AEROMODELLER ANNUAL 1958

AEROMODELLER ANNUAL 1958-59

A review of the year's aero-modelling 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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Per Ardua . . .

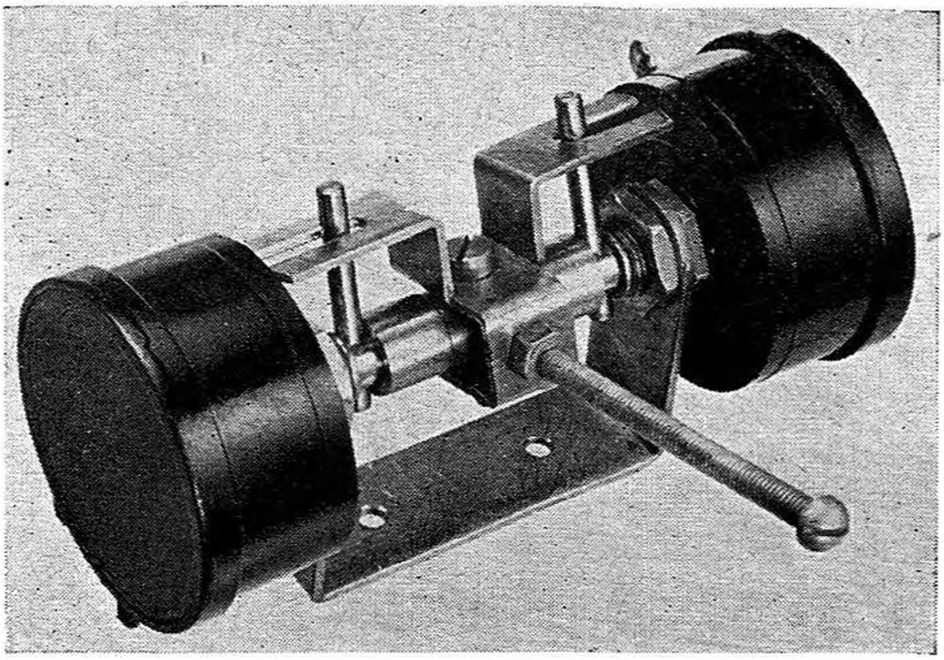
PER ARDUA AD ASTRA, the well-known motto of the Royal Air Force, typifies the average aeromodeller in his struggle to get his model "upwards to the stars" . . . yet he perseveres despite all the difficulties that beset his path, be they technical or municipal. Lack of flying space continues to be the greatest stumblingblock in the progress of British aeromodelling, although surprisingly enough, the keenest support seems to appear in those districts that have the poorest facilities ! London modellers are still faced with the doubtful pleasures of the hills and valleys of Chobham Common, and the populous areas are ever on the search for reasonable stretches of open country for the pursuit of the hobby.

As predicted in the last Annual, reception of the new F.A.I. rules for International contests has been varied, but as always the keen enthusiasts have sunk their objections to the changes in an effort to get the ultimate out of the new-rule machines, and are succeeding to a remarkable degree. Power models are still climbing to fantastic heights, and the reduced rubber content of the Wakefield model seems to have had little effect on duration. Naturally, the margin by which the maximum could be exceeded has been narrowed, but this is not necessarily a bad thing, and a new incentive has been given to the world's experts who have accepted the challenge of the new specifications with commendable zeal.

As indicated last year, interest in control-line flying has intensified, with the accent on team-racing and combat. Stunt flying has received a renewed lease of life with the introduction of new schedules, and in a very short time the enthusiasts have become near-experts in the fresh manoeuvres required. Speed continues to be the "orphan" of the control-line world, yet the same small band of whirling dervishes resolutely plough their lonely furrow (no pun intended !) and consistently improve on previous times.

The past year has witnessed a distinct improvement in the standard of British radio-control flying, the greatest strides being in the multi-channel field, but as yet no *real* beginners' outfit has appeared on the market to fill a vital gap. Perhaps some enterprising manufacturer will produce a really foolproof outfit that will encourage more modellers to take up this interesting phase of aeromodelling, for at present there would appear to be a little too much fiddling and not enough worthwhile flying to satisfy the beginner whose appetite is not yet attuned to the pleasures of circuitry dabbling, and who wishes to get a model into the air rather than join the huddle of experts who discuss rather than dice until it is too late to get airborne !

We note with pleasure and approval the growing interest among members of the trade in the activities (and requirements) of the hobbyists who purchase their wares. For too long has the average manufacturer viewed his customers from his accounts ledgers, and it is perhaps a sign of the times that more and more trade members are getting out onto the flying fields and witnessing at first hand the successes (and otherwise) of their products in the hands of the workaday aeromodeller. It is significant that both merchant and customer are finding that each is human, and problems shared are beneficial to both !



A CONTROL BOX FOR PROPORTIONAL RUDDER AND ELEVATOR

By T. Ives

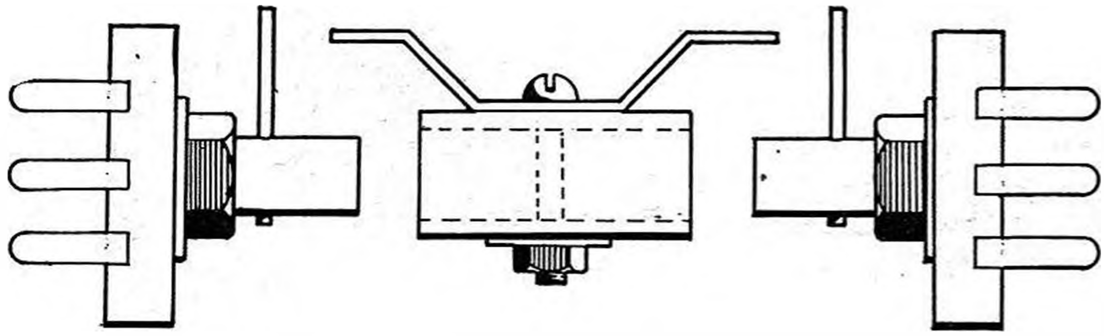
THE NOW WELL-KNOWN "Galloping Ghost" system of proportional control needs a control system in which a change of mark-space ratio will not affect the pulse-rate, and a change of pulse-rate will leave the mark-space unchanged.

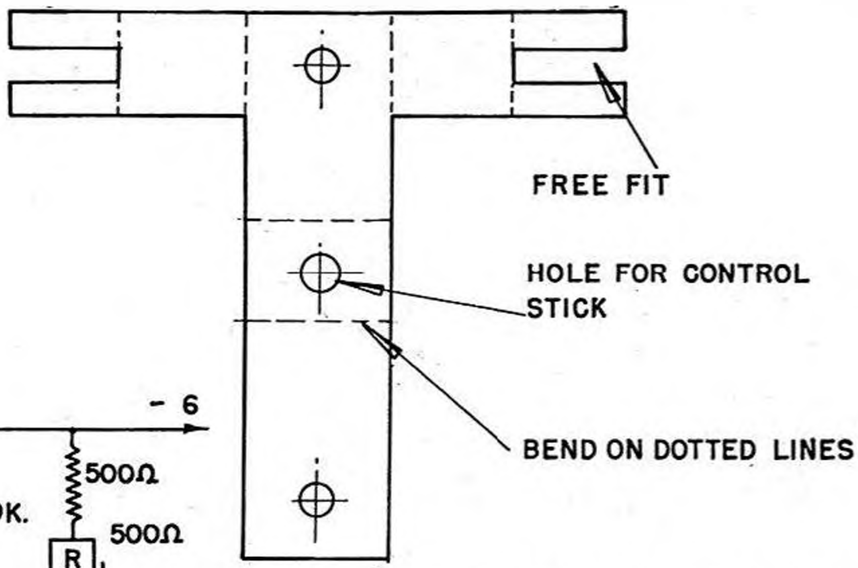
This is quite easy to arrange in theory, but in practice the tolerances in present-day components make it difficult unless, in the case of condensers, a large component is used. However, in the case of aircraft small variations do not have a great effect on the performance of the model, and providing reasonable precautions are taken a satisfactory control can be made which is reasonable in size.

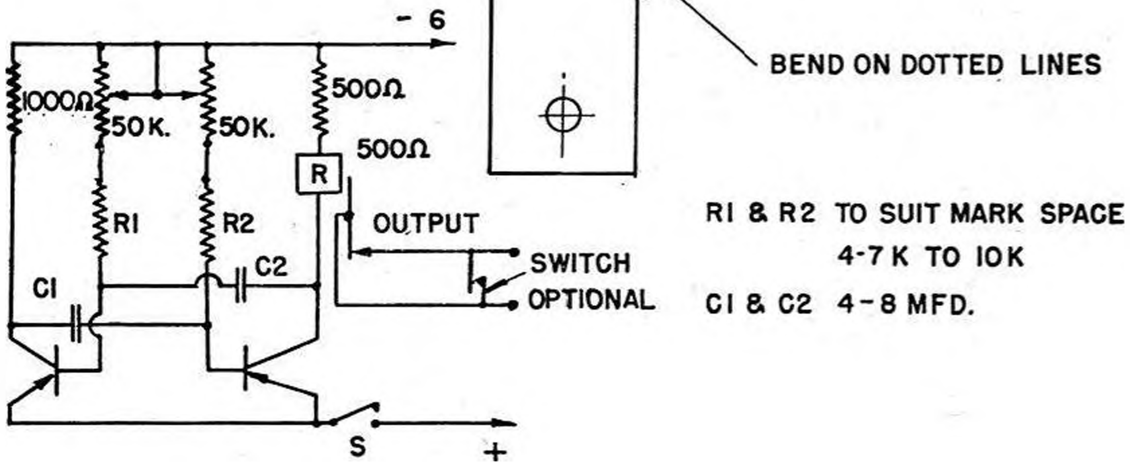
In the case of a valve multi-vibrator a solution can be found, but the L.T. and H.T. batteries present a problem unless the unit is incorporated in the transmitter, and a separate unit made for the potentiometers. The control box to be described uses transistors, and with a total voltage of 6 the whole unit can be housed in quite a small box, leaving the transmitter unaltered.

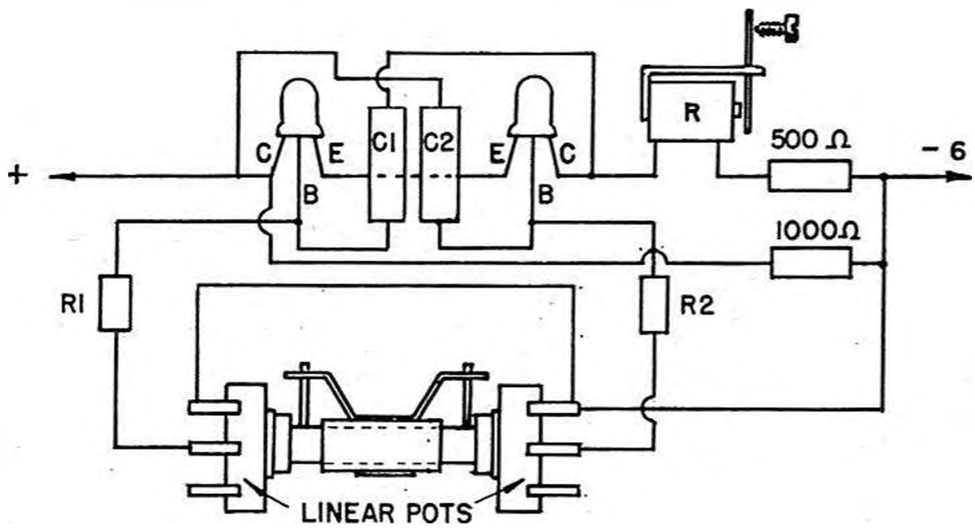
The system at first included the conventional arrangement in which one pot. varied the M-S ratio and the other the pulse rate, but trouble was experienced due to the change of M-S when the pulse rate was varied. As the coupling condensers were of the order of 4 to 8 mfd. the question of size became important. Also it was not easy to arrange control stick linkage without gears, which were considered cumbersome, and in the case of the M-S pot. without gears it was necessary to short out a large proportion of the resistance.

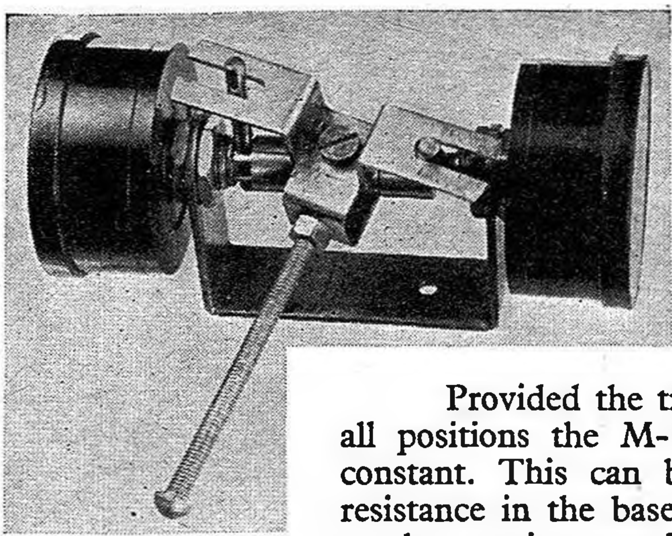
The present system makes use of a differential arrangement in which the M-S ratio is varied by moving the two pots. in opposite directions, and for P-R change moving them in the same direction. Due to the fact that both pots. move together a larger change of resistance is obtained for a given movement of the control lever. Also there is no need to use the whole of the track, and one end of each is left unconnected.




FREE FIT
HOLE FOR CONTROL STICK
BEND ON DOTTED LINES


- 6
1000Ω
50K.
50K.
500Ω
500Ω
R
R1
R2
C1
C2
OUTPUT
SWITCH
OPTIONAL
S
+
R1 & R2 TO SUIT MARK SPACE
4·7K TO 10K
C1 & C2 4-8 MFD.


+
C
E
B
C1
C2
E
C
B
R
500 Ω
- 6
1000Ω
R1
R2
LINEAR POTS



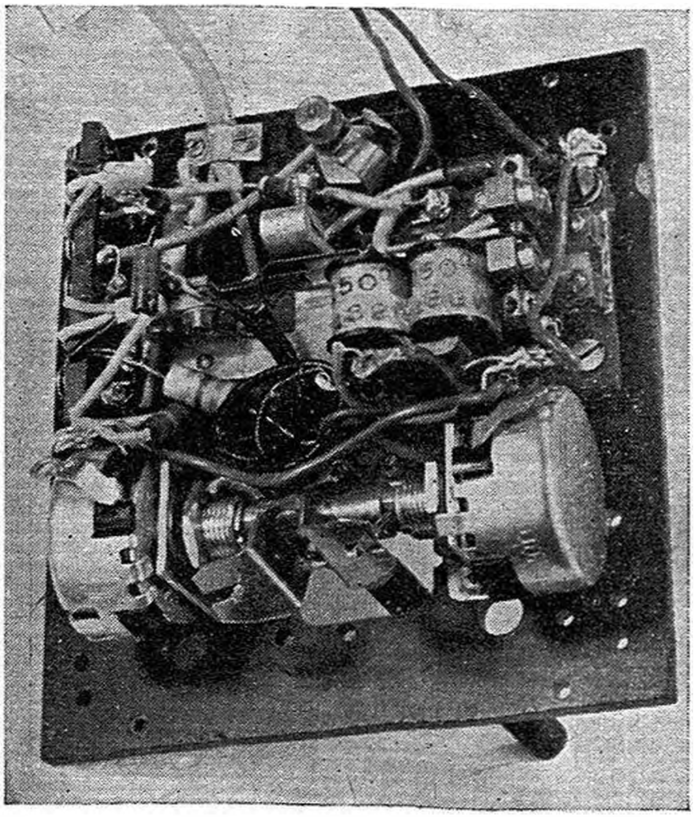
Differential linkage for potentiometers is shown on left. Note the centre sleeve made from brass tubing which is a sliding fit on the two pot. shafts (see diagram). The latter items are drilled to take the steel pins which are a drive fit. It is essential that the pins are a loose fit in the slots of the yoke which can be made from either $\frac{1}{16}$th sheet brass or mild steel.

Provided the transistors are allowed to bottom at all positions the M-S ratio should remain reasonably constant. This can be achieved by keeping the total resistance in the base circuit low enough, and depends on the transistor used. If the collector resistance (which will be about 1,000 ohms) is multiplied by the gain (beta) this should give the approximate limit of base resistance.

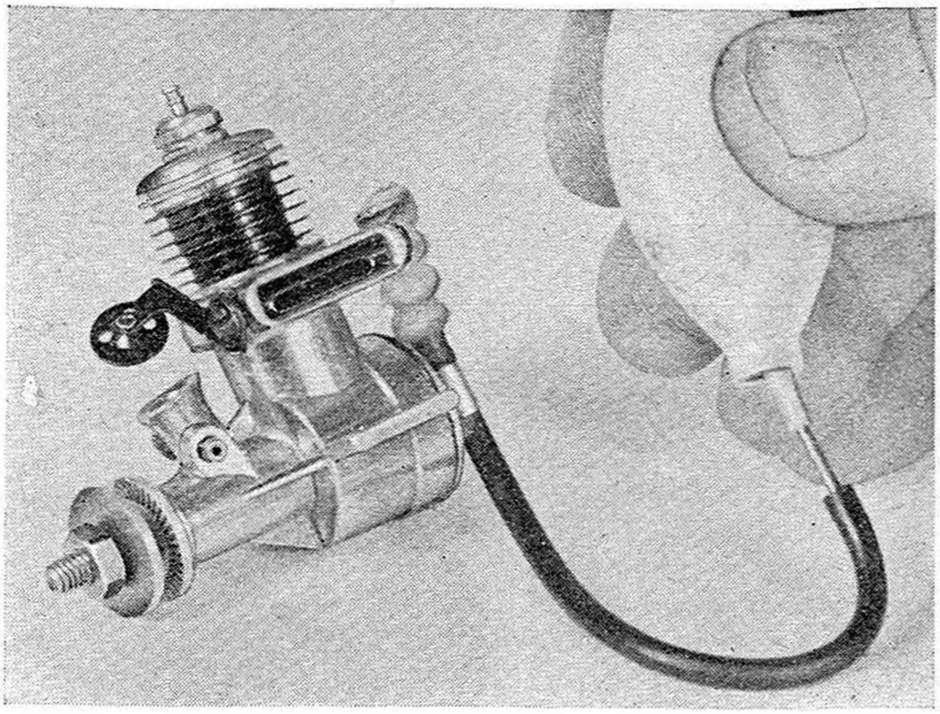
Adjustments can be made by loosening the nut of either pot. and rotating it a fraction ; by soldering a parallel resistor across either pot. ; by varying the resistance of either R1 or R2 ; and by connecting a capacity in parallel with either of those in circuit. It is a question of trial and error, and is not difficult to achieve.

Commence by constructing the potentiometer linkage, the drawings showing this clearly. A fairly large hole is required in the panel to allow for full movement of the control lever, and four twisted rubber bands may be incorporated if automatic centring is required.

The layout of the components is not critical, and may be arranged to suit individual taste. A switch (preferably of the push-pull type) should be fitted for the purpose of switching off the transmitter, and another across the relay contacts will give full signal.



Right: Underview of pulse box showing arrangement of main components. Mounted vertically on the panel is a short paxolin tag board, which can be seen top left. This is drilled to take holding screws and tags by which the two transistors are mounted so avoiding any soldering. A hot iron spells ruin to any transistor ! This prototype unit uses a Siemens reed relay which is not recommended for the job as the long unbalanced armature makes it prone to variation when the box is held in different position. Better to use a relay of the balanced armature type. There is, of course, a box which fits over the electronic gear leaving only the joystick projecting from the paxolin "lid".



ENGINE SPEED CONTROL

By R. G. Moulton

Model power units are not designed, but are the result of practical trial and error in the manufacturers' workshops, plus selection of the right materials. No manufacturer would claim otherwise, for the two-stroke is the most flexible of all internal combustion engines, and until one can be made with transparent cylinder walls and burning a visible gas, we shall never reach the ultimate of perfection.

This flexibility is now assisting with a new approach to radio-control and control-line flying. Control of engine speed has always been a desirable feature, and is common in all petrol ignition engines, but until the 1958 season it never figured much in contest work in Great Britain. The outstanding single development in radio-control at the 1958 British Nationals was the use of exhaust restrictor control, while for sport control-line flying we know of few variations on the popular theme that give as much pleasure as complete control over the power output of a model.

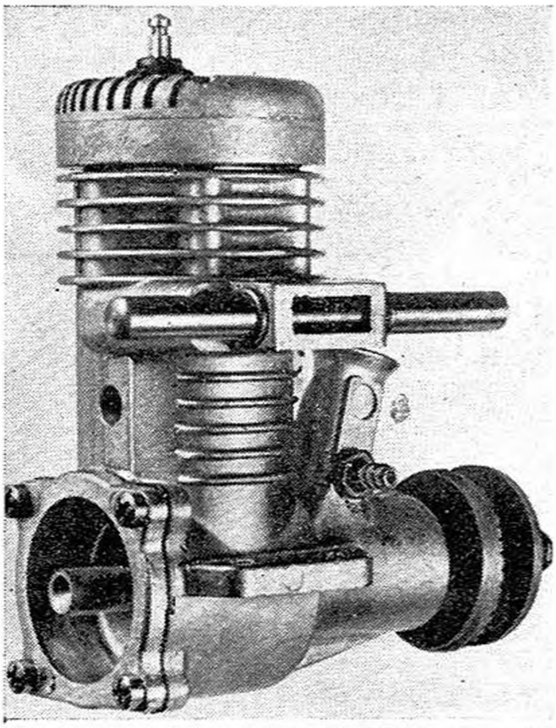
How then can we obtain this control of speed ? There are four basic methods—mixture variation via the metering jet or needle valve ; compression ratio alteration by means of the contra-piston on a diesel ; ignition timing via two-speed ignition points ; and port restriction on any of the three variables of inlet, transfer and exhaust.

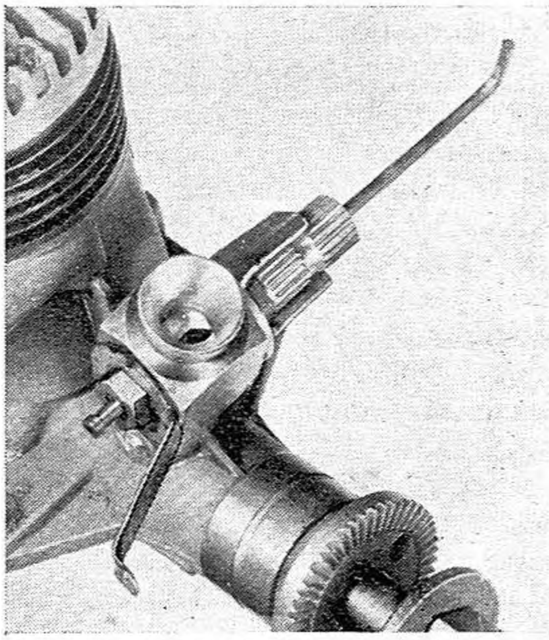
It is not the purpose of this review to describe the operation of such control, for this has been fully described in other articles, but to deal with the various approaches to speed control and to assess their merits, or otherwise.

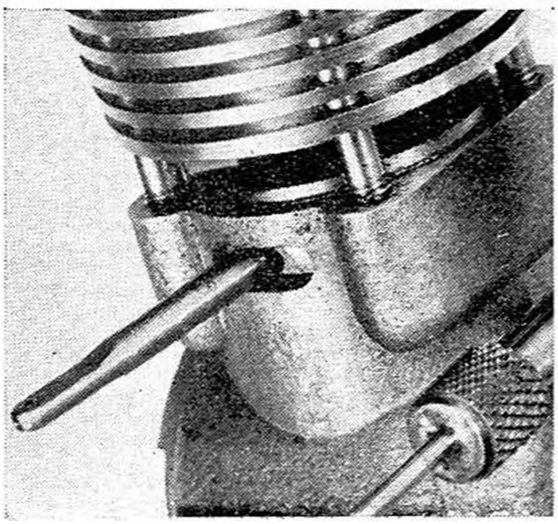
Mixture Variation

The full-size two-stroke as employed for a motor-cycle, scooter, or garden mower uses a combination of wet fuel metering and inlet restriction. Scale

Opposite: Walker Firecracker 1 c.c. engine has combined exhaust and carb. control, giving an r.p.m. range from 2-14,000. Right Top: Fox 35RC has rotary exhaust choke, seen "open" with flattened rod in horizontal position. Centre: Bramco throttle fitted to an O.S. Max 35, with barrel at half-speed position. Bottom: Oliver Tiger transfer control experiment.







effect, including intakes with fractional choke bores, prohibits such application for model purposes, but the slightest alteration in needle valve setting will result in a considerable r.p.m. change, as all modellers know.

The question of how much needle valve-cum-r.p.m. change is desirable is dependent on whether the engine is glowplug or diesel, and in our experience both require a form of additional control to obtain the required control range. With a diesel, for example, the compression can be set to produce 10,000 r.p.m. on a lean needle setting, but by opening up the needle we can, in the case of a side-port engine such as the Mills, get right down to 4,000 r.p.m.—and considerably less than that in firing strokes per minute.

With a rotary valve engine, specially ported for contest work, the reduction in r.p.m. will be much less—in fact some engines may only lose some 2,000 r.p.m. before stopping altogether. The limiting factor is compression ratio, and until we can vary this coincidental with needle control, control via the needle setting is not the best approach to speed control of a diesel engine. Structural reasons prohibit the fitting of twin (fast and slow) needle assemblies to many diesels.

With glowplug operation the range of control is greater, but the risk of the "fire going out" at a crucial moment is ever present. Twin needle valves have long been accepted as a control system for glowplug motors, and usually permit an r.p.m. range of from 8-12,000, but the danger of a wet mixture stifling the plug reduces the chance of achieving a lower r.p.m. The system could be safeguarded by introducing a 1·5 volt booster for the plug as slow speed is selected, but the engine still requires additional intake restriction to regulate the volume of mixture entering the cylinder and crankcase.

Apart from twin-needle assemblies, one can employ a spring-loaded two-position needle, or a coarse pitch needle connected direct to the actuating system. Commercial units are available in the U.S.A. in the form of the ANNCO 2-position unit, which fits a standard needle valve body, and its own self-contained needle for high-speed setting. However, though effective over a 4,000 r.p.m. range, mixture variation does not really reduce the power output to suit modern requirements, for we need an engine to operate from tick-over to full power—a total range of from 10-12,000 r.p.m.

Compression Ratio Variation

Under bench tests, a 45 deg. movement of a diesel contra-piston lever can have a marked effect, and it is possible to obtain a very wide speed range with such control. Mechanically, however, such control is only feasible where a high-powered motorised servo is incorporated, and even then the compression screw is at the whim of the contra-piston, which may stick. So, for practical purposes, this effective form of speed control is untenable.

Ignition Timing

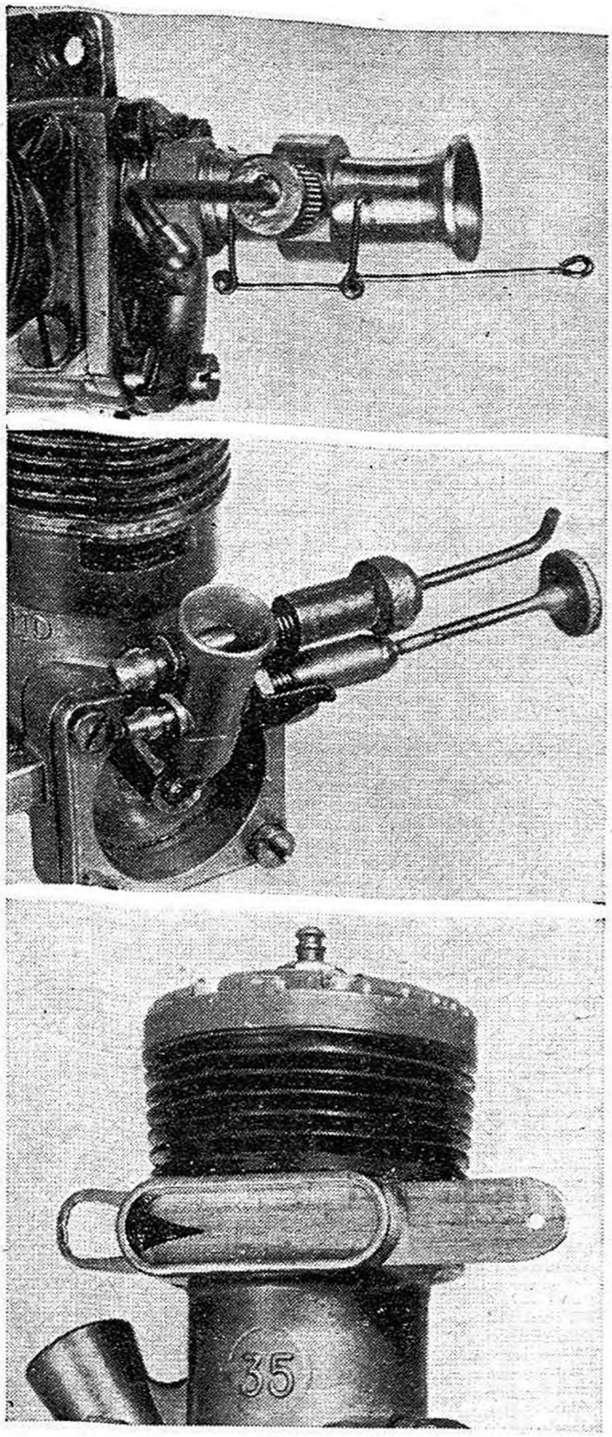
Petrol ignition engines have always had the great advantage that by simply changing the relationship of the make-and-break points to the crank-shaft cam the timing of the ignition spark can be advanced or retarded, and thus control the speed of the engine. On a Frog 500 such control can vary from 5,500 to 9,000 r.p.m. in a full swing of the ignition control lever. By using two sets of points, the range can be obtained by fitting a simple switch in the circuit.

But 5,500 r.p.m. is much more than a tick-over, and further calls for a rich mixture, which in turn reduces top speed slightly. The power/weight ratio plus the penalty of battery and equipment weight with the petrol engine is its main disadvantage, and limits its appeal to those die-hard enthusiasts who regard the unit with some affection, and appreciate the less expensive, non-corrosive qualities of the fuel. If a model can carry the weight without exhibiting underpowered tendencies, then the petrol motor with ignition speed control offers several advantages, not the least being its ability to pick up speed rapidly on a timing change, and its kindness to model finish.

Port Restriction

Ever since manufacturers discovered that—within limits—the larger the ports the more powerful the engine, the two-stroke has changed from a small-ported, muffled unit to a loud-mouthed "neighbour scarer". However, these large ports enable us to control speed by restriction, and, as with the full-size counterpart, first thoughts turned to the intake.

Should a flapper valve with a $\frac{1}{16}$ in. hole drilled through it be pressed against the face of the intake duct, any engine, whether it be diesel, glowplug or petrol, will immediately run rich, and reduce r.p.m. by as much as 40 per cent. But this holds true only as long as the needle setting suits the air in-take restriction, for if on the lean side with a diesel (causing intermitten firing when the model is airborne) then use of a flapper valve can *increas* r.p.m. With a glowplug such a case rarely arises, for the over-lean setting i



Top: F. Rising type "double-butterfly" induction choke on an E.D. 346 Hunter diesel. Centre: Twin needle valves on a Davies-Charlton 2.49 Rapier diesel, one used for high speed, the other for low. Bottom: Roberts "Vari-Speed" slide restrictor control on a K. & B. 35.

quickly defined by a cessation of all activity.

As with mixture variation via the needle valve, so does any form of choke induce an increase in fuel flow, and calls for compression adjustment on a diesel or plug booster for glow. Though simple, the external type of flapper valve is limited in its use, and one must employ a double choke, before and after the spraybar or jet, to compensate the fuel/air mixture. By this means one can safely operate without risk of ill effect or stoppage, whether by means of double butterfly chokes or a rotating barrel around the jet as on the Mills, Bramco, etc. By such means a standard glowplug engine will produce a 50 per cent speed reduction.

On R/C "specials" such as the K. & B., Veco, and Johnson 35s, with revised induction and transfer porting, the speed range is near to 60 per cent of full power, and we face the difficulty of the plug failing to fire unless shielded.

With a diesel, the double butterfly is reasonably effective, causing misfiring on a rich mixture at low speed. In the case of some engines this can have the novel effect of retarding the firing to such an extent that the engine reverses direction. Though this has happened many times in bench tests, we have yet to observe such a phenomenon in the air. (Gives rise to thoughts of new manoeuvres . . . reverse loop for example !)

Testing an E.D.346 we obtained a useful range of 6,400 to 9,800 r.p.m. with a 9×6 prop., using the double butterfly choke as marketed by F. Rising, while the K. & B. 35 with Bramco throttle operates safely from 11,500 down to 5,500 on a 10×6. Manufacturers' R/C specials can be expected to run slower than this, and have the advantage of being fitted with slow speed stops as on a car carburettor, so that the required low speed can be easily adjusted.

So much for the intake, and the next port of call for the mixture is the transfer. With the exception of the Oliver family, who have experimented with all forms of speed control, this system has apparently been overlooked as a source of control. Quite the neatest of devices, the Oliver transfer restrictor is a band around the lower cylinder, which can be rotated through some 20 deg. to reduce the transfer of fuel into the upper cylinder. An r.p.m. range of 8-12,000 is immediate in action, and the cut-out value of the restrictor band will attract the free-flight contest enthusiasts. Unfortunately, the work required to produce so neat a unit renders it unlikely as a commercial venture, so thoughts must be directed to the simpler and surprisingly more effective exhaust area control.

Restriction of the exhaust gases is well known as a cause of loss of power in a carboned-up two-stroke. (Some garages thrive on a reputation for producing power from scooters, merely by removing excess carbon from the exhaust ports !) The principle can be employed deliberately for retarding the firing of a glowplug engine, causing sufficient pressure in the exhaust stack to lower power by as much as 80 per cent.

That most inventive of designers, the late Jim Walker, introduced exhaust control on his Firecracker engine in 1955, and, coupled with an intake flap, the exhaust baffle was incredibly effective. Speed range was from 2-14,000 !

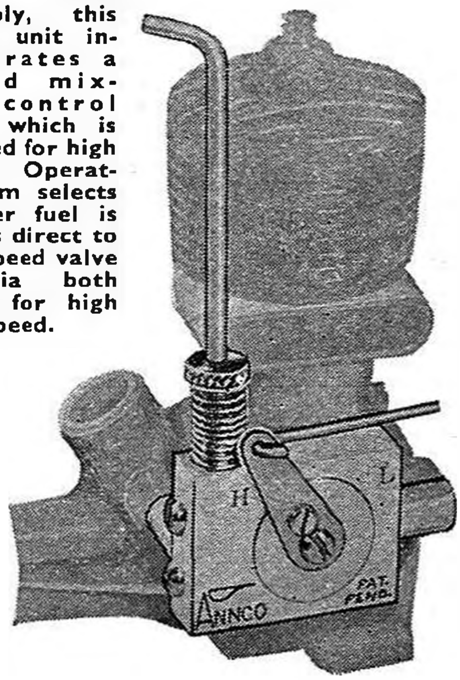
By closing the exhaust port area, a two-stroke loses its scavenging efficiency. There is a build-up of fuel which remains unburned in the upper portion of the cylinder, but an engine will continue to function even with the port reduced to a mere $\frac{1}{16}$ in. square, provided there is sufficient space between the baffle and the inside cylinder walls for the burned gases to escape from the combustion chamber.

There are many approaches to this system, and all are very effective. From some aspects the silencing effect is an advantage, for noise can be reduced at low speed settings so that an engine is inaudible at a short distance, but for a radio flier it might be embarrassing to be under the impression that the motor is "dead", when in fact the model is in a powered descent ! Some aver that exhaust restriction is phoney, and that noise is deceptive, but a tachometer proves otherwise. Three engines (Fox 35 with rotary rod restrictor, OS Max 35 and K. & B. 35 fitted with Roberts Vari-Speed slides) all reduced r.p.m. from 12,000 to less than 3,000 with no ill effect, and only a slight delay in action. The best low-speed figure on these engines fitted with rotary intake restrictors was much higher at 5,500 r.p.m.

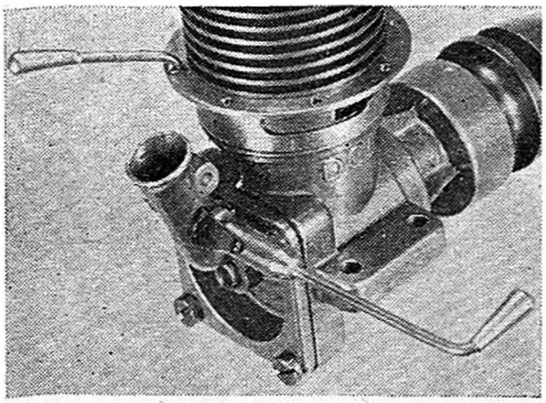
Undoubtedly the ideal would be to couple exhaust and intake controls.

The OS Company of Japan, and Veco Company of U.S.A. produce a coupled system for their engines.

Exhaust control works equally well on diesels, and some lend them-



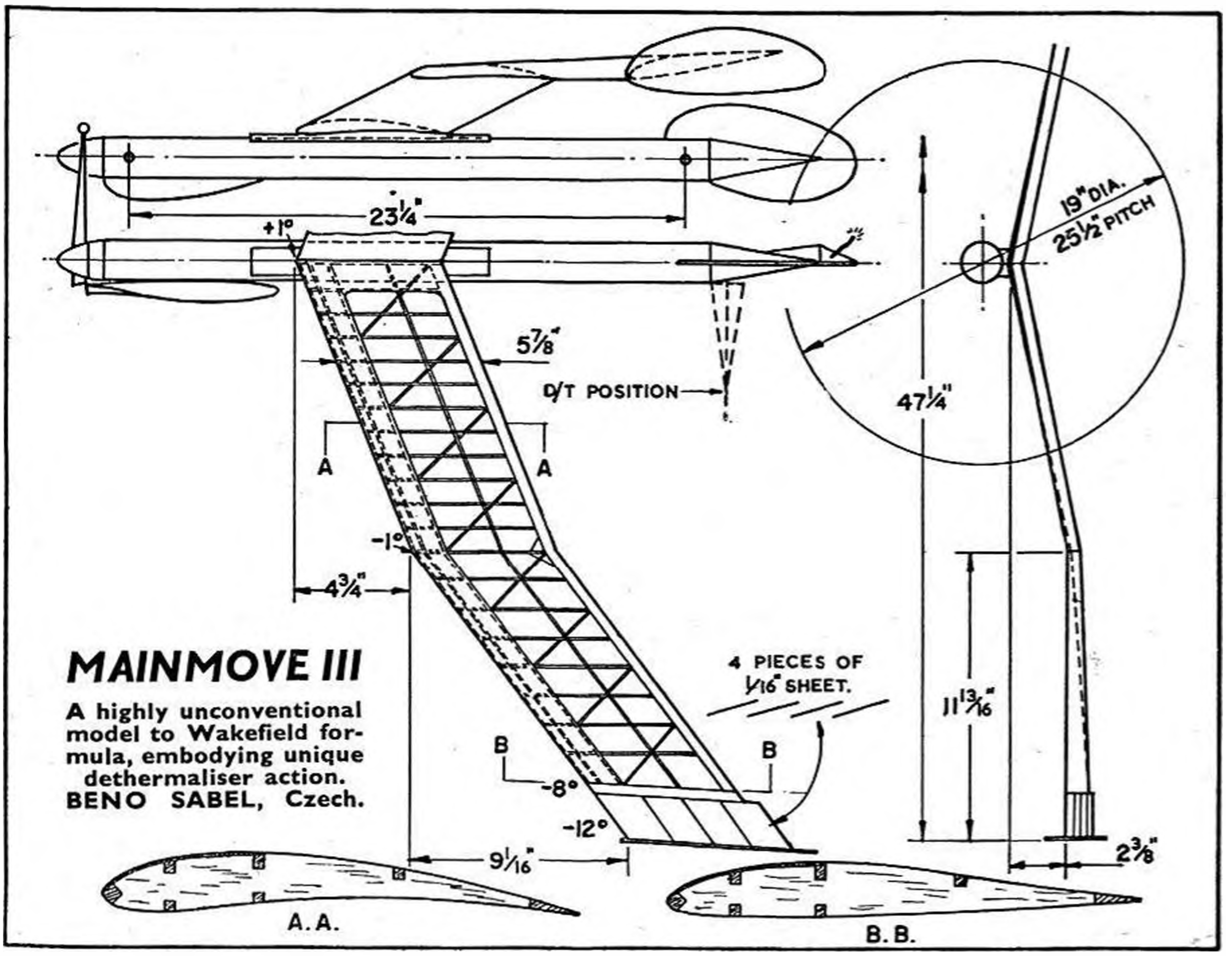
Fitted direct on to the standard needle valve assembly, this Annco unit incorporates a second mixture control valve, which is adjusted for high speed. Operating arm selects whether fuel is to pass direct to slow speed valve or via both valves for high speed.



Experimental collar fitting around a standard Davies-Charlton 2.49 Rapier diesel serves as an exhaust restrictor and provides a good range of speed control without need for altering the mixture. Slots in the collar coincide with exhaust ports on the cylinder jacket for full speed.

selves ideally to a rotary band fitted over the fins. A D.C. Rapier will reduce r.p.m. by 50 per cent, not as much as a glow engine due to the dependence of the diesel on high compression for spontaneous ignition, but a 10 × 4 turning at 4,000 r.p.m. gives a nicely controlled descent, as distinct from climb at 8,000 r.p.m.

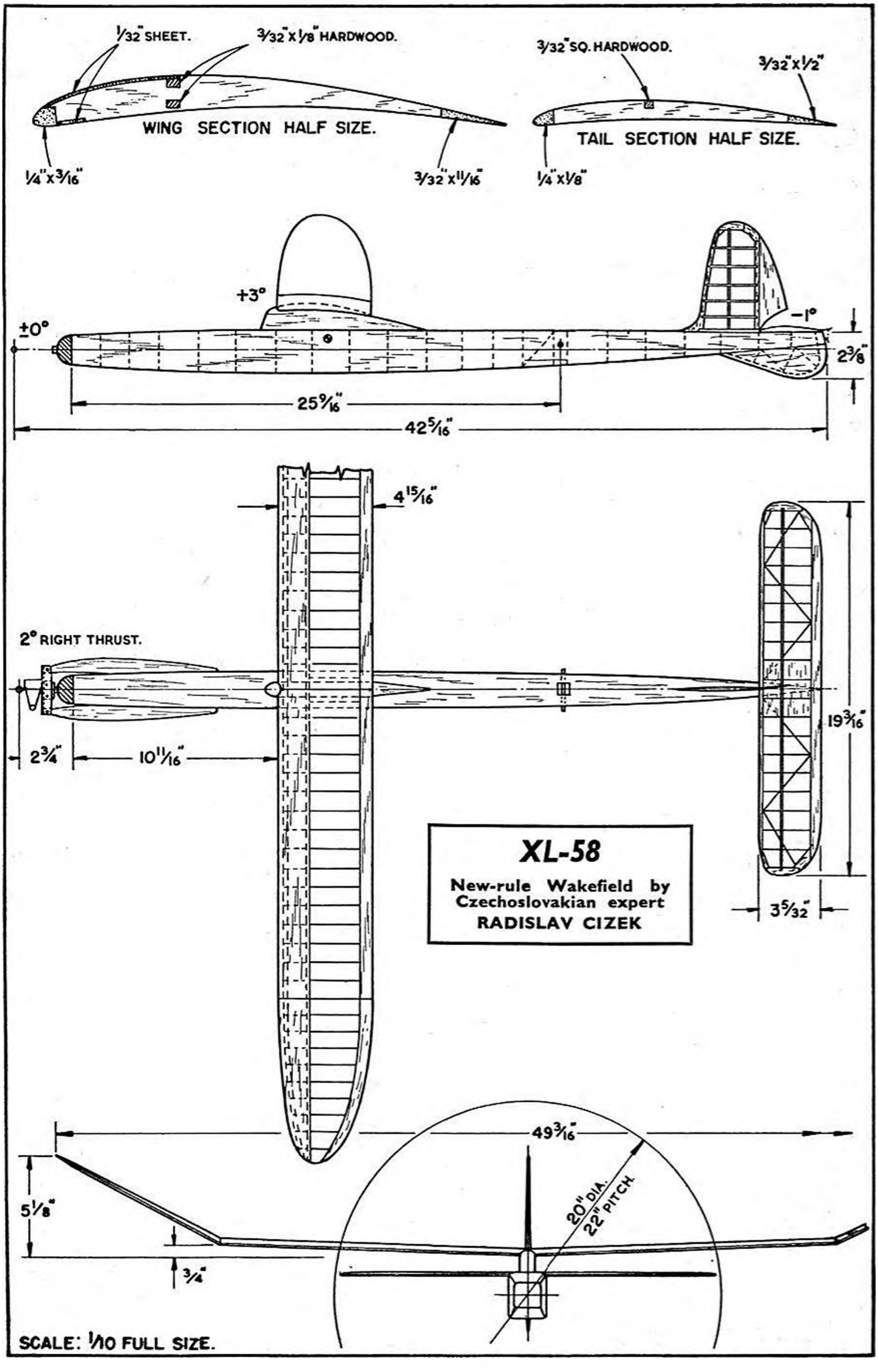
Mechanically the effect on con-rod bearings must become apparent with prolonged back pressure from the exhaust, while the heat generated in a baffled 6 c.c. glowplug exhaust demands a spring or stainless steel sliding restrictor, but these are small penalties to pay for what is, in our estimation, the simplest and most satisfactory of all engine speed control devices.

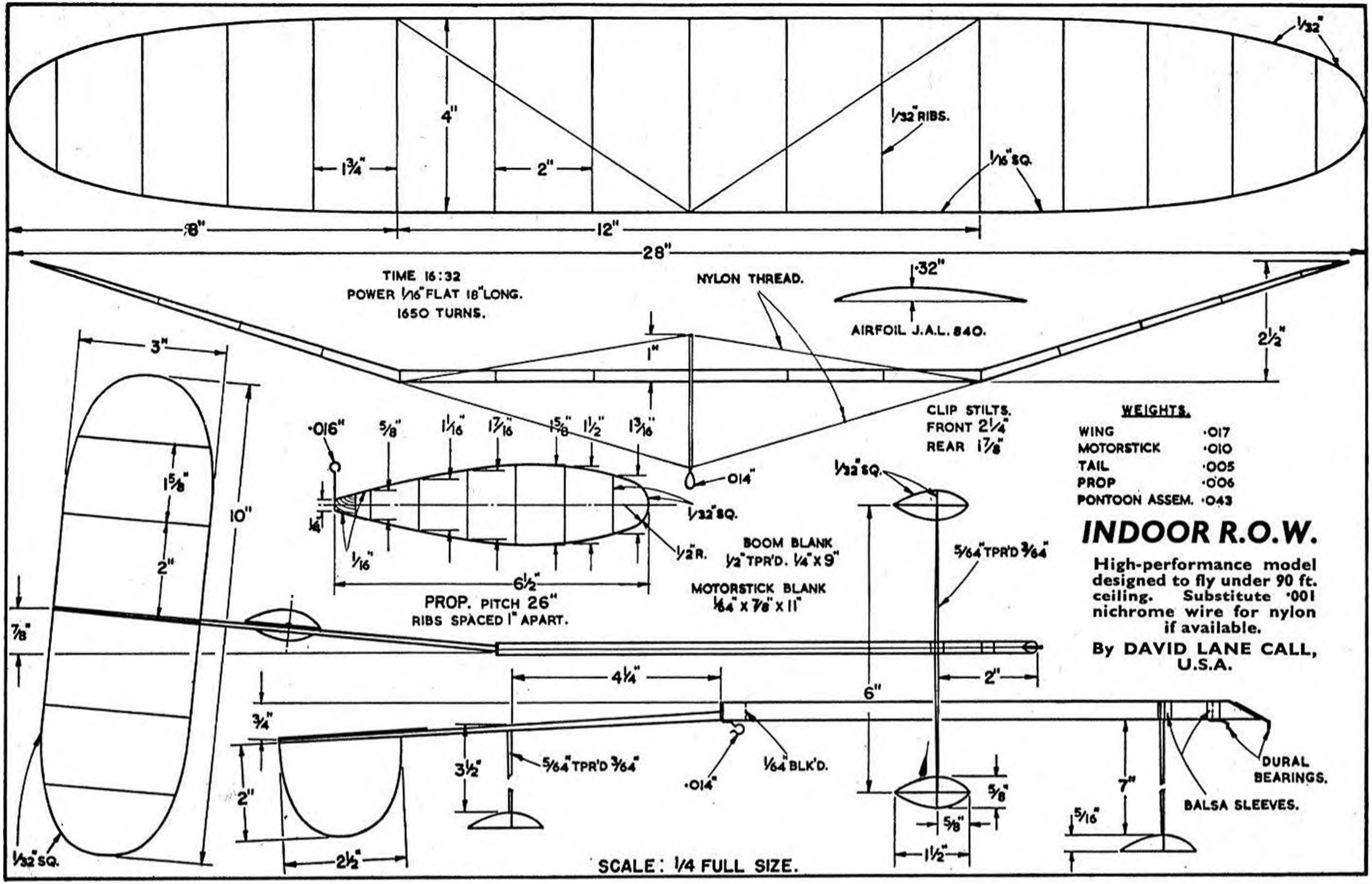


MAINMOVE III

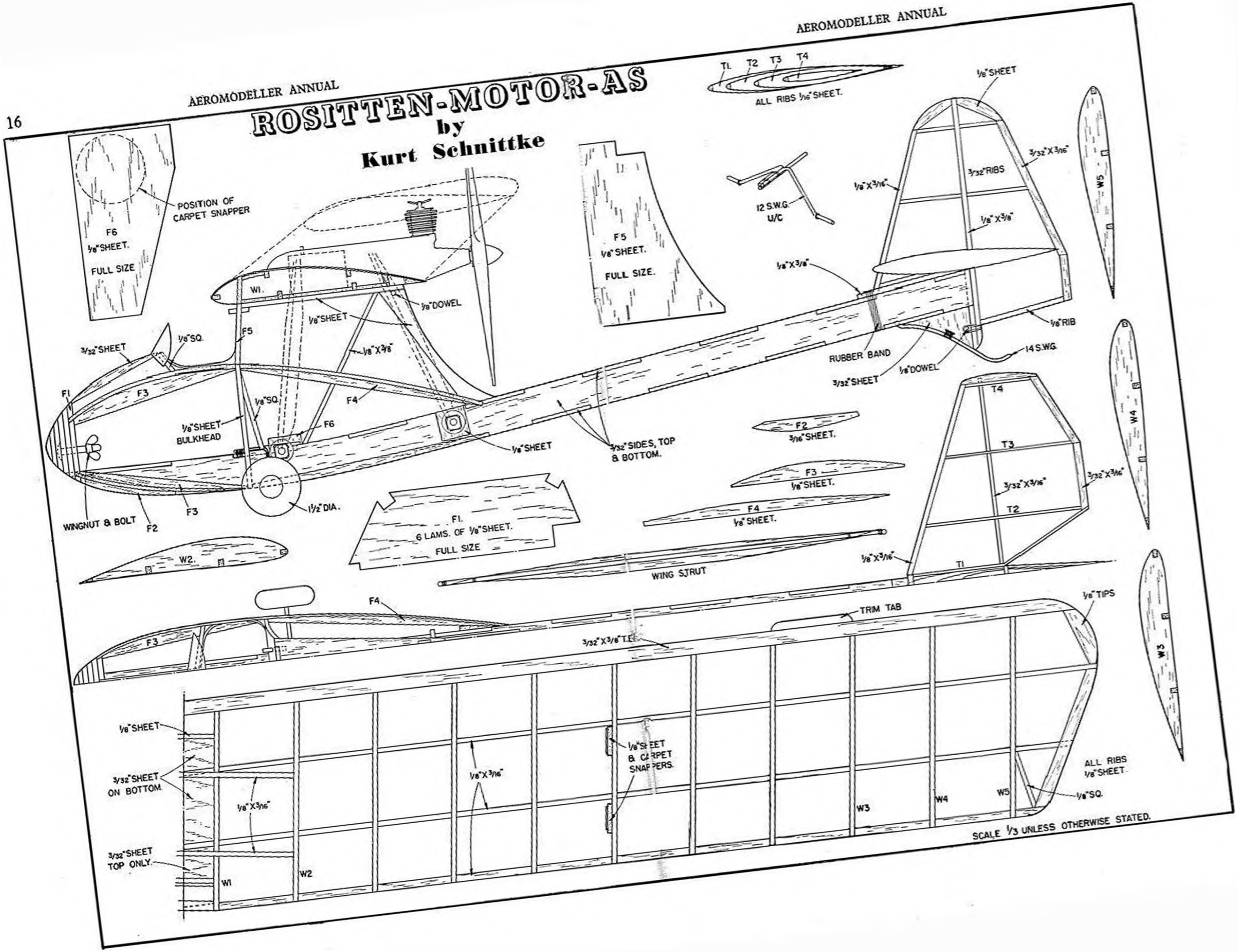
A highly unconventional model to Wakefield formula, embodying unique dethermaliser action. BENO SABEL, Czech.

LETECKY MODELAR


1/32" SHEET.
3/32" x 1/8" HARDWOOD.
WING SECTION HALF SIZE.
1/4" x 3/16"
3/32" x 11/16"
3/32" SQ. HARDWOOD.
3/32" x 1/2"
TAIL SECTION HALF SIZE.
1/4" x 1/8"
+3°
±0°
-1°
2 3/8"
25 9/16"
42 5/16"
4 15/16"
2° RIGHT THRUST.
2 3/4"
10 11/16"
19 3/16"
3 5/32"
XL-58
New-rule Wakefield by Czechoslovakian expert RADISLAV CIZEK
49 3/16"
5 1/8"
3/4"
20" DIA.
22" PITCH.
SCALE: 1/10 FULL SIZE.


1/32"
1/32" RIBS.
4"
1 3/4"
2"
1/16" SQ.
8"
12"
28"
TIME 16:32
POWER 1/16" FLAT 18" LONG.
1650 TURNS.
NYLON THREAD.
·32"
AIRFOIL J.A.L. 840.
2 1/2"
1"
3"
CLIP STILTS.
FRONT 2 1/4"
REAR 1 7/8"
WEIGHTS.
WING ·017
MOTORSTICK ·010
TAIL ·005
PROP ·006
PONTOON ASSEM. ·043
·016"
5/8"
1 1/16"
1 7/16"
1 5/8"
1 1/2"
1 3/16"
·014"
1/32" SQ.
1 5/8"
10"
2"
1/16"
1/2" R.
BOOM BLANK
1/2" TPR'D. 1/4" x 9"
MOTORSTICK BLANK
1/64" x 7/8" x 11"
6 1/2"
PROP. PITCH 26"
RIBS SPACED 1" APART.
5/64" TPR'D 3/64"
INDOOR R.O.W.
High-performance model designed to fly under 90 ft. ceiling. Substitute ·001 nichrome wire for nylon if available.
By DAVID LANE CALL, U.S.A.
7/8"
4 1/4"
2"
6"
3/4"
3 1/2"
5/64" TPR'D 3/64"
·014"
1/64" BLK'D.
2"
5/8"
5/8"
1 1/2"
7"
5/16"
DURAL BEARINGS.
BALSA SLEEVES.
1/32" SQ.
2 1/2"
SCALE: 1/4 FULL SIZE.

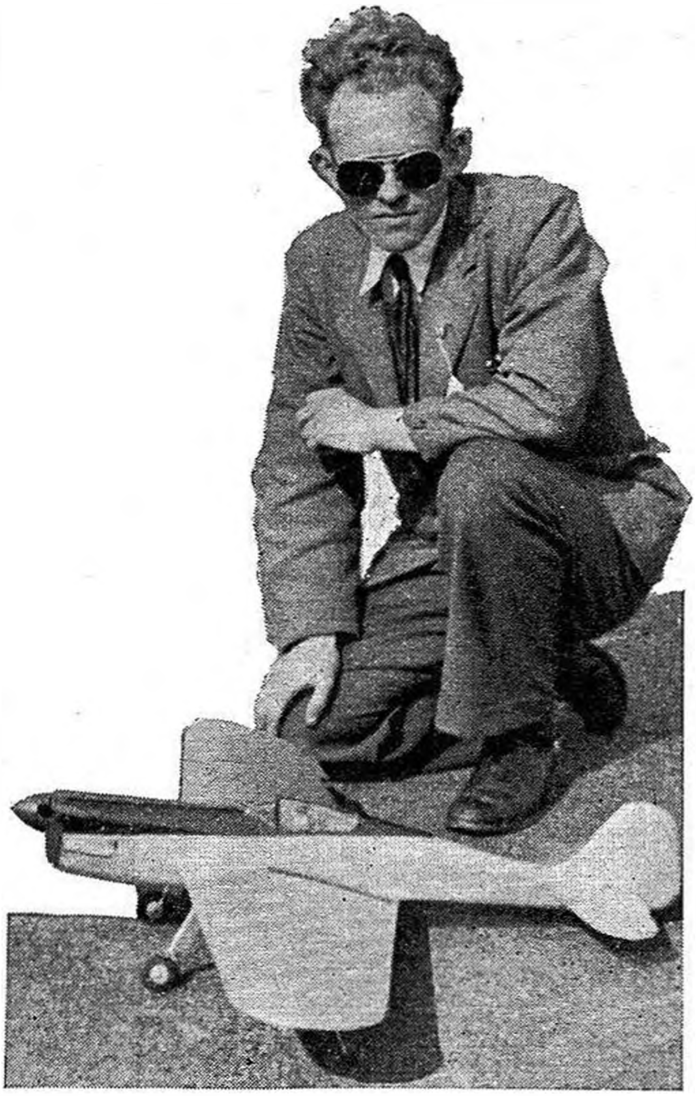
ROSITTEN-MOTOR-AS
by Kurt Schnittke



THE DEVELOPMENT OF A SUCCESSFUL STUNT MODEL

By P. RUSSELL

British stunt Champion 1955, 1956 and 1957.



The author seen here with 334 G-2 (E.D.246 using a 9 x 6 prop.) just after winning the 1956 "Gold" Trophy contest at R.A.F. Waterbeach during that year's British Nationals.

IT SEEMS TO BE fashionable among model aeroplane designers to claim that their models have been "developed" through innumerable prototypes. One often suspects that by "development" they simply mean that they have built a lot of different models—not always the same thing by any means.

In scientific parlance, the word is taken to mean the gradual improvement of a device by a series of experiments and modifications. With models, it is very important to make all mods. in single stages, so that the effect of each separate alteration is clearly seen, without complication from the effect of other modifications.

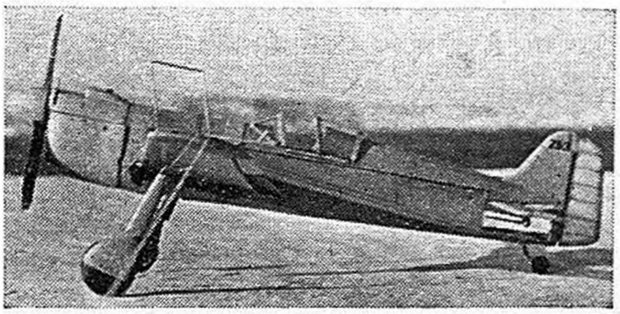
The 334 series of models can claim to have been developed in the true sense. Starting in the autumn of 1946 the design has been steadily plugged, averaging one new model per annum, and even the latest one, the 334H, is almost identical in shape and size to the original, though almost every single feature has been altered at some time or other and the structure has been revised continuously, and the performance improved beyond belief. The original had an Ohlsson 23 for power, weighed 32 oz., including, of course, the ignition equipment, did 48-50 m.p.h., was safe on no more than 45 ft. lines (in calm weather at that) and its "manoeuvres" were limited to fairly steep climbs and dives. 334H, by comparison, has an E.D. 246 (not much more powerful than the Ohlsson), 20 oz., 65 m.p.h., 60 ft. lines in almost any wind, looping radius 7-10 ft., and will almost certainly do the new S.M.A.E. schedule, given a good enough pilot ! The only really big change is in the wing loading, yet, even loaded up to the original's wing loading, the "H" will still do the old S.M.A.E. schedule on a calm day.

The first of the series to be aerobatic was the 301 of 1949. This had an Elfin engine which, theoretically less powerful than the Ohlsson, certainly gave a much more sprightly performance. The model's structure swung to extreme light weight, and it was slightly smaller (230 sq. in.) than its predecessor. As pilot skill improved it was eventually found to be capable of up to vertical eights. Some of these early two-point-fives would give today's experts quite a shaking, and indeed did at the 1958 "Gold Trophy" Contest. The Eifflaender type models had amazing manoeuvrability and appeared to be quite capable of square corners, though they were very fast for their size (70 m.p.h. plus) and quite fragile. Weights for about 200 sq. in. were often as low as 12 oz.

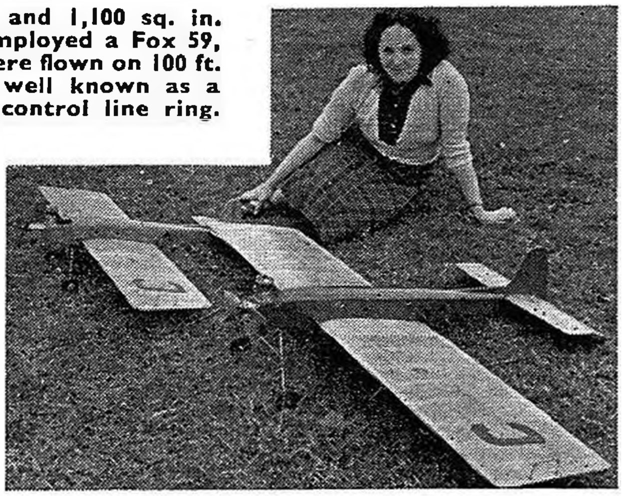
After a couple of amazingly successful years with a model that had originally been built from a kit, the 334 series started in 1950 with the "A". It still looked very much like the old Ohlsson model and was back to the same size, but it incorporated a number of structural improvements learned the hard way from team racers. The most important, as far as making the model last a long time was concerned, was to build up the engine bay as a separate box of hardwood and ply, screwed together. Since adopting this feature no model has died of old age, and in fact the "A" is still flown regularly, after literally hundreds of flights, mainly to test small modifications.

Brian Hewitt (British champion 1949/50) and I had been avid correspondents in the early days of stunt flying, had both tried flaps as an aid to manoeuvring in a half-hearted sort of way, and had not been impressed. However, the 334B of 1952 was tried with flaps—all sorts and sizes of flaps ! Now flaps have been used in full-size aviation since the mid-thirties. The idea was not always to increase lift, but in a certain aeroplane the flaps *were* so used. Normal Cl max. was 1·4, but with 60 degrees of flap (plain flaps, similar to those used on models) this went up to 1·9. Unfortunately this particular aeroplane also had automatic slots, which complicated the issue, but it is safe to assume that the increase would have been to about 1·8 without them.

On the face of it, this looks a great improvement, and well worth while. Unfortunately, when applying them to our model, a number of snags crop up. First, we have to use a symmetrical section, and this doesn't give anything like as good a section with flap depressed as the normal "lifting" section (I could never understand why we call aerofoils with a cambered centre line "lifting sections". Surely *all* wing sections are lifting sections !) Secondly, we scale down to model size, and there is a great drop in overall efficiency, and in consequence the gain from the use of flaps is due to the much reduced Reynolds Number. This loss might be as much as 30 per cent. Also, in connection with scale effect, is the fact that a lower R.N. boundary layer separation takes place earlier, so that the flap has to move further out into the airstream to get the same "bite" on the air. This effect is mitigated by the fact that drag increase is also delayed.



Granddaddy of them all ! The original 280 sq. in. model flown in Malta during 1946.



Mrs. Bridget Russell with 900 and 1,100 sq. in. models. The smaller model employed a Fox 59, the larger a Hornet 60. Both were flown on 100 ft. lines. Mrs. Russell herself is well known as a redoubtable performer in the control line ring.

(It is interesting to note in this connection that George Aldrich, the American champion, has mentioned that he is using bigger flap angles than had been hitherto thought advisable.)

One final snag with flaps when used as a means of increasing manoeuvrability, as distinct from reducing stalling speed, is that they produce an adverse pitching effect, *i.e.*, when you want the nose to pitch up, although the flaps produce the lift in the right direction, they are at the same time trying to pitch the nose down. Thus if you fit flaps to a model that didn't have them before, you will probably find manoeuvrability *reduced* until you fit a bigger elevator. With the 334B it was found that the elevator had to be 15 per cent larger than on the "A", with the same angular travel. The flaps themselves, after much trial and error finally fixed at 15 per cent of the wing area, were actually a part of the aerofoil (*i.e.*, not simply a flat flap hung onto the trailing edge), and moved almost as much as the elevator. Anything less than 15 degrees appeared to have no effect at all.

One point, discovered quite accidentally, is that sweeping forward the flap hinge-line seemed to increase effectiveness quite noticeably. This is probably explained by the fact that the air is "funnelled" into the flaps, and spilling at the tips is reduced. All these flaps were continued right to the tips and the mysterious malady that has recently appeared in articles on stunt flying, variously described as "flop", "tip wobble", "tip stalling", etc., was not experienced. This disease almost certainly has nothing to do with the flaps, but is due to the inefficient blunt, broad tips that are common. These are the worst possible termination to a wing that spends much of its time at high angles of attack. Note that Bob Palmer uses a properly tapered elliptical tip.

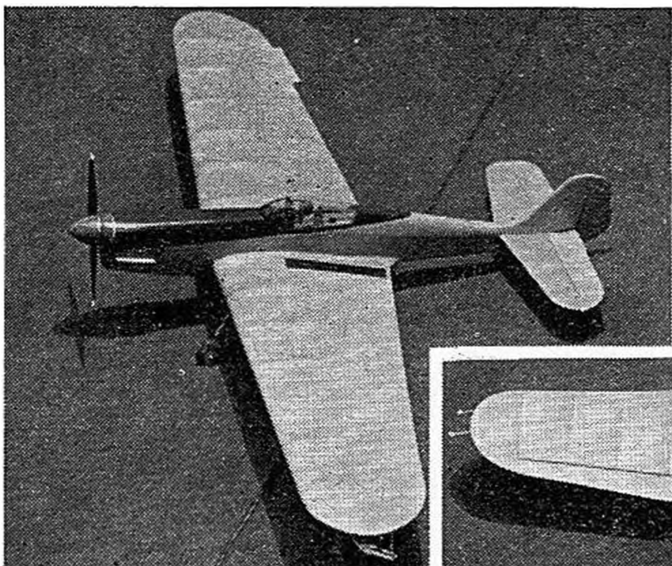
With the 334Bs flap system as efficient as it appeared possible to make it, the model was then flown with the flaps fixed neutral. The drop in manoeuvrability was definite, but disappointingly small. An amusing article appearing recently suggested that flaps are essential to a modern contest model. Anyone doubting that, said the author, should just try flying a flapped model with these appendages disconnected. Presumably he did not realise how ineffective the demonstration was likely to be !

My next model, the 334C, did not have flaps, and the idea was shelved until the introduction of the new schedule made it necessary to use *any* device that increased manoeuvrability, however small the increase. This model was used as a guinea pig for line tension experiments. All the recognised devices were tried ; engine and rudder offset ; asymmetric planforms ; weighted tips ; position of bellcrank and leadouts, etc. While the earlier models had been using some of these devices, the object of the exercise was to find out which were effective and which were not.

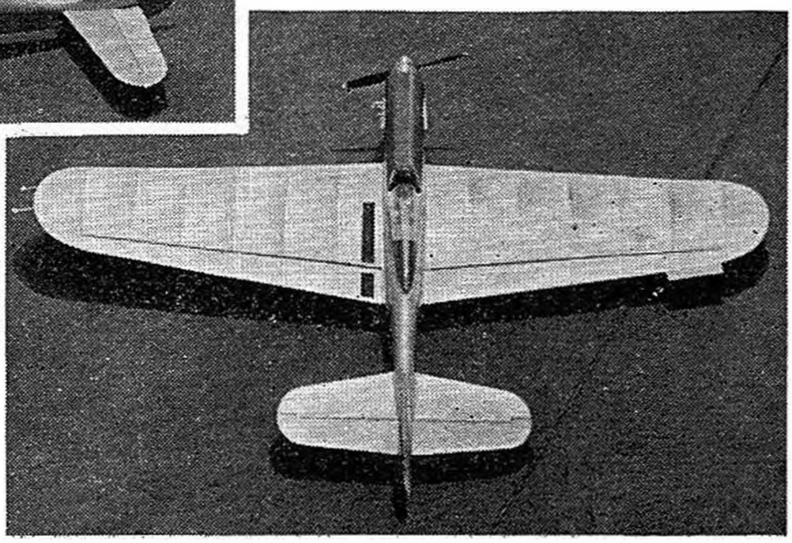
First, one wing longer than the other. Using differentials of up to 10 per cent, this feature produced no visible effect on line tension, or other improvement to flight characteristics at all. It simply produced a number of ribald comments from onlookers who thought the difference was accidental! Engine offset had no effect on fast models, but seemed useful on slow or underpowered models. Rudder, or fin-and-rudder offset, again no effect on fast models, but was useful on slow ones and on the glide. Anything more than 5 degrees proved detrimental, however.

Wingtip weight is very important, especially in complicated manoeuvres as line tension starts to diminish. The weight, which is most effective at slow speeds when you need it most, ensures that the model is trying to roll outwards all the time. About 1 oz. seems to be right on a model of about 300 sq. in. Bellcrank/leadout positions seemed quite critical. A point roughly coinciding with the centre of pressure in level flight seems about right for the pivot, with the centre of gravity at least 10 per cent of the chord further forward. A slight sweep-back on the leadouts seems beneficial. But on a given line length quite the most important factor is speed itself, so that all the devices mentioned must be used in moderation if they produce drag. Weight also is an important factor, of course, but as weight is the antithesis of manoeuvrability, this cannot be used as a device to improve line tension, and in any case would be effective only at low level.

In 1954 the "E" version was built, this time with an upright engine to save the engine in the belly landings then permitted. This version was not considered particularly successful, but it was fourth in the "Gold" that year (our first entry since 1951), the interlude being well spent on team racers, which, apart from the fun and success had with them, provided a lot of useful structural data that was put to good effect in the 334 models. This model was tried with various wing sections. One, with an average thickness of 9 per cent (thicker at the root for structural reasons), produced the fastest 334 of the series, 74 m.p.h.



Left: 334 G-2 is available in plan form through the Aeromodeller Plans Service department under Code No. CL/632, price 6/-



Right: 334H had flaps added for the 1958 contests, but the pilot was hors de combat owing to an accident while acting as a gliding instructor.

The effect on manoeuvrability of this thin section was negligible, but it was almost impossible to fly the model steadily at 6 ft. Climbed to 15 ft. or more and it was all right, probably due to the longitudinal dihedral effect of the slight "up" elevator. This difficulty in low-level flight afflicted all the 334s to some extent, but was reduced to tolerable proportions on the E5, which had a 15 per cent section with the maximum thickness at 30 per cent chord. The E5 was great fun to fly, lots of snap, yet smooth, and it won the 1955 "Gold Trophy".

1956 saw a return to the inverted layout in the 334G, which had the same wing and tail assembly as the E5. As fixed undercarts were now mandatory, a unit resembling that of an Fw 190 was fitted, which seemed to be in keeping with the appearance of the model, but it looked quite ludicrous doing stunts with its wheels down so a "fixed" type was fitted, after the style of the Chipmunk. It still didn't look right to our prejudiced eyes, but was the best solution we could think of. My own flight in the "Gold" that year was probably the best I shall ever make, concluding with a peach of a wheel landing, the model doing at least half a lap with the tail up. The next year, again using the "G", a combination of lack of practice and a coked-up engine "hardening" towards the end of the run produced a very rough, though complete, pattern. Imagine my surprise when I learned the 334 had won again, and by a big margin!

When the new schedule came along, I was against it. None of the people who were loudest in its favour had ever come near to performing the old schedule to anything like perfection, and with our background of full-size aerobatics, where smoothness is all important, I disliked the ugly square manoeuvres. However, as I tackled the problem, I found it an interesting enough technical exercise. Firstly, it was obvious that the "G", ideal as it was for the old schedule, would be no use for the new, where every bit of manoeuvrability would be needed. The easy way would be to simply enlarge the wing, but I was unwilling to sacrifice appearance, as this has always been the first consideration with the 334s, even if it meant sacrificing performance. So the flaps were resurrected, improved, and a little extra area added. In the structural department, weight was reduced also. The result was a useful improvement, and the "H" might have won the contest in 1958, but for the fact that the pilot was at the time spending several weeks supine after unsuccessfully contesting the case of Russell & T.31 v. Sir Isaac Newton! As it happened, a 2·5 diesel still won, thus confounding the "experts" who had been predicting the necessity of a large glow-engined, flapped model for the new schedule. Just for good measure, veteran Gig Eifflaender flew what was apparently one of his lightweight 1949 models into fourth place!

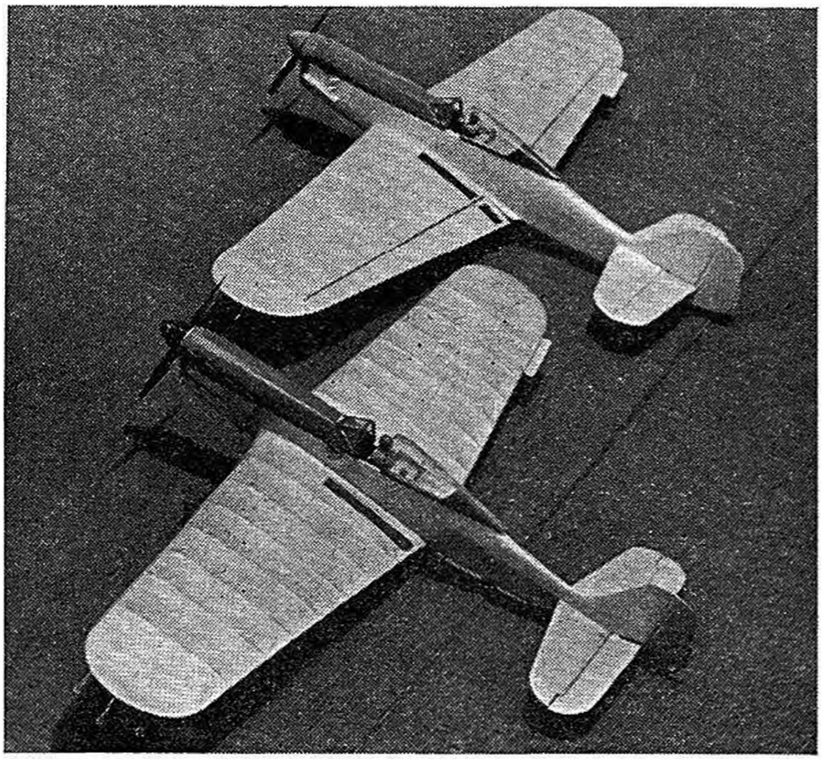
Perhaps in view of the considerable controversy on the subject of large glow-and-flaps v. small diesel, it would be as well to look into the facts.

Aerodynamically, the larger the model the better, for it will be more efficient due to its higher Reynolds Number, and steadier due to its greater mass. As its speed is usually about the same as its smaller rival, it will also have a better ratio of lift inertia, so that it should be better for square corners (whether you like them or not!). It is also a fact that a glow engine, running a bit rich, does tend to "come in" with sharp applications of "g", giving the extra power just when needed. (A diesel tends to do the same thing, of course, but the reaction —at least on all the diesels I have used—is slower, and you don't get the power until it is too late). From personal experience, the most impressive stunt model I ever had was powered by a "Hornet", had 1,100 sq. in. of wing area, but it needed a van to move it and a full-size airfield to fly it, while the racket could be heard miles away !

This brings me to the reason I fly a 2·5 diesel—the noise. In my district, the locals will *just* tolerate the noise of this sized motor ; anything bigger and the complaints come rolling in. The glow engine is not merely noisier, but it also makes a racket that carries further and is more irritating to the uninitiated (and indeed the initiated too, sometimes).

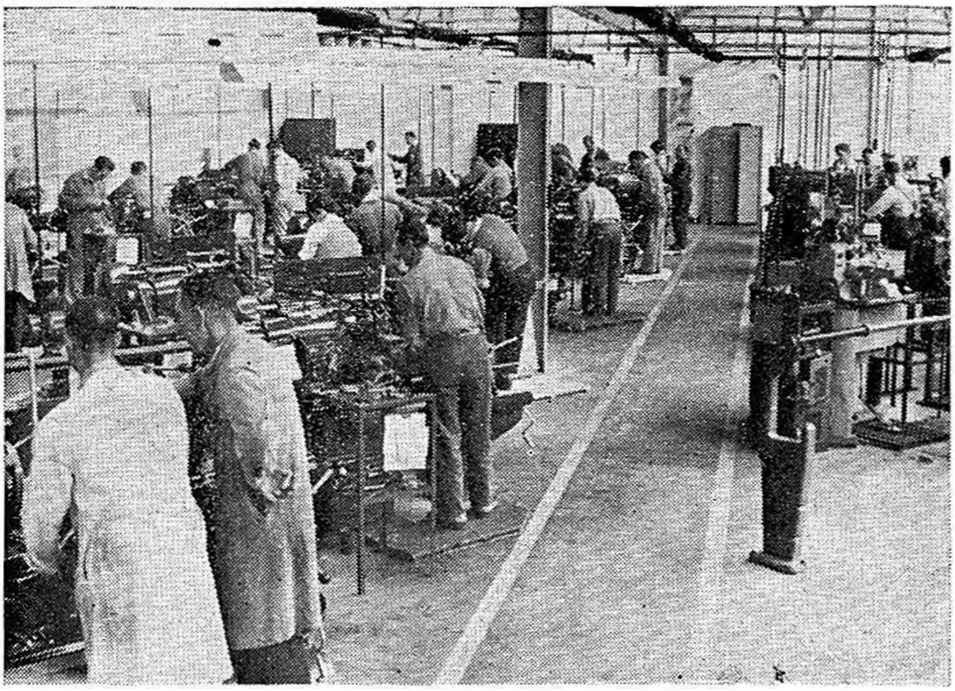
Quite apart from noise, it appears that the bigger models are not much superior when put to the test. Early last year I was fortunate enough to have a number of flights with Bob Palmer's own Thunderbird, probably the best design of the "big" school, and this convinced me that Bob's incredibly precise flying is due to man, not machine. The Thunderbird is *very* manoeuvrable, but so it should be with that enormous wing. It gets back almost to the loadings of the 1949 lightweights with 596 sq. in. and 36 oz. total weight. Though it was not

The first and the last? 334A in the foreground differs little from the latest mark H. Note the general similarity to the F.W. 190. The author is now abandoning this successful line of models for those with a jet-like appearance, using the Chance-Vought Crusader as a basis from which to develop a new series of highly manoeuvrable stunt machines.



possible, I would have dearly loved to have tried a flight with the flaps fixed at neutral, but I am convinced that the loss of manoeuvrability would not be marked. I was a little surprised to find the line tension quite low, especially on the high-level manoeuvres, as the lines in use were 60 ft., the same as used on the lighter, smaller 334, with about one-third the power of the Veco. This is not an attempt to derate the Thunderbird, but simply an attempt to discount the current belief that these large models have some magical properties.

In fact, if this article has any moral, it is that to win stunt contests you must first get the best model you can. Copying other people's designs, or building kits, is a much less satisfactory way than designing the thing yourself. When you develop a model yourself, you know it inside out. Then practise regularly. If you have a natural aptitude it matters not one jot whether you use a 2·5 diesel or a ·35 glow !



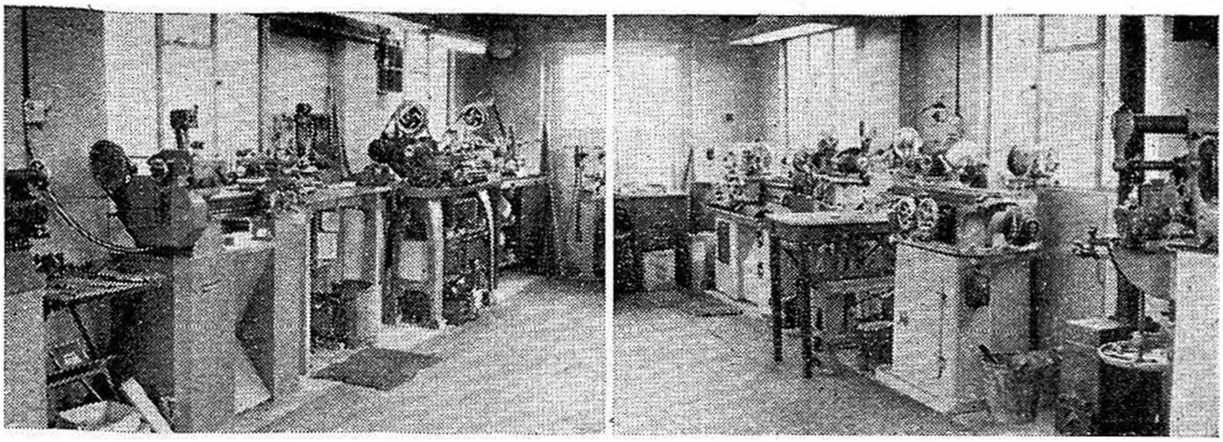
Typical machine shop of a large manufacturer.

THE MANUFACTURE OF MODEL ENGINES

WHILE THE model engineer may be capable of turning out an excellent motor with no more equipment than a small lathe and a drill press, mass production of engines demands a considerable capital outlay for machine tools and associated equipment. Without automatic or semi-automatic production of components the retail price of the engine would be prohibitive to popular sales.

American technique differs considerably from British and Continental European organisation. With their high labour costs it becomes even more important to avoid hand labour and produce as fully as possible by machines. This is one of the main reasons why they have developed the glow motor as their standard form of production, since this does not demand the same close fits and more rigid construction as the diesel. This has also proved advantageous to them in that the very small glow motor can be produced in a reasonably "foolproof" form at a low cost, enabling them to cash in with huge sales on a large popular market. A small diesel, by comparison, is much more difficult to produce in a similar size, and considerably more costly. Under about ·6 c.c. in size, mass production methods are largely unsuited to diesel requirements, and a considerable amount of hand work is required on each individual engine.

America, too, is a manufacturing country which automatically thinks in terms of fully tooling-up on almost any production job—and presumably capital is more readily available to make this possible. As a result many American engine manufacturers have machines which the British manufacturer would find prohibitively costly to install for a similar job ; and probably also more and better machines for close-tolerance work. On the other hand, they would not necessarily be adaptable to a fully automatic production line for diesels without some considerable design modifications and alteration of material specifications. The two industries are quite distinct in this respect. When the Americans pro-



In contrast with the factory shown on previous page, this is the small, but highly specialised machine shop of a company making high performance diesel engines.

duce a diesel they redesign it to fit their established production techniques, although when we or another European country produce a glow motor (other than an adapted version of an existing diesel) we tend to copy American design, if not an exactly similar production technique.

The difference in production techniques established on the two continents considerably affects material selection (see "Know-how on Engine Materials"). Most American engines, for example, use unhardened steel cylinders, machine ground, honed or micro-honed to finish on a fully automatic or semi-automatic basis. (A micro-honed finish is recognisable by the characteristic regular cross-hatch pattern produced on the surface.)

Pistons are similarly finished—again as far as possible on an automatic basis—and graded in certain size limits with a tolerance of, perhaps, ·0001 in. A matching-size piston can then be selected from a suitable grade batch without involving any further mechanical operations. The degree of fit obtained may not be as close as that to which we are accustomed in Great Britain, but is generally satisfactory for glow motors. It may, however, tend to produce individual motors which are rather tight and need quite a lot of running-in time to free properly ; or at the other end of the scale new engines which apparently lack compression.

Typical engine test shop, which is sound-proofed and includes full air venting for the extraction of fumes.

This method of matching cylinders and pistons by selective fitting is typical, but not universal, with American manufacturers. Certainly they have become expert at "finishing to size", and the theoretical ideal of avoiding even selective fitting has been achieved on some productions, operating under the most carefully controlled conditions (which would also imply air conditioning and constant air temperature in the machine shop).

Diesel engine cylinders, by comparison, are almost invariably hardened. The production technique involves finishing the bore by reaming, followed by hardening and then grinding to remove reaming marks and to correct any distortion which may have occurred during heat treatment. The final finish is then obtained by honing. Some manufacturers may prefer to omit grinding after hardening and produce all the trueing and finishing by honing, but this places more onus on the skill of the honing operator and takes just as long, or even longer, than grinding and honing as two separate operations.

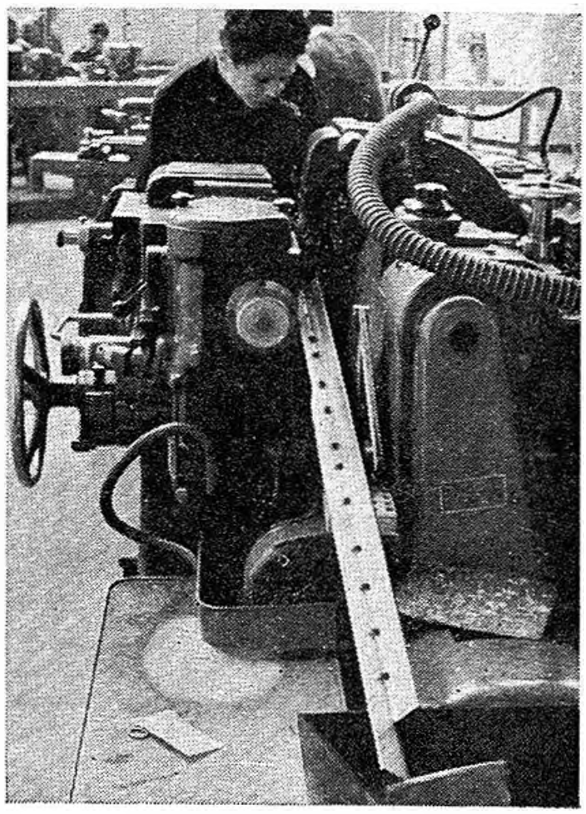
The bore is usually fitted to the piston. A batch of pistons are turned oversize and then finished to nominal size (within limits of the order of plus or minus 1/1,000 in.) by grinding. Possibly three separate grinding stages may be involved—a coarse grinding to remove most of the surplus stock, followed by two finish grinding operations.

The cylinder, turned to the grinding stage, is then fitted to an individual piston by honing in a hand operation, the skill of the honing operator determining the degree of fit obtained and also controlling any "flare" required at the bottom of the cylinder to produce a tapered bore deliberately introduced to reduce piston friction at the bottom of the stroke. Cylinders with elaborate port cut-outs are especially tricky to handle. The position also arises that a centreless ground piston may not be perfectly *circular* in shape, due, perhaps, to slight chatter on the machine. Duplication of the grinding operations will help eliminate such a possibility—unless it is the final grinding which is at fault. Greater consistency may be obtained by grinding between centres with a true grinding wheel, although this is more tedious. The final piston-cylinder fit, however, ultimately depends on the honing operator.

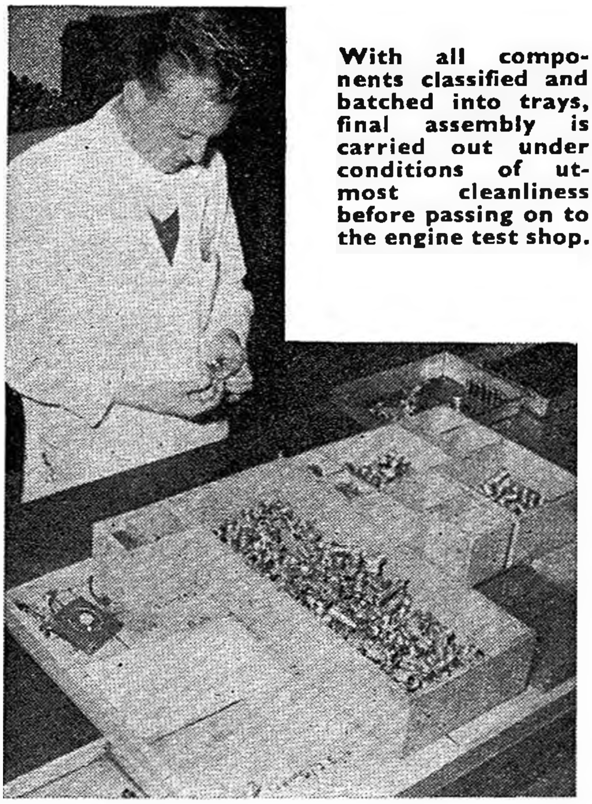
Having obtained a matched piston-cylinder fit there remains the question of fitting the contra-piston, which must be a tight compression seal with enough friction to hold a setting, yet free enough to move under compression with the adjusting screw backed off. A force-fitted contra-piston can distort the top of the cylinder, or even split it.

Orthodox technique here is to machine the contra-piston to nominal oversize dimension and grind down to within a thou. or two or the bore size. The cylinder bore itself is left undisturbed and the contra-piston lapped to fit. In this way any degree of required fit can be achieved.

Some manufacturers use the older method of fitting pistons to a finished bore by lapping. This technique does not appear to have any advantages from a production point of view, but it does, in general, produce a tighter fitting piston-cylinder combination and a new engine may



A fully automatic centreless grinder ejects a stream of contra-pistons at a high rate.



With all components classified and batched into trays, final assembly is carried out under conditions of utmost cleanliness before passing on to the engine test shop.

be that much stiffer in consequence.

Where American manufacturers have turned to small diesel production—albeit on a very limited scale—they have eliminated the lapping-in operation for the piston, preferring to rely on an O-ring seal so that contra-piston manufacture is reduced to a simple turning. This practice has been adopted on one production engine in this country and would certainly be used on more—there being an appreciable saving in production cost for this item—were it not for the fact that the ringed type of contra-piston is far from being universally acceptable to the customer. Its mechanical performance can be just as good as a solid contra-piston, but the characteristic and familiar "feel" of the compression control is destroyed. In a similar manner the average European modeller is familiar with diesel operation and finds glow motors harder to handle, whereas his American counterpart regards a glow motor as child's play to start, but gets into all sorts of trouble handling a diesel, and lacks confidence in it.

Another critical feature of engine construction is the crankshaft and its bearings, particularly in the case of a plain bearing. Again there is a difference in technique in that the Americans favour selective fitting and British manufacturers individual fitting.

Typical American engine crankshafts are finished by grinding and graded in batches of ·0001 in. size and selectively fitted to finished reamed or ground bearings. A typical British engine crankshaft is ground to finish slightly oversize after hardening. The bearing is reamed to nominal size and then matched to fit an individual crankshaft by honing. Where a manufacturer is prepared to accept a relatively slack fit, however, the bearing may be finished to size by reaming only, thereby reducing production costs.

The crankcase unit is invariably a die-casting for a production job. Sand castings do not hold close dimensional tolerances and may present problems in jigging for further work on them, as well as being generally rough and unattractive in appearance. Pressure die-castings are preferred to gravity die-castings on account of their better clarity of detail, etc., and the fact that they can be formed with thinner walls, but gravity die-castings are not entirely ignored.

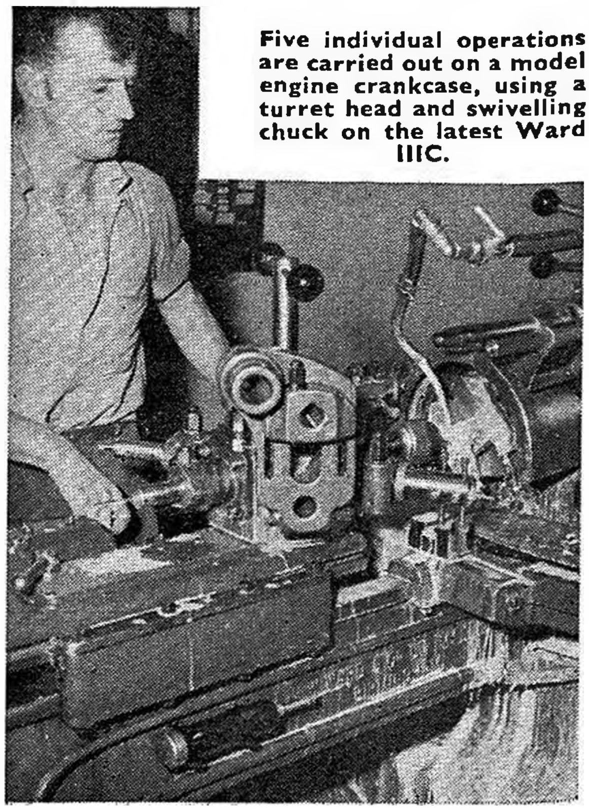
The finish of a die-casting is often improved by mechanical or chemical treatment. Abrasive tumbling is favoured as a simple process of producing a smooth, semi-polished finish cheaply. In this operation castings are loaded into a drum together with suitable abrasive to roughly half fill the drum and then rotated. The tumbling action of parts and abrasive radiuses off sharp edges and generally smooths the metal surface. The process is quite automatic and also controllable. The type of abrasive, degree of loading and the speed of rotation can produce varying degrees of stock removal and surface finish in predetermined times (which may operate as long as twenty-four hours). Also there is a different effect with dry tumbling and wet tumbling (*e.g.*, the contents of the barrel in contact with water).

The more eye-catching finishes—almost mirror-bright surfaces—are usually produced by chemical brightening or electropolishing. The latter is an electrochemical technique where the subject forms the anode in an electrolytic bath and subjected to electro-erosion on surface defects, under controlled conditions. Mechanical polishing and buffing may also be used to produce an attractive finish, although this is less amenable to complicated shapes. Anodising is not applicable to die-cast alloys although magnesium alloy castings can be given an attractive dull black finish by chemical treatment.

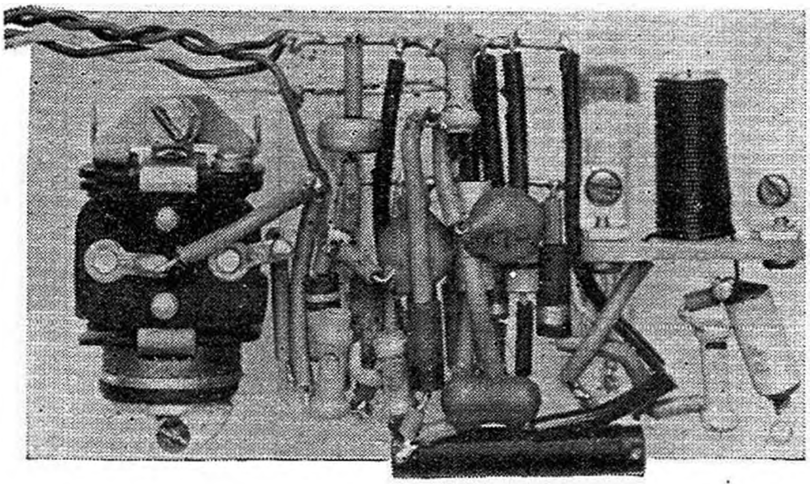
The other features of model engine construction are largely straightforward applications of basic engineering production techniques, utilising castings where practicable (*e.g.*, detachable cylinder heads, crankcase rear covers) which require a certain amount of machining to finish ; or machining the components completely from solid stock. Forgings may be specified for the connecting rod, requiring only drilling out and reaming to size.

As far as possible all machining and drilling operations are completely jigged so that standard dimensions are consistently maintained. But mistakes can occur. An original error in a crankshaft jig can accidentally increase the stroke of the engine to such a value that the displacement is "oversize" for a particular class specification—as has occurred on more than one occasion. Jigs, and fixtures too, are subject to wear and small discrepancies can creep in after a long production run.

Measurable differences can also occur with the bore of individual engines of the same nominal size, particularly in arriving at a matching fit. If a honing operator accidentally hones out an oversize bore common-sense economics demand that he rematches it to an oversize piston, rather than throw it away. In extreme cases differences as much as ·005 in. have been measured on individual bores of the same nominal size, but generally agreement is much closer. The performance of individual engines from a well produced batch are normally remarkably consistent, and such differences as there are normally disappear with running-in.



Five individual operations are carried out on a model engine crankcase, using a turret head and swivelling chuck on the latest Ward IIIC.



A 3-VALVE AUDIO TONE SINGLE-CHANNEL RECEIVER

By C. OLSEN

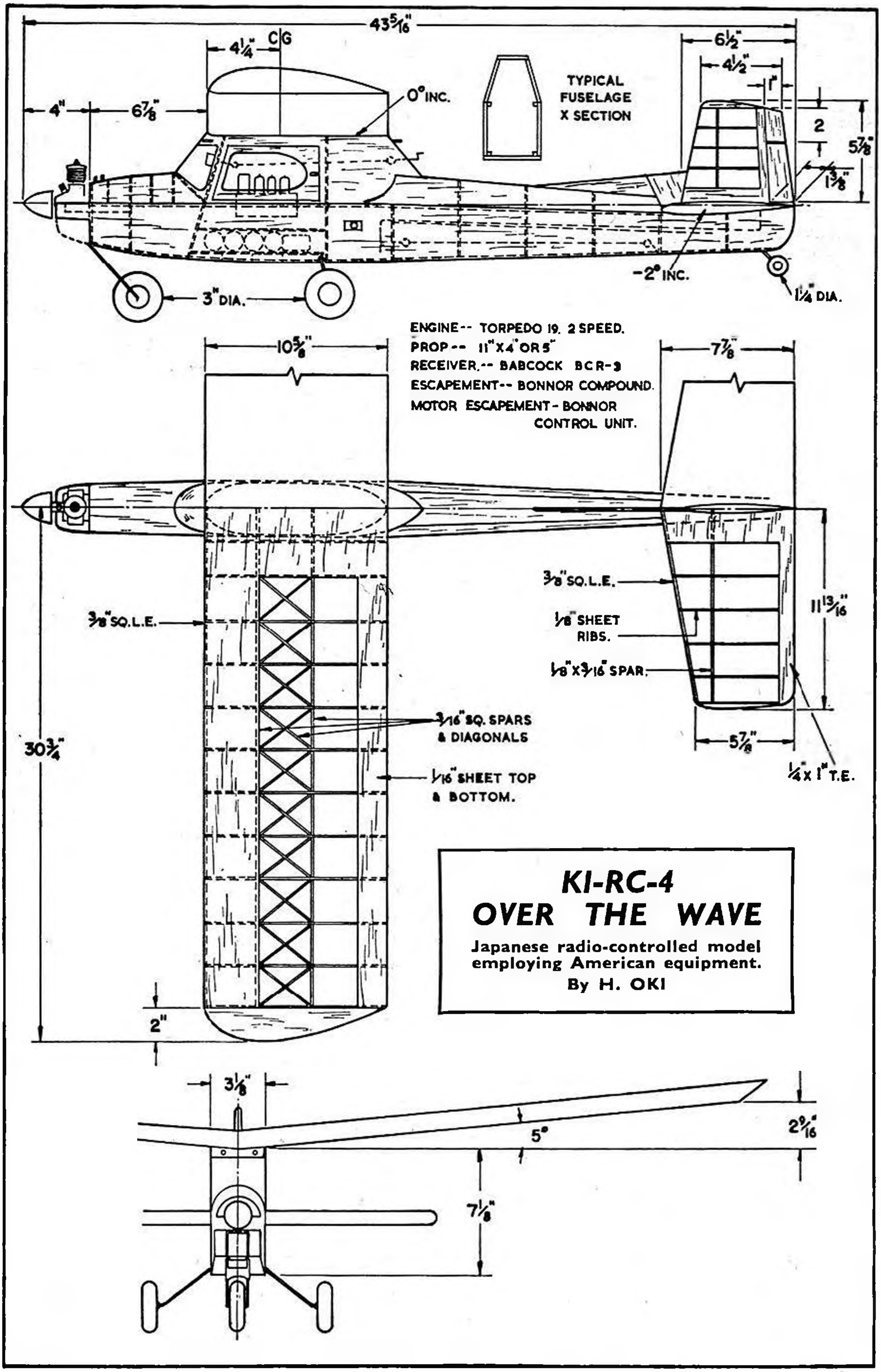
THIS RECEIVER is the result of some months' research into all types of single-channel receivers in an attempt to build one which, while being reliable and having only one tuning adjustment, is also small, light and economical. The receiver described here fulfils these requirements with a size of $3\frac{1}{2}$ in. $\times$ 2 in. $\times$ 1 in. weighing $2\frac{1}{2}$ ozs., and a filament drain of 27·5 to 60 Ma depending on the valves used. Standing current is 2·4 to 2·8 Ma and the change in the relay from 1·5 to 1·9 Ma down to 0, enough to operate most sensitive relays.

Basically the receiver is a miniaturised version of the Tone Aerotrol receiver, and consists of a super-regenerative detector followed by a quench filter network, an amplifying stage, a biasing network and a relay valve. The circuit operates in the following manner : a modulated signal is received by the detector, passed through a quench filter, which reduces the quench component of the signal (present whether a signal is there or not and which will otherwise operate the relay when no signal is present), is amplified and passed to the biasing network as an a.c. voltage. The biasing network rectifies and smooths the a.c. and applies a negative d.c. voltage to the grid of the relay valve, so preventing current flowing through the valve as the relay voltage drops out.

This d.c. voltage is directly related to the strength of the signal coming in and the depth of modulation of the transmitter, which, in nearly all commercial transmitters, is 100 per cent, so this is no problem. On the other hand, if the relay valve needs a very low voltage to prevent current flowing, *i.e.* a sharp cut-off valve, it will operate at a greater range than one with a higher cut-off voltage. Suitable valves for this stage are Mullard DL67 and Hivac XFY 31, 35 and 41, or any valve which will cut off on less than −3 volts. The other stages are not so critical regarding valves, and any one of the normal types will do, *i.e.* DL66 for detector and DF64 for A.F. amplifier.

The relay used in the original receiver was a Manning Carr 7,000 ohms resistance, but any relay which will pull in reliably on 1 to 1·2 Ma should be suitable. Both Gem and Ripmax relays have been used successfully.

Top photo shows the neat arrangement of the components in this near-full size picture.

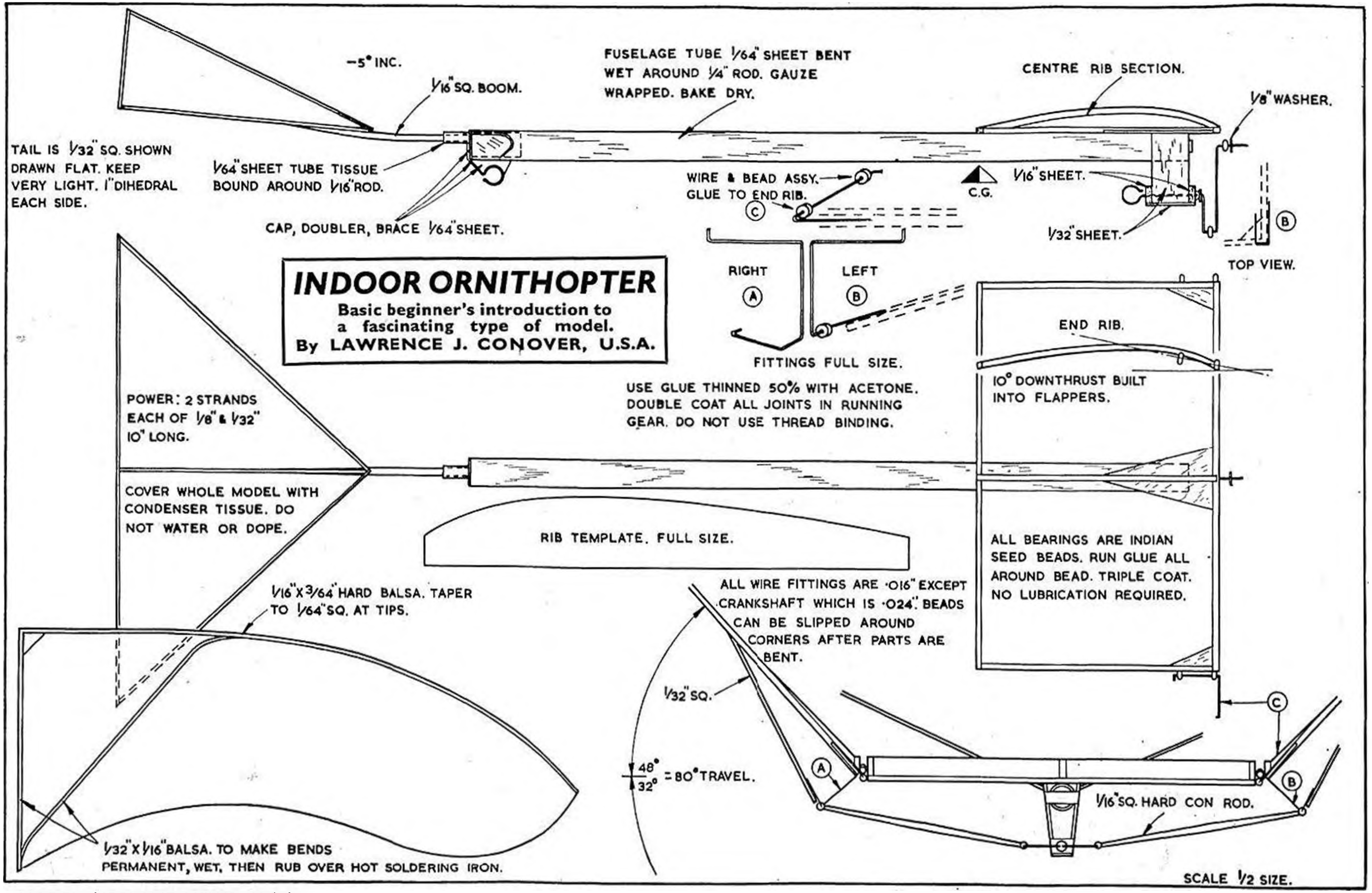


KI-RC-4
OVER THE WAVE

Japanese radio-controlled model employing American equipment.

By H. OKI

THE WORLD'S AIRCRAFT, JAPAN.



MODEL AIRPLANE NEWS, U.S.A.

DESIGNING FOR THE NEW F.A.I. POWER RULES

By
HANS NEELMEIJER

(Translated from "Der Modellbauer")

ON JANUARY 1ST, 1958, the new F.A.I. power rules became effective. Every set of rules places certain limits on the freedom of design, and, as in the past, the best possible solution within these limits will have to be sought.

The margin of excess power available for the climb will be considerably decreased by the higher total weight. In the past a good engine dragged the lighter model up almost regardless. The required minimum wing loading of 20 gr./dm^2 leads to a reasonable size of model, which is substantially equal to the size of machine to which we have been accustomed.

The three minute maximum flight has proved its worth in numerous contests and World Championships, and in normal conditions the model will stay in sight during this time, often landing within the contest site boundaries. Given still air conditions a really first-class power job to the old rules would nearly always do five minutes, so in fact there was a certain rough weather reserve duration. To exceed three minutes will obviously be more difficult under the new rules.

Briefly then, a first-class model will still have a maximum duration of three minutes providing it has been thoroughly trimmed, and will in fact do a little more, but the rough weather reserve factor has vanished.

More than ever there is now a definite need for very careful designing and trimming, and only those who spare no effort and who manage to take every advantage of every little item will prove to be successful.

From a design viewpoint, the pylon layout has proved itself in numerous designs, and will still probably lead the field in the future, although it is not for the want of trying to develop equally successful high-wing layouts. It seems advisable to make the pylon high enough to ensure that it places the wing just outside the propeller slipstream.

In the past, tailplane area was often quite considerable, coupled with a long moment arm. Wing area was then still large enough to obtain wing loadings of 15 to 16 gr./dm^2, but to keep wing loading down, the tailplane area will now

Heading shows John West with his finely-built new-ruler.

have to be smaller for the new rule designs. For the glide and d/t landing, this undoubtedly brings some advantages.

In the following calculations, using Ron Draper's World Championship model as an example, I will endeavour to show the proportions to be aimed at in order to achieve the lowest possible wing loading. (Figs. 1 to 4.)

Our starting point when designing a new model must be the chosen engine, its displacement in c.c.'s multiplied by 300 giving the minimum allowable total weight. For obvious reasons we should not make the power loading higher than necessary, but for safety's sake allow an extra 3 to 5 grams. Dividing the total weight by 20 gives the total projected lifting surface area, and of this at least 75 per cent should be wing area, or better still 80 to 83 per cent. The ratio between wing and tailplane area will then be between 3 and 5-1.

With these proportions, the fuselage length will remain normal. The lower excess power available calls for less longitudinal stability than on the old rule models, but it does mean that during test flying a very reliable trim for climb and glide will have to be achieved.

Small models with 1 c.c. engines will come very close to design limits, and to obtain the required flight stability the maximum allowable lifting surface area must be used. With the larger 2·5 c.c. model it will be easy to stay below the maximum lifting area limit, and the minimum allowable weight is not likely to be exceeded.

To achieve a definite design, total weight will be fairly easy if provision is made at the C.G. for ballasting the complete model up to the required total. (See table.)

My winning model of 1956 with a 2·5 c.c. Schlosser weighed 614 gr. and had a total lifting area loading of 21·3 gr./dm^2. The wing loading was 27 gr./dm^2 ! Climb was good, but suffered somewhat from the generous propeller pitch (180 mm.), the glide being excellent. To bring this model within the new rules it would have to weigh 580 gr. and use a 1·93 c.c. engine.

If the original total weight was retained, a 2·04 c.c. motor would be needed, which when fitted with a good propeller would still result in a respectable climb performance. This model was fitted with variable wing incidence, which would show up to even better advantage.

Higher flying speeds will not cause any aerodynamic problems providing the correct airfoils are chosen, but the increased landing speed coupled with the higher weight needs a sturdier airframe. On hard ground a d/t landing will result in higher impact loads which may cause damage, so the model will

Engine Capacity	Min. Total Weight	Max. Lifting Area	Wing Area	Span	Mean Chord	Tail Area	Moment Arm
c.cm.	gr.	dm^2	dm^2	mm.	mm.	dm^2	mm.
1	300	15	12.2	1000	122	2.8	580-640
1.5	450	22.5	18.3	1200	153	4.2	700-790
1.75	525	26.25	21.35	1300	165	4.9	760-830
2	600	30	24.4	1400	175	5.6	820-900
2.5	750	37.5	30.5	1700	220	7	900-1100

(The values given above may be used as a basis)

therefore have to be built sturdier and the increase in weight used in an intelligent manner.

I have a preference for models with about 600 gr. total weight, but there are no good modern 2 c.c. engines. (It would be a good thing if our engine manufacturers would try to close this gap.)

The three designs depicted in Figs. 5, 6 and 7 are the result of careful calibration and calculations, and are submitted as being of assistance to advanced modellers who can use them as a basis for new models. In them are incorporated the sum total of my not inconsiderable experience, with the exception of the variable wing incidence device.

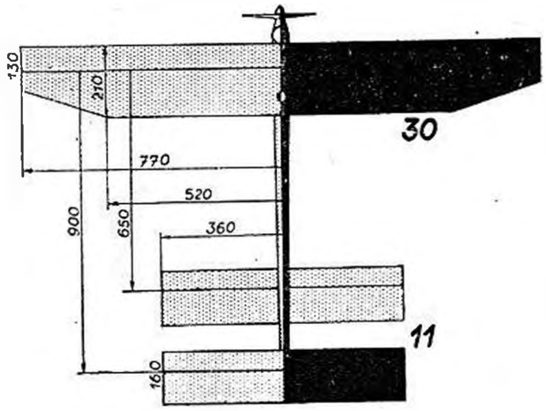


Fig. 1. The 1956 World Championship model by Ron Draper, presented in simplified form. A tailplane moment arm of 650 mm. still gave good longitudinal stability with the same tailplane area.

Total weight:	**504 gr.**
Total area:	**41 dm^2**
Total loading:	**12.3 gr./dm^2**
Wing area:	**30 dm^2**
Loading approx.:	**462 gr. 15.4 gr./dm^2**
Tailplane area:	**11 dm^2**
Loading approx.:	**42 gr. 3.8 gr./dm^2**

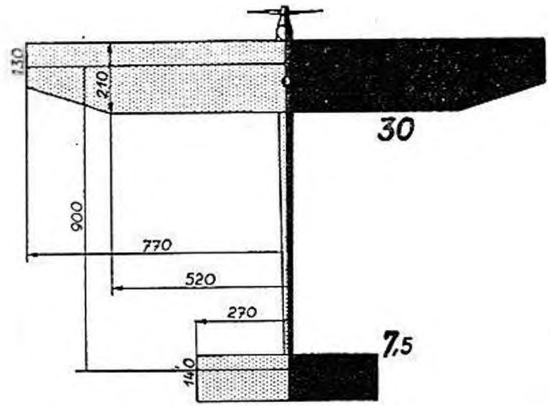


Fig. 2. The old model with a smaller tailplane and 246 gr. ballast. This design had a very good longitudinal stability, and the C.G. is moved slightly forward.

Total weight:	**750 gr.**
Total area:	**37.5 dm^2**
Total loading:	**20 gr./dm^2**
Wing area:	**30 dm^2**
Loading approx.:	**710 gr. 23.7 gr./dm^2**
Tailplane area:	**7.5 dm^2**
Loading approx.:	**40 gr. 5.4 gr./dm^2**

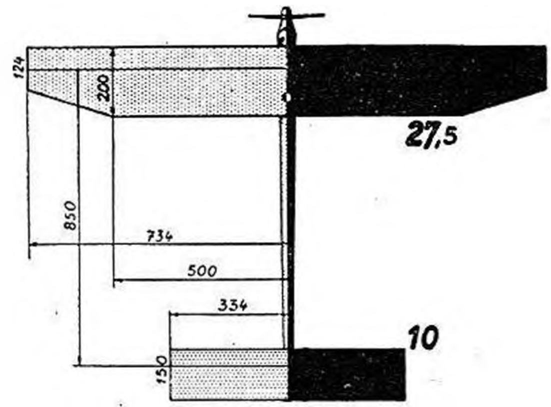


Fig. 3. This design is a smaller version of the old model, and has the highest wing loading of the three examples.

Total weight:	**750 gr.**
Total area:	**37.5 dm^2**
Total loading:	**20 gr./dm^2**
Wing area:	**27.5 dm^2**
Loading approx.:	**688 gr. 25 gr./dm^2**
Tailplane area:	**10 dm^2**
Loading approx.:	**62 gr. 6.2 gr./dm^2**

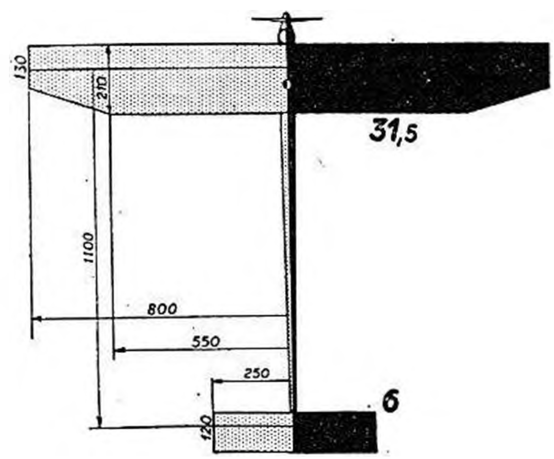
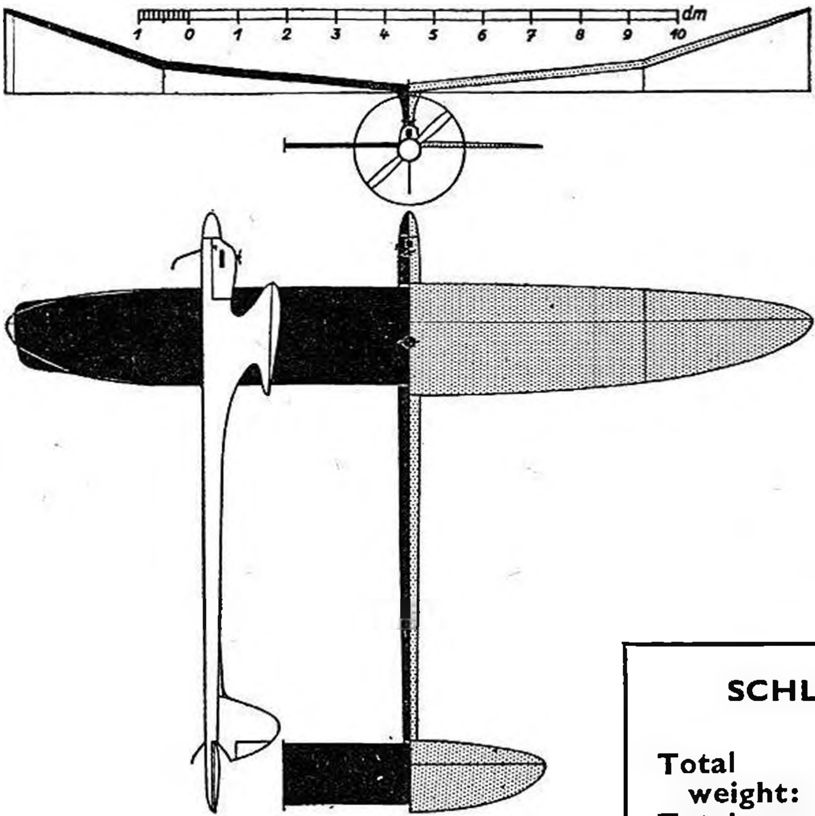


Fig. 4. A rather extreme example, similar to the models of Kucerow. It has the lowest wing loading. The tailplane area will still be sufficient to act as a dethermaliser.

Total weight:	**750 gr.**
Total area:	**37.5 dm^2**
Total loading:	**20 gr./dm^2**
Wing area:	**31.5 dm^2**
Loading approx.:	**718 gr. 22.8 gr./dm^2**
Tailplane area:	**6 dm^2**
Loading approx.:	**32 gr. 5.3 gr./dm^2**



DESIGN No. 5

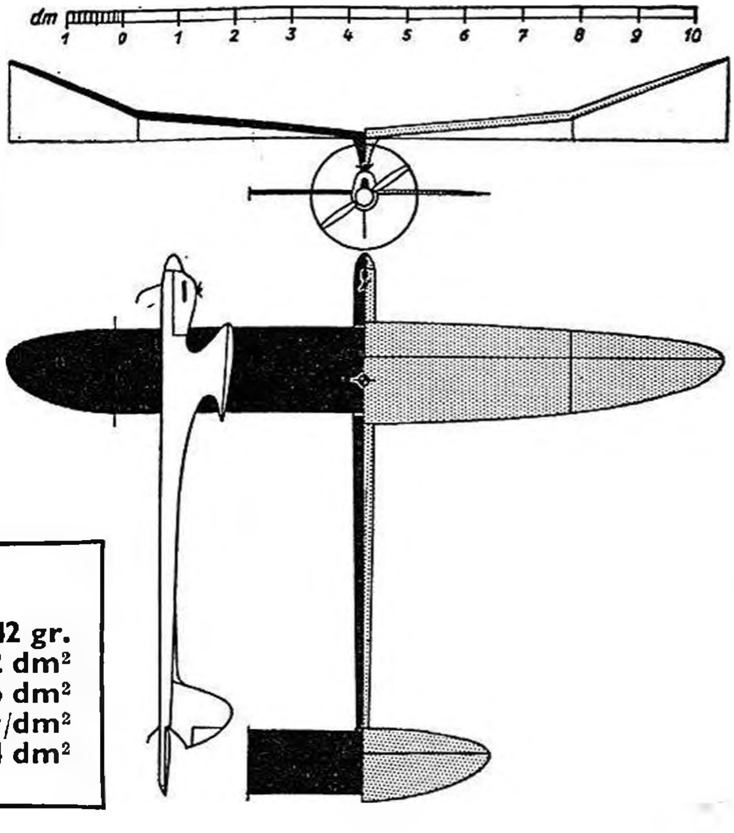
Three wing planforms and two tailplane planforms are given for this design. The best model, aerodynamically and from a strength point of view is the one with elliptical planforms for wing and tail. When accurately built it also has a good appearance, which is certainly no disadvantage, when allied with a good performance. Fuselage cross-section is circular, and engine, tank and timer are fully enclosed.

SCHLOSSER AKTIVIST

	2.43 c.c.	2.47 c.c.
Total weight:	730 gr.	745 gr.
Total area:	36.2 dm^2	36.5 dm^2
Wing area:	30 dm^2	30 dm^2
Loading approx.	23.3 gr./dm^2	23.7 gr./dm^2
Tailplane area:	6.2 dm^2	6.5 dm^2

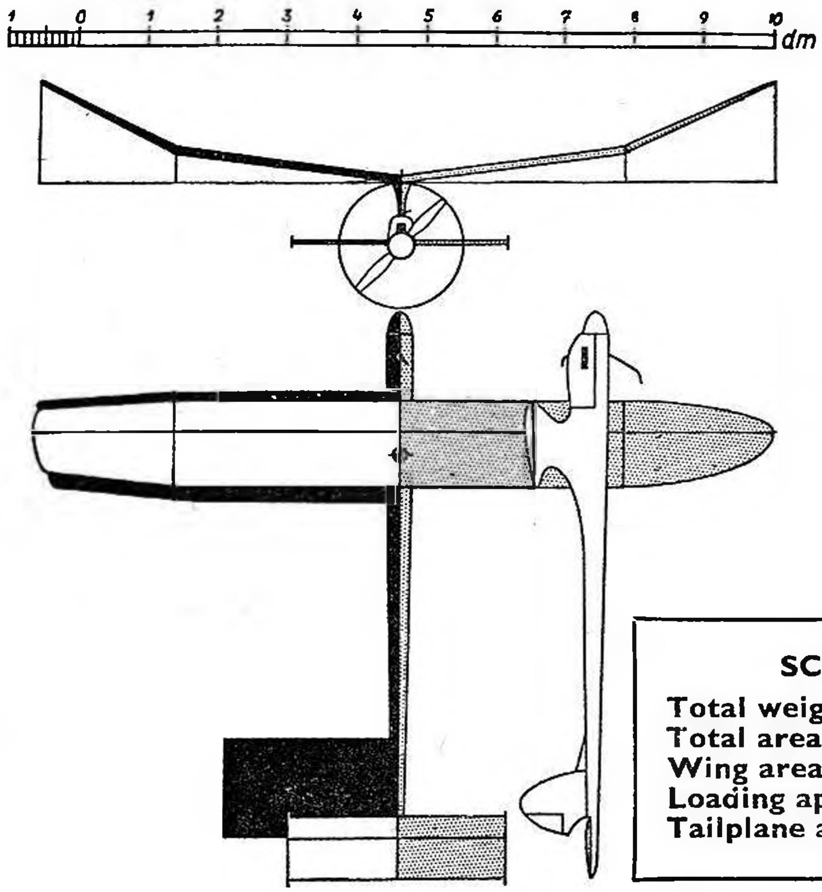
DESIGN No. 6

Two different versions are given here ; the wing planform with the elliptical tips can, of course, be used also with the full elliptical tailplane. Propellers used with the Wilo engine were 194 mm. diameter x 160 mm. pitch, and 194 mm. x 130 mm.



WILO 1.47 c.c.

Total weight:	442 gr.
Total area:	22 dm^2
Wing area:	17.6 dm^2
Loading approx.:	23.7 gr/dm^2
Tailplane area:	4.4 dm^2

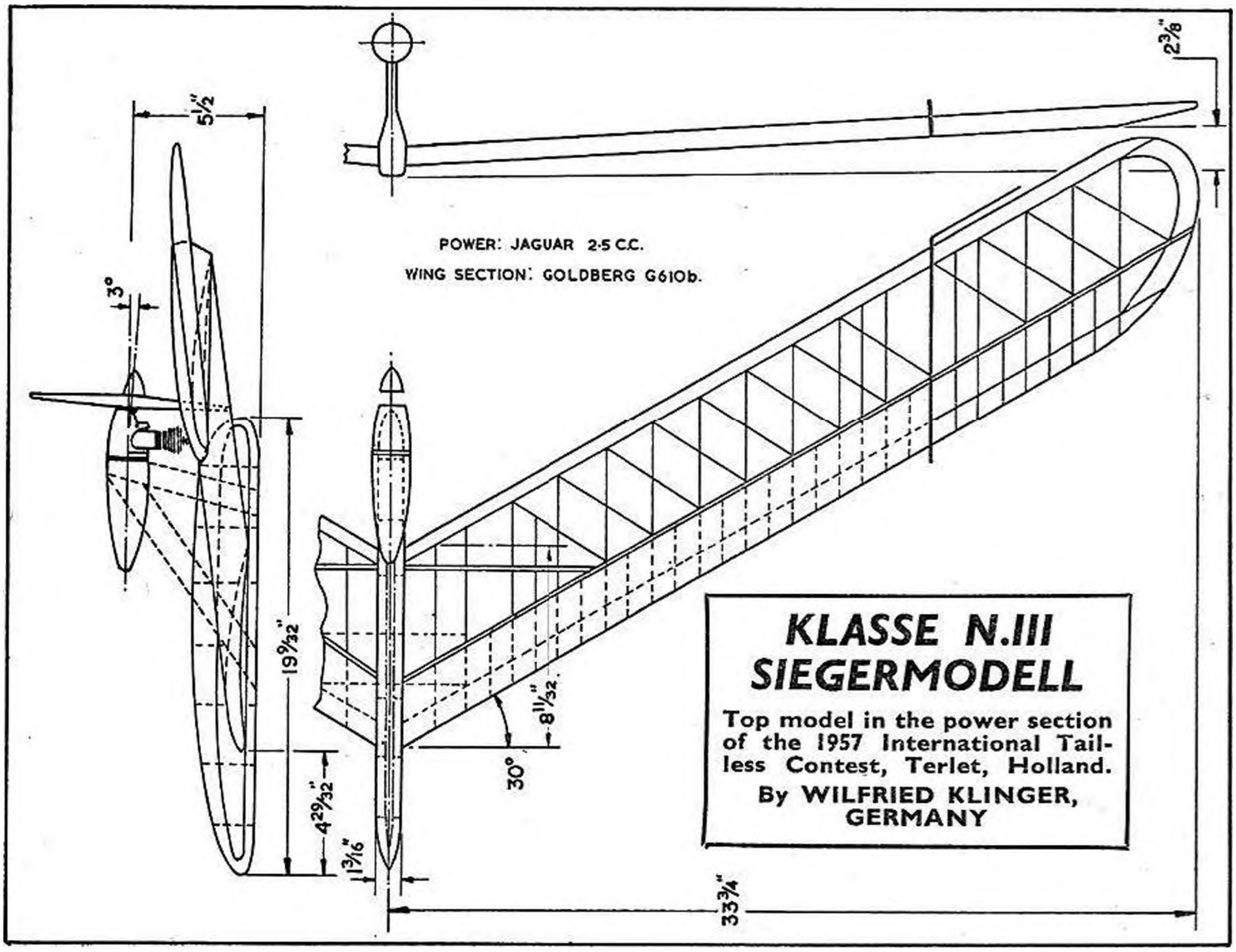


DESIGN No. 7

This 1954 winning model by Benno Schlosser has been sketched in for comparison. Wing chord on such a small model should not be less than 125 mm., otherwise there is a risk that the wing will operate in an unfavourable Reynolds Number range, which will result in an inferior performance. During test flying a suitable turbulator should be tried to see if there is any improvement in performance.

SCHLOSSER 1 c.c.

Total weight:	303 gr.
Total area:	15 dm^2
Wing area:	12.2 dm^2
Loading approx.:	23.5 gr./dm^2
Tailplane area:	2.8 dm^2



KLASSE N.III SIEGERMODELL

Top model in the power section of the 1957 International Tailless Contest, Terlet, Holland.

By WILFRIED KLINGER, GERMANY

FUEL CONSUMPTION

TEAM RACING emphasises the particular, and usually contrasting, requirements of speed and fuel consumption. Experience has shown that speed is important, limiting the choice of engines to the top performers in each class to give speeds of the order of 70 m.p.h. in Class ½A ; 80-90 m.p.h. in Class A and 100-110 m.p.h. in Class B. But speed is only bought at the expense of increased fuel consumption. A typical racing 1·5 c.c. engine, for example, will give a static run of around 140-160 seconds at 11-12,000 r.p.m. (corresponding to a typical choice of propeller size). The sideport Mills 1·3 will give from three to four times this *duration* of run at 10,000 r.p.m.—but, of course, cannot produce a flying speed to compare favourably in the overall picture.

The specific fuel consumption of an engine is an inherent feature of its design. Quite significant differences in results can be achieved with different needle valve settings, and to a lesser extent by using "dopes" in the fuel.

The consumption curve for any engine (duration of run on a given amount of fuel plotted against r.p.m.) is substantially linear, the fuel consumption logically increasing (and thus the duration of run decreasing) with increasing r.p.m. A difference in needle valve setting may represent as much as a 50 per cent difference in performance achieved *for the same apparent speed.*

Fig. 1 plots the results of tests carried out on a typical 1·5 c.c. diesel of "racing" performance. Curve A is the result of adjusting the needle valve at each stage (*i.e.*, with a given propeller size) for the maximum lean mixture on which the engine would run. To achieve this the needle was progressively closed (and compression adjusted correspondingly to suit) until background crackle was just perceptible as a tuning note.

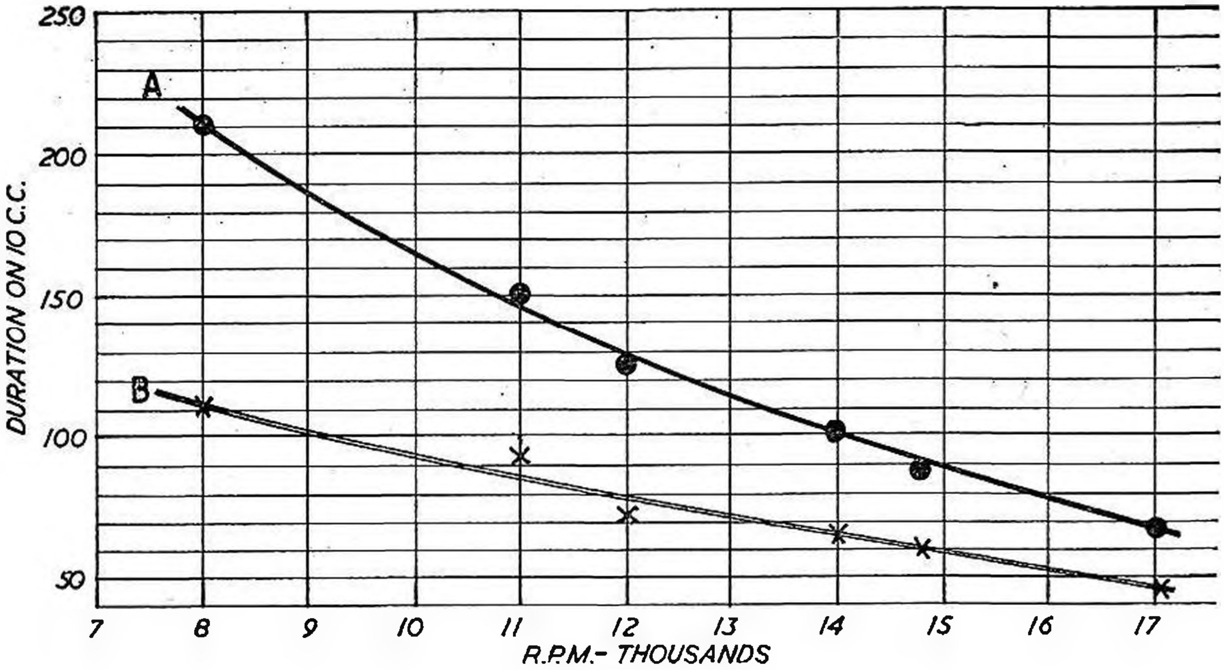
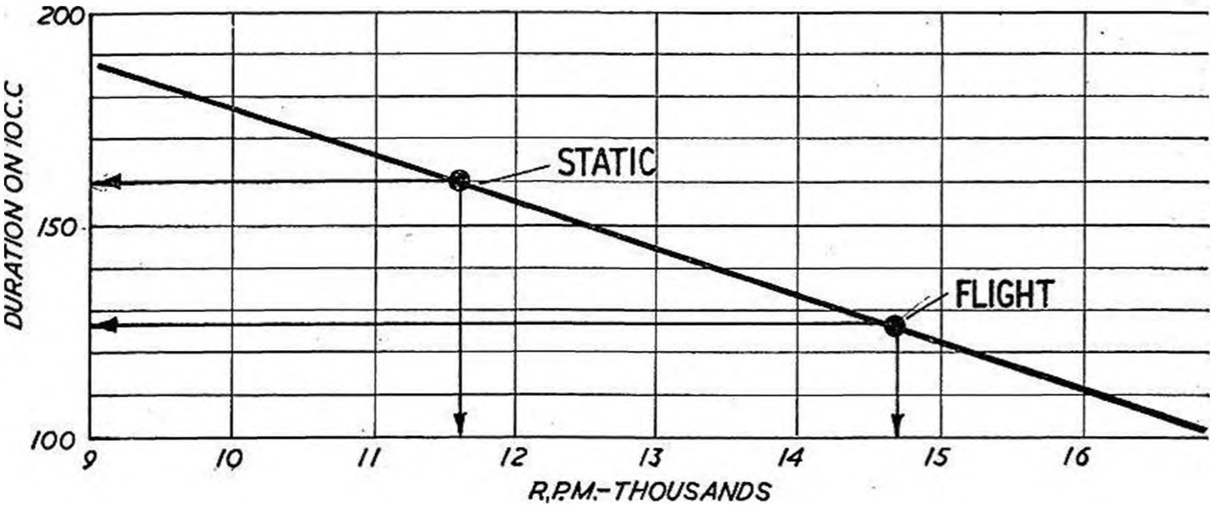


FIG. 1

With each propeller load a further test was then run on maximum rich mixture, corresponding to the needle valve being opened as far as possible from the "lean" position *without any falling off in r.p.m.* Curve B is the result of these tests. The differences are so great as to be extremely important.

Obviously there is a considerable increase in number of laps covered per tank of fuel operating the engine at maximum lean mixture. There is, however, an appreciable difference in the mixture actually supplied to the engine in flight, as compared with static running conditions. This is largely due to the increase in r.p.m. of the engine in flight, but is also affected by the tank position and fuel feed. The static adjustment must be somewhat on the rich side to "lean out" to the required amount in the air. This effect will be more critical on some engines than others, and where the initial adjustment is particularly coarse a finer needle valve may be found a benefit, or the fitting of a spraybar to replace a wall-type jet and needle. (As a point of interest, on the engine tested in Fig. 1 the difference in needle valve setting between "maximum lean" and "maximum rich", *circa*

FIG. 2



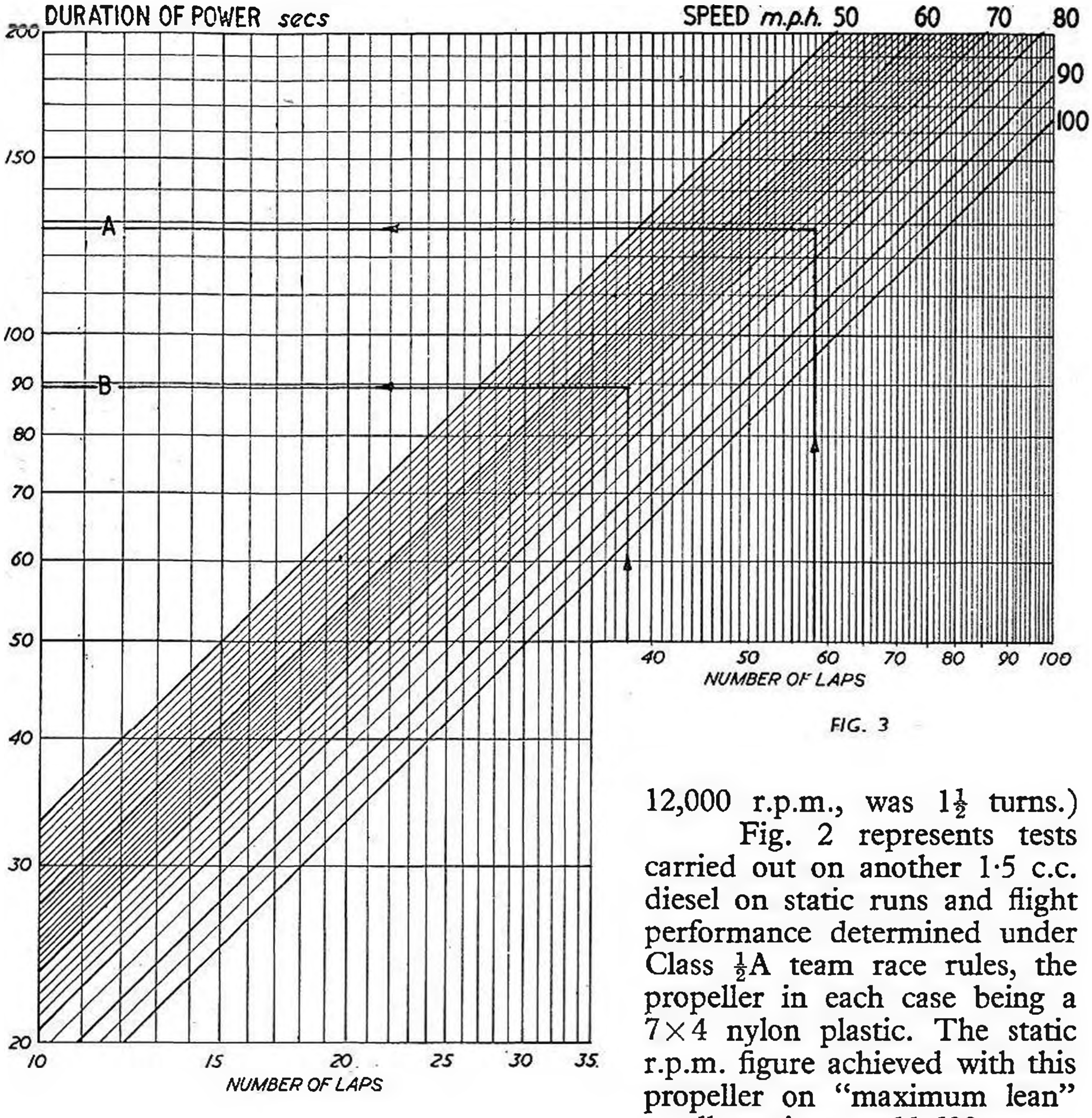


FIG. 3

12,000 r.p.m., was 1½ turns.)

Fig. 2 represents tests carried out on another 1·5 c.c. diesel on static runs and flight performance determined under Class ½A team race rules, the propeller in each case being a 7×4 nylon plastic. The static r.p.m. figure achieved with this propeller on "maximum lean" needle setting was 11,600 r.p.m., yielding a 160-second run on 10 c.c. of fuel. Best flight performance was 58 laps on 10 c.c. of fuel at an average of 75 m.p.h., consistent with a duration of run of 127 seconds.

This latter figure plotted on an extension of the static consumption performance corresponds to an operating r.p.m. of 14,750—a somewhat higher increase in r.p.m. than would be expected. In point of fact the actual flight r.p.m. probably was slightly lower, the lap times varying over 74-76 m.p.h. so that the engine was not operating at "maximum lean" mixture all the time. The figure of flight duration achieved of 0·8 times static duration with the same propeller appears valid as a basis for calculation of performance.

The chart in Fig. 3 gives solutions for number of laps covered in Class ½A relative to duration of run and average speed achieved. Knowing any two of these values, the third factor can be read directly from the chart. Line A plots the flight performance described in Fig. 2 from the known figures for number of laps and speed.

Line B plots the performance of the same model with the engine set to run over-rich. The number of laps covered fell to 38, so that for the same amount of fuel the power flight time was only 89 seconds as against 127 seconds. Once again this drastically underlines the loss of performance through running on an excessively rich mixture.

A further series of tests were conducted with fuel "dopes" on diesel engines, the results of which are plotted in Fig. 4. These cannot be taken as typical for *all* engines but appear substantially similar for a range of crankshaft rotary induction designs tried out.

Line A represents a typical performance on standard fuel with the addition of two per cent nitrate on a relatively low consumption engine, achieving 11,600 r.p.m. on the team race propeller size chosen.

Line B is the performance with the same fuel and nitrate content increased to 4 per cent (the maximum which showed any beneficial effect). The performance is very slightly increased—to a static r.p.m. figure of 11,800—at the expense of opening the needle valve very slightly. The consumption rate is thus slightly increased, and so the duration of run on 10 c.c. decreased by a matter of some 5 seconds.

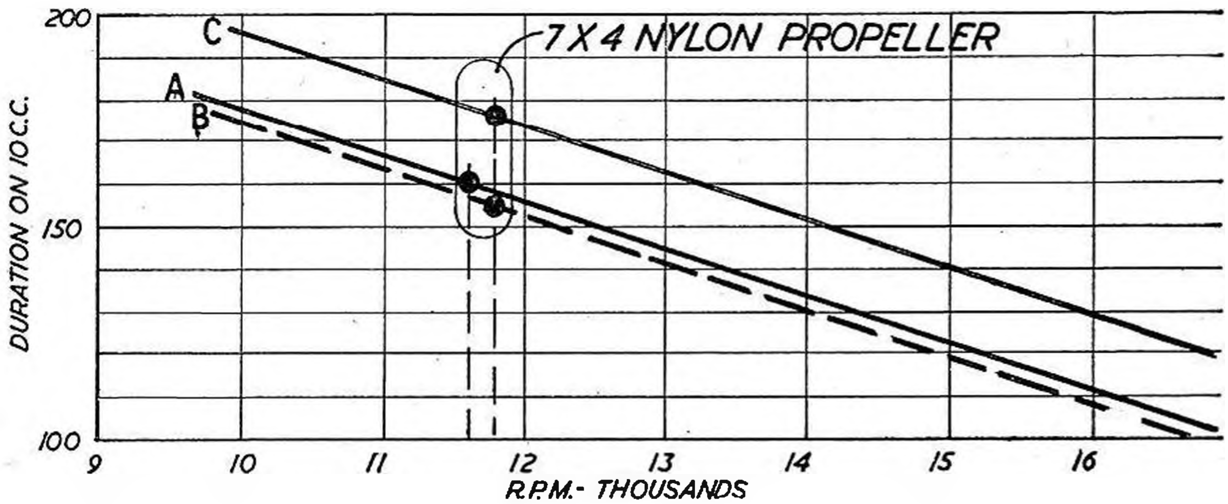


FIG. 4

Line C was plotted with 3 per cent nitrobenzene added to the 4 per cent nitrated fuel, when the engine maintained the same r.p.m. figure at a leaner mixture setting, boosting the static run at 11,800 r.p.m. by 16 seconds—a 10 per cent increase over the original figure, and a 14 per cent increase over the middle figure. Again the benefit obtained is very real and appears substantially proportional to the amount of nitrobenzene added, up to a maximum of about 3 per cent.*

The theoretical performance under flight conditions is then analysed in Fig. 5. Line A represents the nitrated fuel performance and Line B the same fuel with nitrobenzene added. The flight r.p.m. figures corresponding to a factor of 1·25 increase in fuel consumption (flight duration=0·8 × static duration) are hypothetical, but the difference in performance expressed in terms of laps covered on 10 c.c. and derived from Fig. 2 show eight more laps covered at the same speed (arbitrarily taken as 70 m.p.h.).

*As a practical guide for adding "dopes" in small quantities to existing fuel mixtures, measure the amount of fuel in fluid ounces—then calculate percentage proportions required in terms of teaspoonfuls ($\frac{1}{8}$th ounce) or drops (1/480th ounce). Also see table.

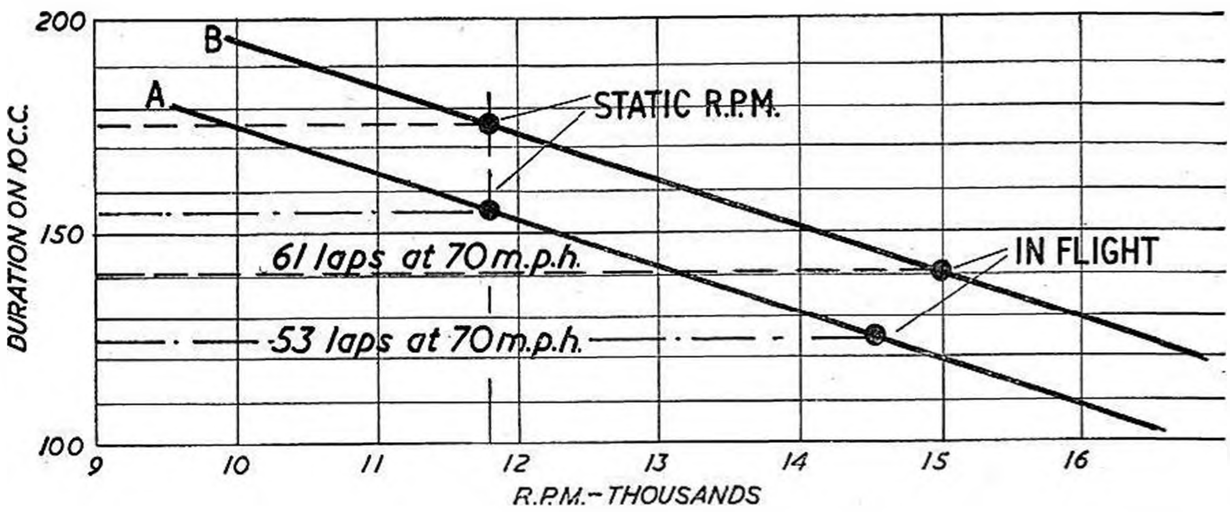


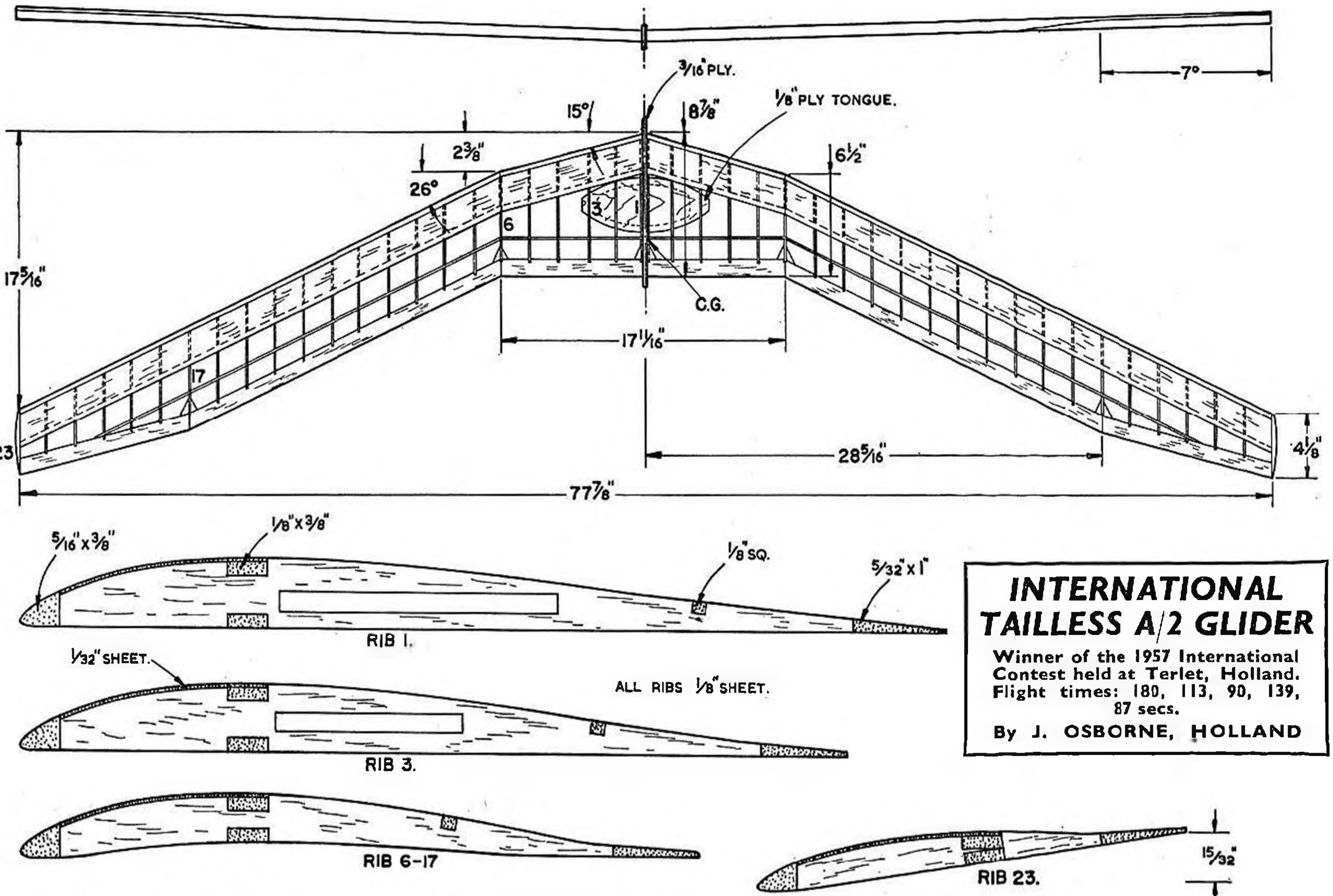
FIG. 5

In practice the gain would probably be less due to the difficulty of obtaining a constant mixture throughout the flight (the true fuel consumption curve varying between "maximum lean" and "maximum rich" over the run, for the same speed) ; and also the possibility of fuel wastage through spillage through the tank vents, etc.

DOPE PROPORTIONS TABLE

AMOUNT OF MADE-UP FUEL (Fluid ounces)	NO. OF DROPS TO BE ADDED TO FUEL			
	1%	2%	3%	4%
20	100	200	300	400
19	95	190	285	380
18	90	180	270	360
17	85	170	255	340
16	80	160	240	320
15	75	150	225	300
14	70	140	210	280
13	65	130	195	260
12	60	120	180	240
11	55	110	165	220
10	50	100	150	200
9	45	90	135	180
8	40	80	120	160
7	35	70	105	140
6	30	60	90	120
8	25	50	75	100
4	20	40	60	80
3	15	30	45	60
2	10	20	30	40

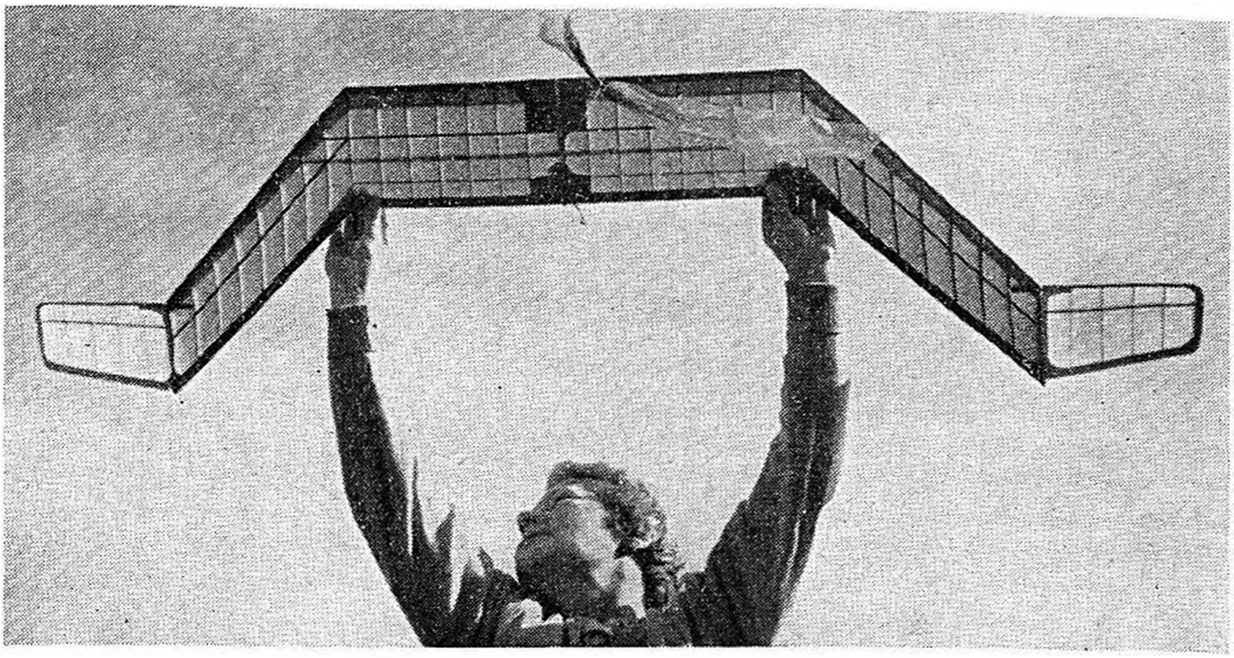
Note: one teaspoonful = 60 drops



INTERNATIONAL TAILLESS A/2 GLIDER

Winner of the 1957 International Contest held at Terlet, Holland. Flight times: 180, 113, 90, 139, 87 secs.

By J. OSBORNE, HOLLAND



ALL-WINGS WITH A DIFFERENCE

By Peter Gasson

I feel it is not so much lack of interest as lack of ingenuity, and the chance that much time and money may be wasted on an unsuccessful project, that has caused the present state of under-development of the flying-wing model aircraft.

In recent years the Southern Cross A.C. have done much to improve the standard of the flying wing, although little has been published of their activities, and as far as I know (with the exception of their large size) the models are all of a standard design.

Even the Continentals, to whom much of the pioneer work must be attributed, have done little since to break away from the universal layout, the only exceptions being the flying plank layout from Switzerland and the swept-forward wing from Germany. Both these layouts, however, originated about ten years ago and in any case neither of these has won popularity elsewhere.

Ten years ago it was almost a universal rule that airfoil sections for flying wings should be of the flat-bottomed type (Clark Y, etc.), for it was claimed that undercambered sections would be far too unstable for use with models without a conventional stabiliser unit. Since that time a few adventurous modellers have used undercambered sections with great success.

The difficulty with all tailless models is how to obtain stability without reducing the overall efficiency to an absurdly low figure (in which case any advantage over the conventional layout is immediately lost). The usual methods of achieving this stability are (*a*) Sweepback, (*b*) Washout and (*c*) Reflex Section.

Due to the unstable characteristics of certain airfoils their selection would not be advisable for use with flying wings ; it is in fact this reason that has led to the use of flat-bottomed sections for so long. The main feature to look for when selecting a wing section is to find one whose centre of pressure (C.P.) movement is very small, while at the same time retaining a reasonably high lift coefficient.

A number of well-tried layouts are shown in Fig. 2, and it is felt that the relative merits of each layout should be fairly apparent from the sketches. However, for those in doubt the following tabulation may be of help :

Layout	Origin	Features
A	HOLLAND (adopted by Great Britain)	Tapered wing, swept back at 15-30°. Lifting section at root, changing to symmetrical section washed out at tip (5-15°). Little or no dihedral.
B	SWITZERLAND	Constant chord wing with reflex wing section. Central fin. No dihedral.
C	GERMANY	Tapered wing, swept forward at 10-25°. Lifting section at root changing to symmetrical section washed in at tip (5-10°). Central pod fuselage. Little or no dihedral.
D	BRITAIN	Constant chord centre section. Tapered tips. Lifting section in centre, changing to symmetrical section washed out at tips; or sub-tips with large washout (5-15°). Little dihedral at tips.
E	AMERICA	Constant chord centre section, tapered at tips. Lifting section throughout, with highly washed-out tip stabilisers. 30-45° sweepback. Little dihedral at tips.

Most Suitable Layout

Method e is the layout which I propose to put forward as the most generally suited to high performance requirements. It will be noted that the centre section contains far more area than the layouts in methods a-d, and it is this feature which makes it superior. The fact that the greater part of area is contained in a forward position necessarily means that the centre of area will be further forward, relative to the wing tips (for a given sweepback). This feature, together with an increase in sweepback (45 deg.), produces a longer effective tail moment arm, and in turn a longer moment arm means a small stabiliser surface. (See Figs. 3 and 4.)

Referring to Fig. 4 :

(Fig. a) For simplicity make AE=ED=DH=eg. 1.
Then Area ABG=Area DEFG
and Area CGD=CGB. As on same base and between equi-distant parallel.
From 1 it is clear that
Area ABG=DEFG=2 CGD=2 CGB.

(Fig. b and c). Finding centres of triangles by intersection of medians and knowing relationship between areas, it follows that the resultant centre of area of each figure is in the ratio $\frac{XY}{3}$ from the line X (since

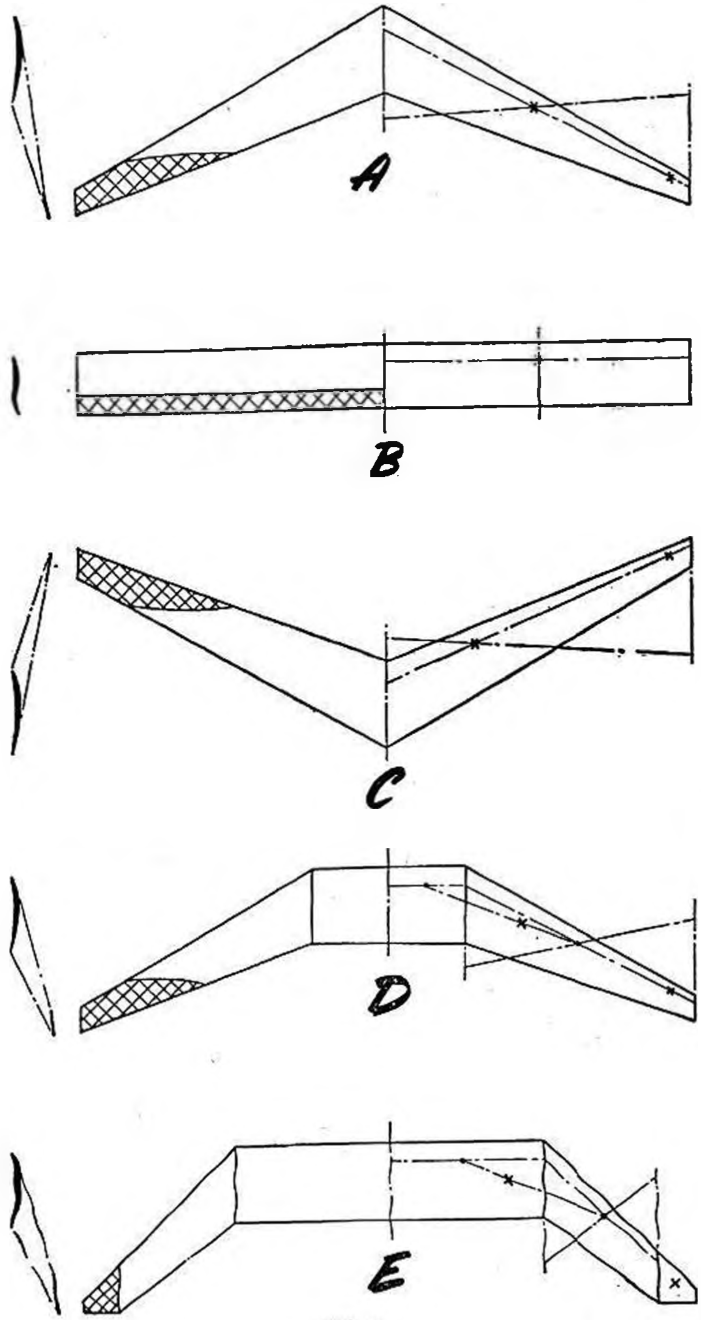


FIG. 2

area of X=2_x Area Y). The distance from this resultant line to the extreme tip may be taken as a measure of moment arm Note that in Fig. 3 (layout e) the distance M is longer than the distance m, indicating that a smaller stabiliser area may be used, in spite of the fact that both layouts have equal areas and equal sweepback distances d.

Having now justified my choice of layout, I will continue to deal with further points which influence the design of an efficient flying wing, so let us first turn our attention to Figure 2(e), which shows clearly the layout which I propose to adopt. Here it will be seen that the wing is divided into three parts, a central lifting section *which includes the whole of the swept portion of the wing, and two small stabiliser tip sections. If by this system we can obtain* sufficient stability, then we will have succeeded in producing a flying wing which has a very high lift stabiliser ratio—a feature for which we are searching. Fig. 5 shows the nature of the forces acting upon the model when arranged in accordance with the above method.

Maximum Stability

Fig. 6 shows the nature of the forces acting upon the model when in horizontal flight. Although this diagram appears rather complicated, all that has to be remembered is that for balance :

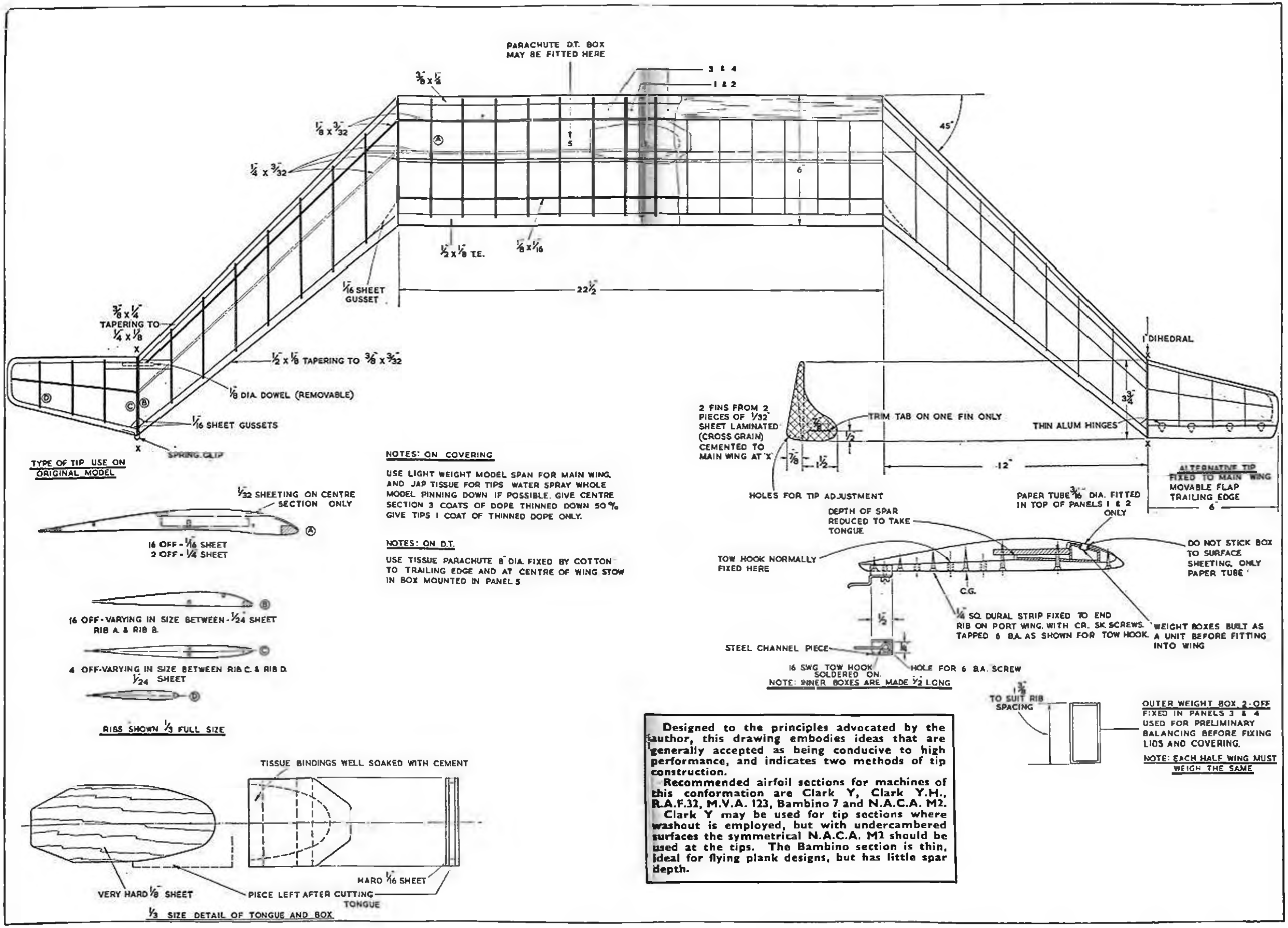
$L_wA = D_wB + L_sa + D_sb.$

and that $W = (L_w - L_s)$ Cosα

where α=gliding angle.

If, as is usual with flying wings, there is no dihedral, then the terms B and b are reduced to zero and the above expression is much simplified and becomes :

$L_wA = L_sa$ (this expression is usually sufficient for normal use).



Designed to the principles advocated by the author, this drawing embodies ideas that are generally accepted as being conducive to high performance, and indicates two methods of tip construction.

Recommended airfoil sections for machines of this conformation are Clark Y, Clark Y.H., R.A.F.32, M.V.A. 123, Bambino 7 and N.A.C.A. M2. Clark Y may be used for tip sections where washout is employed, but with undercambered surfaces the symmetrical N.A.C.A. M2 should be used at the tips. The Bambino section is thin, ideal for flying plank designs, but has little spar depth.

However, turning our attention to the middle diagram, the force set up for normal flight is shown. Note that no lift is being provided by the stabiliser and that the wing lift component is behind the c.g. (This arrangement I have found easiest to handle.) If now a downward gust of wind attacks the model, the force arrangement is altered to that indicated in the top diagram; while, if the gust is an upward one, then the arrangement is as shown below. In either case the point to note is that the stabiliser provides a reverse moment to that which is upsetting the model and as the model is further displaced, so this moment should increase. This is all that is necessary to provide good longitudinal stability. The theoretically-minded reader will appreciate that such a condition is fulfilled when the slope of the total moment curve is from bottom left to top right (when using the usual convention). See Fig. 7.

The reason the model becomes unstable when upset from the normal flying attitude is because of centre of pressure movement. As the angle of attack is increased the centre of pressure moves forward,

FIG. 3

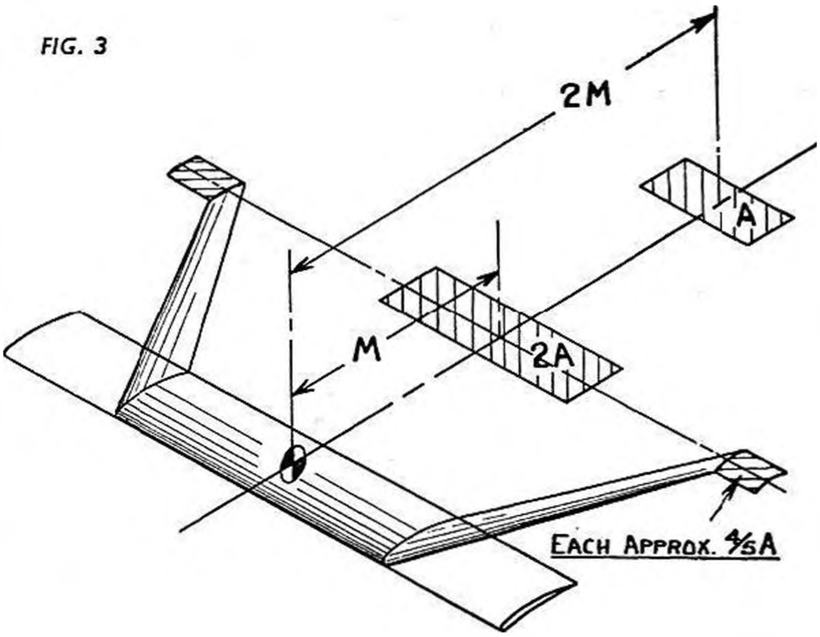
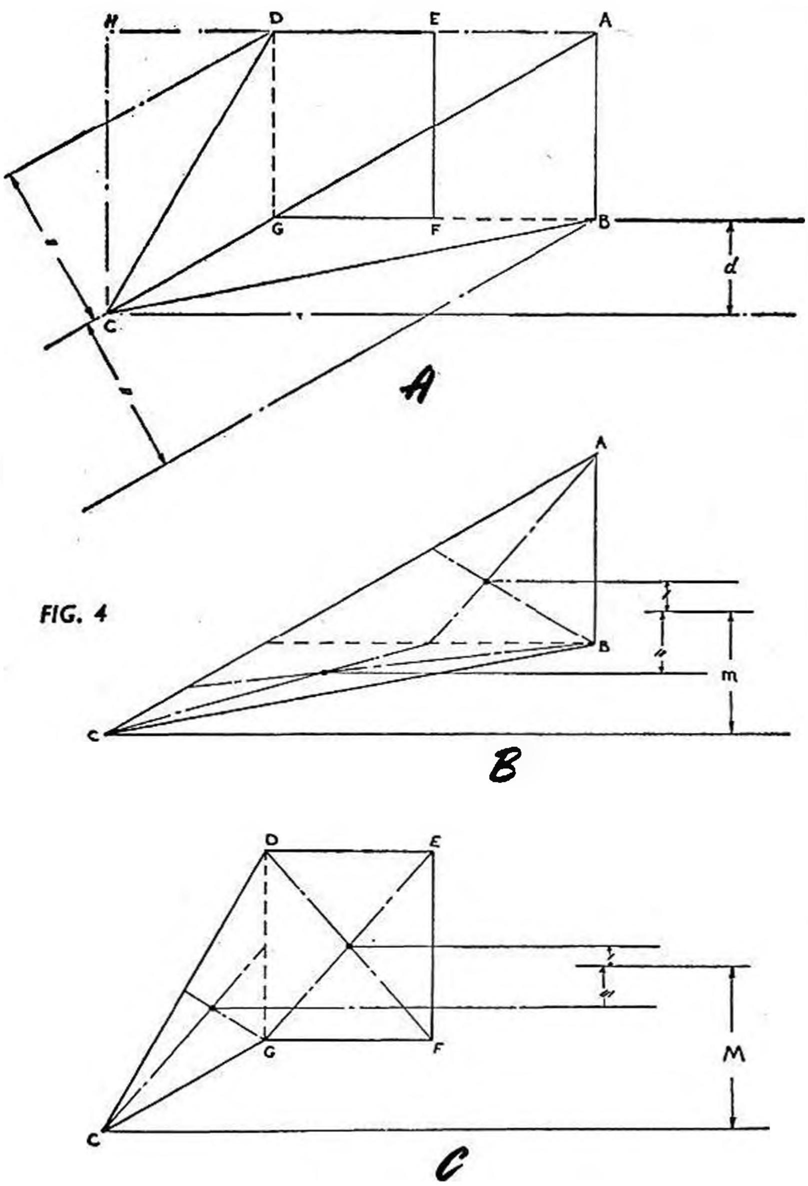


FIG. 4



causing instability, which must be corrected by the stabiliser.

To provide lateral stability, dihedral may be small ($\frac{1}{2}$ in. per ft. of semi span). Some models even fly well without any at all and may be easily recognised on the field by their scythe-like flight path.

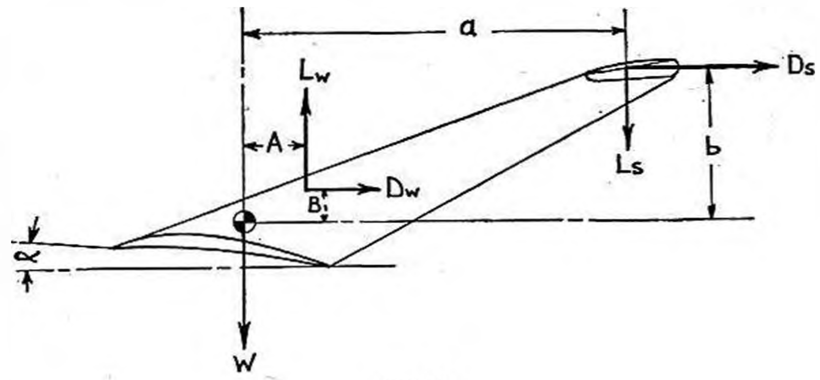


FIG. 5

Fins have greater effect when placed near the tips and due to their position need only be small (4 sq. in. each on normal size models).

Overall weight seems to influence performance very little and frequently varies between 1 oz. per sq. ft. to 5 ozs per sq. ft. The lower value would appear to be about as light as one may normally go. Below 1 oz. per sq. ft. the necessary strength is hard to obtain and since, in practice, no great advantage is apparent there seems no point in stretching things too far. Personally, I have found it easier to fly light models, although I cannot claim any better performance from this type. It is, however, essential to keep the moment of inertia of the model as small as possible. This means that all outboard portions of the model should be kept light consistent with strength.

Construction

Wrong methods or poor workmanship in the construction of a model can lead to many disheartening moments and may even mean the loss of a contest. Once a good standard of building has been achieved, one-third of the way to success has been covered.

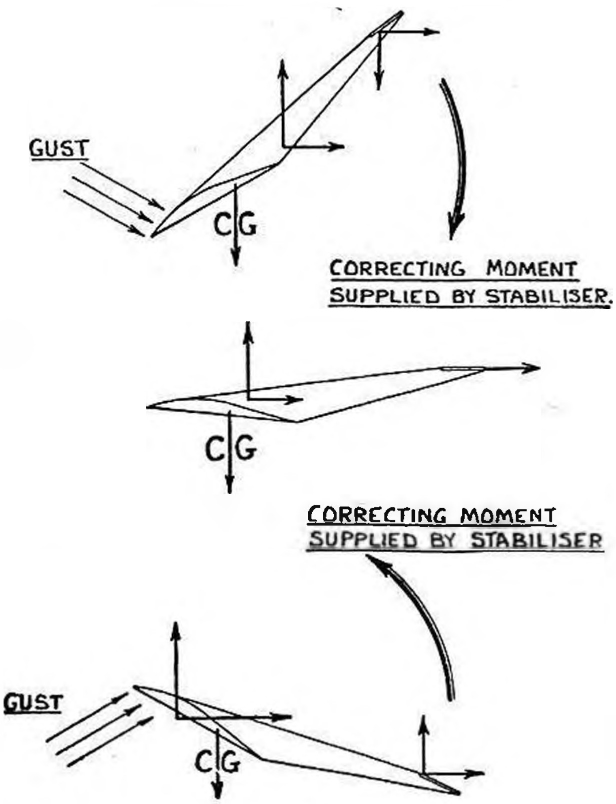
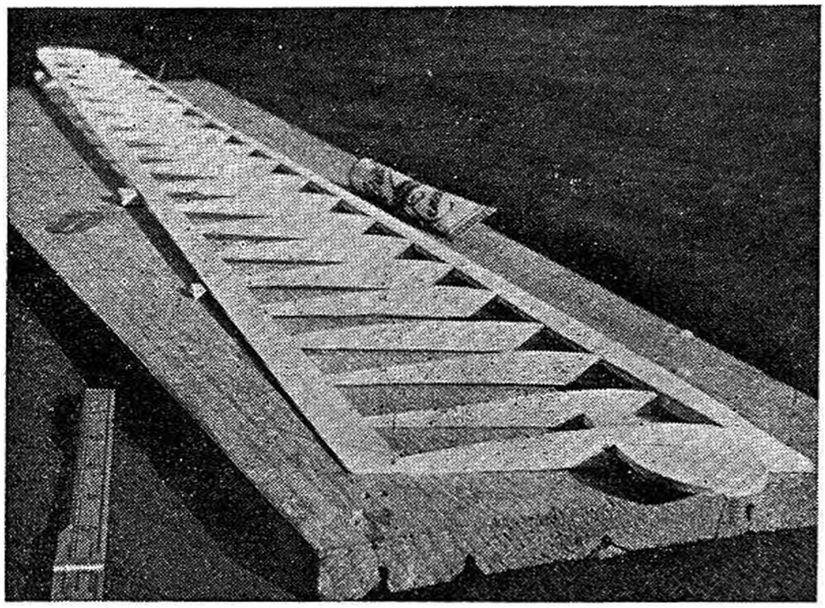


FIG. 6

Over the years methods seem to fluctuate, and what may be recommended one year by one writer is condemned the next year by another. I feel that those modellers to whom this article will be of interest will already be familiar with the many different constructional methods which are today available and will be only too ready to apply their ingenuity and personal tastes to the problem of construction. There are, however, one or two points which may provide material upon which to work.

The point of major importance is tip lightness. It is essential that the tips are made light and I might say, as far as performance is concerned, the lighter the better. The only point which must also be borne in mind is that of rigidity, for without this feature effort to produce light tips is just wasted. Such items as wing boxes, etc., should, therefore, be employed only at the wing roots and in no circumstance should they appear in the outboard portions of the wing. Owing to the shape of any flying wing, it is as well to incorporate a wing box fixing in some form or another. Personally, I prefer a tongue and box fixing, although others have used dowel fixings quite successfully.



Having now outlined the main requirements I will mention a few points which arise in the construction of the model detailed in the drawing. I am, however, including one or two features which have appeared on other all-wings from time to time, as it is felt that these features may also be of interest to anyone wishing to build a model slightly different to the one discussed here.

The main wing construction can be quite standard, made up of the usual spars and parallel ribs, although anyone who is of an ambitious nature could tackle a geodetic layout without undue difficulty. As has already been pointed out, the tip sections need to be light and for this reason all spars should be tapered to provide this lightness. This may at first sight seem a lot of unnecessary work, although anyone who has made an all-wing before will realise its importance. Another method of tip lightening is to use hollow (built-up) ribs. These are quite easily made and are not difficult to assemble. They are in themselves a worthwhile addition to the model. Sheet-covered leading edges are a good thing, but must be made from very light sheet if used extensively for the whole wing, $\frac{1}{32}$ in. thick sheet being ample for models up to 400 sq. in. wing area. With the layout detailed here, it is necessary to use a trailing edge stiffener at the centre section to prevent this from drooping due to the large amount of sweepback. (This stiffener can be seen on heading photo, which shows the finished model. In any case it is clearly shown on the plan and consists of a very hard balsa spar $\frac{1}{8}$ in. deep $\times$ $\frac{1}{16}$ in. thick).

As a word of warning to the uninitiated, dowels break with amazing regularity and it is advisable to have all dowels removable, that is, not cemented in. A method of providing trimming adjustment is shown on the plan and consists essentially of a sheet balsa trim tab, hinged to the trailing edge at the tip section.

The tow hook system shown here is essentially one of simplicity and one which may readily be improved upon when either an auto rudder is introduced or a big model is being considered. For small models, however, it is most suitable and is readily adjustable to accommodate any change in c.g. position which may be found necessary on the flying field.

Summary

It is my opinion that a well-tried model of inferior aerodynamic design is often a more reliable proposition as far as contests are concerned. While advantage can be taken of the layout suggested (method e), I do not wish to be wrongly interpreted. One may have too much of a good thing and it is well when designing a new model to bear in mind that extremes are odious. If the proportions are exaggerated too far, new problems would be created. As stated before, the reduction of inertia is an item of great importance and one which cannot be treated too lightly ; the outboard portions of the model must be kept light, a feature which would not be easily achieved if the centre section was increased too much or the sweepback made excessive. Whether or not there is an inherent aerodynamic disadvantage caused by excessive sweepback I do not know (I certainly know of one advantage), but it is as well to be guided by the old saying "what looks right is right", a saying not to be taken too seriously, although it may serve as a warning.

Today very large all-wing gliders seem to be in favour, no doubt because of their high efficiency and aptitude for remaining in sight for long periods when flown under windy conditions. It would appear that the only disadvantage is their unsuitability for transport.

Conclusion

It has not been the purpose of this article to cover the whole business of all-wing models, or even a small portion of the subject. Its primary object has been to collate a few ideas concerning unusual flying wing gliders in the hope that they may be of use to some readers of this book.

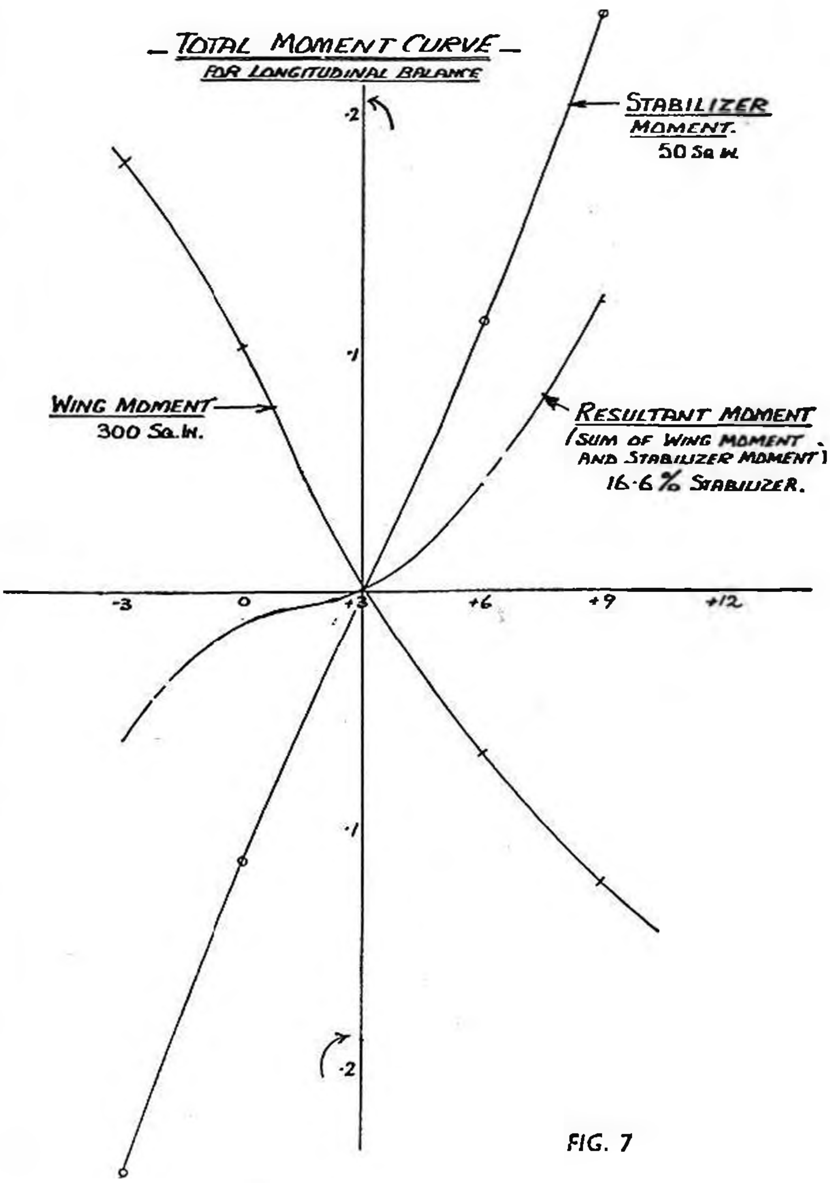


FIG. 7

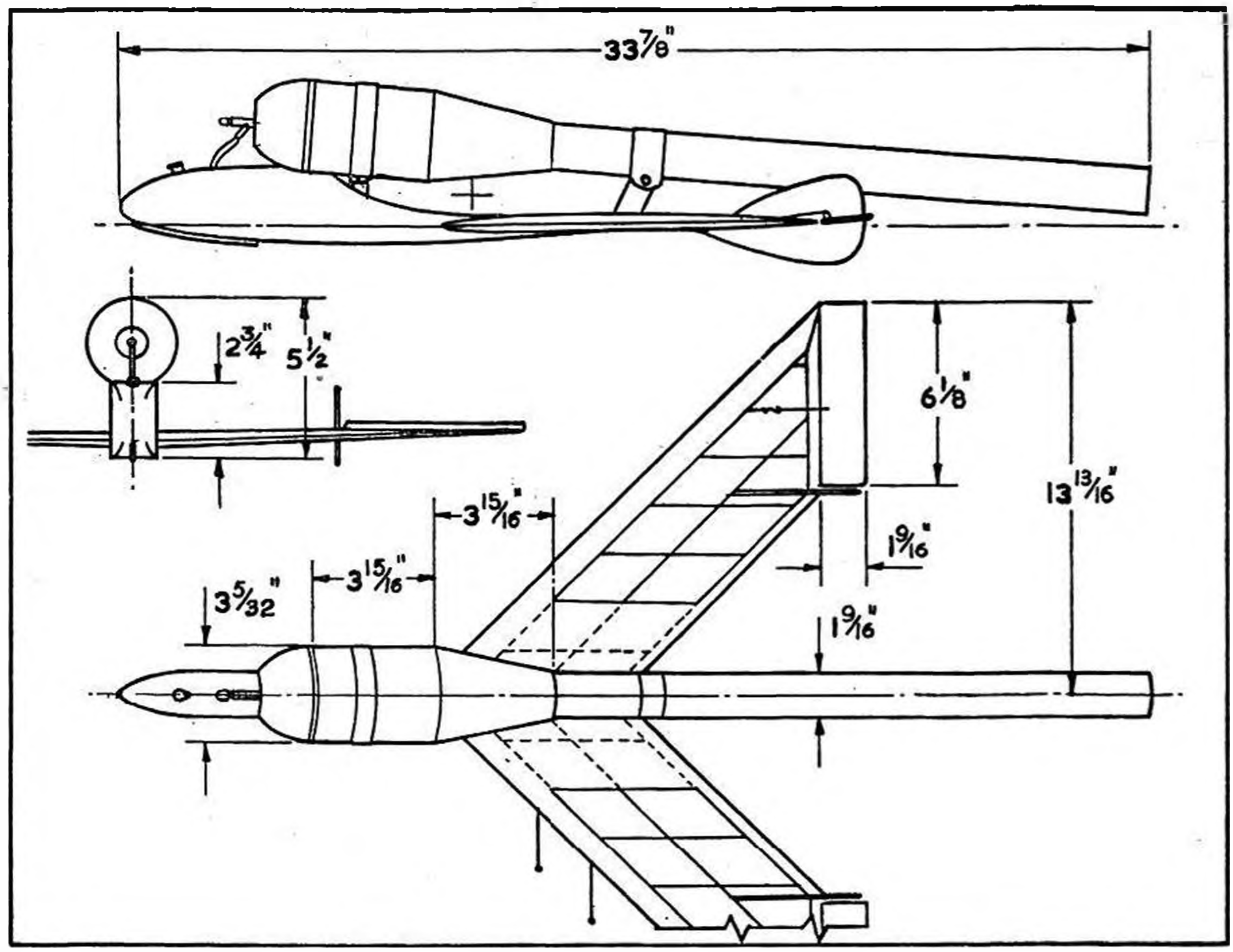
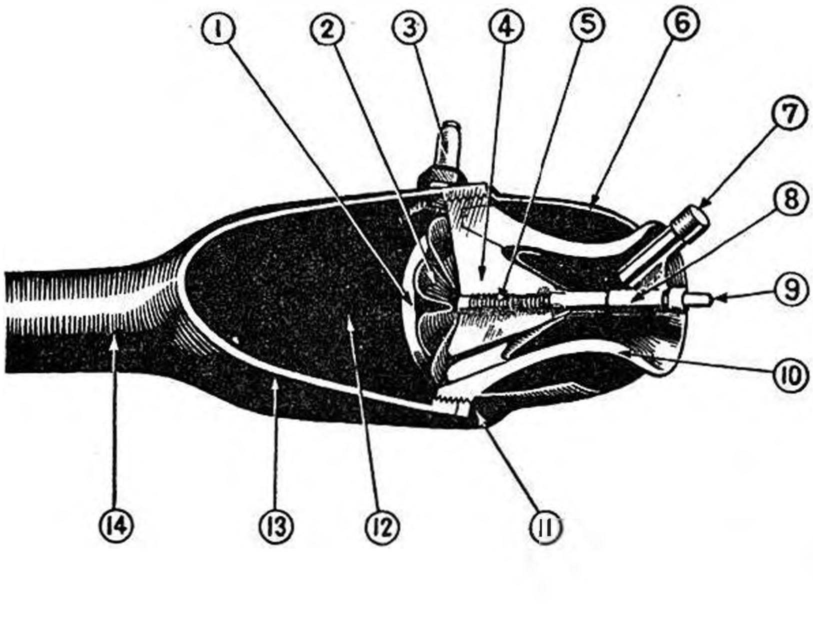


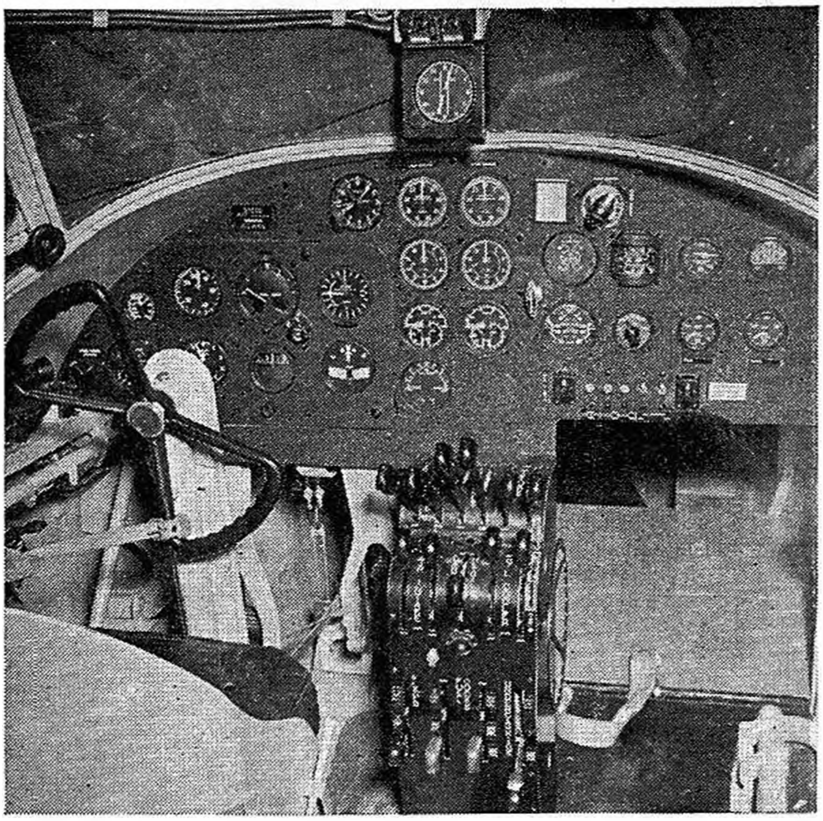
Illustration above shows a revolutionary swept-wing jet-propelled design by Russian exponent Michel Vassilchenko employing the R.A.M. engine. (See 1957/58 Annual.)

Georg Benedek, the famed Hungarian model aerodynamicist, is the current holder of the International Record for jet-propelled models, with a speed of 281.8 k./hr. with his "Mazeppa III". Flight was made on October 27th, 1957, and used Benedek's own-made Aerojet II.

Detailed sketch below shows the Japanese "O.S." jet engine, a good copy of the American "Dynajet" but which, we understand, has suffered from metallurgical troubles causing melting.



1. Back (contact) disc.
2. Petal valve.
3. Ignition plug.
4. Valve seating.
5. Valve fixing screw.
6. Nose shell.
7. Air priming pump.
8. Fuel valve.
9. Fuel line connector.
10. Venturi throat.
11. Locking ring.
12. Combustion chamber.
13. Chamber shell.
14. Tail pipe.



DETAILS MAKE THE DIFFERENCE

By George Cox

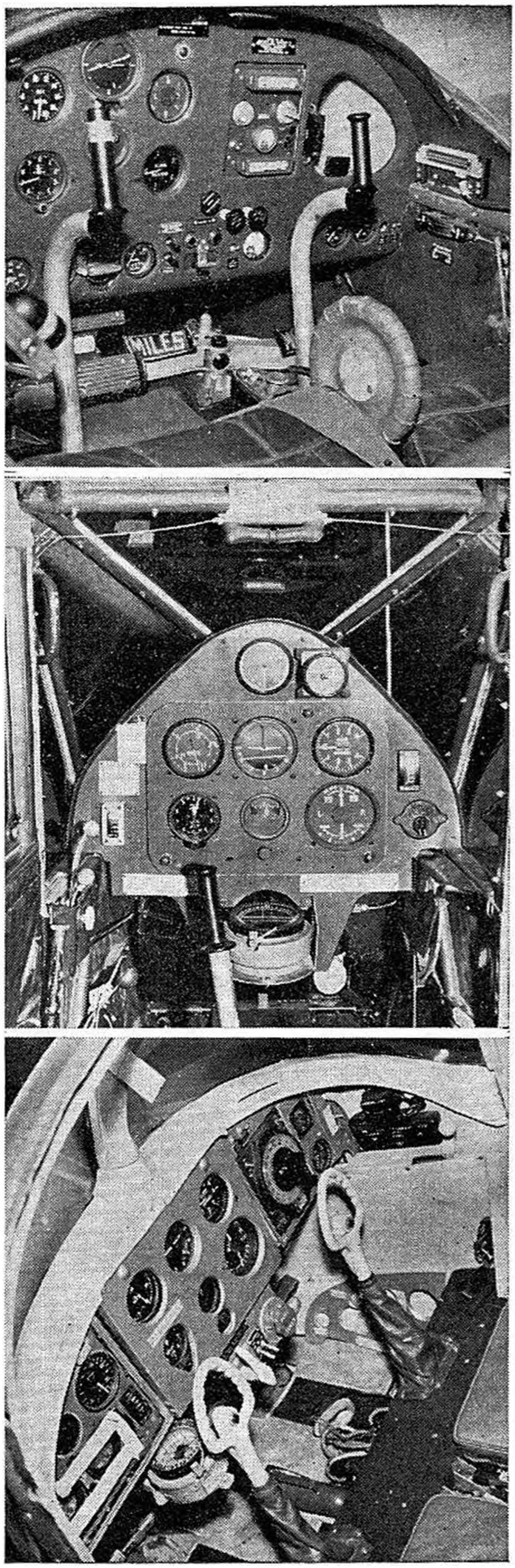
This "Anson" interior shows a typical twin-engine layout. The blind flying panel is directly in front of the pilot's seat; engine, prop, u/c, flaps and fuel cocks in centre console.

When judging the merits of a scale model aircraft the three most important attributes which should be looked for are first, whether the model is in form a lifelike reproduction of the original; second, whether the model has been skilfully and authentically finished; and third, the amount of *realistic* detail which has been incorporated. It is fair to regard the qualities in that order of importance, since the last two are entirely dependent on the first for their effect. We ought, then, to look at this question of detail in its correct perspective, for no amount of diligent attention to detail will transform a disproportionate basis into a realistic model.

It is probably true, however, that more models are ruined by badly executed details and incidentals than anything else. Common faults are World War I models with thick, rounded leading edges, wheels with tyres and discs of the wrong size, too-thick struts made from round wire, and lettering which bears little relation to the original. Despite the fact that instructions for moulding cockpit covers appear periodically in the modelling press, well-finished models may still be seen with painted windows, even in the London museums. With a little practice the moulding process becomes quite simple. What purpose is there in aeromodelling, or any creative pastime if we do not constantly strive for perfection? What lasting satisfaction either?

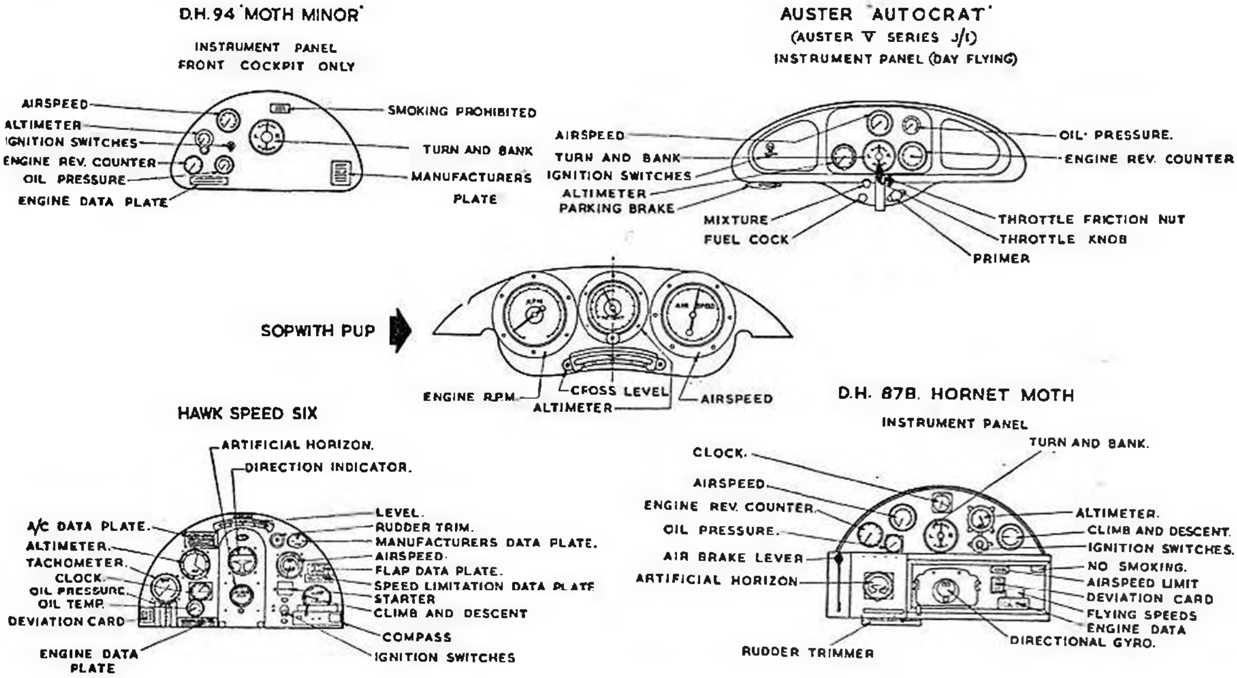
At the other extreme there are the products of the over-zealous model builders—masterpieces of the modeller's art which, if magnified to the size of the original, would be burdened by pitot tubes the size of barn doors and aerial wires an inch in diameter. (The aerial on a 1/72nd scale model would have to be about 0·0008 in. in diameter to be true to scale.) The amount of detail, then, should be determined more by the scale of the model and the skill of its creator rather than his ambition. It is also influenced to a high degree by the amount of information available. Because of space limitation, no plan can supply all the necessary information and the prudent modeller chooses as his subject a machine of which he has ample photographs, or preferably one which he can inspect at his local airfield. This opportunity rarely arises, however, and he therefore has to use a good measure of guesswork and intuition with the consoling thought that no one seeing his model is likely to be in a position to criticise. Deduction is often the only resort when fitting the interiors of models, since very few photographs are available of cockpit arrangements, especially in the case of military aircraft which are security-bound during the period when modellers are most interested in them. There are, nevertheless, many models needlessly marred by the fitting of cockpits. Too many of us hope that one seat, one spurious instrument panel and one pin will fool the world. If photographs of the model to be built are unobtainable the wise thing to do is to use as a guide pictures of another aircraft of the same period and in the same category.

The wide diversity of types of aeroplane makes generalisation impossible, but one or two guiding principles may assist the punctilious modeller. The walls and floor should be the first consideration. The cabin sides of modern civil types are usually lined, and are therefore easily represented by covering with card or sheet balsa with map pockets attached. Military aircraft rarely have this luxury and the actual structure must be copied, especially onto the solid model whose smooth walls are quite unrelated to, say, the wire-braced wood structure of a vintage type. On such a model, if the fuselage is carved from the solid instead of being built



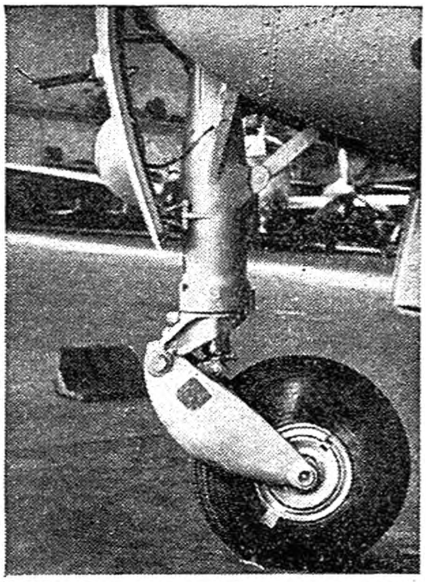
Top: Miles "Gemini" shows tail trimming wheel between the seats, duplicated throttle on cockpit sides. Centre: Puss Moth G-AHLO. Note emergency exit handles at roof level and other handles at door sides. Bottom: "Cygnet" has cream interior with gold centre instrument panel.

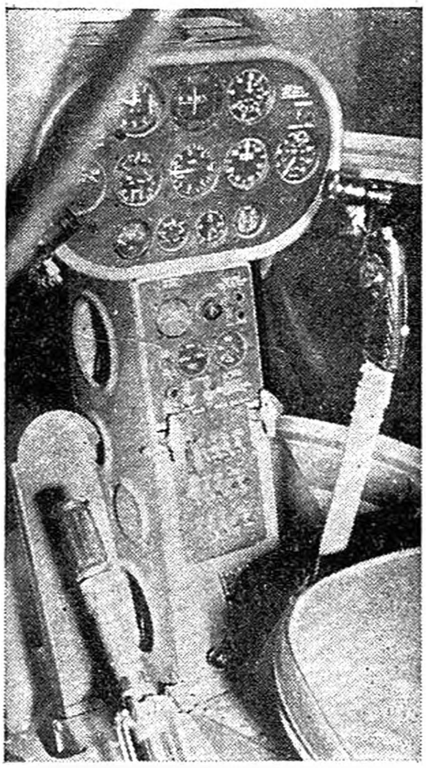
up from sheet, thin strips of wood should be glued to the inside walls to represent the longerons and spacers. The cockpit of a more modern stressed-skin type is quite easily lined with corrugated aluminium foil to give an illusion of stringers. Heavy gauge foil should be used, and the ridges made with the square edge of a steel rule or similar tool pressing the foil into a groove in a block of hardwood.



Floors of early machines were mostly of plywood attached directly to the lower longerons, but as fuselages became more complex and more equipment had to be carried, the flat floor gave way to an irregular surface so cluttered-up with this equipment that the cockpit appeared to be a seat floating in a sea of gadgets. Therefore, while the floor of a Puss Moth may be left quite flat, that of a highly-mechanised fighter should be broken up by the fitting of wood strips leaving heel troughs beneath the rudder pedals and a ridge between seat and control column. Seats were usually of the wicker or basket type but sometimes of plywood, until shortly after the first war when they gave way to the "bucket" or unpadded variety when parachutes were carried, or to upholstered seats in civil aircraft.

Instrumentation varies enormously with the period and type of aircraft. The 1918 machine would have an air-speed indicator, altimeter, inclinometer, compass, engine revolution indicator, oil- and air-pressure gauge, while other equipment would be limited to engine controls, machine-gun gear and perhaps a tail trimming wheel. The small civil machine unequipped with elaborate navigational aids has a bare minimum of instruments, while the airliner's cabin is a bewildering array of instruments spreading between and around the crew, and even above the windscreen. Again, the modelbuilder should find a picture of a similar aircraft to guide him, remembering that the instrument faces are black or grey (the only white instruments to be found are in models !) and that the mounting panels are nowadays often coloured to harmonise with the internal decor. Only rarely are all the instruments mounted on one board. Several separate panels are used to facilitate access for servicing, and in large aircraft they are systematically arranged with the blind flying panel directly in front of the pilot

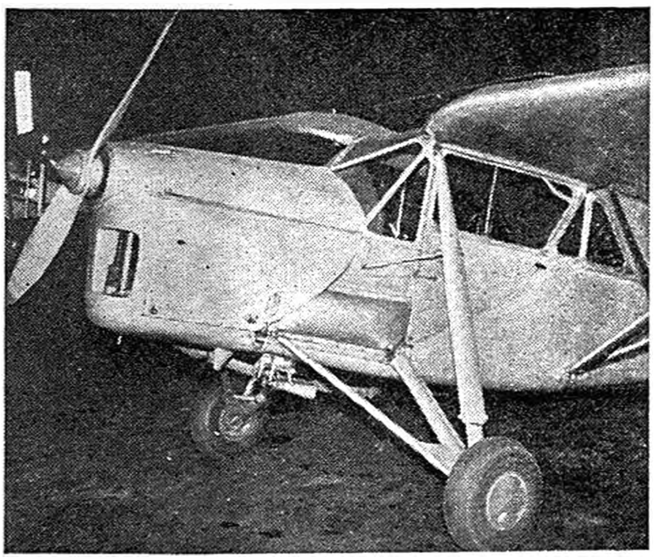




and the engine instruments and ancillary items beside it. The blind flying panel always carries six instruments—air-speed indicator, artificial horizon and rate of climb indicator along the top, and altimeter, gyro compass and turn-and-bank indicator along the bottom. The arrangement of these instruments has by custom and general agreement become standard in all types of aircraft equipped for blind flying, as will be seen in the photographs of Puss Moth and Anson.

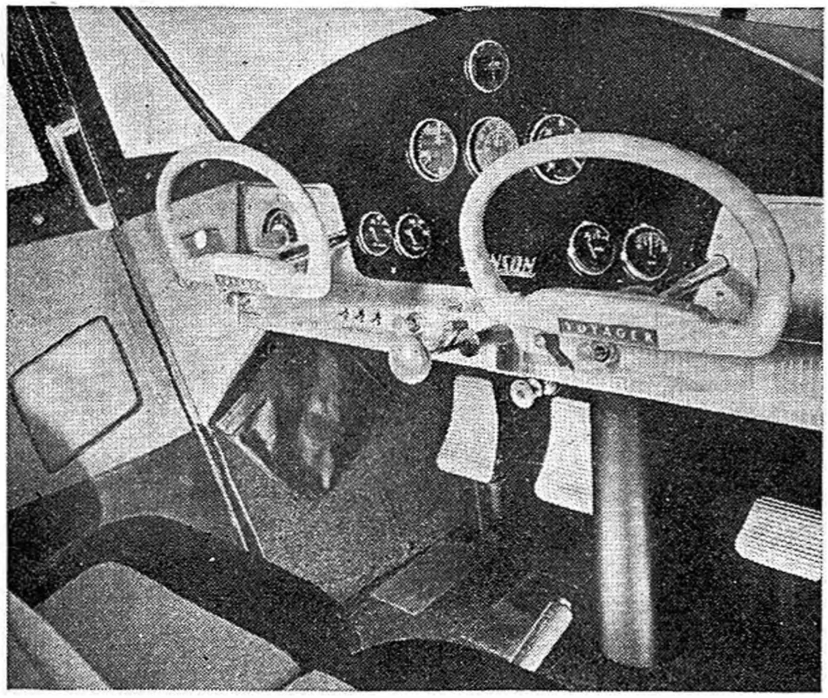
Very realistic instrument panels may be made from scraperboard, obtainable from the local art shop. This is a smooth card with a thin black coating which, when scratched off, shows the white underneath. Extremely fine lines may be drawn with a sharp stylus and perfect circles with dividers. Added realism may be achieved by superimposing on this a second board with holes punched with a six-way leather punch. A layer of acetate sheet between the two adds the finishing touch. On small models switches and knobs present a problem, especially when they need to be spherical. Years ago there used to be a cereal called Minute Tapioca (whether the name referred to the size or the cooking time was never clear). This tapioca was a bare $\frac{1}{16}$ in. in diameter and perfectly round—ideal for the job and not, as one might imagine, perishable. This, if still available, and the smaller cake decorations make good switches and knobs. In the multi-engined aeroplanes the engine, propeller, undercart and flap controls are mounted in a console between the seats, and all consist of levers which just don't look right if represented by ball-headed pins. A better way is to buy a strip of "Easiflo" *silver* solder from the ironmonger. This comes in a perfect rectangular section about $\frac{1}{16}$ in. wide, and if a blob of ordinary soft solder is applied to the end then filed flat a most convincing handle will result.

Having fitted the main items in the cockpit or cabin of the model, we can add a touch of realism by tucking coloured threads



Top: "Heron" nose-wheel. Only a dense material such as fibre is suitable for such intricate turning in a model. Centre: The relative simplicity of a helicopter cockpit. Bottom: Note how Puss Moth engine side panel is hinged at upper edge and held by two fasteners at bottom.

Note the uncluttered, car-type interior of the Stinson "Voyager" with only the essential instruments. Throttle control is the large knob in panel centre.



and wires around the sides and window framing to represent cables and pipes, and administer a sprinkling of small beads, washers, and pin heads as control knobs and gadgets. Good honest guesswork? Downright humbug? That is a matter best left to conscience and the judges, but an artist gives his impression of a subject and in modelling, where facts fall short, should not artistic licence step in?

The exterior of a model is usually more straightforward, and yet it is surprising when examining scale models to find so many suffering the same minor shortcomings. The whole character of a model may be spoiled by wheels which are badly proportioned and clumsily painted. Until recent years few modelbuilders had access to a wood lathe, but the vogue for "do it yourself" has brought small bench lathes within the means of a large proportion of the modelling fraternity. Whereas a few years ago the choice was between hand-carved or manufactured wheels, many modellers are now turning their own. With a little practice it is possible to turn the discs and tyres separately, and this not only obviates the difficulty of achieving a clean colour division line where the tyre meets the rim, but also makes it possible to represent canvas covers on spoked wheels. The axle should be inserted in the disc, and thread wound round the axle, over the rim to the other side, round the axle, and back again. The threads should be coated with glue, and then trimmed. A hole may now be drilled for the valve access opening, and the wheel covered with tissue. When the covering is doped and the tyre added a very good likeness to a spoked wheel will result.

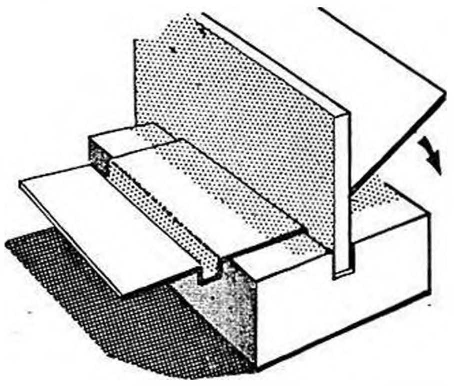
Modern wheels present a quite different problem. These often have the appearance of a series of concentric rings which are virtually impossible to turn in any wood except possibly box. Perspex may be turned on a woodworking lathe, however, and so may fibre, and neither of these materials needs sanding smooth if a really sharp chisel is used.

Another common fault is the surface treatment of an aircraft model. The builder quite rightly takes great pains to obliterate the grain of the wood and produces instead a glass-smooth surface quite unlike the real machine. Often, what appears in photographs or from a distance to be a harmonious combination of smooth curves is, on close examination, a collection of dented, scratched fitting panels encrusted with rivets and fasteners, or fabric stitched, laced or patched. Ascertain from the plan which metal panels are hinged and which are made to be removed completely. Those around the engine are often hinged just the same as the bonnet of a pre-war car, with long piano type hinges and Dzus fasteners of the press-and-turn 90 degrees type. Apply a length of fine wire or smooth thread to the surface of the model for the hinge and show the fastener as a small circle with a slot instead of a pin hole. (See the Puss Moth photo.) Other panels which have only to be removed infrequently are held in place with screws too small to be shown to scale on most models, and fixed panels are riveted. What a depressing sight some models make where zeal for riveting has overcome discretion ! On contemporary aircraft very few rivets can be seen from a distance which reduces the machine to the size of the model, while on the Hunter, for example, the rivets are so well filled as to be virtually invisible.

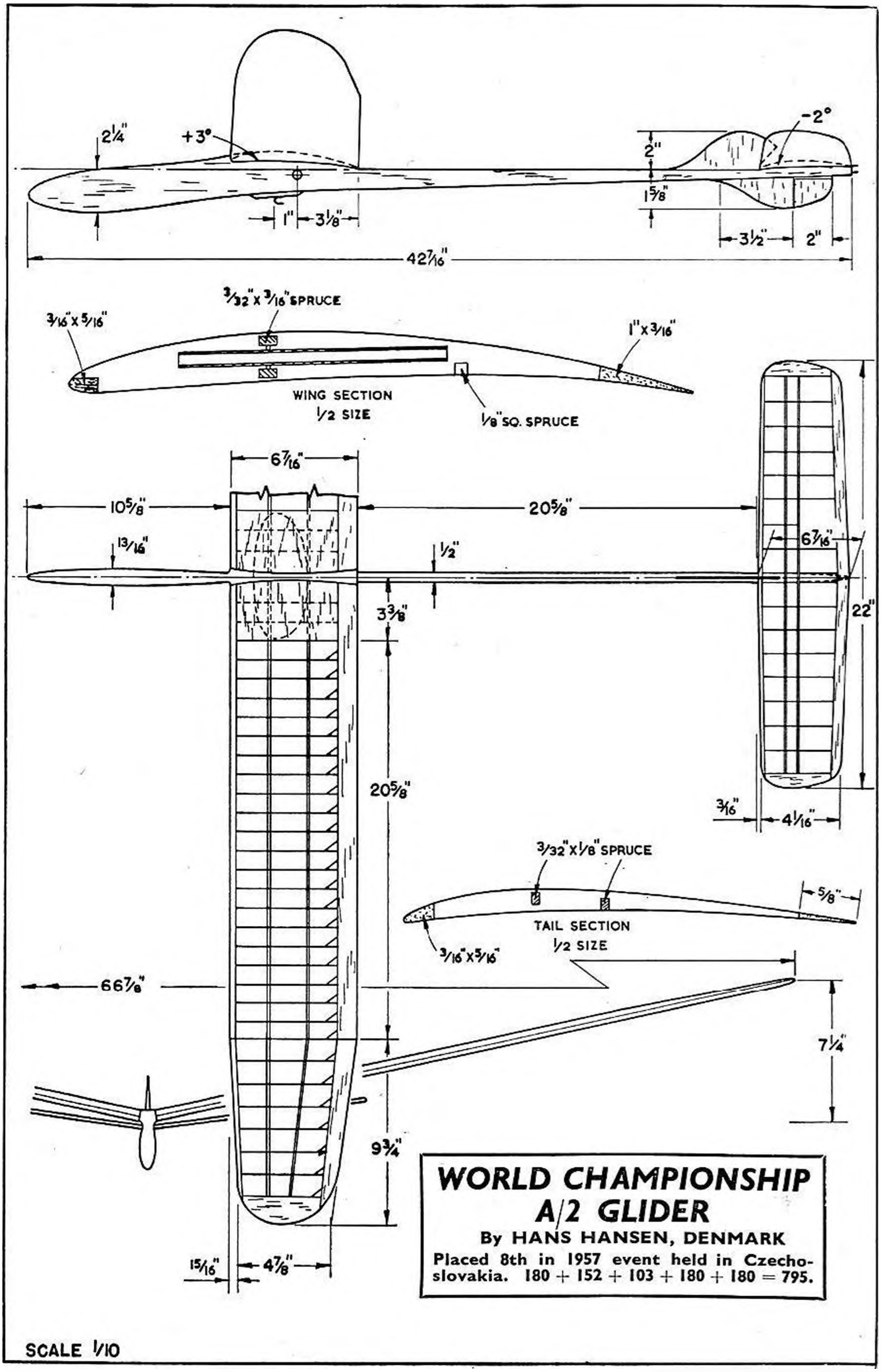
It would be a large model on which the stitching could be shown, but the lacing may be represented on solid models of 1/48th scale and upwards by diagonal knife cuts and on large flying models by inserting $\frac{1}{2}$-in. pins a very short way into the framing, forming parallel lines, then winding Terylene thread in a zig-zag line round the pins. When the thread is secured by dope the pins may be withdrawn, leaving the thread intact. Rivets, similarly, are comparatively easy to reproduce. For the small solid, if the rivets are really prominent and must be shown, the only practicable method is to make a series of pinpricks, either with a small clock wheel or individually, but for the really big model there is an ideal material for rivets, provided the modeller has infinite patience and almost unlimited time. All but the smallest printing works have a perforating machine which, when in good condition, produces in the space of a day millions of minute paper dics. Most printers, if approached tactfully, will gladly supply a bagful to an ambitious modelbuilder. One possible way to apply the perforations is to mount a clock wheel on a spindle, run it along a patch of wet glue, then along the rivet line on the model. If the "rivets" are then liberally sprinkled on the area and then tipped off, there should be one adhering to each glue spot, and these may be straightened and pressed down with a pin.

One last shortcoming which is quite common is the incorrect attachment of bracing wires. Before rigging a biplane it is wise to ascertain whether the wires are fixed to the strut end or to the wing spar at the strut location. Where the wires enter the wing surface short of the strut, separate holes must be made in the wing of a solid model, and the thread taken right through to be trimmed on the outside when the glue is dry. The builder of a flying model is confronted with a sterner problem, and may have to leave part of the covering until the model is rigged, unless small wire loops are led out through the covering to which the threads may be attached.

Perfecting minor details such as these may well occupy as much time as the basic construction of the model, but it is attention to the finer points which often gains those extra marks in a competition and materially affects the result. More important than this is one's pride in achievement, which is the prime stimulus in modelmaking.



MAKING CORRUGATED FOIL FOR COCKPIT WALLS

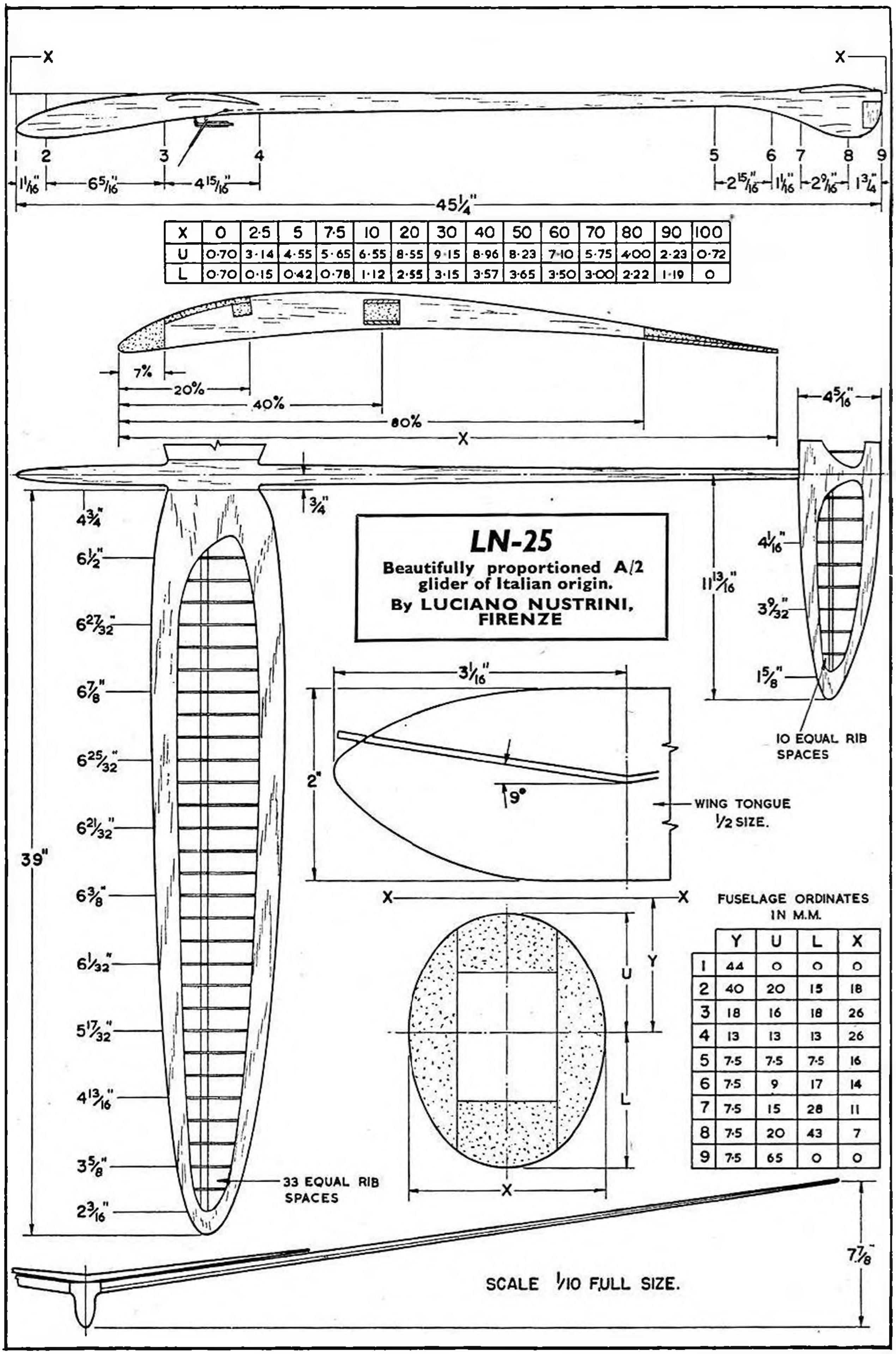


WORLD CHAMPIONSHIP A/2 GLIDER

By HANS HANSEN, DENMARK

Placed 8th in 1957 event held in Czechoslovakia. 180 + 152 + 103 + 180 + 180 = 795.

DRAWING BY R. CIZEK.



LN-25

Beautifully proportioned A/2 glider of Italian origin.

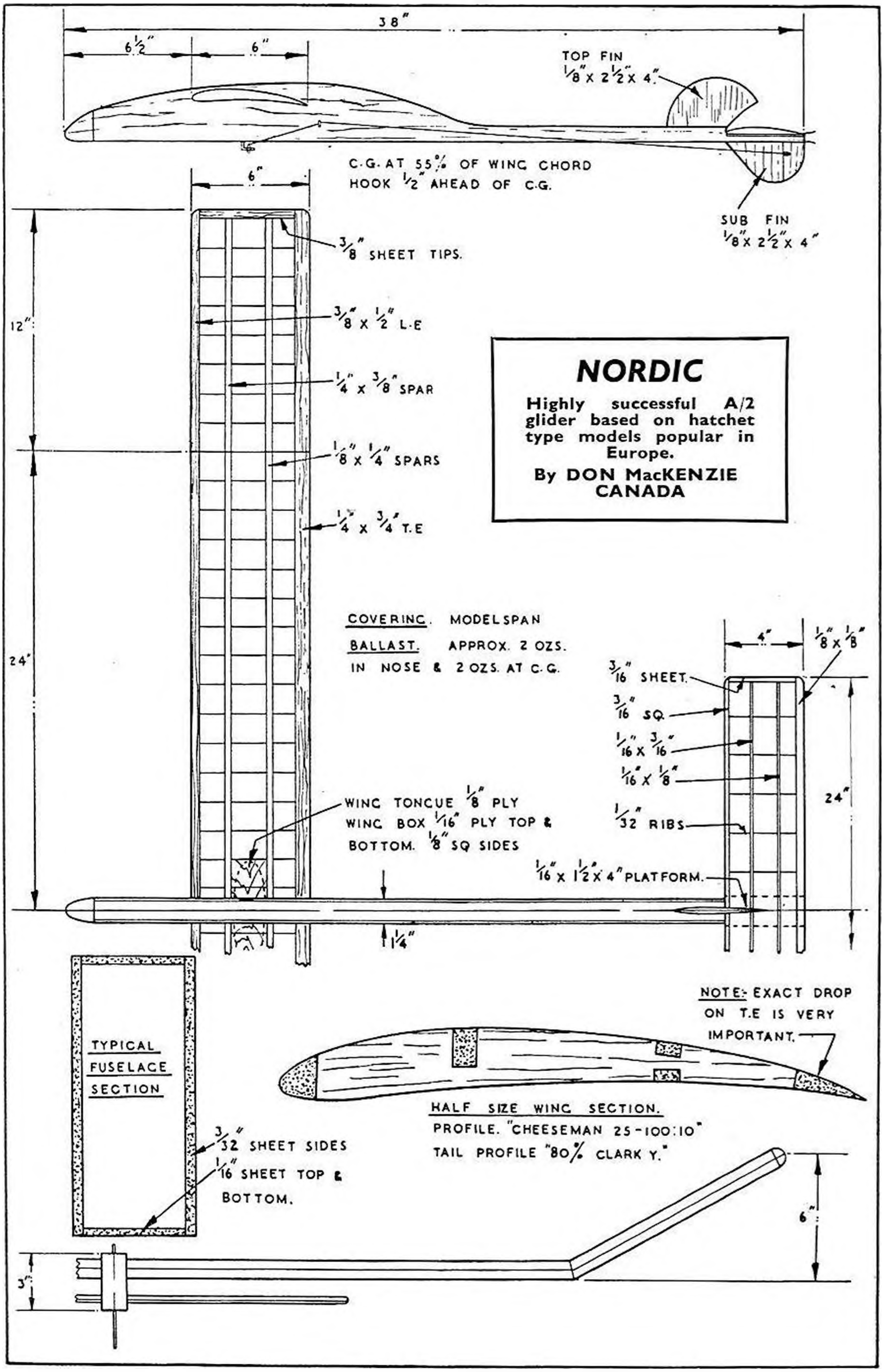
By LUCIANO NUSTRINI, FIRENZE

X	0	2·5	5	7·5	10	20	30	40	50	60	70	80	90	100
U	0·70	3·14	4·55	5·65	6·55	8·55	9·15	8·96	8·23	7·10	5·75	4·00	2·23	0·72
L	0·70	0·15	0·42	0·78	1·12	2·55	3·15	3·57	3·65	3·50	3·00	2·22	1·19	0

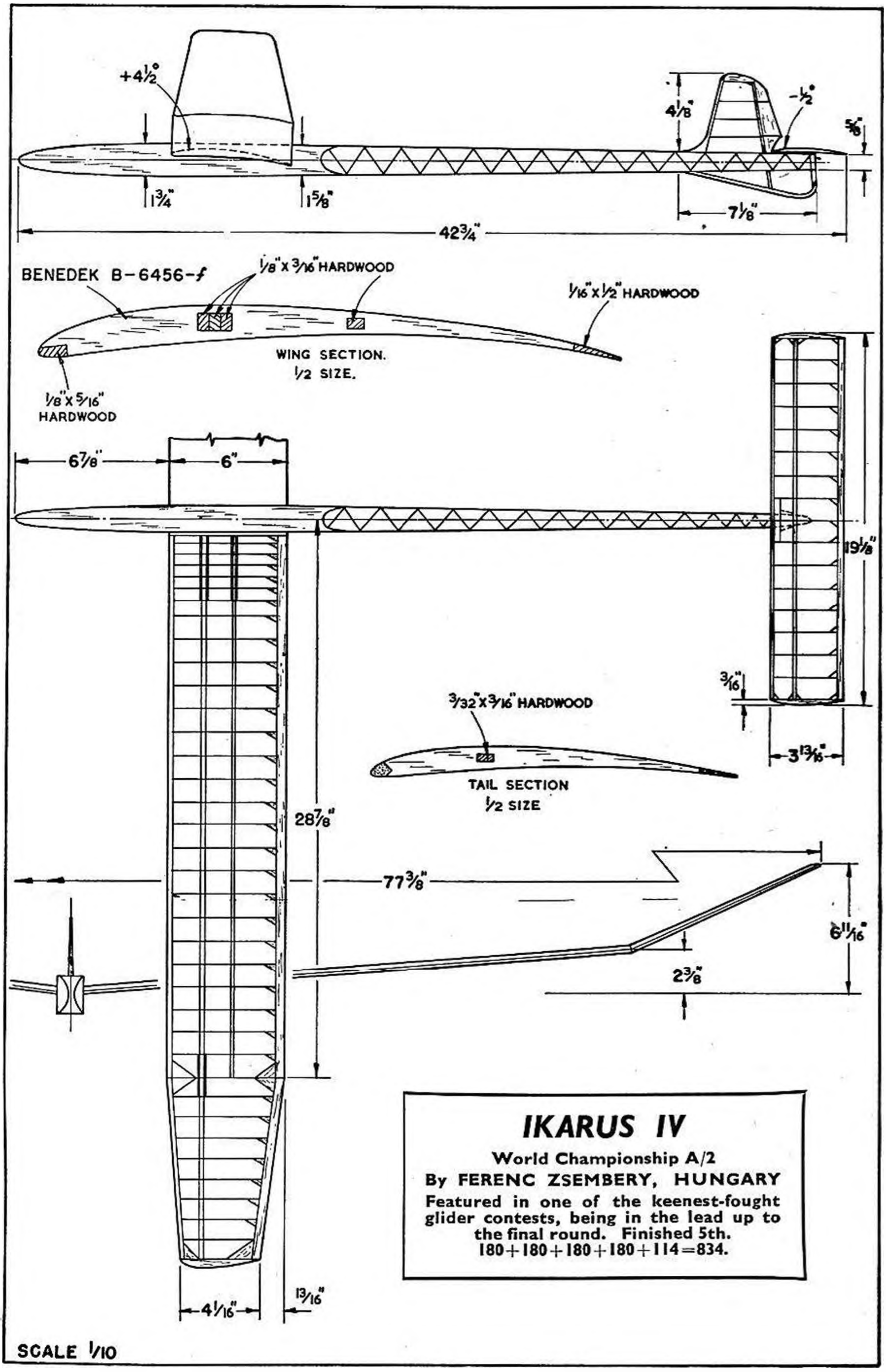
FUSELAGE ORDINATES IN M.M.

	Y	U	L	X
1	44	0	0	0
2	40	20	15	18
3	18	16	18	26
4	13	13	13	26
5	7·5	7·5	7·5	16
6	7·5	9	17	14
7	7·5	15	28	11
8	7·5	20	43	7
9	7·5	65	0	0

AEROMODELLISTA, ITALY.



MONTREAL MODEL FLYING CLUB, CANADA.



IKARUS IV

World Championship A/2

By FERENC ZSEMBERY, HUNGARY

Featured in one of the keenest-fought glider contests, being in the lead up to the final round. Finished 5th. 180+180+180+180+114=834.

DRAWING BY R. CIZEK.

DOPES FOR FUELS

THE CHARACTERISTIC of a good diesel fuel is that it should have good ignition properties and a low "ignition delay" (or ignition lag, as it is sometimes called). In the case of a full scale diesel engine, ignition delay is the time interval between fuel injection (itself timed to occur at the correct part of the stroke), and ignition. Model diesels—more correctly termed compression-ignition engines—compress the fuel mixture within the top of the cylinder to achieve self-ignition. The principle of firing is basically the same, but ignition delay is less readily defined. In simple terms it is the lag between the fuel being compressed to the "firing" point and the point where the charge has fully ignited. In other words the time interval (usually expressed in degrees of crankshaft rotation) between the triggering off and the actual completion of each explosion.

The ignition quality of a diesel fuel is expressed in terms of the cetane number (in a similar manner to the anti-knock properties of a spark-ignition fuel being expressed in terms of octane number). The higher the cetane number the lower the ignition delay, thus increasing the thermal efficiency of the engine.

The cetane number is of very little significance in the case of low and medium speed diesels, but assumes increasing importance the higher the speed of the engine. Most model diesels operate at extremely high speeds and so the cetane number assumes great significance. Since the cetane number of a fuel can only be determined by practical tests in standard engines and the operating conditions of a model diesel are different from that of a conventional diesel with fuel injection, the actual cetane number, as such, has little meaning. Quite obviously, though, its characteristic effect on ignition delay does, and the straightforward, practical manner of raising the cetane number of a model fuel (and thereby reducing ignition delay) is by the addition of "dope".

The maximum compression heat normally generated in a model diesel cylinder is too low for self-ignition of a conventional diesel fuel oil of paraffinic base. Hence, for model fuels, it is necessary to mix the fuel oil with another substance (usually ether) to lower the self-ignition temperature of the mixture to the required level. This type of additive is an essential part of the fuel mixture, although it may itself be a relatively poor fuel as such. Similarly, lubricant is added as a third essential component of the base fuel.

Such a three-part basic fuel mixture will give a good performance in the average diesel over a wide range of proportions. There will obviously be a minimum proportion of lubricant below which the engine will not receive sufficient lubrication. Different proportions of ether will produce varying self-ignition temperatures for the fuel and thus, largely, affect the starting characteristics. Also, the higher the proportion of ether the less the amount of higher calorific value fuel in the mixture, and vice versa.

The ignition delay characteristics of such a fuel are generally satisfactory for moderate speed running, but with a smaller load and higher speeds the delay may be too long for each charge to ignite in time. Approaching 18,000 r.p.m., for instance, each degree of rotation of the crankshaft is accomplished in a matter of 1/100,000th of a second. As a consequence the engine will misfire and not run steadily, and no adjustment of compression setting or needle valve will produce smooth running.

Provided the porting of the engine is adequate for a full charge of fuel and air to be inducted at each stroke, smooth running can only be restored by raising the cetane value of the fuel. Quite a number of chemical substances have this useful effect (see Table 1) but the most commonly employed are amyl nitrite and amyl nitrate. The addition of only a small proportion of dope materially reduces the ignition delay, and also tends to lower the self-ignition temperature of the fuel. This, and other side effects, make the use of too much dope undesirable.

The maximum amount of dope for any diesel fuel, to suit any particular engine, is the *minimum* amount which will give the desired effect of smooth running with that engine. This will seldom be more than 3 per cent by proportion, and is usually much less. If smooth running is not achieved with 3-4 per cent of nitrite or nitrate dope, then almost certainly the fault is not one of ignition delay but a limitation of the "breathing" capacity of the engine.

Most standard commercial fuels contain a small proportion of nitrite or nitrate dope, normally well within the maximum specified above. Where the proportion of nitrate or nitrite additive is of the order of 2 per cent only, some further improvement for very high speed running can be achieved by the addition of more dope.

The presence of a small amount of dope will assist starting by lowering the self-ignition temperature of the fuel. In this respect it is acting as an artificial compression raiser, but this effect will become even more marked as the engine warms up. Hence a fuel with a considerable proportion of dope may well require an appreciable slackening off of the compression as the engine warms up, otherwise the engine will lose power through being over-compressed. On the other hand, a correctly doped fuel will normally tend to run at a lower compression setting than an undoped fuel of similar basic proportions.

A practical disadvantage with dopes is that all tend to be corrosive. Nitrates release nitrous fumes on decomposition, with the likelihood of forming nitric acid within the engine. Peroxide dopes tend to attack and oxidise ferrous metal surfaces. Amyl or ethyl *nitrate* is generally regarded as less objectionable than amyl or ethyl *nitrite* as regards corrosive effects and combustion products of the latter should not normally be left to stand in the engine. In other words, when using a fuel heavily doped with *nitrite* it is good practice to swill out with oil after running, rather than risk having free nitric acid standing in the engine. Quite severe corrosion is commonplace in engines which have been run on heavily doped fuels and then left for a long period.

Another form of dope now coming into use for diesel fuels is nitrobenzene (hitherto regarded as an additive only for glow fuels). The exact action of this dope in diesel fuels has not yet been fully explored, but it does allow a diesel to run on a leaner mixture and thus result in a quite marked saving in fuel consumption. This is obviously a very desirable feature for team racers, or in any other application where fuel economy is important. Nitrobenzene is added in the proportion of 2-3 per cent and is usually most effective in fuels already heavily doped with nitrate.

Other typical glow fuel additives may have an adverse effect on performance. The addition of nitromethane to diesel fuel, for example, tends to destroy its self-ignition properties.

Glow Fuel Dopes

The basis of glow fuel is a straight fuel-oil mixture, normally methanol and castor oil. The latter may itself contain small proportions of additives, if used in the form of a proprietary blended lubricant, which are not effective as fuel dopes and may even be undesirable since they will tend to separate out of the mixture if they are insoluble in methanol.

A "straight" glow fuel can be used in widely varying proportions, about the only limitation being that there should be enough castor oil present for adequate lubrication. Performance is then virtually unrelated to the proportion of methanol in the mixture. A very substantial improvement is, however, realised by the addition of nitroparaffin additives and these alone of the possible "dopes" appear to produce this very desirable effect. They also make it possible to match a fuel to a given compression ratio, and vice versa. These characteristics are interrelated.

Dealing with the effect on compression ratio first, a straight methanol-castor glow fuel will generally call for a high compression ratio to maintain satisfactory running with the glow plug disconnected. This tends to make starting difficult because of the tendency to " kick back" when flicking over, particularly with small propellers, and the engine may also be prone to backfire when starting and run backwards, especially where the porting design does not favour running in a particular direction.

The addition of nitroparaffin acts as an artificial compression raiser again, so that the fuel will fire satisfactorily at a lower (engine) compression ratio. About 5 per cent nitromethane will produce quite an appreciable effect in this direction, so the starting characteristics of the engine can be improved by lowering the (fixed) compression ratio and consistent performance maintained. This is particularly useful to the commercial engine designer in producing an easy-starting, moderate-performance glow motor, compromising on compression ratio to match a relatively inexpensive doped fuel.

Unlike a diesel fuel, increasing the proportion of nitroparaffin still further results in a continued increase in performance. The effect is twofold. The "compression raising" effect of the dope permits the engine compression ratio to be lowered again so that the engine can go faster since it has less internal pumping work to do against compression. Also the decomposition of the nitroparaffin in the mixture promotes faster, more complete burning of the whole charge and increases the amount of fuel which can be burnt at each firing. Since alcohol itself is not particularly high in calorific value the only way a glow motor can produce more power is by burning more fuel *volume* per cycle. It then becomes a question basically of how much fuel can be got into the engine, per charge, together with enough air for complete combustion. Nitroparaffins help in this latter respect by rapidly yielding their oxygen content to assist in complete burning.

Nitroparaffins can be added in large proportions with beneficial effects, although the most marked increase is obtained with the first 10 per cent. After that, adding more nitromethane will increase performance although at a diminishing rate and in the case of most conventional engines a maximum effect is achieved with some 25-40 per cent dope. A higher proportion of dope will then have little or no effect on r.p.m.

This is very much bound up with the design and construction of the individual engine. With orthodox porting there will come a point where no more fuel can be inducted per cycle and so, without appreciably increasing the calorific value of the fuel (which nitroparaffins do not do since they have low calorific value and are not, in themselves, recognised as fuels), the engine will not run faster with any particular load. Special designs can undoubtedly take benefit from increasing the nitroparaffin content of the fuel to 50 or 60 per cent, and sometimes even greater.

Above about 50 per cent nitromethane dope will not mix with a methanol-castor blend—and excess of the nitroparaffin separates out. It can, however, be rendered in complete solution by adding ether or nitrobenzene, which substances appear to have a catalytic effect on solution. Neither ether nor nitrobenzene has any desirable effect as a glow fuel "dope" on its own ; the low anti-knock rating of ether, in fact, is highly undesirable, but both have the effect of promoting cooler running. This would appear the only benefit to be obtained from nitrobenzene, as is frequently recommended in special racing fuels, unless also required as a catalyst.

The question of temperature is important since a "hot" fuel tends to promote hotter running and also to be particularly hard on the glow plug element. One of the main difficulties in using a heavily doped fuel may be getting a suitable glow plug to stand up to it. On the other hand the great flow of fuel through the cylinder can promote a cooling action. The problem is too complex to discuss briefly and a lengthy explanation belongs more to engine design than a description of fuels. Suffice to say that the question of head temperature, compression ratio, glow plug design and the fuel used are all interrelated and the more one tries to get out of an engine, the more critical this relationship becomes.

The only nitroparaffins normally considered as dopes are nitromethane and nitropropane. It used to be held that the former was suitable for alcohol-base glow fuels and the latter petrol-base fuels. In practice, both give an almost identical performance with alcohol-based fuels (petrol-based glow fuels no longer being used) and can be regarded as interchangeable in glow fuel formulaes. Both, however, are extremely expensive and unless special circumstances warrant, a heavily doped glow fuel is an unnecessary extravagance. A practical maximum performance should be obtainable with a conventional glow motor design with no more than 20 per cent nitroparaffin in the mixture.

Similarly, excepting again in the particular circumstances where absolute

TABLE I—DOPES FOR DIESEL FUELS

ADDITIVE	PROPORTIONS		REMARKS
	Minimum* %	Maximum %	
Amyl Nitrite Ethyl Nitrite	2·0	4·0	Commonly used in commercial fuels.
Amyl Nitrate Ethyl Nitrate	2·0	4·0	Less corrosive than Nitrite.
Peroxides, e.g. Butyl, Hydro-Peroxide	—	—	Little tried at present.
Nitrobenzene	2-3	3-4	Has cooling action and lowers fuel consumption.

(*For satisfactory general purpose running.)

maximum performance is required, there appears little call for experimenting other than with the standard nitroparaffin dopes. There is the point, however, that, unlike the diesel, the performance of a glow motor is quite likely to be affected by different fuels and even with low doped fuels (under 10 per cent nitroparaffin) one particular formulation of fuel will probably suit the engine better than others. It is possible literally to "tailor" the engine design around a particular fuel for optimum performance.

Dopes and additives for spark-ignition motors are hardly considered these days, mainly because so few such motors are in use in the aeromodelling world. Also, when employed they are not used under conditions requiring maximum performance—nor can they compete with the glow motor or diesel in this respect. There is little point, therefore, in considering anything other than a straight petrol-oil mixture. It is also a fact that the two-stroke petrol engine runs best on a commercial grade of petrol rather than premium fuels, unless specifically designed to take advantage of the latter using a higher than average compression ratio. With adjustable timing the spark-ignition motor possesses an inherent capacity for tolerating poor fuels and many of the problems associated with compression ignition and glow ignition do not arise.

For the sake of completeness it can be said that the normal purpose of a petrol fuel dope is to raise the self ignition temperature of the fuel and so prevent pre-ignition or "compression-ignition" effects. This can be done by using a fuel with a higher octance rating, the addition of tetra-ethyl lead as a dope, or both. A leaded fuel tends to be corrosive and is not usually suitable for model engines (or any small internal combustion engines for that matter).

Full advantage can only be taken of a high octane fuel if the compression ratio is correspondingly raised to increase the thermal efficiency of the engine. To utilise the highest practicable compression ratios an alcohol fuel becomes the logical choice, with its high self-ignition temperature. Performance is then increased at the expense of increased fuel consumption and greater fuel cost. About the only thing then remaining is to increase the calorific value of the fuel by mixing in diethyl ether or similar additives. Diethyl ether, incidentally, can replace ordinary ethyl ether in a diesel fuel, and alcohol fuels are the basis of all modern glow motor fuels. The more one tries to "hot up" a spark-ignition motor in model sizes the nearer it gets to the glow motor, which is obviously a simpler solution.

TABLE 2—DOPES FOR GLOW FUELS

ADDITIVE	PROPORTIONS		REMARKS
	Minimum %	Maximum %	
Nitromethane Nitropropane	5-10	40 and up	Maximum proportion effective related to engine design.
Nitrobenzene	—	10	Cooling agent, also assists in mixing high proportions of nitroparaffins.
Ether	—	10	Similar to Nitrobenzene in effect, but not recommended.
Amyl Acetate	—	5-10	No apparent effect on its own.
Nitrites	—	5-10	Ditto
Nitrates	—	5-10	Ditto

ROCKET POWER

Of the various possible forms of direct jet propulsion, only the pulse jet and the rocket motor have proved practicable for model work. The former is inherently limited in application and, incidentally, prohibited for use in Great Britain on free flight models—leaving the rocket motor, as typified by the Jetex unit, the only form of power unit available for general application. The first Jetex units were produced in 1947 and until comparatively recently have commanded a monopoly in this field. Other units, and fuels, have, however, been introduced within the last year or so (notably V-Max in this country), although based on virtually identical principles.

Only solid fuel rocket motors are considered for model work, a liquid fuel rocket being too complex to reduce to a diminutive size at a commercial price as well as being potentially much more dangerous. The traditional type of solid fuel rocket burns gunpowder, which is essentially an explosive and difficult to control. The best of the solid rocket fuels belong to a wider class of explosives designated propellants. The main difference between a propellant and a high explosive is that propellants burn harmlessly (if sometimes fiercely) in the open air but have the characteristic property of increasing their rate of burning with increasing pressure of the gases generated.

When a propellant is ignited in a closed chamber gas pressure rises rapidly as burning takes place, further increasing the rate of burning and thus the "explosion" characteristics of the fuel. The rocket motor design aims at achieving an equilibrium condition where the rate of production of the gas (after some initial pressure build-up) exactly balances the outflow through the orifice, consistent with a required thrust level and duration of thrust.

The thrust developed is equal to the rate of consumption of the fuel multiplied by the velocity of the gas jet. Increasing the burning rate as a means of improving thrust means a substantial increase in internal pressure, which must obviously be limited to a certain value otherwise there is a risk of the rocket tube bursting. A commercial unit incorporates a form of "safety valve" to take care of this possibility—*e.g.*, spring loading the cap which can lift under excess pressure and allow gas to escape through an alternative path, or deliberately weakening the metal around the orifice to allow the latter to blow open under excess pressure. In liquid fuel rockets, by contrast, pressure problems are not generally as serious, although the fuels are commonly more toxic and corrosive.

The alternative to excess pressure in the rocket tube itself is speeding up the gases in the jet, which is largely a function of the design of the rocket unit. This factor is quite critical in that with the simple form of standardised design the size of the jet orifice has a marked effect on the thrust developed. Altering the size of the jet, either accidentally when cleaning, or deliberately, will usually have an adverse effect on performance—the original size having been determined as the optimum, established on empirical lines. Many of the detail improvements which have been achieved in the last decade with Jetex units have been related to the interior shape and volume of the combustion chamber, and the form of the jet orifice.

The model rocket motor burns a low-power fuel, suitably below the borderline of an "explosive" as classified by the Home Office. Gunpowder is also a low-powered fuel, depending on the liberation of oxygen from potassium nitrate to promote burning.

Many other substances show an improved performance as a simple rocket fuel, although very few fulfil both the above requirements, and may possess other disadvantages. Sodium nitrate, for example, is a better oxygen-bearing compound than potassium nitrate but is hygroscopic, that is, it tends to absorb moisture. Potassium chlorate is too unstable and unreliable, as also are mixtures of oxygen-bearing compounds and light metals, these showing characteristics which may change spontaneously from propellants to high explosives.

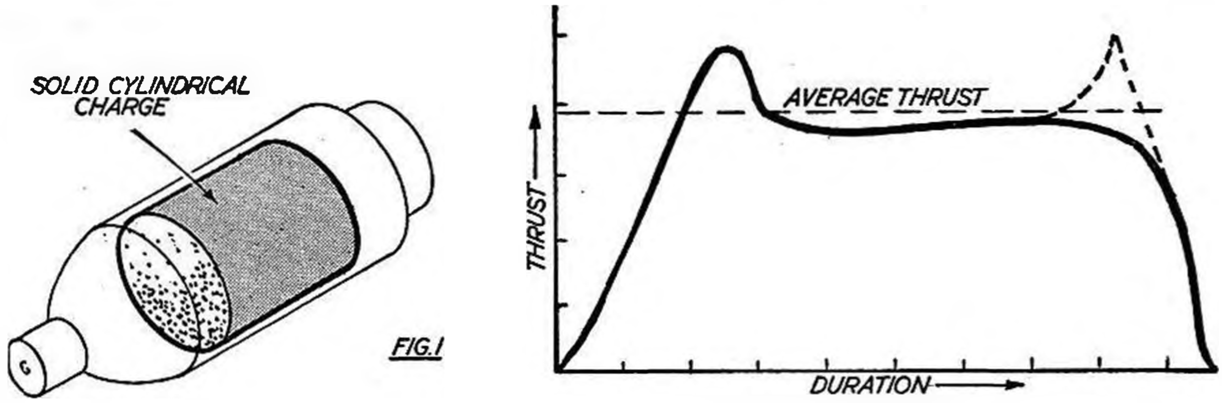


FIG. 1

Of the two standard model rocket fuels so far produced the Jetex fuel is manufactured by Imperial Chemical Industries and described as a guanidine nitrate base ; while V-Max fuel is compounded on a different base. Both are hygroscopic mixtures, necessitating lacquering of the individual pellets immediately after manufacture to prevent them from absorbing excess moisture during their normal storage and shelf life before use. At the flying field on a damp evening, fuel charges are best kept in a metal box. Pellets which have become damp can be restored to full performance by *gentle* heat.

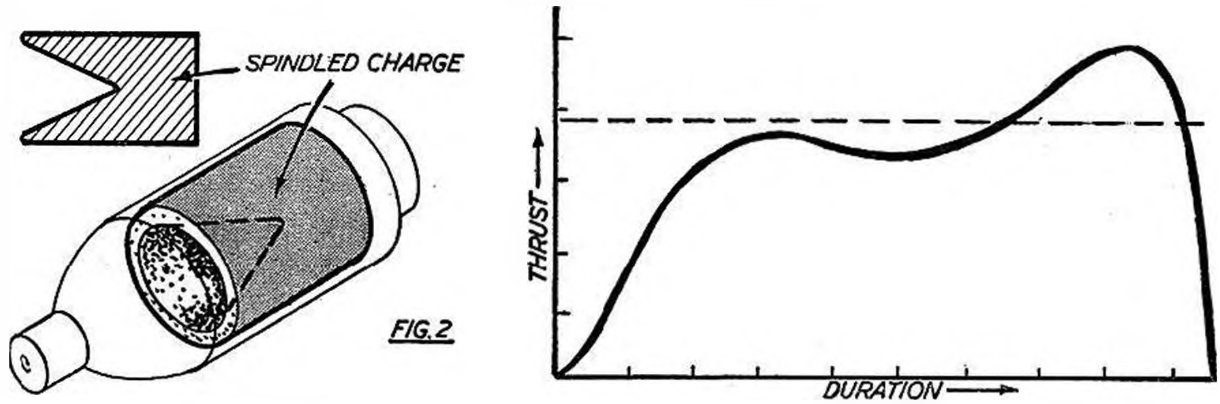


FIG. 2

Apart from arriving at a satisfactory formula for the fuel mix—and the amount of development work which has gone into this and other non-successful projects is considerable—another major problem is consistency. Charges are pelleted from individual batches of made-up mix, with a distinct possibility of variations from batch to batch. Inevitably there are variations. The actual composition of the mix may also be altered slightly for different sizes of pellets, generally aimed at promoting a faster burning rate (and thus greater thrust, *pro rata*) with the larger sizes.

The *specific impulse* of a rocket motor is defined as the jet velocity divided by the acceleration of gravity. Expressed in seconds this represents the time which a unit mass of fuel can support itself against the attraction of gravity, and is more pertinent to astronautics than jet propelled flight. A more practical measure of performance in this case is *total impulse* or the product of thrust and duration of power. This, equally, will depend on the volume (or weight) of the charge and so a simple measure of overall performance is :

$$\frac{\text{total impulse}}{\text{weight of charge}} = \frac{\text{thrust} \times \text{duration}}{\text{weight of charge}}$$

Typical figures achieved with model rocket motors range between 60 and 130, the higher figures being associated with the larger sizes. In full-scale rocketry this represents the reciprocal of *specific consumption.*

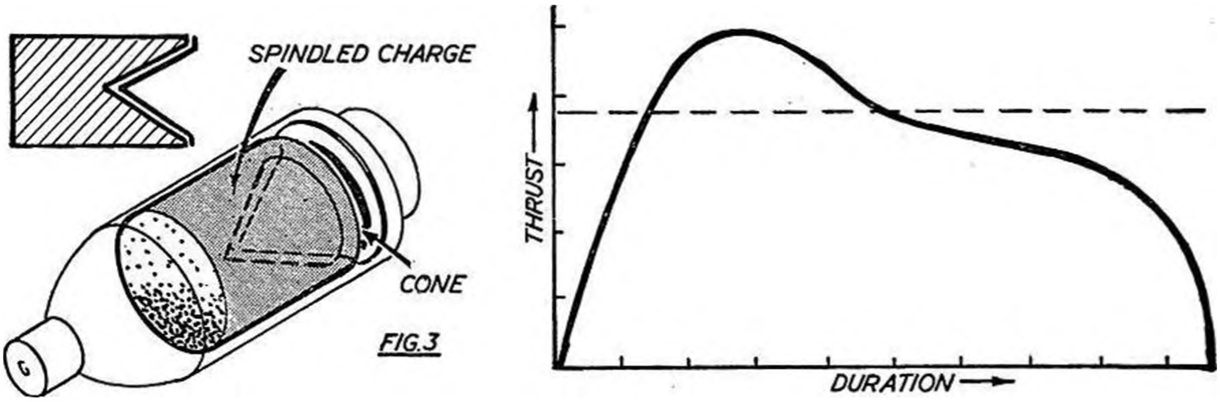


FIG.3

The theoretical maximum exhaust velocity can be calculated on the basis that the rocket is a heat engine converting heat energy (through combustion of the fuel) into kinetic energy. Such calculations are of little use, however, as the actual efficiency achieved (theoretical efficiency=100) can vary enormously with the design of the rocket unit, and may be comparatively low. Typically the efflux velocity from a standard Jetex type motor would appear to be of the order of 1,000 ft./sec.

A basic formula for (overall) rocket performance—in fact probably the most important single formula in rocketry—is that concerning the maximum velocity a rocket can obtain after burning all its fuel. It has no application to models, but is instructive to work as elementary calculations on space travel possibilities. It is :

$$V = v_e \log_e R$$

$$\text{or } V = 2{\cdot}3026\ v_e \log_{10} R$$

where V=maximum velocity or final velocity of the rocket (all fuel burnt)

v_e=exhaust or jet velocity

R=the mass-ratio of the rocket

$$= \frac{\text{initial mass of rocket}}{\text{final mass of rocket, with fuel burnt}}$$

A few sample calculations with existing fuels (see Table 1) will quickly show that impractically high values of mass ratio (R) have to be achieved in order to obtain "escape" velocities (*e.g.*, of the order of 25,000 m.p.h.). This difficulty, at present, can only be overcome by using multi-stage rockets until the appearance of new fuels with substantially greater values of v_e.

Reverting to model rockets, a solid cylindrical charge contained in a close-fitting tube is restricted in burning area to its diameter. Even if the charge is completely consistent in composition it does not follow that its thrust will be consistent. The rate of burning will be affected by any changes in pressure within the tube, and also by changes in temperature. The resultant thrust curve may well show definite "peaks" (Fig. 1) notably an initial "peak" consistent with the initial build-up of pressure, and possibly also an end "peak". There will also be individual, localised peaks and valleys of relatively small magnitude along the length of the thrust curve caused largely by local inconsistencies of charge composition and temperature and pressure variations.

If the charge is shaped with a conical depression at the initial "firing" end (Fig. 2) the initial burning area is reduced with the inner surface of the cone acting as a combustion area which progressively enlarges at the same time as the burning area of the charge enlarges. This is capable of producing a modified thrust curve consistent with an absence of initial "peak" and a higher final thrust value. This form of shaped charge is used on typical gunpowder rockets and with the Jetex Scorpion.

The other possibility is to use a spindled charge the other way round, so that a gradually diminishing area of charge burns away last (Fig. 3). To ensure that the end burning is controlled, however, it is necessary to "face" the cone with a suitably shaped insert which contacts the conical surface and thus restricts its tendency to burn. Without that the already high temperature and pressure achieved within the tube may produce a similar burning rate over the reduced area section. The thrust curve is now modified, as shown, with a gradual falling off of thrust over the last portion of the curve.

The ways of getting *more* thrust out of a given charge are, basically, increasing the temperature of the combustion chamber and increasing the rate of burning. If the jet tube is warmed before the charge is inserted and fired, the

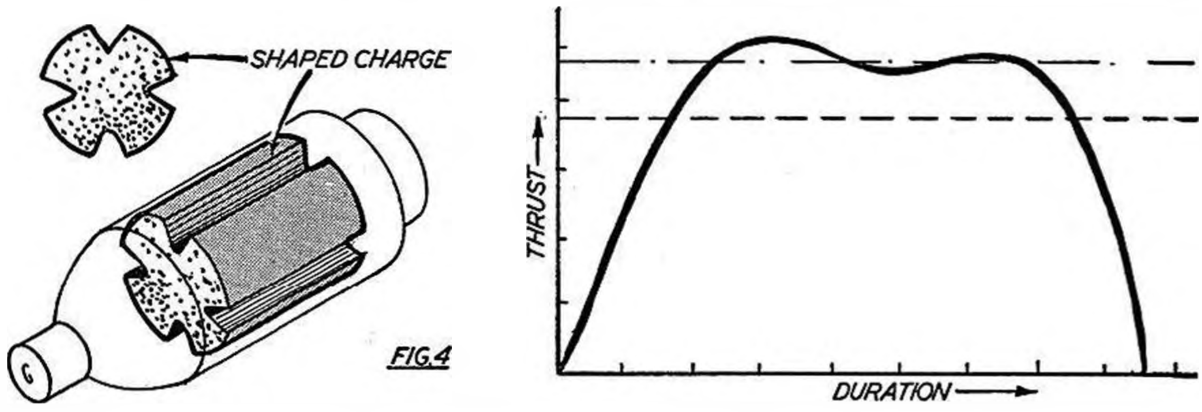


FIG. 4

performance will generally be slightly better, especially if the charge is warmed, too. But this is not a practical proposition, nor is it generally advisable. In any case, the gain is usually relatively small.

Increasing the rate of burning can be achieved by shaping the charge to produce free air space down its length (Fig. 4). The result will be a hotter, higher thrust run (also at higher pressure within the rocket tube), at the expense of a decreased duration.

In practice, a common source of loss of thrust with standard rocket motor units is gas leakage through a badly seating cap ; also partial blockage of the jet orifice with the wire remaining in position after the wick has burnt. Best practice is to use two separate lengths of wick (one coiled on top of the charge and the other a straight length pushed through the jet hole contacting it) so that the portion running through the jet orifice is blown clear with the initial burst.

The evaluation of the performance of a rocket motor—to compare with a conventional model aero engine, is purely a function of thrust and *speed.* Unlike a conventional engine, which develops a definite brake horsepower in driving a particular propeller, irrespective of how fast the model may be flying, the *horsepower* developed by a rocket motor is zero if the model has no speed (*i.e.*, is simply held stationary) and proportionately increases with speed when the model is flying. Knowing the speed, the horsepower equivalent follows as :

$$\text{h.p.}=\frac{\text{thrust (ounces)}\times\text{speed (ft./sec.)}}{8{,}8000}$$

Thus 1 ounce thrust at 60 m.p.h. represents a h.p. equivalent of ·01 at 60 m.p.h., but only ·005 at 30 m.p.h.

Another point to be borne in mind is that the *efficiency* of a rocket motor as a propulsive unit increases with speed. This is characterised by the fact that a rocket-powered model will continue to pick up speed throughout the duration of thrust due to the increasing efficiency of propulsion, and not, as is usually thought, a build-up of *thrust* (although this may also be a contributory cause if the thrust curve is of the form shown in Figs. 1 or 2).

It is therefore true to say that, like a rubber-powered model which is only trimmed properly when it is capable of absorbing maximum turns on the motor, a rocket-powered model is only trimmed properly when it can perform a proper flight pattern throughout the length of the thrust duration. Given proper attention to this point the performance of the majority of rocket-powered models could be substantially improved.

TABLE I
TYPICAL PROPERTIES OF FULL-SIZE ROCKET FUELS

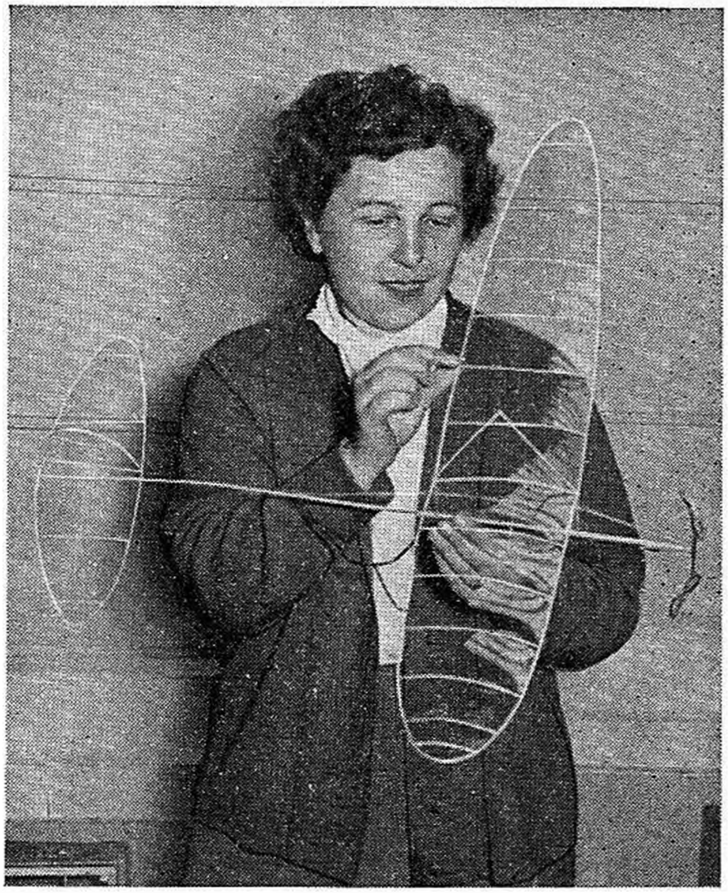
FUEL	HEAT LIBERATED Calories per gm. vol.	HEAT LIBERATED B.Th.U. per lb.	JET VELOCITY ft./sec.	SPECIFIC IMPULSE
Gunpowder	·63	1,130	7,600	220
Hydrogen Peroxide	·38	700	5,960	170
Hydrogen Peroxide plus Petrol	—	—	7,500	220
C-Stoff*	—	—	7,000	200
T-Stoff† and C-Stoff	2·9	5,220	16,320	470
Nitromethane	—	—	7,300	210
Petrol and Oxygen	—	—	17,000	490
Petrol and Nitric Acid	—	—	8,000	230
Oxygen and Methane	—	—	8,500	245
Oxygen and Ammonia	—	—	8,500	245
Oxygen and Hydrazine	—	—	9,200	260
Anicine and Nitric Acid	—	—	7,200	210

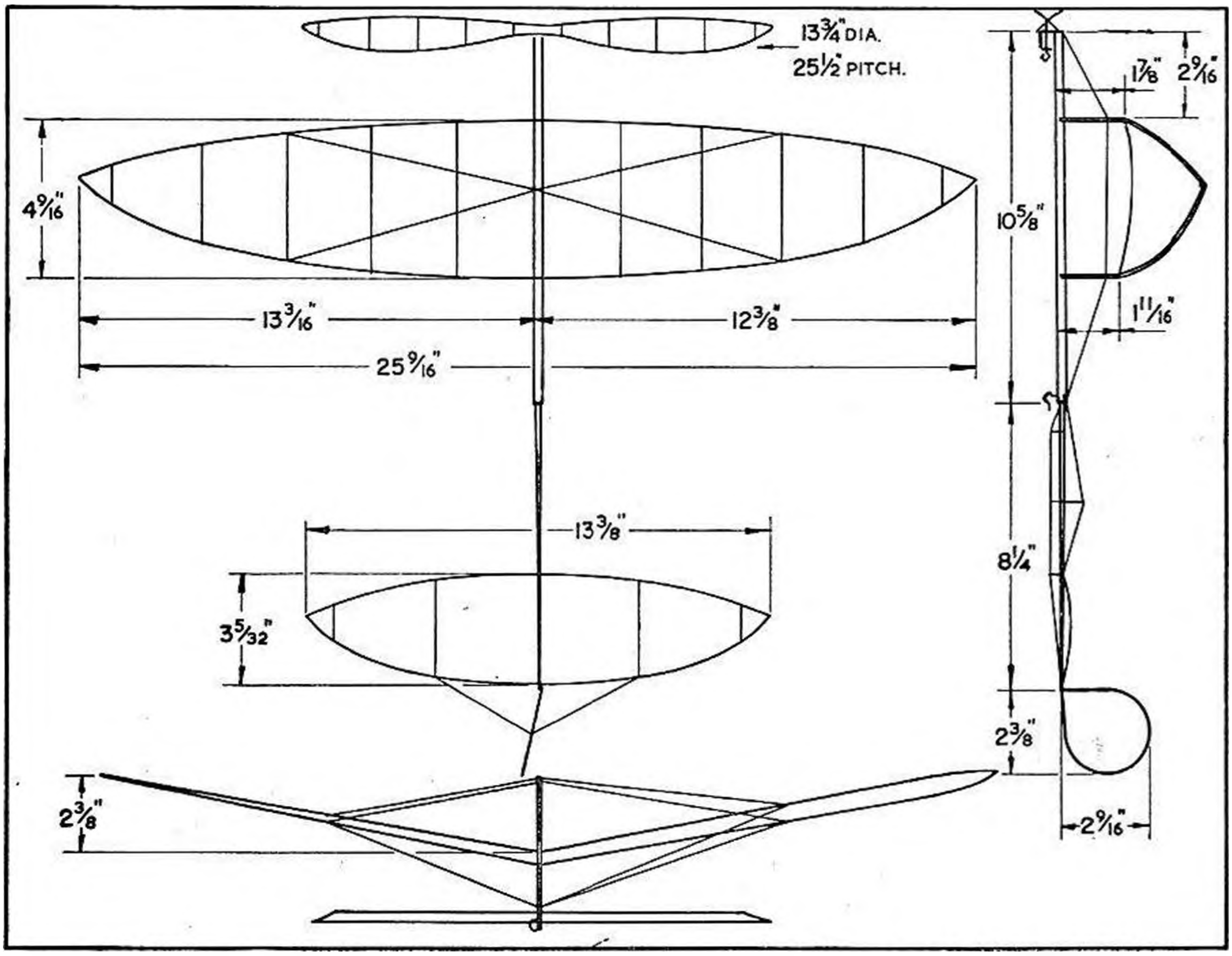
* C-Stoff is a methanol-hydrazine-water mixture.
† T-Stoff is 80 per cent hydrogen peroxide plus a stabiliser.

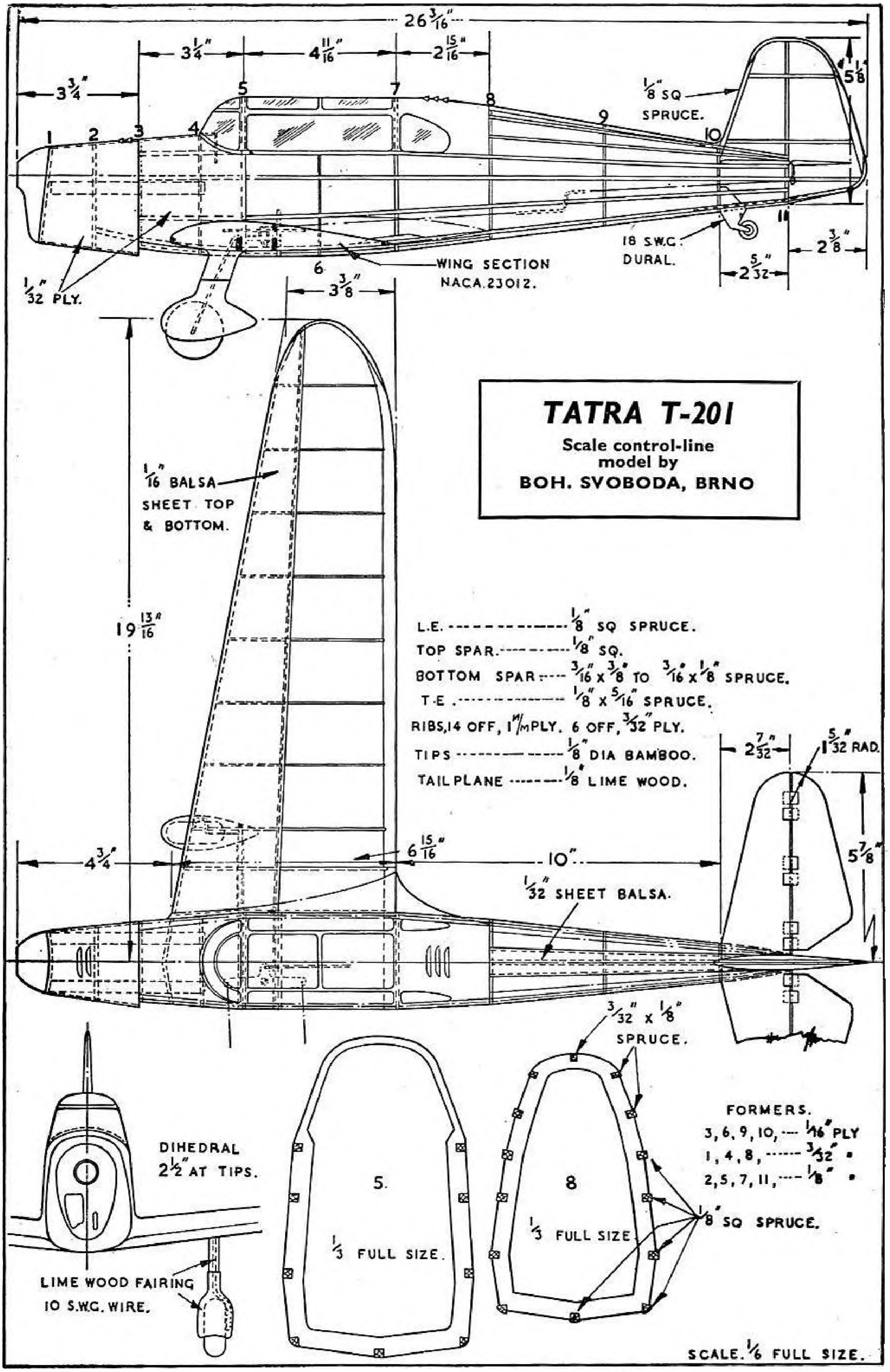
INDOOR MODELLING IN HUNGARY

For many years Hungarian modellers have dominated the World Record listings in rubber-driven classes, and it is no surprise to learn of the high times they set up with microfilm models. Flying in the Halle der Universität in Debrecen on April 27th, 1958, Georg Benedek (whose model is depicted below) made top time of 15 minutes, while Frau C. Abaffy, seen at right with her model, placed fifth with a time of 12 minutes 26 seconds.

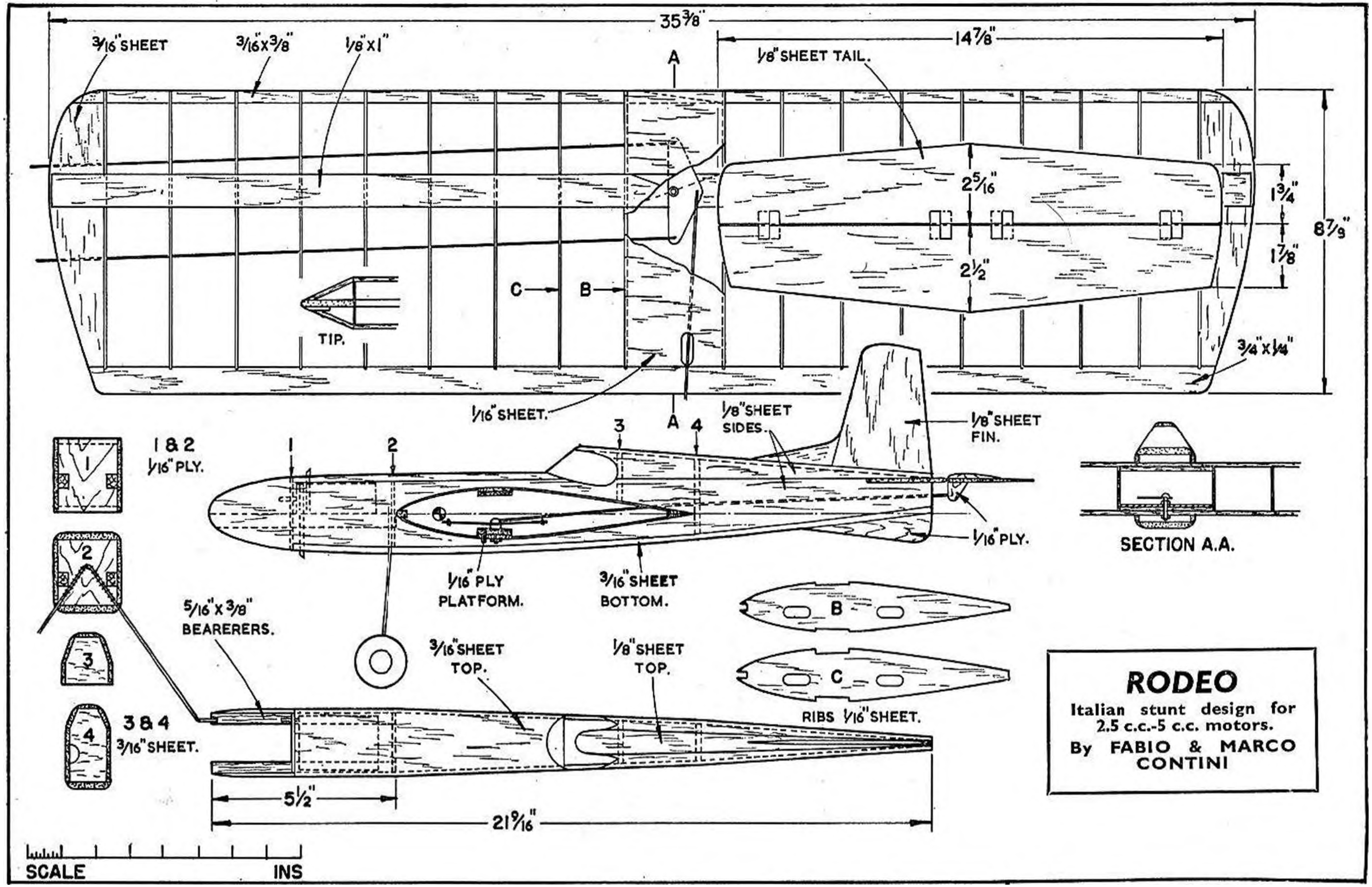
It is anticipated that 1959 will see the inauguration of international indoor contests, probable venue being the large hall mentioned above (the largest in Hungary) with a ceiling height of 30 metres.







LETECKY MODELAR, CZECHOSLOVAKIA.



RODEO

Italian stunt design for 2.5 c.c.-5 c.c. motors.

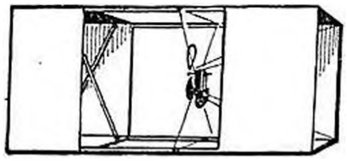
By FABIO & MARCO CONTINI

AEROMODELLISTA, ITALY.

Those were the Days! . . .

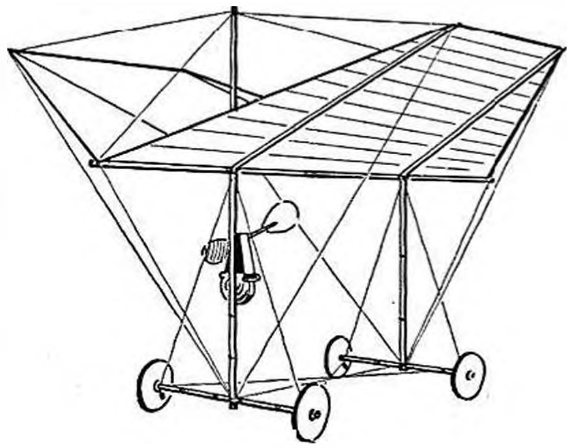
The following sketches were sent us by the late Dick Trevitich, a pioneer British aeromodeller who was noted for his excellent model engineering technique. One of the first exponents of power modelling, his machines were distinguished by metal fittings of superb craftsmanship, and he took many honours at pre-war Model Engineer Exhibitions.

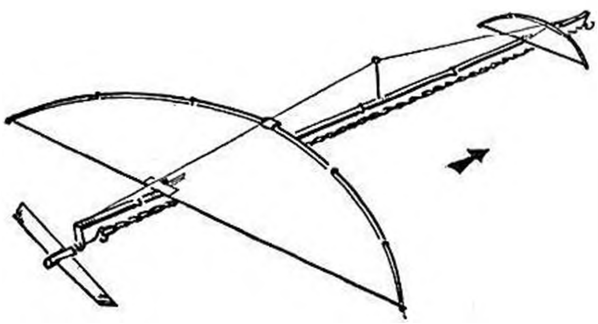
Dick was fortunate enough to be able to closely examine Bleriot's monoplane after its first crossing of the English Channel, and also attended the Bournemouth Aviation Meeting held in 1910. The mechanically driven model always appealed to him, and in turn he experimented with CO_2, compressed air, steam, petrol and compression ignition engines.



1906-1907. An attempt to equip the box-kite, known to most boys of that period, with a propeller. The clockwork motor came from a toy boat, and the affair was slipped from a kite line, which also released the prop.

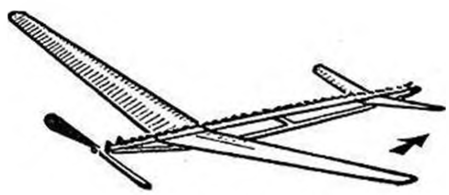
1908. Frame of bamboo, covered with light paper proofed with flour paste. Propeller consisted of flat wooden blades fitted to wooden arms. Frame braced throughout with strong thread. Never rose above launching point, but occasionally would glide satisfactorily. Would probably have done as well without the prop. running, but it looked better !





1909. Frame of bamboo; thread trailing edge; strip rubber obtained from core of golf balls. Prop. made from pine garden labels let into wooden hub. This model did make flights when hand launched, finally breaking glass in greenhouse, which ended its career !

Following Olympia Aero Show of 1909, a number of quite successful models were made based on the " Clarke flyers ", which had curved wooden surfaces. These quite definitely flew, and were very fast.



CLARKE 'FLYER'

GUIDED MITE

The ultimate in miniature radio models

By Bob Coon

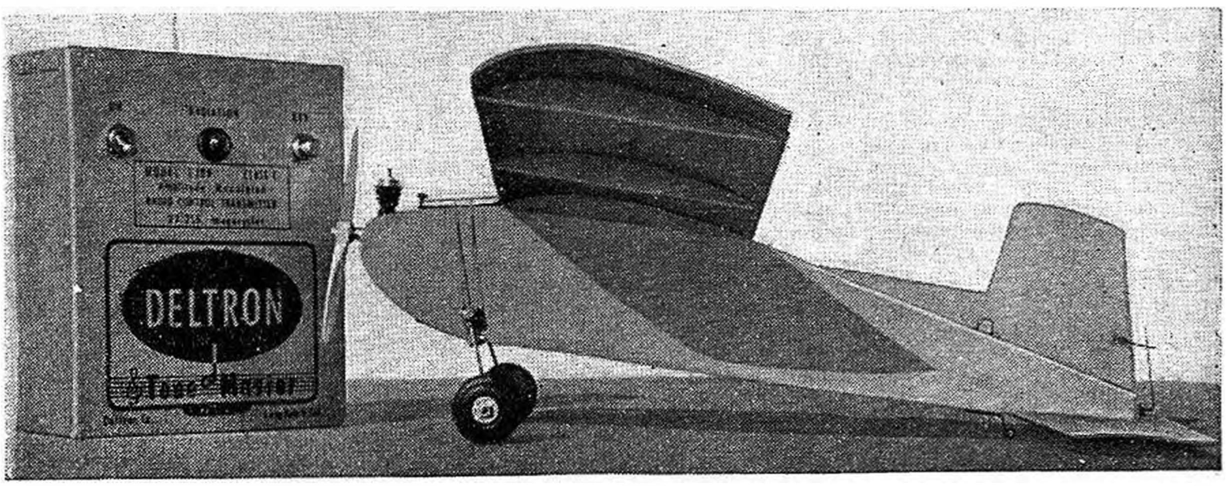
THIS fascinating tiny radio-controlled model is a credit to its designer, particularly as the whole project was conceived, built and flown within a two-week period.

Using the American transistorised Deltron radio equipment, receiver and battery weigh just $2\frac{1}{2}$ ounces. Total weight of the model in flying trim is only 8 ounces, giving a wing loading of 12 ounces per square foot.

The original is powered with a Cox "Pee Wee" motor of ·32 cm3 (·020 cu. in.), which supplies ample power to take the model through most manoeuvres.

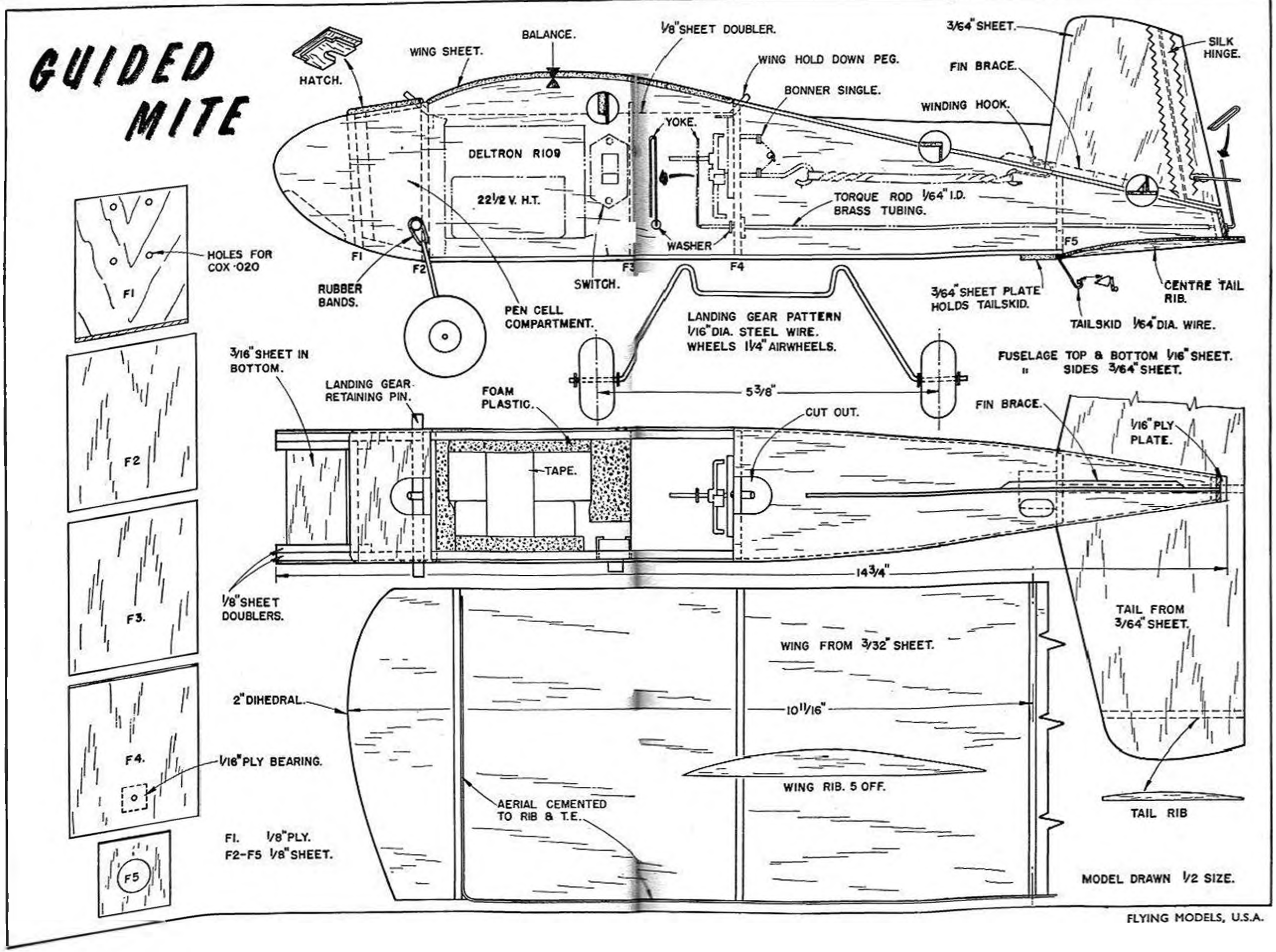
The aerial is cemented to the wing trailing edge, while the radio compartment is lined with sponge or foam plastic to provide impact protection.

Truly, as the designer says, " You'll find she's a swell little model, great for tossing in the back of the family car out of the way !"



(Reproduced by permission of FLYING MODELS, U.S.A.)

GUIDED MITE



FLYING MODELS, U.S.A.

HOTTING-UP AN ENGINE

THE PROCESS of "hotting-up" a model engine can be something of a fallacy. Model engines, due to their relative simplicity, are not amenable to tuning as with full-size engines and a considerable amount of time and effort spent on "reworking" an engine can be entirely wasted—unless one has a particular flair for that sort of thing, and a proper knowledge of the subject.

Basically there are two ways of improving the performance of an engine —finding the best fuel for that particular engine, and "reworking" the mechanical or physical side of the engine to produce improvements in overall efficiency. In the case of glow motors the two may be interrelated and the amount of reworking may range from a mere adjustment of compression ratio to match a particular fuel (see article "Dopes for Fuels"), to an increase in port sizes, etc. Reworking itself may be sub-divided into two categories—the type of work which can be undertaken by the average modeller with limited workshop equipment and that which demands the use of special machine tools and high engineering skill.

Stock engines are mass-produced items and, as such, should be very much the same, provided the design is sound and material selection and manufacturing technique consistent. Certain engines have more handwork applied to them during production (notably the British and Continental diesels and most Japanese engines) which makes the engine performance dependent on the skill of the individual operator. Largely this concerns the matter of running fits, and hence the friction produced by the moving parts.

All engines are improved by careful running-in, regardless of claims to the contrary. A new engine may run well at high speeds and develop plenty of power from the start of its life, but its performance will continue to improve slightly as the moving parts bed down to optimum running fits. No degree of initial fit can exactly allow for the side loads developed on a piston under actual running conditions.

Thus, careful running-in is the simplest and most direct method of "tuning" a new engine, following manufacturers' specification for propeller size, and working up to a nominal maximum speed with a suitable propeller load. This nominal maximum speed should be somewhat higher than the anticipated or quoted r.p.m. for max. b.h.p. for the engine, except in the case of glow motors for racing installations. In the latter case high-speed running-in is usually done with the same size of propeller intended to be used in flight, although even then it is advisable to use a propeller of the same diameter but reduced pitch to produce a static r.p.m. figure corresponding more nearly to the actual flight r.p.m.

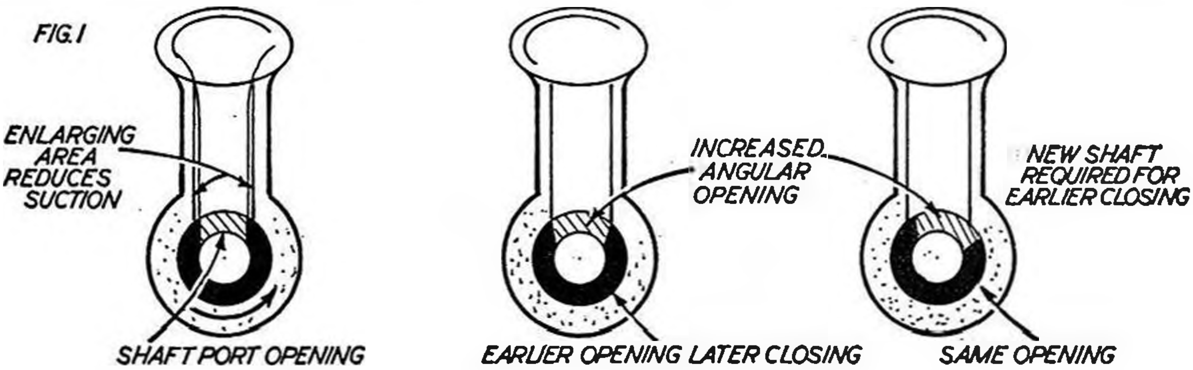
Having properly run-in an engine it is then particularly important not to disturb the geometry of the engine further. This means that if the engine has to be dismantled for any reason the cylinder and piston should always be replaced in exactly the same manner as originally. For similar reasons, any attempt to rework an engine physically should be done when the engine is new and *not* after it has had a fair amount of running time, otherwise it may have to be completely run-in again, re-forming surfaces which have already been "reworked" once by friction and polished. A second run-in period under such circumstances could be unduly long and may even have to be carried to the point where there is excessive wear appearing at some points.

The basic factor when reworking an existing engine is concerned with (*a*) reducing friction and (*b*) assisting and improving the gas flow throughout the engine. The latter is the simplest to tackle and so the techniques involved will be discussed first.

Starting at the intake or choke tube itself, this is usually relatively small in bore on a stock engine to promote good suction and easy starting. Opening out the diameter by drilling will increase the volume of air, and hence the volume of charge inducted into the crankcase at the expense of reducing the gas velocity and suction available to draw fuel out of the spraybar. Retaining the bellmouth entry by enlarging the top of the intake may not be possible as there may be insufficient metal remaining and thus venturi effect is lost. It may thus even be necessary to make and fit a new venturi-shaped top to the tube, or accept the fact that suction will be very poor, requiring the tank to be located level with the spraybar and making the engine more difficult to start. (An extreme case is reached in the case of the Fox 29R where the intake size is opened right out to the point where there is no appreciable suction effect at all and the fuel has to be pressure fed to spray out of the jet hole.)

Opening up the intake bore may mean that the intake port on the shaft (front rotary or barrel valve induction) or rotor disc (rear disc induction) does not now match the intake opening. Opening up this port will affect the timing.

FIG. I



If the port hole is enlarged symmetrically the intake opening will be increased by a proportional amount at each end. If, however, the hole is enlarged by removing metal from the leading edge of the port only (*i.e.*, in the case of a shaft port, opening up one side of the existing hole), the closing point and overlap remains the same (Fig. 1). Thus unwanted "blow-back" effect is not enhanced. This may also be carried out on an engine without increasing the intake tube bore to increase the intake opening period while retaining good "choking" characteristics.

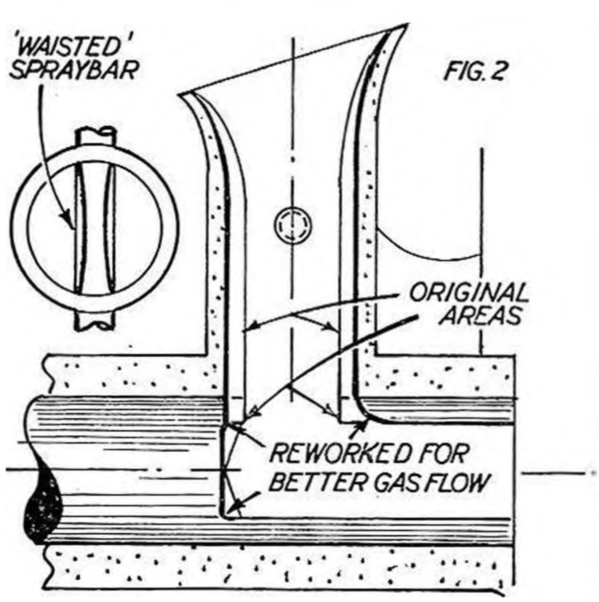
Theoretically a large intake opening requires less overlap since the gas velocity is less. It may then be necessary to provide sub-piston induction (*e.g.*, by shortening the length of the piston) to ensure that sufficient air is inducted into the crankcase. Conversely, a small intake port is consistent with a lot of overlap, at the cost of producing a marked "blow-back" through the intake when choked.

To alter the timing for the intake to close earlier, either a new shaft or new rotor disc is necessary, repositioning the port accordingly. A method of increasing the area of a shaft port without increasing the angular opening is to extend it along the length of the shaft, the angular opening being controlled by the width of the port.

Further improvements which can be effected with regard to the induction are to remove or minimise restrictions to flow, avoid right angle bends as far as possible, and possibly shorten the gas passage (effectively done by opening the port area, incidentally, although the spraybar position may also be lowered and the original hole plugged).

The spraybar itself is an obstruction and there is some theoretical justification for thinning this down as far as possible, or waisting it at the centre (which is the region of highest gas velocity). The wall type jet with only the needle valve traversing the intake tube is the best that can be achieved in this respect, although appreciably coarser in action than the conventional spraybar unit and best suited to larger engine sizes.

Much can also be done to improve the shape of the gas passage at the bottom of the intake, particularly in rounding and smoothing the rear edges of the port opening in the shaft or rotor disc so that the charge can flow through a smooth curve instead of having to negotiate sharp corners. It is quite possible for the port opening to provide a definite gas "trap" at the bottom of the intake tube through overlapping the intake tube slightly, which is not consistent with good gas flow (see Fig. 2). Surplus metal can be removed by grinding (or rubbing with an oilstone) and as a by-product, the strength of the shaft may be improved. The port opening is usually the weakest part of the shaft and the hole cut by milling or drilling leaves relatively rough edges. Smoothing these edges will eliminate stress raisers.



Modifications which do *not* work, as far as the intake system is concerned, include "supercharging" by shaping or extending the intake entry to point directly forward, usually resulting in the engine stopping dead; angling the top of the intake (it seems to make very little difference between dead vertical to 45 degrees); or supplying ram air in any form, except on a sideport engine. With sideport induction, the intake tube facing aft, some improvement may result by extending the length of the intake with a suitable piece of flexible tubing, the length giving optimum results obtainable by cut-and-try methods. This tubing must open downstream; facing it forward will stop the engine.

Internally, the same considerations apply as regards smoothing the contours of the gas passages by rounding off sharp corners, burrs, etc. Polishing of the port faces and gas passages has no significant effect and is largely a waste of time, however much it may appeal as the right thing to do.

Appreciable improvement may be produced by enlarging the port sizes, although in the case of the transfer ports it should be borne in mind that the port sizes must be matched to the transfer passage area. There is no point in enlarging the ports if the transfer passage is too restricted to pass that area of charge, and the effect of enlarged ports will then be to slow down the gas velocity at this point. Undersize ports, relative to the transfer passage size, may well produce a throttling effect on the gas charge.

Any enlargement of the ports in a vertical direction will affect the induction timing, which may not be desirable. Opening out the ports circumferentially will increase area without affecting timing. With the conventional method of cutting the transfer ports directly in the cylinder wall, chamfering off the entry by grinding is usually a good thing, although the ultimate effect will be related to the actual shape of the passage at this point. It is a good thing to produce a curved gas entry into the port opening, but not at the expense of a substantial increase in passage area immediately in front of the port, which allows the charge to expand and slow down (Fig. 3).

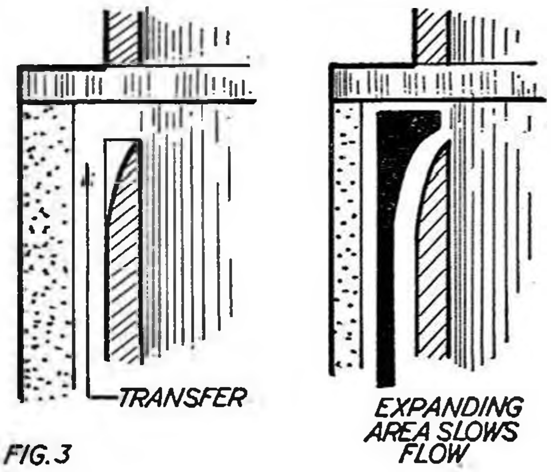


FIG. 3

Exhaust ports are generous enough in size on most stock engines and, even on some racing designs, could well be smaller without detracting from performance. This is also borne out by the fact that exhaust "choking" as a means of throttling down an engine needs to be quite drastic (the exhaust almost completely blanked off) before any appreciable effect is produced. It is advantageous, however, to reduce the width of any pillars blanking the circumferential port opening, and in the case of thick-walled cylinders, reducing these pillars to a wedge shape (Fig. 4).

Work on a hardened cylinder, other than simple grinding, is largely outside the scope of the average modeller. Even with grinding there is the risk of overheating and distorting the walls, although the bottom portion of the cylinder commonly has a generous clearance for the piston and some slight distortion may be tolerated. The skilled engineer—amateur or professional—will appreciate these difficulties and be prepared (and have the necessary equipment) to fabricate and fit an entirely new piston in a completely reworked cylinder if necessary. On the other hand, satisfactory porting modifications on an unhardened cylinder can often, with care, be done with just a few files.

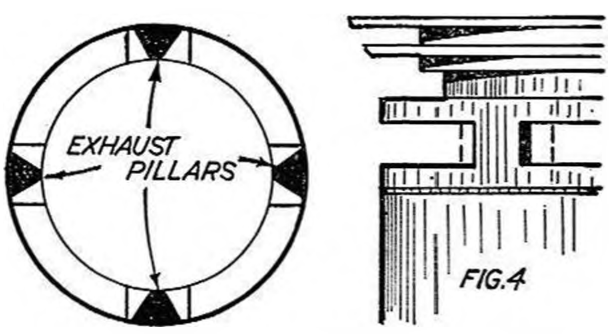


FIG. 4

The "model engineer" has plenty of scope in reworking stock engines. Very few mass-produced engines are truly "square"—that is, the cylinder is not exactly at right angles to the line of the crankshaft. Nor are mating surfaces always as smooth as they could be, and so on. All minor points, but all adding up in the end to quite an appreciable total efficiency loss. Carried to extremes the "engineering reworked" engine might then strip down to merely the original crankcase, with all the other components new—as in the case of the Carter racing engines. Except for the specialised application of control-line speed it is quite unwarranted to go to such extremes, nor is it within the scope of many individuals, however skilled in model engineering, to attempt such extensive reworking and end up with an *improved* performance.

The normal limit of reworking should be confined to the piston and main bearing to reduce the friction of these components as far as possible. Most pistons may, with advantage, be waisted slightly to reduce their bearing area. Most commercial pistons are excessively heavy, which is not necessarily a bad thing for general running and durability but does produce higher than necessary inertia forces within the engine and encourages vibration. Vibration invariably means a loss of power—simply because a certain amount of power must go to producing the vibration which might otherwise be available as useful output. Almost certainly a reworked (lightened) piston will require relapping into the cylinder.

The other main source of friction is the main bearing—a chief source of friction with a plain bearing engine. It is true to say that the performance of a plain bearing engine is as good as its bearing !

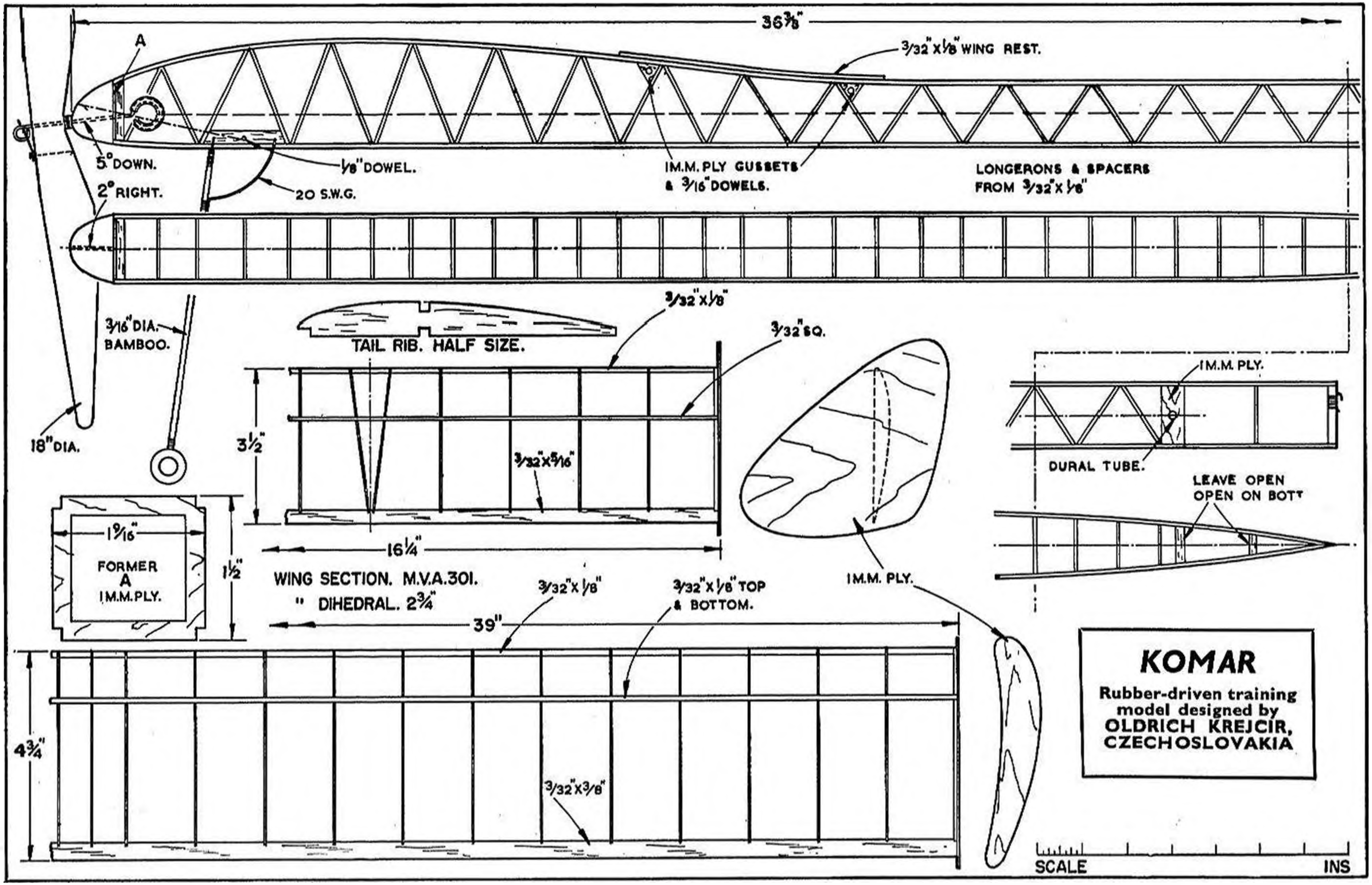
The state of the bearing can usually be estimated accurately when bench running. If the bearing remains cool at both high and low speeds it can be accepted as a good running fit and will not give any trouble. The actual fit of the bearing itself is no guide. Some manufacturers deliberately adopt a relatively slack bearing fit (so that the shaft can actually be moved up and down slightly). Others adopt a much closer fit. Both techniques are quite satisfactory, provided the bearing does not overheat. Cool running is a sign of low friction.

An overheating bearing may be due to a variety of causes : inaccurate crankshaft section, a barrel-shaped bore or a waisted shaft, all contributing to point contact and thus high, localised bearing loads. Such individual cases must be examined on merit, calling for a rebushed bearing or a new shaft, as the case may be.

If there is any evidence of the shaft running dry, oilways may be cut down the length of the bearing with a file, finishing short of the front end. Lubrication of the big and little ends of the connecting rod can also be improved by drilling oil holes. Excess friction from this component may also be caused by lack of parallelism of the bearings, which can be checked by sight and/or direct measurement with lengths of rod fitting each bearing size assembled in the connecting rod (preferably silver steel rod which can be purchased in a variety of accurate sizes). Small errors in alignment can be corrected by bending.

In the case of ball race engines little can be done to improve the bearings, except to replace the ball races by ones of higher quality. This would seldom be called for (unless a race is definitely faulty), except for a special racing engine. Alignment can only be improved at the cost of remachining the housings, or better still remaking this assembly.

An overall requirement to bear in mind when reworking any engine is that any modification which reduces the rigidity of the engine as an assembly is liable to reduce rather than enhance performance. Thus, an extensively reworked cylinder may be fine in theory, but the practical results achieved will be poor if it distorts when running, or even when tightened down. Where sheer maximum performance is the aim, even distortion of the crankcase under running loads can cut down performance. There are no golden rules to success and many hours of careful work may ultimately produce little or no gain. But, for the enthusiast who is prepared to find out the hard way, any stock engine *is* capable of improvement by reworking. For those who want a short cut method—stick to careful running-in as the surest path to success.



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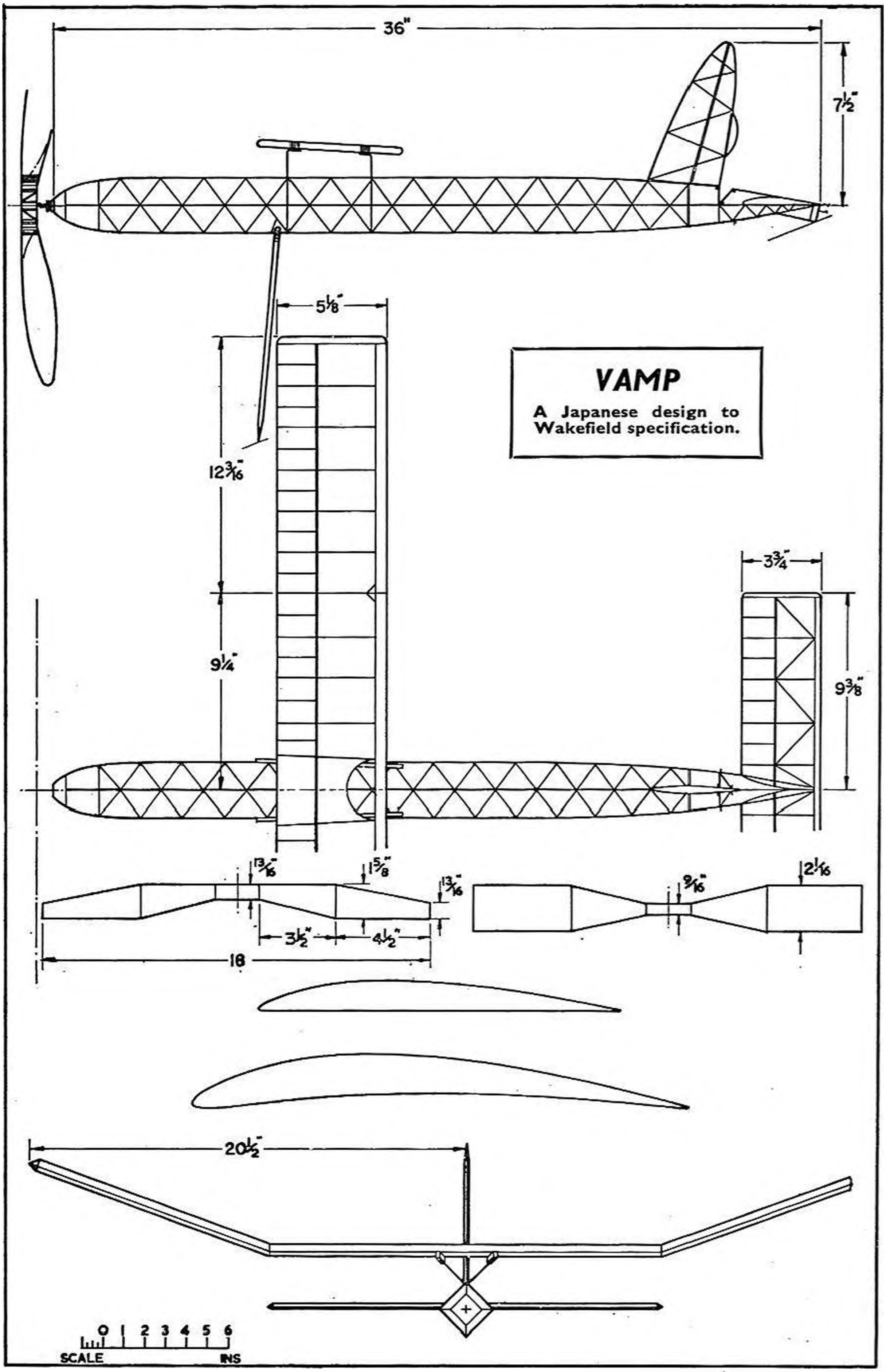
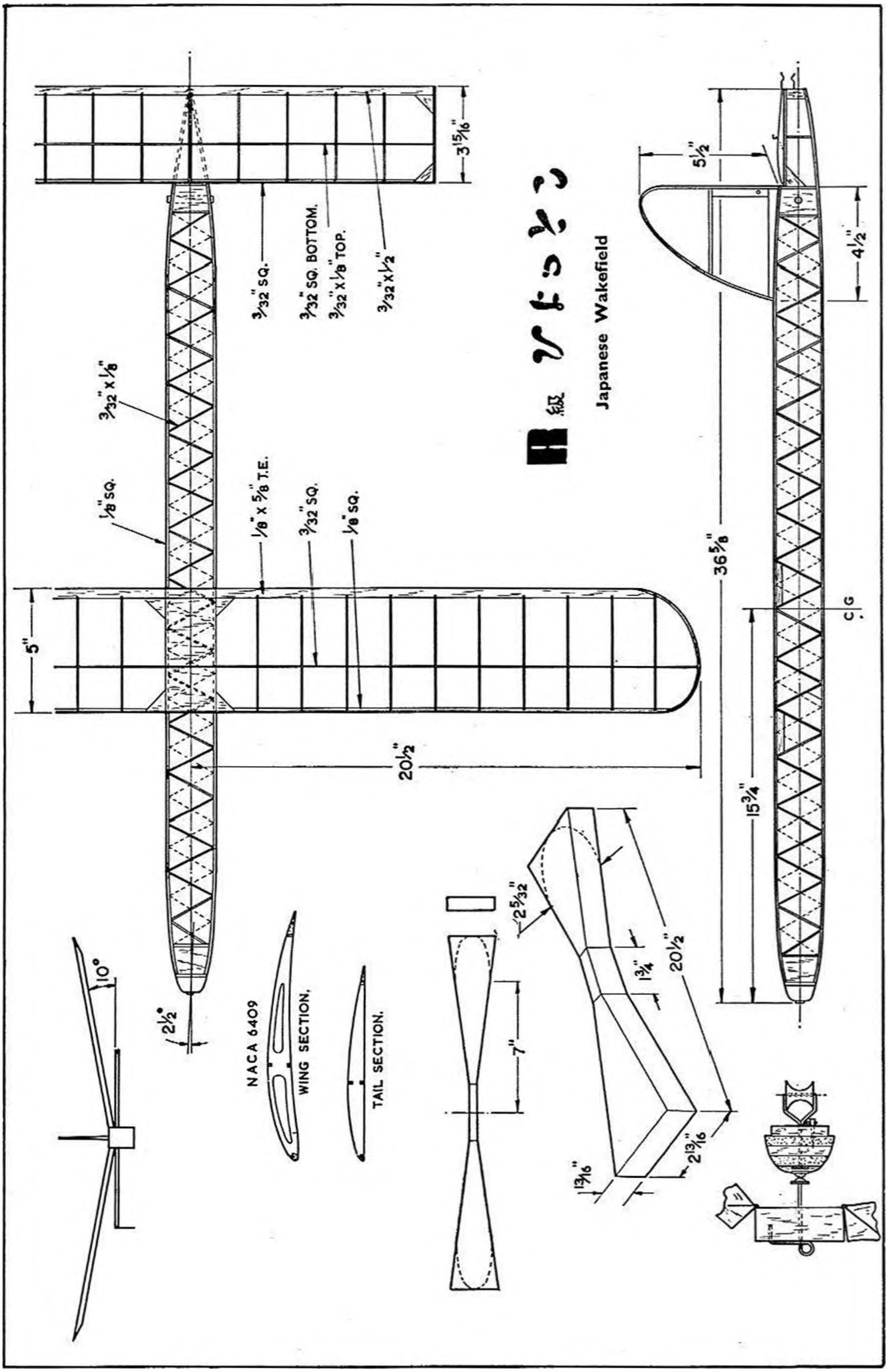
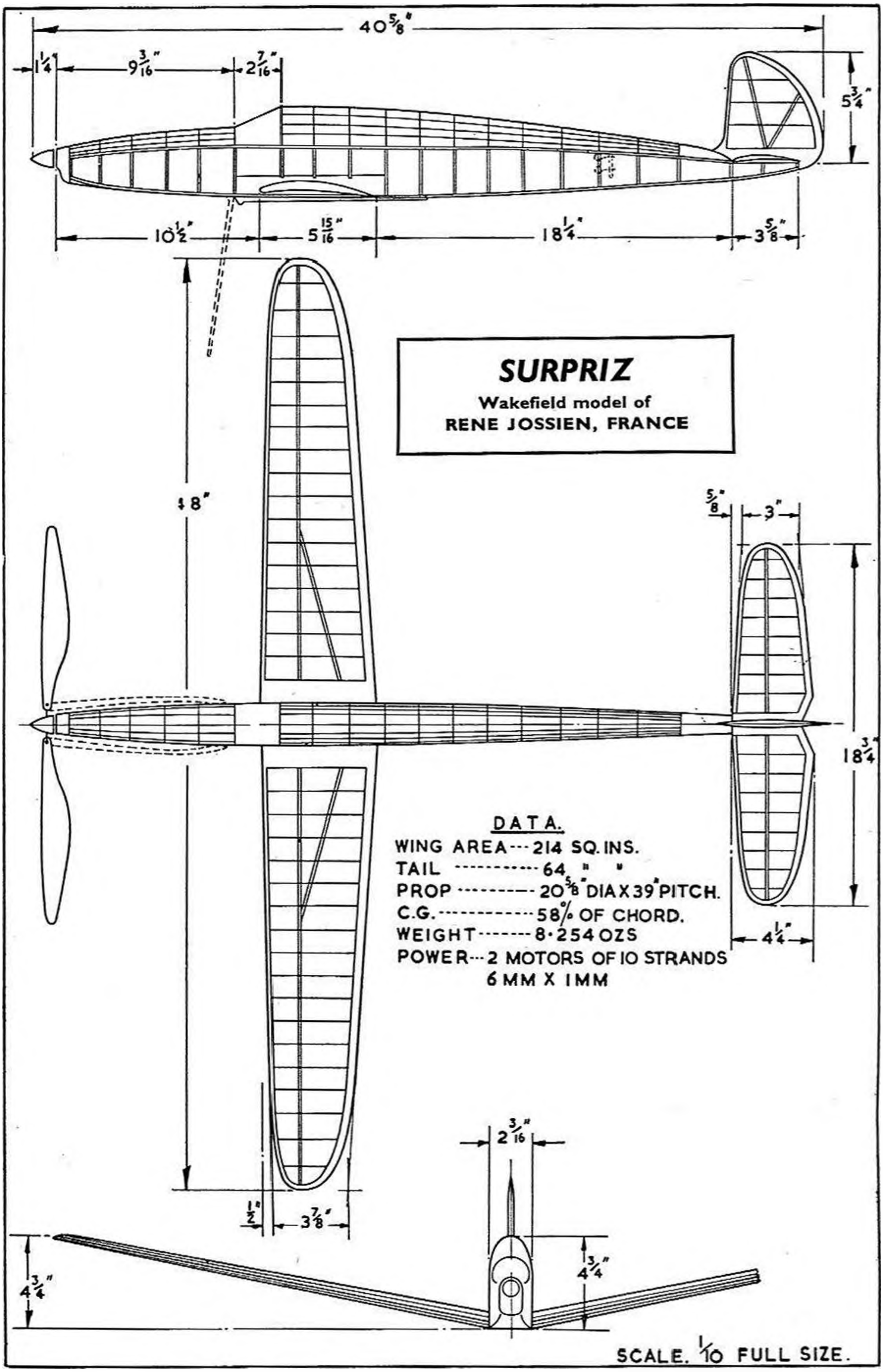
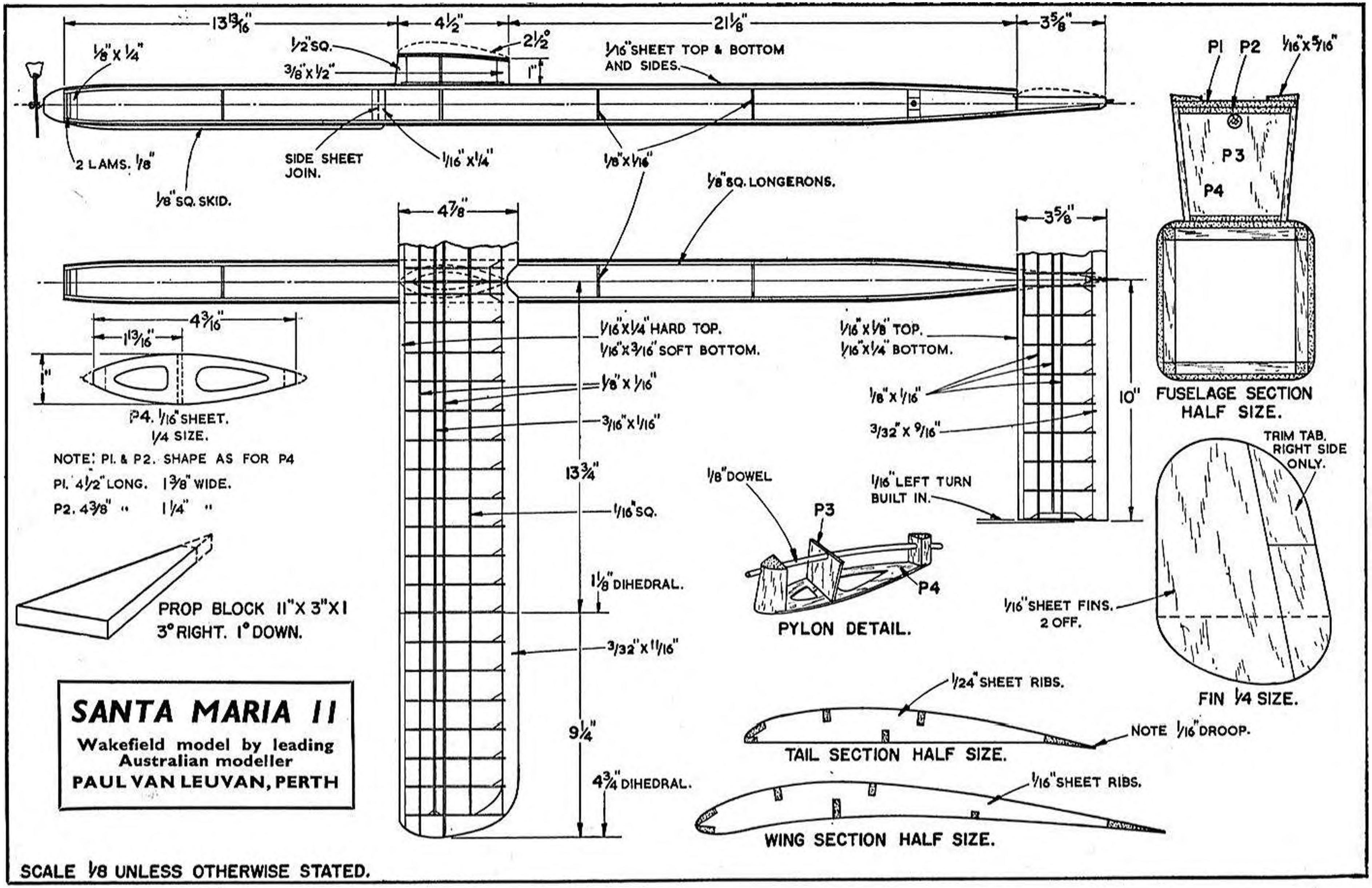


THE WORLD'S AIRCRAFT, JAPAN.

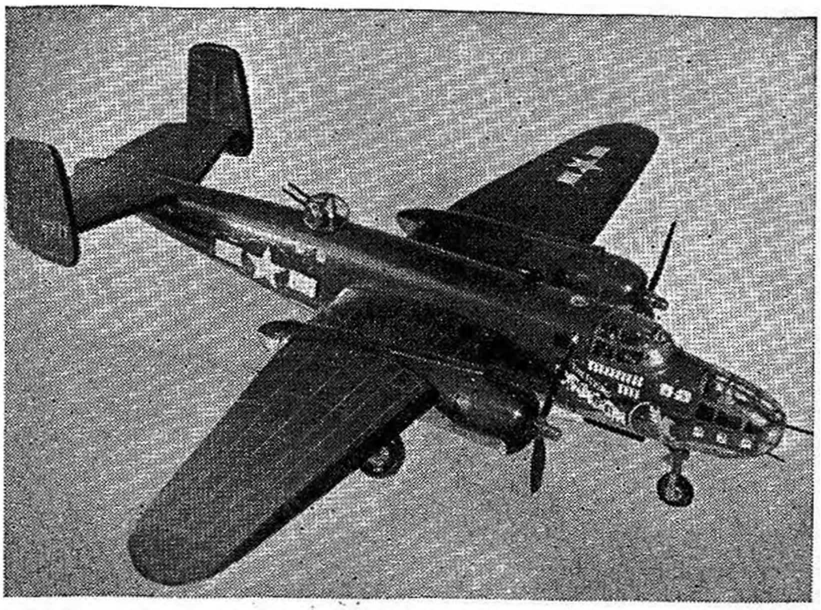

Japanese Wakefield
3 15/16"
3/32" SQ.
3/32" SQ. BOTTOM.
3/32" x 1/8" TOP.
3/32" x 1/2"
3/32" x 1/8
1/8" SQ.
1/8" x 5/8" T.E.
3/32" SQ.
1/8" SQ.
5"
20 1/2"
5 1/2"
4 1/2"
36 5/8"
C.G.
15 3/4"
10°
2 1/2°
NACA 6409
WING SECTION.
TAIL SECTION.
2 5/32"
1 3/4"
20 1/2"
7"
13/16"
2 13/16"



MODELE MAGAZINE, FRANCE.



AUSTRALIAN MODEL NEWS.



SHORT CUTS IN SCALING PLANS

FOR BUILDING purposes little more than a simple outline drawing is required, with spar, rib and spacer positions indicated by single lines. This cuts the preparation time in preparing a full-size working drawing from a reduced scale reproduction to a minimum. A suitable material for drawing is medium thickness tracing paper, sold in rolls approximately 30 in. in width. White shelf paper is a cheaper alternative. Two pieces can easily be joined to make a typical plan sheet, or fuselage and wing plans, etc., can be drawn on separate sheets. Tracing paper has the advantage that the surface is less liable to bond to cement than plain paper, but is a relatively brittle material, easily creased and torn. Both materials need rubbing over with a candle stub (or covering with waxed paper) if they are to be retained for further use after building the model.

If the plan is to be used a lot—*e.g.*, drawing up a design to be used by various club members—it would be a better proposition to obtain die-line prints from the original drawing. In this case the original can still be drawn on tracing paper in pencil—for economy and speed—which will yield perfectly satisfactory prints. Numerous firms specialise in the production of die-lines off original drawings (at least one in most large towns) and the cost is quite modest.

The chief call is for scaling up magazine plans as full-size working drawings. In some cases (typical of British magazine plans) the scale may be specified—*e.g.*, "$\frac{1}{4}$ scale reproduction", "$\frac{1}{3}$ scale . . .", "$\frac{1}{6}$ scale . . .", these being three common sizes. In others no scale may be specified and this has to be established by measurement and calculation.

Usually a plan is dimensioned where no specific scale is mentioned, when the best method of establishing the scale is to measure the *actual* length of the *largest* convenient dimension given (*e.g.*, the wing span or fuselage length) and calculate the scale as :

$$\frac{\textit{actual}\text{ length of dimension length}}{\text{quoted value of dimension}}$$

If, for example, the reduced size plan shows a fuselage marked as 36 in. long, and this length measures as 6 in., the scale of the drawing is $6/36=\frac{1}{6}$.

Repeat this calculation with other major dimensions as a cross check ; if the two calculations do *not* agree, then a bit of detective work may have to be done to decide which is in error. Clues may be the width of sheet panels used in a fuselage side, the size of the engine, wheel diameter, etc. Another useful cross check is that designers *usually*—but not *invariably*—make the wing chord a simple number, *i.e.*, a whole number of inches or a simple fraction.

Where no dimensions are given the scale can only be established by relating a drawing measurement to a known factor. In the case of a silhouette drawing of a full-size aircraft the wing span of the aircraft is known or can be checked. The scale of the drawing can then be calculated as before from a direct measurement—see Fig. 1. Note that here we have calculated the scale relative to the *full-size aircraft* and we must adjust this again to match whatever scale size of *model* is required.

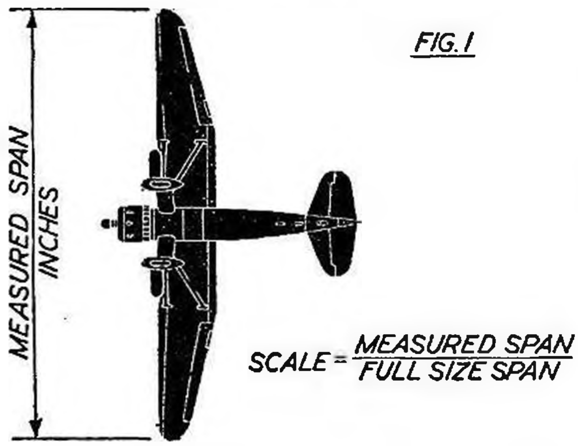


FIG. 1

The rule for arriving at the required scale factor is quite simple. For clarity, write down the two factors :

$$\text{Scale of drawing (relative to full size)} = \frac{\text{plan dimension}}{\text{full-size dimension}}$$

remembering that these two dimensions must be reduced to the same *units* (*e.g.*, feet or inches).*

$$\text{Scale required for model drawing} = \frac{1}{X}$$

Then the *scale factor* for the original drawing is :

$$\frac{1}{X} \times \frac{\text{full-size dimension}}{\text{plan dimension}}$$

This represents the factor by which the *original scale drawing* must be multiplied to arrive at *the required scale* drawing.

With full-size aircraft it is best to take the *wing span* as the basic dimension for calculating scale, since the appropriate full-size figure is usually readily obtainable and not ambiguous. Length dimension, on the other hand, may refer variously to overall length of the complete aircraft, bare fuselage length, complete fuselage-fin length less rudder or elevator, "overhang", etc.

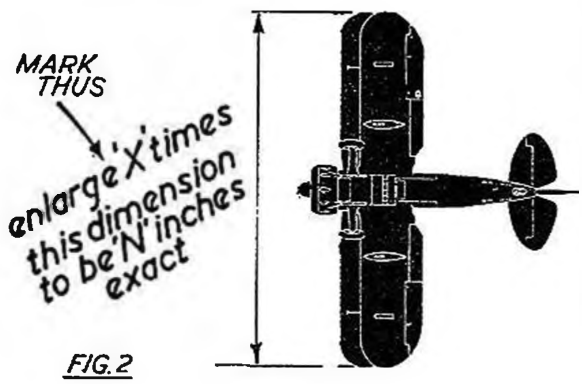
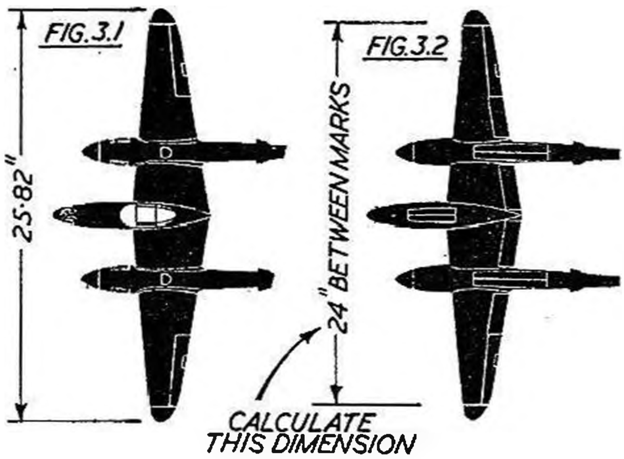


FIG. 2

In the case of model plans with no dimensions or scale indicated, the wing span as given may not be exact—usually rounded off to a whole number and referring either to "flat" span or projected span (tip-to-tip with dihedral). Even where the scale of the plan is definitely indicated a cross check is useful. Printing blocks do not always come out the exact size specified and in a model designed to a particular area rule a small difference could be important.

The whole process of arriving at the *scale factor* is quite simple and takes very little time. Nor does it involve any complicated calculations, although a slide rule is a great help.

*See table for quick conversion of full-size dimensions to convenient decimal fractions.

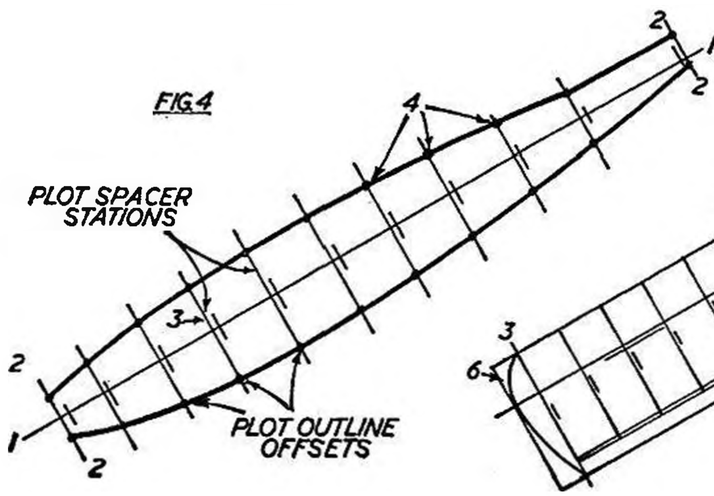


Opinions differ as to the best way of going about drawing up the plan after arriving at the scale factor. The "classic" method involves the use of a scale rule, responsible for the popularity of such scales as ¼ in. to the ft., ⅜ in. to the ft., etc., for scale models. Since in a majority of cases the *scale factor* does not work out at such a convenient value it is usually far quicker and easier to work in decimal measurements (taken from the original reduced size plan) multiplied directly by the scale factor (also reduced to a decimal). This demands the use of a slide rule—otherwise the individual calculations will become tedious—but a slide rule itself is relatively inexpensive (the 1956-7 AEROMODELLER ANNUAL shows how to make one for a matter of a few pence) and very easy to learn to use. The only other equipment required—apart from the usual drawing instruments—is a suitable scale or ruler graduated in inches and 50ths, although you can get by with a normal inches and tenths rule.

Where the scale factor is a simple whole number, plan dimensions can be transferred onto the full-size drawing with dividers, but this is no more rapid than slide rule calculations and more liable to error. The habit of using a slide rule for scaling up drawings is thoroughly worth while and makes for rapid, accurate work.

The simplest of all methods of producing a full-size drawing from an original, having arrived at the scale factor, is to have an enlarged photoprint or photostat copy made—enlarged by that scale factor.

Marking up an original for enlargement is straightforward where a simple scale factor is involved—*e.g.*, simply state what a leading dimension is to be—Fig. 2—or that the original is to be enlarged "X" times. Where a decimal scale factor is involved, however, calling for the "X" dimension to be some exact decimal fraction as in Fig. 3 (*i*) is not suitable. Far better to calculate a key distance on the original which will give a *simple* scaled-up dimension for the photoprint operator to work to, and call for this to be *exact*.



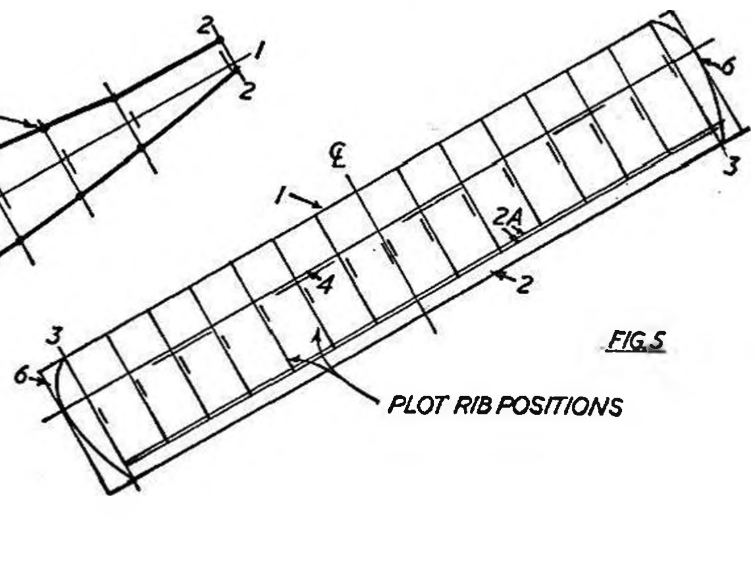
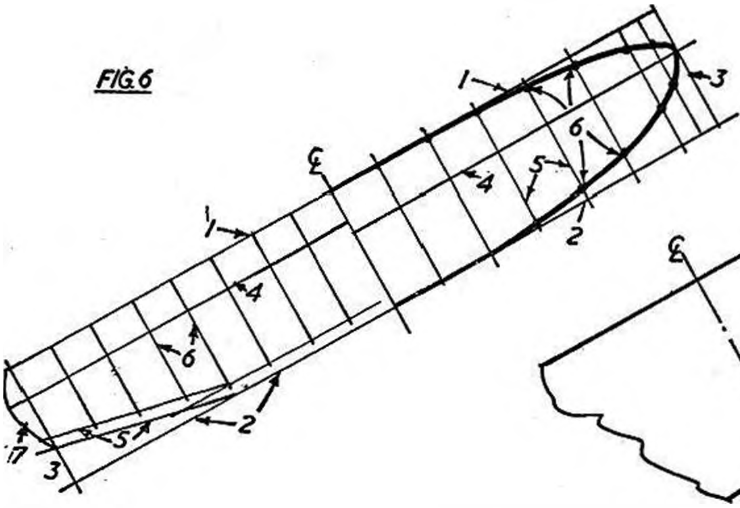


FIG.6



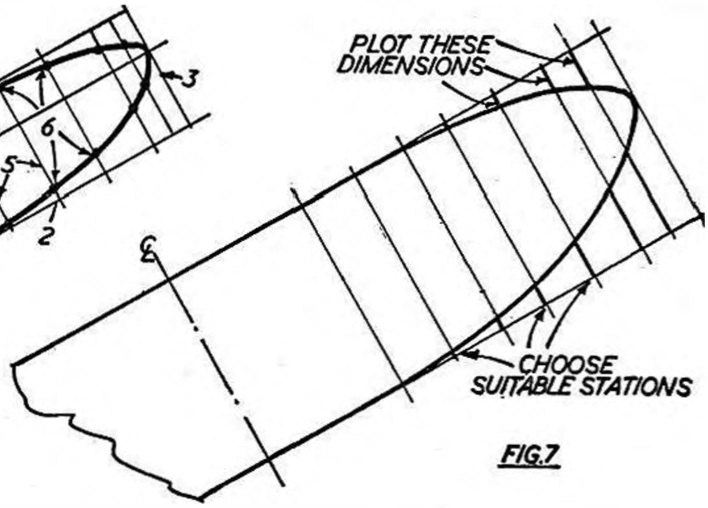


FIG.7

Unless you are particularly pushed for time, drawing up your own plan is usually best. The technique is quite straightforward and obvious with most model plans where components are drawn separately, working to a suitable datum line in each case.

The datum line for the fuselage is nearly always the centre line—Fig. 4. The process of drawing the full-size fuselage then involves :

1. draw centre (datum) line, extending beyond fuselage overall length.
2. Establish end lines. If the nose has a downthrust angle, draw this in.
3. Establish the stations for the vertical spacers, indicating wood thickness approximately (this can be a freehand mark on the appropriate side of the spacer vertical).
4. Plot ordinates or heights at each spacer station and join up to complete the fuselage side elevation.

Note.—In the case of box-type fuselages with conventional longerons a length of longeron section should be bent to shape over the plan to draw in the outlines as this will give a "practical" curve to which the wood will conform.

The drawing of simple wings is detailed in Fig 5, starting with the leading edge as the datum line :

1. Draw a line the full span (or semi-span) dimension, representing the leading edge.
2. Draw trailing edge line the calculated chord distance from the leading edge.

2A. Draw in trailing edge width. If the ribs are slotted into the trailing edge, draw another line indicating actual rib lengths.

3. Draw square tips.
4. Draw spar(s) line(s).
5. Plot rib positions and indicate actual positioning of ribs relative to these lines.
6. Construct a "box" representing the tips and draw in the tip shape.

Where the wing planform is not purely rectangular—Fig. 6—proceed to stage 4, as above, and then :

Either (for a straight-tapered wing)

5. Construct trailing edge taper.
6. Plot rib positions.
7. Construct tip.

Or (for an elliptic or curved planform wing):

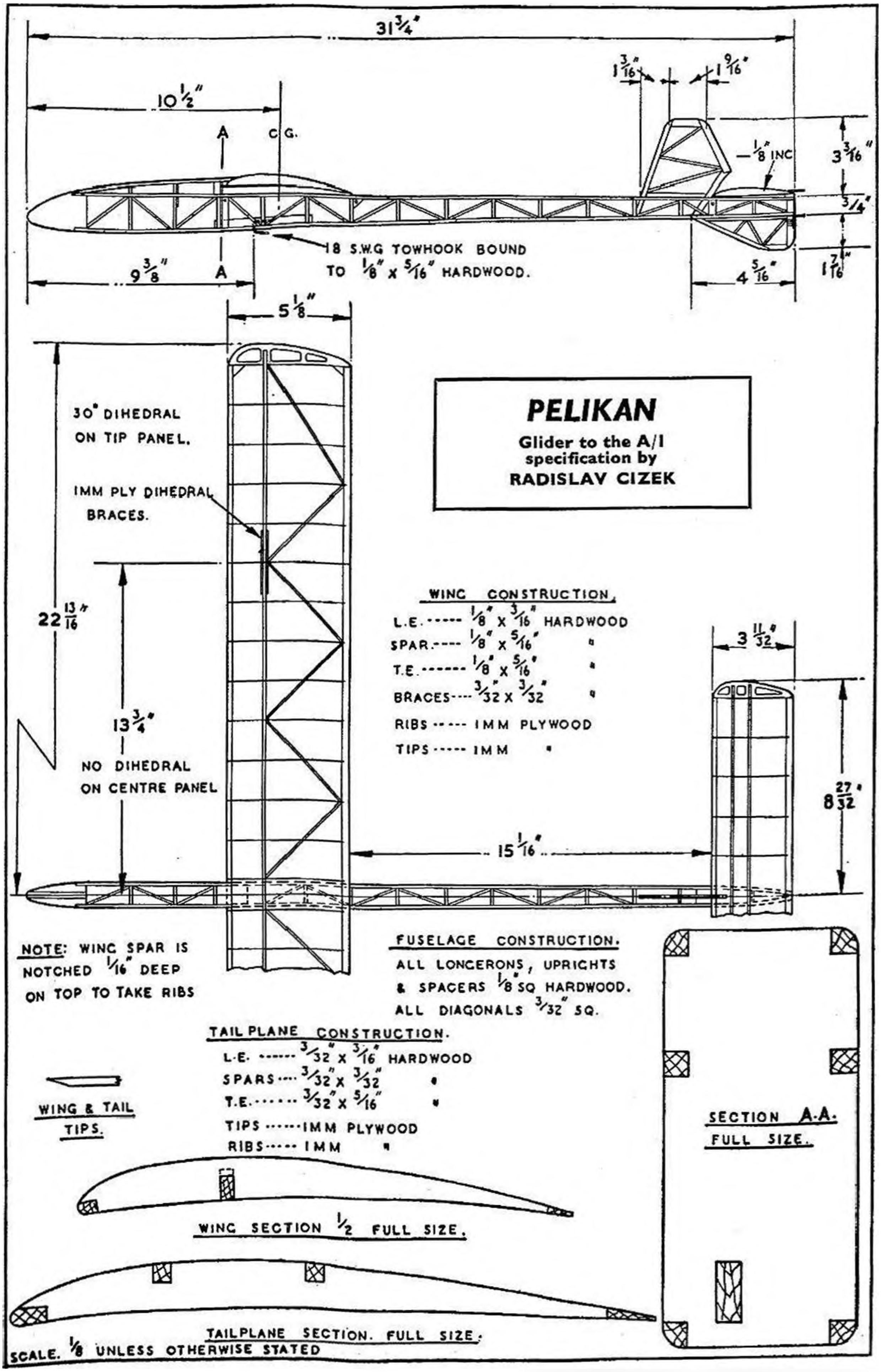
5. Plot rib positions.
6. Plot outline points on individual ribs on either side of the spar line as a datum. Then join to complete wing outline.

A similar procedure may be used for plotting curved wing shapes where there are no ribs to act as convenient stations—*e.g.*, a solid control-line model wing or a drawing from a scale silhouette. Here leading and trailing edge lines are used as datum lines and the semi-span divided up into a number of convenient parallel stations—Fig. 7. Plotted outline points are then measured relative to the leading and trailing edges respectively, and the outline completed by filling in the curve as before. This technique can be used equally well for plotting curved fin and tail shapes and aerofoil sections. Stations can be relatively widely spaced where the outline is substantially straight and closer together in the more curved regions.

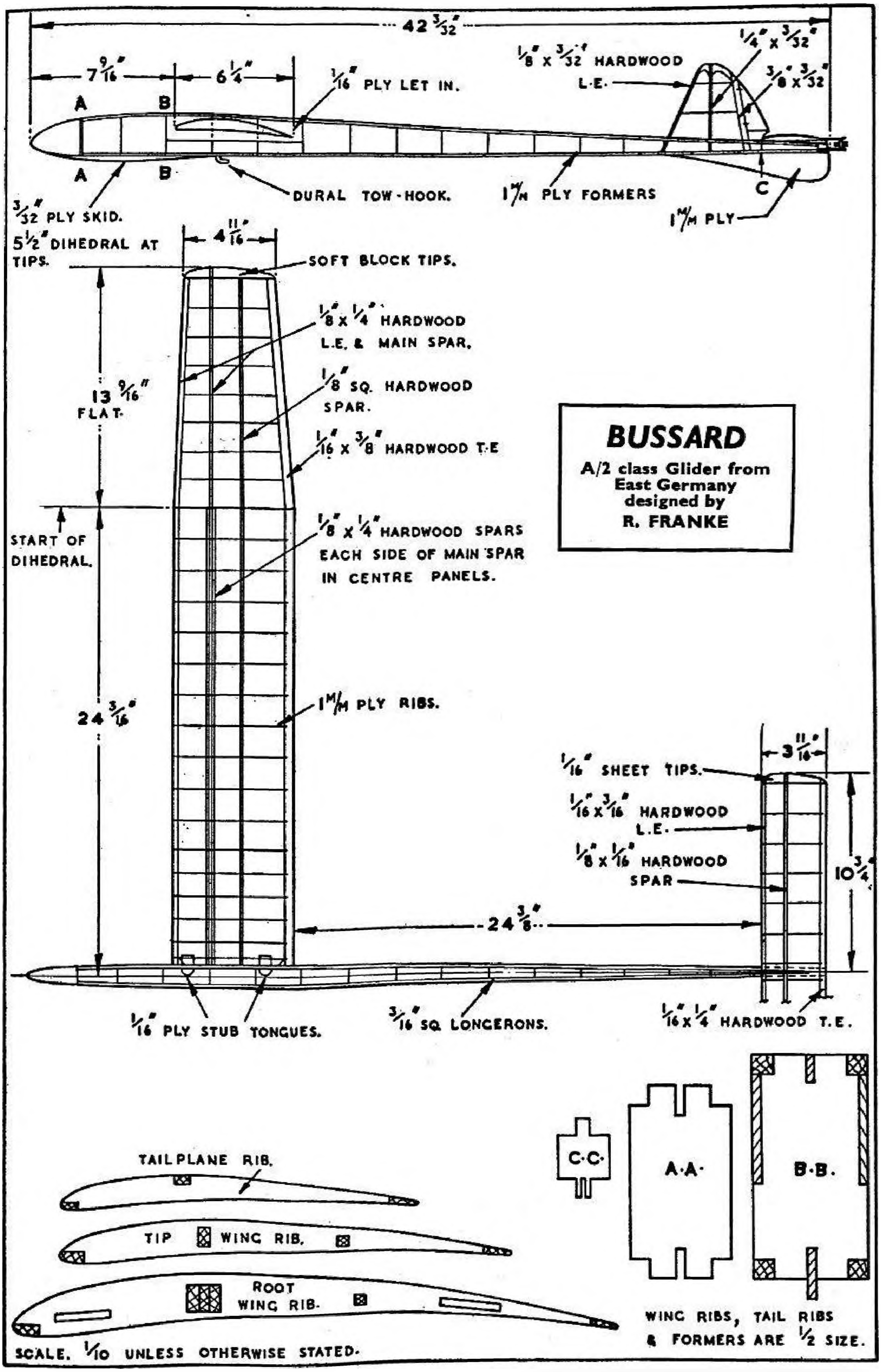
A final tip about making full-size patterns—whether off your full-size drawing when completed, or copying full-size parts which may be given with a reduced scale plan. Rather than trace these on tracing paper, or transferring directly onto the wood via carbon paper, pin a piece of acetate sheet about ·010 in. thick over the drawing and trace on the acetate by scoring with a sharp pointed instrument (*e.g.*, the point of a pair of dividers). You can produce a very accurate tracing in this manner which can then be broken out of the sheet without further cutting for a perfect pattern. Whether you hold the pattern against the wood for cutting out, or stick down with cement or rubber gum, is then a matter of personal choice.

TABLE—FRACTIONS OF A LINEAR FOOT AS DECIMAL EQUIVALENTS

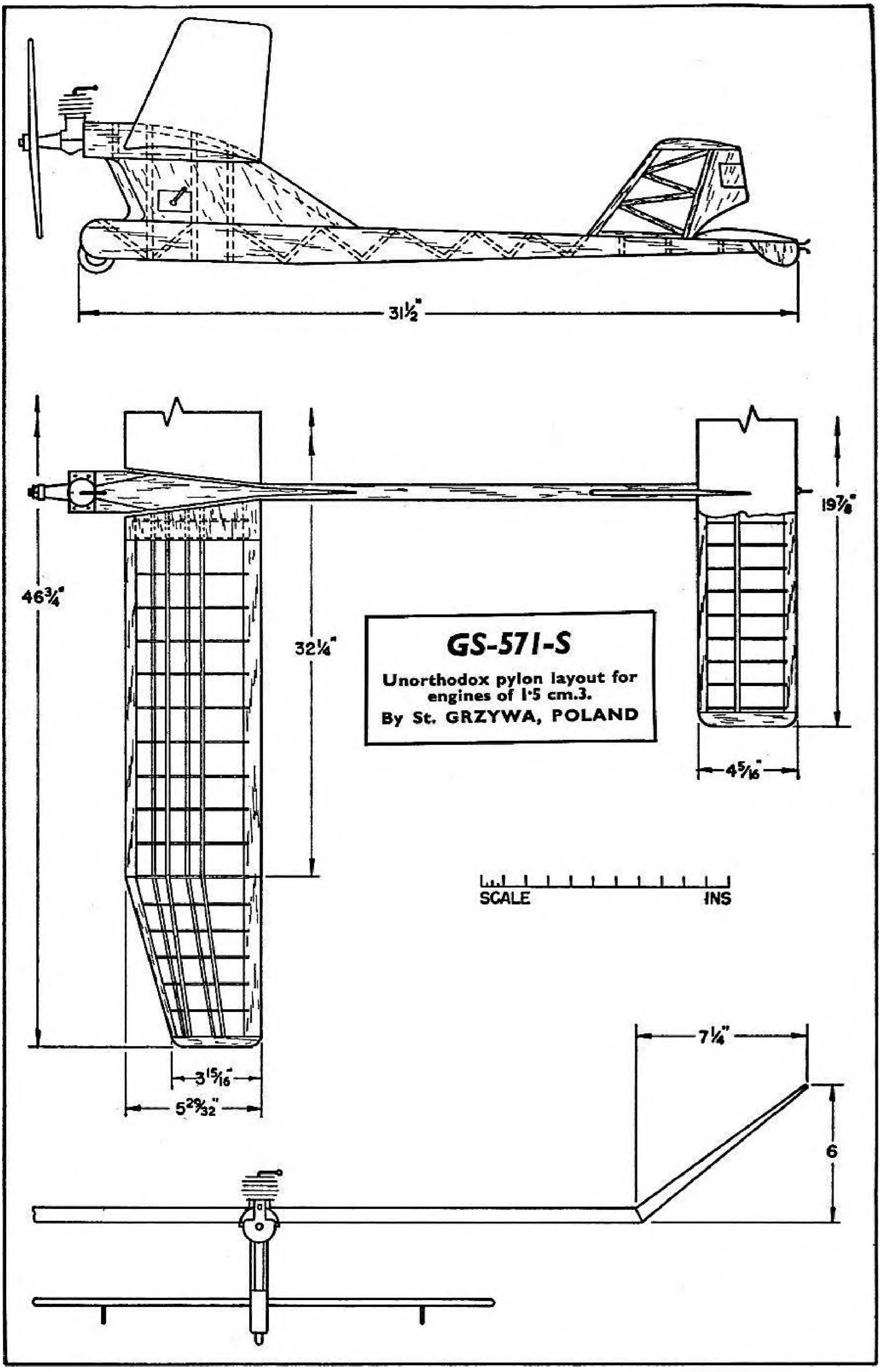
INCHES	0	1	2	3	4	5	6	7	8	9	10	11
Decimal Equivalents	—	·083	·167	·25	·333	·417	·5	·583	·667	·75	·833	·917
1/16	·009	·089	·172	·255	·339	·422	·505	·589	·672	·755	·839	·922
1/8	·010	·094	·177	·260	·344	·427	·510	·594	·677	·760	·844	·927
3/16	·016	·099	·182	·266	·349	·432	·516	·599	·682	·766	·849	·932
1/4	.021	·104	·188	·271	·354	·437	·521	·604	·688	·771	·854	·938
5/16	·026	·109	·193	·276	·359	·443	·526	·609	·693	·776	·859	·943
3/8	·031	·115	·198	·281	·365	·448	·531	·615	·698	·781	·865	·948
7/16	·036	·120	·203	·286	·369	·493	·536	·620	·703	·786	·870	·953
1/2	·042	·125	·208	·292	·375	·458	·542	·625	·708	·792	·875	·958
9/16	·047	·130	·214	·297	·380	·464	·547	·630	·714	·797	·880	·964
5/8	·052	·135	·219	·302	·385	·469	·552	·635	·719	·802	·885	·969
11/16	·057	·141	·224	·307	·390	·474	·557	·641	·724	·807	·891	·974
3/4	·063	·146	·229	·313	·396	·479	·563	·646	·729	·813	·896	·979
13/16	·065	·151	·234	·318	·401	·484	·568	·651	·734	·818	·901	·984
7/8	·073	·156	·240	·323	·406	·490	·573	·656	·740	·823	·906	·990
15/16	·078	·161	·245	·328	·411	·495	·578	·661	·745	·828	·911	·995



LETECKY MODELAR, CZECHOSLOVAKIA.



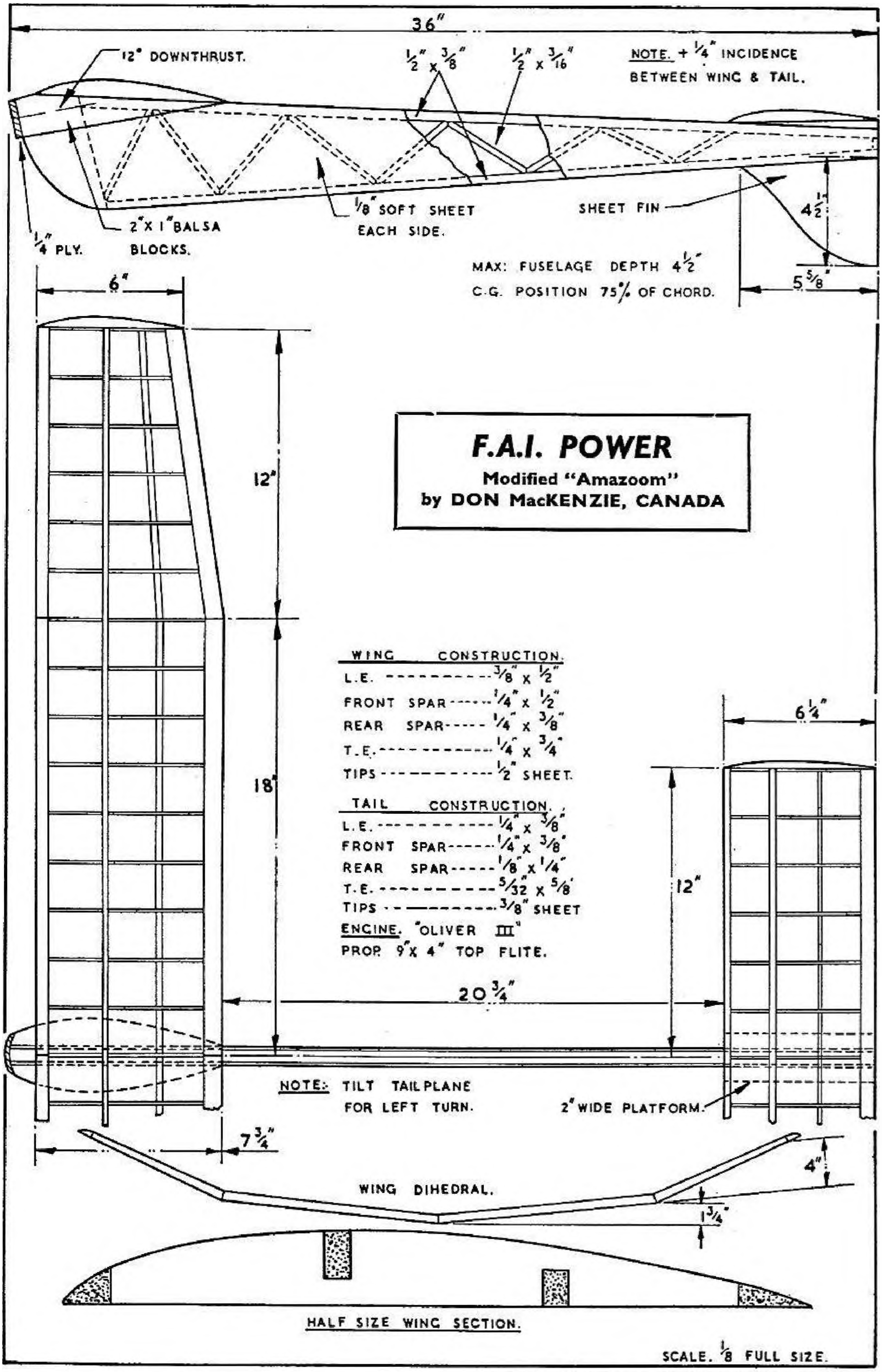
DER MODELLBAUER, EAST GERMANY.



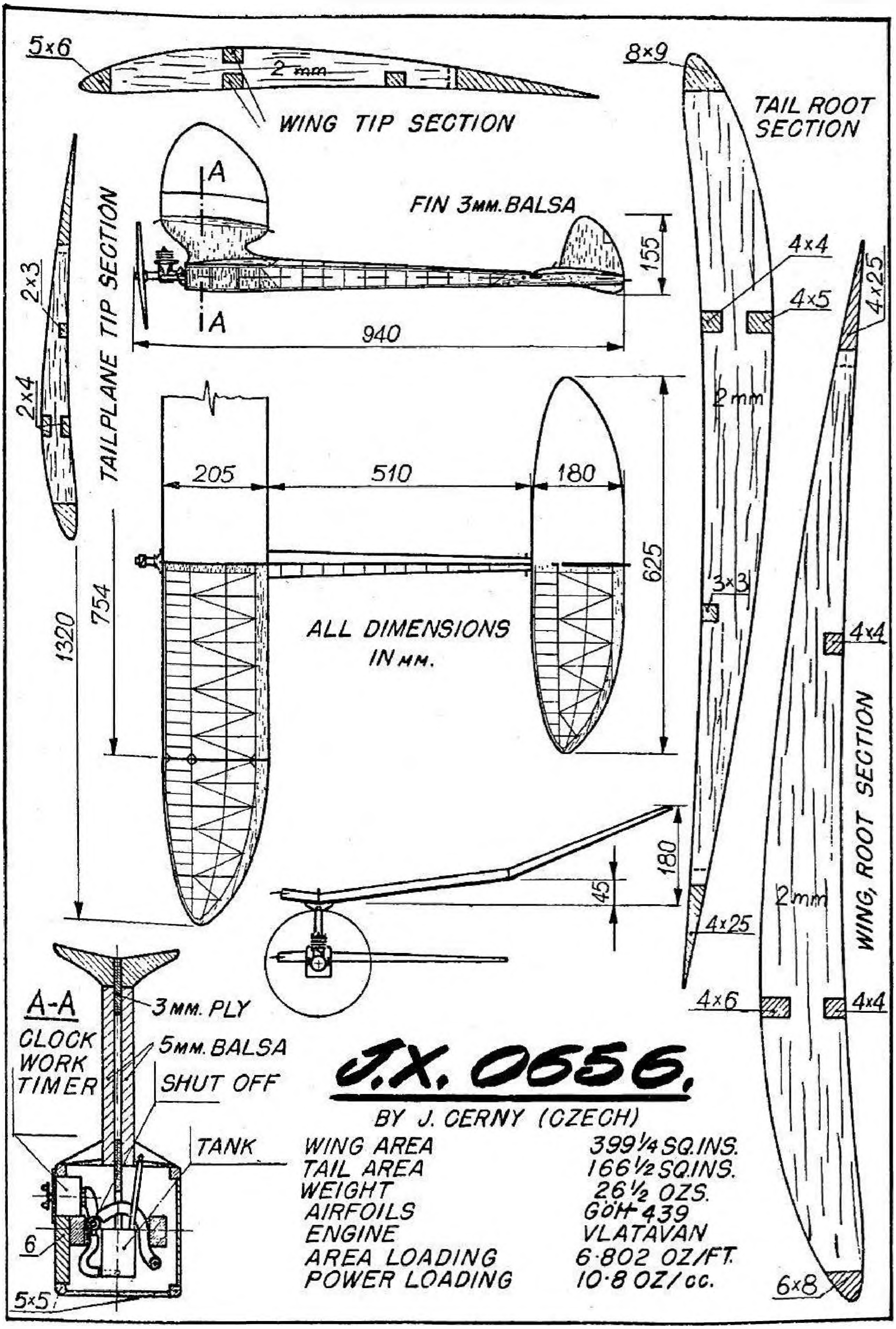
GS-571-S

Unorthodox pylon layout for engines of 1·5 cm.3.
By St. GRZYWA, POLAND

MODELARZ, POLAND



MONTREAL MODEL FLYING CLUB, CANADA.



J.X. 0656.

BY J. CERNY (CZECH)

WING AREA	399¼ SQ.INS.
TAIL AREA	166½ SQ.INS.
WEIGHT	26½ OZS.
AIRFOILS	GÖH 439
ENGINE	VLATAVAN
AREA LOADING	6·802 OZ/FT.
POWER LOADING	10·8 OZ/cc.

AREA CALCULATIONS MADE EASY

By HORST HANDLER

(*With acknowledgments to "Der Modellbauer"*)

WING AND TAILPLANE planforms of models have in general a simple geometric shape, such as rectangular, trapesoidal, elliptical or a combination of these. To simplify the calculation of these areas, a monograph has been designed which allows one to find the answer quickly and accurately.

This monograph will be found very useful during the design stage, and can also aid processors at competitions. The monograph consists of three vertical lines. The left-hand one has a scale giving the half-span (*b*) with a range from 1 to 12 dm. The centre vertical embodies two scales, that on the left giving the area of ellipses ranging from 1·256 to 56·25 dm2, while that on the right provides the areas of rectangular or trapesoidal planforms ranging from 1·6 to 72 dm2.

The right-hand line carries one scale which gives the half chord (*t*), with a range from 0·4 to 1·5 dm.

The use of the monograph is as follows :

Find the value of the ½-span on the (*b*) scale, and the value of the ½-chord on the (*t*) scale. Connect these two points with a straight line.

The intersection of the middle scale will give the area in dm2. If the planform is elliptical the area is found on the left-hand scale ; on the right for rectangular or trapesoidal shapes. Note that for a trapesoidal planform $t = \frac{t1 + t2}{2}$

Examples :

1. *Calculate the area of an elliptical wing with a half-span of* 10·25 *dm, and half-chord of* 0·9 *dm.*
   Connecting 10·25 on the (*b*) scale and 0·9 on the (*t*) scale, the intersection of the centre line reading on the *left* gives the area as 29 dm2.
2. *A tapered tailplane has a half-span of* 2·6 *dm* ; *half-root chord* 0·50 *dm* ; *and half-tip chord* 0·40 *dm.*

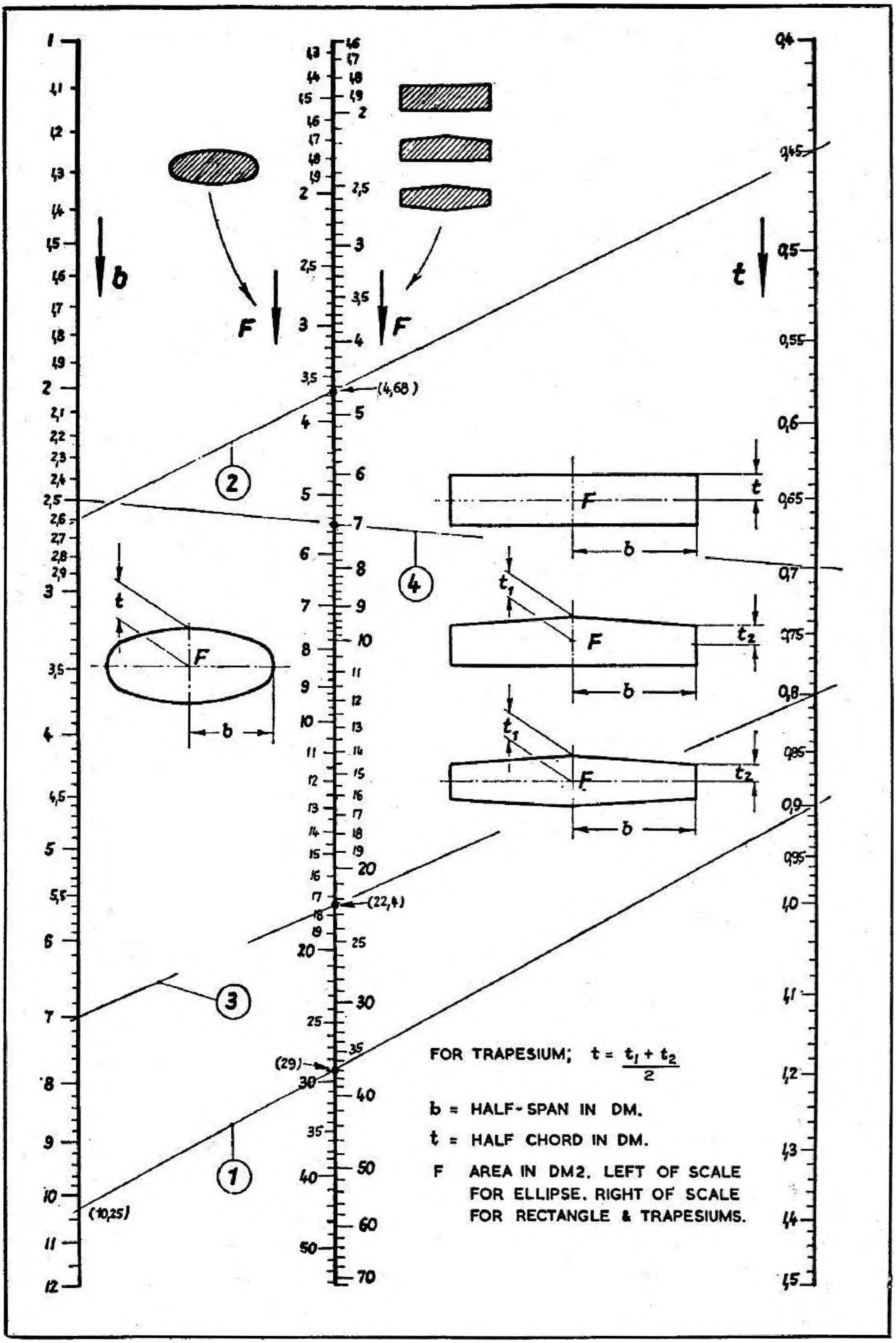
   First calculate (*t*). $(t) = \frac{t1 + t2}{2} = \frac{0{\cdot}5 + 0{\cdot}4}{2} = 0{\cdot}45$ dm.

   Now, connect 2·6 on the (*b*) scale with 0·45 on the (*t*) scale, the intersection with the middle scale (*right*-hand side) giving the area as 4·68 dm2.
3. *A wing has a planform consisting of a combination of a rectangle and a trapesium. The centre rectangle is* 14 *dm*×1·6 *dm, and the tip sections each* 2·5 *dm*×1·2 *dm (tip chord).*
   First find area of rectangle by connecting 7 on the (*b*) scale with 0·8 on the (*t*) scale (line 3), the intersection giving a reading of 22·4 dm2.
   The tip area is found as follows :

   $$t = \frac{t1 + t2}{2} = \frac{0{\cdot}8 + 0{\cdot}6}{2} = 0{\cdot}7 \text{ dm2.}$$

   Connect 2·5 on the (*b*) scale with 0·7 on the (*t*) scale (line 4), the intersection with the middle right-hand scale giving the area as 7 dm2.
   Hence, the total wing area is 22·4+7=29·4 dm2.

A further use for the monograph is to find the ½-chord when ½-span and area are given, or the ½-span when the ½-chord and area are known.


b
F
F
t
(4,68)
(22,4)
(29)
(10,25)
1
2
3
4
t
F
b
t
F
b
t_1
t_2
F
b
t_1
t_2
F
b
FOR TRAPESIUM; $t = \frac{t_1 + t_2}{2}$
b = HALF-SPAN IN DM.
t = HALF CHORD IN DM.
F AREA IN DM2. LEFT OF SCALE FOR ELLIPSE. RIGHT OF SCALE FOR RECTANGLE & TRAPESIUMS.

SCALE EFFECT

A GEOMETRIC SCALE is simple enough to understand. A scale of $\frac{1}{10}$th, for instance, means simply that the smaller subject referred to is one-tenth the size of the larger. It does not follow, however, that a geometric scale is the only form of scale, and in aerodynamics this is certainly not true.

If we take an elementary example of two wings, one one-tenth the size of the other, moving through the air at different speeds, we can easily analyse the respective "aerodynamic" scale values in terms of two-dimensional airflow—*i.e.*, considering the airflow around the aerofoil section only. Each aerofoil will affect a certain "depth" of air, as indicated in Fig. 1. The actual depth we consider is quite arbitrary, but if we call the depth of air affected by the smaller aerofoil (size=1 unit) A_1, and the corresponding depth of air affected by the larger aerofoil A_2, obviously $A_2 = 10 \times A_1$ because aerofoil 2 is ten times as large as aerofoil 1.

The *volume* of air affected in each case is then $A_1 \times V_1$ and $A_2 \times V_2$, respectively, where V_1 is the velocity of aerofoil 1 through the air and V_2 the velocity of aerofoil 2. If the volume of air is the *same* in each case, this means that the same *number of air molecules* are affected by each aerofoil, regardless of their difference in size. Hence, their aerodynamic reactions will be identical, but only if $A_1 \times V_1 = A_2 \times V_2$. Since A_2 equals $10 \times A_1$, we have $A_1 \times V_1 = 10 \times A_1 \times V_2$ or $V_1 = 10 \times V_2$. In other words, for aerodynamic similarity the velocity of the $\frac{1}{10}$th size aerofoil must be *ten times* that of the larger aerofoil.

This applies throughout as an aerodynamic scale, namely that the product of the velocity and the linear size (invariably taken as the chord length in the case of a wing) must be the same for aerodynamic similarity. Aerodynamic scale values are calculated in terms of a quantity called the Reynolds Number, which is simply :

Reynolds Number (RN)=6,300×velocity (ft./sec.)×chord (feet) for a wing.

More conveniently in model work, for quick calculation and comparison, the constant can be ignored and the "Vl" value quoted—being simply velocity× *length*, although the length dimension remains the *chord* length in the case of wings.

The performance of an aerofoil can now be discussed more specifically in relationship to the differences caused by varying the "Vl" value, *i.e.* aerodynamic scale effect. The cause of scale effect is inherently bound up with the natural tendency of any fluid in motion (and air is a fluid in this sense) to cling to a surface over which it is passing. Only a very thin layer of fluid may be affected but this gives rise to a velocity gradient through this layer, irrespective of the shape of the surface—Fig. 2. The depth of this layer in which the velocity is less than some nominal value—*e.g.*, 99 per cent of the main stream velocity—is known as the *boundary layer*. In the illustration the depth of boundary layer shown is greatly

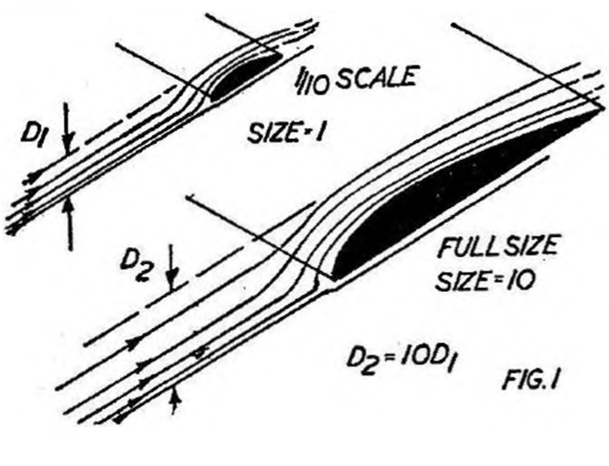


FIG. 1

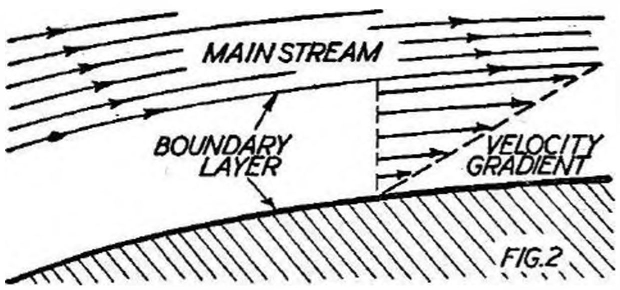


FIG. 2

exaggerated for the sake of clarity. The boundary layer associated with airflow over a typical surface may be only of the order of a few hundredths of an inch thick ; nevertheless, its effect is most marked on the flow characteristics of the main airflow.

At very low values of V1 the flow *in the boundary layer* will tend to be smooth or *laminar*. This is a steady form of flow, but one which is readily displaced. Hence, this condition of flow over a typical aerofoil will readily break away from the upper surface, or *separate*—Fig. 3. In turn this separation disrupts the main airflow which curls up into eddies leaving a large wake. The overall effect is twofold. Early separation means low lift generated ; and the large, eddying wake produced means high drag.

At higher values of V1 the boundary layer flow is quite different. Over the front of the aerofoil the boundary layer is still laminar, but at some point the boundary layer itself changes into *turbulent* flow. This is a much more stable form of flow and one which actually absorbs energy from the main airflow. Hence it is not so readily disturbed and the ultimate separation point is much farther aft—Fig. 4. Thus the same aerofoil, under these boundary layer flow conditions, generates more lift at the same angle of attack, and has less drag because the wake is much reduced in depth.

As a generalisation this holds true for still further increasing values of V1. The higher the V1 value the earlier the establishment of a turbulent boundary layer flow following the laminar nose section flow (which always remains laminar initially, however much progressively reduced in length), and hence the more powerful the turbulent boundary layer flow the later the separation point from the aerofoil. In other words the efficiency of the aerofoil goes on improving with increasing V1, although eventually it will taper off into near-constant values for lift and drag at some high Reynolds Number. This increasing efficiency is far less marked than the drastic change which occurs at the V1 value corresponding to the immediate change from an all-laminar boundary layer flow to one in which the initial flow is laminar, changing to turbulent.

This value of V1 is known as the *critical V*1 for the particular aerofoil concerned. The curves drawn in Fig. 5 showing how the drag of an aerofoil varies with V1 are typical and well illustrate this marked change at some critical value of V1—also that the effect is increased with increasing angle of attack, as one would logically expect from the above explanation.

It will be noticed from the illustration that there are actually *two* critical values of V1 involved. The higher one corresponds to the aerofoil being *accelerated* to give increasing values of V1 and the other to the aerofoil being decelerated. There is an inertia lag in the behaviour of the boundary layer flow, and

FIG. 3

FIG. 4

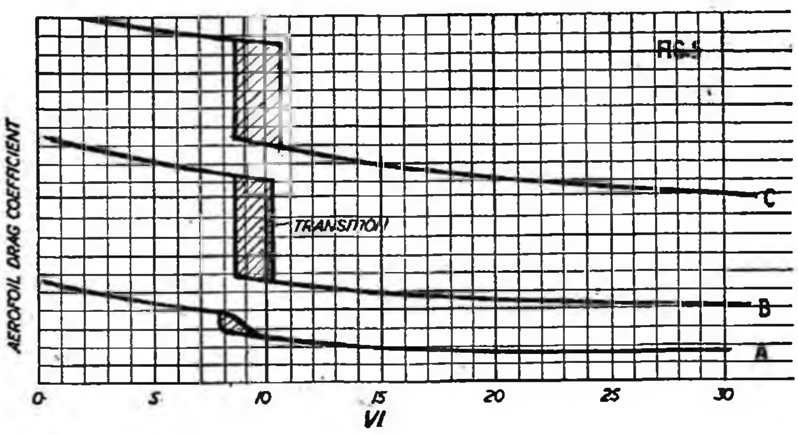


Fig. 5.—The transition point is clearly indicated by a change in the drag coefficient. Curve A corresponds to zero angle of attack; curve B around 5-7 degrees; and curve C at or beyond stall.

its readiness to change from purely laminar to laminar-turbulent, which accounts for this difference. The critical V1 value usually quoted is the higher value, as to achieve a desirable flying speed consistent with a V1 value above the critical region the wing would be accelerated through the critical zone. On the other hand, it is possible that during flight the model may momentarily be slowed to such an extent that the actual operating V1 value falls to below the lower critical V1 value, when the aerofoil characteristics may be expected to change suddenly for the worse. If the model recovers and accelerates back to normal speed, no harm is done.

For comparison of the effect of lift a set of typical lift curves are drawn in Fig. 6, each curve plotted for a specific V1 value. The effect of operating below the critical V1 value is self-evident.

The critical V1 value will be characteristic of the aerofoil section and can only be determined accurately on empirical grounds, *i.e.*, by wind tunnel tests or measured flight tests under controlled conditions. On the other hand special wing sections can be, and have been, calculated and developed, aimed specifically at achieving an extremely low critical V1 value.

In the main these follow two distinct lines of approach—the "laminar flow" sections which aim, as far as possible, at accepting a purely laminar boundary layer flow but delaying its separation point. The other is the evolution of "turbulent flow" sections which aims at inducing an early change of the boundary layer flow to turbulent flow, *i.e.*, establish the desirable boundary layer flow conditions at a lower than normal V1 value.

The practical method of producing similar overall effects is by means of a turbulator or obstruction on or immediately in front of the aerofoil surface, artificially introducing turbulence at this point. This they are no doubt effective in doing, but the turbulence is applied mainly to the main airflow stream in such instances, since the size of the turbula-

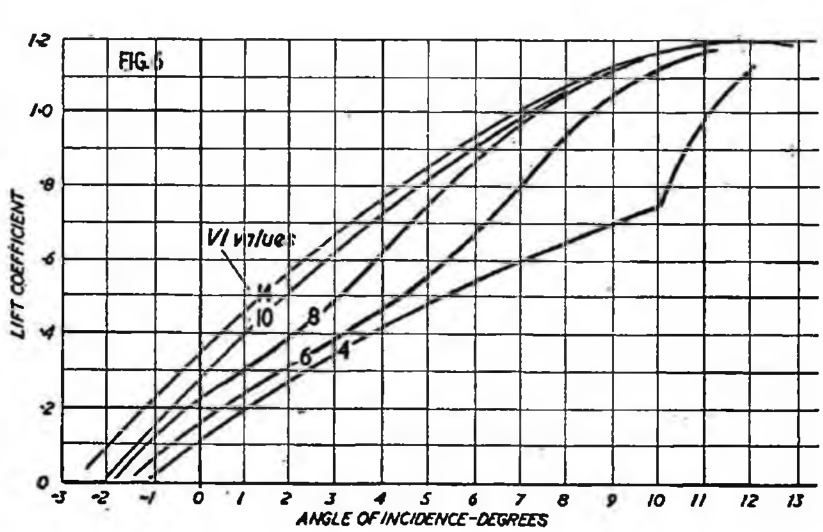
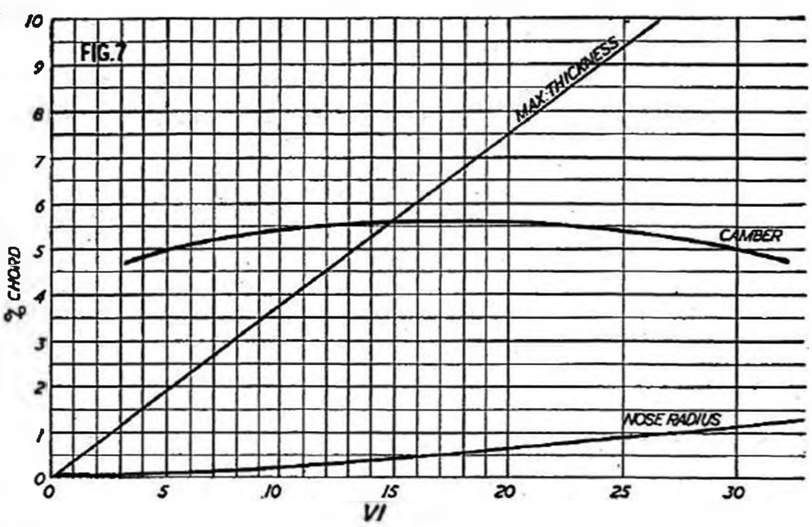


Fig. 6.—Lift curves for a typical aerofoil, plotted against incidence in the usual manner, but with different curves for different VI values. Loss of lift at sub-critical values of VI is most marked.

Fig. 7.—Schmidt curves showing relationship between thickness of aerofoil section, camber, and nose radius on critical V1 of the aerofoil.



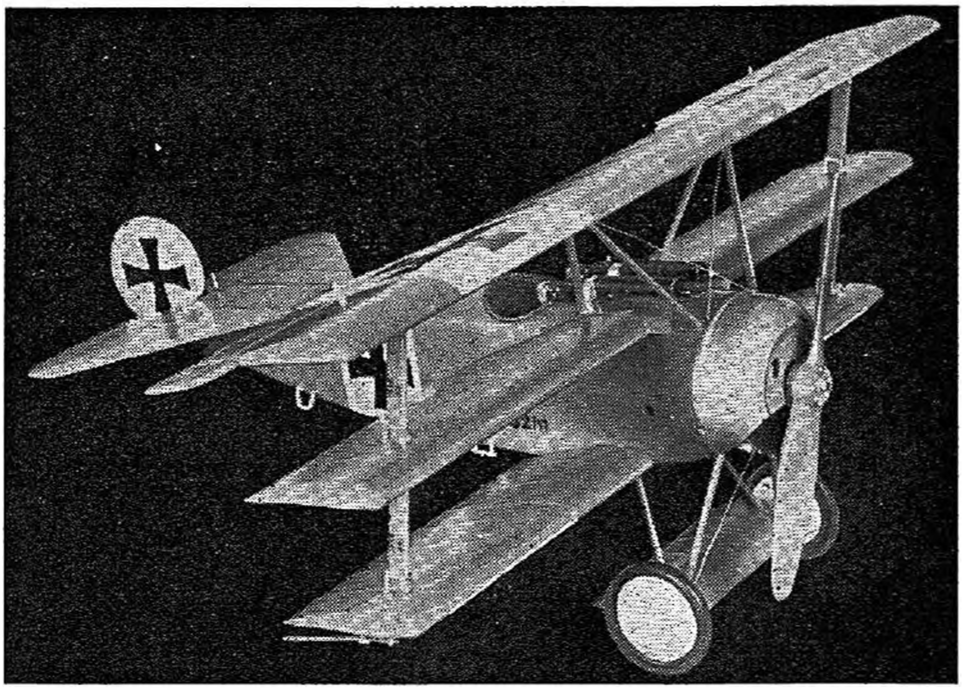
tor, or its position, generally locates at least a substantial part of it outside the actual thickness of the boundary layer. The turbulator has been condemned in theory on this and similar grounds, but in practice it can still produce beneficial results by definitely delaying separation. Whether the normal lift and drag values of the wing are improved as a consequence is debatable. Certainly a turbulator produces a backward movement of the centre of pressure of the wing, consistent with a delayed separation point. Also the stalling characteristics of the wing may be better. But none of the expert modellers who have used them on contest models have justified claims for improved performance as against conventional aerofoils. The same is largely true of the "laminar flow" and "turbulent flow" sections in that no positive overall proof of their superior performance is available with contest models, which logically aim at absolute maximum performance. On the other hand the typical "laminar flow" sections are widely adopted as good aerofoils for model use, particularly on gliders.

The chief characteristics of an aerofoil affecting its critical V1 value have been shown to be the maximum thickness/chord ratio and the radius of the nose entry. The effect of camber appears relatively insignificant. Required values for these criteria for super-critical characteristics are summarised in the Schmidt graph of Fig. 7, although some of these values have been modified by later research workers. Typical critical V1 values for a range of aerofoils are summarised in the table.

If critical V1 value is accepted as a basis for wing design, this presupposes knowledge of the flying speed of the model, and also yields a value of minimum chord for the wing design. For example, suppose the design flying speed, or estimated flying speed, is 20 ft./sec., and the critical V1 of the aerofoil is 10 (ft.$_2$/sec.). Obviously the minimum wing chord to achieve a V1 of 20 is 6 inches. This may not be a practical solution and hence in this case it is necessary to select a section with a lower critical V1 value in order to utilise a smaller wing chord. The only other solution is to increase the flying speed of the model.

Certainly there is much room for further research and development in this direction, particularly as average critical V1 values for typical popular aerofoils often approximate closely to just those values given by normal wing chords for A-2 size gliders and Wakefield models flying at normal speeds. And the overall efficiencies of such models, although high in themselves, are low by comparison with full-size aircraft standards.

Aerofoil section	Nose radius % chord	Critical V1
LDC 2	2·0	
LDC 3	2·0	
LDC 3M	2·0	
Gottingen 417a	1·45	under 6·6
Isacson 03010	0·5	10-12
Isacson 33006	0·0	5·0
Isacson 53009	0·8	10-12
Isacson 53507	0·5	10
Isacson 64009	0·3	15-19
Isacson 73503	0·4	7·0
NACA N.60	1·4	13·3



PLASTICS

By J. D. McHard

Polystyrene plastic assembly kits are now a well-established part of the modelling scene, and the sale of plastic kits accounts for a very large proportion of the average model shop's turnover. During the three years that plastics have been readily available in this country, the general standard of quality and accuracy has been steadily improved, and the number of prototypes available runs well into three figures and is constantly increasing. All tastes are catered for from the Wright Biplane to the latest jet and even missiles !

There is no common scale, each manufacturer having his own preference. Most of the models, however, fall into three scale groups, 1/96th, 1/72nd and 1/48th and the more popular prototypes are often found in all three. A limited selection is available in other scales and the American modeller can now buy some W.W.1 models to 1/24th scale. The detail possible in such a model is almost unlimited and even the covering fabric texture is represented !

The amount of enjoyment gained during and after assembly of a plastic model depends greatly upon the amount of work put into it. Generally speaking, the moulded parts are so beautifully produced and the assembly so carefully worked out that even an unskilled builder can produce an acceptable result.

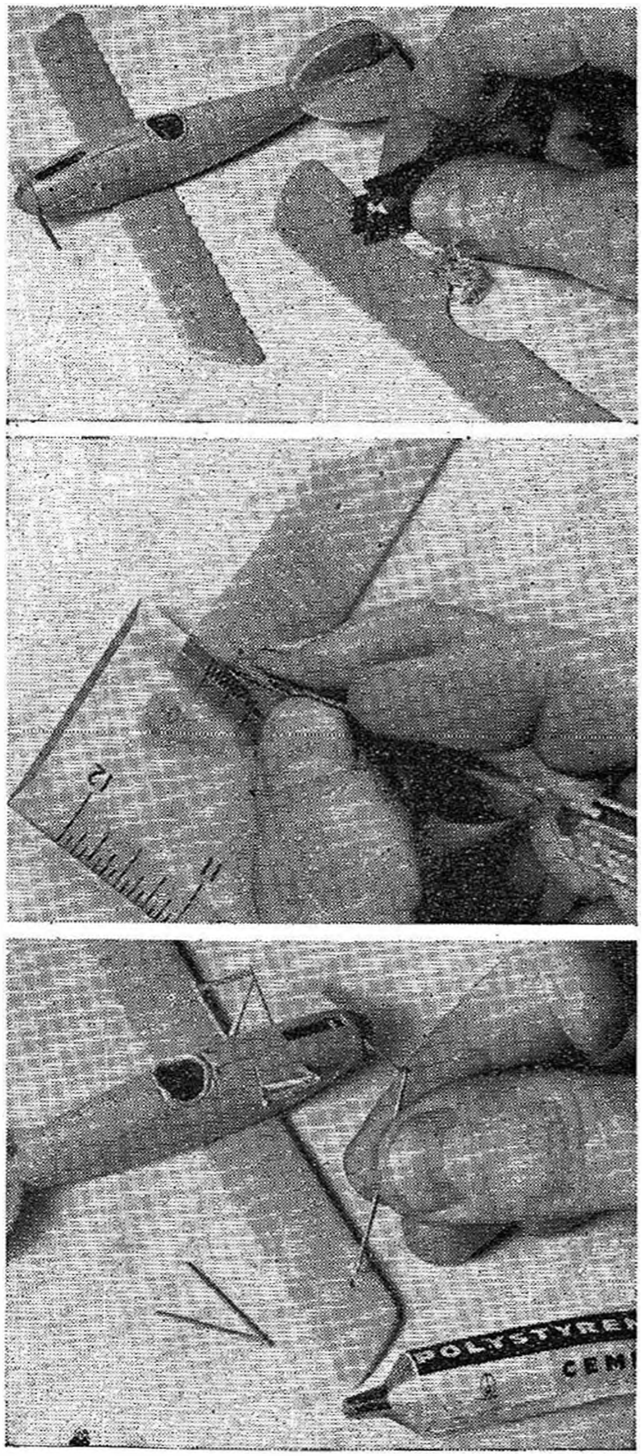
But many modellers require more than this, and a plastic kit will handsomely reward ingenuity and care put into its construction and finishing. We offer here a few suggestions, which we hope will assist you to get the most satisfaction out of these model kits and perhaps inspire further constructional ideas.

Rigging can vastly improve or ruin a model biplane, and if you doubt your ability to successfully carry out the job, it is best omitted ! It can be represented in various ways, depending chiefly upon the scale of the model—1/72nd scale rigging is best represented by human hair or *very fine* wire. 5-amp fuse wire serves for 1/48th scale rigging. Don't use thread unless you're building a ship !

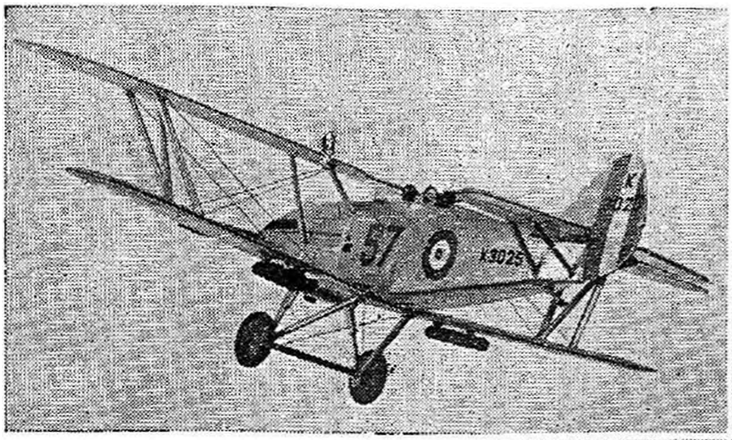
Struts and similar thin components are, due to limitations in the moulding process, often reproduced over-size. This gives a very clumsy, "toyish" look to the finished model, for if anything, these small parts look far better when somewhat under-size. Alterations are easy to carry out with the aid of a file or garnet paper wrapped around a small stick of wood. Scraping with a sharp knife held at right angles to the surface is also a very effective method of removing surplus material. The roughened surface resulting from this treatment can be restored to its original polish by using No. 400 wet or dry abrasive paper with a soapy water lubricant, and then polishing with Duroglit metal polish. The same process is employed to camouflage component joins and remove moulding "flash."

Wing and Tailplane trailing edges should be made as thin as possible, and Polystyrene can be taken down almost to a knife edge without losing much strength. With wings moulded in two halves (upper and under surface) the surplus plastic should be removed from the inner faces of the mouldings before cementing together. This avoids damaging external detail such as ailerons, flaps, rivets, etc. Where in the smaller scales single-piece mouldings are employed it is generally best to thin the plastic out from the under surface. Detail removed in the process can be reintroduced by means of a very sharp scriber. *Ailerons* can often be improved if a thin cut is made from trailing edge to hinge line, separating them from the mainplane surface.

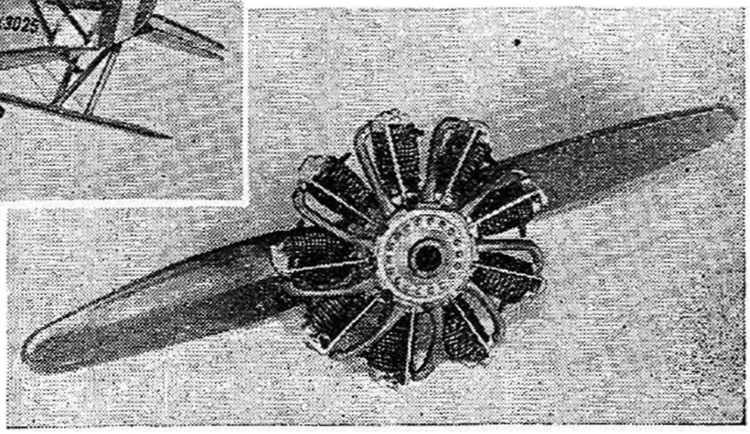
Painting the model will probably occupy more time than the actual assembly, and is undoubtedly the most important single operation of the entire job, for sloppy paintwork will ruin any model. It is impossible to carry out good paintwork with poor brushes and it pays handsome dividends to use sable-hair brushes which, in the



Scraping down in addition to cleaning up "flash" will give a truer scale appearance to most components. Centre shows the undersurface of a wing being scribed with rib lines, thus providing authenticity from all angles. Cement is best applied to strut holes, etc., by means of a pin.



Correct rigging adds greatly to the finished appearance of this Airfix Hawker Hart, but unless the right materials are used with near-scale diameters, such detail is better omitted.



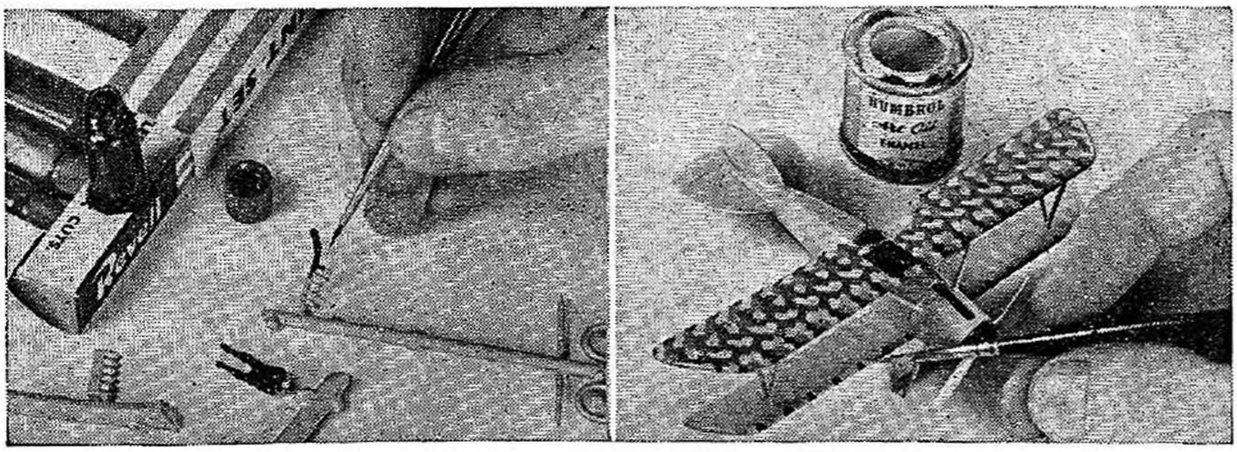
Careful trimming and painting gives a full-size look to this engine and prop. from the large Revell Fokker Triplane, as shown in the heading photo on page 108.

small sizes required for plastics, are not expensive. One each of sizes 00, 2 and 5 will serve most needs.

If carefully constructed and painted, it should be extremely difficult, without actually handling the model, to tell from what material it is made. One of the first things that gives away the fact that it is a plastic model (apart from component joins, which in any case should have been disguised at an early stage of construction) seems to be the excessively glossy, almost tinny surface resulting from the use of most of the plastic paints now on the market. Very few aircraft are highly polished, and a replica wartime machine in glossy finish is completely ruined.

Happily some of the paint people are now supply a matting agent, which, when added to their paints, produces a dulling effect in proportion to the quantity of the agent used. A little experiment on the inner surface of a component before assembly, or on one of the plastic moulding stems, will indicate the correct mixture to produce the desired effect.

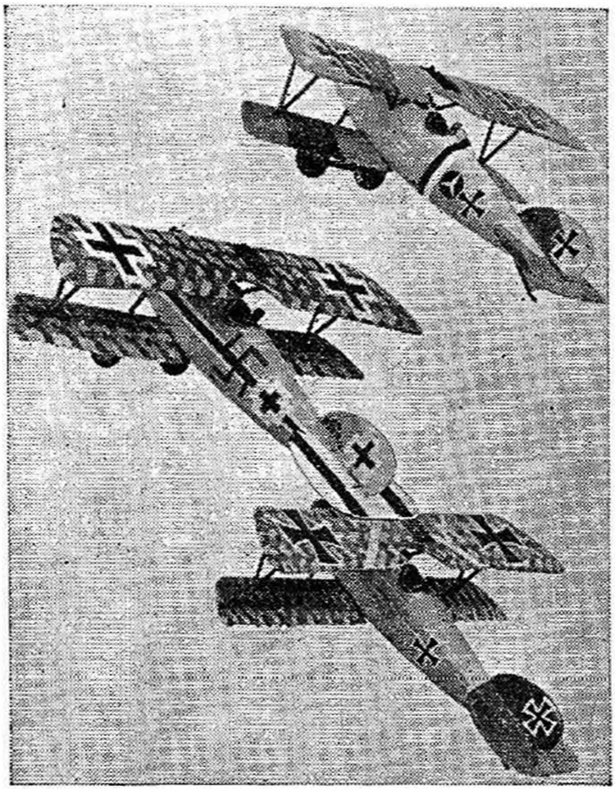
It is now well known, of course, that cellulose base paints cannot be used direct on polystyrene without reticulating the polished surface.



Small components are best painted while still fastened to the moulding stem. Camouflage detail should be added colour by colour with ample time for drying between each coat.

Always paint the model in a dust-free atmosphere, and don't attempt to cover the plastic in one coat if it means laying the paint on really thickly. This will only result in runs, and fine detail in the mouldings will be lost. Use two or more coats and allow each one to thoroughly dry before applying the following coat. Make the brush strokes in a different direction for each coat, thus reducing the chance of paint furrows.

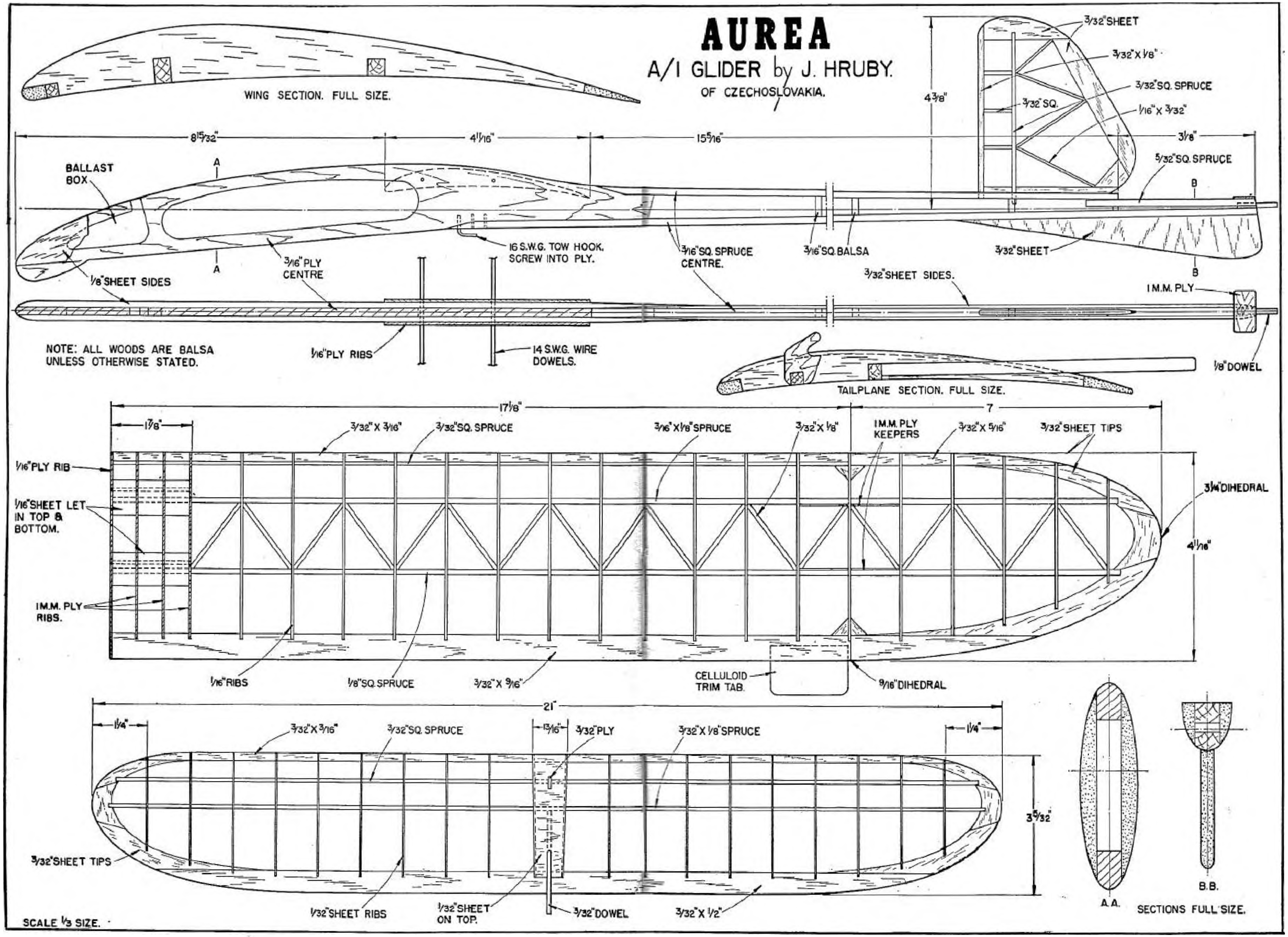
Some of the smaller parts are best painted before assembly, making sure that the paint does not cover any area that must subsequently be cemented, as the cement will not "take" to painted surfaces. These small components are often easier to handle when painting if allowed to remain on the moulding stems until dry.

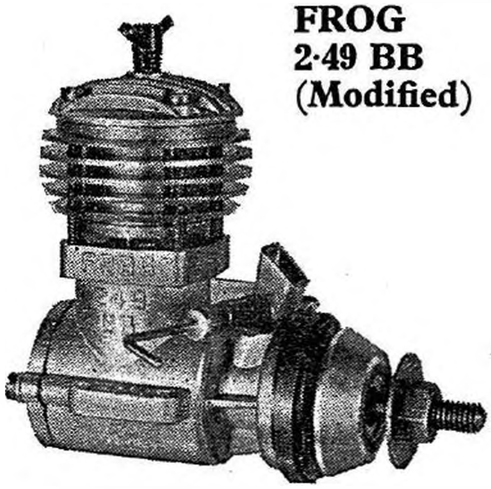


These three Airfix Albatros models are depicted in realistic attitude, and are finished in authentic markings.

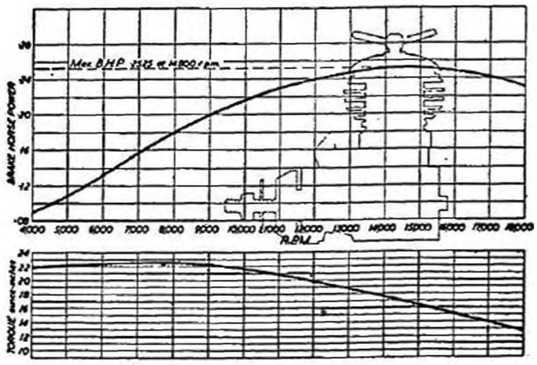
All kits contain suitable transfers with which to decorate the model. Most of these are of very high quality and some kits contain more than one set representing various countries with which the aircraft has seen service, or a selection of squadron markings. If you are adept with the paint brush a very colourful collection could be built up of W.W.1 scouts. The German flying circuses of Albatros, Fokker triplanes and D.7s lend themselves particularly well to this treatment. The monthly AEROMODELLER feature "Decor Detail" frequently features unusual markings and colour schemes of interest.

Many collectors will wish to photograph their models in a realistic setting, and mock dog fights are favourites for fighter aircraft or squadron line-ups on the airfield. Civil types look good against "cloud" backgrounds and so on. There are several books available dealing with model or table-top photography and a visit to your local public library should prove fruitful.


AUREA
A/I GLIDER by J. HRUBY.
OF CZECHOSLOVAKIA.
WING SECTION. FULL SIZE.
8 15/32"
4 11/16"
15 5/16"
3/8"
4 3/8"
BALLAST BOX
A
16 S.W.G. TOW HOOK. SCREW INTO PLY.
3/16" PLY CENTRE
1/8" SHEET SIDES
3/16" SQ. SPRUCE CENTRE.
3/16" SQ. BALSA
3/32" SHEET
3/32" SHEET SIDES.
3/32" SHEET
3/32" X 1/8"
3/32" SQ. SPRUCE
3/32" SQ.
1/16" X 3/32"
5/32" SQ. SPRUCE
B
I.M.M. PLY
1/8" DOWEL
NOTE: ALL WOODS ARE BALSA UNLESS OTHERWISE STATED.
1/16" PLY RIBS
14 S.W.G. WIRE DOWELS.
TAILPLANE SECTION. FULL SIZE.
17 1/8"
7
1 7/8"
3/32" X 3/16"
3/32" SQ. SPRUCE
3/16" X 1/8" SPRUCE
3/32" X 1/8"
I.M.M. PLY KEEPERS
3/32" X 5/16"
3/32" SHEET TIPS
1/16" PLY RIB
1/16" SHEET LET IN TOP & BOTTOM.
I.M.M. PLY RIBS.
3/4" DIHEDRAL
4 11/16"
1/16" RIBS
1/8" SQ. SPRUCE
3/32" X 9/16"
CELLULOID TRIM TAB.
9/16" DIHEDRAL
21"
1/4"
3/32" X 3/16"
3/32" SQ. SPRUCE
13/16"
3/32" PLY
3/32" X 1/8" SPRUCE
1/4"
3 5/32"
3/32" SHEET TIPS
1/32" SHEET RIBS
1/32" SHEET ON TOP.
3/32" DOWEL
3/32" X 1/2"
A.A.
B.B.
SECTIONS FULL SIZE.
SCALE 1/3 SIZE.



FROG 2·49 BB (Modified)



Propeller dia. × pitch	r.p.m.	Propeller dia. × pitch	r.p.m.
9 × 4 (Stant)	11,000	8 × 6 (Trucut)	10,200
8 × 4 (Stant)	13,900	8 × 4 (Trucut)	13,700
7 × 4 (Stant)	15,500	8 × 3 (Trucut)	14,300
7 × 9 (Stant TR)	10,900	7 × 9 (Trucut)	10,400
8 × 5 (Stant)	12,500	7 × 6 (Trucut)	12,000
9 × 6 (Stant)	10,000	7 × 5 (Trucut)	13,400
9 × 3 (Tiger)	12,200	7 × 3 (Trucut)	18,600
8 × 4 (Tiger)	14,400	6 × 10 (Trucut)	13,400
8 × 3½ (Tiger)	15,500	6 × 8 (Trucut)	14,100
6 × 9 (Tiger)	14,500	6 × 6 (Trucut)	16,000
14 × 6 (Trucut)	3,800	6 × 4 (Trucut)	17,500
9 × 4 (Trucut)	11,200		

Propeller—R.P.M. Figures

Fuel used : Frog "Powamix".

Specification

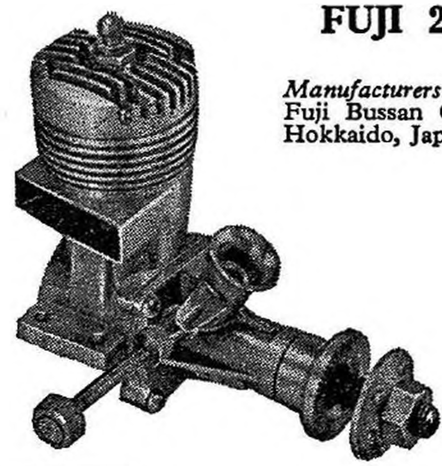
Displacement: 2·467 c.c. (·1505 cu. in.).
Bore: ·5807 in.
Stroke: ·5685 in.
Bore/stroke ratio: 1·02.
Bare weight: 6 ounces.
Max. B.H.P.: ·2525 B.H.P. at 14·800 r.p.m.
Power rating: ·102 B.H.P. per c.c.
Power/weight ratio: ·042 B.H.P. per ounce.

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

Retail price: £4/14/9 (including tax).

FUJI 29

Manufacturers:
Fuji Bussan Co. Ltd., Hokkaido, Japan.



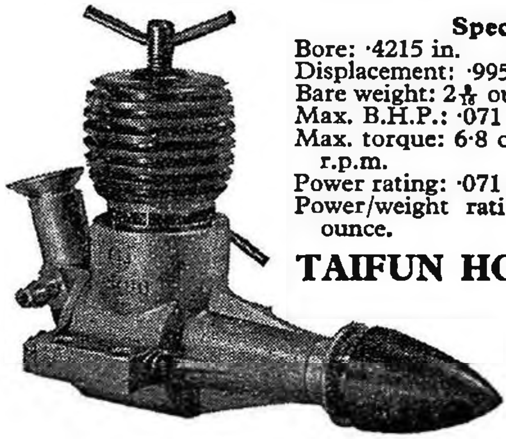
Specification

Displacement: 4·814 c.c. (·2936 cu. in.).
Bore: ·747 in. Stroke: ·670 in.
Bore/stroke ratio: 1·1:1.
Weight: 6½ ounces.
Max. B.H.P.: ·40 at 12,400.
Max. torque: 36·8 ounce-inches at 9,800 r.p.m.
Power rating: ·083 B.H.P. per c.c.
Power/weight rating: ·064 B.H.P. per ounce.

Propeller—R.P.M. Figures

dia. × pitch	r.p.m.
9 × 4 (Stant)	12,300
8 × 4 (Stant)	14,500
10 × 4 (Trucut)	10,800
9 × 5 (Trucut)	13,000
8 × 4 (Trucut)	14,700
7 × 4 (Trucut)	15,900
8 × 3½ (Tiger)	15,500

TAIFUN HOBBY RS



Specification

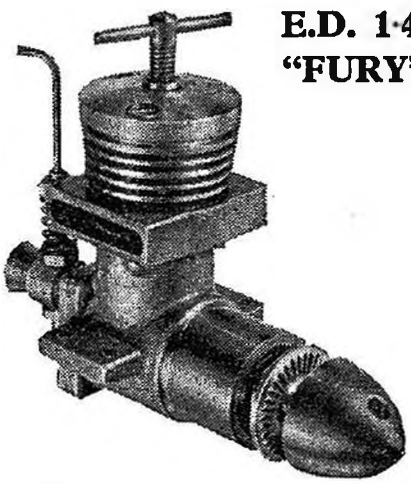
Bore: ·4215 in. Stroke: ·434 in.
Displacement: ·995 c.c. (·0605 cu. in.).
Bare weight: 2$\frac{1}{16}$ ounces.
Max. B.H.P.: ·071 at 12,000 r.p.m.
Max. torque: 6·8 ounce-inches at 9,000 r.p.m.
Power rating: ·071 B.H.P. per c.c.
Power/weight ratio: ·028 B.H.P. per ounce.

Propeller—R.P.M. Figures

dia. × pitch	r.p.m.
7 × 5 (Trucut)	7,200
8 × 3 (Trucut)	8,000
6 × 4 (Trucut)	11,200
6 × 3 (Trucut)	11,500
5 × 3 (Trucut)	13,200
7 × 4 (Frog Nylon)	10,100
6 × 4 (Frog Nylon)	13,400
9 × 3 (Stant)	6,800
7 × 6 (Stant)	9,500
6 × 8 (Stant T/R)	12,200
7 × 4 (Tornado)	11,000

Manufacturers:
Johannes Graupner, Kirchheim-Teck, Germany.

E.D. 1·49 "FURY"



Specification

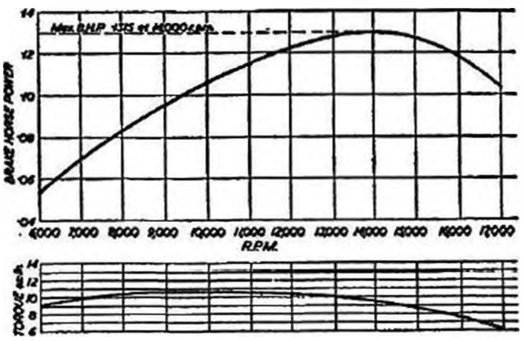
Displacement: 1·500 c.c. (·92 cu. in.).
Bore: ·500 in.
Stroke: ·468 in.
Bore/stroke ratio: 1 : ·92.
Bare weight: 3⅝ ounces.
Max. torque: 10·7 ounce-inches at 10,400 r.p.m.
Max. B.H.P.: ·1315 at 14,000 r.p.m.
Power rating: ·0875 B.H.P. per c.c.
Power/weight ratio: ·0364 B.H.P. per ounce.

Material Specification

Crankcase: magnesium alloy pressure die-casting.
Cylinder: hardened steel.
Cylinder jacket: machined from dural.
Piston: cast iron.
Contra-piston: hardened steel.
Connecting rod: hardened steel.
Main bearings: two ball races.
Induction: reed valve.
Spraybar: brass.
Needle valve: steel, silver soldered (coil spring lock).

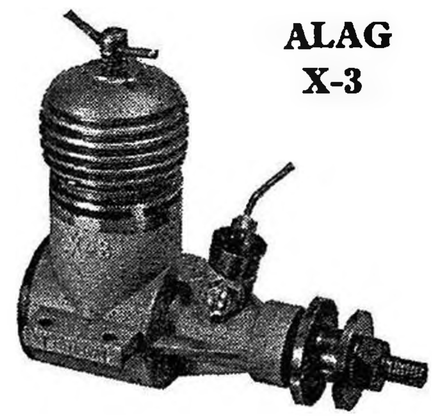
Manufacturers:
Electronic Developments (Surrey) Ltd.,
Island Farm Road, West Molesey, Surrey.

Price: £3/5/0 plus 14/- P.T. Total £3/19/0.



Propeller—R.P.M. Figures	
Propeller dia. × pitch	*r.p.m.*
8×3½ (Tiger)	12,000
8×4 (Tiger)	10,800
9×3 (Tiger)	8,600
6×9 (Tiger)	10,000
10×4 (Trucut)	5,000
9×4 (Trucut)	7,750
8×4 (Trucut)	9,800
7×3 (Trucut)	15,000
7×4 (Trucut)	12,500
7×5 (Trucut)	9,800
7×6 (Trucut)	8,500
6×6 (Trucut)	11,800
7×4 (Stant)	11,900
6×5 (Stant)	13,900
7×6 (Stant)	10,000
8×4 (Stant)	10,000
6×6 (Stant)	12,700
7×4 (Frog nylon)	10,000
6×4 (Frog nylon)	16,000

ALAG X-3



Specification

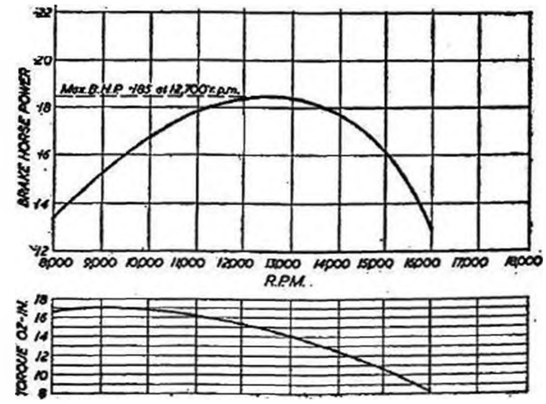
Displacement: 2·456 c.c. (·1498 cu. in.).
Bore: ·5905 in.
Stroke: ·5470 in.
Bore/stroke ratio: 1·1.
Bare weight: 4⅛ ounces.
Max. power: ·185 B.H.P. at 12,700 r.p.m.
Max. torque: 17 ounce-inches at 9,000 r.p.m.
Power rating: ·075 B.H.P. per c.c.
Power/weight ratio: ·045 B.H.P. per ounce.

Propeller—R.P.M. Tests	
Propeller dia. × pitch	*r.p.m.*
9×3 (Tiger)	10,600
8×4 (Tiger)	12,000
8×3½ (Tiger)	13,200
7×4 (Stant)	13,600
8×4 (Stant)	12,200
8×5 (Stant)	11,700
8×6 (Trucut)	9,200
8×4 (Trucut)	12,200
7×9 (Trucut)	9,100
7×4 (Trucut)	13,800
7×3 (Trucut)	15,400

Agents:
Ripmax Ltd.,
39 Parkway,
Camden Town,
N.W.1.

Price:
£3/15/0 plus 12/1 P.T.

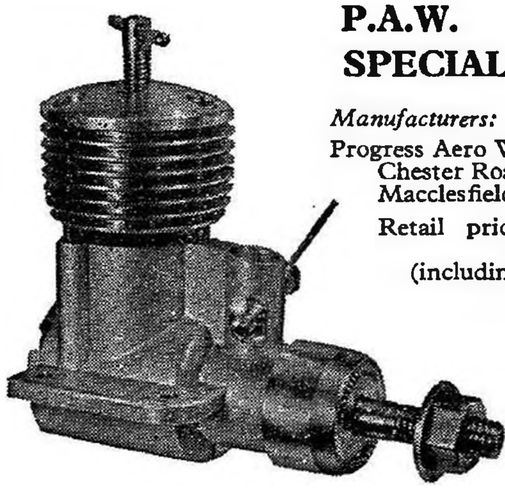
Fuel used:
Mercury No. 8.



P.A.W. SPECIAL

Manufacturers:
Progress Aero Works,
Chester Road,
Macclesfield.

Retail price:
£6/10/0
(including P.T.)

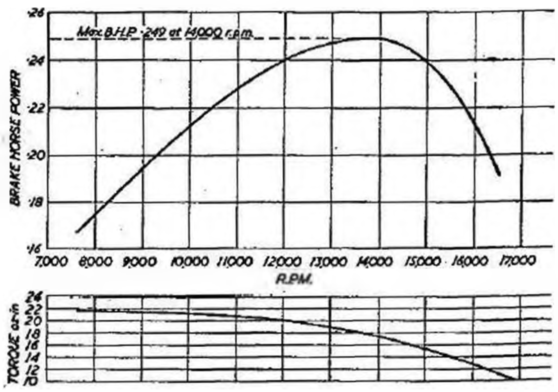


Specification

Displacement: 2·456 c.c. (·1498 cu. in.).
Bore: ·597 in.
Stroke: ·535 in.
Bore/stroke ratio: 1 : 1·09.
Bare weight: 4¾ ounces.
Max. B.H.P.: ·249 at 14,000 r.p.m.
Max. torque: 22 oz.-in. at 7,000 r.p.m.
Power output: ·101 B.H.P. per c.c.
Power rating: ·051 B.H.P. per ounce.

Material Specification

Crankcase: gravity die-casting in light alloy.
Cylinder (liner): Silver steel, ground and lapped.
Piston: Brico cast iron, ground and lapped.
Contra-piston: Brico cast iron, ground and lapped.
Crankshaft: high tensile steel.
Connecting rod: Hiduminium RR.56.
Bearings: rear, Ransom & Marles ⅜ in. ball race front, press-fitted Brico cast iron sleeve.
Cylinder jacket: turned dural.
Back cover: turned dural.
Propeller driver: turned dural.



Propeller dia. × pitch	r.p.m.
9 × 3 (Tiger)	11,500
8 × 4 (Tiger)	14,200
8 × 3½ (Tiger)	15,000
6 × 9 (Tiger)	14,500
9 × 4 (Stant)	10,300
8 × 6 (Stant)	10,900
8 × 5 (Stant)	12,400
7 × 6 (Stant)	13,600
7 × 4 (Stant)	15,000
7 × 3 (Trucut)	16,400
7 × 4 (Trucut)	15,400
7 × 9 (Trucut)	10,400
8 × 4 (Trucut)	13,500
8 × 6 (Trucut)	10,200
8 × 8 (Trucut)	8,200
8 × 10 (Trucut)	7,700
9 × 4 (Trucut)	10,900
10 × 4 (Trucut)	7,900

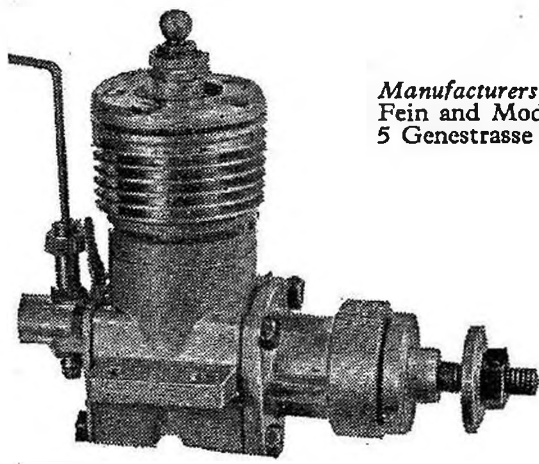
PROPELLER—R.P.M. FIGURES

Fuel used: Mercury No. 8.

WEBRA 2·5R (Glow)

Manufacturers:
Fein and Modelltechnik,
5 Genestrasse Berlin—Schonberg.

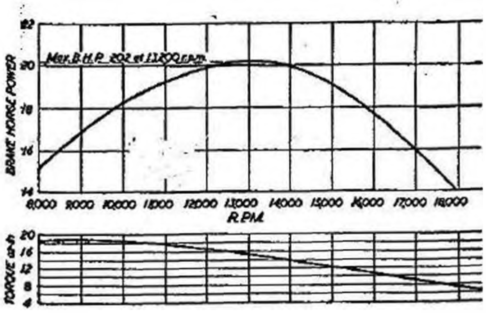
Price:
(Germany)
DM.49·50
(£4/5/0)



PROPELLER—R.P.M. FIGURES

Propeller dia. × pitch	r.p.m.
10 × 9 (Stant)	9,600
9 × 9 (Stant)	10,300
8 × 9 (Stant)	12,500
7 × 9 (Stant)	14,000
6 × 9 (Stant)	16,200
7 × 6 (Stant)	12,800
6 × 6 (Stant)	14,400
9 × 3 (Tiger)	11,900
8 × 3½ (Tiger)	14,200
8 × 4 (Tiger)	13,000

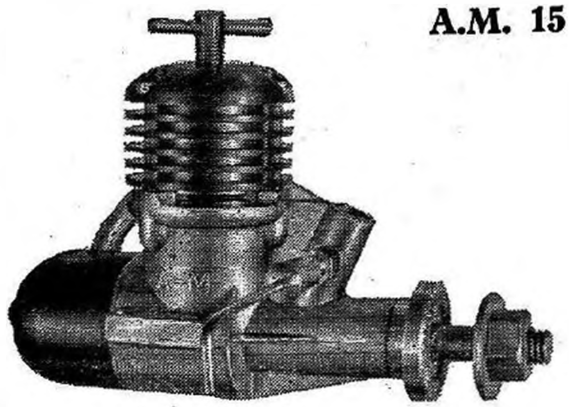
Fuel used: methanol 40 per cent; nithromethane 25 per cent; Castrol M 35 per cent.



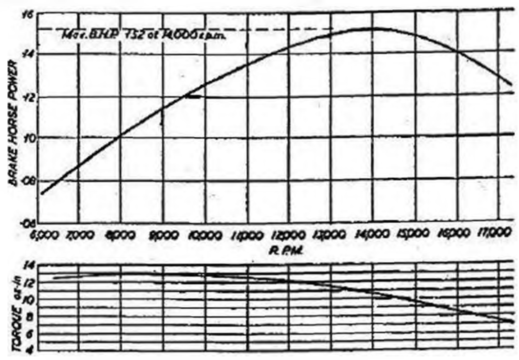
Specification

Displacement: 2·47 c.c. (·15 cu. in.).
Bore: ·612 in. (15·5 mm.).
Stroke: ·513 in. (13 mm.).
Bore/stroke ratio: 1·2
Bare weight 4⅝ ounces.
Max. B.H.P.: ·202 at 13,200 r.p.m.
Max. torque : 19 ounce-inches at 9,000 r.p.m.
Power output: ·082 B.H.P. per c.c.
Power/weight ratio: ·0436 B.H.P. per ounce.

A.M. 15



Manufacturers:
Allen Engineering, 28 Angel Factory Colony, London, N.18.



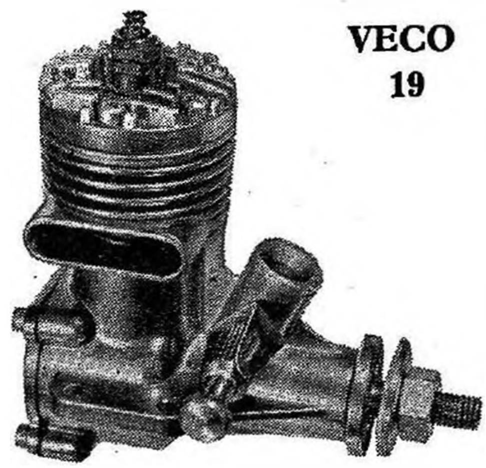
Propeller—R.P.M. Figures	
Propeller dia. × pitch	*r.p.m.*
8 × 4 (Tiger)	11,400
9 × 3 (Tiger)	9,500
8 × 3½ (Tiger)	12,500
10 × 4 (Trucut)	5,600
9 × 4 (Trucut)	8,800
8 × 4 (Trucut)	12,400
8 × 3 (Trucut)	11,300
7 × 6 (Trucut)	12,000
7 × 5 (Trucut)	12,400
7 × 4 (Trucut)	13,700
6 × 6 (Trucut)	13,000
6 × 4 (Trucut)	14,800
6 × 3 (Trucut)	15,400
6 × 4 (Stant)	15,000
8 × 4 (Stant)	11,400
9 × 4 (Stant)	8,400
6 × 4 (Frog nylon)	18,600

Fuel used: Mercury No. 8.

Specification

Displacement: 1·484 c.c. (·094 cu. in.).
Bore: ·5175 in.
Stroke: ·430 in.
Bore/stroke ratio: 1·2 : 1.
Bare weight: 3 ounces (with tank).
Max. B.H.P.: ·152 at 14,000 r.p.m.
Max. torque: 13 ounce-inches at 8,400 r.p.m.
Power ratings: ·102 B.H.P. per c.c.
Power/weight ratio: ·05 B.H.P. per ounce.
Retail price: 59/8.

VECO 19



Propeller—R.P.M. Figures	
Propeller	*r.p.m.*
9 × 4 (Stant)	11,600
8 × 4 (Stant)	14,600
7 × 4 (Stant)	16,200
6 × 4 (Stant)	18,200
8 × 8 (Stant TR)	11,800
7 × 6 (Stant)	15,000
9 × 3 (Tiger)	13,000
6 × 9 (Tiger)	15,250

Fuel used: Standard methanol/castor mixture with 20 per cent nitromethane.

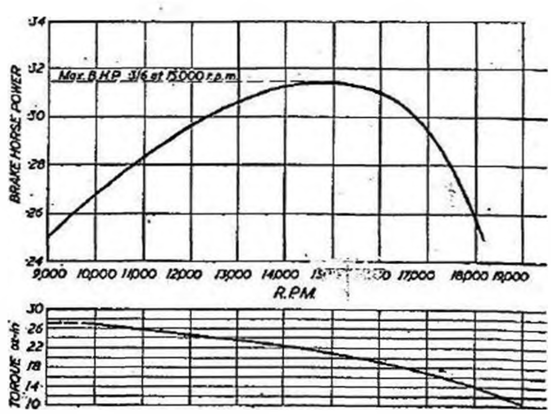
Manufacturers:
Henry Engineering Company,
P.O. Box 229, Burbank, California, U.S.A.
Available in Great Britain through:
H. J. Nicholls Ltd., 308 Holloway Road, London, N.7.

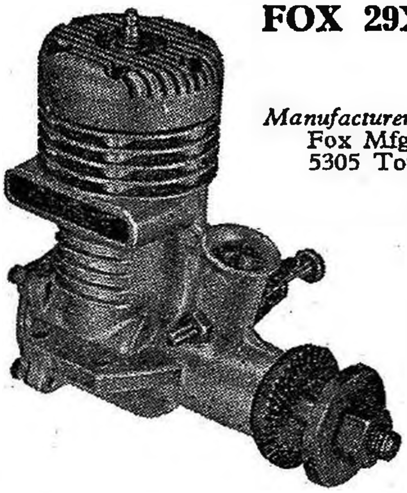
Specification

Displacement: 3·271 c.c. (·1995 cu. in.).
Bore: ·635 in.
Stroke: ·630 in.
Bore/stroke ratio: 1 : 1.
Bare weight: 5½ ounces.
Max. power: ·316 B.H.P. at 15,000 r.p.m.
Max. torque: 27 ounce-inches at 10,000 r.p.m.
Power output: ·0965 B.H.P. per c.c.
Power/weight ratio: ·0575 B.H.P. per ounce.

Material Specification

Cylinder/Crankcase unit: light alloy pressure die-casting, buffed and polished externally.
Cylinder liner: soft steel.
Piston: cast iron.
Connecting rod: light alloy (alloy big end bush).
Crankshaft: soft steel (ground and lapped).
Main bearing: iron.
Spraybar unit: brass.





FOX 29X

Manufacturers:
Fox Mfg. Co. Inc.,
5305 Towson Ave.,
Ft. Smith,
Arkansas,
U.S.A.

Specification

Displacement: 4·896 c.c. (·2955 cu. in.).
Bore: ·738 in.
Stroke: ·697 in.
Bore/stroke ratio: 1·06.
Bare weight: 7½ ounces.
Max. B.H.P.: ·465 B.H.P. at 14,000 r.p.m.
Max. torque: 39 ounce-inches at 10,000 r.p.m.
Power output: ·095 B.H.P. per c.c.
Power/weight ratio: ·062 B.H.P. per ounce.

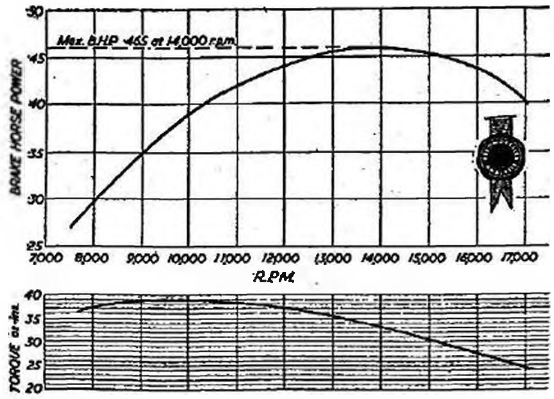
Material Specification

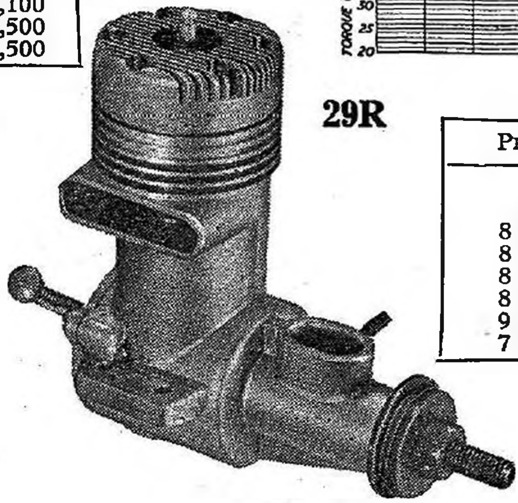
Crankcase unit: light alloy pressure die-casting.
Cylinder liner: alloy steel.
Piston: Meehanite.
Connecting rod: machined from 24 ST aluminium alloy.
Main bearing: Bearing bronze.
Crankshaft: alloy steel, surface hardened to Rockwell "C" '58.
Head: light alloy.
Spraybar: brass.

PROPELLER—R.P.M. FIGURES

Propeller dia. × pitch	r.p.m.
10 × 6 (Topflite)	12,500
12 × 4 (Trucut)	8,200
10 × 4 (Trucut)	10,000
11 × 4 (Trucut)	9,800
9 × 4 (Trucut)	13,700
8 × 8 (Trucut)	12,200
8 × 6 (Trucut)	14,500
8 × 4 (Trucut)	16,000
10 × 4 (Stant)	12,500
9 × 4 (Stant)	13,300
9 × 9 (Stant)	10,400
8 × 4 (Stant)	16,100
8 × 8 (Stant)	13,500
7 × 4 (Stant)	17,500

Fuel used: 20 per cent. nitromethane; 50 per cent methanol; 30 per cent Castor.





29R

Specification

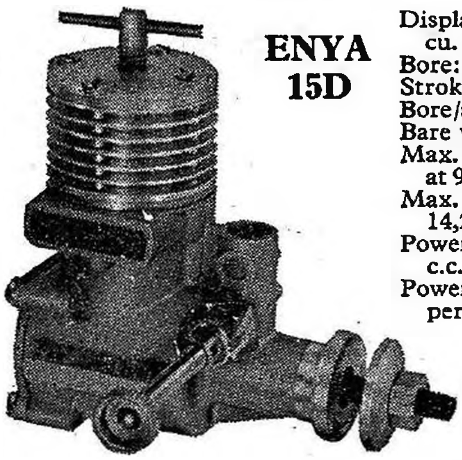
Bore: ·738 in.
Stroke: ·697 in.
Displacement: 4·896 c.c. (·298 cu. in.).
Bore/stroke ratio: 1·06.
Max. B.H.P.: approximate figure 0·61 at 17,500 r.p.m.
Bare weight: 9 ounces.
Power output: approximate figure ·125 B.H.P. per c.c.
Power/weight ratio: approximate figure ·068 B.H.P. per ounce.

FOX 29R

PROPELLER—R.P.M. FIGURES

Propeller dia. × pitch	r.p.m.
8 × 5 (Stant)	16,500
8 × 4 (Stant)	18,000
8 × 6 (Stant)	14,800
8 × 8 (Stant TR)	14,500
9 × 6 (Stant)	13,700
7 × 6 (Stant)	18,400

Fuel used: 50 per cent nitromethane; 25 per cent methanol; 25 per cent castor.



ENYA 15D

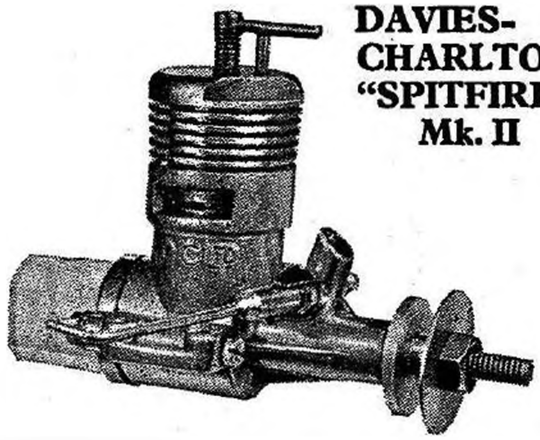
Specification

Displacement: 2·494 c.c. (·1517 cu. in.).
Bore: ·5895 in.
Stroke: ·5565 in.
Bore/stroke ratio: 1·06.
Bare weight: 5¼ ounces.
Max. torque: 22 ounce-inches at 9,000 r.p.m.
Max. B.H.P.: ·252 B.H.P. at 14,200 r.p.m.
Power rating: ·101 B.H.P. per c.c.
Power/weight ratio: ·049 B.H.P. per ounce.

Manufacturers:
Enya Metal Products Co.,
5533 Araicho Nakanoku,
Tokyo, Japan.

PROPELLER—R.P.M. FIGURES

Propeller dia. × pitch	r.p.m.
9 × 6 (Frog nylon)	9,400
9 × 4 (Stant)	10,400
8 × 9 (Stant)	13,500
8 × 5 (Stant)	12,500
8 × 6 (Stant)	11,000
7 × 6 (Stant)	13,600
7 × 4 (Stant)	15,000
9 × 3 (Tiger)	12,200
8 × 3½ (Tiger)	15,000
8 × 4 (Tiger)	14,000
6 × 9 (Tiger)	14,600
7 × 9 (Tornado)	12,000
11 × 4 (Trucut)	7,600
10 × 4 (Trucut)	8,000
9 × 4 (Trucut)	11,200
8 × 4 (Trucut)	13,600
7 × 4 (Trucut)	16,000
7 × 3 (Trucut)	17,300



DAVIES-CHARLTON "SPITFIRE" Mk. II

Manufacturers:
Davies-Charlton Ltd.,
Hill Meadows, Douglas, Isle of Man.
Retail price: £2/12/7 (including tax).

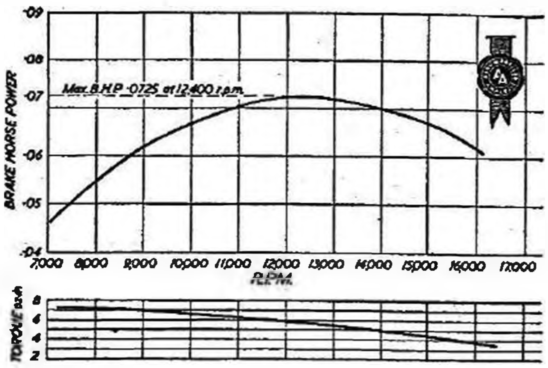
PROPELLER—R.P.M. FIGURES	
Propeller dia. × pitch	*r.p.m.*
6 × 4 (Stant)	12,200
6 × 5 (Stant)	11,800
6 × 6 (Stant)	10,300
7 × 4 (Stant)	9,800
7 × 6 (Stant)	8,500
8 × 3½ (Tiger)	9,700
8 × 4 (Tiger)	9,300
5 × 3 (Trucut)	15,400
6 × 3 (Trucut)	12,400
6 × 4 (Trucut)	11,500
7 × 4 (Trucut)	10,700

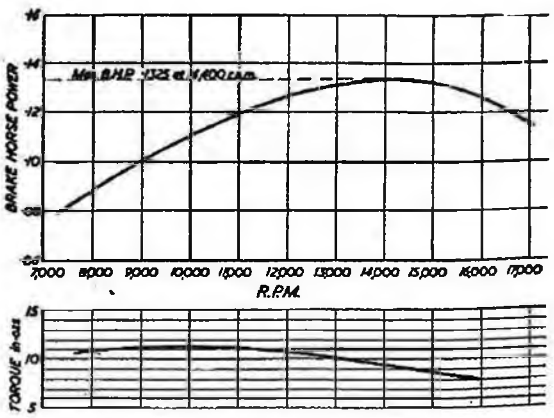
Specification

Displacement: ·9915 c.c. (·6053 cu. in.)
Bore: ·427 in.
Stroke: ·422 in.
Bore/stroke ratio: 1 : 1·01.
Weight (with tank): 3 ounces.
Max. B.H.P.: ·0725 at 12,400 r.p.m.
Max. torque: 7 ounce-inches at 8,000 r.p.m.
Power rating: ·073 B.H.P. per c.c.
Power/weight ratio: ·023 B.H.P. per ounce.

Material Specification

Crankcase: pressure die casting in light alloy.
Cylinder: hardened steel.
Contra piston: steel.
Piston: cast iron.
Connecting rod: light alloy forging.
Cylinder jacket: light alloy, anodised green.
Spraybar assembly: brass.
Tank: transparent acetate plastic.
Propeller shaft thread: 2 B.A.
Mounting bolts: 8 B.A.





Specification

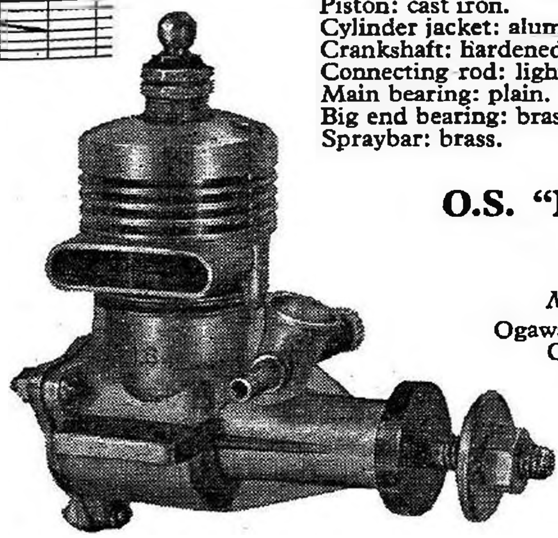
Displacement: 1·615 c.c. (·0985 cu. in.)
Bore: ·529 in.
Stroke : ·448 in.
Bore/stroke ratio: 1·18.
Bare weight: 2 ounces.
Max. B.H.P.: ·1325 at 14,400 r.p.m.
Max. Torque: 11·3 ounce-inches at 9,600.
Power rating: ·0825 B.H.P. per c.c.
Power/weight ratio: ·048 B.H.P. per ounce.

Material Specification

Crankcase unit: light alloy pressure die casting.
Cylinder: hardened steel.
Piston: cast iron.
Cylinder jacket: aluminium.
Crankshaft: hardened steel.
Connecting rod: light alloy die casting.
Main bearing: plain.
Big end bearing: brass bush.
Spraybar: brass.

PROPELLER—R.P.M. FIGURES	
Propeller dia. × pitch	*r.p.m.*
8 × 4 (Stant)	10,800
9 × 4 (Stant)	7,800
6 × 4 (Stant)	14,800
8 × 3 (Trucut)	10,800
7 × 4 (Trucut)	12,800
7 × 3 (Trucut)	15,000
6 × 4 (Trucut)	14,500
6 × 3 (Trucut)	15,500
8 × 3½ (Tiger)	12,000
8 × 4 (Tiger)	11,000
9 × 3 (Tiger)	8,900

Fuel used: 25 per cent castor, 75 per cent methanol, 10 per cent nitro-methane added.



O.S. "PET"

Manufacturers:
Ogawa Model Mfg. Co.,
Osaka, Japan.

List of British National Model Aircraft Records

As at July 31st, 1958

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.)		Northern Heights M.F.C.	18/ 8/1957	219 : 27

Power Driven

Class A...	Springham, H. E.	(Saffron Walden)	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)	17/11/1957	152.4 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/ 7/1957	159.7 m.p.h.
Class VII Jet	Stovold, R. V.	(Guildford)	25/ 9/1949	133.3 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 A (up to 30 sq. in.)	R. T. Parham	(Worcester)	23/ 2/1958	5 : 36
Class B (30-100 sq. in.)	R. C. Monks	(Birmingham)	14/ 4/1957	13 : 53
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.	M. Grimmett	(West Brom.)	13/ 4/1957	5 : 14
Helicopter	R. C. Monks	(Birmingham)	19/11/1954	5 : 01
Ornithopter	D. Poole	(Birmingham)	6/ 1/1957	1 : 52
Rotorplane	D. Poole	(Birmingham)	8/ 5/1955	1 : 26
Glider H.L.	H. O'Donnell	(Whitefield)	23/ 2/1958	0 : 37
Class B Paper covered	J. O'Donnell	(Whitefield)	23/ 2/1958	9 : 07
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)	10/12/1957	54.1 m.p.h.

WORLD AND INTERNATIONAL RECORDS

As at 31st July, 1958

ABSOLUTE WORLD RECORDS

	Duration	V. Cone & R. Chase	U.S.A.	7/ 7/1956	8 hr. 34 min. 21sc.
	Distance	Boricevitch, E.	U.S.S.R.	14/ 8/1952	378.756 km.
	Height	Lioubouchkine, G.	U.S.S.R.	13/ 8/1947	4,152 m.
	Speed	Benedek, G.	Hungary	27/10/1957	281 km/hr.

CLASS F-1-A RUBBER DRIVEN

No.					
1	*Duration*	Kiraly, M.	Hungary	20/ 8/1951	1 hr. 27 min. 17sc.
2	*Distance*	Benedek, G.	Hungary	20/ 8/1947	50,260 km.
3	*Height*	Poich, R.	Hungary	31/ 8/1948	1,442 m.
4	*Speed*	Davidov, V.	U.S.S.R.	11/ 7/1940	107.08 km/hr.

CLASS F-1-B POWER DRIVEN

5	*Duration*	Koulakovsky, I.	U.S.S.R.	6/ 8/1952	6 hr. 1 min.
6	*Distance*	Boricevitch, E.	U.S.S.R.	14/ 8/1952	378,756 km.
7	*Height*	Lioubouchkine, G.	U.S.S.R.	13/ 8/1947	4,152 m.
8	*Speed*	Stiles, E.	U.S.A.	20/ 7/1949	129.768 km/hr.

CLASS F-2-A HELICOPTERS—RUBBER DRIVEN

9	*Duration*	Evergary, G.	Hungary	13/ 6/1950	7 min. 43 sec.
10	*Distance*	Roser, N.	Hungary	9/ 4/1950	238 m.
11	*Height*	*No record established*			
12	*Speed*	*No record established*			

CLASS F-2-B HELICOPTERS—POWER DRIVEN

13	*Duration*	Maibaum, G.	Germany	9/ 8/1956	11 min. 18 sec.
14	*Distance*	Vorobiev, S.	U.S.S.R.	9/ 3/1958	11,920 m.
15	*Height*	*No record established*			
16	*Speed*	*No record established*			

CLASS F-3 GLIDERS

17	*Duration*	Toth, I.	Hungary	24/ 5/1954	4 hr. 34 min. 11 sc.
18	*Distance*	Szomolanyi, F.	Hungary	23/ 7/1951	139.8 km.
19	*Height*	Benedek, G.	Hungary	23/ 5/1948	2,364 m.

CLASS F-1-B RADIO CONTROLLED—POWER

20	*Duration*	Willard, K.	U.S.A.	15/ 4/1958	5 hr. 29 min.*
21	*Distance*	Gorinine, P.	U.S.S.R.	25/ 7/1955	12,961 km.
22	*Height*	Gobeaux, J-P.	Belgium	15/ 8/1955	1,142 m.
23	*Speed*	Gobeaux, J-P.	Belgium	12/ 7/1956	107 km/hr.

CLASS F-3 RADIO CONTROLLED GLIDERS

24	*Duration*	V. Cone & R. Chase	U.S.A.	7/ 7/1956	8 hr. 34 min. 21 sc.
25	*Distance*	*No record established*			
26	*Height*	*No record established*			

CONTROL LINE SPEED

27	*Category I* 0-2.5 c.c. ...	Sladky, J.	Czechoslovakia	13/10/1957	236 km/hr.
28	*Category II* 2.5-5 c.c.	Studeny, B.	Czechoslovakia	15/ 9/1957	244 km/hr.
29	*Category III* 5-10 c.c.	Berke, L.	Hungary	2/10/1954	255 km/hr.
30	*Category Jet*	Benedek, G.	Hungary	27/10/1957	281 km/hr.

(* Subject to confirmation)

MODEL SPECIFICATION FOR WORLD CHAMPIONSHIP FORMULA

Models with Rubber Motors

Class F.I, Group I

Models must conform to the "Wakefield" formula :

Total Area : 17-19 sq. decimetres.

Total Weight : 230 grammes minimum.

Total weight of the rubber motor (lubricated) : 50 grammes maximum.

Gliders

Class F.3

Models must conform to the "Nordic" formula :

Total Area : 32-34 sq. decimetres.

Total Weight : 410 grammes minimum.

Length of Launching Cable : 50 metres maximum.

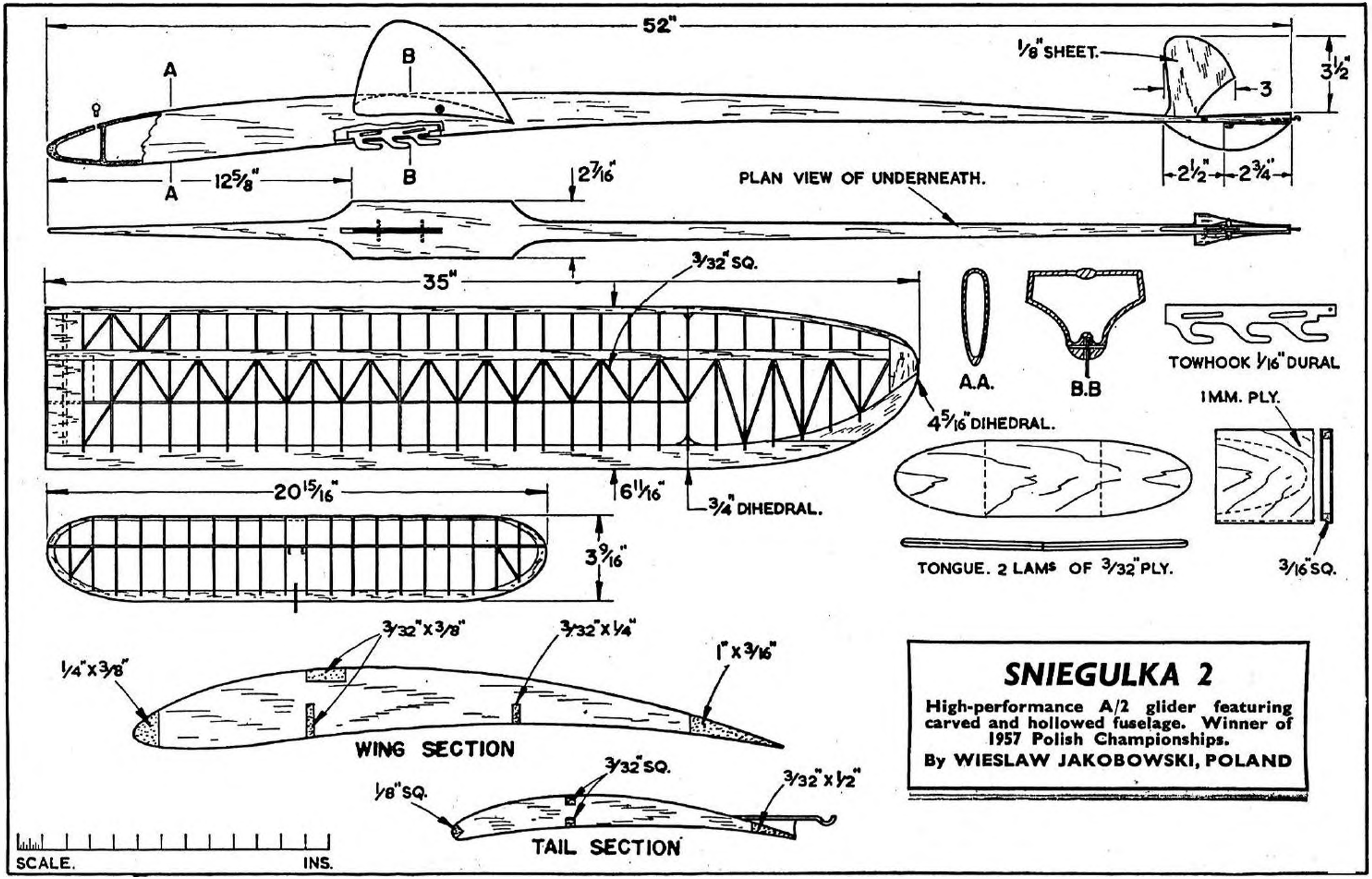
Models with Mechanical Motors

Class F.I, Group I

Motor : 2.5 c.c. maximum capacity.

Load per c.c. : 300 grammes.

Minimum Area Loading : 20 gr/dm2

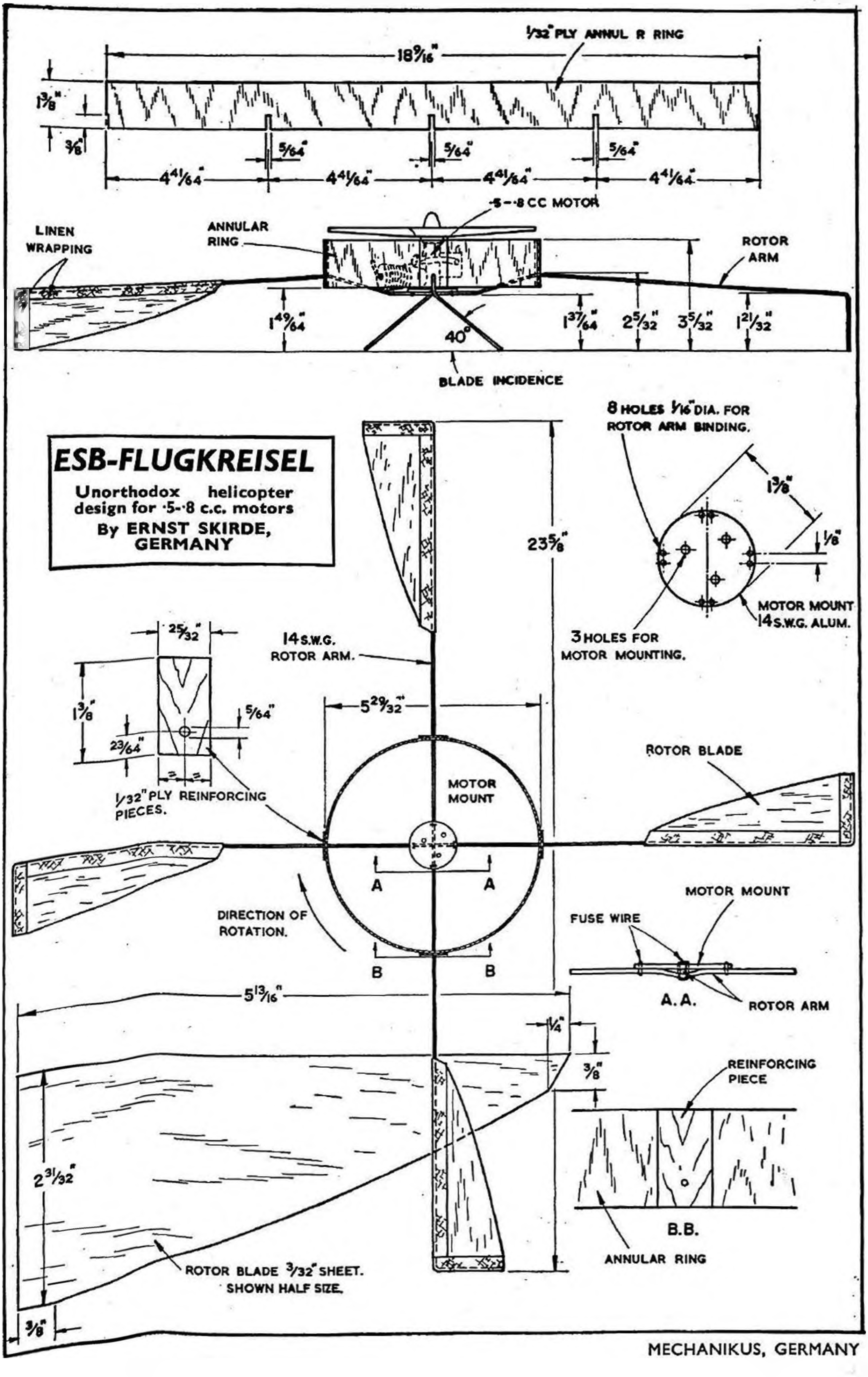


SNIEGULKA 2

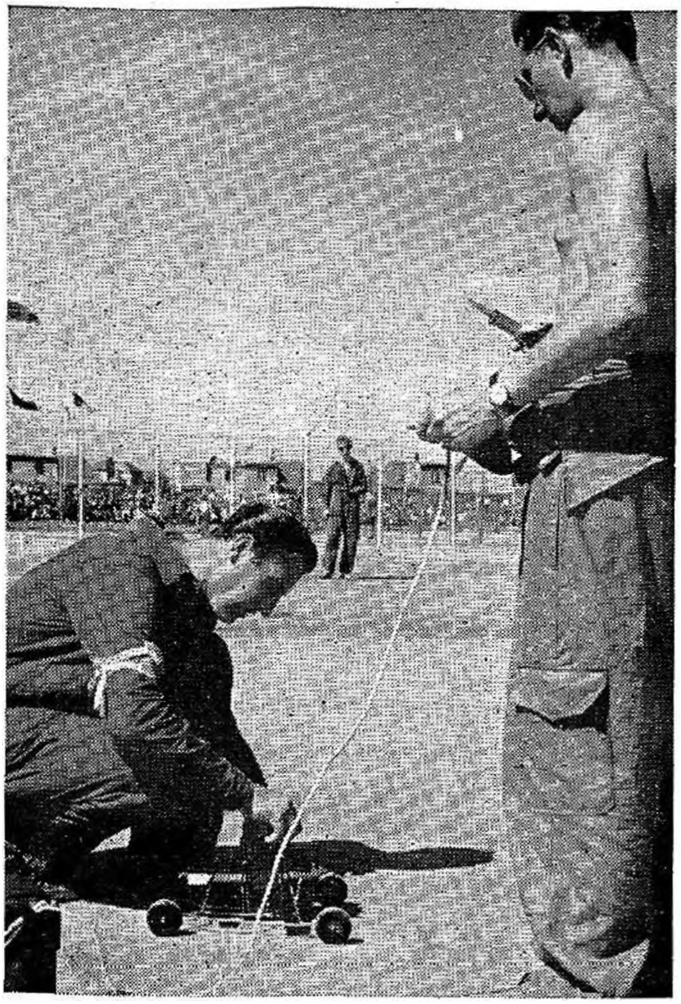
High-performance A/2 glider featuring carved and hollowed fuselage. Winner of 1957 Polish Championships.

By WIESLAW JAKOBOWSKI, POLAND

MODELLISMO, ITALY



MECHANIKUS, GERMANY



WORLD CONTROL LINE SPEED CHAMPIONSHIPS

Held at MLADY BOLESLAV CZECHOSLOVAKIA

August 10-11th, 1957

TEAM RESULTS

1	Czechoslovakia	638
2	Italy	599
3	Hungary ...	594
4	Russia ...	551
5	Sweden ...	499
6	Bulgaria ...	436
7	West Germany	349
8	Belgium ...	342
9	Great Britain	165
10	Finland ...	0

INDIVIDUAL RESULTS

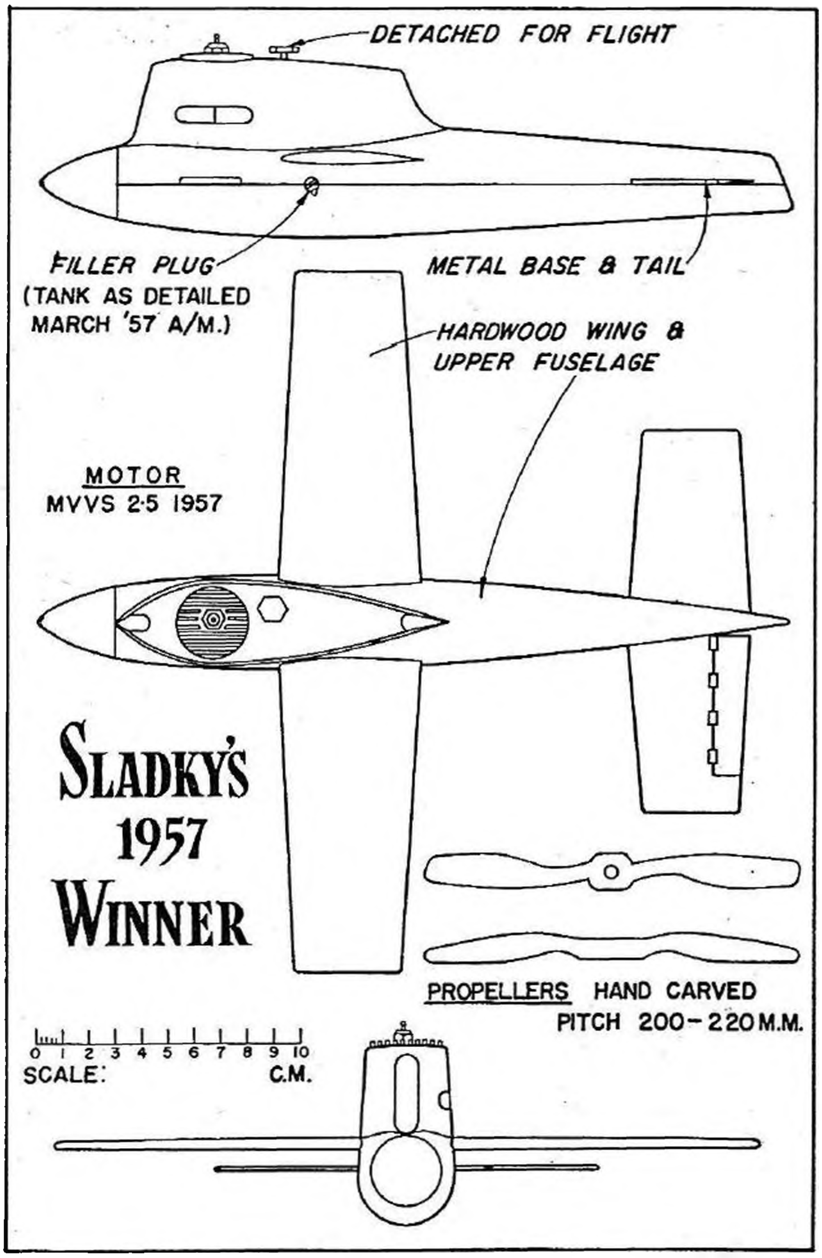
No.	Name	Country	Speed in k/hr. 1	2	3	Best in m.p.h.
1 ...	Sladky, J.	Czechoslovakia ...	205	211	216	134·3
2 ...	Zatocil, M.	Czechoslovakia ...	202	211	214	132·9
3 ...	Pastyrik, F.	Czechoslovakia ...	194	208	0	129·2
4 ...	Krizsma, C.	Hungary	205	0	203	127·3
5 ...	Smejkal, V.	Czechoslovakia ...	204	204	203	126·7
5 ...	Grandesso, Renzo ...	Italy	0	197	204	126·7
7 ...	Vitkovits, M. ...	Hungary	0	184	200	124·3
8 ...	Prati, A.	Italy	192	198	197	123·0
9 ...	Berselli, P. (Prati, A.)	Italy	189	197	180	122·4
10 ...	Vasilchenko, M. ...	Russia	194	185	191	120·5
11 ...	Beck. R.	Hungary	189	0	0	117·4
12 ...	Czizmarek, J. ...	Hungary	0	182	186	115·6
13 ...	Kuznecov, A. ...	Russia	159	184	184	114·3
14 ...	Gorziza, H.	W. Germany ...	0	163	180	111·8
15 ...	Hagberg, B.	Sweden	163	171	179	111·1
16 ...	Gajevski, O. K. ...	Russia	0	163	173	107·5
17 ...	Stouffs, H.	Belgium	0	165	171	106·2
17 ...	Deligne, P.	Belgium	0	160	171	106·2
19 ...	Bovin, L.	Sweden	0	0	169	105·0
19 ...	Frolich, J.	W. Germany ...	0	169	169	105·0

No.	Name	Country	Speed in k/hr. 1	2	3	Best in m.p.h.
21 ...	Natalenko, V.... ...	Russia	165	162	156	102·5
21 ...	Wright, L.	Great Britain	0	165	160	102·5
23 ...	Tinev, S.	Bulgaria	151	160	0	99·4
24 ...	Martinelle, B.... ...	Sweden	147	0	151	93·8
25 ...	Vasilev, I.	Bulgaria	0	0	141	87·6
26 ...	Raskov, K.	Bulgaria	0	0	134	83·3
27 ...	Boncev, L.	Bulgaria	0	0	0	0
28 ...	Cellini, A.	Italy	0	0	0	0
29 ...	Gibbs, R.	Great Britain	0	0	0	0
30 ...	Hagel, R.	Sweden	0	0	0	0
31 ...	Hamalainen, E. ...	Finland	0	0	0	0
32 ...	Jaaskelainen, K. ...	Finland	0	0	0	0

The 1957 Speed Championships were notable for the complete dominance of the Czechoslovakian team, who swept the board to take four of the first five places. Using special State Factory produced M.V.V.S. Vlatavan engines, the Czech team was remarkably well drilled and disciplined, teamwork being amply demonstrated in their quick getaway and lack of fuss. The winner, Sladky, invariably had his model airborne within 3 seconds of the prop. being flicked.

Main British contender, Ray Gibbs, was eliminated at the start of the contest when his record-holding motor exploded, the complete cylinder and head leaving the rest of the motor behind!

Italy and Hungary provided the most serious threat to the Czech equipe, but the Super Tigre and Alag motors did not have the urge of the local "specials."



WORLD GLIDER CHAMPIONSHIPS for SWEDISH CUP

Held at Mlady Boleslav, Czechoslovakia, August 9th, 1957

The 1957 Glider Championships were probably the most exciting of the series to date, with twenty countries competing in fine weather on the airfield at Mlady Boleslav, some thirty miles from Prague.

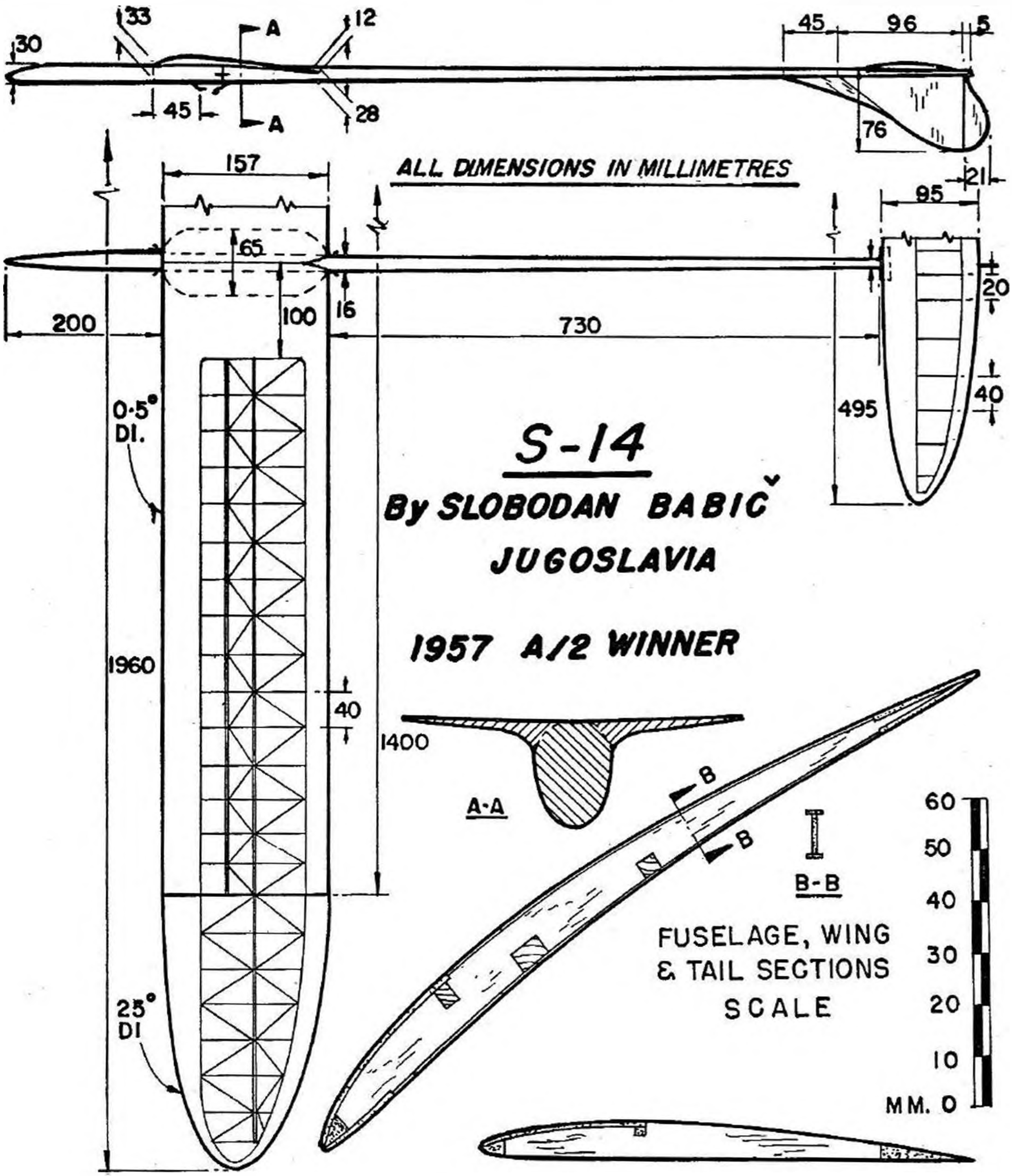
Although by the end of the contest, only Babic of Jugoslavia had a perfect score of five maximums, no less than six competitors had four 3-minute flights to their credit, and tension was extreme as Zsembery (Hungary) and Babic launched for the last flights of the contest.

A/2 INDIVIDUAL RESULTS

No.	Name	Country	1	2	3	4	5	Total
1 ...	Babic, S.	Yugoslavia	180	180	180	180	180	900
2 ...	Sokolov, —. ...	Russia ...	180	180	180	149	165	854
3 ...	Hadzovic, M. ...	Yugoslavia ...	180	180	180	180	117	837
4 ...	Simonov, —. ...	Russia ...	180	180	180	115	180	835
5 ...	Zsembery, F. ...	Hungary ...	180	180	180	180	114	834
6 ...	Michalek, J. ...	Czechoslovakia	180	91	180	180	180	811
7 ...	Kunz, H.	W. Germany	180	180	180	80	180	800
8 ...	Hannay, J.	Great Britain	75	180	180	180	180	795
8 ...	Hansen, H. ...	Denmark ...	180	152	103	180	180	795
10 ...	Medaglia, E. ...	Italy	180	180	180	94	158	792
11 ...	Tisutin, —. ...	Russia ...	171	73	180	180	180	784
12 ...	Thomas, M. ...	Canada ...	155	101	180	180	164	780
13 ...	Simon, C.	Hungary ...	180	180	66	155	180	761
14 ...	Huge, E.	Belgium ...	180	180	118	101	167	748
15 ...	Christenson, E. ...	U.S.A. ...	180	180	66	180	130	736
16 ...	Vuletic, M.	Yugoslavia ...	180	180	92	97	180	729
17 ...	Kalen, A.	Sweden ...	61	180	180	173	134	728
18 ...	Spulak, V. ...	Czechoslovakia	175	88	148	136	180	727
19 ...	Knoos, Per. S. ...	Sweden ...	180	180	70	180	113	723
20 ...	Varetto, C.	Italy	180	180	153	39	167	719

21 ...	Ciesielski, D. ...	W. Germany	180	180	53	123	180	716
22 ...	Hansen, B.	Denmark ...	180	77	150	128	180	715
23 ...	Hajek, H.	Czechoslovakia	109	180	180	180	54	703
24 ...	Neuman, H. ...	W. Germany	180	145	180	73	120	698
25 ...	Nielsen, H. ...	Denmark ...	180	173	104	180	60	697
26 ...	Guidici, G. ...	France ...	180	160	48	121	180	689
26 ...	Czepa, K.	Austria ...	94	170	133	112	180	689
28 ...	Hoadly, P. ...	U.S.A. ...	141	101	180	124	136	682
29 ...	Wiggins, E. ...	Great Britain	180	180	45	140	135	680
29 ...	Nilsson, N. ...	Sweden ...	180	37	180	180	103	680
31 ...	Van Camp, L. ...	Belgium ...	180	130	79	180	107	676
32 ...	Hach, W.	Austria ...	180	180	127	180	6	673
33 ...	Bausch, L.	Holland ...	95	77	180	180	139	671
34 ...	Zengen, L.	W. Germany	122	167	120	75	180	664
35 ...	Daley, J. (Ritz, G.)	U.S.A. ...	72	48	180	180	180	660
36 ...	Crawford, J. ...	Canada ...	180	180	55	63	180	658
37 ...	Tlapak, L.	Austria ...	180	154	111	127	78	650
38 ...	Niemela, S. ...	Finland ...	41	180	102	141	180	644
39 ...	Martin, J.	France ...	180	75	180	158	48	641
40 ...	Takko, S.	Finland ...	77	107	118	180	154	636
40 ...	Macejevski, E. ...	Poland ...	180	75	180	21	180	636
42 ...	Ree, A.	Hungary ...	71	161	89	133	180	634
43 ...	Horyna, V. ...	Czechoslovakia	111	128	180	148	63	630
44 ...	Dihn, J.	Poland ...	180	128	82	156	80	626
45 ...	Fontaine, J. ...	France ...	90	157	113	180	83	623
46 ...	Burgess, R. ...	Great Britain	87	180	180	86	88	621
47 ...	Frederikson, F. ...	Denmark ...	180	25	180	180	52	617
48 ...	Valjcev, A.	Bulgaria ...	166	180	45	104	121	616
49 ...	Tyrell, B.	Great Britain	180	96	52	106	180	614
50 ...	Possenti, A. ...	Italy	180	93	148	70	121	612
51 ...	Hagel, R.	Sweden ...	87	101	180	132	109	609
52 ...	Jastrembski, J. ...	Poland ...	63	180	126	114	116	599
53 ...	Mirdev, A.	Bulgaria ...	113	115	124	106	139	597
54 ...	Guilloteau, R. ...	France ...	126	140	180	79	71	596
55 ...	Vasiljev, —. ...	Russia ...	180	180	77	92	58	587
56 ...	Howie, R. (Feigl) ...	Australia ...	180	180	122	56	45	583
57 ...	Laframboise, J. (Sedivec) ...	Canada ...	41	151	180	88	114	574
58 ...	Hamalainen, E. ...	Finland ...	32	180	99	62	180	553
58 ...	Parucha, N. ...	Poland ...	180	69	85	102	117	553
60 ...	Rosen, N.	Hungary ...	36	71	180	180	84	551
61 ...	Karamitev, P. ...	Bulgaria ...	180	43	155	68	99	545
62 ...	Wilkins, A. ...	Belgium ...	81	93	180	68	118	540
63 ...	Petrovski, P. ...	Yugoslavia ...	180	26	118	71	130	525
63 ...	Buiter, A.	Holland ...	180	56	110	57	122	525
63 ...	Tennissen, A. ...	Holland ...	107	168	53	74	123	525
66 ...	Stojanov, M. ...	Bulgaria ...	45	119	180	63	116	523
67 ...	Smith, P.	Ireland ...	108	38	180	84	111	521
68 ...	Schirru, S.	Italy	41	59	180	78	103	461
69 ...	Etherington, W. (Prochazka) ...	Canada ...	155	92	52	49	86	434
70 ...	Cornellissen, G. ...	Holland ...	64	108	73	98	84	427

71 ...	Thomas, G. ...	U.S.A. ...	61	180	37	81	67	426
72 ...	Maes, J.	Belgium ...	106	27	48	94	39	314
73 ...	Schlederer, M. ...	Austria ...	0	69	39	66	89	263



A/2 TEAM RESULTS

		Points			Points			Points
1	Russia ...	2,473	8	Italy	2,123	15	Poland ...	1,861
2	Yugoslavia ...	2,466	9	Great Britain	2,096	16	Finland ...	1,833
3	Czechoslovakia	2,241	10	U.S.A. ...	2,078	17	Bulgaria ...	1,758
4	Hungary ...	2,229	11-12	Austria ...	2,012	18	Holland ...	1,721
5	West Germany	2,214	11-12	Canada ...	2,012	19	Australia ...	583
6	Denmark ...	2,207	13	Belgium ...	1,964	20	Ireland ...	521
7	Sweden ...	2,131	14	France ...	1,953			

Disciplined teamwork and a most serious observance of their obligations to the Hungarian Aero Club won both Wakefield and F.A.I. Power team awards for Hungary. Expertly managed by Rudi Beck (at left), the team soon acclimatised themselves to strong British winds, and individual power champ, Erno Frigyes, is seen here studying gusty conditions prior to making his last and vital flight with his heavily-loaded model (7.5 oz./sq. ft.)

WORLD CHAMPIONSHIPS 1958, for VICTOR TATIN CUP
Held at Cranfield, England, 3rd August, 1958

No.	Name	Country	1	2	3	4	5	Total
1 ...	Frigyes, E.	Hungary ...	180	180	170	180	180	890
2 ...	Hajek, V.	Czechoslovakia	180	164	180	180	180	884
3 ...	Baker, R. S. B. ...	Australia ...	174	150	180	180	180	864
4 ...	Stabler, R.	Germany ...	133	180	180	180	180	853
5 ...	Ordogh, L.	Hungary ...	126	180	180	180	180	846
6 ...	Bily, J.	Czechoslovakia	180	145	157	180	180	842
7 ...	Hormann, G. ...	Austria ...	147	157	177	180	180	841
8 ...	Glynn, K.	Great Britain	125	180	172	180	180	837
8 ...	Simonetta, A. ...	Italy ...	180	117	180	180	180	837
10 ...	Tuck, H.	Canada ...	180	162	154	180	160	836
11 ...	Dean, W. M. ... ... (Proxy, C. R. Wheeley)	U.S.A. ...	180	180	180	180	113	833
12 ...	Hagel, R. E.	Sweden ...	180	141	174	157	180	832
13 ...	Thompson, J. D. ...	Ireland ...	169	170	180	132	180	831
14 ...	Meczner, A.	Hungary ...	180	118	172	180	180	830
15 ...	Niemi, O.	Finland ...	180	180	180	180	105	825
16 ...	Pelczarski, T. ...	Poland ...	108	180	170	180	180	818
17 ...	Pecorari, V.	Italy ...	180	180	180	97	180	817
18 ...	Piesk, L.	Germany ...	180	180	135	180	141	816
19 ...	Suzuki, H. ... ... (Proxy, J. H. Manville)	Japan ...	164	180	121	169	180	814
20 ...	Collinson, A.	Great Britain	180	180	171	91	180	802
21 ...	Jays, V.	Great Britain	180	180	173	100	162	795
22 ...	Schier, W.	Poland ...	175	127	131	180	180	793
23 ...	Friis, H. O.	Sweden ...	180	139	161	180	132	792
24 ...	Vujic, M.	Yugoslavia ...	180	180	132	180	107	779
25 ...	Patterson, J. A. ...	U.S.A. ...	116	180	144	180	155	775

No.	Name	Country	1	2	3	4	5	Total
26 ...	Malina, Z.	Czechoslovakia	180	131	180	103	180	774
27 ...	Schenker, R.	Switzerland	177	68	180	180	161	766
28 ...	Castegnaro, G. ...	Italy ...	180	180	140	125	139	764
29 ...	Reis, F.	Austria ...	180	121	94	180	180	755
30 ...	Relander, J.	Finland ...	121	168	104	180	180	753
31 ...	Akesson, J. O. ...	Sweden ...	90	180	180	113	180	743
32 ...	Woods, D.	Ireland ...	180	180	60	151	171	742
33 ...	Cerny, R.	Czechoslovakia	180	30	180	180	167	737
34 ...	Raulio, H.	Finland ...	113	74	180	180	180	727
35 ...	Fontaine, J.	France ...	180	180	89	103	171	723
36 ...	Asano, T.	Japan ...	180	68	171	119	180	718
37 ...	Fresl, E.	Yugoslavia ...	100	138	160	180	139	717
38 ...	Conover, L. H. ...	U.S.A. ...	—	180	158	177	180	695
39 ...	Scepanovic, A. ...	Yugoslavia ...	52	180	144	180	130	686
40 ...	Resin, F.	Switzerland	180	112	115	150	125	682
41 ...	Morelli, A.	Ireland ...	180	—	137	168	180	665
42 ...	Gasko, M.	Hungary ...	151	123	150	119	120	663
43 ...	Novta, V.	Yugoslavia ...	122	147	88	106	180	643
44 ...	Ginalski, K.	Poland ...	180	68	92	180	121	641
45 ...	Beck, H.	Germany ...	141	117	115	180	82	635
46 ...	Bulukin, B. W. ...	Norway ...	152	180	62	110	120	624
47 ...	Elder, S.	Ireland ...	168	133	111	137	72	621
48 ...	Czinczel, W.	Germany ...	180	96	64	180	84	604
49 ...	Christensen, N. C. ...	Denmark ...	164	67	93	94	180	598
50 ...	Grappi, R.	Switzerland	108	110	180	17	180	595
51 ...	Karski, S.	Poland ...	180	76	147	180	—	583
52 ...	Piazzoli, C.	Italy ...	137	73	151	180	27	568
53 ...	Fahnrich, W.	Austria ...	53	178	60	180	94	565
54 ...	Czepa, K.	Austria ...	82	74	167	80	139	542
55 ...	Parry, G. E.	Canada ...	140	32	180	180	—	532
56 ...	Bickerstaffe, J. ...	Great Britain	180	118	180	—	—	478
57 ...	Perkins, C. C., Jr. ...	U.S.A. ...	—	115	166	83	109	473
58 ...	Schiltknecht, J.-P. ...	Switzerland	83	180	32	108	—	403
59 ...	Kristensen, F. D. ...	Denmark ...	66	75	47	135	75	398
60 ...	Skard, A.	Norway ...	116	26	109	15	111	377
61 ...	Etherington, W. C. ...	Canada ...	148	180	—	—	—	328
62 ...	Balasse, E.	Belgium ...	70	37	52	—	—	159
63 ...	Verheist, A.	Belgium ...	113	—	—	—	—	113
64 ...	Mackenzie, D. R. ...	Canada ...	93	17	—	—	—	110
65 ...	Karlsson, G.	Sweden ...	50	—	—	—	—	50

FRANJO KLUZ TROPHY—TEAM RESULTS

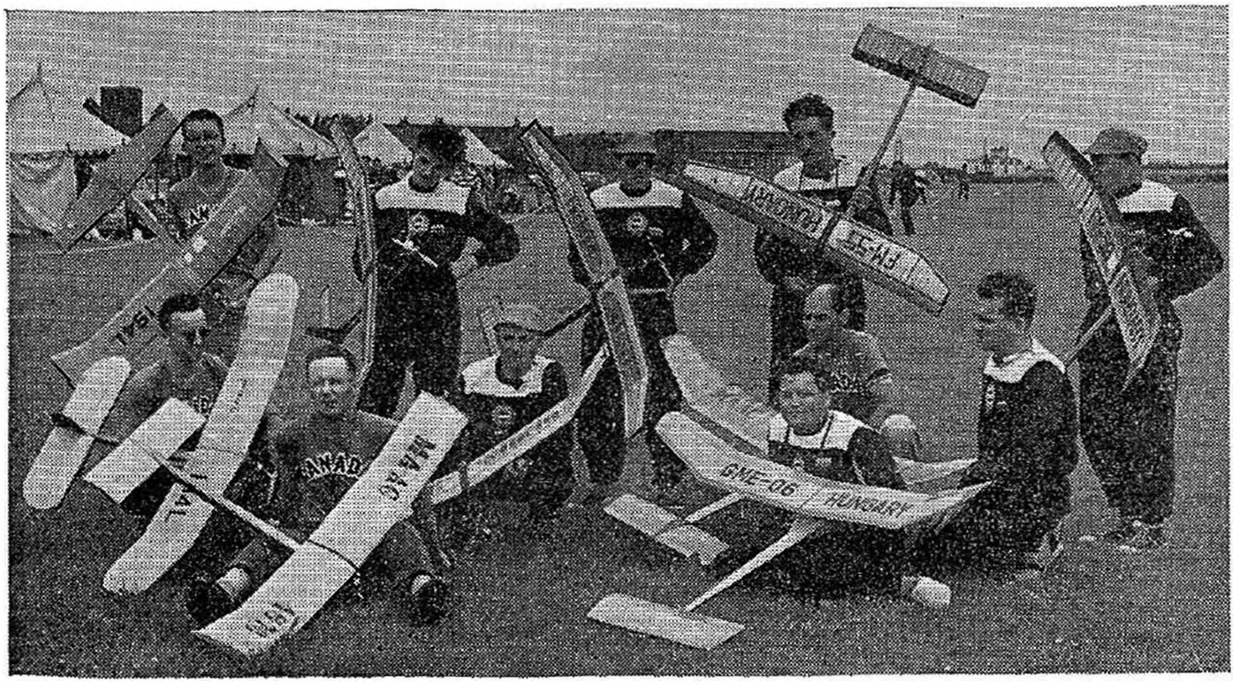
1	Hungary ...	2556	8	U.S.A. ...	2303	15	Japan ...	1532
2	Czechoslovakia	2500	9	Poland ...	2252	16	Norway ...	1001
3	Great Britain	2434	10	Ireland ...	2238	17	Denmark ...	996
4	Italy	2418	11	Yugoslavia ...	2182	18	Australia ...	864
5	Sweden ...	2367	12	Austria ...	2161	19	France ...	723
6	Finland ...	2305	13	Switzerland ...	2043	20	Belgium ...	272
7	Germany ...	2304	14	Canada ...	1696			

WORLD CHAMPIONSHIPS 1958, for WAKEFIELD CUP
Held at Cranfield, England, 4th August, 1958

Australian team-mate, Alan King, winner of 1954 Wakefield Trophy, holds for Bond Baker, the new 1958 champion, prior to the vital last flight which secured individual victory for the globe-trotting Queenslander.

Bottom: International camaraderie at Cranfield during lunch break as Canada and Hungarian teamsters group for a colourful picture in their light and dark blue modelling uniforms.

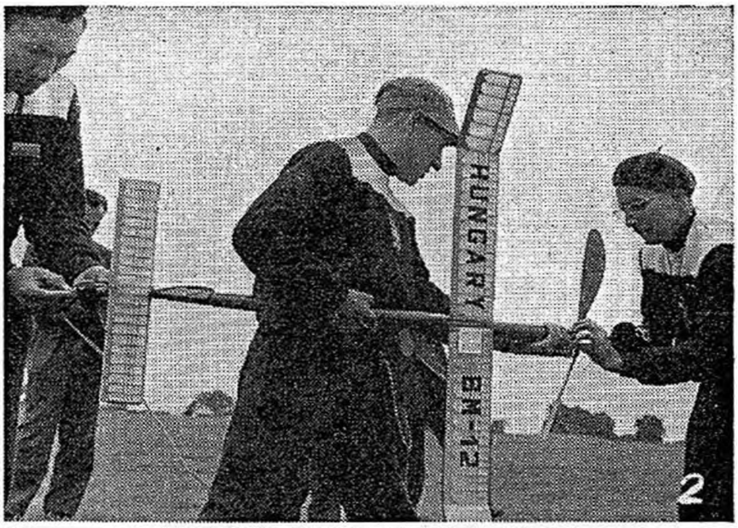
No.	Name	Country	1	2	3	4	5	Total
1 ...	Baker, R. S. B. ...	Australia ...	162	158	180	180	180	860
2 ...	Zurad, S.	Poland ...	180	116	180	180	168	824
3 ...	Johansson, R. K. E. ...	Sweden ...	133	146	180	180	180	819
4 ...	Scardicchio, V. ...	Italy ...	141	180	180	180	136	817
5 ...	Benedek, G.	Hungary ...	180	180	180	173	100	813
6 ...	Kennedy, D. R. ... (Proxy, E. A. Barnacle)	New Zealand	180	180	105	180	164	809



No.	Name	Country	1	2	3	4	5	Total
7 ...	Fea, G.	Italy ...	161	180	140	132	180	793
8 ...	Lefever, G. J. ...	Great Britain	180	98	180	180	126	764
9 ...	Azor, L.	Hungary ...	180	131	180	98	174	763
10 ...	Gordon, A.	Ireland ...	159	160	172	98	168	757
11 ...	Niemstaedt, E. ...	Denmark ...	145	180	180	64	180	749
12 ...	Popovic, K.	Yugoslavia ...	131	99	180	155	180	745
13 ...	Heidmuller, B. ...	Germany ...	180	159	161	180	61	741
13 ...	Widell, K. E. ...	Denmark ...	180	120	180	133	128	741
15 ...	Kothe, H. H. ...	U.S.A. ...	180	76	180	166	133	735
16 ...	Krizsma, G.	Hungary ...	180	180	180	35	153	728
16 ...	Cizek, R.	Czechoslovakia	142	180	180	148	78	728
18 ...	Dvorak, F.	Czechoslovakia	180	180	97	123	138	718
19 ...	Tomkovic, M. ...	Yugoslavia ...	141	180	161	59	173	714
20 ...	Palmer, J.	Great Britain	151	180	180	73	127	711
21 ...	Perineau, M. ...	France ...	173	180	180	21	155	709
22 ...	Draper, R.	Great Britain	180	128	180	116	100	704
23 ...	Balasse, E.	Belgium ...	98	180	77	174	163	692
24 ...	Tysklind, S. L. H. ...	Sweden ...	141	180	180	71	112	684
25 ...	Carroll, J. J.	Ireland ...	125	177	159	56	166	683
26 ...	Fresl, E.	Yugoslavia ...	135	158	180	75	125	673
27 ...	Smolders, J. J. ...	Netherlands	101	180	119	180	86	666
28 ...	Reich, G. A.	U.S.A. ...	150	161	100	180	73	664
29 ...	Simerda, A.	Czechoslovakia	180	112	180	180	6	658
29 ...	Hassny, K.	Poland ...	178	97	178	108	97	658
31 ...	Licen, A.	Italy ...	180	180	77	103	109	649
32 ...	Oswald, A.	Germany ...	105	163	33	180	164	645
32 ...	Hertsch, K.	Germany ...	127	168	84	86	180	645
34 ...	Mackenzie, D. R. ...	Canada ...	139	178	125	94	103	639
35 ...	Grunbaum, P. ...	Austria ...	81	180	180	134	57	632
36 ...	Malkin, J. ... ... (Proxy, R. Baldwin)	New Zealand	148	129	117	76	144	614
37 ...	Bluhm, P.	France ...	180	106	94	117	105	602
38 ...	Hamalainen, E. ...	Finland ...	162	59	104	167	105	597
39 ...	Hakansson, E. ...	Sweden ...	97	180	84	52	180	593
40 ...	Wong, R. ... ... (Proxy, D. Greaves)	New Zealand	110	139	126	102	111	589
41 ...	Visser, P. W.	South Africa	180	85	60	82	180	587
42 ...	Barnes, A. ... ... (Proxy, D. Latter)	New Zealand	88	129	125	145	92	579
43 ...	Kekkonen, A. ...	Finland ...	180	180	74	134	—	568
43 ...	Dormann, H. ...	Germany ...	180	135	72	69	112	568
45 ...	Suter, H.	Switzerland	180	87	180	77	28	552
46 ...	Cannizzo, S. J. ...	U.S.A. ...	180	84	116	85	74	549
47 ...	Hegglin, E.	Switzerland	106	82	148	156	55	547
48 ...	Balasse, Mme. O. ...	Belgium ...	180	116	180	65	—	541
48 ...	Cheurlot, M.	France ...	101	153	55	175	57	541
50 ...	Durhager, H. ...	Austria ...	84	180	91	83	97	535

1. Polish Stanislaw Zurad, placed second in Wakefield with an interesting folding-fuselage, long moment model, was second in the 1958 East European Championships. 2. Doyen of Wakefielders, G. Benedek, is aided by power champion Frigyes and Manager Beck, prior to last flight which might have won the Wakefield for him, but was gusted down during glide. 3. Lazlo Ordogh placed fifth in Power with Mach I model with potent performance. 4. R. Stabler, youthful German reserve, placed fourth with Webra 1.5 models using intricate wing structure. 5. Among the technically interesting designs was that sent by Nonaka, of Japan, with 64 in. wing, flown proxy by Fred Boxall. Unsuited to strong wind conditions, it performed admirably in calm, trim air, but was unstable during contest. 6. Vladimir Hajek, popular young Czech flier, placed second in power with good consistency, uses old rule F.A.I. model with sheet lead ballast in rear section of wing pylon. 7. Topmost British power flier, Ken Glynn, placed eighth, had short first flight due to use of " hot " fuel, giving false ground settings prior to release.


1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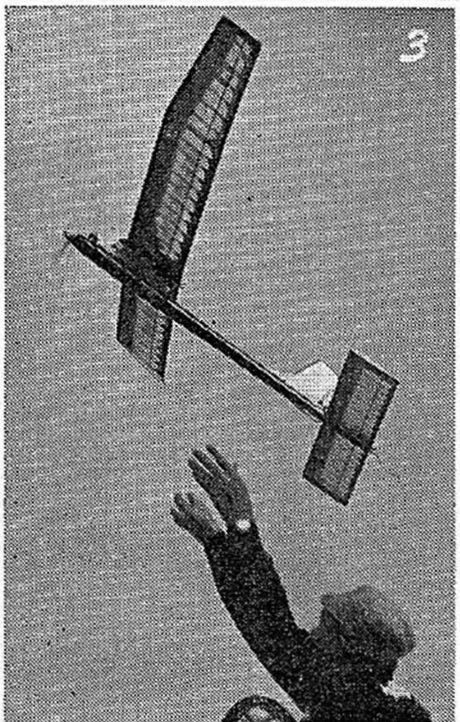
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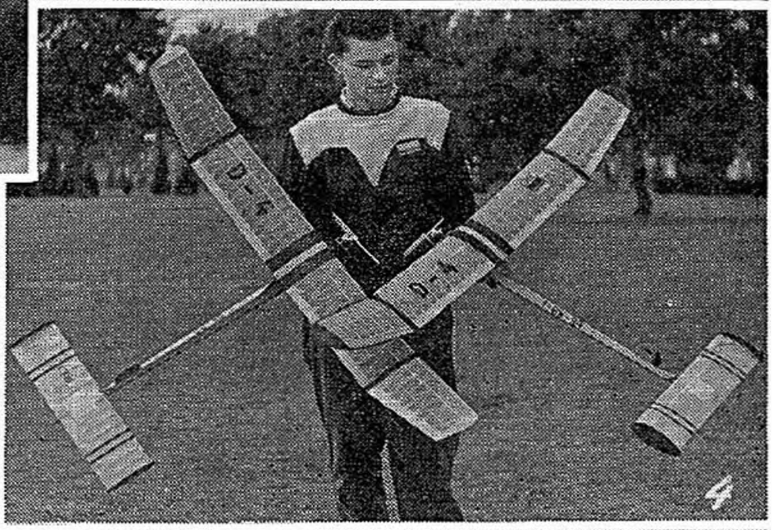
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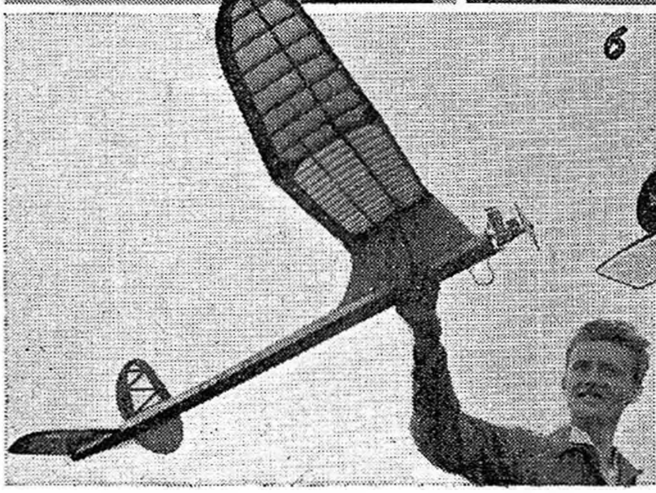
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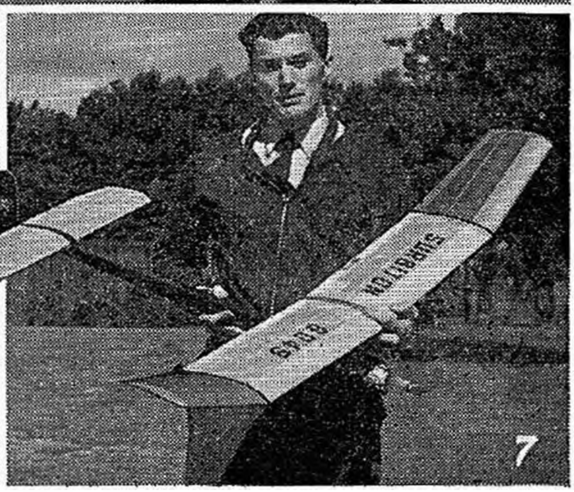
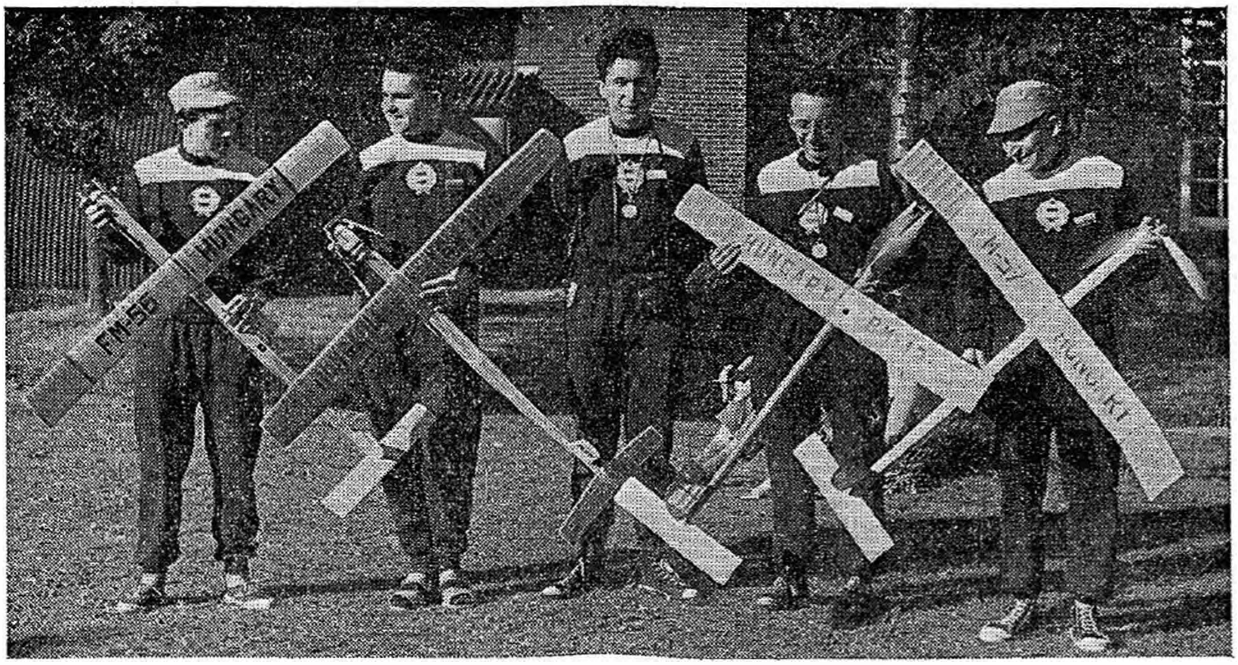

7

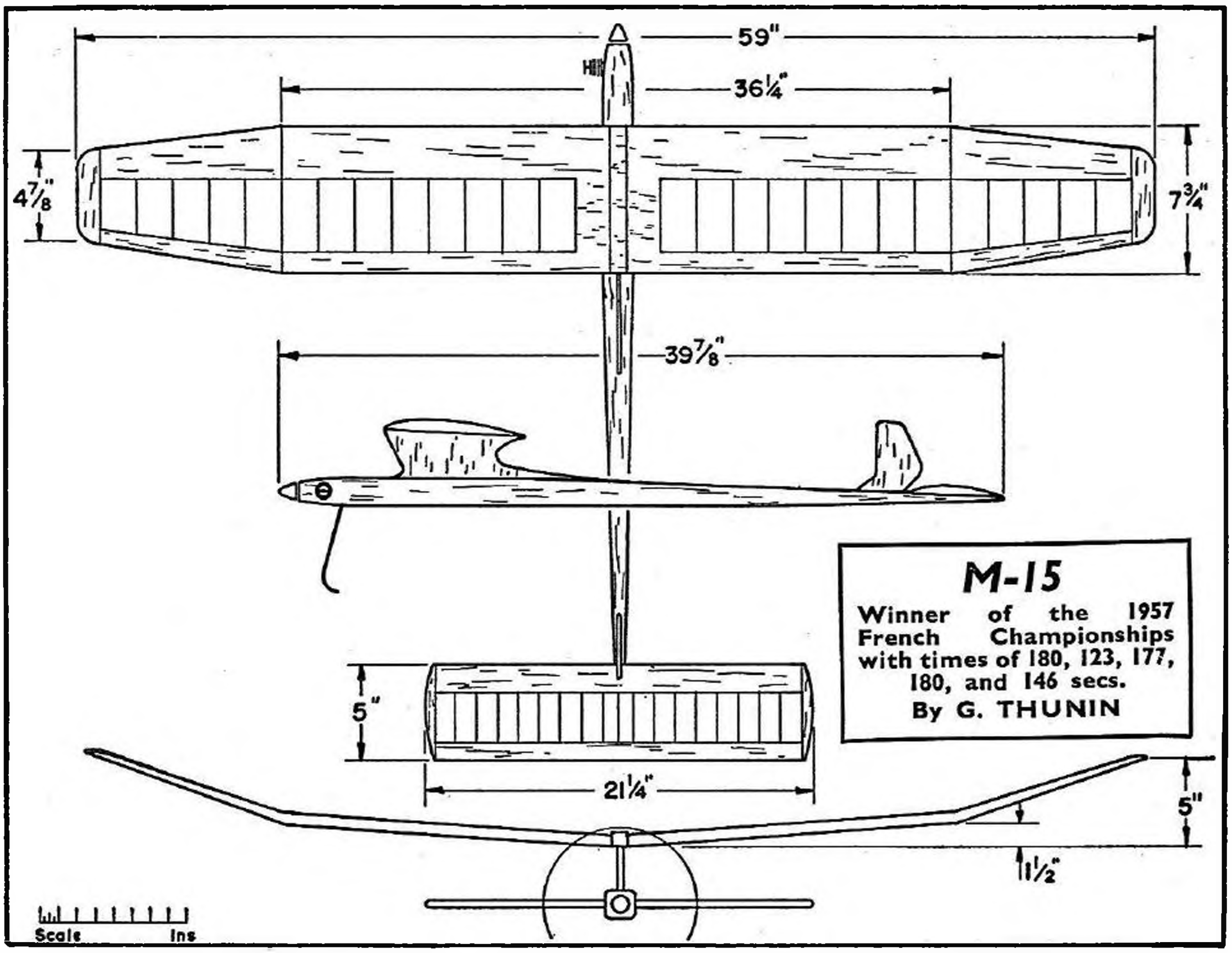
No.	Name	Country	1	2	3	4	5	Total
51 ...	Blomqwist, M. U. ...	Sweden ...	180	81	132	60	47	500
52 ...	Frigyes, E.	Hungary ...	116	180	96	100	—	492
53 ...	Chinchella, B. ... (Proxy, A. King)	Australia ...	163	49	84	79	106	481
54 ...	Taberna, S.	Italy ...	63	180	46	85	105	479
55 ...	Kossowski, A. ...	Poland ...	73	138	153	71	37	472
56 ...	Niestoj, W.	Poland ...	109	113	90	73	82	467
57 ...	Onishi, M. ... ... (Proxy, P. Read)	Japan ...	83	129	52	63	135	462
57 ...	Takko, S.	Finland ...	65	72	118	142	65	462
59 ...	Radovan, R.	Yugoslavia ...	80	92	12	180	90	454
60 ...	Newquist, F. A. ...	U.S.A. ...	122	96	180	52	—	450
61 ...	Hyvarinen, R. ...	Finland ...	180	87	89	83	1	440
62 ...	Muzny, L.	Czechoslovakia	131	102	75	56	69	433
63 ...	Doyle, M.	Ireland ...	100	47	180	95	3	425
64 ...	Ranta, S.	Canada ...	62	78	70	78	136	424
65 ...	Schnurer, H.	Austria ...	96	162	44	62	43	407
65 ...	Gordon, R. C. ...	Canada ...	162	53	106	86	—	407
67 ...	Etherington, W. C. ...	Canada ...	180	45	27	42	82	376
68 ...	Overlaet, G.	Belgium ...	82	60	64	98	60	364
69 ...	Nonaka, S. ... ... (Proxy, F. H. Boxall)	Japan ...	62	113	—	68	86	329
70 ...	Czepa, O.	Austria ...	83	38	36	95	42	294
71 ...	Guilloteau, R. ...	France ...	—	86	100	36	66	288
72 ...	O'Donnell, J. ...	Great Britain	150	8	78	—	—	236
73 ...	Meyer, J.	Switzerland	85	80	—	—	—	165

ALPHONSE PENAUD CUP—TEAM AWARD

1	Hungary ...	2304	7	Germany ...	2031	13	Finland ...	1627	19	Switzerland	1264
2	Italy ...	2259	8	New Zealand	2012	14	Belgium ...	1597	20	Japan ...	791
3	Great Britain	2179	9	Poland ...	1954	15	Austria ...	1574	21	Netherlands	666
4	Yugoslavia	2132	10	U.S.A. ...	1948	16	Denmark ...	1490	22	South Africa	587
5	Czechoslovakia	2104	11	Ireland ...	1865	17	Canada ...	1470			
6	Sweden ...	2096	12	France ...	1852	18	Australia ...	1341			

Victorious Hungarian Wakefield team, Azor, Krizsma, Manager Beck, Benedek, Frigyes. Note use of long tail moments and short, powerful motors.

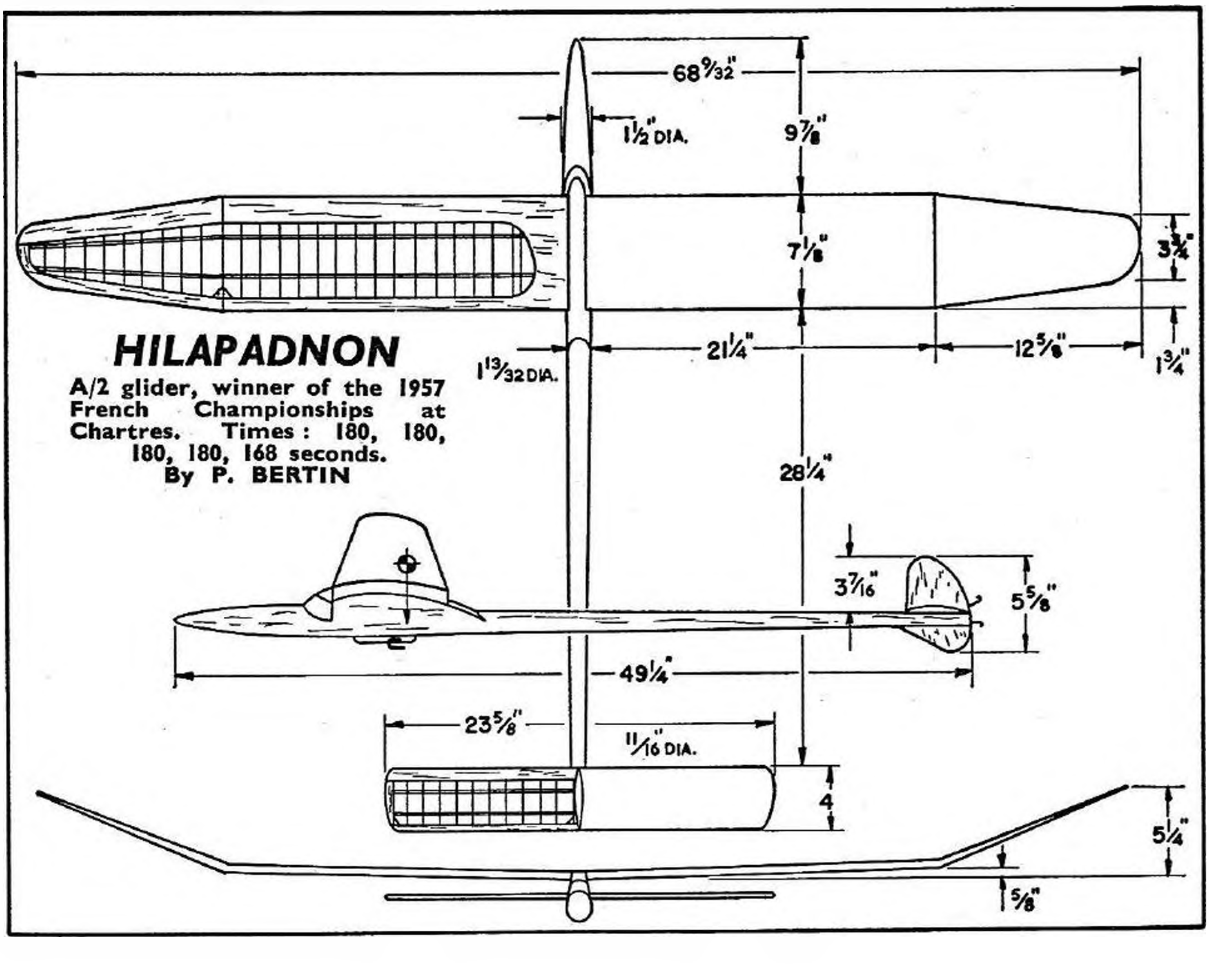




M-15

Winner of the 1957 French Championships with times of 180, 123, 177, 180, and 146 secs.

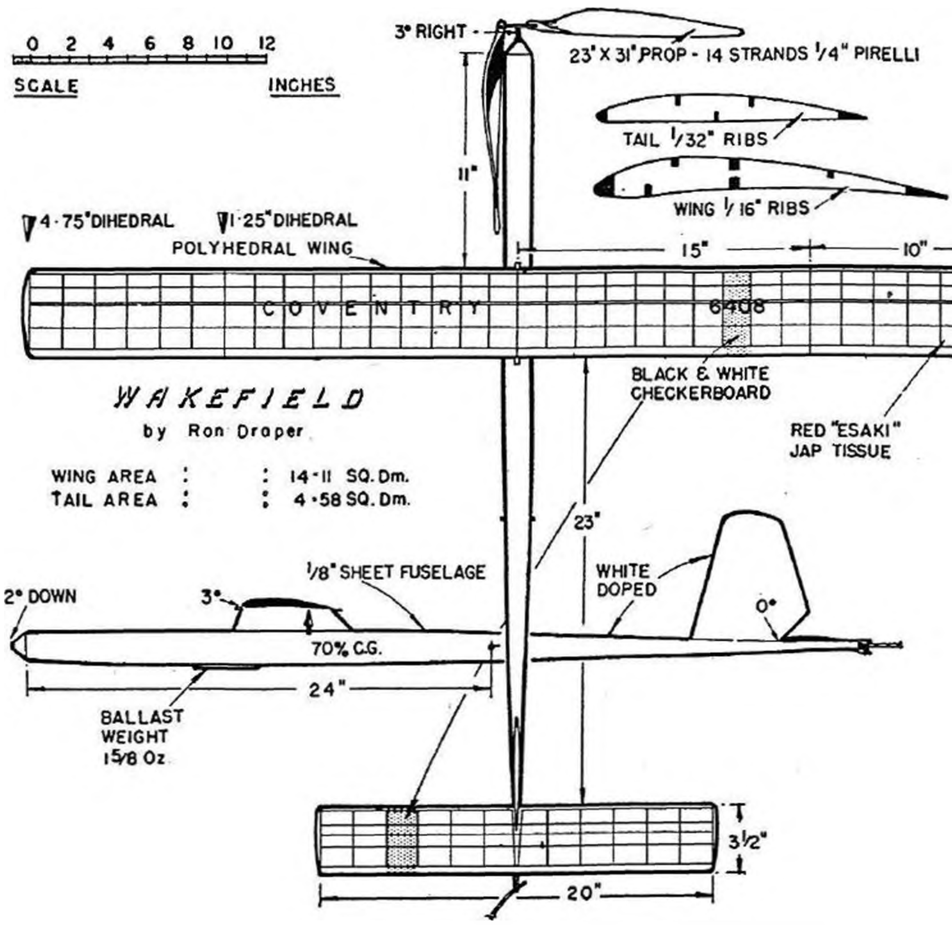
By G. THUNIN



HILAPADNON

A/2 glider, winner of the 1957 French Championships at Chartres. Times: 180, 180, 180, 180, 168 seconds.

By P. BERTIN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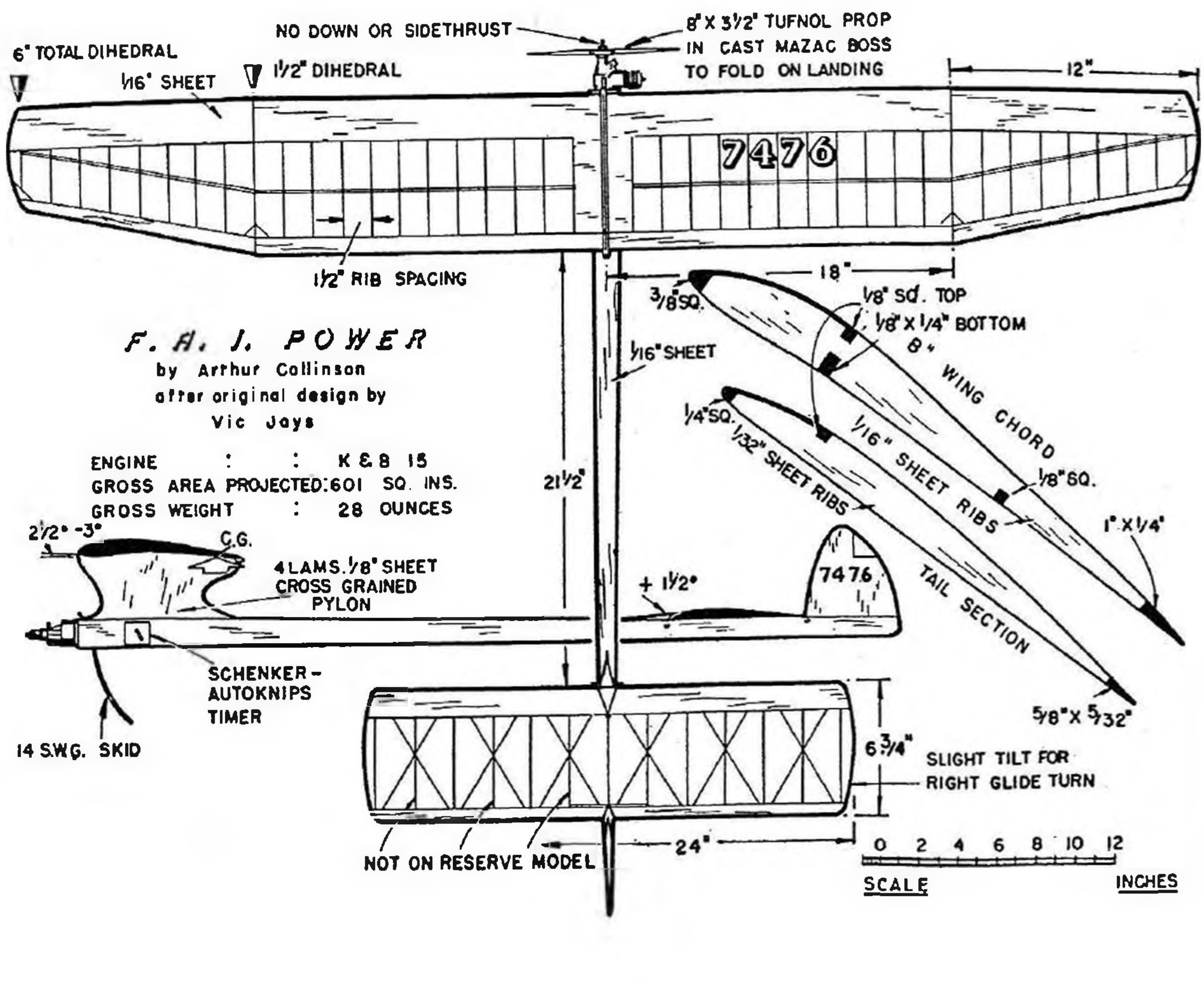
TAIL 1/32" RIBS
WING 1/16" RIBS
11"
4·75° DIHEDRAL
1·25° DIHEDRAL
POLYHEDRAL WING
15"
10"
COVENTRY
6408
4 1/2"
BLACK & WHITE CHECKERBOARD
RED "ESAKI" JAP TISSUE
WAKEFIELD
by Ron Draper
WING AREA : 14·11 SQ. Dm.
TAIL AREA : 4·58 SQ. Dm.
23"
1/8" SHEET FUSELAGE
WHITE DOPED
2° DOWN
3°
0°
70% C.G.
24"
BALLAST WEIGHT 1 5/8 Oz
3 1/2"
20"


NO DOWN OR SIDETHRUST
8" X 3 1/2" TUFNOL PROP IN CAST MAZAC BOSS TO FOLD ON LANDING
6° TOTAL DIHEDRAL
1/16" SHEET
1 1/2" DIHEDRAL
12"
7476
1 1/2" RIB SPACING
18"
3/8 SQ.
1/8" SQ. TOP
1/8" X 1/4" BOTTOM
8" WING CHORD
1/16" SHEET
1/4" SQ.
1/32" SHEET RIBS
1/16" SHEET RIBS
1/8" SQ.
1" X 1/4"
TAIL SECTION
5/8" X 5/32"
F. A. I. POWER
by Arthur Collinson
after original design by
Vic Jays
ENGINE : K & B 15
GROSS AREA PROJECTED : 601 SQ. INS.
GROSS WEIGHT : 28 OUNCES
21 1/2"
2 1/2° -3°
C.G.
4 LAMS. 1/8" SHEET CROSS GRAINED PYLON
+ 1 1/2°
7476
SCHENKER - AUTOKNIPS TIMER
14 S.W.G. SKID
6 3/4"
SLIGHT TILT FOR RIGHT GLIDE TURN
NOT ON RESERVE MODEL
24"
0 2 4 6 8 10 12
SCALE INCHES

CONTEST RESULTS

Members of the 1958 British Wakefield Team look satisfied with their efforts ! From left to right: R. Draper of Coventry (1956 World Power Champion), J. Palmer (Croydon D.M.A.C.), John O'Donnell of Whitefield, and Geoff Lefever (South Essex), both of whom were members of the 1956 Wakefield Team which competed in Sweden.

Results of S.M.A.E. Contests for balance of 1957 Season are included in this report to complete records. Those 1958 events which have been decided before going to press are also included, and will be completed in next year's "Aeromodeller Annual".

August 4th, 1957—NORTHERN GALA *Centralised*

"FLIGHT" CUP (*54 entries*) *U/R Rubber*

1	Lennox, R.	Birmingham	12 : 00
2	Burwood, R.	Surbiton	11 : 09
3	O'Donnell, H.	Whitefield	10 : 59
4	Rhead, B.	Wigan	10 : 31
5	Crossley, P.	Blackheath	10 : 26
6	O'Donnell, J.	Whitefield	10 : 08

C.M.A. CUP (*83 entries*) *U/R Glider*

1	Swinden, R.	Darlington	8 : 52
2	Ellison, I.	Eng. Electric	7 : 41
3	French, G. L.	Laindon	7 : 27
4	Bunch, B.	Scunthorpe	7 : 17
5	Cliff, W.	Prestwick	6 : 55
6	Harrison, K.	Darlington	6 : 35

FROG SENIOR CUP (*87 entries*) *U/R Power*

1	Broomfield, R.	Middlesbrough	10 : 27
2	Lanfranchi, S.	Baildon	9 : 52
3	Worley, N.	Southampton	9 : 31
4	Gaster, M.	Surbiton	9 : 19
5	Halls, J.	York	8 : 17
6	Collinson, A.	Baildon	8 : 08

PAN AMERICAN CUP *1 c.c. Payload* (*19 entries*)

1	Robson, A. M.	Stockton	5 : 43
2	Muller, P.	Surbiton	4 : 23
3	Firth, R.	York	3 : 31
4	Jays, V.	Surbiton	3 : 04
5	Roberts, G.	Lincoln	2 : 49
6	Faulkner, B.	Cheadle	2 : 42

RIPMAX TROPHY (*13 entries*) *Radio*

			Pts.
1	Budding, H.	York	326·2
2	Nixon, J.	North Lincs	157·5
3	Donahue, R.	Kersal	110·0
4	Craggs, R.	North Lincs	108·7
5	Curtiss, M.	C/Member	92·5
6	Nield, W. S.	Cheadle	83·7

TEAM RACE "A"

1 Lawton, —. Perth

TEAM RACE "B"

1 Irvine, R. Perth

SPEED

Class I	Morgan, D.	82 m.p.h.
Class II	Hall, D.	130 m.p.h.
Class III	Drewell, —.	141 m.p.h.

UNITED KINGDOM CHALLENGE MATCH

England	15 points
Scotland	9 points

August 25th, 1957—SOUTH MIDLAND AREA RALLY

Glider			
1	Lefever, G.	S. Essex	3 : 30
2	Thorpe, —.	Long Eaton	3 : 19
3	Posner, D.	Surbiton	3 : 01
Power			
1	Draper, R.	Coventry	3 : 46
2	Cox, —.	St. Albans	3 : 40
3	Jays, V.	Surbiton	1 : 43

Rubber		
1 Lennox, R.	Birmingham	4 : 00
2 Hawkins, —.	W. Middlesex	2 : 40
3 Moore, —.	Leamington	1 : 43
Combat		
1 Grimmett, —.	W. Bromwich	
2 Sadler, B.	Derby	
3 Spencer, B.	Littleover	
Team Race A		
1 Hartwell, P.	Enfield	10 : 06
2 Stephens, —.	Belfairs	10 : 32
3 Goodall, —.	Burton	10 : 49
Team Race B		
1 McGoun, S.	West Essex	7 : 10
2 Tuthill, R.	Enfield	

September 15th, 1957—AREA

HALIFAX TROPHY (70 *entries*) *U/R Power*

1 West, J.	Southern Cross	16 : 00
2 Posner, D.	Surbiton	10 : 47
3 Bickerstaffe, J.	Rugby	10 : 29
4 Jones, B. D.	Epsom	10 : 19
5 Lennox, R.	Birmingham	10 : 16
6 Smith, T. W.	Eng. Electric	10 : 14

MODEL ENGINEER CUP (32 *clubs*)

Team Glider

1 Henley	24 : 37
2 Surbiton	24 : 18
3 Bournemouth	24 : 10
4 Leamington	23 : 10
5 Croydon	22 : 52
6 Southampton	22 : 20

September 22nd, 1957—ALL BRITAIN RALLY

Open Rubber Duration		
T. Chambers	Stockton	8 : 04
Open Glider Duration		
Greygoose, R. G.	Anglia	8 : 47
Open Power Duration		
Straker, A. J.	Springpark	6 : 56
Wakefield New Rules		
Elliot, N. P.	Men of Kent	6 : 54
Concours Scale	Milani, Capt. C.	SPAD XIII
Concours Non-Scale		
Jays, V.	Surbiton	Gastove
Concours Unorthodox		
Woolls, G.	Bristol	Warren-Young Wing
Seaplane Rubber and "Aeromodeller" Trophy		
Walker, G.	Birmingham	4 : 33
Seaplane Power		
Dumble, M. J.	Epsom	3 : 01
Tailless Rubber		
Marshall, J.	Hayes	3 : 19
Tailless Glider		
Giggle, P.	Coventry	6 : 39
Tailless Power		
Fisher, O. F.	Coventry	0 : 46
Team Race A		
Yeldham, G.	Belfairs	8 : 13
Team Race B		
Tuthill, R. J.	Enfield	8 : 13
Clipper Cargo		
Poole, D.	Birmingham	29 oz.
Rally Champion		
Marshall, J.	Hayes	

Number of Clubs competing: 105.

AEROMODELLER "GOLDEN WINGS" CONTEST

						Total
1 Evatt, M. A. C.	Northampton	76	57	32	165	secs.
2 Greaves, D.	Leamington Spa	41	29	73	143	„
3 Stanley, R. C.	Surbiton	27	45	57	129	„
4 Martin, A.	Bedford	36	30	61	127	„
5 Toyer, D.	Irchester	22	46	51	119	„
6 Rogers, C.	Reading	31	30	37	98	„

September 29th, 1957—S.M.A.E. TEAM RACING

Class A (6 *entries*)		
1 Perry, D.	Thameside	11 : 13
2 Giles, G. A.	West Hants	11 : 55
Class A (32 *entries*)		
1 Baxter, F.	Wharfedale	8 : 10
2 Edmunds, R. J.	High Wycombe	8 : 36
Class B (8 *entries*)		
1 Lawton, S. B.	Macclesfield	8 : 22
2 Giles, G. A.	West Hants	10 : 35

October 13th, 1957—AREA

FARROW SHIELD (28 *clubs*) *Team Rubber*

1 Croydon	48 : 00
2 Birmingham	47 : 32
3 Bristol and West	42 : 40
4 Whitefield	42 : 21
5 Halifax	38 : 29
6 Surbiton	36 : 49

(Croydon members recorded maximum possible score)

K. & M.A.A. CUP (176 *entries*) *U/R Glider*

1 Willis, N.	Anglia	12 : 47
2 Wisher, A.	Surbiton	11 : 54
3 Down, J.	South Bristol	9 : 00
4 Waldron, J.	Henley	8 : 58
5 Chadwick, J.	Ashton	8 : 45
6 Illsley, D.	Birmingham	8 : 41

October 27th, 1957 *Decentralised*

HAMLEY TROPHY (49 *entries*) *U/R Power*

1 Stenning, D. W.	C/Member	12 : 00
2 Gaster, M.	Surbiton	11 : 05
3 Fuller, G.	St. Albans	11 : 04

FROG JUNIOR CUP (14 *entries*)

U/R Rubber-Glider

1 Chapman, B.	Hayes	7 : 18
2 Manviell, P.	Bournemouth	5 : 52
3 Greaves, D.	Leamington	5 : 13

WOMEN'S CHALLENGE CUP

Pepper, Miss M. Southampton

1957 SENIOR CHAMPION
O'Donnell, J. Whitefield

1957 JUNIOR CHAMPION
Greaves, D. Leamington

1957 RADIO CHAMPION
Nixon, J. North Lincs

1957 SPEED CHAMPION
Irvine, R. Perth

1957 CHAMPION CLUB
Surbiton M.A.C.

February 23rd, 1958—INDOOR NATIONALS (Manchester)

MICROFILM CLASS (16 *entries*)

1 Read, P.	Birmingham	11 : 23 best
2 Parham, R. T.	Worcester	11 : 10
3 Walker, G.	Birmingham	11 : 08
4 Draper, R.	Coventry	8 : 06
5 O'Donnell, J.	Whitefield	8 : 05
6 Monks, R. C.	Birmingham	7 : 43

TISSUE CLASS (11 *entries*)

1 O'Donnell, J.	Whitefield	9 : 07 best
2 Parham, R. T.	Worcester	7 : 18
3 Read, P.	Birmingham	7 : 11
4 Spurr, A. W.	Tees Group	6 : 16
5 Walker, G.	Birmingham	6 : 03
6 Roberts, G.	Lincoln	5 : 55

CHUCK GLIDER (28 *entries*)

1 O'Donnell, H.	Whitefield	37 secs.
2 Greaves, D.	Leamington	34·7
3 O'Donnell, J.	Whitefield	32·8

4 Monks, R. C.	Birmingham	32·6
5 Ward, A.	Whitefield	28·0
6 Faulkner, B.	Cheadle	27·9

March 16th, 1958 *Decentralised*

GAMAGE CUP (38 *entries*) *U/R Rubber*

1 Fuller, G.	St. Albans	9 : 51
2 Robson, A. M.	Teeside	9 : 38
3 Crossley, P.	Blackheath	9 : 08
4 Latter, D.	Men of Kent	9 : 00
5 Sharp, F.	Blackheath	7 : 57
6 O'Donnell, J.	Whitefield	7 : 51

C.M.A. CUP (72 *entries*) *U/R Glider*

1 Moss, G.	Luton	8 : 09
2 Swindon, R.	Teeside	7 : 25
3 Wisher, A.	Surbiton	7 : 10
4 Collinson, A.	Baildon	6 : 55
5 Topham, D.	Loughborough	6 : 50
6 Ward, C. A.	De Havilland	6 : 43

April 6th, 1958—AREA

LADY SHELLEY CUP (18 *entries*) *Tailless*

1 Murray, W.	Bolton	6 : 01
2 Fox, J.	C/Member	5 : 31
3 Masters, C. J.	Apsley	5 : 29
4 Leath, B. G.	Coventry	5 : 18
5 Marshall, J.	Hayes	5 : 00
6 Gates, G. K.	Southern Cross	4 : 55

WOMEN'S CHALLENGE CUP

(11 *entries*) *U/R Rubber-Glider*

1 Pepper, Miss M.	Southampton	7 : 31
2 Fuller, Mrs.	St. Albans	6 : 54
3 Jenkinson, Miss E.	South Essex	6 : 06
4 Cox, Miss G.	Thameside	5 : 33
5 King, Mrs. P.	Thameside	5 : 28
6 Moulton, Mrs. B.	Wayfarers	5 : 15

JETEX CHALLENGE CUP (10 *entries*) *Jetex*

		Pts.
1 O'Donnell, J.	Whitefield	36·7
2 Worley, N.	Southampton	29·3
3 Buskell, P.	Surbiton	23·5
4 Smeed, S.	Surbiton	18·5
5 Sharp, F.	Blackheath	17·7
6 Dowsett, I.	Hayes	17·2

PILCHER CUP (164 *entries*) *U/R Rubber*

1 Giggle, P.	Southampton	11 : 20
2 Chadwick, J.	Ashton	9 : 00
3 Greaves, D.	Leamington	8 : 50
4 Woodward, T.	Foresters	8 : 16
5 {Greygoose, R.	Anglia	8 : 15
5 {Boxall, R.	Brighton	8 : 15
6 Dowling, B.	Wayfarers	8 : 11

April 27th, 1958—AREA

KEIL TROPHY (31 *clubs*) *Team Power*

1 Coventry D.M.A.C.	32 : 44
2 Surbiton M.F.C.	32 : 20
3 Wakefield M.A.C.	30 : 59
4 Baildon M.A.C.	25 : 34
5 Wigan M.A.C.	23 : 20
6 Teeside A.M.	21 : 01

K. & M.A.A. CUP (135 *entries*) *U/R Glider*

1 O'Donnell, J.	Whitefield	7 : 56
2 Wisher, A.	Surbiton	7 : 32
3 Woodward, T.	Foresters	7 : 23
4 Perry, P.	Birmingham	7 : 19
5 Scott, Miss J.	Foresters	7 : 15
6 Tyrrell, B. L.	Leicester	6 : 41

May 24th-25th, 1958—BRITISH NATIONALS

THURSTON CUP (168 *entries*) *U/R Glider*

1 Pepper, Miss M.	Southampton	9 : 00+5 : 40
2 Morley, D.	Lincoln	9 : 00+2 : 41
3 Taylor, J.	Wayfarers	9 : 00+2 : 20
4 Nicholls, R.	Tynemouth	9 : 00+1 : 50
5 Thorpe, —.	Derby	9 : 00+1 : 35
6 Glynn, K.	Surbiton	9 : 00+1 : 03

SHORT CUP (13 *entries*) *Payload*

1 O'Donnell, J.	Whitefield	8 : 40
2 Monks, R. C.	Birmingham	5 : 38
3 Glynn, K.	Surbiton	5 : 26
4 Farrar, A.	Wakefield	4 : 54
5 Ward, R. A.	Croydon	4 : 50
6 Jays, V.	Surbiton	4 : 29

Arthur Collinson (Baildon) was top man in the 1958 British Power Team selection, closely followed by Ken Glynn, Vic Jays (both of the Surbiton club), and John Bickerstaffe of Rugby. Selection was resultant on a double contest during which ten flights were made, Collinson only missing the maximum possible score by 16 seconds. Glynn was a scant 2 seconds behind with Jays scoring 29 : 21 and Bickerstaffe 28 : 14.

S.M.A.E. TROPHY (12 *entries*) *R/C Multi*

			Pts.
1	Olsen, C. H.	A.R.C.C.	87
2	Askew, R.	Kersal	66
3	Uwins, S. E.	A.R.C.C.	46·5
4	Parkinson, G.	Kendal	41
5	Higham, R.	A.R.C.C.	36
6	Johnson, E.	A.R.C.C.	33

SIR JOHN SHELLEY CUP
(95 *entries*) *U/R Power*

1	O'Donnell, J.	Whitefield	12 : 00+4 : 32
2	Smith, T. W.	Eng. Electric	12 : 00+3 : 10
3	Bickerstaffe, J.	Rugby	12 : 00+2 : 36
4	Posner, D.	Surbiton	11 : 59
5	Riley, J.	Accrington	11 : 39
6	Gough, R.	Enfield	11 : 33

"MODEL AIRCRAFT" TROPHY
(63 *entries*) *U/R Rubber*

1	Boxall, F. A.	Brighton	12 : 00+7 : 28
2	Barnacle, E. A.	Leamington	12 : 00+7 : 02
3	Wannop, U. A.	Edinburgh	12 : 00+5 : 45
4	O'Donnell, J.	Whitefield	12 : 00+5 : 10
5	Draper, R.	Coventry	12 : 00+5 : 05
6	Cartwright, J. K.	Blackburn	12 : 00+5 : 01

RIPMAX TROPHY (18 *entries*) *R/C*

			Pts.
1	Nield, W.	Cheadle	34·5
2	Boys, H.	Northampton	34
3	Lockwood, K.	North Kent	33·5
4	Payne, R.	East Grinstead	24
5	Craggs, R.	North Lincs	23·5
6	Johnson, E.	A.R.C.C.	18

DAVIES "A" TEAM RACE CUP

1	Yeldham, G.	Belfairs
2	Edmonds, R.	High Wycombe
3	Sanger, G.	Wanstead

DAVIES "B" TEAM RACE CUP

1	Walker/Tuthill	Enfield
2	McNess, J. K.	West Essex
3	Hartwell, P. F.	West Essex

COMBAT

1	Kendrick, M.	West Bromwich
2	Tribe, P.	Northwood

SUPER SCALE TROPHY
(9 *entries*) *F/f Scale*

			Pts.
1	Cawley, C.	Mill Hill	72
2	Gates, E.	Blackburn	70
3	McHard, D.	Wayfarers	67
4	Clifton, J.	Doncaster	62
5	Babb, P.	Northwick Park	61
6	Evans, A. W.	Bromley	59

KNOKKE TROPHY (6 *entries*) *C/L Scale*

			Pts.
1	Milani, C.	C/Member	87
2	Godfrey, Cpl. R.	R.A.F., M.A.A.	72
3	Kendrick, M.	West Bromwich	64

"GOLD" TROPHY (12 *entries*) *C/L Stunt*

			Pts.
1	Ridgeway, P.	Macclesfield	418
2	Morley, W.	West Essex	415
3	Jolley, T.	Whitefield	412
4	Eifflander, J. G.	Macclesfield	404
5	Cornell, G.	Croydon	305
6	Blundell, M. E.	Godalming	298

SPEED Class II Gibbs, R. East London

SPEED Class III Drewell, P. Lewisham Orbits

June 7th-8th, 1958—R.A.F. Hemswell

1st SELECTION TEAM TRIALS

Wakefield

1	Draper, R.	Coventry	14 : 54
2	Barnacle, E. A.	Leamington	14 : 35
3	Copland, R.	Northern Heights	14 : 26
4	Palmer, J.	Croydon	14 : 09
5	O'Donnell, J.	Whitefield	14 : 03
6	Lefever, G. J.	South Essex	13 : 54

Power

1	Collinson, A. R.	Baildon	15 : 00
2	Bickerstaffe, J.	Rugby	14 : 56
3	Upson, G. H.	Harrow	14 : 44
4	Glynn, K.	Surbiton	14 : 42
5	Jays, V.	Surbiton	14 : 21
6	Fuller, G.	St. Albans	14 : 07

July 5th-6th, 1958—R.A.F. Hemswell

2nd TEAM SELECTION TRIALS

Wakefield

			Total
1	Draper, R.	Coventry	28 : 32
2	Palmer, J.	Croydon	28 : 18
3	O'Donnell, J.	Whitefield	28 : 12
4	Lefever, G. J.	South Essex	28 : 11
5	Barnacle, E. A.	Leamington	28 : 10
6	Monks, R. C.	Birmingham	27 : 19

Power

			Total
1	Collinson, A. R.	Baildon	29 : 44
2	Glynn, K.	Surbiton	29 : 42
3	Jays, V.	Surbiton	29 : 21
4	Bickerstaffe, J.	Rugby	28 : 14
5	Manville, J. H.	Bournemouth	28 : 10
6	Fuller, G.	St. Albans	27 : 46

June 29th, 1958—R.A.F. Halton

NORTHERN HEIGHTS GALA

QUEEN ELIZABETH CUP A/2 Gliders

			Pts.
1	Norris, R.	Surbiton	1,013
2	Hinds, S.	Reading	1,006
3	Amor, R.	East Essex	881

"FLIGHT" CUP Open Glider

1	Tofield, B.	Watford	8 : 00+9 : 10
2	Fuller, G.	St. Albans	8 : 00+7 : 20
3	Wade, S. A.	C/Member	8 : 00+2 : 25

FAIREY CUP Open Rubber

1	Lennox, R.	Birmingham	8 : 00+5 : 15
2	Burwood, R.	Blackheath	8 : 00+3 : 55
3	Barnacle, E.	Leamington	8 : 00+3 : 44

DE HAVILLAND TROPHY Open Power

1	Fuller, G.	St. Albans	8 : 00+4 : 10
2	Glynn, K.	Surbiton	8 : 00+1 : 43
3	Gough, R.	Enfield	8 : 00+1 : 25

THURSTON HELICOPTER TROPHY

			Pts.
1	Ingram, C. M.	Southampton	564
2	Poole, D.	Birmingham	517
3	Clark, G.	—	290

R.A.F. FLYING REVIEW CUP Radio Control

			feet error
1	Fox, J.	Hatfield	22
2	Grocott, D. A.	—	45
3	McDonald, A.	—	87

KEIL COMBAT CUP

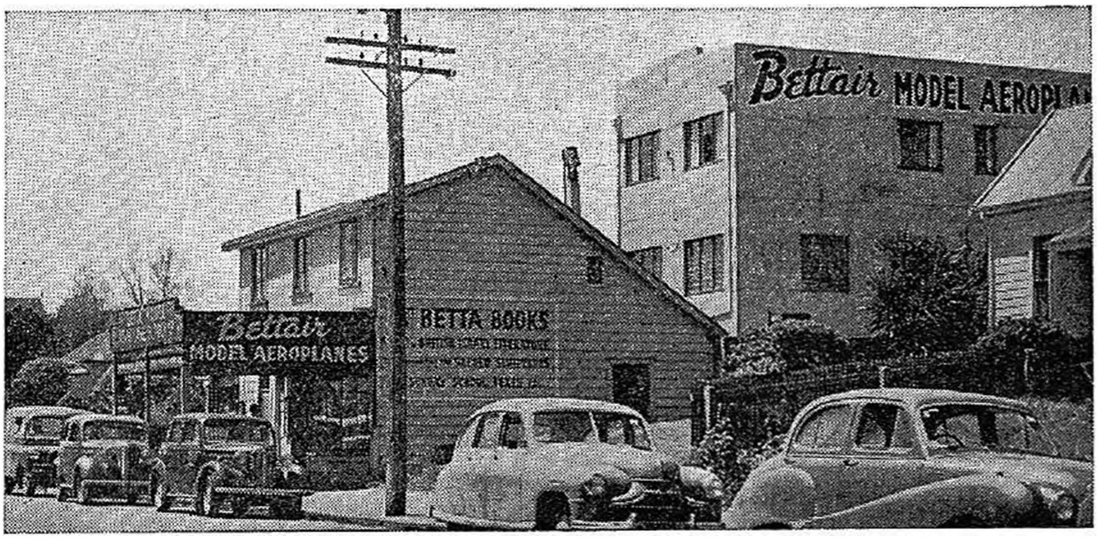
1	Burbrudge, L.	Kenton
2	Hickman, R.	Kenton

CONCOURS D'ELEGANCE

Class 1, Power	Mr. Amesbury
Class 2, General	Mr. Manuel
Class 3, Scale	Mr. McHard
Class 4, Unorthodox	Mr. Reed

"AEROMODELLER" CHALLENGE TROPHY

Gala Champion G. Fuller St. Albans



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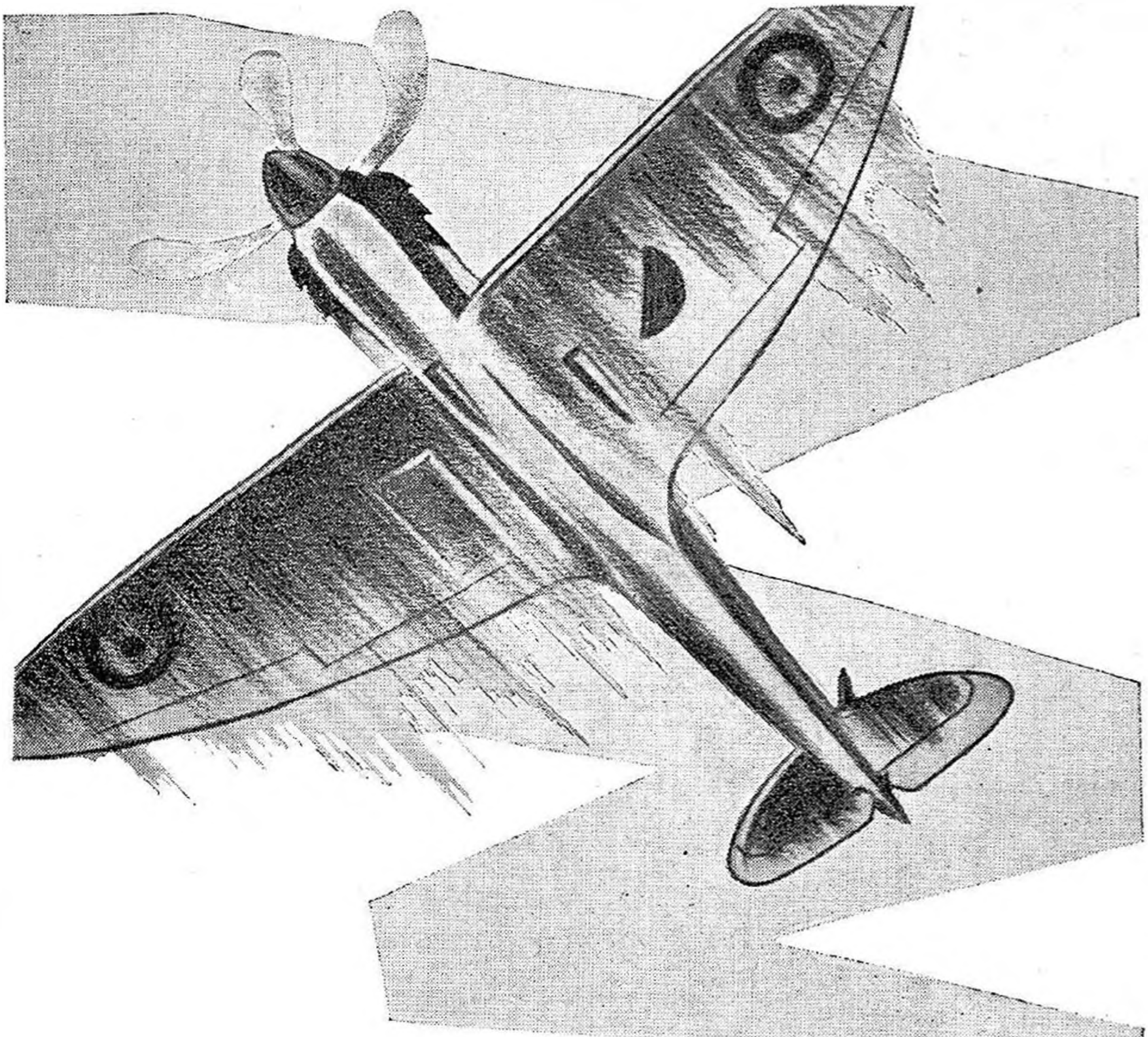


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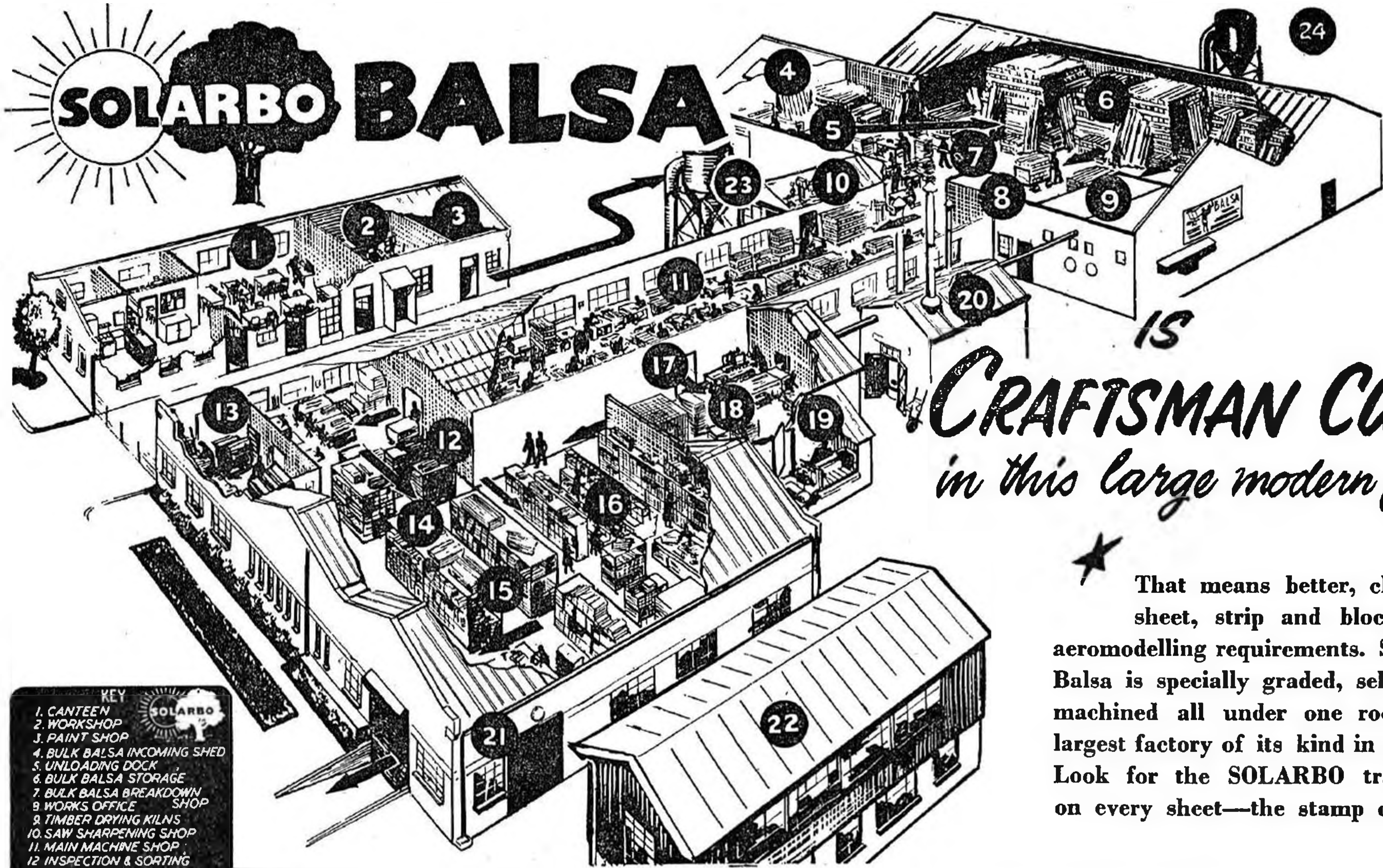

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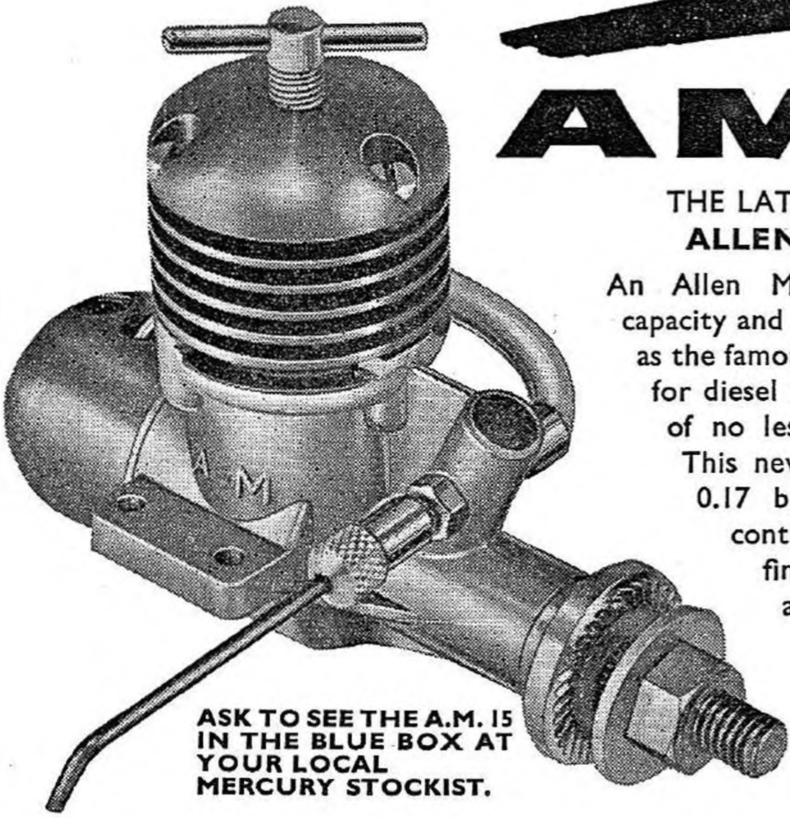

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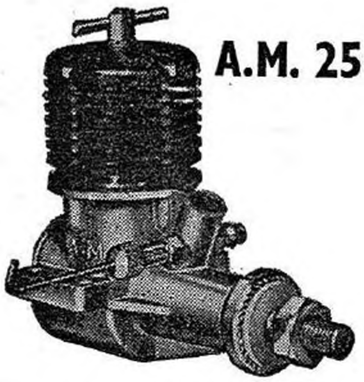

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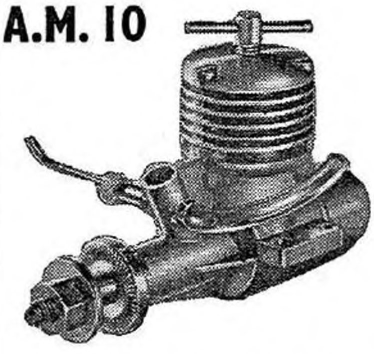

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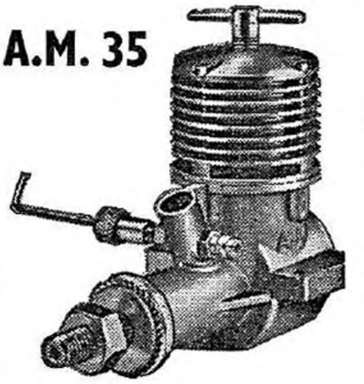

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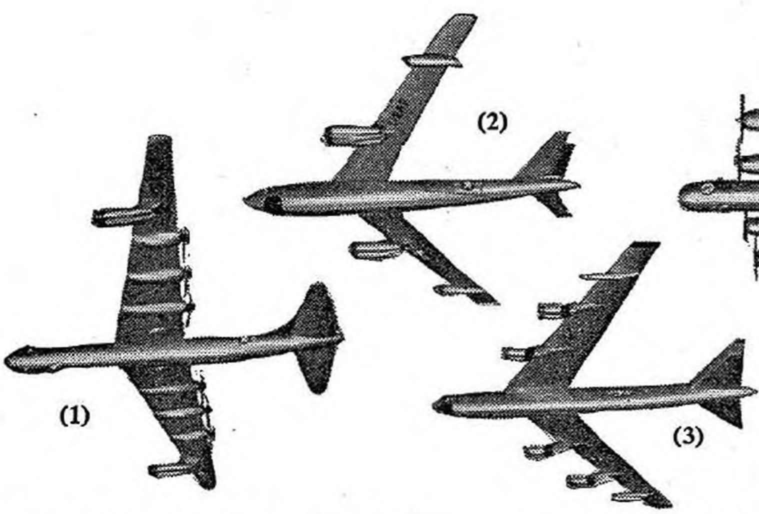

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