AERO MODELLER

MAY 1954

In this Issue

Plans for Jetex powered BOULTON PAUL P.111. How to build your own radio control receiver. Full-size drawing for the SKYHOP trainer glider. Hacklinger on Artificial Turbulence. Details of all the latest in Engine test equipment, Swiss Flying wings and Acetate moulding.

1/6

Digital Edition Magazines.

This issue magazine after the initial original scanning, has been digitally processing for better results and lower capacity Pdf file from me.

The plans and the articles that exist within, you can find published at full dimensions to build a model at the following websites.

All Plans and Articles can be found here:

Hlsat Blog Free Plans and Articles.

http://www.rcgroups.com/forums/member.php?u=107085

AeroFred Gallery Free Plans.

http://aerofred.com/index.php

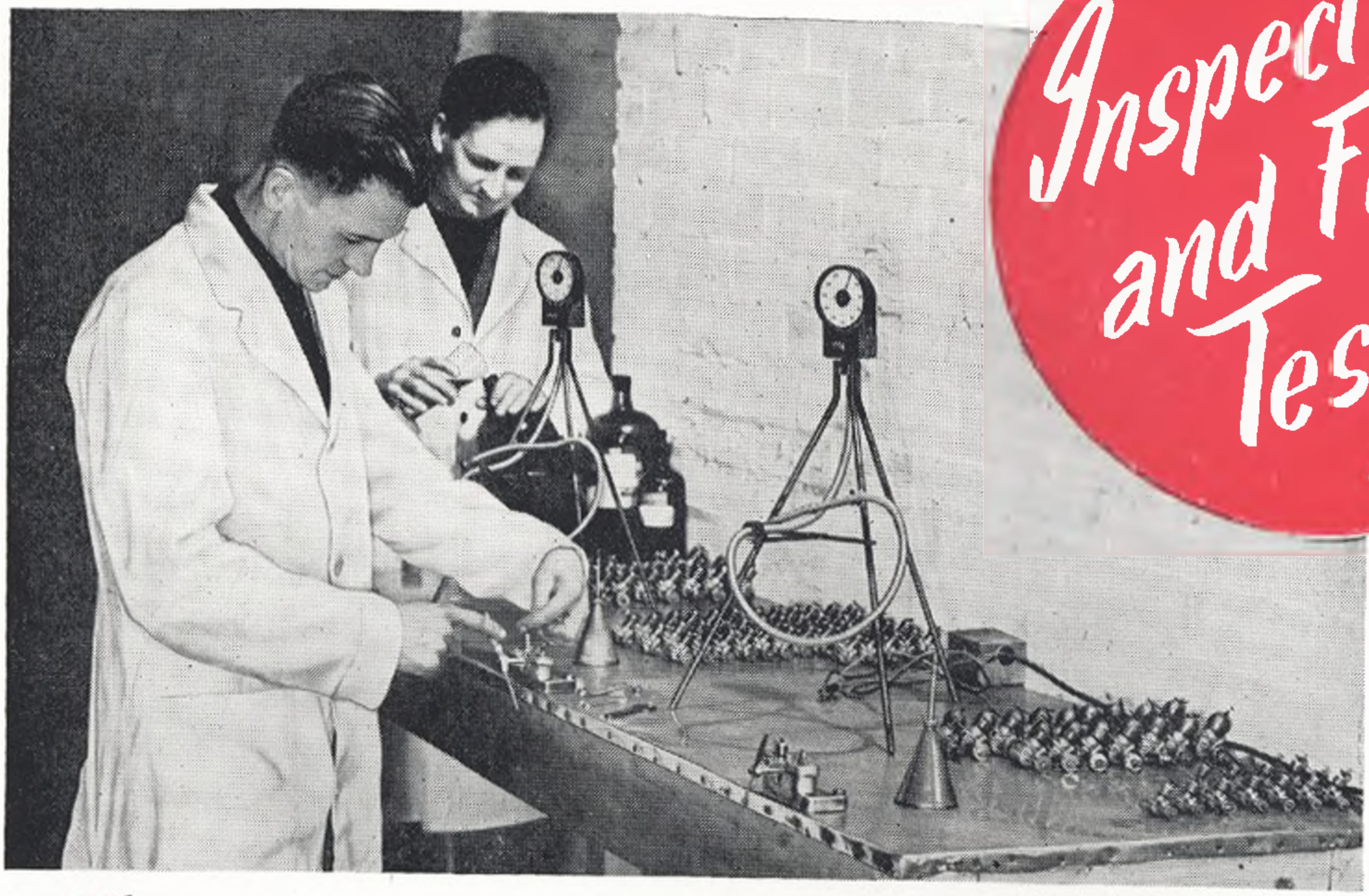
Hip Pocket Aeronautics Gallery Free Plans.

http://www.hippocketaeronautics.com/hpa_plans/index.php

Diligence Work by Hlsat.

Inside Your Engine No. 6

Inspection and Final Testing



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Mk. II JAVELIN

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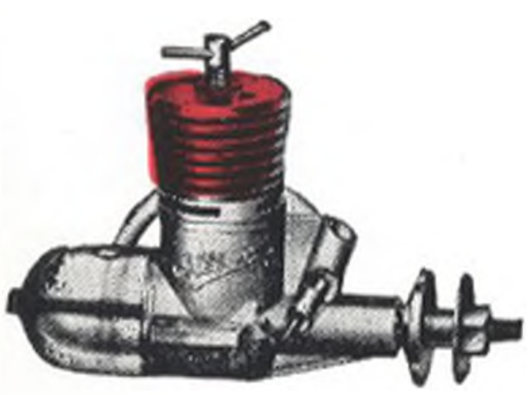

SPITFIRE

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This is one of our most important departments, and quite the most fascinating. Important, because it ensures that the high standard of product our customers expect is maintained. Fascinating, because it is here that all the hours of toil and skill culminate in the healthy note of yet another D.C. engine.

Cleanliness is again all important and we make no apology for mentioning the inevitable metal-topped bench. *Every* engine that leaves our factory is carefully inspected and *hand started* at this bench for its maiden run. Correct fuels ensure smooth running during the test, and once the engine has settled down tachometers confirm that performance is up to standard. So experienced are our testers that they detect merely from engine note whether all is well, but at the moment the wailing of our latest infant "Bambi" is a little strange to them. Eagle-eyed readers will note a few examples of the first production batch on the bench and they are now leaving the factory in increasing numbers.

Aeromodellers will appreciate from the above that we go to a great deal of trouble to ensure that their motors arrive in the pink of condition. It is up to them to carry on the good work by using the correct fuels; by careful treatment during running-in; and by keeping their engines scrupulously clean both before, during and after use.

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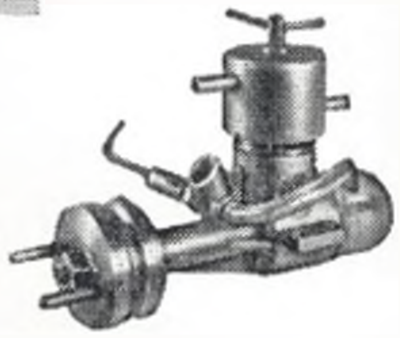

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D.C. 350

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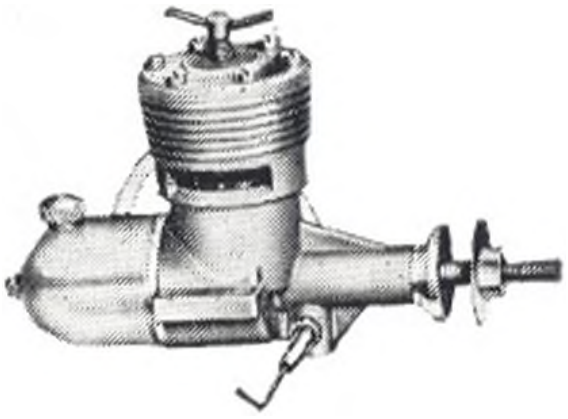

D.C. 350 (G)

3·5 c.c. 78/5

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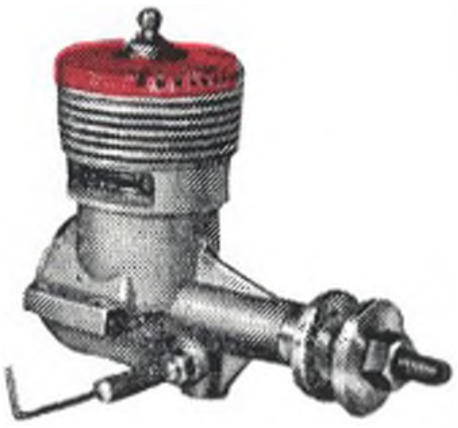
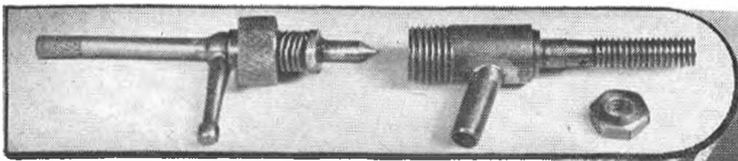
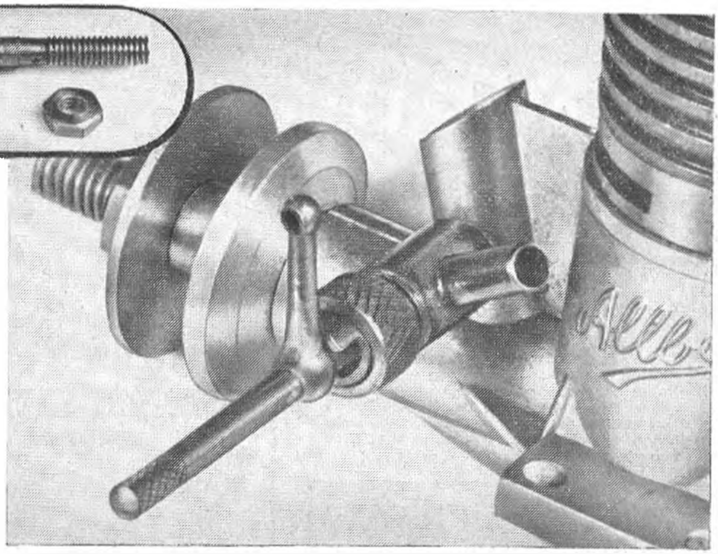




The CUT-OUT you have been waiting for!



Although designed specifically to fit the Dart, Javelin and Spitfire, this combined Cut-out and Jet Assembly can be used for most engines up to 2.5 c.c. capacity. It is completely positive in action, incorporates an anti-vibration collar and an extension so that a timer can be fitted either inside or outside the fuselage. The unit completely dismantles for cleaning, an indispensable feature for reliable operation. Price **9/6**

DAVIES CHARLTON ACCESSORIES

FLYWHEELS

Dart	9/6
Spitfire, Javelin and D.C. 350 ...	11/11

EXTENDED FUEL NEEDLES

Dart, Spitfire, Javelin, D.C. 350 ...	2/5

JAVELIN MARINE FITTINGS

Exhaust Stack	11/11
Silencer	11/11
Water Jacket	19/-
Stern tube assembly, screwed 4 B.A. for propeller, but *not* including propeller	11/11

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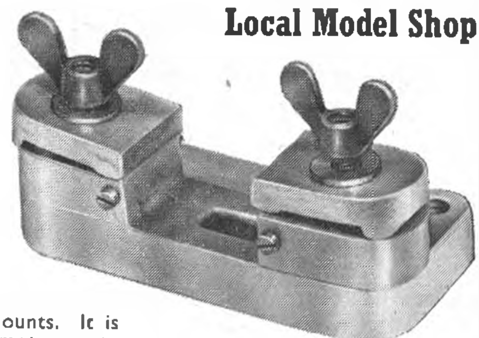

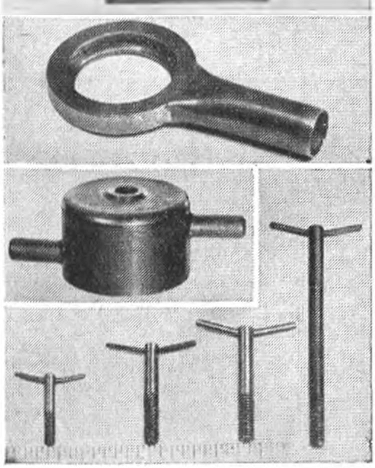

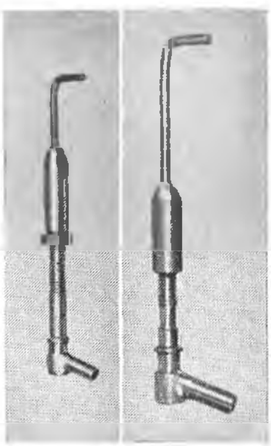

EXTENDED COMPRESSION SCREWS

One inch for Dart, Spitfire, Javelin, D.C. 350	2/5
2¼ inch for Dart, Spitfire, Javelin, D.C. 350	2/10

ANGLED JET ASSEMBLIES

Dart, Spitfire, Javelin, D.C. 350	5/7

RADIAL MOUNTS

Dart, Spitfire and Javelin	4/9

GLOWPLUG HEAD FOR D.C. 350 ... **11/11**

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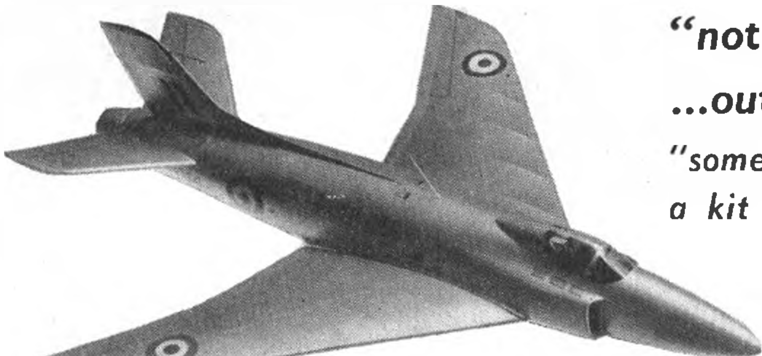

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MODEL AIRCRAFT—March

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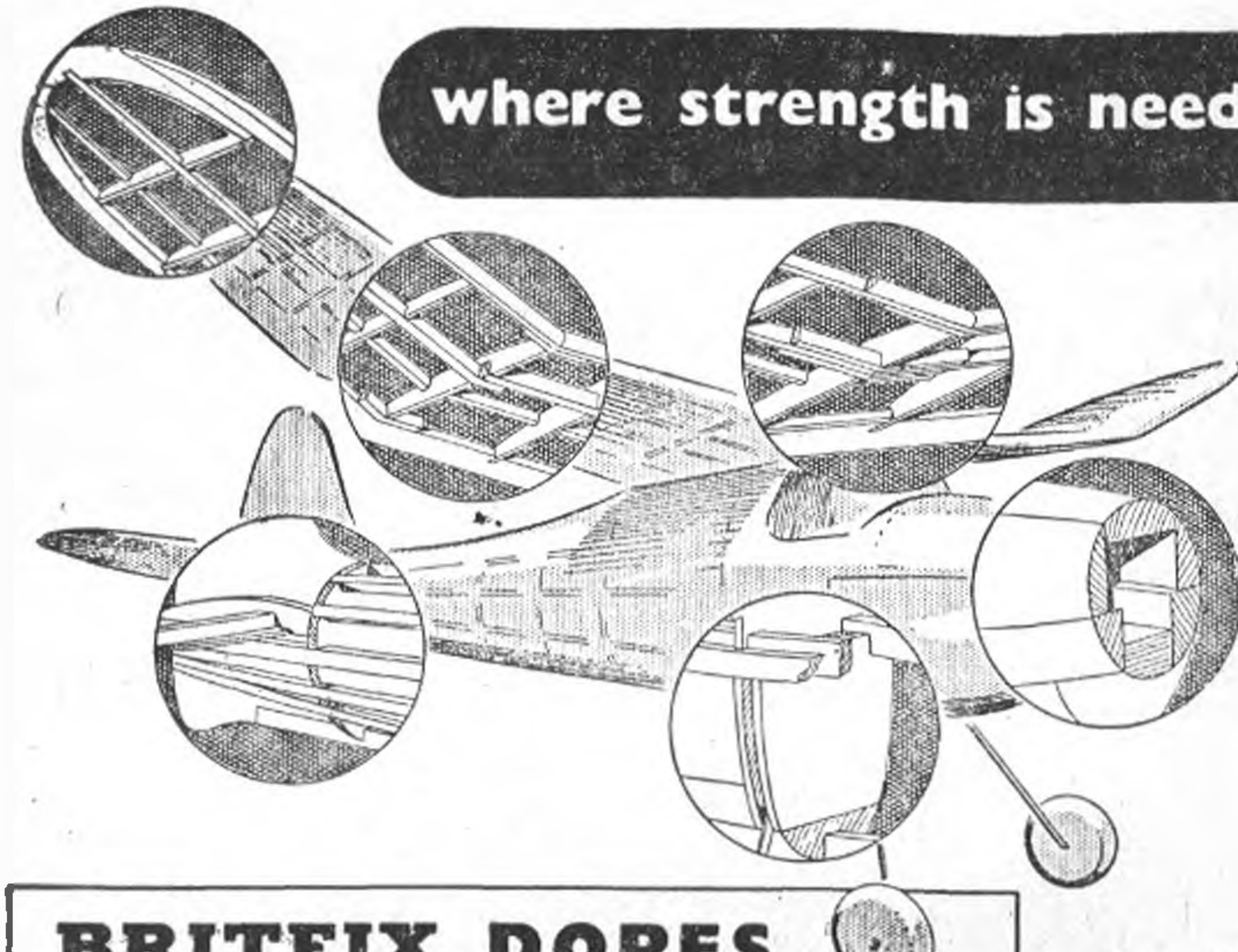

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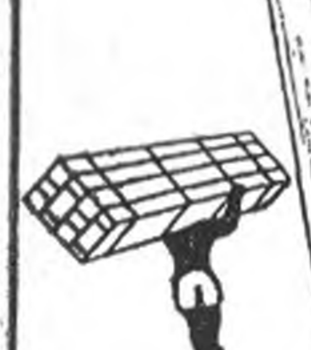

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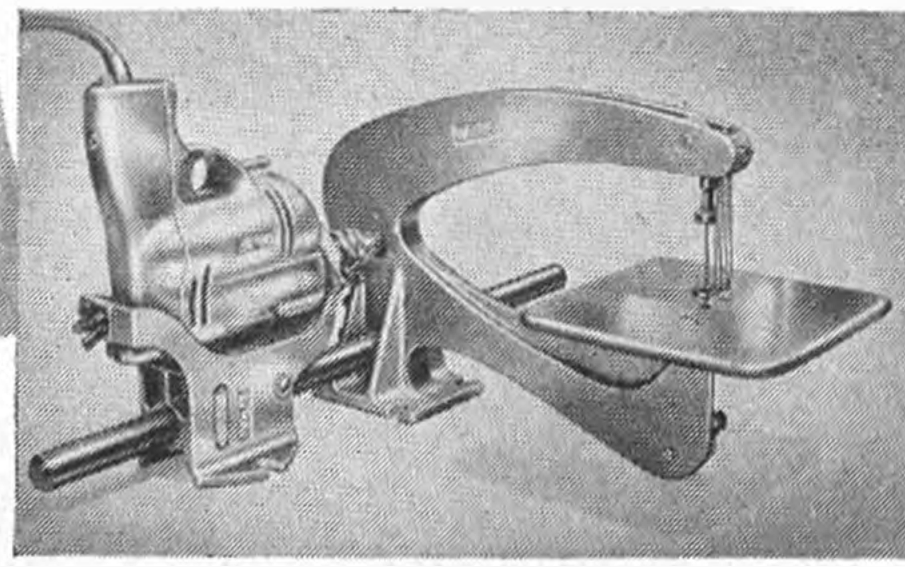

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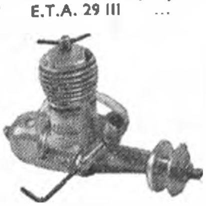
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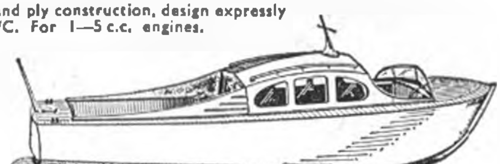

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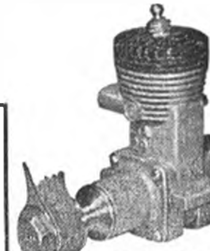
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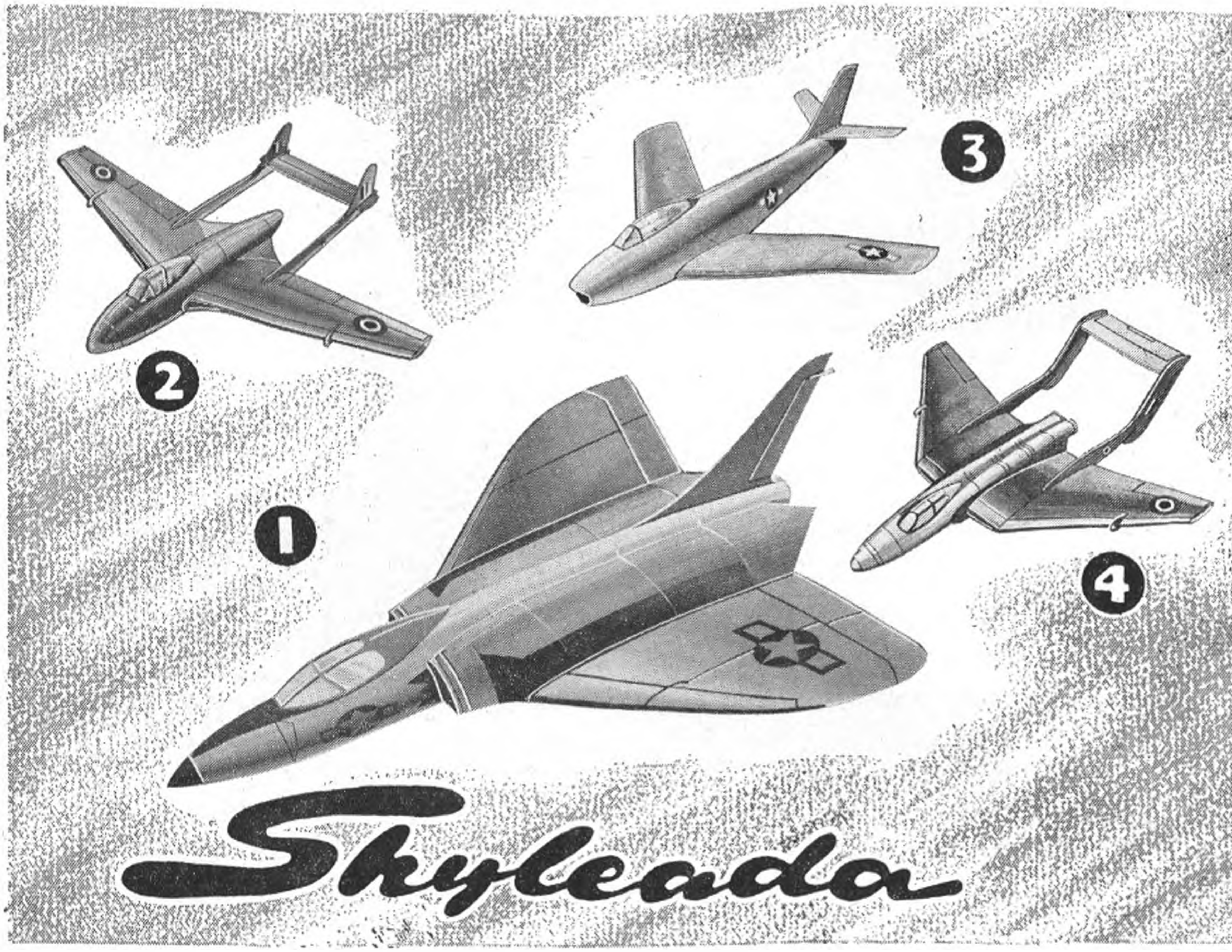

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AERO MODELLER

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Contents

SPECIAL FEATURES Page

"BOULTON PAUL P.III" 236
ARTIFICIAL TURBULENCE 238
"PEREGRINE" 240
RADIO CONTROL IN EASY STAGES 244
CONTEST TECHNIQUE 249
SKYHOP 252
FLYING WINGS 254
FIELD KIT 256
EDDY-CURRENT DYNAMOMETER 258
ACETATE MOULDING 268

REGULAR FEATURES

HANGAR DOORS 234
MODEL NEWS 242
ARMCHAIR AERONAUTICS 257
ENGINE REVIEW—
LE SIMOUNE 262
TRADE NOTES 264
AEROPLANES IN OUTLINE—
DOUGLAS SKYRAY... 266
CLUB NEWS 269

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No Cash—No Teams

SINCE the resumption of model flying World Championships following the war-years' break, the S.M.A.E. has in one way or another managed to send official teams to compete in practically every event staged since 1948. That year saw a grand rallying round of enthusiasts who subscribed the necessary funds to sponsor a six-man team to the States, as a result of which Roy Chesterton brought back the famous Wakefield Trophy to its birthplace.

Since then, the World Championships has expanded to embrace almost every other type of model aircraft, and we now have the Swedish Cup for A/2 Gliders, the F.N.A., F.O.M. trophy for Power models, and the Italian Trophy for Control Line Speed, to which are added team awards to supplement the individual Champion trophies.

Interesting and stimulating as these Championships are, nevertheless to support them in the interests of national prestige requires finance to meet travel and other expenditures. It is in this respect that the S.M.A.E. continually comes up against difficulty, and every year the general funds have to be "raided" in order to provide the British participation which we all desire. However, this situation has continued for too long, and the Council has come to the reluctant conclusion that charity must begin at home, and its general membership must not have its benefits curtailed owing to funds being diverted from their proper use in order to balance out an inadequate International Contest Fund.

It has therefore been decided that, unless sufficient funds are forseen by the end of May to enable full participation in ALL FOUR Championships, NO British Teams will be sent abroad, and we shall have to fall back on the very unsatisfactory substitute of proxy flying. This decision was reached after much heart-searching, but it was deemed equitable to treat all teams on the same basis, and, should the total funds fall short of the required amount, such monies as are received will be placed in the bank as a nucleus on which to build for future years.

Every effort is being made to collect sufficient money in order to ensure proper British representation in America, Denmark, and Holland, and to this end, many schemes are under way for the collection of the required £2,000.

It is up to each and every aeromodeller—contest-minded or otherwise—to rally round and subscribe to the fund. Remember, *if* EVERY READER only subscribed a humble shilling, the required figure would be reached, and we call upon you all to pitch in and make certain that Great Britain will not be "out in the cold" at this years' contests.

The Crossword Competition contained on page 272 will both give you the chance of winning £100, but will also increase the fund usefully, and we look forward to receiving your entry as soon as possible.

For those who prefer to make a direct contribution, we shall be only too pleased to receive donations on behalf of the S.M.A.E. Receipts will be sent if requested, and a list of contributions will appear in both the "AEROMODELLER" and our contemporary in acknowledgement of those who feel as we do, that the aeromodellers of Great Britain must make certain that this country is assured of representation.

It is up to YOU. No contribution is too small—or too big! Let us show that the aeromodellers of this country can stand on their own feet, and no longer go cap-in-hand to those outside our movement in order to ensure our rightful place in the International sphere.

Cover Picture . . . .

The diminutive Boulton Paul P.111 delta aircraft, now approaching its fourth year of continuous flight research into the realms of high speed, slows momentarily for the company camera to display its pure delta outlines. Currently flying in new decor of high gloss black and yellow. The P.111 is seen here in earlier silver finish, and exactly as modelled by D. P. Golding for his 24 in. version reproduced on pages 236/7.

Off to a Bad Start!

The 1954 contest season opened with poor weather pretty general all over the country, high winds being the main factor that competitors had to cope with. The London contingent also had a nice juicy bog to contend with in their chase after models that went quickly out of sight, so it says much for the prowess of the boys that such good times were recorded.

The ever-present Johnny O'Donnell placed top in the Gamage Cup results, bettering even the glider times, and many other well-known names appear in the top section of this and the Pilcher Cup events. It is good to see a number of new names high up in the results, though the overall support for these "season openers" was very poor in relation to previous years. Only 68 entries were received for the Pilcher, and of these three were received after the closing date for entries, and four were not included in the official results owing to incorrect fees being forwarded. For the Gamage, only 42 chaps braved the elements with their rubber jobs, and of these again two were disallowed owing to the returns arriving too late at H.Q.

It passes our understanding why it takes some Comp. Secs. over a week to send in the results of a contest, particularly when the numbers are so small, and we trust that the firm line taken by the Society will wake some folk up in regard to strict attention to regulations. Our sympathies are with the actual fliers who have been penalised through the defalcation of an official, but the remedy lies with them!

J. D. Henderson of Sunderland has a greater measure of condolence, for his total time of 9 : 19 in the Pilcher would have given him the trophy, but he, together with another member of his club and two fellows from Tynemouth, had their entries disallowed through an error on the part of the official who forwarded their entries. Under the circumstances, we trust that the Council will allow the result to be modified, for the fault lay in the misinterpretation of a rule, and was in no way a disregard of requirements.

Brushes in the Sky

Progress in flying and in everything connected with the Royal Air Force and Civil Aviation has been so rapid since its inception a generation or so ago that its importance both in the present and the future tends to be overlooked. It is regrettable that in the early experimental years there were so few artists with opportunity and sufficient interest to record the epoch-making attempts at early flight.

Charles Cundall, R.A., Terence Cuneo, G. H. Davis, S.M.A., Hesketh Hubbard, P.R.B.A., R.O.I., F.S.A., Roy Nockolds, Norman Wilkinson, C.B.E., P.R.I., R.O.I., S.M.A., and Frank Wootton have gathered together to remedy this long-standing omission by forming the Society of Aero Artists.

They hope to bring together the best painters and draughtsmen of the day from those with a genuine interest in aviation.

An exhibition will be held in London during the month of June and all artists and other persons interested in the subject are invited to write to the Secretary, The Society of Aero Artists, 23 Albemarle Street, London, W.1.

My Goodness . . . .

Yes, Guinness will probably be needed for fuel in one event at the All-Britain Rally this year. We refer to the introduction of a Clipper Cargo comp., which, as we mentioned in an Editorial comment a month or two ago, is a logical and interesting development in model flying and one which really gives design a chance with virtually no luck element. While applauding the organisers for including this event (Pan American have presented a cup, incidentally) we cannot help feeling that the rules are a bit dismal, or, rather, that one of them is. Engines of up to 1·5 c.c. are permitted, and this means that, based on the winning model at last year's U.S. Nationals, the top model is likely to be 8 ft. 6 in. span and 10 in. chord, and should weigh 9½ oz. empty, lifting a weight of approximately three pounds. Hmmmmm . . . .

S.M.A.E. £100 Crossword

AS mentioned in our Editorial this month, funds are urgently needed to enable this country to participate in the coming World Championships in the U.S.A., and for this purpose both we, and our contemporary "Model Aircraft" have organised a crossword competition that should appeal to aeromodellers in general. You can send as many entries as you wish, happy in the knowledge that you might win £100, and at the same time support a very worthwhile cause. The puzzle can be found on page 272 of this issue and may we at this juncture remind you to *thoroughly read the rules.*

One final word—don't keep it to yourself. Let Dad and Mum, and even Little Willie have a go! The more entries the merrier, and the merrier our chances of bringing back both the Wakefield and Power Trophies to this country. Your local model shop has additional supplies of entry coupons, and you can if you wish make further entries on plain paper.

Indoor Sport—Again

For many years, the art of indoor flying has been almost non-existent in Great Britain, the sole reason being a sad lack of facilities for the conduct of this fascinating type of model flying. Before the War enthusiasts enjoyed the spaciousness of the Albert Hall in London, and much fine flying was witnessed within the dim precincts of this famous concert hall.

With one or two exceptions, notably the efforts of the North Western Area who for many years staged winter meetings in Manchester—albeit in surroundings that limited the scope of competitors, little or nothing has been done to revive interest in microfilm models, etc., but we are happy to announce that through the good offices of Group Captain Turner, Commanding Officer of R.A.F. Cardington, use of the enormous balloon shed at the Station will be available on July 3/4th, August 7/8th, September 11/12th, and October 9/10th.

Saturday afternoons will be devoted to practice and trimming flying, with the full Sunday taken up with record attempts and contests organised according to requirements on the spot.

Though traditionally indoor flying has been limited to the winter months, neither heating or artificial lighting are available in the Cardington shed, and meetings must be held during the lighter periods. For the 1954 meetings at least, flying is strictly limited to free-flight. Would-be competitors will realise that the extraordinary facilities placed at our disposal (height of ceiling over 180 feet to the first obstruction!) must be devoted to those who are rarely able to get the best out of their specialised models, and such offshoots as R.T.P. must be relegated to smaller halls which can usefully accommodate them.

As the Station is operational, admission is perforce limited to competitors only, and application for admission must be submitted to the S.M.A.E. by the 25th June, 30th July, 3rd September and 1st October respectively in order that the necessary passes may be prepared. No accommodation can be provided for overnight visitors, but with Bedford within easy distance no difficulties should be experienced. More news will be published from time to time, but indoor enthusiasts can now get down to the 1954 "revival."

Straight from the board

Factual commentary on up-to-date aeromodelling activity throughout the British Isles. Follow this new feature for all that's news on what the experts are flying.

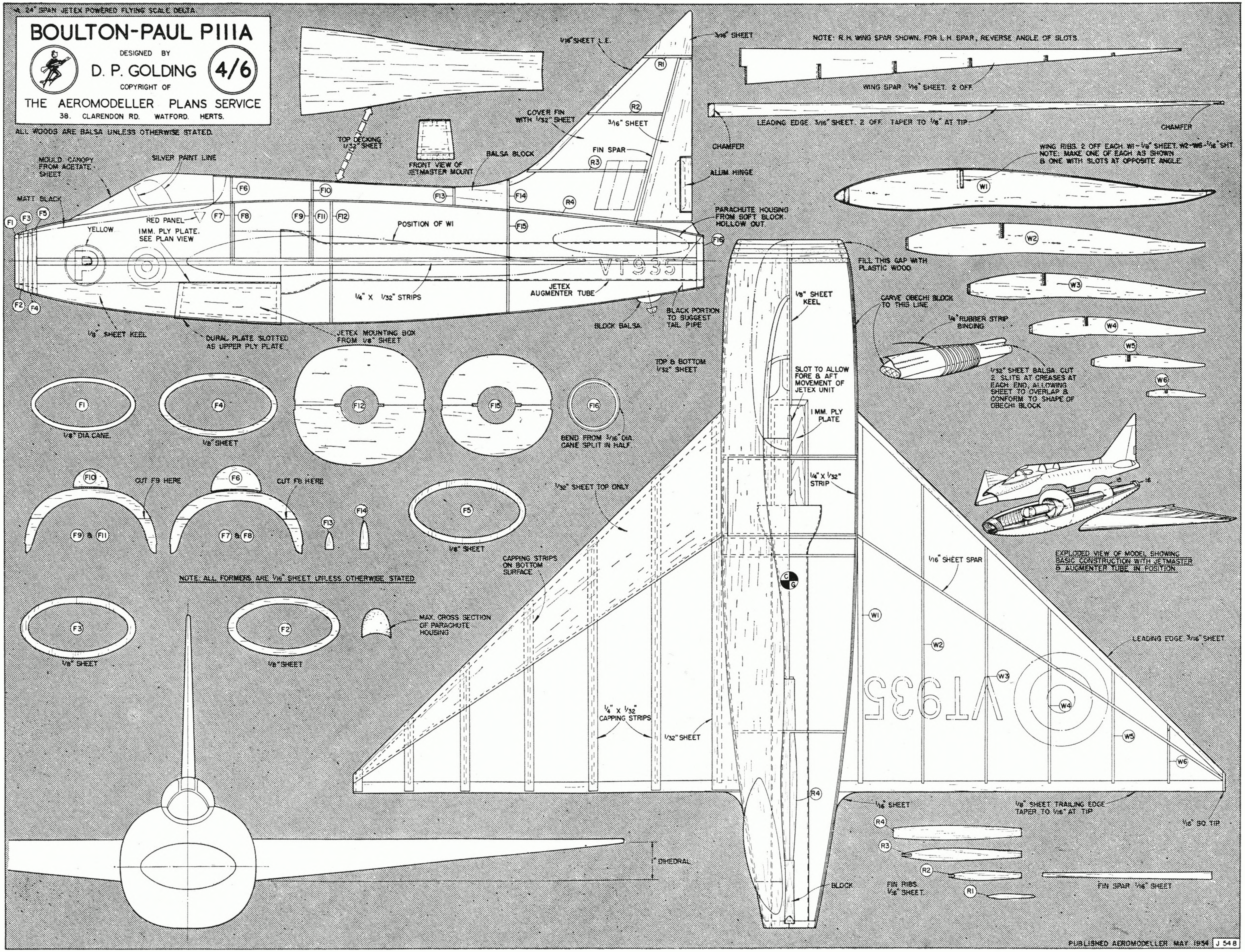
Brian Eggleston of Leeds, top in 1st '54 power eliminator has an Oliver Tiger model worth watching. Underfin is split at 45° to give three point support without vulnerable tip fins normally used. This also gives projected horizontal area which must be taken into account. Average flight is 3 : 15 on 15 secs. with the Tiger producing 12,000 revs on an 8½× 4 in. prop. Other Leeds trend is to ⅞ths size Wakefields with 3-4 oz. rubber and 2-3 oz. airframes. **Ken Rutter's,** with high pitch 16 in. folder prop and 32 in. span, climbs like a "Convertaplane."

From Blackpool **Tom Smith,** the swept-forward addict for high climb power models is pleased with a new one known as "Oliver Twist." This is built extra light, with spars tapering to $\frac{1}{16} \times \frac{1}{8}$ in. and utilises a hotted-up Oliver Tiger for which he has duly paid the Oliver works the extra £2. 10% power more than stock motor output is claimed. Weight is still 6½ ounces, accounting for the lightweight 11 ounce airframe. Another Annenburg protégé is **Ian Harrison** using straight dihedral, with auto rudder arrangement to get away from the enormous amount of left thrust previously required for this type of model. Future plans are for a tailplane negatising arrangement to slow up the glide . . . .

On team racing we learn from **Norman Butcher** that the famous Croydon "Sorcerer" team of Martin/Cameron/Butcher will be operating this year in all circles. They have just concluded tests on a poppet valve ETA 29 conversion, after an idea tried by Peter Buskell on a 246. This is a spring loaded valve of ½ in. diameter, mounted in the dummy backplate which replaces the disc system. Valve seating was ground to 45° and on the crankcase depression, it opened automatically for the inlet, sealing again for compression, etc. Trials gave 24 laps at 85 m.p.h., as against an immediate switch back to disc with 30 laps at 96 m.p.h. so the poppet is out and the ETA runs as before. Though made by one of the leading watchmakers in the country, this Butcher experiment is definitely past tense and not to be advised for 5 c.c. No fuel, prop, line or other changes were made to detract from the comparison.

Some genuine red and yellow Jap tissue came our way recently and enabled tests to be made against Modelspan. For colour, it's richer, goes more translucent with doping, is "harder" and takes one coat less dope for same surface as equivalent Modelspan. But it sags more, is not as strong, and to one of our acquaintance. is harder to handle.

Second in the "Damage" was **John Palmer** of Croydon who is engaged on 300 sq. in. open rubber jobs with geared 16 strand 30 in. motors on a 22 in. × 22 in. Bilgri type prop. For his Wakefield, a cabin diamond making around the 3 : 20 mark in average conditions, the prop blades are skew hinged lightweights of only 0·1 ounce each, and specially arranged to fair in with the fuselage on folding. 14 strands of Pirelli take it up—next model will have same diamond side area; but narrower fuselage.



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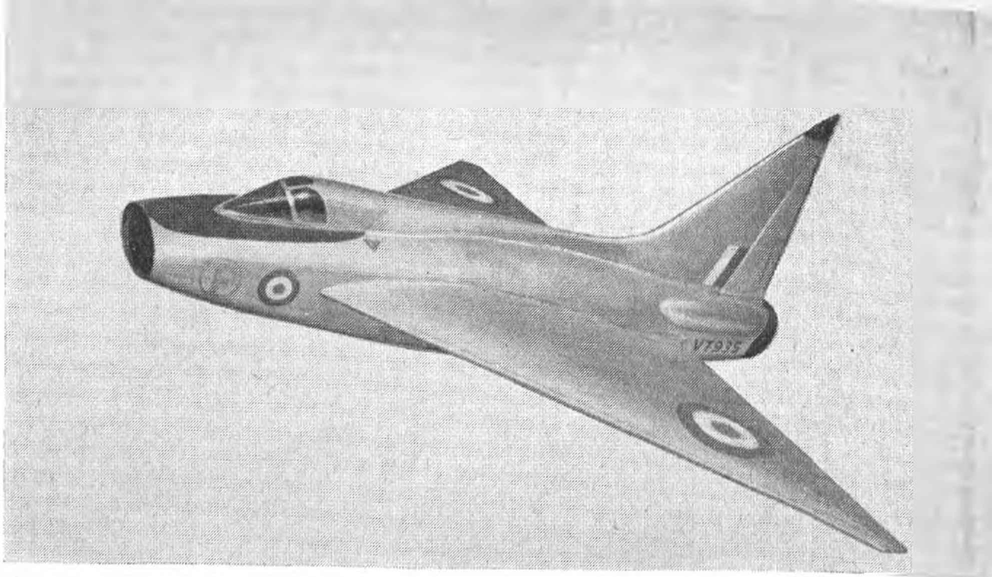
PLANE

ON THE

COVER



A 24 in. Jetex powered

Boulton & Paul P.111A. by D. P. Golding

For Jetmaster or "200"

ONE of the earliest deltas, the P.111A has always attracted modellers with its clean lines, stubby fuselage, and general pert appearance. Besides stubbiness, the body also features, from the modeller's point of view, a capacious interior and easy curves which lend themselves to moulded sheet construction. D. P. Golding has taken full advantage of these points in this neat and smooth-flying scale model.

Building

Construction commences by carving a solid block fuselage (preferably from obechi); this is the only "awkward" stage of the construction, but it is essential for true scale appearance. The block is carved $\frac{1}{32}$ in. undersize overall, smoothed and given one coat of clear dope. Four sheets of fairly soft $\frac{1}{32}$ in. balsa are required, and one of these should be soaked in hot water for about ten minutes. After shaking or wiping off the surplus, lay one edge on the fuselage block centre line and bind tightly with $\frac{1}{4}$ in. rubber. Where wrinkles occur (probably two at each end) cut and allow to overlap, butt-joining when dry. The corresponding quarter should be made in the same way and, when dry butt-joined to the first piece, replacing the complete half-shell on the former and binding in place. Steam in front of a kettle for a couple of minutes and allow to dry before removing and laying aside. The bottom half repeats the process, and two $\frac{1}{32} \times \frac{1}{4}$ strips are cemented along the edges to facilitate jointing. Rubber marks, etc., will sand away quite easily.

Construct all formers and fit in F1–5, the lower halves of F12–15, and F16, followed by the motor mount. Add top halves of F12 and 15, and F7–11 and install the augmenter tube which must be accurately lined up and will need approximately 3 in. cut off the end. Build fin, etc., and fair in place and make parachute housing, which is added after completion of the fuselage. Fit and align top shell and cement in place. Silk cover the lower half up to just above the join and cover the top with rag tissue.

Fit a bevelled cockpit frame ($\frac{1}{8}$ sq. sanded down) and the canopy, which is moulded from acetate sheet in the usual way. The engine hatch can be carefully cut free and cleaned up; it is attached by a silk hinge on the starboard side and held down by a scrap of cellophane tape.

The wing outline is built in place after fitting W1s carefully. It is best to work between two level boards with the fuselage inverted, since only the underside is dihedralled. When the outlines and mainspars are firmly set add ribs; sheet upper leading edge and add cap-strips, etc. Small ailerons can be fitted from W5 to tip to aid trimming if desired Cover with lightweight Modelspan and dope one coat clear.

The fin can be rag-covered and doped, after which the whole model requires two coats of silver. Add black lettering, roundels, and other colour detail.

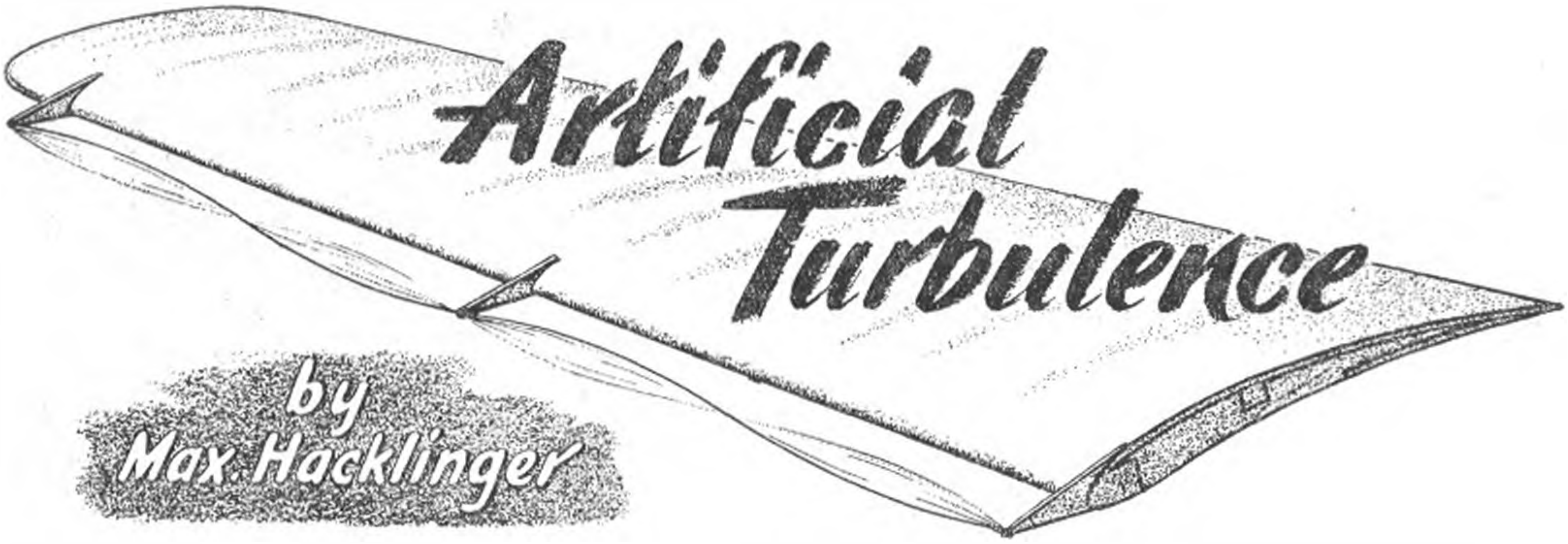
Flying

Check glide with empty unit and avoid a nose-up float. (A calm day is essential.) Load unit and launch naturally, when thrust has built up. Observe trim changes required, especially at end of power run, and when final trim has been achieved cement everything securely. Stall recovery is extremely good, but rough weather flying is not recommended if it can be avoided.

Complete building instructions, including details of cockpit moulding, etc., are included with each copy of the full-size plan, which is available, as noted opposite, price 4/6d. post free from the Aeromodeller Plans Service.

Artificial Turbulence

by Max Hacklinger



Those who wish to make the most of a 164 ft. towline, had better study this summary by an expert on the subject of turbulators.

THE development of high performance models is determined today by one main idea: duration—and this means sinking speed. The decisive part of the model for this factor is the wing—especially in view of the new rules—and all good wings of recent years show two tendencies:

(*a*) the use of slow airfoils, that is airfoils with great lift.

(*b*) the application of high aspect ratios.

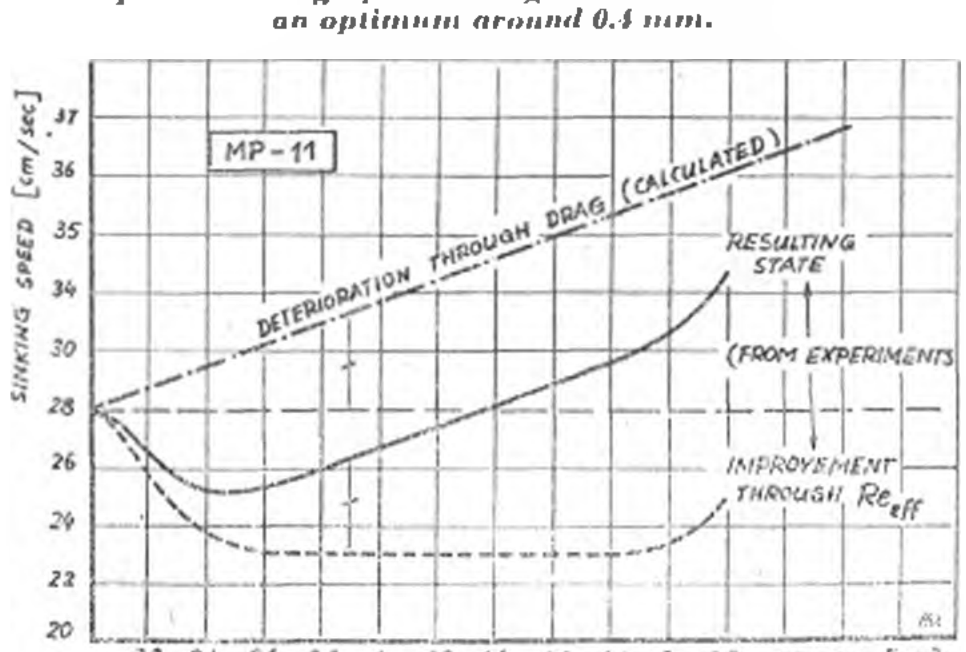
These two fundamental tendencies come to the fore in various countries and usually independently, though there exists an internal connection between them. The greater the lift of our wings, the more it pays to look for means to reduce the increase of induced drag—the most obvious cure is an increase of aspect ratio.

Both tendencies (*a*) and (*b*) result separately in a decrease of the wing Reynolds Number. The majority of our freeflight models are flying with RE < 60,000 and in this typical model-sphere a lot of disagreeable phenomena arise: The boundary layer is partly laminar, partly turbulent, it stalls unusually early on the upper side of the wing, it is decisively influenced by small, often unmeasurable changes of the surface, the flown C_L max. is much smaller than we expect, on the strength of the camber, in other words—our wings get more and more unpleasant attributes in consequence of the inevitable slow speed. To avoid this, a variety of methods have been applied, since it was obvious that the problem was mainly one of turbulence.

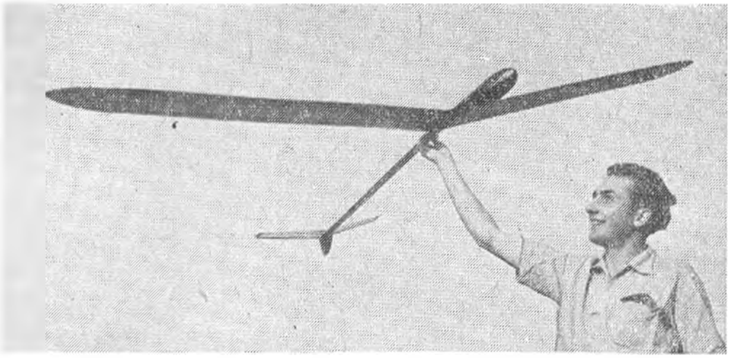
Leading Edge Section: Frequently used is a small radius leading edge (about 1, 2% of the chord) or simply a sharp wing entry. But the boundary layer reacts negatively upon this method. The Cp movement of common model airfoils is great enough even without this, a sharp leading edge still enlarges it and *reduces* longitudinal stability. Moreover, a sharp l.e. reacts as a break-off edge at low angles of attack (5)—the characteristic flight pattern of such a model is "tail up and nose down."

Roughened Upper Surface: A rough surface in the upper first third of the wing has been tested repeatedly. But as long as the structure of the boundary layer in this important part of the airfoil is not entirely clear to us, and as long as we cannot, therefore, cause a deliberately produced disturbance of the surface, so long will this method result only in unexpected stalling phenomena or a detrimental drag.

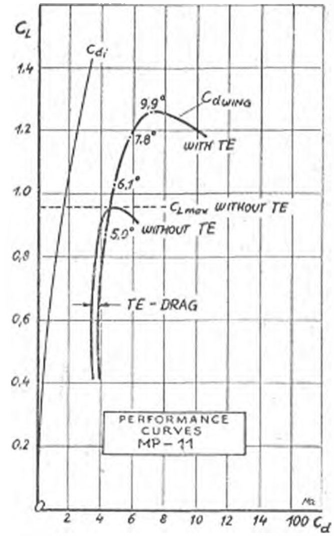
Graph 1. Sinking speed set against Elastic dia. shows an optimum around 0.4 mm.



Author with his 1952 A/2, placed second in the final contest at Graz.



Max and his '53 model, MP-11, analysis of which is given in Graph 2 at right. Thin elastic turbulator cannot be seen in this view, is the type normally sold as Shirring thread.



Strip Surface Turbulators: A Turbulence—strip (about $\frac{1}{16}$ in. sq.) behind the l.e. requires a minimum structural effort and is, therefore, frequently used. From experiments with A-2 models we get the result that the effect of these surface turbulators—even if their optimum position and height has been ascertained by experiments—is smaller than that of a turbulence wire and above all, does not allow the model to fly with the required high angle of attack.

Wire Turbulator: The turbulence wire tightened in front of the leading edge does not produce an appreciable effect so long as it is rigid, and in this state it is particularly touchy to alterations of its position. But since it is much more difficult to prevent vibration in flight than to cause same, the use of an elastic suggests itself.

Turbulence Elastic: This method of exciting artificial turbulence by means of a turbulence-elastic (abbreviated TE) has produced the best results so far and it pays to analyse it.

The first question is how to find the best TE dia. *Graph* 1 shows the two effects separately: on the one hand, increasing TE diameter results in additional drag and this increases μs; on the other hand, the effective Reynolds Number rises with the diameter and this improves the airfoil qualities. These two tendencies act simultaneously and the resulting state shows an optimum near to diameter = 0.4 mm. The thickening of the turbulator by vibration effect is negligibly small.

Further problems arise from the question how to correctly fix the TE.

Tightened elastic does not vibrate during flight with ground frequency, as was supposed originally, but with a high "over frequency" (see heading sketch) an analogy is: wind blowing at telephone wires. So it is satisfactory to fasten the TE at spaces of 16 in. A distance from the leading edge of $\frac{1}{4}$ chord is recommended. In the case of smaller distances, the necessary TE dia. increases rapidly, whereas greater distances only bring extra drag. A failing with our former models was the low mounted TE. The flight measurement of MP—11 showed us that at 5° angle of attack the TE causes drag only, but at 9° improves the performance substantially. This, together with other phenomena, leads us to conjecture that the boundary layer on the lower surface is laminar with the TE arrangement of MP—11 (see airfoil HA—12 in "AEROMODELLER" February issue) and high angles of attack.

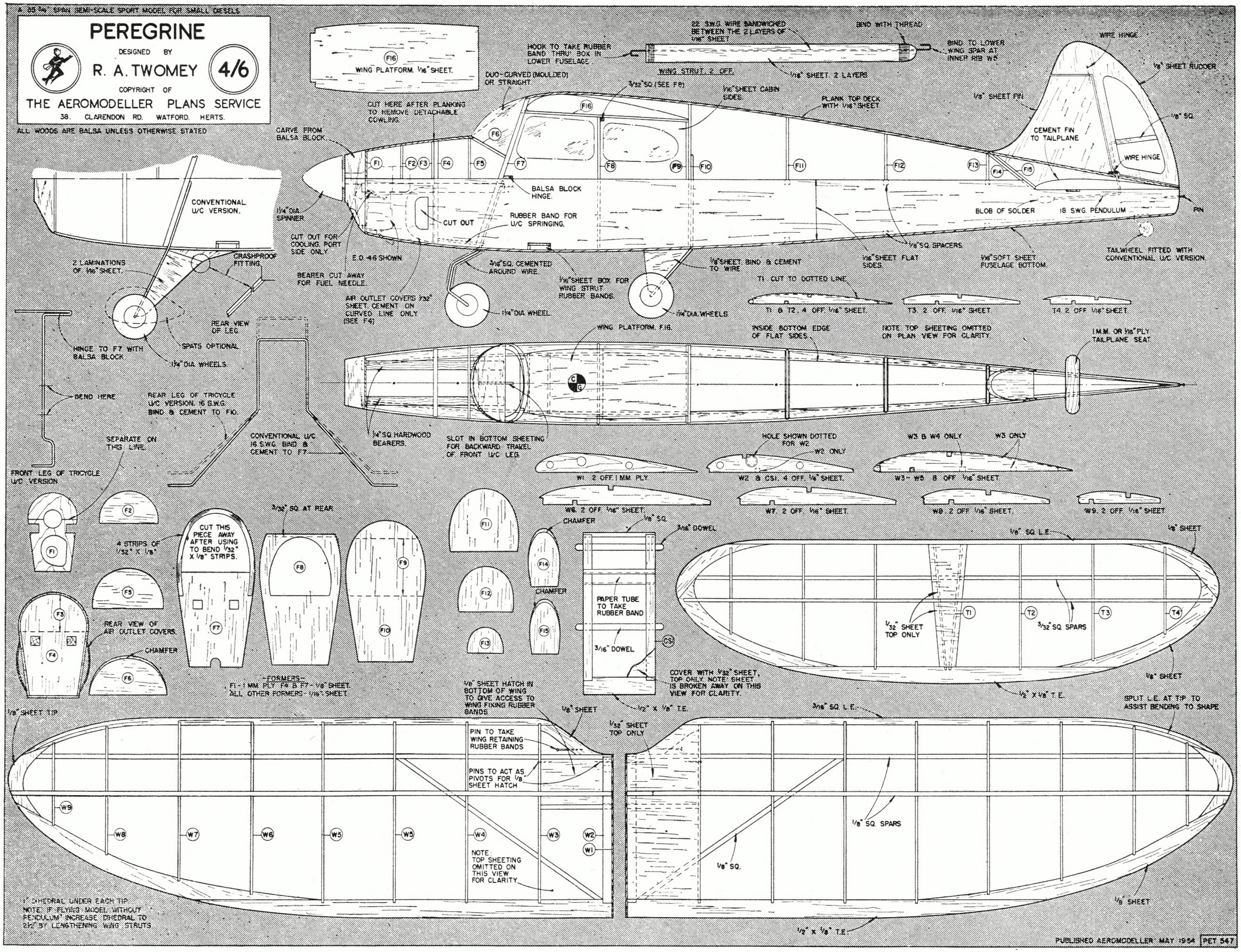
Graph 2: Is an extract from Flight—Measurement MP—11 and shows the characteristic curves with and without TE. They have been evolved in a hall by photo and measurement. They confirm the facts described formerly, that a TE causes a considerable rise of C_L max, that it is only thanks to it that many models can fly with $\frac{C_L^3}{C_D^2}$ max. at all and that the longitudinal stability is improved substantially. (Frank Zaic's Year Book, 1953, p. 78.)

A further corollary of the high C_L max. is the improvement of tow characteristics which become much more steady with the turbulence elastic. In all test models there could also be observed a disadvantage in the method—the inferior reaction upon thermals. Another failing is the additional TE drag. The question of bringing the needed energy into the boundary layer without increase of the total drag (e.g. by adequate formation of the airfoil shape) is a problem of airfoil theory and some time will pass before we discover that solution.

From the sensitivity of Turbulence Elastic to alterations of the angle, we get some important applications. In the same way just as we can reduce the lift gradient $\frac{dC_L}{d\alpha}$ of the wing and improve longitudinal stability, we can also increase it by displacing the wire. The obtainable "servo effects" are remarkable for strengthening the effect of all control surfaces (fins and tails). These experiments are in their initial state, however, and we shall give an account of them later.

NEXT MONTH . . .

another approach to turbulators by S. Suzuki of Japan.



THIS IS A 1/4 SCALE REPRODUCTION OF THE FULL-SIZE PLANS WHICH ARE AVAILABLE, PRICE 4/6 POST FREE, FROM THE AEROMODELLER PLANS SERVICE

PEREGRINE

BY DICK TWOMEY

A Concours d'Elegance class model for the point-fives

TOO much dihedral spoils many semi-scale models, but one way to overcome the need for it is to install a pendulum rudder. If you have never tried one, don't worry—nor had Dick Twomey till he built the original "Peregrine," and now he is a complete convert, with ideas of fitting pendulums to all types of models! If you don't fancy putting one in, build the model with increased dihedral (2½ in. under each tip) by lengthening the wing struts. You have, too, the alternatives of a tricycle gear or a conventional undercarriage, with or without spats.

Though not a beginner's model, the trim lines, all-sheeted fuselage, and concealed wing fixing, etc., make this an excellent choice for builders who prefer a realistic model lending itself to a high finish or those looking for a rugged, all-weather sports flier.

Construction

The basic fuselage sides are first joined at tail and F7, 8, 9 and 10 inserted. Assemble the bearers and F1-6, placing F3 and 4 tight together but not cementing them. Carve and hollow nose-block and plank nose with $\frac{1}{16}$ in. strips, after checking the engine for fit. Shape the undercarriage and install the nosewheel (if used).

This is hinged as shown, between the bearers, F7, and block then sprung by means of rubber bands extending to F4. Add remainder of formers and spacers and construct the centre-section, checking carefully that F16 is set on F7, 8 and 9 at the correct incidence. Fit wing locating dowels, and box for strut.

Build the tailplane before planking the fuselage top and note that the $\frac{1}{32}$ in. sheeting on top of the centre-section extends $\frac{1}{8}$ in. over the ribs to facilitate covering. Fit small tongues to lock the tail in positive alignment.

F15 can be cemented to the tailplane l.e. and the fuselage planking extended right over to the t.e. after cementing the fin onto tailplane. The rudder is lightened and must move freely; the partial aerodynamic balance plus the lightweight means that very little pendulum weight is required. Full movement is $\frac{3}{16}$ in. each side of neutral.

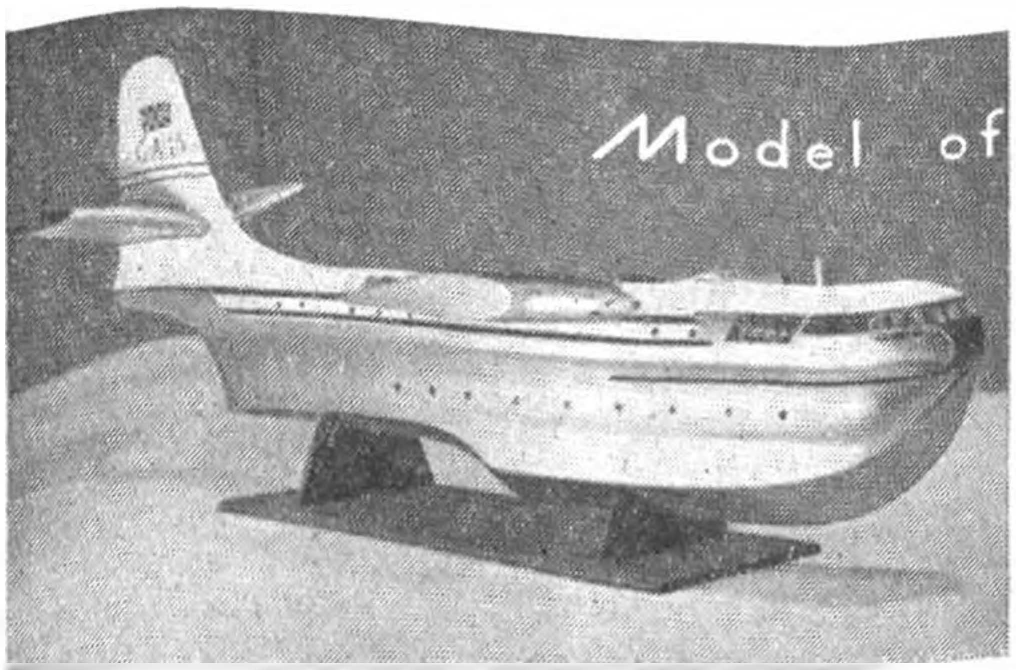
Fuselage cockpit details can now be added, a dashboard and dummy controls, etc. The whole of the under-side is covered with soft $\frac{1}{16}$ in. leaving a nosewheel movement slot (if necessary) and providing drainholes in the engine bay. Complete gill slots, etc.

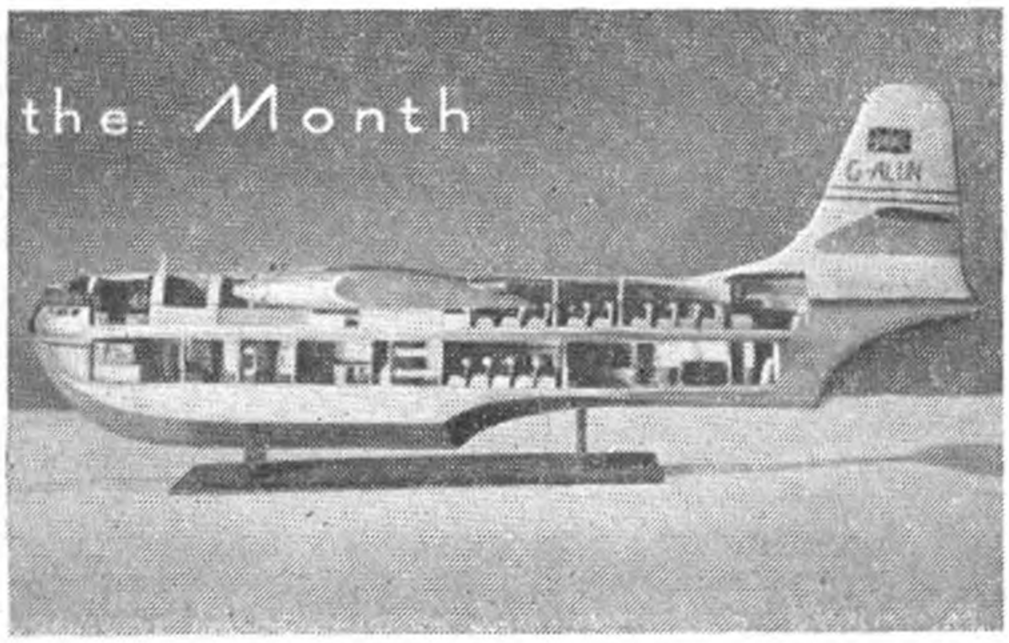
The wings are straightforward and each is fitted with a small hatch to ease attachment. Rubber bands, passed through the centre section tube and root ribs by means of a 16 s.w.g. hook, loop over pins embedded in the l.e. making the wings virtually crash-proof and easily dismantled for transport. The wing struts must be accurate, and are built up from two strips of $\frac{1}{16}$ in. × ½ in. grooved inside to take 22 s.w.g. wire. The wire is looped at each end and bound at the top to the lower mainspar at inner rib W5; the lower loop fits in the strut box and is linked to its opposite number with rubber bands.

Cabin covering at the sides is simple but the windscreen shown is duo-curved and must be moulded. A straight screen can be substituted with a slight loss of appearance if desired. The entire model should be covered with lightweight Modelspan and suitably doped.

The important points in flying are (a) check that the c.g. is as shown (b) check that there are no warps, that fin is neutral and secure, and that pendulum operates freely. Tailplane packing may be used if necessary, although the prototype flew as drawn. With neither down or side thrust a wide left climbing turn is to be expected with a fairly straight glide. Gusts, bad launches, etc., are all magically ironed out by the pendulum, so if you've never tried a pendulum, "Peregrine" can teach you something!

Model of the Month

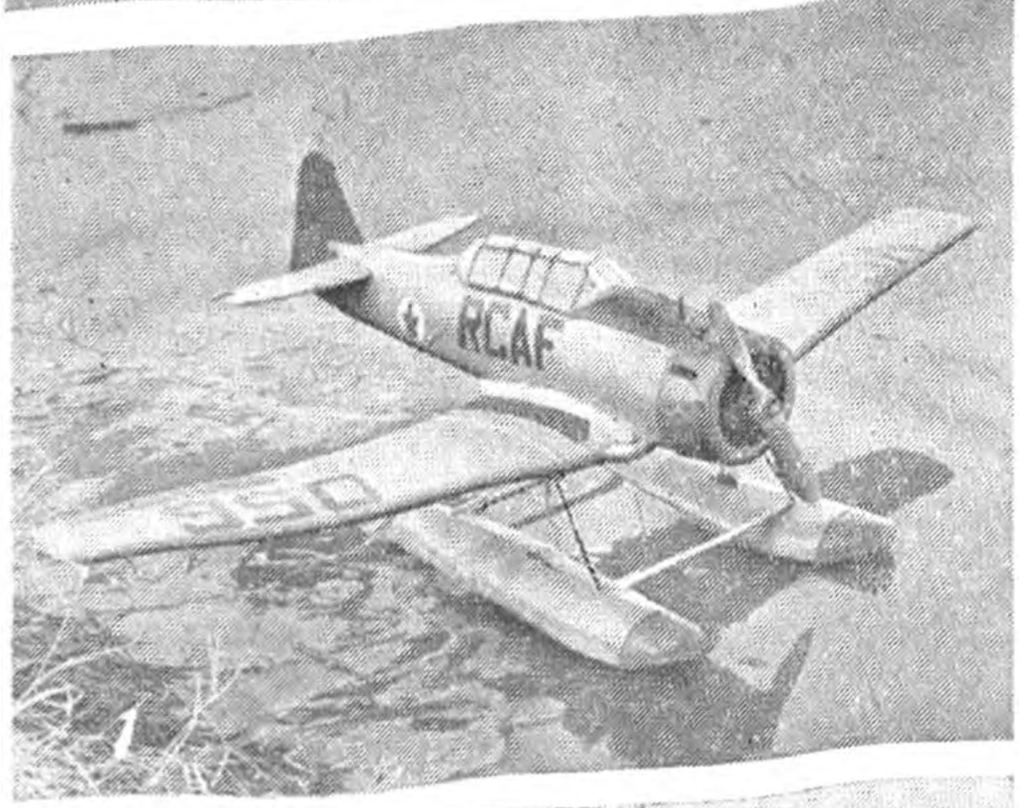




model news

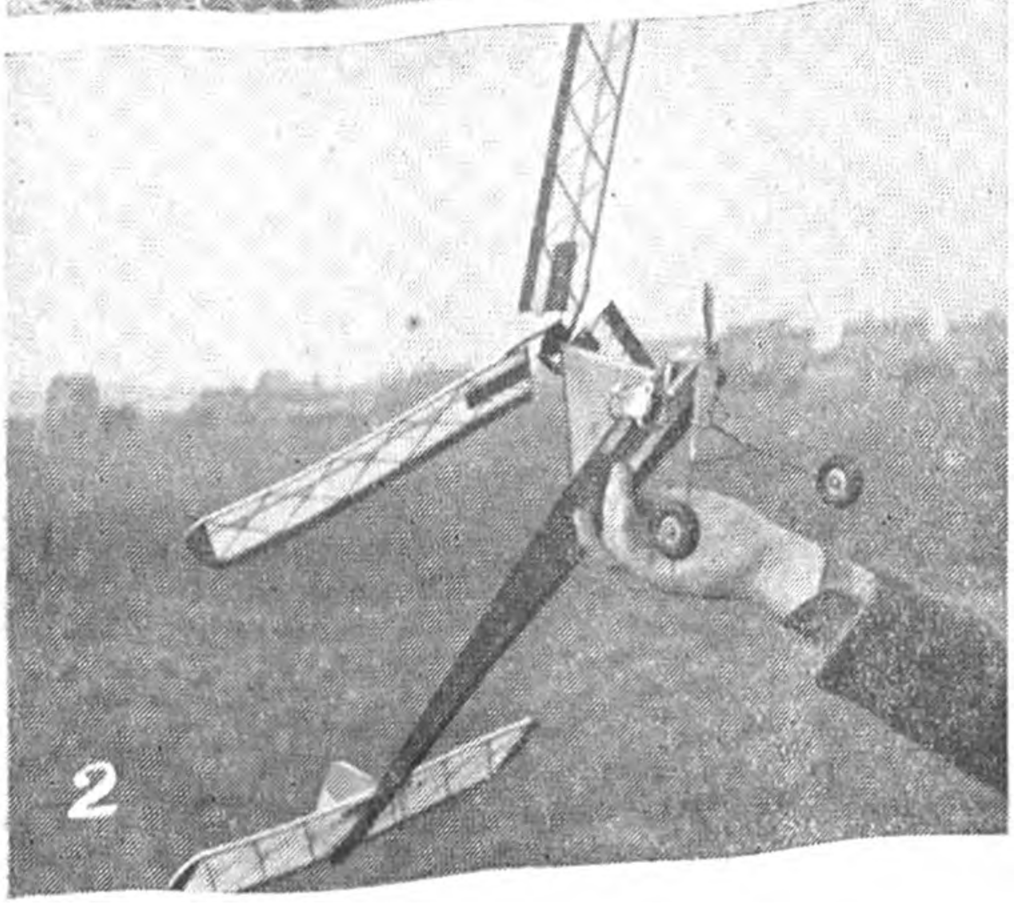
A MAMMOTH effort among solid scale models takes pride of place as Model of the Month and for G. A. Wingrove, serving in the R.A.F. at Fayid in the Canal Zone, it represents no less than 320 hours of modelmaking. Built to $\frac{1}{16}$ in. to 1 ft. scale, this Saunders Roe Princess carries every detail to be found both inside and outside of the real flying boat. Colour scheme is authentic, being a perfect replica of Mr. Richard Lonsdale-Hands interior design, and all internal structure is reproduced to scale in balsa or thin veneers.

Having completed this job, L.A.C. Wingrove is now busily engaged on a similar replica of the Britannia to add to his collection which already includes the Viscount 800 and Avro Atlantic.



1

Bob McCall's floatplane version of the Harvard trainer in photo **1** was also featured in last month's World News; but we thought this second view might help to encourage more attempts at this neglected side of control line flying. Floatplanes on lines, particularly scale models, give an unmatched thrill at each and every take-off or landing. This Harvard is 42 in. span and has a K & B ·29 (5 c.c.) glowplug engine, floats are scale type and mild manoeuvres can be undertaken . . . why not try the seaplane Spitfire or one of the single float Kawanishi fighters?

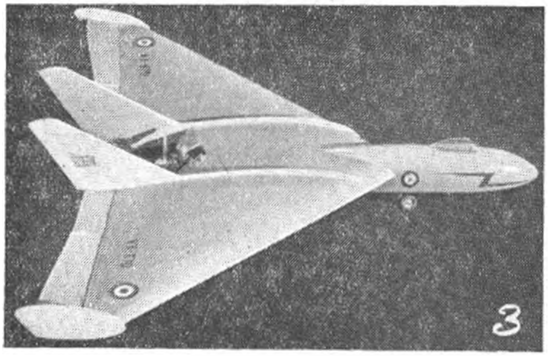


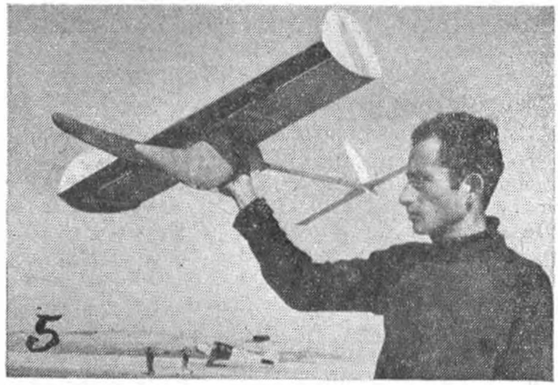
2

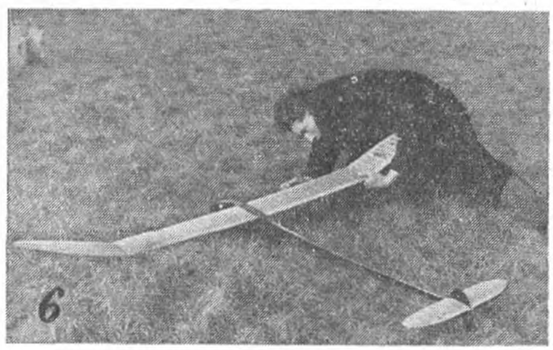
Geodetic style structure and detachable blades are rotor modifications for the APS Ro-Dart in **2** built by Paul Quinn of the Whitefield M.A.C., and without affecting the aerodynamic design, these structural alterations do give several advantages. Other Ro-Dart builders will welcome this photographic tip, for it makes the model even easier to transport, and increases the blade rigidity.

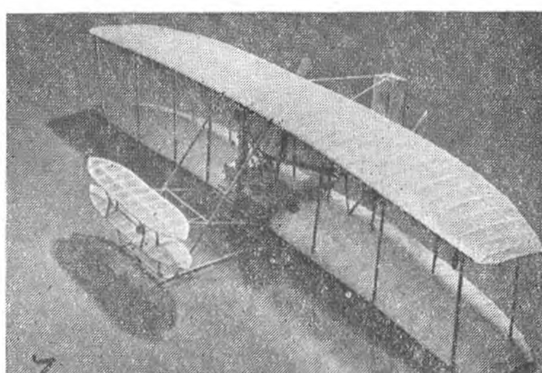
One of, if not the most active northerly club in the British Isles is that at Wick in Scotland; but for all their isolation the lads are by no means behind the times, as witness W. B. Bremner's APS Vultan in **3**. Powered by an Elfin 1·49, the Vultan has been displaying its delta form over the highlands giving excellent performance in all conditions, and knowing the vicious breezes that can blow in those parts, readers may take it from us that this is a good recommendation for an all-weather model.

What happens to the actual prototypes of APS







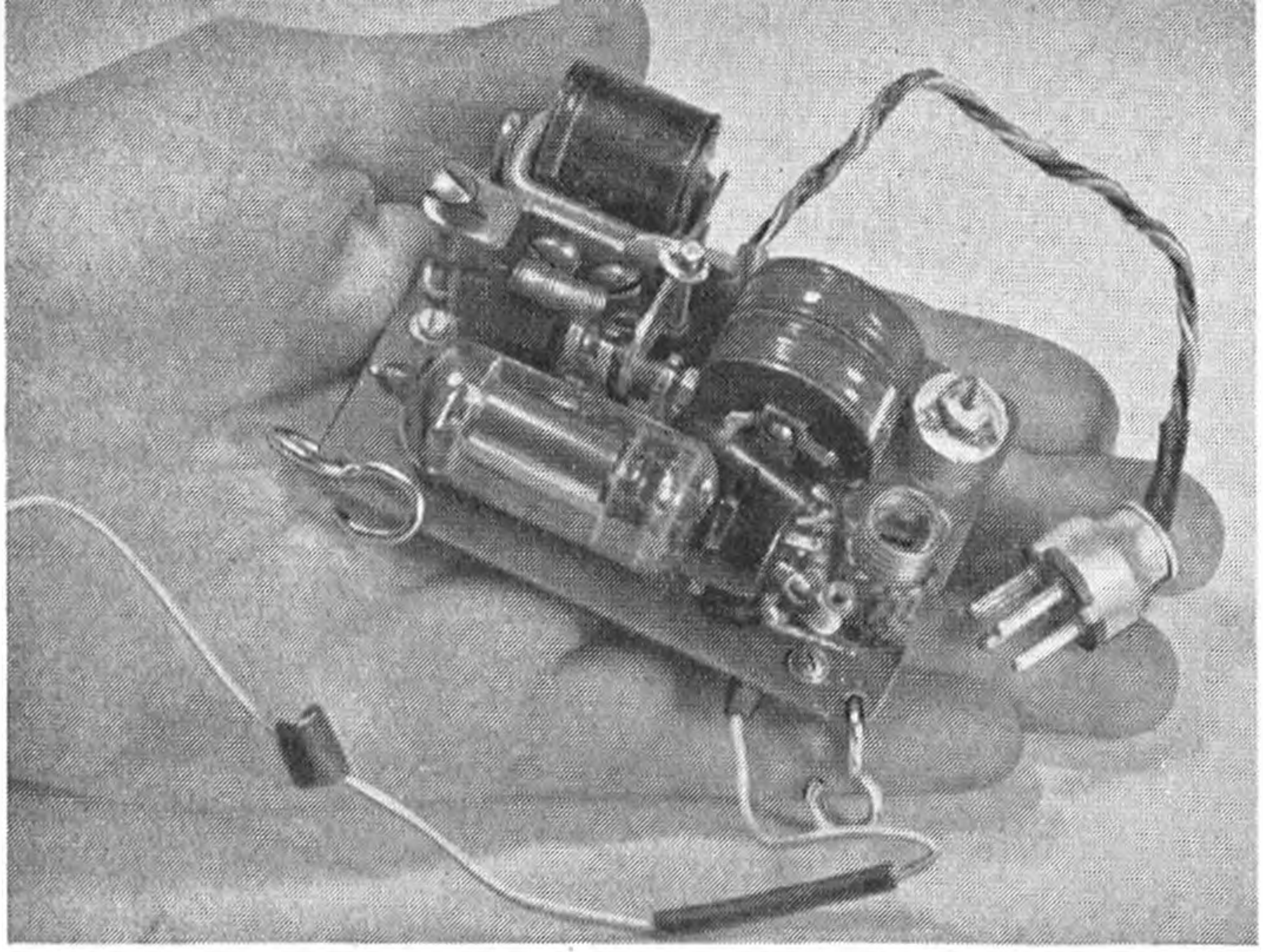


designs? Contest models do, of course go on to win or place in many an event; but the scale models are not made for this purpose. Ray Booth's Avro 504K, seen in **1**, went on show at the Festival of Britain and then came back to Ray for a recovering and renovating job that added another 75 hours to its building time. Right now it is in Australia, on loan from Avro's, so this APS prototype is really getting around . . . and don't forget, it's still a flying model, with the diesel substituted by a dummy rotary engine.

Shlomo Yarkoni, chief flying instructor of the Israel Aero Club, has made what he calls a "Slot-plane," and we gather that this is not a bad proposition for a new approach to reducing sinking speed. Cyrano de Bergerac is the apt name for this unusual design (**5**) . . . perhaps that nose is there for sniffing out the thermals!

Our recent article on Compass steering as developed by E. H. Coppard has already evoked considerable interest, and photo **6** shows the creator sorting out the electrics in one of his test models. This is an APS Tadpole, which would appear to be a particularly suitable design for this kind of flying. The forward fuselage takes care of compass and battery accommodation, whilst the slim rear boom and long tail moment give just the right effect to the compass-actuated rudder. On one windy day at Epsom, when A/2's were disappearing O.O.S. within 2 minutes over the downs, this Tadpole zig-zagged into wind for two to three minutes at a time, never landing farther than 100 yards from the launching spot at any time.

Flashback to the past now, in **7** Mr. Tomkinson of the De Havilland Tech. School sends us this photo of the perfect scale Wright Biplane which is a proud possession of the De H. museum and was made for the "50 years of Flight" celebration. With detail right down to Orville Wright's pair of gloves, this is probably one of the most authentic Wright Biplane models in existence, for it will be remembered that De Havilland students were responsible for the actual size replica which is exhibited in the Science Museum, and was made from measurements of the original before it was returned to the U.S.A.



Radio Control

Making your own Aeromodeller No. 1 Receiver

. . . by SID MILLER

Introduction

DURING the past year or two, many articles have been written about Radio Control. Whilst excellent—most of them have been far too technical for the majority of readers.

In the following article, Sid Miller gives a test report and detailed instructions for constructing and operating a first-class radio control receiver, with suggestions on its installation in the model. Field checks and possible trouble shooting are also covered. The receiver is the Aeromodeller No. 1, originally described in the October 1952 issue.

A report on the receiver would be valueless unless the transmitter type and power used are given. These items will therefore be briefly dealt with first.

When first starting on Radio Control we knew nothing of its requirements or principles. We know more now, a lot more, but lack of "know how" should not stop anyone trying. We shall learn as we go. Given a good receiver circuit, success is more dependent on good workmanship and attention to detail than all the radio knowledge and theory in the world.

The equipment described is the simplest possible, being reliable, economical and easy to transport. If a cyclist, you will find the latter important. The following data has been obtained over a period of more than twelve months using the same model (Rohma), receiver and transmitter. Apart from batteries, no replacements were required. Flying was continued throughout the winter, snow, ice, rain or wind—(not too much). Ploughed fields and golf bunkers shake up the "innards" somewhat, but no harm has been done, in fact, the receiver now seems to work better than ever!

Transmitter

The original is the Flight Control Mk. III—four years old and still going strong. Originally, it had a V-type aerial dipole, but has since been converted to the more usual quarter wave (single vertical rod). Any of the battery operated commercial transmitters are suitable, but if a home constructed one is desired APS also supply plans of an excellent job, which we thoroughly recommend. (JUDD Tx "MODEL MAKER," plan No. MM/234, 2/6d.). On our own transmitter we first operated with the full 5 watts input allowed by the G.P.O., but soon found that with the receiver used, this was quite unnecessary. An input of 3 watts was found to be ample, this being obtained with 120 volts H.T. and an anode current of 25 milliamps.

The H.T. battery lasted two years using the plate current mentioned, and still gave good results when discarded. Usage included all bench and field testing. The L.T. is a 1·5 volt "Alldry 1" and should last a full flying season. No component or valve replacements were required, although the TX received a good battering, being carried most of the time in the trailer with the model.

Some indication that the TX is always working satisfactorily is essential and it is suggested that, as a multi-range meter will be wanted for later battery checks and receiver operation, the multi-range meter described in the April, 1950 "AEROMODELLER" should be constructed. This is a simple and reliable accessory. One modification is suggested. Replace the meter with a two pin polarised socket, wiring the thick socket to the original positive (+) meter connection and the negative (–) to the thin socket. This will enable the same meter to be used for both multi-purpose and receiver field checks, thereby reducing the initial cost.

The No. 1 Receiver

This is a first-class unit, never having let us down, despite very rough usage. It has proved stable, quite easy to adjust, will stay set and is *very economical* on batteries. The range is all that could be desired, being far greater than sight, with a five foot model. As described, it weighs 5¼ oz. with a 2½ oz. Sigma SCR 522 Relay, Aerial, battery leads, and four-pin plug. Weight could be reduced and wiring simplified by a different layout, but experience has proved that shown to be the best. Field servicing, get-at-ability and ease of construction have been fully considered. Checking and adjustments can

in easy stages . . . .

be made through a side hatch in the fuselage, to tuning, sensitivity trimmer, and relay without removing any of the flying surfaces. If, on a dicey landing, one is in doubt about possible damage to components or wiring, it can soon be spotted and put right. *We strongly advise against any alteration to the layout whatever.* Before we proceed any further, a word or two on the relay. The Sigma SCR 522 5,000 ohms coil resistance type, although heavy (2½ oz.), is a marvellous job and really priceless, especially on this type of receiver. *The weight means nothing* compared to reliability, for once adjusted it will stay set for months.

To return to the receiver. With batteries as recommended, *i.e.* H.T. 45v, the standing current should be about 2 m/a. On the eight receivers we have made or rectified it varied between 1·75 m/a to 2·2 m/a. This depends on the valve and/or the winding and positioning of the quench coils. The current drop on signal should be at *least* 1 *m/a* or possibly 1·2 m/a. This applies at close range or absolute maximum range. Its performance is similar to the thyratron or gas valve, *i.e.* full drop, independent of distance, or no drop at all. This is a great advantage as the relay can be set to operate about halfway between standing current and full current drop. This gives a reasonable pull in and drop out power to the relay armature. If vibration still affects the relay, an increase in current drop by raising the H.T. voltage to 67½ vs., should put things right. Standing current will then be about 3 m/a dropping to about 1·2 m/a. The smallest deaf-aid batteries (122 size) will stand the extra drain, but must be watched carefully. Here the larger 110's are recommended, providing the model can take the extra weight. The smaller 122's at 45 volts with a 2 m/a drain lasted 9 months average flying, flights being between 5 to 10 minutes. This includes field and bench testing. We never swop our batteries about! With the receiver switched on they still read 36 volts, the standing current holding steady on 1·75 m/a giving the usual 1 m/a drop. This after a number of flights during the day. A reliable low tension (L.T.) supply is available in two 1·5 volt Pencells, wired in parallel. As the filament drain is only 50 m/a (as is the XFG1) this battery will last some considerable time. When checked, again under load, and found to be approx. 1·3 volts (not less), it should be changed

Soldering

Before starting on the receiver construction, we should like to make a few comments on soldering. An article in the "AEROMODELLER"—October, 1951, covered this topic, but mainly dealt with airframe fixtures made of steel wire. While the general procedure is similar concerning radio joints, one has to be *very particular indeed* regarding cleanliness, as the joint must be made quickly. When purchased, most radio components have already had the wires or tags tinned. Unfortunately, during storage and handling they become cirty, therefore, clean every contact to be soldered until it is as bright as a new pin. Re-tin leaving any holes or slits open in valveholder and tags. The iron must be hot! Not just hot enough to melt the solder, but also hot enough to transfer some heat to the joint without the iron cooling too much. When the iron gets dirty—wipe quickly with a clean rag while still hot. The original tinning should remain behind. The joint should be made instantly, the solder literally "flowing" on, and no pressure on the iron is required, as if held in position for more than a few seconds it may be the ruin of a component. "Ersin" Multicore solder should be used, being obtainable in 6d. lengths. On no account use corrosive fluxes such as Bakers' Fluid, Arax cored solder, or killed spirits. If uncertain of your ability to solder quickly to short wiring, a useful tip is to wrap a small piece of fairly damp cotton wool or newspaper round the end of the component, thus preventing the heat from spreading too quickly. This applies particularly to the 3·3 megs. resistor and 100 pfs. grid condenser connected to tag 3 of valve holder.

The Panel (Fig. 1)

This is made from $\frac{1}{16}$ in. Paxolin sheet, wnich is obtainable from any radio dealer. Paxolin is rather brittle, but can be cut with a fretsaw, using a medium cut blade. Cut to size as shown in Fig. 1, afterwards making a tracing of Fig. 1, fixing to the Paxolin with sellotape. Centre punch holes where

Here's what you need . . .

	Component List	Retail Price Inc. Tax
1	Paxolin Panel 3¼" x 2¼" x $\frac{1}{16}$"	
*1	7 or 8 pfs. Philips Beehive Condenser	1s. 6d.
1	⅜" Aladdin Former with Slug. (*See* Text)	1s. 1d.
1	3.3 megohms Resistance (⅛th Watt)	6d.
1	100 pfs. Fixed Condenser. (Tubular Ceramic) ...	1s. 0d.
1	.003 mfd. Fixed Condenser. (Hunts Miniature) ...	1s. 3d.
1	.01 mfd. Fixed Condenser (Hunts Miniature) ...	1s. 6d.
1	B7G Button Valve Base (Amphenol)	1s. 0d.
1	Relay (Sigma SCR522, Siemens 73, E.C.C.) ...	Variable
1	Valve 3S4	15s. 3d.
1	4-Pin Polarised Plug (Miniature)	6d.
*	Quantity 38g. Enamelled Copper Wire (2-oz. Reel) ...	2s. 9d.
*2	or 3 yards each of RED, BLUE, BLACK, YELLOW and WHITE Lightweight plastic-covered stranded wire	yard 1½d.
1	doz. 8BA ½" length Bolts and full Nuts (Brass or Cadmium-plated Steel)	10d.
2	doz. 8BA Washers	4d.
1	doz. 8BA Solder Tags (double-ended preferred) ...	5d.
1	yard 2 mm. Systoflex Sleeving	4d.
1	1" 8BA Bolt	

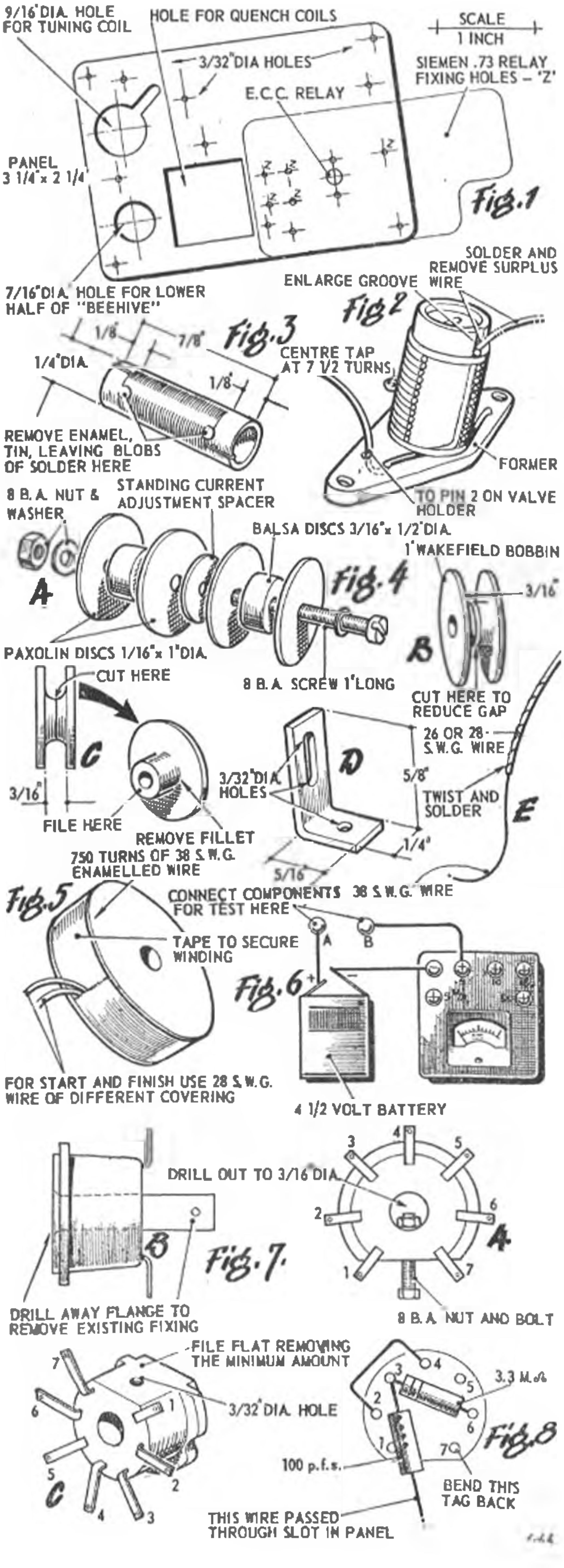
The following components, while not essential, are strongly recommended as spark suppressor and are fitted across the relay contact points:

1	100 ohms Resistor	¼ Watt—6d.
1	.1 mfd. Fixed Condenser (Hunts)—High voltage not essential	1s. 3d.

Components required for attachment to fuselage:

1	50k. ohms Potentiometer (Miniature) (25k. or 100k. will do)	3s. 9d.
1	On-Off Switch. Double Pole, Single Throw (D.P.S.T.) E.D. Flat Type	3s. 9d.
1	4-pin Polarised Socket	6d.
1	2-pin Polarised Socket	6d.

The items marked * may be difficult to obtain locally.



marked. Use moderate pressure when drilling, or badly chipped holes will result. Remove all burrs from both sides of the panel. The lighter line in Fig. 1, represents the Siemens 73 relay, which will be mounted, with its own base on top of the panel, in the assembly stage, to be described next month.

All holes should be drilled 3/32 in. dia. except the four corner ones, which are 1/8 in. dia. Fretsaw out the tuning coil hole, not forgetting the projecting slot, the Beehive Condenser hole (a trifle undersize), and also the square for the quench coils. As very few Sigma relays are obtainable, no holes are shown as the position of these vary with each one. The E. C. C. relay will fit comfortably being very simple to fix. Drill to suit relay.

The Tuning Coil (Fig. 2)

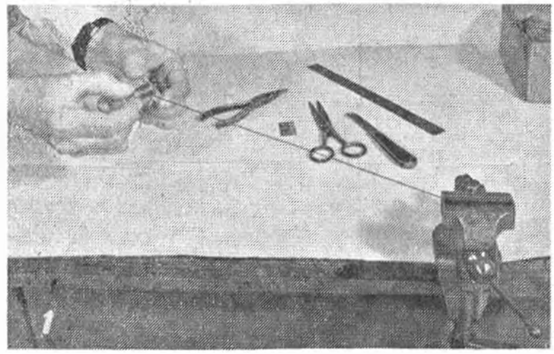
Taking the Aladdin former, which should be of the transparent type having four fine grooves spaced round the circumference. One of these should be made deeper and wider using a small file or penknife point. This should be made deep enough to hold in position a short length of 20 G. or 22 G. *tinned* copper wire. If your particular former is plain, a groove must be made the full length of the former, conveniently near the wire fixing holes. When working on the former it is advisable to keep the slug inside, thus allowing the former to be handled without splitting. This size wire is also used to wire up the receiver where required and about 1 yard will do, being obtained from Woolworths as plastic covered single cored, the covering being removed. Taking about 4 in., feed through the two holes (Fig. 2), leaving about 1½ in. for connection to valveholder. Bend and form into groove as shown. Take about 24 in. of the flexible, covered wire (that to be used for battery leads), thread this into the other holes leaving about 1½ in. spare. The other end of the wire should be secured to the bench or vice. Stretching the wire taut, wind on 7½ turns by turning the former, working towards the bench. (Photo 1). Making sure the length of tinned wire is in its groove, wind over it. It will then be held firmly in position. At 7½ turns, and still keeping the wire stretched, cut round the covering with a razor blade—being careful not to cut into the fine strands of wire. Pull back the covering until about ⅜ in. of bare wire is exposed. Double back and twist into a loop. Continue by winding on another 7½ turns. As the 15th turn crosses the bare wire, note the spot and again cut through the insulation. Pull back the covering and, bending the stiff wire outward (Fig. 2), twist the bare part round it close to the former. Making sure the coil winding is tight, apply flux and solder. Cut away surplus wire. Twist centre tap tight and tin. The length of the completed winding should be approximately ¾ in. which is the length of the slug. This means that the plastic covering must be very thin. If other wire is used, *i.e.* enamelled, the turns should be spaced accordingly, to bring the coil to the desired length. Only an approximate length is needed. The plastic covered type makes a firmer and better job.

The High Frequency Choke (Fig. 3)

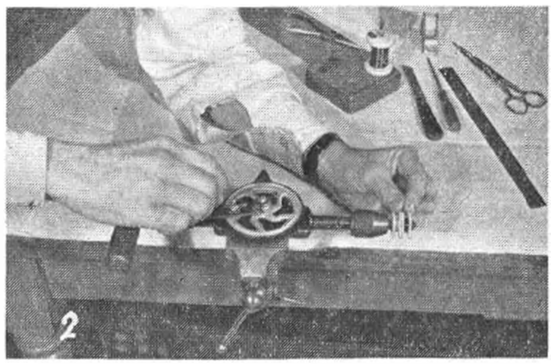
This is 80 turns of 38 G. enamelled wire on a $\frac{1}{4}$ in. dia. former $\frac{7}{8}$ in. long. The former is made of gummed paper wound on a $\frac{3}{16}$ in. dowel. The *outside dia. should not be less than $\frac{1}{4}$ in.* Apply a thin smear of cement to the outside and dope black if desired. To wind, make a fine hole $\frac{1}{8}$ in. from one end and thread the wire through two or three times, passing it over and over the end of the tube. Fix a hand drill firmly to the bench and place a short length of $\frac{3}{16}$ in. dowel in the drill chuck. The tubing is pushed onto it wired end first. The opposite end of the tube should project clear of the dowel to enable another hole to be made $\frac{3}{8}$ in. from the first. Placing the spool of 38 G. wire in a container, hold the wire near the tubing and slowly turn the drill, guiding along the tube. Wind the turns as close and even as possible, filling up the space between the holes. There is no need to count the turns. Secure the end of the winding in the same manner as the start, making sure the turns have been kept firm and tight. The enamel should be scraped from a small area at each end, with a razor blade, removing as much a possible from between the turns. Smear with flux and tin. A small blob of solder will form, which should contact several turns. Fig 3 will make this clear. This completes the H. F. C.

The Quench Coils

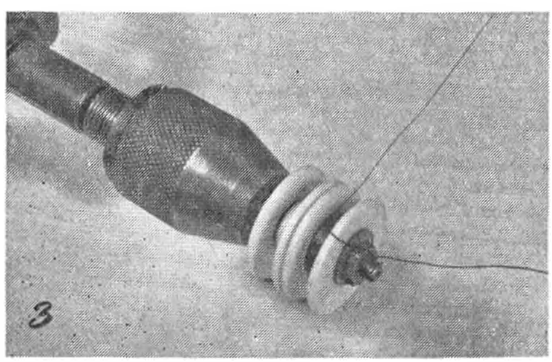
The formers can be made in two ways. (A)—Four 1 in. dia. paxolin discs are cut and drilled $\frac{3}{32}$ in. centres. These are spaced with $\frac{1}{2}$ in. dia. $\frac{3}{16}$ in. thick hard balsa discs. Fig. 4a. (B)—Wakefield bobbins can be used, after some modification, making a much stronger and better job. As the gap between the side plates is $\frac{1}{4}$ in., this must be reduced to $\frac{3}{16}$ in. by cutting through the centre (Fig. 4b). Sand or file off surplus, keeping the faces square rejoining with cement. After completing both bobbins, bolt together and wind a $\frac{3}{16}$ in. wide strip of adhesive tape or gummed paper tightly round the centre of each until the required $\frac{1}{2}$ in. dia. is reached. As the centre holes in the bobbins are larger than wanted, fuel tubing should be slipped over the 8 B.A. securing bolt when fixing for winding and later mounting to the bracket, using suitable washers at each end. The Wakefield bobbins will take a 2 B.A. threaded rod (Photo 3). Should the bobbins be of the type as in Fig. 4c, cut as before and file the curved shoulder away. Proceed then as in Fig. 4b. The material is quite easy to work. The mounting bracket is shown in Fig. 4d and should need no explanation. The bolt securing the bobbins is now firmly fitted into the hand-drill chuck. 750 turns of 38 G. enamelled wire has to be wound into each section, and in the same direction. This is done in the same manner as the high frequency choke. (Photo 2.) Before commencing, however, a short length of thicker wire must be soldered to the 38 G. Size 26 or 28 G. covered wire will do, about 9 in. long. As the finish of the winding will be treated in the same way, it is



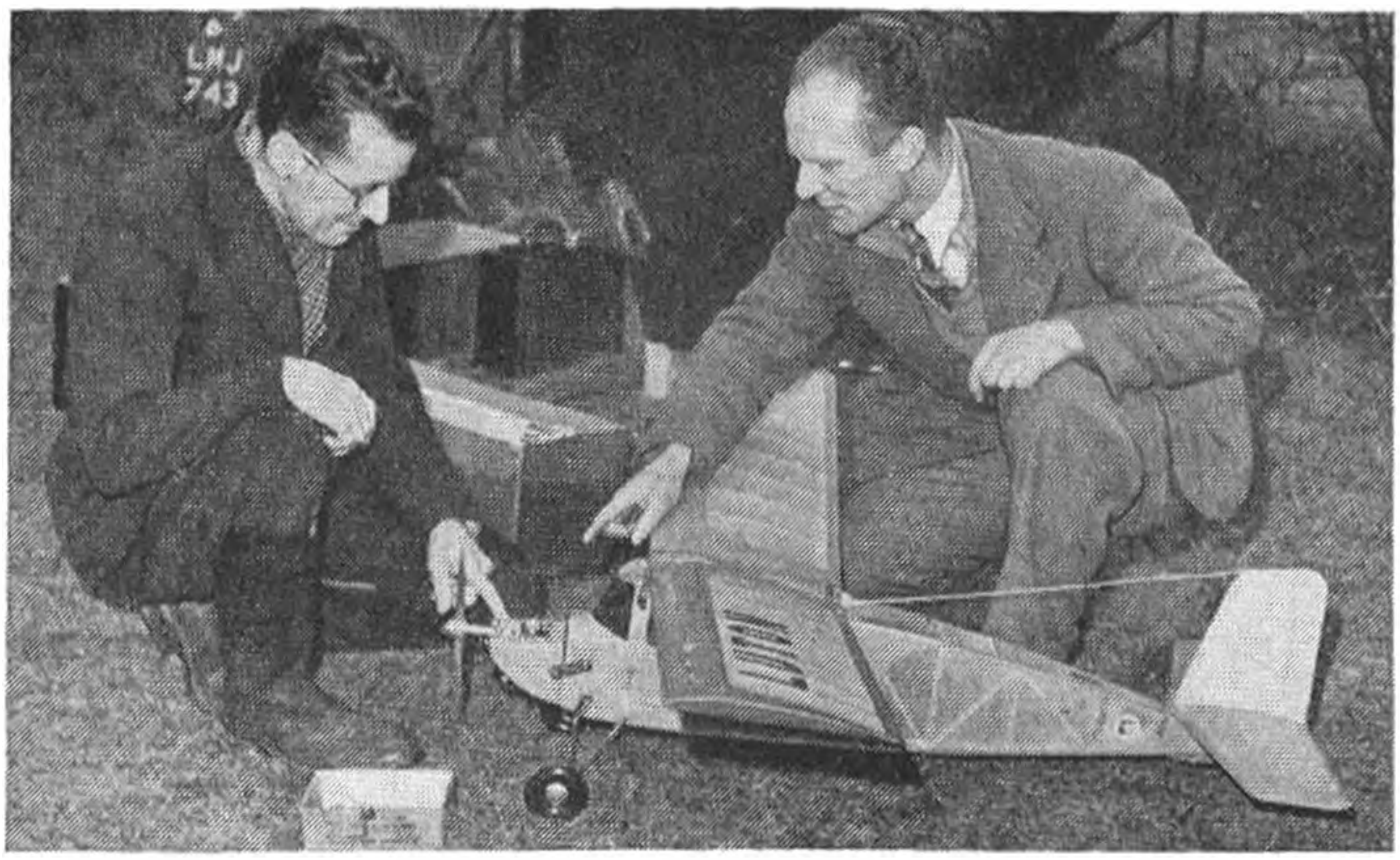
Winding the tuning coil with fifteen turns of plastic covered flexible wire onto an Aladdin former. At the halfway stage of 7½ turns, a loop is wound into the wire as a centre tap for a purpose we shall describe next month in the assembly stage.



The Quench coils are made with the use of either paxolin discs or Wakefield model bobbins. Winding the 750 turns onto each of the two sections is easily done by fixing the drillbrace in a vice and winding straight off a reel of 38G. wire.



Close up of the drill chuck and partly wound bobbin shows the 2 B.A. threaded rod used to hold them firm during the operation and the free end of the thicker connection wire from the inside beginning, held with Sellotape to the outside of the bobbin.



Sid Miller explains the "works" of his famous Rohma design, now available as a full-size plan through "Aeromodeller" Plans Service, to Clubmate Dan Bateman. Rohma is Sid's favourite model, and this series of Radio Control in easy stages . . . the model, the receiver and radio operation is based on his experience in flying this same model/radio combination for over two years in all conditions.

advisable to use different coloured wire which will enable the start and finish of each coil to be located when wiring up. It is suggested that enamelled wire for the start, and double cotton or silk covered for the finish, be used. Clean the ends to be joined and twist as shown in Fig. 4c. A small piece of sellotape is covered over the joint to insulate. Two or three turns of the thicker wire are wound round the bobbin centre, the end of the wire being passd up the inside face of the bobbin, being secured to the outer face with sticky tape (Photo 3). Do not cut off, leaving the few inches for connecting purposes.

Making sure the thicker wire is wound firmly round the bobbin centre, wind steadily holding the wire close to the bobbin, working it from side to side *slowly*, winding hank fashion. There is no need to get the layers evenly placed but watch out for hollows and humps which can be filled in or avoided as the bobbin fills up. Keep the wire under a fair tension, but do not overdo it, or it will break. 750 turns should just fill the bobbin. The exact number is not important, but get as near as possible. When the winding has been complete the second piece of thicker wire is soldered on. Remember, choose wire with a different covering. Again covering the joint with sellotape, wind once round the complete coil, bringing the end out near to where the start is located. Before releasing the wire, bind a piece of $\frac{3}{16}$ in. wide adhesive tape once round the coil, thus securing the end. Taking the start, also wind this once round over the tape, covering with a further single layer of tape. The coil should now be as in Fig. 5. Repeat with the other bobbin, making sure to wind in the same direction. A refinement is to cover each coil with sellotape, overlapping the bobbin sides and thus holding the complete bobbin together. If it is desired to separate the coils for any reason, mark the inner faces then correct replacement will be certain.

Component Test

When the time comes to switch on the finished receiver, there is always the possibility of "no joy". To save later trouble or doubt, it is advised to test the previous components for continuity before final assembly into position. Fig 6. gives the test circuit, the ends of the various windings being bared and connected to points A and B. A flick of the meter pointer will indicate a continuous circuit.

The Valve Holder

This should be the type having a black base (AMPHENOL). Remove the aluminium mounting ring. Gently bend back all the tags and fix end of centre tube in vice. Drill away top of tube and pull base upwards off the tube Fig. 7b. Carefully drill out centre hole $\frac{3}{16}$ in. dia. A flat is then filed on base side between tags 1 and 7. Fig. 7. A and C. Drill a $\frac{3}{32}$ in. hole through the side of the base into the $\frac{3}{16}$ in. centre hole. Fig. 7 C. Drill carefully, keeping the drill vertical. An 8 B.A. nut is now slipped into the $\frac{3}{16}$ in. centre hole wedging with a sliver of balsa. Thread an 8 B.A. bolt into the smaller hole and work the nut about until the bolt can be screwed on to it Withdraw the wedge. Before mounting the valve base, one end each of the 3·3 megohms resistance and the 100 pfs. condenser should be soldered to tag 3. The other end of the resistance is soldered to tag 6. The 100 pfs. fixed condenser is adjusted so that the free end can be pushed through the slot in the panel when fixing the base. Fig. 8. A short length of stiff wire, suitably insulated with sleeving, is connected between tags 2 and 4. Bend tag 7 right back against side of base out of the way.

Next Month . . .

Sid Miller describes the assembly, toning and field operation of this easy-to-make receiver.

Peter Gasson discusses

Contest technique

IS IT LUCK which wins contests? Or is it skill and judgement? Probably some of both, but the fact that year after year all the major contests are won by a nucleus of experts points to skill being the major factor. The best thing which could happen to aeromodelling would be for the trophies to be wrested from the grasp of the select few and shared among those who take a keen delight in their hobby but always seem to fall down when it comes to a contest.

Probably the first essential is to make the model as foolproof as possible to mishaps on the day, especially with regard to the dethermaliser. It is ironical that in a contest, although intent on getting the best out of a model, one is just as pre-occupied with curbing its duration within sight of the time-keeper.

5 Minute Model Myth

We hear a lot about the so-called five minute model. It is debatable whether a model which consistently clocks five minutes in still air has ever been achieved. A model which does 6, 5, and 4 minutes with an occasional 2½ minute flight can hardly be called a five minute model although this is the mathematical average. At present day standards a five minute flight must have had thermal assistance.

Three minutes is more like the normal flight average. There are but two contests a year flown under what is hoped will be non-thermal conditions, so the main contest requirement is not a still-air five minute model but one which can catch the most thermals and can be flown with no fear of it folding up in the rough landing it may receive.

"Borrowed" or Originated ?

The model itself, the main character in the drama of the contest, should be paid careful and exhaustive attention. A contest entails a number of decisions and one is encountered with the very first thoughts of the contest model. Do we design our own model? Or use someone else's design? If the second course is adopted, the spending of much time, thought and ingenuity is avoided without lessening the chance of success. A good example of this was the 1948 Wakefield Trials, won by Roy Chesterton with an Evans design which is now the celebrated Jaguar. The sense of achievement in success, however, with an original design is not to be compared with that when a "borrowed" model is used.

The word "design" is somewhat misleading since only one in a thousand modellers actually make any calculations other than for wing area.

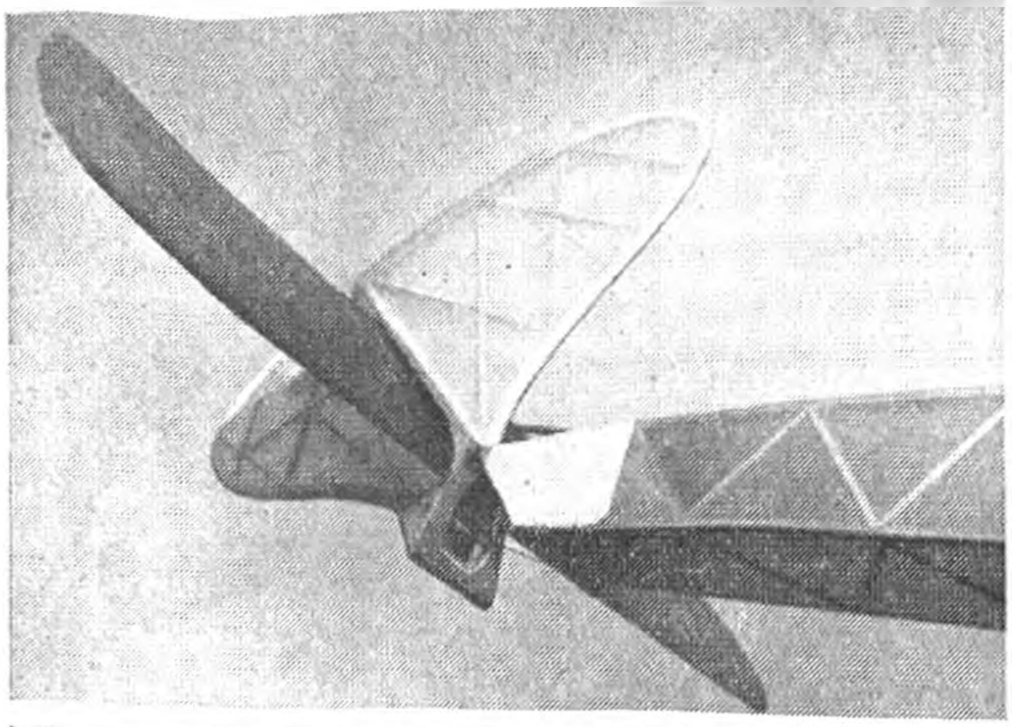
The best plan to adopt is to choose a model which has given the best results in the past and develop it by practical research.

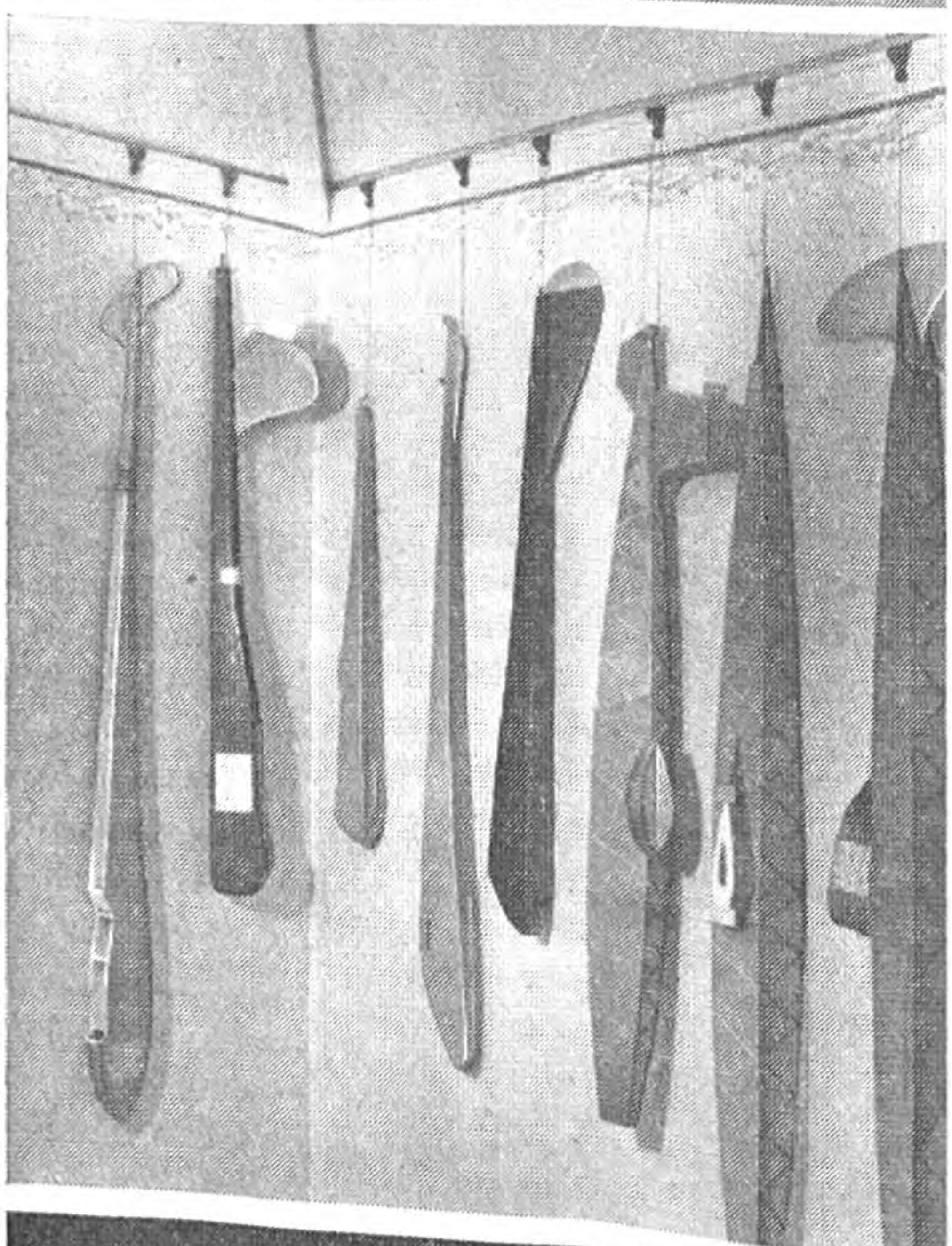
D.T. Hints

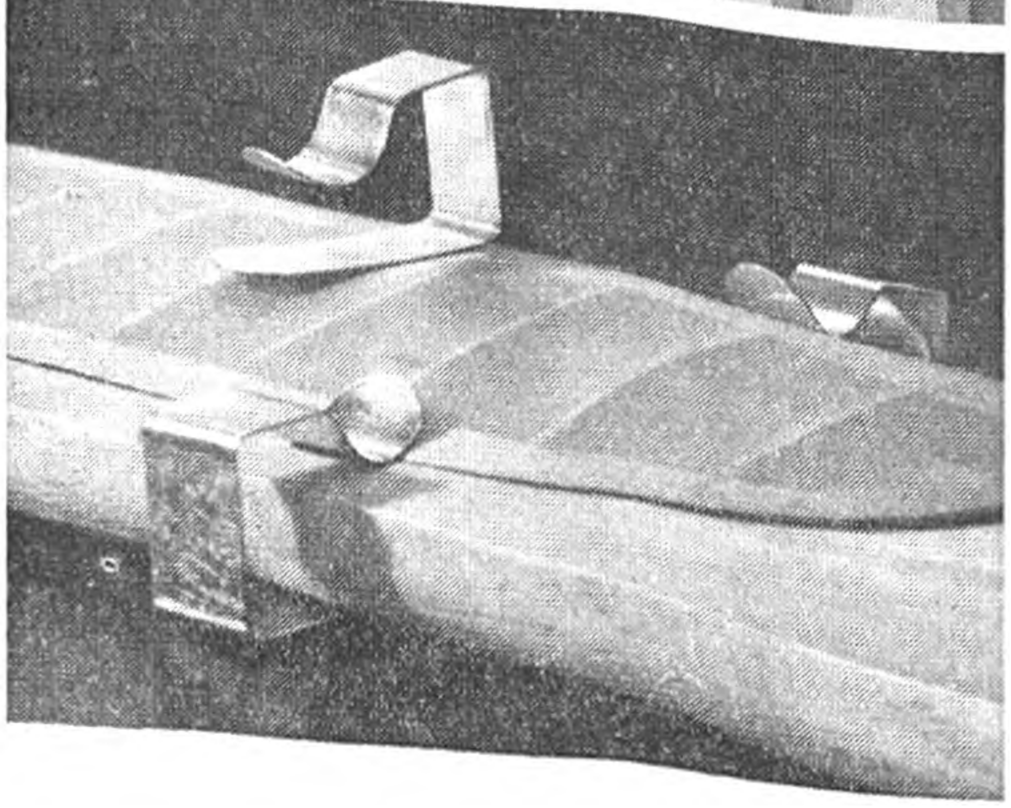
The main factor governing the D.T. is its operation which must be foolproof and accurate. Everything depends on the fuse which must be carefully prepared. The best type of fuse is about $\frac{3}{16}$ in. or ¼ in. diameter white soft and closely wound piping cord which will burn steadily without further treatment. If there is any doubt about this it is advisable to treat it in a cold saturated solution of potassium Nitrate for about 20 to 25 minutes. When dry, a fuse treated in this way is certain not to go out under normal conditions or when the rubber retaining band is reached. The method of attachment to the unit should not bring the fuse into contact with any metal which would absorb heat and cause the fuse to go out before reaching the retaining band. If backing is found necessary to stop tissue burning, thin asbestos sheet is best as it cannot conduct any heat from the fuse.

The only really reliable type of dethermaliser is the tip-up tail. This brings the model down in a vertical descent but it remains horizontal all the time. Once adjusted, the tip-up tail is perfectly safe and ensures as soft a landing as can be expected. It is usually possible to reach the model and catch it before it makes contact with the ground.

Hingeing the fuselage itself is suitable for a long-fuselaged model as it often breaks it into a convenient length for transport. If none of these methods







can be incorporated in the design, the parachute is the next best alternative.

On the Day

Before making a competition flight, all parts of the model should be carefully checked. When your card is given in, indicating you are ready to fly, the D.T. fuse should be pulled to the exact length required to get the model down within about 5½ minutes or the time it takes on that particular day to drift out of sight. The best arrangement for retrieving models is a motor cycle with a pillion rider so that one may later chase on foot if necessary. If neither a bike or a car is available, the modeller has to be something of an athlete.

Some of the winds encountered on competition days put the chaser-on-foot at a great disadvantage as he *may* find that to keep up with the model he has to run about 4,000 to 5,000 yards in five minutes, which is over three times the speed of the best Olympic runner for that distance. If a model is valued, it is advisable to set a 2½ minute fuse on such days while an even safer step is to keep the model in the box with the hope of the weather changing. If a strong wind has persisted throughout the morning, there is usually a very good chance that it will drop before the evening.

Model recovery

Even on the few still days a contest falls on, a model can be lost because of D.T. failure. It is useless to run after a model floating at 2,000 feet and whose D.T. is five minutes overdue. I have run eight miles after such a model and then lost it vertically overhead. This chase was, as most chases are, across country where there are no buses, so after losing the model, I had to walk eight miles back.

Very often it is necessary to estimate the location of a model which has landed some distance down wind. It not always is possible to be right under the model when it lands and very often its owner is trailing half a mile behind. In such cases it is possible to locate the model by "pin-pointing" on the horizon.

By lining up suitable landmarks such as trees or large buildings it is easy to find the model quickly. If it was last seen in front of a large oak tree and between a house and main road and only about 30 ft. up, it can be assumed the model would be down in half a minute. If the wind is blowing at, for example, 20 m.p.h. a simple calculation would tell you the distance within which you could expect to find the model.

Distance (miles) = Speed × Time (hours). Substituting the known facts into this equation gives:

Top: An efficient tip-up tail dethermaliser using a "broken" and hinged fuselage. Note thin asbestos sheet to prevent the fuse burning any tissue.

Centre: Hanging fuselages vertically on a convenient wall keeps them straight and true.

Left: "Terry" drawing board clips keep wings and tail planes flat and warp-free on a storage board.

distance = 20 × ½ × 1/60 or 20/120 which equals 1/6th of a mile or 300 yards.

This establishes that the model has landed within 300 yards behind the oak tree or possibly just in front of it. If the model was flying in 50 ft. diameter circles it is unlikely to be more than 60 ft. on either side of the tree. *See Heading illustration.*

Larger clubs are fortunate if they can arrange to place a recovery party down-wind which gets over nearly all retrieving problems. An even better idea is to recruit a band of "Fetchermites" as described in the May issue of the "AEROMODELLER"!

Multi-Coloured Covering

Models can reach the limit of visibility on a flight of much less than five minutes and it pays to use brightly coloured tissue. It has been proved over and over again that red is best against the usual sky background, but a red model passing dark trees is often invisible after half a mile. Therefore another colour is required and the best for contrast is yellow or white. Other colours with respective range figures may be seen in the table. A glossy finish will always be more visible as it reflects more light. On ultra-lightweight models a glossy finish is out of the question although the prop blades may be glossed without an appreciable increase in weight. A disadvantage of covering a lightweight with red tissue is that a dark surface is more likely to cause warping on sunny days as it absorbs more heat than the lighter colours.

The conclusion seems to be that good visibility demands a multi-coloured model, or at least a model which is likely to have at least one contrasting colour against any background. With a well-trimmed model which is banking, a white top surface with red underneath will produce a flashing, alternating effect.

Storing a Champion

Many fly the same contest models for some years, and even if the majority of models do not last so long, storage is a factor which cannot be given too much attention. Models should at all times be kept indoors and if they cannot be stored behind a locked door, younger brothers and sisters must be treated as mortal enemies where contest models are concerned.

Wings and tailplanes should be pinned down to prevent warping if they are to be stored for any length of time and it is a good plan to adopt this procedure for all models whenever they are not in immediate use. Fuselages should be hung vertically from the tail to help prevent bends occurring, especially on a long moment-arm job. Wings and tailplanes are best kept down with specially-made clips although for light structures, drawing board slide clips may be used. They cost about 4d. each and only four are required for a Wakefield tailplane.

Rubber motors also need careful storing. If bought by the lb. and left open to the air for long before it is used, it soon deteriorates and becomes useless for model work. It should be loosely hanked and wrapped in three or four layers of newspaper. New rubber is usually covered in French chalk, an additional preservative. If the rubber has been made into a motor it is only necessary to remove the bobbins and any cording turns. It may then be wrapped up in newspaper with every confidence of it remaining in good condition for up to a year.

WIND SPEED TABLE

Classification	Description	Speed in m.p.h.
Calm	Smoke rises Vertically ...	0 – 1
Light Breeze ...	Rustling leaves or Wind Felt slightly	2 – 7
Gentle Breeze	Handkerchief Extends ...	8 – 14
Fresh Breeze ...	Small leafy trees and Branches sway ...	15 – 24
Strong Breeze ...	Telegraph Wires "Sing" ...	25 – 35

Weather Worries

Weather is often the cause of triumph or despair to flyers at contests. Nobody needs telling that our weather is very unstable and that one has little hope of forecasting more than a few hours ahead. There are no absolutely reliable indications of good flying weather. Often, two models trimmed to a similar flight pattern and having practically identical performance can be released at the same time and yet return flights as diverse as 2 mins. and 5 mins. respectively. Localised air currents account for the fact that although flying only 50 feet apart, one model often sinks while a second goes up.

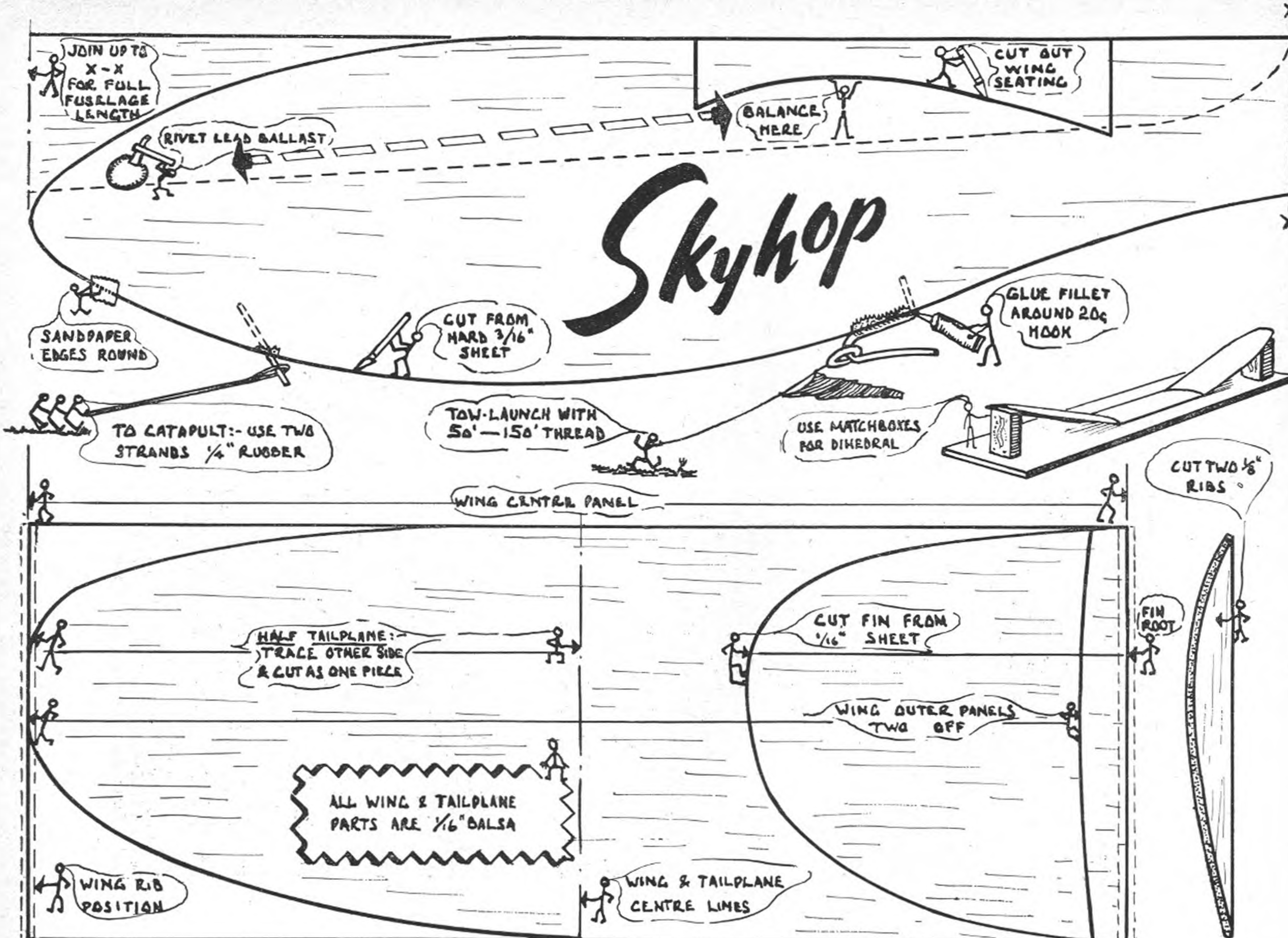
Thermals are most prevalent during the early afternoon and still air (no wind) later in the evening, although this is usually not until after 7 p.m. when most contests are over. When flying gliders it is possible to feel lift when towing up. Scandinavian modellers actually wait with the model on top of the line for some lift to come along before they release it. A good tip to follow.

When a model enters any lift, its circular flight immediately tightens. This serves as a useful hint to put a best leg forward as it usually means a maximum. Pockets of lift like this can sometimes be a mixed blessing if the turn tightens so much that the model spins out of it almost immediately.

As to the actual trimming and flying of the model, that's left to you. The flying itself is no different at a contest than at any other time. Success, however, can only be reached after hours of work on the flying field and experience gained by one's mistakes.

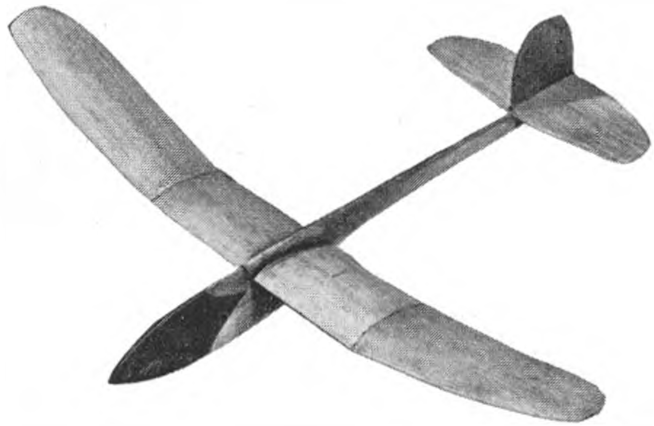
RANGE COLOUR CHART

Colour	Relative Range of Visibility	Background
Red	3 miles	White
Green or Black	2½ ,, ...	White
White	2 ,, ...	Blue
Yellow ...	2 ,, ...	Black



Skyhop
JOIN UP TO X - X FOR FULL FUSELAGE LENGTH
RIVET LEAD BALLAST
BALANCE HERE
CUT OUT WING SEATING
SANDPAPER EDGES ROUND
CUT FROM HARD 3/16" SHEET
GLUE FILLET AROUND 20g HOOK
TO CATAPULT:- USE TWO STRANDS 1/4" RUBBER
TOW-LAUNCH WITH 50'—150' THREAD
USE MATCHBOXES FOR DIHEDRAL
CUT TWO 1/8" RIBS
WING CENTRE PANEL
HALF TAILPLANE:- TRACE OTHER SIDE & CUT AS ONE PIECE
CUT FIN FROM 1/16" SHEET
FIN ROOT
WING OUTER PANELS TWO OFF
ALL WING & TAILPLANE PARTS ARE 1/16" BALSA
WING RIB POSITION
WING & TAILPLANE CENTRE LINES

Skyhop



A 23 ins. SHEET BALSA TOWLINE TRAINER BY J. RODERICK

THIS is primarily a beginners model, and as such, is intended for newcomers to the hobby and to those who have yet to try tow-line gliders. We make no elaborate claims for duration, but performance is good and all up cost is less than three shillings. It can be built in an evening and should last just as long as you avoid treading on it!

Choose rock hard $\frac{3}{16}$ in. balsa for the fuselage and medium $\frac{1}{16}$ in. for flying surfaces. You will also require a few inches of 20 s.w.g. piano wire and a small tube of cement.

Trace patterns on to the wood, and cut out (a fretsaw or a hacksaw blade is a help with the fuselage, which is traced in two stages to cover its full length). Round off all corners of the fuselage, with the exception of wing and tail positions and then cut out the wing seat. Sand the wing, fin and tail smooth, and cement the fin upright to the centre line of the tailplane, then put aside to dry.

Take up the two wing ribs and draw a pencil line on the upper surface from L.E. to T.E. dividing the rib in two. Fix the ribs upright on the building board by means of pins driven through the outer half of the ribs. Smear cement on the inner half of the ribs, place the wing centre panel over them and pin down. When this is dry the dihedralled tips may be attached by cementing the root of the wing tip to the rib and the end of the wing centre panel. At the same time, prop up the wing tips $2\frac{1}{4}$ in. from the building board with match-boxes standing on end.

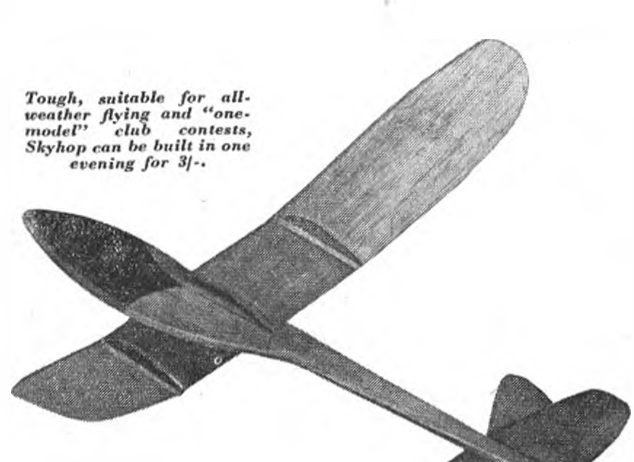
Now cement the wing to the fuselage using the wing centre line as a guide. Add the tail assembly and the cut out fuselage part. Turn the model upside-down, so that it rests on wing and fin-tips, and check for alignment.

When you are satisfied that everything is true, fillet all wood-to-wood joints with a line of cement. Bend the tow and catapult hooks from 20 s.w.g. and push them into the fuselage where shown, cementing around them for strength.

Give the model a coat of clear dope, and sand well. Any desired decoration can be applied around the nose portion. To achieve proper balance, cut a small slot in the nose of the fuselage and push in lead ballast until the model balances at one third of the chord back from the L.E. Now test glide with hand launches. Warp the tail trailing edge upwards if the model dives, and downward if it should stall. Turn is obtained by bending the fin T.E. in the desired direction; but don't try for a tight turn, it will only result in towing instability.

Start towing tests using a 50 ft. line of strong carpet thread with a small brass curtain ring attached Slip the ring on to the towhook, get an assistant to help launch and give a running tow *into wind*. Skyhop will quickly rise kite fashion and the running tow is reduced to walking pace as maximum height is reached. Slacken the line and the model is "on its own," free to glide in 50 ft. circles for durations of up to 90 seconds with as much as 150 ft. of tow line.

For catapult launch use two strands of $\frac{1}{4} \times \frac{1}{24}$ in. rubber, 6 ft. long, attached to a peg in the ground and 50 ft. of line.

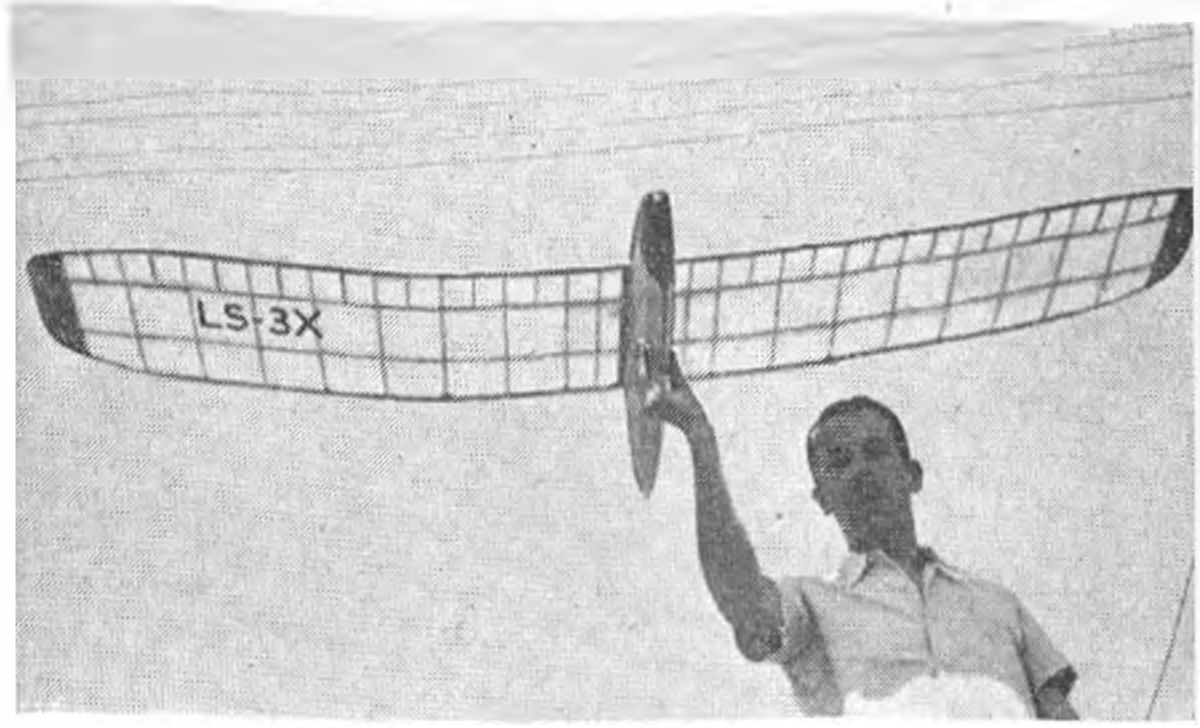


Tough, suitable for all-weather flying and "one-model" club contests, Skyhop can be built in one evening for 3/-.

Flying Wings

—the Swiss approach

The unswept flying wing is a comparative novelty in any British contest for tailless models, yet in Switzerland, thanks to the development of special aerofoils, the simple "flying plank" reigns supreme. Story of this trend is told in words and pictures by MAURICE DUFEY.



Roger Stamm and his Pelerin 3 with larger fuselage for slope soaring. Note lightweight structure.

THIS story began in 1944 when a team from Romande (the French-speaking district of Switzerland) attended a contest at Lyons for model aircraft. There they became acquainted with Monsieur Guy Borgé, the protagonist of tailless flying wings using self-stabilising section without sweepback and with large fin area. Truth to say he wasn't the inventor, but he was the one who first had the idea of applying that formula to models, inspired by the developments of Monsieur Fauvel of full-size glider fame.

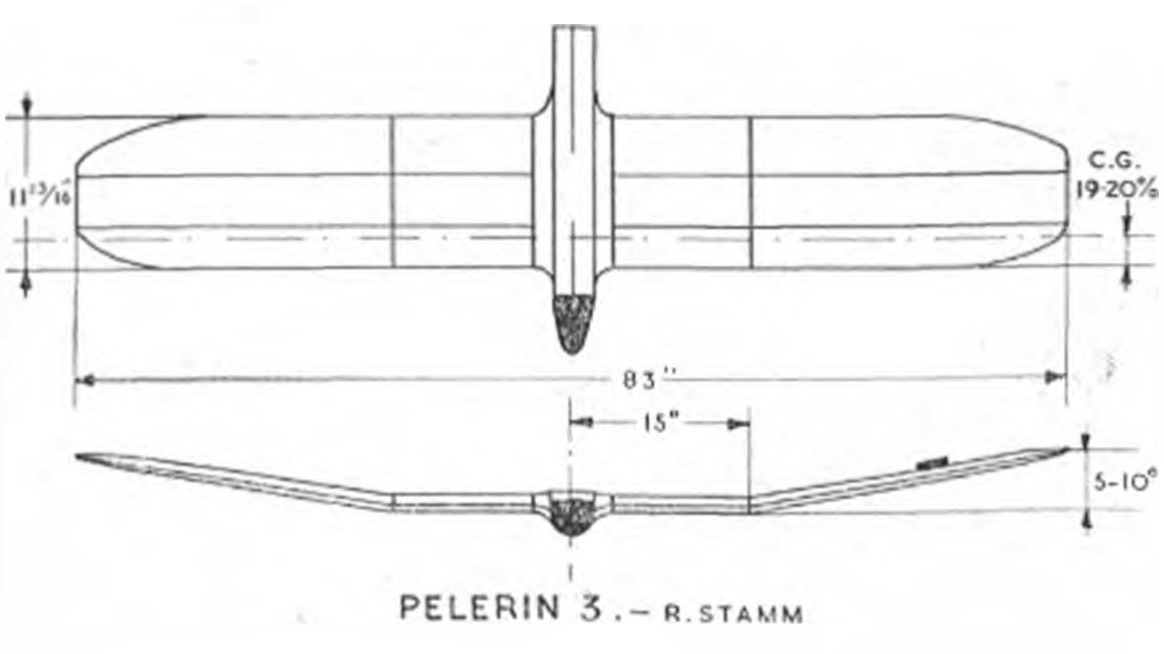
The latter's famous Fauvel AV-36 Monobloc tailless sailplane is achieving international fame to such extent that no less than 45 of them were under construction by amateurs or clubs throughout the world in 1953. Such is true recognition of the advantages to be obtained from the simplest of flying wing designs.

In early 1944, Swiss modellers in Lausanne, Vevey and Yverdon were experimenting with wing sections B2, B3 and others suitably modified when constructing tailless models of a new style. (*Photo top centre*) and from these evolved the now standard shape.

This formula has been inspired above all by a desire for simplicity, for complicated plan forms are always to be avoided. The wing should, for preference be rectangular and unswept to align the centres of lift. It needs little dihedral, about 5–10° more is required for low wings.

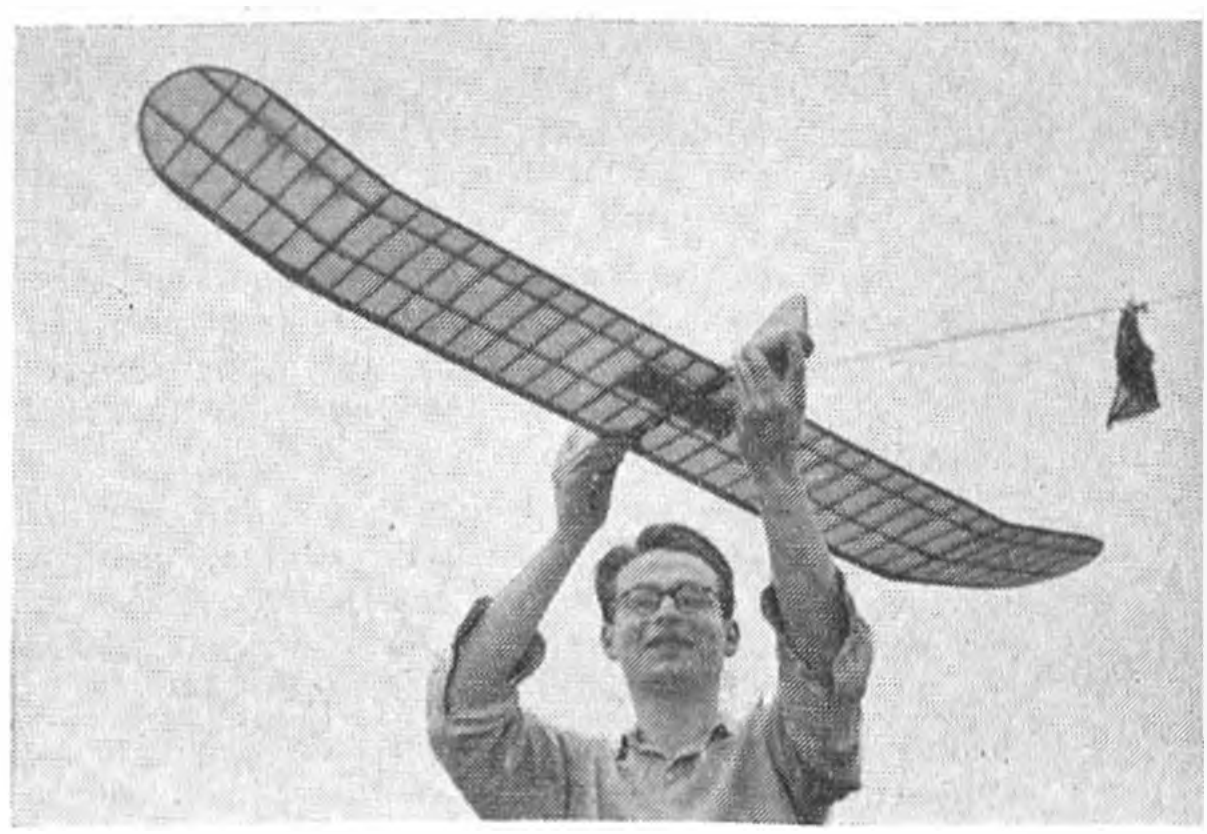
Selection of the aerofoil is important for it is from this that a great deal of the attitude in flight will depend. These wings fly with an incidence of 5–7° and the centre of lift is situated about 17% chord from the leading edge. Originally, a fuselage of generous proportions and a large fin were considered indispensable; but in time their size has diminished and on slope soaring models this large fin is compensated by the surface in front of the centre to gravity to ensure good directional stability.

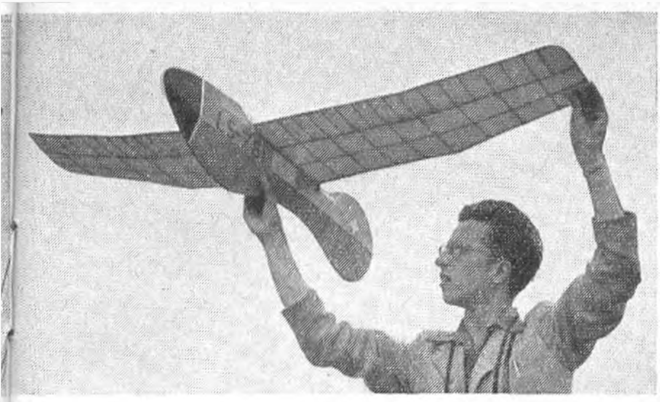
During 1944–45, models had good quality of flight stability; but high sinking speed, admissible in slope soaring, was too great for tow-line flying



Roger Stamm's successful design with dual duty fuselages.

Jean Jacques Bodmer of Vevey shows forward tow-hook position on this design.





R. Hagemann of Lausanne with one of first flying wings of this type.

Towlaunching is achieved without difficulty; but requires care on the part of the launcher, as demonstrated by this Yverdon modeller

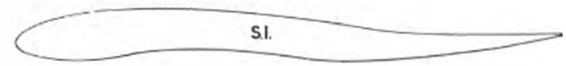
and the pursuit of thermals. Thus in 1946 R. Stamm designed the "Salamander" which had excellent qualities of style and made numerous flights of more than 5 minutes in spite of its small span. An enlarged version of this machine beat the Swiss record in its class with a flight of more than 19 minutes O.O.S. at Lyons in 1947.

Again, in 1947, C. Baumgartner of Yverdon (*Photo bottom right*) carried off the National contest when his model out-classed by a large margin the flying wings of classic Vee-form with a flight of 14 minutes 45 seconds.

Le Pelerin 3, of R. Stamm of Lausanne (*see drawing*), is the final result of a series developed from the Salamander. Two fuselages are provided, one for tow-line flying and the other for slope soaring. The theoretical C.L. for the profile used (S.1.) is at 17% of the chord of the wing, but thanks to excellent stability, it can be put back to 20% if following a circular flight path. One can thus obtain a slowly undulating flight which permits a model to maintain or even to gain height into wind, achieving, however imperfectly, the "sailing" flight of certain birds.

These few lines may help to decide a few English modellers to abandon the classic shape of swept flying wings with ordinary profiles and marked wash-out of incidence between centre section and tips.

Tailless enthusiasts might well adopt this less orthodox shape of construction which is very much more simple and which now has proved itself. Do not be discouraged at the amount of lead necessary to obtain proper trim! Section S1 is given here for reference for future designers who are advised to make use of it with every confidence.

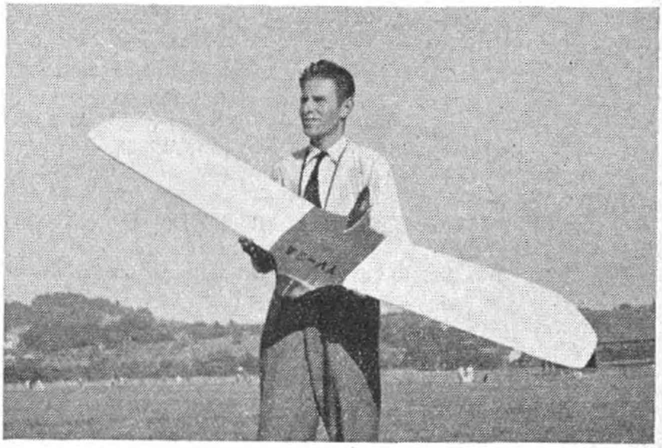


ORDINATES FOR THE SELF-STABILISING AEROFOIL—S.1.

% Chord	0	1.25	2.5	5.0	7.5	10	15	20	30	40	50	60	70	80	90	95	100
Upper	3.5	5.25	6.0	7.0	7.7	8.2	9.0	9.3	9.5	9.0	8.0	6.5	5.2	4.7	4.7	4.7	4.7
Lower	3.5	1.8	1.4	0.8	0.4	0.1	0.2	1.0	2.0	1.8	1.0	0.0	0.4	1.4	2.5	3.4	4.4

Top view of Roger Stamm's Pelerin arranged for towlaunch shows aerofoil fuselage section with fore and aft fins.

Nationals winner in 1947, C. Baumgartner of Yverdon had this model aloft for 14 : 45 in one flight.



make up your . . . Field Kit

suggested by **V. H. Izard**

"BE PREPARED," the time-honoured motto of the world-wide Scouting movement, might well apply to our hobby of aeromodelling. We are not referring to the chap who travels five miles to the flying field and then discovers that he has left a vital tailplane back at home, for that is just plain forgetfulness. Preparation for any eventuality is the idea we have in mind, and the means to cover any possibility of mishap is through one carefully packed bag of field kit.

What could happen on the flying field, say, to prevent that important third round flight in a competition? Torn tissue, a broken longeron, loose wing box, broken propeller, loose diesel engine, lost needle valve, bent propshaft on a rubber job, or even the loss of the last wing-retaining rubber band—all of these could, and do, happen and for each, there is a simple cure . . . that field kit.

Start thinking of the things that *might* happen to your model on the field, and work out just what material you would like to have at hand for a swift repair. Certain "first-aids" come to mind immediately, rubber-bands, Sellotape, pins, cement and a razor-blade among them: but in order to cater for every possible contingency, an adequate field kit requires many other items.

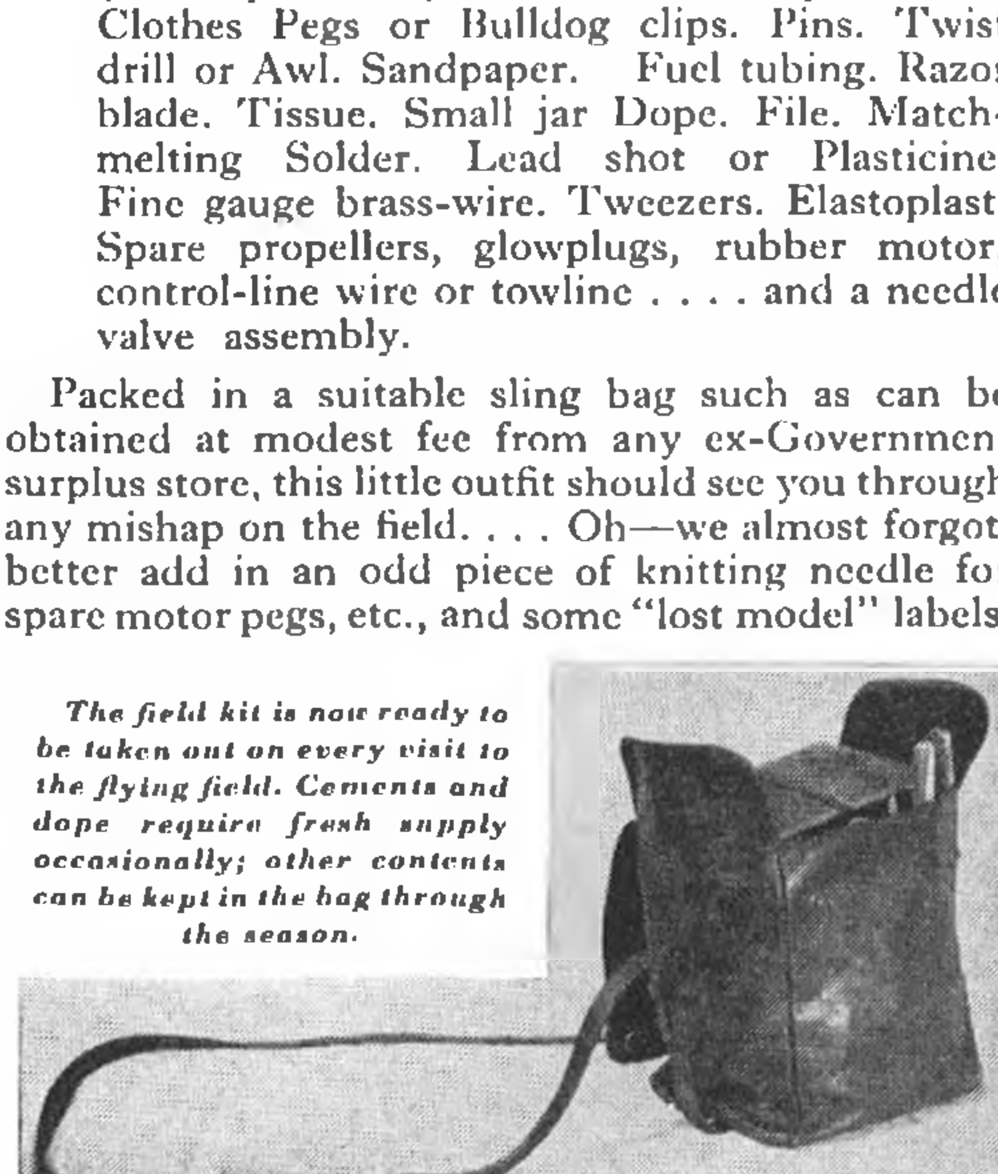
Our list is intended for your guidance. If you have no interest in power models, then certain accessories can be left out of your pack. First we have the items for general operation—

> Winder; Towline or Winch; Fuel can and rag; Dethermaliser fuse; Matches; Stopwatch; Rubber bands. Battery leads . . . and meters for radio control.

Then the bits and pieces for repair, the spares and the tools—

> A tin of more rubber bands of all sizes. Balsa strip and scrap, 1 mm. and $\frac{1}{16}$ in. ply. Wire. Wire-cutting pliers. Small pliers. Screwdriver. Plug and prop-nut spanner. Scissors. Cement. Tissue cement. Rubber lubricant (tubes preferred). Thread. Sellotape. Three Clothes Pegs or Bulldog clips. Pins. Twist drill or Awl. Sandpaper. Fuel tubing. Razor blade. Tissue. Small jar Dope. File. Match-melting Solder. Lead shot or Plasticine. Fine gauge brass-wire. Tweezers. Elastoplast. Spare propellers, glowplugs, rubber motor, control-line wire or towline . . . . and a needle valve assembly.

Packed in a suitable sling bag such as can be obtained at modest fee from any ex-Government surplus store, this little outfit should see you through any mishap on the field. . . . Oh—we almost forgot, better add in an odd piece of knitting needle for spare motor pegs, etc., and some "lost model" labels.



The field kit is now ready to be taken out on every visit to the flying field. Cements and dope require fresh supply occasionally; other contents can be kept in the bag through the season.

OWEN THETFORD
REVIEWS NEW BOOKS

Armchair AERONAUTICS

War in the Air

Royal Air Force, 1939-45. Volume 1. "The Fight at Odds." By Denis Richards (H.M.S.O. 13s. 6d.). 430 pages illustrated.

The Fight at Odds is the first of three volumes relating the history of the Royal Air Force in the Second World War. This volume begins with the first plans for the expansion of the R.A.F. in 1934 and ends with operations in the Middle East in 1941. The campaigns in France and Norway the early raids of Bomber Command and the Battle of Britain, are covered very fully in an immensely readable prose style. There is an especially stirring account of the heroic "last ditch" operations against the Luftwaffe by the Gladiators of No. 263 Squadron, which flew from a frozen lake in Norway in 1940 and, as is to be expected from a history written with access to official records, a lot of new facts emerge about such matters as the radio counter-measures used to disorganise the German night raiders.

In an otherwise admirable narrative, there are occasional sad little errors. One is surprised to read (page 19) that "The R.A.F. in 1934 was a force of wooden biplanes!" Wooden construction of British military aircraft was generally abandoned in the 'twenties in favour of metal (albeit covered with fabric) with the emergence of such types as the Bulldog, Fury and Hart. All history will rejoice in Appendix III, which gives a complete list of R.A.F. Squadrons at home and overseas as at September, 1939, but will be disappointed to find that equipment and bases are not given, though they are included in the similar table of Battle of Britain Squadrons in Appendix X.

Dogfights and Test Pilots

Test Pilot by Neville Duke. (Allan Wingate 12s. 6d.). 215 pages illustrated.

Few test pilots have become so famous as Neville Duke. Brilliant demonstrations of the Hawker Hunter before vast crowds at Farnborough and elsewhere have made his name a byword to millions. Yet few will have realised that such spectacular appearances, of brief duration, are merely the climax of months of hard work on development test flying and a lot of cool, analytical thinking of the type more often associated with a scientist than the popular idea of a test pilot. The modern test pilot's day-to-day work, his mental reactions, his feeling for the great spaces of the air, have never before been described so convincingly and in such detail.

Fascinating as these chapters are, however, many will find the earlier pages on Neville Duke's career as a fighter pilot even more exciting. Beginning with No. 92 (East India) Squadron on Spitfires at Biggin Hill in 1941, he went on to join No. 112 Squadron (Tomahawks) in North Africa, and afterwards commanded No. 145 Squadron (Spitfires) in Italy. At 21, he was a Squadron Leader with a D.S.O., two D.F.C.s and 28 enemy aircraft to his credit! Only a few years before, he had been a schoolboy with a treasured collection of model aircraft, who had just formed the first "Skybird Club" in his district and had his first flight in a rotary-engined Avro 504K.

From these early days in Tonbridge, gazing at Gauntlets and Virginias on Air Exercises, dodging school to investigate a force-landed Miles Hawk, grew the determination to join the Royal Air Force, which culminated in the author qualifying as a pilot at Sealand on a Miles Master in 1940. Since the Western Desert, offering joyrides to the public in an old Tomtit, air-racing in the Hawker P.1040 (forerunner of the Hunter), ferrying Fury fighters to Pakistan and, of course, breaking the sound barrier on the Hunter.

The Yellow-Nosed Boys

Heaven Next Stop, by Gunther Bloemertz. (William Kimber, 12s. 6d.), 189 pages illustrated.

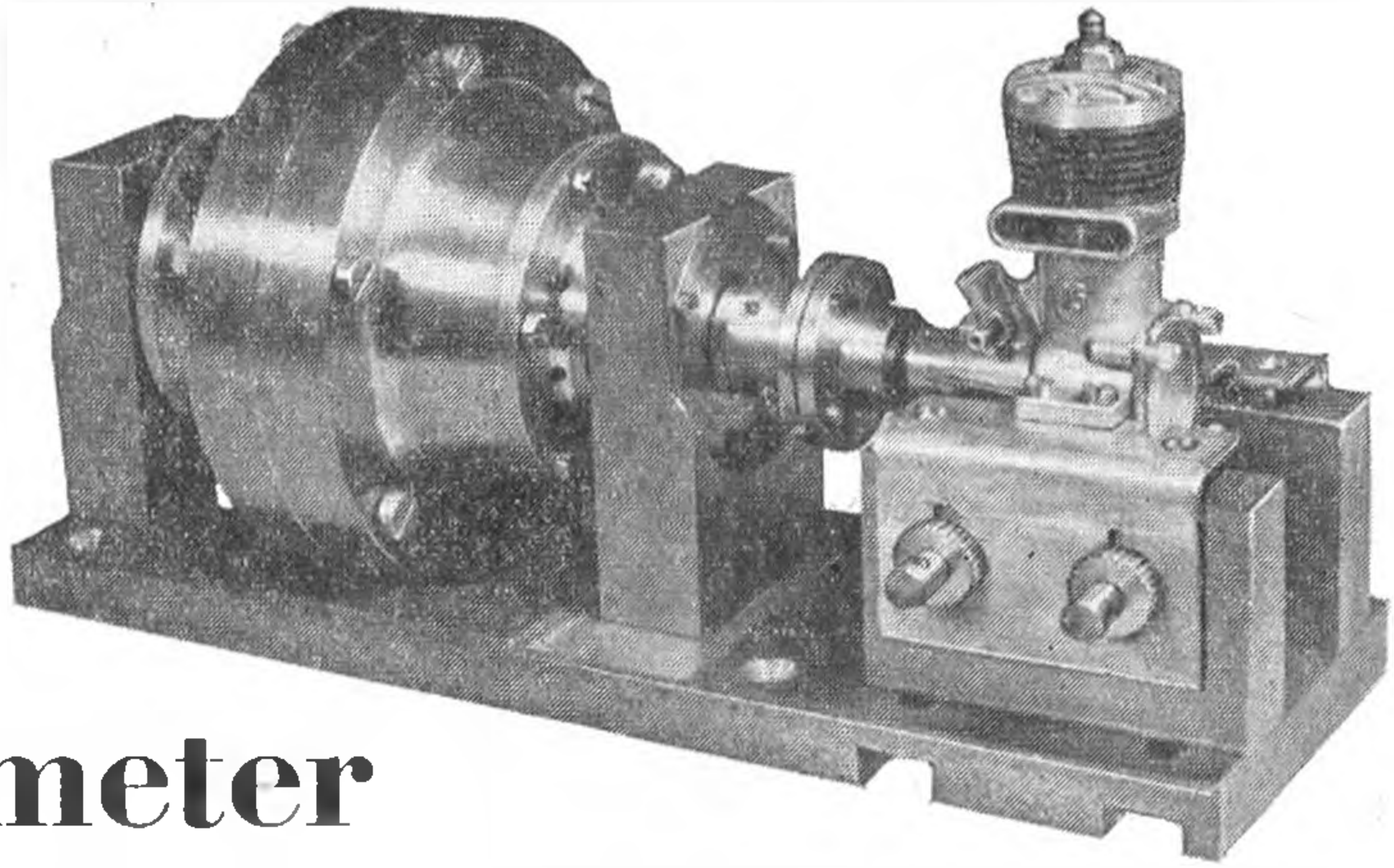
These are the personal reminiscences of a pilot who flew Focke-Wulf 190 single-seat fighters with one of the crack units of the Luftwaffe in 1941-45, the "Abbeville Boys." They were so named because they were based at Abbeville airfield in Northern France and their yellow-nosed aircraft became something of a legend. By a curious twist, the same airfield had been used by the Royal Flying Corps in the First World War.

There is always a certain fascination in reading about war episodes as seen through enemy eyes, and the author has many interesting anecdotes to tell, not the least being the revelation that Luftwaffe delinquents were given *Mein Kampf* to read as punishment during detention! But the descriptions of air fighting are rather disappointing and one would have welcomed, for example, more technical details about how the Fw 190 was flown in combat, the relative merits of the various sub-types, and so on. One is left with no very definite impression as to what German pilots thought of this outstanding fighter, which seems a pity.

Bloemertz was shot down as the Allies advanced into Northern France after D-Day, and one of the highlights of his narrative is his rescue from under the guns of Sherman tanks by a Fieseler Storch, which landed in No Man's land to pick him up. Equally vivid is the account of a night spent in a German town during a heavy raid by Bomber Command.

At last—a really authentic means of engine testing

Eddy-current dynamometer



Specially made for "Aeromodeller" this remarkable test unit by R. H. Warring and E. Hook has been made with full co-operation of Messrs. Heenan & Froude, World leaders in dynamometer design.

IN conducting the first of these new series of test—now some two years ago—the disturbing factor emerged that test figures realised with the apparatus "inherited" with the job were of an appreciably lower order than would be anticipated from comparison with previously published figures on engine performances.

As a rough and ready rule, a brake horse power rating of 1 h.p. per 10 c.c. can be used as a guide. That normally holds true for about the middle range of model engine sizes. With increasing engine size volumetric efficiency tends to increase, so that the good 10 c.c. motor may actually develop more than 1 h.p. With decreasing size, the opposite is true. The average 1 c.c. motor will probably develop less than .1 h.p. the 0.5 c.c. size something less than .05 h.p.—say around .04 h.p. as a reasonably good figure—see Fig. 1.

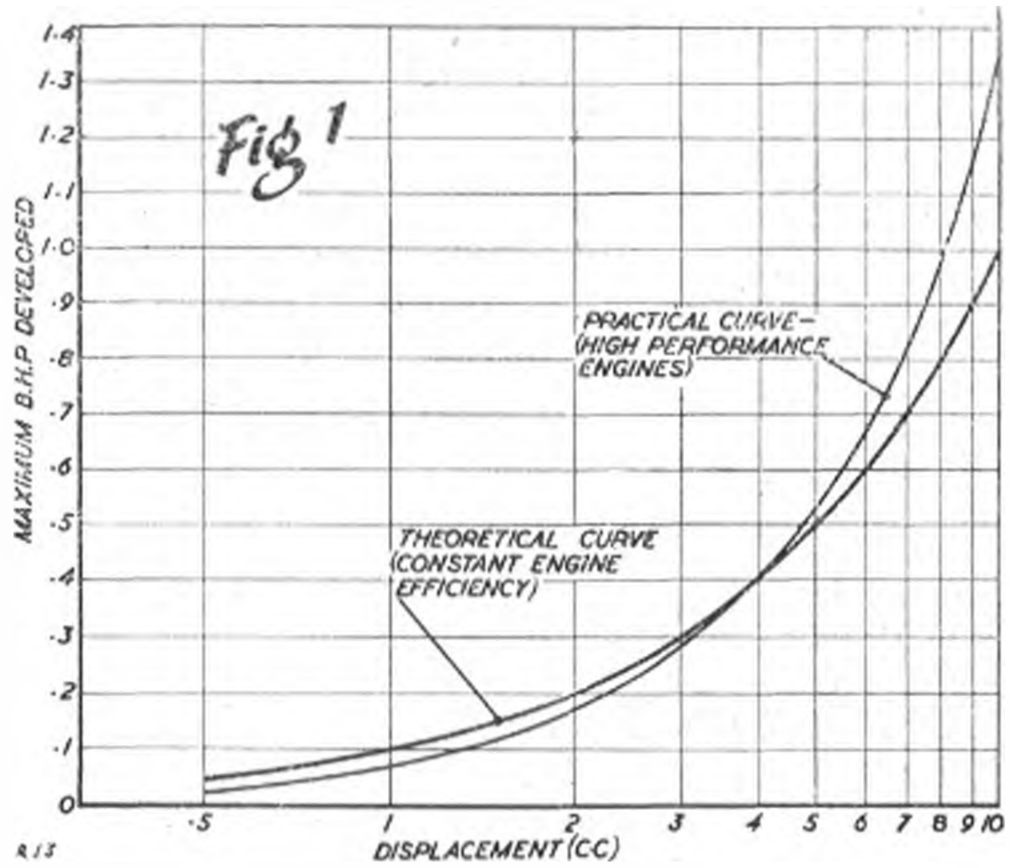
The early tests conducted had two features in common. Maximum h.p. came out at something like one half of the anticipated results and all readings were consistently low. By checking and re-checking technique, the possibility of working errors was elaminated. The very consistency of the results was further proof to the contrary here. Nor was the basic formula wrong, for this, too, was checked and re-checked—worked backwards and forwards from first principles, always to the same result.

Had it not been for the fact that other published data from different sources (*i.e.* different test apparatus) was of the anticipated order of power it could have been assumed that different technique was responsible for differences in results between earlier standards and current test figures. The root of the problem, however, undoubtedly lay deeper than that.

The high mass or inertia of the machine was soon proved not to be the trouble. The original machine was built at a time when large capacity engines were current. A baby half c.c. motor was virtually lost on it. A special lightweight beam built for these small motors produced no more flattering results.

About the only thing left to suspect was that the slipstream effect of the propellers used on the engines might appreciably modify the torque readings obtained. After the first two or three test efforts were, in fact, made, to shield the apparatus from the slipstream, with some noticeable improvement. Since such shields or baffles had to be mounted as close behind the propeller disc as possible, and certainly in front of the cylinder, such an expedient could, only be regarded as a temporary one.

At about this time the opportunity arose to discuss the whole problem with Messrs. Heenan and Froude, undoubtedly world leaders in the



design and manufacture of large dynamometers for brake testing all kinds of "full size" engines. The question of measuring fractional horsepowers was well outside their normal sphere but their comments on the types of dynamometers and their various limitations were most enlightening. Some typical forms of dynamometers and their limitations are shown in Fig. 2.

The principle of the torque reaction beam, which is the basis of the original Aeromodeller apparatus and probably the majority of other "power testing" machines, was described in March issue. The engine is centrally mounted on a freely pivoted counter-balanced arm or beam. When the engine is running, driving a propeller, fan, airbrake or flywheel, etc., it is applying a torque at the shaft to drive that particular load at that particular speed. By the principle of reaction an equal and opposite torque is produced on the fixed part of the engine (*i.e.* the crankcase-cylinder assembly), which will tend to rotate in the opposite direction. The crankcase being fixed to the beam, the beam tends to rotate in the opposite direction to the shaft.

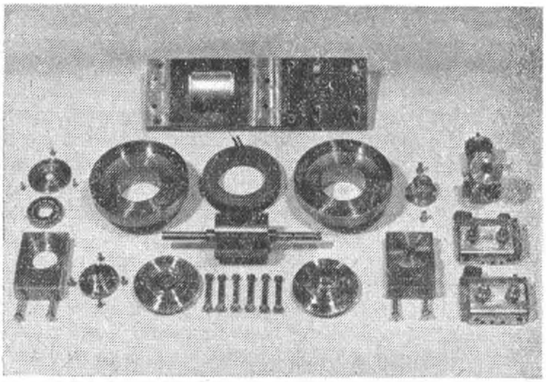
The amount of reaction torque can now be measured, quite simply, by sliding a weight along the "high" side of the beam until it balances exactly horizontal. Reaction torque at this balance, which is equal to shaft torque, is then the product of the weight required to balance the beam, times its distance from the pivot point. The relationship between B.H.P. and torque is explained diagrammatically in Fig. 3.

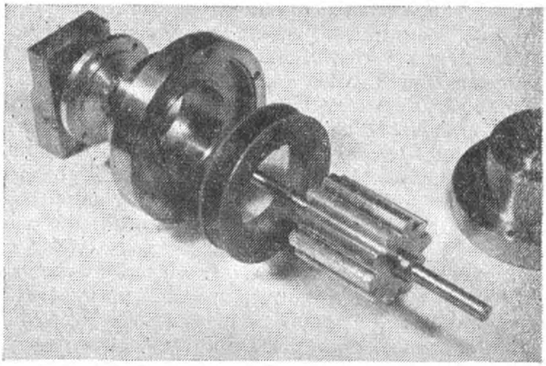
Large Margin of Error

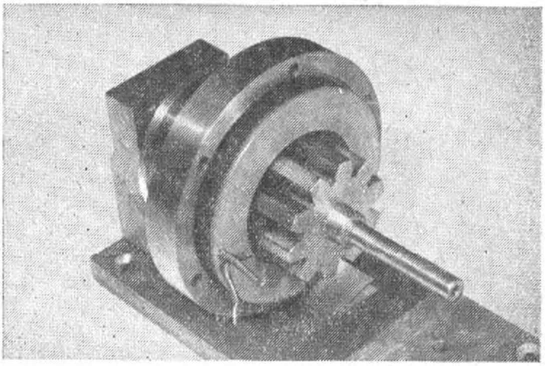
Now torque reaction apparatus of this kind was used in the 1920's for testing full size aircraft engines. It was fairly soon abandoned in favour of alternative means since the errors achieved were of the order of 30 to 50 per cent! Mainly this was due to slipstream effect, caused by the spiralling slipstream striking the side of the fixed engine, etc., and modifying the turning moment tending to tilt the beam. Slipstream effect tends to give a false *low* reading of torque, irrespective of the direction of rotation of the engine.

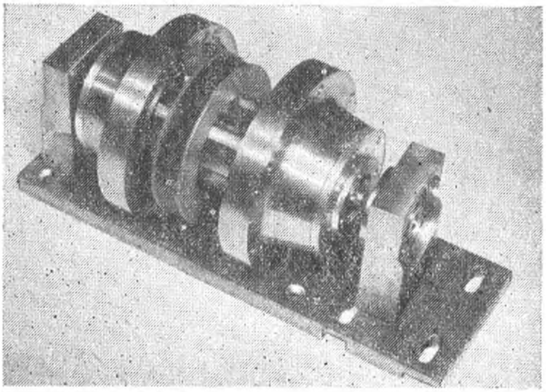
Other error-contributing factors are the jet effect of side-facing exhaust ports or exhaust stacks, the unbalance effect of an asymmetric engine immediately the beam is rotated away from the horizontal, resistance of any leads (*e.g.* to plug) and so on. The smaller the force being weighed the greater the cumulative effect of such errors could be.

Now slipstream effect could be eliminated by using a load which does not produce a stream of air flowing past the engine, such as a flywheel. The whole principle of brake horse power determination, however, depends on measuring the torque produced over a range of speeds, from which a curve can be plotted either of torque against r.p.m. or, more usually, brake horse power against r.p.m. The









Top to bottom photos, right, show assembly stages of the eddy-current dynamometer. All parts, including test engine and universal mounts are seen at top. Then the rotor, stator and casing are mated for assembly. In 3, the toothed rotor is located, showing electrical field leads to stator, and bottom, other casing half and ball race bearings fit onto solid baseplate.

former curve tends to decrease with r.p.m. The latter curve increases at first, reaches a peak at some high r.p.m. figure (maximum b.h.p. of the engine) and then drops with increasing r.p.m. again.

A family of propellers is one of the most useful ways of getting a series of runs at different r.p.m. figures (and equivalent thus taking a series of torque readings, converted to b.h.p. figures) since r.p.m. figures with different propeller sizes are also of interest of engine users. An inconvenience, from the operating point of view, is that the engine has to be stopped, the propeller changed and engine restarted at each step.

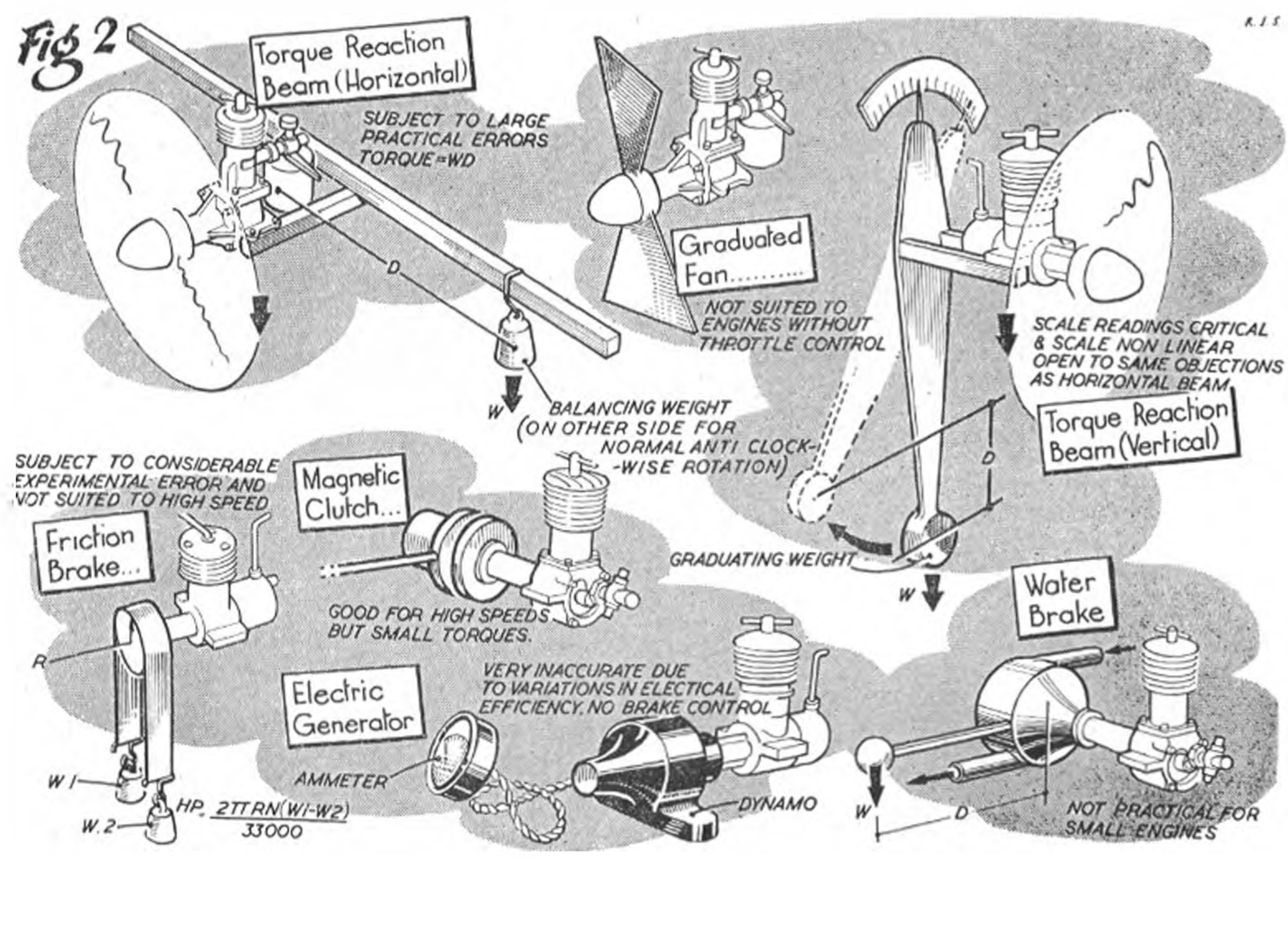
Replacing the family of airscrews with an air-brake does not eliminate slipstream, since the blades of the airbrake have to be adjusted at each step, usually by twisting, to slow down or speed up the engine, as required. Again the whole test is conducted in a series of runs. This time there is no comparable propeller-r.p.m. data and also there is the very real danger of getting the brake dynamically unbalanced setting up vibration, is inevitably a source of loss of power.

Flywheels can be used for loads for high speed running—and in fact, proved the only satisfactory form of load for very high speeds. The equivalent size in "propeller load" renders hand starting too hazardous, or too difficult. A series of flywheels of different weights however, would be impractical or a complete range of tests. Band brakes or similar devices operating on a flywheel to vary the speed are likewise subject to practical objections.

The best solution to the problem of *accurate* testing of fractional horse power motors, was, therefore, pretty obviously another form of test apparatus which would not be subject to such working errors (of a largely unpredictable value) or objections on the grounds of practicability.

A possibility which occured was to work strictly on a family of propellers of similar geometric proportions but different pitches and diameters, basing b.h.p. figures on power absorption figures to the r.p.m. at which individual propellers were driven. One major difficulty was how to calibrate the family of propellers. The other, more important, objection was that the high speed runs necessary to carry the tests past the maximum b.h.p. point on the performance curves would have to be attempted with very tiny propellers.

The first alternative investigated was a motor-generator or, virtually, a dynamo coupled to the engine shaft. Shaft torque driving the dynamo would then be measurable in terms of current produced. This method, however, did not lend itself too readily to accurate speed control and overall accuracy was likely to be of a low order. The heating effect in the coils and varying electrical efficiences could play havoc with the final results. Although motor generators of this type are used for full scale testing, more often than not torque is determined by weighing the torque on the floating casing of the machine.



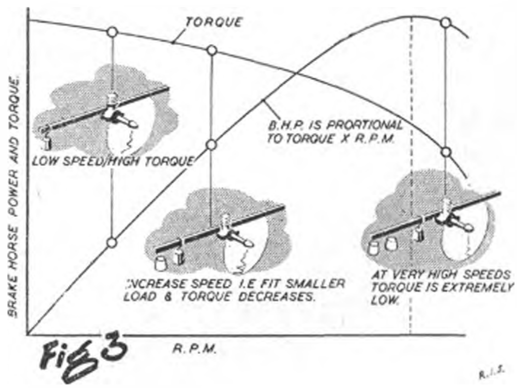


Fig 3

In full scale work there are two main types of dynamometers in current use—one a water brake and one an electric brake, working on eddy current principles. The former was ruled out as impractical for the size of dynamometer contemplated but the potentialities of the latter were investigated in some detail. A tentative design for the latter was suggested by Heenan and Froude with a nominal capacity of 1 h.p. at 10,000 r.p.m.

Eddy-Current Dynamometer

The principle of the eddy-current dynamometer can be explained with reference to Fig. 4. The rotor constructed of a special form of iron, is in the form of a toothed flywheel rotating with small clearance inside a cylindrical casing or housing. Surrounding the casing is a field coil which can be connected to a source of electricity. The casing itself is freely mounted on trunnions.

In use, the rotor shaft is coupled to the engine shaft and thus driven by it. A direct current is fed to the field coil, producing a magnetic field within the housing. The teeth of the rotor cut this field, introducing eddy currents which resist the rotation of the rotor, *i.e.* exert a braking effect. The amount of braking is readily controlled by adjusting the current flow through the field coil.

The rotor, in other words, is trying to drag the casing round with it by a magnetic coupling effect and measuring the turning force or torque on the casing is a measure of the shaft torque, *i.e.*, the torque supplied by the engine driving the rotor. This torque is readily found by a sliding weight on a graduated arm, as in the case of the torque reaction apparatus. This time, however, the only losses are the very small friction in the bearings carrying the outer casing and any stiffness in the leads connecting to the field coil. These should be negligible. At the same time there is a fully variable speed control. The speed of the rotor (and thus the engine on test) is dependent on the braking effect produced by the current flowing through the field coil. Vary the current and the speed can be varied at will. Torque readings at different speeds can therefore be taken without stopping the engine.

Construction of the AEROMODELLER eddy-current dynamometer has been carried out by E. Hook to Heenan and Froude's basic design and from start to completing took some 120 hours of careful work. Other problems had then to be met, such as a suitable means of coupling up the rotor shaft to the individual engines, and also a means of starting the engine once coupled up—to say nothing of a "universal" mount for the engine capable of taking all sizes likely to be encountered.

It became evident that even before the basic dynamometer was completed that the rotor size would be beyond the capacity of the smallest sizes of engines. Windage alone would limit maximum r.p.m. attained to too low a figure. Operating on exactly the same principle, alternative rotor designs, which can be interchanged, one of filled-in (plain periphery) and one of lightweight construction (plastic with inset slugs) are in the course of building to cover the full range of model engines from .05 c.c. up to 10 c.c. or larger with maximum test r.p.m. of the order of 20,000, if required. Interchange of rotors will not affect the accuracy of the results.

The gap in the usual engine analysis series has been due to the time taken in bringing the dynamometer to the working stage. Even so, considerable development work is still necessary to bring it to the final state required. Such development will not affect the accuracy of the readings, or make the machine more efficient. It is being aimed at finding the best motor designs for different sizes of engines and developing the control gear to the point where all the readings—torque r.p.m. and b.h.p. can be read off direct from dials, retaining means for a mechanical cross-check on both r.p.m. and torque.

WATCH NEXT MONTH
for the first of the *New* Series of tests

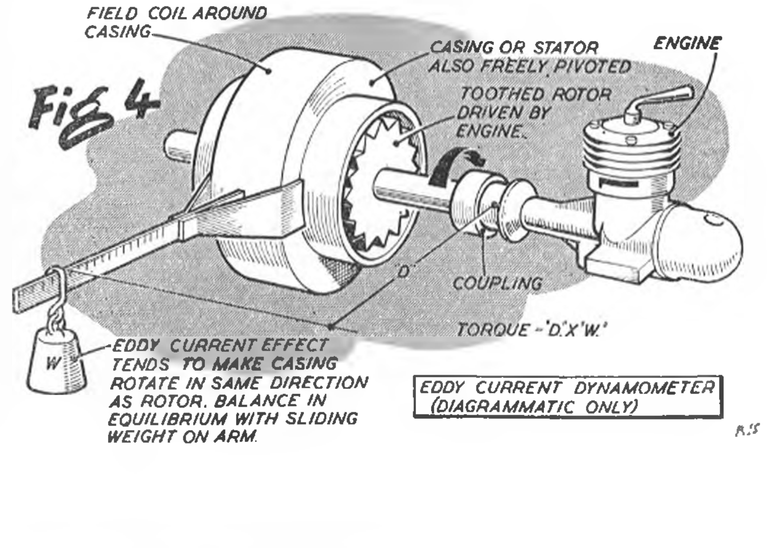
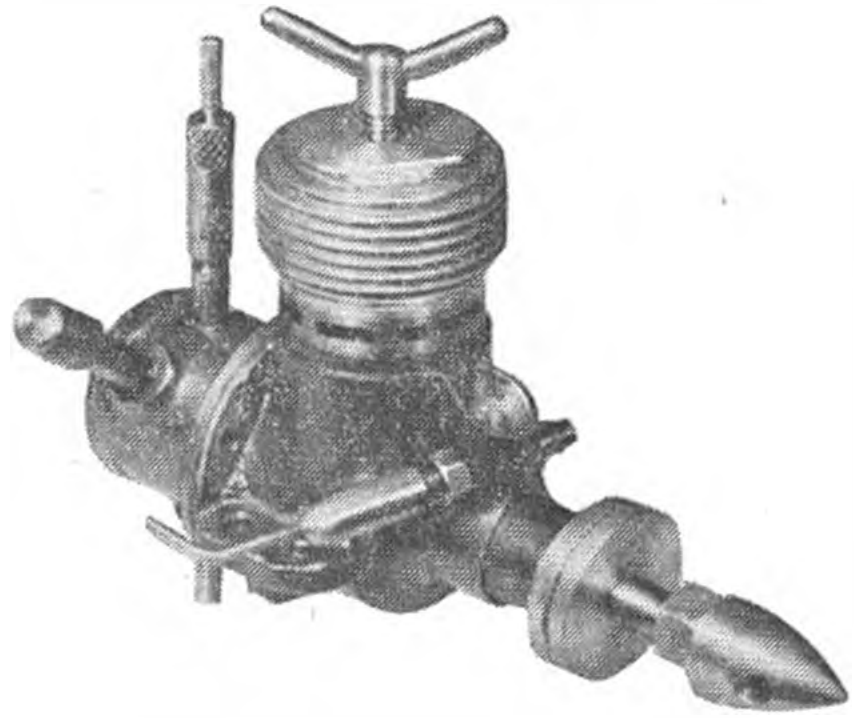


Fig 4

ENGINE REVIEW

By Ron Warring



le Simoun HR 15

New French 1·5 cc. diesel

IF this new French engine was freely available on the British market, almost certainly the less experienced customers would find it difficult to start and be disappointed with its performance. Compared with the best of home-made diesels of similar size, it lacks the same positive "feel" for starting—mainly because it is set up quite tight and there is considerable friction between piston and cylinder at bottom dead centre, a condition which is only relieved by prolonged running in. Once starting technique is mastered, however, and the engine run-in properly *le Simoun* HR 15 is a sturdy, reliable, and powerful unit.

Novel features

Superficial examination shows the HR 15 to have some rather novel features, some undoubtedly good and others of questionable value. On the face of it one of the "good" points is an integral tank with a cut-out incorporated. This works on the plunger principle, the feed pipe being extended up through the top of the tank and the spring loaded plunger mounted well clear and readily accessible. The tank itself is of thin brass with large soldered nuts acting as "anchor points" for the various fittings—effective, if clumsy looking. The filler tube extends at an angle of 45 degrees from the right side of the tank and is fitted with a large screw-on cap. The size of all this gadgetry looks a little out of place on what is a "baby" motor.

The angled-back needle valve is good, although the bent up wire end is a little hard on the fingers: (a knurled disc on the end of the needle valve would have been a better design feature than a cap for the filler tube, for instance). Another good feature is the alternative beam or radial mounting provided by the cast-in lugs and crankcase rear face. If radially mounted, however, the tank becomes something of a nuisance with its three protruding pipes. The tank itself can be unscrewed (the best way of doing this without crushing the thin metal was found to be to remove the fuel pipe, insert a steel wire "tommy bar" through the two holes and twist); when the engine looks much more compact and surprisingly like any other modern 1·5 c.c. diesel.

Other points worthy of a "good" rating were the easy-to-hold compression adjustment lever (aided by the fact that the cylinder casing does not get very hot, even after prolonged running); the sensibly knurled backplate; and the blue paint finish to tank and crankcase casting which gave the finished job a most attractive appearance. This paint, however, soon chips off.

The long and small diameter spinner nut is most attractive from the aesthetic point of view—but highly dangerous in a head-on collision! It would be wisest, we feel, to replace with a standard nut. A propeller nut was, in fact, furnished with the engine as well as a spinner. Apart from this, our only real criticism is concerned with the tightness of the fit between the piston and cylinder.

Tight assembly

After a lot of initial "trial and error", running position for the needle valve was found to be only 1¼ turns open. The duration of run which could be sustained was quite short at first and was traced to the fact that the cylinder unit had a tendency to unscrew. Tightening this right up produced a definite binding between piston and cylinder at bottom dead centre and after dissembling the engine completely to find a possible cause it can only be assumed that the bottom of the cylinder was slightly distorted by screwing completely "home." The engine was assembled still tight and started and ran quite satisfactorily, gradually wearing itself in to a normal running fit. It was found when running that the needle valve control was fairly critical but compression could be adjusted over half a turn without stopping the engine.

There is no gasket between the cylinder and crankcase unit but the length of thread involved should be sufficient to give an adequate gas seal. However, in view of the "tightening up" experienced when the cylinder was screwed right down it appears that a soft metal gasket might have been a solution to this trouble. The resulting lowering of the compression ratio could easily have been taken up by the contra-piston adjustment which was far in excess of that required for operation.

For both starting and running the compression required was quite high. The HR 15 did not appear to like too rich a mixture for starting and flooding inevitably meant a delayed start. Priming through the ports is made difficult by the fact that the exhaust ports are so narrow, and priming through the intake or finger choking tends to fill the crankcase before an adequate starting mixture is transferred to the head. A direct prime was found to be best, but more than average practice time was necessary to establish the best starting "drill." Having once found a satisfactory procedure, no further starting difficulties were experienced.

The manufacturers recommend a 9 × 4 propeller for free flight and an 8 × 5 propeller for control line stunt. Both these sizes seem excessive for the capacity of the engine and r.p.m. tests did, in fact, indicate that with such loads the engine is undoubtedly working at well below peak power. Possibly the r.p.m. figures could be improved upon with further running-in of the engine, but they would be about the speeds to be expected from a good 1·5 c.c. diesel. For contest work, at least, a 7 × 4 propeller would appear to be a better proposition for free flight, and possibly a 6 × 5 or 7 × 4 propeller for control line stunt.

Regarding constructional features the cylinder is turned from nickel-chrome steel, heat treated to harden. The piston is of cast iron of a type with quite a high hardness and strength. The connecting rod is forged from dural and the crankshaft is chrome-steel. This runs in a phosphor bronze bush forming the main bearing, inserted in a light alloy cast crankcase unit. The specimen received for test was very well made and nicely finished. The tank finish is not quite so good as the rest of the unit and overall appearance would, we feel, have been improved by making this of plastic rather than thin metal. The incorporation of a cut-out device in the tank is to be praised, particularly since it is quite positive in action. The spring loading is, however, rather on the high side for safe operation by an "airdraulic" type of timer. And just to be contrary, if given this engine to install in a model off would come the tank to take advantage of the radial mount and bolt the power unit directly onto the firewall!

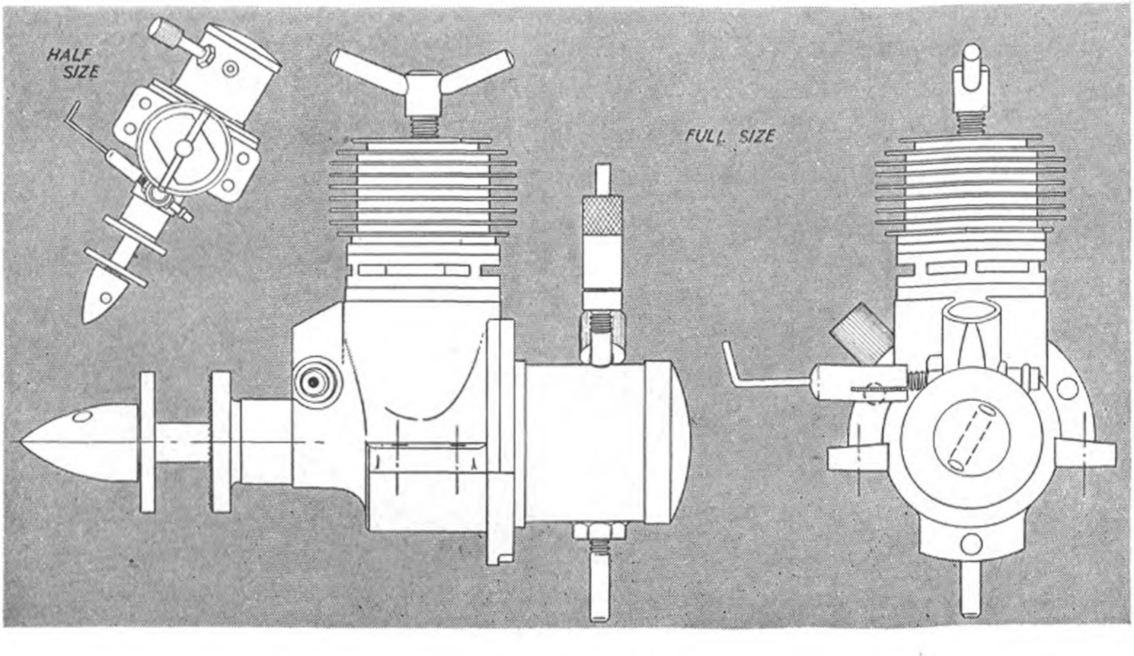
PROPELLER SPEED TESTS

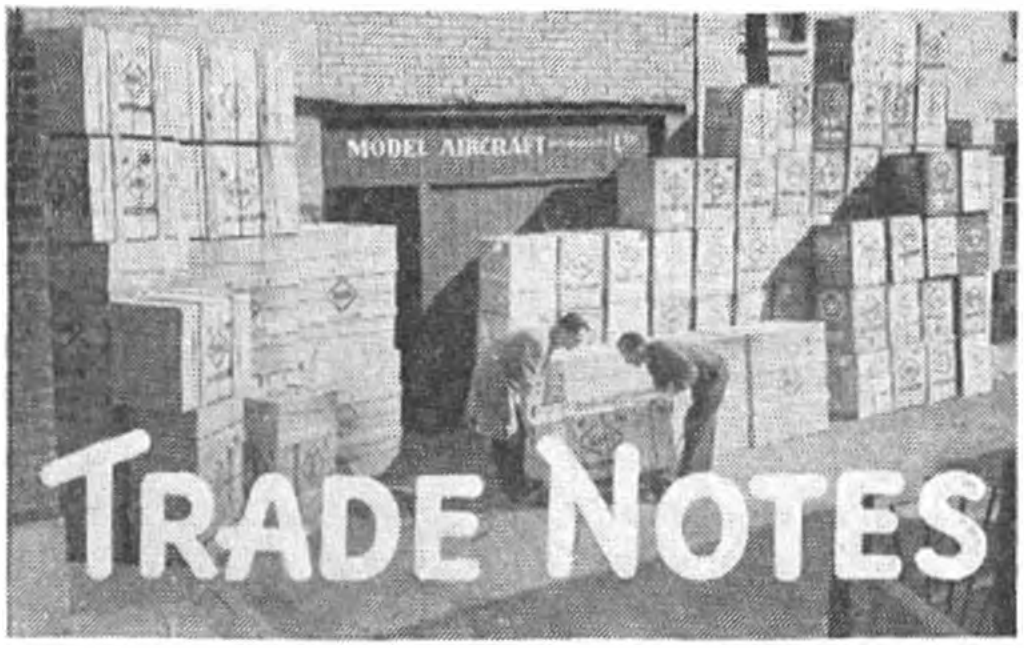
Family of constant geometric pitch wooden airscrews and Mercury No. 8 fuel.

SPECIFICATION

Normal Capacity: 1.5 c.c. (.09 cu. in.)
Bore: 13 m.m.
Stroke 12 m.m.
Weight: 2.625 oz.
Mounting: Beam/Radial
Price: 4,900 franc (£5 approx.)
Manufacturers: Laboratoire Diesel. 62 Rue de Stalingrad, Grenoble, France.

Propeller Dia./Pitch	R.P.M.
9 × 6	5,800
9 × 4	7,250
8 × 4	9,500
8 × 8	7,550
7 × 4	10,300
6 × 4	11,200





Weighing just over 2½ tons, this 82-crate consignment of "Veron" kits and accessories was recently despatched to Australia. Over 10,000 kits of all types went into this order, one of the largest that "Veron" have ever handled.

WELCOME announcement from the **Davies-Charlton** establishment at Barnoldswick is that at long last that little gem, the Bambi miniature diesel is in regular production. When Mr. Davies first introduced us to this tiny mite last October we charged ourselves with the duty of finding out the kind of model/propeller/total weight combination it would require.

Many were the hours of flicking-starting-stopping put in by our editorial Ron Moulton in first attempts at genuine aviation, and after considerable effort, a series of brief flights served as reward for a very stiff right arm. The "model" was a Wakefield tailplane serving as a wing, with 1/32nd sheet tail and ¼ sq. balsa fuselage . . . all-up weight including ⅜ oz.: Bambi;—2¼ ounces. Obviously this prototype engine left a few points to be improved, and the D-C boys thoroughly agreed.

Result of these initial tests is the production Bambi, now bored out to be 0·13 c.c., and with revised porting. Believe us—it's a beauty. A standard motor, straight from assembly went into a bipe with 112 sq. in. wing area, total weight 2 ounces and we obtained a zippy climb immediately—we even had to add in a spot of downthrust to trim! Much is left to be found out on the prop side, but something in the region of a 4½ in. × 1½ in. will be the eventual standard for this small capacity and the most suitable prop will in any case be sold with the motor. One thing is certain, radial type scale engine cowls are out, since every part of the small prop is needed for thrust, and cowl effect, or even a bulky fuselage, can reduce efficiency below the required minimum. On fuels, we've been through the book, trying all the commercial brands and a few inter-mixes of our own. Mercury 6 gives reliable starting characteristics and 6R with REDEX is to be recommended for initial running-in stages—with either, one is assured of peak revs and minimum compression/carburettion sensitivity. A new fuel, developed specially for the Bambi, will be marketed by D-C at the earliest opportunity.

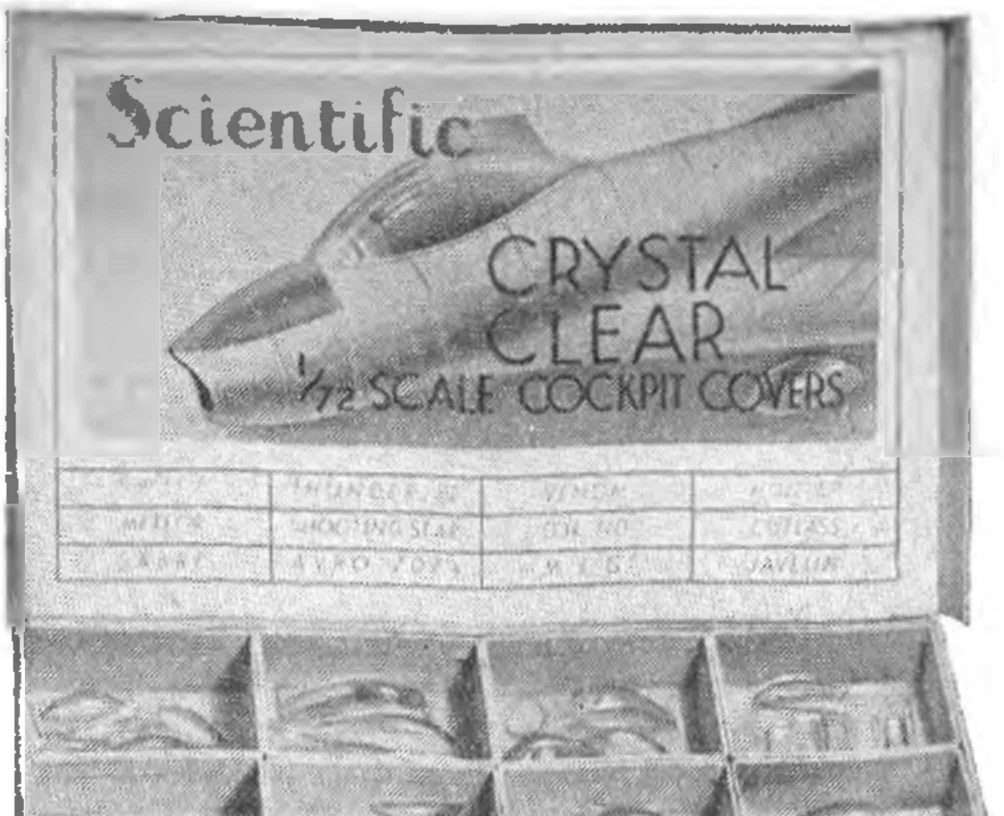
Kit designers are currently hard at work to produce Bambi "specials" but in the meantime, we suggest 60-80 sq. in. wings for a monoplane, 110 sq. in. for a bipe, total weight less than 2½ oz., and above all, design to fly slowly.

Other releases from Davies-Charlton, on the accessory side, is the answer to the power modeller's prayer, a needle valve/cut-out assembly that fits all D-C products and more besides. Spring loaded plunger is positive, can be pulled over and tripped easily by all timers, dismantles for cleaning and has a projection for cowled engines. At 9/6d., this is an item many will consider indispensable. For the same figure one can now buy the D-C universal engine mount for radial or beam engine bench running. It will accommodate any of the popular engines (though some, with awkwardly situated beams above the thrustline require packing) and is robust enough to withstand the longest of running periods with the most vibrationary of engines. A thoroughly useful piece of casting, well designed and which at 9/6d. will be well received.

Mentioning fuels earlier reminds us of a visit paid to the **High Flash Petroleum Co. Ltd.** works at Croydon, where we were struck by the meticulous effort on the part of proprietors Baldwin and Thomas to maintain the high standard of cleanliness and purity in the **Mercury** fuel range. Oils are the finest Esso grades, there's not a trace of reclaimed oil in the establishment, and the Nitrates, Nitro Methanes etc., are the purest that can be bought. Speaking of Nitro, "Tommy" Thomas told us that current price fluctuates in the region of £12–£15 per gallon and one well-known racing car manufacturer was using it at the rate of 500 gallons a month last season . . . and winning. Tommy is a "500" racing driver with a beautifully prepared special for this year at Brands Hatch and tells us that the four wheel drifters dislike Nitro users intensely. "Get into the fumes of that stuff, and you have two alternatives—pass—or drop back" states Mr. Thomas. The former is usually impossible, so the Nitro goes ahead.

Latest additions to the **Skyleada** range of flying scale "Star" series kits for Jetex 50, include the D.H.110, Douglas Skyray, North American F.100 Super Sabre and D.H. Venom. This makes the range of jets quite the most up-to-date in the World, and as already mentioned in these columns, value at 3/6d. each is remarkable.

Dealers have already received the new **Scientific** range of 1/72nd moulded cockpit covers, distributed by B.M.A. Ltd., with open arms, and no wonder, for they are neatly displayed in a twelve section box ready for counter sale.



At 3½d. each, they are a boon to the solid modeller. Now how about a 1/48th range as well—and transfers too?

New names in the trade are always welcome, so to **Odeon Radio** of Harrow and **Bob Wheatley** of Bournemouth we wish every success. The Harrovians are radio gen-men, their shop is smart, they have the stock—and the answers too. If you are local to them, pay them a visit, if distant, send 3d. stamp for their complete stock list. Bob Wheatley rightly advertises as the *active* aeromodeller, the man who knows what he is selling, and carries an ample stock of all kits, engines and accessories. Send 3d. stamps to him for return postage of his catalogue.

A number of readers have written to us in the past regarding Fibreglass, its applications to modelling, and its value as a medium for virtually indestructible moulded components. Our own experiments and investigations began after the 1953 Farnborough show; but though we managed to obtain advice and information from the principal manufacturers, it was plainly obvious that the amateur experimenter in this line is not entirely welcome. Congratulations then to **P. Smith** (Croydon 9652) for his foresight in producing for 6/6d. plus 1/1d. tax, a set of materials for **Bondaglass.** A 2 oz. bottle of resin with accelerator added, a gelatine capsule for that terribly expensive "catalyst agent," and six feet of 2 in. wide woven glass tape go to make up a set for experiment, with full instructions. Wings, cowlings, wheel spats, all with perfectly smooth surface, and virtually unbreakable can be made with this initial set and at a later date, larger sets, for bigger jobs will be available for aeromodellers.

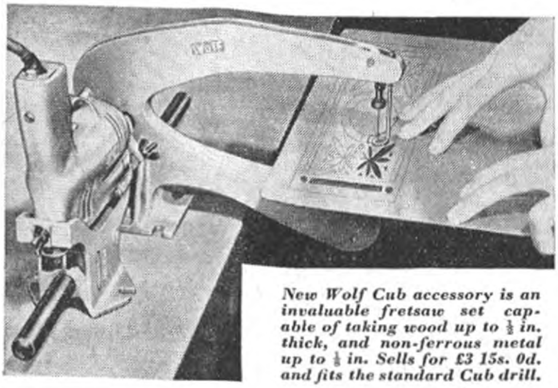
Pirelli rubber, re-introduced into this country in 1948, quickly became a favourite with many leading Wakefield flyers. Torque characteristics of this Pirelli were somewhat different to Dunlop or T-56, with a tendency to give more power over the middle part of the run and a lower initial torque.

Last year the makers (Pirelli Revere of Milan, Italy) did undoubtedly turn out a bad batch of rubber, virtually useless for contest work. The British distributors to the model trade—**Ripmax**—did, in fact, return the bulk of this as unsuitable for the aeromodellers' needs. With the arrival of a fresh consignment from Italy last October we thought it worthwhile to test sample skeins to check the quality of Pirelli available for the 1954 contest season.

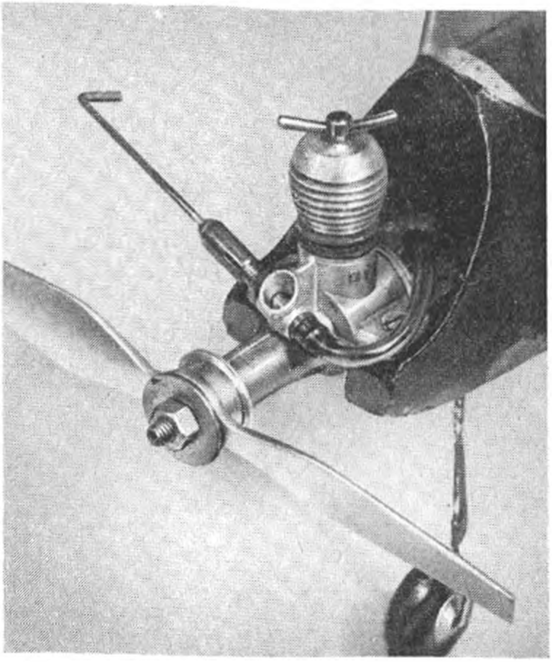
The ¼ in. strip is well up to the old high standard and we have no hesitation in recommending as directly comparable with the best Dunlop strip and somewhat superior to T-56. A 38-foot length will, when lubricated make up into a Wakefield motor of just under the limit (actually about 2·8 ounces).

The $\frac{3}{16}$ in. strip tested was of approximately the same quality but, physically, is under size and so what would appear an identical motor in nominal cross section is, in fact, less powerful and longer. For example, 16 strands of $\frac{3}{16}$ in. strip is equivalent to 12 strands of ¼ in. strip, if both are the same thickness and cut to exact strip width in each case. The true equivalent in cross sectional area with Pirelli is more nearly 17 strands of $\frac{3}{16}$ in. equal to 12 strands of ¼ in. strip.

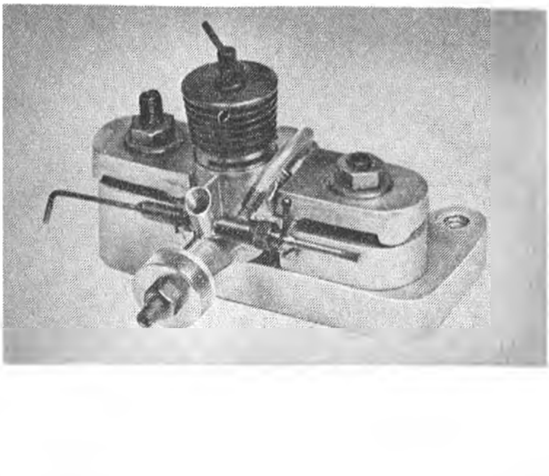
One point you can watch for. The new Pirelli is a black rubber and both the ¼ and $\frac{3}{16}$ in. strip are identical in appearance and texture. The "bad" batch mentioned above was of a lighter colour and retained a certain chalky whiteness, even when lubricated.

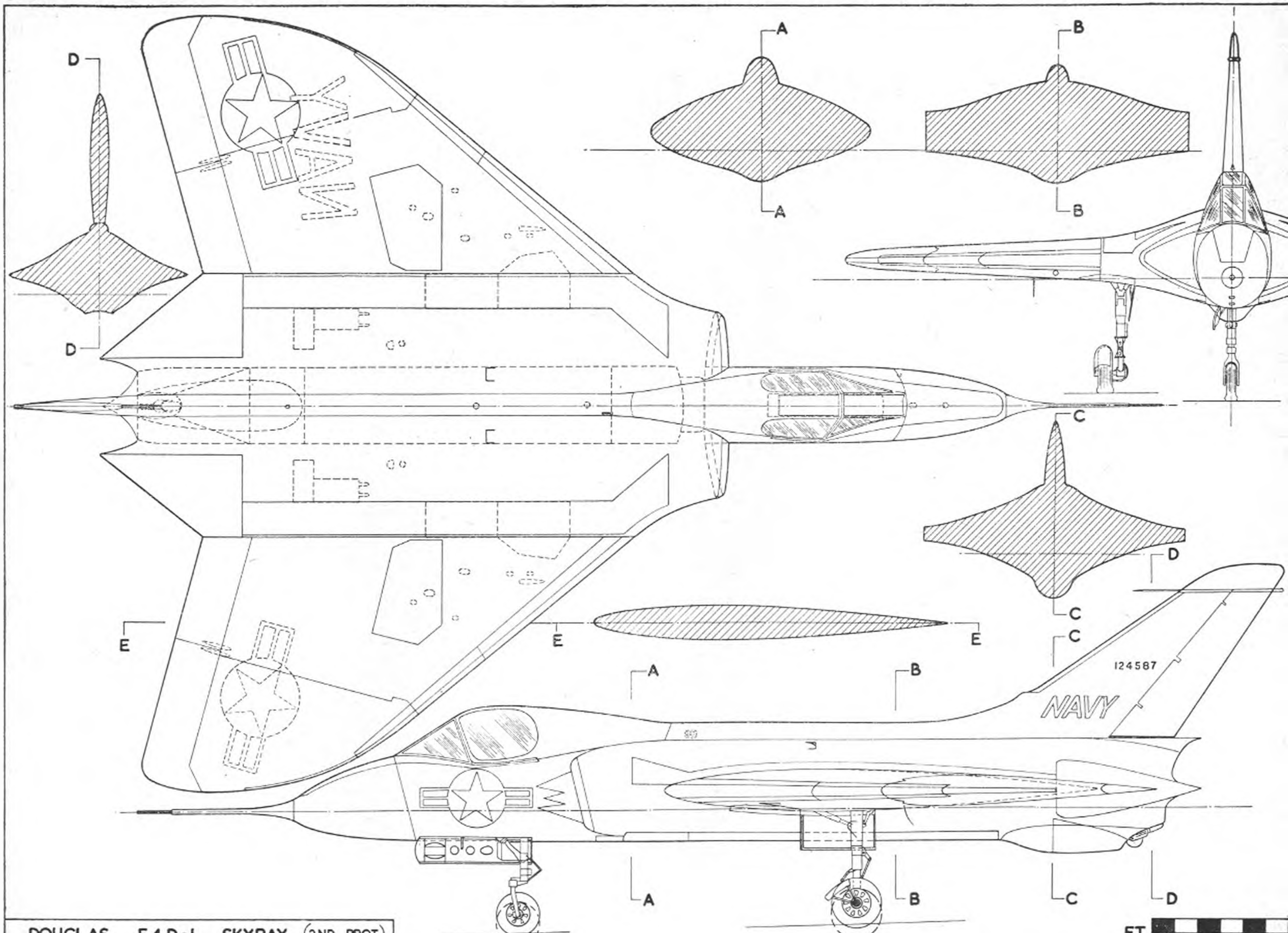


New Wolf Cub accessory is an invaluable fretsaw set capable of taking wood up to ½ in. thick, and non-ferrous metal up to ⅛ in. Sells for £3 15s. 0d. and fits the standard Cub drill.

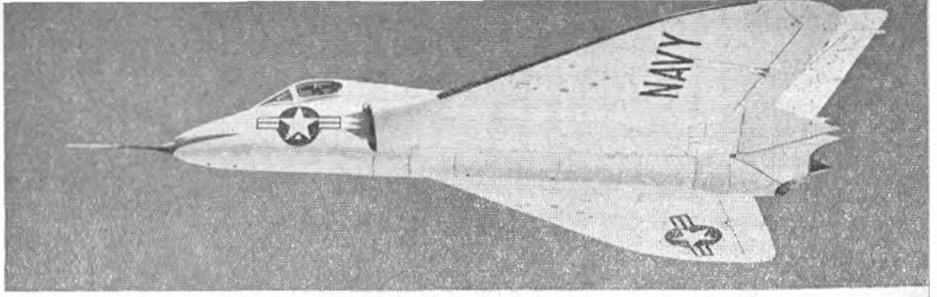


Above: The Bambi, with 4½ in. metal prop in A/M test model, now has normal type contra-piston screw, revised porting. Is easy to start and runs fast. Below: A Spitfire in the new D-C test mount and fitted with the cut-out needle valve, another D-C accessory.





DOUGLAS F4D-1 SKYRAY (2ND. PROT.)



Aeroplanes in Outline . . . No. 13

by J. R. Enoch

DOUGLAS SKYRAY

WHILST studying the design projects of the delta pioneer, Professor Lippisch, the Douglas Aircraft Company were asked by the U.S. Navy to undertake the development of such a design.

Led by Ed. Heineman, Chief Engineer of the Douglas El Segundo plant, the design team had by 1948 evolved the F4D-1 Skyray, intended specifically for carrier borne fleet interception duties. After being catapult launched from an aircraft carrier, the Skyray can climb almost vertically at a rate of between 15,000 ft. and 18,000 ft. per minute to an altitude of 50,000 ft. approx, sufficient fuel being carried for a duration of about 45 minutes.

On January 23rd, 1951, the aircraft made its first flight, piloted by Larry Peyton, veteran test pilot of the Douglas Aircraft Company. Having taken off from Edwards Air Force base, Muroc, California, the aircraft was airborne at altitude, for thirty minutes.

Finished in high gloss midnight blue, with a matt surface anti-dazzle patch on the nose, the aircraft was originally powered by a Westinghouse J.40-WE-6 of 7,000 lb. thrust, the efflux passing through a small orifice, under which is the fairing to contain the retractable arrestor hook. On this aircraft no provision was made for wing folding.

The second prototype, which is the record breaking aircraft, differs in many ways from the first machine, the rear fuselage having been re-designed almost completely. Installation of a Westinghouse J.40-WE-10 with the production type afterburner, has necessitated a much larger tailpipe nozzle, and consequently, the fin root and wing trailing edge have been re-shaped.

Of extremely clean aerodynamic form, the white painted second prototype, though officially reported to be supersonic, is capable of both a short take off and landing run due to the novel wing features, yet no flaps are fitted. Leading edge slats and large air brakes with a conventional rudder and power assisted elevons, operating jointly as elevators or in opposition as ailerons, combine to allow exceptionally good manoeuvrability.

The fuselage which is very gracefully blended into the wings, has a slim nose containing radar equipment, to which a long probe is fitted for test purposes. The large cockpit, fitted with an ejector seat, has an unusually shaped windscreen, and when closed, the rearward sliding flat-topped canopy forms the forward part of the spine which extends straight along the top of the fuselage to the tall moderately swept fin and rudder. This has a small air intake near its base, and a pressure head close to the top of the fin.

Almost the whole length of the underside of the fuselage is taken up by what appear to be bomb doors, but these presumably provide access to the engine bay for servicing and maintenance. Necessitated by the fitting of the large afterburner, there is a large bulbous fairing under the rear fuselage, and its lower rear surface hinges down with the arrester hook. The latter is unusual, since it appears to be articulated, and at the joint is located a small wheel which would act as a tail bumper in normal landings. It is reported that amongst the armament, air to air rockets are carried in a retractable launcher situated in the fuselage.

The wings have folding tips to facilitate carrier stowage, and contain the forward retracting main wheels. Like other U.S. Naval types the F4D-1 has, in addition to rockets, four 20 mm. cannon, presumably wing mounted just outboard of the undercarriage.

The engine intended for production Skyrays was originally the Westinghouse J.40, as fitted to both prototypes, but since this turbojet has now been withdrawn from the Navy's plans, a power plant of Pratt and Whitney or Rolls Royce origin may be substituted. With the afterburner in operation, the J.40 thrust was boosted to almost 12,500 lb. for short periods.

Having completed acceptance trials ashore, and at sea, on board the U.S.S. Coral Sea, in October 1953, the Skyray has been ordered into quantity production, and delivery is scheduled for late 1954.

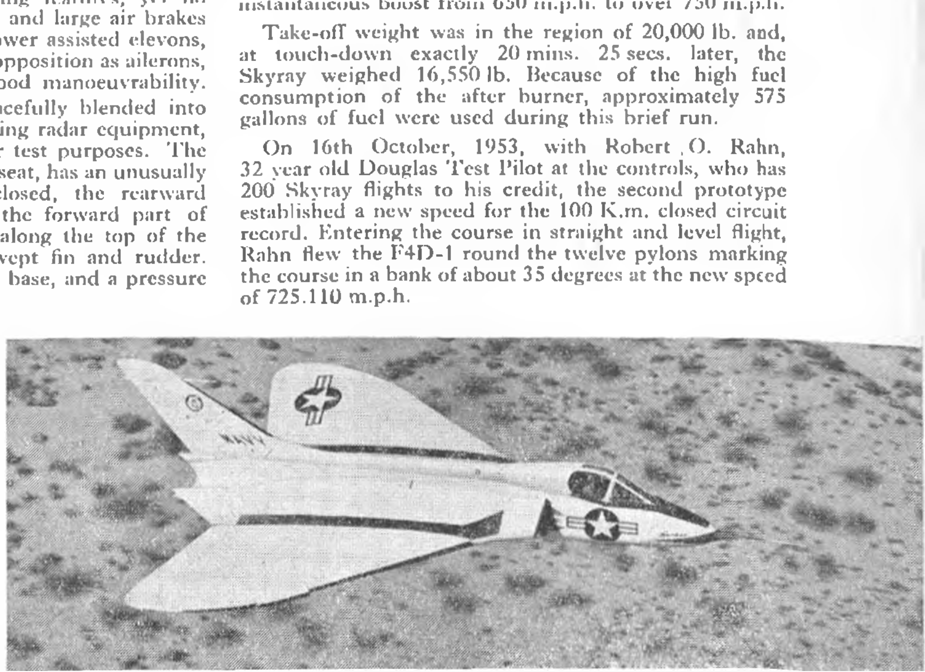
Lt.-Comdr. James B. Verdin piloted the aircraft over the shores of the Salton Sea, California, on 3rd October, 1953, at an average speed of 753.4 m.p.h. In four runs at less than 100 ft., the speeds recorded were respectively, 746.075, 761.414, 746.053, and 759.449 m.p.h. The flight plan called for Verdin to cut in the after burner 30 seconds before reaching the course, giving the aircraft an instantaneous boost from 650 m.p.h. to over 750 m.p.h.

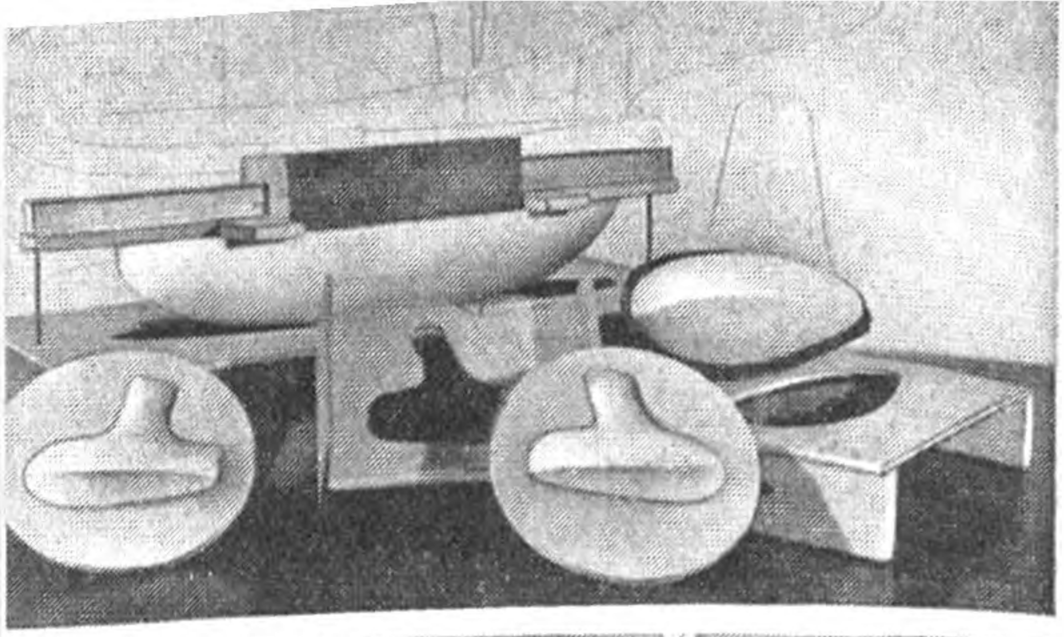
Take-off weight was in the region of 20,000 lb. and, at touch-down exactly 20 mins. 25 secs. later, the Skyray weighed 16,550 lb. Because of the high fuel consumption of the after burner, approximately 575 gallons of fuel were used during this brief run.

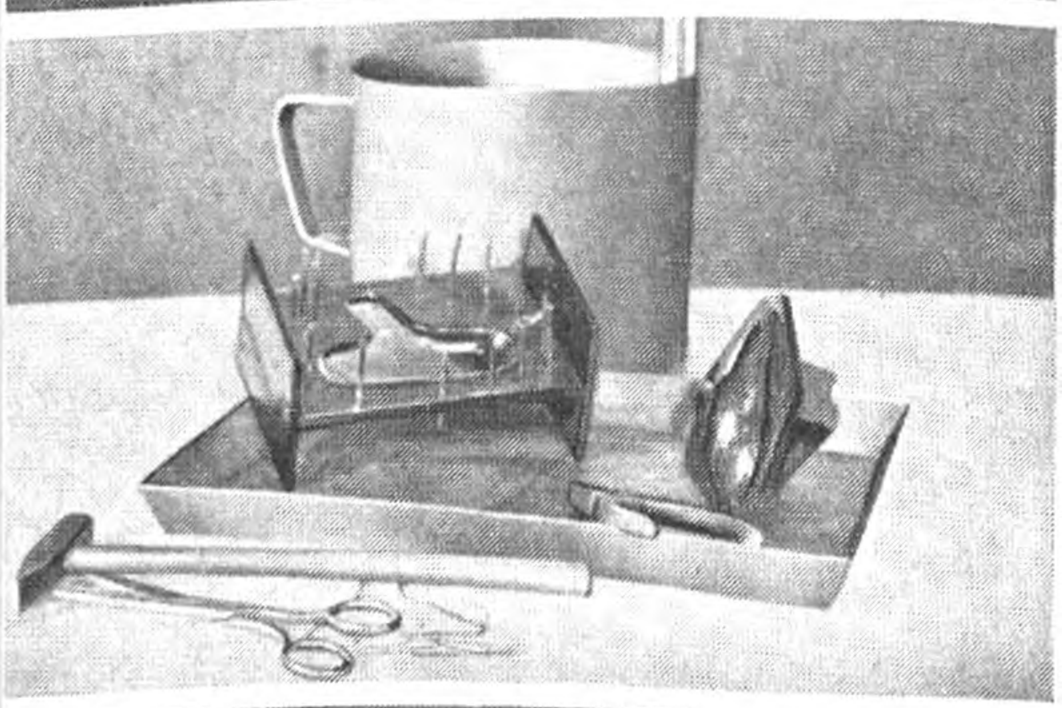
On 16th October, 1953, with Robert O. Rahn, 32 year old Douglas Test Pilot at the controls, who has 200 Skyray flights to his credit, the second prototype established a new speed for the 100 K.m. closed circuit record. Entering the course in straight and level flight, Rahn flew the F4D-1 round the twelve pylons marking the course in a bank of about 35 degrees at the new speed of 725.110 m.p.h.

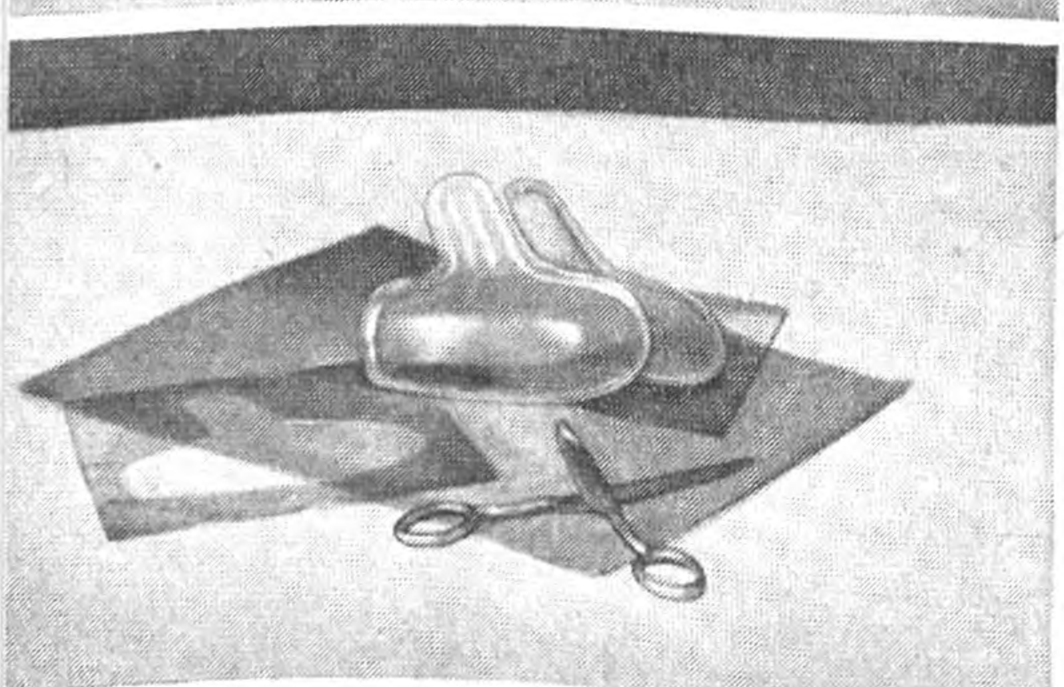
Two Douglas photos show the vivid high gloss black and white finish of the record breaking Skyray. Span is 33 ft. 6 in., length more than 50 ft.

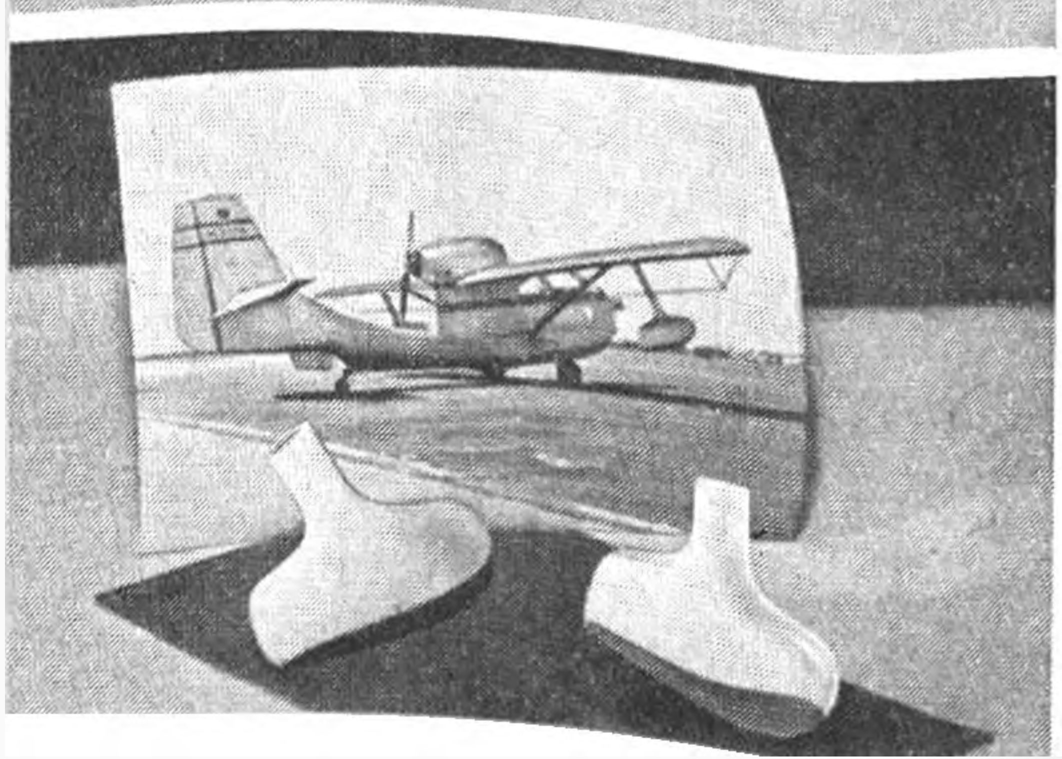
1/72nd scale "J" type reprints and 1/48th "A" type die-line prints of the drawing opposite can be obtained through APS, price 6d. and 1/- respectively.











make your own cockpit covers, floats, etc. . . . by

Acetate moulding

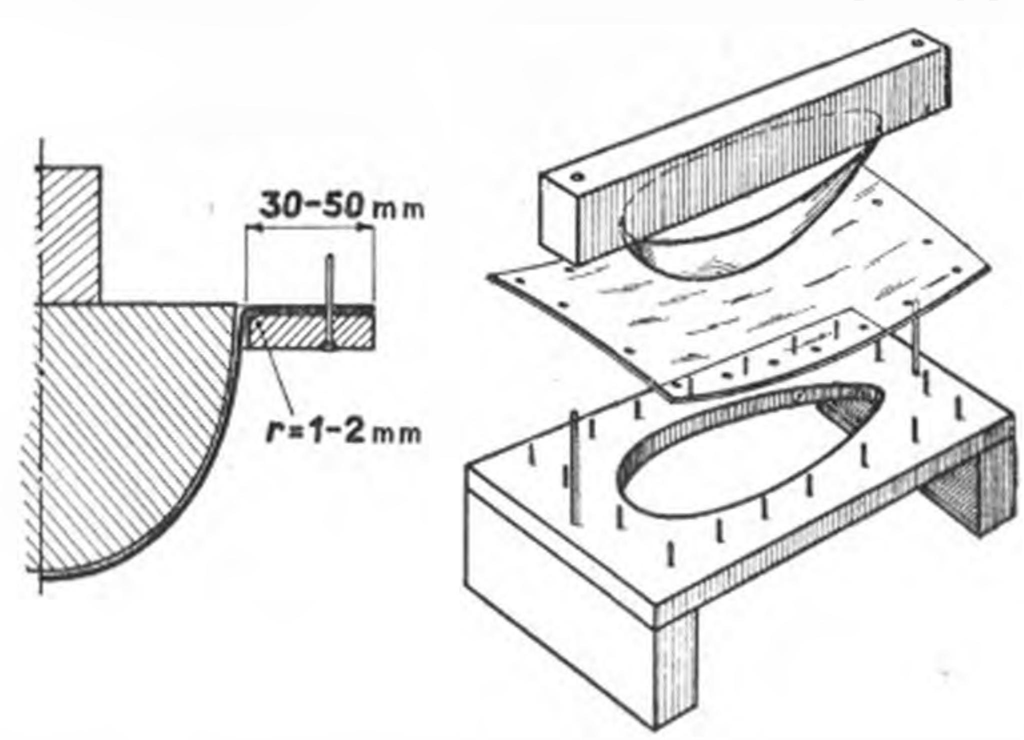
suggests E. BRAUNER

FOR the realistic type of model, whether it be accurate solid scale or semi-scale free-flighter, a well-moulded cockpit canopy doubles the effect of good finish, and is in fact, an indispensable feature. Most modellers adopt the system of heating Cellastoid, or acetate sheet in an oven or by an electric fire, and then forcing the wooden pattern onto the plastic so that it adopts the desired curvature. But this method has its disadvantages, and tends to limit the work to shallow mouldings only.

Using a pot of hot mineral oil at a temperature of about 160° C., it is possible to obtain instantaneous malleability of the moulding material, and an even wall thickness in the final job. Unlike the electric fire process, the entire die, with material and pattern are immersed in the heat of the oil, and none of the heat given to the acetate is lost on the wooden parts.

Procedure is as follows:—make the wooden pattern as accurately as possible, allowing it to be undersize by the amount of thickness in the acetate. Now cut a corresponding hole in a rectangle of ply (at least $\frac{3}{8}$ in.) so that the pattern will pass through with enough clearance for the acetate. There should be sufficient area around the hole to retain the flat acetate sheet with strong pins every inch or so, and all edges at the upper face of this plate should be radiused as in the sketch below.

For electric moulding, simply hold the mounted acetate in front of an electric fire until it achieves a malleable state. The pattern is then forced onto the transparent material and through the hole. For oil heating, immerse the entire job in the pot and work with tongs to push the pattern in place. Remove, and allow to drain off in a drip tray, then wash down with paraffin and when dry, shine up with best quality polish.



Photos demonstrate, top to bottom:—the wooden patterns, with appropriate ply moulds; the acetate after moulding in hot oil is formed to the pattern and now drains clean; washed in paraffin and rough trimmed; then two halves are cemented together with acetone solvent; bottom, finished and painted, the result is a perfect lightweight pair of scale SeaBee floats.

CLUB NEWS

Modified Rudderbug with Sills radio is demonstrated by P. Jackson to members of the new NORTH LINCS. M.A.S.

ABOUT this time of year, speculation on the possible weather coming along is by no means uncommon, and it is interesting to think back about "typical" years and so forth. Whenever the Gamage Cup has enjoyed good weather, the subsequent programme is always topsy-turvy—meetings normally blessed with excellent flying conditions are rained out, and contests notorious for dud weather bask in windless sunshine. No kidding, there seems to be a definite pattern. Still, "Damage" day this year was at its customary worst, and one thing is thus pretty certain—we shall get very much the mixture as before!

Southern Area

A bright idea is a photo-board up in the club-room, as may be seen in the **WEST HANTS A.A.** meeting-place, the West End Cafe (next to Bournemouth West Station) on the first Tuesday in each month. Everyone likes looking at photographs of other bods' activities, and touches like this do a lot towards holding a club together.

It's quite a change to hear of a *rubber* R.T.P. speed event these days! Junior P. Farmborugh recorded 31.6 m.p.h. to win **READING D.M.A.C.'s** contest; the model was a slab-sider with $\frac{1}{8}$ in. sheet wings and eight strands of $\frac{1}{4}$ in. flat turning a plastic prop. Members were called upon to explain their plans at a design contest, which proved quite amusing; B. Beale's racer and D. Stanning's F/F power job tied for top place.

Excellent facilities are offered to members of **SALISBURY D.M.E.S.**, since most of last year was spent in building a clubroom (with lathes, welding plant, etc.) valued at £500, in the Leg of Mutton Field, off Castle Street. The Society, embracing all models, plans a car track, railway, etc., and is anxious to increase membership. A Whitsun exhibition is scheduled and a prize will be awarded to the best model aircraft constructed by any under-16.

High winds (o.o.s. in under a minute) upset the intending Pilcher entrants from **FARNBOROUGH M.A.C.**, but a club contest was bl-er-flown. Each month the boys fly all F/F types in a mixed event, points being awarded to the first three; at the end of the year the highest points total earns a cup.

BRITISH NATIONALS

Accommodation.—Camping permitted *after* 7 p.m. on Friday, June 4th, water and usual offices provided, plus a mobile canteen morning and evening. Standard charge 2s. 6d. per tent or caravan. Cafe 2 min. walk from site. No engines to be run after 9 p.m. All inquiries in by May 22nd please. Hotel accommodation—cannot be undertaken by organisers. City guidebooks available for those applying before May 1st.

Parking.—Limited space for campers' vehicles near camp site. All other vehicles in special car park under R.A.F. police. Large vehicles, 2s. 6d. per period, cars 1s., motor-cycles 6d. No vehicles permitted in flying area except for officials' and Press use. Transport of equipment to flying area only by arrangement. Vehicles in unauthorised areas will be removed. No responsibility can be accepted for accidents occurring.

North Eastern Area

The '54 season holds contests ranging from scrambles to Paa-load for **NOVACASTRIA M.A.S.** members, the latter due to the popularity of *Paageboy*. B. Freeman's "reinforced" *Skyskooter* for sport flying has caused amusement, since it weighs more than it should do with radio! Junior R. Hornsby looks like being the first member airborne with a *Seraph*, while member Scott is enjoying flying pusher jobs, including a *Pushycat*.

South Western Area

A steady increase of **BRISTOL AND WEST M.A.C.** membership has resulted from the encouragement of Sunday morning flying on Dundham Downs, where a good crowd of fliers and spectators has become regular. The last winter meeting was devoted to prize-giving, and the winter programme was voted the best in the club's 20 years existence. The West of England Championship is booked for September 5th at Lulsgate, on a similar basis to last year's.

South Eastern Area

Lack of suitable flying fields is shifting the focus to team racers in **SEVENOAKS M.A.C.**, though the hard core of free-flighters still remains. Living in the "Garden of England" has its disadvantages!

Midland Area

Contest-minded modellers are wooed by the **BLACKHEATH AND HALESOWEN M.A.C.**, who suggest that they are the only club in the district catering for members who are serious in that direction. Four local clubs have now combined to form an association to foster mutual co-operation with its benefits in respect

CONTEST RESULTS

GAMAGE CUP
(14/3/54)

1.	J. O'Donnell	Whitefield	10 : 44
2.	J. Palmer	Croydon	9 : 53
3.	J. Gorham	Ipswich	9 : 32
4.	C. Christie	Bucksburn	9 : 24
5.	E. Bennett	Croydon	8 : 17
6.	V. Thomas	Northwick Park	8 : 03

(40 entries)

PILCHER CUP
(14/3/54)

1.	D. A. Laxton	Oundle	9 : 04
2.	A. Wisher	Brixton	8 : 51
3.	J. Waldron	Henley	8 : 37
4.	J. Kay	Loughborough	7 : 25
5.	G. Gooding	Hull Pegasus	7 : 19
	J. Allsop	St. Albans	

(61 entries)

of exhibitions, travel to meetings, etc. Juniors Wright and Castle have been dabbling in microfilm with flyable results; G. Walker is concentrating on a Foster Wakefield, J. Adamson on A2 stuff, and sec. P. Weldon on an assortment varying from a Jetex duration effort to an autogiro.

Possible amalgamation is also a topic in the **OSWESTRY M.A.C.,** this time with the local M.E.S. and with the ultimate aim of a clubhouse with car and rail tracks, etc.

The **COVENTRY R.C.M.C.** is now the Coventry Group of the I.R.C.M.S. meeting on the first Wednesday of each month at 8 p.m. at the A.A.S. Club, 78 Holyhead Road, Coventry. The secretary of this fifth I.R.C.M.S. group is P. Haselock, 25 Wainbody Avenue, Coventry, by the way.

East Anglian Area

That date we mentioned to team-race fans, August 8th, is now confirmed for the **CAMBRIDGE M.A.C.** rally, which will be held on Messrs. Pye, Ltd.'s sports ground, St. Andrews Road. ½A, A and B racing, and combat are on the programme, and all the gen. can be obtained from M. D. Gates, 90 Whitehill Road, Cambridge.

Northern Area

A common situation is remarked upon by the **WEST YORKS M.A.S.** There are lots of free-lance sports fliers in the district who don't join a club since they feel that only hot competition men are encouraged. If only they would come to meetings, laments the P.R.O., we could get down to organising suitable events. Perhaps the new S.M.A.E. scheme will improve the state of affairs? Another difficulty—that of subs.—is also being tackled by this club. Anyone six months' behind automatically forfeits membership and his chance in the subsidised coach trip runs to rallies. Well, fair enough!

HULL PEGASUS M.F.C. are still wondering what hit them on Gamage day. Test flights eliminated all but one entry (for the Pilcher) and the comp. sec. was heard beseeching the chuck glider addicts (the only ones left with flyable models) to put up a few times to fill his records-sheet up! However, plenty of interesting new models (even a rubber canard) are on the way. High speed deltas (as February "AEROMODELLER") are all the rage.

Flying space is again a headache, forcing **MEANWOOD I.M.** to adopt C/L as their principal home interest. Combat using scaled up or down *Kombat Kapers* and derivatives such as *Ker, Kopy Kat,* and the latest, *Koncrete Kracker*—a lethal 144 sq. in. following a B.B. Amco—holds premier place, but sixteen or so B.B. Amco stunt jobs are in the offing. Several C/L canards have been tried, and 10 c.c. team racers are just appearing, two having flown (Anderson Spitfire, Super Cyclone) and four more (Nordec, Fox 59, and two McCoy 49s) being on the way.

Pre-season activity in **BRADFORD M.A.C.** is intense and it may be a portent that Silvio Lanfranchi is offsetting his seven new contest jobs (including a Torp. 15 PAA-loader) by flying a venerable pre-pylon cabin job powered by an Ohlsson 60. J. Pannett borrowed a Torp. and fitted it to an *Eliminator*, and with a stuck timer and no D/T was lucky to have the model rescued the following day from telephone wires a couple of miles off.

Some strong munching, interspersed with trophy presentation, ensured a pleasant evening for **BARNSLEY D.M.A.C.** members attending the Annual Social. Lots of new jobs are in preparation, although winter weather has limited flying. Combat and A2 are attracting the members and contest interest is very high.

An excellent club-room has assisted **WORKSOP AEROMODELLERS** to enjoy the best winter season they've had. Two meetings a week, with small power and hand tools available, not to mention cups of tea and facilities for pole flying . . .! However, the niff of spring in the air has caused attendances to fade a little lately, a trend not helped by the six keen members who have bought a full-size glider; no doubt interest will perk up when the contests are in full swing.

London Area

Bad weather has affected **CROYDON D.M.A.C.,** so that the last 1953 club comps. have only just been run off. Roy Yeabsley's thin-fuse '54 A2 topped the glider list and Ed. Bennett flew an old-rule Wake to a very narrow win over a clutch of new-rulers. A well-attended dinner put 1953 firmly behind and the men are now sharpening their stopwatches for the 1954 Gala on May 2nd.

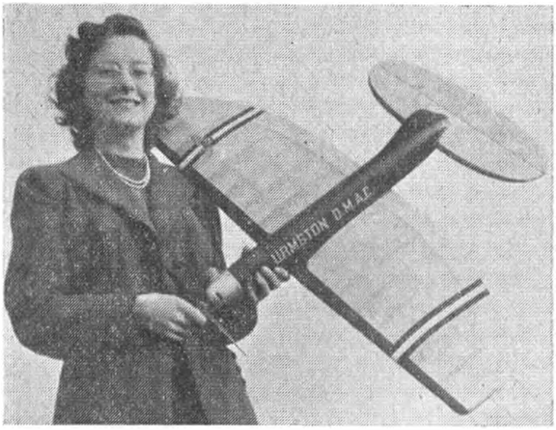
A cascade of **WEST MIDDLESEX M.F.C.** members into a lower floor was avoided by a timely warning of dry rot, as the after-dinner party games commenced at the club's first Annual get-together. This club believes in an early start, since it has already flown off its 1954 comps., results being: power, H. Hubble, 4 : 49, glider, P. Law (*Tadpole*), 8 : 26, rubber, G. Over, 7 : 59.

The new Queen Elizabeth Cup rules are confirmed as up to 5 c.c., F.A.I. power and wing loadings, etc., 15 sec. run from optional release, one attempt per round (over-run disqualifies), 5 min. max., bonus for landing within airfield, general S.M.A.E. rules apply where relevant. Entrant must construct all of model with exception of motor, timers, tanks, wheels and propellers, and all models must be insured. The event will, of course, be flown at the **NORTHERN HEIGHTS M.F.C.** gala on June 20th.

Another team-racing rally is dated for July 11th, this being staged by the **ENFIELD D.M.A.C.** on the

CONTEST CALENDAR

April 25th	Weston Cup 2nd Wakefield Elim.	} Area	
	Astral Trophy 2nd Power Elim.		
May 1st/2nd	International R/C Meeting	Evere, Belgium	
May 2nd	Croydon Gala	Chobham Common	
May 22nd/23rd	International Team Trials	Cent.	
June 5th/6th/7th	British Nationals	Waterbeach	



Miss Eileen Whiston, treasurer of the Urmston D.M.A.C. and her Yulon 29 powered "Musketeer", a combination which is making the club's stunt men pull up their socks!

north end of Enfield playing fields, adjacent to the Great Cambridge Road. ½A (to High Wycombe rules), A and B racing will take place. Details from R. J. Tuthill, 79 Birkbeck Road, Enfield, Middx. In other spheres, Jetex R.T.P. (scale jobs that fly slowly enough to be seen at exhibitions) and externally controlled C/L with .5s are receiving attention, while outdoors interest is centred on 230 sq. in. total, 6 oz. rubber jobs, using 12 strands of ¼ in. R. Tuthill has a boy-size pulse jet, 2 lbs. thrust for 10 oz. weight, though the Mk II should only weigh 7 oz.

WEST ESSEX AEROMODELLERS meet at the Markhouse Road Schools, Walthamstow, each Wednesday at 8 p.m. and would welcome any new members along.

Amalgamation—this time with a radio society—brought the total membership of **BRENTWOOD D.M.E.S.** to over 65. With radio members, it is no wonder that a club radio project is on the way, and the choice has settled on a 9 ft. medium aspect ratio power-assisted glider.

North Western Area

Due to the recent disbandment of the **MERSEYSIDE M.A.S.**, the organisation of the 12th Annual Slope Soaring Meeting, Clwyd Hills, has been taken over by the **CHESTER M.F.C.** The main award will be the Gosling Sailplane Trophy for the best non-R/C flight. A radio event may be included if sufficient interest is shown, when we may expect a new British record ?

The **MILLOM M.A.C.**, three years old, is itching to get at contests this year. The club would like to augment its keen but small membership; potential members write to T. Williams, 20 Lapstone Road, Millom, Cumberland.

For enthusiasm, **TAME M.A.C.** takes some beating. This practically sports-only club meets on the field each Sunday, hail, rain or snow. Whether numbness has anything to do with the member who seems to have developed the habit of losing his grip when flying stunt C/L we don't know, but the results are highly diverting!

Monday nights at the local Brinkway Schools, sees the 27 members of the new **EDGELEY HEATH M.A.S.** in session. New members cordially invited along.

E. Horwich's 9 ft. glider won the Lawton Cup and J. O'Donnell (rubber) the Elite Cup at the **WHITEFIELD M.A.C.'s** interclub event in February. Whitefield also came out on top in a R.T.P. team-race with **SHARSTON AND CHEADLE** clubs, despite this form of competition being relatively new to them. Two other competitions in February saw J. Trainer win the Novices' event with a 6 : 10 glider total, and E. Horwich power with 7 : 10.

The first two monthly handicap events have worked out well for **WALLASEY M.A.C.**, and certainly appear to give inexperienced members a good chance, even though sec. J. Hannay won the first (rubber) and scratch man, junior C. Bryan, the second (power).

Scotland

Profits from the canteen of the "red lichties"—otherwise the **ARBROATH M.A.C.**—have proved high, especially off the water in the tea. ("No cracks, ye Sassenachs!). The use of the R.N.A.S. 'drome, H.M.S. Condor, makes Arbroath the flying centre of the whole of Angus.

A new club, **BRECHIN M.A.C.** (J. Dunbar, sec., clubrooms, 28 High Street, Brechin, Angus) is evidence of increasing interest in this region. A.P.S. designs are most popular with members, two *Seraphs*, and two *Pushycats*, a *Sky Pal*, a *Chipmunk*, and a *Tiger Moth*, being among others on the board.

BUCKSBURN A.T. have re-joined the S.M.A.E. and are looking forward to the Scottish Power and Rubber Nationals, probably to be held on July 4th at Condor.

Thirty members are listed on the strength of the **CONDOR M.A.C.** itself, where power duration is the favourite. With a new clubroom and a revival of contest interest, things should start moving in this club.

A programme of R.T.P., etc., has kept things going throughout the winter for **DUNDEE M.A.C.**, but with the annual film show now over outside activity is increasing.

A very successful show in a central arcade by the "gable endies"—**MONTROSE M.A.C.** to you and I—again saw a predominance of A.P.S. designs (they *must* be more economical!) and several new members resulted. Plans and magazines formed an attractive background to the models. Odd twist to the tale of two A2s lost in the nearby tidal basin, mentioned in these columns—Petrie's, with name and address on a transfer, which soaked off, was fished out and returned. Campbells', with indelible names and addresses all over it, has never been heard of again!

Which reminds us of a very odd story of a junior in the Hull Pegasus Club. Seems he had a large cabin job which flew very well. Arrived at field one day and decided to try R.O.G. No joy. After several attempts gave up and reverted to H.L. Could only get powered glides. Sometime later the penny dropped—he'd packed all his sandwiches, etc., in the roomy fuselage for transport to the field!

Ouch! ! The CLUBMAN

NEW CLUBS

HASTINGS AND BEXHILL AEROMODELLERS.
T. A. Skinner, 16 Shepherd Street, St. Leonards-on-Sea, Sussex.
EDGELEY HEATH M.A.S.
H. Green, 166 Northgate Road, Edgeley, Stockport.
ICKENHAM C.A. M.A.C.
D. Turner, 1 The Crossway, Hillingdon, Middx.

S.M.A.E. Crossword £100 CASH PRIZE

Help the fund to send our teams to America for the World Championships and at the same time win yourself this magnificent cash prize.

To ENTER this competition you simply solve the puzzle with the best and most apt answers you can find for the clues and send your entry in accordance with the directions given below. Every entry will be examined and the prize of £100 awarded to the entrant who, in any one attempt, has submitted the solution adjudged by the Adjudication Committee to be the best received—aptness and accuracy of answers to the puzzle and the clues being the test of merit. In the event of a tie the prize will be divided.

1. Each entrant's initial attempt/s must be completed IN INK, in block letters on the proper printed coupon.
2. The fee for one attempt is 1/-, and 4d. for each subsequent attempt.
3. Every entry must be accompanied by a Postal Order. (Loose stamps will NOT be accepted.)
4. Additional attempts in excess of three can be submitted on plain paper. Such attempts must be completed in full on a copy of the square.
5. Cut out the whole of the coupon around the dotted line (do NOT separate any of the squares).
6. Sign and address the coupon entering the number and value of the P.O. where indicated.
7. Write your name and address on the back of the P.O., which must be made payable to S.M.A.E. Limited and crossed /& Co./
8. Entry must be posted with P.O. in sealed 2½d. stamped envelope to reach this address:—
   S.M.A.E. X-Word,
   c/o. "Aero Modeller,"
   38 Clarendon Road,
   Watford, Herts,
   by the first post on **Monday, June 14th, 1954.**
9. Every coupon or attempt paper must bear entrant's own usual signature and address.
10. NO ALTERATIONS ALLOWED.
11. Proof of posting not accepted as proof of delivery.
12. No responsibility accepted for entries lost or delayed.
13. The Editor's decision is final and legally binding.
14. No correspondence can be entered into.
15. Employees of The Model Aeronautical Press Ltd., and Percival Marshall Ltd., and their families not eligible.

- - - CUT COUPON OUT WHOLE WHETHER ONE OR MORE SQUARES USED. - - -

In entering the S.M.A.E. X-Word competition, I agree to the full rules as published as final and legally binding.

Signed (Mr./Mrs./Miss)..............................

Address ....

....

One Square 1/-.
Each subsequent square 4d.
Enter P.O. Number and value here:
P.O. No..................
Value ....

- - - CUT COUPON OUT WHOLE WHETHER ONE OR MORE SQUARES USED. - - -

CLUES

Across.

1. Contest modellers should know every one.
6. Abbreviation.
7. Towlines sometimes do this.
8. Eager for drink.
10. Needed for model flying.
11. Avoid this with your engine.
14. Models in this are easily seen.
16. Abbreviation.
17. A little can be beneficial—too much can do harm.
22. Sometimes necessary to do this with opposite sex.
23. May affect landing.

Down.

2. Engines which are this upset their fliers.
3. What the Bookmaker—does not always win.
4. Abbreviation.
5. Modellers should always be this.
6. There is usually one of these at a contest.
9. Artistic State.
12. Abbreviation.
13. This begins when friends fall out.
15. Often seen near the green.
18. Time keepers need to do this.
19. A game.
20. A good this will sometimes loosen a sticking part.
21. Peas may be found in it.

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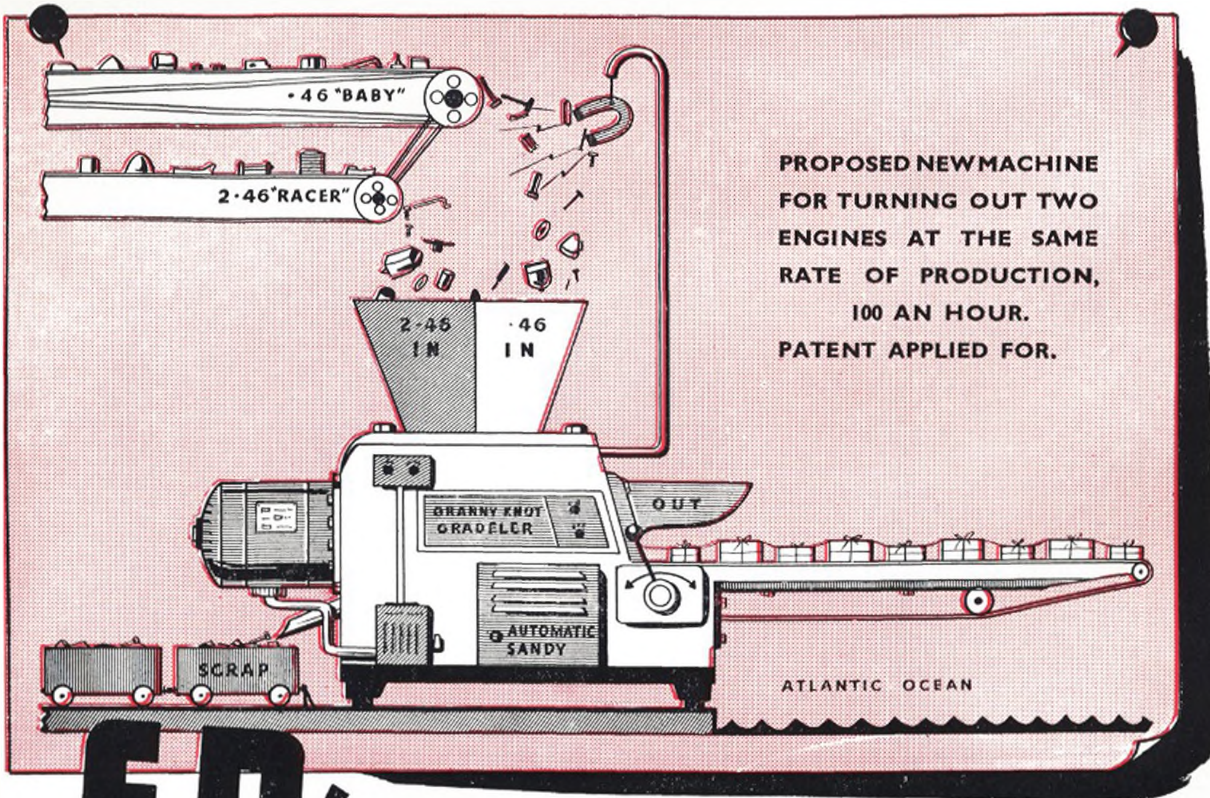

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