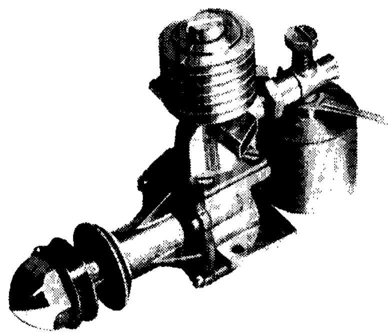
MAR.
1950

1/3

AEROMODELLER

E.D.
THE VERDICT OF THE MAJORITY



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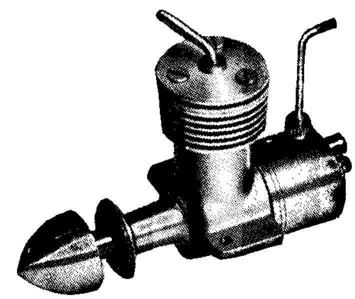

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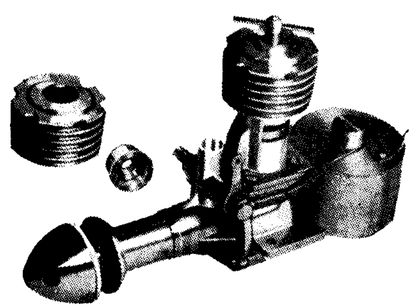

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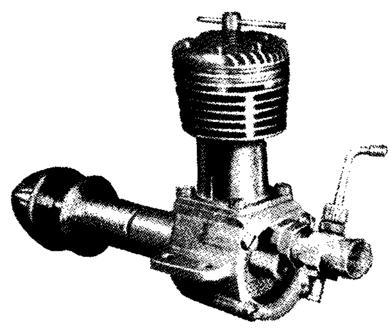

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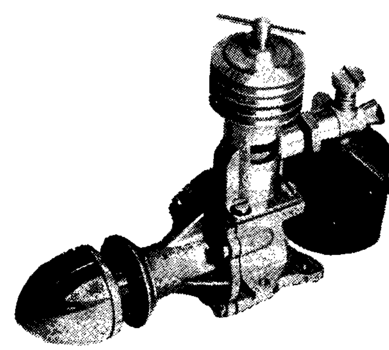

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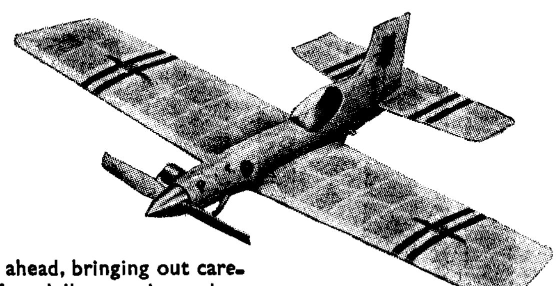

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14/6

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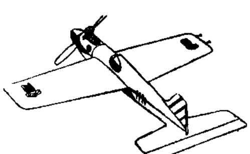

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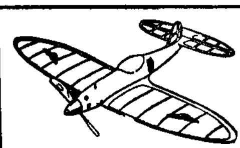

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Semi-scale C/L stunt model for Elfin 1·8. **19/6**

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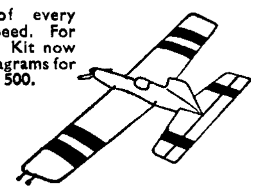
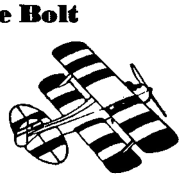


27/6

De Bolt



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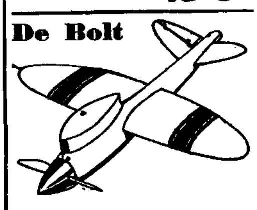

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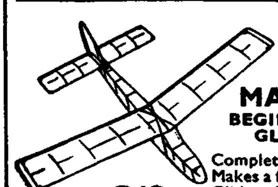

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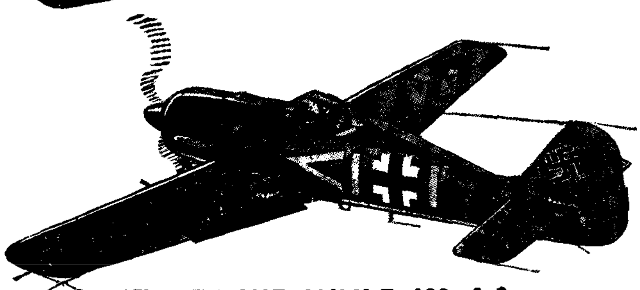

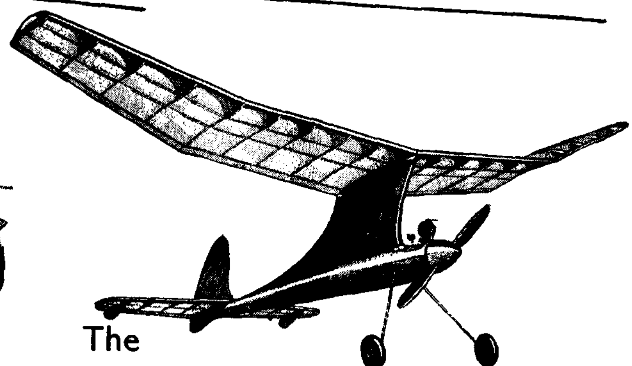

The FOCKE-WULF 190 A.3.

Verons amazing new true-scale control line model. Powered by a Diesel or Glow-Plug Motor of 3 to 8 c.c. this famous German war-plane gives an astounding performance flying at speeds exceeding 60 m.p.h. The now famous flap and elevator control ensure stunting capabilities which are phenomenal. With a span of 33½ ins. its clean straight lines make it ideally simple to build.

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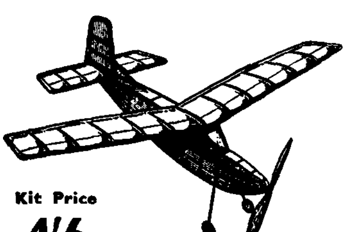
Kit contains metal spinner and lightweight Sorbo Rubber wheels. All high grade materials.

Kit Price **19/9**

The "RASCAL"

24" SPAN LIGHTWEIGHT CABIN DURATION MODEL

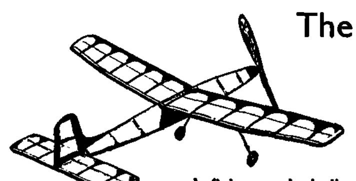


A model which has superb performance, excellent flying qualities and is designed in the "modern trend" — its performance is excellent. Kit contains everything necessary to build and fly the model, including a semi-finished hand-carved balsa prop.

Kit Price **4/6**

The "GOBLIN"

20 in. SPAN LIGHTWEIGHT DURATION MODEL



The ideal kit for the beginner. Flies with perfect stability. Kit contains everything you need for building and flying — including a semi-finished hand-carved Balsa Airscrew.

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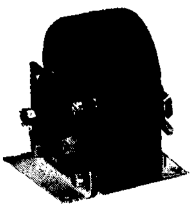

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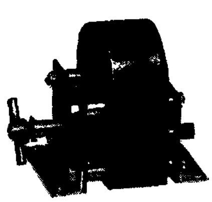

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Approx. ·4 amp. cons.
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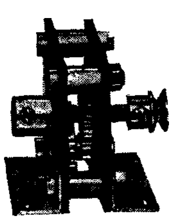

The TAYCOL 'Reduction Gear Unit'
For any model electric motor
4/1 Ratio
Precision Gears
Size
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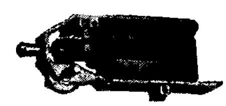

The "TAYCOL" TC/5 Electric Motor Unit
For "00" gauge Railways
Meshed Gear Box 40/1 Ratio
Dimensions
58 m.m. × 12·5 m.m. × 21 m.m

The TAYCOL 'STAR' Model Electric Motor with speed control and reversing switch 4½–9 volts. Approx. ·8 amp. cons. 3⅜ × 2¼ × 1⅝ ins.

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Mounting .. .. Beam or Radial
Supplied complete with K.L.G. MINIGLOW Plug and free-flight tank.
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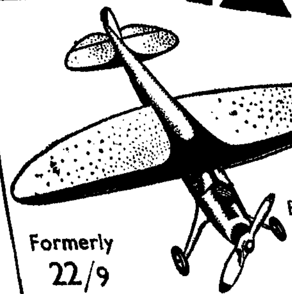

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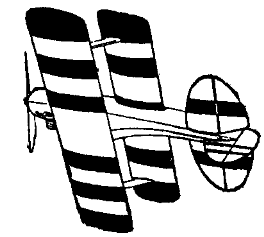

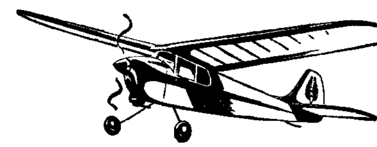

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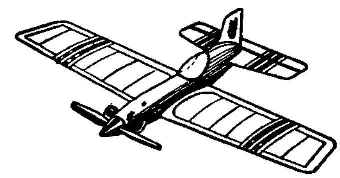

JUNIOR MONITOR

Span 30 ins.

This is the ideal Kit for all Elfin 1·8 and 2·49 owners. Specially designed and tested, "Junior" has all the virtues of its full size predecessor. Selected Solarbo balsa with many cut-outs, moulded cockpit, hardware, etc.

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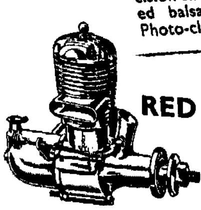

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R.P.M. 4,000 to 15,000

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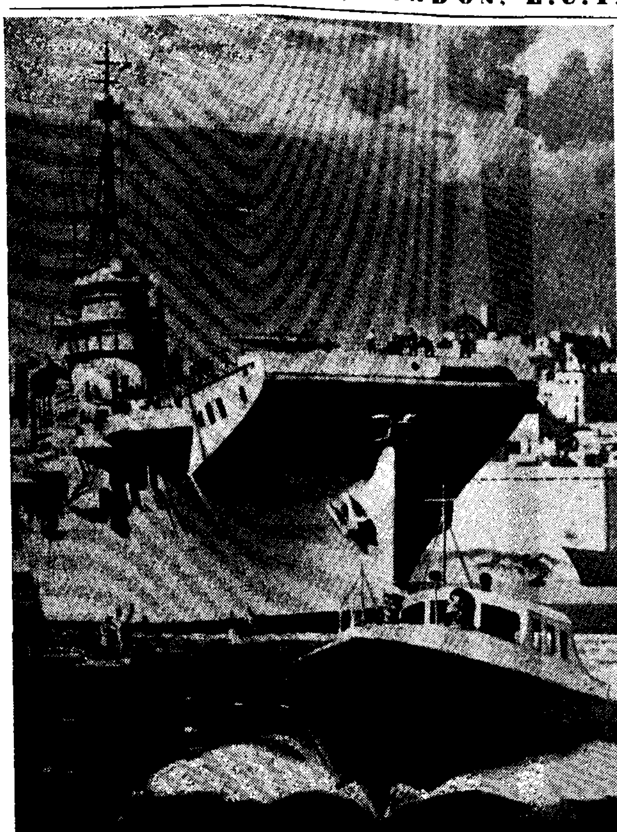

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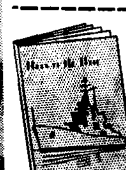

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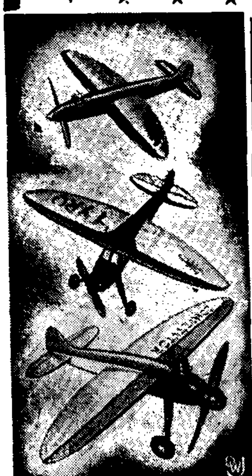

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F.A.I. Records

A STUDY of the current list of International Model Aircraft Records (page 151) would indicate at first glance a sad state of affairs in British aeromodelling. However, do not be too hasty in condemning the apparent lack of interest on the part of the British aeromodelling public, for many factors have gone into the heavy Soviet predominence in the sphere of International Records.

Apart from general weather conditions—which we all know to be "somewhat variable" in this island—it would appear that the main factor operating in favour of the Russians (and Hungarians) is the co-operation, almost amounting to sponsorship, given by their Governments, presumably with a view to still further enhancing the prestige of those countries.

Whilst we personally have no grumble with such an admirable attitude, it must be borne in mind that such official assistance makes the successful attacking of such high records something of a costly affair, and one in which we of Great Britain can at present only participate in a somewhat scrappy manner. We understand that special days are organized by the Soviet authorities for attacks on International Records, and this is a lead we might well follow were it not for the ever fickle conditions dealt to us by the Clerk of the Weather.

Discounting the weather (which is recognised as generally more stable and predictable on the large Continents) we are faced with the material assistance afforded our Russian contemporaries. We are informed that full Service facilities are placed at the disposal of would-be record breakers, the Red Air Force providing full-size aircraft, etc., for the following, height checking, etc., on a scale that we in this country cannot contemplate. Though I do not doubt the interest of our own R.A.F. personnel, I cannot by any stretch of the imagination conceive an aeromodelling meeting in this country with Service personnel standing by ready to check and/or follow a model aircraft, no matter what was involved!

However, despite our lack of facilities there is nothing to stop any enthusiast " having a go " at some of the more modest classes, and it is pleasant to record that a few keen modellers in this country are now making great efforts to lower the number of records held at present by the U.S.S.R. and other countries. We advocate a keener interest on the part of our own authorities to support and assist such attempts, particularly with the provision of reasonable ground facilities that would accommodate the extra engine run required (and allowed) for attacks on duration or other International figures.

To the handful of triers after a place on the F.A.I. List, our best wishes, and may the end of this season see Great Britain mentioned in more than its present two categories.

Contents

VOL. XV. No. 170. MARCH, 1950

" World Wide Aeromodellers "

A recent survey of our Overseas Subscribers revealed, amongst several interesting facts, that this journal is read in at least fifty countries. These range from the U.S.A. to Australia, from the U.S.S.R. to Argentina, from Sweden to Ceylon and Pakistan to Cochin China. Neither differences of politics nor native tongue are a bar to taking the AEROMODELLER; it is to be found in Poland, in Syria, in Finland, in Italy, in Israel and in Equador. The Balearic Islands have their aeromodellers, so have Portugal and Iran.

So, the AEROMODELLER serves the World of model aircraft enthusiasts and links peoples of all colours and creeds through one common hobby. From time to time correspondence comes in from readers in all corners of the Globe, many of them, obviously, having struggled with a limited knowledge of the English language, in their efforts to keep us up to date with items of interest. To wit, the following extract, taken at random: ". . I am sorry for not knowledge very good your language, seeing that I was in the intention to go in England for to improve the English language." Many letters reach us in the native language of the writers and must be translated before we can glean the contents, but this is no disadvantage and we encourage further correspondence, in any language. Such letters are always welcome for, through them, we are able to keep in touch with the trend of modelling matters wherever model aircraft are built and flown. Indeed, we would take this opportunity of inviting letters from our Overseas readers, giving us news of their models and modelling activities, for inclusion in a projected World News feature which, we hope, will become a regular item of the magazine. In this issue will be found news from New Zealand, India, and of course, the United States; we look forward to the future inclusion of items from all parts and of many nationalities. We do not expect lengthy articles; mere snippets of news will suffice and we are always pleased to see and use good photographs. The more varied the material we receive the more interesting the feature will be, so it is up to our far-flung friends and brother Aeromodellers to put pens to paper and let us know what goes on. Remember, we do not mind if your English is not up to University standard; we do not even mind if it is not in English . . . write to us anyhow, if you have anything of interest to say. If your model has skis and you fly from a frozen lake, let us know: if your flying field is a thousand square miles of prairie or a clearing in the jungle other readers would be interested to hear about it. Do you strip balsa direct from the tree, do you tap the rubber for your own motors, do your thermals turn into sandstorms, do you launch your gliders from a mountain top, is your nearest model shop fifty miles away or five hundred or five thousand? Anything of interest; facts, figures, unusual, exciting or just routine to you, may be entirely new and unheard of to modellers elsewhere. Our wish is to be able to bring the World of Aeromodellers together through a " World Wide " AEROMODELLER feature. Let us hear from you!

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R. F. L. Gosling with his graceful yet highly efficient "Tern II" Sailplane at Nerquis Moor. We hope to feature his latest development of this model the "Nordec Tern", which is to the A.2. specifications, in our next issue.

Channel Crossing

The English Channel has, for as long as we can remember, been associated with the history and well-being of our island. We are proud of the fact that the last to cross it with ulterior motive and succeed was William the Conqueror.

Since his day most of the crossings have been of a unique or friendly nature. Hardy souls have swum it, either in one or both directions; a variety of strange craft have boated across; and for many years the idea of tunnelling beneath it has been in men's minds. In fact, one way and another this precious little stretch of water has been a testing ground, or should we say water, for those who wish to achieve something in their particular sphere.

There was Bleriot who, in his frail contraption of wood and wires, made history on the 25th July, 1909, and so fathered the countless flights by aircraft commonplace today, but an adventure beyond magnitude in the infancy of aviation.

Then of course there was Pierre, that somewhat unwilling sea lion who managed the crossing on the end of a rope assisted by a diet of fresh herrings every mile or two. He was, we are afraid, an unwitting token of modern ballyhoo and one cannot help but compare the ludicrous occasion of his crossing with that momentous flight of Bleriot's and conclude that the waters of the Channel ran warm with indignation at the affront.

Which brings us to our main point that any crossing by man or machine should be a real test and not just a Dover–Calais run, especially as we understand it will shortly be the turn of model aeronautics to take up the watery gauntlet by venturing the crossing with a radio controlled model.

Reports have appeared in the Press and already one reader enquires as to how the attempt will be made. He asks, he says, because he feels it would hardly be fair to follow the aircraft with the transmitter in a boat. This to him apparently smacks of the unfortunate Pierre. He does not, however, offer a suggestion as to how it should be done, which is not surprising as the problem is by no means a simple one.

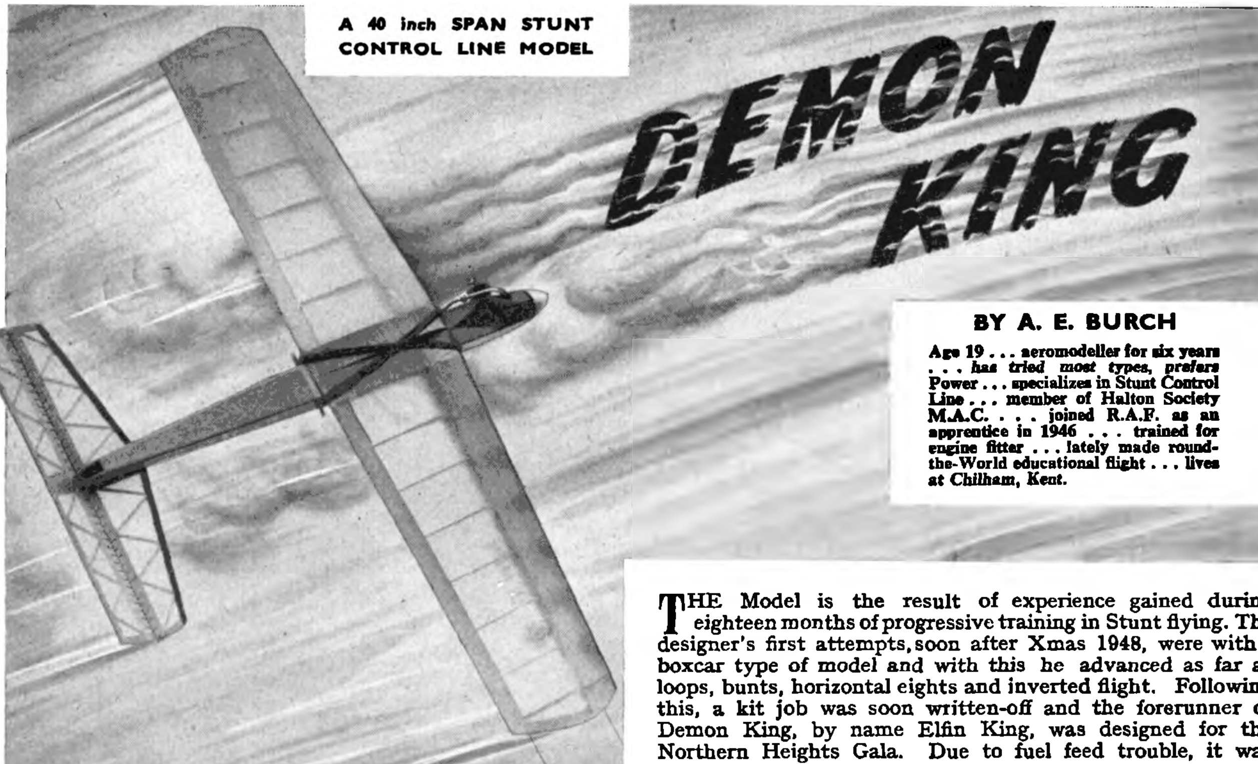
Even with items such as fuel payload and radio range solved there is still the all-important question of visibility. By using two transmitters, one on either shore with one taking over from the other approximately half way across, the operators would still have difficulty in keeping the model in sight, assuming they were using powerful binoculars.

It is certainly a most intriguing problem and no doubt many of our readers who are radio enthusiasts will have ideas on the subject. We ourselves feel that irrespective of method used the aircraft should take off and land at pre-selected points and wish those who attempt this venturesome crossing the best of luck.

The first across, besides becoming the "Bleriot" of aeromodelling, will deserve praise indeed for perpetrating the advancement of model aeronautics in the public eye.

A 40 inch SPAN STUNT CONTROL LINE MODEL

DEMON KING

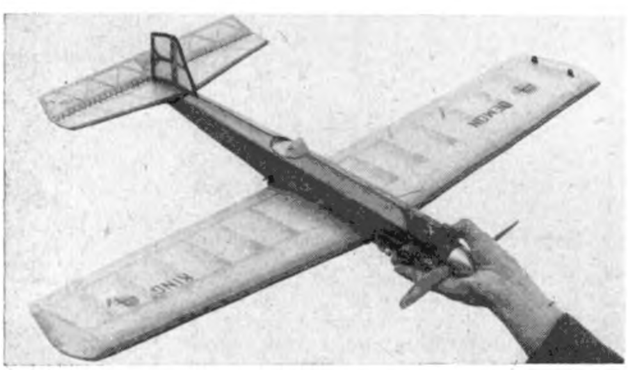


BY A. E. BURCH

Age 19 . . . aeromodeller for six years . . . *has tried most types, prefers* Power . . . specializes in Stunt Control Line . . . member of Halton Society M.A.C. . . . joined R.A.F. as an apprentice in 1946 . . . trained for engine fitter . . . lately made round-the-World educational flight . . . lives at Chilham, Kent.

THE Model is the result of experience gained during eighteen months of progressive training in Stunt flying. The designer's first attempts, soon after Xmas 1948, were with a boxcar type of model and with this he advanced as far as loops, bunts, horizontal eights and inverted flight. Following this, a kit job was soon written-off and the forerunner of Demon King, by name Elfin King, was designed for the Northern Heights Gala. Due to fuel feed trouble, it was unable to show its paces, but gave its designer many hours of flying in Camp. It was found to be very easy to control through all manoeuvres. Having bought an Amco 3·5, Burch immediately scaled up his design, the result being Demon King. With the same performance characteristics combined with the ease of construction and great strength, this was the answer to all his problems and, on 60 ft. lines this model was found to be smooth in all the stunts of the Schedule.

At the end of September last, the designer demonstrated with Demon King on the field at Eaton Bray, and the performance was all that could be wished for; the AEROMODELLER's own C.L. addicts were most impressed. The designer suggests that first flights are made on 50 ft. Light Laystrate lines, using a 9 by 6 prop. This will allow sufficient time to think about the manoeuvres, while giving plenty of "feel" on the lines. The maximum line length advised is 60 ft., when familiar with the handling of the model. With the Amco and a 9 by 6 prop. Demon King flies at between 60 and 70 m.p.h., is easy to control, and any manoeuvre in the book may be attempted with confidence.



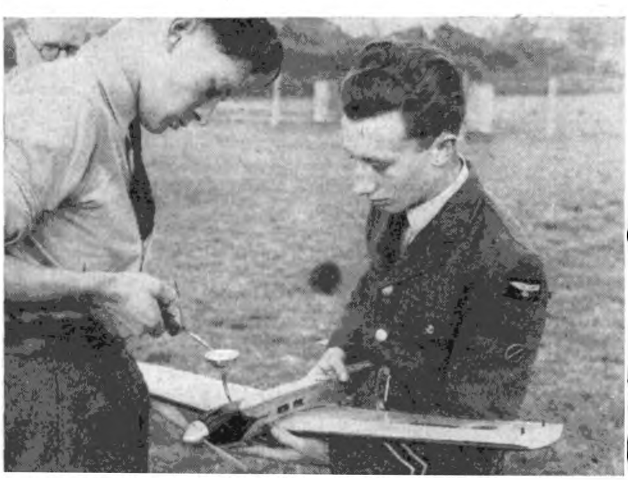
Notes on Construction.

While the work entailed is perfectly straightforward the following pointers may be useful.

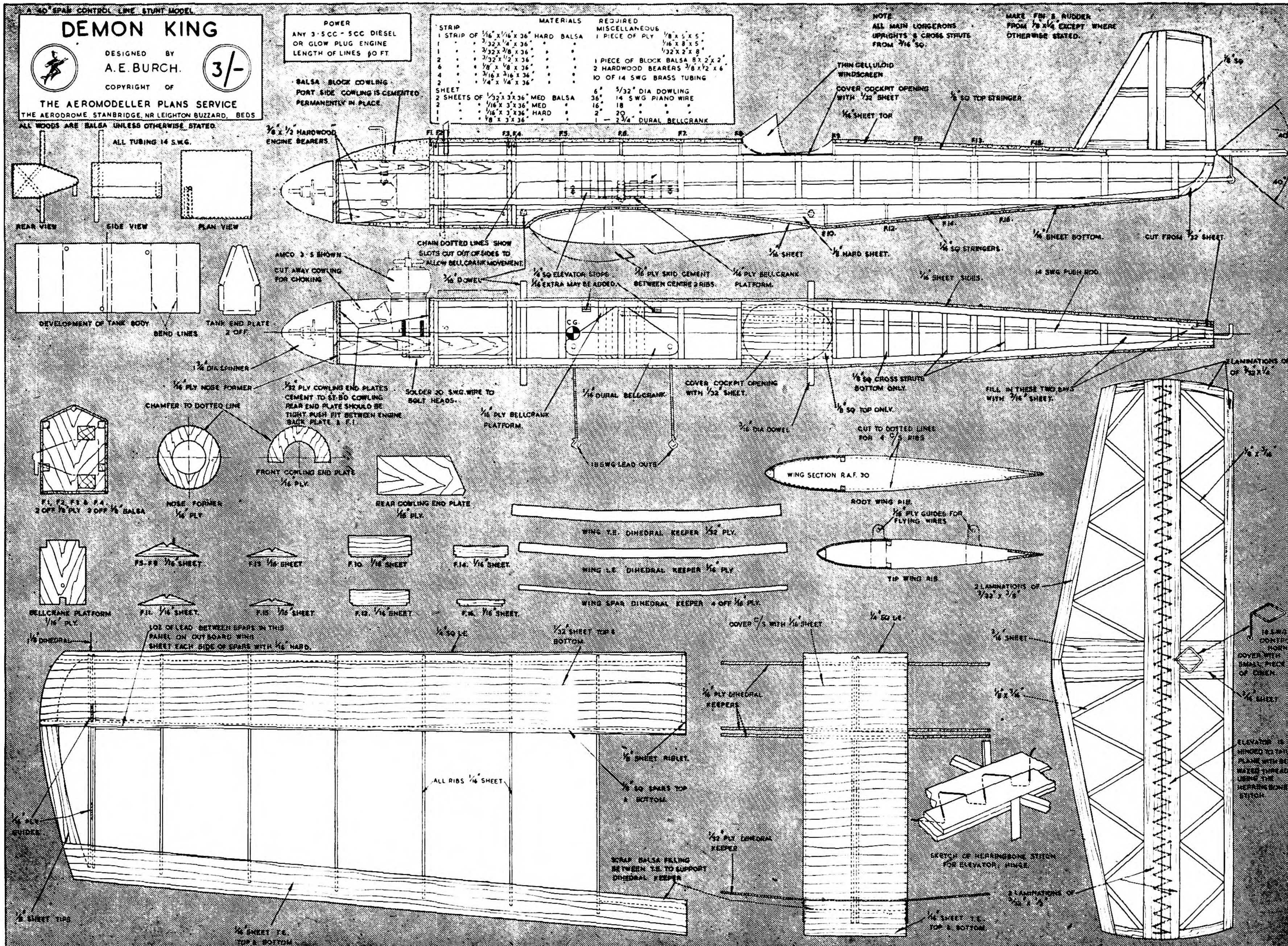
"This is a Helluva model fellas!"

The assembly of bearers and Formers 1 to 4 is done first and after installation of bellcrank, lead-outs, push-pull rod and tank, the sides are added. The cowling is made next followed by the tail surfaces. The wings are built in three sections, assembled after the internal construction is completed.

Tailplane and fin are double-cemented to the fuselage; wing is attached with strong rubber bands.



The Designer, extreme left, "tanks up" assisted by a fellow cadet.



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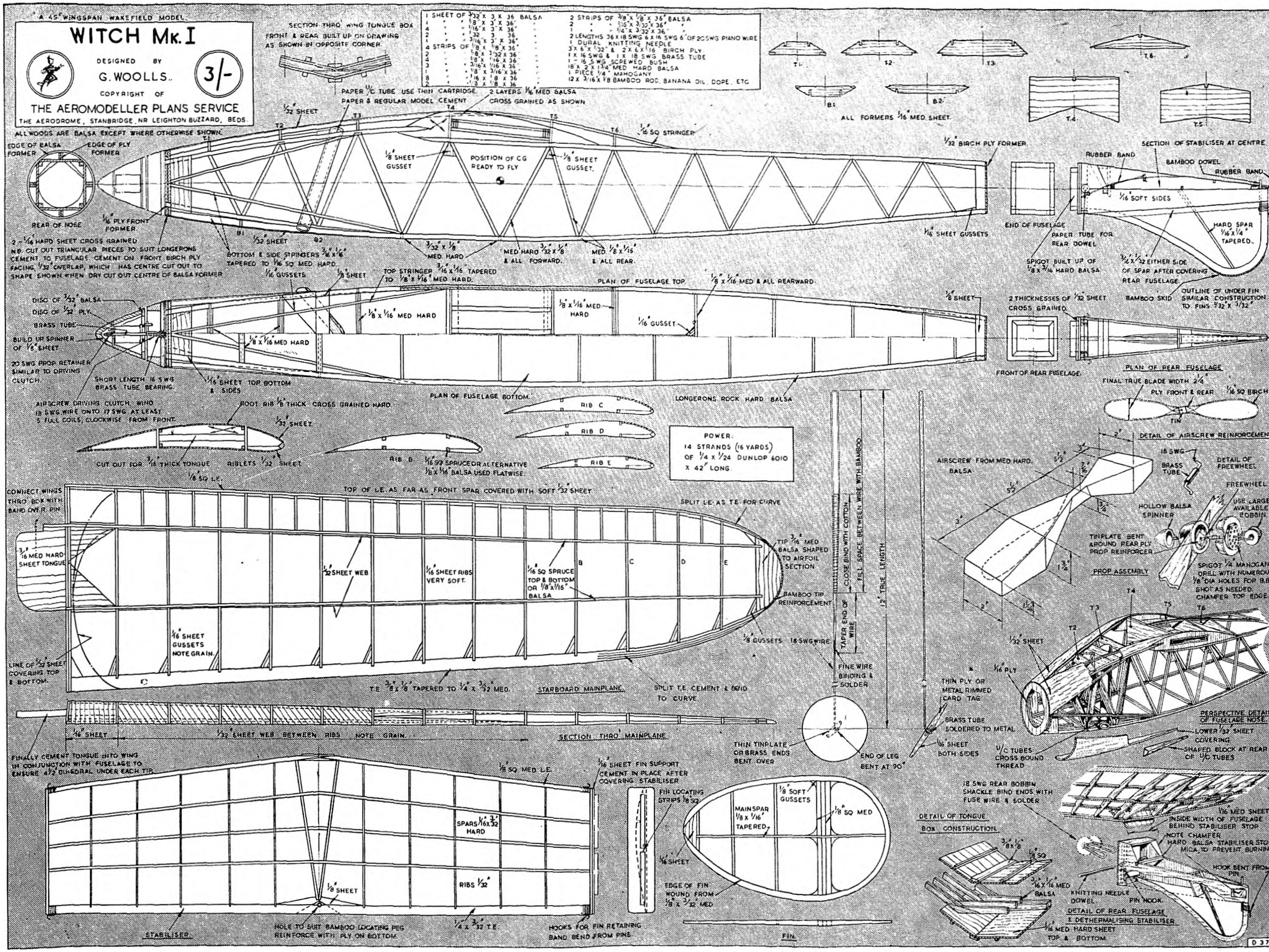

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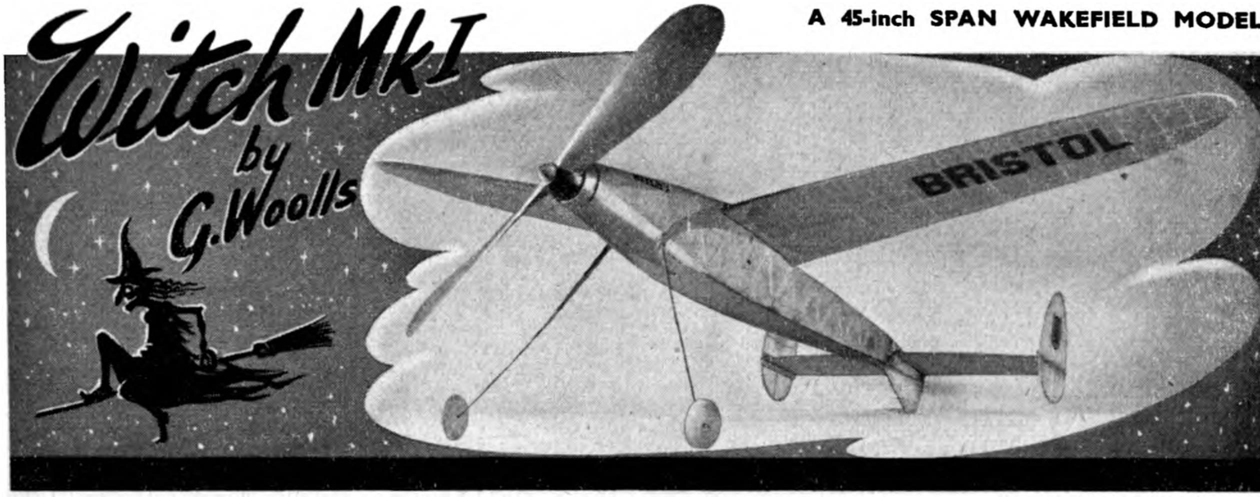
A 45-inch SPAN WAKEFIELD MODEL



THE "Witch" was developed from a peg-legged parasol slab-sider built in 1945. This prototype was slowly and laboriously modified into a more or less normal shoulder-wing streamline slab-sider, which, although weighing around eleven ounces, had quite a good performance. This latter model and the knowledge and experience gained while experimenting with it, were incorporated in "Witch". The construction may seem a little unorthodox in many respects, and some Wakefield builders may criticise it as being rather too solid, but the fact that the original Witch weighs nine and a quarter ounces ready to fly, is compensated for by strength and non-warping flying surfaces. "Witch I" flew away on half turns, immediately before entering the Gutteridge Trophy Contest and has flown consistently well ever since. Throughout the 1949 Contest Season the flights have averaged over three minutes, placing nineteenth in the Flight Cup, eleventh in the Gutteridge, and coming 18th in the Wakefield Trials.

To those who intend building this design, the designer directs the wish that you should construct it exactly as per the plan, test fly it in that form and give it a fair chance, before making those modifications which, you are quite sure, would improve it one hundred per cent !

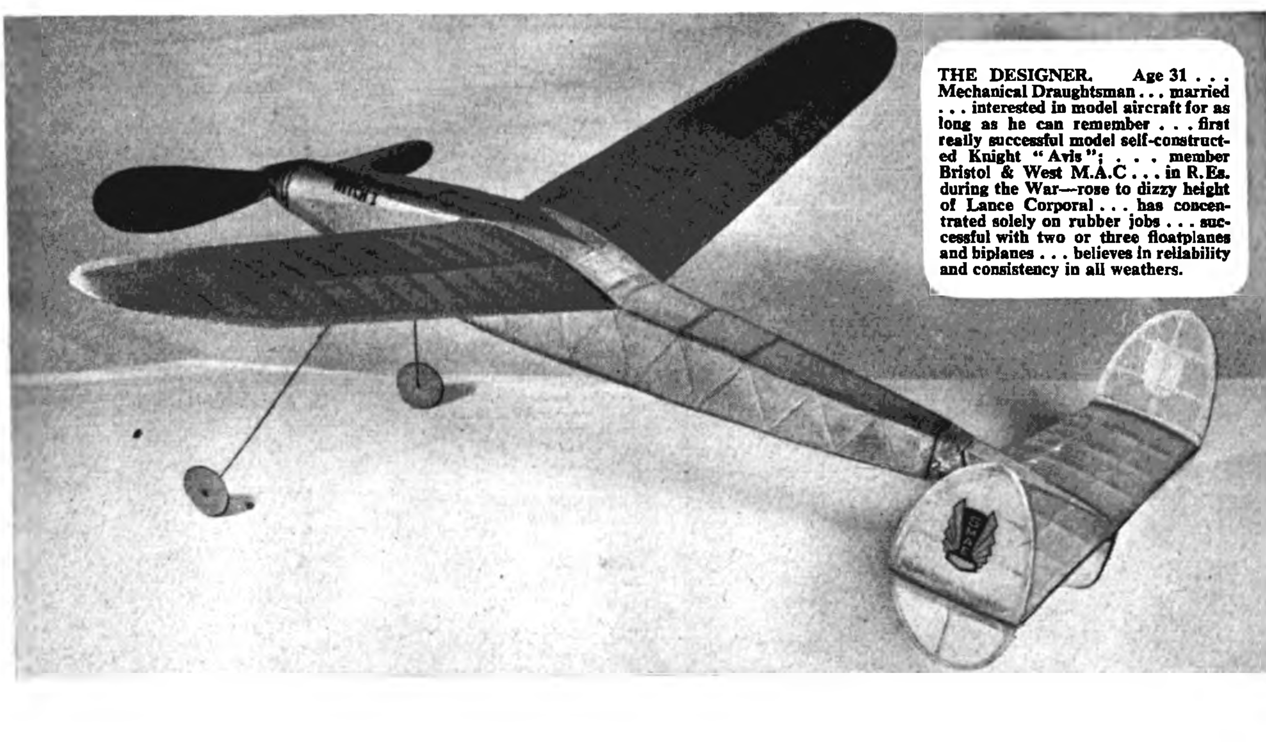
Construction.

As this will be sufficiently clear from the plan, only a few guides will be given here.

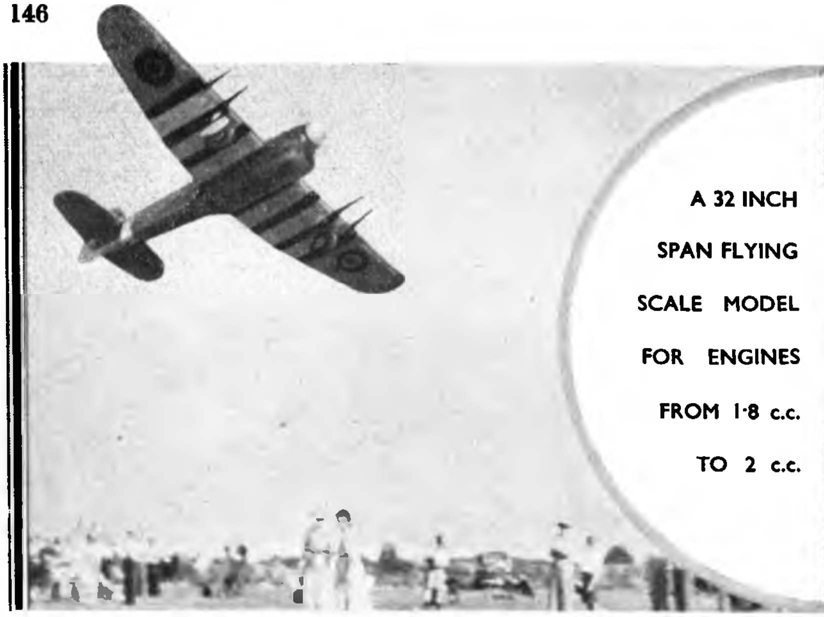
The Wing Box is built first, making it rather wider than necessary, so that it can be trimmed to exact length after assembly.

Templates for the sides of the box should be cut from thin, stiff card. The hardest available balsa should be used for the longerons, and the side plate placed on the plan first when building the sides. The Dethermalizer is built in and is of the Flip Up tail type, operated by rubber bands and a fuse.

The wing section is N.A.C.A. 6412 and the tip dihedral is 4½ inches. The prop driving clutch shown in the drawing is perfectly satisfactory and should be a tight screw fit on the shaft. The airscrew used and given on the plan has performed well; it was carved from hard balsa with plywood facings either side of the hub and 1/16th birch binding around the blades to strengthen them.



THE DESIGNER. Age 31 . . . Mechanical Draughtsman . . . married . . . interested in model aircraft for as long as he can remember . . . first really successful model self-constructed Knight "Avis"; . . . member Bristol & West M.A.C . . . in R.Es. during the War—rose to dizzy height of Lance Corporal . . . has concentrated solely on rubber jobs . . . successful with two or three floatplanes and biplanes . . . believes in reliability and consistency in all weathers.



A 32 INCH SPAN FLYING SCALE MODEL FOR ENGINES FROM 1·8 c.c. TO 2 c.c.

TYPHOON 1B

BY P. E. NORMAN

Age 37 . . . . married . . . . two children . . . . profession: Sculptor and Art Instructor at College of Art . . . . subjects: metalwork and sculpture . . . Exhibited at Royal Academy in Sculpture, Stone, Wood, and Ivory for six consecutive years . . . . has six wood sculptures in luxury suites of R.M.S. Queen Elizabeth . . . . besides aeromodelling, makes and plays violins as a hobby . . . . holds over 40 certificates in Musical Festivals, and Silver Challenge Cups for violin Sonata and Solo Playing. In aeromodelling:—dislikes flimsy pylon models . . . . feels that Control Line Flying (query Flying!) is an easy way out as far as Scale Models are concerned . . . . experimented with pendulum control in 1928 with Sopwith Camels and S.E.s rubber-powered . . . . interested mainly these days in strong, fast scale or semi-scale low-wing types, power-driven . . . . owns more than 40 power models, including a 40" span Spitfire.

THE designer states that, throughout his modelling years, it has always been his ambition to build and fly scale models of low-wing fighters, having the same flight characteristics as the full-size machines. These are:—high speed and extreme manœuvrability with very little regard for the glide after the engine cuts. He believes that the quest for a glide of long duration with this type of model is all wrong; who judges the performance of a Spitfire or Tempest by what it does when the engine has stopped? In the majority of cases, the pilot would be only too anxious to open the hood and jump in the event of the engine cutting in the air! Provided, therefore, that the model is strong enough to withstand the crashes, it should not matter much what happens after the engine cuts.

In order to reproduce fighter performance it is necessary to have high power, and to withstand the high-speed crashes which must occur, the model has to be extremely strong.

Another major problem is the propeller; usually of enormous size in proportion to the model and with three or four blades, which result in great torque and gyroscopic forces. In the case of the Typhoon, Tempest, Spitfire and F.W.190, the propeller has a diameter of approximately one third the span.

Apart from these items, there are aerodynamic problems which must be overcome; very small dihedral angle, small tail and rudder areas, true airfoil sections and so on, which further handicap the success of the projected model.

The type of construction and size of model to fulfil the requirements were only found after many experiments; spans of about 32 ins. and all-up weights of 22 ozs. to 26 ozs. were the result. This particular Typhoon, which is one of several has a span of 32 ins. and an all-up weight of almost 26 ozs: This gives a wing loading of 1¼ lbs. sq. ft.

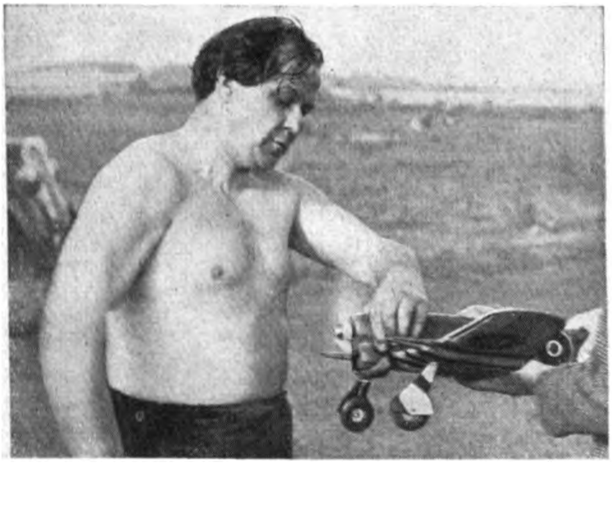
The trimming and flying of this type of model is quite different to any other and has to be carried out with the greatest care if results are to be obtained. Due to the heavy loading, the Typhoon flies and glides fast, so hand-launched glides are difficult; any sudden jerk will throw the elevator weight backwards and forwards.

The correct drill is to place the model on smooth ground and, grasping the top of the fin, run forward until there is some sign of lifting. Repeat this several times until the model actually leaves the ground, when a tendency to turn in either direction may be noted. In the latter event, the wing should be slewed a fraction to bring the side which drops, a little ahead of the other.

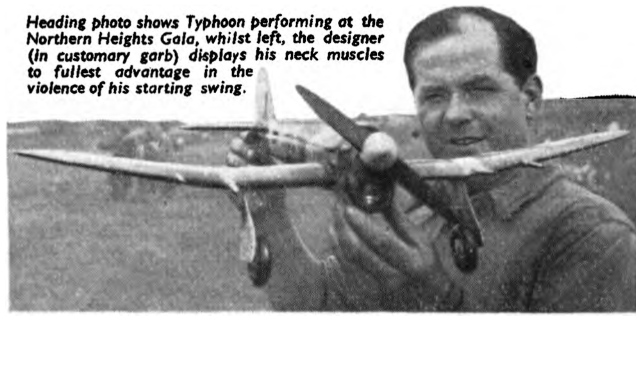
If sloping ground, up which a breeze is blowing, is available, the model may be hand-launched. Run forward until the model tries to become airborne, and release. Slight nose heaviness is a good thing to maintain forward speed and, at height, the auto-elevators will take care of the longitudinal attitude. When these preliminary tests are completed satisfactorily, a power flight can be tried.

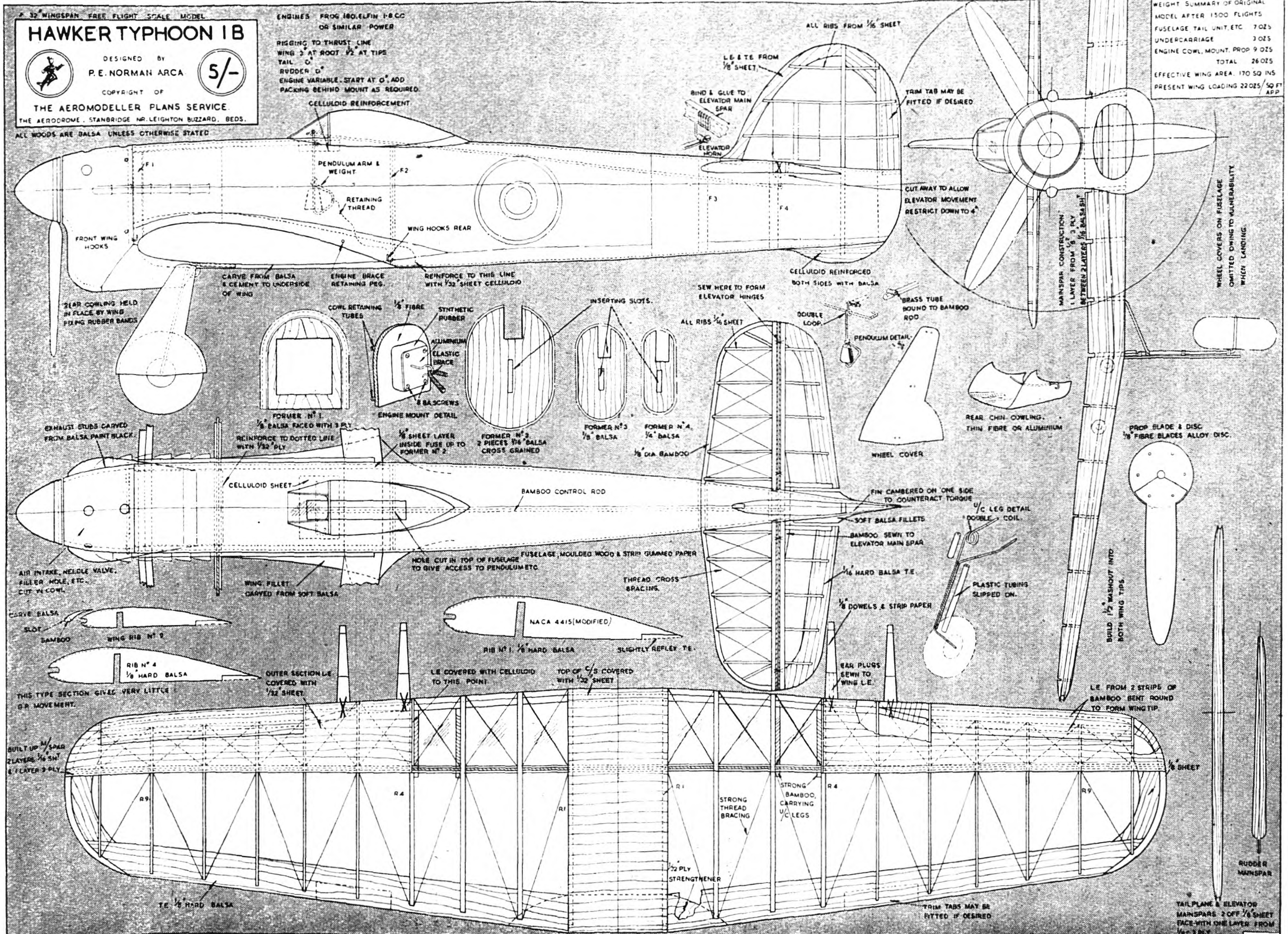
Steep left turns must be counteracted with engine offset and right turns are not permissible, as they will result in a gyroscopic spin, from which there is no recovery.

For those who would like to try their hand at building and flying one of these scale Typhoons and experiencing the thrill of the long fast take-off and the high-speed manœuvre flight, detailed building instructions will be supplied with the full-size A.P.S. plan. Several new methods of construction and a pendulum-controlled elevator are used, and the designer advises anyone without much modelling experience *not* to attempt building the model.



Heading photo shows Typhoon performing at the Northern Heights Gala, whilst left, the designer (in customary garb) displays his neck muscles to fullest advantage in the violence of his starting swing.





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MINIATURE ENGINE FUELS

by

F. C. B. MARSHALL, Ph.D., D.I.C., B.Sc., F.R.I.C.

F. C. B. MARSHALL has been Technical and Managing Director of BARRON INDUSTRIES (CHESTERFIELD) LTD since its formation in 1947. Prior to that he was for some years senior research chemist to the British Diesel Oil and Petrol Co. Ltd. During the War was engaged in research on rocket design with the Ministry of Supply, before which he was a senior research chemist both at the Paint Research Station and in industry.

FUEL TECHNOLOGY is a modest, not very highly publicised, branch of knowledge, with the result that the average Aeromodeller probably knows less about the fuels he uses than about any other aspect of his craft. This is greatly to be regretted since engine performance—and engine life—depends not only on engine design and workmanship but also on the characteristics of the fuels used in them. These notes have been prepared for the guidance of modellers who like to experiment with fuel mixtures of their own—to help them to experiment intelligently without undue waste of time and materials—and to assist them in judging the suitability of commercial brands of fuel for whatever purpose they may have in mind. No attempt has been made to write a " Formulary " or to review existing commercial fuels. What has been attempted is a concise and simplified account of the properties and functions of the major fuel ingredients, and an outline of the basic scientific principles to be followed in working out the design of a fuel for any particular purpose.

Before it is possible to proceed to the formulation of a satisfactory " Diesel " or " Glo " fuel it is necessary to be familiar with certain fundamental properties of fuel components such as " *Flash Point* ", " *Heat of Combustion* ", " *S.I.T.* ", etc., and a short explanation of the more important of these terms is given below.

EXPLOSIVE LIMITS. When the vapour of an inflammable liquid is mixed with air the mixture will only burn if the concentration of vapour lies between certain limits known as the " *Explosive Limits* ". These limits vary considerably for different liquids, as shown in TABLE I.

TABLE I.—Explosive Limits.

SUBSTANCE	EXPLOSIVE LIMITS % of vapour in the air	
	Lower	Upper
Benzene	1·35	8
Acetone	3	13
Methyl Alcohol (Methanol)	5·5	21
Ethyl Alcohol ... ... (ordinary alcohol)	2·8	9·5
Ethyl Ether	1·7	48
Paraffin Hydrocarbons...	about 1	about 3·5

Taking Methanol as an example it can be seen that if the concentration of methanol vapour in the air is less than 5½% the mixture will be too weak to fire, whilst if it exceeds 21% the mixture will be too rich.

FLASH POINT. " *Flash Point* " is a measure of the inflammability of a liquid. If a little inflammable liquid is placed in the bottom of a small metal cup it will give off vapour into the air space above it. If this concentration reaches the lower explosive limit the mixture of air and vapour will " flash " if a small flame or spark is brought above the cup. If the liquid does not vaporise readily (paraffin oil for example) it may be necessary to warm it until a certain critical temperature is reached at which enough vapour is given off to form the explosive mixture. This temperature, below which ignition will not take place, is known as the " *Flash Point* ", and varies widely for different liquids, as shown in TABLE II.

TABLE II.—Flash Points.

LIQUID	FLASH POINT
Ethyl Ether	—41° C.
Benzene	—21° C.
Acetone	—17° C.
Toluene	— 2° C.
Methanol	0° C.
Butyl Acetate	25° C.
Paraffin and Diesel Oil ...	about 65° C.

SPONTANEOUS IGNITION TEMPERATURE. Also known as " *Self Ignition Temperature* ", " *Auto-Ignition Temperature* ", and " *S.I.T.* " for short. This is the temperature at which a mixture of inflammable vapour and air will ignite *without* the application of a flame or spark. S.I.T. is totally unrelated to the Flash Point, and should not be confused with it. TABLE III gives some typical values.

TABLE III.—Spontaneous Ignition Temperatures.

SUBSTANCE	SELF-IGNITION TEMPERATURE
Acetone	630° C.
Benzene	580° C.
Toluene	553° C.
Ethyl Acetate	484° C.
Methanol	475° C.
Ethyl Alcohol	421° C.
Amyl Acetate	379° C.
*" Petrol "	280° C.
Coml. Diesel Oil	240° to 260° C.
Paraffin	about 250° C.
High Cetane Val. Gas Oil	220° to 240° C.
Ethyl Ether	188° C.

* This refers to a straight-run petroleum fraction of low Octane Value, before " leading " or admixture with benzene, etc.

A good commercial petrol will be higher than 280°, and an aviation spirit higher still.

It can be seen that paraffinic hydrocarbons (paraffin, diesel oil etc., are mixtures of these), and ethers, have low S.I.T.'s whilst " aromatic " hydrocarbons from coal-tar like benzene and toluene, and the alcohols, have very high values.

HEAT OF COMBUSTION. The Heat of Combustion—also known as the " *Calorific Value* "—is the total amount of heat liberated when a given quantity of a substance is completely burned. It is, therefore, a direct measure of the total intrinsic energy, and hence of the available power, of a fuel. Some approximate values are recorded in TABLE IV, from which it can be seen why, for example, an alcohol fuel requires larger carburettor jets than petrol; more fuel must be flooded into the cylinders per stroke in order to give a comparable power output. The figures also make it clear why alcohols run " cooler " than hydrocarbon fuels, and are therefore favoured for racing engines.

OCTANE VALUE. Pure Iso-Octane is a very good anti-knock fuel for spark ignition engines, since it has a high S.I.T., whilst Pentane, with a very low S.I.T. is a bad fuel. Other fuels are compared as regards performance with mixtures of iso-octane and pentane and thereby given an " Octane " rating. If the fuel is as good as iso-octane its

Octane Value is 100, whilst if it is only as good as a mixture of equal parts iso-octane and pentane its Octane Value is 50.

CETANE VALUE. This is a method of assessing the values of diesel fuels by comparing their performance in a test engine with mixtures of different proportions of the excellent diesel fuel cetane and the very poor diesel fuel methyl-naphthalene. Cetane and Cetene Values may also be calculated indirectly from the specific gravity and Aniline Point of the fuel, but this method is not applicable if " dopes " are present. A high Cetane Value means a low Octane Value, and *vice versa*.

IGNITION LAG. When a mixture of a diesel fuel vapour and air is raised to the Self Ignition Temperature, there may be a considerable delay before the explosion actually takes place. This time interval is known as the " Ignition Lag " and for smooth running should be small. The running characteristics of a poor fuel may be enormously improved by reducing the ignition lag by making small additions of certain " dopes ". This must not be overdone since too short an ignition lag causes detonation, etc.

TABLE IV.—Calorific Values.

SUBSTANCE		HEAT OF COMBUSTION (calories)
HYDROCARBONS :	Paraffin Oil ...	11,000
	Diesel Oil ...	10,900
	Petrol	10,000
	Benzene ...	9,960
ETHERS :	Ethyl Ether ...	8,800
	Methylal ...	7,900
KETONES :	Acetone ...	7,300
ESTERS :	Ethyl Acetate...	6,100
ALCOHOLS :	Ethyl Alcohol...	7,000
	Methanol ...	5,330
NITRO HYDROCARBONS :	Nitrobenzene...	6,030
	Nitromethane	5,370
	Nitroethane ...	4,300
	Nitropropane...	2,790
ETHYL NITRITE	... ...	4,400
ETHYL NITRATE	... ...	3,560

TYPES OF LIQUID FUELS

LIQUID FUELS for internal combustion engines are of two fundamentally different types, namely those to be fired by spark or hot-wire ignition and those designed to ignite under the heat of compression alone, without the application of a spark or other local hot-spot. The former fuels, of which petrol is the commonest example, should contain a low-boiling fraction (the " light ends ") of low Flash Point to ensure starting from cold, but must have a *high* S.I.T. to prevent firing taking place under compression alone before the spark passes. The second type of fuel, for use in Diesel engines, need not possess a low Flash Point but *must* have a low S.I.T. It follows that a good petrol fuel will be a bad diesel fuel—and *vice versa*.

Miniature Diesel Fuels

THE DIESEL FUELS used in road transport vehicles are fairly high-boiling fractions from natural petroleum consisting mainly of certain types of " paraffinic " hydrocarbons. Such a " gas oil " has a Spontaneous Ignition Temperature around 250° C. and when forced into the cylinders in finely atomised form will fire satisfactorily under the high-temperature conditions prevailing in these very high-compression full-scale engines. But they will not ignite in a model " Diesel " unless it is hot, and to enable miniature compression-ignition two-stroke engines to be started it is customary to add a proportion of Ethyl Ether, which combines the phenomenally low S.I.T. of 188° C. with very wide Explosive Limits. Since the miniature " Diesel " is a two-stroke engine, lubricant must also be incorporated in the fuel. Finally, to ensure smooth even running it is often advantageous to include a small proportion of a further component, the " dope ". It is worth while to study in some detail the functions and properties of these *four vital components*.

(*1*). *The Paraffinic Base-Fuel.*

This is the main ingredient of the fuel. Its function is to provide most of the energy of the fuel, and it should therefore possess high Calorific Value and low S.I.T. Reference to TABLE III will show that, with the exception of certain ethers, the only readily available substances with relatively low S.I.T.'s are the *paraffin* hydrocarbons—which fortunately also possess very high Calorific Values. Ruling out individual pure hydrocarbons like pentane, hexane, heptane, etc., on the grounds of expense, this virtually narrows down our choice of base fuel to PARAFFIN OIL, COMMERCIAL DIESEL OIL and special HIGH CETANE GAS OIL FRACTIONS, if available. There is little to choose between paraffin and diesel oil, the latter having its higher viscosity and greater " oiliness " to recommend it. It can be seen, partly by reference to TABLE III, that the addition of petrol, benzene, toluene, naphthalene, turpentine, white spirit, or in fact any of the fantastic materials that have from time to time been recommended, must of necessity make the fuel worse, because of the high S.I.T.'s of these substances. Their use to " deaden down " the detonation of the ether is a case of two wrongs failing to make a right : a fuel that needs deadening down has got far too much ether in it.

(*2*). *The Lubricant.*

The lubricating component of the fuel may be any good quality lubricating oil, either mineral or vegetable. The only limitation imposed by vegetable oils like Castor Oil is that, alone, they will not blend with paraffin base fuels ; castor oil can be used only in a fuel ready-mixed with ether, which will keep all the components in solution. There is scope for experimenting with different grades and qualities of oil.

With regard to the *quantity* of oil to incorporate in the fuel, this again is a matter for experiment. Many miniature engine fuels are grossly over-lubricated, with the result that they are unnecessarily messy in use, and also require more ether than they otherwise would. In designing a diesel fuel it should be borne in mind that the oil has one function only —to provide adequate lubrication—and that it should not be expected to burn, to moderate the explosive tendencies of excess ether, or to do anything else. A two-stroke motor-cycle engine runs on the road for long periods at a time under much greater (and varying) load than any model engine, and with considerably greater bearing and piston speeds, yet seldom does the percentage of lubricant in the fuel exceed 7½%. It is desirable in formulating a model diesel fuel to increase this proportion for the following reasons :—(1) a new engine may have tight spots and require excessive lubrication till it is run-in, (2) in a very old, or badly made engine, the piston may be a poor fit in the bore, so that a fairly thick viscous fuel is needed in order to seal the compression, and (3) the manufacturer must allow a reasonable safety factor. Point 2 normally affects only the ease of starting : once the engine has been started it will usually continue to run perfectly satisfactorily even on a very thin fuel. With old engines starting can usually be facilitated by injecting a drop or two of lubricating oil through the ports.

For a normal fuel for use in a run-in engine in good condition, oil percentages in the region 30% to 50% are unnecessarily high. If the aeromodeller experiments with proportions of oil in the range 12%–20% for racing blends and 20%–30% for general-purpose and running-in fuels, he will not go far wrong. Diesel oil based fuels tend to require rather less than those blended with paraffin.

(*3*). *Ether.*

Apart from its low S.I.T., which enables it to start easily, and its wide Explosive Limits which ensure that throttle settings are not critical, *ether is a bad diesel fuel.* It has a considerably lower Calorific Value than the paraffinic base-fuel and it detonates or " knocks " badly. Excess of ether means correspondingly less base-fuel in the formulation, and hence a fuel of lower calorific value than need be, whilst its detonating propensities when present in excess cause diesel knock and impose undue strains on the con-rod. Ether should, therefore, be added to a diesel fuel for one purpose only, namely to make the engine start. Just enough for this purpose should be added—*and no more.* 30%–35% is excessive, and modellers are recommended to experiment in the range 20%–30%. It cannot be overstressed that the function of the ether is solely to bring about easy starting ; it should not be expected to usurp the function of the base-fuel.

There seems to be some confusion regarding the grades of ether suitable for use in fuels. Ether is manufactured from ordinary ethyl alcohol, two molecules of which join together, with the elimination of water, thus :—

$$C_2H_5{-}O\boxed{H} + H\boxed{O}C_2H_5 \longrightarrow C_2H_5{-}O{-}C_2H_5 + H_2O$$

2 Ethyl Alcohol 1 Ethyl Ether Water

The process is usually carried out by heating the alcohol with concentrated sulphuric acid, which absorbs the water formed—which is why the product is sometimes called "sulphuric ether". The ether which distils over is washed free from acid, purified, dried and re-distilled. It therefore contains no acid whether it is sold as "Anaesthetic Ether" "Ether ·720" "Ether B.S.S. 759", "Sulphuric Ether" or "Ether Meth.". All these materials are, effectively, the same thing ; and if properly manufactured are all harmless to model engines. The ·720 refers to the specific gravity of the product and shows the substantial absence of water ; B.S.S. 579 refers to the appropriate British Standards Specification laying down the standard of purity ; "Ether Meth." indicates that the ether was not manufactured from pure ethyl alcohol but from methylated spirits, which contain a few percent of methanol—this will give traces of methyl-ethyl and di-methyl ethers in the product, which are not harmful. Anaesthetic ether is made from pure alcohol and usually contains a proportion of deliberately added alcohol, and sometimes other additives, to prevent peroxide formation on storage. It is more expensive than other grades and, if anything, is slightly less suitable for fuel work.

The di-ether, Methylal, with the chemical formula $CH_3{-}O{-}CH_2{-}O{-}CH_3$, may be used partly or wholly to replace ethyl ether in certain specialised fuel formulations. The higher ethers Amyl Ether and Butyl Ether are too high boiling to be valuable alone, but may be used mixed with ethyl ether. Isopropyl Ether, unlike the straight-chain ethers above, has a very high S.I.T. and is not suitable for use in diesel fuels. It is a possible ingredient of glo-fuels.

(4). *Dopes.*

There are a number of well recognised "dopes" which may be added to diesel fuels, best known of which are

Ethyl and Amyl Nitrites
Ethyl and Amyl Nitrates
β-Chloro-ethyl Nitrate
Paraldehyde
Various organic peroxides like Tertiary Butyl Hydro-Peroxide, Di-Tertiary Butyl Peroxide, etc.

The choice of dope is usually determined by price and availability.

The function of the dope is to reduce "Ignition Lag" and thereby give smooth powerful running. Very little dope is needed for this purpose, the precise amount depending on the particular fuel formulation, and is a matter for experiment in each case. Seldom is more than 3% required, and modellers would be well advised to start with about 1% of dope and gradually increase, by not more than ½% at a time up to a maximum of about 2½%, until smooth even running is obtained—and then to STOP. This is a case of "a little of what you fancy does you good"—but a little bit more can play hell. Dopes should be used *solely* for the purpose described above and should under no circumstances be used in excess to assist starting. They do, indeed, lower S.I.T. somewhat, but their effect in this direction is most marked with the first few per cent. and then falls off very rapidly. It should be remembered that nitrate dopes are, in effect, high explosives and that when they burn they generate nitrous fumes. An overdoped fuel requires the compression setting of the engine to be drastically reduced as the engine warms up, it sets up unnecessary strains in the engine, and it is corrosive.

A proprietary brand of fuel will be a carefully balanced blend of ingredients with the correct amount of dope ; no attempt should be made to "improve" it by further dope additions.

Following the basic principles discussed above, and bearing in mind that each component of the mixture has its own specialised part to play in the performance of the final fuel, it is now possible to set about designing a good diesel fuel for a particular engine or for a specific purpose. A good Running-In fuel for new engines and for general purpose flying would look something like this :

PARAFFINIC BASE FUEL	45–60%
LUBRICANT	20–30%
DOPE	1–2½%
ETHER	20–25%

whilst a Racing or Competition fuel might well be :

PARAFFINIC BASE FUEL	55–65%
LUBRICANT	12½–20%
DOPE	1–3%
ETHER	20%

If the fuel is of the ready-mixed variety all the ingredients are mixed together, and the lubricant may be castor oil. But if the fuel is to have its ether added immediately before use, only the first three components are mixed in each case ; in which event mineral lubricant must be employed.

Starting with either of the above basic formulations as a guide, the ideal fuel for a particular purpose and individual engine can readily be worked out on the test bench by modifying the components of the appropriate formula a very few per cent. at a time until optimum performance is obtained. It should be borne in mind that the perfect fuel for one engine may not be ideal for another with totally different design characteristics, and the really scientific flying enthusiast will study the individual fuel requirements of all the more important engines in his "armoury". It should also, of course, be appreciated that different fuels may require different starting and running settings—and the careful experimenter has to develop a considerable amount of patience.

RUNNING-IN—ENGINE TEMPERATURE.

It follows from the increased proportion of base-fuel and the reduced proportion of ether that a "racing" fuel will run hotter than a running-in or general-purpose fuel, because of its higher Calorific Value. This relatively high-temperature running has been known to worry some modellers, who sometimes attribute it to frictional heat arising from under-lubrication. Any well-formulated racing fuel is, by its very nature, bound to run hot—and it is advantageous that it should do. The efficiency of operation of the internal combustion engine increases, within reasonable limits, with increase in temperature of running, hence the modern practice of cooling full-scale aero engines with ethylene glycol (b.p. 198° C.) instead of with water (b.p. 100° C.).

It is clearly not the wish of the reputable fuel manufacturer to ruin his customers' engines, and his branded fuels will have undergone extensive tests on a range of engines before being launched on the market. There should, therefore, be no cause for uneasiness in using well-known proprietary brand fuel. But if the modeller is still anxious, it is suggested that he feel, not the cylinder-head where combustion of powerful fuel is taking place, but the crankshaft main-bearing. If this remains moderately cool he need have no fear of a seizure.

WARNING. In fairness to the manufacturer, as well as in his own interests, the modeller should, of course, be careful only to use a fuel for the purpose for which it is intended. A "Competition" or "Racing" mixture is, as its name implies, intended for high-speed work, and the manufacturer assumes his customer will not be expecting to develop maximum power and revs with a new engine straight out of its box. A "Standard" or "Running-In" fuel should always be used with new engines, which should first be run on the bench for some time with an oversize propeller. After the engine has loosened up it should be run for another half-hour or more with a standard prop., still on the same type of fuel. Only after proper running in, and after a fair amount of work, should peak output with racing fuels be attempted.

(To be continued.)

INTERNATIONAL MODEL AIRCRAFT RECORDS DECEMBER 1949

CATEGORY	POWER	Record Type	Name	Nation	Identification	Date	Performance
AEROPLANES — FREE FLIGHT — Orthodox	Rubber Motors	Duration	Vassily Nassonov	U.S.S.R.	BM-I	Aug. 10th, 1949	1 hr. 16 min.
		Distance	Georges Benedek	Hungary		Aug. 20th, 1947	50·260 km.
		Height	Roland Poich	Hungary		Aug. 31st, 1948	1442 m.
		Speed	Vladimir Davidov	U.S.S.R.		July 11th, 1940	107·08 km./hr.
AEROPLANES — FREE FLIGHT — Tail-less	Rubber Motors	Duration	Ivan Poich	Hungary	CF-P.12	Sept. 25th, 1949	5 min. 47 secs.
		Distance	Tibor Gall	Hungary	GCS-I	April 17th, 1949	0·720 km.
		Height					
		Speed					
AEROPLANES — FREE FLIGHT — Orthodox	Mech. Motors	Duration	Georges Lioubouchkine	U.S.S.R.	AMM-4	July 12th, 1947	3 hr. 48 min. 45 secs.
		Distance	Serge Malik	U.S.S.R.	VIP-10D2	Sept. 19th, 1947	210·63 km.
		Height	Georges Lioubouchkine	U.S.S.R.	AMM-4	Aug. 13th, 1947	4125 m.
		Speed	Eug. Stiles	U.S.A.	Triumph 51	July 20th, 1949	129·768 km./hr.
AEROPLANES — FREE FLIGHT — Tail-less	Mech. Motors	Duration	Khatchatour Babaiane	U.S.S.R.	AMM-4	Aug. 14th, 1949	17 min. 36 secs.
		Distance	Michael A. King	England	E.D., Bee	Oct. 29th, 1949	2·6 km.
		Height					
		Speed					
AEROPLANES — Circular Flight	Mech. Motors	Speed I					
		Speed II					
		Speed III	M. Georges Benedek	Hungary	2 c.c. E.D. Mk. II	Nov. 22nd, 1949	70·450 km. per hr.
		Speed III (tailless)	M. Youry Koukhra	U.S.S.R.	9·8 c.c. AMM/4	Nov. 28th, 1949	87·156 km./hr.
		Speed Jet					
AEROPLANES — Tele-contr. Flight	Mech. Motors	Duration					
		Distance					
		Height					
		Speed					
SPECIAL AIRCRAFT	Rubber Motors	Duration	Raymond Musgrove	England		Nov. 28th, 1948	1 min. 6·8 secs.
		Distance					
		Height					
		Speed					
SPECIAL AIRCRAFT	Mech. Motors	Duration					
		Distance					
		Height					
		Speed (circular)	Leonard Mouridhev	U.S.S.R.	AMM-4	Aug. 14th, 1949	41·234 km./hr.
SPECIAL AIRCRAFT	Gliders	Duration					
		Distance					
		Height					
HYDROPLANES — Orthodox	Rubber Motors	Duration	A. I. Vassiliev	U.S.S.R.		Aug. 19th, 1948	41 min.
		Distance	Ernest Horvath	Hungary	TM-16	Sept. 10th, 1949	45·150 km.
		Height	Ladislas Winkler	Hungary	C.F.W.	Aug. 17th, 1949	136 m.
		Speed	Boris Abramov	U.S.S.R.		Aug. 6th, 1940	76.896 km./hr.
HYDROPLANES — Orthodox	Mech. Motors	Duration	Georges Lioubouchkine	U.S.S.R.	AMM-4	Oct. 19th, 1949	1 hr. 18 min. 40 secs.
		Distance	Mikhael Vassiltchenko	U.S.S.R.	VIP-10	Aug. 17th, 1948	58·843 km.
		Height	Irakli Kavsadze	U.S.S.R.		Aug. 8th, 1940	4110 m.
		Speed	Roman Khabavar	U.S.S.R.	MK-3	Aug. 18th, 1948	50·050 km./hr.
HYDROPLANES — Tailless	Rubber Motors	Duration	Louis Aszalay	Hungary	ACS-I	July 31st, 1949	1 min. 5 secs.
		Distance	Eugene Abaffy	Hungary	CF-AX	July 10th, 1949	435 m.
		Height					
		Speed					
HYDROPLANES — Tailless	Mech. Motors	Duration					
		Distance					
		Height					
		Speed					
SAILPLANES — Orthodox	Free Flight	Duration	Traugott Haslach	Switzerland		June 4th, 1944	2 hr. 21 min.
		Distance	M. Varache	France		July 21st, 1946	98·720 km.
		Height	Georges Benedek	Hungary		May 23rd, 1948	2364 m.
SAILPLANES — Orthodox	Tele-contr.	Duration					
		Distance					
		Height					
SAILPLANES — Tailless	Free Flight	Duration	Michel Kiraly	Hungary	UV-C8	July 17th, 1949	9 min. 55 secs.
		Distance	M. Ladislas Hodi	Hungary		Oct. 16th, 1949	2·560 m.
		Height					
SAILPLANES — Tailless	Tele-contr.	Duration					
		Distance					
		Height					

FIRST ALL INDIA AEROMOD

Top left: AEROMODELLER Challenge Cup won by Mathew Ewing, who proved Champion of the meeting. Above: Relaxation after the meeting — hard worked Secretary Roy will be noted in centre downing a tankard of water.

Below centre: Line up of models and distinguished spectators. To right of bamboo pole is H. H. Rani Joyoto Devee of Rajnandgaon, a Vice President of the A.I.A.A.

Bottom: Father and Son Yates wind up their Frog Venus for the rubber duration event.

THE first organised " All India Model Aircraft Rally " was held on the 18th December, 1949, on the Race Course at Barrackpore, 18 miles from Calcutta. There are no " miles of rolling downs " here; with but half a square mile at our disposal, surrounded by high trees, jungle and paddy fields with their numerous irrigation ponds, one has to be careful and hopeful that the thermals, which can operate like an elevator in a New York skyscraper, will deal gently with one's craft.

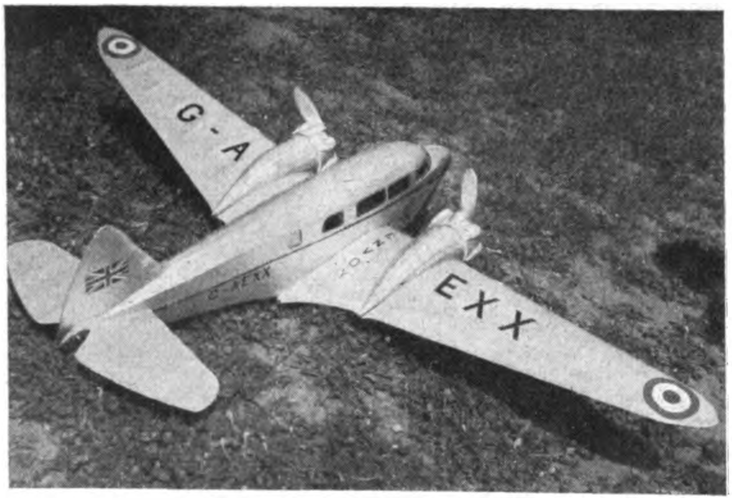
The Rally was organised by the " All India Aeromodellers' Association ", a two year old baby in the family of aeromodelling organisations. With no knowledge, other than the fact that it would not rain on the selected day (possibly its one advantage over U.K. clubs), the Competition Committee boldly drew up a programme of ten events ranging from power (both duration and control line), jet, rubber and gliders to solid models.

The Rally was advertised and the immediate response was greater, by far, than the most optimistic of the Committee members had dared expect; 147 entries were received, covering 60 models, and the Committee sat down with the " pleasant " headache of trying to rearrange the event timings to enable the full programme to be completed in daylight (it is dark at 5.15 p.m.)

The great day dawned! The modellers turned out in full force. What they lacked in competition experience was made up in enthusiasm and the air was soon resounding to the noise of warming up petrol and diesel engines.

Some confusion reigned during the checking-in of entries, as competitors were keener to get into the field of battle than be delayed in headquarters by competition red-tape. Once this was dealt with satisfactorily and the proceedings got under way, everything went remarkably smoothly despite the spectators, few of whom had ever been present at such a function before, and consequently tended to over-run the free flight runway. Our microphone king, Gerry Baker, at first tried gentle coaxing to persuade them to stand at a safe distance from the take-off area but, after a model had been written off as a result of crashing into the crowd at the time of take-off, his voice hardened and lost its sweetness. Luckily, the control-line area was well fenced off with bamboo and no spectator trouble was experienced in these events.

The control-line events, precision flying and speed, attracted a large audience which was fascinated by the manœuvres of which this type of model is capable. During the intervals between actual competition events Captain Anderson, who has concentrated on control line, gave an exciting and thrilling demonstration of stunting a high powered, streamlined model of his own design. His wingovers, loops and inverted flying at speed had never before been seen on this side of India and



ELLERS' ASSOCIATION RALLY

the expressions of amazement and incredulity on the faces of the spectators were a delight to see.

An excellently finished Veron " Goshawk " powered with a 6 c.c. Stentor engine entered by Mr. K. L. Roy in the " Control Line Speed " event had to be withdrawn on account of ignition trouble—however when Mr. Roy was informed that his plane had been judged the best model in the " Concours d'Elegance " event, and that to win the first prize he had only to make a qualifying flight of 20 seconds, frantic efforts were made to get the engine running. Surrounded by assistants and spectators brimming with advice, Mr. Roy coaxed and cajoled the stubborn engine for almost half an hour. Loud cheers greeted him when the engine burst into life after a freshly charged " Nife " accumulator had been put in, and the plane made a graceful take-off in the control line area and completed the requisite time of flight.

The beauty and grace of the free-flight models were greatly admired and the spectators took a keen interest in the r.o.g. take-offs and landings. Some outstanding flights, much in excess of the organisers' expectations, were obtained by power models, particularly Mr. Mathew Ewing's "Cirro-jet" with a Jetex 200 Motor, which made six flights during the day, all of which recorded excellent timings, in spite of being attacked by high flying hawks. The gracefulness of this model, both in its climb and its glide, was a delight to watch and the spectators showed their appreciation in no uncertain manner. With this model, Mr. Mathew Ewing, affectionately called by us " Mac," had two well-deserved victories in the Free-Flight Jet and the Open Duration for any Type of Model events, that for the latter being the Silver Cup presented by the AEROMODELLER. Manbendra N. Pal, a junior competitor, flying a "Martinet" powered by a Mills ·75 c.c. had an excellent flight of 6 minutes 15 seconds, but it ended disastrously by flying out of sight into the jungle, from which it could not be recovered. This was the model's first flight and it was Manbendra's first power model built entirely by himself. The story goes that he worked throughout the night before the Rally to finish it, and was still using cement and dope in the bus on the way to the flying field. Another unfortunate competitor was Captain Shorter, whose Keilkraft " Bandit " made a wonderful flight from a lovely take-off to a perfect landing in the Open Power Duration.

On the whole, the day was considered a great success, including the picnic lunch of sandwiches and beer during the short interval in the middle of the day. The difficulties and snags that did crop up, and these were much fewer and much less disturbing than the pessimists expected, are all regarded as the teething troubles of an infant venture into the field of aeromodelling competitions.

Above left : Dick Hardaker's beautifully finished rubber-powered Airspeed Envoy, built from A.P.S. plans. Above right : B. Jhunjhunwala launching his Cirro-jet, Jetex powered model. A similar model flown by Ewing won the AEROMODELLER trophy.

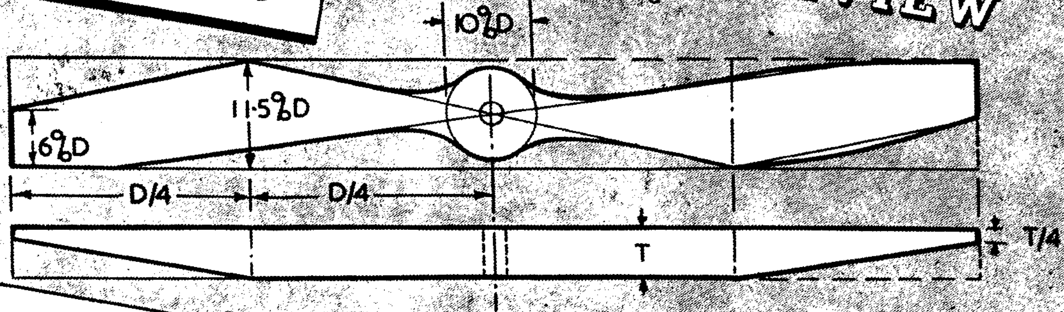
Below centre : Another view of the line-up of models entered in the All India Contest.

Bottom : The youngest member Beppu Roy with his Veron Speedee C/L model, flown for him by Captain Anderson — though Junior flies himself on less public occasions.

POWER PROP REVIEW

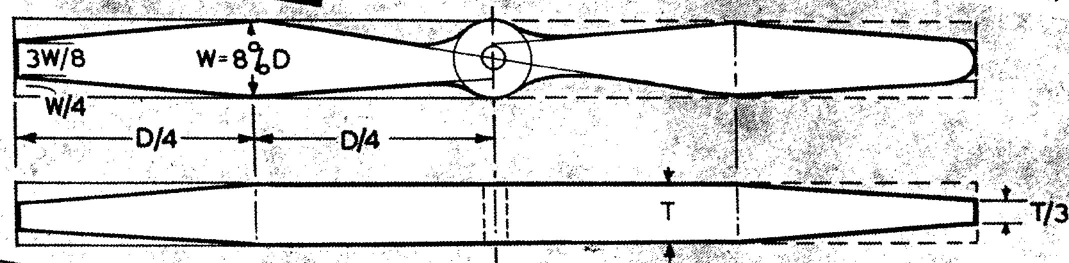
PART TWO

TRUFLO



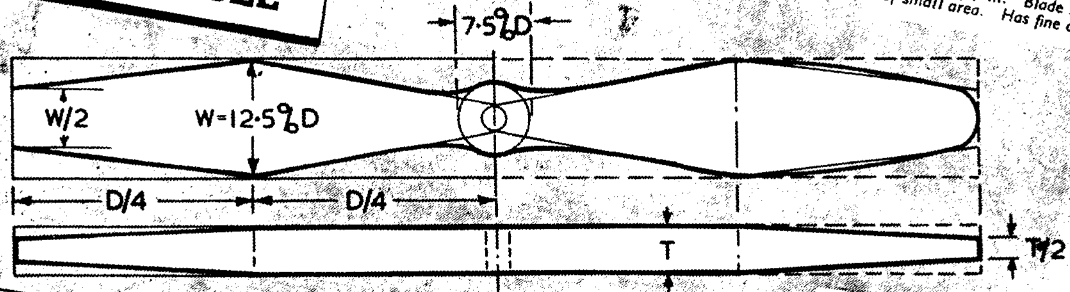
Chauviere type propeller, best applied to free flight power. Pitch decreases towards tip, which usually adds r.p.m. to motor.

POWER



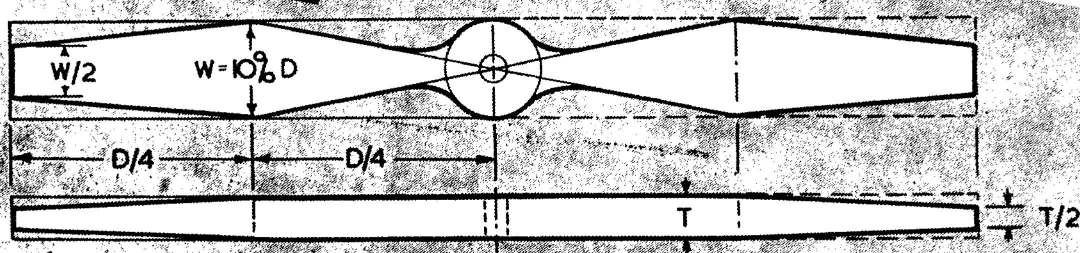
This is a speed control line prop designed by Carl Goldberg and marketed by his (American) firm. Blade is narrow, and of small area. Has fine contest record.

PINNACLE



New S.J.A. free flight prop based on the American Air-O and featuring generous blade area. Also should be well suited to control line stunt.

TRU-CUT



This is the symmetrical type prop which is a good general purpose design for both free flight and control line. The squared corners given by straight tapering should be rounded off, for preference.

Making RUBBER MOTORS

BY
R. H. WARRING

INCLUDING A NEW METHOD OF CORDING

RUBBER motors should never just "happen". They require a certain amount of making, just like any other component of a model and the more care and attention you give to this particular part of the finished model, the better will be the results.

In the first place many people—and not all of them beginners—are quite at a loss to decide just how much rubber is required for a particular model, and the only true guide here is experience. Fortunately, however, the basic requirements can be expressed in terms of a few simple rules. By observing these, anyone can at least start off on the right foot and build up their own experience from there.

The first rule is simply this; the weight of the rubber motor should account for at least one third of the *total weight* of the model in flying conditions. Or, in other words, whatever the weight of the complete model *without* the motor, the motor you use should be at least one half of this figure. To clear up any possible doubt, let us take a typical example.

The complete model, assembled ready for flying, but *without* the motor, weighs four ounces. Therefore you will require at least one half of 4 ounces (i.e. 2 ounces) weight of rubber for the motor.

Actually, most competition fliers use a higher percentage of motor weight. The average eight-ounce Wakefield (and there are very few in number built right down to this minimum limit) has a motor weight of 3¼ to 3½ ounces (40-44 per cent total weight). A nine to ten ounce Wakefield may have four ounces of rubber or more (40-44 per cent. total), whilst lightweight and FAI rubber models sometimes approach a figure of 50 per cent. motor weight.

This latter figure is just about the practical upper limit, just as one third or 33⅓ per cent. total weight is the lowest practical limit. So if you want to approach more closely to best duration standards you must calculate motor weight to these higher percentages. The results can be expressed in simple tabular form, when it can be always available for reference with any new model. (Table I.)

TABLE I. RUBBER WEIGHTS.

Weight of Model less motor. (ozs.)	WEIGHT OF RUBBER (ozs.) 35%	40%	45%	50%
1	0·7	0·8	0·9	1
2	1·4	1·6	1·8	2
3	2·1	2·4	2·7	3
4	2·8	3·2	3·6	4
5	3·5	4·0	4·5	5
6	4·2	4·8	5·4	6
7	4·9	5·6	6·3	7
8	5·6	6·4	7·2	8
For every additional ¼ oz. ADD	0·09	0·1	0·11	⅛

e.g. Completed Model, without motor, weighs 4⅜ ozs. For a 35% motor, weight of rubber required is $2{\cdot}8+3\times0{\cdot}09=3{\cdot}07$ ozs. (3 ozs.) making total weight 4⅜ ozs. (4·375 ozs.) + 3·07 = 7·445 ozs. (7⅜ ozs.)

TABLE II. RUBBER LENGTHS.

Size of Strip	Weight in ounces. ⅛	1	1¼	1½	1¾	2	2¼	2½	2¾	3	3¼	3½	3¾	4
¼×1/24	2	15	18	22	25	29	32	36	39	44	48	51	54	58
¼×1/30	2¼	18	23	27	32	36	41	45	50	54	59	63	67	72
3/16×1/24	2½	19	24	29	33	38	43	48	54	57	62	67	72	77
3/16×1/30	3	24	30	36	42	48	54	60	66	72	78	84	90	96
⅛×1/30	4½	36	45	54	63	72	81	90	99	108	117	126	135	144

Above Table gives Lengths of Rubber in Feet.

e.g. A 3¼ oz. motor requires 48 ft. (16 yds.) of ¼×1/24 strip, or 59 ft. (20 yds.) of ¼×1/30 strip, etc.

N.B.—For general use, work to nearest equivalent yard above calculated length required.

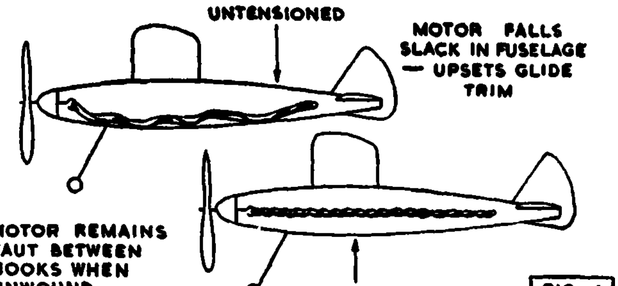


FIG. 1

So now we have found how much *weight* of rubber is required, but as most rubber is bought by *length* we need another table giving rubber weight in terms of length. Unfortunately it does not always follow that rubber strip of the same section always weighs the same (i.e. has the same density). Some ¼×1/24 strip, for example, is very much heavier than others. Sometimes, you also get variations throughout the length of one skein of rubber, so that the strip from one end of the skein is heavier than that off the other end. This, however, is not so common. So, a table converting weight into lengths will not be foolproof, although it will be a most useful general guide. (Table II.)

The next stage is simply deciding how the length of rubber required should be made up. How many strands or, how long is the finished motor to be?

Now, lacking any previous experience with a particular design of model there is one general rule here which works out very satisfactorily. That is: *the length of the finished motor should be roughly the same as the wing-span of the model.* This will not, usually, give an immediate answer, for there is one other item which requires adjustment. Obviously, the final motor must be made up into a whole number of strands for one thing. Furthermore, the finished motor length, of roughly the same length as the wing-span, will be much longer than the distance between the front and rear motor hooks. This means that the motor will have to be tensioned or so arranged that it will never unwind completely in the model. If it does unwind completely it will fall about inside the fuselage unevenly and upset the glide trim. Some method of tensioning is necessary, so that a certain number of turns are always retained on the motor, to keep it stretched between the motor hooks after unwinding—(see Fig. 1.)

The most usual, and simplest, means of tensioning the motor is by the method known as "cording", where the pre-tensioning turns are put on when making up the motor to put into the model. This is fully described later in the article, but anticipating this we can say that for ease of making up a corded motor, the number of strands in the motor should be divisible by four—or, at least, divisible by two. That is to say, 8–, 12–, 16–, 20– strand motors, and so on are easy to cord. 6–, 10–, 14–, 18–, etc. strand motors *can* be corded, but are not quite so easy to handle. Motors with an odd number of strands are the most difficult to cord properly.

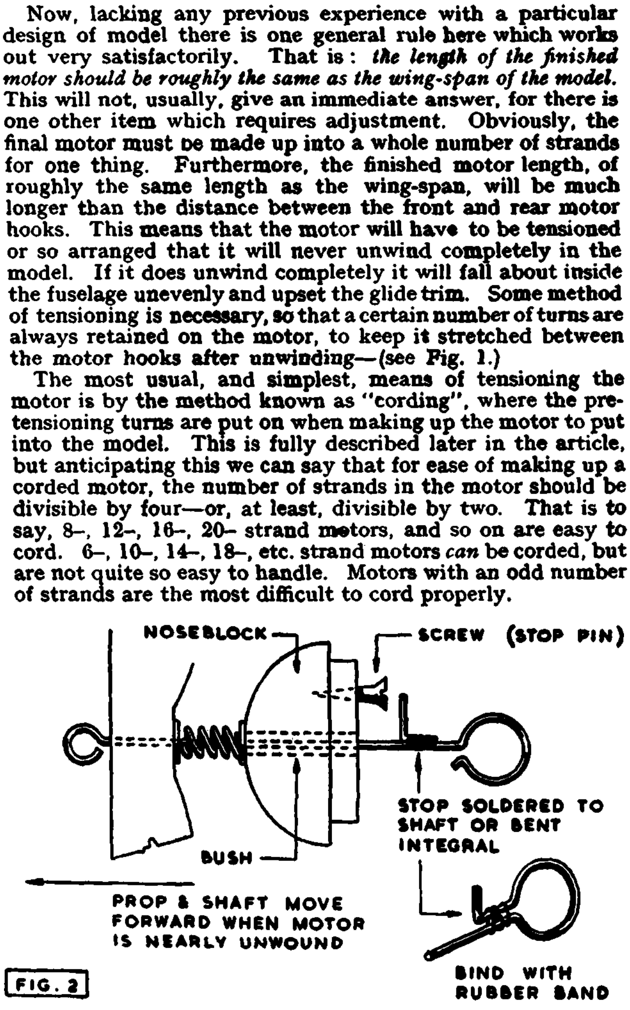


FIG. 2

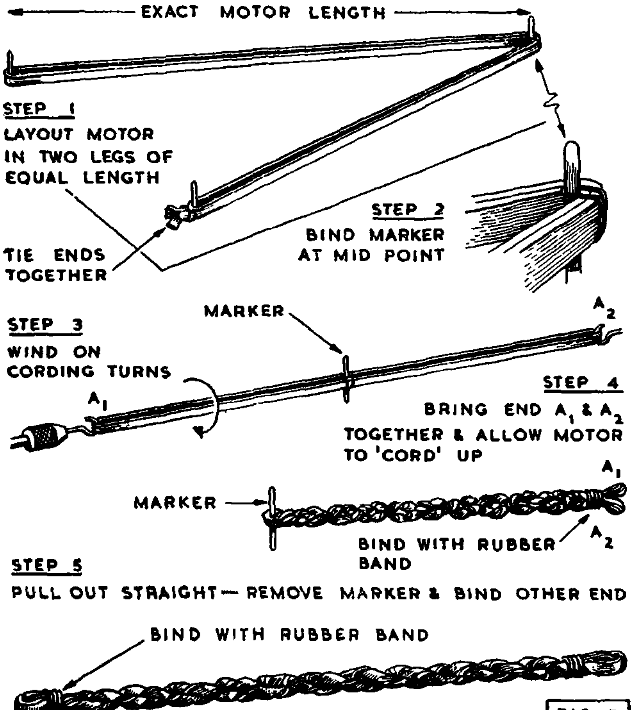


FIG. 3

If, therefore, your approximate motor length figure (i.e. the wing span) divides into the total length of rubber required to give an odd number of strands, then, either the final motor length must be adjusted slightly so that you do get a convenient number of strands, or another *size* of rubber strip used, which will make up more readily into an even number of strands of the required length.

This, of course, is the basic method; experts work more on the quality of any given batch of rubber. If that quality is superior to any other they will use it, irrespective of how it makes up.

The remaining item outstanding is pre-tensioning the motor. Mechanical tensioners are used on many models, particularly those employing folding props. The principle of a mechanical tensioner is simply that a spring is fitted in the propeller assembly which draws the shaft forward when the motor tension dies off (*i.e.* the motor is nearly unwound). A suitable strip is soldered onto the shaft, or bent integral with the rubber hook, so that in its forward position it engages with a pin (usually a screw) in the noseblock and stops the motor from unwinding further. The strength of the spring and the length of this pin are so adjusted that sufficient turns remain on the motor to keep it taut between the rubber hooks. (Fig. 2.) A mechanical stop of this nature also serves the purpose of stopping the shaft in a particular position, which is essential with a folding propeller so that the blade always folds against the same part of the fuselage. Mechanical tensioners and folding props, therefore, go hand in hand.

For freewheeling propellers, however, it is usual to *cord* the motor, this being almost universal practice with such types. The most widely used method of "cording", "rope tensioning," will be described here.

Stages in making a corded motor are illustrated in Fig. 3. The motor is laid out on a clean drawing board, or other suitable surface, in two legs of identical length (each equal to the required motor length), with half the finished number of strands required in each leg. Here, we see the importance of having a number of strands divisible by four. Unless this is so, the two ends of the rubber will come at the ends of separate legs (if the number of strands is divisible by two only), or one at the end of one leg and one at the middle point (if an odd number of strands are required). In the first case, the two ends are simply knotted together. In the other cases, each end must be made off into a loop, which is reasonably satisfactory, but there is always a tendency for the finished motor to break a strand at one or both of these loop-knots.

When the motor has been laid out carefully, bind a "marker" at the centre point with a rubber band. A piece of knitting needle about 3 inches long makes an excellent marker. Then remove the motor from the board, hook one end onto a winder and fix or hold the other end. Wind on a number of cording turns, *in the same direction as you normally wind the motor up*. There is no definite formula for the number of cording turns to apply. About 150 is quite adequate for any Wakefield motor, or, as a very general rule, between 10 and 15 per cent. of the estimated maximum turns of the motor. Too many cording turns are better than too few. If not enough cording turns are used the motor may not tension properly, or only tension for the first two or three windings, and then be too slack. A little practice will soon indicate the best number of turns for any particular model.

When the cording turns have been applied, double the motor back over itself so that the two ends come together, and allow the rubber to wind round itself, still holding the two ends together. Bind these ends together with a rubber band about one inch in from the actual free end. Then catch hold of the other end of the motor by the centre marker and pull out. Either hook this point of the motor onto the winder and allow the rope to unravel, or simply let it unravel itself. The appearance of the motor should then be something like that shown in the final diagram of Fig. 3. Bind the (centre) end with a rubber band, just as you did the other ends, and the motor is then ready to insert in the model.

There are many advantages to be had with a corded motor. It tensions itself and should then need no further adjustment although it is always advisable to unravel the cord if the motor is not to be used for any length of time and re-cord when required again. It can be pulled out to much longer than its normal tensioned length, so that inserting it in the model is very simple. The additional length is taken up again on the first winding. Also, it is pretty-well foolproof, since it does not have to rely on a mechanical stop, which can, and often does, fail, particularly with large powerful motors.

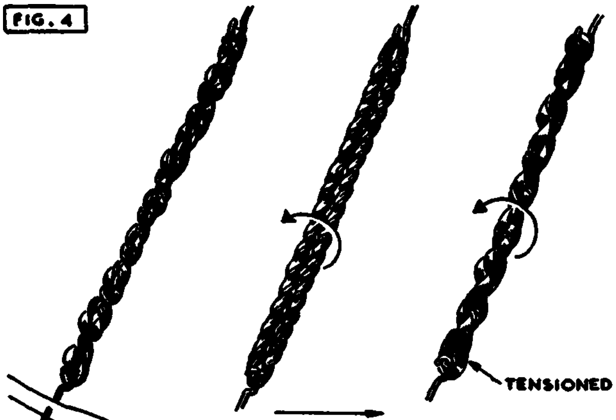
Contest Application.

Specialising in one standard design of Wakefield model, as the writer has done for the past three years, detail development and experience should have guaranteed consistency. For example, in late evening conditions with damp air, the covering slack on wings and tail, it is relatively easy to get four minutes plus by winding the motor up to 90 per cent. maximum turns, when the model is properly in trim. Change of trim of the model itself seems largely to have been overcome. The particular model flown in the 1949 Trials and Finals has retained the same thrust line and tailplane setting for about a year through various extremes of weather—and a contributing factor here has been letting the model "age" before flying. That is to say, after building, covering and doping in the usual manner, with all surfaces pinned down to prevent warping, the model is left for three weeks or so before trimming, so that any slight warps that are likely to come in, do appear before trimming and the line up then remains "set". There is little evidence to show that this "set" has changed at all throughout the season.

So, with a model which retains the same trim and will do over four minutes in non-lifting air, it is difficult to appreciate, at first, why any flight during the day, when conditions are usually much better, should be less than at that time. Flights on a sunny day should, in fact, be very much better. With better evening air conditions, *e.g.* less damp so that covering does not slacken off, five minutes can be bettered with a good motor. Yet, although the actual contest flights made with that particular model showed a majority of "limit" times, there were a sufficient number of low flight times to render the problem of consistency still unsolved.

Granted that the model itself can retain a consistent trim,

FIG. 4



STAGES IN UNWINDING (CORDED CLOCKWISE)

the problem of consistent high flight times appears to be:—
(1) Rubber motor efficiency. (2) Weather conditions.
(3) Mechanical failure (rubber bunching).

No. 1 is a very real problem, in fact the major headache facing rubber fliers during the past year. The conclusions, and compromises, worked out by the writer during the '49 season proved reasonably satisfactory in that the number of low duration flights (under three minutes) directly attributable to rubber failure (low torque) were very few in number.

Point No. 2 is still improperly understood. There are undoubtedly conditions where large air masses are sinking at quite an appreciable velocity and, if you are unlucky enough to fly off in one of these periods, you may find that your model is climbing and gliding in a downdraught which may be as high as 10 ft. per sec. But this is another subject.

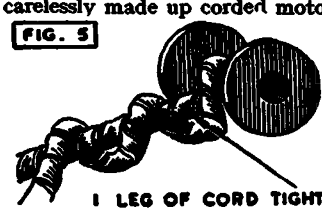
The third point—rubber bunching—is one which should be readily overcome. Yet the writer, who reckons to make up a corded motor as carefully as anyone, had three cases of bad rubber bunching in major contest flights which ruined the flight times concerned. This led to some post-season research on the subject which has produced some surprising results.

A normal corded motor when unwinding, first unwinds completely into two separate skeins, then winds back over itself again to take up slack in the motor and give a properly tensioned motor for the glide—(Fig. 4.)

Bunching occurs when the motor does not unwind properly and a large knot of rubber remains at one point (almost invariably at the extremities and usually the rear end) so that the centre of gravity of the whole motor is moved back, upsetting the glide trim of the model. When a bunch starts, it usually grows to quite considerable proportions, so that the rubber pushes right through the side of the fuselage. A bad bunch can shift the C.G. of the motor back an inch, and since the motor accounts for upwards of 40 per cent. of the total weight of the model, the effect on trim is most marked.

Inadequate rubber clearance, poor winding technique, carelessly made up corded motors, can all lead to bunching, but with all these possibilities eliminated, bunching can, and still does, occur.

FIG. 5



1 LEG OF CORD TIGHT

On the various occasions where bunching occurred, the writer took pains to examine the motor in question carefully to seek a possible reason. The cause was usually obvious. The appearance of the motor was as in Fig. 5—one skein of the chord tight and straight, with the other wrapped around it. In other words, it appeared that the exact mid-position had not been marked out when originally cording the motor. This may have been acceptable the first time it happened but when bunching still occurred at odd occasions after *particular care* had been taken to lay out the original motor accurately, the solution obviously lay elsewhere.

At first it seemed possible that rubber might creep from one cord of the motor to the other, either during winding or unwinding, and some tests were made with points actually marked on the two cords of the motor each one inch from each end. There was not the slightest tendency for the motor to creep around the end fittings.

Having eliminated this possibility it seemed that the only way in which the bunch conditions of Fig. 5 could be formed in a corded motor, was, *if in applying the corded turns to the motor in the first case, these turns were not evenly distributed along the length of the motor.* The tests made to check this confirmed that this was, exactly, where the trouble did lie.

Test motors were very carefully marked out into five equal parts and cording turns applied at one end, as per normal procedure. Each section (one fifth) was then unwound independently and the number of turns noted. Result and averages of a large number of tests are given in the table Fig. 6.

200 TURNS APPLIED ← MOTOR MARKED OFF IN 5 EQUAL PARTS →

RUBBER	T	T	T	T	T
GREY	44	40	40	38	38
BROWN	37	35	33	44	51

T :- TURNS

FIG. 6

Two major points are apparent. First, the number of turns applied to one end of the motor are, certainly, not distributed evenly along the length of that motor. Second, the grey rubber tested (Dunlop) differed from the brown (T-56) in that turns were concentrated at opposite ends. This difference was also more marked in the case of T-56. Practical experience bears this out, for T-56 was found to bunch more readily than Dunlop.

Taking typical test figures for T-56, we can see what happens when we make up a corded motor in the normal manner (Fig. 4.) Applying 200 cording turns, these turns are distributed along the length shown (Fig. 7.) Doubling the motor

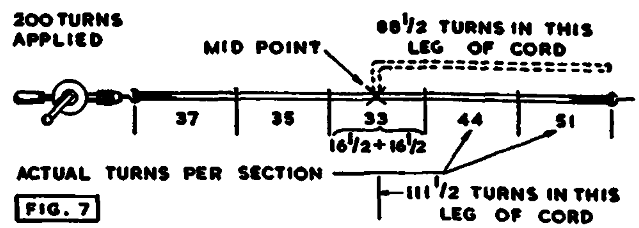


FIG. 7

back to make up the final motor, one leg of the chord now has 89 turns in it and the other 111. In other words, each leg of the chord is under different tension and conditions favourable to bunching are present.

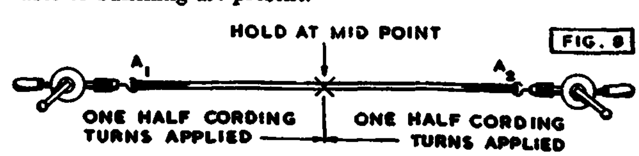
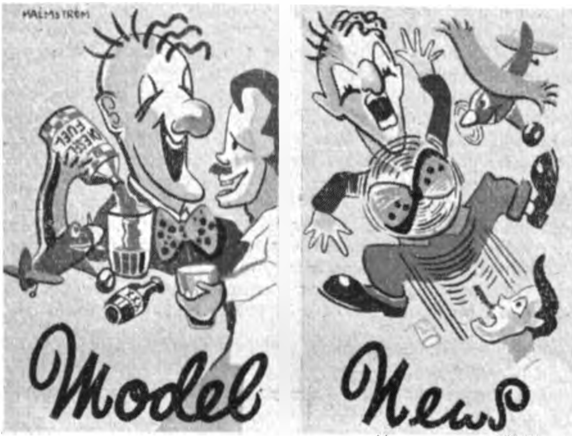


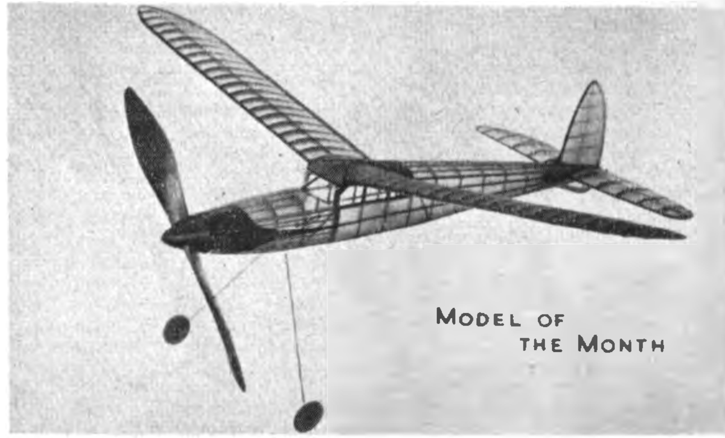
FIG. 8

BRING A_1 & A_2 TOGETHER, AS NORMALLY, TO COMPLETE CORDED MOTOR

To eliminate this, a new method of making up a corded motor must be adopted (Fig. 8.) The motor is laid out as before, with the exact centre marked, but from here on the centre is held (or fixed) and one half of the cording turns required *applied from each end in turn.* The motor is then doubled back, pulled out evenly and the ends bound as before. Each leg of the chord should then be identical, with the possibility of bunching eliminated.

The full value of this method of cording still remains to be checked by practice. It has already been used on static tests and under flight conditions with every sign of consistency, but it will still need several months of contest flying to prove, finally, that this is the solution to rubber bunching.





ALTHOUGH still under the influence of Diesel Fuel XXX, Fliar Phil pauses whilst in full flight to remind his reader(s) that he is still open to receive good model photographs. At the moment we could do with a few more shots of solid models—for some reason or other there seems to have been a dearth of material in this department lately, and Fliar Phil refuses to believe that *all* the solid modellers in our midst have gone to earth.

Opening this month's batch of contributions, title of Model of the Month goes undoubtedly to the partnership of E. Williams and B. Turner of Bradford.

The model is the well-known Aristocrat Wakefield design, and the beautiful lines are shown to their best advantage in this photo taken by B. Turner.

Next we have a very fine action shot by E. Stoffel of Ilford showing C. Cox launching a power model based on the Sportswagon design. The machine has a wing span of 6 ft., weighs 3 lbs. and is powered by a 5 c.c. Vulture engine.

The K.K. Scout shown in photo No. 3 is a most creditable effort by 14-year-old John Boynton of Northallerton, Yorks. This is the first model that John has tackled, and from the looks of things, Fliar Phil hopes it will prove to be the First of the Many!

Next we come to a type of model rarely seen nowadays—a flying scale seaplane, in this case the ever popular Supermarine S.6B of Schneider Trophy fame built by P. O'Keeffe of Charing, Kent. The model is built to a scale of ½ in. to 1 ft., weighs 2 ozs. including rubber, and incorporates such details as pitot tube on wingtip, mass balances on ailerons and rudder, air scoops, and oil cooler pipes along the fuselage sides.

Next to the S.6B we have a most interesting piece of conversion work by G. B. Onions of Oxford, who tells us that originally this model started life as a G.A.L. Horsa glider, built from AEROMODELLER plans in 1943. Owing to the wartime balsa shortage, the machine was constructed mainly from hardwoods, but last year reader Onions stripped off the sheet covering and scrapped the existing nose and tail units. New covering consists of 1/32 in. balsa sheet, and provision has been made for two Jetex 100 units, the final result being somewhat like the English Electric Canberra B.1 jet bomber.

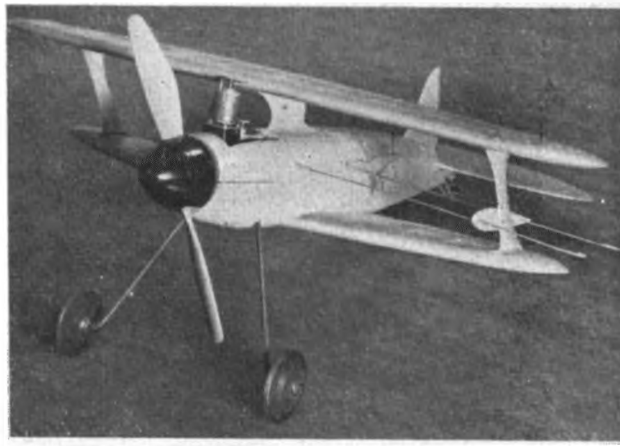
The "Aqua-Aerocraft" (British Pat. No. 587,317) is the invention of L. Morgan of Gloucester. At the time of writing the machine has not been test flown, and we shall be glad to publish further details as soon as it has done so.

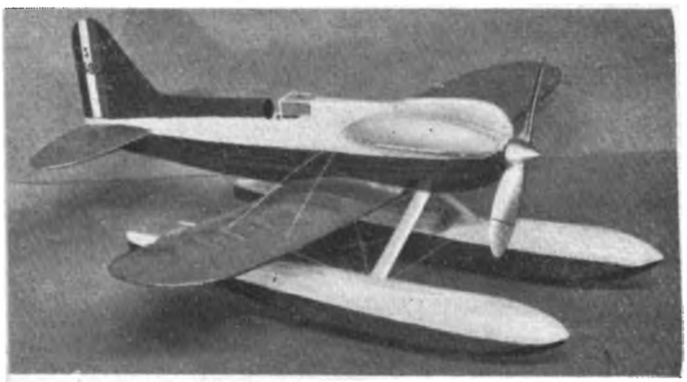
The photo at bottom right shows B. D. Gardner of Putney with his "Zenith Star" high performance sailplane. This model was started during the 1948 camps at Eaton Bray, and completed in February last year. Successful early tests regularly turned in flights of 3–4 minutes duration, after which it was fitted with a 1·8 c.c. Elfin engine mounted on a pylon over the wing, the object being to convert the model to radio control. The model was subsequently lost after a flight of 2½ minutes, and when found, strange to relate, the engine had unscrewed its mounting bolts and disappeared!

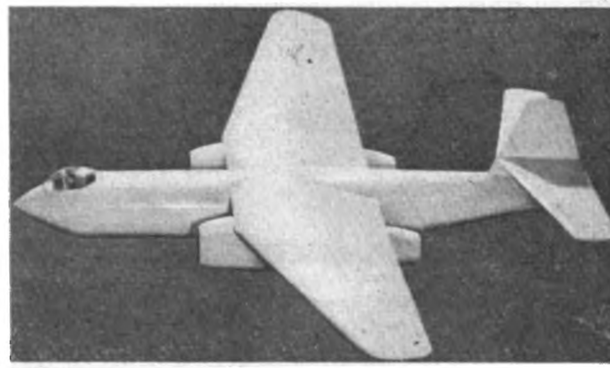
Its powered life being of necessity at an end, the model next distinguishes itself by being placed 3rd in the Pilcher Cup, one flight being of 7½ minutes duration, landing on the spot from whence it was launched. Conforming to F.A.I. rules, "Zenith Star" has a wingspan of 11 ft. 5 ins. and a length of 6 ft. 2 ins.

Next we have a radio-controlled flying scale Fairchild Argus by D. Henstridge of Lancing, Sussex. The model appeared at the Southern Counties Rally, Thorney Island, last year. It is covered with jap and rag tissue, powered by an E.D. 3·49 c.c. Diesel engine, and incorporates a Mercury-Cossor receiver controlling the rudder only. The photo, by J. H. Court of Worthing, shows S. Spraggs (B.Sc.Eng.) with the model and a 3-valve home-made transmitter of his own design.

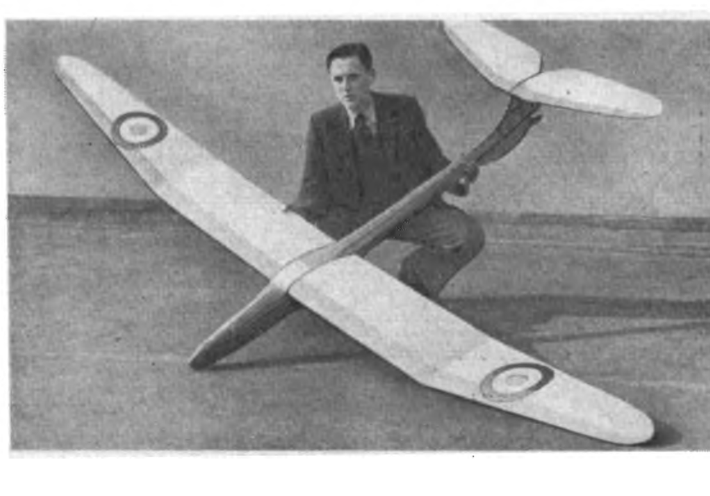
All good things come to an end, or so it must have

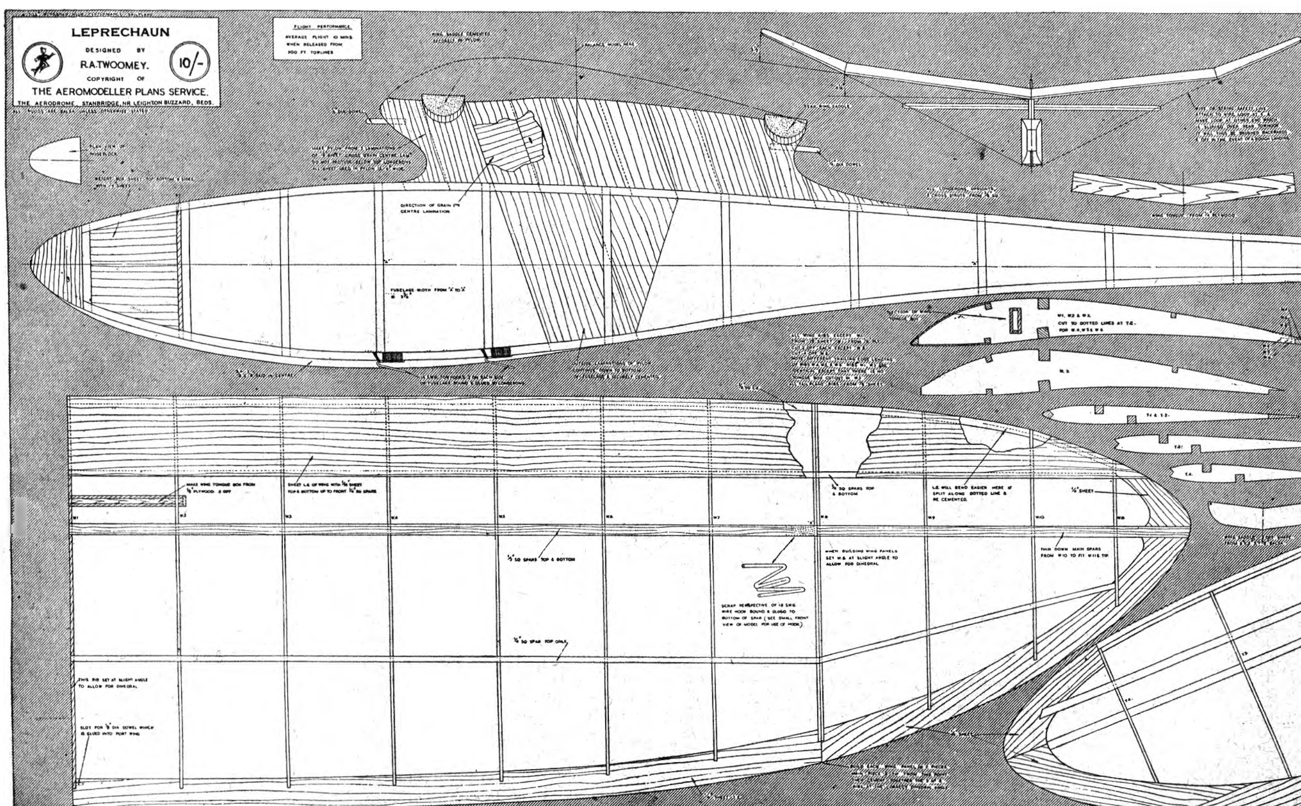




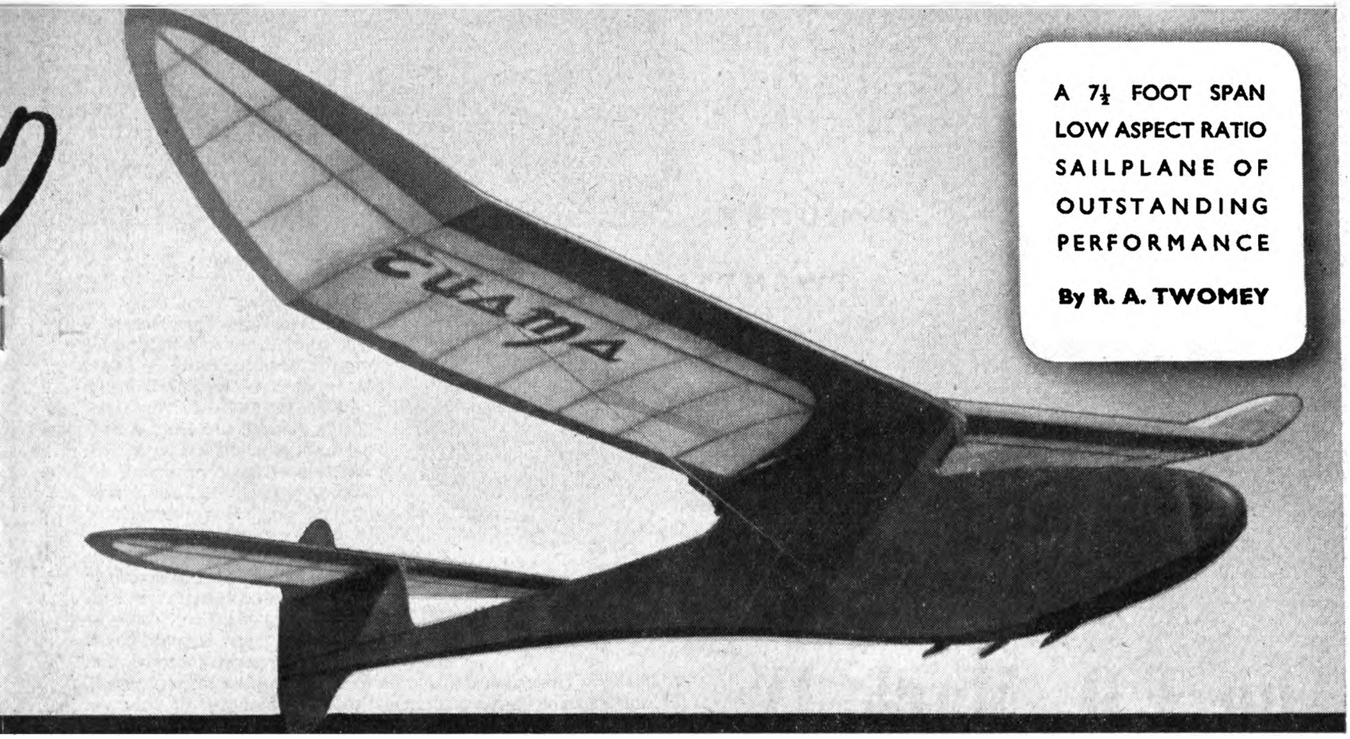


seemed when this semi-scale control-liner by E. C. Scott of Northfield, Birmingham, went in at full bore after a push rod had come adrift from its control horn. The result shown in photo No. 9 is what the R.A.F would term "Cat. E."!



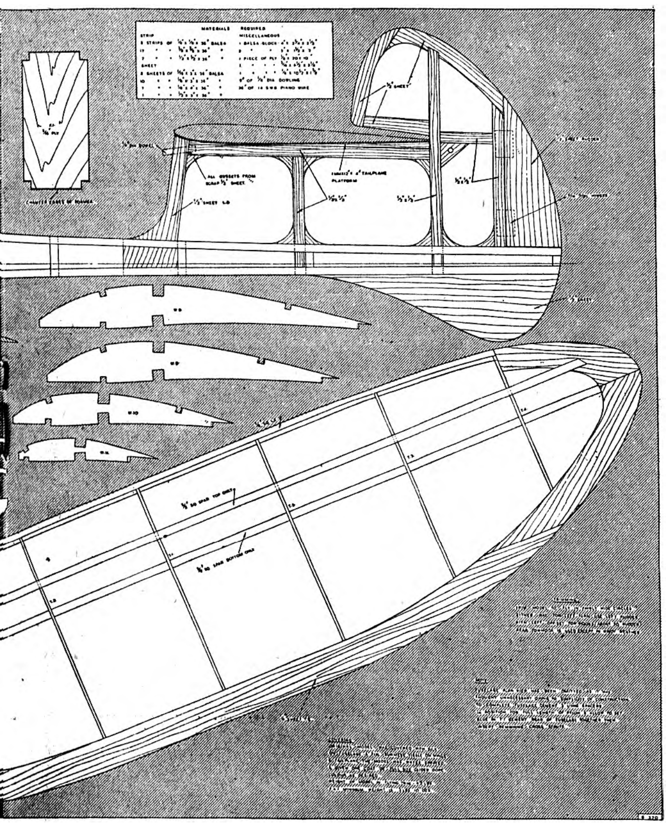


THIS IS A 1/9 SCALE REPRODUCTION OF THE FULL SIZE PLANS WHICH ARE AVAILABLE PRICE 10/– P



A 7½ FOOT SPAN LOW ASPECT RATIO SAILPLANE OF OUTSTANDING PERFORMANCE

By R. A. TWOMEY



POST FREE FROM THE AEROMODELLER PLANS SERVICE

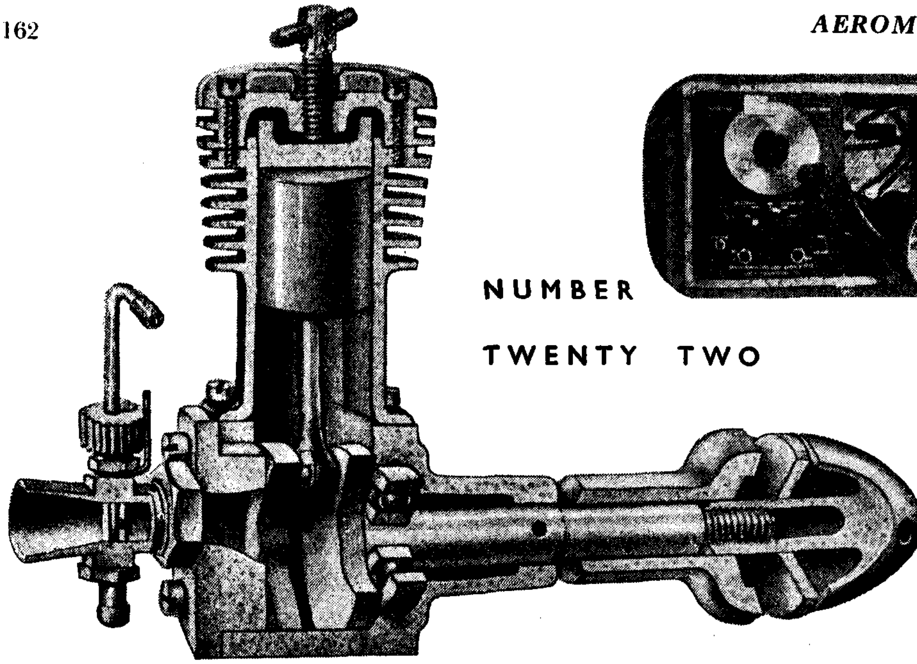
THE designer of this model is already well-known to readers of the AEROMODELLER for his Cobra and Rebel, which were published while he was still at school. He is already making a place for himself in Contests, but, at present, National Service has him in the R.A.F.

Leprechaun, his latest design, has one feature unusual in high-performance sailplanes ; low aspect ratio, in this case 6 : 1. He had felt for some time that low aspect ratio deserved more attention, being more stable, and on Leprechaun consistently high performance has proved its efficiency. A special wing section developed from the Swedish series has been used, and this combined with the low A.R., pylon, polyhedral and high tailplane mounting forward of the fin, make the design the acme of stability.

Although the span is only 103 inches, the wing area is greater than that of most of the famous 10 and 11 foot sail planes, being 1,647 sq. ins. The construction of the model is perfectly straightforward and should create no difficulties for anyone with average modelling experience. The designer wishes to stress the fact that the tailplane must be attached to the fuselage very securely ; Leprechaun's one and only off day, when she misbehaved on the line and turned in poor flights, was due to the tailplane slipping out of position.

Details of the sailplane's performance to date are sufficiently impressive to warrant giving them in full ;

First flight ; 20 : 20 o.o.s. A recent flight : 2½ hours, 22 miles. First Contest flights (May 1949) : aggregate of three ; 21 : 36·8. These were flown in high wind and the towline broke in the first two launches. The third flight time was 20 : 20 o.o.s. and the club record. Three weeks later it scored 20 : 29 on two flights and, in the Pilcher Cup was lost on the first flight of 18 : 50. Leprechaun also holds the Club hand-launch record with 4 : 04. In July 1949, Twomey broke his earlier record with 23 : 00 o.o.s. followed by an unofficially timed 30 : 00 o.o.s. The average time for June and July of last year, flying in thermal and non-thermal conditions, averaged over 12 minutes, under official timers, and those of October, over 9 mins. Altogether, Leprechaun has had more flights of over a quarter of an hour than she has had under, which is a noteworthy fact, and given a towline strong enough to take up her 4½ lbs. she will make full height before flying off, every time.



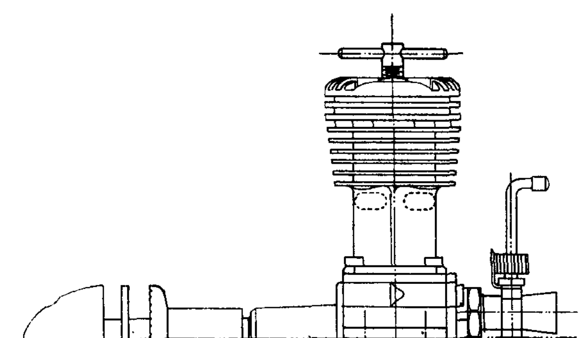
NUMBER

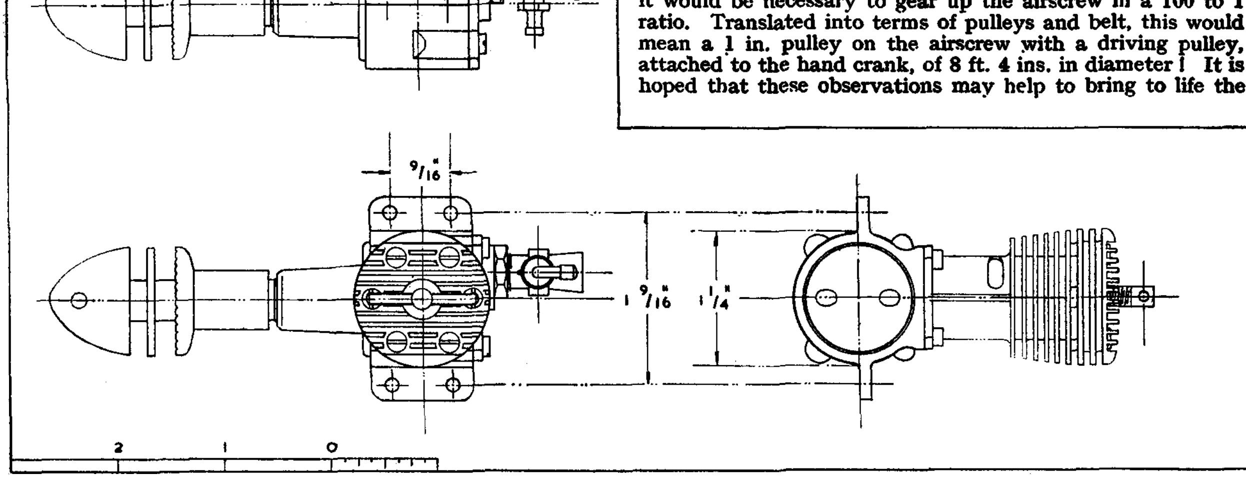
TWENTY TWO

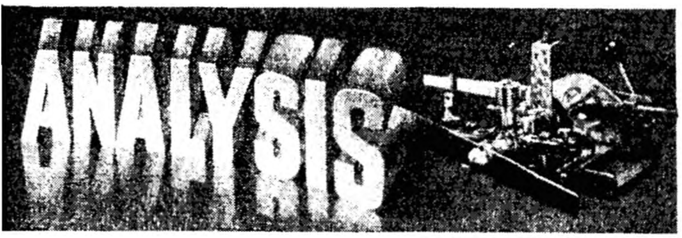
The E.D. Mark IV.

THE great popularity of control-line flying has had its repercussions in the model engine sphere, and we have lately seen the advent of many new designs from manufacturers of long standing. The aeromodeller has now a formidable array from which to make choice, as the new engines are mostly additions to the existing ranges. This is all to the good, especially as the new models invariably show that manufacturers are quick to profit from experience, and are capable of making their products better and better. Improvement seems to run along the lines of more efficient porting arrangements, the increased use of rotary-disc inlet valves, and the incorporation of ball-bearing crankshafts. These factors, coupled with an intelligent use of suitable materials for the more highly-stressed parts, have resulted, in the main, in engines of reliability and power not deemed possible a few years, or even months, ago.

The E.D. Mk. IV Diesel is a good example of this fortunate trend, and shows that British engines can equal those fabulous output figures given by American manufacturers; of which we were, perhaps unjustly, rather sceptical in the past. The test results of the present engine show that a unit of just over 3·5 c.c. capacity can yield an output of more than ½ horse-power. Aeromodellers in general do not, perhaps, quite realise what this means, but may be moved to a better appreciation by remembering the fact that it has been reliably computed that a strong man can develop about 1/3 horse-power in an all-out effort for a short time. This proposition may be somewhat difficult to grasp at first sight, but may be better understood if one imagines a 10 in. propeller coupled by suitable gearing to a hand crank. How many of you think that you could turn the airscrew at 10,000 r.p.m.? Assuming that one could turn the hand crank at 100 turns per minute, it would be necessary to gear up the airscrew in a 100 to 1 ratio. Translated into terms of pulleys and belt, this would mean a 1 in. pulley on the airscrew with a driving pulley, attached to the hand crank, of 8 ft. 4 ins. in diameter! It is hoped that these observations may help to bring to life the

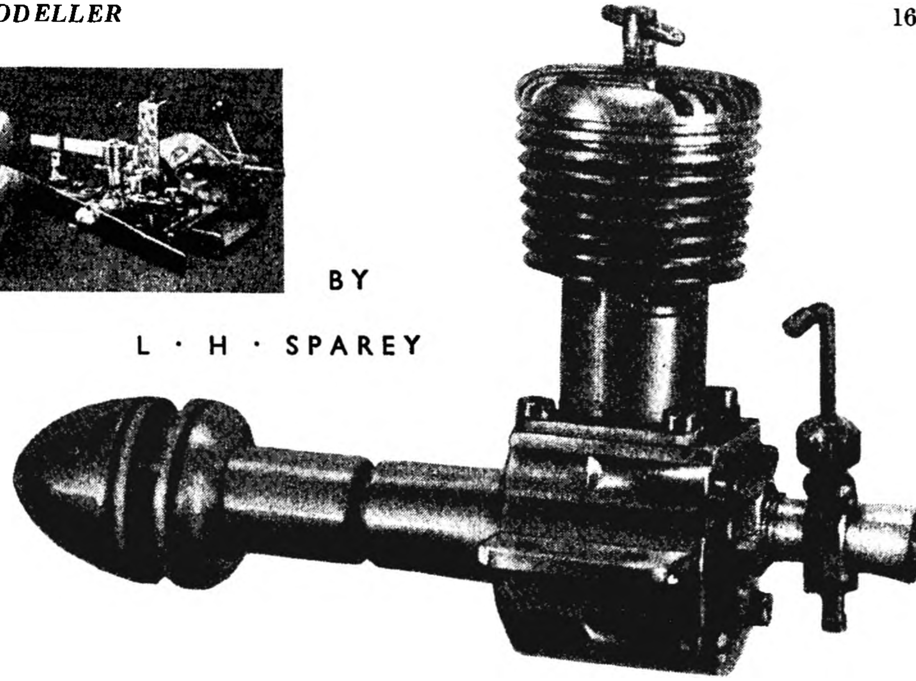






BY

L · H · SPAREY



graceful little curves which appear in these pages.

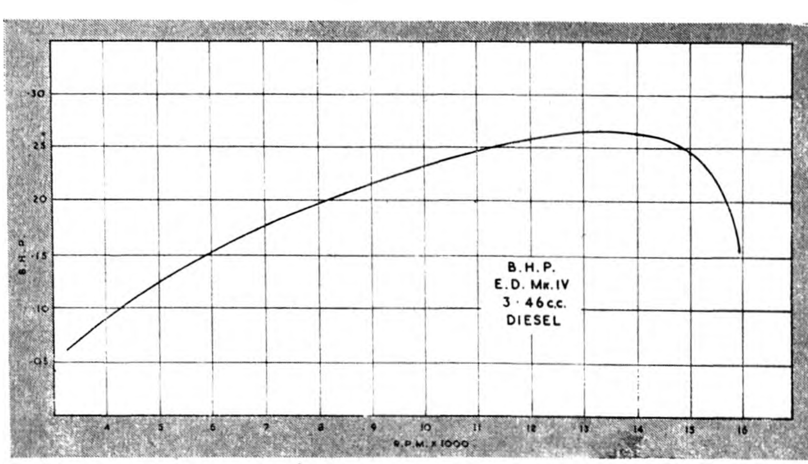
As for the qualities of the latest E.D. engine the power curve really says all that there is to say. It may be mentioned that it ran consistently at all tested speeds, and seemed exceptionally happy at those above the 10,000 r.p.m. mark. The engine was not exceptionally sensitive to throttle control, and a fair latitude in needle setting could be permitted without noticeable effect. Similarly, the adjustment of the compression lever was not unduly fussy, so that the engine was extremely easy to handle.

TEST

Engine : E.D. Mark IV 3·46 c.c. capacity Diesel.
Fuel : E.D. " Competition."
Starting : Pulley-and-cord used for convenience of test, but engine started without trouble when experimentally hand-started from time to time.
Running : Extremely consistent at all speeds, but especially so at the higher ranges. Behaviour under various loads was characteristic more of a 4-stroke than a 2-stroke. At no speed range was fluctuation and hunting evident. There seems to be a slight vibrationary period at around 9,000 r.p.m.
B.H.P. : A maximum output of ·265 b.h.p. was found at 13,300 r.p.m., although but slight output variation was evident between about 11,400 and 14,900 r.p.m. Between these speeds a drop from maximum of only ·015 b.h.p. was noted. Output is exceptionally consistent at the higher speed range, and it may be said that the engine is running efficiently at any speed between 10,000 and 15,000 r.p.m. Beyond this speed power falls rapidly, while at the other end of the scale a marked decrease is noted below about 7,000 r.p.m.
Checked Weight : 6·5 ozs. less tank.
Power/Weight Ratio : ·650 b.h.p./lb.
Remarks : Engine was run-in for 1½ hours continuous running at 4,000 r.p.m. No mechanical trouble experienced throughout test. The engine is noteworthy for its high power output, easy handling, and consistent running qualities. Also for the fact that the measured b.h.p. is in excess of that claimed by the manufacturers whose figure is ·25 b.h.p.

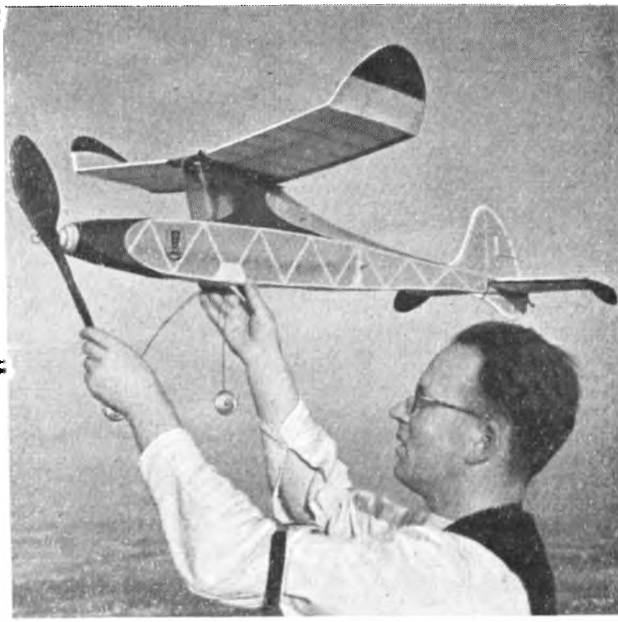
GENERAL CONSTRUCTIONAL DATA

Name : E.D. Mark IV.
Manufacturers : Electronic Developments (Surrey) Ltd., Kingston-on-Thames.
Retail Price : £4. 12s. 6d.
Delivery : Immediate.
Spares : Immediate.
Type : C. L. Diesel.
Specified Fuel : E.D. Standard Fuel.
Capacity : 3·46 c.c., ·21 cu. ins.
Weight (bare) : 6½ ozs.
Compression Ratio : 18 : 1.
Mounting : Beam, upright or inverted.
Recommended Airscrews : 9½×6 ins. to 11×5 ins.
Flywheel : 2¼ ins. diameter, 4½ ozs.
Tank : Separate.
Bore : ·656. **Stroke :** ·625.
Cylinder : Hardened steel, flange fitting, attached to crankcase by four screws.
Cylinder Head : Dural. Finned. Attached by six holding-down screws.
Crankcase : Die-cast aluminium alloy.
Piston : Cast iron. Flat top. No rings. Contra Piston : hardened steel. Adjustment by Vernier screw.
Connecting Rod : Hardened steel. Floating bronze bush big end.
Crankpin Bearing : Floating bronze bush.
Crankshaft : Hardened steel.
Main Bearing : Single ball-race inner, plain outer.
Little End Bearing : Plain.
Crankshaft Valve : Disc induction.
Special Features : Big end designed to prevent scouring of crankpin, easily replaceable when worn. Transfer ports machined in cylinder skirt. Outside cylinder skirt is camturned to maintain even section. Ball-race crankshaft.



ESPECIALLY FOR THE BEGINNER

PART THREE BY REV. F. CALLON



A Hi-climber Wakefield built by the Author and held by a friend.

"MARCH brings breezes loud and shrill......"

Hardly the weather for flying lightweight models! But wait for it; even in March there is often a fair percentage of calm days. And believe me, they *are* worth waiting for, since I have found that about half the smash-ups in the case of small gliders have been due to too much wind. So those of you who have models ready for the air, keep a weather-eye open!

Building the Wing.

There's a friend of mine who holds that once you have built the fuselage of a model, the plane is as good as in the air. Wings, fins and tailplanes (he says) are simple little details which can be put together in no time. Some day you may come to agree with him—I haven't yet—but for the present we will take this part of the construction step by step as usual. Have a good look at the accompanying diagrams, to make sure that you know the names of the various components with which we will be dealing. You will notice that the tail-plane is very similar to the wing in construction, except that it is smaller, and (usually) has no dihedral, i.e. it is flat and has no upward " bends " like the wing.

The general procedure for wing building is as follows:— First, cut out the ribs and wing tips; pin the trailing edge (" T.E." in future) over the place marked for it on the plan; cement the ribs and spars in their correct positions with regard to the T.E., and finally cement the leading edge (L.E.) against the forward ends of the ribs.

The Ribs.

If you are working from a kit, these will all be marked out and numbered on sheet balsa. All you have to do in this case is to cut them out with a razor blade or balsa knife, put them together (in their correct order if the wing tapers towards the tip), and holding them firmly side to side, sand them until they are perfectly uniform above and below. This is best carried out by pushing large pins right through the sandwich of ribs, two from each side, which prevents any possibility of an odd one or two shifting during the sanding operation. (See Fig. 1.)

If you are working from a plan only, then there are two possibilities.

(1) If all the ribs are the same size, trace one of them through the plan onto a piece of very thin—1 mm.—plywood or stiff cardboard, using carbon paper for his. Cut out this rib from the plywood or card, sand it to the correct shape, and then lay it onto the sheet balsa and use it as a template, drawing round it as many ribs as you need. A ball point pen is ideal for the job.

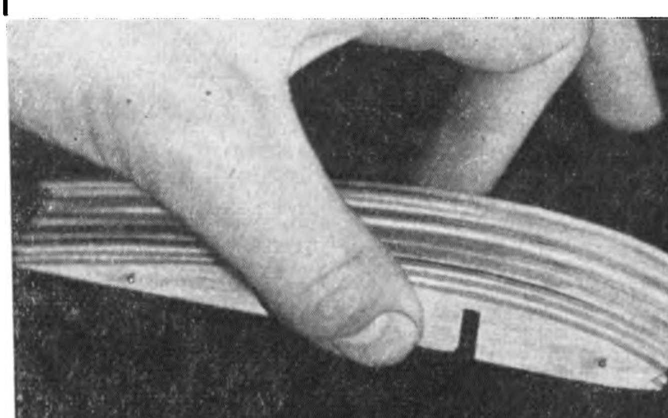
(2) If the wing tapers towards the tips, then all the ribs on each half of the wing will be slightly different in size—larger in the middle, and smaller towards the wing tips. In this case, trace out the largest and the smallest ribs onto thin plywood; cut them out and sand to shape. Now sandwich between these two plywood ribs as many rectangles of the balsa as there are ribs needed for *half* the wing; to start with, the rectangles must be slightly larger than the largest rib. Use first a knife, then rough sandpaper, and finally smooth sandpaper to work down the "sandwich" in a smooth graduation from the shape of the large plywood rib to the small one. Repeat this for the other half of the wings, and there you have a full set of ribs.

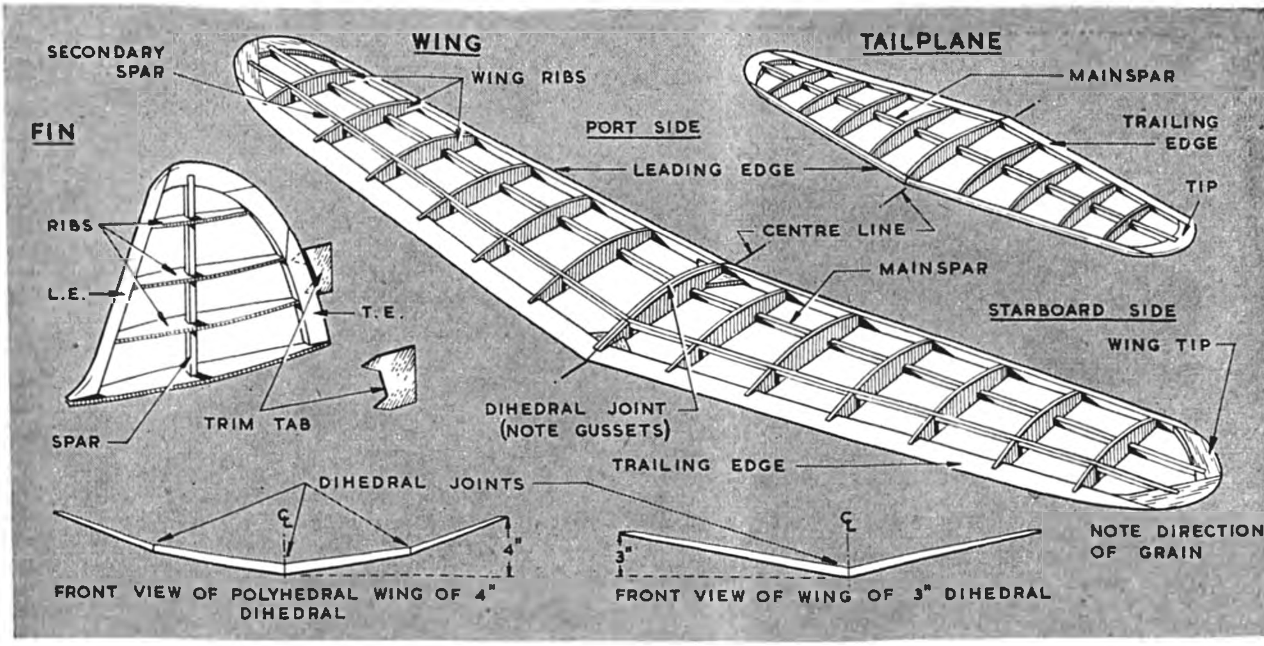
Each rib must be slotted at the point where the spar passes through it—there may be as many as four slots necessary if there are four spars. The slots will be marked on ribs in a kit, and should be cut out individually. When working from a plan alone, there are, once more, two possibilities:

(1) Where the spars run parallel to the L.E., pack the ribs side to side once more with their forward ends in a straight line. Mark the position of the slot or slots on one of the outside ribs, and holding the bundle firmly, cut out the row like a small trench across all the ribs together.

(2) If the line of slots is not parallel to the L.E. or the T.E., then each individual rib must be laid in its proper position over the plan, and the points marked on it where the spars are to pass.

Fig. 1. The set of ribs roughly cut out and held firmly side to side ready to be sandpapered to a uniform shape. Note the pins which are pushed through ribs from each side to hold them in position.





Wing Tips.

We have already seen that balsa wood is strongest *along* the grain and not across it. This is the reason why a semi-circular wing tip is seldom cut out of a single piece of sheet balsa, for then the grain would be bound to run cross-wise at least one at point, making it very weak. The various sections of the wing tips in a kit will already be marked with the grain running *lengthwise*. Be sure to trace these sections *along* the grain if you are working from a plan.

Chamfering.

Though you might not think so, the wing is almost finished at this stage. Most of the work has been done once the ribs and wing-tips are cut out, and the actual cementing together does not take long. But there is just one more thing to be done before we lay out the wing, and this has to do with the L.E. and the T.E.

A mistake which beginners often make is not to bother sanding down the L.E. and T.E. properly. The aerofoil

Fig. 2. The port half of a wing is here partly laid out. Some of the ribs are cemented to the T.E. and secondary spar (S.S.), and the mainspar (M.S.). The Leading Edge has not yet been added.

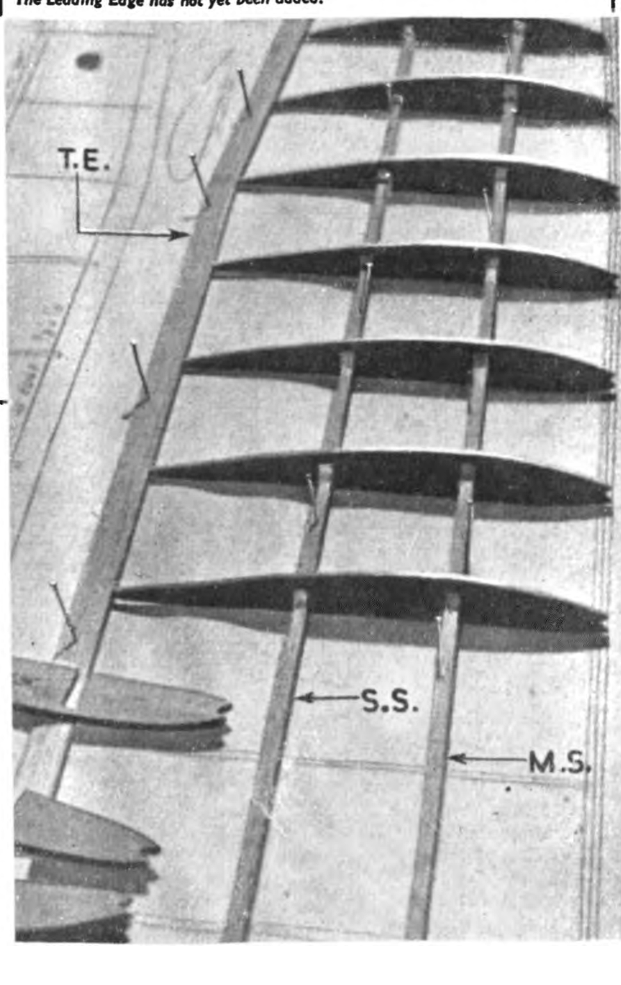
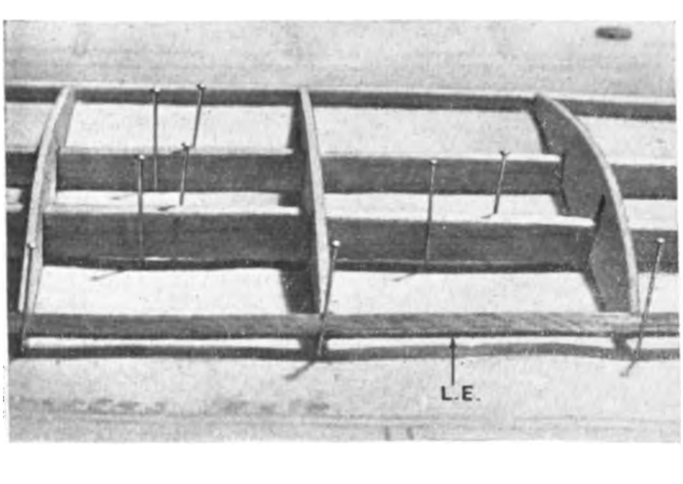


Fig. 3. A front view of part of the wing after the Leading Edge (L.E.) has been added. Note the pins holding the L.E. firmly against the front of each rib. An extra blob of cement should be added at each of these joints for extra strength.



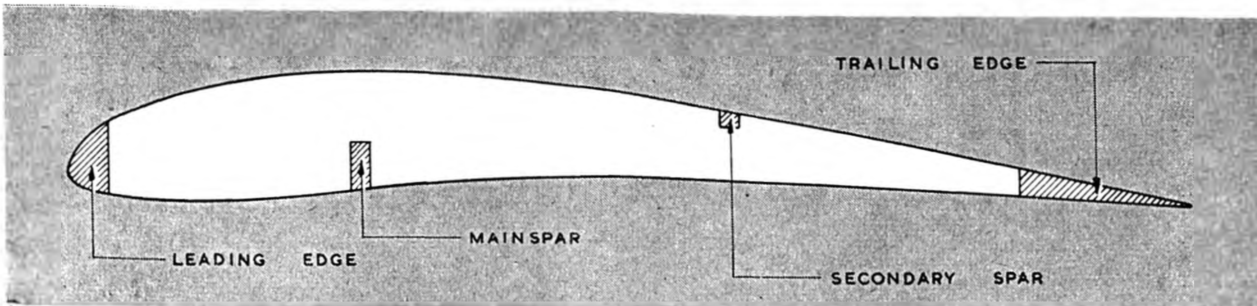


Fig. A. Shows a typical aerofoil section (or cross-section) of a wing, with the L.E. and T.E. chamfered down to follow the smooth lines of the rib.

section of a wing should be rounded at the front and tapering to a knife-edge at the rear. The wing ought to glide through the air like a fish gliding through water, without leaving a ripple behind it, and a fish-shaped wing section is just what we need for this result.

Some people prefer to leave this smoothing off process until the wing is cemented together, but I have always found it easier to do beforehand, certainly with regard to the T.E., at any rate. Starting with a spar of perhaps ⅛ in. or 3/32 in. by ½ in. we must cut and sand until the whole length slopes down from its original thickness at the forward edge to 1/64 in. or less at the rear. To do this, hold the spar firmly along the extreme edge of your work board or table, and scrub away with the sandpaper wrapped tightly round a block of wood. If the L.E. is to be cemented to the ribs in an upright diamond position, the chamfering can be best left until after this has been done.

Laying out the Wing.

With some designs the ribs have to be let into the T.E. for greater strength, and a narrow slot must be cut for the rear of each rib. To do this, lay the T.E. in position over the plan, and mark the points where each rib joins it. Next, make a small cut with a hack-saw blade at each of these points, and widen the cuts with an ordinary nail-file until they are just wide enough to receive the ribs. If the ribs are joined on by butt joints, you will be saved this trouble.

Now lay the T.E. in position on the plan, and secure it by pushing through straight pins every few inches. Also pin in place any spar which has to be let into the *underside* of the ribs. If the ribs have an under-camber i.e., if they are hollow shaped underneath—then this mainspar will have to be packed up off the plan by means of scrap pieces of balsa laid across underneath the spaces between the rib positions. With some undercambered wings, the forward edge of the T.E must be packed up in the same way.

If the plan prints the wing as one whole unit, then build it in one piece, cutting across it afterwards where the dihedral comes. Normally, however, the wing is printed in two halves, and so port and starboard have to be built separately and joined afterwards. Occasionally only one *half* of the wing is printed; suppose this is the starboard side, then the port side will have to be traced out as the reverse of the printed half. The simplest way to do this is to pin down the plan with some carbon paper underneath it—business side up. Then pencil over all the lines carefully and firmly. The results will be a plan of the port wing on the reverse side of the paper.

So far we have got the T.E. and lower spar pinned to the plan. To these now cement the ribs in order, (Fig. 2). Then cement in the upper spars (if any), and finally add the L.E., holding it firmly against the front of the ribs by means of straight pins (Fig. 3). It is quite a good idea to go over all the joints made by the ribs with the T.E. and L.E., adding a further dab of cement to each one.

Dihedral Joints.

These must be extra strong. You can't have too many gussets round a dihedral joint. Often a piece of hard sheet balsa or even of 1/16 in. plywood, cut to the correct " dihedral angle ", is cemented along the L.E. or the mainspar at this point. In any case, I think you will find the following a reliable method of making a sound job of it.

We will suppose for the sake of simplicity that your wing is not a polyhedral, but has only one " bend " in it, and that at the centre, where the two halves are joined together. (Large wings are sometimes left permanently in two halves which are pushed together for flying by means of a couple of pegs or dowels of hard wood. Building in these dowels accurately is rather a tricky job for a beginner, so even if your present plan recommends them, I would suggest that you leave them out and build the wing in one piece). The plan will state that your wing is to have a certain " tip dihedral "; we will say it is 3 ins. This means that when the finished wing is placed evenly on a flat surface, there should be a drop of 3 ins. from each wing tip to the ground. Now, if you push one half of the wing down flat, the other wing tip will lift to a height of SIX inches, from the ground. Got it ? Then here we are with the two halves of the wing ready to be joined. Pin one of them down flat on to the workboard. Place the other half against it at the centre, and use a small box or block of wood to lift the tip of this half up to a height of exactly six inches—measure it. Now put plenty of cement in the centre joint where the two halves meet; press them together, and hold them *absolutely rigid* for thirty seconds or a minute until the cement has started to set. Leave them alone for a few more minutes, and then add some good strong gussets.

Tailplane and Fin.

The tailplane is constructed in just the same way as the wing, but it is smaller and simpler, and so will not take nearly so long. Cut out all the ribs and do what chamfering you can before pinning down.

It is not usually advisable to pin down the fin when cementing it together, and in any case this would often be quite difficult and call for a lot of packing, since the fin ribs are generally curved on both sides. If it has to be cemented permanently onto the fuselage, and so cannot be adjusted from side to side to direct the plane when in flight, then it is a good idea to add a " trim tab " One way of doing this is to push a small piece of thin sheet tin into the T.E. of the fin with a line of cement along the joint. But do not add your trim tab until the model has been built and covered and is ready for the air. The method of mounting the fin and tailplane varies with different designs, so study your plan carefully on this point.

Final Sanding.

All that remains now is to go over the entire model, fuselage, wing and tail units, with a piece of fine sandpaper, in order to smooth off any little inaccuracies and remove any sharp blobs of hard cement that may be sticking up here and there. This will make for easier covering, and will give a smoother finish to the appearance of the model.

And now we really have finished with most of the difficulties. Next month I hope to show you that covering a plane is one of the easiest parts of modelling.


Bernie Aurand of San Mateo, California, with his 65" span, Drone-powered original design. All-up weight is 4 lbs.

AMERICAN NEWS LETTER

Bill Winter

LAST October, rules, questionnaires, based on questions from builders, the advisory committees, and the Nationals, were sent out to Contest Board Members, A.M.A. clubs, and others. According to Walt Good, Chairman, Contest Board, the more than 2,000 opinions registered provide an excellent sampling. Anti-climatic, but exciting none the less, is the recognition of " 1/2 A " in free flight, an event for engines of from ·000 to ·050 cubic inch displacement.

With the addition of this new class the number of classes remain unchanged, the old Class D, or Frankenstein class, being combined with C. The set-up for 1950, then, is Class ½ A—·000 to ·050; Class A—·051 to ·200; Class B—·201 to ·300; Class C—·301 to ·650. Fliers have a choice of a 15-second engine run if the ship is hand launched, or a 20-second run if r.o.g. If r.o.g. motor runs are reduced at a contest, the hand launch run must be five seconds less. In either case, a landing gear is required.

In the speed field, any method of launching is permitted and there will be a standard wire diameter for each class, sizes yet to be announced. Don't read that too quickly; note that " any method " of launching. Control-line novelty stunt is suspended for lack of interest. Team racing rules still are not complete.

For indoor rubber, outdoor rubber, and tow-line glider, rules are altered to agree with free flight gas on number of flights, attempts, etc., Six attempts are allowed for three official flights, with delayed and voided flights counting as attempts with no time recorded. Outdoor glider men will be permitted three gliders, rather than one as in 1949.

Bill Tyler, indoor man from way back and art editor of Air Trails, states it is pretty bad when a man can do 30 minutes indoors and all the columns ignore the fact. Bill, like the rest of the balding indoor sharpies, has been gunning for 30 minutes for so long that the achievement ranks with the explosion of the first atomic bomb. Last August 14, at the blimp hangar in Lakehurst, N.J., Pete Andrews did 32 : 19·8 in Class C Open HL Stick. Then, on September 25 at the same hangar, Bill also broke the half-hour mark with 30 : 37·2 in Class D Open HL Stick.

It was Pete Andrews, you may recall, who pioneered and developed the modern method of building up a microfilm covered prop with the proper pitch from hub to tip. This prop was so much lighter that it made possible further savings in weight throughout the rest of the ship. This is why indoor times have been jumping for the past two years. Bill Tyler's designs are unique in that they feature a Manta-type wing with its extremely wide centre-section chord with severe sweep to the point where the normal leading edge is intersected. According to Bill, this gives excellent control over the stall. When we asked him what next, after that 30-minute mark, he said " Forty minutes ! "

We were more than amazed to find that 141 National Records have been recognized. Counting junior, senior, and open in every event and class, there actually are close to 150 record possibilities. The roster is full of surprises. For example, the jet record is only 145·16 miles an hour, held in Open by W. Harold Bunting, Greensboro, N.C. In free flight gas there are two perfect records (three ten-minute times), one by Russell Hiatt (who flew a Folk Climax, we believe), in B Open, Taft, California; and the other by Dennis Davis in C Open, San Diego, California. Indoor records, despite the present record flurry, prove durable, with numerous times listed from as far back as 1940. We count 20 records from 1940–1941 ! In all, 45 records are listed for the slow motion fliers.

Word comes from California of novel trends in rubber. On a recent occasion a qualified modeller timed motor runs. The great majority of the ships were using runs of 30 seconds and less. These models climbed rapidly to a great height then depended on thermals. One-bladed free-wheelers were the vogue, with non-tensioned motors. If we didn't know this correspondent we'd say someone was pulling our leg. But such models are said to be seeing serious duty in the hands of well-known coast fliers. California, of course, is " big thermal" country.

Seeing that the AEROMODELLER carries no American ads we can give you the low down (ssshhh!) on the popularity of some of our products as reported from the field. Here's a typical sampling from a south-eastern area.

" Speed models in well known rut. All seem conventional with cowl openings on inside of circle and outlets on other side. Vee tail, one elevator, is the mainstay. Aluminium and magnesium gaining in popularity for motor mounts. Hell-Razor bottoms very popular. (Hell Razor bottoms are advertised as used on Fong's 159 m.p.h. D Class record holder.) Prop hand-carved or re-carved. Stock props mostly Tornadoes. Dooling 61 and 29 (the latter newly on market) are best sellers. Bantam and McCoy in A, McCoy 29 in B, McCoy 49 in C, Dooling and Hornet in D. Roughest finishes are seen on jets. Stunt design trending toward original, with Lil Duper Zilch, Warrior, Flying Clown the most used (Flying Clown six out of ten). Stunt rib most used is NACA 0009. Glow plug rules the day in both speed and stunt. Baby Spitfire is most popular engine, Ohlsson 29 second, Torpedo 29 close after, Forster 29, Ohlsson 23 RV, all more or less of a toss up. OK Cubs in both ·74 and ·09 becoming very popular.

" In free flight everything centers currently about Half A, but Class B still retains an edge. Class C and D definitely out. Ignition rules in free flight but glow plugs surely creeping in. Favorite props run about 11–6. Some kits, but mostly originals. Torpedo and Ohlsson 29 very popular, as is the 23, the Forsters, with Triumphs and Anderson Spitfires okay in D (now combined with C). Super Cyclones and Ohlsson 60's still going. Bantam and Ohlsson 19 in A. Atwood Champions from pre-war still going like mad."

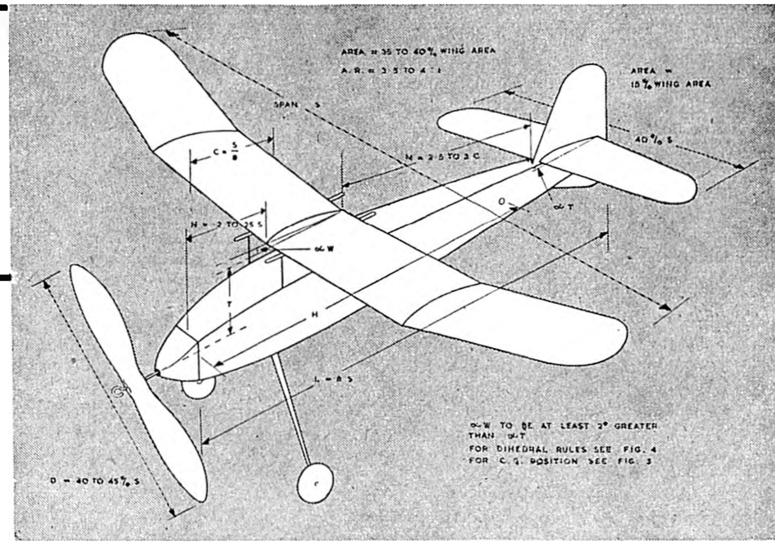
About a year ago we tried the NACA 4612 airfoil on a Wakefield (the Eureka) and had excellent results, especially on the glide. The same section also gave good results on the Gamecock gas model prepared especially for the AEROMODELLER. As with a new medicine it takes a long time to confirm the value of an airfoil for modelling work. From the north-west several people have advised us that a stand-out Wakefield was being flown by Charles Wood. From Wood it is learned that the model is one of a series and, after ordinary results with an RAF 32, the 4612 was substituted. In wet, foggy weather with an unbraided motor, Wood had done 3 : 33. The next model in the series was 30 seconds better. Wood thinks the NACA 4612 the greatest section for Wakefields yet developed. But in Wood's part of the country the boys doubt that any Wakefield can do more than four minutes in dead air. The probable explanation is that the long motor-run model would be blown away too low on the horizon many a typical contest day, so the emphasis remains on getting high as quickly as possible.

Flash : The 1950 Nationals will be held at Dallas, Texas, on the Naval Air Station. Indoor events probably will be held at nearby Fort Worth. Probable date is July 24. Sponsors are the Navy and the local and National Exchange Clubs, a civic organization. Exchange always has supported model aviation and sponsored a 1939 Nationals in Detroit.

It's designed for you!

Number One **Part Two**

RUBBER MODELS



THE propeller, of course, will have a very considerable effect on the efficiency of the power flight, and, here again, we have many problems to face. Obviously, from any given amount of rubber we can only get so much energy. That is to say, if we have a motor weighing 3 ounces we shall, broadly speaking, get the same amount of energy out of that motor if we use a large number of strands of a short, powerful thrust, as with a smaller number of strands and a longer, moderate thrust. In terms of performance, with identical propeller efficiencies, we get the same amount of altitude!

Actually, of course, this is not quite true, otherwise the obvious solution would be to use any given motor *weight* in the minimum number of strands so as to get increased overall flight duration by increasing the power-on duration. The danger in working at the lower end of the power output range (i.e. minimum number of strands), is that the power available is marginal. The slightest difference (tiring rubber, or poor weather conditions) may kill the climb completely. And there is also the fact that the fast revving propeller is working at a different figure of efficiency to its slow revving counterpart.

Broadly speaking, the more rubber we can use, the better the performance, although there are practical limits again. Adding more rubber means adding more weight, so the result may be better climb but faster glide and possibly *decreased* overall performance. A figure of about 50 per cent. of the total weight for (rubber) motor weight, is about the maximum possible and it is usual to work to a much lower figure. Alternatively, a motor weight of less than one third of the total weight of the model gives relatively poor results. (See p. 151.)

Now, with this proportion of rubber, experience has shown us that the propeller diameter should be roughly 40 to 45 per cent. of the wing span, and nothing much less will give *consistent* "duration" results up to modern contest standard. The greater the proportion of rubber, the greater the required propeller diameter, so that a 50 per cent. motor weight could well handle a 50 per cent. span propeller, this, surprisingly enough, holds true. The percentage figure for motor weight gives an equivalent percentage figure for prop diameter (expressed as a proportion of the wing span for average A.R.)

The remaining leading propeller factor, the pitch, is then closely allied to the rest of the design. Large diameter propellers are a source of considerable drag, once the power has run out, even when made to freewheel, and so it is common practice on duration rubber models to use a folding prop. This, properly done, must benefit the glide and so there is a natural tendency to emphasise this point. To take advantage of good glide characteristics, maximum altitude is aimed at by using a powerful motor and relatively fine propeller pitch.

Selection of pitch for this type of flying generally lies between 1·0 and 1·3 times the diameter. Also most successful models of this type utilise parasol wing mounting. This layout seems better suited to handling the C.G. shift when the propeller does fold, so that the model can be initially trimmed for a very good glide and still retain an efficient trim under power. If trimmed first for glide, with the prop. unfolded (i.e. on the power run) the C.G. will have moved forward slightly making the model nose heavy and it is a noticeable characteristic of some models of this type that they tend to nose down slightly towards the end of the power run until the prop does fold and restore proper glide trim.

Those modellers who still prefer the freewheeling type of propeller can claim advantages for this system in that it is less critical and does give greater overall efficiency on the climb. But is it most necessary to start with a relatively high pitch, for anything less than 1·3 times the diameter will have a very considerable braking effect when freewheeling and ruin the glide. Average pitch figures run from 1·3× diameter, up to 1·75× diameter, with 1·5× diameter as a good design average.

This modifies the type of climb and gives most efficient results with moderate power extended over a much longer

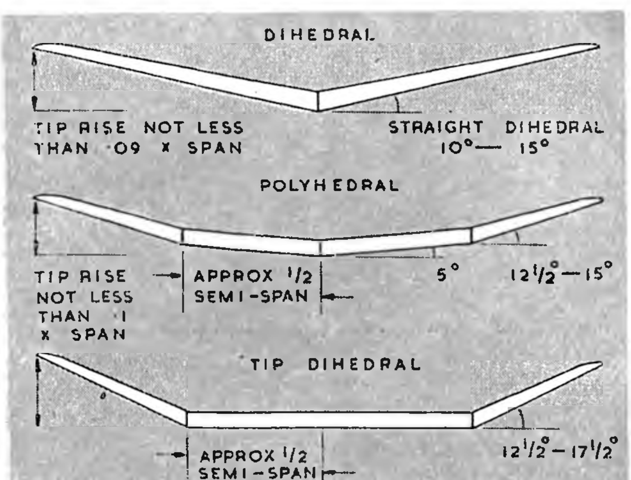


FIG. 4

TABLE II PROP. BLOCK DIMENSIONS

		Length = Diameter	Width	Depth
(1)	Lightweight	12	1¾	1¼
	Heavyweight	12	1⅞	1⅜
(2)	Lightweight	14	2	1¼
	Heavyweight	14	1¾	1⅜
(3)	Lightweight	17	2¼	1⅜
	Heavyweight	17	2	1¼
(4)	Lightweight	20	2⅜	1⅝
	Heavyweight	20	2¼	1½

time than the other system. Properly adjusted, although the initial rate of climb may be lower, it should be possible to reach a greater height, eventually, under power, with the advantage of added power duration. The over-all (still-air) flight time will be higher if the glide can be trimmed out to take advantage of these two points, but it generally needs an expert to do this.

This controversial point is also subject to argument, in that contest flying is generally carried out where thermals are the rule, rather than the exception, and the fast-climbing, folding prop. machine, reaching thermal height quickly and then having a superior glide, is likely to score. Only in perfectly calm conditions is the other type of model likely to have the advantage, although the experts who stick to this system will claim that this type has, at least an equal chance of catching a thermal as the other type, with the additional safeguard of a reasonably high duration in poor conditions. Proportioning the model from these basic criteria is then relatively simple, for one has only to fit in shapes within the required figures, keeping to averages for aspect ratios and fin areas.

Aspect ratio is not a critical factor on rubber models. What may be gained by higher aspect ratios is more than lost through the reduced aerodynamic efficiency of smaller chords, and the reduced strength weight factor. A high aspect ratio wing is either weaker for the same weight, or heavier for the same strength, as a lower aspect ratio wing of the same area. A figure of 8 : 1 is a very satisfactory choice, although some of the smaller lightweight models go down to 6 : 1. A higher figure of 10 : 1 is generally associated with shoulder wing models where the fuselage "artificially" increases the span. Tailplane aspect ratio is lower again, mainly for reasons of structural economy, with 3·5 to 4 a very good compromise.

As regards plan form, there is, virtually, no need to depart from a rectangular wing, except on shoulder wing models. In the latter case, quite apart from appearance, a moderately tapered wing can give the benefits of increased aspect ratio without the drawbacks noted above. But for all other cases, parallel chord with rounded tips is quite satisfactory. Wing tips should always be rounded or elliptic, for the wings are operating at a fairly high angle of attack, as mentioned previously, and squared tips under such conditions tend to have high drag. The tailplane, however is operating at a lower angle of attack and blunt tips have little ill effect.

Dihedral is another factor which is not too critical. In fact, the general rule here is, *use whatever form of dihedral you prefer as long as you have enough of it.* It is far better to have too much rather than too little.

For straight dihedralled wings, the minimum figure for adequate stability is 10 degrees, and you can increase this to 15 degrees with no appreciable effect on the efficiency of the wings again contrary to popular belief.

When handling designs intended for more powerful motors, i.e., fast climbing types, polyhedral is preferable—this in two breaks in each wing half rather than a straight centre section with tip dihedral, Fig. 4. These breaks should occur, roughly, half way along the semi-span. In terms of weight, dihedral joints are expensive and should be avoided, where possible, which is about the only justification for a tip-dihedralled wing as this eliminates the centre break.

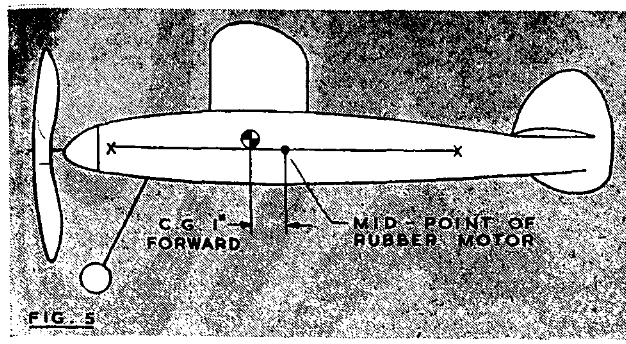


FIG. 5

The fin is still, unfortunately, a subject which is indeterminate, yet the whole spiral characteristics of the model hinge on its area and location. Unlike power duration models, it is better to have too big a fin than too small a fin and a minimum figure of 15 per cent. of the wing area is suggested. It should be disposed about the fuselage centre line with, at least, one-third of its area below and its uppermost point should never come above the tip of the wings. These simple practical generalisations are drawn from conclusions based on previous articles and experiments on *spiral stability* and should ensure a reasonable degree of success on any projected rubber model design. Should spiral instability troubles still appear, during test flying, then anti-spin fins should be used on the tailplane as an almost certain cure. Many otherwise unstable models have been rendered perfectly stable by this method and they are now often included on the original design.

Centre of gravity position, the other major factor not covered in the specification and analysis, is shown in the form of a simple solution in Fig. 5. Whilst most models are designed to have a certain amount of fore-and-aft movement of the wings, for final adjustment, it is always necessary to estimate the final C.G. position, if only to determine the wing mount position. In the case of a fixed shoulder-wing design, of course, it is necessary to be reasonably sure of the wing position, otherwise one may have to add unwanted weight, in the form of ballast, to trim the model.

The rubber motor is the greatest single factor affecting the final C.G. position. This accounts for up to 50 per cent. of the total weight and is strung throughout the length of the fuselage and it is found, as a general rule, that on models of Wakefield proportions, the final C.G. comes out about one inch in front of the *centre of the rubber motor*. This means that you can adjust "N" and "H" as necessary to get the wings in the right place, once having settled on the C.G. position required. Other models of different specifications to the Wakefield can be adjusted proportionally, according to size, although the proportions given in the general specification and tables will be found to hold true in the majority of cases. This C.G. check is a final step which can be applied after the design has been laid out and before building it.

TABLE III. CONSTRUCTIONAL DATA

Model	WINGS						FUSELAGE			TAILPLANE		UNDERCARRIAGE	
	Type	L.E.	Spars	T.E.	Ribs	Covering	Longerons	Spacers	Covering	Type	Spar(s)	Material	Wheel dia.
(1) 100 sq. in.	Sparless	1/8×1/4	—	3/8×3/32	1/32	Tissue	1/16 sq.	1/16 sq.	Tissue	Sparless	—	18g wire	1¼"
	Monospar	3/32 sq.	1/4×1/16	1/4×1/16									
(2) 150 sq. in.	Sparless	1/8×3/8	—	3/8×1/16	1/32	Tissue	3/32 sq.	3/32 sq. or 3/32×1/16	Tissue	Sparless	—	16g wire	1¼"–1½"
	Monospar	3/16 sq.	3/8×3/32	1/2×1/8						Monospar	1/4×1/16		
	Multi-spar	1/8 sq.	1/16 sq.	1/4×3/32									
(3) 200 sq. in.	Monospar	3/16 sq.	1/2×3/32	1/2×1/8	1/32 or 1/24	Tissue or sheet L.E.	1/8 sq.	1/8 sq. or 1/8×3/32	Tissue	Monospar	3/8×1/16	1/16×3/32 Bamboo or 16g wire	1½"–2"
	Two-spar	1/8 sq.	1/2×1/16	1/2×1/8						Multi-spar	1/16 sq.		
	Multi-spar	1/8 sq.	1/16 sq.	3/8×1/8									
(4) 300 sq. in	Monospar	3/16 sq.	1/2×1/8	3/4×1/16	1/24	Tissue or sheet L.E.	5/32 sq. or 3/16 sq.	5/32 sq. or 3/16×1/8	Double tissue or silk-span	Monospar	1/2×3/32	1/4×1/8 Bamboo or 14g wire	2"–2½"
	Two-spar	3/16 sq.	1/2×1/8 / 3/8×3/32	5/8×1/16						Multi-spar	1/16 sq.		

RADIO CONTROL NOTES

by **HOWARD BOYS**

Guy Raemackers of Belgium (left) using an interesting small transmitter and dipole aerial. Length of aerial suggests a frequency of 60 or 70 m/s and aerial lead appears to be a "resonant line".

QUERIES have been received regarding aerial lengths; here is a typical one. " I cannot accommodate an aerial 50 inches long. Is such a length necessary, and if so can it be bent into a U shape, or in what other way can the difficulty be overcome ? " The simple answer is that it is possible to use short aerials quite successfully. It is generally best to use an aerial a definite fraction of a wavelength long, but when it comes to 1/8 or less there seems to be no advantage gained, 50 inches is around the 1/8 wavelength, but let us look into this wavelength business, which is also tied up with frequency. The frequency allowed for model control is between 26·96 and 27·28 megacycles per second. There is another frequency allowed of 464 to 465 m/s but this is best left to the real radio man at present.

If a stone is dropped into a pond or lake it sends out waves, and the wavelength is the distance from the top of one wave to the top of the next. See Fig. 1. A radio transmitter sends out waves in the same way, and the wavelength is measured in metres. The frequency is the rate at which the waves are sent out and is measured in cycles per second, one cycle being from zero to the top of one wave, down to the bottom and up to the zero line again, see Fig. 1. 27 megacycles is 27,000,000 cycles, which means that a radio control transmitter sends out 27 million complete waves every second. These waves travel at a speed of 186,000 miles or 300,000,000 metres per second. So if 27 million waves per second go 300 million metres per second, the length of each wave is 300 divided by 27 which equals about 11 metres. (The actual wavelength for model control works out at between 11·127 and 10·997 metres). If the aerial was made 11 metres long it would just hold one complete wave at any instant. A half, or even a quarter wave aerial will tune to the wavelength, but a 1/8 does not seem to do so. In the case of a full wave aerial, the wave standing in the aerial at a given instant will have no current at the end, the current rising to a maximum positive at the ¼ point, going down to zero at the ½, then going to maximum negative at the ¾, and zero again at the end. See Fig. 2. The instantaneous current in the half and quarter wave aerials will also be as shown in Fig. 2. The actual length of a quarter wave aerial will be about 8 ft. 6 ins., or a little less than a quarter wave in space; this is due to what is called " end effects ". An aerial of this length on a receiver would give excellent results, but is rather long for a model aeroplane. For any length less than a quarter wave it seems best to use the longest aerial that can be conveniently fitted. Professional radio engineers generally agree that it is best to keep the aerial straight, as bends cut down the radiation (or pick up). The writer, however, noticed that pulling a curly, flexible aerial out straight, did not seem to make much difference with a Cossor receiver, though the actual length of wire did.

A standard Mercury Cossor receiver was tried with different lengths of aerial and different signal strengths, one signal strong enough to give maximum current drop, the other rather weaker to give the effect of greater range. The results are given in Table A. A 52-inch long aerial gave the idling current as stated on the test ticket attached to the receiver, and it had been noted that folding a few inches back on itself made no difference to the idling current, whereas cutting it short did. The 52 inch aerial was then folded double loosely, without making any apparent difference to the current or the current drop. The aerial was folded again, giving four strands about 13 inches long, still with practically no alteration to the current. Actually the current drop in this case was about 5% less. It seems from this that a long aerial folded up can be very effective, the folding being arranged in an open manner as if fastened to four fuselage longerons, as in Fig. 3a. Next an aerial of 63 inches was tried, using a weak signal. It was cut short in steps of 3 inches, and the current readings are giving in Table B. From this it seems that the only real difference between a 30-inch aerial, and a 60-inch aerial is small difference in the current flowing. The actual current change, which is what really matters for sensitivity and range, is not altered. If an adjustable contact is fitted on the Cossor relay, as described in the December 1949 AEROMODELLER, best use can be made of these shorter aerials. A 63-inch aerial was then wound into a 1-inch diameter spiral and gradually stretched out to see what could be done with a long wire in a

TABLE A
Strong Signal

Anode Current Idling	Anode Current with Signal	Aerial	Current Drop
3	1·75	52" Open	1·25
3	1·75	52" Doubled to 26"	1·25
2·9	1·8	52" Quadrupled Tightly	1·1
2·85	1·75	Ends connected together	1·1
2·95	1·8	52" Quadrupled and spaced 1½"	1·15

TABLE B
Weak Signal

Anode Current		Aerial Length	Current Drop
Idling	With Signal		
2·95	2·45	63"	·5
2·9	2·45	60"	·45
2·9	2·4	57"	·5
2·9	2·4	54"	·5
2·9	2·4	51"	·5
2·9	2·4	48"	·5
2·9	2·4	45"	·5
2·9	2·35	42"	·55
2·9	2·35	39"	·55
2·87	2·32	36"	·55
2·85	2·3	33"	·55
2·85	2·3	30"	·55

short space. The long wire was used to raise the current to suit the fixed setting of the standard Cossor relay, and these results are given in Table C, the spiral aerial being shown in Fig. 3b. The fact that the idling current does not rise above 2·9 ma. is most likely due to battery voltage having got a bit low. It is interesting to note from this, that there is no change in results between 24 inches and 42 inches, so that a long aerial can be used to pull the idling current up to the required value, and the aerial coiled or folded to get it inside the fuselage. If it is coiled, it would be best to support it on a balsa rod and fasten it at intervals, so that it would not get stretched or bent due to landing shocks. Lots of other experiments have been carried out at different times with different aerials on the Cossor receiver, and there seems a slight tendency for aerials of 28 inches to 30 inches long to give best results, though the idling current is a little less than that specified by the makers. It is still enough, however, to enable the receiver to be used without altering the relay setting.

The reason for the results obtainable with a quarter wave aerial is because it will "resonate" or tune itself. If the aerial will tune itself, it will give a stronger signal at the receiver end. Suppose you hang a weight on a rubber band; it will bounce up and down, or oscillate, at a certain speed according to the weight and the length of the rubber. The longer the rubber the slower the speed of oscillation. You can keep it bouncing up and down by gently tapping it underneath at the right speed. If this tapping underneath is done with a wave, as in Fig. 4, only one wavelength, or frequency, will suit the weight and rubber. If the frequency of the wave is fixed, the length of the rubber band can be adjusted, until the weight will bounce up and down "in tune" with the waves. When this happens the two are said to "resonate". A radio control receiver has to be tuned to resonate with the transmitter, and if the aerial itself is also tuned to resonance, it will provide bigger voltage kicks to the receiver. A quarter wave "resonant" aerial has not, so far, been tried on a receiver, as it would be too long to use on any normal model. Experiments have been confined to the sort of lengths that can be used.

With transmitters it is a simple matter to use an aerial of resonant length. It is usual to fit a quarter wave single pole vertically, which will give good results. The transmitter aerial should be lengthened or shortened to give the greatest current change with the receiver at a distance.

Connected with this subject of wavelength and frequency is also that of interference. One correspondent suggested that Radio Sonde might be causing interference with model control. This has, consequently, been investigated, but the power used is so low that interference from that source is most unlikely, even with a super-sensitive receiver at close range. What is more likely is, that a model control transmitter might easily

TABLE C
Weak Signal

Idling Current	Current with Signal	Coil Stretched To	Current Drop
2·7	2·1	4"	·5
2·8	2·3	12"	·5
2·85	2·35	16"	·5
2·9	2·4	24"	·5
2·9	2·4	24"	·5
2·9	2·4	30"	·5
2·9	2·4	36"	·5
2·9	2·4	42"	·5

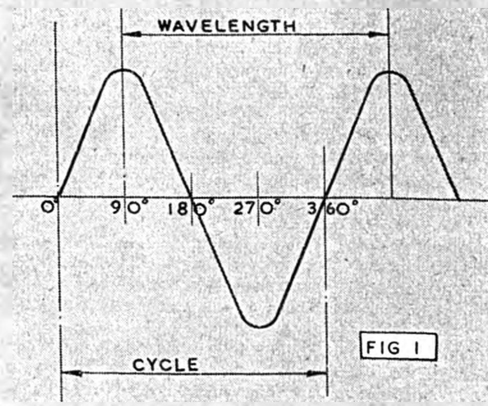


FIG 1

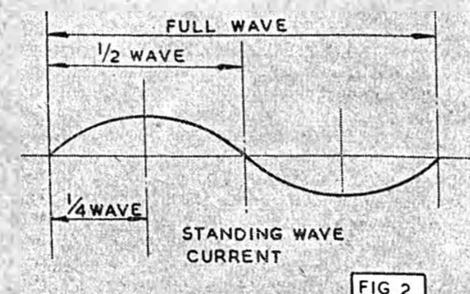


FIG 2

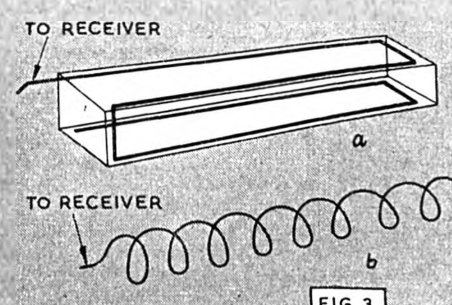


FIG 3

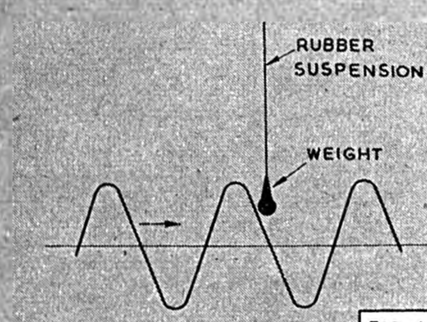


FIG 4

go slightly off the allotted frequency and interfere with Radio Sonde.

It is essential that model control transmitters be kept within the allotted frequency, otherwise there is the danger that the use of radio for this purpose will be banned. Some means of frequently checking model control transmitters is needed.

There is another source of possible interference with model control which might be found in certain districts ; there are some transmitters about, over which the authorities maintain secrecy. One is believed to be about 10 miles from the writer and it can be tuned in on the Cossor receiver and gives a current drop of ·3 m.a. It can also be heard on phones and seems to cover a fairly wide band. The current drop is continuous so the station is easily identified, but it was puzzling at first, but, providing the model control frequency is adhered to, there seems no danger of trouble.

With home constructed radio equipment, the item which seems to frighten the builders most is the relay. These are sometimes available from government surplus stores, but the modeller does not always know just the sort of thing to look for. Some cheap ones, although not ideal can be adapted, so let us see what is wanted.

Generally, the relay coil should have about 10,000 to 15,000 turns of wire of about 44 to 48 gauge, and the resistance be about 5,000 ohms. If the current flowing through the relay in the receiver is about 2 milliamps the coil could have about 7,000 turns, and if it was 44 gauge wire the resistance would be about 1,000 ohms, and the size about ¾ inch diameter and ¾ inch long. The weight would be about 2 ounces, for the whole relay. If the current flowing is only 1 milliamp the relay coil will need about the 15,000 turns, and the resistance can be higher, up to 8,000 or 10,000 ohms. If you should come across a relay of a little less than one ounce weight, the resistance would need to be 5,000 to 10,000 ohms. One firm is, in fact, making such a relay for model control receivers. If you should obtain a relay with a resistance of more than 4,000 ohms and a weight of three ounces or more, the weight can be reduced, quite a bit, by unwinding the coil, and in some cases mounting bases can be removed. The best type of relay for model aircraft purposes will have the armature inertia balanced. That is, the weight of the armature each side of the pivot point will be equal, so that it will balance on a knife edge. In this way, shaking the relay up and down will not open and close the contacts. The writer, not having discovered a suitable relay at a suitable price, constructed his own, and the design is shown in Fig. 5, with all the parts dimentioned. The coil was wound by The L.S. Repair Service, of 49, Trinity Rd., Upper Tooting, S.W.1, the cost of this, including postage, was eight shillings. The soft iron for the frame was cut from a relay that proved too big and heavy for model use. The proper type of soft iron must be used for good results and it is worth while paying half a crown for the right type of relay to scrap. The one used was of American manufacture, weighed 11 ounces and had a resistance of 12,000 ohms. The home-made relay has been adjusted to pull on at decimal 3 milliamps, and drop off at decimal two five milliamps. This is better than is needed, and is a good feature.

The bobbin is made from plastic with fabric reinforcing such as " Tufnol ", but could be made from paper and card. It is wound full of No. 48 enamelled copper wire, which will amount to about 20,000 turns and a resistance of 8,000 ohms. For a receiver taking 3 milliamps it could be reduced to 12,000 to 15,000 turns. The core is made from soft iron as previously mentioned, and it is important to file the top flat and smooth with a very fine file, leaving it polished. The armature must be made from similar soft iron, and filed flat and smooth where it fits on the core. The bracket is made from 20 s.w.g. aluminium, and the contact bar, from grey fibre, though any good rigid insulator would do. The spring is made of 15 turns of spring steel wire of 33 s.w.g. Its tension can be adjusted a little by bending the solder tag to which it is fixed. The solder tags are 24 s.w.g. brass. The adjusting screw that forms the contact should have some sort of contact material soldered to it, and similar material should be solderd to the armature to match up with it. This material might well be taken from the contacts of a scrap relay. When assembled and adjusted, it is best to solder the spring to the solder tag and armature. The leads to escapement and battery are taken from the two solder tags.

A larger relay could be made on the same lines, using a larger bobbin wound with thicker wire, and the rest of the parts made to suit.

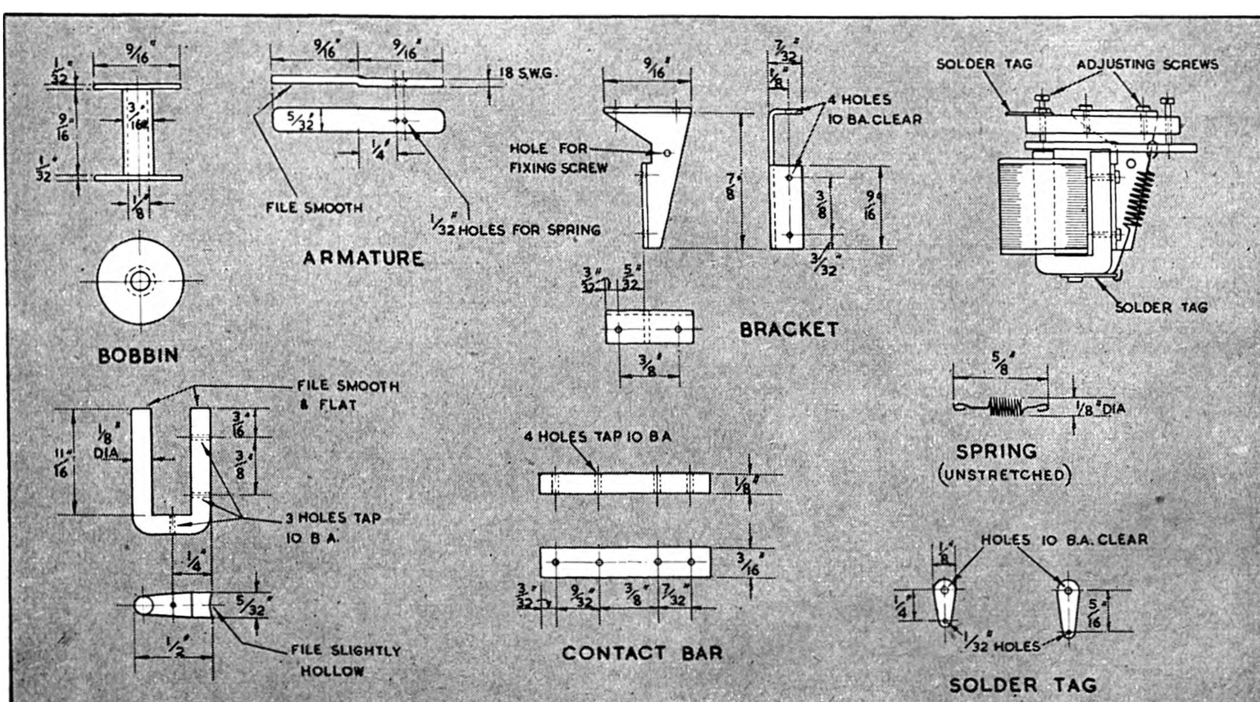


FIG. 5

NEW ZEALAND NEWS

FROM FRANK BETHWAITE

The Author, holding his profile fuselage sailplane.

As our Nationals approach, modellers from up and down New Zealand are tuning their ships and preparing for the trek to the northern city of Hamilton, whose club is sponsoring this year's event. Facilities offered contestants are inclusive accommodation and workshop, etc., together with the use of the local Aerodrome for Free-flight and C.L. speed, a sportsground for Aerobatic and prototype contests, and a very large, open exhibition building for indoor free-flight and tethered flight.

New Zealand is a long country, and the distances to be travelled make impossible local meetings of national importance such as Northern Heights, and St. Albans Rallies. Therefore, the annual Nationals here is usually a five or six day meeting, with contests for all major classes. Trophies and awards are given to all class winners, class group winners, (gas free-flight, rubber, C.L. etc.) and inevitably, to a Senior and Junior National Champion of Champions. An interesting rule-change this year requires that the Champion of Champions shall be decided on points from only five, " star " classes, and not as previously awarded from the whole nineteen events. This decision is in line with the New Zealand Model Aeronautical Association's policy of fostering quality, and not just numbers, at the Nationals.

The Star Classes are :—

1. (Rubber) Wakefield.
2. (Gas Free-Flight) Class A, 20 sec. motor run, R.O.G., best duration of 3 attempts.
3. (Glider) Towline Sailplane, 100 ft. line, 3 ozs./100 sq. in. wing loading, best duration of 3 attempts.
4. (Control Line) Aerobatic. (Speed is considered too expensive to be of universal application).
5. (Indoors) Tethered, " Round-the-pole ", Class B, 3 ft. 6 in. pole, 12 ft. line, best duration of 3 attempts. (Not all clubs have facilities for unrestricted free-flight indoors).

From the foregoing it may be rightly presumed that the average New Zealand modeller is an all-rounder ; this is mainly true. Control line has, for some years past, been popular in the windy winter months—also indoor work. In summer we fly outdoor ships, more heavily loaded and more sturdily built, than the usual English model (Yes, wind again). Our records are, on the average lower, because even a large model has usually drifted out of sight after 15–20 minutes.

It is of interest to note that the semi-scale " prototype " C.L. class is coming into its own, together with pure stunt and speed. Rules formulated this year define it as :—

A scale model of a known aircraft, or an original design representing present day full-scale practice. Strict accuracy of scale will not be necessary, but points will be given for details, ingenuity in adaption, construction and finish and airworthiness. Points will be awarded for :—

(a) Construction, 20; (b) Finish, 15; (c) Originality and Design 15; (d) Take off 20; (e) Landing 10; (f) Attitude in air 20 (Steady flight etc.).

Another class of interest, if only because it is peculiar to New Zealand, is our " Aggregate " class. This began as an Auckland club stunt, but rapidly became so popular, and developed such a healthy type of model (and contestant), that it was soon written into the N.Z. Association rules as an official class. Briefly, the idea is to get as much time into a two hours period as is possible with a power model. It works this way :—A two hour period is allocated during the day by the contest directors. At the commencement, every contestant starts up and begins flying. Nothing under 30 seconds is counted, and everything over 3 minutes is counted as 3 minutes only. Come rain, snow, gale, or just bright sunshine, the contest goes on until, two hours later, the deadline is reached and nothing further is counted. All times are then added up, and the competitor with the greatest total wins.

At first reading, this may be visualized as just a wild scramble. But in practice it is astounding how few ships will stand two hours of continuous starting, flying, and landing, without giving trouble of sorts. Also, of course, the man who can control his ship with precision enough to make it gain headway against the wind drift, and then land back near him, stands an enormous advantage over the uncontrolled free-flighter who must chase his ship and bring it back to the launching point.

Starting must be reliable, not just once, but dozens of times. Wing and tail fixings must be rigid during periods of continuous starting and flying, yet be able to give an occasional rough landing without damage. Quick repairs pay off. The whole contest is two hours of real fun, and has proved a valuable shot in the arm to free-flight —not that free-flight had ever really lagged. The present N.Z. record, is 45 mins. 0·2/5 seconds. Think you could beat it ?

D. Oliver of Tauranga, left, carving a prop. on the electric sander. What a time saver! Boxcar type Stunt C/L job nearby. "Wangajag" Wakefield design, right, just released by designer B. J. Reid, Secretary Wanganui M.A.C. Could be of Jaguar descent!

SPIRAL STABILITY

by
B · U · HAISMAN
seen here with his 1949 Wakefield Model.

THERE is still little agreement on the subject of spiral stability: one which has caused more inconclusive written and verbal conflict than any other aspect of model aircraft performance. Many theories have been put forward dealing with cause and effect, but there have not been so many with obvious and practical applications. It now appears that modellers are more or less content to regard the problem as one which is ever with us, in spite of the frequency with which one sees models plummeting earthward in sickening spirals. Nine times out of ten it happens under power, so the damage is usually far beyond the healing powers of a tube of cement. While being very good for trade, this state of affairs does not tend to give us more inherently stable aircraft.

The purpose of this treatise is to trace the development of the problem, to briefly state the most plausible theories and practical remedies and to estimate their value in the light of contemporary knowledge. It should at least provide the garrulous section of the modelling community with some better excuses than " wrong propellers ", " rubber with too much torque in it ", " downdraught ", and, if it's a kit model, " poor design ", etc. If only such people would apply the ingenuity with which they excuse themselves to designing and building better models!

Spiral instability first became a real menace in the mid-thirties, when the Americans began to equip their models for high climb, though Charles Grant had in some measure anticipated the problem. His theory of correct placement of side areas, i.e., the C.L.A. behind and slightly below the C.G. was incorporated in his K.G., a lumbering 10 ft. span petrol model with several flights of over an hour to its credit, and whose stable flying qualities ably supported the theory. The K.G., however, was a relatively slow-flying model, and there is no knowing how it would have reacted with a high power/weight ratio.

The fast spiral climb technique was first applied to rubber models. Larger dihedral angles gave more lateral stability, which together with anti torque thrust settings, raised a model's chances of survival. Yet there was no positive method of arriving at good stability via design.

Frank Zaic dealt at length with the subject in his 1938 Year Book. His involved argument can be boiled down to the advocacy of generous dihedral as a means of reducing rudder and offset sensitivity; he did not believe that a normal model, with right rudder and right offset, can be so designed as to counteract the unstable forces in operation during a steep right bank, without incurring a big loss in overall efficiency.

With the advent of the twenty-second motor run, power models, which were formerly docile, began to show vicious tendencies. Gaining maximum altitude in twenty seconds became everyone's métier. Flying speeds increased, and it was soon obvious that the old design pattern was obsolete as far as duration flying was concerned, because it had not that essential reserve of stability. Then in 1938, as the result of a bet that he could not produce a four foot model capable of handling a ¼ h.p. motor, Carl Goldberg developed the ubiquitous Zipper—and won the bet. Although the machine tends to spin in when throttled back it is still reproduced and copied all over the world. The majority of power kits ought, in justice, to bear Goldberg's name.

The theory behind the Zipper was a fallible one. Such phrases as " riding on the pylon in steep banks " and " the air pushes against the pylon in skids " clang horribly to-day, though occasionally one still hears arguments based on the idea that the airflow conveniently affects only that part of the model under consideration. It is most important that the aircraft be considered as a *whole*.

Goldberg recently rose in defence of his pylon jobs, whose layout (said the theoretical experts) broke the laws of stable design, and said that maximum spiral stability was achieved by combining great lateral stability with the smallest rudder: a statement which seems to be well borne out by the popular Banshee. " Air Trails " editor, Bill Winter, wrote an interesting article in reply and indicated his preference for the low C.L.A. high C.G. concept, therein showing rare intellectual honesty for a modelling writer by admitting there was enough practical evidence to prove both sides of the question. This seeming lack of common factors in the various theories may suggest that they are all fallacious, or that each does contribute something to a complex fluid motion of the airstream.

The most radical explanation of spiral instability may be credited to Frank Zaic, whose circular flow theory received less attention than it deserved.

The theory states roughly that, in a tight bank, the air is striking the airfoil from above, resulting in the loss of lift, so that if the angle of incidence is increased the wing will thus continue to react normally in a bank. However, when maximum efficiency is sought there are optimum values of longitudinal dihedral, so that a gain in spiral stability may result in a loss of efficiency. We cannot wholly limit the movement of the lift resultant, although we must prevent it moving so far rearward that it results in a continuous dive.

Peter Bowers, of California, a member of the Boeing design staff, seemed to be thinking of this when he recently named the lifting tail as a contributor to spiral instability. He claimed that its use was largely traditional, and that setting a lifting tail at a negative angle was similar to setting a tail with a streamlined section at 0°, with the desirable difference that the latter arrangement offered less drag and was less critical, while having the same effective longitudinal dihedral. The writer is convinced that this is true, and that by using symmetrical or bi-convex tailplane sections the movement of the lift resultant may be limited (Fig. 1).

R. H. Warring has said that low placement of after side areas, coupled with high C.G. location, is an effective antidote to the free-flighters' biggest headache. This follows Grant's conception of the problem—that the longitudinal axis (the line joining the centre of the after side areas and the C.G.) should slant upwards, so as to produce, in a bank, a rolling moment with a nose-up tendency. Obviously, a model may safely fly all day in a tight vertical bank as long as the nose does not drop and the wings continue to lift. But I doubt whether Warring's auxiliary fins are in themselves the answer to spiral instability. I have flown several shoulder wing Wakefields with and without auxiliary fins, without any visible difference in flight characteristics. If they are found to be necessary an increase in fin area is indicated, this being preferable as there is less interference drag.

It is likely that each of the foregoing theories has something to commend it. The writer can, at least, offer sound evidence in support of one of them, viz., the slanting axis theory. Ethel Dillon of the L.M.A.S. used to fly a simple glider with the layout as in Figure 2, which will be seen to conform.

It could " turn on a sixpence and leave threepence change," and the wings always remained dead level. It was trimmed beyond the stall for straight flight, and when set to circle tightly it took advantage of the lightest of air currents. The writer is currently experimenting with canard models and has found that they possess inherent spiral stability to a high degree. They have been deliberately flown in tight, vertically banked circles, horribly near the deck, and have shown no tendency to come in ; as torque lessened they slowly levelled out and flew normally. Warring's well-known contest glider conforms to the slanting axis layout, and possesses good spiral stability. So do the Banshee, Grant's Sky Bait, and the Jersey Javelin.

Yet the model's side elevation is not the sole criterion, for the use of a large angle of down-thrust may achieve the same result by causing the machine, at least during power flight, to assume an attitude where the longitudinal axis has the required positive inclination. Thus, as gliding flight is not too critical, a model with an otherwise unstable layout may be made to fly safely by the use of down-thrust. It was once taken for granted that down-thrust was an inefficient means of arriving at a safe trim, but this prejudice now seems to be disappearing. Anyway, as far as spiral stability is concerned it seems to be a good thing : and tests have been quoted showing an *increase* in airscrew efficiency at angles of yaw as great as ten degrees. Dr. Walter Good was probably the first to prove the value of a large angle of down-thrust on a high-powered model with his unconventional Guff—the first high-wing model to give the rampaging Zippers a run for their money. The slanting axis theory does seem to have something. The writer's last Wakefield was high powered and had five degrees of down-thrust. It was ridiculously easy to trim and flew most stably.

The practical remedies of spiral instability arrived at by trim or mechanical devices are fairly well known. The Belgians introduced the pendulum rudder some years ago, as a highly effective means of preventing undue banking during the critical power-on period. While it is doubtful whether stability could be achieved on certain flying scale models in any other way, the writer regards this as a first-aid measure for duration models and is convinced that complete stability may be achieved by correct design and trim.

Banking can not only result in a spiral dive, but is responsible for a loss of lift in a vertical direction ; for maximum climb the wing should, ideally, remain level throughout the flight. Wing warping is a further means of combating undesirable banking tendencies. Two years ago the writer decided that the best way to make spiral climb a safe proposition was to wash-out the outer wing tip about two degrees. The former world distance record holder could thereby turn very tightly and often take advantage of rising air that other models could not. The American Henry Struck used to trim his power jobs similarly by washing-in the inner tip. And in days of old when duration models had their wings strapped on top of the fuselage with rubber it was common practice to slew the whole wing to place the inner tip farther forward, or even move the whole wing over slightly (as is still done with micro film models). The advent of the shoulder wing fitting and the V-keyed pylon wing put a stop to these useful, if unæsthetic, practices.

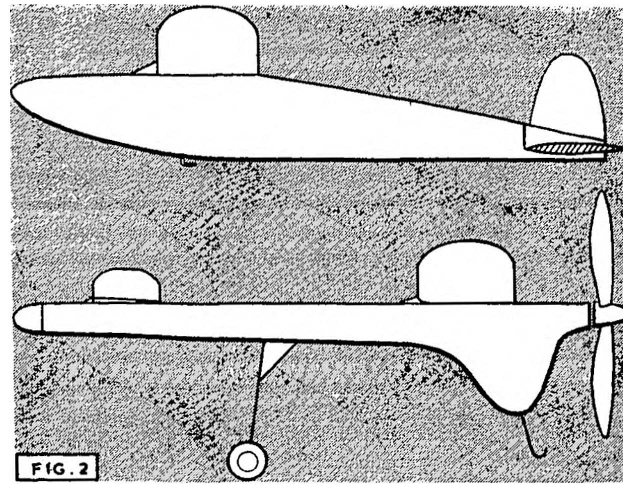


FIG. 2

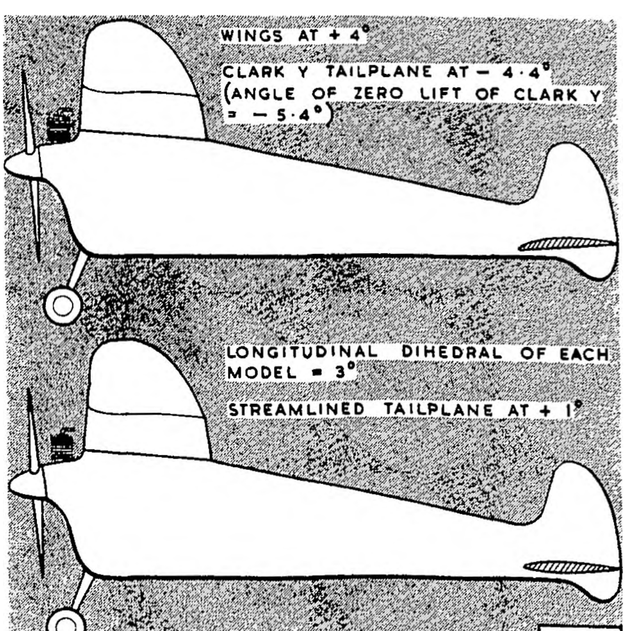


FIG. 1

Still another way to induce flat and tight turns is to raise the inner tip of the tail-plane. Great claims have been made for the efficacy of this method by certain noted American power flyers, and it has been used with happy results on power models and gliders by Liverpool club members.

After all, why should flying surfaces be symmetrically opposed when models normally fly in continuous circles ? That they are is probably due to the old, and slowly disappearing idea, that duration aircraft should (for a reason which has yet to be stated) look like man-carrying aircraft. When it is realised that nearly all manually-controlled aircraft will spiral dive quite readily when left alone it should not seem odd that models subject to proportionately greater disturbing influences, tend to do the same.

In the light of the most strongly established contemporary knowledge of the subject, the following points may usefully be borne in mind when designing and trimming a model for good spiral stability :—

(1) Place the C.L.A. below the C.G., and disperse after side areas fairly low.
(2) Unless the model is one of a series, be prepared to build more than one fin before one of optimum area is found.
(3) Use bi-convex or symmetrical-sectioned tail-planes.
(4) Don't be reluctant to use large angles of downthrust. (With rubber models a smooth change from power to gliding flight usually indicates the correct downthrust.)
(5) Trim to avoid sharply banked altitudes during flight. (A power model is safe in a banked climb with *left* thrust, and right rudder to keep the nose up, resulting in a left-handed climb and a glide to the right.)
(6) If you have the courage try an asymmetrical layout—Cahill showed the way at last year's Wakefield Finals.

A power model which violated most of the above points appeared at Sealand recently. Without any delay at all it performed the most spectacular spiral dive and ensuing " explosion of sticks " the writer has ever witnessed.

AIRCRAFT DESCRIBED No. 29 By E. J. RIDING

The HAWKER N7/46

Aeromodeller Photos.

THE Hawker N7/46 forms an interesting contrast to the Sopwith Buffalo described in this series last month—in actual fact it can be likened to a direct descendant of the latter type, for when the Sopwith Aviation Co., Ltd., closed down in 1921, a new company known as the H. G. Hawker Engineering Co., Ltd., was formed to take over the aviation interests of the original firm.

The N7/46 is an offshoot from the original P.1040 design of 1944 the new designation being allotted to the machine when it was submitted for consideration by the Navy in connection with tenders issued for a Naval Interceptor Fighter in December 1945.

Described as a deck landing fighter, the N7 is powered by a Rolls-Royce Nene turbojet unit developing 5,000 lbs. static thrust. It has such modern refinements as power operated wing folding gear, retractable deck-arresting arm and single hook type catapult fittings. The armament consists of four 20 mm. cannon mounted two on either side and to the rear of the pilot's seat, which incidentally is of the Martin-Baker ejector pattern.

Appearing publicly for the first time at the 1948 S.B.A.C. Display at South Farnborough, the P.1040 design showed its paces against contemporary fighter types at the National Air Races at Elmdon on July 30–31st last, when Messrs. Neville Duke and T. S. Wade secured first place respectively in the Kemsley High Speed Trophy and the S.B.A.C. race. Duke's average speed round the course was 562·56 m.p.h.

At the moment an initial contract for three prototype and one structural test aircraft has been received from the Navy, and the machine has been given the type name of Seahawk.

Construction : The fuselage is a monococque light alloy structure built up from "Z" frames and stringers. The centre plane is integral with the fuselage, the main and rear spars being part and parcel of the fuselage structure. The Nene jet unit is mounted immediately in front of the main spar and the efflux is lead away through a specially designed bifurcated jet pipe, forming outlets on either side of the fuselage aft of the wing trailing edge.

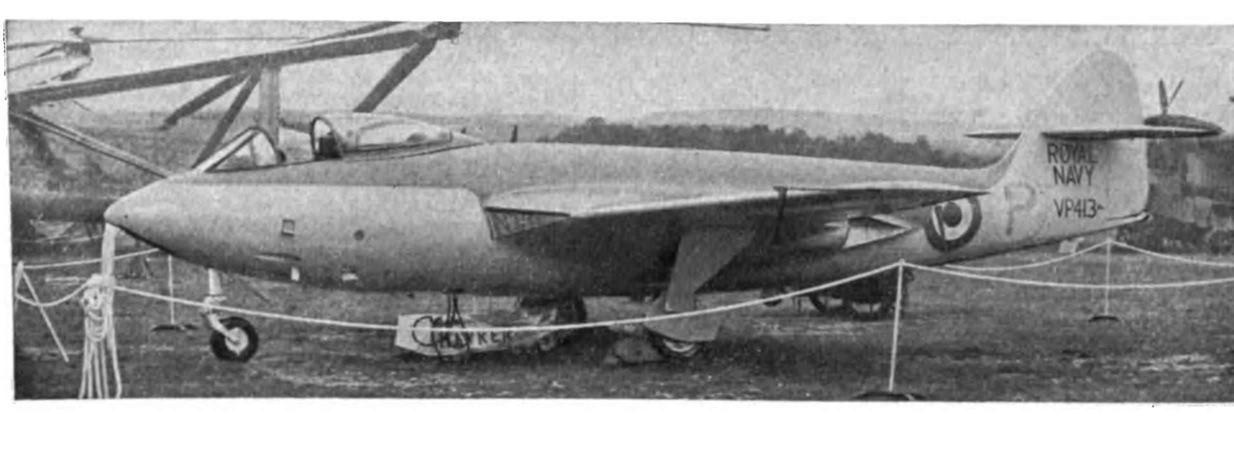
The three fuel tanks are situated as follows —(a) immediately behind the pilot's seat, (b) over the rear end of the power plant, and (c) between the two jet effluxes.

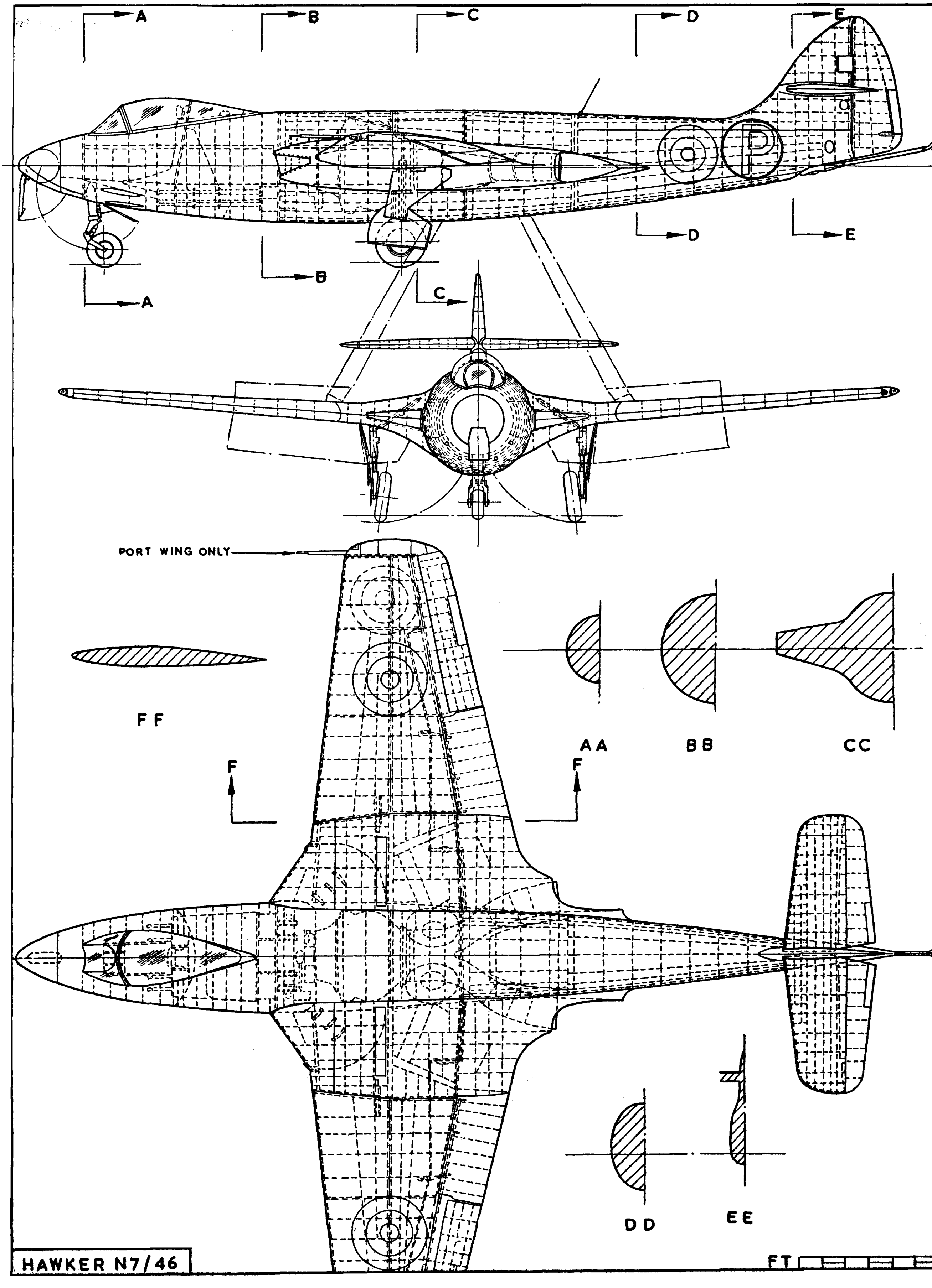
The wings are designed to fold upwards, and consist of one main spar, a rear spar, and conventional ribs and stringers with light alloy covering. The span when folded is 15 ft. 9 in. The flaps are situated one on each stub and extension plane of each wing and dive brakes are fitted forward of the stub wing main spar. The main undercarriage retracts inwards into the fuselage belly and the nose wheel oleo is raised forwards and upwards into the extreme nose. The deck arrester hook is mounted on the underside of the fuselage beneath the tailplane.

Colour : Standard Naval camouflage scheme, i.e. dark sea grey upper surfaces of wings and fuselage, duck egg blue under surfaces. Red, white and blue roundels on wings and fuselage; red, white and blue fin flash. Black serial number VP413 on fuselage sides, and on underside of wings only—tops of letters to leading edge on port wing and reversed on starboard wing (looking at the machine from below). Yellow circumscribed "P" symbol aft of fuselage roundels.

Specification : Span 36 ft. 6 ins. Length 39 ft. 7 ins. Height 10 ft. 6 ins. Wheelbase 12 ft. 8¼ ins. Wing area 268 sq. ft. Wing Section H.054010/37, modified. Dihedral: 4½ degrees, Incidence: ½ degree, Tailplane Span: 103·2" Further details not yet released.

¼ in. to 1 ft. reproductions of the G.A. Drawings are available price 1/– from A.P.S., copies of photographs from Eaton Bray Studios at usual prices.

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CLUB NEWS

J. B. Knight of North Kent who placed second in the Bill White Memorial Cup contest, holds for a fellow competitor.

As you all know, this year's Wakefield Contest will be held in Finland, and in addition it is hoped to send an official British team to participate in the International Glider Contest in Sweden a few days later.

In the past, the authorities in this country have had to practically beg the necessary finance to send out official representatives to overseas contests, a condition which should not obtain in our hobby. This year a move is being made to gather together the necessary finance in a different manner, and for this purpose a special Wakefield Draw has been organised. Tickets, which are available at 1/- each, will qualify 100 lucky winners for prizes of all types, the first being a trip to Finland to witness the Wakefield Contest, second prize a similar trip to Sweden and third prize a complete outfit of model kit, engine and equipment for the construction of a first-class radio-control model.

I am certain that, with the proper co-operation from the aeromodellers of this country, sufficient funds can be raised to finance both teams, and no doubt the money will be more willingly available than by the old method of soliciting a straightforward donation.

If you are unable to purchase tickets via your local club, applications can be dealt with from this office on behalf of the S.M.A.E. So run around and make this a collection of sufficient standard to give ourselves the fullest opportunity for regaining the Wakefield Trophy for Great Britain, and also establishing ourselves in the new International Contest which commences this year.

Incidentally, we learn from a Swedish correspondent that the meeting will be held at Eslöv in southern Sweden, and in addition to the A-2 Glider Class there will be contests for Wakefield and power models. Entries will be restricted to official nominations, but the number per team is not yet known, although it will probably be six.

Malden, Surrey, is one of the first towns to have its own airfield for the flying of model aircraft. The Council have decided that an area 350 ft. by 250 ft. be laid out in the Green Lane Recreation Ground for use as a model airfield, flying obviously being confined to control-line models. It is a great pity that other towns and cities of much larger populations than Malden are so restrictive in their outlook towards our hobby. (See later remarks re Birmingham.)

The Annual General Meeting of the **MIDLAND AREA** was very well attended, and honoured by the presence of Mr. A. F. Houlberg and H. W. Barker (S.M.A.E. Treasurer). The general business discussed indicated a healthy state of affairs, with finance again showing a profit on the year's working. This Area now boasts an Affiliated Club efficiency of some 68 per cent., and many more clubs currently unattached have indicated early application to join the rest. Much discussion took place on the subject of the proper approach to local authorities, as the Birmingham and District Councils are proving somewhat allergic to aeromodellers as a whole. As a result of the deliberations, a deputation under the direction of "Chuck" Doughty is being organised to meet, and if possible give a suitable demonstration to, the various Councillors. We wish them luck, and trust that amicable arrangements will speedily be reached.

Another Area to hold its A.G.M. recently was the **SOUTH-WESTERN AREA**, who met at Torquay in January. The financing of a team from the Area to the 1950 Nationals was discussed, also the possibility of a change in the method of prize awards at Area rallies. A return to the old system of cups and medals is advocated (this also being under consideration by the Midland Area).

At a meeting of the **NORTHERN AREA** Committee it was decided to obtain a trophy for inter-club competition on a knock-out basis. Suggested rules are that three types of models shall compete against each other; rubber jobs to be hand launched, gliders T.L. with up to 300 ft. of line, and power models H.L. with 15 seconds maximum engine run. The 1950 Northern Area Rally will take place in conjunction with the S.M.A.E. contests on September 3rd.

I had the pleasure of attending two further Area A.G.M.'s last month, the first being that held at Londonderry House by the **LONDON AREA.** Contrary to what I have been led to believe, business was conducted in a quiet manner, though naturally punctuated by the usual "ribbing" that is inseparable from any gathering of aeromodellers! One very good resolution passed at this meeting was the decision to compile a roster of suitable stewards, timekeepers, etc., who would be called upon in rotation during the season, thus relieving as far as possible the old system of things being left to a mere handful. A further worthwhile proposal that may bring fruit is that no timekeeper shall officiate for the flights of a fellow club member. This will undoubtedly cut out the criticisms we have all heard in the past, and is a system well worth copying in all Areas.

My other visit was to the **NORTH-WESTERN AREA**, who held their meeting on my old stamping ground in Manchester. Barry Haisman was elected Chairman in succession to "Bob" Gosling, who retired owing to his many other commitments, all other officers being duly re-elected. The "Gosling Trophy" for the longest distance flown by a sailplane in S.M.A.E. contests during 1949 was presented to P. R. Criddle of Whitefield, whose machine flew 16 miles. The loss of Sealand was of course thoroughly discussed, but the meeting was informed that the management of Haydock Park Racecourse have granted permission for the use of the course for Area meetings. Though not ideal for free-flight, it is at least something until something better turns up.

The last Area to send in news of its activities is the **NORTH-EASTERN AREA**, who held a Winter Rally on the Town Moor, North Shields, on Sunday, January 22nd. Six clubs provided some 40 competitors, and in good weather for the time of year, three contests were conducted with the following results :—

Open Rubber	**R. Hymers**	**(Bishop Auckland)**	**4 : 06**
	G. Nicholson	**(North Shields)**	**3 : 53**
	F. Cooknell	**(Blyth)**	**3 : 15**
Power/Ratio	**A. Wilkinson**	**(North Shields)**	**8.3-1**
	F. Fox	**(North Shields)**	**8·2**
	J. Ramsden	**(North Shields)**	**7·9**
Open Glider	**K. Murray**	**(North Shields)**	**6 : 30**
	R. Anderson	**(Blyth)**	**5 : 46**
	D. Shawcross	**(North Shields)**	**5 : 34**

The "**BILL WHITE**" **MEMORIAL CUP** contest was held on Blackheath on the 8th January, when 108 competitors from no less than 27 clubs attended, a fine tribute to Bill's memory. Spectators were treated to a display of good flying with rubber-powered models—quite a change from the prolific crashery seen at most power contests! "Rip" was seen flying a 20-year-old "Kinglet", and it was soon evident that a number were trying out their 1950 Wakefields with an eye to Finland. Results were :—

R. Yeabsley	(Croydon)	10 : 05·7
J. B. Knight	(North Kent)	8 : 56·6
S. Miller	(Luton)	8 : 21·8
S. Taylor	(Brixton)	8 : 21·7
R. Ladd	(Croydon)	8 : 21·4
J. Howard	(North Kent)	8 : 14

The **WALLASEY M.A.C.** can look back on a most enjoyable year's flying. Although not figuring to a great extent in major competitions, they had the satisfaction of seeing Tom Beverley gain 1st place in the Class II speed control-line event at Sealand. This club has been granted the use of an excellent field in the local park for C/L flying, and were in some measure able to thank the local council by putting on a display at the local schools. As a result, the officers were invited to the Mayor's Annual Civic Reception and Dinner—certainly in great contrast to the attitude of some local governments! Does the answer lie in the correct approach to the subject by the club? Too many think that facilities should be laid on for them without any effort on their part, and grouse rather than help themselves. Perhaps Wallasey will tell us how they went about it.

The 2nd North Hampshire Rally will be held on Sunday, April 30th, at R.A.F. Station, Odiham, when seven events will be run. Full details can be obtained from the secretary of the **ODIHAM & D.M.A.C.**, C. R. Foot, "Jolly Miller Cottage", North Warnborough, Odiham, Hants.

The **AMPLEFORTH COLLEGE M.A.C.** had a great season in 1949, the term opening with Dick Twomey (now in the R.A.F.) raising the power ratio record to 37–1, the model travelling 11·7 miles. A gala was held on the moors, when Twomey won the "Brackenbury Cup" with a flight of 1,220 seconds with his "Leprechaun", following this up with flights of 1,230 and 1,290 seconds. At a later competition he put up a flight of 18 minutes with the same plane and was o.o.s. for some 7 hours, returning too late to get in another flight for the competition, which was won by D. R. Goodman's "Thermalist" with times of 7 : 17 and 16 : 28. A competition held during the Xmas term was for power/ratio, won by M. D. Pitel's Elfin-powered "Powerhouse" with a ratio of 12. His chief rival, the new secretary, P. James, was unable to start his engine until he found that his home-made cut-out was as effective in the off position as the on!

L. Barr was the top performer in the **PHAROS M.A.C.** last year, for beside winning the Nationals Championship and the Thurston Cup, he won the rubber event at the West Essex gala, was a member of the team which placed 6th in the M.E. No. 1 Cup, and was chosen to represent the London Area in the R.T.P. contest at Manchester. Other outstanding fliers have been Junior R. Kreeger and J. Higgings, whilst ace glider designer P. Gilbert (designer of the Thurston Cup winner) proved his own ability by placing 2nd at the Odiham gala.

It is with pride that the **LUTON & D.M.A.S.** announce that three of their stalwarts were flying on Xmas morning, all testing Wakefields. In spite of the rough wind, Bateman put in a flight of 2 : 30 o.o.s. over the local "mountains". An exhibition is being arranged in March.

Activity in the **LOUGHBOROUGH COLLEGE M.A.C.** centres around large gliders, A/2 gliders, Wakefields, R/C, and flying scale power. Their first R/C model has been successfully flown, and an extensive programme is under way in readiness for a projected exhibition. Club records at present are :—

Wakefield	G. E. Salt	15 : 00 o.o.s.
Glider	G. E. Salt	8 : 25 o.o.s.
Power/Ratio	G. Ball	49–1
C/L Speed	W. Ross	74·3 m.p.h.

The **KNUTSFORD & D.M.F.C.** has almost doubled its membership recently, and it is surprising to learn (or is it!) that C/L interest has waned with these chaps. They are fortunate in having a completely equipped workshop at their disposal, and can leave stuff about from one week to the next. A scheme for the encouragement of newcomers is recommended, the club having purchased a 7 ft. span glider kit from general funds, and newcomers are put on to individual components under the direction of "old hands"

LIVERPOOL M.A.S. have an idea for raising club funds. A member pays 3d. for three consecutive flights in any class, and at the end of the year half the kitty goes to the chap with the highest total, and half to the club. (Number of attempts strictly unlimited!) This club is proposing that North-Western Area events shall be limited to holders of "A" class Merit Certificates, with timekeepers recruited from a non-aeromodelling section of the public (British Legion or similar body). We'll be interested in the outcome of their experiments.

The **KODAK S.E.E. & C.** are pleased to announce that their next Open Exhibition will be held on the 1st and 2nd of April at the Kodak Hall. Full details from Mr. G. G. Corder, Kodak Hall, Wealdstone, Middlesex.

Outdoor flying has continued in the **WHITEFIELD M.A.C.** despite the usual Manchester weather, J. O'Donnell obtaining 14 consecutive flights of 2–3 minutes with a Wakefield at the beginning of January, also three flights of 4 : 25, 3 : 30 and 4 : 11 on January 22nd with a 6 ft. F.A.I. glider. R. Woodhouse has a rubber-driven Canard which is turning in consistent flights of about 80 seconds with a best time of 1 : 38 H.L. Flying is being carried out with speed R.T.P. models, main trouble encountered being bouncing, which leaves a trail of broken propellers and other debris!

The **ST. ALBANS M.A.C.** have been enjoying themselves with lectures and film shows recently, and are now busy preparing for their next "All Herts. Rally". A team-racing C/L event is being introduced this year, rules being briefly as follows: model to be semi-scale in appearance with fixed undercart and cockpit; minimum wing area 25 sq. ins. per c.c.; maximum engine size 5 c.c. with maximum fuel tank capacity of 1 fluid ounce; engine cut-out to be incorporated, and a looped tail skid for use with a take-off "stooge". Models must be flown on 52½ ft. lines, and races will take place over a distance of 10 miles. Teams a maximum of three members and one model. Any constructive suggestions for modification of these rules will be welcomed by the club.

Several sailplanes to the A/2 specification are on the boards of the **ICARIANS M.F.C.**, whilst '49 Wakefield teamer Eric Smith is hard at it practising for this year's event. He is painstakingly getting acquainted with E. W. Evans' "Clipper" design, latest developments bringing about a lighter fuselage and propeller of wide chord and little camber. The club is making an organised attack on the S.E. Area C/L Rally at Brighton at Easter.

The **SOUTHERN CROSS A.C.** announce their 3rd Exhibition, to be held in the York Place Hall, London Road, Brighton, opening on Saturday the 8th April and running till the 15th. Ten classes are open for competition and entries are welcomed from anywhere in the county.

A rather surprising piece of news comes from Harrow this month, for the old established **HARROW M.A.C.** has disbanded owing to lack of interest, and general apathy amongst its members. A trust has been formed to hold the assets of the club in case there should be a revival of interest in the Harrow district and a fresh club formed. And this in spite of the fact that new clubs are coming into being all over the country, and the hobby increasing in strength every week! Strange, but regrettable nevertheless.

A general shake-up has occurred in the **BIRMINGHAM M.A.C.**, a number of enthusiastic members being browned off with the "passenger" section of the club. "Chuck" Doughty has accepted Chairmanship of the club on the understanding that they pull their socks up and get down to active flying and participation in local and national events. Before accepting election he made it very plain that a great deal of re-organisation was necessary, and in future membership will entail full support of S.M.A.E. competitions in the spheres in which members profess an interest. Members are currently being vetted in relation to their support at meetings and general activities during the past 12 months, and it is hoped by this means to weed out the "don't care" element. The nine committee members have held two meetings in a week, and are now counted as the hardest working and swearing bunch in the Midlands!

Competition Secretary Bob Copland was unanimously re-elected Chairman, whilst, for his services to the club during recent years F. E. Wilson was honoured with Life Membership to the club.

With the advent of the 1950 season, the **LINCOLN & D.M.A.S.** members are getting down to serious building in the form of hordes of scale models. By the look of recent club meetings one would easily think that it was pre-war—when models resembled aeroplanes! Pete Clarke's R/C "Windjammer" is undergoing first tests—all up weight 56 ozs.

Preparations are now under way for the 3rd annual exhibition of the **PLUMSTEAD & D.M.A.C.**, whilst several R/C sets are being readied. "Hot" motors are gradually being acquired, which indicates that the present ratio record of 9·4 will not last long.

The high standard of modelling by junior and older members of the **YORK M.A.S.** was praised by their President, Mr. D. W. Pickering at their A.G.M., who urged still more help for officers at rallies and lesser events through the season, thus enabling a fairer share out of flying hours, and help more competitors into the field at the more important events. The "Thorpe Trophy" for gliders went to A. Wharrie, and Sam Messom collected the "Dodd Trophy" for Wakefields. M/s. Good and Backhouse were also trophy winners, a close runner up being junior Roy Hodgson.

Highlight of the **WEST ESSEX AEROMODELLERS'** January activities was a film show attended by some 130 chaps from all parts of London. One bod from well outside London was "yours truly", giving a running commentary on the AEROMODELLER Wakefield films, and it was a pleasure to show to such an appreciative audience. The show has inspired W.E. to make a film of their own activities during 1950, and Eddie Keil has come to the rescue with the loan of a ciné-camera. Following the successes of their team visit to Switzerland last year, international participation is being well taken care of this year, and I hear rumours of a 70-seater plane being booked to transport the club to Paris in the summer. Oo la la.

The **DARLINGTON M.A.C.** announce that their 1950 Rally will take place on July 16th. No further details are given at this stage, but no doubt these can be obtained from the secretary on application.

The **HUDDERSFIELD AIR LEAGUE M.A.C.** is running a very good club magazine, which is a good scheme for keeping up the interest of members, particularly in the "close" season. Their "Woods Smith Championship Contests" saw some pretty good flying, winners being W. Ellis (Glider), P. H. Stringer (Rubber), D. Ford (Power) and D. Earnshaw (C/L Stunt). Stringer collected 1,275 points to win the Championship from Ellis, with F. Ackroyd placing third.

Quite a bunch of overseas readers are asking for pen pals this month, so if any of you have the urge to improve your aeromodelling knowledge and/or foreign languages, try some of the following: R. D. Whitelow (21 years old), 60, Ashburnham Road, Toronto, Ont., Canada; 19-year-old Jean Paul Ney, Douvat par Roulons, Doules, France; J. Tj. Schreuder, Jan Litharthuis, Linder Grecht 85, Amsterdam, Holland; 16-year-old Craig Atkins of 45, Ormond Road, Moonee Ponds, W.4, Melbourne, Australia; Richard Wolski, Jaronia 8/3, Byton, Poland; and finally, Zoric Dusan, Beograd, Vojv. Dobrnjca 44, Yugoslavia, this chap being particularly keen on R/C.

And so to this month's Tall Story. J. R. Dunstan of Salcombe, S. Devon, writes of a friend who lost his power plane when flying from an old airfield on the coast, the only obstructions being radar towers. Following an ordinary launch, the model struck a thermal and went cruising out over the briny, being lost to sight after 20 minutes of hard watching. This chap was somewhat surprised to be told next morning by an R.A.F. Sergeant that he had lost his plane the day before! Explanation was that some radar equipment was being tested out, and the model had been picked up on the screen as it was leaving the 'drome, and radar followed until it was lost some 8 miles out in the English Channel. Seems we have a new means of keeping track of those lost models—if we can persuade someone to lay on full radar stations on our model flying fields!

The CLUBMAN.

NEW CLUBS

DROYLESDEN M.F.C.
E. Walker, 9, Wordsworth Avenue, Manor Road, Droylesden, Manchester.
WORTHING HIGH SCHOOL M.F.C.
B. J. Belcher, 2, Mill Road, Worthing, Sussex.
FYLDE COAST M.A.C.
R. S. Stahel, 26, Bedford Avenue, Cleveleys, Nr. Blackpool.
KINGS LYNN S.M.E.E.
D. Stanley, Harrowdene, Wellesley Street, Kings Lynn.
SATYRS (LEE) M.F.C.
W. J. Bishop, 15, Gellatly Road, New Cross, S.E.14.
HAINAULT M.E.C.
H. G. Stone, 128, Arrowsmith Road, Chigwell, Essex.
HORLEY & D.M.A.C.
E. A. Worthy, 6, Station Close, Horley, Surrey.
LANARK M.F.C.
W. A. Shanks, 7, Stanmore Avenue, Lanark, Lanarkshire.

CHANGE OF SECRETARY

NORTH DOWNS AEROMODELLERS
P. F. Wilson, 314, Carshalton Road, Carshalton, Surrey.
R.A.F. MIDDLE WALLOP M.A.C.
F/Lt. F. A. J. Gunn, Officers' Mess, R.A.F., Middle Wallop Nr. Stockbridge, Hants.
MEDWAY M.F.C.
Miss D. Jones, 64, Jackson Avenue, Rochester, Kent.
AYLESBURY M.F.C.
P. Morris, 15, Cambridge Street, Aylesbury, Bucks.
GILLINGHAM M.F.C.
L. F. Lockyer, 91, Shakespeare Road, Gillingham, Kent.
EALING & D.M.F.C.
L. R. Friend, 175, Gunnersbury Lane, Acton, W.3.
ERDINGTON & D.M.A.C.
C. P. Williams, 27, Mount Street, Nechells, Birmingham, 7.
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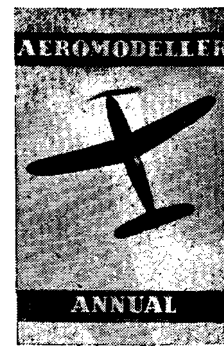

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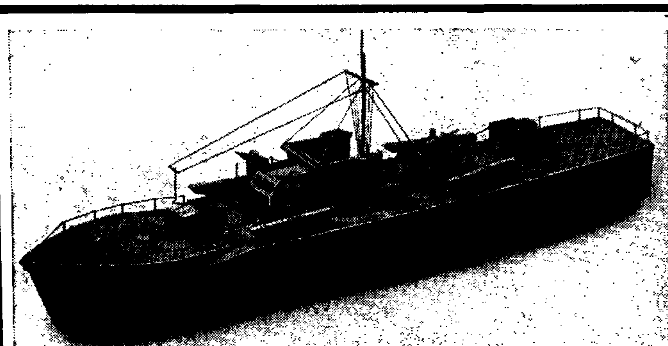

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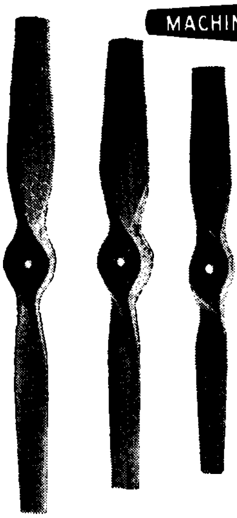

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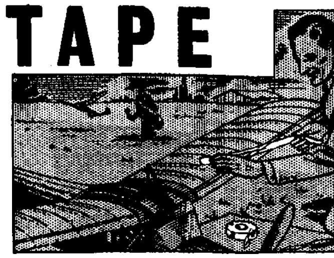

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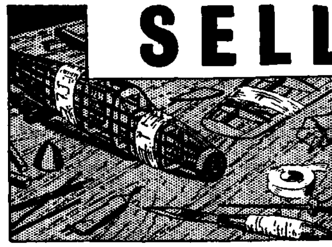

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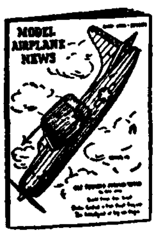

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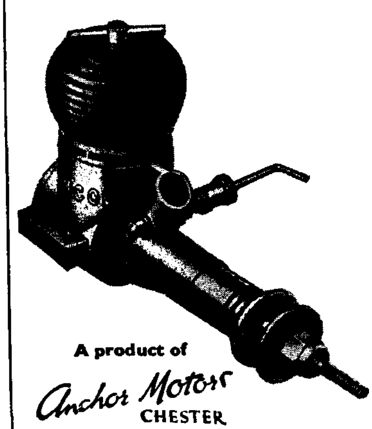

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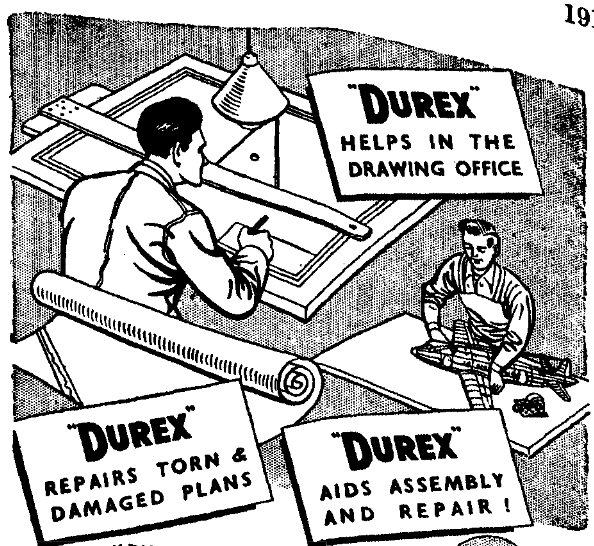

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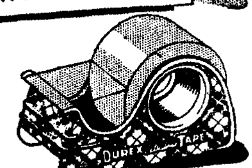

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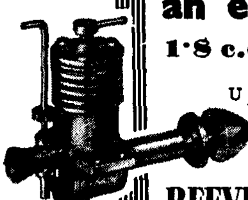

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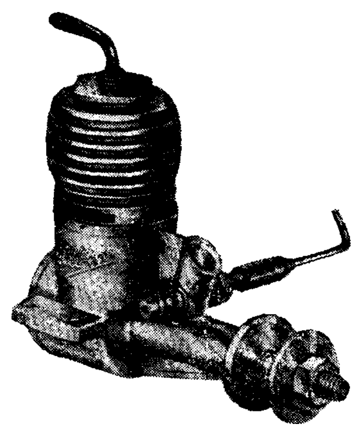

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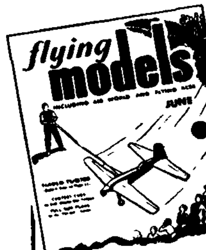

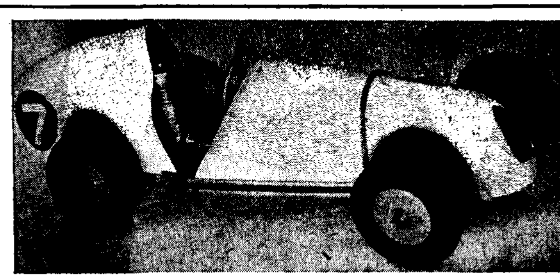

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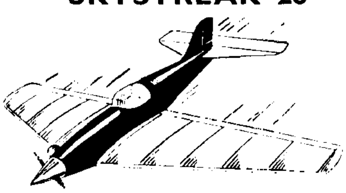

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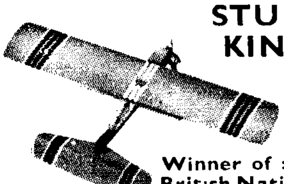

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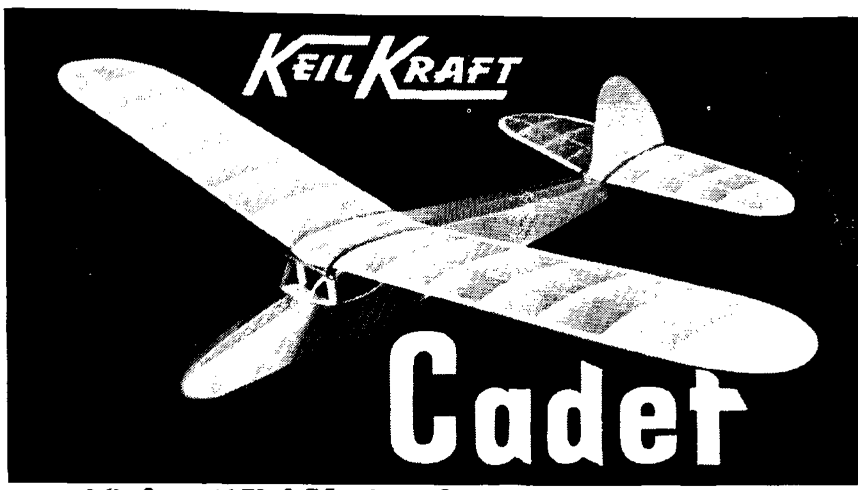

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