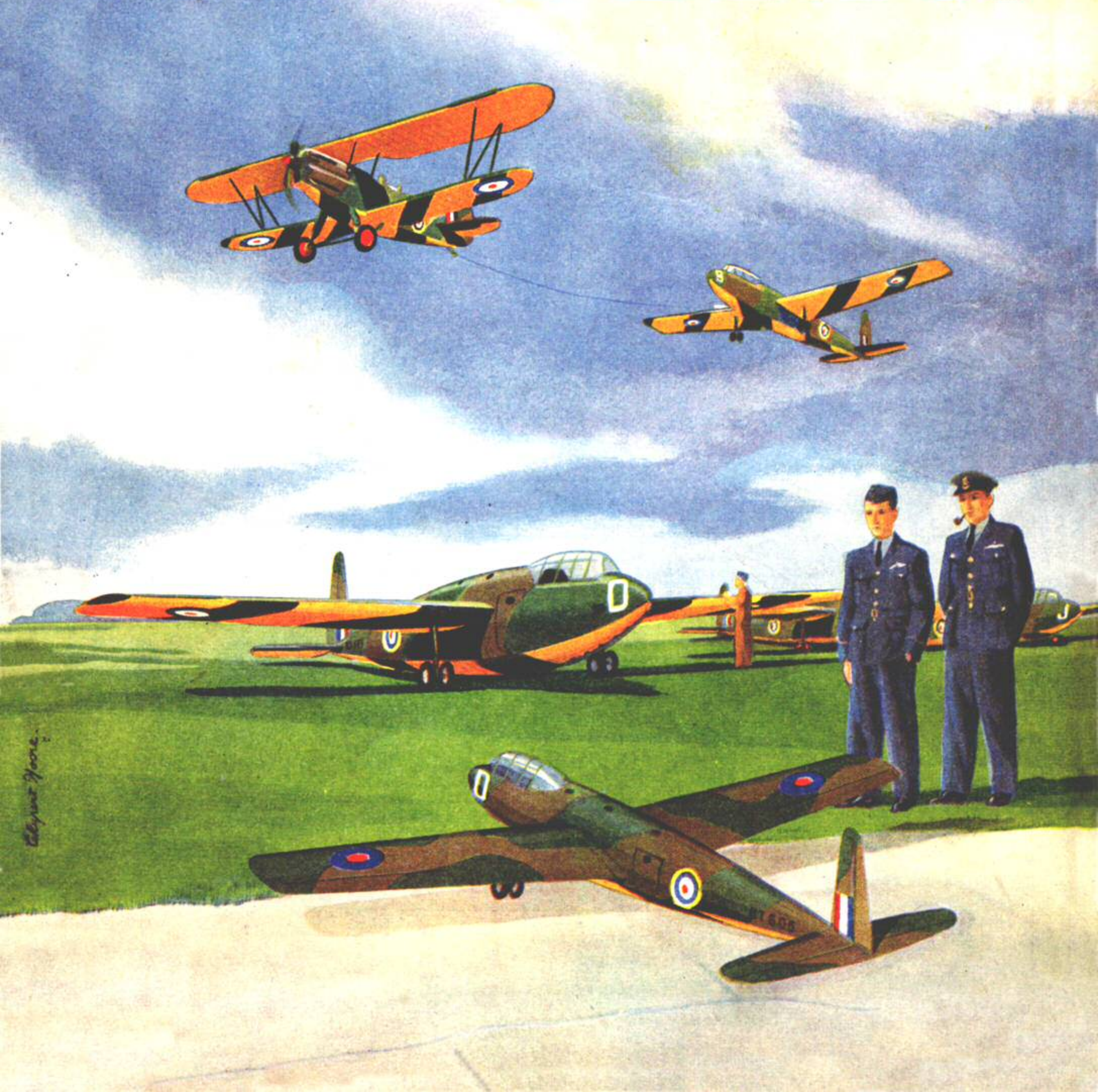
AERO MODELLER

OCT. 1942
VOL. 7 No 83
ONE SHILLING



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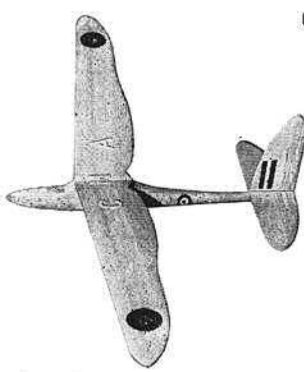
D.H. DRAGONFLY	5/6
FAIREY BATTLE	5/6
CURTISS P.37	6/3
BELL AIRACOBRA	6/3
BLACKBURN SKUA	6/9

THE C.M.A. GLIDER



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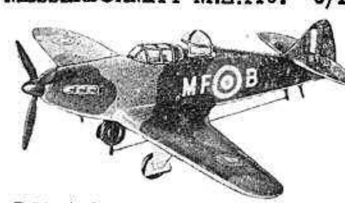
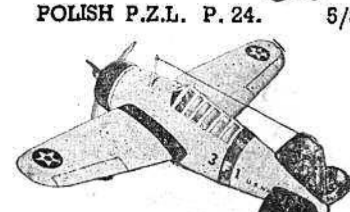


BOULTON PAUL DEFIANT. 6/9

POLISH P.Z.L. P. 24. 5/3



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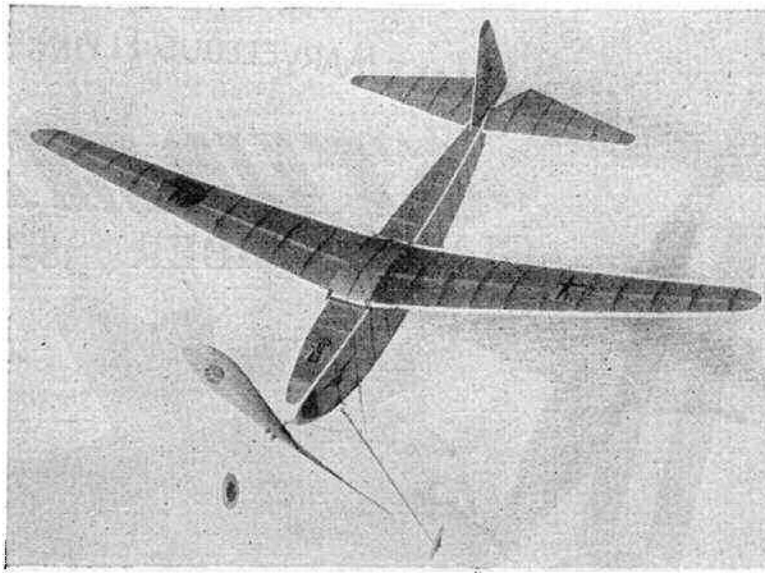

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KITS contain: Comprehensive full-size plan, cut ribs, formers cut and notched for longerons, wing spars cut, tapered and dihedral angle incorporated, propeller block and instructions with illustrations for carving, finest quality piano wire shaft fitted with foolproof freewheel device, **Jap** tissue, **rubber** motor, highest quality woods, dope, cement, etc., etc.

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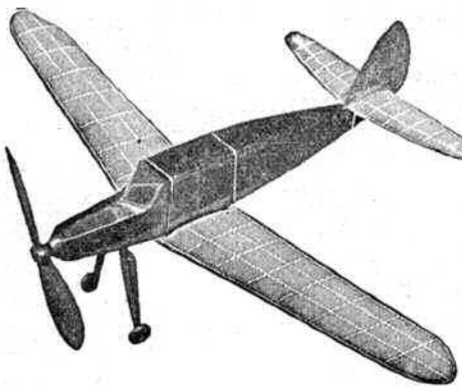
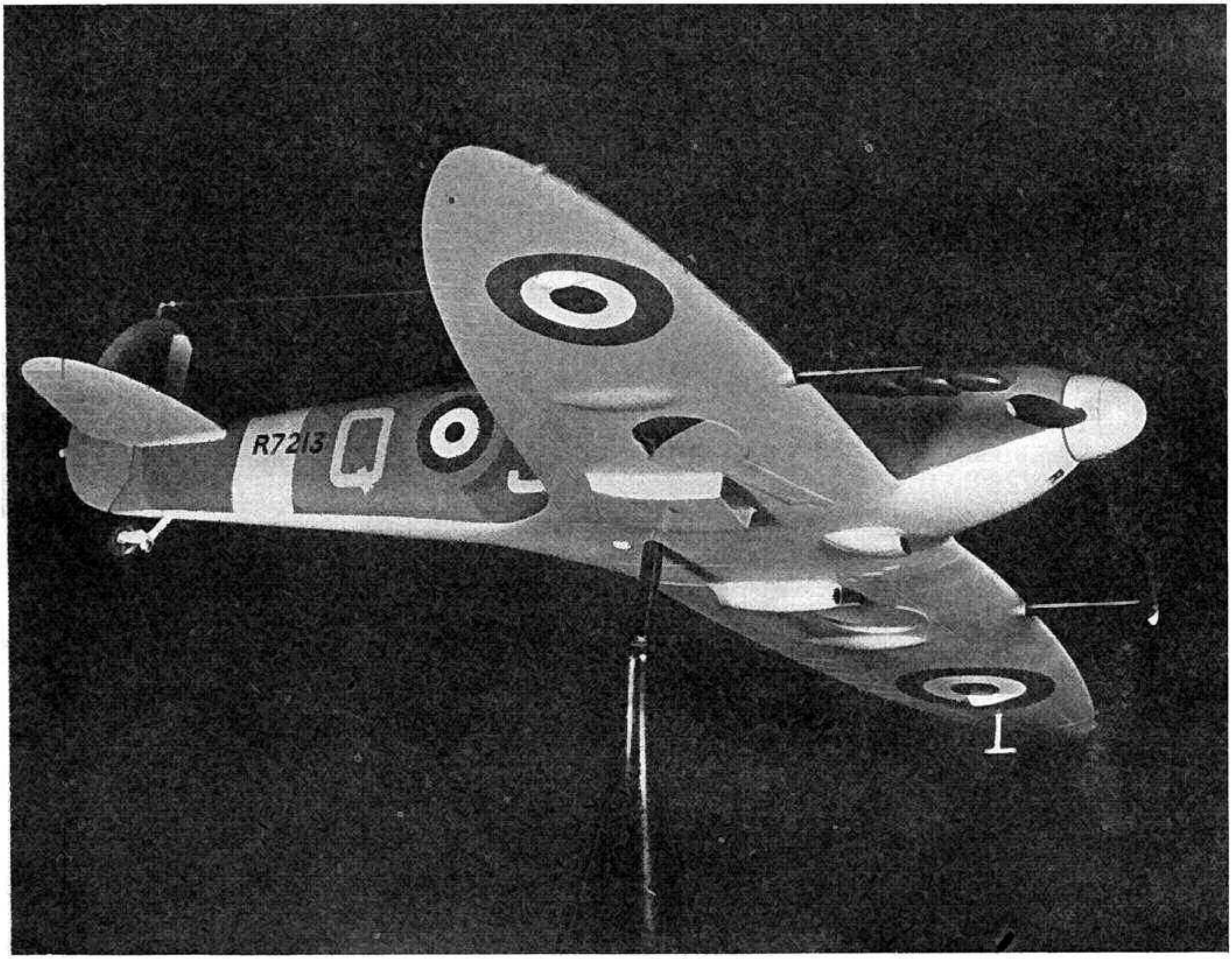




A superb example of the solid modellers' art. This model of the Spitfire Vb is to a scale of ½-in. to the foot, i.e. 1/24th full size and illustrates the amount of detail that may be incorporated by the craftsman. Congratulations, Mr. Ian Moore, on a fine piece of work!

Contents of this issue.

THE AERO MODELLER

(INCORPORATING "THE MODEL AEROPLANE CONSTRUCTOR") Established in 1936

(Proprietors: Model Aeronautical Press, Ltd.)

THE MODEL AERONAUTICAL JOURNAL OF THE BRITISH EMPIRE

Managing Editor: D. A. Russell, *A.M.I.Mech.E.* *Editor:* C. S. Rushbrooke

Vol. VII - No. 83 OCTOBER, 1942

ALLEN HOUSE, NEWARKE ST., LEICESTER

EDITORIAL

AGAINST orders for over 200 copies of the full size drawings of Mr. Galeota's race-car, we have received just one complaint—that the space devoted to the model might more usefully have been used for an article on model aircraft. (Note: This objection was not to the race car as such, but was essentially that the complainant would have preferred the space to have been devoted to model aircraft.)

We conclude that our "diagnosis," as to the reception the race car would receive, was correct. There must be several thousands of miniature petrol engines in this country; yet, judging from our recent correspondence, most of those enthusiasts who have written in for plans of the car ask—"Where can I obtain a petrol engine?" If it would be of any assistance to readers generally, we are ready to provide space for those who have engines, and pneumatic tyres available, to announce short particulars, which should be communicated to Clubman.

On page 454 we publish an announcement on behalf of the National Guild of Aeromodellists to the effect that third-party insurance, on exactly similar lines to that available for petrol planes, is available to owners of model race cars. Premium is 2s. 6d. from date of enrolment to January 31st, 1943, and thereafter 2s. 6d. per annum from February 1st of each year.

We are pleased to have been able to negotiate this latest insurance cover on behalf of our readers, and acknowledge the co-operation of Lloyds Underwriters in this matter. Attention is called to the notice on page 455 to the effect that all entrants to the A.M. competitions for race cars must be issued under the N.G.A. Policy. We might take this opportunity of reminding readers that the full third party cover is afforded on payment of a yearly subscription of 6d. by owners of rubber-driven model aircraft and gliders. And Gliders! That brings us to the Hotspur II competition, and a similar announcement to the effect that entrants for that competition also, must be covered by N.G.A. Third-Party Insurance.

A fully comprehensive description of the construction of the Hotspur is given on pages 447-450 of this issue and we are hoping for a record number of entries for the competition run in conjunction with this model. Full details of this were given on page 390 of the September issue. Suffice it to remind readers here that a prize of £10. 10s. 0d. is being offered!

And still more Gliders . . .

Once again we have news for the glider fans. L. G. Temple, a well-known authority on the subject, contributes a two page article on *launching*, which should prove invaluable to all readers. It is a most annoying fact that a glider trimmed to fly well when hand launched will often exhibit unstable characteristics when on a towline, and with the length of line necessarily restricted for competition work at the present time, this means that the results obtained are but a poor indication of the model's capabilities. This article on launching, which has been especially written for THE AERO-MODELLER, follows a similar one by R. H. Warring in the May issue and we hope that readers will learn from these contributors. We would emphasise, however, that *practice* is the sure path to success, and thus for results the flier must familiarise himself with the various launching methods available.

Another feature worthy of consideration is the automatic rudder control, a full description of which is given in "Model Gliders," one of the most popular Harborough books yet published. The first print is rapidly selling out, but we still have a number of copies at THE AERO-MODELLER offices which may be obtained for the price of 4s. 4½d. post free.

A further article is pending on the various systems of pulley launch.

Slots and Slats and things!

Another feature which, we feel sure, will fulfil a long-felt need is the comprehensive article on slots, with full data on the various possible combination of slotted wings. All flying model fans will find pages 468 to 471 of great interest, which article, judging by past correspondence, is long overdue!

We invite readers to send in the results of their various experiments in this field and further suggestions. Should the occasion warrant it we have a further article on the same subject in mind—with the results of various practical tests.

Five Models in this Issue.

Five model plans in one issue would mean that nearly one fifth of the journal would consist entirely of drawings. Giving both quality and quantity we have arranged for one full size plan to be made available separately.

This machine, which is a departure from the conventional type of duration model, is the Fokker type monoplane featured on pages 474 and 475. With four flying models detailed in this issue besides this, we hope that readers will appreciate that they are better served by giving just the general description of a machine of this nature and making the plans available through the Aero-Modeller Plans Service. Thus, anyone who is not particularly interested in building this model does not sacrifice reading space to those who are; and to the latter —well, the full size plan with every part detailed

is a far better proposition than having to scale up a small drawing.

. . . .those that have erred and strayed.

A regular feature of THE AERO-MODELLER, almost equivalent to Monthly Memoranda, Technical Topics, etc., is the necessity of asking for addresses! This month we have another batch—orders received but no indication as to where to send the goods! May we state once again—write your name and address on every order sent to this office, and to any of the advertisers in this journal, PLEASE.

If the following culprits will communicate with us we shall be pleased to send them their long overdue orders.

S. Aston—order for Model Gliders—returned from address given and marked " not known."

The Hotspur II in flight.

Photo by courtesy of Barratt's Photo Press.

R. Mepham. Plans.

No name—no address!! Plans.

Petrol Model flying.

In view of the serious consequences which might well develop through infringement of present restrictions—either wilfully or through ignorance—the following letter from the S.M.A.E. should be read carefully.

The Editor,

Dear Sir,

As Press Secretary to the S.M.A.E. I feel it my duty to point out once again—especially for the benefit of those who are either not aware or who, unfortunately, deliberately ignore it—that an Air Ministry Order has been in force for some time forbidding the flying of petrol-driven models.

This Order includes even the smallest " taxi-test," and whilst I can fully appreciate how the petrol model owner is sorely tempted to try his craft for only the shortest of flips, I earnestly appeal to them not to do so and to remember that it is just possible that through their hasty action the entire movement might be banned. The prospect of writing " finis " to all model flying, whether rubber-driven or otherwise, is rather appalling, and this alone should be more than sufficient to deter the petrol model owner from taking his model out at all, let alone giving the motor even the shortest of runs. After all, the war cannot last for ever, and if through ignorance or neglect of the Air Ministry's Order the flying of all types of models were banned, it requires little imagination to visualise the feelings of the culprit to be pointed out and known as the guilty person responsible for depriving many thousands of other people of one of the most intelligent and recreative hobbies in existence.

Yours faithfully,

H. W. Hills,

Press Secretary.

We, too, have erred. . . .

The prototype Miles Master, a photograph of which appeared in last month's Editorial, was not, as stated, built by D. M. Roberts, but by A. F. Bristow. We extend out apologies to this gentleman for this error, but as his name was not given on the photograph in question it was unavoidable.

Readers should note that when sending photographs of models the subject, the name of the builder and the photographer (if other than the builder) should be clearly stated.

A slant on model design.

A survey of Airfoil Section Sheet sales well illustrates the rather " deep in the rut " attitude that many model designers take in regard to wing profile selection. The most popular sections are :—

R.A.F. 32	12 per cent. total.
Clark Y	10 per cent. total.
Eiffel 400	8 per cent. total.
Grant X-8	6 per cent. total.

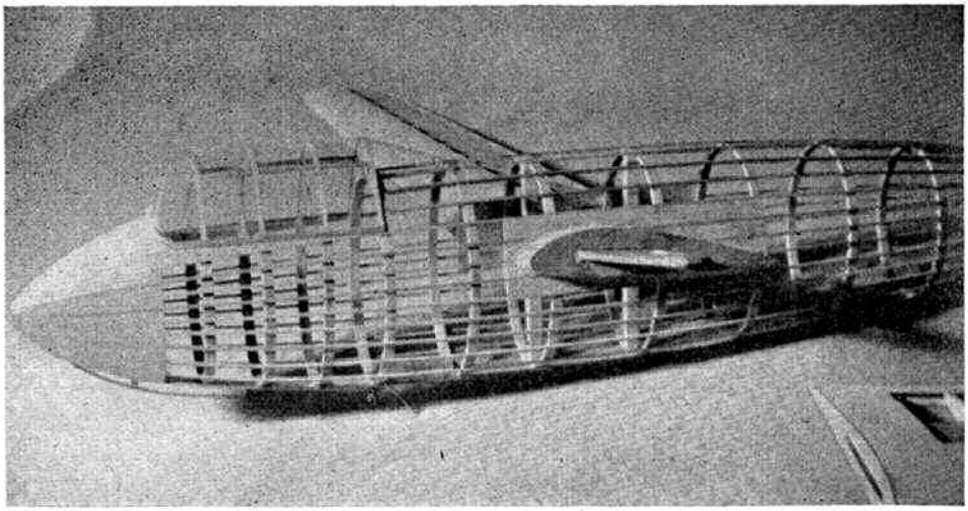
Thus these four sections alone account for nearly 40 per cent. of the total requirements. The relatively poor support of the famous Gottingen sections is rather surprising.

Now each of the thirty six sections available were chosen *because they were particularly suited for model work* and thus we feel that many readers are not realising or taking advantage of the opportunity offered. A short article will be forthcoming in a future issue concerning the merits of these lesser-known airfoils which, up to the present time, appear to be rather obscured by the dazzling brilliance of the well known " popular " types. D. A. R.

HOTSPUR II

CONSTRUCTIONAL DETAILS DESCRIBED BY W. A. DEAN

Reduced scale plans of this fine flying scale model are given on pages 464 and 465 of this issue. Full size plans are available through the Aeromodeller Plans Service, Ltd., price 4/-, post free. Details of a grand competition for this model were given on page 390 of the September issue.



THE "General Aircraft Hotspur" is the first British military glider, of which both data and photographs have been released since the beginning of the war.

At the moment, these machines are mostly used for training purposes—ballast being carried instead of the six fully equipped soldiers who are normally passengers.

No details of the construction have as yet been released, but it is apparent from the available photographs, that this is of wood with ply and fabric covering.

As troop-carrying aircraft are usually abandoned after a landing in enemy territory, the "Hotspur" has not been finished in an elaborate manner. The minimum amount of instruments have been fitted, the pilot only having to contend with as many as one would expect to find in the average car.

Perhaps it is to be expected that the designers of the "Owlet" and "Cygnet" would produce a glider with a tricycle landing technique. As the landing speed is somewhere about 60 m.p.h. and no brakes are fitted, the front skid is rubbed along the ground in order to shorten the landing run. When the machine comes to a standstill, it settles back on to the small skid, set midway between the wings and tailplane.

If a landing has to be made in a small area or on very rough ground, the wheels can be dropped and the skid alone used.

The "glasshouse" is set well forward in the nose, and provides the pilot with good visibility in all directions. This is an absolute necessity for safety. For when flying in formation a careful lookout has to be kept, in order to avoid straying towards any of the towing cables of the accompanying machines.

The "Hotspur" was chosen as a flying model partly because of its popular appeal at the moment and partly on account of the general layout. The latter was the main reason, as the "Hotspur" is the type of glider that a non-scale modeller might design for normal contest work. Without the cabin, it becomes just another well streamlined mid-wing model.

At the moment, there is no national record available for scale gliders, probably because of the unsuitability of most full size designs for model work. This is a pity, because if the "Hotspur" is typical of the present trend of full size glider design, many modellers will no doubt turn to scale gliders as soon as information on other new British and foreign types becomes available.

Only two small deviations from scale were made in the case of the "Hotspur" model. The tailplane area was slightly increased and wing dihedral increased.

One of the worst bugbears of modelling full size gliders is that, in most cases, only a very small portion of the fuselage projects in front of the main plane leading edge. Which usually means that something like half a pound of lead has to be placed in the nose before the C.G. can be shifted forward to the correct position.

The wing section employed on the full size machine is interesting, there being quite a deep convex undersurface to it. It would appear to be after the style of the R.A.F. 31 airfoil, which is hardly the type one would chose for model use, as soaring flights—unlike the full size machine—are aimed at. So on the model, the Gottinger 398 section has been used.

Although the scale of 1 in. to the 1 ft. only gives a span of some 46 in., the model is larger than would at first be expected. This is because of the rather low aspect ratio and blunt tips of the main plane.

Providing the building instructions are carefully read and no attempt is made to rush the model, no real difficulties should be encountered in the construction. The trickiest parts to construct are the formers, which are wound from hardwood strip. A little time spent in making one or two practice formers will be amply repaid, particularly in regard to the lap jointing.

For ease of transport and safety in crashes, knock-off wings—both backward and forward—have been fitted. The fin plugs into the tailplane, which in turn is attached to the fuselage by rubber bands.

In short, the model has all the advantages of the non-scale type, plus the fact that it looks like the real thing.

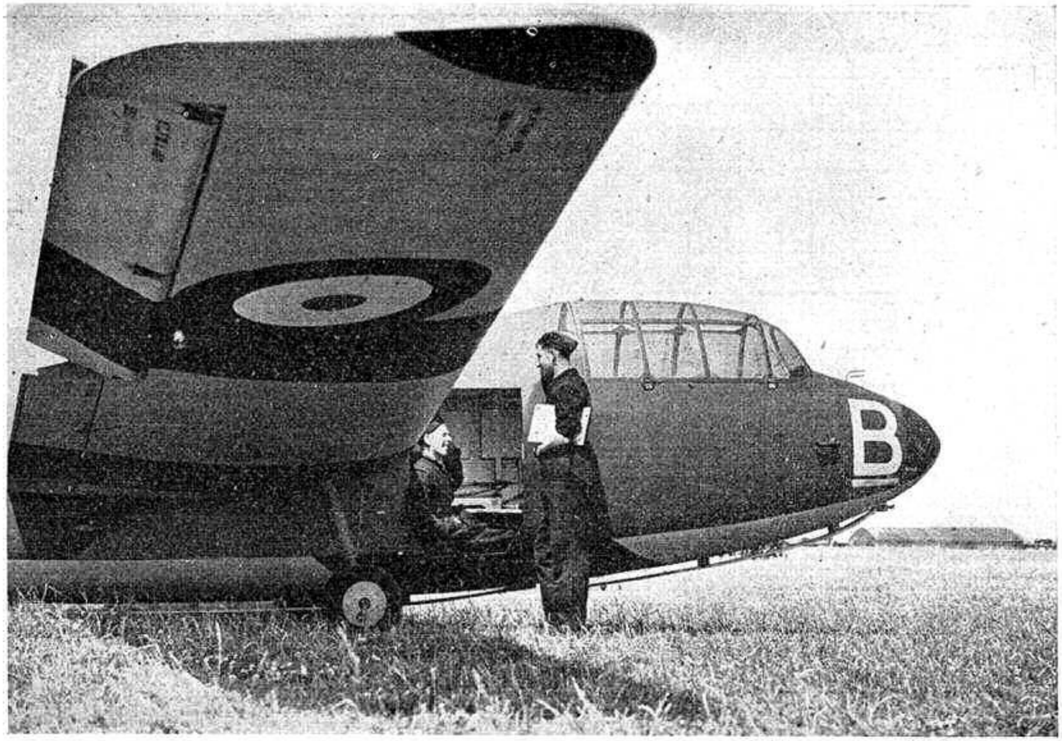
Ready for flying, the all up weight is 16 oz., which gives a wing loading of 8·5 oz. per square foot. Rather high, but as L. G. Temple and many others have shown us, the heavier type of glider is usually amongst the most successful.

Nearly all hard woods are called for in the construction, balsa only being used for the ribs, leading and trailing edges, and the sheet covering. This measure was not taken on account of the scarcity of balsa, but because of the greater suitability of hard woods generally, for large gliders.

Building instructions for each separate component are given in detail below.

Although other parts may be cut out whilst waiting for, say, the wing panels to set—the complete assemblies should be tackled in the same order as they are described in the instructions.

Slow-drying cellulose cement should be used for the hardwood joints and a quick drying cement for those of balsa.



The Hotspur II is employed extensively on training duties and a good number are in service. The relatively long tail moment arm and the fine streamlining of the fuselage is particularly suited to model work and little or no deviation from scale is necessary.

[Photo by courtesy of "The Aeroplane."

Mainplane.

This member is made in two halves, which are fitted together by means of a tongue and box fitting.

First of all, cut out the tongue from a piece of 3 ply and make the two wing boxes on it. These should be a very tight fit, as any trace of looseness will soon become worse after the first few flights. The outside of the boxes are covered with silk—or should this be unobtainable—several wrappings of bamboo paper.

The ribs are cut in pairs. Care should be taken, that those through which the wing boxes pass, are absolutely accurate.

Pin a piece of balsa sheet—large enough to cover the underside of the leading edge—on to the full size plan of one panel. The underside of the trailing edge is also pinned down. Cement the lower spar to the sheeting, followed by the ribs.

Next add the upper spar and fix the wing box in position. The leading edge is carved to shape, cemented in place and the panel removed from the plan. The sheet covering is then attached to the leading edge—pins being used to keep it in place until the cement dries. The upper sheet covering is added, using the same method. Next comes the upper portion of the trailing edge and the capping strips. Lastly, sheet in between ribs 1 and 2, then attach RIB B to the root rib. The tip is built up from several laminations of $\frac{1}{4}$ sheet and carved after being cemented to the last rib, so as to ensure a perfect shape.

Repeat for the other panel, then attach both sides to the tongue. Cut a slight groove down the centre line of the upper surface of the tongue and crack to achieve the correct dihedral. When this has been done, prop up the tips, pour plenty of cement in the crack and cement the two dihedral keepers in place.

Fuselage.

The hard wood strip for the formers should be allowed to soak for at least twelve hours before use. Cut the templates from any scrap sheet wood about $\frac{1}{4}$ in. thick, such as box planking, etc., and mark off the stringer position as indicated on the drawings.

Keep the strip in water until it is actually needed. Take a piece of approximately the right length, remove the surplus water and lap one end. This lap is held tightly to a flat portion of the template, which is then rolled along the strip until a complete loop has been made. Wrap round with thread or rubber and put aside to dry for an hour or two. When the wood is quite dry, cement can be applied to the joint and the binding replaced. Lastly, the surplus strip is trimmed off at the joint.

The centres of the templates are drilled or cut to receive a $\frac{1}{8}$ in. dowel. Mark off the template positions on the dowel, then cement them in place on it.

The four main stringers (shown in heavy black) and the keel are first attached to the formers. If these are fitted quite accurately, the rest of the fuselage construction will follow on smoothly from this point.

The remaining stringers with the exception of those marked "X" may now be fitted.

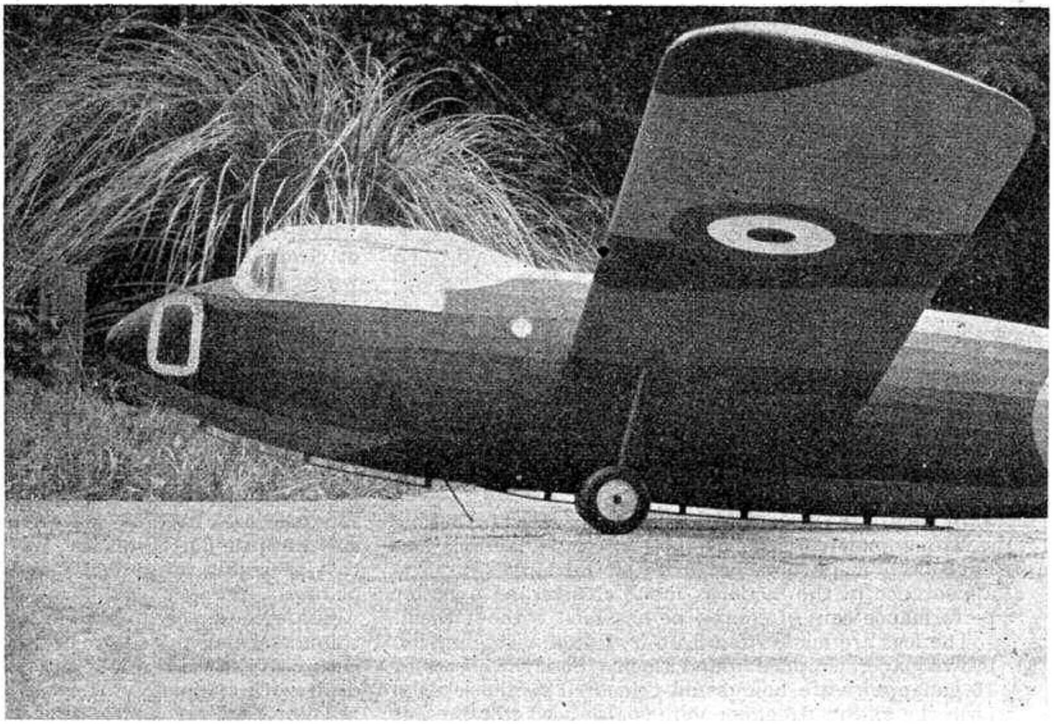
It is best not only to be guided by the positions marked on the formers, but also by sighting along the stringers to ensure that no waves or bumps occur.

The actual position of the stringers on the middle and two end formers should, however, be strictly adhered to, otherwise there is a danger of getting a twist to the whole structure. It will be found helpful if the remaining stringers are held roughly in position by elastic bands, when each is then treated separately and cemented to every former.

The next stage is to attach the wing tongue to formers F.8 and F.9, at the correct angle of incidence as indicated.

Before finally cementing in place, put the wings on to ensure that they both form similar angles with the fuselage sides.

The fuselage jig should be removed at this stage. The templates are split with the grain and separated from the dowel, with a pair of long-nosed pliers. Then the eight remaining stringers and the $\frac{1}{2}$ in. by $\frac{1}{4}$ in. braces can be added. Alternative method of separating false formers is to cut them in half before assembly, stick together with strips of paper, they can then be easily separated.



The model, and, opposite, the real thing. The only distinguishing feature is the tow hook located between the first and second skids on the model. Finished in correct camouflage colours and possessed of fine flight performances the Hotspur II is a worthy addition to any modellers' collection.

For strength and to facilitate covering, ⅛ in. sheet is cemented between these stringers in the vicinity of the tongue, the surplus sheet which projects above the stringers being sanded down flush with them.

Cut the four "A" ribs from 1/32 in. ply and cement them to the protruding pieces of the tongue. Check to see if the two outer ribs are set square with the fuselage, by attaching a piece of thread to the extreme rear of the fuselage and stretching it to each wing tip in turn. If the ribs are correctly positioned, fill in the space between them with ½ in. sheet balsa.

Leave a small portion above the level of the ribs. When both sides have set quite firmly, remove the wing panels and sand the sheet down to the contour of the ribs.

⅛ in. sheet balsa is also used to cover in the nose between formers 1 and 2. The nose block is made from a solid piece of hardwood or very hard balsa. This is only roughly carved to shape first of all, and is finished off with medium sandpaper after cementing to former No. 1.

An entirely new method of construction has been used for the cabin, whereby the strength has been brought up to that of the surrounding fuselage structure, and the realism considerably increased.

This has been made possible by making much smaller ply formers than are customary and then fitting pieces of celluloid of the same thickness of the ply, in the cut-out portion.

When the outer celluloid cover is in place, these celluloid reinforcements are almost invisible.

The five cabin formers are first cemented to the respective fuselage formers and then the horizontal pieces of 1/16 in. square birch cemented between them. Three separate pieces of celluloid are used to cover over the cabin between F.3A, F.4A, F.5A and F.6A. The portion between 2A and 3A is a little bit too involved to attempt to cover with a single piece, so two sections are cemented to the sides and joined at the top.

Attach each piece of celluloid by one edge first, allow to set, then bend over and keep in place with rubber bands or pins until the cement dries.

Make a paper template for the rearmost piece of the cabin, only attaching the celluloid very lightly as it will have to be removed when the bamboo paper covering is being applied.

Pipe spills are used to give the cabin a recessed effect and also to cover up the joints between the separate pieces of celluloid.

The towing hook assembly is cemented and bound to the right hand side of the keel (viewing from the front). Two long strips of balsa are used to cover in between the three bottom stringers up to F.11.

Small pieces of birch are used to represent the rubber cushions of the full size middle skid. These are cemented to the fuselage first and the skids attached to them afterwards.

The centre skid—the one just behind the towing hook—is not at any time in contact with the ground, so there is no need for this part to be unduly strong. On the other hand, the front and rear skids will both have to withstand severe landing shocks and should therefore be firmly attached to the fuselage.

Lastly, smear cement between the stringers rear of F.15 and cut away the piece marked "XX."

Tailplane.

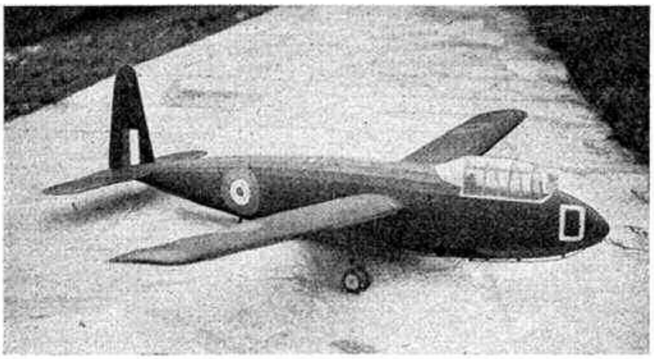
The ribs of both the tailplane and fin are made from pieces of strip balsa.

Pin the lower rib strips to the plan and cement the main spar leading and trailing edges to it. Then add the upper rib strips and the piece of the fuselage which was cut away. The tips are made from pieces of sheet balsa and cut to shape after being cemented in place.

A tube is wound from gummed brown paper and cemented to this unit to provide a fixing for the fin. Make sure that this tube is set upright by inserting a length of dowel and checking with a set square.

The fin construction is similar to that of the tailplane, except that in this case a dowel is used as the main spar.

As the airfoil section is symmetrical, the leading and trailing edges are both packed up with scrap balsa when this member is pinned to the plan.



Undercarriage.

Although the model can still be claimed as an authentic flying replica without the undercarriage, it was felt that some readers may care to fit one for exhibition purposes, etc.

In view of the structural difficulties involved in making a strong undercarriage of this type, the landing legs have been made detachable for flying purposes. The appearance of the model is much clearer and a better performance can, of course, be obtained without them.

The legs are made from 3/16 in. dowel with gummed brown paper wrapped round them. Straight pieces of 16 gauge wire are bound and cemented to the legs, to form the axles. 16 gauge wire is also used to represent the front bracing pieces.

Paper tubes are rolled round the legs and then cemented inside the wings at W.3. Plug in the legs to obtain the correct forward start and then pour plenty of cement around the tubes.

The wheels used on the original model were standard wooden balloon ones, with discs of 1/32 in. balsa cemented to the inner portion.

Covering.

Plain white bamboo paper is used to cover the entire model and use tissue paste as the adhesive. Banana oil is best for keeping down the overlapping portions, but is not an absolute necessity.

The wing panels are covered in two pieces each. First attach the paper to the root rib, then stretch taut to the tip. Apply paste to the leading and trailing edges and pull the paper outwards to them. Repeat for the underside, only in this case, paste must also be applied to the capping strips, as there is a slight undercamber to the ribs.

Use the same method for the tailplane. Two pieces of tissue are needed for each side. The fin is covered with two pieces of tissue in the same manner as the wings.

The fuselage is covered with several long strips of bamboo paper. Try to cover as large an area as possible with a single piece—between five or six stringers is the maximum width that can be managed, without getting any really bad wrinkles.

Each piece of paper is stretched tightly along the fuselage and attached to the centre stringer of the group under consideration. Paste is then applied to the outermost stringers only and the paper pulled taut to them.

When a portion has to be covered, with paper already in place on either side, a considerably wider piece of paper than the actual width of this portion should be used, the surplus being trimmed off after the paste.

Water dope the entire model and then apply one coat of clear dope. Pin the flying surfaces to a flat board whilst the dope is drying. If the fuselage develops a twist at any stage in the construction, it is an easy matter to get rid of it whilst the dope is still wet.

To ensure accuracy in the colouring of the model, all the dividing lines should be marked out beforehand. Pencil is better than nothing, but the ideal way is to use indian ink applied with a ruling pen and a pair of ink spring bows.

A straight edge of thin celluloid can be used for drawing the diagonals on the under surfaces. The shadow shading lines can, of course, be drawn in free hand. The lines should be marked on the assembled model so that they join up perfectly at the wing roots and tailplane.

Coloured dopes are used throughout, clear dope or thinners being added to obtain the right consistency. Two coats of each colour are needed—one colour being dealt with completely at a time.

The R.A.F. roundels and fin markings should be painted in first, followed by the rest of the colour scheme. The order in which the colours are applied, is not important, but mistakes can be more easily rectified if the lighter ones are used first.

Flying.

Lead shot is poured in the nose block until the model balances at about 30 per cent of the root chord.

Test flights should be made on a gentle slope if possible—any changes in trim being made by varying the amount of weight carried in the nose.

The estimated gliding ratio of the original model is in the vicinity of 10:1, and a marked tendency to soar is noted in any wind.

Tow line flights can be made in the usual manner, using the wire hook fitted for this purpose.

In this month's "Fighting Aircraft of the Present War," H. J. Cooper has dealt fully with the "Hector," which is mostly used for towing the Hotspurs. With this information a really keen modeller could scale up the drawings to 1/12 in. full size and build a model of the "tug" as well as the Hotspur.

The hardest part of flying the two models together would be obtaining a smooth getaway with the Hotspur. When both models were safely in the air, there is no reason why the Hotspur should not behave as well as it does on the tow-line.

Some form of cable release will, of course, be necessary, so that the Hotspur is given a "high start." Should the reader be tempted to try this very ambitious project, the wing loading of the tug must be higher than that of the glider; otherwise a number of insurmountable difficulties may arise.

REDUCED SCALE WORKING DRAWINGS ON PAGES 464 AND 465

FULL SIZE PLANS, PRICE 4/– POST FREE, FROM THIS OFFICE

£10 : 10 : 0 FOR THE MODELLER OBTAINING THE BEST FLIGHT WITH A MODEL HOTSPUR II BUILT FROM AEROMODELLER PLANS

SEE PAGE 390 OF SEPTEMBER ISSUE FOR FULL DETAILS

THE STREAMLINER—By W. A. DEAN

The Fuselage.

This member is made up in the usual way on a jig. First of all cut out all the bulkheads, replace their centres by cementing lightly, cut holes in them to take a length of ½ in. square birch and then thread them on to it.

Cement the four 1/16 in. square stringers in place, then make the undercarriage to the shape indicated on the plan, bending it to trap the two pieces of brass tube at the top. Spread a coat of cement over the part of Former "C" where the pieces of tube fall, wait until it is quite dry and then attach them with plenty of cement. The wheels are quite straightforward and are kept on, when completed, by a dab of solder. The spring arrangement, consisting of a piece of thread and a rubber band, is cemented in place. Wind a paper tube about 6 in. long, around a piece of ⅛ in. dowel, using white tissue paste as adhesive. When quite dry cut off pieces to the size required and cement to formers "C" and "E." Save the remaining tube for the wing halves.

Finally, fit ¼ in. blocks for the tail plug fixture, then the fuselage is ready for the sheet covering to be applied. This consists of eight pieces of 1/32 in. sheet, roughly cut to shape and trimmed on assembly.

Now cut the two "X" ribs from 1/16 in. sheet and attach them to the projecting pieces of paper tube. Fill in the spaces on either side with scrap and finish off into a neat fairing with plastic balsa.

The Wing.

The wing is in two separate pieces. The dowel in each half passing through the fuselage and then into tubes set in each other.

Commence by drawing both wing panels full size on to a piece of cartridge paper, then pin to a piece of stout 3-ply. Make the ribs in pairs from 1/32 in. sheet.

To build one panel, pin the lower 1/16 in. square spar on to the drawing. Cement the ribs to it and then add the upper spar.

The outer portion of the trailing edge is made from 1/16 in. sheet and joined to the inner piece of 1/16 in. by ⅛ in. strip. Cut ⅛ in. slots in it to take the ribs, pin in place on the plan and cement to the ribs. The leading edge is a piece of ⅛ in. square set on edge, the end being steamed to form the curve at the tip.

The sheet covering on the leading edge is in two pieces. Use pins and elastic bands to keep it in place until the cement has set. The paper tube and dowel are attached lightly, parts being firmly fixed after other parts have been built and the correct dihedral ascertained.

The Tail Plane.

The tailplane construction is similar to the wing. When completed, cut the portion of the fuselage away at "XX" so that former "K" still remains with the fuselage. Cut a hole as large as possible in this former to provide access to the rubber. Shape the underneath of the portion which has been cut away, to fit the upper contour of the tailplane, then cement together. Make another top half of "K" and inset it into the leading edge.

The upper half of the fin is cemented to the tailplane and faired into it with plastic balsa. The lower half is cemented to the fuselage to form the skid.

Propeller Assembly.

All details are given on the plan, so all that needs to be said is just how the freewheel operates.

When under pressure the prop shaft revolves in an anti-clockwise direction, viewed from the front. This brings the bent over portion up against the upright side of the stop "A." When the rubber is unwound the propeller still turns with the wind pressure, until the prop shaft slides up and over the inclined side of "A." The advantage of this type of freewheel is that nothing has to be connected up before winding. Immediately any pressure is put on the rubber the shaft connects up with the propeller.

Covering.

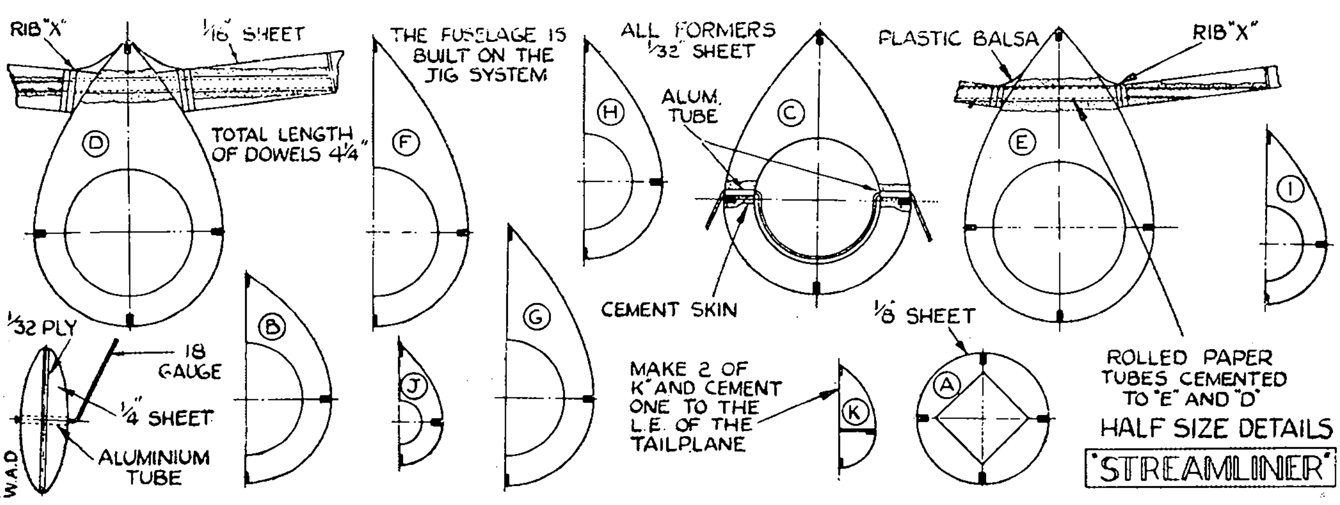
Before applying the tissue covering, go over the entire model with some very fine glass paper in order to remove any roughness which might spoil the finish.

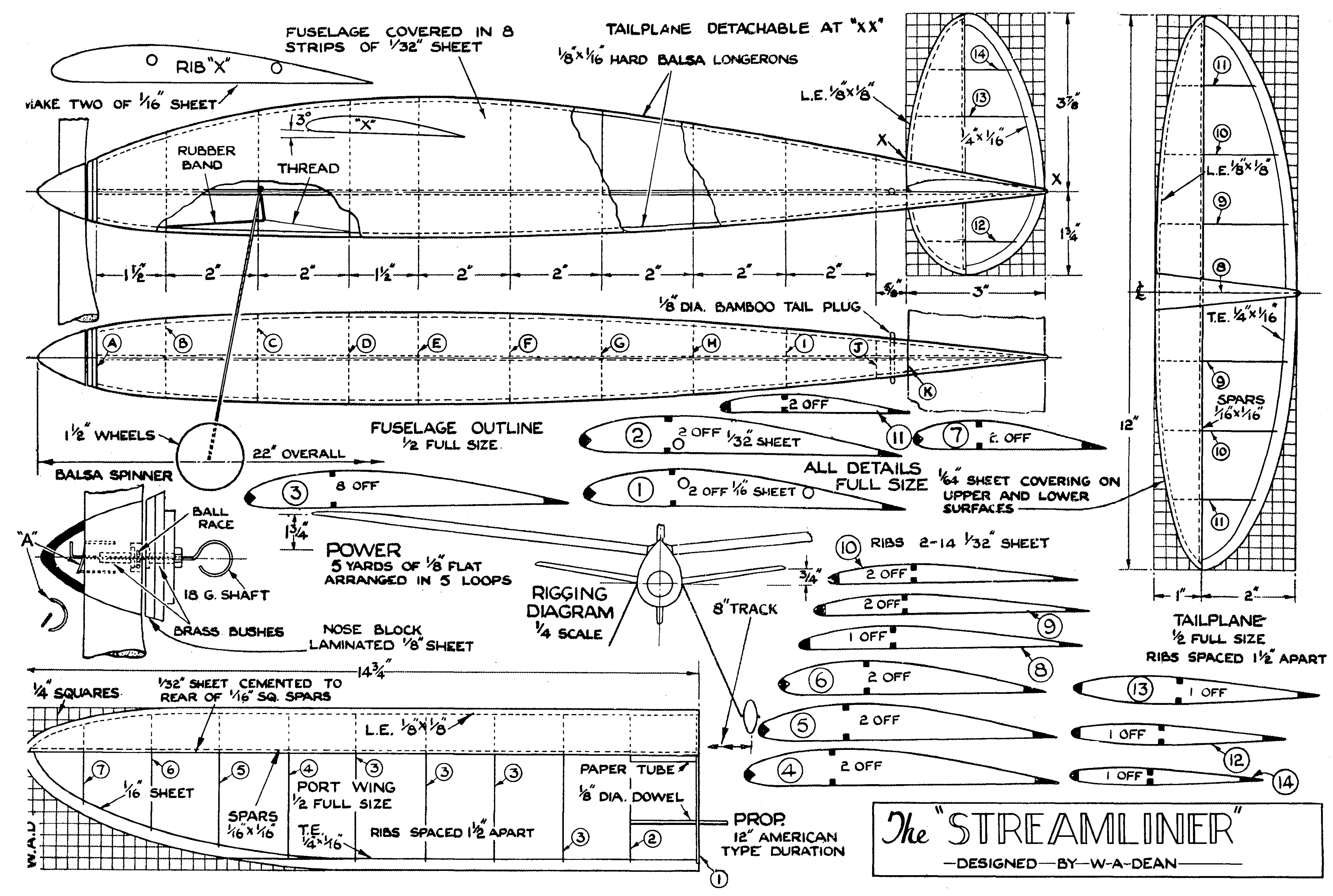
Cover the flying surfaces with tissue, using a white paste such as "Grip-fix" and then spraying with water afterwards to tighten it. Give the wings two coats of dope and then one of banana oil. The tailplane is given one coat of each. Apply three coats of banana oil to the fuselage and prop assembly, sanding in between coats.

Flying.

Test fly in long grass on a few turns. If possible, try to obtain the correct trim by means of warping the flying surfaces slightly. If this proves insufficient, use a movable weight slung underneath the fuselage. The model should be trimmed to circle to the right by means of slight side thrust, this means that the model circles on power and flies straight on the glide.

BUILD FROM THE PLANS ON PAGES 452 and 453.




FUSELAGE COVERED IN 8 STRIPS OF 1/32" SHEET
TAILPLANE DETACHABLE AT "XX"
1/8"x1/16" HARD BALSA LONGERONS
RIB "X"
MAKE TWO OF 1/16" SHEET
3°
"X"
RUBBER BAND
THREAD
L.E. 1/8"x1/8"
1/4"x1/16"
X
X
3 7/8"
1 3/4"
1 1/2"
2"
2"
1 1/2"
2"
2"
2"
2"
2"
5/8"
3"
1/8" DIA. BAMBOO TAIL PLUG
A
B
C
D
E
F
G
H
I
J
K
2 OFF
2 OFF 1/32" SHEET
2. OFF
1 1/2" WHEELS
FUSELAGE OUTLINE
1/2 FULL SIZE
22" OVERALL
BALSA SPINNER
8 OFF
2 OFF 1/16" SHEET
ALL DETAILS FULL SIZE
1/64" SHEET COVERING ON UPPER AND LOWER SURFACES
BALL RACE
"A"
1 3/4"
POWER
5 YARDS OF 1/8" FLAT ARRANGED IN 5 LOOPS
18 G. SHAFT
BRASS BUSHES
NOSE BLOCK LAMINATED 1/8" SHEET
RIGGING DIAGRAM
1/4 SCALE
3/4"
8" TRACK
RIBS 2-14 1/32" SHEET
2 OFF
2 OFF
1 OFF
2 OFF
2 OFF
2 OFF
L.E. 1/8"x1/8"
T.E. 1/4"x1/16"
SPARS 1/16"x1/16"
12"
1"
2"
TAILPLANE
1/2 FULL SIZE
RIBS SPACED 1 1/2" APART
1 OFF
1 OFF
1 OFF
14 3/4"
1/4" SQUARES
1/32" SHEET CEMENTED TO REAR OF 1/16" SQ. SPARS
L.E. 1/8"x1/8"
1/16" SHEET
SPARS 1/16"x1/16"
PORT WING
1/2 FULL SIZE
T.E. 1/4"x1/16"
RIBS SPACED 1 1/2" APART
PAPER TUBE
1/8" DIA. DOWEL
PROP.
12" AMERICAN TYPE DURATION
W.A.D.
The "STREAMLINER"
—DESIGNED—BY—W-A-DEAN—

MODEL RACE CARS

By D. A. RUSSELL, A.M.I.Mech.E.

This article has been especially written in response to popular demand for guidance in the design of model race cars. Readers are reminded that two grand prizes of 10 guineas each have been offered, full details and rules of this competition being given on pages 391, 392 and 393 of last month's issue.

Attention is drawn to the fact that all model cars entered MUST BE INSURED UNDER THE NEW N.G.A. SCHEME, details of which are given on the opposite page. Apart from merely being a competition rule this scheme is an admirable safeguard for ALL model builders.

FROM the correspondence already received, it is clear that the article on the "A–G" race car published in last month's AERO MODELLER has aroused some considerable interest amongst petrol engine owners; and the following notes are offered with a view to assisting those enthusiasts who propose to design and build their own cars.

Firstly, in regard to the power unit. It is essential that a fly-wheel be fitted; otherwise uneven running will result the moment the wheels cease to have contact with the ground. A flywheel will *reduce* wheel-spin should "bouncing" occur when passing over rough ground of a "ridgy" nature. For engines up to 6 cc. the diameter and width might be from 2 in. to 3 in. by ⅜ in. to ½ in. respectively; and for engines between 6 and 10 cc. the dimensions could range between 3 in. to 3½ in. by ½ in. to ⅝ in. respectively.

The flywheel should be of cast iron or steel, securely fixed to the engine shaft; it should be provided with a groove for the starting cord, and should have a slot or other suitable device provided for engagement with the driven shaft of the gear box.

Mr. Galeota used standard Meccano parts for his gear box; whether such units will take the power from a 10 cc. engine I cannot say—until I have tried—but I shall try! The gears should, of course, run in oil; and in fact for high speed work *must* do so. A simple gear box can be easily built up from 1/16 in. steel plate —with corners of ¼ in. by ¼ in. by 1/16 in. angle bolted and soldered. Gear-shafts should not run in the 1/16 in. thick sides of the gear box; but in bushes or ball races secured to the sides. The brass collars supplied by the Meccano Co., and fitted with grub screws for securing them to the standard meccano shaft, would do quite well, if hard soldered to the insides of the gear box plates.

Mr. Galeota chose front wheel drive, I think for simplicity and with the idea of combining the bevel drive to the axle with the gear box. I see no reason to depart from that, except that I disdain the starting cord and hope to crank up the engine by a starting handle fitted in the usual place! This can quite well be arranged by mounting the bevel wheel to one side of the gear box, and allowing the main driving shaft (from the engine) to be extended forward to the front of the car. (This means that the spur gears used for reduction purposes must be mounted one-above-the-other so that the driving shaft can pass underneath or over the (cross) bevel shaft transmitting the drive to the wheels; and not side-by-side, as in Mr. Galeota's car, as, of course, then the (cross) bevel shaft, and gears shafts are on the same axis.)

Now for the chassis. I do not think that there is any need for a chassis of the type usually constituted for a racing car, i.e. one built up from a number of channels and tubes and complete with laminated springs, shackles, etc. It seems that the chassis may well be constructed by joining two side members of about ¾ in. by ¼ in. ash, spruce or birch by 3 or 4 cross members of a similar section. Joints should be morticed, and/or reinforced by fillets of 1/16 in. 3-ply.

With front wheel drive, it is the *rear* axle which is slightly swivelled for steering purposes. This may be effected by mounting one end of the axle shaft in a self-aligning ball bearing, suitably mounted on the chassis frame and arranging for the ball race carrying the other end of the axle to be adjustable in a fore and aft direction. Mounting for the front axle could consist of ball races mounted in fairly soft rubber blocks, thus providing a certain amount of resiliency. As for tyres, those sold for petrol planes should be quite suitable. Of course, new ones are not now available, but there must be a considerable number about the country. As alternatives to pneumatics, "hollow" tyres, as made by several manufacturers before the war, and fitted round glass/bakelite ashtrays might well be considered. They would have to be mounted on specially made wheels which gripped the sides of the tyres. I do not advise built up wheels—far better to keep to plain wooden ones, tuned up by any carpenter, to which suitable bush or ball race bearings can be fitted.

As for the "finishings"—here is a change for the "scale" fans! Dummy brake drums, steering rods, petrol tanks, etc., can be easily fabricated from thin 3-ply and balsa. Balsa can also be used for fairings over the wheel axles, to say nothing of the springs and shackles which aren't there!.

The body and bonnet will be "easy money," the former carved from a block of balsa, the latter built up from thin ply. Exhaust pipes can be built up from short lengths of flexible gas tubing, or the flexible outer casing of speedometer or revolution counter drives for car or aircraft engines.

Mr. Galeota told me that it is possible to run the car to and fro across a garden, catching it with both hands, swiftly turning round, and replacing it on the ground—at speeds up to 20 m.p.h.; but for R.T.P. work and for higher speeds I advise the fitting of a time switch in the usual way.

Most model power boat racing is R.T.P., and in many cases the line from the pole to the boat is so attached to the latter, that, under the tension caused by centrifugal forces as the boat circles the pole, contact in the ignition circuit is maintained. However, should the line break, the ignition circuit is also broken, thus preventing the boat hitting the side of the pond at full speed.

I strongly advise the fitting of such a device to model race cars, together with a time switch.

As regards weight distribution, I can only suggest that the coil and battery are placed over the rear axle, as it seems to me that, generally speaking, the weight on back and front axles should be about the same.

Cooling must, of course, be well looked after, as there will be no airscrew providing a blast over the cylinder; so the radiator should be well honeycombed, air inlets provided at the top and sides of the front of the bonnet, and ample provision made for exit of the heated air.

As for performance—here are some calculations which will show that *theoretically*, very high speeds should be obtained from these model race cars. I might add, that in America speeds in excess of 100 m.p.h. are claimed!

Tractive resistance due to motion is composed roughly of two parts.

(i) Rolling friction.

(ii) Air drag.

(i) This may be represented by the equation, frictional force, F, $= \mu W$ where W = wt. of car.

μ = co-eff. of rolling friction.

Approx values of μ for model work are

- μ for rubber tyres on concrete ·05.
- μ for rubber tyres on hard turf ·075.
- μ for rubber tyres on short grass ·1.
- μ for rubber tyres on long grass ·15.
- μ for rubber tyres on soft ground ·3 to ·5.

(ii) This is the result of air resistance and the general formula $D = K\,A\,V^2$ may be applied. The value of K will depend upon the actual layout of the car and the degree of streamlining. For a flat plate K = ·0015–200 and a general value for cars may be assumed to be ·001.

Based upon the above it is possible to make a few sample calculations.

Model (A) B.H.P. available = ·2.

Weight of car = 5 lbs. Normal cross sectional area = 6 sq. in. It is assumed that the car is to be run over short grass, and thus $\mu = \cdot 1$.

Total tractive resistance = friction + air drag

$$= \cdot 1 \times 5 + \frac{\cdot 001 \times 6 \times V^2}{144}$$

$$= \cdot 5 + \cdot 0000416 \times V^2$$

H.P. required $= \frac{R.V.}{375}$ where V is expressed in m.p.h.

$$= \frac{(\cdot 5 + \cdot 0000416\,V^2)\,V.}{375}$$

At maximum speed $HP_r = HP_a$. Thus maximum speed is given immediately by the cubic equation $\cdot 2 = \frac{(\cdot 5 + \cdot 0000416\,V^2)\,V}{375}$ in the particular case in point.

This equation has three roots of the form

$$V = A + B, \text{ or } -\frac{A+B}{2} + \frac{A-B}{2}\sqrt{-3}, \text{ or } -\frac{A+B}{2} - \frac{A-B}{2}\sqrt{-3}$$

where

$$A = \sqrt[3]{\frac{75}{\cdot 0000832} + \sqrt{\frac{\frac{75^2}{\cdot 0000416^2}}{4} + \frac{\frac{\cdot 5^3}{\cdot 0000416^3}}{27}}} \text{ r (sic)}$$

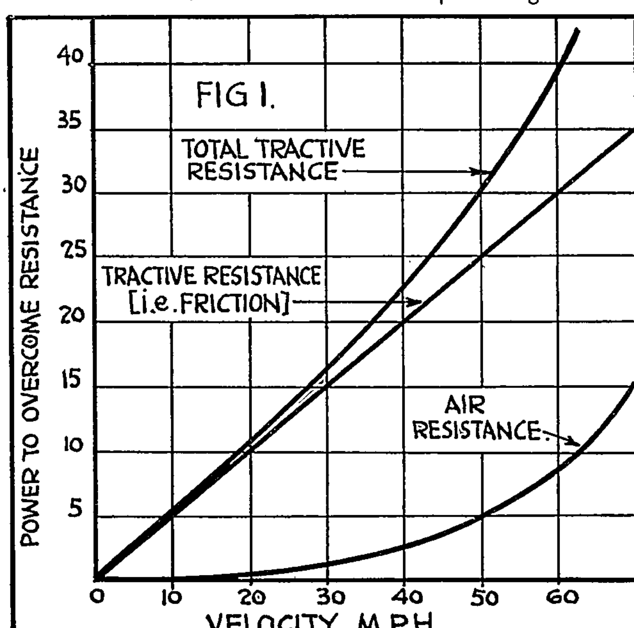
$$B = \sqrt[3]{\frac{75}{\cdot 0000832} - \sqrt{\frac{\frac{75^2}{\cdot 0000416}}{4} + \frac{\frac{\cdot 5^3}{\cdot 0000416^3}}{27}}}$$

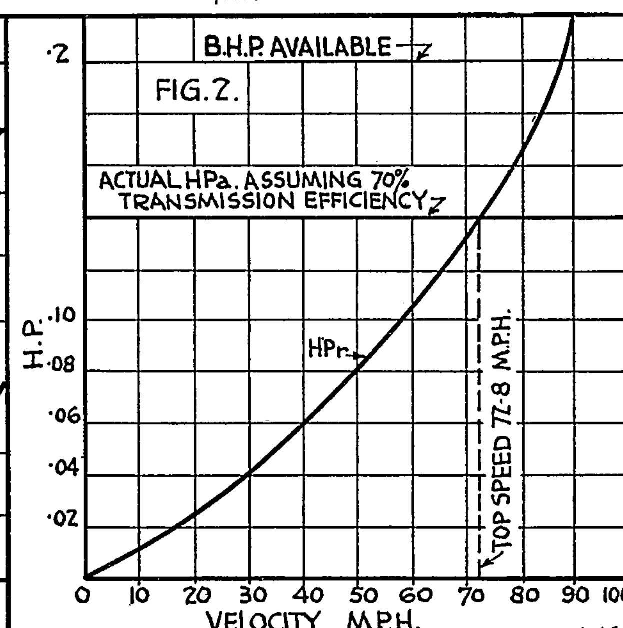
and maximum speed is given by one of these. Such complication is to be avoided and thus the graph Fig. 1, is interesting. In this the two resistance components, friction and air drag, are plotted separately over a fair speed range. It will be appreciated from this that the effect of air drag is not readily felt until high speeds are reached and thus the problem may be considerably simplified by considering the tractive resistance as composed of pure rolling friction.

The equation for top speed then immediately simplifies to

$$H\,Pa = HPr = \frac{\mu W.V.}{375.}$$

$$\text{i.e. } V = \frac{375\,H.Pa}{\mu W.}$$





Now H Pa = μ BHP, where μ is the mechanical efficiency of the transmission. Assuming an average value of 70 per cent. the top speed for the example under consideration becomes

$$V = \frac{70 \times \cdot 2 \times 375}{100 \times \cdot 1 \times 5}$$
$$= 105 \text{ m.p.h.}$$

At such high speeds, however, approximately one-half of the main resistance will be air drag and thus it would appear that we cannot neglect air resistance if accuracy is required for high speeds.

The solution, then, must be graphical for simplicity. Using the first equation for total resistance this must be computed for various speeds and a graph drawn as in Fig. 2. A further graph, a straight line, is drawn representing H.Pa. Where this cuts the first curve, the corresponding value for velocity gives top speed. The top speed given by this method for the same example is 72·8 m.p.h.

Calculations may be made also, in regard to acceleration, with a view to deciding possible gear ratios. This will also serve as a pointer as to the optimum rate of revolutions of the engine.

In the previous example quoted, the top speed is 72.8 m.p.h. or approximately 106 feet per second. Assuming a wheel diameter of 4 in., the rate of revolution of the driving wheels (no slip) must be

$$\frac{106}{\frac{4\pi}{12}} \text{ r.p.s.}$$
$$=100 \text{ r.p.s. approx.}$$
$$=6{,}000 \text{ r.p.m. approx.}$$

To obtain the B.H.P. quoted from the particular engine employed, it may be advantageous to use a flywheel and run the engine at a higher rate than this, say 12,000 r.p.m. or 200 r.p.s. when a 2:1 reduction gear would be required. A figure slightly above the calculated speed might be allowed to take care of a certain amount of slip which is inevitable—just what percentage I am not prepared to "guesstimate," but with correct springing, it should not be more than 3 to 5 per cent.

In my opinion it should be quite possible to run a well designed and properly tuned two stroke, such as is used for model aero work, at speeds between 10—15,000 r.p.m. by fitting a suitable flywheel.

The calculation of acceleration for a given fixed power output is rather complex. This is rendered more difficult by the fact that the engine is developing power below its maximum at speeds below the maximum design r.p.m.

The general equation of motion may be given as

$$\frac{W}{g} \quad V. \quad \frac{dV}{ds} = P - \mu W - KAV^2$$

and solution by integral calculus is somewhat involved.

However, simplifying the equation, and assuming a constant power available P. it should thus be possible to calculate acceleration for a number of velocities up to top speed when the combined resistances will obviously equal P and acceleration will disappear.

Such a graph is shown in Fig. 3, where acceleration at any point can be quickly read off.

Given these figures the time to accelerate to any given speed from rest or from any other speed may be calculated from the general equation.

$$V = U + ft^2 \quad \ldots\ldots\ldots\ldots \text{(I)}$$

or the distance covered from

$$S = Ut + \tfrac{1}{2} ft^2 \quad \ldots\ldots\ldots\ldots \text{(II)}$$

A further general equation of motion which may be usefully employed is

$$V^2 = U^2 + 2\, fs \quad \ldots\ldots\ldots\ldots \text{(III).}$$

In practice, of course, questions of acceleration will arise only in the case of "standing starts," and it is with a view to making conditions as simple as possible, since we are all beginners, that I have organised the first competition on the basis of a fixed number of "all out" laps, thus allowing each car to get into its stride in its own manner, and in its own time, before timing is commenced.

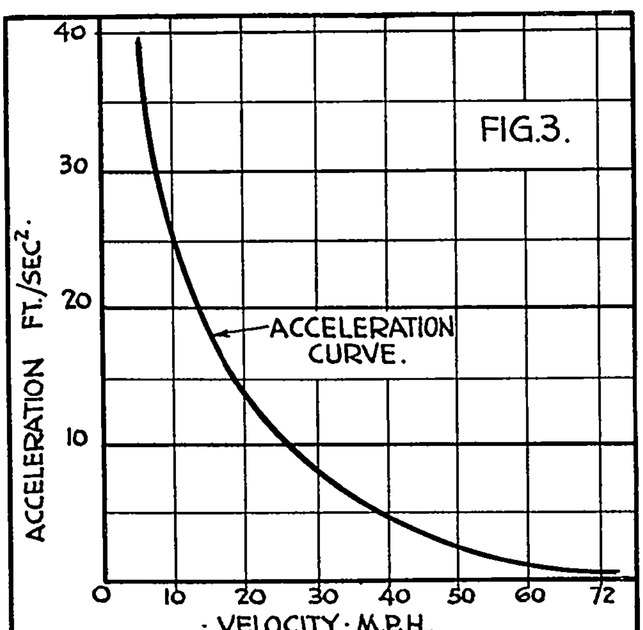
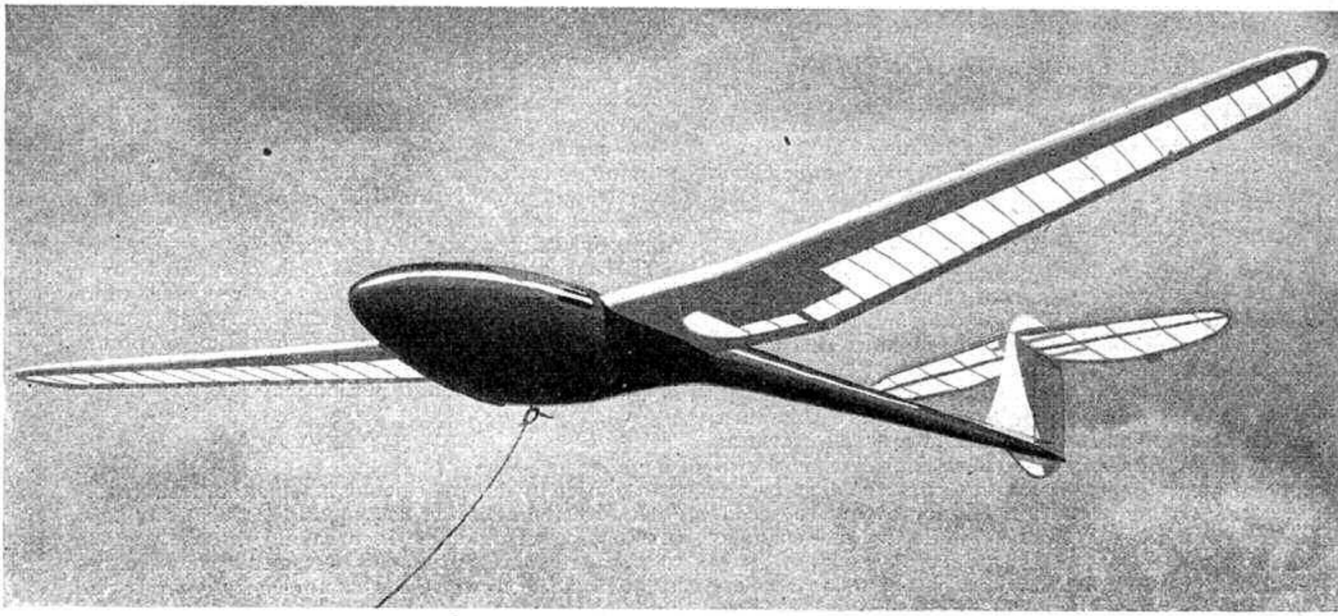


FIG.3.

As a guide to the builder the following types of cars are suggested as suitable prototypes for model work. Each of these machines have been detailed in Motor Sport and copies of the magazine in which they appear may be purchased from their offices, the address being : Motor Sport, 21, City Road, London, E.C.1.

		Price
Alfa Romeo 1½ litre two-seater	March 1934	2/-
Alfa Romeo 1¾ litre "Zagato"	Aug. 1936	1/6
Aston-Martin Ulster	Aug. 1937	1/6
Aston-Martin Le Mans	June 1933	2/-
Aston-Martin International	Aug. 1932	2/-
Bentley 4½ litre Le Mans	Jan. 1942	1/-
Bentley 3 litre "Blue Label" (Special)	Feb. 1939	1/-
Bugatti 3.3 litre	June 1939	1/-
H.R.G. 1½ litre Le Mans	Dec. 1939	1/-
Lagonda 4½ litre	May 1936	1/6
Mercedes-Benz 5.4 litre and similar models; M.G. Midget; J3; Double Twelve; J1; T, etc.	May 1933; June 1930; Sept. 1932	2/-
Stutz "Black Hawk"	Jan. 1930	2/-
Triumph "Gloria"	Jan. 1934	2/-
Wolseley "Hornet"	April 1934; Sept. 1930	2/-; 2/-



LAUNCHING YOUR SAILPLANE *By* L. G. TEMPLE

The first method of launching which I will discuss is the *Hand Launch*. It is one of those things that look so easy, but are really quite difficult if you want to get good results. Really long flights are possible with only a very slight slope. The prevailing wind should be more or less at right-angles to the line of the slope. Launch from near the brow of the hill, never down towards the bottom.

I have found that the best "contour soaring" is obtained by trimming the machine so that it can be launched slightly to one side of the direct breeze direction; it is a good plan to have a model that flies either "crabwise" or in very large circles.

For contour soaring from a hand launch, *great* lateral stability is necessary. You must have a machine it is impossible to upset; one which can be launched at any angle to the wind without the likelihood of its side-slipping or spinning. The crabwise attitude is much better than when a machine tries to fly directly into wind all the time, unless the breeze is very slight. There is no slowing-up or stall, and very often a model with good weathercock control will tack up and down over a slope.

I consider that for this type of flying it is essential to have a long moment-arm, a large and "powerful" fin in conjunction with a shortish nose, and a great reserve of lateral stability.

There is another method of obtaining quite good hand-launched flights even on flat ground; it is a somewhat unexploited phase of model sailplane flying, but one that interests me very much. I refer to "Dynamic Soaring." This is soaring by taking full advantage of the rising and falling wind velocities on a gusty day. The machine should be trimmed to make one complete circle per cycle of wind, and here again it is best to launch it slightly out of wind, but in such a direction that it turns away from the wind and does not crab along as it would in slope-soaring.

The actual launch is not easy to describe; it would be best to practice it until you feel confident under all conditions. Handling a model with a large wing-area, in a breeze, can be anything but a joke, so remember that it is not quite as simple as it looks. The main thing is to get your machine launched at its actual flying speed; this means that you must gauge the amount of force needed, according to the strength of the breeze.

I do not agree with people who say that to do hand-launching you must hold the machine under the centre of gravity and fling it. I can't get a big, heavy model to fly like that. For one thing, it is easily possible for a large sailplane to jump completely out of your hands if a gust comes up while you are standing still, if you launch that way. I stand facing the direction in which I want the machine to fly, with my legs well apart, and with my left hand I support, but *not* grip, the belly of the fuselage just behind the nose. My right hand grips the fuselage firmly just in front of the fin. The machine must naturally be launched in its normal flying attitude—pointing slightly downwards. The actual launch is a long, even motion, and the right hand produces the force. Hold the model as far back over your right shoulder as possible, and bring your right arm forward in a long, steady swinging push, all the time keeping your left hand under the fuselage to steady it. The momentum is considerable and can be increased on a calm day by lunging forward from the waist. Only release the rear of the fuselage when you have reached the full travel of arm and body.

Those of you who, like myself, are motor cyclists as well as aero-modellers, will see that hand-launching is like kick-starting a motor-bike: in both cases a long, even motion is much better than a short jerky one.

Next, there is the *Winch Launch*. This is generally used in contest work, and, as most of you know, it is often a matter of knack. There are, all the same, one or two small points which may help some of you who have had bothersome experiences of winch-launching.

The launching hook is best placed rather well forward—rather more so than the Germans used to advise—and the diagram will give you my idea of it. The hook should be fairly long—an inch or so—or else there is danger of premature releasing; this is more likely to happen on a heavy model than a very light one. For large, heavy models it is most important to use a geared-up winch, about 6 : 1 or 8 : 1, so that when you wind slowly the line comes in fast. A long handle (giving a great moment-arm when operating it) is a point worth remembering, and some means of keeping the line at a tangent to the drum is useful. A wire bar serves quite nicely.

A winch firmly fixed to stout leather or webbing " harness " and attached to the operator's body is vastly preferable to one merely held in your hands. I cannot say I really like the fixed type of winch, which is placed on, or pegged into, the ground ; you have no movement or chance of movement in such a case.

At the moment of take-off from the line, I find it is best to wind very gently for a moment, letting the model " kite " along at about its normal flying speed ; then take up the slack in the line by winding a couple of turns on the drum, fast ; and the actual release is usually helped by back-pedalling and giving the line a sharp tweak. This method nearly always works well, but on most launches the model will *slip off the line by itself* ; it is only when it tends to stick and refuses to come off that you need resort to the back-pedal-and-tweak method.

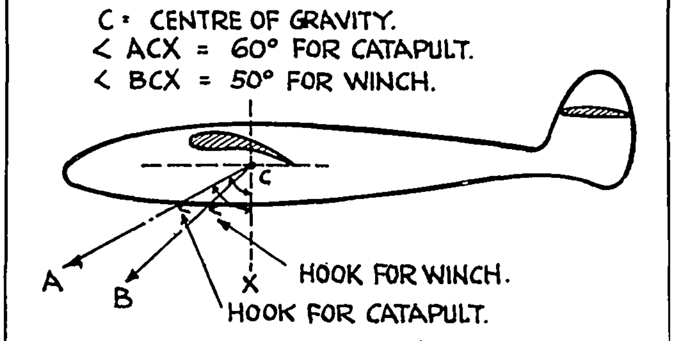
Another small point : I find it best to give a sideways pull on the line, just before the actual release, to get the machine out of wind ; if it is let off directly into wind it generally slows up or tries to stall, whereas the slightly side-wind release starts the model in a flat, fast glide.

To produce a turn in free flight, and yet keep the machine straight while towed, I set one half of the tail-plane at a slightly greater incidence than the other ; I am afraid I cannot give exact figures for this setting, as it varies according to the tailplane aspect ratio and the proportion of tail moment-arm to overall length. The towing hook is offset to counteract any turn on the line—this again being a question of trial and error to find the exact degree of offset. It is absolutely essential that the two panels of the wing should be at exactly the same angle of incidence, or else there will be a dreadful crash when you try winch-launching, and you may try anything you like but you will not be able to get a straight tow unless your wings are true. This is a point to watch carefully, because I know from bitter experience that a model may appear perfectly trimmed, and in fact may fly quite straight when hand-launched, but immediately it is winched up, it will veer to one side and spin. (Yes, I've had some . . . including my 1942 " hope " in the Pilcher Cup.)

It may be of interest to note that a machine suspected of these antics—and it is very hard to line up the whippy, all-hardwood wings of a modern machine—may be tried out first on a catapult ; this will show up the faults, but they are not so violent as on a winch, so you will have a chance to see if your model is going to misbehave or not, without the bother of spending half an hour picking up broken pieces !

Two final points : a model with twin fins is generally remarkably straight on the line ; and if you propose using a hook-controlled automatic rudder on anything weighing over a pound or so, make a rigid " protector " in front of the movable hook, or else you will have constant repair work to do. Unprotected hooks are satisfactory on light models, but the force of a big machine coming down will do a great deal of damage to an ordinary wire hook unless it is guarded.

Thirdly, there is the *Catapult Launch*. This is a popular system, frequently used by the Germans, and I will describe the two most useful variations.



LAUNCHING HOOK POSITION.

The usual catapult is simply a long peg fixed firmly in the ground, with a launching cord made of rubber and thread ; about one-third of the total length is rubber, and this is placed nearest the peg. The launching procedure is to hook the line on to the model, walk backwards with it until you feel it pulling hard enough, then face dead into wind, walk fast with the machine until you feel it beginning to lift . . . then release, hold your breath, and pray !

A much safer form of catapult launch is to have two pegs, with *exactly* equal lengths of rubber attached to each, and the line fixed between the ends of the two elastics. The attachment ring must be at the exact centre of the cord. The launching methods are the same as for a single line, except that your prayers need not be quite so fervent, as it is a safer system.

There are, however, two serious snags in this double-catapult launch, unless it is done with true German thoroughness . . . forward any fifth columnists willing to demonstrate . . . .

(*a*) The pegs must be set in a line exactly at right-angles to the wind direction, and

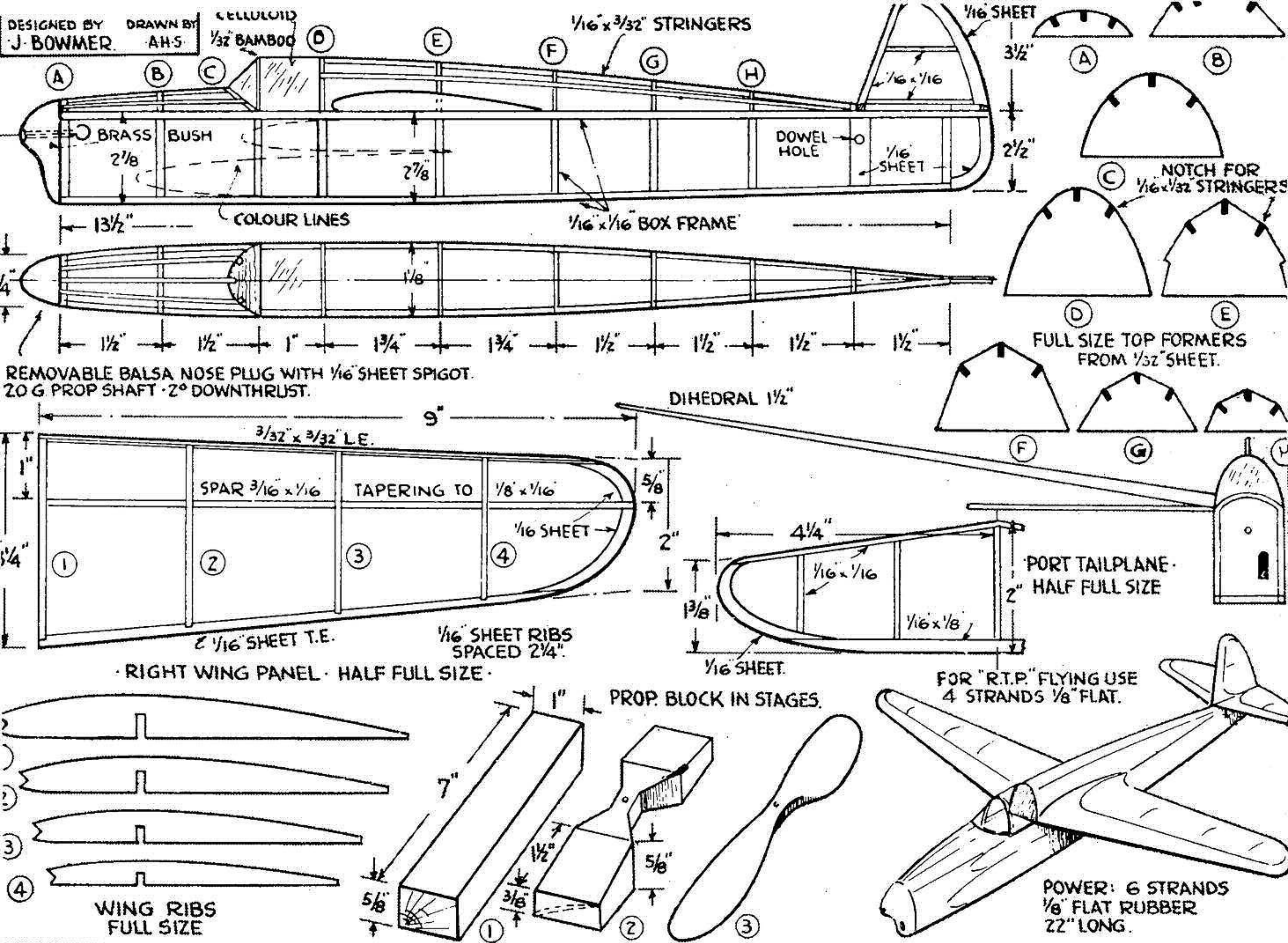
(*b*) The tension from the model to each " arm " of the catapult, *i.e.* each peg, must be identical.

Given these conditions, this is my favourite method of launching, except the hand-launch, which is my special pet.

For winch- and catapult-launching, fishing line is an excellent type of cable to use.

Before I finish this article—which has not been easy to write, because launching is so much a combination of knack, practice, and one's own ideas—there are a few final points. For altitude over flat country, you cannot beat the winch-launch. Catapulting is great fun, but you do not get tremendous altitude, so it is not much use in a dead flat field ; do not use too much rubber on your catapult, or you will stall your sailplane every time.

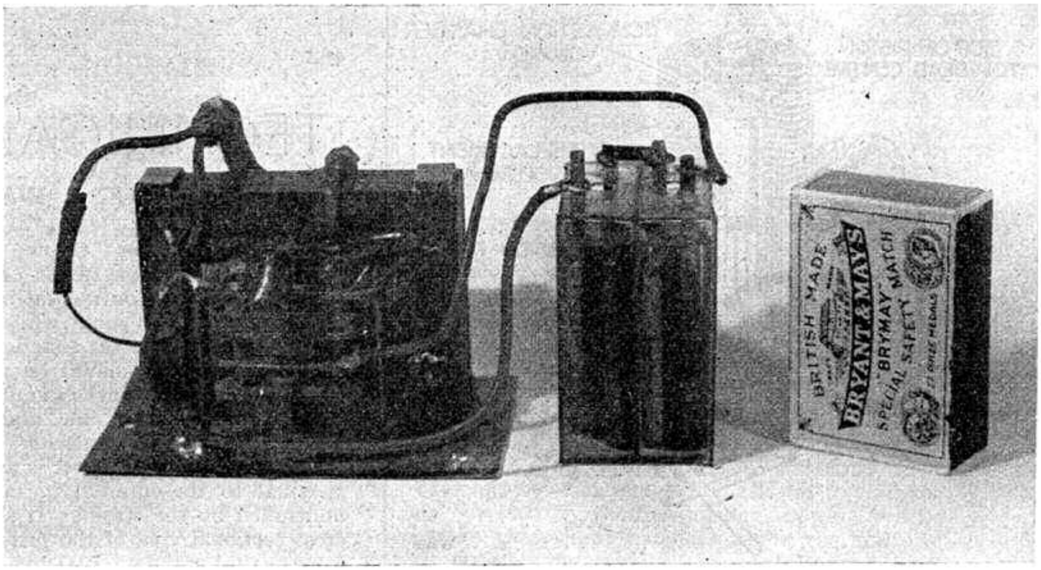
Three strands of $\frac{1}{8}$ in. by $\frac{1}{30}$ in. rubber will do for models up to 10 oz. weight ; four strands for models of 10 to 20 oz; and three or four strands of $\frac{1}{4}$ in. by $\frac{1}{30}$ in. rubber will take care of anything up to four pounds flying weight. The launching hook should be further forward for catapulting than for winching. In hand-launching, the main thing to watch is a tendency for the model to turn back into the hillside (hence my insistence on the slightly sideways, " crab-like " flying attitude) and finally, do not forget that a large, fast sailplane—usually with a pointed nose—is an admirable projectile, so steer clear of the crowds, and insure with the N.G.A. !


DESIGNED BY J·BOWMER
DRAWN BY AH·S
CELLULOID
1/32" BAMBOO
1/16"x3/32" STRINGERS
1/16" SHEET
1/16"x1/16
BRASS BUSH
2 7/8
2 7/8
DOWEL HOLE
1/16 SHEET
3 1/2"
2 1/2"
COLOUR LINES
1/16"x1/16" BOX FRAME
13 1/2"
1/8
1 1/2" 1 1/2" 1" 1 3/4" 1 3/4" 1 1/2" 1 1/2" 1 1/2" 1 1/2"
REMOVABLE BALSA NOSE PLUG WITH 1/16" SHEET SPIGOT.
20 G PROP SHAFT · 2° DOWNTHRUST.
NOTCH FOR 1/16x1/32 STRINGERS
FULL SIZE TOP FORMERS FROM 1/32" SHEET.
DIHEDRAL 1 1/2"
9"
3/32" x 3/32" L.E.
1"
SPAR 3/16 x 1/16
TAPERING TO
1/8" x 1/16
5/8
1/16 SHEET
2"
1/16 SHEET T.E.
1/16" SHEET RIBS SPACED 2 1/4".
· RIGHT WING PANEL · HALF FULL SIZE ·
4 1/4"
1/16"x1/16
1 3/8"
1/16"x1/8
2"
1/16" SHEET.
PORT TAILPLANE · HALF FULL SIZE
FOR "R.T.P." FLYING USE 4 STRANDS 1/8" FLAT.
PROP. BLOCK IN STAGES.
1"
7"
5/8"
1 1/2"
3/8"
5/8"
WING RIBS FULL SIZE
POWER: 6 STRANDS 1/8" FLAT RUBBER 22" LONG.

ANOTHER MINIATURE ACCUMULATOR

By A. WILSON

Another interesting article on a subject which will appeal to all petrol model fans and will, we hope, further the development of such components.



General Survey.

Before we get involved with the actual construction of the cells, let us give a thought to the operating conditions. Using a four volt accumulator, measurements were taken of the current flow on closed circuit and running conditions. This was found to be 4 amperes and 1·5 amperes respectively. The latter figure could be reduced to 1 amp. with a carefully designed contact breaker. These figures show that the small accumulator will be seriously overloaded at all times—but, more particularly when starting up—as then there will be momentary surges of 4 amps. Just a warning word here, do not let the 4 amps. flow for any length of time through the coil, otherwise the excessive heat may break down the H.T. insulation and ruin the coil. So far the outlook is not very promising, but cheer up, from here we start to forge ahead.

As we require a comparatively large current from small plates, we must have thin plates, to get as much area as possible in contact with the acid. Plates should be as near to each other as possible, and separators should be perforated. In my next attempts I shall slide the plates into grooves in the sides of the cells, and eliminate separators. Having briefly outlined the problem, let us now attempt to solve it.

Construction.

It was obvious that the size of the accumulator would be governed by the finished weight permissible, and it was decided that up to 6 ozs. for a 4-volt battery would be quite acceptable.

Negative and positive plates were cut from an old wireless accumulator and reduced until the weight was 1 oz. each—thus making the weight of the active material 4 ozs. Each plate then had a connecting bar of thin lead strip soldered to its outer edge in a calculated position. For this rather ticklish job the writer used an ordinary soldering iron kept clean in spirits, and used resin as a flux—not exactly a text book method, but it works.

Next a pair of plates with separator were measured, and a container made from sheet celluloid ·022 in. thick. A cement was made by dissolving a few strips of the celluloid in a 50/50 mixture of amyl-acetate and acetone. Threepennyworth of each from the chemist will make several cells.

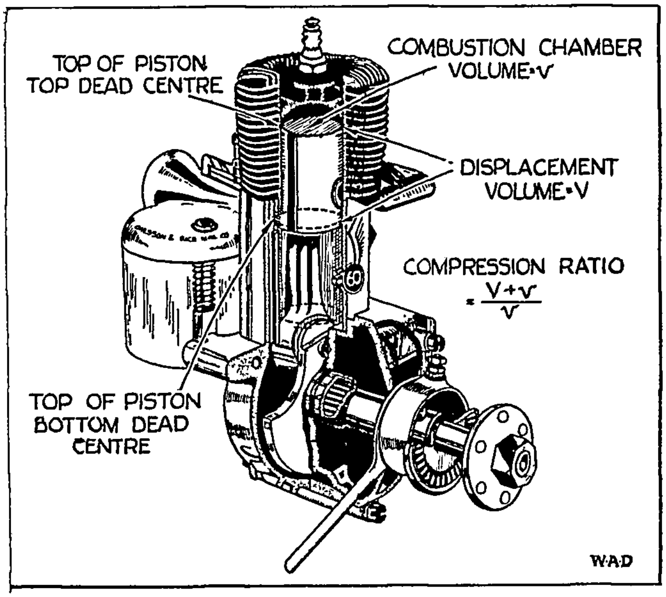
Now with the plates inserted and the connecting bars vertical, cut the tops of the cells from the sheet celluloid, drilling the holes for the connecting bars in the required position, not forgetting the filling hole.

Slide the tops on the connecting bars and cement into place. Then connect one positive bar to the negative in the other cell, and the other positive and negative bars are the 4-volt terminals. Fill cells with acid of 1·280 Sp.g., and charge at approximately 100 milliamps. The finished weight will be in the region of 5 ozs. The writer made up a small metal rectifier for charging at 50–150 milliamps, but excellent results were obtained by charging from a 6-volt car battery through a flash lamp bulb. The bulb glows very dimly at 100 m/a. Keep on charge about 12 hours, by which time the voltage across the cells will be nearly 5 volts, this is as it should be and we are now ready for the tests.

Operating.

The battery was connected to a 9 cc. Ohlsson and 12 (twelve) starts and one minute runs were made before the battery showed signs of exhaustion. Undoubtedly the overload mentioned at the start of this article was proving too much for the little fellow, especially as no recuperative time was allowed between runs. Further tests were made after a recharge—but using a 6-volt booster battery across the internal 4-volt for starting only. Under these conditions all starting current was taken from the 6-volt, and in addition, a charging current of about 1 ampere flowed through our small accumulator. This was much better, Dozens of one minute runs were made with no sign of the miniature getting run down, and at the end of the day the Ohlsson started quite easily on the small battery only. In fact, results were so encouraging that the writer is determined to make further experiments on the following lines.

Plates will be made from thin sheet lead and left solid—when immersed in a free electrolyte and charged and discharged at a low rate, the plates will gradually "form" into active material and overload will not affect them so much as pasted plates. Also solid electrolyte must be used when flying, as a spill would cause a nasty mess with free acid. Solid electrolyte is made by mixing three parts of cold 1·400 Sp.g. sulphuric acid with one part of sodium silicate of 1·200 Sp.g. This should solidify in 5 or 6 minutes, so have the cells all ready for filling. Please add the acid to the sodium, otherwise there may be an accident. Well, that is all this time. I wonder how many models will be fired by miniature accumulators after the war?



TECHNICAL TOPICS

By R. H. WARRING

THE term " internal combustion engine " emphasises the essential difference between the old steam engines and the modern type of power unit ; emphasising in fact, that the power is produced in a single stage where the energy of the fuel is transformed into direct useful work instead of the two stages of the steam unit where the energy of the fuel is employed to produce steam and the steam thus produced may then be utilised for doing work. Thus this single stage conversion of fuel results in a high thermal efficiency—a small petrol engine being the equal of the best of the high-pressure steam units.

It is interesting to note that the first internal combustion engines employed coal gas as a fuel ; now, of course, liquid fuel is mainly employed. Recent advances in design and the introduction of heat-resisting light metal alloys has resulted in a power-weight ratio of approximately 1 lb. per B.H.P. being realised on certain full size engines and about 2 lbs. per B.H.P. in model practice. This amazing advance in design has outstripped the average layman and so I intend to go back to first principles and explain the fundamentals of the small two stroke engine and discuss the problem in general.

The two stroke is essentially defined by the fact that one complete cycle is carried out per revolution of the engine, i.e. two strokes of the piston, up and down. This type of operation has, surprisingly enough, found most favour for the extremely small engines and very large marine units. It suffers from certain inherent disadvantages in that the " ultimate " pressure exerted by the piston is reduced and, employing ports instead of valves, the weight of charge drawn in each stroke is apt to be relatively low, with a considerable portion of unburnt charge escaping direct through the exhaust port. Its relative simplicity, both in construction and maintenance, offsets this and careful design can reduce the effect of these bad characteristics to a minimum. For the purpose of model aero. engines the type is approaching the ideal and, below 10 cc. capacity, will, almost certainly, hold its own against all comers.

Firstly, a knowledge of the manner of presenting engine specifications is required. The basic dimensions are the *bore* and the *stroke ;* the first is the internal diameter of the cylinder (or of each cylinder in the case of a multi-cylinder engine), and the other is the extreme movement of the piston from the top to the bottom of its stroke. It logically follows that the stroke is equal to twice the radius or " throw " of the crankshaft. Here, now, we come to our first " confusion " of definitions. The English and Continental measurements are almost invariably given in mm., whilst inches are standard in the United States of America. Thus the following conversion factors should be noted :—

To change mm. to inches, multiply by .03937.

To change inches to mm., multiply by 2.540.

Then there is the *capacity.* If this is thought of as the piston swept volume it is at once seen that capacity is equal to the internal normal area of the cylinder multiplied by the stroke. It should be noted that the cross sectional area of the *piston* is not necessarily the same as that of the internal area of the cylinder, although for model engines where rings are rarely employed this difference is very small. To ensure absolute accuracy, however, it must be understood that the bore refers to the internal diameter of the *cylinder.* The capacity of an engine whose dimensions are expressed in mm. is given by the following equation :—

$$\text{Capacity (in cc.)} = \frac{\pi \, b^2 \, s \, N}{4{,}000}$$

Where b = bore ; s = stroke ; and N = number of cylinders. A similar formula giving the capacity of the cylinder in cu. ins. when the dimensions are expressed in inches is :—

$$\text{Capacity (in cu. ins.)} = \frac{\pi \, b^2 \, s \, N}{4}$$

Conversion factors for changing cu. ins. into cc. and vice-versa were given in " Technical Topics " for May, 1942.

Now reference to the heading illustration will show that the complete internal volume of the cylinder is made up of the piston swept volume and a small space or chamber above the top of the stroke of the piston. This space is known as the *combustion chamber* and it is into this that the mixture is compressed prior to ignition. Calling this volume v and the piston swept volume, i.e. the capacity, V the compression ratio is defined by the ratio $\frac{V+v}{v}$. In general, it may be said that increasing the compression ratio increases both the power and the thermal efficiency of the engine. On the other hand, high compression ratios tend to produce harsh running or detonation of the fuel. By the latter is meant that the fuel explodes with a violent force, instead of igniting smoothly, with consequent loss of power. A further point to consider is the fact that the compression is adiabatic and considerable heat is generated, sufficient in certain cases to pre-ignite the charge, causing a back pressure on the piston with, again, loss of power and increased wear on the engine.

The actual shape of the combustion chamber is important to combat these unwanted characteristics and special " anti-knock " fuels may be employed, but in model work this problem is rarely acute. An enlightening point is, however, the fact that rotary valves do allow the charge to be compressed under cooler conditions and thus may be employed to advantage where extremely high compression ratios are desirable.

(*concluded on page* 486)

CALLING ALL A.T.C.

YOU CAN ONLY BECOME

A Real Aircraftsman

by Building

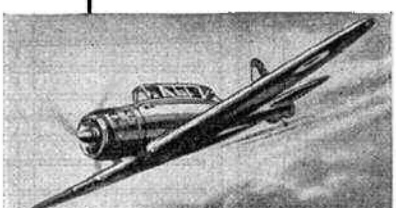
DROME


HURRICANE 4/10


GLADIATOR 7/9

SQUARE JIG ASSEMBLY SCALE SETS

Jig with formers slipped on ready for stringers — nearly the whole plane can be completed before it need be pulled off jig.

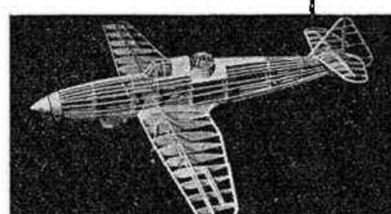

SKUA 6/8


SPITFIRE 4/10

KITS CONTAIN

Jig, Variable Pitch Airscrew, Printed Formers, Wheels, Camouflage Tissue, Insignias, Tissue Paste, Dope and Cement.

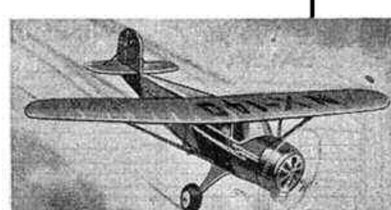

LYSANDER 4/10


DEFIANT 9/9 SPAN 24"

SIMPLE FUSELAGE KITS NOT REQUIRING JIG ASSEMBLY


TAYLOR CUB 4/3

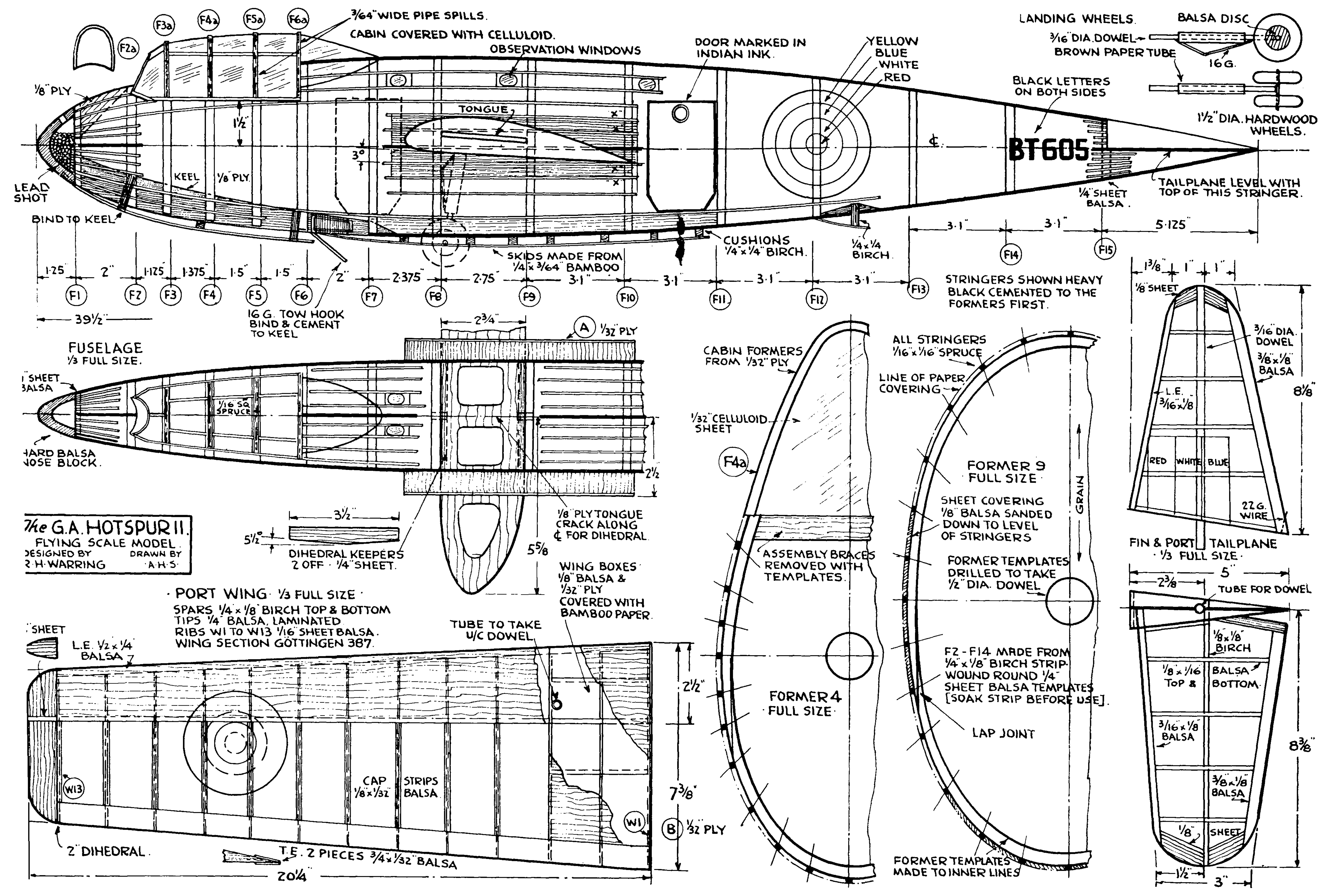

PUSS MOTH 3/6


MONOCOUPE 3/6

FROM ALL DEALERS

Model Aerodrome

144, STRATFORD ROAD, BIRMINGHAM, 11.


3/64" WIDE PIPE SPILLS.
CABIN COVERED WITH CELLULOID.
OBSERVATION WINDOWS
DOOR MARKED IN INDIAN INK.
YELLOW
BLUE
WHITE
RED
LANDING WHEELS.
BALSA DISC
3/16" DIA. DOWEL
BROWN PAPER TUBE
16 G.
BLACK LETTERS ON BOTH SIDES
1½" DIA. HARDWOOD WHEELS.
F2a
F3a
F4a
F5a
F6a
1/8" PLY
1½"
TONGUE
3°
BT605
LEAD SHOT
KEEL
1/8" PLY
BIND TO KEEL
TAILPLANE LEVEL WITH TOP OF THIS STRINGER.
1/4" SHEET BALSA.
CUSHIONS 1/4" x 1/4" BIRCH.
1/4 x 1/4 BIRCH.
SKIDS MADE FROM 1/4 x 3/64" BAMBOO
1·25
2"
1·125
1·375
1·5
1·5
2"
2·375
2·75
3·1
3·1
3·1
3·1
3·1
3·1
5·125
F1
F2
F3
F4
F5
F6
F7
F8
F9
F10
F11
F12
F13
F14
F15
39½"
16 G. TOW HOOK BIND & CEMENT TO KEEL
STRINGERS SHOWN HEAVY BLACK CEMENTED TO THE FORMERS FIRST.
FUSELAGE 1/3 FULL SIZE.
2¾"
A 1/32" PLY
1" SHEET BALSA
1/16 SQ SPRUCE
HARD BALSA NOSE BLOCK.
2½
1/8" PLY TONGUE CRACK ALONG ℄ FOR DIHEDRAL.
5⅝
3½"
5½°
DIHEDRAL KEEPERS 2 OFF · 1/4" SHEET.
The G.A. HOTSPUR II.
FLYING SCALE MODEL.
DESIGNED BY R.H. WARRING
DRAWN BY A.H.S.
PORT WING · 1/3 FULL SIZE ·
SPARS 1/4 x 1/8 BIRCH TOP & BOTTOM
TIPS 1/4 BALSA, LAMINATED
RIBS W1 TO W13 1/16" SHEET BALSA.
WING SECTION GÖTTINGEN 387.
WING BOXES 1/8" BALSA & 1/32" PLY COVERED WITH BAMBOO PAPER.
TUBE TO TAKE U/C DOWEL
SHEET
L.E. 1/2 x 1/4 BALSA
2½"
CAP 1/8" x 1/32
STRIPS BALSA
W13
W1
7⅜"
B 1/32 PLY
2" DIHEDRAL.
T.E. 2 PIECES 3/4 x 1/32" BALSA
20¼"
CABIN FORMERS FROM 1/32" PLY
1/32" CELLULOID SHEET
F4a
ASSEMBLY BRACES REMOVED WITH TEMPLATES.
FORMER 4 FULL SIZE
ALL STRINGERS 1/16" x 1/16" SPRUCE
LINE OF PAPER COVERING
FORMER 9 FULL SIZE
GRAIN
SHEET COVERING 1/8" BALSA SANDED DOWN TO LEVEL OF STRINGERS
FORMER TEMPLATES DRILLED TO TAKE 1/2" DIA. DOWEL
F2 - F14 MADE FROM 1/4" x 1/8" BIRCH STRIP WOUND ROUND 1/4" SHEET BALSA TEMPLATES [SOAK STRIP BEFORE USE].
LAP JOINT
FORMER TEMPLATES MADE TO INNER LINES
1⅜"
1"
1"
1/8" SHEET
3/16" DIA. DOWEL
3/8" x 1/8" BALSA
8⅛"
L.E. 3/16" x 1/8
RED
WHITE
BLUE
22 G. WIRE
FIN & PORT TAILPLANE · 1/3 FULL SIZE ·
5"
2⅜"
TUBE FOR DOWEL
1/8" x 1/8" BIRCH
1/8" x 1/16 TOP &
BALSA BOTTOM.
3/16 x 1/8 BALSA
3/8 x 1/8 BALSA
8⅜"
1/8" SHEET
1½"
3"


FROG
SCALE
MODEL
AIRCRAFT
FROG
TRADE MARK
REGD.
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A PAGE FOR SOLID FANS——BY A. S. ROSENFELD

A SUPER FINISH FOR SCALE MODELS

THIS method for finishing solid and flying scale models will amply repay any extra time taken. So many modellers will take pains to turn out excellent construction and covering and then completely nullify their labours when painting is attempted.

The only necessities are a good selection of coloured dopes and an old scent spray with the bulb removed and replaced by a short length of rubber tubing—windscreen wiper tubing is admirable.

Firstly the tissue and wood coverings are treated in the usual way with dope or banana oil.

The dope should be thinned down with an equal amount of the correct thinners and the scent spray half filled.

The family should then be warned. They will need to spend the rest of the evening in their gas masks.

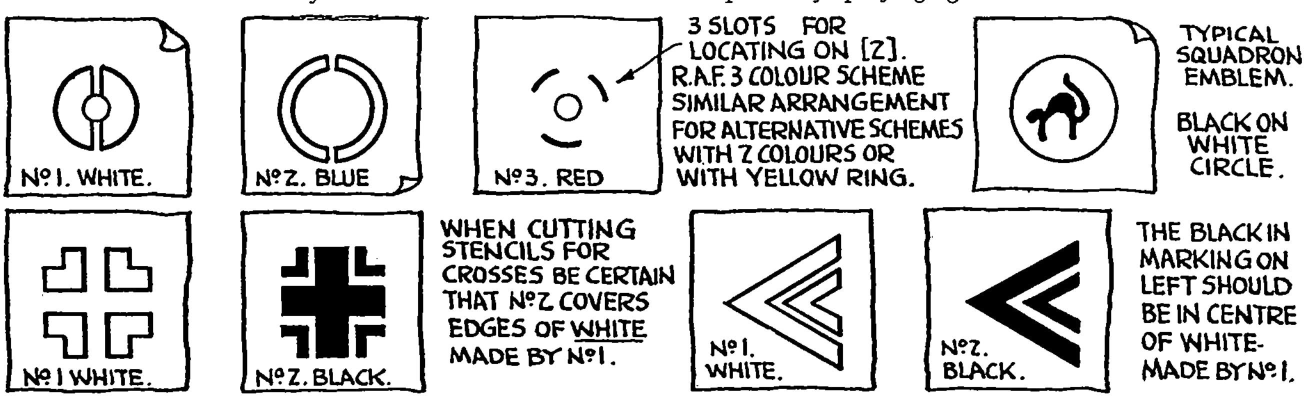
The whole upper surface of the machine should be sprayed earth brown while fully assembled. Items such as cockpit covers, gun turrets, etc., should be carefully masked with paper. For a small model, say up to three feet in wing span, it is quite satisfactory to supply pressure to the spray with the mouth. For larger models an old car or motor-cycle inner tube with an outlet in addition to the valve may be used.

One or two pieces of note paper should now be cut with wavy edges, the size of the waves depending on the scale of the model. Suggestions are shown in Fig. These are used to mask the portions to remain brown. At this stage an assistant would prove invaluable to hold the mask close to the work. The closeness determines the sharpness of the line between the colours.

The spray is carefully emptied and cleaned out with thinners and then filled with green dope thinned out as before. The portions of the model not covered by the mask are now sprayed, completing one section at a time and using different masks to vary the "pattern." Care must be taken when removing the mask not to trail the wet edges. When dry the lines of demarkation will be seen to have that slight haziness which the full size machines possess and which is never obtained with brushes.

Insignia are then sprayed on in their respective colours by means of the stencils shewn. In the case of both British and German insignia the white is sprayed first through its correct stencil and then when dry the remaining colours and stencils follow.

In the case of R.A.F. roundels bridges have to be left in the stencils to retain the centre portions. They must, therefore, be rotated part of a revolution and the circle completed by spraying again.



MOULDED PARTS FOR SCALE MODELS

THE appearance of scale models will be greatly enhanced if hollow, bulbous parts such as wheel facings, spats, exhaust stubs and air intakes are faithfully reproduced, not by a solid block of balsa but with a part with the appearance of sheet material.

The writer has evolved a method of making mouldings which has given every satisfaction on both flying and non-flying models. It is applicable to 1/72 in. scale or to a 6 ft. petrol model.

The making of an ejector exhaust for a Merlin engined machine will serve to illustrate the methods.

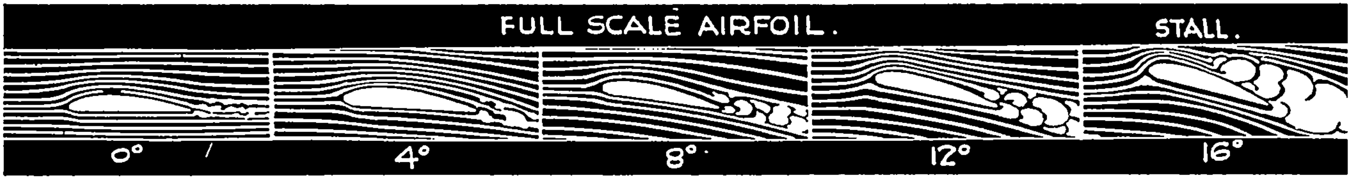
First a wax model is prepared exactly the same shape as the finished job *but 3/32 in. smaller on all* dimensions. The wax is smoothed out with the fingers and then held under cold water for a few moments to harden. Now a tube of plastic balsa is taken, of as smooth a texture as is obtainable (fortunately the only brand obtainable by the writer locally is of such a 'grain'). A thin layer of plastic wood is applied to the wax, leaving only the portions meant to be open free from covering. If the fingers are periodically moistened with water the smoothing out will be facilitated while the water will be in no way detrimental to the plastic wood.

After allowing periods of an hour or two to elapse, two further coats are applied, bringing the overall dimensions to slightly over those required. The surface is then sanded perfectly smoothly down to size when set.

The wax is then softened in hot water and withdrawn. The plastic balsa which was in contact with the wax will be found to be quite soft, but after a few moments exposure to the atmosphere will harden. The finished article is then cemented in the usual way to a sheet balsa support on the fuselage.

One word of warning. Do not attempt to apply thick coats of plastic balsa. The shrinkage on drying would cause cracking or distortion of the wax template.

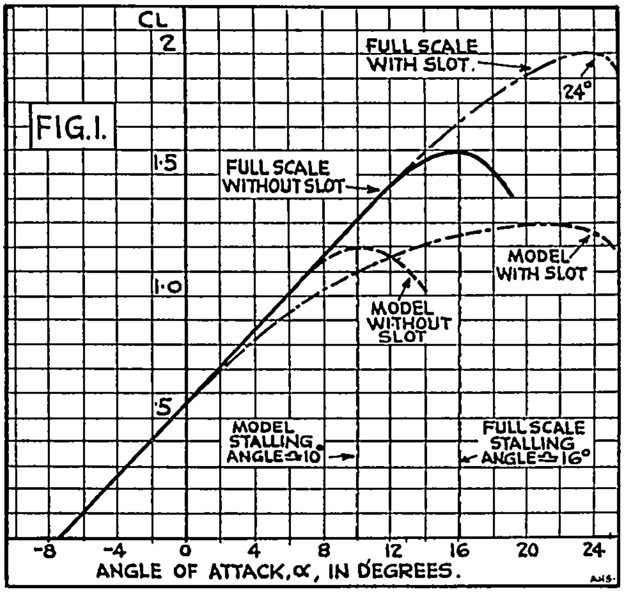
The parts have an amazing strength to weight ratio and for this reason may easily be mistaken for bakelite. A point which will undoubtedly appeal to detail fiends is that joints in pressings, rivet heads, etc., may be simulated to a degree impossible in balsa.



SLOTS

AND OTHER RELATED DEVICES

By R. H. WARRING



THE possibility of obtaining that "little extra" from any piece of apparatus is always enticing and considerable interest has centred of late around the use of slots and similar devices. It is generally known that slots prolong the stall of a wing or airfoil but *quantitative* data on the subject is scarce, in fact almost non-existent, for model work. We must, therefore, turn to full-size figures for guidance but the would-be model designer must *not* blindly follow full-size formulæ and practice. As an example many full size designers consider that the chief purpose of slots and flaps is to increase the maximum lift and therefore reduce the landing speed. In model work we are more concerned with the *stability* of the system. Admittedly, this too enters into full-size practice, but is not always the main criterion.

To begin with, everyone is familiar with the conventional worry of plotting the lift coefficient against angle of attack to obtain a *lift curve* for the airfoil under consideration. Generalising at this stage, it may be said that this lift curve is a straight line from zero lift to within a few degrees of the stall. This is given by theory and confirmed by practice. At around 16 degree angle of attack the airfoil is stalled, i.e. the lift drops off: this for full-scale practice. In model work this stall occurs somewhat earlier—around 10 degrees, see Figure 1. Thus the question of combating or prolonging this early stalling angle is of paramount importance in model work.

The main devices open to use are (i) the slot, (ii) disruptors, (iii) turbulators, (iv) boundary layer control, (v) the Magnus effect, (vi) rider planes. Of these, the former three are well known (turbulators, introduced by the author, were described in the July AERO MODELLER), whilst the other three are mainly of academic interest for the moment. The question of flaps is ignored in this present article, as the whole subject, although related, is too lengthy.

Now a slot consists essentially of a small rider plane of airfoil section fixed at some negative angle of attack forward of the main airfoil. Its actual shape and altitude we will discuss later. This system has the peculiar characteristic of delaying the break-away of the airflow over the wing and thus delaying the stall.

A simple explanation of this is as follows. At normal angles of attack, i.e. below the stall, there is a gradual pressure increase at the rear upper surface of the airfoil which grows with increasing angle of attack; the disruption of the boundary layer being progressive and moving forward. Finally, a vortex is formed over the rear upper surface causing a break-away of the flow over the whole section and consequently, a stall. With a slot fitted, air shoots out of the slot as the critical angle is neared, thus "revitalising" the boundary layer and retarding the formation of the lift destroying vortex.

At normal altitudes there is little or no airflow through the slot itself. This has been amply illustrated in practice by the experience of L. G. Temple, of glider fame. His 7 ft. span 'Tribute' had stood out in a shower of rain and droplets of water had collected in the slot itself. Shortly afterwards, the model was launched and, on rising up in a gust and approaching the stall, a spray of water shot out of the slot indicating that a powerful stream of air was flowing through at this altitude.

The action of the slot, then, results in a prolongation of the lift curve. In the case of a full-scale slotted airfoil this results in a marked increase in the maximum lift, but this effect is less noticeable in model work. It would rather appear that a model slotted airfoil gives a lift curve with a flattened peak with no great increase in C_L max., if any. This does mean, however, that the airfoil does not immediately lose lift on reaching its normal critical angle of attack and thus is of great value to the model designer where stability is the main criterion.

Unfortunately, these beneficial results are not obtained without cost; the cost in this case being an increase in drag. This is often combatted in full-size design by suitable arrangement of the slot mechanism so that the slat is normally flush with the main airfoil. At high angles of attack, i.e. when the slot is needed, the 'suction' over the leading edge is sufficiently powerful to pull open the slat; the whole movement being entirely automatic. Alternatively, the system may be arranged to be directly under the control of the pilot.

These complications are hardly worth while on small models and thus slots, when fitted, are usually of the fixed type, i.e. permanently open. For best results, *the slot should extend along the whole leading edge*, but a large tailplane is usually sufficient to ensure adequate

longitudinal stability. The main use of a slot, then, in *model work* is not as above, but as an anti-spin factor as described below.

A model flying at any angle of attack below stalling altitude will automatically tend to right itself if caused to sideslip by any force. That is, should one wing drop during flight the model will commence to sideslip in the direction of the lower wing, resulting in an increased angle of attack on this wing. This increased angle of attack results in more lift on the dropping wing and thus recovery is affected. Now if the model is stalled, or very near stalling, and one wing drops the angle of attack is increased as before, *but now exceeds the critical angle*. In other words, the dropping wing *looses* lift, which still further aggravates the original displacement and the machine is forced into a spin.

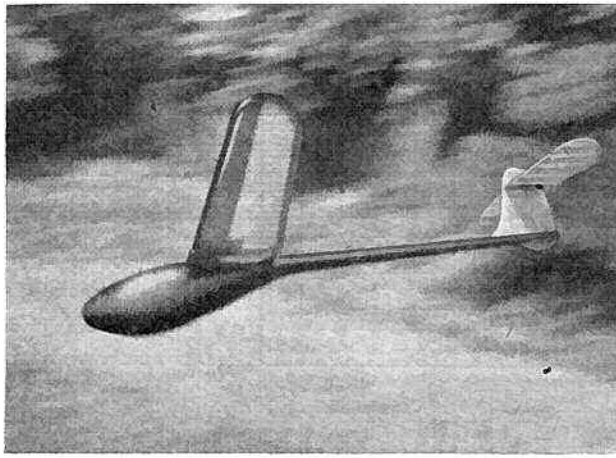
If slots are fitted to the outboard wing panels, the critical angle at this point is raised and thus the danger of a spin following a stall is overcome. Lt.-Col. Bowden, Dr. Forster and others speak highly of wing tip slots employed in this manner where stability of a high order is required as on large petrol models.

Spinning can, of course, be prevented by other methods, but usually this results in loss of efficiency. The reserve of *dynamic* stability on the normal rubber-powered model is usually quite high and thus recovery from such a spin is rapid, but with heavier loadings the loss of height in such an unwanted manœuvre is often dangerous.

Thus, wing tip slots are useful on machines with a fairly high wing loading, preventing as they do the stalling and dropping of one wing tip. This tendency may also be present if the model is suddenly yawed by some force or other and it also allows of greater latitude in vertical tail areas—a sore point with most designers.

These slots may be either of two forms; the ordinary slot discussed above, or the letter box slot, so called because it is actually incorporated in the main airfoil itself. These types are shown in Figs. 2 and 3. This latter type has found much favour in full scale work as a stability measure, but for models it is rather difficult to decide between the two. The letter box slot is attractive if only for its neatness, but, in general, the results obtained in model work are rather disappointing. Their operation does not appear positive enough and until more accurate data is available it is the opinion of the author that present results indicate that the normal fixed type of slot is to be preferred.

Typical layouts which apply to nearly all the airfoils employed on model work are given in Figs 2 and 3, with also characteristic graphs showing the effect on lift and drag. This data on the letter box slot is for low speed work and thus may be applied direct to model design, but, of course, only for the section specified. Their *general* characteristics may be regarded in a comparative manner. Unfortunately, the tests on the normal fixed type of slot is at a higher Reynolds Number than we would desire, and such high values of C_L max. may not be obtained in model practice.



The author's model sailplane "Aeolus" fitted with wing tip slots.

As will be seen from the graph of Fig 2, the stalling angle of the section is increased from 13 degrees to approximately 22 degrees, and C_L max. from 1·2 to 1·42 by fitting a normal fixed type of slot to a basic Clark Y wing. This data applies to slots *extending along the whole of the leading edge*, and is for an aspect ratio of 6 at a Reynolds Number of approximately 75,000. I can only warn readers that these figures must be treated with caution as the wind tunnel in which the test was conducted was never fully explored as regards degree of turbulance and other sources of error.

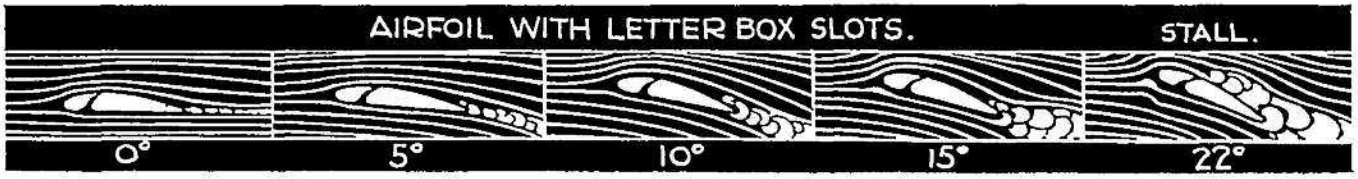
Similar remarks apply to the graph of Fig. 3 for the letter box slot, which is quoted from an American source, and the actual conditions of test are unknown. Whilst not wishing to disparage such low speed data that is available, it is as well to realise that unless elaborate precautions are taken many sources of error may be entirely neglected. However, these figures are no more doubtful than the majority from which the model designer usually works, and the general layouts suggested should prove a useful guide to the constructor.

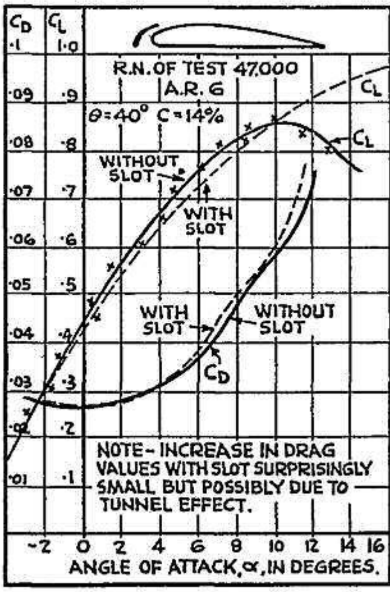
The other test for the letter box slot indicates a lessening of the slope of the lift curve with a flattened peak. This was actually conducted at, or near, the usual model Reynolds Number and shows no material increase in C_L max. However, the *stalling angle* is raised nearly ten degrees and thus, in spite of the rapid drag increase at this region, the arrangement should prove stable.

The drag curve shows that at *all* angles of attack the drag of the particular wing is higher, even more marked at low angles of attack than in the case of the fixed slot.

The choice is now left to the model designer. In practice, the fixed type of slot has definitely proved that it *does* work, whereas the same beneficial effects have not *always* been obtained with the latter type.

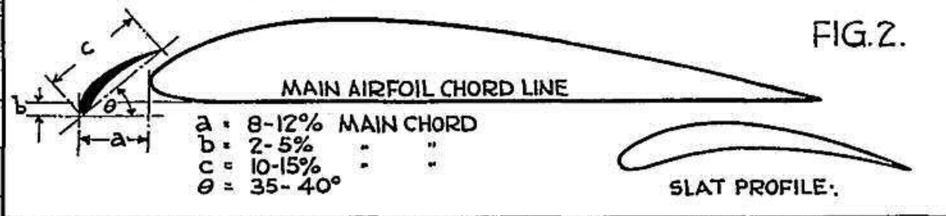
Concluding this short article with a brief reference to the other devices previously mentioned we will consider first the *turbulator*. As noted previously, model wings



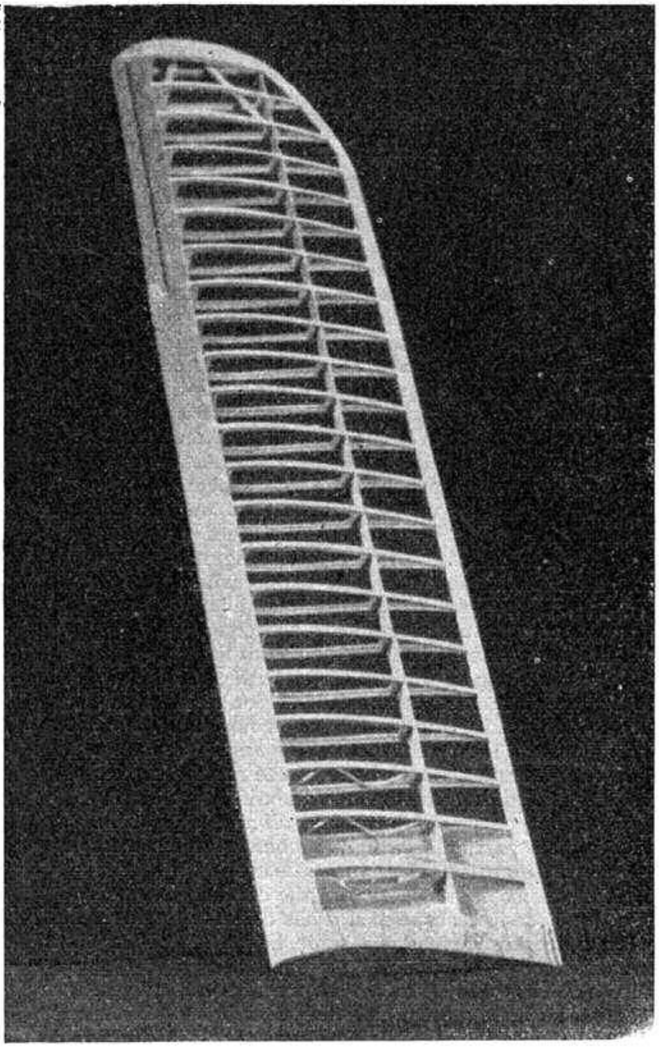


APPROXIMATE OPTIMUM POSITION FOR FIXED SLOT.

FIG. 2.



SLOT COMBINATION.	C_L MAX.	C_D MIN.	C_LMAX/C_DMIN.	α FOR C_LMAX.
	1·291	·0152	85·0	15°
	1·772	·0240	73·8	24°
	1·596	·0199	80·3	21°
	1·548	·0188	82·3	19°
	1·440	·0164	87·8	17°
	1·902	·0278	68·3	24°
	1·881	·0270	69·7	24°
	1·813	·0243	74·6	23°



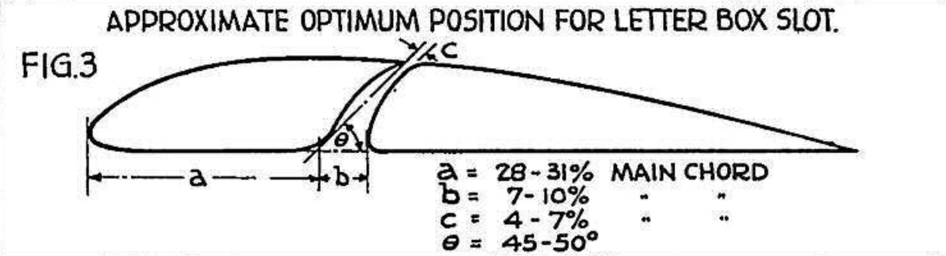
stall at an early angle and turbulators are suggested devices for artificially increasing the operative Reynolds Number. In other words, with these devices operating properly, full-scale conditions are approached, i.e. the stalling angle occurs later as in full-scale work. Again, no definite statement can be made on account of the lack of low speed data and the question is left open for more development work and research.

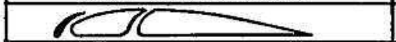
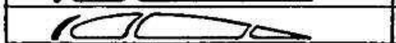
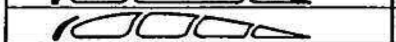
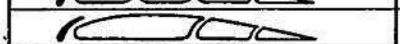
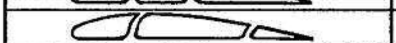
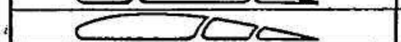
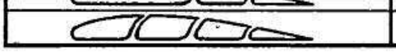
Another well-known device of Italian origin is the *Mattioli Randisi disruptor*. Their successful operation would appear to depend upon the fact that they set the air flowing over the wing in turbulent motion. Now a turbulent flow resists displacement more readily than purely laminar flow, although its drag values are higher. Thus a higher angle of attack may be reached before the flow over the airfoil breaks down and thus the stall is delayed. The general effect on the lift curve is a lessening of the slope and a flattening of the peak. Thus, although the arrangement may be stable, there is a danger of lowering the lift values of the wing at normal operative angles of attack to a figure below that of useful application.

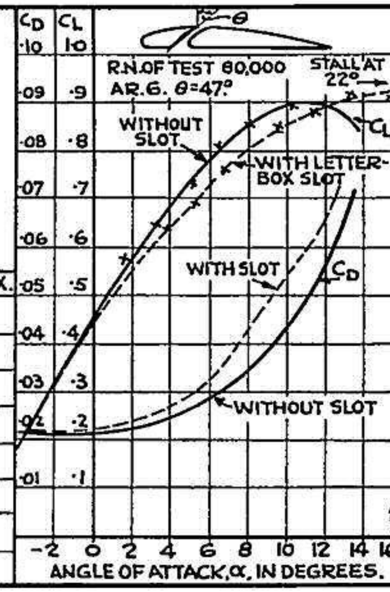
Then there is the Magnus effect. The actual airflow over a wing may be simulated by imposing a circulatory flow upon a purely translational flow. The origin of this circulation is probably found in the viscosity of a real fluid for any body moving through a perfect fluid experiences no force acting upon it other than induced effects. It is this breakdown of the circulatory flow that accounts for the stall, a phenomenon which theory entirely fails to predict, although recent research in higher mathematics has indicated possible lines on which to work. The point is, then, that every effort must be made to conserve circulation around a lifting surface.

A circulatory flow of the nature desired is set up around a rotating cylinder, and thus, if the normal wings are replaced by rotating cylinders, these will generate lift and also be impossible to stall. This has, however, not worked out well in practice, but a further development is of interest.

In this, the leading edge of the wing is replaced by a rotating cylinder, the profile of which joins into the general lines of the wing itself. This rotating leading



SLOT COMBINATION.	CL MAX.	CD MIN.	CL MAX/CD MIN.	α FOR CL MAX.
	1·930	·0340	56·8	25°
	1·885	·0319	59·2	24°
	1·885	·0363	51·9	25°
	1·850	·0298	62·1	24°
	1·692	·0228	74·2	22°
	1·672	·0214	78·2	22°
	1·510	·0208	72·6	19°
	1·662	·0258	64·4	22°



edge, which must be power driven, does preserve circulating flow, and thus lift, up to surprisingly high values of angles of attack. In some instances, the stall as such is non-apparent, lift still being maintained with angles of attack of 60 degrees or more. Drag values at this altitude are, however, very high and little or no practical application has yet suggested itself.

A more direct method which gained the interest of many prominent aeronautical scientists in recent years is *boundary layer control*. In this, the cause or the stall, i.e. the disruption of the boundary layer at the rear of the upper surface, is tackled at the source. Suction is applied direct to the boundary layer at this point when the angle of attack approaches the stall, thus forcing the flow to remain streamlined.

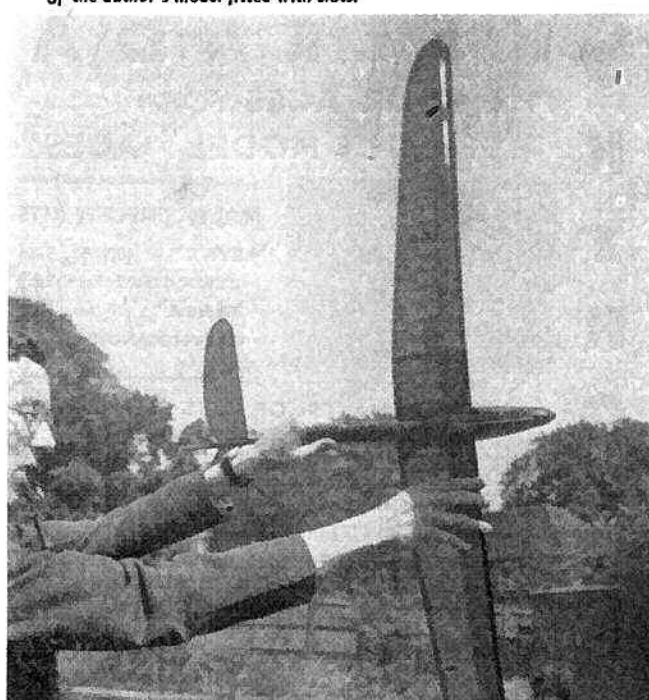
This method has many possibilities for the power needed to generate sufficient suction is remarkably small. Practical tests have, however, so far proved disappointing. Some remarkable results have been achieved, but it would appear that the method only works well on thick sections well beyond the type suitable for model work. Angles of attack of 40 degrees and more have been reached with C_L values over 4, and the optimum point of application for the "suction" would appear to be 60 per cent. of the chord from the leading edge.

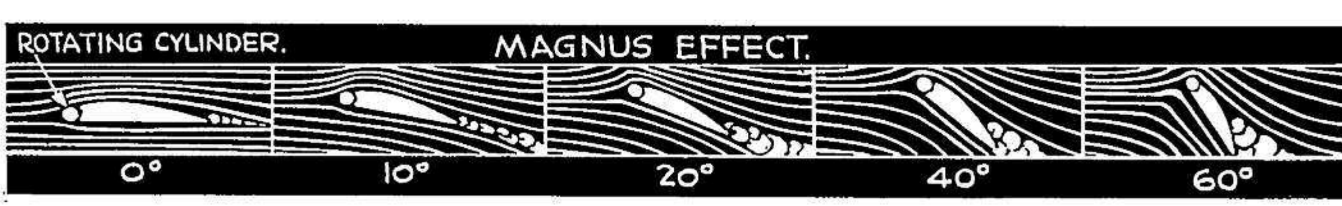
The final method of stabilising in airfoil near the stall to be mentioned is the rider plane, a small auxiliary airfoil mounted *above* and behind the main wing in the manner of a bird slot. An article on this layout by a prominent authority is pending and so no further details will be given here. Similar schemes with inverted rider 'planes and venturi trailing edge flow designed and tested by the author are also subject for a further article if the demand warrants it.

To conclude, I would like to mention a further use to which slots have been put. Some years ago I tested a number of slotted airscrews to a design by a Mr. Randall of Worthing. These were essentially of the letter-box variety, but further tests with normal leading edge slots indicated promising results. Surprisingly high angles of attack for the blades were achieved with no great falling off in thrust and further research is imminent. The value of a stall-proof airscrew is readily appreciated and reliable data will be published when and if available. The author's main regret is lack of sufficient time to test and develop these numerous ideas —a failing which only time itself can remedy!

Slots, too, are a valuable associate of flaps, but the latter are seldom employed on the normal type of model on account of their relatively high drag. When conditions become normal once again there is no doubt that they will be employed extensively on large petrol models.

The photograph on the opposite page shows a sailplane wing built by L. G. Temple and features built-in leading edge slots. These have not proved particularly efficient in flight and have now been filled in completely. The photograph below shows another view of the author's model fitted with slots.





A HEIGHT FINDER

By P. G. NEWCOMBE

THIS height finder is very simple to make and is a novelty to use. It can be profitably employed in judging heights for competitions as well as estimating the performance figures for various aircraft.

Construction.

A strong baseboard which will not warp is first obtained. It can be of any desired length and width, but preferably not less than six feet long. Another board the same length as the first is required and is hinged to it along one of the long sides. This second piece—the elevating board—may be cut out as shown or the " arms " may be screwed on to it.

On one of these " arms "—the right-hand one in the diagram—a large scale is fitted graduated in degrees and minutes. A pointer carrying two sights as shown is then pivoted at the centre of this scale. This is extended beyond the pivot so that the excess length may form a handle by which it is conveniently manipulated. The pointer itself should be made of thin wood with a pin stuck in the end that moves over the scale. The sights themselves are simple to make. The backsight is made by crossing at right-angles two fine wires on a plywood ring or screw eye whilst the foresight is merely a pin with a small blob of wax or solder stuck to it. A similar pair of sights are fitted to the other arm of the elevating board as shown in diagram 1. Care must be taken to see that the sights are arranged in exactly the same plane.

A vertical scale is also fitted to the baseboard graduated in degrees and minutes, so that the actual elevation of the elevating board can be read off.

The baseboard is then attached to a stout pole about six or seven feet long by means of a swivel joint—a " Meccano " roller bearing will do for this. During use the pole should be firmly embedded in the ground and the baseboard levelled, preferably with the aid of a spirit level. For transport the pole should be sawn in half and refitted by forcing three prongs of wire into one end, locating in holes drilled in the other end for erection.

Operation.

Two people are needed to man the height finder—one at the fixed sights and one at the swivelling sights. The person operating the fixed sights lines them up on the object, thereby getting the angle of elevation. If the object is moving this angle will alter, of course, but this does not matter as the other angle will alter accordingly. The second operator lines the swivelling sights up on the object and both read their sighting angles simultaneously.

Theory and Calculation.

Diagram 2 gives an outline of the conditions when the sights are lined up.

Let the constant length between the fixed sights and the sight on the left be BC, and the object at the point A.

Then $AB = BC \tan \alpha$

The vertical height of the object above the baseboard is AD.

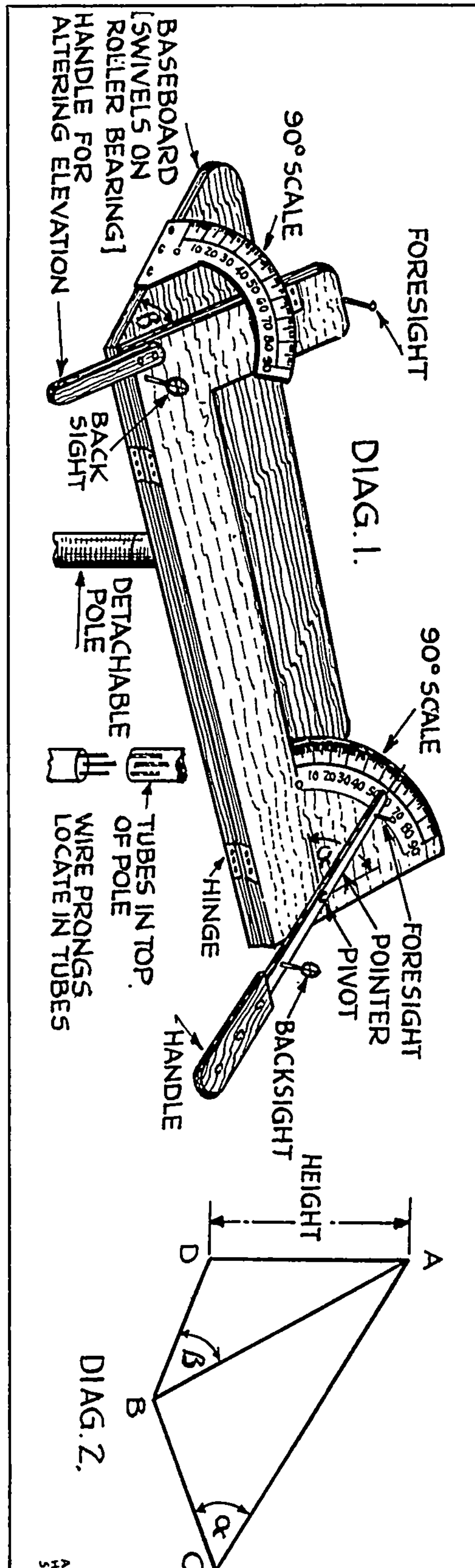
Now $AD = AB \sin \beta$

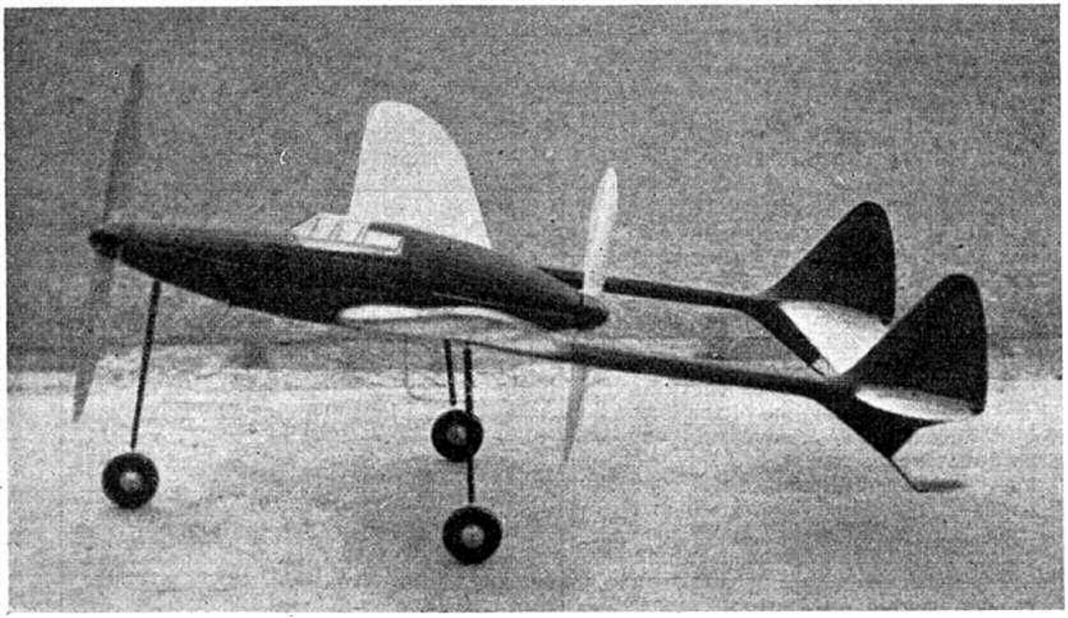
$= BC \sin \beta \tan \alpha$

Thus the height may be found by calculation.

For meticulous accuracy the height of the baseboard itself above the ground should be added to this figure, but this will involve but a fractional error when the altitude is considerable.

Once the operators have got accustomed to working the height finder they may also like to try their hand at estimating speeds, and other performance figures by taking sights at different intervals of time—in fact the applications of this useful piece of apparatus are various.





A FOKKER TYPE DURATION MODEL

By

K. H. HODGSON

A unique model, based on the layout of the Fokker D.23, which is capable of long and stable flights.

THE push-pull layout with twin booms is an attractive escape from the usual run of duration machines and is capable of giving almost equal results. The machine presented here is one which has been carefully developed for some considerable time with a view to eliminating all the "bugs" so that the relatively inexperienced aero-modeller can tackle the job without qualms.

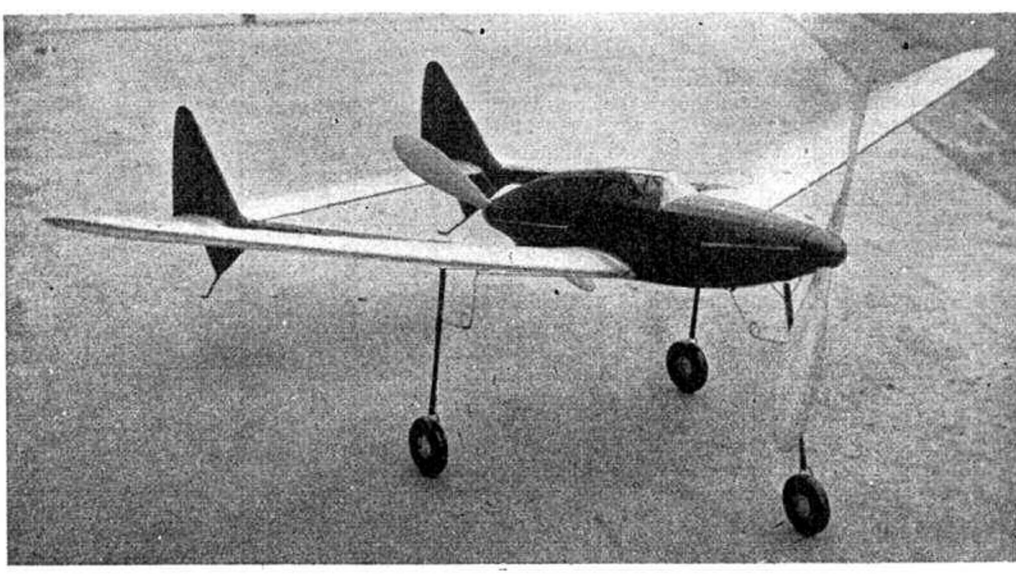
As will be seen from the photographs the fuselage is relatively short and carries an airscrew at each end. Streamlining of the whole machine is carried out to a fine degree and yet the total weight of the completed model should not exceed 7 ounces. The power is relatively small and thus little or no trimming difficulties should be experienced. The torques of the two airscrews should balance out when each has an equal number of turns on the motor, although with the rear airscrew operating in the slipstream of the front airscrew it should have a slightly greater pitch. In practice any slight unbalance of these conditions does not affect the trim of the whole machine to any marked degree and the model is particularly pleasing to fly.

The machine can be set to circle by turning the trim tab on the right fin. Although not aerodynamically sound this method works quite well, but if the builder wishes a trim tab may be incorporated on each fin and each should be turned an equal amount to give the desired circle.

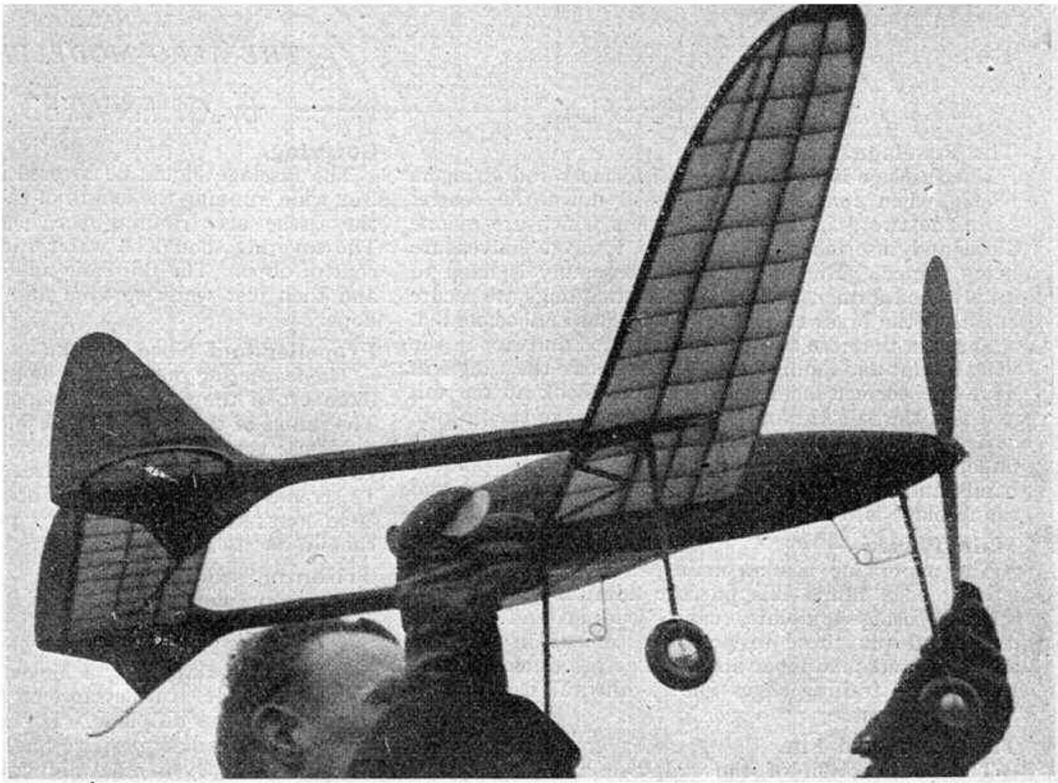
The fin area is large and thus weathercock stability of a high order is present. Such a layout tends toward spiral instability in tight turns and thus this model should not be trimmed to fly in small circles. The ideal trim should be fairly shallow circles with moderate power giving a long, sweeping climb followed by a flat glide. As yet no thermals have been struck with the original model but flights up to two minutes duration have been obtained and during testing one obtained the impression that with careful construction and attention to trimming details the average duration in still air should be in the region of two to two and a half minutes. R.O.G flights are obtained with ease and there is no troublesome torque reactions leading to ground instability.

Construction follows along fairly orthodox lines, but the builder with a little experience should have no difficulty in following the plans. These have been prepared especially for THE AERO-MODELLER PLANS SERVICE and show all parts full size together with explanatory notes of all stages of construction. This method of presentation is preferable to giving a small drawing in the magazine which, on account of the size

The two photographs on this page give a general idea of the layout of the machine and the fine degree of streamlining which is possible. The twin booms of small cross-section, but ample strength, carry the tail unit. Each airscrew is driven by a separate motor and revolves in opposite directions.



Hand launching this machine is a trifle tricky and demands practice. The left hand grasps the front airscrew and the right hand holds both the rear of the fuselage and the rear airscrew. The front airscrew is released first. The gloves worn in this photo are not to guard the fingers against knocks from the airscrews—they merely indicate that the weather was cold! Rising off ground launch is somewhat easier.



of the machine, tends to become rather involved and scaling up a difficult problem.

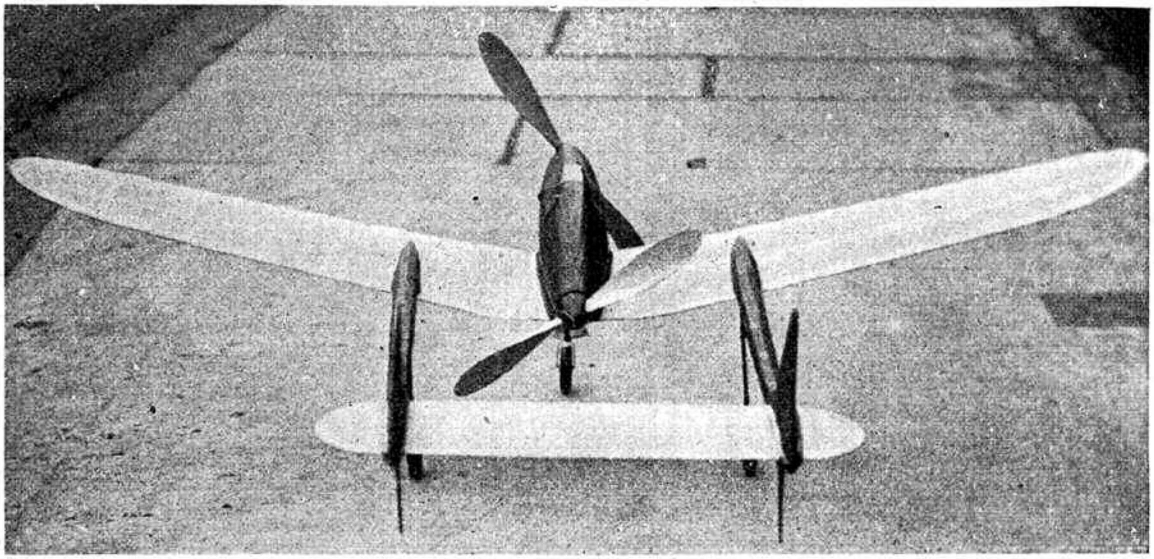
The twin booms experience a considerable load, especially in hard landings, and thus must be carefully built. The type of construction shown on the plans with diagonal bracing between each former gives a structure which is virtually unbreakable if properly made and not abused. They are permanently cemented to the wings, this being thought preferable to a plug-in fixing, with the result that there is no danger of the line-up being accidentally altered. The complete tail unit is detachable and sits on the extremes of the two booms, where it is located by elastic bands.

The motors should consist of ten strands of 3/16 in. by 1/30 in. rubber on each airscrew, about twice the length of the fuselage and pre-wound to tension in the familiar "White" manner. These should each be capable of taking about 800 turns, when well lubricated and pre-wound. In spite of the size of the model the weight of rubber employed is surprisingly small—an important factor in these days!—and yet the performance does not suffer.

Winding may present certain difficulties until the procedure is mastered. Each motor must be wound separately and it is advisable to start with the rear motor. This, unfortunately, must be stretched at an angle to avoid the tailplane and it is not possible to safely put on "competition turns" in this manner. For normal flying, however, this does not matter as full turns are seldom approached. For "absolute" turns the tailplane should be removed entirely and replaced again when the motor is wound and rear "noseblock" in place. The front motor is wound in the normal manner.

Main dimensions of the model are :—

Span : 42 in.
Length over all : 30 in.
Length of fuselage : 19 in.
Airscrew diameter : 12 in.
Weight in flying trim : 7 ounces.



This rear view shows the well-designed wing and the relatively large tailplane which ensures ample longitudinal stability under all normal conditions. There is little danger of the rear airscrew cutting through the booms since ample clearance is provided and the components are not readily displaced.

THE FIREFLY —— by G. F. WEBB

The Fuselage.

The fuselage is built up of half formers and stringers which, when completed, are joined down the centre. Note the two ⅛ in. plywood formers which are in one piece and inserted when the two fuselage halves are being joined. The undercarriage assembly is fixed to its plywood former, making sure all buildings are secure and that the brass tubing is well bound and cemented.

Sheet in the nose and tail as indicated and slot in the wing mount and landing skid, making sure the wing will have the correct incidence. Fit the block at the tail and add the tailskid and paper tube to take the fin rod, cementing all parts securely. Last of all, sheet in the undercarriage well, and add the doors, fit all rubber bands and hooks which retract the undercarriage and the fuselage is ready for covering.

Main Plane.

The mainplane has no mainspar, but a box section leading edge fulfils this purpose admirably. Cut out all ribs using template, carve leading and trailing edges and pin these in position, cement in all ribs, add tips, and sandpaper all irregularities down. Crack leading and trailing edges for tip-dihedral, cement well and leave to set.

Tail-plane and Fin.

The construction of the tailplane and fin is very simple and very similar to the mainplane construction, but care should be taken to build these units free from warps as this plane is very sensitive to empennage control. Cement all hooks and the fin rod very securely.

Covering.

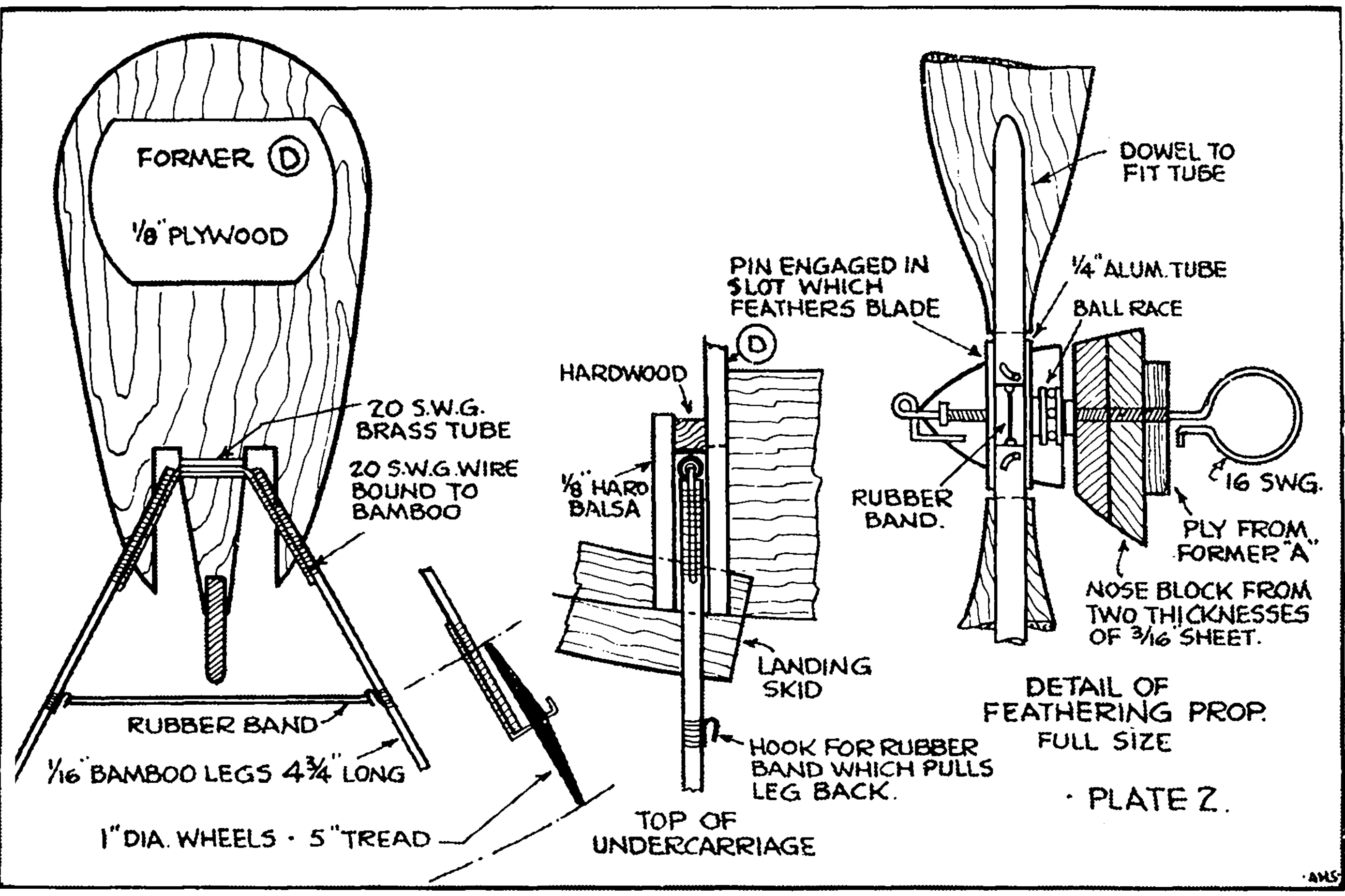
The fuselage should be covered in strips about 1 in.–2 in. wide, running the length of the fuselage, the grain of the tissue also running the length of the fuselage. The covering should be water sprayed, then given one coat of dope. The tailplane and fin should be covered and then just water-sprayed and given a coat of thin dope.

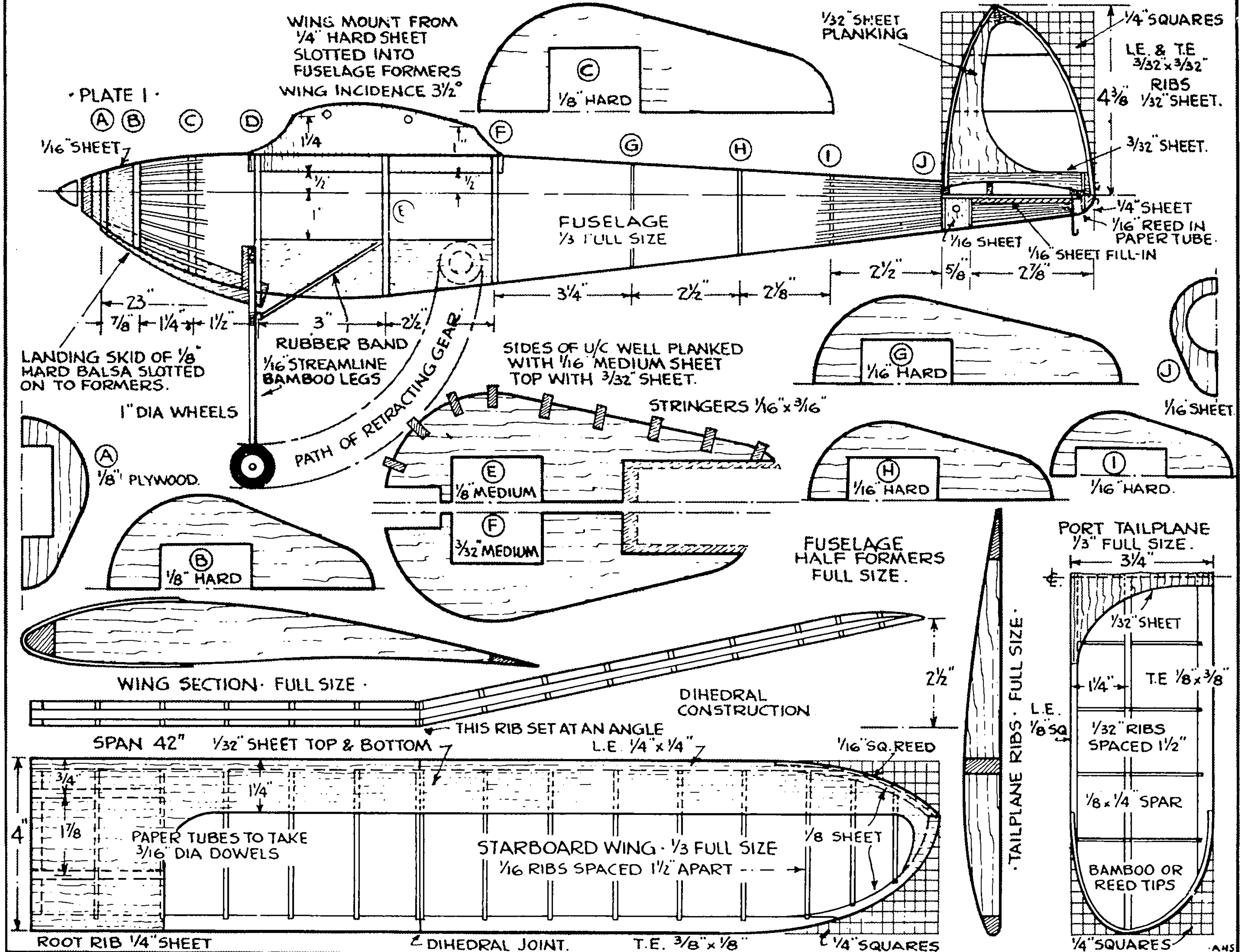
Propeller and Nose Block.

The feathering prop should be built up as shown. The diameter of the feathering propeller should be 12 in. The radius of the single-bladed folder, about 7 in., and if a normal type of prop and freewheel is used, a 12 in.–13 in. propeller is the correct size. Power is provided by 12 strands of 3/16 in. flat rubber, each strand being 30 in. long; a " White " rubber rope method of tensioning should be used

Trimming and Flying.

The model should balance ⅓ of the chord distance from the leading edge. If the model is nose heavy add weight in the form of clay under the tailplane decking. When the correct balance is achieved further adjustment should be made, if necessary, by changing the angle of incidence of the tailplane. If the model is tail heavy give the tailplane a positive angle of incidence until a flat glide is achieved. All gliding tests should, of course, be carried out with the undercart retracted and the prop folded if a folding prop is used. Down-thrust is necessary under full power, but no side-thrust because of the parasol wing reducing the effect of torque.





· PLATE 1 ·
WING MOUNT FROM 1/4" HARD SHEET SLOTTED INTO FUSELAGE FORMERS
WING INCIDENCE 3½°
A B C D E F G H I J
1/16" SHEET
1¼
1"
½"
1"
FUSELAGE 1/3 FULL SIZE
3¼" 2½" 2⅛" 2½" 5/8 2⅞"
23"
7/8" 1¼" 1½" 3" 2½"
RUBBER BAND
1/16 STREAMLINE BAMBOO LEGS
LANDING SKID OF 1/8" HARD BALSA SLOTTED ON TO FORMERS.
1" DIA WHEELS
PATH OF RETRACTING GEAR
1/32" SHEET PLANKING
1/4" SQUARES
L.E. & T.E 3/32" x 3/32"
RIBS 1/32" SHEET.
4⅜
3/32" SHEET.
1/4" SHEET
1/16" REED IN PAPER TUBE
1/16 SHEET
1/16" SHEET FILL-IN
C 1/8" HARD
A 1/8" PLYWOOD.
B 1/8" HARD
SIDES OF U/C WELL PLANKED WITH 1/16 MEDIUM SHEET TOP WITH 3/32" SHEET.
STRINGERS 1/16" x 3/16"
E 1/8" MEDIUM
F 3/32" MEDIUM
G 1/16" HARD
H 1/16" HARD
I 1/16" HARD.
J 1/16" SHEET.
FUSELAGE HALF FORMERS FULL SIZE.
WING SECTION · FULL SIZE ·
DIHEDRAL CONSTRUCTION
2½"
THIS RIB SET AT AN ANGLE
SPAN 42"
1/32" SHEET TOP & BOTTOM
L.E. 1/4" x 1/4"
1/16" SQ. REED
3/4"
1¼"
4"
1⅞
PAPER TUBES TO TAKE 3/16" DIA DOWELS
STARBOARD WING · 1/3 FULL SIZE
1/16 RIBS SPACED 1½" APART
1/8 SHEET
ROOT RIB 1/4" SHEET
DIHEDRAL JOINT.
T.E. 3/8" x 1/8"
1/4" SQUARES
· TAILPLANE RIBS · FULL SIZE ·
PORT TAILPLANE 1/3" FULL SIZE.
3¼"
1/32" SHEET
1¼"
T.E 1/8" x 3/8"
L.E. 1/8 SQ
1/32" RIBS SPACED 1½"
1/8 x 1/4" SPAR
BAMBOO OR REED TIPS
1/4" SQUARES
A.H.S.

A SUGGESTED METHOD OF AIRSCREW DESIGN

By R. BURNS

An interesting article in which Mr. Burns suggests an extremely simple method of designing an airscrew to suit the model. It is the correct design and matching of power and rubber that distinguishes the experienced aeromodeller and its importance cannot be over-emphasized. The theory of airscrew design is extremely complicated and beyond the scope of the average enthusiast, so that simplified generalisations are to be welcomed. Another interesting article on the same subject is pending for a future issue, and in the meantime, we invite readers to send in their opinions or ideas on this article and the subject in general. Owing to the variation in torque of a rubber motor, model airscrews cannot be operating at their maximum efficiency for the whole of the power run, and the point raised about the "flatness" of the torque curve is therefore important. To get over this drawback a variable pitch airscrew is necessary and we promise readers details of this later, should there be a demand for it.

MOST people agree that the right airscrew will make a great deal of difference to a model's performance but if you ask for advice as to which is the ideal airscrew, you come up against a great diversion of opinion, ranging from "Diameter 40 per cent. of wing span, long pitch," to "Don't try a prop. of your own, buy one and try adding or taking off strands until it seems alright!" A result of this is that a good many models designed by their owners are fitted either with huge airscrews which turn gently under the power of two dozen or more strands and boast motor runs (hardly "power" runs!) of three minutes, or have small, fine pitch airscrews which, on being released, emit a fierce whine and pull the machine up vertically.

Now the present article is the result of the author being a nosey parker and simply hating to have things happening under his nose without trying to find out what makes them act that way. During the 1941 season an opportunity of doing some investigation came up and figures for motor run, pitch, diameter and motor strands for seven models (five with single blades and two with double blades and adjustable pitch) were collected and in addition odd tests were made by timing other people's machines both at the Glasgow clubs ground and at Stewarton. At the end of the season I had quite a lot of data and a terrific lot of repairs!

About that time my friends (both of them) made rude remarks as I was often seen in a deep daydream. However, I wasn't asleep, only thinking it out and it went like this.

An airscrew blade is like a wing, so its reactions will vary with V^2, (i.e. velocity squared), and depend upon angle of attack, section, etc. If the pitch is so set that the angle of attack is around 6 or 7 degrees, which seemed to give best results on my 'plane, one variable is eliminated, but if not we must have an item representing this factor which we will call S, the slip as a percentage of the pitch.

Now torque varies with the resultant aerodynamic force acting on the blades and so torque varies as V^2 or V as $\sqrt{\text{torque}}$. Also if this reaction varies with blade area, V^2 will vary as $\frac{1}{\text{blade area}}$ or $V \propto \sqrt{\frac{1}{\text{area.}}}$ Blade area will depend upon maximum blade width × diameter (i.e. B × D,) and V varies as $\sqrt{\frac{1}{\text{B.D.}}}$ Airspeed V of blade will be related to revs. per second and diameter.

∴ V varies as revs. per sec. × diameter

$$\text{or r.p.s.} \propto \frac{V}{D}$$

$$\text{But } V \quad \frac{\sqrt{\text{torque}}}{S \times B \times D}, \text{ therefore}$$

$$\text{r.p.s.} = \frac{K}{D} \times \sqrt{\frac{\text{torque}}{S \times B \times D}}$$

At this point I had a horrible feeling that I had seen that formula before and I dived into the bookshelf in search of sundry learned tomes which I have had to buy in self defence since I took up this game! Finally I ran it to ground in Zaic's 1938 Year Book, page 147, where Mr. Alvrid Palmgrem states:—

$$\text{r.p.s.} = K \times \sqrt{\frac{\text{torque}}{B \times P \times D^2}}$$

Now to save labour (the original being in metric units) I decided to make use of Mr. Palmgrem's formula and supply my own constants from the various data that I had collected. The final result was that it almost exactly fitted the observed power runs except in one case where the error was 7 per cent., the model not being efficient.

The formula now becomes:—

$$\text{r.p.s.} = \frac{2{,}000}{D^2} \sqrt{\frac{\text{Average torque}}{B/D \times \text{pitch}}} \quad \text{for single blades.}$$

$$\text{r.p.s.} = \frac{1{,}500}{D^2} \sqrt{\frac{\text{Average torque}}{B/D \times \text{pitch}}} \quad \text{for two blades.}$$

This is now in more convenient form than the original P, D and B are measured in inches, average torque is in inch-ounces. B/D, the ration of maximum blade width to diameter, is calculated as a decimal and has been used in a range of values of from ·125 to ·18, giving blade widths of from 1½ in. to 2¼ in. on a 12 in. diameter airscrew.

Well, there I was with a formula and I at once tried to use it to design an airscrew for a 1 sq. ft., 5 ounce model powered with 1 ounce of rubber. Estimated power run was 45 seconds and, to my surprise, I found that ten tests ranged from 43–46 seconds, the average being 45 secs.! Moreover, the model had a nice high climb and looked very steady, maintaining the same climb for about 35 seconds out of 45. The average duration in still air is around 90 secs. I also tried the formula on a R.T.P. machine and found that I could forecast the revs. per second exactly, or to within 2 per cent.

Now, obviously there may be more things to find out so I will give the limitations to the formula as far as my experience dictates up to the present.

(i) The results have only been tested on normal duration types. Such machines as flying scale models having large radial motor cowlings may not follow the formula owing to the interference caused and a "blanking out" of a large area of the airscrew disc.

(ii) There was a tensioner used in all cases. If this is omitted the power run may be longer although it is not anticipated that this would alter the performance greatly as the last few turns deliver next to no power.

(iii) The slip of the propeller must be enough to give the blades an angle of attack of about 4 degrees. In practice, adding about $\frac{1}{3}$ or 35 per cent. to actual advance in one revolution will cover this usually.

(iv) The blades must be well finished and have some undercamber, usually $\frac{1}{8}$ in. on a 2 in. blade width. They should not be too thick.

Having explained all this, the details of the steps to be covered are as follows. You require to know the weight of rubber; the average torque it delivers on each of a given number of arrangements (i.e. into a different number of strands), and the corresponding permissable turns; the distance between hooks in the fuselage; and the model's flying speed. The difference between one kind of rubber and another is so great that figures for torque and turns will have to be found by tests.

At this point may I suggest that you use a type of rubber having a flattish portion in the middle of the torque curve—see fig. 1. The airscrew can then be designed for this portion (X-X), and will then be at its best for a reasonably long part of the power run. A motor whose length is twice the distance between hooks is preferable to one that is shorter and thicker.

Then you must decide the *length* of power run you want. I advise taking about half the average duration for the type you are dealing with. The subsequent steps are best illustrated by an example.

Our suggested model is to fly at 18 ft./sec. and is to be powered by 1 ounce of rubber. We will assume that this particular brand of rubber makes up into ten strands 30 in. long, the distance between hooks being 16 in. in the fuselage. We will further assume that such a motor gives an average torque of 5 inch-ounces and takes 900 turns. (*Note.*—This corresponds to 2,350 ft./lb. of energy per pound of rubber.)

The duration of such a type should be about 100 secs. and so that fixes our power run at 50 secs. Now in 50 secs. our model flies $50 \times 18 = 900$ ft. Since the number of turns on the motor is 900 this means an advance of 1 ft. per revolution of the airscrew. The slip is about one-third of this and so the (geometric) pitch is 16 in. The airscrew is to have one blade, width 15 per cent. of the diameter, so that B/D equals ·15.

From the formula:—

$$\text{revs. per sec.} = \frac{2{,}000}{D^2}\sqrt{\frac{\text{Average torque}}{B/D \times \text{pitch}}}$$

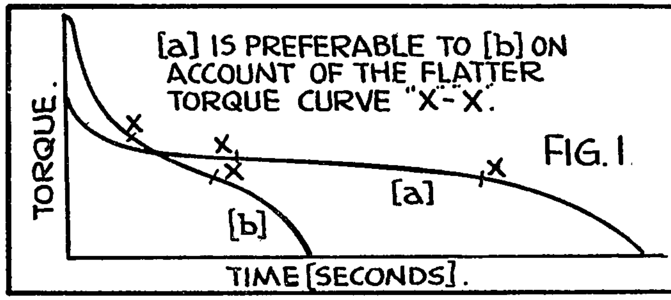
$$\text{i.e. } \frac{900}{50} = \frac{2{,}000}{D^2}\sqrt{\frac{5}{\cdot 15 \times 16}}$$

Hence $18\,D^2 = 2{,}000\sqrt{2 \cdot 08}$

or $D = \sqrt{160}$

$= 12 \cdot 63$

Blade width $= 12 \cdot 63 \times \cdot 15 = 1 \cdot 9$ in.

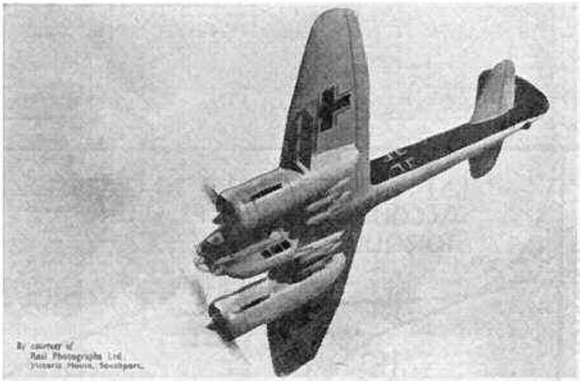


Thus our airscrew is 12·63 in. diameter, 16 in. pitch and blade width 1·9 in. Now I expect that all the people who use very large airscrews will say that this is far too small, but I think that if you test your own rubber and design a model along these lines you may change your opinion. Of course, if you prefer a longer power run the formula will still apply but give a different airscrew diameter.

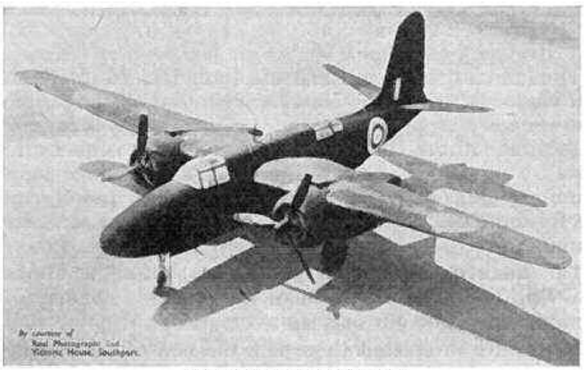
The quantity of rubber employed should be about one-third of the total weight of the model. This is not a maximum value but only an average.

If you are interested there is a method of estimating the performance of a model detailed in a previous issue of THE AERO-MODELLER which would "round off" the calculations nicely as well as comparing the effects on total duration of different power runs. Recent experience suggests that drag increases quite rapidly if short power runs are used (e.g. 50 secs. in a Wakefield), due to increase in slipstream velocity and this should be borne in mind.

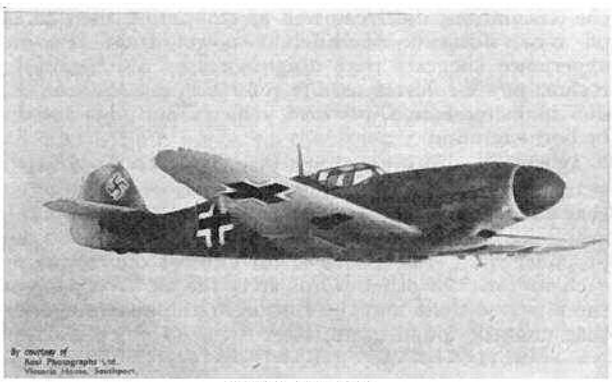
As a matter of interest the formula holds good when gears are used if the average torque is *divided* by the gear ratio and the rubber turns are *multiplied* by the gear ratio. If two skeins are used not geared up to the propeller shaft, the torque is the sum of the torque of each motor. In other words it is the turns (r.p.s.) of the airscrew shaft and the torque at the airscrew shaft that must be found in all cases.



JUNKERS J.U.88.



DOUGLAS "HAVOC."



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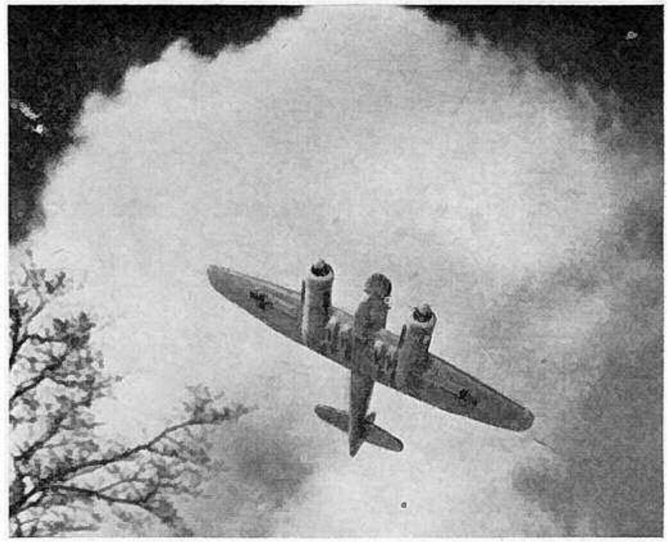


A finely posed photograph of a model Ju88 built by R. E. Gage of Swindon. The natural background proves most effective.

Prototype and Production Lancasters.

Information has been released concerning the service markings of the prototype Lancaster four-motor heavy bombers. Such details are of great interest to the solid modeller but are rarely forthcoming in wartime, and the Lancaster is, in fact, the only new Service type on which the data is forthcoming.

The first prototype Lancaster, which was much nearer to being a four-motor version of the Manchester than is the production version, was serially numbered BT 308. It was fitted with the Rolls-Royce Merlin X motors instead of the Merlin XX now installed and weighed only 50,000 lb. all-up. The roundels and fin markings were of the old variation with a wide white band.

The second prototype on which the production version is based was numbered L 7527 and had Merlin XX motors. Both prototypes carried the usual night-bomber camouflage.

Production Lancasters are flown by squadrons "QR," "OL" and "EM" amongst others. Lancaster R 5699 from "QR" squadron took part in the great raid on Dusseldorf on August 1st, 1942. One Lancaster, R 5852, is interesting in that it has been in service with two different squadrons. When it was first delivered to an operational unit it was machine "R" of "EM" squadron. It is now machine "W" of "OL" squadron and the original lettering is still faintly visible through the new paint.

New Coastal Command Markings.

A new camouflage scheme for all aeroplanes operating under Coastal Command with the exception of fighters has been introduced by the Air Ministry. The "sky" shade formerly applied to the undersurfaces has been superseded by a clear white. The sides of the fuselage and the vertical tail areas are regarded as "undersurfaces" and are painted white. The motor cowlings and nacelles have the upper half camouflaged and the lower half white. The new markings are applicable to such types as the Beaufort I and II, certain Wellingtons and Whitleys, mine-laying Hampden Is and IIs, Liberator II anti-submarine patrol and Fortress II four-motor bombers. The upper surface camouflage is unchanged and remains dark slate grey and extra dark sea grey.

U.S. Army Air Forces in Europe.

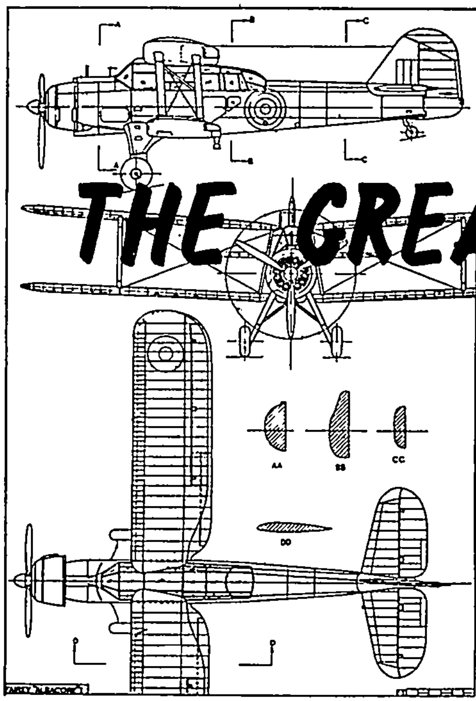
Fighter and bomber squadrons of the United States Army Air Forces are now operating from British aerodromes and are equipped with Spitfire Vs, A-20C Boston IIIs, and B-17E Fortress IIs. Camouflage on the upper surfaces is olive drab whilst the undersurfaces on both fighters and bombers is a light battleship grey. The most recent form of national insignia, the five-pointed white star on a blue disc background without the red centre-disc, is carried on the fuselage sides, above the port wing and below the starboard wing. The characteristic red, white and blue fin stripes are normally painted on the fin to eliminate the possibility of attack by British fighters. A system of code unit letters similar to our own has been developed. The aircraft serial number is painted on the fin near the top and not on the fuselage as on British aircraft. For identification purposes the fighters often carry a broad yellow or white band on the wing surfaces in a chord-wise direction just inboard of the national markings.

Distribution of American R.A.F. Aeroplanes.

It is believed that many readers will appreciate a list of American types serving with the R.A.F. indicating the Command or theatre of war in which the machines are operating. The list which follows summarises the duties on which the various types have been, or are, engaged, and reference to previous articles in this series will explain the markings which are carried. The list is as comprehensive as censorship regulations will allow and includes all American aeroplanes *actually serving* with the R.A.F. at home and overseas in September, 1942. Types on order but not yet delivered are excluded.

Day fighters with Fighter Command: Bell Airacobra I; Night fighters with Fighter Command: Douglas Havoc I and II; Fighter-reconnaissance with Army Co-operation Command: Curtiss Tomahawk II and North American Mustang I; Air Observation Post with Army Co-operation Command: Vultee Vigilant I; Day bombers with Bomber Command: Douglas Boston III and North American Mitchell III; Reconnaissance-bombers with Coastal Command: Lockheed Hudson I, II, III, IV and V, Lockheed-Vega Ventura I; Anti-submarine patrol bombers with Coastal Command: Consolidated Liberator II and Boeing Fortress II; High-altitude bombers with Bomber Command: Boeing Fortress I; General reconnaissance flyingboats with Coastal Command: Consolidated Catalina; Ferry Command: Fairchild Argus I; Training Command: North American Harvard I, Curtiss Cleveland I, Douglas Boston, Curtiss Mohawk III, IV, Brewster Buffalo I; Fighters with Middle East Command: Curtiss Tomahawk II and Curtiss Kittyhawk I, II and III; Fighters with Far Eastern Command: Brewster Buffalo II, Curtiss Mohawk IV; Day bombers with Middle East Command: Glenn Martin Maryland I, II; Glenn Martin Baltimore I, II and III; Douglas Boston III, Northrop Nomad I; Fighters with Fleet Air Arm: Grumman Martlet I, II, III and IV; Spotter-reconnaissance: Vought-Sikorsky Kingfisher; Dive-bomber trainer: Vought-Sikorsky Chesapeake I; Amphibians with Air-Sea Rescue Service: Grumman Goose I.

(*concluded on page 486*)



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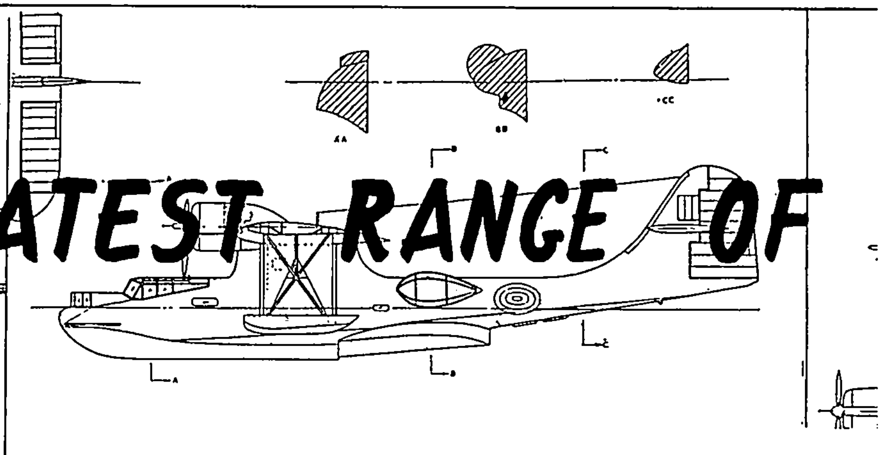

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VICKERS-ARMSTRONGS WELLINGTON I
VICKERS-ARMSTRONGS WELLINGTON II and III
VICKERS-ARMSTRONGS SPITFIRE II
VICKERS-ARMSTRONGS SPITFIRE III and V
WESTLAND LYSANDER II
WESTLAND WHIRLWIND I

AMERICAN :

BELL AIRACOBRA (PROTOTYPE)
BELL AIRACOBRA I
BOEING FORTRESS I
BREWSTER BUFFALO I
CESSNA CRANE I
CONSOLIDATED PBY-5 (28-5)
CONSOLIDATED CATALINA I
CONSOLIDATED LIBERATOR I
CURTISS YP-37
CURTISS A-18
CURTISS SBC-4 HELLDIVER (CLEVELAND)
CURTISS 75a HAWK
CURTISS MOHAWK IV
CURTISS P-40 TOMAHAWK I
CURTISS TOMAHAWK II
CURTISS KITTYHAWK II
CURTISS-WRIGHT C.W.21

DOUGLAS (NORTHROP) 8a
DOUGLAS B-18a DIGBY I
DOUGLAS D.B.7 BOSTON II
DOUGLAS D.B.7 HAVOC I
DOUGLAS D.B.7b BOSTON III and D.B.7a HAVOC II
FAIRCHILD F.24 (C.61) ARGUS
GRUMMAN F2F-I
GRUMMAN MARTLET I
GRUMMAN SKYROCKET
LOCKHEED HUDSON I
LOCKHEED HUDSON V
LOCKHEED 322-61 LIGHTNING
MARTIN MARYLAND II
MARTIN BALTIMORE I
NORTH AMERICAN N.A.50
NORTH AMERICAN HARVARD I
NORTH AMERICAN HARVARD II
NORTH AMERICAN YALE I
NORTH AMERICAN MUSTANG I
NORTHROP N-3 PB
REPUBLIC P-43 LANCER
SEVERSKY P-35
VOUGHT-SIKORSKY CHESAPEAKE I
VULTEE VANGUARD I

GERMAN :

ARADO Ar 95-SEE
ARADO Ar 96b
ARADO Ar 196
BLOHM & VOSS Ha 139
BLOHM & VOSS Bv 140
BLOHM & VOSS Bv 142
BÜCKER JUNGMANN
BÜCKER JUNGMEISTER
DORNIER Do 17P
DORNIER Do 17Z

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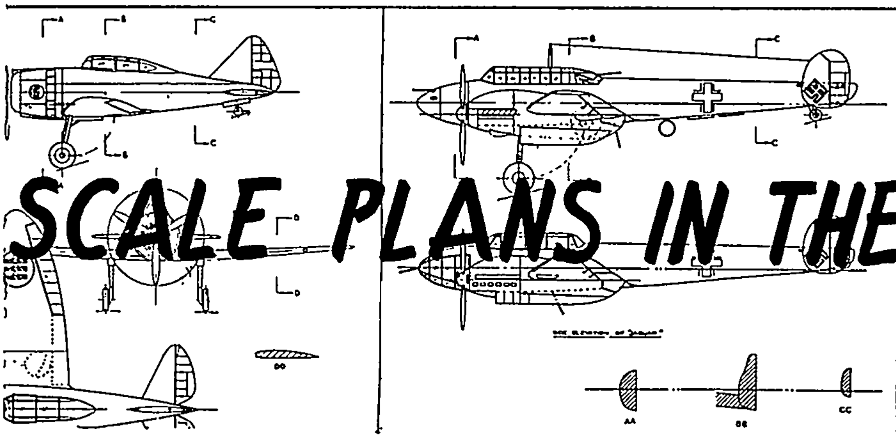

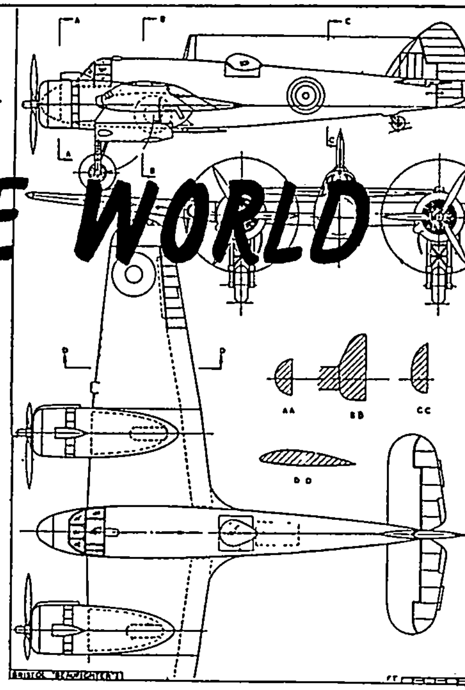

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DORNIER Do 24
DORNIER Do 26K
DORNIER Do 215

FIESLER Fi 156 STORCH
FIESLER Fi 167

FOCKE-WULF Fw 58 WEIHE
FOCKE-WULF Fw 187
FOCKE-WULF Fw 189
FOCKE-WULF Fw 190H
FOCKE-WULF Fw 200 CONDOR
FOCKE-WULF Fw 200K KURIER

GOTHA Go 149

HEINKEL He 59
HEINKEL He 60
HEINKEL He 111K Mk. Va
HEINKEL He 112
HEINKEL He 113
HEINKEL He 114
HEINKEL He 115

HENSCHEL Hs 126

JUNKERS Ju 52/3m
JUNKERS Ju 86K
JUNKERS Ju 87B
JUNKERS Ju 88K A-1
JUNKERS Ju 89K

MESSERSCHMITT Me 109E
MESSERSCHMITT Me 109F
MESSERSCHMITT Me 110 C-5

ITALIAN :

BREDA 64
BREDA 88 LINCE

CAPRONI Ca.133
CAPRONI Ca.135bis
CAPRONI Ca.310 LIBECCIO
CAPRONI Ca.311
CAPRONI Ca. 312bis
CAPRONI REGGIANE RE.2000 FALCO I

CANT Z.501
CANT Z.506b AIRONE
CANT Z.1007bis ALCIONE

FIAT B.R.20 CICOGNA
FIAT C.R.42 FRECCIA
FIAT G.50 FALCO

MACCHI C.200 SAETTA

PIAGGIO P.32bis

SAVOIA-MARCHETTI S.M.79 SPARVIERO
SAVOIA-MARCHETTI S.M.79b
SAVOIA-MARCHETTI S.M.81 PIPISTRELLO
SAVOIA-MARCHETTI S.M.82 CANGURU

AUSTRALIAN :

C.A.C. WIRRAWAY
D.H. MOTH MINOR

CANADIAN :

D.H. 82C TIGER MOTH
FAIRCHILD M-62
FLEET FINCH
FLEET FORT I

NOORDUYN NORSEMAN

RUSSIAN :

I-15 CHATO
I-16 RATA
I-17
R-10
SB-2
TB-3

FRENCH :

AMIOT 370
BLOCH 151
BREGUET 690-1

DEWOITINE D.510
DEWOITINE D.520

LOIRE-ET-OLIVIER LeO 45 B.4

MORANE-SAULNIER M.S.406 C1

POTEZ 63
POTEZ 63-11

POLISH :

P.Z.L. P.XXIV
P.Z.L. MEWA
P.Z.L. SUM
P.Z.L. LOS

BELGIAN :

FAIREY FIREFLY II
FAIREY FOX VI

DUTCH :

FOKKER G-1
FOKKER T-8-W

KOOLHOVEN F.K. 52
KOOLHOVEN F.K. 58

IRAQI :

D.H.84a DRAGON
HAWKER NISR

JUGOSLAV :

HAWKER FURY (JUGOSLAV)
IKARUS IK-2

GREEK :

HAWKER HORSLEY

JAPANESE :

MITSUBISHI KARIGANE II

Also SCALE PLANS OF AIRCRAFT OF THE 1914-18 WAR

A COMPLEMENTARY RANGE TO THE 'PLANES OF THE PRESENT WAR LISTED ABOVE

BRITISH :

ARMSTRONG-WHITWORTH F.K.8
AVRO 504K
B.E.2c and 2d
BRISTOL BULLET (D SCOUT)
BRISTOL F2B FIGHTER
BRISTOL MONOPLANE
D.H.1a
D.H.2
D.H.4
D.H.5
D.H.6.
D.H.9
D.H.9a
D.H.10
MARTINSYDE G.100 ELEPHANT
MARTINSYDE F.4 BUZZARD
R.E.8
S.E.5a
SHORT N2B
SOPWITH CAMEL F.1
SOPWITH DOLPHIN
SOPWITH 1½ STRUTTER
SOPWITH TABLOID
SOPWITH TRIPLANE

FRENCH :

BREGUET 14A.2
MAURICE FARMAN SHORTHORN
NIEUPORT 28 C.1
NIEUPORT 17 C.1
SPAD S.VII

GERMAN :

ALBATROSS C.III
ALBATROSS D.I
ALBATROSS D.III
D.F.W. AVIATIK C.V.
FOKKER MONOPLANE
FOKKER D.VI
FOKKER D.VII
FOKKER Dr.I TRIPLANE
HALBERSTADT D
HALBERSTADT C.L.IV
HANOVERANA C.L.III
L.V.G. C.V.
PFALZ D.III
PFALZ D.XII
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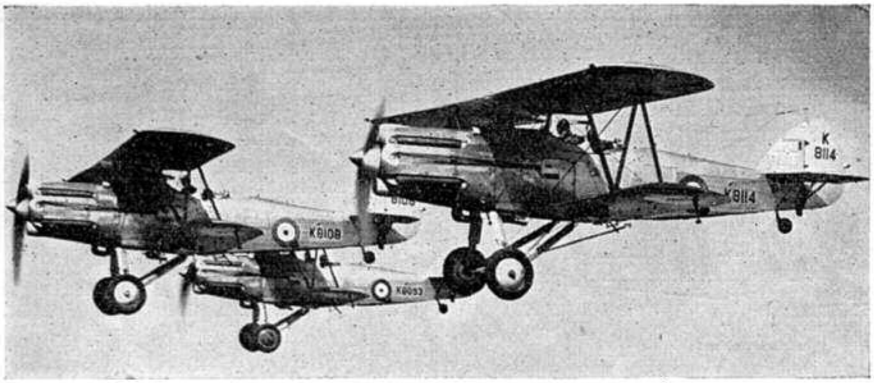


Photo by courtesy of "Flight."

FIGHTING AIRCRAFT OF THE PRESENT WAR—XXII

By H. J. Cooper

THE HAWKER HECTOR

THE release by the Air Ministry of information relating to the G.A.L. Hotspur training glider has brought into the news the Hawker Hector, which type, supplemented by Lysanders and Audaxes, is now used for glider-towing.

The genesis of the Hector Army Co-operation biplane lies, as in so many Hawker designs, in the Hart two-seat day-bomber of 1930. Towards the end of 1933, a Hart, K 2434, was withdrawn from service and fitted experimentally with the then new Napier air-cooled motor with twenty-four cylinders in H form. This motor subsequently became known as the Dagger and developed about 750 h.p. This Dagger-Hart was seen in the Experimental Type Park at the Hendon Display of 1934, and was used for all subsequent development. The first production model, K 3719, appeared late in 1935, and an announcement was made that a number had been ordered by the Air Ministry. The contract was executed by the Westland Aircraft Company, and in March, 1937, the first Hectors were delivered to No. 13 (Army Co-operation) Squadron, stationed at Odiham, in Hampshire, where they replaced the Audax, which had been in service since 1932-3 and is now used mostly for training purposes. The Hector was followed in the squadrons by the Westland Lysander.

When the first production Hector appeared it revealed one major modification to the original Dagger-Hart. The installation of the new motor resulted in the centre of gravity being moved forward, and the swept-back upper wing, so characteristic of the Hart and its derivatives, was replaced by an untapered straight wing.

Structurally the Hector follows the general practice employed in its predecessors. The wings are built up of high-tensile steel spars with duralumin ribs and are covered with fabric. The fuselage is built of steel tubular longerons in the conventional Hawker style, and is covered forward with metal plates and aft with fabric, except for some metal panels for oblique and vertical photography. The tail-unit is constructed similarly to the wings.

The Napier-Halford Dagger III motor which is fitted to the Hector gives a normal output of 725 h.p. at 3,500 r.p.m. at 3,500 ft., and a maximum output of 805 h.p. at 4,000 r.p.m at 5,000 ft. There is capacity for 90 gallons of petrol and 7 gallons of oil.

The crew is housed in open cockpits in the usual manner. The pilot in an A.C. machine, occupying the forward cockpit, acts also as observer, photographer and wireless-operator: the gunner is employed solely in defence of the machine against attack from the air.

When in squadron service the Hector was armed with a fixed Vickers gun in the port side of the motor cowling which fired ahead through the airscrew disc; the gunner operated a movable Lewis on a patent Hawker mounting over the rear cockpit. Eight 20 lb. or two 112 lb. bombs were carried in racks below the wings. Full radio and night-flying apparatus was fitted. In its present form the Hector carries no armament.

The Hector can be more readily confused with the Fury than with the Harts. It is rather larger than the Fury and the cut-out in the upper plane is one point whereby it can be recognised. In the side view the absence of sweep-back and the air-intakes above and below the motor resembling a radial cowling are the main recognition features. The Napier motor has a distinctive note that resembles a powerful Gipsy motor.

Glider-towing Hectors are shadow-shaded dark green and dark earth above and on the sides, and the undersurfaces are yellow. Black diagonal bands (see Mr. Rupert Moore's cover painting) are painted below the fuselage and the lower plane. The tailplane is black with the elevators yellow. The under surface of the top plane is also yellow. Roundels above the wings are red and blue; on the fuselage they are red, white and blue surrounded by yellow, and underneath the wings are red, white and blue. The usual fin marking is carried. A black serial number is painted on each side of the fuselage ahead of the tailplane.

While Hectors were in squadron service they were coloured all silver, and roundels on wings and fuselage were red, white and blue. In addition to No. 13 (A.C.) Squadron, Hectors formed the equipment of Nos. 2, 4, 26, 53 and 59 Squadrons. No. 2 Squadron carried as a marking a black triangle on each side of the fuselage aft of the roundel. The serial number was painted in black through a space in this triangle, on each side of the rudder and below the wings. One flight from this squadron carried the serial numbers K 9737, K 9738 and K 9739. During Divisional manœuvres held in the autumn of 1937 Hectors of No. 4 (A.C.) Squadron were given a coat of light green distemper as a marking of the Second Division. One such machine bore the serial number K 8120 and bore the squadron crest on the fin. The flight of Hectors shewn in the accompanying photograph is from No. 13 squadron.

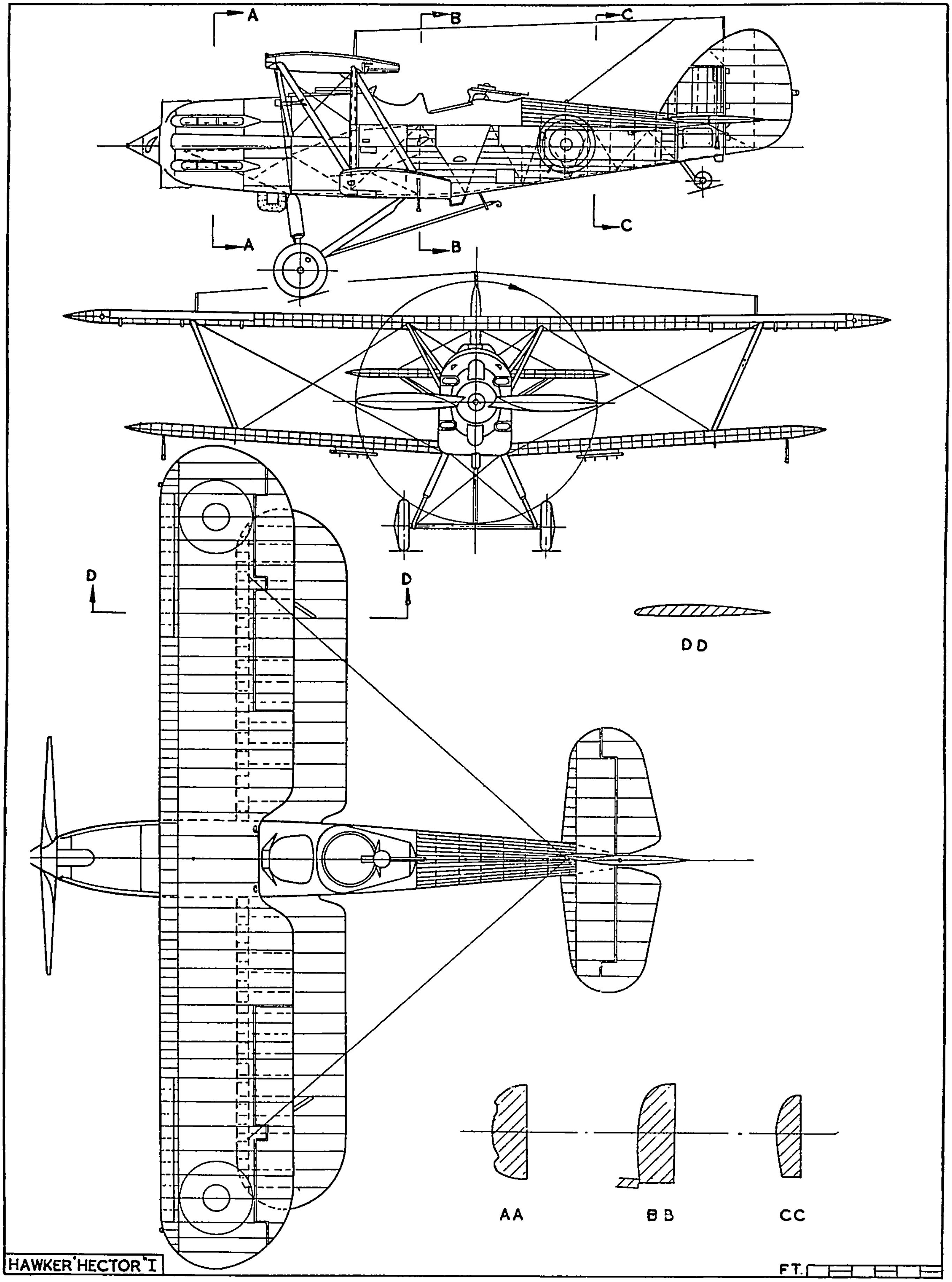
Specification.

Performance : Max. speed: 187 m.p.h. at 5,560 ft.; operating speed: 178 m.p.h. at 13,120 ft.; landing speed: 62 m.p.h.; climb to 6,560 ft., 3·4 mins.; climb to 9,840 ft., 5·5 mins.; service ceiling: 24,000 ft.; endurance at 178 m.p.h. at 4,500 ft.: 2·4 hrs.

Weights : Tare (with fixed equipment): 3,389 lbs.; loaded: 4,887 lbs.

Loadings : Wing: 14 lbs./sq. ft.; power: 6 lbs./h.p.

Dimensions : Span (upper): 36 ft. $11\frac{3}{8}$ in.; (lower): 31 ft. 4 in.; length: 29 ft. $9\frac{3}{4}$ in.; height: 10 ft. 5 in.; tailplane span: 12 ft. 0 in.; track: 6 ft. $4\frac{1}{4}$ in.; airscrew diameter: 10 ft. 9 in.; wing area: 348 sq. ft.



HAWKER 'HECTOR' I

TECHNICAL TOPICS *(concluded from page 462)*

This now leads to the question of cooling. Model aero engines are invariably air cooled; that is the cylinder and head are finned to increase the surface area exposed to the airstream enabling heat to be dispersed direct from the metal to the atmosphere. The working temperature is quite high, but provided that a free draught of air is circulating and the engine is correctly designed there is little danger of seizing up.

Both the top of the cylinder and the piston crown are heated during combustion and thus the object of the design and choice of metals is such as to give rapid dispersal of this heat to the air. In this respect aluminium alloys are excellent on account of their good conductivity of heat, but they suffer from one serious defect. The coefficient of expansion of aluminium is relatively high and thus for small engines where no rings are employed there is a grave danger of an aluminium piston seizing up. This is unfortunate, but the best combination I have found in my association with the design of small engines, both from the point of actual running friction and adequate heat dispersal, is steel and cast iron, the latter preferably for the piston. The steel cylinder may take the form of only a liner with the outer cylinder walls of aluminium or aluminium alloy, shrunk on. Again there is a danger of this expanding under heat but the result is not so serious as a seizing up of the engine and is quite satisfactory for short runs.

Fortunately the problem of valves and valve ports do not concern us with the two stroke engine, but it will be appreciated where these are employed they must be capable of working at extremely high temperatures.

MONTHLY MEMORANDA *(concluded from page 481)*

The Liberator Series.

A good deal of confusion as to the characteristics and uses of the various Consolidated Liberator four-motor bombers is apparent and the following is an attempt to clarify the position:—(*a*) Liberator I (Twin Wasp S3C4–G motors) is the Consolidated Model 32B and the U.S. Army Air Forces B–24B. In this country it is not used on operations, but rather as a transport by the Ferry Command on the Atlantic flights. It is designated the LB–30 when used for this purpose and no gun turrets are fitted. (*b*) Liberator II (Twin Wasp S3C4–G motors) is the Consolidated Model 32C and the U.S. Army Air Forces B–24C. This is the version employed on anti-submarine reconnaissance patrol by the R.A.F. Coastal Command. It is fitted with power-driven Boulton and Paul gun turrets and has a battery of fixed shell-guns beneath the fuselage belly. (*c*) Liberator III (S4C4–G Twin Wasp motors) is the Consolidated Model 32D and the U.S. Army Air Forces B–24D. It differs from preceding versions in having a modified dorsal gun turret moved forward behind the pilots' cabin and higher-powered motors. (*d*) Liberator IV is the latest version now being produced at the collossal Ford factories. It has elliptical cowlings and an unspecified motor with turbo-driven superchargers. In the U.S. Army Air Corps it is known as the B–24E and by the Consolidated Factory as the Model 32E. A fifth type of Liberator used on the Atlantic Ferry run as the LB–30A is a special model of the Model 32D and was previously used by the U.S. Army as the B–24B. It is known as the Liberator IIIa.

Club News By CLUBMAN

WELL, at long last I am able to give you a full account of the National contests, at least up to the K. & M.A.A. Cup event, which is the latest to be squeezed in before press date. Bushy Park continue their winning streak, whilst W. Jones of the Golden Wings club is to be congratulated on his successes in the Flight Cup and Gutteridge Trophy events. Several new names have appeared in the top flight this year, though some of the good old-stagers still seem to retain their skill, and place consistently high in all comps.

Weather conditions have been far from ideal for most of the events, but the times recorded are amazingly good in some instances. The "Model Engineer No. 2 Cup" attracted 95 entries, while the "Flight Cup" had 88 competitors. Surprisingly enough, the "Gutteridge" event only received 48 entries, which is strange in view of the fact that Wakefield models are required, and surely there is no shortage of this class of machine.

With only the "Thurston Glider Cup" to be competed for, it seems a foregone conclusion that Bushy Park bag the trophy for 1942, and their consistency certainly merits their win. However, more of that later, for there are many slips between the cup and the lip, and it does not do to make too sure of a thing until it is over. I have not kept a check on the individual scores this year, but think it will be something of a tussle amongst two or three this time, with the favourite A. H. Taylor of Bushy Park. That is purely a guess, and a full working out of scores might prove me wrong, but we shall see later on.

A number of interesting matters arise from recent S.M.A.E. Council meetings. The question of Trustees for the Society has meant much head-scratching, but the researches have brought many interesting points to light, and there is no doubt that the present activities of the governing body are paving the way to a much higher organised state of affairs in the future. The current growth of the movement brings in its train many requirements that were unnecessary in earlier times, and I am pleased to see that steps are being taken to be fully prepared for future eventualities.

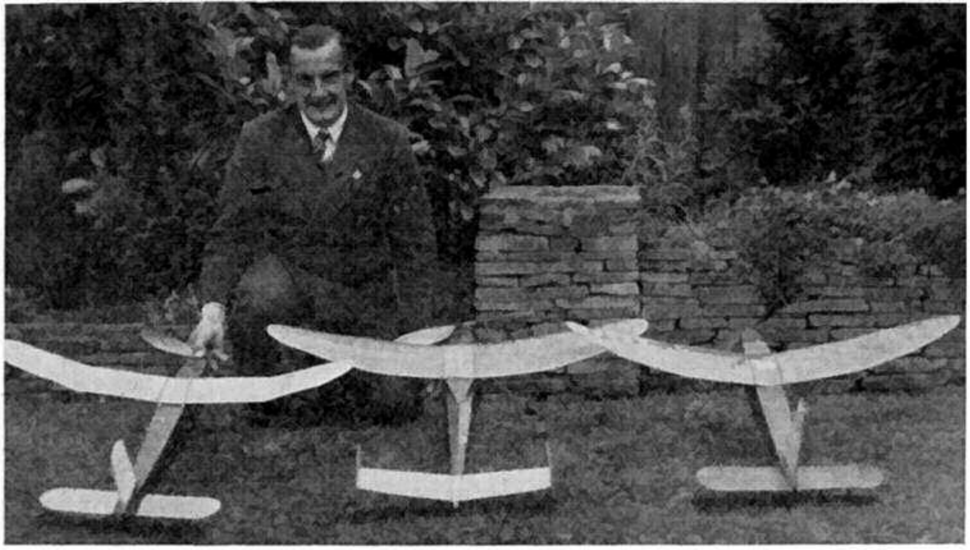
One far-reaching matter is the possible revision of affiliation fees, and certain conditions of membership. You remember my remarks some time back regarding certain suggestions the Editor had to make to the Council. One of these is a suggested new type of membership on an Associate basis, mainly to cater for the very large number of aero-modellists who are unable for various reasons to enjoy membership via a club. There are many, and I hope to see this group catered for in some future classification. However, the whole matter is under discussion, and will be tabled at the Annual General Meeting, which should be one of the most important in the annals of the Society.

A wise and far-reaching amendment to competition rules has taken place, whereby the former time limit has been waived for the duration of the war. Many competitors are now working on Sundays, and the old closing time of 7 p.m. placed an unfair restriction on such chaps. Also, the shortage and non-existent supply of stop watches—which has been handicapping many clubs—is eased by the decision to allow one watch to two timekeepers in future. This should be a welcome concession for many new clubs.

Congratulations to Bill White of the Blackheath Club, who has raised the Class "A" record for towline launch gliders to 3 : 37·15. I expect a determined effort will be made on the new listings shortly, and would point out that there are many new classes in which initial records can be set up. Everything must have a start, and it is high time some of you were getting down to some flying in these new classifications.

Northern Heights M.F.C. won the "Bedfordshire Model Aero Silver Challenge Cup," staged by the IGRANIC S. & S. Club, their aggregate being 1,531·6 secs. Oxford placed second with a total of 1,172·8, Bushy Park third with 1,007·5, and Halifax fourth with 993·6 secs.

Top: Members of the Ashton & D.M.A.C. ready for the fray.



W. Jones, winner of the Flight Cup and Gutteridge Trophy, with three of his specials. The Flight winner is on the left and the Gutteridge machine on the right. Model in the centre is a Zaic New Yorker.

Weather all round was poor, and quite a number of wrecked machines were reported. The organisers wish to extend their thanks to all clubs who supported the contest, and their condolences with those who had such a bad time one way and another.

A West Country team of spotters have taken up the construction of small scale models in order to aid them in their recognition, and find the application to detail greatly helps their roof work. A well-known Council member has been keeping a fatherly eye on their activities, and many promising modellers are reported.

Folding props. are becoming the vogue with the LEEDS M.F.C. since M/s. Furse and Tubbs have been cleaning things up a bit in recent comps. The former aggregated 4 : 47·9 in the latest duration event, Tubbs clocking 3 : 24·9. The latter fellow later raised the club H.L. record to 1 : 50·2, and lost it for good a few days later! (No—the model, not the record!!)

The WALTHAMSTOW M.A.C. have obtained the use of the Markhouse Road School for indoor flying this winter, and look forward to some interesting flying, many microfilmies having already put in an appearance. It is hoped to try out r.t.p. speed work—and a few fat aero-modellers are assured of a special welcome. Why? . . . to sit on the base of the pole.

The " Wilkinson Challenge Shield " will be held during September, full details to be obtained from the secretary of the SHEFFIELD AIR LEAGUE SOCIETY, Mr. Cudworth, 18, Derbyshire Lane, Sheffield, 8.

Ian Donaldson of the WHITEFIELD M.F.C., who has held nine of the club's records in the past twelve months, has raised the club glider record to 1 : 55, but. this pales into insignificance against the flight

S.M.A.E. NATIONAL CONTEST RESULTS

The Pilcher Cup.

		Aggregate
1.	A. H. Taylor, Bushy Park	230.7
2.	R. J. Boxall, Brighton	218.6
3.	H. R. Jeffs, Streatham	203.5
4.	F. Jeffrey, Blackheath	193.45
5.	R. E. Galbreath, Blackheath	185.9
6.	R. Pribyl, Streatham	180.0
7.	A. T. Taylor, Bushy Park	147.5
8.	H. A. King, Brighton	146.2
9.	A. H. Lee, Bristol	144.2
10.	M. Wright, Bushy Park	143.5
11.	R. Sylvester, Bushy Park	137.0
12.	D. Blair, Birmingham	128.3

THE FLIGHT CUP.

		Aggregate
1.	W. Jones, Golden Wings	575.2
2.	J. A. D. Noakes, Birmingham	487.3
3.	D. Searle, Bushy Park	428.3
4.	A. H. Taylor, Bushy Park	420.5
5.	F. Wilkinson, Leicester	377.0
6.	R. A. Kimber, Golden Wings	370.7
7.	R. Sylvester, Bushy Park	368.7
8.	F. W. Davies, Leicester	341.0
9.	G. A. Prins, Blackheath	324.9
10.	G. E. Dunmore, Leicester	302.0
11.	J. C. Lucas, Brighton	290.0
12.	D. J. Dawson, Leicester	260.0

Model Engineer No. 1 Cup.

	pts.
Bushy Park	1074.2
Luton	630.75
Streatham	597.9
Northern Heights	530.5
Birmingham	436.15
Blackheath	398.8
Bristol	242
Beverley	212.8
Oxford	196.6

Model Engineer Cup, No. 2

		Aggregate
1.	N. Gregory, Harrow	750.5
2.	M. Wright, Bushy Park	634.0
3.	A. H. Taylor, Bushy Park	614.0
4.	D. Lofts, Northern Heights	603.5
5.	J. North, Blackheath	590.2
6.	M. Farthing, Croydon	483.4
7.	C. S. Wilkins, Bristol	453.6
8.	P. C. Doughty, Birmingham	448.6
9.	J. L. Pitcher, Croydon	357.6
10.	A. A. Courtney, Oxford	356.4
11.	A. Wyman, Walton	337.0
12.	H. C. Barton, Hawker	323.25

Gutteridge Trophy.

		Aggregate
1.	W. Jones, Golden Wings	744.5
2.	J. Townsend, Ilkley	616.0
3.	A. H. Lee, Bristol	568.8
4.	E. Brown, Ashton	552.4
5.	D. Searle, Bushy Park	387.8
6.	A. F. Houlberg, Oxford	383.5
7.	C. E. P. Smith, Bristol	375.0
8.	A. H. Taylor, Bushy Park	375.0
9.	R. Hinks, Luton	365.5
10.	J. Devall, Northern Heights	345.5
11.	F. Ivory, Golden Wings	330.6
12.	H. A. C. Hassall, Birmingham	322.6

WOMEN'S CHALLENGE CUP.

		Aggregate
1.	Mrs. A. M. Buckeridge (Pharos)	288.5
2.	Mrs. M. Morgan (Cardiff)	196.0
3.	Mrs. Clark (Luton)	180.3
4.	Miss M. D. Kershaw (Leicester)	114.0
5.	Mrs. Dalby (Beverley)	79.0
6.	Miss Chard (Bristol)	45.55

made by E. W. Chamberlain's "Clipper," which clocked 47 minutes on the 12th July. Unfortunately, no official timekeepers were present, and therefore no credit can be entered on the records chart. Hard luck.

Another club glider record to go bust is that of the BURY & D.M.A.C., D. Winterburn raising the figure to 1 : 38. R.T.P. flying is indulged in when the weather is too bad for outdoor work (and that's pretty frequent up that end of the country), and E. Simpson won a recent contest with a time of 55 secs.

August 16th proved a really fine day with the NORTHERN HEIGHTS M.F.C., and advantage was taken to run off two contests. The first, for the "Wilson Cup," brought out some fine Wakefield models, and at least a dozen junior members were able to put up times of from 350–700 secs. for three flights. One new member, who has forsaken petrol-driven model speed boats for rubber-driven model 'planes, was timed one evening for 45 mins. o.o.s. with an "Air Cadet," the model alighting some 8 miles away after floating around for 3½ hours.

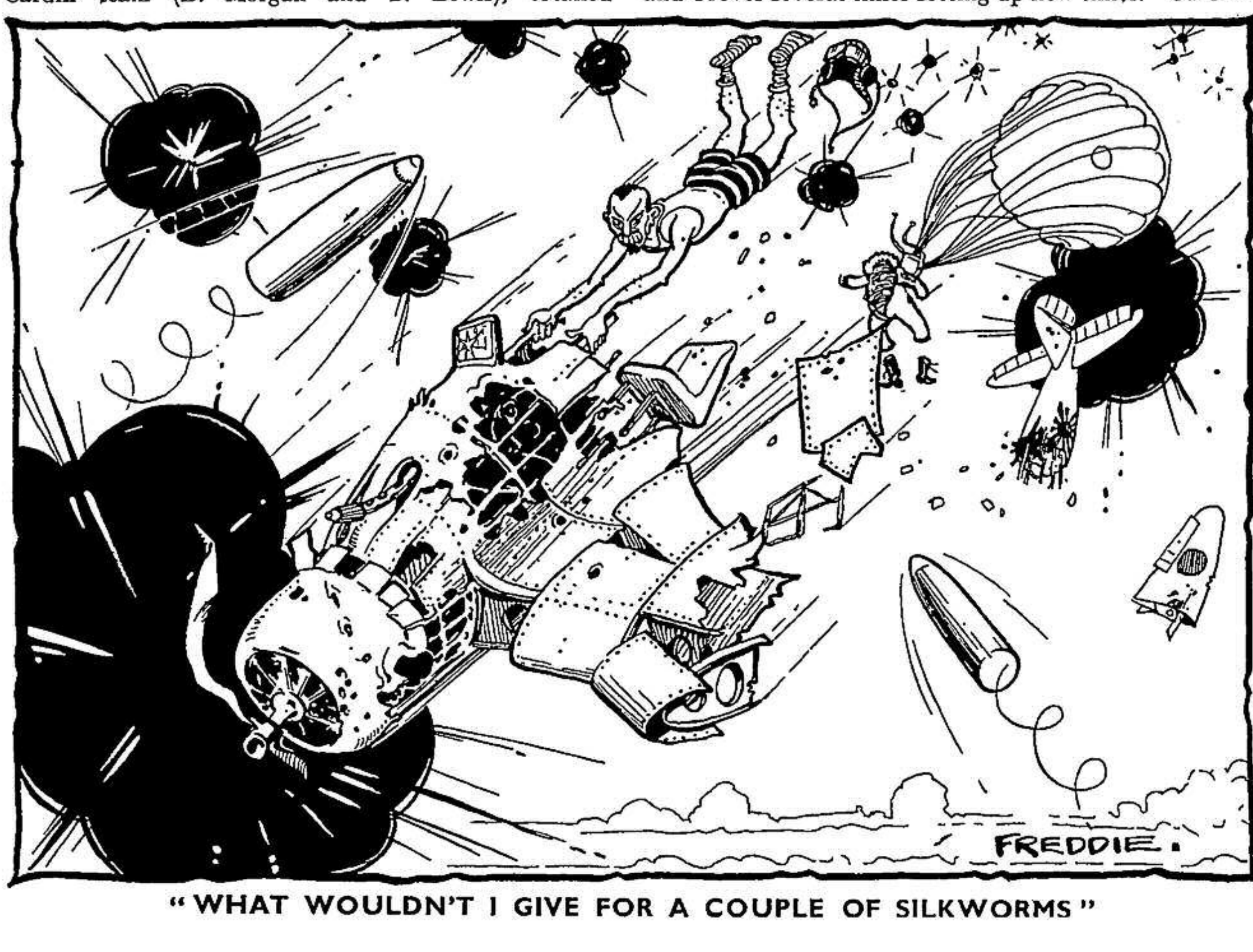
Quite a good entry was received by the CARDIFF M.A.C. for the Welsh Rally staged last month. Unfortunately travel difficulties prevented some entries, though the Mountain Ash team cycled the 25 miles to Cardiff to do their stuff! A sunny day with a fair amount of wind welcomed the competitors, and the Cardiff team (B. Morgan and T. Lewis), totalled 271 secs. to win. Barry came second with 136·5, and Mountain Ash third with 109.

Brightening the dark man's lot! A snap sent in by a reader in far Sudan.

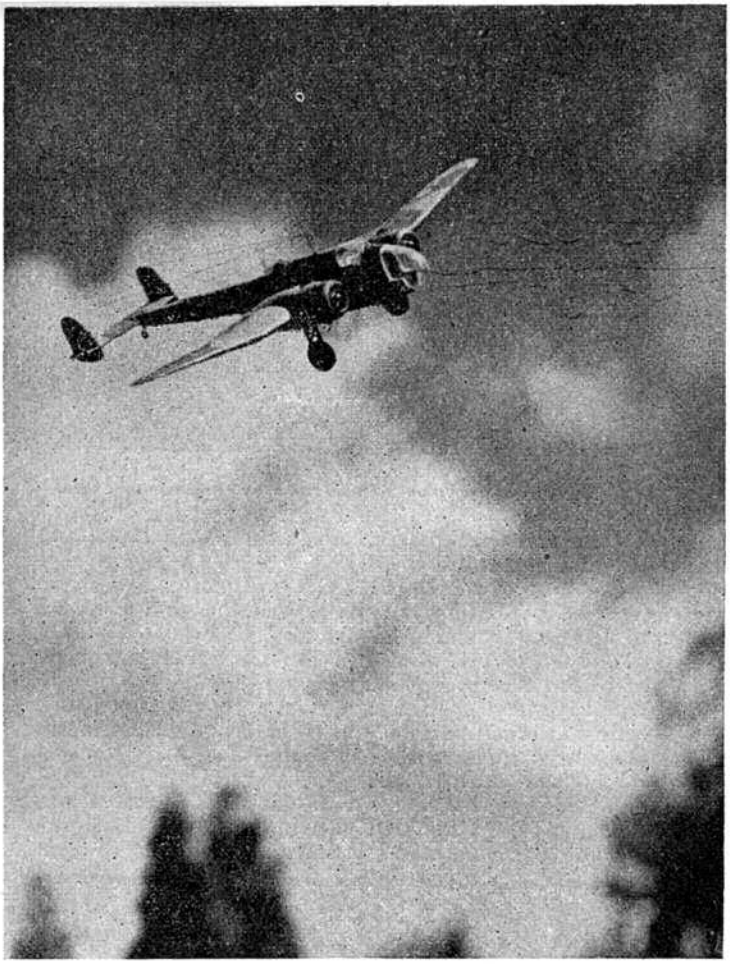
Speaking of the MOUNTAIN ASH M.A.C., we have news that T. Horseman has raised the gliding record to just over two minutes with his "Kirby Kite."

The GRANTHAM M.A.C. now number 37 members, and things are progressing very steadily. Best time to date with these chaps is 1 : 50, set up by Mr. Horrigan's lifting fuselage machine. Mr. Charles gained a second place at a Lincoln meeting with 1 : 48, Mr. Horrigan placing third with 1 : 30.

A determined attack on the club glider record was staged by the EASTBOURNE M.F.C., M/s. Burleton and Groves several times setting up new times. Current



"WHAT WOULDN'T I GIVE FOR A COUPLE OF SILKWORMS"



Nice appreciation of background and positioning by F. Rogers of Woking.

record is held by the latter chap with 2 : 22, the flight being made in the half light, and the model lost. A Gala Day held on August Bank Holiday was spoilt by bad weather. Burleton won the Open Duration event with an aggregate time of 2 : 09·5, W. Bracey the Novices event with 50·4 secs., and L. Downer the Nomination event. The latter fellow put up the best time of 1 : 13·2, and followed up by winning another comp. the following Sunday with an aggregate of 3 : 22·7.

The CROYDON & D.M.A.C. again had bad luck with the weather when staging their second Open Day. However, before the rain started in earnest and put a stop to things altogether, many good flights had been made. Mick Farthing aggregated 13 : 42 to win, Mrs. Harris clocked 11 : 06·4, and Wright 9 : 32·8. Farthing also won the Clarke Trophy, thus making four firsts in two days! Nice work! New records recently set up are Junior Lightweight 3 : 21 by B. G. Green, Senior Lightweight 9 : 40 by T. Buxton, and Senior Heavyweight 5 : 57·6 by L. Pitcher.

The POOLE M.A.C. have concentrated on gliders following a lecture by our old friend J. Leadbetter (formerly of Southport). The record at present is not high (1 : 20 by R. Lawrence), only 10 seconds behind the rubber-driven model record held by L. Smith. Any club interested in arranging an inter-club affair should get in touch with the secretary, F. Jones, 14, Beaconsfield Road, Parslone, Dorset.

The Midland Rally, staged by the LEICESTER M.A.C. on August 2nd suffered, as so many other meetings on that date, from poor weather. However, clubs from Birmingham, Peterborough, Coventry, Hinckley and Leicester assisted in the affair, and flying was carried out between showers and storms. Results were :—

Open Duration : W. Bushell (Birmingham), 381 pts.
C. Palmer (Hinckley), 362 pts.
F. Ivory (Golden Wings), 297·7 pts.

Gliders : C. Wilkinson (Leicester), 184·2 pts.
{F. Davies
{F. Wilkinson (Leicester), 183·2 pts.
G. Dunmore (Leicester), 97·9 pts.

Nomination : E. Skidmore (Birmingham), ·5 sec. error.
E. Kendrick (Birmingham), 1 sec. error.
H. Brown (Birmingham), 1·8 sec. error.

Team Inter-Club : Birmingham "A."
Leicester.
Birmingham "B."

Best flight of the day was by C. Doughty of Birmingham, who clocked 5 : 48 o.o.s. This flight was made on the edge of a thunderstorm, the timing being made from under the shelter of the handy r.o.g. board!! The Leicester Club had fair success in the "Flight Cup," gaining 5th, 8th, 10th, 12th, and 15th places.

The BLACKHEATH M.F.C. met at Tattenham Corner for the M.E. No. 2 contest, but high wind put paid to many promising models. R. Galbreath managed to put up 2 : 05, next best being H. Baines' 59·6. The club now has the use of their old clubroom and r.t.p. contests are to be held at future meetings.

Glad news is to hand from the NORTH KENT M.A.S., a 70-acre field having been secured. This news will be welcomed by all who know the trials and tribulations of this club, and I look forward to seeing and hearing more of happenings down that way from now onwards.

The ARBROATH M.A.C. now numbers twenty members, average age 15 years, and indoor meetings are now held in the hall of the Ladylaon Church. An unusual type of contest, in which competitors total as much flying time as possible between two stated dates, was won by E. J. Joss.

Proceeds of £10 were devoted to the R.A.F. Benevolent Fund as a result of the exhibition staged by the THATCHAM M.A.C., when over sixty models were on show.

The BROMLEY SOLID MODEL A.C. held their first show in aid of Red Cross funds, £20 being raised in consequence. Judging the 150 models was no easy task, and it took two experienced judges over two hours to select the winners. J. N. Keyte won two of the three classes with his "Whirlwind" and "Beaufighter" models, R. Mundy winning the flying-boat class with a "Lerwick."

The secretary of the SOUTH BIRMINGHAM M.F.C. advises his new address as follows: W. Louch, 33, Eachway Cottages, Rubery, nr. Birmingham.

Mrs. A. M. Buckeridge, president of the PHAROS M.A.C. placed eighth in the Weston Cup with one flight of 9 : 15·2, this forming a new club record for Wakefield models. The all-out record is held by J. P. Buckeridge with 14 : 7, the Junior figure by R. Sykes at 2 : 20, and the r.t.p. record of 1 : 30 goes to H. Skudder.

The WITNEY M.A.C. record has again been broken by Mr. Humphries, whose model went o.o.s. at 12 : 59,

whilst the 144 square inch class figure is held by C. Warner's "Air Cadet" at 2 : 50·3. An interesting innovation in this club is the means of recording record flights. All officially timed flights of over one minute are entered into a duplicate book, details of model, time, weather, etc., all being recorded, and the top copy handed to the competitor. The duplicate of course remains in the book, and forms an invaluable aid to the club recording clerk.

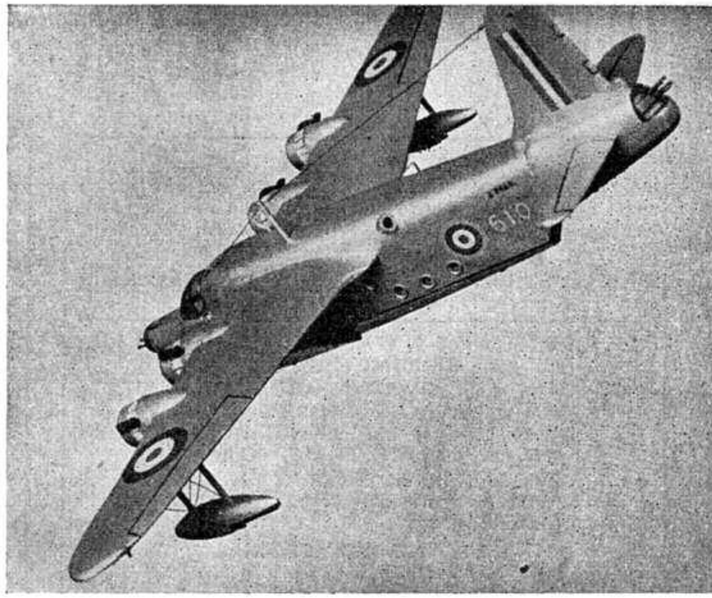
The ILKLEY M.A.C. held an inter-club event with the Harrogate boys, the latter piling up 395 points to the Ilkley chaps' 369. J. Townsend of Ilkley made best time of the day with an aggregate of 3 : 07·75, while Dale of Harrogate put up the highest individual flight of 1 : 36.

A club is being formed at Brandon Colliery to be known as the BRANDON M.A.F.C., and the secretary, Mr. N. Wilkinson, of Hospital Lodge, Brandon Colliery, Co. Durham, would be pleased to hear from prospective members.

The ASHTON & D.M.A.C. have struck a bad patch this year, having lost their flying field, and being turfed out of odd corners ever since. This, coupled with the other commitments of members, has brought about a marked decrease in contest work, but a visit to the Bury club's rally showed that they can still fly 'em when it comes to the point.

D. Brown of the CIRRUS (Tunbridge Wells) M.F.C. clocked 1 : 23 and A. F. Hubble lost his "Lynx" at 1 : 19 when taking the top places in an inter-club meet with the Sevenoaks M.A.C.

The HALSTEAD & D.M.A.C. suggest that a suitable trophy might be set up by the S.M.A.E. in memory of Lord Wakefield, and would be willing to kick off with a donation. Any ideas on this subject, fellows ?



A good model well photographed. Note particularly the neat letterings and markings—a point where far too many models are spoilt. Builder is P. Ridgewell of Whetstone.

And so my bonny lads, cheerio for yet another month. Keep your chins up, and even if there is a shortage of rubber, and little or no balsa, remember that good models can still be built that do not require any means of propulsion, and think back on what the oldtimers used before the introduction of featherweight woods. Be seein' you.

The CLUBMAN.

Made and printed in Great Britain by Alabaster, Passmore & Sons, Ltd., London and Maidstone, for the Proprietors and Publishers, The Model Aeronautical Press, Ltd., Allen House, Newarke Street, Leicester. Trade Distributors: Horace Marshall & Son, Ltd., Temple House, Tallis Street, London, E.C.4—C1601. Sole Agents for Australia and New Zealand: Gordon & Gotch (Australasia), Ltd. Registered at the G.P.O. for transmission by Canadian Magazine Post.