCREW DATA

Self-tapping screws, available in small sizes, are useful for jointing sheet metal cowling parts but are only fully effective if the right size of hole is drilled originally in the metal. Consult the tables for the *type* of self-tapping screw to use and matching drill sizes.

Materials	Thin Sheet Metals	Steel Sheet	Aluminium Die Castings	Thermoset Plastics
Screw Type	Type A	Type Z	Type Z	Type Z

Sheet Metal Gauge	16	18	20	22	24	26
Screw Size No. 2 (·086 in.)	No. 48	No. 49	No. 50	No. 51	No. 52	No. 52

N.B.—This table gives recommended drill sizes for holes
For die castings a No. 47 drill is recommended for screw size No. 2

KEEP IT COOL

If an engine has got really hot after a run and proves difficult to start again, a simple method of cooling it is to pour fuel over the cylinder. It is a smoky and smelly treatment, but effective—for both diesel and glow fuels evaporate rapidly to promote cooling. Nor is it a bad thing for an engine to get a "wash down" occasionally to remove grit, *etc.*, which may have collected on the cylinder and could work its way inside through the exhaust.

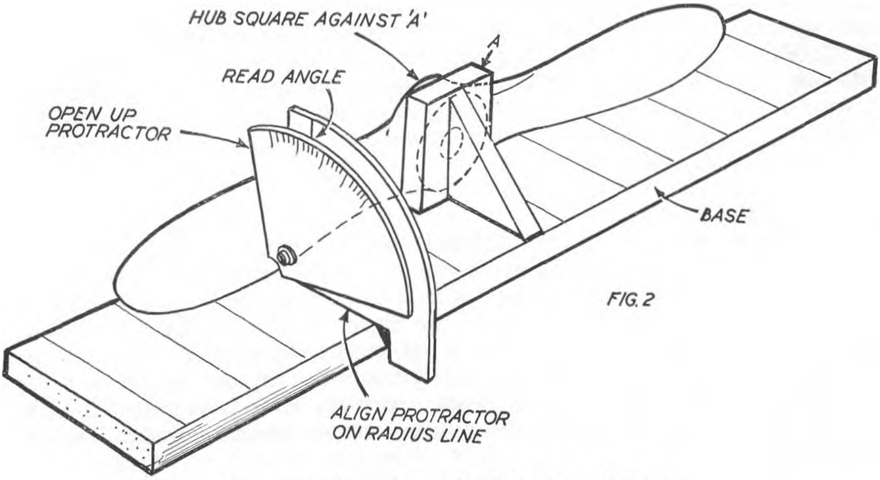


FIG. 2

PROPELLER PITCH CALCULATOR

THE pitch of commercial propellers is generally nominal and there are cases where a 4 in. pitch propeller, for example, actually has a greater actual pitch than a 6 in. propeller. This gadget is designed for quick and accurate checking of power propeller pitch at any point along the blades. But first some general remarks about pitch and how it is defined.

Geometric pitch—or theoretical pitch—is calculated as the advance per revolution the propeller would make if screwing its way through a solid medium (like a bolt screwing into a nut). It can be calculated from the blade angle at any radius. Calling the blade angle θ and the radius at the point of measurement R

$$\text{geometric pitch} = 2\pi R \tan \theta$$

As far as "squared" dimensions are concerned(*i.e.*, propeller blank dimensions at this radius), $\tan \theta = T/W$ (see Fig. 1).

Therefore, geometric pitch $= 2\pi R\ T/W$.

Logically, the propeller is designed to have a constant geometric pitch along the whole length of its blade so that all parts of the blade are tending to advance (or screw forwards) at the same rate. Thus as "R" increases the blade angle must decrease so that the product $R \times \tan \theta$ remains constant. Hence the changing blade angle from root to tip.

In practice, this is not always followed so that a propeller may not, in

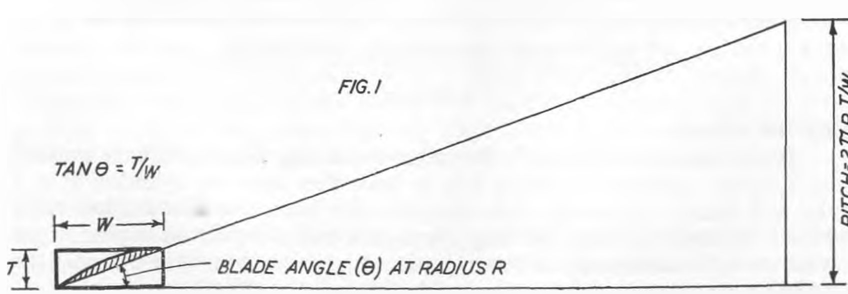
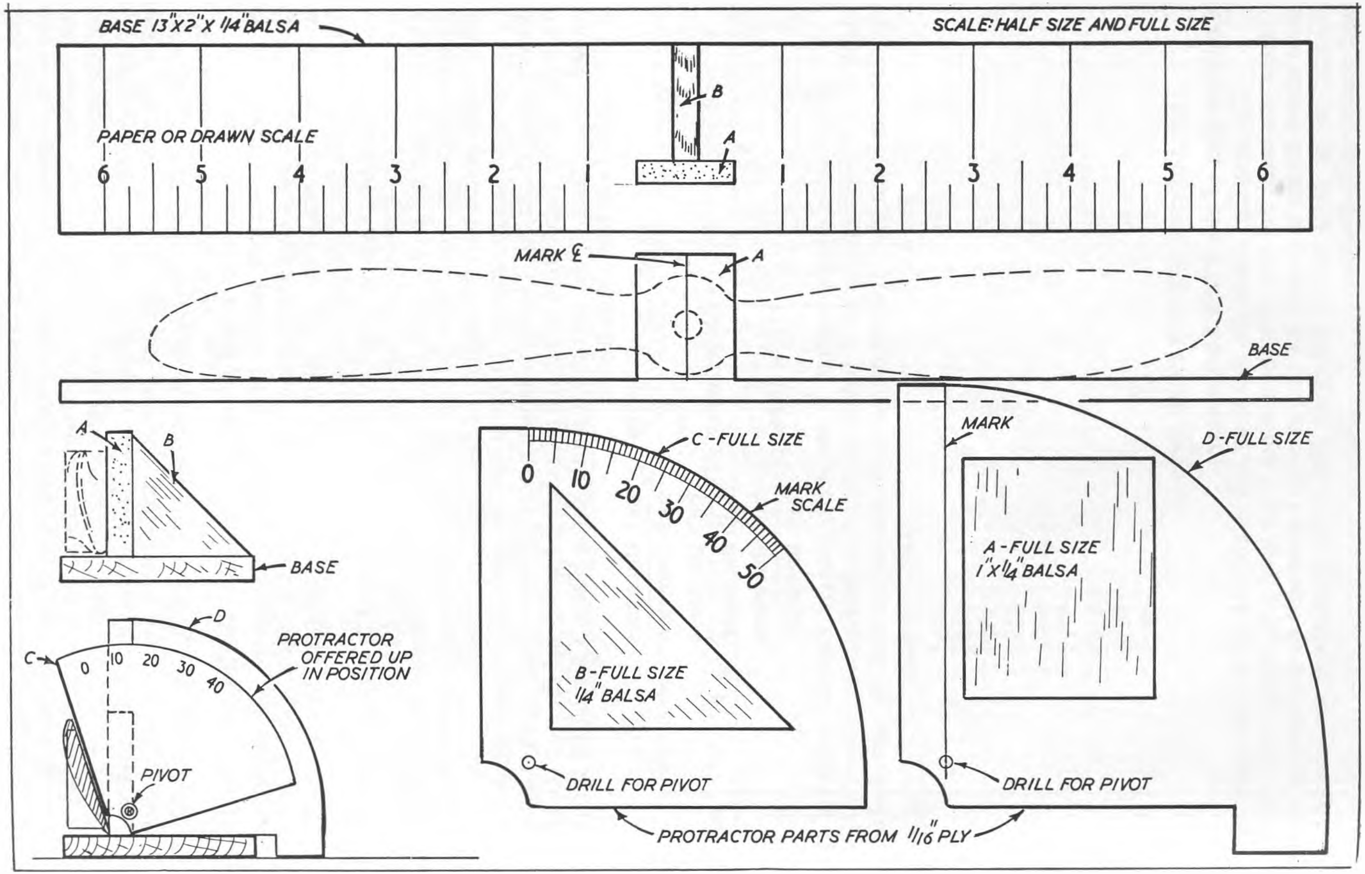


FIG. 1


BASE 13"X2"X 1/4" BALSA
SCALE: HALF SIZE AND FULL SIZE
PAPER OR DRAWN SCALE
6 5 4 3 2 1 1 2 3 4 5 6
B
A
MARK ℄
A
BASE
A
B
BASE
C -FULL SIZE
0 10 20 30 40 50
MARK SCALE
D -FULL SIZE
MARK
A - FULL SIZE
1"X 1/4" BALSA
B - FULL SIZE
1/4" BALSA
D
C
0 10 20 30 40
PROTRACTOR OFFERED UP IN POSITION
PIVOT
DRILL FOR PIVOT
DRILL FOR PIVOT
PROTRACTOR PARTS FROM 1/16" PLY

fact, be true geometric pitch throughout. One reason is that a propeller may be carved or shaped from a standard blank pattern, originally produced to simplified outlines conforming to an approximate true geometric pitch change. It is not always possible to preserve true geometric pitch approaching the roots, for example, without unduly weakening the blade or producing an undesirable shape. In other cases propellers may be deliberately designed with wash-in towards the tips (effectively, increasing geometric pitch), or even wash-out (decreasing geometric pitch).

Small variations in actual geometric pitch along the length of the blade do not seem to matter much. Large differences, however, do cause inefficiency, especially if they occur over the outer half of the blade. Wash-in is more acceptable than wash-out. The latter merely causes the propeller to rev. faster without producing a corresponding increase in thrust.

Geometric pitch, as specified, is normally related to the geometric pitch at a particular radius—usually half radius or sometimes ·6 radius from the root. This is the normal check point for establishing pitch. Whether the propeller is constant geometric pitch then follows by taking blade angle measurements at other radius points and comparing the calculated pitch results.

A rapid approximation of pitch can be made by measuring the hub diameter and thickness. The hub diameter nearly always equals (approximately) the width of the blank from which the propeller is formed and the hub thickness usually corresponds to the maximum depth of the blank. Calculating the pitch at half radius from these dimensions:

$$\text{pitch} = 2\pi \times \frac{\text{radius}}{2} \times \frac{\text{hub thickness}}{\text{hub diameter}}$$

$$= 22/7 \times \text{radius} \times \frac{\text{hub thickness}}{\text{hub diameter}}$$

$$= 11/7 \times \text{diameter} \times \frac{\text{hub thickness}}{\text{hub diameter}}$$

If a further approximation is assumed, namely that the width of the blank of a conventional type of power propeller is approximately *one-tenth* of the diameter, then pitch follows merely from measurement of the hub *thickness.*

Pitch (*in.*)	*Hub Thickness* (*in.*)
4	·2546
6	·3819
7	·4456
8	·5092
9	·5729
10	·6365
12	·7638
14	·8921

This, however, is a very rough method.

Construction of the Pitch Calculator

The drawings show the assembly half scale and all the necessary parts (except the base) full-size. The base is cut from hard $\frac{1}{4}$ in. sheet balsa with the scale either drawn in indian ink on paper and cemented to the base, or drawn directly on the balsa with a ball-point pen. Scale graduations are simply inch and quarter-inch divisions.

Cement on parts *A* and *B* at the exact centre, making sure that *A* is also parallel with the front edge of the base. A centre line must also be marked or scribed down the front of part *A*.

The two protractor parts are cut from $\frac{1}{16}$ in. ply. The protractor scale is marked on part *C* (or on paper, cemented in place accurately). Drill accurately at the pivot points to take a 10 B.A. screw to act as a pivot. Assemble on this screw with a washer each side and tighten up until the protractor is stiff but can easily be adjusted between the thumb and finger.

Using the Pitch Calculator

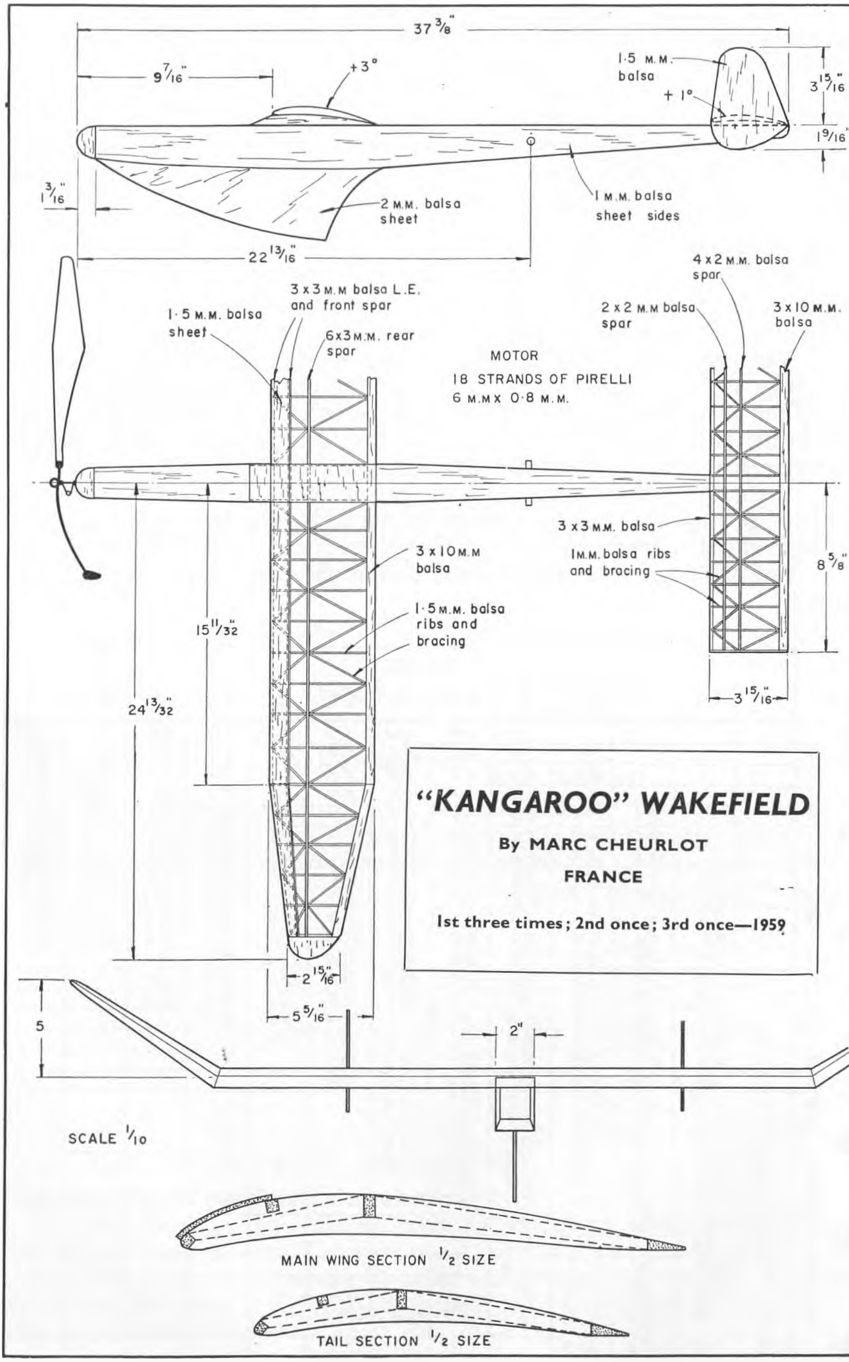
The set-up for measuring pitch is shown in Fig. 2. The propeller is placed on the base and held square against the face of part *A*. Sight through the hole in the hub onto the centre line mark to centre the propeller accurately.

The protractor is now offered up at the appropriate radius at which the pitch angle is to be measured and part *C* rotated until it lies tangential to the back of the blade. Then simply read the angle recorded to the nearest degree and refer to the table for the corresponding pitch at that particular radius. Repeat measurements, as required at other radius stations.

If the back of the propeller blade is convex the position of *C* must be estimated as tangential to a line joining the actual leading and trailing edges of the blade at that station, otherwise measurement is exactly as before.

For half degrees or fractions of a degree, the table figures can be interpolated.

	RADIUS												
DEGREES	1	1½	2	2½	3	3½	4	4½	5	5½	6	6½	7
10					3·3	3·8	4·4	4·9	5·5	6·0	6·6	7·1	7·7
11				3·0	3·6	4·2	4·8	5·4	6·0	6·6	7·2	7·8	8·4
12				3·3	4·1	4·7	5·4	6·1	6·7	7·4	8·1	8·8	9·4
13				3·6	4·4	5·1	5·8	6·5	7·2	7·9	8·7	9·4	10·2
14			3·1	3·9	4·7	5·5	6·2	7·0	7·8	8·5	9·3	10·1	10·9
15			3·4	4·2	5·1	5·9	6·8	7·7	8·5	9·3	10·2	11·0	11·9
16			3·6	4·5	5·4	6·3	7·2	8·1	9·0	9·9	10·8	11·7	12·6
17		2·9	3·9	4·8	5·8	6·7	7·7	8·6	9·6	10·5	11·5	12·4	13·4
18		3·1	4·1	5·1	6·2	7·2	8·2	9·2	10·2	11·2	12·3	13·3	14·3
19		3·3	4·3	5·5	6·5	7·6	8·7	9·8	10·9	12·0	13·0	14·1	15·2
20		3·5	4·6	5·8	6·9	8·0	9·2	10·4	11·5	12·6	13·8	15·0	16·1
21		3·6	4·8	6·0	7·2	8·4	9·6	10·8	12·0	13·2	14·4		
22		3·8	5·0	6·3	7·6	8·9	10·0	11·3	12·6	13·9	15·1		
23		4·0	5·3	6·6	8·0	9·3	10·6	11·9	13·2	14·5	15·9		
24		4·2	5·6	6·9	8·4	9·7	11·1	12·4	13·9	15·2			
25	2·9	4·4	5·8	7·3	8·8	10·1	11·6	13·1	14·5				
26	3·1	4·6	6·1	7·6	9·2	10·7	12·2	13·7					
27	3·2	4·8	6·4	8·0	9·6	11·2	12·8	14·4					
28	3·3	5·0	6·7	8·3	9·9	11·7	13·4						
29	3·5	5·2	7·0	8·8	10·5	12·3	14·0						
30	3·6	5·4	7·3	9·0	10·8	12·7	14·6						
31	3·8	5·7	7·6	9·5	11·4	13·3	15·2						
32	3·9	5·8	7·8	9·7	11·7	13·6							
33	4·1	6·1	8·0	10·1	12·1	14·1							
34	4·2	6·3	8·4	10·5	12·6								
35	4·4	6·6	8·8	11·0	13·2								
36	4·6	6·9	9·2	11·5	13·8								
37	4·7	7·1	9·5	11·9	14·1								
38	4·9	7·4	9·8	12·3	14·7								
39	5·1	7·7	10·2	12·8	15·3								
40	5·3	8·0	10·6	13·3									



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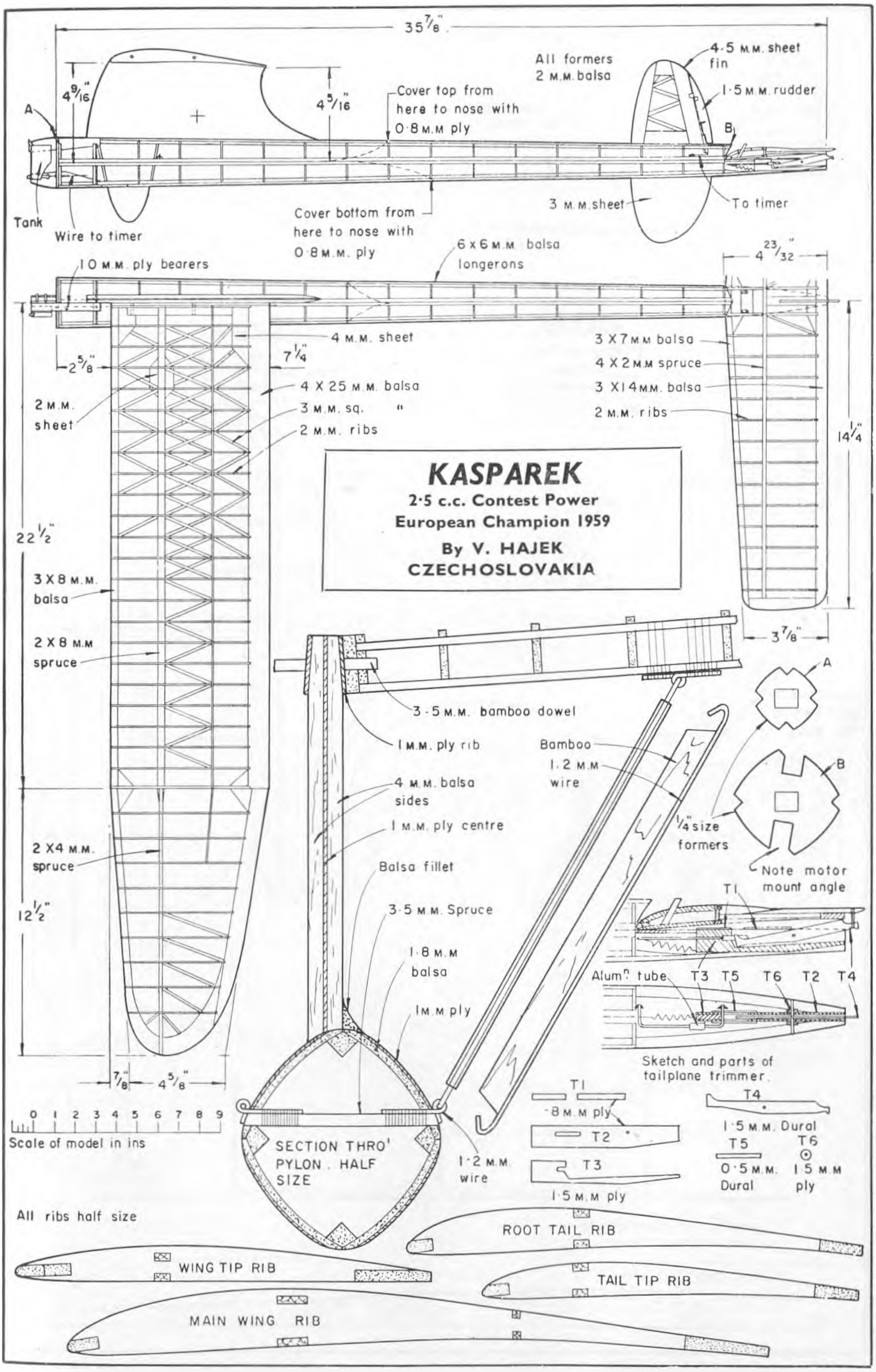
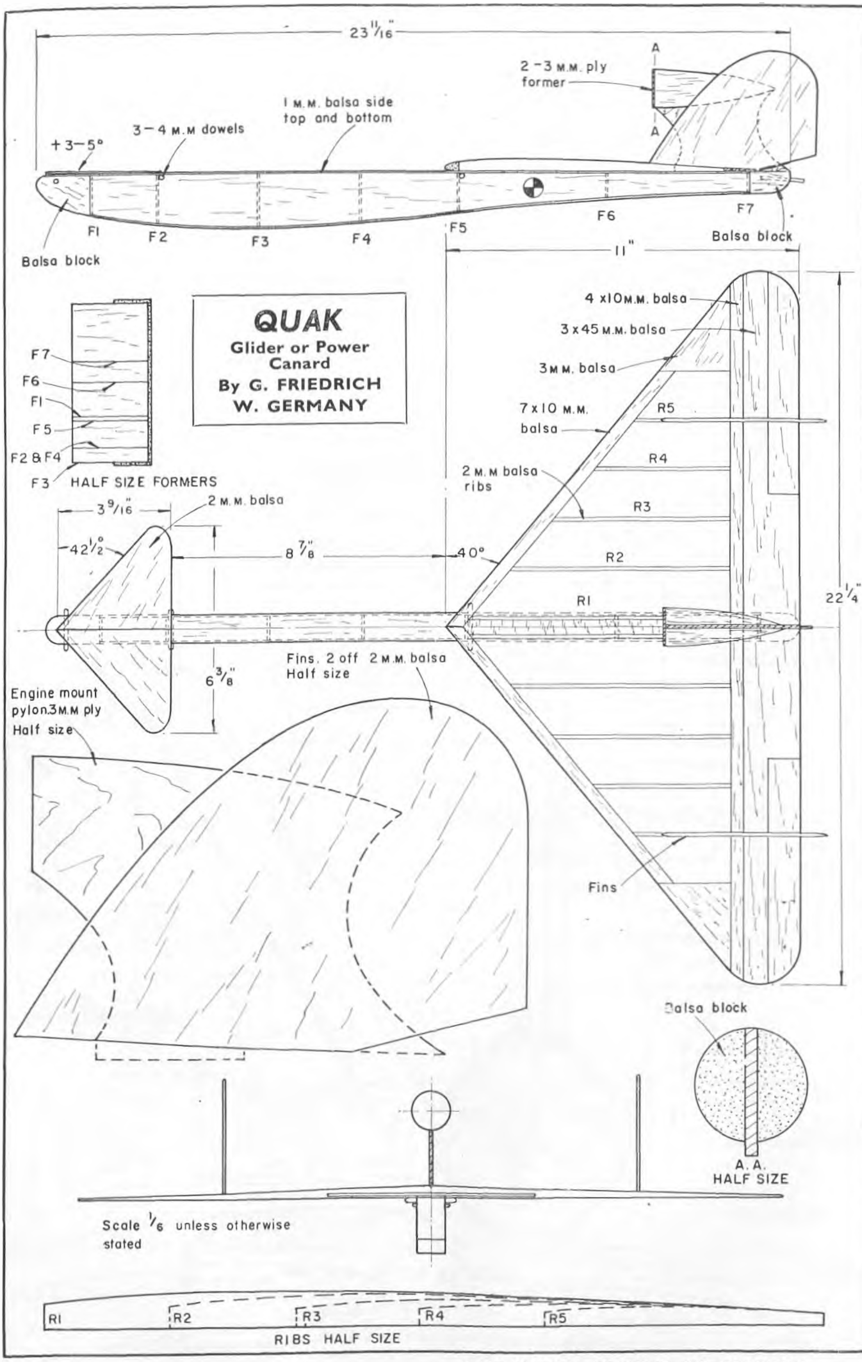
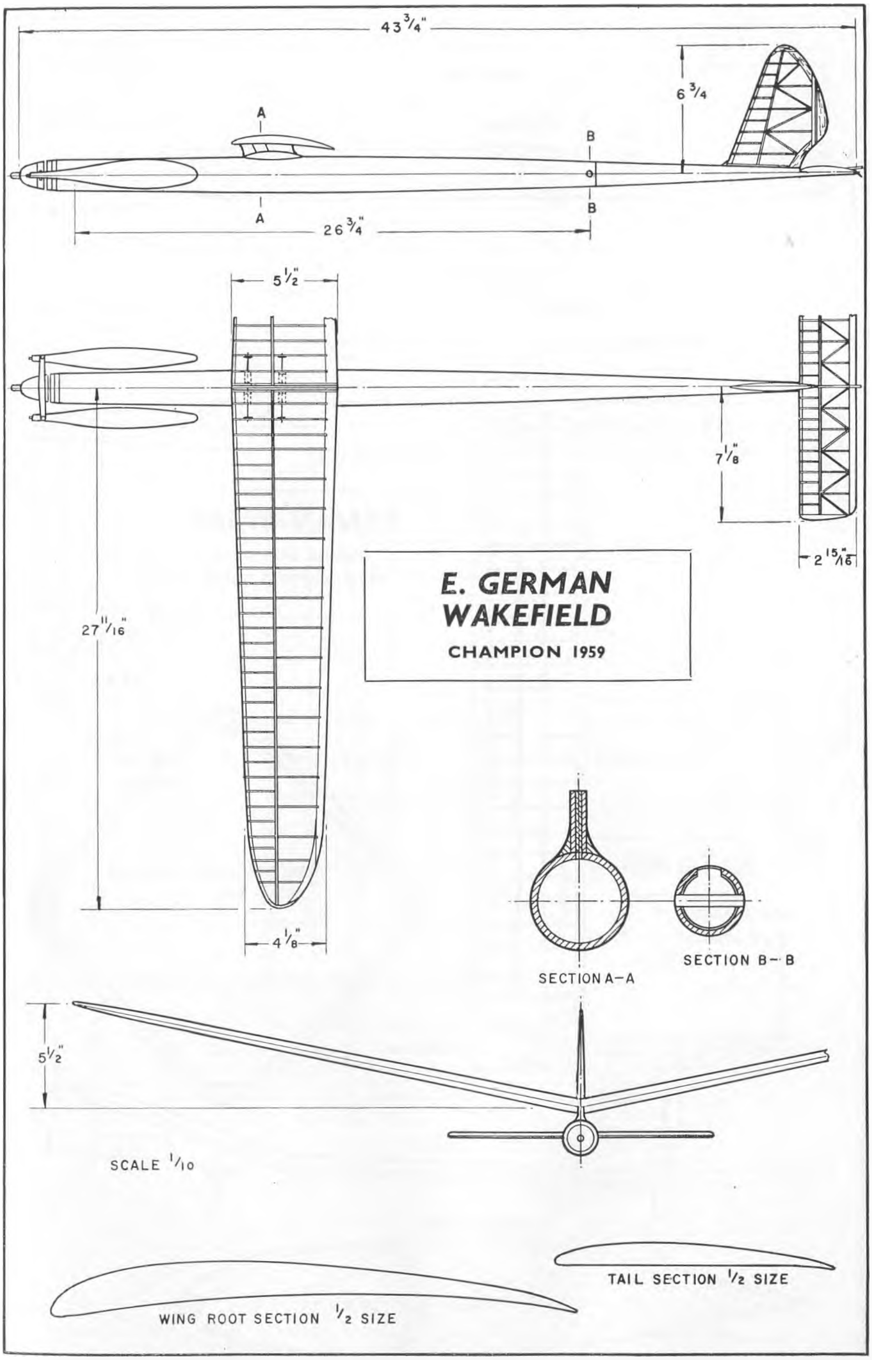


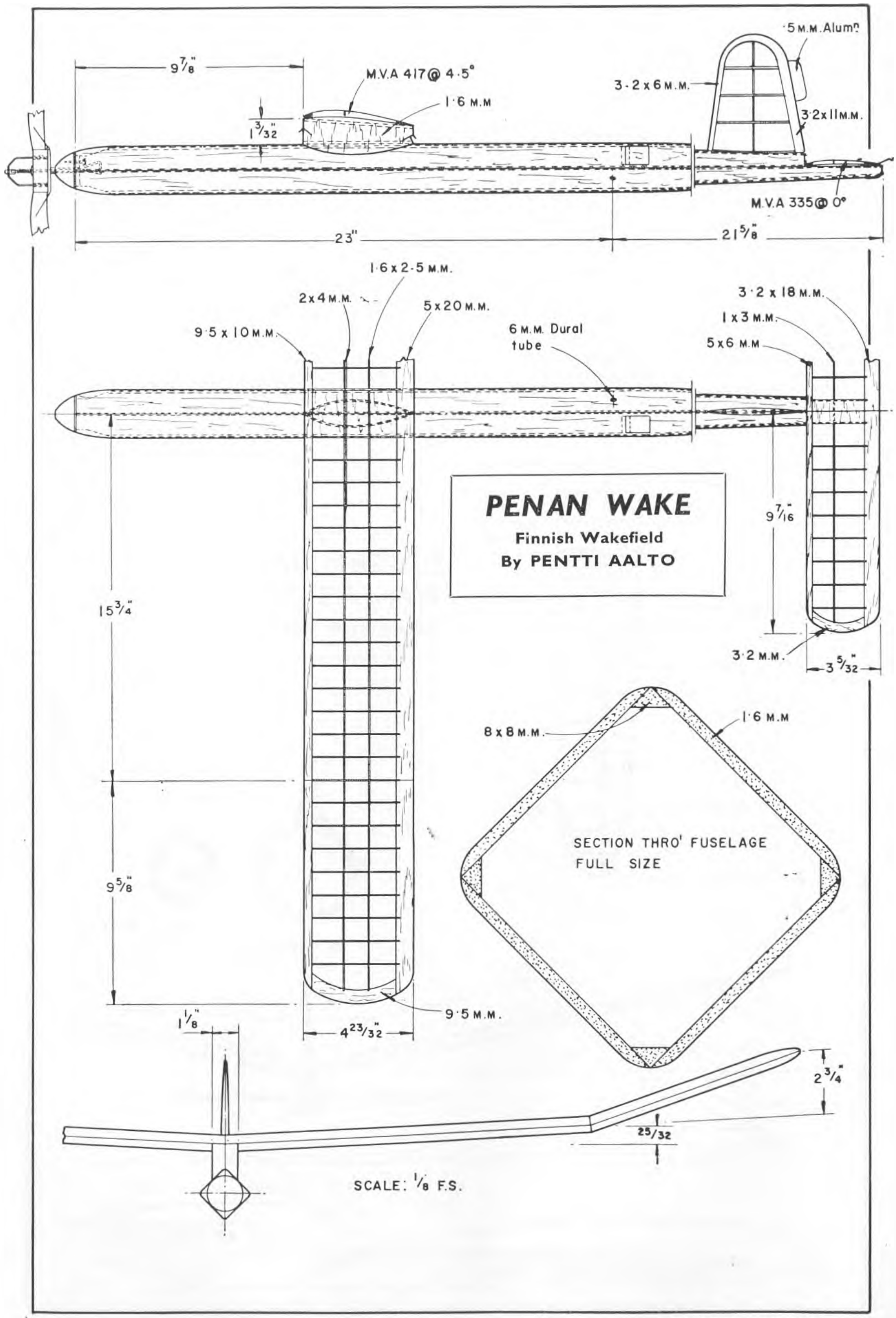
LETECKY MODELAR, CZECHOSLOVAKIA



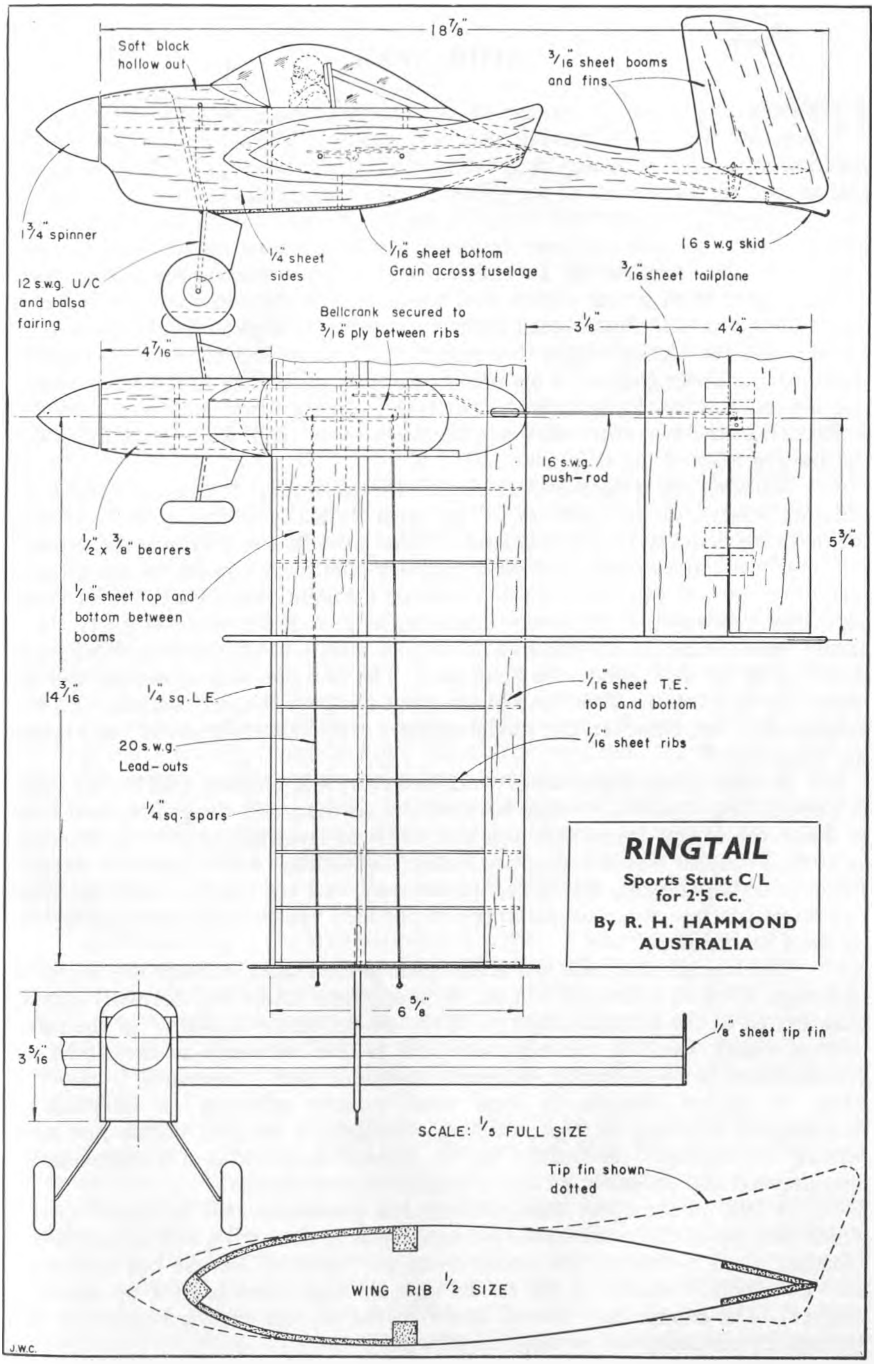
FLUG MODELL TECHNIK, W. GERMANY



MODELL BAU, E. GERMANY



ILMAILU, FINLAND



AUSTRALIAN MODEL NEWS

GLIDE TRIM

HOWEVER much may be written on the theory of glide performance the only practical way of achieving the best possible glide remains the purely practical method of *trimming*. And even here both the type of glide trim required and individual assessment of the trim can vary considerably.

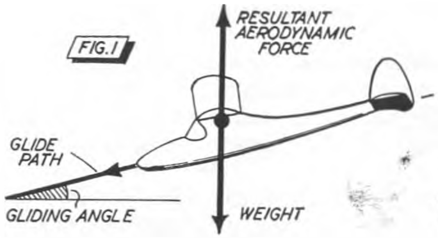
The difference between a contest model trimmed out for the best possible glide performance and the same design—or even the same model—not so well-trimmed can be remarkable. In both cases the flight pattern may appear good but, to quote from actual experience, a subtle difference in trim can increase time of descent (and thus overall flight duration from a given height) from 47·5 seconds per 100 feet of height to a matter of 25 seconds per 100 feet—roughly doubling the sinking speed. This with apparently good trim in the second case, not obvious under-elevation with the model gliding steep and fast. And the difference in the two trims may not be much more than $\frac{1}{32}$ in. packing under the trailing edge of the tailplane.

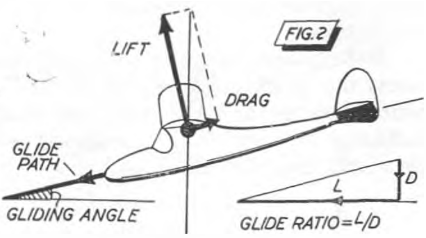
Without experience and an "eye" for trimming, it can be difficult to estimate when trim is "spot on". The main difficulty is that it is necessary, mentally, to dissociate one's self from a fixed observation point on the ground and "fly" with the model. Just observing a model from a point on the ground introduces optical illusion. The flight seems different headed into wind, compared with downwind. It is only different, in *fact*, if the wind is gusty. In a steady wind the model is flying in a mass of air which, to all intents and purposes is *still* air as far as the model is concerned. The fact that this whole mass of air is moving in a certain direction has no effect at all on the performance. To the ground observer, however, the model appears to fly slower "upwind" and speed up "downwind".

If there is any appreciable wind, however, it is unlikely that the air mass *will* be moving steadily. Friction between the air mass and the ground will tend to make the lowest layers slow up, with the next layer rolling over it. Changes in ground contour will also produce further deflections of the steady air stream. Below a certain height, therefore, the air may well tend to be turbulent with individual patches of air accelerating—to produce "gusts"—or decelerating—to produce momentary "lulls".

These gusts and lulls *will* affect glide performance because the model is no longer flying in a mass of still air, although their effect will normally appear exaggerated to the ground observer. If the model turns "upwind" at the same time as a gust occurs it will normally tend to soar (although to the model, of course, there is no difference between "upwind" and "downwind", only the effect of sudden changes in local wind velocity affecting its airspeed or momentarily affecting its flight attitude). Similary, if the gust occurs just after turning "downwind" (as defined by the ground observer) it will momentarily lose airspeed and probably go into a shallow dive to correct.

A lull, on the other hand, will tend to produce a stall on either course, which because of the *groundspeed* the model has to start with, will appear like a "soaring" stall to the ground observer on an "upwind" course but a dive on the "downwind" course (as the model puts its nose down to pick up speed to recover). The momentary loss of speed in the second case is hidden by the increase in groundspeed turning "downwind".





This simplified description—and there are obvious variations—explains the need for appreciating *what is happening to the model* rather than simply observing what the model is doing as the essence of good trimming technique. It also underlines the truth of the basic recommendation that trimming should always be done in calm air, so that one can be sure that variations in flight pattern are caused by trim rather than gusts. Contrary to some opinions, this calm air trim should then hold good in *any* weather. If the model goes out of trim in high winds—*e.g.*, starts stalling badly—this is more likely to be a design limitation in that there is insufficient reserve of automatic stability for rough weather flying, or some other factor such as flexing surfaces is upsetting the original trim. There are certain exceptions to this rule where a change of trim to a faster, flatter glide may be beneficial under particular circumstances, but not normally where maximum *duration* is the main aim.

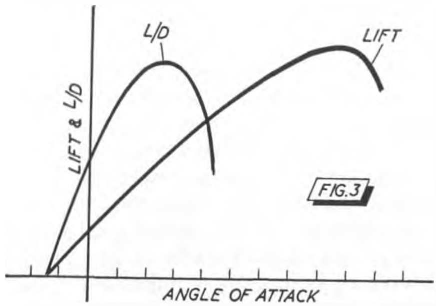
Now trim, however established (*e.g.*, with ballast weight, adjusting wing or tailplane rigging incidence, or shifting wing position) merely aims at establishing a balance of forces so that the model is in equilibrium—which means, in effect, that the wing is flying at a specific and constant angle of attack. In the case of a glider, or any aircraft gliding with power off, only two forces are involved—the resultant aerodynamic force generated and the weight—Fig. 1. With this balance of forces the wing has a certain incidence or angle of attack relative to the flight path, which remains constant unless the force balance is disturbed by some external condition (or some inherent instability which means that the original balance established cannot be maintained). The fact that the tailplane may also have an angle of attack (positive or negative) is merely incidental to establishing the balance or trim.

Although Fig. 1 is a true diagram of forces, it does not tell us very much. In other words, although the wing-fuselage-tail combination generates a single resultant aerodynamic force in fact, unless we split this into separate "lift" and "drag" forces such a diagram is not going to help very much. Hence Fig. 2 is the established method of plotting the force balance where the resultant aerodynamic force is split into two components—lift vertical to the flight path and drag parallel to it.

A simple rule of geometry now establishes that the *gliding angle* is directly related to the ratio Lift/Drag. Rather than refer to angles, in fact, it is more usual to specify glide ratio, which is then equal to Lift/Drag directly.

For the flattest gliding angle (highest glide ratio) it is thus obviously necessary to adjust the trim so that the Lift/Drag (L/D) ratio is a maximum. Ignoring the fact that the tail may contribute a certain amount of lift (also the fuselage, although this is generally negligible), the Lift force is taken as being contributed by the wings. But the Drag arises from a combination of wing, fuselage and tail drag. The latter two components, in fact, simply detract from wing performance, although wing drag is an inescapable feature of lift production.

It is not possible, therefore, to take aerofoil characteristics alone and assess the incidence at which the L/D ratio is a maximum—see Fig. 3. The added fuselage and tail drag will modify the curve, and alter somewhat the incidence at which L/D maximum occurs. It will, however, still be a fairly *small* incidence value.



Even if it were possible to obtain all the necessary data and establish this incidence value accurately it would still not help much for trimming since we have no means of establishing *what the actual angle of attack of the wings is in flight.* In full-size gliders, of course, it can be related to a definite airspeed and trim adjusted to give this flying speed. But understanding the principle involved will help in establishing trim on practical lines.

The main point to appreciate is that with the trim giving *flattest glide* the operative wing incidence will be quite small, and thus the model will have to fly relatively fast to generate the required lift. With such a trim the model will cover the greatest distance from a given height, but its sinking speed may be quite high because of its relatively high flying speed.

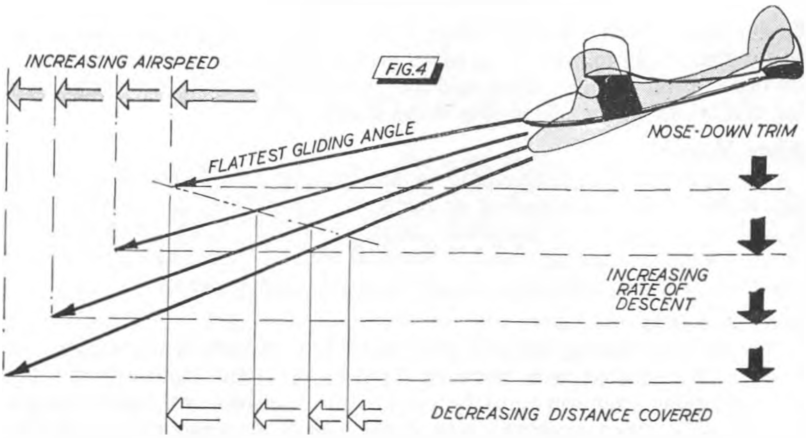
It will not, of course, be the *fastest* gliding speed. If we further adjust the trim to decrease the operating incidence of the wing still further (*e.g.*, with more nose weight, packing up the wing trailing edge or tailplane leading edge), the glide angle will progressively steepen and flying speed increase—and so also will the distance covered from a given height, with sinking speed increasing rapidly. At some arbitrary point the flight path becomes a "dive" rather than a "glide". Such a range of trim is normally outside model requirements, except for radio control flying.

Taking the trim the other way by increasing the operating angle of attack of the wings (by removing weight from the nose, packing up the trailing edge of the tailplane or the leading edge of the wing), we again get a steepening of the *glide angle,* but this time accompanied by a *decrease* in flying speed, and, most significant of all, *a decrease in sinking speed.* This is obviously the region for "duration" trim to give maximum time of descent from a given height.

The important thing to appreciate here is that the *gliding angle* is no guide at all to good "duration" trim. Sinking speed goes on *decreasing* as the actual gliding angle becomes steeper and the model flies slower, virtually right up to the stalling point. We trim in this region on *flying speed,* then, rather than on the appearance of the glide.

In point of fact trim for minimum sinking speed will occur on nearly all conventional aircraft at an angle of attack just a little below the stall or, theoretically, at the incidence where the ratio Lift 1·5/Drag is a maximum. The quantity C_L^{15}/C_D is known as the "power factor" (where C_L is the lift coefficient and C_D the overall drag coefficient) and is derived, simply, like this:

The "aerodynamic power" for propelling a glider along its flight path is



derived from the component of the Lift force forwards and parallel to the flight path, this "power" force balancing the resistance.

The power required to keep the model in motion is equal to drag $\times$ velocity. Now drag is inversely proportional to L/D and velocity is inversely proportional to $\sqrt{C_L}$ (or C_{LS}).

Hence power varies inversely as $\frac{C_L}{C_D} \times C_{LS}^{15}$ or $\frac{C_L^{1\cdot5}}{C_D}$

Thus the higher the power factor the lower the forward component of the lift force required and the greater the vertical lift.

Again there is no practical method of calculating and fixing the angle of attack at which the power factor is a maximum on a model, so we have simply to work on the known fact that it occurs a matter of a degree or so just before the stalling angle. Hence for maximum "duration" glide performance the model is invariably trimmed out just on the point of stalling—*i.e.*, at virtually its lowest flying speed. This may virtually halve the sinking speed compared with *flattest gliding angle* trim, although the glide may not *appear* so good because of the lower forward speed and the steeper gliding angle.

Finally, to summarise these main points under specific headings.

Towline Gliders

Without exception, these should be trimmed for *minimum sinking speed* since maximum duration from height is the principal aim. A practical method of achieving this trim is to go on increasing elevation, a little at a time, until the model is definitely stalling. Then add turn adjustment until the stall is just ironed out. This should be optimum trim, the "turn out of a stall" condition also being excellent for meeting gusts.

An important point is that glide trim adjustments should be made *off tow-launched flights* from a minimum height of about 50 ft. Hand-launched tests can only establish glide trim roughly, and a model trimmed near the limit of stalling may, in fact, actually stall gently on approaching within twenty feet or so of the ground. If trimmed initially near ground level it may, in actual fact, be underelevated when tow launched from a height.

Slope-soaring Hand and-launched Gliders

While minimum sinking speed would appear desirable, a faster flying speed may be necessary for satisfactory penetration. With a "floating", near-stall trim, too, a model is more likely to turn off to one side in a gust. Trimming for flattest gliding angle can often give more satisfactory results here, but much depends on the directional and longitudinal stability of the design as well as the conditions under which it is being flown.

Rubber Models

A right-hand circling climb is the general rule followed by a right-hand circling glide (freewheeling or feathering propellers) or a left-hand glide with folding propellers (to minimise the effect of trim shift). In all cases trimming for minimum sinking speed is essential which is why (like gliders) a turn on the glide is highly desirable, except for really calm weather.

Power Duration

Minimum sinking speed is the desirable trim, which represents a considerable difference in trim between "power on" and "power off" flight. Hence particular attention must be paid to the transition so that no height is lost in a stall or other unwanted manoeuvre. Again a circling glide is desirable.

Free Flight Power (Sports)

A trim mid-way between flattest glide and minimum sinking speed is a good compromise. This gives a good glide approach angle without excessive flying speed. There are no set rules here, but bear in mind that the nearer the model is trimmed to minimum sinking speed the more "nose up" the approach and the lower the speed to be lost in "rolling" on the ground.

Radio Control

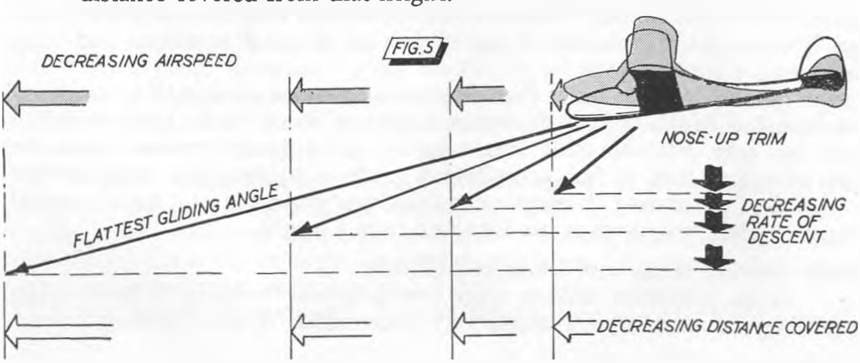
Neutral glide trim is generally established near the flattest gliding angle trim for good penetration and a fast approach. Trimming near the stall produces too much "float" and the approach becomes more difficult to judge. Points to bear in mind when elevator control is available are:

(*i*) If the neutral trim corresponds to a slow, floating glide, using down elevator to lose height and descend more quickly may, in fact, carry the model well past the intended land spot because the *gliding angle* is flattened out.

(*ii*) With a slight "diving" glide trim (past the flattest glide trim), up elevator may again increase the distance covered from a given height by bringing into flattest glide trim; or drastically reduce the distance covered on the glide into wind if trimmed nearer the stall point.

(*iii*) With neutral glide trim corresponding to flattest gliding angle, applying a little more "down" to increase the speed of approach will decrease the distance covered from that height.

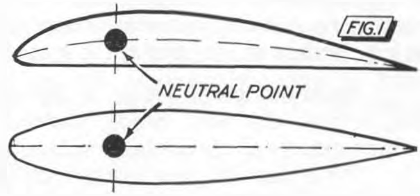
FIG. 5



THE "NEUTRAL POINT"

MODERN aerodynamic theory for assessing stability refers to the *neutral point* of an aeroplane—a term which is often quoted in design articles but remains completely meaningless to most readers. This brief description aims at giving a simplified explanation of what the neutral point is, and its significance.

Starting first with any aerofoil section, the increase in lifting effect due to increasing angle of attack is concentrated at a particular point known as the aerodynamic centre—see Fig. 1. This holds true for all conventional aerofoils, regardless of camber, and is positioned at 25 per cent of the chord back from the leading edge.



When two aerofoils are arranged in combination—*e.g.*, a wing and a tailplane, as in Fig. 2—each aerofoil will have its own aerodynamic centre. The *combination* will also have a corresponding mean aerodynamic centre, equivalent to the point where the total lift (and drag) forces of the two separate aerofoils effectively act. This mean aerodynamic centre must necessarily lie between the two aerofoils, closer to the larger one or most effective lift producer. It is called the *neutral point.*

Thus, by definition, the *neutral point* is that point between the wing and tailplane where the aerodynamic forces acting on the model (or full-size aircraft) can be replaced by an equivalent total lift force and drag force. It is usually (in model practice, at least) determined only with reference to wing and tailplane forces, fuselage effects, slipstream and propeller areas, *etc.*, generally being ignored.

The significance of the neutral point in governing longitudinal stability is simply this. Any gust or disturbing force which momentarily upsets the normal flight path of the model will cause a change in angle of attack and thus a change in lift. This will be translated as an increase (or decrease) in the total lift force at the neutral point—see Fig. 3. In either case, provided the neutral point is behind the centre of gravity, a stable or correcting action is introduced—*e.g.*, the increase in lift at the neutral point tends to rotate the model nose-down about the c.g. to correct, and vice versa with a decrease in lift. The "power" of this automatic correction is governed by the distance between the neutral point

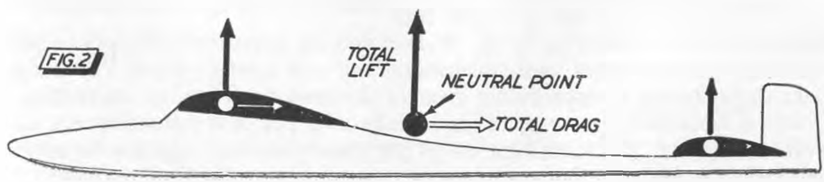
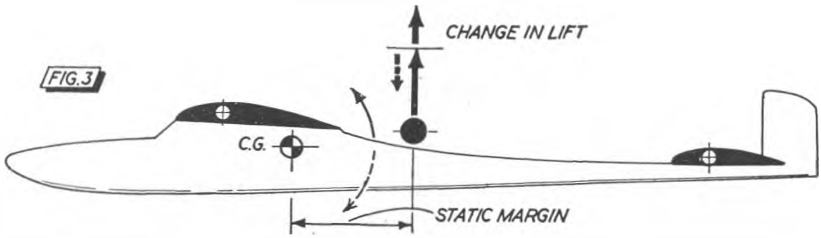


FIG. 3



and the centre of gravity, often referred to as the *static margin* or stability margin.

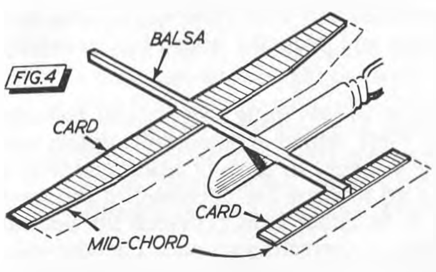
The neutral point, apart from governing "correction" by virtue of its distance behind the centre of gravity, also determines the maximum possible aft rigging position for the centre of gravity. Stability becomes neutral (no recovery from a displacement) when the c.g. and neutral point coincide. With the c.g. farther aft, of course, the system is completely *un*stable.

Accurate determination of the neutral point by simple techniques, however, is not very easy. Since, however, it is seldom necessary to know the position exactly the following practical method will suffice for most purposes.

Wing and tailplane outline are drawn, to scale, on a fairly heavy sheet material, like thickish card. Mark the mid-chord line on each surface and cut out the front areas (*i.e.*, wing and tail area in front of the mid-chord).

For the fuselage, substitute a length of balsa strip, say $\frac{3}{16}$ in. sq. or $\frac{1}{4}$ in. $\times$ $\frac{1}{8}$ in. *light* balsa. Cement on the cut out wing and tail part areas *exactly* in the same position as they would be to scale. Balancing the model on a knife edge will then determine the neutral point—see Fig. 4.

FIG. 4



This method will normally show the neutral point farther aft than it will probably appear on the actual model. This is because the tailplane efficiency as a lifting agent will be lower than the complete "part" area used. An allowance can be made for this by reducing the cut-out tail area before finding the balance point. The amount of reduction required can only be guessed at.

Some suggested values are:

Rubber models—reduce tail by 45 per cent.

Gliders—reduce tail by 33 per cent.

These figures are quoted by N. K. Walker and are presumed to apply to short to medium moment arms and conventional tail unit configuration. For designs where the tailplane is appreciably clear of downwash effects, no correction of tail area is necessary. In marginal cases, take a 10 per cent reduction as a conservative estimate. The same figure—10 per cent reduction—can also be applied to all long moment arm designs where downwash effects are less marked.

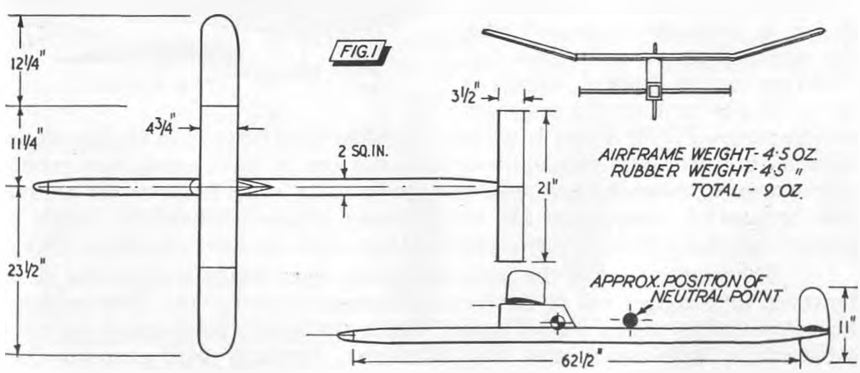
LONG OR SHORT MOMENT ARM

IN pre-war aeromodelling days the main subject of design controversy was streamliner *versus* slabsider, centred primarily around the Wakefield class of model. It was never fully thrashed out, primarily because other design considerations became more important—the chief one being that performance was more directly related to the weight of rubber which could be carried and economy of structure rather than purity of aerodynamic form was the leading factor, leading to increasing motor length to be accommodated.

Ultimately this resulted in the bold, unconventional design evolved initially by Hank Cole with ultra-long moment arm, centre of gravity behind the pylon-mounted wing and large sub-rudder area—Fig. 1. Primarily this was a well-reasoned, scientific design, developed not so much to accommodate a long motor length as to yield maximum performance in its class and at the same time possess extreme spiral stability. Although a freak design it was extremely successful in calm conditions, and the layout was successfully copied by other leading American modellers to the extent of winning places in U.S. Wakefield teams.

Like most other "extreme" designs, however, it failed to survive on merit. Even before later rules restricted rubber weight—and thus ended the development of Wakefield design on a sheer performance basis—the more conventional layouts incorporating taut rubber motors in two lengths with return gears proved a better overall proposition—less vulnerable and more consistent under all conditions, as well as matching or even exceeding the still air performance of the best of the long jobs. Fuselage length had been pushed up by the necessity of providing up to 36 inches between rubber fixings, and so tail moment arms were somewhat longer than hitherto, but this was largely a secondary effect arising out of another major design requirement.

It was, however, found that these models handled well, were most efficient and had excellent spiral stability allied to a pylon or semi-pylon mounted wing. Hence although the original necessity of providing fuselage length disappeared with restricted rubber rules, the apparent aerodynamic advantages offered by the stretched fuselage were retained, particularly as the basic design layout was now extensively developed and proven.



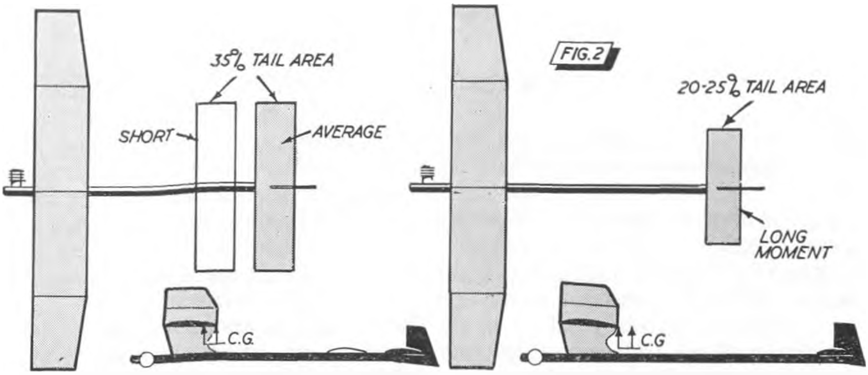


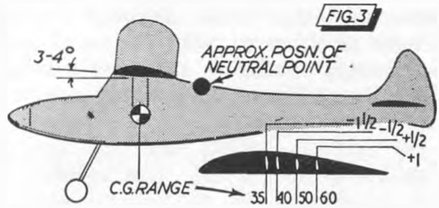
FIG. 2

With power models the position has been somewhat different. The long moment arm design evolved at a much earlier stage in an attempt to improve on the basic pylon layout devised by Carl Goldberg. It was not feasible to take to the extreme possible with rubber model fuselages because of structural difficulties. But again it showed particular advantages to be gained in the matter of "power on" control and sheer performance. The former factor became even more important with increasing engine powers and so the present-day power duration design has become more or less standardised with a reasonably long moment arm and centre of gravity rigged well aft—Fig. 2. The "extremes"—such as large tailplanes on long moment arms—have gradually proven wanting and been eliminated.

The chief limitation with a high-performance power design is that it has been evolved through a background of specialised development and is essentially a specialist's model. Not only can the less experienced modeller accidentally counter some of the desirable features simply in building it, but he may also find it very tricky to trim and handle. The "old fashioned" shorter moment arm layout—invariably retained for sports free flight models—is still much *safer* to handle.

The main reason is the greater margin of stablity—or margin for error in building and adjustment, if you like—with the type of rigging involved. The shorter moment arm design is invariably balanced with the centre of gravity well forward—35-40 per cent on "sports" layouts or up to 60 per cent aft for optimum performance—Fig. 3. There is usually a substantial difference in rigging angles between the wing and tailplane—up to 4 degrees or more—and thus greater scope for adjustment before things become "critical". Inertia forces are minimised because all components are fairly closely grouped around the centre of gravity and thus a little "overweight" building need not have disastrous effects.

FIG. 3



The farther *forward* the centre of gravity when finally trimmed for glide, however, the stronger will be the looping tendency under power. This need not be a major worry with a rubber model, which can usually be trimmed out quite satisfactorily with downthrust and sidethrust. Similarly with a sports type power model, provided excessive engine power is not used (*i.e.*, too large an engine). The "power duration" layout (*C*) will also require downthrust (and possibly some sidethrust) to trim out, however, and spiral stability becomes more and more difficult to achieve as engine power is increased in an attempt to improve on climb performance.

Controlling the "power on" looping tendency by increasing the tailplane *area* does nothing to improve spiral stability on such a layout and may even aggravate the problem. Hence adopting this "safe" rigging with a relatively short moment arm only remains safe provided excessive power is not used. In such cases the model becomes increasingly difficult to trim. It can be done, however, but a better solution is to increase model *size* and sacrifice some potential climb performance while gaining out on improved glide from the larger area.

Any one of these layouts is also in difficulties if the centre of gravity is rigged too far aft. This serves only to make the tailplane trim setting increasingly critical, especially for "power on" flight. In a short moment arm design the tailplane is intended as—or should be used as—a stabiliser only and should not be called upon to provide any marked proportion of the total lift, because of the small static margin resulting (see article on the neutral point).

Where total area is limited, as in a contest model specification, this is where the long moment arm design theoretically scores. Take a hypothetical lift coefficient curve for an aerofoil as in Fig. 4 and see the effective performance of two different layouts, both with the wing area three times the tailplane area (*i.e.*, one-third tailplane).

Model A rigged with the wing contributing nearly all the lift (say c.g. at 40 per cent), corresponding approximately to a $3\frac{1}{2}$ degree difference in rigging angles.

Operating angle of attack of wing (glide trim)=8 deg., corresponding lift coefficient ·8

and of tailplane $=8-3\frac{1}{2}=4\frac{1}{2}$ deg.

The effective angle of attack of the tailplane will be appreciably reduced by downwash by up to one-half the wing angle of attack. Thus actual tailplane incidence $=4\frac{1}{2}-\frac{1}{2}=\frac{1}{2}$ deg.

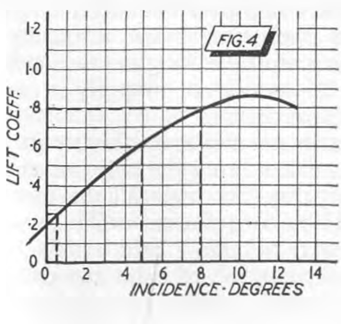
Corresponding lift coefficient ·25

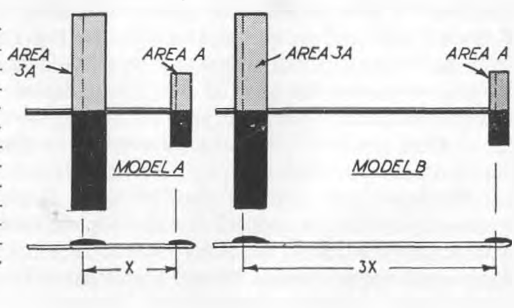
Total lift is then proportional to $\cdot 8\times 3A+\cdot 25\times A=2\cdot 65A$

Model B rigged with c.g. at trailing edge, corresponding to approximately 1 deg. difference in incidence between wing and tail.

Operating angle of attack of wing = 8 deg., as before, corresponding to lift coefficient ·8

Operating angle of attack of tailplane $=8-1$ deg. $=7$ deg., less downwash effect. This will be markedly reduced compared with the





short moment arm layout, so assume 2 deg. maximum downwash. Actual angle of attack of tailplane then equals $7-2=5$ deg., corresponding lift coefficient ·6

Total lift is proportional to $\cdot 8 \times 3A + \cdot 6 \times A = 3\cdot 0A$

Thus Model B 1·13 or 13 per cent more efficient in lift production than Model A for the same total area (although the drag will be slightly higher).

This is only a simplified example. Obviously the ratio of improvement can be further increased by decreasing the tailplane area to put more area into the wing on Model B. For the same control effect, the tailplane area can be reduced to one-third of A (since the moment arm is three times longer), when the lift efficiency is improved by some 18 per cent.

Ossi Czepa first utilised this design approach to maximum advantage in winning the 1951 A2 contest at Bled, Yugoslavia and while this extreme approach has not been maintained, glider tailplane areas have tended to get progessively smaller and moment arms longer to get maximum lifting efficiency out of a limited total area design specification.

This is more readily expressed in terms of *tailplane volume coefficient* which can be calculated as:

$$\frac{\text{tailplane area (sq. in.)} \times \text{tail moment arm}}{\text{wing area (sq. in.)} \times \text{wing mean chord (in.)}}$$

The moment arm, strictly speaking, should be measured from 50 per cent of the wing chord to 25 per cent of the tailplane chord. Typical tailplane volume coefficients for modern A2 gliders range between ·7 and ·85. It is instructive to analyse successful designs as they appear on this basis and keep a record of tailplane volume coefficients.

With powered models the tail volume coefficient is normally greater since a very small tailplane is not suitable for "power on" control and even with extreme "stretched" designs tail areas of up to 35 per cent of the wing area may still be employed. The farthest aft centre of gravity position which can be utilised (for maximum tailplane incidence) is limited, theoretically at least, by the position of the neutral point. This must lie behind the centre of gravity to produce dynamic stability or automatic recovery from a gust or disturbance which momentarily changes the angle of attack of the wings.

A high-mounted wing is also desirable with a long moment arm—and virtually inevitable on a power-duration layout. This not only has a beneficial effect on longitudinal control but has a marked contribution towards spiral stability. A looping tendency, in fact, is not necessarily bad, if it can be turned into a stable, upward spiralling climb. But to achieve this successfully with high power the design must possess good spiral stability, otherwise the nose may be pulled down into a spiral dive from which there is no recovery. An interesting point here is that moving the centre of gravity back improves the effectiveness of both pylon mounting and wing dihedral in combatting spiral instability. Thus since an aft centre of gravity position is characteristic of long moment arm designs, provided the rest of the design layout is worked out properly it can prove *more* spirally stable than a short moment arm design.

One practical limitation, however, is that inertia forces are higher in a long moment arm layout and it is virtually essential to build the tailplane and rear fuselage *light* (particularly the tail). If not, they can undo all the aerodynamic advantages gained by the layout and this is a feature where even experienced modellers often fall down. It is not easy to build a light, rigid tailplane—but some careful thought and meticulous selection of balsa can often nearly *halve* tailplane weight for virtually the same rigidity and strength.

STRUCTURE DESIGN CHARTS

THERE are no established rules for airframe design although certain *types* of construction show up to advantage for particular types of models and have been adopted as standard practice. Material sizes, however, are largely arbitrary. Some designers prefer to work in hard or very hard balsa for spars, longerons, stringers, *etc.*, and favour smaller cross sections to save weight. Others favour the use of lighter balsa and larger spar sizes to give suitable strength. Local strength is often a deciding factor.

In general, average construction tends to be unnecessarily heavy, particularly in the choice of heavier grades of balsa where absolute strength is not necessary—*e.g.*, in sheet covering. Even if total model weight is not all that important, proper selection of balsa *is* important to ensure maximum strength where it is most needed and *lightness* at the extremities of the model (*e.g.*, at the tail and wing tips) to minimise inertia forces.

It is not commonly realised that a box fuselage, say, with $\frac{1}{8}$ in. square longerons can be made both *lighter* and *stronger* than a similar box fuselage constructed in hard (and heavy) $\frac{3}{32}$ in. square, particularly if the spacer sizes are reduced (say to $\frac{1}{8}$ in. $\times$ $\frac{1}{16}$ in.).

$\frac{3}{32}$ in. square Fuselage

4 longerons $\times 3 \times 3$ units of area $=36$ units
3 equivalent lengths of spacer $=27$ units
Total 63 units of area
Relative weight in 14 lb. per cube balsa $=14\times 63=882$

$\frac{1}{8}$ in. square Fuselage

4 longerons $\times 4 \times 4$ units of area $=64$ units
3 equivalent lengths of spacer $\times 4 \times 2$ units of area $=24$ units
Total 88 units of area
Relative weight in 10 lb. per cube balsa $=880$
Relative weight in 8 lb. per cube balsa $=724$

The former fuselage will be more robust and generally stronger overall and locally than the $\frac{3}{32}$ in. sq. fuselage. The latter construction will have similar overall strength to the $\frac{3}{32}$ in. sq. fuselage at a lighter weight.

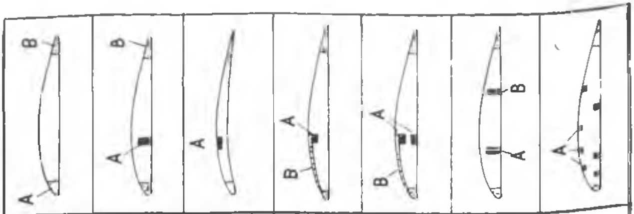
The following structural design charts have, therefore, been prepared on the basis of arriving at economic lightweight structures using medium and light-medium density balsa and reasonable spar sizes throughout. Wood sizes shown are intended mainly as a guide and are not necessarily binding. Similarly, there may be individual preferences for a particular type of construction.

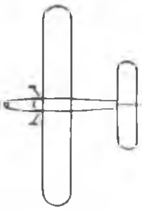
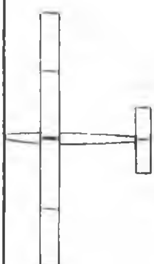
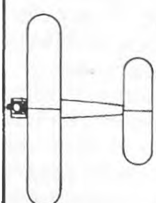
Where a constructional method is listed as "not recommended" for a particular size or type of model this may be due to a variety of reasons, such as susceptibility to warping, unnecessary complication or weight. It does not necessarily rule out this method but merely underlines that if it is adopted it has certain limitations and an alternative method would be a preferred choice.

Where a constructional method is listed as "not suitable" it should not be chosen "just to be different". It has been tried and found wanting for the type or size of model concerned. The "specially recommended" structures apply

WINGS

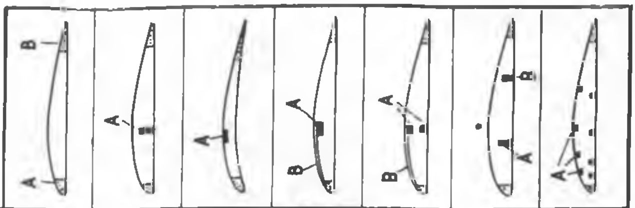
NOTES:
N.R NOT RECOMMENDED
H-HARDWOOD

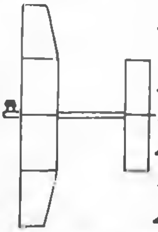
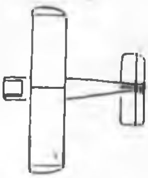
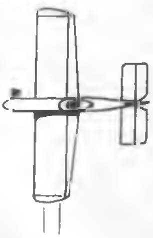
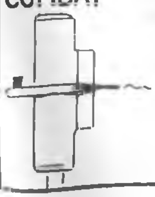


	SPAN SIZE	1	2	3	4	5	6	7
RUBBER 	UP TO 20"	A 3/8x5/16 B 1/2x1/8	A 5/16x3/32 B 3/8x3/32	N.R	N.R	N.R	N.R	N.R
	20"-26"	A 3/8 SQ. B 1/2x3/16	A 3/8x3/32 B 3/8x1/2	N.R	N.R	N.R	N.R	N.R
	24"-30"	A 1/2x3/8 B 3/4x1/4	A 3/8x1/8 B 1/2x1/8	N.R	N.R	N.R	A 3/16x3/32 B 1/4x3/32	A 1/16 SQ
	30"-36"	A 5/8x1/2 B 3/4x3/16	A 3/8x1/8 B 1/2x1/8	N.R	A 1/8 SQ B 1/32	A 3/32 SQ B 1/32	A 3/8x3/32 B 1/4x3/32	A 1/16 SQ.
	36"-42"	N.R	A 3/8x3/16 B 1/2x3/16	N.R	A 3/16x3/32 B 1/32	A 1/8 SQ B 1/32	A 3/8x1/8 B 1/4x1/8	A 1/16 SQ.
	WAKEFIELD	N.R	N.R	A 3/16x1/16 H	A 1/4x1/8 B 1/32	A 1/8 SQ B 1/32	A 3/8x1/8 B 3/8x1/8	A 1/16 SQ.
GLIDER 	UP TO 20"	A 3/8x5/16 B 1/2x1/8	A 5/16x3/32 B 3/8x3/32	N.R	N.R	N.R	N.R	N.R
	20"-24"	A 3/8 SQ. B 1/2x3/16	A 3/8x3/32 B 3/8x1/8	N.R	N.R	N.R	A 1/4x3/32 B 1/4x3/32	N.R
	24"-30"	N.R	A 1/2x1/8 B 1/2x1/8	A 1/4x1/8	A 1/8x1/16 B 1/32	A 1/8x1/16 B NO	A 3/8x3/32 B 1/4x3/32	A 1/16 SQ.
	30"-36"	N.R	A 1/2x1/8 B 1/2x3/16	A 3/16x1/16 H	A 1/8x3/32 B 1/32	A 1/8x3/32 B 1/32	A 1/2x1/8 B 3/8x3/32	A 1/16 SQ
	36"-48"	N.R	N.R	A 1/4x3/32 H	A 3/16x1/8 B 1/32	A 3/16x3/32 B 1/32	A 3/8x3/16 B 3/8x1/8	N.R
	48"-60"	N.R	N.R	A 3/8x1/8 H	A 3/16x3/32 H B 1/20	A 3/16 SQ B 1/20	N.R	N.R
F/F SPORTS 	UNDER 30"	A 1/2x3/8 B 3/4x1/4	A 1/2x1/8 B 1/2x1/8	N.R	A 1/4x3/32 B 1/32	N.R	A 1/2x3/16 B 1/2x1/8	N.R
	30"-36"	N.R	A 1/2x1/8 B 3/4x3/16	N.R	A 3/8x3/32 B 1/16	A 3/32 SQ B 1/20	A 1/2x3/16 B 3/8x3/32	N.R
	36"-40"	N.R	A 1/2x3/16 B 3/4x1/4	N.R	A 3/8x3/32 B 1/16	A 1/8 SQ B 1/20	A 1/2x1/4 B 3/8x1/8	N.R
	40"-48"	N.R	A 1/2x1/4 B 1 x 1/4	N.R	A 3/8x1/4 B 1/16	A 3/16 SQ B 1/16	A 1/2x1/4 B 3/8x3/16	N.R
	48"-60"	N.R	N.R	N.R	A 1/2x3/16 B 1/16	A 3/16 SQ B 1/16	A 1/2x1/4 B 3/8x1/4	N.R
	60"-72"	N.R	N.R	N.R	N.R	A 1/4 SQ B 1/16	A 1/2x1/4 B 1/2x1/4	N.R

WINGS

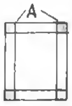
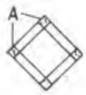
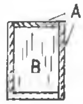
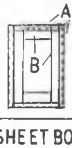
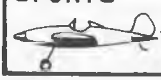
NOTE:
N.R NOT RECOMMENDED

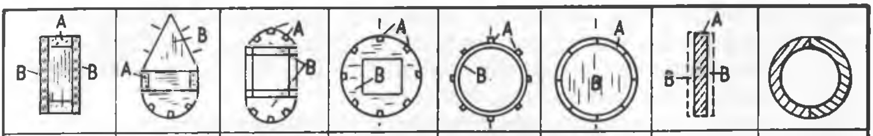


F/F DURATION 	UP TO 30"	A 3/8×1/4 B 1/2×1/8	A 3/8×1/8	A 3/16×3/32	A 3/16 3/32 B 1/32	N.R	A 3/8×3/32 B 1/4×1/8	A 1/16 SQ
	30"–36"	N.R	A 3/8×3/16	A 1/4×1/8	A 1/4×3/32 B 1/20	A 1/8 SQ B 1/20	A 3/8×3/16 B 1/4×3/16	A 3/32 SQ
	36"–40"	N.R	A 1/2×3/16	N.R	A 3/8×1/8 B 1/16	A 1/8 SQ B 1/20	A 3/8×1/4 B 3/8×1/8	N.R
	40"–48"	N.R	N.R	N.R	A 1/2×3/16 B 1/16	A 3/16 SQ B 1/16	A 1/2×1/4 B 3/8×3/16	N.R
	48"–60"	N.R	N.R	N.R	A 1/2×1/4 B 1/16	A 1/4 SQ B 1/16	A 1/2×1/4 B 3/8×1/4	N.R
RADIO CONTROL 	30"–40"	N.R	A 1/2 1/4	N.R	A 3/8×3/16 B 1/16	A 1/8 SQ B 1/16	A 1/2×1/4 B 3/8×1/8	N.R
	40"–48"	N.R	N.R	N.R	A 1/2×1/4 B 1/16	A 3/16 SQ B 1/16	A 1/2×1/4 B 3/8×3/16	N.R
	48"–60"	N.R	N.R	N.R	N.R	A 1/4 SQ B 1/16	A 1/2×1/4 B 1/2×1/4	N.R
	60"–72"	N.R	N.R	N.R	N.R	A 1/4 SQ B 1/16	A 1/2×1/4 B 1/2×1/4	N.R
C/L STUNT 	20"–24"	A 3/8 SQ A 3/4×1/4	B 3/8×3/16	N.R	N.R	N.R	N.R	N.R
	24"–30"	A 1/2 SQ B 1×3/8	A 3/8×1/4	N.R	A 3/32 SQ 1/20	A 3/32 SQ B 1/20	A 3/8×3/16 B 1/4×1/8	N.R
	30"–36"	N.R	A 1/2×1/4	N.R	A 1/8 SQ B 1/16	A 1/8 SQ B 1/16	A 1/2×1/4 B 3/8×3/32	N.R
	36"–48"	N.R	N.R	N.R	A 3/16 SQ B 1/16	A 3/16 SQ B 1/16	A 1/2×1/4 B 3/8×3/16	N.R
	48"–60"	N.R	N.R	N.R	A 1/4 B 1/16	A 1/4 B 3/32	A 1/2×1/4 B 1/2×1/4	N.R
C/L COMBAT 	UP TO 30"	A 1/2×3/8 B 1×3/8	A 1/2×1/8	N.R	A 3/8×3/32 B 1/16	A 1/8 SQ B 1/16	A 1/2×3/16 B 3/8×1/8	N.R
	30"–36"	N.R	A 1/2×3/16	N.R	A 3/8×3/32 B 1/16	A 3/16 SQ B 1/16	A 1/2×1/4 B 1/2×3/16	N.R
	36"–44"	N.R	N.R	N.R	A 1/2×1/8 B 1/16	A 1/4 SQ B 1/16	A 1/2×1/4 B 1/2×1/4	N.R
	44"–50"	N.R	N.R	N.R	A 1/2×3/16 B 1/16	A 1/4 SQ B 1/16	A 5/8×3/8 B 1/2×1/4	N.R

FUSELAGE

NOTES:
N.R- NOT RECOMMENDED
N.S- NOT SUITABLE
H- HARDWOOD
P- PLY

		 TISSUE BOX	 DIAMOND	 SHEET BOX	 SHEET BOX	 TRIANGL'R	 TUBE
RUBBER 	SMALL	A 1/16×3/32	A 1/8×1/16	N.R	N.S	N.S	A 1/20
	MEDIUM	A 3/32 SQ	A 3/32 SQ	A 1/16 B 1/16	N.R	N.S	A 1/16
	LARGE	A 1/8 SQ	A 1/8 SQ	A 1/16 B 3/32	A 1/32 B 3/32 SQ	N.S	A 1/16
	WAKEFIELD	A 1/8 SQ OR H	N.R	A 1/16 B 1/8	A 1/16 B 1/8 SQ	N.R	A 1/16 OR DURAL
GLIDER 	SMALL	A 3/32 SQ	A 3/32 SQ	N.R	A 1/20 B 1/16 SQ	N.S	A 1/16
	MEDIUM	A 1/8 SQ	A 1/8 SQ	A 1/20 B 3/32	A 1/16 B 1/8 SQ	A 1/16	A 1/16
	LARGE	A 3/16 SQ	A 3/16 SQ	A 1/16 B 1/8	A 1/16 B 3/16 SQ	A 3/32	N.R
	A-2	N.R	N.R	A 1/16 B 1/8	A 1/16 B 1/8 SQ	A 3/32	A ·5MM. P
F/F SPORTS 	SMALL	A 1/8 SQ	A 1/8 SQ	A 1/16 B 1/8	A 1/16 B 3/32 SQ	N.S	N.R
	MEDIUM	A 3/16 SQ	A 3/16 SQ	A 1/16 B 1/8	A 1/16 B 1/8 SQ	N.S	N.R
	LARGE	A 1/4 SQ	A 1/4 SQ	A 1/16 B 3/16	A 1/16 B 3/16 SQ	N.S	N.R
F/F DURATION 	SMALL	A 1/8 SQ	A 1/8 SQ	A 1/16 B 3/32	A 1/16 B 1/8 SQ	A 1/16	N.R
	MEDIUM	A 3/16 SQ	A 3/16 SQ	A 3/32 B 1/8	A 3/32 B 1/8 SQ	A 3/32	N.R
	LARGE	A 1/4 SQ	N.R	A 3/32 B 3/16	A 3/32 B 3/16 SQ	A 1/8	N.R
RADIO CONTROL 	SMALL	A 3/16 SQ	N.R	A 3/32 B 1/8	A 1/16 B 1/8 SQ	N.R	N.S
	MEDIUM	A 1/4 SQ	N.R	A 3/32 B 3/16	A 3/32 B 3/16 SQ	N.R	N.S
	LARGE	A 1/4 SQ	N.R	A 3/32 B 1/4	A 3/32 B 3/16 SQ	N.R	N.S
C/L STUNT 	SMALL	A 1/8 SQ	N.R	A 1/16 B 3/32	A 1/16 B 1/8 SQ	N.S	N.S
	MEDIUM	N.R	N.R	A 3/32 B 1/8	A 3/32 B 3/16 SQ	N.S	N.S
	LARGE	N.R	N.R	A 1/8 B 3/16	A 1/8 B 3/16 SQ	N.S	N.S
C/L COMBAT 	SMALL	N.R	N.R	A 1/16 B 1/8	A 1/16 B 1/8 SQ	N.R	N.S
	MEDIUM	N.R	N.R	A 3/32 B 3/16	A 3/32 B 3/16 SQ	N.R	N.S
	LARGE	N.R	N.R	A 1/8 B 1/4	A 1/8 B 3/16 SQ	N.S	N.S
C/L SPORTS 	SMALL	A 1/8 SQ	A 1/8 SQ	A 1/16 B 3/32	A 1/16 B 1/8 SQ	N.R	N.S
	MEDIUM	A 3/16 SQ	A 3/16 SQ	A 3/32 B 1/8	A 3/32 B 1/8 SQ	N.S	N.S
	LARGE	A 1/4 SQ	A 1/4 SQ	A 1/8 B 3/16	A 1/8 B 3/16 SQ	N.S	N.S



VERT. CRUTCH	HOR. CRUTCH	FAIRED BOX	STREAMLINE	STREAMLINE	MONOCOQUE	PROFILE	HOLLOW LOG
N.S	N.S	A 1/16 SQ B 1/16 SQ	A 1/16 SQ B 1/20	N.R	N.R	N.S	N.S
N.S	N.S	A 1/16 SQ B 3/32 SQ	A 1/16 SQ B 1/16	A 1/16 SQ B LAMN.	N.R	N.S	N.S
N.S	N.S	A 1/16 SQ B 1/8 SQ	A 1/16 SQ B 3/32	A 1/16 SQ B LAMN.	A 1/16 B LAMN.	N.S	N.S
N.S	N.S	A 1/16 SQ B 1/8 SQ	N.R	A 3/32 SQ B 1/16 SQ H	A 1/16 B LAMN.	N.S	N.R
A 1/2 × 1/8 B 1/16	A 1/2 × 1/8 B 1/16	A 1/16 SQ B 3/32 SQ	A 1/16 SQ B 1/16	A 1/16 SQ B LAMN.	A 1/16 B 1/16	A 1/8-3/16 B 1/16 P	N.S
A 1/2 × 3/16 B 3/32	A 1/2 × 3/16 B 3/32	A 1/16 SQ B 3/32 SQ	A 1/16 SQ B 3/32	A 1/16 SQ B LAMN	A 1/16 B 3/32	A 3/16 B 1/8	FOR POD
A 1/2 × 1/4 B 1/8	A 1/2 × 1/4 B 1/8	A 3/32 SQ B 1/8 SQ	A 3/32 SQ B 1/8	A 3/32 SQ B LAMN	A 1/16 B 1/8	N.S	FOR POD
A 1/2 × 3/16 B 1/8	A 1/2 × 3/16 B 1/8	A 3/32 SQ B 3/16 SQ	N.R	N.R	A 1/16 B 1/8	N.S	N.R
N.S	A 1/2 × 3/16 B 3/32	A 3/32 SQ B 1/8 SQ	A 1/16 SQ B 3/32	A 1/16 B LAMN.	N.R	A 3/16 B 1/16 P	N.R
N.S	A 1/2 × 3/16 B 1/8	A 1/8 SQ B 3/16-1/8 SQ	A 3/32 SQ B 1/8 SQ	A 3/32 SQ B LAMN	A 1/16 B 1/8	A 3/16 B 3/32 P	N.R
N.S	A 1/2 × 1/4 B 3/16	A 1/8 SQ B 3/16 SQ	A 1/8 SQ B 3/16	A 1/8 SQ B LAMN.	A 3/32 B 3/16	N.R	N.R
A 3/8 × 3/16 B 1/16	N.R	N.R	N.R	N.R	N.R	A 1/4 B 1/16 P	N.S
A 1/2 × 1/4 B 1/16	N.R	N.R	N.R	N.R	N.R	N.R	N.S
A 1/2 × 1/4 B 3/32	N.R	N.R	N.R	N.R	N.R	N.R	N.S
N.S	N.R	A 3/32 SQ B 3/16 SQ	N.R	N.R	N.R	N.S	N.R
N.S	A 1/2 × 1/4 B 3/16	A 1/8 SQ B 3/16 SQ	N.R	N.R	N.R	N.S	N.R
N.S	A 1/2 × 1/4 B 1/4	A 1/8 SQ B 1/4 SQ	N.R	N.R	N.R	N.S	N.R
A 1/2 × 1/8 B 1/16	N.R	N.R	A 1/16 SQ B 3/32	N.R	N.R	A 1/4 B 1/16 P	O.K
N.R	A 1/2 × 3/16 B 1/8	N.R	A 3/32 SQ B 1/8	N.R	A 1/16 B 1/8	A 3/8 B 3/32 P	O.K
N.R	A 1/2 × 1/4 B 3/16	N.R	A 1/8 SQ B 3/16	N.R	A 3/32 B 3/16	N.R	O.K
A 1/2 × 1/4 B 1/16	N.R	N.R	N.R	N.R	N.R	A 1/4 B 1/16 P	O.K
A 1/2 × 3/16 B 3/32	N.R	N.R	N.R	N.R	N.R	A 3/8 B 3/32 P	O.K
A 1/2 × 1/4 B 1/8	N.R	N.R	N.R	N.R	N.R	A 1/2 B 1/8 P	O.K
A 1/2 × 1/8 B 1/16	N.R	A 3/32 SQ B 3/32 SQ	N.R	A 3/32 SQ B LAMN	A 1/16 B 1/8	A 1/4 B 1/16 P	O.K
A 1/2 × 3/16 B 3/32	N.R	A 1/8 SQ B 1/8 SQ	N.R	A 3/32 SQ B LAMN.	A 3/32 B 3/16	A 3/8 B 3/32 P	O.K
A 1/2 × 1/4 B 1/8	N.R	A 1/8 SQ B 3/16 SQ	N.R	A 1/8 SQ B LAMN	A 3/32 B 3/16	A 1/2 B 1/8 P	O.K

mainly to contest types, where high consistency coupled with fine trimming is of prime importance, and excessively heavy structures must be avoided.

The tables cover, separately, recommendations for:

Wing construction and spar and rib sizes.

Fuselage construction, selection of type and material sizes.

Tailplane construction, selection of type and basic material sizes.

WING CONSTRUCTION

The choice of spar section and arrangement is governed to a large extent by the aerofoil section to be employed, and also the plan form if this departs markedly from purely rectangular outlines. It is impossible to list all forms of spar arrangements since many of these are established to individual designer's ideas. The table, therefore, confines analysis to a comprehensive selection of the more orthodox arrangements.

The Monospar Wing

The straightforward monospar wing, although simple and particularly suited to small models, is weak in torsion. Spar depth (which governs bending strength) is limited by the thickness of the aerofoil section available, the spar usually being placed at maximum rib thickness. Leading and trailing edge sections are largely governed by the aerofoil section.

The orthodox method is to slot the mainspar into the bottom of the rib (1). It is better practice, however, to pass the spar through the rib (2). Although this reduces the maximum spar depth which can be accommodated and makes the wing more difficult to build, it reduces the tendency to warp or the section to distort with contraction of the cement. In the case of a symmetrical aerofoil, the spar should be disposed about the centre line of the rib (3).

Where the aerofoil section is thin, a stronger wing with very little extra total weight can be produced by using a thin mainspar slotted into the top of the aerofoil and reinforcing to the leading edge with light sheet covering (4). Alternatively the spar can be laid flat and leading and trailing edge widths extended (5). The latter method is often used on thin glider wings with a hardwood (spruce) mainspar.

Monospar construction is a general recommendation for all types of free flight models, but improved in the larger sizes with both sheet covering of the leading edge and the addition of diagonal bracing.

Two-spar construction is inherently heavier, but lighter stiff spars can be selected to avoid any weight penalty. The rear spar then minimises a warping tendency on a large chord which would otherwise be present with monospar construction.

The advantages of multi-spar construction are often overlooked for tailplanes and this type could probably be more widely adopted. The all-sheet tailplane, although excellent for control line models (and virtually the standard choice on all but large stunt models), is not suitable for free flight models on account of its weight—free flight tailplane areas invariably being large.

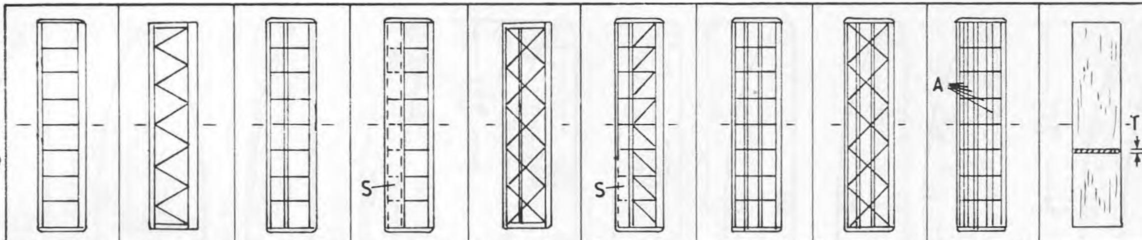
The Two-spar Wing

The straightforward two-spar arrangement (1) gives greater bending strength and resistance to torsion on larger wings. Again it is improved by taking the spars through the aerofoil section (2), and equally disposed about the centre line on a symmetrical section. Spar sections can be similar, although theoretically the front spar should be both deeper and thicker for equal loading.

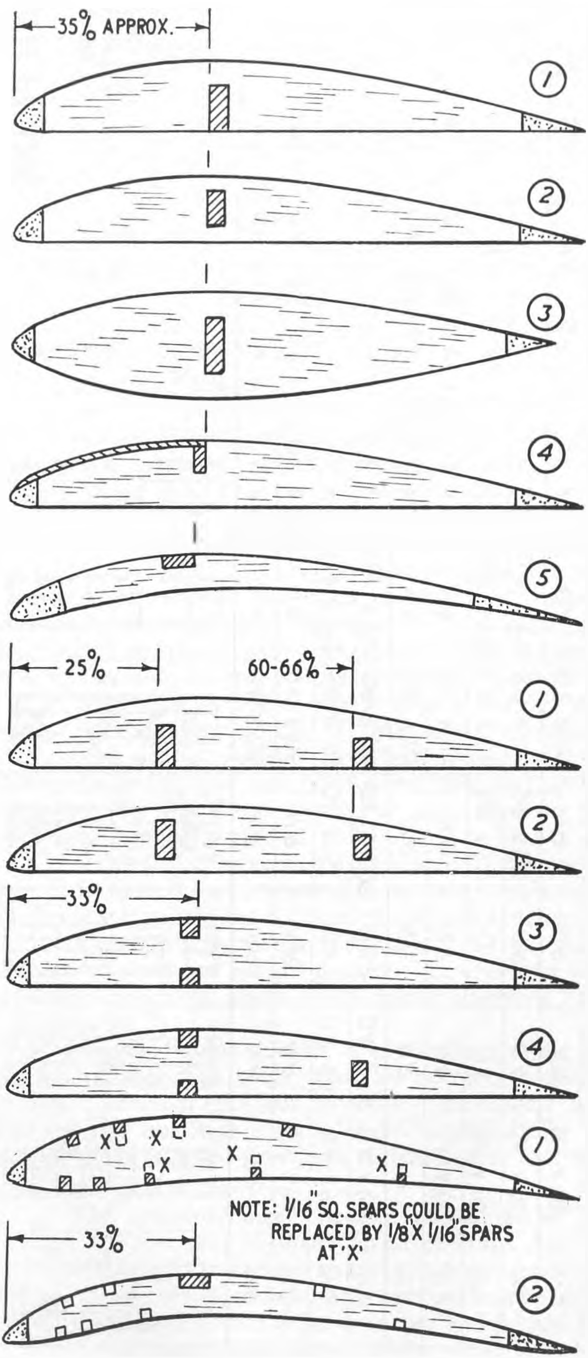
A variation, producing a lighter wing, is to use square section spars

TAILPLANE

NOTES:
S-SHEET COVERING
R-RIB THICKNESS
N.R-NOT RECOMMENDED
S.R-SPECIALLY "
N.S-NOT SUITABLE



RUBBER ALL TYPES	SMALL	O.K. R 1/20	O.K. R 1/20	O.K R 1/20	N.R	O.K R 1/20	N.R.	N.R	N.R	N.R	N.R
	MEDIUM	O.K R 1/16	O.K R 1/16	O.K R 1/16	N.R	O.K R 1/16	N.R	N.R	N.R	O.K A 1/16°	N.S
	LARGE	N.S	N.R	O.K R 1/16	O.K S 1/32	SR R 1/16	O.K NO'S'	O.K	O.K R 1/16	O.K A 1/16°	N.S
	WAKEFIELD	N.S	N.R	O.K R 1/32	O.K S 1/32	SR R 1/32	OK S 1/32	OK	OK R 1/32	OK A 1/16°	N.S
GLIDERS ALL TYPES	SMALL	O.K R 1/20	O.K R 1/20	O.K R 1/20	N.R	O.K R 1/20	N.R	N.R	N.R	N.R	N.R
	MEDIUM	O.K R 1/16	O.K R 1/16	O.K R 1/16	N.R	O.K R 1/16	N.R	N.R	N.R	O.K A 1/16°	N.S
	LARGE	N.S	N.R	O.K R 1/16	O.K S 1/32	O.K R 1/16	SP S 1/32	O.K	O.K	OK A 1/16°	N.S
	A-2	N.S	N.R	O.K R 1/16	O.K S 1/32	SR R 1/16	SR S 1/32	O.K	O.K	OK A 1/16°	N.S
F/F POWER	SMALL	N.R	O.K R 1/16	O.K R 1/16	O.K	O.K R 1/16	N.R	N.R	N.R	O.K A 1/16°	N.S
	MEDIUM	N.S	N.R	O.K R 1/16	SR S 1/32	SR R 1/16	O.K NO'S'	O.K R 1/16	O.K	O.K A 1/16°	N.S
	LARGE	N.S	N.R	OK R 3/32	SP S 1/16	SP R 1/16	SR NO'S'	O.K R 3/32	O.K	OK A 3/32°	N.S
RADIO CONTROL	SMALL	N.R	O.K R 3/16°	O.K R 1/16	O.K S 1/32	O.K R 1/16	N.R	O.K R 1/16	O.K R 1/16	O.K A 1/16°	N.S
	MEDIUM	N.S	N.R	O.K R 1/16	O.K S 1/20	O.K R 1/16	N.R	O.K R 1/16	O.K R 1/16	O.K A 3/32	N.S
	LARGE	N.S	N.R	O.K R 3/32	O.K S 1/16	O.K R 3/32	N.R	O.K R 3/32	O.K R 3/32	N.R	N.S
C/L ALL TYPES	SMALL	N.R	O.K	O.K	N.R	N.R	N.S	N.S	N.S.	N.S	SR T 3/32
	LARGE	N.R	O.K	O.K	N.R	N.R	N.R	N.S	N.S	N.S	SR T 1/8-3/16



disposed above each other (3). This is virtually a monospar arrangement with a "split" spar and additional bending strength can be given by filling in between the top and bottom spars with sheet balsa webs. Further strength is added by sheeting into the leading edge—either on the top surface only or on both top and bottom surfaces. For large wings, further strength can be given by the addition of a rear spar (4), reverting to a true two-spar arrangement.

The Multi-spar Wing

This is a particularly light and rigid form of construction, although locally weak because of the small sections which must be used on the individual spars. Main point to watch (1) is that the top and bottom spars are "balanced". If there is an excess of spars on the top, the resulting structure will tend to warp downwards, and vice versa.

The multispar wing has given good service on larger rubber models. A modern variation, where weight is not so important, is to ally the warp-resistance and rigidity of multi-spar construction with one main load-bearing spar of thicker section (usually in hardwood), laid flat on the upper surface (2).

FUSELAGE CONSTRUCTION

The tissue-covered box fuselage still remains the most popular choice for almost all types of free flight models. For power models, however, the sheet box offers many advantages. It is not widely used in kit designs because of the extra material cost involved, but it is well suited to sports free flight in any size and virtually a standard for radio control models. Apart from a good strength/weight ratio, building is much simplified with this type of construction.

The vertical crutch is the modern standard for power duration fuselages where only a minimum cross sectional area is required and the fuselage is regarded as purely functional. The vertical crutch is an original method developed for power models and widely used at one time, although now more or less disregarded. It does tend to produce a rather heavy fuselage but is still excellent for the larger sizes of sports free flight models where a departure from the orthodox "box" section is required.

Streamlined section fuselages, also, have largely fallen into disfavour, partly because of their vulnerability, but mainly because of the extra difficulty of building. Half-shell construction is the logical choice with sheet balsa formers, where one fuselage half can be built complete with stringers flat over the plan and the other half formers and stringers then added. Streamlined stringered construction on laminated formers wound from $\frac{1}{32}$ in. balsa strips gives a stronger, lighter fuselage but has to be built on a jig. Monocoque construction may be done on sheet or laminated formers, but again is tedious. The profile fuselage is mainly restricted to control line applications, as is also "hollow log" construction.

TAILPLANE CONSTRUCTION

No definite recommendations can be laid down for spar sizes for tailplanes as the governing factor is rigidity and resistance to warping rather than bending strength. All tailplanes should be built as light as possible, using the smallest section spars and lightest wood density consistent with stiffness requirements.

Similar remarks to wing construction then apply as regards selection of type. Anti-warp rib arrangement—either Warren girder or geodetic—offers particular advantages for contest models although the complication may be thought unnecessary for sports models. Sparless construction is suitable only for the smallest models as it is very prone to warp.

PAINTING BALSA WITHOUT FILLING

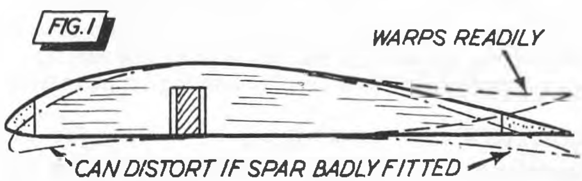
To take ordinary cellulose finishes satisfactorily, balsa requires several coats of grain filler or sealer, sanding between each coat. Many emulsion paints can be painted on balsa without producing a marked grain-raising effect, so colouring can be applied direct without pre-treatment of the wood. The result is a "flat" colour with grain marking tending to show up, but without that "fluffiness" resulting when colour dopes are applied direct.

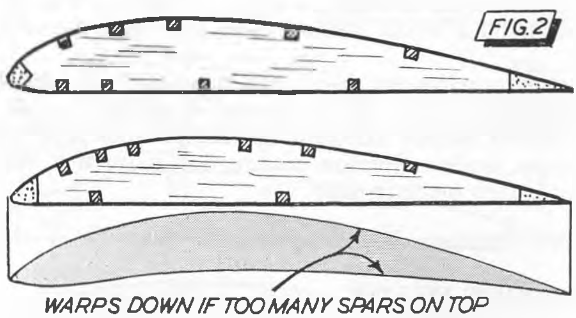
WING BRACING

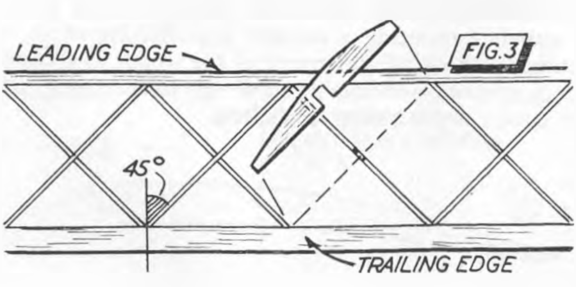
THE wing is the most vulnerable part of a model, yet model wings are far stronger, proportionately, and stiffer, than full-size aircraft wings. The strength requirements are, in any case, more severe, particularly with the necessity of being able to withstand bad landings. Yet although a high-strength component, built-up model wing structures are inherently weak on two scores—torsional deflection and localised bending loads at the wing centre.

A simple monospar wing structure as in Fig. 1 has good strength in bending but relatively low torsional rigidity or resistance to twisting. It relies essentially on taut covering to give it stiffness in this direction. That in itself is a satisfactory solution, except for the fact that taut covering is not always consistent in behaviour and the very act of tautening (with the application of dope) can cause distortion of the structure.

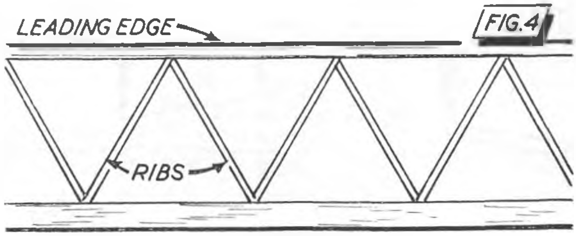
Just looking at the relative spar depths clearly indicates that the trailing edge will be prone to pulling or warping upwards towards the tips—introducing wash-in. Aerodynamically this is not bad, nor does it affect the strength of the wing. But it is bad if excessive and, more important, it can change under different conditions affecting the tautness of the covering and alter the trim.

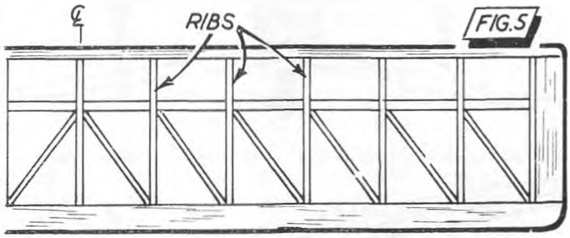


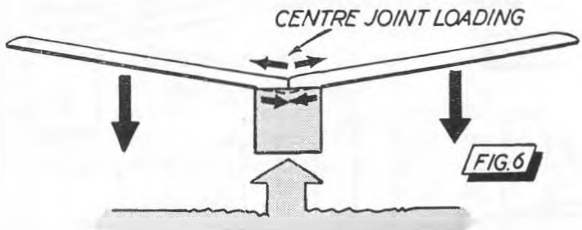




Other wing designs are better in this respect, the multi-spar arrangement of Fig. 2 being most warp-resistant, in fact, provided the spar positioning is properly balanced. If an excess of spars is employed, say on the upper surface, this will produce a natural tendency for the wing to warp downwards—either along the span to produce a "gull" wing effect or, more likely, an asymmetric warp with both "gulling" and twisting. The main limitation of the multi-spar







wing, however, is the necessity of using small spar sections which are thus locally weak.

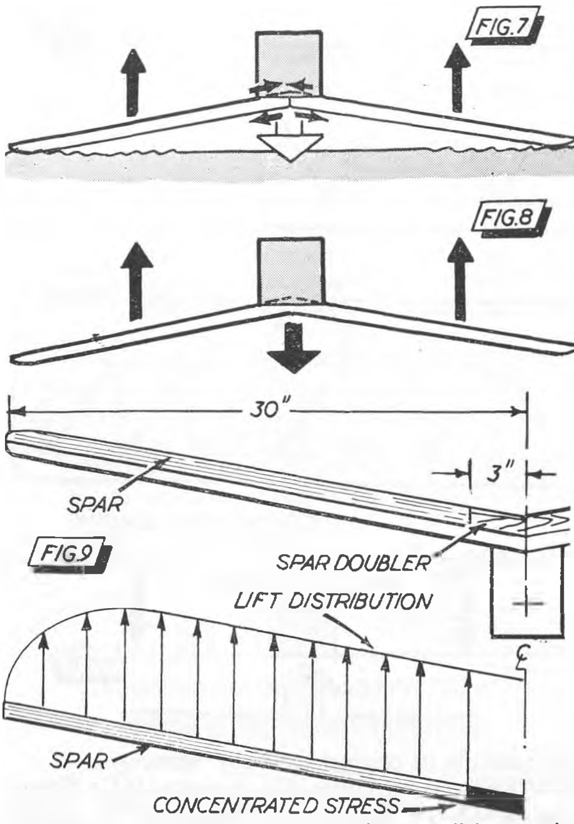
Fortunately, complete torsional rigidity can be achieved with relatively simple structures and orthodox spar arrangements and it is surprising that these are not more universally adopted. "Geodetic" rib arrangement with a 45 deg. pitch (Fig. 3) gives a twist-free wing with almost any type of spar arrangement. Such a wing will normally stay "as built"—which is a point to bear in mind since if not built absolutely flat (or incorporating any wash-out as may be called for) it cannot be twisted "true" after covering and retain such a setting. It will always tend to revert to its original "as built" state.

"W" spacing of ribs is nearly as effective—Fig. 4—provided a reasonably large pitch angle is maintained. The problem of "filling in" the leading edge section with this—and with geodetic—is not difficult, with riblets or leading edge sheet covering, etc. And the fact that both types have been developed successfully for contest models proves that they need carry no weight penalty. Either could be more widely adopted for sports models, and for radio control.

The somewhat simpler alternative of using angled bracing between conventional ribs—Fig. 5—does carry a weight penalty and can be a source of trouble *unless the bracings are added while the remainder of the wing is being built and pinned down flat.* If cut and fitted *after* the main wing frame has been removed from the building board there is a considerable danger of progressively introducing a wash-in warp if the braces are tightly fitted, or wash-out warp due to cement contraction if cut slightly short of a length.

With all torsional bracing—or torsional-resistant structures—the same rule holds good to complete the whole structure while the wing is pinned down flat on the building board. The foregoing comments, of course, apply equally well to tailplanes as wings.

Normal flight bending loads are readily accommodated by the spar sizes and bending loads only become a problem in severe manoeuvres and rough landings. The weakest point—in fact the only point—requiring detailed attention being the centre wing joint. Dihedral joints in polyhedral wings need similar bracing, but not to the same degree. Simple local reinforcement of the



spar and leading and trailing edge joints is all that is required here.

The wing centre joint is stressed by a sudden download on each wing half in landing—and this can be quite severe if the rate of vertical descent suddenly interrupted is quite high, as in a dethermalised landing. If the model turns over, the stress is basically similar—although this may appear less obvious at first. The inertia of the fuselage thrown onto the wing centre joint — Fig. 7 — is producing a similar high tensional force at the top of the wing joint and a compressive force at the bottom.

Severe flight loads brought on by abrupt manoeuvres such as a loop, fast tow launching or pulling out of a dive reverse the loading condition, or in a bunt or inverted flying, produce similar effects to "landing" loads—Fig. 8. The requirement of the centre joint, therefore, is to be capable of resisting both high localised tensional and compressive loads throughout.

Common practice is to "double up" this joint area on the spar(s) with ply braces, the selection of suitable ply thickness being an arbitrary value estimated to withstand the most severe loading case. Usually it is, but as the length of such braces is commonly restricted to the centre rib spacing the overall strength of the wing is not much improved. If the "span" of the brace, for example, is one-tenth of the semi-span—Fig. 9—it is only virtually relieving the wing of one-tenth of its load and the other nine-tenths is transferred to the point where the brace terminates. Small wonder, then, that breakage is commonplace *at the point where the brace stops.*

With average free flight models probably the severe loading condition to produce breakage never arises, but it is particularly important in wings which may deliberately be highly stressed (*e.g.*, radio control models, "rough weather" towliners, *etc.*). The real answer is to *distribute* any localised stress, or adopt some other form of bracing which minimises high "peak" stresses.

Carrying the centre section brace way out along the semi-span seems an answer, except that this means "breaking" the brace in some way to accommodate anything but very modest dihedral angles. On a radio control wing where dihedral is usually low (of the order of 5-6 deg.) a straight bracing spar can sometimes be employed, doubled up with additional reinforcement at the centre, if necessary, with a further distribution of stress from the end points outwards with inter-spar bracing as in Fig. 10. Calling for a hardwood stub spar of generous depth, this can add appreciable weight, yet this penalty need not be excessive with careful design and sensible proportions. Nor is it weight which will be harmful to any extent, being mainly concentrated in the centre of the wing.

Going to the other extreme and eliminating *any* bracing at the centre of a radio model wing has also proved satisfactory. Bonner introduced this on the "Smog Hog" design (after numerous wing failures with conventional dihedral braces), merely scarf-jointing the top and bottom balsa mainspars—Fig. 11. Such a joint does not inspire confidence, yet it appears to have worked out well in practice, provided the wing structure is kept light. It provides "stress relief" in the sense that there are no sections of the spar subject to high localised bending stresses but the actual spar *joints* are liable to severe tensional and compressive loadings—hence the importance of making these joints really well with double-cementing.

A further alternative is strut bracing, again a method which has been used very successfully on contest Wakefield and glider models to provide maximum possible resistance to upward bending with very light wing structures —Fig. 12. This type of bracing largely relieves the wing roots from stresses—the root fittings being mainly location points—and also gives a flexible joint at the centre so that the wings can virtually bend downwards in a turn-over landing. This latter feature could be eliminated, if necessary (*e.g.*, to take inverted flight loads) by making the struts rigid.

A single tin wire brace to each wing has proved quite adequate for gliders up to A2 size, with the strut attachment point between 25 and 33 per cent of the semi-span out. The main limitation is that the strut angle must not be less than 30 deg. (and preferably 45 deg.) for suitable bracing effect, hence the system is no longer applicable to modern contest designs with their small depth of fuselage, unless using a pylon wing mount. Smaller strut angles could be accommodated with rigid struts (*e.g.*,

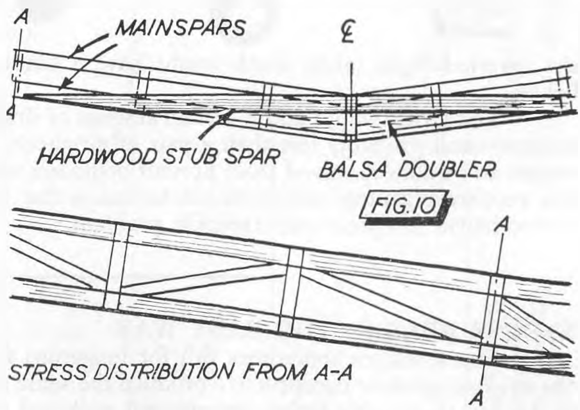


FIG. 10

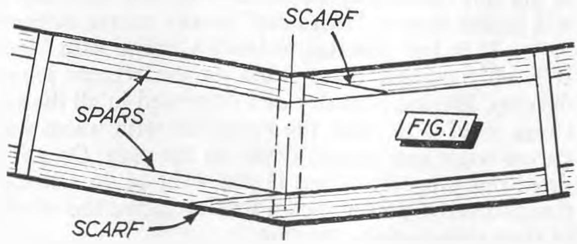


FIG. 11

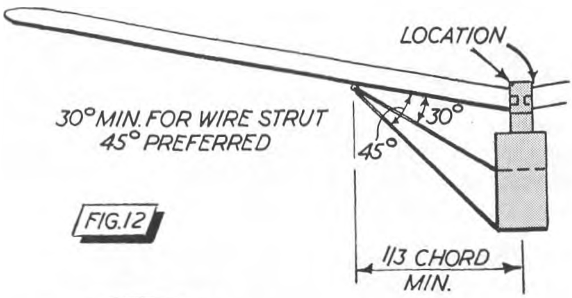


FIG. 12

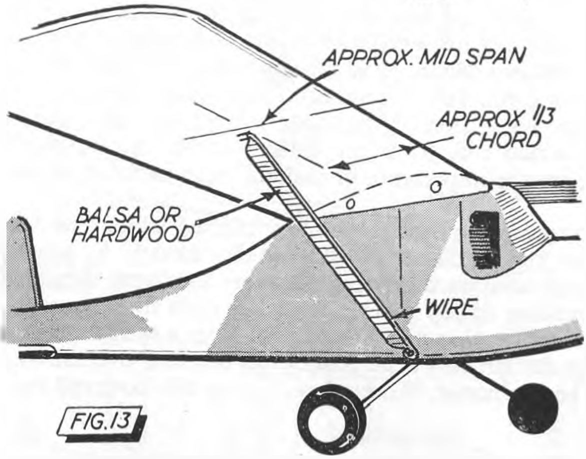


FIG. 13

wire bound to balsa or spruce fairings), but would carry a weight and drag penalty beyond their usefulness for contest designs.

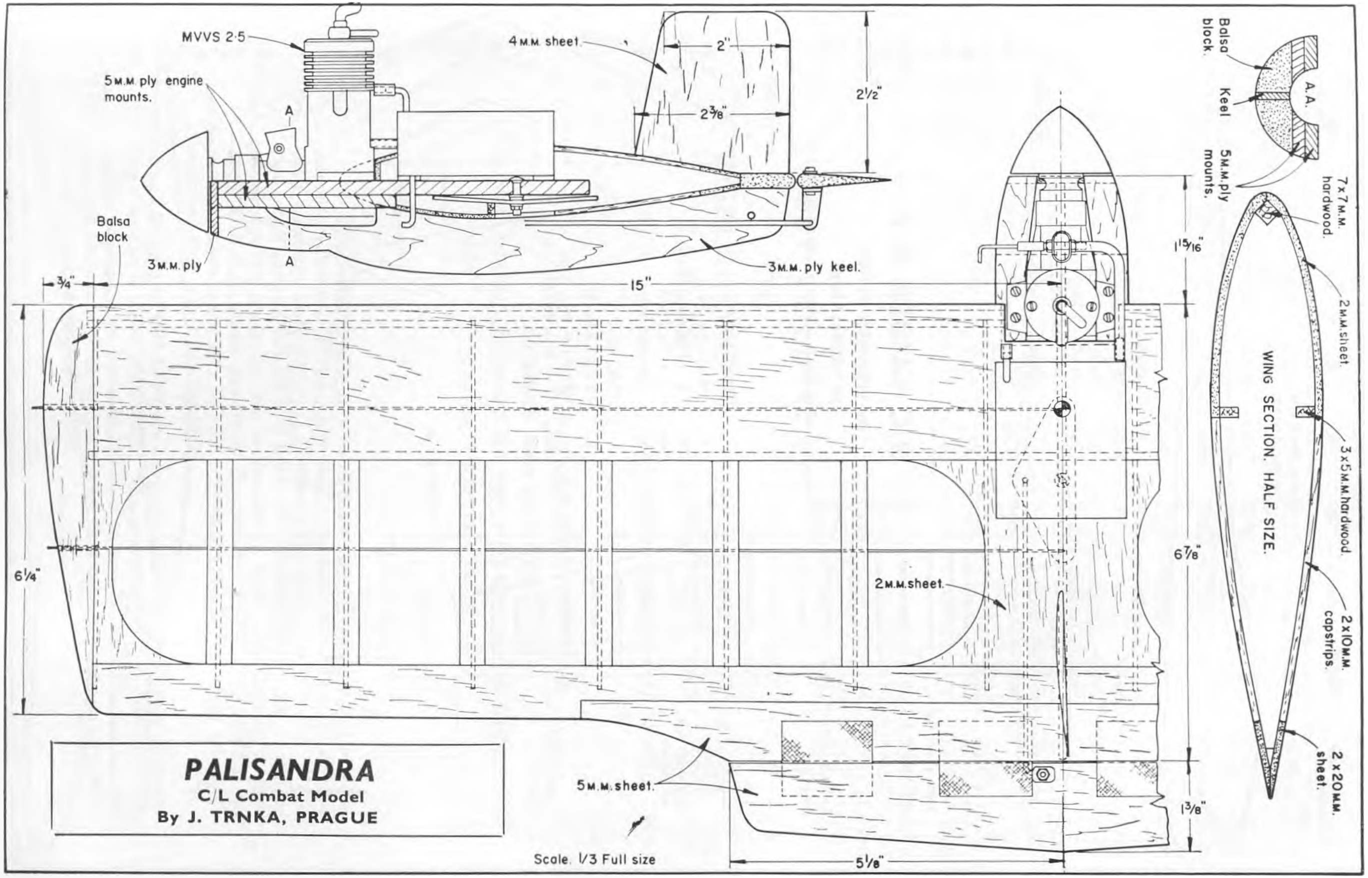
Strut bracing can still be a satisfactory answer for radio models, however, particularly with a view to keeping wing structures really light for minimum total flying weight. A single rigid strut would be satisfactory for a wing rigid in torsion — Fig. 13 — but if in any doubts as to whether the wing could twist under flight loads, a V-strut would be advisable. Root ribs would then have only to locate positively onto the fuselage and be held in place by bands with sufficient tension to resist inverted flight loads which might have a tendency to separate the wing halves.

The struts would add a certain amount of drag, but by no means a large amount—and probably less than a pair of airwheels. They would enable wing weight to be almost halved from present orthodox one-piece wing construction and another advantage not to be overlooked is that the wings would dismantle in two halves to reduce the transport problem.

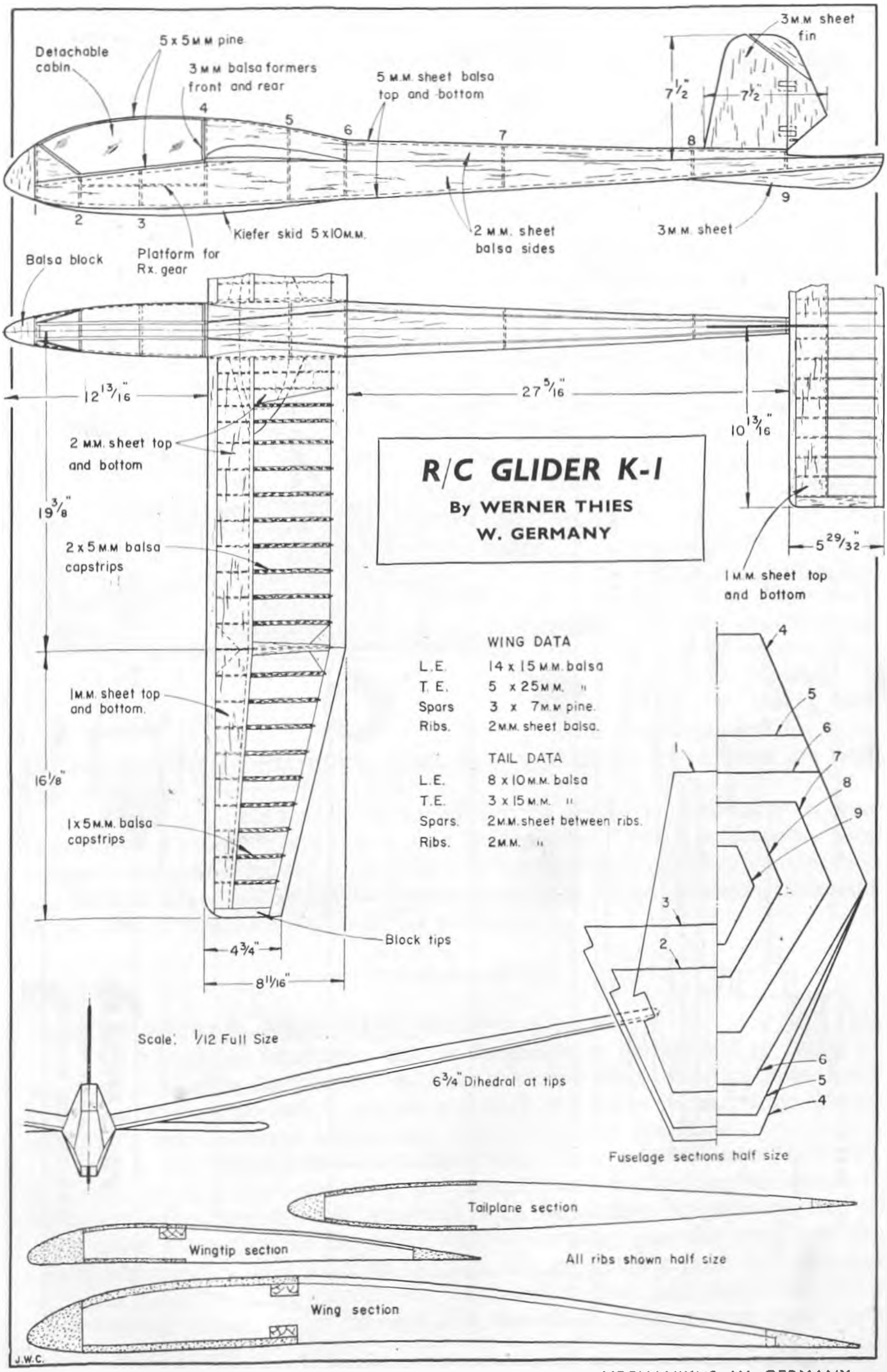
STRESS RELIEF—THE EASY WAY

Box fuselages sometimes call for longerons to be steamed to curve, or the strip can often be dampened to produce the same effect. But wet balsa needs to dry out thoroughly before cement will stick and make proper joints. Hence it is always best to "bend dry" to any curves whenever possible.

It is bad practice to leave a frame with "locked-in" stresses, however. It is only putting more strain on the cement joints and asking for warps to develop. Having bent dry *and* cemented in all the spacers, a simple method of stress relief is to paint the longerons with warm water over the lengths of the curves while still pinned down on the plan. Do not remove until the wood has dried out properly. Then if you want to do a first-class job, particularly on a tissue-covered power model fuselage, give the whole frame two or three coats of clear dope before covering.



LETECKY MODELAR, CZECHOSLOVAKIA



MECHANIKUS, W. GERMANY

Bore (in.)	STROKE (in.) ·35	·36	·37	·38	·39	·40	·41	·42	·43	·44
·35	·5523	·5681	·5839	·5997	·6155	·6312	·6470	·6628	·6786	·6944
·36	·5842	·6009	·6176	·6343	·6510	·6676	·6843	·7010	·7177	·7344
·37	·6171	·6347	·6523	·6699	·6875	·7052	·7228	·7404	·7580	·7756
·38	·6510	·6696	·6882	·7068	·7254	·7440	·7626	·7812	·7998	·8184
·39	·6860	·7056	·7252	·7448	·7644	·7840	·8036	·8232	·8428	·8624
·400	·7214	·7420	·7626	·7832	·8038	·8244	·8450	·8656	·8862	·9068
·41	·7578	·7795	·8011	·8228	·8444	·8660	·8876	·9093	·9309	·9526
·42	·7952	·8179	·8406	·8633	·8860	·9088	·9315	·9542	·9769	·9996
·43	·8334	·8572	·8810	·9048	·9286	·9524	·9762	1·0000	1·0238	1·0476
·44	·8729	·8978	·9228	·9477	·9726	·9976	1·0225	1·0475	1·0724	1·0974
·45	·9125	·9386	·9647	·9908	1·0168	1·0428	1·0688	1·0949	1·1210	1·1470
·46	·9541	·9814	1·0086	1·0359	1·0631	1·0904	1·1176	1·1449	1·1721	1·1994
·47	·9954	1·0238	1·0523	1·0807	1·1092	1·1376	1·1660	1·1945	1·2229	1·2514
·48	1·0388	1·0685	1·0982	1·1279	1·1576	1·1872	1·2169	1·2466	1·2763	1·3059
·49	1·0826	1·1135	1·1444	1·1753	1·2062	1·2372	1·2681	1·2990	1·3299	1·3608
·500	1·1274	1·1596	1·1918	1·2240	1·2562	1·2884	1·3206	1·3528	1·3850	1·4172
·51						1·3400	1·3735	1·4070	1·4405	1·4740
·52						1·3928	1·4276	1·4624	1·4972	1·5320
·53						1·4468	1·4830	1·5192	1·5553	1·5915
·54						1·5020	1·5395	1·5771	1·6146	1·6522
·55						1·5580	1·5969	1·6359	1·6748	1·7137
·56						1·6152	1·6556	1·6960	1·7364	1·7768
·57						1·6736	1·7154	1·7572	1·7991	1·8409
·58						1·7328	1·7761	1·8194	1·8627	1·9060
·59						1·7932	1·8380	1·8828	1·9277	1·9725
·600						1·8540	1·9004	1·9467	1·9931	2·0394
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SWEPT VOLUME OR DISPLACEMENT TABLES

READ BORE VALUES DOWNWARDS
STROKE VALUES ACROSS
NOTE: DISPLACEMENT OR SWEPT VOLUME IS GIVEN IN CUBIC CENTIMETRES

The following tables have been specially compiled for the *Aeromodeller Annual* to give instantaneous solutions to engine displacement calculations, knowing the bore and stroke. The bore and stroke values are plotted in *inches*, while the displacement figures given in the tables are in *cubic centimetres*, consistent with European practice. To convert cubic centimetres to cubic inches multiply by ·061; to convert cubic inches to cubic centimetres multiply by 16·39.

Bore and stroke figures are given in progressively increasing sizes in 1/100th inch steps. If more precise determination is required, e.g., the bore or stroke value is determined to the nearest thousandth of an inch, corresponding values can readily be obtained by interpolation.

Bore (in.)	STROKE (in.) ·45	·46	·47	·48	·49	·50	·51	·52	·53	·54
·35	·7101	·7259	·7417	·7575	·7733	·7890				
·36	·7510	·7677	·7844	·8011	·8178	·8345				
·37	·7933	·8109	·8285	·8462	·8639	·8815				
·38	·8370	·8556	·8742	·8928	·9114	·9300				
·39	·8820	·9016	·9212	·9408	·9604	·9800				
·400	·9274	·9480	·9686	·9892	1·0098	1·0305				
·41	·9742	·9958	1·0175	1·0391	1·0608	1·0825	1·1041	1·1258	1·1474	1·1690
·42	1·0224	1·0451	1·0678	1·0905	1·1132	1·1360	1·1587	1·1814	1·2041	1·2268
·43	1·0714	1·0952	1·1190	1·1428	1·1666	1·1905	1·2143	1·2381	1·2619	1·2857
·44	1·1223	1·1473	1·1722	1·1972	1·2221	1·2470	1·2719	1·2969	1·3218	1·3467
·45	1·1731	1·1992	1·2252	1·2513	1·2774	1·3035	1·3296	1·3557	1·3818	1·4078
·46	1·2266	1·2539	1·2811	1·3084	1·3357	1·3630	1·3903	1·4175	1·4448	1·4720
·47	1·2798	1·3083	1·3367	1·3652	1·3936	1·4220	1·4505	1·4789	1·5073	1·5357
·48	1·3356	1·3653	1·3950	1·4247	1·4543	1·4840	1·5137	1·5434	1·5731	1·6028
·49	1·3918	1·4227	1·4536	1·4845	1·5154	1·5465	1·5774	1·6083	1·6393	1·6702
·500	1·4494	1·4816	1·5138	1·5460	1·5782	1·6105	1·6427	1·6749	1·7071	1·7393
·51	1·5075	1·5410	1·5745	1·6080	1·6415	1·6750	1·7085	1·7420	1·7755	1·8090
·52	1·5668	1·6017	1·6365	1·6713	1·7062	1·7410	1·7758	1·8106	1·8454	1·8803
·53	1·6277	1·6639	1·7000	1·7362	1·7724	1·8085	1·8447	1·8809	1·9171	1·9533
·54	1·6898	1·7273	1·7649	1·8024	1·8400	1·8775	1·9150	1·9526	1·9901	2·0276
·55	1·7527	1·7916	1·8306	1·8695	1·9085	1·9475	1·9864	2·0254	2·0643	2·1033
·56	1·8171	1·8575	1·8979	1·9383	1·9786	2·0190	2·0594	2·0998	2·1401	2·1804
·57	1·8828	1·9247	1·9665	2·0084	2·0502	2·0920	2·1338	2·1756	2·2175	2·2593
·58	1·9494	1·9927	2·0360	2·0794	2·1227	2·1660	2·2093	2·2526	2·2960	2·3393
·59	2·0173	2·0621	2·1070	2·1518	2·1966	2·2415	2·2863	2·3311	2·3760	2·4208
·600	2·0857	2·1321	2·1785	2·2248	2·2712	2·3175	2·3638	2·4102	2·4565	2·5029
·61						2·3960	2·4439	2·4918	2·5397	2·5877
·62						2·4755	2·5250	2·5744	2·6245	2·6739
·63						2·5560	2·6071	2·6582	2·7093	2·7604
·64						2·6370	2·6897	2·7425	2·7952	2·8480
·65						2·7205	2·7749	2·8293	2·8837	2·9381
·66						2·8050	2·8611	2·9172	2·9733	3·0294
·67						2·8905	2·9483	3·0061	3·0639	3·1217
·68						2·9775	3·0370	3·0966	3·1561	3·2157
·69						3·0655	3·1268	3·1881	3·2494	3·3107
·700						3·1550	3·2181	3·2812	3·3443	3·4074
·71						3·2460	3·3109	3·3758	3·4407	3·5057
·72						3·3385	3·4053	3·4721	3·5389	3·6057
·73						3·4315	3·5001	3·5687	3·6373	3·7059
·74						3·5265	3·5970	3·6675	3·7380	3·8086
·75						3·6220	3·6944	3·7669	3·8393	3·9117
·76										
·77										
·78										
·79										
·800										
·81										
·82										
·83										
·84										
·85										

STROKE (in.)										Bore
·55	·56	·57	·58	·59	·60	·61	·62	·63	·64	(in.)
										·35
										·36
										·37
										·38
										·39
										·400
1·1906	1·2123	1·2340	1·2556	1·2774	1·2990	1·3206	1·3423	1·3639	1·3856	·41
1·2496	1·2723	1·2956	1·3177	1·3404	1·3632	1·3859	1·4086	1·4313	1·4540	·42
1·3095	1·3333	1·3571	1·3709	1·3947	1·4286	1·4524	1·4762	1·5000	1·5238	·43
1·3717	1·3966	1·4216	1·4465	1·4715	1·4964	1·5214	1·5464	1·5714	1·5964	·44
1·4339	1·4600	1·4861	1·5122	1·5382	1·5642	1·5902	1·6163	1·6424	1·6685	·45
1·4993	1·5265	1·5538	1·5810	1·6083	1·6356	1·6628	1·6901	1·7173	1·7446	·46
1·5642	1·5926	1·6211	1·6495	1·6780	1·7064	1·7348	1·7633	1·7917	1·8202	·47
1·6325	1·6622	1·6918	1·7215	1·7511	1·7808	1·8104	1·8401	1·8698	1·8995	·48
1·7011	1·7320	1·7629	1·7938	1·8248	1·8558	1·8868	1·9177	1·9486	1·9795	·49
1·7715	1·8037	1·8359	1·8681	1·9003	1·9326	1·9648	1·9970	2·0292	2·0614	·500
1·8425	1·8760	1·9095	1·9430	1·9765	2·0100	2·0435	2·0770	2·1105	2·1440	·51
1·9151	1·9499	1·9847	2·0195	2·0543	2·0892	2·1240	2·1588	2·1936	2·2284	·52
1·9894	2·0256	2·0618	2·0979	2·1341	2·1702	2·2064	2·2426	2·2788	2·3149	·53
2·0656	2·1031	2·1406	2·1781	2·2156	2·2530	2·2905	2·3281	2·3656	2·4031	·54
2·1422	2·1811	2·2201	2·2590	2·2980	2·3370	2·3759	2·4149	2·4538	2·4929	·55
2·2208	2·2612	2·3016	2·3420	2·3824	2·4228	2·4632	2·5036	2·5440	2·5844	·56
2·3012	2·3430	2·3849	2·4265	2·4686	2·5104	2·5522	2·5941	2·6359	2·6779	·57
2·3826	2·4259	2·4692	2·5125	2·5558	2·5992	2·6425	2·6858	2·7291	2·7724	·58
2·4656	2·5105	2·5553	2·6002	2·6450	2·6898	2·7346	2·7795	2·8243	2·8691	·59
2·5492	2·5956	2·6419	2·6883	2·7346	2·7810	2·8273	2·8737	2·9200	2·9664	·600
2·6356	2·6835	2·7314	2·7793	2·8273	2·8752	2·9231	2·9710	3·0190	3·0669	·61
2·7234	2·7728	2·8223	2·8717	2·9212	2·9706	3·0201	3·0696	3·1191	3·1686	·62
2·8115	2·8626	2·9137	2·9649	3·0160	3·0672	3·1183	3·1694	3·2206	3·2717	·63
2·9007	2·9535	3·0062	3·0590	3·1117	3·1644	3·2171	3·2699	3·3226	3·3754	·64
2·9925	3·0469	3·1013	3·1558	3·2102	3·2646	3·3190	3·3734	3·4278	3·4822	·65
3·0855	3·1416	3·1977	3·2538	3·3099	3·3660	3·4221	3·4782	3·5343	3·5904	·66
3·1795	3·2373	3·2951	3·3529	3·4107	3·4686	3·5264	3·5842	3·6420	3·6998	·67
3·2752	3·3348	3·3943	3·4539	3·5134	3·5730	3·6325	3·6921	3·7516	3·8112	·68
3·3720	3·4333	3·4946	3·5559	3·6172	3·6786	3·7399	3·8012	3·8625	3·9238	·69
3·4705	3·5336	3·5967	3·6598	3·7229	3·7860	3·8491	3·9122	3·9753	4·0384	·700
3·5706	3·6355	3·7004	3·7654	3·8303	3·8952	3·9601	4·0250	4·0899	4·1548	·71
3·6724	3·7391	3·8059	3·8727	3·9395	4·0062	4·0730	4·1398	4·2066	4·2733	·72
3·7746	3·8433	3·9119	3·9805	4·0492	4·1178	4·1864	4·2550	4·3236	4·3923	·73
3·8791	3·9496	4·0201	4·0906	4·1612	4·2318	4·3023	4·3728	4·4433	4·5139	·74
3·9842	4·0566	4·1291	4·2015	4·2740	4·3464	4·4188	4·4913	4·5637	4·6362	·75
					4·4634	4·5378	4·6122	4·6866	4·7610	·76
					4·5828	4·6592	4·7356	4·8120	4·8884	·77
					4·7004	4·7787	4·8570	4·9354	5·0137	·78
					4·8222	4·9026	4·9830	5·0633	5·1437	·79
					4·9458	5·0282	5·1106	5·1931	5·2755	·500
					5·0688	5·1533	5·2378	5·3223	5·4068	·81
					5·1960	5·2826	5·3692	5·4558	5·5424	·82
					5·3232	5·4119	5·5006	5·5893	5·6780	·83
					5·4528	5·5437	5·6346	5·7255	5·8164	·84
					5·5842	5·6773	5·7704	5·8635	5·9566	·85

Bore (in.)	STROKE (in.) ·65	·66	·67	·68	·69	·70	·71	·72	·73	·74
·35										
·36										
·37										
·38										
·39										
·400										
·41										
·42										
·43										
·44										
·45										
·46	1·7719	1·7991	1·8264	1·8536	1·8809	1·9082				
·47	1·8486	1·8771	1·9055	1·9340	1·9624	1·9908				
·48	1·9291	1·9588	1·9884	2·0180	2·0477	2·0776				
·49	2·0105	2·0414	2·0723	2·1033	2·1342	2·1651				
·500	2·0937	2·1259	2·1581	2·1903	2·2225	2·2547				
·51	2·1780	2·2110	2·2445	2·2780	2·3115	2·3450	2·3785	2·4120	2·4455	2·4790
·52	2·2633	2·2981	2·3329	2·3677	2·4025	2·4374	2·4722	2·5070	2·5418	2·5766
·53	2·3510	2·3872	2·4234	2·4596	2·4957	2·5319	2·5681	2·6043	2·6405	2·6766
·54	2·4407	2·4783	2·5158	2·5533	2·5909	2·6285	2·6660	2·7036	2·7411	2·7787
·55	2·5318	2·5708	2·6098	2·6489	2·6879	2·7265	2·7655	2·8044	2·8433	2·8823
·56	2·6247	2·6651	2·7055	2·7458	2·7862	2·8266	2·8670	2·9074	2·9478	2·9882
·57	2·7197	2·7615	2·8033	2·8452	2·8870	2·9288	2·9706	3·0124	3·0542	3·0961
·58	2·8158	2·8591	2·9024	2·9457	2·9890	3·0324	3·0757	3·1190	3·1623	3·2056
·59	2·9140	2·9588	3·0036	3·0485	3·0933	3·1381	3·1829	3·2277	3·2726	3·3174
·600	3·0128	3·0591	3·1055	3·1518	3·1982	3·2445	3·2908	3·3372	3·3835	3·4299
·61	3·1148	3·1627	3·2106	3·2586	3·3065	3·3544	3·4023	3·4502	3·4982	3·5461
·62	3·2181	3·2676	3·3171	3·3666	3·4161	3·4657	3·5152	3·5647	3·6142	3·6637
·63	3·3228	3·3739	3·4251	3·4762	3·5273	3·5784	3·6295	3·6806	3·7318	3·7829
·64	3·4281	3·4809	3·5336	3·5864	3·6391	3·6918	3·7445	3·7973	3·8500	3·9028
·65	3·5366	3·5910	3·6454	3·6998	3·7542	3·8087	3·8631	3·9175	3·9719	4·0263
·66	3·6465	3·7026	3·7587	3·8148	3·8709	3·9270	3·9831	4·0392	4·0953	4·1514
·67	3·7576	3·8154	3·8732	3·9310	3·9888	4·0467	4·1045	4·1623	4·2201	4·2779
·68	3·8708	3·9303	3·9899	4·0494	4·1090	4·1685	4·2280	4·2876	4·3471	4·4067
·69	3·9851	4·0464	4·1077	4·1690	4·2303	4·2917	4·3530	4·4143	4·4756	4·5369
·700	4·1015	4·1646	4·2277	4·2908	4·3539	4·4170	4·4801	4·5432	4·6063	4·6694
·71	4·2197	4·2846	4·3496	4·4145	4·4795	4·5444	4·6093	4·6742	4·7391	4·8040
·72	4·3401	4·4069	4·4737	4·5404	4·6072	4·6739	4·7407	4·8075	4·8743	4·9410
·73	4·4609	4·5295	4·5981	4·6668	4·7354	4·8041	4·8727	4·9413	5·0099	5·0786
·74	4·5844	4·6549	4·7255	4·7960	4·8665	4·9371	5·0076	5·0781	5·1487	5·2192
·75	4·7086	4·7811	4·8535	4·9260	4·9984	5·0708	5·1432	5·2157	5·2881	5·3606
·76	4·8354	4·9098	4·9842	5·0586	5·1330	5·2073	5·2817	5·3561	5·4305	5·5049
·77	4·9648	5·0412	5·1176	5·1940	5·2704	5·3466	5·4230	5·4994	5·5758	5·6522
·78	5·0920	5·1703	5·2486	5·3271	5·4054	5·4838	5·5621	5·6404	5·7188	5·7971
·79	5·2241	5·3045	5·3848	5·4652	5·5456	5·6259	5·7063	5·7867	5·8670	5·9474
·800	5·3579	5·4404	5·5228	5·6052	5·6877	5·7701	5·8525	5·9349	6·0174	6·0998
·81	5·4913	5·5758	5·6603	5·7448	5·8292	5·9136	5·9981	6·0826	6·1671	6·2516
·82	5·6290	5·7156	5·8022	5·8888	5·9754	6·0620	6·1486	6·2352	6·3218	6·4084
·83	5·7667	5·8554	5·9441	6·0329	6·1216	6·2104	6·2991	6·3875	6·4765	6·5652
·84	5·9073	5·9982	6·0891	6·1800	6·2708	6·3616	6·4525	6·5434	6·6343	6·7252
·85	6·0497	6·1427	6·2358	6·3289	6·4220	6·5149	6·6079	6·7010	6·7941	6·8871

STROKE (in.)										Bore
·75	·76	·77	·78	·79	**·80**	·81	·82	·83	·84	**(in.)**
										·35
										·36
										·37
										·38
										·39
										·400
										·41
										·42
										·43
										·44
										·45
										·46
										·47
										·48
										·49
										·500
2·5125	2·5460	2·5795								·51
2·6115	2·6463	2·6811								·52
2·7128	2·7490	2·7851								·53
2·8162	2·8537	2·8913								·54
2·9213	2·9602	2·9992								·55
3·0285	3·0689	3·1092	3·1496	3·1900						·56
3·1379	3·1797	3·2215	3·2634	3·3052						·57
3·2489	3·2922	3·3355	3·3788	3·4222						·58
3·3622	3·4070	3·4519	3·4967	3·5415						·59
3·4762	3·5226	3·5689	3·6153	3·6616	3·7080	3·7543	3·8007	3·8470	3·8934	**·600**
3·5940	3·6419	3·6899	3·7378	3·7857	3·8336	3·8815	3·9294	3·9774	4·0253	·61
3·7132	3·7627	3·8122	3·8617	3·9112	3·9608	4·0103	4·0598	4·1093	4·1588	·62
3·8340	3·8851	3·9363	3·9874	4·0385	4·0896	4·1407	4·1918	4·2429	4·2941	·63
3·9555	4·0083	4·0610	4·1138	4·1665	4·2192	4·2719	4·3247	4·3774	4·4302	·64
4·0807	4·1351	4·1895	4·2439	4·2983	4·3528	4·4072	4·4616	4·5160	4·5704	·65
4·2075	4·2636	4·3197	4·3758	4·4319	4·4880	4·5441	4·6002	4·6563	4·7124	·66
4·3357	4·3935	4·4513	4·5091	4·5669	4·6248	4·6826	4·7404	4·7982	4·8560	·67
4·4662	4·5258	4·5853	4·6449	4·7044	4·7640	4·8235	4·8831	4·9426	5·0022	·68
4·5982	4·6595	4·7208	4·7821	4·8434	4·9048	4·9661	5·0274	5·0887	5·1500	·69
4·7325	4·7956	4·8587	4·9218	4·9849	5·0480	5·1111	5·1742	5·2373	5·3004	**·700**
4·8690	4·9339	4·9988	5·0638	5·1287	5·1936	5·2585	5·3234	5·3883	5·4532	·71
5·0078	5·0746	5·1414	5·2081	5·2749	5·3416	5·4084	5·4752	5·5420	5·6088	·72
5·1472	5·2158	5·2845	5·3531	5·4217	5·4904	5·5590	5·6276	5·6962	5·7649	·73
5·2898	5·3603	5·4308	5·5014	5·5719	5·6424	5·7129	5·7834	5·8540	5·9245	·74
5·4330	5·5055	5·5729	5·6504	5·7228	5·7952	5·8676	5·9401	6·0125	6·0850	·75
5·5793	5·6537	5·7281	5·8025	5·8769	5·9512	6·0256	6·1000	6·1744	6·2488	·76
5·7286	5·8050	5·8814	5·9578	6·0342	6·1104	6·1868	6·2632	6·3396	6·4160	·77
5·8755	5·9538	6·0321	6·1105	6·1888	6·2672	6·3455	6·4238	6·5022	6·5805	·78
6·0277	6·1081	6·1884	6·2688	6·3492	6·4296	6·5099	6·5903	6·6707	6·7511	·79
6·1823	6·2647	6·3472	6·4296	6·5120	6·5944	6·6768	6·7692	6·8517	6·9341	**·800**
6·3361	6·4206	6·5051	6·5895	6·6740	6·7584	6·8429	6·9273	7·0118	7·0963	·81
6·4950	6·5816	6·6682	6·7548	6·8414	6·9280	7·0146	7·1012	7·1878	7·2744	·82
6·6540	6·7427	6·8314	6·9202	7·0089	7·0976	7·1863	7·2750	7·3637	7·4524	·83
6·8160	6·9068	6·9986	7·0895	7·1800	7·2704	7·3613	7·4521	7·5430	7·6338	·84
6·9802	7·0733	7·1663	7·2594	7·3525	7·4456	7·5387	9·6318	9·7248	9·8179	·85

MOTOR INSTALLATION GEN

The following tables summarised mounting data, *etc.*, for a representative range of engines divided into class sizes. All engines in a given table can be regarded as interchangeable (except the Bambi and Kemp diesels in the up to ·8 c.c. class) as far as individual model designs are concerned. Top performance, of course, will result from the most powerful engine in a particular class. Some designs will also take a wider range of engines—*e.g.*, a model designed for 2·5 c.c. power may also be flown successfully on 1·5 c.c. engines with a reduced performance and also on 3·5 c.c. engines with increased performance.

The upper table summarises mounting dimensions and relevant data. The mounting bolt hole diameter in the bearers ("d") is specified in terms of drill sizes to give both a *clearance* hole size for the bolt or a *tapping* hole size through which the mounting bolts must be screwed in position. The latter is favoured by some modellers as giving a more positive, firmer engine fixing.

Common mount sizes are given in each class. Leading dimensions in this respect are the distance between bearers (equivalent to giving the necessary crankcase clearance) and the lateral distance between fixing holes (*A*). The longitudinal spacing of the holes (*B*) can be adjusted, if necessary, to match individual engines but the other two dimensions are fixed by installation.

Before actually drilling the bearers the hole positions should be marked by laying the engine in position and actually marking off the holes through the holes in the lugs. This will then give accurate positioning regardless of small variations on individual engines or slight differences over nominal dimensions. A good technique is to mark and drill one hole first—*e.g.*, one of the front holes —and then mount the engine with this single bolt temporarily. Check engine alignment and then mark the other three hole positions. Remove the engine and drill the remaining three holes, spotting the centre of each hole first.

The bottom table gives rigging factors applicable to the fitting of engines other than the original design engine. There may be a considerable difference in weight between different engines in the same class and to mount, say, a heavy engine on a model originally designed and proven with a light engine will upset the balance and call for retrimming. Although the different centre of gravity position may be accommodated successfully by trimming, performance (and stability) may suffer.

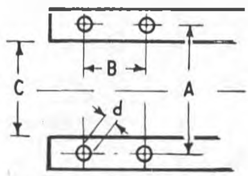
Table figures give the factor by which the *original* engine moment arm should be multiplied to arrive at the correct moment arm for the alternative engine. A nominal measurement can be taken for the moment arm, a suitable choice being the distance of the rear mounting bolt on the engine to the centre of gravity of the model.

An example should make the use of these factors clear. Suppose the original design utilised a Frog 500 engine and the model as built is to be fitted with a Taplin Twin. The moment arm factor in this case (read from the table for 5-7 c.c. engines) is ·52.

Suppose measurement off the plan gives a figure of 9 in. as the distance from the centre of gravity or point of balance of the model to the rear engine bolt. To preserve the same centre of gravity position the Taplin Twin should be positioned so that the corresponding distance is $\cdot 52 \times 9 = 4\cdot 68$ in. In other words, the nose should be shortened by a little over 4 in. to mount the Taplin Twin for the same balance point.

UP TO ·8 c.c.

BEAM MOUNTING



COMMON MOUNT

(1) A – 15/16" B – 5/16" C – 11/16"

ENGINE	DISPLACEM'T C.C.	DISPLACEM'T CU.IN.	MOUNTING DIMENSIONS A"	MOUNTING DIMENSIONS B"	MOUNTING DIMENSIONS C"	RADIAL FIX	COMMON MT	d CLEAR	d TAP
BAMBI	·15	·009			9/16				
KEMP	·20	·122	13/16	1/4	9/16			No43	No50
E.D. BABY	·47	·028	15/16		3/4		(1)	No34	No43
FROG 50	·49	·030	15/16	5/16	5/8	2	(1)	No43	No50
D-C DART	·55	·034	15/16	5/16	11/16		(1)	No34	No43
A-S 55	·57	·035	15/16	5/16	21/32	2	(1)	"	"
MILLS 75	·75	·047	1 1/8	3/8	7/8			"	"
D-C MERLIN	·76	·047	1 3/16	9/16	13/16	2		"	"
FROG 80	·80	·049	15/16	5/16	11/16	2	(1)	"	"
E.D. PEP	·80	·049	15/16	5/16	11/16		(1)	"	"
D-C BANTAM	·76	·047	15/16	5/16	11/16		(1)	"	"
A-M 049	·83	·050	7/8	11/32	11/16	3		"	"
FROG 049	·81	·049	15/16	5/16	11/16	2	(1)	"	"

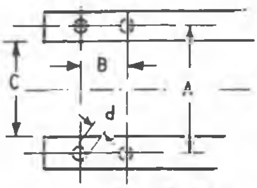
No dimensions for radial mounting are given since these are normally specific to individual engines and readily marked on the ply firewall. The common beam mount specified will accommodate all the engines noted and is the (unofficial) British standard for ·5 c.c. to ·8 c.c. engines to which designers generally conform.

Factors between ·90 and 1·10 can be taken as unity, but all lower and higher factors should be used for correct installation. Note particularly that in the case of engines with integral tanks the front bulkhead may have to be cut to pass the tank through it.

DESIGN ENGINE ↓ / ENGINE USED →	OZ.	BAMBI	E.D.BABY	FROG 50	DART	A-S 55	MILLS 75	MERLIN	S.MERLIN	FROG 80	E.D PEP	BANTAM	A-M 049	FROG 049
BAMBI	·75	—	—	—	—	—	—	—	—	—	—	—	—	—
E.D.BABY	1·4	—	—	1·12	1·12	·93	·70	·80	·72	·72	·80	1·08	·80	·78
FROG 50	1·25	—	·90	—	1·0	·83	·62	·71	·66	·66	·70	·96	·71	·70
D-C DART	1·25	—	·90	1·0	—	·83	·62	·71	·66	·66	·70	·96	·71	·70
A-S 55	1·5	—	1·07	1·2	1·2	—	·76	·86	·79	·79	·83	1·15	·86	·83
MILLS ·75	2·0	—	1·43	1·6	1·6	1·33	—	1·14	1·05	1·05	1·1	1·53	1·14	1·1
D-C MERLIN	1·75	—	1·25	1·4	1·4	1·17	·88	—	·92	·92	·98	1·35	1·0	·98
D-C SUPER MERLIN	1·9	—	1·35	1·52	1·52	1·27	·95	1·08	—	1·0	1·05	1·46	1·08	1·05
FROG 80	1·9	—	1·35	1·52	1·52	1·27	·95	1·08	1·0	—	1·05	1·46	1·08	1·05
E.D. PEP	1·8	—	1·29	1·44	1·44	1·2	·90	1·03	·95	·95	—	1·38	1·03	1·0
D-C BANTAM	1·3	—	·93	1·04	1·04	·87	·65	·74	·68	·68	·72	—	·74	·72
A-M 049	1·25	—	1·25	1·4	1·4	1·17	·88	1·0	·92	·92	·98	1·35	—	·98
FROG 049	1·8	—	1·29	1·44	1·44	1·2	·90	1·03	·95	·95	1·0	1·38	1·03	—

1-1·55 c.c.

BEAM MOUNTING:



COMMON MOUNTS

(2) A-1 1/8" C-7/8"

(3) A-1 3/16" C-7/8"

Two common mount sizes are specified for this class, between them accommodating the majority of engines as noted. The "B" dimension can be adjusted, as necessary, to suit individual engines and should always be marked out using the engine as a template rather than working to specific dimensions.

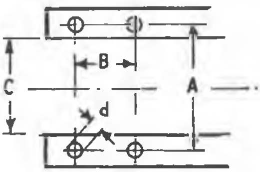
Weight factors are largely non-critical in this size range, with the exception of the M-E Heron, Tiger Cub and E.D. Super Fury.

ENGINE	DISPL'MNT.		MOUNTING DIMENSIONS			RADIAL FIX	COMMON MT.	d	
	C.C.	CU.IN.	A"	B"	C"			CLEAR	TAP
D-C SPITFIRE	·975	·059	1 3/16	9/16	13/16	2	(3)	No 34	No 43
E.D BEE	·98	·06	1 3/16	7/16	15/16		(3)	"	"
M·E HERON	1·0	·061	1 1/8	3/8	7/8	3	(2)	No 43	No 50
A-M 10	1·0	·061	1 1/8	1/2	7/8		(2)	No 34	No 43
FROG 100	1·0	·061	1 3/16	7/16	7/8	2	(3)	"	"
MILLS 1·3	1·33	·081	1 3/8	7/16	1			"	"
E.D HORNET	1·45	·085	1 3/16	7/16	7/8		(3)	"	"
TIGER CUB	1·47	·089	1 3/8	1/2	1 1/8			"	"
PAW SPECIAL	1·47	·089	1 5/32	5/8	7/8			"	"
A-M 15	1·48	·090	1 3/32	1/2	7/8		(2)	"	"
FROG 149	1·49	·091	1 3/16	7/16	7/8	2	(2)	"	"
FROG 150	1·49	·091	1 3/16	7/16	7/8	2	(3)	"	"
SUPER FURY	1·49	·091	1 1/4	15/32	15/16			"	"
D-C SABRE	1·49	·091	1 3/16	9/16	13/16	2	(3)	"	"
ALAG X-4	1·52	·094	1 3/32	13/32	7/8		(2)	"	"

ENGINE USED → / DESIGN ENGINE ↓	OZ.	SPITFIRE	BEE	HERON	A-M 10	FROG 100	MILLS 1·3	HORNET	TIGER CUB	PAW SPEC'L.	A-M 15	FROG 149	FROG 150	SUPER FURY	SABRE	ALAG X-4
D-C SPITFIRE	3·0	—	1·08	1·88	1·0	·92	·92	·92	·80	·86	1·02	·92	·92	·80	·92	1·0
E-D BEE	2·75	·92	—	1·72	·92	·85	·85	·85	·73	·78	·92	·85	·85	·73	·85	·92
M-E HERON	1·6	·53	·58	—	·53	·49	·49	·49	·43	·46	·53	·49	·49	·43	·49	·53
A-M 10	3·0	1·0	1·08	1·88	—	·92	·92	·92	·80	·86	1·0	·92	·92	·80	·92	1·0
FROG 100	3·25	1·08	1·18	2·0	1·08	—	1·0	1·0	·87	·93	1·08	1·0	1·0	·87	1·0	1·08
MILLS 1·3	3·25	1·08	1·18	2·0	1·08	1·0	—	1·0	·87	·93	1·08	1·0	1·0	·87	1·0	1·08
E.D HORNET	3·25	1·08	1·18	2·0	1·08	1·0	1·0	—	·87	·93	1·08	1·0	1·0	·87	1·0	1·08
OLIVER TIGER CUB	3·75	1·25	1·36	2·34	1·25	1·15	1·15	1·15	—	1·07	1·25	1·15	1·15	1·0	1·15	1·25
P.A.W. SPECIAL	3·5	1·17	1·27	2·18	1·17	1·08	1·08	1·08	·93	—	1·17	1·08	1·08	·93	1·08	1·17
A-M 15	3·0	1·0	1·08	1·88	1·0	·92	·92	·92	·80	·86	—	·92	·92	·80	·92	1·0
FROG 149	3·25	1·08	1·18	2·0	1·08	1·0	1·0	1·0	·87	·93	1·08	—	1·0	·87	1·0	1·08
FROG 150	3·25	1·08	1·18	2·0	1·08	1·0	1·0	1·0	·87	·93	1·08	1·0	—	·87	1·0	1·08
E.D SUPER FURY	3·75	1·25	1·36	2·34	1·25	1·15	1·15	1·15	1·0	1·07	1·25	1·15	1·15	—	1·15	1·25
D-C SABRE	3·25	1·08	1·18	2·0	1·08	1·0	1·0	1·0	·87	·93	1·08	1·0	1·0	·87	—	1·08
ALLBON JAVELIN	3·0	1·0	1·08	1·88	1·0	·92	·92	·92	·80	·86	1·0	·92	·92	·80	·92	1·0
ALAG X-4	3·0	1·0	1·08	1·88	1·0	·92	·92	·92	·80	·86	1·0	·92	·92	·80	·92	—

2-2·5 c.c.

BEAM MOUNTING



COMMON MOUNTS

④ A-1¼" C-1"

⑤ A-1 5/16" C-1"

⑥ A-1⅜" C-1 1/16"

Three common mount sizes are specified for this class. The "B" dimension can be adjusted, as necessary, to suit individual engines and should always be marked out using the engine as a template rather than working to specific dimensions. 6 B.A. mounting bolts are standard throughout this class.

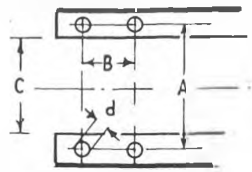
Weight factors show considerable variation but factors between ·90 and 1·10 can be taken as unity.

ENGINE	DISPL'MNT. C.C.	DISPL'MNT. CU.IN.	MOUNTING DIMENSIONS A"	MOUNTING DIMENSIONS B"	MOUNTING DIMENSIONS C"	RADIAL FIX	COMMON MT.	d CLEAR	d TAP
E.D. COMP.	2·0	·122	1 9/16	9/16	1			No.34	No.43
A-M 25	2·4	·147	1 5/16	9/16	1		⑤	"	"
FOX 15	2·42	·148	1¼	½	⅞		④	"	"
COX OLYMPIC	2·42	·148	1¼	½	1		④	"	"
K&B TORP. 15	2·43	·149	1¼	⅜	15/16		④	"	"
E.D RACER	2·46	·15	1⅜	9/16	1 1/16		⑥	"	"
P.A.W. SPECIAL	2·46	·15	1 5/16	29/32	1		⑤	"	"
D-C RAPIER	2·47	·15	1⅜	½	1 1/16		⑥	"	"
ELFIN 2·49	2·48	·15				4		"	"
TAIFUN BLIZ.	2·48	·15	1 11/32	⅝	1		⑤	"	"
SILVER STR'K	2·49	·15	1 5/16	9/16	1		⑤	"	"
FROG 249	2·49	·15	1⅜	9/16	1 1/16		⑥	"	"
ENYA 15D	2·49	·15	1 7/16	9/16	1⅛			"	"
OLIV. TIGER	2·49	·15			1¼			"	"
ELFIN 249BB	2·49	·15	1 5/16	17/32	1 1/16		⑤	"	"

DESIGN ENGINE ↓ / ENGINE USED →	OZ.	E.D COMP	A-M25	FOX 15	OLYMPIC	K&B 15	E.D RACER	P.A.W. SPEC'L	RAPIER	ELFIN 249	BLIZZARD	S-STREAK	FROG 249	ENYA 15D	TIGER	ELFIN 249BB
E.D COMP. SPECIAL	5·75	–	1·44	1·44	1·44	1·53	1·07	1·17	1·15	1·92	·88	1·03	1·0	1·13	·93	1·1
A-M 25	4·0	·70	–	1·0	1·0	1·07	·74	·82	·80	1·33	·62	·71	·70	·78	·65	·76
FOX 15	4·0	·70	1·0	–	1·0	1·07	·74	·82	·80	1·33	·62	·71	·70	·78	·65	·76
COX OLYMPIC	4·0	·70	1·0	1·0	–	1·07	·74	·82	·80	1·33	·62	·71	·70	·78	·65	·76
K&B TORPEDO 15	3·75	·65	·94	·94	·94	–	·70	·77	·75	1·25	·58	·67	·66	·74	·60	·71
E.D RACER	5·4	·94	1·35	1·35	1·35	1·44	–	1·1	1·08	1·8	·83	·96	·95	1·06	·87	1·03
P.A.W. SPECIAL	4·9	·85	1·22	1·22	1·22	1·3	·91	–	·98	1·63	·75	·87	·86	·96	·79	·93
D-C RAPIER	5·0	·87	1·25	1·25	1·25	1·33	·93	1·02	–	1·05	·77	·89	·88	·98	·81	·95
ELFIN 2·49R	3·0	·52	·75	·75	·75	·80	·56	·61	·60	–	·46	·54	·53	·59	·48	·57
TAIFUN BLIZZARD	6·5	1·13	1·62	1·62	1·62	1·73	1·20	1·32	1·30	2·16	–	1·16	1·14	1·27	1·05	1·24
SILVER STREAK	5·6	·98	1·4	1·4	1·4	1·5	1·04	1·14	1·12	1·87	·86	–	·98	1·1	·90	1·07
FROG 249 BB	5·7	1·0	1·43	1·43	1·43	1·52	1·05	1·16	1·14	1·89	·88	1·0	–	1·12	·92	1·09
ENYA 15D	5·1	·85	1·27	1·27	1·27	1·35	·95	1·04	1·0	·67	·80	·91	·90	–	·83	·97
OLIVER TIGER	6·2	1·08	1·55	1·55	1·55	1·65	1·15	1·26	1·24	2·06	·95	1·1	1·09	1·22	–	1·18
ELFIN 249BB	5·25	·91	1·31	1·31	1·31	1·4	·97	1·07	1·05	1·75	·81	·94	·92	1·03	·85	–

3-3·5 c.c.

BEAM MOUNTING



COMMON MOUNT

(7) A - 1 3/8" C - 1 1/8"

(8) A - 1 7/16" C - 1 1/8"

ENGINE	DISPL'MNT. C.C.	DISPL'MNT. CU.IN.	MOUNTING DIMENSIONS A"	MOUNTING DIMENSIONS B"	MOUNTING DIMENSIONS C"	RADIAL	COMMON MT	d CLEAR	d TAP
ETA 19	3·25	·19	1 13/16	1/2	1 1/16			No.34	No.43
VECO 19	3·27	·19	1 7/16	5/8	1 1/8		(8)	"	"
A-M 35	3·42	·21	1 5/16	9/16	1		(5)	"	"
FROG 349	3·43	·21	1 3/8	1 1/16	1 1/8		(7)	"	"
FROG 349BB	3·43	·21	1 3/8	11/16	1 1/8		(7)	"	"
AMCO 3·5	3·43	·21	1 3/8	3/4	1 1/8	R	(7)	"	"
D-C MANXMAN	3·44	·21	1 7/16	5/8	1 1/8		(8)	"	"
E.D HUNTER	3·46	·21	1 5/8	9/16	1 5/16			"	"
SILVER ARROW	3·48	·22	1 9/16	9/16	1 1/8			"	"

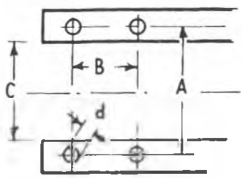
Two common mount sizes are specified, but note also that 2·5 a.c. 3·5 c.c. engines may be largely interchangeable on model designs. 6 B.A. mounting bolts are standard.

This class of engine comprises both diesel and glow motors with a considerable difference in weight. Performance of the sports type 3·5 c c. motors may be very little different from that of the more powerful 2·5 c.c. motors. Appropriate weight factors for the use of a 3·5 c.c. engine on an original 2·5 c.c. design, or vice versa, can be estimated by taking a similar motor weight in the appropriate table, or calculated as the ratio of the two weights (remembering that the heavier the engine to be used the smaller will be the weight factor).

DESIGN ENGINE ↓ / ENGINE USED →	OZ.	*ETA 19*	*VECO 19*	*A-M 35*	*FROG 349PB*	*FROG 349BB*	*AMCO 3·5*	*MANXMAN*	*HUNTER*	*SILVER ARROW*
ETA 19	4·5	–	·82	1·06	·69	·67	·82	·69	·69	·63
VECO 19	5·5	1·22	–	1·3	·85	·82	1·0	·85	·85	·76
A-M 35	4·25	·94	·77	–	·65	·63	·77	·65	·65	·59
FROG 349 PB	6·5	1·45	1·18	1·53	–	·97	1·18	1·53	1·53	·90
FROG 349 BB	6·7	1·49	1·22	1·58	1·03	–	1·22	1·03	1·03	·93
AMCO 3·5	5·5	1·22	1·0	1·3	·85	·82	–	·85	·85	·76
D-C MANXMAN	6·5	1·45	1·18	1·53	1·0	·97	1·18	–	1·0	·90
E D HUNTER	6·5	1·45	1·18	1·53	1·0	·97	1·18	1·0	–	·90
RIVERS SILVER ARROW	7·2	1·60	1·31	1·70	1·11	1·07	1·31	1·11	1·11	–

5-7 c.c.

BEAM MOUNTING



COMMON MOUNTS

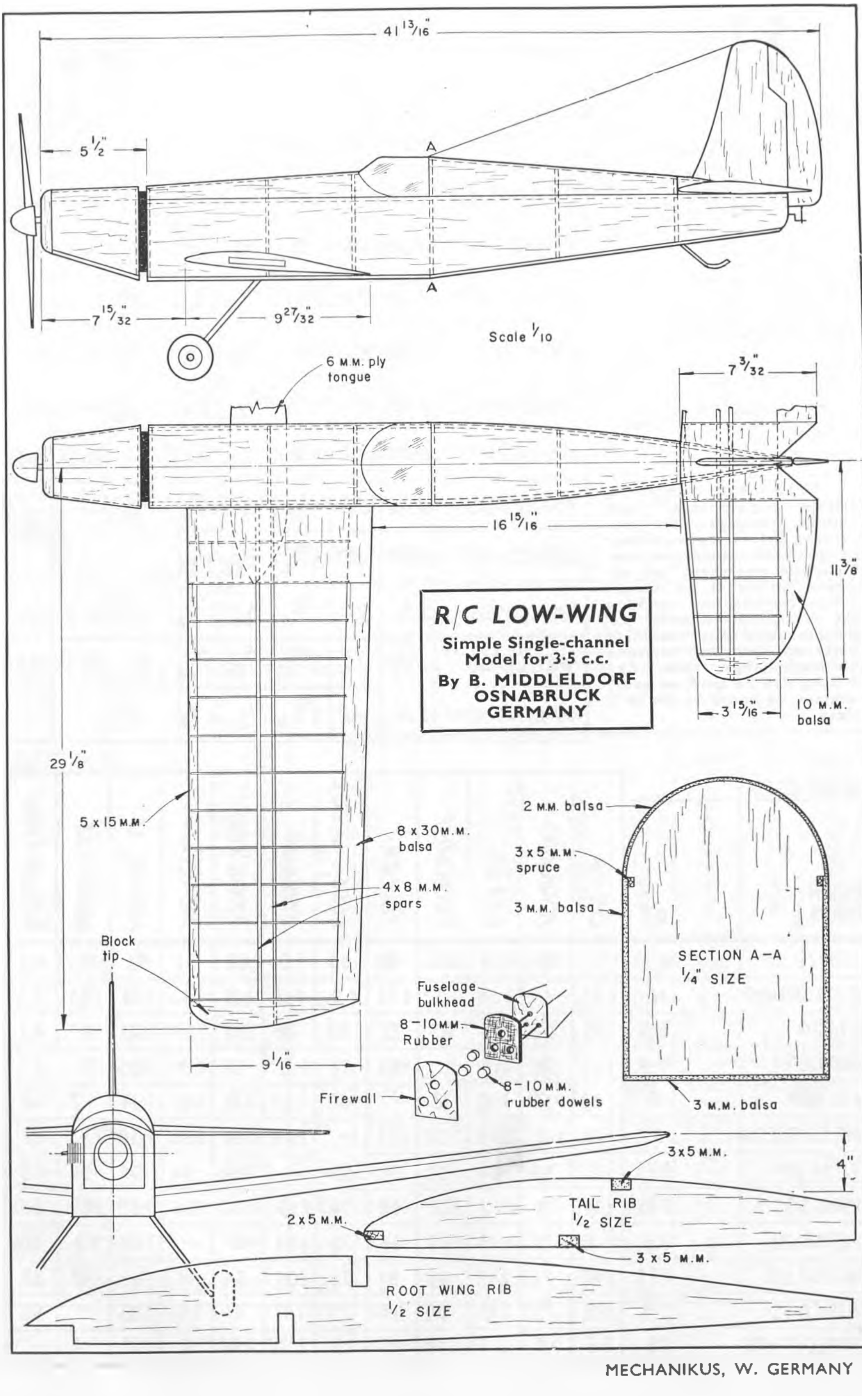
(9) A - 1 9/16" C - 1 5/16"

(10) A - 1 5/8" C - 1 3/8"

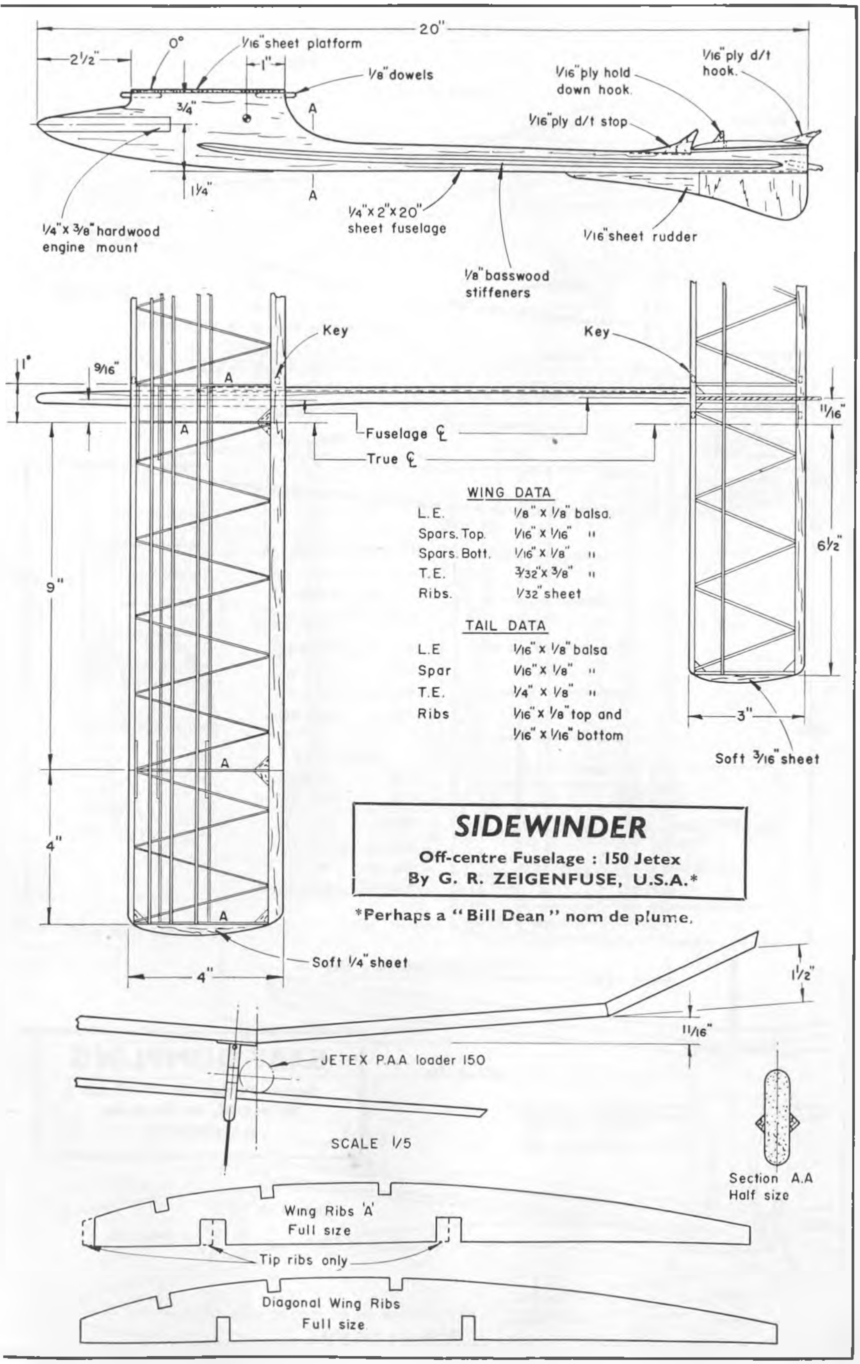
This class comprises, mainly single-cylinder glow motors. However, the two current British twin-cylinder designs with comparable performance represent an extreme difference in weight which considerably modifies the design installation requirements. 6 B.A. mounting bolts are standard practice although larger sizes (e.g., 5 B.A.) can be used on some engines, as noted by the drill sizes.

ENGINE	DISPL'M'NT.		MOUNTING DIMENSIONS			RADIAL	COMMON MT.	d	
	C.C	CU.IN.	A"	B"	C"			CLEAR	TAP
O-S 29	4·86	·29	1 5/8	13/16	1 1/4		(10)	No30	No32
D-C TORNADO	4·86	·29				1 5/32 SQ		No34	No43
ETA 29	4·88	·29	1 5/8	9/16	1 1/4		(10)	No34	No43
GLO CHIEF	4·92	·29	1 9/16	11/16	1 5/16		(9)	No30	No37
FOX 29	4·92	·29	1 5/8	9/16	1 3/8		(10)	No34	No43
MILES SPL	4·92	·29	1 5/8	5/8	1 1/4		(10)	No30	No32
ENYA 29	4·94	·29	1 11/16	9/16	1 1/4			No34	No43
FROG 500	4·95	·30	1 5/8	5/8	1 7/32		(10)	"	"
MERCO 29	4·95	·30	1 19/32	25/32	1 5/16			"	"
MCCOY 35	5·75	·35	1 9/16	9/16	1 5/16		(9)	No30	No32
MERCO 35	5·8	·35	1 19/32	25/32	1 5/16			No34	No43
TAPLIN TWIN	6·92	·42	1 9/16	1/2	1 5/16		(9)	"	"

DESIGN ENGINE ↓ / ENGINE USED →	OZ.	OS 29	TORNADO	ETA 29	GLO CHIEF	FOX 29	MILES SPEC'L	ENYA 29	FROG 500	MERCO 29	MCCOY 35	MERCO 35	TAPLIN TWIN
O-S 29	6·8	–	·68	1·04	·90	·76	·68	1·0	·88	·91	·94	·91	·45
D-C TORNADO	10	1·47	–	1·54	1·32	1·11	1·0	1·48	1·29	1·33	1·38	1·33	·67
ETA 29	6·5	·95	·65	–	85	·72	·65	·96	·84	·87	·90	·87	·43
GLO CHIEF	7·6	1·12	·76	1·17	–	·85	·76	1·13	·98	1·0	1·05	1·0	·51
FOX 29R	9	1·32	·90	1·38	1·18	–	·90	1·33	1·16	1·2	1·24	1·2	·60
MILES SPECIAL	10	1·47	1·0	1·54	1·37	1·11	–	1·48	1·29	1·33	1·38	1·33	·67
ENYA 29	6·75	1·0	·68	1·04	·90	·76	·68	–	·88	·91	·94	·91	·45
FROG 500	7·75	1·14	·78	1·19	1·02	·86	·78	1·15	–	1·03	1·07	1·03	·52
MERCO 29	7·5	1·10	·75	1·15	·99	·84	·75	1·11	·97	–	1·03	1·0	·50
MCCOY 35	7·25	1·07	·73	1·12	·95	·81	·73	1·07	·94	·97	–	·97	·48
MERCO 35	7·5	1·10	·75	1·15	·99	·84	·75	1·11	·97	1·0	1·03	–	·50
TAPLIN TWIN	15	2·2	1·5	2·3	1·98	1·66	1·5	2·22	1·94	2·0	2·07	2·0	–



MECHANIKUS, W. GERMANY



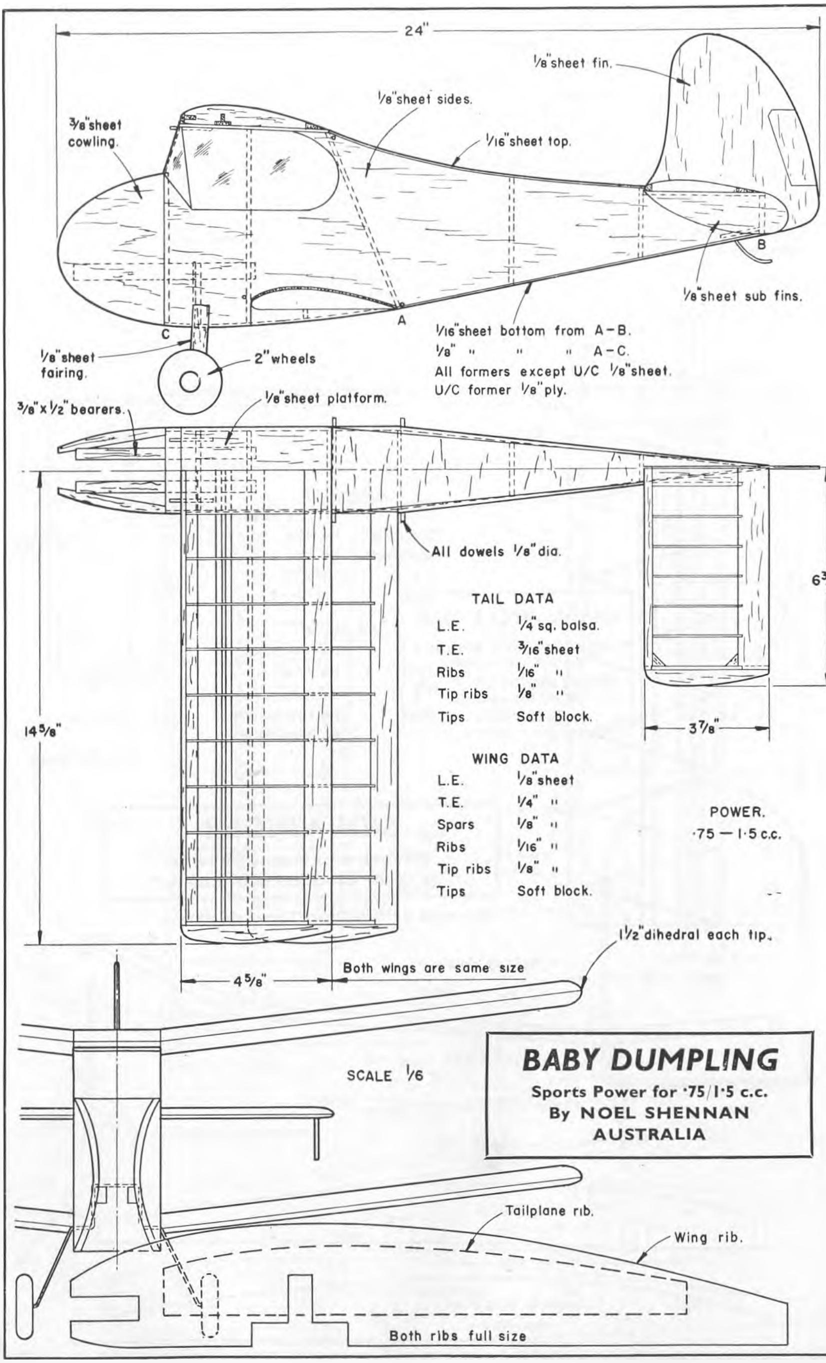
SIDEWINDER

Off-centre Fuselage : 150 Jetex

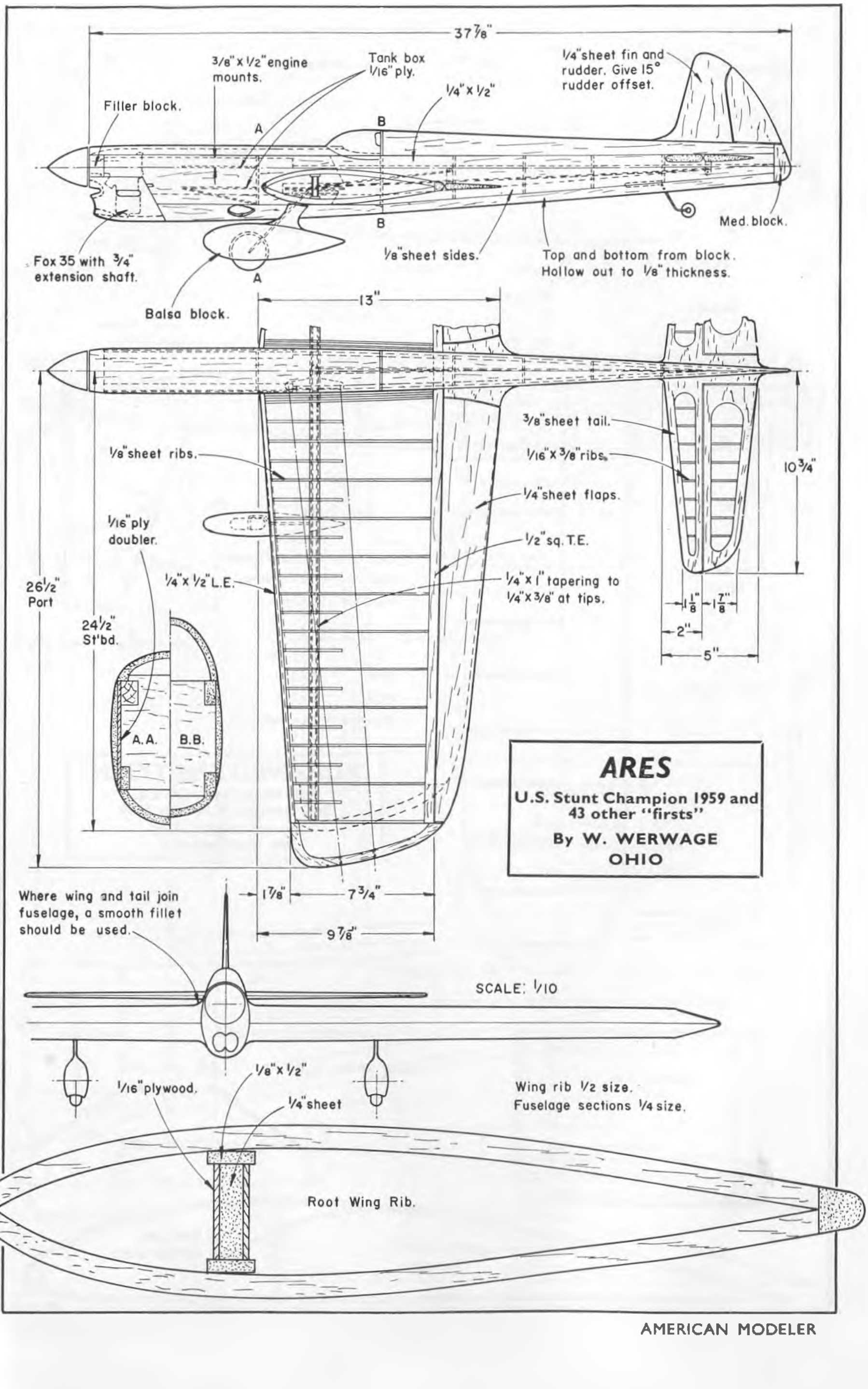
By G. R. ZEIGENFUSE, U.S.A.*

*Perhaps a "Bill Dean" nom de plume.

FLYING MODELS



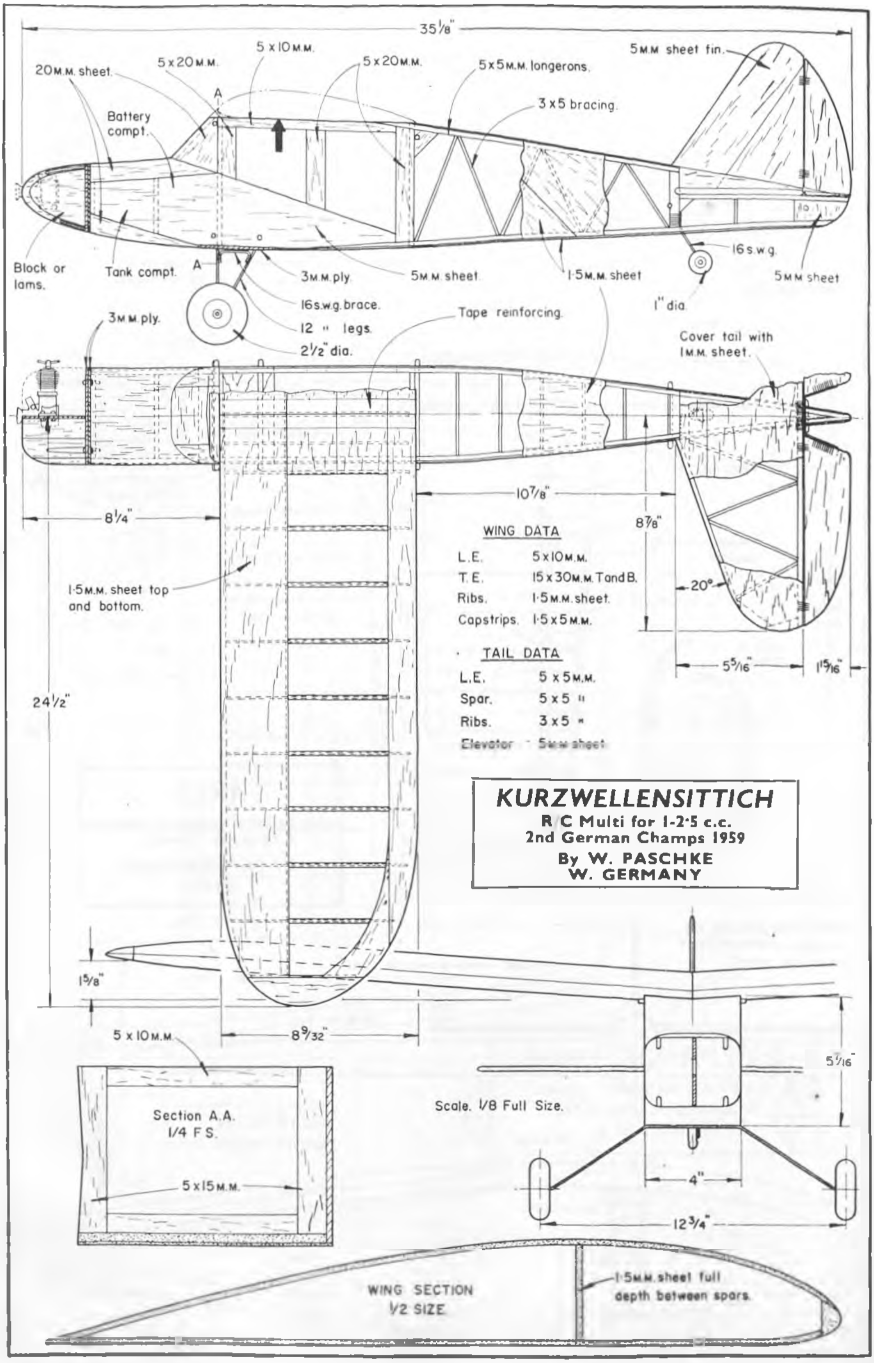
AUSTRALIAN MODEL NEWS



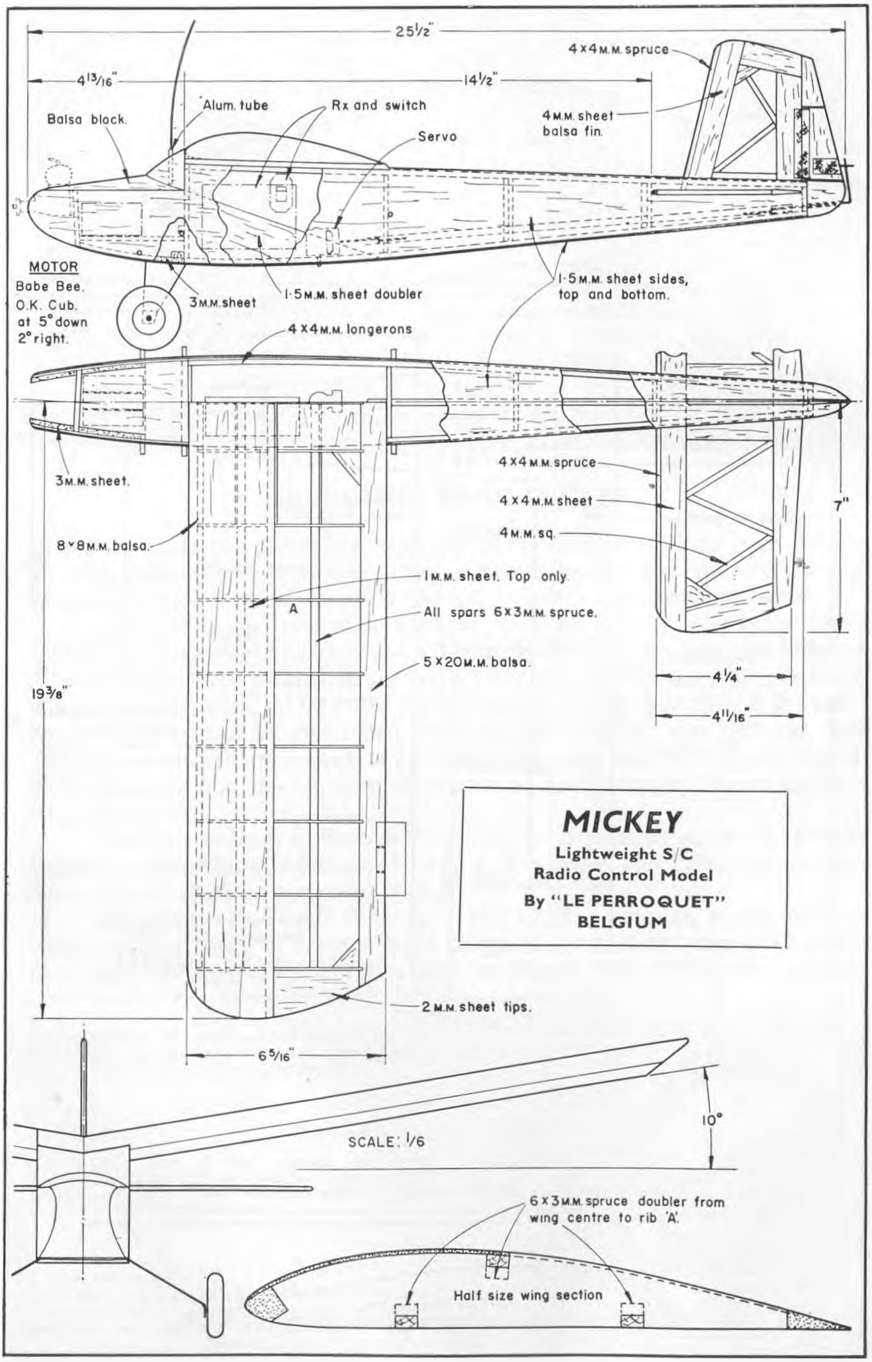
ARES

U.S. Stunt Champion 1959 and 43 other "firsts"

By W. WERWAGE OHIO



MODELL, GERMANY

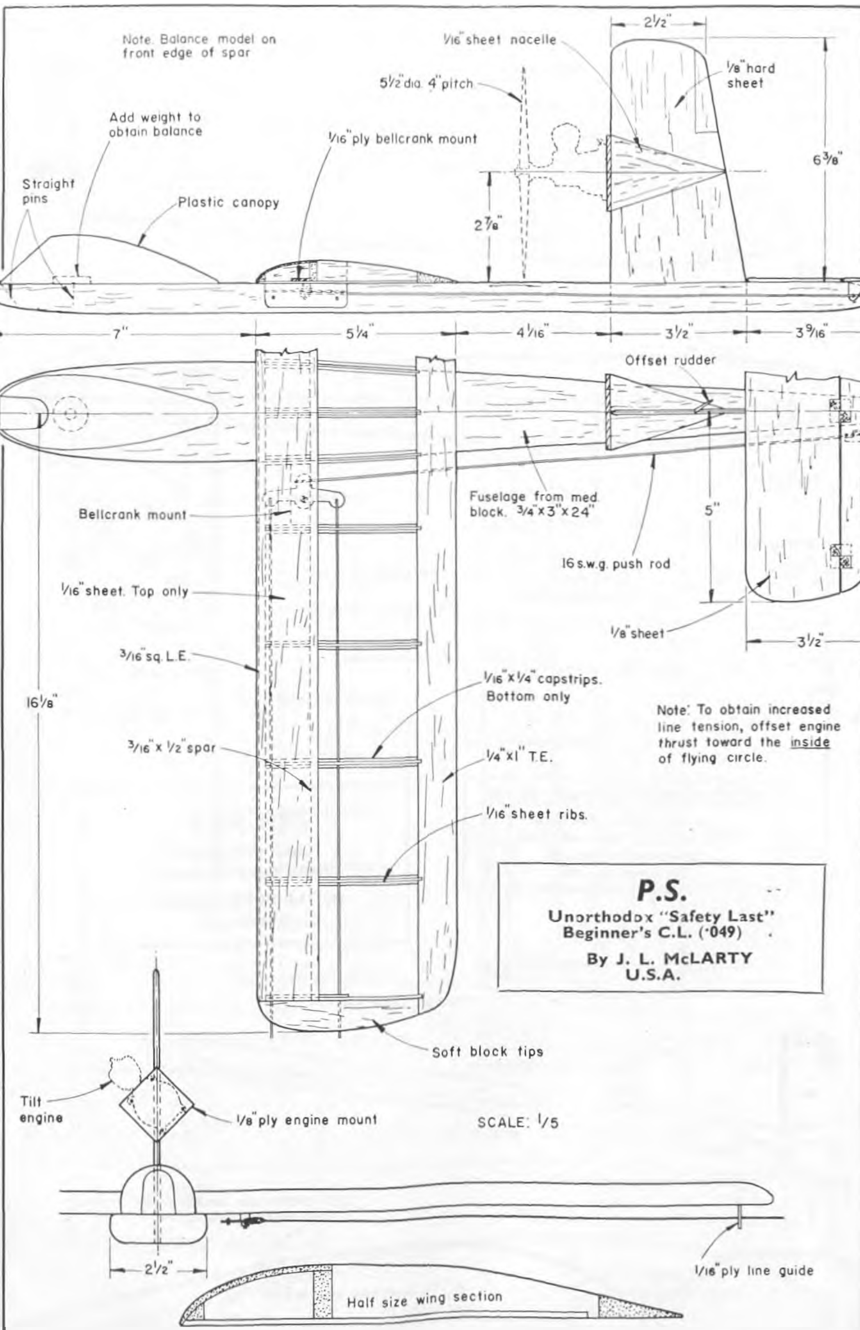


MICKEY

Lightweight S/C Radio Control Model

By "LE PERROQUET" BELGIUM

MODEL AVIA



AMERICAN MODELER

ELECTRIC FREE FLIGHT

THE use of electric power for small free flying models has long been the ideal but unattainable dream of many a model maker and countless are the approaches which have been made though so few the recorded successes.

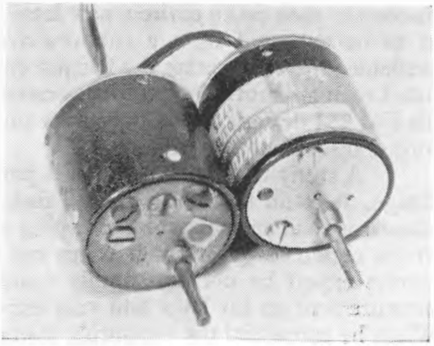
Colonel Taplin proved it possible when he flew an all-electric "Radio Queen" on demonstration flights in England in 1957. His system was to employ a 24-volt Emerson type D20 motor and a 28 oz. pack of Venner silver/zinc light-weight accumulators. All-up, the model weight was no less than 8 lb. yet the model was flown under full control with propeller r.p.m. approximately 8,000 and the motor drawing 8 amp. at 30 volts. The great snag of such a commendable enterprise was the expense of operation. For example, the accumulators alone cost £30.

On the continent of Europe Fred Militky, chief designer of the Graupner concern at Kirchheim/Teck near Stuttgart, Germany, had been experimenting with small models for a number of years.

But it was not until February 1959 when a German model magazine editor became aware of a remarkable midget electric motor that Fred Militky first began to realise his ambition and on March 18th, 1959, after countless

Top left: Fred Militky launches his FM 251 for our camera and promptly loses the model on a 22-minute out-of-sight flight !

Top right: John Taylor releases our test Rubberdub with original Micromax motor for a flat climb. New motor offers great improvement.



At right: Original and latest Micromax motors compared with external difference in screw position and number plus Graupner ident label.

Fred Militky prepares FM 248, and all-red model with lightweight built-up fuselage, small tail and high cambered wings.

tests, his FM 241 (Fred's 241st design) went away out of sight after a five-minute climb—all on electric power.

The man responsible for the design of this remarkable power unit, now sold on the model market as the Micromax, is Dr. Ing. Fritz Faulhaber, and the initial purpose in industry for the motor was as a servo for use in remotely controlled camera shutters, etc. The motor has been in large-scale production and is widely used for a variety of purposes in research and development projects for the aviation industry. Initially, the motor was produced with a final 1 : 59 reduction gearing made integral with the motor to the standards of first-class watch-making precision. Another variant was produced with a ratio of 1 : 3·9 and then, the 1 : 15 version appeared and it is this particular type, known as the T 03/15, which is directly applicable to use in model aircraft. The author was given a most convincing demonstration of the possibilities inherent in the application of the Micromax to aeromodelling when Fred Militky made a twenty-minute out-of-sight flight in September 1959. The rate of climb of this particular model, FM 251, was not far short of that obtained on a sport rubber model and yet this was only in the experimental stage.

As readers of "AEROMODELLER" will know, through the issues of December 1959 and March 1960, we have been able to conduct a similar series of experiments using a 1 : 15 Micromax from the very first batch produced for modelling and after initial problems had been overcome with power supply and model design, a reasonable standard of steady flight was obtained.

Subsequently, the Micromax has been altered in small detail, the result of which has been an increase in power output not unnaturally with an increase in current consumption but still well within the limits of the power supply chosen for our models. As an example of the increase in performance, free running revolutions have leaped from 21,000 to 30,000. When fitted with the production type Micromax, our experimental model based upon the A.P.S. *Rubberdub* took on an entirely new lease of life and adopted a rate of climb such as to be expected from a rubber-driven version, except that the increased available power overcame the friction connection used and "clutch slip" terminated each attempt. The positive connection devised by Fred Militky for use in his FM 254 design, *Silentius*, is most successful in transmitting all of the motor torque through to the airscrew.

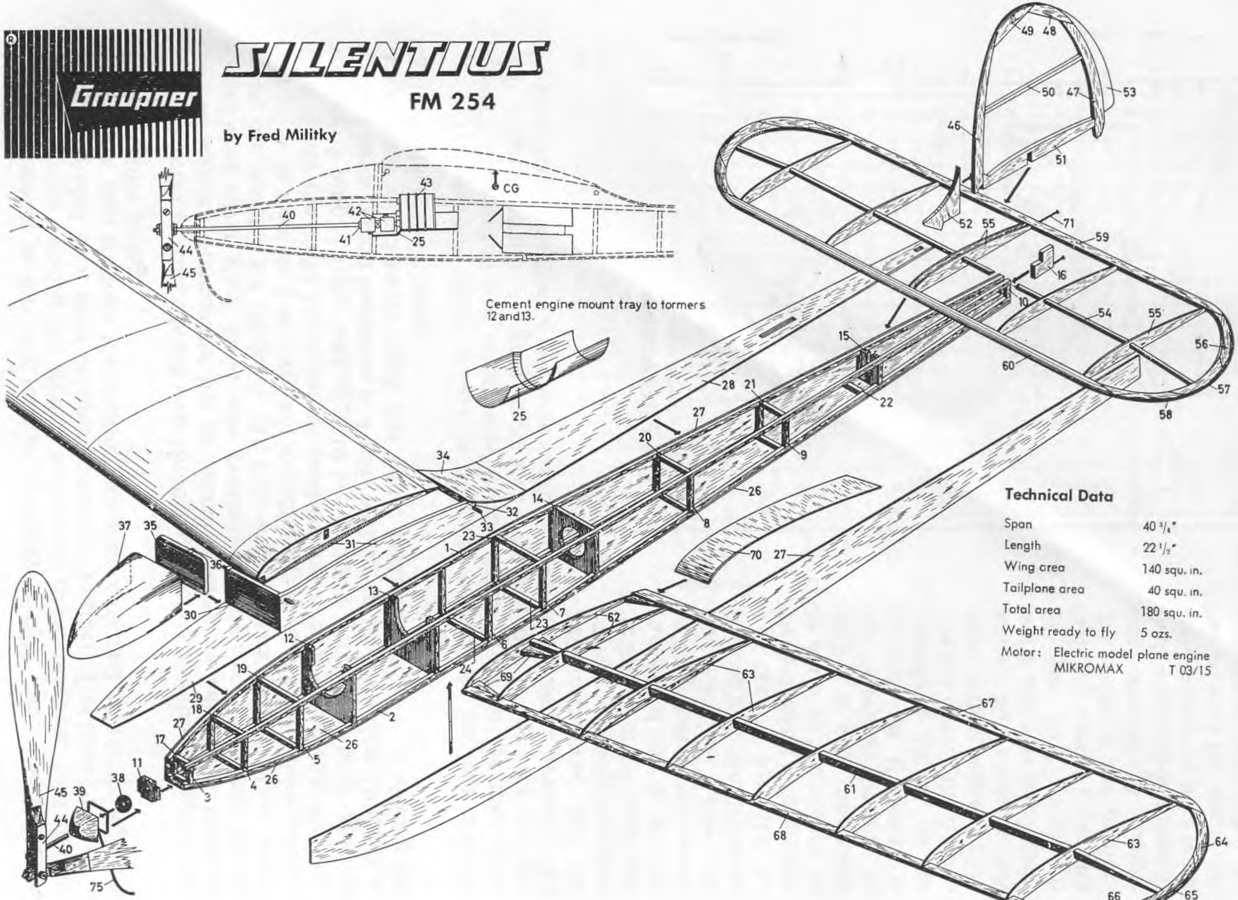
A study of the motor itself is particularly revealing for its precision and design. It could truthfully be said that it is more complex and demanding in standards than any miniature glowplug or diesel model engine—hence the price in the region of £3 sterling. When our first Micromax was shown to an electronics expert he not unnaturally wanted to test its abilities and began with measurement on his large and very expensive meter of the internal resistance. When he connected the measuring contacts, the Micromax started revolving on

Graupner

SILENTIUS

FM 254

by Fred Militky



Technical Data

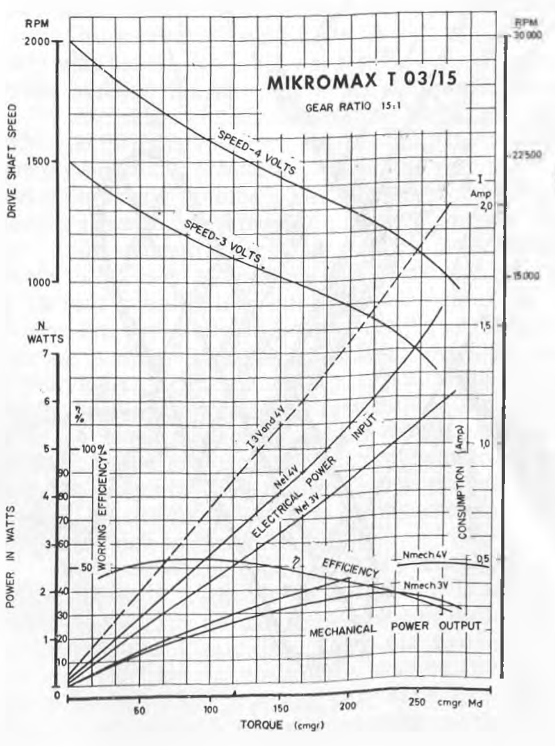
Span	40 3/4"
Length	22 1/2"
Wing area	140 squ. in.
Tailplane area	40 squ. in.
Total area	180 squ. in.
Weight ready to fly	5 ozs.
Motor:	Electric model plane engine MIKROMAX T 03/15

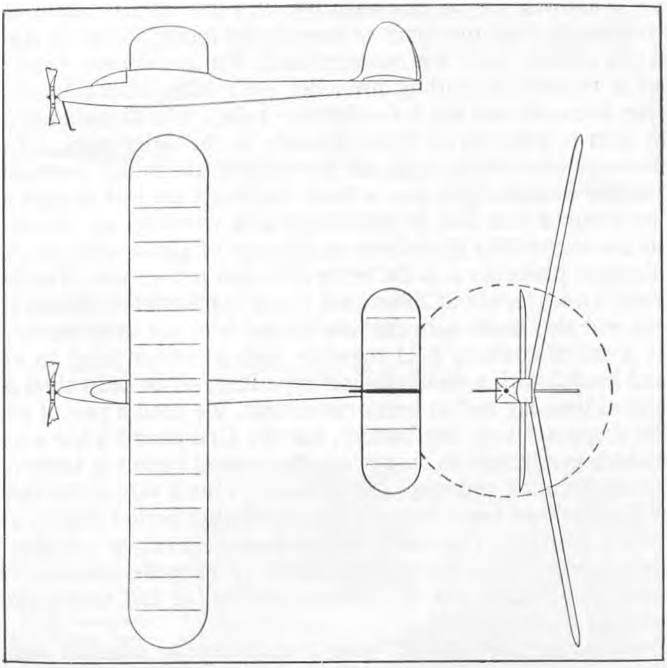
the power supplied by the meter! Only one other motor in our knowledge enjoys this capability through low internal resistance and that is the similar "Distler".

Micromax motors will start on a supply of 0·05 volts. The induction part of its wave winding lies around the outside of the magnetic field and the field is provided by a fixed ceramic permanent magnet. The lines of force in this magnet pass through the rotating armature coils and return through the iron base outer casing.

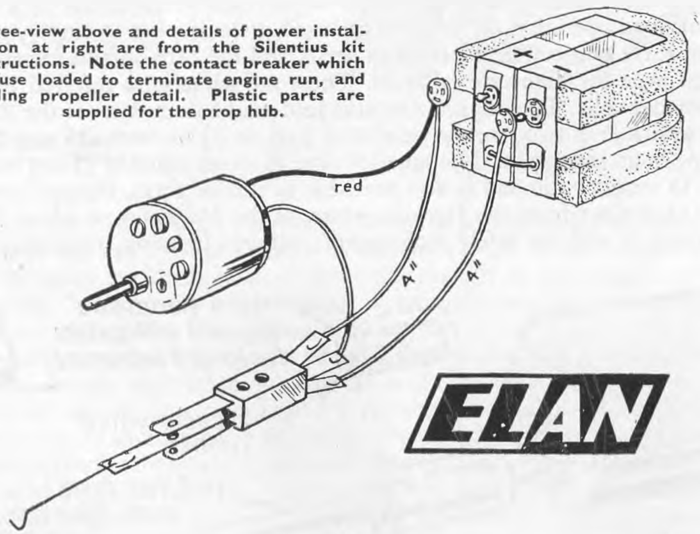
In order to reduce brush wear through continued operation at high r.p.m. the five segment commutator has an overall diameter of only $\frac{3}{64}$ in. made of 95 per cent silver alloy. Gold wire brushes, incidentally replaceable by the works, are doubled for efficiency. All this, with gearbox, weighs ·9 oz. and is only $\frac{51}{64}$ in. in diamter, $\frac{7}{8}$ in. long, not including the shaft, which projects another $\frac{13}{32}$ in. While the initial Micromax we used was operated at about 14,000 r.p.m., drawing ·5 amp. on the load of a 10 in. diameter propeller, the production T 03/15 has a voltage limitation of 4 volts with up to 1·5 amps load, although in practice one would rarely reach this figure except in the case of stalling the shaft, of which, more anon.

The gearbox which is said to have no requirement for lubrication is perfectly constructed and remarkably friction free. A flat on the final drive shaft permits the use of a grub screw lock for connection to the propeller and this is, indeed, essential, if one is to make full use of the torque available. We have mentioned that the current consumption has a limitation of 1·5 amps and this would only be reached in the event of the motor being stalled. Those not familiar with electric motor operation should be warned that it is dangerous to allow the motor to be stalled at any time since the windings would be burned out if power is connected. Hence, on our original model, the friction drive system without grub screw, but unfortunately while this was satisfactory for the first motor, it certainly cannot cope with the power of the production version. A simple shaft connection immediately behind the nose block can be used for quick disconnection should the model hit the ground when power is on and thus

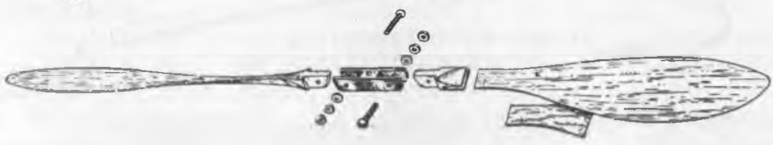




Three-view above and details of power installation at right are from the Silentius kit instructions. Note the contact breaker which is fuse loaded to terminate engine run, and folding propeller detail. Plastic parts are supplied for the prop hub.

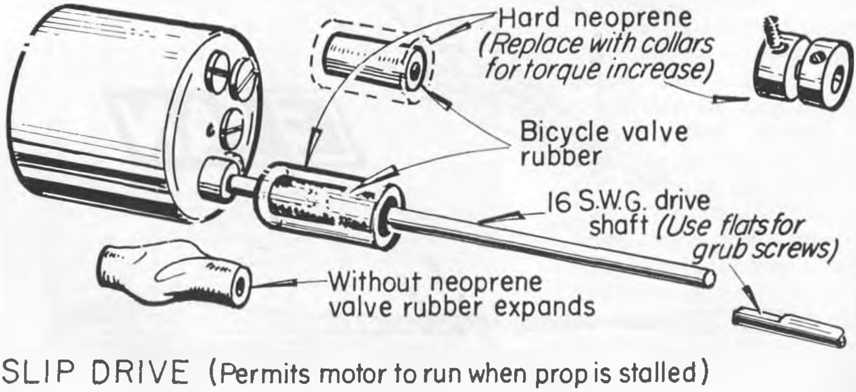


ELAN

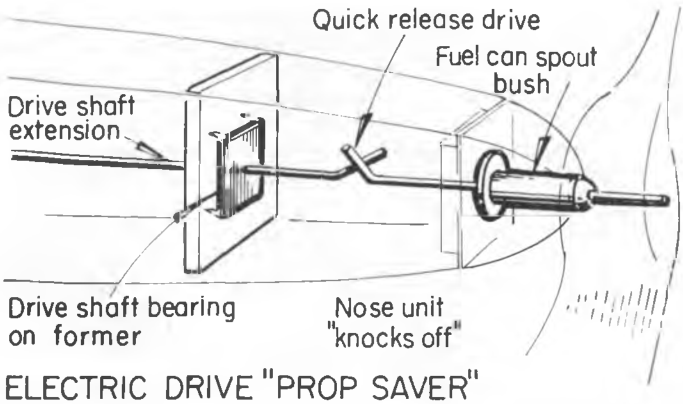


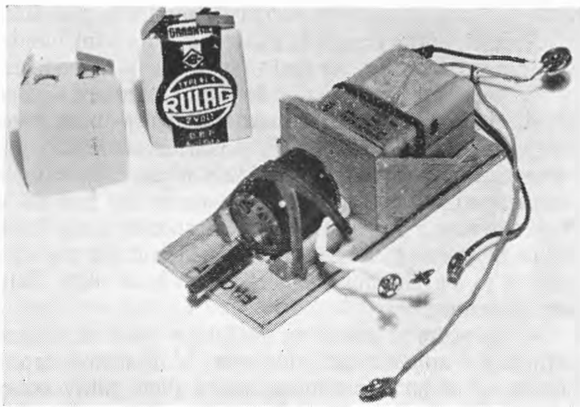
the motor is allowed to run free with the very low current drain of something like 50 milliamps until the timer or fuse device incorporated on the model disconnects the power. Such was our approach, but in *Silentius* Fred Militky has developed a twin-blade folding propeller with balsa blades fixed to a plastic three-piece hub unit and the hub is firmly bolted to a threaded propeller shaft which in turn is grub screw fitted securely to the Micromax. This allows *no* slip in the event of a contact with the ground with the motor running but such is the torque that in our experience, a blade shears off the hub in such an accident. Lest it be thought that this is mentioned as a warning, we hasten to make it clear that the eventuality is unlikely as the rate of climb with the *Silentius* and 12¾ in. diameter propeller is in the order of 3½ feet per second. The fuse operated timer should be set for about 20 seconds motor run both to conserve the batteries and motor and also make sure that the model does not drift too far. The timer is simply a set of contacts held together with a rubber band to maintain the circuit and loaded with a dethermaliser type fuse, set to burn through the band at the desired time lag and so break the circuit. We used a pair of contacts from an old flat shape 4·5 volt dry battery, but the Graupner kit has a novel contact breaker which is adjusted so that when the normal circuit is broken, the motor itself is short circuited and stops immediately. This is due to the fact that it has a normal tendency to free wheel for a considerable period due to its very high efficiency as a dynamo. The quick stop arrangement serves a double purpose in the German design since the prompt arrest of propeller motion will fling the blades back, so avoiding risk of breakage on landing and also streamlining the aeroplane for a better glide.

Power source for electric flying is undoubtedly superior with miniature lead-acid accumulators offering 2 volts supply and rechargeable at a low rate for continued operation. If dry cells are used, then one has to employ a 4·5 volt pack of three pen cell units wired in series and the cells should certainly be of the new type for high rate of drain. These are sometimes referred to as high performance cells. The original German lead-acid accumulator is the Rulag and this is available in two sizes or weights of ⅞ oz. or 1½ oz. with ·35 amp hour and ·7 amp. hour capacities. The smaller type is quite suitable giving very good power to weight ratio and is also available in similar form, though moulded in yellow as distinct from the German white, as the Magnatex, made in England. Both types of cell are safely rechargeable without piercing, providing one can



SLIP DRIVE (Permits motor to run when prop is stalled)





Installation detail for test Rubberdub shown with German Rulag 2-volt cells at left and British Magnatex in the balsa holder. Snap fasteners make quick detachable connectors. Above is the safety device enabling the prop. to disengage from the motor drive in the event of a crash, thus saving motor windings from a dead stall short circuit.

charge at about 15 milliamps overnight. Since the plastic casing expands as the acid gases so one can arrange a simple automatic switch in the charger to make the accumulators cut themselves off from the charger as they tend to blow up like balloons. Such a ready-made charger is, naturally enough, already available from Messrs. Graupner. The degree of expansion is remarkable, but if left to rest, the batteries subside to normal proportions and are, of course, fully charged once more. In our experience one can get a dozen flights before the accumulators appear to lose power and need a recharge. Since the accumulators are sealed they can be mounted any way in the fuselage and if taped together can be contained conveniently adjacent to the motor with short leads of low resistance. In the leaflet supplied with the T 03/15 it is recommended that the voltage be decreased or longer leads of from ·2 to ·5 ohms be employed for first flights with fresh batteries but this really applies to use of 4·5 volt pen cells.

Model design for electric power where the weight of the motor, accumulators and leads amount to something in the region of 2¾ oz. still means that one must be careful to restrict model construction weight and have a low-wing loading. Our thoughts were first directed towards a delta from expanded polystyrene with the power unit mounted above the centre section. Gross area of the delta was 160 sq. in. and with the power pack installed the total weight was an acceptable 5½ oz. However, the delta planform proved unacceptable since flying speed was too high and despite the power of the Micromax this speed could not be reached even after a long series of propeller tests ranging from 6 in. to 12 in. diameter. Fred Militky's models had been entirely conventional, using standard lightweight rubber-driven model design practice and, in consequence, we fell back on the A.P.S. *Rubberdub* which proved most successful with an all-up weight fractionally over 5 oz.

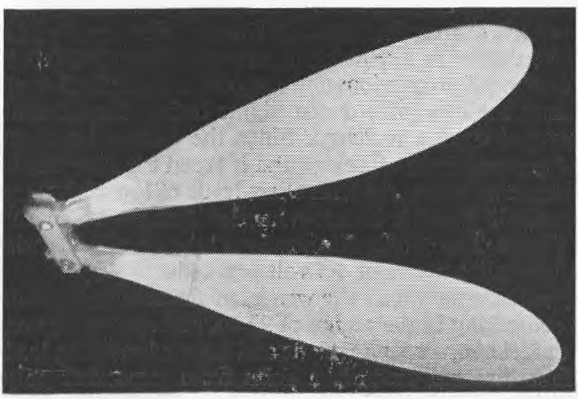
However, the lighter loading and specially developed construction of the larger *Silentius* indicates the type of model likely to produce the most outstanding results. FM 248 was 31 in. span with an all-up weight of 4½ oz. and a wing area of 138 sq. in. FM 251 was 35½ in. span, weighing 4½ oz. with wing area increased to about 190 sq. in. and *Silentius* is larger in span at 40¾ in. for a smaller wing area of 140 sq. in. and total weight of 5 oz.

The essence of successful kit model design work is to produce something which will be attractive to the masses and the point must have been foremost in Fred Militky's mind that if *Silentius* is to be successful in the model market it must be by no means a specialist's model but be simple to build with a degree of tolerance in the design to allow the more ham-handed types to achieve success. Speaking personally, we feel that he has achieved his object admirably.

Fuselage construction follows a standard system of longerons and spacers which are afterwards protected with balsa sheet covering. The flying surfaces, although naturally employing small dimension components, are easy to construct and warps avoided if building advice is closely followed. The constructional cut-away view from the plan illustrates the general assembly.

Flying a new model is always an exciting business, made doubly inspiring in the case of electric power, which is for the moment a noise-free novelty, certain to be the forerunner of a whole wide field of new achievement in aeromodelling.

In years to come, we shall look back on these early experiments perhaps with slight amusement. However, it is always more exciting to be in at the beginning of an experiment rather than glibly accept a fully developed item (whether it be anything from eight-channel radio control to an over-the-counter racing car) and one's first experience of releasing the switch and launching an electrically powered model is memorable. For one thing it is more



Graupner prop shown folded. Blades are moulded laminated sheet, with reinforcement at root to enter the hub.

Our power unit as it fits in special Rubberdub fuselage. Motor is retained by rubber bands, also accumulators. Wing seats on a parasol of wire and dowel.

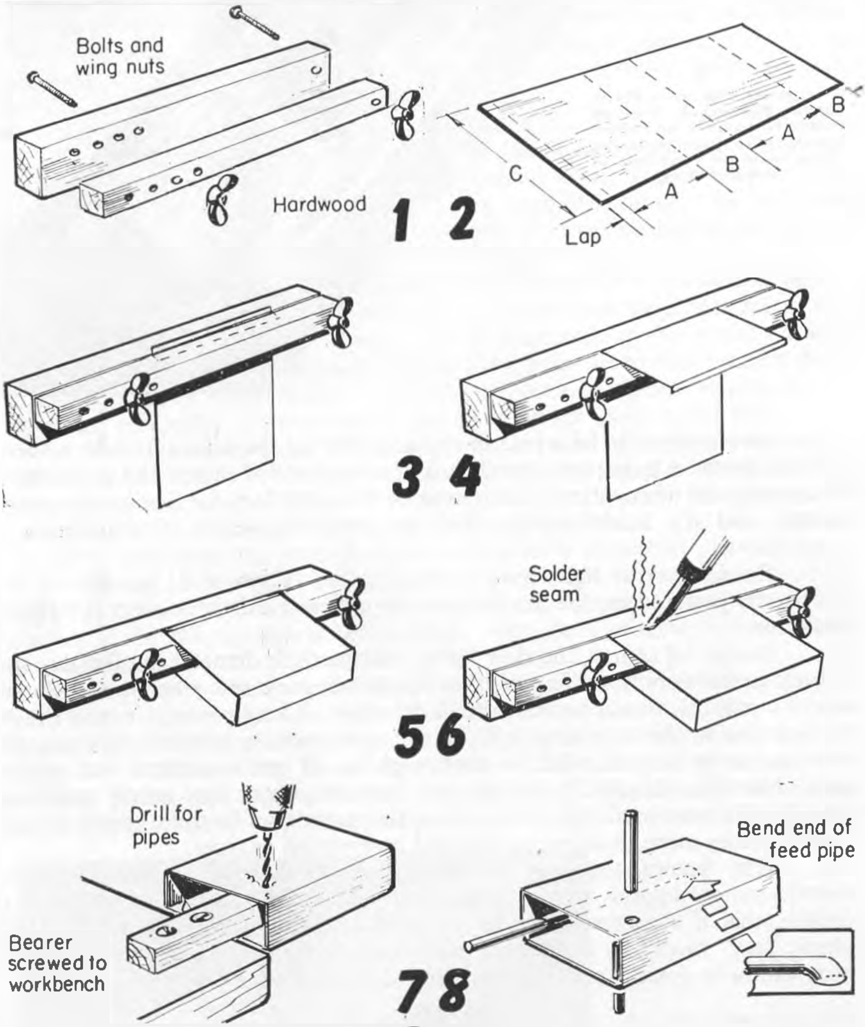
than a pleasure just to let a pair of contacts join for the operator to be assured that the motor is going to start! The quiet whirr of the motor and propeller is fascinating and when, after a climb to some 80 to 100 feet, the fuse breaks power contact and the model glides back to earth, the sense of satisfaction is considerable.

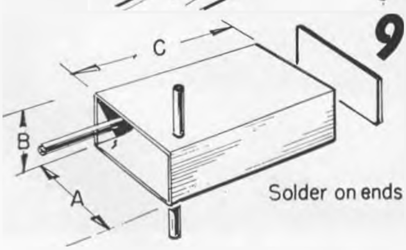
Because of the light wing loading in the region of 3½ oz. per sq. ft., electrically powered models are thermal sensitive and a dethermaliser is strongly advisable.

Snags? Of course, the slow flying characteristic demands a calm day and electric power is only for fair weather flying, but as so many aeromodellers are shy of wind, this would be but a small deterrent. A long power run is not to be advised due to the increasing load on the motor which, after all, is a valuable item and must be preserved for continued use. If one is content with engine runs of between 20 and 30 seconds, and these are, in any case, amply satisfying, then the Micromax will last, even outlast, the majority of far more simple though perhaps often more troublesome internal combustion engines.

Who knows, this type of flying may yet develop as new miniature electric motors appear, into a competition class? Time will tell. One thing is certain, that if a cheaper unit can be produced, then the ready-moulded all-plastic "toy" model for clip-in batteries, ready to fly straight out of the display box, will be in great demand at Christmas time in 1963, 1964, 1965? ?

TANKS the easy way





Capacity	A	B	C
10cc	10mm	25mm	40mm
15cc	12mm	25mm	50mm
30cc	15mm	30mm	66mm

A NEW APPROACH TO THERMAL FLYING

Continental flyers take their thermals rather more seriously than we do, and this report by a German enthusiast on his search for thermal conditions on "non-thermal" days will be of special interest to R/C glider modellers.

GROWING interest in radio controlled gliding (and on the continent in compass steering models) prompts this new approach to thermal flying.

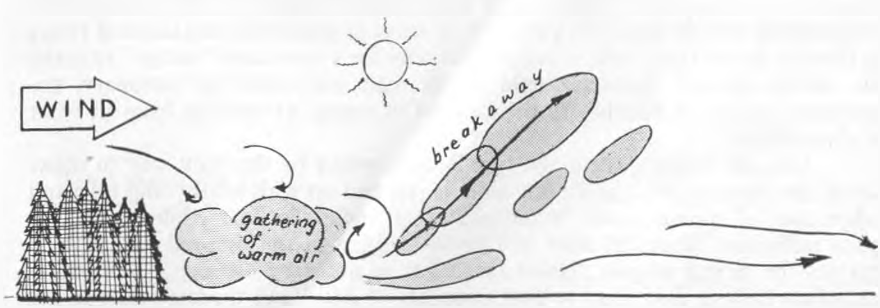
Certainly normal circling flight is the only way to fly a model when there's little horizontal air movement. Under such conditions thermals are rather small in diameter, requiring tight circling models to make use of lift. A steering device for straight flight would be of no special value under such conditions.

But how often do we find such ideal weather conditions for thermal flying? Meteorologists state that fine weather periods with little wind in summer—that intrigued modellers into designing our modern thermal soarers—have rather been an exception than the rule. They tell us that the normal pattern would be a cool summer with rather breezy air at times. The writer has been observing weather conditions for a long period and his findings are: 70 to 80 per cent of flying occasions were "blessed" with so strong a breeze that a model by only flying straight ahead remained stationary over the launching field, or was even blown backwards a little.

Flying a straight course under such conditions is not very satisfying. Thermals of the bubble type shift with the wind so that they would be of doubtful assistance. In any event maximums are scarce on windy days, and even "flying for fun" loses its meaning after several marathon recovery runs.

We have been fortunate in developing a method of enjoying this typical sort of weather, provided flying site is chosen with care, whereby accumulated material on thermal characteristics, not previously considered of value to modellers, can be put to good use.

Fig. 1.—Formation of a thermal field leewards of an obstruction.



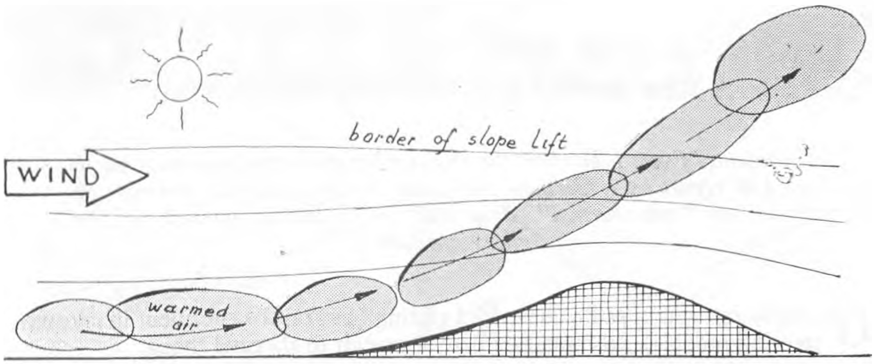


Fig. 2.—Departure of thermals on a wedge (or in front of a wood).

Thermal Fields like Slope-lift

The harder the wind blows, the more jagged and sporadic are the thermals close to the ground (patchy thermals). This has encouraged the writer to make for the leeward of hills and woods, where there is less wind. In those wind-protected quarters there is an appreciably higher rate of thermal formation, due to better penetration of sun rays, and, leeward vortices make thermals depart all right (see Fig. 1). With a strong wind in evidence, there is a quite frequent thermal "departure", as compared with normal. However, we must add, that leeward thermals with strong wind are usually weaker but more frequent than in still air. So they can cause a lift field similar to slope soaring conditions.

Thermal research flying in a heather district near Munich leeward of a small wood, proved these assertions. One can make quite appreciable durations with a self-steered model there. During our trials, the field of thermals remained quite stationary. This could be checked by the tell-tale smoke-trail from a nearby factory chimney. Nonetheless, we had windy but sunny weather and no clouds. Trying this region on cooler days we found more downdraughts than lift, just in the very region we'd been thermal riding before.

Similar thermal conditions may be found in front of woods and ridges. If there is a sufficient volume of warm air close to the ground, the resulting thermal bubble will slip leeward onto the "obstruction region". The wedge-shaped ridge, or the turbulence wedge of the wooded hill help the bubbles depart, which keep on rising like hot air balloons. Height will be much greater than normal lift on ridges (see Fig. 2). If there is sometimes no thermal rising in front of an obstacle, well, there is need only for a moderate "wedge" to make the bubble depart. Resulting field of thermals will often be stationary, the intensity varying in relation to the amount of warm air coming from in front of the obstacle.

On low wedges, certainly, tow-launch would be the only way to make use of the thermal field, as the intensity is stepped up with height. Big hills and ridges are, of course, more "economic" than molehills. Here, hand-launch is quite sufficient. Slope-lift then will be the bridge to the thermal field, which enables the model to gain greater heights than normally observed. Sometimes modellers believe that there is only slope-lift on a hill and thermals only in the flat country. Actually there is nowhere more thermal-lift than on a hill.

Now, where there are no "wedges" or obstructions causing thermals to depart the same phenomenon may occur at the brink of differently planted areas. For instance, if there is a swampy area next to a sandy patch of heather, provided, of course, that both areas are sufficiently large. As soon as warmed air is blown over a "cold" region, a breakaway will most likely occur at the borderline. This will result in an almost "thermal-front" like field of lift (see Fig. 3). Flights of this pattern have been made by the author, over a 5-6 acre rain-wet lentil field lying behind an already ploughed dry field. Height gained was about 60 ft. Of course, wind direction should be at right angles to borderline. If wind blows parallel to borderline, then the lift seems to be closer to the edge than before and rather stop the "warmer" ground than the damp and cooler area. However, there is little research data as yet to support this trial.

Artificial, Arbitrary Breakaway of Thermal-bubbles?

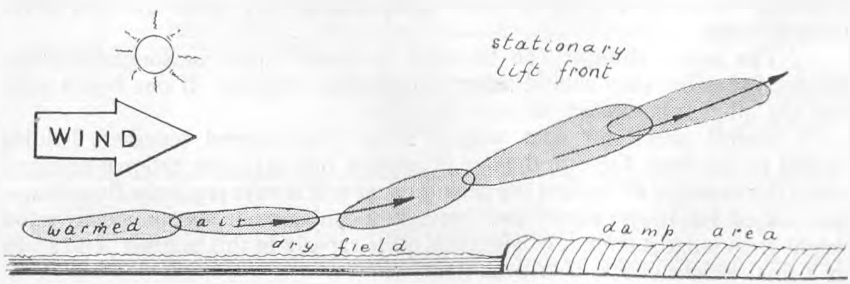
In connection with the departure of thermals on obstructions on windy, sunny days there are past trials of interest to students of breakaway thermal-bubbles with still air weather.

We would refer to a contribution by the American scientist Huffacker written in 1897 (!). He made silk paper strips rise, by simply flapping a fan, with which he caused the breakaway of the thermal. This worked particularly well on hot days in the Indian summer. He goes on to say that sometimes by just one stroke he could trigger a chimney-like stream of up-rising air which sent his silk strips floating upwards for quite a height. What he meant to prove by this was that a vulture flying through a not yet released thermal bubble could trigger it just by violent flapping of his wings, so being able to soar on afterwards without moving his wings or expending energy. This phenomenon, Huffacker says, is a MUST for vultures who can't always be sure to find rising ready at beck and call and around a district where they could be sure of finding a carcass to feed on.

We also may recall, that in the early days of thermal flight, when the departure of thermals was explored, people considered creating a "disturbance of some kind" to make bubbles break away. Driving cars through the appropriate region or diving with a sailplane into the bubble are told to have met with some success. The writer feels one need not resort to such tricks. Just make the wind throw such bubbles against some obstruction or wedge, in lieu of moving such obstacles against the stationary air.

If it is true that a car going through the base of a "ripe" thermal bubble, can make for the breakaway, why shouldn't a wedge of some height in windy conditions be in a position to effect the same triggering?

Fig. 3.—Formation of a stationary thermal front at the juncture of two different types of ground.



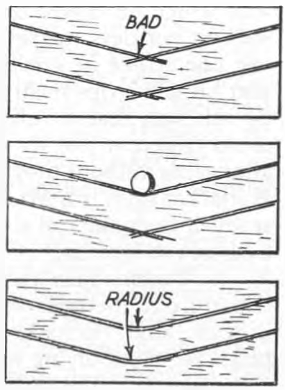
Do Birds Know Stationary Thermal-fields?

Yes, they do. While we were doing our research flights in that heather near Munich, we could study the flight antics of a stork who made a straight course thermal flight over the borderline of a wood losing no height at all over quite a time. Buzzards may be seen sometimes making head-on long duration soaring flights against the wind which may be strong at that, using stationary fields of thermals as described above.

In this connection we can quote from Pierre Idrac's classic book on *Experimental Research on the Soaring Flight of Birds* who says: "If the breeze is gaining force, one can very often see the birds giving up circling flight making head-on straight flights or in a broken line or even remaining stationary all the time". Similar flight patterns have been recorded by Huffacker who studied the large continental soaring birds.

This is enough theory on a very interesting field of studies. We can only suggest practical trials on sunny, windy days and tabulation of findings. Of course, besides self-steered and R/C models normal gliders would indicate stationary thermal-fields, but not so typically as they leave lift-zones due to wind-drift.

PLY DIHEDRAL KEEPERS



Thin plywood is generally quite adequate for spar joiners and dihedral keepers. One-quarter of the spar thickness at dihedral joints and twice this thickness at centre wing joints (one keeper of one-half the spar thickness or, preferably, two keepers, one each side of the spar, each one-quarter of the spar thickness).

Ply joiners should be cut *carefully*. If sawn, there is a danger of "notching" the centre of the brace and consequently weakening it. This applies particularly to the top cut. It is better to drill a $\frac{1}{4}$ in. diameter hole in the ply first and cut to this hole rather than attempt two straight saw cuts meeting at the centre. If the keepers are cut with a fretsaw or jigsaw, take the cut through a radius at the centre rather than abruptly changing direction.

A SIMPLE SPAR CHECK

To check balsa spar strip, try holding it by one end and whipping it up and down gently. You can usually tell by the "feel" if the strip is good and true. A hidden defect or a piece of short grain will usually make the spar break under this test.

The safe technique can be used to "pair" spars or longeron stock. Whipped together they should behave in the same manner. If one bends more than the other it is weaker, or more flexible.

Simple check for spar weights is to drop several together, holding parallel to the floor. Despite the law of physics that says gravitational acceleration is the same for all bodies, the heaviest spar will always reach the floor first—provided all fall in the same "flat" way. You can sort out approximately equal weight strip lengths from a whole batch quite rapidly in this manner. Use scales for a final weight check, if critical.

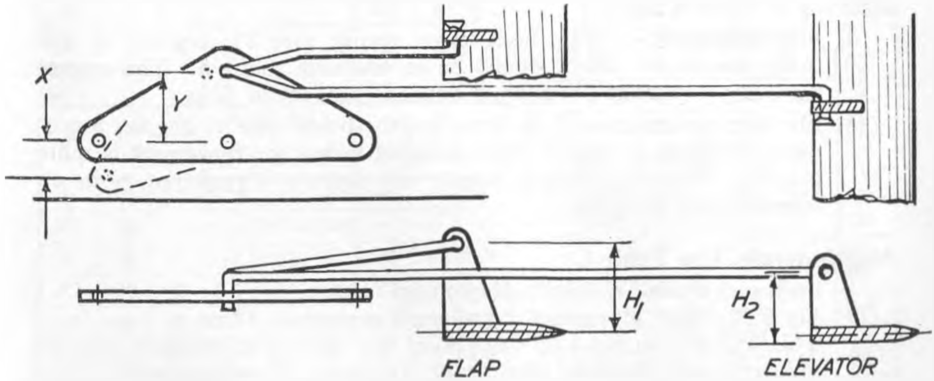
BELLCRANK GEOMETRY

THE mechanics of control plate movement are largely "guesstimated" in the average design—which frequently calls for modification of control horn length or some other major amendment to compensate for lack of necessary movement. The accompanying tables have, therefore, been designed to summarise the geometry of bellcrank-push-rod-control horn movements so that suitable dimensions can be chosen rapidly in the initial design stage.

The basis of the bellcrank movement is a rotation about its pivot point to give an effective displacement of dimension *X*—which may be limited by the structure, such as the side of the fuselage, *etc.*, in the final installation. This is translated into a push-pull movement by coupling the push rod to the point dimensioned *Y* from the pivot, the relative displacement of *X* and *Y* being governed by the control plate size and dimension *Y*.

Tables A1, A2, A3 and A4 give push-pull movements from a mean centre position obtained with four typical sizes of bellcrank over a range of possible bellcrank displacements (*X*) and various *Y* dimensions. For example, with a 2 in. bellcrank, capable of a displacement of ·4 in. (*X*=·4) and *Y* dimension of ½ in., the *maximum* push-pull which can be obtained (from Table A2) is seen to be ·20 in.

Table B relates push-pull movement to degrees control surface deflection obtained with various horn lengths. The *effective* length of the control horn is measured to the point where the control surface actually pivots. In the case of



PUSH-PULL MOVEMENT	·1"	·2"	·3"	·4"	·5"	·6"	·7"	·8"	·9"	1·0"
DISPLACEMENT PER INCH 'H'	5½°	11°	17½°	23½°	30°	37°	44½°	53°	64°	—

conventional tape hinges, this normally means the length of the control horn above the control surface *plus* the thickness of the surface for a *downward* movement ; and control horn length to the top surface *only* for upward movement. (With the horn reversed, the opposite applies.) Thus the two movements are not identical and symmetrical displacement for a given push-pull movement is not possible. However, this is a small point and can be ignored and control horn height H measured either to the upper surface, or the centre line, as preferred. Other forms of hinges definitely pivot about the centre line and in such cases horn length should be measured to this centre line or hinge line.

Table C provides an alternative approach by giving horn length H required to produce a required control surface movement (θ degrees) from a given (or available) push-pull movement. Table D gives displacement in degrees for a range of push-pull movements per inch length of control horn (H).

Use of the Tables

Basic geometry of the control installation follows the conventional pattern where the main dimensions of the control plate are determined by standard practice or personal preference. The position of the bellcrank is usually limited within a certain range, whence a logical X dimension follows.

Push-pull movement available can then be read from tables A1, A2, A3 or A4, as appropriate—or interpolated for sizes of bellcrank not covered by these tables.

A suitable control horn length (for flaps and elevators, independently) can then be determined from Table B, taking a somewhat higher angular displacement figure than that required to allow for losses in the movement due to any slack, *etc.*

Example: Given a 2 in. bellcrank with a Y dimension of $\frac{1}{2}$ in. and a possible displacement when mounted of ·4 in., determine the control horn length for (*a*) a flap movement of 25 degrees; (*b*) an elevator movement of 35 degrees.

From Table A2, push-pull movement available is seen to be ·20 in. Referring to Table B for:

(*a*) Flap movement—a $\frac{1}{2}$ in. horn length should give 23$\frac{1}{2}$ degrees up and down movement, which should be an adequate solution. The control horn can be shortened slightly, if desired—*e.g.*, say to $\frac{7}{16}$ in.

(*b*) Elevator movement—a $\frac{3}{8}$ in. horn length should give 32 degrees movement, which is perhaps a little marginal unless the movement is quite positive. Decrease the horn length very slightly, if preferred, to be on safe side—say to ·35 in.

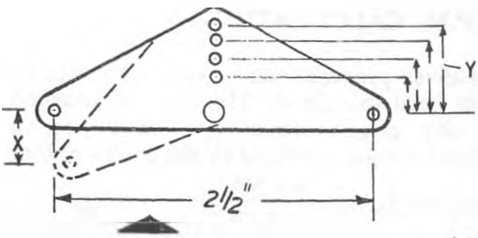
Alternatively, Use Table C

Push-pull available, already determined=·20 in.

(*a*) For a 25 degree movement, horn length required=·48 in.
This will give an exact 25 degrees up and down displacement, with no linkage losses. Decrease horn length if thought desirable—say to $\frac{1}{2}$ in.

(*b*) For a 35 degree movement, horn length required=·35 in. To allow for slack, *etc.*, decrease horn length slightly—*e.g.*, to ·33 in.

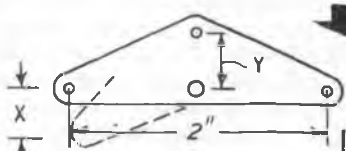
Note: For intermediate values of push-pull movement not shown in the tables, take the next highest (or lowest) figure to be on the safe side, or an average of the two nearest readings as an *approximate* figure.



CONTROL PLATE GEOMETRY

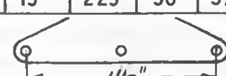
A1

X ↓	'Y' DIMENSION 1/4"	3/8"	1/2"	5/8"	3/4"
·1	·02	·03	·04	·05	·06
·2	·04	·06	·08	·10	·12
·3	·06	·09	·12	·15	·18
·4	·08	·12	·16	·20	·24
·5	·10	·15	·20	·25	·30
·6	·12	·18	·24	·30	·36
·7	·14	·21	·28	·35	·42
·8	·16	·24	·32	·40	·49



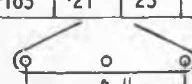
A2

X ↓	'Y' DIMENSION 1/4"	3/8"	1/2"	5/8"	3/4"
·1	·025	·038	·050	·063	·075
·2	·05	·075	·10	·125	·15
·3	·075	·125	·15	·188	·225
·4	·10	·15	·20	·25	·30
·5	·125	·188	·25	·31	·38
·6	·15	·225	·30	·375	·45



A3

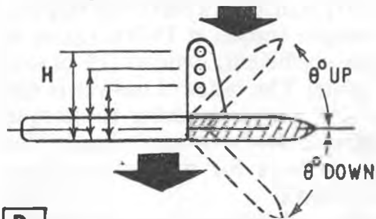
X ↓	'Y' DIMENSION 1/4"	5/16"	3/8"	7/16"	1/2"
·1	·033	·041	·05	·058	·067
·2	·067	·083	·10	·117	·133
·3	·10	·125	·15	·175	·20
·4	·133	·167	·20	·233	·267
·5	·165	·21	·25	·29	·33



A4

X ↓	'Y' DIMENSION 1/4"	5/16"	3/8	7/16"	1/2"
·1	·04	·05	·06	·07	·08
·2	·08	·10	·12	·14	·16
·3	·12	·15	·18	·21	·24
·4	·16	·20	·24	·28	·32

CONTROL HORN GEOMETRY



B

PUSH-PULL	'H' DIMENSION 1/4"	3/8"	1/2"	5/8"	3/4"	7/8"
·1	24°	15½°	11½°	9°	7½°	6½°
·2	53°	32°	23½°	18½°	15½°	13°
·3	–	43°	37°	28½°	23½°	19½°
·4	–	–	53°	40°	31½°	26½°
·5	–	–	–	53°	41°	33½°
·6	–	–	–	–	52°	42°

C

θ°	PUSH-PULL ·1"	·2"	·3"	·4"	·5"	·6"	·7"	·8"
5	1·15	2·3	3·45	–	–	–	–	–
10	·58	1·16	1·74	2·34	2·88	–	–	–
15	·39	·76	1·14	1·56	1·91	2·30	2·69	3·06
20	·29	·58	·87	1·17	1·46	1·75	2·05	2·34
25	·24	·48	·71	·95	1·19	1·43	1·66	1·90
30	·20	·40	·60	·80	1·0	1·2	1·4	1·6
35	·17	·35	·52	·72	·84	1·01	1·16	1·39
40	·16	·31	·46	·62	·78	·94	1·09	1·25
45	·14	·28	·42	·56	·70	·84	·98	1·12
60	·12	·23	·35	·46	·58	·69	·80	·92

PROPELLER—R.P.M. CALCULATIONS

THE theoretical performance of any given propeller can be estimated once its torque absorption coefficient has been calculated. This can be obtained knowing the r.p.m. produced by any given torque—*e.g.*, associating a given r.p.m. figure for an engine with the torque produced by the engine at that r.p.m. Then:

$$\text{Torque (absorption) coefficient} = \frac{\text{torque}}{(\text{r.p.m.})^2}$$

The nomogram opposite enables the torque coefficient to be determined without calculation. Simply connect the torque value on the left-hand scale to the r.p.m. figure on the right-hand scale and read off the torque coefficient on the centre scale.

Example: A given propeller achieved 11,000 r.p.m. with a particular engine. Reference to engine test data shows that the engine torque at 11,000 r.p.m. is 14 ounce-inches. To find the propeller torque coefficient, connect 14 in.-oz. torque to 11,000 r.p.m. Answer: $\cdot 116 \times 10^{-6}$. Note: The order of answer is not important as adjustments can readily be made, if necessary, using the torque coefficient to calculate subsequent r.p.m. at different torques, *etc.* Correctly (for torque measured in ounce-inches), the scale answers for torque coefficient should be multiplied by 10^{-6}, *i.e.*, divided by 1,000,000.

The nomogram can equally well be used to calculate r.p.m. for a known (or predetermined) torque coefficient for a different value of torque; or torque associated with any other r.p.m. figure.

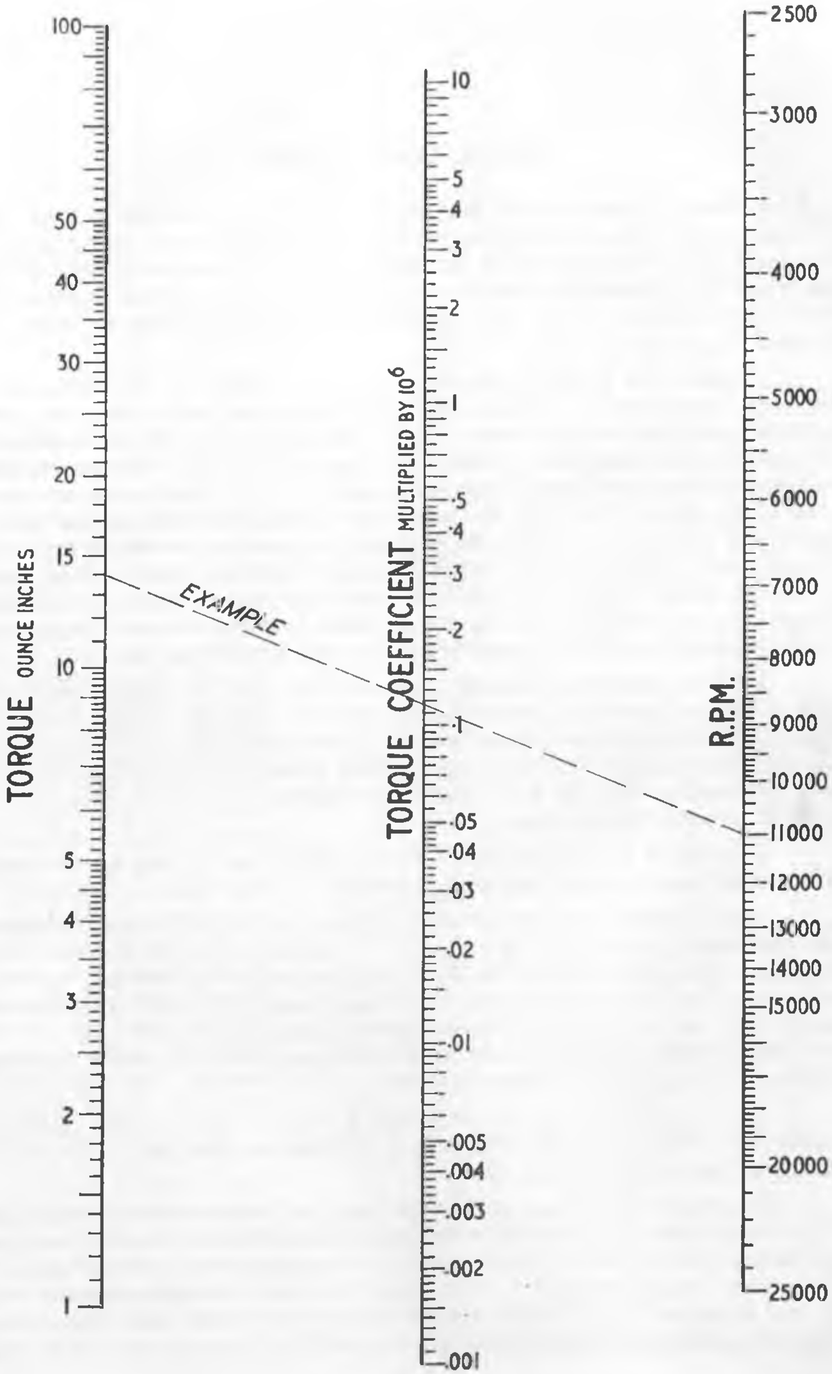
$$\text{r.p.m.} = \frac{\sqrt{\text{torque}}}{\sqrt{\text{torque coefficient}}}$$

$$\text{Torque} = (\text{r.p.m.}) \times \text{torque coefficient}$$

Unfortunately the use of calibrated propellers (*i.e.*, a series of propellers of calculated torque coefficients) is not an accurate method of power analysis. Thus, although simpler, it cannot replace dynamometer tests.

The table summarises calculated values of torque coefficients for a range of wooden propellers as yielded by six different engines under closely controlled test conditions (torque coefficients multiplied by 10^9), indicating in some instances considerable differences. Under less rigidly controlled conditions much greater differences would be likely. In this case, also, the particular 7×5 propeller used was undoubtedly wrongly marked and almost certainly a 7×4.

PROPELLER	7×4	7×5	7×6	7×8	8×4	8×5	8×6	8×8	9×4	9×6	9×8	10×4	10×6	11×5
ENGINE A	40	71·5	92·5	128	101	127	177	246	188	218	380	362	423	446
B	77	72	96·5	125	96	126	176	243	190	224	—	—	—	—
C	70	74·5	104	—	102	131	172	238	182	220	—	—	—	-
D	74	68	98	—	94	129	171	-	195	218	—	—	—	—
E	72	70	94	136	98	127	181	—	—	-	-	—	—	-
F	—	—	—	—	—	130	176	240	180	230	371	360	408	451
AVERAGE	*73*	*71*	*97*	*130*	*98*	*128*	*176*	*242*	*187*	*222*	*376*	*361*	*416*	*446*


TORQUE OUNCE INCHES
100
50
40
30
20
15
10
5
4
3
2
1
EXAMPLE
TORQUE COEFFICIENT MULTIPLIED BY 10^6
10
5
4
3
2
1
·5
·4
·3
·2
·1
·05
·04
·03
·02
·01
·005
·004
·003
·002
·001
R.P.M.
2500
3000
4000
5000
6000
7000
8000
9000
10 000
11000
12000
13000
14000
15000
20000
25000

SIMPLE EGG CURVES

MOST would-be designers can manage to draw elliptical fuselage sections, but many still boggle at the thought of those compound curve shapes such as are found in Spitfire and similar fuselages, though their shape is ideal both in looks and performance for models such as stunt c/l and, indeed essential for some scale designs. We can best follow our German contributor's name for them of "egg-curves".

Construction is based on ellipse drawing known as the "Two-circle Method". Procedure is as follows (Fig. 1): Draw major and minor axes, and with compass point at O, draw two circles of radius $\frac{1}{2}AA$ and $\frac{1}{2}BB$. From point O draw any line that intersects the two circles (marked 1 and 2). Where horizontal and vertical lines from 1 and 2 intersect is point 3. This is the first construction point of the ellipse. The "any line" procedure is continued until enough points have been indicated to enable the ellipse to be completed with the aid of a French curve, drawing a line through all points. Only one quarter ellipse need be so completed, tracing off the other three-quarters. This gives a normal ellipse only, not the proposed egg-curve. Such a method is more complicated than is necessary and can be simplified for the egg-curves as in Fig. 2.

Here we first draw a rectangle to enclose the major and minor axes of the desired ellipse. Bisect OA_1 and OB_2 from point C_1 with line at right angles to B_1 A_1 producing compass points 1 and 2. Repeat for OA_2 and OB_1 from point C_3 to produce compass points 3 and 4. With radius $2B_1$ and $4B_2$ scribe two arcs. With radius $3A_2$ and $1A_1$ scribe two smaller arcs. Join arcs with French curve to produce desired ellipse.

Once again we have produced a pure ellipse, but by simpler methods. We can now proceed to our actual "egg-curves".

Let us assume you wish to make a fighter or similar stunter. Elevation and plan drawings are first required, as, for example, Fig. 3. In this low wing design the maximum width of the fuselage cross section will be fairly low. On side view a line is, therefore, drawn to pass through all points of maximum width. This may be a curve, or more simply, a straight line. This provides the basic requirement for our egg-curves. We need only now to draw the requisite number of formers, in our case, seven only.

The dimensions required are height h of the former, and the width w, which can be taken from the drawings. In addition we need the height of the maximum width from a datum line.

Production of the egg curve (which applies to any former) is shown in Fig. 4. First draw height h, width w and height of maximum width, Hw. Bisect h, and draw a circle of radius $\frac{1}{2}h$ with point Ch as compass point (circle of height). Then mark compass point Cw either direct from side view or by formula $e = \frac{1}{2}h$- and draw circle of width with Cw as compass point (dotted line circle). The two-circle method of ellipse construction is used to finish the job. Draw any

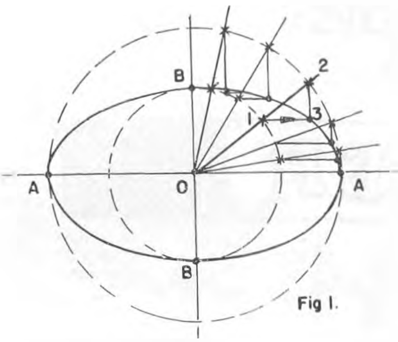


Fig 1.

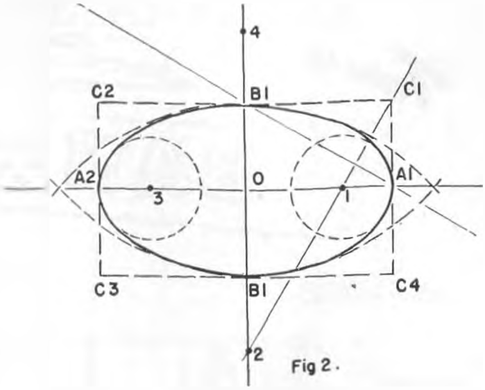


Fig 2.

lines from *Cw* (being careful not to confuse with *Ch*) that intersect the two circles in points 1 and 2. The vertical and horizontal lines through these points intersect in points 3, which are points of the egg curve. All that is needed is to repeat until enough points have been made to allow smooth joining, again with suitable French curves. Remember that only half need be so drawn —the other half is traced off.

Where a cabin is to be included the upper curve must be "idealised" to obtain a smooth shape without awkward corners, which can lead to difficulties when planking. After completing formers located about the cabin they can then be cut to take it.

Use of this method will be found a great improvement on the lazy "by eye" construction that less well-informed builders must perforce follow.

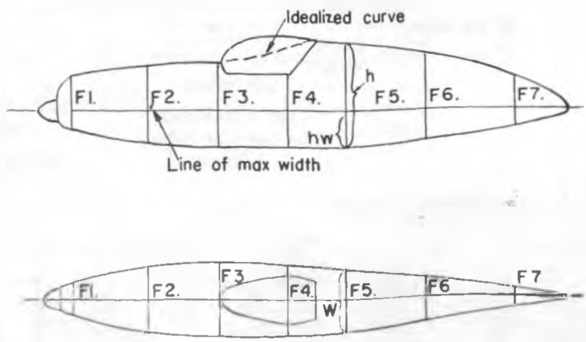
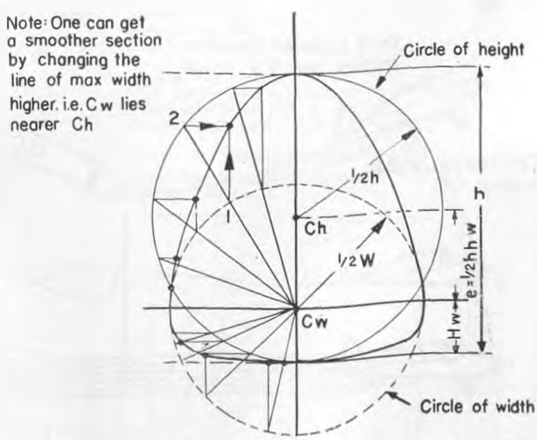
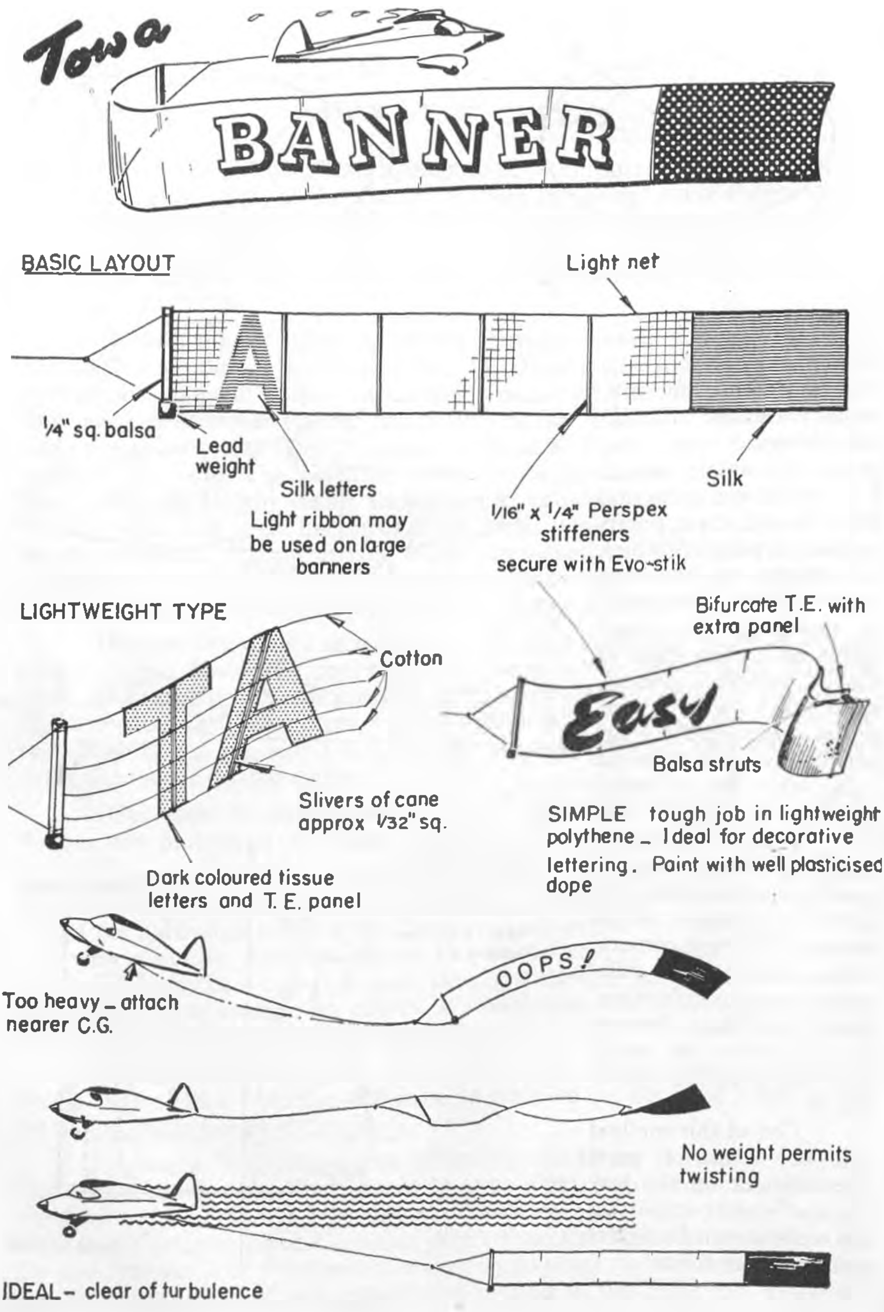


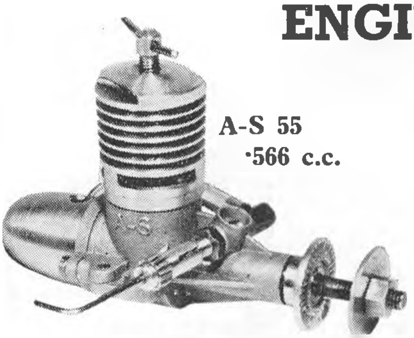
Fig 3



Fuselage construction with egg-curve sections


Tow a
BANNER
BASIC LAYOUT
Light net
1/4" sq. balsa
Lead weight
Silk letters
Light ribbon may be used on large banners
1/16" x 1/4" Perspex stiffeners
secure with Evo-stik
Silk
LIGHTWEIGHT TYPE
Cotton
Slivers of cane approx 1/32" sq.
Dark coloured tissue letters and T. E. panel
Bifurcate T.E. with extra panel
Easy
Balsa struts
SIMPLE tough job in lightweight polythene _ Ideal for decorative lettering. Paint with well plasticised dope
OOPS!
Too heavy _ attach nearer C.G.
No weight permits twisting
IDEAL – clear of turbulence

ENGINE ANALYSIS



A-S 55
·566 c.c.

Specification

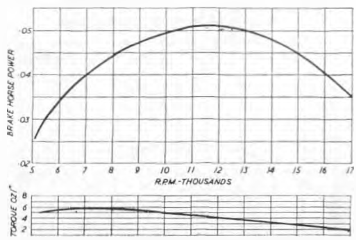
Displacement: ·566 c.c. (·034 cu. in.)
Bore: ·350 in.
Stroke: ·356 in.
Bore/stroke ratio: ·98
Bare weight: 1½ ounces
Max. B.H.P.: ·0515 at 12,000 r.p.m.
Max. torque: 6 ounces-inches at 8,000 r.p.m.
Power rating: ·091 B.H.P. per c.c.
Power/weight ratio: ·034 B.H.P. per ounce

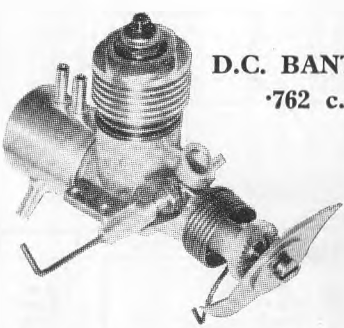
Material Specification

Cylinder: cast iron
Crankcase: light alloy pressure die casting
Piston and contra-piston: cast iron
Crankshaft: hardened nickel chrome steel
Connecting rod: light alloy forging RR56
Cylinder jacket: turned dural
Spraybar: dural (angled)
Crankcase back cover: light alloy die casting
Tank: aluminium turning
Propeller driver: turned dural with split brass collet
Manufacturers:
ALLBON-SAUNDERS LTD.,
Pembroke Works, Milton, Berks
Retail price: £2/15/6

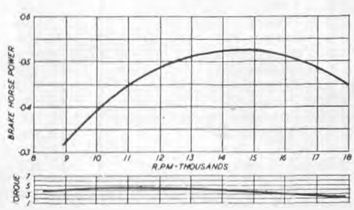
PROPELLER—R.P.M. FIGURES	
Propeller dia. × pitch	*r.p.m.*
6 ×4 (Frog nylon)	12,500
7 ×4 (Frog nylon)	9,000
7 ×6 (Frog nylon)	8,000
8 ×4 (Frog nylon)	7,000
8 ×6 (Frog nylon)	5,200
5 ×6 (Frog nylon)	11,000
5¼×3½ (D-C nylon)	16,800
6 ×4 (D-C nylon)	14,500
8 ×4 (Trucut)	7,200
7 ×6 (Trucut)	6,500
7 ×3 (Trucut)	10,000
6 ×6 (Trucut)	8,800
6 ×4 (Trucut)	9,200
6 ×3 (Trucut)	11,500
7 ×4 (Stant)	8,900
6 ×4 (Stant)	10,500

Fuel used: Mercury No. 8
Manufacturers recommended propeller sizes:
Running in 7×4
Free flight 7×4 or 6×4
Control line 6×6 or 6×4
AEROMODELLER Plans Service Power Coding "C"





D.C. BANTAM
·762 c.c.



Specification

Displacement: ·762 c.c. (·0465 cu. in.)
Bore: ·410 in.
Stroke: ·352 in.
Bore/stroke ratio: 1·17
Bare weight: 1·3 ounces
1·5 ounces (with tank)
Max. power: ·053 B.H.P. at 15,000 r.p.m.
Max. torque: 4·5 inch/ounces at 10,500 r.p.m.
Power rating: ·07 B.H.P. per c.c.
Power/weight ratio: ·035 B.H.P. per ounce

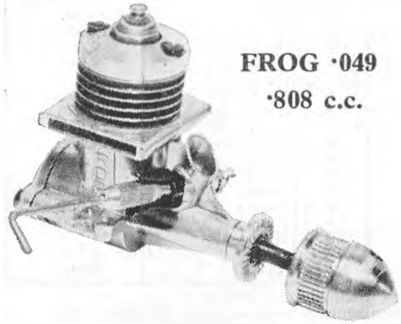
Material Specification

Crankcase: light alloy pressure die casting
Cylinder: leaded steel

PROPELLER—R.P.M. FIGURES	
Propeller dia. × pitch	*r.p.m.*
6 ×4 (Stant)	9,200
6 ×4 (Trucut)	9,000
5 ×3 (Trucut)	13,600
6 ×4 (Frog nylon)	12,400
5 ×6 (Frog nylon)	10,600
5 ×6 (Frog plastic) (styrene)	11,700
6 ×4 (Tornado nylon)	10,800
6 ×3 (Tornado wood)	12,200
5½×3 (O.K. plastic	12,900
6 ×4 (D-C nylon)	14,200
5¼×3½ (D-C nylon)	17,600

Fuel used: Davies-Charlton "Quickstart"

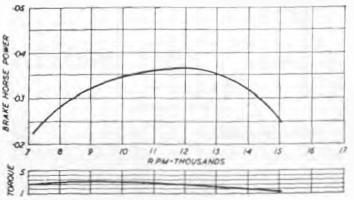
Cylinder jacket and head: turned dural
Piston: hardened steel
Crankshaft: hardened steel, 6 B.A. propeller shaft (bolt)
Connecting rod: light alloy forging
Bearings: all plain
Plug: KLG Miniglow X, short reach, 1·5 volt
Spraybar assembly: light alloy Propeller driver: dural
Manufacturers:
DAVIES-CHARLTON LTD.,
Hills Meadows, Douglas, Isle of Man
AEROMODELLER Plans Service Coding "C"



FROG ·049
·808 c.c.

Specification

Displacement: ·808 c.c. (·04926 cu. in.)
Bore: ·400 in.
Stroke: ·392 in.
Bare weight: 1·8 ounces
Max. power: ·037 B.H.P. at 12,000 r.p.m.
Power rating: ·046 B.H.P. per c.c.
Power/weight ratio: ·0205 B.H.P. per ounce



Material Specification

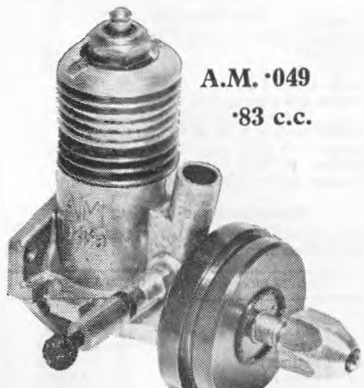
Crankcase: light alloy pressure die-casting
Cylinder: leaded steel
Piston: cast iron
Connecting rod: light alloy forging
Crankshaft: hardened steel—3 B.A. propeller shaft thread
Main bearing: plain
Prop. driver: dural
Cylinder head: dural
Spraybar: brass (ratchet spring locking)
Glow plug: KLG Miniglow "X"
Manufacturers:
INTERNATIONAL MODEL AIRCRAFT LTD.,
Morden Road, Merton, S.W.19.

PROPELLER—R.P.M. FIGURES

Propeller dia. × pitch	*r.p.m.*
7 × 4 (Stant)	7,400
6 × 4 (Stant)	8,400
6 × 4 (Trucut)	7,600
5 × 3 (Trucut)	11,900
6 × 4 (Frog nylon)	11,400
6 × 6 (Frog nylon)	8,400
5 × 6 (Frog nylon)	10,600
5 × 6 (Frog plastic) (styrene)	9,700
6 × 4 (Tornado nylon)	9,600
6 × 3 (Tornado wood)	10,600
5¼ × 3 (O.K. plastic)	11,500
6 × 4 (D-C nylon)	12,400
5¼ × 3½ (D-C nylon)	14,400

Fuel used: equivalent 60-25-15, methanol, castor, nitromethane blend

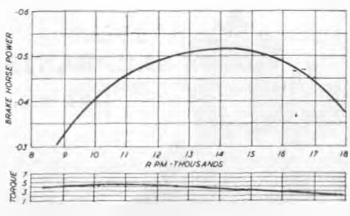
AEROMODELLER Plans Service Coding "B"



A.M. ·049
·83 c.c.

Specification

Displacement: ·83 c.c. (·5065 cu. in.)
Bore: ·421 in.
Stroke: ·364 in.
Bore/stroke ratio: 1:16
Bare weight: 1¾ ounces
Max. power: ·052 B.H.P. at 14,000 r.p.m.
Power rating: ·0625 B.H.P. per c.c.
Power/weight ratio: ·03 B.H.P. per ounce



PROPELLER—R.P.M. FIGURES

Propeller dia. × pitch	*r.p.m.*
7 × 4 (Stant)	8,400
6 × 4 (Stant)	9,200
6 × 4 (Trucut)	8,600
5 × 3 (Trucut)	13,600
6 × 4 (Frog nylon)	12,600
6 × 6 (Frog nylon)	8,400
5 × 6 (Frog nylon)	11,800
5 × 6 (Frog plastic) (styrene)	10,700
6 × 4 (Tornado nylon)	10,800
6 × 3 (Tornado wood)	12,400
5¼ × 3 (O.K. plastic)	13,200
6 × 4 (D-C nylon)	13,900
5¼ × 3½ (D-C nylon)	17,200

Fuel used: equivalent 60-25-15, methanol, castor, nitromethane blend

AEROMODELLER Plans Service Coding "C"

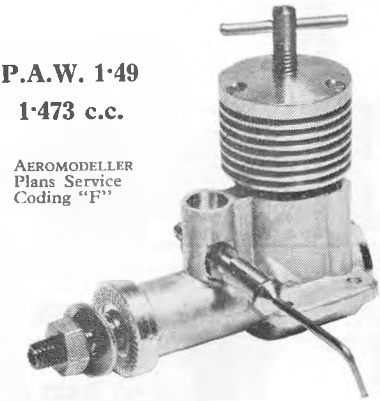
Material Specification

Crankcase casting: light alloy pressure die casting
Cylinder: leaded mild steel
Piston: hardened steel
Connecting rod: hardened steel
Little end: ball and socket joint
Bearings: plain Crankshaft: hardened steel
Spraybar: brass Cylinder jacket: dural

Manufacturers:
D. J. ALLEN ENGINEERING,
28 Angel Factory Colony, London, N.18

P.A.W. 1·49
1·473 c.c.

AEROMODELLER
Plans Service
Coding "F"



Specification

Displacement: 1·473 c.c. (09 cu. in.)
Bore: ·494 in.
Stroke :·469 in.
Bare weight: 3¼ ounces
Max. torque: 14 ounce-inches at 7,000 r.p.m.
Max. power: 176 B.H.P. at 17,000 r.p.m.
Power rating: 12 B.H.P. per c.c.
Power/weight ratio: ·05 B.H.P. per ounce

Material Specification

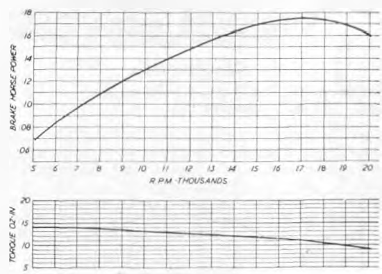
Crankcase: gravity die-casting in light alloy
Cylinder: hardened steel
Piston: brico cast iron
Contra-piston: brico cast iron
Connecting rod: machined from Hiduminium light alloy
Bearing: cast iron bush
Spraybar: brass
Cylinder jacket: machined from dural

PROPELLER—R.P.M. FIGURES

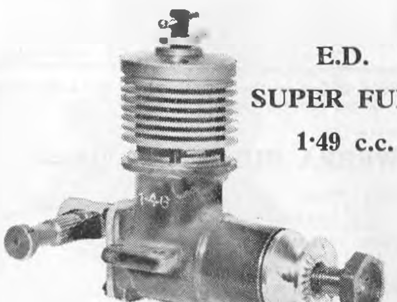
Propeller dia. × pitch	r.p.m.
6 × 6 (Trucut)	13,600
6 × 3 (Trucut)	18,000
6 × 4 (Trucut)	16,500
8 × 4 (Trucut)	11,400
9 × 4 (Trucut)	9,000
10 × 4 (Trucut)	6,500
8 × 6 (Trucut)	8,400
12 × 4 (Trucut)	5,000
6 × 4 (Stant)	16,800
6 × 5 (Stant)	15,300
7 × 3 (Stant)	15,500
7 × 4 (Stant)	13,600
8 × 4 (Stant)	11,200
8 × 5 (Stant)	10,000
9 × 3½ (Tiger)	9,000
8 × 4 (Tiger)	11,800
8 × 3½ (Tiger)	12,700
7 × 4 (Frog nylon)	15,400
6 × 4 (Frog nylon)	20,000 plus
8 × 4 (Frog nylon)	11,600
8 × 5 (Frog nylon)	9,500
8 × 6 (Frog nylon)	8,500
7 × 6 (Frog nylon)	13,600

Fuel used: Mercury No. 8

Manufacturers and Distributors:
PROGRESS AERO WORKS,
Chester Road, Macclesfield
Retail price (including Purchase Tax): £4/6/0
Export price: £3/12/10

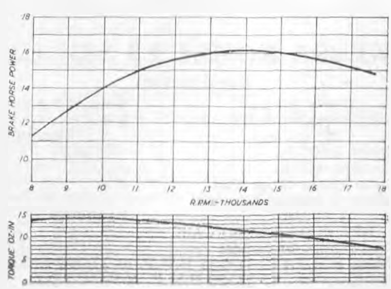


E.D.
SUPER FURY
1·49 c.c.



Specification

Displacement: 1·49 c.c. (·092 cu. in.)
Bore: ·500 in.
Stroke: ·462 in.
Weight: 3¾ ounces
Max. power: 162 B.H.P. at 14,000 r.p.m.
Max. torque: 14 ounce-inches at 10,000 r.p.m.
Power rating: 11 B.H.P. per c.c.
Power/weight ratio: ·043 B.H.P. per ounce



Propeller dia. × pitch	r.p.m.
10 × 4 (Trucut)	6,000
9 × 4 (Trucut)	8,800
8 × 6 (Trucut)	8,400
8 × 4 (Trucut)	11,500
8 × 3 (Trucut)	11,700
7 × 5 (Trucut)	12,000
7 × 4 (Trucut)	13,500
7 × 3 (Trucut)	15,500
6 × 6 (Trucut)	13,400
6 × 3 (Trucut)	16,400
8 × 4 (Stant)	11,400
7 × 6 (Stant)	12,200
7 × 4 (Stant)	13,600
6 × 5 (Stant)	15,400
9 × 6 (Frog nylon)	8,000
8 × 6 (Frog nylon)	8,400
8 × 4 (Frog nylon)	11,300
7 × 6 (Frog nylon)	13,000
7 × 4 (Frog nylon)	15,000
6 × 4 (Frog nylon)	19,000 plus

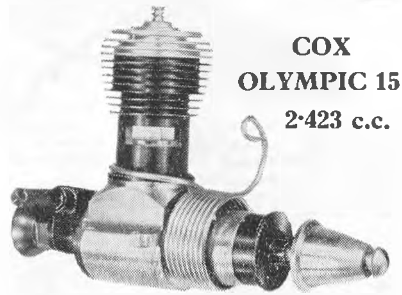
Propeller—R.P.M. Figures

Material Specification

Crankcase: LM2 aluminium alloy pressure die casting
Cylinder: hardened steel (55 Rockwell). Ground and wet honed bore
Piston: cast iron
Contra piston: hardened steel
Connecting rod: RR.56 light alloy forging—heat treated and tumbled
Main bearing: ¼ × ⅝ × ·196 front ball race: ¼ × ¾ × 7/32 rear ball race
Induction: rear disc, rotary (moulded Bakelite)
Prop. driver: light alloy (dural)
Cylinder jacket: light alloy (dural, anodised blue)
Needle valve: brass thimble
Compression locking lever: brass, cadmium plated
Manufacturers:
Electronic Developments Ltd.,
Island Farm Road, West Molesey, Surrey
Price (including Purchase Tax): £3/15/3

Test fuel: Mercury No. 8

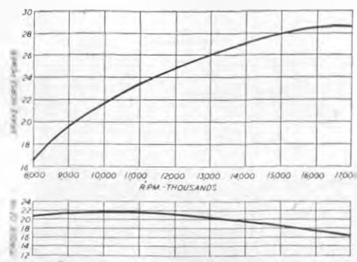
Aeromodeller Plans Service Power Coding "F"



COX OLYMPIC 15 2·423 c.c.

Specification

Displacement: 2·423 c.c. (.1478 cu. in.)
Bore: ·585 in. Stroke: ·55



Aeromodeller Plans Service Coding "G"

Bore/stroke ratio: 1·07
Bare weight: 4 ounces
Max. B.H.P.: ·287 at 16,500 r.p.m.
Max. torque: 22 ounce-inches at 10,000 r.p.m.
Power rating: ·118 B.H.P. per c.c.
Power/weight ratio: ·072 B.H.P. per ounce

Material Specification

Crankcase: light alloy, machined from bar stock
Cylinder: mild steel
Piston: hardened steel
Connecting rod: hardened steel
Crankshaft: hardened steel
Main bearing: twin ball races
Cylinder head: light alloy (integral glow element)
Rear cover and venturi: light alloy (anodised red)
Prop. driver: light alloy (anodised blue)
Manufacturers:
L. M. Cox Manufacturing Co.,
Santa Ana, California, U.S.A.
Price in U.S.: $12·98

Propeller—R.P.M. Figures

Propeller dia. × pitch	r.p.m.
10 × 4 (Trucut)	7,300
9 × 4 (Trucut)	11,200
8 × 4 (Trucut)	13,800
8 × 3 (Trucut)	14,000
7 × 6 (Trucut)	12,600
9 × 3 (Tiger)	12,400
8 × 4 (Tiger)	14,800
10 × 6 (Frog nylon)	7,800
9 × 6 (Frog nylon)	10,200
7 × 4 (Frog nylon)	16,000 plus

Fuel: 20 per cent nitromethane, 20 per cent castor 60 per cent methanol

WEBRA KOMET 2.5 2.454 c.c.

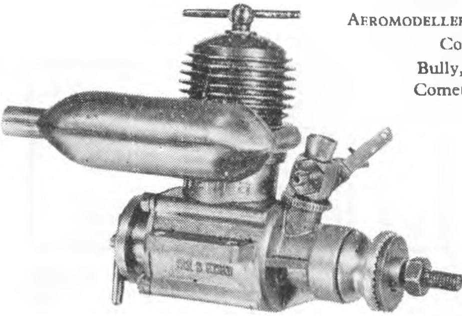
Specification

	Bully 3·5 c.c.	Komet 2·5 c.c.
Displacement:	3·416 c.c. (·208 cu. in.)	2·454 c.c. (·175 cu. in.)
Bore:	·6505 in.	·551 in.
Stroke:	·627 in.	·627 in.
Bore/stroke ratio:	1·04	·88
Weight: standard engine:	5½ ounces	5½ ounces
with exhaust throttle and pump:	6⅜ ounces	

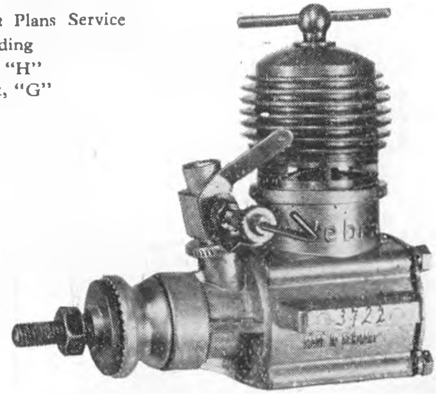
Max. B.H.P.: (2·5) ·235 B.H.P. at 13,000 r.p.m.
(3·5) ·20 B.H.P. at 9,500 r.p.m.

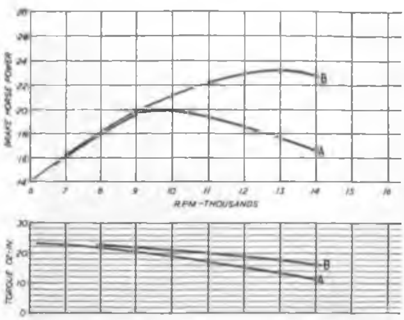
WEBRA BULLY 3.5 3.416 c.c.

Max torque:
(2·5) (3·5) } 23 ounce-inches at 6.500 r.p.m.
Power rating:
(2·5) ·069 B.H.P. per c.c.
(3·5) ·059 B.H.P. per c.c.
Power/weight ratio:
(2·5) ·043 B.H.P. per ounce
(3.5) ·03 B.H.P. per ounce
Manufacturers:
Fem & Modelltechnik,
5 Genestrasse, Berlin-Schonberg



AEROMODELLER Plans Service
Coding
Bully, "H"
Comet, "G"





Propeller—r.p.m. and Power Curves
(*A* represents 3·5 c.c. Bully with throttle, silencer and pump.
B represents 2·5 c.c. Komet.)

Material Specification

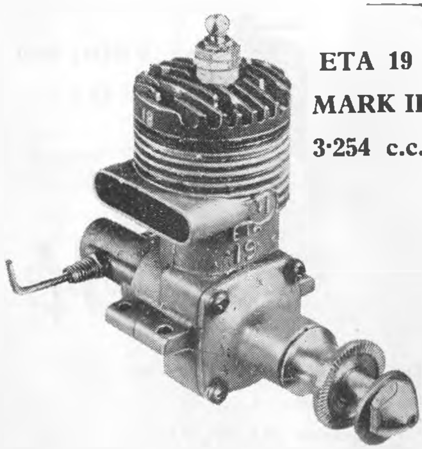
Crankcase: Pressure die cast light alloy
Cylinder: hardened steel
Cylinder jacket: light alloy anodised, red "Komet" or blue "Bully"
Piston: cast Perlite iron
Contra piston: hardened steel
Crankshaft: hardened steel with extension screw
Connecting rod: forged dural
Main bearing: plain
Spraybar assembly (and barrel throttle): brass
Exhaust unit: pressure die-cast light alloy

PROPELLER—R.P.M. FIGURES

Propeller	*Bully with silencer and fuel pump r.p.m.*	*Komet r.p.m.*
12 × 4 (Trucut)	6,500	
11 × 4 (Trucut)	7,700	
10 × 4 (Trucut)	8,700	8,800
9 × 6 (Trucut)	8,500	
9 × 5 (Trucut)	9,200	
9 × 4 (Trucut)	10,400	10,400
8 × 5 (Trucut)	10,500	
8 × 4 (Trucut)	12,000	13,300
8 × 3 (Trucut)	12,500	
10 × 6 (Frog nylon)	8,200	8,500
9 × 6 (Frog nylon)	9,600	10,000
8 × 8 (Frog nylon)	7,600	
8 × 5 (Frog nylon)	—	11,400

Fuel used: 2 per cent nitrated, standard diesel mix.
Throttle control: fully effective in reducing speed to 2,500-2,700 r.p.m. on engine fitted with exhaust unit. Partially effective only on engine without exhaust unit, reducing idling r.p.m. to approx. 3,000 r.p.m. but fluctuating.

ETA 19 MARK II 3·254 c.c.



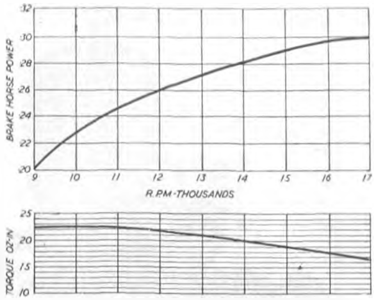
AEROMODELLER Plans Service Coding "H".

Specification

Displacement: 3·254 c.c. (·1985 cu. in.)
Bore: ·640 in.
Stroke: ·617 in.
Bore/stroke ratio: 1·04
Bare weight: 4½ ounces
Max. B.H.P.: ·30 at 16,800 r.p.m.
Max. torque: 22·6 ounce-inches at 9,800 r.p.m.
Power rating: ·093 B.H.P. per c.c.
Power/weight ratio: ·067 B.H.P. per ounce
Manufacturers:
E.T.A. INSTRUMENTS LTD.,
289 High Street, Watford, Herts
Price (including Purchase Tax): £6/15/5

Material Specification

Crankcase: light alloy pressure die casting, vapour blast finish
Cylinder: cast iron
Piston: cast iron
Cylinder head: light alloy
Crankshaft: hardened steel
Rotor disc: tufnol
Bearings: ½ in. ball race (rear); $\frac{3}{16}$ in. lightweight ball race (front)
Propeller driver: dural

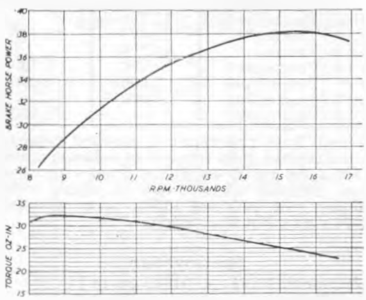


Specification

Displacement: 3·46 c.c. (·211 cu. in.)
Bore: ·647 in.
Stroke: ·624 in.
Weight: 7⅛ ounces
Max. power: ·382 B.H.P. at 15,500 r.p.m.
Max. torque: 32 ounce-inches at 9,000 r.p.m.
Power rating: ·11 B.H.P. per c.c.
Power/weight ratio: ·054 B.H.P. per ounce.

Material Specification

Crankcase: light alloy gravity die casting
Cylinder: hardened steel, stress relieved
Cylinder jacket: dural, turned
Piston: Meehanite, ground and honed
Contra piston: Meehanite, ground and honed
Crankshaft: 85-ton steel, hardened on journals, tempered on crank pin and threaded length



Propeller—R.P.M. Figures	
Propeller dia. × pitch	*r.p.m.*
10 × 6 (Frog nylon)	10,200
9 × 6 (Frog nylon)	11,900
8 × 8 (Frog nylon)	9,200
8 × 6 (Frog nylon)	12,800
8 × 5 (Frog nylon)	13,600
12 × 4 (Trucut)	7,500
11 × 4 (Trucut)	9,400
10 × 8 (Trucut)	7,600
10 × 4 (Trucut)	10,000
9 × 4 (Trucut)	12,900
8 × 6 (Trucut)	12,100
8 × 4 (Trucut)	15,200
10 × 6 (Stant)	9,000
9 × 6 (Stant)	11,000
9 × 5 (Stant)	11,000
9 × 4 (Stant)	12,400
8 × 4 (Stant)	15,100

Test Fuel: Mercury No. 8
AEROMODELLER Plans Service Power Coding "J"

Prop. nut sleeve: dural
Con. rod: dural
Glow plug: Standard KLG (long reach)

Propeller—R.P.M. Figures	
Propeller dia. × pitch	*r.p.m.*
10 × 6 (Frog nylon)	7,300
9 × 6 (Frog nylon)	10,500
8 × 5 (Frog nylon)	10,800
9 × 4 (Trucut)	11,400
8 × 4 (Trucut)	14,000
7 × 4 (Trucut)	16,600
7 × 3 (Trucut)	18,000 plus

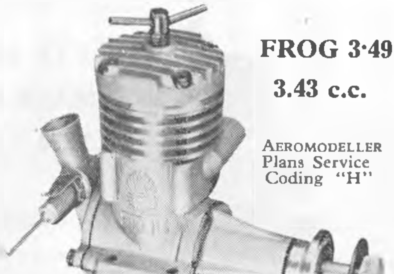
Fuel used: Standard methanol; castor mixture made up to the equivalent of 20 per cent nitromethane

RIVERS 3·5 c.c. SILVER ARROW

Bearing sleeve: hardened steel
Bearings: rollers (sleeve and rollers forming an integral twin roller race assembly)
Connecting rod: DTD 363 dural
Spray bar assembly: brass, 4 B.A.
Prop. driver (hub): machined from dural
Manufacturers:
A. E. Rivers Ltd.,
15 Maswell Park Road, Hounslow, Middlesex
Price (including Purchase Tax): £6/5/8.

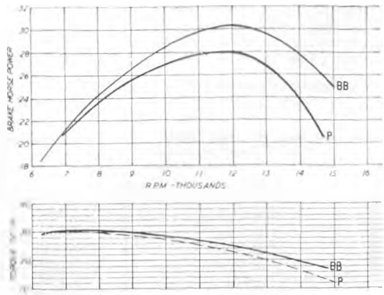
FROG 3·49
3.43 c.c.

AEROMODELLER Plans Service Coding "H"



Specification

Displacement: 3·43 c.c. (·209 cu. in.)
Bore: ·6665 Stroke: ·600
Bore/stroke ratio: 1·1
Max. power:
Plain bearing: ·28 B.H.P. at 12,000
Ball bearing: ·3025 B.H.P. at 12,200



Max. torque:
Plain bearing: 30 ounce-inches at 7,500
Ball bearing: 31 ounce-inches at 8,000
Weight:
Plain bearing: 6¼ ounces
Ball bearing: 6⅜ ounces
Power rating:
Plain bearing: ·082 B.H.P. per c.c.
Ball bearing: ·088 B.H.P. per c.c.
Power/weight ratio:
Plain bearing: ·043 B.H.P. per ounce
Ball bearing: ·046 B.H.P. per ounce

Material Specification

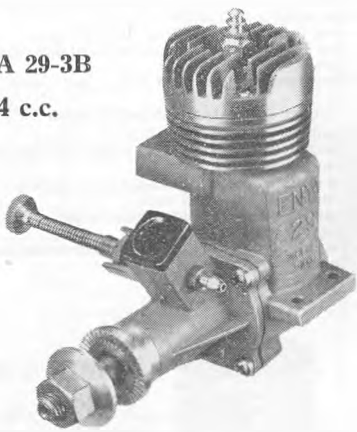
Crankcase: LAC 112a alloy pressure die casting
Cylinder: steel, hardened and tempered
Piston: meehanite
Contra piston: mild steel
Crankshaft: hardened steel
Bearing: Vandervell sintered bronze sleeve. Rear bearing on ball race-ball race
Induction: Hardened steel drum mounted in rear cover
Cylinder head: LAC 112a alloy die casting
Propeller shaft: high tensile 1 in. diameter light alloy bolt
Manufacturers:
INTERNATIONAL MODEL AIRCRAFT LTD.,
Morden Road, Merton, S.W.19
Price (including Purchase Tax):
349 BB version £3/19/2
349 Plain Bearing £3/13/3

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

Fuel used: Frog "Powamix"

ENYA 29-3B

4·94 c.c.

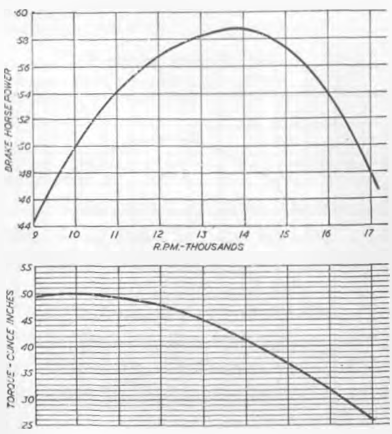


Specification

Displacement: 4·94 c.c. (·3012 cu. in.)
Bore: ·735 in.
Stroke: ·710 in.
Bore/stroke ratio: 1·035
Bare weight: 6¾ ounces
Max. B.H.P.: ·59 B.H.P. at 14,000 r.p.m.
Max. torque: 50 ounce/inches at 10,000 r.p.m.
Power rating: ·12 B.H.P. per c.c.
Power/weight ratio: ·0875 B.H.P. per ounce

Material Specification

Crankcase unit: pressure die casting in light alloy
Cylinder: cast iron
Piston: cast iron
Cylinder head: light alloy die casting
Connecting rod: light alloy die casting (bronze bushed big end)
Crankshaft: hardened steel
Main bearing: bronze bush (cast integral with front crankcase unit)
Spraybar assembly: nickel-plated brass
Venturi: thermostat plastic moulding
Propeller driver: dural
Manufacturers:
SABURO ENYA, Japan



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

Fuel used: 40 per cent methanol, 40 per cent castor, 20 per cent nitromethane
Glow plug: KLG long reach
Standard glow plug supplied is Enya No. 5 (1·5 volts). Performance was found to be virtually identical

Recommended propeller sizes:
Free flight: 11 × 4, 11 × 3, 10 × 4
Control line stunt: 10 × 5, 9 × 6
Control line speed: 7 × 9, 7 × 10, 6½ × 10

AEROMODELLER Plans Service Coding "J"

MERCO 35
5·794 c.c.

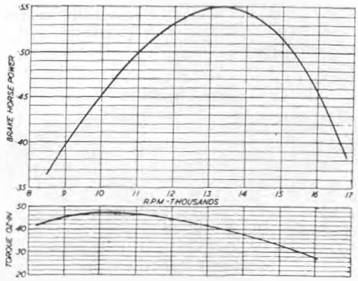
Specification
Displacement: 5·794 c.c. (·353 cu. in.)
Bore: ·800 in.
Stroke: ·703 in.
Bore/stroke ratio: 1·14
Bare weight: 7½ ounces
Max. power: ·55 B.H.P. at 13,400 r.p.m.
Max. torque: 47 ounce-inches at 10,400 r.p.m.
Power rating: ·095 B.H.P. per c.c.
Power/weight ratio: ·073 B.H.P. per ounce

Material Specification
Crankcase: L.M.6 light alloy die casting
Cylinder liner: leaded mild steel, unhardened
Piston: meehanite
Connecting rod: R.R.56 light alloy forging
Crankshaft: hardened steel
Main bearing: phosphor-bronze bush
Spraybar assembly: brass
Head: light alloy die casting (stove enamelled)
Propeller driver: dural
Propeller nut: ¼ in. B.S.F.

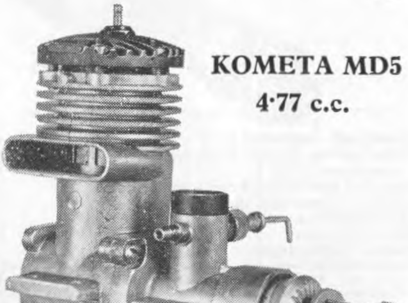
PROPELLER—R.P.M. FIGURES

Propeller dia. × pitch	*r.p.m.*
10 × 6 (Frog nylon)	11,200
9 × 6 (Frog nylon)	13,800
8 × 4 (Frog nylon)	16,000
9 × 4 (Frog nylon)	13,500
12 × 4 (Trucut)	9,000
11 × 4 (Trucut)	11,000
11 × 6 (Trucut)	9,400
10 × 6 (Trucut)	11,000
10 × 4 (Trucut)	11,500
9 × 6 (Trucut)	12,000
9 × 4 (Trucut)	14,200
9 × 5 (Stant)	13,200
9 × 4 (Stant)	14,000
8 × 4 (Stant)	16,000
10 × 4 (Stant)	13,200

Fuel used: 32½ per cent castor, 52½ per cent methanol, 15 per cent nitromethane



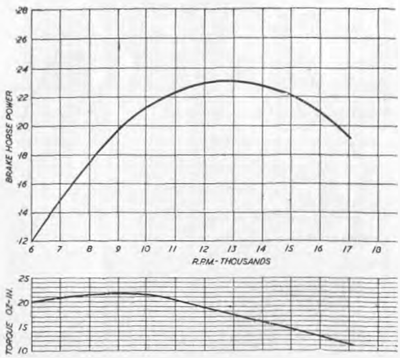
AEROMODELLER Plans Service Coding "J"



KOMETA MD5
4·77 c.c.

Specification
Displacement : 4·77 c.c. (·299 cu. in.)
Bore : ·747 in.
Stroke : ·664 in.
Bore/stroke ratio : 1·085 : 1
Weight : 8 ounces

AEROMODELLER Plans Service Coding "H"



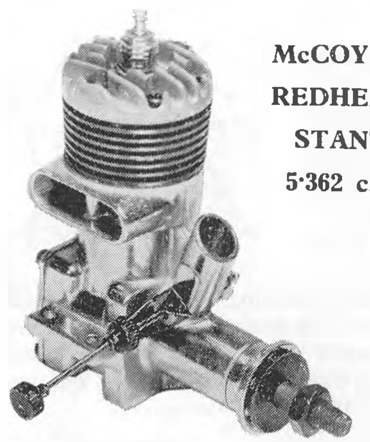
Max. B.H.P. : ·234 at 13,000 r.p.m.
Max. torque : 21·8 ounce-inches at 9,000 r.p.m.
Power output : ·049 B.H.P. per c.c.
Power/weight ratio : ·029 B.H.P. per ounce

Material Specification

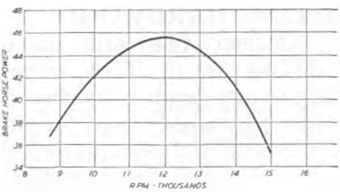
Crankcase and cylinder jacket : light alloy pressure die casting
Cylinder : steel, heat treated and annealed
Piston : light alloy casting, machined to finish. Two cast iron rings
Crankshaft : hardened steel
Con. rod : light alloy forging (casting ?)
Bearings : two ball races (Russian origin)
Bearing unit : light alloy die casting
Cylinder head : light alloy die casting, anodised. Aluminium gasket seal
Spraybar : brass, plated needle and thimble
Venturi : aluminium, anodised
Prop. driver : light alloy, brass split collet

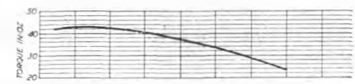
PROPELLER—R.P.M. FIGURES	
Propeller dia. × pitch	*r.p.m.*
12 × 4 (Trucut)	6,000
10 × 4 (Trucut)	7,400
9 × 4 (Trucut)	10,900
8 × 4 (Trucut)	12,800
8 × 3 (Trucut)	13,600
7 × 4 (Trucut)	15,000
9 × 4 (Stant)	10,600
8 × 4 (Stant)	13,000
7 × 4 (Stant)	14,300
9 × 6 (Frog nylon)	10,600
10 × 6 (Frog nylon)	8,500
8 × 4 (Tiger)	13,600

Fuel used : Mercury No. 7



McCOY 35 REDHEAD STANT 5·362 c.c.





Specification

Displacement: 5·326 c.c. (·327 cu. in.)
Bore: ·775 in.
Stroke: ·743 in.
Weight: 7¼ ounces
Max. power: ·455 B.H.P. at 12,000 r.p.m.
Max. torque: 43 ounce-inches at 9,500 r.p.m.
Power rating: ·085 B.H.P. per c.c.
Power/weight ratio: ·063 B.H.P. per ounce

Material Specification

Crankcase: light alloy die casting
Cylinder: unhardened steel
Piston: cast iron
Connecting rod: light alloy forging
Gudgeon pin: silver steel, hollow brass end pads
Cylinder head: light alloy casting
Crankshaft: hardened steel, ground to finish
Main bearing: cast iron, reamed to finish
Manufacturers:
THE TESTOR CORPORATION,
Rockford, Illinois, U.S.A.
Price at source: $11·95

PROPELLER—R.P.M. FIGURES	
Propeller dia. × pitch	*r.p.m.*
10 × 6 (Frog nylon)	11,000
9 × 6 (Frog nylon)	13,000
12 × 4 (Trucut)	9,000
11 × 4 (Trucut)	10,200
10 × 4 (Trucut)	10,800
9 × 4 (Trucut)	13,500
9 × 6 (Trucut)	11,700

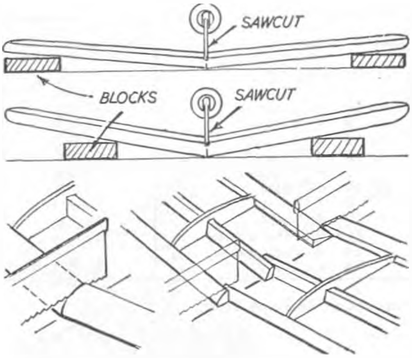
Fuel used: K.K. Methanex
AEROMODELLER Plans Service Power Coding "K"

"CUT AND TRY" COMPOUND JOINTS

The most accurate method of trimming butt-jointed wing spars at a centre wing joint is "cut and try", using a thin sawblade—*e.g.*, a fine hacksaw blade or, preferably, a small stiff-backed saw.

First trim the spar edges to rough angle, but overlength. Then support the wing halves at a corresponding dihedral (appreciably less than that required) and run the saw blade between the spar ends to trim to this setting. Increase the dihedral progressively (*e.g.*, by moving the blocks inwards), trimming each time, until the correct dihedral is obtained with a dead-true fit on all the spars.

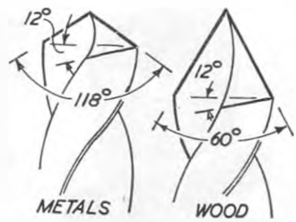
The technique is simply that with the spars pressed together their ends



will be trimmed to a correct matching angle by sawing gently through the joint. Each spar joint is, of course, treated separately—leading edge, mainspar(s) and trailing edge at each stage.

An alternative method is to set the two wing halves up at the *correct* dihedral initially, but with the spars staggered behind each other. One sawcut through each spar pair then produces a matching joint face.

DRILLING HARDWOOD



Ordinary twist drills are *not* the right kind for drilling wood. They definitely overheat if drilling to any depth in hardwoods. However, they are almost invariably used for wood drilling up to $\frac{1}{4}$ in. diameter and especially on thin materials like ply. You can make a twist drill cut better in all woods by using a more pointed tip—ground to 60 deg. instead of the 118 deg. standard for metal drilling.

Useful drill sizes to know are those corresponding to "clearance" and "tapping" sizes for standard model threads and wire gauges. Data on these are given in the tables. Clearance drill sizes are essentially nominal, but are based on the smallest clearance dimension given with standard drills. Various tapping sizes are possible, resulting in different depths of thread cut.

CLEARANCE DRILLS FOR S.W.G. WIRE SIZES

S.W.G	8	10	12	14	16	18	20	22
Drill No.	20	30	36	46	51	55	63	69

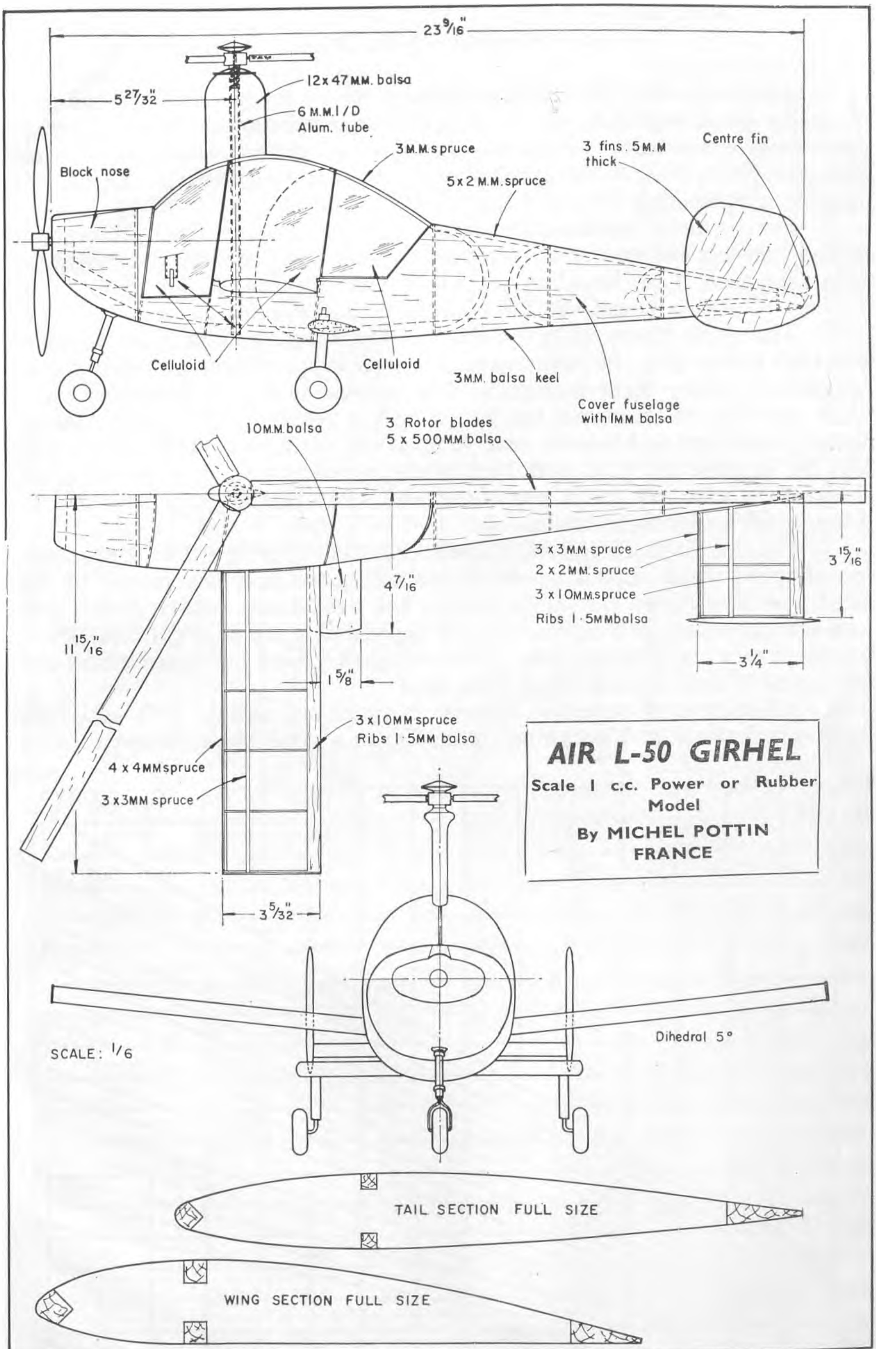
CLEARANCE DRILLS FOR B.A. SCREW THREADS

B.A. Size	0	1	2	3	4	6	8	10
Drill	6 mm. or $\frac{1}{4}$"	No. 3	No. 12 or [illegible]	No. 19 or $\frac{11}{64}$"	No. 27 or $\frac{5}{32}$"	No. 34 or [illegible]	No. 43 or [illegible]	No. 50 or [illegible]

TAPPING DRILLS FOR B.A. SCREW THREADS

B.A. Size	0	1	2	3	4	6	8	10
Tapping Drills*	No. 12 (100) No. 11 (96) No. 10 (90) No. 9 (85) No. 8 (78) No. 7 (74)	$\frac{11}{64}$" (86) No. 19 (100) No. 18 (92) No. 17 (89) No. 16 (74)	$\frac{5}{32}$" (75) No. 26 (99) No. 25 (93) No. 24 (86) No. 23 (81) No. 22 (73)	No. 30 (95)	No. 34 (99) No. 33 (92) No. 32 (83)	No. 44 (96) No. 43 (84)	No. 51 (96) No. 50 (81)	No. 55 (90) No. 54 (88)

* Figures in brackets give corresponding depth of thread (%).



MODELE REDUIT D'AVION

SPEED TABLES

THE main table lists theoretical maximum speeds for given r.p.m. and propeller pitch combinations (actually 3·6 per cent below the true theoretical figure to give convenient figures and to allow for practical variations in actual geometric pitch, *etc.*). Actual speed achieved with any particular model-engine-propeller combination will equal this speed less the *slip*.

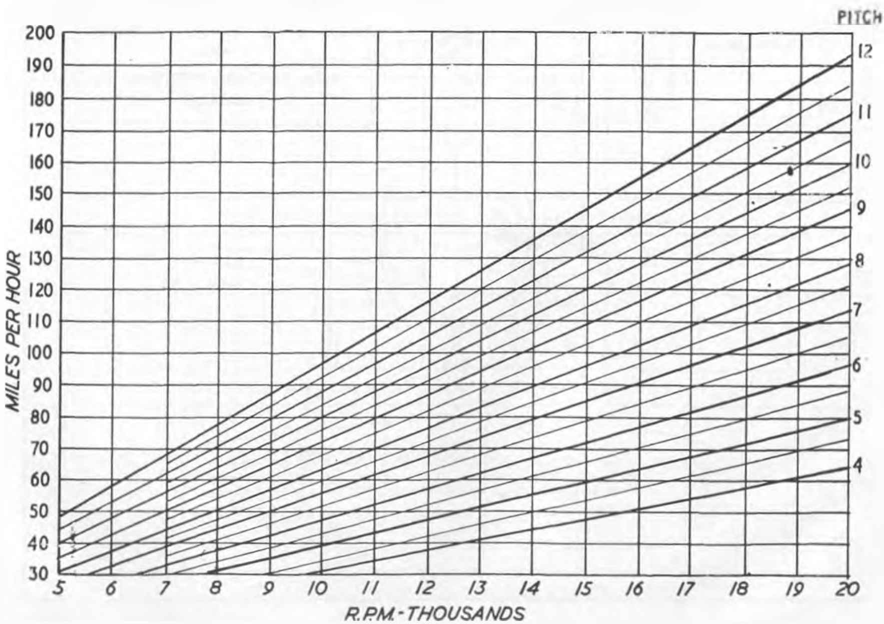
For a general estimate, slip can be taken as a nominal 20 per cent for control line models; and 20-25 per cent for free flight models, depending on design and trim. Thus for a 6 in. pitch propeller turning at 12,000 r.p.m.:

speed = 80% of 66 m.p.h. = 52·8 m.p.h.

The r.p.m. figure refers to the actual operating r.p.m. in flight, which is invariably higher than the static r.p.m. achieved with the same propeller due to "unloading" under flight conditions. The increase in flight r.p.m. over static r.p.m. can only be estimated, but 10 per cent is generally taken as an average figure. Glow motors, however, tend to speed up in the air more than diesels. Also the increase in r.p.m. with high pitch propellers may be expected to be greater than with low pitch propellers; and some plastic propellers tend to change pitch under flight conditions.

The chart is based on control line speed data and gives a close approximation of speed which should be obtainable with given propeller pitches at the stated operating r.p.m. (*i.e.*, flight r.p.m., not static r.p.m. achieved with that particular propeller). It is estimated on an approximate slip of 15 per cent, which appears to be a practical figure for a well-designed control line speed model and also typical of a good streamlined team racer.

Adjustment of propeller *diameter* is concerned mainly with achieving the required *thrust* and operating r.p.m. Given a good blade section to start

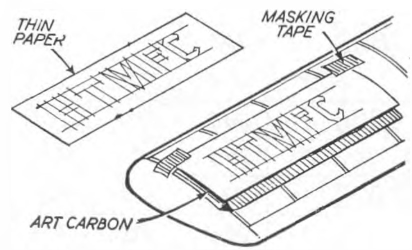


M.P.H. FOR GIVEN PITCH and R.P.M. (NO SLIP)
(3·6 per cent below theoretical figure)

R.P.M	PROPELLER PITCH—INCHES 3	4	5	6	7	8	9	10
5,000	15·0	20·0	25·0	30·0	35·0	40·0	45·0	50·0
500	16·5	22·0	27·5	33·0	38·5	44·0	49·0	55·0
6,000	18·0	24·0	30·0	36·0	42·0	48·0	54·0	60·0
500	19·5	26·0	32·5	39·0	45·5	52·0	58·5	65·0
7,000	21·0	28·0	35·0	42·0	49·0	56·0	63·0	70·0
500	22·5	30·0	37·5	45·0	52·5	60·0	67·5	75·0
8,000	24·0	32·0	40·0	48·0	56·0	64·0	72·0	80·0
500	25·5	34·0	42·5	51·0	59·5	68·0	76·7	85·0
9,000	27·0	36·0	45·0	54·0	63·0	72·0	81·0	90·0
500	28·5	38·0	47·5	57·0	66·5	76·0	85·5	95·0
10,000	30·0	40·0	50·0	60·0	70·0	80·0	90·0	100·0
500	31·5	42·0	52·5	63·0	73·5	84·0	94·5	105·0
11,000	33·0	44·0	55·0	66·0	77·0	88·0	99·0	110·0
500	34·5	46·0	57·5	69·0	80·5	92·0	103·5	115·0
12,000	36·0	48·0	60·0	72·0	84·0	96·0	108·0	120·0
500	37·5	50·0	62·5	75·0	87·5	100·0	112·5	125·0
13,000	39·0	52·0	65·0	78·0	91·0	104·0	117·0	130·0
500	40·5	54·0	67·5	81·0	94·5	108·0	121·5	135·0
14,000	42·0	56·0	70·0	84·0	98·0	112·0	126·0	140·0
500	43·5	58·0	72·5	87·0	101·5	116·0	130·5	145·0
15,000	45·0	60·0	75·0	90·0	105.0	120.0	135.0	150·0
500	46·5	62·0	77·5	93·0	108·5	124·0	139·5	155·0
16,000	48·0	64·0	80·0	96·0	112·0	128·0	144·0	160·0
500	49·5	66·0	82·5	99·0	115·5	132·0	148·5	165·0
17,000	51·0	68·0	85·0	102·0	119·0	136·0	153·0	170·0
500	52·5	70·0	87·5	105·0	122·5	140·0	157·5	175·0
18,000	54·0	72·0	90·0	108·0	126·0	144·0	162·0	180·0
500	55·5	74·0	92·5	111·0	129·5	148·0	166·5	185·0
19,000	57·0	76·0	95·0	114·0	133·0	152·0	171·0	190·0
500	58·5	78·0	97·5	117·0	136·5	156·0	175·5	195·0
20,000	60·0	80·0	100·0	120·0	140·0	160·0	180·0	200·0

with, diameter can be considered as controlling *thrust* (fixing a minimum diameter size below which the necessary thrust is no longer available), and finally the blade *section* the ultimate r.p.m. achieved. The correct initial choice of propeller, and any subsequent re-working, are critical factors in arriving at the maximum potential speed estimated by the *graph*. It is unlikely that such speeds will be exceeded under normal operating conditions, but it should be possible to achieve them. The theoretical figures given in the table cannot, of course, be achieved in normal horizontal flight as at such corresponding speeds the propeller would be generating no thrust.

"SIGNWRITING" TIP

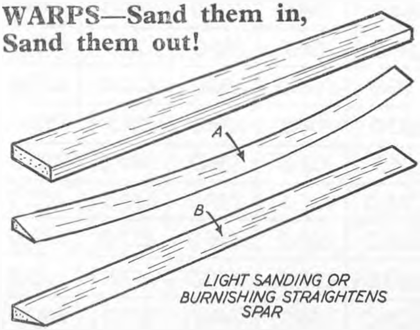


Anyone with a reasonably steady hand can do a successful job of " signwriting" on wings, *etc.* First the letters (or numbers) should be drawn out full-size between guide lines, on thin paper, just as they are to appear. It is far easier to rough out and finalise outlines and proportions on flat paper than trying to do this direct on a wing or fuselage surface—and a more artistically gifted friend can often be co-opted at this stage.

The pattern is then fixed in position using masking tape at the two top corners (do not use ordinary cellulose tape as this may stick too well to remove). Lay a piece of *draughting carbon* underneath and transfer the pattern onto the wing surface with a pencil, ruling all straight edges for neatness.

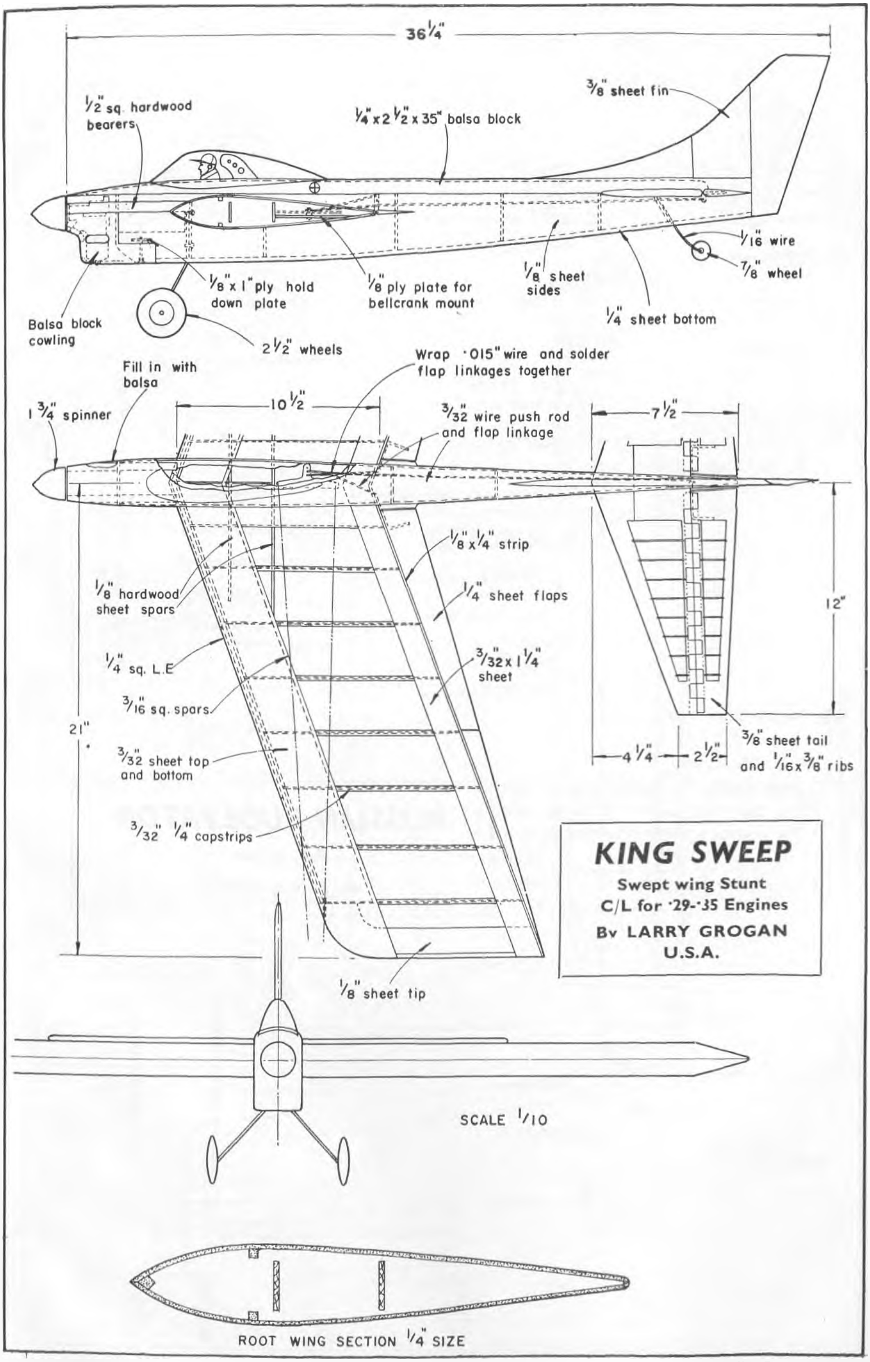
Remove the pattern and carbon and then block in with solid colour freehand. You will find it easiest to carefully draw in the outline of each letter first, then fill in solid. Clean off ragged edges *immediately* by scraping with a razor blade. Finally, if your edges are not as neat as you want them, use a ruling pen and coloured dope to *draw* the finished outlines.

WARPS—Sand them in, Sand them out!

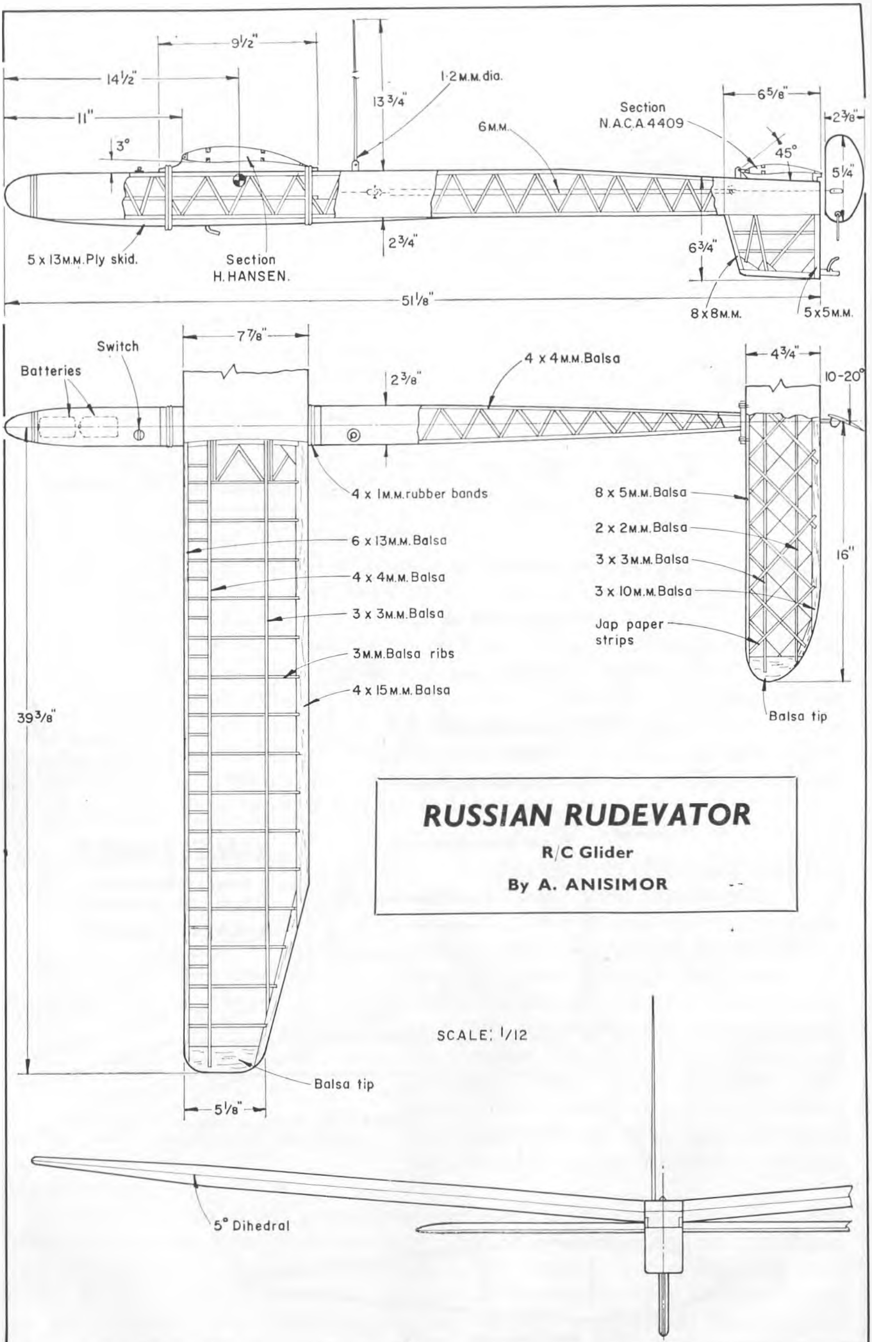


The very act of shaping a trailing edge section from rectangular strip tends to give it an inherent curl or warp. This is especially true of finish-sanding a trailing edge, which then inevitably tends to curl up. Thus on light wings and tails, the trailing edge should always be *finished* before pinning down over the plan. Shape it *after* you have completed the frame and you are working in a natural warp. This may not show up at once, but it will certainly develop after covering.

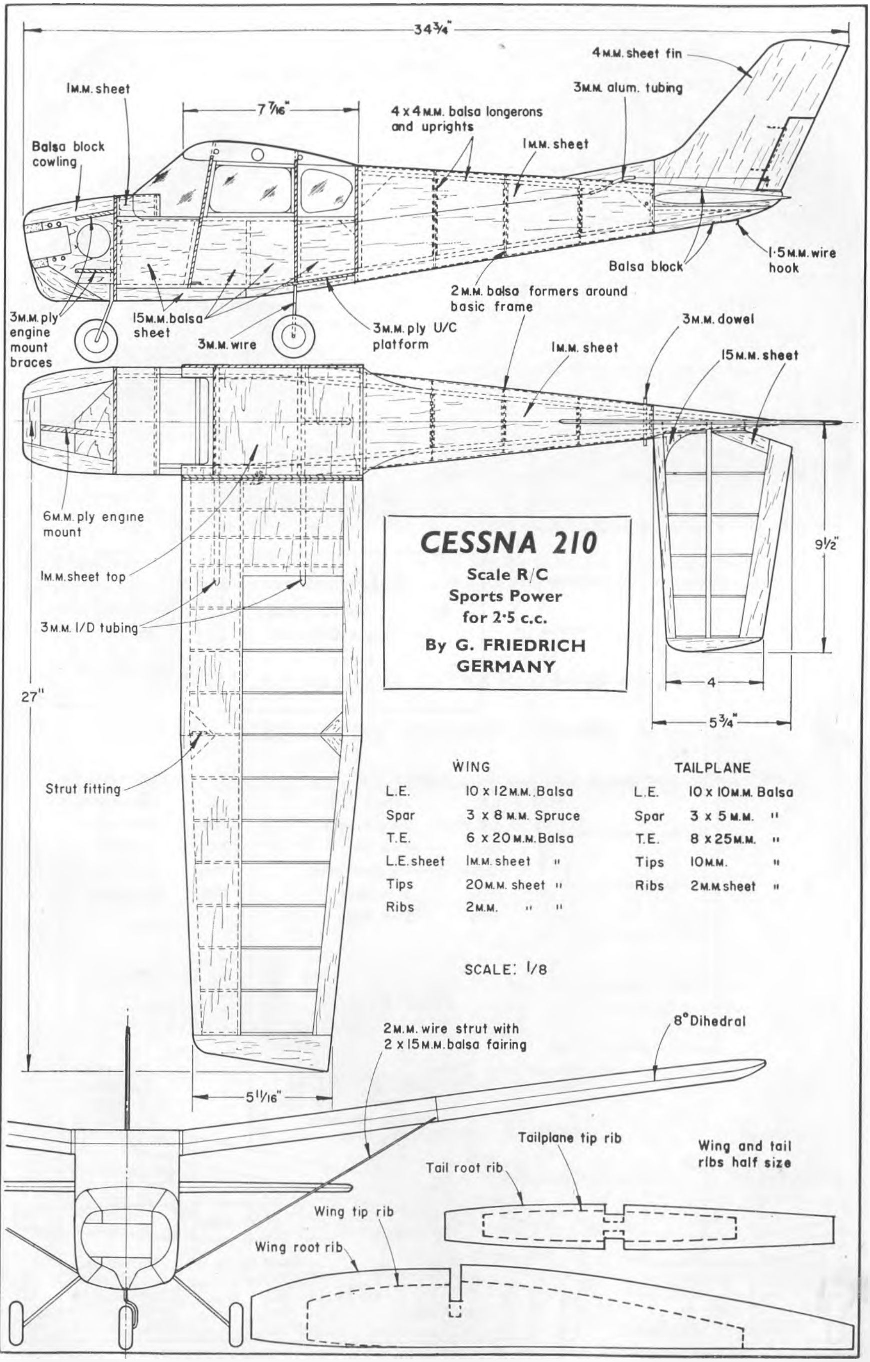
Here is a tip about controlling the warping of spars, *etc.* Take that trailing edge section again which has been finished by sanding and has developed a curl through the work done on surface *A*. Now turn it over and lightly sand surface *B*. This method also works on normal rectangular spar sections which have got a natural warp. Sanding the face on the "outside" of the curl will gradually straighten the length out.



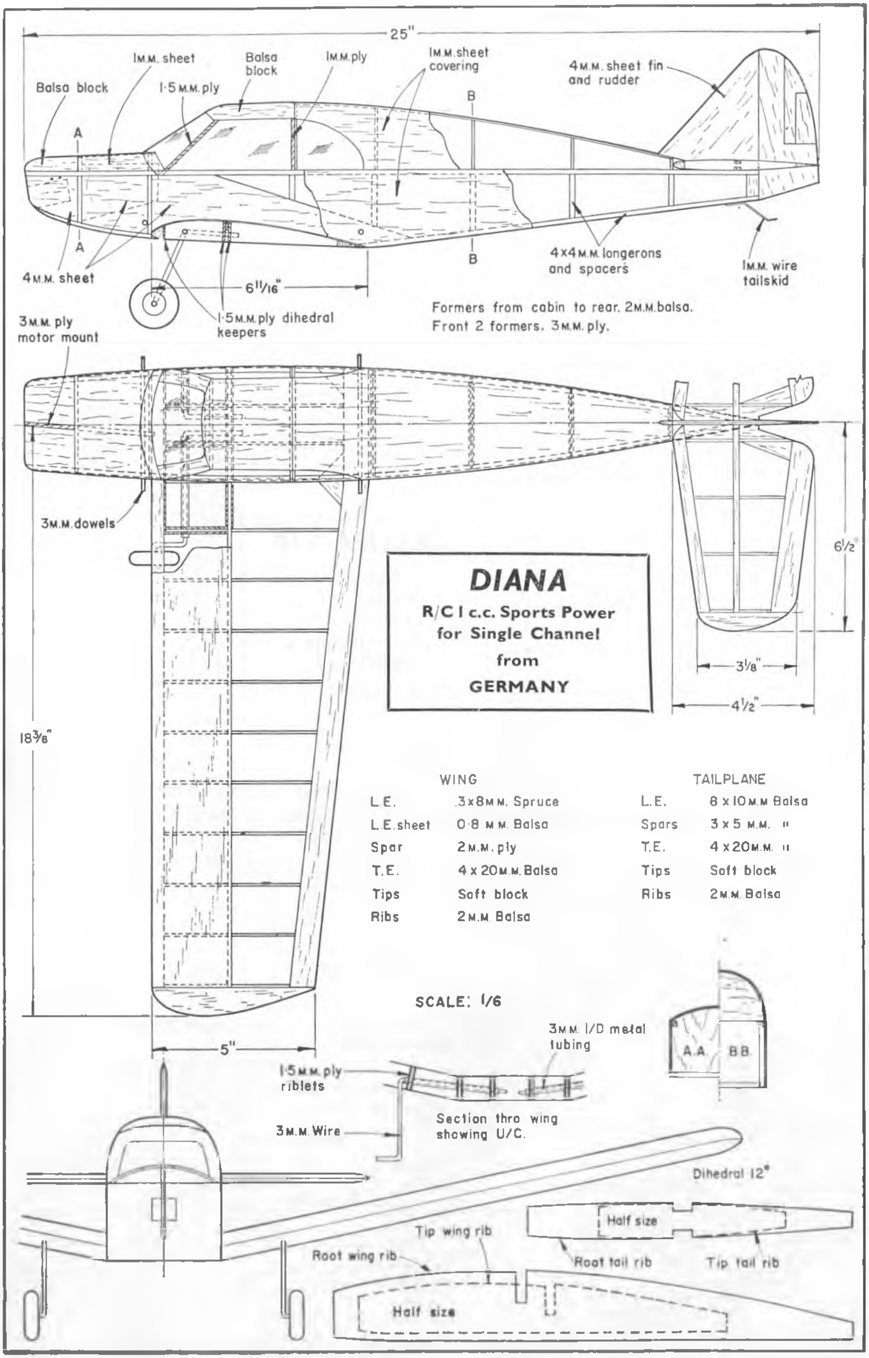
FLYING MODELS


9½"
14½"
11"
3°
13¾"
1·2 M.M. dia.
6 M.M.
Section
N.A.C.A. 4409
6⅝"
2⅜"
45°
5¼"
5 x 13 M.M. Ply skid.
Section
H. HANSEN.
2¾"
6¾"
51⅛"
8 x 8 M.M.
5 x 5 M.M.
Switch
Batteries
7⅞"
2⅜"
4 x 4 M.M. Balsa
4¾"
10-20°
4 x 1 M.M. rubber bands
6 x 13 M.M. Balsa
4 x 4 M.M. Balsa
3 x 3 M.M. Balsa
3 M.M. Balsa ribs
4 x 15 M.M. Balsa
8 x 5 M.M. Balsa
2 x 2 M.M. Balsa
3 x 3 M.M. Balsa
3 x 10 M.M. Balsa
Jap paper strips
16"
Balsa tip
39⅜"
RUSSIAN RUDEVATOR
R/C Glider
By A. ANISIMOR
SCALE: 1/12
Balsa tip
5⅛"
5° Dihedral

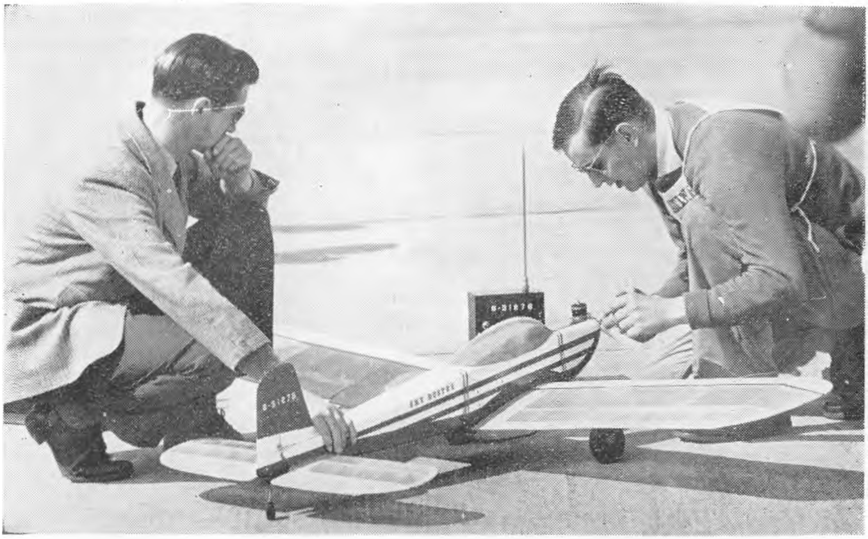
MECHANIKUS



FLUG MODELL-TECHNIK



FLUG MODELL-TECHNIK



Frank van den Bergh who came fourth and top British team member prepares to start his *Sky Duster*. Assisting him is Ed. Johnson, a fine r/c flyer himself, who was acting for the first time as British Team Manager.

FIRST F.A.I. RADIO CONTROLLED MODEL AIRCRAFT CHAMPIONSHIP

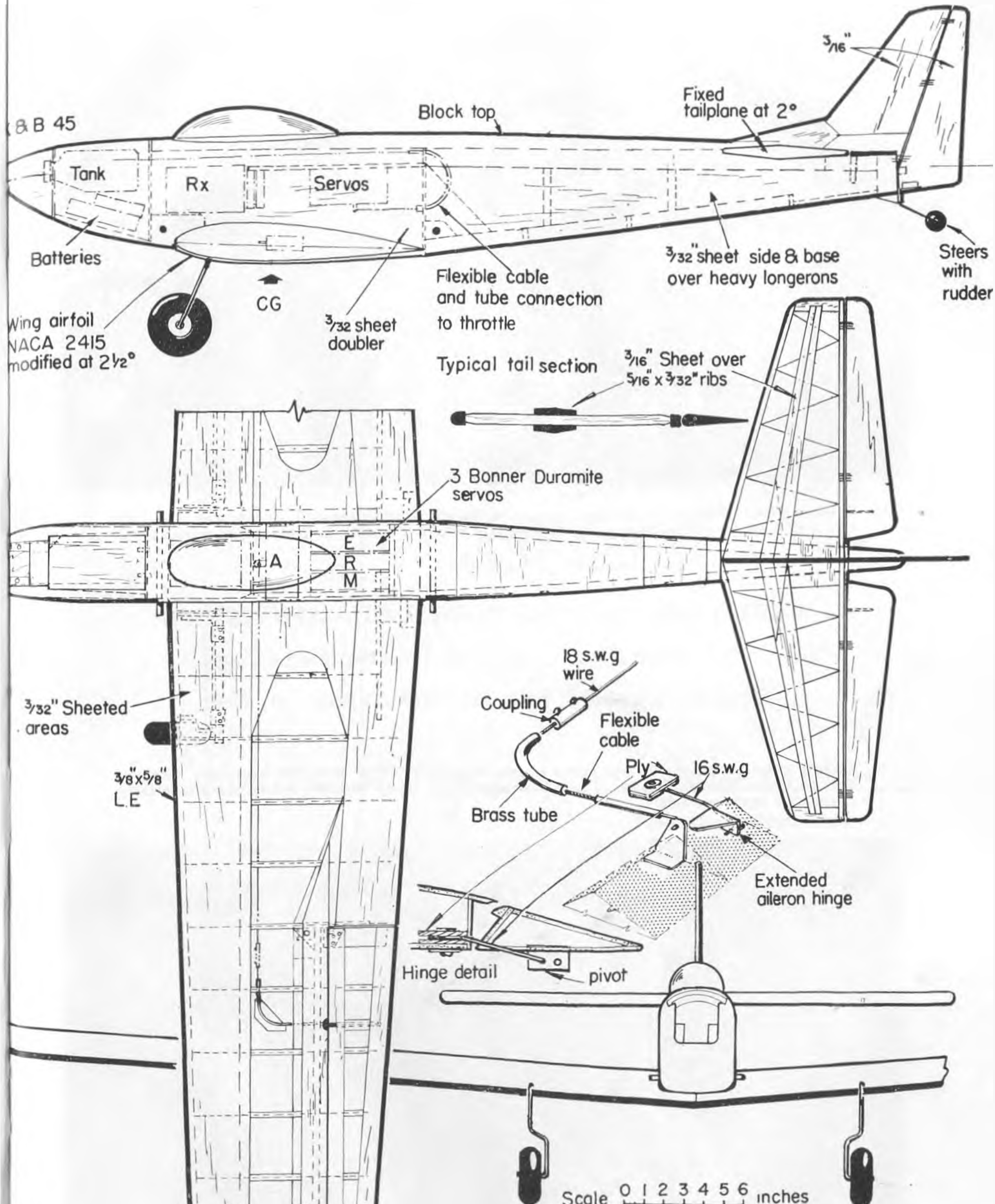
Held at Dubendorf, Zurich, Switzerland, July 23rd/25th, 1960

RESULTS

Place	Name	Country	1	2	Total	Engine	R/C Equipment
1	Kazmirski, E. ...	U.S.A. ...	6,275	6,183	12,458	K. & B. 45	Orbit
2	Samann, G. ...	Germany ...	5,611	5,650	11,261	Ruppert 9·7	Bellaphon
3	Stegmaier, K-H. ...	Germany ...	5,233	5,940	11,173	Ruppert 9·3	Stegmaier
4	Van den Bergh, F.	Great Britain ...	5,082	5,932	11,014	K. & B. 45	Orbit
5	Olsen, C. H. ...	England ...	5,317	5,327	10,644	ETA 29	R.E.P
6	Gobeaux, J-P. ...	Belgium ...	4,977	5,021	9,998	Ruppert 9·6	o/d
7	De Bolt, H. F. ...	U.S.A. ...	2,702	5,668	8,370	K. & B. 45	Bramc
8	Uwins, S. E. ...	England ...	1,678	5,394	7,072	Merco 35	R.E.P.
9	Klauser, E. ...	Switzerland ...	2,651	3,951	6,602	FMO	o/d
10	Dunham, R. ...	U.S.A. ...	4,923	385	5,308	K. & B. 45	Orbit
11	Bickel, F.	Switzerland ...	610	3,844	4,454	O.S. 35	Nievergelt
12	De Dobbeler, J. ...	Belgium ...	820	1,869	2,689	Webra	Orbit
13	Maritz, W.	Switzerland ...	1,151	425	1,576	Ruppert 7·6	OMU
14	Hajic, J.	Czechoslovakia	800	631	1,431	M.V.V.S.	o/d
15	Havlin, Z.	Czechoslovakia	754	336	1,090	M.V.V.S.	o/d
16	Dilot, R.	Sweden ...	105	850	955	K. & B. 45	Bramco
17	Gast, H.	Germany ...	632	—	632	Ruppert 9·6	Stegmaier
18	Michalovic, J. ...	Czechoslovakia	514	—	514	M.V.V.S.	o/d
19	Corghi, E.	Italy	425	—	425	—	—
20	Eliasson, P-A. ...	Sweden ...	95	—	95	O.S. 29	REP

Winner Ed. Kazmirski of U.S.A. with his winning model *Orion* as superbly finished a machine as ever graced a world championship. Famous radio control pioneer Dr. Walt Good, U.S. Team Manager, is in the background with the team's monitor in his hand.

Second man, Gustav Samann of Germany, with Mrs. Samann who proved a most attractive and skilful mechanic. This is the first occasion another German has surpassed the famous K. H. Stegmaier, who followed in third place.



Ed. Kazmirski's *Orion* a model of 5 ft. 8 in. wingspan, and all up weight of about 6 lbs. 2 oz., and wingloading of 16 oz. to the square foot. Sleek lines make for good penetration, and, in common with usual U.S. practice, is flown continuously at high speed throughout the pattern.

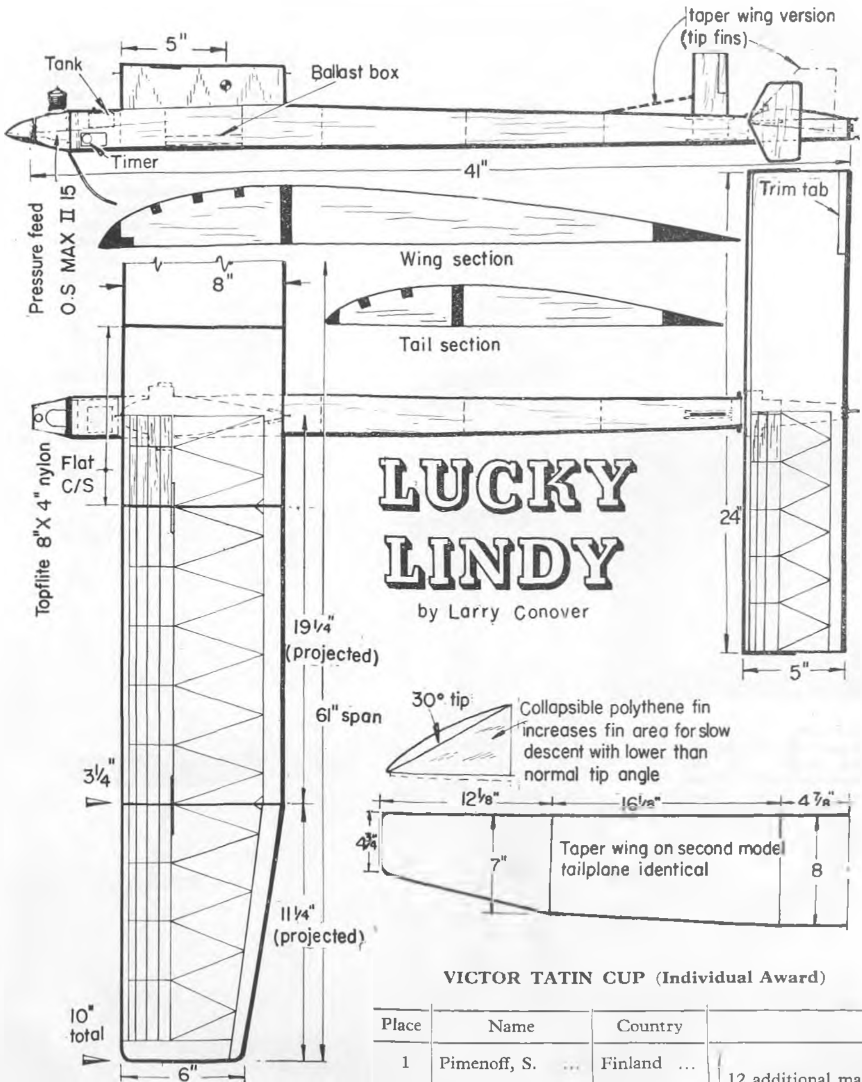
Famous five! Survivors of the marathon fly-off, who remained undefeated after 17 rounds! Left to right: Sheppard, Pimenoff, Conover, Guerra and Hagel, declared joint winners.

WORLD FREE FLIGHT POWER CHAMPIONSHIPS

for Franjo Kluz Trophy and Victor Tatin Cup

Held at Cranfield, July 31st and August 1st, 1960

Second time successful in the team event, the Hungarians pose for a victory picture. Left to right: Simon, Frigyes, Team Manager Beck, and Meczner, with their identically decorated team models.



Lucky Lindy—one of the winning five. Larry Conover's model was in the opinion of the experts the model with the "most in hand"—with greater height on power run, and more altitude when d/t came in. Taper wing version was used only for first round.

VICTOR TATIN CUP (Individual Award)

Place	Name	Country	
1	Pimenoff, S. ...	Finland ...	12 additional maximums at close of fly-off. Each has been declared JOINT CHAMPION
	Guerra, G. ...	Italy ...	
	Sheppard, J. ...	New Zealand	
	Hagel, R. E. ...	Sweden ...	
	Conover, L. H....	U.S.A. ...	
6	Sulisz, Z. ...	Poland ...	8 Maximums and 0
7	POSNER, D. S.	Great Britain	4 Maximums and 156
8	Frigyes, E. ...	Hungary ...	3 Maximums and 129
9	Bulukin, B. W.	Norway ...	2 Maximums and 147
10	Fontaine, J. ...	France ...	1 Maximum and 177
11	Johannessen, T.	Norway ...	1 Maximum and 0
12	Miller, E. W. ...	U.S.A. ...	86
13	Winn, J. (V. Jays)	New Zealand	8

Study in launching styles!
Top left is Pimenoff, at an early morning practice flight fairly zinging it away. Identical release angle was noticed on every flight.

Centre: Redoubtable Guerra of Italy, who waited until the engine scream was just right (18,000 r.p.m. plus by the way) and then launched firm footed.

Below: Larry Conover had the easiest task. Lucky Lindy flew out of his hands. He is poised quietly and has just pointed her and let go.

Below: Hagejof Sweden with his equal-first model. It was powered with the ever popular Oliver Tiger in common with three others in the fly-off thirteen.

VICTOR TATIN CUP—INDIVIDUAL RESULTS

Place	Name	Country	Flight 1	2	3	4	5	Tot.	Engine
1	Pimenoff, S. ...	Finland ...	180	180	180	180	180	900	ETA 15
	Fontaine J. ...	France ...	180	180	180	180	180	900	Oliver Tiger
	POSNER, D. S.	Great Britain ...	180	180	180	180	180	900	ETA 15
	Frigyes, E. ...	Hungary ...	180	180	180	180	180	900	Kriszma Record
	Guerra, G. ...	Italy	180	180	180	180	180	900	Super Tigre G20G
	Sheppard, J. ...	New Zealand ...	180	180	180	180	180	900	ETA 15
	Winn, J. (V. Jays)	New Zealand ...	180	180	180	180	180	900	Cox Olympic
	Bulukin, B. W. ...	Norway ...	180	180	180	180	180	900	Oliver Tiger
	Johannessen, T.	Norway ...	180	180	180	180	180	900	Oliver Tiger
	Sulisz, Z. ...	Poland ...	180	180	180	180	180	900	Kriszma Record
	Hagel, R. E. ...	Sweden ...	180	180	180	180	180	900	Oliver Tiger
	Conover, L. H. ...	U.S.A.... ...	180	180	180	180	180	900	O.S. Max 15
	Miller, E. W. ...	U.S.A.... ...	180	180	180	180	180	900	O.S. Max, 15
14	Grappi, R. ...	Switzerland ...	180	176	180	180	180	896	Taifun Hurricane
15	Giudici, G. ...	France ...	173	180	180	180	180	893	Oliver Tiger
16	Beck, H.... ...	Germany ...	180	180	173	177	180	890	Webra MACH 1
17	Czerny, J. ...	Czechoslovakia	168	180	180	180	180	888	M.V.V.S. 2·5 G
18	Meczner, A. ...	Hungary ...	180	167	180	180	180	887	Kriszma Record
19	Bousfield, K. ...	Canada ...	180	180	175	171	180	886	Cox Olympic
20	Simon G. ...	Hungary ...	180	180	180	180	165	885	Kriszma Record
21	Scott, J.	Canada ...	180	180	180	180	164	884	Oliver Tiger
22	Czepa, O. ...	Austria ...	180	180	180	162	180	882	Cox Olympic
23	Schilling, H. G....	Germany ...	180	180	161	180	180	881	O/D 2 c.c.
24	Green, K. W. (J. West)	Australia ...	160	180	180	180	180	880	O.S. Max 15
	Padavano, E. ...	Italy	180	180	165	175	180	880	Super Tigre G20D
26	Hagberg, M. ...	Sweden ...	180	180	180	157	180	877	Oliver Tiger
27	Thompson, J. ...	Ireland ...	178	180	180	180	152	870	Oliver Tiger
28	Eng, E.	Switzerland ...	157	180	180	160	180	857	Webra Record
	Falecki, J. ...	Poland... ...	167	179	170	161	180	857	Kriszma Record
30	Blanchard, W. S.	U.S.A.... ...	134	180	180	180	180	854	Cox (Drum)
31	Jokinen, I. ...	Finland ...	180	180	180	180	127	847	Oliver Tiger
	SIMEONS, J. R.	Great Britain ...	164	180	180	143	180	847	ETA 15
33	Groves, K. ...	Canada ...	126	180	180	180	180	846	Sugden Special
34	Czerny, R. ...	Czechoslovakia	180	180	180	180	125	845	M.V.V.S. 2·5 D
	Hajek, V. ...	Czechoslovakia	140	180	180	165	180	845	M.V.V.S. 2·5 D
36	Guilloteau, R. ...	France... ...	180	180	180	121	180	841	Super Tigre G.30
37	Hormann, G. ...	Austria ...	180	180	110	180	180	830	Cox Olympic
38	Ono, H. (A. W. Spurr)	Japan	180	180	180	180	105	825	Enya 15D
39	Morelli, A. (G. Woodsworth)	Ireland ...	171	180	180	180	112	823	Oliver Tiger
40	Schenker, R. ...	Switzerland ...	180	120	180	180	148	808	Oliver Tiger
41	Rizzo, S.... ...	Italy	178	180	180	106	160	804	Super Tigre G20D
42	O'Sullivan, J. ...	Ireland ...	134	180	180	122	180	796	PAW 1·49
43	Eriksson, M. ...	Sweden ...	146	139	128	180	180	773	Oliver Tiger
44	Dalseg, G. ...	... ...	114	180	180	119	173	766	Oliver Tiger
45	Baker, R. S. B. ...	Australia ...	125	163	180	156	131	755	Oliver Tiger
46	Suzuki, H. (T. W. Smith)	Japan	0	180	180	180	180	720	Enya 15D
47	YOUNG, A. G.	Great Britain ...	169	174	179	116	76	714	Oliver Tiger
48	Hewittson, N. (K. J. Glynn) ...	New Zealand ...	52	180	180	180	111	701	Oliver Tiger
49	Sorensen, H. S. ...	Denmark ...	127	139	180	0	180	626	Zeiss III
50	Schwend, T. ...	Germany ...	0	152	180	167	92	591	Webra Mach 1
51	Gerstrom, C. ...	Denmark ...	92	172	72	120	118	574	Zeiss III
52	Niemi, O. ...	Finland ...	5	0	115	180	180	480	Oliver Tiger
53	Niedermayr, F. ...	Austria ...	75	22	61	102	146	406	Webra Mach 1
54	Christensen, N. C.	Denmark ...	59	130	101	0	0	290	Oliver Tiger

FRANJO KLUZ TROPHY (Team Results)

1. Hungary
2. U.S.A.
3. France
4. Canada
5. Italy
6. Czechoslovakia
7. Norway
8. Switzerland
9. Sweden
10. New Zealand
11. Ireland
12. Great Britain
13. Germany
14. Finland
15. Austria
16. Poland
17. Australia
18. Japan
19. Denmark

Free flight scale winner at British Nationals: B. Newman with his A.M.35 powered D.H. Beaver. Inset: Twin contra-rotating props, driving OS 15 and OS 35 of Bruce Randle's Gannet A.E.W., flown in Knokke C/L contest.

CONTEST RESULTS

Results of S.M.A.E. Contests for balance of 1959 season are included in this report to complete records. Those 1960 events which have been decided before going to press are also included and will be completed in next year's AEROMODELLER ANNUAL.

GODALMING C/L RALLY—June 14th, 1959.

Class "B" Team Race

1 McNess, J. K.	West Essex	7 : 46·5
2 Walker/Tuthill	Enfield	7 : 54·6
3 Drewell, P.	LOMAC	11 : 5

F.A.I. Team Race

1 Hartwell/Allen	Enfield	5 : 38·8
2 Williams, J.	Ecurie Endevour	5 : 47·5
3 Tyler, D.	Feltham Eagles	5 : 47·8

Combat

1 Palmer, J.	Wimbledon
2 Cherry, D.	Wimbledon

Sunt

		pts.
1 Fisher	Coventry	448
2 Brown, R.	Lee Bees	447
3 Thwaites, P.	Lee Bees	405
4 Perry, J.	Wimbledon	367

NORTHERN HEIGHTS GALA—June 21st, 1959—R.A.F. Halton.

Queen Elizabeth Cup (Wakefield)

		pts.
1 Lefever, G. J.	South Essex	501
2 Fuller, G.	St. Albans	480
3 Dixon, M.	Leamington	417

Flight Cup (Open Rubber)

1 Greaves, D.	Leamington	360 + 395
2 Elliott, N. P.	Men of Kent	360 + 363
3 Barnacle, E.	Leamington	360 + 296

Fairey Cup (Open Glider)

1 Foxall, J. H.	Northwick Park	360 + 145
2 Orde-Hume, J.	Northampton	360 + 103
3 Wiggins, E.	Leamington	360 + 99

Thurston Trophy (Helicopter) *pts.*

1 Jukes, E. J.	107
2 Dudley, R. M.	82
3 Boreham, F. G.	28

De Havilland Bowl (Open Power)

1 Lennox, N.	Birmingham	360 + 189
2 Lovett, M.		360 + 160
3 Dodd, P.	Surbiton	360 + 124

R.A.F. Review Cup (Radio Control, spot landing)

1 Norman, P. E.	19 ft.
2 Knights, D.	48 ft.
3 Batchelor, J.	55 ft.

Keil Cup (combat)

1 Pratt, K.	Northwood
2 Smith, M.	High Wycombe

Concours d'Elegance

General Flying Models	Williamson —.	A/2 Glider
Power Models	Spence, V.	Westland Widgeon
Flying Scale	Aaron, R. L.	Bleriot
Special Award	Evans, A. W.	Sikorski 39B

"AEROMODELLER" Trophy Gala Championship

Barnacle, E. Leamington

THE MODEL ENGINEER CUP (Team Glider)—July 12th, 1959. 156 *entries*).

1 St. Albans	25·43
2 Northern Heights	21·34
3 Birmingham	21·21
4 Essex	20·22
5 Baildon	19·57
6 Coventry	19·46

FLIGHT CUP (**Open Rubber**)**—July 12th, 1959.** (51 *entries*).

U/R Rubber

1 O'Donnell, J.	Whitefield	11·20
2 Crossley, P.	Blackheath	10·52
3 Tubbs, H.	Baildon	9·55
4 Chambers, T. B.	Teeside	9·33
5 Roberts, G. L.	Lincoln	8·49
6 Thorp, E.	Derby	7·57

F.A.I. POWER CHAMPIONSHIPS—"Aeromodeller" Cup—July 12th, 1959. (15 *entries*).

1 Posner, D.	Surbiton	29·58
2 Jays, V.	Surbiton	29·53
3 Manville, P.	Bournemouth	28·45
4 Young, A.	Surbiton	28·26
5 Cox, B.	St. Albans	28·22
6 Spurr, A. W.	Teeside	25·52

NORTHERN GALA—September 6th, 1959—R.A.F. Rufforth. (153 *Competitors*: 9 *triple maximums*).

Open Rubber (**Caton Trophy**)

1 O'Donnell, J.	Whitefield	12·00 + 5·28
2 Elliott, N.	N. Kent	12·00 + 4·30
3 Black, E.	Glasgow	12·00 + 4·10
4 Cliff, N.	Prestwick	12·00 + 3·34
5 Kimber, A.	Eng. Elec.	12·00 + 3·27
6 Pool, J.	Halifax	12·00 + 3·15

P.A.A. Load (7 *Competitors*)

1 Collinson	Faildon	9·08
2 Farrar, A.	Wakefield	6·41
3 Muller, P.	Surbiton	5·18
4 Lord, E.	E. Lancs	5·15
5 Firth, R.	Sheffield	5·15
6 Robson, A.	Teeside	2·29

Open Glider (99 *Competititors*, 6 *triple maximums*.

1 Jackson, C.	Chorlton	9·00 + 2·13
2 Rider, J.	Wigan	9·00 + 2·12
3 Sheppard, J. M.	New Zealand	9·00 + 1·58
4 Shirt, R.	N. Sheffield	9·00 + 1·55
5 Garnett, A.	E. Lancs	9·00 + 1·25
6 Broadbent, E.	Ashton	9·00 + 1·23

Open Power (**Hamley Trophy**). (70 *Competitors*)

1 Collinson, A. R.	Baildon	12·00 + 7·58
2 Hutton, G.	Wallasey	12·00 + 4·51
3 Hosker, M.	Wigan	12·00 + 4·03
4 Hopkins, J. H.	Chorlton	11·52
5 Smith, T.	Cheadle	11·33
6 O'Donnell, J.	Whitefield	11·20

Team Racing—Class ½A

1 Basset, M.	Sidcup
2 Dew, D. R.	Sidcup
3 Templeman, J.	Sidcup

Class A

1 Stevens, F.	Enfield
2 Kirton, N.	Stanley
3 Riley, J.	Enfield

Glider from the Zigs M.F.C. being launched during Open Glider event at the British Nationals.

New name in combat during 1960, Healy of Weston-super-Mare fuels up his model at Northern Heights Gala—fine weather as usual!

Woodford "Stockport Advertiser" Rally entry. David Brown of Radcliffe with his scaled down version of Chris Olsen's *Uproar* Powered by a Mills ·75 it proved a consistent free flight performer.

Class B

1	Drewell, P.	Lomac
2	Rowley, T.	Neath
3	Steward, L.	West Essex

Radio Control ("Aeromodeller" Trophy

			pts.
1	Olsen, C. H.	C.M.	208·5
2	Johnson, J. E.	A.R.C.C.	165·5
3	Singleton, J.	A.R.C.C.	65·5

SCOTTISH GALA—August 23rd, 1959—R.A.F· Abbotsinch.

Open Rubber

1	Hosker, M.	Wigan	12·00
2	O'Donnell, J.	Whitefield	11·51
3	Wannop, U. A.	Edinburgh	11·28
4	B, Picken	Wigan	11·11
5	Pool, J. B.	Halifax	9·43
6	Tubbs, H.	Baildon	9·35

Open Glider

1	Talbot, B.	Wigan	9·00
2	Tideswell, G.	Baildon	7·53
3	Spurr, A. W.	Teeside	7·17
4	Meechan, W.	Glasgow	7·15
5	Foster, R.	Sheffield	7·06
6	Picken, B.	Wigan	6·58

Open Power

1	Farrar, A.	Wakefield	10·30
2	Talbot, B.	Wigan	9·55
3	Reid, D.	Edinburgh	9·24
4	Smith, A. J.	Stranraer	9·03
5	Lawrie, T.	Paisley	8·48
6	Campbell, J.	Paisley	8·36

Radio Control "Taplin" Trophy

			pts.
1	Parkinson, G. W.	Kendal	28
2	Craig, J.	C.M.	21
3	Dowker, P.	Kendal	17

Team Race—Class A **Class B**

1 Stoddart J. 1 Forrest, R.

KEIL TROPHY (Team Power)—**September 20th, 1959.** (31 *Clubs entered*).

1	Surbiton	48·00
2	East Lancs	45·32
3	St. Albans	44·43
4	Ashton	40·34
5	Coventry	38·18
6	Wigan	36·03

FARROW SHIELD (Team Rubber)—**September 20th, 1959.** (29 *Clubs entered*).

1	Coventry	44·32
2	Birmingham	43·25
3	Leamington	43·07
4	Hayes	41·07
5	Croydon	39·10
6	Surbiton	38·31

FROG JUNIOR TROPHY (Open Rubber/Glider)—**September 20th, 1959.** (20 *entries*).

1	Tossell, A.	Port Talbot	8·07
2	Jackson, C.	Chorlton	8·06
3	Moore, G.	Port Talbot	6·46

PLUGGE CUP

		pts.
1	Baildon	1544·243
2	Surbiton	1281·214
3	Coventry	1173·994

CROYDON GALA

Rubber

1	O'Donnel, J.	Whitefield	9·00 + 4 : 42
2	Thorpe, E.	Derby	9·00 + 3 : 10

Glider

1	Monks, R.	Birmingham	9·00 + : 10
2	O'Donnell, J.	Whitefield	9·00 + : 28

Power

1	Wisher, J.	Surbiton	7 : 50
2	Muller, P.	Surbiton	7 : 14

Slope Soaring

1	Baguley, I.	Hayes	2 : 11
2	Fuller, G.	St. Albans	1 : 15

ARTHUR MULLET MEMORIAL TROPHY

Barker, H. W.

½A Team Race (Cent.)—**September 27th 1959.** (3 *entries*).

1	Place, R.	Wharfedale
2	Turner, B.	Wharfedale

Class A Team Race. (19 *entries*).

1	Crofts, R.	Derby
2	Horton, J.	Wharfedale
3	Devill, R.	Derby

Class B Team Race. (13 *entries*).

1	Heworth, D.	Wharfedale
2	Rowley	Heath
3	Watson, J. K.	Thornaby

FROG SENIOR CUP (Open Power D/C)—**October 11th, 1959.** (97 *entries*).

1	Fuller, G.	St. Albans	12 : 00	12 : 06
2	Thorne, C.	Letchworth	12 : 00	7 : 26
3	O'Donnell, J.	Whitefield	12 : 00	6 : 59
4	Birks, J.	Chorlton	8 : 11	

C.M.A. CUP (Open Glider D/C). (150 *entries*).

1	Wright, J. (Jnr.)	Derby	9 : 00	2 : 43
2	Thorpe, E.	Derby	9 : 00	2 : 24
3	Smith, M.	Norwich	9 : 00	2 : 17

Senior Championship Trophy

O'Donnell, J.

Heather Cup (Junior Champion)

Mc.Lean, P. C.

Sid Allen Memorial Trophy (R/C Champion)

Olsen, C. H.

Witney Straight Trophy (Champion Area)

Midland

INDOOR NATIONALS — Corn Exchange, Manchester—February 13th/14th, 1960.

Microfilm (13 *entries*)

1	Parker, G.	Teeside	10 : 02
2	O'Donnell, J.	Whitefield	8 : 11
3	Grimmett, M.	West Brom.	7 : 46

Paper (13 *entries*)

1	Parham, R. T.	C.M.	8 : 08
2	Jukes, B.	Birmingham	7 : 58
3	Barnacle, E.	Leamington	7 : 35

Chuck Glider (33 *entries*)

1	Ellison, J. T.	Whitefield	0 : 38
2	O'Donnell, H.	Whitefield	0 : 37
3	Freeston, G.	Sheffield	0 : 30

WHITE CUP (Open Power)—March 6th, 1960. *Decentralised.* (59 *entries*).

1	Roberts, G. L.	Lincoln	12 : 00	4 : 04
2	Castell, G.	Letchworth	12 : 00	2 : 25
3	Thorne, C.	Letchworth	12 : 00	2 : 05
4	Willis, N.	Essex	11 : 51	
5	Carter, A.	Liverpool	11 : 28	

GAMAGE CUP (Open Rubber)—March 6th, 1960. *Decentralised.* (46 *entries*).

1	Elliott, N. P.	Southampton	12 : 00	4 : 50
2	Morley, D.	Lincoln		11 : 45
3	Monks R.	Birmingham		10 : 40
4	Parker A.	Exmouth		10 : 31
5	Broady, S.	Teeside		10 : 13

PILCHER CUP (Open Glider)—March 6th, 1960. *Decentralised.* (115 *entries*).

1	Dowling, B.	Watford Wayfarers	8 : 43
2	Dallimer, G. W.	Stevenage	8 : 40
3	Webb, A. C.	Brierly Hill	8 : 31
4	Aitkenhead, C. C.	Glevum	8 : 30
5	Perry, D.	Birmingham	8 : 03

K.M.A.A. CUP (F.A.I. Glider)—March 26th, 1960. *Area.* (169 *entries*).

1	Partirdge, D.	Croydon	15 : 00	1 : 47
2	Burrows, N.	St. Albans	13 : 42	
3	Bishop, J.	Small Heath	13 : 40	
4	Monks, R.	Birmingham	13 : 37	
5	Martin	Birmingham	13 : 36	
6	Wade, S. A.	C.M.	13 : 32	

GUTTERIDGE TROPHY (F.A.I. Rubber, Wakefield)—March 26th, 1960. *Area.* (39 *entries*).

1	Greaves, D.	Leamington	12 : 32
2	Roberts, G. L.	Lincoln	12 : 23
3	Picken, B.	Wigan	11 : 50
4	Wingate, J.	Eng. Elec.	11 : 34
5	Elliott, M. P.	Southampton	11 : 19
6	Rowe, B.	St. Albans	11 : 18

***WOMEN'S CUP—April 10th, 1960.** (*Provisional result*). (2 *entries*).

1	Allsopp, Miss S.	Essex	0 18
2	Kings, Mrs. P.	Essex	0 11

***JETEX TROPHY—April 10th, 1960.** (*Provisional result*). (3 *entries*).

1	O'Donnell, J.	Whitefield	20·5
2	Pressnell, M.	Essex	7·9
3	Worley, N.	Southampton	2·0

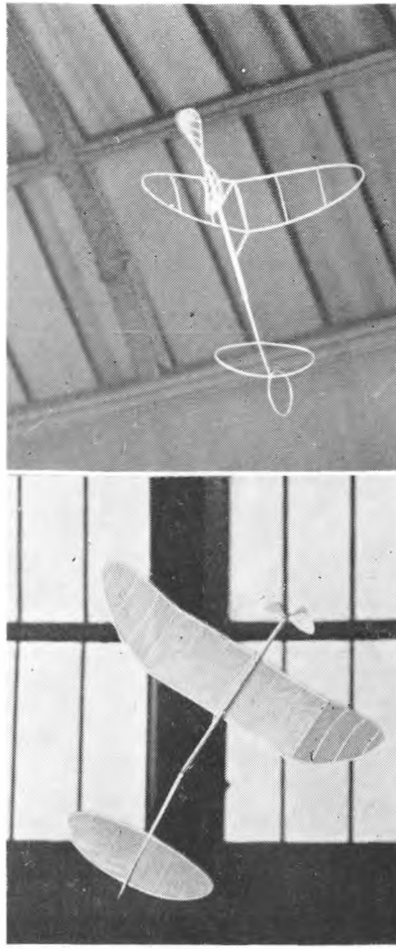
(* Below minimum entry to rank officially).

S.M.A.E. CUP (F.A.I. Glider)—April 10th, 1960. *Area.* (28 *entries*).

1	Tideswell, G.	Baildon	10 00
2	O'Donnell, J.	Whitefield	9·49
3	Lawson, P.	Baildon	9 08
4	Beal, G.	Mexboro'	6 56
5	Robson, A. M.	Teeside	6 17
6	Carson, P.	Sheffield	5 53

ASTRAL TROPHY (F.A.I. Power)—April 10th, 1960. *Area.* (16 *entries*).

1	Spurr, A. W.	Teeside	8·47
2	Wilmot, D.	Essex	6·09
3	King, M.	Essex	4·21
4	Cox, B.	St. Albans	2·37
5	Robson, D.	East Lancs	2·11
6	Eckersley, S.	Baildon	2·07



Shots from Indoor Nationals at the Corn Exchange, Manchester. Top, is Parham's Class A Microfilm entry, and below appears J. O'Donnell's paper covered model.

WESTON CUP (F.A.I. Rubber, Wakefield)—May 1st, 1950 *Area.* (58 *entries*).

1	O'Donnell, J.	Whitefield	14 : 40
2	{ Barnacle, E. A.	Leamington	14 : 21
	{ Roberts, L.	Lincoln	14 : 21
4	Elliot, N.	Southampton	14 : 14
5	Fuller, G.	St. Albans	14 : 00
6	Jackson, E.	Baildon	13 : 43

HALIFAX TROPHY (F.A.I. Power)—May 1st, 1960. *Area.* (96 *entries*).

1	{ Jays, V.	Surbiton	15 : 00	15 : 00
	{ Guller, G.	St. Albans	15 : 00	15 : 00
3	Thorne, C.	Letchworth	14 : 58	
4	Swinden, R.	Teeside	14 : 53	
5	Mac, H...	C.M.	14 : 52	
	Deacon, J. C.	York	14 : 52	

INDOOR RALLY — May 7th/8th — R.A.F. Cardington.

Class A Microfilm

Parham, R. T.	10 : 20
Robson, M.	10 : 21
Parham, R. T.	10 : 41
Parham R. T.	12 : 16

Class B Microfilm

Draper, R.	16 : 06
O'Donnell, J.	16 : 14
Draper, R.	20 : 06
Parham, R. T.	20 : 07
Spurr, A. W.	20 : 34

Class C Microfilm

Read, P.	24 : 30
Draper, R.	25 : 54
Read, P.	26 : 57
Draper, R.	27 : 25

STOCKPORT ADVERTISER RALLY—Woodford.

Senior Power (107 *entries*)

1 Barnes, J.	Liverpool	5 : 40
2 Emery, Sgt.	R.A.F. Scampton	5 : 39
3 Savini, S.	Liverpool	5 : 25

Senior Glider (137 *entries*)

1 Beal, G.	Mexborough	5 : 38
2 Rose, J. E.	Sheffield	5 : 35
3 Bailey, J. D. E.	Whitefield	5 : 28

Senior Rubber (59 *entries*)

1 Hannay, J.	Wallasey	6 : 00 +3 : 00
2 Tubbs, H.	Baildon	6 : 00 +2 : 14
3 Faulkner, B.	Cheadle	6 : 00

Junior Power (21 *entries*)

1 Stone, D.	Chorlton	4 : 03
2 Birks, J.	Chorlton	2 : 02
3 Bowland, D.	Baildon	1 : 53

Junior Glider (27 *entries*)

1 Oldfield, P.	Chorlton	4 : 27
2 Carter, N.	Cheadle	4 : 23
3 Speakman, D.	Chester	3 : 14

Junior Rubber (6 *entries*)

1 Smith, B. W.	English Electric	3 : 25
2 Wright, J.	Peterborough	1 : 06

Senior Rally Champion

O'Donnell, J.	Whitefield	14 : 16

Junior Rally Champion

Oldfield, P.	Chorlton	4 : 27

Ladies Challenge Trophy

Smith, Mrs. W. M.	English Electric	2 : 41

E. J. Riding Trophy

		pts.
1 Abell, C.	Doncaster (Caproni)	94
2 Coates, E. A.	Blackburn Aircraft (Sopwith 1½ Strutter)	66
3 Jones, R. H.	Chorlton (Typhoon)	63

Team Race Class A

1 Davy-long	Wharfedale	6 : 01·5
2 Baxter-Horton	Wharfedale	6 : 11

Combat

		pts.
1 Benoy, J.	Enfield	230
2 Perry, P.	Northwood	82

Radio Control—Multi

1 Singleton, J.	Larkhill	186
2 Johnson, E.	Larkhill	182
3 Rodgers, P. E.	High Wycombe	172

Radio Control—Rudder

1 Neild, W.	Cheadle	77
2 Collinson, A.	Baildon	45

BRITISH NATIONAL CHAMPIONSHIPS—June 5th/6th, 1960—R A.F. Scampton.

Thurston Cup (Open Glider) (287 *entries*)

1 Dallimer, G.	Stevenage	9 : 00	6 : 52
2 Wyatt, C.	Ashton	9 : 00	5 : 50
3 Borrill, J.	Boston	9 : 00	5 : 09
4 West, J.	Brighton	9 : 00	4 : 56
5 Simeons, J.	St. Albans	9 : 00	4 : 45
6 Cleghorn, W.	St. Albans	9 : 00	4 : 27

Sir John Shelley (Open Power) (277 *entries*)

1 Smith, T. W.	English Elec.	12 : 00	5 : 51
2 French, G. R.	Essex	12 : 00	5 : 04
3 Edwards, D.	St. Albans	12 : 00	4 : 27
4 Eggleston, B.	Baildon	12 : 00	
5 Draper, R.	Coventry	11 : 59	
6 Buskell, P.	Surbiton	11 : 55	

Model Aircraft Trophy (Open Rubber) (138 *entries*)

1 Draper, R.	Coventry	12 : 00	6 : 42
2 Lennox, R.	Birmingham	12 : 00	5 : 51
3 Wright, J.	Peterborough	12 : 00	5 : 30
4 Greaves, D.	Leamington	12 : 00	5 : 13
5 Monks, R.	Birmingham	12 : 00	4 : 59
6 Barnes, J. E.	Liverpool	12 : 00	4 : 39

Lady Shelley (Open Tailless) (48 *entries*)

1 Marshall, J.	Hayes	5 : 57
2 Hendrall, B.	Heswall	5 : 15
3 Gates, G. K.	Southern X	4 : 00
4 Bow, B.	Bristol Aces	3 : 48
5 Wingate, J.	Chichester	3 : 04
6 Woodward, T.	Foresters	2 : 55

Short Cup (P.A.A. Load) (21 *entries*)

1 Fuller, G.	St. Albans	7 : 42
2 O'Donnell, J.	Whitefield	7 : 35
3 Sinden, R.	Teeside	6 : 13
4 Young, A.	St. Albans	4 : 52
5 Knight, D.	St. Albans	4 : 45
6 Glynn, K.	Surbiton	3 : 09

Ripmax Shield (R/C Single Control) (39 *entries*)

		pts.
1 Knight, D.	Wagtails	892
2 White, G. K.	Wagtails	618
3 Thumpston, D. E.	Sutton Coldfield	502·5
4 Collinson, A. R.	Baildon	359·5
5 Pearson, J.	Sutton Coldfield	320

S.M.A.E. Cup (R/C Multi-control) (43 *entries*)

		pys.
1 Van den Bergh, F.	Bromley	3565·5
2 Coppard, E. H.	Bromley	2844
3 Singleton, J.	A.R.C.C.	2744·5
4 Rogers, P.	High Wycombe	2690
5 Olsen, C. H.	C.M.	2242
6 Johnson, E.	A.R.C.C.	673

Super Scale Trophy (Free Flight Scale) (20 *entries*)

		pts.
1 Newman, B. E.	Blackheath	80
2 Simmance, J. L.	Northwood	68
3 Partridge, D.	Croydon	63

Knokke Trophy (Scale Control Line) (28 *entries*)

		pts.
1 Fletcher, G.	Croydon	86
2 Day, A. C.	West Bromwich	84
3 Milani, C.	Watford Wanderers	81

Gold Trophy (Control Line Aerobatic) (46 *entries*)

		pts.
1 Brown, R.	Lee Bees	621
2 Horrocks, B.	Wolves	608
3 Jolley, T.	Whitefield	539·5
4 Day, D.	Wolves	535
5 Warburton, F.	Bolton	513
6 Day, K.	Lee Bees	510

Davies A Trophy Team Racing Class A (102 *entries*)

1 Smith, M.	High Wycombe
2 Bernhard, N.	Belgium
3 Pasco, T.	Thornaby

Davies B Trophy Team Racing Class B (51 *entries*)

1 Haworth, D.	Wharfedale
2 Drewell, P.	West Essex
3 Horton, —.	

Class ½A Team Racing (67 *entries*)

1 Bassett, M.	Sidcup
2 Dew, D. R.	
3 Nixon, D.	Hinckley

Combat

1 Kendrick M.	West Bromwich
2 Greenaway, R.	Hayes

Speed (Class 1)

		m.p.h.
1 Gibbs, R.	Hornchurch	117·5
2 Wright, P.	West Essex	115·9
3 Taylor, J.	Hayes	103·5

Speed (Class 2)

1 Stephens, P.	Belfairs	139·8
2 { Watson, J.	West Essex	131·6
{ Billington, M. A.	Brixton	131·6

Speed (Class 3)

1 Johnson, G.	Cambridge	156·4
2 Drewll, P.	West Essex	152·3
3 McGladdery, P.	Hayes	118·3

SCHEDULE OF INTERNATIONAL RECORDS

Class F-1-A *Rubber-driven*					
1	Duration	M. Kiraly	Hungary	20/8/1951	1 hr. 27 min. 17 sec.
2	Distance	G. Benedek	Hungary	20/8/1947	50,260 km.
3	Height	R. Poich	Hungary	31/8/1948	1,442 m.
4	Speed	V. Davidov	U.S.S.R.	16/9/1947	107·080 km./hr.
Class F-1-B *Power-driven*					
5	Duration	L. Koulakovsky	U.S.S.R.	6/8/1952	6 hr. 1 min.
6	Distance	E. Boricevitch	U.S.S.R.	14/8/1952	378,756 km. *
7	Height	G. Lioubouchkine	U.S.S.R.	13/8/1947	4,152 m.*
8	Speed	E. Stiles	U.S.A.	20/7/1949	129·768 km./hr.
Class F-2-A *Rubber-driven Helicopter*					
9	Duration	G. Evergary	Hungary	13/6/1950	7 min. 43 sec.
10	Distance	G. Pelegi	Italy	27/7/1958	605·10 m.
11	Height	G. Pelegi	Italy	21/7/1958	205·12 m.
12	Speed	No record established.			
Class F-2-B *Power-driven Helicopter*					
13	Duration	B. Borissov	U.S.S.R.	18/8/1959	54 min. 37 sec.
14	Distance	B. Borissov	U.S.S.R.	18/8/1959	20·100 km.
15	Height	B. Borissov	U.S.S.R.	18/8/1959	2·128 m.
16	Speed	No record established.			
Class F- 3 *Sailplane*					
17	Duration	I. Toth	Hungary	24/5/1954	4 hr. 34 min. 11 sec.
18	Distance	F. Szomolanyi	Hungary	23/7/1951	139·8 km.
19	Height	G. Benedek	Hungary	23/5/1948	2,364 m.
Class F-1-B *Radio Control (Power)*					
20	Duration	K. A. Willard	U.S.A.	15/4/1958	5 hr. 28 min. 57 sec.
21	Distance	C. Dance/W. Skeels	Great Britain	8/5/1960	73·223 km.
22	Height	J-P. Gobeaux	Belgium	15/8/1955	1·142 m.
23	Speed	Dunham/Bentley	U.S.A.	15/5/1960	184·230 km./hr.
Class F-3 *Radio Control (Sailplane)*					
24	Duration	Cone/Chase	U.S.A.	7/7/1956	8hr. 34 min. 21 sec. *
25	Distance	N. Malikov	U.S.S.R.	22/8/1959	6,300 m.
26	Height	N. Drojjine	U.S.S.R.	6/6/1959	603 m.
Class F-1-D *Control-line Speed*					
27	Class I	J. Sladky	Czechoslovakia	13/10/1957	236 km./hr.
28	Class II	Shelton/Harris	U.S.A.	23/7/1958	253 km./hr.
29	Class III	Lauderdale/Jehlik	U.S.A.	24/7/1958	274 km./hr.
Class F-1-C *Control-line Jet*					
30	Jet	I. Ivannikov	U.S.S.R.	5/9/1958	301 km./hr.*
Class F-1-B *Radio Control (Power)*					
31	Distance in Closed Circuit	C. Adcock	Great Britain	13/2/1960	13·469 km.

(*—Indicates World Record in Duration, Distance, Height or Speed.)

BRITISH RECORDS

In accordance with a decision of the Council of the S.M.A.E. made on the 21st November, 1959, the then existing schedule of British Model Aircraft Records became redundant on the 31st December 1959, and was replaced by the following schedule as from the 1st January, 1960.

Record No.		
1	Rubber-driven	**OPEN CLASS:** to include monoplane, biplane, canard, scale, ornithopter, float-plane, etc.
2	,, ,,	**TAILLESS:**
3	,, ,,	**ROTORPLANE:** to include autogiro, helicopter, etc.
4	,, ,,	**FLYING BOAT:**
5	Power-driven	**OPEN CLASS:** (as No. 1)
6	,, ,,	**TAILLESS:**
7	,, ,,	**ROTORPLANE:** (as No. 3)
8	,, ,,	**FLYING BOAT:**
9	Sailplane	**TOW LAUNCHED:**
10	,,	**SLOPE SOARING:**
11	,,	**TAILLESS:**
12	Control-line Speed	**FAI CLASS I** (0—2·5 cc.)
13	,, ,, ,,	**FAI CLASS II** (2·5—5 cc.)
14	,, ,, ,,	**FAI CLASS III** (5—10 cc.)
15	,, ,, ,,	**FAI JET.**
16	Radio Controlled	**POWER:**
17	,, ,,	**SAILPLANE:**
18	Indoor	**MICROFILM COVERED:**
19	,,	**PAPER COVERED:**
20	,,	**H. L. GLIDER:**
21	,,	**UNORTHODOX:** Tailless helicopter, etc.

(Following representations, the possibility of extending the schedule of records for Indoor Flying is under consideration.)

In order to stimulate interest, Record Certificates will be awarded on an annual basis for the best performance in each of the 21 categories in each calendar year.

From the above list, six overall performances will be recognised as Absolute British Records in the following categories:

Duration: Rubber-driven; power; sailplane; radio-control; indoor.
Speed: Control-line.

The schedule of Absolute Records will be carried forward year by year, irrespective of the annual classification.

RUBBER MOTOR TURNS TABLES

The following tables are calculated to give maximum safe turns on made-up, lubricated and run-in rubber motors in standard quality aero-strip. The figures allow a nominal safety margin of 5 per cent and are based on actual breaking turns tests.

To use the tables, select the appropriate rubber strip size and number of strands. Either calculate maximum turns by multiplying turns per inch figure by *actual* motor length (*i.e.*, not distance between hooks); or read directly from the table if the required motor length is given. Longer motor lengths can be accommodated by addition, e.g., for a 46 in. motor length, add turns for a 10 in. motor and a 36 in. motor.

$\frac{1}{4}\times 24$ STRIP MAXIMUM TURNS

		NUMBER OF STRANDS							
		2	4	6	8	10	12	14	16
PER INCH		*60*	*46*	*36*	*30*	*26*	*24*	*22*	*20*
MOTOR LENGTH INCHES	10	600	460	360	300	260	240	220	200
	20	1,200	900	720	600	520	480	440	400
	22	1,320	1,000	790	660	570	530	480	440
	24	1,440	1,100	860	720	620	580	520	480
	26	1,560	1,200	930	780	670	630	560	520
	28	1,680	1,300	1,000	840	725	680	600	560
	30	1,800	1,400	1,080	900	780	725	650	600
	32	1,920	1,500	1,150	960	830	775	690	640
	34	2,040	1,600	1,220	1,020	880	825	735	680
	36	2,160	1,700	1,300	1,080	930	875	780	720

$\frac{3}{16}\times 24$ STRIP MAXIMUM TURNS

		NUMBER OF STRANDS										
		2	4	8	10	12	14	16	18	20	22	24
PER INCH		*66*	*49*	*35*	*31*	*29*	*27*	*26*	*24*	*23*	*21*	*20*
MOTOR LENGTH INCHES	10	650	500	350	310	290	270	255	240	225	210	200
	20	1,300	1,000	700	620	580	540	520	480	450	420	400
	22	1430	1,100	770	680	640	600	570	530	500	460	440
	24	1,560	1,200	800	740	700	650	620	580	550	500	480
	26	1,700	1,300	910	800	760	700	670	610	600	550	520
	28	1,820	1,400	980	870	820	750	720	660	640	590	560
	30	1,950	1,500	1,050	930	880	800	780	710	680	630	600
	32	2,080	1,600	1,120	990	940	850	830	760	720	670	640
	34	2,200	1,700	1,190	1,050	1,000	900	880	820	760	710	680
	36	2,350	1,800	1,260	1,120	1,050	950	930	860	800	750	720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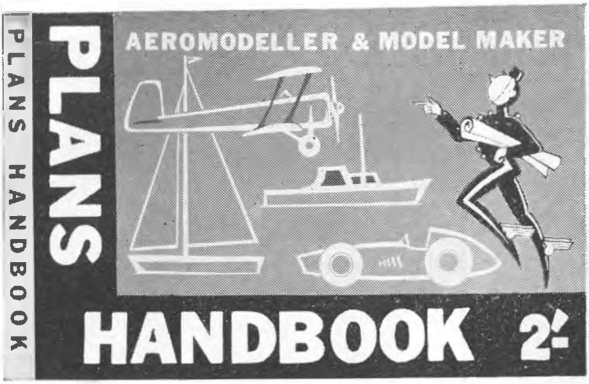

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