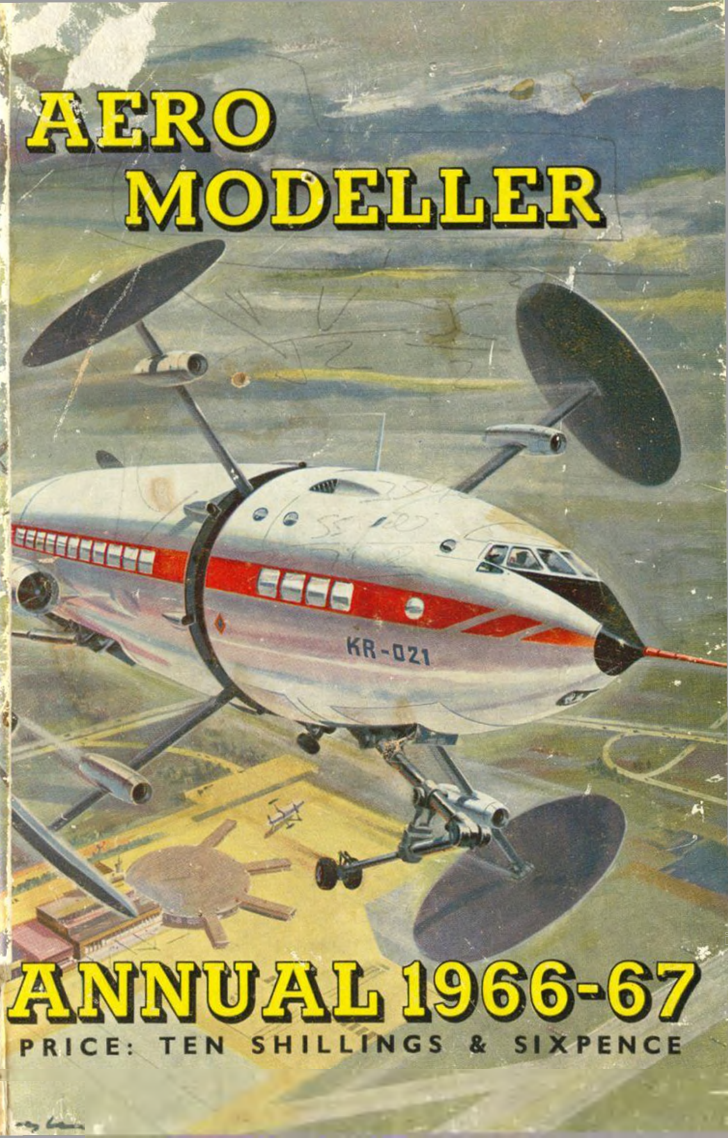
AERO MODELLER ANNUAL 1966-67



AEROMODELLER ANNUAL 1966-67

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

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

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AEROMODELLER ANNUAL 1966-67

acknowledges with thanks the under-noted sources, representing a selection of the world's aeromodelling literature.

American Modeler	*U.S.A.*
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Flying Models	*U.S.A.*
I.M.A.C. Newsletter	*U.S.A.*
Modelar	*Czechoslovakia*
Model Airplane News	*U.S.A.*
Modele Magazine	*France*
Modellezes	*Hungary*
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R/C Modeler	*U.S.A.*
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and club enthusiasts throughout the world.

Articles specially prepared for the Annual by:

Peter Chinn
Tony Dowdeswell
Erich Heimann
Ron Moulton
Ron Warring

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INTRODUCTION

MAJOR hobby progress in 1966 has been in the realm of radio control, so that it is particularly pleasing to be able to report outstanding new World Records in this branch of aeromodelling. With the co-operation of U.S. Military Bases in the Washington, D.C., area Maynard Hill established new world records, including a *nominated* course distance of 184 miles, pinpointing destination within a few hundred feet. We are also delighted to record that the power unit was the British designed and built Merco motor (a cheer for Dennis Allen!) equipped with Geoff Pike's Gee-Dee silencer unit. The model has been aptly named *Stretcher*. Maynard Hill has a speed record of 140 m.p.h. currently awaiting ratification, and is in hot pursuit of the altitude record of 18,000 ft. Meanwhile, in South Africa Geoff Brooke-Smith was achieving a new endurance record of 11 hrs. 33 min. with a glider. This too is another outstanding achievement. Bearing in mind the limitations of hours of daylight, recording equipment and model specifications relating to weight and size, we can claim giant strides during the year that will soon be past.

Other developments must not be overlooked. Taking an example from work in silencing motor cycles, a tuned exhaust system has been evolved and adapted in a practical rather than a theoretical way, to provide silence (which is essential to the continued existence of near-urban flying grounds) with a bonus of extra performance (which goes far to reconcile flyers to the problems of containing the still cumbersome unit in a streamlined body!) At long last too, scale modelling in very truth is benefiting by the great upsurge of interest that has been inspired by the magnificent showing of contestants at this year's radio control scale event at the Nationals, held for the first time this year at R.A.F. Hullavington. Our hosts could not have been kinder, and 1966 must rank as the most successful Nats. yet! Goodyear Pylon Racing is also gaining in popularity, in spite of initial qualms on the safety angle. Meetings are now attracting some two dozen entries per meeting, with very thrilling entertainment thanks to reliable superhet gear that permits simultaneous racing. Expansion must be watched with great care to ensure that development does not lead to a stereotyped design and stagnation; perhaps some system of handicapping will encourage a wider range of models.

As we go to press the Control Line World Championships are due to take place at R.A.F. Swinderby. This is a great work of organisation, with some three hundred competitors and officials representing an entry of twenty-three nations. Some new world records can be expected here, with speeds of 150 m.p.h. and new figures, too, in team racing, which is now a very sophisticated medium. The burden of a meeting such as this falls on an entirely voluntary body, the Society of Model Aeronautical Engineers (S.M.A.E.), which must surely be the only body of its kind in the world that stages events of this magnitude without a penny of government assistance. It is indeed only possible because of the generous help given by the R.A.F. at all levels, and the keen interest shown by their own model aircraft group the R.A.F.M.A.A., whose members provide a full quota of aid. The sad loss during the year of two stalwart S.M.A.E. organisers will be particularly felt at this juncture. In January Harry Barker, former treasurer of the society for some fifteen years, died; and previous August, Secretary-Treasurer, Sam Messom, for twenty years an officer of the society died. These two friends had for long been the leading spirits of our annual Nats., and co-ordinated catering and contests between them at many a national and international meeting. It will be hard to find their like again.

Our old friends will note a few changes in this year's Annual. Rather more articles are offered than previously, and we have treated the year's model engines in a new way. Other minor alterations, include a little more space devoted to contest reports, and a more selective assortment of plans. All this for no change in price after 18 years of continuous annual production. This is surely some sort of a record and shows we intend to maintain our price level (and value) for as long as we possibly can.

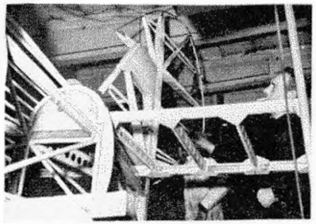
Fokker DRI replica made by J. Bitz of Augsburg West Germany for "Blue Max" flying is one of two. They arrived red, and were subsequently painted with octagon scheme to identify them to viewers as German aircraft in battle scenes. Apart from these colours and radial Siemens engine, the DRI is a faithful replica in all respects.

SCALE MODELLING—FULL SIZE!

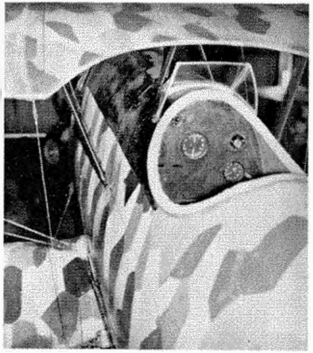
"*HAVE you got the Pfalz DIII in your plans range?*" The query came from Doug Bianchi, genial proprietor of Personal Plane Services and of recent fame for his construction of the Demoiselle replicas used in "Those Magnificent Men in their Flying Machines". Our prompt assurance that indeed we did have the Pfalz as a flying model plan (FSP 775, price 10*s*. for a 46½ in. span free flight design) and also as a 1/48th scale plan was met with glee.

Quite obviously Douglas was "up to something" so a few days after despatching the plans we advanced on the hangars of P.P.S. at White Waltham to satisfy our curiosity. In that discreet alleyway that bordered almost upon the "secret passage" definition in Doug's old workshops (He is now at Wycombe Air Park, Booker) we discovered a Pfalz embryo. Frankly speaking, it looked more like a Tiger Moth being disguised for a Carnival Float than an aeroplane, but the drawings on the wall, the marks on the floor, and the cut and trying that was going on was to eventually produce yet another replica "quickie" for the filmindustry.

This was to be but one of nine full-size flying "models" made for the 20th Century Fox production "The Blue Max". Specifications and contracts allowed about six months for all design, construction and testing ready for filming in Eire and clearly Doug Bianchi was anxious to uncover the snags of a W.W.1 aircraft replica as early as possible. For this reason a standard metal tube Tiger Moth fuselage, complete with control units was employed as a basic structure. This was embellished with ply formers, stringers and ply covering so that it departed considerably from the complex if elegant diagonally



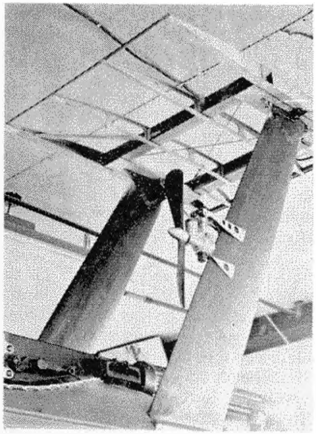
Will that do? Doug Bianchi checks Tiger Moth rudder ready for conversion on his Pfalz replica in alleyway assembly shop at White Waltham.



Cockpit of the Bianchi Pfalz is stark but sufficient for the purpose. Tiger Moth controls used with external cables to rudder.

wrapped monocoque skin of the real Pfalz. Other Tiger Moth parts, the tail spars, the wings and hardware became converted to Pfalz-like shapes though we shall never really forgive Doug for the lop-eared rudder! As it happened this was the first aircraft to be completed for the film and apart from heavy aileron control it was practically snag free. Coloured initially silver, it really looked ready for action with a Gipsy Major modified for upright running. Carrying distinctly unauthentic cocoa and Horlicks octagon pattern camouflage as applied later, it has displayed fine manoeuvrability at several air shows since completion of the film.

A second Pfalz was designed to use more genuine scale structure by Ray



Left, Carl Swanson's magnificent Sopwith Triplane carries finest detail as seen here on upper wing struts, with wind driven air pressure pump for fuel tank preservation.

Doug Bianchi made a Fokker EIII "Eindekker" with a 4 cylinder engine which has flown sufficiently well to encourage production of more.

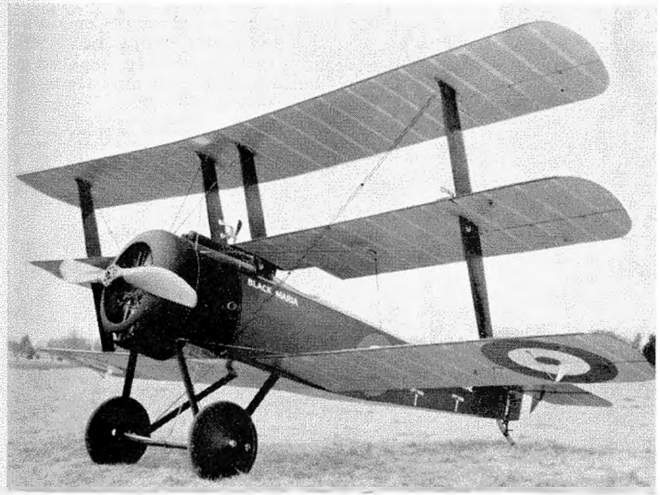
Hilborne and was made all silver with yellow tail unit by the Hampshire Aero Club. This one had a little difficulty with wing flex but is in fact far more handsome with its internal cable runs, and general shape of the curvaceous and slender fuselage. Stalling speed was only 38 m.p.h. so that it could operate with ease from the small Irish airstrips while the film was in production.

Other German aircraft replicas were made on the Continent. Claude Rousseau in Dinard set up a production line of three Fokker D VIIs. Close study of the rebuilt example in the Musee de L'Air in Paris enabled Claude to produce a very close replica with Gipsy Queen engines taken from De Havilland Dragon Rapides! However, these D VIIs turned out tail heavy due to the fact that the substitute gauge of metal tubing had to be used in view of the time scale and this, coupled with the need for a better matched propeller, reduced rate of climb.

The D VIIs were camouflaged from the start and after testing were flown across two seas via Britain to the Irish base. Structure as well as shape is deceptively realistic. Only the propellers tend to give away the fact that these D VIIs are anything other than the genuine article. Coloured in the octagonal scheme they differ only in insignia, one carrying a dull red band around the fuselage and the other a yellow shield emblem by the cockpit. The camouflage had been laboriously applied in dope on the fabric by stencil and this technique was to be applied to almost all the aircraft featured in the Blue Max production.

For example, the pair of Fokker DRI Triplane replicas made at Augsburg

Carl Swanson's Sopwith Triplane has an air of superb authenticity. It is painted as Collishaw's "Black Maria" ready for exhibition in Candian National Museum. Rotary engine started at first pull for first run after 40 years rest!

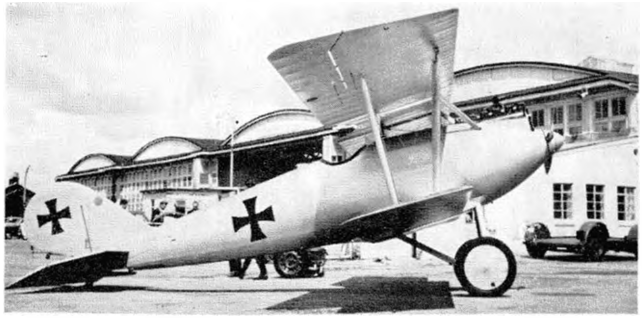


by John Bitz were delivered in a bright red scheme. They were then camouflaged and later, had another temporary red applied in emulsion paint which was subsequently washed off to reveal camouflage for the rest of the filming. These Triplanes were beautifully constructed and instead of a rotary, used a Siemens radial engine. Apart from a symptom of underpower and poor visibility on take-off and landing, they were very much liked by the pilots and their precision in flight is fully evident in the scene where one passes through the piers of a bridge.

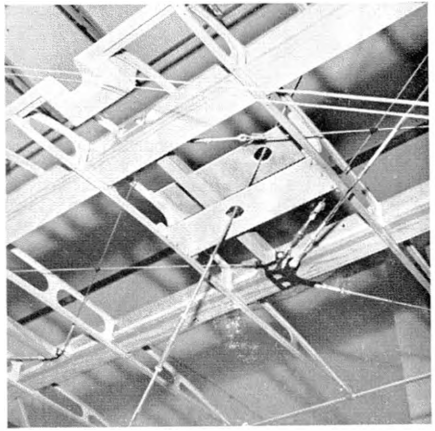
To represent the British side of this story, a pair of SE5s were made by Miles Marine at Shoreham. Here the end product was impressively better than the original for the Gipsy Queen engines taken from Percival Prentices were greater in power, and lighter than the old Viper. This called for a larger nose (and larger fin) than should be; but only the purists would notice! What *will* be noticed in the film is the odd SE5 in German markings! These background fillers might not be so outragous a travesty as might at first be imagined for the Germans operated a selection of allied machines during both world wars. The SE5s were doped in camouflage, then sprayed over with washable emulsion when required to be British! This simplified the operation as the aircraft could easily revert to German colours by means of a hot water wash!

The Blue Max replicas were very much a "rush" job. Film people wait for no one, and time is allowed no consideration. When they say they want a Pfalz in May, six months hence, it matters nothing to them that drawings of the full size machine may not exist or that there might not be a few minor problems such as finding suitable engines, wheels or even getting the product to fly safely! Yet the inventiveness of the enthusiastic constructors in Britain, France and Germany met this challenge. Luckily, data on the full size was available. The SE5 drawings still exist at the Royal Aircraft Establishment, Farnborough, and reports on the German machines are to be found in many libraries. Completely authentic structure could be a liability for it demands greater attention to assembly details and often involves procedure which can now be simplified to advantage. But for the purists among replica builders (and there are many engaged in this occupation) nothing but the real thing will suffice.

Silver Pfalz by Hampshire Aero Club at "Pfalz flugzeugwerke, Southampton am Itchen" with yellow tail unit as it first appeared. This more faithful replica with monocoque fuselage was less rigid than the other Pfalz.

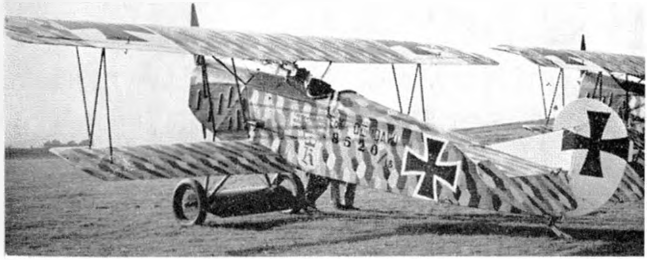


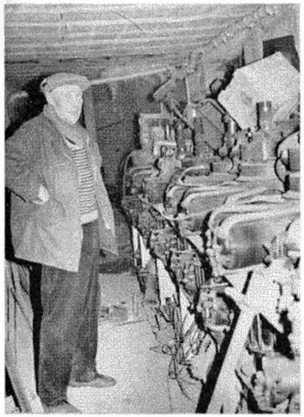
Spacious assembly area for the Hampshire Pfalz at Southampton. Note the larger rudder on this machine.

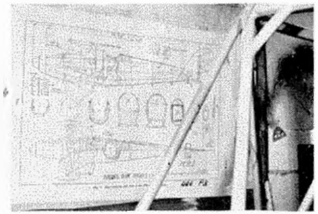


Detail on the Swanson Triplane. View of the middle area of uncovered middle wing at the juncture of compression struts, flying wires, landing wires drag snd anti-drag wires. Note the cutout in the leading edge for the double flying wires to go through. The excellent craftsmanship of Mr. Swanson is apparent.

One of three Fokker D.VII's by Claude Rousseau of Dinard, France. These were delivered in the octagon camouflage scheme and this one has a yellow shield for Klugerman's aircraft in the "Blue Max" film, see below cockpit.





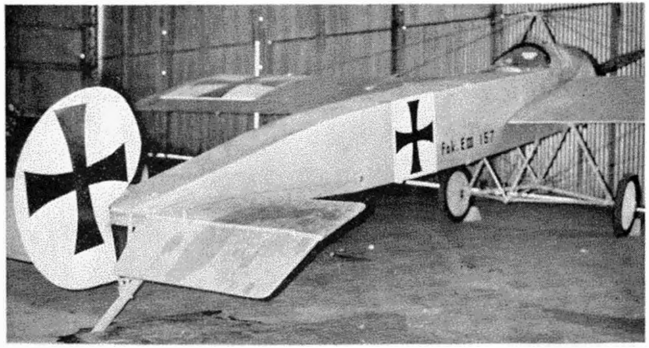


Above, a page from "Flight" photo-enlarged and pinned to the wall of Personal Plane Services workshop was Doug Bianchi's guide for altering Tiger Moth parts.

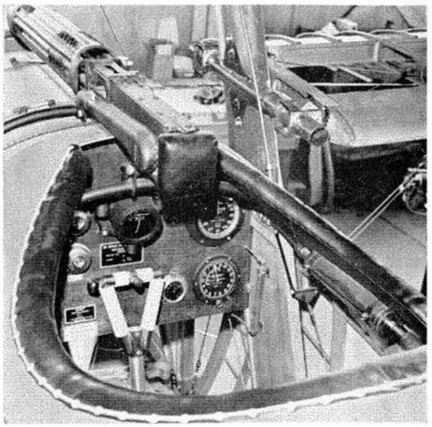
Left, 70-year-old Jean Salis of France and part of his treasure trove in the shape of World War One aero engines at La Ferte.

Below, Doug Bianchi's Fokker EIII has elevators and ailerons as distinct from the original and he is to revise the fuselage lines on subsequent aircraft but what a thrill it is to see these old shapes airborne!

Many are one-time aeromodellers and appeal to us for advice on where to get some items. A request for a genuine Air Speed Indicator to fit a replica Sopwith Pup that is due to commemorate the first landing on an aircraft carrier on August 2nd, 1967 is typical. A set of Sopwith Triplane drawings for a modeller pilot in Texas. Snipe references for a Californian and many others are typical requests. Pilots in the U.S.A. have their own organisation known as the "Experimental Aircraft Association" for the home-builders, many of whom have turned to reminiscence in replica construction of Triplanes, etc. There is no rush to complete the project to a contract time and the detail achieved is remarkable. One who combines such enthusiasm for replicas and reconstruction with a



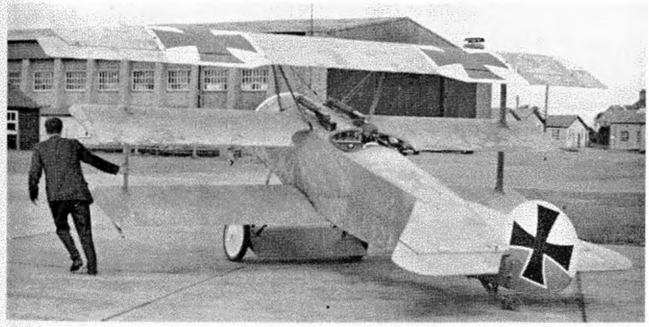
Carl Swanson's Sopwith Triplane at right. General view of the cockpit, the 303 Vickers machine gun mounted to the top of the Cowl. The uncovered fittings and mountings for the wing roots are clearly shown here. A wood fairing would go over the mounting fittings for the wing. Original instruments are seen in the cockpit. On the right and just under the leather crash padding is the hand pressure pump for the fuel tanks should the wind drive go out of service.



Fokker DRI Triplane heads for a red respray after getting streaky in the rain. Later camouflaged, the DRI arrived at Casement airfield Dublin during the Leinster control line model trials, doubtless causing no end of a diversion.

museum standard is Carl Swanson of Sycamore, Illinois. Carl started a Sopwith Triplane in June, 1963 and finished it in the colours of Canadian Ace, F/L Raymond Collishaw as "*Black Maria*" in February, 1966. Photographs illustrate the superb workmanship on this aircraft which will go to the Canadian National Museum. What satisfaction he must have had when the engine fired at first pull of the prop after over 45 years of storage!

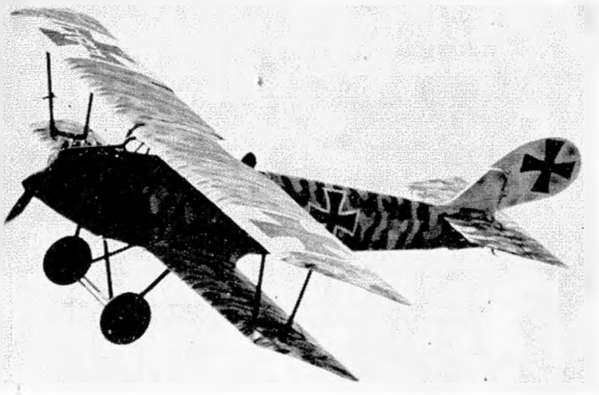
Another ardent enthusiast is Jean Salis in France. Responsible for many of the fine replicas in the Musee de l'Air, Paris, that Mecca for all who are interested in famous and rare aircraft, Jean is the owner of more rotary engines than anyone else in our knowledge. He plans to build his own Museum (despite



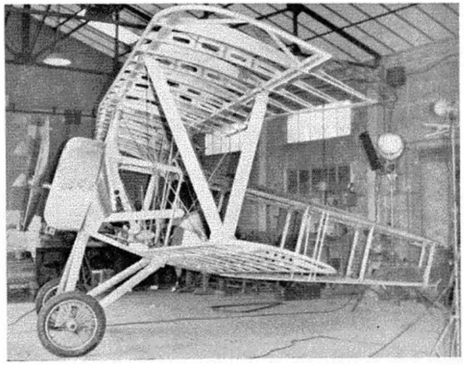
With constant speed prop fixed in pitch and longer nose for Gipsy Queen engine, the S.E.5 replicas by Miles Marine are the snappiest of the fighters in "Blue Max". Also appeared in German colours —see text.

his 70 years) and will house many of the aircraft he has built from scratch or has renovated. A two-seater Wright biplane and a Bleriot are his proud possessions, each a fine flier and used in films. The Bleriot celebrated the crossing of the channel for its owner when he was a young 63 years of age! Jean made a Nieuport XI "Bebe" for the City of Verdun last April/May. Not a detail was spared. The engine shone like a new pin, copper pipes glistening, yet this was not to fly. It was made to commemorate the victories of the French Air Force 50 years earlier and had been made with such loving care and attention we are sure it only needed petrol and oil for a proving flight.

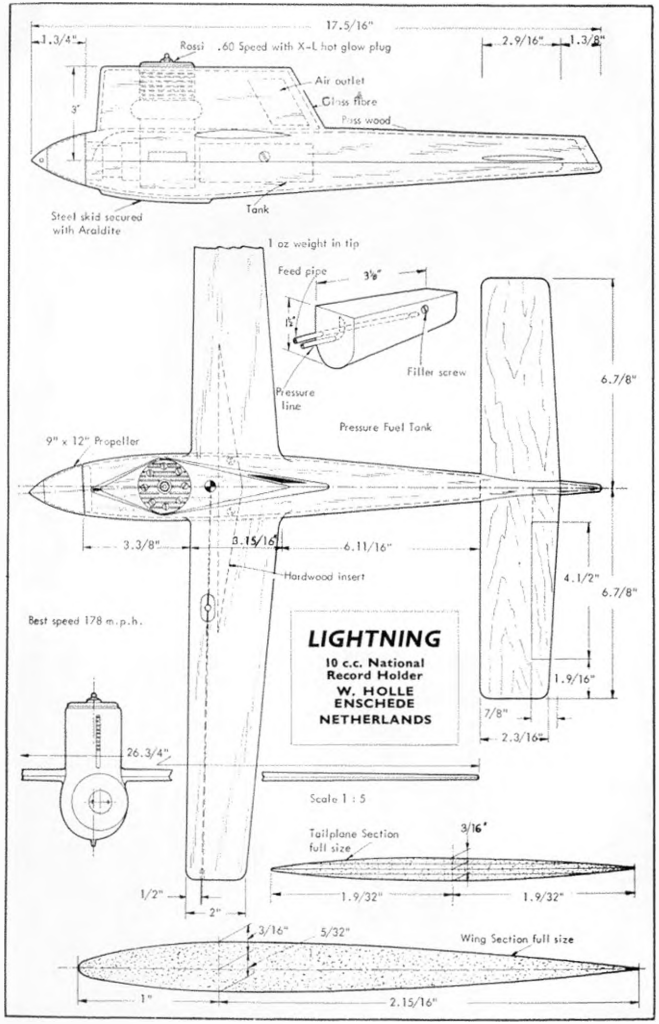
The zest with which these replica makers engage themselves in their hobby is so very much akin to aeromodelling that it seems only natural that so many of them should have "graduated" (if that is the correct term) from balsa and cellulose cement to spruce and casein glue. The fascination of something delightfully historic being re-cast in the modern age after almost half a century is creating a new interest, which might well be called scale modelling—full size.

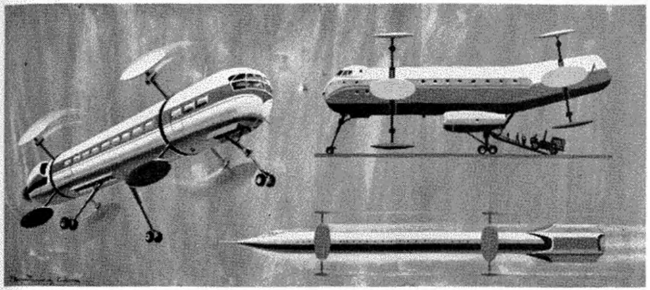


Civil registration G-ATIF across starboard upper insignia gives away the fact that this is Doug Bianchi's replica Pfalz DIII. Piloted here by P. Benest at an air display, the film flights with this machine were mainly piloted by Joan Hughes who flew the "Demoiselle" in "Those Magnificent Men in their Flying Machines". Rudder shape distinguishes it from from the Hampshire Aero Club replica, also slightly different fuselage shape and external cables not visible here.



Nieuport Bebe framework by Jean Salis in France made in '66 for the City of Verdum to commemorate 50th Anniversary of Verdum air battles. Machine is complete to last detail though not destined to fly.



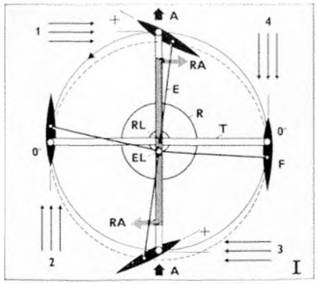


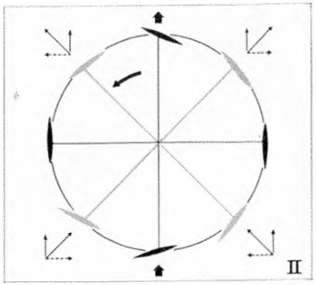
These artist's impressions show possible versions of a Rotoplane: a medium-range airbus, a freight plane and a long-range transport jet.

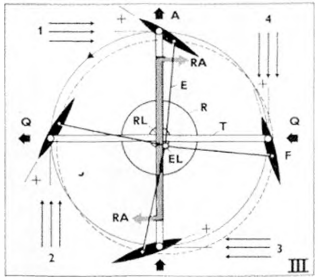
DR. KALETSCH'S ROTARY WINGS

VERTICAL take off and landing (V.T.O.L.) *plus* high cruising speed are characteristics which aircraft designers all over the world have continually endeavoured to achieve in one aircraft. The difficulties involved in such a project result in compromise but several aircraft engineers have succeeded in developing a few V.T.O.L.—military aircraft such as the Hawker Siddeley P 1127 and the German VJ 101. In the transport field there are the Ling-Temco-Vought CX-142 A and the Canadair CL-84 which each have tilt wings or the Do 31, with its special lifting engines, a prototype of which left the Dornier factory in November, 1965. While all these designs are based on the conception of a normal aircraft which is converted to become a V.T.O.L. plane by adding lifting engines or thrust converters, a German inventor, 37-year-old Dr. Reinhold Kaletsch from Lollar (West Germany), has tried to establish an entirely different conception for V.T.O.L.

Years ago Dr. Kaletsch gave up his work as a doctor because of his interest in engineering methods. The inventive "amateur-engineer" has become the owner of a medium-size factory for large glass-fibre reinforced structural parts and his factory now exploits several Kaletsch patents. His latest patent is the conception of the new V.T.O.L. aircraft, which was applied for on January 6th, 1966, after a first 24 in. long test model had made some flights on an improvised test bench. This will be Dr. Kaletsch's eighteenth patent. Kaletsch's Roto-plane has a long cylindrical fuselage with jet-nacelles for propulsion. Lift is provided by rotors, but the axes of these rotors are not vertical to the centre line of the plane as with helicopters. They coincide with the centre line of the fuselage. The inventor intends to have two jet-driven rotors each with three or four arms carrying an elliptical wing with variable angle of incidence and these "wings" will provide sufficient lift as they rotate around the *static* fuselage for take off. An ingenious and simple mechanical device allows a constant change of the angle of incidence or pitch. For example, follow one wing in rotation around the fuselage. Its angle of incidence or pitch changes as follows. In







AERODYNAMICS OF THE ROTATING WINGS

Fig. 1.—Rotorsystem with jets and variable angle of incidence control: A lift, RA Rotor jets, E push rods, R fuselage, RL Rotor-bearing, F wing, EL eccentric pivot, T Rotor arms. The three fine arrows indicate the airflow resulting from the motion of the rotor. In position 1 the upper wing has reached its maximum pitch, in positions 2 and 4 the angle of incidence is 0° i.e. no lift at all. In position 3 the former upper side of the wing-section is now the lower one, but the angle of attack is positive.

Fig. 2.—The different components of lift occurring with a Rotoplane: If one wing is right above the fuselage and another one just below it (black sections), the wing system produces lift without any lateral components, as the two other wings right and left of the fuselage do not produce any lift. In the intermediate positions the wing system produces just the same amount of lift, which results of four lift vertical lift components, while their lateral components balance each other. Arrows show lift components, dotted arrows, lateral components of lift.

Fig. 3.—By laterally shifting the eccentric pivot point EL of the push rods, the wings right and left of the fuselage get a positive angle of attack resulting in side-lift Q. If aircraft has two rotors, one can achieve a parallel shift of the whole fuselage if both rotors are influenced. If only one rotor is influenced by laterally shifting the pivot, the aircraft moves around in a turn.

Fig. 4.—Airflow diagram: Left column with static wing paddles, right column with wing which can be swivelled against the airflow to achieve optimum results.
R rotation, V propulsion. 1. Take-off, 2. Transition, 3. Cruising.

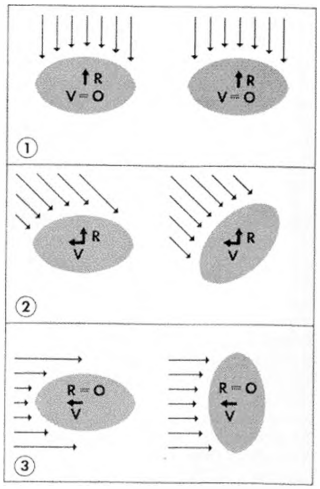
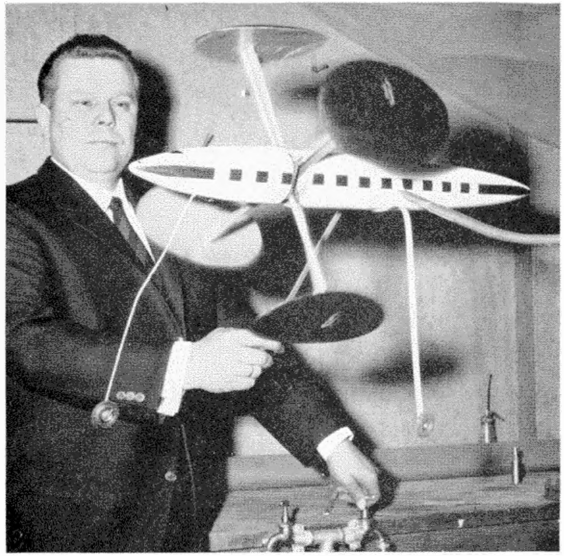
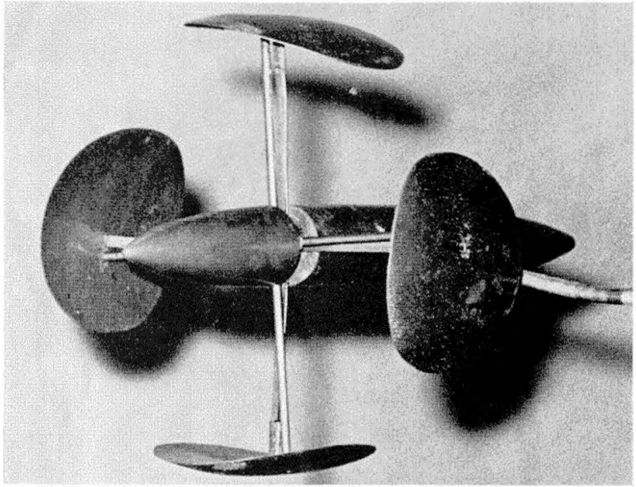


Fig. 4.



Compressed air through a water-hose . . . moves the rotor-wings of the model . . . . . the rotor rotates more and more quickly . . . and makes the Rotoplane take off vertically.

position **1** of *Fig.* 1. "A" this wing is above the fuselage, its pitch and lift reach the maximum figure. If this particular wing now moves around the fuselage in an anti-clockwise direction, pitch and lift are constantly reduced when approaching position **2**, where the pitch is exactly 0° and the lift zero. Then both pitch and lift again rise to a maximum, when the wing is below the fuselage. If we observe the motion of the wing, we see that the former upper side of the wing-section now has become its lower side. If fully symmetrical airfoils are used, this means that the lift generated by the wing, which is just below the fuselage (position **3**), is just as great as that of the wing in position **1** above the fuselage. The change of pitch is achieved by pushrods mounted on an eccentric axis. All vertical components produce the necessary lift while all the side components balance each other (see *Fig* 2). Rotation of the fuselage due to the torque of an engine (mounted in the fuselage to make the wings rotate) is one of several technical problems which arise. It would be an advantage that the rotors should be powered by jets which are mounted to the rotor arms and which can be shifted during the phase of transition to produce thrust for propulsion, in addition to the propulsion-jets attached to the rear end of the fuselage. If such a system is used, only very little torque reaction has to be balanced, and this results from



the friction of the main rotor-bearings. This remaining torque seems to be so little, that it could be balanced by a low centre of gravity of the fuselage itself, if symmetrical wing sections are going to be used.

The variation of the pitch of the wings is achieved by a simple eccentric control, which enables the pilot to influence the *amount* and the *direction* of the lift of the wings. This system can also be easily adapted to make the aircraft fly in a turn or even move *across* the normal direction of flight. This is especially useful during the phase of transition from V.T.O.L. to forward flight because it helps to manoeuvre the plane in any direction desired by the pilot.

Take-off with a Kaletsch Rotoplane would be controlled as follows. First of all the pilot accelerates the two rotors of the aircraft—one of them being mounted in the forward section of the fuselage and a second one of the same or even slightly smaller size at the rear end of the aircraft—until they achieve the essential revs. During this process the pitch of the wings is 0°. Now the pilot increases the pitch and the plane slowly starts to rise in a vertical direction. In order to initiate the transition the pilot now starts the propulsion jets and increases thrust. With increasing propulsion the rotors can be slowed down and will finally come to a complete stop. The elliptical wings are now exposed to an airstream coming from the front end of the fuselage due to the propulsion of the aircraft and produce lift as do the wings of a normal aircraft. When cruising, the whole fuselage is intended to be slightly inclined to produce a positive angle of attack for the wings. But there is a considerable disadvantage, as the wings now face their chord to the airflow, which causes enormous drag due to low aspect ratio. There are two means of reducing this drag. One solution

may be that the wings should be less elliptical and more circular in shape, which reduces the difference between the two directions of airflow. On the other hand, this solution involves more drag in the V.T.O.L.-phase, so that this solution is only a compromise between two bad layouts. Better results are achieved by a mechanical solution, which swivels the wings 90° during the transition period, so that their leading edge always faces the airflow vertically.

Dr. Kaletsch proved his theory through experiments on lift, speed and energy. An electric motor is used for power, so that the current and amperage can be easily controlled. The test rotor has a diameter of about 21½ in. and develops a fairly high specific lift of 2½ lb. sq. ft. of wing area. The speed of the airflow amounts to about 50 m.p.h. at 900 r.p.m. When considering the value of this we must bear in mind that these results were obtained with roughly shaped wings and without any calculated data concerning the size, shape, etc.,

The demonstration model of Dr. Kaletsch's Rotoplane had only one rotor, while large full-size machines would probably have two rotors. The elliptical wings are adjusted lengthwise for take-off and landing and will be shifted against the flight direction for cruising in order to achieve a maximum lift coefficient.

Dr. Reinhold Kaletsch talking to Erich Heimann in his factory in Lollar near Geissen, where he demonstrated a model of his Rotoplane. The Rotoplane on its spider-like undercarriage. The plane does not need a runway as it gently lands vertically.

of the wings. The only aim Dr. Kaletsch had, was to prove by an experiment if his theory was right or wrong. These results from a compressed-air-propelled tethered model proved that the private studies of aerodynamics Dr. Kaletsch had started four years ago had led to a visible result.

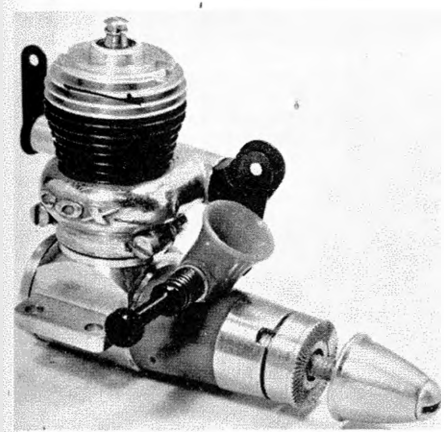
His tethered model was built within two nights and consists of a balsa fuselage carrying a bearing for one rotor and a simple automatic pitch control made from a length of brass. The model is tethered by two $\frac{3}{8}$ in. aluminium tubes supplying compressed air for the rotor and the propulsion jet at the rear of the model. A modified lawn-sprinkler serves as a pylon and carries the two aluminium tubes. The weight of the model and of the tubing is nearly balanced by a counterweight mounted to the free end of the swivel arm, so that the rotor only has to overcome a load of about 2 oz., but the actual lift amounts to about $6\frac{1}{2}$ oz. This simple demonstration model does not reveal how much centrifugal force contributes to keeping the model airborne when cruising after the rotor has stopped, but a more elaborate test bench and a radio controlled model will very soon show if the principle really works on a larger scale.

Experts voiced their opinion that the Kaletsch principle might be realised on a large scale if aviation industry succeeds in solving the technical problems involved. Bearings for the rotors and the enormous stress on the rotor-arm (which has to accept alternating changes of lift) plus the need to carry fuel in the fuselage, and a high telescoped undercarriage are obvious problems. On the other hand, the Rotoplane features several advantages if compared to the wing of a high-speed jet which is always a compromise between the conditions for high speed flying and those of take-off and landing.

Dr. Kaletsch calculates that a jet following his new principle and having the same size and weight as a Boeing 707 would only need half the wing area and should be able to take off and land vertically. Stability during the take-off and landing manoeuvres would be very high due to the gyro-effect of the rotors, which on the other hand requires considerable forces when manoeuvring the aircraft, but as the pilot can easily influence the *amount and direction* of the aerodynamic forces of a Rotoplane, this problem should be solved.

With a 40 ft. diam. rotor and about 300 r.p.m. the airflow would achieve the cruising speed of a Boeing 707 (approximately 550 m.p.h.) which gives quite an interesting prospect in regard to the resulting lift. When cruising, the plane would probably have less drag due to its smaller wing area, which might effect higher speed, greater range or less power required.

Such a tempting outlook should not precipitate exaggerated optimism. The first quite successful experiments are only a small step and for the time being one cannot say if a full-size Kaletsch aircraft will ever find its way into the skies because there are so many technical problems which have to be solved first. However, it does offer modellers food for thought.



Smallest of the radio-control engines available, Cox Medallion 049 with Cox Throttle Control.

TESTER'S TWELVEMONTH

A Review of 20 Current Engines tested during 1966

by

Peter Chinn

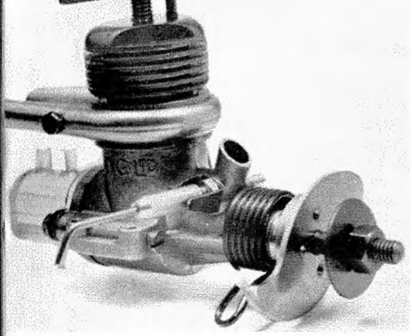
At the present time, the world's model aircraft engines number something like 350 different types. Every year at least 15 per cent of these are replaced by new or modified models, most of which, sooner or later, pass through our hands.

The majority of these engines are subjected to our standard test procedure, the results of which are usually published. Exceptions to this rule are made in the case of certain engines that are unobtainable through regular channels in the U.K. or U.S.A., or where a manufacturer has such a large and constantly developing range (O.S. and Super-Tigre are examples here) that a certain amount of "rationing" has to be applied.

Here we should, perhaps, point out that, of the eighteen countries now making model engines, the U.S.A. and Japan contribute over half the present range of different makes and types. Japan, in fact, now leads the U.S.A. in this respect, although the U.S. is still far ahead in total production volume. The range of British engines has tended to contract during recent years but the U.K. still occupies third place, ahead of West Germany and Italy.

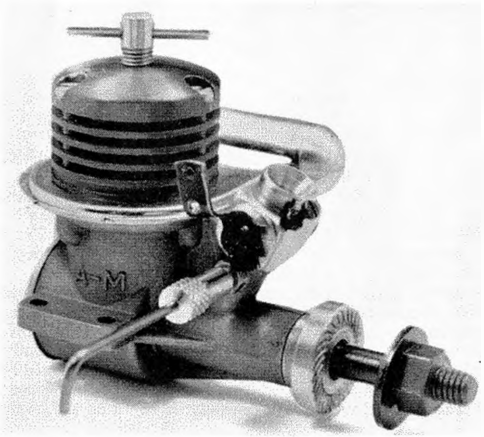
For this review, we have chosen twenty current engines on which tests have been carried out during the past year. In most cases, further data can be found on these in the 1966 issues of *Aeromodeller* and *Radio Control Models & Electronics*. Engines are arranged in order of cylinder capacity. We start with the R/C version of the 0.817 c.c. *Cox Medallion* 049.

This is the standard Medallion 049 with the addition of Cox's Throttle Control conversion kit. Cox do not make the R/C version as a separate engine: one must purchase the easy-to-fit Throttle Control as a separate item. In this form the Medallion 049 is the smallest radio-control type engine currently available and it weighs only 1.8 oz. Performance curves are altered appreciably by addition of the throttle control parts and, whereas the standard engine is best on a 6×3 or $5\frac{1}{2}\times3$ prop, the TC version will generally do better on a 6×4 or even a 7×3.



Tested with manufacturers' silencers fitted were the latest versions of two British 1 c.c. engines, Davies-Charlton's "*Quick-start*" *Spitfire* and D. J. Allen Engineering's *A-M* 10. Both are shaft valve, radial-port motors designed some ten years ago and are fairly typical of the steady-selling small diesels that are the mainstay of the British model aircraft engine industry. The 0.976 c.c. Spitfire is supplied complete with fuel tank and with a spring-starter unit that will help the beginner, although the engine is quite easy to hand-start. An exceptionally informative instruction leaflet is included with each D-C motor and helps to make this easy-handling diesel an excellent choice as a beginner's first engine.

The 1.003 c.c. A-M 10 was tested in its R/C version—*i.e.*, with barrel type throttle. In contrast to our findings on the earlier standard model, our test 10 R/C needed, to ensure easy starting from cold, a prime through the exhaust ports. Since this is not possible with the silencer fitted, we primed the intake instead and then inverted the engine to induce the charge into the combustion chamber. The silencer is very neat and quite effective and does not reduce power unduly. As befits an engine made by a firm now world-famous for its big Merco multi-R/C engines, the sturdy A-M has a good power output and, for a 1 c.c. motor, an appreciably better-than-average idling speed.

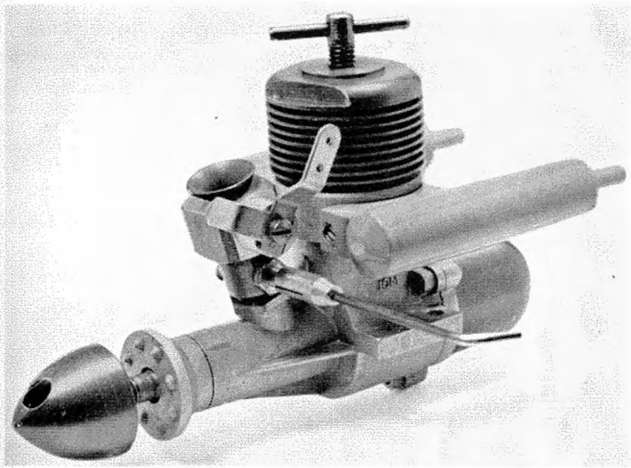


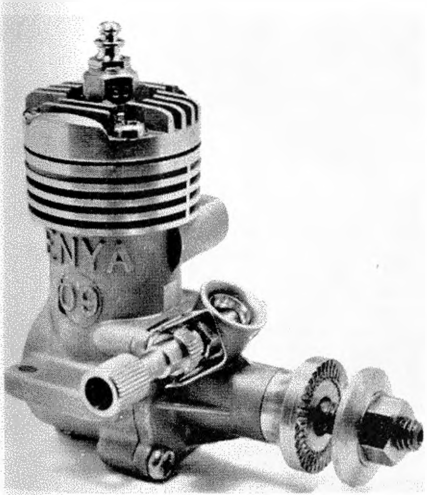
Top left, D-C Quickstart Spitfire with D-C silencer.

Top right, M. E. Snipe R/C with M.E. Twin silencer.

Left, Allen-Mercury 10 R/C with A-M silencer.

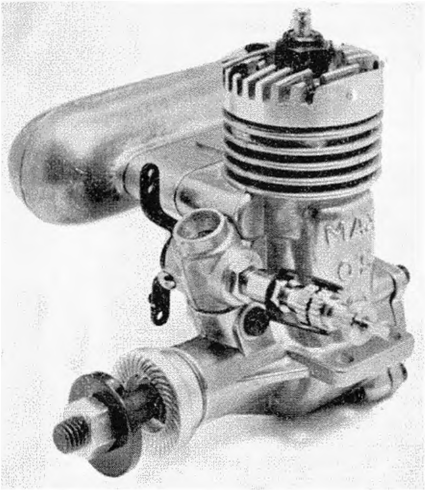
Right, Enya 09-III no silencer available as yet.





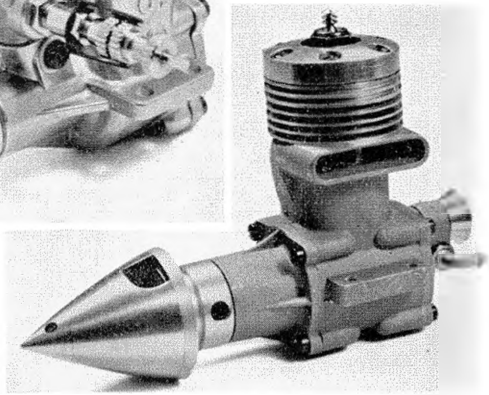
One third British engine is another small diesel, the 1.494 c.c. *M.E. Snipe* in its throttle-equipped R/C version and with M.E's very neat twin silencers. Standard and R/C carburettors are interchangeable, enabling the standard model to be converted to the throttle type and vice versa. The Snipe R/C, with silencers, is not the lightest in its class, but we found it pleasant to handle and there was no deterioration in starting qualities with the silencers fitted.

Next up in size were two of the latest small glow-plug engines from the two leading Japanese manufacturers, Enya and O.S. The *Enya 09-III* is the third of the well-tried Enya 09 series and is a complete re-design of the



O.S. Max 10 R/C with O.S. Jetstream silencer.

K&B Torpedo 15R Series 64.

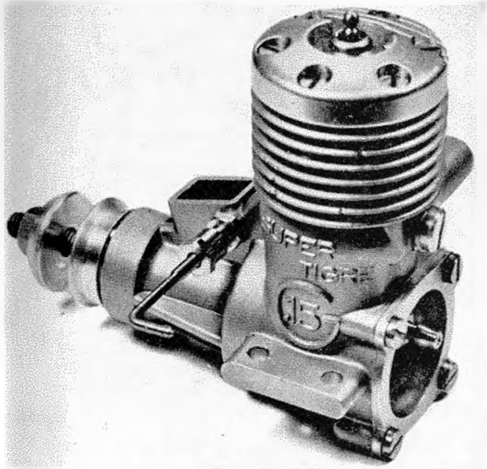


model with new component parts throughout including a bigger crankshaft, allowing a larger gas passage and with re-timed porting. The Enya silencer range does not yet include a size for this new model, which was therefore tested without silencer. On standard 5 per cent nitromethane fuel it yielded the uncommonly good output of almost 0.19 b.h.p. at 16,000 r.p.m. We were therefore encouraged to re-test the engine on 30 per cent pure nitromethane (43 per cent commercial blend) and with the venturi restrictor removed. In this form the engine reached 0.24 b.h.p. at 20,000 r.p.m., a figure exceeded only by the Cox Tee-Dee 09. Unfortunately, at 1.619 c.c., the Enya does not fit into any convenient British contest class where its potential can be fully utilised.

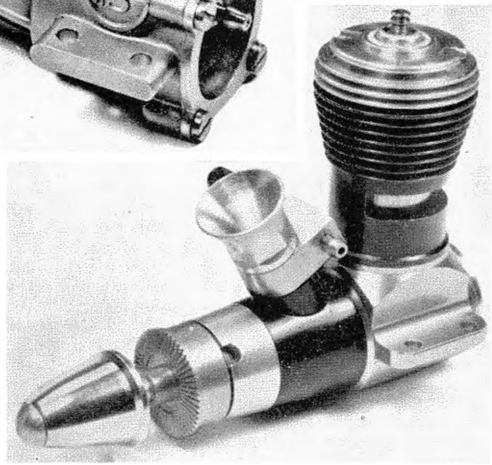
Unlike all other small throttle-equipped motors, the 1.749 c.c. *O.S. Max*-10 *R/C* was designed specifically for radio-control and, as such, really sets a new standard. It is very much a scaled down "multi" engine in power (just over .14 b.h.p. at 14,000 r.p.m., with silencer, on 5 per cent nitro), in throttling ability (safe idling speed of around 2,500 r.p.m.) and in general design. The excellent throttle range of the Max-10 R/C makes it a particularly

good choice for use with the new 3-position single-channel servos. It is easy to handle, well made, compact and light in weight, (3.8 oz. including Jetstream silencer).

Being the officially recognised displacement for World Championship speed and free-flight events, the 2.5 c.c. class naturally includes engines having the highest specific power outputs of any model i.c. motors produced to date and the most successful of current production engines in this field is, undoubtedly, the 2.474 c.c. Italian *Super-Tigre G.*15. On test, ours delivered 0.47 b.h.p. at close on 22,000 r.p.m. using FAI standard methanol/castor fuel. Ported and timed for high crankshaft speeds, the G.15 must be propped for



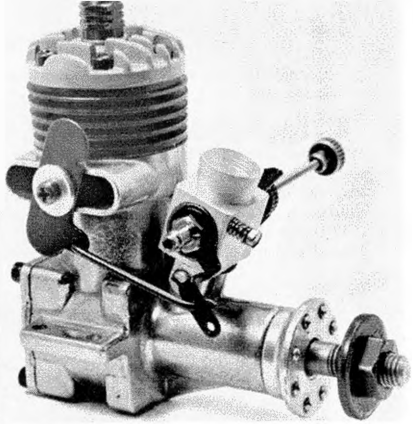
Super-Tigre G.15 almost a half-horse-power.

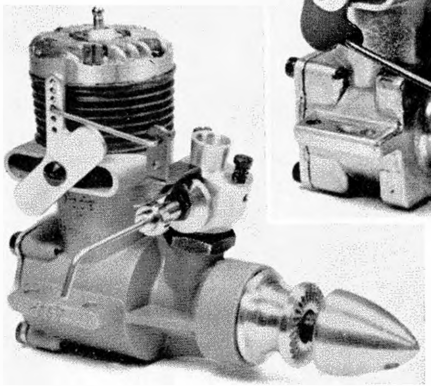


Cox Special 15 Mk. II.

McCoy Blue-Head 19 R C.

Below, Webra Glo-Star R C.





Opposite, Taifun Bison R C with Taifun silencer.

these high speeds for maximum performance. On anything much bigger than 8×4 prop, the performance is quite disappointing, although the use of a 50 per cent nitromethane content fuel will help a great deal in events where such fuels are allowed.

The same goes for the 2.488 c.c. *K&B Torpedo* 15*R Series* 64 from the U.S.A. which, in the case of our test sample, matched the performance, on FAI fuel, of our G.15. This engine is a great improvement on the original "Series 61" Torpedo 15R. Despite a similarity of performance, the shaft-valve G.15 and disc-valve 15R are by no means similar in design: flat crown piston, unorthodox transfer timing and offset shaft-valve intake on the G.15; special crankshaft counterbalancing, long exhaust timing lead and rear rotary disc-valve induction on the K&B. Super-Tigre, however, have been offering disc-valve conversion sets for the G.15 and are expected to announce a new rear rotary-valve .15 in late 1966 or early 1967. Twin ballbearings are featured by both G.15 and K&B.

The 2.499 c.c. American *Cox Special* 15 *Mk. II*, developed from the earlier Tee-Dee 15 and Special Mk. I, had a better performance than the K&B or S.T., on straight fuel, up to 14,000-15,000 r.p.m. but, reaching the peak of its b.h.p. curve three to four thousand r.p.m. earlier, lacked the all-out urge of the other two engines, developing a maximum of 0.38 b.h.p. This is, of course, a lighter, plain bearing engine.

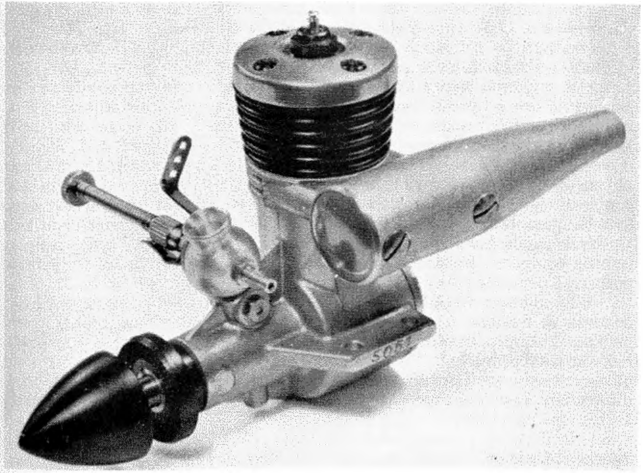
In what might be termed the intermediate R/C engine class, we tested three engines, the 3.272 c.c. *McCoy Blue Head* 19 *R/C* from the U.S. and two

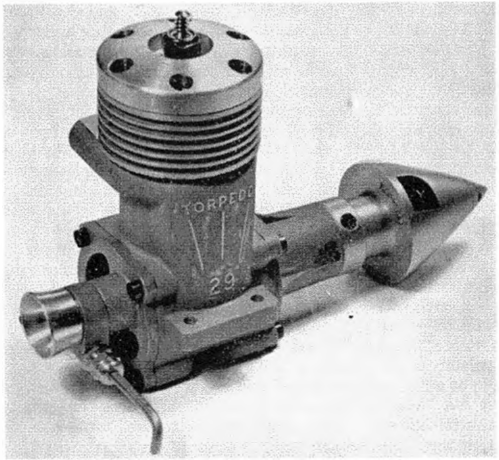
West German products, the 3.422 c.c. *Webra Glo-Star R/C* and 3.619 c.c. *Taifun Bison R/C*. The McCoy is the cheapest of the group, costing under £5 in the U.K. We found it to be easy starting and of quite good performance (approximately 0.25 b.h.p. at 12,000 r.p.m. on 5 per cent nitro). Practical idling speed was of around 3,000 r.p.m. on suitable props.

The Glo-Star is a twin ballbearing motor and was notable for its very good throttling (approximately 2,500 r.p.m. safe idling speed) and useful power output of nearly 0.27 b.h.p. at just over 12,000 r.p.m. We also tested the Glo-Star with the Webra silencer system fitted. This consists of a neat angled extension on the exhaust, connected, with synthetic rubber tube, to a straight-through absorption type silencer of the "Burgess" pattern which must be mounted separately. On a 9×4 prop, (turned at 11,200 r.p.m. without silencer) r.p.m. drop, with extension, silencer and 2 inch connecting tube, was 400 r.p.m.

Good cold starting and instant hot re-starting were characteristic of the Taifun Bison. The throttle was less impressive and the minimum idling speed on suitable props was not less than 4,000 r.p.m. Power output was, however good, being approximately equal to that of the Glo-Star. The maker's silencer for the Bison is a simple expansion chamber which fits straight onto the exhaust duct and absorbs only about 200 r.p.m., on a 9×4 prop.

Sole example of a 5 c.c. engine tested was the latest *Series* 64 model of the 4.887 c.c. *K&B* 29*R*. Many of the racing hybrid specials in the U.S., which dominate the .29 control-line speed class there, have been based on this much improved K&B and it was, therefore, no surprise to find this engine delivering an output of better than 1.0 b.h.p. at over 19,000 r.p.m. on 50 per cent pure nitromethane and 0.76 b.h.p. at 18,000 on FAI fuel. Like all modern speed





K&B Torpedo 29R Series 64 delivers over one horse-power.

engines, the K&B requires a pressurised fuel feed. Despite its outstanding performance, we found the Series 64 29R very easy to handle.

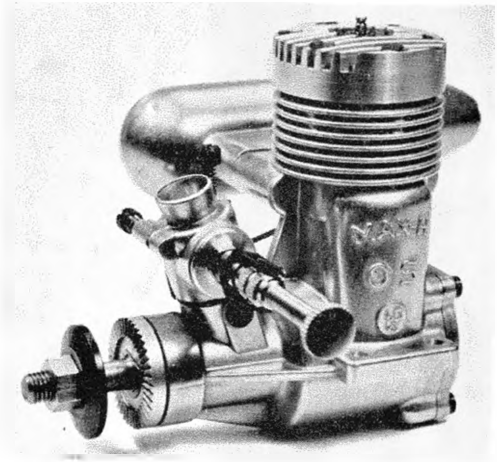
During the year we tested three throttle-equipped .40 cu. in. engines, the 6.499 c.c. *O.S. Max-H* 40 *R/C*, the 6.537 c.c. *McCoy "Blue Head"* 40 *R/C* and the 6.539 c.c. *K&B Torpedo* 40 *R/C Series* 66. The O.S. was the first of these on the market and quickly became very popular in the U.S., U.K. and Japan as a natural choice for Goodyear R/C pylon racing on account of its excellent all-round performance. On test, using ordinary 5 per cent nitro R/C fuel, our example reached 0.70 b.h.p. at a little over 13,500 r.p.m. unsilenced and 0.59 b.h.p. at approximately 12,400 r.p.m. with O.S. Type R/C-L silencer.

The McCoy is an R/C version of the standard McCoy Red Head 40 and also uses some parts common to the McCoy 35 R/C engine. A lighter and simpler design than the O.S., it has a somewhat lower performance and developed 0.46 b.h.p. at 10,800 r.p.m. on test. It may not arouse much excitement as a Goodyear engine but many modellers, attracted by the fact that it is the cheapest throttle equipped .40 on the market, may find it to their liking for general purpose R/C or for "third-line" control-line work.

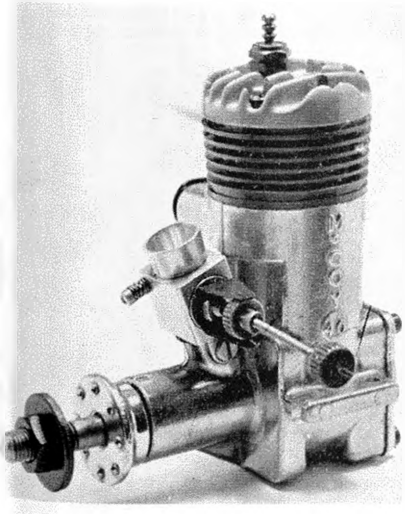
In contrast, the K&B is the most expensive R/C 40 and emerged from our tests as the most powerful of the group with 0.75 b.h.p. at 14,000 r.p.m. on 5 per cent nitro, unsilenced. Our test model would not, however, drop much below a 7,000 r.p.m. "idle" before running rich and an increase in the diameter of the non-adjustable airbleed hole would seem to be called for. This engine, incidentally, is unique among current production models in its use of a single Dykes type piston ring.

In the 45 R/C class, a new Japanese make appeared in the shape of the 7.695 c.c. *Ueda* 45. The first example tried was very easy to start with reason-

Right, O.S. Max-H 40 R/C with O.S. Jetstream silencer. A popular choice for R/C pylon racing.

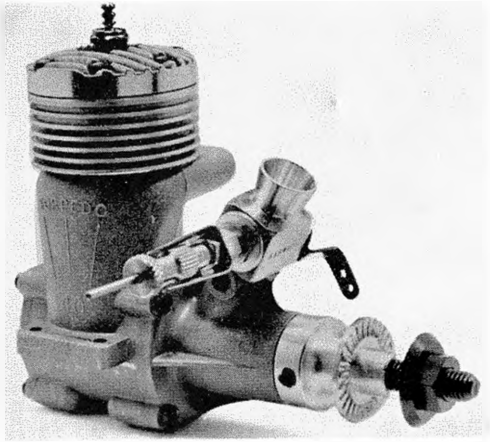


Below, McCoy Blue-Head 40 R/C.



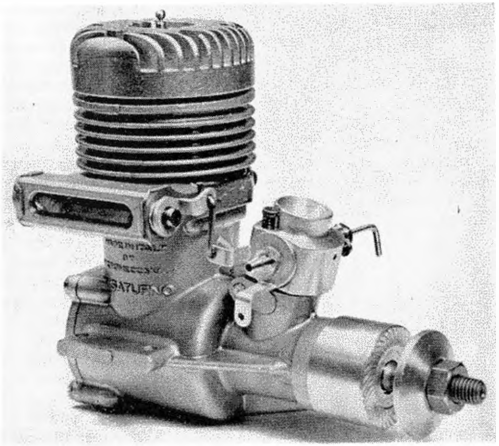
ably good idling but, in our tests, proved disappointing in the power department with only 0.43 b.h.p. at 9,700 r.p.m. Investigation as to the cause of this revealed that port timing was, to put it mildly, all hay-wire. As a result of these findings, the U.K. importers, Messrs. Modelradio, are now offering a modified version which shows a vast improvement on the earlier standard model. A quick check showed b.h.p. to be raised by more than 50 per cent (enough to put the Ueda among the top performers in this class) without loss of handling qualities or throttle response.

Rapidly becoming one of the most competitive engine classes is the large multi R/C group—*i.e.*, the R/C .60's. So far as the U.K. is concerned, the British Merco 61 stands



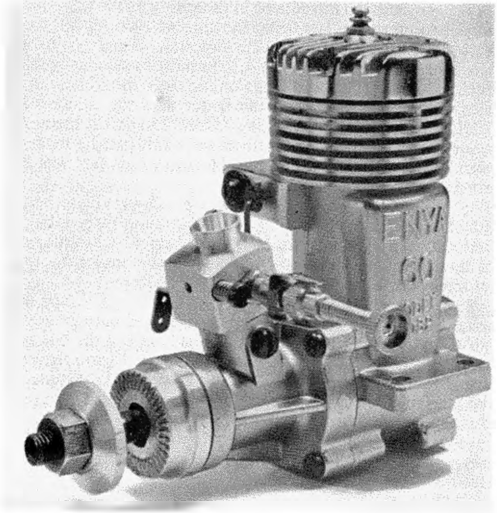
Most powerful of the 6.5 c.c. engines, K&B Torpedo 40 R C Series 66.

out as by far the most widely used—and the most successful—multi engine and we have tested no other R C 60 to date that would lead us to suppose that its popularity is in any danger in the immediate future. Nevertheless, the 9.95

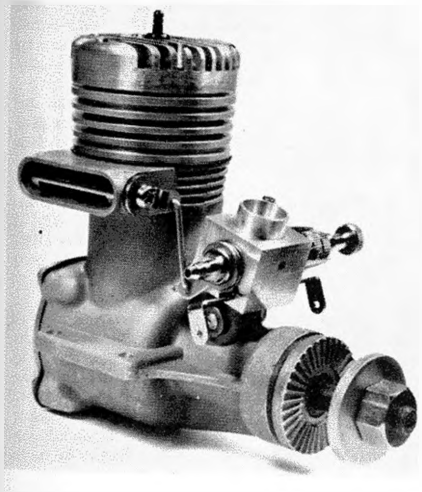


Super-Tigre S.T. 60 R/C World Record holder for R/C speed.

Very clean and polished, the Enya 60-II TV.



Below, Ueda 45 R C.



c.c. Italian *Super-Tigre* 60 *R C* has a considerable following, particularly in the U.S.A. and in Germany. Likewise, the 9.95 c.c. Japanese *Enya* 60-*II TV*, after a shaky start in 1965, has recently been adopted by several of the top American multi flyers. Lastly, the new 10.01 c.c *Veco* 61 *R C*—winner in prototype form, of the 1965 U.S. Nationals multi event, is an obvious contender for future honours.

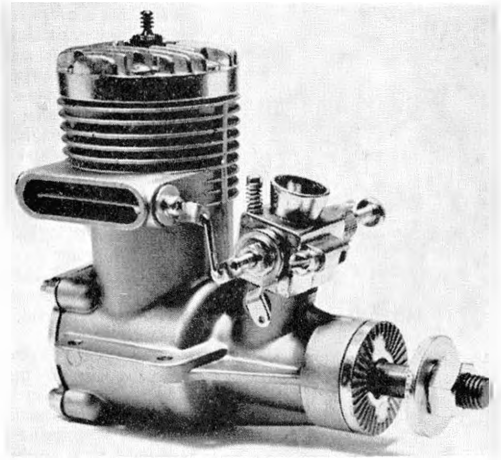
Super-Tigre are notorious for the frequency with which design changes are made and many modifications have been made to the

S.T.60 since it was introduced in the spring of 1964. We have had three different models on test, the last being the current 1966 model, with single needle valve carburettor and hemispherical combustion chamber. As supplied, the S.T.60 would not idle reliably below 3,200 r.p.m. on standard prop sizes and 5 per cent fuel. This was improved by enlarging the airbleed hole in the carburettor. We also found that the engine ran better with the compression ratio reduced by adding an extra head gasket, a procedure to which many American users have resorted. The lower compression ratio also cured a tendency for the engine to start backwards. Maximum output reached on test was 0.87 b.h.p. at 11,000 r.p.m., without silencer.

The Enya 60-II TV bettered the Super-Tigre both in regard to power (0.92 b.h.p. at 12,000 r.p.m.) and throttling (safe idling 2,500-2,700 r.p.m.) but shared its tendency to occasionally start backwards or kick its prop loose. This was helped by adding a .025 in. gasket under the cylinder head at a cost of around 200 r.p.m. on 11×6 and 11×8 props.

The Veco 61 R/C, designed by Clarence Lee, was more docile to handle, yet, at 0.97 b.h.p. at 12,800 r.p.m., developed more power than the Enya and a good deal more than the S.T. It also had the best throttle and the only complaint we had was that, while the running-in period was relatively short, many more hours running were required to thoroughly bed the piston rings before the engine became an easy starter. The Veco is the most expensive of the three, but it also has the best finish.

In all, 1966 was quite a good year for new engines, but, already, there are signs that we shall have some even more interesting products to describe in 1967.



The very powerful and easy to control Veco 61 R/C Series 200.

FUEL FORMULAE

To economise on running costs, many modellers make up their own fuel mixtures from basic ingredients, when the savings possible can be quite considerable if you do a lot of flying. It is not unknown, for example, for a *gallon* or more of fuel to be used up simply running in a large R/C engine to the point where its throttle response is completely consistent. Clubs in particular can benefit from making up bulk fuel—but this will not necessarily appeal to the "contest" types who will probably have their own specific preferences!

To start with **diesel fuels,** the basic ingredients involved are paraffin, lubricating oil and ether. Diesels are usually not too critical about the fuels on which they will *run*, but for best performance it may be necessary to "tailor" the fuel to suit the particular engine.

This largely affects the ether content. Some diesels will start and run well on a low ether content (*e.g.* 20 per cent). Others, usually the smaller sizes, need a higher ether content for easy starting (up to 40 per cent). Since ether is an expensive constituent—and not, incidentally a very good fuel as far as energy content—the optimum fuel is one with the lowest ether content which gives easy starting.

Lubricant proportion can vary between about 20 per cent and 33⅓ per cent. The higher figure is advisable for running in new engines, but once run-in the lubricant proportion can be dropped. It is not generally recommended to go below 20 per cent lubricant, however, although some "racing" fuels do use less.

The lower the ether proportion and the lubricant proportion, obviously the higher the percentage of paraffin, which is the main "power" ingredient. It is also the least expensive constituent, so the most "powerful" fuel the engine will accept (lowest ether and oil) is also the most economical. It is not economical, though, if this means cutting down the lubricant so much that the engine overheats and seizes!

The question of which type of lubricant to use—mineral oil or castor—is quite open. Castor is often thought to be the better lubricant, but these days there is little difference between the two types. There is also the fact that unless pure (degummed) castor oil or a pure castor-based oil is used, the castor constituent can produce a white precipitate on standing which can clog fuel lines or the needle valve jet if drawn into the engine.

To produce consistent running a basic diesel fuel may need the addition of "dope". This is amyl nitrate (or amyl nitrite) which is added in small proportions only. Its effect is to reduce the ignition lag of the fuel and so promote smoother running. The amount of dope needed to produce the required effect will vary with the basic fuel formulation and the engine and can only be determined experimentally. The maximum amount of dope required should never exceed about 3 per cent as above this it will have little beneficial effect and can even be *harmful*. This is because nitrous fumes are released by the dope when

burnt which can cause corrosion inside the engine, and so the least amount of dope present the better from the corrosion aspect.

A point to bear in mind is that different fuel proportions will require different settings on a particular diesel. Also the higher the proportion of dope the more it will be found necessary to back off the compression as the engine warms up.

Costs of the various ingredients required are approximately as follows:

Ether	6/- per pint
Lubricant	Mineral base (two-stroke oil)—2/5 per pint; or 16/10 per gallon
	Castor base (Castrol R)—3/9 per pint; 27/- per gallon
Paraffin	2/4 per gallon
Amyl nitrate	2/9 per ounce

Ether can be purchased from chemists under the name Anaesthetic Ether, Ether BSS 759, Ether 0.720, Sulphuric Ether or Ether Meth—all of which mean the same thing. Lubricating oil can be purchased from a garage. For a mineral-base lubricant any *two-stroke* oil is satisfactory. Modern crankcase oils (for car engines) contain additives which are not necessary to two-stroke engines, but they will not do any harm for the oil does not stop long in the engine anyway. You can even use a cheap oil—preferably SAE 40—for greater economy. For a castor-base lubricant, use Castrol R.

Paraffin you can buy from a garage or ironmongers. Amyl nitrate, which has its main application as a heart stimulant, you will have to get from the chemist again.

Proportions and costs for three typical diesel fuels are then summarised in Tables I, II and III. Fuel A should be suitable for running-in all types and sizes of diesels. When free, fuel B1 or B2 can be used for general running, depending on whether the design of engine needs a moderate or high ether content. Easy starting is the criterion here. Fuel C is one which could be used with a high speed diesel, properly run in, for competition work.

Note, however, that these are general formulas and could probably be improved upon by experiment to match an *individual engine*.

There is another constituent which can often be used to advantage to reduce fuel consumption. This is nitrobenzine, which can be added to any basic (or "matched") fuel mixture in moderate proportions—*e.g.*, up to 10 per cent maximum. This additive has the property of allowing the diesel to run on a slightly more closed throttle setting without loss of revs or power—a valuable saving in the case of team racers, for example. Ordinary benzine has a similar effect as an additive. Not all diesels, however, do show any economy of running with benzine additives.

Glow fuels are considerably simpler since a basic fuel mixture consists of 70-80 per cent methanol and 30-20 per cent lubricant. However, glow engines are much more fussy than diesels on "matched" fuel mixtures and are normally designed around a particular mixture, especially the high-performance engines.

The basic fuel characteristics are adjusted by a doping additive, in this case nitromethane. Unlike diesel "dope", nitromethane can be added in any proportion from a few per cent up and performance will tend to increase with increasing proportion of dope. The only limit to the actual increase in performance achieved with increasing amount of dope is the compression ratio of the engine. If too high, there will come a time when a further increase in

nitromethane will have no effect. Similarly, if the engine is designed with a fairly low compression ratio to take advantage of high-nitro fuels, it may not start or run consistently on fuels which do not contain a generous proportion of nitromethane.

This is a typical characteristic of racing glow engines. Since nitromethane is an extremely expensive constituent, for maximum economy of operation the glow engine has to be *designed* to run on a low-nitro or undoped fuel.

Methanol, or methyl alcohol, can be obtained from some garages, but more readily from specialist suppliers or even from the chemist (at higher price). The lubricant is normally castor base, such as Castrol R (obtainable from a garage) or pure degummed castor oil (from the chemist). Mineral oils are not normally used since they will not mix with methanol. However, if it is preferred to use a mineral-oil lubricant it can be blended satisfactorily if a little ether is added to the mixture. This can be ignored as a constituent. The same comment as for diesel fuels applies. Castor blends which contain additives or gums can precipitate out.

Constituent costs are approximately as follows:

Methanol	15/- per gallon
Castrol R	3/9 per pint; or 27/- per gallon
Nitromethane	27/6 per ½ litre; or 136/- per gallon

Table IV then gives typical glow fuel costs for a basic 75:25 methanol: lubricant proportion. This basic ratio should be reduced for running-in a new engine (*e.g.* to 70:30 methanol:castor); and increased when the engine is completely free (*e.g.*, to 80:20 methanol:castor). The nitromethane content used depends entirely on the requirements of the particular engine and the purpose for which it is being used. There is no point in running on a higher proportion of nitromethane than absolutely necessary, except where maximum performance is the aim when the nitro content can be advanced to the point where the engine shows no further improvement in performance. Nitromethane should not be needed at all in a running-in fuel, except the minimum amount that may prove necessary on a low compression engine to give reasonably smooth running.

Table VI then summarises some further pertinent and comparative figures regarding operating costs of engines on various fuels. Remember, that in assessing true costs there will always be some wastage. It always uses up more than 30 c.c. of fuel filling a 30 c.c. tank, for instance!

TABLE I. BASIC DIESEL FUEL "A"

CONSTITUENTS	Paraffin	Ether*	Lubricant
PROPORTIONS %	33⅓	33⅓	33⅓
TO MAKE 1 GALLON	⅓ Gallon	⅓ Gallon	⅓ Gallon

* May need adjusting

COST PER GALLON with	MINERAL OIL	CASTOR OIL
NOMINAL	23/3	26/10
BULK†	22/6	25/10
ADDITIONAL Cost per Gallon of Amyl Nitrate Additive		
1%		4/3
2%		8/6
3%		12/9

†Oil bought in gallon quantities

E.g. a gallon of fuel "A" with mineral oil lubricant and 2% amyl nitrate will cost 31/- to 31/9 or approximately 4/- per pint.

TABLE II. STANDARD DIESEL FUELS

	B1 (LOW ETHER)*			B2 (HIGH ETHER)†		
CONSTITUENTS	Paraffin	Ether	Oil	Paraffin	Ether	Oil
PROPORTIONS %	50	25	25	40	35	25
TO MAKE 1 GALLON	4 pints	2 pints	2 pints	64 oz.	56 oz.	2 pints

* Generally suitable for larger diesels
† Usually required by small size diesels

APPROXIMATE COSTS* (Per Gallon)	B1 Mineral	B1 Castor	B2 Mineral	B2 Castor
STRAIGHT	18/-	20/8	22/3	24/11
1% AMYL NITRATE	22/3	24/11	26/6	29/2
2% AMYL NITRATE	26/6	29/2	30/9	33/5
3% AMYL NITRATE	30/9	33/5	35/-	37/8

* Some saving possible by buying oil in bulk

TABLE III. COMPETITION DIESEL FUEL "C"

CONSTITUENTS	Paraffin	Ether	Oil
PROPORTIONS %	55	25*	20
TO MAKE 1 GALLON	88 ounces	40 ounces	32 ounces

* May need adjustment

APPROXIMATE COSTS† (Per Gallon)	Mineral Oil	Castor Oil
STRAIGHT	17/2	19/4
1% AMYL NITRATE	21/5	23/7
2% AMYL NITRATE	25/8	27/10
3% AMYL NITRATE	29/11	32/1

† Some saving possible by buying oil in bulk

TABLE IV. GLOW FUEL COSTS

(Approximate cost per gallon based on Nitromethane bought in quantity at approximately 136/- per gallon)

METHANOL: CASTOR	80 : 20	75 : 25	70 : 30
STRAIGHT FUEL	18/-	18/9	19/-
5% NITROMETHANE	23/10	24/8	25/1
10% NITROMETHANE	29/8	30/4	30/7
15% NITROMETHANE	35/7	36/3	36/6
20% NITROMETHANE	41/5	42/-	42/3
30% NITROMETHANE	53/1	53/8	53/11
40% NITROMETHANE	64/8	65/2	65/6

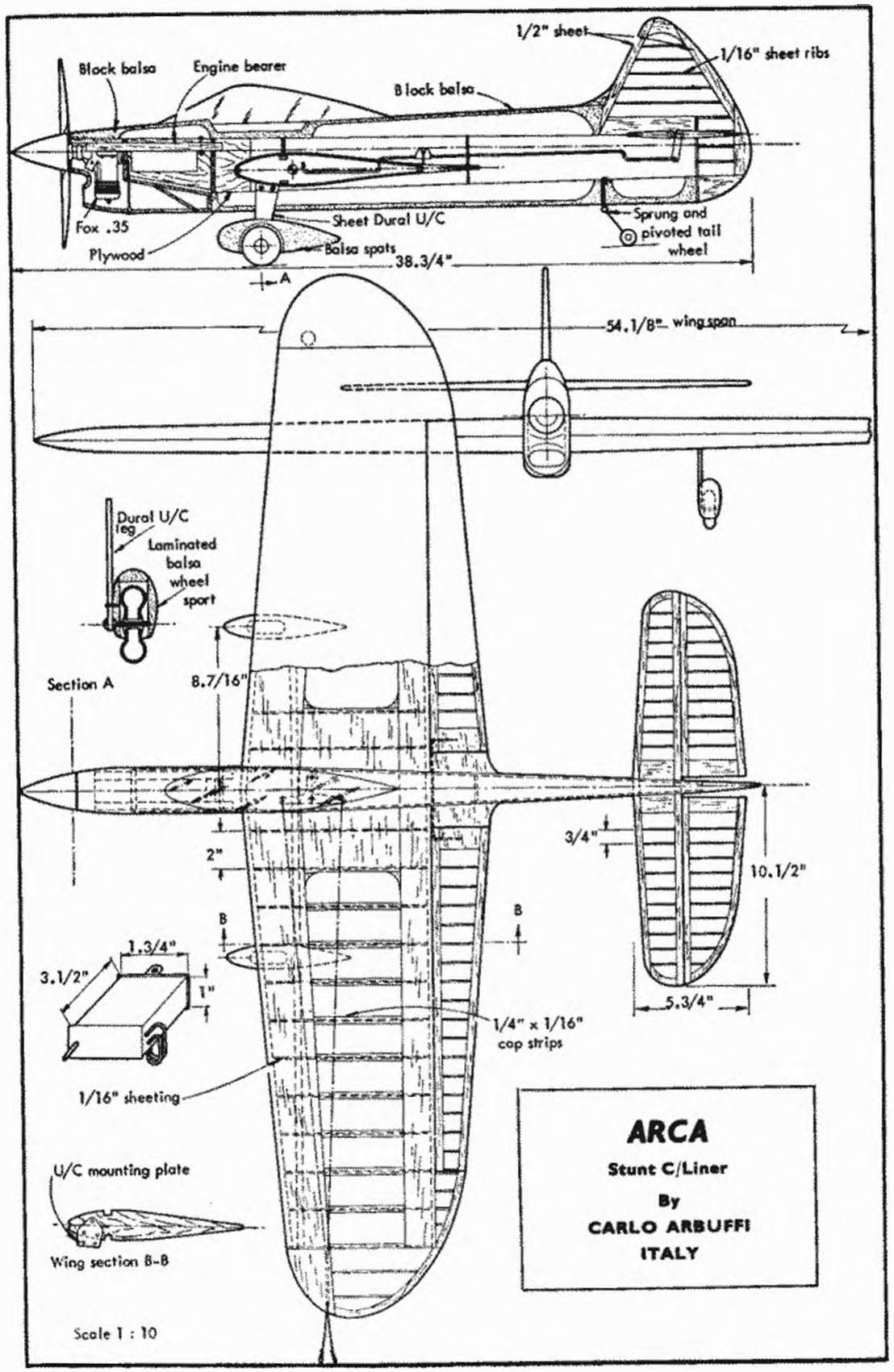
TABLE V. PROPORTIONS FOR MAKING UP METHANOL : CASTOR : NITROMETHANE

	80 : 20	75 : 25	70 : 30
STRAIGHT FUEL	4 : 1 : 0	3 : 1 : 0	7 : 3 : 0
5% NITROMETHANE	76 : 19 : 5	71·25 : 23·75 : 5	66·5 : 28·5 : 5
10% NITROMETHANE	72 : 18 : 10	67/5 : 22·5 : 10	63 : 27 : 10
15% NITROMETHANE	68 : 17 : 15	63/75 : 21·25 : 15	59·5 : 25·5 : 15
20% NITROMETHANE	64 : 16 : 20	60 : 20 : 20	56 : 24 : 20
30% NITROMETHANE	56 : 14 : 30	52·5 : 17·5 : 30	49 : 12 : 30
40% NITROMETHANE	48 : 12 : 40	45 : 15 : 40	42 : 18 : 40

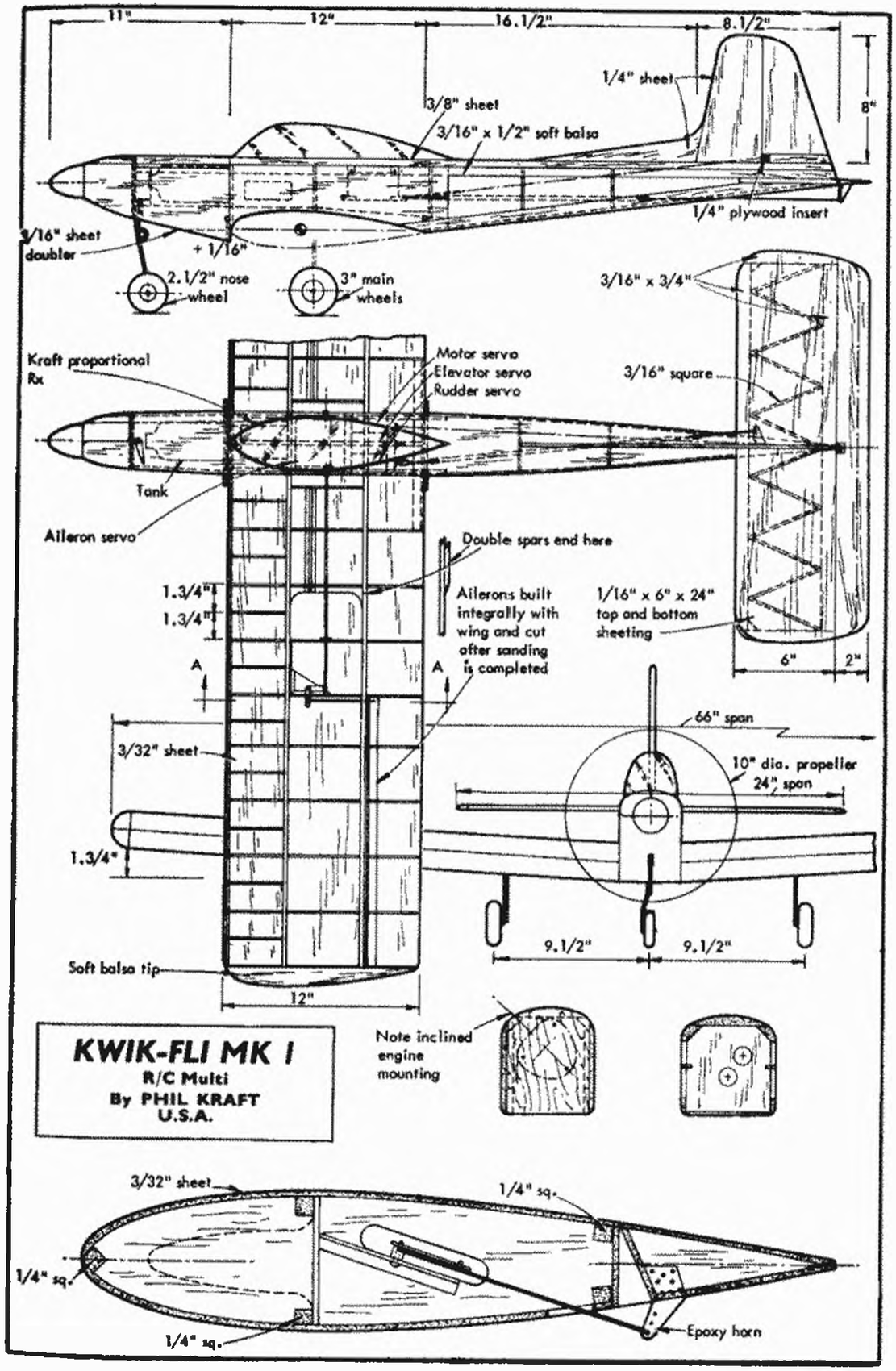
* Based on true Nitromethane percentages

TABLE VI. FUEL CONSUMPTION COSTS—PENCE

FUEL	QUANTITY CONSUMED—C.C.								
	10	15	20	30	50	100	200	300	500
DIESEL B1 (Mineral oil) STRAIGHT	·5	·7	1·0	1·33	2·38	4·75	9·5	13·25	23·75
1% AMYL NITRATE	·6	·9	1·2	1·8	2·95	5·9	11·8	17·7	29·5
2% AMYL NITRATE	·7	1·0	1·4	2·1	3·50	7·0	14·0	21·0	35·0
3% AMYL NITRATE	·8	1·2	1·6	2·4	4·1	8·1	16·2	24·3	40·5
DIESEL B2 (Mineral Oil) STRAIGHT	·6	·9	1·2	1·8	2·95	5·9	11·8	17·7	29·5
1% AMYL NITRATE	·7	1·0	1·4	2·1	3·5	7·0	14·0	21·0	35·0
2% AMYL NITRATE	·8	1·2	1·6	2·4	4·1	8·1	16·2	24·3	40·5
3% AMYL NITRATE	·9	1·4	1·8	2·8	4·6	9·2	18·4	27·6	46·0
DIESEL C (Castor) 1% AMYL NITRATE	·6	·95	1·35	1·9	3·2	6·25	13·5	18·75	31·75
2% AMYL NITRATE	·7	1·1	1·5	2·2	3·8	7·35	14·7	22·05	36·75
3% AMYL NITRATE	·8	1·25	1·65	2·5	4·1	8·25	16·5	24·75	41·25
75 : 25 GLOW FUEL STRAIGHT	·5	·75	1·0	1·5	2·5	5·0	10·0	15·0	25·0
5% NITROMETHANE	·65	1·0	1·3	1·95	3·25	6·5	13·0	19·5	32·5
10% NITROMETHANE	·8	1·2	1·6	2·4	4·0	8·0	16·0	24·0	40·0
15% NITROMETHANE	1·0	1·45	1·9	2·9	4·85	9·7	19·4	29·1	48·5
20% NITROMETHANE	1·1	1·66	2·2	3·33	5·55	11·1	22·2	33·3	55·5
30% NITROMETHANE	1·4	2·15	2·8	4·3	7·1	14·2	28·4	42·6	71·0
40% NITROMETHANE	1·7	2·6	3·4	5·2	8·6	17·2	34·4	51·6	86·0



MODELLISTICA, ITALY



RC MODELER, U.S.A.

METRICS

If metric dimensions confuse you, don't worry. There are plenty of first-class engineers who would have to use a slide rule to work out what, say, 808 millimetres is in inches before they could visualise the actual length involved. In fact, what's your immediate estimate for this conversion—about 32 inches? . . . 34½ inches? . . . 37 inches? If you got the middle one then you may be one of those lucky people who can "think" metric as well as English units. If not, you best bet is conversion tables!

Let's start with length or linear measure. As a rough approximation 25 millimetres equal one inch, but that is only all right for approximate whole number conversion. Thus 1,000 mm. is about 40 inches; but apply the same rule to, say, 1180 mm. and the mental arithmetic involved is not so easy. Also this approximate rule is not accurate enough for, say, drawing up plans. For all linear conversion, therefore, Tables I and II should be used since they give quick and accurate results, covering all plan dimensions which you are likely to encounter.

For much smaller dimensions, such as those represented by material sizes, conversion tables like these can be a little cumbersome to use, and even confusing. There are no *exact* equivalents of standard metric strip sizes and sheet thicknesses, for example, only "near equivalents". These are best worked out as a separate reference—

STANDARD METRIC SIZE	INCH EQUIVALENT	NEAREST STANDARD INCH EQUIVALENT
·5 mm.	·0197"	1/64th
·8 mm.	·0315"	1/32nd
1 mm.	·0394"	3/64th
1·5 mm.	·0591"	1/16th
2 mm.	·0787"	5/64th
2·5 mm.	·0985"	—
3 mm.	·1181"	1/8th
4 mm.	·1575"	5/32nd
5 mm.	·1969"	13/64th
6 mm.	·2362"	15/64th
8 mm.	·3150"	5/16th
10 mm.	·3937"	25/64th
15 mm.	·5906"	19/32nd
20 mm.	·7874"	25/32nd
25 mm.	·9843"	63/64th

The above are the material sizes used on Continental plans. If you need to convert "backwards" from English to metric equivalents, use this table—

INS.	1/64	1/32	3/32/	1/8	5/32	3/16	1/4	5/16	3/8	7/16	1/2	5/8	3/4	7/8	1
mm.	·4	·794	2·381	3·175	3·969	4·7625	6·35	7·94	9·525	11·1125	12·7	15·875	19·05	22·225	25·4

Strangely enough some Continental countries like Holland and Belgium favour the standard English length for balsa strip and sheet (36 in. or 915 mm.), although thicknesses and widths are in standard metric sizes. Other countries, notably Belgium, France, Germany, Norway and Sweden use a metre length as standard (39·37 inches). Standard sheet *widths* are all quite similar—

METRIC	ENGLISH actual	ENGLISH nominal
50 mm.	1·9685"	2"
75 mm.	2·95276"	3"
100 mm.	3·937"	4"
150 mm.	5·9055"	6"

Areas can be a little more confusing since metric areas can be specified in square millimetres, square centimetres, square decimetres, or square metres. The significant figures are the same in each case. It is only a case of repositioning the decimal point, representing a shift of 100 in each case.

Thus—1 square inch = 645·16 sq. mm.
= 6·4516 sq. cm.
= ·064516 sq. dm.
= ·00064516 sq. m.

Since the square centimetre is about the most convenient unit for model areas (avoiding too large a whole number, or too many decimal points), Tables III and IV have been worked out on this basis, with the square inch as the standard English unit for area. And for good measure, Tables V and VI give similar conversions with sq. ft. as the standard English unit. This can be helpful for arriving at loading figures, although why modellers persist in using full scale units (*e.g.*, pounds per sq. ft.) instead of logical model units like ounces per 100 sq. in. is difficult to justify on logical grounds.

TABLE I
CONVERSION MILLIMETRES TO INCHES

mm.	0	1	2	3	4	5	6	7	8	9
0	—	·0394	·0787	·1181	·1575	·1969	·2362	·2756	·3150	·3543
10	·3937	·4331	·4724	·5118	·5512	·5906	·6299	·6693	·7087	·7480
20	·7874	·8268	·8661	·9055	·9449	·9843	1·0236	1·0630	1·1024	1·1417
30	1·1811	1·2205	1·2598	1·2992	1·3386	1·3780	1·4173	1·4570	1·4961	1·5354
40	1·5748	1·6142	1·6535	1·6929	1·7323	1·7717	1·8110	1·8504	1·8898	1·9291
50	1·9685	2·0079	2·0472	2·0866	2·1260	2·1654	2·2047	2·2441	2·2835	2·3228
60	2·3622	2·4016	2·4409	2·4803	2·5197	2·5591	2·5984	2·6378	2·6772	2·7165
70	2·7559	2·7953	2·8347	2·8740	2·9134	2·9528	2·9921	3·0315	3·0709	3·1102
80	3·1496	3·1890	3·2284	3·2677	3·3071	3·3465	3·3858	3·4252	3·4646	3·5039
90	3·5433	3·5827	3·6221	3·6614	3·7008	3·7402	3·7795	3·8189	3·8583	3·8976

TABLE II
CONVERSION—INCHES TO MILLIMETRES

INS.	0	1/8	1/4	3/8	1/2	5/8	3/4	7/8
0	—	3·175	6·35	9·525	12·7	15·875	19·05	22·225
1	25·4	28·575	31·75	34·925	36·1	41·275	44·45	47·625
2	50·8	53·975	57·15	60·325	63·5	66·675	69·85	73·025
3	76·2	79·375	82·55	85·725	88·9	92·075	95·25	98·425
4	101·6	104·775	107·95	111·125	114·3	117·475	120·65	123·825
5	127·0	130·175	133·35	136·525	139·7	142·875	146·05	149·225
6	152·4	155·575	158·75	161·925	165·1	168·275	171·45	174·625
7	177·8	180·875	184·15	187·325	190·5	193·625	196·85	200·025
8	203·2	206·375	209·55	212·725	215·9	219·075	222·25	225·425
9	228·6	231·775	234·95	238·125	241·3	244·475	247·65	250·825

TABLE III

SQUARE CENTIMETRES TO SQUARE INCHES

SQ. INS.	-	1	2	3	4	5	6	7	8	9
0	—	0·155	0·310	0·465	0·620	0·775	0·093	1·085	1·240	1·395
10	1·550	1·705	1·860	2·015	2·170	2·325	2·480	2·635	2·790	2·945
20	3·100†	3·255	3·410	3·565	3·720	3·875	4·030	4·185	4·340	4·495
30	4·650	4·805	4·960	5·115	5·270	5·425	5·580	5·735	5·890	6·045
40	6·200	6·355	6·510	6·665	6·820	6·975	7·130	7·285	7·440	7·595
50	7·750	7·905	8·060	8·215	8·370	8·525	8·680	8·835	8·990	9·145
60	9·300	9·455	9·610	9·7650	9·920	10·08	10·23	10·39	10·54	10·70
70	10·85	11·01	11·16	11·32	11·47	11·63	11·78	11·94	12·09	12·25
80	12·40	12·56	12·71	12·87	13·02	13·18	13·33	13·49	13·64	13·80
90	13·95	14·11	14·26	14·42	14·57	14·73	14·88	15·04	15·19	15·35
100	15·50	15·66	15·81	15·97	16·12	16·28	16·43	16·59	16·74	16·90
110	17·05	17·21	17·36	17·52	17·67	17·83	17·98	18·14	18·29	18·45
120	18·60	18·76	18·91*	19·07	19·22	19·38	19·53	19·69	19·84	20·00
130	20·15	20·31	20·46	20·62	20·77	20·93	21·08	21·24	21·39	21·55
140	21·70	21·86	22·01	22·17	22·32	22·48	22·63	22·79	22·94	23·10
150	23·25	23·41	23·56	23·72	23·87	24·03	24·18	24·34	24·49	24·65
160	24·80	24·96	25·11	25·27	25·42	25·58	25·73	25·89	26·04	26·20
170	26·35	26·51	26·66	26·82	26·97	27·13	27·28	27·44	27·59	27·75
180	27·90	28·06	28·21	28·37	28·52	28·68	28·83	28·99	29·14	29·30
190	29·45	29·61	29·76	29·92	30·07	30·22	30·38	30·54	30·69	30·85
200	31·00	31·16	31·31	31·47	31·62	31·78	31·93	32·09	32·24	32·40
210	32·55	32·71	32·86	33·02	33·17	33·33	33·48	33·64	33·79	33·95
220	34·10	34·26	34·41	34·57	34·72	34·88	35·03	35·19	35·34	35·50
230	35·65	35·81	35·96	36·12	36·27	36·43	36·58	36·74	36·89	37·05
240	37·20	37·36	37·50	37·66	37·82	37·98	38·13	38·29	38·44	38·60
250	38·75	38·91	39·06	39·22	39·37	39·53	39·68	39·84	40·00	40·15
260	40·30	40·46	40·61	40·77	40·92	41·08	41·23	41·39	41·54	41·70
270	41·85	42·01	42·16	42·32	42·47	42·63	42·78	42·94	43·09	43·25
280	43·40	43·56	43·71	43·87	44·02	44·18	44·33	44·49	44·64	44·80
290	44·95	45·11	45·26	45·42	45·57	45·73	45·88	46·04	46·19	46·35
300	46·50	46·66	46·81	46·97	47·12	47·28	47·43	47·59	47·74	47·90
310	48·00	48·21	48·36	48·52	48·67	48·83	48·98	49·14	49·29	49·45
320	49·60	49·76	49·91	50·07	50·22	50·38	50·53	50·69	50·84	51·00
330	51·15	51·31	51·46	51·62	51·77	51·93	52·08	52·24	52·39	52·55
340	52·70	52·86	53·01	53·17	53·32	53·48	53·63	53·785	53·94	54·10
350	54·25	54·41	54·56	54·72	54·87	55·03	55·18	55·34	55·49	55·65
360	55·80	55·96	56·11	56·27	56·42	56·58	56·73	56·89	57·04	57·20
370	57·35	57·51	57·66	57·82	57·97	58·13	58·28	58·44	58·59	58·75
380	58·90	59·06	59·21	59·37	59·52	59·68	59·83	59·99	60·14	60·30
390	60·45	60·61	60·76	60·92	61·07	61·23	61·38	61·54	61·69	61·85
400	62·00	62·16	62·31	62·47	62·62	62·78	62·93	63·09	63·24	63·40
410	63·55	63·71	63·86	64·02	64·17	64·33	64·48	64·64	64·79	64·95
420	65·10	65·26	65·41	65·57	65·72	65·88	66·03	66·19	66·34	66·50
430	66·65	66·81	66·96	67·12	67·27	67·43	67·58	67·74	67·89	68·05
440	68·20	68·36	68·51	68·67	68·82	68·98	69·13	69·29	69·44	69·60
450	69·75	69·91	70·06	70·22	70·37	70·53	70·68	70·84	71·00	71·15
460	71·30	71·46	71·61	71·77	71·92	72·08	72·23	72·39	72·54	72·70
470	72·85	73·01	73·16	73·32	73·47	73·63	73·78	73·94	74·09	74·25
480	74·40	74·56	74·71	74·87	75·02	75·18	75·33	75·49	75·64	75·80
490	75·95	76·11	76·26	76·42	76·57	76·73	76·88	77·04	77·19	77·35

TABLE IV

SQUARE INCHES TO SQUARE CENTIMETRES

SQ. INS.	-	1	2	3	4	5	6	7	8	9
0	—	6·452	12·90	19·36	25·81	32·26	38·71	45·16	51·61	58·06
10	64·52	70·97	77·42	83·87	90·32	96·77	103·23	109·7	116·1	122·6
20	129·0	135·5	141·9	148·4	154·8	161·3	167·7	174·2	180·7	187·1
30	193·6	200·0	206·5	212·9	219·4	225·8	232·3	238·7	245·2	251·6
40	258·1	264·5	271·0	277·4	283·9	290·3	296·7	303·2	309·7	316·1
50	322·6	329·0	335·5	341·9	348·8	354·8	361·3	367·7	374·2	380·6
60	387·1	393·5	400·0	406·5	412·9	419·4	425·8	432·3	438·7	445·2
70	451·6	450·0	464·5	475·0	477·4	483·9	490·3	496·8	503·2	509·7
80	516·1	522·6	529·0	535·5	542·0	548·4	554·8	561·3	567·7	574·2
90	580·6	587·1	593·6	600·0	606·5	612·9	619·4	625·8	632·3	638·7
100	645·2	651·6	658·1	664·5	671·0	677·4	683·9	690·3	696·8	703·2
110	709·7	716·1	722·6	729·0	735·5	742·0	748·4	754·8	761·3	767·7
120	774·2	780·6	787·1	793·6	800·0	806·5	812·9	819·4	825·8	832·3
130	838·7	845·2	851·6	858·1	864·5	871·0	877·4	883·9	890·3	896·8
140	903·2	909·7	916·1	922·6	929·0	935·5	941·9	948·4	954·8	961·3
150	967·7	972·2	980·6	987·1	993·6	1000·0	1006·5	1012·9	1019·4	1025·8
160	1032·3	1038·7	1045·2	1051·6	1058·1	1064·5	1071·0	1077·4	1083·9	1090·3
170	1096·8	1103·2	1109·7	1116·1	1122·6	1129·0	1135·5	1141·9	1148·4	1154·8
180	1161·3	1167·7	1174·2	1180·6	1187·1	1193·6	1200·0	1206·5	1212·9	1219·4
190	1225·8	1232·3	1238·7	1245·2	1251·6	1258·1	1264·5	1271·0	1277·4	1283·9
200	1290·3	1296·8	1303·2	1309·7	1316·1	1322·6	1329·0	1335·5	1341·9	1348·4
210	1354·8	1361·3	1367·7	1374·2	1380·6	1387·1	1393·6	1400·0	1406·5	1412·9
220	1419·4	1425·8	1432·3	1438·7	1445·2	1451·6	1458·1	1464·5	1471·0	1477·0
230	1483·9	1490·3	1496·8	1503·2	1509·7	1516·1	1522·6	1529·0	1535·5	1541·9
240	1548·4	1554·8	1561·3	1567·7	1574·2	1580·6	1587·1	1593·6	1600·0	1606·5
250	1612·9	1619·4	1625·8	1632·3	1638·7	1648·2	1651·6	1658·1	1664·5	1671·0
260	1677·4	1683·9	1690·3	1696·8	1763·2	1709·7	1716·1	1722·6	1729·0	1735·5
270	1742·0	1748·4	1754·8	1761·3	1767·7	1774·2	1780·6	1787·1	1793·5	1800·0
280	1806·5	1812·9	1819·4	1825·8	1832·3	1838·7	1845·2	1851·6	1858·1	1864·5
290	1871·0	1877·4	1883·9	1890·3	1896·8	1903·2	1909·7	1916·1	1922·6	1929·0
300	1935·5	1942·0	1948·4	1954·8	1961·3	1967·7	1974·2	1980·6	1987·1	1993·5
310	2000·0	2006·5	2012·9	2019·4	2025·8	2032·3	2038·7	2045·2	2051·6	2058·1
320	2064·5	2071·0	2077·4	2083·9	2090·3	2096·8	2103·2	2109·7	2116·1	2122·6
330	2129·0	2135·5	2142·0	2148·4	2154·8	2161·3	2167·7	2174·2	2180·64	2187·1
340	2193·5	2200·0	2206·5	2212·9	2219·4	2225·8	2232·3	2238·7	2245·2	2251·6
350	2258·1	2264·5	2271·0	2277·4	2283·9	2290·3	2296·8	2303·2	2309·7	2316·1
360	2322·6	2329·0	2335·5	2341·9	2348·4	2354·3	2361·3	2367·7	2374·2	2380·6
370	2387·1	2393·5	2400·0	2406·5	2412·9	2419·4	2425·8	2432·3	2438·7	2445·2
380	2451·6	2458·1	2464·5	2471·0	2477·4	2483·9	2490·3	2496·8	2503·2	2509·7
390	2516·18	2522·6	2529·0	2535·5	2541·9	2548·4	2554·8	2561·3	2567·7	2574·2
400	2580·6	2587·1	2593·5	2600·0	2606·5	2612·9	2619·4	2625·8	2632·3	2638·7
410	2645·2	2651·6	2658·1	2664·5	2671·0	2677·4	2683·9	2690·3	2696·8	2703·3
420	2709·7	2716·1	2722·6	2729·0	2735·5	2741·93	2748·4	2754·8	2761·3	2767·74
430	2774·2	2780·6	2787·1	2793·5	2800·0	2806·5	2812·9	2819·4	2825·8	2832·3
440	2838·7	2845·2	2851·6	2858·1	2864·5	2871·0	2877·4	2883·9	2890·3	2896·8
450	2903·2	2909·7	2916·1	2922·6	2929·0	2935·5	2941·9	2948·4	2954·8	2961·3
460	2967·7	2974·2	2980·6	2987·1	2993·5	3000·0	3006·5	3012·9	3019·4	3025·8
470	3023·3	3038·7	3045·2	3051·6	3058·1	3064·5	3071·0	3077·4	3082·9	3090·3
480	3096·8	3103·2	3109·7	3116·1	3122·6	3129·0	3135·5	3141·9	3148·4	3154·8
490	3161·3	3167·7	3174·2	3180·6	3187·1	3193·5	3200·0	3206·5	3212·9	3219·4

V SQUARE CENTIMETRES TO SQUARE FEET

SQ. CM.	-	1	2	3	4	5	6	7	8	9
0	—	·001076	·002153	·003229	·004306	·005382	·006458	·007535	·008611	·009688
10	·01076	·01184	·01292	·01399	·01507	·01615	·01722	·01830	·01938	·02045
20	·02153	·02260	·02368	·02476	·02583	·02691	·02799	·02906	·03014	·03122
30	·03229	·03337	·03444	·03552	·03660	·03767	·03875	·03983	·04090	·04198
40	·04306	·04413	·04521	·04628	·04736	·04844	·04951	·05059	·05167	·05274
50	·05382	·05490	·05597	·05705	·05813	·05920	·06028	·06135	·06243	·06351
60	·06458	·06566	·06674	·06781	·06889	·06997	·07104	·07212	·07320	·07427
70	·07535	·07642	·07750	·07858	·07965	·08073	·08181	·08288	·08396	·08504
80	·08611	·08719	·08826	·08934	·09042	·09149	·09257	·09365	·09472	·09580
90	·09688	·09795	·09903	·10014	·10118	·10226	·10333	·10441	·10549	·10656
100	·10764	—	—	—	—	—	—	—	—	—

IX GRAMS TO OUNCES

GRAMS	-	1	2	3	4	5	6	7	8	9
0	—	·03527	·07055	·10582	·14110	·17636	·21164	·24692	·28219	·31747
10	·3527	·3880	·4233	·4585	·4938	·5291	·5643	·5996	·6349	·6702
20	·7055	·7407	·7760	·8112	·8465	·8818	·9170	·9523	·9876	1·0229
30	1·0582	1·0934	1·1287	1·1639	1·1992	1·2345	1·2697	1·3050	1·3403	1·3756
40	1·4110	1·4461	1·4814	1·5166	1·5519	1·5872	1·6224	1·6577	1·6930	1·7283
50	1·7637	1·7988	1·8341	1·8693	1·9046	1·9399	1·9751	2·0104	2·0457	2·0810
60	2·1164	2·1515	2·1868	2·2220	2·2573	2·2926	2·3278	2·3631	2·3984	2·4337
70	2·4692	2·5042	2·5395	2·5747	2·6100	2·6453	2·6805	2·7158	2·7511	2·7864
80	2·8219	2·8569	2·8922	2·9274	2·9627	2·9980	3·0332	3·0685	3·1038	3·1391
90	3·1747	3·2096	3·2449	3·2801	3·3154	3·3507	3·3859	3·4212	3·4565	3·4918
100	3·5274	—	—	—	—	—	—	—	—	—

XI KILOGRAMS TO POUNDS

(Note: this Table can also be used to convert grams into pounds by dividing the answer by 1,000)

KILOGRAMS	-	·1	·2	·3	·4	·5	·6	·7	·8	·9
0	—	·2204	·4409	·6614	·8819	1·1023	1·3224	1·5432	1·7637	1·9842
1	2·2046	2·4251	2·6456	2·8660	3·0865	3·3069	3·5274	3·7479	3·9683	4·1888
2	4·4092	4·6297	4·8502	5·0706	5·2911	5·5116	5·7320	5·9525	6·1729	6·3934
3	6·6139	6·8343	7·0548	7·2753	7·4957	7·7162	7·9366	8·1571	8·3776	8·5980
4	8·8185	9·0390	9·2594	9·4799	9·7003	9·9208	10·1413	10·3617	10·5822	10·8026
5	11·0231	11·2436	11·4640	11·6845	11·9050	12·1254	12·3459	12·5663	12·7868	13·0073
6	13·2277	13·4482	13·6687	13·8891	14·1096	14·3300	14·5505	14·7710	14·9914	15·2119
7	15·4324	15·6528	15·8733	16·0937	16·3142	16·5347	16·7551	16·9756	17·1961	17·4165
8	17·6370	17·8574	18·0779	18·2984	18·5188	18·7393	18·9598	19·1802	19·4007	19·6211
9	19·8416	20·0621	20·2825	20·5030	20·7235	20·9439	21·1644	21·3848	21·6053	21·8258
10	22·0462	22·2667	22·4871	22·7076	22·9281	23·1485	23·3690	23·5895	23·8099	24·0304

VI SQUARE INCHES TO SQUARE FEET

SQ. INS.	-	1	2	3	4	5	6	7	8	9
0	—	·006944	·01389	·02083	·02778	·03472	·04167	·04861	·05555	·06250
10	·06944	·07639	·08333	·09027	·09722	·10416	·11111	·11805	·12499	·13194
20	·13889	·14583	·15277	·15971	·16666	·17360	·18055	·18749	·19443	·20138
30	·20833	·21527	·22221	·22915	·23610	·24304	·24999	·25693	·26387	·27082
40	·27777	·28471	·29165	·29859	·30554	·31248	·31943	·32637	·33331	·34026
50	·34721	·35415	·36109	·36803	·37498	·38192	·38887	·39581	·40275	·40970
60	·41665	·42359	·43053	·43747	·44442	·45136	·45831	·46525	·47219	·47914
70	·48609	·49303	·49997	·50691	·51386	·52080	·52775	·53469	·54163	·54858
80	·55553	·56247	·56941	·57635	·58330	·59024	·59719	·60413	·61107	·61802
90	·62497	·63191	·63885	·64579	·65274	·65968	·66663	·67357	·68051	·68746
100	·69444	—	—	—	—	—	—	—	—	—

X OUNCES TO GRAMS

OUNCES	-	·1	·2	·3	·4	·5	·6	·7	·8	·9
0	—	2·835	5·670	8·505	11·340	14·175	17·010	19·845	22·680	25·515
1	28·35	31·19	34·02	36·85	39·69	42·53	45·36	48·20	51·03	53·87
2	56·70	59·54	62·37	65·20	68·04	70·87	73·71	76·54	79·38	82·21
3	85·05	87·89	90·72	93·55	96·39	99·23	102·06	104·90	107·73	110·57
4	113·40	116·24	119·07	121·90	124·74	127·57	130·41	133·25	136·08	138·91
5	141·75	144·59	147·42	150·25	153·09	155·93	158·76	161·61	164·43	167·27
6	170·10	172·94	175·77	178·60	181·44	184·27	187·11	189·95	192·78	195·61
7	198·45	201·29	204·12	206·95	209·79	212·63	215·46	218·31	221·13	223·97
8	226·80	229·64	232·47	235·30	238·14	240·97	243·81	246·65	249·48	252·31
9	295·15	257·99	260·82	263·65	266·49	269·33	272·16	275·01	277·83	280·67
10	283·50	—	—	—	—	—	—	—	—	—

XII POUNDS TO KILOGRAMS

(Note: To convert to grams, multiply by 1,000)

LB	-	·1	·2	·3	·4	·5	·6	·7	·8	·9
0	—	·04536	·09072	·13608	·18144	·22680	·27216	·31752	·36287	·40823
1	·4536	·4990	·5443	·5897	·6350	·6804	·7258	·7711	·8165	·8618
2	·9072	·9525	·9980	1·0433	1·0886	1·1340	1·1793	1·2247	1·2701	1·3154
3	1·3608	1·4061	1·4515	1·4969	1·5422	1·5876	1·6329	1·6783	1·7237	1·7690
4	1·8144	1·8597	1·9051	1·9505	1·9958	2·0412	2·0865	2·1319	2·1772	2·2226
5	2·2680	2·3133	2·3587	2·4040	2·4494	2·4948	2·5401	2·5855	2·6308	2·6762
6	2·7216	2·7670	2·8123	2·8576	2·9030	2·9484	2·9937	3·0391	3·0844	3·1298
7	3·1752	3·2205	3·2659	3·3112	3·3566	3·4019	3·4473	3·4927	3·5380	3·5834
8	3·6287	3·6741	3·7195	3·7648	3·8102	3·8555	3·9009	3·9463	3·9916	4·0370
9	4·0823	4·1277	4·1731	4·2184	4·2638	4·3091	4·3545	4·3999	4·4452	4·4906
10	4·5360	4·6266	4·6266	4·6720	4·7174	4·7627	4·8081	4·8534	4·9888	4·9442

For cubic measurement there is standardisation on cubic inches for English units and cubic centimetres for metric units, although they are often mixed illogically. Thus conventional British engineering practice is to specify engine bore and stroke sizes in inches and swept volume in metric units (c.c.). Tables VII and VIII summarise a full range of conversions, whilst these further simplified tables related to standard engine sizes are useful for direct comparison.

METRIC SIZE (capacity)	ENGLISH EQUIVALENT (cu. in.) actual	nominal
0·5 c.c.	·0305119	·03
0·75 c.c.	·0427166	·04
1·0 c.c.	·061024	·06
1·5 c.c.	·091536	·09
2·0 c.c.	·122047	·122
2·5 c.c.	·152559	·15
3·0 c.c.	·183071	·18
3·5 c.c.	·213583	·21
5·0 c.c.	·305119	·30
7·5 c.c.	·457678	·45
10·0 c.c.	·61024	·61

ENGLISH SIZE (capacity)	METRIC EQUIVALENT	(nominal)
·01 cu. in.	·164 c.c.	
·02 cu. in.	·328 c.c.	
·049 cu. in.	·80297 c.c.	(0·8 c.c.)
·051 cu. in.	·83574 c.c.	
·09 cu. in.	1·47484 c.c.	(1·5 c.c.)
·15 cu. in.	2·45806 c.c.	(2·5 c.c.)
·19 cu. in.	3·11354	
·29 cu. in.	4·75225 c.c.	(5·0 c.c.)
·35 cu. in.	5·7355 c.c.	(6·0 c.c.)
·45 cu. in.	7·3742 c.c.	
·49 cu. in.	8·0297 c.c.	(8·0 c.c.)
·60 cu. in.	9·8322 c.c.	
·61 cu. in.	9·9961 c.c.	(10·0 c.c.)

Finally, *weights*. The standard metric unit is the kilogram, but for convenience in model sizes the gram is normally adopted, when 1,000 grams equals 2·20462 pounds; or 1 gram equals ·035274 ounces. That makes 453·592 grams in one pound; or 28·3495 grams to one ounce. As an approximate rule for rough working we can reckon on 30 grams being equal to one ounce, which is an easy enough exercise in mental arithmetic. For more accurate working we must use conversion tables—see Tables IX, X, XI and XII.

VII

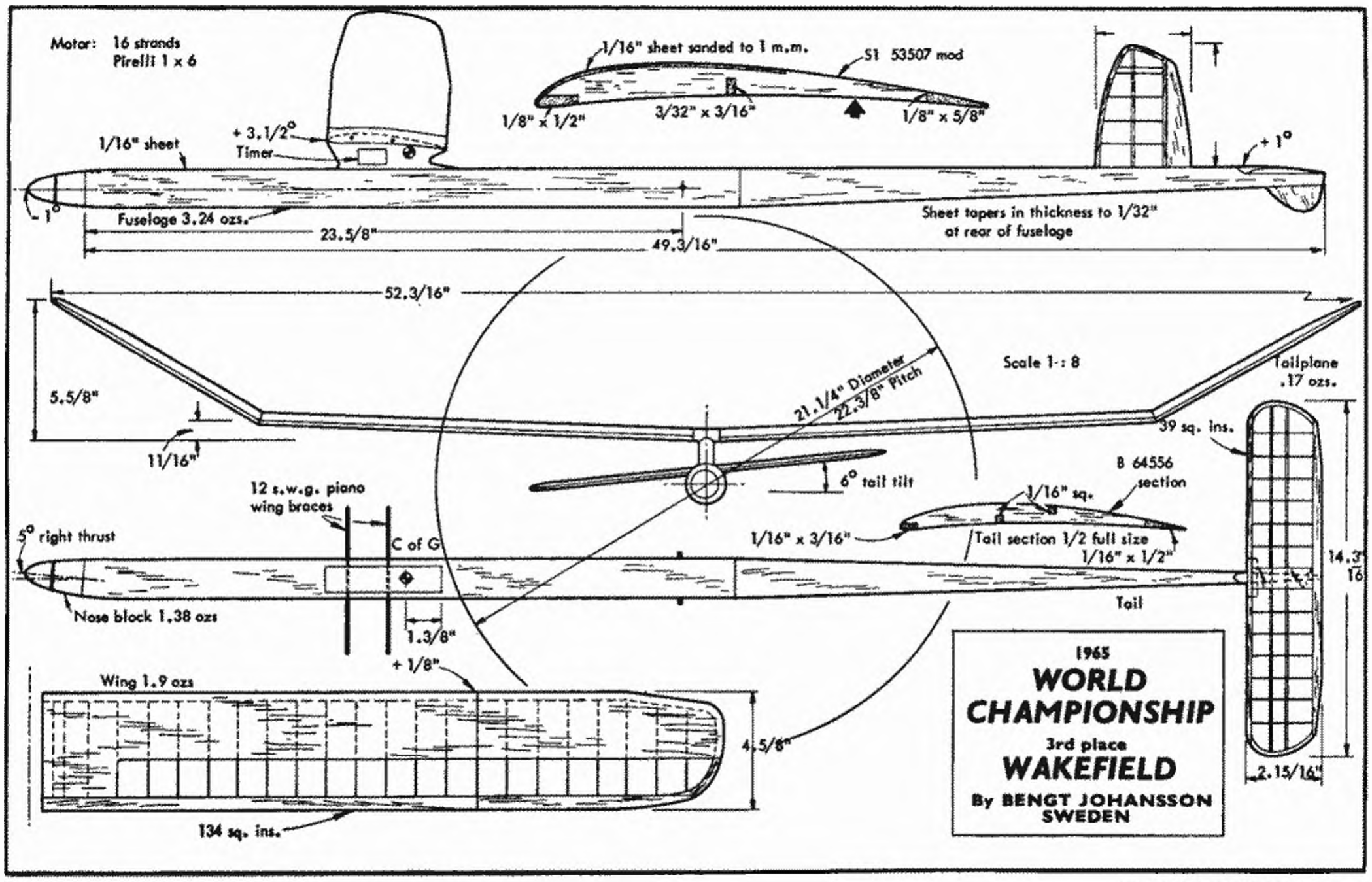
CUBIC INCHES TO CUBIC CENTIMETRES

CU. IN.	0·00	0·01	0·02	0·03	0·04	0·05	0·06	0·07	0·08	0·09
—	—	0·16357	0·32774	0·49162	0·65548	0·81935	0·98322	1·14709	1·31097	1·47484
0·1	1·63871	1·80258	1·96645	2·1303	2·2942	2·4581	2·6219	2·7858	2·9497	3·1135
0·2	3·27741	3·44128	3·66515	3·7690	3·9329	4·0968	4·2606	4·4245	4·5884	4·7523
0·3	4·91612	5·0800	5·2430	5·4077	5·5716	5·7355	5·8993	6·0632	6·2271	6·3910
0·4	6·5548	6·7187	6·8826	7·0464	7·2103	7·3742	7·5380	7·7019	7·8658	8·0297
0·5	8·1935	8·3574	8·5213	8·6851	8·8490	9·0129	9·1768	9·3406	9·5045	9·6684
0·6	9·8322	9·9961	10·1600	10·3239	10·4877	10·6516	10·8155	10·9793	11·1432	11·3071
0·7	11·4709	11·6348	11·7957	11·9626	12·1264	12·2903	12·4542	12·6180	12·7810	12·9458
0·8	13·1097	13·2735	13·4374	13·6013	13·7651	13·9290	14·0929	14·2567	14·4206	14·5845
0·9	14·7484	14·9122	15·0761	15·2400	15·4038	15·5677	15·7316	15·8955	16·0593	16·2232
1·0	16·3871									

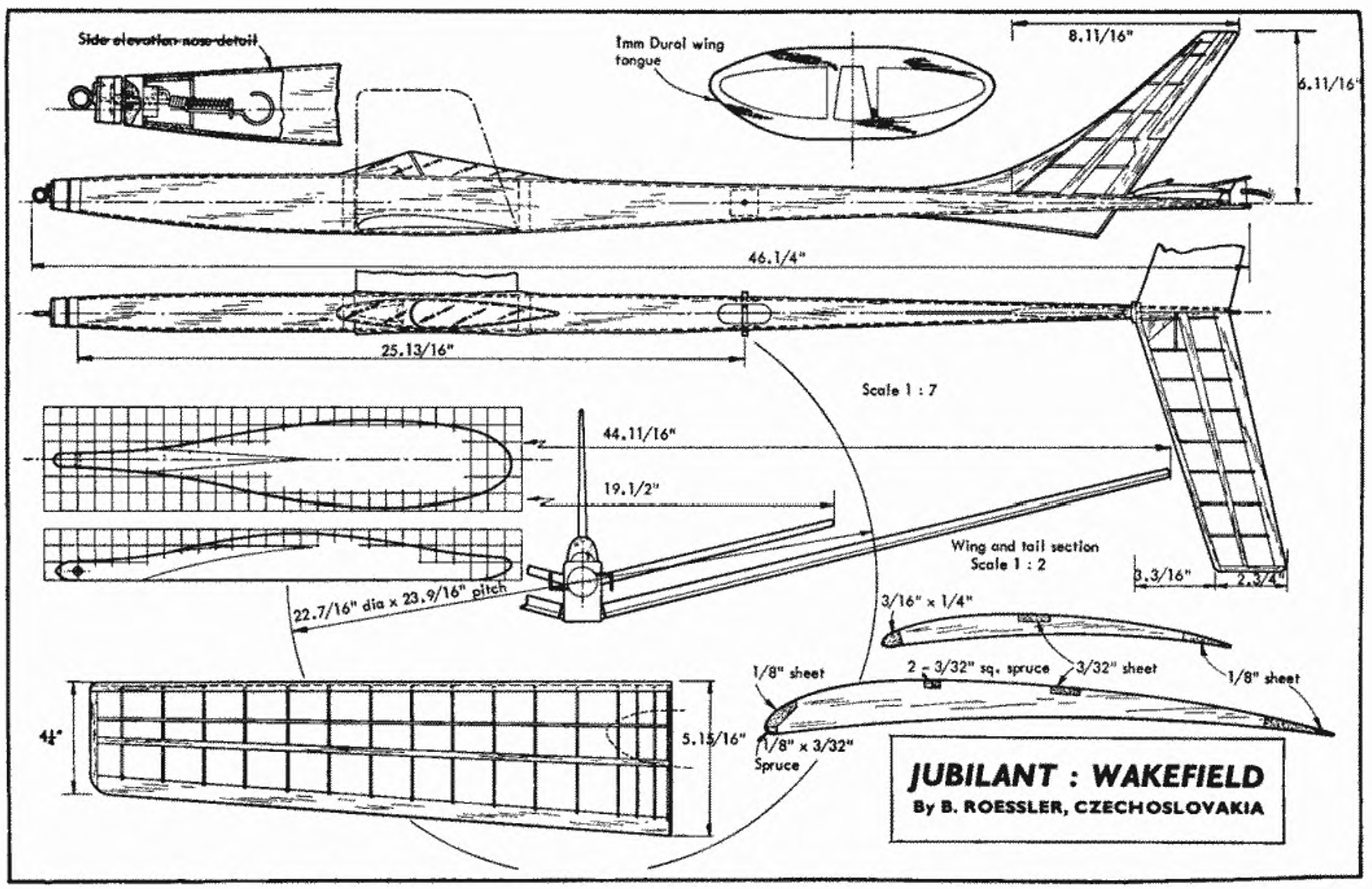
VIII

CUBIC CENTIMETRES TO CUBIC INCHES

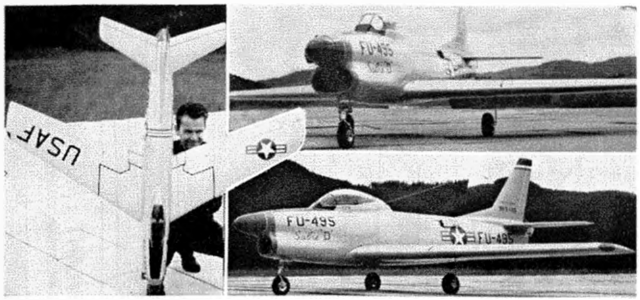
C.C.	0·00	0·1	0·2	0·3	0·4	0·5	0·6	0·7	0·8	0·9
—	—	0·06102	0·012205	0·018307	0·024410	0·030512	0·36614	0·002717	0·048819	0·05492
1	0·061024	0·067126	0·073228	0·079331	0·085433	0·091536	0·097638	0·103740	0·109843	0·115945
2	0·122047	0·128150	0·134252	0·140355	0·146457	0·152559	0·158662	0·164764	0·170866	0·176969
3	0·183071	0·189174	0·195276	0·201378	0·207481	0·213583	0·219685	0·225788	0·231890	0·237993
4	0·244095	0·250197	0·256300	0·262402	0·265504	0·274607	0·280709	0·286812	0·292914	0·299016
5	0·305119	0·311221	0·317323	0·323426	0·329528	0·335631	0·341733	0·347835	0·353938	0·360040
6	0·366142	0·372245	0·378347	0·384450	0·390552	0·396654	0·402757	0·408859	0·414961	0·421064
7	0·427166	0·433269	0·439371	0·445473	0·451576	0·457678	0·463780	0·469883	0·475985	0·482088
8	0·488190	0·494292	0·50039	0·50650	0·51260	0·51870	0·52480	0·53091	0·53701	0·54311
9	0·54921	0·55532	0·56142	0·56752	0·57362	0·57973	0·58583	0·59193	0·59803	0·60414
10	0·61024									



MODELLFLYG, SWEDEN



MODELAR, CZECHOSLOVAKIA



Swiss modeller Fritz Meier-Patton with his Merco 61-powered F86D Sabre. This 62 in. span scale model weighs 9 lbs., uses NACA 2415 wing section has 67° sweepback, and is flown with full house Kraft 12 plus flaps.

SWEPT WINGS

SWEEPBACK or a swept wing planform is an essential feature of modern subsonic full-size jet aircraft, the angle of sweep to a large extent governing the limiting Mach number (maximum permissible speed). It is one of the chief factors governing the aerodynamic performance of the wing. At much lower speeds, and in model sizes, sweepback has a far less significant effect. In the case of model design, at least, it is probably true to say that the choice of a swept wing is only justified on appearance and that aerodynamic advantages are virtually negligible. In fact, the parallel chord "straight" wing with squared tips and a suitable aspect ratio is probably the most effective shape as far as model performance is concerned, and simpler than other types to build.

However, a lot of tapered wings automatically incorporate a certain amount of sweep, apart from the deliberate incorporation of sweep in a planform. Its effects, therefore, are worth knowing.

Basically, the only beneficial aerodynamic effect that sweepback is likely to give (at model speeds) is a slight improvement in recovery in a sideslip. In this respect sweepback acts in a similar manner to dihedral, but the effect is much less marked. Thus about 15 degrees of sweepback is needed to give the same effect as 1 degree of dihedral. Since free flight models need generous dihedral angles anyway, there is not much to be "saved" in the way of dihedral without going to excessive sweepback angles; and an excessive sweep angle will only reduce the efficiency of the wing and introduce other stability problems.

Sweepback appears to be particularly detrimental to stability in the rolling plane on approaching the stall since it tends to aggravate the tip stalling tendencies at high angles of attack. This will be most marked where the swept wing is tapered as well—so probably the prettiest of swept wing shapes with a straight trailing edge and sweptback leading edge is one of the least desirable aerodynamically. Strangely enough this is one of the shapes now being adopted for types of models where loss of stability at the stall is least desirable—the high speed fully aerobatic R/C multi model.

Actually, this is not a contradiction between "theory" and "practice". Although a wing planform with a straight trailing edge and sweptback leading edge is susceptible to tip stalling and adverse stability in roll at high angles of attack, this is only likely to be marked with higher taper ratios. If the taper is only slight to moderate—say the tip chord not less than about two-thirds of the root chord—performance should be directly comparable with a "straight" wing; with some possibility of improvement in yawing stability during manoeuvres. It is only when the taper ratio is high that the swept leading edge planform is likely to be troublesome. A wing with moderate leading edge sweepback also looks "right" from the point of view of stability.

Theory (and wind tunnel tests) predict, however, that there will be a certain loss of maximum lift and a slight increase in drag with such a planform. The loss of lift is likely to be of the order of 5 per cent per 10 degrees of sweepback. This is probably of academic interest only on models, but it does underline the fact that a fully swept wing of, say, 30 degrees sweep (Fig. 2) will only "save" 2 degrees of dihedral, and the overall loss of efficiency will be high, compared with a straight wing of the same area.

Such a planform may well be adopted for stability reasons, however, as on a tailless model. Although more prone to tip stalling, especially with a tapered as well as swept planform, introducing marked aerodynamic twist or "washout" at the tips can ensure that the centre part of the wing will always stall first. Under such conditions the tips, which are still lifting, have a corrective effect, rather like a tailplane—Fig. 3.

This condition is a little critical since, as previously noted, tapered sweptback wings suffer a loss of stability in roll approaching the stall and so although the stall may be corrected by delaying the tip stall with washout and asymmetric conditions on the two tip portions of the wing can induce violent rolling. The only way to reduce this to a minimum is to increase the washout still more—and further lower the overall efficiency of the wing. Thus a model with this layout is not usually noted for its performance; or its rapid recovery should it stall.

FIG. 2.

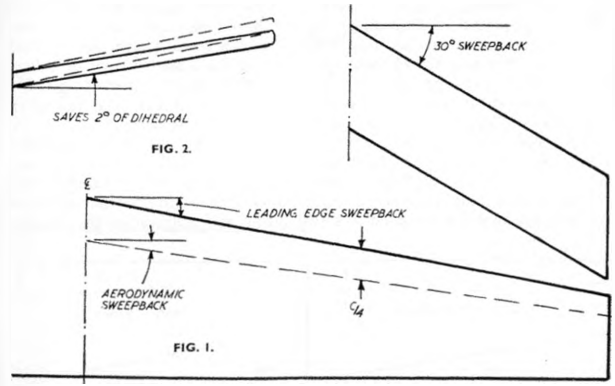


FIG. 1.

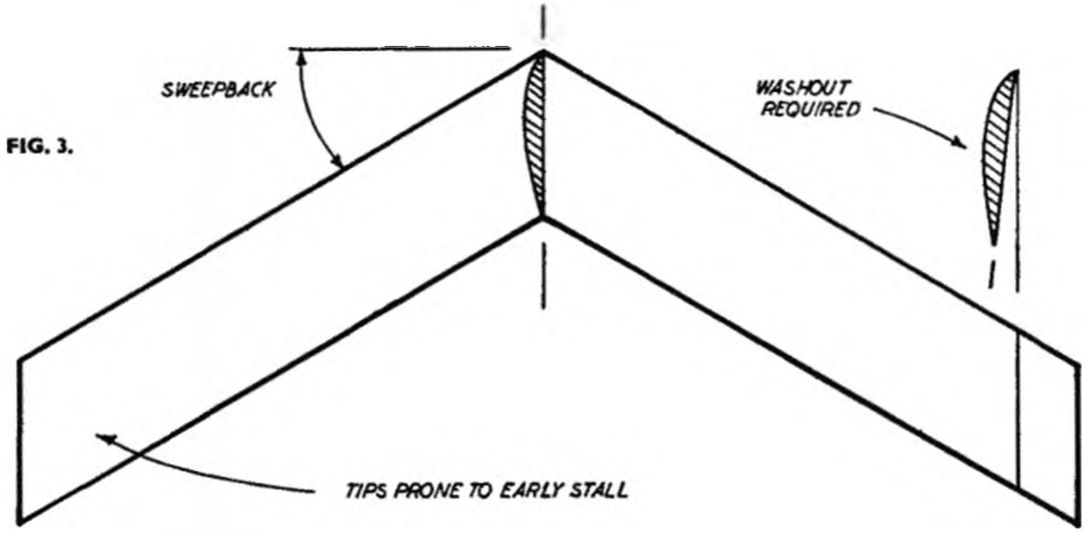


FIG. 3.

For exactly the same reasons, a similar planform used to reduce tailplane area on a more conventional design will be less efficient than a straight wing and conventional tailplane size of the same total area. The loss is accounted for by the necessary washout using the wing planform as a stabilising factor.

With sweep forward the results are somewhat different. A wing with a straight leading edge and sweptforward trailing edge can, in fact, accommodate a high degree of taper without suffering from tip stalling characteristics. Theory predicts that sweepforward can even be beneficial in offsetting the tip stalling characteristics of a taper wing. This is because with such a planform—Fig. 4—the inflow of air around the tips and over the top surface of the wing at the rear promotes a certain amount of boundary layer control which has the effect of transferring the stagnant air within the tip region towards the centre of the wing. As a result the tip flow is straightened and the point at which the initial stall is likely to occur is transferred towards the centre of the wing.

This is particularly interesting because a common planform, particularly with power-duration models, is a parallel chord centre section with tips tapered with a sweptforward trailing edge—Fig. 5. Aerodynamically, at least as far as tip stalling characteristics are concerned, this is a better shape than a parallel chord wing extending right to the tips; or to leading edge tip taper or balanced tip taper with no sweep—Fig. 6. Yet this shape evolved initially purely on practical grounds, it being both easier and stronger to "break" the trailing edge rather than the leading edge (or both) at the start of the taper.

Theoretically, at least, there are good grounds for choosing complete sweepforward for a tapered wing planform, when a quite generous taper can be employed without running into tip stalling or adverse rolling stability—Fig. 7. If a stall does develop, however, it will occur over the centre portion of the wing first with the forward mounted tips still lifting and aggravating the condition.

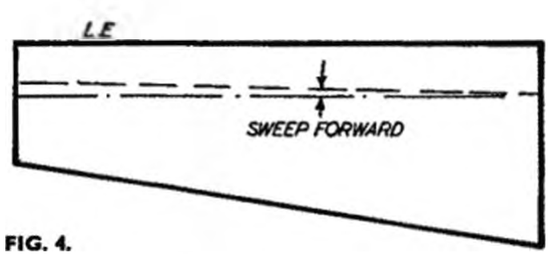


FIG. 4.

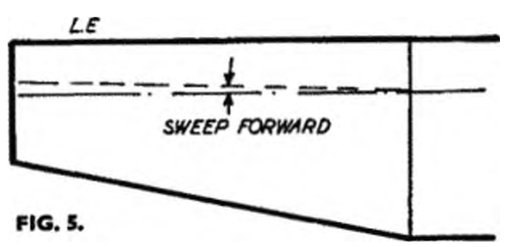


FIG. 5.

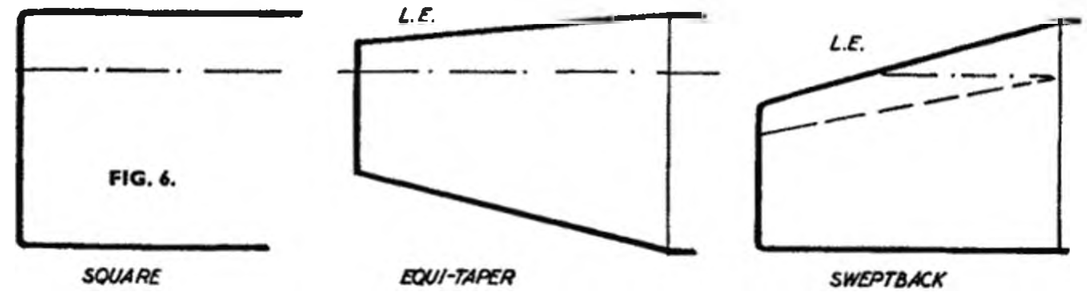


FIG. 6.

Such a layout also tends to become tricky to trim and since it does not appear to offer any overall advantages over conventional layouts, finds little favour. It remains, however, a field for experiment and still appears from time to time in both model and full-size designs.

Summarising, it can probably be said that as far as model design is concerned there is no real need to incorporate sweepback or sweepforward on wings; and that even with a tapered wing an equi-taper is probably still the most efficient and generally satisfactory form—Fig. 8. However, for taper applied to one edge only, a sweptforward trailing edge is to be preferred to a sweptback leading edge on theoretical grounds, and permits the use of higher taper ratios without running into tip stalling troubles. Sweepforward is certainly to be preferred to sweepback for tip shapes (*i.e.*, outboard panels of wings). If a sweptback leading edge planform is employed, then the amount of taper should be restricted to a moderate figure.

Of course, there are other variations and other planforms which will also work, and compromises to be made between efficiency, stability and appearance. That is one of the great attractions of aeromodelling—offering scope to try out something different. When the design aims at maximum performance, however, it is the conventional and proven outline shapes and proportions which invariably show up best.

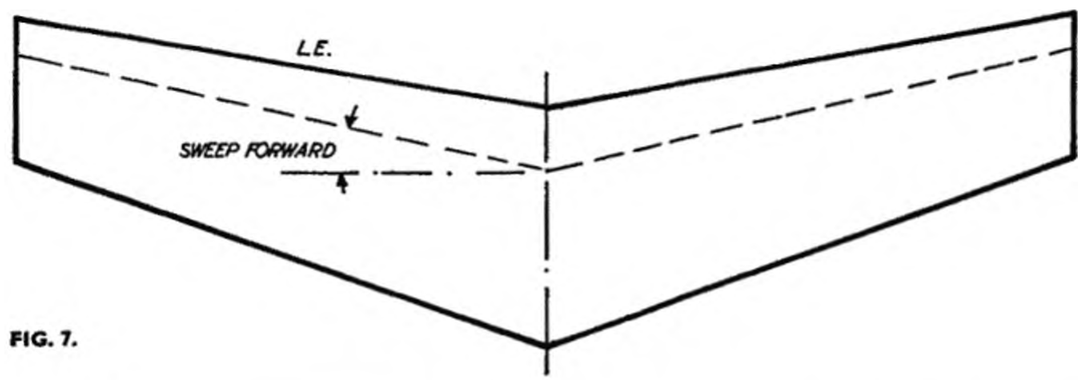


FIG. 7.

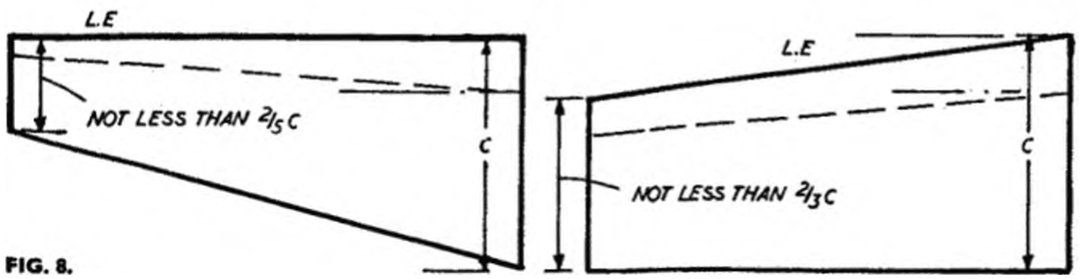
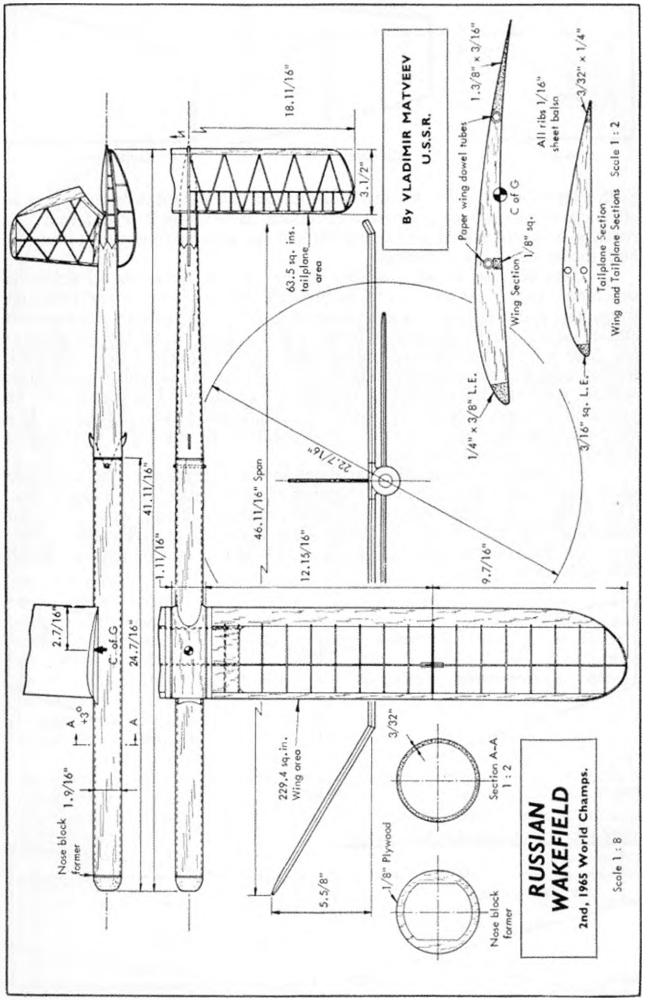


FIG. 8.



MODELAR CZECHOSLOVAKIA & MODELLEZES, HUNGARY

That maestro of the rubber-powered model John O'Donnell puts on the turns with David Tipper holding model securely by nose and at the rubber peg rearwards. In the background of this 1965 World Champs photo are June O'Donnell and Dave Posner.

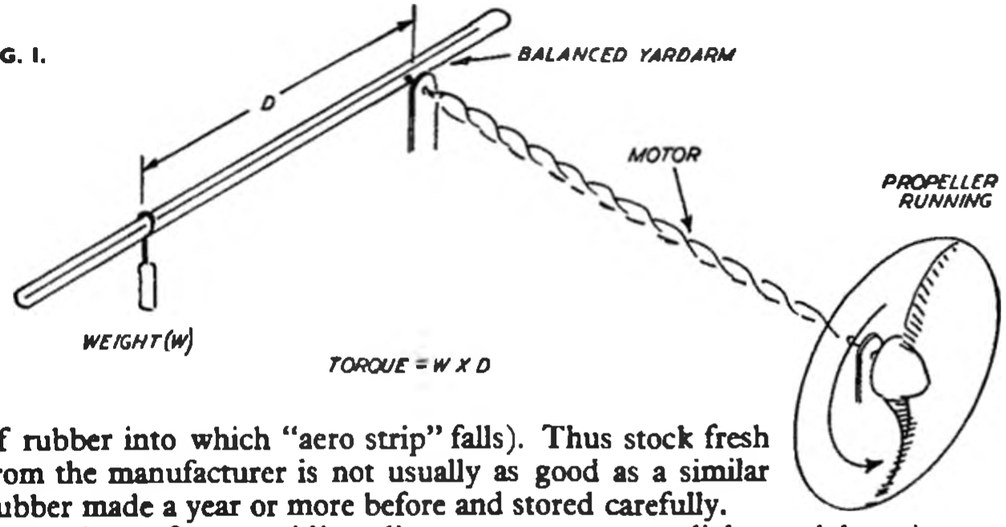
RUBBER MOTORS

STRIP rubber for powering model aircraft represents such an infinitesimal part of the overall commercial demand for rubber of all types that it is almost an accident that suitable high quality strip is available at all. Today, in fact, there is less variety, both in different types and sizes, than there was twenty to thirty years ago—and the quality and performance of "aero strip" is no better than it was then. Thus for contest work—particularly where rubber weight is restricted—selection by testing of available strip is virtually essential.

So called aero strip is a vulcanised natural rubber with possibly up to 30 per cent fillers (*e.g.*, furnace black or channel black). The introduction of fillers tends to reduce the elongation (compared with a pure gum rubber), but can materially improve the tear resistance, which is important. Tensile strength remains substantially the same (*e.g.*, around 4,000 p.s.i.) with permanent set held to about 10 per cent. Permanent set means the increase in natural or unstretched length when the rubber is first subjected to stretching. Too high a permanent stretch generally means variable performance, especially breaking strength. Too small a permanent strength denotes lack of "elasticity" or suitable characteristics for storing energy when wound up in the form of a conventional rubber motor.

This is one check on suitability. A permanent set of more than 10 per cent usually means that the rubber is too soft, or very likely too fresh. Even though the rubber compound employed is stabilised by vulcanising, mechanical characteristics will usually go on improving with age (especially with the class

FIG. 1.



of rubber into which "aero strip" falls). Thus stock fresh from the manufacturer is not usually as good as a similar rubber made a year or more before and stored carefully.

Apart from avoiding direct exposure to sunlight, and heat in general (natural rubbers suffer harm at temperatures above that of boiling water), little care is needed in storage. Rubber can be placed in a sack or similar container and left in a cool, dark place for years and (generally) only improve in quality, if it is good stock to start with.

In addition to consistence of performance and freedom from local breakage, the important properties of a rubber motor are the *torque* or turning effort it can develop; and the maximum turns the motor will take. Both quantities can be expressed as formulas, although in each case solutions can only be calculated after the corresponding coefficient in the formula has been found by practical test. Also calculation of torque by formula is not of very great use since the actual torque output will vary continuously, from a maximum when fully wound, and then displaying different "run down" characteristics with different brands of rubber. However, we will quote the formulas and explain their possible uses later.

Torque formula—

$$\text{Torque} = K_q . A^{1.5}$$

where K_q is a practical coefficient

A is the cross sectional area of the rubber motor $= N \times S$, where $n =$ number of strands and $S =$ cross sectional area of one strand.

Maximum turns formula

$$\text{Maximum turns} = \frac{K_t}{\sqrt{A}}$$

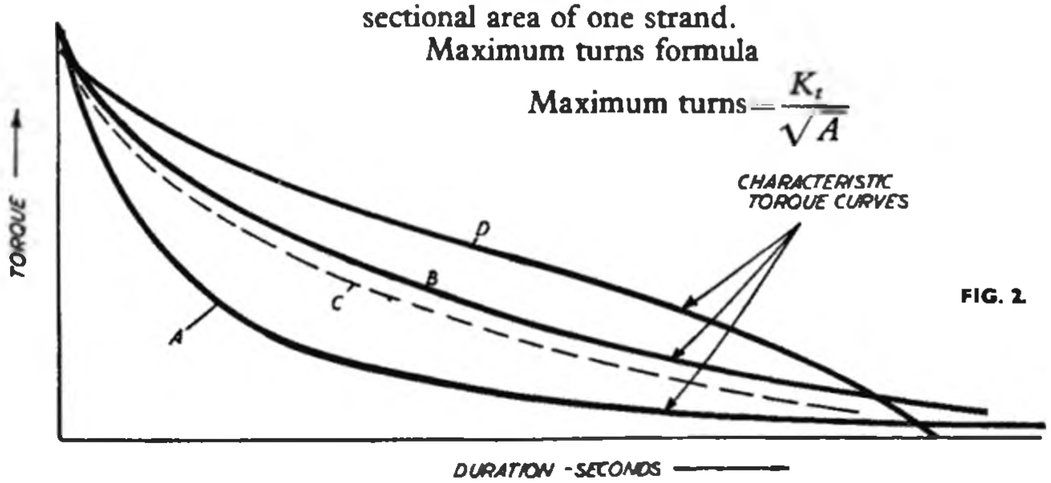


FIG. 2.

where K_t is, again, another practical coefficient depending on rubber quality, lubrication and, to some extent, also variable with external conditions. The value of K_t will also tend to change with the age of the rubber and number of times the motor has been wound.

Torque can only be determined by test, using some sort of apparatus enabling direct measurement to be made. A basic form of torque tester is shown in Fig. 1 which literally "weighs" the torque output on the opposite end of the rubber motor to that driving the propeller.

Such a torque tester can be made to accommodate a full-size motor (*i.e.*, the same as that used in a model, driving the same propeller and with the same distance between hooks). It will then enable made-up motors to be tested directly. Results are then best compared on a graph.

Fig. 2 illustrates, diagrammatically, some basic forms of torque curve. Curve *A* if for a rubber motor which is not suitable. The torque falls off too rapidly and although this may give a long motor run the *useful* power run is far too short.

Curve *B* is more typical of a good motor, and might well be adopted as a standard. In other words, once a particular motor is found to give good results it is torque tested and the plotted curve adopted as a standard for comparison with future batches of rubber. A motor made up for another batch of the same rubber might show different results—*e.g.*, curve *C* which is slightly inferior, and thus performance on that motor will be that much down.

Curve *D* shows quite a distinct type of curve which is characteristic of a particular type of rubber. It is just the type wanted for its *average* torque is much higher, and there will be a marked improvement in model performance.

The above method of testing is tedious, for it means making up "full size" motors each time for testing; but it is the most accurate for it takes into account most of the other possible variables involved, *e.g.*

(*i*) Possible bunching effects since the motor is unwinding under the same conditions as in the model.

(*ii*) Possible variations in rubber performance along its length since the motor is a complete length.

(*iii*) Elimination of errors when calculating from a torque coefficient determined by "sample" testing on short lengths of strip.

The simpler technique is to carry out a similar test but with a two-strand motor only, say 10 in. long, using apparatus like that shown in Fig. 3. Actual torque can still be measured, but the results are mainly comparative. It is still necessary to establish a standard curve—*i.e.*, by testing a two-strand motor from a full-size motor which gives the required performance.

A further virtue of the two-strand method of testing is that the same, or similar, samples can be wound to breaking point to determine K_t (using well-lubricated rubber, of course); when the theoretical breaking turns for any size of motor in that same rubber strip can be calculated from the maximum turns formula.

From the two-strand motor breaking test

$$K_t = \frac{\text{turns to break} \times 1{\cdot}414\sqrt{S}}{\text{actual length of test motor, in inches}}$$

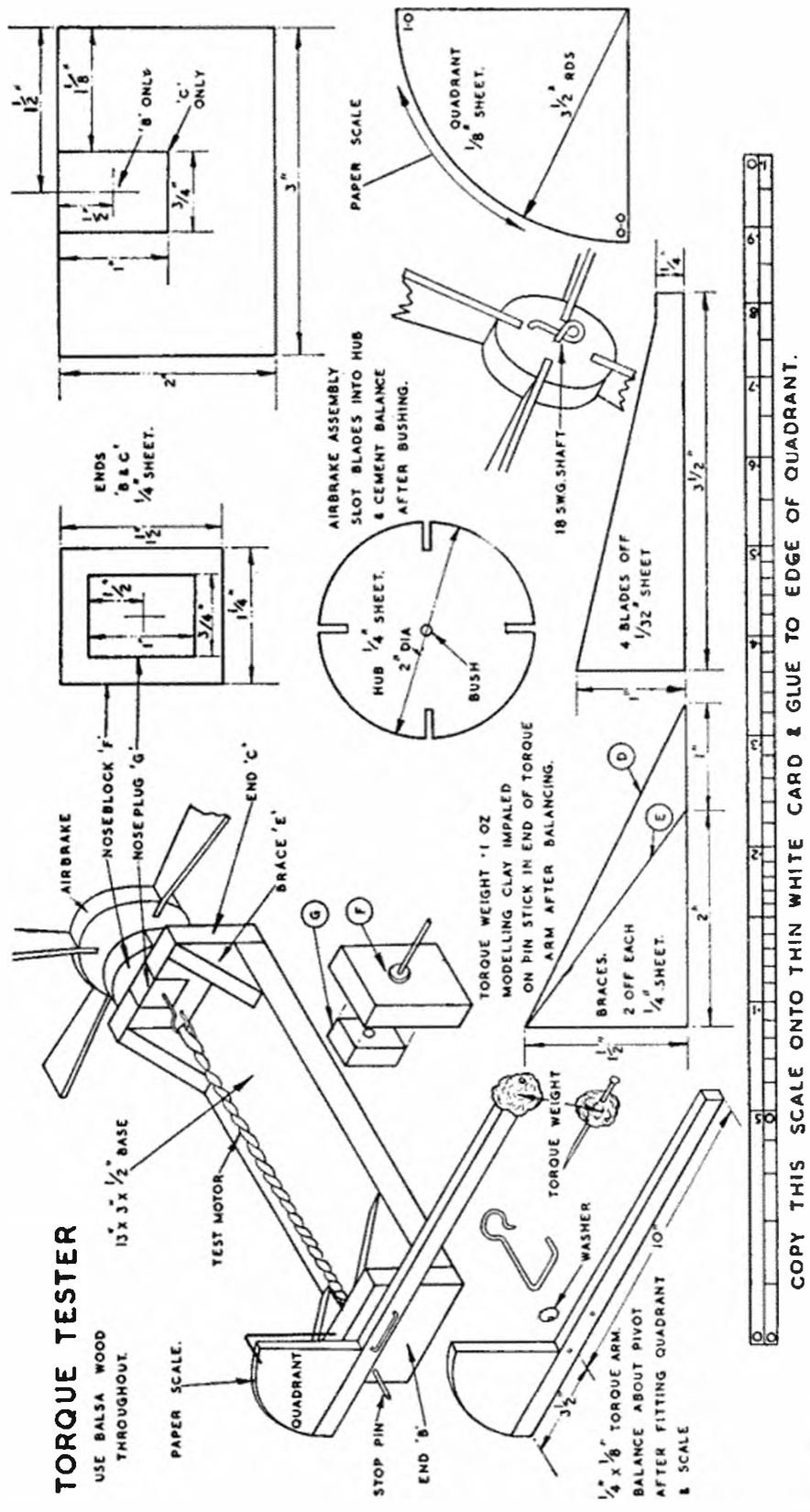


FIG. 3.

Maximum turns for any other size of motor in the same strip can then be calculated from

$$\text{Maximum turns} = \frac{K_t \times \text{actual length of motor (inches)}}{\sqrt{N}}$$

where N = number of strands

The "actual length" in both the above formulas must refer either to the measured length as originally made up in both cases; or measured length after taking up the full permanent set. The former—*i.e.*, original made up lengths—is the more usual to adopt.

For torque comparison it is necessary to adopt some specific point on the torque curve as a basis for calculation—*e.g.*, say a point about midway along the power run on the "standard" motor—Fig. 4. The equivalent size *or cross section* of motor in another rubber with different torque characteristics (as measured) to give the *same* torque at this point can then be calculated from

$$A_2 = A_1 \quad {}^{3}/_{2}\sqrt{\frac{Q_2}{Q_1}}$$

where A_1 = cross section of "standard" motor (no. of strands times actual cross section)

A_2 = cross section of other rubber strip.

Q_1 = torque value taken from standard rubber test curve

Q_2 = torque value of other rubber strip at same duration point on the graph.

Equally, of course, test figures can be used to determine the torque coefficient C_q for various rubber samples when this can be inserted in the basic torque formula to calculate the size of motor required for any chosen torque value. One must not lose sight of the fact, however, that varying the cross section will alter the maximum turns figure and length of power run and modify the form of the full torque curve. It is thus better to "find" a rubber with the required torque characteristics, by test (equal to or better than the required standard), rather than "adjust" the cross section of a rubber motor which does not come up to the performance required.

For those who do not wish to go to all this trouble of torque testing there is a simpler method. This is the extension test, or measuring the pull developed

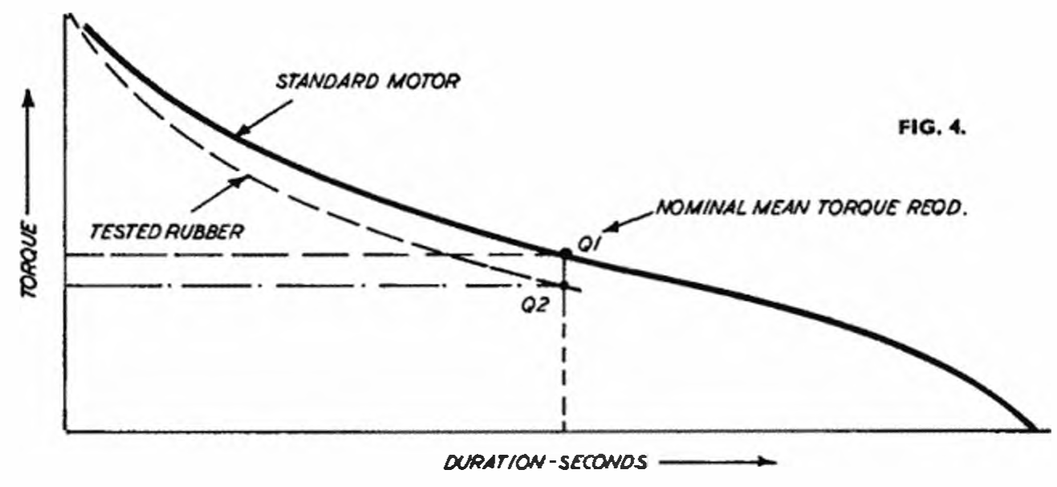


FIG. 4.

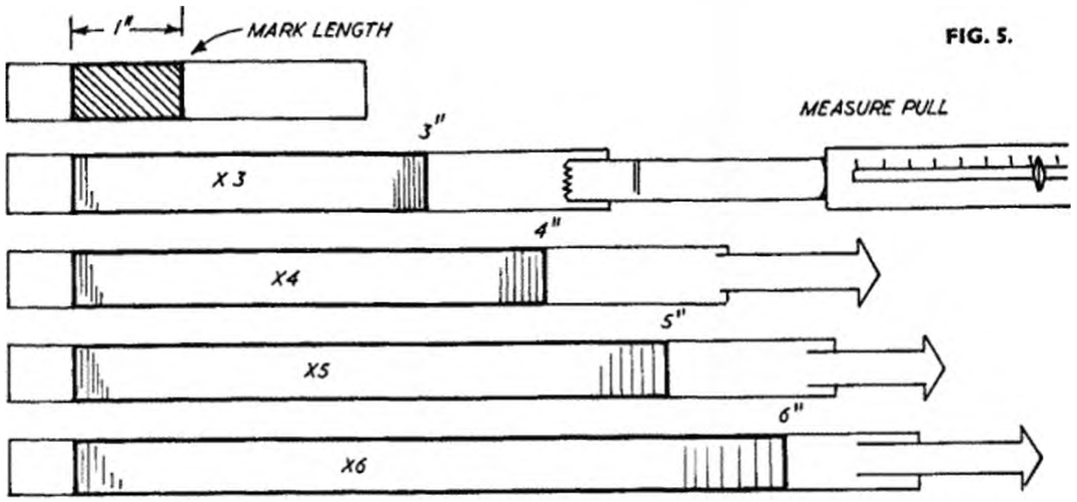


FIG. 5.

by a length of strip when stretched a predetermined amount. This "pull" figure will be directly related to its likely torque output—the higher the pull for a specified extension, the greater the power (torque output) when wound as a rubber motor. It can be further extended to embrace the cross section of the rubber by calculating the modulus involved; and this can also be determined at different extensions. An additional virtue is that this form of test can be carried out on very short lengths of strip—testing, for example the ends and middle of a hank separately to see if performance is consistent.

The technique involved is simple. A convenient length, say 1 in., is marked with a ball point pen on a length of strip. One end of the sample is

TABLE I
SAMPLE TEST FIGURES FOR RUBBER MODULI
(Two Different Brands of ¼ × 24 Strip Compared)

SPECIMEN A	Section	Cross Section	Extension 300%	400%	500%	600%
New	·248" × ·042"	·0104 sq. in.	138	183	300	385
Run-in	·240" × ·04"	·0096 sq. in.	124	182·5	254	355
Comparative Moduli (%)			90	100	85	92
SPECIMEN B						
New	·242" × ·045"	·0109 sq. in.	132	206	276	345
Run-in	·235" × ·045"	·0105 sq. in.	125	167	209	280
Comparative Moduli (%)			95	81	76	81

Note: from these data may be deduced
(i) Rubber A has about the same end torque (300% modulus) and a higher initial torque (600% modulus). With rubber B torque is maintained at a rather higher level towards the end of the power run (400%) modulus).
(ii) Rubber A loses little power at the end of the run when broken-in.
(iii) Rubber B suffers a greater loss of middle torque when broken-in than the other specimen.
(iv) Rubber B suffers less section reduction when broken-in, and thus has a lower permanent set.
(v) Quite possibly rubber A is older than rubber B, and specimen B may well improve with keeping (e.g., comparative moduli figures improve).

held and the other end attached to a spring balance and pulled. Measurements of the "pull" needed to extend the original marked length to 3 in., 4 in., 5 in. and 6 in. are then taken—Fig. 5. These figures give the "pull" for extensions of 300, 400, 500 and 600 per cent, respectively. If these are divided by the actual cross section of the strip (the original cross section for convenience), this will give the corresponding moduli figures, which can be tabulated—see Table 1.

Testing various different strip rubbers in this manner and tabulating the results will give useful comparative data. Thus the modulus figure for 600 per cent extension will give an indication of initial torque; modulus figures at 400 and 500 per cent an indication of the torque over the middle part of the power run; and the modulus at 300 per cent extension an indication of torque over the latter part of the power run. In all cases, the higher the modulus figure the higher the torque. On this basis one can both compare likely performance of different rubbers tested and also get an idea of their characteristic torque curve.

Tests conducted on this basis will give different results for the same strip when tested new and run-in—again very useful for comparison purposes. Bear in mind that the cross section will be reduced slightly when run-in (due to the permanent set). In any case the modulus can only be calculated accurately against *measured* cross section and not the nominal cross section of the strip.

In this respect, in fact, the modulus figure gives a more exact comparison between different rubbers (which may vary quite appreciably in actual cross section) than straightforward torque testing of motors of the same number of strands. However, it is more liable to experimental error and small differences in moduli between different rubbers can mean quite large differences in performance with made-up motors. It is not a substitute for torque testing as the most reliable method, but it is very much simpler and quicker.

From the specific to the more general characteristcs of rubber motors—starting with lubrication. The use of a suitable lubricant is *essential*, and there are only two types—a soft soap and glycerine mixture, or castor oil. Either is quite satisfactory, but the soap mixture is a little more slippery and usually preferred. On the other hand, castor oil does not dry out so readily, so taken all round there is little to choose between them. Castor oil is more convenient since it can be bought as medicinal castor oil and requires no making up. Soap mixtures have to be made by simmering (unscented) soft soap and glycerine mixed with water. Proportions are not critical but the following formula is recommended—

Soft soap	4 ounces
Glycerine	4 tablespoons
Water	1 pint

Pre-tensioning or cording is invariably applied to rubber motors which are longer than the distance between hooks, the basic technique involved being illustrated in Fig. 6. The motor is originally made up *twice* the length required with *one half* the number of strands, and the mid point marked (*e.g.*, by binding a short length of plastic knitting needle at this point with a rubber band). About 150 turns are then wound onto the motor in the same direction as normal winding up, ends *A* and *B* brought together and, with the motor held at the mid point *C*, the winder unwound until the motor takes up a roped appearance. Ends are then bound with rubber bands.

The length will have shortened appreciably; but if not enough unwind

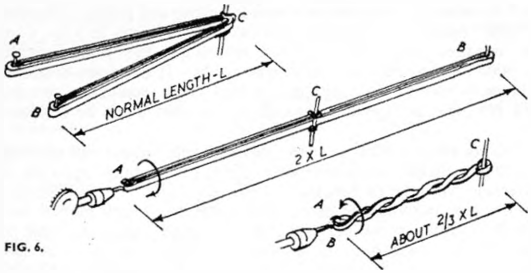


FIG. 6.

and repeat the process using more "cording" turns. Aim to get a little more than the required shortening without overdoing the number of cording turns as these will reduce the maximum turns by one half the number of cording turns applied.

For competition flying motors are invariably stretch wound and this method is, in fact, the best method of winding *any* rubber motor. It actually puts less strain on the individual strands, and also increases the possible maximum turns. Stretching to three times the natural length of the motor, and coming in on the last one-third of the winding turns shows a 30 per cent increase, approximately on the number of turns which could be applied safely to the same motor without stretch winding. Stretching to the absolute limit—six times, and coming in gradually after half turns—shows a very slight increase in maximum turns possible, but considerably increases the strain on the motor.

Bunching is a problem with very long motors, both during winding *and* unwinding. The best type of propeller shaft hook for preventing the motor climbing around the hook and bunching up in the nose is the S-hook. This provides automatic self-centering of the motor, *provided it is bent the right way*—see Fig. 7. There is no better shape of hook. With an anti-bunch hook on the

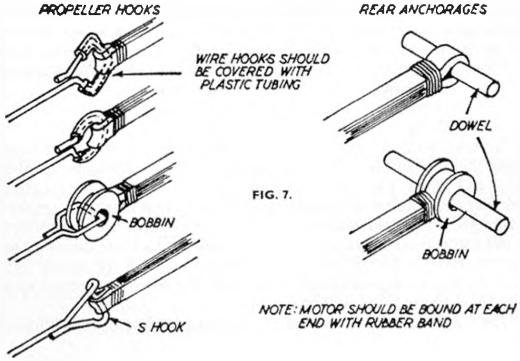


FIG. 7.

MAXIMUM TURNS PER INCH OF MOTOR LENGTH

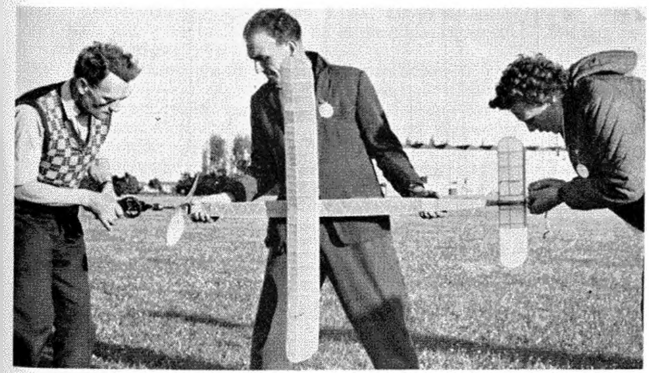
STRIP SIZE	NUMBER OF STRANDS											
	2	4	6	8	10	12	14	16	18	20	22	24
1/8 × 30	90	64	51	44	38	36	33	31	30	29	28	26
1/16 × 30	82	51	44	37	33	31	29	28	27	26	25	24
1/16 × 24	66	49	41	35	31	29	27	26	24	23	21	—
1/4 × 30	63	47	39	33	30	28	26	25	24	—	—	—
1/4 × 24	60	46	36	30	26	24	22	20	—	—	—	—

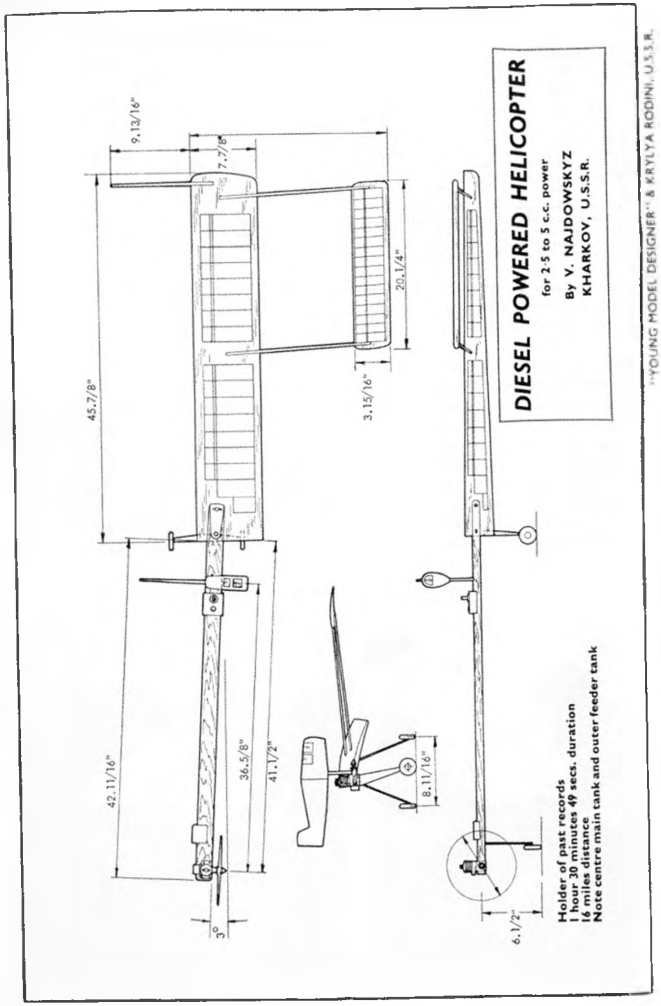
This table can be used as a general guide for "safe maximum turns" for lubricated, broken-in motors. Multiply by actual made-up length of motor (in inches) for turns figure.
For contest work, maximum turns for a given motor size should always be determined by practical tests—never by formula or table estimate.

front end and a bobbin at the rear end (or another S-hook), it is then only a matter of proper winding technique to avoid bunching. Main thing to watch is not to come in too fast, particularly with the last remaining turns.

Bunching during unwinding is often unsuspected for it usually clears itself, unless the fuselage cross section is too small. Even a bunch which develops and then clears, however, can have an effect on trim, so overlong motors are not a good idea for contest work. In fact, smoothest running always comes from a motor which is reasonably taut between hooks without cording. This is readily possible to arrange with "limited rubber" formula contest models; but for unlimited rubber designs requires either a very long fuselage or a split motor and return gears at the tail. The latter method may seem old-fashioned (and it was, in fact, first used by Frank Zaic some thirty years ago) but it does, in fact, give the smoothest power run of all from a rubber motor and was a feature of most of the leading Wakefield models in the last years of the unrestricted rubber rule.

Last turns are on, R. Boxall prepares to unhook his winder and slip noseblock securely in place, whilst Mrs. Kathy Allan makes ready the d.t. fuse.





"YOUNG MODEL DESIGNER" & KRYLYA RODINI, U.S.S.R.

RADIO CONTROLLED BIRD SCARER

SCARECROWS don't work so if you want to scare off the birds in the garden why not build yourself a hawk?

Faced with removing about 10,000 birds from the approaches of the new Auckland International Airport, this is what an ornithologist has done with sweeping success. Mr. E. K. Saul of the wildlife division of the New Zealand Department of Internal Affairs was charged with finding a way to persuade birds roosting on mudflats near the over-run are on the seaward side of the airport to choose alternative accommodation. (About 160 acres of the Manakau Harbour were reclaimed to build the £10 million airport.) Aviation authorities ruled that the birds were a serious hazard to aircraft using the airport. Mr. Saul had about a year in which to complete the assignment before the airport came into use in November, 1965. After months of research, during which he plotted tide-cycles and studied the habits of the 20 species of birds in residence, Mr. Saul took a tip from a crane-driver and made a kite in the shape of a carrier hawk. Birds have an inborn fear of hawks. On its first flight the "hawk" did the trick. Thousands of godwits, gulls and oyster-catchers, took off in the opposite direction. But they had nowhere else to go, so back they came.

The next job was to provide alternative roosts on a nearby island away from the flight path of the jet aircraft. Bulldozers levelled the ground, artificial tidal inlets were created and the new housing scheme for feathered squatters was completed. Meanwhile, Mr. Saul went back to the drawing board and had a chat with a model aircraft enthusiast, Mr. A. R. Truman, who agreed to design a plane roughly in the shape of a hawk as an improvement on the kite scheme. Mr. Truman spent 80 hours on the model before it was ready for its first test flight. Television and newspaper photographers and reporters were in attendance at the airport to see the radio-controlled hawk make its first appearance. With a wingspan of 5 ft. 9 in. and a motor capable of 40 m.p.h., the hawk zoomed up over the roosting birds, scattered them in all directions.

Although research is not yet complete and adjustments are still being made to the design of the "hawk", about 90% of the birds have been scared away. The hawk is called "Kahu II". Kahu is Maori for hawk. The II is in deference to one or two real hawks in the area, but they aren't much use. They can't be controlled by radio.

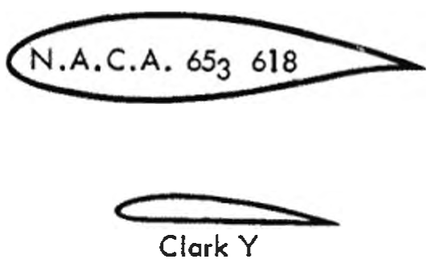
BOUNDARY LAYER CONTROL FOR MODEL SAILPLANES

by P. A. Shepherd

THIS article is intended to supply food for thought on a method of improving the performance of model sailplanes. It is not limited, however, to gliders and suggestions are included for utilising boundary layer control (B.L.C.) on other types of model aircraft.

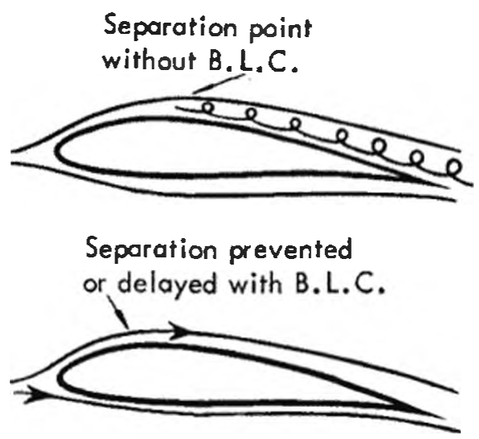
The author has carried out a number of tests on model gliders with portions of the wing equipped with B.L.C. devices and on a variety of aerofoils of 9 in. span by 3 in. chord in wind tunnel conditions. An A/2 class has been constructed with developments of the ideas outlined here embodied in it.

First, a change from the conventional thin, under-cambered "clutching hand" aerofoils to a laminar flow section should give a marked reduction in drag, this is shown diagrammatically in *Fig.* 1. Not all laminar sections are suitable for model work; two which show promise are N.A.C.A. 64_3-618 and N.A.C.A. 65_3-618.



Both aerofoils produce equal drag at equal speed

Fig. 1.



Effect of boundary layer control

Fig. 2.

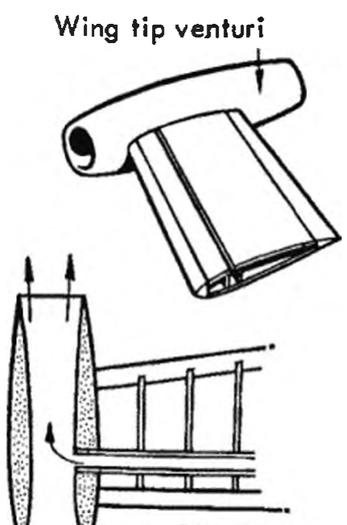


Fig. 4.

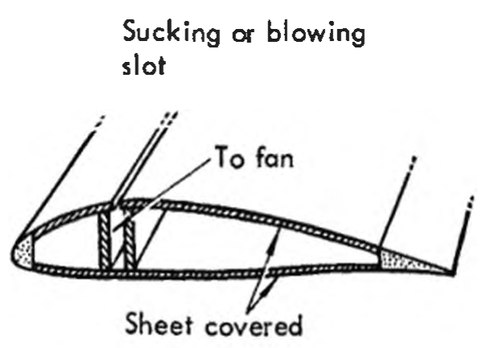


Fig. 3.

The small chord of a model and the relatively dense air in which the model operates should give a reasonable Reynolds Number for a laminar section. These sections should be particularly suitable for R/C gliders.

So, without having to resort to any exotic method, the drag of a wing can be reduced considerably by employing a laminar flow section. The surface finish of such a wing must be much better than average otherwise any benefits will be nullified.

The object of boundary layer control is to influence the thin, slow-moving layer of air adjacent to the surface of a wing or body in order to prevent separation occurring. (*Fig.* 2). To some extent B.L.C. has been used on model sailplanes in the form of turbulators on or ahead of the leading edge or by vortex generators or even sandpaper on the leading edge.

For the serious experimenter, it is suggested that there are more dramatic reductions in drag to be gained with little effort.

The two methods normally employed for B.L.C. are either to suck small quantities of air from the wing upper surface into ducting built in the wing or to blow out through slits or holes, again on the upper surface (*Fig.*3). Possibly the simplest form of boundary layer control for models is the suction method, this can be done by hollow spars, at about the 25% chord point, connected to a suction fan driven by a small Kako type electric motor in the fuselage. The wings should be sheet covered and a very narrow slit through which the boundary layer air passes, formed in the upper surface on the centre of the spar. This slit should not be more than about ·005 in. wide and extend over the full span. Instead of a slit, an area of porous material or a row of small holes could be tried, again over the hollow spar.

To try the blowing method just reverse the motor wiring.

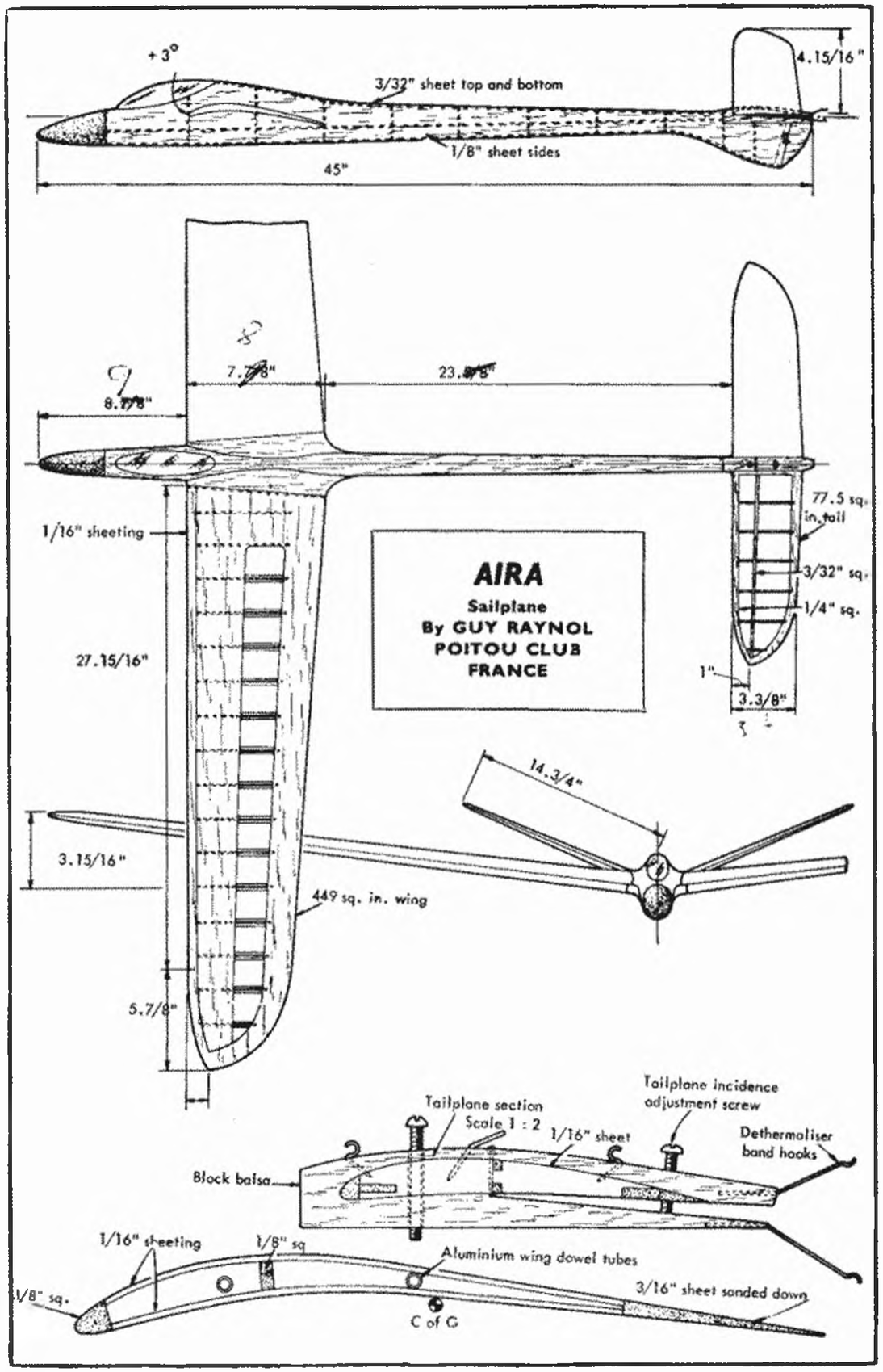
The wing could possibly be sucked by venturis on the wing tips or by the fuselage being flattened and turned into a two dimensional venturi, although the drag produced by the additional wetted area in the venturis may outweigh the benefits of B.L.C. (*Fig.* 4).

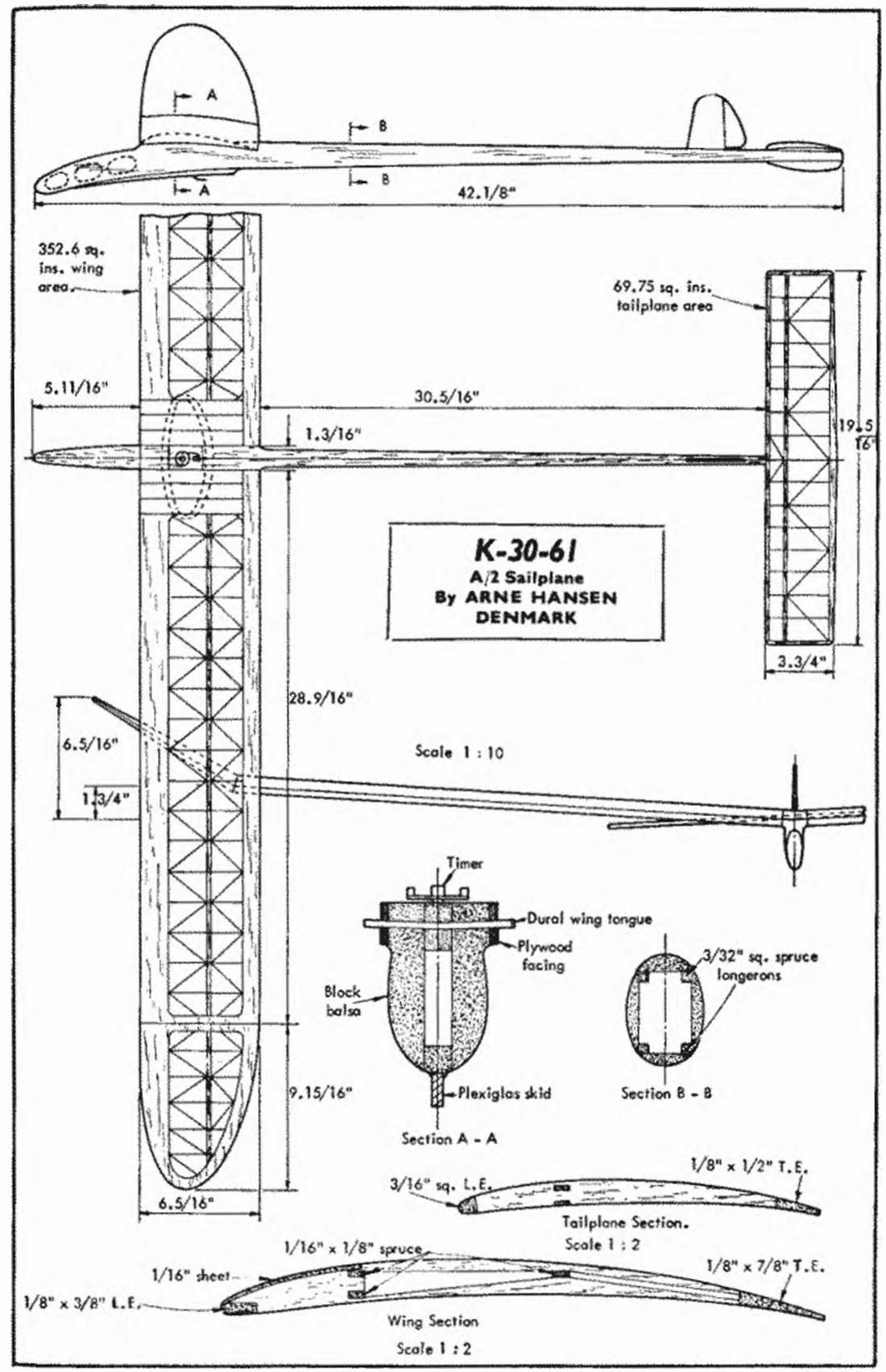
Aerofoil shapes designed specially for B.L.C. applications on full-size aircraft have given better results than more normal sections adapted for sucking or blowing so there seems to be room for experimentation in this sphere too.

Finally, a couple of suggestions for other models. Control of the boundary layer on a rubber model airscrew could give a number of advantages. This could possibly be arranged by having a centrifugal impeller made from balsa incorporated in the prop. hub with sucking or blowing ducts built into the hollow blades. Of course, the impeller would absorb some power from the rubber motor so would it all be worthwhile? It might be worth finding out.

B.L.C. applied to the wings of a team racer could reduce the drag and increase the range, it should be fairly easy to arrange by having scoops or intakes in the leading edge in the airscrew slipstream with ducts in the wings for blowing just behind the L.E. The ducts would have to be carefully arranged for maximum effect but it might be possible.

There is the case for B.L.C. then, for the adventurous modeller it could offer exciting possibilities. Why *not* try it?


+3°
3/32" sheet top and bottom
4.15/16"
1/8" sheet sides
45"
7.7/8"
23.7/8"
8.7/8"
1/16" sheeting
77.5 sq. in. tail
3/32" sq.
1/4" sq.
AIRA
Sailplane
By GUY RAYNOL
POITOU CLUB
FRANCE
27.15/16"
1"
3.3/8"
14.3/4"
3.15/16"
449 sq. in. wing
5.7/8"
Tailplane section
Scale 1 : 2
1/16" sheet
Tailplane incidence adjustment screw
Dethermaliser band hooks
Block balsa
1/16" sheeting
1/8" sq
Aluminium wing dowel tubes
1/8" sq.
3/16" sheet sanded down
C of G


A
B
A
B
42.1/8"
352.6 sq. ins. wing area
69.75 sq. ins. tailplane area
5.11/16"
30.5/16"
1.3/16"
19.5/16"
K-30-61
A/2 Sailplane
By ARNE HANSEN
DENMARK
3.3/4"
28.9/16"
6.5/16"
Scale 1 : 10
1.3/4"
Timer
Dural wing tongue
Plywood facing
Block balsa
3/32" sq. spruce longerons
9.15/16"
Plexiglas skid
Section B - B
Section A - A
1/8" x 1/2" T.E.
3/16" sq. L.E.
Tailplane Section.
Scale 1 : 2
6.5/16"
1/16" x 1/8" spruce
1/16" sheet
1/8" x 7/8" T.E.
1/8" x 3/8" L.E.
Wing Section
Scale 1 : 2

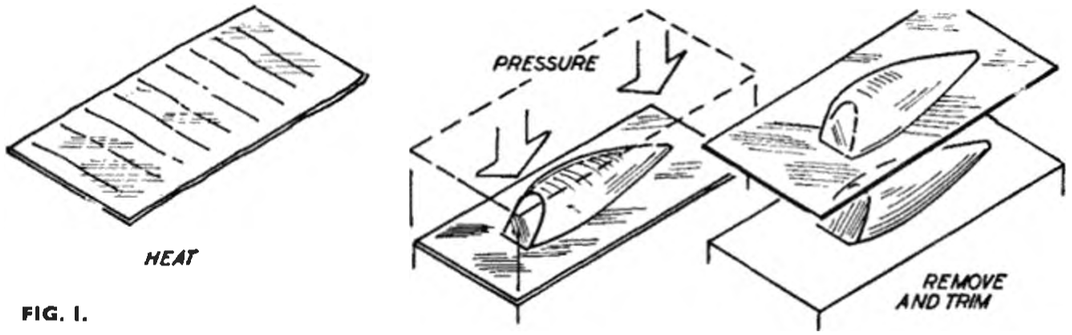


FIG. 1.

CANOPY MOULDING

THERE are four main materials available in sheet form from which clear (transparent) mouldings can be made—

(*i*) *Cellulose nitrate*—or *Celluloid*, also available under the trade name Xylonite.

(*ii*) *Cellulose acetate*—normally called "*acetate sheet*" and also available under such trade names as *Bexoid* and *Cellon*.

(*iii*) *Cellulose acetate butyrate*—normally called *C.A.B.*

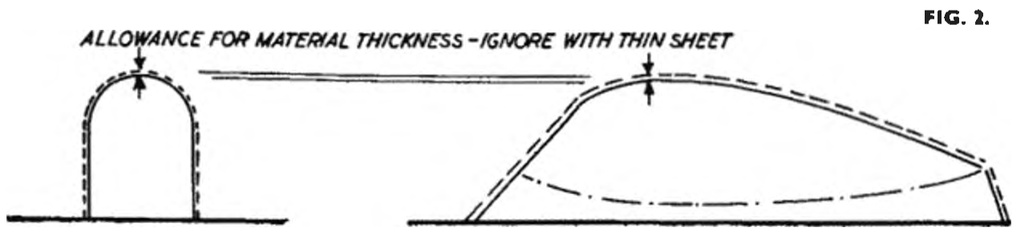
(*iv*) *Methyl methacrylate*—better known as "*Perspex*"; or in America as "*Plexiglass*"!

Of these, acetate is the normal clear plastic sheet supplied in kits, or available from model shops, for "glazing" cabin windows, etc. Until comparatively recently it has also been the main material from which moulded canopies have been produced. C.A.B. is very similar in appearance and properties, but generally produces a slightly clearer and better moulding job and is generally to be preferred. It is a little more expensive than acetate, but not unduly so.

Celluloid is the "original" clear plastic, but not much used these days. It is a little more difficult to draw and mould than acetate. It is also inflammable, so that if heated too much it will burn violently. Nevertheless it produces a tougher moulding than acetate for the same thickness, if the job is properly done, but not so clear. The appearance is generally very slightly brown-grey and the material will continue to discolour with age.

Perspex has true optical properties. That is to say it is glass clear and will produce similarly clear mouldings. The only limitations are that it is a comparatively brittle material and it is not available in very thin sheets. The two cancel each out. Mouldings have to be made fairly thick, because of lack of availability of thinner sheet stock, and so they are usually strong enough, although heavy. Thus "Perspex" mouldings are only really suitable for larger sizes.

FIG. 2.



Clear mouldings can be produced in other materials. The optical properties of polystyrene can approach that of Perspex, for example, but shapes need injection moulding. This usually produces stress patterns which detract somewhat from clearness. Also the material is quite brittle. Its use is virtually confined to the injection moulding of canopies, etc., for plastic kits.

Sheet plastic materials like P.V.C. and polythene are semi-clear, and are very easily moulded. Such mouldings are flexible rather than rigid, however; as well as looking unrealistic because of their residual opacity. They are not worth considering for serious model work. The choice, therefore, really boils down to acetate or C.A.B. for small and medium size canopies using sheet material 10 to 20 thou. thick; and thicker acetate or C.A.B. for large canopies, or the thinnest available Perspex (usually $\frac{3}{32}$ in.).

The basic of moulding sheet plastic material is extremely straightforward and involves only (Fig. 1)—

(*i*) *Heating the material* to a temperature where it becomes plastic.

(*ii*) *Applying some sort of force* to stretch and form the material in its plastic state around a suitable pattern.

(*iii*) *Allowing to cool* and then removing the finished moulding.

Putting these steps into practice can be a little more difficult!

As regards heating, all the materials mentioned become plastic at about the temperature of boiling water, or very slightly above. At a higher temperature they will begin to melt. For easy manipulation the material needs to be heated to a temperature about midway between the softening and melting points. This is appreciably higher than the temperature of boiling water, so heating must be applied by other means.

The correct way is to immerse the material in a bath of a liquid which can be heated to the required temperature and allow it to soak for a period at that temperature. However, this is a fussy job, and also potentially dangerous in that it involves handling the material in and out of a very hot liquid. For one-off jobs it is far more convenient to use the cooker oven, when the only precautionary measures needed are a pair of old gloves for handling the hot sheet.

The moulded shape required is derived from a pattern, which can be a true shape (*i.e.*, a male pattern) or an "opposite" shape (*i.e.*, a female pattern. Starting point in either case is a *male* pattern, which can be carved from hardwood. If necessary a female pattern can be cast from this (in which case the male pattern is finished actual size). If the male pattern is to be used for moulding this should be finished undersize by the thickness of the moulding—Fig. 2. This is not usually very important with canopies, but an allowance of at least half the thickness of the original sheet is advisable when moulding thicker materials, *e.g.*, Perspex.

For one-off jobs or small production runs the use of a male pattern offers the simplest technique. The pattern should be made deeper than the actual moulding required—Fig. 3—and the shape must avoid re-entrant curves. To mould a true "bubble" canopy, for example, a female mould would be required and a more elaborate technique involving blowing or sucking the heated plastic into the mould. This can often be avoided by using a male moulding and "cheating" when fitting the canopy in place by drawing in the lower edges to give a "bubble" effect.—Fig. 4.

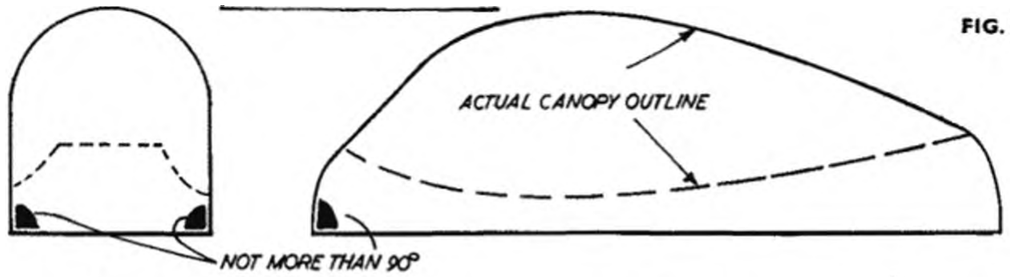


FIG. 3.

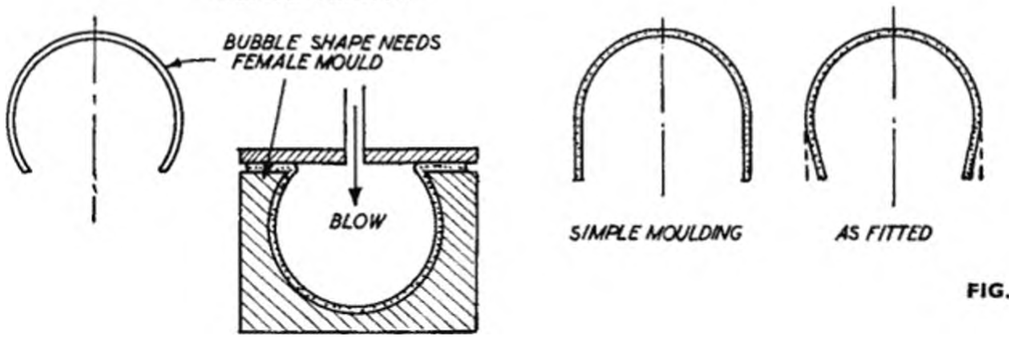


FIG. 4

With a male pattern the force necessary to draw the plasticised sheet over the pattern is most simply provided by hand, using a rigid mask shape, as shown in Fig. 5. This is simple a cut-out shape conforming to the plan shape of the pattern, but oversize by the thickness of the material being used. A suitable mask can be made from ply with the shape cut out with a fretsaw and smoothed with glasspaper.

From then on it is largely a matter of trial and error. Needless to say, for a smooth moulding the pattern should be sanded down to the smoothest possible finish, but do not wax or attempt to fill the surface grain with dope as this could cause "gassing" under the heat of the sheet being moulded. Simply use a wood for the pattern which *can* be sanded really smooth—not balsa or obeche, for example.

Set the oven for a moderate heat and lay the sheet plastic on the runners which normally carry the roasting pan—but make sure they are absolutely clean first. Leave the oven door open so that you can watch and see when the sheet is starting to droop. This means that it has become quite plastic and is ready for moulding. Pick up the mask and lay on the plastic sheet still in the oven (using gloves, of course). Pick up both together and transfer to the top of the pattern and press down. If all is well, you will find that you have drawn a clean moulding first go. But there are things that can go wrong.

If the moulding will not draw to its full depth first time, then either the plastic has not been heated long enough or the oven is not hot enough. You can try reheating the same piece. With thicker sheet it may be necessary to complete the moulding in several stages of heat, mould, reheat, and so on. It is better to do this than risk overheating the plastic.

Overheating can cause bubbles to appear in an otherwise clear moulding (notably in *C.A.B.*), excessive thinning at the top of the shape, or even tearing, or bursting. Wrinkles are usually caused by uneven heating of the plastic or trying to mould a shape which represents too drastic a draw, or too abrupt a change in cross-section. Wrinkles are quite normal around and under the mask, but these come below the line at which the moulding is to be cut off and so do not matter.

Loss of optical properties in the moulding—*e.g.*, areas of distorted vision or partial opacity—can be due to overheating or underheating and excessive drawing, or pressing down too fast causing excessive local thinning of the material. Sometimes, too, a moulding will have numerous spots in it. If these are not minute bubbles due to overheating, then quite probably they are simply dust which was originally on the sheet or the surface of the pattern.

The technique is simple enough. The main thing that counts is the knack of doing it just right, which is a matter of practice and correcting when faults do occur. The same technique can be applied to both small and large mouldings. They will draw equally well over a male pattern provided the plastic is allowed to soak up enough heat to become properly plasticised.

The thinner the sheet the easier it is to mould, but the greater the chance of overheating. Thicker sheet produces a more rigid and better moulding, if done properly. Err on the side of a generous thickness, even if it does make the job harder. Your "one-off" canopy" should then be far superior to any ready-made job.

The basic method described is also suitable for "quantity" production since the pattern is retained undamaged; but for such work the process is a slow one. For a proper production technique vacuum forming would normally be used (with a male pattern); or blow moulding with a female mould for large canopies (particularly in "*Perspex*"). Either of these techniques is suitable for amateur work since the pressures required are relatively low. Sufficient pressure for vacuum forming small areas, for example, can be obtained from a "jet" type suction pump attached to a water tap. Adequate pressure for blow moulding can be obtained from an inflated toy balloon. For limited runs, however, neither technique offers any particular advantage over the hand drawing method described and are more difficult to rig. With "pressure" moulding (*i.e.*, vacuum formed or blown), it is possible to reproduce detail lines in the canopy moulding —but again this is not *realistic* detail. Frame lines are best represented by metal foil or metallised paper cut in thin strips and cemented to a perfectly plain canopy moulding. Painted on detail needs to be drawn on with a ruling pen for accuracy, or with the aid of masking tape to get straight edges to the lines.

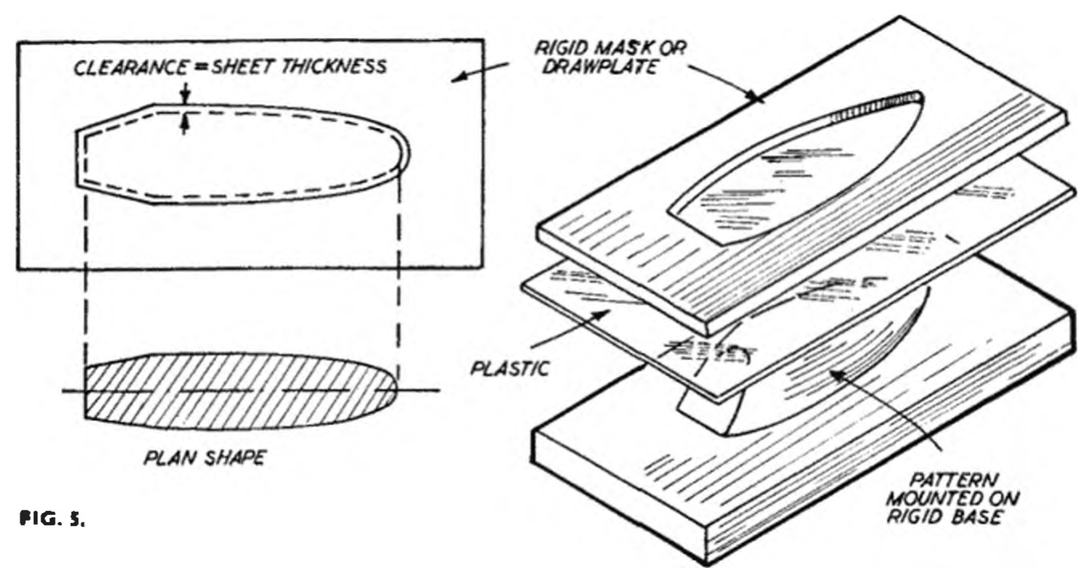


FIG. 5.

THICKNESS OF SHEET PLASTIC MOULDINGS

WHILST the thickness of a finished moulding produced from sheet material is influenced by a considerable number of empirical factors, a reasonably accurate guide as to the likely mean or nominal thickness of the finished moulding is provided by the accompanying nomogram. This demands measurement or a reasonably close approximation of the projected base area of the moulded shape and the surface area of the finished moulding. These two values are then connected with a line joining the appropriate scales. A second line or straight edge is then laid from the point where the first line crossed the thin vertical line to the sheet thickness scales.

Example 1: To find the nominal thickness of a moulding of 45 sq. in. surface area drawn from a projected base area of 16 sq. in. in 8 thou. sheet. *Answer:* 3 thou. mean thickness.

Example 2: To find the thickness of sheet which should be used to achieve a moulding not less than 15 thou. thick, when the projected base area is 34·5 sq. in. and the surface area of the finished moulding is 73 sq. in. *Answer:* approximately 32 thou. initial sheet thickness.

The nominal thickness of the moulding refers to the typical mean thickness consistent with uniform drawing and flow of material. In practice flow is unlikely to be completely uniform and is controlled or affected by such factors as moulding temperature, the physical shape of the mould pattern (which affects localised speed of drawing), method and speed of drawing, etc. These variable factors can also be used for control purposes. It may also be possible to "steal" additional volume of material from outside the projected base area during drawing.

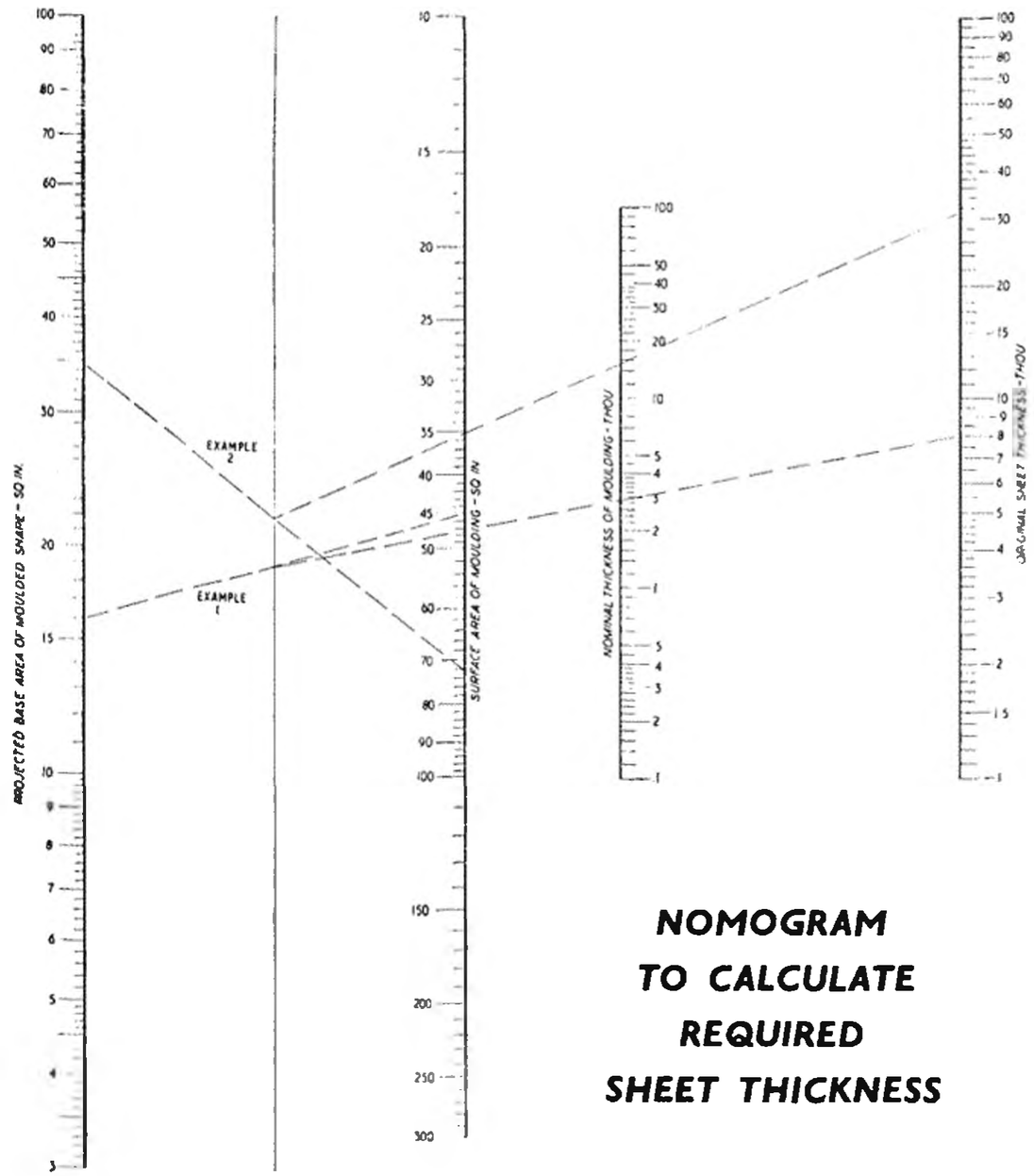
The nomographic solution for nominal thickness of moulding thus represents the likely *minimum* thickness of the moulding, except where the shape may lead to localised high drawing speeds and consequent over-thinning. If actual thicknesses achieved are lower than the nomogram value, then possibly the technique is at fault (*e.g.*, sheet temperature too low, leading to excessive localised drawing over parts of the mould. Thus in Example 2 it should be readily possible to achieve the desired minimum moulding thickness in 30 thou. or even thinner material, if care is taken to establish the best technique.

Since the nomographic solution is nominal and intended as a general guide only, completely accurate determination of projected base area and surface area of the moulding is not necessary. Thus in the case of complex shapes the projected base area can be estimated by "squaring" and counting the number of full squares enclosed. The surface area can be similarly estimated by using a 1 in. wide strip of paper marked off in 1 in. squares with which the surface is progressively "covered", counting the total number of squares involved. The surface area of basically rectangular shapes can be approximated by measuring an equivalent "square-edged box" shape, calculating the areas of the five faces and summing.

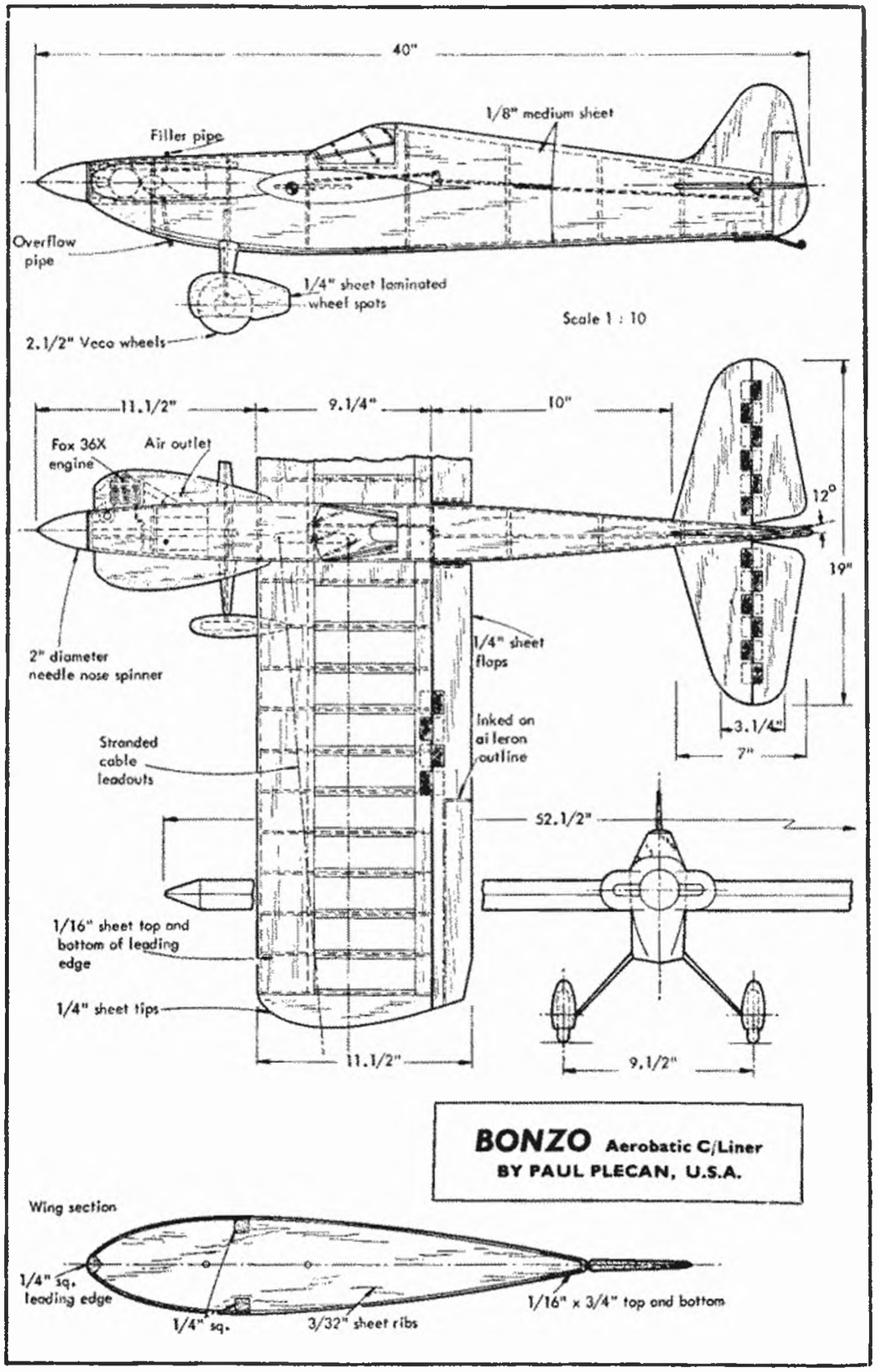
In the majority of cases for production design, moulding thickness is often of relative unimportance and established by "cut and try" methods. The primary requirement is the finished form, and overall as well as local weakness (*i.e.*, thinness) may be tolerated, or if necessary adjusted by going to a slightly

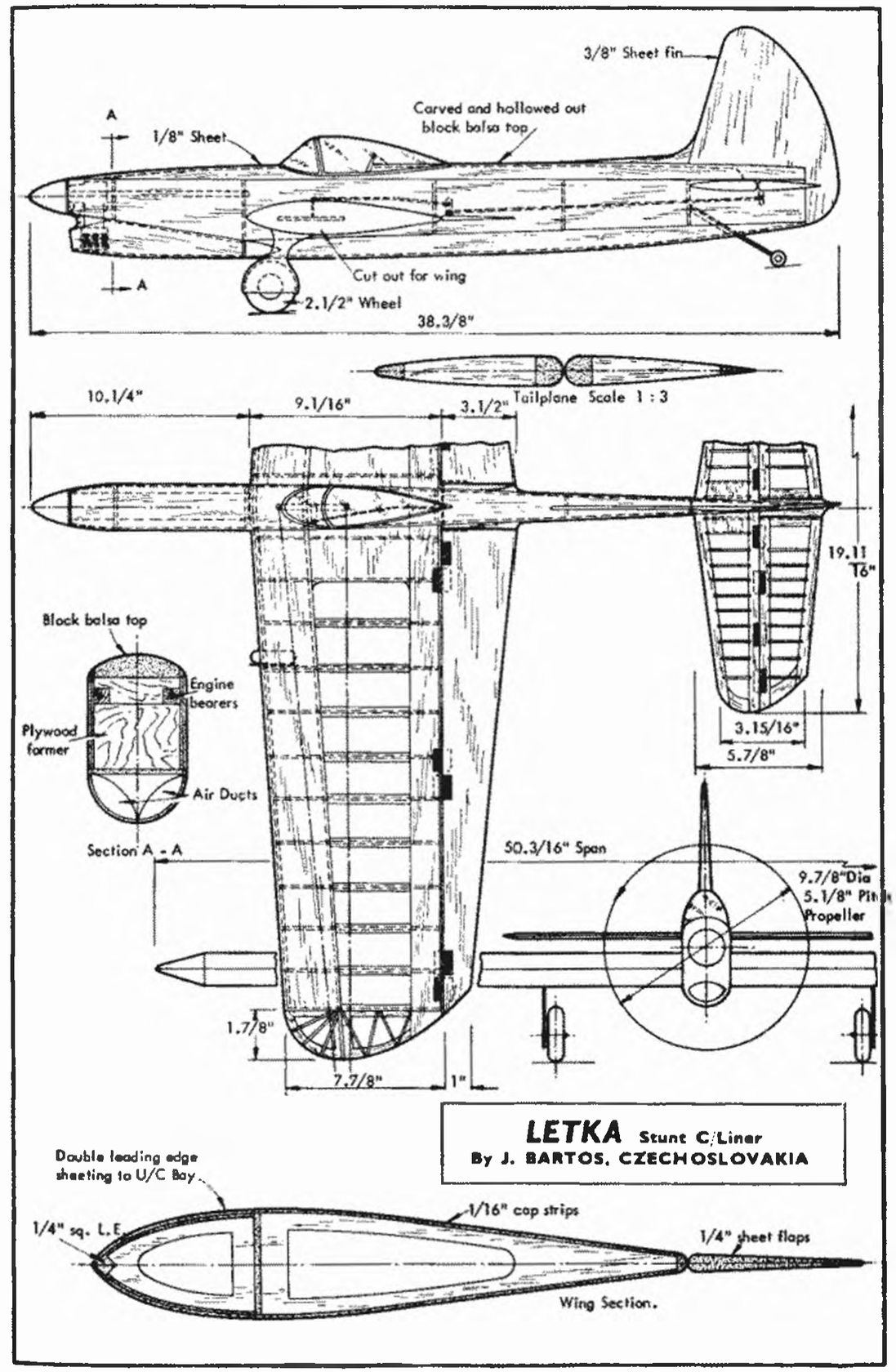
greater initial sheet thickness (although this will increase the unit cost). Very rarely, in fact, is even the simple check made of cutting a moulding and measuring the material thickness along the length of the cut line. The variations which may show up in such a test are often quite revealing, and a good check on the suitability of the moulding technique, for the material used and the shape being accommodated.

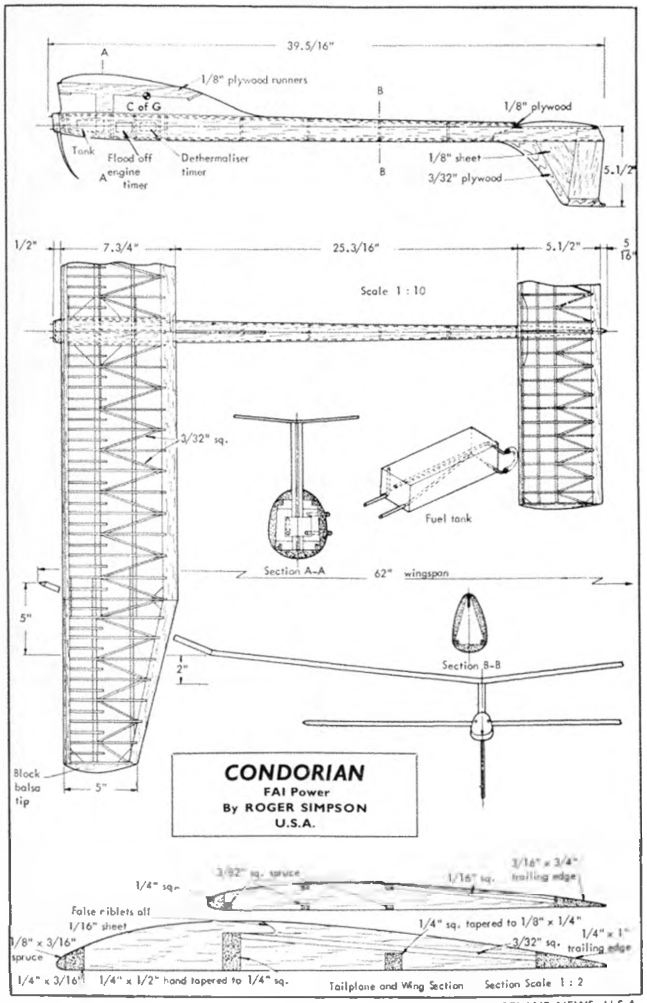
In some cases, for example, cross-sectional measurement may show that the initial sheet thickness is retained, or even built up, over substantially large areas, at the expense of excessive thinning in other regions. With an adjustment of technique to avoid, or at least reduce, such non-uniform flow, it may well be possible to produce a moulding of similar overall strength in thinner material, and thus with a marked saving in cost.



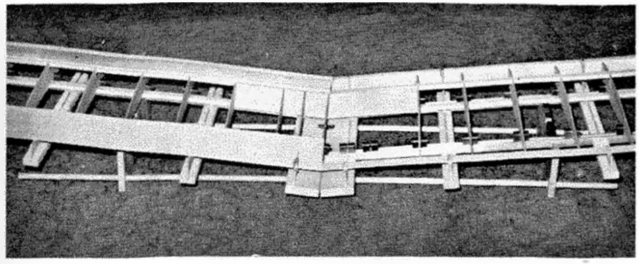
NOMOGRAM TO CALCULATE REQUIRED SHEET THICKNESS


40"
1/8" medium sheet
Filler pipe
Overflow pipe
1/4" sheet laminated wheel spots
Scale 1 : 10
2.1/2" Veco wheels
11.1/2"
9.1/4"
10"
Fox 36X engine
Air outlet
12°
19"
2" diameter needle nose spinner
1/4" sheet flaps
Inked on aileron outline
3.1/4"
7"
Stranded cable leadouts
52.1/2"
1/16" sheet top and bottom of leading edge
1/4" sheet tips
11.1/2"
9.1/2"
BONZO Aerobatic C/Liner
BY PAUL PLECAN, U.S.A.
Wing section
1/4" sq. leading edge
1/4" sq.
3/32" sheet ribs
1/16" x 3/4" top and bottom


3/8" Sheet fin
Carved and hollowed out block balsa top
A
1/8" Sheet
A
Cut out for wing
2.1/2" Wheel
38.3/8"
10.1/4"
9.1/16"
3.1/2"
Tailplane Scale 1 : 3
19.11/16"
Block balsa top
Engine bearers
Plywood former
Air Ducts
Section A - A
3.15/16"
5.7/8"
50.3/16" Span
9.7/8" Dia
5.1/8" Pitch
Propeller
1.7/8"
7.7/8"
1"
LETKA Stunt C/Liner
By J. BARTOS, CZECHOSLOVAKIA
Double leading edge sheeting to U/C Bay
1/4" sq. L.E.
1/16" cap strips
1/4" sheet flaps
Wing Section.



MODEL AIRPLANE NEWS, U.S.A

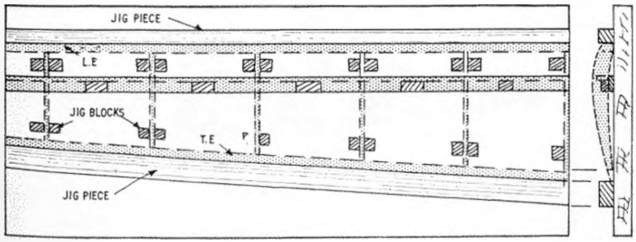


Aristocraft wing in Broadfield Uni-Wing-A-Jig. The tendency to use sophisticated building technique to match the new materials is increasing rapidly as a new generation of modellers is attracted to the hobby.

JIGGERY-POKERY

EVERY time you build a conventional fuselage side frame or assemble a wing panel flat over a plan you are, in effect, employing a "one off" jig—using pins as the jig holders and perhaps packing blocks under the wing leading and trailing edges. Normally, however, the word "jig" is taken to mean something more advanced in building technique which also lends itself to repetitive construction of identical assemblies. These devices can range from the very simple to the quite sophisticated—the latter lending themselves best to commercial production. They have, in fact, become something of a vogue in the United States.

Let's consider wings, as these are the most straightforward components to adapt to jig-building. For flat bottom or undercambered sections, starting point for a jig can be any rigid, flat and absolutely true surface, like a selected plank of wood. If the wing planform is drawn directly onto this base, blocks can be located to hold the individual members—leading and trailing edges and ribs—as in Fig. 1. Assembly is then a matter of locating these parts in the jig and cementing together, and building can be completed to an advanced stage—including leading edge sheeting, if required, before the structure is finally removed from the jig.



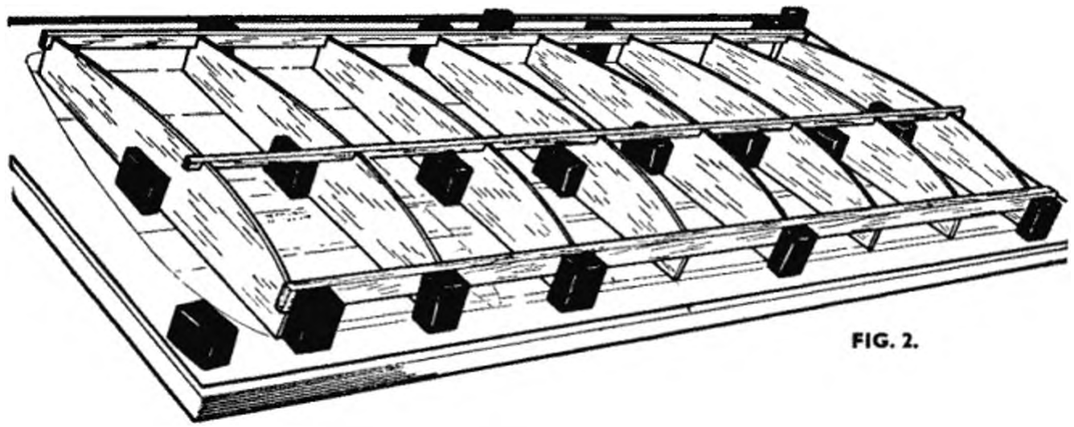


FIG. 2.

This latter is an important point. Besides making for rapid assembly by locating all the parts which go to make up the complete structure automatically and rapidly, a jig should enable as much as possible of the complete structure to be done in the jig; and this should also include joining wing panels at their correct dihedral angle (*i.e.*, by placing two jig panels together). Provided the jig is true, the resulting structure should be true. Building a part assembly in a jig and then removing for, say, the addition of sheet covering, can induce warps. The other virtue of a properly designed jig is that it enables exact duplicates to be built—the only variable being any difference in wood densities involved. A building jig is not so satisfactory for "duplicate" work if it has to be broken down each time to release a completed assembly.

The simple jig design of Fig. 1 has certain limitations. It is necessary to arrange the jigging pieces with "clearance" for completing all necessary glue joints; but with wood (hardwood, not balsa) as the simple choice for jigging pieces there is still the chance of the frame sticking in the jig. This risk can be minimised by wax polishing the complete jig. The other disadvantage is that the jig is not adjustable. That is, it must be set up for a specific wing design and a separate jig is required for each different design. It is really only an extension of standard building technique, using fixed jigging blocks instead of pins.

A proprietary unit which overcomes these basic limitations is the **Magna-Jig:** Basically, this is again only an extension of normal building methods, but uses a *steel* building board and powerful magnets as jigging blocks. Building is done over a plan in the normal way, laid out on the (metal) building board, and the magnetic blocks used to hold the various parts in place—Fig. 2. This may appear somewhat non-positive but, in fact, the magnets are very difficult

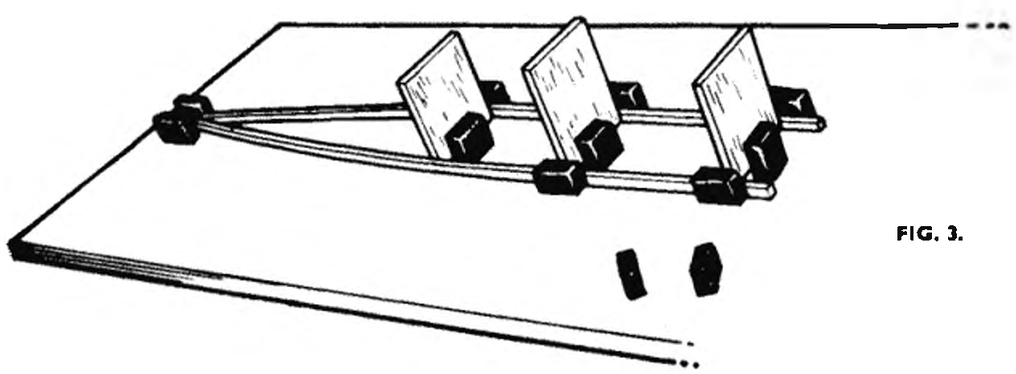


FIG. 3.

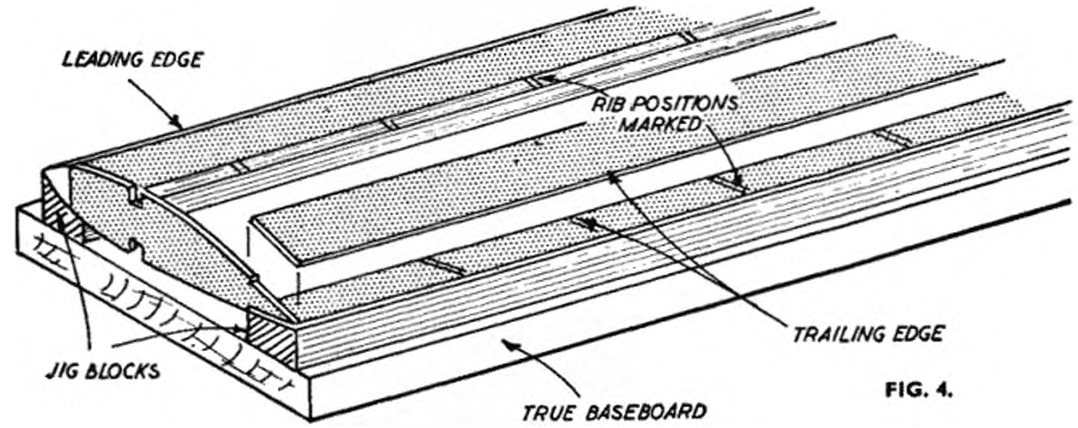


FIG. 4.

to displace once positioned and are very effective as clamping and holding devices. Used in conjunction with soft iron keeper bars they can also be used as true clamps, as in Fig. 3. This makes the system extremely versatile and adaptable to virtually any type of model construction or assembly. The other virtue of the system is that it can be set up very rapidly. The main disadvantage is that it is relatively costly. It is also not an absolutely positive form of jig for individual magnets can get displaced.

A simple form of home-made jig which can be set up for any particular wing design employing bi-convex sections and broken down and re-made for other shapes is shown in Fig. 4. Starting point is a substantial and true wood base panel of adequate size, on which are mounted leading and trailing edge jig blocks aligned with the outline. These blocks are shaped to accommodate the shape of the leading and trailing edge sections and aligned for height by packing strips, as necessary. They are then nailed or screwed down to the baseboard. Assembly then proceeds by pinning the leading and trailing edge members in the jig first, followed by the ribs and spars. Rib positions are either marked in pencil on the jig, or positioned by eye over a plan drawing mounted on the baseboard. Rib slots then provide alignment for spars.

This is by no means a "foolproof" jig design. It is difficult or even impossible to use on wings which have a small leading edge section, for example. The **"Thingamajig"** developed by Chuck Cunningham overcomes this limitation by using deeper blocks for the leading and trailing edge jig blocks with a slot to locate the leading edge—Fig. 5. These blocks are aligned over a suitable flat surface to conform to the wing outline and then rigidly joined with cross braces whilst the blocks are on the flat surface. With leading and trailing edges fixed to their respective jig blocks wing assembly is then completed *within* the

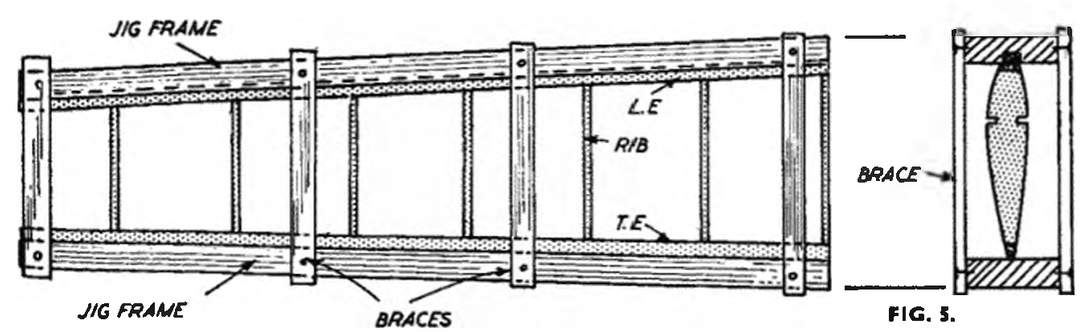


FIG. 5.

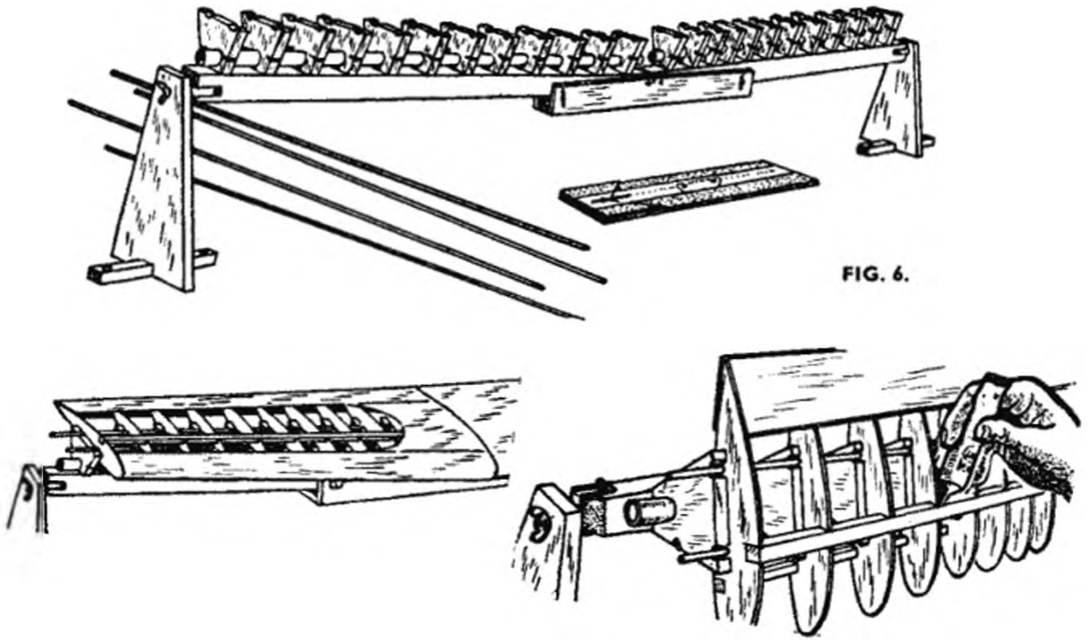


FIG. 6.

depth of the jig, with the advantage that the jig can be turned over and the wing worked on from either side. This type of jig relies on the use of stout leading and trailing edge blocks and the cross braces for rigidity. It does not have to be anchored down to a flat surface for building—only initial alignment. It, too, has its limitations—mainly in the matter of anchoring the trailing edge to its jig block. This is quite easy where the trailing edge is formed by a reasonably deep spar—auch as an R/C wing to be fitted with trailing edge ailerons, when this spar can be pinned to the rear jig block. It is not so easy to accommodate a conventional tapered trailing edge, or a built-up sheet trailing edge.

Commercial building jigs tend to be more complicated—so complicated in some cases that they are difficult to describe since many are true engineering jigs. Given the pieces to assemble, however, they do make sense!

The **A-Justo jig** is a typical example of a "full size engineering" production jig scaled down for building model wings on a principle foreign to model practice. Basically, this jig mounts all the *ribs* in a complete wing—Fig. 6—

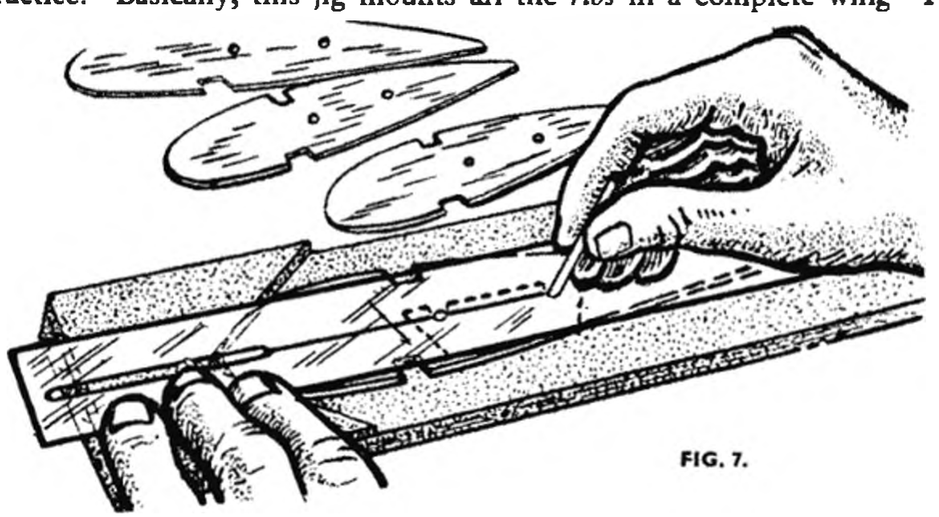


FIG. 7.

after which the remainder of the assembly is completed around these accurately positioned ribs. The whole assembly rotates 360 degrees for working access to top, bottom or edges and a typical wing structure can be 95 per cent complete, including dihedral jointing and all sheeting before it needs to be removed from the jig.

There is nothing particularly tricky about setting up or using the A-Justo jig. An actual spar joined at the centre with the proper dihedral angle can be used as a pattern for aligning the jig rib holders; and at the same time marked with rib positions for positioning the holders correctly along the jig rail. The only other preparation is then making the locating holes in the individual ribs for which a special indexing tool is used—Fig. 7. After the individual ribs are slid onto the two jigging rods and then mounted on the main jig, held in place with rubber bands.

Limitations of this system? As far as we can see—not having actually used this particular type of jig—a complete dependence on the set of ribs being absolutely accurate and also strong enough to stand working on for assembly of the leading and trailing edges in particular. The fitting of spars into rib notches which were slightly undersize, for instance, could distort the rib section. Also, using a variable material like balsa, a curve could be built into a trailing edge, and there is no control over the actual outline other than by sighting and

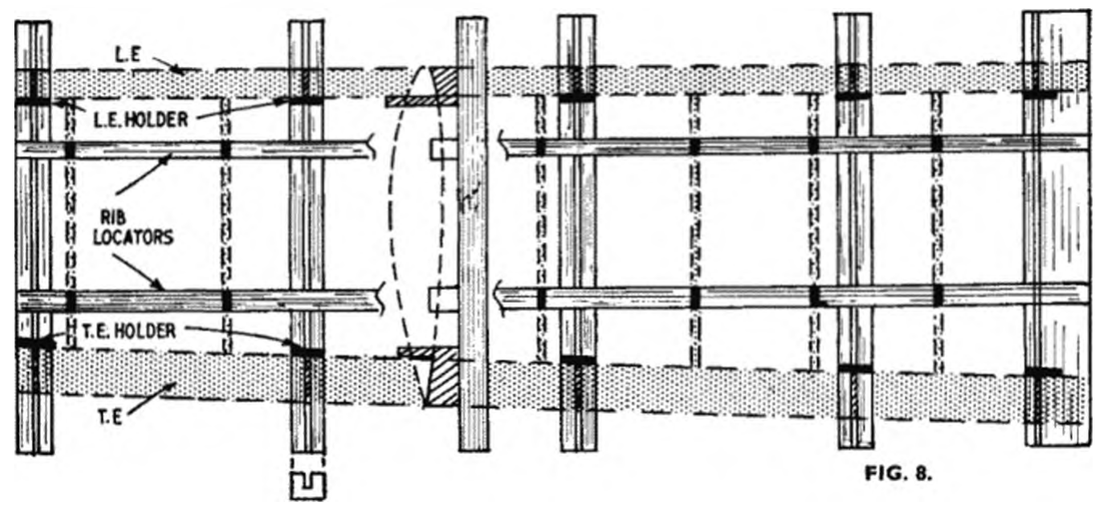
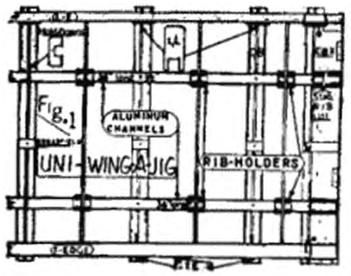


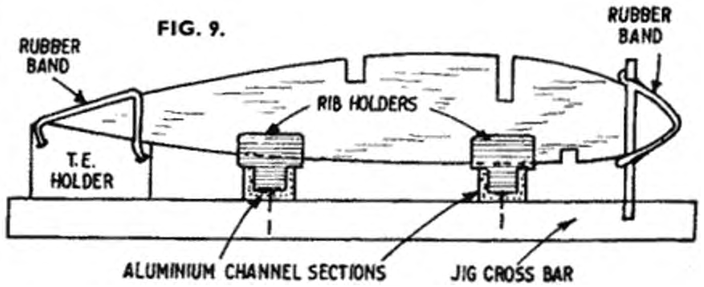
FIG. 8.

measurement. Further, if the ribs are on the weak side, they may break when being worked on.

The **Broadfield Wing-a-Jig** is much more complex, employing drilled and notched spars and holders assembled in suitable positions with screws, and additional holders. The jig is, in fact, virtually built like a framework over the original plan, after which it is ready to accept the individual parts for building the wing proper. The basic idea can be followed from Fig. 8.

This shows the original Wing-a-Jig which was all wood. A later development—the **Uni-Wing-a-Jig**—is based on the use of aluminium channel spars and rib holders, with moulded cross bars and supporters for leading and trailing edges "slot locked" into the jig crossbars. Besides eliminating any possibility of the structural parts sticking to the jib—although Britfix will stick pretty well to aluminium alloy!—this system makes for simple adjustment and setting up of the original jig—Fig. 9. Both types of Wing-a-Jig lend themselves to all types



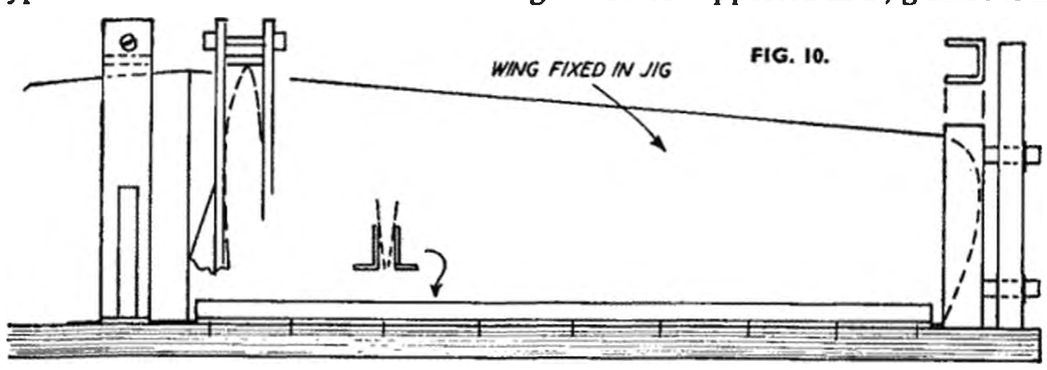


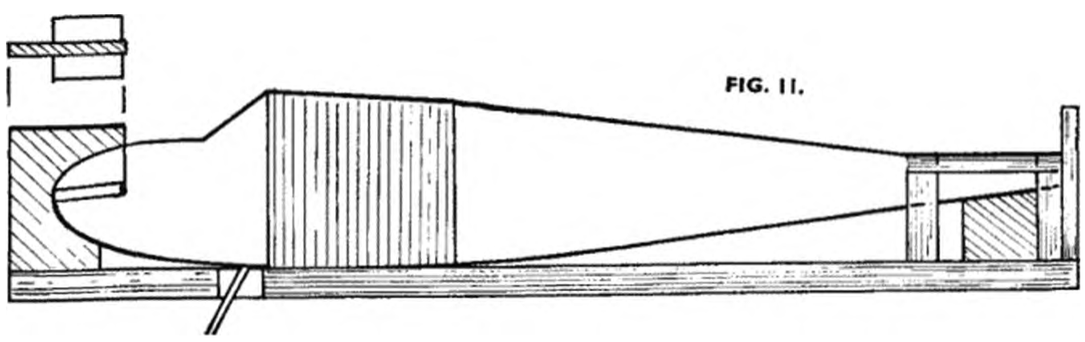
of wing and tailplane shapes (being simply "built" to the required planform); and also to building a complete wing in one go with dihedral at a single centre joint.

A number of other types of jig have been produced specifically for handling expanded polystyrene wing cores which subsequently require covering —*e.g.*, with balsa sheet, wood veneer or in other cases just nylon or tissue. There is a good case for using a jig for such jobs. Cores are normally shaped by hot wire cutting (except on some kit jobs where they are produced in moulds) and opposite hand panels are not always identical, particularly as regards freedom from warps. Such faults are more likely to be removed in a jig when sheet covering than working freehand on the cores, which can induce further warps.

Since the wing is virtually complete in form—*i.e.*, is already a complete core—the jig for handling can be much simpler. In fact, it may even be satisfactory to support just the centre and tip sections in accurate alignment, although full trailing edge location along its length would also be desirable—Fig. 10. Both surfaces of the wing core can then be worked on for sheet covering without any chance of introducing distortion.

Wing jigs of this type are also recommended and used for nylon covering both polystyrene cores and built-up balsa wings. The advantage with the latter type is the same as above. With the wing structure supported in a jig there is no

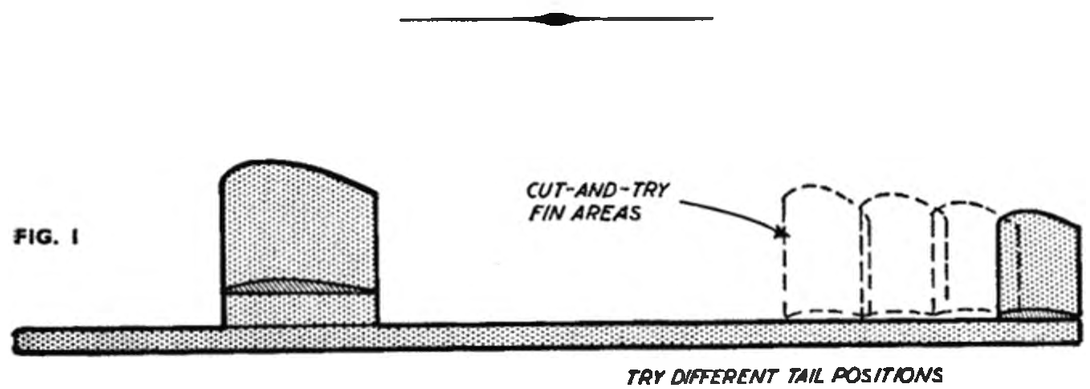




chance of introducing a warp however taut the covering is pulled in place; and doping can also be done with the wing still in the jig.

There appears to have been no commercial development at all of jigs for fuselages, other than the use of self-jigging types of constructions in certain kits. Individual modellers, too, seldom seem to find it necessary to make special fuselage jigs, although these could be of considerable value. Thus if a fuselage is damaged in a crash, a jig could be used to complete a repair with the knowledge that the fuselage will be aligned exactly as the original.

The difficulty here is that this would normally call for an external type jig which is not easily adaptable to a *constructional* jig without becoming quite complicated. The same thing could be met with a simple *rigging jig* as in Fig. 11 which is used merely to align critical settings after a fuselage is completed in the conventional manner of building (or repaired after a crash).



CUT AND TRY DESIGN

A FIRST-CLASS model design just does not happen—it has to be based on experience of what will give the best results. Yet most people are content to adopt a standard layout and be content with that, although it is pretty obvious that there is every chance that it can be improved upon. No model—not even a consistent contest winner—is as good as it *could* be. There is always something to improve, and the only way to find out what, and how, can only be based on practical results.

The process of developing a new contest design, for example, should first of all lead to the production of a prototype for testing out thoroughly and proving the construction. It can even be roughly built, if you want to save time. It will still serve its purpose in helping to produce a better model for use from the original design. Also, being a "rough" model you will not mind it getting knocked about a bit, or "bodged up" for some experimental flight testing. Its life is only intended to take it through the practical development period. Meantime, having built the prototype you have "verified" the construction and undoubtedly found some detail improvements. You can start building the "final" model (and a duplicate for a reserve) whilst waiting for fine weather for flight testing the prototype—provided you do not anticipate any drastic flight changes.

Flight testing can be confined to verifying balance and trim and proving detail; or even be used as a method of assessing quite major design changes.

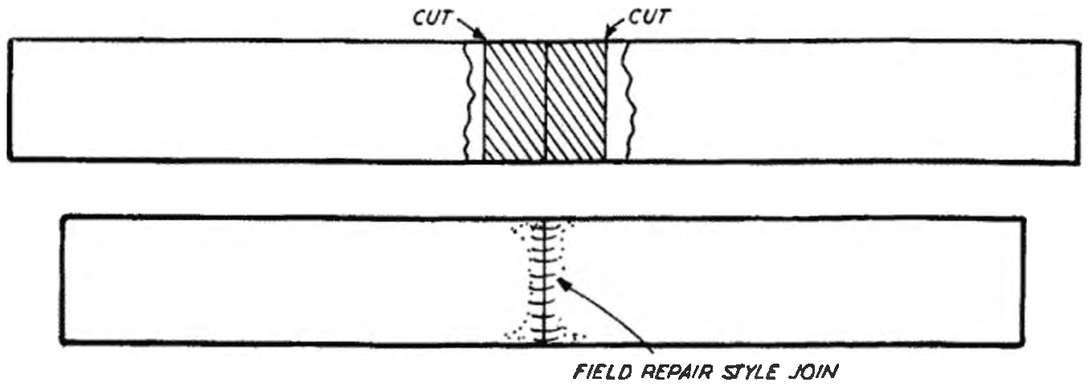


FIG. 2

For simplicity, suppose we are dealing with a glider and are not too sure about "optimum" moment arm. The prototype is made with a long moment arm, with provision made to re-position the tail unit at different positions—Fig. 1. The model can then be flight tested with each configuration—checking the effect on towline stability and flight performance.

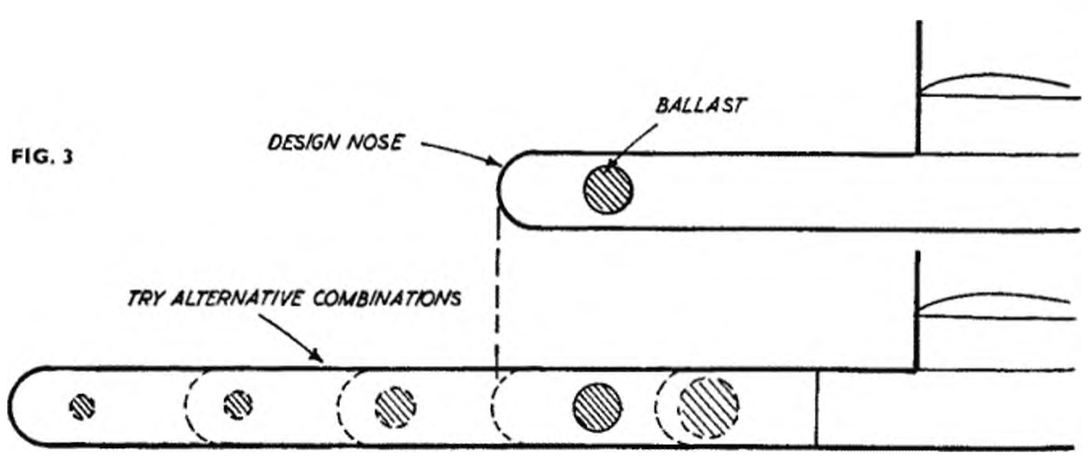
If the shorter moment arm seems to offer some advantage, it may be worthwhile to repeat the experimental testing with a slightly larger tailplane area—and remember fin areas, too, may have to be adjusted for optimum performance with each configuration. At least you can decide on a moment arm which *is* satisfactory—as shown by flight testing.

If by any chance you have ended up with a tailplane area which puts the total area outside the contest specification, then simply cut the wing in half, chop a bit off and re-check. It is only a rough model and the modification work only needs to be up to "field repair" standard.

Perhaps you think that nose length might be another "variable" worth investigating. In this case, make the prototype with a minimum length nose and flight test it in that condition. Then add a false nose, in sheet balsa, and try alternative lengths and corresponding different balance weights and weight positions. The model will probably look horrible, but you are only experimenting, and you are bound to learn *something* if you work from one extreme to the other in flight testing different configurations.

In a similar manner you can try the effect on stability of different fuselage

FIG. 3



shapes, using a "basic" shape for the prototype fuselage and adding mock shapes cut from light sheet—Fig. 4. You can also use this as a method of improving the appearance of a model. No shape looks *quite* the same when built as a three-dimensional model as it does on the plan. Wing and tailplane tip shapes, for instance, often look quite different to the "plan" shape. Fins also tend to look smaller on the finished model than on the plan.

If you are contemplating "cut and try" design on a fairly extensive basis, use sheet balsa as far as possible for the "variable" parts. A sheet fin or tailplane can be trimmed to a new shape or size on the flying field with scissors to get the effect required; or pieces can always be added on with cement *and* pins (then you don't have to wait for the cement to dry!).

By the end of the test programme your prototype model will be looking really sad—if, indeed, it has survived that long. If it has crashed, however, that may have been a configuration you contemplated building for a "final" model, and so it will have been worth it to have found that out—or the reason which *caused* the crash.

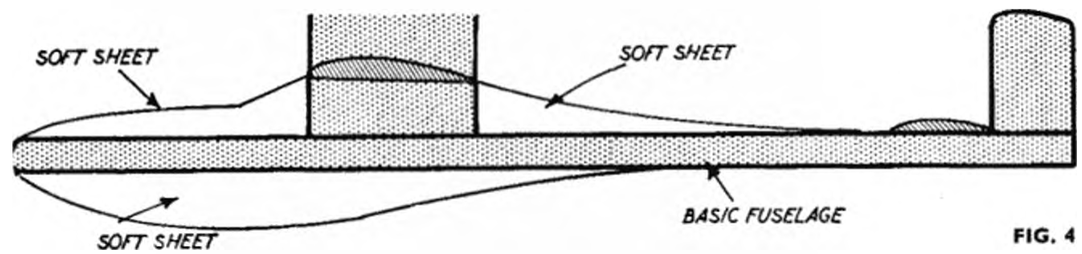


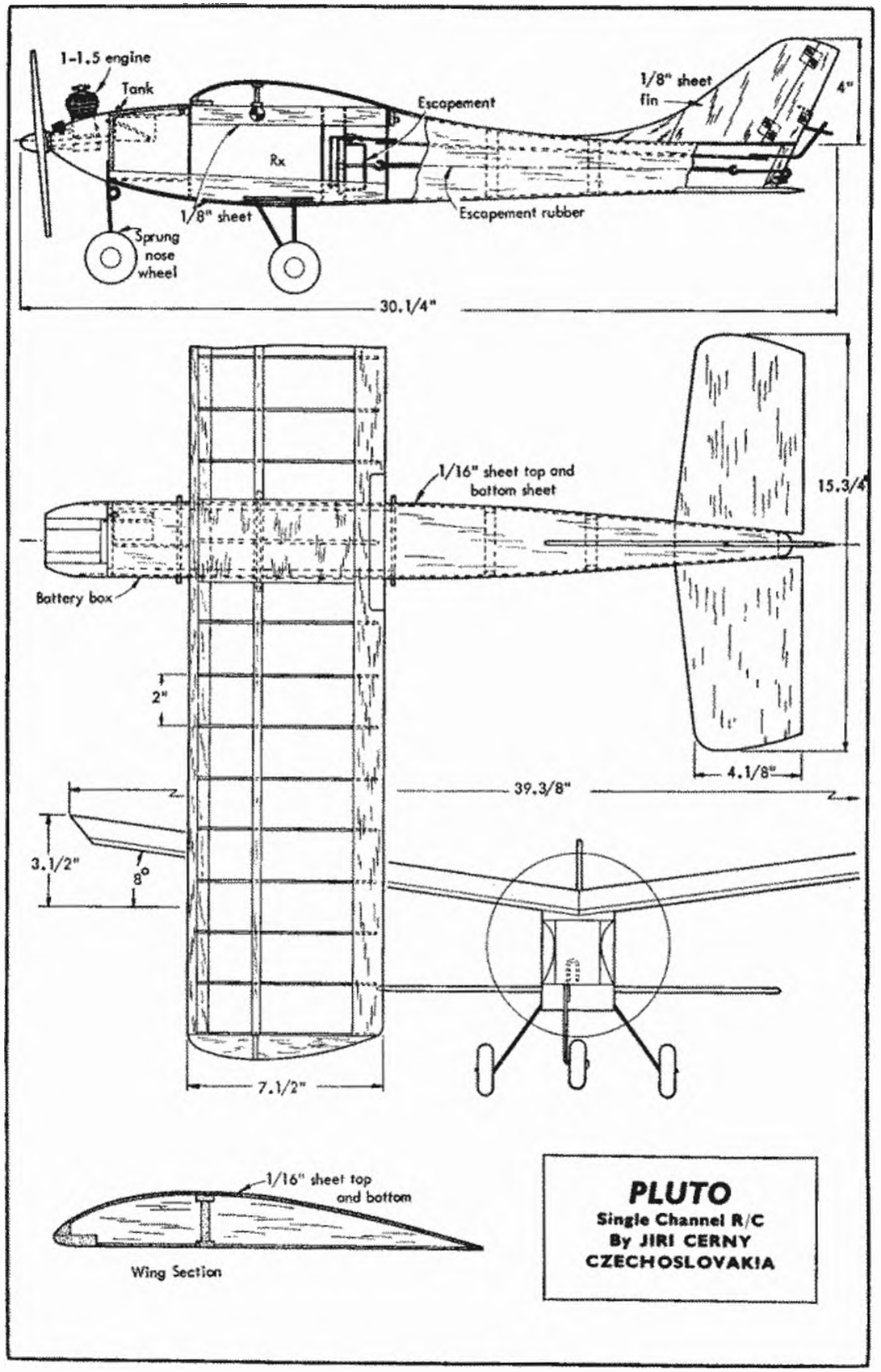
FIG. 4

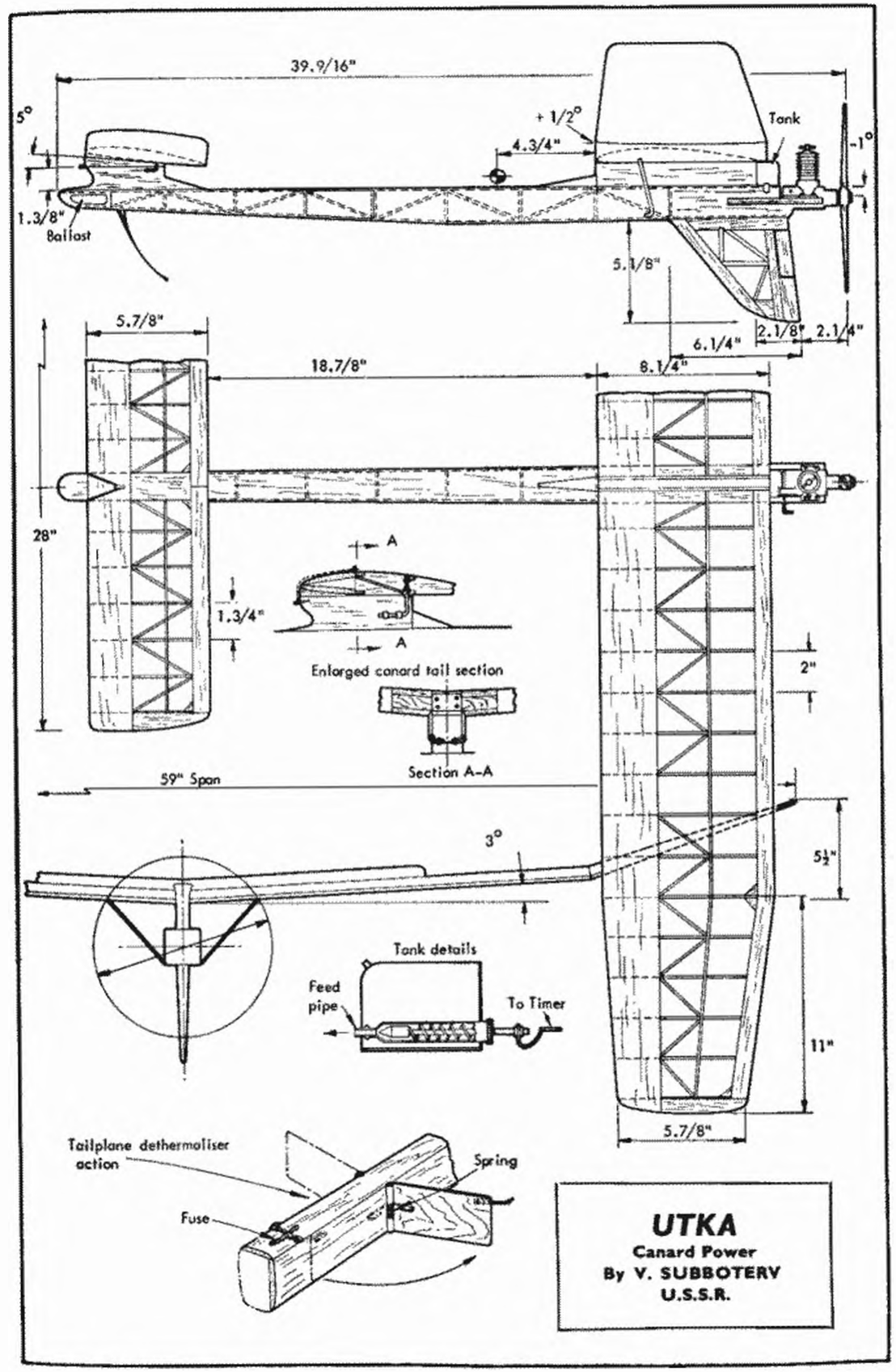
Generally, however, prototypes have a habit of surviving when, apart from their "tatty" appearance, they would probably make a very good "reserve" model. Remember, however, that any model you build from the experience gained with the prototype should be a *better* model, so prepare a proper reserve and plan to write the prototype off when it has finished the job for which it was originally intended.

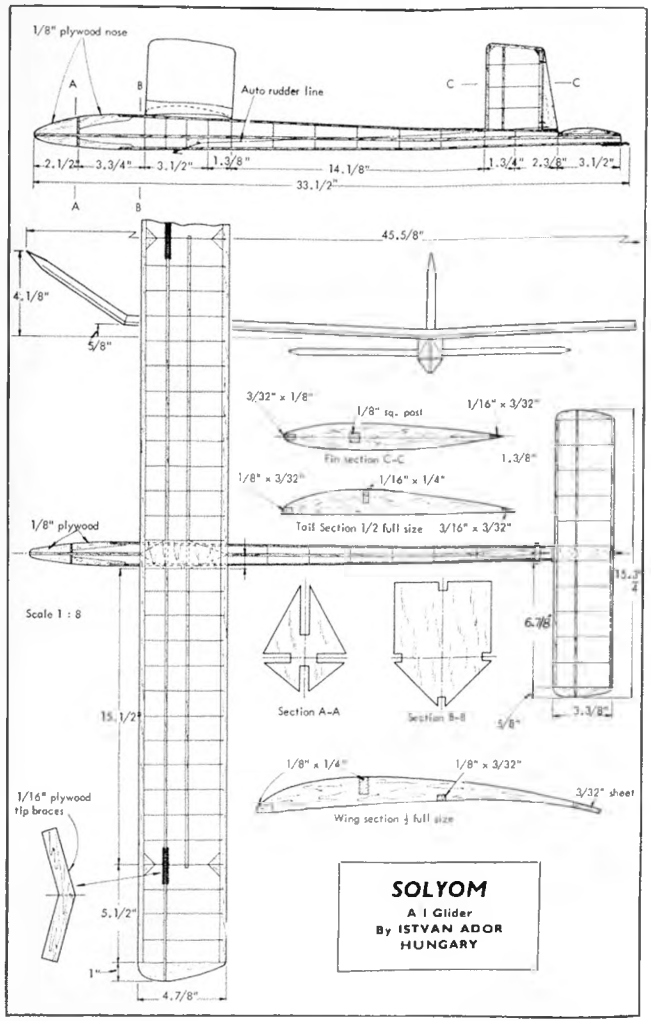
Even then it can still yield useful information—deliberately loading a wing to failure, for example, to see *where* it breaks and whether or not the constructional detail could not be improved. Almost certainly the prototype will show up some parts of the airframe which could do with boosting up and others which are stronger—and thus heavier—than they need be.

The prototype model is also the one to try out anything which you may regard with suspicion if it came to applying it to a final design. This can be a new covering material, where you are not sure of its weight and suitability; a new fuel-proof dope; and so on. It can also be used to prove a new constructional technique with which you have no previous practical experience. Not many people, for example, believed that it was possible to butt-cement wings together on large R/C models without using ply joiners and a boosted up or braced centre section area, until other modellers showed that it did work. Even now, though, many aeromodellers still do not believe it!

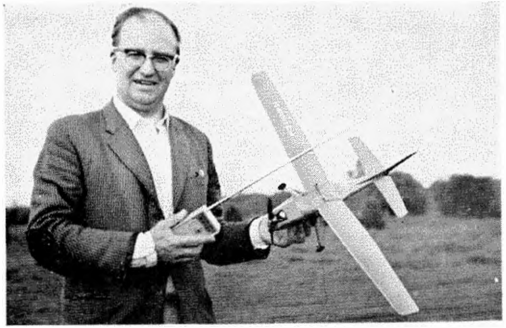
There's nothing like finding out *yourself* whether something works or not. You have then proved or disproved it to your own satisfaction, which means that you can have confidence in it, or reject it as a possibility. A prototype model, *plus* as much cut-and-try design is a wonderful confidence builder—and it does definitely help produce better models.


1-1.5 engine
Tank
Escapement
1/8" sheet fin
4"
Rx
1/8" sheet
Escapement rubber
Sprung nose wheel
30.1/4"
1/16" sheet top and bottom sheet
15.3/4"
Battery box
2"
4.1/8"
39.3/8"
3.1/2"
8°
7.1/2"
1/16" sheet top and bottom
Wing Section
PLUTO
Single Channel R/C
By JIRI CERNY
CZECHOSLOVAKIA


39.9/16"
5°
+ 1/2°
4.3/4"
Tank
-1°
1.3/8"
Ballast
5.1/8"
5.7/8"
2.1/8"
2.1/4"
6.1/4"
18.7/8"
8.1/4"
28"
1.3/4"
A
A
Enlarged canard tail section
Section A-A
2"
59" Span
3°
5½"
Tank details
Feed pipe
To Timer
11"
5.7/8"
Tailplane dethermaliser action
Spring
Fuse
UTKA
Canard Power
By V. SUBBOTERV
U.S.S.R.



MODELLEZES, HUNGARY



Co-Editor Ron Moulton with one of the most remarkable ready-to-fly plastic models yet tested, the Futaba Cessna with single channel radio control. During tests it explored an apple tree from tip to trunk with slightest damage. Model is moulded in expanded polystrene.

NEW MATERIALS

BALSA remains the standard material for airframe construction, mainly because of its favourable strength weight ratio and the ease with which it can be worked. Alternative materials, however, now have their definite place, both for unit and complete air frame components.

Plastics have obvious possibilities, but the term "plastics" is so wide as to have little meaning. One first thinks of the conventional mouldable plastics, like acetate, polystyrene, P.V.C. and polythene, all of which are available in sheet as well as finished moulded forms. The latter are precluded, unless specially made for the job, on account of the tooling costs involved. Thus as far as the average aeromodeller is concerned the use of moulded plastic materials is limited to finished components, such as moulded nylon bellcranks, control horns, etc.; or such mould components as may be included in a particular kit.

All these materials are thermoplastic. That is, they are softened by heat and set again on cooling. This means that in sheet form they can be reworked by heating and simple moulding techniques. Unfortunately none of the plastics in this class have a particularly good strength weight ratio (except nylon, which is not produced in sheet form anyway). Thus to mould wing or fuselage shells at a reasonable weight a thin material has to be used. The resulting shell will then inevitably suffer from lack of rigidity and lack of both overall and local strength at highly stressed points. This can, of course, be overcome by incorporating stiffeners, etc., or even stiffening "rib" sections in the moulding itself. Such methods are used on commercial productions, but the resulting models are limited in size and performance and belong more to the "toy" category. The use of moulded sheet plastics can largely be dismissed as far as suitability to serious model construction is concerned, except possibly for detail parts such as fairings and, of course, the moulding of cockpit canopies. Here clear plastic is the standard material used.

Glass fibre mouldings are quite a different matter. The material is properly described as *glass reinforced plastic* (G.R.P.)—not "Fibreglass" which is a trade name for glass fibres on their own. The moulding is actually produced in a thermo-setting plastic resin (usually polyester), and the glass fibre is a

TABLE I. STRENGTH WEIGHT RATIO OF VARIOUS MATERIALS

MATERIAL	S.G.	BENDING A	BENDING B	TENSION A	TENSION B	COMPRESSION A	COMPRESSION B
Balsa*	14	25,000	100	18,000	100	5,700	100
Aluminium	2 7	—	—	5-13,000	28-72	5-13,000	90-230
Steel	7 8	—	—	8,500	47	9,000	157
GRP—Mat	1 6	15,750	63	16,000	90	9,000 Min.	157
		—	—	—	—	16,000 Max.	280
GRP—Cloth	1 8	28,000	112	22,000 Min.	120	16,000 Min.	280
		—	—	44,000 Max.	240	19,500 Max.	340

* Typical Light-medium

NOTE: A = Actual (Typical) Strength weight
B = Comparative figures where Balsa = 100

reinforcement for the resin. Such mouldings have a very favourable strength weight ratio—see Table I—but to keep weight down to suitable figures for complete components the thickness of the moulding has to be kept to a minimum. This can result in lack of flexibility, or call for the extensive use of stiffeners, etc. Usually the solution adopted is to use a more generous thickness of moulding. As a result a complete G.R.P. wing or fuselage is substantially heavier than its balsa counterpart—but also very much stronger. This solution can be adopted for radio control and control line models, where weight is not all that critical; but the weight factor virtually precludes the use of G.R.P. for smaller, lighter free flight models.

There is also the point that the production of G.R.P. mouldings requires first the construction of a suitable mould. Thus it is a lengthy building operation for one off jobs. It becomes more economical both in time and materials when a number can be produced off the same mould, and commercial shells are produced on this basis. These are the best ways to try out G.R.P. construction, although individual moulding does offer more scope. It is undoubtedly an excellent—and probably the best—method of making engine cowling shells and wheel pants for scale and semi-scale models, for example; but such mouldings will only show a good surface finish if made in female moulds. Rough surface mouldings in G.R.P. can be laid up on the most elementary moulds—even a Plasticine model—but need an immense amount of working on to flat down to a smooth surface finish. It is quicker, in fact, to make a G.R.P. female mould off a reasonably smooth pattern (the smoother the better, of course) and lay up the final job in this mould, even for a "one off" project.

For those who do not mind spending the time—and working with a particu-

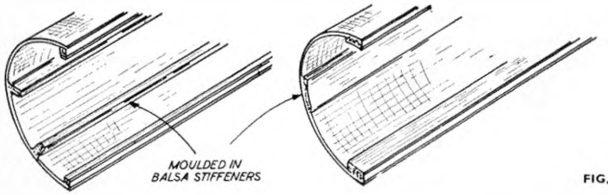
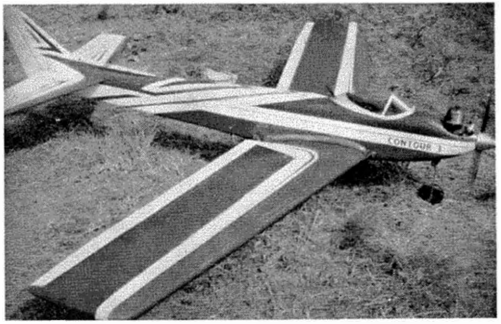


FIG. 1



Swept wings are one new look — another is the use of veneer covered foam plastic wing cores. This design is South African Jim Connaker's "Contour Mk. 3" with South African Constellation 7 proportional R C gear.

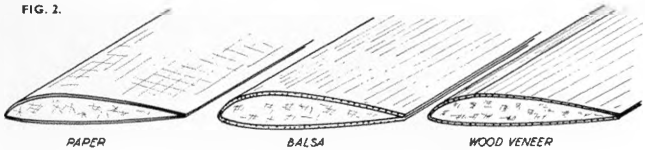
larly "messy" material—individual construction of larger shells for fuselages or wing panels can be most rewarding. There is also considerable scope for improvement on existing techniques. Most mouldings are laid up with a "minimum" but fairly generous skin thickness, and local reinforcement with tape or additional glass cloth. A lighter job with the same or even better stiffness could undoubtedly be produced by using an even thinner skin and incorporating balsa stringers and stiffeners, etc., for local or "beam" stiffness—Fig. 1. This makes the job a lot more complex, but it could show substantial savings in weight. Most G.R.P. mouldings produced are far stronger than they need be as regards skin strength, and in consequence a lot heavier than they need be.

The other plastic material with the most attractive possibilities for airframe construction is *expanded polystyrene*. This, in effect, is merely solid plastic material which has been expanded by "foaming" to produce a cellular structure of low density. Naturally this reduces the strength at the same time, and so such materials are only really useful employed in substantially solid sections of reasonably generous thickness. Since the density of foam plastics can range down to as little as 2 pounds per cubic foot (or one-third the weight of the lightest balsa), this means that solid wings, tailplanes and fuselage mouldings can be produced without necessarily suffering any weight penalty.

There are, of course, limitations. Strength is the main one, and this is directly related to the density of the foam, as well as the characteristics of the original material. A large number of plastics can be expanded by foaming, but only a few have a suitable strength weight ratio for model aircraft construction. *Expanded polystyrene* is the main material, but expanded polyurethane is another which may well come to the fore. This has a similar or better strength to expanded polystyrene, at similar foam densities, but tends to be rather more rigid and less subject to solvent and chemical attack. On the debit side it appears to be a little more tricky to handle for moulding, although it can be "carved" with a hot wire when in solid form just like expanded polystyrene.

Expanded plastics of this type are not as strong as balsa, even at similar densities (*e.g.*, 6 lb. density foam is weaker, mechanically, than solid 6 lb. density balsa). For fairly heavily stressed parts, therefore, it normally needs reinforcement. This applies mainly to wing mouldings.

FIG. 2.

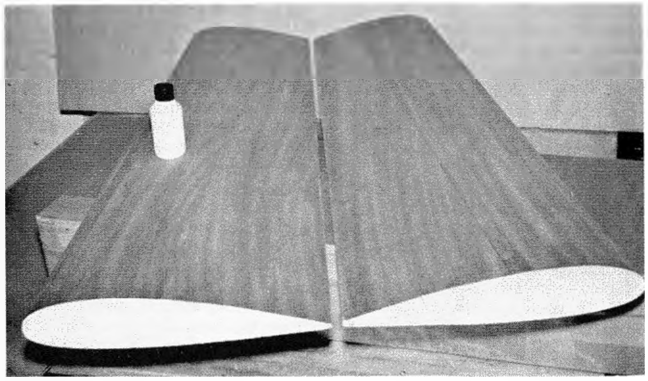


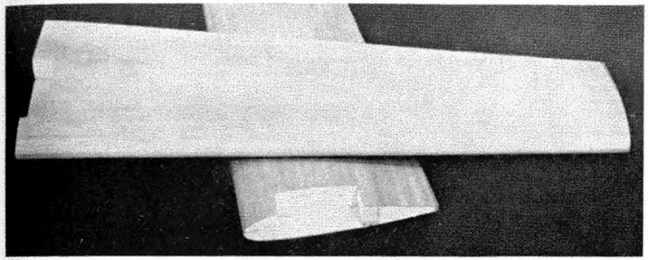
In small sizes—say up to about 36 in. span—foam plastic wing cores can be suitably reinforced by covering with heavyweight tissue. In addition to providing skin stiffness and a stressed skin effect, this will also give a good surface finish. Larger wing mouldings need covering with sheet balsa or wood veneer when the bulk of the bending strength is provided by the stressed skin structure so produced. Such a covering applied directly to the foam core also provides excellent local strength and stiffness—Fig. 2.

Foam densities used range from about 2 to 6 pounds per cubic foot. The lighter density is adequate (particularly in polyurethane) provided a reasonable surface can be produced—*i.e.*, not too crumbly and full of blow holes. Average foam density usually runs at about 4 pounds per cubic foot; sometimes higher with moulded shapes. Total weight is inevitably higher than that of a conventional balsa structure since the foam plastic component must be solid (or at least have very thick walls in the case of a fuselage moulding); which weight will be still further increased by "skinning". Nevertheless the finished job of adequate strength should work out lighter than a G.R.P. moulding.

Because of its lower strength, however, it is more suitable for wings only on large models, although adequate for fuselages on smaller free flight models. It is doubtful that it offers much advantage for tailplane or fin construction since these can be duplicated at a similar weight and much greater strength in balsa, especially where thin aerofoil sections are involved. Basically, too, expanded polystyrene construction is better suited to free flight and R/C models rather than control line models, although there is no reason why it should not be more widely applied to wings with the latter types, particularly thick section wings. One of the great advantages of the material is the ease with which it can be worked and complete wings carved from a slab. The necessary skinning process takes far longer than making the actual core and the larger the wing the more important this aspect of expanded plastic construction becomes.

Expanded foam cores by C. S. Developments with mahogany Veneer covering.





Aviette Kits foam core wings have cut out for aileron servo incorporated.

Further improvements might be expected by combining a thin G.R.P. skin with a foam plastic core—this being the principle employed in the construction of many large rigid G.R.P. mouldings, such as boat hulls. In this case the foam invariably employed is polyurethane. It has only been applied to a very limited extent as yet for model aircraft mouldings and the technique involved is somewhat tricky. To produce a good external surface on a wing moulding, for example, the whole job would need to be laid up, or "coined", in a suitable female mould. Currently a limited number of commercial mouldings of this type are appearing, but no comparative data are available. Properly designed, this combination of a G.R.P. skin with a foam plastic core should offer comparable strength at very much lighter weight than a conventional G.R.P. moulding.

In the more conventional materials field improvements are always possible, but less spectacular and often having limited application only. *Plywood*, for example, is basically an "improved" wood in sheet form, with obvious application for highly stressed parts. Plywood with a balsa core is another material which is an improvement on ordinary plywood as regards weight, without sacrificing much strength, particularly when end grain balsa is used for the core—Fig. 3. This results in a particularly stiff material, the ply skins

FIG. 3.

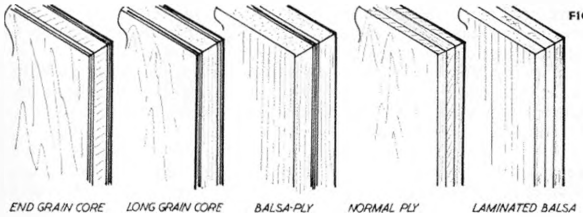
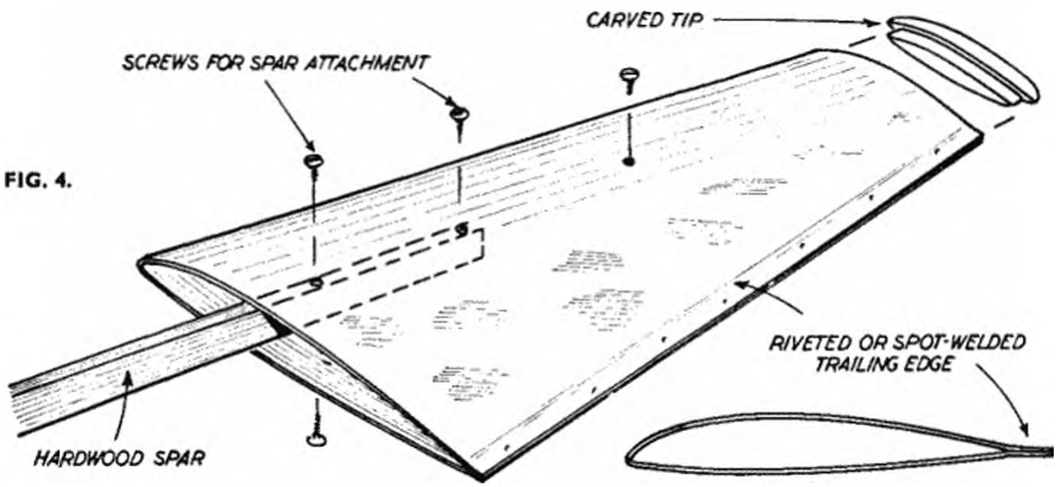


FIG. 4.



absorbing tensile and shear stresses and the balsa core offering high strength in compression and rigidity to the whole. Such a material would make an excellent lightweight firewall, for example.

An ordinary ply-balsa-ply sandwich, on the other hand merely offers a method of skin-stiffening for the balsa core, with increased overall resistance to tension and shear, but reduced strength in compression.

Balsa-ply, which has appeared recently as an aeromodelling material, turns the sandwich inside-out. Here the core is ply and the two face pieces balsa. This would appear an excellent material for formers since the ply provides strength and stiffness with a lightweight material and the outside balsa surfaces are far more "cementable" than ply. Also it is possible to use a solid former without adding excess weight; virtually as strong as a ply former which would have to be cut out at the centre to reduce weight.

Metal construction comes under descriptions of new materials although its use for aeromodelling is certainly not new. Over forty years ago many ready-to-fly models in the "toy" category where made from bent wire frames with soldered assembly, and they flew very well. At the same time the "serious" aeromodellers were using piano wire for wing tip and tailplane and fin outlines and tail ribs. This method of construction has recently been revived for the production of "toy" types of flying models.

More seriously, metal construction using tubes and shaped sections in aluminium with clipped and riveted joints was employed in Germany before World War II for model glider construction, including competition types. Balsa at the time was largely unavailable in that country and the main alternative airframe materials were spruce and birch. These original methods of metal airframe construction were somewhat tedious, following full scale practice as far as possible, and do not appear to have surivved for long.

Shortly after the war with interest in control line flying growing at a fantastic rate, sheet metal construction was employed both individually and commercially in the United States for the production of fuselage shells and wing and tail panels for speed models. Again it appears to have been more of a phase than a trend, although for the modeller who can work accurately with metal there is hardly a simpler method of making a straight taper control line speed or team racer wing than on the lines of Fig. 4. It is still a "new" material in that it

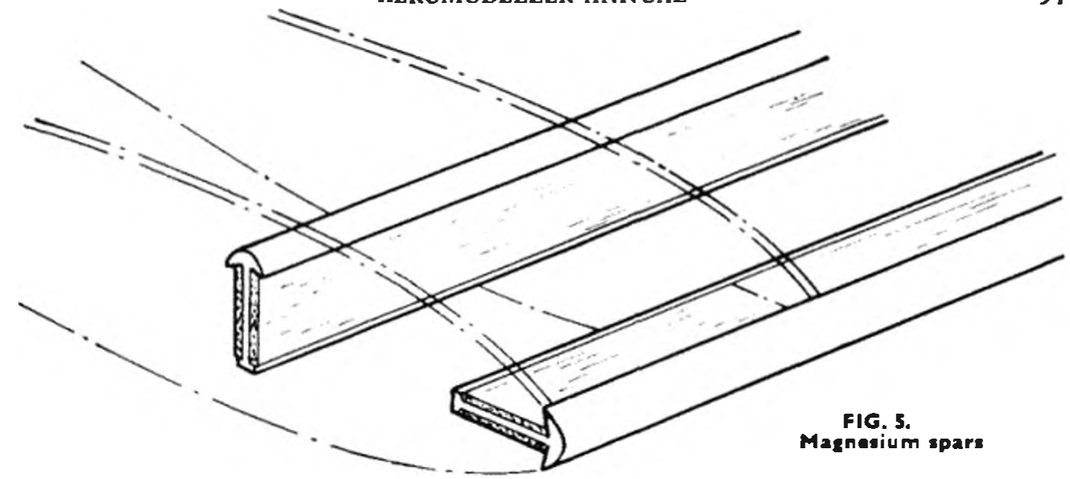


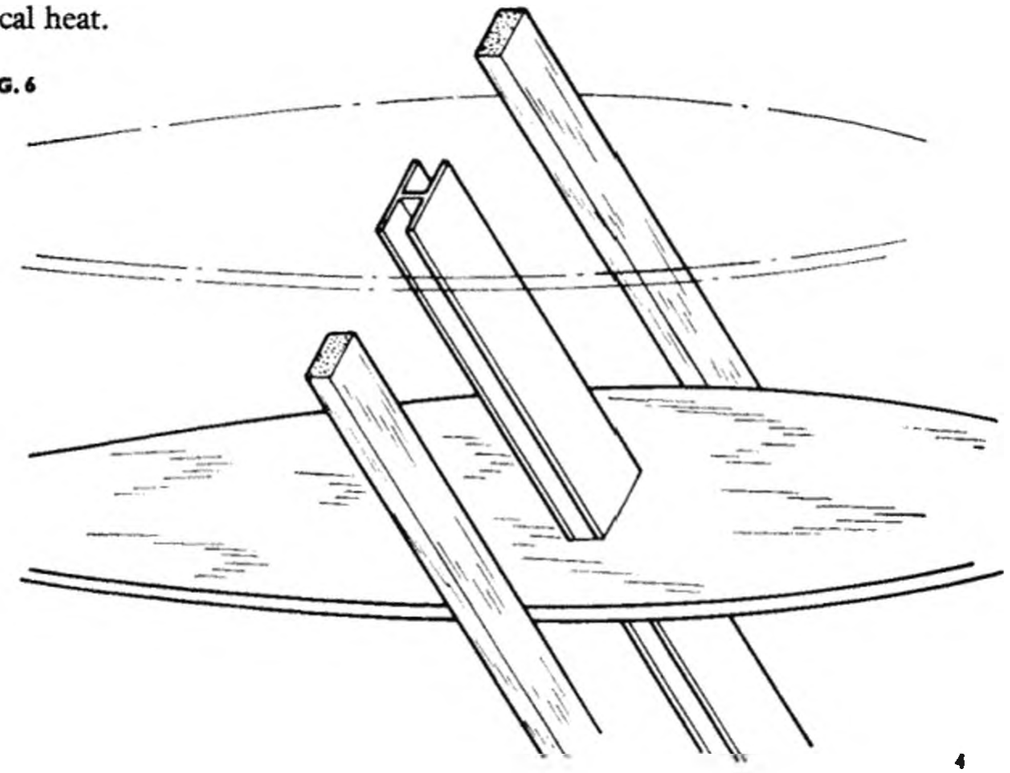
FIG. 5.
Magnesium spars

has only had limited exploitation so far and the results achieved at the time were at least reasonably satisfactory.

Later, in this country, **International Model Aircraft** brought out a kit for an all-metal construction free flight power model, with spars, longerons, spacers and outlines in extruded section magnesium alloy and pressed sheet aluminium ribs, cowling and other panel parts. Jointing was by special clips and the complete airframe was an all-metal "skeleton", finished by tissue covering.

This particular model did not prove a commercial success, but as far as the model performance was concerned it was not excessively heavy and flew as well as most sports free flight power models on a 1 c.c. or 1·5 c.c. engine. It was as strong as a balsa model—or stronger—as far as normal flying loads were concerned but, unlike balsa it bent rather than broke on heavy impact. Repairs could be made by straightening out, after softening the magnesium alloy with local heat.

FIG. 6



Although this model is now history—and, in fact, the design and technique originated in Germany as a development of the earlier work on all-metal construction mentioned above—somewhat similar materials for metal construction are appearing again in the United States. These are the special sections in magnesium alloy offered by **Sullivan** products, but restricted mainly to leading and trailing edge and wing mainspar construction—Figs. 5 and 6.

The particular magnesium alloy used is one-half the weight of aluminium, which still works out at about thirteen times the weight of 10 lb. density balsa as a direct comparison. The amount of solid metal in the section, however, is relatively small, so direct weight comparison is more favourable.

The range available includes "H" and "I" beams and a special section, with alternative uses. A neat feature is that the special dovetail section enables a length of $\frac{1}{32}$ in. thick balsa sheet to be mounted on each side of the spar web, where it can be cemented in place with balsa cement or epoxy resin, offering a balsa surface for gluing the spar in place in a conventional balsa frame. Alternatively the spar could readily be glued to a balsa framework without facing, using epoxy resin adhesive, and also the web drilled out to lighten, if necessary.

Obvious applications apart from mainspars and leading or trailing edges include spar braces (*e.g.*, at a dihedral joint or to take an undercarriage; a mounting plate for a bellcrank or landing gear; leading edge reinforcement on a solid balsa wing, or on a combat or rat racer wing; and so on—Fig. 7.

The spar material can also be bent, if necessary, after first softening by heating to not more than 300 degrees C. The best method of bending is shown in Fig. 8. The spar is held in a vice, heat applied via a flame (a small butane blow torch is excellent for this purpose) and the spar then pulled round to the bend angle required as soon as it goes soft. It will re-harden in the joint area on cooling.

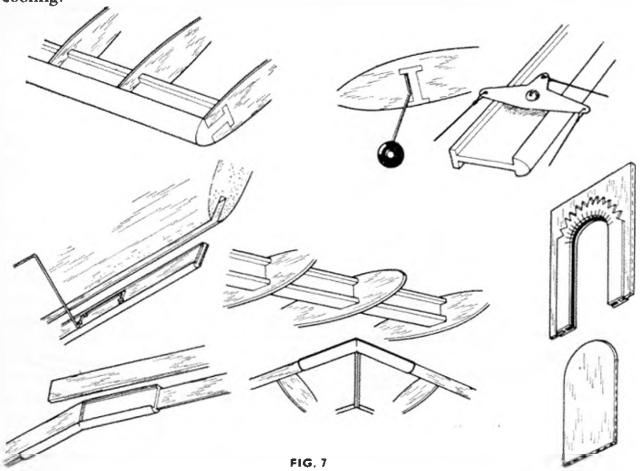


FIG. 7

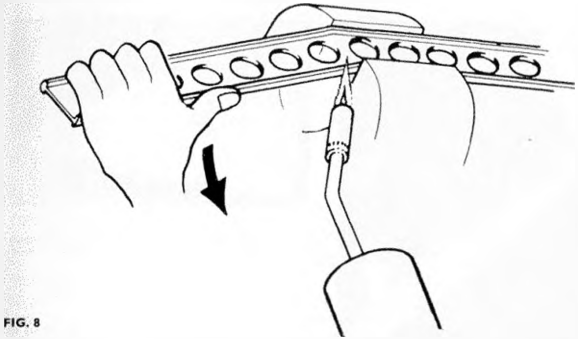


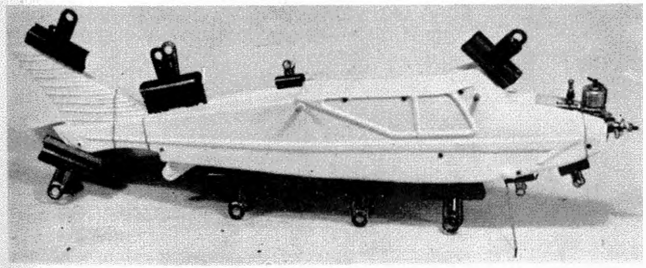
FIG. 8

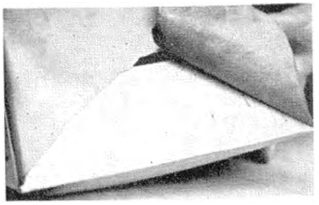
Mention of epoxy resin emphasises that probably the greatest advance in new materials has been in the adhesive field. *Epoxy resin* adhesive, properly used, will glue virtually anything to anything and is ideal for securing wood to metal, making a really strong job of gluing wood bearers into a glass fibre moulding, and so on. And even the long reign of balsa cement as the standard adhesive for balsa has been challenged by P.V.A. "white glue", which many modellers now prefer for airframe assembly. Certainly it is easier to use than balsa cement for attaching large areas of sheeting as well as being non-staining (any surplus glue is simply wiped off.) It does, however, take considerably longer to dry and set than balsa cement.

Contact adhesives have also found favour. These have the advantage of sticking immediately and are attractive for such jobs as securing sheet coverings on wings; also tip blocks which can then be worked on for final shaping without having to wait for a long time for cement or P.V.A. adhesive to set. Generally, however, contact adhesives are not regarded as suitable for "structural" work.

Developments in a similar field have also led to the appearance of a far

E. D. Champion ready to fly a kit project in vacuum formed plastic seen being assembled along fuselage halves which have "flash" edges. Model was never introduced to the market though all tests were successful.





Above, tearing MonoKote is a tough business. As it comes away it takes top of balsa surface.

Left, Dragonkraft glider fuselage is moulded in glass fibre includes tail platform and the fin, an elegant shape, perfect for slope soaring.

wider range of finishes than hitherto. Whereas cellulose dopes and butyrate dopes are "standard" materials, polyrethane and epoxy resin finishes now offer considerable advantages as regards gloss, durability and fuel proofing. Tautening still has to be done with (cellulose) shrinking dopes, but the synthetic resin finishes are better for final finishing.

A point to bear in mind, however, is that synthetic resin finishes of these types are not compatible with other finishes. If applied over cellulose dopes (used as a basic coating), epoxy resin finishes in particular can react chemically. All finishes of this type can, however, usually be applied over a cellulose "base" provided adequate time has been allowed for all traces of volatile cellulose solvents to have dried out.

To get best results with these special finishes, too, a specific technique must usually be followed, which may make the complete finishing job a fairly lengthy process. The results which can be obtained, however, are far superior to that which can be achieved with conventional finishes. An outstanding "new material" finish of this type is "Hobby Poxy", based on epoxy resins, both clear and coloured. Clear epoxy resin and clear polyurethane are also suitable as final "fuelproofing" coats over conventional finishes, with the above proviso.

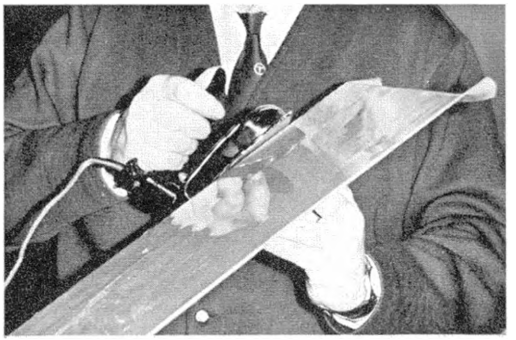
Probably the one material to appear this year which marks the most significant advance is "*Monokote*" covering. Again this is not completely new. "Monokote" is a very thin plastic (polyester) film and the first use of such a material for covering was "*Melinex*" employed on the Hatfield man-powered aeroplane and, later, by individual modellers. However, "Melinex" is plain film and not the least trouble experienced with its use as a covering material was a suitable adhesive for sticking it to the underlying framework. "Monokote" goes one further in using a similar film base but with an opaque colour coating on the underside plus a final coating of adhesive. This adhesive is tacky when the backing paper is peeled off, enabling the covering to be positioned on the framework, when the application of heat from an iron completes the bonding on process and virtually seals the covering down. Final tautening is then achieved by the application of further heat all over the surface, either with an iron or hot air.

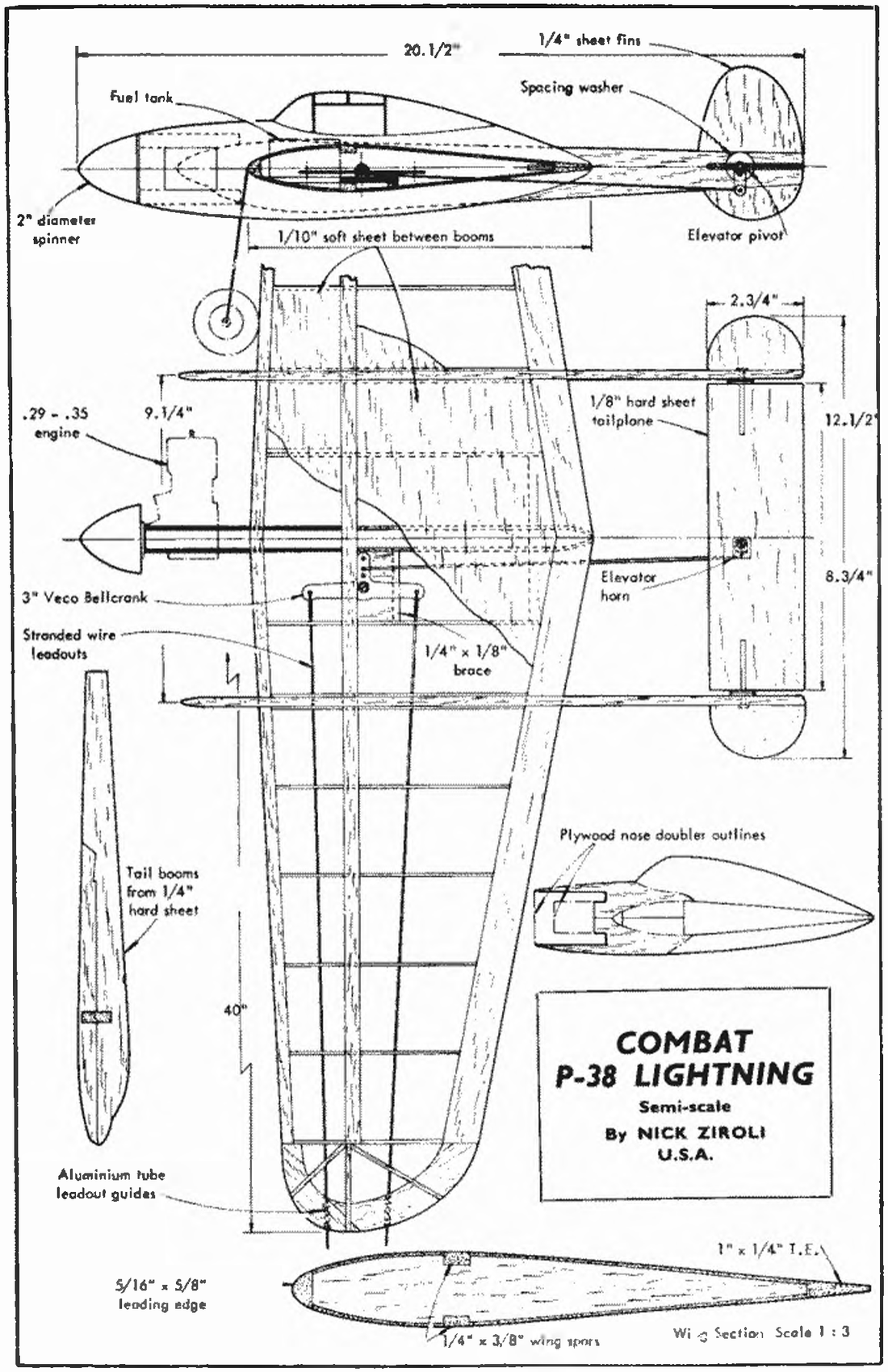
The advantage offered by "Monokote"—and there are other similar materials now appearing—is that it can be applied quite rapidly and easily and the finish, once heat-shrunk, is permanent with a high gloss comparable with any exhibition standard conventional colour finishing process. It is also fully fuelproof, provided all edges are properly sealed, and the covering material itself is extremely strong and puncture resistant—far better than nylon in these respects. Weight is greater than nylon covering alone, but directly comparable or even less than nylon covering plus normal dope finishing. The overall cost is also almost directly comparable. The material itself is relatively expensive, but it completely eliminates the need to buy any dopes or other finishes for completing the job. Most significant of all is the time saving, for a complete model could be finished in an evening's work, ready for flying the next day.

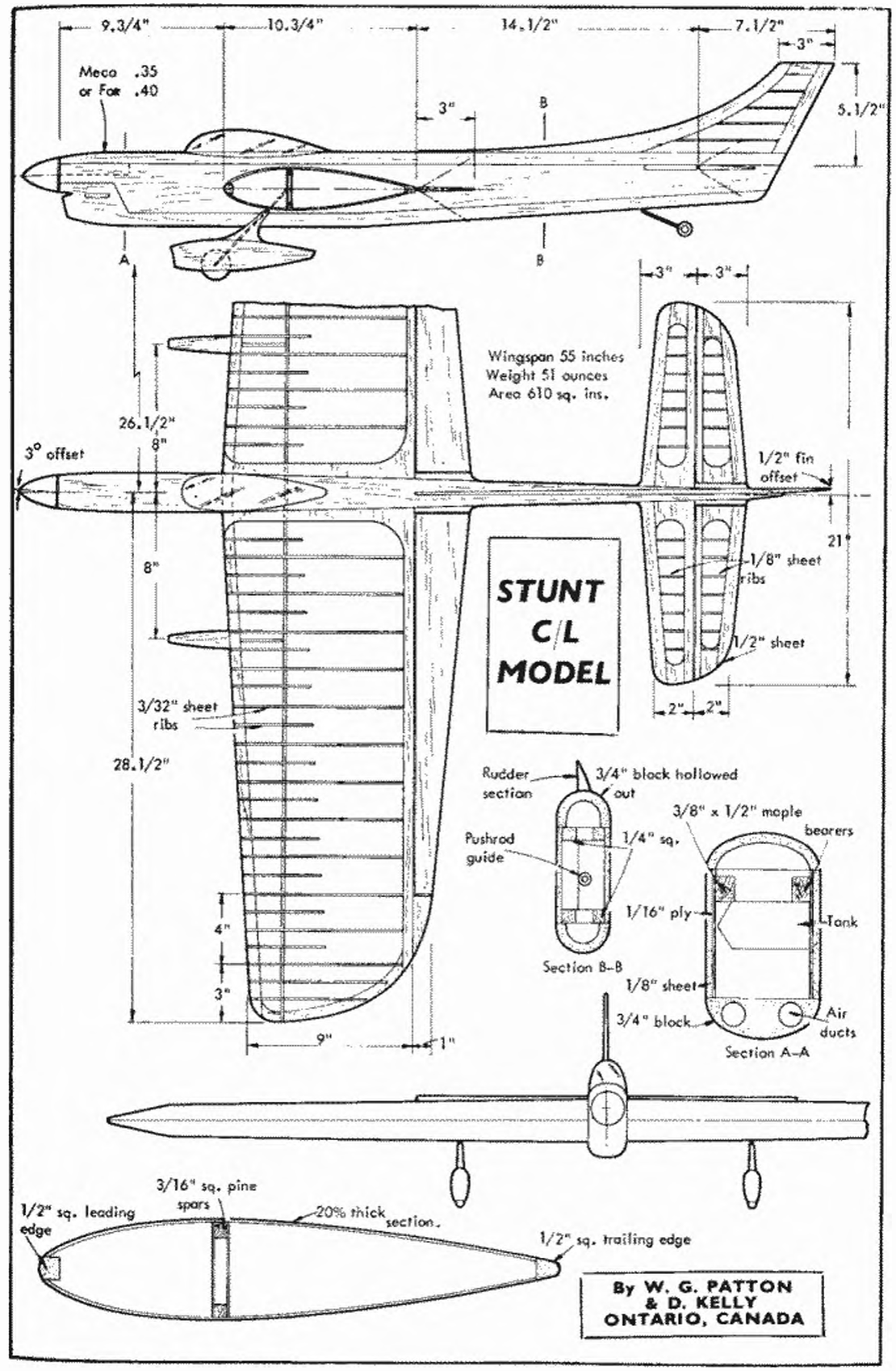
There are, of course, disadvantages. Although the material will stretch to a certain extent, covering compound curves is a little tricky and is best tackled in sections. Also the resultant surface finish will only be as smooth as the surface over which it is laid. Any surface defects will show through. Also, although quite taut when heat shrunk, the film is still somewhat flexible and thus does not impart the same rigidity as a conventional doped covering. It is thus more suitable for covering structures which are rigid to start with and not lightweight structures which rely on the tautness of the covering to provide final stiffness and rigidity. Thus the more obvious applications are for covering R/C models and control line models which have reasonably rigid structures; and larger free flight models (*e.g.*, power models and gliders).

"Monokote" is also an excellent material for surface finishing expanded polystyrene wings, but it cannot be applied over the bare core since the heat necessary to obtain adhesion, and also tauten the covering, would melt the foam plastic. It is possible to get away with it if the expanded polystyrene is tissue covered first, but there may be some local softening. "Monokote" covering is quite straightforward on wing panels which have been skinned in balsa sheet or wood veneer, although in the latter case there may be troubles through evaporation of solvent causing bubbles under the covering which have to be worked out. Applied over balsa, the solvent seems to be readily absorbed by the balsa and does not form air bubbles.

Max Coote of Ripmax demonstrates the ease of application of Mono-Kote with a warm iron. This coloured, self adhesive sheet plastic is one of the discoveries of 1966, eliminates dope and to a large extent model surface preparation.




20.1/2"
1/4" sheet fins
Fuel tank
Spacing washer
2" diameter spinner
1/10" soft sheet between booms
Elevator pivot
2.3/4"
.29 - .35 engine
9.1/4"
1/8" hard sheet tailplane
12.1/2"
Elevator horn
8.3/4"
3" Veco Bellcrank
Stranded wire leadouts
1/4" x 1/8" brace
Tail booms from 1/4" hard sheet
Plywood nose doubler outlines
40"
COMBAT
P-38 LIGHTNING
Semi-scale
By NICK ZIROLI
U.S.A.
Aluminium tube leadout guides
1" x 1/4" T.E.
5/16" x 5/8" leading edge
1/4" x 3/8" wing spars
Wing Section Scale 1 : 3


9.3/4"
10.3/4"
14.1/2"
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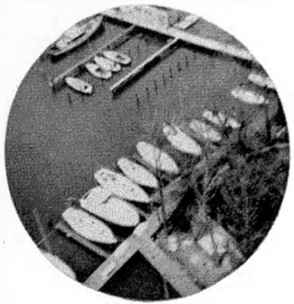
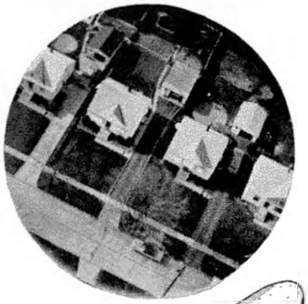
3"
Meco .35 or Fox .40
5.1/2"
A
B
Wingspan 55 inches
Weight 51 ounces
Area 610 sq. ins.
26.1/2"
8"
3° offset
1/2" fin offset
21"
1/8" sheet ribs
STUNT
C/L
MODEL
1/2" sheet
3/32" sheet ribs
28.1/2"
Rudder section
3/4" block hollowed out
Pushrod guide
1/4" sq.
3/8" x 1/2" maple bearers
1/16" ply
Tank
Section B-B
1/8" sheet
3/4" block
Air ducts
Section A-A
4"
9"
1"
3/16" sq. pine spars
1/2" sq. leading edge
20% thick section.
1/2" sq. trailing edge
By W. G. PATTON
& D. KELLY
ONTARIO, CANADA



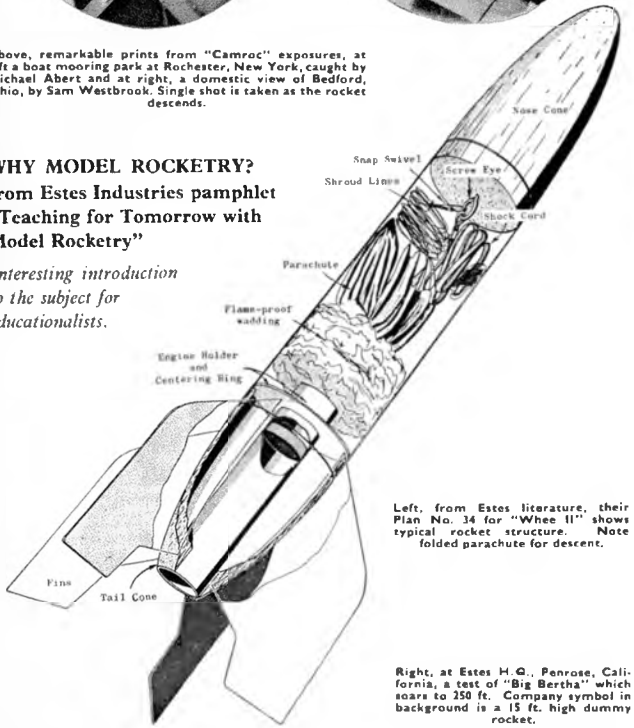


Above, remarkable prints from "Camroc" exposures, at left a boat mooring park at Rochester, New York, caught by Michael Abert and at right, a domestic view of Bedford, Ohio, by Sam Westbrook. Single shot is taken as the rocket descends.

WHY MODEL ROCKETRY?

from Estes Industries pamphlet "Teaching for Tomorrow with Model Rocketry"

Interesting introduction to the subject for educationalists.



Left, from Estes literature, their Plan No. 34 for "Whee II" shows typical rocket structure. Note folded parachute for descent.

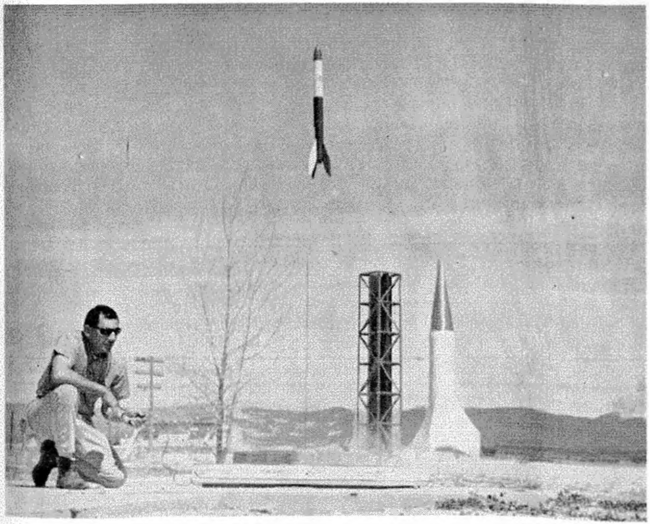
Right, at Estes H.Q., Penrose, California, a test of "Big Bertha" which soars to 250 ft. Company symbol in background is a 15 ft. high dummy rocket.

When the first Sputnik was launched in 1957, boys and young men across the U.S.A. set out to try to emulate, in their backyards, the feats of the professionals. Match heads, gunpowder, zinc and sulphur, and other mixtures were poured into gas pipes, conduit, or almost any other container to form rockets. Probably the climax of this madness came in Floydada, Texas, when seven students were injured and a chemistry teacher killed by the explosion of a "small" demonstration rocket engine built by the teacher.

It was out of this situation that model rocketry grew. Model rocketry was intended from the beginning to provide a safe, reliable means to allow America's young enthusiasts to express their desire for the stars without injuring or killing themselves. In the years since its inception in 1957, model rocketry has enjoyed one of the best safety records of any sport or active hobby.

Model rocketry's excellent safety record is largely due to the nature of the propellent means used. The model rocketeer does not build his own engine, but uses one which is commercially prepared and has been proven safe. The model rocket engine is non-metallic, highly insensitive to heat and shock, and limited in size. There are no 800 lb. stove pipe missiles in model rocketry. A model rocket, by definition, weighs no more than 16 oz., with most weighing between 1 and 3 oz. The amount of propellent used rarely exceeds ¼ oz.

The typical model rocket engine consists of a non-metallic casing, a nozzle, propellent, a time delay charge, and an ejection charge to activate the recovery system. The rocket itself can attain altitudes of over 1,000 ft. single staged, and is returned by a parachute or similar device to be flown again and again by simply replacing the expended engine. While the high school senior



chemistry class may, in some cases, feel they are ready to start research into fuel mixtures, generally little will be learned by such a programme since the student still does not have sufficient background or safe equipment to handle thermo-setting resins, binding agents, inhibitors, and the other *basic* elements of modern propellent technology. Rather than waste time trying to find the best mixture of zinc and sulphur, an unsatisfactory and unreliable propellent at best, teachers are finding more and more the advisability of using a model rocket engine and focusing the attention of students on the more rewarding aspects of rocketry.

It is well known that a student learns most rapidly and retains a larger part of what he learns when he can associate his learning activities with his other interests and needs, realising that what he is studying will have a practical application at some future date. Thus the first use of model rocketry comes in arousing the student's interest and bringing home to him the practical value of learning.

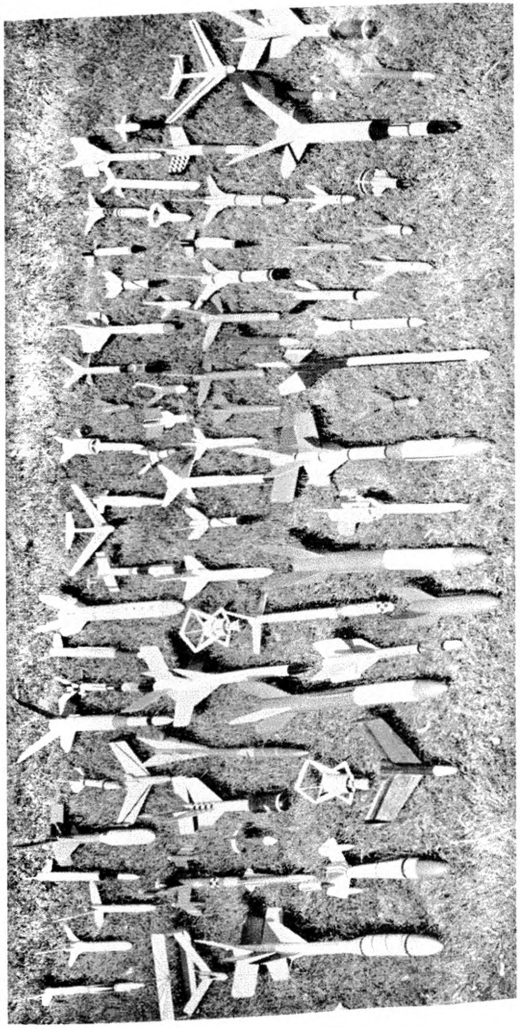
There are few young people who will remain unimpressed by the sight of a small rocket soaring hundreds of feet into the air and returning suspended by a parachute. Most of them will automatically ask the question, "Can I build one too?" The teacher can encourage them to do so, secure in his knowledge of the safety factors of model rocketry. When Johnny launches his rocket to 500 ft., and breaks a balsa fin on landing because his parachute didn't open completely, Mike is going to decide that he can do better, and will set out to try.

Here the teacher can discreetly step in, and encourage both co-operative and competitive activities. After the student has read some of the literature supplied by the manufacturer, listened to a few simple explanations by the teacher, and discussed rocketry with his peers, he begins to understand some of the underlying principles associated with rocketry, such as propulsion by reaction, centre of mass, stability, drag, acceleration, and trajectory. He has by no means mastered these fields, but he is beginning to realise their value. In short, he is becoming interested in learning.

At an early stage in the pupil's acquaintance with model rocketry, the teacher may well initiate the first group activity. One teacher began his students' activity by dividing them into four groups, one to construct the rocket, another to forecast and observe the weather up to launching, another to construct and operate the electrical launching system, and the fourth to determine, by mathematics, the altitude attained by the rocket. Each group was empowered to delay or postpone the launching for any necessary reason, and each was interested in insuring that its part of the launching went off perfectly. The result was that, with careful guiding by the teacher, each group began to learn a considerable amount about the sciences in its particular area. By rotating groups, the learning of each group was rounded.

The actual methods used by the teacher are not of prime importance, and the teacher need not be a science expert to use model rocketry.

In demonstrating principles of physics, model rocketry again shows considerable adaptability. Rocket propulsion may be demonstrated much more effectively and impressively by using either a model rocket engine and a simple static thrust stand or a model rocket engine in a flying rocket than by using a balloon and the blackboard. Similarly, vector forces can be demonstrated by showing the relative effect of wind and forward velocity on rocket flight. Acceleration and motion can be demonstrated in numerous ways, along with *g* forces, time-velocity relations, average velocity, negative acceleration, trajectory,



This impressive display of various rockets is indicative of the interest shown in the U.S.A. by amateur designers and manufacturers, in this particular case, Estes Industries. Multiple stage, boost glide, payload and scale types can be seen here.

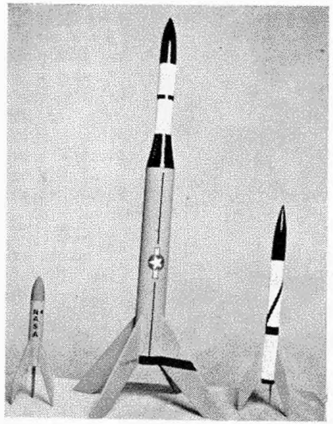
air drag effects, and theoretical versus actual performance with no more than a model rocket, a simple tracking device, and the blackboard.

In the area of force alone, model rocketry provides for interesting and clear demonstrations of Newton's laws of motion. The effect of rocket weight on rocket velocity and altitude can demonstrate that the body at rest tends to remain at rest and the body in motion tends to remain in motion.

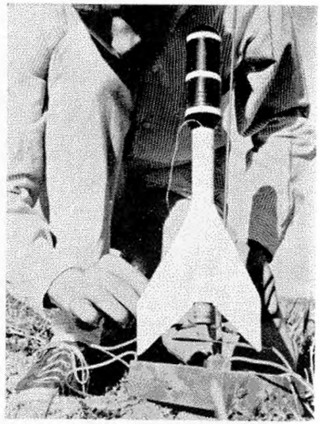
Demonstrations using model rocketry can range further afield than just the physics of motion and force. For example, in meteorology the rocket can provide for studies of wind speeds at various altitudes and studies of thermals and vertical air currents. The simple launching of a grasshopper or mouse can provide for countless studies in animal behaviour and biology. In the area of mathematics the determination of a rocket's altitude provides a very effective means of introducing trigonometry, and the calculation of rocket flight characteristics can involve geometry, algebra, and even calculus.

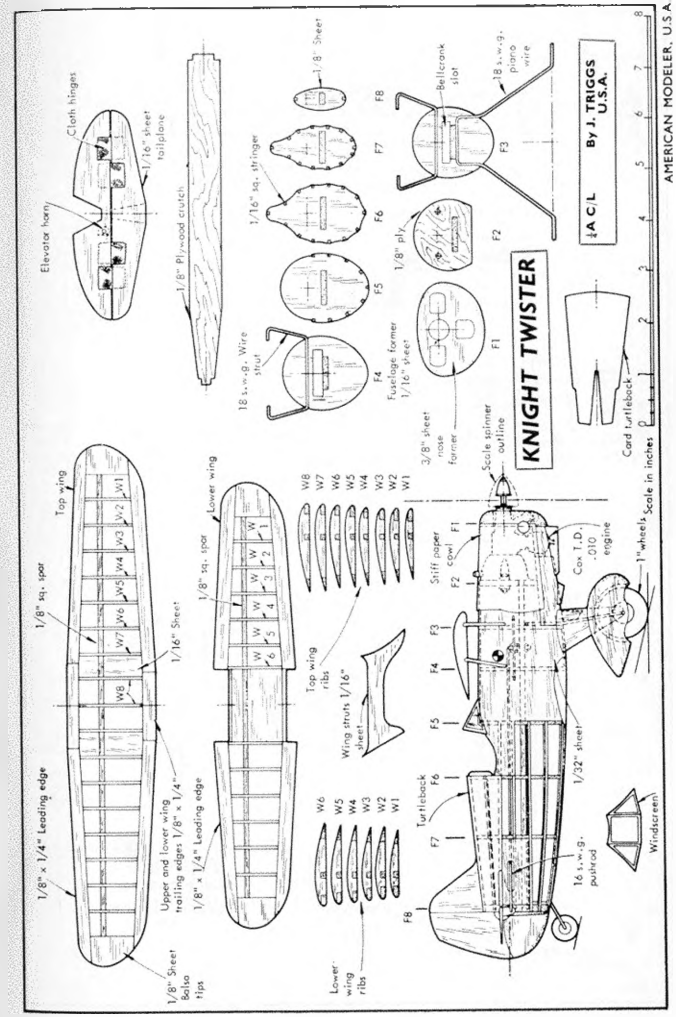
Optics and photography can be introduced by the design and launching of a camera rocket, leading into studies of lenses, reflection and refraction, studies of the eye, telescopes, aerial photography, mapping, and many other fields. Electricity can be covered in the design and function of launching systems, communications devices, and other accessories for model rocket operation. It can be seen that applications of model rocketry in the classroom are numerous. By encouraging the student's interest in rocketry and space, he will also be encouraged to further efforts in language, arts, history, mathematics, and the like, first as they relate to his rocketry activities, and later for their own sake.

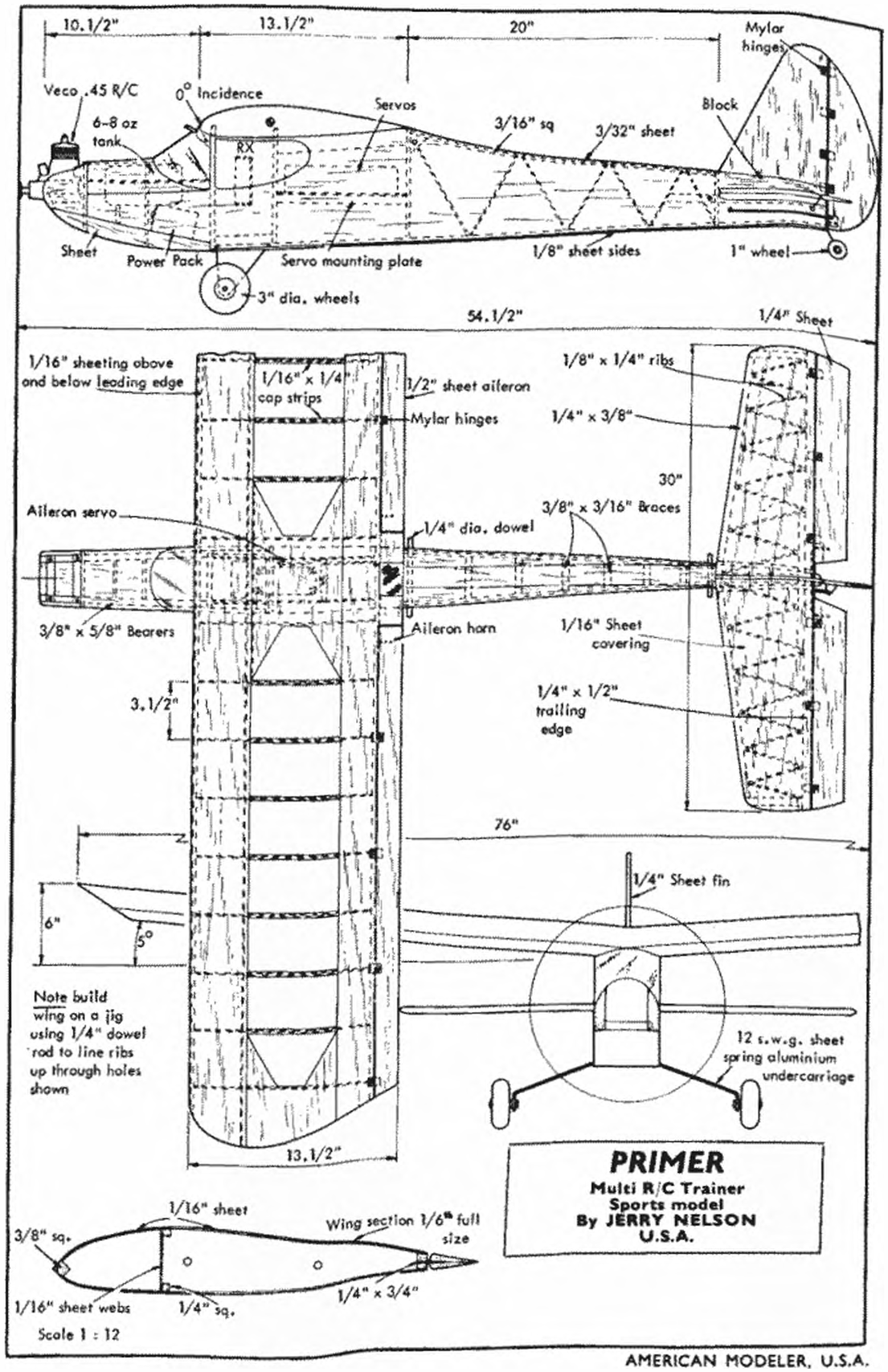
Estes kit rockets, left to right, the "Scout" has no 'chute and tumbles back to earth, the "Cobra" in centre takes 3 units and "Skyhook" at right soars to 1,200 ft.

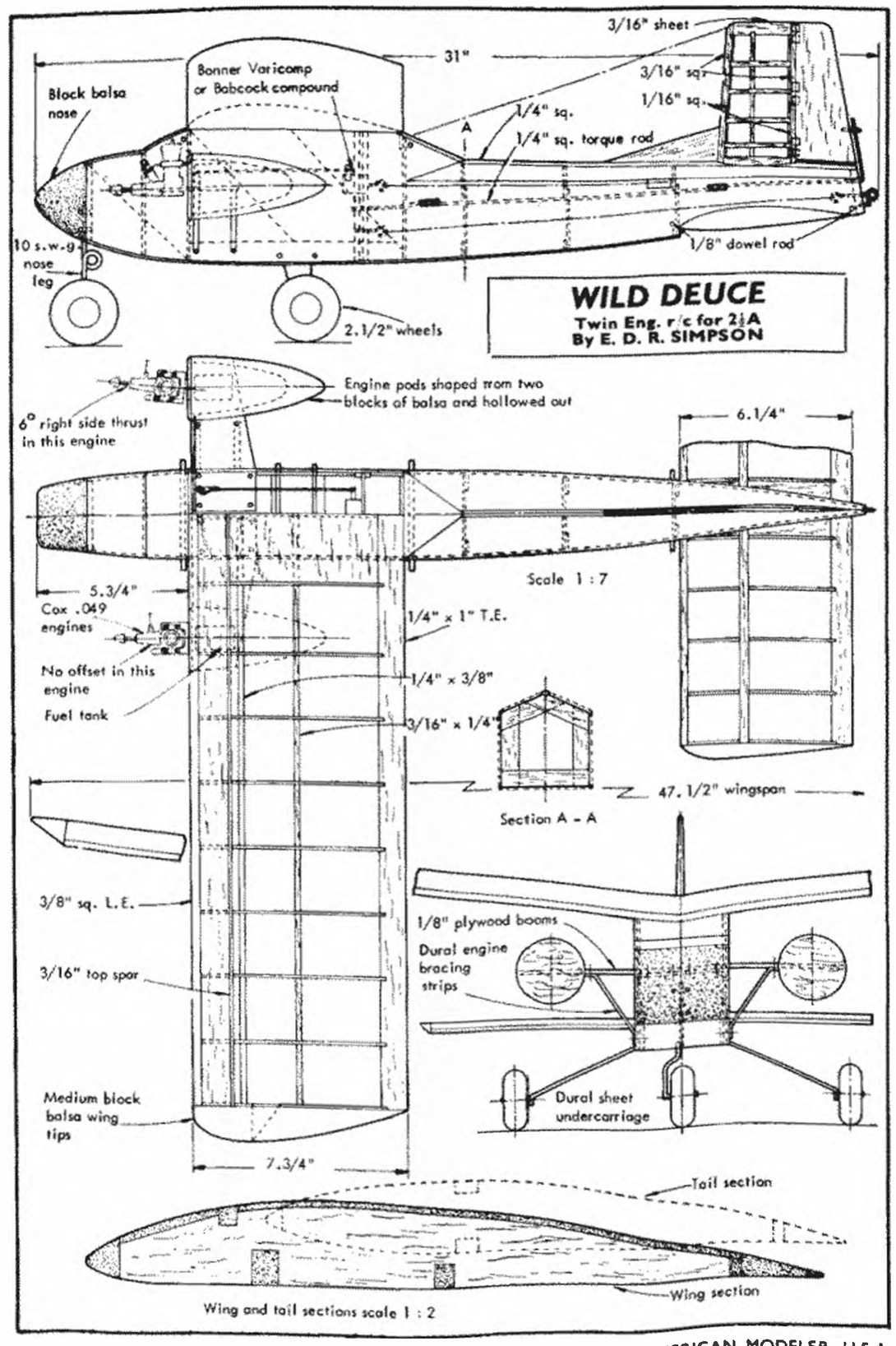


"Camroc" being set up for a launch. The bulbous head carries a lens and circular negative, see page 104 for typical results of this rocket photography.





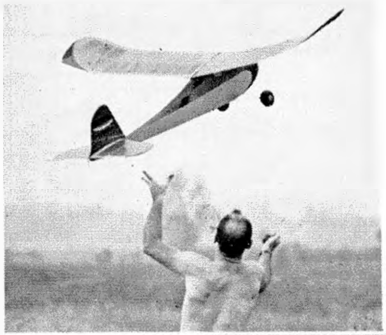

10.1/2"
13.1/2"
20"
Mylar hinges
Veco .45 R/C
0° Incidence
6-8 oz tank
Servos
RX
3/16" sq
3/32" sheet
Block
Sheet
Power Pack
Servo mounting plate
1/8" sheet sides
1" wheel
3" dia. wheels
54.1/2"
1/4" Sheet
1/16" sheeting above and below leading edge
1/16" x 1/4" cap strips
1/2" sheet aileron
Mylar hinges
1/8" x 1/4" ribs
1/4" x 3/8"
30"
Aileron servo
1/4" dia. dowel
3/8" x 3/16" Braces
3/8" x 5/8" Bearers
Aileron horn
1/16" Sheet covering
3.1/2"
1/4" x 1/2" trailing edge
76"
1/4" Sheet fin
6"
5°
Note build wing on a jig using 1/4" dowel rod to line ribs up through holes shown
12 s.w.g. sheet spring aluminium undercarriage
13.1/2"
PRIMER
Multi R/C Trainer
Sports model
By JERRY NELSON
U.S.A.
1/16" sheet
3/8" sq.
Wing section 1/6th full size
1/16" sheet webs
1/4" sq.
1/4" x 3/4"
Scale 1 : 12


3/16" sheet
31"
Bonner Varicomp or Babcock compound
Block balsa nose
3/16" sq.
1/16" sq.
1/4" sq.
A
1/4" sq. torque rod
10 s.w.g. nose leg
1/8" dowel rod
2.1/2" wheels
WILD DEUCE
Twin Eng. r/c for 2½A
By E. D. R. SIMPSON
Engine pods shaped from two blocks of balsa and hollowed out
6° right side thrust in this engine
6.1/4"
5.3/4"
Cox .049 engines
Scale 1 : 7
1/4" x 1" T.E.
No offset in this engine
1/4" x 3/8"
Fuel tank
3/16" x 1/4"
47.1/2" wingspan
Section A - A
3/8" sq. L.E.
1/8" plywood booms
Dural engine bracing strips
3/16" top spar
Dural sheet undercarriage
Medium block balsa wing tips
7.3/4"
Tail section
Wing section
Wing and tail sections scale 1 : 2

CHICAGO AERONAUTS OLD TIMERS' CONTEST

Photographed by Dick Stouffer

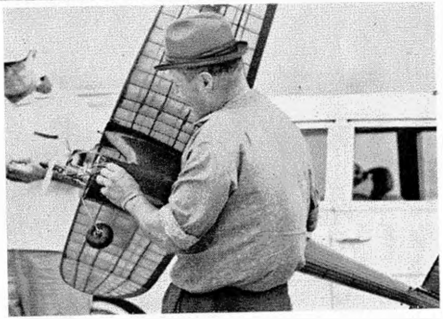
Wayne Cain with Ken Willard's "Cavu", Arden 09 ignition, and Austin timer complete a true vintage subject with the old style features we recall with fond affection.



Ken Tillou launches his "Buzzard Bombshell" with Fox .35 Glow engine installed. This Konefes design was a Nationals winner, and set a trend in cabin power models.

Chuck Borneman, Kokomo, Indiana Aeromodellers with ignition Zipper at Launch. Goldberg's Zipper was first of the Pylon power designs.

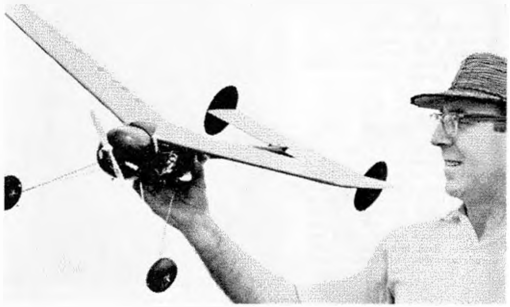
Modified Zipper with Forster 29 ignition, engine by Frank Cisco. Fuselage is simplified from ellipse with stringers to diamond cross section.



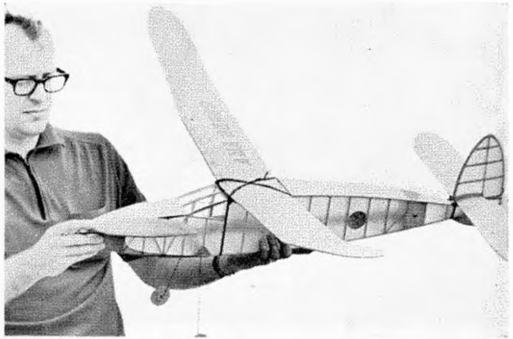
Milt Burley with Orwick .60 ignition and "Sailplane" by Goldberg, the most famous of all big power models, and a grand flier.

Dick Lyons, Libertyville, Illinois with Frank Ehling's "Midget Gas Winner" from April 1940. T.D. .049 Golden Bee engine in it may be modern but the design still carries on the old atmosphere.

Claude Ditto, Milwaukee, Wisc., with O&R 29 ignition 1939 Zipper from original kit. The Zipper was a very popular kit model, having the elegance of elliptical surfaces and sections with the then "new" pylon lay-out.

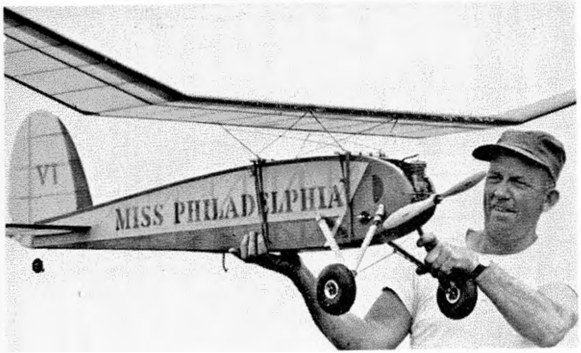


J. E. DeYarman, Milwaukee, Wisc., holds his Flying Aces "Gas Flea" by Paul Plecan T.D. 049 engine may look weird but way back, this was "it" for a while!

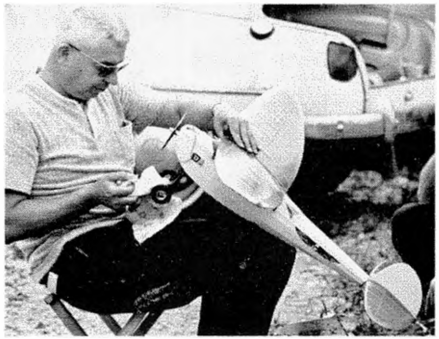


Joe McCarthy, Wauwatosa, Wisc., with his Korda Wakefield. Was there ever a more famous, or satisfyingly simple rubber model to the "Wakefield" specification!

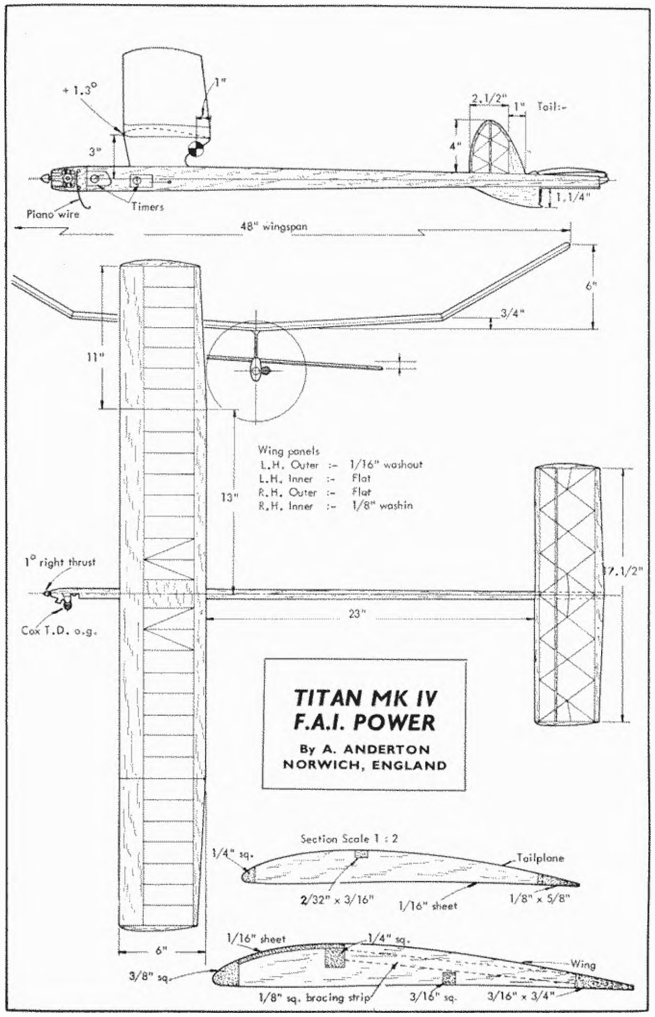
Ed Rangus with his "Buzzard Bombshell" and Pacemaker 59 ignition engine. Weight 4½ pounds. They really go—these Bombshells, note high set wing.

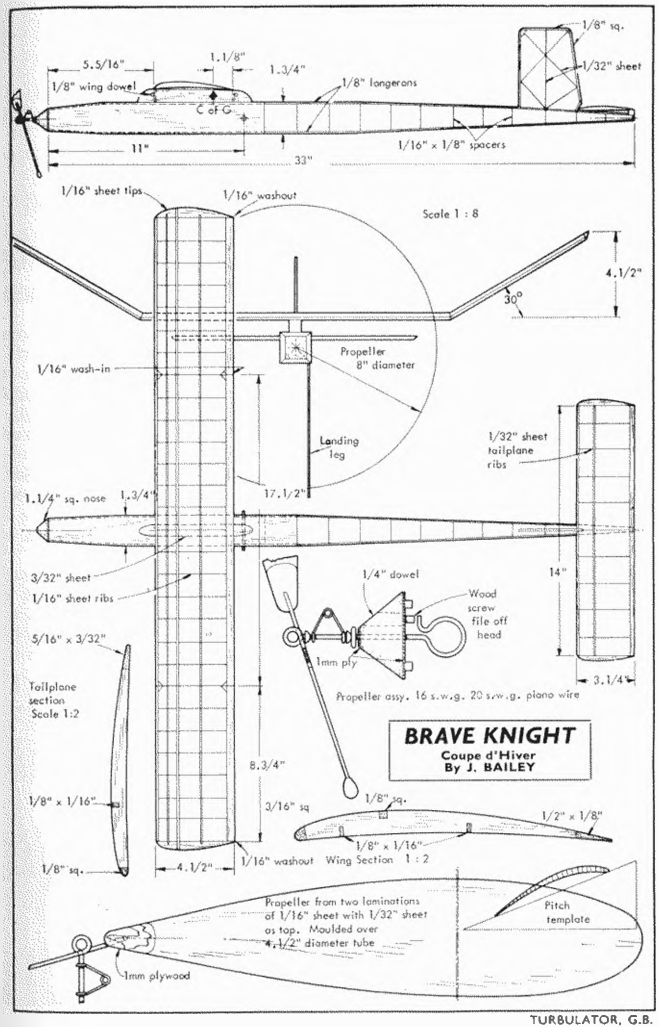


Joseph Beron, Cicero, Ill., with 1937 "Miss Philadelphia". Super Cyclone Engine ignition. 7 9" span with 14" chord. Weight 5 pounds, all the tradition of early undercarriage and wire Cabane design.



Dick Lyons, Libertyville, Illinois with Gordon Murray's "The Answer" T.D. 049 engine—a truly lovely model.





TURBULATOR, G.B.

At the British National Championships, Peter Waters lands his fast "Shoelace" Racer after winning demonstration event. Model powered by potent K. & B. 40 R/C Motor and equipped with Minx Astromite VI proportional.

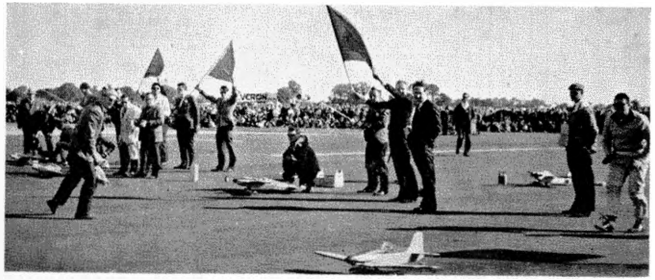
GOODYEAR PYLON RACING THE R/C BOOM EVENT

RADIO control pylon racing has been with us for some years now. As originally planned, the event was arranged so that racers flew the course individually against a stop watch—not much fun really. It is for this reason this brand of R/C pylon racing never quite achieved real popularity.

Few R/C enthusiasts however, have not imagined the thrill of racing R/C models simultaneously, and it is probably inevitable that such a competition should eventually come into being. First to put the idea into practice were a group of Californian R/C'ers, the central figure of whom was Jerry Nelson, a well-known American R/C flyer.

The idea was to pattern models after the famous full size Goodyear racers of the '40s and '50s and race them over a set course simultaneously. Having outlined the model specifications, Jerry set to and designed several near scale models, plans for which he subsequently offered for sale, and it is probably due to this enterprise that the Goodyear R/C event received the initial boost which set it on the way to popularity.

Goodyear racing was demonstrated at the 1966 British National Championships, R.A.F. Hullavington, Wilts. Here Peter Waters starts one of the qualifying heats.



To organise this new competition, Jerry Nelson and friends organised the National Miniature Pylon Racing Association, (N.M.P.R.A.) to further the event, allotting racing numbers to members.

The N.M.P.R.A. rules call for a model with a wing area of not less than 450 sq. in. including the centre section where the fuselage seats. The machine must not weigh less than 4½ lbs. and not more than 6½ lbs.

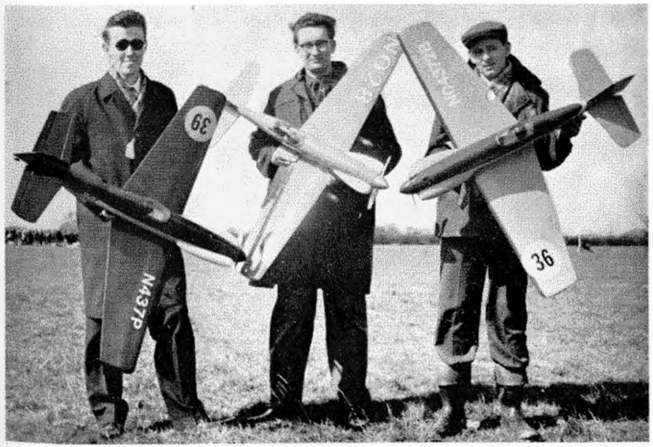
Although originally a maximum wing span was imposed, this was subsequently lifted but even so wing spans of Goodyear racers rarely exceed 54 in. in span. The fuselage must have a minimum depth at the cockpit of 7 in. and a minimum width of 3½ in. at the same point. The engine must be at least partially cowled and dummy side cheeks are compulsory.

Maximum engine capacity is ·40 cu. in. It must be a stock production type manufactured in quantities greater than 100 units, and may not be tuned or reworked. The motor must also have an effective throttle which allows the model to taxi on the ground.

One of the objects of the N.M.P.R.A. rules is to provide a good looking model that has the appearance of the full size 190 cu. in. Goodyear race machines. The object is to force the modeller to produce a model that looks like a full size racer and to prevent the degeneration in appearance that has occurred in control line team racing.

This does not prevent the modeller from designing a "prototype" machine providing it embodies the general appearance characteristics of the full size machines. However, in order to encourage adherence to scale, the N.M.P.R.A. rules provide a handicap system which will give the accurate scale model a head start.

Three LARCAS club members who have competed vigorously in 1966 British Goodyear events. Left to right: Barry Purslow, D. Arthur and Derek Brunt—all with Cosmic Wind racers.



Left: Coming in fast of a dead-stick landing—D. A. Doust's Denight Special, caught in action at the 1966 Bristol R/C M.A.C. Annual Rally.

Below: Bristol R/C M.A.C. were first to organise Goodyear race event in Britain. Below left: G. Warren's Lil'Knarf gets off to a good start. Below right: At the same meeting, Roy Yates, Eastcote, flew Orbit 10 equipped Aeolus machine

Opposite: Racers lined up for Goodyear Race demonstration at 1965 U.S. Nats. Note variety in design of racing machines.

For scale models there is a maximum of 10 appearance points (5 for workmanship 5 for finish). A maximum of 20 points will be awarded for scale fidelity, proof of which must be provided by the contestant.

Points are awarded on the following basis:

	Points
1. Fuselage and undercarriage group:	
Side elevation outline	4
Cross section	1
Cockpit detail	1
Engine cowling	1
Landing gear and wheel spats	1
2. Wing group:	
Platform	3
Control surface outline	1
Dihedral	1
3. Tailplane:	
Planform	3
Control surface outline	1
4. Fin and Rudder:	
Outline	2
Control surface outline	1

"Prototype racers may also obtain a 15 second head start through appearance and workmanship points on a basis of 15 points for appearance (workmanship and finish) and 10 points for realism.

This system of judging may seem rather crude, but it must be emphasised that this is not a scale event—the object is merely to preserve the appearance and atmosphere of the full size racing event on which the R/C competition class is modelled and to arrest any degeneration of model appearance for the sake of performance that might harm the popularity of the event.

The models

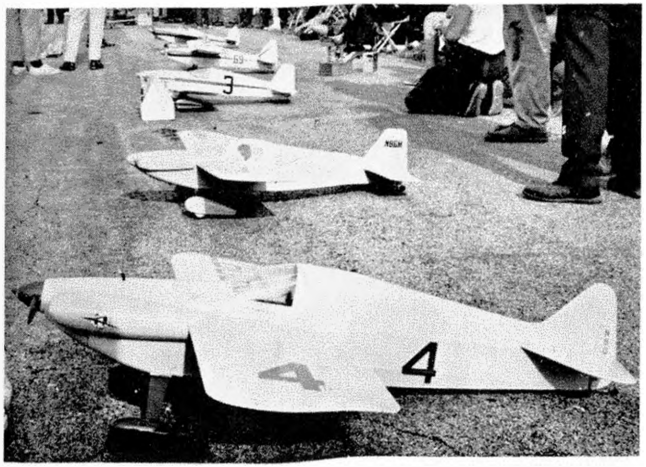
What kind of model does the N.M.P.R.A. rules create? Generally, these have a wing span of 48-54 in. and have a wing area of 460-480 sq. in.

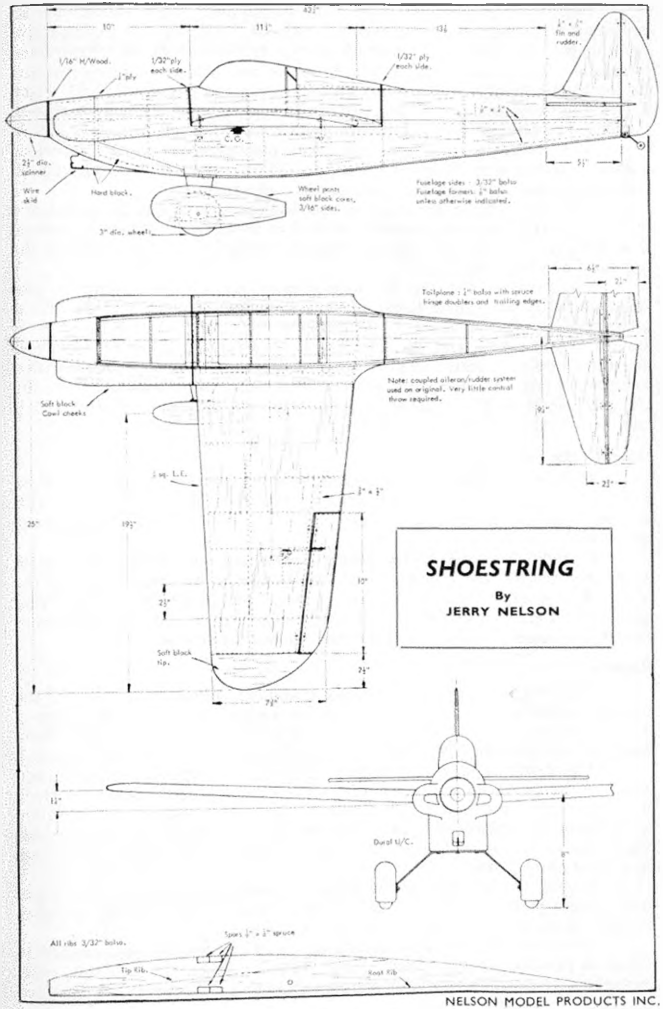
Left: Jerry Nelson designed, near-scale Shoestring is a popular machine. This one, built by Geoff Franklin, Leicester, has Super Tigre 40 R C power and Kraft KP6 proportional radio.

Below: Interesting Goodyear Racers seen at the 1965 U.S. Nationals. At front, Steve Witman Bonzo, near Scale machine, and behind a "prototype" design Li'Knarf.

Mostly they are scale-like caricatures of the full size Goodyear racers usually with rather sleeker fuselages and less pronounced side cheeks. All carry wheel spats.

Construction is simple, following general R C practice. Most racers have flat bottomed wing sections. This is the practice originally adopted in Jerry Nelson's designs and has become generally accepted. The wing sections are very thin, and consequently the wing usually relies on its all balsa sheet skinning for most of its structural strength, since there is room for wing spars of only very shallow depth. The centre section should be further strengthened with wide bandage or glass fibre cloth.





Full house proportional radio control equipment will of course offer an advantage with these models as with any other R C aircraft, but a competitive performance can however, be achieved with only six channel non-proportional multi gear. In fact, the first N.M.P.R.A. contest race held in California was won by Joe Martin flying a six channel reed radio equipped Denight Special, which defeated all the proportional equipped opposition—trimming and practice won the day. The Denight Special has now been kitted by Sterling Models in U.S.A.

Most Goodyear racers use maximum displacement engines for obvious reasons, but during the 1966 contest season, ·35 racers here in Britain have been putting up some creditable performances in competition.

An obvious query regarding the powerplant limit is why the choice of a ·40 cu. in. maximum displacement—why not go to ·45 cu. in. to take in all those now outdated ·45 cu. in. glow motors which just a few years ago were used for the big multi aerobatic machines?

The answer is that the ·45s were sloggers, not revvers, designed to turn large propellers and handle larger and heavier loads. The 35s and 40s on the other hand rev fast—a K&B 35 for instance will turn a 10 · 6 in. prop. at around 13,000 r.p.m., and an O.S. H40 R C (greatly favoured by Goodyear racers) will do even better. This is what we want and it is even probable that some of the best ·29 motors would be of good use to the Goodyear event—the ETA 29 comes readily to mind as a possible candidate and throttles well if modified to take a Johnson Automix Carb.

How do the racers perform?

It is quite clear that the model specifications laid out in the N.M.P.R.A. rules have created an entirely new kind of model—small, light, fast and with all round manoeuvrability that rivals the full-house multi competition aerobatic machines.

Correctly trimmed, and assuming a reasonable pilot ability, these small, convenient models are a thrill to fly. Originally, it was suggested that the N.M.P.R.A. specifications would create a model with inherently vicious flying qualities, but such has not been the case, provided that weight is not allowed to escalate too much—a 5½ lbs. model is not really difficult to fly.

Racing

The event is run over a narrow triangular course, each point of the triangle marked with a pylon. The apex pylon is placed 606 ft. from the centre of the base, and the two base pylons placed 50 ft. either side of the base line centre. Races are run over ten laps, covering a total distance of 2½ miles (see diagram).

The course is laid out so that the apex of the triangular course is into wind. Although raced simultaneously, models actually race against the clock and their times for the course then posted. For safety reasons, the racers are not released simultaneously, but at intervals of five seconds, and it is for this reason that models are judged on time taken to negotiate the course, rather than on a "first home" basis.

In spite of this however, the effect of model racing against model is not lost, because machines tend to "pace" each other and the challenge therefore becomes to overhaul every racer you come up against.

Obviously, the best racing technique is to fly as tight a course around the pylons as possible without actually cutting a pylon short. In each race, competitors are given colours (usually corresponding to Tx. frequency). Pilots then

Précis of N.M.P.R.A. Rules and Model Specifications.

Objective

The purpose of this event is to cover the prescribed course at the highest possible rate of speed with a radio controlled model aeroplane patterned after the 190 cubic inch class racing aeroplanes commonly known as the Goodyear pylon racers. Race results will be posted in miles per hour.

Engines

Total piston displacement must not exceed .40 cu. in. Engine must be a stock production engine that has been produced in quantities greater than a hundred units. Any changes other than modifications or changes in the throttle mechanism will not be allowed. If any changes are found the entry is subject to disqualification. The engine will be equipped with an operating throttle that will allow the model to taxi at a rate of speed less than a fast walk.

Fuel Tank And Fuel

Must have a minimum of 4 oz. capacity but need not be filled to capacity. Only commercially available fuels may be used.

Fuselage

The fuselage will have a minimum outside width of 3½ inches at the location of the pilot. The ship will have a minimum height of 7 inches at the location at the pilot. The engines will be at least partially cowled with a minimum of half the bottom of the crankcase hidden.

Spinner

The model will have rounded propeller spinner of at least 1½ inches diameter. This applies to a conventional tractor engine installation.

Landing Gear

Non-retractable type. Wheels must be 2⅜ inches in diameter or larger. At least two wheels of the specified size must be used. Auxiliary or third wheel on tricycle type may be of any size but not retractable. A positive means of steering on the ground will be provided.

Cockpit

A scale like cockpit will be provided. A solid or painted cockpit canopy will be allowed. The canopy outline will be such to allow a scale size pilot whose head size is 2 inches from his chin to the top of his head. There will be a clear forward and side vision of the pilot at least ¾ inch from eye level to the top of the enclosure with a pilot in normal sitting position. A pilot need not be installed.

Wings

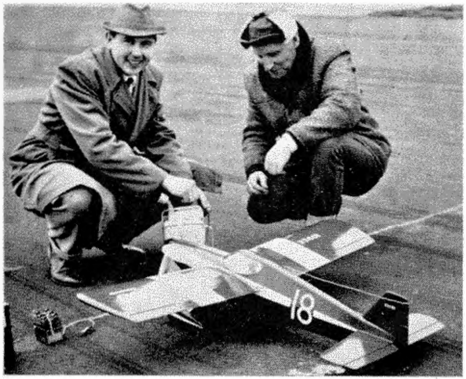
Minimum of 450 sq. in. of wing area must be used, including that area displaced by the fuselage, but not including fillets or stall strips. Flaps are permitted but wing area is to be figured with flaps retracted. Maximum span will be 54 inches.

Weight

Weight less fuel but including all equipment necessary for flight will be at least 4½ pounds.

Racing Numbers

Racing numbers may be obtained from the National Miniature Pylon Racing Association secretary. The use of these numbers is highly recommended. The numbers are located on the upper left and lower right hand wing panel facing towards the left side. The number will be right side up with the model in a left bank. The numbers will be at least 3 inches high on the wings.



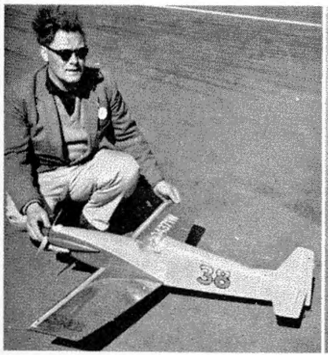
Fast racer seen at 1966 rallies was Hris Lil' Knarf by G. Warren, Reading. 5 lb. model used F. & M. Digital 5 radio and U.S.40 power.

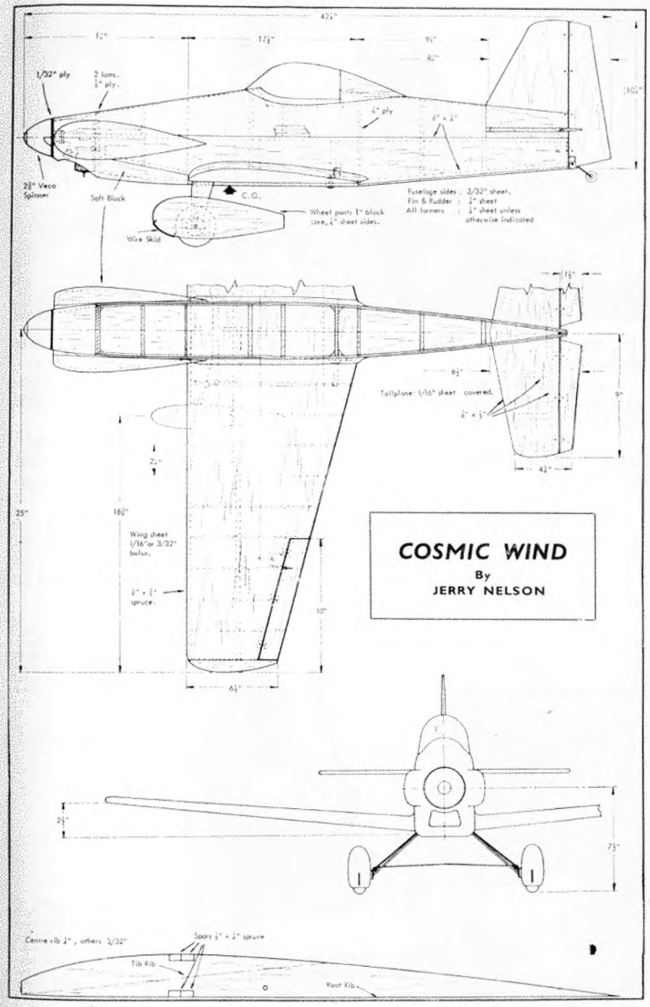
Below left: Smart Aeolus "prototype" design built by Allan Whitaker for Metz 10 radio. Prototype Aeolus designed by Dick Riggs, U.S.A., managed 119 m.p.h. Below right: another Lil' Knarf by Roger Hargreaves uses O.S.40 motor and Citizen-Ship A.P. proportional. Model is Monokote covered.

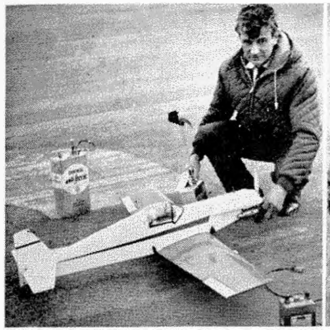
position themselves with their callers near the down wind pylons, where marshals, each with a coloured flag, signal when a particular model has reached the upwind pylon. At this point, the pilot cuts the pylon as tight as possible to enter the down wind leg, to the down wind pylons, to turn about ready for another lap.

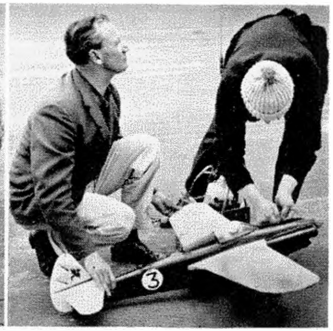
Naturally, the tightest course ensures that the 10 laps are negotiated in as short a time as possible, and during the 1966 contest season, it has become quite obvious that a slower model, flying a low, tight course can outpace a faster machine flying a loose course around the pylons.

The N.M.P.R.A. rules boldly discourage specialisation with the object of providing a model which is as much for the Sunday afternoon fly-around as for roaring around the pylons. Since most racers turn out around the 50 in.









wing span mark, they transport very conveniently, often without even taking off the wing.

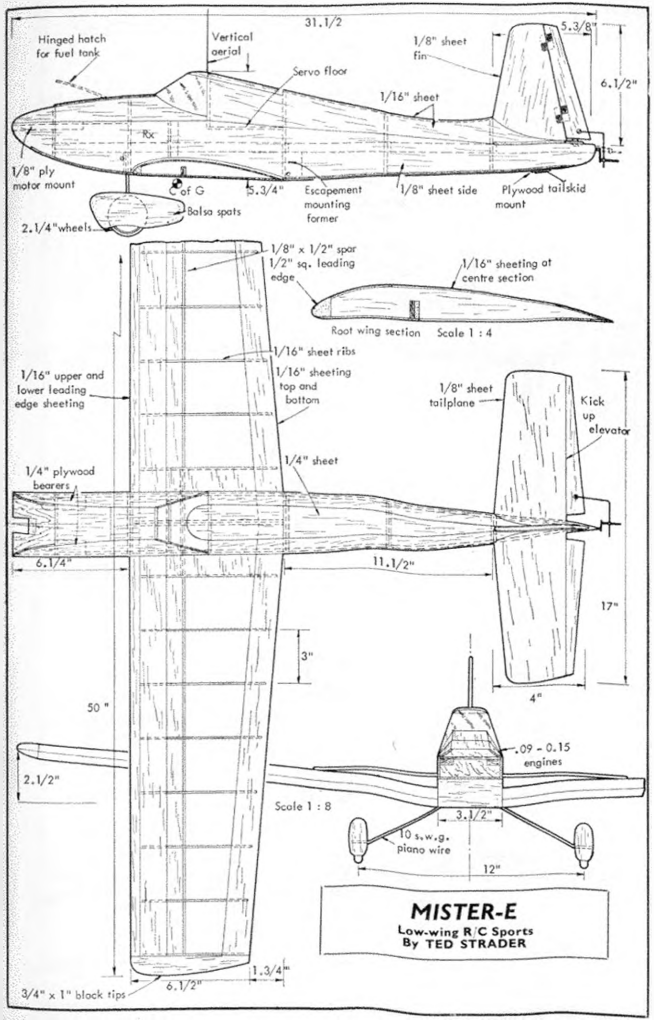
It is not necessary to use the most expensive radio equipment—six channel gear is perfectly adequate, you just eliminate rudder or couple rudder and ailerons either mechanically or electrically.

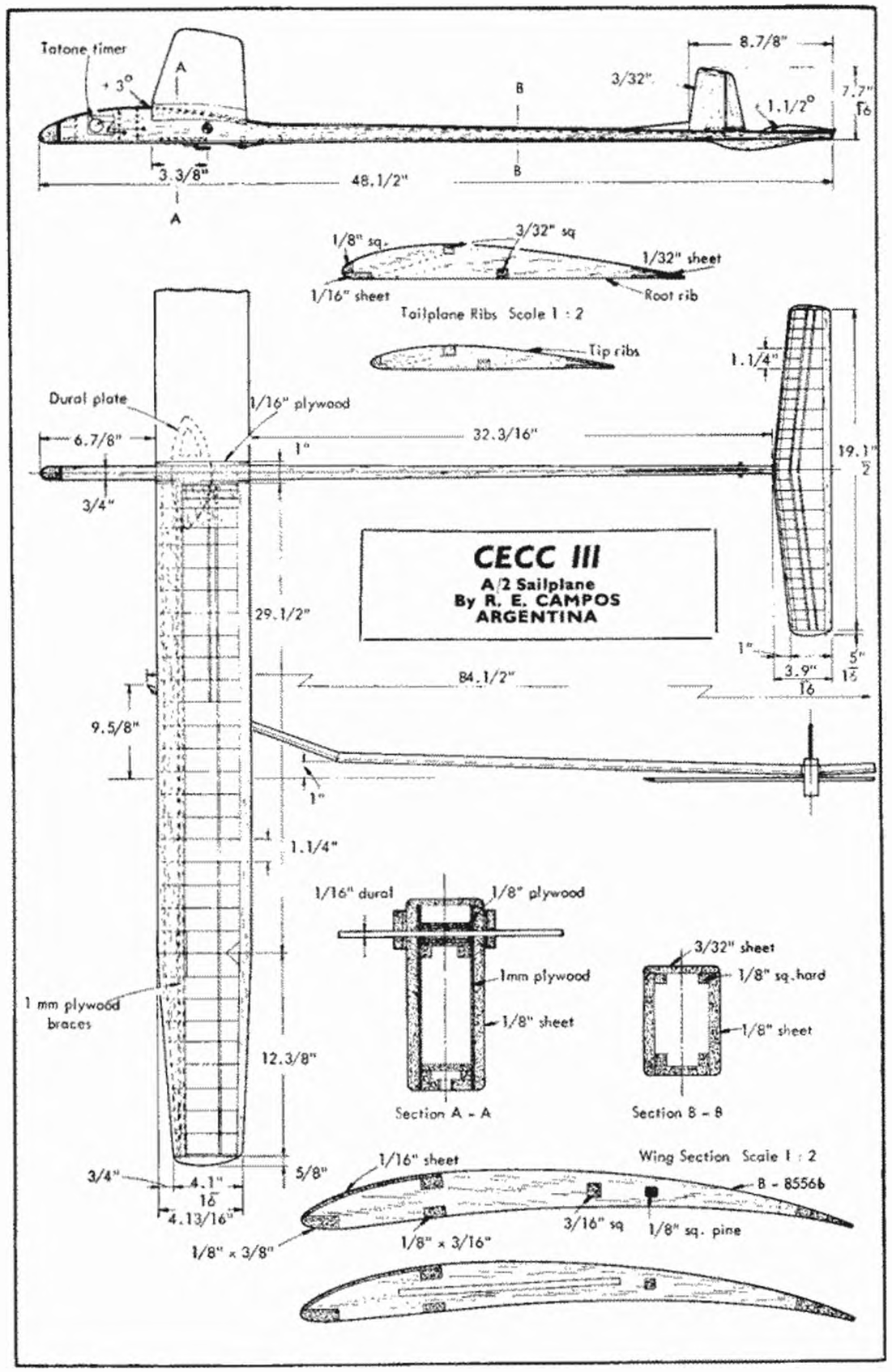
You don't have to be an expert flyer. Flight-wise all you do is fly straight and then turn left to be in the contest. It's not necessarily the fastest model that wins, because pilot ability, which you accumulate with practice counts considerably.

In other words, the Goodyear event has every indication of being the long awaited event designed for every R/C'er. The possibilities are endless. The full size American Bendix and Thompson Trophy races lend themselves to similar treatment, and in Britain there's the Kings Cup Air Race, with all its colourful machines.

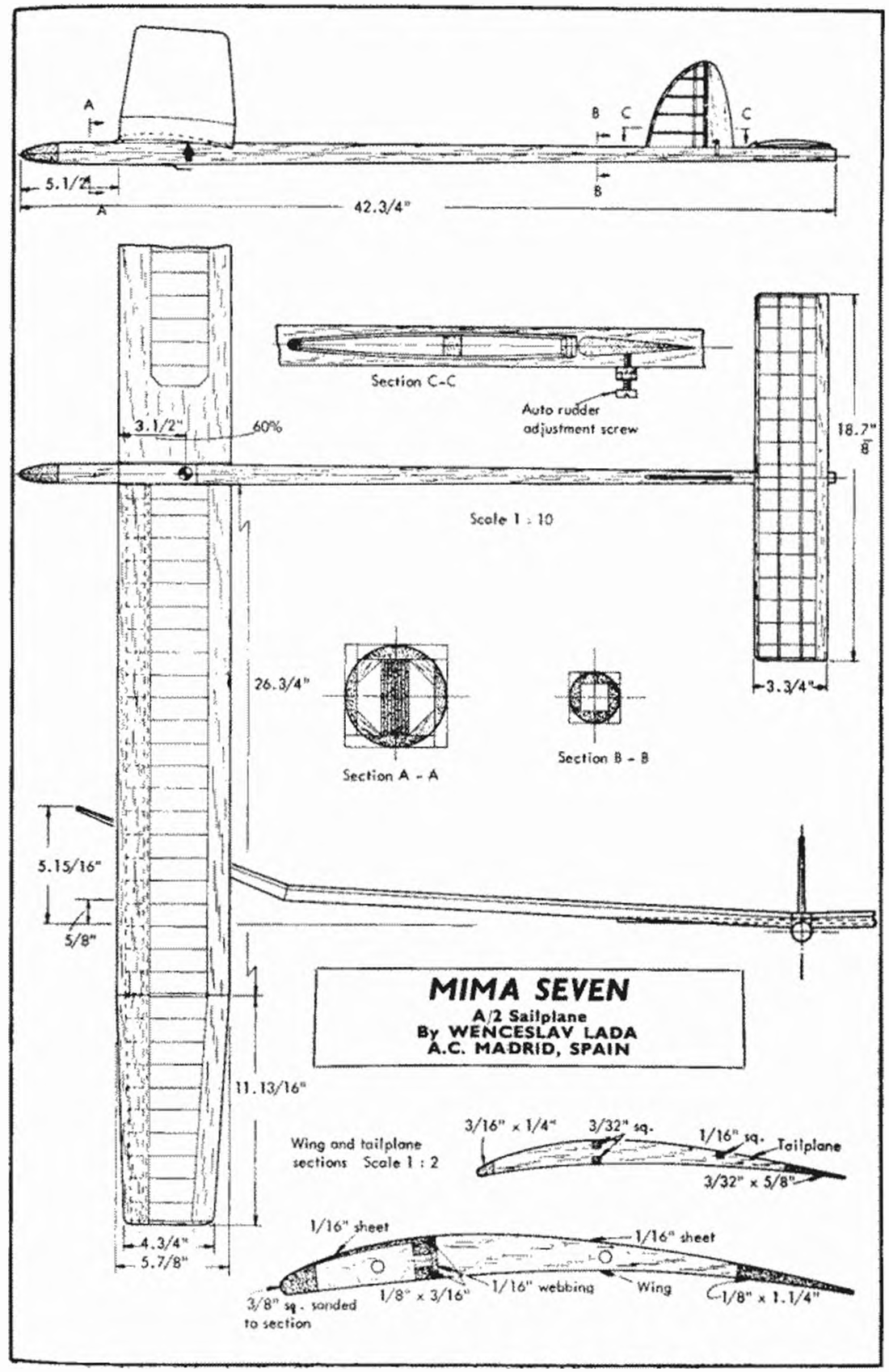
Above left: Another Aeolus racer by Peter Gardner, Buccaneers M.A.C. used Bonner Digimite proportional R C equipment. Above right: Jerry Nelson designed Shoestring is popular. This one seen at Bristol R C M.A.C. Annual Rally 1966.

Left: D. A. Doust of Bristol R C M.A.C. with nicely finished Danight Special from Sterling kit, has performed well at races in Britain during 1966 season. Uses Orbit 10 radio and O.S.40 power.

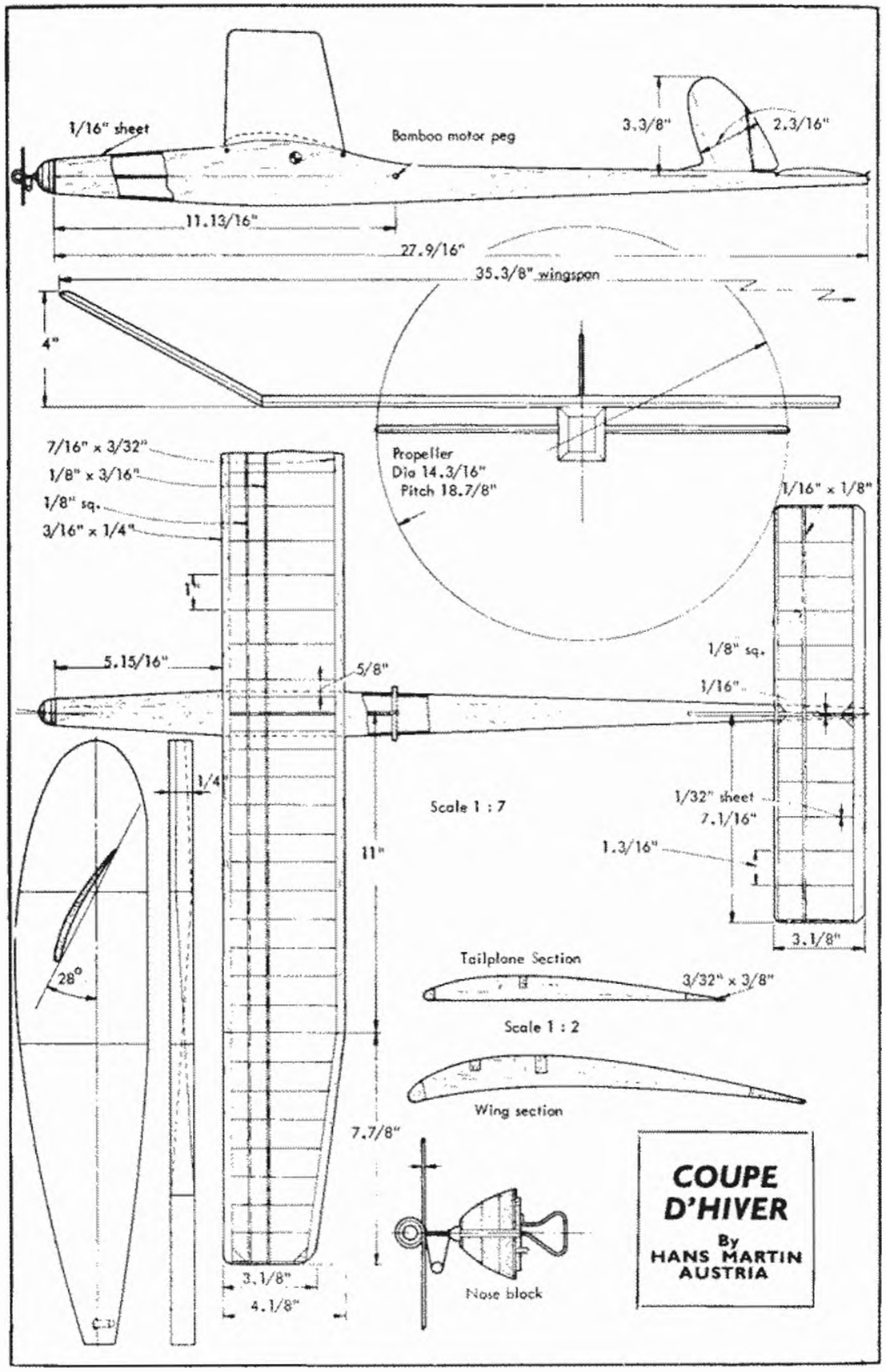




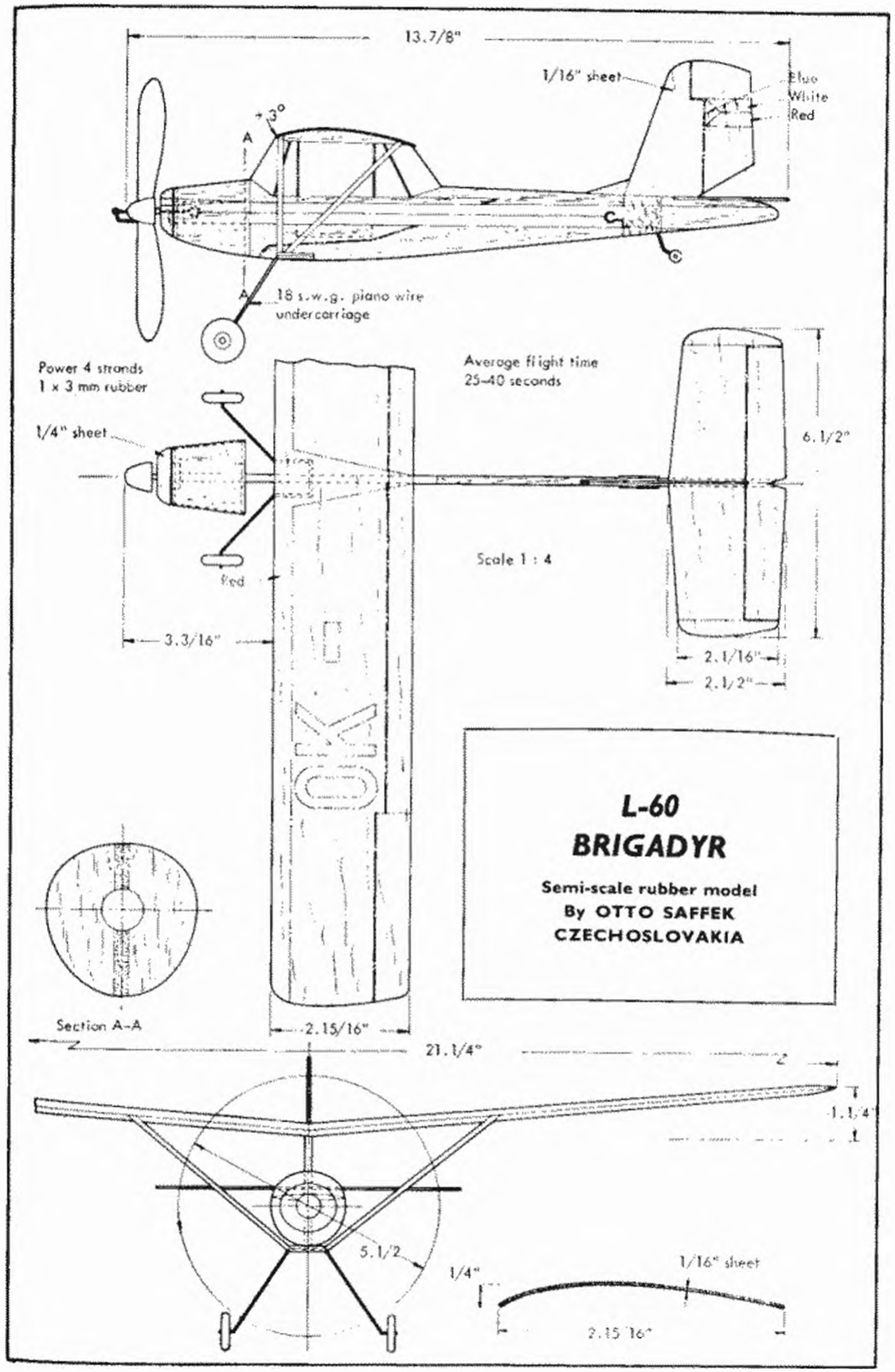
ARGENTINA



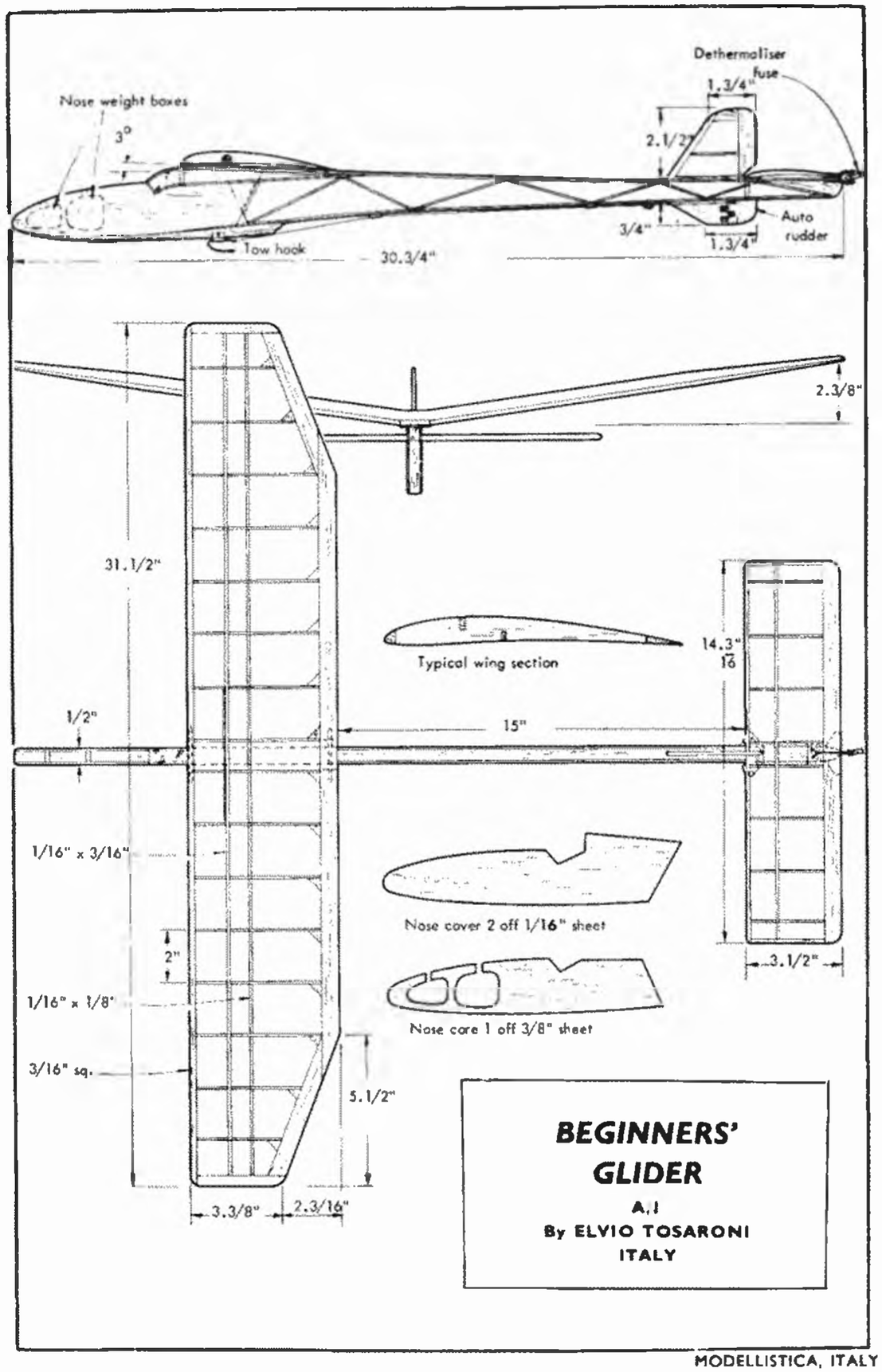
AVION, SPAIN

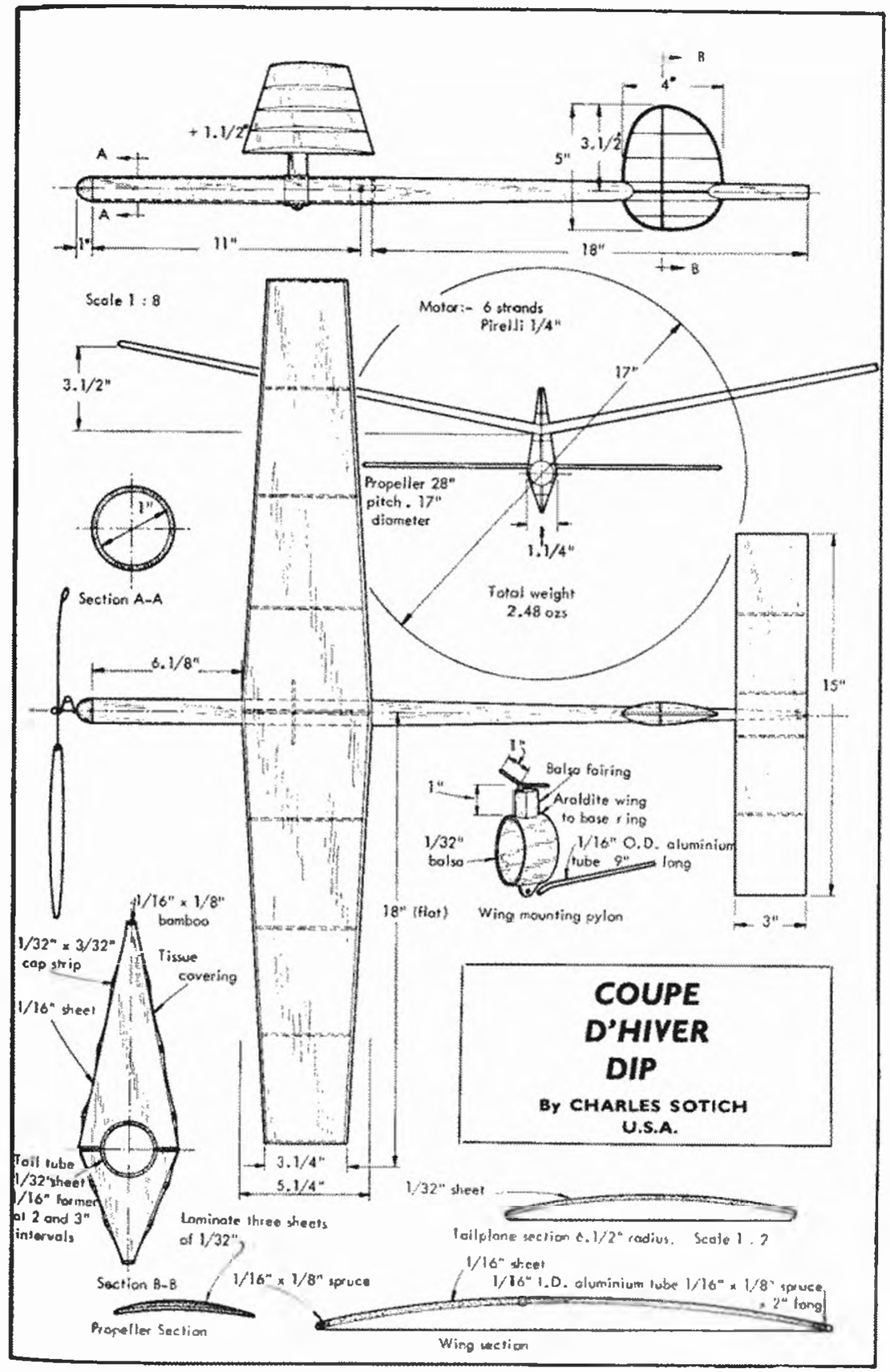


MODELLEZES, HUNGARY

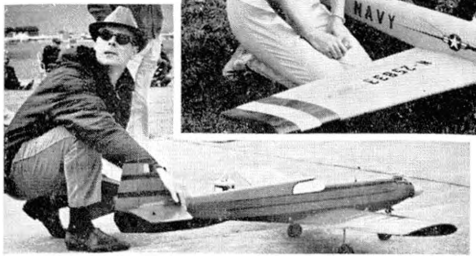


MODELAR, CZECHOSLOVAKIA


Dethermaliser fuse
1.3/4"
Nose weight boxes
3°
2.1/2"
3/4"
1.3/4"
Auto rudder
Tow hook
30.3/4"
2.3/8"
31.1/2"
Typical wing section
14.3/16"
1/2"
15"
1/16" x 3/16"
Nose cover 2 off 1/16" sheet
2"
1/16" x 1/8"
Nose core 1 off 3/8" sheet
3/16" sq.
5.1/2"
3.1/2"
3.3/8"
2.3/16"
BEGINNERS' GLIDER
A.1
By ELVIO TOSARONI
ITALY


B
4"
+ 1.1/2"
3.1/2"
5"
A
A
1"
11"
18"
B
Scale 1 : 8
Motor:- 6 strands Pirelli 1/4"
17"
3.1/2"
Propeller 28" pitch . 17" diameter
1"
1.1/4"
Section A-A
Total weight 2.48 ozs
6.1/8"
15"
1"
Balsa fairing
1"
Araldite wing to base ring
1/32" balsa
1/16" O.D. aluminium tube 9" long
1/16" x 1/8" bamboo
18" (flat)
Wing mounting pylon
3"
1/32" x 3/32" cap strip
Tissue covering
1/16" sheet
COUPE D'HIVER DIP
By CHARLES SOTICH
U.S.A.
Tail tube 1/32" sheet 1/16" former at 2 and 3" intervals
3.1/4"
5.1/4"
1/32" sheet
Laminate three sheets of 1/32"
Tailplane section 6.1/2" radius. Scale 1 . 2
Section B-B
1/16" x 1/8" spruce
1/16" sheet
1/16" I.D. aluminium tube 1/16" x 1/8" spruce 2" long
Propeller Section
Wing section

At the 1965 World Radio Control Championships Dr. Ralph Brooke of U.S.A. retained his World Champions crown first gained in 1963. Dr. Brooke, seen at right flew his original "Crusader" design using prototype Orbit 7-14 Digital proportional equipment and Merco 61 powerplant.



Surprising second placer at the 1965 World R C Championships was Belgium Chris Teuwen flying his original "Trouble" seen left, equipped with Bonner Digimite proportional radio.

WORLD CHAMPIONSHIPS FOR RADIO CONTROL MODELS

August 8th-15th, 1965 (Ljungbyhed, Sweden)

			Round 1	*Round 2*	*Round 3*	*Total*
1	R. Brooke	U.S.A.	6,151	7,008	7,188	20,347
2	C. Teuwen	Belgium	6,168	7,216	6,609	19,993
3	C. Weirick	U.S.A.	6,217	6,403	7,269	19,889
4	P. Stephenson	Norway	5,997	6,103	6,779	18,879
5	**C. Olsen**	**Great Britain**	6,005	6,066	6,257	18,328
6	Z. Ritchie	U.S.A.	5,404	6,095	6,211	17,710
7	R. Chapman	Canada	5,848	5,013	6,732	17,593
8	**S. Foster**	**Great Britain**	5,092	5,476	5,862	16,430
9	K. Blauhorn	W. Germany	4,691	5,313	6,168	16,172
10	H. Tom	Canada	5,616	5,504	4,930	16,050
11	J. von Segebaden	Sweden	5,186	4,939	5,600	15,725
12	F. Bosch	W. Germany	5,654	2,287	6,974	15,455
13	C. Sweatman	S. Africa	4,675	4,958	5,578	15,211
14	W. Hichcox	Canada	4,329	4,804	5,305	14,438
15	G. Haegman	Belgium	4,649	5,176	4,454	14,279
16	H. Rasmussen	Denmark	4,189	4,934	5,140	14,263
17	**P. Waters**	**Great Britain**	3,923	4,560	4,986	13,460
18	E. Corghi	Italy	3,966	5,000	4,438	13,404
19	S. Kato	Japan	4,065	4,826	4,502	13,393
20	J. Wessels	S. Africa	4,659	3,862	4,574	13,095
21	O. Mantelli	Italy	3,826	4,316	4,413	12,555
22	F. Guglielminetti	Italy	3,366	3,390	4,522	11,278
23	J. Hackhe	Denmark	3,469	3,844	3,927	11,240
24	K. Bauerheim	W. Germany	5,152	5,315	535	11,002
25	C. Culverwell	S. Africa	5,276	1,065	4,638	10,979
26	J. Levenstam	Sweden	3,590	3,303	3,749	10,642
27	A. vander Burg	Holland	3,708	2,261	4,127	10,456
28	J. van Vliet	Holland	845	4,569	4,964	10,378
29	M. Kato	Japan	4,388	4,950	988	10,326
30	U. Tonnessen	Norway	3,256	3,066	3,280	9,602
31	R. Dilot	Sweden	3,643	3,032	2,914	9,589
32	J. de Dobbelier	Belgium	1,395	3,243	4,697	9,317
33	E. Andersen	Denmark	2,850	938	3,904	7,692
34	F. Martens	Holland	2,961	2,707	485	6,153
35	J. Michalovic	Czechoslovakia	1,274	2,072	1,339	4,685

Highest placing British flier at the 1965 World R C Championship was Chris Olsen, who placed fifth to beat many proportional operators with his F & M Midas Matador equipped "Upset".

TEAM POSITIONS

1	U.S.A.	57,946
2	**Great Britain**	48,277
3	Canada	48,081
4	Belgium	43,589
5	West Germany	42,629
6	South Africa	39,285
7	Italy	37,237
8	Sweden	35,066
9	Denmark	33,195
10	Norway	28,481
11	Holland	26,987
12	Japan	23,719
13	Czechoslovakia	4,685

Team Positions—TEAM RACING

1	Finland	876
2	Austria	876
3	Italy	886
4	**Great Britain**	889
5	France	901
6	Hungary	932
7	Spain	943
8	W. Germany	994
9	Switzerland	1,098

13th CRITERIUM OF ACES

Held at Biersct, Belgium, August 28th 29th, 1965

TEAM RACING

			Heat 1	*Heat 2*	*Final*	*Engine*
1	**Place-Haworth**	**Great Britain**	**4 : 43**	4 : 47	10 : 07·8	Eta 15 Mk. II
2	Stockton-Jehlik	U.S.A.	4 : 59	**4 : 41**	10 : 11·2	Super Tigre G20D
3	Sundell-Sundell	Finland	5 : 09·5	**4 : 43**	11 : 48	Oliver Tiger Mk. III
4	Fabre-Favre	France	5 : 1	**4 : 44**		Eta 15 Mk. II
5	Fontana-Amodio	Italy	5 : 37	**4 : 44**		Super Tigre G20D
6	Jarvi-Aarnipalo	Finland	5 : 18	**4 : 45**		Eta 15 Mk. II
7	Fischer-Meusburger	Austria	—	**4 : 45**		Bugl
8	Mohai-Markotai	Hungary	**4 : 47**	4 : 48		Moki TR-6
9	Honenberg-Turk	Austria	4 : 53	4 : 48		Bugl
10	Tinef-Raschoff	Bulgaria	4 : 48	6 : 22		Super Tigre G20D
11	Bonnin-Carreras	Spain	4 : 56	4 : 50		Super Tigre G20D
12	Ahlstrom-Samuelson	Sweden	**4 : 50**	—		Oliver Tiger Mk. III
13	Alseby-Hagberg	Sweden	5 : 28	**4 : 55**		Eta 15 Mk. II
14	Costa-Marcelli	Italy	5 : 05	**4 : 59**		Super Tigre G20D
15	Bador-Bador	France		4 : 59		
16	**Turner-Hughes**	**Great Britain**		5 : 02		
17	Kroff-Russ	Austria		5 :03		
18	Cipolla-Cipolla	Italy		5 : 03		
19	**Balch-Dell**	**Great Britain**		5 : 04		
20	Methemeier-Methemeier	Holland		5 : 04		
21	Arroyo-Ruiz	Spain		5 : 05		
22	Trnka-Drazek	Czechoslovakia		5 : 05		
23	Palho-Nore	Finland		5 : 08		
24	Schevin-Souliac	France		5 : 18		
25	Matile-Meier	Switzerland		5 : 21		
26	Gambocz-Toth	Hungary		5 : 22		
27	Purgai-Katona	Hungary		5 : 23		
28	Schluter-Fromm	W. Germany		5 : 24		
29	Lenzen-Rumpel	W. Germany		5 : 27		
30	Nenin-Creola	Belgium		5 : 36		
31	Gafner-Gafner	Switzerland		5 : 37		
32	Lutkat-Lutkat	W. Germany		5 : 43		
33	Comas-Parramon	Spain		5 : 48		
34	Vanderrijcke-Vanderbeke	Belgium		6 : 49		
35	Galli-Wittwer	Switzerland		7 : 20		

Fastest heat times only for places 15 to 35

SPEED

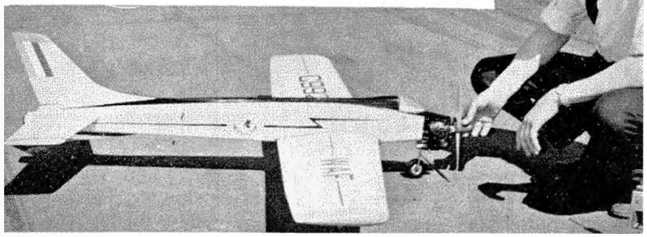
			Round 1 m.p.h.	Round 2 m.p.h.	Round 3 m.p.h.	Engine
1	I. Toth	Hungary	**140·7**	—	—	Moki S-3
2	M. Sebestyen	Hungary	**135·6**	136·4	—	Moki S-3
3	J. Sladky	Czechoslovakia	135·5	130·8	**135·6**	M.V.V.S. 2·5 RL
4	R. Ekholm	Finland	127·8	131·6	**133·3**	Super Tigre G 15
5	J. Magne	France	**131·6**	120·3	125·0	Super Tigre G 20
6	A. Malik	W. Germany	131·6	131·6	—	Super Tigre G. 20
7	R. Meibach	W. Germany	117·1	126·4	**130·8**	Super Tigre G 20
8	G. Kriszma	Hungary	117·7	**130·8**	—	Moki S-3
9	G. Tinef	Bulgaria	**130·1**	129·3	—	Super Tigre G 15
10	H. Freundt	Austria	**130·1**	—	—	Bugl
11	Rasckoff	Bulgaria	**128·6**	—	—	Super Tigre G 15
12	Z. Pech	Czechoslovakia	127·0	**127·8**	125·0	M.V.V.S. 2·5 RL
13	J. Vala	Finland	122·9	**125·0**	—	Super Tigre G 15
14	**R. MacGladdery**	**Great Britain**	119·6	**123·6**	—	Super Tigre G 15
15	Jenatton	France		123·1		
16	**K. Lindsey**	**Great Britain**		121·6		
17	F. Zilliken	W. Germany		120·9		
18	H. Hensius	Holland		119·6		
19	Stefanos	Bulgaria		118·4		Fastest times only for places 15 to 23.
20	O. Kiedberg	Sweden		115·9		
21	**B. Jackson**	**Great Britain**		114·7		
22	M. Angeloz	Switzerland		114·7		
23	W. Holle	Holland		96·5		

AEROBATICS

			Round 1	Round 2	Round 3	Total	Engine
1	J. Kari	Finland	3,918	4,252	3,994	12,164	Veco 35
2	L. Van den Hout	Holland	4,006	3,815	3,733	11,603	Veco 45
3	J. Gabris	Czechoslovakia	3,693	3,714	3,976	11,383	M.V.V.S. 5·6
4	K. Seeger	W. Germany	3,731	3,858	3,581	11,170	Fox 35
5	G. Egervary	Hungary	3,724	3,557	3,841	11,122	Veco 35
6	M. Souliac	France	3,571	3,486	3,621	10,678	Fox 35
7	M. Vanderbeke	Belgium	3,407	3,599	3,653	10,659	Fox 35
8	C. Sbragia	Italy	3,451	3,678	3,361	10,490	Fox 35
9	C. Arbuffi	Italy	3,286	3,831	3,355	10,472	Fox 35
10	L. Compostella	Italy	3,988	4,127	2,314	10,329	Fox 53
11	B. Metkemeijer	Holland				10,396	
12	A. Kaminski	W. Germany				10,350	
13	G. Masnik	Hungary				10,296	
14	P. Tupker	Holland				10,142	
15	T. Vellai	Hungary				10,098	
16	M. Feit	France				9,945	
17	M. Salathe	France				9,797	
18	Milanoff	Bulgaria				9,435	
19	**M. Reeves**	**Great Britain**				9,237	
20	J. Kalev	Bulgaria				9,175	
21	J. Bartoli	Monaco				8,605	
22	J. Trnka	Czechoslovakia				8,115	
23	R. Pfuur	W. Germany				8,108	
24	**J. Mannall**	**Great Britain**				7,858	
25	P. Cohen	Belgium				7,396	
26	H. Tork	Austria				7,337	
27	G. Collignon	Belgium				7,228	
28	C. Galli	Switzerland				6,790	
29	A. Jankov	Bulgaria				6,686	
30	C. Walter	Switzerland				3,888	
31	Patiala	Finland				3,249	

Team Positions—SPEED

1	Hungary	7	France
2	W. Germany	8	Holland
3	Bulgaria	9	Austria
4	**Great Britain**	10	Sweden
5	Czechoslovakia	11	Switzerland
6	Finland		



One of Britain's foremost multi contest fliers is Peter Waters from South Wales, seen here with latest 67 inch span "Saracen" design equipped with Min-X proportional, which Peter used to win 1966 British National Championships.

AEROBATICS—Team Positions

1	Holland	32,141
2	Hungary	31,516
3	Italy	31,391
4	France	30,420
5	W. Germany	29,628
6	Bulgaria	25,296
7	Belgium	25,283
8	Czechoslovakia	19,498
9	**Great Britain**	17,895
10	Finland	15,413
11	Switzerland	10,678
12	Monaco	8,605
13	Austria	7,337

22nd INTERNATIONAL COUPE d'HIVER CONTEST CHAVENAY, FRANCE

February 27th, 1966

Oskar Ehmann and his "Nikolina" Coupe d'Hiver design were deserving winners of the 1966 International event. Plans for this model were included in December 1964 "Aeromodeller" also available as plan D873 price 3/6 plus 6d post from Aeromodeller Plans Service.

OFFICIAL RESULTS

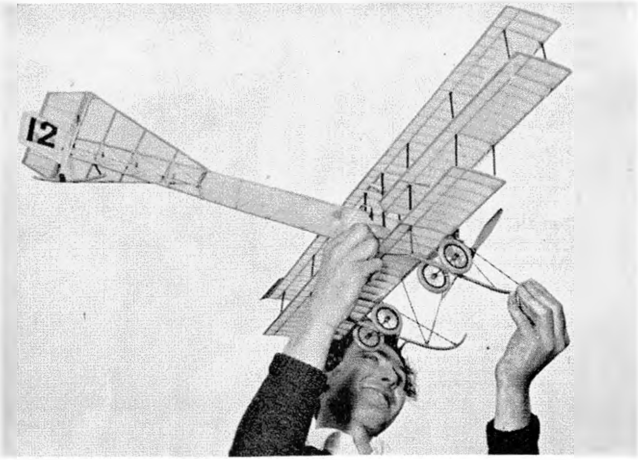
Place	Name	Club	1	2	3	Total
1	Oskar Ehmann	Reutlingen (D)	120	120	115	355
2	**John O'Donnell**	**Whitefield (G.B.)**	111	120	120	351
3	Georges Matherat	Dauphine (F)	112	120	117	349
4	**Shirley Horton**	**Crawley (G.B.)**	120	120	99	339
5	André Meritte	A.M.A. (F)	97	120	120	337
6	Jean-Pierre Templier	P.A.M. (F)	88	117	120	325
7	Charles Luisicic	Paul Andrillon (F)	120	120	83	323
8	F. Monts (Proxy-O'Donnell)	Kansas (U.S.A.)	105	120	91	316
9	**Jack Allen**	**Brighton (G.B.)**	91	104	120	315
10	Jean-Pierre Templier	P.A.M. (F)	120	112	82	314
11	**David Tipper**	**St. Albans (G.B.)**	120	107	85	312
11	Alain Landeau	P.A.M. (F)	120	97	95	312
13	**Henry Tubbs**	**Buildon (G.B.)**	90	120	99	309
14	**Richard Bailey**	**Surbiton (G.B.)**	120	66	120	306
15	Philippe Lepage	P.A.M. (F)	120	120	62	302
16	L. Y. Sonneborn	Amsterdam (N)	120	110	69	299

OTHER BRITISH AND PROXY-FLOWN PLACINGS FOR U.S.A. IN FIRST 75

22	Bruce Rowe	St. Albans (G.B.)	120	88	73	281
24	Bill Horton	Crawley (G.B.)	87	120	65	272
36	Vince Taylor	St. Albans (G.B.)	120	65	66	251
40	Laurie Burrows	Blackheath (G.B.)	120	68	58	246
41	J. Fluehr (Proxy Rowe)	U.S.A.	80	95	69	244
43	D. Linstrum (Proxy Cameron)	U.S.A.	85	88	97	243
46	Jack Allen	Brighton (G.B.)	120	120	—	240
48	Graham Head	Lee Bees (G.B.)	59	120	56	235
49	Dick Johnson	St. Albans (G.B.)	48	120	63	231
52	E. Dolby (Proxy Piav)	U.S.A.	54	70	101	225
53	R. Schroder (Proxy Horton)	U.S.A.	108	58	58	224
57	John Mabey	Lee Bees (G.B.)	120	36	60	216
57	Peter Cameron	Crawley (G.B.)	58	81	77	216
59	R. Taylor (Proxy Tipper)	U.S.A.	82	69	64	215
60	C. Sotich (Proxy Taylor)	U.S.A.	51	91	68	210
61	Graham Head	Lee Bees (G.B.)	96	70	43	299
65	John Mabey	Lee Bees (G.B.)	55	39	105	199
67	H. Struck (Proxy Pierrard)	U.S.A.	112	48	35	195
71	Gordon Cornell	Croydon (G.B.)	42	72	73	187
71	John Dumble	Richmond (G.B.)	42	79	66	187

208 *entries.* 130 *of which made* 344 *official flights*

(F) France, (D) Germany, (N) Netherlands, (G.B.) Great Britain
(U.S.A.) United States of America



D. Jackson of Stockport was first "Mag. Men" scale contest at Old Warden airfield with his terrific replica of the Avro 4 Triplane powered by Amco 87 diesel. Note spoked wheels and scale spacing structure.

CONTEST RESULTS

Results of most S.M.A.E. Contests for balance of 1965 season are included in this report to complete records. Those 1966 events which have been decided before going to press are also included and will be completed in next year's AEROMODELLER ANNUAL.

CHESTER M.F.C. SLOPE SOARING—July 11th, 1965 (Clwyd)

Single Surface R/C		
1 P. Downham	Enfield	
2 P. Teakle	Weston	
3 E. Clutton	Five Towns	
Multi R/C		
1 A. L. Gwynn	LARCAS	
Gosling Trophy		
1 A. Moss	Whitefield	
Junior		
1 Miss Hannay	Wallasey	
Novice Stunt		
1 E. Herbert	Blackburn	584
2 M. Gagg	Handsworth	464
3 M. Scotto	Bilston	124
Combat A		
1 P. Smith	Outlaws	
2 —. Dunker	Madmacs	
Combat B		
1 D. Sizmur	Sidcup	
2 A. Oakley	Madmacs	
A Team Racing		
1 Turner/Hughes	Wharfedale	
2 Davy/Hudson	Wharfedale	
3 Rudd/Balch	Feltham/Hayes	

N.W. AREA BURTONWOOD CRITERIUM—July 25th, 1965 (R.A.F. Burtonwood)

F.A.I. Team Reace		
1 Davy/Hudson	Wharfedale	10 : 40·6
2 Turner/Hughes	Wharfedale	11 : 11
3 Place/Haworth	Wharfedale	Rtd.
B. Team Race		
1 Skitt/Hardcastle	Wolves	9 : 10
2 Laurie/Wallace	Novocastria	10 : 06
3 Dugmore/Bell	Novocastria	Rtd.
Handicap Speed		
1 J. Penton (1·5 c.c.)	N. Sheffield	77·9 m.p.h.
2 M. Smith—(1·5 c.c.)	N. Sheffield	77·4 m.p.h.
3 B. Jackson—(2·5 c.c.)	Worksop	102·6 m.p.h.
Aerobatics		
1 J. Mannall	Lincoln	1,097
2 H. Dowbekin	Horwich	1,063
3 E. Brownlow	Horwich	1,004

EAST ANGLIAN AREA GALA—August 1st, 1965 (R.A.F. Upwood)

Combined F.A.I.		
1 B. Rowe	St. Albans (Wakefield)	13 : 13
2 R. Lennox	Birmingham (Wakefield)	12 : 56
3 G. Lefever	Norwich (Wakefield)	12 : 46
Coupe d'Hiver		
1 D. White	York	5 : 28
2 B. Rowe	St. Albans	4 : 48
3 —. Fleetwood	Hornchurch	4 : 11
Open Glider		
1 A. Young	St. Albans	9 : 00
2 P. Perry	Birmingham	8 : 45
3 J. O'Donnell	Whitefield	8 : 14
Open Rubber		
1 T. Stoker	Baildon	9 : 00 + 7 : 07
2 R. Paveley	Hornchurch	9 : 00 + 6 : 20
3 D. Hipperson	Croydon	9 : 00 + 6 : 12

Open Power		
1 J. West	Brighton	9 : 00 + 6 : 20
2 T. Stoker	Baildon	9 : 00 + 6 : 03
3 R. Monks	Birmingham	9 : 00 + 4 : 51

S.M.A.E. SUMMER GALA—August 8th, 1965 (R.A.F. Odiham)

Davies B Trophy—Class B Team Race		
1 Skitt/Hardcastle	Wolves	8 : 59·4
2 M. Atwell	Chingford	Disq.
2 Laurie/Bell	Novocastria	Disq.
A Team Race		
1 Turner/Hughes	Wharfedale	9 : 09
2 Dell/Fry	Feltham/Hayes	9 : 22
3 Goodhead/Meekins	Deltas	11 : 57
Chuck Glider		
1 Fleetwood	Hornchurch	4 : 02
2 Marriott	Abingdon	3 : 40
3 Bayram	Lincoln	3 : 37
P.A.A. Load		
1 D. Hipperson	Croydon	
Multi R/C		
1 F. Knowles	Surrey R/C	
2 P. Rogers	H. Wycombe	
3 B. Burt	Surrey R/C	
Combat		
1 R. Wilkens	Sidcup	
2 M. Nelson	Cambridge	
3 M. Larcombe	Hayes	
3 N. Tidey	Bald Eagles	
Open Power		
1 K. Glynn	Surbiton	9 : 00 + 5 : 04
2 P. Buskell	Surbiton	9 : 00 + 4 : 07
3 R. Monks	Birmingham	9 : 00 + 4 : 01
Open Glider		
1 L. Larrimore	Lee Bees	9 : 00 + 15 : 13
2 D. Wiseman	York	9 : 00 + 4 : 37
3 J. O'Donnell	Whitefield	9 : 00 + 4 : 35
Open Rubber		
1 A. Wisher	Croydon	9 : 00 + 27 : 26
2 A. Wells	Hornchurch	9 : 00 + 27 : 13
3 D. Hipperson	Croydon	9 : 00 + 27 : 10

SOUTH COAST GALA—August 29th, 1965—(Chobham Common)

Open Rubber		
1 L. Oulds	Crawley	7 : 13
2 J. Allen	Brighton	7 : 09
3 A. Wisher	Croydon	6 : 22
Open Power		
1 M. Gaster	Surbiton	8 : 05
2 G. Cornell	Croydon	7 : 11
3 R. Johnson	St. Albans	6 : 17
Open Glider		
1 D. Glue	Brighton	6 : 59
2 K. Smith	Croydon	6 : 48
3 J. Burke	Norwich	6 : 42

Combined F.A.I.		
1 S. Savini	Wallasey	7 : 29
2 D. Hipperson	Croydon	6 : 36
3 J. West	Brighton	6 : 00
A Power		
1 P. Jellis	Croydon	8 : 04
2 G. Head	Lee Bees	7 : 47
3 J. Bailey	Bristol & West	6 : 31
Tailless Glider		
1 J. Marshall	Hayes	3 : 32
2 H. Torode	C.M	3 : 14
3 J. Kay	Hayes	

WOODFORD RALLY—August 29th, 1965 (Woodford, Cheshire)

Combat		
1 B. Flockhart	Madmac	
2 T. Lee	Wharfedale	
3 L. Scurfield	Tynemouth	
A Team Race		
1 Hudson/Davy	Wharfedale	10 : 38·2
2 Taylor/Jones	Derby	11 : 54
3 Heaton/Ross	Warrington	62 laps
B Team Race		
1 Yates/Hampson	Leigh	7 : 18·5
2 Skitt/Hardcastle	Wolves	8 : 53·5
3 Dugmore/Bell	Novocastria	64 laps
F.A.I. Team Race		
1 Wallace/Laurie	Novocastria	11 : 47·6
2 Peart/Kirton	Novocastria	13 : 08·5
3 Barber/Morrall	Whitefield	19 : 20

Top, Open Rubber winner and thus British Champ in the class is M. Parrott of Whitefield who won "Model Aircraft" trophy at Hullavington Nats with 6:39 flight in fly-off.

British Reps at Liege for 1965 Criterium of Aces are left to right, M. Davis and B. Burnstead in Combat (placed 1st and 2nd) and Don Harworth and Dick Place (who won team race)—a quartet of British winners!

Multi R/C
1 D. Read — Rolls-Royce — 1,734
2 R. Hargreaves — C/M — 1,531
3 C. Pike — Nottingham — 1,550

Single R/C
1 R. Donahue — LARCAS — 557
2 R. Campbell — Wanstead — 333
3 E. Horwich — LARCAS — 30

C/L Scale
1 J. Bodey—(Halifax) — Heswell — 570
2 D. Day—(Fokker D VII) — Wolves — 508
3 B. Ivans—(Hampden) — Wolves — 490

F/F Scale
1 J. Simmance (Sopwith) — Wharfedale — 609
2 L. Kelsall—(B.E. 2e) — C/M — 543
3 J. Palmer—(Sopwith) — Wanstead — 524

Chuck Glider
1 R. Roberts — Whitefield — 174 secs.
2 K. Robinson — Whitefield — 165 secs.
3 J. Radcliffe — Timperley — 161 secs.

Coupe d'Hiver
1 H. Tubbs — Baildon — 5 : 18
2 D. White — York — 4 : 06
3 J. O'Donnell — Whitefield — 3 : 12

Tailless
1 J. Pool — York — 5 : 46
2 G. Tideswell — Baildon — 5 : 35
3 D. Wiseman — York — 5 : 33

Open Rubber
1 J. O'Donnell — Whitefield — 8 : 47
2 P. Lowe — Sharston — 7 : 33
3 B. Day — Walsall — 7 : 28

Open Glider
1 D. Wiseman — York — 7 : 06
2 B. Spencer — Ashton — 6 : 11
3 G. Lowe — Wallasey — 6 : 00

Open Power
1 J. McCann — Tynemouth — 8 : 59
2 P. Cliffe — Stockport — 8 : 55
3 J. O'Donnell — Whitefield — 8 : 37

Rally Champion
J. O'Donnell — 20 : 36

NORTHERN GALA—September 5th, 1965 (R.A.F. Church Fenton)

Open Rubber
1 D. Morley — Lincoln — 9 : 00 + 5 : 32
2 D. Poole — Birmingham — 9 : 00 + 5 : 31
3 H. Tubbs — Baildon — 9 : 00 + 5 : 02

Tailless
1 K. Attiwell — York — 5 : 29
2 D. Wiseman — York — 5 : 04
3 G. Abbott — York — 1 : 55

Open Power
1 J. O'Donnell — Whitefield — 9 : 00
2 G. Doncaster — Baildon — 8 : 55
3 T. Stoker — Baildon — 8 : 45

P.A.A. Load
1 D. Hipperson — Croydon — 6 : 08

Open Glider
1 J. O'Donnell — Whitefield — 8 : 07
2 P. Jellis — Croydon — 7 : 03
3 U. Wannop — Wallasey — 7 : 01

F.A.I. T/R
1 Balch/King — Feltham/Hayes — 10 : 41·2
2 Turner/Hughes — Wharfedale — 10 : 43
3 Reid — Dumbarton — 11 : 03·2

Combat
1 M. Nelson — Cambridge
2 J. Gardiner — Sunderland

½A T/R
1 Turner/Hughes — Wharfedale — 9 : 10·5
2 Heaton/Ross — Warrington — 9 : 47
3 King/Balch — F/H — 10 : 44

Stunt
1 J. Mannall — Lincoln — 963 pts.
2 T. Jolley — Kidderminster — 931 pts.
3 D. Day — Wolves — 913 pts.

Multi R/C
1 Purslow — LARCAS — 1,611 pts.
2 Newitt — LARCAS — 1,481 pts.
3 Daniel — C/M — 1,476 pts.

2nd place in 1966 National Champs for combat was taken by these modellers from Maidenhead with Copeman tuned Oliver Tiger powered "Twister".

Trio of Maximum performance Ladies, Mrs. Mary Day, Mrs. Kathy Allen and Mrs. Shirley Horton who were in the fly-off which Kathy won with a fourth maximum.

Opposite, Dave Platt's 11 lb. North American T 28B scale model with McCoy 60 retract gear and F & M R C, was leading model in the Scale contest at the Nats, most impressive in the air too.

SOUTH MIDLAND GALA—September 12th, 1965 (Cranfield)

Rubber
1 J. Allen — Brighton — 9 : 00 + 5 : 58
2 R. Bailey — Surbiton — 9 : 00 + 5 : 47
3 R. Monks — Birmingham — 9 : 00 + 5 : 40

Power
1 M. Green — Lincoln — 9 : 00 + 6 : 00
2 J. West — Brighton — 9 : 00 + 4 : 51
3 P. Buskell — Surbiton — 9 : 00 + 4 : 34

Coupe d'Hiver
1 J. O'Donnell — Whitefield — 5 : 28
2 L. Burrows — Blackheath — 4 : 44
3 R. Bailey — Surbiton — 4 : 39

Glider
1 M. Woodhouse — Norwich — 9 : 00 + 4 : 14
2 E. Drew — Bristol & West — 9 : 00 + 3 : 55
3 M. Smith — Norwich — 9 : 00 + 3 : 50

½A Power
1 R. Monks — Birmingham — 9 : 00 + 4 : 48
2 J. Boxall — Croydon — 9 : 00 + 4 : 02
3 K. Smith — Croydon — 9 : 00 + 2 : 05

Chuck Glider
1 P. Bayram — Lincoln — 3 : 00 + 1 : 07
2 M. Bayram — Lincoln — 3 : 00 + 0 : 57
3 —. Fleetwood — Hornchurch — 3 : 00 + 0 : 55

Combat
1 R. Wilkens — Sidcup
2 D. Fry — Feltham/Hayes

F/A.I. T/R
1 Turner/Hughes — Wharfedale — 10 : 35·2
2 Davy/Hudson — Wharfedale — 11 : 07·5
3 Franklin/Ives — Wanstead — Rtd.

½A T/R
1 Davy/Hudson — Wharfedale — 8 : 48
2 Turner/Hughes — Wharfedale — 8 : 56
3 Dell/Fry — Feltham/Hayes — 9 : 45

Stunt
1 T. Jolley — Kidderminster — 2,227 pts.
2 D. Day — Wolves — 2,087 pts.
3 M. Reeves — Wanstead — 2,079 pts.

R/C Single
1 R. Tom — South Wales R/C — 208 pts.
2 A. Bird — — 242 pts.
3 —. Bookham — — 255 pts.

R/C Multi
1 P. Waters — South Wales R/C — 2,907 pts.
2 G. Franklin — L.A.R.K.S. — 2,532 pts.
3 E. Johnson — Bristol R/C M.A.C. — 2,435 pts.

S.M.A.E. RESULTS

KEIL TROPHY—Team Power—September 26th, 1965
1 Wallasey (A team) — 31 : 28
2 St. Albans (A team) — 30 : 18
3 Whitefield (A team) — 29 : 26

OPEN GLIDER—September 26th, 1965
1 R. Pollard — Tynemouth — 9 : 00 - 3 : 14
2 B. Spencer — Ashton — 9 : 00 + 2 : 54
3 D. Wiseman — York — 9 : 00 + 2 : 54

AREA CHAMPIONSHIPS—October 3rd, 1965
1 Northern — 848 pts.
2 North Western — 784 pts.
3 E. Midland — 387 pts.

LUTON D.M.A.S. SLOPE SOARING RALLY —October 3rd, 1965 (Ivinghoe Beacon)

Free Flight
1 T. Faulkner — Luton
2 D. Edwards — St. Albans

Single Channel
1 C. Newton — Nazeing
2 G. Bushell — —
3 J. Beer — Enfield

Multi Channel
1 K. G. Humber — Solent Heights
2 R. Godden — Cambridge
3 J. Dumble — Richmond

FLIGHT CUP—Open Rubber—October 17th, 1965
1 B. Picken — Wallasey — 9 : 00 + 8 : 40
2 D. Wotton — Hayes — 9 : 00 + 8 : 15
3 D. Woods — St. Albans — 9 : 00 + 8 : 01

QUICK START TROPHY—½A Power—October 17th, 1965
1 E. French — Essex — 9 : 00 + 4 : 39
2 R. Monks — Birmingham — 9 : 00 + 4 : 13
3 D. Hipperson — Croydon — 9 : 00 + 3 : 35

PLUGGE CUP
1 St. Albans — 1228.5 pts.
2 York — 1240 pts.
3 Whitefield — 1174.5 pts.

N. AREA F.A.I. GALA—October 24th, 1965 (R.A.F. Topcliffe)

Team Racing
1 Place/Haworth — Wharfedale — 10 : 05
2 Kirton/Peart — Novocastria — 11 : 06·1
3 Balch King — Feltham/Hayes — 12 : 01

Glider
1 M. Woodhouse — Norwich — 13 : 00
2 J. O'Donnell — Whitefield — 12 : 58
3 R. Pollard — Tynemouth — 12 : 18

Power
1 G. French — Essex — 15 : 00
2 J. West — Brighton — 14 : 57
3 A. Carter — Liverpool — 14 : 15

Rubber
1 H. Tubbs — Baildon — 15 : 00 - 4 : 00
2 T. Stoker — Baildon — 15 : 00 - 3 : 15
3 J. Shaw — Sheffield S.A. — 15 : 00 - 3 : 05

Aerobatics
1 G. Higgs — Horwich — 2711 pts.

Combat
1 L. Scurfield — Tynemouth
2 S. Smith — Feltham

Wilkinson Challenge Shield
Whitefield — 39 : 57

1966

K.M.A.A. CUP—F.A.I. Glider—March 27th, 1966 *(Area Centralised)*
1 J. Allen — Brighton — 2 : 20
2 C. Foss — Brighton — 2 : 17
3 J. Edwards — Croydon — 1 : 39

FROG SENIOR CUP—Open Power—March 27th, 1966 *(Area Centralised)*

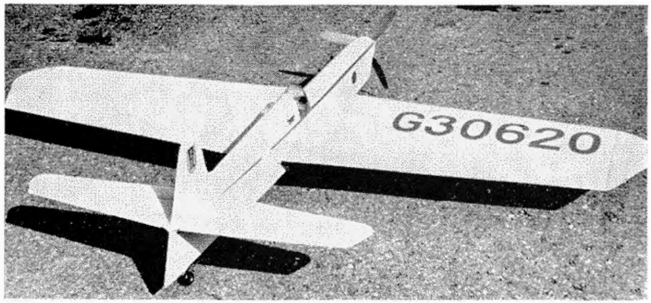
1 A. Moss	Whitefield	1 : 23
2 T. Payne	Northampton	0 : 57
3 A. Childs	Brighton	0 : 08

OPEN RUBBER—March 27th, 1966 *(Area Centralised)*

1 H. Tubbs	Baildon	4 : 17
2 J. O'Donnell	Whitefield	4 : 01
3 W. Horton	Crawley	0 : 47

COUPE d'HIVER—March 27th, 1966 *(Area Centralised)*

1 P. Cameron	Crawley	2 : 55
2 A. Crisp	Croydon	0 : 51
3 M. Brown	Maidenhead	0 : 20



SOUTH OF ENGLAND GALA—April 10th and 11th, 1966 (Chobham Common)

Open Glider		
1 L. Larrimore	Lee Bees	9 : 00 + 9 : 45
2 P. Hansford	Blackheath	9 : 00 + 4 : 35
3 A. Wisher	Croydon	9 : 00 + 1 : 49
A Power		
1 J. Boxall	Croydon	9 : 00 + 1 : 23
2 M. Brown	Maidenhead	9 : 00
3 K. Smith	Croydon	7 : 08
Combined F.A.I.		
1 E. Drew	Bristol & West	14 : 33
2 D. Kidner	St. Albans	14 : 01
3 T. Punter	Hayes	13 : 37
Coupe d'Hiver		
1 R. Johnson	St. Albans	5 : 37
2 D. Tipper	St. Albans	5 : 31
3 G. Cornell	Croydon	5 : 11
Open Power		
1 D. Edwards	St. Albans	9 : 00
2 P. Buskell	Surbiton	8 : 57
3 J. West	Brighton	8 : 14
A 1 Glider		
1 A. Crisp	Croydon	8 : 38
2 P. Newell	Surbiton	6 : 45
3 G. Cornell	Croydon	6 : 17
Open Rubber		
1 A. Wisher	Croydon	9 : 00 + 5 : 58
2 C. Foss	Brighton	9 : 00 + 5 : 26
3 A. Wells	Hornchurch	9 : 00 + 4 : 50
Chuck Glider		
1 A. McCombie	Blackheath	3 : 48
2 A. Slater	Leatherhead	3 : 42
3 A. Wells	Hornchurch	3 : 02

N. W. AREA EASTER MEETING—April 10th and 11th, 1966 (R.A.F. Tern Hill)

Multi		
1 B. Purslow	LARCAS	4,016
2 D. Hammant	Grimsby	3,676
3 K. Jones	Tamworth	3,569
C/L Stunt		
1 T. Jolley	Whitefield	1,555
2 H. Dowbekin	Horwich	1,495
3 N. Reeves	Wanstead	1,445
B Team Race		
1 A. Dell	Feltham	8 : 50
2 Skitt/Hardcastle	Wolves	9 : 15·3
3 Balch/King	Feltham	10 : 29·9
A Team Race		
1 Place/Haworth	Wharfedale	8 : 54·4
2 Smith/Brown	Feltham	9 : 02·5
3 Davy/Hudson	Wharfedale	Retd.
Power		
1 T. Payne	Northampton	9 : 00 + 3 : 14
2 R. Monks	Birmingham	9 : 00 − 2 : 54
3 B. Hooley	B.A.C. Warton	84 : 50

Opposite. Back to modelling after a lapse of 15 years Alan Russell of Berkhamsted (ex-Leicester) won the Nats glider event with "Migrator" A 2.

Right. Leading control-line scale entry at the Nats was John Simmance's Martin B 26 Marauder with twin Super Tigre 5 c.c. engines, retract gear, flaps, lights, etc.

Tom Jolley's "Nobler" took first place in the Gold " Trophy to add yet another year of success for this aged design which retains its popularity over the years so well. Note the 3-blade prop used on the Fox 35.

A Power		
1 J. Bailey	Bristol West	9 : 00
2 J. O'Donnell	Whitefield	8 : 18
3 R. Monks	Birmingham	8 : 14
Chuck Glider		
1 R. Roberts	Whitefield	3 : 39
2 P. Bayram	Lincoln	3 : 37
3 D. Brown	Spitfires	2 : 21
Free Style Radio Control		
1 D. Hammant	Grimsby	130 } Fly off
2 A. Whittaker	LARCAS	130 } Fly off
3 D. Platt	Wanstead	108
C/L Scale		
1 A. Day	Birmingham	583
2 W. Forrester	Wanstead	582
3 D. Platt	Wanstead	565
Combat		
1 Leadbeater	Bedford	
2 Crawford	M.C.C.	
3 Melrose	Heanor	
3 Ledger	Heanor	
F.A.I. T R		
1 Turner/Hughes	Wharfedale	11 : 19·2
2 Place/Haworth	Wharfedale	11 : 36·2
3 Davy/Hudson	Wharfedale	Retd.
Rubber		
1 R. Lennox	Birmingham	9 : 00 + 4 : 24
2 B. Day	C.M.	9 : 00 + 3 : 35
3 D. Morley	Lincoln	9 : 00 + 3 : 16
Glider		
1 P. Foster	Timperley	9 : 00
2 A. Brocklehurst	Halifax	8 : 57
3 Moore	West Coventry	8 : 50
Tailess		
1 K. Attiwell	York	6 : 11
2 J. Pool	York	5 : 25
3 D. Culpin	Rolls-Royce	4 : 26
F F Scale		
1 J. Palmer	Wanstead	518
2 G. Lewis	Spitfires	380
3 E. Clutton	Spitfires	377

BRISTOL, GOODYEAR R/C RACE—April 11th, 1966 (R.A.F. Hullavington)

1 P. Waters	South Wales R/C	3 : 38
2 D. Brunt	LARCAS	3 : 53
3 B. Purslow	LARCAS	3 : 54

HALFAX TROPHY—F.A.I. POWER—April 17th, 1966 *(Area Centralised)*

1 D. Edwards	St. Albans	13 : 42
2 A. Percival	Grantham	13 : 40
3 S. Savini	Wallasey	13 : 28

GAMAGE CUP OPEN RUBBER—April 17th, 1966 *(Area Centralised)*

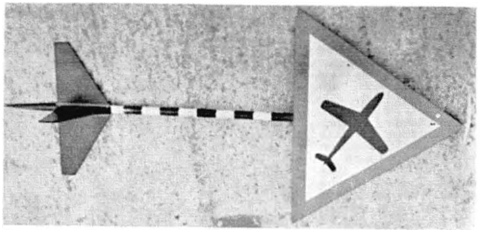
1 A. Wells	Hornchurch	9 : 00 + 3 : 28
2 B. Day	Walsall	9 : 00 + 3 : 11
3 K. Smith	Croydon	8 : 48

OPEN GLIDER—April 17th, 1966 *(Area Centralised)*

1 D. Yates	Wigan	9 : 00 + 2 : 11
2 M. Pressnell	Essex	8 : 49
3 L. Moore	West Coventry	8 : 45

N.W. AREA 2nd BURTONWOOD CRITERIUM—May 8th, 1966 (R.A.F. Burtonwood)

Stunt		
1 J. Mannall	Lincoln	
2 T. Jolley	Whitefield	
3 G. Higgs	Horwich	
Novice Stunt		
1 C. W. Draper	Gee Dee	
Scale		
1 P. Simmonds	Wolves	954
Combat "A"		
1 Sewell	Whitefield	
2 Hockhart	Madmacs	
3 Dowling	Liverpool	
Combat "A"		
1 J. Fortheringham	Madmac	
2 I. Coutts	Madmac	
3 J. Wynne	Stockport	
A Team Race		
1 Royle/Salmon	Shrewsbury	9 : 45
2 Davy/Hudson	Wharfedale	10 : 3
3 Place/Haworth	Wharfedale	10 : 15
B Team Race		
1 Davy/Hudson	Wharfedale	8 : 49
2 Heaton/Ross	Warrington	9 : 23
3 Laurie/Wallace	Novocastria	Retd.
F.A.I. Team Race		
1 Place/Haworth	Wharfedale	9 : 45
2 Franklin/Ives	Wanstead	9 : 53
3 Booth/Taylor	Rolls-Royce	164 laps
Rat Race		
1 T. Jolley	Whitefield	8 : 25
2 K. Morrisey	Sharston	Retd.
3 Smith	North Sheffield	Retd.
Handicap Speed		
1 I. Roffey—(10 0 c.c.)	Brixton	158 : 7 m.p.h.
2 J. Hall (5 0 c.c.)	Brixton	131 : 6 m.p.h.
3 Parker/Aldred (1 5 c.c.)	North Sheffield	82 : 2 m.p.h.



Unorthodox contest at the Nats brought forth a wide variety of types including this "Flying sign" by Mick Charles of Watford M.A.C. All balsa, it climbs at a fantastic rate. Structural details were in August edition of "Aeromodeller".

WESTON CUP—F.A.I. Rubber—May 15th, 1966 (Area Centralised)

1	R. Wotton	Hayes	15 : 00 + 4 : 00 + 5 : 00 + 6 : 0 + 2 : 13
2	J. West	Brighton	15 : 00 + 1 : 28
3	M. Dixon	Birmingham	14 : 18

WHITE CUP—Open Power—May 15th, 1966 (Area Centralised)

1	J. Phillips	S. Bristol	9 : 00 + 6 : 58
2	V. Taylor	St. Albans	9 : 00 + 4 : 50
3	P. Bayram	Lincoln	9 : 00 + 2 : 55

FROG JUNIOR—May 15th, 1966 (Area Centralised)

1	P. Whitehead	York	9 : 00 + 4 : 27
2	P. Moate	Croydon	9 : 00 + 1 : 52
3	C. Booth	Norwich	9 : 00 + 1 : 15

BRITISH NATIONAL CHAMPIONSHIPS—May 29th and 30th, 1966 (R.A.F. Hullavington)

S.M.A.E. Trophy—R/C Aerobatics

1	P. T. Waters	South Wales R/C	2549·5
2	F. Van den Bergh	Bromley	2311
3	B. Burt	Surrey R/C Club	2251

Radio Control Scale

1	D. Platt	Wanstead	847
2	D. Thumpston	C/M	830
3	A. Falley	Bromley	703

Knokke No. 2 Trophy—C/L Scale

1	J. Simmance	C/M	479
2	B. Ball	Wanstead	447
3	S. Anderson	E. Renfrew	420

R.A.F.M.A.A. Trophy—(1A Team Race)

1	Turner/Hughes	Wharfedale	4 : 34	9 : 10
2	Smith/Brown	Feltham/Hayes	4 : 19	9 : 20
3	Heaton/Ross	Leigh	4 : 20	Retd.

Gold Trophy—Aerobatics

1	T. Jolley	Whitefield	1,098
2	H. Dowbekin	Horwich	1,031
3	D. Day	Wolves	1,014

Davies "A" Trophy—(F.A.I. Team Race)

1	Place/Haworth	Wharfedale	4 : 37	10 : 41
2	Rudd/Longhurst	Feltham/Hayes	5 : 06	11 : 08
3	Manser/Green	Wanstead	5 : 08	11 : 19

Speed

1	M. Billington—(10·0 c.c.)	Brixton	158 : 7 m.p.h.
2	W. Bessant—(1·5 c.c.)	Southampton	97 : 3 m.p.h.
3	I. Roffey—(10·0 c.c.)	Brixton	154 : 3 m.p.h.

Combat

1	M. Davis	Outlaws
2	K. Roper	Maidenhead
3	—. Shaughnessy	Luton
3	B. Flockhart	Madmac

"Model Aircraft" Trophy—Open Rubber

1	M. Parrott	Whitefield	9 : 00 + 6 : 39
2	R. Elliott	Lee Bees	9 : 00 + 4 : 37
3	R. Monks	Birmingham	9 : 00 + 4 : 35

Thurston Cup—Open Glider

1	A. Russell	C/M	9 : 00 + 10 : 14
2	J. Bailey	Bristol & West	9 : 00 + 8 : 24
3	D. White	York	9 : 00 + 8 : 19

"Sir John Shelley" Trophy—Open Power

1	G. Rawsell	C/M	9 : 00 + 3 : 38
2	R. Baggott	Birmingham	9 : 00 + 0 : 53
3	J. O'Donnell	Whitefield	8 : 52

Women's Cup

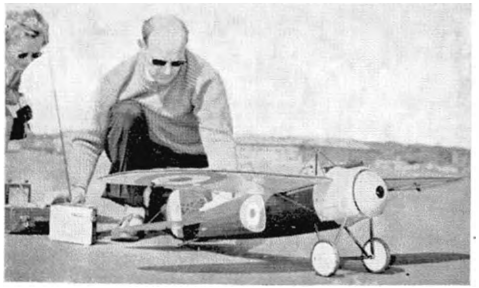
1	Mrs. K. Allen	Brighton	9 : 00 + 6 : 41
2	Mrs. M. Day	C/M	9 : 00 + 5 : 48
3	Mrs. S. Horton	Crawley	9 : 00 + 3 : 01

Senior Champions

1	R. Lennox	Birmingham	178·8 pts.
2	J. O'Donnell	Whitefield	153·4 pts.
3	D. White	York	98·4 pts.

Junior Champions

1	Ledger	Feltham	83·1 pts.
2	Taylor	Rolls Royce	75·2 pts.
3	Smith	Northwood	70·6 pts.



Mr. & Mrs. Dennis Thumpston from Sutton Coldfield with the Bristol MIC monoplane which was placed 2nd in the Nats and 2nd at Bath Festival. This remarkable scale R/C model has the servos inside the pilot, bullets for the guns and lenses in the sight!

Area Champions

London	846 pts.
Western	479 pts.
E. Anglian	470 pts.

WORLD CONTROL LINE CHAMPIONSHIP TEAM SELECTION TRIALS—June 26th, 1966 (R.A.F. Swinderby)

C/L Scale

1	A. Day	Handsworth	491 pts.
2	S. Perry	Wolves	383 pts.
3	R. Ivans	Handsworth	366 pts.

Team Race

1	Turner/Hughes	Wharfedale	Selected on basis of fastest heats and consistency. Fastest heat 4: 47 (Turner)
2	Place/Haworth	Wharfedale	
3	Nixon/Ellis	Hinkley	

Speed

1	K. Lindsey	Hayes	131 : 6 m.p.h.
2	B. Jackson	North Sheffield	128 : 4 m.p.h.
3	W. Firbank	North Sheffield	128 : 4 m.p.h.

Stunt

					Total of Best two
1	J. Mannall	Lincoln	1,009	1,034	1,074	2,108
2	T. Jolley	Kidderminster	988	1,025	1,062	2,087
3	H. Dowbekin	Horwich	920	732	1,001	1,921

WORLD RECORDS (established in the last year)

RADIO CONTROL POWER DRIVEN

Distance (*U.S.S.R.*)

"Stretcher" by Maynard Hill, motor Merco 61 10 c.c. from Batavia to Canojaharie, New York, October 2nd, 1965 . . . 296.356 km. (184.147 miles).

Height (*U.S.A.*)

"Foo Too" by William C. Northrop, Jr., motor Super Tigre 56 at Dahlgren, Virginia, September 5th, 1965 . . . 5062.7 m. (16,610 ft.).

Speed in a straight line (*U.S.A.*)

M. L. Hill motor Super Tigre 60, Westover, June 26th, 1966 . . . 226 km/h. (140 m.p.h.).

Distance in a close Circuit (*U.S.A.*)

"Stretcher" by Maynard L. Hill, motor Merco 0,49 at Layhill (Maryland) June 4th, 1965 . . . 280 km.

R/C GLIDERS

Class F-3 B to D

Duration (*South Africa*)

G. Brooke-Smith at Tygerberg Hills, Cape Town, on November 14th, 1965 . . . 11h. 33m. 28s.

Distance in a straight line (*U.S.S.R.*)

N. Malikov, May 17th, 1965, Toula to Kalmyki . . . 16,725 km.

Height (*U.S.S.R.*)

N. Malikov from Toula, May 19th, 1965 . . . 872 m.

Distance in a closed circuit (*U.S.A.*)

Glider of Mr. F. Colver at Irvine Ranch (California) on May 8th, 1965 . . . 70,1 km.

POWER DRIVEN HELICOPTERS

Duration (*Rumania*)

Stefan Purice, 1 motor Schlosser, 2.5 c.c. at Clincen, October 1st, 1965 . . . 3h. 12m.

Speed in a straight line (*U.S.S.R.*)

A. Victortchik, Moscow, August 10th, 1965 . . . 25.5 km/h.

ABSOLUTE RECORDS

Class E-1-E

Duration (*South Africa*)

Geoffrey Brooke-Smith, November 14th, 1965 . . . 11h. 33m. 28s.

Distance in a straight line (*U.S.S.R.*)

Evgueny Boricevitch, August 14th, 1952 . . . 378,756 km.

Height (*U.S.S.R.*)

Georges Lioubouchkine, August 13th, 1947 . . . 4,152 m.

Speed (*Italy*)

E. Zanin, Rome, April 26th, 1964 . . . 327 km/h.

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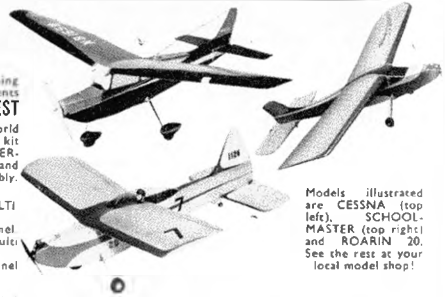

Models illustrated are CESSNA (top left), SCHOOLMASTER (top right) and ROARIN 20. See the rest at your local model shop!

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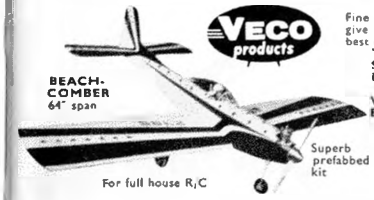

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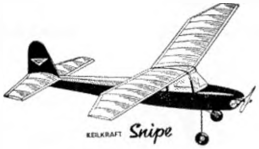

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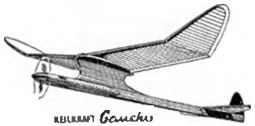

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1. If a bundle of strip lengths is supported over the edge of a table you can easily separate the "stiff" from the "flexible" strip by the amounts they bend at the end.
2. If a bundle of strips are dropped (not tangled up together!) the heaviest strips will reach the floor first.
3. Grasp four to six strips firmly and "whip" up and down gently. Matched strips will whip the same amount.
4. Following 1, 2 and 3 should give you a number of matched strips. Now check them individually for weight.
5. Finally, a quality check. Actually you should **start** with this by asking for Solarbo strip by name. You will then end up at step 4 with matched strips and quality automatically assured!

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