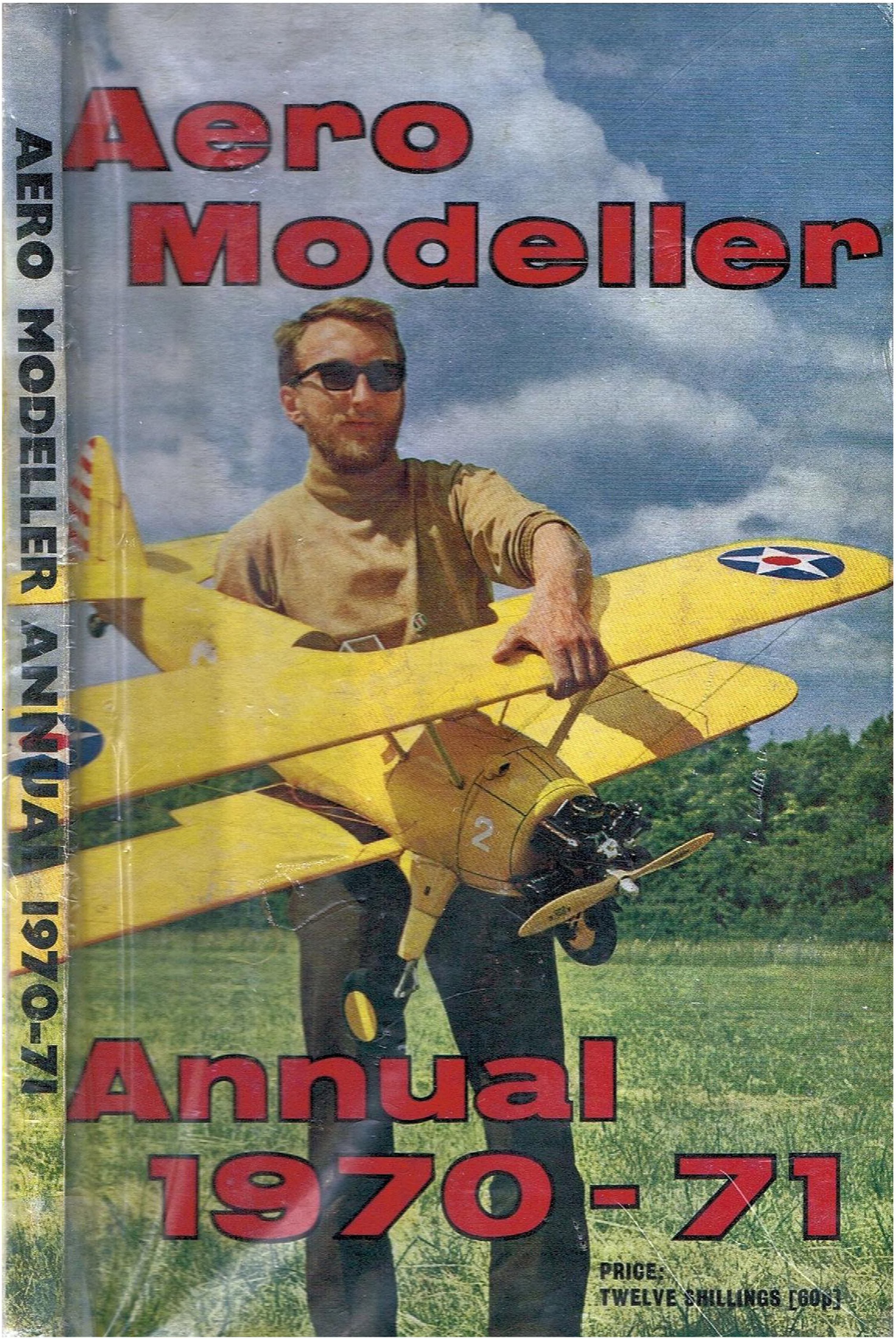
AERO MODELLER ANNUAL 1970-71
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AEROMODELLER ANNUAL 1970-71

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

Compiled and Edited by
R. G. MOULTON
and
D. J. LAIDLAW-DICKSON

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AEROMODELLER ANNUAL 1970–71

acknowledges with thanks the undernoted sources, representing a selection of the World's aeromodelling literature:

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CONTENTS

COVER: Sterling PT. 17 Kit Model. Merco 61. Sprengbrook R/C, International Polyurethane finish, by Richard Nicholls.

INTRODUCTION

ANOTHER year gone; but not quite so much to report as was our proud pleasure this time last year! Press dates preclude any announcement of British World Championship results—for as this edition passes through the presses, the British Team wends its way to Namur in Belgium. At this scenic site, the control line aces will battle for honours which appear to be diminishing in value. No longer do we learn of frenetic preparations or possible record breaking achievements in team race or speed. Instead there is an unmistakable retraction of interest. This is partly due to lack of travel funds in Western currency for some Eastern States, and partly the result of declining activity. Yet control line is by no means dead! Maybe the lack of any radical developments has diminished the attraction of top class contest flying. Reversion to the two line control system for speed in the F.A.I. class has undoubtedly raised the domestic levels. What is needed next is the more rapid spread of "know-how" at the few control line speed circuits. Similarly, the aerobatic class is healthily supported at home though still at a stage way below World class. There remain the highly competitive Combat and Racing classes. Both are be-devilled with misunderstandings. The Combat regulations devised by the F.A.I. have not survived their probationary period with great honours as witness the complete lack of interest in the International Championships displayed by the potential winners from this country. Rule mix-ups in a vitriolic event are not conducive to good relations! The F.A.I. control line sub-committee is to sort out the problems of scoring, time keeping and judging what we know to be a great event for the quick-witted young flyer. In Team Racing, the regulations are similarly subject to committee controversy with the French pressing for further safety precautions. Use of the compulsory helmet for mechanics has already shown benefit, and much as we all resent rule changes, the improvement of safety standards ought to take priority even if it means a change of refuelling procedure. There remains the trio of racing events, those for "Mouse", "Rat" and "Goodyear". Each has a very healthy following, especially since the model finish is not demanding and participation at club and rally contests produces very even standards where the relative new-comer can stand a chance.

In the free flight categories we have success to report with two admirable second places by Ian Keynes (Wakefield) and Tony Young (A/2 Glider) in the International Criterium. Our power exponents were less blessed, and at the end of the winter event in Austria, those stalwarts French and West found themselves battling with two feet of snow as well as the strong opposition. It is in free flight that we see the sharpest edges of contest developments this year. Tactics, standards, and the very size of the contests have improved greatly and this in turn is reflected in a high proportion of free-flight designs which have been published in the world's model press over the past twelve months. Thus our selection of designs for this Annual is also predominantly free flight. We believe that it is largely due to the open outlook of the free-flight modeller that we find so many detail innovations and design variations. Their world is truly universal—a great contrast to the insular attitude of most radio control flyers.

The only way to achieve comparable standards is to venture out and compete overseas—and when the sea is a mere 90 minutes ship-crossing time there is no excuse for the radio control aerobatic pilot who finds himself outclassed by his Continental competitors at the next World Championships. Study of the results from major European events this year indicates high standards among German and French R/C flyers. An exception is, of course, flying scale. Here we have a long experience, accelerated by work for films by some of our leading modellers and encouraged by an enthusiasm which is part of the British characteristic.

This Annual is distributed as nine national teams converge on Cranfield, that traditional centre of high quality World Championships. They will compete in the control line and radio control classes for the first ever World Championships and the entry list contains a galaxy of talent. As a spectacle it will inspire and entertain—bringing new challenge to an increasingly popular category.

And what of other matters? The radio controlled Helicopter is nearer to practical success. Ing. D. Schlueter, author of our main feature last year has now taken his scale type Bell to over 300 ft. altitude and sustained over 10 minutes flight duration. The Wankel engine has "arrived" from German manufacturer Johannes Graupner, engineered by Ogawa in Osaka, Japan. The electric-powered round-the-pole model is now, thanks in turn to model racing cars, a very attractive and practical subject for home activity.

In the pages which follow we present a selected range of designs and features which are calculated to inform the reader of significant changes. Electric power flight on 40-ft. line radius speaks for itself, so does a home-built epitrochoidal engine, or Dave Platt's technique for scale model finishes. We urge those with a creative bent to digest the findings by Canadian experimenters on popular glider airfoils.

The "Long-line" electric flight pioneers of Grantham and District M.A.C. with their models.

ELECTRIC-POWERED R.T.P.

by Peter Bullivant

ELECTRIC-POWERED, tethered Round-The-Po le (R.T.P.) model aircraft are by no means new to model flyers; indeed many of the more elderly of the modelling fraternity may remember the thrill of watching an electric-powered model *Miles Magister* circling its pylon apparently incessantly throughout the first Model Aircraft Exhibition held at the Dorland Hall, Regent Street, London in 1945. During the period of the Exhibition, this model flew over 1,000 miles, wore out a pair of rubber tyres and two motors.

The following year it was the turn of a highly detailed *Vickers Viking* equipped with a retracting undercarriage and controlled from a panel which incorporated a warning horn and red light should a "wheels up" landing be attempted. This device was for the benefit of members of the public who were invited to pilot the model on "circuits and bumps".

Plans of these models were published in the AEROMODELLER at that time, but attractive as they were, the drawback to the average aeromodeller was the necessity to have to produce his own motors, as there were few suitable proprietary motors readily available. This factor was probably responsible for the limited following that this branch of our hobby received at that time.

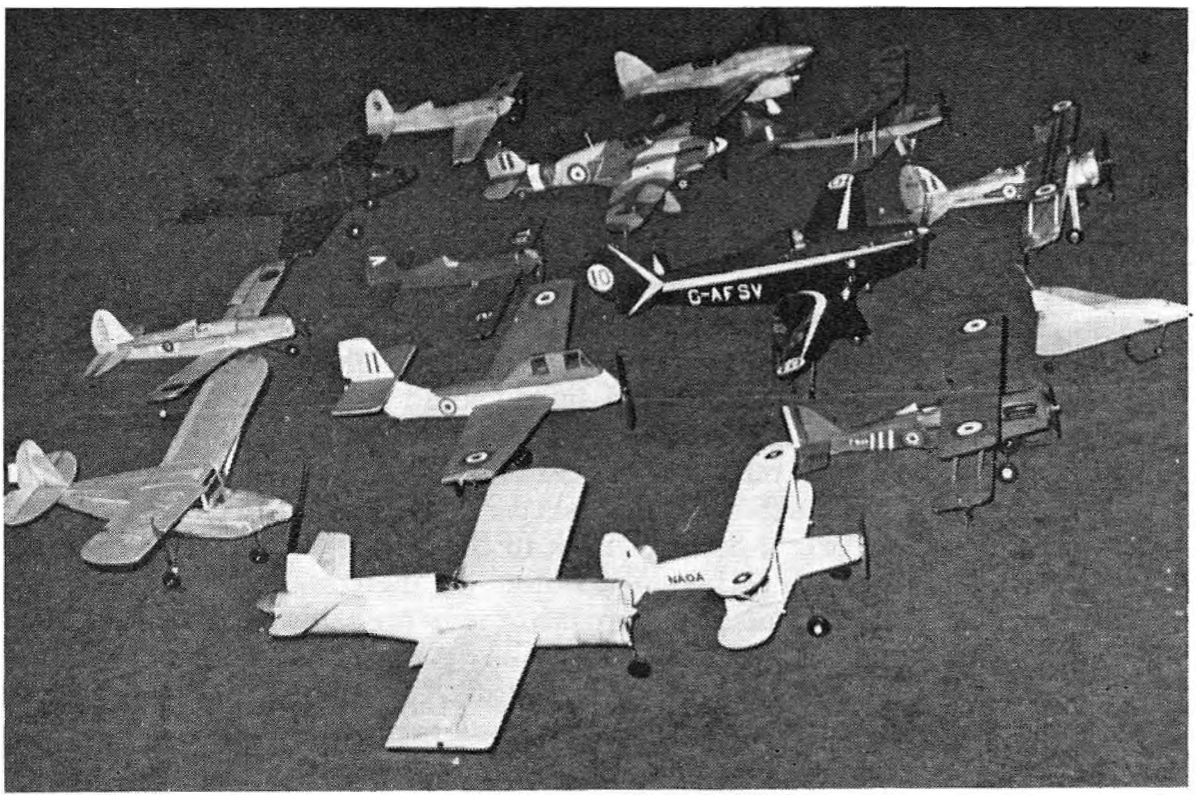
The situation today has changed considerably in as much as there is a wealth of reasonably priced powerful electric slot car motors readily available on the market.

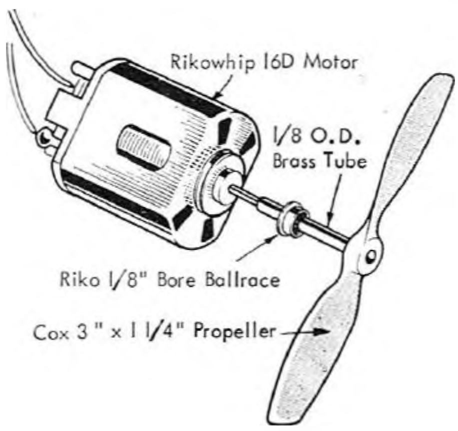
Although there are no kits specifically designed to incorporate these 12-volt motors, it is a simple matter to adapt one of the numerous rubber-powered flying model kits to be seen in the model shops today. The main requirements are: a strong motor support, motor mounted so that it coincides with the centre of gravity; a suitable extension shaft to the propeller (if a direct drive is preferred); a front plain or ball bearing to support the propeller shaft; provision for motor cooling, and a strengthened undercarriage and supporting members. An alternative drive arrangement is to gear the motor down in the region of 4 : 1, thus permitting the use of larger, and often more efficient, propellers which do not look out of proportion when used on scale models with large cowled radial engines.

The power supply required for these motors is basically 12 volts d.c. This can be obtained by using a transformer/rectifier from the mains supply, or by using one or more suitable 12-volt batteries. The power to the model is fed down two thin shellaced copper wires (varying gauges can be used—0·030 in. or 0·011 in. depending on the length of wires to be used, bearing in mind the available power supply and resistance of the wires causing voltage drop).

The central pylon can be a very simple affair well within the constructional capability of even quite junior modellers, using simple parts which are easily obtainable.

Electric flying has attractions all of its own. It is an excellent introduction to aeromodelling; youngsters can successfully fly even if they are unable to handle diesel or glo' engines or adjust rubber driven models. For the scale enthusiast, it offers an unlimited source of designs with the additional advantage that the motors can be neatly hidden within the scale contours of the model without that ungainly and unrealistic cylinder head protruding offendingly through the cowling. There is little noise to offend neighbours, so that "back lawn" flying may be safely contemplated on windless days. (Weather is no





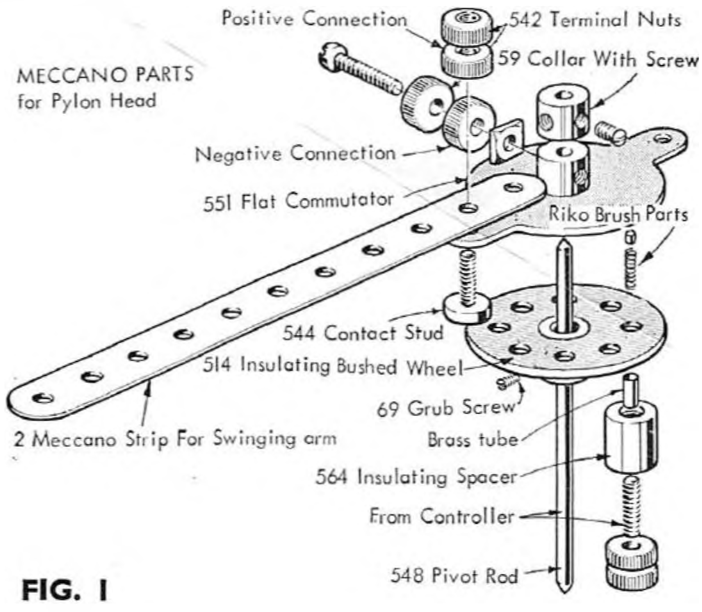


FIG. I

Opposite: Selection of Grantham models includes many kit conversions from KeilKraft, Frogflite and Veron designs. At right, the Aeromodeller pylon head as used at "Model Engineer" exhibitions from standard Meccano parts as numbered, and above, the standard direct drive motor/prop combination

problem indoors.) No more of these oil-stained "best Sunday suits" and subsequent cries of dismay from the family! In these days of super sophisticated prefabricated kits, "trendy" designs and cut-and-dried competition rules in almost every branch of aeromodelling, it is quite refreshing to discover a comparatively untried new field of our hobby. The scope is tremendous: duration attempts, racing, scale events, glider and banner towing, formation flying (using a twin-headed pylon), night flying (using small electric bulbs on the aircraft), carrier events, aerobatics, combat and bombing competitions. Models can be single- or multi-engined with fixed or retracting undercarriages. Working flaps or elevators can be incorporated for slow-speed flight or aerobatics, Autogyros, "tractor" or "pusher" designs, or jet-like aircraft using ducted fan motors, mounted within the fuselage.

Line lengths seem only to be limited by the available power supply and flying space. Standard S.M.A.E. ½A team race line lengths (46 ft. 8 in.) are quite practicable.

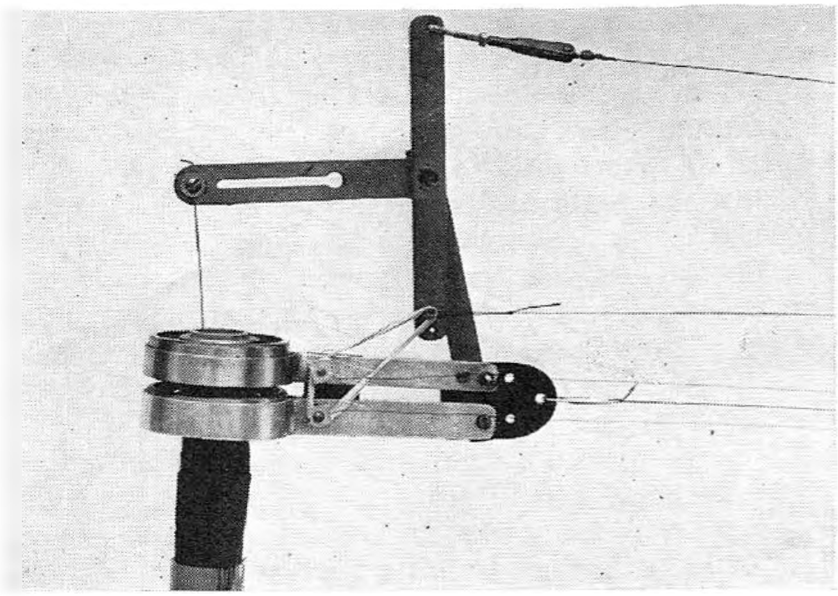
Wingspans can be as small as 4 in. or as large as 5 ft.

Last, but by no means a small consideration, models can be flown for years within the protective confines of the living room or hangar, and electric R.T.P. is easy on the pocket.

So, *how is it done*? Well, let us consider the electrical flying activities of several groups of flyers and discover the results they have arrived at through several years of trial and error.

The Grantham and District Model Aircraft Society electrical R.T.P. flying section was formed in September 1969 as a result of several further discussions arising from a casual conversation in a local model shop between the Section Secretary, Mr. Peter Hunt and the writer in 1966. The final decision to get the scheme "off the ground" was "sparked off" by two articles which had appeared on the subject; the first in the March 1969 AEROMODELLER following a series of experiments by the A.M. Staff, the second, an article by Pat March in the August 1969 *American Modeler*, which the writer brought home after a visit to Canada.

The first task, to construct a suitable pylon, was completed within a few days adopting an idea used by the AEROMODELLER staff. The pylon (shown in



Originally created by Doug McHard for his "Model Aircraft" feature, this substantial head is used at Grantham, with elevator control if needed. Right is the Pat March design for a Carrier Deck, as made and tried by Grantham Club.

Fig. 1) was assembled basically from standard Meccano parts, with the exception of the metal base. Two other pylons were constructed shortly afterwards, using an alternative arrangement similar to that shown in a copy of *Model Aircraft*, dating back to September 1963 (see Fig. 2).

A control panel was made incorporating two plug points for "dual flying" when using two **Riko** 7·5 ohm push-button speed controllers. The panel incorporated a simple "throw" switch to facilitate reversal of propeller direction.

A series of twin power lines varying in length from 6 to 15 ft. were prepared from 0·011 in. fine shellaced copper wire. Each set of power lines terminated with a miniature *Radio Control* two-pin male plug for attachment to

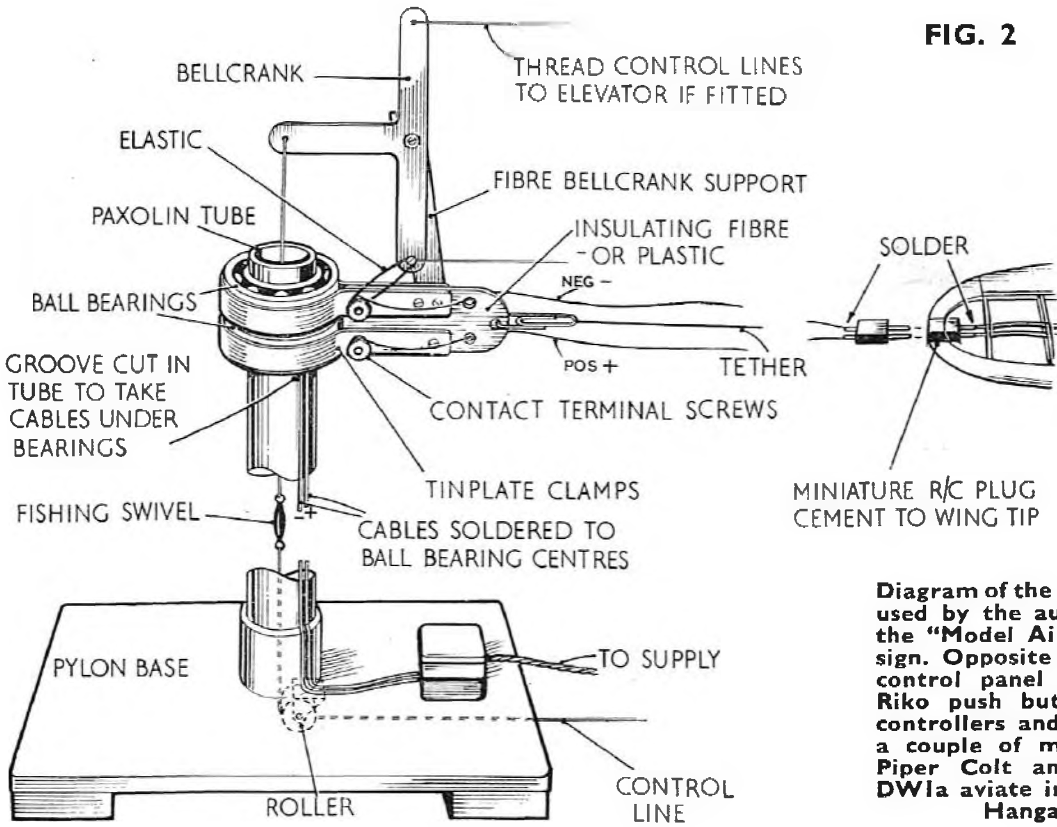
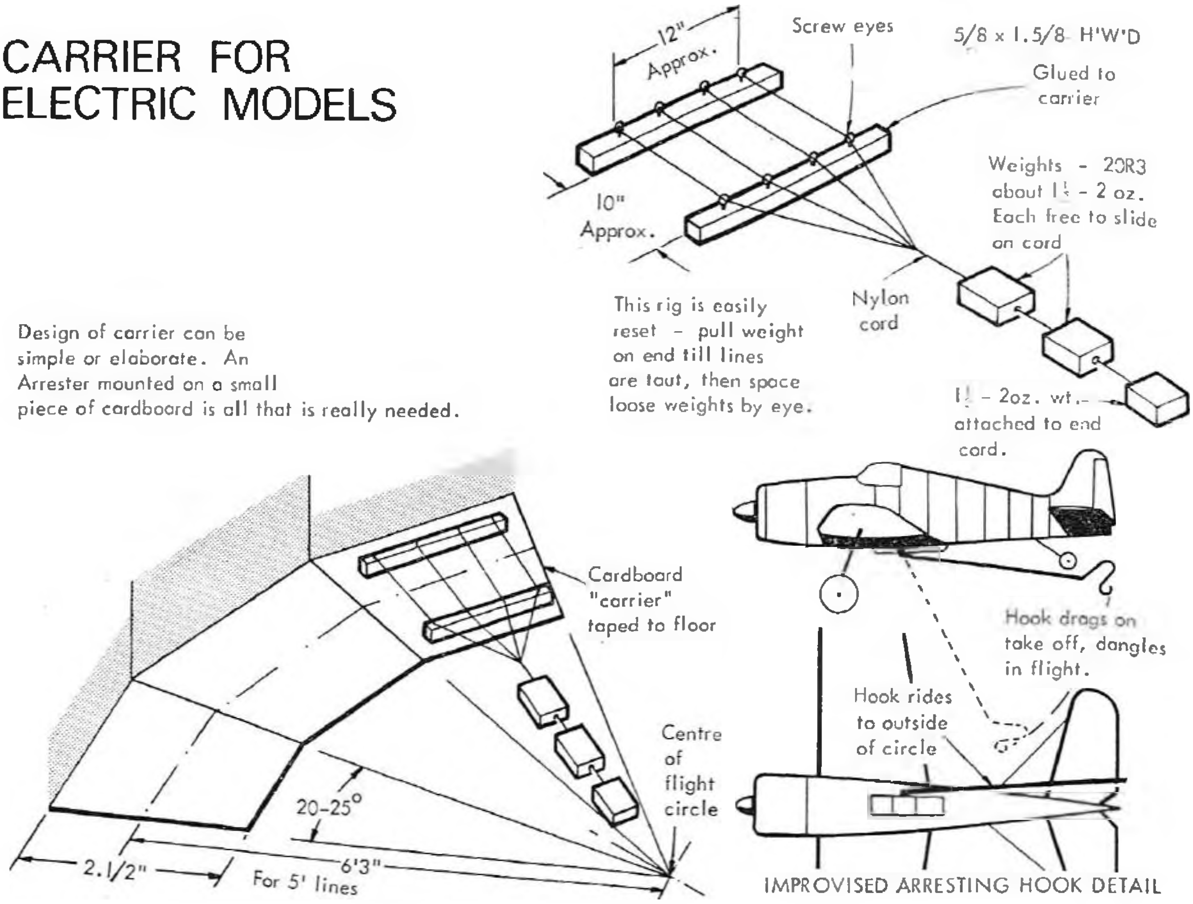


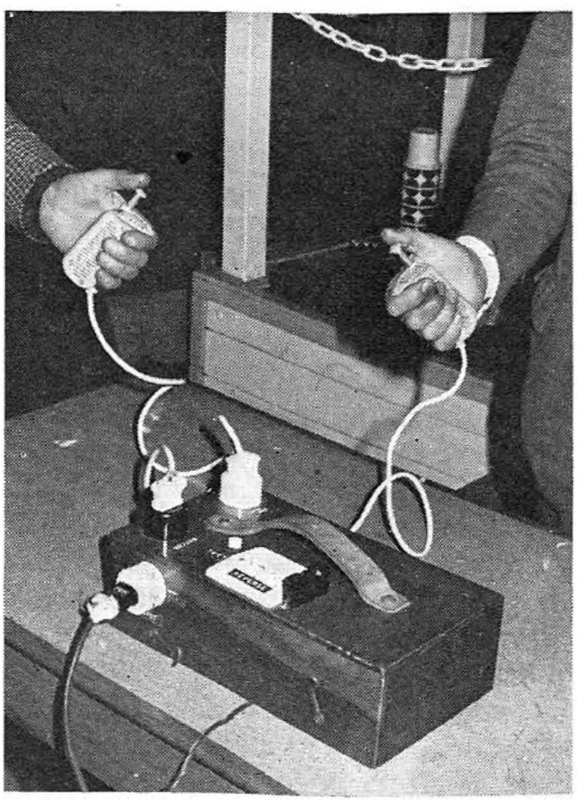
FIG. 2

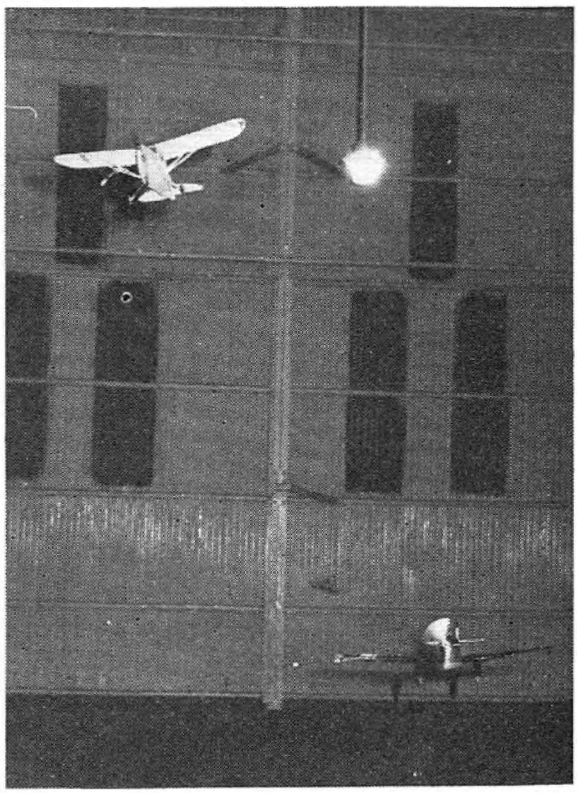
Diagram of the Pylon head used by the author from the "Model Aircraft" design. Opposite left is the control panel with Two Riko push button speed controllers and far right, a couple of models, the Piper Colt and Chilton DW1a aviate in the Drill Hangar.

CARRIER FOR ELECTRIC MODELS



the female plug on the right-hand wing tip of each model, the other ends being bared for attachment to the contact screws on the pylon head. To eliminate stress on the power lines caused by the centrifugal force exerted on the model in





flight, a separate cotton tether was used, in each case of slightly shorter length than that of the power lines. The reason for attaching these lines to the right-hand wing tip, thus giving *clockwise* flying, is because the propeller torque tends to turn the model away from the pylon, thus keeping the tether taut. One drawback with this direction of flight, however, is that the shorter the lines, the more reluctant the model is to become airborne, due to a phenomenon known as "Gyroscopic Precession". The rapidly rotating mass of the armature of the electric motor can be compared to a gyroscope. Consequently, any force applied to the "flat" face of the gyroscope behaves as if that force was applied "90° removed in the direction of rotation", and thus causes the gyroscope to "dip" or "precess". Hence, it can be seen that the yawing force that the tether exerts on the "near side" (i.e. nearest pylon) of the front face of the armature, results in the removal of that force through 90° in the direction of rotation to the bottom of the front face of the rotating armature, thus in turn causing the whole armature (thus the model) to "pitch" forwards. The longer the tether, the less pronounced this "pitch" becomes.

There is a certain amount of speculation amongst club members as to the virtues of using elevator control, as it has been noticed that any rapid upwards pitch of the model often causes a swing or yaw to develop towards the tether and pylon.

For several weeks, the Club was content to fly on lines of 15 ft. in length, but one or two more "venturesome" types became restless and 25 ft. became the target. This was so successful that it was decided to see just what the limit could be. By this time the Club was holding regular weekly electric R.T.P. meetings in a 90-ft. wide Royal Air Force drill hangar, a facility generously afforded by the Station Commander.

The maximum radius line length used by the Grantham Club successfully to date is 43 ft., a limitation only imposed by the dimensions of the hangar. Members believe that this may well be a record (?).

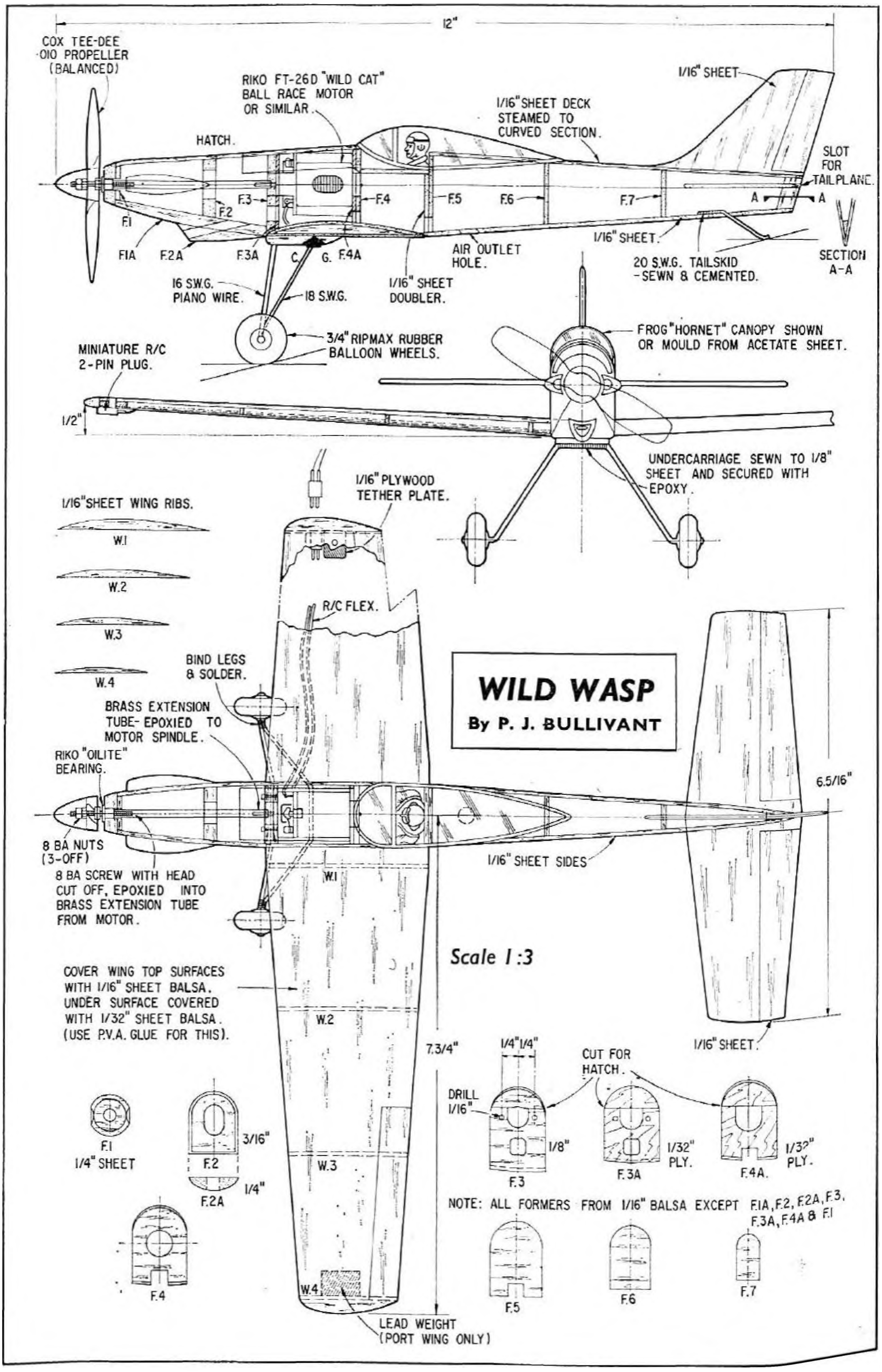
The first model to fly on these 43 ft. lines was a **Veron** *Cosmic Wind* built from the kit by a junior modeller, Martin Little, aged 13. The power was a **Revell** *Fireball* motor driving a **Cox** 3 in. $\times 1\frac{1}{4}$ in. propeller. The model was quite fast and very stable on the lines.

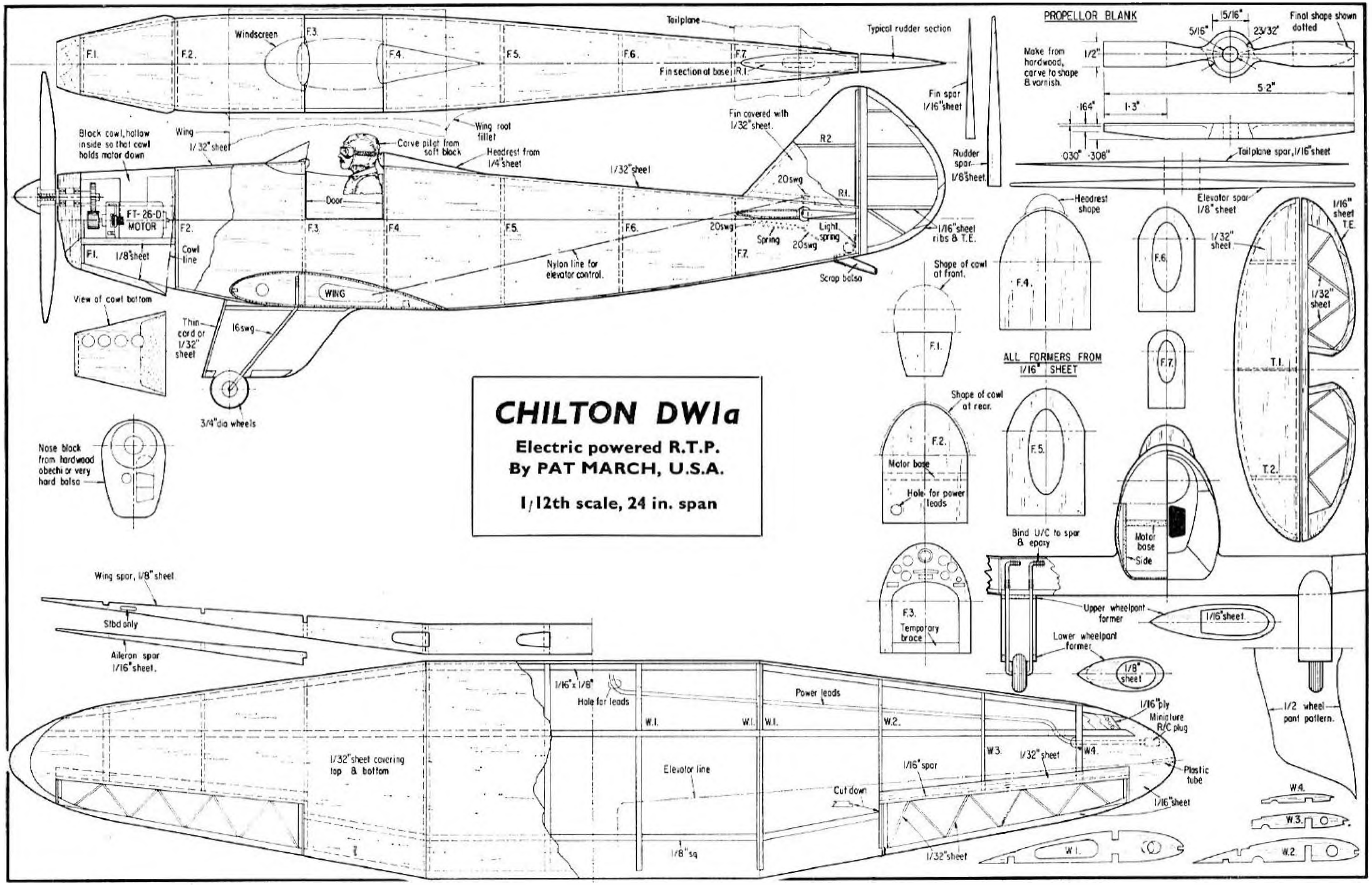
The Secretary constructed a carrier deck quite simply from wooden battens and cardboard, and this has been used on frequent occasions although at time of writing, this has not been organised as a competition item.

Formation flying has been very popular using the Meccano pylon head arranged for two-at-a-time flying. Pilots often fly their models mere inches apart, a spectacle requiring no mean skill and often a lot of patience in repair work!

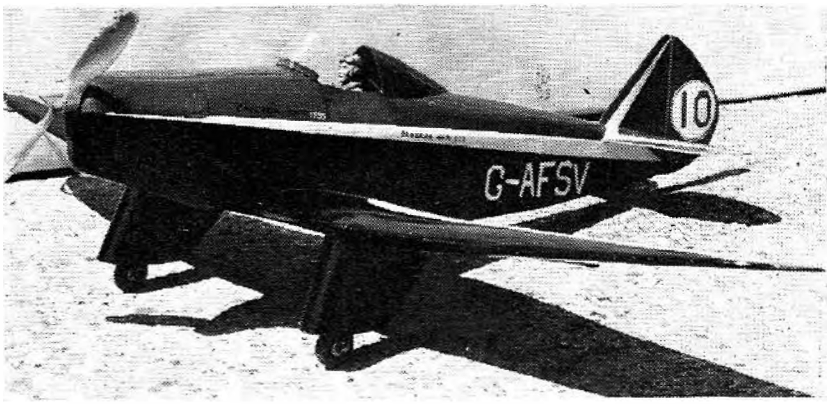
Team races are very popular within the Club. Competitors have to fly on 25 ft. length lines over a predetermined and timed number of laps (generally 100), during which "enforced landings" have to be made into a marked out area, once during every 25 laps. The pilot has to "field" his own model after completing one of these enforced landings by placing it at the rear marker before take-off. Fastest model to date has been a simple racer constructed entirely of sheet balsa made by Mick Bellamy and clocking 43 m.p.h. using a **Riko** FT-26D motor directly driving a **Cox** 3 in. $\times 1\frac{1}{4}$ in. propeller.

Another very fast model, which unfortunately disintegrated following a broken tether line, was the *Wild Wasp*, designed by the writer, a plan of which appears opposite. Maximum speed attained was 38 m.p.h. using only approximately three-quarters of the voltage now available. (The Club uses


12"
COX TEE-DEE ·010 PROPELLER (BALANCED)
RIKO FT-26D "WILD CAT" BALL RACE MOTOR OR SIMILAR.
1/16" SHEET
1/16" SHEET DECK STEAMED TO CURVED SECTION.
HATCH.
SLOT FOR TAILPLANE.
F.1 F.2 F.3 F.4 F.5 F.6 F.7
A A
FIA F.2A F.3A C G. F.4A
AIR OUTLET HOLE.
1/16" SHEET.
20 S.W.G. TAILSKID -SEWN & CEMENTED.
SECTION A-A
16 S.W.G. PIANO WIRE.
18 S.W.G.
1/16" SHEET DOUBLER.
3/4" RIPMAX RUBBER BALLOON WHEELS.
FROG "HORNET" CANOPY SHOWN OR MOULD FROM ACETATE SHEET.
MINIATURE R/C 2-PIN PLUG.
1/2"
UNDERCARRIAGE SEWN TO 1/8" SHEET AND SECURED WITH EPOXY.
1/16" PLYWOOD TETHER PLATE.
1/16" SHEET WING RIBS.
W.1
W.2
W.3
W.4
R/C FLEX.
BIND LEGS & SOLDER.
BRASS EXTENSION TUBE- EPOXIED TO MOTOR SPINDLE.
RIKO "OILITE" BEARING.
8 BA NUTS (3-OFF)
8 BA SCREW WITH HEAD CUT OFF, EPOXIED INTO BRASS EXTENSION TUBE FROM MOTOR.
1/16" SHEET SIDES
6.5/16"
WILD WASP
By P. J. BULLIVANT
Scale 1:3
COVER WING TOP SURFACES WITH 1/16" SHEET BALSA. UNDER SURFACE COVERED WITH 1/32" SHEET BALSA. (USE P.V.A. GLUE FOR THIS).
7.3/4"
1/4" 1/4"
DRILL 1/16"
CUT FOR HATCH.
1/16" SHEET.
F.1 1/4" SHEET
3/16"
F.2
1/4"
F.2A
1/8"
F.3
1/32" PLY.
F.3A
1/32" PLY.
F.4A.
NOTE: ALL FORMERS FROM 1/16" BALSA EXCEPT F.1A, F.2, F.2A, F.3, F.3A, F.4A & F.1
F.4
F.5
F.6
F.7
LEAD WEIGHT (PORT WING ONLY)


CHILTON DW1a
Electric powered R.T.P.
By PAT MARCH, U.S.A.
1/12th scale, 24 in. span
PROPELLOR BLANK
Make from hardwood, carve to shape & varnish.
Final shape shown dotted
Typical rudder section
Tailplane
Windscreen
Fin section at base
Fin spar 1/16" sheet
Fin covered with 1/32" sheet.
Rudder spar 1/8" sheet.
Tailplane spar, 1/16" sheet
Block cowl, hollow inside so that cowl holds motor down
Wing
1/32" sheet
Carve pilot from soft block
Wing root fillet
Headrest from 1/4" sheet
Door
FT-26-D MOTOR
Cowl line
1/8" sheet
Nylon line for elevator control.
Spring
Light spring
20swg
1/16" sheet ribs & T.E.
Scrap balsa
View of cowl bottom
Thin cord or 1/32" sheet
16swg
3/4" dia wheels
Nose block from hardwood obechi or very hard balsa
Headrest shape
Elevator spar 1/8" sheet
Shape of cowl at front.
Shape of cowl at rear.
ALL FORMERS FROM 1/16" SHEET
Motor base
Hole for power leads
Temporary brace
Bind U/C to spar & epoxy
Side
Upper wheelpant former
Lower wheelpant former
1/16" sheet
1/8" sheet
1/2 wheel pant pattern.
Wing spar, 1/8" sheet
Stbd only
Aileron spar 1/16" sheet.
1/16" x 1/8"
Hole for leads
Power leads
1/16" ply
Miniature R/C plug
1/32" sheet covering top & bottom
Elevator line
1/16" spar
Cut down
Plastic tube
1/8" sq
1/32" sheet

Designed by Pat March, and made by David Wyatt, the Chilton DW1a makes a fine subject for geared motors, see plan opposite.

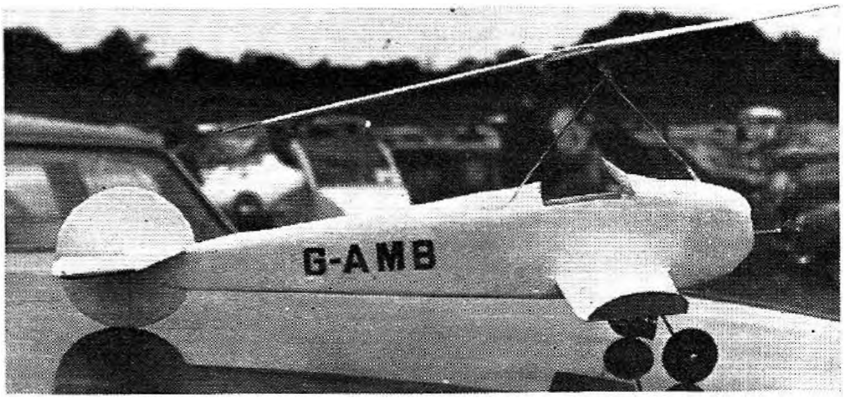


up to four 12-volt motor-car batteries connected in series according to the length of line.)

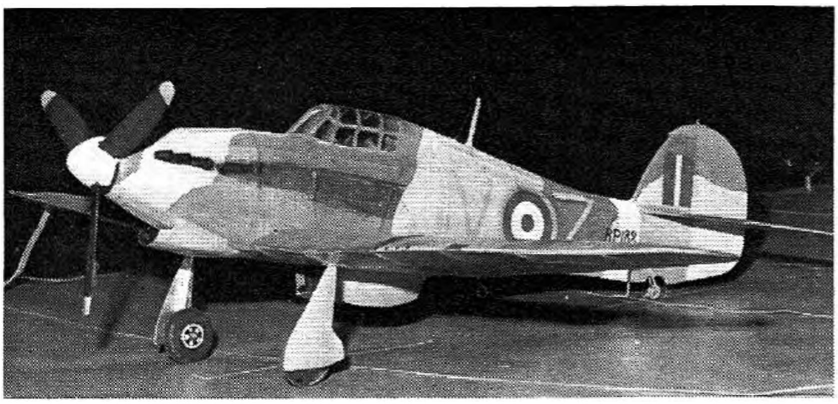
During one evening flying session, a model **Frogflite** *Beagle Pup* powered by a **Riko** FT-26D turning a **Cox** 3 in.$\times 1\frac{1}{4}$ in. propeller, stayed airborne for a continuous 3-hour period, at the end of which the motor was tested and found to be still quite cool!

A certain amount of "specialisation" has developed within the electric section, some modellers preferring direct drive and others using geared motors. One enthusiast, David Wyatt has concentrated all his efforts on models powered by **Riko** FT-26D motors with gearing. Dave has flown many successful hours on lines varying from 15 ft. to 40 ft. using mostly slow flying scale models, such as a **Veron** *Hawker Fury*, propeller geared down 4 : 1, a **Keilkraft** *S.E.5A* geared down $3\frac{1}{2}$: 1, and notably a beautiful 24 in. wingspan *Chilton*. This model was built to try out a plan supplied to the AEROMODELLER by Pat March of Ohio, who is a well-known pioneer of electric R.T.P. flying in the U.S.A., and whose activities are mentioned later in this article. The *Chilton* has been flown using a combination of split trailing edge flaps and up elevator control, but was rather too sensitive in "pitch" this way. At first, on short lines, the model appeared to need elevator to "unstick" and to prevent the nose from pitching forward grazing the propeller on the ground, but once on 35 ft. length lines the problems disappeared and it now regularly performs, flying at almost scale speed in a very stable manner. Colour scheme is red, black and white after the original aircraft which can be seen at the Shuttleworth Trust, Old Warden.

The Grantham electric section Secretary, Peter Hunt, has been specialising in various "direct drive" models based on the highly successful **Frogflite** *Ryan PT20* which received such acclaim when tested by the AEROMODELLER staff. One variant powered by an FT-26D and driving a **Cox** 3 in.$\times 1\frac{1}{4}$ in. propeller



Mick Bellamy's Autogyro is a unique selection of a subject for electric R.T.P., and has proved most successful. It opens up all sorts of prospects for the future—why not a Fairey Rotodyne, or a free-lance rotary wing model with rotor tilt control?



Left: Tom Walker's Hawker Hurricane kit conversion from the Keil-kraft flying scale model with a geared motor and three blade propeller.

Right is David Wyatt and his beautifully constructed Chilton DW1a and far right author Peter Bullivant with the DH 88 Comet prototype model before painting.

(with extension shaft) flies as a monoplane in races, but is convertible to a biplane for slow speed flight by use of a clip on upper mainplane.

One of Peter's models, which has probably logged up more successful flying time than any other Club type, is a *Piper Colt* made from a **Lindoe** kit and powered by a rather larger motor, the Mabuchi FT 36 D swinging a **Cox** $4\frac{1}{2}$ in. propeller. This model regularly flies effortlessly on 43 ft. lines, has been used at local displays, and is ideal for formation flying. The motor is situated in the cabin, and has a copper extension shaft running through an Oilite nose bearing to the propeller.

Always striving to beat his own speed records, and still progressing, Mick Bellamy has set the pace for the rest of the Club. He has built many "way-out" designs in his quest for speed, including an FT-26D powered miniature *Delta*, and an all sheet 43 m.p.h. record holder driven by a **Cox** 3 in. $\times 1\frac{1}{4}$ in. propeller. The propeller is mounted directly on the motor which in turn is mounted near to the centre of gravity of the model in a very short nose. In contrast to his usual trend, Mick has successfully flown an *Auto Gyro*, powered by a **Riko** FT-26D and based on drawings of a control line version previously published in the 1957 Annual.

For the scale enthusiast who has limited spare time for building, one evenings work is all that is necessary to produce an attractive scale model. One of the **Strombecker** lightweight plastic rubber-powered flying kits can be obtained. The writer purchased a **Strombecker** *Ryan N.Y.P. Spirit of St. Louis* kit and found that the only modification necessary to convert the model to electric power was to make two $\frac{1}{16}$ in. plywood bulkheads to act as motor mounts for the **Riko** FT-26D, which fitted so neatly into the ready-made slots within the fuselage shell that one would think the kit was designed for the job. Plasticine ballast was added by packing into the inside recess of the scale radial motor and an Oilite bearing used instead of the original propeller button supplied with the kit. All that remained was to strengthen the underside of the wings by using two $\frac{1}{8}$-in. square balsa main spars. Flying on a **Cox** 3 in. propeller, the *Spirit of St. Louis* flew beautifully slowly on partial power, but was capable of loops when flaps made from plastic card were used in conjunction with bursts of power.

Another recent model built and flown successfully by the writer is the *D.H. Comet 88 racer* (of England/Australia fame). This 21 in. twin carries two FT-26D motors using brass extension shafts running through $\frac{1}{8}$-in. ball bearing prop shafts mountings. The propellers are both the **Cox** 3 in. $\times 1\frac{1}{2}$ in. type. This model started life with a conventional control-line bellcrank-elevator control arrangement. but after a series of heavy landings the elevators have been fixed.

The scale nose landing light of this model automatically illuminates when the motors are running and provides a fascinating diversion when flown in darkness!

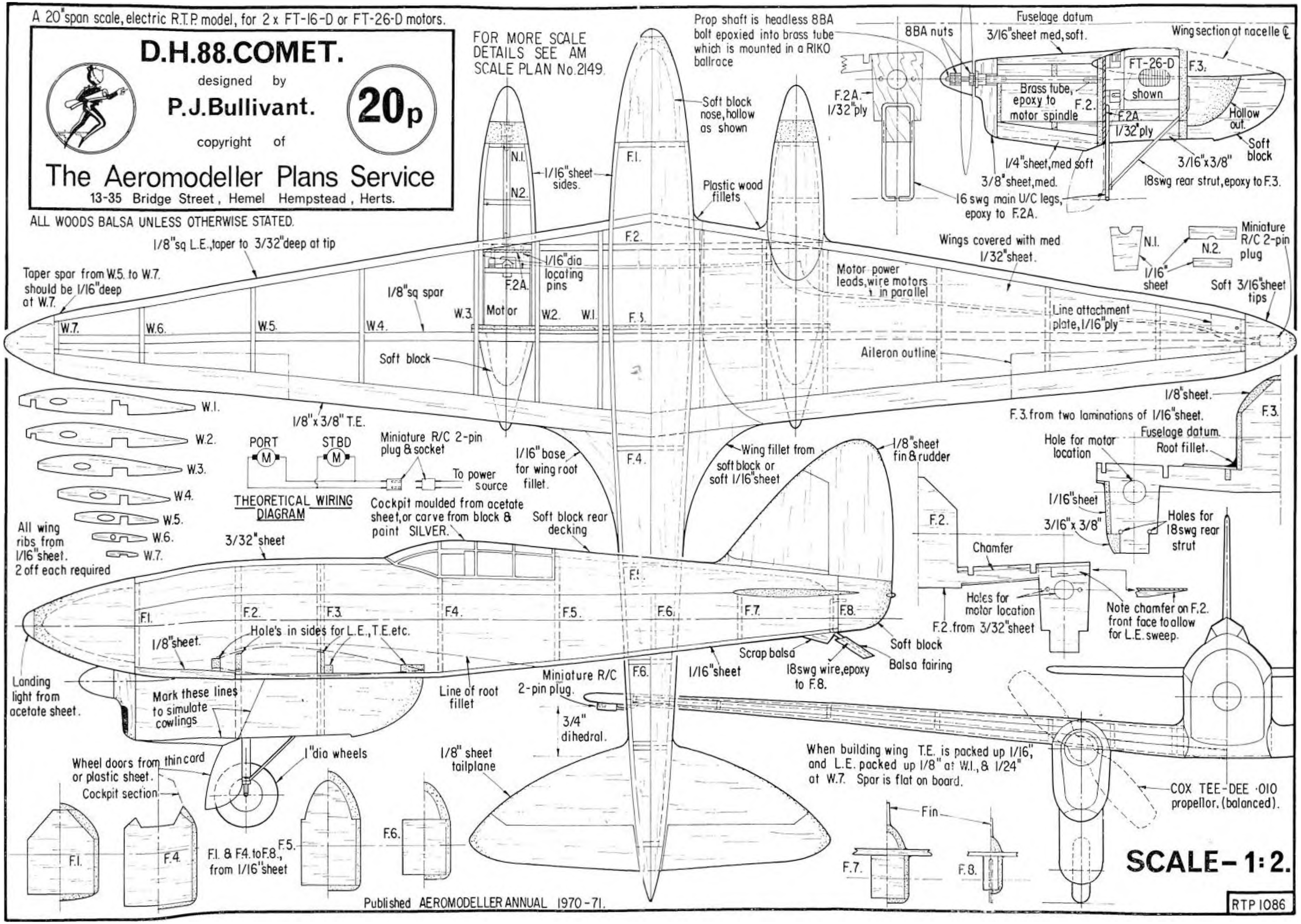
A selection of scale models flown with varying degrees of success by modeller Tom Walker includes: the **Lindoe** *Spitfire* and *Hurricane*, **Frogflite** *Tiger Moth* and *Gladiator* and another *Hurricane*, this time from a Keilkraft kit using a geared motor driving a three-bladed propeller.

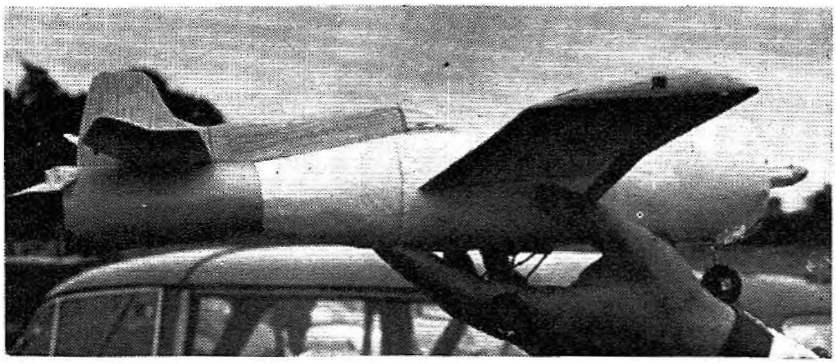
A **Keilkraft** *Westland Lysander*, this time by Jack Ward, with a FT-26D motor mounted directly within the cowling and swinging a **Top Flite** three-bladed propeller frequently receives applause and sighs of appreciation from spectators as it flies almost silently on its gentle circuits and landings.

Because of the necessity to step up the power due to voltage losses on long lines, it was found that **Riko** commercial hand controllers were overheating after repeated use in conjunction with 48 volts power source. The Club now restricts the use of these controllers up to 25 ft. line lengths and with a maximum of 36 volts at source. A heavy duty rheostat of the type used for dimming theatre lights has been obtained and is proving advantageous in that the sliding control lever can be left in any desired position leaving the model flying automatically or ticking over on the ground. This unit provides subtle control at low speeds. Readers who are interested in starting electric model flying are advised to try to obtain a suitable heavy-duty controller unless they only wish to fly on short lines with 12 volts power source.

Ducted Fans

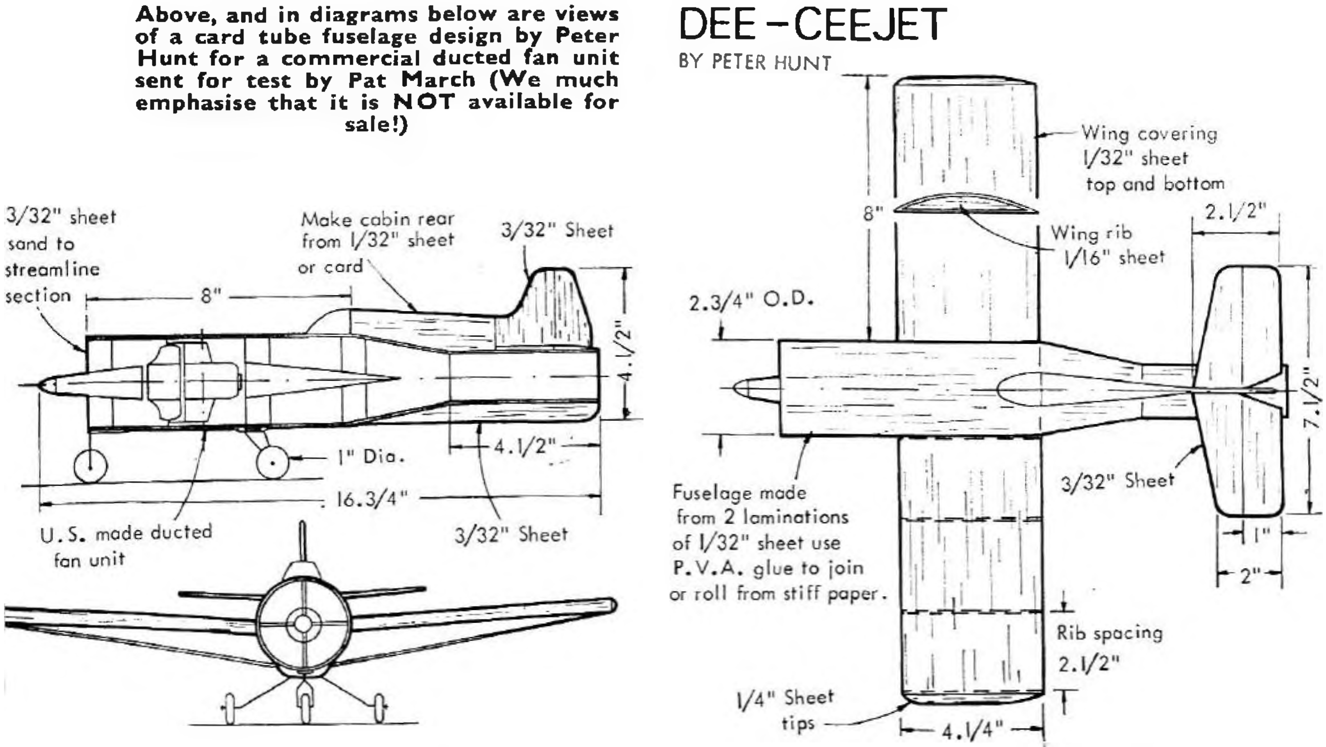
A proprietary ducted fan unit comprising a Mabuchi FT-36D motor and a two-bladed impeller was sent to the AEROMODELLER offices by American modeller Pat March for evaluation. The unit was in turn passed on to the Grantham Club for flying trials. A simple jet-like design was quickly produced by Peter Hunt to prove the practicability of this sort of propulsion unit. The model was reluctant to "lift off" when attached to the short 15 ft. lines, but after


A 20"span scale, electric R.T.P. model, for 2 x FT-16-D or FT-26-D motors.
D.H.88.COMET.
designed by
P.J.Bullivant.
20p
copyright of
The Aeromodeller Plans Service
13-35 Bridge Street, Hemel Hempstead, Herts.
ALL WOODS BALSA UNLESS OTHERWISE STATED.
FOR MORE SCALE DETAILS SEE AM SCALE PLAN No.2149.
1/8"sq L.E.,taper to 3/32"deep at tip
Taper spar from W.5. to W.7. should be 1/16"deep at W.7.
1/8"sq spar
1/16"sheet sides.
1/16"dia locating pins
Motor
Soft block
1/8"x3/8" T.E.
Prop shaft is headless 8BA bolt epoxied into brass tube which is mounted in a RIKO ballrace
Soft block nose, hollow as shown
Plastic wood fillets
F.2A. 1/32"ply
8BA nuts
Fuselage datum
3/16"sheet med, soft.
Wing section at nacelle ℄
FT-26-D shown
Brass tube, epoxy to motor spindle
1/32"ply
Hollow out.
Soft block
3/16"x3/8"
1/4"sheet, med soft
3/8"sheet, med.
16 swg main U/C legs, epoxy to F.2A.
18swg rear strut, epoxy to F.3.
Wings covered with med 1/32"sheet.
Motor power leads, wire motors in parallel
Line attachment plate, 1/16"ply
Aileron outline
Miniature R/C 2-pin plug
1/16" sheet
Soft 3/16"sheet tips
1/8"sheet.
F.3. from two laminations of 1/16"sheet.
Fuselage datum.
Root fillet.
Hole for motor location
1/16"sheet
3/16"x 3/8"
Holes for 18swg rear strut
Chamfer
Holes for motor location
F.2. from 3/32"sheet
Note chamfer on F.2. front face to allow for L.E. sweep.
All wing ribs from 1/16"sheet. 2 off each required
PORT
STBD
Miniature R/C 2-pin plug & socket
To power source
THEORETICAL WIRING DIAGRAM
1/16" base for wing root fillet.
Cockpit moulded from acetate sheet, or carve from block & paint SILVER.
Soft block rear decking
Wing fillet from soft block or soft 1/16"sheet
1/8"sheet fin & rudder
3/32"sheet
1/8"sheet.
Hole's in sides for L.E., T.E. etc.
Scrap balsa
Soft block
Balsa fairing
18swg wire, epoxy to F.8.
1/16"sheet
Landing light from acetate sheet.
Mark these lines to simulate cowlings
Line of root fillet
Miniature R/C 2-pin plug.
3/4" dihedral.
Wheel doors from thin card or plastic sheet.
Cockpit section
1"dia wheels
1/8" sheet tailplane
F.1. & F.4. to F.8., from 1/16"sheet
When building wing T.E. is packed up 1/16", and L.E. packed up 1/8" at W.1., & 1/24" at W.7. Spar is flat on board.
Fin
COX TEE-DEE ·010 propellor. (balanced).
SCALE-1:2.
Published AEROMODELLER ANNUAL 1970-71.
RTP 1086



Right: the Pat March group, at Cincinnati, Ohio, with Pat at rear holding the Demoiselle model. Pat's discoveries in electric round-the-pole flying coincided remarkably with Aeromodeller findings.

Above, and in diagrams below are views of a card tube fuselage design by Peter Hunt for a commercial ducted fan unit sent for test by Pat March (We much emphasise that it is NOT available for sale!)



considerable trimming it has since flown successfully on 25 ft. lines. This type of propulsion has been the subject of a series of experiments by a group of enthusiasts in the United States of America under the guidance of Pat March. So let us take a look at what has been going on over there for the past few years.

The Tri-County Model Club electric flying section had its foundation in Cincinnati, Ohio in July 1963, when the Club members rigged a small model to a counterbalanced rod on a pylon. The pylon was fixed to the top of a car which was to be used in a street parade. The model plane circled the car roof on its counterbalanced arm throughout the parade powered by a slot racing motor and current from the car's battery. The parade entry was a great success and led to a controversy within the Club which in turn started members talking seriously of electric round-the-pole flying.

Early experiments proved the necessity of carefully matching the propeller and motor. During one of the early flights, the motor, overloaded by a 6 in. (rubber-type) propeller, ignited the model's covering. While all watched aghast, the model circled in flames, then crashed in a smoking ruin.

The Club was fortunate in obtaining a supply of Mabuchi FT-36D-22120 motors. These are rather large and slow for slot racers, but were admirably suited to driving small propellers (4·6 in. diameter × 4 in. pitch to 5·5 in. diameter × 3 in. pitch). The motors which weigh 38 grams (1·⅓rd oz.) produce

0·01 h.p. at about 10,000 r.p.m. This motor was powerful enough to swing quite large propellers and therefore little consideration was given by members to the possibility of using gearing.

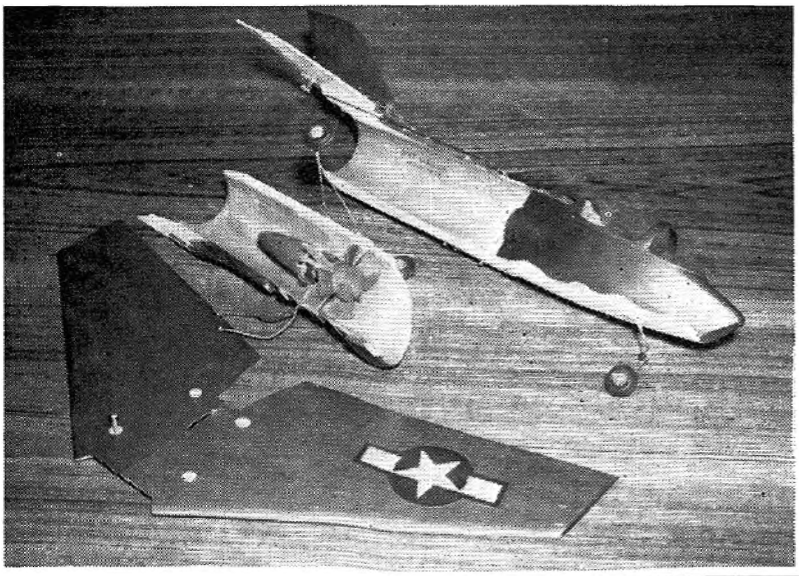
The Club's usual flying site is a basement that would permit a flying circle only 13 ft. in diameter, with 8 ft. head room. Main leader and electric "pioneer", Pat March, described one of his early epic flights with *Demoiselle* as rather hair-raising, ending up with a direct hit and total destruction of an overhead electric lamp bulb. Lengths of lines used vary from 5 ft. to 15 ft.

Some of the earliest models were built for speed. The earliest official record of the Club was 22 m.p.h. and the latest 43·5 m.p.h., with greater prospects in mind.

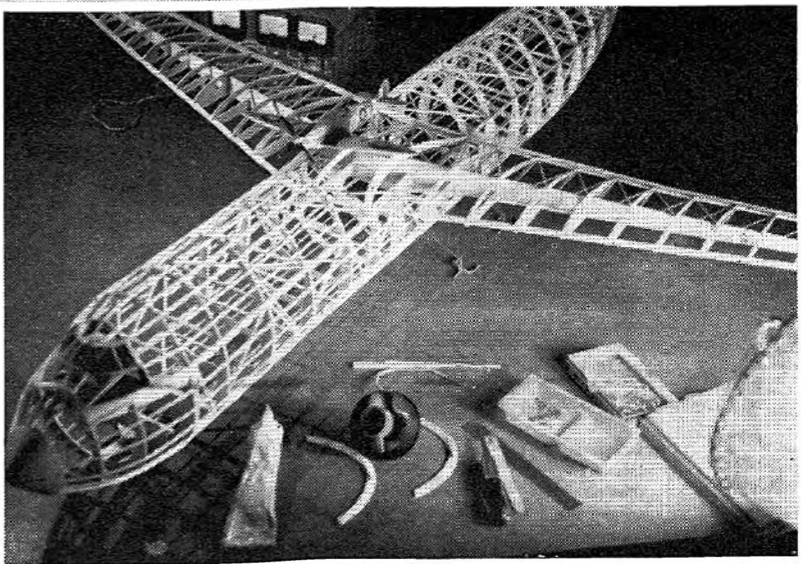
Experiments with elevator control within the Club using only up movement has proved to be quite successful. Down movements of the elevators proved rather disastrous on the short lines in use. Some of the pilots built in a capability for using down elevator but an occasional prang has generally resulted. Normally the elevator movement is "up" only and a spring is used to return the elevator to neutral. Using this system, quite reasonable aerobatics have been achieved including mild wingovers and occasional loops. As in Grantham (U.K.), members of the Tri-County Club have made many models from modified rubber-powerd kits. On biplanes, monofilament bracing is used. This is installed somewhat slack, then tightened by heat from a cigarette or soldering iron. Tension is tested by plucking the wire and adjusting until all the wires of similar length produce a similar note.

The Club has a number of drawings of original designs for the use of members, including simple sheet models, sport models, and relatively advanced scale designs. *Voltswagon* (shown in plan form, page 24) is representative of the type of model used by the Club. It is a most versatile design and has been

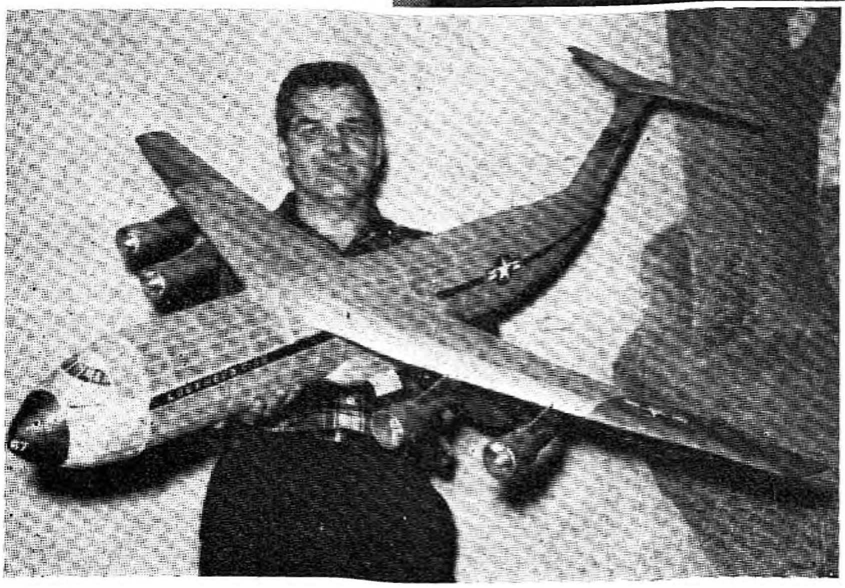
used as a trainer, motor test bed, carrier landing experimental model, banner and glider tug and "blind flyer" (using landing lights in the dark). Smallest Club model is a speedster with only 4 in. wingspan! It flew at 19 m.p.h. on 2 ft. lines powered by a Mabuchi ST.02 motor turning a $1\frac{1}{2}$ in. $\times$ 1 in. propeller.



Prototype for commercial model at left uses special motor driving ducted fan at 28,000 r.p.m. Span is 20 in., could be made to weigh 4 oz. total.

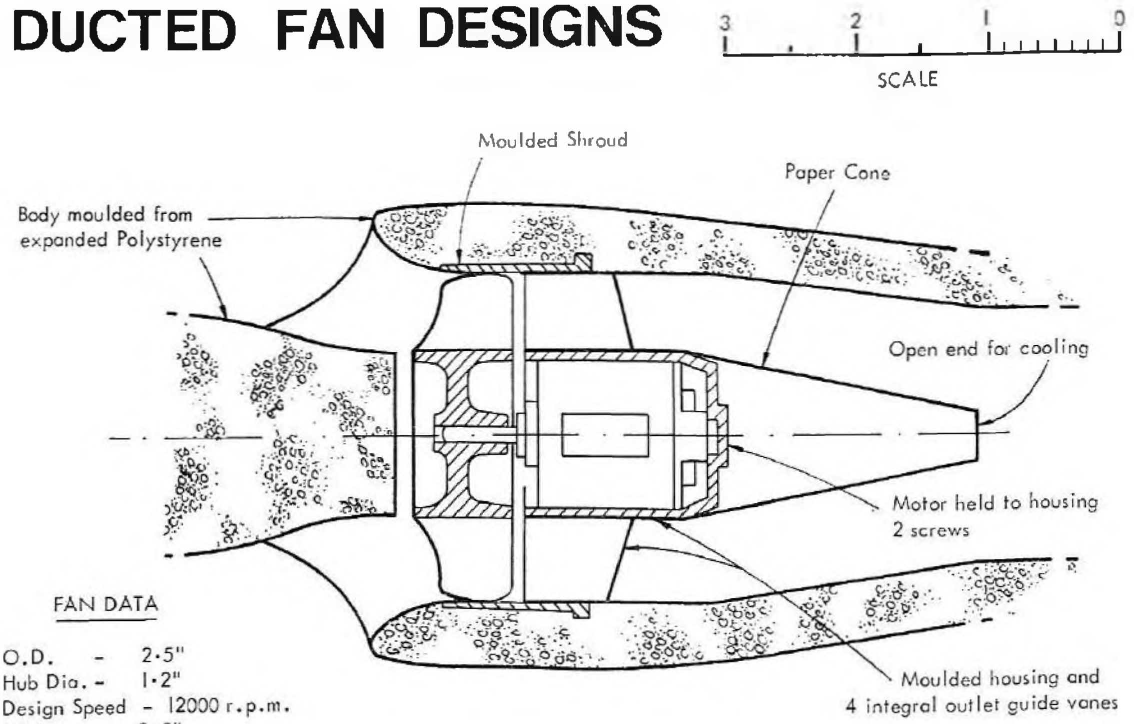


Structure of Pat March's Lockheed C-5a Galaxy with ducted fan unit on bench shows what can be done. Look closely—there's a Spitfire to the same scale on the centre section!



Pat March and completed Galaxy, a triumph of lightweight design and enterprise which should look great when flown on large radius.

DUCTED FAN DESIGNS

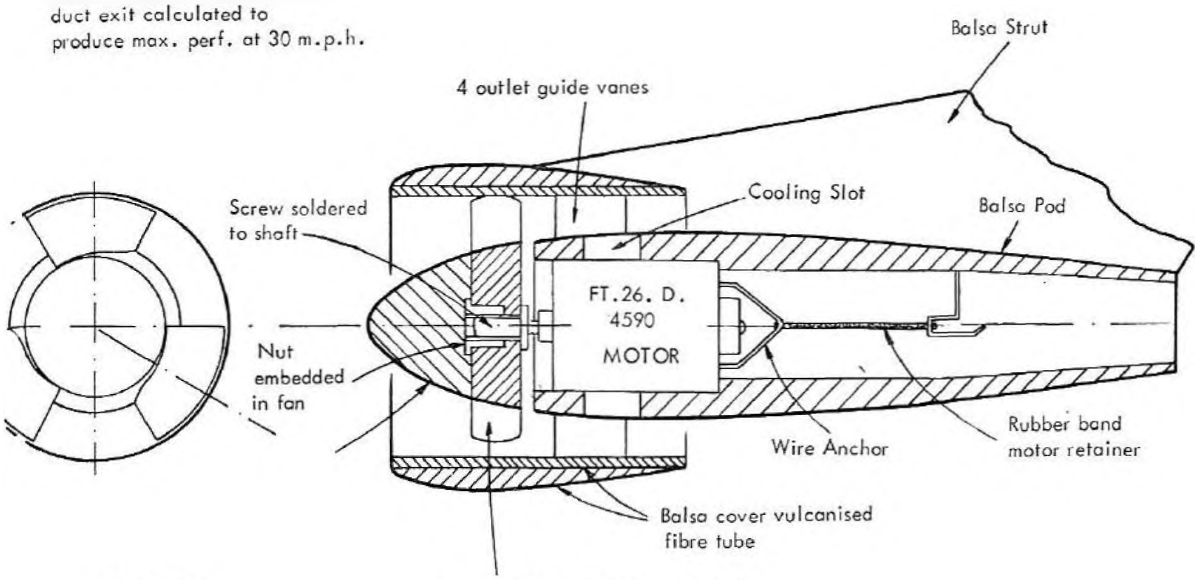


FAN DATA

O.D. - 2·5"
Hub Dia. - 1·2"
Design Speed - 12000 r.p.m.
Pitch - 3·5"
Jet - 2·6" Dia.
Static Thrust 1.8 oz.
Blade Width 0.75" Const.
Number Blades 2

'JET STREAK' FAN

Note: Dias. at fan exit and duct exit calculated to produce max. perf. at 30 m.p.h.



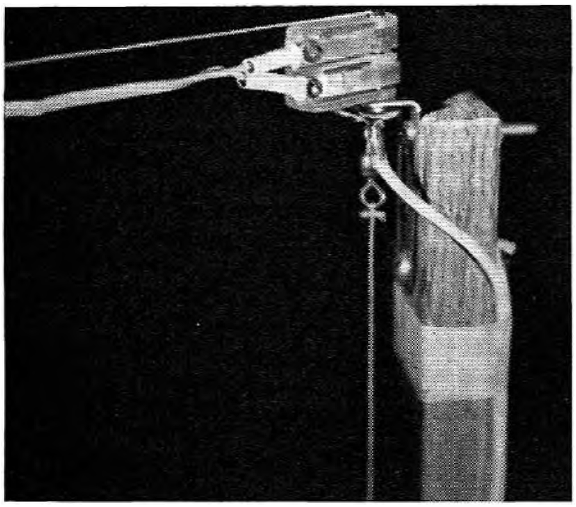
FAN DATA

O.D. - 2·00"
Hub Dia. - 1·12" Max.
Pitch - 2"
Design Speed - 22500 r.p.m.

4 motors used in series operated by 55 volt well smoothed D.C. supply

'C5-A' FAN

The largest model is a scale *Lockheed Galaxy* spanning 56 in. ($\frac{1}{4}$ in. to 1 in. scale). The model weighs about $1\frac{1}{2}$ lb., flies on four FT-26D motors turning ducted fan impellers in scale pods. The motors are connected in series and take a current of 2 amperes at 50 volts, to fly at 35 m.p.h. Three other ducted fan designs were flown, one was put into production by the Kenner Products Company.



Original Pat March pylon head at left, compares with the development sketched opposite.

Smaller faster motors than the FT-36D have also been extensively used but are not considered by the Club to be so satisfactory. The Club is now using gearing. One example is an FT-26D with 2 : 1 gearing turning a 4·23 in. diam. × 4·23 in. pitch propeller at 12,000 r.p.m. This should provide peak efficiency at 45 m.p.h. with considerably more power available than the with FT-36D.

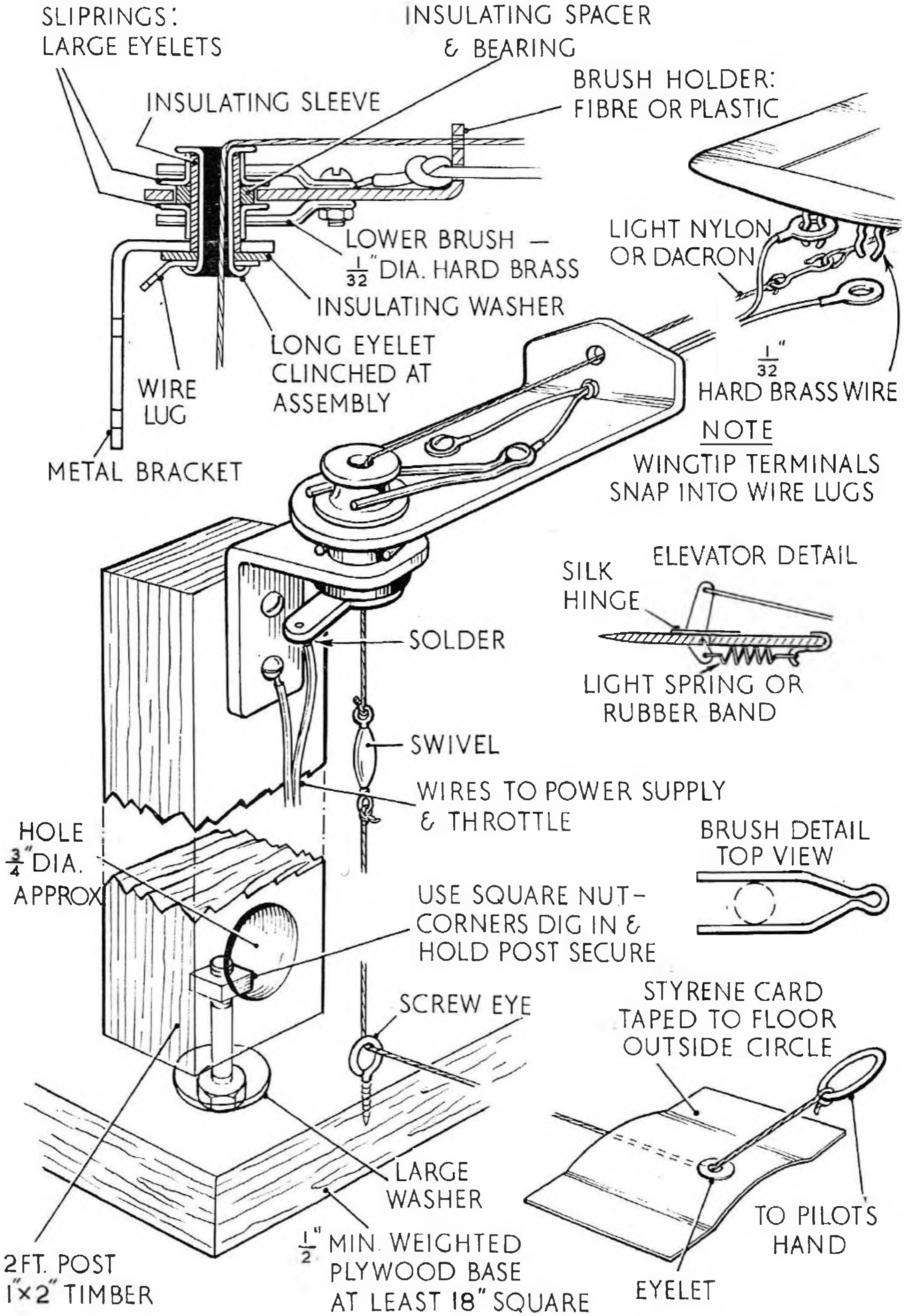
The general trend within the Tri-County's Club in the U.S.A. appears then to be emphasis on larger motors with gearing, few extension shafts, and short lines dictated by lack of flying space. Elevator control is used and ducted fan models flying on multi-strand lines no longer than 7 ft. Pylons are high enough to allow the power lines to slope down to the model at approximately 18 degrees or approximately 2 : 6 slope.

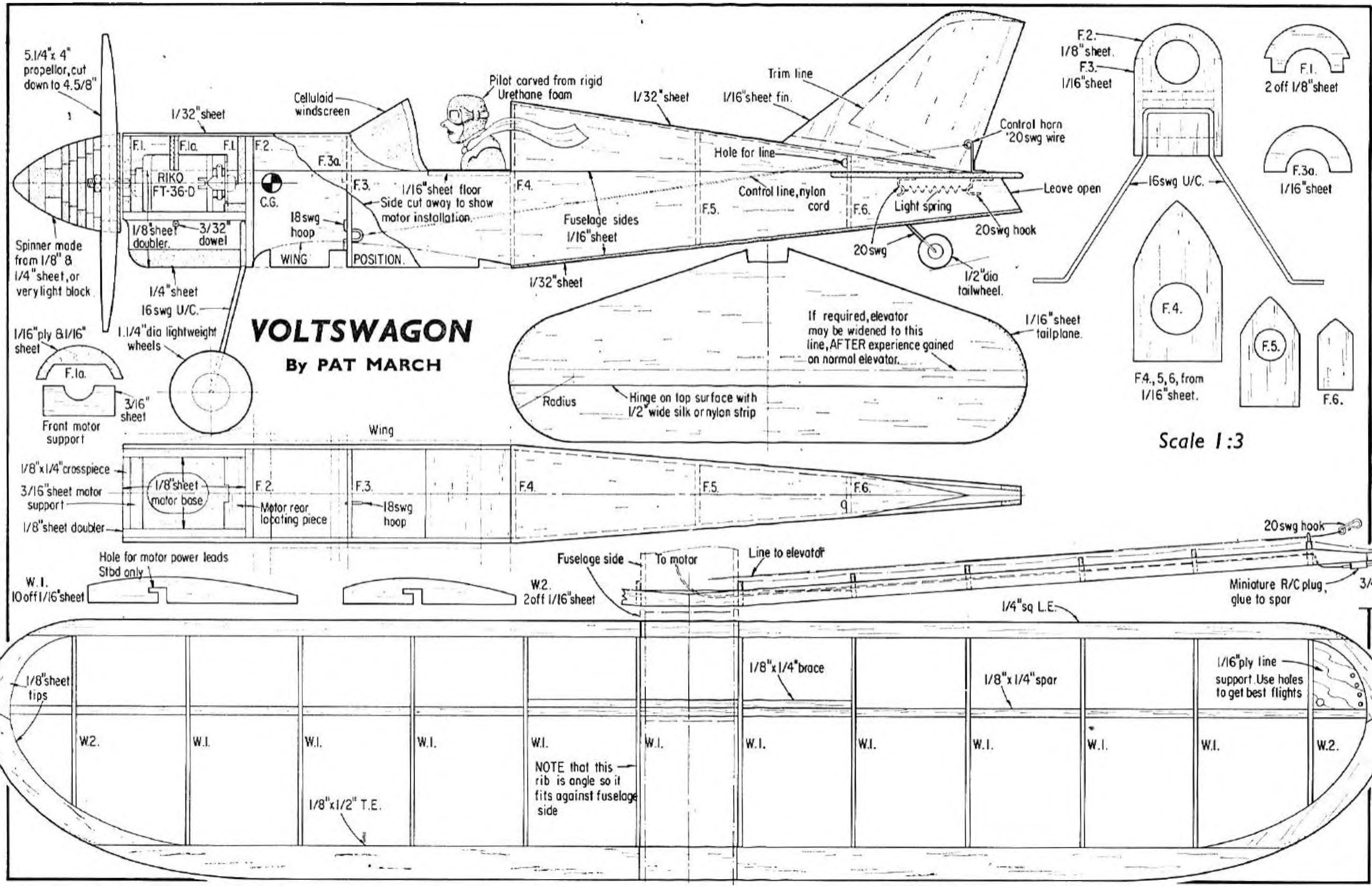
The original pylon used by the Club was constructed in 1966 and has been in use ever since. The pylon head was built using a piece of Plexiglas ("Perspex") shaped by hand drill and file. The head was fitted to a wooden beam screwed into a base (see Fig. 3). A second far simpler head since successfully used by the Club is that shown in Fig. 4. Both of these heads incorporate provision for elevator control; the nylon or Dacron control line is connected to a spring (or rubber) loaded self-centreing "up only" elevator in the model, it passes down through the centre tube or eyelet which forms part of the head and through screw eye in the wooden base, and from there close to the ground to the outside of the flying circle where the line is finally held down by a piece of styrene card and then up to the pilot's hand. This simple system of control appears to be quite efficient and provides a certain amount of "feel" for the pilot.

A hint from Pat March to readers is to take note of the identification numbers when purchasing these Mabuchi motors as they are of definite significance. For example, the Mabuchi FT-36D 22120: the first two digits after the "D" indicate the wire size in hundredths of a millimetre, and the following digits shown the number of turns of wire per pole. His favourite motors, in addition to the large FT-36D 22120 and 27110, are the FT-26D 2675 and the smaller FT-16D 18110. He warns that there are at least two different versions of each of these motors indistinguishable by inspection, but the lower-powered versions are quite worthless for aeroplane flying. The only test is by using an ammeter.

Pat also advises readers who intend using slot car push-button hand controllers to disconnect the "brake" feature, as this is undesirable in these flying models. Pat has also produced equations for calculating the best gears to use, most efficient prop sizes, etc.

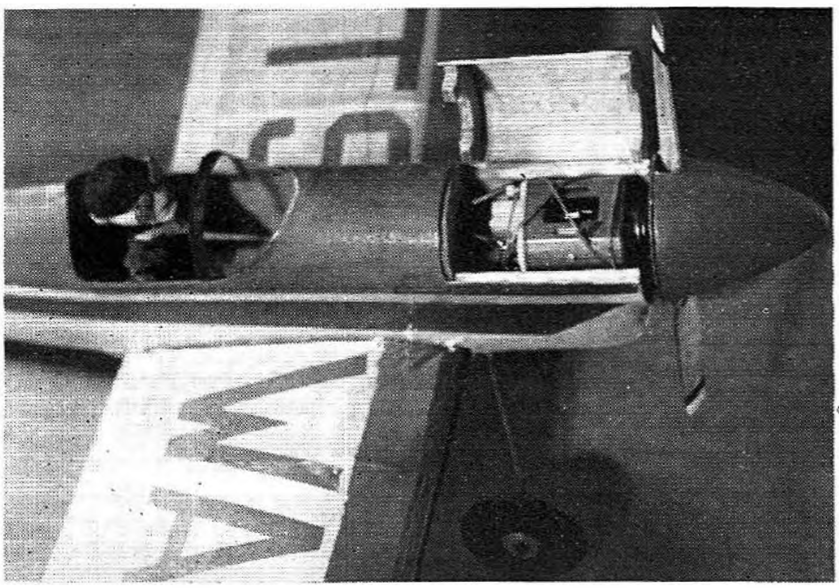
Back again this side of the "pond" to look at the activities of a keen set of electric flyers, members of the **Bristol Bulldogs M.A.C.** who all work for the British Aircraft Corporation wind tunnel department.


SLIPRINGS: LARGE EYELETS
INSULATING SPACER & BEARING
BRUSH HOLDER: FIBRE OR PLASTIC
INSULATING SLEEVE
LOWER BRUSH — $\frac{1}{32}$" DIA. HARD BRASS
INSULATING WASHER
LONG EYELET CLINCHED AT ASSEMBLY
WIRE LUG
METAL BRACKET
LIGHT NYLON OR DACRON
$\frac{1}{32}$" HARD BRASS WIRE
NOTE
WINGTIP TERMINALS SNAP INTO WIRE LUGS
ELEVATOR DETAIL
SILK HINGE
LIGHT SPRING OR RUBBER BAND
SOLDER
SWIVEL
WIRES TO POWER SUPPLY & THROTTLE
BRUSH DETAIL TOP VIEW
HOLE $\frac{3}{4}$" DIA. APPROX
USE SQUARE NUT– CORNERS DIG IN & HOLD POST SECURE
SCREW EYE
STYRENE CARD TAPED TO FLOOR OUTSIDE CIRCLE
LARGE WASHER
TO PILOTS HAND
2FT. POST 1"×2" TIMBER
$\frac{1}{2}$" MIN. WEIGHTED PLYWOOD BASE AT LEAST 18" SQUARE
EYELET



VOLTSWAGON
By PAT MARCH
Scale 1:3
5.1/4"x 4" propellor, cut down to 4.5/8"
1/32" sheet
Celluloid windscreen
Pilot carved from rigid Urethane foam
1/32" sheet
Trim line
1/16" sheet fin.
F.1. F.1a. F.1. F.2.
F.3a.
RIKO FT-36-D
C.G.
F.3. 1/16" sheet floor
Side cut away to show motor installation.
F.4.
Hole for line
Control horn 20 swg wire
Control line, nylon cord
F.5. F.6.
Light spring
Leave open
20 swg hook
Fuselage sides 1/16" sheet
18 swg hoop
1/8" sheet doubler.
3/32" dowel
WING POSITION.
20 swg
1/2" dia tailwheel.
Spinner made from 1/8" & 1/4" sheet, or very light block
1/4" sheet
16 swg U/C.
1/32" sheet
1.1/4" dia lightweight wheels
1/16" ply & 1/16" sheet
F.1a.
3/16" sheet
Front motor support
If required, elevator may be widened to this line, AFTER experience gained on normal elevator.
1/16" sheet tailplane.
Radius
Hinge on top surface with 1/2" wide silk or nylon strip
F.2. 1/8" sheet.
F.3. 1/16" sheet
F.1. 2 off 1/8" sheet
16 swg U/C.
F.3a. 1/16" sheet
F.4.
F.5.
F.6.
F.4., 5, 6, from 1/16" sheet.
Wing
1/8"x1/4" crosspiece
3/16" sheet motor support
1/8" sheet motor base
1/8" sheet doubler
F.2. F.3. F.4. F.5. F.6.
Motor rear locating piece
18 swg hoop
20 swg hook
Hole for motor power leads Stbd only
W.1. 10 off 1/16" sheet
W.2. 2 off 1/16" sheet
Fuselage side
To motor
Line to elevator
Miniature R/C plug, glue to spar
3/4"
1/4" sq L.E.
1/8" sheet tips
1/8"x1/4" brace
1/8"x1/4" spar
1/16" ply line support. Use holes to get best flights
W.2. W.1. W.1. W.1. W.1. W.1. W.1. W.1. W.1. W.1. W.1. W.2.
NOTE that this rib is angle so it fits against fuselage side
1/8"x1/2" T.E.

The Voltswagon, as published by American Aircraft Modeler is an attractive sports design for direct drive, plan opposite.

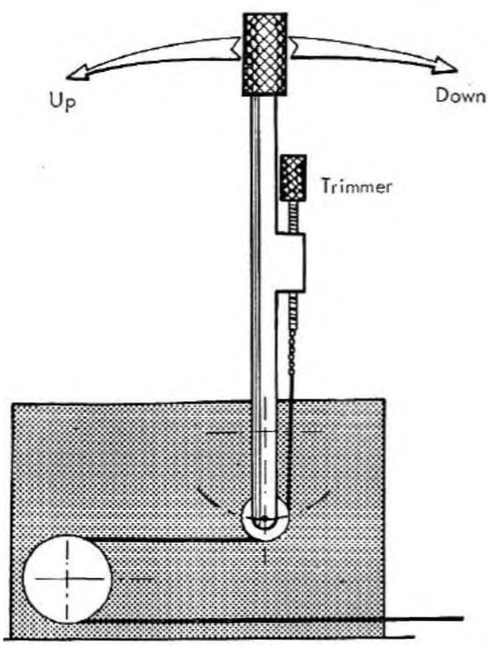


Engine room in the Voltswagon opened to reveal the FT-36D motor. Model would also perform well on the Slot Car FT 26D Units known as: Mura Group 20, Champion Black Power or Big Chief or the Rikobomb, depending on line radius.

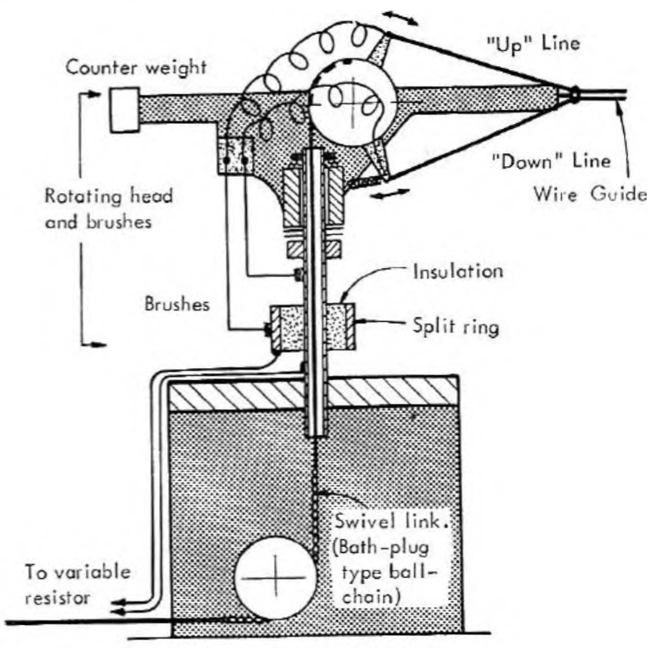
These enthusiasts have been developing electric flying over the past twelve months and are adopting techniques very similar to those employed by the Grantham boys. The pylon they use is made almost entirely from Meccano parts. Using a similar idea to that shown in the *Control line Manual*, the Club have constructed a small "joystick" unit which incorporates a very useful line trimming device and a throttle lever controller based on electric train principle which can be pushed past a neutral position to provide reverse thrust for S.T.O.L. (Grantham members have used a similar idea employing a redundant full-size glider control column, but now prefer to just pull the end of the tether by hand using the idea devised by Pat March in the U.S.A.)

The "Bulldogs" use an assortment of transformers producing up to 40 volts (open circuit) at the controller which gives 12 volts at the motor on full throttle. The Club favours **Rikowhip** motors and **Cox** 3 in. × 1¼ in. propellers producing 2 oz. thrust on 12 volts, giving a model of 2 to 3 oz. weight quite a reasonable performance.

Pioneer of the group, Roger Redman, started by flying models in his lounge on 4 ft. lines using 34 g shellaced copper wire where 25 volts (open circuit) at the controller gave 10 to 12 volts at the motor.



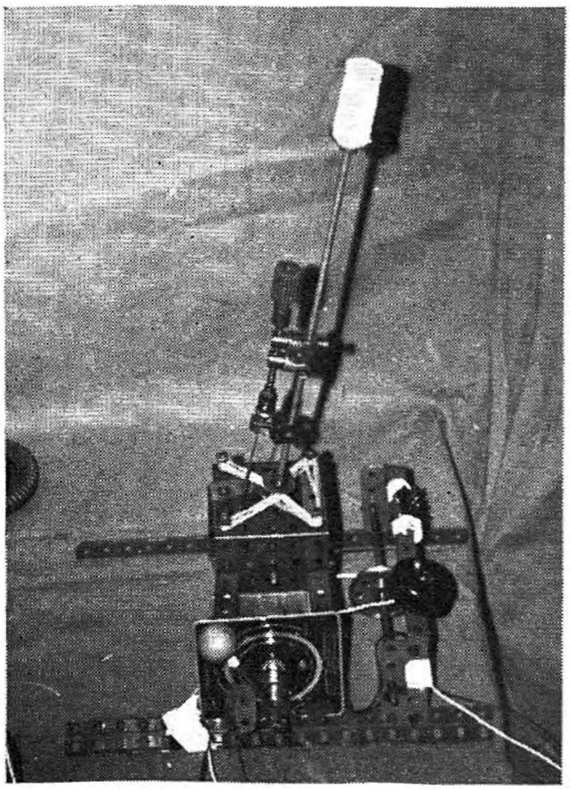
JOYSTICK UNIT

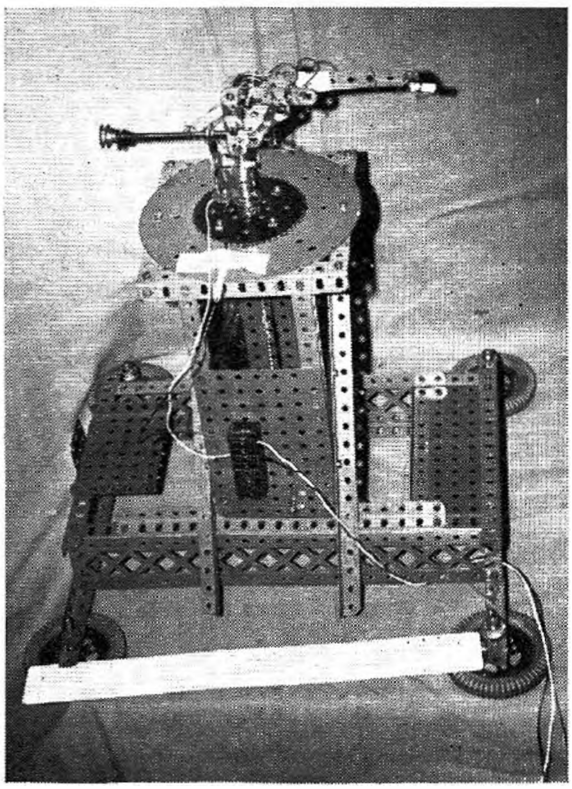


CENTRAL PYLON

Several of his friends became very interested, one of them started building an additional pylon. To the relief of their wives, flying sessions moved from their dwellings into the B.A.C. Filton canteen. First flights in the canteen were on 10 ft. radius lines of 30 g. wire using 40 volts supply giving 12 volts at the model. Control and performance were very good.

The emphasis with this Club is speed and elevator control. A particularly attractive sports design (No. 9—top right in the photograph) incorporating elevator control, flies rock-steady at 30 m.p.h. at ground level, or climbs to almost 8 ft. altitude with just a gentle touch of the stick. Low-speed performance





Opposite: diagrams and photos of the control and pylon head used by Bristol Bulldogs. Single point lead-out for control wires is considered essential. Joystick has electric train "throttle" control and is tensioned to "Up" elevator position.

Bristol Bulldog's models No. 8 (on left) a flying test bed for just about everything, No. 5 speed model for R.T.P. only, no elevator control, No. 9 a sport/racer, No. 10 (on right), No. 15 with trike U/C, No. 18 the tailed delta with trike U/C.

of this model is good—as low as 10 m.p.h. using a fair amount of power and quite a lot of up elevator, but it has a vicious stall.

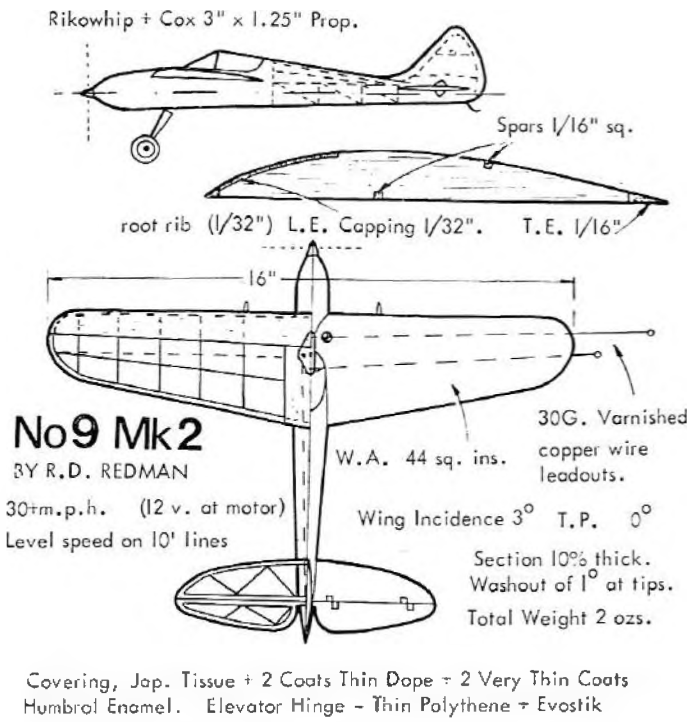
Another of Roger's *electroplanes* (No. 10—bottom right in the photograph) has a built-up plank wing with end-plates, coupled elevators and flaps, symmetrical wing section and 60 sq. in. wing area with ½ chord tail moment. This model is very responsive on 10 ft. lines, but although it will fly on 15 ft. lines with voltage stepped up, control is a bit vague at low speeds or high altitude.

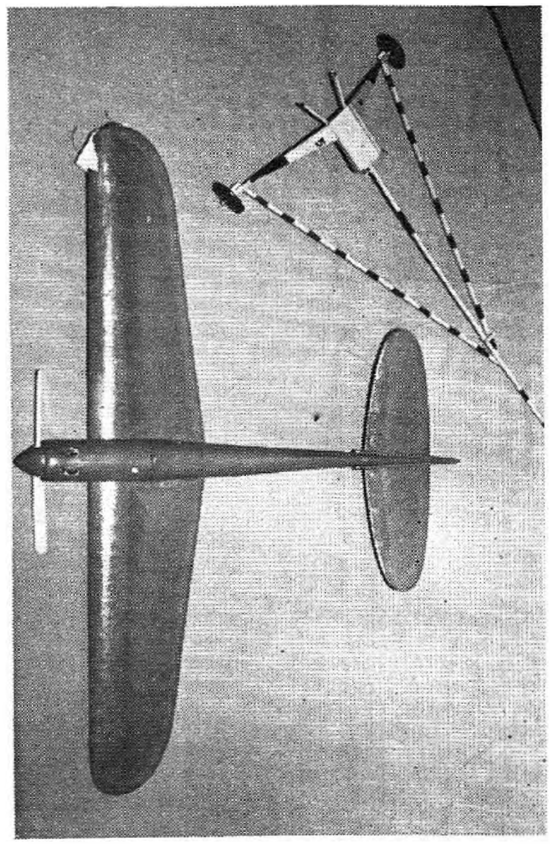
A neat little 16 in. span tricycle undercarriage design by Roger (upper left in the photograph) is No. 15. This model weighs 3 oz. and has a 50 sq. in. wing. The model originally incorporated a retractable undercarriage, but this was only partially successful. The propeller is fitted to an alloy extension which is fitted to the motor shaft using a grub screw.

A "hot" speed design by Roger using a drop off dolly has clocked 35 m.p.h. on a modified **Scalextric** motor in Roger's lounge. Tailplane incidence is adjustable by using a dowel swivel. This model has great speed potential with its drop off dolly undercarriage and could surely top the "forties" if given a better motor such as a **Rikowhip** 1015 (ball race) or a **Riko** Wildcat 1016 (ball race).

The Bulldogs are limited to 20 ft. radius lines at present. They are concentrating on Scale and Stunt designs, one model has performed successful loops on 12 ft. lines with a 70 sq. in. wing, using direct drive.

It is difficult to make the choice of an "ideal" motor. Undoubtedly the FT-36D (marketed by Revell, Cox, and others under various trade names) is a very good choice with its ability to swing a comparatively large propeller without the necessity for gearing, however, they are not easily obtainable. The **Rikowhip** R1015 (ball race) motor is good and will perform quite well with or without gearing, but in my experience the **Riko** Wildcat R1016 is the best bet. Having compared the 'Whip and Wildcat in Grantham we found that the Whip performed marginally on 40 ft. lines using a 48 volt power source (12 volt car

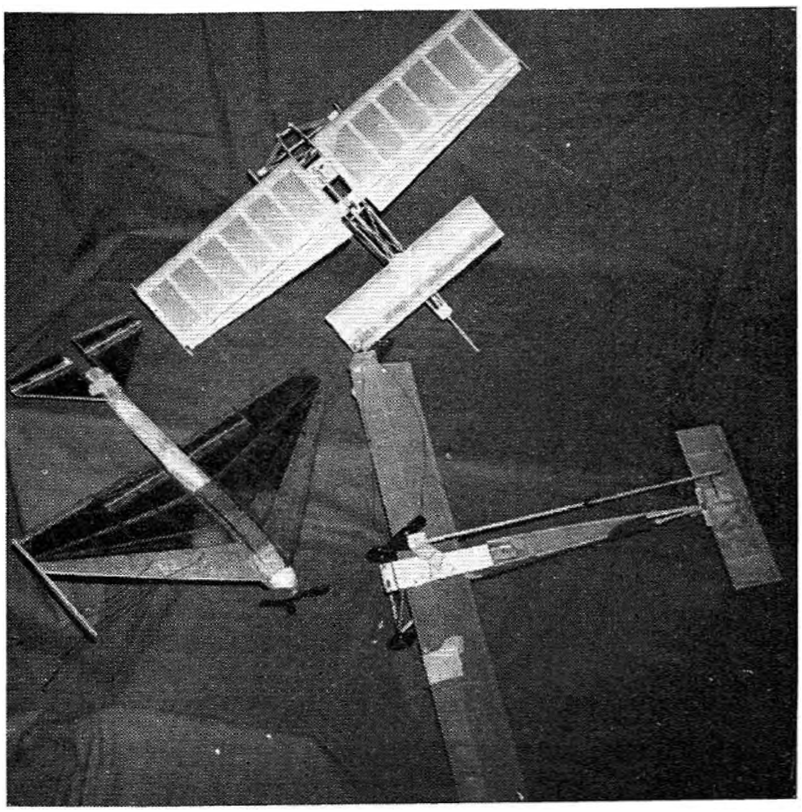




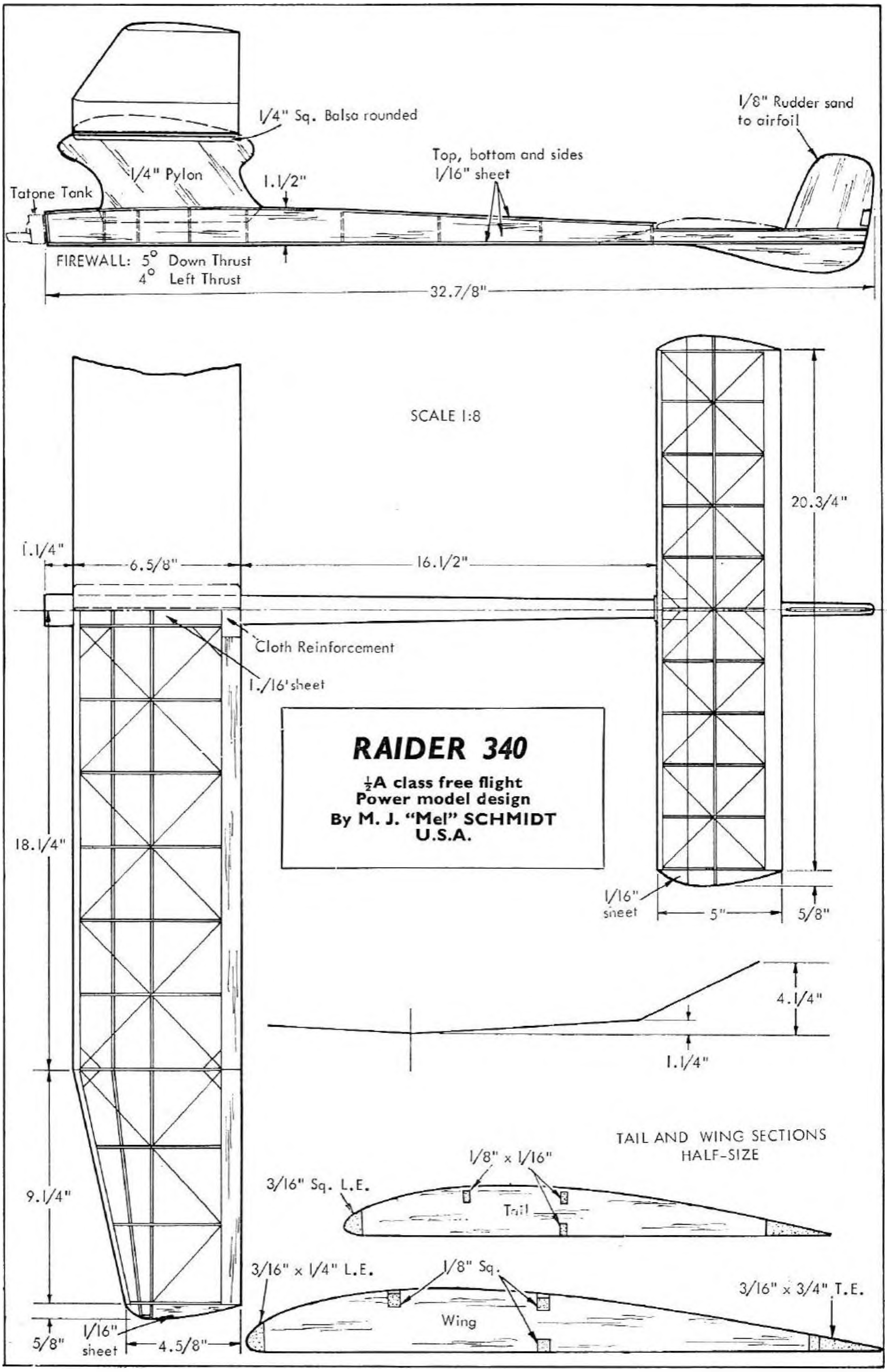
Roger Redman's sport flying design above, and at right—his speed model with take-off dolly. Has a Scalextric motor, 4 × 2 in. balsa prop. best speed 35 m.p.h.

batteries in series), whilst the Wildcat, on similar length lines, gives the impression that it has far more "to give", however, the "Cat" is no longer imported.

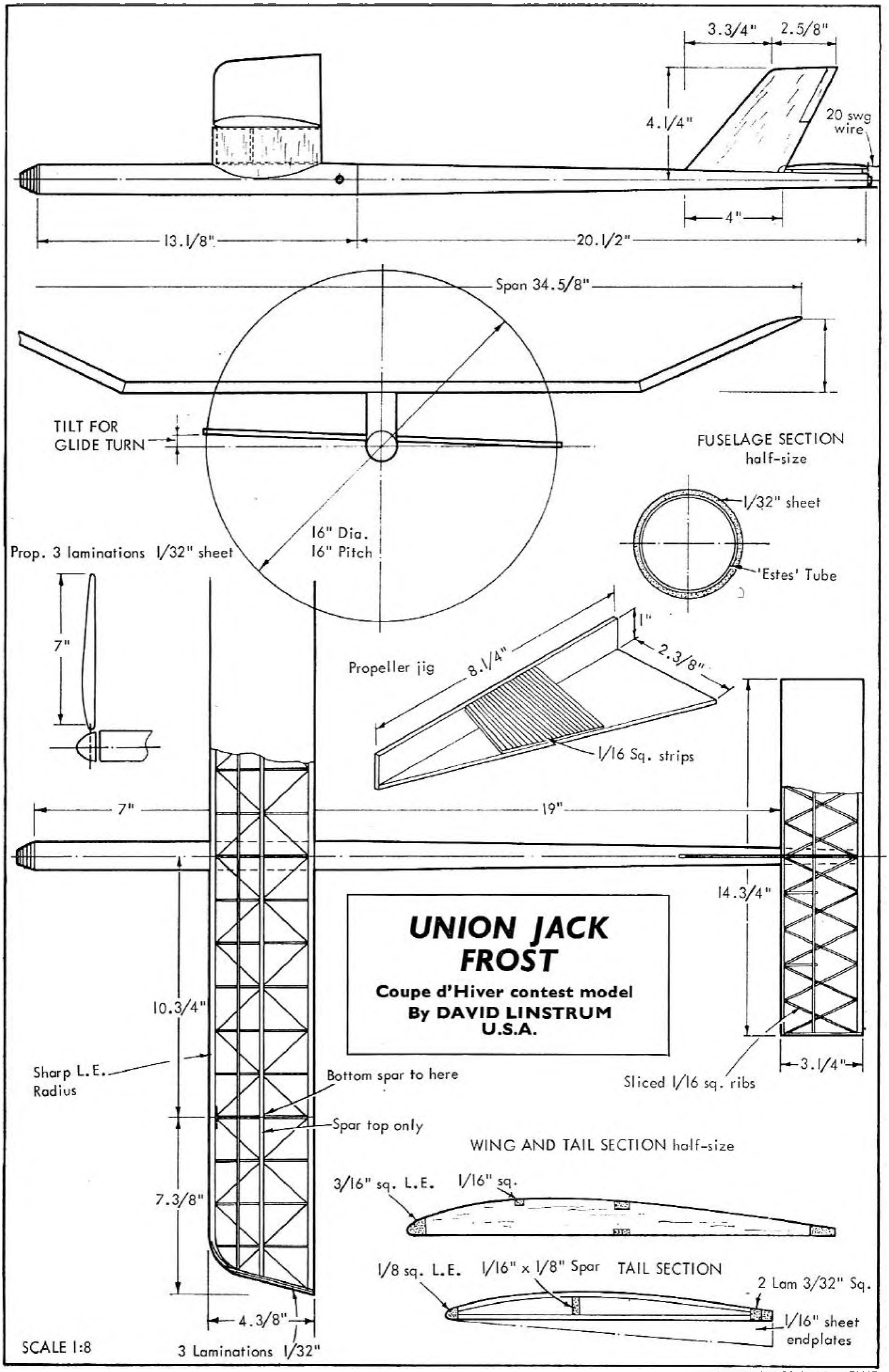
No doubt the next year or so will see great advances in this form of modelling, who knows, maybe one day electric round-the-pole flying will be given equal priority to all other events at the Nats!



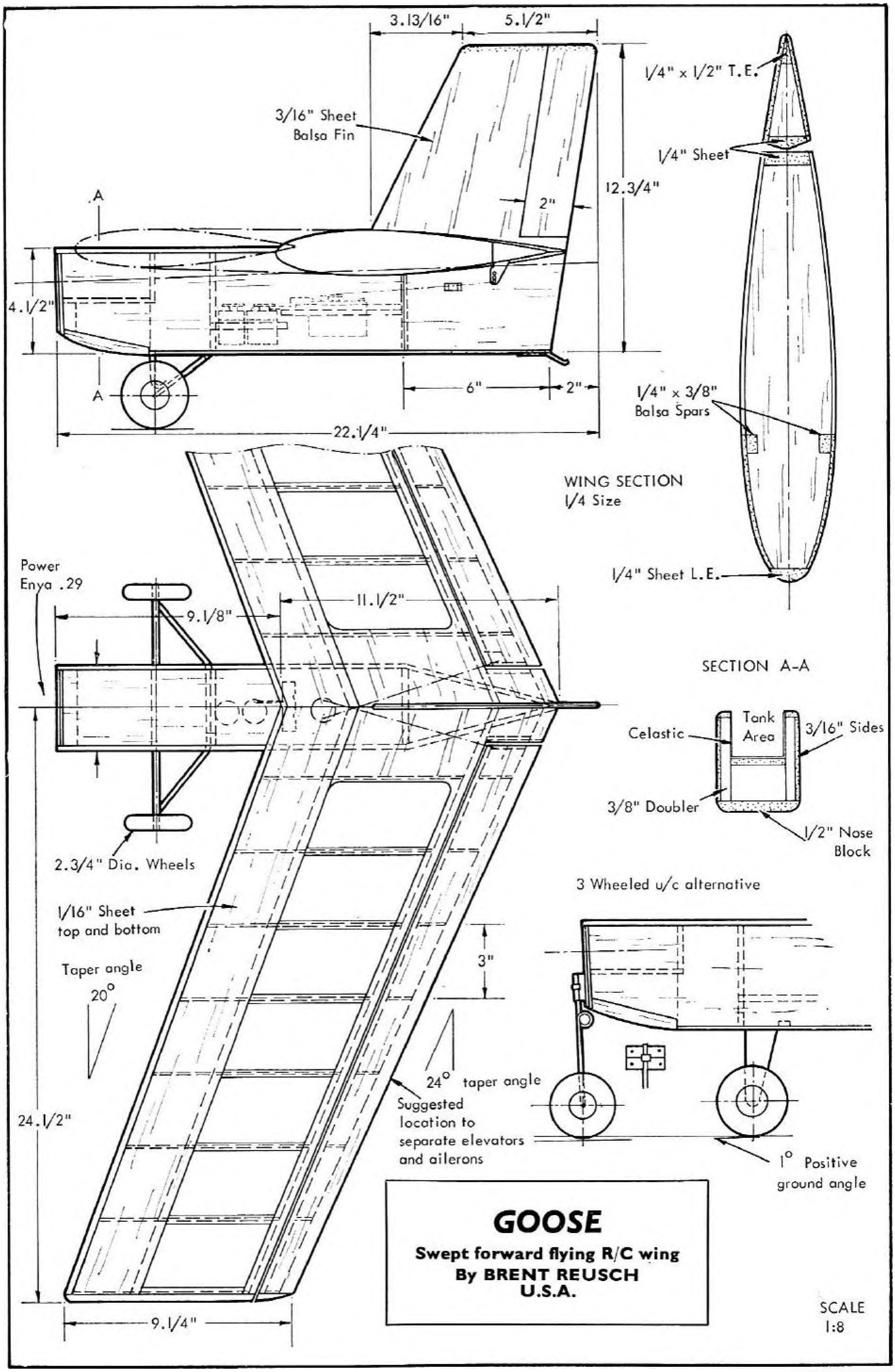
Left, the Delta No. 18 started life tailless but the degree of elevator required kept CL down and restricted altitude. The tailplane was added on a long moment arm and performance is very good. The photo shows it between modifications. Others are the flying test bed at bottom right and above, a model with coupled elevators and flaps.



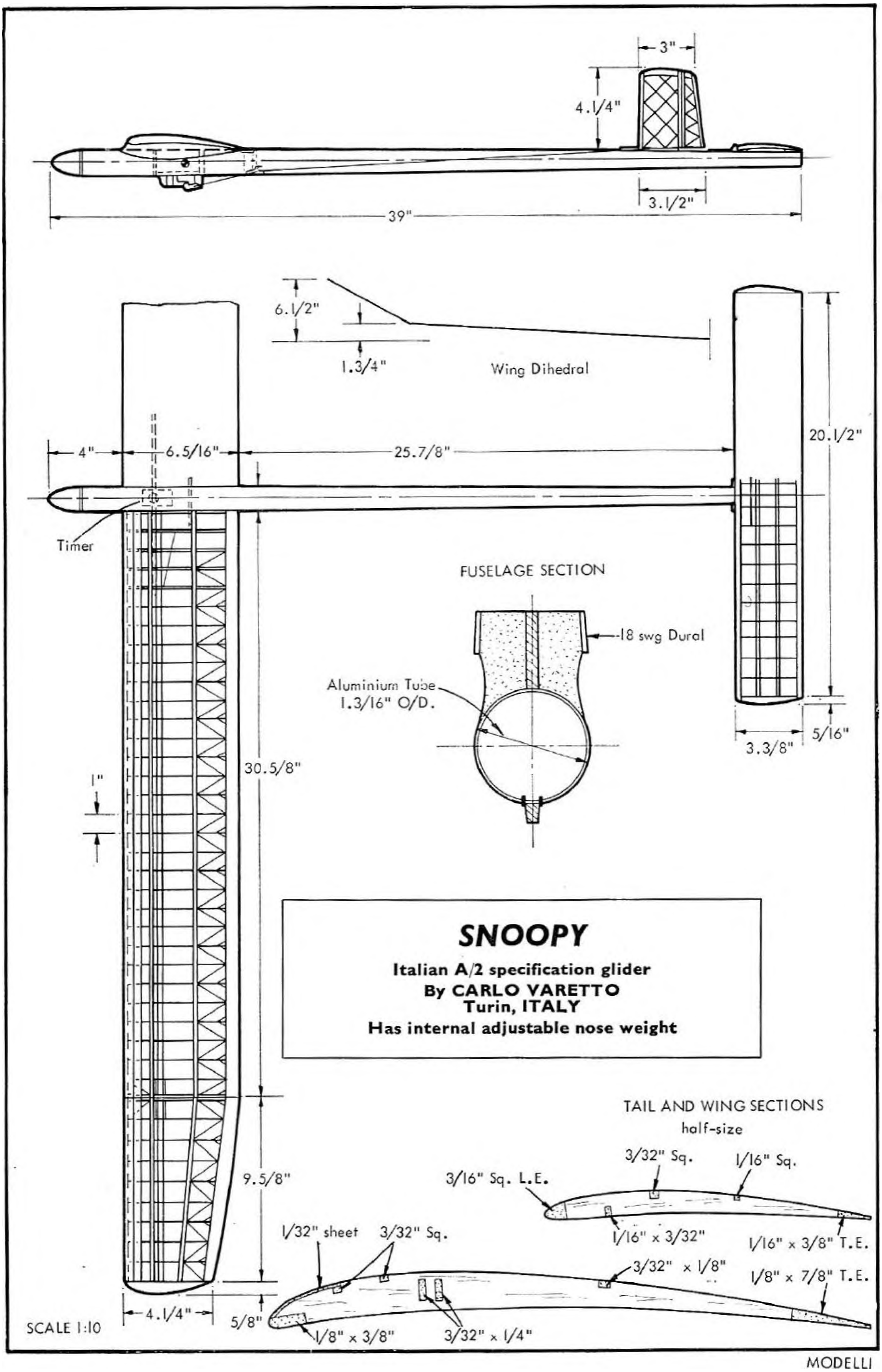
MODEL AIRPLANE NEWS



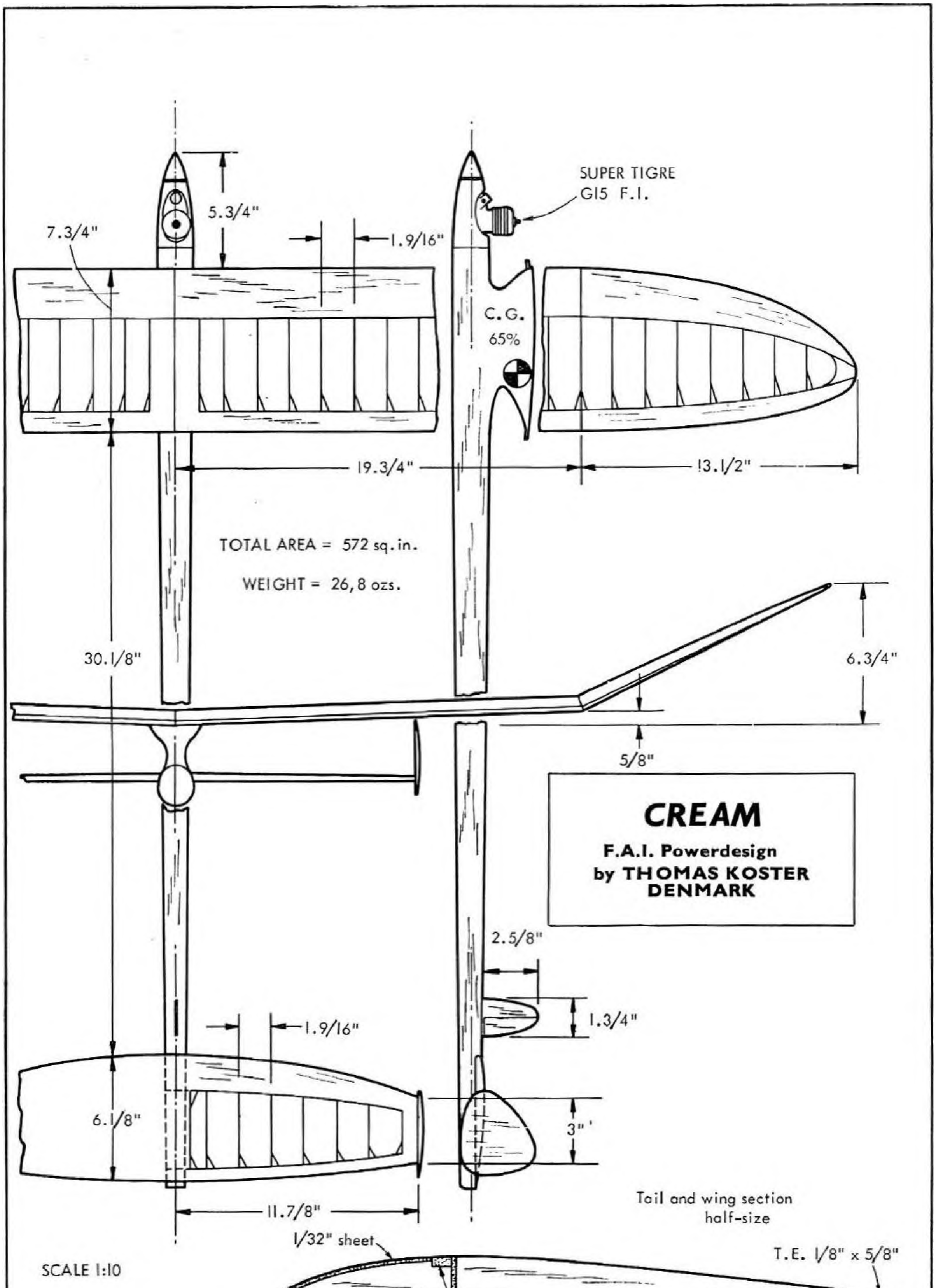
MODEL AIRPLANE NEWS

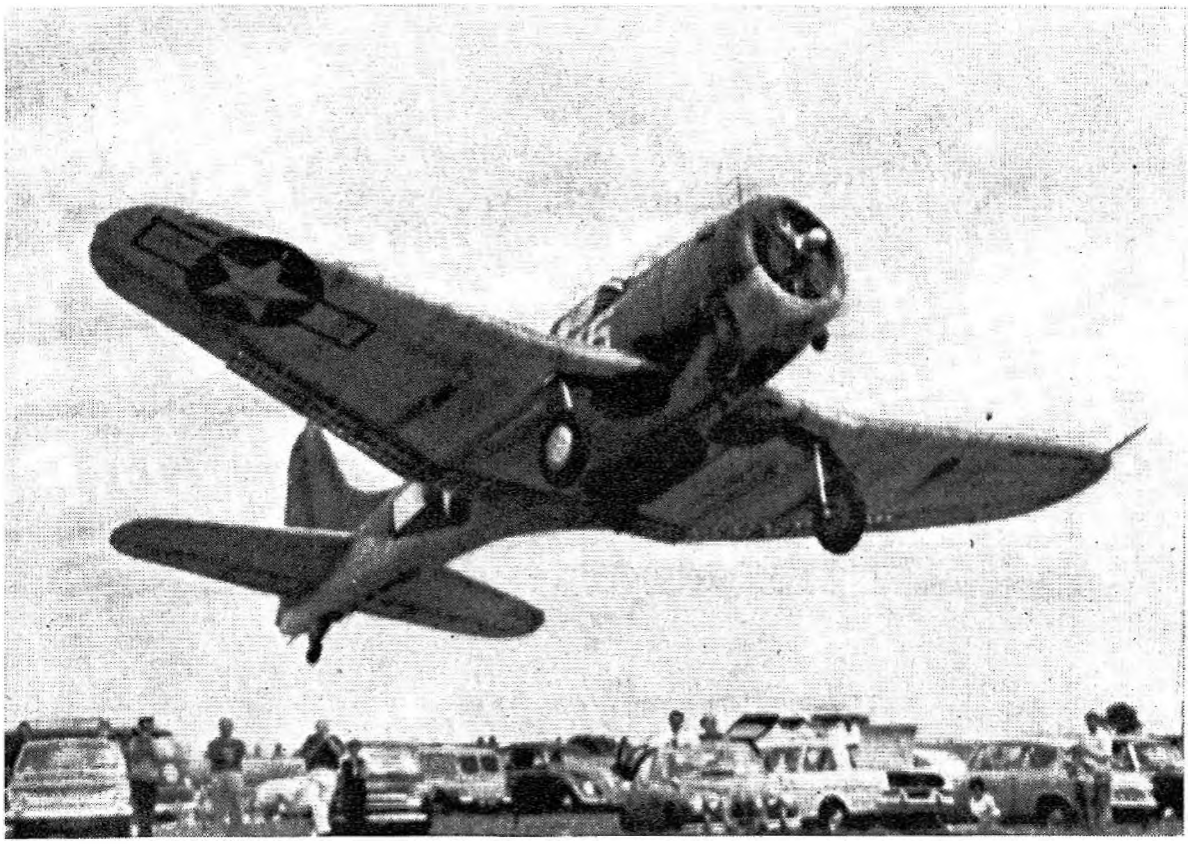

3.13/16"
5.1/2"
1/4" x 1/2" T.E.
3/16" Sheet Balsa Fin
1/4" Sheet
12.3/4"
A
2"
4.1/2"
A
6"
2"
1/4" x 3/8" Balsa Spars
22.1/4"
WING SECTION 1/4 Size
Power Enya .29
1/4" Sheet L.E.
11.1/2"
9.1/8"
SECTION A-A
Celastic
Tank Area
3/16" Sides
3/8" Doubler
1/2" Nose Block
2.3/4" Dia. Wheels
3 Wheeled u/c alternative
1/16" Sheet top and bottom
3"
Taper angle 20°
24° taper angle
Suggested location to separate elevators and ailerons
24.1/2"
1° Positive ground angle
GOOSE
Swept forward flying R/C wing
By BRENT REUSCH
U.S.A.
SCALE 1:8
9.1/4"

R/C MODELER


3"
4.1/4"
3.1/2"
39"
6.1/2"
1.3/4"
Wing Dihedral
20.1/2"
4"
6.5/16"
25.7/8"
Timer
FUSELAGE SECTION
18 swg Dural
Aluminium Tube
1.3/16" O/D.
3.3/8"
5/16"
30.5/8"
1"
SNOOPY
Italian A/2 specification glider
By CARLO VARETTO
Turin, ITALY
Has internal adjustable nose weight
TAIL AND WING SECTIONS
half-size
3/32" Sq.
1/16" Sq.
3/16" Sq. L.E.
9.5/8"
1/16" x 3/32"
1/16" x 3/8" T.E.
1/32" sheet
3/32" Sq.
3/32" x 1/8"
1/8" x 7/8" T.E.
4.1/4"
5/8"
1/8" x 3/8"
3/32" x 1/4"
SCALE 1:10

MODELLI


SUPER TIGRE
G15 F.I.
7.3/4"
5.3/4"
1.9/16"
C.G.
65%
19.3/4"
13.1/2"
TOTAL AREA = 572 sq.in.
WEIGHT = 26,8 ozs.
30.1/8"
6.3/4"
5/8"
CREAM
F.A.I. Powerdesign
by THOMAS KOSTER
DENMARK
2.5/8"
1.3/4"
1.9/16"
6.1/8"
3"
11.7/8"
Tail and wing section
half-size
1/32" sheet
T.E. 1/8" x 5/8"
SCALE 1:10
1/16" sheet
3/32" x 1/4"
3.1/16" x 3/32" spans
1/32" sheet
L.E. 1/4"sq.
1/16" sheet
T.E. 1/4" x 1"



ADDING REALISM TO RC SCALE MODELS

by Dave Platt

WHEN we construct a scale model we are attempting to reproduce a subject airplane in a miniature, but otherwise identical form. To do this, we scale all the dimensions down by the same factor and this guarantees that our model will be a recognisable facsimile of the design of that subject.

If we now attend carefully to the colour layout and markings of the chosen subject, our model takes on the appearance of that airplane in a more particular way and we now also have the purpose of the subject.

At this point most builders stop, believing the model to be finished. It isn't. One vital ingredient is missing: one that is more important to the final effectiveness of the model than purpose or minor niceties of design.

This ingredient is character. If we forget this, our models will always be just that—nice models; nothing more. We must somehow capture the air, the dignity, the very *soul* of this proud machine that flies or stands on a runway like it is King of the Universe.

Sounds a bit romantic? Well, I'd have to admit that it does. But if we can at least be *aware* of this mysterious something that radiates or exudes from an airplane, we are on the road to creating a work of art that transcends the model and becomes a true replica.

I'm going to assume that the modeller can design, build and paint his model in the correct colour scheme; so let's forget about these aspects for a while and discuss how we might inject the character we've spoken about.

An airplane is a tool. It's a tool for doing a specific job. That job may be to carry passengers or its owner from A to B—in this case it's a vehicle of transport, like a car. Or the job could be to destroy—to drop bombs, shoot up or shoot down the enemy's tools. Because an airplane is a tool it is subject to the same treatment as any other tool: a whole lot of abuse and a whole little of respect. It's called upon to do its designed job (and more than it was designed for) with unfailing willingness and reliability, coupled with the barest minimum of essential care and maintenance. Let's itemise some of the effects that this love and attention have on the appearance of an airplane and also some other inevitable effects that are not man-made.

I've written them in order of importance:

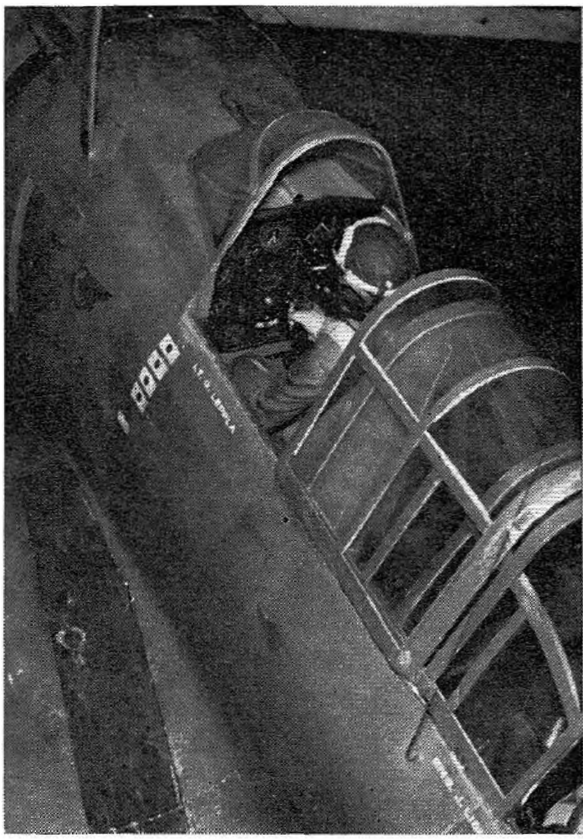
1. Colour perspective.
2. Usage.
3. Mechanical.
4. Weather.

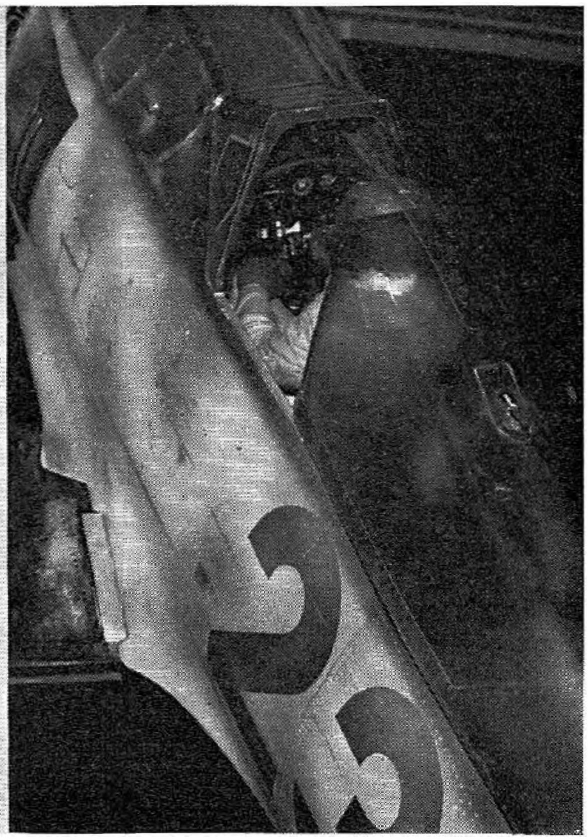
In a minute we'll take these items one by one and discuss each more fully. But first, did you notice something about this list? The adding of realistic effects to a model is commonly known as "Weathering". Yet, this guy wants us to believe that not only is weather just one of *four* major factors affecting airplanes, it's the *least* in importance!

How come?

Let's take each item now and the answer to this, and a whole lot more, shall be revealed.

Opposite, Dave Platt's first Douglas SBD Dauntless takes off at R.A.F. Upwood during an S.M.A.E. All-Scale meeting. Note the deflected flaps, undercarriage about to retract, painted marks on undersurface to simulate full size usage. Below left, after emigrating to the U.S.A., Dave made another Dauntless, here's the cockpit area and at right is his subsequent Focke-Wulf FW 190, each fully equipped with dummy instruments and pilot (Dick Stouffer photos).





Left: Dave Platts' first Dauntless shows the panel markings on wing surface, scuffed wing root area and the aircrew in the cockpits. Perforated flaps split to act as dive brakes.

Opposite, another view of the Dauntless at R.A.F. Hullavington, with flaps depressed for take off and the pilot seeking a clear passage to start up and taxi! Variation of colour effect adds considerably to the realism.

Colour perspective

Stand by a tree. Look at it and we see that the bark is brown and the leaves are green, basically, but there are many shades of each. Now move away 100 yards and look again. Right away, the varied shades have disappeared and the trunk is plain brown, the leaves plain green.

Move another quarter-mile and we now see much more even colour throughout—brown seems less brown and green less green. Matter of fact, it would be difficult to tell just what colour a tree is at this distance if we didn't already know so well that it's brown and green.

Move away again—now the tree is on the horizon a mile-and-a-half away. The colour of this tree is now a medium grey all over with no colour distinctions.

This effect is known as colour perspective. It happens because the air we look through is neither as clean nor as transparent as we think. Between our eyes and the tree, there was airborne dust in untold quantities. And dust is grey.

What difference does this make to our scale model? Consider this; looking at a one-eighth full size model from 10 ft. is the same as looking at the real plane from 80 ft. away, right? Wrong! It's wrong because when we looked at the big one, there was eight times as much atmosphere between our eyes and the real plane as there was between our eyes and the model. This had the effect of toning-down the colours on the real plane more than those on the model.

We must compensate for this. We do it by giving the model an even and *very light* spray-coat of medium-grey after the colour scheme is completed and all markings are on. The coat should cover all surfaces including the glass areas.

I gave colour-perspective first place on my list because it is the most inevitable. Even a model of a so-called "factory-fresh" and unused airplane is subject to this universal law.

(Having mentioned the words "factory fresh" let's explode another myth. Many times a builder of a glossy scale model will excuse himself by falling back on the theory that his model represents a "factory-fresh" airplane. So how, one asks, did it get Squadron markings and crest, and a victory tally?)

Usage

Chronologically, the next appearance changes to a full-size 'plane are caused by usage. We can sub-divide this category into these major items:

(*a*) Dirt and grime.
(*b*) Paint chippings and scratches.
(*c*) Oil and fuel stains.
(*d*) Burns.
(*e*) Damage.

(*a*) Is best represented by careful and very soft sprays of dark (charcoal) grey on the completed model. Remember here that dirt normally follows the line-of-flight. Thus, it will form behind protuberances on the aircraft and diminish as the distance from the protuberance increases. Panels of slightly unequal levels, e.g. along wing, stab and fuselage sheeting joints, also show the effect to a lesser extent, especially those opposed to the line-of-flight.

(*b*) Simulate paint chipping and scratches with silver paint on a small stiff-haired brush that has been scrubbed on a piece of scrap paper until almost dry. Then jab the brush on the model to leave irregularly shaped wear marks.

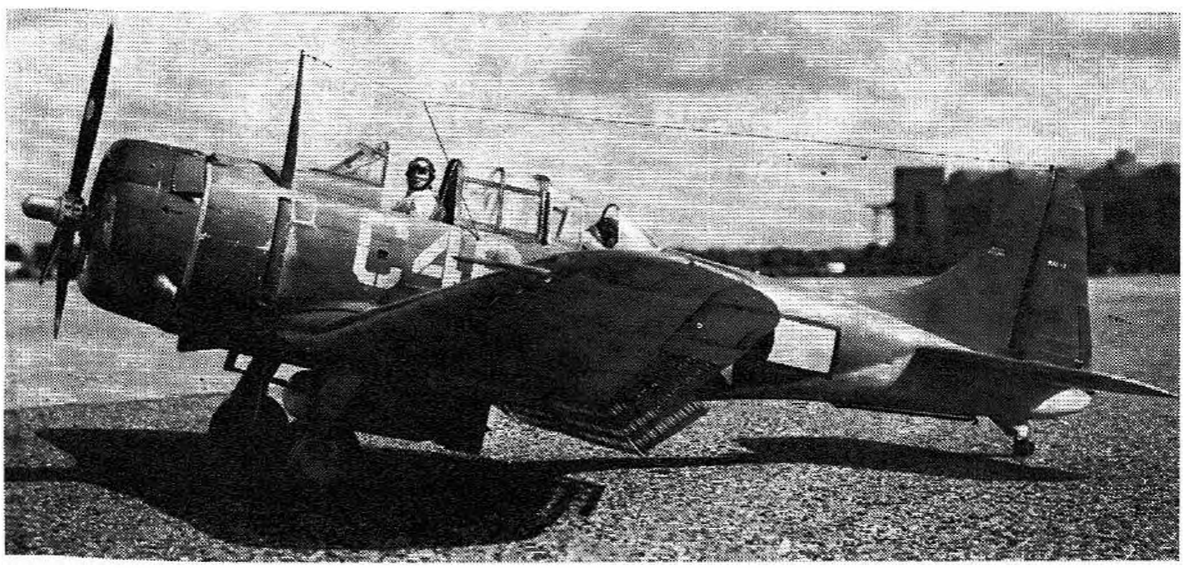
These marks most commonly occur at the places where the crew enter the plane and where mechanics perform routine work. Fuel fillers, ammunition storage areas and inspection hatches or panels gather wear of this kind in an unbelievably short time in use—especially military use, where a proud owner is not around to moan about the least mark! I have personally examined a fighter which was withdrawn from service after six weeks service; it had precious little paint on the wing roots.

(*c*) Oil and fuel stains are best applied by rubbing the model at the appropriate places with some staining agent on a soft cheesecloth.

(*d*) Burns form around and behind exhaust pipes. Soot from the exhaust often marks an aircraft for several feet. At the Kansas Nats 1968 we examined Lockheed P2V's with exhaust marks that were very prominent and reached the trailing edge of the wing. Use near-black or fawn, apply by spray.

Before applying such marks, find out whether burns of this kind are characteristic of the type of plane: Skyraiders always mark, Spitfires seldom do.

This brings up an important point. Study as many photos as possible of



your chosen subject. Look "through" the jazzy schemes and study the usage-marks, noting which ones seem to occur consistently. Concentrate on these parts of your model.

(*e*) Damage, of course, can happen anywhere and to any degree. This is impossible to detail. Just use your imagination.

Mechanical

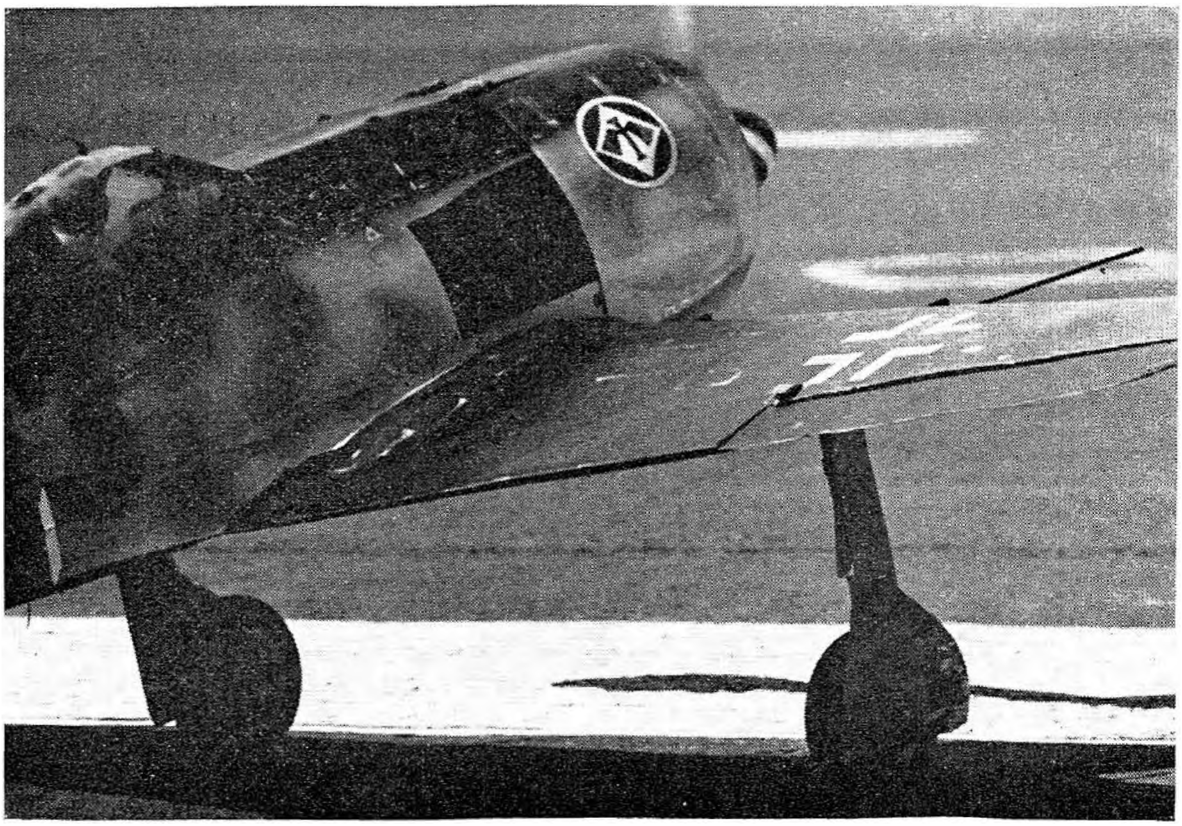
Mechanical causes of significant appearance changes can be broken down as:

(*a*) Repairs.
(*b*) Holes (bullet and otherwise).

(*a*) Repairs to an aircraft typically take the forms of patches in damaged metal or fabric. Very often, patches in metal structure have fresh paint applied which shows as a sharply contrasting colour even when the colours are "the same". Patches in fabric may have the same treatment, or can be painted in red primary-dope which often is left just this way. It is not uncommon to encounter airplanes with dozens of such red patches in wartime.

(*b*) Imagine this situation: Someone decided to add some device or other on to an airplane and goes ahead and bolts it in place. Later, it is decided to remove the gadget. Do you think that they then bother to fill in the holes after removing it? NOT likely! On a trip to the Smithsonian I noticed this on a few aircraft. Here again, use your imagination—but don't over-do it.

The atmosphere of realism in this long focus shot by Dick Stouffer is helped by the slightly drooped wing flap and the aileron shroud. This model suffered from under-carriage difficulties but remains one of Dave's favourites and has since appeared in other colours to show that like the Dauntless, Dave has no objections to making more than one of the same subject.



Weather

So finally we come to weathering. I say finally, because the other things described previously have a rapid effect on the appearance of an airplane, whereas weathering takes time. Even then, the effects are subtle and a good deal of caution is necessary here.

(*a*) Fading.
(*b*) Cracking and peeling.
(*c*) Rust and other corrosion.

Fading. All paints fade in time. Under certain conditions, such as continued exposure to strong sunlight, fading to a noticeable extent can happen in two months.

I simulate fading with a very light or pale grey sprayed from a distance and in merging formation. The upper surface of the wings and stab and top of the fuselage fade more rapidly than the sides of the fuselage and the fin; the whole undersurface scarcely at all.

Cracking and peeling are best done by flaking off the odd area of paint with a knife. Here's another trick which I have used: after spraying the colour dope and before it has a chance to cure properly and become fuelproof, rub in some fuel on a rag. The paint will lift and flake off.

Rust is easy. Simply buy a pot of rust enamel from the hobby shop (sold for model railroad use) and paint it on. Don't use too much—tatty and beaten airplanes may be, but rusty they aren't. The odd spot here and there is all you need.

Tools

To finish up with, a short paragraph about the "tools of the trade".

Really, apart from masking tape and some more of the usual stuff found in any modeller's workshop, there is only one tool. This is an airbrush. *A really good airbrush*. The type of "airbrush" that has a hole which you block with your forefinger to spray, then release to stop, is fine for plastic models but will not do for really intricate detail.

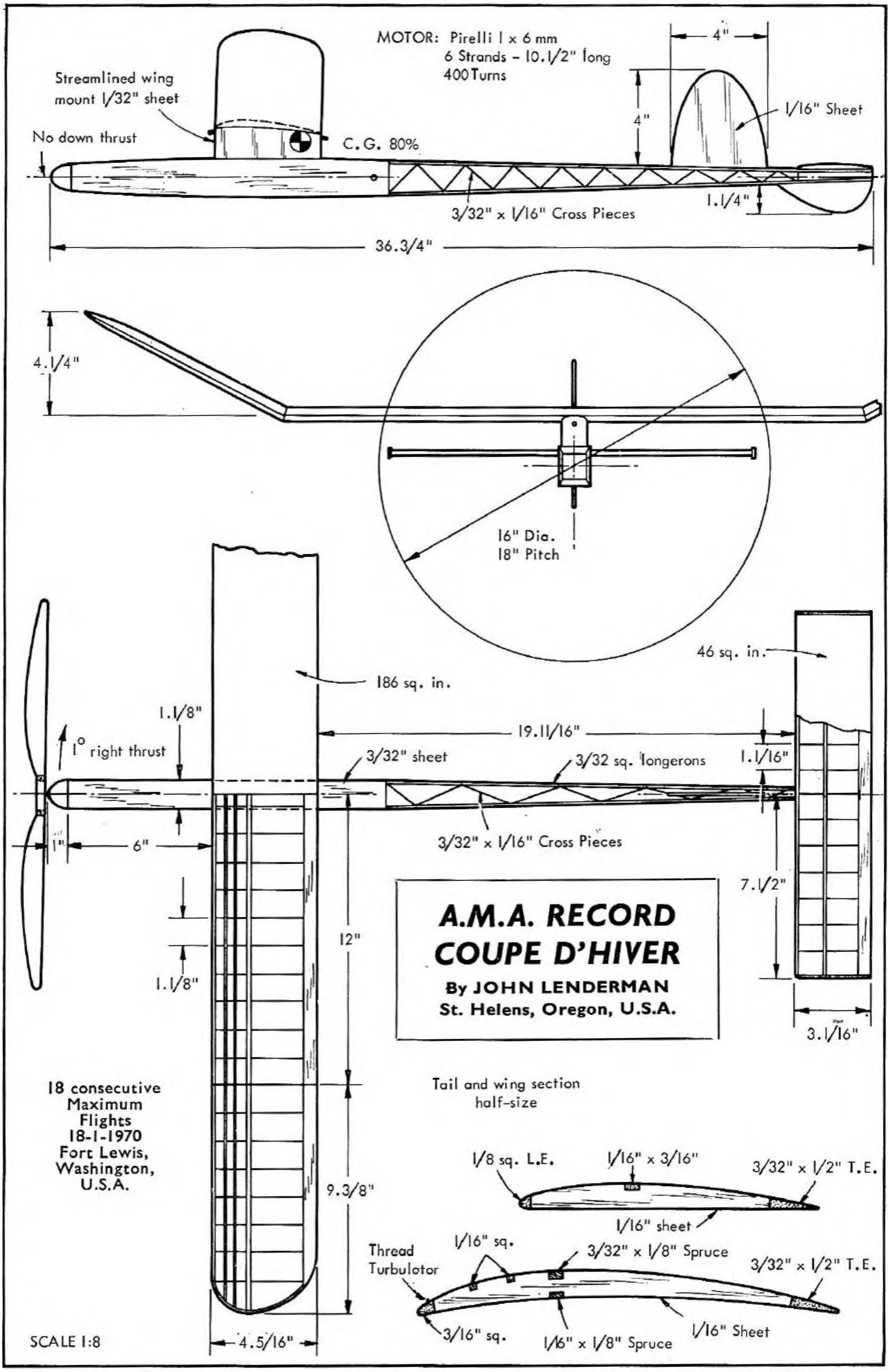
Also, an airbrush with a vertical paint nozzle which is raised or lowered relative to the horizontal air nozzle in order to control the paint flow is no good either because we have to stop spraying in order to alter the setting. What we need is an airbrush which has a trigger that is controllable by a screw, so that we can adjust the flow for more or less paint *while spraying*. It should be possible to adjust the spray down to the point where a $\frac{1}{16}$ in. diameter "mottle" can be sprayed from a distance of 3 in. or so, and take several seconds to form.

These simple tests will ensure that you get the right kind of airbrush; one that will serve you for all work. Such brushes are not cheap—mine cost nearly £40 without the compressor.

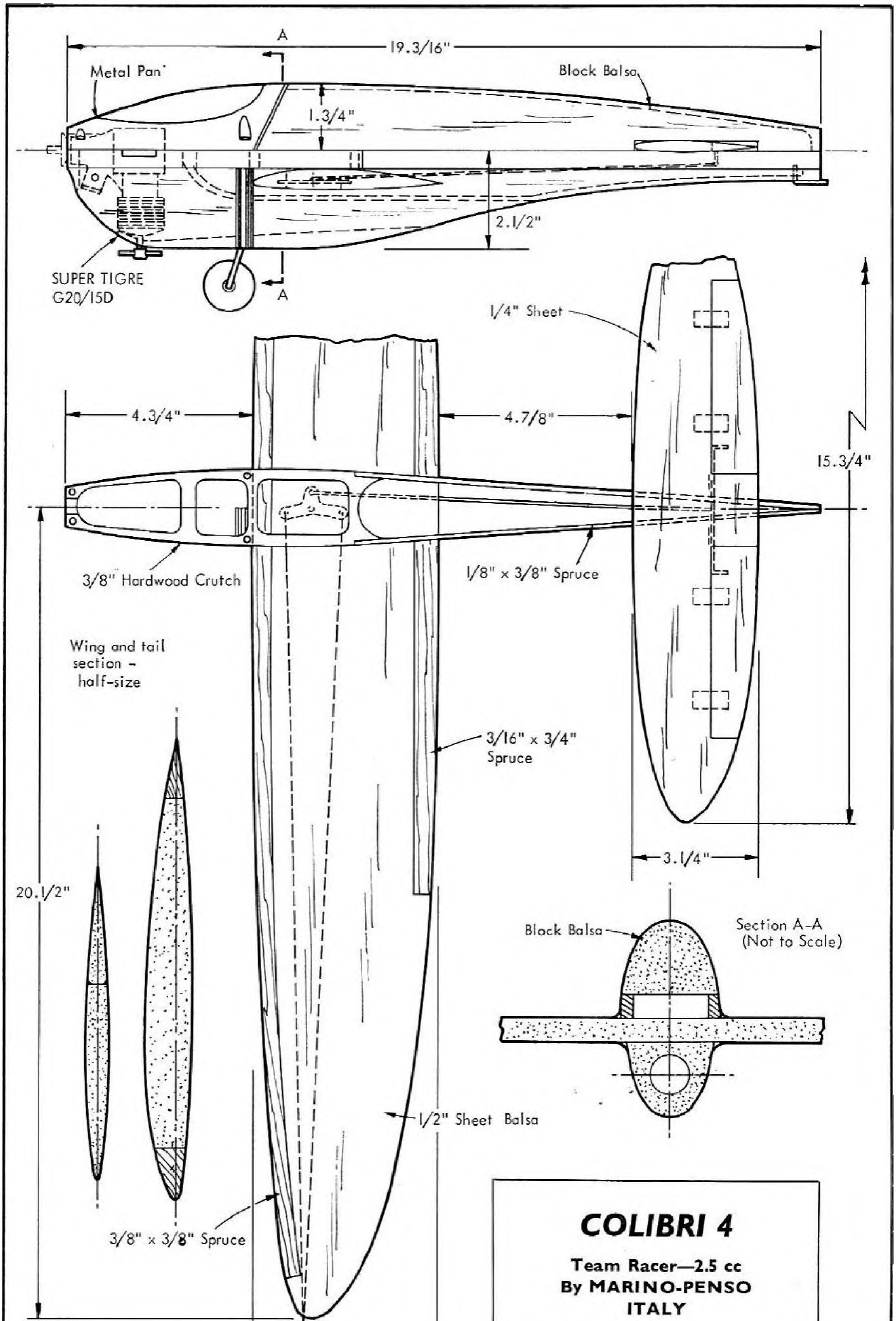
The compressor should be fitted with a water trap, or you will be for ever blowing out the water which forms when air is compressed. Usually, high humidity conditions and/or small nozzle openings aggravate this problem.

As with any new experience area of modelling mistakes will be made, and first results are far from good. But persistence will pay off. Best of luck and here's to more realistic scale models!

(*Reprinted by courtesy of the District of Columbia Radio Control Club, Inc., from the* 12*th Annual DC/RC Symposium.*)



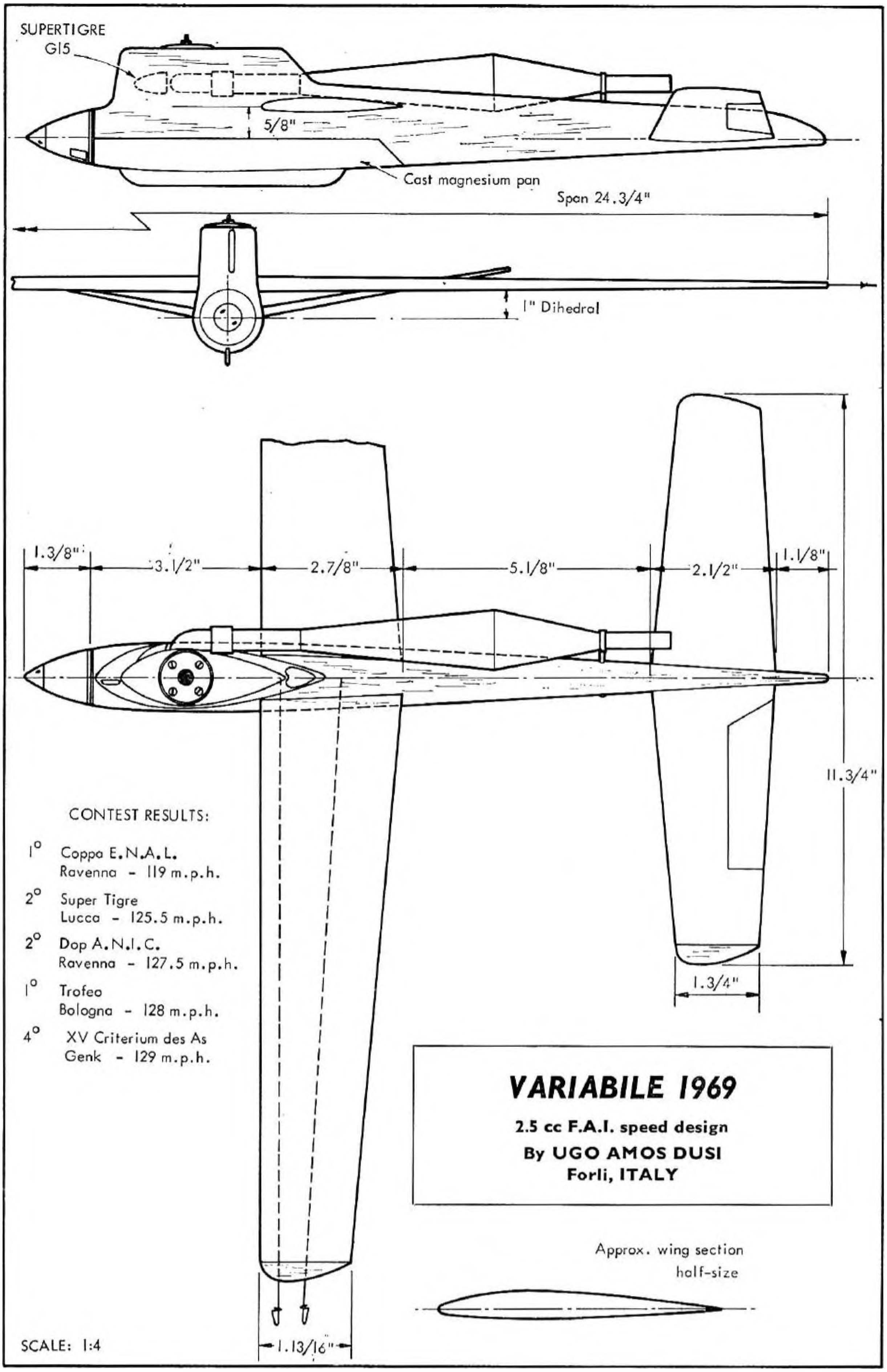
"WILLAMETTE MC PATTER" U.S.A.

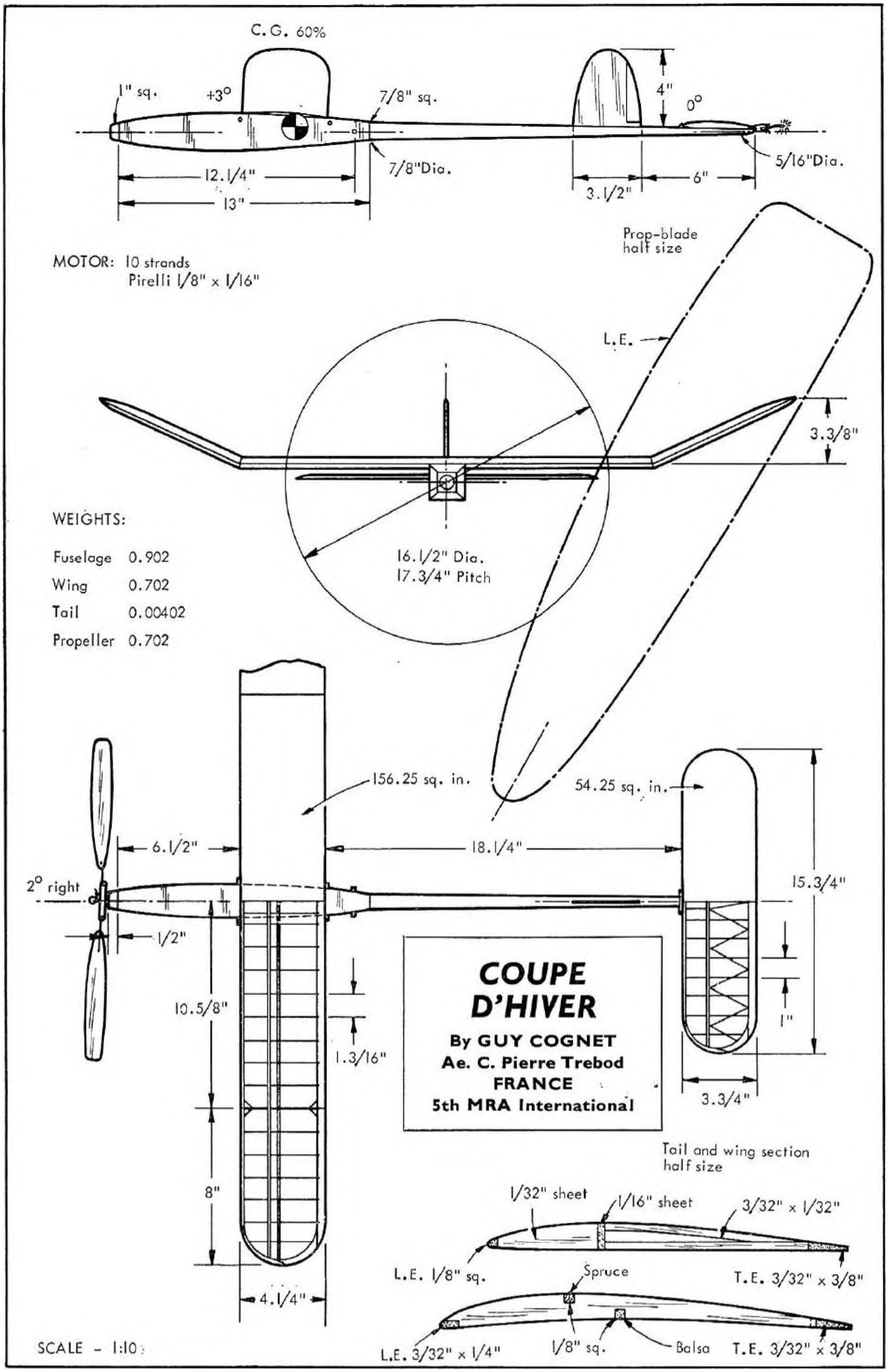


COLIBRI 4

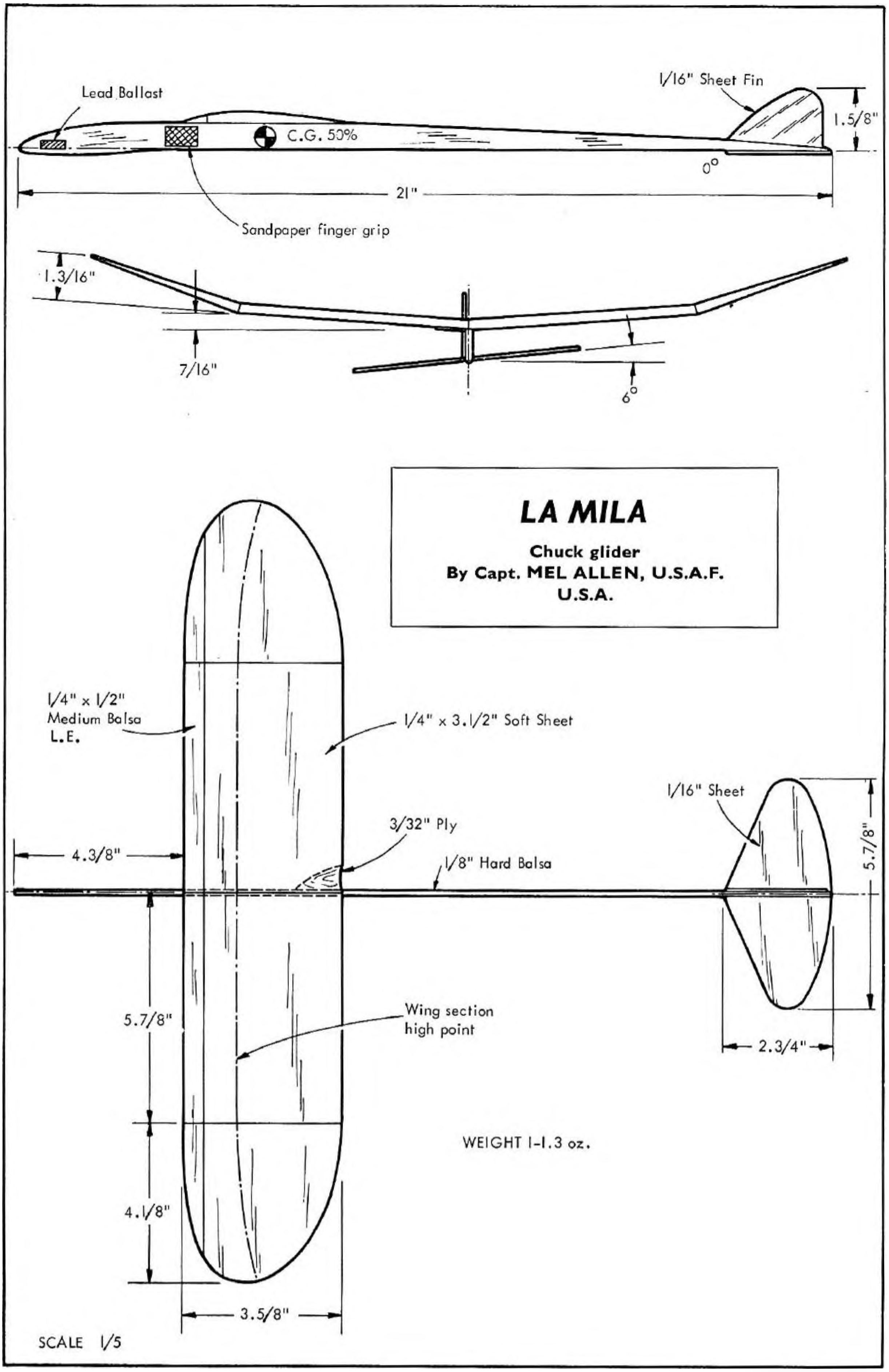
Team Racer—2.5 cc
By MARINO-PENSO
ITALY

MODELLI


SUPERTIGRE
G15
5/8"
Cast magnesium pan
Span 24.3/4"
1" Dihedral
1.3/8"
3.1/2"
2.7/8"
5.1/8"
2.1/2"
1.1/8"
11.3/4"
CONTEST RESULTS:
1° Coppa E.N.A.L.
Ravenna - 119 m.p.h.
2° Super Tigre
Lucca - 125.5 m.p.h.
2° Dop A.N.I.C.
Ravenna - 127.5 m.p.h.
1° Trofeo
Bologna - 128 m.p.h.
4° XV Criterium des As
Genk - 129 m.p.h.
1.3/4"
VARIABILE 1969
2.5 cc F.A.I. speed design
By UGO AMOS DUSI
Forli, ITALY
Approx. wing section
half-size
SCALE: 1:4
1.13/16"



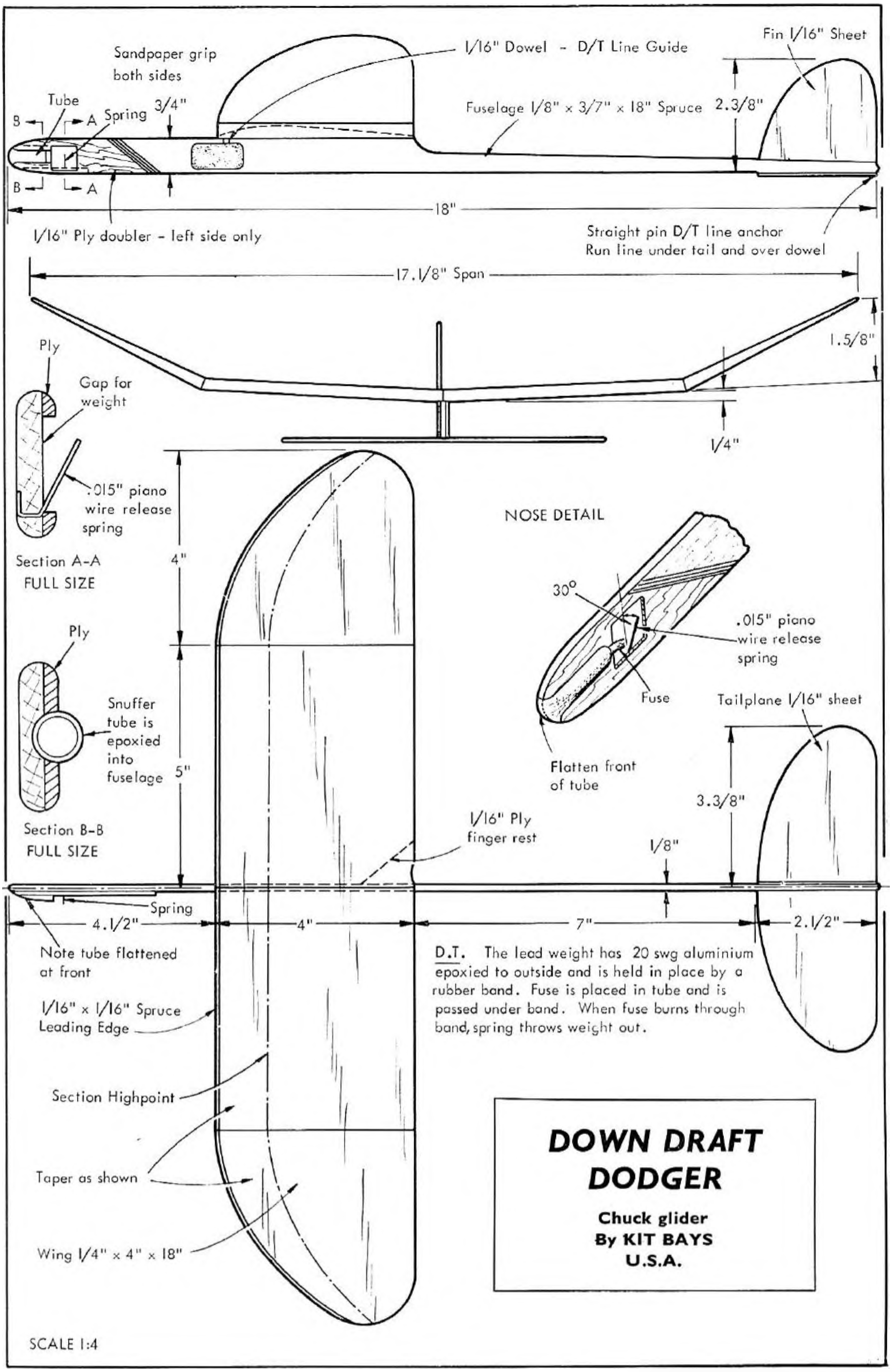
MODELE MAGAZINE



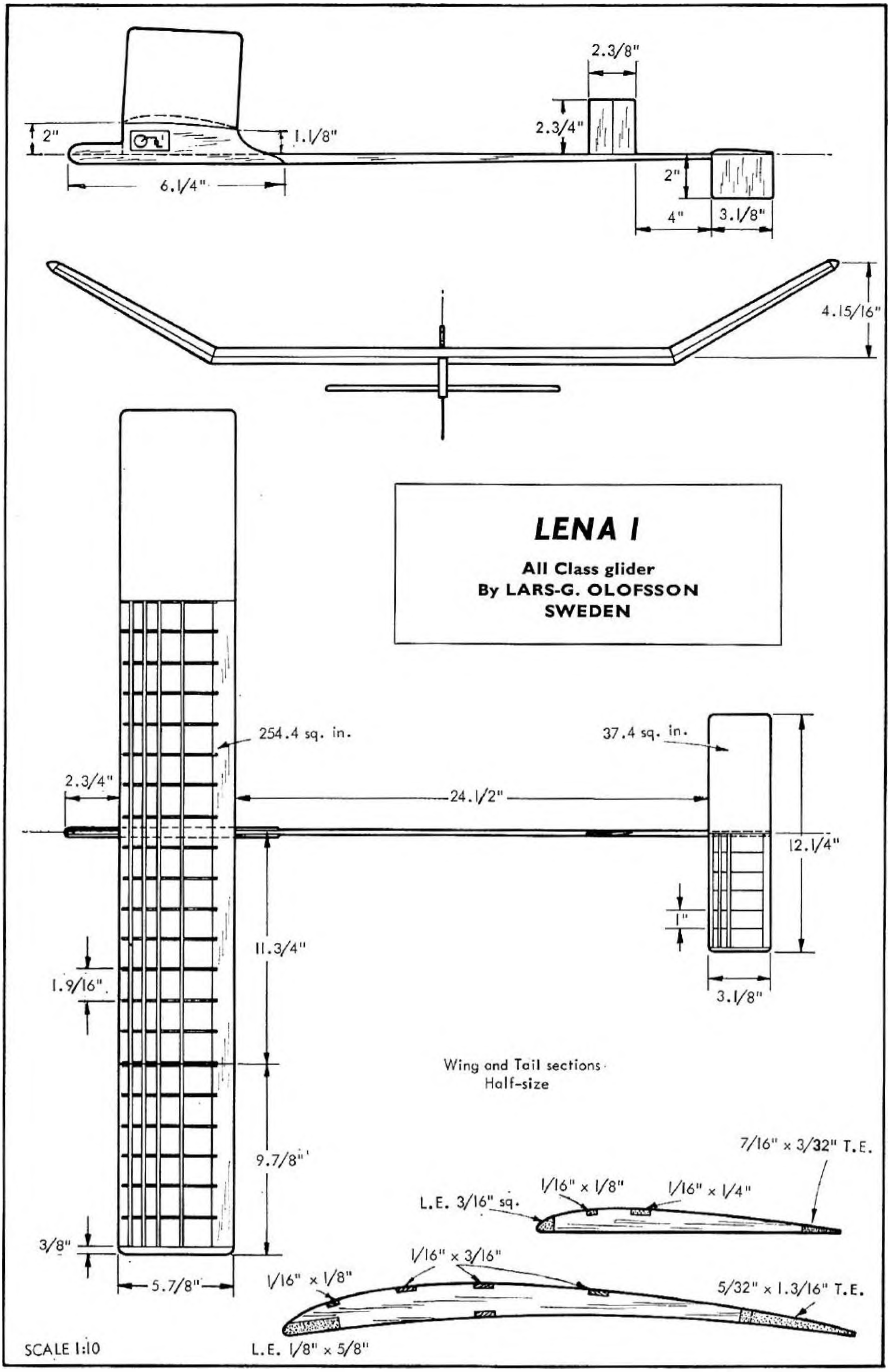
LA MILA

Chuck glider
By Capt. MEL ALLEN, U.S.A.F.
U.S.A.

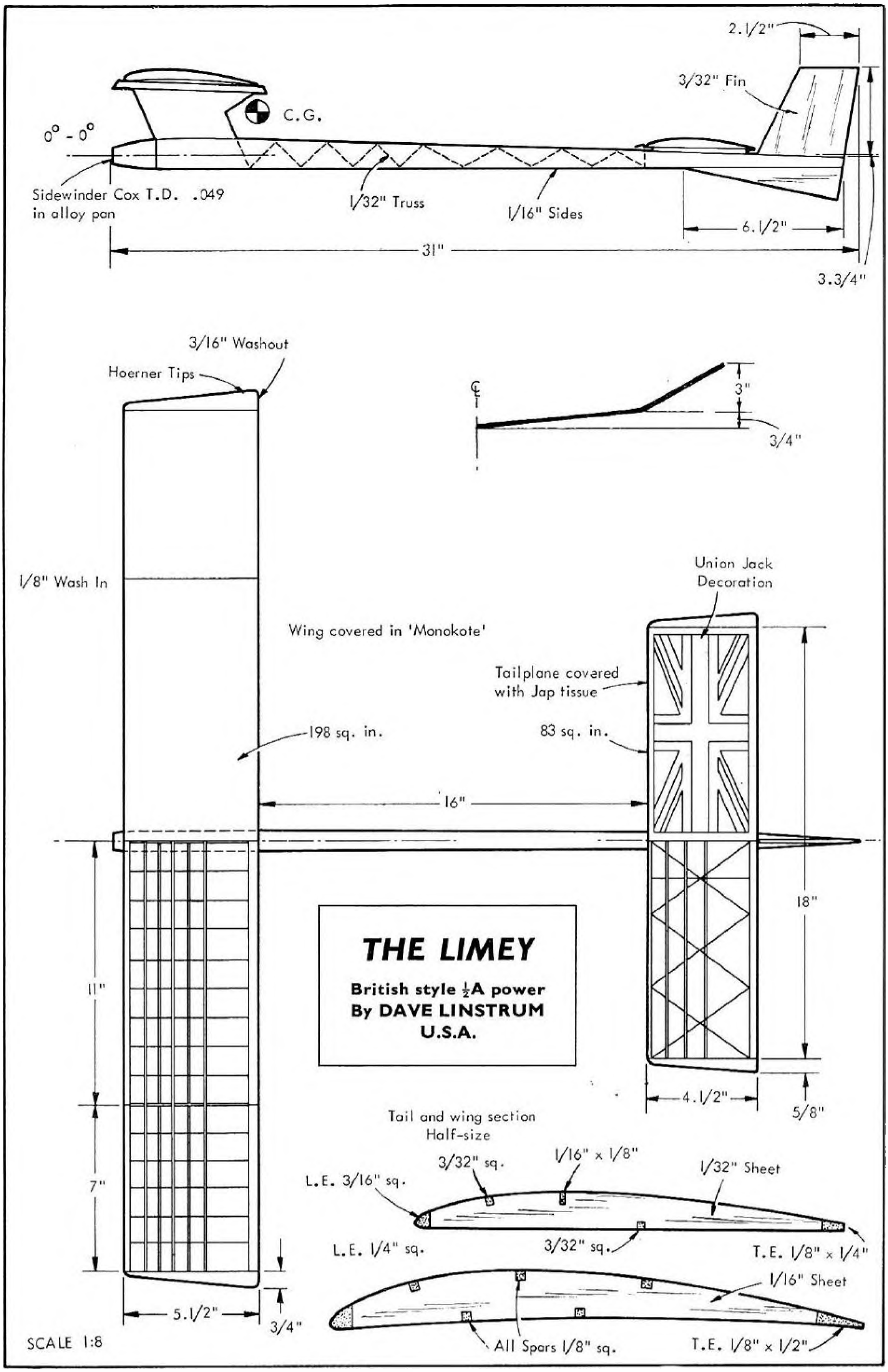
FLYING MODELS

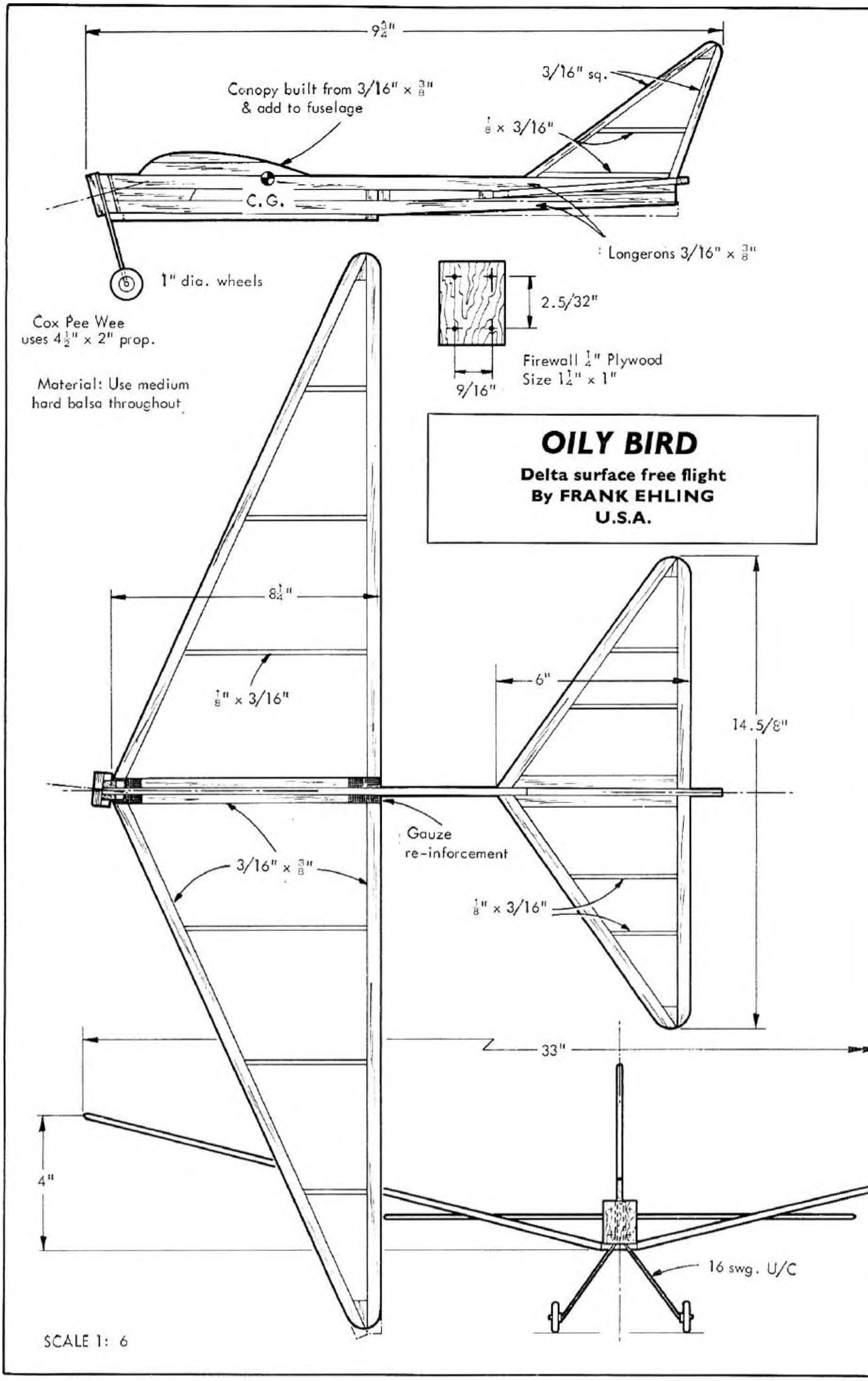


AMERICAN AIRCRAFT MODELER

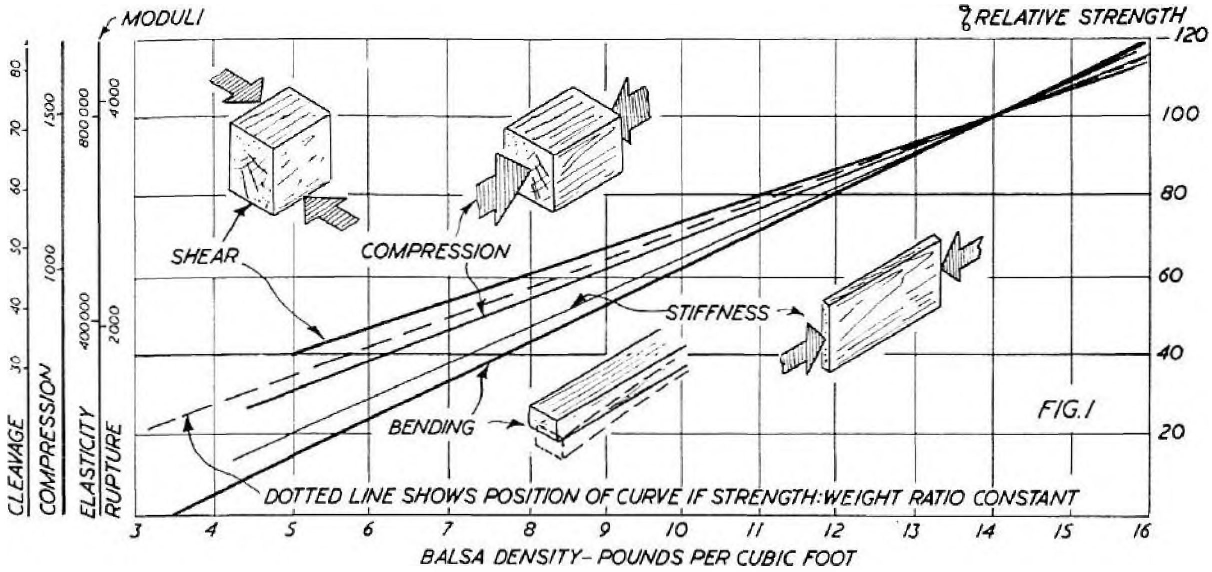


"STABBEN" - SWEDEN


2.1/2"
3/32" Fin
C.G.
0° - 0°
Sidewinder Cox T.D. .049
in alloy pan
1/32" Truss
1/16" Sides
6.1/2"
31"
3.3/4"
3/16" Washout
Hoerner Tips
3"
3/4"
1/8" Wash In
Union Jack
Decoration
Wing covered in 'Monokote'
Tailplane covered
with Jap tissue
198 sq. in.
83 sq. in.
16"
18"
THE LIMEY
British style ½A power
By DAVE LINSTRUM
U.S.A.
11"
4.1/2"
5/8"
Tail and wing section
Half-size
3/32" sq.
1/16" x 1/8"
1/32" Sheet
L.E. 3/16" sq.
7"
L.E. 1/4" sq.
3/32" sq.
T.E. 1/8" x 1/4"
1/16" Sheet
5.1/2"
3/4"
SCALE 1:8
All Spars 1/8" sq.
T.E. 1/8" x 1/2"



AMERICAN AIRCRAFT MODELER



THE STRENGTH OF BALSA

SOME years ago Solarbo Ltd. produced some test figures on the strength of balsa wood. These data were related only to balsa *density*, and not to type of cut, etc. (Table I). Also balsa, not being a strictly homogeneous material, is liable to suffer density and strength variations throughout any particular specimen piece. Hence the figures can be quoted only as nominal "average" performance, but since the majority of sheet and strip sizes cut by the various mills is graded only by density, they can be used to calculate the average strengths of typical stock sizes of wood.

Ignoring side issues (like the type of cut), the strength of balsa is obviously related to its density. Thus, heavy balsa is the strongest and 12 lb. density grade is a good, medium-hard grade suitable for most structural purposes. 14-lb. balsa, the heaviest of the test samples, is equivalent to "hard" stock. Identification of balsa "grade" and balsa density is summarised in Table II, these figures being based on published data of weights of balsa sheet.

If we take hard balsa as normally the heaviest grade used for model aircraft work and consider that the mechanical properties of this grade are 100%, the respective strengths of lighter grades as shown by the test data in Table I can be plotted in the form of a simple graph (Fig. 1). From this graph it is easy to make quick comparisons of the strength values of different grades of balsa. We find, for instance, that for half the bending strength the corresponding balsa density is about 9 lb. per cu. ft.—not one-half of 14 lb. = 7 lb. per cube. Thus,

Table I. STRENGTH OF BALSA (SOLARBO LTD.)

Species	*Weight: lb. per cu. ft.*	*Modulus of rupture (binding strength)*	*Modulus of elasticity (stiffness)*	*Compression parallel to grain*	*Cleavage*
Balsa	5	720	163,400	464	29
Balsa	9	2,160	456,000	1,095	49
Balsa	14	4,176	800,000	1,740	72

Table II. CLASSIFICATION OF BALSA GRADES
(*Aeromodeller Annual* 1954–55)

Balsa density (lb./cu. ft.)	*Grade*
6	Very light (soft)
8	Light
10	Light medium
12	Medium
14	Medium-hard
16	Hard

if the initial test figures are accepted as accurate, the strength of balsa wood is not *directly* proportional to its density. Similarly for stiffness, strength in compression and strength in shear.

Now it is quite easy to analyse these curves and give the results in the form of a simple formula. The most direct way to do this is to find the *relative strength* of balsa as affected by its density. The results work out as follows:

Strength in bending:

$$\text{relative strength} = 9{\cdot}5 \times \text{density} - 35$$

Stiffness:

$$\text{relative stiffness} = 8{\cdot}75 \times \text{density} - 23$$

Compression (resistance to):

$$\text{relative strength} = 7{\cdot}6 \times \text{density} - 6$$

Strength in shear:

$$\text{relative strength} = 6{\cdot}7 \times \text{density} + 6$$

These formulae are very easy to work out and provide a means of estimating the relative strength values of different sizes of wood used as stressed members in an airframe. For example, *longerons* require a high degree of stiffness; good strength in bending if they have to be bent into curved shape in forming the fuselage sides; and good compressive strength to take the tension of the motor in a rubber model fuselage. All *spars* obviously require a high bending strength. *Ribs* and *spacers* require to be stiff. Admittedly some of these factors are greatly affected by the type of cut, quarter-grained stock being particularly excellent for ribs because of its inherent stiffness. Thus, comparative figures based on the original test figures can apply only to similar *cuts* of wood.

Now if these data are correct, bending strength varies at a greater rate than density (roughly 20% as against 15%). In other words the strength : weight ratio, as regards strength in bending, *increases* with increasing density. A complete set of figures are calculated out in Table III (or could be read off the original graph). Thus, if a 14-lb. density spar was just man enough for a particular job, replacing it with strip cut from 10-lb. stock would require nearly *twice* the cross-section to do the same duty, with an appreciably greater total weight.

Similarly with stiffness. Here again strength : weight ratio tends to increase with increasing density, so there is weight to be saved using heavier grade wood—but only if rib *thickness* is cut down at the same time to reduce wood volume, in a practical design problem. This implies, in fact, that for *similar*

stiffness at the *same* total weight, thin rib sheet of higher density is preferable to softer, thicker sheet. Just selecting light wood for ribs does not, in other words, automatically guarantee the most economic structure.

As regards strength in compression, the strength : weight ratio remains about the same throughout the density range. For resistance to shearing loads, the strength : weight ratio tends slightly to *decrease* with increasing density. These differences are probably too small to have any practical significance.

Undoubtedly the main lesson to be learnt from such a simple analysis is that *hard* balsa should always be used for spars and other highly stressed members subject to *bending* loads. If properly used this can result in a *lighter* overall structure, simply because you can afford to cut down the cross-section slightly for the same strength. There are other equally interesting conclusions which can be drawn by working out some practical examples fitted into the simple formulae given. After all, the *structural* design of any aeroplane, model or full size, is usually the most important feature in the long run.

Table III
STRENGTH IN BENDING

Balsa density (lb./cu. ft.)	*Pressure strength*
6	22
8	41
10	60
12	80
14	100
16	120

Table IV
STIFFNESS

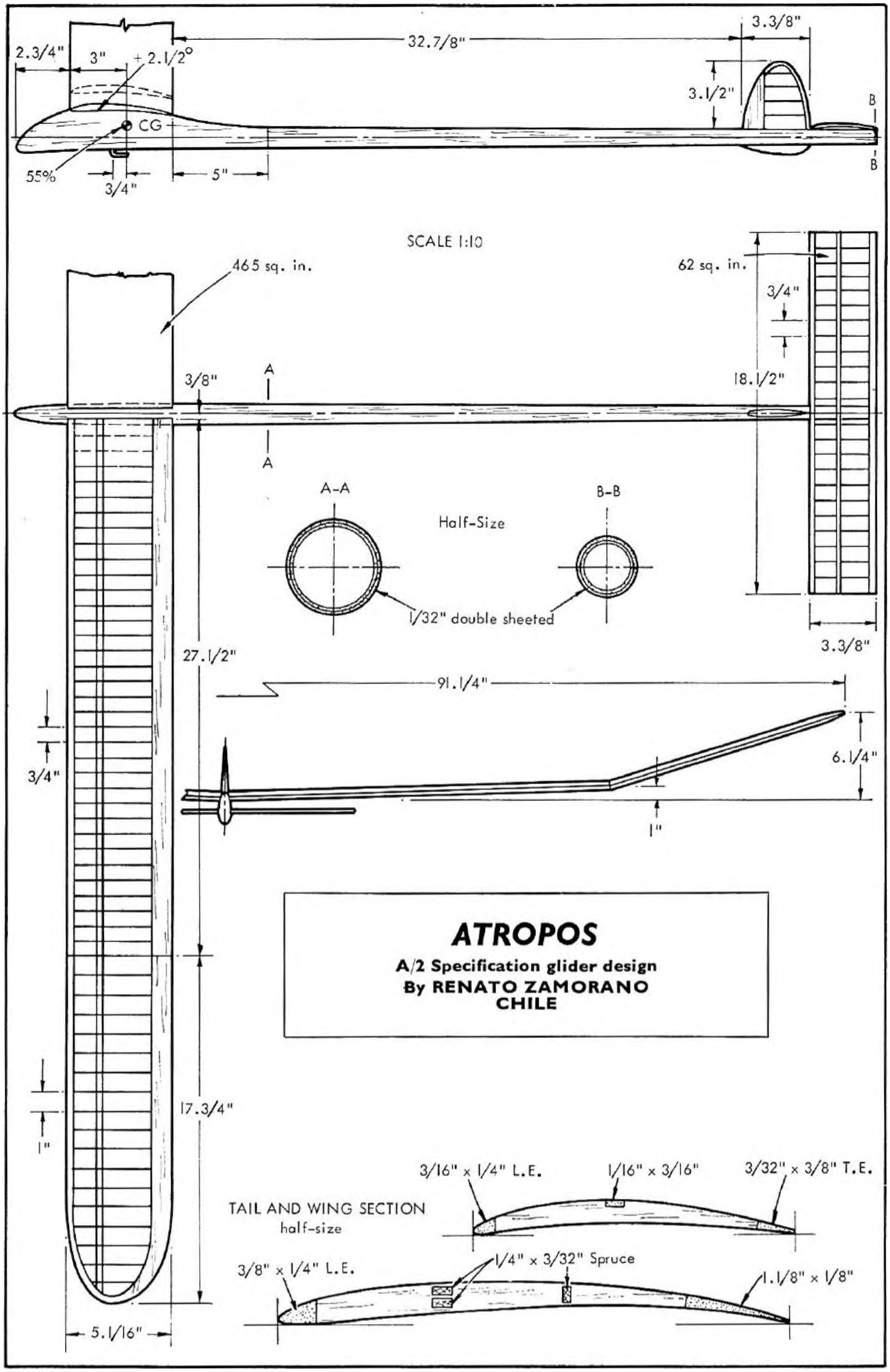
Balsa density (lb./cu. ft.)	*Pressure strength*
6	29·5
8	47
10	64·5
17	82
14	100
16	117

Table V
STRENGTH IN COMPRESSION
(parallel to grain)

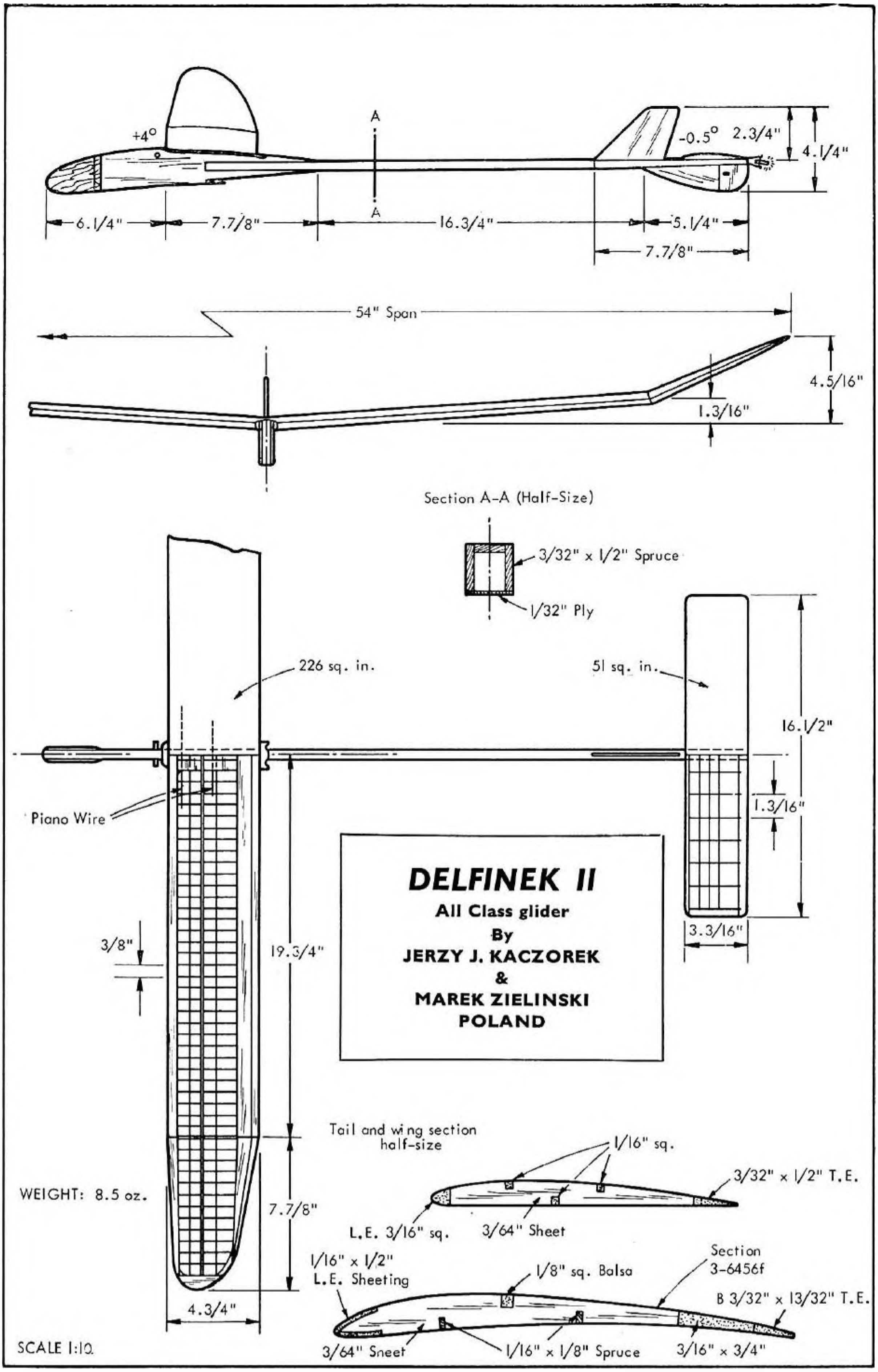
Balsa density (lb./cu. ft.)	*Pressure strength*
6	40
8	55
10	70
12	85
14	100
16	115

Table VI
STRENGTH IN SHEAR

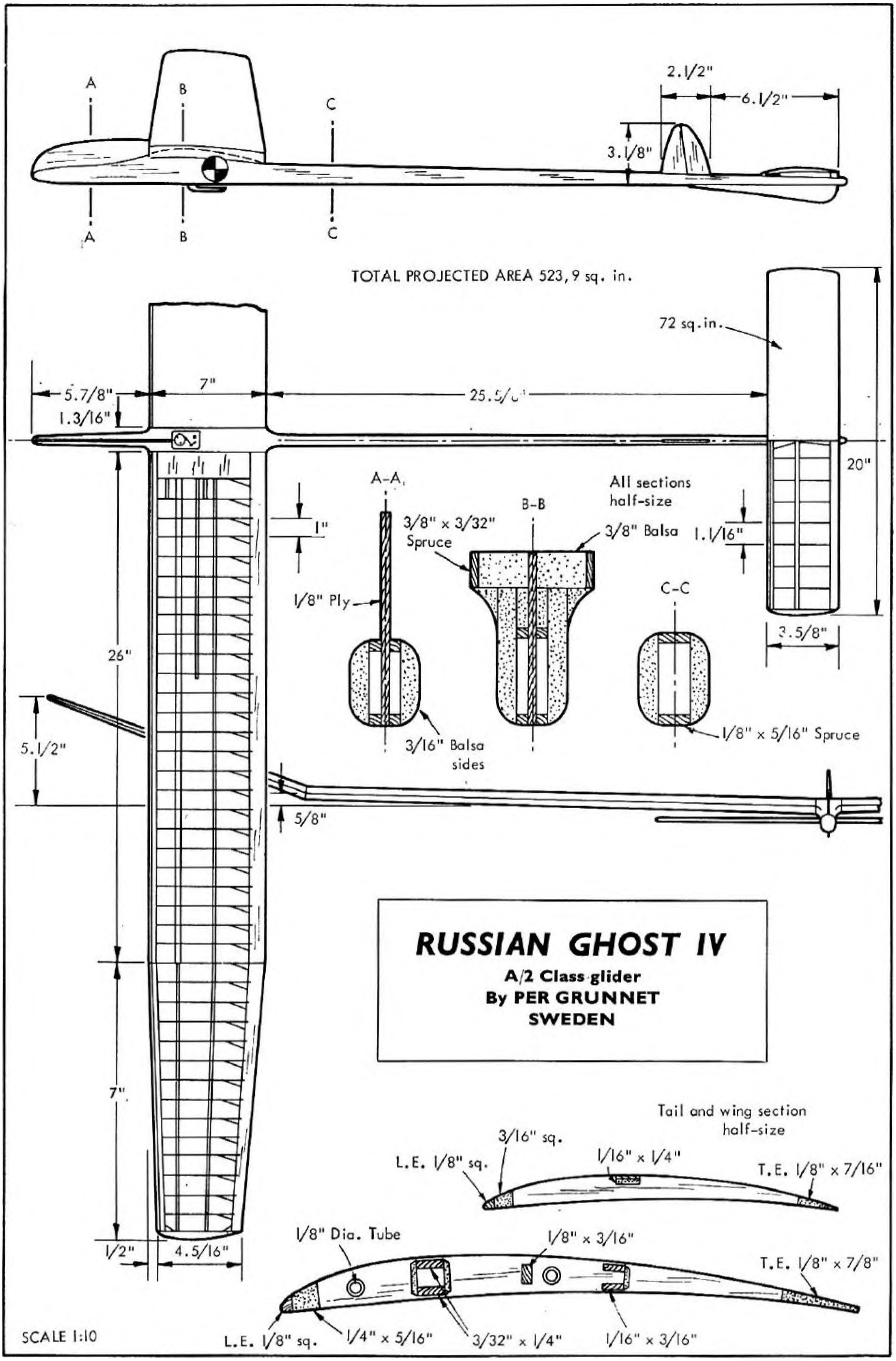
Balsa density (lb./cu. ft.)	*Pressure strength*
6	46
8	60
10	73
17	86
14	100
16	113



SPORT MODELISMO



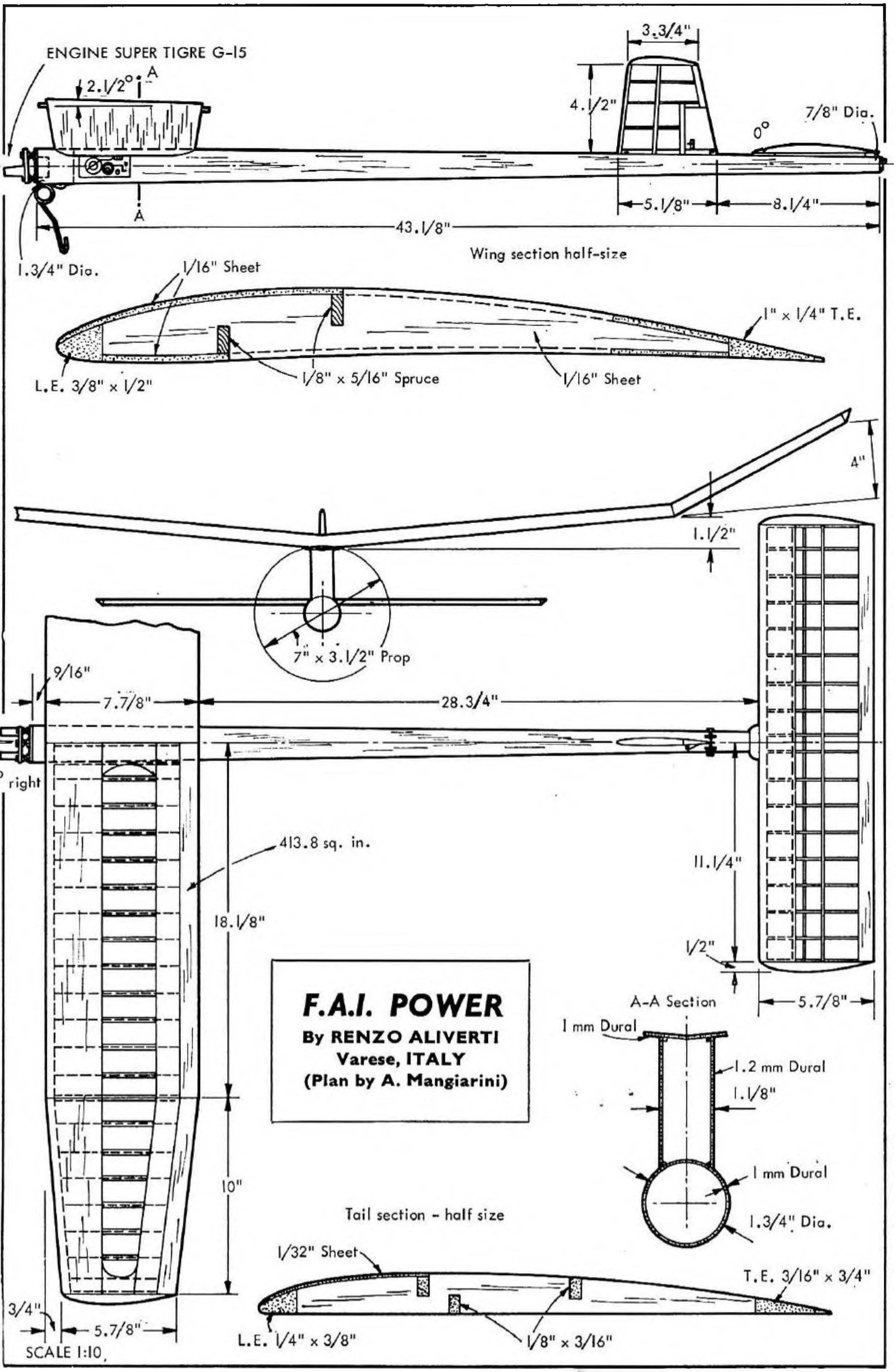
SKRZYDLATA POLSKA - POLAND



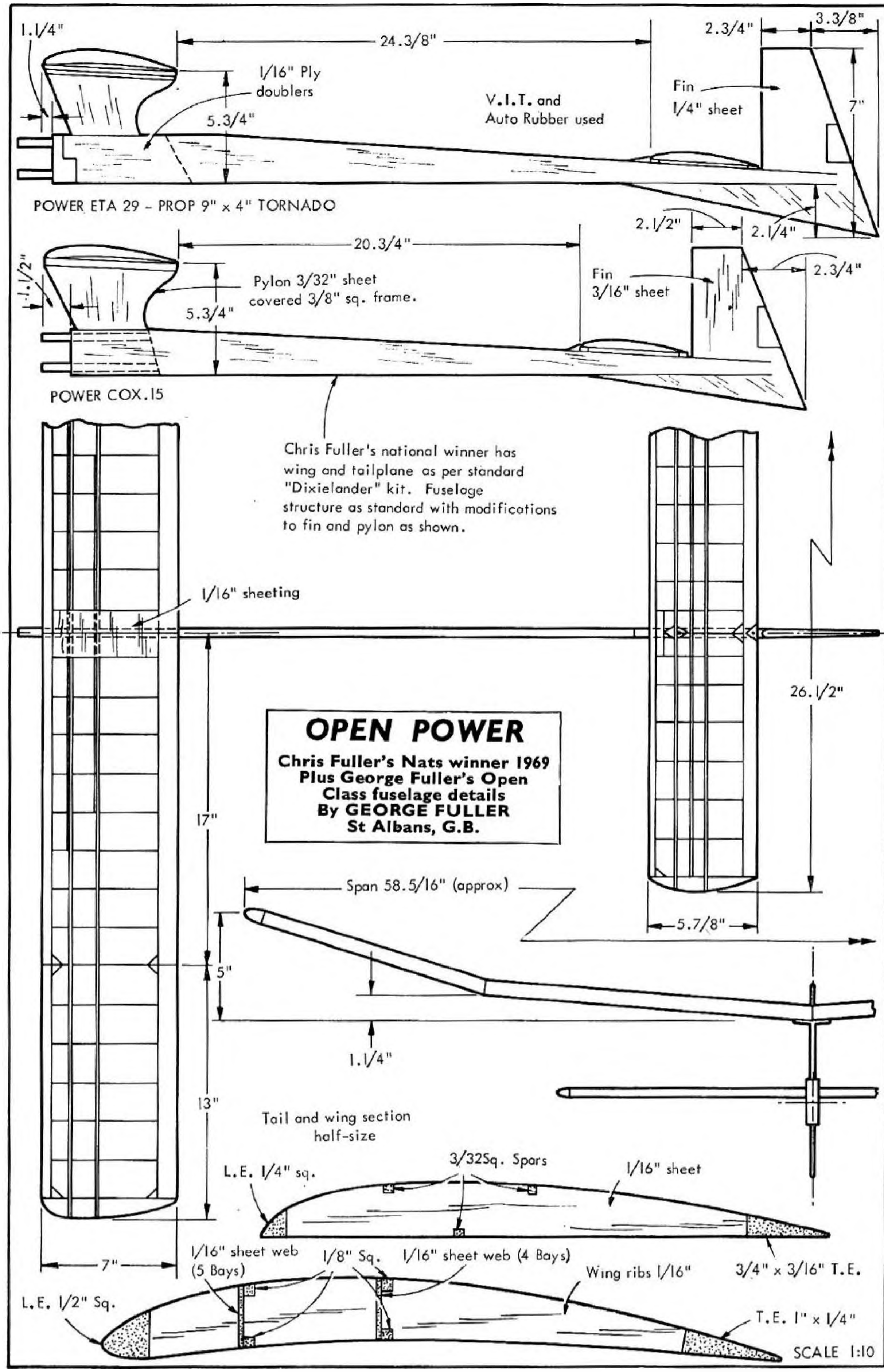
RUSSIAN GHOST IV

A/2 Class glider
By PER GRUNNET
SWEDEN

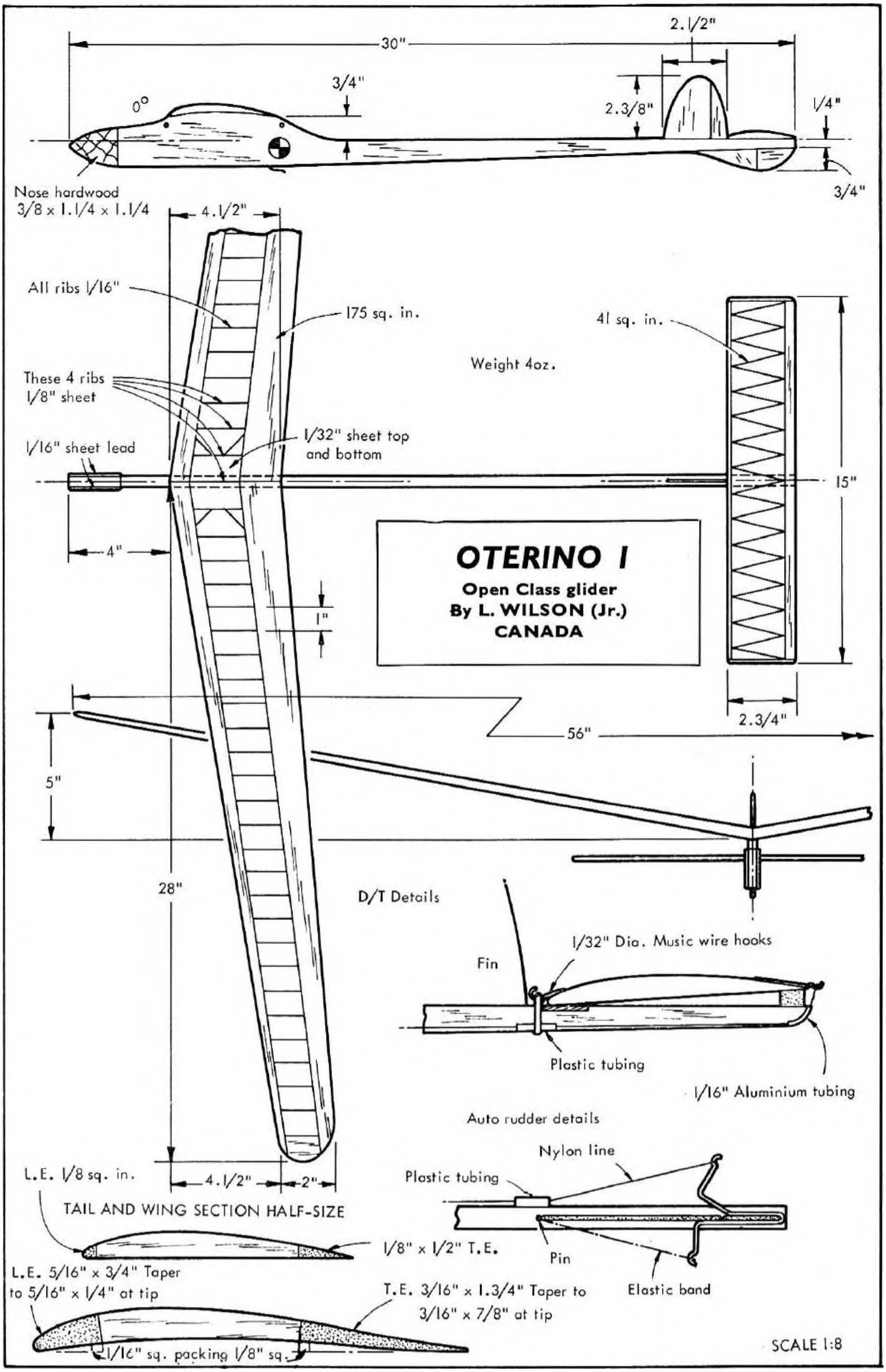
"STABBEN" SWEDEN



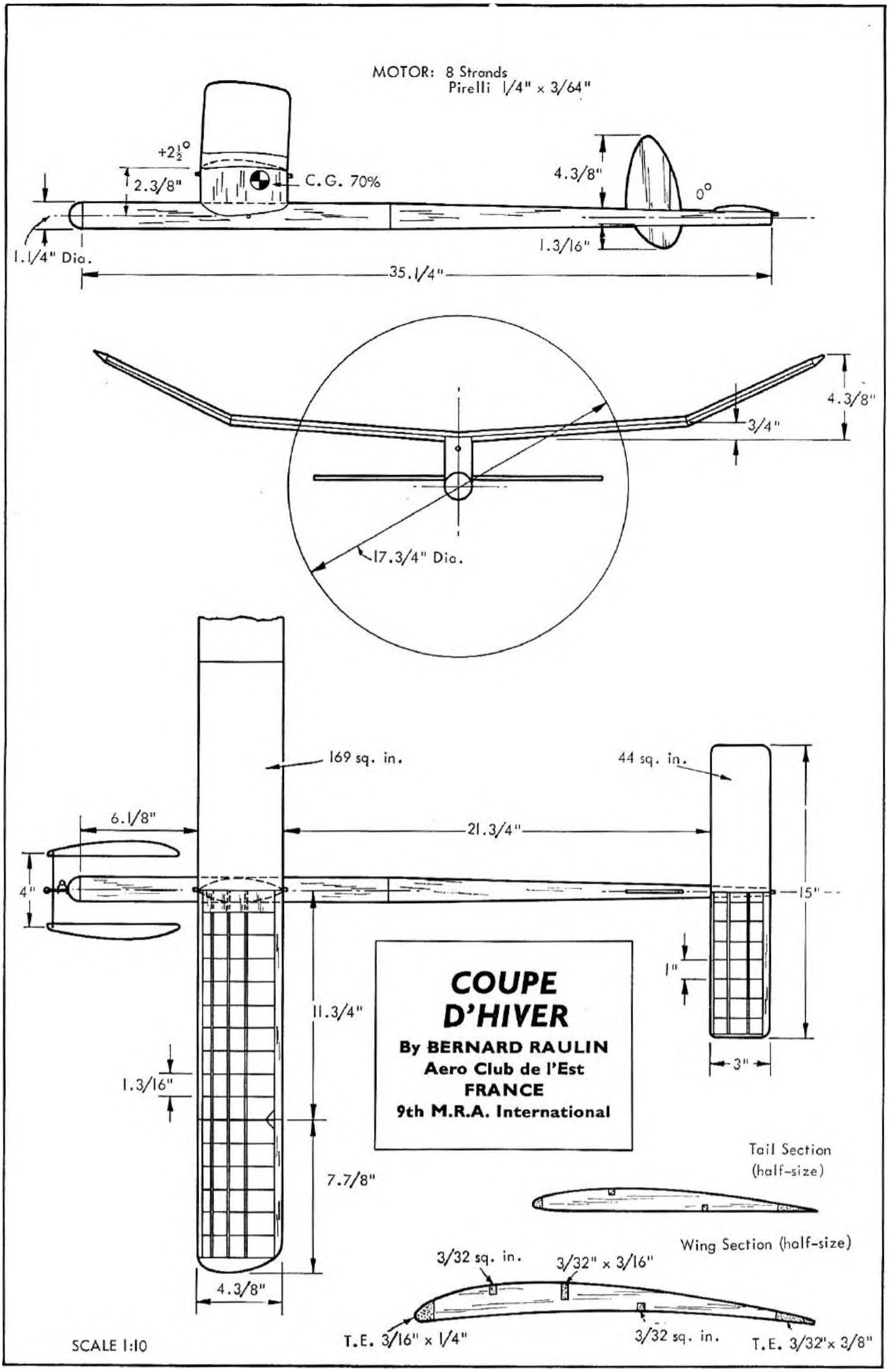
"LA MANICA A VENTO" VARESE - ITALY



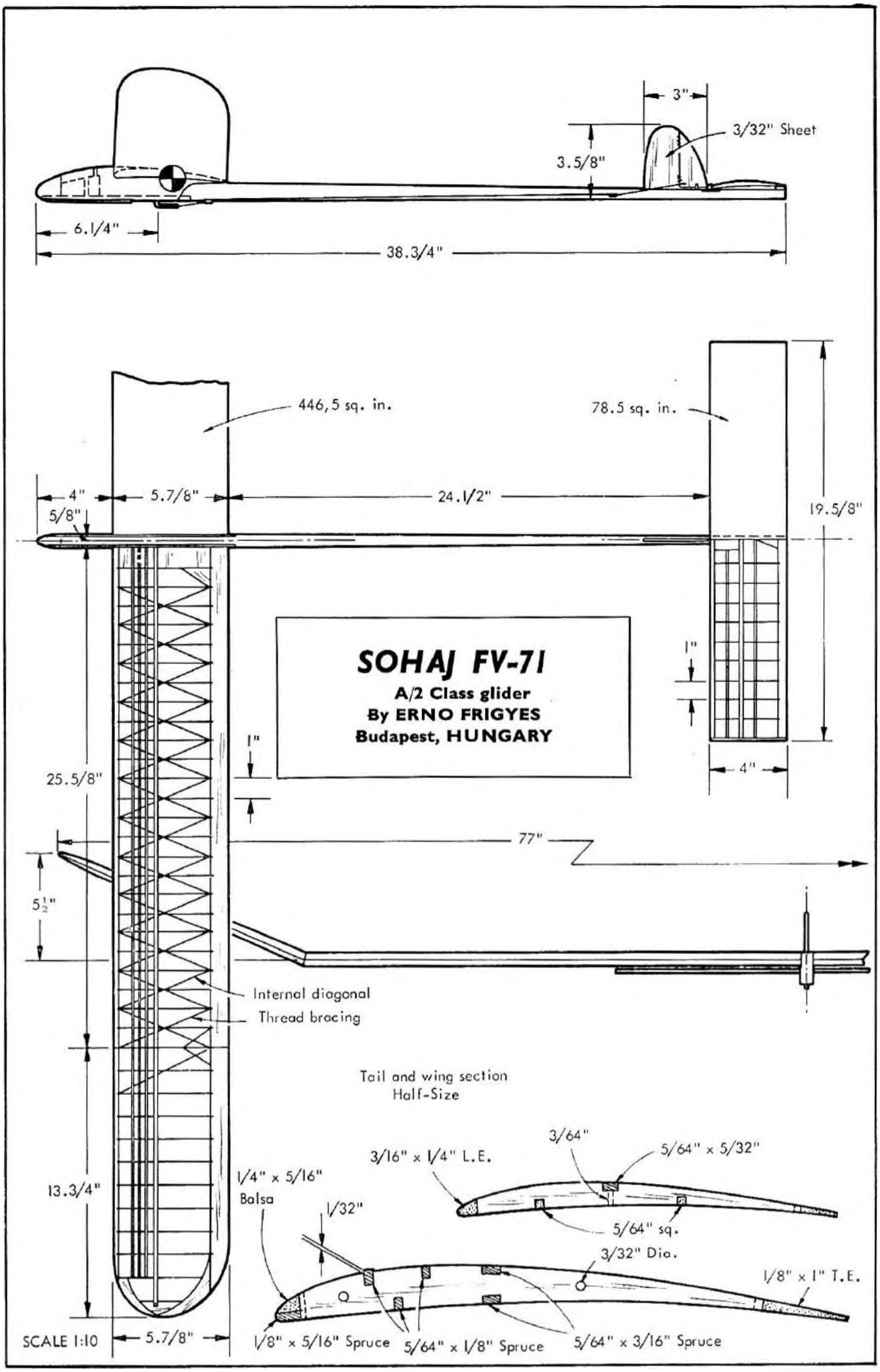
"THERMAL" ST. ALBANS



CANADIAN MODEL AIRCRAFT

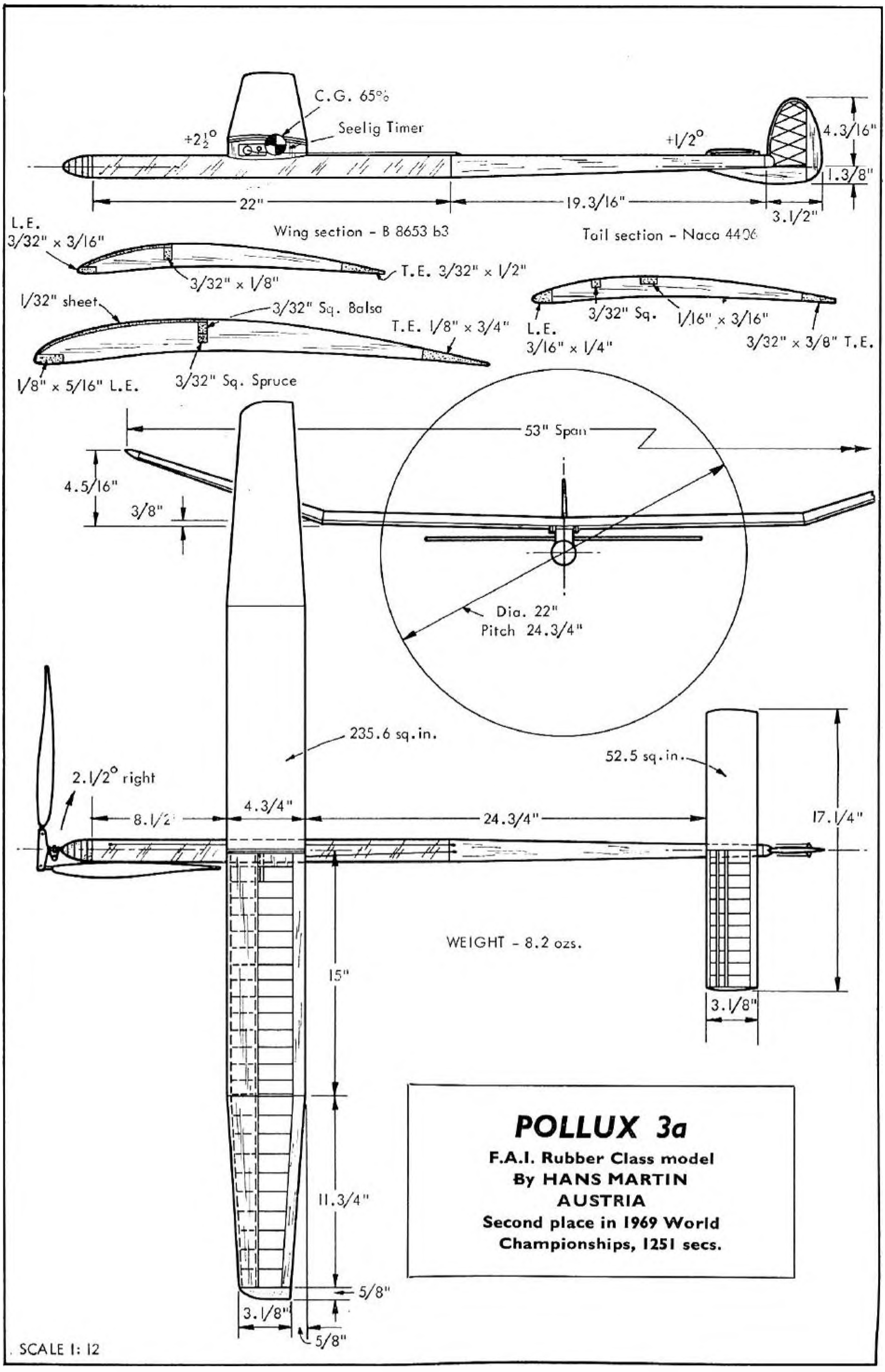


MODELE - FRANCE

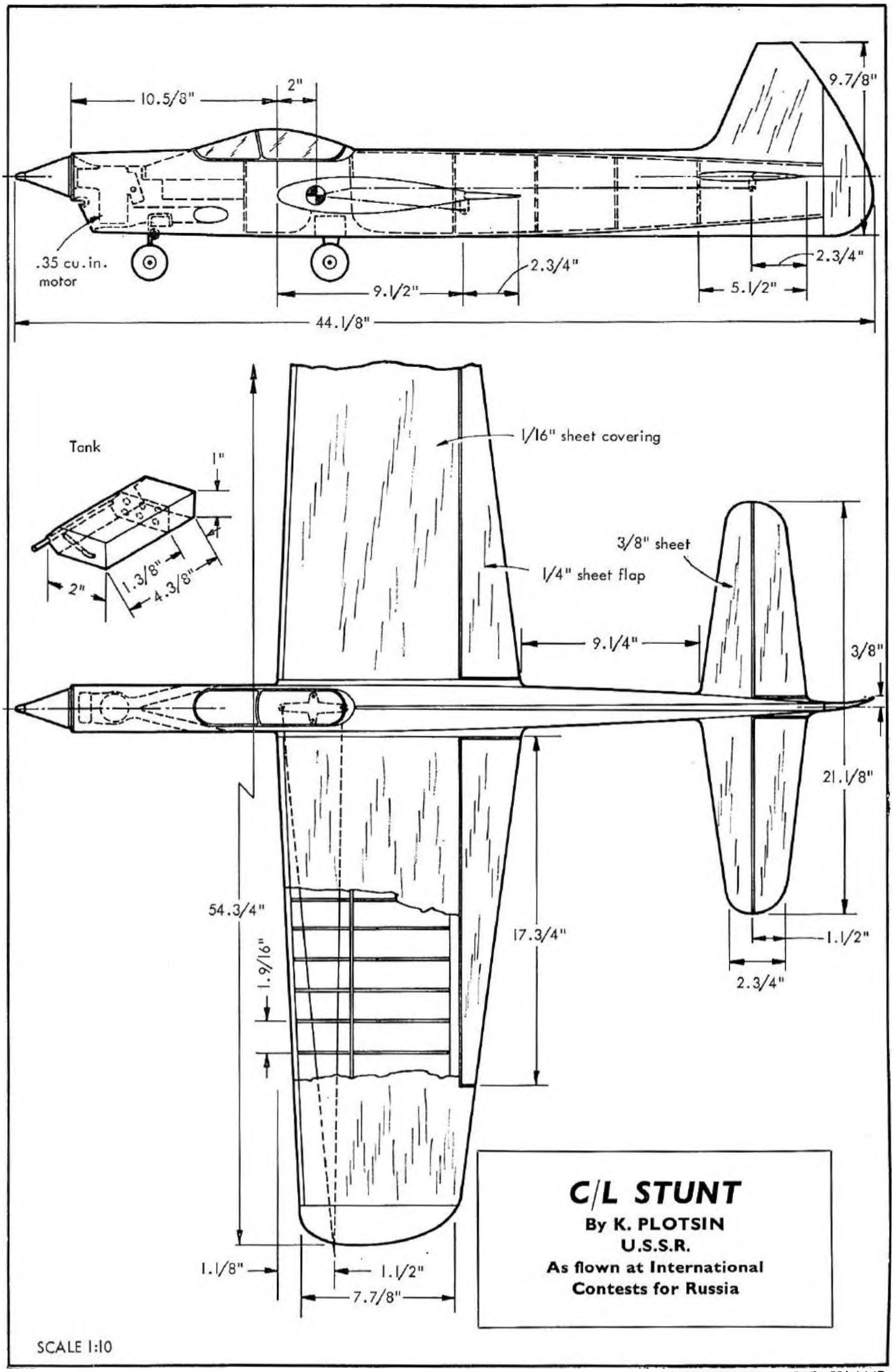


3"
3/32" Sheet
3.5/8"
6.1/4"
38.3/4"
446,5 sq. in.
78.5 sq. in.
4"
5.7/8"
24.1/2"
5/8"
19.5/8"
SOHAJ FV-71
A/2 Class glider
By ERNO FRIGYES
Budapest, HUNGARY
1"
1"
4"
25.5/8"
77"
5½"
Internal diagonal
Thread bracing
Tail and wing section
Half-Size
3/64"
3/16" x 1/4" L.E.
5/64" x 5/32"
1/4" x 5/16"
Balsa
1/32"
5/64" sq.
3/32" Dia.
1/8" x 1" T.E.
13.3/4"
SCALE 1:10
5.7/8"
1/8" x 5/16" Spruce
5/64" x 1/8" Spruce
5/64" x 3/16" Spruce

MODELLEZES


C.G. 65%
Seelig Timer
+2½°
+1/2°
4.3/16"
1.3/8"
22"
19.3/16"
3.1/2"
Wing section - B 8653 b3
Tail section - Naca 4406
L.E.
3/32" x 3/16"
3/32" x 1/8"
T.E. 3/32" x 1/2"
1/32" sheet
3/32" Sq. Balsa
T.E. 1/8" x 3/4"
1/8" x 5/16" L.E.
3/32" Sq. Spruce
3/32" Sq.
1/16" x 3/16"
L.E.
3/16" x 1/4"
3/32" x 3/8" T.E.
53" Span
4.5/16"
3/8"
Dia. 22"
Pitch 24.3/4"
235.6 sq.in.
52.5 sq.in.
2.1/2° right
8.1/2"
4.3/4"
24.3/4"
17.1/4"
WEIGHT - 8.2 ozs.
15"
3.1/8"
11.3/4"
5/8"
3.1/8"
5/8"
SCALE 1: 12
POLLUX 3a
F.A.I. Rubber Class model
By HANS MARTIN
AUSTRIA
Second place in 1969 World
Championships, 1251 secs.

AUSTROFLUG



WINGS OF THE FATHERLAND

THE CENTRE OF PRESSURE

by J. G. Langford, New Zealand

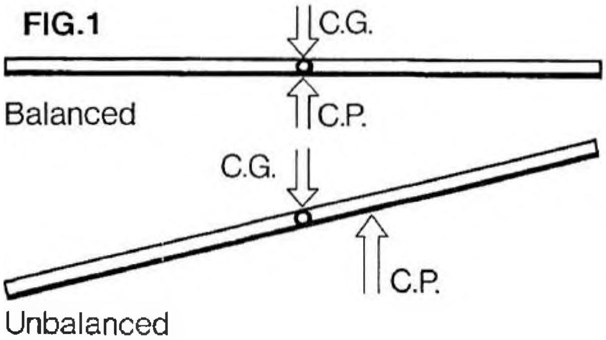
How often do we read in constructional articles and kit-building instructions for free-flight models: "Before flight balance model at the point shown and test glide. If nose-heavy put packing under trailing edge of tailplane." Now this method of initial trimming is common knowledge to most of us, but to a large number there is only an obscure connection between the balance point (centre of gravity) and the tailplane incidence. The connecting link is, of course, the centre of lift, or, as it is more usually stated, the centre of pressure.

Balance a poker horizontally on one finger. Balance will only occur at one point, when the finger is placed under the centre of gravity of the poker. Move the finger noticeably either way and one end or the other of the poker will fall. The finger can be likened to the centre of pressure of our lifting surfaces and this position occurs longitudinally in our model where there is an aerodynamic concentration of the lift forces of the combined wing and tailplane surfaces.

Most models are designed to glide with their fuselage attitudes within a few degrees either way of the horizontal, and to do so it is obvious, from our poker example, that a force arrangement with the C.P. vertically, or nearly vertically in line with the C.G. should maintain this attitude in the glide. The ideal arrangement, used on piloted aircraft is to have the C.P. nominally above the C.G., but this set-up is too "knife-edged" for models unless we have some method of elevator control to re-trim the machine from frequent changes of attitude. For our purpose it is necessary to have the C.G. slightly ahead of the C.P. so that in the event of disturbance or loss of speed the model will tend to drop its nose, and dive slightly to regain a stable attitude. This is most essential in passing from powered to gliding flight when the thrust disappears, speed drops suddenly and the model would normally stall without some built-in method of increasing speed and lift.

Now, like the C.G., the term C.P. is often used loosely to define the fore and aft position of the lift point of a surface, or a combination of surfaces. In actual fact, of course, it can be defined as an exact point, and assuming our lifting areas to be symmetrically disposed about our fore and aft centre line, it is obvious that it will also lie on this centre line. This point is called the neutral point (Fig. 2).

If a model has a warped wing the lift on one side will exceed the lift on the other, and the neutral point will consequently be displaced towards the side giving the most lift. We can again see here our old friend the unbalanced poker, and it is this displacement which causes the model to bank (Fig. 3).



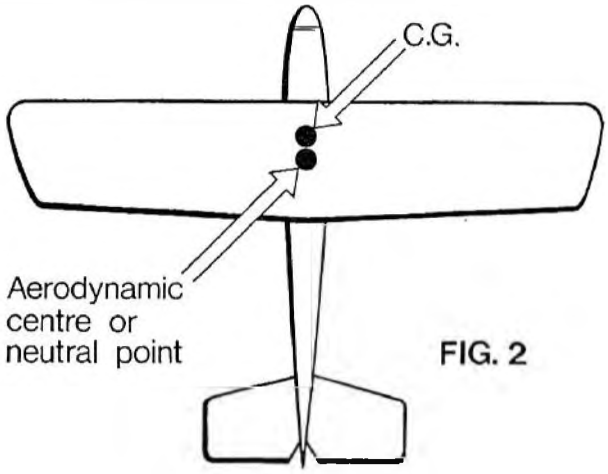


FIG. 2

In the case of a simple rectangular wing of say Clark Y section the C.P. lies roughly one-third back from the leading edge when the wing is at an angle of attack of 4°. If the angle of attack increases the C.P. moves forward, and when it decreases (high speed) the C.P. moves backward. This characteristic is, in a way, unfortunate for us, since, should our model be flying in a nose up, partially stalled condition, nothing could be better for it than a sharp rearward movement of the lift point to behind the C.G. restoring it to a level attitude. The reverse happens, however, tending to make matters still worse. However, in practice, the lifting moment of our tailplane is normally sufficient to damp out the worst of these changes in attack angles.

Until fairly recently it was considered that the sole function of a tailplane should be to stabilise the model against fore and aft disturbances. The tailplane was therefore of a symetrical streamlined section and rigged to fly at 0° angle of attack, giving no lift. In other words, it merely held the main plane "in the groove" at, say, 4° attack. If you look at old-time glider plans you will see in most cases that the balance point is roughly one-third back from the main plane leading edge since the main plane was normally the only lifting surface.

However, times have changed, and now our tailplane often lifts as well. This means that the C.P. is now a resultant force from wing and tail, and the more lift the tail is designed to give the farther back moves the total reaction. Thus, generally speaking, the larger the tailplane the farther back goes the C.P. and thus the C.G. This is particularly noticeable on power duration designs with large tailplanes where the C.P. can be anything between 50–100% from the wing leading edge (Fig. 4).

What we must remember is that although the balance point on a design may seem a long way back, the C.P. is always a little farther back still.

We can now see that if we have built our model to a proven plan with the tail and wing incidences correct, and the model balancing where indicated, a good glide should result showing that our C.G. and C.P. are in their right places. Usually slight inaccuracies have crept into our incidence setting, however, giving us a C.P. too far forward or rearward of our C.G. If a model shows a stalling tendency on gliding our C.P. is too far forward, and to bring it back we increase the lift on the tailplane by packing the leading edge. It must be emphasised that this method can only be used for trimming out *small* inaccuracies. If used to extremes we shall reduce or increase the angle of attack of our wing on which we rely for most of our lift, to a point where it is operating at very inefficient lift/drag ratios, and induce unpleasant stability characteristics. Therefore, if your model needs packing to a point where the wing–tail incidences differ much from 2–4 always move your C.G. position first by weight adjustments or ballast.

In conclusion, unless you fully understand what you are aiming for, never be tempted into altering your hard-won glide stability to cure power-on troubles. Thrust line adjustments with your motor will take care of most of these.

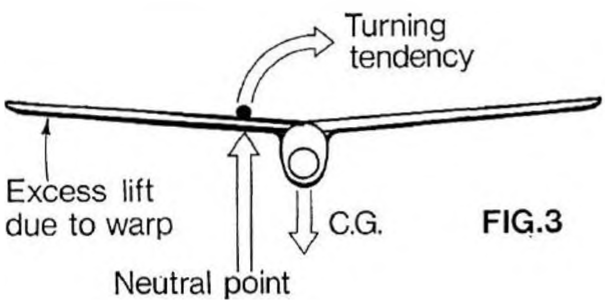
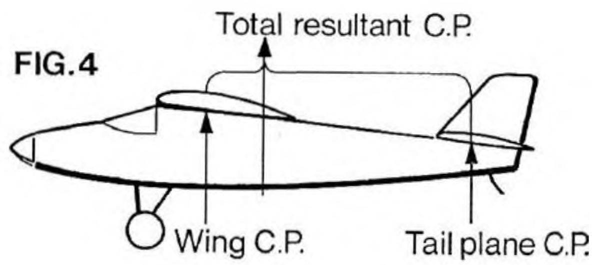
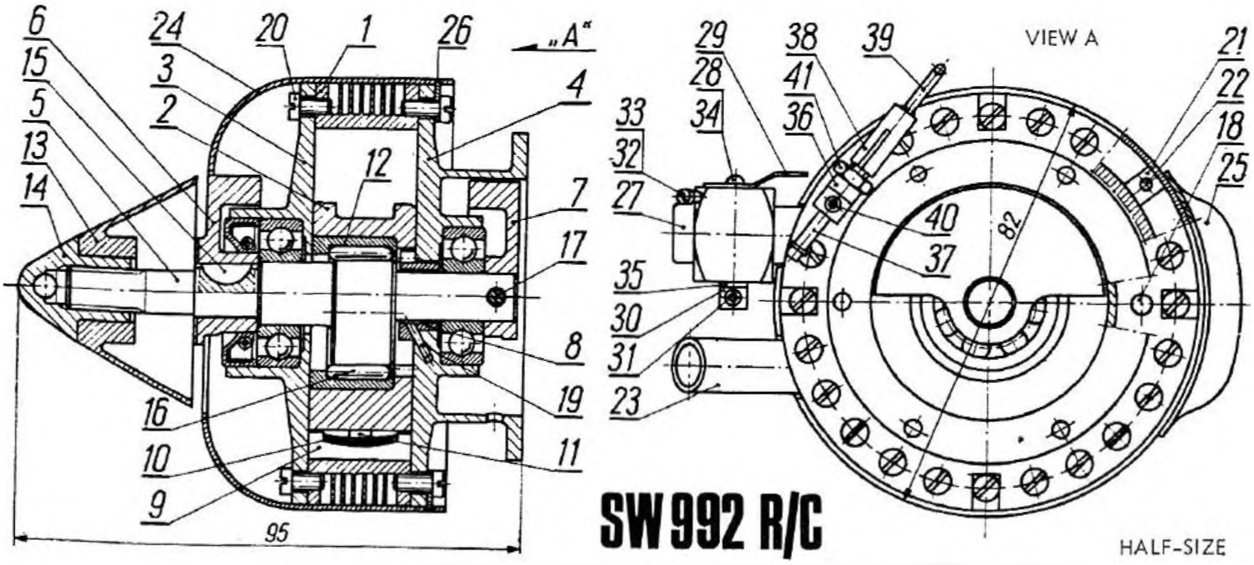


FIG.3

FIG.4




PART IDENTIFICATION AND GENERAL ARRANGEMENT DIAGRAMS

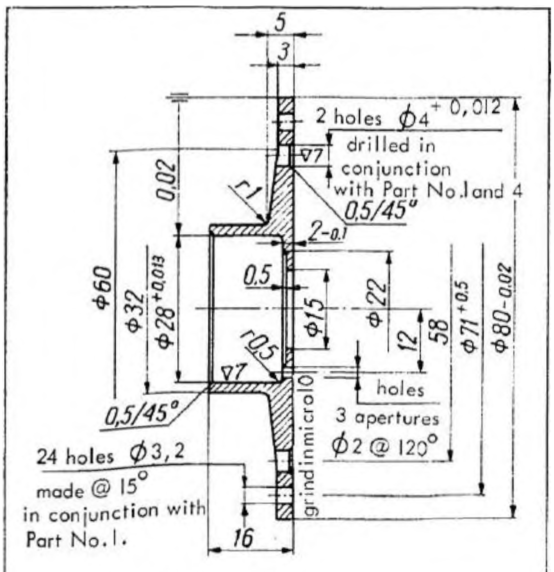
POLISH 10cc EPITROCHOIDAL ENGINE DATA

by Julian Falecki

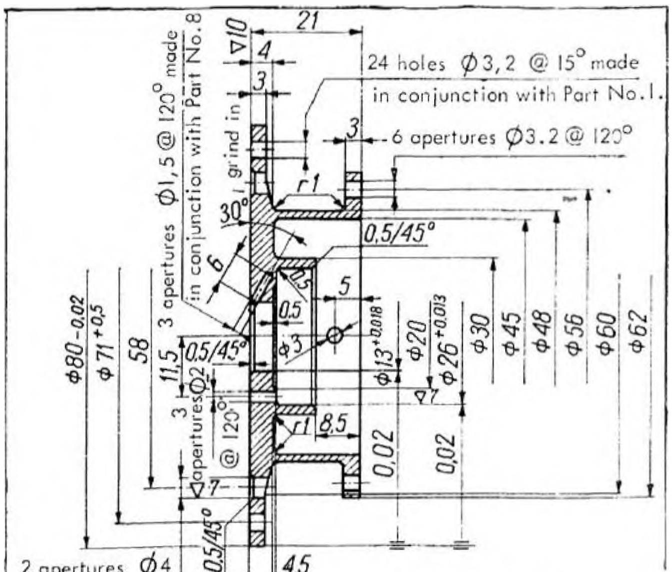
PART IDENTIFICATION

1. Cylinder
2. Piston
3. Front Plate
4. Back Plate
5. Crankshaft
6. Front Counterweight & drive plate
7. Rear Counterweight
8. Gear (static)
9. Piston Seal
10. Spring
11. Inset
12. Bearing Sleeve
13. Spinner
14. Spinner Nut
15. Shaft Key
16. Roller Bearing
17. Shaft Pin
18. Cylinder Pin
19. Gear Pin
20. Assembly Screw
21. Spacer
22. Spacer Pin
23. Exhaust Stub
24. Cowl
25. Airscoop
26. Fixing Plate
27. Carburetter Body
28. Throttle Barrel
29. Throttle Lever
30. Spray Nozzle
31. Fuel Inlet
32. Throttle Stop Bolt
33. Stop Spring
34. Throttle Rivet
35. Throttle Washer
36. Needle valve bracket
37. Needle valve body
38. Needle valve sleeve
39. Needle valve
40. Fuel inlet
41. Lock nut

In 1964 we reprinted the SW92 from "Skrzydlata Polska" as the first such design, and that magazine has lamented that despite design leadership, Poland failed to take commercial advantage. Meanwhile the Graupner NSU Wankel 5 cc unit has appeared, made in Japan by OS and now, the SW 992 updated 10 cc design as reprinted here. It incorporates a throttle, is better balanced, has better bearing life and is more flexible than Falecki's first engine. Power rating is 1.7 b.h.p. at 15,000 r.p.m. It drives a 12 × 6 in. prop, weighs approximately 18 oz. and is designed for the model engineer. Don't ask *us* to convert the material specs—they are in original Polish—but experienced engineers will have no difficulty in following the data for the 41 different parts.

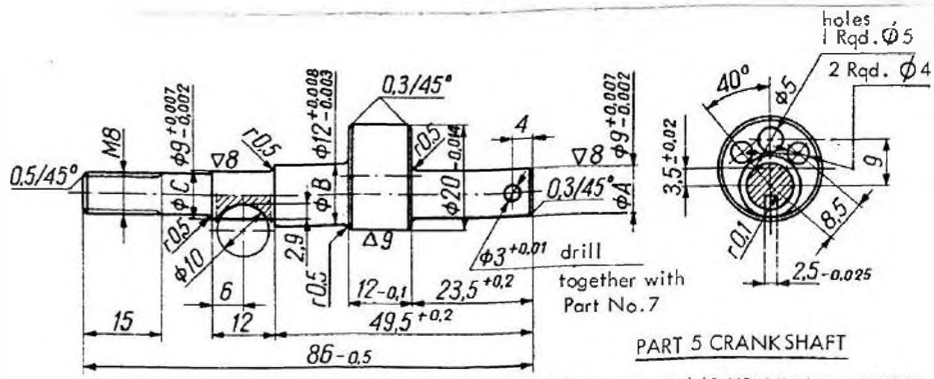


PART 3 FRONT PLATE
1 Rqd. material : general finish micro 5



PART 4 BACK PLATE
1 Rqd. material PA6 finish micro 5

All parts are shown with metric dimensions and finish standards. All materials are quoted in original Polish specifications

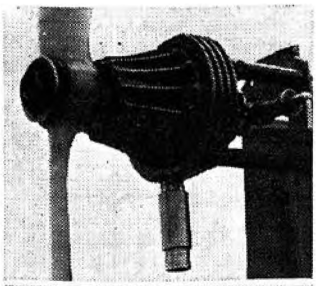


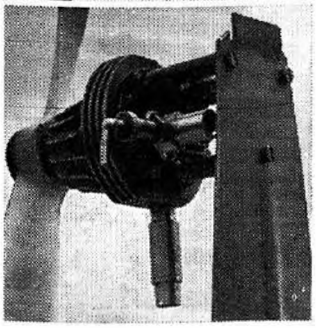
PART 5 CRANKSHAFT

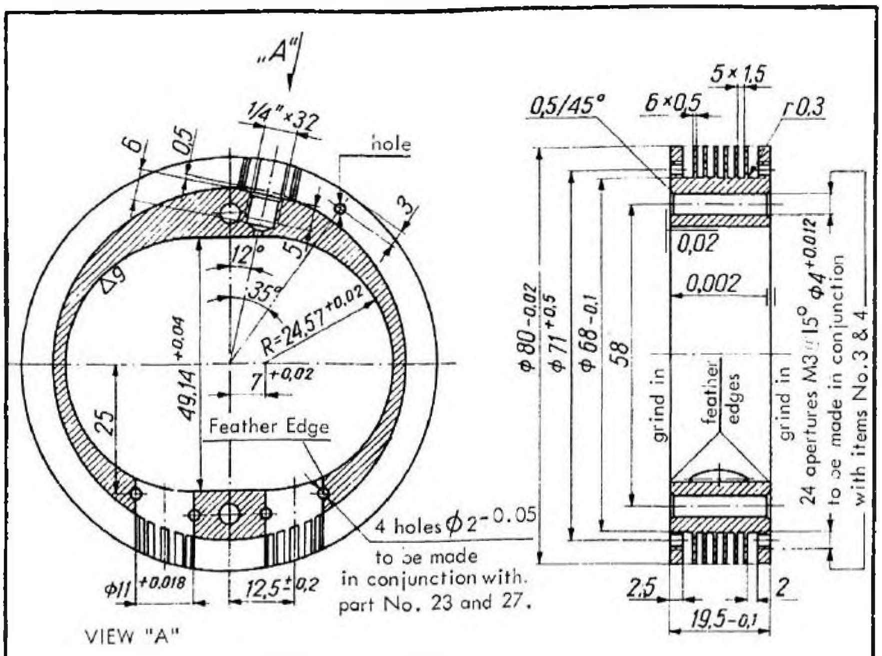
I Rqd. material 18 H2N4WA or 18H2N2
General finish micro 6

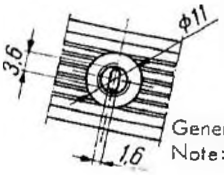
Note: Surface Ø20 – 0.014 depth of carburization 0.8 - 1 Hrc min. 58 Rr = 100-120 KG/mm²
Centring holes allowed Permissible excentricity Ø B and ØC in relation to ØA 0.02

Below: Home constructed rotary piston engine with several unique features was made by J. Howard and displayed at South Coast R/C rally, no news as yet of its use in a model.





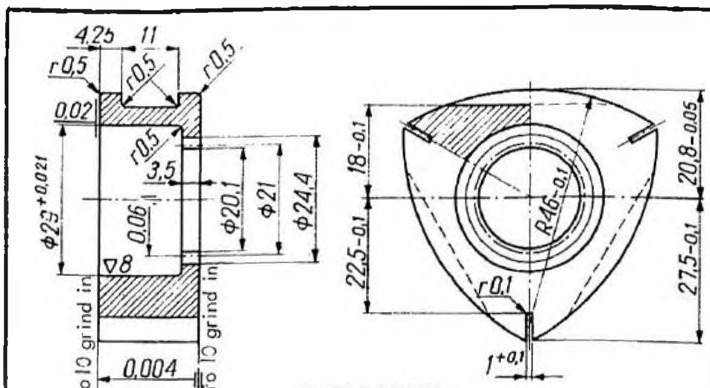




PART 1 CYLINDER

I Rqd. material 45 Rr = 60 – 70 KG/mm²
or ZsP55 H_B = 240 - 280 KG/mm²

General (ordinary) Finish (machining) to surface Micro 5 .
Note: With material 45 surface to be chromium hardened 0.15 – 0.25



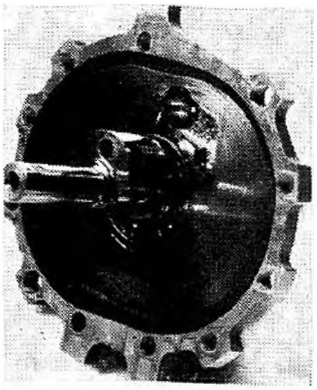
PART 2 PISTON

TRANSMISSION GEARING

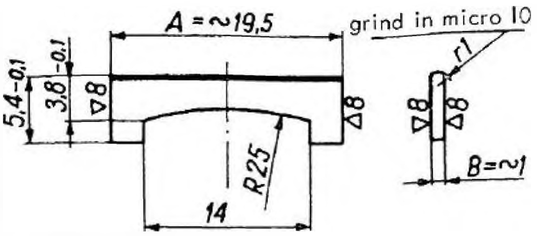
Number of teeth	21
Module	1
Nominal angle of contact	20°
Coefficient of tooth height	1
Displacement of tooth profile	0.43
Measurement across rollers	19.62
Diameter of roller	1.65

No. 2. PISTON

I Rqd. material 45 Rr = 60 – 70 KG/mm²
ZsP55 HB = 240 – 280 KG/mm² General (ordinary) finish micro 7
Note: Axial play of Piston in Cylinder 5 – 10
Edges of end face of teeth to be chamfered at surface micro 10 0.3/45°



Inside face of the back cover on the Graupner-Wankel shows eccentric crankshaft lobe which follows oscillating piston.

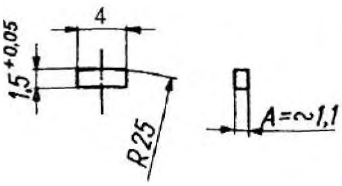


PART 9 PISTON SEAL

3 Rqd. material ZsP55 HB = 240-280 KG/mm^2

Note: Dimension A to be smaller than width of cylinder by 0,03 - 0,05

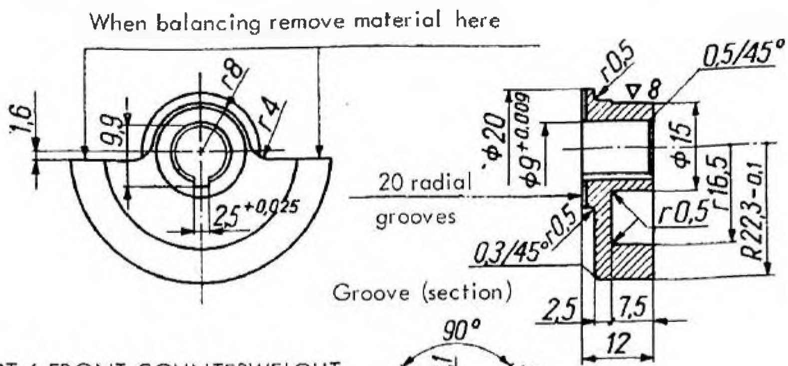
Dimension B should allow clearance of strip in cutouts of piston to be 0,01 - 0,03

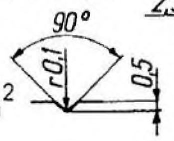


PART 11 INSERT

3 Rqd. material PA6 micro 5

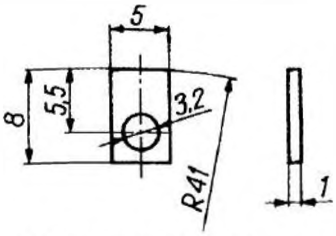
Note: make to fit tight in piston cut-out. (dimension A)





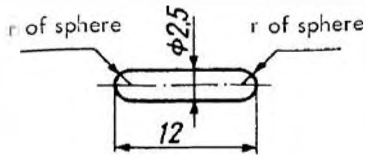
PART 6 FRONT COUNTERWEIGHT

I Rqd. material 45 Rr = 60 - 70 KG/mm^2 micro 5



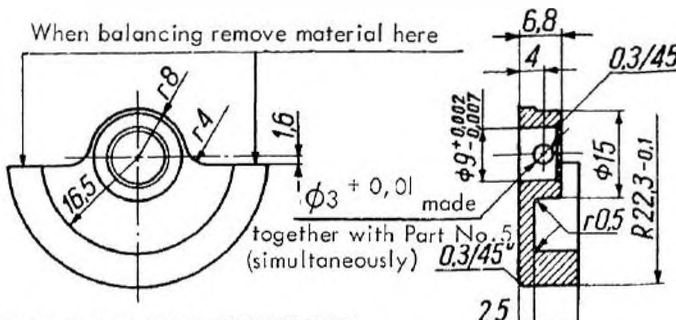
PART 26 FIXING PLATE

4 Rqd. material 20 micro 4



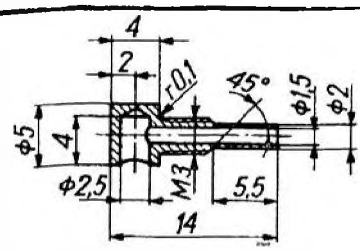
PART 16 ROLLER BEARING

28 Rqd.



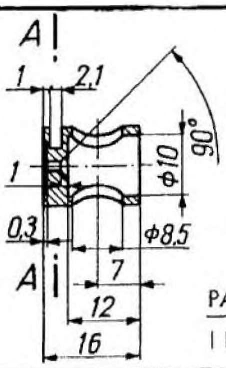
PART 7 REAR COUNTERWEIGHT

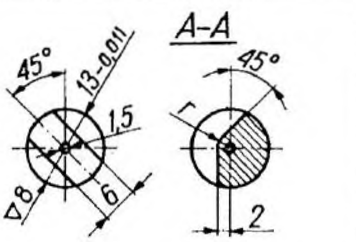
I Rqd. material 45 Rr = 60 - 70 KG/mm^2



PART 30 SPRAY NOZZLE

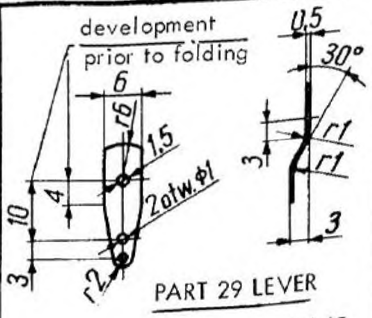
I Rqd. material 63 or 45 micro 5





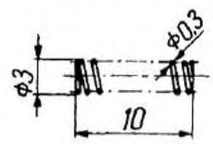
PART 28 THROTTLE

I Rqd. material M63 or 45 micro 5



PART 29 LEVER

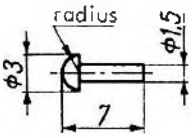
I Rqd. material 15



9 coils

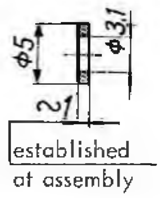
PART 33 SPRING

I Rqd. material OWS



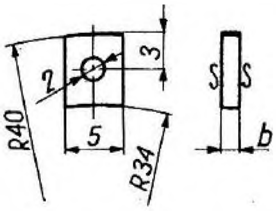
PART 34 RIVET

1 Rqd. material 15 micro 3



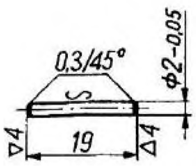
PART 35 WASHER

1 Rqd. material PA6 micro 5



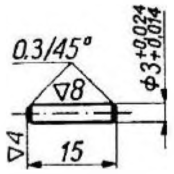
PART 21 SPACER

2 Rqd. b = 2, 5 Rqd. b= 1,5
material PA6 micro 4



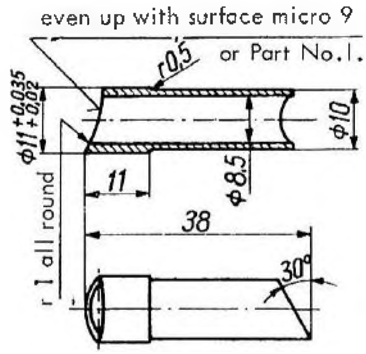
PART 22 PIN

5 Rqd. material D 65



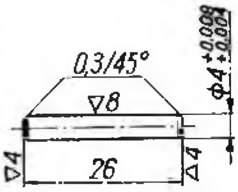
PART 17 PIN

1 Rqd. material 45
Rr = 60 - 70 KG/mm²



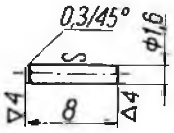
PART 23 EXHAUST STUB

1 Rqd. material PA6 micro 5



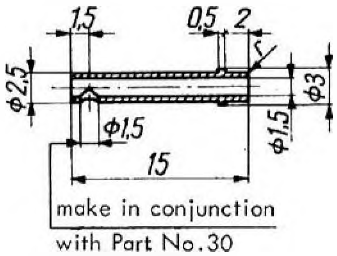
PART 18 PIN

2 Rqd. material 45
Rr = 60-70 KG/mm²



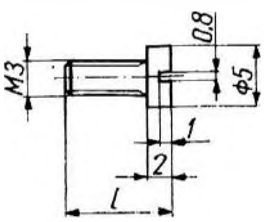
PART 19 PIN

3 Rqd. material D65



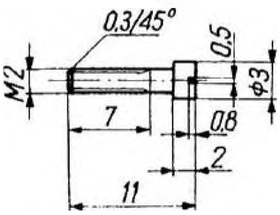
PART 31 INLET

1 Rqd. material M63.



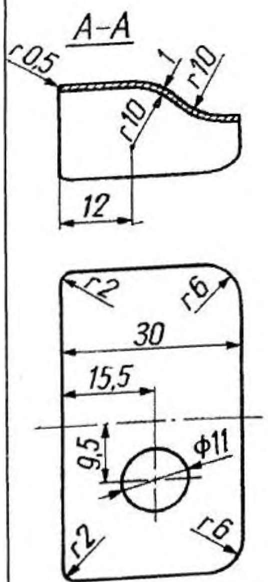
PART 20 SCREW

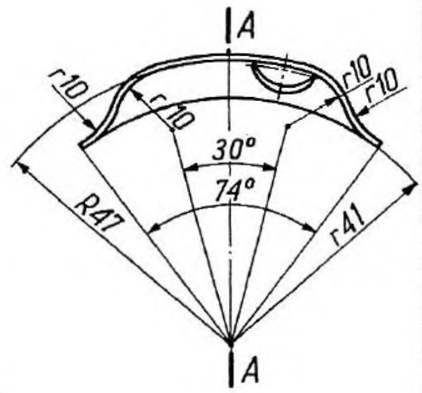
6 Rqd. l = 9 42 Rqd. l = 8
material 45 micro 5
Rr = 60-70 KG/mm²



PART 32 BOLT

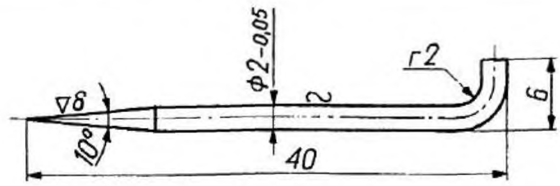
1 Rqd. material 45 micro 5





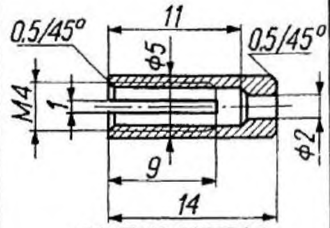
COOLING
PART 25 AIR INLET

1 Rqd. material : PA1



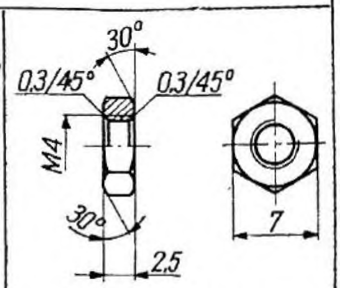
PART 39 NEEDLE VALVE

1 Rqd. material : D65



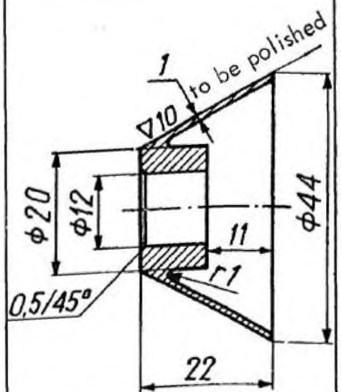
PART 38 NEEDLE VALVE SLEEVE

1 Rqd. material : M63 micro 5



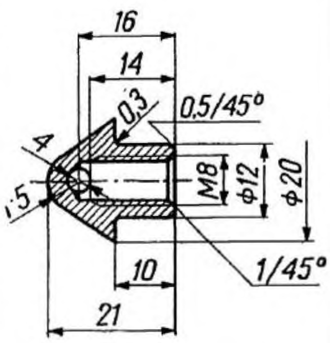
PART 41 NUT

1 Rqd. material : M63 micro 5



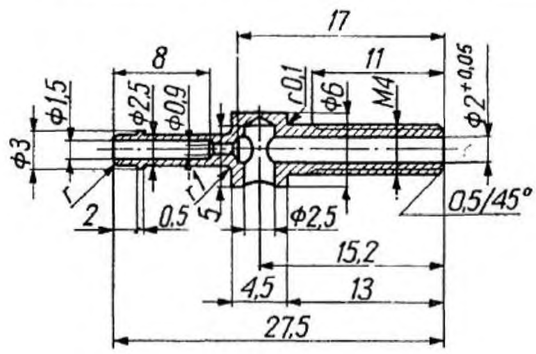
PART 13 AIRSCREW SPINNER

1 Rqd. material: PA6 micro 5



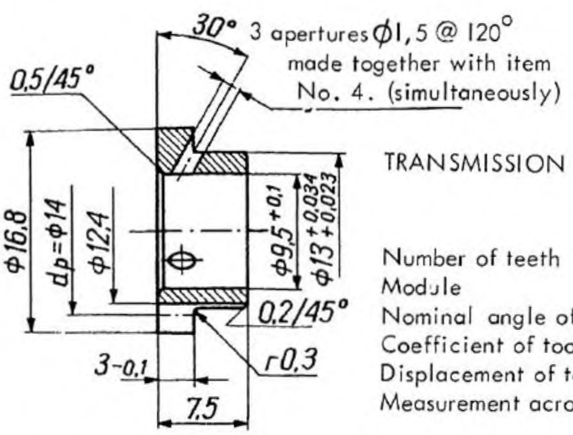
PART 14 SPINNER NUT

1 Rqd. material : PA6 micro 5



PART 37 NEEDLE VALVE BODY

1 Rqd. material : M63 or : 45 micro 5

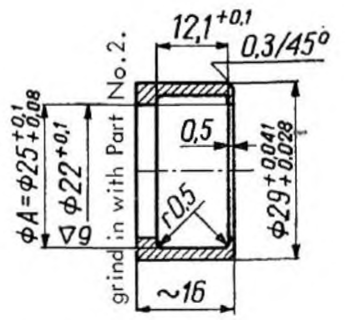


TRANSMISSION GEARING

Number of teeth	14
Module	1
Nominal angle of contact	20°
Coefficient of tooth height	1
Displacement of tooth profile	0.43
Measurement across 3 teeth	7.87

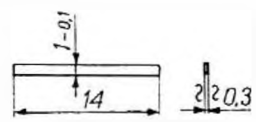
PART 8 GEAR micro 6

1 Rqd. material : 18H2N4WA or 18H2N2 or 30HGS
Rr = 100 - 120 KG/mm^2



PART 12 BEARING SLEEVE

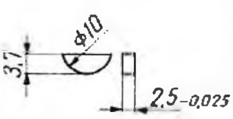
1 Rqd. material LH15 or 18H2N4WA
Carburize 0.8 - 1
HRC min 62 Micro 5
Note: φ A = φ25 $^{+0,1}_{+0,08}$ attain in piston (Part No.2)



PART 10 SPRING

9 Rqd. material 50HFA Micro 4

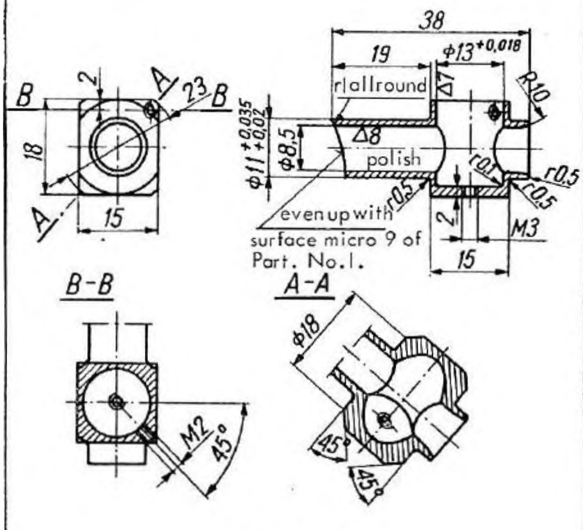
Rr = 150 - 160 KG/mm²



PART 15 INSET KEY

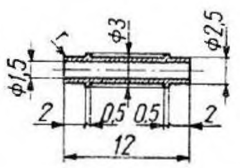
1 Rqd. material 65Micro 6

Rr = 80 - 95 KG/mm²



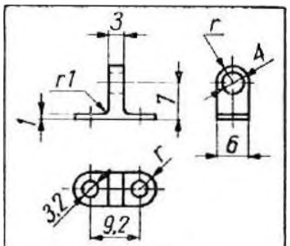
PART 27 CARBURETTOR

1 Rqd. material PA6 micro 5



PART 40 FUEL INLET

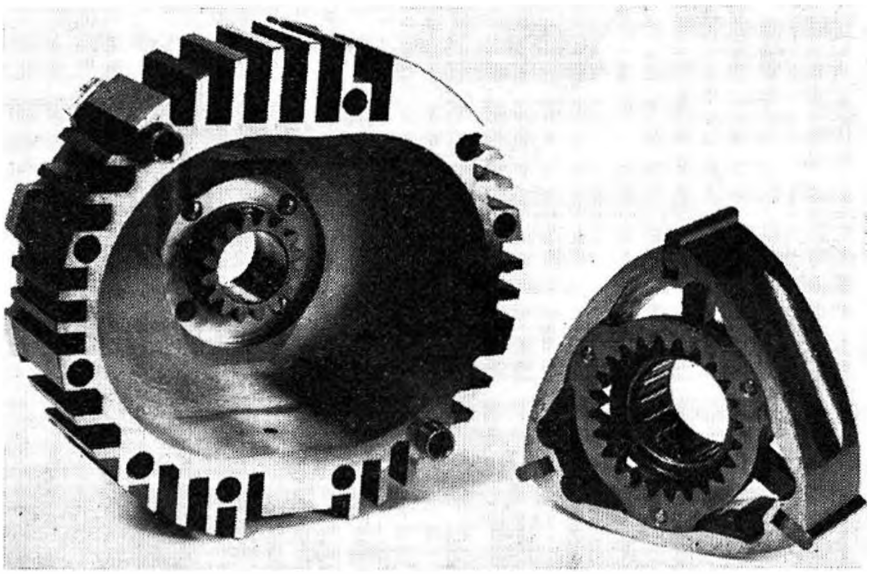
1 Rqd. material M63

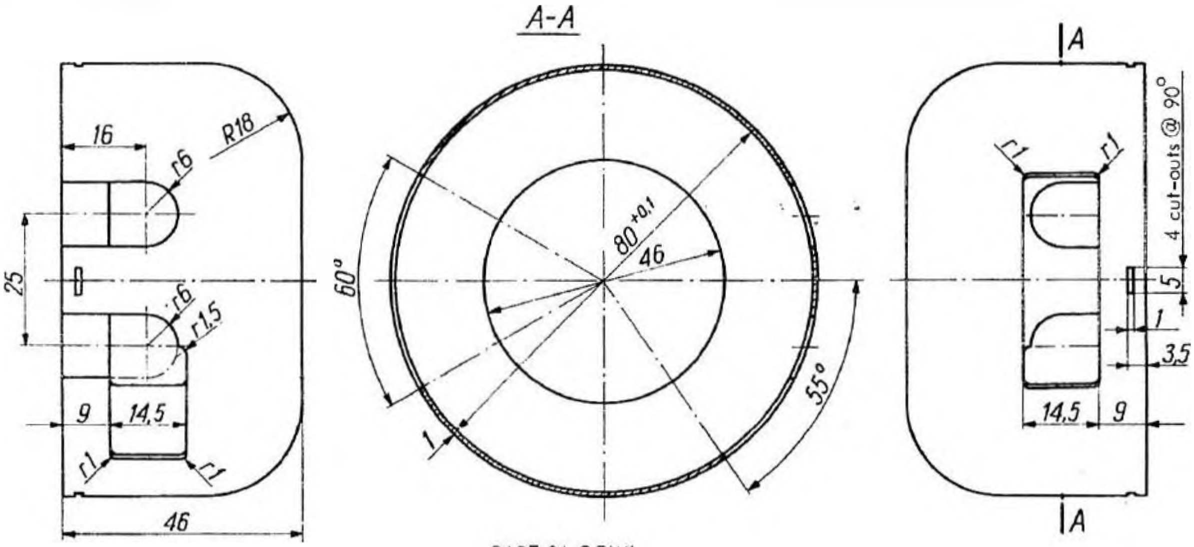


PART 36 BRACKET

1 Rqd. material 45 micro 5

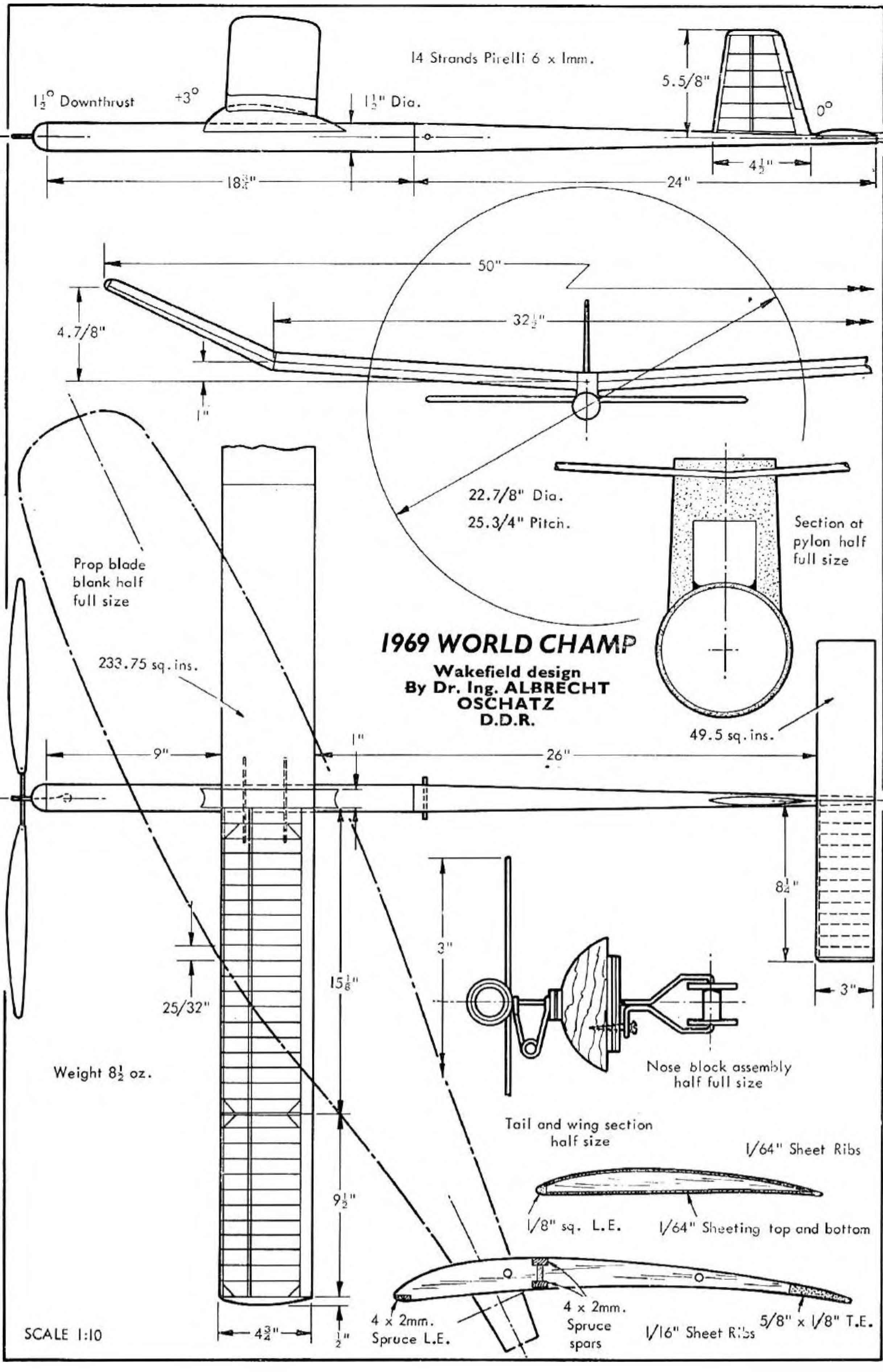
At right: The "cylinder" of the Graupner-Wankel with back plate still in place showing the static gear. To right is the rotary piston (Trochoide) with protruding seals (compression ratio 7.5:1) and eccentrically mounted internal gear to mesh with static gear on back plate. These details are generally similar to the system employed by Falecki. The Graupner-Wankel, distributed by Rip-Max Ltd. is the only model engine of this type, licensed for production, and is a magnificent example of engineering production of the highest quality.



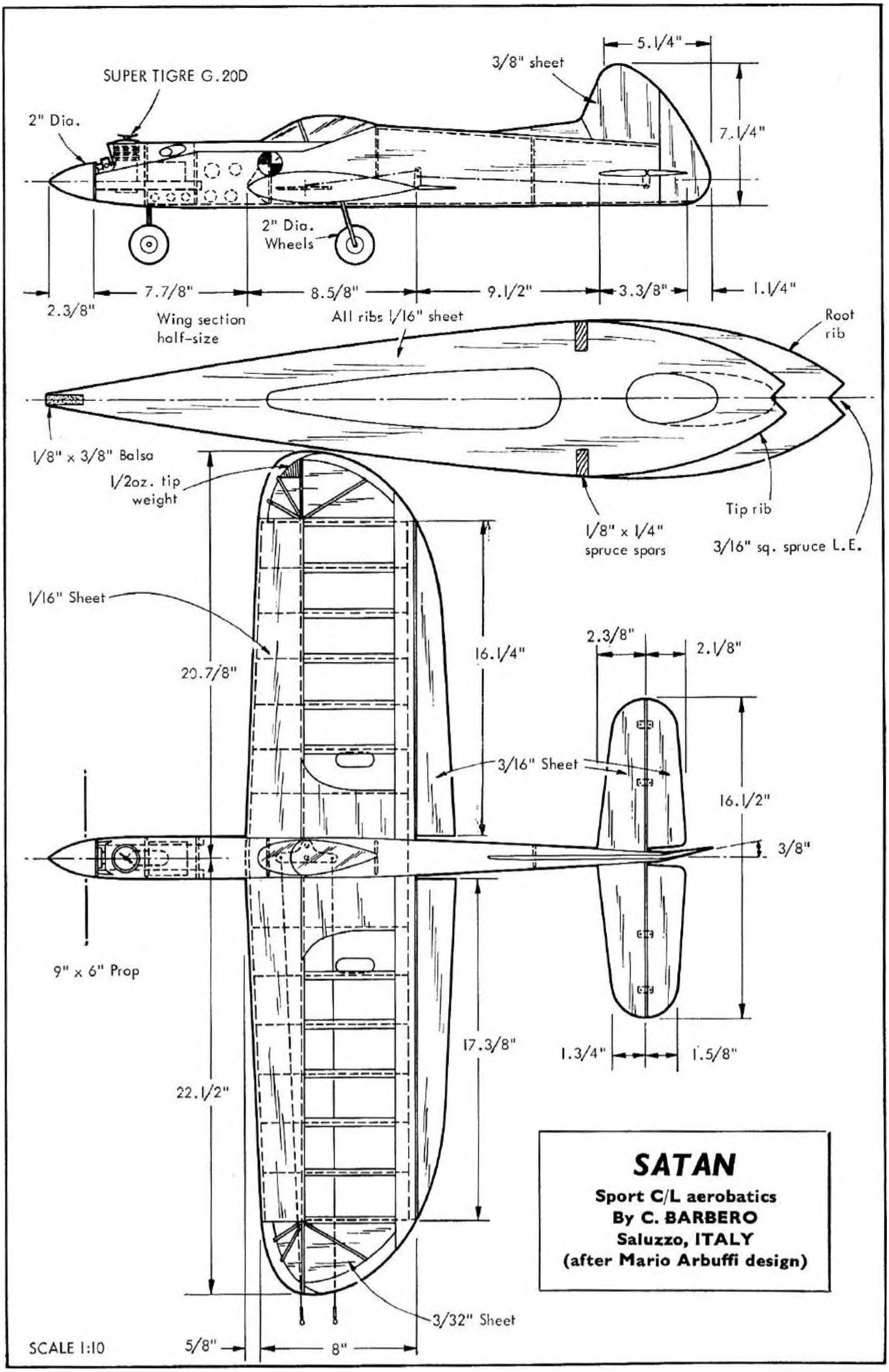


PART 24 COWL

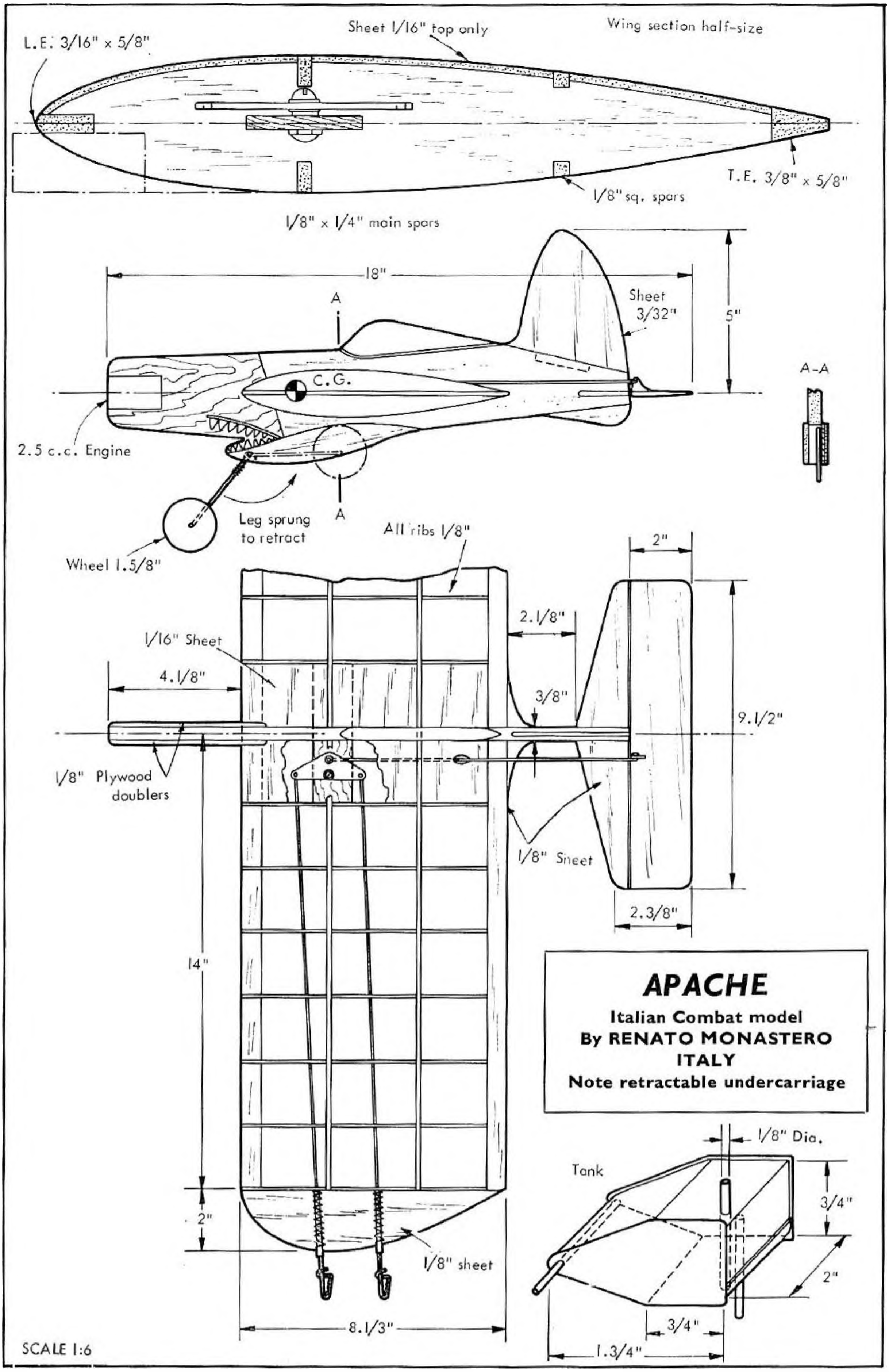
1 Rqd. material PA1



MODELLI e SPORT



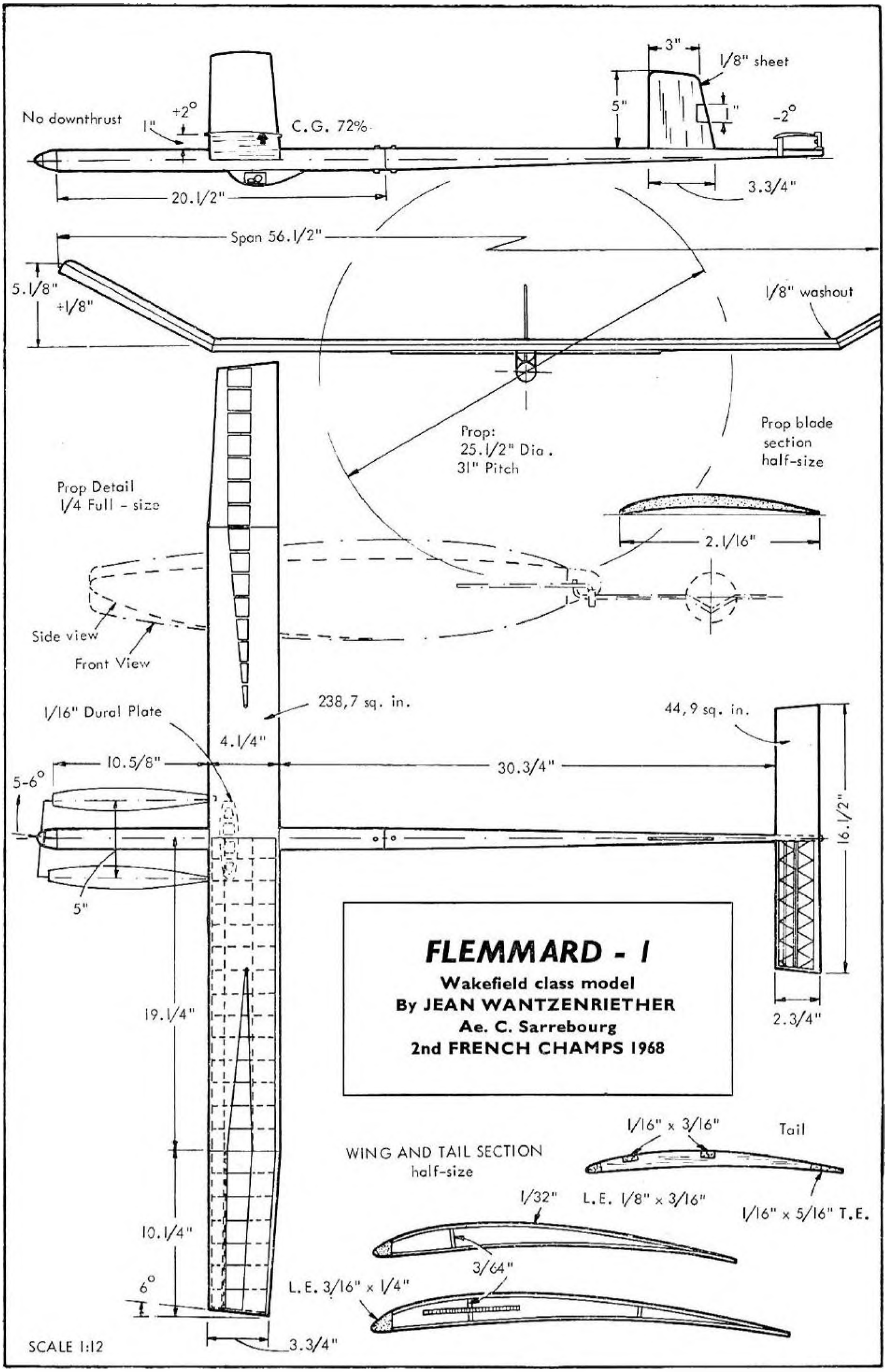
MODELLISTICA



APACHE

Italian Combat model
By RENATO MONASTERO
ITALY
Note retractable undercarriage

MODELLI e SPORT



MODELE REDUIT D' AVION

A RELATIONSHIP BETWEEN BASIC AIRFOIL PARAMETERS/ASPECT RATIO AND RATE OF SINK OF NORDIC A-2 GLIDERS

by Peter J. Allnutt and Kenneth R. Kaczanowski

Acknowledgment

We are extremely grateful to Mr. Brian Eggleston, B.Sc.(Eng.), of DeHavilland, Canada, and to Dr. David Surry of the National Physical Laboratories, England, for their helpful suggestions and critique in the formative stages of this paper.

Introduction

Minimum changes to A-2 glider specifications during the last decade have enabled one to observe a "settling out" pattern in maximum still air duration for these gliders. The mean duration for all types ("still air" and "storm" models grouped together) seems to fall in approximately the 150 second region. Much experimentation has been done on wing sections, on a trial and error basis, resulting in either positive or negative results without actually being aware of what definite relationships there existed between wing section parameters and "still air" duration. It was therefore decided that perhaps a more careful statistical examination of these parameters taken from a cross-section of gliders already tested and flown would reveal some of their relationships.

Figure 1, below, illustrates the basic parameters analysed.

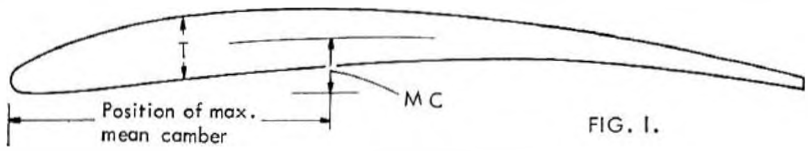


FIG. I.

Appendix I shows all of the sections analysed, and Table I contains the summary of data from these sections.

All of the gliders were to F.A.I. Class FIA (A-2 Nordic) specifications.

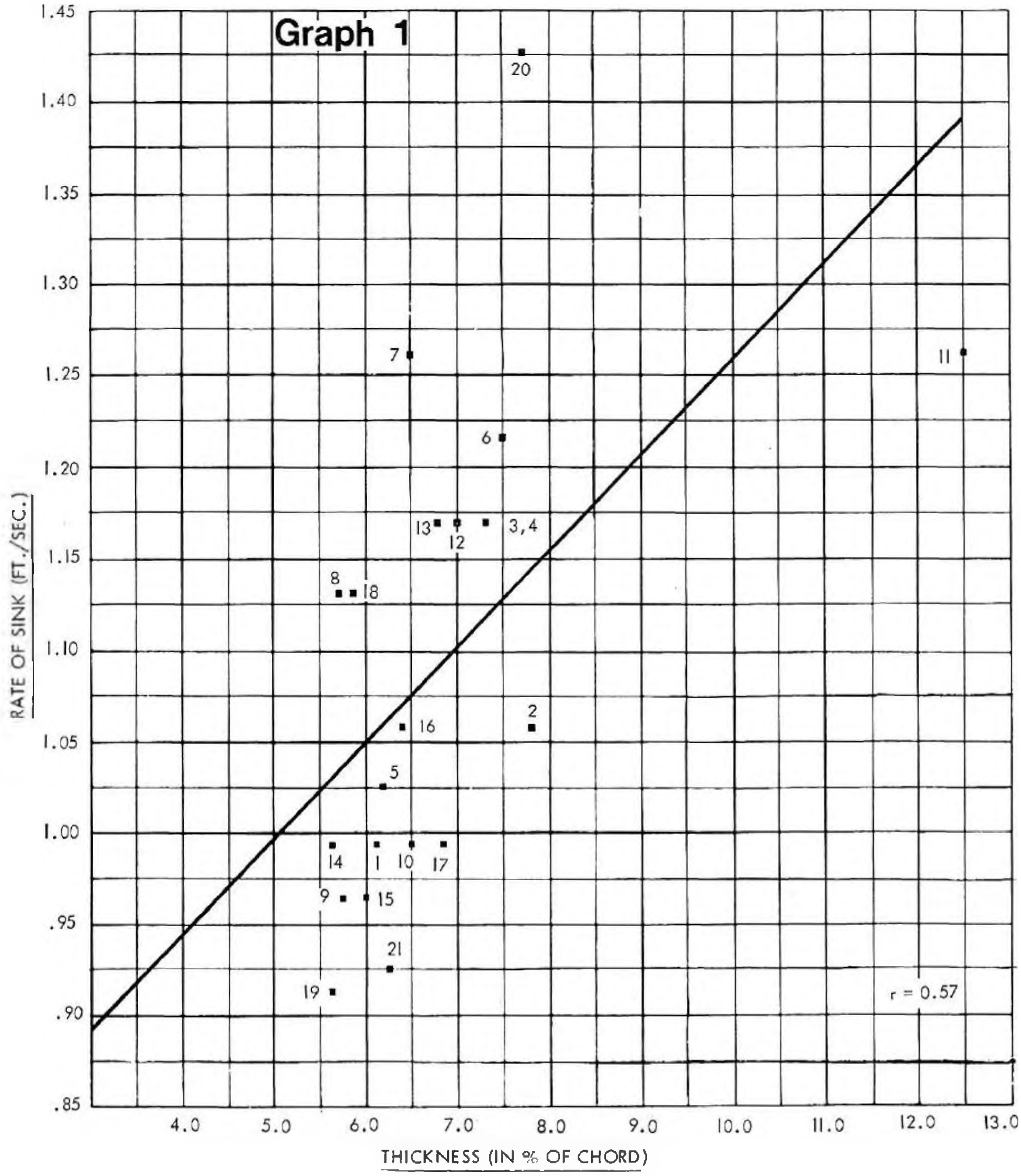
Initially, all of the main parameters were plotted against rate of sink in order to determine what correlation existed (if any), and also some plots were carried out between combinations of parameters and rate of sink.

General Parameters

Plots of undercamber and mean camber singularly indicated no correlation. The same was true of *position* of undercamber, mean camber, thickness and top camber singularly. This was expected in that these positions serve only to fix the fairing shape of the section and are determinants of the stability of the section.

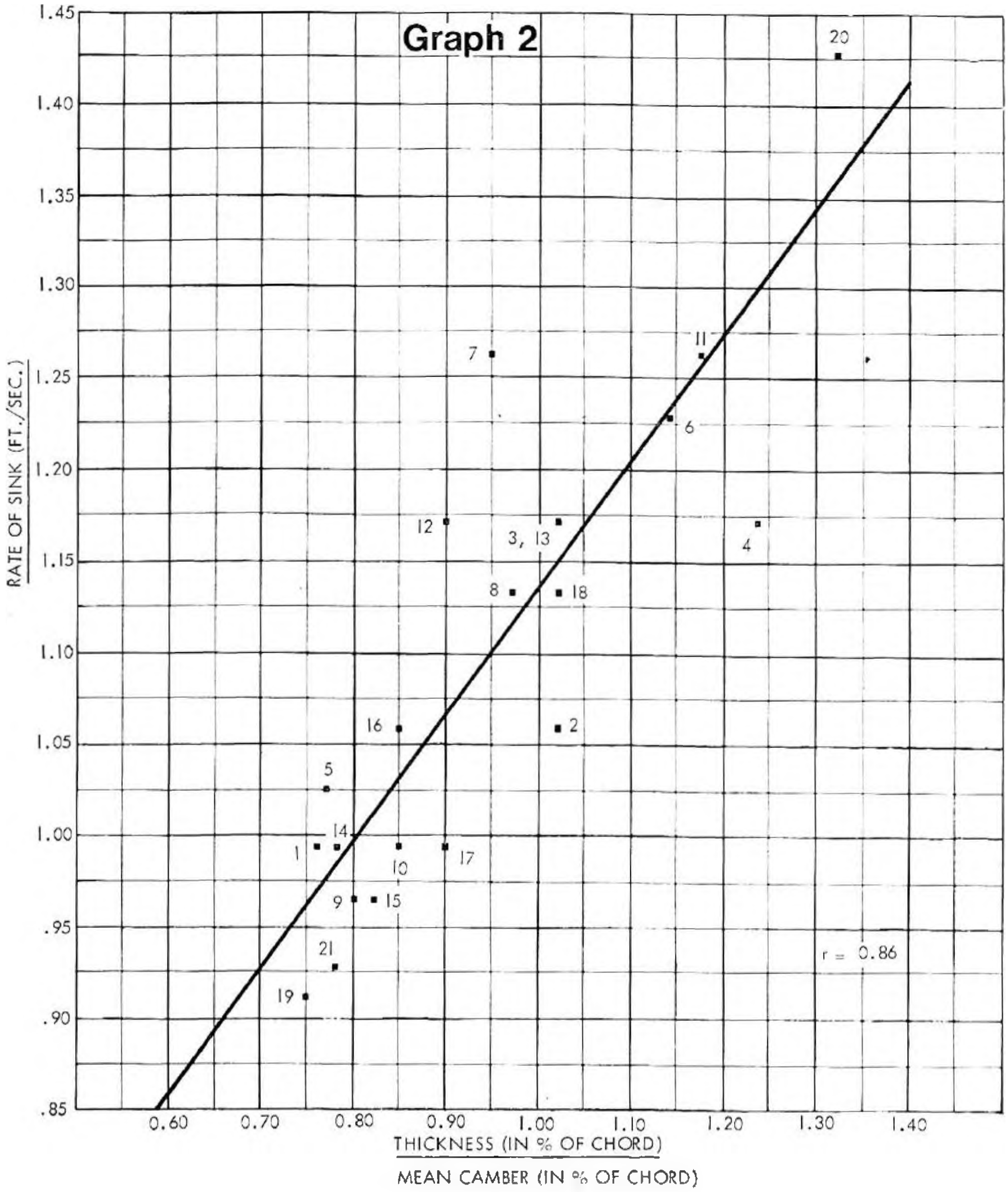
Thickness

Thickness (in % of chord) was plotted against Rate of Sink (see Graph No. 1 and Column 2, Table I). As can be seen, there is some relationship, in that



decreasing thickness tends to decrease Rate of Sink, but the correlation coefficient is far too small to be significant. Lowering thickness will decrease profile drag, but at the same time will decrease lift. It appears that a point is reached, where decreasing this parameter causes a loss of lift that is large enough that it cannot be compensated for by the decrease in profile drag, and thus the Rate of Sink cannot be decreased any further. Present-day performance sections tend to average about 5·5 to 6·5% thickness. A recent test of this one parameter was done, in which the section used on the glider had a thickness of *only 4·2%* (other airfoil parameters and aspect ratio were average), but the average "still air" duration remained at only 155 seconds.

However, we know that increasing Mean Camber increases lift, to a certain degree. Therefore, a combination of variables was indicated for further plots.

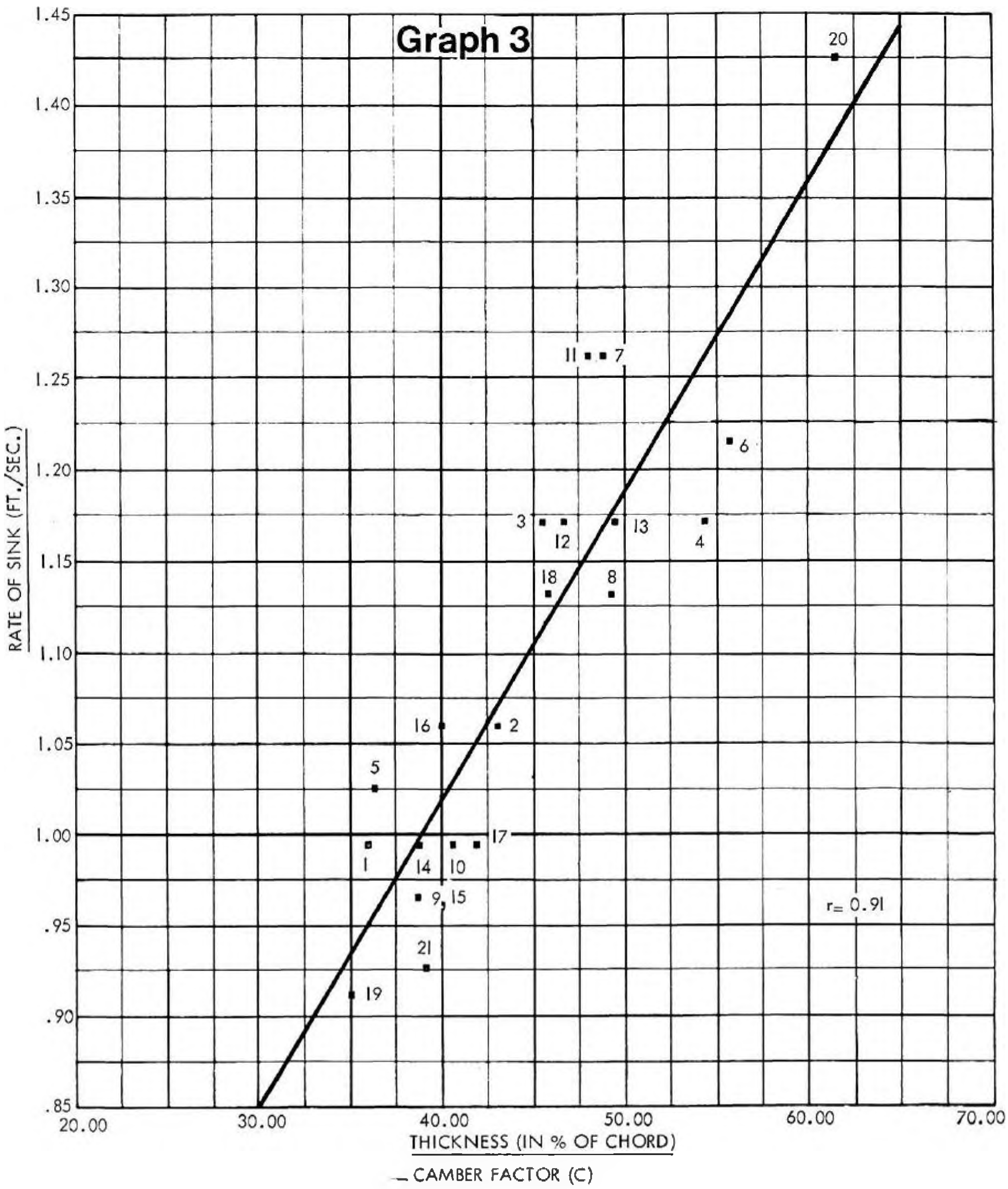


Thickness/Mean Camber Ratio

Graph No. 2 shows the plot of the ratio of Thickness ÷ Mean Camber against Rate of Sink. Now, a distinct pattern is indicated. There appears to be a definite relationship being supported by a somewhat higher correlation coefficient, but still not statistically significant. A decrease in this ratio shows a decrease in Rate of Sink.

Thickness/Mean Camber/Position of Mean Camber

Graph No. 3 introduces the *position* of Mean Camber into the Thickness/Mean Camber ratio, in order to determine whether or not this parameter has any distinct effect upon Rate of Sink. From Appendix II, a Camber Factor (C) or coefficient was determined for each airfoil section (i.e. Mean Camber/Position of Mean Camber). As can be seen, the correlation coefficient has increased in

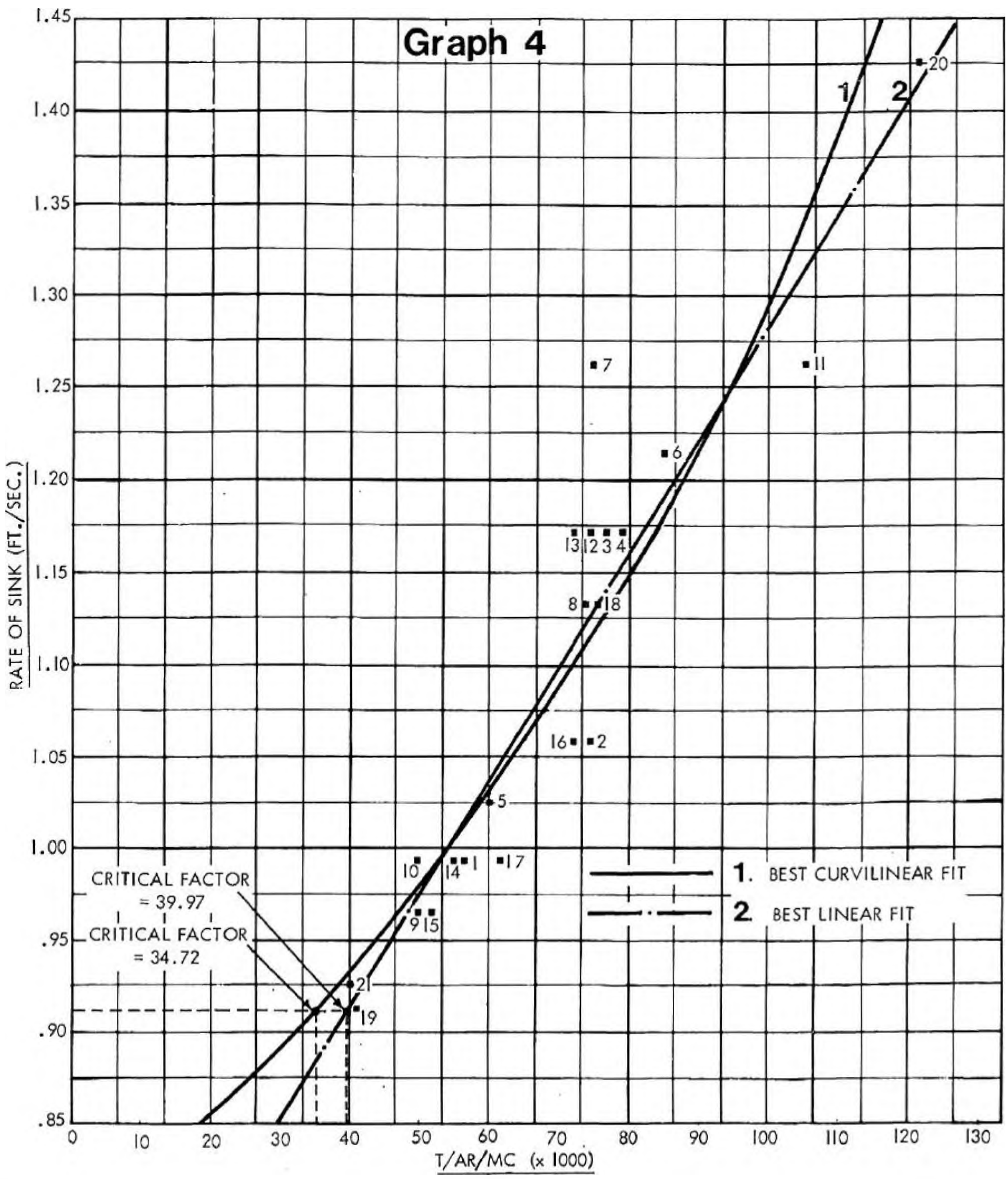


marked fashion. Therefore, we can surmise that the Position of Mean Camber has a small effect upon Rate of Sink, when used in conjunction with the other two variables (Thickness and Mean Camber). However, as previously stated, *Position* of Mean Camber *alone*, has no discernible effect. More detail on the relationship between Mean Camber and position of Mean Camber will be discussed later.

At this stage, we had now analysed all parameters of the airfoil proper. Therefore, the last remaining parameter affecting Rate of Sink was Aspect Ratio.

Aspect Ratio

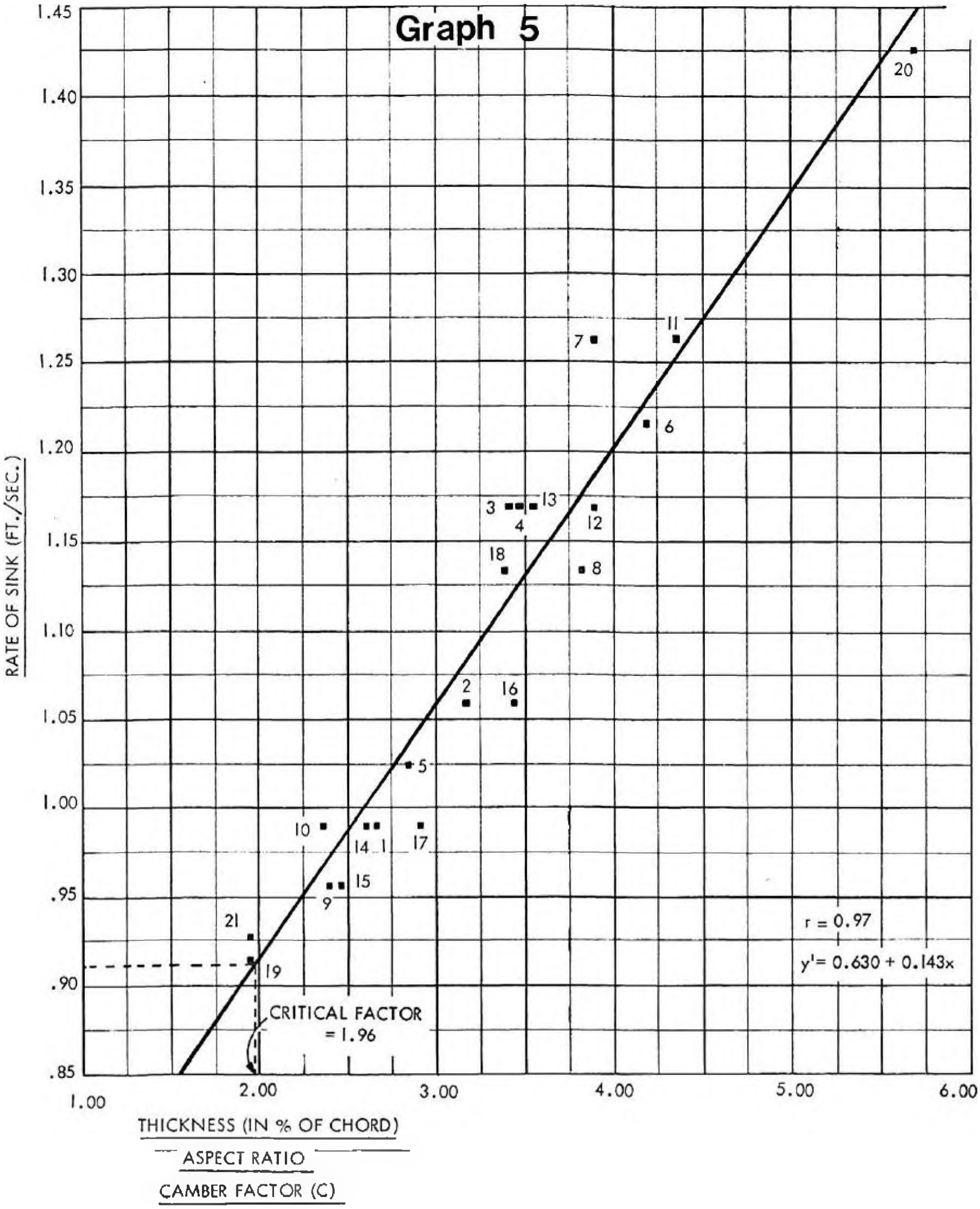
Graph No. 4 is a plot of the Thickness ÷ Aspect Ratio ÷ Mean Camber (Column 7, Table I) against Rate of Sink. The relationship has now become even more significant with a correlation coefficient of 0·94. This graph can be



used with confidence in its accuracy if one wishes to avoid the added complications of the following graph.

At this point we again introduced the Camber Factor (C), and the final results obtained are plotted in Graph No. 5 (Column 10, Table I). This latter plot indicates a correlation coefficient of 0·97, which is quite statistically significant. It can be seen that Aspect Ratio has a pronounced effect upon the Rate of Sink. Therefore, we decided to use Graph No. 5 for our final conclusions.

It can now be seen that knowing the airfoil parameters and Aspect Ratio of any given design, a very quick and fairly accurate appraisal can be made of its potential "still air" Rate of Sink, in the design stage. This assumes that one will be using a section already in use and therefore the only variable that could be designed for is the Aspect Ratio. However, if one should desire to design his own section, then the formula will enable him to calculate the parameters necessary to achieve any desired Rate of Sink.



From Graph No. 5 it can be seen that the Critical Factor (K) necessary to achieve a Rate of Sink of 0·911 ft./sec. (i.e. 180 sec. duration) is 1·96. The formula necessary to arrive at this value is as follows:

$$\frac{\frac{T}{A/R}}{C} = K$$

where T = Thickness (% of chord); A/R = Aspect Ratio; C = Camber Factor; K = Critical Factor.

For example, take Sample Glider No. 10, and substitute values in formula as follows:

$$\frac{\frac{6{\cdot}5}{16{\cdot}9}}{0{\cdot}16} = 2{\cdot}40$$

Now, substitute this Critical Factor of 2·40 for (x) into the following linear regression equation to determine theoretical Rate of Sink:

$y' = 0{\cdot}630 + 0{\cdot}143x$ where y' = Rate of Sink (ft./sec.)

Therefore, $y' = 0{\cdot}630 + 0{\cdot}143\ (2.40)$

$y' = 0{\cdot}973$ ft./sec.

Now convert Rate of Sink into duration as follows:

$$\frac{164}{y'} = \text{Duration (seconds)}$$

or

$$\frac{164}{0{\cdot}973} = 168 \text{ seconds (theoretical)}$$

From the *actual* flight data, the Rate of Sink is 0·994 ft./sec., and the duration is 165 seconds. (See Columns 9 and 8, respectively, Table I.) Rate of Sink (y′) may be determined directly from Graph No. 5 by simply reading off the value for a Critical Factor of 2·40, which is 0·973 ft./sec.

The following table compares the *predicted* duration of the sample gliders with the *actual observed* durations. A Chi-Square test on the predicted values indicates a very high degree of statistical significance. This is indicated by the small degree of variance between predicted and observed values in most cases. Note that the mean predicted and the mean observed, for all gliders, are practically identical.

Glider No.	*Predicted duration (seconds)*	*Observed average duration (seconds)*
1	163	165
2	151	155
3	146	140
4	146	140
5	159	160
6	133	135
7	138	130
8	140	145
9	168	170
10	168	165
11	131	130
12	138	140
13	145	140
14	164	165
15	167	170
16	146	155
17	157	165
18	147	145
19	181	180
20	114	115
21	180	177
Mean, all Gliders	151·5	151·8

A note should be made here for those who may wish to design their own airfoil section in conjunction with the formula. The formula will not enable one to determine an exact value for Thickness and Mean Camber/Location of Mean Camber and Aspect Ratio variables, but certain limits for both can be laid down within which these values should fall.

Referring back to the previous example of Glider No. 10, we saw that:

$$\frac{\frac{\text{Thickness}}{\text{Aspect Ratio}}}{\text{Camber Factor}} = \frac{\frac{6\cdot5}{16\cdot9}}{\cdot16} = 2\cdot40$$

(Bear in mind that we are trying to lower our Critical Factor value from 2·40 in order to achieve optimum Rate of Sink of 0·911 ft./sec.) Therefore, let us analyse each variable separately. In regards to *Thickness* alone, it can be readily seen that decreasing same (say from 6·5% to 6%) and maintaining the other variables constant (namely Aspect Ratio at 16·9, and Camber Factor at ·16), we will be able to decrease the Critical Factor to 2·22. Also, as previously mentioned, we should stay within Thickness limits of 5·5% to 6·5%.

Next, let us keep Thickness and Aspect Ratio variables constant, and change the value for Camber Factor. *Increasing* this value will also lower our Critical Factor, and correspondingly, our Rate of Sink. However, an analysis of the two variables composing the Camber Factor (namely, Mean Camber and Location of same) should be done first. The limits for Mean Camber, for high performance gliders should be in the order of 7% to 8%, and prefereably within the narrower region of 7·5% to 8%. We know that lift increases with increasing Mean Camber, but also so does drag. In addition, Mean Camber should be examined along with Location of same, as the two are interrelated, and both also have a definite effect upon the stability factor. In other words, we know that increasing Mean Camber, and moving the Location of Mean Camber *rearward* we increase Centre of Pressure travel. We also know that, conversely, a reduction in Mean Camber or a shift of Location forward, enables us to use less tailplane area to control Centre of Pressure Travel. Since we are designing for high performance, by necessity our tailplane area should be kept to a minimum (say 65 sq. in.). This means that out Mean Camber should not exceed 8%, and our Location of same should be kept as far forward as possible. The following table will serve to illustrate these points (see also Appendix II).

Camber Factor=0·16		*Camber Factor=0·17*		*Camber Factor=0·18*		*Camber Factor=0·20*	
Mean Camber	*Location of Mean Camber*	*Mean Camber*	*Location of Mean Camber*	*Mean Camber*	*Location of Mean Camber*	*Mean Camber*	*Location of Mean Camber*
7·5%	44%	7·9%	44%	8·2%	44%	9·2%	44%
6·9%	50%	7·3%	50%	7·7%	50%	8·6%	50%
6·1%	60%	6·4%	60%	6·7%	60%	7·4%	60%

The present limits for high performance gliders, for Location of Mean Camber fall between 40% and 45%. Referring back to our example of Glider No. 10, we see that the present Mean Camber is 7·62%, located at 41%. It has

been previously stated that *increasing* the Camber Factor will lower our Rate of Sink. Therefore, if we increase our Camber Factor from 0·16 to say 0·17, and maintain our location at 41%, then this change will require an increase in Mean Camber to approximately 8·25%. However, since we have set the upper limit at 8%, then the only change open to us is to move the Location rearward to say 44%. Generally speaking, the above table shows that maintaining Location constant and increasing Camber Factor, requires an increase in Mean Camber. Therefore, once again referring to Glider No. 10, we are limited in the amount that we can increase the Camber Factor to. In this case, an increase to 0·17 from 0·16. A higher value than 0·17 would require an extreme increase in Mean Camber to above 8%, which, of course, is detrimental to our requirements.

Let us now examine the effect of change of Aspect Ratio, and keep Thickness and Camber Factor constant. Naturally, *increasing* Aspect Ratio will *decrease* our Critical Factor, and thus also our Rate of Sink. The following table indicates the Aspect Ratio that would be required to achieve 180 seconds duration (i.e. Rate of Sink of 0·911 ft./sec.) with each of the sample gliders, if the parameters of Thickness and Camber Factor remained as they presently are in Columns 2 and 6 of Table I.

e.g. Glider No. 1:

$$\frac{\frac{\text{Thickness}}{\text{Aspect Ratio}}}{\text{Camber Factor}} = \frac{\frac{6 \cdot 1}{x}}{0 \cdot 17} = 1 \cdot 96$$

where x = Aspect Ratio and 1·96 = Critical Factor (K) for 0·911 ft./sec.

$$\therefore x = 18 \cdot 3$$

Glider No.	Aspect Ratio required	Glider No.	Aspect ratio required
1	18·3	12	23·8
2	21·9	13	25·1
3	23·3	14	19·0
4	27·6	15	19·7
5	18·5	16	20·4
6	28·3	17	21·3
7	24·9	18	23·3
8	25·1	19	17·9
9	19·7	20	31·4
10	20·7	21	19·8
11	24·5		

As can be clearly seen, and for the majority of the above gliders, an increase in Aspect Ratio to the magnitude shown, in order to achieve 0·911 ft./sec. Rate of Sink, would not be feasible. This can be traced back to the fact that there is usually an incorrect mix of Thickness and Camber Factor parameters. Referring to Columns 2 and 3 of Table I, it can be seen that for the majority of cases, Thickness alone is usually too high a percentage, Mean Camber alone is too low (or Location of Mean Camber is too far back), or it can be a combination of all parameters. Therefore, a redesign of the section or a new section would be required, and as mentioned previously, this would call for a decrease of Thickness, increase of Mean Camber, re-Location forward of Mean Camber, or a combination of all. It would now be found that having done this, the Aspect

Ratio increase required to achieve 0·911 ft./sec. would be appreciably reduced. e.g. Glider No. 10:

(*a*) Present parameters: $\dfrac{\dfrac{6{\cdot}5\ (T)}{16{\cdot}9\ (A/R)}}{{\cdot}16\ (C)} = 2{\cdot}40$ (Critical Factor)

— Present Aspect Ratio required for 0·911 ft./sec. (see above Table =20·7.

(*b*) With redesigned parameters of Thickness and Camber Factor:

$\dfrac{\dfrac{6{\cdot}0}{A/R}}{{\cdot}17} = 1{\cdot}96$ where ·17 = 8% Mean Camber at 44%

∴ A/R required would now be = 18·0

Aspect Ratio may be varied to suit the type of glider envisioned, whether it be of the "still air" or "storm" type. Bear in mind that when decreasing the chord to below 6 in., one may find that the particular airfoil may operate sub-critically at this low Reynolds Number range, and thus lift may suffer drastically. This is not to say that a 6 in. chord is the dividing line, as many sections operate efficiently at chord widths less than this.

The following is a suggested initial framework for the parameters for high performance gliders:

1. *Thickness*—should be kept to between 5·5% to 6·5%.
2. *Mean Camber*—should be limited to between 7·2% to 8%.
3. *Location of Mean Camber*—should be between 39% to 45%.
4. *Aspect Ratio*—in excess of 15·1, but for 180 seconds duration and over, at least 20 : 1.

Summary

The study of full size airfoils and aircraft performance methods, although providing some insight into the characteristics important to A-2 performance, has only limited applicability to the fact that Reynolds No. effects and lack of suitable research data make direct analysis impossible. However, some valid points can be made, based upon such experience, i.e.

1. Airfoil stall properties and C_L–C_D relationships depend upon many *interrelated* parameters, including:

(*a*) nose radius
(*b*) trailing edge angle
(*c*) thickness close to the nose (say t/c 5%)
(*d*) chordwise position of the maximum value of and actual shape of the camber line
(*e*) the thickness distribution, maximum value and chordwise location
(*f*) Reynolds number
(*g*) surface finish.

2. The wing/airfoil parameter relationships as derived from our data reflect their association with duration, which in this case is an "overall" performance figure. Therefore, the predicted durations are susceptible to a certain amount of variation. Only by carrying out a controlled test would one possibly be able to extricate and isolate parameter relationships that would be relatively

unsusceptible to variance. The following could be one proposed method for predicting A-2 performance. A rigorous analysis for deriving airfoil characteristics from flight test would:

(*a*) change only the airfoil section at fixed aspect ratio, with the remainder of the model geometry held constant
(*b*) have a uniform type of structure for each wing section
(*c*) test the models in a controlled fashion (i.e. hangar tests, catapult launch, with speed and rate of sink defined to 1–2%
(*d*) tests for various aspect ratios would be a problem as ideally the models should have similar longitudinal stability and this would involve varying tail arm/area in some fashion.

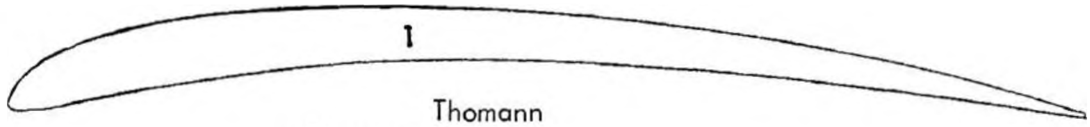
Thus the above defined controlled test and the obvious complex interrelationships involved in the minimum rate of sink of an aircraft suggest some possible shortcomings of our results:

(*a*) Rate of sink is a derived quantity (not directly measurable), and assumes full line height and release at glide conditions. Of course, depending on the material structure of the line, the length may be far short of 164 ft.
(*b*) The variance in model proportions, tail area, tail arm, model cleanliness, type of wing structure (tissue sag versus a sheet surface or spar protrusion) indicates that the effects of airfoil geometry would be difficult to extricate.
(*c*) The Camber Factor as originally derived by Beuermann* probably related to longitudinal stability as well as to airfoil performance, hence including it directly in any performance only equation could be questionable. Tail geometry changes should enable similar stability characteristics to be achieved with (almost) any airfoil.

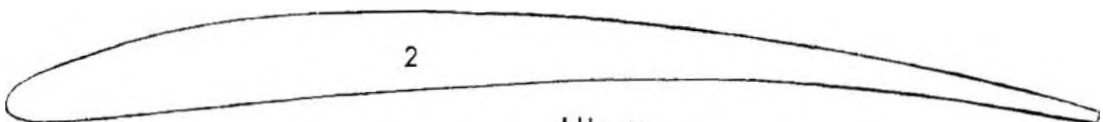
Possibly we have established a trend rather than an absolute relationship, and only further controlled tests will provide the answer. However, the formula is very encouraging in its high accuracy of predictability, and thus perhaps, for the ordinary glider builder, its use would be sufficient for his purposes in the design stages. It is our opinion that empirical methods will always supercede the pure theoretical work in the model glider field, due to the high tolerances associated with model gliders *per se*.

* Aeromodeller Annual 1961-62

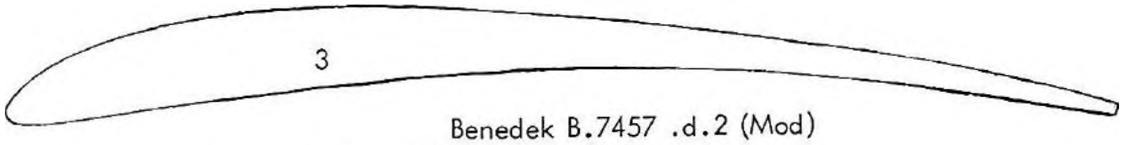
APPENDIX 1 Airfoils used in tests



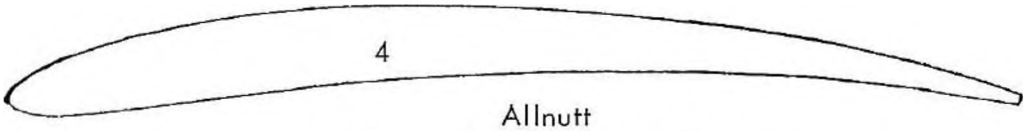
Thomann
Thomann "Aquila"



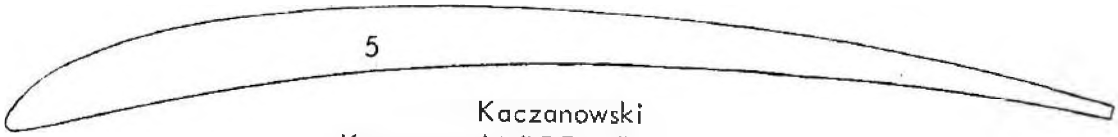
Allnutt
Allnutt "Arabesque No. 6"



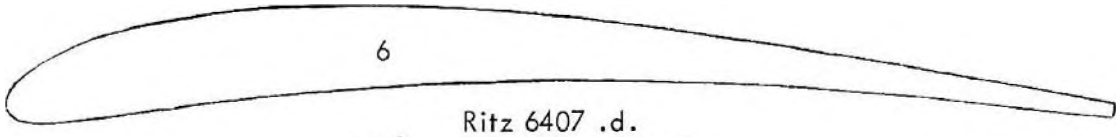
Benedek B.7457 .d.2 (Mod)
Allnutt "Adagio Mk.III"



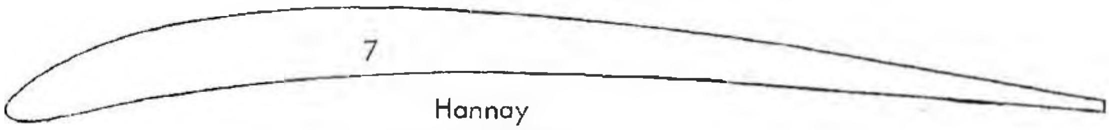
Allnutt
Allnutt "Arabesque No. 7"



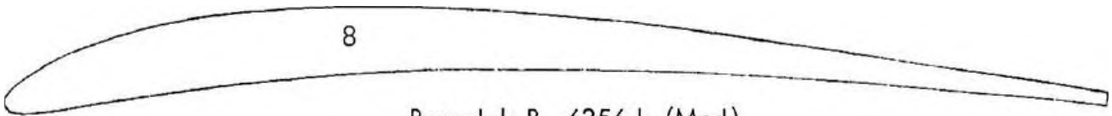
Kaczanowski
Kaczanowski "GF-6"



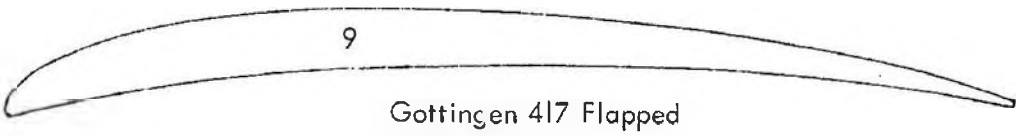
Ritz 6407 .d.
Allnutt "Arabesque No. 9"



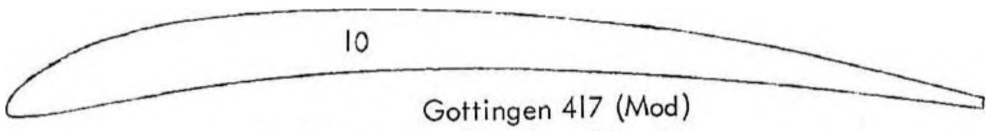
Hannay
Thompson "Bosco"



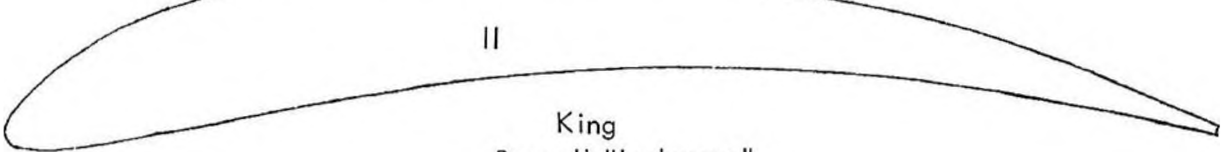
Benedek B. 6356 b (Mod)
Allnutt "Arabesque No. 2"



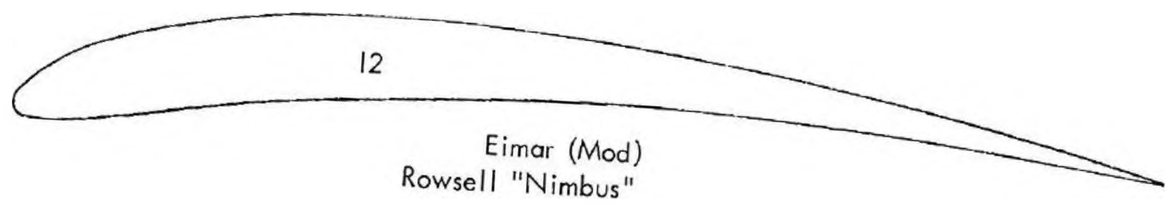
Gottingen 417 Flapped
Thomson "Firebird"



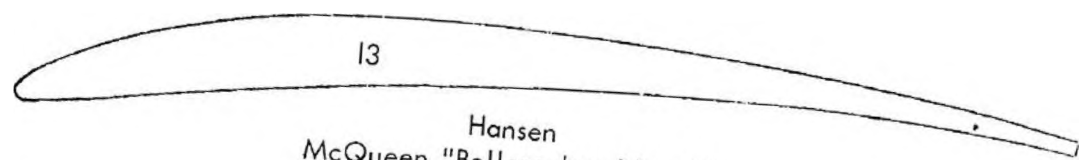
Gottingen 417 (Mod)
McQueen "Bellerophon No. 6"



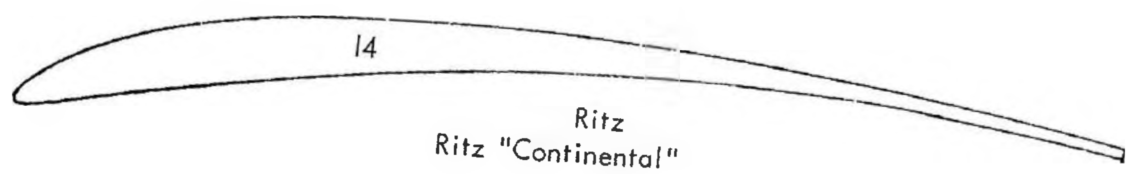
King
Rowsell "Inchworm"



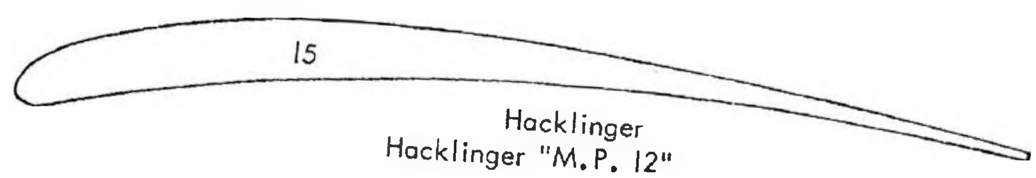
12
Eimar (Mod)
Rowsell "Nimbus"



13
Hansen
McQueen "Bellerophon No. 5"

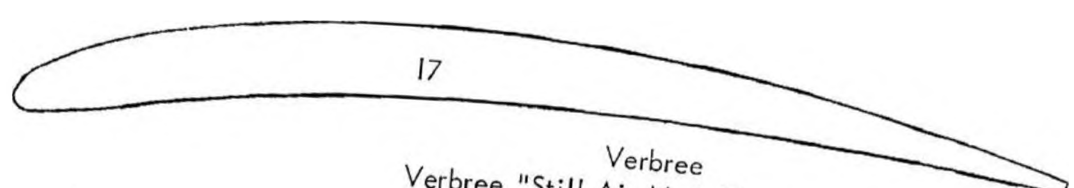


14
Ritz
Ritz "Continental"

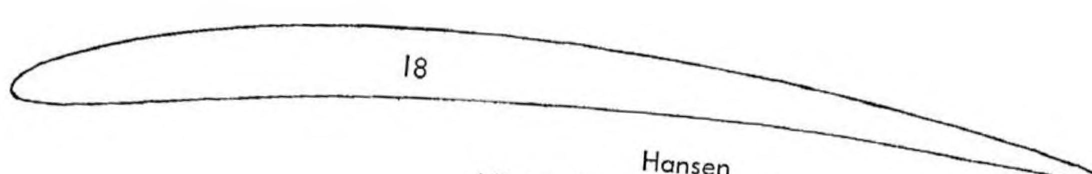


15
Hacklinger
Hacklinger "M.P. 12"

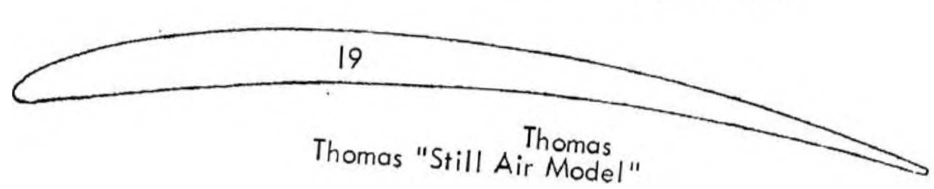
16
Gottingen 417 (Mod)
McQueen "Bellerophon No. 1"



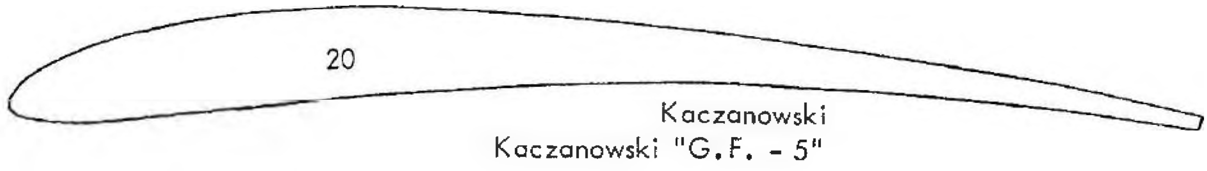
17
Verbree
Verbree "Still Air Model"

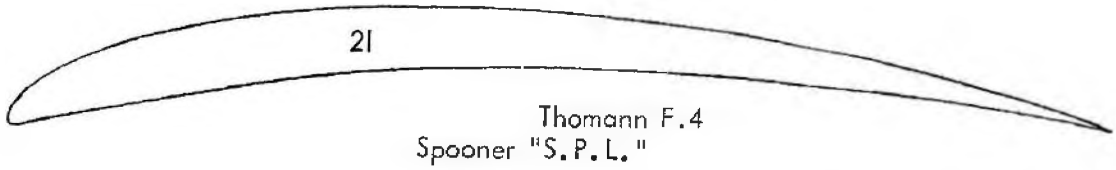


18
Hansen
Allnutt "Adagio Mk. II"

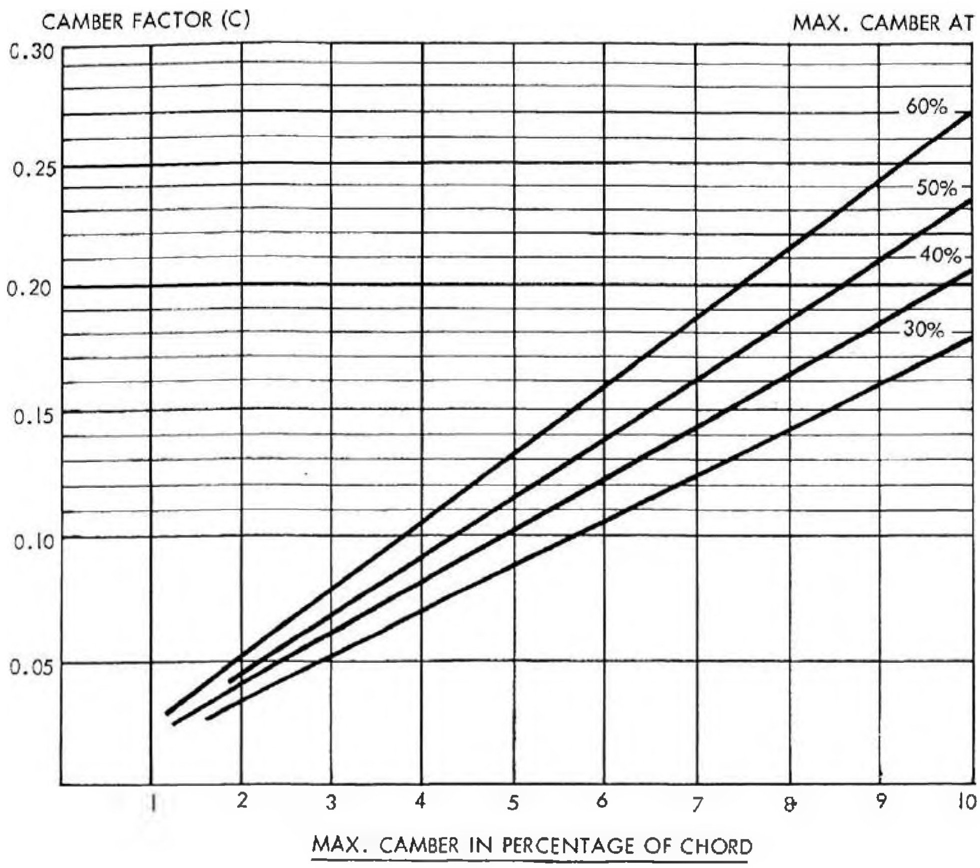


19
Thomas
Thomas "Still Air Model"





APPENDIX 2



APPENDIX 3

Description of Sample

A random sample of twenty-one A2 gliders was selected. Note was made of the basic parameters of the airfoil section used, along with the aspect ratio of the wing itself. It was especially desirable that well-flown machines be selected

for analysis, as the observation of each one's mean duration would be more accurately reflected by a series of observed times, thus tending to eliminate any bias that may have been present due to lift and downdraught. Of course, some bias will be present in the actual measurement of wing section parameters, but this will be statistically insignificant. Also, some bias is present in that the observed mean durations are rounded off to the nearest 5 sec.

All correlation coefficients (r) are indicated on the graphs and are significant at a level of probability of 95%. The F-Test for linearity indicates that a straight line fit for the data is quite representative, also at a 95% level. Finally, a Chi-Square Test on predicted and observed duration values is significant at a level of 99%.

The correlation coefficient of 0·97 for the final graph is less than perfect (1·00) due to several reasons. Other variables may still be missing from the final formula, and also the sample taken is quite small as compared to the universe of gliders. In addition, there are particularly detailed differences between gliders in construction, tail geometry and drag of parts other than the wing. It is unlikely that a larger sample taken would indicate an even higher correlation, unless similar models and construction were used. A larger sample would only present more statistically significant results.

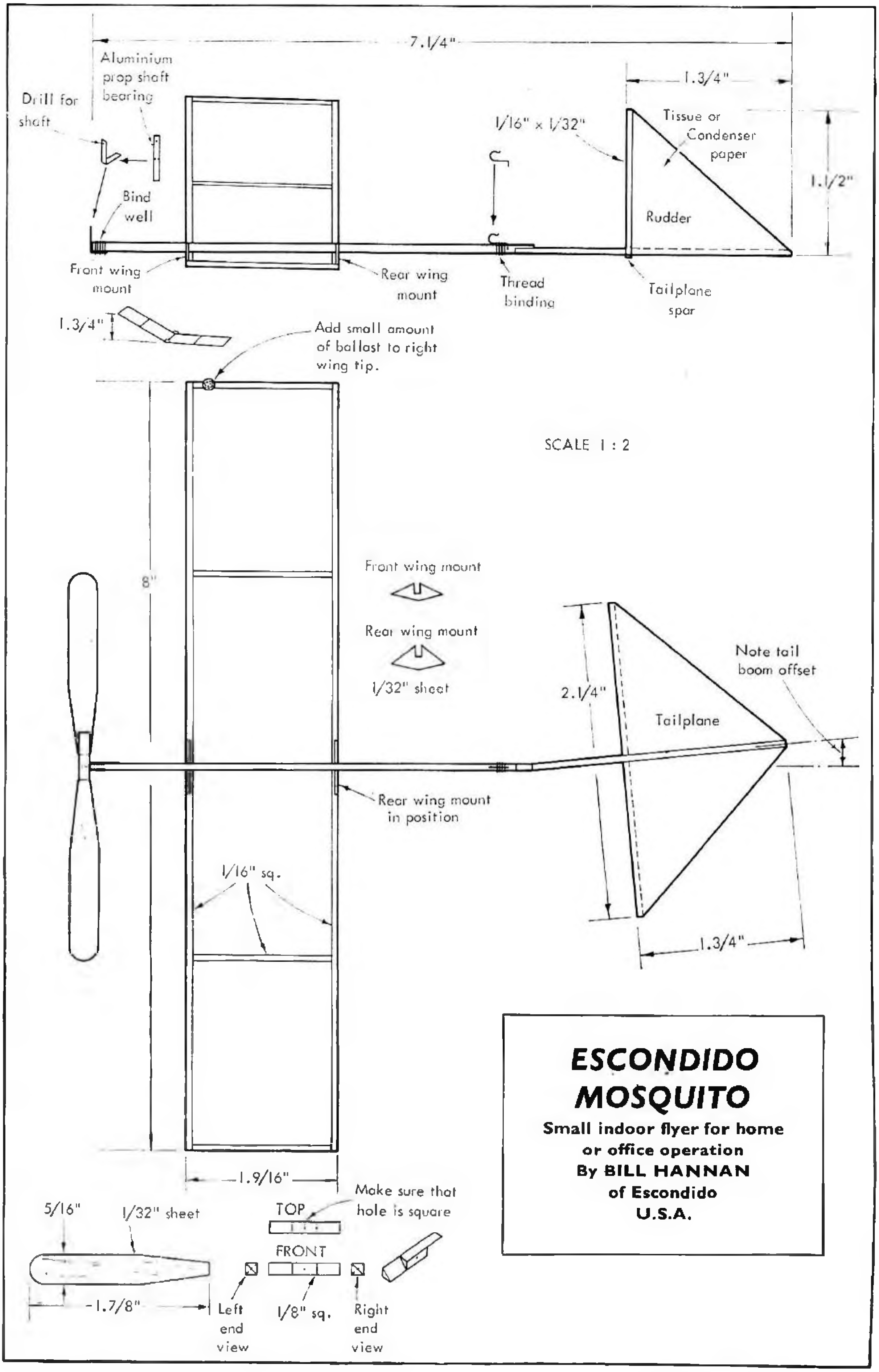
The *limits of prediction* on the *predicted* duration (or Rate of Sink) for the theoretical model are on the order of +7% at a level of 95% probability. In other words, with a Critical Factor of 1·96, the range for a Rate of Sink of 0·9111 ft./sec. is from 0·8465 to 0·9757 ft./sec. *For any given model,* the limits of prediction will vary from that denoted above according to the calculated Critical Factor for that given model.

TABLE 1

SUMMARY OF AIRFOIL PARAMETERS, ASPECT RATIO, AND THEIR DEGREE OF ASSOCIATION

No.	(1) Chord	(1) Thickness (% of chord)	(3) Mean Camber (% of chord)	(4) Position of Mean Camber (in %)	(5) Aspect Ratio	Ratio 2 : 3	(6) Camber Factor (C) 3/4	Ratio 2 : 6	(7) Duration (Average) (min./sec.)	(8) Rate of Sink (ft./sec.)	(9) Critical Factor (K) 2 : 5–6
1	5·9	6·1	8·00	40	13·6	0·76	·17	35·88	2·45	0·994	2·64
2	5·85	7·3	7·17	50	13·5	1·02	·17	42·94	2·35	1·058	3·18
3	6·0	7·3	7·17	45	13·2	1·02	·16	45·62	2·20	1·171	3·46
4	5·5	7·3	5·90	50	15·6	1·24	·135	54·07	2·20	1·171	3·47
5	6·0	6·17	8·00	42·7	12·9	0·77	·17	36·29	2·40	1·025	7·81
6	6·0	7·5	6·67	38·5	13·2	1·12	·135	55·56	2·15	1·215	4·21
7	6·0	6·5	6·84	35	12·6	0·95	·133	48·87	2·20	1·262	3·88
8	6·0	6·3	6·50	36·5	13·0	0·97	·128	49·22	2·25	1·131	3·79
9	5·5	5·8	7·26	40	16·0	0·80	·15	38·67	2·50	0·965	2·42
10	5·25	6·5	7·62	41	16·9	0·85	·16	40·62	2·45	0·994	2·40
11	6·5	12·5	10·60	52	11·1	1·18	·26	48·08	2·10	1·262	4·33
12	6·25	7·0	7·75	36	12·0	0·90	·15	46·67	2·20	1·171	3·89
13	5·8	6·9	6·78	41	14·1	1·02	·14	49·28	2·20	1·171	3·50
14	6·0	5·6	7·07	43	14·3	0·79	·15	38·62	2·45	0·994	2·61
15	5·5	6·0	7·28	42	15·8	0·82	·155	38·71	2·50	0·965	2·45
16	6·2	6·4	7·52	44	11·6	0·85	·16	40·00	2·35	1·058	3·45
17	5·8	6·9	7·65	42·5	14·5	0·90	·165	41·82	2·45	0·994	2·88
18	5·9	6·4	6·27	45	13·5	1·02	·14	45·71	2·25	1·131	3·37
19	5·0	5·6	7·50	42	18·0	0·75	·16	35·00	3·00	0·911	1·94
20	6·5	7·7	5·85	41·5	10·8	1·32	·125	61·60	1·55	1·426	5·70
21	4·72	6·2	7·90	38·8	19·8	0·78	·16	39·24	2·57	0·926	1·96

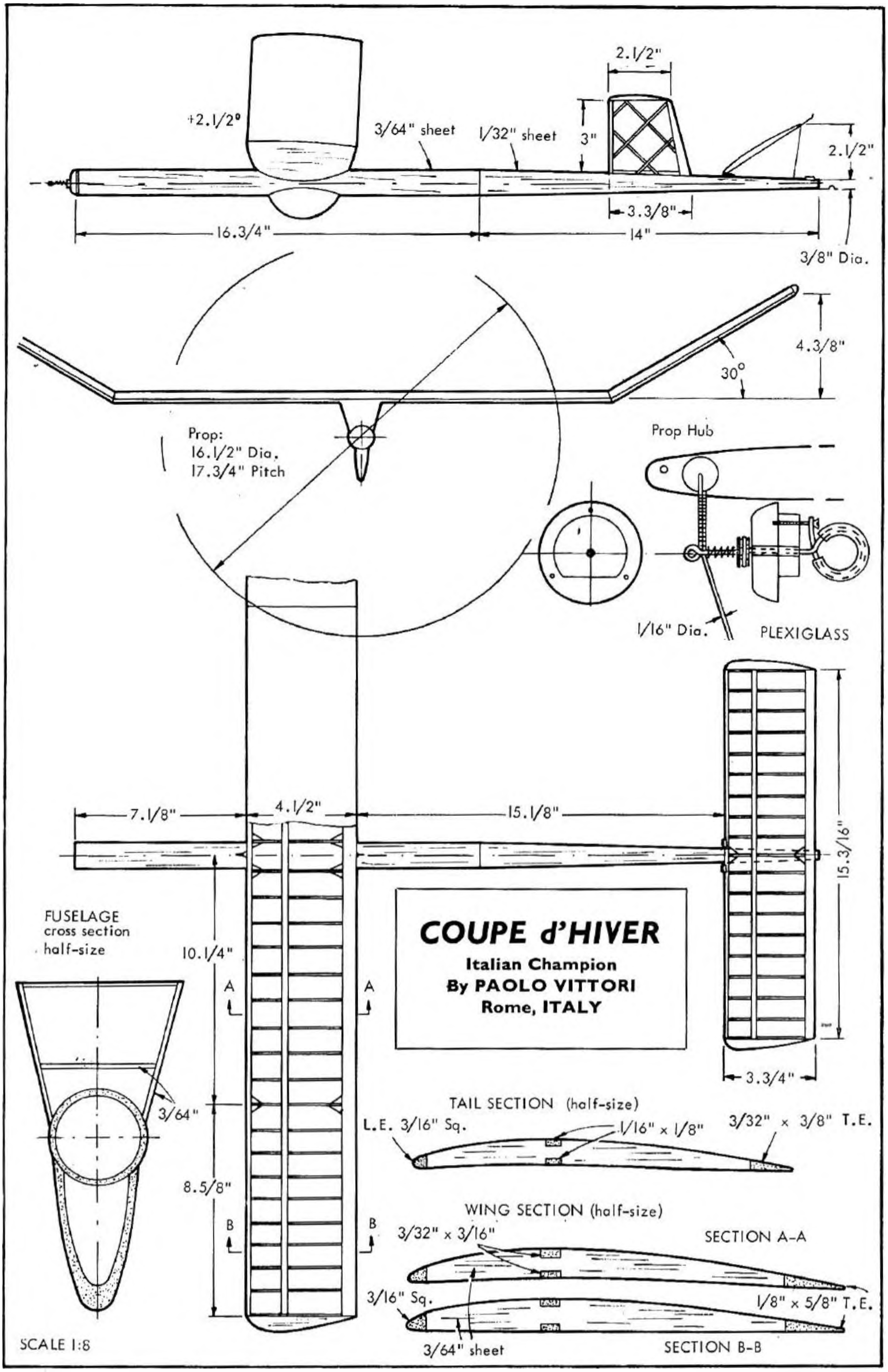
Mean Duration: 2·32 Median Duration: 2·35



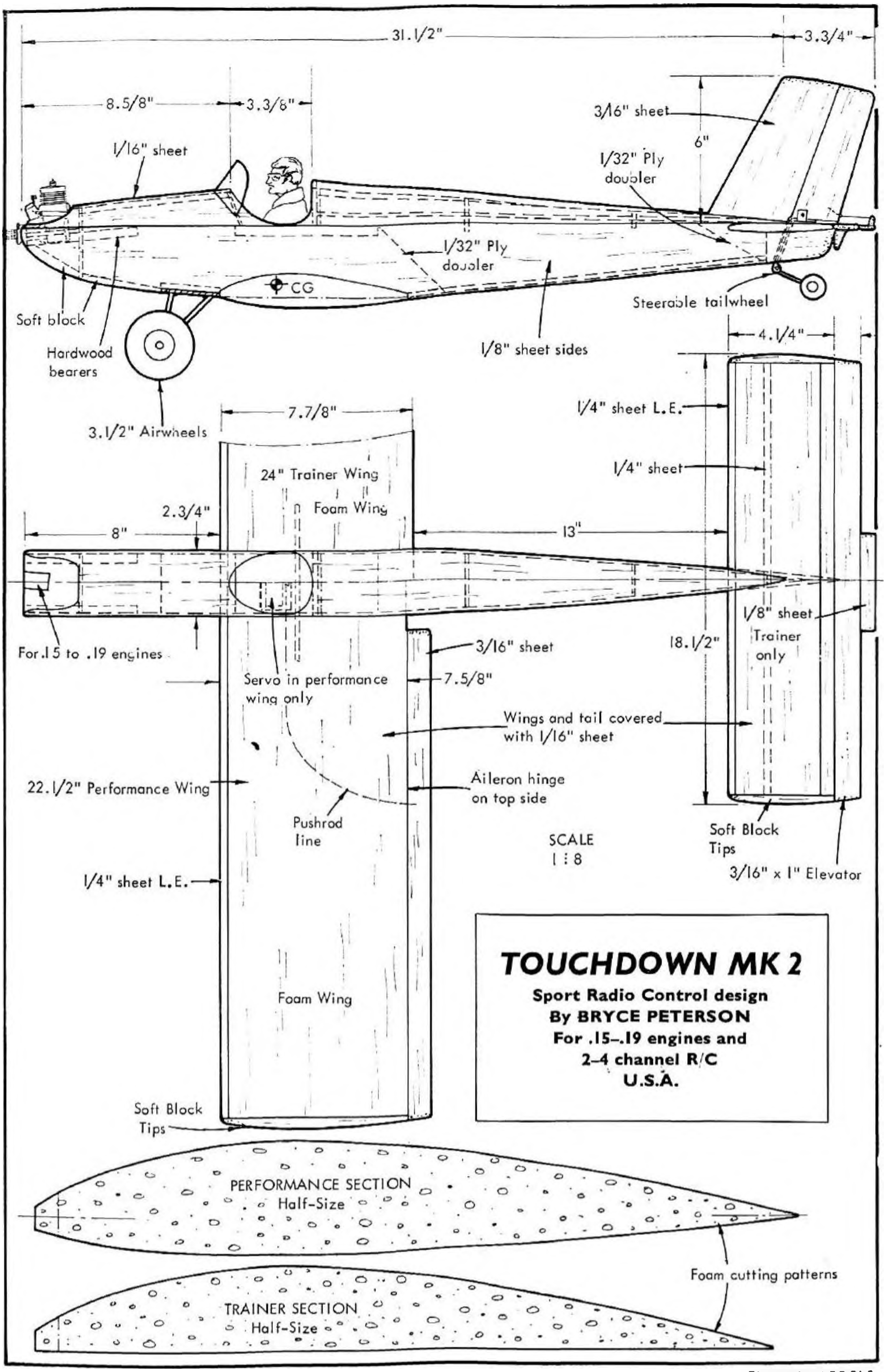
ESCONDIDO MOSQUITO

Small indoor flyer for home or office operation

By BILL HANNAN of Escondido U.S.A.



MODELLISTICA



FLYING MODELS

BLACKBURN AIRCRAFT (WELFARE) MODEL FLYING CLUB

The Display Team on home ground at Hawker Siddeley's Airfield at Brough, East Yorkshire.

THE BLACKBURN (WELFARE) M.A.C. DISPLAY TEAM

by Kelvin R. Poulton, Display Team Manager

FOR the past eleven years the Blackburn Aircraft M.A.C. have organised a model flying display team, which during this period have provided control line demonstrations before members of the public at most of the summer events held in the East Riding of Yorkshire.

From very simple beginnings the team has grown in both size and strength, until at present when we have an extremely popular organisation which can provide a varied and entertaining model flying display lasting approximately 45 minutes.

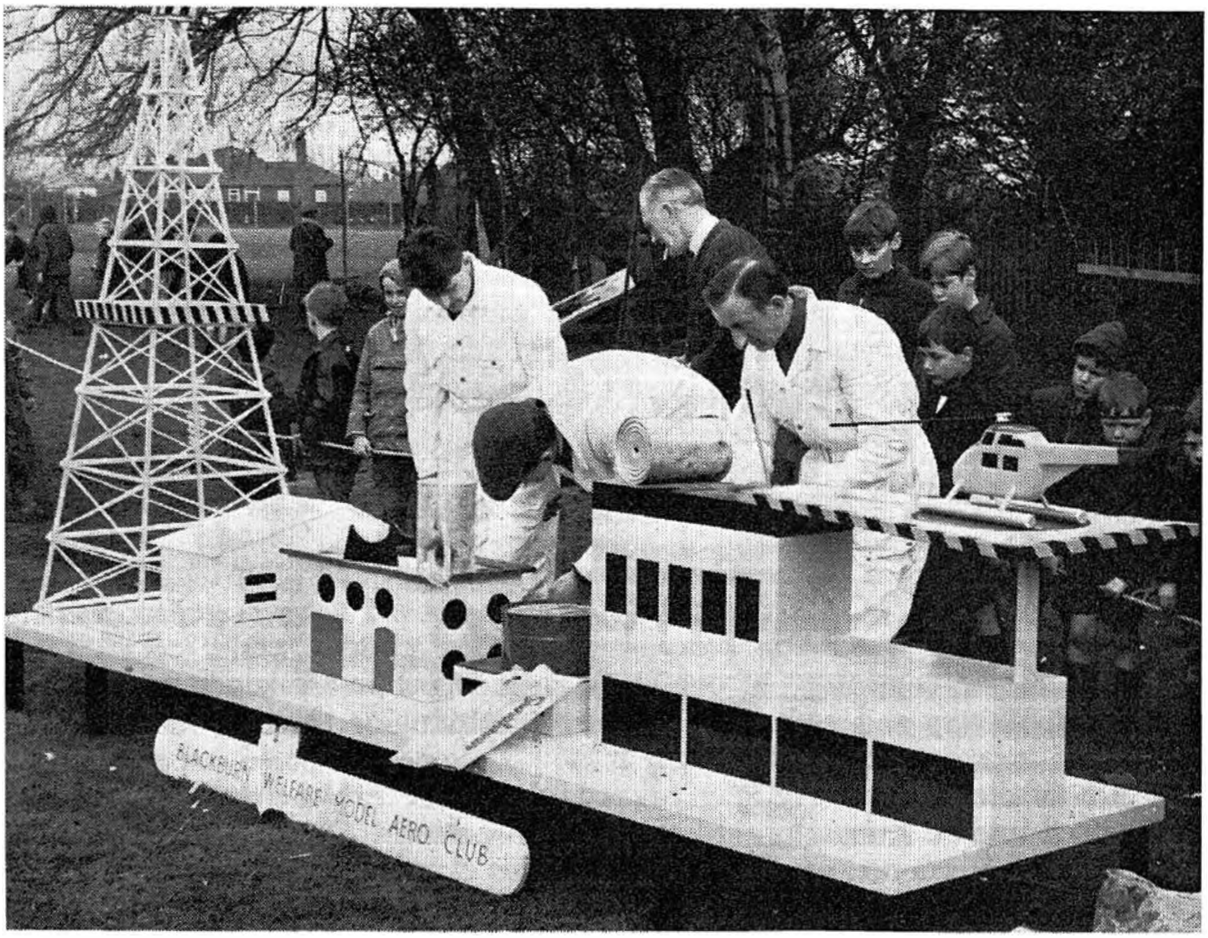
The current programme of our team calls for reliability of both members and their equipment, so as to fulfil the part that we have to play and the part that is expected of us. We try to look upon ourselves now not so much as a band of sports fliers, but out of necessity a team of "showmen". One might tend to look upon this strange expression applied to aeromodelling as a rather large-headed approach; but careful planning and consideration of audience response to each item of the display, results in the provision of what an audience will like.

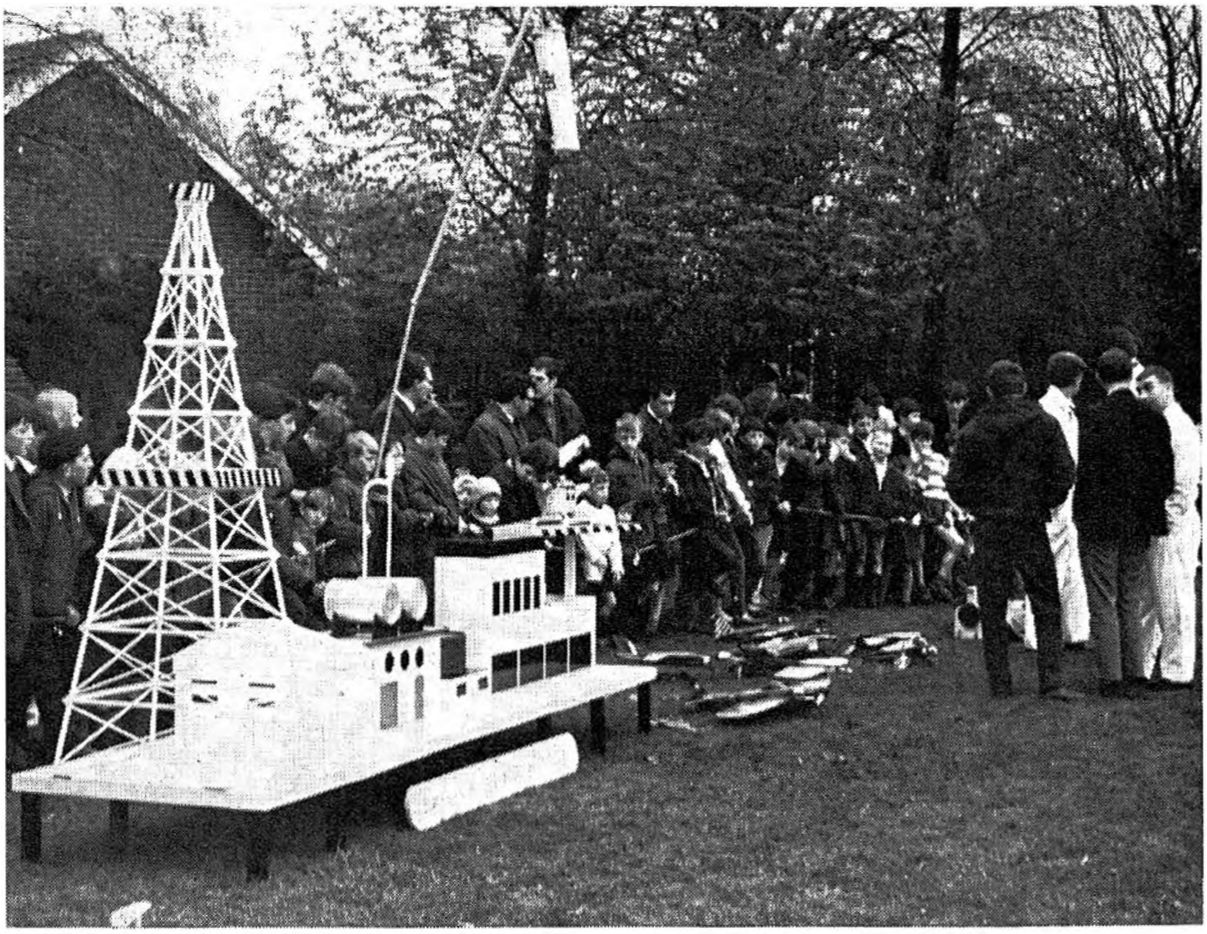
To obtain the maximum effect or appeal from a display, we have had to change our programming quite considerably. What is interesting to the budding aeromodeller could well prove extremely boring for the more uninitiated. The totally "uninformed" usually make up over 90% of the audience and they are almost certainly there to be entertained. To try and cater for their needs we have adopted a display pattern which not only gives them the excitement but also needs their participation. This is easily achieved with a public address system (usually on site) and a good man for the job. We are rather fortunate in having two such team members in Bob Kinroy and Pete Spence. Both are excellent at making the kids and dads, of course, cheer as our various items get under way.

Our programme opens up with balloon bursting and barrier crashing, the pilot, John Harrison, takes inspiration from the kid's cheers as he pops off his objectives, producing some very near misses into the process.

Rat racing runs at No. 2 in our display, here we have three "ratters" all coloured differently (for easy recognition) racing together for a duration of five

Team members "Banger" John Harrison, Chris Thurley, Pop Poulton and behind, Albert Hartley preparing the setpiece.





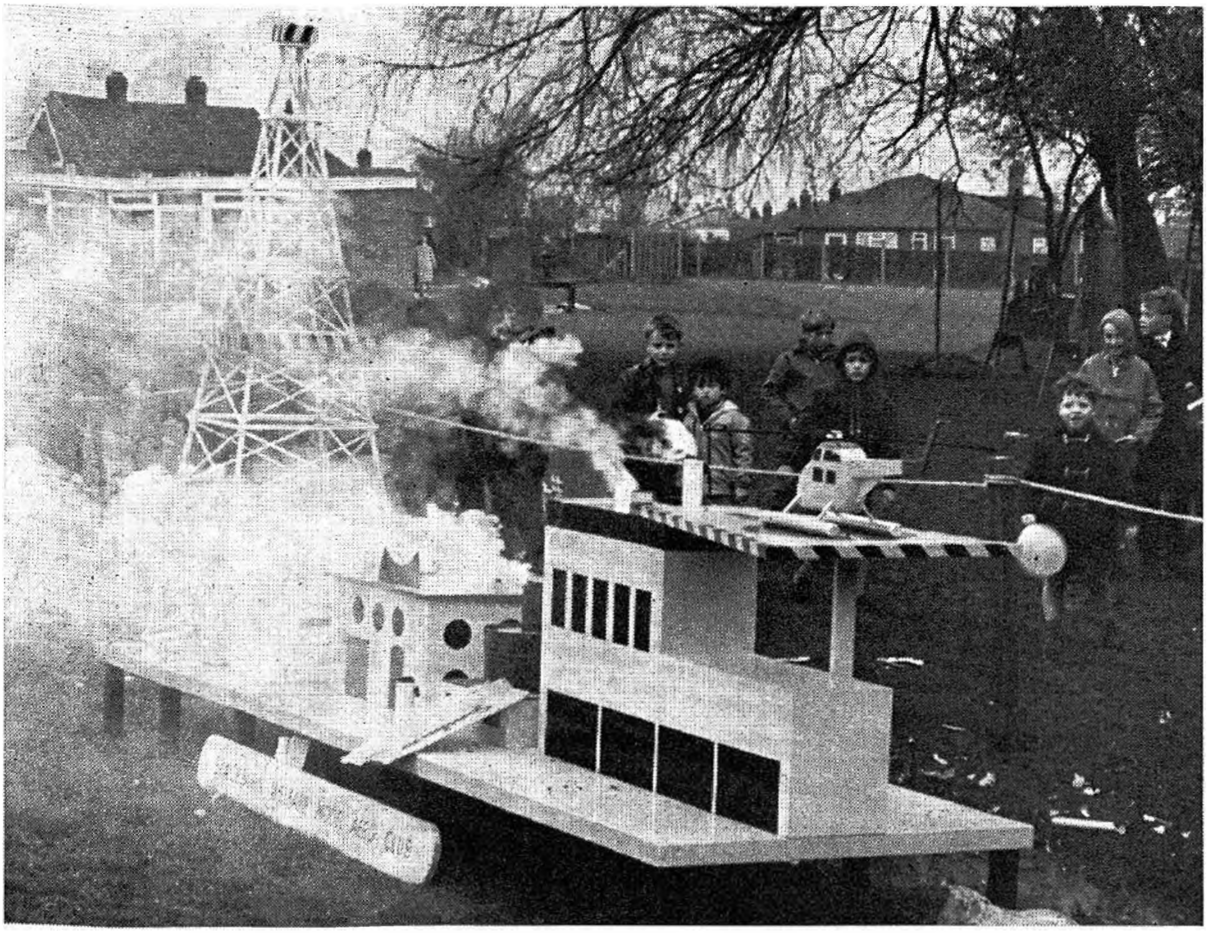
Everything ready for "off"—some of the team rehearse before the display begins.

minutes, covering as many laps as possible, not exactly to S.M.A.E. rules but better suited to our programme. The race is started "le Man" fashion and the audience usually help in the counting down, whilst also providing plenty of cheers for their particular favourite during the fast and furious pit stops. This item I'm sure must tend to bring out the gambling instincts of some of the spectators judging by the rather mixed remarks as the winner is announced.

From a very exciting fast-flying item we move to our next item which is aerobatics. This has been simplified somewhat and the emphasis is on very, very smooth manoeuvres with extremely low flying if conditions allow. We use only a basic flight pattern repeated several times (laymen tend to be confused with a full S.M.A.E. schedule). Using plenty of low, sharp, clean pullouts from wing-overs, the approach is very exciting to the spectator for there always seems a very good chance of a "prang".

Next the crown killer—Combat. We try to look upon this item as a "put up" job, it has to be, for competative combat is not only expensive but models never seem to be airborne for very long. This, of course, would create great problems in the continuity of our show so it is purposely kept tamed down somewhat. We try and make up for this by introducing three or four models, sometimes more, all flying together, it now becomes a comedy spot and the attention of the audience is drawn towards the pilots with their mass of twisted and locked bodies. Mortality rate of models is extremely low and the audience can be fully entertained for the duration of this event.

To wind up our model flying display we have what we call our "Set-



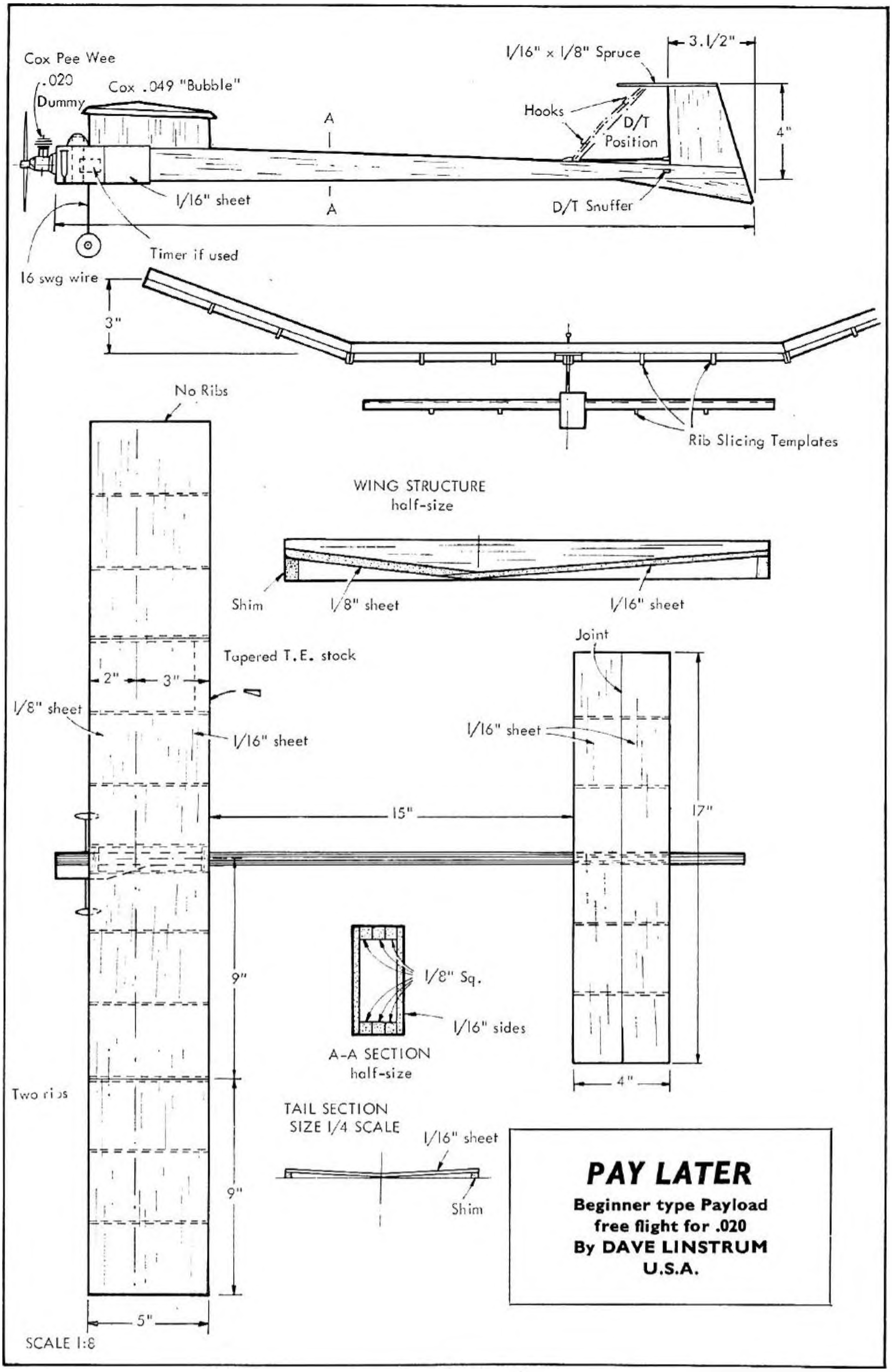
Set piece being attacked—halfway through the firework sequence.

Piece" item, this is a large model layout of an alien off-shore oil or gas drilling rig, which is completely blown apart by our attacking aircraft! Well, that is what we *like* the audience to think, actually all the bangs, flashes, smoke, etc., are provided by fireworks placed on and around the "set-piece" and electronically discharged from a master console unit some distance away. The explosions, of course, coincide exactly with the dive bombing attitude of the three attacking aircraft.

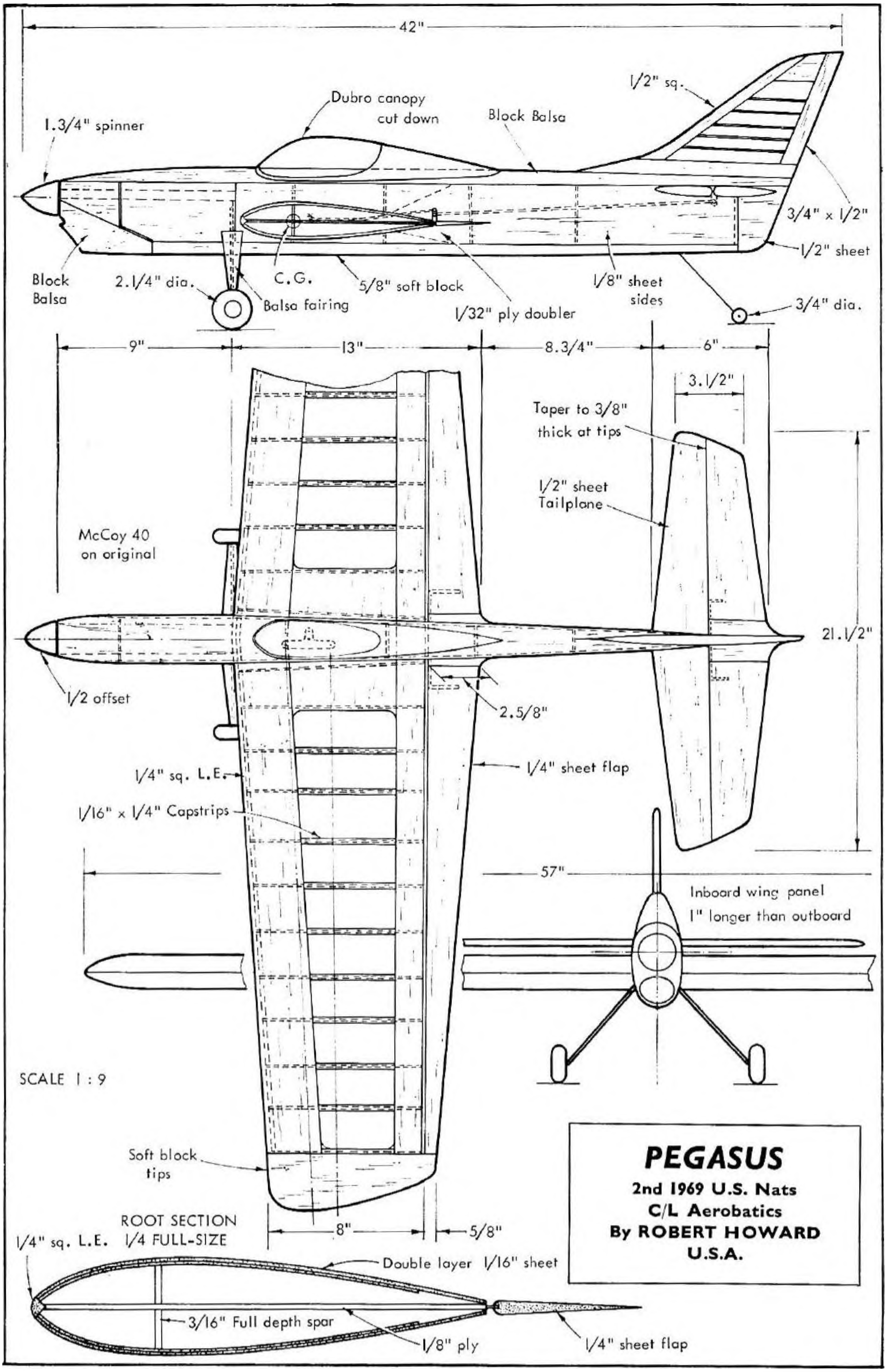
This event, with its approach to reality grips the attention of the audience and provides a final climax to our show.

In conclusion, the display programme that we now use at least eight times per season at different venues, is a culmination of years of hard work and research. Much thought is given to ways of seeking yet more ideas and gimmicks to improve our standard and presentation of displays. We try to put over our hobby to the general public in the way that they might appreciate it.

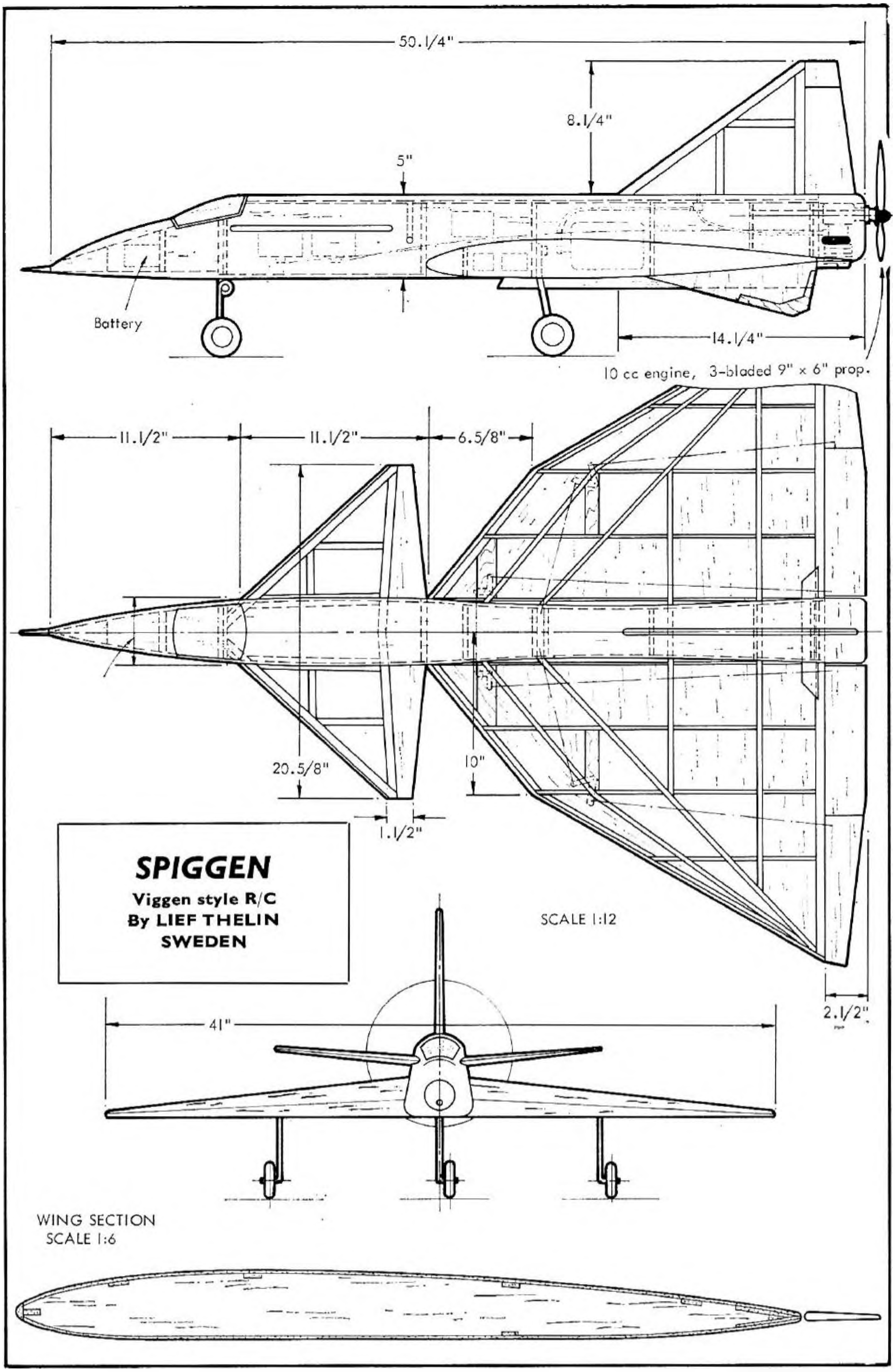
This not only gives us a feeling of satisfaction for a job well done but we know that in our own way we are helping to promote one of the greatest hobbies—Aeromodelling.



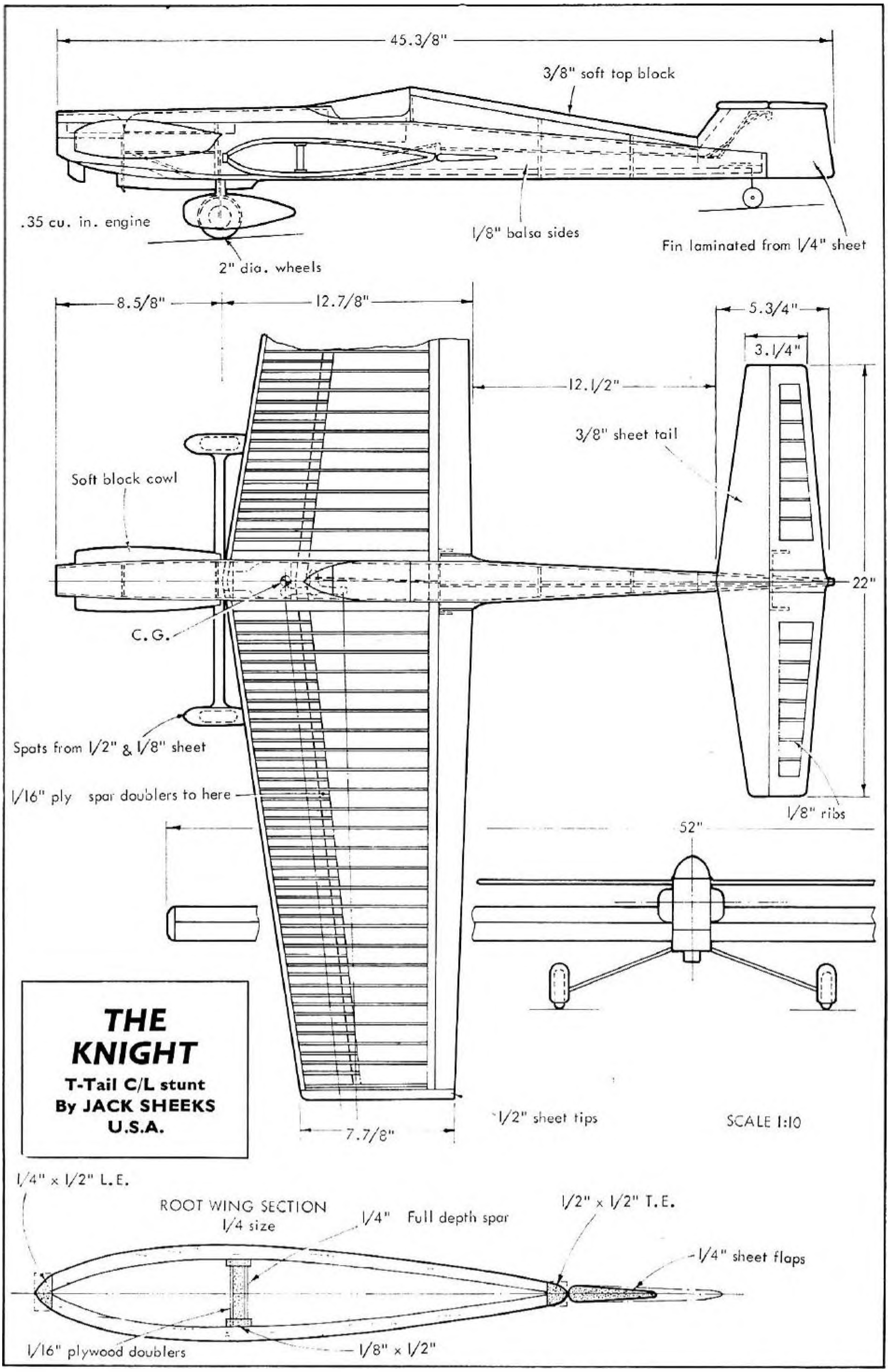
MODEL AIRPLANE NEWS

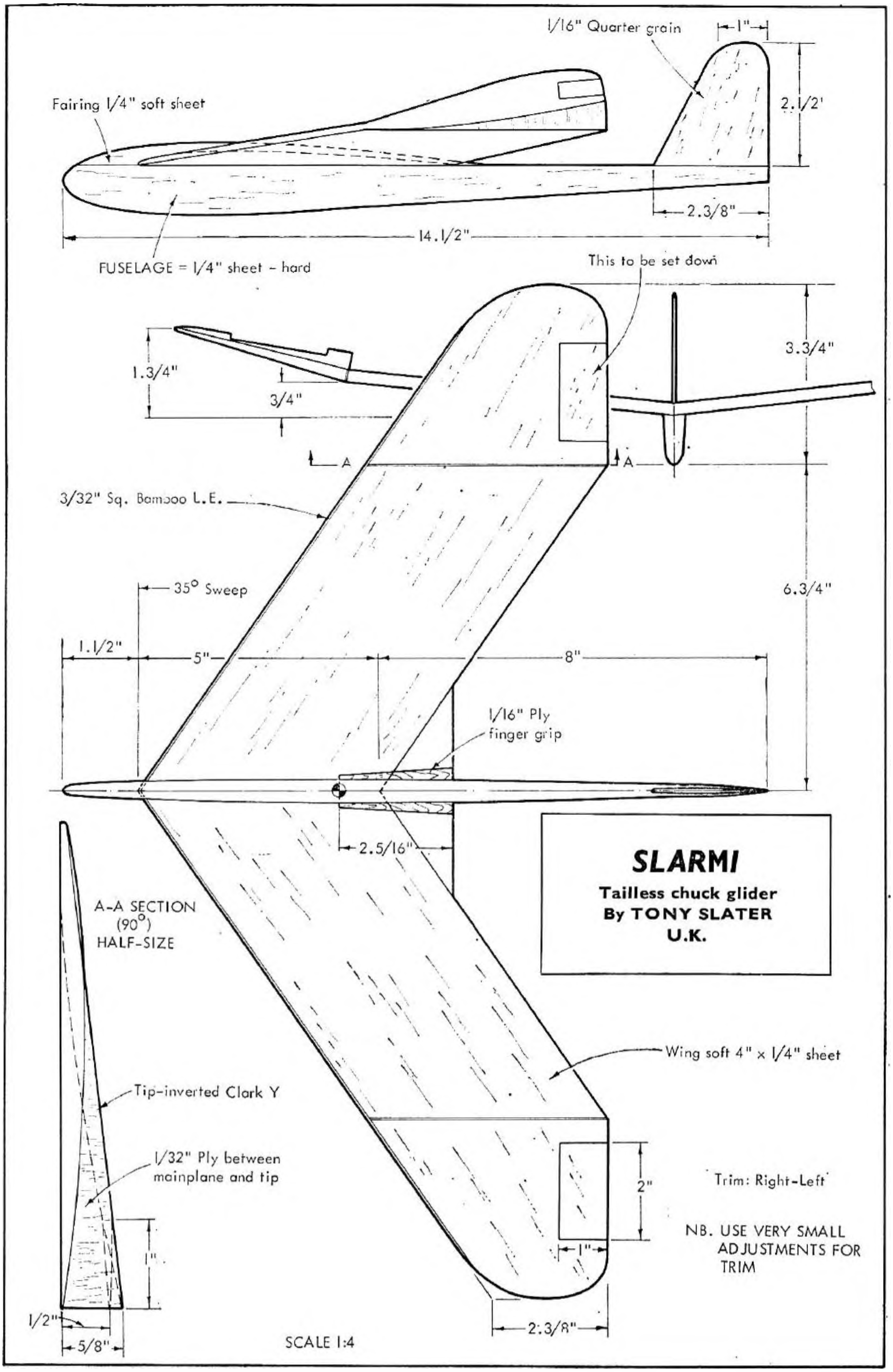


FLYING MODELS

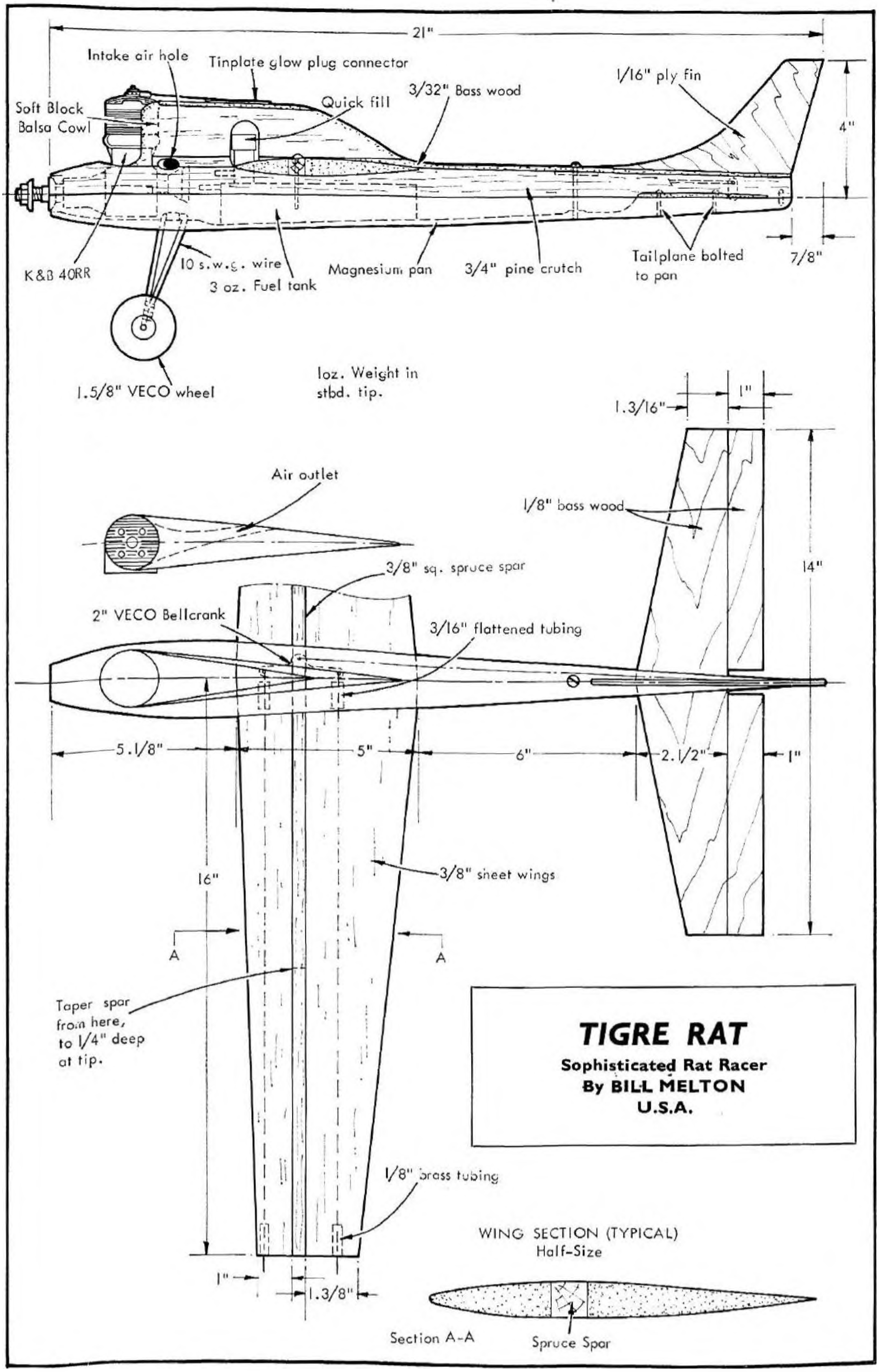


MODELL FLYGNYTT


45.3/8"
3/8" soft top block
.35 cu. in. engine
1/8" balsa sides
Fin laminated from 1/4" sheet
2" dia. wheels
8.5/8"
12.7/8"
5.3/4"
3.1/4"
12.1/2"
3/8" sheet tail
Soft block cowl
22"
C.G.
Spots from 1/2" & 1/8" sheet
1/16" ply spar doublers to here
1/8" ribs
52"
THE KNIGHT
T-Tail C/L stunt
By JACK SHEEKS
U.S.A.
1/2" sheet tips
SCALE 1:10
7.7/8"
1/4" x 1/2" L.E.
ROOT WING SECTION
1/4 size
1/4" Full depth spar
1/2" x 1/2" T.E.
1/4" sheet flaps
1/16" plywood doublers
1/8" x 1/2"



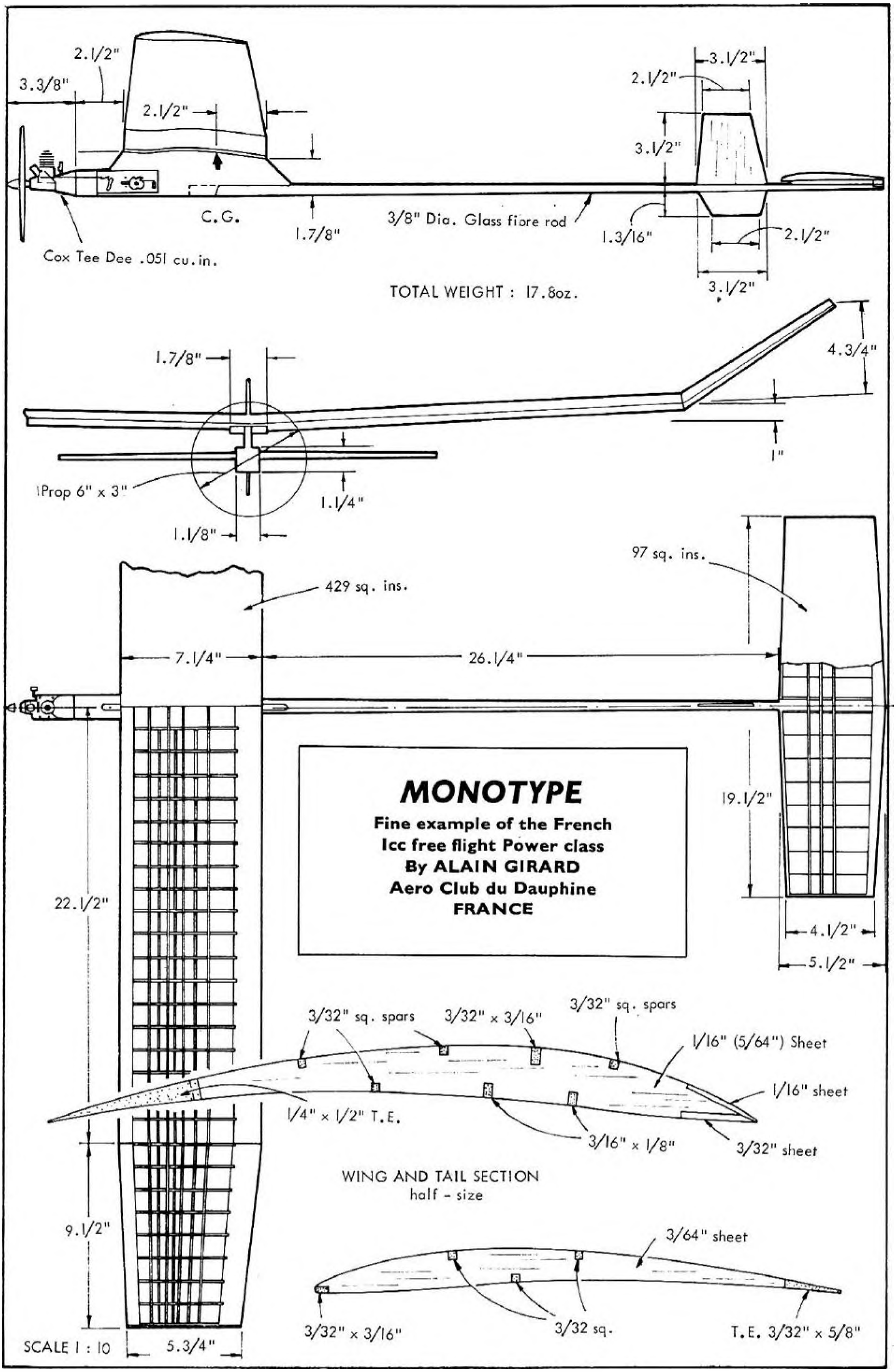
TAIL-LESS NEWS



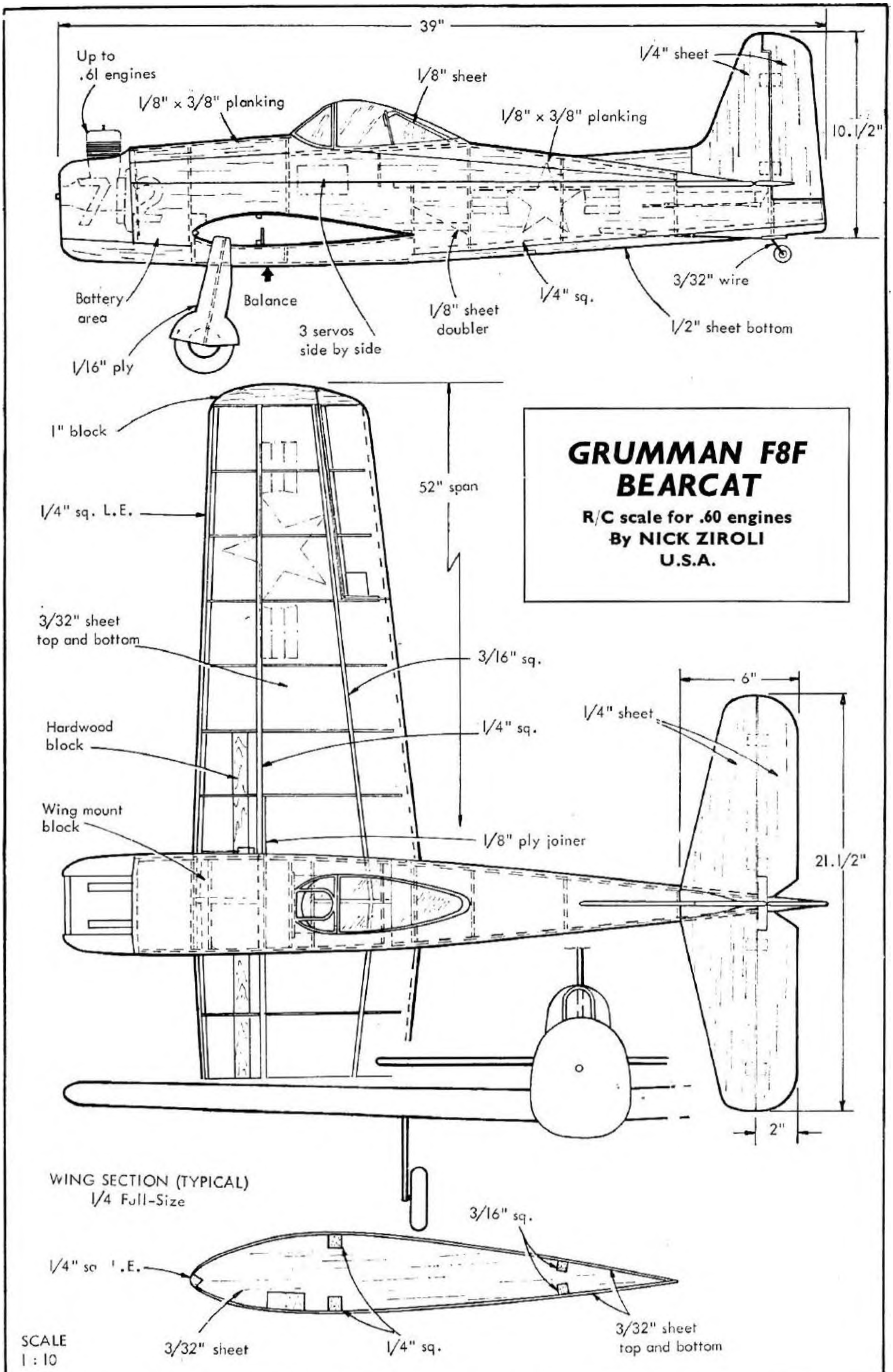
TIGRE RAT

Sophisticated Rat Racer
By BILL MELTON
U.S.A.

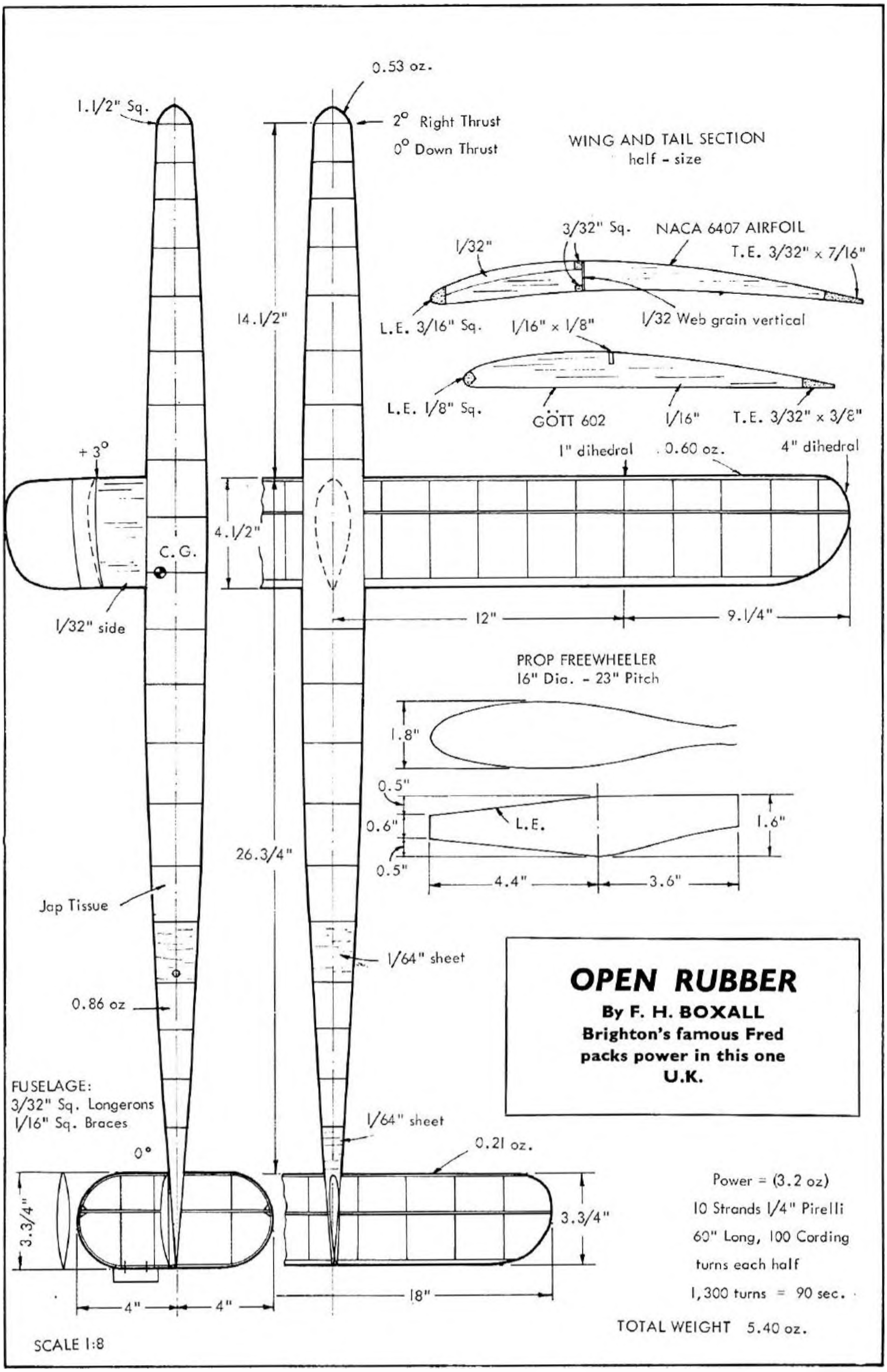
MODEL AIRPLANE NEWS



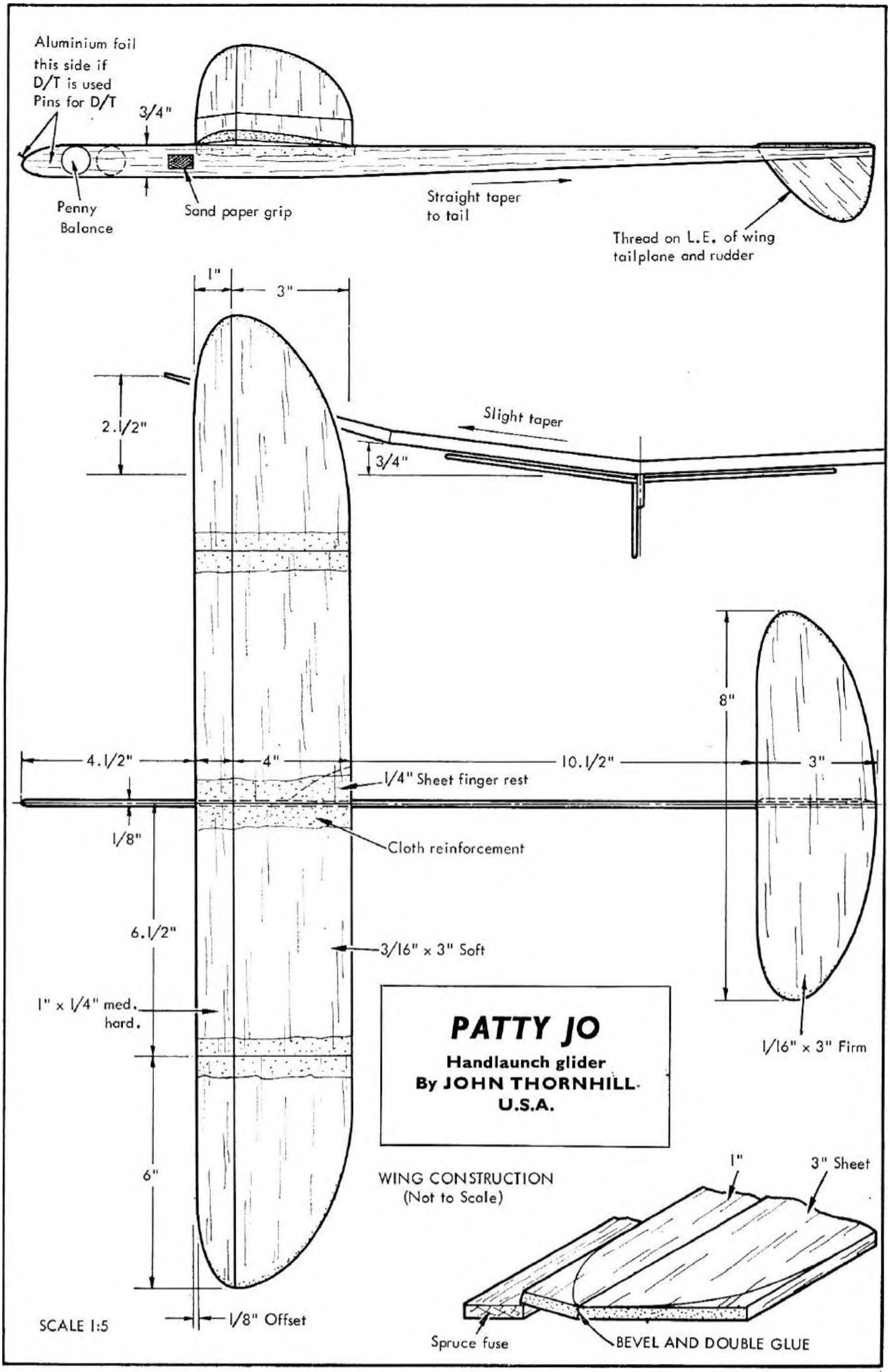
MODEL REDUIT D'AVION



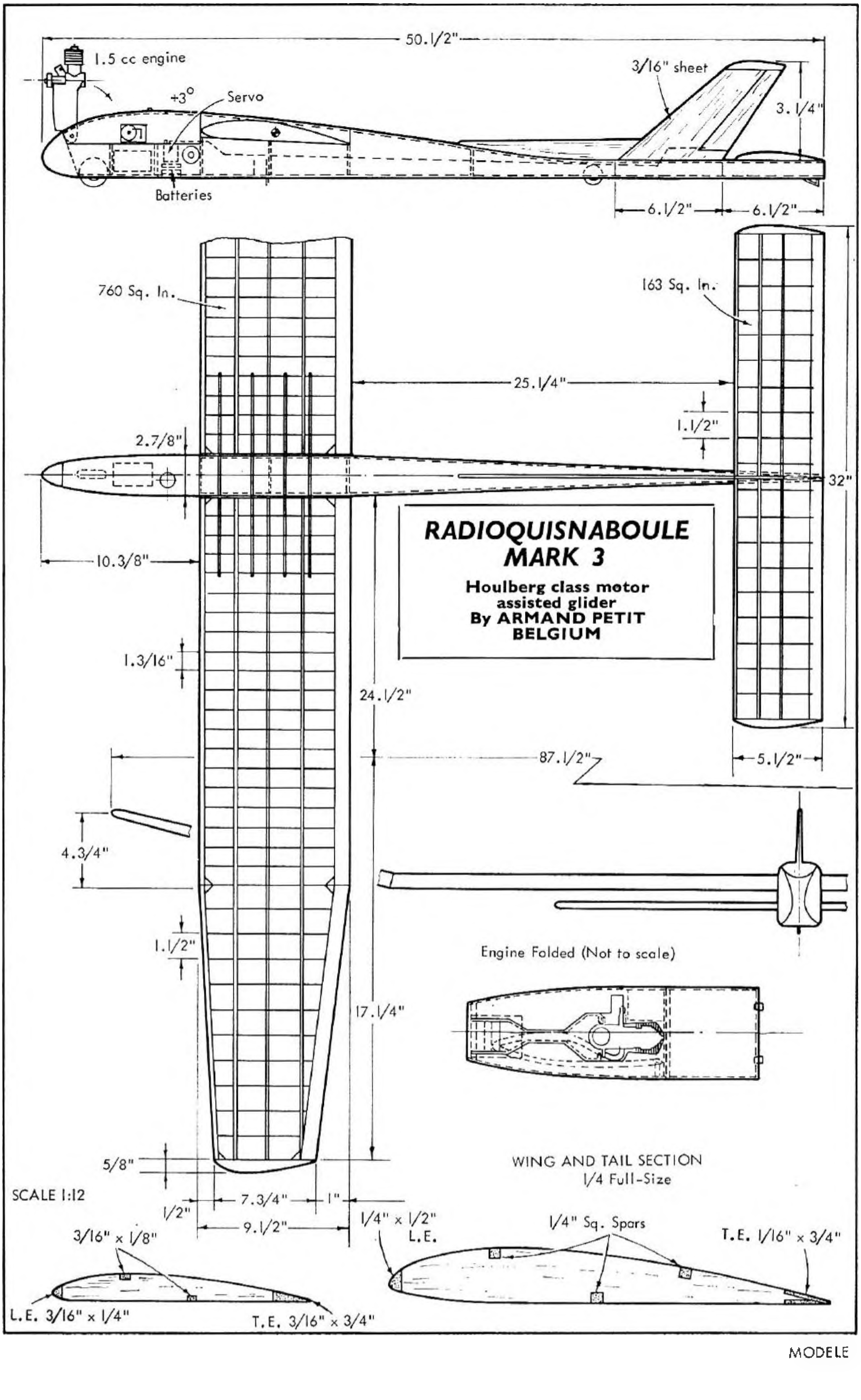
FLYING MODELS


OPEN RUBBER
By F. H. BOXALL
Brighton's famous Fred packs power in this one
U.K.
0.53 oz.
1.1/2" Sq.
2° Right Thrust
0° Down Thrust
WING AND TAIL SECTION
half - size
3/32" Sq.
NACA 6407 AIRFOIL
1/32"
T.E. 3/32" x 7/16"
L.E. 3/16" Sq.
1/16" x 1/8"
1/32 Web grain vertical
14.1/2"
L.E. 1/8" Sq.
GÖTT 602
1/16"
T.E. 3/32" x 3/8"
+ 3°
1" dihedral
0.60 oz.
4" dihedral
4.1/2"
C.G.
1/32" side
12"
9.1/4"
PROP FREEWHEELER
16" Dia. - 23" Pitch
1.8"
0.5"
0.6"
L.E.
1.6"
0.5"
26.3/4"
4.4"
3.6"
Jap Tissue
1/64" sheet
0.86 oz
FUSELAGE:
3/32" Sq. Longerons
1/16" Sq. Braces
1/64" sheet
0.21 oz.
0°
3.3/4"
3.3/4"
4"
4"
18"
Power = (3.2 oz)
10 Strands 1/4" Pirelli
60" Long, 100 Cording
turns each half
1,300 turns = 90 sec.
TOTAL WEIGHT 5.40 oz.
SCALE 1:8

SEADOG



AMERICAN AIRCRAFT MODELER


50.1/2"
1.5 cc engine
+3°
Servo
Batteries
3/16" sheet
3.1/4"
6.1/2"
6.1/2"
760 Sq. In.
163 Sq. In.
25.1/4"
1.1/2"
2.7/8"
32"
10.3/8"
RADIOQUISNABOULE
MARK 3
Houlberg class motor
assisted glider
By ARMAND PETIT
BELGIUM
1.3/16"
24.1/2"
87.1/2"
5.1/2"
4.3/4"
1.1/2"
Engine Folded (Not to scale)
17.1/4"
5/8"
WING AND TAIL SECTION
1/4 Full-Size
SCALE 1:12
7.3/4"
1"
1/2"
9.1/2"
1/4" x 1/2"
L.E.
1/4" Sq. Spars
T.E. 1/16" x 3/4"
3/16" x 1/8"
L.E. 3/16" x 1/4"
T.E. 3/16" x 3/4"

MODELE

INTERNATIONAL RECORDS

Free Flight
Class F-1-B
RUBBER DRIVEN

No. 1 **Duration**
V. Fiodorov (*U.S.S.R.*), June 19th, 1964 ... ... 1h. 41m. 32s.

No. 2 **Distance in a straight line**
G. Tchiglitsev (*U.S.S.R.*), July 1st, 1962 ... ... 371,189 km.

No. 3 **Altitude**
V. Fiodorov (*U.S.S.R.*), June 19th, 1964 ... ... 1,732 m.

No. 4 **Speed in a straight line**
A. Noujny (*U.S.S.R.*), May 5th, 1968 ... ... 116·128 km/h.

POWER MODELS
Class F-1-C

No. 5 **Duration**
I. Koulakovsky (*U.S.S.R.*), August 6th, 1952 ... ... 6h. 1m.

No. 6 **Distance in a straight line**
E. Borcevitch (*U.S.S.R.*), August 15th, 1952 ... ... 378,756 km. *

No. 7 **Altitude**
G. Lioubouchkine (*U.S.S.R.*), August 13th, 1947 ... ... 4,152 m.

No. 8 **Speed in a straight line**
A. Noujny (*U.S.S.R.*), June 16th, 1968 ... ... 144 km/h.

RUBBER-DRIVEN HELICOPTER
Class F-1-F

No. 9 **Duration**
A. Nazarov (*U.S.S.R.*), June 3rd, 1968 ... ... 33m. 26·7s.

No. 10 **Distance in a straight line**
V. Kramarenko (*U.S.S.R.*), June 3rd, 1968 ... ... 4,653·5 m.

No. 11 **Altitude**
A. Voltchanovsky (*U.S.S.R.*), June 4th, 1968 ... ... 352 m.

No. 12 **Speed in a straight line**
P. Motekaitis (*U.S.S.R.*), June 8th, 1968 ... ... 116·247 km/h.

POWER-DRIVEN HELICOPTER
Class F-1-A

No. 13 **Duration**
S. Purice (*Rumania*), October 1st, 1965 ... ... 3h. 12 m.

No. 14 **Distance in a straight line**
V. I. Titlov (*Hungary*), October 1st, 1963 ... ... 91·491 km.

No. 15 **Altitude**
S. Purice (*Rumania*), September 24th, 1963 ... ... 3,750 m.

No. 16 **Speed in a straight line**
A. Voltchanovsky (*U.S.S.R.*), June 16th, 1968 ... 95·997 km/h.

GLIDERS
Class F-1-A

No. 17 **Duration**
M. Milutinovic (*Yugoslavia*), May 15th, 1960 ... 4h. 58m. 10s.

No. 18 **Distance in a straight line**
Z. Taus (*Czech*), March 31st, 1962 ... ... 310·33 km.

No. 19 **Altitude**
G. Benedek (*Hungary*), May 23rd, 1948 ... ... 2,364 m.

INDOOR MODELS
Class F-1-D

No. 32 **Duration**
K. H. Rieke (*W. Germany*), September 22nd, 1962 ... 45m. 40s.
Speed
P. Motekaitis (*U.S.S.R.*), June 8th, 1968 ... ... 78·332 km/h.

No. 32a **Less than 8 m. ceiling**
Duration
J. Kalina (*Czech*), September 13th, 1969 ... ... 21m. 6s.

No. 32b **8–15 m. ceiling**
Duration
Jiri Kalina (*Czech*), September 19th, 1966 ... ... 26m. 40s.

RADIO CONTROL POWER DRIVEN
Class F-3-A

No. 20 **Duration**
Maynard Hill (*U.S.A.*), June 1st, 1969 ... ... 11h. 32m. 30s.

No. 21 **Distance in a straight line**
A. Bellocchio (*Italy*), July 25th, 1969 ... ... 377·350 km.

No. 22 **Altitude**
M. Hill (*U.S.A.*), September 4th, 1969 ... ... 6,992 m. *

No. 23 **Speed in a straight line**
W. Käseberg (*W. Germany*), April 14th, 1968 ... 320 km/h.

No. 31 **Distance in a closed circuit**
B. Kunce (*U.S.A.*), February 17th, 1968 ... ... 338·04 km.

R/C SEAPLANE

No. 48 **Duration**
D. L. Gregory (*U.S.A.*), October 27th, 1968 ... ... 2h. 8m. 40s.

No. 49 **Distance in a straight line**
L. Aldochine and Y. Valentinov (*U.S.S.R.*), October 11th, 1969 19 km. 250 m.

No. 50 **Altitude**
M. Hill (*U.S.A.*), September 3rd, 1967 ... ... 5,651 m.

No. 51 **Speed in a straight line**
P. F. Di Notto (*U.S.A.*), May 9th, 1970 ... ... 222 km/h.

No. 52 **Distance in a closed circuit**
D. Gregory (*U.S.A.*), June 1st, 1968 ... ... 116·217 km.

R/C GLIDERS
Class F-3-B

No. 24 **Duration**
W. Kaiser (*W. Germany*), July 3rd, 1969 ... ... 17h. 43m.

No. 25 **Distance in a straight line**
G. Martin (*U.S.A.*), April 12th, 1970 ... ... 34·6 km.

No. 26 **Altitude**
Raymond Smith (*U.S.A.*), September 2nd, 1968 ... ... 1,521 m.

No. 33 **Speed in a straight line**
D. Willoughby (*U.S.A.*), June 21st, 1969 ... ... 138·46 km/h.

No. 34 **Distance in a closed circuit**
W. Kaiser (*W. Germany*), July 5th, 1969 ... ... 201 km.

R/C HELICOPTER
Class F-3-C

No. 35 **Duration**
L. Aldoshin and V. Gavrutenov (*U.S.S.R.*), April 18th, 1970... 3m. 15s.

No. 36 **Distance in a straight line**
L. Aldoshin and V. Gavrutenov (*U.S.S.R.*), April 18th, 1970... 750 m.

CONTROL LINE
Class F-2-A

No. 27 **Speed (2·5 c.c.)**
Lauderdale/McDonald (*U.S.A.*), May 4th, 1963... ... 273·66 km/h.

No. 28 **Speed (2·5–5 c.c.)**
McDonald (*U.S.A.*), November 15th, 1964 ... ... 288·95 km/h.

No. 29 **Speed (5–10 c.c.)**
V. Kouznetsov (*U.S.S.R.*), September 30th, 1962 ... 316 km/h.

JET MODELS

No. 30 **Speed**
E. Zanin (*Italy*), April 26th, 1964 327 km/h. *

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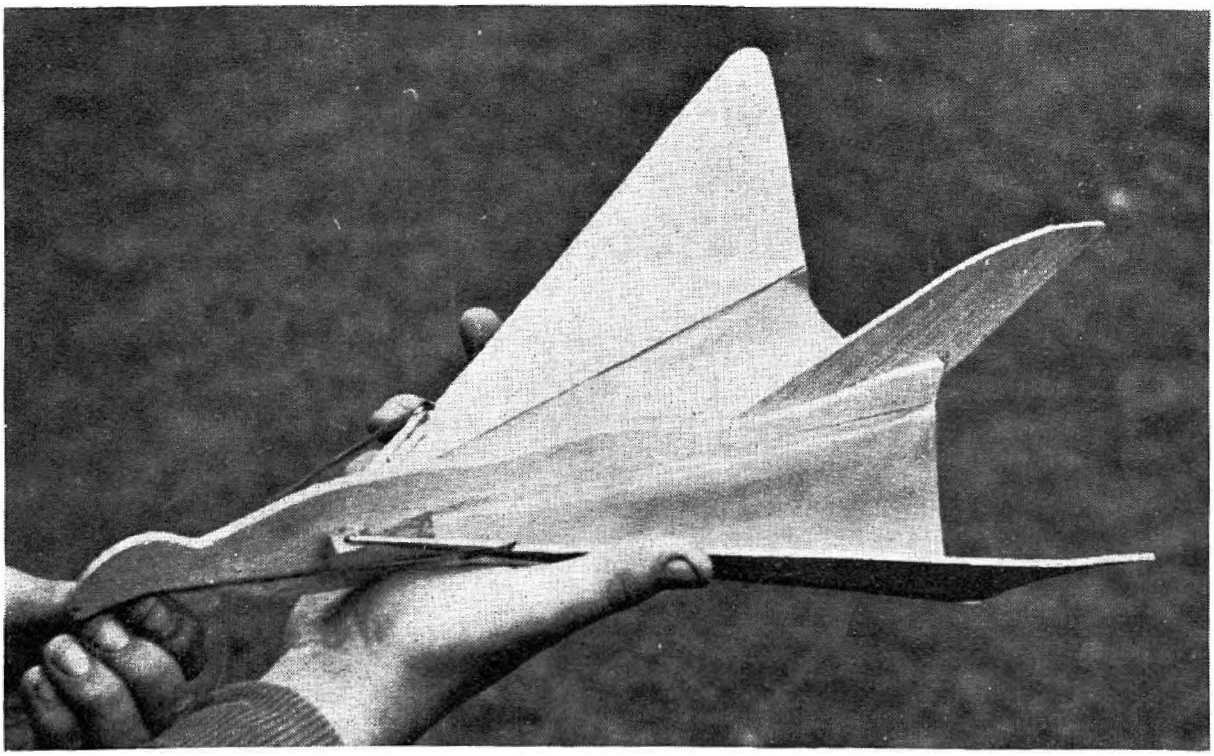
* *Outright World Records*




The three things you need
for successful modelling
Skill, patience and Humbrol
You've got to work
at the first two
but you can buy the
third at any
good modelling shop
brush
cleaner
spray
enamel
Your models deserve the best and
you'll certainly get the best from
Humbrol. Ask for these products
by name—enamels (matt or gloss)
for brushing or spraying on;
modelling adhesives of every kind;
craft knives, dopes, thinners, brush
cleaners, fuel proofers, authentic
colours and metallics.
And the very latest—Humbrol
poster colours—They're thixotropic
and are wonderful for painting
scenic backgrounds, paper
sculptures or pictures.
Remember—Humbrol helps you
make better models!
HUMBROL
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