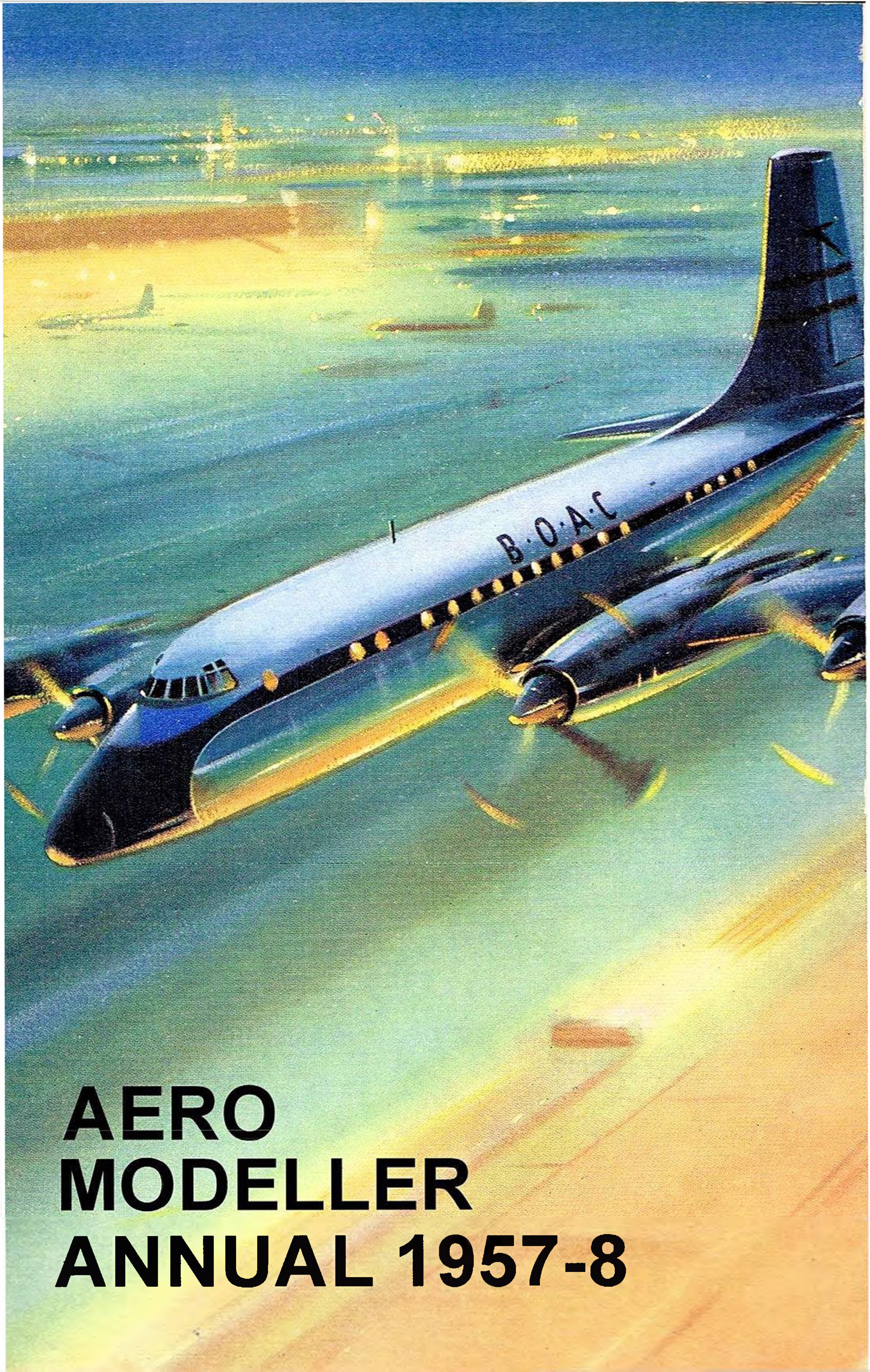

AERO MODELLER ANNUAL 1957-8

AEROMODELLER ANNUAL 1957-58

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
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and
D. J. LAIDLAW-DICKSON

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Introduction

A New Era

HIGHLIGHT OF THE British year has undoubtedly been official recognition of the hobby by the award of the M.B.E. to Mr. A. F. Houlberg, chairman of the S.M.A.E., and president of the F.A.I. Models Commission. Thus, belatedly, the sterling work of this British pioneer has been recognised in aviation circles, and the art of aeromodelling accepted as a pursuit on a par with other sporting activities. Another major award was that of the Royal Aero Club's Bronze Medal to Raymond Gibbs, ace British speed-man, and holder of two world records.

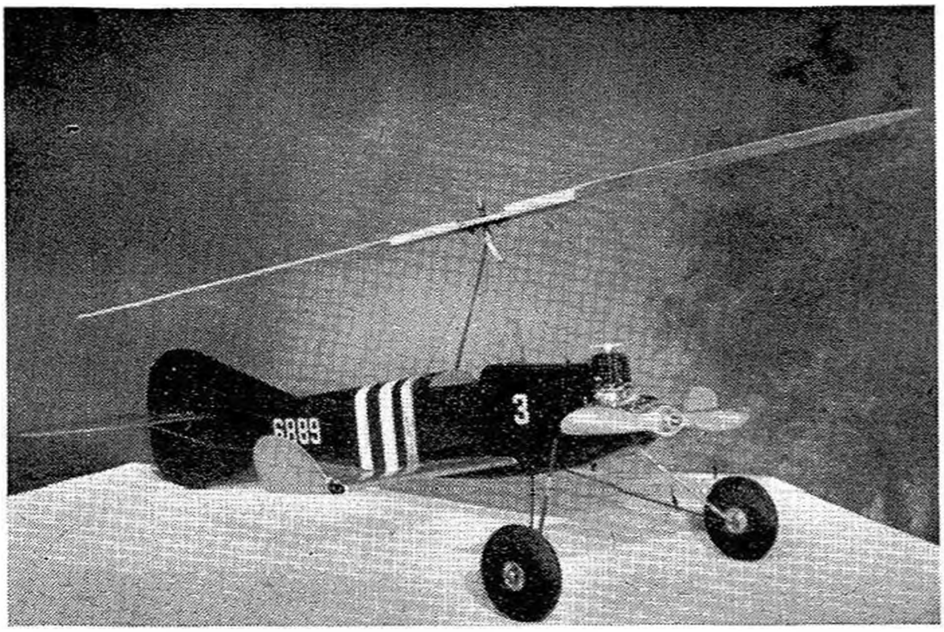
Since the last Annual appeared, we have witnessed a number of advances in the sphere of aeromodelling—and some rather heated controversy on the vexed question of rules for International contests. Presumably as a result of the multiple fly-offs at Wiesbaden in 1955, strenuous efforts have been made to avoid a repetition in the future, but whereas many were of the opinion that minor modifications to the contest rules would suffice, the Models Commission—rightly or wrongly—has introduced drastic changes to model specifications, still further reducing the rubber content of Wakefield models, and increasing the load factor for power models. Time will show whether or not these changes will bring about the desired results, but during the transition period tempers have frayed, and a further section of keen contest men have given up the pursuit of International honours.

Equally drastic (and unpopular) has been the placing of World Championship events on a bi-annual basis. The reasons given are those of expense and the difficulties of organisation ; yet the Commission continues to promote and encourage minor International events, the majority of which are supported by those countries which voted for bi-annual Championships ! We are sorry, but we fail to see the logic of this latest regulation, and watch with considerable interest the results of this division of interest.

Great Britain has witnessed considerable stimulation of interest in the hobby during the past twelve months, a notable feature being the return to favour of control-line flying. More and more attention is being devoted to the improvement of stunt flying, and the demonstrations by American champion Bob Palmer during his visit to Woburn Park gave British stunt men much to think about—and a clear indication of their future development.

Accompanying Bob was his compatriot, Howard Bonner, who showed just how spectacular radio-control flying can be when tackled with the meticulous care evident in his models and flying. British radio flying is sadly behind the American standard as demonstrated by Howard, and such participation as has been undertaken in International contests indicates that the British modeller has much to learn. Bright spot of the radio firmament is the increasing interest in slope soaring with radio-controlled gliders, some very fine flights being made during the past season, with the British record steadily reaching higher figures.

The plastics cult still forges ahead, and some excellent examples of high-grade mouldings have appeared on the world markets. Despite the Jeremiah attitude of some diehards, we welcome the advent of these kits, for the art of assembly inevitably leads some to progress to the joys of construction and flying, and every convert is welcome to the fold.



CONTROL-LINE AUTOGYROS

By C. P. G. WHELDON

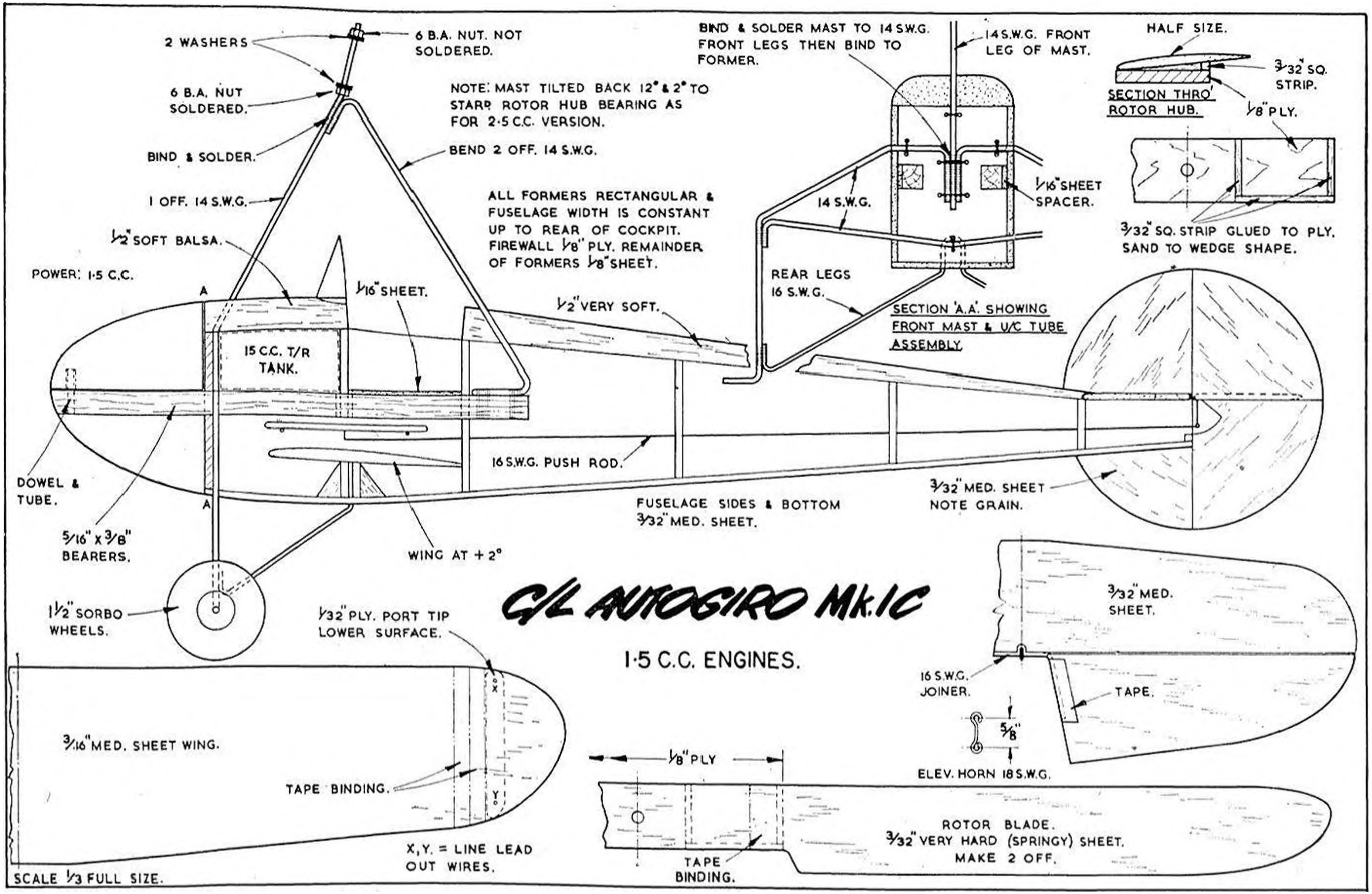
THE DEVELOPMENT of the two Autogyros described was undertaken through a desire of the author for a control-line model for display work that would be "different", and could also be transported easily. The latest design—Mark 2c—is most satisfying and enables one to appreciate the differences between rotary winged flight and the conventional.

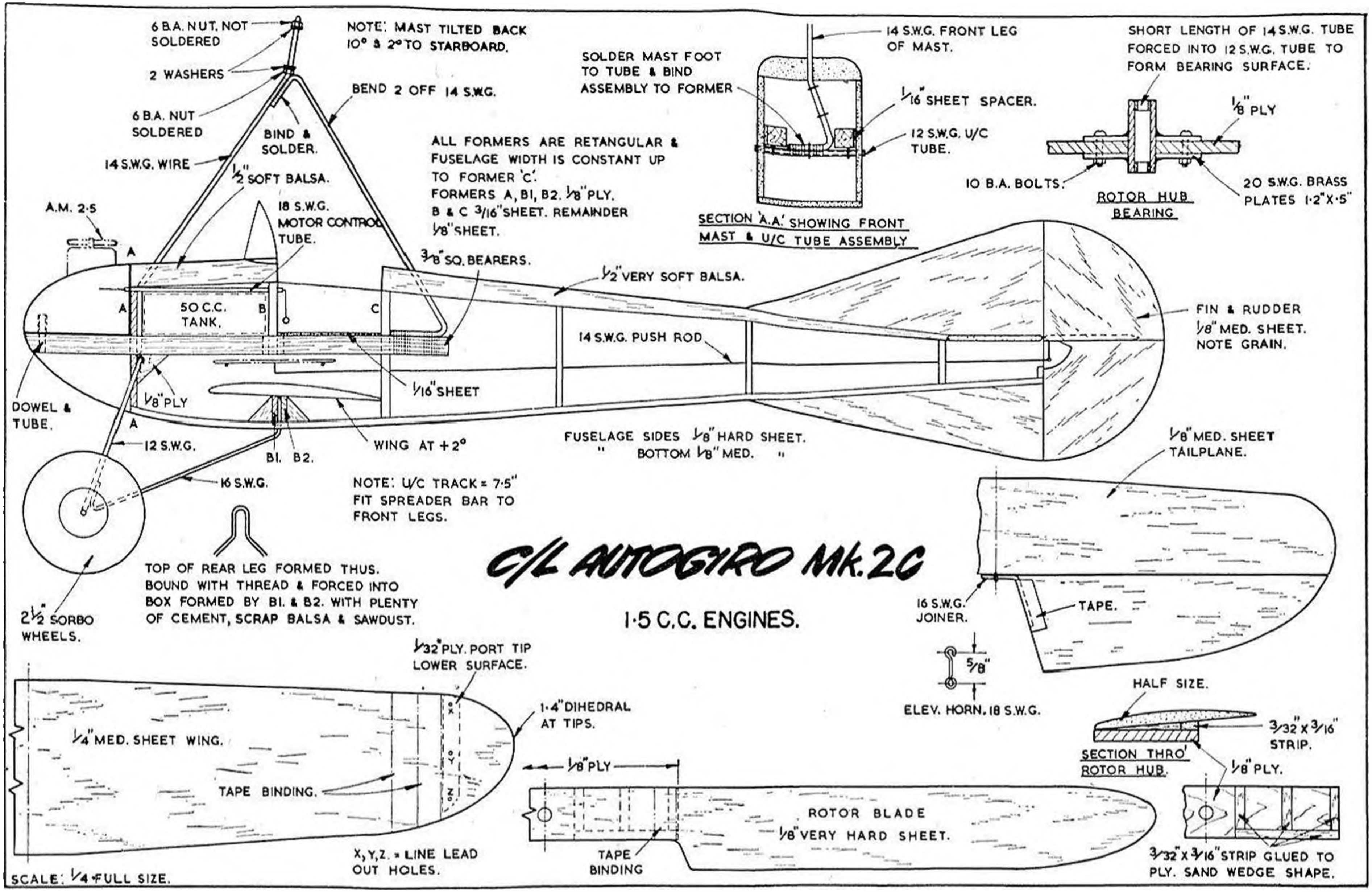
Contrary to popular opinion, the Autogyro layout is quite stable, and is no more difficult to fly control-line than any other type of model. The rotors, revolving anti-clockwise, appear to counteract any tendency for the models to "come in" on the lines. This peculiarity works in our favour as the higher a model flies the less line tension one normally gets, but, with Autogyro, the higher one gets the more rapid become the revolutions of the rotors and so the tighter the tendency to pull out. Both models will almost free-flight round the circle high up.

The ultimate example of the Autogyro's capabilities lies in its ability to hover. Both models will do this. The manœuvre is carried out in the small version by juggling with the forward speed of the model—by applying up elevator (gently) just as it is coming into wind—and balancing this against the wind speed. The larger model, with motor control, will perform in this manner but can also be made to hover in almost any wind by using the motor control and elevators together. This does require a little practice. When hovering, the models will assume an angle of about 45 degrees to the horizontal, and the whole effect is most unusual.

When flying either of the models described normal control techniques can be used. Take-off's are quite normal except in gusty conditions when, if a gust catches the rotors as she comes into wind for the take-off, the model will

Heading shows the 2·5 c.c. version of this fascinating project.


C/L AUTOGIRO Mk.IC
1·5 C.C. ENGINES.
2 WASHERS
6 B.A. NUT. NOT SOLDERED.
6 B.A. NUT SOLDERED.
BIND & SOLDER.
1 OFF. 14 S.W.G.
½" SOFT BALSA.
POWER: 1·5 C.C.
NOTE: MAST TILTED BACK 12° & 2° TO STARBD ROTOR HUB BEARING AS FOR 2·5 C.C. VERSION.
BEND 2 OFF. 14 S.W.G.
ALL FORMERS RECTANGULAR & FUSELAGE WIDTH IS CONSTANT UP TO REAR OF COCKPIT. FIREWALL ⅛" PLY. REMAINDER OF FORMERS ⅛" SHEET.
1/16" SHEET.
½" VERY SOFT.
15 C.C. T/R TANK.
A
A
DOWEL & TUBE.
5/16" x 3/8" BEARERS.
16 S.W.G. PUSH ROD.
WING AT + 2°
FUSELAGE SIDES & BOTTOM 3/32" MED. SHEET.
1½" SORBO WHEELS.
BIND & SOLDER MAST TO 14 S.W.G. FRONT LEGS THEN BIND TO FORMER.
14 S.W.G. FRONT LEG OF MAST.
14 S.W.G.
1/16" SHEET SPACER.
REAR LEGS 16 S.W.G.
SECTION 'A.A.' SHOWING FRONT MAST & U/C TUBE ASSEMBLY.
HALF SIZE.
SECTION THRO' ROTOR HUB.
3/32" SQ. STRIP.
⅛" PLY.
3/32" SQ. STRIP GLUED TO PLY. SAND TO WEDGE SHAPE.
3/32" MED. SHEET NOTE GRAIN.
3/32" MED. SHEET.
16 S.W.G. JOINER.
TAPE.
5/8"
ELEV. HORN 18 S.W.G.
1/32" PLY. PORT TIP LOWER SURFACE.
3/16" MED. SHEET WING.
TAPE BINDING.
X
Y
X, Y. = LINE LEAD OUT WIRES.
SCALE ⅓ FULL SIZE.
⅛" PLY
ROTOR BLADE. 3/32" VERY HARD (SPRINGY) SHEET. MAKE 2 OFF.
TAPE BINDING.


6 B.A. NUT. NOT SOLDERED
2 WASHERS
6 B.A. NUT SOLDERED
14 S.W.G. WIRE
NOTE: MAST TILTED BACK 10° & 2° TO STARBOARD.
BEND 2 OFF 14 S.W.G.
BIND & SOLDER.
1/2" SOFT BALSA.
A.M. 2·5
18 S.W.G. MOTOR CONTROL TUBE.
ALL FORMERS ARE RETANGULAR & FUSELAGE WIDTH IS CONSTANT UP TO FORMER 'C'.
FORMERS A, B1, B2. 1/8" PLY.
B & C 3/16" SHEET. REMAINDER 1/8" SHEET.
3/8" SQ. BEARERS.
1/2" VERY SOFT BALSA.
SOLDER MAST FOOT TO TUBE & BIND ASSEMBLY TO FORMER
14 S.W.G. FRONT LEG OF MAST.
1/16" SHEET SPACER.
12 S.W.G. U/C TUBE.
SECTION 'A.A.' SHOWING FRONT MAST & U/C TUBE ASSEMBLY
SHORT LENGTH OF 14 S.W.G. TUBE FORCED INTO 12 S.W.G. TUBE TO FORM BEARING SURFACE.
1/8" PLY
10 B.A. BOLTS.
ROTOR HUB BEARING
20 S.W.G. BRASS PLATES 1·2" X ·5"
50 C.C. TANK.
A
B
C
14 S.W.G. PUSH ROD
FIN & RUDDER 1/8" MED. SHEET. NOTE GRAIN.
DOWEL & TUBE.
1/8" PLY
1/16" SHEET
12 S.W.G.
B1. B2.
WING AT +2°
FUSELAGE SIDES 1/8" HARD SHEET.
" BOTTOM 1/8" MED. "
1/8" MED. SHEET TAILPLANE.
16 S.W.G.
NOTE: U/C TRACK = 7·5"
FIT SPREADER BAR TO FRONT LEGS.
C/L AUTOGIRO Mk.2C
TOP OF REAR LEG FORMED THUS. BOUND WITH THREAD & FORCED INTO BOX FORMED BY B1. & B2. WITH PLENTY OF CEMENT, SCRAP BALSA & SAWDUST.
2 1/2" SORBO WHEELS.
1·5 C.C. ENGINES.
16 S.W.G. JOINER.
TAPE.
5/8"
ELEV. HORN. 18 S.W.G.
HALF SIZE.
1/32" PLY. PORT TIP LOWER SURFACE.
1·4" DIHEDRAL AT TIPS.
1/4" MED. SHEET WING.
TAPE BINDING.
X, Y, Z. = LINE LEAD OUT HOLES.
3/32" X 3/16" STRIP.
SECTION THRO' ROTOR HUB.
1/8" PLY.
1/8" PLY
ROTOR BLADE
1/8" VERY HARD SHEET.
TAPE BINDING
3/32" X 3/16" STRIP GLUED TO PLY. SAND WEDGE SHAPE.
SCALE: 1/4 FULL SIZE.

leap off the ground nearly vertically and one must be ready to control this. The landing requires a slightly different technique as there is practically no glide. When the motor cuts the model should be at shoulder height and left to "glide" to about 3 feet when full up should be applied. The model will rear up, rotors revving fast, and settle down quite gently—VERTICALLY. The 2·5 c.c. version can perform wingovers and very nearly vertical climbs and dives, only spare the rotors, they have to do a lot of work !

Both models were developed through a series of "marks", the following facts emerging. The rotor blades require to be of the fairly low aspect-ratio (for an Autogyro) of about 7, and should be of fairly fine pitch—about 5 degrees. The rotor mast (shaft) should be tilted back approximately 12 degrees to the thrust line and offset to the outside of the circle about 2 degrees. Centre of gravity must be just in front of the mast, for if under the rotor bearing the model becomes very tricky ; the further forward the more docile. Fine pitch airscrews are essential.

Construction.

Both models have identical basic constructional features and are really rugged. The "heart" of the model is the engine bearer assembly. The motor to be used is bolted to the bearers—after facing the outer edges of the bearer with $\frac{1}{16}$ in. sheet back to position of Former C. The main $\frac{1}{8}$ in. ply Former A is cut out and the front leg of the mast and undercarriage assembly bound to it with rigging cord. (See plan for details of mast and undercarriage fixing). This former is then cemented to bearers and the space in between bearers filled in with $\frac{3}{16}$ in. sheet to the control plate mounting, which is a piece of engine bearer. Control plate mounting is then cemented in place, followed by the fitting of control plate bolt, tank, and Former B. Rear legs of mast are then bent to shape —one left hand and one right hand—and bound to bearers with rigging cord, the top ends being bound to front leg of mast with fuse wire and soldered. PUT PLENTY OF CEMENT ON ALL MAST AND UNDERCARRIAGE CORD BINDING. Former C is cemented in place and then cockpit floor. This completes all the hard work—the remainder of the model is conventional.

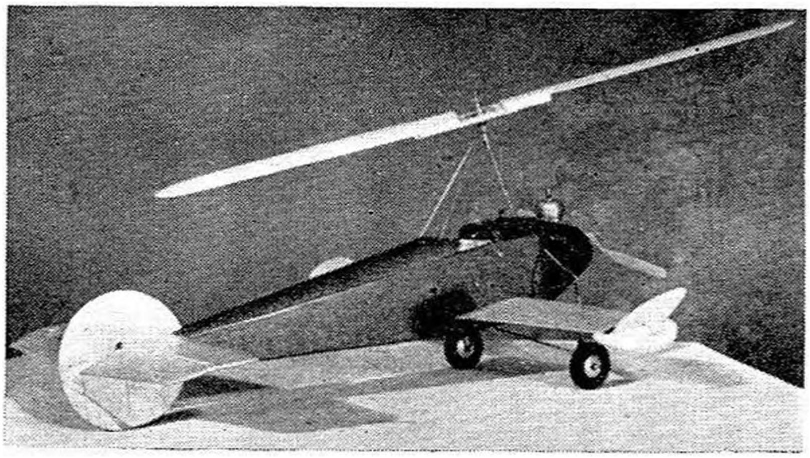
The fuselage sides are cut out—not forgetting the slots for the wing— and cemented to the bearer assembly. When dry the tail end is pulled together and formers D, E and F cemented in place. The $\frac{1}{2}$ in. soft top sheeting is added, carved and sanded to shape.

The tail unit is of conventional construction and requires no description. With control plate fitted and locked in neutral, and 14 SWG push rod in position, tailplane is cemented in place, followed by fin.

Wings are carved to shape and sanded, and, after control-line lead outs have been fitted to control plate, may be cemented in position. Crack wing tips for dihedral and fill in cracks with scrap wood and plenty of cement. Reinforce these joints with tape patches well cemented. Add ply reinforcement to port-tip and fore holes for lead outs, cementing little pieces of celluloid tube in them to form bearings for wires. Sheet in bottom of fuselage and fill in fuselage nose —between basic sides—with laminated sheet (cross grained). Any thickness on hand will do.

Sand model well, give one coat of thick clear dope, sand again when dry, and then cover the whole of model with tissue. Give two coats of clear and one coat of plasticised dope. Colour trim to taste, but keep colour dope away from rear end of model or it will turn out tail heavy.

1·5 c.c. version shows a wing-tip modification (radar scanner!) used in tests to see if the model could be made to fly on longer lines. Made of hollow block with $\frac{1}{2}$ oz. lead weight inside, no real improvement was apparent.



Rotors.

Cut out the two rotor blades from hard, springy sheet and note that they must be the same (*not* one left hand and one right hand, as one would for wings). Shape to section and sand smooth. Cut piece of $\frac{1}{8}$ in. ply to size required, mark out blade positions, and centre line for bearing. Cement on the $\frac{3}{32}$ in. strips and when dry sand to wedge shape as shown on plan. Cement blades in position and bind with tape.

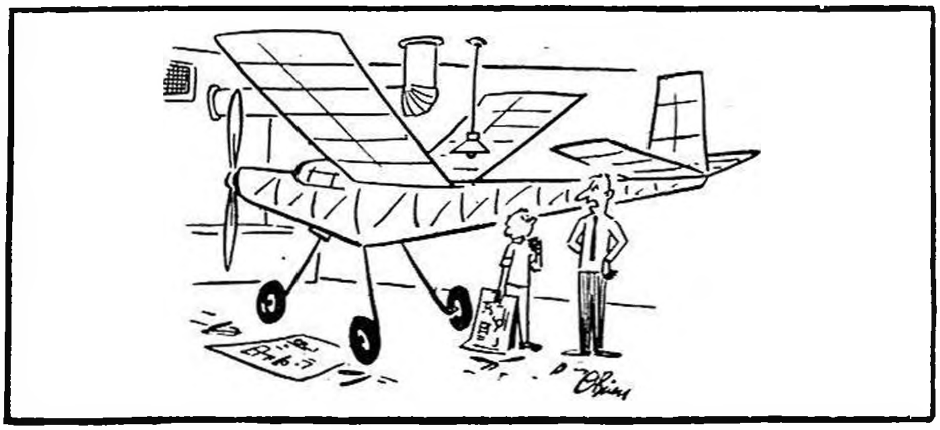
Blades should now be finished off chuck-glider fashion. My method is to rub in a coat of thick plasticised dope with a rag ; sand when dry ; brush on a thick coat of the same dope ; and sand again when dry. Polish up with wax polish. Cut out parts for bearing assembly as shown on the plan, bolt unit in place, and solder up. Remember, the rotors are the "wings" of this model and are very easy to make, so make a good job of them. When rotor assembly is finished balance by pushing lead shot—if required—into lightest blade tip, covering shot with a skin of cement. Balance assembly well as when revving at high speed the rotors will vibrate anyway, and if really off-balance may not revolve fast enough or may shake the model to pieces.

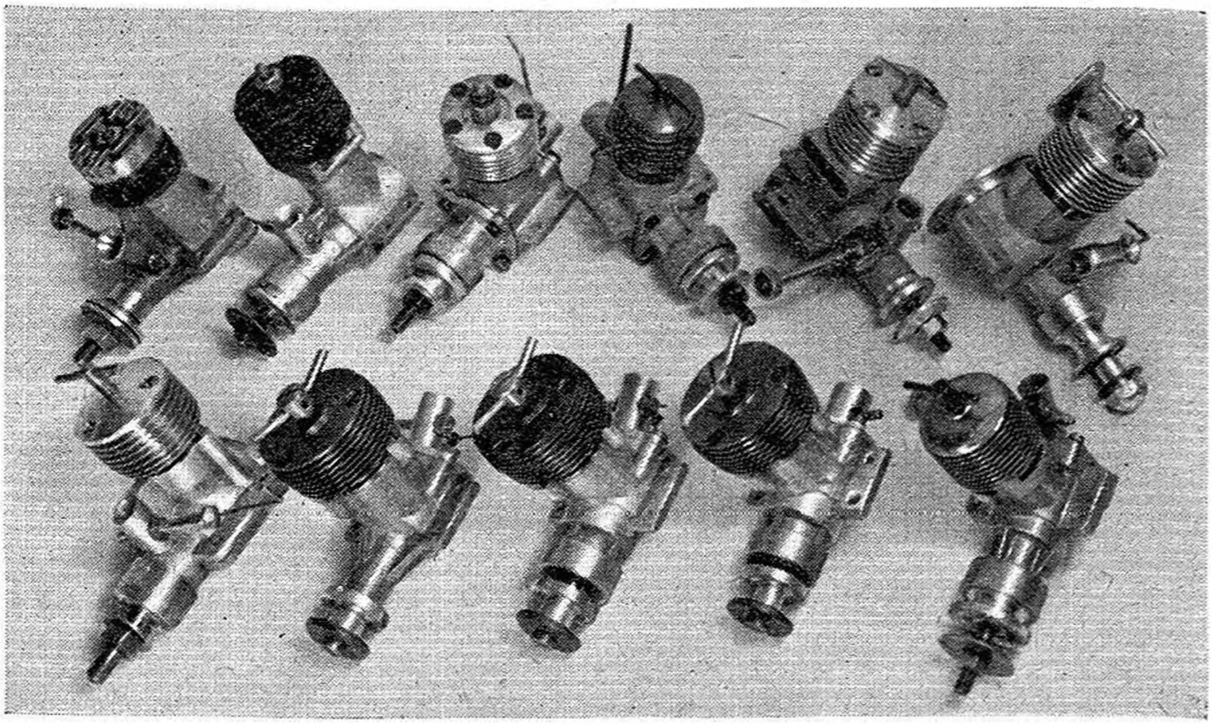
Do not attempt to hand launch model. Let it R.O.G. I have never attempted to H.L. my model and shudder to think of the result if I did !

Finally a note of warning. When carrying the model it is very easy to knock off the tailplane, for one is apt to misjudge its span because of the small wing. I have wiped mine off three times.

AND NOW — HOW DO YOU GET IT OUT OF THE BASEMENT?

Flying Models





2·5 c.c. REVIEW— R. G. Moulton

Complete revolutions per minute tests on a series of International class engines from seven countries.

"It's not what you've got—it's the way that you use it"—is a familiar phrase that has direct application to the world of Contest Aeromodelling. In the power classes, 2·5 c.c. is the International limit for duration, speed and team races, so it is not unexpected that the range of engines available in this capacity class are diverse in design and running characteristics. This brief feature follows the theme of last season's "Aeromodeller Annual" report on the ·8 c.c. units, and deals with a selected variety of engines, the majority of which were specially picked in view of the fact that they are *not* generally available, and yet offer a standard of performance that gives basis for interesting comparison.

The table gives a final summary of R.P.M. tests using a family of hand finished props, plus the die cast Frog Nylon 9 in. × 6 in. Doubtless many of the figures quoted could be improved upon by any individual modeller, but for comparative purposes with the same pair of hands operating each motor in turn through over 120 lengthy runs, using the same fuel formula for each diesel, and adapting Nitro Methane content for Glowplug, then certainly the results must show the performance likely to be expected by the average operator in normal conditions of air temperature *circa* 65-70 deg. F.

No attempt has been made to find the ideal prop. size for any of the engines, but the figures give a lead towards the peak performance range and suggest the diameter/pitch ratios most likely to absorb the full engine power. This is particularly evident in engines designed for a specific purpose such as the Czechoslovakian **VLATAVAN** 2·5 c.c. racing glowplug engine, produced

Heading: top row, O.S. MAX. 15, Barbini B.40 TN., Webra 2.5R, Webra Mach I, Enya 15D and Oliver Tiger Mk. III. Bottom row, Eifflaender Special, Zeiss Activist II, Activist IV, Activist V and D.C. Rapier.

from the design by J. Sladky and J. Koci under the guidance of Zdenek Husicka at the M.V.V.S. laboratory in Brno. Likened to a miniature Dooling, the Vlatavan is remarkable as it is virtually useless with large diameter propellers. It cannot drive the Frog Nylon 9×6 with any consistency, yet on an 8 ×3½ in. it soars above all others, leading even the Oliver Tiger III, for it holds the r.p.m. without misfire and gives the impression of being able to run much faster when moving through the air. This Vlatavan is, like most of the engines tested, easy to start, but, having rings on an alloy piston which is in itself relieved of a large wall area for transfer ports, it has remarkable "one-way-only" compression, doubtless due to running-in with an abrasive. On a 6×9, it holds 14,000 r.p.m. in standard form, equal to many re-worked specials.

With plain bearings the **O.S. MAX. 15** from Japan has a disadvantage when running "light" but with an 8×4 load it matches (even passes) many of its contemporaries, including ball-race diesels. The O.S. Max has especially fine piston/cylinder fit, employing generous ports and working on the principle that close-tolerance manufacture gives a good initial output, likely to taper off through extensive use. This is not the case with the Italian **BARBINI** and West German **WEBRA 2.5R,** two widely different designs stemming from diesel experience and made to last to the bitter end. In fact the Webra, like its Mach I brother, retains the unwelcome characteristic of being so tightly lapped that a cylinder prime can wash lubricant from the walls, and the piston squeaks in protest. It is, like the Barbini, a delight to handle and with obvious leanings towards the 9×3 size, while the Italian Black-Head prefers an inch less diameter.

Handling these four top-class glowplug engines from Europe leaves one in no doubt as to why this form of ignition is more popular in foreign parts where the diesel is at all difficult to operate. The diesel is fuel sensitive in hot climates, fussy at high altitudes, and not so smooth running if Amyl Nitrate or Nitrite is not obtainable for the fuel. But for us at near sea level, in temperate climates, the diesel remains supreme for free-flight and team-racing. In speed, no one can argue against glow superiority for high r.p.m. without misfire.

One of the great advantages of the diesel is its ability to build up r.p.m. when the model gets under way, and no diesel is more impressive for this than the **OLIVER TIGER** in its various forms. For years now it has reigned supreme in Class A and F.A.I. team racing, where its most useful prop. size is 7×9—the same size used for glowplug engines of twice the capacity in class B, giving an airspeed advantage of only 10 m.p.h. or so. Though rivalled by many other recently introduced diesels, the Tiger remains the smoothest, fastest and most predictable of all and has but one failing in being unable to hold very high r.p.m. for speed work from a ground setting.

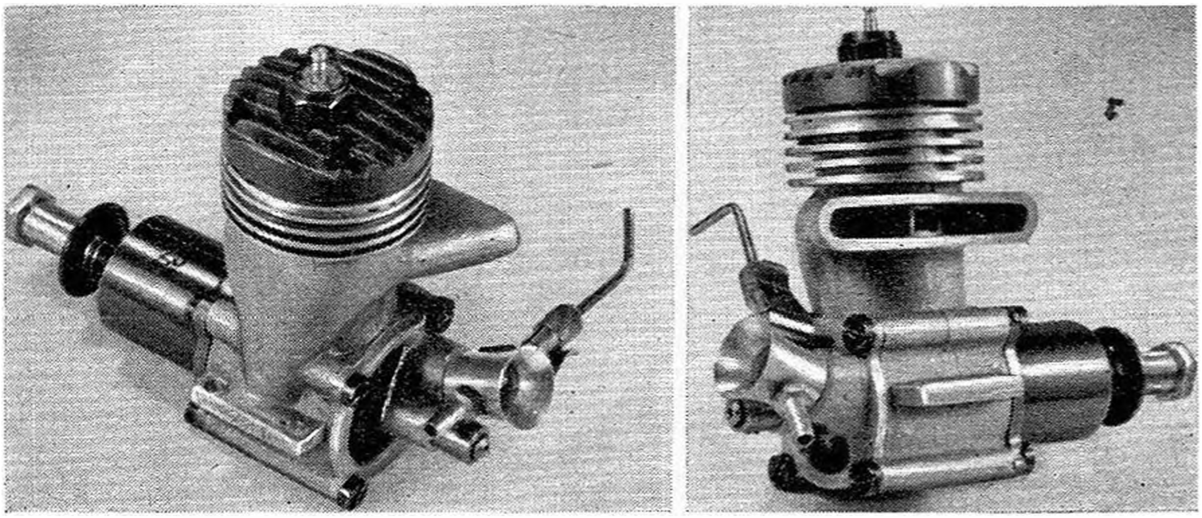
Three engines which approach the O. Tiger's performance (in standard form) are the Japanese **ENYA 15,** British **EIFFLAENDER** and

Neat export from Hungary, the Alag X-3 is cleanly cast, has Bakelite back plate and carb. throat.

FROG 249 Mk. II. Although they do not reach the same excellence in *all* categories (F/F, T/R, R/C, etc.) as the Tiger, each has particular advantages within its rev. range and, in good hands, *could* more than match the Tiger. For example, the Frog, with a Nylon 9×6 of same manufacture, can turn faster than any other 2·5 c.c. motor in our stable, and for free-flight, although far from smooth, even with liberal dosings of nitrate, it holds a respectable 15,000. Some degree of inconsistency with the Frog can be overcome with careful attention to the needle valve.

The Enya is a beautifully smooth running unit, rather rough on the control side, with coarse threaded contra piston screw and needle ; but flexible enough in settings to allow for any ham operator to find near-peak performance. Moderate consumption rate makes it a team racing rival for the O. Tiger.

The Eifflaender is so different it deserves full credit for really outstanding free-flight application. Very light weight, coupled with a peak figure around 15,000 r.p.m. and fairly heavy fuel consumption (for rapid cut-out) will make it a



Speed modellers' dream engine, in appearance at least, the Vlatavan 2·5 c.c. racing engine features all the known design requirements for power at high r.p.m.

favourite for open and F.A.I. contests. This motor can really hold its revs at a constant figure if allowed a warm-up period, and much of the credit for its smoothness should go to the large bearer lugs and near-balanced piston and rod.

For good, if less spectacular performance, the unpretentious Hungarian **ALAG X-3** and **D.C. RAPIER** from the Isle of Man can satisfy anyone who wants an engine that will last a long while, stand up to abuse and crashes, yet offering excellent handling characteristics.

The Alag X-3 is a very small job, cleanly cast and with a Bakelite back plate and carburettor throat. Like other East European engines, it needs only a light upper cylinder prime for an immediate start, and is one of the smoothest running plain bearing engines in our experience. The Rapier is equally smooth and has a burly air about it in spite of a very small prop. shaft diameter and the reduced overhang of the down draught carburettor. Slightly inconsistent above 12,500 r.p.m. it has a liking for a load, and the 9×6 gives it best opportunity to show a handsome r.p.m. figure. The prototype of this engine was exceptional on an 8×4 turning up to 14,000 r.p.m. and there is no reason to suppose that a well run-in (with undisturbed assembly) Rapier could not approach that figure as the unit tested was "straight out of the box."

Lastly, the interesting group of Carl Zeiss engines from the Soviet Zone of Germany. Known as the **ACTIVIST,** the engine now appears in at least five, if not six, versions and these are reed ("membrane") and rear disc (with either rotation for induction timing) with plain bearing, ball race and screwed cylinder assembly variants. All are as cleanly cast and beautifully machined as one would expect from one of the world's leading camera and optical instrument manufacturers.

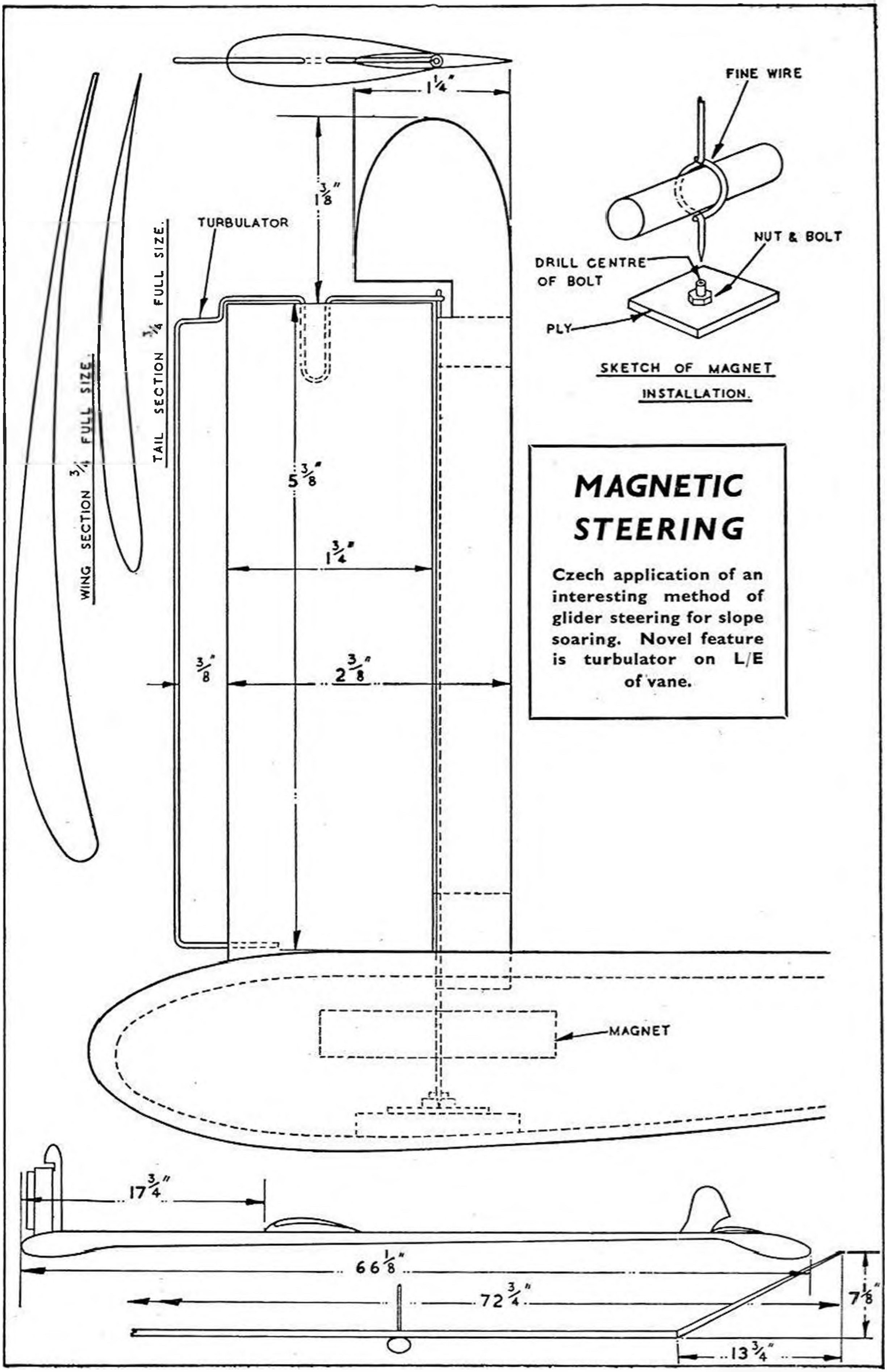
Yet there is a peculiarity in the Zeiss range that indicates a failing during the process of manufacture. The plain bearing version (II) is faster than those with a ball bearing supported shaft ! Alignment of the races always has been a leading point with miniature racing type engines and with all their facilities at Jena, Zeiss have a small problem on their hands. The claim for .36 b.h.p. can only be taken as an indication of East Zone optimism, but nevertheless, in spite of contra pistons that run-back, end float on race mounted shafts and power loss on warning up, the Activist series are most attractive in appearance and offer a lead to all other engine makers in the provision of an immediate cut-out devise on the disc induction system.

The table speaks for itself, and should not be taken as quoting the maximum possible r.p.m. figures for any of the units tested, but rather as a comparative table based solely on one modeller's findings.

PROPELLER-R.P.M. TESTS 2·5 c.c.

Engine		Sport or R/C 9×6	Freeflight 9×3	Stunt or F/F 8×4	Freeflight 8×3½	Team race 7×9
(DIESEL)						
Enya 15D	(Jap.)	9,400	12,100	13,200	14,250	12,000
Eifflaender	(G.B.)	9,300	12,250	13,500	14,800	11,600
Oliver Tiger III	(G.B.)	9,950	12,150	14,000	15,400	11,800
Zeiss Activist V (Reed BB)	(E. Germany)	8,400	10,050	11,600	14,200	10,800
Zeiss Activist IV (Disc BB)	(E. Germany)	8,800	10,600	11,800	14,300	10,200
Zeiss Activist II (Plain Disc)	(E. Germany)	9,000	10,900	12,200	14,850	11,000
Alag X-3	(Hungary)	8,800	10,850	12,000	13,200	10,900
D.C. Rapier	(G.B.)	9,100	10,900	12,200	13,600	11,000
Frog 249 Mk. II	(G.B.)	10,100	11,950	13,200	15,000	11,400
(GLOW)						
Barbini B.40	(Italy)	9,000	10,800	12,900	14,000	11,100
O.S. Max 15	(Jap.)	8,900	11,800	13,100	13,800	11,000
Webra 2.5R	(Germany)		11,900	13,000	14,200	11,000
Vlatavan 2.5	(Czech)		8,800	11,000	15,400	9,500

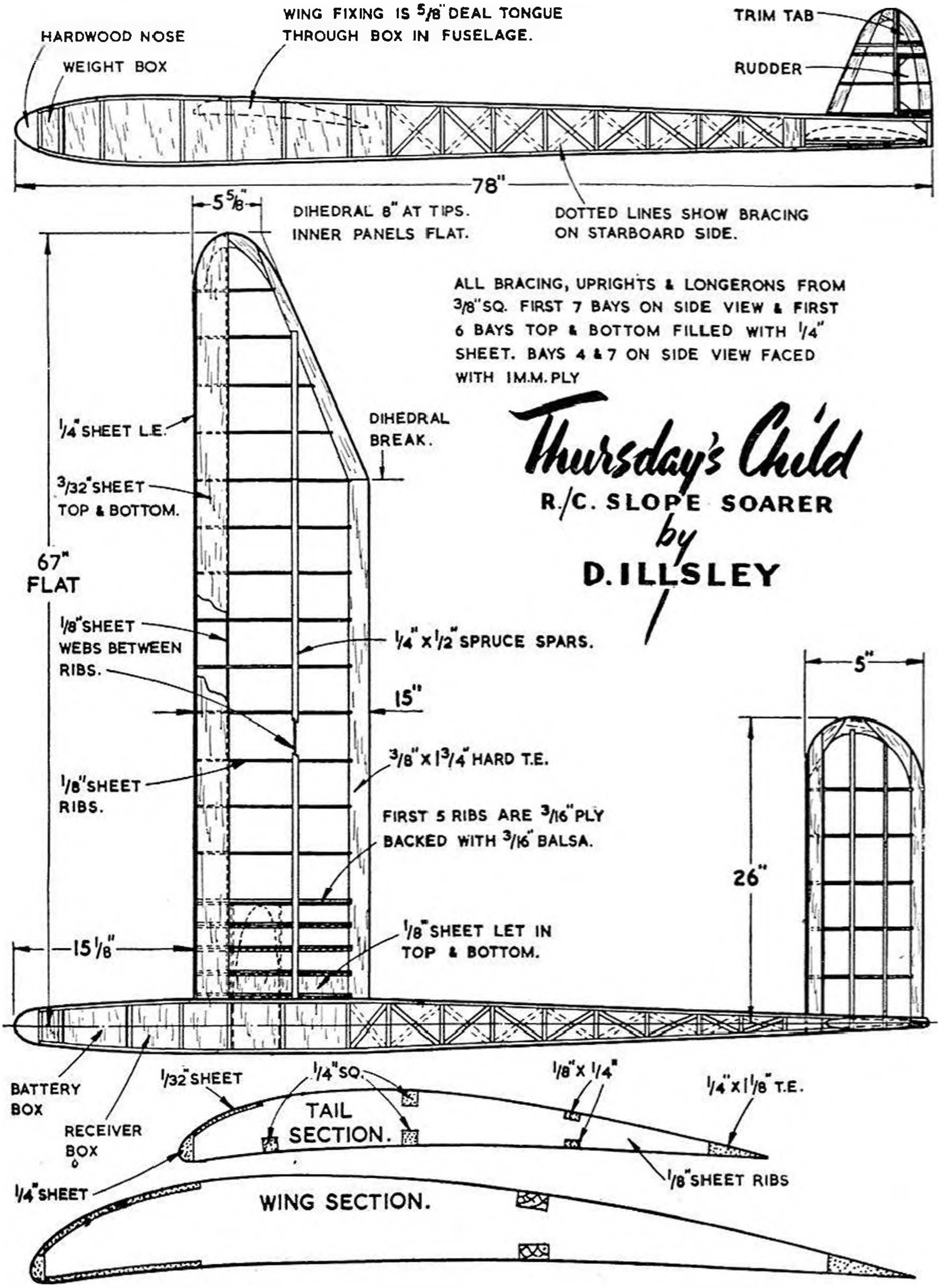
DID YOU KNOW THAT . . . ? IF your glow engine is hard to start again when still sizzling from a hot run, an injection of neat castor or sewing machine oil in the exhaust port will remedy the loss of compression. IF your diesel cylinder liner wanders round out of true line-up, it may cost you up to 1,250 r.p.m. in top end performance. IF you employ Nitro Benzine or Methane in your fuel, you should flush the engine with paraffin or thin oil after use to avoid corrosion.



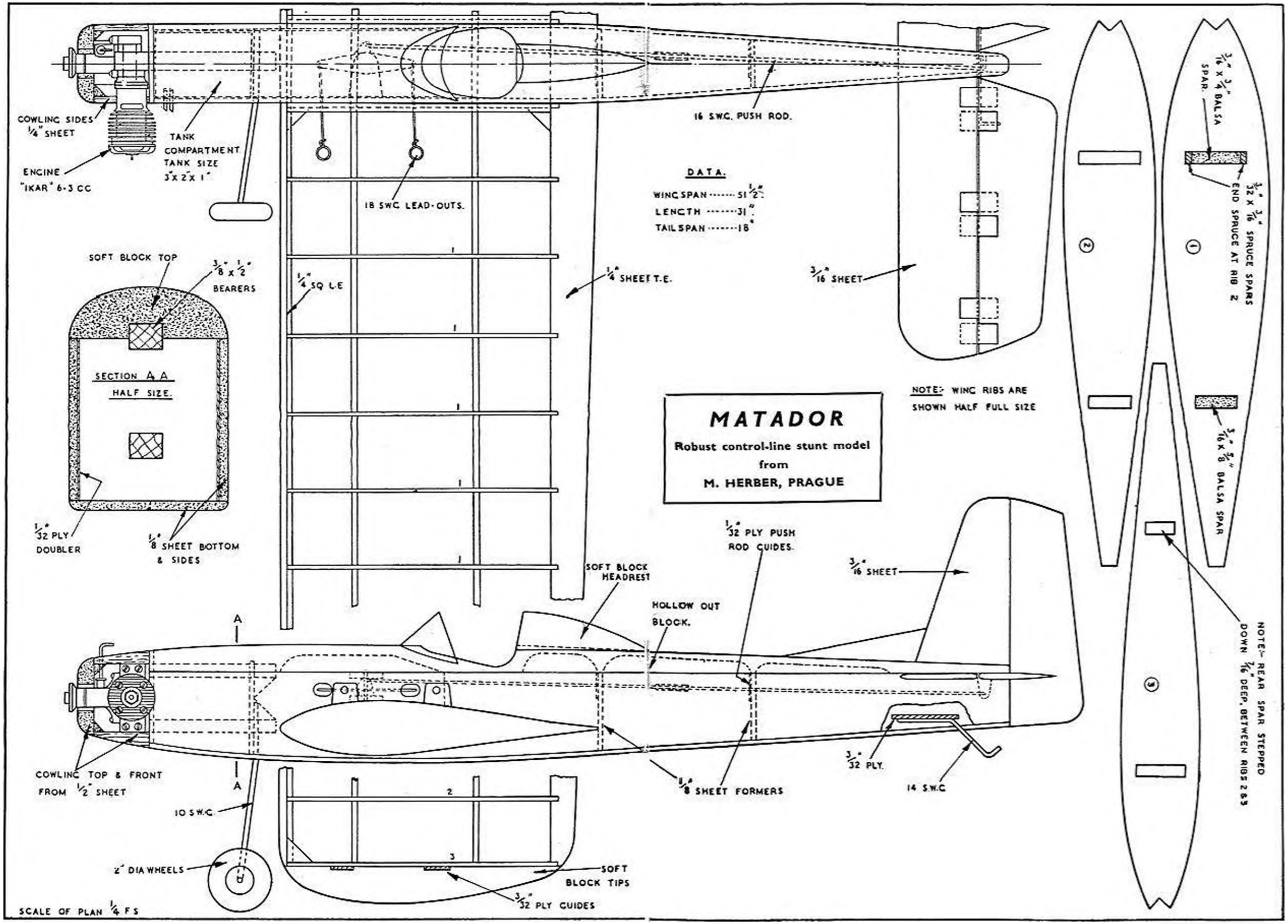
MAGNETIC STEERING

Czech application of an interesting method of glider steering for slope soaring. Novel feature is turbulator on L/E of vane.

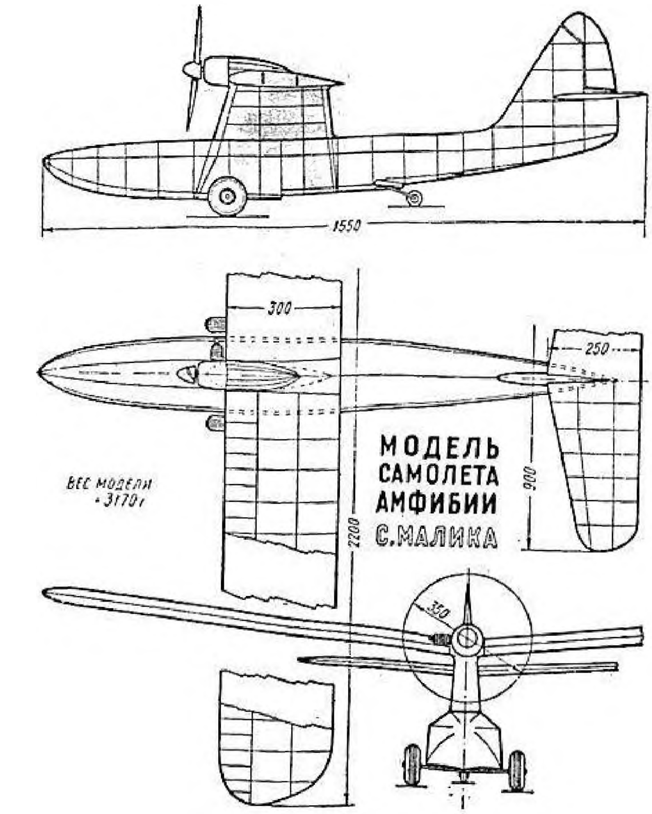
LETECKY MODELAR

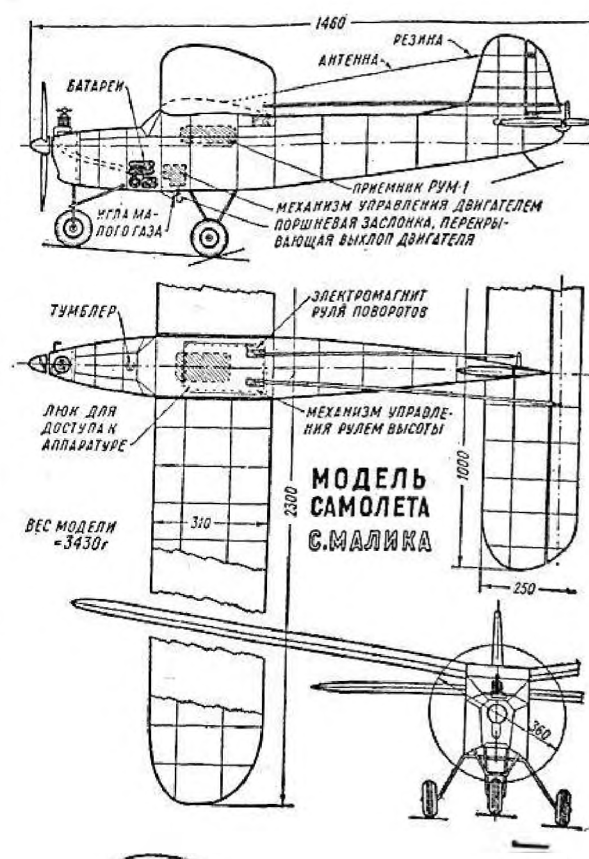


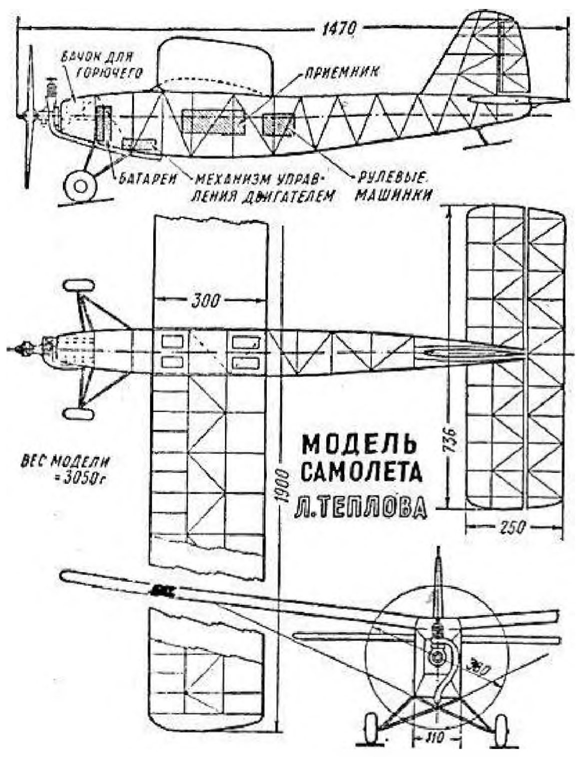
1957 has witnessed much activity in the field of radio-controlled glider flying, notably by the Northern Heights M.F.C. team flying from Ivinghoe Beacon, Bucks. However, their high times were bettered on the 21st April when F. Vale and D. Illsley of the Midlands flew the above model from the hills above Dovedale for a total time of 2 hours 23 min. 19 secs., to set a new British record for the class. (Current international figure is 8 hours 34 min. 21 secs. set by Dr. Robert Chase in California in July 1956.)

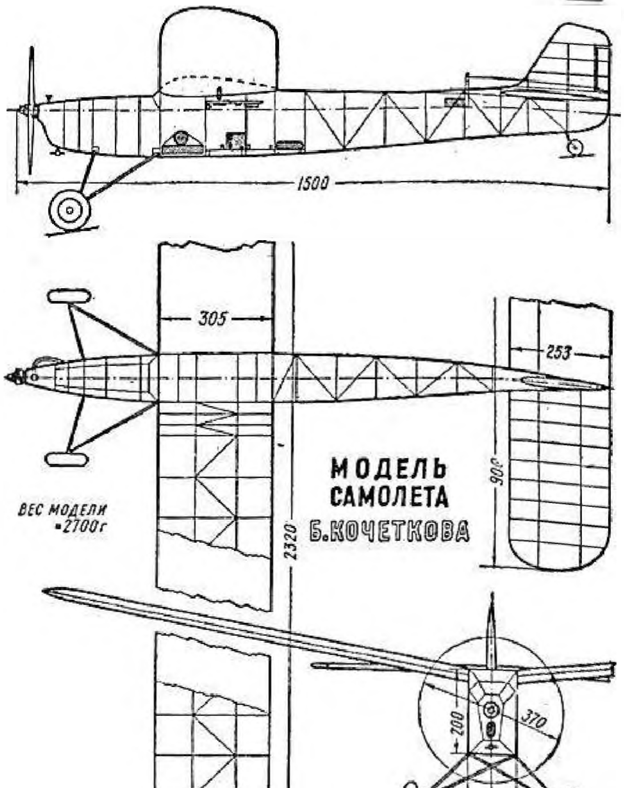


LETECKY MODELAR









The above four examples of Russian Radio Models show an orthodox approach to model design (if one excepts the flying boat), though we have no doubt they exhibit the usual Russian excellence of construction and well-thought-out practical application.

DR. WALT GOOD'S DUAL PROPORTIONAL RADIO CONTROL TWO-TONE PULSE WIDTH SYSTEM

By HILTON L. O'HEFFERNAN

THE BRIEF description of the above system by Claude McCullough in the May 1956 issue of the "AEROMODELLER" so intrigued me that I wrote to Walt Good, and he very kindly sent me the circuit diagrams.

Since a British version of the sub-miniature American 1AG4 and 1AH4 valves he used in the receiver was unobtainable I decided to use the B7G based valve types. The receiver was to be tested out in an old model of mine and therefore the need to build a really compact version was not necessary ; all the components used were those I had in stock and were, therefore, by no means the smallest obtainable.

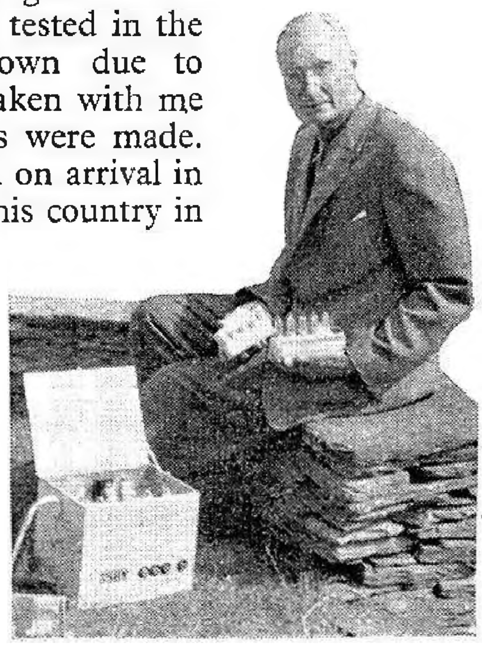
The valves used were 1S4 as detector, 1L4 as audio amplifier and three 3Q4s as relay operating valves. (I understand 3V4s are electrically the same as 3Q4s so advise the use of 3V4s since these types are also used in the ground station equipment.) The receiver measures 6 in. $\times 2\frac{1}{2}$ in. $\times$ 4 in. high, including a foam rubber cover which completely encloses the five valves. With three E.C.C. 5A relays the weight is $9\frac{1}{3}$ ozs.

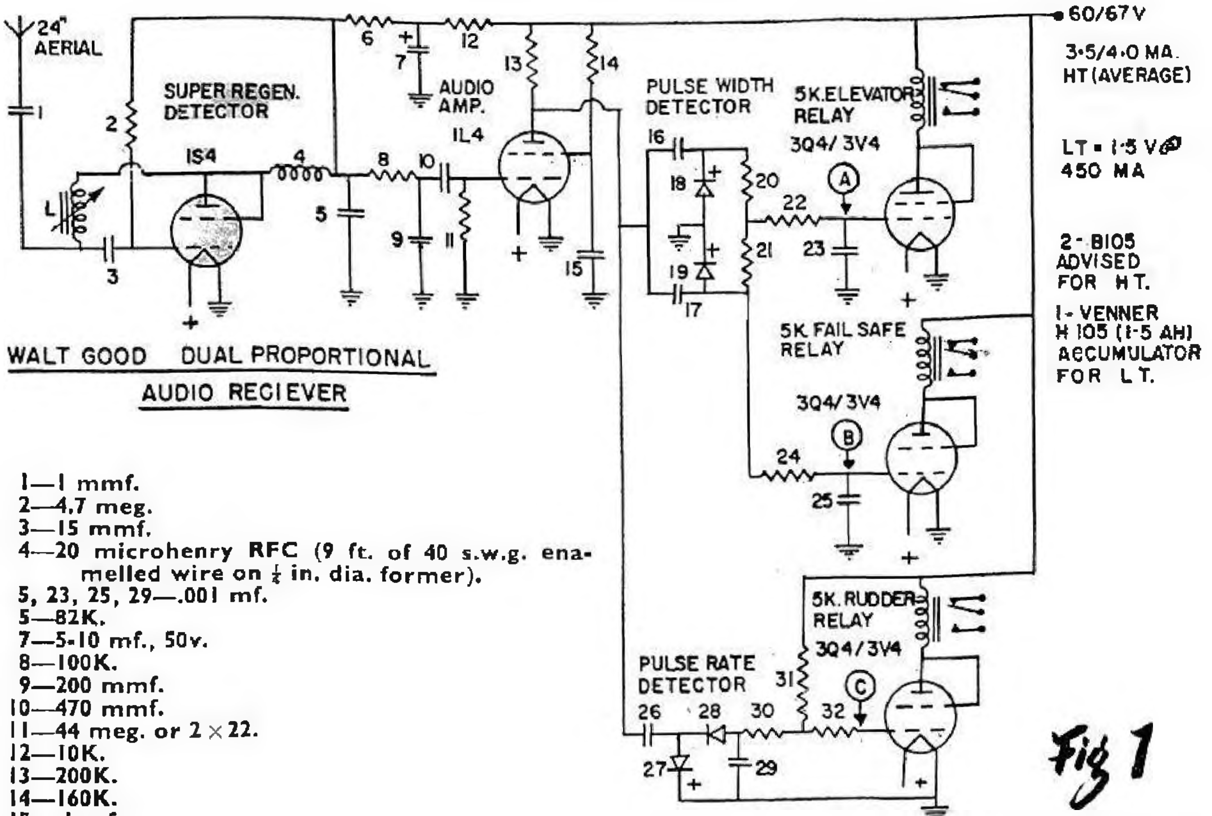
The two pulsers and the audio oscillator use the 3V4 valves specified by Walt Good : I did not use his transmitter circuit because it was not suitable for the frequency of the crystal I wished to use, and also because I have always preferred 6-volt indirectly heated type valves for transmitters, since these appear much more robust and reliable in such operation than directly heated types. The transmitter circuit shown has been used in two previous c.w. transmitters and has been found extremely reliable and easy to adjust. A 90-volt H.T. battery provides power for the pulsers and audio oscillator, whilst a well-smoothed motor generator (capable of giving 300/350 volt with 12-volt d.c. input) supplies the transmitter.

During the whole of the tests with this system (24 long flights) never more than 4/6 volts input to the m.g. were used and the transmitter H.T. was around 100 volt or less. Input to the final valve was usually *1/7 watt* and this gave a completely adequate range.

The equipment was thoroughly ground tested in the model during November 1956, but not flown due to inclement weather. It was then cased up and taken with me by sea to Cape Town, where all the test flights were made. The reliability was such that everything worked on arrival in South Africa and again when it came back to this country in April 1957, after travelling over 12,500 miles. The receiver was retuned once during the six months and then only a quarter turn of the slug was needed for best results. Only one component needed replacing—the 1 meg. potentiometer used for elevator control became erratic.

Although so completely reliable, this is a complicated piece of equipment (by our R/C model standards) and should *not* be attempted unless one is experienced in radio receiver construction.





1—1 mmf.
2—4,7 meg.
3—15 mmf.
4—20 microhenry RFC (9 ft. of 40 s.w.g. enamelled wire on ¼ in. dia. former).
5, 23, 25, 29—.001 mf.
5—82K.
7—5-10 mf., 50v.
8—100K.
9—200 mmf.
10—470 mmf.
11—44 meg. or 2 × 22.
12—10K.
13—200K.
14—160K.
15—.1 mf.
16, 17—.002 mf.
18, 19, 27, 28—Diode.
20—6.2 meg.
21—3.0 meg.
22, 24, 32—10 meg.
26—330 mmf.
30—2.2 meg.
31—22 meg.
L = 30 turns No. 36 enamelled wire on ¼ in. dia. former, or 20 turns No. 26 on $\frac{7}{16}$ in. dia.

Fig 1

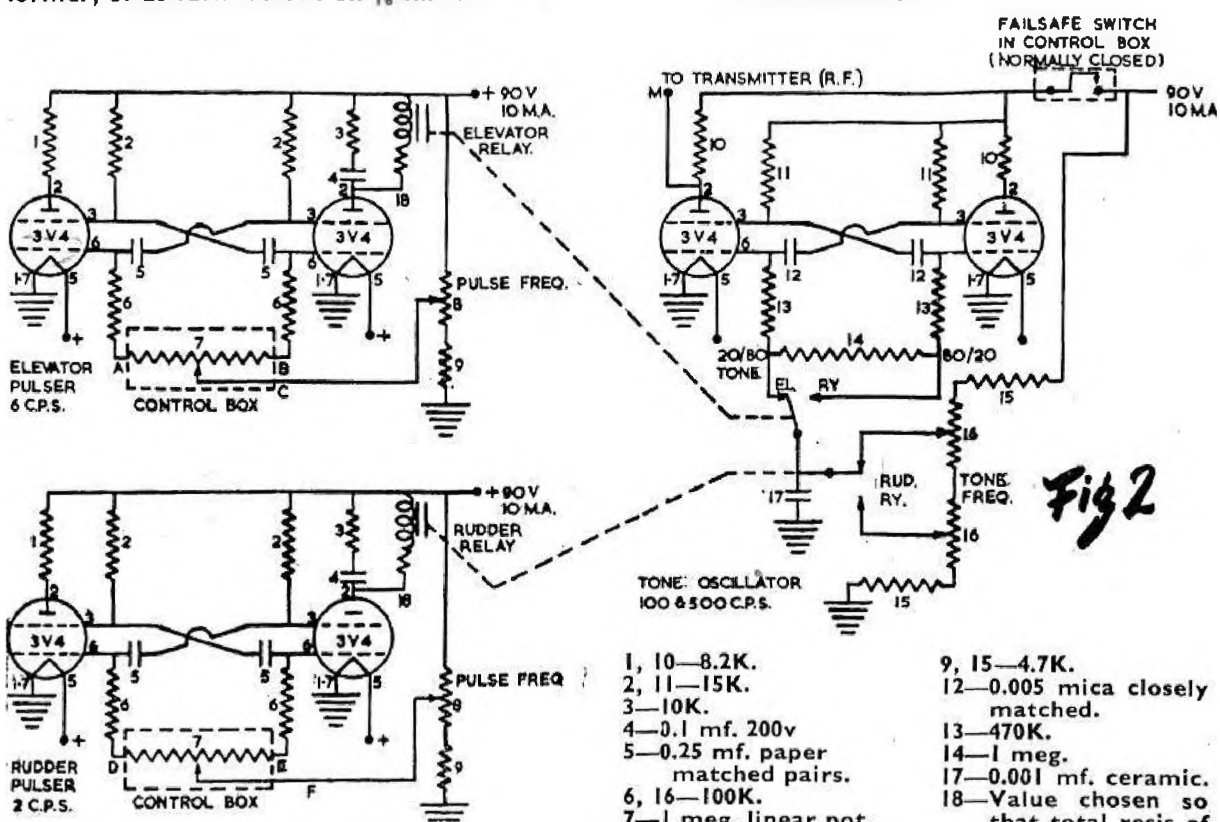
DIODES: 20 meg. minimum back resistance, temperature insensitive to 150 deg. F. Brimar type M3.

CONTROL VOLTAGES:

(A) +3v at 20/80 tone.
−14.5v at 80/20 tone.

(B) Exceeds −10v for any pulse width/rate.
−1v for carrier only.

(C) +2v at 100 cps.
−11v at 500 cps.



SHIELD LEADS ABC FROM LEADS DEF IN CONTROL CABLE

Fig 2

1, 10—8.2K.
2, 11—15K.
3—10K.
4—0.1 mf. 200v
5—0.25 mf. paper matched pairs.
6, 16—100K.
7—1 meg. linear pot.
8—100K pot.
9, 15—4.7K.
12—0.005 mica closely matched.
13—470K.
14—1 meg.
17—0.001 mf. ceramic.
18—Value chosen so that total resis of relay coil + resis (18) = 8.2K.

Both relays 5000 ohm coil (ECC 5A type used).

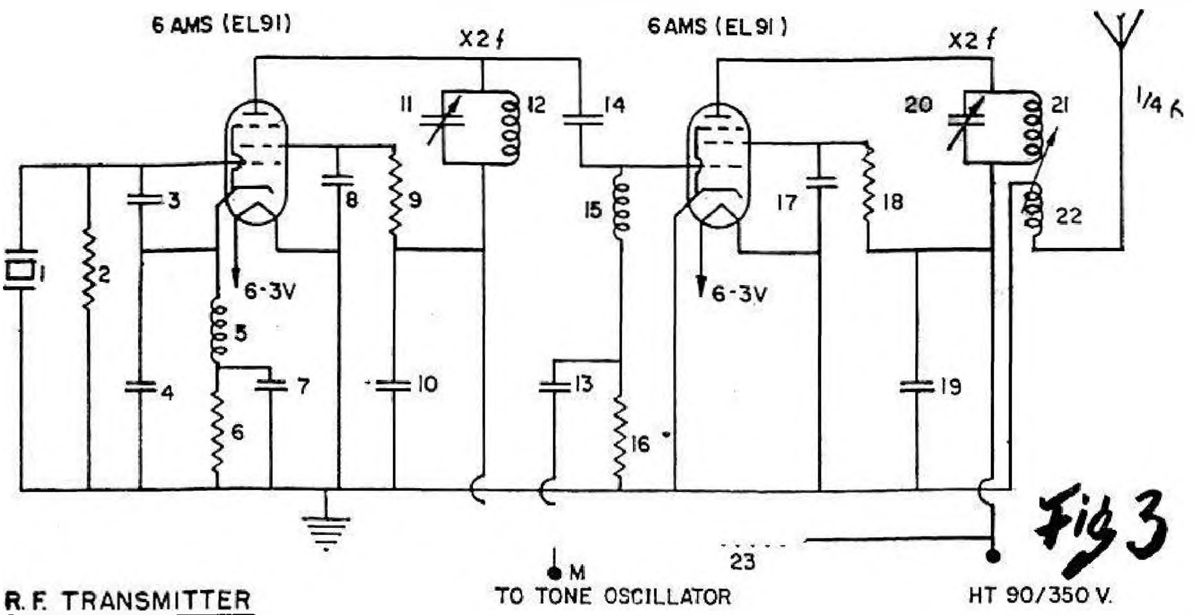


Fig 3

R.F. TRANSMITTER

1—6740 KC quartz crystal.
2—50 K.
3—30 mmf.
4—40 mmf.
5—RFC 2.5 mH.
6—180 ohms.
7—.01 mf. mica.
8, 10, 17—.003 mf. mica 500v.
9, 23—27K.
11, 20—3/30 mmf. Philips beehive.
12—17 turns 18 s.w.g. enamelled wire, $\frac{3}{4}$ in. dia., $1\frac{1}{8}$ in. long.
13, 19—.01 mf. mica, 500v.
14—100 mmf. 500v.
15—RFC 2.5 mH.
16—2.2 meg.
18—33K.
21—21 turns 16 s.w.g. enamelled wire, $\frac{3}{4}$ in. dia., $\frac{7}{8}$ in. long.
22—4 turns 18 s.w.g. enamelled wire to fit inside item 21.

All resistances—1 watt.

The System

Dual proportional control means a proportional rudder and a proportional elevator which are simultaneous so that any degree of rudder can be commanded along with any amount of elevator. Let go of the stick, it snaps back to centre as do the rudder and elevator. The system described here also permits engine control and a fail-safe connection which centres the rudder and elevator in case of transmitter failure or a jamming signal.

The Pulse Width Detector uses a diode bridge circuit which can tell the difference between narrow and broad pulses. It has the property of giving out a positive voltage at point "A" (diagram 1) when broad pulses are used and a negative voltage when narrow pulses are received. This voltage is led to the grid of the relay valve. Thus for broad pulses the valve conducts and the relay pulls in (4 ma) ; for narrow pulses the valve is cut off and the relay drops out (0 ma). Now imagine the transmitter tone being switched back and forth from broad to narrow at six cycles per second. As a result, the receiver relay will follow and we have our elevator control using the pulse width detector. The six cps. switching can be varied in dwell time to give regular proportional action.

Fortunately the pulse width detector does not respond to difference in tone frequency, so if we could find another circuit that is sensitive to tone frequency but not to tone width we would have a second independent control. This is exactly what the Pulse Rate Detector does ; it has the property of giving out a negative voltage at point "C" (diagram 1) when a high tone is received and little or no voltage for a low tone. Thus if we switch back and forth at 2 cps. between 100 cps. and 500 cps. the relay will follow and we have a rudder control.

While the elevator and rudder are being operated, there is always a tone present. Now we can connect a third relay valve to a negative diode and keep the relay open as long as a tone is received. This is done by tapping into the negative end of the pulse width bridge (saving a diode !) and adding the fail-safe valve an·' ·elay as shown. When no tone is sent, such as carrier or no signal, all three relays pull in. This would normally result in full Right and full Down except that the back contact of the fail-safe relay is connected to the actuator battery and removes the voltage from the rubber and elevator actuators, allowing them to return to neutral due to rubber band centring. The other contact on the fail-safe relay is connected to an engine control actuator, escapement or motor. Thus a 0·1 second blip of carrier momentarily centres the controls and changes the engine speed. A long spell of carrier or transmitter failure causes immediate centring of rudder and elevator and could also cut the engine if desired.

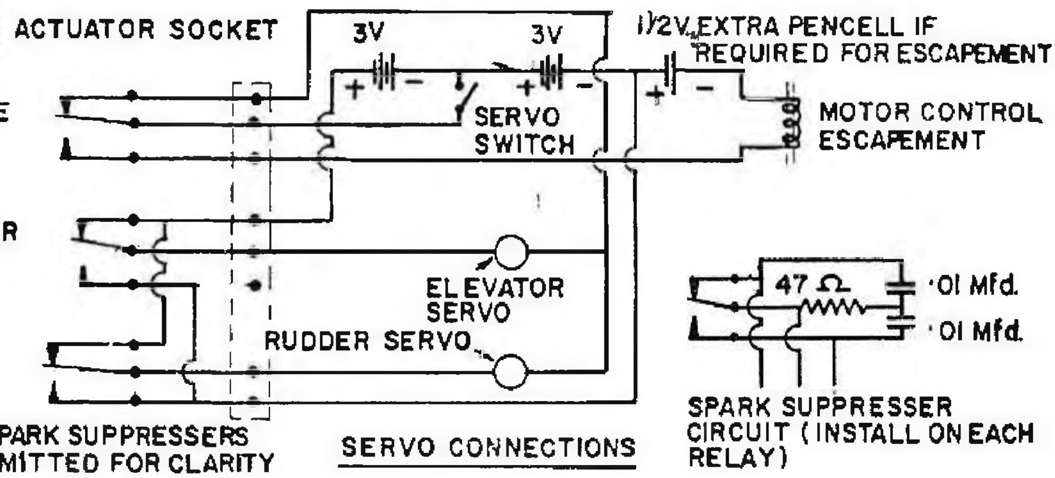
The actuators are Mighty Midget motors with rubber band centring on the motor shaft. An extra gear (another "M.M." pinion and gear) is added and 3 volts used. This arrangement delivers about 8 inch ounces of torque.

Receiver (Figure 1)

The 1S4 is the super regenerative detector. Capacitor 7 and resistor 12 form a decoupling filter which prevents "motorboating" with worn H.T. batteries. Resistor 8 and capacitor 9 are the quench filter and attenuate most of the 80 KC quench frequency before it gets to the audio stage. The 1L4 amplifies the audio and distributes it to the three relay circuits, as described earlier. The filters 22, 23 and 24, 25 remove any tone before reaching the relay valve grids.

The only portion in which placement of the components and their values is particularly critical is the detector stage. The tuning coil (L), grid condenser

Fig 4



(3), aerial coupling condenser (1), grid leak (2), and RFC (4) should be kept in the clear and away from other components. Both the aerial coupling condenser and grid condenser really need adjusting to get the *best* results from any 1S4 valve. To do this, substitute a 3/30 mmf. Philips Beehive condenser for the fixed 15 mmf. grid condenser and use a semi-variable (0·5-3 mmf.) condenser for the aerial coupling condenser, using the exact length (24 in.) of aerial wire that will be used in the model. Use only the detector and audio stages, connecting a pair of high resistance headphones through a ·001 mfd. condenser to the audio anode, the other headphone lead going to LT—. Adjust the aerial coupling and grid condensers until you hear a smooth rushing sound, which is *reduced* when a signal is tuned in. Tune around on the dust core and try to pick up an amateur phone signal on 28 mc. (which will help you locate the desired 27 mc. as well). The best position for the grid condenser is just a bit more capacity than the value at which the hiss stops (detector stops super-regenerating). More capacity in the aerial coupling condenser means more grid condenser capacity—there is an optimum position for both. A final test, at this stage, is to progressively lower

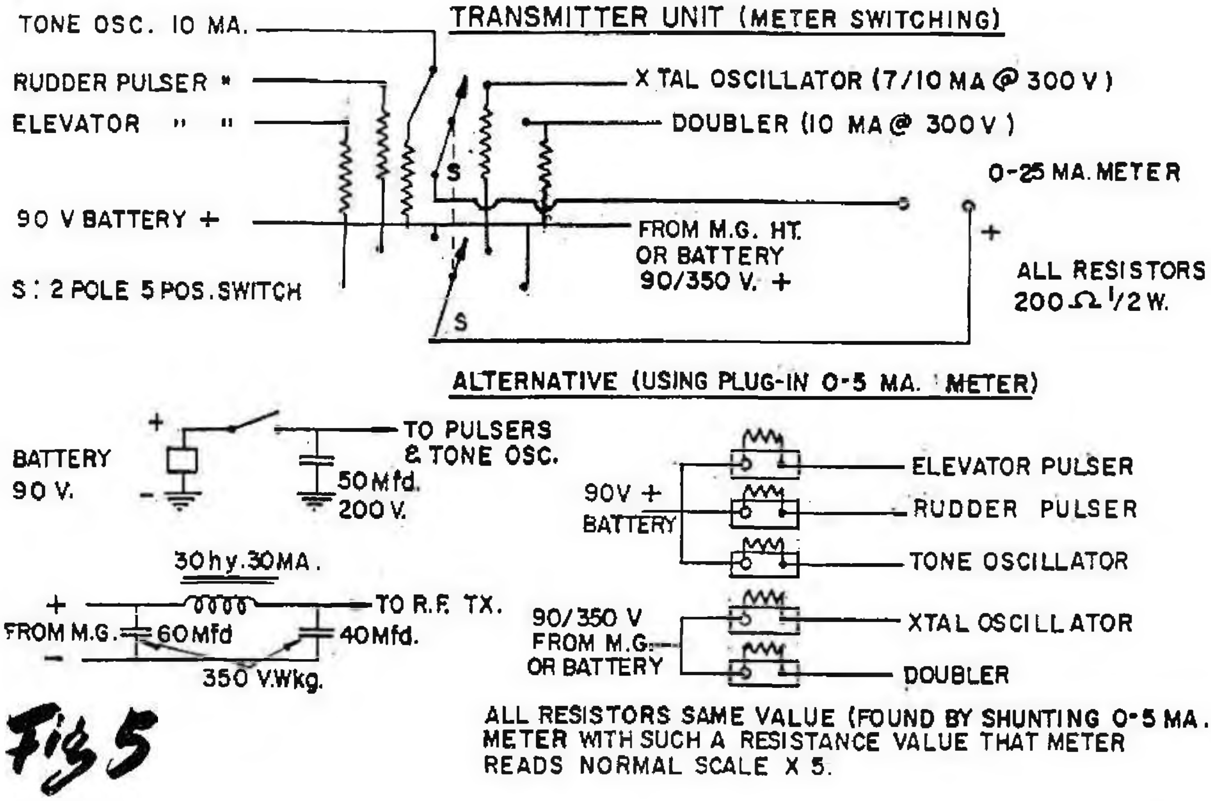


Fig 5

the H.T. by, say, 10 volts and check that the detector valve still oscillates (adding 10 volts of old pencells in series with the H.T. battery but with the polarity *reversed* in an easy way). Remove headphones, plug in the three relay valves (with meter or meters in their anode circuits) and tune the receiver to the transmitter—using not more than 90 VHT on the R.F. portion of the transmitter and, of course, no aerial. If all three channels work as they should, adjust receiver for maximum sensitivity on the *rudder* channel (the elevator and fail-safe valves may be removed to save batteries during this test). Set the transmitter controls for left rudder (minimum rudder relay current) and centre elevator. Adjust receiver tuning, aerial coupling and grid condenser for maximum dip in the rudder relay valve current. If you then mark the setting on the Philips condenser and take it to a good service dealer who possesses a capacity measuring bridge he can check it and supply a fixed ceramic condenser to suit. Fit this and recheck, making final adjustments with the aerial coupling condenser. (If space permits, the Philips condenser can be left permanently in circuit as the grid condenser).

(*Note* : When soldering the M3 diodes, clamp the wire between the diode and the point of soldering with a pair of pliers to prevent heat from reaching and damaging the diode.)

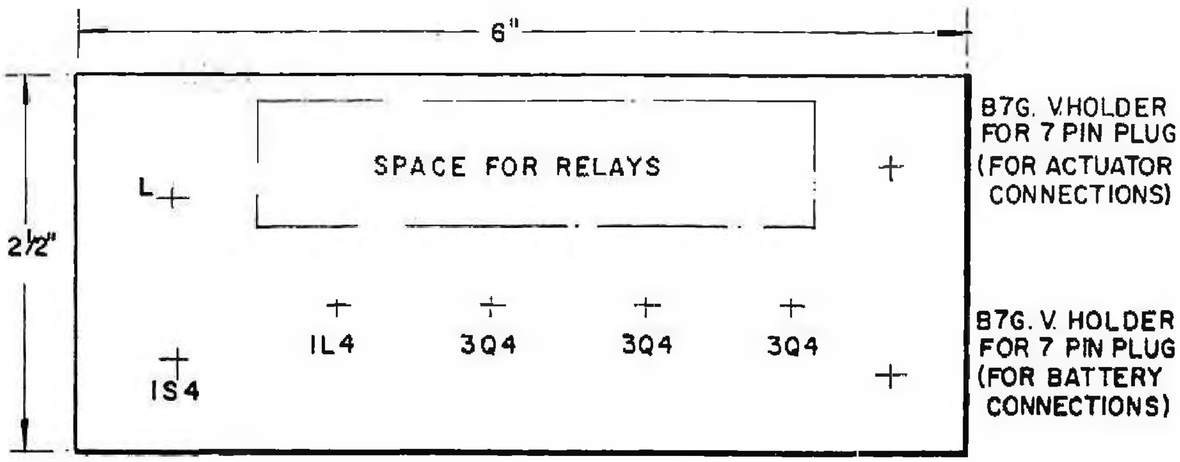


Fig 6 VIEW OF RECEIVER PANEL (UNDERSIDE)

Transmitter Unit (Figures 2 and 3)

The transmitter is composed of four principal sections : (1) Rudder pulser ; (2) Elevator pulser ; (3) Tone oscillator and (4) R.F. transmitter. The function of each section will be described.

Both rudder and elevator pulsers use identical circuits and the associated control box follows along the lines given in the "Galloping Ghost" article in the "AEROMODELLER" of July 1957, p. 375. Incidentally, all electronic pulsers are balanced devices and hence the critical parts (0·25 mfd., 15K and 100K) should be well matched. The two pulsers are shown in Figure 2 on the left-hand side.

The tone oscillator is another multi-vibrator circuit but this time the output tone is either 100 or 500 cps. The four wave forms are obtained by switching in the grid circuits. Switches are the contacts of the pulser relays. The tone oscillator is shown on the right side of Figure 2. Note the rudder relay switches the grid return from a low voltage to a high voltage. This provides the two tones. The elevator relay switches from one side of the grid resistor string to the other. This makes the tone wave lop-sided, either 80/20 ratio or 20/80. Since the pulser relays are independent, the outgoing tone wave depends on which relay contacts happen to be closed at that instant. There are four combinations of the relay contact positions which yield the four-wave forms. The output of the plate point M (of the tone oscillator Figure 2) of one of the 3V4's is connected to the R.F. transmitter and provides the modulation. The carrier only signal is sent by pressing the "panic" button which removes the H.T. voltage from the tone oscillator.

The tone oscillator is set to the two tones by adjusting the 100K pots. Rudder relay may be held against the high or low tone contact with your finger. Low tone should be between 80 and 120 cps. and the high tone between 500 and 600 cps. Tones can be referenced to an audio oscillator or to appropriate piano notes. Switching the elevator relay armature from one contact to the other should not change the frequency by more than a few cycles. The tone ratio is preset by the choice of the 470K—1 meg.—470K resistor string and should give about 80/20 and 20/80. A cathode ray oscilloscope is a very handy tool at this time to observe the voltage pattern at point M. With the pulsers in operation the switching from one wave form to another should appear almost instantaneous with no evidence of contact bounce or dirty contacts.

The R.F. transmitter consists of a 6740 kc. crystal and crystal oscillator valve, which also frequency doubles (13,480 kc.) in its anode circuit. This in turn drives a further doubler stage (26960 kc.) which is the valve delivering power to the usual ¼-wave rod aerial. Tone modulation is applied via its grid circuit.

To tune this up it is advised that resistor 23 (figure 3) be shorted out and that the grid leak 16 of 2·2 megs be replaced by a resistor of 100K., with a 0—1 ma. meter connected between this resistor and ground to read the grid current of the doubler stage valve. Plug in the crystal and both valves but remove the H.T. voltage from the doubler stage. Using about 90/100 volts on the crystal oscillator, tune 11 until the best reading is obtained on the 0—1 ma. grid meter. (The anode current of the crystal oscillator stage should show a slight *dip* corresponding to maximum grid current.) Connect the 90/100 volt H.T. to the doubler stage and, watching the doubler anode current meter, tune 20 for the greatest possible dip. Connect a flash lamp bulb between aerial terminal and chassis (with no aerial connected) and adjust the aerial coupling coil 22 (in relation to the anode coil 21) and tune 20 to get the brightest possible bulb light. When satisfied, remove the bulb and connect the aerial. Use a field strength meter and repeat above procedure for the best reading. Then remove the 100K resistor and 0—1 ma. meter, reconnect the 2·2 meg grid leak and remove the short circuit across the 27K resistor.

The R.F. transmitter is now ready to be modulated with the audio tone and, if all is well, when the elevator control is varied the anode current of the final stage should just about double its value. Little change takes place when the rudder control is varied.

A final word concerning the polarity of the actuator and relay connections. It is suggested that when all receiver relay coils are de-energised the rudder and elevator are in "left" and "up". A broken L.T. or H.T. battery connection would give this result. Of course the most likely "fail-safe" condition is either carrier or no signal. This energises all receiver relays and opens the rudder and elevator actuators.

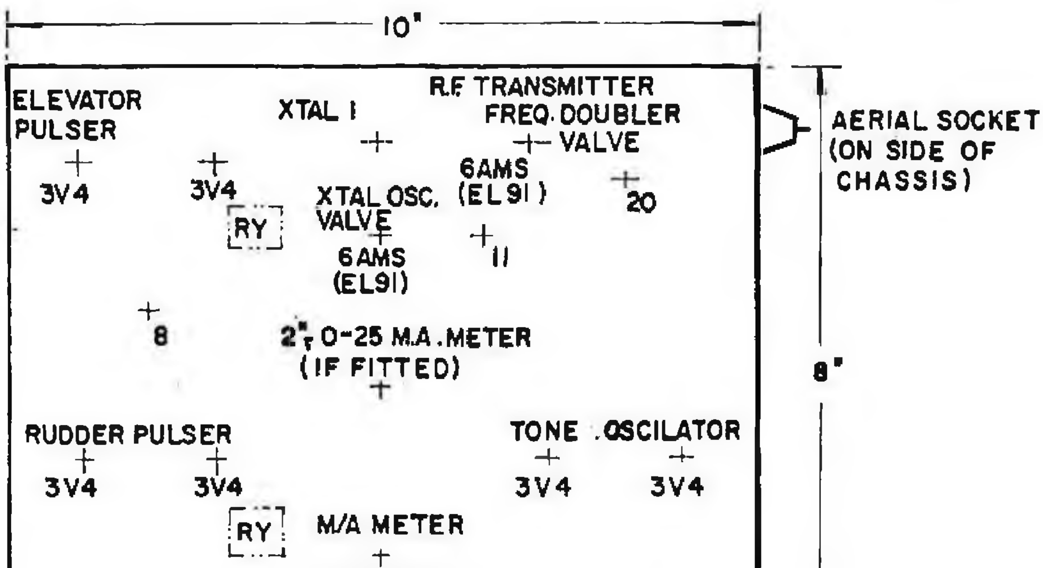
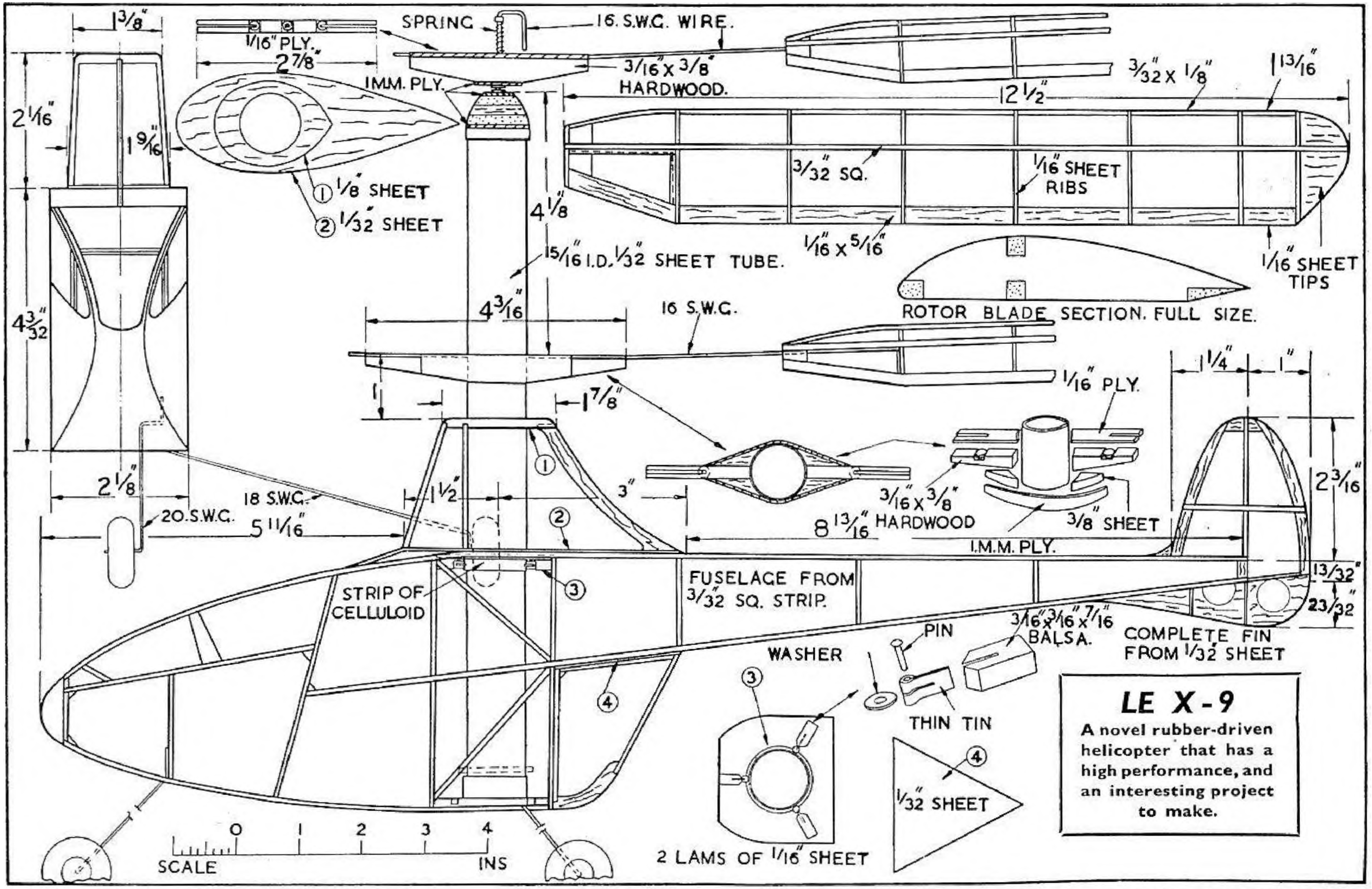


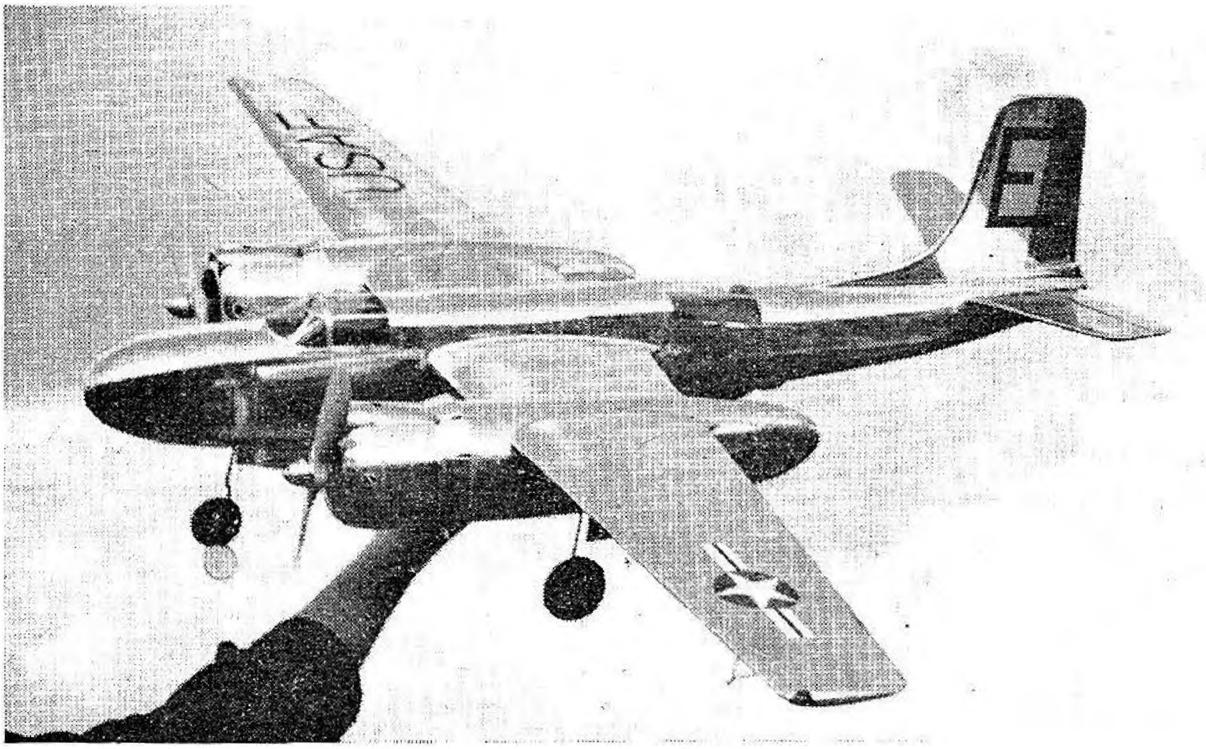
Fig 7 TOP VIEW OF TRANSMITTER CHASSIS



LE X-9

A novel rubber-driven helicopter that has a high performance, and an interesting project to make.

MODÉLE MAGAZINE, FRANCE



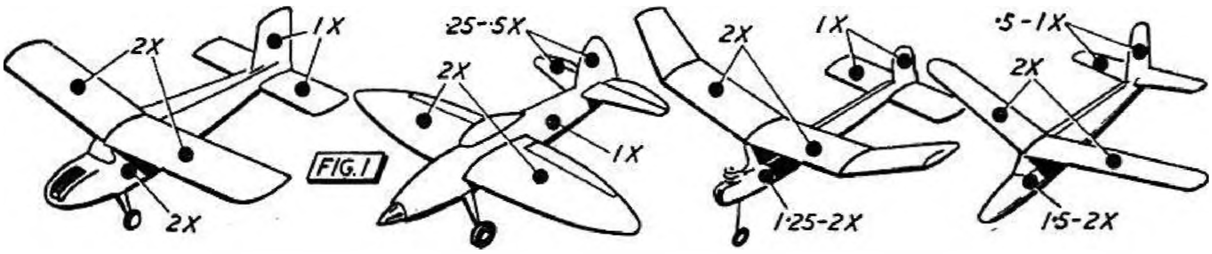
METAL COVERING

WHILST ALUMINIUM is the lightest of all pigmented dopes, a painted aluminium finish on a model does not give a realistic metal-covered finish. During the past three or four years covering with metal foil or metallised paper has come into use to impart scale realism, with varying degrees of success. Properly done, metallised covering is most effective, durable, and well worth the extra effort involved. Applied without knowledge of the proper technique the resulting appearance is poor, the covering soon tends to peel round the edges and the metal surface perhaps becomes stained after a while due to adhesive soaking through.

Application of metal covering is really limited only by two considerations—the extra weight involved, and the fact that it can only be applied successfully over perfectly smooth surfaces. The greatest drawback to all thin metal surfaces, whether in foil form or on paper backing, is that they wrinkle readily. Due to the high gloss of the surface the slightest wrinkle or irregularity in the surface shows up badly (one has only to examine at close range the stressed skin covering on a modern aircraft in "natural" metal finish to see how the quite small surface deviations give the whole skin a "quilted" appearance). Such wrinkles can be smoothed out before applying the metal covering, but it will then follow any deviations of the surface over which it is applied. It cannot be tautened after application, so it is impossible to produce a perfectly smooth covering over an open frame, for example. It can be applied over a doped, tissue covered frame, but again cannot be made to conform to the complex curvatures of the covering, so that the result is generally unsatisfactory. The only truly satisfactory results come from applying the metal covering over a smooth (usually sheet balsa) surface which has been grain-filled, rubbed down and polished to a glass-smooth finish. The point to bear in mind is that the metal finish, when applied, will be no smoother in appearance than the surface to which it is attached.

This beautifully finished model of the A.P.S. Douglas A.26 Invader (C/L 520) is a fine example of metallised covering.

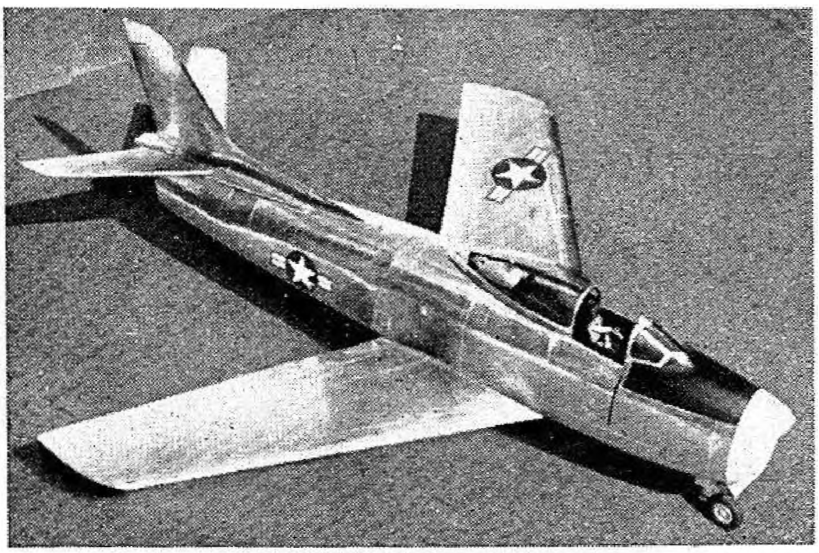
On the weight side, aluminium pigmented dope adds approximately ·03 to ·05 ounces weight per 100 sq. in. per coat. Before aluminium doping, both tissue and silk (or nylon) covering must first be tautened and sealed with clear tautening dope. A first coat of clear dope (50 per cent dope, 50 per cent thinners) adds about ·005 ounces per 100 sq. in. on Jap tissues ; ·015 ounces per 100 sq. in. on silk or nylon ; and ·025 ounces per 100 sq. in. on Modelspan tissues. Subsequent coats of clear dope add approximately ·005, ·015 and ·015 ounces per 100 sq. in. respectively.



The most convenient form of metal covering is metallised paper (actually a wallpaper on which one side is coated with a thin layer of polished aluminium). The weight of this metallised paper is about ·2 ounces per 100 sq. in. which, allowing for the weight of adhesive used in attaching, gives a covering weight of approximately ·25 ounces per 100 sq. in. Alternative materials are aluminium foil (see Table I for weights) and the German *Klebmetal*, which has a weight of approximately ·6 ounces per 100 sq. in.

Approximate figures for areas of covering on typical model layouts are given in Fig. 1, based on wing area. The fuselage of an average cabin layout, for example, has a covered area of about twice the wing area ; the tail surfaces a covered area roughly equal to the wing area. Using these data as a basis, and bearing in mind the requirement that a sheet surface is required for smooth metal covering, the extra weight of metal covering can readily be estimated. Such added weight is only important on free flight models, where it is usually found that a metal covered fuselage and fin (which are frequently sheet or sheet-covered components) can readily be tolerated.

Metal covering can also be attached quite successfully to flat tissue-covered frames, such as the underside of the wings and tailplane, but not



J. Donovour-Hickie is well known for his finely constructed and finished models. This example of his work, a Super Sabre, was one of the first models to make use of metal foil covering, the whole machine being constructed around a pulse-jet engine.

always with the same degree of smoothness that can be obtained over a flat sheet surface. If covered wings are to be "metallised", usually the best plan is to restrict such metal covering to, say, the extent of a sheet covered leading edge. Where the wing is all-sheet (or sheet covered), as on a control line model, there is no reason why the whole wing should not be treated and some excellent effects have been obtained in this manner, particularly with scale models.

Metallised paper is easier to work than aluminium foil since the paper backing is more readily bonded to the surface to be covered. It can also be formed to duo-curves to some extent merely by rubbing in place, although it is ·0035 in. thick and essentially a "rigid" material for normal use. It is still necessary, however, to use an adhesive which will stick metal to metal since lap-over joints are to be preferred at edges rather than butt jointing the covering sheets. This makes for a neater job and is more durable in that the edges have less tendency to peel in service. A properly applied metallised paper covering on a power model fuselage, in fact, can stand up to fuel being thrown onto it far better than doped and proofed tissue covering.

Rubber gum is not a satisfactory adhesive for metallised paper. It gives a good bond to sheet balsa but will not stick to doped tissue or to the metallised

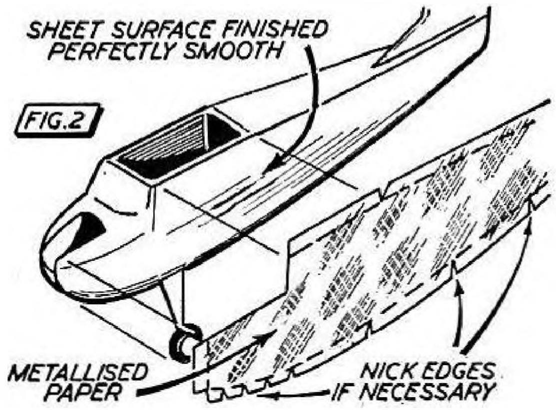


FIG. 2

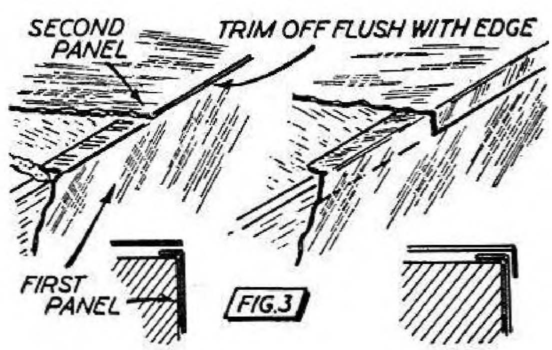


FIG. 3

surface. It also has the undesirable property of continuing to soak through the covering and may eventually appear through the outer metal surface in the form of a stain or apparent corrosion.

Rubber solutions and cements, on the other hand, are generally excellent for the job, particularly the non-latex types. The thin cements in the form of amber coloured solutions are easy to apply, set very rapidly and give a tenacious bond to doped tissue, balsa and metal surfaces. Stains produced by excess solution being smeared onto the metal surface can be removed with benzine (or acetone, depending on the type of cement). The so-called "impact" adhesives (actually contact adhesives) are also excellent, but in this case the two surfaces are best brought together before the full setting time has been allowed so that the covering can be "worked" in place, if necessary.

Rubber solutions and cements usually have some solvent action on coloured cellulose finishes, which may call for careful work if a panel of metallised covering is to be laid on an already doped fuselage, etc., *e.g.*, in the form of decorative strips. In such cases it is best to use a type of adhesive which requires only one coating (*i.e.*, not a coat on both surfaces to be joined, as with a contact adhesive). Best practice in bonding, however, is always to coat the two surfaces to be joined whenever this can be done conveniently.

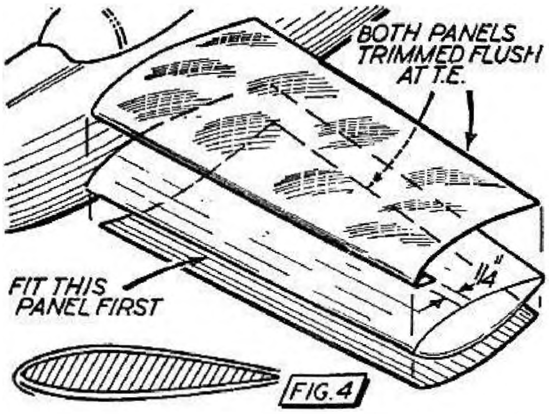


FIG. 4

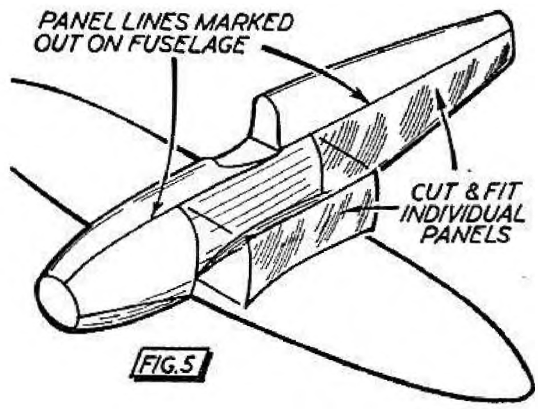


FIG. 5

The metal covering of smooth, flat surfaces is not at all difficult. It is important, however, to first work the surface to as smooth a finish as possible, with the complete elimination of irregularities. Even a small spot of grit will show through the final covering in exaggerated appearance.

First step is to sand the balsa surface down perfectly smooth without humps or hollows or other irregularities. It should then be given at least three coats of sanding sealer, leaving to dry out thoroughly between each coat and flatting down perfectly smooth with garnet paper before applying the next coat. Sanding sealer does not fill in irregularities in the original surface and time "saved" in original preparation is actually no saving at all in the long run. For a really first class finish, in fact, anything up to seven or eight coats of sanding sealer may have to be used.

Metallised wallpaper is sold in rolls and, even with careful handling, usually exhibits a certain "wrinkle" pattern when a piece is cut off. A panel of the required size should be cut—allowing half an inch or so all round for a simple fuselage covering job, as in Fig. 2—making sure that no definite creases are included in this piece. The panel should then be laid face down on a sheet of perfectly clean glass and rubbed over evenly and gently with a soft pad (*e.g.*, a pad of cotton wool) to flatten out any surface irregularities.

Dust off the fuselage side, as a precaution, and then coat both the fuselage and the paper backing of the covering panel with rubber solution. The two can then be brought together almost immediately and smoothed in place, making sure that the edges are properly stuck down. If the edges are to be turned over, this should be done during the rubbing on stage. Otherwise they are trimmed off flush with a razor blade. Some typical edge joints are shown in Fig. 3.

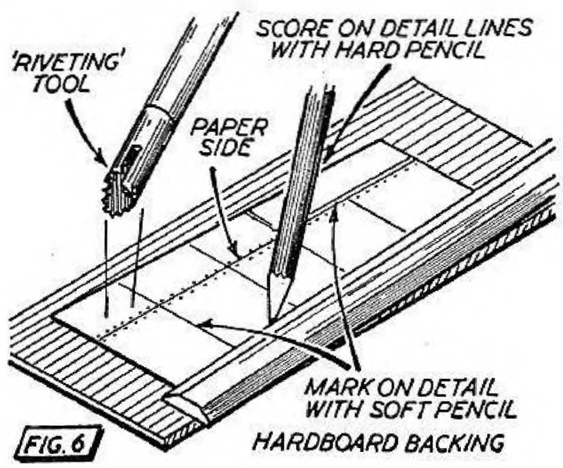


FIG. 6

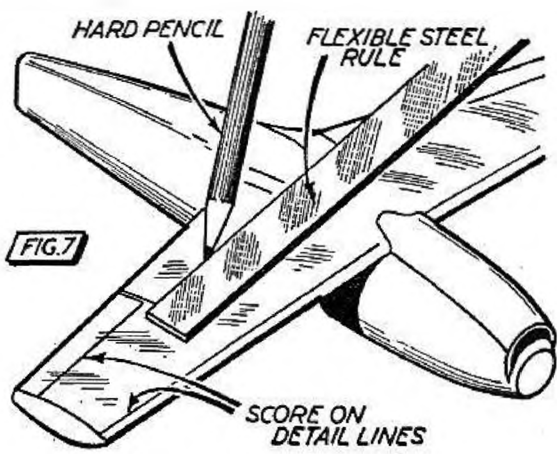
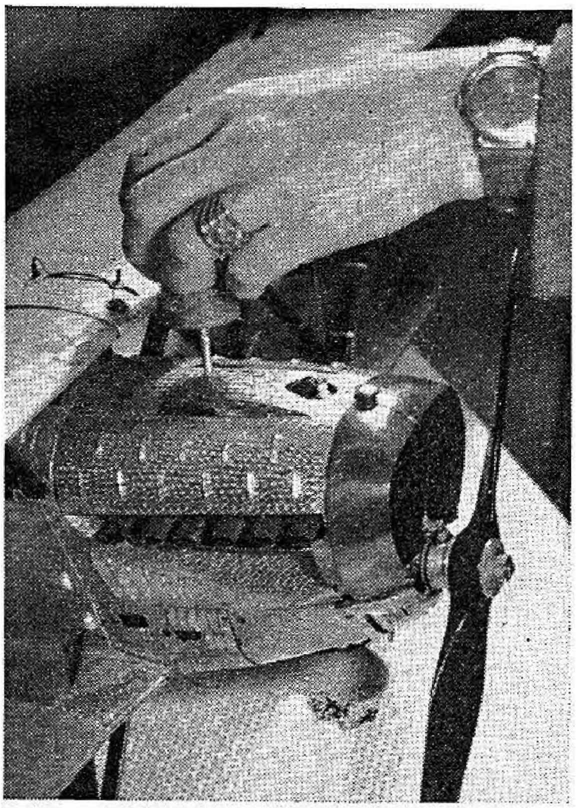


FIG. 7

Any pressure applied to the covering must be done with a soft cloth ; a finger nail can score the surface permanently. Provided the original fuselage surfaces are smooth the result, with care, should be a perfectly flat and smooth surface—a far smoother surface than is normally seen on a full size aeroplane, in fact. The covering requires no further protective treatment, although it can be given a coat of clear lacquer or fuel proofer, if desired. It will also readily take colour doping for trim, transfers, etc. Masking tape should *not* be used on the metal surface for laying out colour trim lines as this may peel off the metal layer when removed. If masking is essential, *e.g.*, for spray painting trim, then it is best cut from plain paper and attached with rubber gum, lightly applied to the back of the paper. Excess rubber gum left on the metal surface when the masking paper is removed can be rubbed off with the fingers. Normally the best method of applying decorative trim is by using a ruling pen and thinned coloured dope to establish the outline and then filling in with a brush.

Curved solid surfaces such as wings are readily dealt with, using separate panels of covering for the top and bottom surfaces. A wrap-around leading edge joint is generally best, with the trailing edge covering trimmed off flush—see Fig .4. Tips will require separate pieces for covering, or if the shape is too complex for the covering to be " moulded " to conform without wrinkling, are best painted.

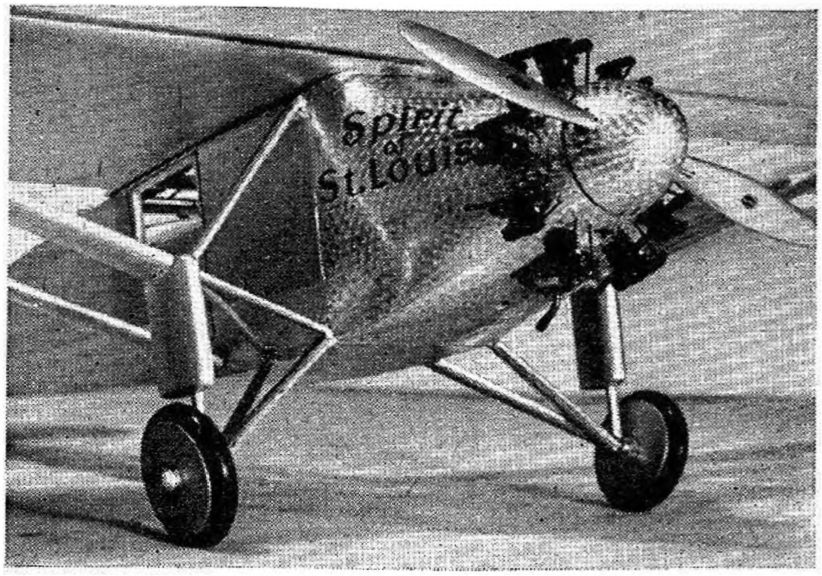
In the case of more complicated curved shapes—*e.g.*, a rounded fuselage —covering is best attempted in panels—see Fig. 5. Logical panel lines will suggest themselves, or be dictated by the panels lines on a full size prototype and should be marked out accurately on the fuselage in soft pencil. The covering panels are then cut to rough size, laid on the fuselage and moulded to shape by rubbing gently. They can then be trimmed to exact size with a razor blade and finally coated with adhesive and rubbed down in place. Panels should be prepared and fitted one at a time, with individual panels butted against each other. A lap joint is to be avoided as this will give an ugly bulge, unless this is definitely desired to duplicate a scale feature.



A metal cowling has an authentic " engine turned" effect applied by means of a small electric motor, abrasive tip being of medium hard rubber.

Certain detail lines, etc., can be embossed or scribed on the covering panels before they are attached to a model, or after. Raised detail is marked on the covering panel from the back before cementing on the panel—see Fig. 6—using a hard pencil for drawing panel lines and a simple tool made from a clock wheel for embossing rivet lines. The best backing to use under the panel whilst marking out is a piece of perfectly clean hardboard, shiny surface up.

The alternative of working on the sheet covering after it is in position is a little more tricky, but



Another example of the engine-turned effect is clearly seen on this beautiful model of the Ryan N.Y.P. "Spirit of St. Louis" (A.P.S. drawing FSP/663). This model was featured in the June, 1957 issue of AEROMODELLER—coinciding with the film depicting Charles Lindbergh's epic flight.

does give a more accurate representation of "engraved" panels, etc.—Fig. 7. Raised head rivets, of course, would still have to be marked from the back before attaching the panel, to be true in scale effect.

The scope of applying metallised paper covering to scale models, and of adding fine detail, is considerable. Such treatment takes time and care to complete properly, but is well worth the effort. It can, for instance, transform a carved wooden "solid" into a most expensive looking "all metal" model with finer detail and a far more realistic metal surface than that given by the plastic mouldings.

As regards applying metallised paper over tissue covered frames, results are generally disappointing close up, although the overall effect from a distance may be magnificent. One common failing is that metallised paper covering stuck down all over to doped tissue tends to develop a slack appearance which will not subsequently tauten up. Better results, in fact, are usually obtained by sticking the metallised paper to the leading and trailing edges only and smoothing in place as taut as possible. Another method which has shown promise is to warm the covering panel thoroughly before applying it to expand the metal (this usually works best if the paper backing is lightly damped first) and then sticking it down whilst still hot. It does then tauten up somewhat on cooling.

TABLE I.
WEIGHTS OF THIN ALUMINIUM SHEET AND FOIL

	Thickness	Weight in Ounces per 100 sq. in.
SHEET	30 swg*	·1209
	31 swg	·113
	32 swg	·106
	33 swg	·098
	34 swg	·090
	35 swg	·082
	36 swg	·074
	37 swg	·066
	38 swg	·059
FOIL	·005 in.	·049
	·004 in.	·039
	·003 in.	·029
	·002 in.	·0195
	·001 in.	·0098

*This is the thinnest sheet size commonly available.

MY EXPERIENCES IN THE CONSTRUCTION OF MODEL PULSE JETS

★

By I. IVANNIKOV
(*Soviet Master of Sport*)

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(*Literal translation from the Russian results in some unwieldy words and phrases, so for the purpose of this article a degree of Anglicism has been introduced and the colloquial term 'jet engine' used instead of 'Pulsatory reactive impellent", etc.*)

I BEGAN building model pulse jet aircraft several years ago, the first of these having the usual layout of fuselage, wings, stabiliser and engine. In this model a jet motor RAM-1 (Fig. 1) built by Mr. Vasilchenko was fitted with the petrol tank placed in the nose of the fuselage. This model flew at a speed of 110-130 km/hr, though on shorter lines a speed of 135-150 km/hr was developed, but the engine always stopped.

After a series of bold experiments it was evident that an opposing stream of air, during the process of combustion and exhaust, accumulated at the inlet of the diffuser and partly blocked the jet aperture in the tube lead-in of the fuel feed, thus automatically starving the fuel-air mixture. At the same time the pressure of the combustible diminished in output, and this double leaning of the mixture caused the motor to cease to operate. In short, with a motor where frequency of pulsations are of greater importance than with RAM-1, automatic leaning of the mixture considerably advances the speed of flight.

With my second unsatisfactory model, the motor appeared to work erratically on the climb, and at the moment of take-off the motor often went out of control through jolting. This is accounted for by the fact that the level of fuel in the tank is lower than the aperture of the jet, and, at the moment of impulse, reflex combustion occurs at the fuel feed in the tank.

A year was spent in experiment, then RAM-1 (1953) was made with an annular tank and a lengthened diffuser (Fig. 1b). The diffuser and rear wall—cellular casing radiator—was constructed of cotton-paper fabric and covered with a casein adhesive and a three-fold layer of aerovarnish (enamel).

The fuel jet was made of copper tubing with a section of 3×2 mm., and placed crosswise in the rear end of the diffuser duct. In the end of this tube there are up to nine jet apertures, each with a diameter of 0·4 mm., whilst the petrol feed is fitted with a needle valve made from a 2·6 mm. bolt. The tank vent has a diameter of 3×2 mm. in the direction of the opposing stream, whilst the exhaust (resonance chamber) is shortened by 70 mm.

The setting of the tank in the nose of the motor permitted a change in the model layout. The engine is synchronised and fitted to the fuselage, together with the wings and stabiliser, and steel yokes strengthen the structure. This model developed a speed of 200·055 km/hr.

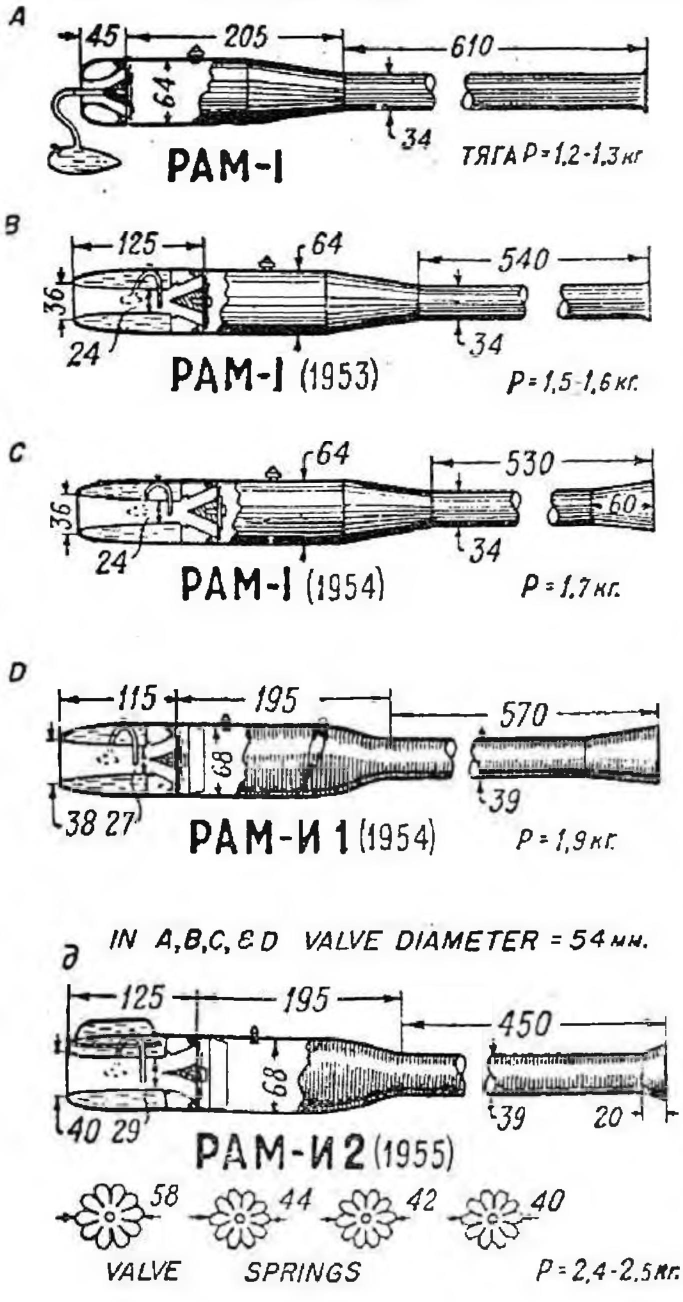


FIG. I

The fuel level in the annular tank should be level with the jet aperture coincident with climbing flight, and should not influence the operation of the engine. Always, when the fuel level was a little higher than the jet, the reflex of combustion was absent. At the moment of increase of speed of the model, both at the start and commencement of climb, there occurs a partial enrichment of the mixture, but this is compensated for by the increased intake of air.

The series of motors RAM-1 have a thrust of from 1·2 to 1·3 kilogrammes, but after fitting the annular tank, together with the lengthened diffuser, the thrust increased to from 1·5 to 1·6 kgs. The increased thrust therefore results from the greater intake of fuel-air mixture in the combustion chamber, this increase occurring by reason of the direction of the stream of air in the lengthened diffuser; i.e. less vortical motion is generated in front of the vent or valve, therefore, there is a greater amount of mixture in the combustion chamber.

Following certain experiments on the exhaust tube on this motor, a funnel-shaped orifice

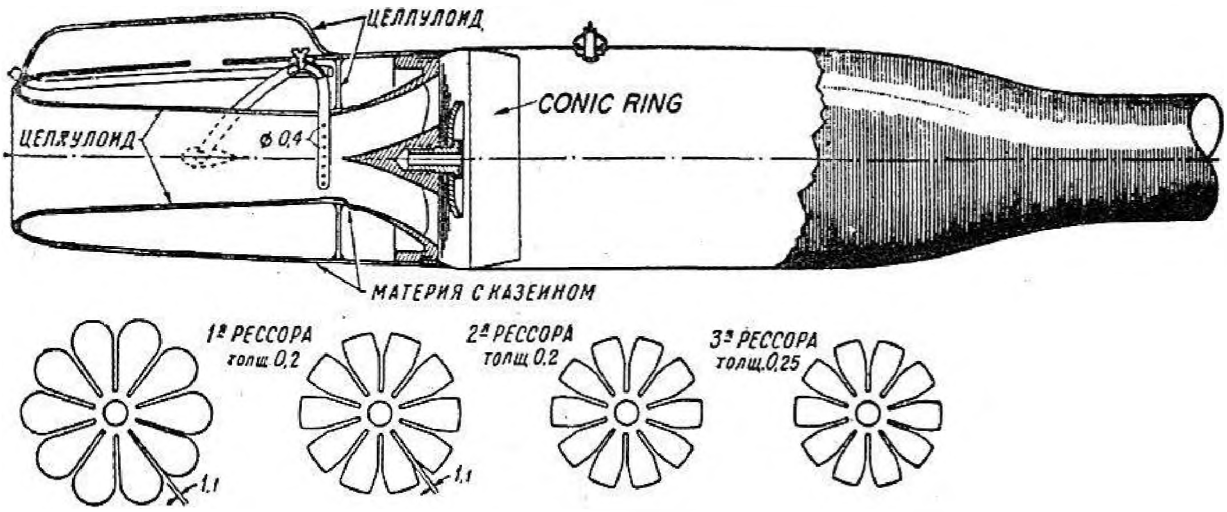


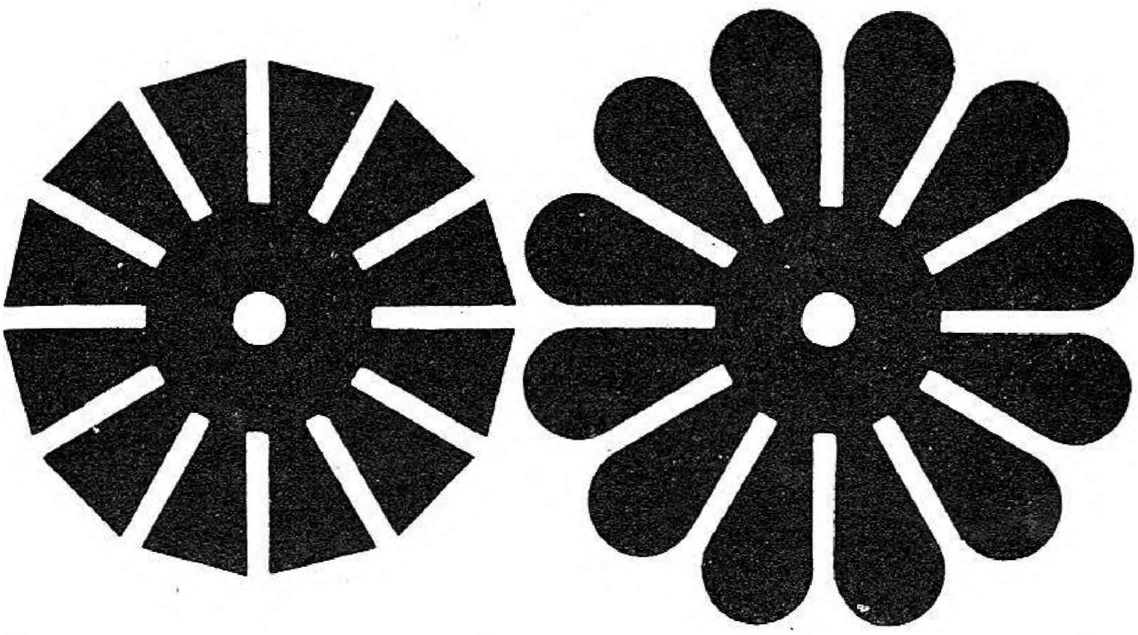
FIG. 2

was incorporated having a length of 60 mm. the flange having an angle of 7 degrees ; a waste valve was fitted, and there was a reduction of the central cone (Fig. 1c). These alterations produced an increase of flight speed to 210 km/hr.

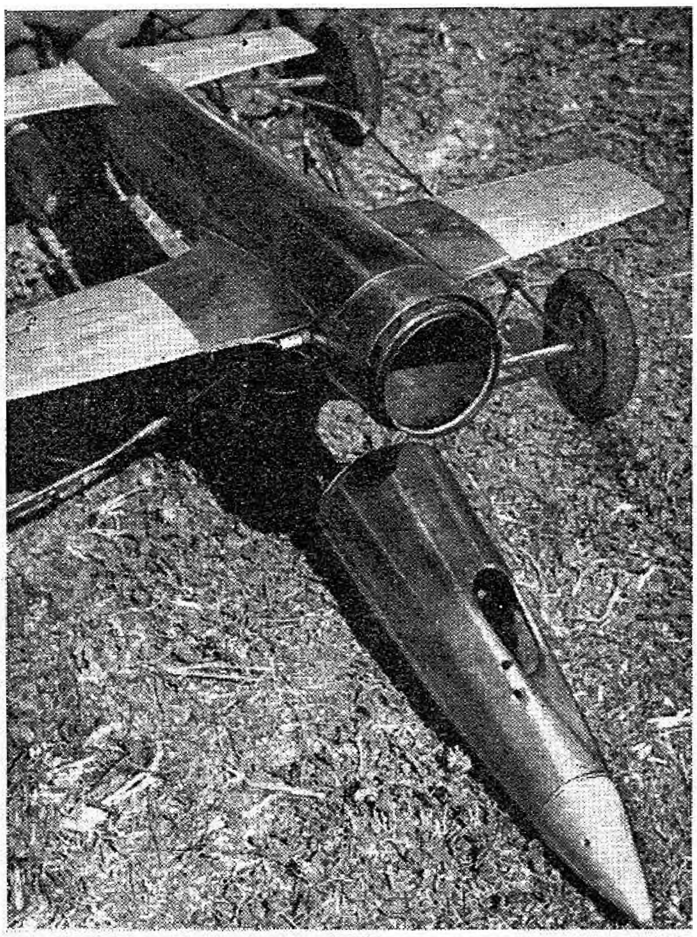
In 1954 I made the new engine RAM-N1, the tube being of 0·3 mm. stainless steel, the valve petal being as on RAM-1. The valve was fixed as with RAM-1, but is of stronger construction. The combustion chamber was at first 64 mm. diameter, but was later enlarged on a mandrel to 68 mm., and the section from combustion chamber to the exhaust pipe was streamlined.

The exhaust tube has a diameter of 39 mm., and at its end is a funnel-shaped orifice 70 mm. long with the flange set at an angle of 7 degrees. Inside the combustion chamber is a welded conic ring, with a 7 degree taper and a length of 15 mm., which recedes from the walls of the chamber, thus directing the incoming fuel-air mixture.

The calculated low temperature of the mixture raises the coefficient of



Shown above are full-size diagrams of the valve gear employed in the Czechoslovakian LETMO motor. Right is the sealing (petal) valve, with left the backing spring, two of which are used. Note different shape of the backing spring to that incorporated in the Russian engine.

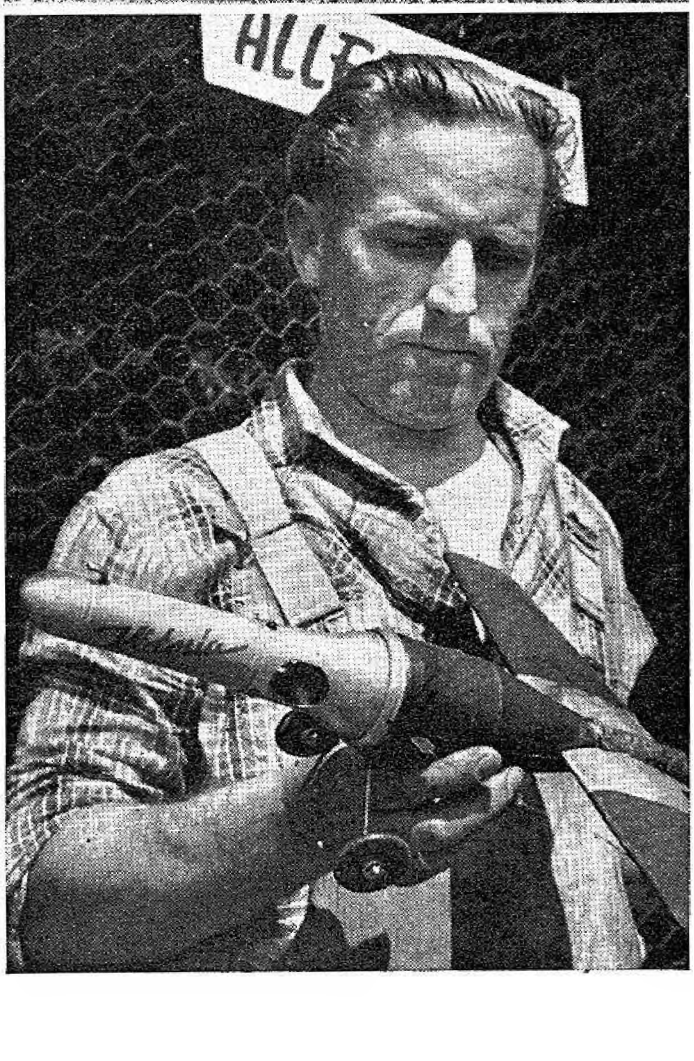


Letmo powered model of J. Sladky (Czechoslovakia) shows all-metal fuselage, nose piece containing the valve gear and tank. Seen at Brussels, 1957.

the filled combustion chamber, and during the combustion of the hot gases, insulation by the conic ring remains in operation. This assists in synchronizing the ignition of the mixture along the whole length of the chamber, and in consequence the process of combustion is considerably shortened.

The conic ring facilitates the work of the valve. A high coefficient for a complete and shortened process of combustion would raise the pressure in the combustion chamber, and this could have a nullifying effect upon the work of the valve. In order to avoid this, and in order to lower the pressure as well as to accelerate the process of exhaust, an exhaust pipe of 39 mm. diameter was fitted. This motor had a thrust of 1·9 kg., and at the 1954 International Competition, a model powered with this unit achieved a speed of 230 km/hr.

A year later I constructed the engine RAM-N2, which differed from RAM-N1 in the following particulars: the diameter of the valve was increased from 54 to 58 mm., with the holes in the valve seating suitably increased in size (Fig. 1e). The valve was made of heat resistant steel with a thickness of 0·2 mm., and in order that the valve

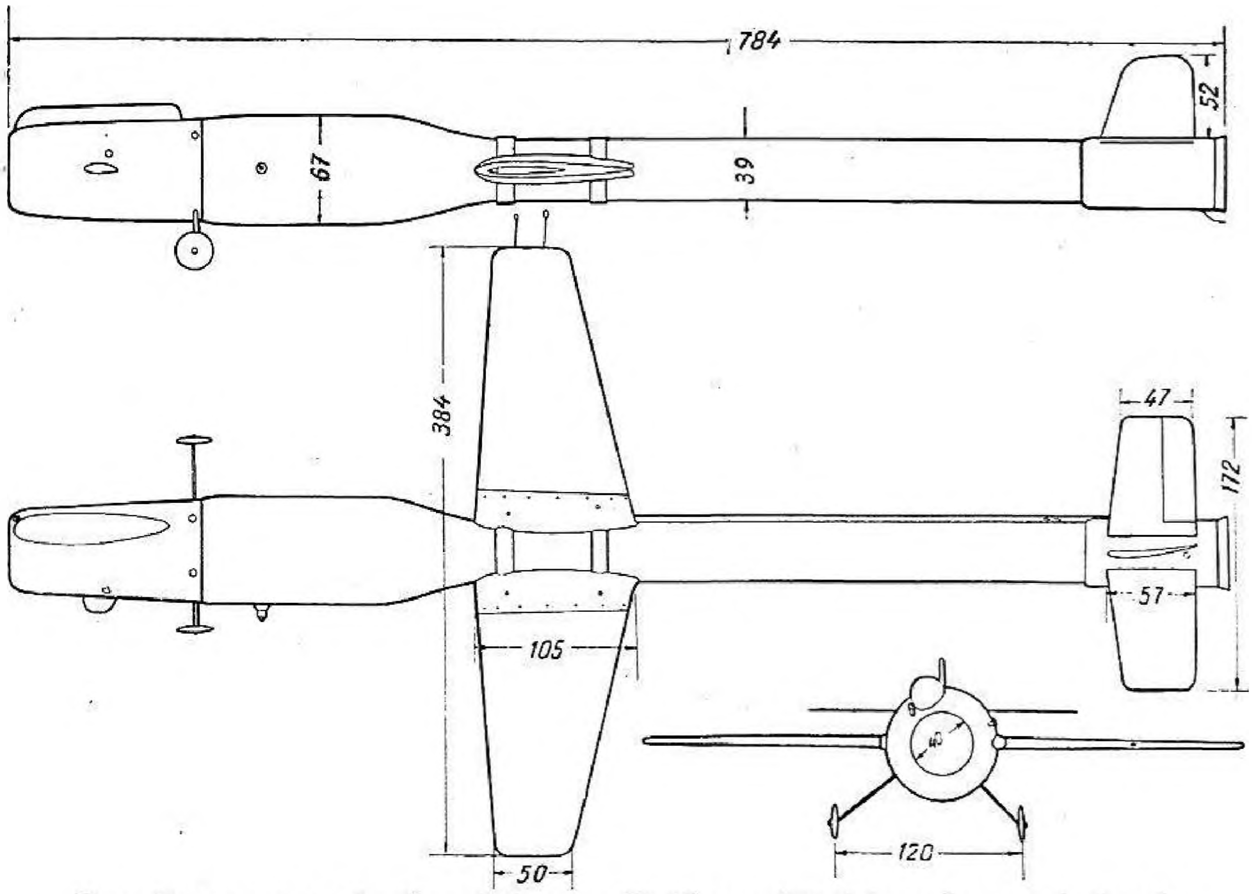


Gorziza (Germany) with East German power unit "Victoria." Nose cone follows Czech practice of embodying gear and tank. Undercarriage is fixed.

should be more rigid, three supporting valve springs were fitted (Fig. 2) The first and second springs had a thickness of 0·2 mm., and the third 0·25 mm. The increased length of the intake/combustion chamber section was compensated by shortening the exhaust tube, and the bell-mouth was also reduced in length. This motor developed a thrust of from 2·4 to 2·5 kg.

A model with a similar motor achieved the greatest speed in flight (275·004 km/hr) at the International Competition held in Czechoslovakia in 1955, and a description of the construction of this model appeared in No. 10 1955 of the journal "Wings of the Fatherland". The tank was made of celluloid and cotton/fabric material, held together with casein glue and covered with aero lacquer. (At the time there was a shortage of suitable material, and in order to overcome this the tank, diffuser, and heat radiation casing for RAM-N2 was made of stainless steel. A model fitted with this tank achieved a maximum speed of 250 km/hr.)

Steady running of the motor in flight, and upon the ground, depends upon the quality of the fuel-air mixture and on the operation of the valve. Quality of the mixture depends, in principle, upon the shape of the diffuser, its location, and on the size of the jet aperture; use of the correct degree of pressure; centrifugal force; together with the functioning of the fuel. At first the model attained a speed of from 230 to 240 km/hr., and more when the centrifugal force became rather stronger, influenced by the quality of the mixture. A greater diameter of the valve (holding) washer contributes to penetration of the combustible gas into the diffuser, therefore on RAM-N2



General arrangement drawings of the record holding model of the author, employing the RAM-N2 motor. A speed of 275 km./hr. was set up in August, 1955, and still stands at date of publication. All dimensions are given in millimetres.

Sladky assisting Gorziza to start the "Victoria." Leads from a vibrator coil go to the spark plug, and an air jet is held in the nose orifice, fed by the hardest working member of the team on the pump. Flame indicates an overrich mixture.

the washer size was not increased notwithstanding the increase of the diameter of the valve.

The model possesses good horizontal stability when the point of balance is on or forward of the leading edge of the wing. With my latest model, the point of balance (without fuel) was found to be some 30 mm. forward of the leading edge. An attempt to increase speed by means of various petrols did not give tangible results, and the flights were performed for the most part on aviation spirit B-70.

Extracts from F.A.I. CODE SPORTIF, Aeromodels, Section 4.

2.1.6. In the case of aeromodels with reaction engines, the following characteristics are insisted upon :
Maximum weight of the engine, bare : 0,500 kg.
Maximum total weight of the aeromodel in flying trim, with fuel : 1 kg.

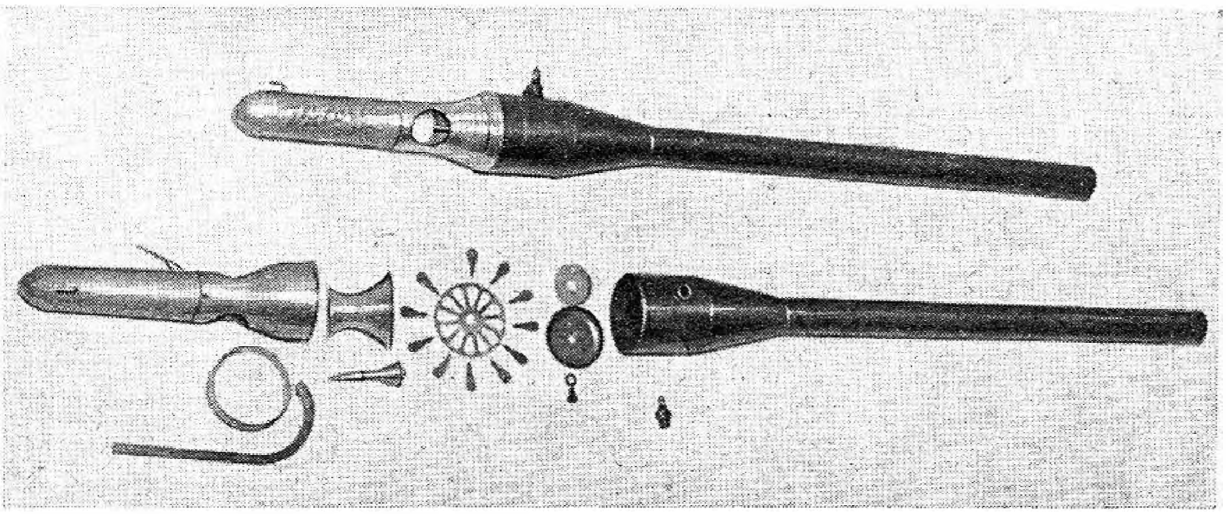
7.3.1. The distance to be flown must be a minimum of 1 kilometre.
Minimum radius of each circle of flight must be 19·90 metres (62·27 ft.) giving 8 laps to the kilometre.

PULSE JET POWER PLANT
"VICTORIA MD I"

AN interesting comparison with the Russian jet units just described is afforded by the "Victoria", produced in the Eastern Zone of Germany by the Polygraph Victoria Works at Heidenau, Saxony, makers of typewriters and printing machinery.

Layout of the unit is based on the Czech powerplant LETMO MP 250/52, in fact it is an improved version of that motor. Modifications have been made to the jet assembly, now needle-valve controlled; the assembly of head and pulse tube is now screw-on; and a fixed, integral level-mounted tank is fitted ahead of the intake. The flutter valve petals are screened to protect them from undue heat.

The tube is formed from $\frac{1}{64}$ in. steel sheet, rolled and seam welded, the front end incorporating a threaded retaining ring to hold the jet head and related parts in place. Copied from the Letmo, the needle-valve outlets from the fuel line comprise three radial holes set at 120° to each other, fuel being sprayed evenly through these openings into the jet head.



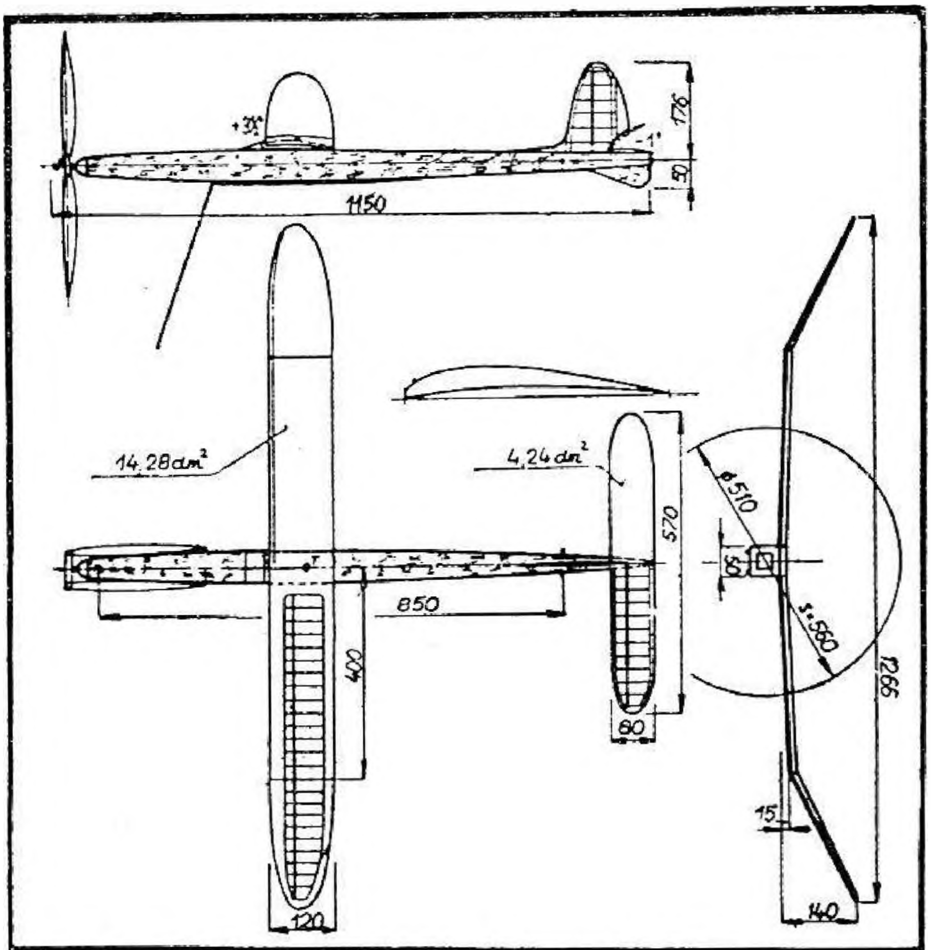
The reed disc is 12-petaled, each petal being individual and held in a special rig and holder. Razor blade steel is only available in East Germany as narrow band material, and a Swedish steel of 1 mm. thickness is employed. It is claimed that the individual petals have an advantage over the multi-petaled one piece valves in that the steel having been rolled in the direction of each petal, the strength factor is standard for each petal. In the event of a petal burning out, this can be easily replaced instead of the complete petal unit.

With a capacity of 120 c.c. (approx. $4\frac{1}{4}$ ozs.) the fuel tank is integral with the powerplant, with a regulator placed inside the tank assembly. Consisting of a normal needle valve assembly, adjustment to suit fuel feed requirements is quite easy. Rate of pulsing is 2-300 cycles per second.

Total length of the unit is $31\frac{11}{16}$ in. with a maximum diameter of $2\frac{1}{2}$ ins. Weight without fuel is $11\frac{1}{4}$ ozs., and a static thrust of 3·5 lbs. is claimed.

Readers interested in making their own pulse jet units should read the article by Czech contributor E. Brauner in the July 1955 AEROMODELLER. A few issues are still available at 1s. 9d. post free from Model Aeronautical Press Ltd.

This finely proportioned Wakefield model is the product of Radoslav Cizek, a leading modeller in Czechoslovakia. Fuselage is sheeted, with the general construction following usual practice. Design has been developed over a number of years, resulting in a clean, well-tried layout with a high performance.



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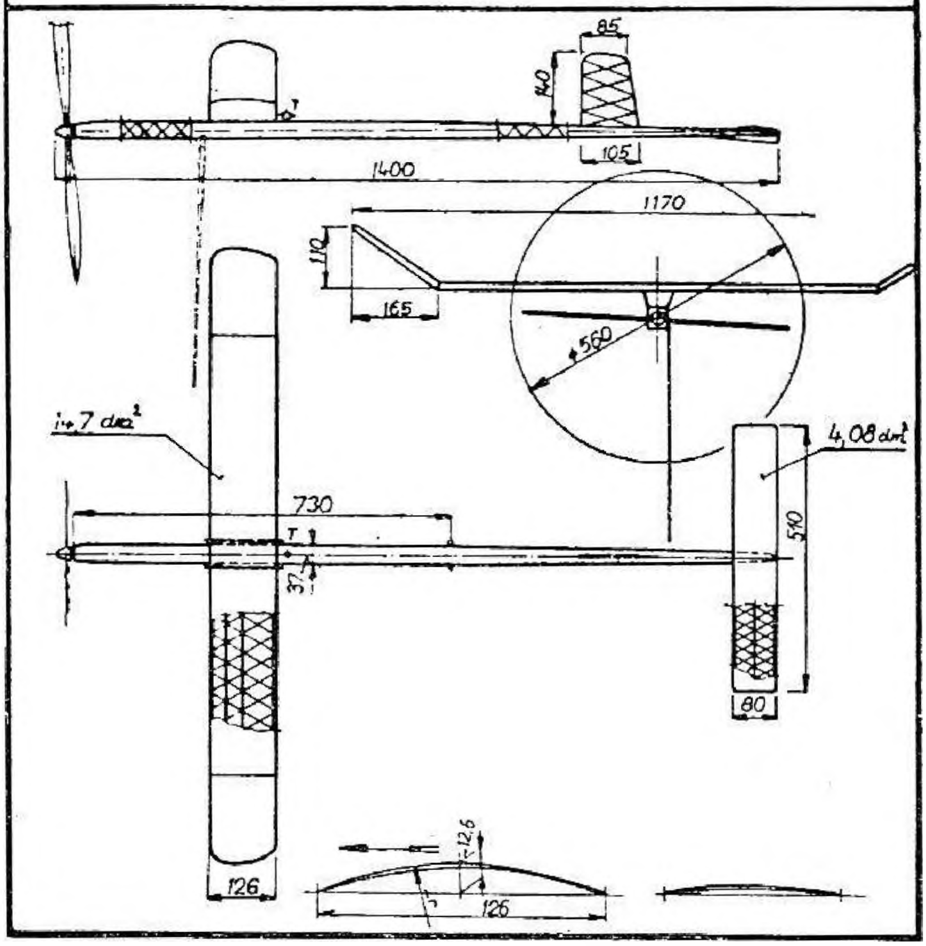
Typical of Russian practice is this Wakefield model used by Vladimar Matvejev at the 1956 World Championships held in Sweden. The ultra-thin wing section is notable, also the system of construction using various reeds in place of the more usual balsa.



SPIRAL STABILITY

SPIRAL STABILITY is probably the least understood, and at the same time the most important feature, in any free flight design. The effect of lack of spiral stability is all too apparent. A model starts a turn which tends to get tighter, with the angle of bank increasing ; the nose drops, until the model ends up in a tight, diving turn—a spiral dive—from which there is no recovery unless some definite change in trim is involved (*e.g.*, the motor cutting).

This manœuvre is commonly confused with a spin ; in fact the standard radio control model manœuvre designated a "spin" and performed by holding on rudder is a spiral dive, not a spin. A true spin involves first stalling the wings and then applying rudder to produce a special form of auto-rotation. Normally this requires manipulation of motor, rudder and elevator controls to perform. Ordinary free flight models are seldom, if ever, likely to go into a true spin. If they stall out of a turn into the start of a true spin they will either recover automatically, or if unstable go into a spiral dive.

Basically, the initial cause or start of a spin is a stall, and that of a spiral dive an excessive angle of bank which produces yawing, or sideslipping, or both—generally conditions of *under*-elevation. In the original example quoted, for instance, putting over the rudder produces an under-elevated condition if held on. The model has lost a certain amount of vertical lift and there is also a certain proportion of the lift force effective in pulling the model inwards—see Fig. 1—normally balancing the centrifugal force. If the bank is excessive, sideslipping starts—and probably also a tendency for the model to "yaw" or line up in a direction different to its actual flight path. What happens after that is largely dependent on the design layout, and how fast the model is flying. Some models will quickly generate a vicious spiral dive, others hold a more stable diving turn.

Spiral stability, however, is not *dependent* on a model being under-elevated. Rather a spirally unstable model gets itself into an "under-elevated" condition as a result of starting a turn during which unstable forces build up because of the design layout. This is usually more marked on powered models than on gliders since torque reaction produces yawing and banking, which leads to sideslipping ; also the greater speed of flight of a powered model magnifies the effect of any unstable movement.

There is no universal agreement on the subject of the optimum design layout for best spiral stability. In the past a number of different theories have been advanced on model design (largely to do with side area disposition) which have led to exaggerated shapes—such as deep-bellied fuselages incorporating an effective fin shape below the wing position, forward mounted fins, underslung (rear) fins, and so on. In a number of instances these have proved effective to a degree, but have generally represented

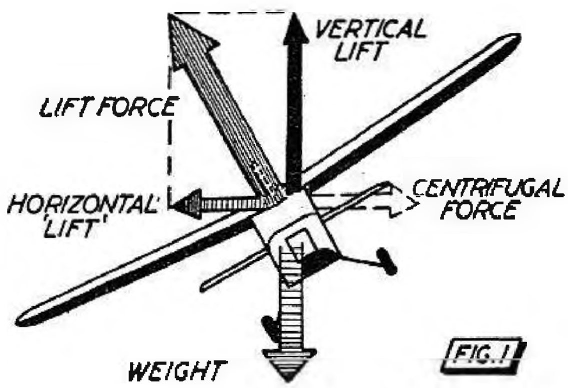


FIG. 1

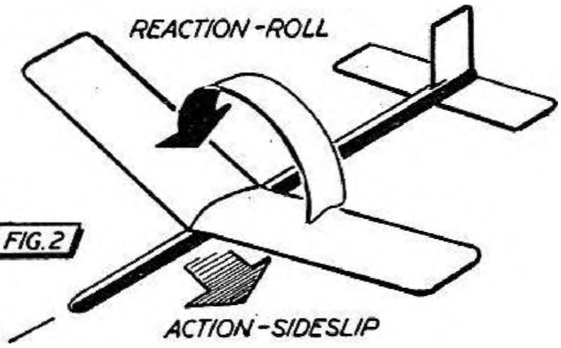


FIG. 2

only a "phase". More conservative layouts have proved equally satisfactory from the spiral stability point of view, without structural or other aerodynamic penalties. Also, in either case a spirally stable design can be made spirally *unstable* (usually by accident) by faulty trimming.

Basically, "cause" and "effect" are simple to analyse. The "cause" is a sideslip or yaw, which is present normally on powered flight, and could be produced by a momentary disturbance on the glide. However, in the latter case the "effects" are less marked and so a model which is spirally stable under power is unlikely to be spirally unstable on the glide, unless there is a marked change in trim towards an under-elevated condition.

The "effects" consist of four separate, but interrelated reactions. Two of these are stable and two unstable. The secret of design is ensuring that the combined stable reactions are greater in effect than the unstable ones. The degree of spiral stability then depends on how much greater the combined stable forces are.

Each separate displacement—*i.e.*, sideslipping or yawing—produces both a stable and an unstable reaction. When a model sideslips the fact that the wing has dihedral means that the inner wing (*i.e.*, the wing nearest the direction of sideslip) has an effective increase in angle of attack and so generates more lift than the outer wing—see Fig. 2. Thus there is a reaction tending to roll the model outwards away from the direction of sideslip, and the greater the dihedral angle the greater the rolling force developed. This is a stabilising force.

However, a sideslip exposes the side areas of a model to a "crosswind" effect which may or may not produce a roll reaction, and one which, in turn, may be stable or unstable. Also, considering the side areas pivoted vertically about the centre of gravity, there will be a yawing force generated tending to turn the model in the direction of sideslip—Fig. 3. This is an unstable reaction.

In the case of the model being caused to yaw, it is being rotated about a vertical axis and any acceleration about this axis will be resisted by the damping or "drag" action of the side areas being displaced—see Fig. 4. With plenty of side area to provide "damping", this is a stable arrangement.

Against this a yaw, in rotating the model about a vertical axis, is increasing the velocity of the outer wing and decreasing the velocity of the inner wing —Fig. 5—producing a roll in the direction of yaw. This is definitely unstable, whereas the rolling forces produced in a yaw by the side areas (mentioned above) may be stable *or* unstable, or zero.

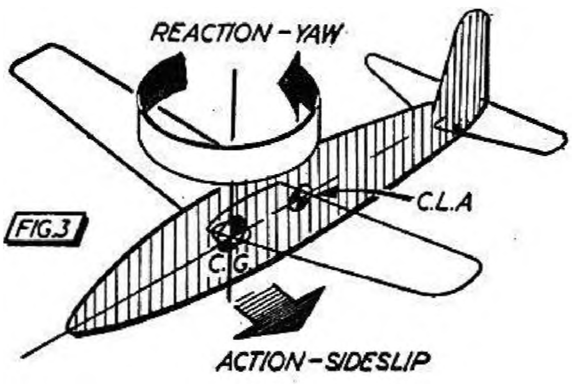
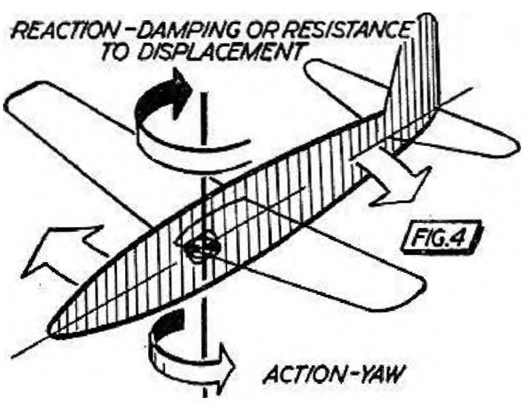


FIG. 3

We can now analyse these statements in terms of design features. Dihedral is a primary stabilising force since it produces a desirable roll reaction, and so the more prone the model towards spiral instability

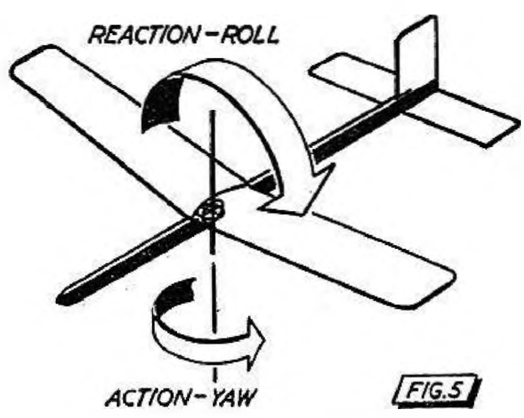


troubles the greater the dihedral angle employed. Thus a powered model needs more dihedral than a glider ; and further the more highly powered the model, again the greater the dihedral (with polyhedral usually favoured here on account of its stronger reaction). Excess of dihedral can, however, lead to continuous over-correction and a form of rocking instability known as "Dutch rolling". This is not necessarily serious, but is not desirable. It is sometimes tolerated on duration-type models,. but generally to be avoided on radio control designs, hence the latter tend to have relatively low dihedral angles. Dutch rolling can be cured by increasing the fin area, but there are limits to this area (as will be seen later) if spiral stability troubles are to be avoided.

The desirable damping in yaw (Fig. 4) is produced by generous side areas and long fuselages. Thus a long model, or one with a deep fuselage, is far better than a "stick" type in this respect; and slabsiders somewhat better than streamliners. Streamlining off the nose of a slabsider will also reduce the effective (forward) damping area. The "sleeker" the fuselage, in fact, the more important it becomes to reduce the *undesirable* yawing effect caused by sideslipping (Fig. 3) as there is less *stable* reaction available to offset it.

The features which contribute to the *unstable* yawing reaction in a sideslip are excessive areas aft of the centre of gravity—*e.g.*, large fin, long fuselage, centre of gravity well forward on a pylon model—and high inertia forces (*e.g.*, heavy wings, rear fuselage, tail) especially in the absence of damping. In terms of side areas generally, we see that we cannot afford the luxury of a large fin to balance a large wing dihedral on a high-performance power model. In the case of a rubber model the fin is necessarily larger to achieve a similar centre of lateral area position (because of the longer nose and propeller side area), and can be increased still further to improve yaw damping (Fig. 4). Many spiral instability troubles on contest rubber models can, in fact, often be cured by increasing the fin area.

The chief "unknowns" are the unstable rolling forces produced in sideslipping and yawing. The simplest of these to analyse is the effect of wing aspect ratio. For a given rate of yaw the higher the aspect ratio the greater the increase in tip lift one side and reduction of lift on the other side, in direct proportion to the spans. High aspect ratio wings, too, tend to be heavier, and thus have higher inertia forces when displaced. On the other hand, a low aspect ratio may aggravate torque control problems on a high-powered model (due to the lower span) ; reduce the margin of longitudinal stability (due to the actual centre of pressure travel being greater on account of the larger chord) ; and reduce the aerodynamic efficiency of the wing (although this later is a debatable point—what is lost



in reduced aspect ratio is compensated for by the increased efficiency of a larger chord).

The rolling effect of side areas in a yaw is opposite for areas forward and aft of the centre of gravity. As Fig. 6 shows diagrammatically, forward side area above the c.g. tends to produce a roll in a favourable direction (away from the yaw) ; and Fig. 7 that forward side area below the c.g. an unstable roll into the direction of yaw. With the aft side areas, high side areas produce an unwanted direction of roll and low side areas a favourable roll reaction—Fig. 8. This is the basis of those design layouts like Fig. 9, which have fairly generous front side areas and a low slung fin (in some cases all the fin is underneath the fuselage). It will be appreciated that the pylon in such a layout is most beneficial (from the point of view of added spiral stability) the farther aft the c.g. which, incidentally, also makes the wing side area more effective. Hence a pylon model is usually most spirally stable with the c.g. near, or even beyond, the trailing edge (although longitudinal stability is reduced, as a consequence). Similar reasoning will also show that an anhedralled tailplane is beneficial to spiral stability, bearing in mind the reversed dihedral reaction.

The whole object is to prevent the model rolling into a steepening bank on turning and to *reduce* the angle of bank should the turn tighten, which will then have the effect of bringing the nose up for recovery. If the angle of bank is allowed to increase, then the nose will drop and conditions will become worsened.

The problem is not always clear-cut for it is possible to trim a model to fly in turns with little or no bank, when it is actually skidding or sideslipping outwards, which can reverse some of the effects discussed. Thus on some layouts spiral stability may be achieved by trimming rather than design features.

FIG. 6

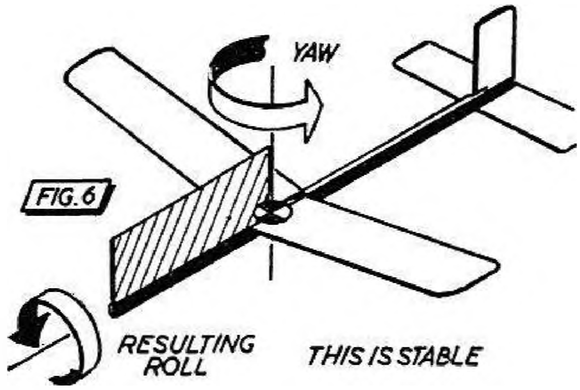


FIG. 7

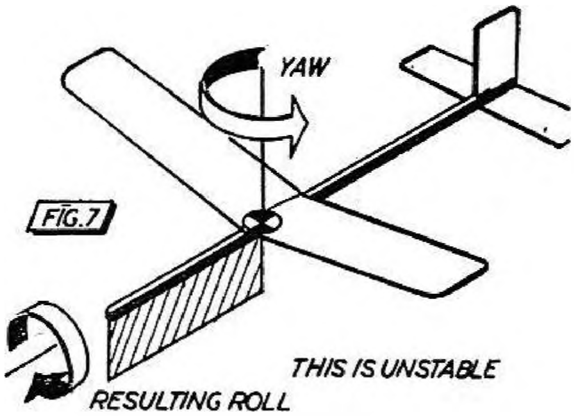


FIG. 8

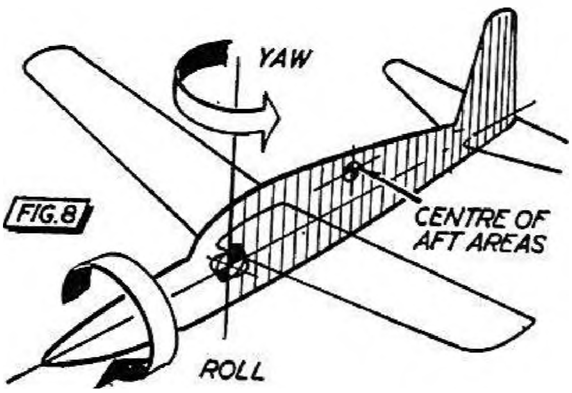
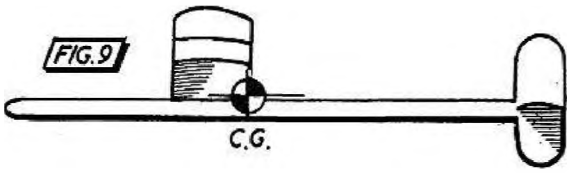
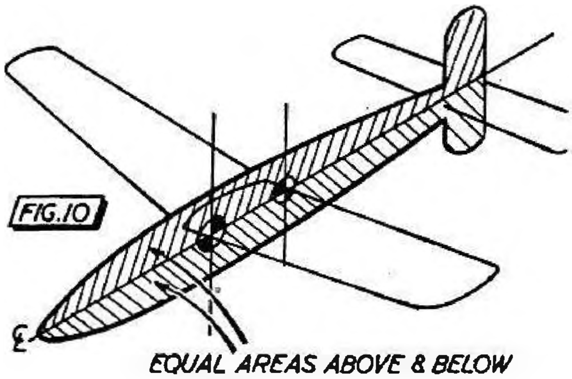
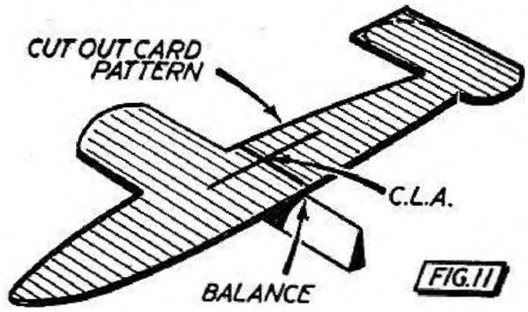


FIG. 9



Designwise it is possible to produce a layout in which all the unstable



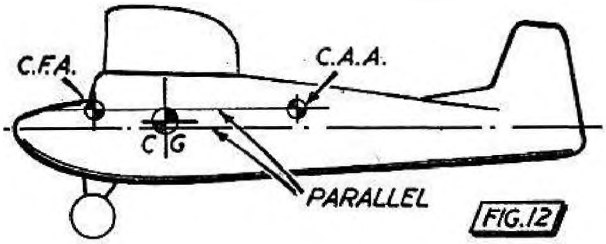


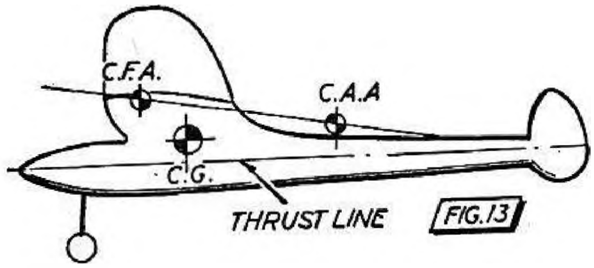
rolling forces produced by sideslipping or yawing are zero, or appreciably zero, so that the only unstable reaction remaining to be countered is the yaw reaction due to sideslipping—suitably offset by correct disposition of side areas.

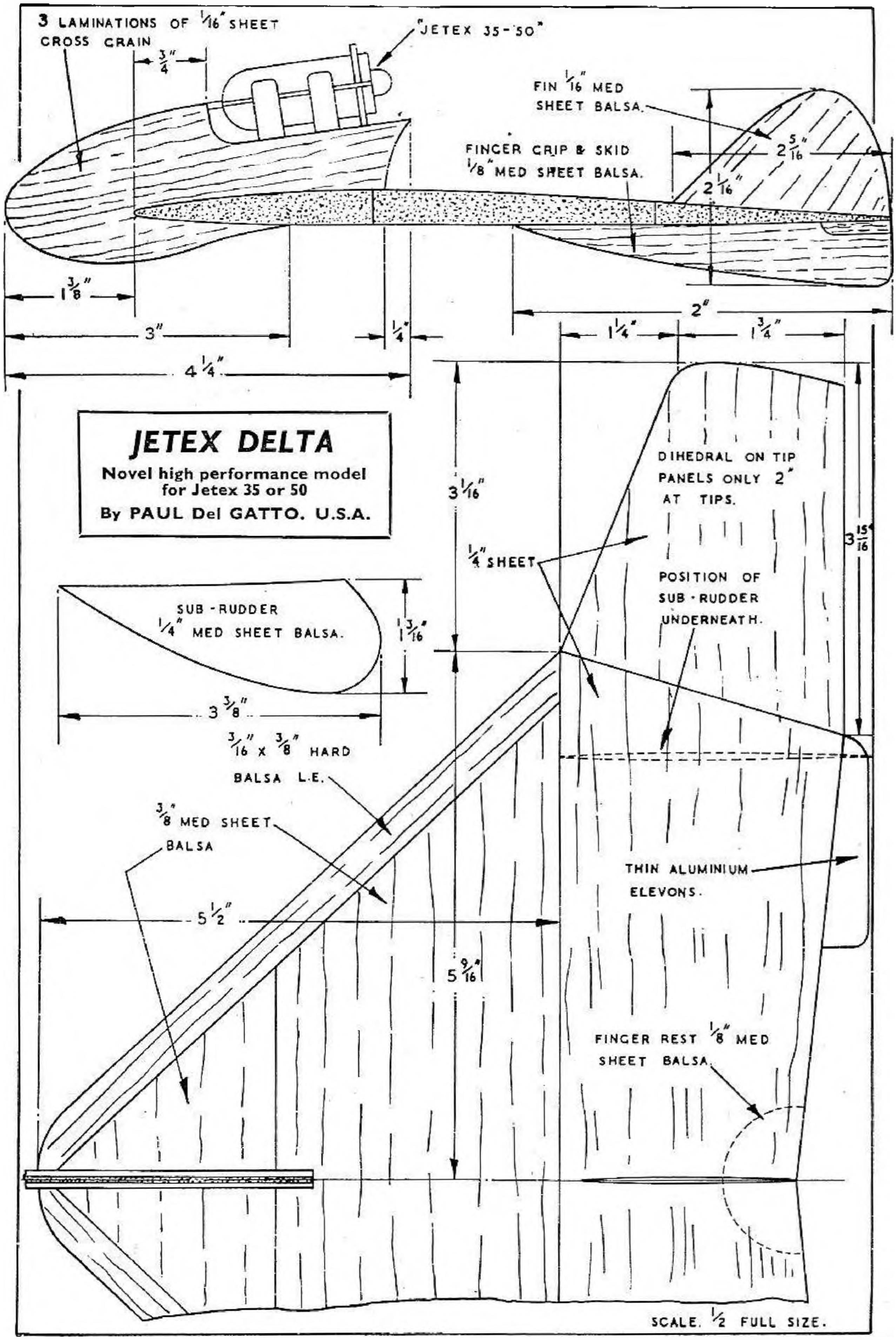
It will be seen, for instance (Fig. 10) that if the c.g. and C.L.A. are in line with the flight path, sideslipping will produce no rolling effect (unless the trim attitude of the model changes). To achieve this normally requires a fairly high c.g. position, contrary to the popular belief that "low slung weights" make for stability.

To establish the centre of lateral area (total area) at the correct distance behind the c.g. a card model is cut out representing the projected sides areas of the model, then balanced on a knife-edge to establish, in two directions at right angles, to find the centre of balance of the pattern, which corresponds to the centre of the cut-out area—Fig. 11. This area can be adjusted—fore and aft, up and down, as necessary, by trimming the fin area shape. The fin cut-out shape is usually left deliberately oversize to start with so that this can be done.

Various design theories are also based on the alignment of the forward and rear centres of lateral area. A pattern is prepared, as above, and then cut in half at the c.g. position (usually at right angles to the fuselage centre line, but more correctly at right angles to the flight path). The centres of the fore and aft areas can then be found separately. Good spiral stability characteristics are then either based on aligning these two centres parallel with the flight path, Fig. 12, or inclined upwards—Fig. 13. The former method is coming into increasing use for the design layout of radio control models as giving desirable "roll and bank" characteristics, arranging the centres parallel with the thrust line. It appears to give very good results.







MODEL AIRPLANE NEWS, U.S.A.

MERAVIAN 3

Designed by W. TINKER

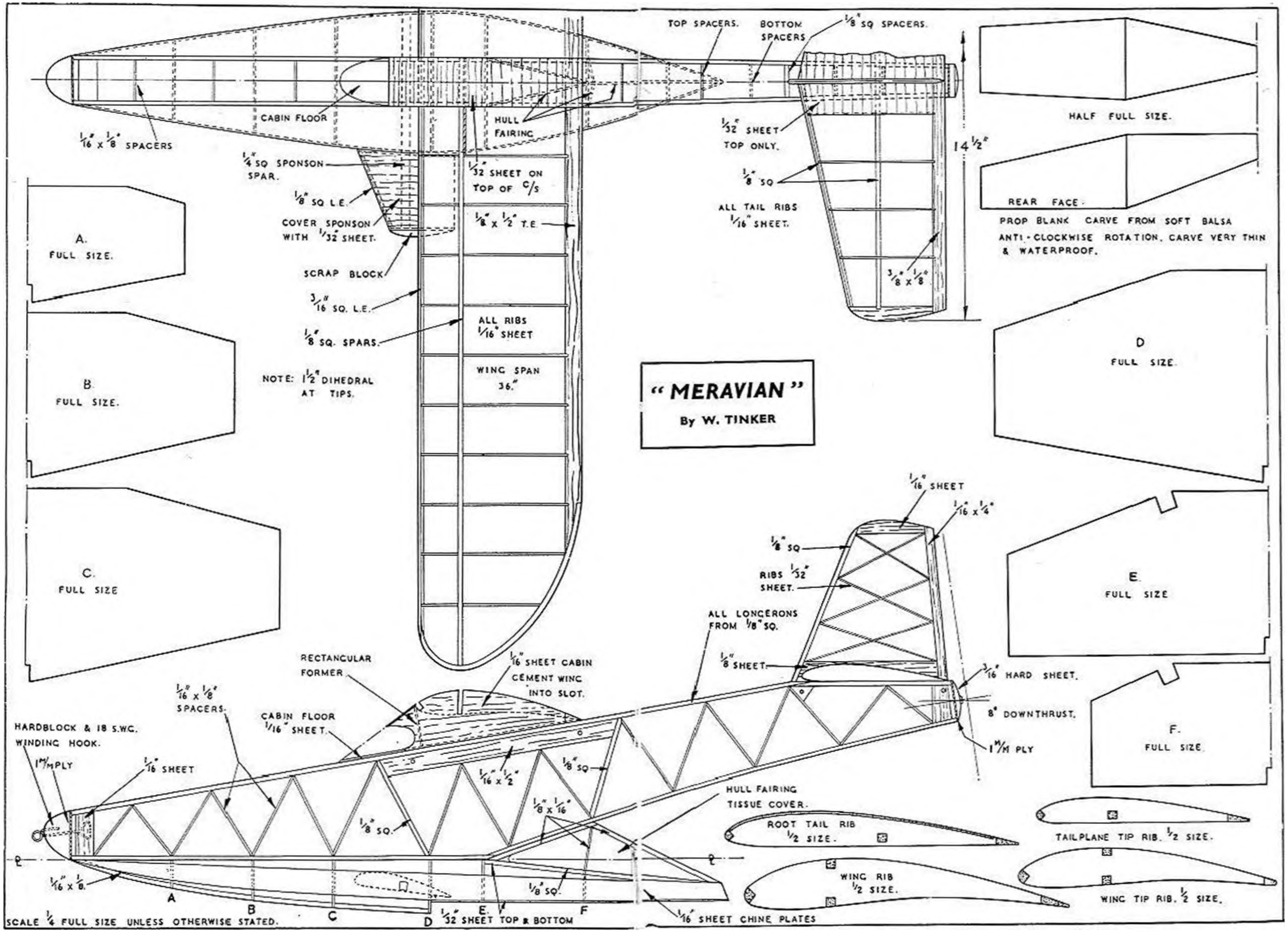
MERAVIAN 3 is the third in a series of boats being developed to break the existing British record for this class, currently standing at 1 : 05.

This version placed second in the C. H. Roberts Cup, in 1956, and its best flight fell short of the record by some ten seconds. However, the aircraft can be relied upon to perform consistently—providing there is a breeze blowing ! The single motor does not produce enough power to unstick the model from dead calm water.

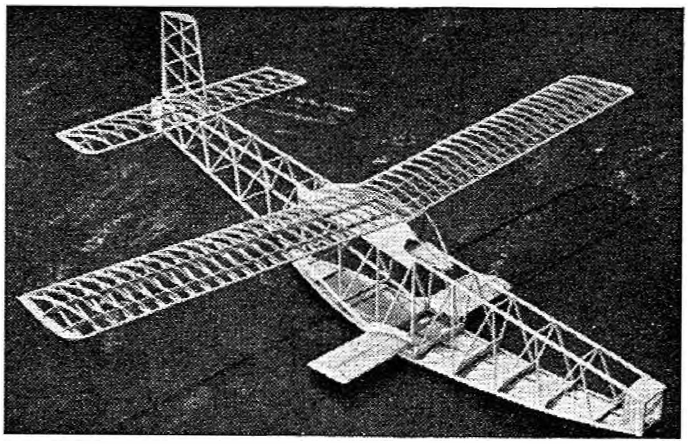
The design breaks away from "conventional" rubber powered flying boats, in that an attempt has been made to develop a simpler, more efficient and more easily trimmed machine, by eliminating twin motors. The advantages include smooth airflow over the flying surfaces, lower drag, less complicated winding technique and a longer motor run. The only real disadvantage is the lower power available, making the take-off more protracted than that of the twins. It is beneficial to keep the airframe as light as possible. The construction is orthodox, and only a brief guide is necessary.

Hull. Construct the basic frame and sheet in bow and stern bays. Add formers, chine plates, keel, etc. Slot in sponson spar and then sheet the hull where indicated. Cement sponson ribs in position, add leading edge and cover with sheet. Glue ply facing formers in place, and if desired give the bare framework a coat of clear aerolac, to resist absorption in the event of water inadvertently getting inside the hull. Cover underside of tail boom, dope, and then add stern fairing.

Wings. Build in normal manner, omitting at this stage the cabin sides. Cover undersurface first, leaving out the tissue at the centre section. Add cabin components and sheet top of centre section. Glue in address panel, glaze cabin with thin perspex and then finish covering the assembly.



"MERAVIAN"
By W. TINKER
TOP SPACERS.
BOTTOM SPACERS.
1/8" SQ SPACERS.
CABIN FLOOR
HULL FAIRING
1/16" x 1/8" SPACERS
1/4" SQ SPONSON SPAR.
1/32" SHEET ON TOP OF C/S
1/8" SQ L.E.
COVER SPONSON WITH 1/32" SHEET.
1/8" x 1/2" T.E.
SCRAP BLOCK
3/16" SQ. L.E.
ALL RIBS 1/16" SHEET
1/8" SQ. SPARS.
NOTE: 1 1/2" DIHEDRAL AT TIPS.
WING SPAN 36."
1/32" SHEET TOP ONLY.
1/8" SQ
ALL TAIL RIBS 1/16" SHEET.
3/8" x 1/8"
14 1/2"
HALF FULL SIZE.
REAR FACE.
PROP BLANK CARVE FROM SOFT BALSA
ANTI-CLOCKWISE ROTATION. CARVE VERY THIN & WATERPROOF.
A. FULL SIZE.
B. FULL SIZE.
C. FULL SIZE
D FULL SIZE.
E. FULL SIZE
F. FULL SIZE.
1/16" SHEET
1/16" x 1/4"
1/8" SQ
RIBS 1/32" SHEET.
ALL LONGERONS FROM 1/8" SQ.
1/8" SHEET.
3/16" HARD SHEET.
8° DOWNTHRUST.
1 M/M PLY
RECTANGULAR FORMER
1/16" SHEET CABIN CEMENT WING INTO SLOT.
1/16" x 1/8" SPACERS.
CABIN FLOOR 1/16" SHEET.
HARDBLOCK & 18 S.W.G. WINDING HOOK.
1 M/M PLY
1/16" SHEET
1/16" x 1/2"
1/8" SQ.
1/8" x 1/16"
1/8" SQ.
HULL FAIRING TISSUE COVER.
ROOT TAIL RIB 1/2 SIZE.
TAILPLANE TIP RIB. 1/2 SIZE.
WING RIB 1/2 SIZE.
WING TIP RIB. 1/2 SIZE.
1/16" x 1/8"
1/8" SQ.
A B C D E F
SCALE 1/4 FULL SIZE UNLESS OTHERWISE STATED.
1/32" SHEET TOP & BOTTOM
1/16" SHEET CHINE PLATES



At left is shown the seventh model in the "Meravian" series. Wing span is 36 in., with an overall length of 39 in., and area of 180 sq. in.

LDC.2 section is used for the wing, with ribs built up of $\frac{1}{16} \times \frac{1}{32}$ on $\frac{1}{4} \times \frac{1}{32}$ spars in geodetic form. Forward part of the hull is an inverted V in section, forming a concave against the usual convex form.

Thrust will be via a four-bladed propeller made up in two rows, forward two blades having fine pitch, with the rear pair set coarser. Estimated all-up weight is 5 ozs.

Tail Unit. Use light grade wood and make every effort to eliminate warps.

Propeller. This forms a weighty item placed a long way from the C.G., and therefore this unit should be lightened as much as possible. The propeller is protected to a large degree by the rest of the aircraft and may be carved to "indoor" dimensions. Tissue cover and waterproof.

Reduction of propeller drag during the glide is still the subject of experiments. Feathering is probably the ideal arrangement, but liable to be unduly heavy for this layout. Folding has been tried with some success, but peculiar evolutions have become evident during trials with this method, and it cannot be said to be reliable, although on average glide performance was better. Free-wheeling shows no major vices, but creates a prohibitive amount of drag high up, making a tendency to stall the model more easily.

Finish. Cover the entire model with lightweight tissue giving two coats of thin dope, followed by at least two coats of clear Aerolac to waterproof. The surfaces in contact with the water will appreciate a total of four coats of waterproof.

Protect the keel, stem and sponson tips with perspex.

Flying. Small amount of ballast may be necessary to position the C.G. where indicated. Trim over long grass by normal procedure, altering the thrust angle if necessary, to obtain the best climb. Take-off from water should present no difficulties assuming maximum power and a gentle breeze. The prototype has hauled 9 ozs. out of the water but the sodden mass did not climb very far ! A new machine should weigh around 5-6 ozs. Wind motor from the bow.

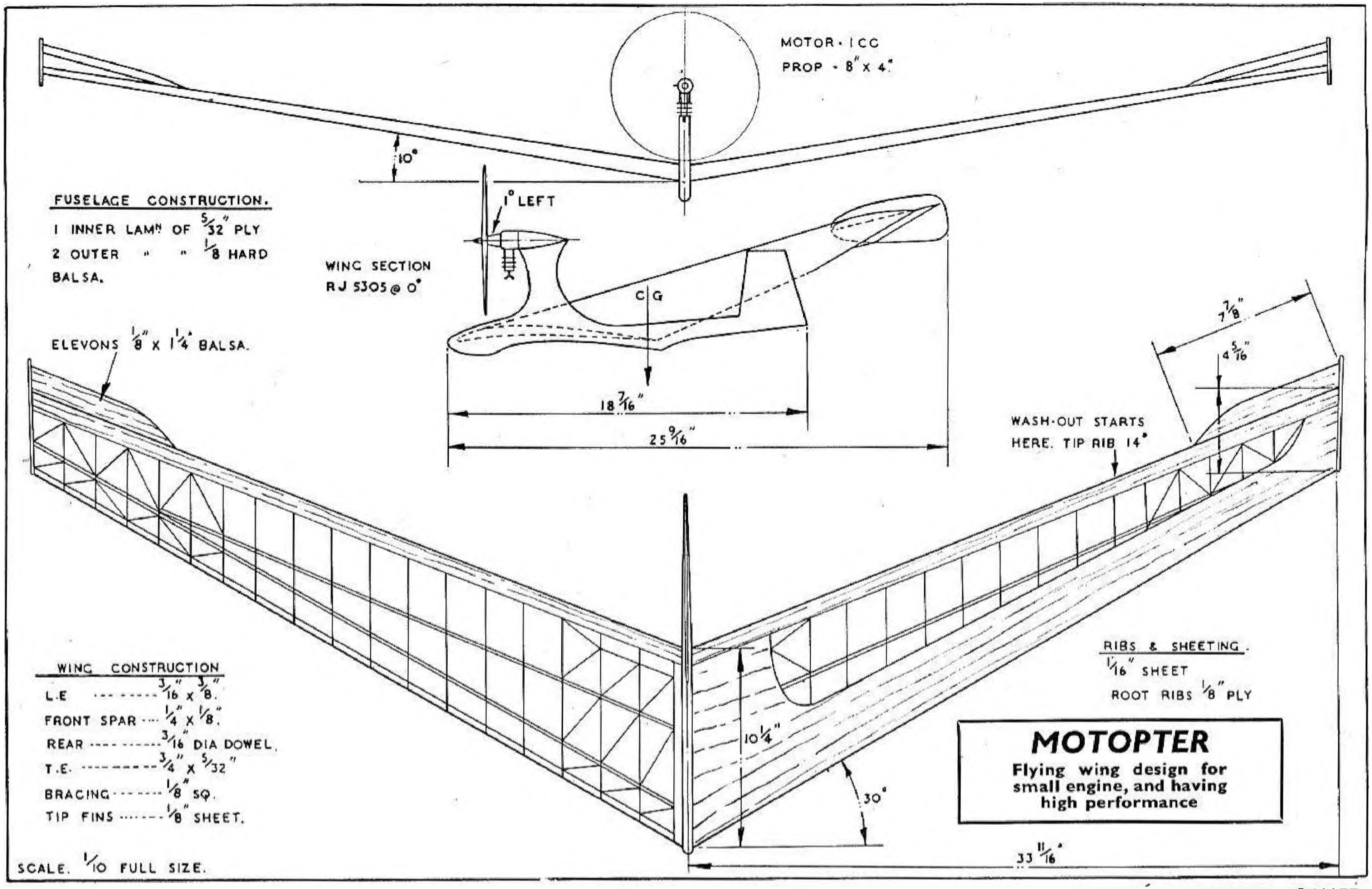
For the experimenter who may wish to improve the design, the following pointers may be of value :

Allow plenty of clearance between the propeller tip and the water. Lack of clearance results in sudden change of direction during take-off runs, as the propeller strikes the water.

Simultaneously the distance between the propeller centre and the water surface must be kept at a minimum, to reduce the large negative couple set up by the high thrust line and the very low drag line during take-off.

These obviously clash and restrict propeller diameters considerably, and a multi-bladed propeller may be beneficial in this layout.

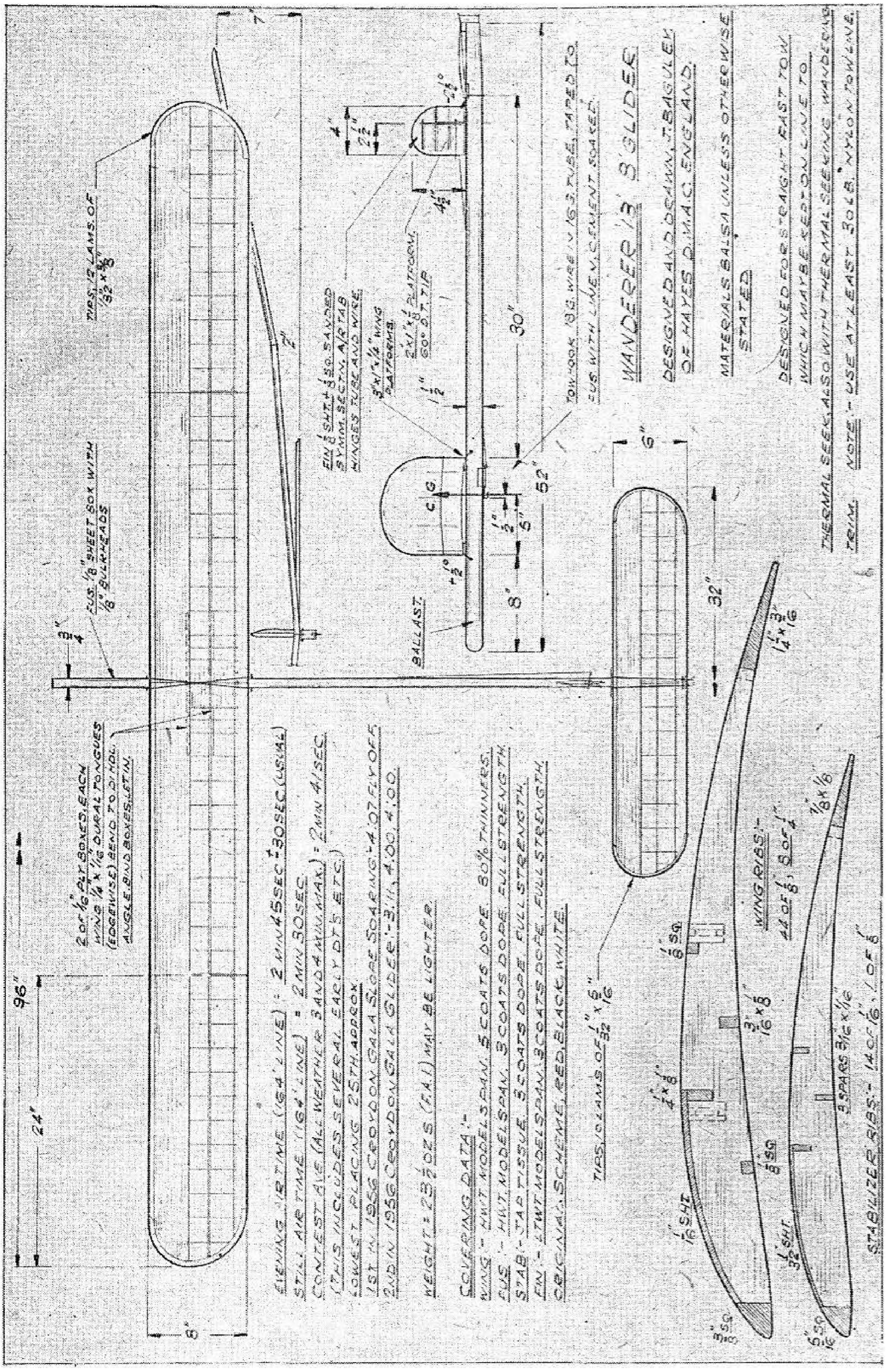
Hull design is a hit-and-miss affair. Ideally considerable research and practical experiment should be carried out on model hulls at model speeds before anything definite can be stated on the best form. The experimenter is left to follow his own theories.

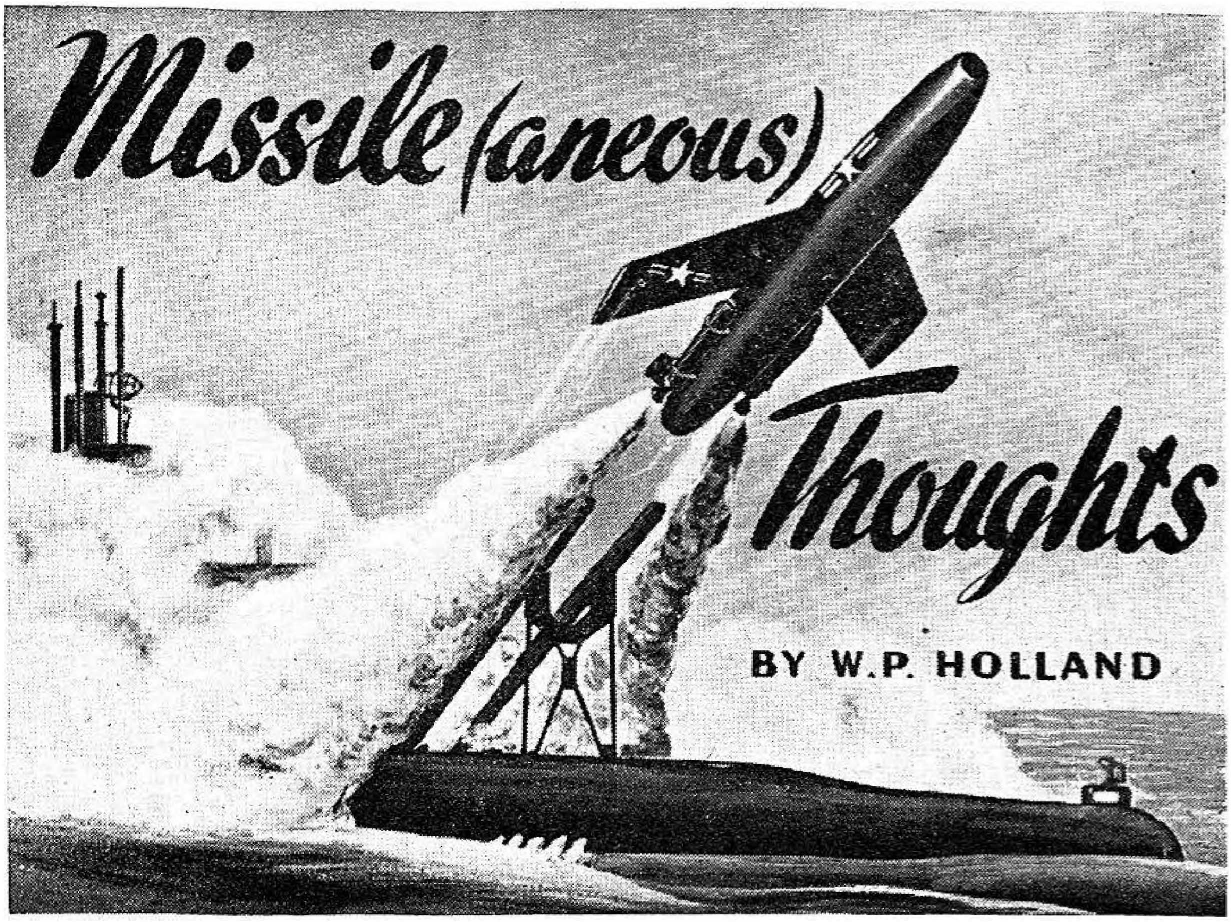


MOTOPTER

Flying wing design for small engine, and having high performance

MODÉLE MAGAZINE, FRANCE.


96"
24"
8"
3/4"
7"
2"
2 OF 1/16" PLY BOXES, EACH WING 1/4" x 1/16" DURAL TONGUES (EDGEWISE) BEND TO DIHDL. ANGLE. BIND BOXES, LET IN.
FUS. 1/8" SHEET BOX WITH 1/8" BULKHEADS
TIPS, 12 LAMS. OF 1/32" x 3/8"
EVENING AIR TIME (164' LINE) = 2 MIN 45 SEC ± 30 SEC (USUAL)
STILL AIR TIME (164' LINE) = 2 MIN 30 SEC.
CONTEST AVE. (ALL WEATHER 3 AND 4 MIN. MAX.) = 2 MIN 41 SEC.
(THIS INCLUDES SEVERAL EARLY DT'S ETC.)
LOWEST PLACING 25TH. APPROX.
1ST IN 1956 CROYDON GALA SLOPE SOARING:- 4:07 FLY OFF.
2ND IN 1956 CROYDON GALA GLIDER:- 3:11, 4:00, 4:00.
WEIGHT = 23 3/7 OZS (F.A.I.) MAY BE LIGHTER.
COVERING DATA:-
WING:- HWT. MODELSPAN. 5 COATS DOPE. 80% THINNERS.
FUS.:- HWT. MODELSPAN. 3 COATS DOPE. FULL STRENGTH.
STAB.:- JAP TISSUE. 5 COATS DOPE. FULL STRENGTH.
FIN:- LTWT. MODELSPAN. 3 COATS DOPE. FULL STRENGTH.
ORIGINAL SCHEME, RED, BLACK, WHITE.
FIN 1/8" SHT. + 1/8" SQ. SANDED SYMM. SECTN. A/R TAB HINGES TUBE AND WIRE.
3/8" x 1" x 1/4" WING PLATFORMS.
2" x 1" x 1/8" PLATFORM. 60° D.T. TIP
BALLAST.
C.G.
+1/2°
-2 1/2°
4"
2 1/2"
4 1/2"
1 1/2"
1/2"
8"
5"
30"
52"
TOWHOOK 18G. WIRE IN 16G. TUBE, TAPED TO FUS. WITH LINEN, CEMENT SOAKED.
TIPS, 10 LAMS. OF 1/32" x 5/16"
6"
32"
WANDERER 13 8' GLIDER
DESIGNED AND DRAWN, J. BAGULEY, OF HAYES D.M.A.C. ENGLAND.
MATERIALS BALSA UNLESS OTHERWISE STATED.
DESIGNED FOR STRAIGHT FAST TOW WHICH MAY BE KEPT ON LINE TO THERMAL SEEK, ALSO WITH THERMAL SEEKING WANDERING TRIM.
NOTE:- USE AT LEAST 30 LB. NYLON TOWLINE.
1/16" SHT.
1/4" x 1/8"
1/8" SQ.
3/8" SQ.
1/8" SQ.
3/16" x 1/8"
1 1/4" x 3/16"
WING RIBS:- 44 OF 1/8", 8 OF 1/4"
1/32" SHT.
5/16" SQ.
1/8" x 1/16"
3 SPARS 3/16" x 1/16"
STABILIZER RIBS:- 14 OF 1/16", 1 OF 1/8"



HITHERTO, COMPARATIVE peace had reigned on the flying field . . . but now eyes were cast apprehensively in the direction of what appeared to be a jet bomber of unidentifiable origin, cruising—well it must have been pretty high, you could hear no sound.

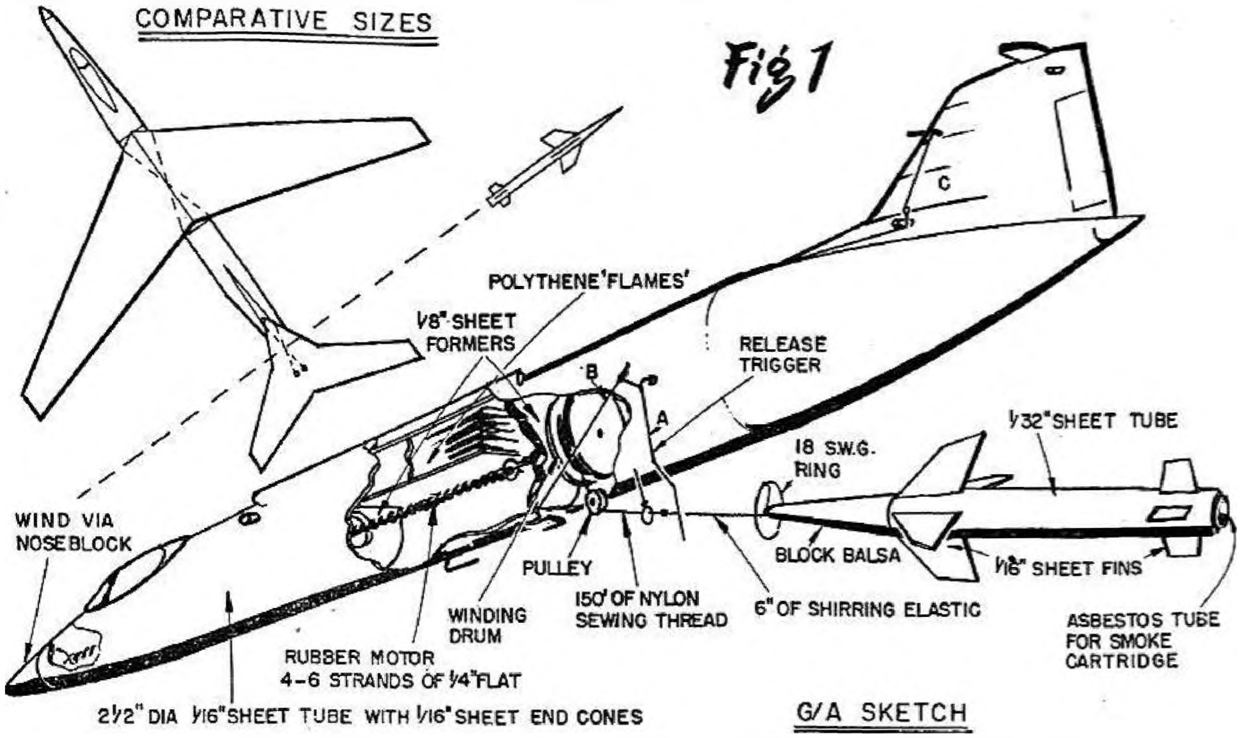
It was when a not-so-attentive observer drew our attention to a puff of smoke on the ground, that things really began to happen . . . A bright red something emerged from the smoke and rose into the air. "A Missile," we said. Breathlessly we watched as the little packet of trouble accelerated and set course in the direction of the bomber ; faster, faster, weaving slightly and closing in. We got worried, this was darn near overhead !

Rooted to the spot, well we just hoped NOT ! The crew of the bomber must have had similar thoughts, for she began to turn in what was to be a fruitless attempt to shake off the attack. Rapidly the gap closed, the missile, obviously self homing, followed every movement, then struck. It was over . . . with a burst of flame the wings parted company with the fuselage, hung for a moment then broke in half, followed by the complete tailplane. What was left of the fuselage descended in a horizontal position enveloped in sheets of flame. A solitary white parachute floated down some seconds later.

It was when we saw someone picking up the pieces that we realised that we had been witnessing a performance of MODELS !

Wasteful ? Just tuck in the polythene "flames", replace the rubber

Heading picture shows one version of air power from under the seas, with an American Regulus missile being launched from a submarine platform.



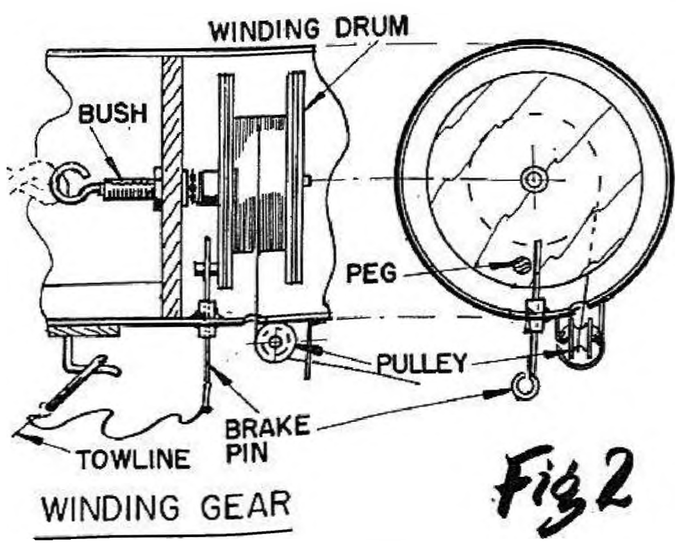
bands and smoke cartridges, set the release trigger, hook on the tow line, and off she goes for the next performance.

You can do this . . . really surprise the spectators at your club field and clear a little flying space at the more crowded rallies !

Take a look at the sketches (Fig. 1) and the mystery is revealed. It is best to use a swept-wing layout, and fairly large tailplane so that the C.G. comes as near to the centre of the fuselage as possible. This, in turn means that the fuselage C.G. is central and allows this component to descend on an even keel, so saving damage.

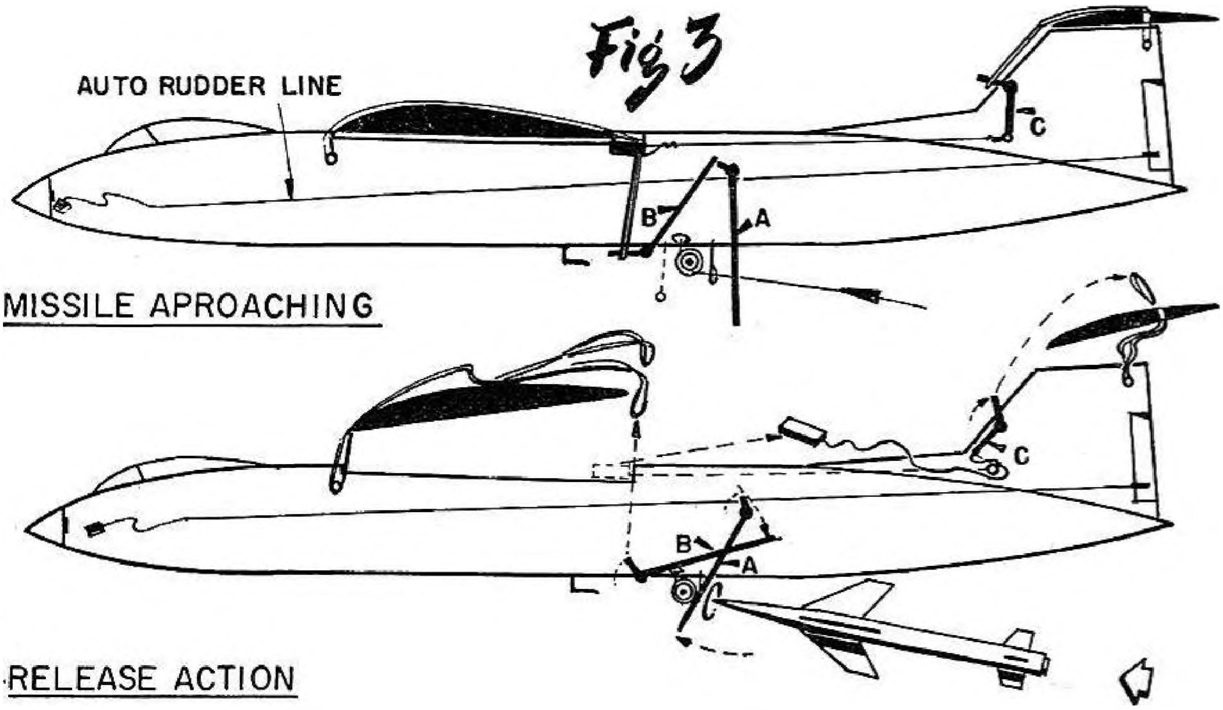
Wings and tail are cap strip type rib construction, and in this case were borrowed from "Prop Secret" (A.P.S. U/604). The mechanical details, though simple are best explained by the sketches. The launching technique is as follows :

1. Take the missile downwind of the bomber, the full length of its line.
2. Place winch brake in position (Fig. 2).



Peter Holland of the AEROMODELLER staff is well known for a fertile imagination, and a practical application of unorthodox ideas into models that really work.

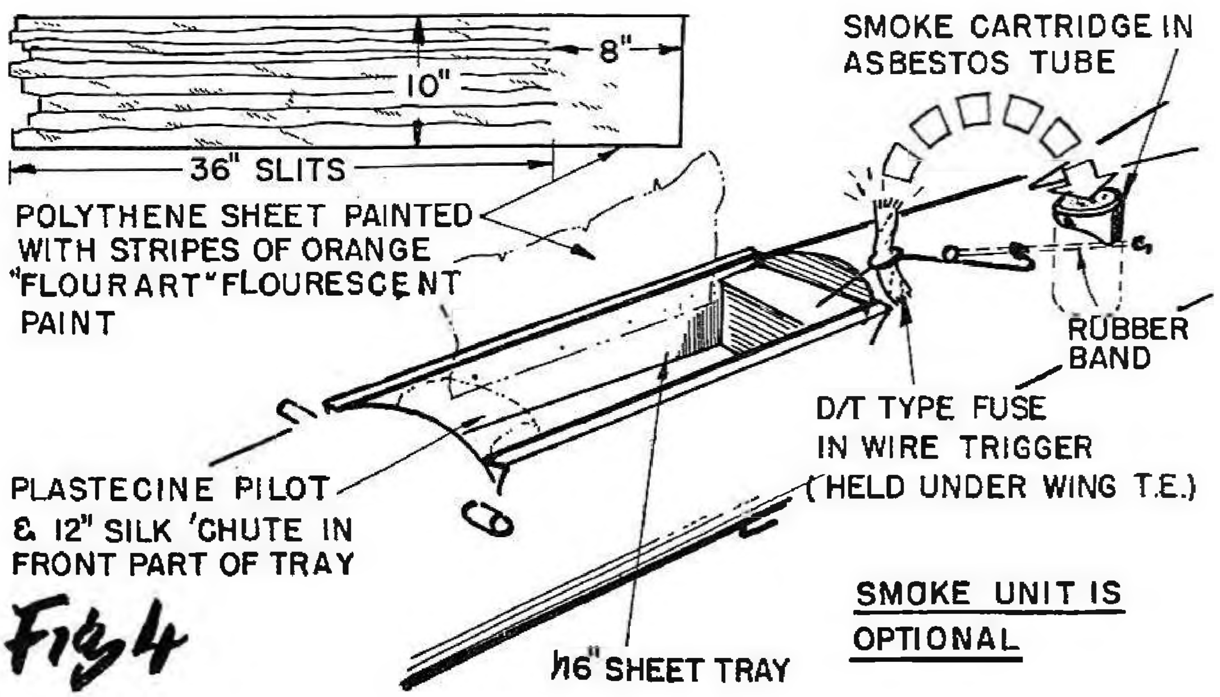
Notable are his "space" models featured from time to time in MODEL MAKER, whilst his aircraft designs include "Miranda" (seaplane), "Biplay", "PAA-packet", and "Prop-Secret"—a novel delta type model employing an ingenious method of propeller drive.

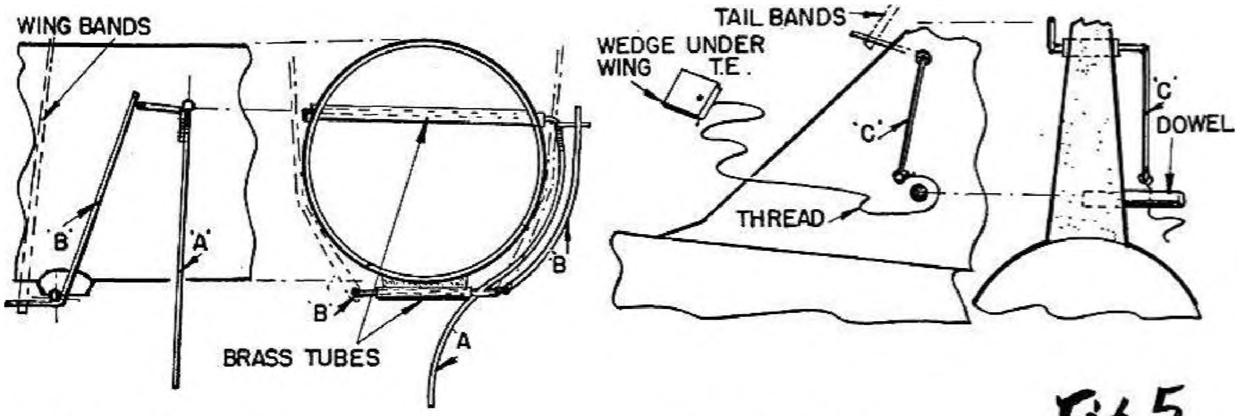


3. Light missile smoke cartridge (optional).
4. Tow up bomber till missile is seen to leave ground.

The rest is automatic ; as soon as the towline is released the winch brake is off and the missile is hauled up to the bomber. As the tension on the winch motor is lessened the auto rudder pin is released from behind the noseblock (Fig. 3).

The wire ring on the missile nose strikes the release trigger and frees the wing bands. As soon as the T.E. is clear of the fuselage, the tail release peg slips out and frees the tail bands via the tail release lever. At the same time the fuse is allowed to rest on the smoke ca dge with the obvious result (Fig. 4). Meanwhile the "flames" have unrolled d the "pilot" has bailed out from the





WING RELEASE TAIL RELEASE Fig 5

now open tray on the fuselage. (Fig. 5 shows the release gear in detail.) The flames act as a form of air brake and stabiliser so the heaviest component descends quite safely. A loose-fitting tongue ensures the separation of the wing halves. Watch out for thermals, for though the complete act is the best form of D.T. yet . . . the tailplane may decide not to return ! Perhaps a blob of plasticine on its L.E. would discourage it sufficiently.

Though the required duration of the bomber is only about 10 to 20 seconds, glide should first be trimmed without the missile. No trouble was experienced with the prototype ; towing was perfect, and the duration surprisingly high, a good point, for the missile acts as a considerable braking effect.

It is advisable to check that the winch in the bomber can lift about ½ oz. more than the missile when fully hauled in. This overcomes the drag of the missile when travelling at about twice the speed of the bomber.

DOES MODELLING HELP!

In a study made of American Academy of Model Aeronautics membership by the Washington H.Q., it was found that :

6,000 (43 per cent) of members are attending school or college.

3,700 are taking engineering or preparatory courses for engineering degrees.

8,000 (57 per cent) are employed or working with the military forces.

1,800 of these are with aviation companies, whilst 2,800 are employed as engineers, scientists and technicians in other fields, many related to aviation.

53 per cent of the membership stated that their experience as modellers had influenced their choice of careers or had proven of valuable assistance in their jobs.

All of which convinces us more than ever that aeromodelling is as helpful as it is absorbing in its interest, with a profound influence on its followers.

FLYWEIGHT

By R. T. PARHAM

A simple microfilm model to the new Class A (up to 30 *sq. ins.) specification, and suitable for small hall flying.*

THIS small, simple stick model is capable of good durations when flown in a hall of reasonable size, and yet can provide considerable enjoyment when flown at home. The original model made a flight of 6 min. 50 secs. on approximately half turns at the meeting staged in Manchester, and it consistently averages 1½ minutes in an ordinary drawing-room.

Motor Stick

Cut the blank from lightly sanded $\frac{1}{64}$ in. quarter grained balsa, and prepare a $\frac{5}{32}$ in. × 10 in. long former, straight, and preferably of metal. To make the stick, take a piece of Modelspan 9 in. × 4 in., dampen, and roll on to the former for two turns. Lay on a flat surface, and put the balsa blank, which has been previously soaked in hot water, into position and roll until both blank and tissue are completely wrapped around the former. Dry out the assembly in front of a fire, carefully unroll the tissue and remove the balsa tube. Slide the tube back on to the former and cement the seam.

Sand lightly, remove from former, trim the ends, and cement the end caps in position. Cut end caps oversize from $\frac{1}{64}$ in. sheet, sanding to shape after the cement has set. Complete by installing the aluminium bearing and rear hook, securely cementing into position.

Wing

Sand a piece of $\frac{1}{32}$ in. sheet lightly, and with a steel rule or other firm straight edge, cut main and tip spars. Tip radius is formed by soaking the spars in hot water, then running them carefully round a 1½ in. diameter balsa former, holding in place with strips of tissue until thoroughly dried out. Ribs are cut from $\frac{1}{64}$ in. sheet, using a ply template as shown.

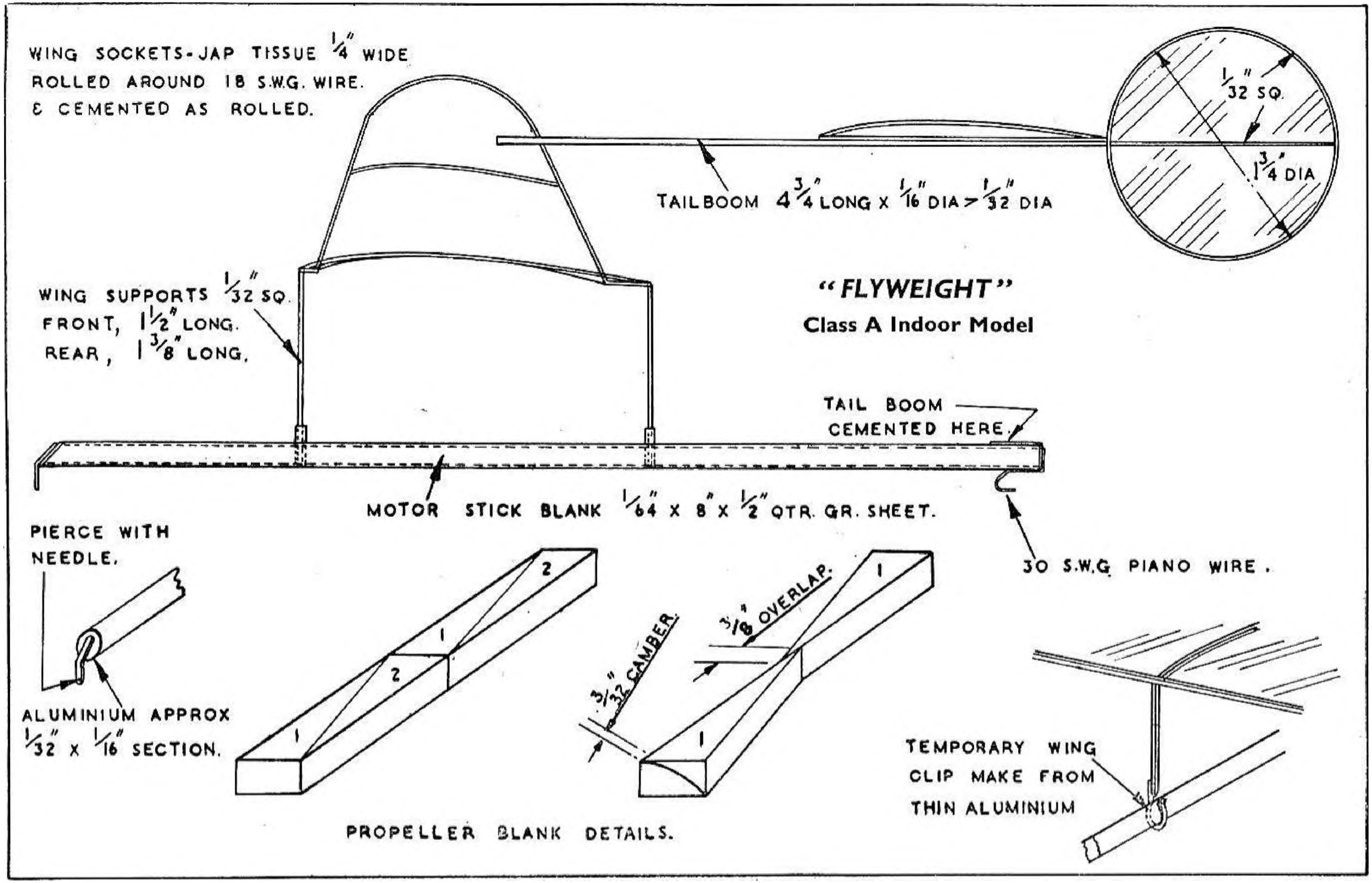
Assemble wing on the plan, using pins on either side of the spars to locate them. Trim ribs to size by removing surplus from the rear ends, and cement in place. (Always use cement sparingly with indoor models!) When set, remove frame from plan, and check before covering.

Tailplane and fin are constructed in the same manner as the wing.

Covering

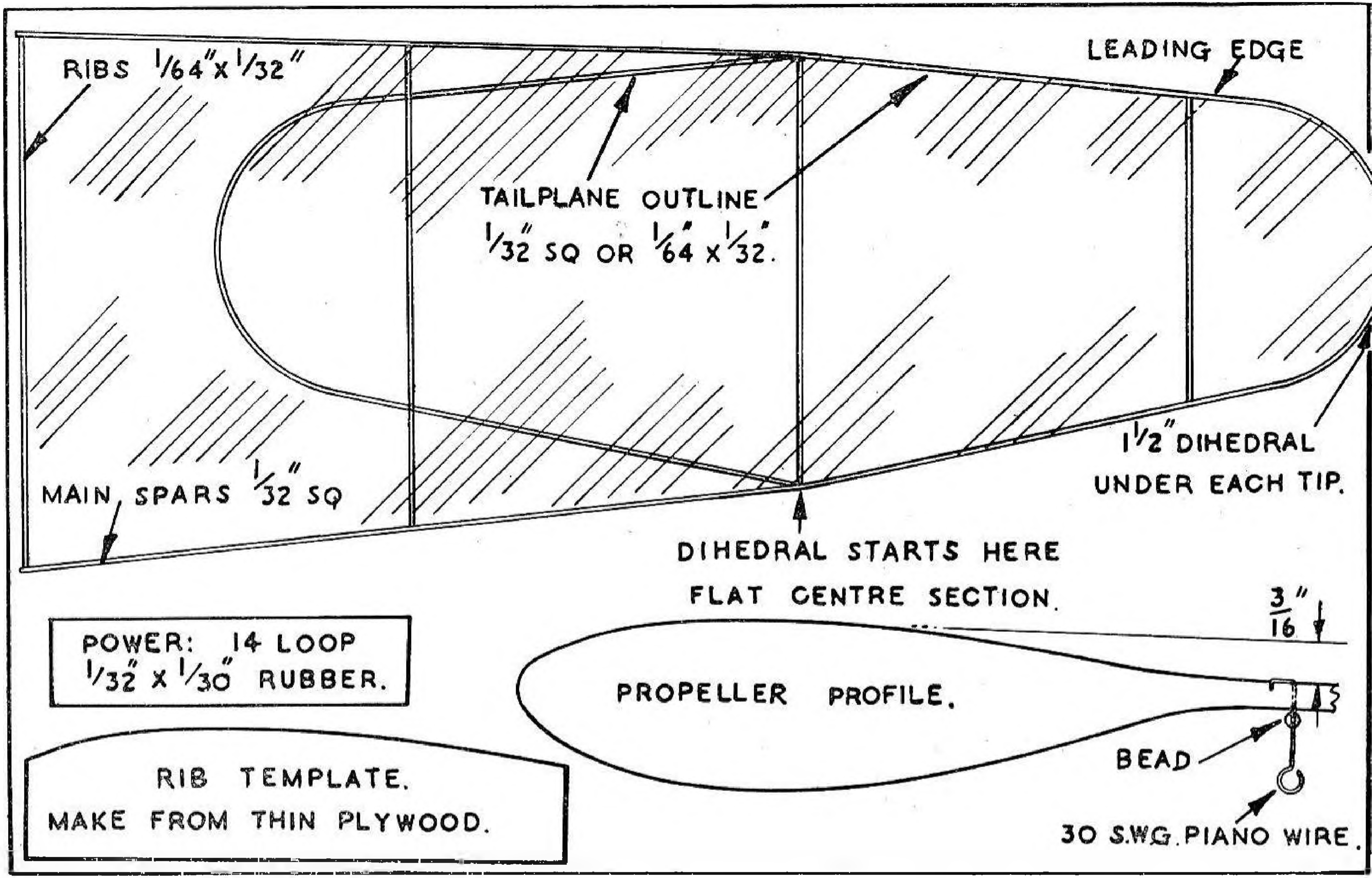
Support the wing frame about ¼ in. above a table on balsa scrap, first having applied saliva to the outline and dihedral ribs by running the tongue over these parts. Lower a sheet of microfilm gently on to the frame, making sure that the film adheres to the spars. Blow gently on to the film to assist this if necessary.

Trim from the sheet by dipping a small brush into dope thinners, drawing lightly over the film about ½ in. from the outline. The film will immediately dissolve, and care must be taken to ensure that the solvent does not get too near the outline, or that too much thinners is used. Complete the covering by running the tongue lightly around the outline to curl any surplus film against the spars.



"FLYWEIGHT"

Class A Indoor Model


RIBS 1/64" x 1/32"
LEADING EDGE
TAILPLANE OUTLINE
1/32" SQ OR 1/64" x 1/32".
1 1/2" DIHEDRAL
UNDER EACH TIP.
MAIN SPARS 1/32" SQ
DIHEDRAL STARTS HERE
FLAT CENTRE SECTION.
POWER: 14 LOOP
1/32" x 1/30" RUBBER.
3/16"
PROPELLER PROFILE.
BEAD
RIB TEMPLATE.
MAKE FROM THIN PLYWOOD.
30 S.W.G. PIANO WIRE.

Setting in the dihedral is tricky. Place the wing on a flat surface and carefully nick the spars at the dihedral joins with a razor blade. Lift the tips and rest them on suitable packing to give the correct angle. Cement the joins, taking great care that the cement does not come into contact with—and thus dissolve—the microfilm. Loose film caused by raising the tips can be tightened by drawing a small brush moistened with water along the dihedral rib.

To complete the wing, cut the supports to size and cement them in position.

Propeller

Whilst it is possible to produce a satisfactory propeller from sheet, the carved article is invariably much better. To produce blades that are matched for stiffness, weight, etc., cut the block as shown. This provides material for two props, and is therefore an economical proposition. Cement two half-blanks together with overlap as shown, and when set pierce the shaft hole with a fine needle.

With a very sharp knife, carve the underside of blades first, checking the camber from time to time and finishing with the finest sandpaper. Now carve and sand the convex side, gradually reducing the thickness of the blades down to $\frac{1}{64}$ in. or less at the tips, and not more than $\frac{1}{16}$ in. at the hub. Make a stiff paper template of the blade profile, and cut each blade to correct shape. Sanding carefully, merge the blade and hub, check for balance and instal shaft.

Assembly and Flying

From very thin aluminium make two temporary wing-clips as shown, cementing them to the wing supports. Assemble the propeller on to its bearing, first slipping on a small bead or washer to act as a bearing. Hang a loop of $\frac{1}{32}$ in. $\times$ $\frac{1}{20}$ in. rubber between the hooks, a test glide. Move the wing forward or backward to get the best rate of descent. Now offset the fin about $\frac{1}{4}$ in. to turn the model to the left, and wash out the inboard wing a little to prevent diving.

Start test flying with about 500 turns on the motor, and when all is well, mark the wing-support positions on the motor stick. Install the tissue sockets, and discard the temporary clips. Minor adjustments can be made by altering the wing incidence.

Materials Required

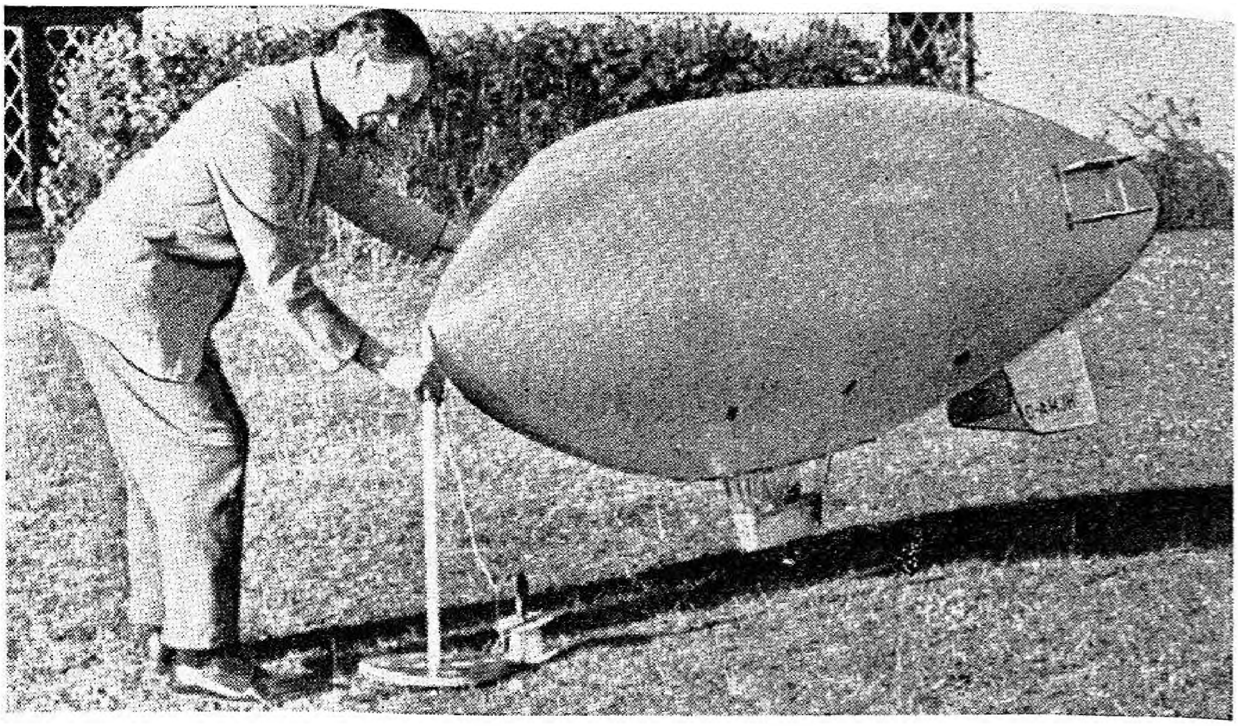
1 sheet quarter-grained indoor balsa $\frac{1}{64}$ in. $\times$ 2 in. $\times$ 18 in.
1 sheet straight-grained indoor balsa $\frac{1}{32}$ in. $\times$ 2 in. $\times$ 18 in.
1 block straight-grained indoor balsa $1\frac{1}{8}$ in. $\times$ $\frac{5}{8}$ in. $\times$ 9 in.

Microfilm Solution

2 oz. bottle Titanine clear dope, $\frac{3}{4}$ full.
Thinners to fill.
3 drops Castor Oil.

Mix well by shaking, and allow to settle before use.

Sheets of microfilm should be hung in a dust-free cupboard for at least a week before using, otherwise continuing shrinkage will distort the airframes.



MODEL AIRSHIPS

By LORD VENTRY

MODEL AIRSHIPS, capable of flying, are so rare that some notes on a couple of ships, constructed by Mr. Raymond Morse of Repps, Potters Heigham, Norfolk, may be of interest. Mr. Morse has supplied full technical data, produced at the end of this article.

DPN.30.

This model, like that of the projected Bournemouth II, is built to a scale of one inch to the foot. The original ship was a Parseval Natz semi-rigid, which carried out some 500 advertising and joy-riding flights in Germany in the early 1930's. They began operations back in 1928, and, except for the war years, at least one ship has been in use. Although more than 172,000 flights have been carried out, and 5,500,000 miles flown, no passenger has been injured.

The envelope of the model is made from white Polythene, and is stabilised by four single planes. The car is enclosed, and attached to the envelope by means of a keel. A small model aircraft diesel motor is attached to the stern of the car, the airship therefore being a pusher.

Inflation is from a B.O.C. hydrogen cylinder of 165 cu. ft., and takes less than five minutes. Under test, the car and planes were quickly attached, and the ship taken outdoors to fly. There was a gusty breeze, but after the motor was started and the ship ballasted to equilibrium, she flew well and fast, with her trail rope down in case she sailed away.

The fact that she was semi-captive, combined with the falling temperature and the fact that there was no ballonet, caused loss of pressure, but in spite of this severe handicap she behaved well. A ballonet inflated with air would have made all the difference, and if lift allows, will probably be fitted. The single planes also need pressure, otherwise they tend to droop, which naturally reduces their effectiveness.

Bournemouth II.

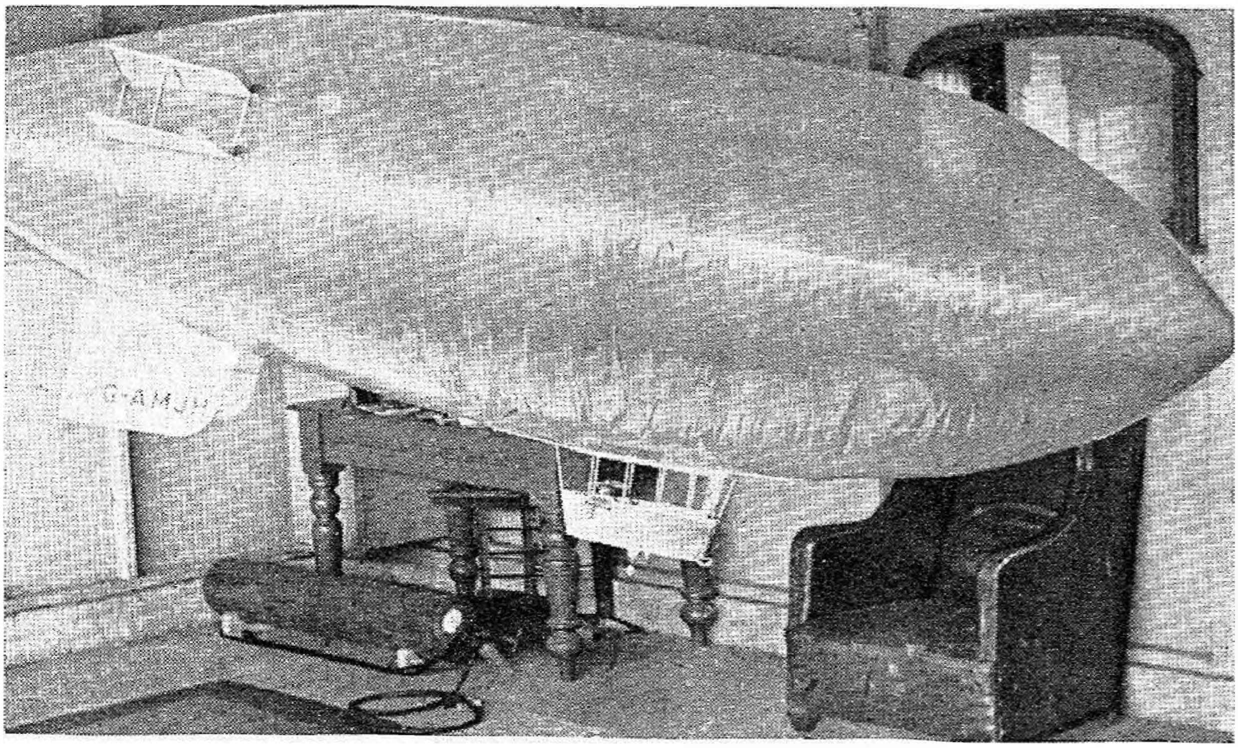
Alas, the full-size Bournemouth II does not yet exist, and as there is no money at present to build her, it was decided to build a flying model, especially as it was desired to test the effectiveness of swivelling propellers. This model is slightly larger than the DPN.30, and her Polythene envelope is blue coloured, and of excellent shape. Great efforts were made to ensure that car and planes could be attached to the envelope as quickly and simply as possible, and this Mr. Morse has achieved. The car has a small, oblong frame which clips onto the envelope, and there are four steadying suspension points on each side of the car. At present they are not bridled where they meet the envelope, and this would be an improvement on the model—and quite vital on a full-size ship.

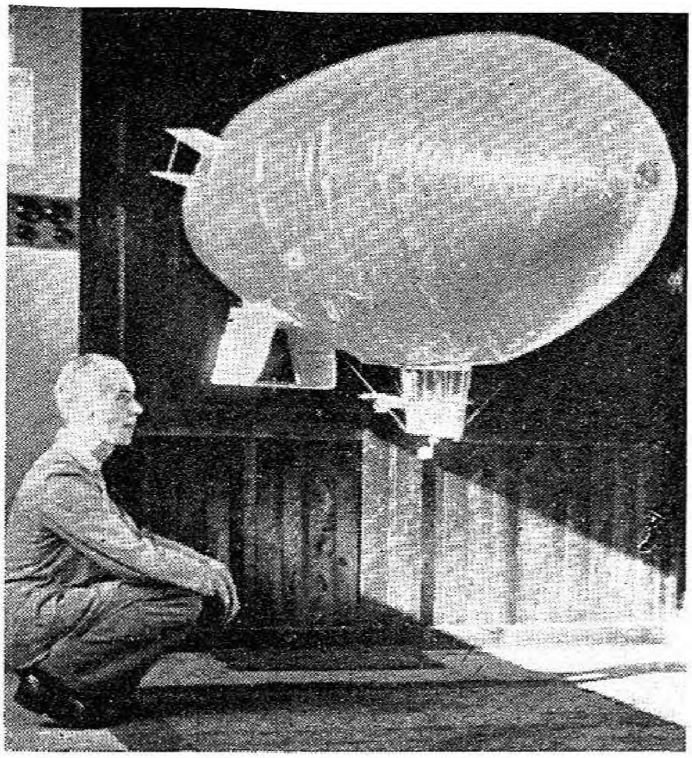
Planes are of biplane conformation, and so self-supporting. They clip onto the envelope in a second or two, and do not need any stay wires in the model. Even on the full size ship, the number of stay wires would be reduced to a minimum, the planes being copied from those designed by the famous French airship firm of Zodiacs and used on their fine little motorised kite balloons, which were virtually small airships, built for the Armée de L'Air. The planes being self-supporting were quite efficient.

The car is semi-enclosed, and is modelled on the cars of the Goodyear Blimps, the L class airships of the U.S. Navy. Inside the car are the electric batteries which drive the two tiny electric motors. These motors are mounted at each end of a tubular beam, which is mounted amidships. This beam can be turned through 360 degrees, and carrying the motors and propellers with it, the power can be used to drive the ship ahead or astern, and up or down vertically or diagonally. The airship, therefore, has a helicopter-like performance, and can take off vertically when heavier than air, and be pulled down vertically when lighter than air.

Flying Bournemouth II.

This model was inflated and ready for flight in a very short space of time, then, ballasted up to about 1¼ ozs. heavy, the propellers were turned to the





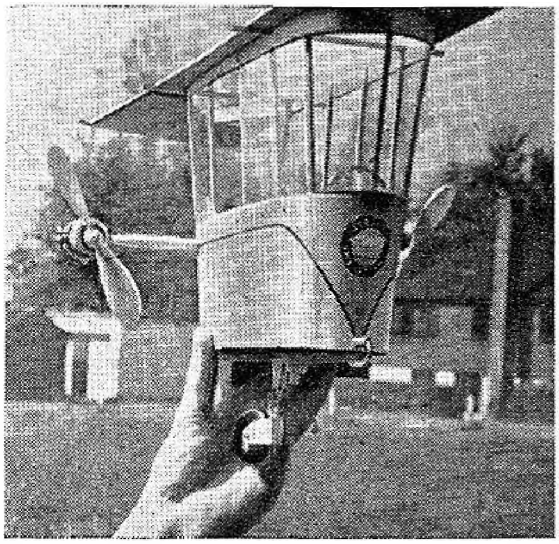
lifting position, and up she went like a helicopter. The propellers were then swivelled for a forward drive, and she forged ahead at about 3 miles per hour. With the propellers giving a slightly downward thrust, she made a good landing on the castering wheel located under the car.

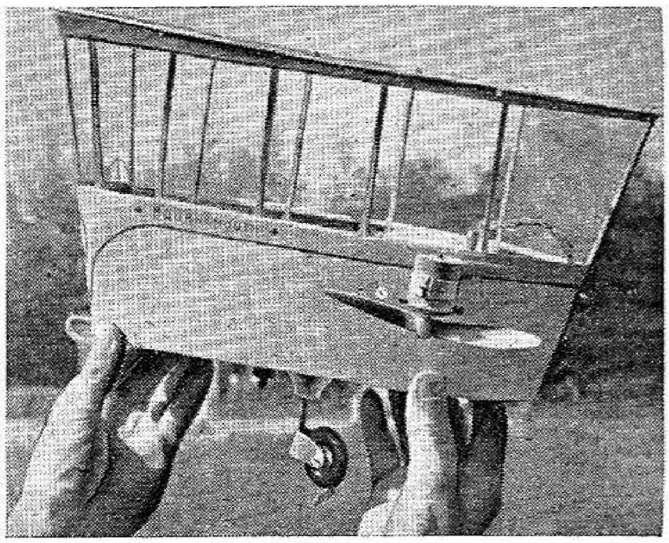
On other flights the propellers were swivelled to about 70 degrees up. Then she left the ground climbing on an even keel, and it was interesting to see her moving forward quite fast, even when the propellers were well over 60 degrees up or down. On one occasion she landed quite well, going astern.

It is understood that the two motors only represent some 30 h.p. in a full size ship, which is about half power for a small airship like the proposed Bournemouth II, which should in reality have some 70 h.p. to drive her. As a result, the model is too slow to fly out of doors unless there is a calm. She did, however, make one good flight of at least 3 to 5 m.p.h. in quite a gusty breeze, and proved stable as far as could be seen. Moored to a post driven into the ground she swung head to wind, with the car wheel on the ground, much like a full size airship would have done.

A ballonet would improve matters, as, owing to a leak (since stopped) and to falling temperature, the envelope became rather flabby. The model later flew half a mile, being held, however, by the bow guy in case she should "go native" and sail away.

The turning circle is about 50 feet, and she answers her twin rudder well. The monoplane elevator was quite useless, however, and will be replaced by a biplane elevator.





In the writer's opinion, Mr. Morse deserves full marks for the work he is doing on model airships, for the problems are much the same as those met with full scale airships. The models look so like their full size sisters whilst flying, and they are quite fascinating to handle. They would prove ideal for Air Scout and Air Cadet training, and, provided that pressure can be maintained, very interesting experiments in ground handling could be carried out, including of course, mooring out.

The next step will be to see if it is not possible to build a radio controlled model, and a start has been made working this out on paper. If one is debarred from working with the real thing, models certainly make an interesting, and it is hoped useful, substitute. They are certainly much cheaper !

MODEL AIRSHIP DATA

	DPN 30	Bournemouth II
Volume :	30 cu. ft.	34 cu. ft.
Length :	8 ft. 4 in.	9 ft.
Diameter :	2 ft. 4 in.	2 ft. 9 in.
Weight of envelope :	16 ozs.	11 ozs.
Car length :	13 in.	14 in.
Weight of car unit :	11 ozs.	8 ozs. + 8 ozs. batteries.
Motive Power :	0·5 c.c. Allbon Dart driving 4-bladed 7 x 5 prop.	2 Taplin electric motors driving two 5 in. tractor airscrews. (Thrust on full voltage 1¼ ozs.)
Planes :	Cruciform system of 4 single planes. Weight 2 ozs.	3 sets of biplanes. Twin sets of rudders attached to bottom planes, with monoplane elevator. Weight 2 ozs.
Performance :	Duration : 10-15 mins. Speed : 8-10 m.p.h.	Duration : 2-3 hours Speed : approx. 3 m.p.h.
Gross weight in static equilibrium :	32 ozs.	36 ozs.
General Data		
Envelope material :	2½ thou. Polythene	ditto
Seams :	Electric welded and taped 4 gores.	Flame welded, no taping. 8 gores.
Car framing :	⅛ in. sq. balsa	ditto
Car sheeting :	$\frac{1}{64}$ in. balsa	$\frac{1}{32}$ in. balsa
Planes :	$\frac{1}{16}$ in. sheet balsa, silver doped.	Tissue covered built up type 2 coats silver dope.

WORLD CHAMPIONSHIPS 1956, for WAKEFIELD CUP
Held at Hoganas, Sweden, 19th August, 1956

No.	Name	Country	1	2	3	4	5	Total
1 ...	Petersson, L.	Sweden ...	180	180	180	180	159	879
2 ...	Kothe, H.*	U.S.A. ...	180	180	180	180	154	874
3 ...	O'Donnell, John ...	Great Britain	180	180	180	151	180	871
3 ...	Knudsen, Erik ...	Denmark ...	180	166	180	165	180	871
5 ...	Smirnov, E.	Russia ...	180	163	167	160	180	850
6 ...	O'Donnell, H. ...	Great Britain	178	175	142	180	173	848
7 ...	Ahman, R.	Sweden ...	135	154	180	180	180	829
8 ...	Ivannikov, I.	Russia ...	180	180	180	131	140	811
9 ...	Kolpakov, V.	Russia ...	180	143	126	180	180	809
10 ...	Hyvarinen, R. ...	Finland ...	166	180	172	132	158	808
11 ...	Smolders, J.	Holland ...	177	165	155	160	147	804
12 ...	Haag, R.	Sweden ...	180	141	145	180	155	801
13 ...	Kolb, J.	U.S.A. ...	180	180	110	163	155	788
14 ...	Scardicchio, V. ...	Italy... ...	180	180	127	180	118	785
15 ...	Montplaisir, C.* ...	U.S.A. ...	139	180	180	180	103	782
16 ...	Cizek, R.	Czechoslovakia	180	171	176	103	136	766
17 ...	Lefever, G. J. ...	Great Britain	98	180	147	180	145	750
18 ...	Alinari, A.	Italy... ...	156	180	111	130	146	723
19 ...	Giudici, C.	France ...	132	180	126	116	168	722
20 ...	Fea, G.	Italy... ...	180	180	180	180	—	720
21 ...	Hertsch, K.	Germany ...	180	180	99	118	133	710
22 ...	Guilloteau, R. ...	France ...	132	177	100	125	171	705
23 ...	Sorensen, N. ...	Denmark ...	149	180	111	130	124	694
24 ...	Altmann, J.	Germany ...	180	142	180	161	25	688
25 ...	Hamalainen, E. ...	Finland ...	150	144	145	126	110	675
26 ...	Dormann, H. ...	Germany ...	159	147	107	128	128	669
27 ...	Cassi, G.	Italy... ...	151	178	89	87	159	664
28 ...	Molbach, T.	Norway ...	100	180	134	131	98	643
29 ...	Nienstedt, E.	Denmark ...	149	130	—	180	180	639
30 ...	Hemola, J.	Czechoslovakia	146	69	124	180	190	628

On the rostrum following the prize giving are Anders Hakansson (proxy for Kothe), Lennart Petersson holding the world famous trophy, and Erik Knudsen (Denmark) and John O'Donnell (Great Britain) who tied for third place.

No.	Name	Country	1	2	3	4	5	Total
31 ...	Coughlin, G.	U.S.A. ...	158	127	112	137	93	627
32 ...	Heidmuller, B.* ...	Germany ...	150	129	54	180	100	613
33 ...	Loates, *	Canada ...	89	156	180	180	—	605
34 ...	Revell, H.	Great Britain	141	147	91	104	121	604
35 ...	Bausch, L.	Holland ...	110	133	134	139	87	603
36 ...	Matvejev, V.	Russia ...	180	180	—	180	—	540
37 ...	Wong, D.*	New Zealand	99	180	120	82	37	518
38 ...	Takko, S.	Finland ...	93	153	141	130	—	517
39 ...	Lifka, L.	Czechoslovakia	145	125	88	88	69	515
40 ...	Bluhm, P.	France ...	—	102	134	107	149	492
41 ...	Knoos, S.	Sweden ...	165	144	114	58	—	481
42 ...	Burger, C.	Holland ...	132	103	120	—	118	473
42 ...	Bobkowski, A. ...	Guatemala ...	126	180	167	—	—	473
44 ...	Nurminen, S. ...	Finland ...	44	151	113	93	67	468
45 ...	Heesemans, R. ...	Holland ...	122	107	60	39	136	464
46 ...	Widell, H. E. ...	Denmark ...	161	75	169	45	—	450
47 ...	Nonaka, Y.*	Japan ...	137	94	121	23	58	433
48 ...	Alfara, A.*	Guatemala ...	33	117	121	150	—	421
49 ...	Mackenzie, D.* ...	Canada ...	132	—	145	127	—	404
50 ...	Popelar, V.	Czechoslovakia	158	—	—	89	140	387
51 ...	Viggiano, O.* ...	Argentine ...	40	167	162	—	—	369
52 ...	Baker, B.	Australia ...	180	—	159	—	—	339
53 ...	Gordon, R.*	Canada ...	180	139	—	—	—	319
54 ...	Nonaka, S.*	Japan ...	143	92	—	—	—	235
55 ...	Leong, A.*	New Zealand	93	85	—	—	—	178
56 ...	Groves, K.*	Canada ...	68	—	78	—	—	146
57 ...	Heiret, J.	Norway ...	86	—	—	—	—	86
58 ...	Macaulay, A.* ...	New Zealand	—	—	23	—	—	23
59 ...	Bird, R. *	Australia ...	—	—	—	—	—	—
60 ...	Pardo, J.*	Guatemala ...	—	—	—	—	—	—
61 ...	Roots, B.*	New Zealand	—	—	—	—	—	—
62 ...	Cheurlot, M.	France	—	—	—	—	—	—

(* denotes Proxy flown)

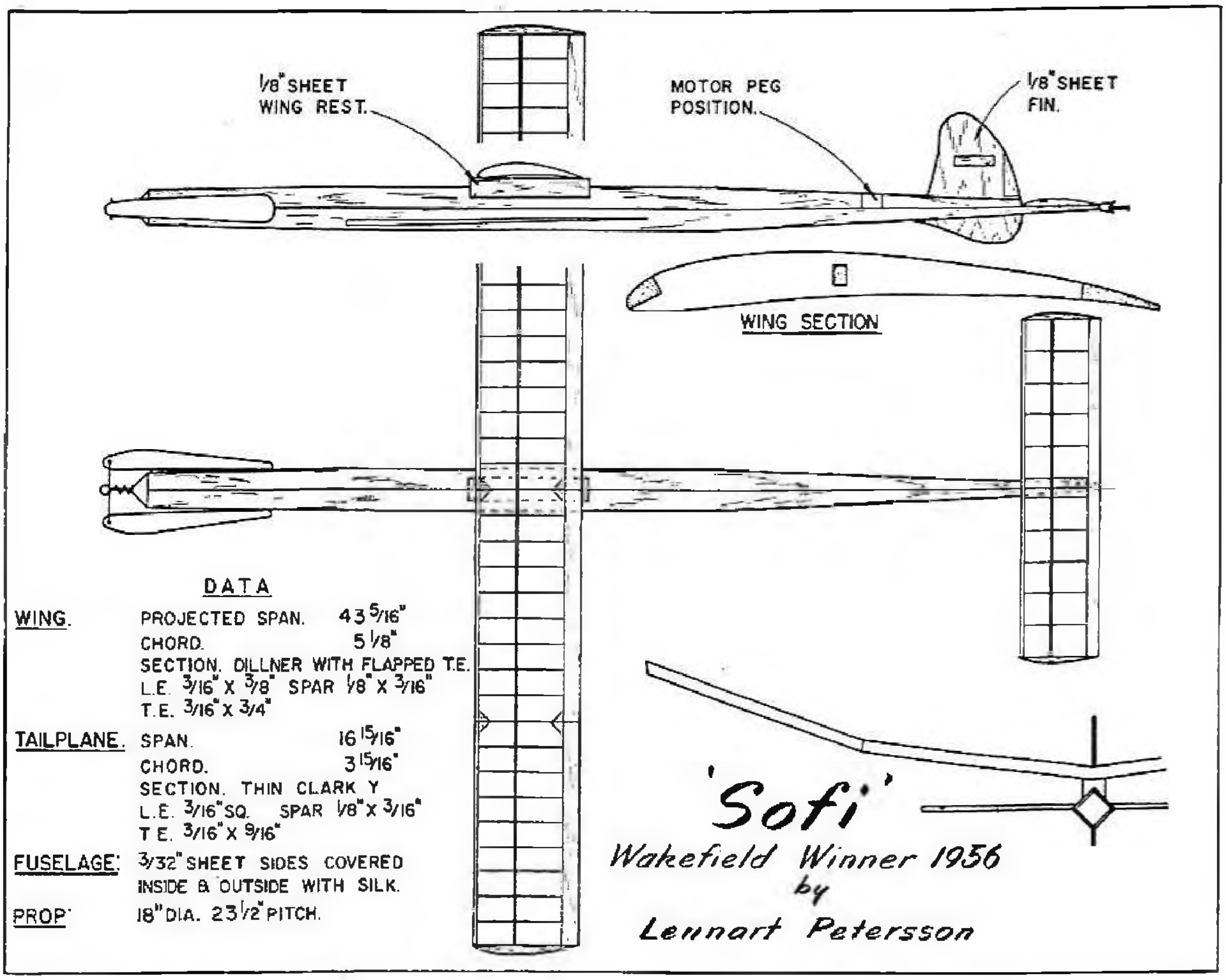
TEAM RESULTS

1	Sweden ...	2509	7	Germany ...	2067	13	Guatemala ...	894
2	Russia ...	2470	8	Finland ...	2000	14	Norway ...	729
3	Great Britain	2469	9	France ...	1919	15	New Zealand	724
4	U.S.A. ...	2444	10	Czechoslovakia	1909	16	Japan ...	668
5	Italy	2228	11	Holland ...	1880	17	Argentine ...	369
6	Denmark ...	2204	12	Canada ...	1328	18	Australia ...	339

The 1956 Wakefield Cup contest was notable for the varying conditions that obtained during the contest, many flights being taken in pouring rain. Also, this was the first time that direct competition had been received from the Soviet Union, the Russian modellers proving their abilities conclusively.

Organised by the Kungl Svenska Aeroklubben with their usual meticulous care, fortunes of the contest changed repeatedly during the day, a few seconds lost in one round being sufficient to put any competitor out of the running until the closing stages.

Everyone's sympathies were with consistent Wakefield-man G. Fea of Italy, for, with four maximum flights to his credit at the expense of two lost models, he had no machine with which to make his fifth flight and thus lost the finest chance Italy has yet had to claim the contest.



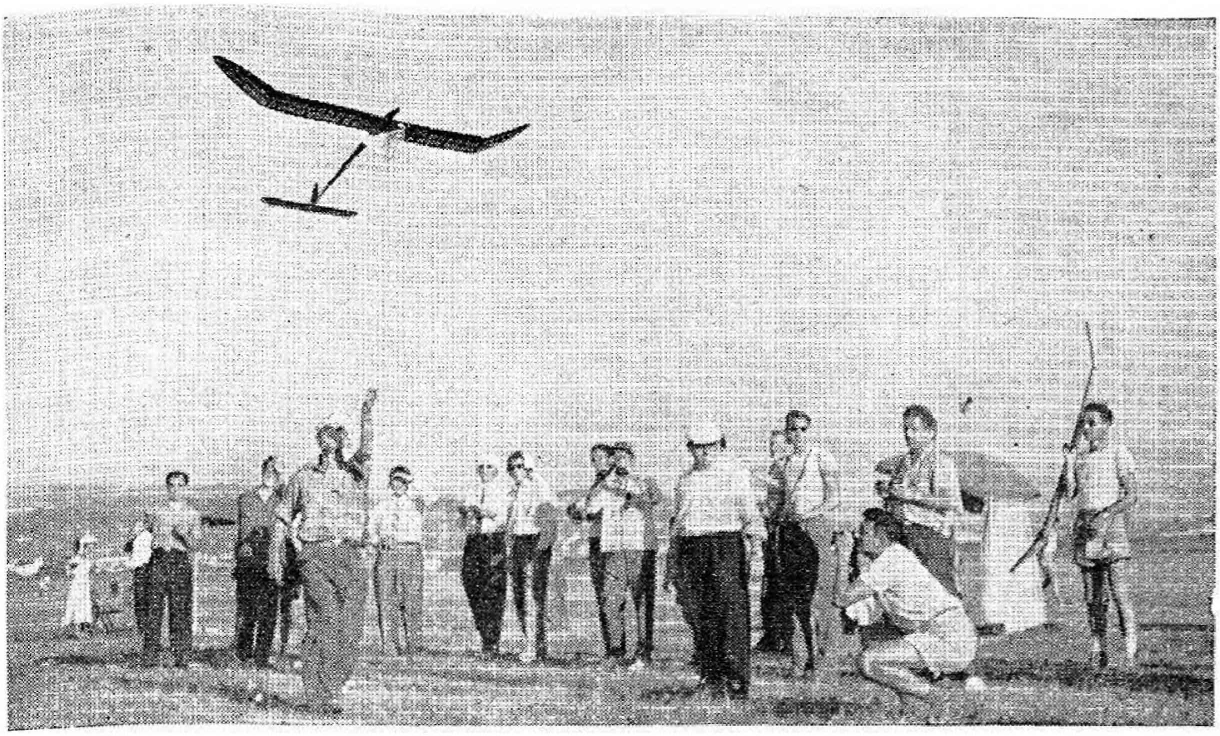
The winning model by Petersson was of straight-forward, clean design, and typical of the high standard of craftsmanship expected of Swedish modellers. Covering of fuselage *inside* with silk is a unique feature.

Typical of the Russian Wakefield models was this machine being launched by V. Kolpakov. Built in the main from quite unorthodox materials, the flying surfaces were extremely flexible yet strong, workmanship being excellent.

WORLD GLIDER CHAMPIONSHIPS for SWEDISH CUP
Held at Florence, Italy, September 30th, 1956

No.	Name	Country	1	2	3	4	5	Total
1 ...	Brems	Belgium ...	145	180	180	180	168	853
2 ...	Amor	Great Britain	180	180	180	180	115	835
3 ...	Thoman	Switzerland	139	142	180	180	180	821
4 ...	Hansen	Denmark ...	180	180	160	180	119	819
5 ...	Kalen	Sweden ...	97	180	180	180	180	817
6 ...	Spulak	Czechoslovakia	155	132	180	167	180	814
7 ...	Jones, B.	Canada ...	81	180	180	170	180	791
8 ...	Horyna	Czechoslovakia	177	138	142	180	152	789
9 ...	Larsson	Sweden ...	86	180	180	157	180	783
10 ...	Hajek	Czechoslovakia	148	180	180	180	89	777
11 ...	Stepanek	Czechoslovakia	142	180	125	163	160	770
12 ...	Roser	Hungary ...	180	67	180	180	163	770
13 ...	Papendorf	Germany ...	180	147	180	101	157	765
14 ...	Nilsen	Denmark ...	76	180	180	180	141	757
15 ...	Wheeler*	New Zealand	180	180	180	111	102	753
16 ...	Gussenhoven	Holland ...	102	180	156	137	177	752
17 ...	Lindner	Germany ...	180	165	180	114	107	746
18 ...	Templier	France ...	120	180	180	123	142	745
19 ...	Rodoczi	Hungary ...	180	180	146	102	122	730
20 ...	Schnabel	Switzerland	152	180	145	105	146	728
21 ...	Simon, G.	Hungary ...	180	85	100	180	166	711
22 ...	Giusti, E.	Italy ...	74	180	180	99	178	711
23 ...	Watson*	New Zealand	144	138	69	180	180	711
24 ...	Norbert	Hungary ...	180	180	73	99	172	704
25 ...	Jedelsky	Austria ...	100	158	135	180	130	703

Top : Marcel Brems exhibits the surprise winner.



Held in typical hot, dusty, Italian weather, the glider fliers had difficulty at times in getting their models away cleanly. Boxall launches for Bob Amor, top man in the British team.

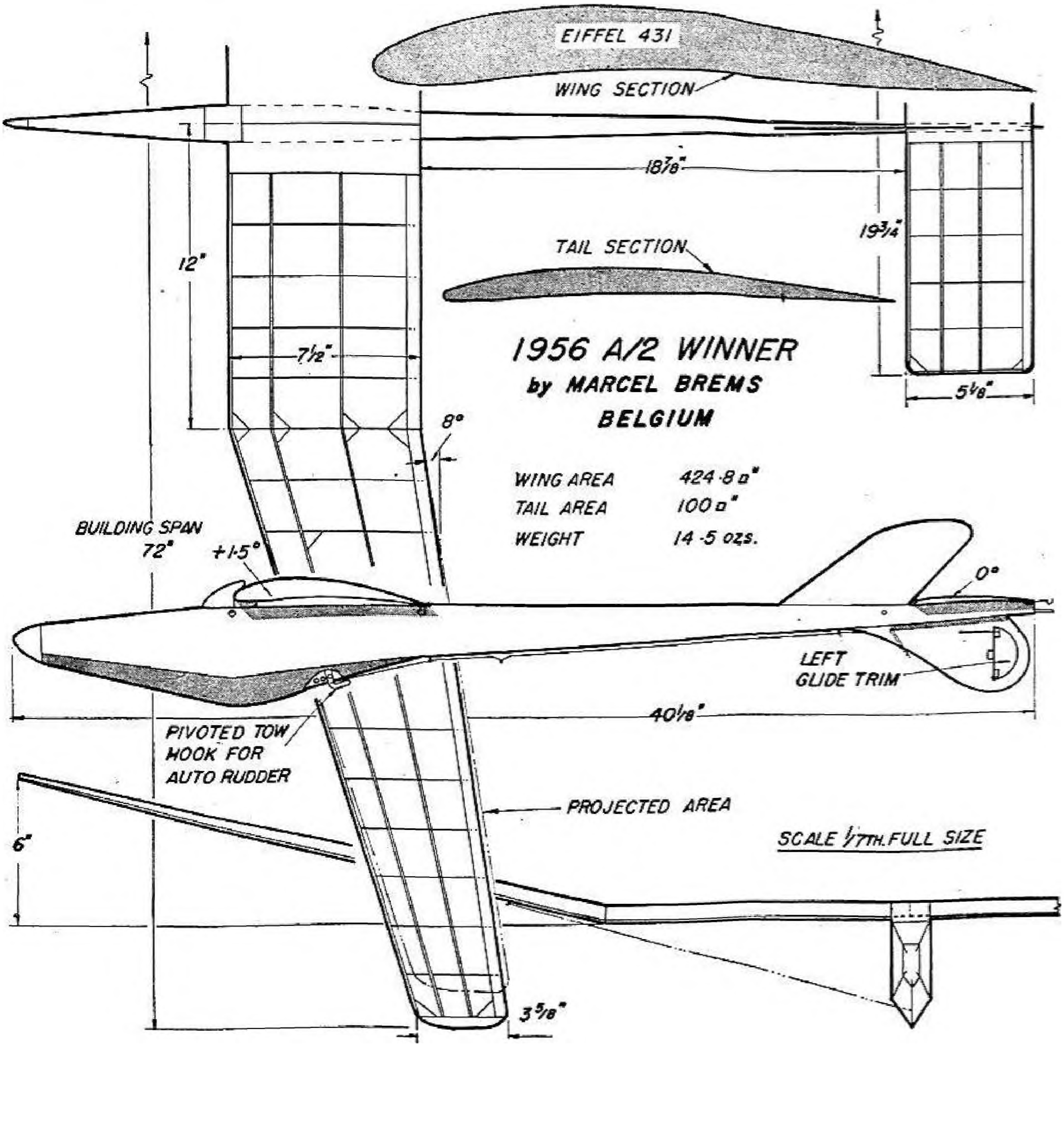
26	Terrill	New Zealand	180	64	180	180	97	701
27	Ito Kinzol*	Japan	180	92	180	131	112	695
28	Joansson	Sweden	180	167	61	180	105	693
29	Maes	Belgium	66	180	180	119	144	689
30	Esuelt	Holland	130	180	180	67	131	688
31	Bucher	Switzerland	100	180	44	180	180	684
32	Aubertin	Monaco	180	158	85	65	180	668
33	Mackenzie	Canada	109	83	180	154	139	665
34	Boxall	Great Britain	180	84	180	76	145	665
35	Wilkin	Belgium	93	60	180	180	150	663
36	Goetz	France	126	83	180	164	106	659
37	Guilloteau	France	159	94	97	180	126	656
38	Czincel	Germany	180	36	104	161	168	649
39	Posa	Italy	180	80	180	81	114	635
40	Bilgri*	U.S.A.	87	134	65	180	165	631
41	Hansen, H.	Denmark	180	97	180	33	135	625
42	Nironi	Italy	180	114	78	101	135	608
43	Jacob	Israel	104	165	104	78	149	600
44	Hujikawa*	Japan	180	84	94	58	179	595
45	Sugden*	Canada	180	85	49	100	180	594
46	Hauenstein	Switzerland	100	51	180	118	141	590
47	Hammer	Germany	104	107	27	168	168	574
48	Hermes*	U.S.A.	102	72	180	90	127	571
49	Willis	Great Britain	130	100	180	54	107	571
50	Buiter	Holland	149	70	141	73	120	553
51	Severs	Holland	127	60	109	180	75	551
52	Fontaine	France	93	41	162	105	150	551
53	Wastl	Austria	159	94	125	86	55	519
54	Caprara	Italy	112	79	108	100	118	517
55	Hasegawa*	Japan	172	143	48	44	110	517

56 ...	Roberts	Great Britain	105	54	124	123	105	511
57 ...	Czepa	Austria ...	129	92	—	142	145	508
58 ...	Petit	Belgium ...	180	61	34	129	82	486
59 ...	Karp*	Israel ...	39	58	180	31	178	486
60 ...	Hartill*	U.S.A. ...	180	68	55	127	51	481
61 ...	Howlett*	New Zealand	89	108	64	98	93	452
62 ...	Exell	Austria ...	40	43	144	180	40	447
63 ...	Yllan	Spain ...	116	126	59	140	—	441
64 ...	Aubertin	Monaco ...	58	180	59	53	81	431
65 ...	Frederiksen	Denmark ...	84	65	62	135	57	403
66 ...	Moulton*	U.S.A. ...	—	39	180	41	132	392

(* denotes Proxy flown)

TEAM RESULTS

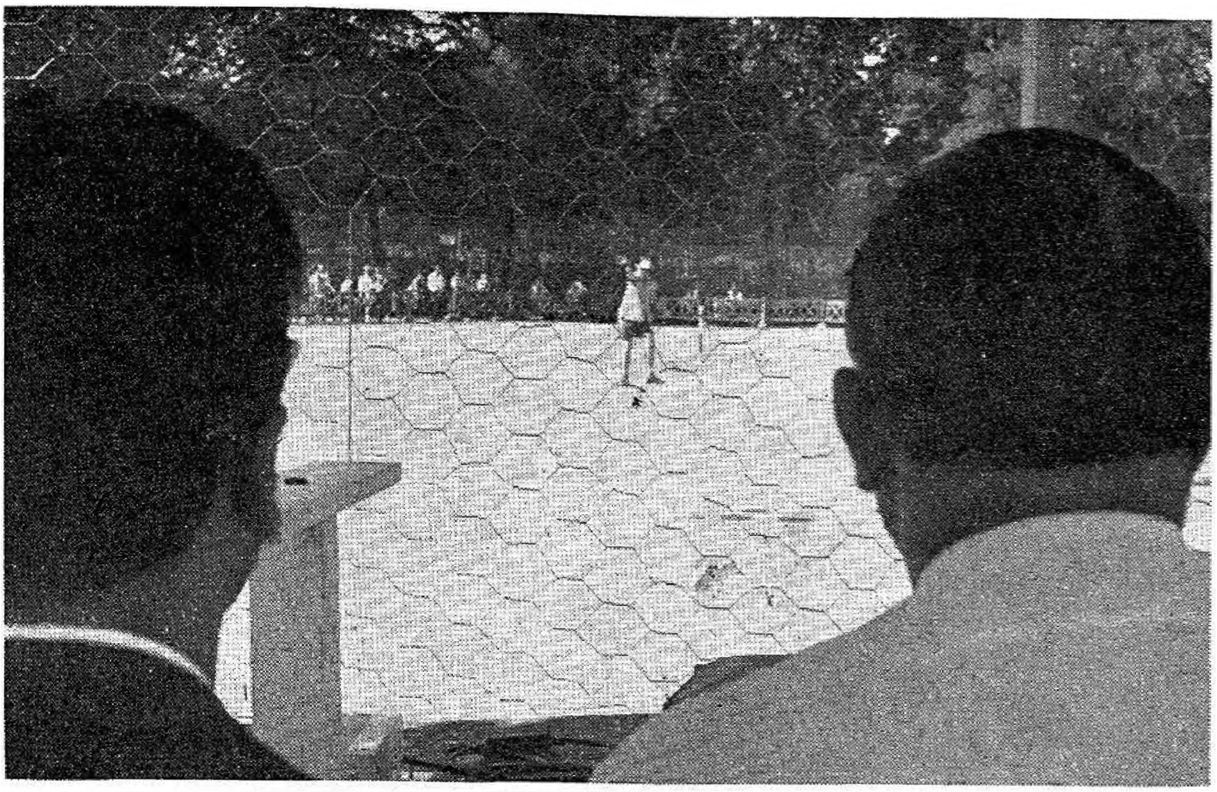
1 Czechoslovakia 2380
2 Sweden ... 2293
3 Switzerland ... 2233
4 Hungary ... 2211
5 Belgium ... 2205
6 Denmark ... 2201
7 New Zealand 2165
8 Germany ... 2160
9 Great Britain 2071
10 France ... 2060
11 Canada ... 2050
12 Holland ... 1997
13 Italy 1953
14 Japan ... 1804
15 Austria ... 1733
16 U.S.A. ... 1680



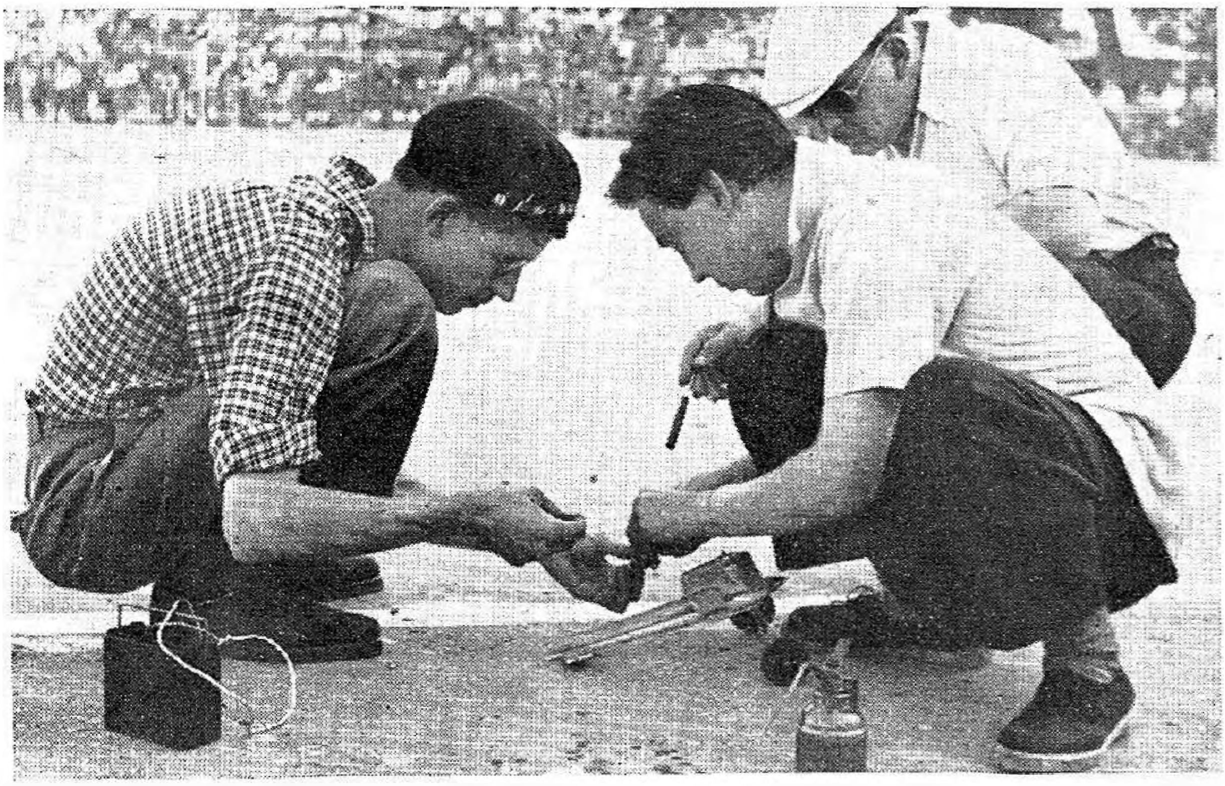
WORLD CONTROL LINE SPEED CHAMPIONSHIPS

Held at Florence, Italy, October 1st, 1956

No.	Name	Country	Engine	k.p.h.	m.p.h.
1 ...	Gibbs	Great Britain ...	Carter	211	131·1
2 ...	Vitkovics	Hungary	BRMV	205	127·4
3 ...	Cellini	Italy...	B.40	200	124·3
4 ...	Smejkal	Czechoslovakia ...	MVVS	196	121·8
5 ...	Batllo	Spain	G.20	195	121·2
6 ...	Prati	Italy	G.20	194	120·5
6 ...	Sladky	Czechoslovakia ...	S.K.	194	120·5
6 ...	Zatocil	Czechoslovakia ...	MVVS	194	120·5
6 ...	Vydra	Czechoslovakia ...	MVVS	194	120·5
10 ...	Gogorcena ...	Spain	G.20	193	119·9
11 ...	Beck	Hungary	BRMV	191	118·7
12 ...	Fernandez ...	Spain	G.20	188	116·8
13 ...	Jaaskelainen ...	Finland	G.20	186	115·6
14 ...	Berselli	Italy	G.20	185	115·0
15 ...	Monti	Italy	G.20	184	114·3
15 ...	Wright	Great Britain ...	Carter	184	114·3
17 ...	Yllan	Spain	G.20	180	111·8
18 ...	Krizsma	Hungary	Alag VI	179	111·2
18 ...	Jarry-Desloges ...	France	Jarry Vega	179	111·2
20 ...	Rosenlund ...	Sweden	G.20	177	110·0
21 ...	Labarde	France	Jarry Eega	173	107·5
22 ...	Horvah	Hungary	Torp. 15	171	106·3
23 ...	Gorziza	Germany	G.20	166	103·1
24 ...	Puschel	Germany	O.S. 15	162	100·7
25 ...	Frohlich	Germany	G.20	160	99·4



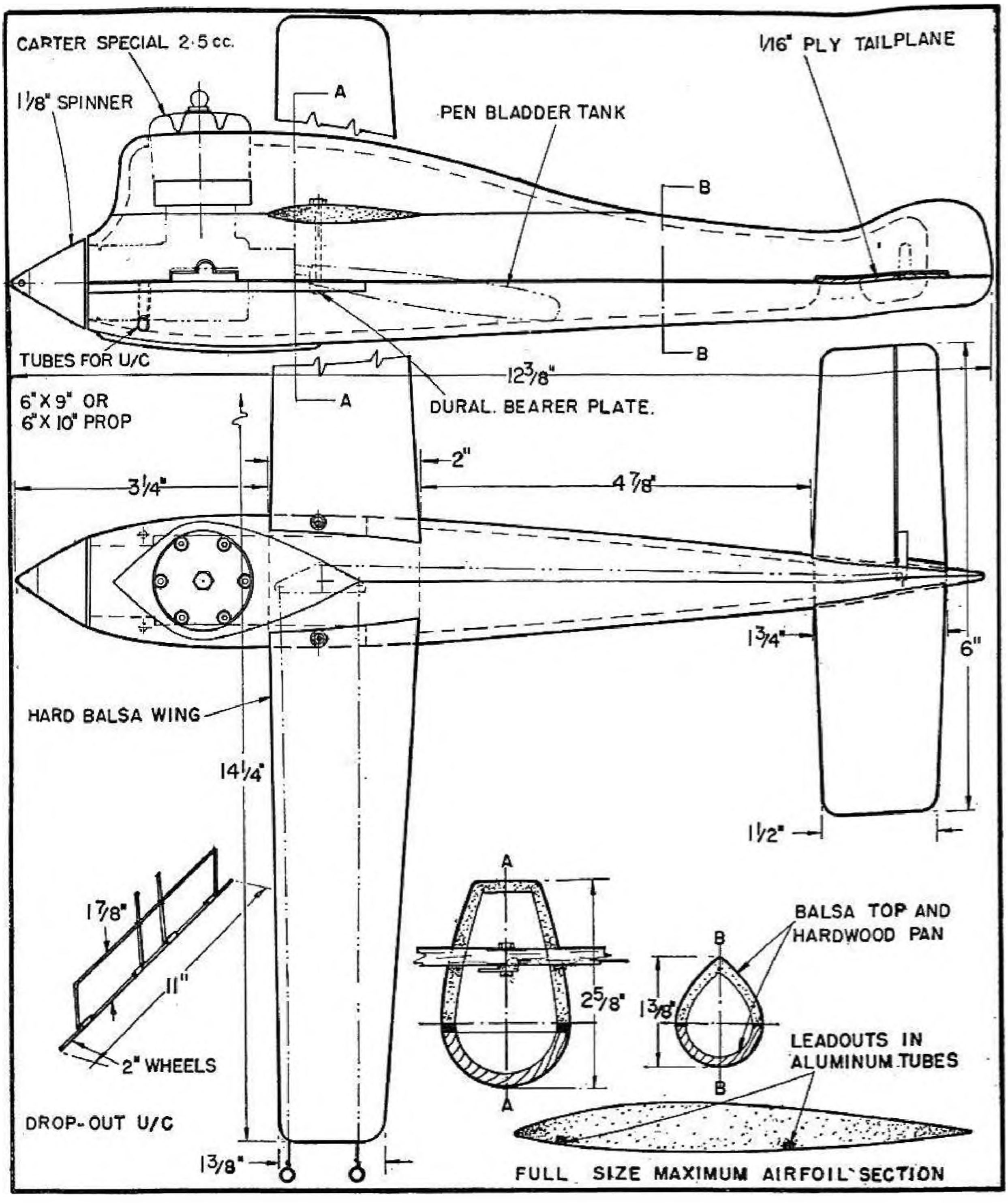
Cages—officials, for the use of : Both timekeepers and spectators were well protected by a formidable barrier of wire netting whilst the speed kings held court in the centre of the plaza. Page 71 : Ray (Gadget) Gibbs appears well pleased with his winning efforts.



26 ...	Schafer	Germany	Webra-glow	158	98·8
27 ...	Hie	France	Webra M. 1	142	98·2
28 ...	Deligne	Belgium	G.20	159	88·2

TEAM RESULTS

1	Czechoslovakia	584	3	Spain ...	576	5	France ...	510
2	Italy	579	4	Hungary ...	575	6	Germany ...	488



The Gibbs/Carter combination of flier and engine tuner have worked so well together in recent years that they provide formidable opposition to any in the world of control-line speed.

At present Gibbs holds three of the six British Speed records as follows :

Class II (2.5 c.c.)	129.3 m.p.h. (208 k/hr.)
Class IV (5c.c.)	146.2 m.p.h. (235 k/hr.)
Class VI (10 c.c.)	159.7 m.p.h. (257 k/hr.)

The Class IV British record also forms the International Class II record, whilst Gibbs holds the International Class I record with a speed of 225 k/hr., set up during the evening of the Speed Championships described on the preceding pages.

The model shown above is the holder of the 129.3 m.p.h. record.

HANDLING A NEW ENGINE

Any engine is far easier to operate on a test bench than when installed in a model, because it can be mounted rigidly and in the best position for access to the controls, etc. Preliminary bench running is also necessary both to get familiar with any individual characteristics of the engine, and to give it any necessary running-in time required to free it up. Then when the motor is subsequently installed in the model you both know how to handle it and can be confident that it will give a consistent performance. In the case of an engine to be installed in a speed model, running-in may be prolonged to bring the engine up to "peak" condition, and also to experiment with fuels, etc., for maximum power output.

All new engines are test run at the end of any manufacturing line. Quite commonly, however, they are tested on propellers different in size to those which will be used in service—usually a larger size of propeller so that the proving run is made only at a moderate speed. Starting may also be done with a mechanical drive rather than by hand. The actual amount of running time any individual production engine may have before being boxed and despatched to the shops generally varies between less than a minute to not more than three or four minutes at the outside. Individual engines of the same make are therefore likely to be purchased showing different degrees of "stiffness".

Stiffness in an engine due to the thickening of oil remaining on the surfaces during standing should not be confused with mechanical stiffness. You can only judge how stiff an engine is by squirting in a little fuel through the exhaust port and turning it over; or better still giving it a short run under power and then seeing how it feels. Motoring an engine without it firing—*e.g.*, coupling the shaft to an electric motor and letting the motor drive the engine—is not good practice. It is running the engine under quite artificial loading conditions and unless oil is continually fed onto the rubbing surfaces these can run dry and score. Motoring an engine with adequate lubrication and adding an abrasive to the oil with the purpose of "polishing" or rubbing down high spots can do nothing but harm. If persisted in it will probably destroy the piston-cylinder fit and ruin the main bearing. The only way to run in an engine is to make it run under its own power.

It seems unnecessary to remark that the engine should be bolted or clamped down properly before attempting to run it—but so many people still continue to ignore this obvious requirement. The full complement of bolts should be used to hold the engine down (four usually, but two in the case of some of the smaller engines) and should be checked periodically to see that they have not vibrated loose.

Preferably erect a shield behind the engine to absorb fuel and exhaust spray, which might otherwise stain a wall. If noise is a deterrent against prolonged running of the engine in the workshop, fit up a silencer attached to the exhaust —see Fig. 1. This also enables a length of hose to be attached to the end of the silencer and led out of a suitable window to disperse exhaust fumes. In any case adequate ventilation should be provided in any room where engines are being run, if you are to avoid being half choked. You may like the smell of a potent glow or diesel fuel, but exhaust fumes will not do you any good.

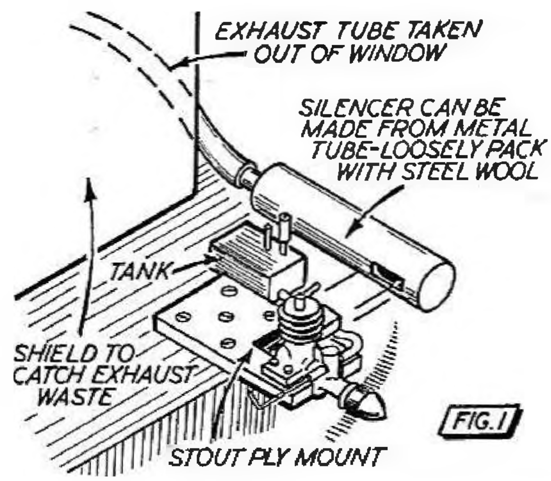


FIG. 1

For the first runs, select a propeller size which is slightly larger than one which would normally be used on a model—a size which will load the engine to about 10,000 r.p.m. A few runs with this will enable you to master starting technique without risking the "kick" which a high-powered engine can give on a smaller propeller ; and also give some indication as to the amount of running-in the engine is likely to require.

A stiff engine may tend to fade within half a minute's running on the first two or three attempts, but within half a dozen runs should run out a tank without faltering or slowing up unduly, unless exceptionally stiff. If it does continue to labour to a halt, feel the main bearing to see if it is overheating here. It is more difficult to judge cylinder overheating for most cylinders run hot in any case. The main bearing, however, should run cool at all speeds.

The usual cause of an engine slowing right up after a short run is a stiff piston-cylinder fit. This should not occur at moderate speeds unless the piston is very stiff. Stiffness in the main bearing—*e.g.*, a localised rubbing spot causing the bearing to overheat—is more likely to produce inconsistent running, as well as holding the speed of the motor down generally. You can try squirting fuel over the bearing to cool it when the engine is running to see if this makes any difference. If it does, you can only hope that more and more running will relieve this condition, which running should be done at high speed (*i.e.*, with a smaller propeller) to relieve the bearing of some load.

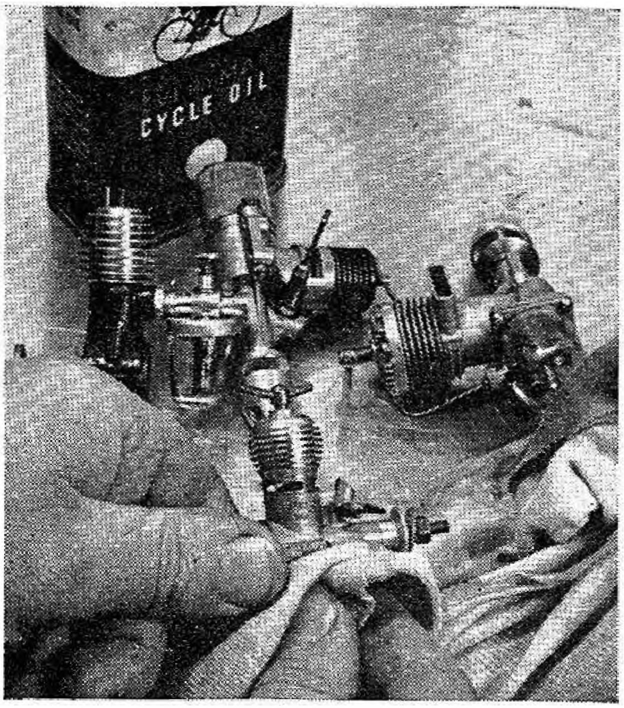
There is little point in trying to run a motor in gradually. As soon as you are confident about handling it, fit a propeller of the size you will eventually use on the model and continue running in on that, or even a slightly smaller propeller. In other words, running in, after an initial trial, is best done at the speed you intend to operate the motor, or even slightly above (but *not* above in the case of racing engines). All parts will then become bedded down under what will become normal operating conditions. The piston-cylinder fit is likely to be just as stiff at this speed after an hour or more running at some low speed than if the engine is brought up to this speed after a short preliminary run or two.

Although some people express doubts on this point, any *undue* stiffness on the part of the piston can be relieved rapidly, and without harming the engine, by injecting an abrasive, such as metal polish, in small quantities. Half a dozen drops in the intake as the engine is running, followed by a few more drops of neat oil (or abrasive mixed with oil) can make a world of difference. All the abrasive is washed out of the engine by the normal scavenging action and can be judged quite clear by the time that the exhaust oil no longer shows any signs of metallic grey colour.

Finger choking is very common with miniature diesel motors, whilst some require actual priming with fuel through the ports.

Using an abrasive when the engine is *not* running under its own power is a sure way of asking for a ruined engine. Also abrasive treatment should not be used on ball race engines ; engines with ringed pistons; or racing engines set up to close and *accurate* fits in the first place. Where the abrasive treatment is most effective is with ordinary run-of-the-mill engines which are, for some reason or other, too stiff initially to the point where running in is restricted to relatively short runs (due to the engine slowing and "seizing") over the first quarter of an hour or so. With a majority of engines it is quite unnecessary to adopt such action which is, after all, a little on the drastic side. But metal polish can be a great help in running in a sports type engine quickly.

Running in time for an average plain bearing set up with a fairly loose bearing initially need only be a matter of five or ten minutes actual running time (at the required operating speed). The same generalisation is true of most ball bearing engines. Where a manufacturer states that an hour or so's running-in time should be given, then performance can be expected to improve slightly over this period, although consistent running may or may not be achieved right away. Normally an engine is considered ready for use (*i.e.*, installation in a



After-care of engines is most important, not least being the thorough cleaning down of all get-at-able parts as soon as possible after running.

model) when it will hold a consistent load-speed of the right order for a satisfactory duration. In other words, when it will turn your "flight" propeller at a consistent speed, without falling off in power, for the duration of a full tank. At the end of this run the bearing should feel quite cool.

It is normally easy to judge whether or not an engine is slowing up and losing power by the change in exhaust note—although listening to the sound of the engine is no reliable judge of its *actual* r.p.m. A standard rev. counter can, of course, be used for accurate r.p.m. measurement (bearing in mind that with the smaller engines, in particular, this will put an extra load on the shaft and slow the engine). A reed type tachometer is accurate enough for general bench testing.

A crude, but quite effective, reed-type tachometer can be made as shown in Fig. 2, from two pieces of hardwood strapped together with rubber bands and a length of 20 s.w.g. wire. The graduations shown are approximate only, but are accurate enough in a comparative sense.

With a tachometer, an engine can be "measured" during running-in on the basis that when it will hold a *consistent* speed with any propeller it is "run-in" well enough to operate at that speed. The particular engines which benefit from fairly protracted running-in will show a gradual improvement in r.p.m. achieved with a particular propeller. When the point is reached where further running time does not result in any increase in r.p.m. with that particular propeller, there is little or nothing to be gained in giving it further bench running time with that size of propeller.

Care of Your Engine in Use

It is important that your engine be mounted securely in a model, with bolts properly tightened and the motor mount as rigid as possible. Where every little bit of extra power counts, as in a speed control line model, it is an advantage to have the crankcase fitting snugly against the speed pan, both to assist in heat dissipation and to support the crankcase against possible distortion. On other models this is not important, but in all cases vibration should be reduced as far as possible.

No abrasive whatever should be allowed in an engine after it has been run-in—and dirt and dust particles are abrasive ! This means that for maximum life from an engine only clean fuel should be used (filtering the fuel before use if there is any possibility of it being dirty). If an engine gets covered in dirt following a crash, it should be cleaned as far as possible before attempting to turn the shaft over to see if the engine is damaged.

There is little call for the average owner to take an engine apart. If this is attempted for any reason, only the right size and type of screwdriver should be used for removing screws, a proper spanner (not pliers) for removing a glow plug, and so on.

In reassembling, the cylinder or cylinder liner and the piston should be replaced in the same position they were initially, so that they fit together again in exactly the same way as they were run-in. If necessary, mark these components before you take them off to make sure that you do get them back the same way. In the case of engines with deflectors on the piston, getting the piston or liner back the wrong way round will affect the whole timing of the engine.

On engines where the cylinder liner is held down by a jacket secured with screws through the head, excessive tightening of these screws can distort the liner, which will cause loss of power or erratic running. The same effect will be produced by head screws which are too loose. An engine which refuses to "suck", or runs badly, may be suffering from a gas leak, due to loosening of assembly screws through vibration.

New engines are not normally run-in on racing type fuels, since this is both unnecessarily expensive and the fuel may contain only a marginal proportion of lubricant. However, a racing engine may only run satisfactorily on a "doped" fuel, when a fuel of racing proportions must be used, preferably with the lubricating oil content boosted by at least 10 per cent. The compression ratio of a glow motor—and particularly a racing type engine—is often closely balanced to a particular fuel mixture (*i.e.*, nitromethane proportion), and may have poor starting or running characteristics on a "straight" fuel. Diesels are considerably more flexible in this respect and will run on a wide variety of fuels, provided these contain a satisfactory proportion of lubricant. The addition of amyl nitrate or nitrite normally improves starting characteristics and a nitrated fuel can be used from the first run. It is quite unnecessary—and can be harmful—to increase the proportion of ether in a commercial fuel, under the impression that this will make a new engine start easier and run cooler.

The use of colloidal graphite in the fuel as a running-in compound has been tried in the past but has seldom yielded worthwhile results to compensate for the greater messiness of the exhaust waste. Possibly a new engine run extensively on a graphited fuel would eventually show some benefits, but tens of hours of running time would be necessary to achieve any definite advantage. Ordinary mineral, vegetable and synthetic oils as used in present day commercial fuels are normally perfectly satisfactory without further additives.

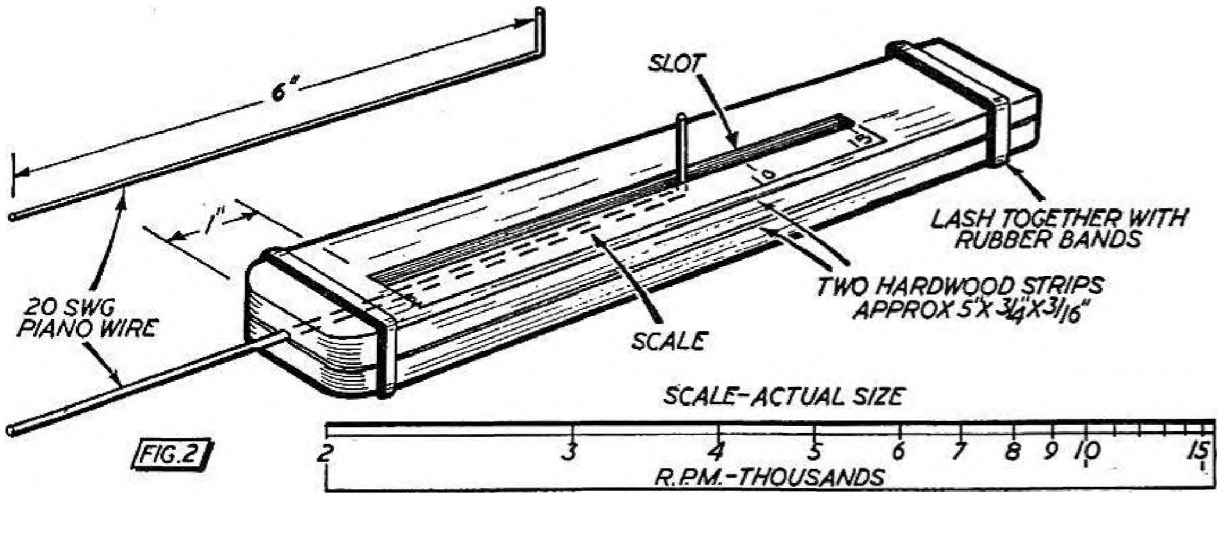
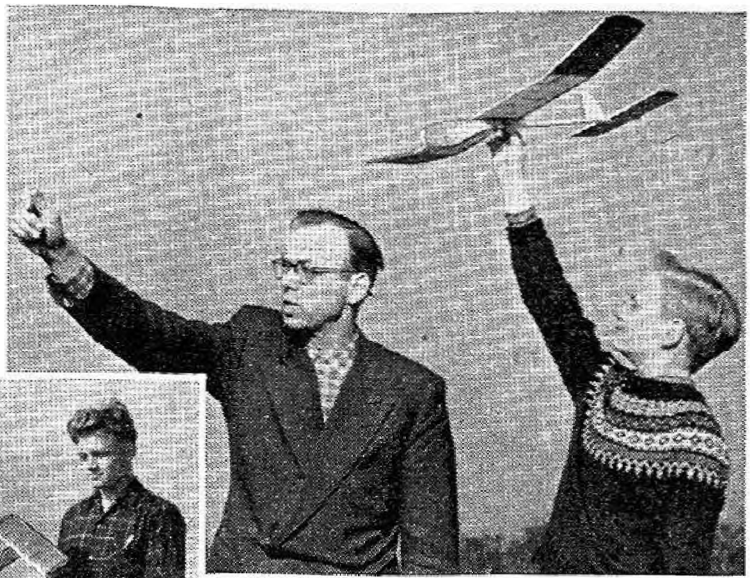
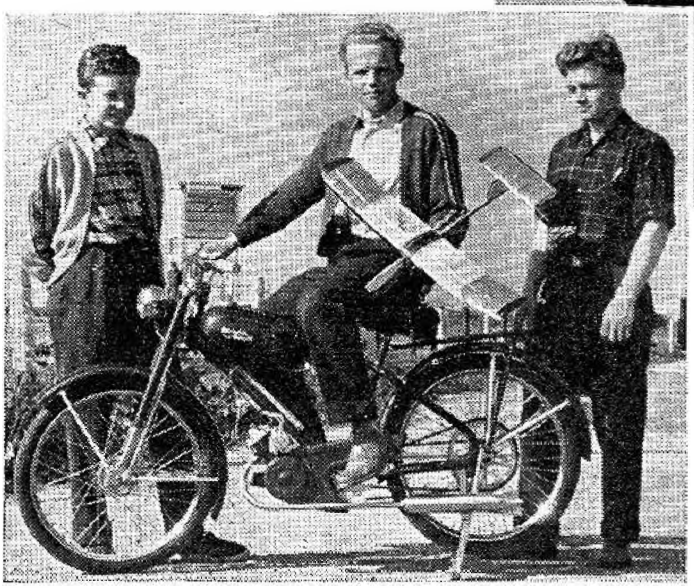


FIG.2



Knud Hansen, a pioneer Danish aeromodeller, teaches his son the correct handling of his "Tops" model. Below is seen proud winner Kristian Skovlyst with the Diesella motor cycle won by his top performance in the contest, totalling 423 seconds for the five rounds.



"TOPS"

★

A simply constructed model to the increasingly popular A/I specification, as developed by the Royal Danish Aeroclub.

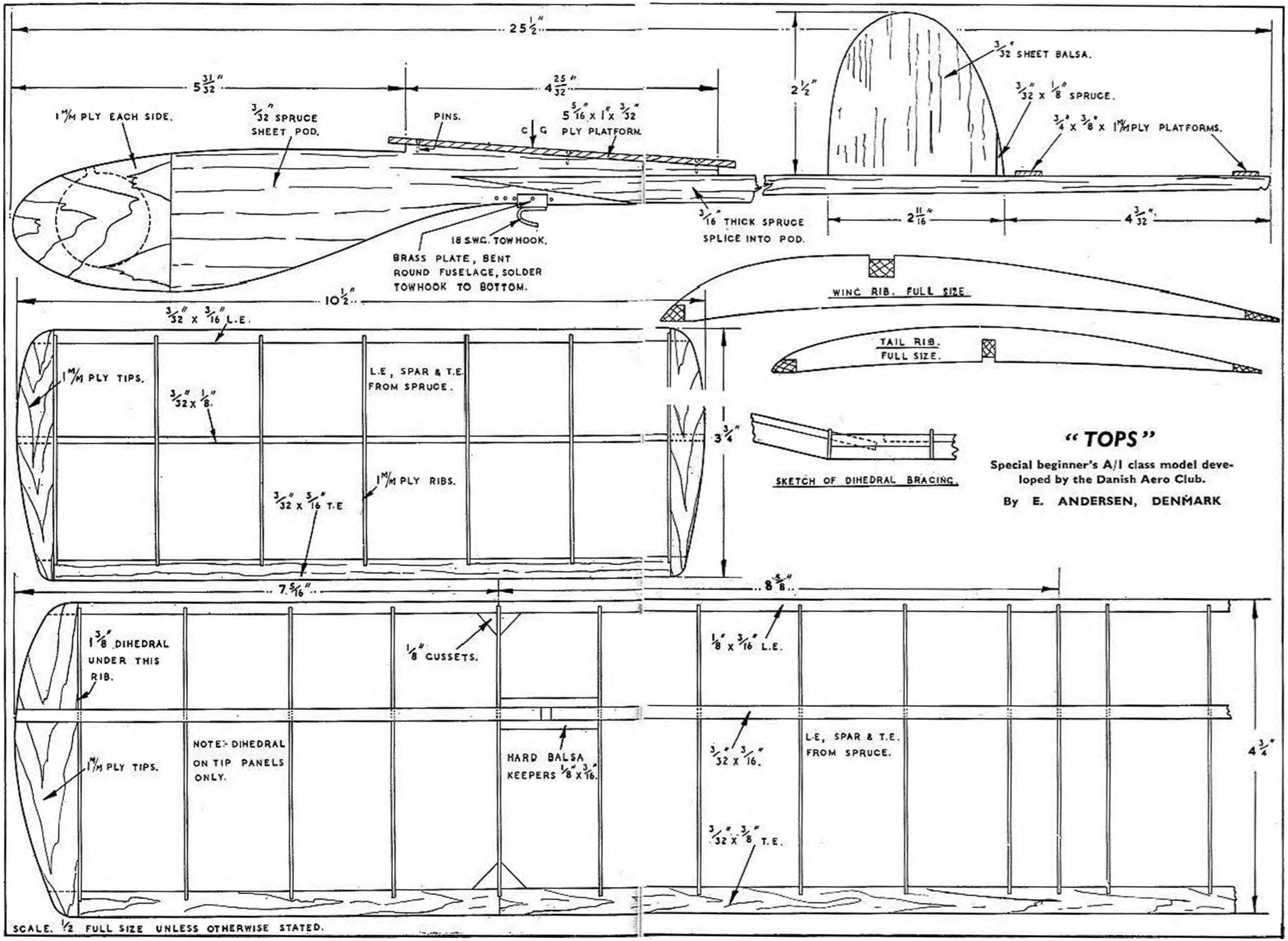
★

In an endeavour to encourage aeromodelling among the motor cycle-keen young people of Denmark, the Royal Danish Aeroclub organised a special contest in which boys built models to a standard specification, and, via a series of elimination events culminating in a centralised contest, competed for a motor cycle as first prize. Ten boys were invited to Odense, all between the ages of 12 and 20, only one of whom had had previous contest experience.

The contest was flown under F.A.I. rules, but without the allowance of a reserve model. Though the first round showed up the inexperience of the contestants, fine weather helped the modellers to put on a very closely contested event, eventual winner being Kristian Skovlyst of Herning, Jutland, followed by Jorgen Olsen of Copenhagen and Benny Busted of Arhus. The winner totalled over a minute more than his nearest rival.

Construction of the model shown overpage follows usual Scandinavian practice in employing hardwoods to a greater extent than in most countries. Their use produces a very robust model that will stand an enormous amount of hard flying, and the specified materials should be adhered to where possible, but quite successful models will result from the use of hard balsa, etc. However, we do advise hardwood for the stick fuselage.

(With acknowledgements to the Royal Danish Aeroclub)



"TOPS"

Special beginner's A/1 class model developed by the Danish Aero Club.

By E. ANDERSEN, DENMARK

YOUR POWER PROP

THE PRESENT day commercial engine—diesel or glow—is more than powerful enough for average requirements. It does not, therefore, usually matter if it is used to drive a propeller of badly matched size, or one which is relatively inefficient, except on models where maximum performance is a necessity. Often, in fact, the use of an inefficient, or relatively inefficient propeller on a sports model is a good thing in "taming" an engine and so avoiding a lot of trimming troubles. A notable exception is that of the smallest sizes of motors—half c.c. or under—where engine efficiency is lower and power output may be marginal for getting a model to fly at all. Then the choice of the right propeller may make all the difference. On contest models, and particularly control line speed models, choice of the right propeller for the job may be the most important single factor in the whole set-up.

It is a well known fact that an engine develops maximum or "peak" power at a certain speed. Run below that speed it is not giving all the power that could be extracted from it. At a higher speed than the peak, although its actual r.p.m. is higher, the *available* power is lowered by the extra power absorbed internally by friction. Virtually the only way of controlling the speed at which an engine runs is by the size of the propeller fitted.

The apparent solution, then, is to select a propeller size which will load the engine to just that amount necessary for the r.p.m. figure to correspond to the peak point on the power curve—the latter figure being established by tests under varying loads to arrive at a plot of graph of power output *versus* r.p.m. There is no dearth of data on this latter subject and power curves of most of the current production engines have been published in the "AEROMODELLER" and elsewhere. These are generally typical of all engines of a particular make or model.

Unfortunately static power tests assess the performance of an engine under somewhat artificial conditions. The most marked difference is that when an engine is fitted into a model and operated under flight conditions the propeller is unloaded to a certain extent (depending on the speed of the model), and thus the engine speeds up. The faster the model flies the greater this unloading, so that there can be a considerable difference between static r.p.m., as readily measured with a given propeller size, and the operating r.p.m. in flight. It may be a matter of 1,000 r.p.m. or so on a free flight model, and perhaps 4,000-5,000 r.p.m. on a control line speed model. The flight r.p.m. cannot be measured and there is little definite check that can be made on such figures.

Quite obviously, however, if the propeller size is selected to give a static r.p.m. figure corresponding to peak r.p.m. the engine will operate beyond its peak in flight, and so not develop its maximum power output. Hence a propeller size is selected to give a static r.p.m. figure somewhat below the desired operating r.p.m.

Static power tests can, in fact, be misleading, particularly in assessing the relative merits of "racing" diesels and glow engines as used in control line speed models. The diesel will commonly show up much better on static test than its glow equivalent but is beaten in the air by an (apparently) less powerful engine. Largely this is because the latter type has to peak at a much higher speed to achieve maximum specific power output, which it can readily do when the high pitch propeller is unloaded in the air. With the more heavily constructed diesel the peak r.p.m. is lower and boosting power by pushing the peak farther along the r.p.m. scale aggravates vibration problems. Vibration means power loss and so the diesel begins to lose out once you get into the range of "racing" speeds *in a model.*

The chief criteria with a control line speed model are propeller pitch and operating r.p.m. Table I gives data closely approximating to actual results achieved in practice, from which a selection can be made of the propeller pitch required to achieve a desired speed with a particular engine. If the engine peaks at 16,000 r.p.m. for example, it will need a 10 in. pitch propeller to achieve 130 m.p.h. With an 8 in. pitch propeller it cannot be expected to do more than 105 m.p.h. With a 12 in. pitch propeller it could be 155 m.p.h.—if it could turn the propeller at that speed. In fact, whatever propeller pitch is selected, the choice is invalid *if* the engine cannot achieve peak r.p.m. with it in flight.

Theoretically, at least, the geometric pitch of a propeller does not affect the power absorbed by the propeller under flight conditions, if the flight speed can increase with propeller pitch so that the angle of attack of the blades is the same. Increasing the pitch of a propeller on static r.p.m. tests, on the other hand, results in a marked increase in loading and loss of speed.

The limitation to increasing the flight speed of the model "in step" with increasing propeller pitch is the overall drag increasing as (the square of) the speed. To overcome this increase in drag the propeller must develop more thrust. The limitation to r.p.m. achieved with a particular propeller in flight is the diameter size and blade area and thickness, of which the diameter is the chief factor. Torque absorbed by a propeller is proportional to the fifth power of the diameter.

Thus trimming the diameter of a propeller will increase the operating r.p.m., but at the expense of loss of thrust. Reducing the blade area is another method of decreasing the power absorbed by the propeller, again accompanied

TABLE I.—PROP. PITCH/SPEED RELATIONSHIP

"In flight" r.p.m. given for different speeds and different pitches

Speed m.p.h.	PROPELLER PITCH (inches)										
	2	3	4	5	6	7	8	9	10	11	12
30	18,750	12,500	9,375	7,500	6,250	5,400	4,700	4,200	3,750	3,400	3,125
40	25,000	16,660	12,500	10,000	8,330	7,150	6,256	5,600	5,000	4,550	4,166
50	31,250	20,800	15,625	12,500	10,400	9,000	7,812	7,000	6,250	5,700	5,208
60	37,500	25,000	18,750	15,000	12,500	10,700	9,500	8,400	7,500	6,800	6,250
70	43,750	29,000	21,875	17,500	14,600	12,500	11,000	9,750	8,750	8,000	7,292
80	50,000	33,000	25,000	20,000	16,666	14,300	12,500	11,000	10,000	9,100	8,333
90	—	37,500	28,125	22,500	18,750	16,000	14,000	12,500	11,250	10,250	9,375
100	—	41,500	31,250	25,000	20,800	17,800	15,625	14,000	12,500	11,400	10,417
110	—	46,000	34,375	27,500	23,000	19,700	17,000	15,400	13,750	12,500	11,458
120	—	50,000	37,500	30,000	25,000	21,500	18,750	16,700	15,000	13,600	12,500
130	—	—	40,625	32,500	27,000	23,200	20,300	18,000	16,250	14,800	13,542
140	—	—	43,750	35,000	29,000	25,000	22,000	19,500	17,500	16,000	14,583
150	—	—	46,875	37,500	31,250	27,000	23,500	21,000	18,750	17,000	15,625
160	—	—	50,000	40,000	33,300	28,600	25,000	22,250	20,000	18,200	16,666

by a loss of thrust. Thinning the propeller blades is a method of reducing propeller drag without seriously reducing the thrust, if at all. To get both the operating speed and the thrust required, first requirement is therefore a thin propeller blade section, followed by trimming down the diameter, as necessary, to arrive at the correct operating r.p.m. in flight—the peak power r.p.m. of the engine being used.

If the model will not achieve the design speed—then either the propeller is not letting the engine speed up to peak r.p.m. or it is not generating enough thrust to balance the overall drag at that design speed, or both. If the thrust is only sufficient to balance the drag at some lower speed then the propeller is over-pitched for that speed. Consequently the effective angle of attack of the blades is higher, absorbing more power and slowing up the engine. About the only answer in such a case is to reduce the pitch of the propeller.

Another basic difference between diesels and glow motors to be borne in mind is that the performance of the former can be improved only up to a certain point by "hot" fuels—*e.g.*, by the addition of "dope" in the form of amyl nitrite or amyl nitrate. A glow motor, on the other hand, is much more flexible and performance can be boosted effectively by increasing proportions of nitromethane and similar "dopes", and if necessary adjusting the compression ratio and type of plug to suit. Thus the final balance is achieved by matching engine, propeller and *fuel* to achieve the required performance.

With other types of control line models, although the requirements may be less exacting, propeller pitch is still more important than diameter, as a general rule. High speed is desirable in a combat model, without sacrificing thrust, and so to have an excess of thrust available for sharp manœuvres a

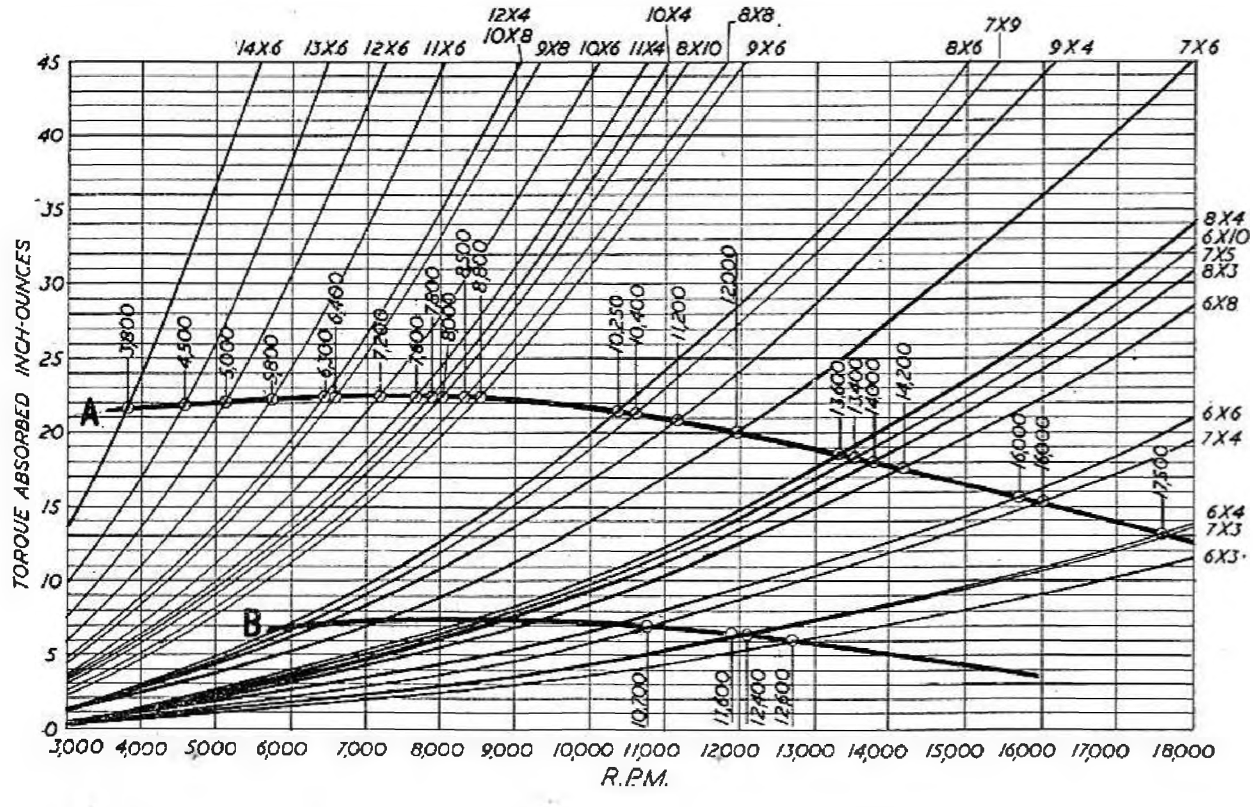


Fig. 1.—Two typical torque curves superimposed on a set of power-absorption curves for Trucut propellers. Curve A is of a racing type 2.5 c.c. diesel. Curve B is of a sports type 1 c.c. diesel. Where the torque curves cut the propeller curves, the corresponding r.p.m. figure is the speed at which that particular engine should drive that propeller. Actual measured r.p.m. figures are shown on the graph for comparison of theory and practice.

diameter size is usually selected on the generous side and some pitch sacrificed as a consequence. Team racers can approximate more closely to speed model requirements, but maximum fuel economy for a particular engine should be

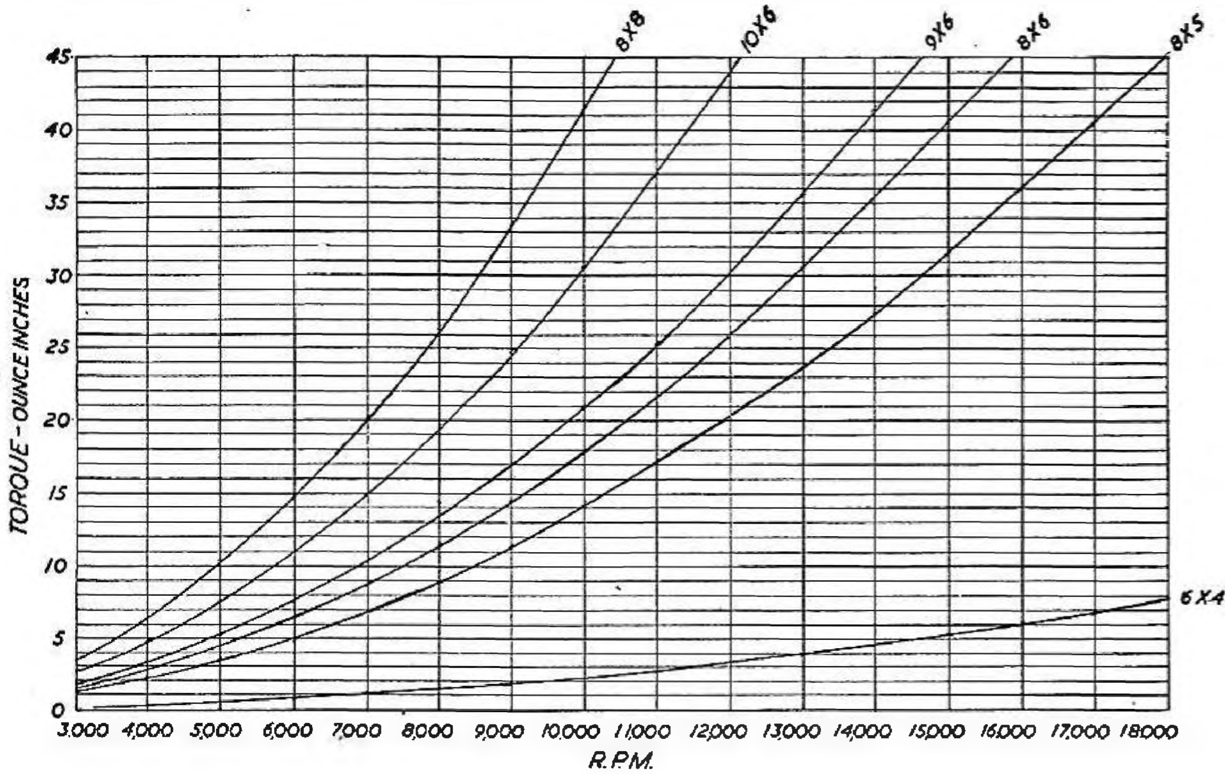


Fig. 2.—Prop./torque curves for the Frog Nylon propellers.

realised by balancing pitch against flying speed on the lines of the figures in Table I.

Small control line models flown on the "baby" size of engines commonly lack thrust, usually because the engine speed is held down by the wrong size of propeller. Either the diameter is too large (with low pitch) or the pitch too high to achieve a normal flying speed of 30-40 m.p.h. with the operating speed of the engine at 13,000-14,000 r.p.m. (which is about the normal peak for small engines). The table figures still apply for setting on a probable pitch size, with the diameter then selected (or trimmed) to give the required r.p.m.

For free flight models, as a general rule, almost the reverse is true. If maximum performance is the aim, a propeller size to give maximum thrust is required, which does not necessarily correspond to the engine operating at peak r.p.m. There appears to be appreciable scale effect or loss of efficiency with decreasing diameter, so that often a larger diameter size (with relatively low pitch) which loads the engine to run *below* its peak r.p.m. will develop maximum thrust. This appears to be particularly true in the case of the smallest diesels. With small glow motors high speed operation is essential, calling for very fine pitch propellers.

However, the basic criterion can again be pitch, selecting a relatively low pitch and using the largest possible diameter size consistent with maximum performance. For example, standardising on a pitch of, say, 4 inches for a 2·5 c.c. diesel, try flight testing on increasing diameter sizes of this pitch until a size is reached where there is a definite fall off in performance (*e.g.*, climb). Then either use the next largest diameter, or re-work the "maximum diameter"

PROPELLER SELECTION TABLE

These data do not necessarily apply to any specific engine within the class sizes indicated, but are intended as a general guide as to the r.p.m. figures likely to be achieved with the commercial propellers listed. Omission of a particular size of propeller from the list does not imply that it is unsuitable, merely that no test data are available on this particular size.

Size and Type of Engine	STATIC R.P.M. RANGE						
	8,000-10,000	10,000-11,000	11,000-12,000	12,000-13,000	13,000-14,000	14,000-15,000	15,000-16,000
5 c.c. Diesel	Trucut 12×4 10×8 9×8 10×6 11×4 Stant 10×6 Frog Nylon 8×8	Trucut 10×4 8×10 8×8 9×6 Stant 9×9 (TR) 9×8 Frog Nylon 10×6	Stant 8×9 (TR) 8×8	Trucut 8×6 Stant 10×5 9×6 Frog Nylon 9×6	Trucut 9×4 7×9 Frog Nylon 8×6 Stant 9×4 8×8 7×9 (TR) 8×6	—	—
5 c.c. Racing Glow	—	—	Trucut 8×8 9×6 Stant 8×9 Frog Nylon 10×6	Stant 8×9 (TR) 8×8	Frog Nylon 9×6 Stant 10×5 9×6	Trucut 8×6 7×9 9×4 Frog Nylon 8×6 Stant 9×4 8×8 7×9(TR) 8×6	—
3·5 c.c. Sports Diesel ...	Trucut 10×6 11×4 10×9 8×10 8×8 9×6 Stant 10×6 9×9 (TR) 9×8 Frog Nylon 8×8 10×6	Stant 8×9 (TR) 8×8	Trucut 8×6 7×9 Frog Nylon 9×6 8×6 Stant 9×6 10×5 9×4 8×8 7×9 (TR)	Trucut 9×4 7×6 Frog Nylon 8×5	Stant 8×5	—	—
High Performance 2·5 c.c. Diesel	Trucut 8×8 8×6 9×6 Stant 8×9 (TR) 8×8 Frog Nylon 10×6	Trucut 8×6 7×9 Frog Nylon 9×6 8×6 Stant 9×6 10×5 9×4 8×8 7×9 (TR) 8×6	Trucut 9×4 7×6 Frog Nylon 8×5	Stant 8×5	Trucut 8×4 8×3 6×10 7×5 Stant 8×4 7×8 7×6	Trucut Stant 6×8	Trucut 6×6 7×4 Stant 7×4
Sports Type 2·5 c.c. Diesel	Trucut 9×6 8×6 Frog Nylon 10×6 9×6 Stant 8×8 (TR) 9×6 10×5 8×9 (TR) 10×4	Trucut 7×9 9×4 Frog Nylon 8×6 Stant 9×4 8×8 7×9 (TR) 8×6	Trucut 7×6 Frog Nylon 8×5 Stant 8×5	Trucut 8×4 6×10 Stant 7×8 8×4	Trucut 6×8 Stant 7×6	—	—

PROPELLER SELECTION TABLE—contd.

High Performance 1·5 c.c. Diesel	Trucut: 8×6, 7×9, 9×4, 7×6 Stant: 9×4, 8×5, 7×9 (TR), 8×6 Frog Nylon: 8×6, 8×5	Trucut: 8×4 Stant: 8×5	Trucut: 6×10, 7×5, 8×3, 6×8 Stant: 8×4, 7×8, 7×6	Trucut: 6×6 Stant: 7×4	Trucut: 7×4 Stant: 6×6	Trucut: 6×4, 7×3 Stant: 6×5	Trucut: 6×3 Stant: 6×4
Sports Type 1·5 c.c. Diesel	Trucut: 9×4, 7×6 Stant: 8×6, 8×5 Frog Nylon: 8×6, 8×5	Trucut: 8×4, 8×3, 7×5, 6×10, 6×8 Stant: 8×4, 7×8, 7×6	Trucut: 6×6 Stant: 7×4	Trucut: 7×4 Stant: 6×6	Trucut: 6×4, 7×3 Stant: 6×4	—	—
1 c.c. Diesel	Trucut: 8×4, 6×10, 7×5, 8×3, 6×8 Stant: 8×4, 7×8, 7×6, 7×5	Trucut: 6×6, 7×4 Stant: 7×4, 6×6	Trucut: 6×4, 7×3	Trucut: 6×3 Stant: 6×4	Trucut: 6×3	Frog Nylon: 6×4	
·75-·8 c.c. Diesel	Trucut: 6×8, 6×6, 7×4 Stant: 7×4, 6×6	Trucut: 6×4, 7×3 Stant: 6×5	Trucut: 6×3 Stant: 6×4	Trucut: 5×3 Frog Nylon: 6×9	—	—	—
15 c.c. Diesel and Glow Motors under 1 c.c.	Suitable sizes of propellers for the very small engines are strictly limited, and makers' recommendations should be adhered to. For control line work, .5 c.c. diesels generally operate best on a 4-5 in. pitch propeller, trimming the diameter as necessary to achieve high r.p.m. Small glow motors and very small diesels (under .5 c.c.) often give best results with 4-6 in. diameter metal (aluminium) propellers where the pitch angle can be adjusted by bending for best results.						

propeller by thinning the blades to recover the slight fall-off in performance.

There is an apparent exception to this rule. Some contest type power models which feature a vertical or near-vertical climb perform best on a relatively high pitch propeller (with diameter trimmed to get a high operating r.p.m.). Theoretically such a propeller is operating inefficiently in a vertical climb, but probably most of the work is being done by the *back* of the blades where the high angle of attack is effective in generating the thrust. This is something of a fallacy for a *vertical* climb does not give the *maximum* rate of climb with any type of power aeroplane; but this trim may well be adopted out of considerations of making the model stable under power.

Knowing the torque output of a particular motor (*e.g.*, from the torque-r.p.m. curve published in engine test reports) and having data on the power absorption characteristics of a given series of propellers, it is possible to predetermine engine speed with any particular propeller size. Such data, however, are not always consistent with practical results. Individual engine outputs may vary from standard figures obtained from a particular test engine; different fuels may affect engine performance ; and individual examples of propellers may vary slightly, all making for inconsistencies. There is a further practical consideration that there are "good" and "bad" propeller sizes for particular engines. For no apparent reason an engine which shows a marked power loss on a particular propeller size, or runs badly on it. Diesels, too, commonly run better on the heavier plastic propellers than wooden ones; whilst glow motors often run better on light wood propellers. Any selection of propeller size by charts must, therefore, be regarded as tentative only, subject to amendment following practical tests.

Fig. 1 shows a plot of torque absorbed by a set of Trucut wooden propellers against r.p.m. On this graph are also plotted two torque curves produced by engines on test. Where the torque curve for an engine crosses any particular

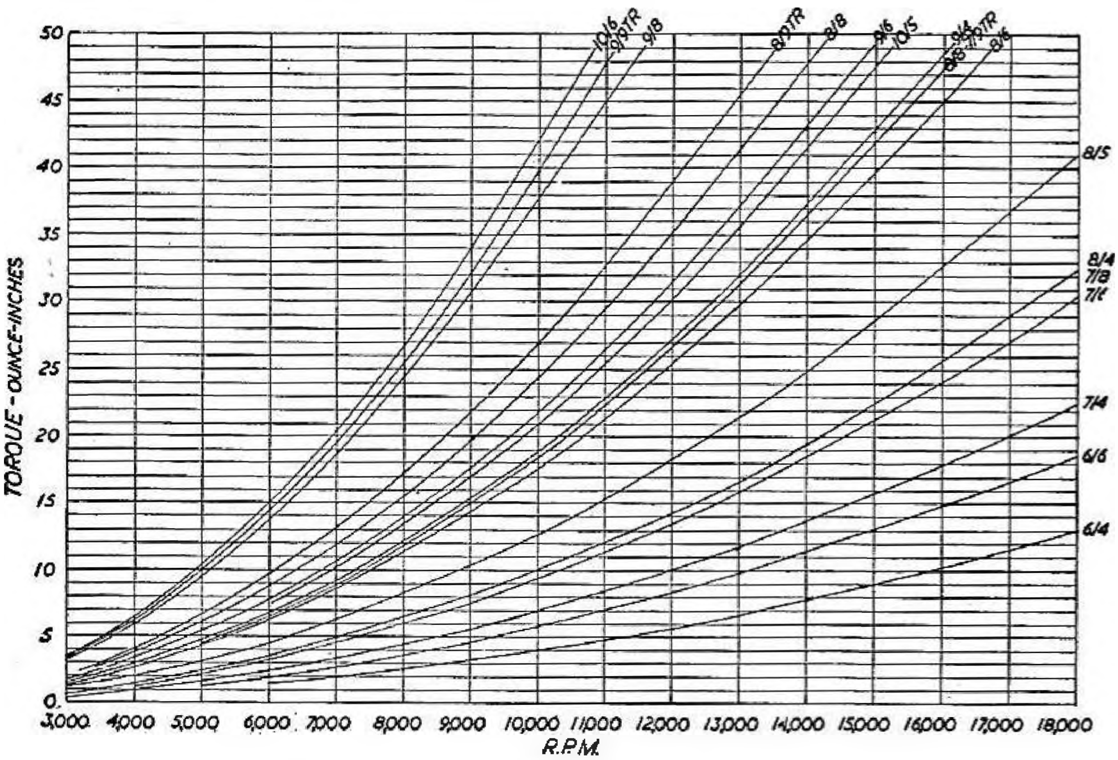


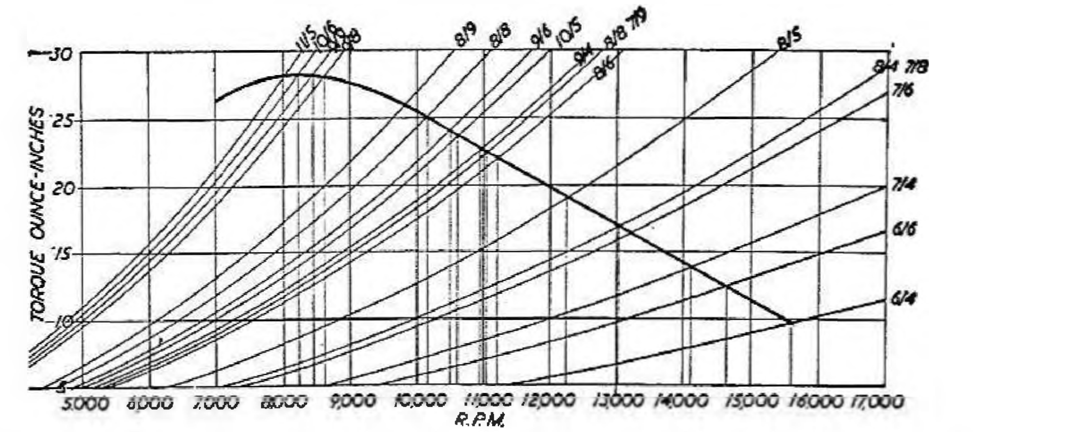
Fig. 3.—Prop./torque curves for Stant propellers.

propeller curve, that point should be the speed at which that engine will drive that particular propeller. All these data are based on static tests and therefore refer to static r.p.m. figures, such as would be obtained on bench running. Actual measured r.p.m. figures are shown on the graph showing that in these two cases agreement is quite good throughout.

Similar power absorption curves for other commercial propellers are given in Figs. 2, 3 and 4. These can be used in the same way, plotting on the torque curve of the engine you wish to analyse (or drawing this on tracing paper to lay over the propeller curves).

Figures for plastic propellers are rather less reliable since the actual geometry of these propellers can vary. Pitch can be different on different specimens of the same nominal size, one of which has been still hot when removed from the mould and the other allowed to cool down first. With thin bladed plastic propellers, static r.p.m. figures can be virtually meaningless for the blades may flex considerably whilst running, continually changing the loading,

Fig. 4.—Torque curves for Stant propellers are shown superimposed with a typical torque curve for a 2·5 c.c. engine. Intersection points traced down to base giving anticipated r.p.m. figures.



and thus the r.p.m. of the engine. In flight flexible propellers of this type seem to settle down to a consistent pitch setting under aerodynamic loading and then perform quite consistently. Thus only flight tests can establish if such a propeller is suitable for a particular model.

It will be seen from a study of the propeller curves that two different sizes of propellers often give the same, or nearly the same performance. In such cases, if the corresponding r.p.m. figure approximates to the required operating r.p.m. of the engine, the larger diameter size usually corresponds to a "free flight" propeller, and the larger pitch size to a control line propeller.

As a rough rule for making an allowance for the difference between static r.p.m. and actual operating r.p.m. in the air, add 10 per cent to the static r.p.m. to give flight r.p.m. on free flight models, and control line models where the propeller pitch used is not greater than 5 inches. For other control line model sizes, add 12½-15 per cent to the static r.p.m. to arrive at a flight r.p.m. figure.

The apparently unequal grading between regular "steps" in propeller sizes is due to the fact that pitch sizes quoted for commercial propellers are usually nominal and frequently differ by as much as 25 per cent from true or measured geometric pitch. Thus it does not follow that the same nominal sizes of different commercial series have the same pitch. This fact can be used to advantage to fill in "gaps" in one series with sizes from another series, if necessary.

A final point to bear in mind in selecting a propeller size for a free flight model. Anything that alters the engine r.p.m. (*e.g.*, a change in pitch or diameter) will also alter the power *trim* of the model, since it will alter the torque reaction compensated for in the original trim. This fact can also be put to advantage in power trimming, where maximum performance is not necessarily the aim, slowing the engine with a larger diameter (or pitch) propeller to promote a natural power-on turn to the left ; or using a propeller with less pitch or smaller diameter to assist a turn to the right.

MODELLING TIPS . . .

Before pouring molten lead into the nose of your next glider, build a lead foil lining into the weight box during construction. This insulates the balsa from the hot lead, eliminating fire hazard, and avoids the use of water for cooling—always a dangerous procedure. Kup-Kake foil is ideal. . . . To keep dust out of a 360 deg. exhaust system whilst sanding the cowl, etc., slip a piece of old cycle inner tube over the cylinder. Also useful for storing the model in the usual dusty atmosphere of a modeller's workshop.

TRACK THAT CLIMB

Some rate of climb research with smoke trails conducted by Peter Holland.

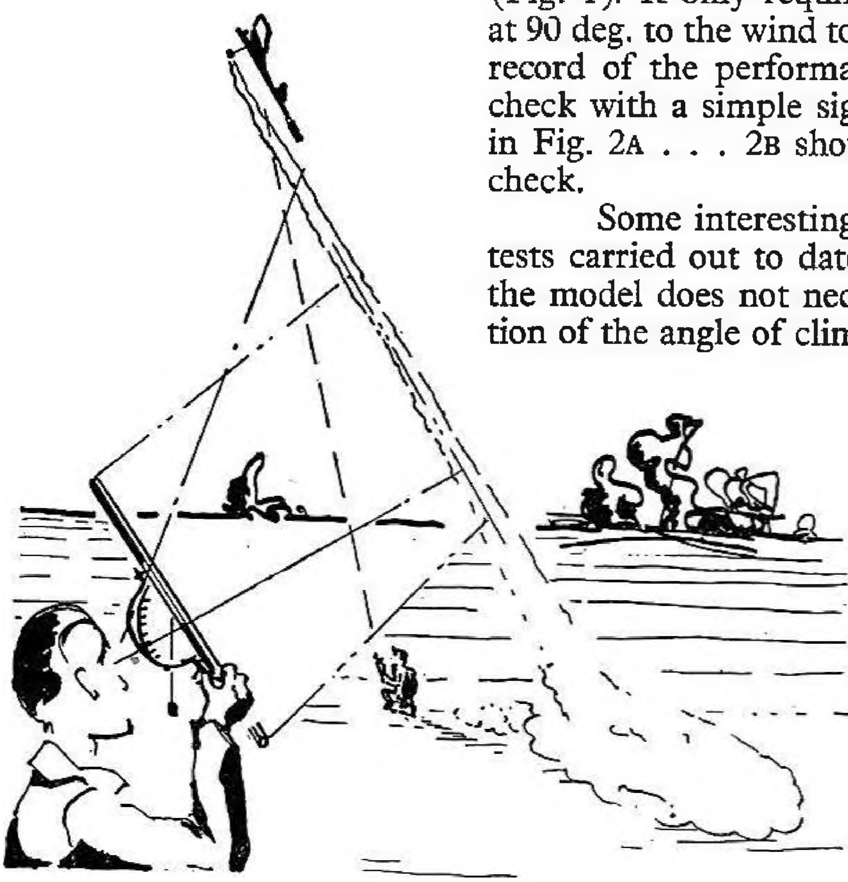
THE MODEL streaked skywards from the club field . . . "How's that for a vertical climb ?" its proud owner remarked. "Bet its about sixty degrees" was the sceptical retort. . . . There followed much hand waving, and adjectival comment, terminated only by an apologetic statement to the effect that the D/T had gone out just before launching !

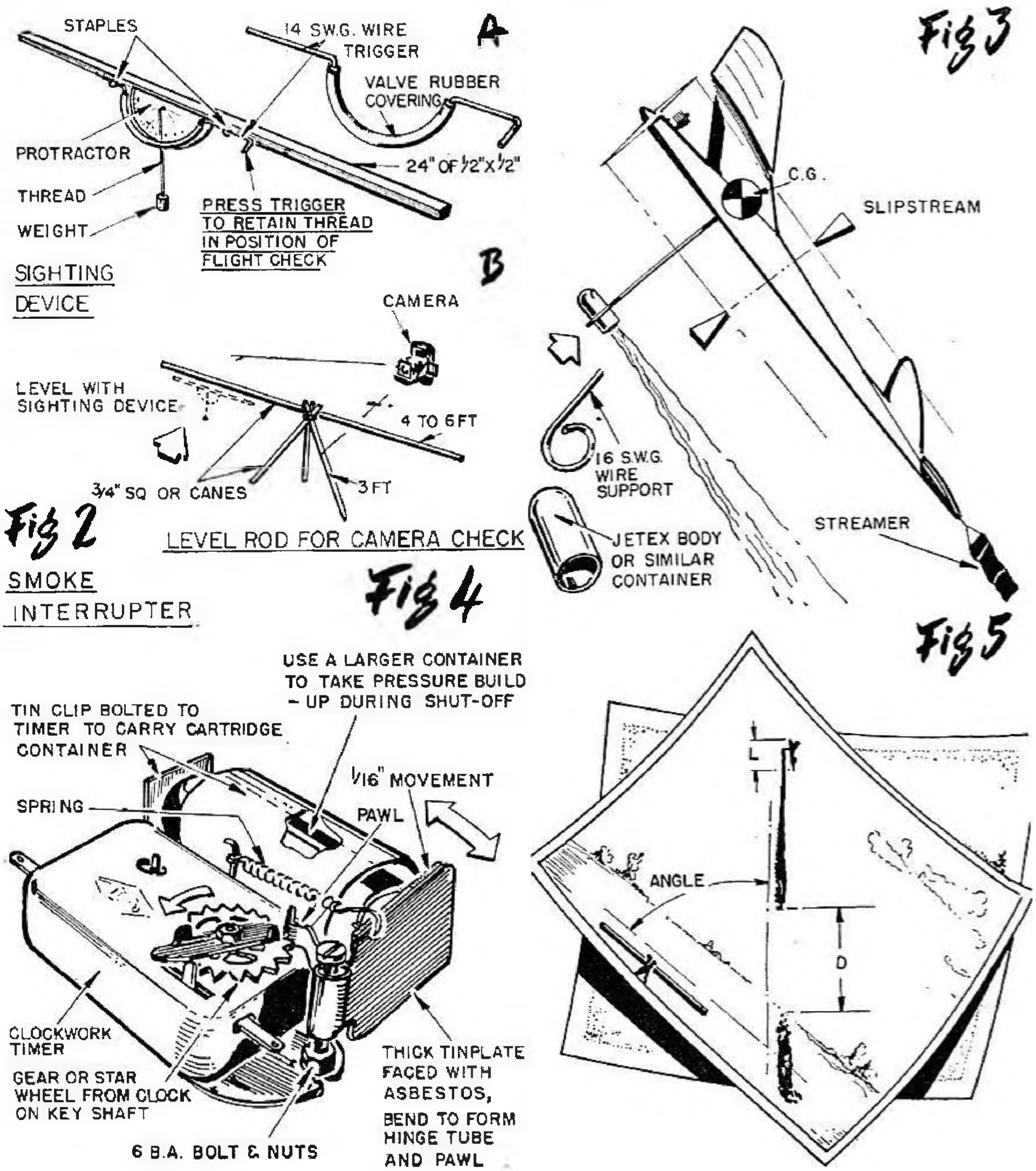
Now since the model had executed a straight climb into wind there seemed to be some grounds for doubting the perpendicularity of the ascent. Indeed, if one could only find a reasonable way of measuring the angle of climb THROUGHOUT the power run, relative to any air conditions, then a better check on performance could be made.

It follows that one could redesign with a more accurately estimated mean flight path, and perhaps avoid some of the heartburn and breakages incurred in trimming.

Measuring the ground airspeed is not good enough when estimating the wind strength. A series of air speed indicators at various heights on kite strings were envisaged, so that, with an estimate of the height, the resultant angle might be found with a little calculation, knowing of course, the time taken to reach that altitude. This system seemed a little cumbersome and prone to inaccuracy due to the number of variables, and one must draw the line somewhere. . . . Well, that is just what we did . . . a line of SMOKE in the air, which traced faithfully the path of the model RELATIVE TO THE WIND (Fig. 1). It only required a photograph taken at 90 deg. to the wind to make a quick, accurate record of the performance, or an on-the-spot check with a simple sighting device illustrated in Fig. 2A . . . 2B shows level bar for camera check.

Some interesting facts emerge from the tests carried out to date. Viewing the angle of the model does not necessarily give an indication of the angle of climb. The acceleration of the model gives a false impression of the flight path if curved, or apparently curved, unless smoke plotted. Smoke plotting takes into account slight thermal and down draught induced changes in the rate of climb, and still gives a consistent angle indication. Sudden gusts at





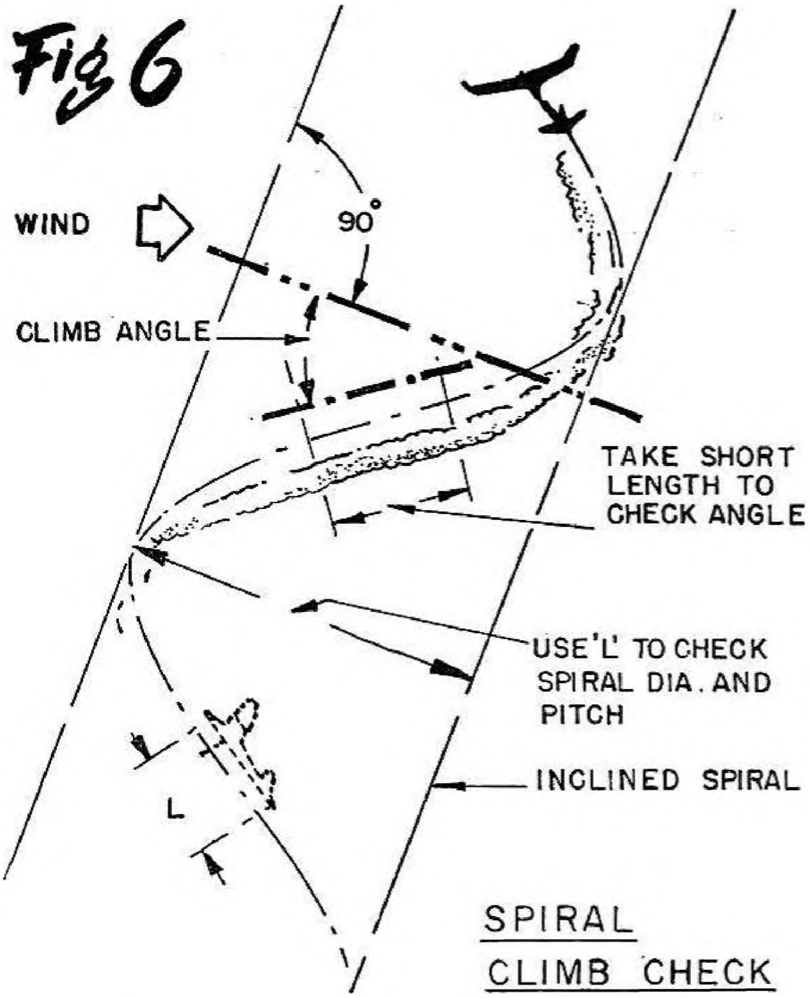
various heights will stretch the smoke trail and give a somewhat "bumpy" looking result, so it is best to concentrate on a reading of the trail immediately issued by the model when testing in turbulent conditions (not to be recommended for tests anyway). A more accurate check is possible of difference between still air and fast drift performance of the model.

We need a dense, fast produced smoke, of approximately 15 seconds duration. This can be produced chemically or pyrotechnically, and most "stinks" enthusiasts should be able to produce a suitable emitter. Remember that is in an offence to modify fireworks, so do not fit them as a means of producing smoke ; it is considered a modification to fit a firework to model aircraft, according to the Act.

Position the smoke unit as near the centre of gravity of the model as possible and away from slipstream and the fuselage if there is any danger of fire or acid burns. Keep as small and light as possible even at the expense of short duration. Fig. 3 shows some alternatives.

Camera recording of the trail is best done at as great a distance from the take-off as possible, or as allowed by the visibility of the smoke. This ensures that the perspective effect at the top of the climb is more easily corrected, due to the narrower angle of view. We are lucky in having a steep hill in part of our club flying area, and in consequence can start a little way up the climb, as it were, by launching from the bottom and photographing from the top of the hill.

Fig 6



SPIRAL CLIMB CHECK

Now we come to an interesting diversion from the original purpose of the experiments. If the smoke is emitted in short puffs at predetermined intervals, and the model length is made up to an easily calculated dimension by adding a small streamer, then a photograph taken will give two records, one of angle of climb, and one of rate of climb and acceleration. It is a comparatively simple matter to fit a timer-operated cap to the smoke unit, so that the smoke is restricted and released in one second puffs. A clockwork timer is best for the purpose and will also serve as the motor timer. Fig. 4 shows a typical installation. Remember to have the cap sprung to avoid excess pressure. The weight of the unit is only a fraction of an ounce over the normal weight of the clockwork timer, which most models carry as normal load.

In order to calculate the rate of climb, it is necessary to measure the distance between centre of smoke puffs and compare with the length of the model (plus streamer if any), a simple matter from the photograph, especially if you have an enlarger to bring the dimensions to some recognised factor. You now have a simple calculation :

$\frac{D}{L} \times F$ — ft./sec. Where D is distance between puffs. L is length of model plus streamer, F feet.

Well, there you are, it is as simple as that (see Fig. 5) and of course you will know how to deal with such remarks as "Obviously, his motor needs a rebore" and "A good bit of D.T. fuse is one thing, but . . ."

An alternative system is somewhat lighter in weight, but requires the use of a stop watch. The margin of error is quite small, and one can still obtain a reasonable estimate of the rate of climb.

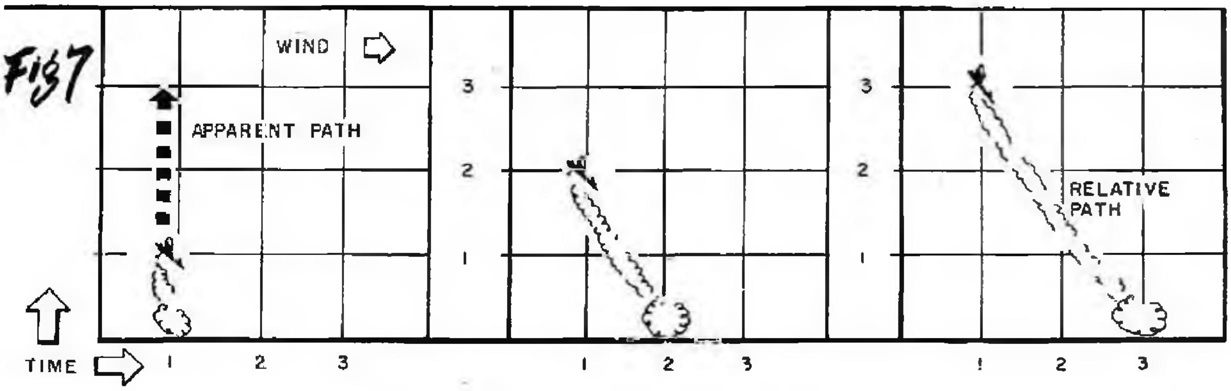
Fit the model with the smoke unit as for angle-of-climb tests ; arrange a short fuse to jettison the cartridge after say 5 seconds, or use a cartridge which will burn out in that time and finish abruptly and cleanly. The exact time does not matter to within a few seconds. Now hold the camera and its shutter release in one hand and a stop watch in the other ; watch the model from the launch, through the camera viewfinder (an open sports type is useful here) and as soon as the smoke trail is seen to end, start the watch, still following the model with the camera, allowing a further five seconds (again not necessarily accurate) then simultaneously clock-off and take the exposure. You should find that by measuring the distance between the end of the smoke trail and the model, dividing by the length of the model, multiplying by the length of the model in feet (as compared on the print) and dividing by the number of seconds clocked on the watch, you have an answer in feet-per-second.

Remember that whichever way you measure the model speed this is only the flying speed, and the actual vertical rate of climb must be calculated from the flying speed and horizontal drift component, measurable in the same way from the photograph as the flying speed and angle-of-climb check.

The writer has found the whole system extremely simple to operate, and apart from a few extra calculations necessary for spiral climbs, that is to say in the actual rate of climb check, angle is as before if taken over a short section of the turn, with a final check on diameter of spiral by the comparative measuring system already described, to enable a correction to be made (Fig. 6.)

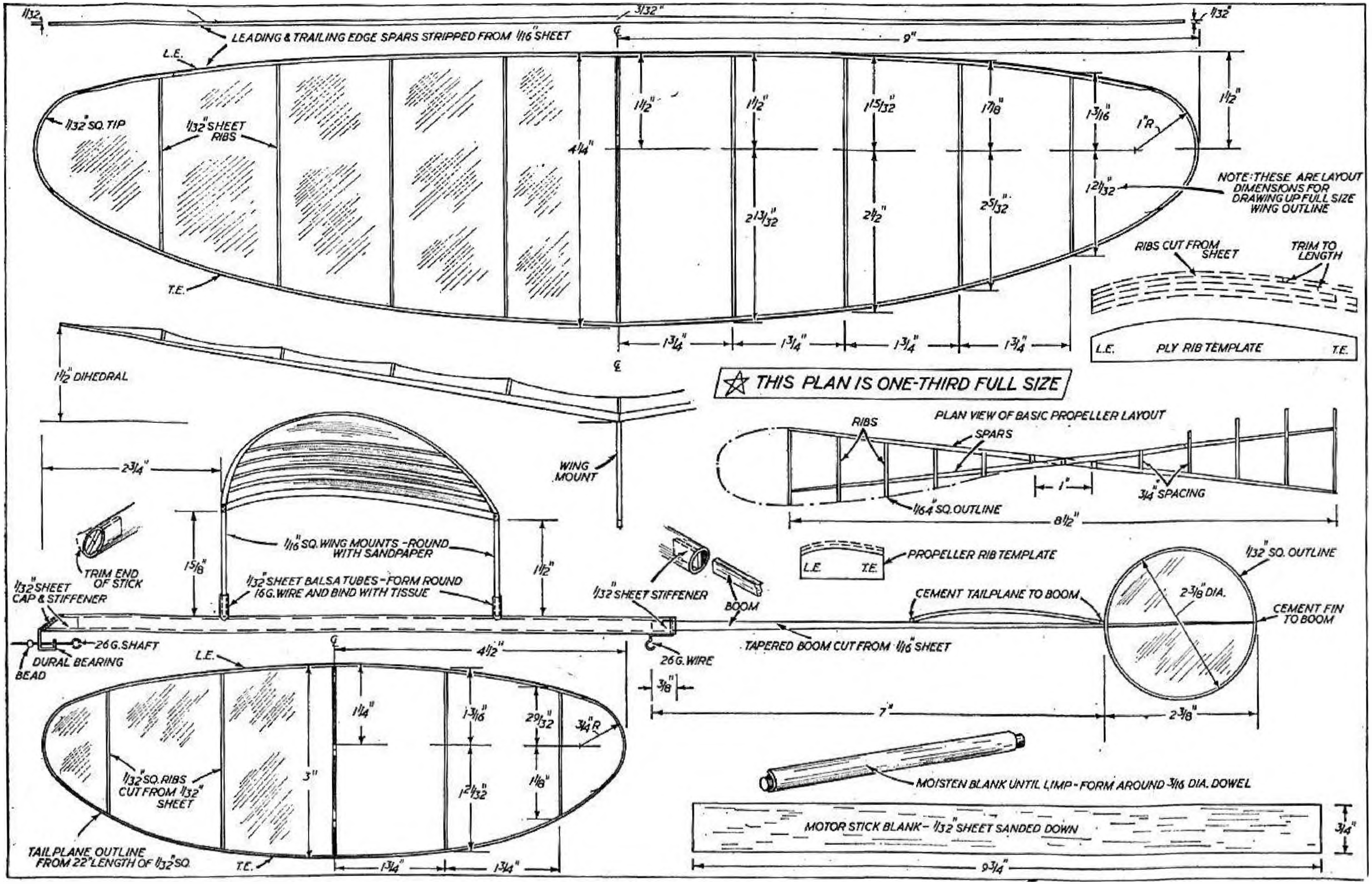
One can readily appreciate the deception of an apparently vertical climb by studying Fig. 7. The diagrams represent the path of the smoke travelling with the wing compared with the apparent path of the model at one second intervals.

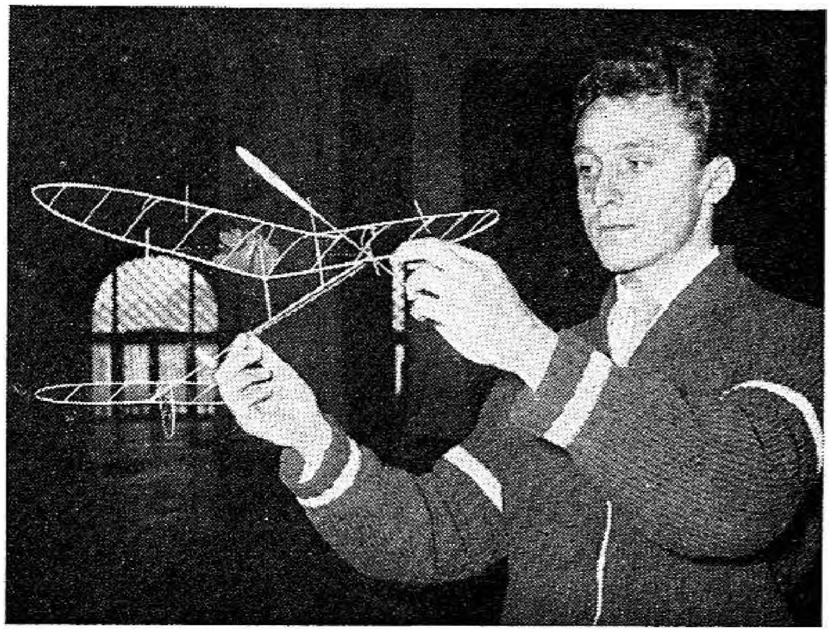
Fig 7



MODELLING TIPS . . .

White parachute silk, as sold by war surplus shops, can be coloured by dipping into a concentrated cloth dye, such as the Drummer type obtainable in Britain. . . . To normalise metal engine bearers bent up from light alloy, first heat over a gas flame and, when hot, stroke with an old match end. When the match leaves a brown line on the alloy, plunge the metal into cold water and it will bend without cracking for a period of about two hours. Bend over a radius to avoid undue stress. Metal returns to its hard state without further treatment.


LEADING & TRAILING EDGE SPARS STRIPPED FROM 1/16" SHEET
L.E.
T.E.
1/32" SQ. TIP
1/32" SHEET RIBS
NOTE: THESE ARE LAYOUT DIMENSIONS FOR DRAWING UP FULL SIZE WING OUTLINE
RIBS CUT FROM SHEET
TRIM TO LENGTH
PLY RIB TEMPLATE
THIS PLAN IS ONE-THIRD FULL SIZE
1 1/2" DIHEDRAL
WING MOUNT
PLAN VIEW OF BASIC PROPELLER LAYOUT
RIBS
SPARS
3/4" SPACING
1/64" SQ. OUTLINE
PROPELLER RIB TEMPLATE
1/16" SQ. WING MOUNTS - ROUND WITH SANDPAPER
1/32" SHEET BALSA TUBES - FORM ROUND 16 G. WIRE AND BIND WITH TISSUE
TRIM END OF STICK
1/32" SHEET CAP & STIFFENER
26 G. SHAFT
DURAL BEARING
BEAD
1/32" SHEET STIFFENER
BOOM
26 G. WIRE
CEMENT TAILPLANE TO BOOM
TAPERED BOOM CUT FROM 1/16" SHEET
1/32" SQ. OUTLINE
2 3/8" DIA.
CEMENT FIN TO BOOM
1/32" SQ. RIBS CUT FROM 1/32" SHEET
TAILPLANE OUTLINE FROM 22" LENGTH OF 1/32" SQ.
MOISTEN BLANK UNTIL LIMP - FORM AROUND 3/16 DIA. DOWEL
MOTOR STICK BLANK - 1/32" SHEET SANDED DOWN



Peter Roser, of Budapest, holds his microfilm model which set up a time of 13 min., 48 secs. at a recent indoor contest in that city. The model described below, also that on page 48, are ideal for small hall flying.

MICROFILM "TRAINER"

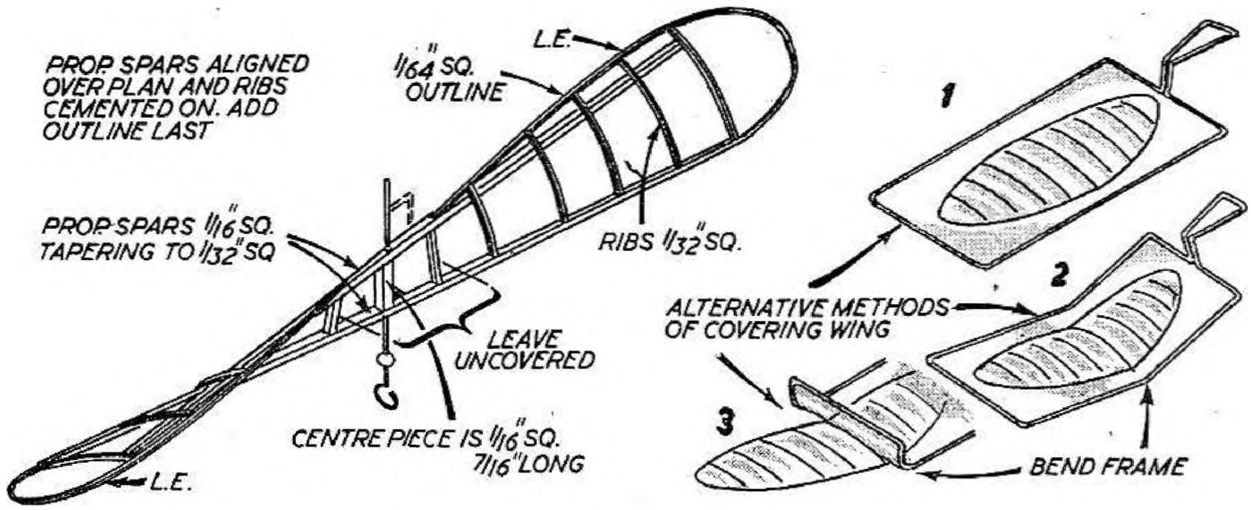
USE LIGHT, white balsa for all the wood, but check that it is reasonably strong stock, not brittle. The wing leading and trailing edges are cut with a razor blade and a metal rule or straightedge to the taper shown. $\frac{1}{32}$ sq. pieces for the wing tips, tailplane outlines and fin are stripped from $\frac{1}{32}$ in. sheet, again with a razor blade and straightedge. All sheets should be sanded smooth on both sides with number 4/0 or finer glasspaper *before* stripping.

Ribs are cut from light *quarter grain* sheet (speckled surface appearance and with a rigid feel when bent). The motor stick is from $\frac{1}{64}$ in. sheet (or $\frac{1}{32}$ in. sheet sanded down) of the type of stock which bends readily edge to edge. It is no use trying to form the motor stick from rigid sheet.

Draw up full size outlines for the wing, tailplane and pin on uncreased paper. Wing leading and trailing edges are pinned down flat over the plan. The $\frac{1}{32}$ in. sq. tips, and the tailplane and fin outline are bent by moistening thoroughly (*e.g.*, with saliva) and then forming around a hot electric light bulb. If the pieces crack, try sheet with a different "cut" for stripping the $\frac{1}{32}$ in. square stock. Heat forming with a light bulb and moistened strip is very easy and effective with the right kind of strip.

All cement joints should be well made, but avoid blobs of excessive cement. Also do not attempt to cement the heat-formed strips until they are quite dry. Leave them pinned in place to dry out. Outline joints—(*e.g.*, tailplane and fin outline, wing tips to main spars)—should be scarfed. Ribs are simply butt-jointed to the edges with cement. Main constructional details are shown on the plan and details of the built-up propeller assembly are given in the diagrams overleaf.

There are three alternative methods of covering the wing. The wing may be built flat and covered with one sheet of microfilm before cracking and cementing to the dihedral angle required. The slack film at the centre can then be taken up by applying *gentle* heat (not a naked flame), or rubbing over very carefully with a wet finger. If this method is used it is best to employ "fresh" film—*i.e.*, film just made and not dried or "aged".

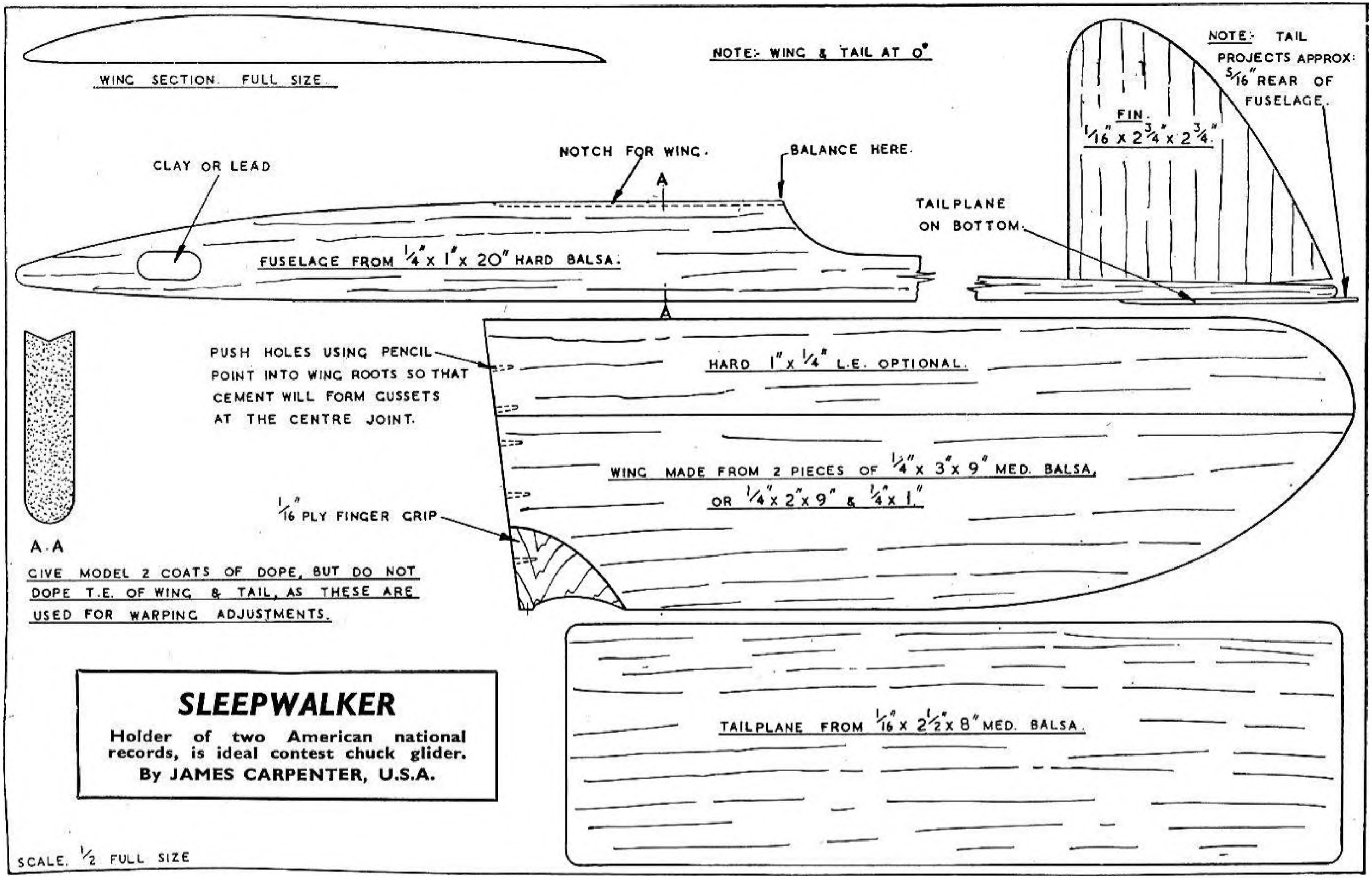


The dihedralled wing can be covered in one piece (1) provided the frame is generously oversize to allow plenty of spare film around the edges. It should then be possible to press the dihedralled wing frame onto the film. Bending the frame to "dihedral" the film will make the job much easier, at the risk of getting slack film (2). In this case, again use fresh film as this will tighten up somewhat.

The dihedralled wing can also be covered with two separated pieces. Cover one side first and trim flush with the centre rib. The frame end is bent up when applying the covering to the other side (3) so that the centre can be trimmed neatly with a hot wire. Rub over the joint with a wet finger to "weld", as necessary.

Motor size will depend on the weight of individual models. Use $\frac{1}{16}$ in. strip (or $\frac{1}{24}$ in. square) and start with a 15 in. loop. Decrease motor *length* if underpowered to decrease total weight.

The young idea in the Far East. Picture shows the little son of Bunjo Yanagimachi holding his father's "Tom Thumb" (June, 1954 Aeromodeller). Model is Bambi powered. Aeromodelling in Japan is exhibiting strong American influence today, whilst retaining the painstaking care of the Oriental.

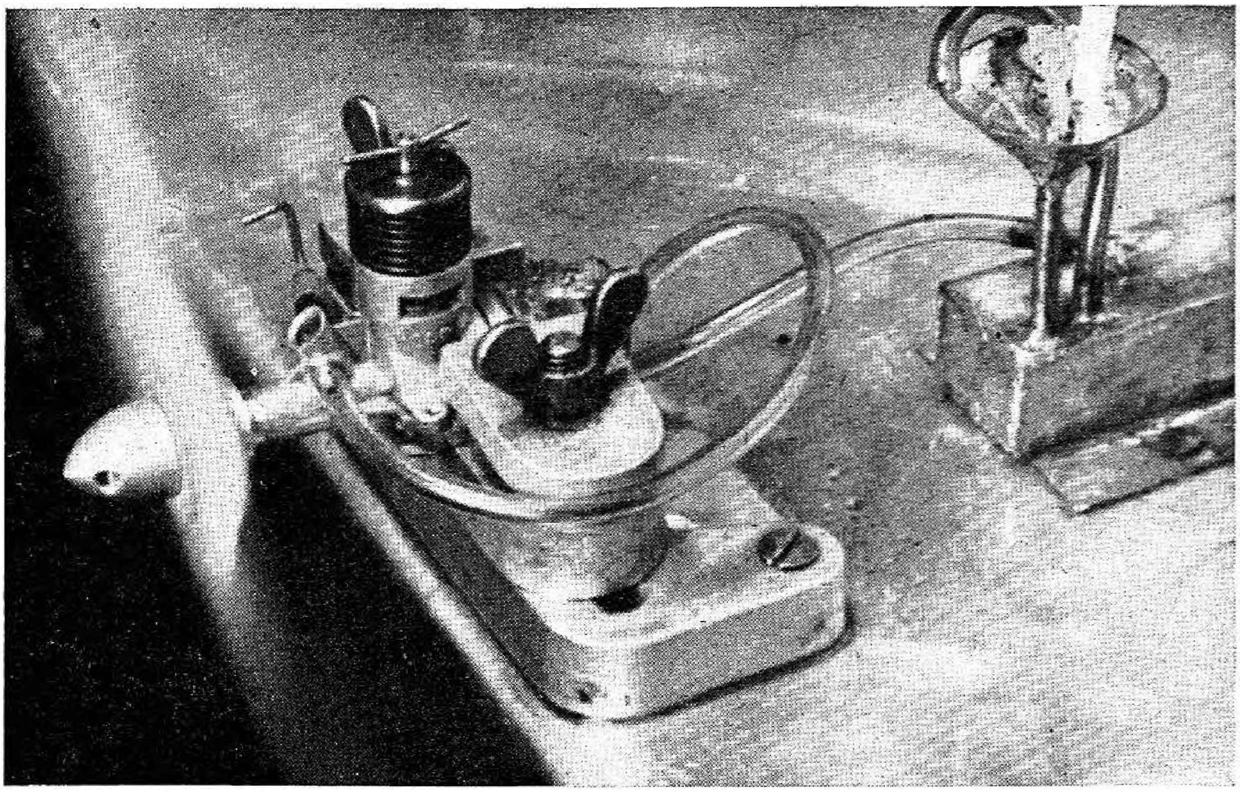


SLEEPWALKER

Holder of two American national records, is ideal contest chuck glider.

By JAMES CARPENTER, U.S.A.

FLYING MODELS, U.S.A.



THE MECHANICS OF RUNNING-IN AN ENGINE

EXCEPT FOR the relatively few "specialist" engines, all model engines are manufactured on a mass-production scale. To ensure a satisfactory standard of performance the fit of certain parts—notably that of the shaft in the main bearing and the piston in the cylinder—has to be held to very close tolerances. These parts are either graded and fitted by selection, or individually fitted, depending on the production technique favoured by a particular firm. Even so there will still be some variation in the fits of different production models of the same engine, resulting in different degrees of "stiffness" which may well affect the initial starting and running characteristics.

Every new engine, model or full size, requires a certain amount of "running-in" before the various moving parts are quite free and running "smooth". It is during this period that any high spots or small irregularities left after manufacture are flattened down. These are all causing excess friction and so until "run-in" the engine cannot develop its maximum power output. Also, because of this extra friction, the engine will run hotter when brand new and if it is very "tight" this heating up may even expand the piston to such an extent that it tends to seize in the cylinder.

Thus the amount of running-in necessary to free an engine properly depends largely on its initial stiffness, as manufactured. Unfortunately there are no general rules for "running-in time" applicable to all model engines. This varies quite considerably with different makes, and different designs of engine, but generally the manufacturer includes a note on this point in his instruction leaflet. Some engines are manufactured to tolerances and surface finishes which require no running-in at all and can be operated at full power right from the start. Others, usually racing-type engines, are set up so tight initially that they need two or three hours' running, or even more, to free up completely. An average production engine, however, tends to be only a little on the stiff side and is usually free enough to install in a model after running through, say, half a dozen tankfuls of fuel.

It is a characteristic of most racing engines used for speed model work (*e.g.*, control line speed, or racing power boats) that power output will go on increasing slightly with running time up to a point where they are literally at their peak. They will then maintain this performance consistently for a period, after which with further running their performance gradually deteriorates again. This is less true with engines used for less arduous duties, such as in free flight models, which once run-in will hold a consistent performance for a long time. In the case of sports models, where the engine is never run "flat out", the useful life of the engine may be hundreds of hours, with proper care. This is particularly true of diesels which are made to more robust standards and rather closer fits than glow motors, as a general rule.

Regarding the initial set-up of an engine, some manufacturers believe in "tight" fits, others in generous ones. It is a common belief amongst modellers that a good engine has a tight piston-cylinder fit, when you can turn the engine over by hand and feel the compression in the head—as well as seeing that there is no leakage past the piston. This, however, does not necessarily have any bearing on the performance of an engine—only its starting characteristics. For minimum *running* friction the piston wants to be a free fit in the cylinder—as free as you can get it, in fact, provided the pumping efficiency of the engine is not impaired (*i.e.*, the piston will still do its main job of compressing the fuel mixture in the head).

The piston fit in a glow engine can be very free indeed, because it does not rely so much on good compression in the head as a diesel, so manufacturers commonly set up a glow motor much more free than a diesel. If too free, starting may be difficult because it will not compress the charge of fuel mixture in the head, but this can usually be overcome by injecting oil (or fuel-oil mixture) into the head to act as a temporary seal. Once running the apparent lack of seal will make little difference. Glow motors with their slacker initial piston fit usually tend to wear out more rapidly than a diesel and this treatment may be necessary on an old motor for satisfactory starting. On the other hand, a glow motor with a "tight" piston is usually a poor starter and a bad runner. It may need a lot of running-in to get it operating smoothly.

A diesel, by contrast, may run satisfactorily if the piston is so tight it literally "squeaks"—provided it receives adequate lubrication and does not overheat. Clearances, in any case, are usually modified by expansion when the engine heats up and so the "feel" of an engine turned over cold is not necessarily any guide as to how it will run. The main thing that produces good running

FIG. 1

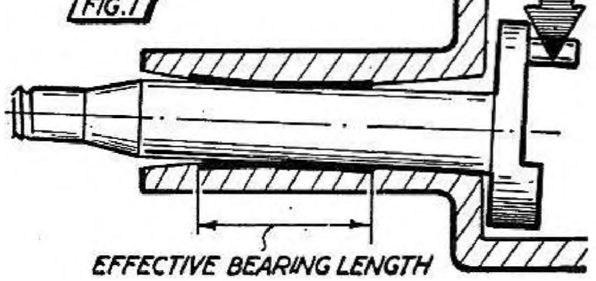
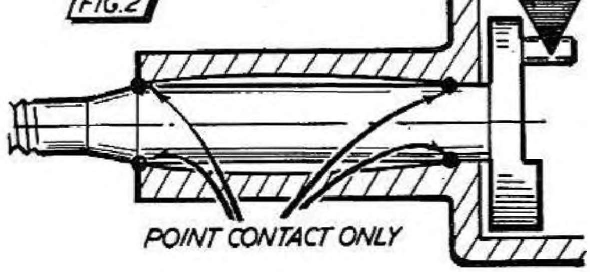


FIG. 2



characteristics is maintenance of a true geometric fit, *i.e.*, lack of distortion, and minimum rubbing area. To produce the latter, manufacturers commonly "waist" the piston on racing engines (*i.e.*, relieve the centre portion so that this section of the piston does not touch the cylinder bore) ; and open up or "relieve" the bore slightly at the bottom of the cylinder (so that the piston is a relatively slack fit in this section of the bore).

If a piston does run stiff in the bore, it will slow the engine up. If it is excessively tight it will cause the piston and cylinder to overheat, which will make things worse. Both conditions can generally be relieved by running-in.

More important from the standpoint of the ultimate performance of any particular engine is the fit of the main bearing. This is the major source of friction in an engine and unfortunately it does not follow that running-in will guarantee that it will bed down to a satisfactory running fit. In most cases it will, but if the bearing is faulty initially, no amount of running-in will ever cure the trouble, and so the engine will never be able to operate at peak efficiency. The only cure—to obtain a really consistent engine—is to replace the shaft and/or bearing.

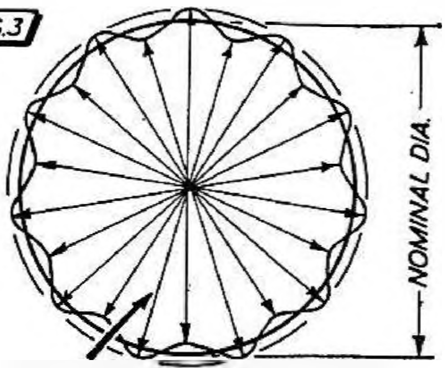
Again the "feel" of the bearing is no real clue as to its potential performance. An apparently loose bearing, for instance, may be an ideal running fit, even if the sideways or up-and-down play on the end of the shaft appears excessive. Such a bearing will tend to develop a bellmouth bore (bearing in mind that the working pressure is applied on one end of the shaft), shown greatly exaggerated in Fig. 1. This means that a generous amount of the shaft is fully supported by the bearings, and hence contact pressure on the bearing surface is fairly low. If the bearing bore is barrel-shaped—shown greatly exaggerated in Fig. 2—there is literally only point contact for the shaft under working pressure and hence extreme pressure on the bearing at these points. Hence the considerable possibility of overheating and scoring, even though the bearing may feel smooth and tight initially.

Since, in all plain bearing engines, the bearing fit is the major factor determining the ultimate performance of any particular design, this bedding down of the bearing is the most important feature of running-in. This, in turn, will depend on the initial finish of the bearing, which varies with individual manufacturers. If the bearing is reamed to size it is left with a number of small high spots (theoretically as many circumferential high spots as the reamer has flutes ; less clearly defined in the case of a spiral-fluted reamer). By honing the bearing after reaming not all the high spots are flattened but the whole bearing surface is generally improved. Both techniques are in common use by British and American manufacturers. Some American engines have the bearing bores finished by broaching which should, theoretically at least, give the nearest practical approach to a truly circular bore. The actual finish achieved with any of these methods, however, depends to a large extent on the operator.

The crankshaft is commonly finished by centreless grinding, which produces a constant *diameter* shaft, but not necessarily one which is truly circular. For instance, slight "chatter" during this operation will produce a section of the form shown exaggerated in Fig. 3. Similarly, if the shaft is finished by grinding between centres, it may accidentally be given a barrel-shape or "waisted" shape—again grossly exaggerated in Fig. 4. Of the two the barrel shape is to be preferred since a waisted shaft again produces "point" contact and high localised bearing pressure.

The usual British method of "matching" crankshafts to bearings is to machine the crankshaft oversize, harden and then grind down to a matter of one half to one thou. above the nominal bearing bore. Bearings are then honed individually to fit a particular shaft. Hence satisfactory interchangeability of shafts by random selection is unlikely and a replacement shaft usually calls for a replacement crankcase as well.

FIG.3

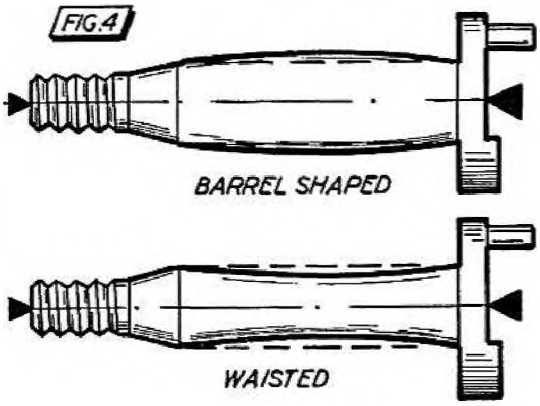


ALL THESE DIAMETERS EQUAL

American practice, commonly, is to grade finished batches of crankshafts to within ·0001 in. in size and select shafts from within suitable limits to match finished bearings. Thus providing the bearing itself is undamaged, a replacement shaft can be fitted by selection. On ball race engines, of course, the shaft is finished to a size corresponding to a press fit in the bore of the ball race(s).

Ball races need no "running-in" unless the piston has deliberately been made a tight fit, or the piston and cylinder surfaces are such that an appreciable amount of rubbing wear is desirable "to finish". Because of their lower bearing friction a ball race engine will generally run up to faster speeds—*e.g.*, up to 20,000 r.p.m. on propeller loads—and develop peak power at higher speeds than plain bearing engines—*e.g.*, 14,000-17,000 r.p.m., whereas plain bearing engines commonly peak at 10,000 to 14,000 r.p.m. Glow motors are generally designed to run at higher speeds than diesels and so with a plain bearing glow motor more attention may have to be given to bearing finish to achieve this end.

FIG.4



As a generalisation, bearing friction is the predominant friction load on the engine up to some 14-15,000 r.p.m. At higher speeds, provided the bearing is a good running fit, piston-cylinder friction is mainly responsible for absorbing power within the engine. This is largely because as speed increases torque and the brake mean effective pressure falls off. Hence the actual load or pressure on the bearing *decreases* with speed—a point to bear in mind when running-in a plain bearing. If the bearing is stiff, then damage is more likely to be done to it by running at moderate speeds than at high speeds.

FUSELAGE GEOMETRY

Correct planning of model shapes can make all the difference to looks and performance.

THE FUSELAGE on any aeroplane is essentially a "parasite", necessary to hold the functional components (wings, tail unit, engine) in their correct positions, and also to house payload, etc. Where models are concerned, a stick will frequently fulfil all the requirements of a fuselage, hence the favouring of this type for purely functional designs.

Until comparatively recently there used to be rules governing the cross section of model fuselages. Such a rule was originally introduced over a quarter of a century ago with a view to ensuring that the appearance of a contest model bore a certain amount of "realism". The standard British rule was that the smallest size for the maximum cross sectional area of the fuselage had to be (length) 2/100. Length was at first defined as basic fuselage length, later, the overall length of the model. Later, under post-war F.A.I. influence, minimum fuselage area was related to total area (wings and tail), or to a fixed minimum for a particular specification. The F.A.I. fuselage rule permitted a slimmer fuselage than hitherto and was welcomed by most designers. When all fuselage cross section rules were ultimately waived it was more or less natural that designers free from restriction went over completely to a basic "stick" outline, which has tended to obscure the fact that the characteristics of a stick fuselage are not necessarily all favourable.

From the point of view of parasitic drag, the resistance of a nicely streamlined fuselage from 30 inches long and with a maximum cross section of 6 inches diameter is roughly the same as that of a penny, face side to the airstream. So bulk of cross section does not necessarily mean high parasitic drag, provided the fuselage shape is nicely streamlined. It will have a higher drag than a slender fuselage of similar length, mainly because of its greater wetted area (total surface area). Inherently, too, it will be heavier for comparable overall strength, because of the greater amount of material in it. But as an article elsewhere in the Annual explains, fuselage area can play an important part in damping when displaced, and so assist spiral stability.

Thus reducing a fuselage cross section to a minimum is not automatically good design practice, even on functional models. On models where appearance counts as well as performance cross section nearly always approximates to the old (length) 2/100 rule, usually unintentionally, and the outline is much more pleasing as a consequence. Commonly enough, too, models with an "old-fashioned" bulky fuselage continue to perform just as well as their slick modern counterparts with stick fuselages.

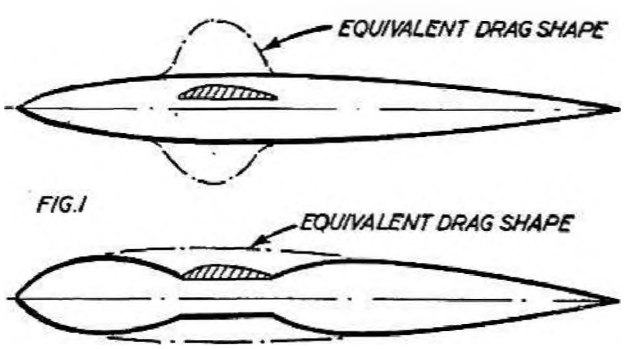
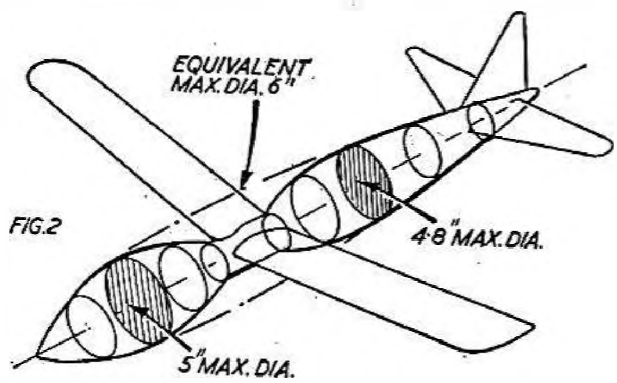


FIG. I

An interesting theory was put forward some time ago that the full size aircraft "area rule", applied to transonic aircraft design, might also give good results on models, despite the fact that the two air-speed regions concerned are at extremes. This rule is based on the conception that the effective cross section of an aircraft, as far as drag at transonic speeds is concerned, includes in the cross section of the wings and other appendages. Thus the "drag shape" of an apparently streamlined design may be humped, offering considerable resistance, as sketched in Fig. 1. To preserve a streamlined overall drag shape the fuselage needs to be nipped in or "waisted" at the region of the wing root, shown in the second sketch. The reduction in area at the waisted portion then corresponds to the cross sectional area of the wing.



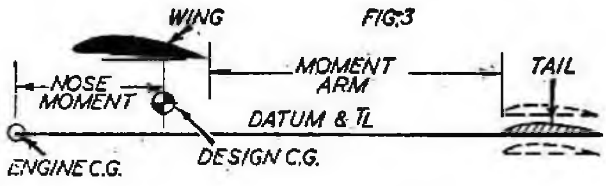
Applied to a typical model design, where the wing cross section is proportionately much greater than that of a transonic full size aircraft, a considerable degree of "waisting" would be necessary to achieve a similar arithmetic balance of cross sections. The resulting design would appear rather like Fig. 2 with bulbous fore and afterbody fairings. It is certainly an odd shape for a fuselage, but not entirely unfamiliar. It resembles in appearance a flying insect. As yet, however, such layouts have not been tried in practice on models.

Basic geometry of a conventional fuselage usually starts with a datum line, about which the component positions are accurately distributed, relative to the required centre of gravity position. Thus Fig. 3 represents a typical skeleton outline for a power model fuselage where the leading criteria usually are :

Wing height above datum (and rigging incidence).
Thrust line (longantal equivalent)—usually along datum.
Tailplane moment arm.*
Front fuselage length to motor c.g. (or centre line of cylinder) for required overall c.g. position.

The actual vertical position of the tailplane is seldom critical, but is usually on or slightly above the datum line. Tailplane rigging incidence is decided with reference to the wing incidence and c.g. position (the farther aft the c.g. the smaller the difference between wing and tailplane incidences).

A wide variety of fuselage shapes is then possible around this skeleton —Fig. 4. The pure stick design (A), representing a minimum of "parasitic" appendage will tend to be structurally weak (and possibly more critical as regards spiral stability due to lack of damping). Hence a built-up "stick" is preferable (B). Carrying this a little further a recognisable "fuselage" appears (C). In this case it is common to find the fuselage "hump" shaped to give a flat bottom surface for ease of construction—and ostensibly a "lifting" fuselage to provide a certain amount of lift, although any contribution in this respect is negligible.



Other designers may prefer a more substantial built-up fuselage (D), or one where the rear section of the fuselage has considerable area (E). Both

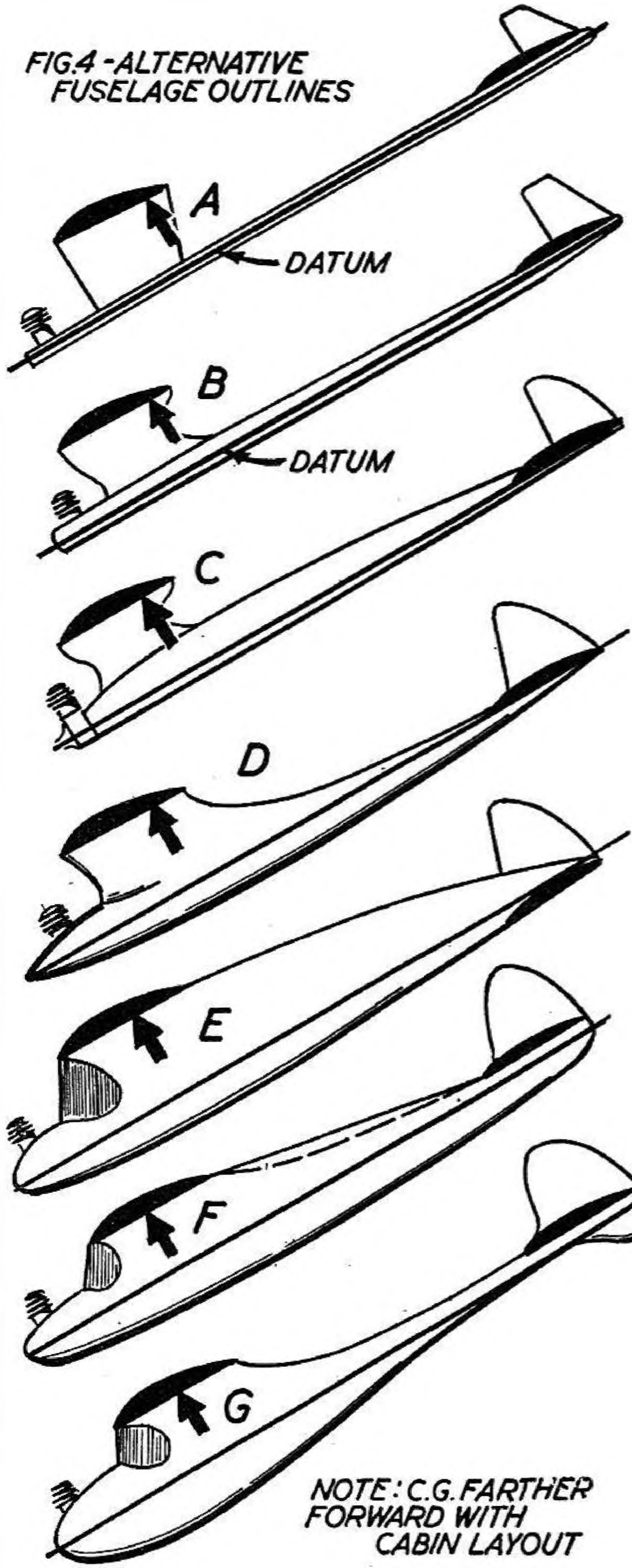
* The true moment arm of the tailplane is measured from the tailplane centre of pressure to the c.g. This is not a fixed dimension since the centre of pressure moves with changing angle of attack. It is, therefore, more convenient to adopt a nominal fixed dimension to define the tailplane moment arm—the distance between the wing trailing edge and tailplane leading edge commonly being adopted.

shapes were very common at one period. Compared with A, B or C, however, these outlines represent more weight aft, and hence a more forward position of the motor to balance at the same c.g. position.

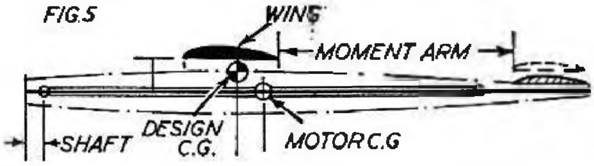
Outline (E) is very similar to an orthodox cabin layout, except that in the latter case (F) the original "skeleton" proportions are slightly different (c.g. farther forward and wing position lower). Fuselage top lines may be straight, humped or pulled in, more or less according to the whim of the individual designer. A cabin model may also retain the essentially deep fuselage of a duration layout (measured to the wing height) with pulled-in lines as (G).

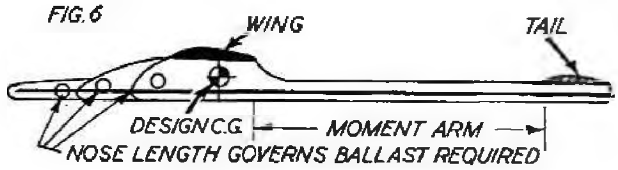
Skeleton proportions are best established by studying published designs of similar types and sizes, *i.e.*, are judged by experience rather than by calculation or working to any fixed set of rules. Lacking individual experience one can always draw on the experience of others by studying plans of their models. This is quite accepted practice. Even the top-notch designers follow the same principle as witness the similarity between many independent designs. Model size is important because with smaller engines sizes, engine weight tends to be proportionately higher

FIG.4 - ALTERNATIVE FUSELAGE OUTLINES



(compared with the rest of the airframe). Hence fuselage nose length is shorter. Another point to bear in mind is that in studying plans of American designs





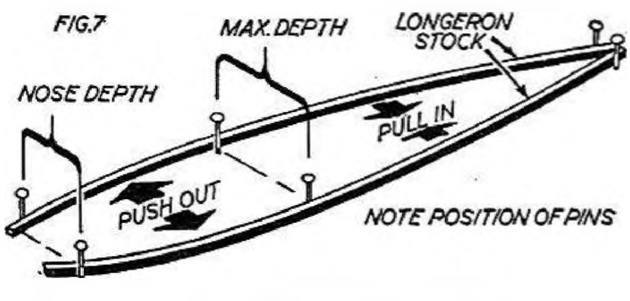
these are normally designed for glow engines which are normally appreciably lighter than diesels of the same capacity. This again can affect nose length. If you want to work out the difference, as a simple calculation :

$$\text{Nose length (new design) from c.g.} = \text{nose length of design studied} \times \frac{\text{weight of design engine}}{\text{weight of alternative engine}}$$

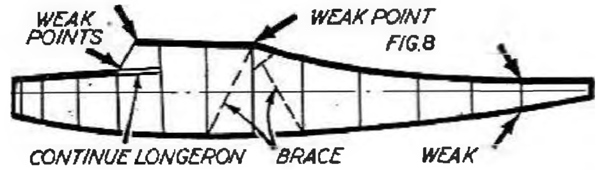
With a rubber model the fuselage "skeleton" is balanced around the rubber motor—Fig. 5. The c.g. of the complete model, generally speaking, works out a little in front of the centre of the motor, which fixes the wing position. The tailplane is invariably carried behind the rear of the motor, fuselage length normally being determined by the length of motor required, and the tail moment arm adopted. The very long fuselage model, which enjoyed a vogue in the days of old-rule (unrestricted rubber) Wakefields is still carried over on many designs using relatively short motor lengths under the new rules so that the rear fuselage length is considerably extended and it is, in effect, nothing more than a boom to carry the tail unit. This extra weight has the effect of bringing the model c.g. aft of the rubber centre. A long fuselage design with unrestricted rubber usually works out with the c.g. coincident with the rubber centre (but vertically above it, due to the weight of the wings).

Wing height is largely governed by c.g. rigging position, the farther aft the c.g., generally speaking, the higher the wing is mounted. The fuselage may then be a stick type, carrying the wing on a pylon mount since an "enveloping" fuselage would be somewhat bulky.

Glider fuselage layout is even simpler since wing height is not particularly important and so it is mainly a case of arranging the wing and tailplane at the required moment arm and rigging incidences. Fuselage nose length (and shape) may then be dictated by stability requirements (see article on "Spiral Stability"). A main point to bear in mind with regard to the geometry is that the shorter the nose length the greater the amount of ballast weight which will be required to arrive at the design c.g. position. Conversely, extending the nose length sufficiently the model can be balanced without ballast (although it may then need ballast weight at the c.g. to bring up to a specification weight), but the resulting fuselage will be far more vulnerable.



On slabsided fuselages longeron curves should, as far as possible, be made to conform to the "natural" curve of the longeron material (and size). On built-up stick type fuselages the longerons may be straight, end to end, and so this does not apply. But a common error in drawing out deeper fuselages is to draw the outlines with French curves or drawing instruments, rather than with sample lengths of the actual longerons.



Taking two sample longeron strips and pinning over the skeleton drawing at the nose, tail and the widest section (usually about one-third to 40 per cent back), these longerons will assume a "natural" curve. This will not necessarily be the best profile for the fuselage and can be improved by pulling in the rear curves and opening out the front curves, as shown (Fig. 7). Quite a lot of adjustment can be made in this fashion to arrive at a final, suitable shape, with the advantage that you are sure that the longeron stock will accommodate these curves readily. With plain drawn curves, quite often bends are too severe (particularly at the nose), so that the longerons are strained in place when building and will tend to "spring" when the sides are removed from the building board.

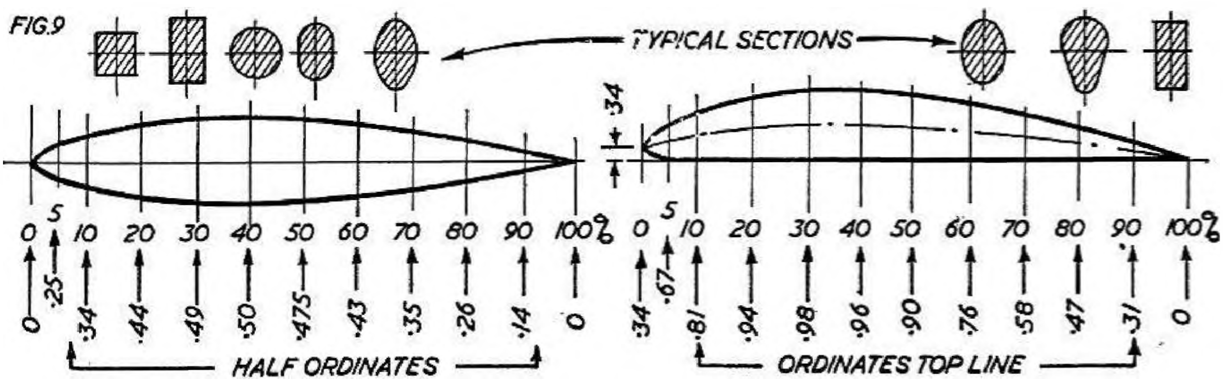
Where breaks in the outline are unavoidable—*e.g.*, with a cabin fuselage—every abrupt change in section is a weak point. This calls for distribution of the loads at these points, either with bracing or continuing a longeron member past the "break"—Fig. 8. Again the same remarks apply with regard to the main curves—plot these with longeron lengths rather than just drawing them in. You will have a stronger and truer fuselage as a consequence.

The increasing use of sheet sided fuselages has, of course, given greater freedom to design outline since any shape of curve can be cut. Also the sheet, acting as a stressed skin, can take quite high loads. The weakest points will still be at the major changes of section *of the whole aeroplane*, *i.e.*, usually at the wing leading and trailing edge positions and the tailplane leading edge position. The latter, in particular, may well pay for internal bracing to distribute crash loads.

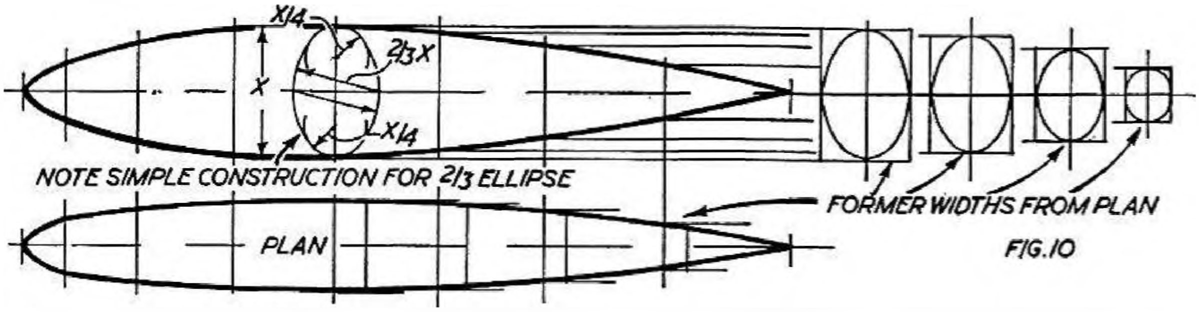
It is to be regretted that the built-up streamlined fuselage model is now very much in the minority, although it remains one of the most attractive of all design layouts in appearance. Profile shape is based on a good streamlined form, such as shown in Fig. 9, which can be calculated for any desired diameter or depth (depending on whether a circular or elliptic cross section is used). The pear-shaped section normally utilises a similar streamlined profile plotted about a curved centre line so that the bottom line of the fuselage is flat, or substantially flat.

Stages in plotting an elliptic section fuselage are shown in Fig. 10. Only a few former positions are shown, for clarity. The first step is to plot the fuselage side elevation in the form of a good streamlined shape ; and then similarly the

FIG.9



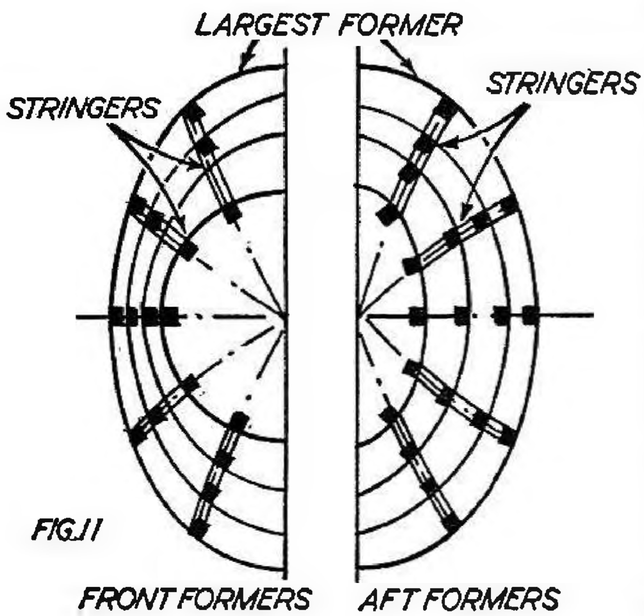
plan view. This will probably differ in form slightly for the nose section may be circular, this needing a proportionate widening out of the plan shape at the nose.



Former positions are then drawn in as verticals. The actual spacing will have to be decided by such features as where the wing fixings are attached, undercarriage fixing, etc. ; and also the closeness of the spacing required to prevent stringers sagging between the formers and giving the covered fuselage a "starved horse" appearance. This also applies to sheet covered fuselages, particularly when using thin sheet covering as a "stressed skin" or monocoque construction over formers.

Each former station can then be drawn as a rectangle, as shown, representing the depth and width of the fuselage at that station. The appropriate shape is then drawn in to match the rectangle. Actually all the formers forward of the largest section would be drawn on the largest former (drawn first) ; and all the aft sections drawn superimposed on an identical drawing of the largest section. It is then easy to "blend" the former shapes to achieve smooth changes in section, if necessary.

Similar superimposed section drawings are also used for plotting stringer positions on individual formers—Fig. 11. This is essential if the formers are to be notched. If the stringers merely cement onto plain formers (*e.g.*, laminated hoops) then it is usually only necessary to mark the stringer positions on a few formers chosen along the length of the fuselage, align the stringers on these marks and "sight" in position on the other formers by eye before cementing down. Stringer lines as drawn on the superimposed cross sections can be straight lines from the mid-section to the end section (which will tend to give rather severe lines to all but circular cross-section fuselages) or pleasantly curved.



With monocoque fuselages of circular cross section, the covering panels can be cut as "gores". If the sheet covering is to be applied in eight strips, the width of each strip or gore will be one eighth of the former circumference at each former station. It is not convenient to measure this off the section drawing, although it could be calculated (arc length = gore width = ·01745 = radius = included angle = ·7854 radius in this example). A better way is to do it graphically, as in Fig. 12.

Here the line AB is drawn to 1 : 1 scale to represent the circumference of the smallest former. This is subdivided into the required number of equal parts (eight). Draw lines BD and CE at right angles to AB-BC being one subdivision apart. Strike AD_1 (where AD_1 — circumference of largest former to cut BD at D_1 and CE at E_1. E_1D_1 measured off the drawing then represents the gore width at this station. Repeat with AD_2, representing the circumference of the next former, and so on. A tedious job is you have to calculate the circumference of each former, but use the table below.

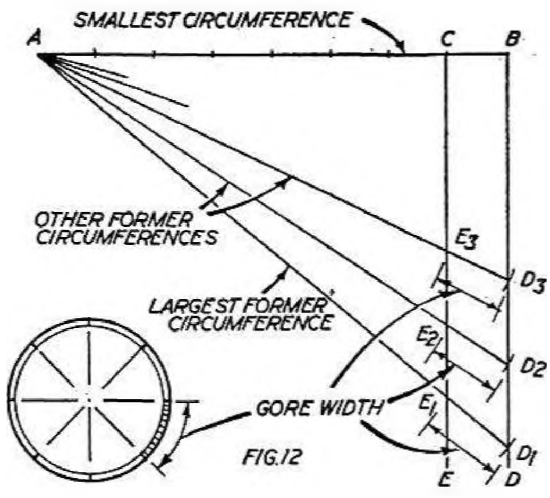


FIG. 12

CIRCUMFERENCES OF CIRCLES

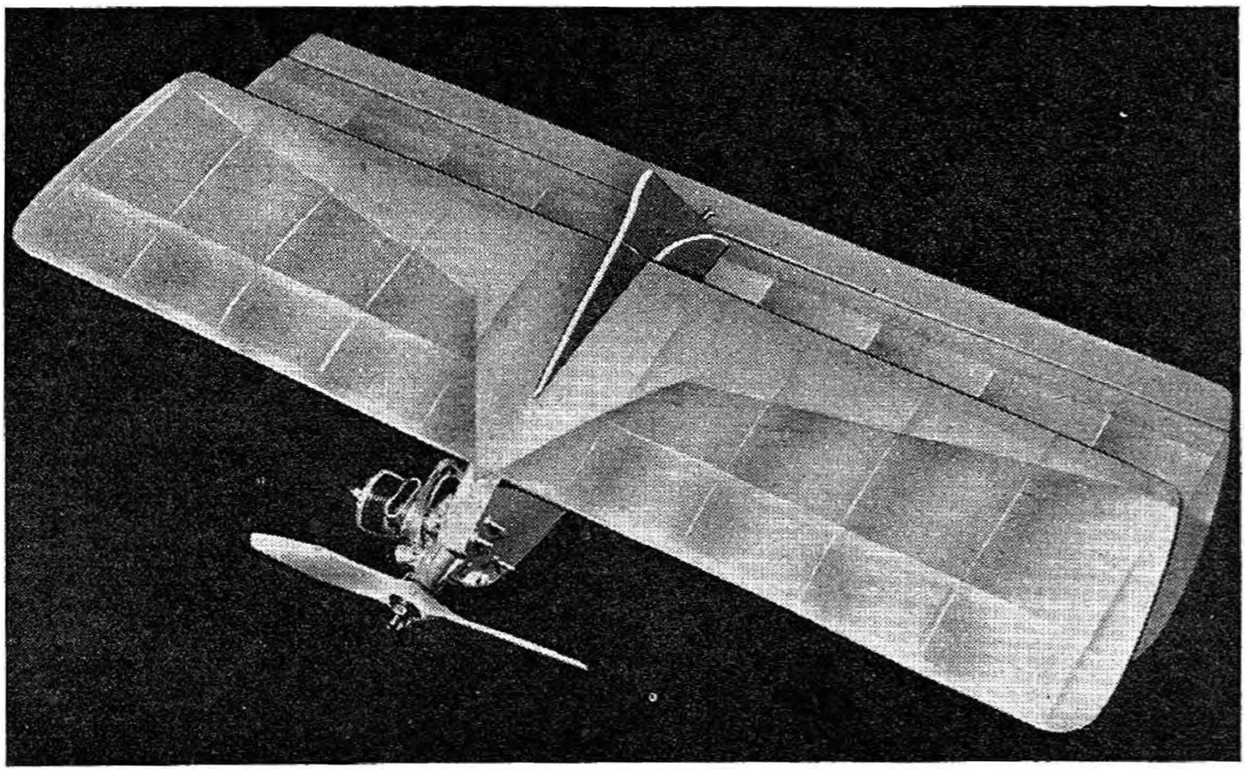
Dia.	Circumference	Dia.	Circumference	Dia.	Circumference	Dia.	Circumference	Dia.	Circumference
1	3·1416	2	6·2832	3	9·4248	4	12·5664	5	15·7080
1/16	3·3379	1/16	6·4795	1/16	9·6211	1/16	12·7627	1/16	15·9043
1/8	3·5343	1/8	6·6759	1/8	9·8175	1/8	12·9591	1/8	16·1007
3/16	3·7306	3/16	6·8722	3/16	10·0138	3/16	13·1554	3/16	16·2970
1/4	3·9270	1/4	7·0686	1/4	10·2102	1/4	13·3518	1/4	16·4934
5/16	4·1233	5/16	7·2649	5/16	10·4065	5/16	13·5481	5/16	16·6897
3/8	4·3197	3/8	7·4613	3/8	10·6029	3/8	13·7445	3/8	16·8861
7/16	4·5160	7/16	7·6576	7/16	10·7992	7/16	13·9408	7/16	17·0824
1/2	4·7124	1/2	7·8540	1/2	10·9956	1/2	14·1732	1/2	17·2788
9/16	4·9087	9/16	8·0503	9/16	11·1919	9/16	14·3335	9/16	17·4751
5/8	5·1051	5/8	8·2467	5/8	11·3883	5/8	14·5299	5/8	17·6715
11/16	5·3014	11/16	8·4430	11/16	11·5846	11/16	14·7262	11/16	17·8678
3/4	5·4978	3/4	8·6394	3/4	11·7810	3/4	14·9226	3/4	18·0642
13/16	5·6941	13/16	8·8357	13/16	11·9773	13/16	15·1189	13/16	18·2605
7/8	5·8905	7/8	9·0321	7/8	12·1737	7/8	15·3153	7/8	18·4569
15/16	6·0868	15/16	9·2284	15/16	12·3700	15/16	15·5116	15/16	18·6532

DID YOU KNOW THAT . . .

Experts cover their lightweight models with Jap or superfine tissue by first doping the structure, then overlaying the tissue dry, which is then painted over with thinners where intended to stick to the framework. The thinners works through the tissue to the dope and is fused to the construction. Tissue is then water-shrunk by using a fine scent spray. This method avoids those unsightly paste marks. . . .

Many A/2 gliders employ hardwood spars instead of balsa. Minimum allowed weight of 14½ ozs. permits this extra weight, for the strength factor increases considerably. It is important to keep the wing construction weight inboard and away from the tips, and to ensure that wing halves balance each other. . . .

To light your D/T fuse on a windy day, use another piece of fuse that can be permanently alight, with the end of the ball projecting through a tight fitting hole in the lid of a tin can. Should fuse be forgotten, it will automatically snub out when reaching the hole.



MANX CAT IV

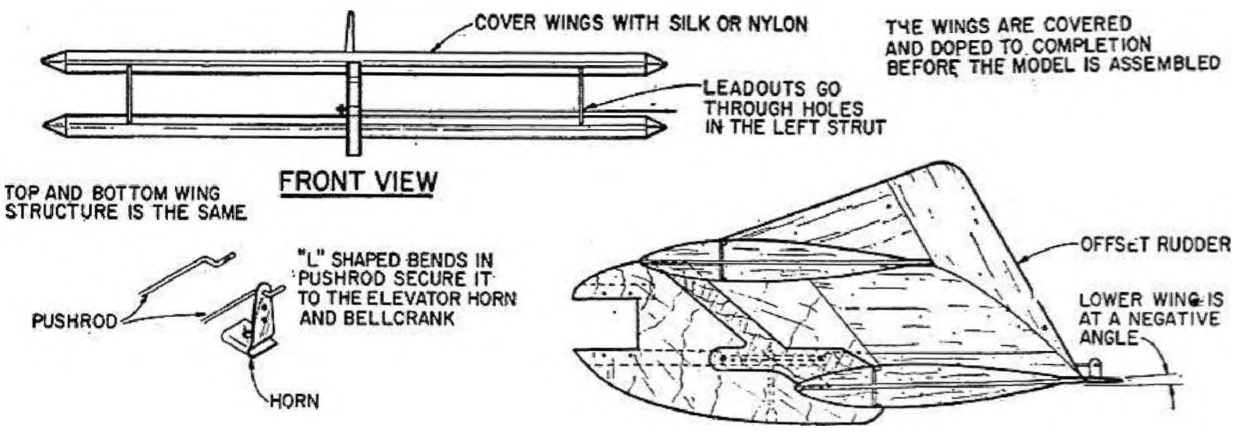
By Bob Buragas
(Editor "Flying Models", U.S.A.)

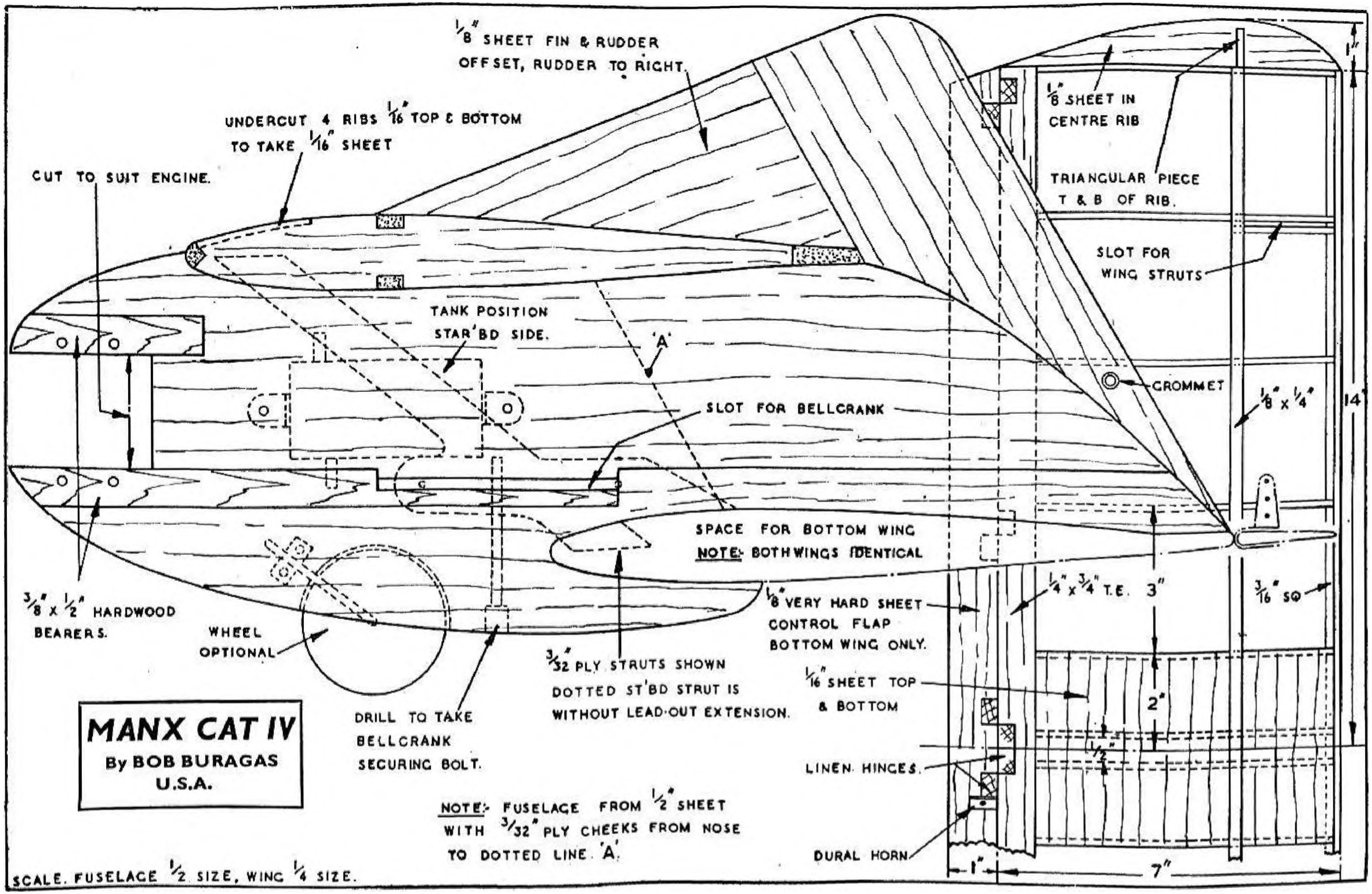
Seldom does a designer get a different idea that works out as a "natural," and here is a "natural" if there ever was one.

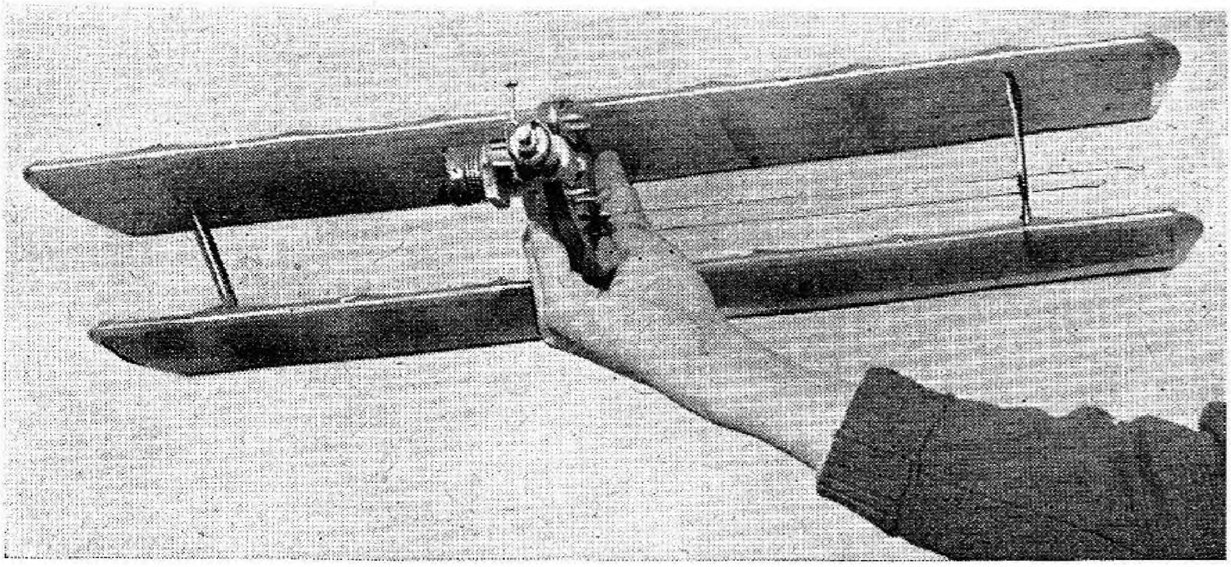
"Manx Cat I" was a super simple model that featured square wing tips and a super-thick airfoil. This 'foil was chosen to produce good lift and strength. A profile fuselage was employed and it was further simplified by cutting it from a piece of ⅜ in. plywood sheet to eliminate construction.

A Fox ·25 was used to power the ship and it looked formidably large on the fuselage. Calls of "Rat Racer" could be heard from the sidelines. Not being able to stall longer we finally started the engine and flew the ship.

Balance, trim, control surface area, you name it, all worked out to a "T." It's true the ship was fast. The 5 in. by 20 in. wings totalled slightly over 200 square inches of area including the flap control. However, the thick airfoil was obviously slowing the ship while making manœuvring tight and smooth.




1/8" SHEET FIN & RUDDER OFFSET, RUDDER TO RIGHT.
UNDERCUT 4 RIBS 1/16" TOP & BOTTOM TO TAKE 1/16" SHEET
CUT TO SUIT ENGINE.
1/8" SHEET IN CENTRE RIB
TRIANGULAR PIECE T & B OF RIB.
SLOT FOR WING STRUTS
1"
TANK POSITION STAR'BD SIDE.
'A'
GROMMET
1/8" x 1/4"
14"
SLOT FOR BELLCRANK
SPACE FOR BOTTOM WING
NOTE:- BOTH WINGS IDENTICAL
3/8" x 1/2" HARDWOOD BEARERS.
WHEEL OPTIONAL
1/8" VERY HARD SHEET CONTROL FLAP BOTTOM WING ONLY.
1/4" x 3/4" T.E.
3"
3/16" SQ
3/32" PLY STRUTS SHOWN DOTTED ST'BD STRUT IS WITHOUT LEAD-OUT EXTENSION.
1/16" SHEET TOP & BOTTOM
2"
1/2"
MANX CAT IV
By BOB BURAGAS
U.S.A.
DRILL TO TAKE BELLCRANK SECURING BOLT.
LINEN HINGES.
NOTE:- FUSELAGE FROM 1/2" SHEET WITH 3/32" PLY CHEEKS FROM NOSE TO DOTTED LINE 'A'.
DURAL HORN
1"
7"
SCALE. FUSELAGE 1/2 SIZE, WING 1/4 SIZE.



Unlike most wings, this ship grooves itself. It holds a control position until you signal "go," then "go" it does! Ever see a really square corner? This ship can do it.

But though we hit the design "on the head," we still didn't have what we wanted. The ship wasn't as clean looking as we wanted it to be, so Manx Cat IV was finally developed as shown.

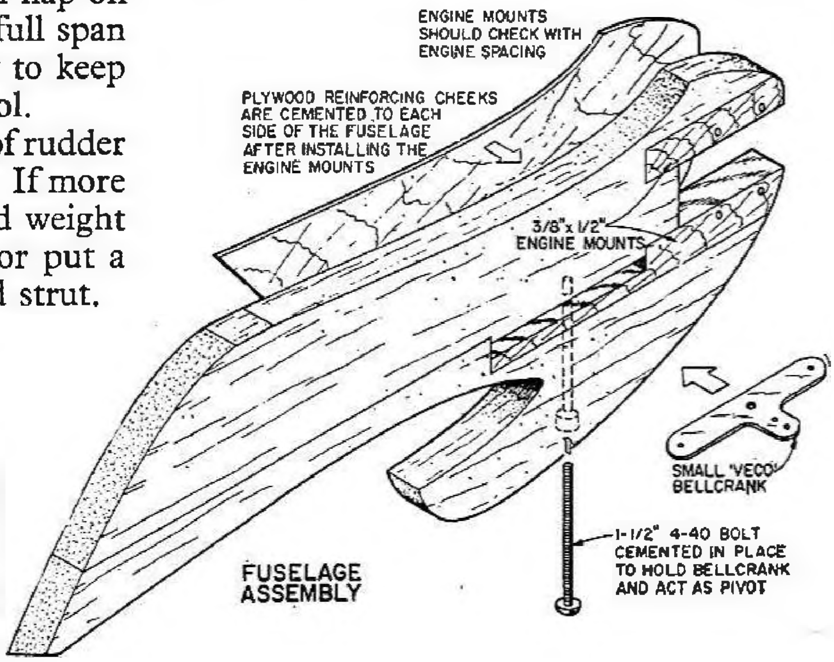
The "Cat" is not a critical design evolution and there are many inviting possibilities which have not yet been explored. We hasten to inform that there are a few pitfalls and we'd like to warn you of them.

On seeing the "Cat," one modeller hurried home and built a ship which looked just like it with one exception. Being a cautious cuss he mounted a stabiliser and elevator between the wings to act as a control surface. We shuddered at the idea 'cause it just didn't "look" right.

The elevator-stabiliser idea didn't work. It appears the upper wing blanketed the control. This is just a guess because the ship went in like a sacket of cement and there was little time for a good observation. These "Cats" really move.

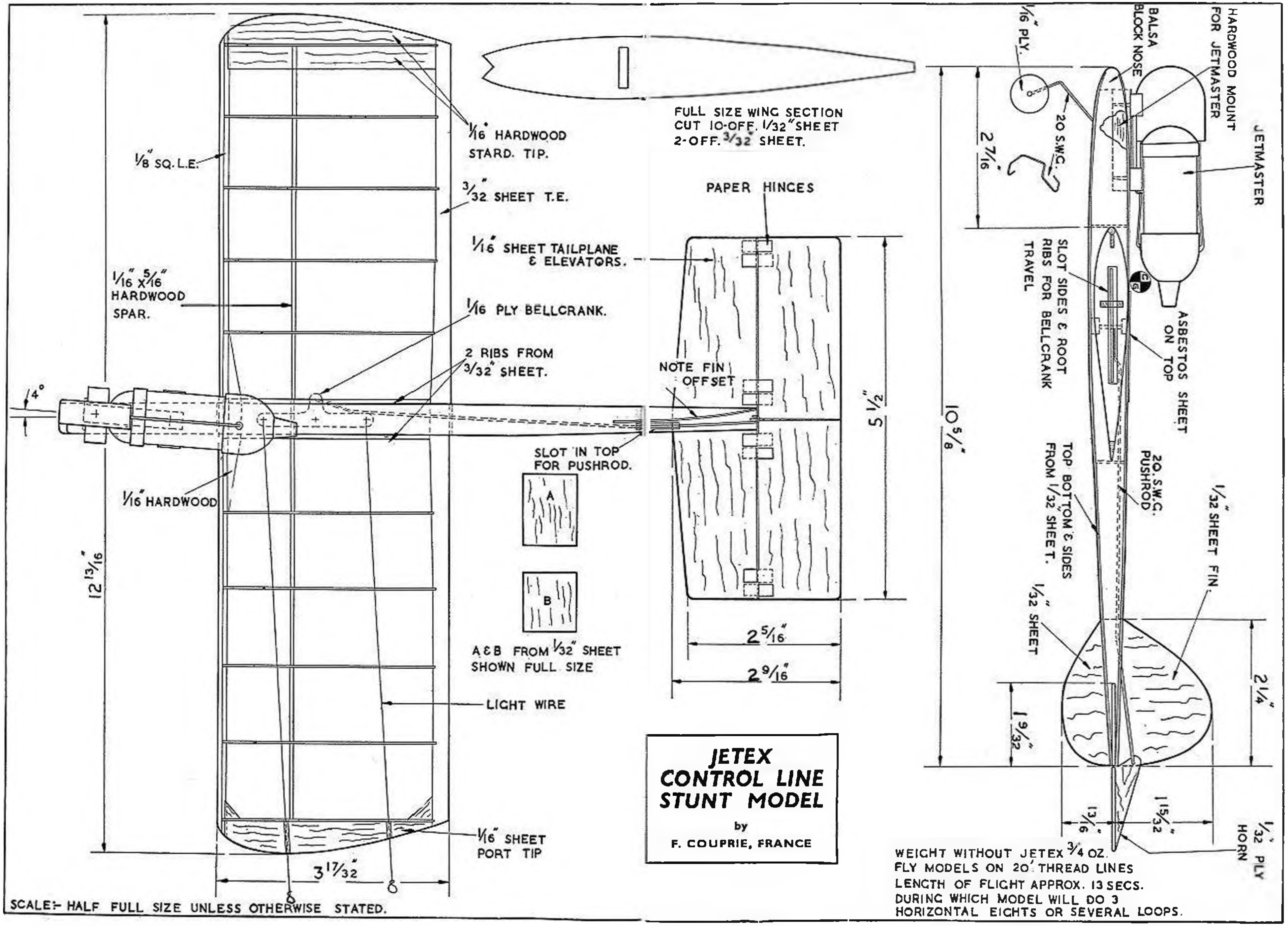
Keeping the Centre of Gravity forward helps to eliminate most problems as does keeping the control flap on the small side. We used a full span flap and kept it very narrow to keep from stalling out the control.

Keep a fair amount of rudder offset as shown on the plan. If more outward pull is needed, add weight in the outboard wing tip or put a rudder tab on the outboard strut.



(Balsa unless otherwise specified)

2—$\frac{3}{16}$" × $\frac{3}{16}$" × 36"	Leading edges
4—$\frac{1}{8}$" × $\frac{1}{4}$" × 36"	Spars
2—$\frac{1}{4}$" × $\frac{3}{4}$" × 36"	Trailing edges
2—$\frac{1}{8}$" × 3" × 36"	Ribs, tips, flap, rudder
1—$\frac{1}{16}$" × 2" × 36"	Planking, tip braces
1—$\frac{1}{2}$" × 3" × 36" (soft)	Fuselage
1—$\frac{3}{8}$" × $\frac{1}{2}$" × 12" (hardwood)	Engine mounts



1/16" HARDWOOD STARD. TIP.
1/8" SQ. L.E.
3/32" SHEET T.E.
1/16" SHEET TAILPLANE & ELEVATORS.
1/16" x 5/16" HARDWOOD SPAR.
1/16 PLY BELLCRANK.
2 RIBS FROM 3/32" SHEET.
4°
1/16" HARDWOOD
12 13/16"
FULL SIZE WING SECTION CUT 10-OFF. 1/32" SHEET 2-OFF. 3/32" SHEET.
PAPER HINGES
NOTE FIN OFFSET
SLOT IN TOP FOR PUSHROD.
A
B
A & B FROM 1/32" SHEET SHOWN FULL SIZE
5 1/2"
2 5/16"
2 9/16"
LIGHT WIRE
1/16" SHEET PORT TIP
3 17/32"
SCALE:- HALF FULL SIZE UNLESS OTHERWISE STATED.
JETEX CONTROL LINE STUNT MODEL
by
F. COUPRIE, FRANCE
HARDWOOD MOUNT FOR JETMASTER
BALSA BLOCK NOSE
1/16" PLY.
20 S.W.G.
2 7/16"
JETMASTER
SLOT SIDES & ROOT RIBS FOR BELLCRANK TRAVEL
ASBESTOS SHEET ON TOP
CG
10 5/8"
20. S.W.G. PUSHROD
TOP BOTTOM & SIDES FROM 1/32" SHEET.
1/32" SHEET FIN.
1/32" SHEET
2 1/4"
1 9/32"
13/16"
1 15/32"
1/32" PLY HORN
WEIGHT WITHOUT JETEX 3/4 OZ.
FLY MODELS ON 20' THREAD LINES
LENGTH OF FLIGHT APPROX. 13 SECS.
DURING WHICH MODEL WILL DO 3 HORIZONTAL EIGHTS OR SEVERAL LOOPS.

PLASTIC MOULDINGS

PLASTIC MOULDINGS, generally speaking, are made by one of two basic methods. The plastic can be in the form of powder, moulded to shape under heat and pressure in metal dies ; or the moulding can be formed from sheet material, softened by heating and then shaped by pressure. The former method involves the use of expensive machines and moulds, but is ideally suited to the mass production of a large number of similar items. Apart from initial costs it is also a cheap production process, since plastic in the form of moulding powders is very much cheaper than the same plastic material in sheet form. Forming sheet plastic, however, can be tackled with quite elementary equipment and is a suitable method for the model maker.

Commercially, too, there has been an increase in interest in forming sheet plastic articles, largely on account of the introduction of vacuum forming as a manufacturing technique. In this process, which again can be duplicated with simple equipment, sheet plastic can be formed, after softening by heat, by sucking down onto, or into, a shaped mould. The particular advantage compared with injection moulding is that the mould can be wood, or plaster, or some similar inexpensive material.

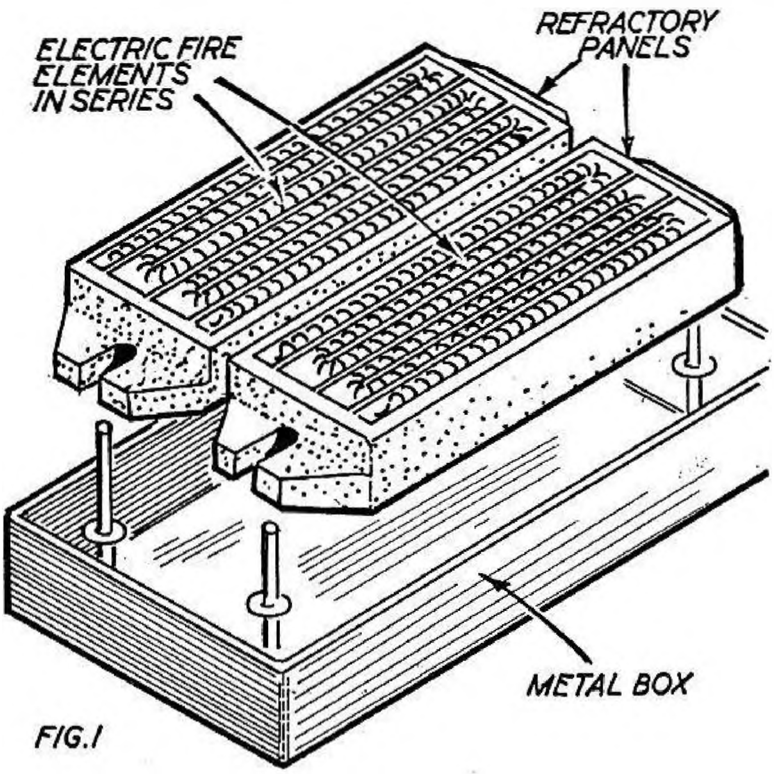
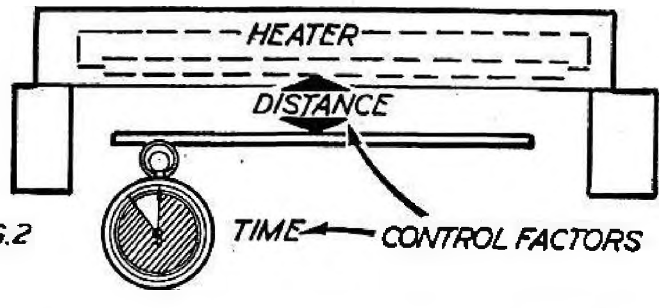


FIG. I

For ordinary "one off" jobs, however, pressure moulding is usually the simplest, and the most direct method to use. It is particularly applicable to the making of transparent canopies, simple "box" shapes, etc., where the depth of moulding is not excessive—*e.g.*, not more than the dimension of the smallest "plan" dimension. A spinner shape, for example, just about comes within this limit where the overall length of the spinner is about equal to its diameter. Pressure moulding a longer spinner may be a little more difficult as the material may be overstrained by the depth of draw, with resulting thin walls (or actual failure of the material to mould to full depth without cracking or tearing). Similar limitations are apparent with vacuum forming, using elementary equipment, although the latter has the particular advantage that fine detail markings can be incorporated on the finished moulding —*e.g.*, panel lines on a cockpit cover. For those desiring similar detail without the complication of vacuum forming, then a modification of pressure forming can be used, as described later.

Mouldings from sheet plastic, with limited equipment, are best kept to simple shapes and forms. Undercuts, etc., can be produced, but it usually means the making of a split mould. The size of the moulding is not so limited. It simply means making up a large enough pattern or mould to accommodate the sheet, and providing uniform heating over the sheet to soften it prior to moulding.

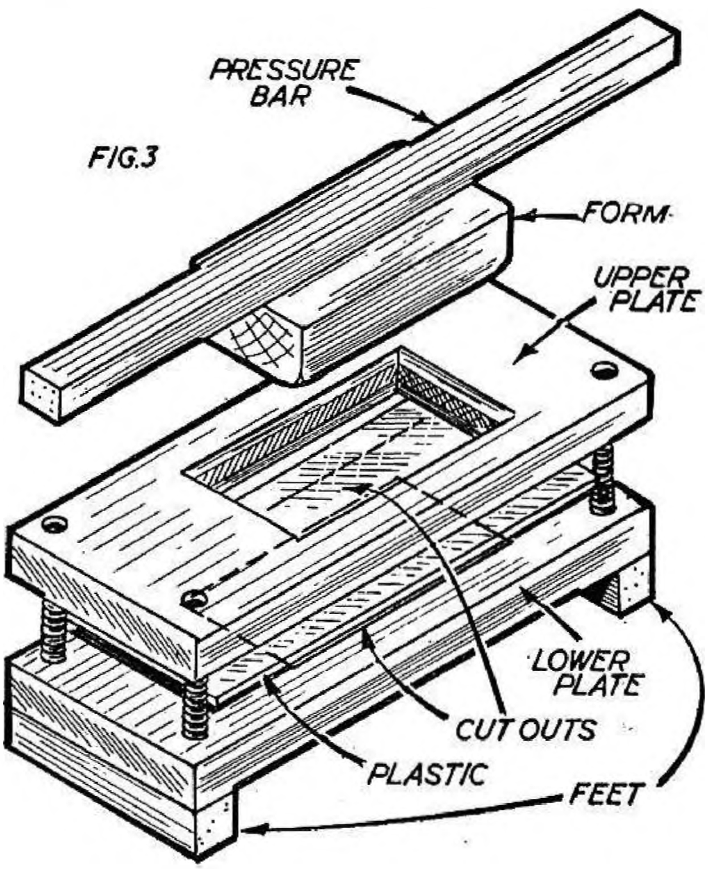
FIG.2



Structural forms, such as fuselage shells, etc., are not usually suited to sheet mouldings, except for small models. Moulded fuselage shells in acetate or similar plastic, for example, are quite suitable for small rubber and glider fuselages up to about 12 inches in length, but less suitable for a control line model fuselage of the same size where the shells are more heavily stressed. Nor are thermoplastic materials particularly suitable for stressed mouldings (with the exception of nylon, which can only be injection moulded). So for cowlings, etc., a reinforced plastic is to be preferred, if a plastic moulding is required. The logical material in such cases is fibreglass, where strength is provided by glass cloth layers and the plastic used is a thermo*setting* resin used to impregnate the glass and set it to a hard, rigid form. The technique is quite different to any other form of plastic moulding since the material in this case is merely laid on a suitable form, coated with resin and left to set. After that it is rock hard, comparable in toughness and rigidity with mild steel.

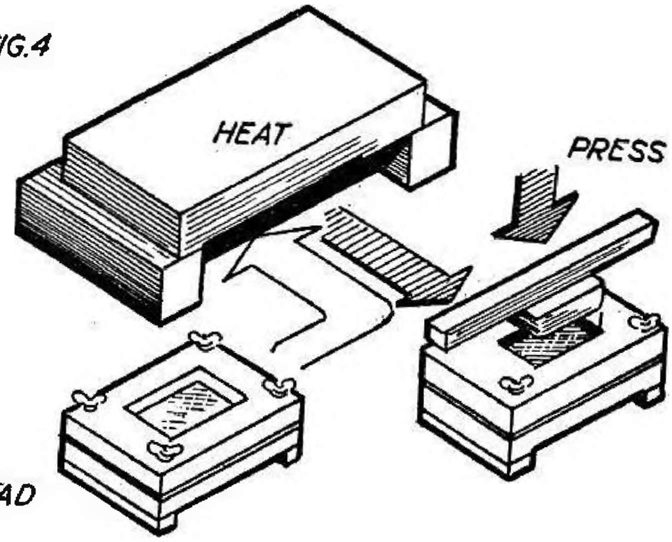
One limitation with all these plastic materials is weight. Acetate sheet, cellulose nitrate (celluloid), Perspex and P.V.C. have a density greater than 1 (*i.e.*, they sink in water) and so plastic mouldings are invariably heavier than corresponding sheet balsa parts (average density about ·14). They need to be about one-eighth the thickness (or volume) of balsa for similar weight, which generally means a relatively thin and weak moulding. Glass plastic is even heavier than balsa (about 10-12 times), but is much stronger than the thermoplastic materials. Thin shells can, therefore, be used to advantage, but still restricted to components where weight is not critical, such as engine cowlings, team racer fuselage, etc.

FIG.3



Moulding of all the thermoplastic sheet materials—acetate, celluloid, P.V.C., etc.—follows similar techniques. Whatever method of moulding is employed a basic requirement is that of heating the plastic material up to its softening temperature so that it will flow or deform to the shape required. Almost all the trouble in "amateur" moulding is incorrect heating—too much, or too little, or non-uniform heating, so the construction of a suitable heater is a wise investment.

FIG.4



Such a heater can be made simply, and cheaply, from two standard electric fire elements connected in series and mounted on suitable fireclay or refractory bases—see Fig. 1. The whole can be mounted inside a metal box (*e.g.*, a radio chassis, undrilled, which can be purchased in all sizes quite cheaply from a radio supply shop) to make a neat, rigid job.

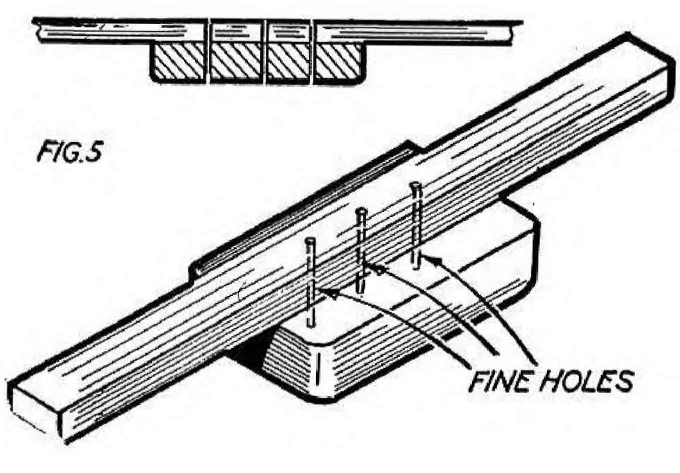
Because the elements are connected in series this heater will operate at "black" or "dull red" heat only. This gives more uniform through heating of plastic sheet. For example, holding $\frac{1}{16}$ in. plastic sheet in front of an ordinary electric fire the side nearest the fire heats up most because plastics are not good heat conductors and by the time the far side of the plastic sheet has reached its plastic temperature the near side is melting, or bubbling.

The alternative to a made-up heater is an ordinary domestic gas (or electric) oven, set to the required temperature, found by experiment. A workshop heater unit is, however, much easier to use, and better for establishing the optimum moulding temperature for a given job, and given plastic, which is quite critical.

Heating is controlled both by the distance between the heating elements and the plastic sheet, and the time the sheet is under the heater—Fig. 2. The heater should be switched on at least a quarter-of-an-hour before it is required for use as it will take about this time to heat up to a uniform temperature. It can be supported, as shown, on wood blocks facing onto a heat-resistance surface (*e.g.*, as asbestos mat).

The distance between heater and plastic sheet will probably be controlled by the method of moulding used, *i.e.*, the thickness of the clamping arrangement used to hold the plastic sheet, but can readily be adjusted by varying the height of the wood blocks, or using wood runners to raise the sheet clamp when slid under the heater. A working distance between heater and sheet plastic of 1-1½ inches is about best. This enables wooden clamps to be used without them overheating or scorching during the heating up period, and gives a heating up time of between 30 seconds to 90 seconds, depending on the type and thickness of the plastic.

FIG.5



Design details of a suitable mould and forming plate are shown in Fig. 3. The forming plate actually consists of two identical pieces, either dowelled together for location or (better) clamped together with four screws and wing nuts. These plates can be made from $\frac{3}{8}$-$\frac{1}{2}$ in. resin-bounded ply.

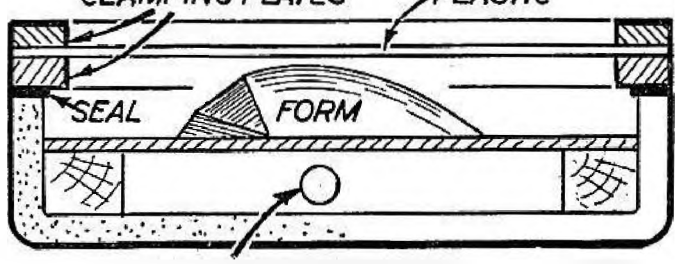


FIG. 6

The form is a pattern of the actual moulded shape required (less an allowance for plastic sheet thickness) and should be made from hardwood. It is attached to a pressure bar (*e.g.*, a 6 to 8 inch length of wood, at least $\frac{5}{8}$ in. square) together with a spacer equal in thickness to the top plate. The cutout portion of the top plate can form this spacer and also act as a location piece to centre the form in the jig when making the actual moulding. The lower plate is cut-out to a matching shape with the base of the form, plus an allowance for plastic sheet thickness all round.

These allowances—*e.g.*, on the finished size of the form, and clearance on the lower plate cut out—are nominal. On an average draw the plastic sheet thickness will be decreased to roughly one-half of its original thickness, so this figure can be used as a "finished size" allowance for the form. The plate cut out needs a more generous allowance, say equal to the sheet thickness. If necessary, this can be further relieved if the plastic will not draw properly, or shows signs of scoring. It may also help if the top edges of the lower plate cut out are rounded off slightly. These are features which can be attended to by trial and error.

The other point to watch is that when the form is in position it should not protrude beyond the plate assembly when the latter is resting on a flat surface. For all but shallow draws (less than the plate thickness), this will mean providing the bottom plate with "feet" or similar supports. Otherwise in moulding the bottom of the plastic will come in contact with the work surface and be marked, ruining the moulding.

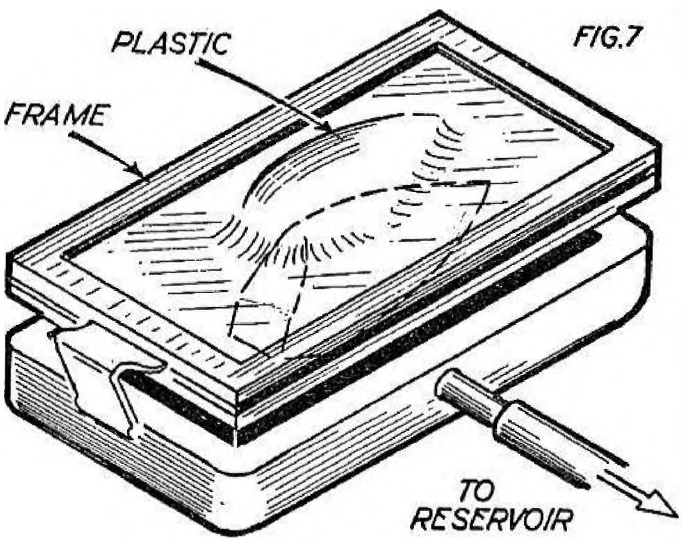


FIG. 7

The moulding cycle then follows the simple procedure shown diagrammatically in Fig. 4. The plastic sheet is cut to size and clamped between the two plates. This assembly is then slid under the heater and left for the appropriate time (determined by prior experiment with a number of test pieces). It is then withdrawn from the heater and immediately the form pressed in place strongly by grasping the pressure bar in both hands (one each end). Make sure that the bar goes down perfectly flat against the top plate and hold down for a time roughly equivalent to the heating time. Then release, disassemble the mould plates and remove the finished moulding. Rather than lengthy description, possible faults, and cures, are detailed in the accompanying trouble-shooting chart.

The above technique is simple pressure moulding which, besides being quite straightforward and capable of giving excellent results, does not require a super-finish on the form to get perfectly smooth mouldings off. Any bad imperfections or roughness will show, but minor defects will not. A reasonably smooth form will give a very smooth moulding, as a general rule.

A simple modification of the form can be used to produce the equivalent of a vacuum formed moulding. That is, by drilling a number of fine holes right through the form, as shown in Fig. 5, the "cushion" of air which tends to be trapped and drawn down between the form and the plastic sheet in the original process can now escape. The fact that this air is under pressure tends to suck the plastic sheet back into intimate contact with the form, as it escapes, so that the plastic sheet conforms to any embossing or detail markings on the form. In a similar way any imperfections on the form will be duplicated on the moulding. To get a first-class finish, in fact, the form should be polished and any detail markings required added very carefully by scoring, or building up (*e.g.*, wire, card or thin ply shapes added).

True vacuum forming requires some elaboration of the equipment. In an original method tried—and which proved very satisfactory for shallow shapes—a metal box replaced the bottom moulding plate, fitted with a rubber sealing strip around the top edge. The upper plate is now completely cut away and is little more than a simple frame, clamping the plastic sheet to the top of the mould box. The male form attaches to a false bottom in the mould box at a height to give minimum clearance between the top of the form and the plastic sheet—Fig. 6. The false bottom is pierced with a number of holes, mainly around the periphery of the form, and the form itself also pierced with fine holes, thus interconnecting the top and bottom chambers of the box. The two chambers together form a sealed unit, with an outlet pipe suitably mounted in the lower chamber.

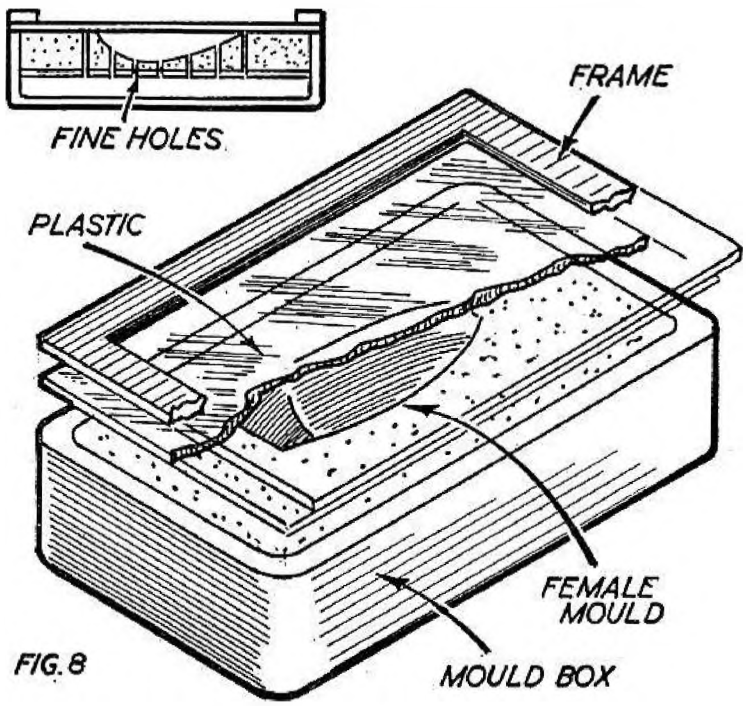


FIG. 8

This is connected with a length of stout rubber tubing to an air reservoir (*e.g.*, a large metal tin suitably sealed and airtight). Another outlet pipe connects, via stout rubber tubing again, to a standard filter pump connected to an ordinary domestic water tap. (These filter pumps are readily obtainable and quite inexpensive.)

The procedure is that by turning on the water tap the filter pump exhausts the reservoir down to some 4-6 lb. pressure (depending on the water mains pressure), with the reservoir outlet tap "off" (or tubing clip in place) to isolate the reservoir from the mould. The mould is then placed under the heater for the required heating time, when the tap is opened to provide suction pressure to the mould chambers, drawing the sheet down over the form—the mould then being removed from under the heater immediately.

This method could be improved upon in detail—*e.g.*, using mechanical pump to exhaust the reservoir, although these are noisy items requiring a lot of power to drive. The area of plastic required to produce a single moulding is rather high. The reservoir volume must be at least twice the total volume of the mould box for satisfactory performance (although much of the lower chamber volume can be blocked off, if desired). It is also rather limited to the depth of draw possible with low vacuum pressures obtainable with a water-operated filter pump because of the double fold which the plastic sheet has to undergo.

A far better arrangement is to have a very shallow mould box with the plastic clamped in a separate frame and readily detachable and quickly clamped back on it—Fig. 7. A male mould is then mounted on top of the mould box, suitably vented with fine holes to the chamber below.

The frame holding the plastic sheet is then heated independently, or with the frame supported on blocks above the mould box so that it does not "rock" on the form. When sufficiently plasticised it is immediately forced down over the form and clamped with quick-acting clamps to the mould box. Suction pressure is then applied to draw the still plastic sheet down snugly over the form. The main difficulty is a mechanical one—arranging that the clamping plates can be locked onto the mould box with an airtight seal before the plastic has chilled to below its plastic temperature.

The further alternative is a female mould instead of a male form, where the plastic sheet can be clamped in place before heating—Fig. 8. The female mould can be in plaster, made off a wooden male form, provided a good enough finish can be obtained on the plaster surface. It is vented with a number of very fine holes to the bottom of the mould box, which in turn is connected to the vacuum reservoir.

For moulding symmetrical shapes there is a technique known as blow moulding which can readily be duplicated using a mould box like that described for vacuum forming. The plastic sheet in this case is clamped over the top of an open box (again with an airtight seal)—Fig. 9. Immediately after the plastic sheet is brought to a plastic state (under the heater), *positive* pressure is applied to the mould box to blow, virtually, a bubble in the plastic. A circular cut-out in the clamping plate will produce a hemispherical bubble, a rectangular cut-out and "bath" shape, and so on. Quite good canopies can be "blown" from a normal canopy plan shape cut in the clamping plate and this method has, in fact, been used on a larger scale for making full size aircraft canopies in Perspex. Flats can also be formed on the moulding by positioning flat surfaces above the cut-out so that the plastic "bubble" bears against them when it is formed.

A similar form of air reservoir can be used for "blowing", but this time pumped up to about 20-30 pounds pressure with a tyre pump. Blowing air must be controlled by a tap, or pinching the inlet tube, so that the shape is not "over-blown" and so distorted, or even ruptured. The moulding operation must, however, be completed quickly as the air will chill the plastic sheet quite rapidly.

If a reservoir is used (satisfactory results can sometimes be achieved with

SHEET PLASTICS FOR MOULDING

Type of plastic	Main applications
Acetate sheet (clear)	Cockpit covers, transparencies, etc.
Acetate sheet (opaque)	Rigid mouldings, *e.g.*, spinners, box shapes, etc.
Celluloid	Cockpit covers, etc. Not recommended as this material is inflammable and also discolours with age.
Perspex	Larger cockpit covers and transparencies.
P.V.C. (flexible)	Flexible mouldings. Clear flexible sheet goes cloudy on moulding and so is unsuitable for transparencies.
P.V.C. (rigid)	Excellent for rigid mouldings, particularly radio control equipment covers, etc.
Laminated plastics	These are thermoset plastics and cannot be re-shaped by moulding.

TROUBLE-SHOOTING CHART—PLASTIC MOULDINGS

Fault	Cause
Too stiff to form	Insufficient heating time. Bottom plate cut-out too small.
Tears when moulding	Insufficient heating time. Depth of draw too great for thickness of sheet (*i.e.*, sheet too thin).
Finished moulding blistered	Too much heating time.
Finished moulding pock marked	Dirt or grit on form or sheet. Moulding may be "bottoming" on table, etc.
Finished moulding warped	Insufficient "holding" time after press-forming.
Thin patches in moulding	Too great a depth of draw, or too abrupt sections (*e.g.*, give more generous corner radii).
Score marks on moulding	Smooth edges of bottom plate—if necessary, round edges and sand on draft.
Moulding cloudy	Too great a depth of draw. Too much heating time.
Moulding rough	Very rough form (pressure moulding). Rough or dirty form (vacuum moulding).
Moulding discoloured	Too much heating time. Grease on form.

a footpump connected direct to the moulding box with a long length of tube to act as a reservoir), it must be stouter than a sealed tin. The latter will withstand vacuum pressures of the order produced with a tap-operated filter pump and if it does collapse will collapse inwards, without harm to anyone. A vessel which bursts when pressurised with air, however, can be extremely dangerous. Thus a proper pressure vessel should be used for blow moulding, preferably fitted with a pressure gauge (so that you can always have the right order of pressure for a particular moulding job) ; and a safety valve so that the reservoir cannot accidentally be charged to an excess and possibly dangerous pressure. Any remaining pressure should be let off when the equipment is no longer in use.

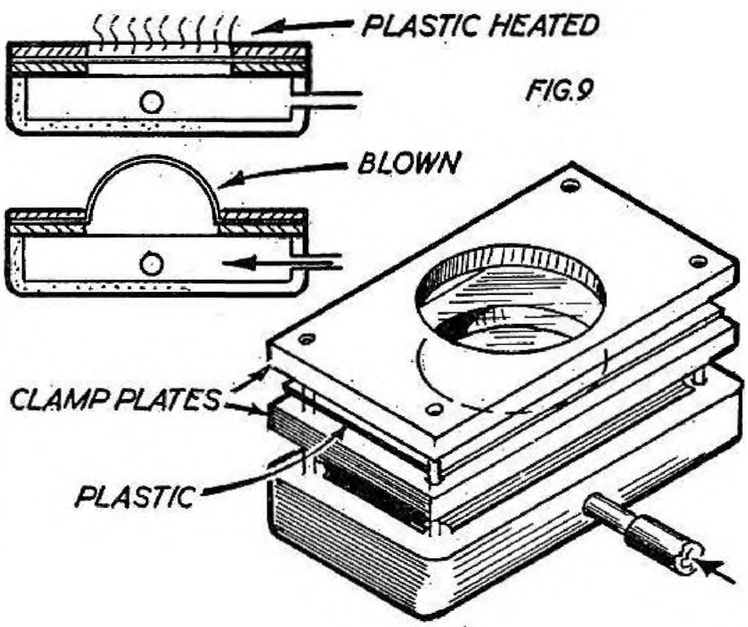
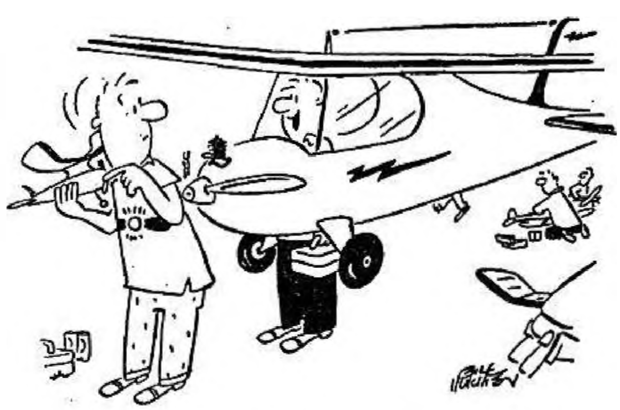


FIG.9

Plastic moulding can be quite good fun—and most rewarding. At least half the secret is "know-how" acquired by experience and practical tests to establish correct heating times, etc., for different materials and sheet thickness. Results up to the best professional standards are readily obtainable and scope is not restricted merely to cockpit canopies and other simple fittings. Outside of actual aircraft parts, it is equally satisfying to be able to mould small parts containers for the model box, covers for pieces of equipment, etc., etc. Check with the table which plastics to use for particular jobs. All the materials listed are readily obtainable and suitable for amateur working.

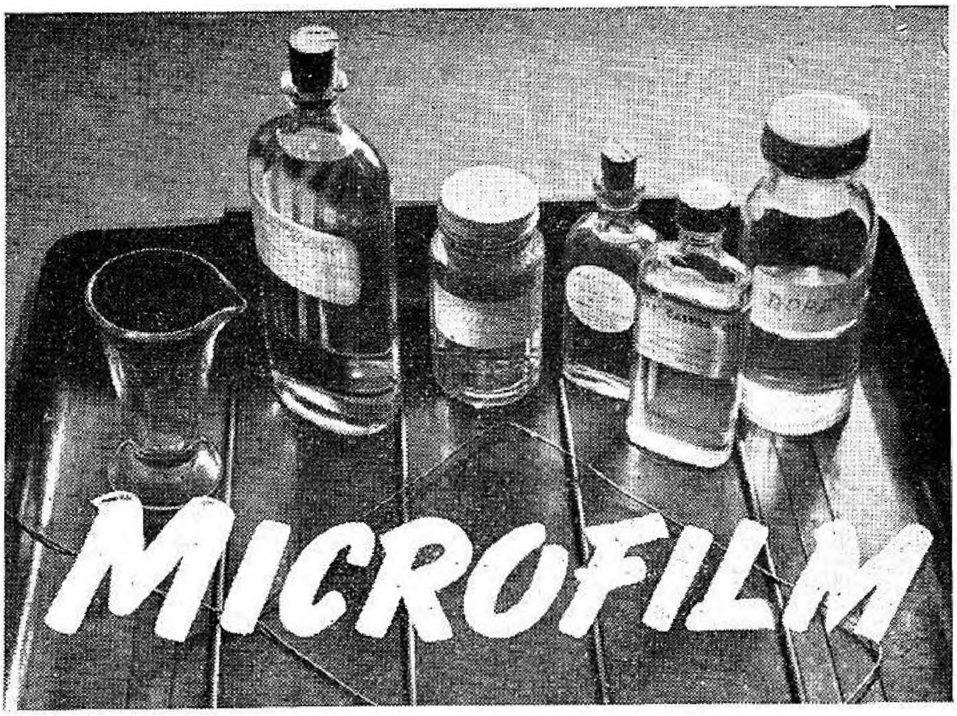
MODELLING TIPS . . .

When single-hand unreeling a new set of control lines ready for a meeting, obtain a couple of medium sized flower pots. Have one at each end of your line distance, and jam the reel over the tapered top and place a stone on top. This discourages the wire unreeling all over the place. . . . To clean a dope brush, yet retaining a reasonably clean pot of thinners, wrap the bristles in a double thickness of heavy tissue, then douse in the thinners. Tissue will filter the dope from the stock thinners, and can be used to wipe out excess pigment.



"Which way to the R/C area, Buddy?"

American Modeler



MICROFILM WAS first introduced as a covering material for indoor models by Kittel, of America, in 1931. It is, virtually, nothing more than a very thin film of dope, prepared by pouring liquid dope on clear water where it spreads out over the surface into an extremely thin film which sets or hardens in a matter of a minute or so, and can then be lifted off ready for application to a model.

Its particular advantages are that, as a covering material it is non-porous, very light, easy to fix, uniformly smooth and reasonably stable. It does not have to be tautened after application, nor does it slacken off or tighten up appreciably under different atmospheric conditions. Hence it can be applied over an extremely light frame without fear of subsequent warping. And since, in general, the lighter the overall weight of an indoor model the better its performance, the microfilm model will always outperform its tissue covered counterpart.

The main limitation of microfilm is its low strength. The film is readily holed or damaged, even by comparatively gentle handling. In fact, microfilm is not normally handled at all. But it is not as weak as many people imagine and provided the proper technique is followed in making the film and covering the model, and in subsequent handling of the model, it will give perfectly satisfactory service and long life. The main source of damage is usually in storage. A microfilm model is a relatively fragile affair and so light that it may be wafted off the top of a cupboard by a slight draught. The only way to keep a microfilm model properly is in a box, or in its own travelling case, which besides protecting it from mechanical damage will also keep it from getting dusty (and you cannot dust off a microfilm covered surface like you would an ordinary model wing !).

Many people are put off microfilm models because they think they are too tricky to build, or need too large a space to fly them properly. Construction is, admittedly, rather more delicate than ordinary model building, but the making of microfilm and applying it as a covering material is quite straightforward. As to size limitations, small free flight microfilm models can be flown in any average size sitting room—without fear of damage to furniture and fittings, because they are so light and fly so slowly—and regularly achieve durations of one to two minutes. For round-the-pole flying, models designed with microfilm covered wings and tail units will invariably outperform the all-tissue covered model. So one does not need access to a large hall to put microfilm to work to advantage. Given any reasonably sized hall, such as a typical club room, flights of three to five minutes duration should be obtainable, with practice, with medium size models. The really long durations possible with microfilm models —twenty minutes or so—do need large areas to achieve, and large models. But these are models for the expert.

A common mistake is to build models which are too large, and too light and fragile, for the available flying conditions. Small to medium size models, more robustly built, will give far better results for restricted space flying, and be easier to build and handle. Plans of a typical medium-size model with a wing area of 60 sq. in. are given at the end of the article, which should be capable of flights of up to ten minutes duration in really large halls but can equally well be be flown in large rooms with a ceiling of only 10 feet or so. In the latter case, duration will largely depend on trimming—how many circles you can achieve before the model hits the wall or hangs up on some obstacle. Microfilm covering is used throughout, even for the propeller. The built-up microfilm propeller is much simpler to make—and lighter—than a carved balsa propeller to indoor standards.

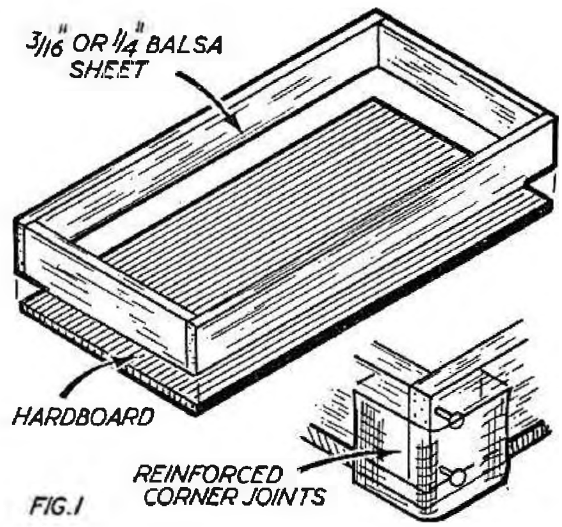


FIG. 1

Microfilm solution is a lacquer, and the material used for covering a lacquer film—virtually the film of dope, on its own, which is normally applied over tissue covering. Any lacquer consists essentially of a *base*, which forms the "body" of the solution, a solvent to dissolve the base, and a plasticiser to give the dried film a certain amount of flexibility to prevent it cracking or wrinkling. Coloured lacquers, of course, also incorporate a pigment, but these are not used for microfilm. Microfilm has it own natural colour (prepared from clear lacquers) because it is so thin that ordinary white light is diffracted passing through it giving the appearance of one or other, or a mixture, of true "rainbow" colour(s). The colour of microfilm is, in fact, a reliable guide to its thickness, and hence its weight.

Most clear lacquers will form a film when poured onto water. However the film is usually heavy (because the solution does not spread well over the water surfaces), weak or patchy (due to the presence of gums and resins), wrinkled and even sticky. Certain ready-made lacquers, however, of which ordinary clear dope is one, will produce very nice films, except that they are apt to be rather wrinkled.

This is because they are not sufficiently plasticised for our purpose. A simple remedy is to add more plasticiser to the dope—castor oil being a very effective plasticiser—until wrinkling just disappears, or is restricted to the edges of the film. The amount of castor oil required will vary with the type of dope used and is best found by experiment.

Start with, say, a one-half or one ounce bottleful of clear dope and pour a little onto the middle of a surface of clean water (*e.g.*, in a bowl or tray, or in a special tank, as described later). Note how the film spreads and wrinkles. Add two or three drops of castor oil to the dope, mix well, and repeat the experiment. Continue, as necessary, until a film is formed which wrinkles only round the edges. Your solution is then just right for making microfilm.

Too much plasticiser will produce a film which remains tacky when dry, which is no good. Some people prefer to use tricresyl phosphate as a plasticiser instead of castor oil to be sure of not getting a tacky film. Camphorated oil and Canadian balsam are other suitable plasticisers, but have no advantages over castor oil.

The flow of the solution over the surface of the water is largely governed by water temperature and the amount of solvent in the solution. Except on very cold days the temperature of ordinary tap water is suitable, although some people definitely prefer lukewarm water. A film can be made to spread more thinly by adding more solvent (*e.g.*, dope thinners), but too much solvent will ruin the film. It will make it patchy and probably run to holes or weak spots. Ordinary model dope (from a fresh tin or bottle) is usually about right for microfilm solutions without the addition of more solvent, *i.e.*, with the addition of castor oil (up to 10 drops per ounce of dope) to plasticise. Some dopes may even give satisfactory films without the addition of any further plasticiser (castor oil).

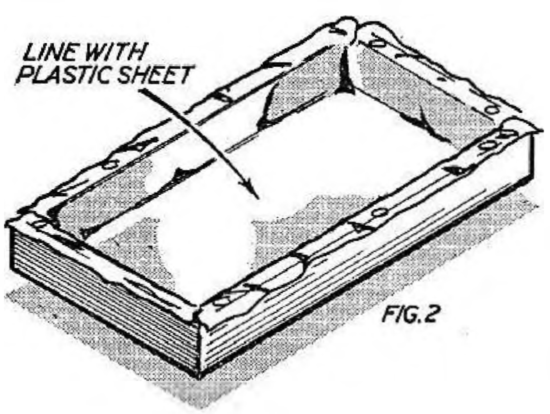


FIG. 2

For those who prefer a more "scientific" solution, this can be compounded from pure base, solvent and plasticiser materials. The "base" in dope is pyroxalin, which may be purchased from the chemist as collodion or flexible collodion. (*Flexible* collodion is pure collodion plasticised with castor oil). A suitable solvent is amyl acetate or acetone, in the proportion 12-16 drops per ounce of collodion. The plasticiser is castor oil—10-14 drops per ounce for collodion base ; slightly less for flexible collodion base (since this already contains some plasticiser.) The exact proportion of castor oil required is best determined by experiment, as above. Tricresyl phosphate can be used in place of castor oil, if preferred, but a slightly greater amount will be required (*e.g.*, up to 16 drops per ounce).

Made-up microfilm solutions will keep indefinitely in a well-corked bottle. Keep a record of the final mixture arrived at to give a suitable film so that you can duplicate it again later, if required.

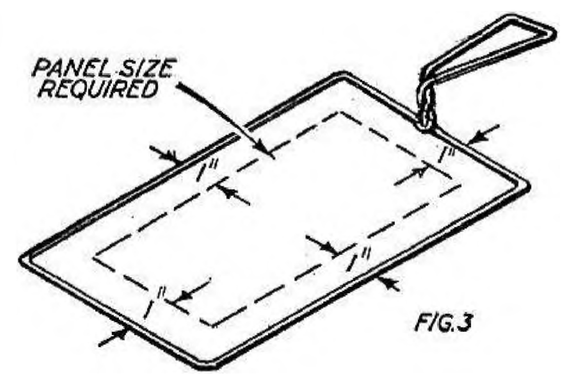


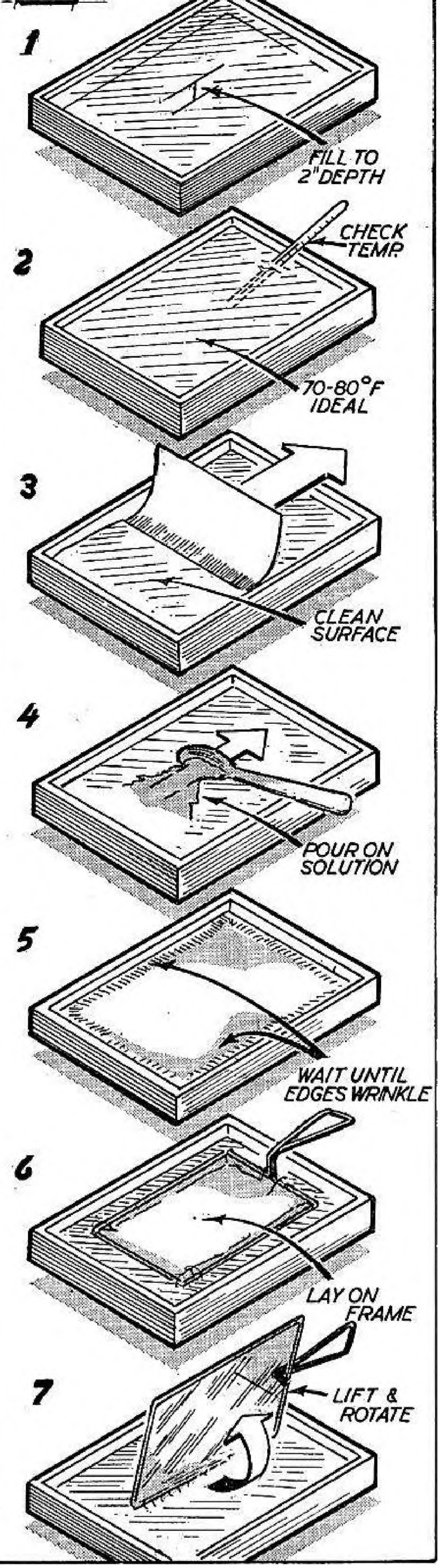
FIG. 3

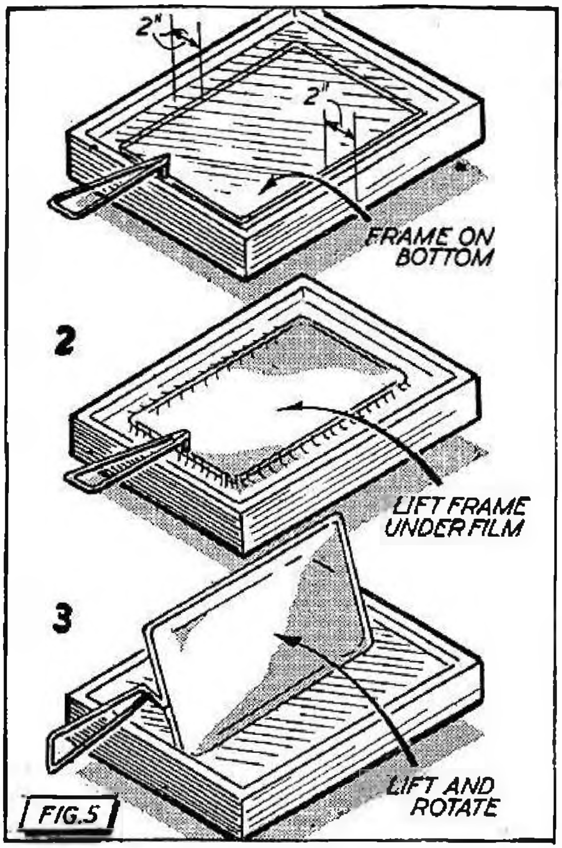
Although traditionally microfilm sheets are made in the family bath—being the only ready source of a sheet of water large enough to make large films—a far more satisfactory method is to make up a tray of the required size. This can be used on the table, at a convenient working height. The size of the tray should be some 6 inches longer and wider than the largest film which is required. It is usually best to work with a depth of water of 1 to 2 inches, so the sides of the tray should be slightly greater than this. Conveniently, standard 3 in. wide balsa sheet can be used for the sides, cemented down securely to a suitable base panel, which can be hardboard for cheapness, or balsa sheets side by side—Fig. 1. It is advisable to pin and reinforce the corners with cemented on bandage strips to make sure that the tray will not collapse.

The tray need not be waterproof, but instead can be lined with flexible plastic sheet—*e.g.*, an old plastic raincoat, or polythene sheet. The plastic is merely draped over the tray neatly and uniformly and can be attached to the top of the sides with drawing pins, if necessary.—Fig. 2. Trim off any surplus plastic neatly, as otherwise this may get in the way, or get caught in a sleeve.

For lifting the film off the water, once formed, a number of wire frames are required. These should be made from a non-rusting, easily bent wire such as galvanised iron wire, or brass wire (far more expensive than galvanised). The frames should be at least 2 inches longer and wider than the actual covering area required—Fig. 3. Wire size is governed by the size of the frames, 16 s.w.g. being adequate for frames up to a foot along, 14 s.w.g. being adequate for larger sizes. A convenient grip for holding and lifting is easily bent by bringing the two wire ends together, as shown. The

FIG.4





After many years in the doldrums, indoor flying has taken on a new lease of life, and the introduction of new record classifications has created new interest in this fascinating phase of aeromodelling.

more frames you have the better, for you can then make up a large number of sheets, selecting the best for covering.

Before filling the tank, make sure that the plastic covering is clean. If greasy or dirty, wash in detergent and then rinse thoroughly in clean water. The tank can then be filled to a level of about two inches with clean water. Water temperature, ideally, should be between 70 and 80 deg. F. If below 60 deg. F., add warm water to raise the temperature. The *surface* of the water should then be cleaned thoroughly by drawing over it the edge of a piece of newspaper.

The microfilm solution is best poured on *via* a teaspoon (or a dessert-spoon for a very large sheet), which enables you to control the amount of solution used each time. Pour on with an even, sweeping motion from one end of the tank to the other. Do *not* simply pour all the solution into the middle of the water and expect it to spread out evenly.

If the solution is properly proportioned—and you have poured on enough—the film should spread right to the edges of the tank. Almost at once it will begin to set and the edges start to wrinkle. In about half a minute the film will be quite set and ready for lifting off.

To do this, lay the wire frame on top of the film, resting your wrist or arm on the table for support, as necessary, and with the free hand, double back the edges of the film over the wire frame. Make sure that *all* the film edge is turned over the frame. The frame should then be rotated gently to lift the film off the water, finally lifting it quite clear. The complete sequence is shown in Fig. 4.

There is an alternative method of lifting the film where the frame is submerged in the water *before* pouring the film. After the film has set the frame is lifted to contact the underside of the film when the edges are wrapped under the frame edges all round. Again the film is finally lifted by a rotating motion of the frame—Fig. 5. This method has the disadvantage that if the film, as poured, is not large enough for the frame it is wasted. With the former method the undersize film could be lifted by selecting a smaller frame—and be usable for a tailplane, etc.

All films, once lifted, should be left to "age" before applying to the model. During this period they dry and take up a certain amount of "set"

TROUBLE-SHOOTING TABLE—MICROFILM SOLUTIONS

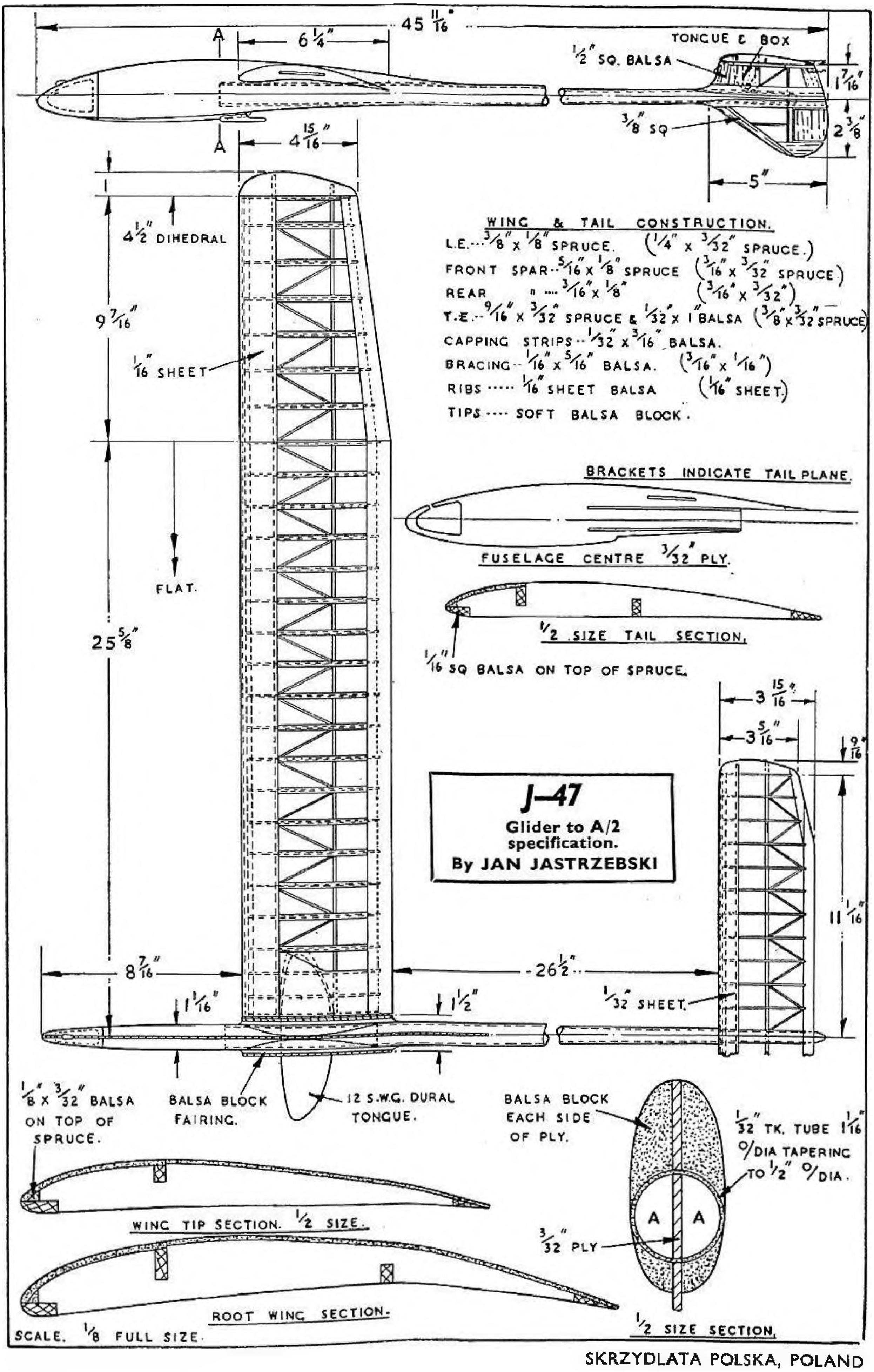
Fault	Cause	Cure
Film wrinkled all over	Lack of plasticiser	Add more castor oil
Film sticky	Too much plasticiser	Add more dope
Film cloudy	Water too cold	Add warm water
Film does not spread	Water too cold Not enough solvent	Add warm water Thin mixture with solvent
Film patchy and weak	Too much solvent	Add more dope
Film has holes	Water surface dirty	Clean
Film too thin	Water too hot Too much solvent	Add cold water Add more dope
Film too thick	Water too cold	Add warm water

tauten up and harden slightly. They are then stable and stronger than when first made. Any water drops on the film should be shaken off, as far as possible, and the film then hung up by the frame in a dust-free atmosphere, like the inside of a cupboard. An ageing period of 24 hours is generally considered best.

The colour of the film, as mentioned, is a guide to its thickness (and strength). A satisfactory general-purpose film is red-green in colour. Absence of colour or a clear film means that it is excessively thick. A yellow or violet, a thin film. Film thickness is largely controlled by the proportion of solvent in the microfilm solution, the water temperature, and the amount poured onto the water, all of which factors are adjustable. For convenience of reference, typical faults both with microfilm solutions and finished films are detailed in the accompanying trouble-shooting chart.

TROUBLE-SHOOTING TABLE—FINISHED FILMS
(Assuming solution is adjusted to apparent correct mixture)

Fault	Probable cause
Film too small	Not enough solution poured on. Pouring not even. Water too cold. Frame too big for tank.
Film breaks on lifting	Edges not turned over properly. Water trapped on top of film when lifting.
Film has small holes	Dirty water surface.
Film slack	Should tauten on drying (check solution for too much plasticiser).
Film variable	Pouring may be uneven—check microfilm solution.



SKRZYDLATA POLSKA, POLAND

"MOULDED" BALSA CONSTRUCTION

BALSA IS A far from satisfactory material for "moulded" type of construction since it has no definite "plastic yield" point, except under extremely high pressures. In the latter connection it is interesting to learn that balsa can be compressed fairly readily up to, say, a tenth of its original thickness to yield a quite solid and remarkably durable material, but still retaining the general characteristics of balsa. In a moistened state, and with the application of heat, balsa can also be bent to curve readily, and will stay bent on drying, like any other wood. But trying to form balsa to curve in two directions simultaneously is far more difficult and, in fact, limited. Even the modern commercial processes of moulding balsa fuselage shells under heat and pressure often have to "tuck" or "fold" the material to achieve duo-curvature, especially tapering curves.

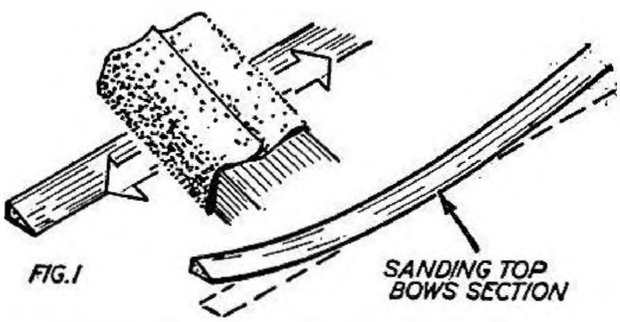


FIG. 1

One of the simplest ways of "moulding" balsa—which most people do accidentally without realising it—is working on one face of a flat strip, such as when sanding a trailing edge down to final shape. The act of shaping and finally sanding the top face of the "wedge" section puts the fibres of this face in tension, so that the result is a curved strip—Fig. 1. To take out the curvature it is only necessary to sand the bottom face lightly until the strip length is straight again. This is a point worth watching in wing and tail-plane construction for if the trailing edge strip is naturally curved, when finished, pinning it down flat when building will not automatically ensure that it is properly flattened (unless the ribs are geodetic or similar anti-warp arrangement). Thus such a wing will immediately tend to warp again as soon as it is removed from the building board. If the trailing edge is finally sanded after the wing frame is built, then a warping tendency is given by this treatment, unless the underside of the trailing edge is similarly sanded.

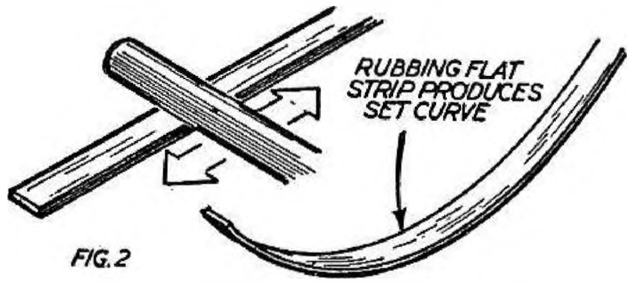


FIG. 2

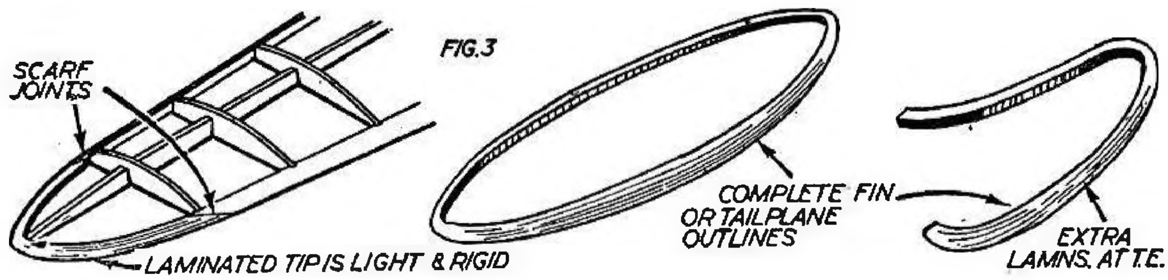
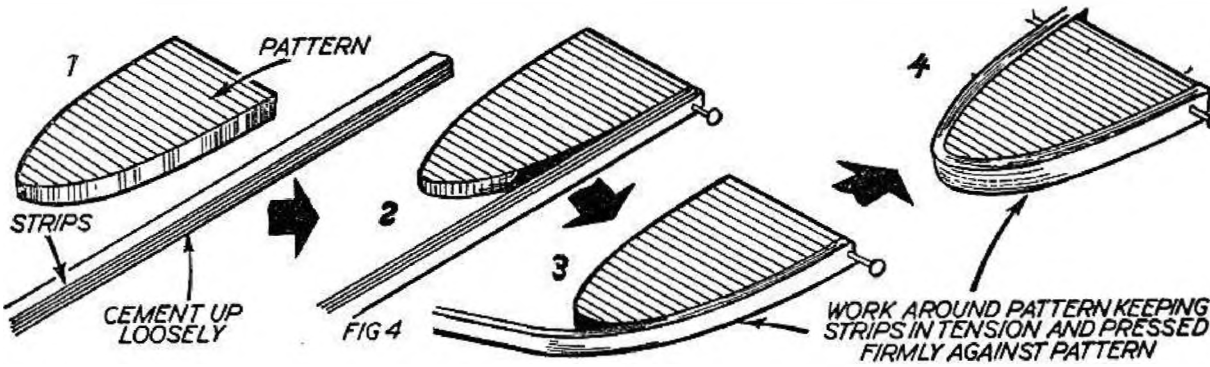


FIG. 3

We can use a similar principle for bending strip balsa—*i.e.*, "moulding" it to a curved shape. If one side of a piece of strip is rubbed hard with a pencil, or a piece of dowel, it will develop a curve towards that side—Fig. 2. It is possible, with care and patience, to form a foot length of strip into a circle in this way.

It is not a very exact method of forming strip, however, although it can be used effectively in many instances.

Where a "moulded" length of balsa is required—*e.g.*, for a rounded or elliptic wing or tailplane tip, or even a complete outline for a former, a tailplane

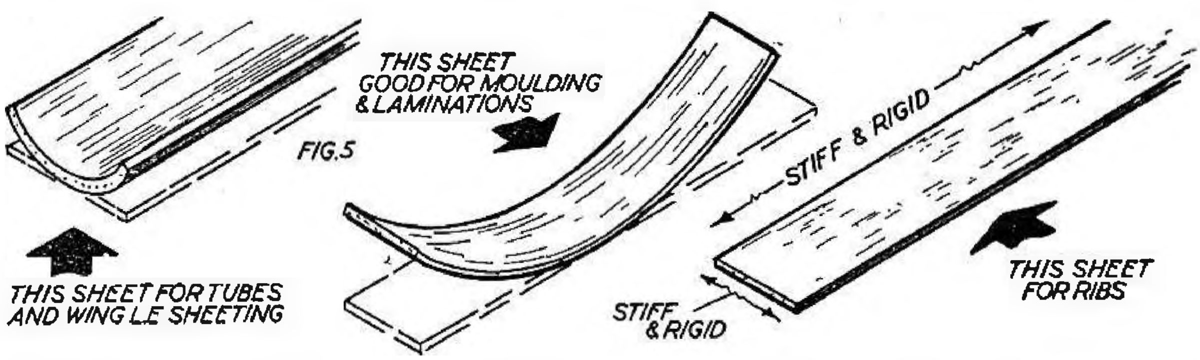


or fin—a far better method is lamination. (Fig.3). This was once widely used in airframe construction, but has largely gone out of favour since modern design outlines favour "square" shapes which are more readily formed from balsa sheet, strip or block.

With laminated mouldings, balsa strips are used of a thickness which will bend readily around the outline shape required without cracking. Usually $\frac{1}{32}$ in. strips are employed since, if the right grade of wood is selected, these will bend round a $\frac{1}{2}$ in. radius or less without cracking. $\frac{1}{16}$ in. thick strips can be used for more generous bend radii ; and $\frac{3}{32}$ or $\frac{1}{8}$ in. strips, if necessary, for leading and trailing edge lengths, to save on the number of laminations.

Starting point is a pattern of the inside shape required, which can be cut either from thick card or sheet balsa. The edges of the pattern should be properly smoothed and rubbed over with a candle to make them non-adhesive to cement. A sufficient number of laminations are used to build up the required strength and section width, doubling up with further laminations in certain areas, if necessary (*e.g.*, on the trailing edge of a tailplane or fin outline).

The lamination strips should be cut from a single sheet, selected as being light and bending readily end to end. Check with the first strip cut off that it will bend round the pattern without cracking. The best method of making the final laminated moulding is to bend them to shape all at once. Use a slow



drying cement, coat all the strips generously, but evenly, with cement (the inner and outer strips on one side only) and pile up together. Now pin securely to one end of the pattern. Apply pressure on the laminations away from this fixing point and work right round the outline, forcing the laminations hard together and close up against the pattern all the way. Finally pin the far end and leave to set—follow Fig. 4. This should eliminate any "dry joint" spots, and, by applying pressure inwards against the pattern all the time, reduce the chance of breaking or kinking the laminations on the sharper part of the bends.

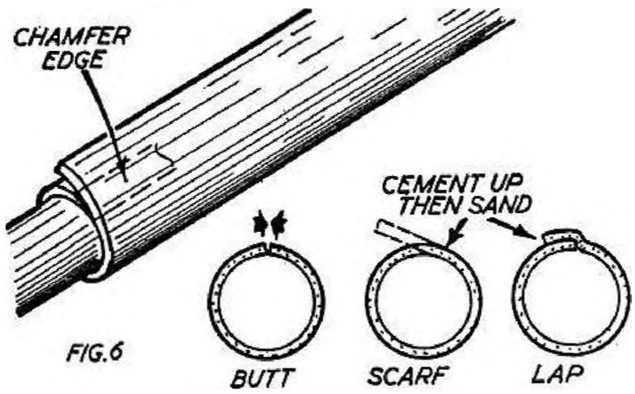


FIG. 6

A point to bear in mind is that when making identical parts, *e.g.*, two wing tips, use double width laminations. Then a single moulding, sawn down the middle when set, will make both tips—and they will be identical in shape. Sawing is better than cutting with a knife as with the latter method the blade may wander off the centre line.

Sheet balsa will readily mould into "straight" curves, provided you select initially sheet which is flexible, edge to edge. Certain cuts of sheet are stiff in this direction, or even brittle. If you cannot identify the "cut" by examination of the sheet, flexing it will soon show which job it is best suited for—see Fig. 5.

The former "cut" can often be rolled dry into a tubular shape, although it is usually best to thoroughly moisten the sheet first to be on the safe side. Then wrap round a suitable former—*e.g.*, of the diameter you want the finished tube to be—bind with rubber strip (or wool or tissue strips in the case of very light, thin sheet) and leave to dry. When dry, trim down for the edge joint, cement up and bind onto the former again, lightly this time. The former should be waxed to prevent the tube sticking to it, and should also be withdrawn before the cement has fully set. Two typical joints are shown in Fig. 6, the scarf joint being the hardest to make accurately, but the strongest. Lap joints are not statisfactory from the appearance point of view.

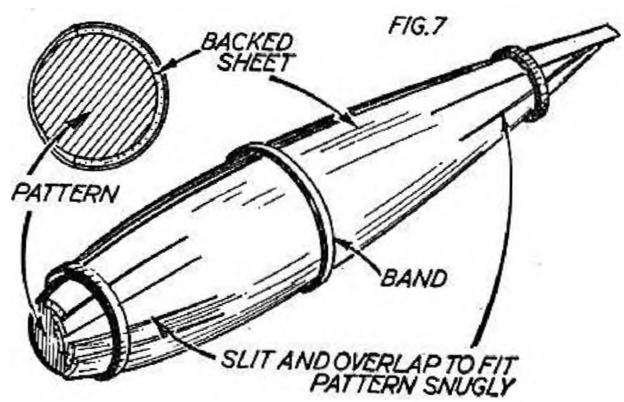


FIG. 7

A method of wrapping tubular shapes, etc., with sheet balsa in a dry state is first to cover the inside of the sheet with tissue or lightweight silk, applied with photopaste. This will prevent the balsa splitting when it is bent and is particularly effective with thicker sheets (but here you must use silk or linen facing, not tissue).

Backed sheet can also be used successfully for making semi-moulded fuselage shells with duo-curvature. This is a somewhat tedious way of making a "one off" fuselage since a solid pattern of the actual fuselage has to be made first, on which the shells are formed. Once the pattern has been made, however, any number of identical fuselages can be made off it.

Preferably the width of the sheet should be at least equal to half the maximum circumference of the fuselage. Narrower width sheet can be joined —and the backing (preferably silk) will reinforce the butt joint—but there is always some danger of this joint line parting when the sheet is being formed.

The sheet should be well moistened and bound to the fuselage form at the widest part. Rubber bands can be used to strap the sheet roughly to the other ends of the form. Working with more rubber strip, or bands, from the middle section see how far the sheet can be moulded to the shape of the form. Fig. 7. When it becomes impossible to accommodate the curvature without a crease developing, slit the sheet from here to the end and overlap, binding securely in place. Repeat for both ends ; the front end possibly needing three or more slits to conform completely to the required shape. The sheet should then be left to dry out, still bound to the form.

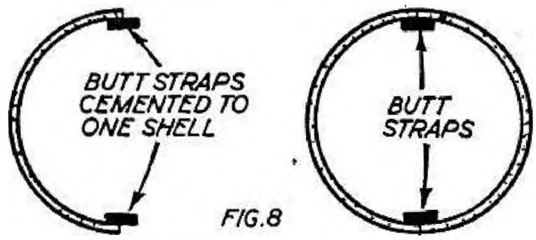


FIG.8

The majority of the binding can then be removed, leaving just the middle binding to keep the rough shell in position. Where the balsa skin overlaps it should then be trimmed down with a really sharp blade so that the two pieces will now fit together neatly with a butt joint. Take time and care to get these joints as neat as possible and then hold in place with a strip of cellulose tape over the whole length of joint. When all the overlaps have been turned into accurate butt joints and taped, the shell can be removed from the form.

Additional binding strips should now be cemented to the *inside* of the shell over the whole of the length of the butt joint areas. When set, pull off the cellulose tape from the outer surfaces and coat both inside and outside of the shell generously with dope. Leave until touch dry and then bind back lightly onto the form and leave until the dope has thoroughly dried out (6-8 hours).

The second half shell is made in a similar manner. Both shells can then be assembled on the form again, with overlapping edges, for trimming the final joint line. In the complete fuselage a number of formers will probably be necessary for internal bracing, fixing points, etc., and these will help in aligning the two shells when they are finally joined together. However, it will be advisable to run a butt strap under the shell joint, *i.e.*, a strip of balsa first cemented on one shell (top and bottom edges) and the other shell cemented over this—Fig. 8.

This method lends itself to many applications and can also be worked in quite thick sheet (*e.g.*, up to $\frac{1}{8}$ in., or even soft $\frac{3}{16}$ in.) Thicker sheet has the advantage of leaving more to work on when sanding down. Nothing thinner than $\frac{1}{16}$ in. sheet should be used for semi-moulded shells, otherwise the walls will be locally weak and also prone to sink in between formers.

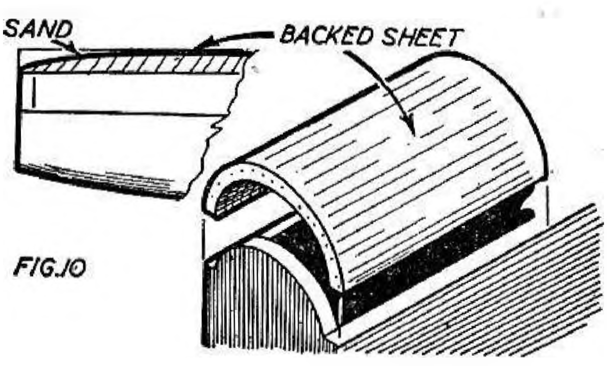
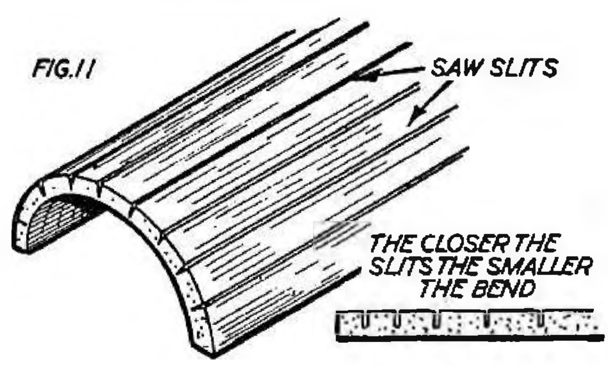


FIG.10

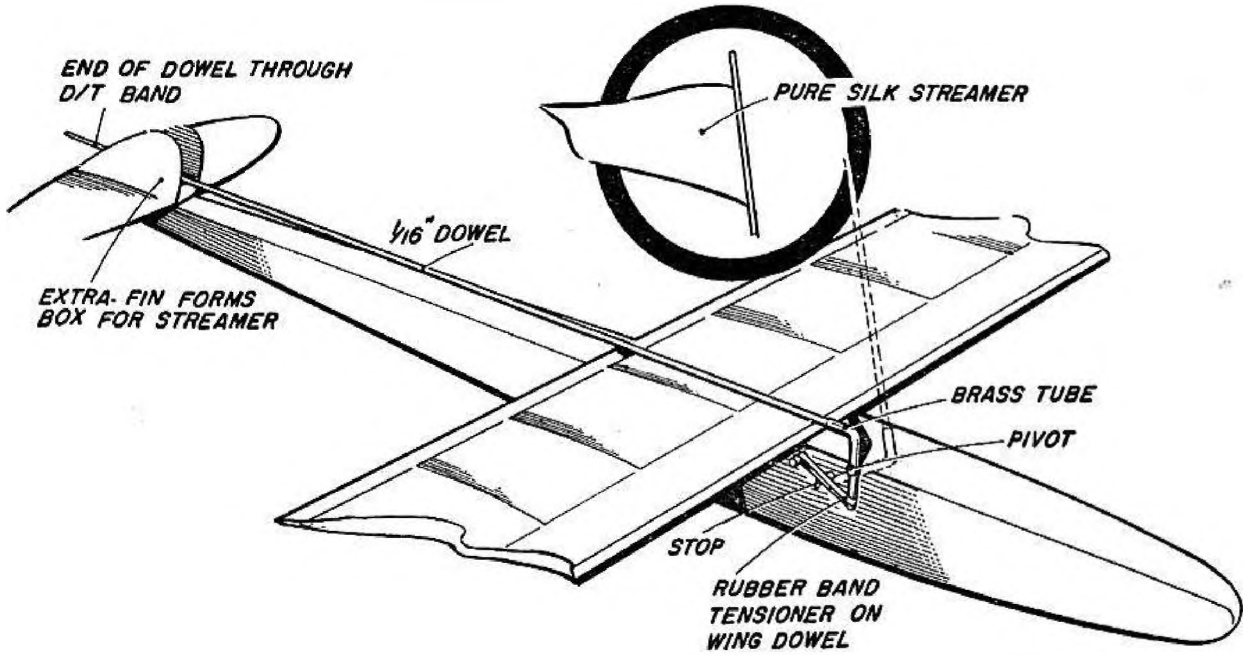
FIG.11


A further ready application of backed sheet is for cowlings and similar areas of sheet covering calling for a fairly sharp curvature. If thick sheet is used again—$\frac{1}{8}$ in. or $\frac{3}{16}$ in.—this leaves plenty of spare material for sanding down to a double curve (at the expense of thinning the sheet at the ends). See Fig. 10.

An alternative here is to use "integral strip" instead of sheet. If you have handled a kit with "integral strip" in it—the kind of strip which is cut in sheet form and not quite cut through—you may have noticed how easily such a sheet will bend edge-to-edge. If solid sheet is cut roughly two-thirds to three-quarters the way through—Fig. 11—it will bend with remarkable ease, the closer the spacing of the cuts the smaller the radius of bend possible. The main trouble is in cutting the sheet to a uniform depth, necessitating a stop mounted on the knife blade for consistent work. Semi-cut sheet is, however, remarkably effective for curved covering jobs once you have got the knack of cutting it without cutting *through* the sheet and although the cuts open up when the sheet is bent in place these gaps are readily filled with grain filler, or even sanded out, when finishing.

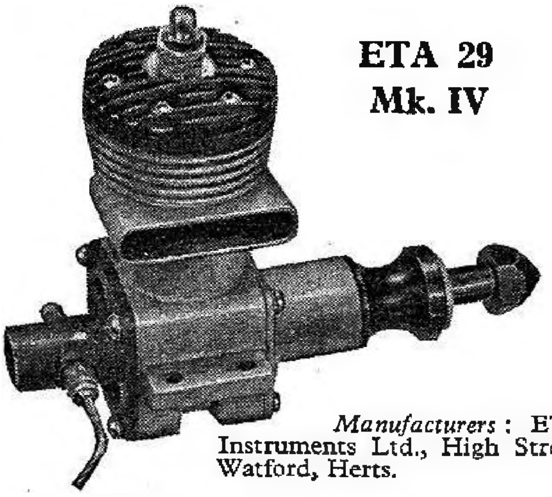
MODEL FINDER

A Novel Retrieving Method



This novel idea comes from S. A. Wade, of Loughborough. Models d/t'd over long grass or crops are often difficult to see, and this handy little gadget provides a simple yet practical solution.

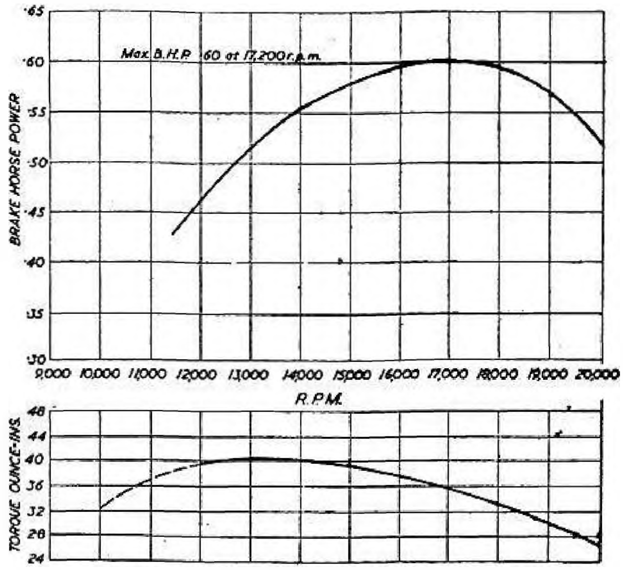
A suitable length of $\frac{1}{16}$ in. dowel is pivoted to the fuselage via a short length of brass tube, the pure silk streamer (recommended as it does not crease) being accommodated in a box at the tail end of the machine. Normal d/t operates the release, and the flag should assist observation whilst descending as well as serving its purpose of a focal point when grounded.



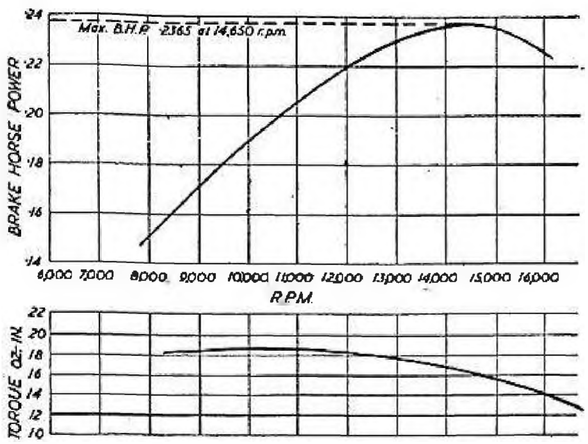
ETA 29 Mk. IV

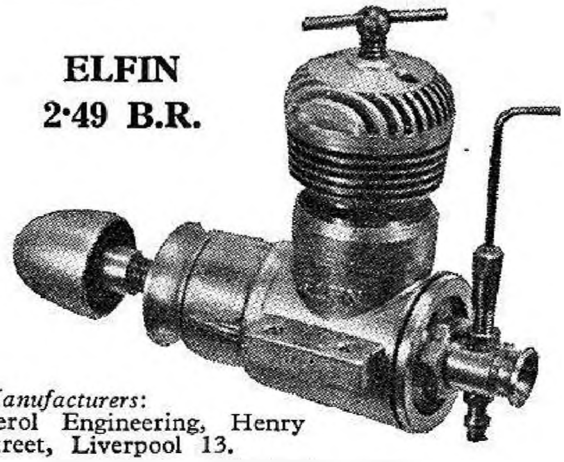
Manufacturers : ETA Instruments Ltd., High Street, Watford, Herts.

Propeller	R.P.M.
dia. × pitch	
8 × 4 (Stant)	18,000
8 × 5 (Stant)	16,750
8 × 6 (Stant)	14,800
9 × 4 (Trucut)	14,300
9 × 5 (Stant)	13,000
10 × 4 (Stant)	13,000
8 × 9 (Stant TR)	12,100
8 × 8 (Stant TR)	14,600
7 × 9 (Stant TR)	14,500
7 × 8 (Stant)	18,000
7 × 6 (Stant)	18,800



Displacement: 4·884 c.c. (·2979 cu. in.).
Bore: ·750 in.
Stroke: ·674 in.
Bore/Stroke ratio: 1·11
Bare weight: 6½ ounces.
Retail price: £7/6/4 in. P.T.
Max. B.H.P.: ·605 at 17, 200 r.p.m.
Max. torque: 40·5 ounce-inches at 13,500 r.p.m.
Power rating: ·123 B.H.P. per c.c.
Power/weight ratio: ·0925 B.H.P. per ounce.





ELFIN 2·49 B.R.

Manufacturers: Aerol Engineering, Henry Street, Liverpool 13.

Retail Price: £3/19/8 inc. P.T.

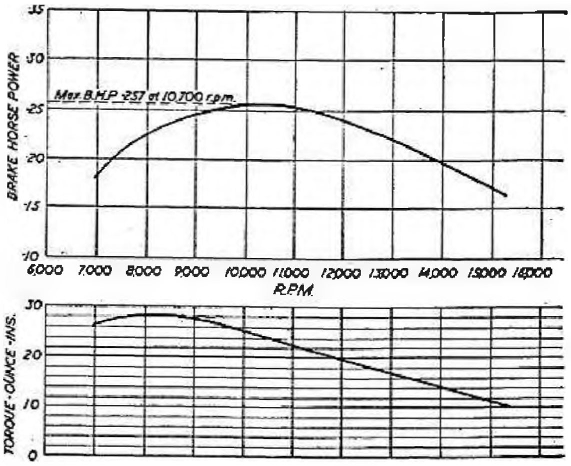
Bore: ·5675 in.
Stroke: ·600 in.
Displacement: 2·486 c.c. (·1518 cu. in.)
Bore/Stroke ratio: ·945.
Bare weight: 5¼ ounces.
Max. B.H.P.: ·202 at 13,200 r.p.m.
Power rating: ·0815 B.H.P. per c.c.
Power/weight ratio: ·9385 B.H.P. per ounce.

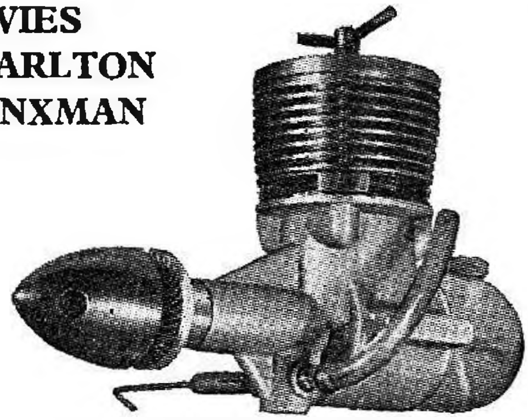
Material Specification

Crankcase: Light alloy pressure die casting (scratch brush finished).
Cylinder: Hardened steel.
Crankshaft: Hardened steel, ground between centres.
Crankshaft bearing: Two Hoffman ball races.
Connecting rod: Turned dural.
Piston: Cast iron, honed.
Contra-piston: Cast iron.
Cylinder jacket and head: Light alloy, machined.

Propeller	R.P.M.	
dia. × pitch		
9 × 4	9,800	
8 × 8	8,900	
8 × 6	10,100	
8 × 5	11,750	all
8 × 4	12,800	Stant
7 × 6	13,000	wooden
7 × 4	14,300	props.
8 × 6 (TR)	8,600	
8 × 8 (TR)	10,100	
7 × 9 (TR)	10,100	
10 × 6	8,300	
9 × 6	9,500	all
8 × 8	7,200	Frog
8 × 6	10,100	Nylon
8 × 5	11,300	props.

DAVIES CHARLTON MANXMAN





Bore: ·680 in.
Stroke: ·5625 in.
Displacement: 3·444 c.c. (·21 cu. in.)
Bore/Stroke ratio: 1·17.
Bare weight: 6½ ounces (including tank).
Max. B.H.P.: ·257 at 10,700 r.p.m.
Max. torque: 28·2 ounce-inches at 8,250 r.p.m.
Power rating: ·075 B.H.P. per c.c.
Power/Weight ratio: ·0395 B.H.P. per ounce.

Material Specification

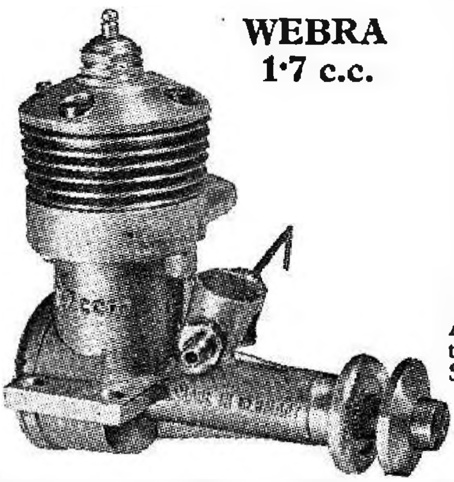
Crankcase: Light alloy die casting.
Cylinder: Hardened steel.
Cylinder jacket: Almn. (anodised red).
Piston: Meehanite.
Contra-piston: Meehanite.
Connecting rod: Aluminium alloy.
Crankshaft: Nickel chrome alloy steel.
Crankshaft bearing: Plain.
Spinner nut: Dural (anodised red).

Propeller	R.P.M.
dia. × pitch	
11 × 5	8,000
10 × 6	8,200
9 × 8	8,600
10 × 4	10,400
9 × 5	10,500
9 × 4	11,000
8 × 6	11,200
8 × 8	10,000
8 × 5	12,250
8 × 4	13,000
7 × 6	13,300
7 × 5	14,000
8 × 9 (TR)	9,600
8 × 8 (TR)	10,900
7 × 9 (TR)	11,000

Manufacturers:
Davies Charlton Limited,
Hills Meadows,
Douglas, Isle of Man.

Retail Price:
66/- plus 14/11 P.T.
Total £4/0/11

WEBRA 1·7 c.c.



Propeller	R.P.M.
dia. × pitch	
8 × 5 (Stant)	7,800
8 × 4 (Stant)	9,000
7 × 4 (Stant)	10,800
7 × 3 (Stant)	11,600
6 × 4 (Stant)	12,200
6 × 3 (Trucut)	13,000
6 × 3 (American)	14,300
6 × 4 (Frog nylon)	14,500

Displacement: 1·512 c.c. (·0923 cu. in).
Bore: ·507 in.
Stroke: ·457 in.
Bore/Stroke ratio: 1·11
Weight: 3·8 ounces.
Max. power output: ·1535 B.H.P. at 14,500 r.p.m.
Max. torque: 13·4 ounce-inches at 9·500 r.p.m.
Power rating: ·105 B.H.P. per c.c.
Power/weight ratio: ·04 B.H.P. per ounce.

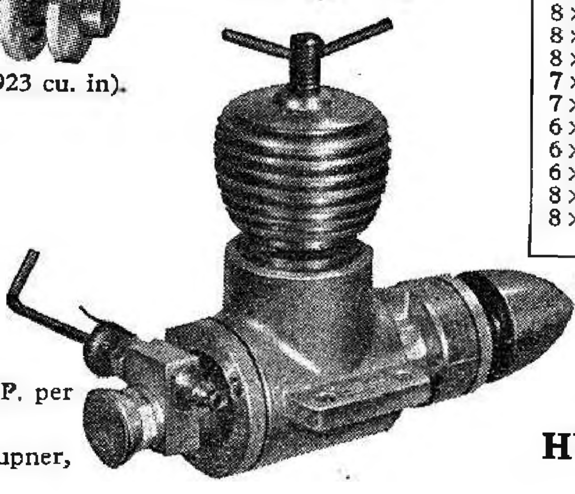
Manufacturers: Johannes Graupner, Kirchheim-Teck, Germany.

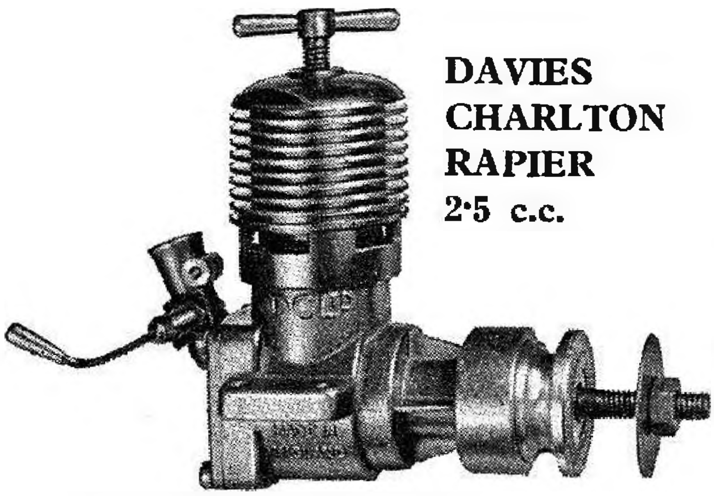
TAIFUN HURRIKAN 1·48

Displacement: 1·745 c.c. (·1064 cu. in.).
Bore: ·513 in.
Stroke: ·515 in.
Bore/Stroke ratio: 1·0
Weight: 2¼ ounces.
Max. B.H.P.: ·090 at 13,000 r.p.m.
Max. torque: 8·5 ounce-inches at 8,500 r.p.m.
Power rating: ·0515 B.H.P. per c.c.
Power/weight ratio: ·036 B.H.P. per ounce.

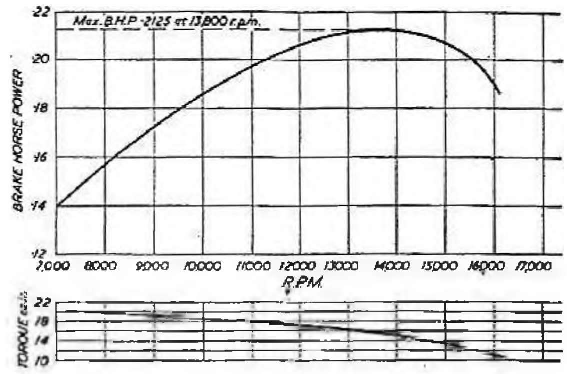
Propeller	R.P.M.
dia. × pitch	
9 × 4 (Stant)	8,200
8 × 5 (Stant)	10,300
8 × 6 (Stant)	8,250
8 × 4 (Stant)	11,400
7 × 4 (Stant)	12,800
7 × 6 (Stant)	11,200
6 × 4 (Stant)	15,400
6 × 3 (Trucut)	16,900
6 × 4 (Frog nylon)	18,300
8 × 5 (Frog nylon)	10,000
8 × 6 (Frog nylon)	8,800

Manufacturers: Fein und Modelltechnik, Genestrasse 5, Berlin-Schoneberg, Germany.





DAVIES CHARLTON RAPIER 2·5 c.c.



Displacement: 2·469 c.c. (·150 cu. in.)
Bore: ·5785.
Stroke: ·5705
Bore/Stroke ratio: 1·01
Bare weight: 5 ounces.
Max. B.H.P.: ·2125 at 13,800 r.p.m.
Max. torque: 20 ounce-inches at 7,500 r.p.m.
Power rating: ·086 B.H.P. per c.c.
Power/weight ratio: ·0425 B.H.P. per ounce.

PROPELLER	R.P.M.
dia. × pitch	
9 × 5 (Stant)	9,200
8 × 4 (Stant)	12,900
8 × 6 (Stant)	10,000
8 × 8 (Stant)	8,900
7 × 4 (Stant)	14,500
7 × 6 (Stant)	13,300
6 × 4 (Stant)	16,200
6 × 6 (Stant)	15,100
8 × 4 (Tiger)	12,200
8 × 3½ (Tiger)	13,800
6 × 9 (Tiger)	13,800
10 × 4 (Trucut)	7,700
9 × 4 (Trucut)	10,400
8 × 4 (Trucut)	13,300
7 × 4 (Trucut)	15,100

Manufacturers:
Davies-Charlton Ltd.,
Hills Meadows,
Douglas, Isle of Man.

Retail Price:
£3/7/0 (including tax)

Fuel used: Mercury No. 8 and Allbon diesel fuel.

Material Specification :

Crankcase: Pressure die-cast light alloy.
Crankshaft: Hardened steel.
Cylinder: Steel.
Contra Piston: Steel.
Piston: Cast iron.
Cylinder jacket: Light alloy (anodised green).
Rear rotor: Die-cast light alloy.
Main bearings: Two ¼-in. bore Hoffmann ball bearings.
Spraybar: Brass.

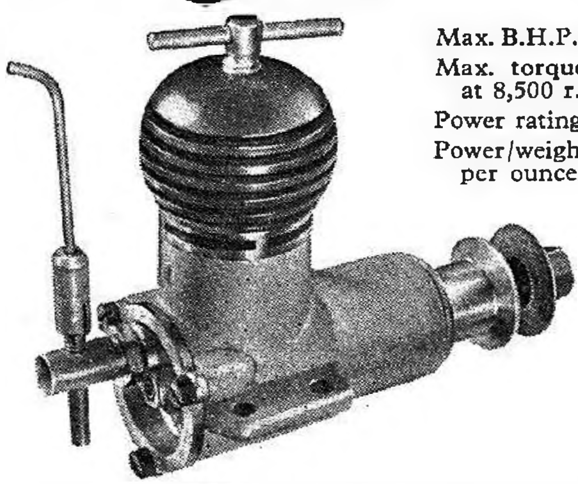
BYRA 1·5 c.c.

Bore: ·494 in.
Stroke: ·455 in.
Displacement: 1·43 c.c. (·087 cu. in.)
Bore/stroke ratio: 1·085
Weight: 3¾ ounces.
Price: 515 Pesetas.

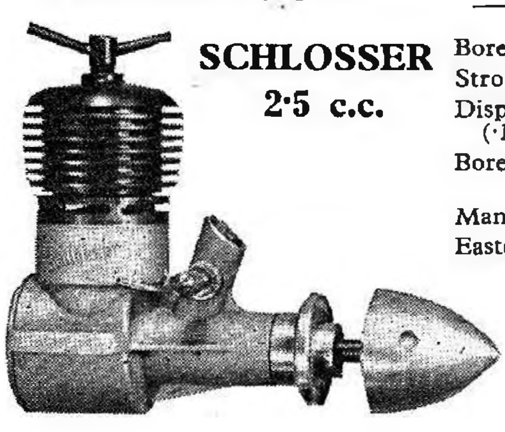
Max. B.H.P.: ·114 at 12,000 r.p.m.
Max. torque: 11·4 ounce-inches at 8,500 r.p.m.
Power rating: ·08 B.H.P. per c.c.
Power/weight ratio: ·0314 B.H.P. per ounce.

PROPELLER	R.P.M.
dia. × pitch	
8 × 5 (Stant)	9,500
8 × 4 (Stant)	10,400
7 × 8 (Stant)	10,300
7 × 4 (Stant)	11,500
6 × 4 (Stant)	13,600
6 × 4 (Frog nylon)	16,000

Manufacturers:
F. Batllo, Barcelona, Spain.



SCHLOSSER 2·5 c.c.



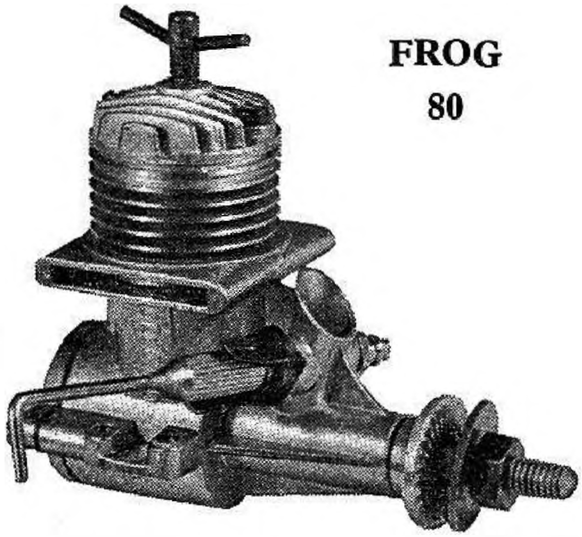
Bore: ·603 in.
Stroke: ·521 in.
Displacement: 2·496 c.c. (·1488 cu. in.)
Bore/stroke ratio: 1·16

Manufactured in
Eastern Zone Germany.

PROPELLER dia pitch	R.P.M.
9 × 4	9,500
9 × 8	7,300
9 × 4	9,800
8 × 8	9,250
8 × 5	11,400
7 × 6	13,350
7 × 5	15,000

Bare weight: 3¾ ounces.
Max. B.H.P.: ·215 at 14,000 r.p.m.
Max. torque: 20 ounce-inches at 7,500 r.p.m.
Power rating: ·086 B.H.P. per c.c.
Power/weight ratio: ·0575 B.H.P per ounce.

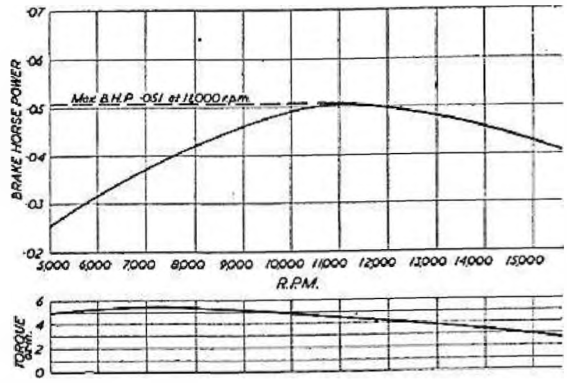
FROG 80



Manufacturers:
International Model Aircraft Ltd.,
Morden Road, Merton.

Retail Price:
45/- inc. Tax

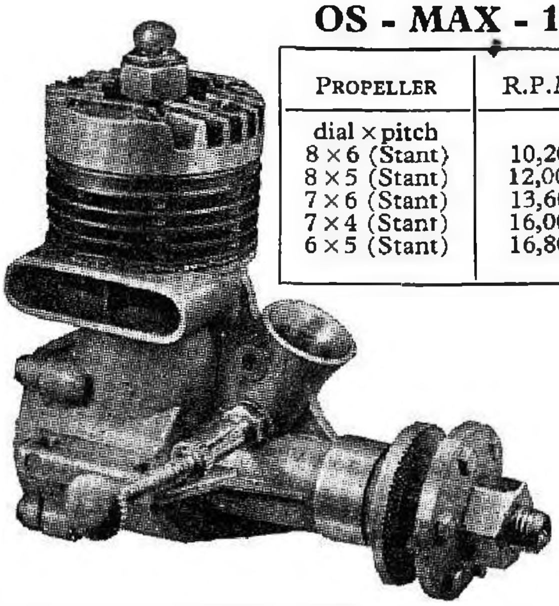
PROPELLER	R.P.M.
dia. × pitch	
9 × 6 (Frog nylon)	4,500
8 × 6 (Frog nylon)	5,250
6 × 6 (Stant)	8,000
6 × 4 (Stant)	11,000
5 × 6 (Frog plastic)	10,500
6 × 4 (Frog nylon)	12,800



Bore: ·400 in.
Stroke: ·390 in.
Displacement: ·804 c.c. (·49 cu in.)
Bore/Stroke ratio: 1·025
Weight: 1·9 ounces.
Max. B.H.P.: ·051 at 11,000 r.p.m.
Max. torque: 5·4 ounce-inches at 7,000 r.p.m.
Power rating: ·0635 B.H.P. per c.c.
Power/weight ratio: ·025 B.H.P. per ounce.

Material Specification
Crankcase unit: Light alloy pressure die casting.
Cylinder: Steel (no cylinder jacket).
Piston: Cast iron.
Contra-piston: Mild steel (with fitted O-ring).
Con. rod: Light alloy forging.
Crankshaft: Steel.
Bearing: Plain (reamed and honed).
Cylinder head: Light alloy die casting (nylon insert for compression screw).
Spraybar: Brass.

OS - MAX - 15



PROPELLER	R.P.M.
dial × pitch	
8 × 6 (Stant)	10,200
8 × 5 (Stant)	12,000
7 × 6 (Stant)	13,600
7 × 4 (Stant)	16,000
6 × 5 (Stant)	16,800

Bore: ·599 in.
Stroke: ·549 in.
Displacement: 2·53 c.c. (·154 cu. in.).
Bore/Stroke ratio: 1·03.
Bare weight: 3$\frac{1}{16}$ ounces.
Max. B.H.P.: ·2365 at 14,650 r.p.m.
Max. torque: 18·5 ounce-inches a 10,500 r.p.m.
Power rating: ·093 B.H.P. per c.c.
Power/weight ratio: ·07 B.H.P. per ounce.

Manufacturers:
Ogawa Model Mfg. Co., 518 Kumatacho, Higahs Sumiyoshi, Osaka, Japan.

BARBINI B.40 TN

Distributors:
Solaria, Via V. Monti 8, Milan.

PROPELLER	R.P.M.
dia. × pitch	
8 × 6 (Stant)	9,600
8 × 4 (Stant)	12,500
8 × 5 (Stant)	11,200
9 × 4 (Stant)	9,400
7 × 6 (Stant)	12,400
7 × 4 (Stant)	13,900
6 × 4 (Stant)	16,400
6 × 4 (Frog nylon)	18,000
8 × 5 (Frog nylon)	10,500
6 × 9 (Tiger)	12,900
8 × 3½ (Tiger)	14,000
8 × 4 (Tiger)	13,000
9 × 3 (Tiger)	11,100

Displacement: 2·5 c.c. (·152 cu. in.).
Bore: ·574 in.
Stroke: ·590 in.
Bore/Stroke ratio: 0·95
Bare Weight: 4$\frac{3}{8}$ ounces.
Max. B.H.P.: ·189 at 14,000 r.p.m.
Max. torque: 16 inch-ounces at 9,500 r.p.m.
Power output: ·0725 B.H.P. per c.c.
Power/Weight ratio: ·04 B.H.P. per ounce.

List of British National Model Aircraft Records

As at July 31st, 1957

Rubber Driven

Monoplane	Boxall, F. H.	(Brighton)	15/ 5/1949	35 : 00
Biplane	Young, J. O.	(Harrow)	9/ 6/1940	31 : 05
Wakefield	Boxall, F. H.	(Brighton)	15/ 5/1949	35 : 00
Canard	Harrison, G. H.	(Hull Pegasus)	23/ 3/1952	6 : 12
Scale	Marcus, N. G.	(Croydon)	18 /8/1946	5 : 22
Tailless	Woolls, G. A. T.	(Bristol & West)	25/ 9/1955	4 : 56
Helicopter	Tangney, J. F.	(Croydon & U.S.A.)	2/ 7/1950	2 : 44
Rotor plane	Crow, S. R.	(Blackheath)	23/ 3/1936	0 : 40
Floatplane	Parham, R. T.	(Worcester)	27/ 7/1947	8 : 55
Ornithopter	White, J. S.	(Barking)	20/ 6/1954	1 : 55
Flying Boat	Parker, R. A.	(Kentish Nomads)	24/ 8/1952	1 : 05

Sailplane

Tow Launch	Allsop, J.	(St. Albans)	11/ 4/1954	90 : 30
Hand Launch	Campbell-Kelly, G.	(Sutton Coldfield)	29/ 7/1951	24 : 30
Tailless, (T. L.)	Lucas, A. R.	(Port Talbot)	21/ 8/1950	22 : 34
Tailless (H.L.)	Wilde, H. F.	(Chester)	4/ 9/1949	3 : 17
A/2 (T.L.)	Allsop, J.	(St. Albans)	11/ 4/1954	90 : 30
A/2 (H.L.)	Campbell-Kelly, G.	(Sutton Coldfield)	29/ 7/1951	24 : 30
Radio Control (H.L.)	F. Vale/D. Illsley	(Birmingham)	21/ 4/1957	143 : 19

Power Driven

Class A	Springham, H. E.	(Saffron Waldon)	12/ 6/1949	25 : 01
Class B	Dallaway, W. E.	(Birmingham)	17/ 4/1949	20 : 28
Class C	Gaster, M.	(C/Member)	15/ 7/1951	10 : 44
Tailless	Fisher, O. F. W.	(I.R.C.M.S.)	21/ 3/1954	4 : 12
Scale	Tinker, W. T.	(Ewell)	1/ 2/1950	1 : 37
Floatplane	Lucas, I. C.	(Brighton)	11/10/1953	4 : 58
Flying Boat	Gregory, N.	(Harrow)	18/10/1947	2 : 09
Radio Control	O'Heffernan, H. L.	(Salcombe)	7/10/1954	151 : 20
Class I Speed	Bassett, D. M. J.	(Sidcup)	16/ 9/1956	88.4 m.p.h.
Class II Speed	Gibbs, R.	(East London)	18/12/1955	129.3 m.p.h.
Class III Speed	Hall, J. F.	(Chingford)	20/ 9/1953	114.7 m.p.h.
Class IV Speed	Gibbs, R.	(East London)	25/ 9/1955	146.2 m.p.h.
Class V Speed	J. F. Hall	(Chingford)	7/ 7/1957	150 m.p.h.
Class VI Speed	Gibbs, R.	(East London)	15/ 7/1956	159.7 m.p.h.
Class VII Jet	Stovold, R. V.	(Guildford)	25/ 9/1949	133.33 m.p.h.

Lightweight—Rubber Driven

Monoplane	Wiggins, E. E.	(Leamington)	11/ 7/1954	40 : 13
Biplane	O'Donnell, J.	(Whitefield)	18/ 5/1952	6 : 46
Canard	Lake, R. T.	(Surbiton)	7/ 4/1952	7 : 32
Scale	Woolls, G. A. T.	(Bristol & West)	26/ 6/1955	1 : 22
Floatplane	Taylor, P. T.	(Croydon)	24/ 8/1952	5 : 15
Flying Boat	Rainer, M.	(North Kent)	28/ 6/1947	1 : 09

Lightweight—Sailplane

Tow Launch	Green, D.	(Oakington)	11/ 4/1954	36 : 02
Hand Launch	Redfern, S.	(Chester)	11/ 7/1954	11 : 15
Tailless (T.L.)	Couling, N. F.	(Sevenoaks)	3/ 6/1951	22 : 22
Tailless (H.L.)	Wilde, H. F.	(Chester)	11/ 7/1954	9 : 51
Canard (T.L.)	Caple, G.	(R.A.F. M.A.A.)	7/ 9/1952	22 : 11

Lightweight—Power Driven

Class A	Archer, W.	(Cheadle)	2/ 7/1950	31 : 05
Class B	V. Jays	(Surbiton)	23/ 9/1956	5 : 23
Class C	Ward, R. A.	(Croydon)	25/ 6/1950	5 : 33
Tailless	Fisher, O. F. W.	(I.R.C.M.S.)	27/ 7/1954	3 : 02
Floatplane	Mussell, A.	(Brighton)	11/10/1953	2 : 53

INDOOR

Class C (Open)	P. Read	(Birmingham)		
Class A (up to 30 sq. in.)	R. C. Monks	(Birmingham)	14/ 4/1957	13 : 53
Class B (30-100 sq. in.)	No record established			
Class C (over 100 sq. in.)	P. Read	(Birmingham)	10/10/1954	23 : 58
Fuselage R. O. G.	R. T. Parham	(Worcester)	13/ 4/1957	7 : 49
Tailless H.L.	R. C. Monks	(Birmingham)	12/ 9/1954	4 : 13
Helicopter	R. C. Monks	(Birmingham)	19/11/1954	5 : 01
Ornithopter	D. Poole	(Birmingham)	2/11/1956	1 : 39
Rotorplane	D. Poole	(Birmingham)	8/ 5/1955	1 : 26
R.T.P. Class A	P. Read	(Birmingham)	16/11/1956	7 : 27
R.T.P. Class B	R. T. Parham	(Worcester)	20/ 3/1948	4 : 26
R.T.P. Speed	R. L. S. Taylor	(Brixton)	16/10/1956	45.1 m.p.h.

CONTEST RESULTS

John Hannay, of Wallasey, who tied for top place in the 1957 A/2 Selection Trials with E. Wiggins, of Leamington, was also in the British team competing in Denmark in 1955. Contest for 1957 was in Czechoslovakia.

Results of S.M.A.E. Contests for balance of 1956 Season are included in this report to complete records. Those 1957 events which have been decided before going to press are also included, and will be completed in next year's "AEROMODELLER ANNUAL."

August 5th, 1956—INTERNATIONAL RADIO CONTROL MEETING

Held at Wellesbourne Mountford

	points
1 Webster, R.	361·3
2 Higham, R. S.	346
3 Hemsley, O. M.	317·6
4 Boys, H.	266·2
5 Fisher, K.	215·1
6 Johnson, F.	158

August 25th, 1956—SOUTH MIDLAND AREA RALLY

Held at Cranfield

Rubber :	Monks, R. C.	Birmingham	9 : 00
Power :	Posner, D.	N. W. Middlesex	9 : 00
Glider :	Barr, L.	Pharos	9 : 00
Radio :	Webster, J. P.	Country Member	48 *points*
Team A :	Hartwell, P.	Enfield	10 : 19
Team B :	Platt, D.	Wanstead	11 : 00
Combat :	Wilks, D.	West Bromwich	

September 9th, 1956—HALIFAX TROPHY

F.A.I. Power (77 *entries*) *Area Centralised*

1 Gaster, M.	Country Member	15 : 00+3 : 26
2 Lanfranchi, S.	Bradford	14 : 39
3 Draper, R.	Coventry	14 : 37
4 Spurr, A.	Middlesbrough	14 : 36
5 Posner, D.	N. W. Middlesex	14 : 35
6 Eggleston, B.	Whitefield	14 : 17

September 9th—K. & M.A.A. CUP

A/2 Glider (120 *entries*) *Area Centralised*

1 Palmer, J.	Croydon	11 : 58
2 Thorogood, R.	Mill Hill	11 : 45
3 Giggle, P.	Southampton	11 : 42
4 Wellbourne, E.	Hayes	11 : 39
5 Burwood, R.	Blackheath	11 : 34
6 Hey, L.	Leeds	11 : 27

August 25/26th, 1956—P.A.A. SCOTTISH FESTIVAL

Held at Abbotsinch

America Class P.A.A.

1 Done, J.	Wallasey	5 : 56
2 Farrar, A.	Wakefield	5 : 25

Int. P.A.A. Load

March 17th, 1957—GAMAGE CUP

Unrestricted Rubber (116 *entries*) *Decentralised*

1 Barnacle, E. A.	Leamington	7 : 39
2 Wiggins, E. E.	Leamington	6 : 54
3 Lennox, R.	Birmingham	6 : 45
4 Chambers, T. B.	Stockton	6 : 06
5 O'Donnell, J.	Whitefield	6 : 03
6 Moore, L. E. / Greaves, D.	Leamington / Leamington	5 : 57

March 31st, 1957—KEIL TROPHY

Team Power *Area Centralised*

(42 *clubs* ; 114 *entries*)

1 Coventry & D.M.A.C.	37 : 04
2 Baildon M.A.C.	35 : 56
3 Whitefield M.A.C.	31 : 00
4 Surbiton D.M.A.C.	28 : 31
5 Walsall M.A.C.	25 : 50
6 Birmingham M.A.C.	25 : 56

March 31st, 1957—S.M.A.E. CUP

A/2 Glider eliminator *Area Centralised*
(254 *entries*)

1	Jays, V.	Surbiton	13 : 15
2	Tideswell, G.	Baildon	13 : 07
3	Oliver, K.	Foresters	13 : 01
4	Cameron, G.	Baildon	12 : 49
5	Lefever, G.	South Essex	12 : 48
6	Dowling, B.	Wayfarers	12 : 29

April 14th, 1957—INDOOR CHAMPIONSHIPS
Held at Manchester Corn Exchange

Microfilm under 100 sq. in.

1	R. Monks	Birmingham	13 : 53
2	O'Donnell, J.	Whitefield	12 : 38
3	Read, P.	Birmingham	11 : 16
4	Poole, D.	Birmingham	10 : 46
5	King, A.	Australia	8 : 21
6	Parham, R.	Worcester	8 : 09

Microfilm over 100 sq. in.

1	O'Donnell, J.	Whitefield	11 : 50
2	Copland, R.	N. Heights	11 : 46
3	Read, P.	Birmingham	9 : 42
4	Monks, R.	Birmingham	9 : 04
5	Poole, D.	Birmingham	8 : 24

Tissue covered

1	Poole, D.	Birmingham	6 : 53
2	Read, P.	Birmingham	5 : 12
3	Monks, R.	Birmingham	4 : 43
4	Parham, R.	Worcester	4 : 33

Chuck Glider

1	Dixon, J. H.	Unattached	30 *secs.*
2	O'Donnell, J.	Whitefield	27
3	Monks, P.	Birmingham	26
4	O'Donnell, H.	Whitefield	22
5	Hartley, J.	Wolves	19
6	Watson, M.	Whitefield	19

April 28th, 1957—WESTON CUP

Unrestricted Rubber *Decentralised*
(60 *entries*)

1	Monks, R. C.	Birmingham	12 : 00+5 : 23
2	Callinan, J.	Surbiton	11 : 30
3	Burwood, J.	Surbiton	11 : 25
4	Miller, K. J.	Croydon	11 : 17
5	Moore, L. E.	Leamington	10 : 45
6	Rutter, K. P. F. / Dennison, W.	Baildon / Wakefield	10 : 40

April 28th, 1957—LADY SHELLEY CUP

Open Tailless (17 *entries*) *Decentralised*

1	Marshall, J.	Hayes	8 : 39
2	Grant, K.	Halifax	6 : 25
3	Neath, P. G.	Coventry	5 : 53
4	Nicholls, A.	De Havilland	5 : 07
5	Hardman, R.	Bolton	4 : 57
6	Wassall, J.	Hayes	4 : 29

May 19th, 1957—GUTTERIDGE TROPHY

1	Giggle, P.	Southampton	11.37
2	Bennett, F.	Croydon	10·07
3	LeFever, G.	South Essex	9·56
4	Read, P.	Birmingham	9·56
5	O'Donnell, J.	Whitefield	9·45
6	Sharp, F.	Blackheath	9·30

May 19th, 1957—ASTRAL TROPHY

1	Monks, R.	Birmingham	12·00 × 4·31
2	Buskell, P.	Surbiton	11·57
3	Posner, D.	Surbiton	11·49
4	Green, M.	Croydon	11·31
5	Mack, B.	Henlow R.A.F.	10·50
6	Lanfranchi	Birmingham	10·40

June 9th/10th, 1957—BRITISH NATIONALS
Held at R.A.F. Waterbeach

"AEROMODELLER" R/C TROPHY
(48 *entries*)

1	Honnest-Redlich, G.	A.R.C.C. (Multi)	270
2	Knowles, F.	Croydon (S.Ch.)	202·5
3	Boys, H.	Rugby (S.Ch.)	188·75
4	Rice, B.	Croydon (S.Ch.)	170
5	Soper, J.	A.R.C.C. (S.Ch.)	141·25
6	Donahue, R.	Kersal (Multi)	139

S.M.A.E. R/C TROPHY
(45 *entries*)

1	Nixon, J.	North Lincs (S.Ch.)	172·5
2	Donahue, R.	Kersal (Multi)	146
3	Honnest-Redlich, G.	A.R.C. (Multi)	115
4	Parkinson, G.	Kendal (Multi)	100
5	Fox, J.	Hatfield (S.Ch.)	93·75
6	Firth, R.	York (S.Ch.)	90

THURSTON GLIDER
(317 *entries*)

1	Giggle, P.	Southampton	12 × 1 : 3
2	Willis, N.	Anglia	12 × 0 : 40
3	Greygoose, R.	Anglia	8 : 58
4	Woods, D.	Luton	8 : 43
5	Winder, G.	De Havilland	8 : 24
6	Woodward, T.	Foresters	8 : 13

SHORT CUP (PAYLOAD)
(22 *entries*)

1	Glynn, K.	Surbiton	6 :123
2	Monks, R.	Birmingham	5 : 59
3	Baguley, J.	Hayes	5 : 34

TEAM RACE DAVIES TROPHY (Class A)
(114 *entries*)

1	Edmonds, E.	High Wycombe	8 : 12 (10 miles)
2	Bassett, M.	East London	
3	Allen, J.	Enfield	

DAVIES TROPHY (Class B)
(10 *entries*)

1	Tuthill/Walker	Enfield	7 : 59 (10 miles)
2	McGoun, S.	West Essex	
3	McFarlane, W.	Glasgow	

SIR JOHN SHELLEY (Power)
(309 *entries*)

1	Green, M.	Croydon	12 : 00
2	O'Donnell, J.	Whitefield	11 : 57
3	Lanfranchi, S.	Leeds	11 : 18
4	Jackson, D. W.	Ashton	11 : 15
5	French G. R.	Anglia	10 : 59

MODEL AIRCRAFT TROPHY (Rubber)
(124 *entries*)

1	Monks, R.	Birmingham	12 : 00
2	Boxall, F.	Brighton	11 : 42
3	Wannop, V.A.	Edinburgh	11 : 49
4	Greave, D.	Leamington	11 : 42

SUPER SCALE
(12 *entries*)

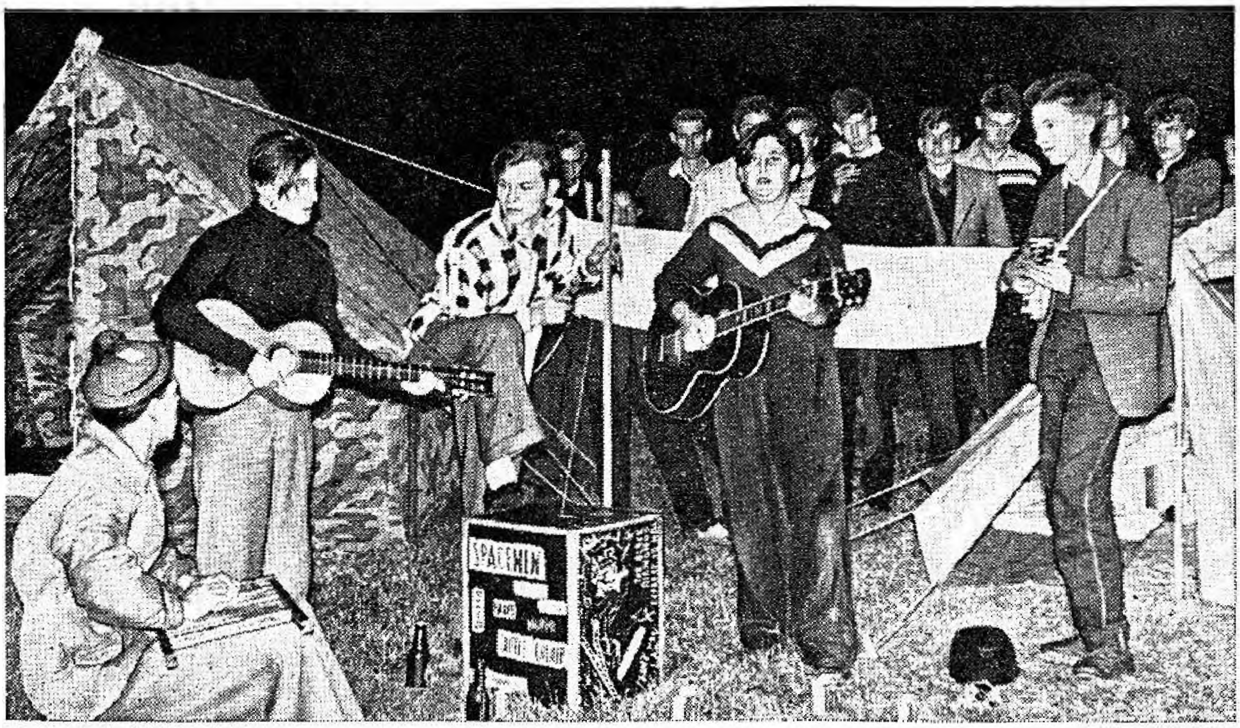
			Pts.
1	Norman, F/O H.	R.A.F.M.A.A. (Colerne)	79
2	Godfrey, Cpl.	R.A.F.M.A.A. (Waterbeach)	77
3	Datkiewicz, Z. A.	P.A.F.A.	76

SPEED

			m.p.h.
2·5 c.c.	Gibbs, R.	London	120·4
5 c.c.	Lawton, S.	Macclesfield	115
10 c.c.	Mendham, M.	Watford	137

GOLD TROPHY
(39 *entries*)

				Pts.
1	Russell, P. G.	Worksop	E.D. 2·46	248
2	Chislett, D.	Dagenham	Frog 500	219
3	Jolly, T.	Whitefield	Fox 35	213
4	Platt, D.	Wanstead	Veco 19	207
5	Eifflaender, T. G.	Macclesfield	O/D Special	195
6	Grimmett, M.	W. Bromwich	O. Tiger	149



A new sight (and sound !) at the 1957 Nationals was the Skiffle Group formed by the Wanstead club members, who livened up the somewhat damp camping area with their repertoire. Not so pleasant were the [illegible] engine noises in the wee sma' hours.

June 16th, 1957—STOCKPORT EXPRESS RALLY

Held at Woodford

POWER

1 A. Collinson	Baildon	6 : 00
2 C. E. Day	Sheffield	6 : 00
Best Jr. R. Lawther	Cheadle	4 : 31

RUBBER

1 K. Horry	Bristol	6 : 00
2 R. Pollard	Tynemouth	6 : 00
Best Jr. L. England	Colne	5 : 00

GLIDER

1 R. Burgess	Doncaster	6 : 00
2 J. Ellison	Avro	5 : 50
Best Jr. M. Macconnell	Sharston	5 : 22

JETEX

R. Roberts	Bolton

RADIO

1 R. Donahue	Kersal

SCALE

1 J. Bridgewood	Doncaster

TEAM RACE A

1 Perry, A.	Wharfedale

TEAM RACE B

1 Oswell	Tynemouth

LADIES' CUP

Davey, Mrs.	Blackpool

SENIOR CHAMPION

Donnell, J. O.	Whitefield

JUNIOR CHAMPION

M. Hosker	Urmston

June 23rd, 1957—CLWYD GLIDER RALLY

RADIO

1 Vale and Illsley	Burton and Birmingham	1 : 1·22
2 Bailey, D.	Burton-on-Trent	31 : 29

OPEN

1 Donnell, J. O.	Whitefield	6 : 15
2 Houghton, W.	Rhyl	4 : 6

A/2

1 Chadwick, J.	Ashton	5 : 57
2 S. Hinds	Wallasey	4 : 38

JUNIOR

1 J. Conroy	Moreton	6 : 51
2 J. Trickett	Chester	2 : 58

TAILLESS

1 Morris, J.	Wallasey	2 : 18

GOSLING TROPHY

O'Donnell, J.	Whitefield	6 : 15

June 23rd, 1957—NORTHERN HEIGHTS GALA

Held at R.A.F. Halton

THE QUEEN ELIZABETH CUP

		pts.
1 Posner, D.	Surbiton	720
2 Young, A. G.	Surbiton	696

FLIGHT CUP (Glider)

1 Larcey, P.	Henley	3 : 00
2 French, T. L.	Wayfarers	8 : 00

FAIREY CUP (Rubber)

1. Monks, R.	Birmingham	8 : 00
2. Crossley, P. J.	Blackheath	8 : 00

DE HAVILLAND TROPHY (Power)

1 Buskell, P.	Surbiton	8 : 00
2 Jays, V.	C.M.	8 : 00

THURSTON HELICOPTER TROPHY

1 Poole, D.	Birmingham
2 Ingram, M.	Jetex

R.A.F. FLYING REVIEW CUP (R/C Spot Landing)

		pts.
1 Daines, J. H.	Worcester	84

KEIL COMBAT CUP

1	Grimmett, M.	West Bromwich
2	Warren, J.	Enfield

"AEROMODELLER" TROPHY (Gala Championship)

Monks, R. Birmingham

June 30th, 1957—INTERNATIONAL TEAM TRIALS (A/2)

Held at R.A.F. Hemswell

1	Hannay, J.	Wallasey	15 : 00
	Wiggins, E. E.	Leamington	15 : 00
3	Burgess, R. A.	Doncaster	14 : 22
4	Tyrell, B. I.	Leicester	14 : 19
5	Wareham, C. R.	Bournemouth	14 : 10
6	French, G.	Laindon	14 : 01

July 7th, 1957—PILCHER CUP

Decentralised

(29 *entries*)

1	Smith, M. J.	Norwich	9 : 00
2	Greaves, D.	Leamington	7 : 27
3	Woodward, T.	Foresters	6 : 39
4	Petrie, D. L.	Montrose	6 : 37
5	King, Mrs. P. R.	Thameside	6 : 28
6	Giggle, P.	Southampton	6 : 07

July 7th, 1957—JETEX CHALLENGE TROPHY

Decentralised

(10 *entries*)

			pts.
1	Armstrong, R	Belfast	27
2	Smith, M. J.	Norwich	18·4
3	Doyle, M.	Belfast	15·5
4	Presnall, M. S.	Thameside	11·6
5	Gilmore, J.	Thameside	10·5
6	Barron, R	Southampton	8·6

July 14th—SCOTTISH GALA

Held at Stranraer

U/R GLIDER (14 *entries*)

1	O'Donnell, J.	Whitefield	4 : 37
2	G. R. Sleight	Prestwick	4 : 16
3	E. Black	Glasgow MAC	2 : 28 J

U/R POWER (18 *entries*)

1	Posner, D. S.	Surbiton	7 : 02
2	Jays, V.	Surbiton	6 : 02
3	Jackson, D. W.	Ashton	4 : 10

U/R RUBBER (Caton Trophy) (4 *entries*)

1	Finlayson, J.	Glasgow	4 : 57
2	O'Donnell, J.	Whitefield	3 : 22

TAPLIN TROPHY (Radio Control) (9 *entries*)

			pts.
1	Donahue	Kersal	75
2	Fraser, R. D.	Kirkcaldy	62·5

CLASS A TEAM RACE

1 Cunningham, R. Prestwick

CLASS B TEAM RACE

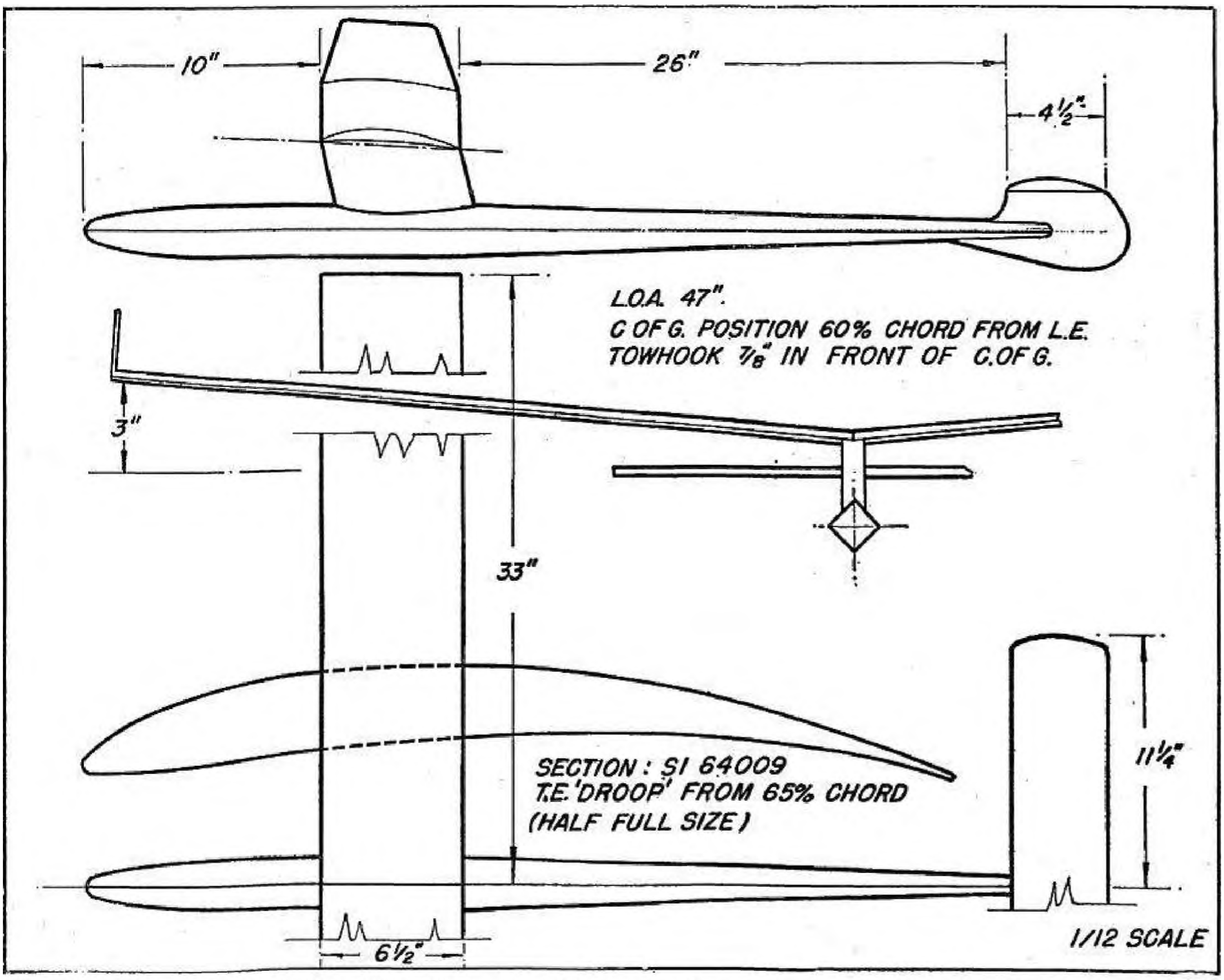
1 Irvine, R. Perth MAC

CLASS II SPEED

1 Irvine, R. Perth MAC 101·8 m.p.h.

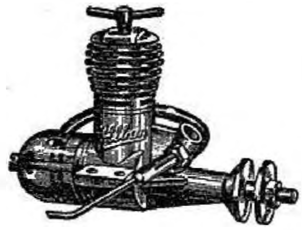
CLASS III SPEED

1 Irvine R. Perth MAC 130 m.p.h.



Brian Tyrell (Leicester M.A.C.) flew this Brewster designed model into an "A/2" team place.

For every class of MODEL



BAMBI

Bore—.218"
Stroke—.250"
Capacity—.15 c.c.
—.009 cu. ins.
Weight—$\frac{3}{8}$ oz.
Propeller—$4\frac{1}{2}$" dia.
Supplied with engine.

The world's smallest production diesel engine. This has been developed for the experienced modeller and is ideal for small scale models.

DART

Bore—.350"
Stroke—.350"
Capacity—.5 c.c.
—.03 cu. ins.
Weight—$1\frac{1}{4}$ ozs.
Propeller—C/L 6" x 4"
—F/F 7" x 4"

Undisputed champion of the "point fives", it is built like a watch and has a performance that would not disgrace many larger engines.

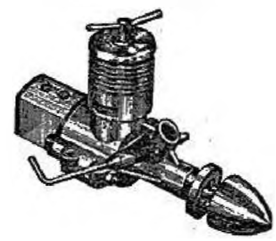
STANDARD MERLIN

Bore—.375"
Stroke—.420"
Capacity—.76 c.c.
—.046 cu. ins.
Weight—$1\frac{3}{8}$ ozs.
Propeller—C/L 6" x 6"
—F/F 7" x 4"

For those with a tight budget this is the ideal engine. All the virtues of the Super Merlin, but without the extra fittings. Positive lock needle valve.

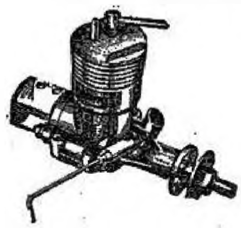
SUPER MERLIN

Bore—.375"
Stroke—.420"
Capacity—.76 c.c.
—.046 cu. ins.
Weight—$1\frac{3}{8}$ ozs.
Propeller—C/L 6" x 6"
—F/F 7" x 4"



Performance is as good as it looks, and it really is easy to start and operate. Complete with propeller, spinner and tommy bar.

SPITFIRE Mk II

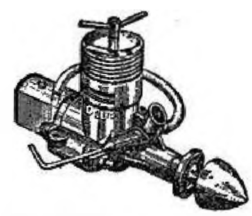


Bore—.425"
Stroke—.420"
Capacity—1 c.c.
—.06 cu. ins.
Weight—3 ozs.
Propeller—C/L 7" x 5"
—F/F 8" x 4"

The perfect engine for the beginner. Combines easy starting, flexibility and long life with sparkling performance. A limit stop ensures that the compression setting can be found without difficulty.

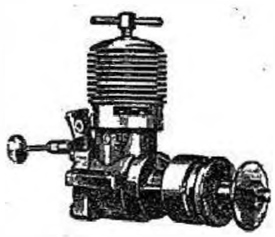
SABRE

Bore—.525"
Stroke—.420"
Capacity—1.49 c.c.
—.09 cu. ins.
Weight—$3\frac{1}{4}$ ozs.
Propeller—C/L 7" x 6"
—F/F 8" x 4"



This powerful motor is ideal for the smaller radio control model as well as free-flight and control line. Complete with propeller, spinner, tommy bar and plastic fuel tank.

RAPIER

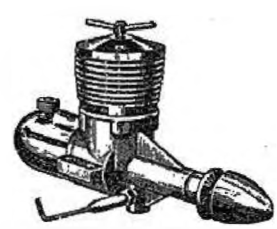


Bore—.580"
Stroke—.575"
Capacity—2.49 c/c/
—.15 cu. ins.
Weight—$5\frac{1}{4}$ ozs.
Propeller—C/L 9 "x 6"
—F/F 9" x 4"

A high performance engine with twin ball races, downdraught carburettor and rear rotary valve. Provision for a two-speed fitting or choke assembly.

MANXMAN

Bore—.687"
Stroke—.562"
Capacity—3.5 c.c.
—.21 cu. ins.
Weight—$5\frac{1}{2}$ ins.
Propeller—C/L 9" x 8"
—F/F 10" x 6"



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6 Market Street,
LOUGHBOROUGH.

LINCOLNSHIRE

A. Sherman,
2 and 2a Allanby Street,
SCUNTHORPE.

MIDDLESEX

Arnold,
194 Baker Street,
ENFIELD.

Beazley's (Twickenham) Ltd.,
138/140 Heath Road,
TWICKENHAM.

MODEL SHOP DIRECTORY

NORFOLK

H. & C. Williment,
41 St. Benedicts,
NORWICH.

NORTHUMBERLAND

Hobbies Ltd.,
42 Dean Street,
NEWCASTLE-UPON-TYNE.

The Model Shop (Newcastle) [Ltd.,
18 Blenheim Street,
NEWCASTLE-UPON-TYNE.

OXFORDSHIRE

Howes,
9-10 Broad Street,
OXFORD.

STAFFORDSHIRE

John W. Bagnall,
South Walls Road,
STAFFORD.

" Dunn's,"
67 Lower High Street,
CRADLEY HEATH.

SURREY

Electronic Developments (Surrey) Ltd.,
Island Farm Road,
WEST MOLESEY.

Heset Model Supplies,
61 Brighton Road,
SOUTH CROYDON.

International Model Aircraft [Ltd.,
Morden Road,
MERTON.

Mills Bros. Ltd.,
143 Goldsworth Road,
WOKING.

Whitewoods,
108 Brighton Road,
SURBITON.

SUSSEX

Model Aerodrome Ltd.,
37 West Street,
BRIGHTON.

Planet Models & Handicrafts,
108 The Hornet,
CHICHESTER.

Solarbo Ltd.,
Commerce Way,
LANCING.

WARWICKSHIRE

Hobbies Ltd.,
100a Dale End,
BIRMINGHAM, 4.

Model Aerodrome Ltd.,
43 Temple Row,
BIRMINGHAM.

Model Aerodrome Ltd.,
141 Stratford Road,
BIRMINGHAM.

A. J. Reeves & Co. (Birmingham) Ltd.,
416 Moseley Road,
BIRMINGHAM, 12.

WILTSHIRE

William B. Abel & Son Ltd.,
143 Fisherton Street,
SALISBURY.

Hobby's Corner,
24 Fleet Street,
SWINDON.

WORCESTERSHIRE

Trevor Baddeley,
56 Friar Street,
WORCESTER.

A. N. Cutler,
7 Bridge Street,
WORCESTER.

Dunn's Model Shop,
Castle Hill,
DUDLEY.

YORKSHIRE

Hobbies Ltd.,
4 St. Paul's Parade,
SHEFFIELD.

Hobbies Ltd.,
10 Queen Victoria Street,
LEEDS.

Hobbies Ltd.,
10 Paragon Square,
HULL.

Humber Oil Co. Ltd.,
Marfleet,
HULL.

E. R. Lister Model Shop,
16 Wilson Street,
MIDDLESBROUGH.

Model Shop (Chas. Skinner),
83 Station Road,
REDCAR.

ISLE OF MAN

Davies Charlton & Co.,
Hills Meadow,
DOUGLAS.

SCOTLAND

Caledonia Model Coy.,
5 Pitt Street,
GLASGOW, C.2.

Hobbies Ltd.,
326 Argyle Street,
GLASGOW.

Martin Models,
42 Belmont Street,
ABERDEEN.

"Modelcrafts,"
112 High Street,
FALKIRK.

Peter Montgomery,
273 High Street,
KIRKCALDY.

John Ure & Son,
"The Model Shop",
4 Manor Street,
FALKIRK.

WALES

Eric Edwards,
The Studio and Model Shop
BARMOUTH.

OVERSEAS

NEW ZEALAND

"Betta" Model Aeroplane Supply Co.,
182-186 Devon Street East,
New Plymouth,
NEW ZEALAND.

A. M. Martin Ltd.,
89/93 Customs Street East,
Auckland,
NEW ZEALAND.

HONG KONG

Radar Company,
2 Observatory Road,
Tsinshatsui,
Kowloon,
HONG KONG.

ITALY

Solaria,
Via V. Monti 8,
Milan, ITALY.