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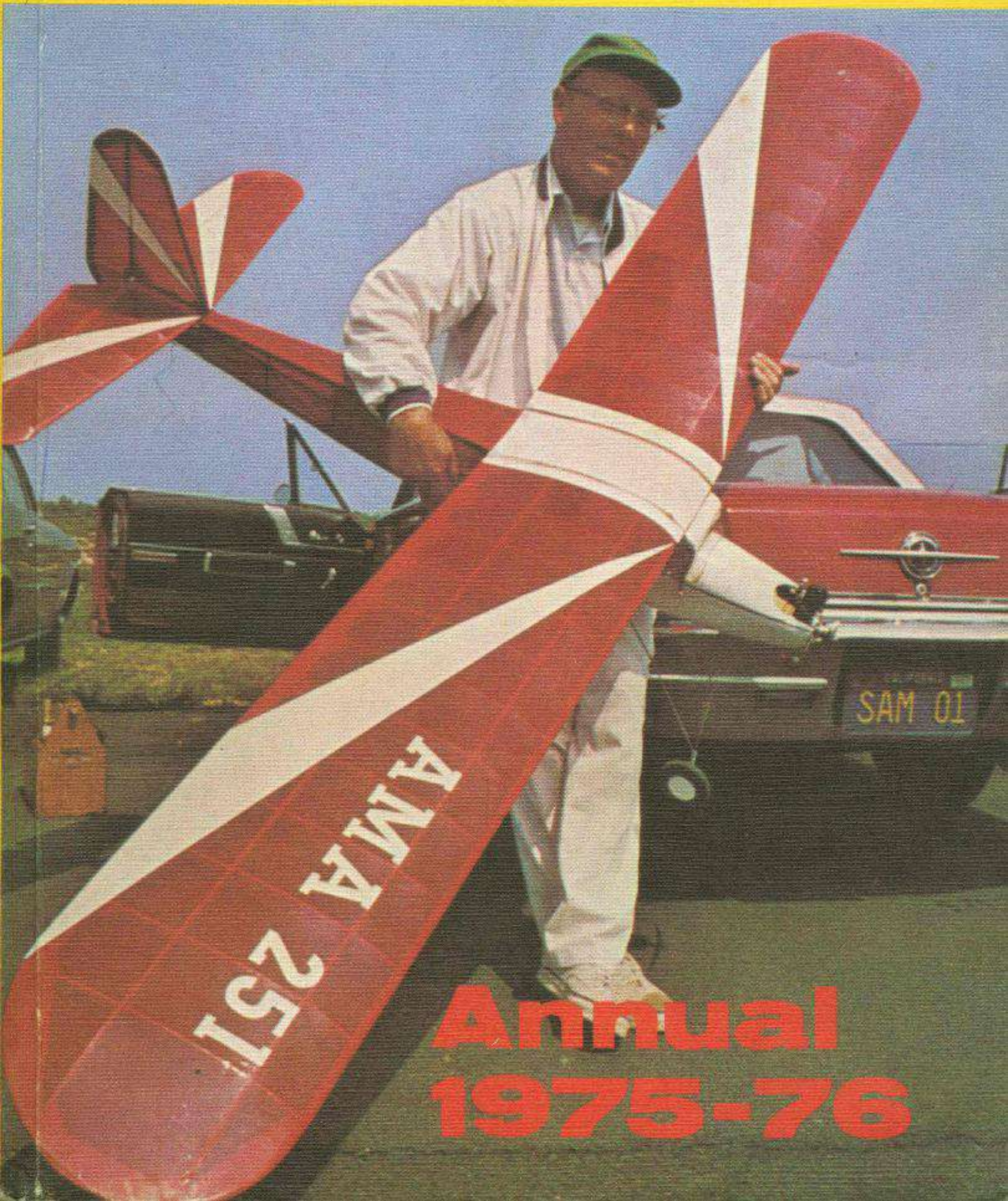

Annual 1975-76

AEROMODELLER ANNUAL

1975-76

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

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AEROMODELLER ANNUAL 1975–76

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CONTENTS

INTRODUCTION

DESPITE the galloping inflation which has sent prices rocketing in all directions except downwards, aeromodelling has continued to enjoy the incredible boom which we noted this time last year. If anything, the boom has been even greater, for although Value Added Tax went up by 17% on radio equipment, the gross cost of a radio outfit in Sterling prices is far cheaper for the British modeller than for his opposite numbers in other European countries.

The imported items have risen as the international monetary exchange rates knock the Pound Sterling lower, and a reaction to this has been (at last!) the blossoming in Britain of many small firms making kits.

For years we have campaigned for new kits to suit the novice aeromodeller and now we have lots. Sleeve bags of balsa parts for chuck gliders, simple boxes for kits to make A/1 gliders or small rubber duration designs are just what have been needed. The new brand names are sure to find a welcome market. One of them secured the agreement to make the BBC Hawk, a double delta take-off of Frank Ehling's famous Dart Dip which has sold by the hundreds of thousands in the U.S.A. The Hawk was demonstrated in the 10 part BBC-TV programme "Model World" and so had a magnificent send-off in mid year. It ought to go on for ever as a standard first-time recommendation by all model shop proprietors and club leaders as it offers instant success after an hour or two of very simple structural assembly.

But balsa is no longer cheap—*was it ever*? At one stage it was also rare. Empty warehouses in Britain were a symbol of their reliance upon an unstable South American situation. When the crops (bananas etc.) and oil are more remunerative, the shippers are less interested and our supplies suffer. It never ceases to surprise us how manufacturers maintain the flow of balsa kits, sheet and strip wood from what is after all, a weed growth in the Ecuadorian highlands!

The year started with a disappointment which although only affecting about 200 modellers directly, had a significance that might change the international outlook in Coupe d'Hiver. What happened was that a postal strike paralysed French communications at the end of 1974. The French Model Federation could not proceed with organisation of the Coupe d'Hiver International in February 1975 although the strike was by then long settled. As originator of the class and this particular event, Maurice Bayet of *Modele Reduit D'Avion* was naturally dismayed and he has given sanction for the Anglo-French challenge to take place near London during November '75. What the support will be is anyone's guess but it might possibly provide just the right kind of boost for the class in Britain. World Championships take place too late in the year for us to comment here: but the National Championships in May were big, well attended and cold enough to remain a permanent memory for all who attended. The suitability of R.A.F. Finningley is questionable but it was Hobson's Choice for the S.M.A.E. and they made the best of a 2 mile concrete strip by filling every niche with the 40 contests. Of all the impressionable events and the fine International support, our particular recollection is of the youngsters taking part in Sue Miller's events for the under-16s. The standard glider (a *Sattelite*,—the model which narrowly lost the vote for being the F.A.I. Standard Junior glider design) was a great success and to see an eleven year old towing an A/1 masterly in a 15kt breeze when adults elsewhere were making a muck of it, was very heartening.

Among the contests we've seen in the months since writing last year's intro to the Annual, the one which gave us greatest satisfaction was the *Militky Pokal* in Switzerland—for electric power; the greatest thrills came in the Combat finals at the Nats, and the most emotive was the Class B team race final where for once in twenty years the Taylor, Yeldham, Oates and MacNess team had to watch (their old model fell apart in heats, and its repaired tank failed the test by becoming oversize) and after a dramatic hare and tortoise start the Parisian Magne—Sugurue team won the British Trophy at the cost of a French finger tip.

Quite a year—and one which will confirm the solid support for Aeromodelling when all around us in the world teeters on the brink of collapse.

On the Cover

John Pond—United States ambassador for old time (note his car registration) and the R/C assist which he promotes in following pages.

"Mr. Old Timer" himself, with Merco 60 powered "New Ruler" converted to radio control as described in this feature. See also, the cover photo of John Pond with his far travelled car and R/C assisted "Dall-aire" with Ohlsson 60.

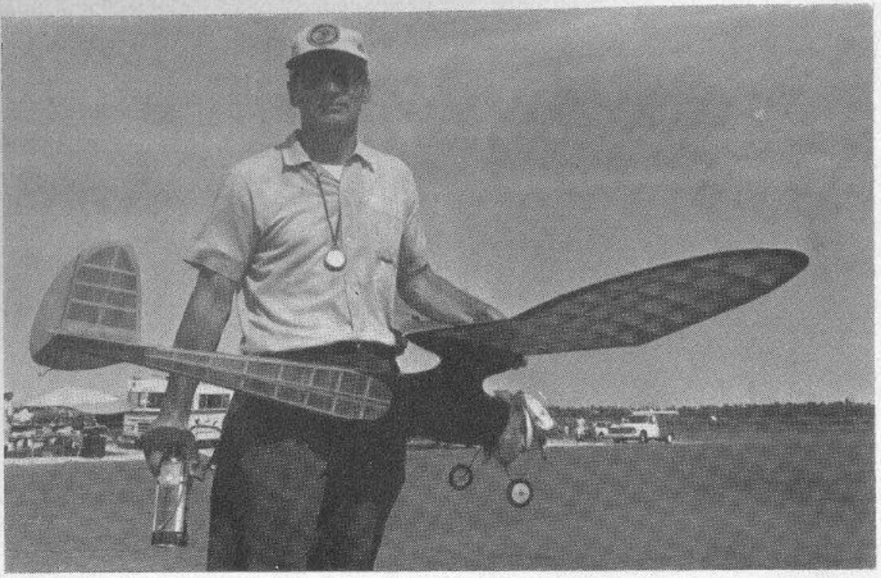
OLD TIME FREE FLIGHT WITH RADIO ASSIST
by John Pond, "SAM 01"

WITHOUT a doubt, the emergence of the old Timer Events in the sixties was the best thing that could have happened to the ever dwindling interest in sport free flight. During the past decade, the concept of old timers has spread from the United States across both the Pacific and Atlantic Oceans. In Australia, the events have been adopted as a formal competition event at their Nationals.

Just about the time the old timer movement was fully recognized by all phases of modelling, an even better fun idea developed on the Eastern Coast of U.S.A. in the form of *radio assisted* free flight. This idea swept the Atlantic Seaboard like wildfire. Here was a chance to fly those old nostalgic models of huge wingspans competitively from small fields with no fear of losing many months of loving labour (not to mention the extraordinary cost of balsa nowadays).

It soon became quite apparent with radio control assist, the average modeller did not have to conform to the hot pylon concept for ultimate performance. With models being controlled with in-flight trim, many of the excellent performing (and realistic looking!) cabin designs formerly powered by slow turning engines, were then able to utilize modern high power R/C glow engines. This very fact brought out many modellers who had enough of modern high speed stunt models going under the guise of sport or trainer types.

Of course, certain types of models will dominate any sport based on the ease of construction, availability of kits, and general pleasing lines. In addition, any model enjoying a modicum of success at the competitions is immediately copied as there is an implied guarantee of success for the imitator.



Most popular of all the subjects for R/C assist is the Cleveland Playboy Senior, a pylon design for '49 to '60 engines which performs well on wheels or floats and has relatively simple structure. It looks great when covered with bright silk.

For the modeller who wants to fly from congested areas in just about any type of weather, the old timer radio assist model offers not only nostalgia, pride of craftsmanship, and realistic flying, but a most relaxing form of flying; a combination of power and glider operation that allows the pilot to relax and converse with his fellow modeller and friends.

By this time, the reader's interest has been aroused to the point to ask *what* is the best model to use? Experience has shown that the most popular kit designs (in their day) are *still* the most popular and for good reason; they *still* fly well! Probably the best cabin models (if size is no objection) are Taibi's *Powerhouse*, Scientific *Miss America*, Berkeley *Super Buccaneer*, Scientific *Mercury*, Comet *Clipper*, and the redoubtable *Buzzard Bombshell*. In the pylon area, the *Playboy Senior* is far and away the most popular of all. Simple of construction, high performance, and ease in handling are the attributes leading to the great numbers of this model in use. Those preferring time consuming intricate construction (which show craftsmanship at its best), the Comet series of *Sailplane* and *Zipper* are best.

Surprisingly, there are quite a few sources of old time kits in the U.S.A. The most popular are the P & W Partial Kits (producing ten models) and Chuck Gill Distributor manufacturing the *Powerhouse* and Scientific *Coronet* Cabin models. For those who prefer other designs, plans are available for scratch building from John Pond Old Time Plan Service, the "Model Builder" magazine, and a few scattered designs from Aeromodeller Plans Service. All plans provided are strictly free flight designs, and certain modifications are in order for radio control installation and use.

Before any construction is attempted, it must be borne in mind the models will be powered by modern glow engines. In addition, the model will be carrying a payload of almost a pound. These two factors, added weight and faster flying, will induce stresses that were not considered in the original design. Of all parts, the wing is the most vulnerable and will be considered first.

The writer has found from long and often bitter experience that spruce spars are the best. By reducing the size of the original spars where say $\frac{1}{4}$ sq. in. balsa is specified, to reduce it to $\frac{3}{16}$ sq. in. spruce; the addition of added weight is very small, while the strength factor is more than doubled! In addition, the writer prefers the combination of "D" spar and box spar. (See *Fig*. 1). This has proved to be virtually unbreakable.

In converting the wing to radio control then, the design must consist of two forward spars with two rearward spars forming the "box". These spars are then webbed, that is to say, vertical soft $\frac{1}{16}$ in. (watch your weight here!) balsa sheet is placed between the ribs and glued to the spars. At the centre section, $\frac{1}{8}$-in. birch (three to five veneer) plywood is employed for at least two bays of ribs on each side of the dihedral joint. You may smash your leading and trailing edges, crumple the ribs, but you won't be breaking any spars!

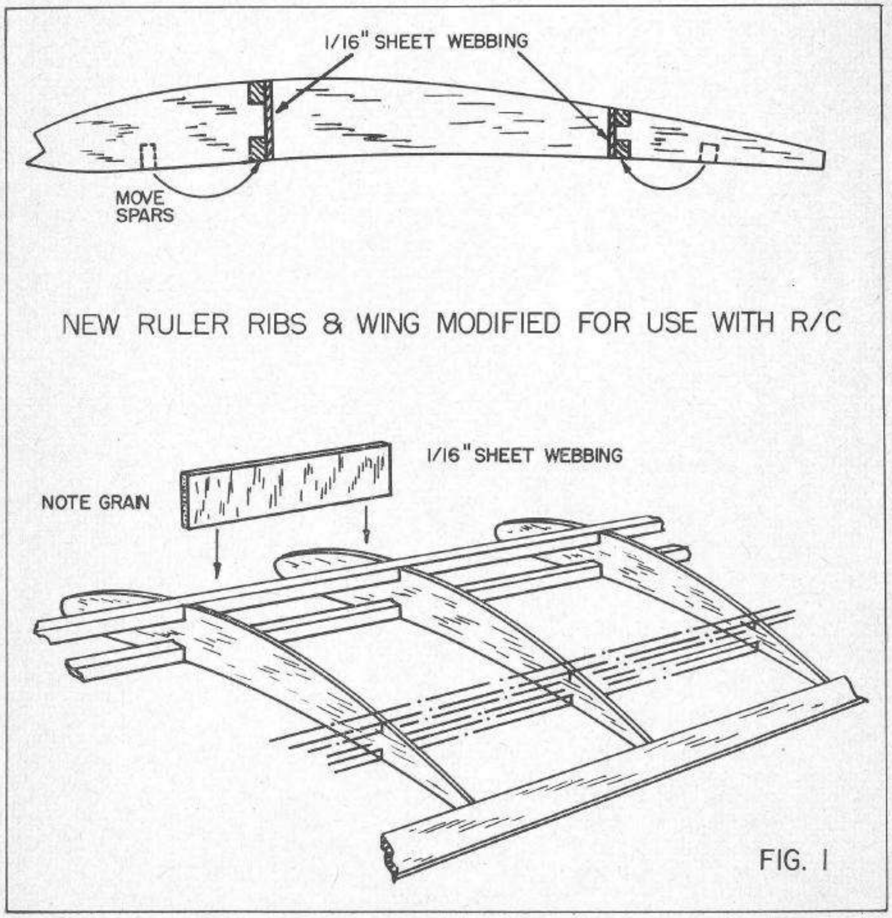


FIG. 1

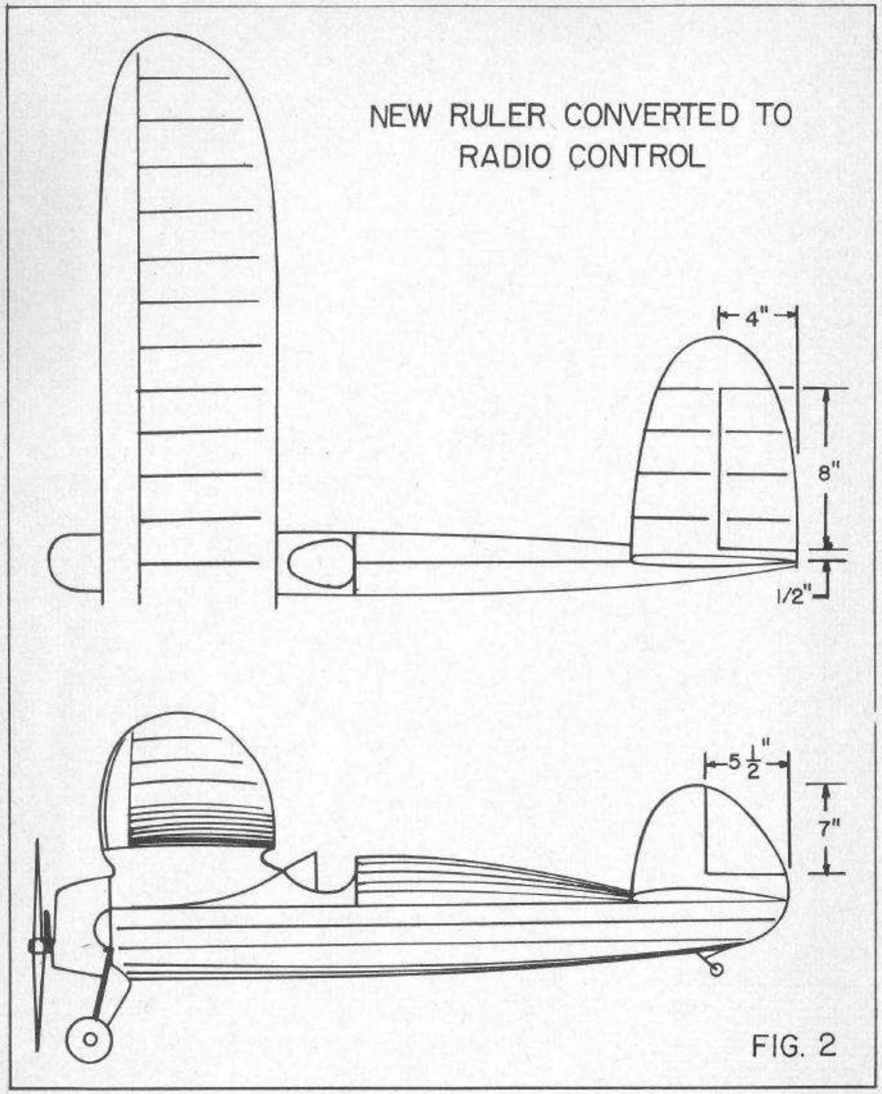


FIG. 2

For maximum strength, the writer uses $\frac{1}{16}$-in. soft balsa sheet leading edges, top and bottom. This forms the "D" spar referred to earlier. One can fully stunt his old timer, a feature to be prized, as many times the model will loop in a high wind of its own volition. Moreover, the model can be dived or spun with impunity allowing the model to escape some of those remarkable updrafts known as thermals.

The tails now come in for our scrutiny. Referring to *Fig*. 2, the reader will immediately notice the very large control surfaces. Contrary to any other line of reasoning, these large elevators and rudders with commensurate large movement

are absolutely essential in the glide. Granted, controlling the model under power will be a shade touchy, but if the model is properly trimmed like any good free flight should be, then the amount of flight correction during the power run should be minimal. After all, we *are* flying free flight with occasional radio interference!

Once the power has cut, the glide, which is generally superlative, is quite slow. Hence, large surfaces and large angles of movement are required. A good ratio to bear in mind would be a rudder at least 40% of the original fin area.

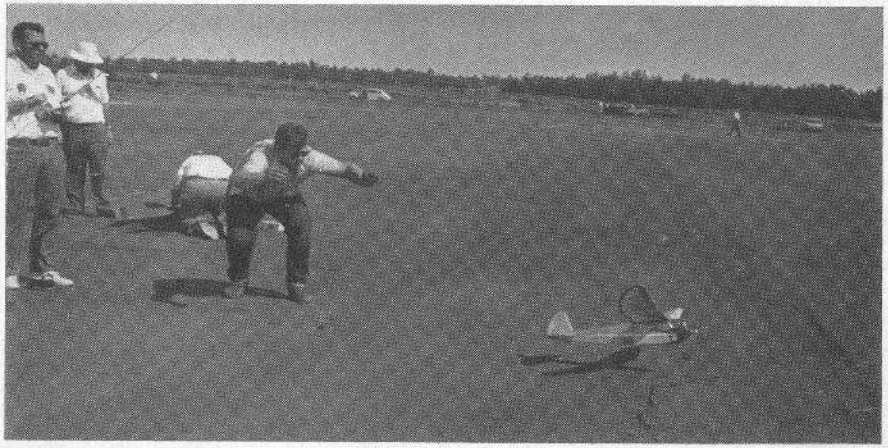
Elevators fall in about the same category but can be flown as low as 25% of the original stabilizer. Movements should be unrestricted, employing the full throw of the servo and any multiplying factor available on the horn. This will be discussed later, on flying trim.

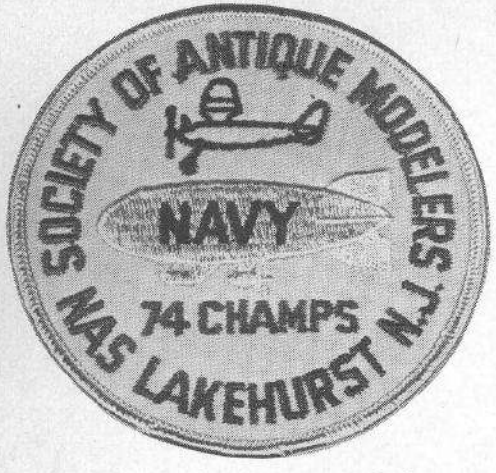
The fuselage (the thing that holds the wing and tail together) is the last item to consider. Fuselages can be reinforced rather simply by the addition of sheeting around the nose and heavier plywood firewalls. Allowance should be made to hold the tails to the fuselage with nylon bolts. Rubber bands for these surfaces are to be avoided. On the other hand, wings are *always* rubber-banded on to the pylon or fuselage.

The selection of the proper power plant generally depends on your particular interest, sport or competition. The present rules for the limited engine run duration events dictate the hottest engine you can crowd into the nose (and yet conform to power regulations). The majority of model builders use glow plug engines as they are easily obtainable, reliable, and operation is simple. A third servo is generally used to retard the throttle, which if set properly, will give the same effect as a shutoff timer. There are advantages to being able to throttle your engine, particularly in the test flights. Now you don't have to stand in agony while your model spirals in a death dervish towards the ground. Simply chop the motor and straighten the turn! The mortality rate on radio assisted free flight models is quite low.

In the **Texaco** type events, when the emphasis is on engine economy, the model is given $\frac{1}{4}$ oz. of fuel per pound of model up to seven pounds. Most glow

A Comet Clipper R/C assist is released, the payload making little difference to the sprightly take-off characteristics. Scene is the 1974 SAM Champs at NAS, Lakehurst.





Embroidered patch souvenir of the 1974 SAM Champs (left) where the Radio Control Assist event was well supported, especially by resident Cdr. Jack Bolton, USN (right) with his personal fleet of Old Timers, covering all classes and with a "New Ruler" prominent in the foreground.

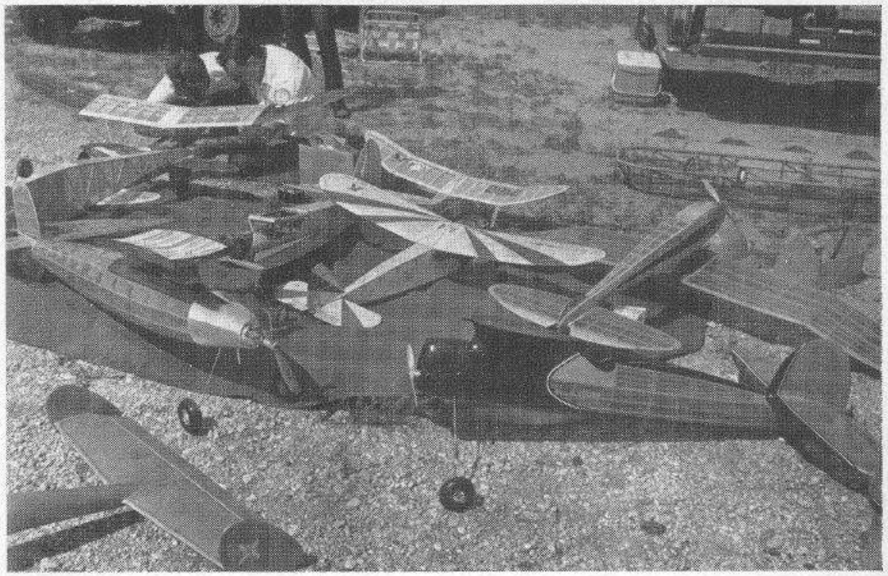
engines are notoriously poor on fuel economy. Hence, it is best to use an old ignition engine or better yet, convert one of the modern glow engines. With new engine porting developments, metallurgy progress, and better quality control, the modern glow engine when converted to ignition is a remarkable fuel miser. The writer has never had less than seven minutes motor run of $1\frac{3}{4}$ oz. of fuel utilizing a Veco 50 or Enya 45. Surprisingly, the Merco 61 is the champion of all fuel hoarders running well over 10 minutes on the same allotment. (As discovered by Maynard Hill in his world record attempts).

However, there are certain drawbacks to be overcome when using spark ignition. The radio receiver must be completely shielded from the ignition components. Copper boxes are best, but brass and tin can be used to house all ignition parts *including the batteries*. (Tests show batteries give off quite a lot of RF). Articles have been published on how to seal the ignition box and properly ground it, so the writer will not repeat this process. One word of caution. Do not use sensitively tuned radio sets as they more readily accept the signals given off by the ignition. Many of the older sets are excellent for this purpose.

A few construction hints are in order before we complete our "free flight". Generous use of the expoxy glues on dihedral joints and other high stress points is highly recommended. In addition, the expoxy should be painted on all firewalls, inside of cowls, and other areas exposed to exhaust fuel. After all, we are going to keep this model a long time! No out of sight flights here!

Covering: Probably the most debatable subject of all, but for long wear and tear resulting from hundreds of flights, the new mylar coverings such as "Monokote", "Solarfilm", etc., are by far the most durable. Best of all, the weight saving over silk and dope is surprising! Try weighing silk with six coats of dope and compare! Regardless what the purists say, we want the model to look good and most of all, to LAST!

So we have now arrived at the day we have completed our *Buzzard Bombshell* with a hot ·29 cu. in. engine in the nose, and we are ready to fly. While dozens of articles have been written on how to trim a free flight, only a few principles apply here. Assuming you have built the model so that the tails line up with the wing (as viewed from the front), check to see if you have at least one to two degrees of incidence in the wing. The motor should also have a slight amount of



downthrust, varying from two to three degrees. The model should be balanced *exactly* on the centre of gravity for maximum performance. A nose heavy condition for the initial flight is preferred.

Before going to the field or before attempting any flights, check the motor idle to see that the engine quits when the throttle lever is pulled to full retard. This is a must for any trial flights! Some idle should be retained for low power-on attempts. Also, check your tail surfaces to be sure all moving surfaces are dead zero-zero. Before flying, put in *down* trim on the elevator by use of the elevator trim lever. This will keep the model from zooming too steeply on take-off. Looping on take-off is generally fatal for any type of model. Check the location of the pushrod in the control horn. It should be at least one hole away from the most sensitive set-up (the closest hole to the moving surfaces). Control should be no less than $\frac{1}{2}$-in. each way at the trailing edge. The more the better! The amount of desired control can be arrived at after several flights.

Now, assuming everything is in order, the model is carefully lined directly into the wind and the motor is started. For a start use only $\frac{2}{3}$rd power. Any less than this is as bad as full power. You simply cannot control a slow responding model. Make sure you have someone with you who knows how to control a radio model. Learning by yourself is a laborious process of rebuilds!

As noted before, release the model directly into the wind. As the model gathers speed, gently (and I mean *gently*!) feed in a little *up* elevator. As soon as the model breaks ground it should climb of its own volition. If it is found the model is still climbing too steeply, the pilot will have to push the elevator stick gently forward. In any case, give the model a chance to fly! Do not immediately go through a series of corrections, most of which it turns out are unnecessary. After all, this design used to fly by itself. It isn't going to need that much help!

The initial flight is always the one that generates the butterflies in the stomach. If your first flight is successful, fly again immediately! The main point is to get the model trimmed out to the point where a minimum of commands are required. Of course, on windy days, the model must be kept heading into the wind, necessitating alert control to any bad turning characteristics.

The power cuts. You are probably better than 300 feet high. Now the real fun starts. You are immediately amazed at the transition to a slow and stately glide. This is the point where you can relax and start showing off your old free flight prowess in hunting up a thermal to prolong the glide portion of the flight.

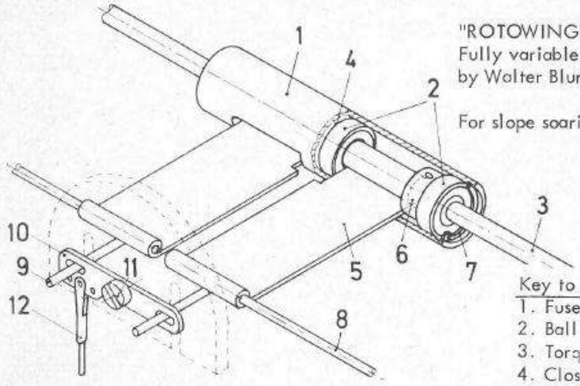
Although it has been said many times, repeating the old warning won't hurt. *Don't let the model get downwind* during the early stages of learning. When facing the model downwind, all rudder commands are reversed; something the neophyte finds hard to overcome. Radio models have been lost this way! Besides, it is a lot easier to fly the model in front of you.

If you haven't been converted to this form of flying by now, you will be when you bring the model in for a landing and find it will practically glide in by itself. A short walk to retrieve it (perhaps a dozen or so steps at most) will make a believer out of you! This old timer *radio assist* is the greatest thing yet!

ALL-MOVING SURFACES

by Walter Blumer, Switzerland

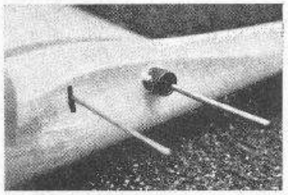
Use of fully articulated surfaces for extreme efficiency in aerobatics has long been the subject of experiment. In the U.K. it has two main proponents in Messrs. Annenberg and Falconer but few models have actually appeared. The Weybridge "Dumbo" man-powered aircraft has all-moving wings for different reasons, and proved the practicality. Now the concept has been developed for aerobatic slope soaring in Switzerland and these sketches from "Aero Revue" will inspire others to experiment.

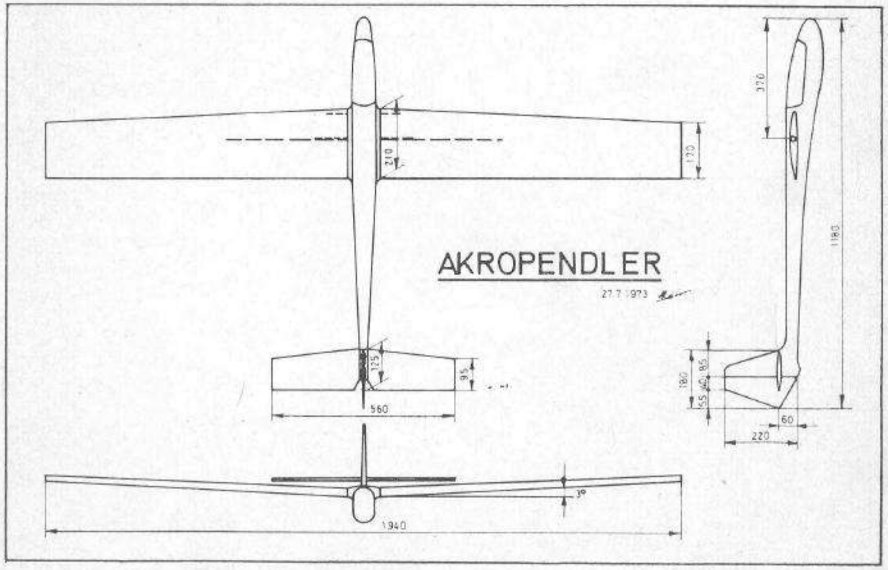


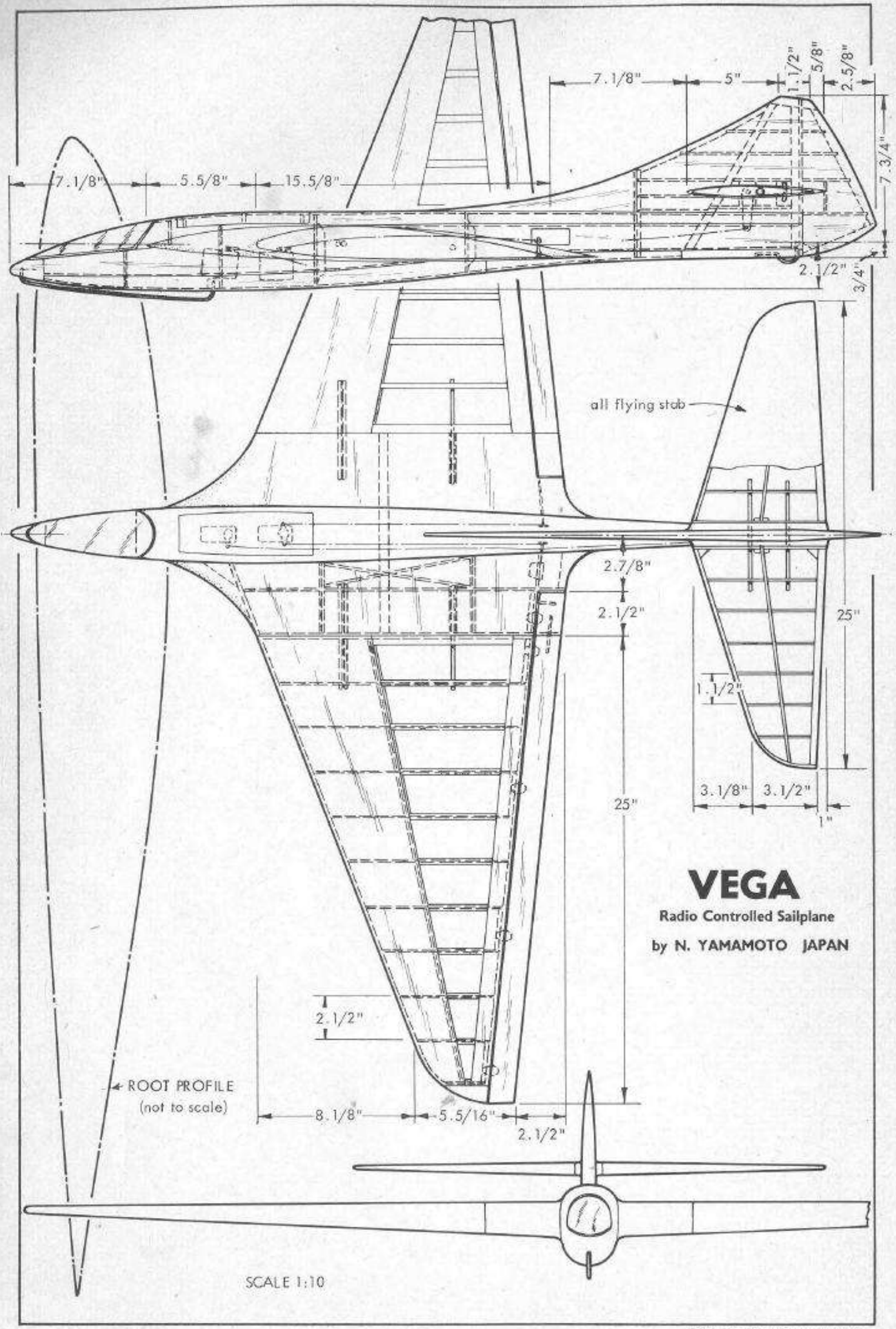
"ROTOWING"
Fully variable incidence wing control
by Walter Blumer, Nussbaumen, Switzerland

For slope soaring aerobatics

Key to sketch
1. Fuselage mounted outer casing
2. Ball Bearing torque rod supports
3. Torque arms/wing panel joiners
4. Close tolerance bearing and spacer
5. Incidence actuating plate
6. Locking ferrule
7. C ring retainer
8. Front spar position rods
9. Actuating link
10. Tee crank on
11. Crankpivot
12. Servo clevis





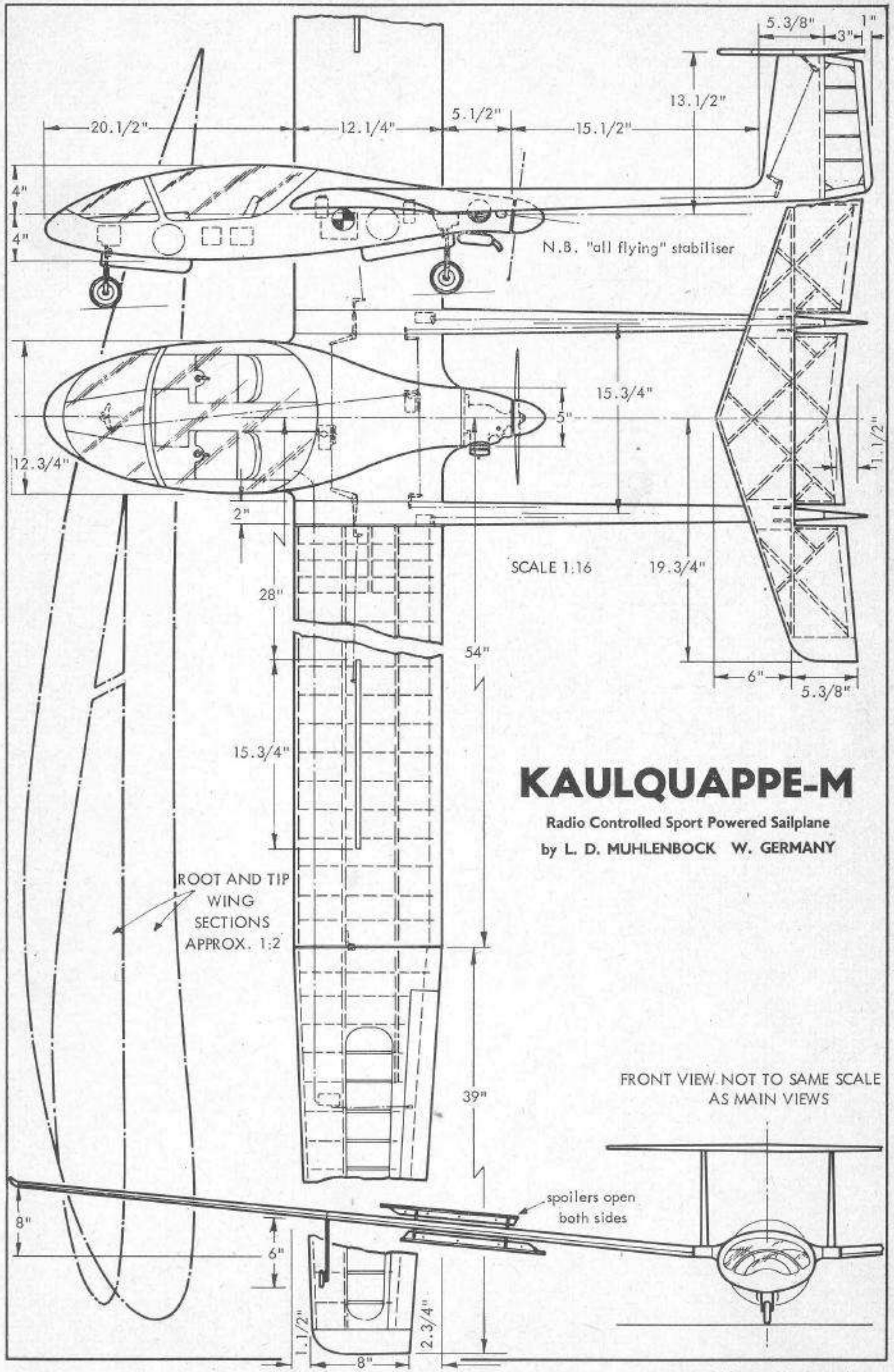


VEGA

Radio Controlled Sailplane

by N. YAMAMOTO JAPAN

R/C TECHNIQUE JAPAN

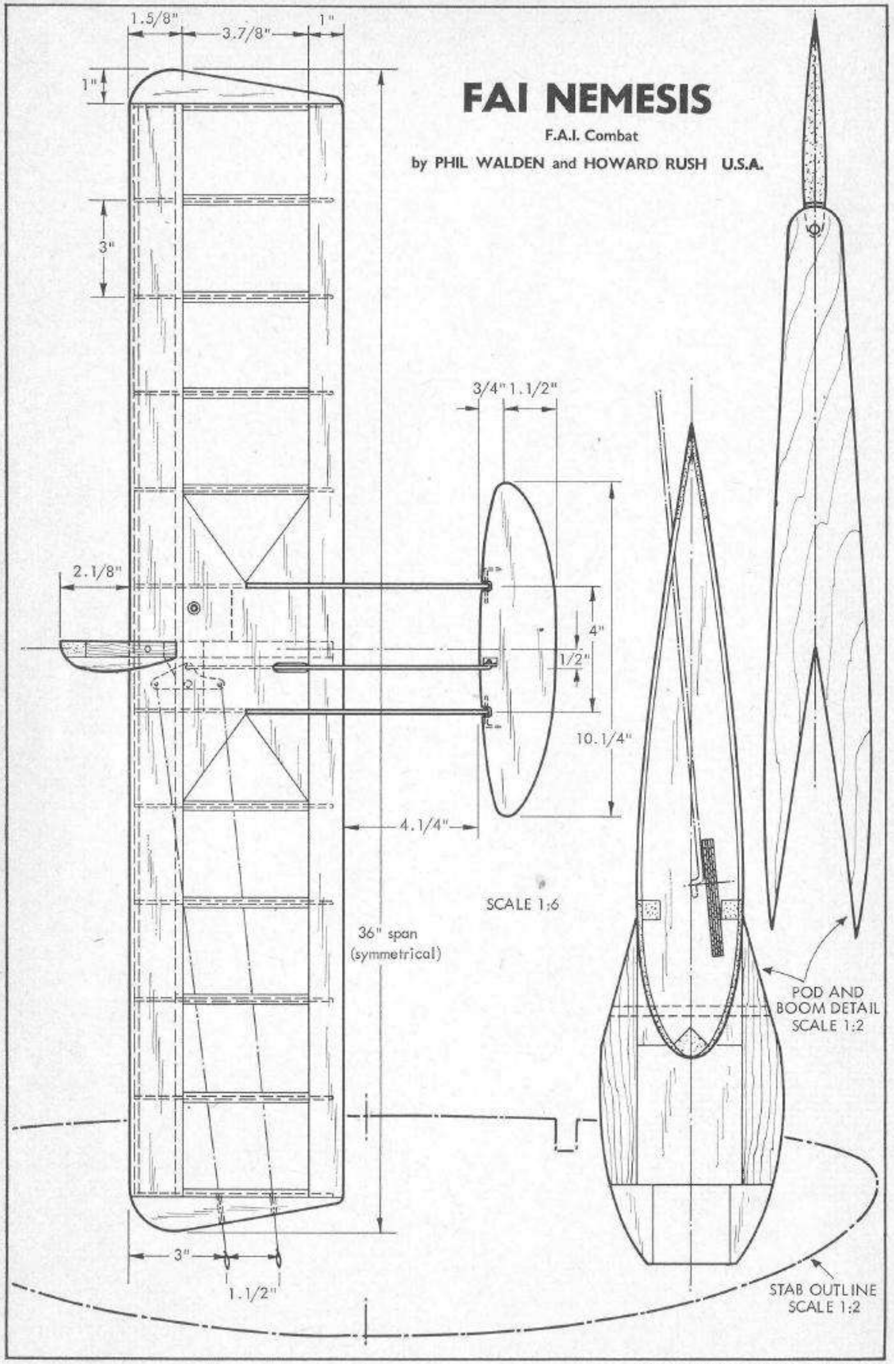


KAULQUAPPE-M

Radio Controlled Sport Powered Sailplane

by L. D. MUHLENBOCK W. GERMANY

MODELL W. GERMANY

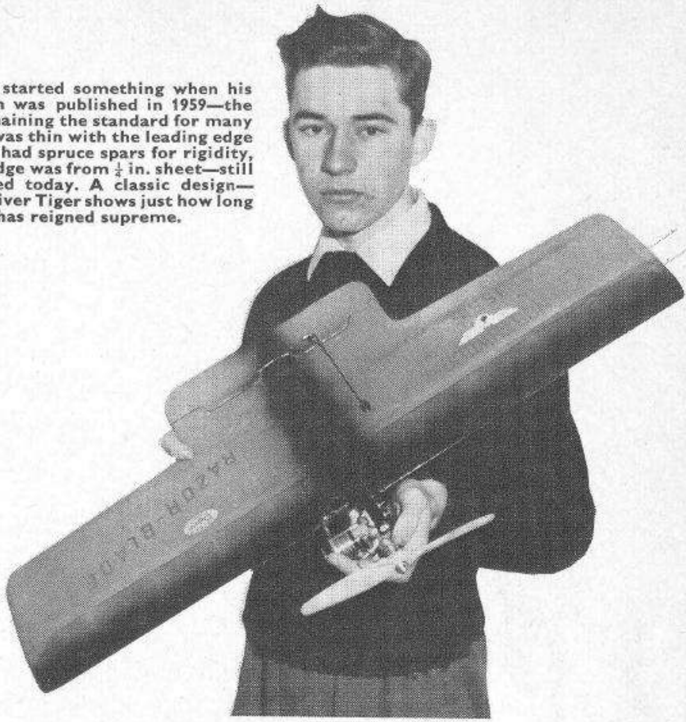


FAI NEMESIS

F.A.I. Combat

by PHIL WALDEN and HOWARD RUSH U.S.A.

VANCOUVER G.M.C. CANADA



Peter Tribe really started something when his "Razor Blade" plan was published in 1959—the basic planform remaining the standard for many years. The section was thin with the leading edge just $\frac{3}{8}$ in. deep, and had spruce spars for rigidity, while the trailing edge was from $\frac{1}{4}$ in. sheet—still frequently employed today. A classic design—and the use of an Oliver Tiger shows just how long this diesel has reigned supreme.

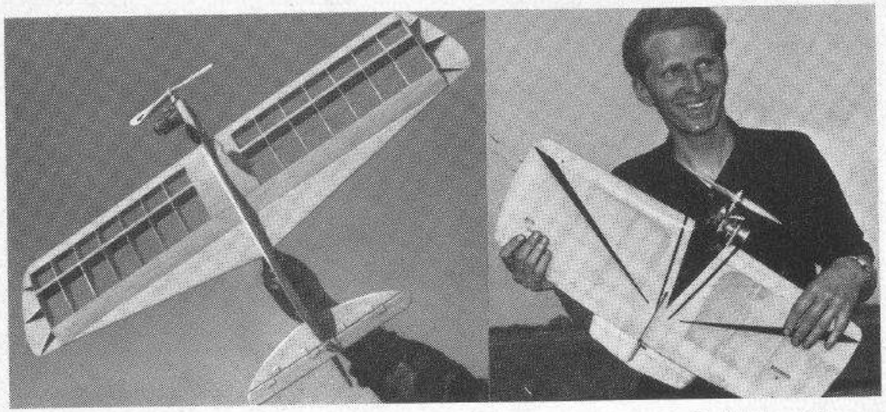
COMBAT—WHICH WAY NOW?

by P. S. Richardson

SINCE combat flying was introduced into Gt. Britain in the mid '50s it has rapidly progressed to being the most popular and best supported competitive control line event. This is hardly surprising, as the event has proved to be enormous fun for both competitor and spectator alike, while the models themselves are quick and cheap to make; in addition suitable engines are not prohibitively expensive to buy. As success depends upon highly manoeuvrable and fast machines, quick reflexes from the pilot plus a "well trained" pit crew, the event appeals particularly to younger enthusiasts flying in the company of like-minded club members.

In common with any other competitive class of aeromodelling, model design is constantly changing in the search for a better machine, but there have been several "landmarks" over the years, which have caused a slight stagnation of ideas. The purpose of this feature is thus to trace the history and determine the current design trends.

Since combat flying originated in the U.S.A. (albeit with 0·35 cu. in. motors) it was logical that their models should be copied, but scaled down to suit "our" rules which then insisted on an engine capacity limit of 3·5 c.c. These were commonly profile-fuselaged stunt models with wing areas in the region of 300–350 sq. in., or else "plank wings" with an upright engine mounted on a rectangular box fuselage which carried a conventional tailplane close to the trailing edge to give a very short moment arm.



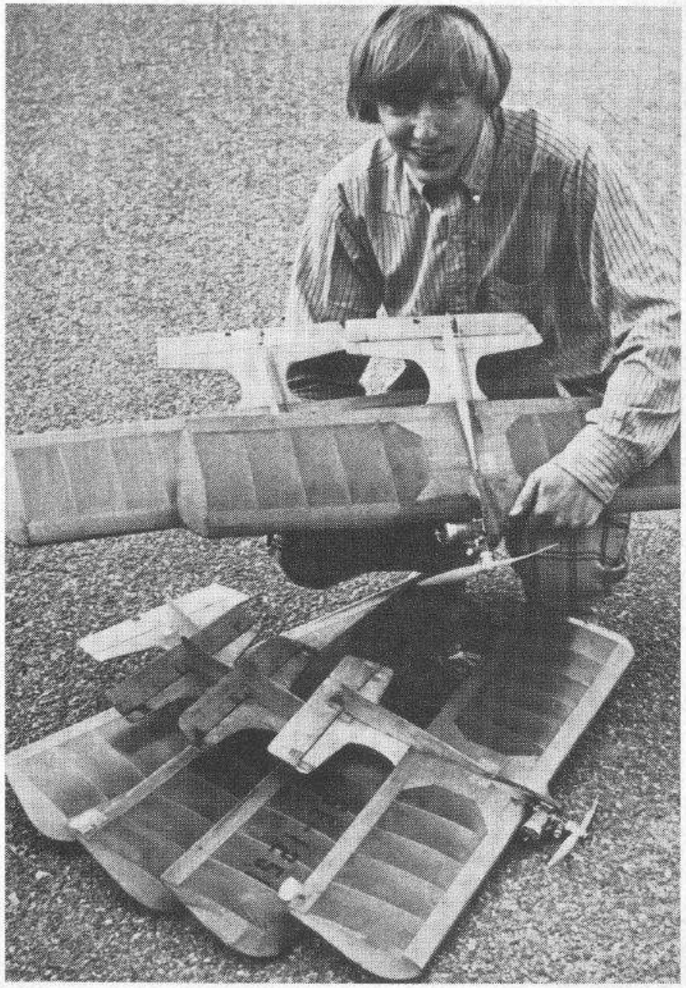
Two milestones in design. At left is George Aldrich's famous "Peacemaker" with its profile fuselage and very sturdy wing construction. A really good flier, but too heavy and slow to be competitive today. Compare the wing platform shape with "modern" trends. At right is Mike Davis' "Dominator", first of the "new breed" of flying wings, with its "flat" sectioned ribs, thick, rounded leading edge and absence of spars. A really tough and highly successful model—still an ideal combat trainer.

Perhaps the first "classic" design to emerge in this country was designed by an American—George Aldrich who gave us the much loved *Peacemaker*. This profile fuselaged, thick wing sectioned model had an excellent aerobatic performance, but was handicapped with a weight of around 20–22 oz. for its 280 sq. in. wing area. Nonetheless, it remained quite competitive for several years, and was widely copied. However, modellers were quick to appreciate the drawbacks of a conventional profile design—the tailplane was rather vulnerable in a crash and fuselage breakages were quite common. Working on the principle that "what isn't there can't get broken", the flying-wing increased in popularity, the "standard" for many seasons being Pete Tribe's *Razor Blade*, a design which won or was placed in nearly every combat event entered in 1958. This model featured a thin symmetrical wing section, a pair of spruce spars to aid rigidity, and a very strong "fuselage" arrangement with bearers extending over the full chord. Being basically a $32 \times 7\frac{1}{2}$-in. "plank" the wing had a trailing edge extension to carry the elevator—a basic shape that has retained popularity through the next 17 years! No doubt about it, the *Razor Blade* was a milestone in combat development, and while many modellers attempted variations on this theme, nothing radically different appeared until the middle '60s. That is not to say other approaches were not tried, they were, but most people stuck to wing areas of around 220–260 sq. in. thin symmetrical airfoil sections and quite flexible, spar supported structures, although weight-conscious people were striving to keep the total to under 16 oz.

However, in 1965 Mike Davis won the Criterium des As meeting in Belgium with his *Dominator* design, and what a change that was! Gone were the thin sections, fairly high aspect ratios, spar reinforced wings, and in their place was a model with a "strange" airfoil, being one inch thick and dead flat for 33% of the chord before tapering down to the sheet trailing edge slotted into the ribs. The

leading edge was laminated from sheet and was well rounded, while area was up to around 275 sq. in. Spars were dispensed with, and the "fuselage" abbreviated to a smaller pod to house the motor.

The benefits were manifold. The flat wing section enabled models to be built directly on the work bench, so that a perfectly "true" wing was easily made —very important for any model. The robust leading edge was U-shaped in section which "keyed" the ribs in place while slotting the trailing edge into the ribs aided rigidity and this, combined with the lower aspect ratio, enabled spars to be completely eliminated. This in turn made it easier to install the fuel tank, although a ply plate had to be added to carry the bellcrank mount. However, this was made adequately strong by anchoring it in place with a dowel passing through the bearers. The "fuselage" was very much shortened, but the flat section enabled the bearers to be epoxied directly over the centre section sheeting, and they were

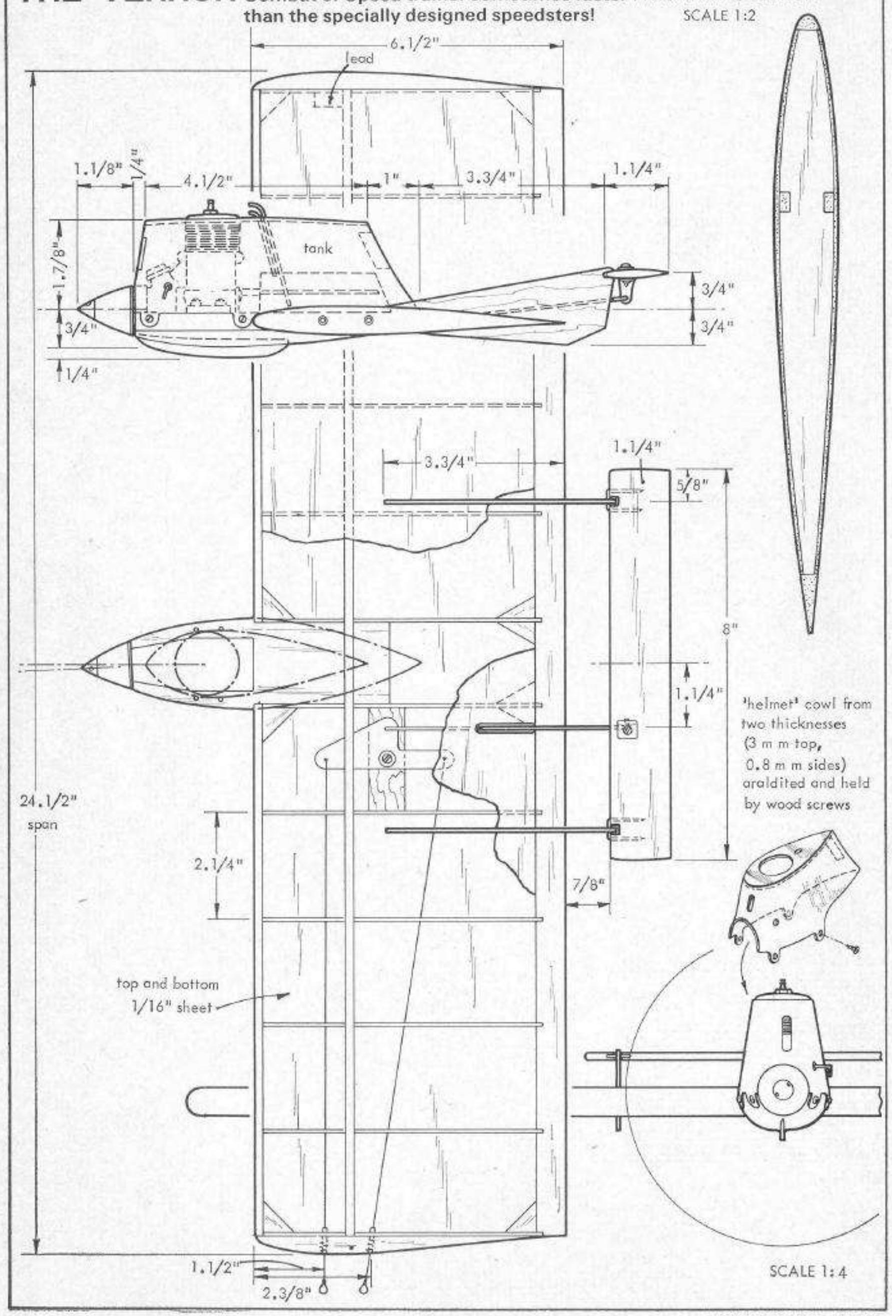


Sweden's Steffan Larsson discovered the secret to success was light weight at the expense of strength—typified in his "Ruter-ess" model.
The leading edge consisted of a $\frac{1}{16}$ in. sheet "D" box which was light (but hard to repair), while the separate tail-plane set off another design trend.

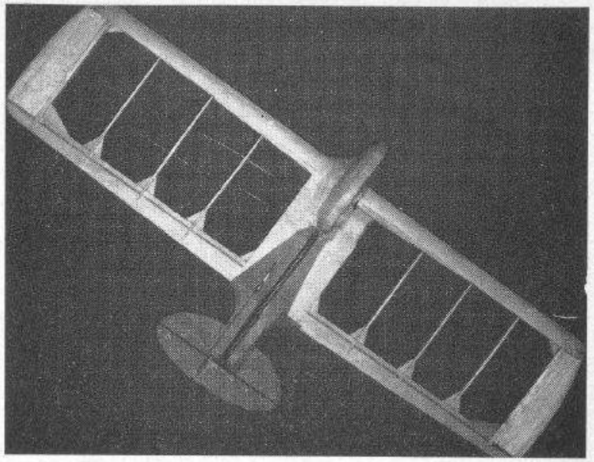
THE TERROR

by Duilio Garbolino

Combat or Speed trainer sometimes faster than the specially designed speedsters!



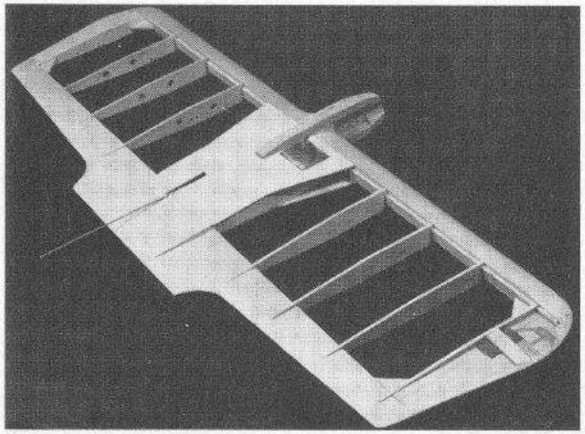
MODELLISTICA ITALY



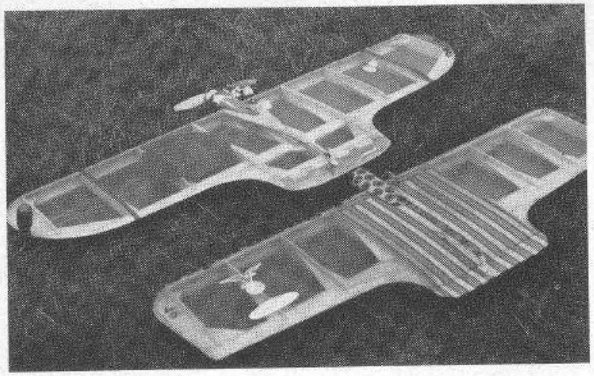
Steve Jones continued the "Ruter-ess" theme with his "Orcrist", which adapted the layout to "British" constructional ideas, which certainly improved the strength. It was very successful, as he won the 1971 British Nationals, although the separate tail proved somewhat vulnerable in "accidents".

supported by a $\frac{1}{16}$-in. ply plate and $\frac{1}{2}$-in. balsa fairing. In all, a very robust design which proved extremely successful. However, with the advantage of hindsight, Mike made just two "errors". Firstly, the swept leading edge meant that the C.G. was rather far forward, it often being necessary to add tail weight to bring it back to the correct position, and secondly, there was just a little too much wood in the design—it was all too easy to end up with a model weighing 18–20 oz. unless great care was taken in wood selection. Certainly another landmark in design!

From here, however, designs seemed to revert back to the *Razor Blade* plan form—albeit with smoother styling and lower aspect ratio—but the construction techniques exploited by the *Dominator* were continued. The "flat" wing section certainly did not harm performance, and made it much easier to build a warp free wing, so they remained. Sheet trailing edges let into ribs also gave a good compromise for strength and rigidity versus acceptable weight, so they too stayed. Leading edges, however, were frequently from 1-in. square section balsa, often supported to some extent by spruce, and all these design features were typified in the *Warlord*, a model which has many people claiming as its designer, although



The "Warlord", designed by Vernon Hunt, met with enormous success and was the first competitive combat model to be commercially kitted. Note the "standard" design features of a spruce reinforced 1 in. square leading edge, $\frac{1}{4}$ in. sheet trailing edge, "flat" sectioned ribs and sturdy engine pod. Lack of reinforcing gussets at the rib/trailing edge joint caused a weak point, but the design was highly competitive when built to weights of around 13–14 oz.



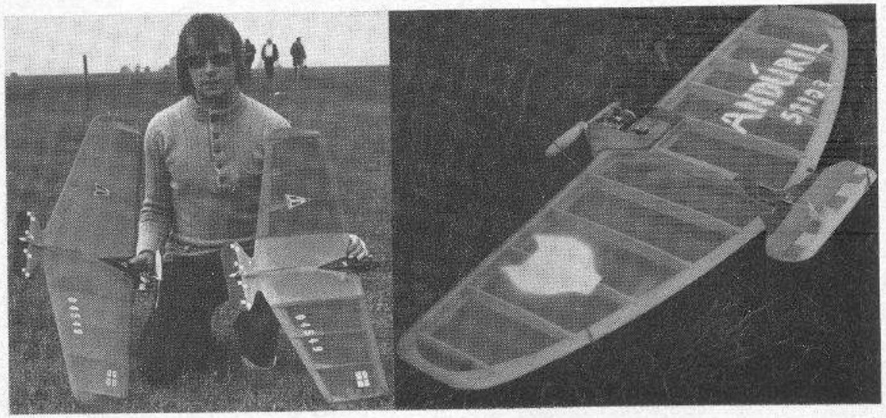
And then models began to grow! Richard Evans first produced his "Ironmonger" design, enlarged it slightly to form his "Super Ironmonger" (fore ground) then "stretched" it and increased the chord slightly to form his "Vertigo" design, seen behind. Note too how the centre section sheeting has been reduced to the minimum, the lightening holes in the trailing edge extension, plus the use of iron-on mylar covering.

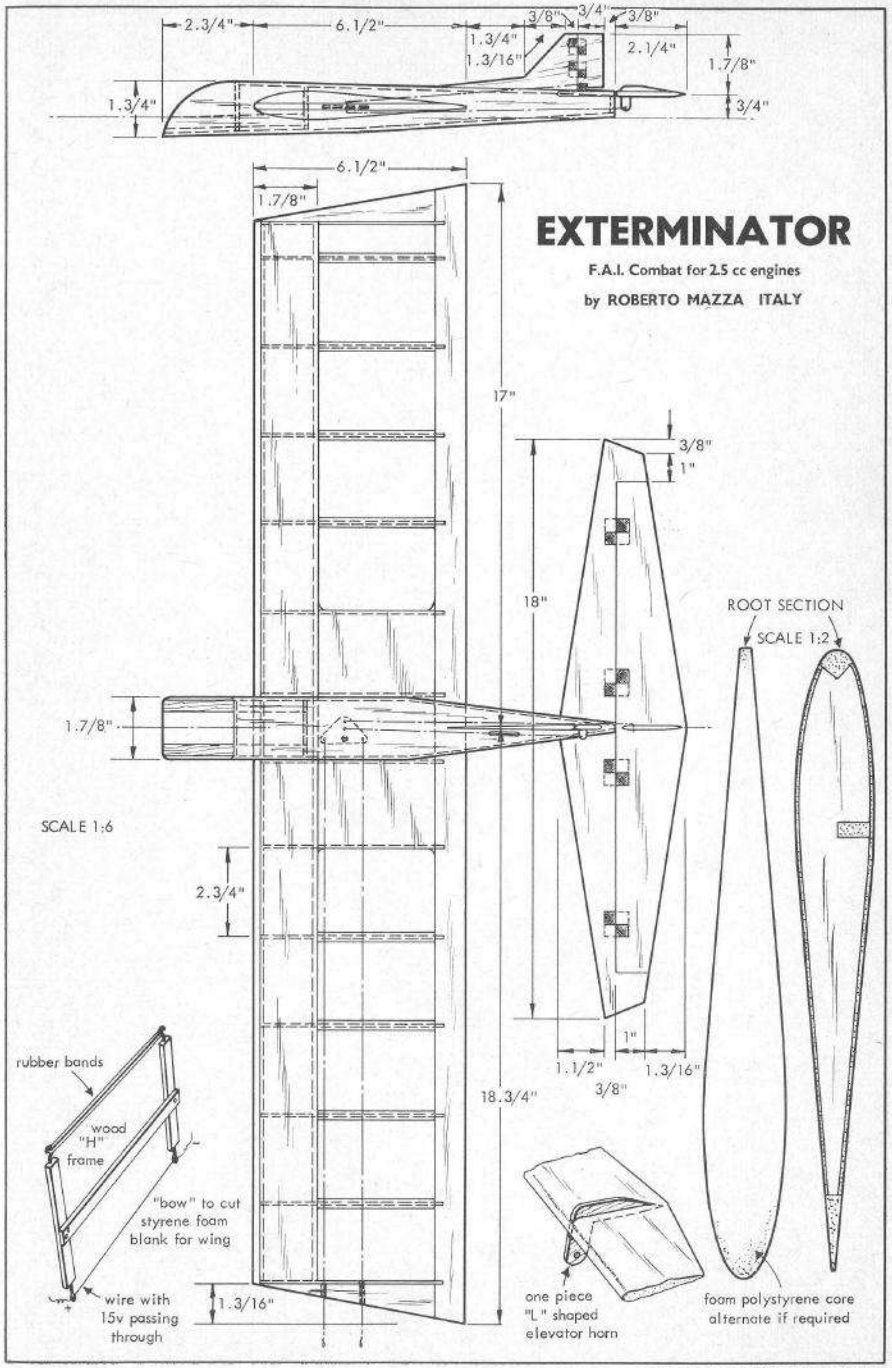
credit is normally attributed to Vernon Hunt who has had such outstanding success with it, particularly in the early 70s. Wing area incidently was approximately 280 sq. in.

By this time, light weight was becoming the obvious answer to success, and strength was being sacrificed to this end, with lighter and lighter grades of wood being used. By retaining relatively thick sections of wood (1-in. square leading edges, $\frac{1}{8}$-in. thick ribs, $\frac{1}{4}$-in. sheet trailing edges,) stiffness was retained while weight reduced.

All the designs mentioned so far have been British—for the simple reason that the event was particularly popular in the U.K., and the European's, while "catching on" fast, had much to learn in both model and flying styles. However, as a "flashback", we should also mention the *Ruter-ess* design of Sweden's Steffan Larsson and Roger Holmberg, published in 1968. This was quite a different approach—the model being extremely light (12–13 oz. was typical) and featuring a tail mounted behind the wing's trailing edge. It was an extremely "hot"

Typical of the current trend of large taper-wing designs is Dave Wood's "Titan"—seen at left. The model on the right has the centre section covered in nylon, the tips with mylar film. The "Titan" is now available in kit form. At right is an early version of Mick Tiernan's "Anduril" design, which has had much competition success. The later, straight-tapered trailing edge version, is now being produced commercially in kit form. In this model, Mick is employing a crankcase-pressurised fuel tank system.



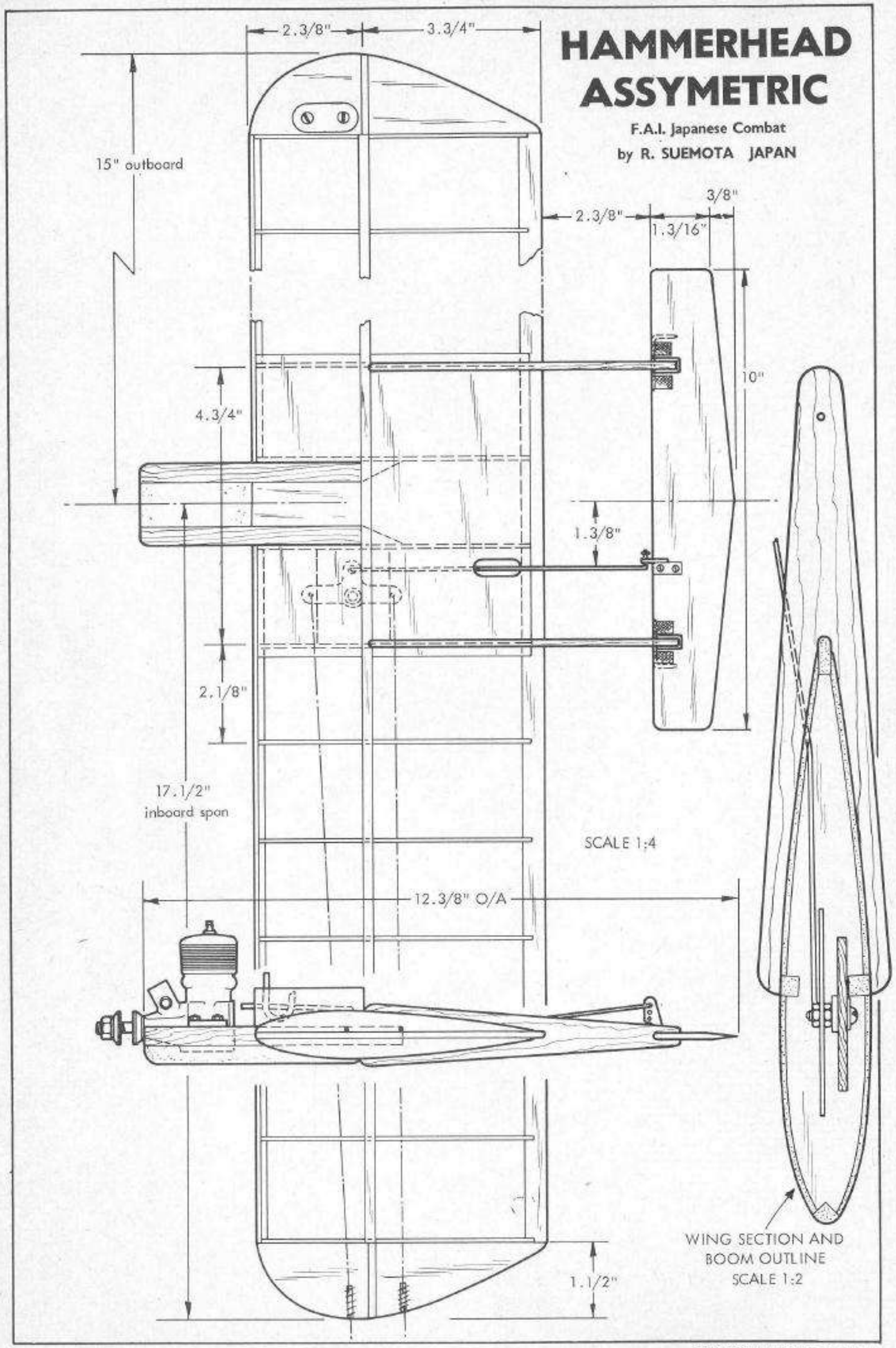


EXTERMINATOR

F.A.I. Combat for 2.5 cc engines

by ROBERTO MAZZA ITALY

MODELLI IN EUROPA ITALY



C/L TECHNIQUE JAPAN

Vernon Hunt joined the ranks of the "big model" brigade—this design having around 390 square inches of wing area, tipping the scales at between 13 and 14 ounces. The leading edge is channel-sectioned for lightness, and spruce reinforced for strength. Root chord is nearly 12 in. wide while the span is 35 inches. He qualified for the 1975 European Championships with this model.

performer, but never really captured the imagination of U.K. fliers as it was also fragile, featuring as it did a $\frac{1}{16}$-in. sheet "D" box leading edge, plus $\frac{1}{16}$-in. sheet ribs. It also featured a true "airfoil section" and had a wing area of just 230 sq. in. Perhaps if it had been designed by a British flier more would have been seen around the combat circles! However, the design was not quite forgotten—Steve Jones took the basic layout but utilising "British" style construction and increasing the wing area by another 50 sq. in. produced his *Orcrist* design which won the 1971 British Nationals event, and sparked off a whole spate of "separate tail" designs.

About this time, Mick Tiernan took this "separate tail" design layout and added it to a tapered wing design, which in plan-form closely resembled Mr. Aldrich's *Peacemaker*! Almost full circle perhaps . . . The incredibly tight-turning radius of this model, together no doubt with its very different appearance, resulted in a whole new breed of taper-wing designs, typified by Mick's later *Anduril* design and Steve Wood's *Titan*. Both models feature minimum balsa content, highly tapered wings and separate tail planes, but most important of all, the wings are large—approximately 36-in. span and around 300 in. in wing area. At last the answer is becoming clear: a model in practical terms cannot be made lighter than around 13 oz., so for maximum performance, the wing area is increased to lower the wing loading. Frankly, it seems that the wing plan-form has little bearing on absolute performance, nor has airfoil section: it is the *lightest wing loading* that counts! Naturally, this cannot be taken to extremes—too big a model will be too weak, and would need a much more powerful motor to "tow it around" at a competitive speed.

Thus we now determine that the model should have a wing area of at least 300 sq. in., weigh around 13–14 oz., be structurally stiff, and still of course be as crash proof as possible. The question is, how to achieve it? Let us examine the various important design areas and see how they can be improved.

Wing Plan-form

One advantage of a tapered wing is that a very wide root chord has to be employed—this means that the tailplane/elevator is mounted up to 15-in. from the motor, the heaviest individual part of the complete model. Thus a broad chord means that ballast is virtually never needed to bring the centre of gravity back to its optimum position—a weight saving over the "conventional" wing right away. However, if a lower aspect ratio, constant chord wing were employed, this would have the same effect, while saving the weight of sections of leading and trailing edges (longer ribs are lighter than longer L.E. and T.E.'s). Unfortunately this would also mean that if a 1-in. deep section is employed, the percentage thickness is reduced, and efficiency may suffer. Worth experimenting perhaps? A separate tail means extra balsa, which must be heavier, so perhaps elevators will be boom mounted once more (easy to mount on a tapered wing) or lighter still, hinged directly to the trailing edge.

In qualifying the earlier statement that plan-form has little effect on absolute performance, it should be added that a tapered wing design will have far less tendency to tip stall in very tight manoeuvres and is probably better in windy weather.

Wing Section

Most combat fliers will admit that the actual wing section is relatively unimportant—but don't tell the aerodynamicists! The flat-sectioned wing aids building considerably as already mentioned, but one drawback is that where the trailing edge slots into the rib, there is a severe weak point. The usual answer is to employ large gussets at each wing rib/trailing edge joint, but one answer may be to continue the "flat" portion of the rib to 80 or 90% of the chord—see *Figure 1.* This leaves a lot of "meat" on the rib around the potential weak point and is lighter and quicker too! At least one top combat flyer is currently trying this approach.

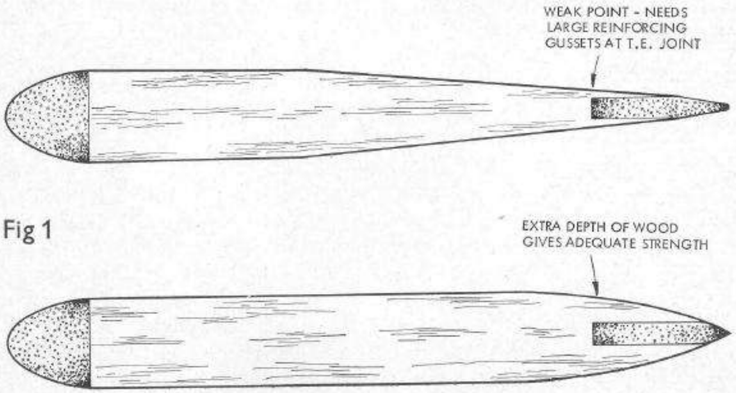


Fig 1

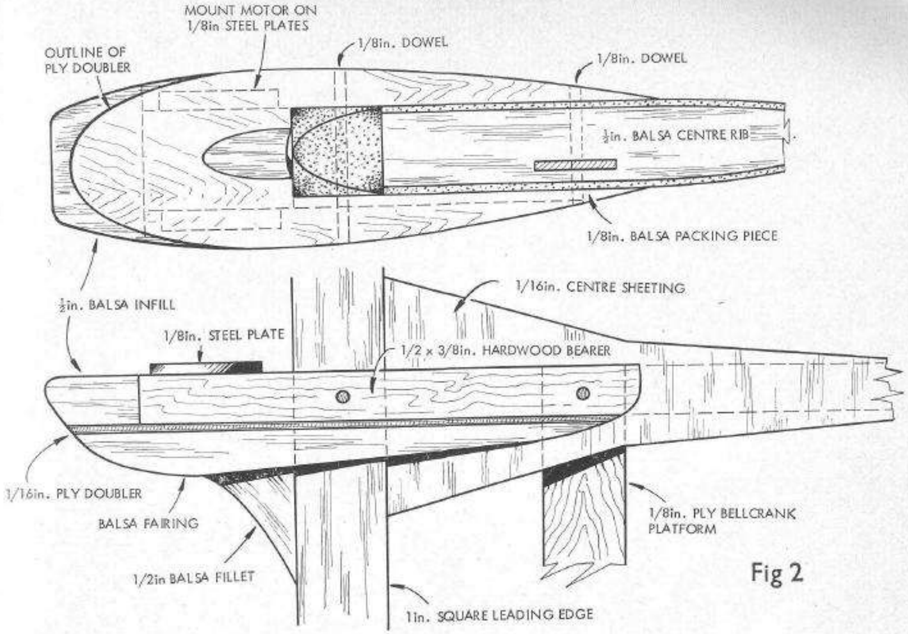


Fig 2

However, there is now something of a return to a "proper" stunt section i.e. a thick, fully symmetrical airfoil—but the success of this largely will depend on the power of the motor: read on for further details!

Wing Construction

The only way to save weight is to use less or lighter materials! As for the leading edge, this can be reduced by using moulded-section balsa, as available from Ripmax or Veron, or even laminated from separate pieces of wood to form a basic U-shape. As for the trailing edge, a balsa/spruce lamination can save weight without sacrificing stiffness if the width is reduced accordingly. At the centre section, sheeting is now reduced to a minimum, just sufficient to give support to the covering material being employed. Whereas nylon covering was once the "standard" for these models, one of the iron-on plastic coverings such as *Solarfilm* or *Kwikcote* is now popular as they are lighter and quicker to apply. However, they do not add strength as nylon does, so sometimes nylon is employed around the centre section, and film for the tips.

A further, and relatively unemployed development, would be the incorporation of a veneer and expanded polystyrene "sandwich"—this could doubtless be used in areas such as wing tips where it provides a stiff and very light structure. Perhaps further experimentation would reveal that polystyrene could be employed for rib centres etc., provided that it is suitably stiffened with conventional materials.

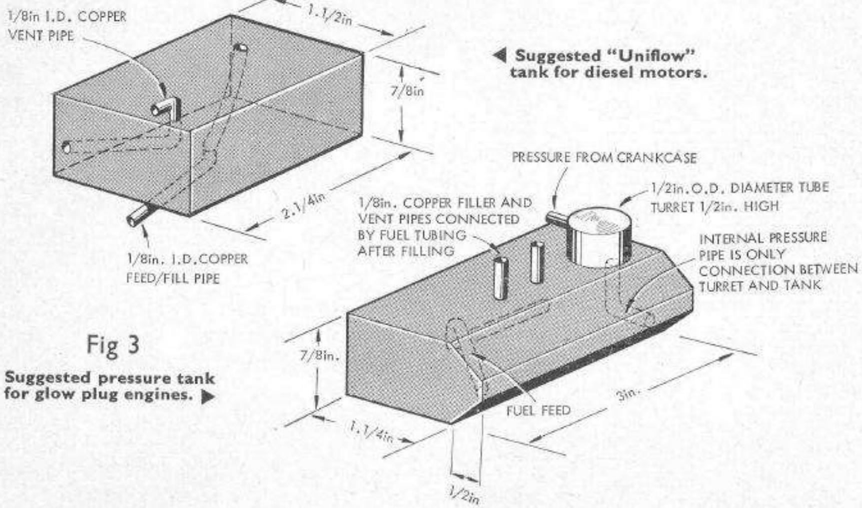
Engine Pod

The currently employed fuselage or engine pod is probably the best possible compromise between strength and weight, so it is unlikely that this could be bettered. Do remember the gusset between pod and leading edge though, as well as the ⅛-in. dowels (see *Fig.* 2). These really help rigidity—and a motor that is not rigidly mounted wastes power through vibration.

* * *

So far we have not mentioned the all important engine. For so many years now, the Oliver Tiger diesel has remained supreme, both in standard or Copeman tuned guises. However, while it is extremely reliable, it is now being challenged by one or two others. The MVVS diesel is more powerful, but less reliable and unless modified, prone to breaking con-rods etc. as the standard of workmanship leaves something to be desired. Also, the use of glow engines is beginning to catch on, as they provide more power (and this is easily increased by adding nitro methane to the fuel) but are only for the experienced combat flier with an equally experienced pit crew, as they are harder to operate satisfactorily. Note too that some glow engines offer a weight saving over the traditional diesel. These glow engines need a pressurised fuel system (such as shown in *Fig. 3*). but probably the best is a bladder (*Fig. 4*) or 'pacifier' (*Fig. 5*) tank. This "tank" may be housed in a cardboard tube or balsa box (fully fuel proofed we should add) and which again is lighter than the normal tin-plate tank used for diesels. And while on the subject of tanks for diesels, we should point out that the Uniflow (*Fig. 3*) gives the most consistent feed. For so long now modellers have used "Mustard tin" tanks, looking upon them as the ultimate, but we would query why? The sole advantage of these tanks (which derive their name from the fact that Messrs. Coleman used to supply mustard powder in these tinplate containers) is that they are easy to make, just requiring soldering the seams and lid together. They are not a "magic" shape, and in fact are too deep in section to fit neatly within a normal model.

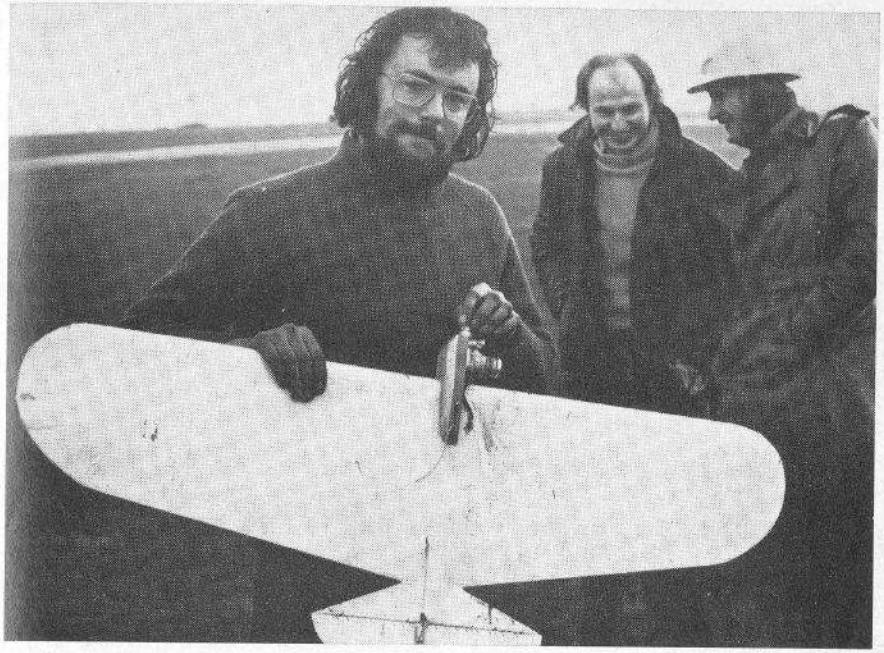
We have already shown how large-area models have a better aerobatic performance—but there is of course a snag: you cannot expect a big model to fly as fast as its smaller brethren when using the same power—drag is a speed killer.



◀ **Suggested "Uniflow" tank for diesel motors.**

Fig 3

Suggested pressure tank for glow plug engines. ▶



Returning to the combat scene after a number of years absence, Richard Wilkins set the 1975 scene alight with his outstanding flying ability, married to his very fast Super Tigre G15 glow powered, large area design which features polystyrene foam wing tips and leading edge sections for lightness. Motor runs on a pressurised fuel supply—using a metal tank, not a "pacifier".

The answer to this problem would seem to be the glow engine as they can give the necessary power to really tow a big (but light, remember?) model along at a good speed. In addition, we previously mentioned thick wing sections now being popular: a "good" glow engine will cope with a really big model (380 sq. in. 40-in. wing span, 1¼-in. thick section) but a diesel could not hope to compete on

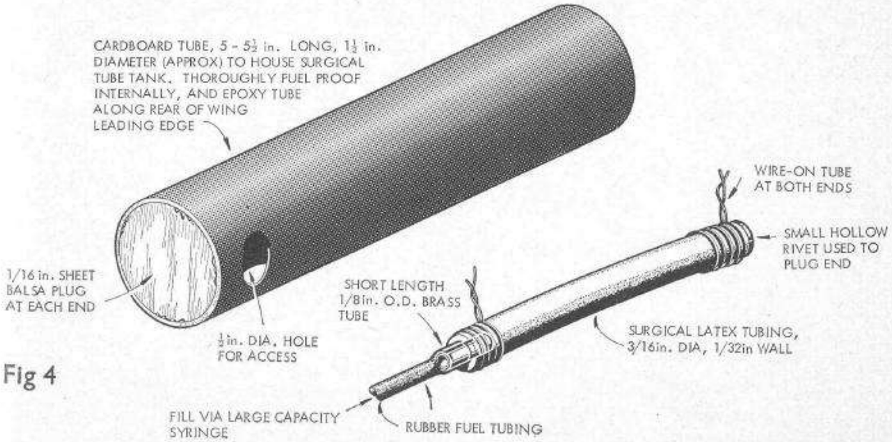


Fig 4

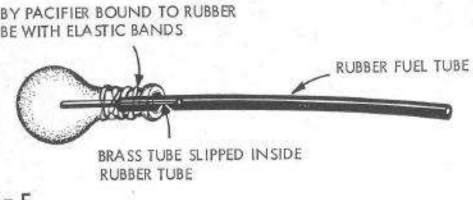
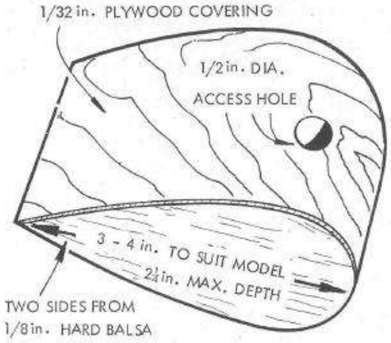


Fig 5



level terms. If you really prefer to stay with diesels, we would suggest a wing area of around 325 sq. in. and with a section not more than 1-in. thick—possibly less. And even this size demands a *really* good diesel.

Which glow engine to choose? At present the Super Tigre G15 FI is the most popular, and cheapest, being readily available and having a good power output, while also being quite economical on glow plugs—an important factor. However, the Australian Taipan 15 is a most promising design, while wealthy fliers will no doubt be tempted by the Rossi 15 for the ultimate in power . . . but success with this latter motor will need some experimentation.

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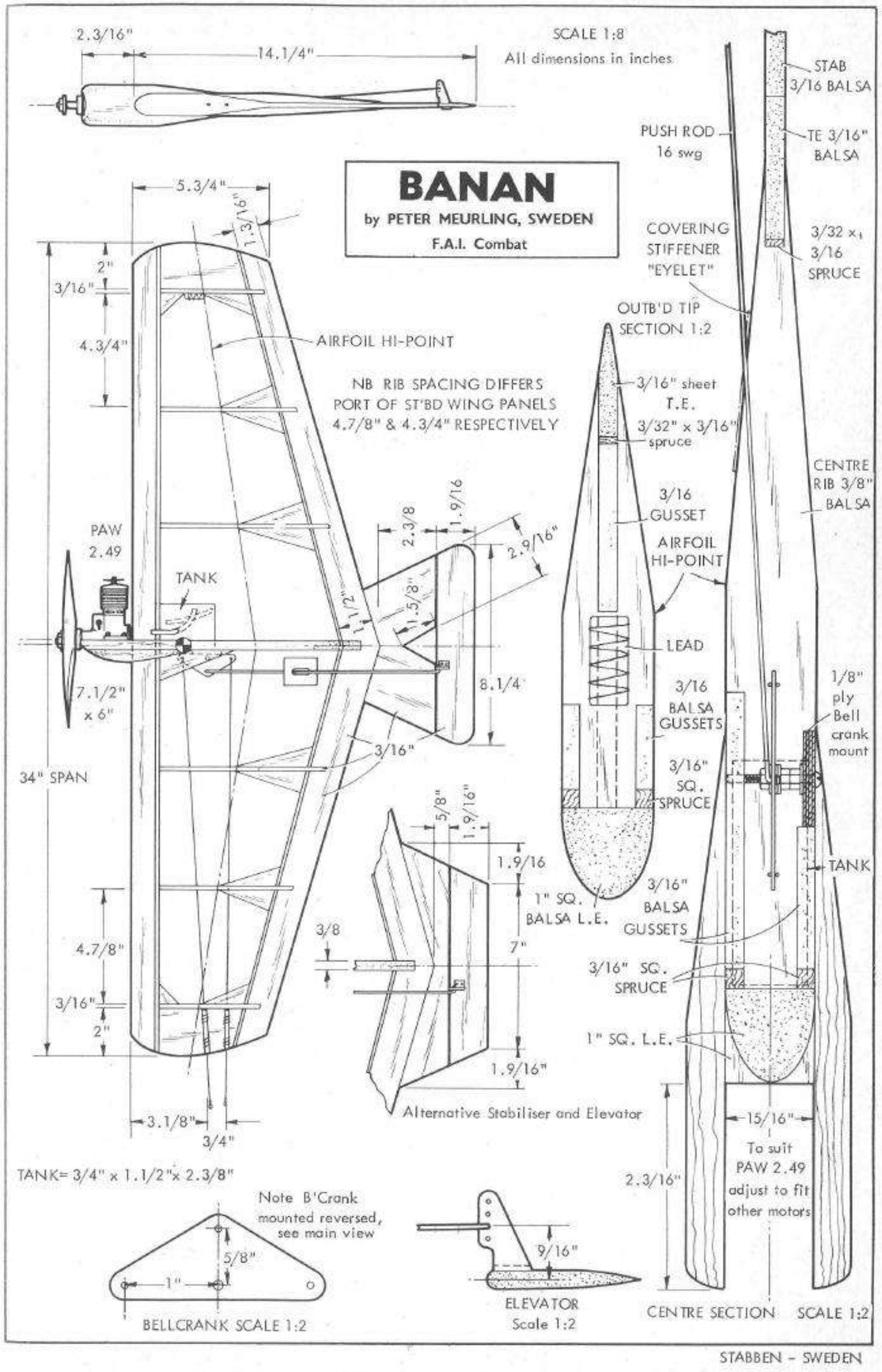

BANAN

by PETER MEURLING, SWEDEN

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STABBEN - SWEDEN

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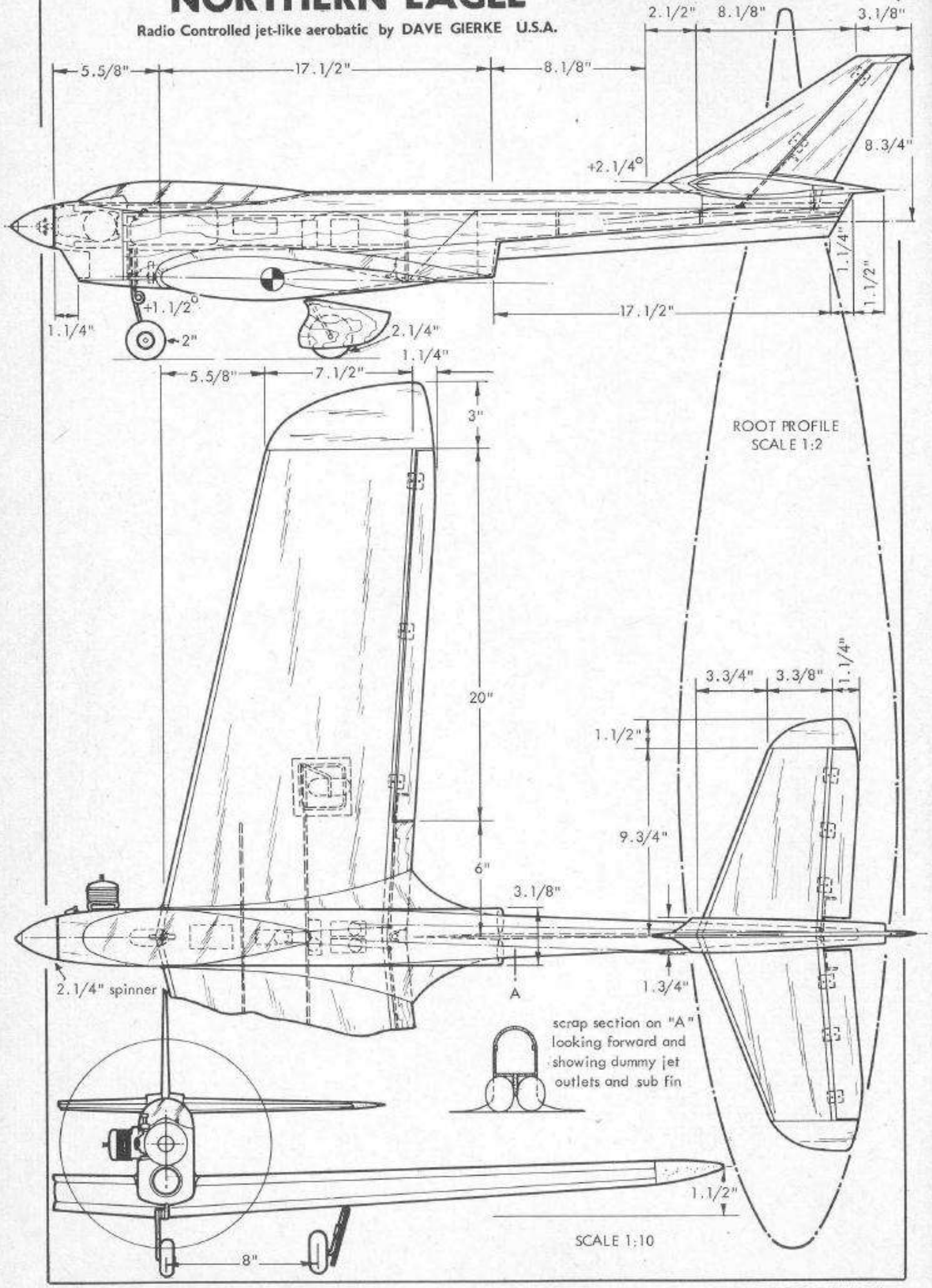
Radio Controlled jet-like aerobatic by DAVE GIERKE U.S.A.



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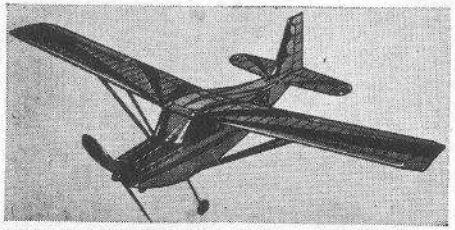

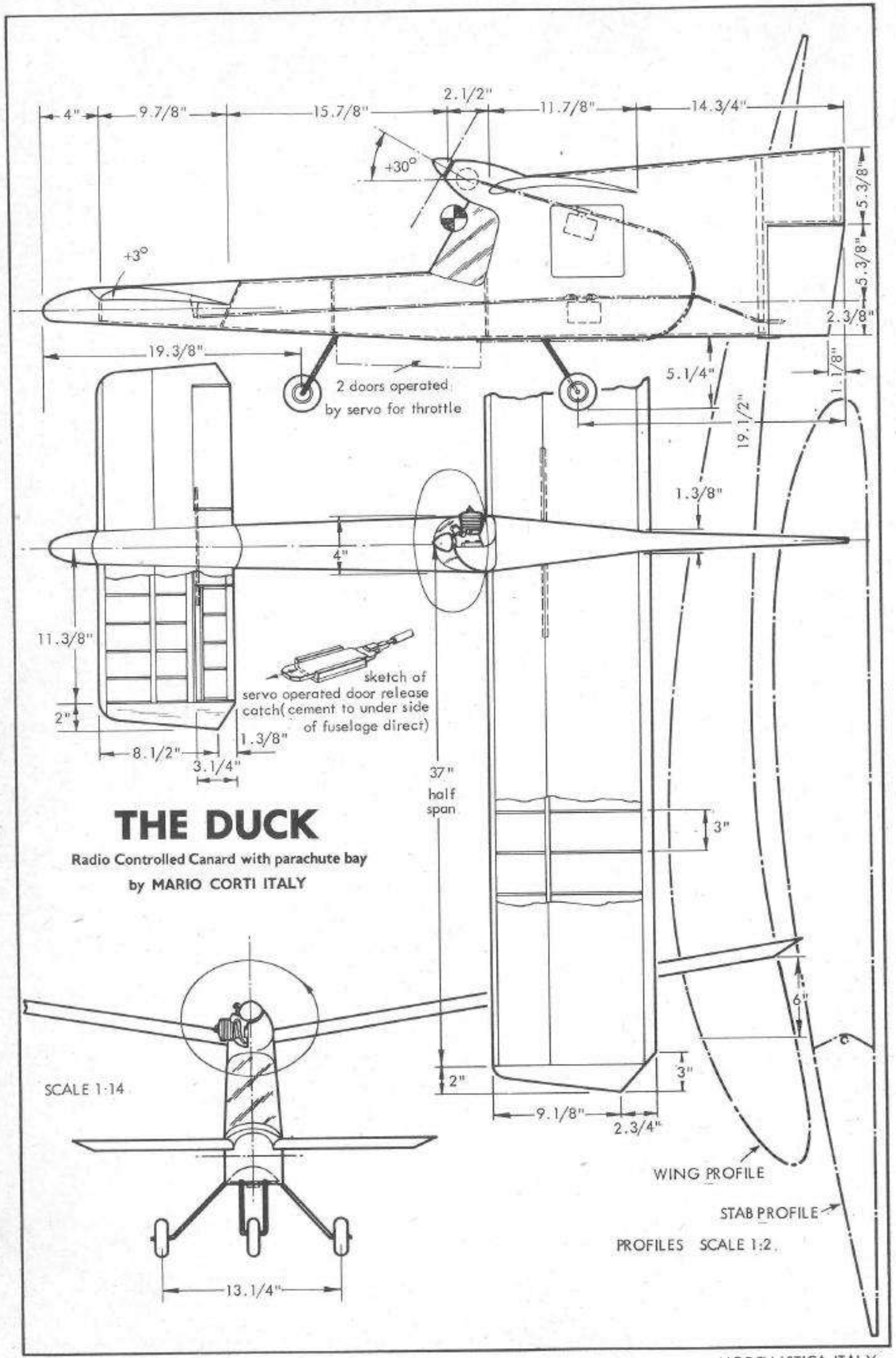

THE DUCK

Radio Controlled Canard with parachute bay

by MARIO CORTI ITALY

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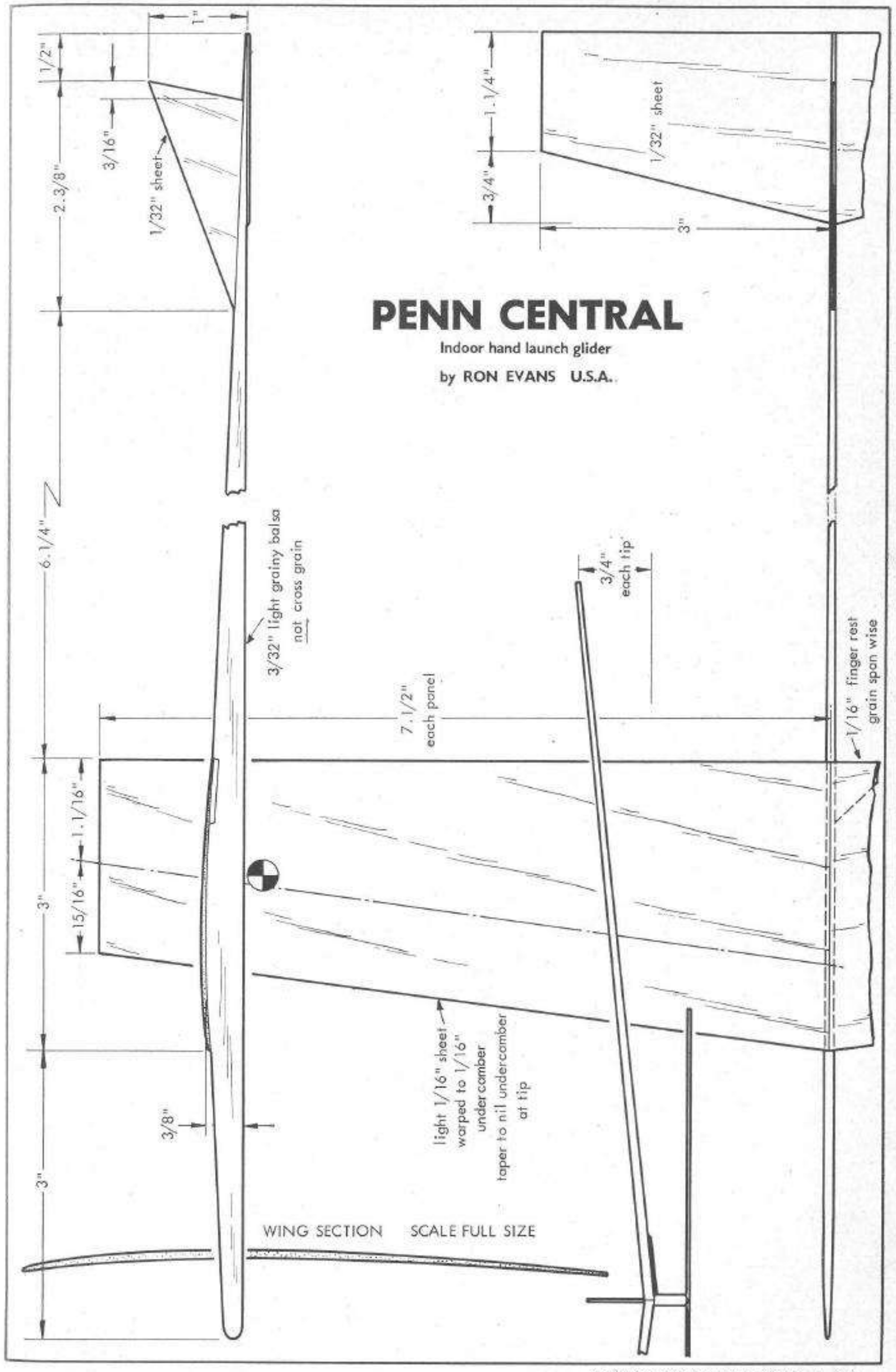

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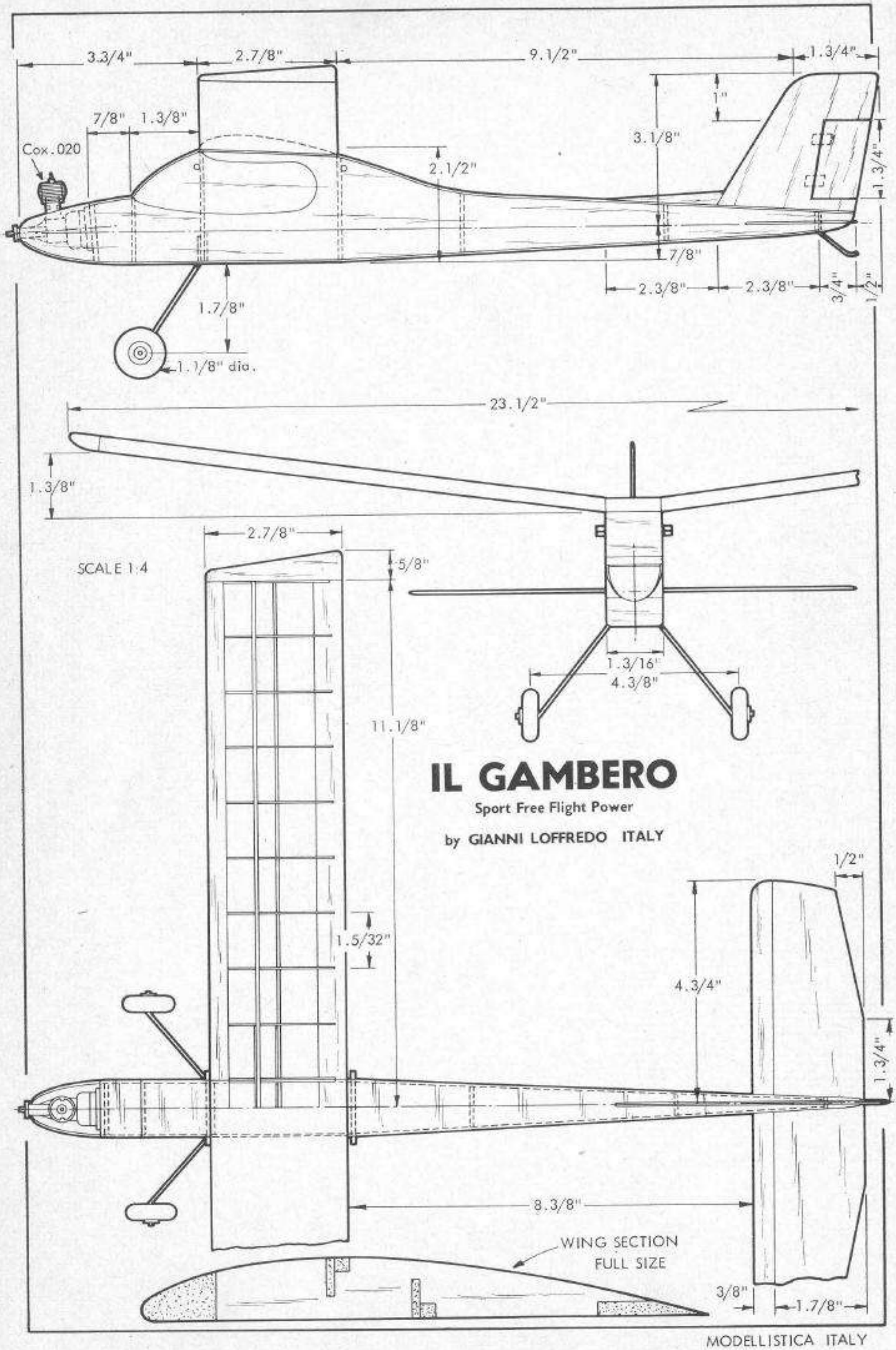

IL GAMBERO

Sport Free Flight Power

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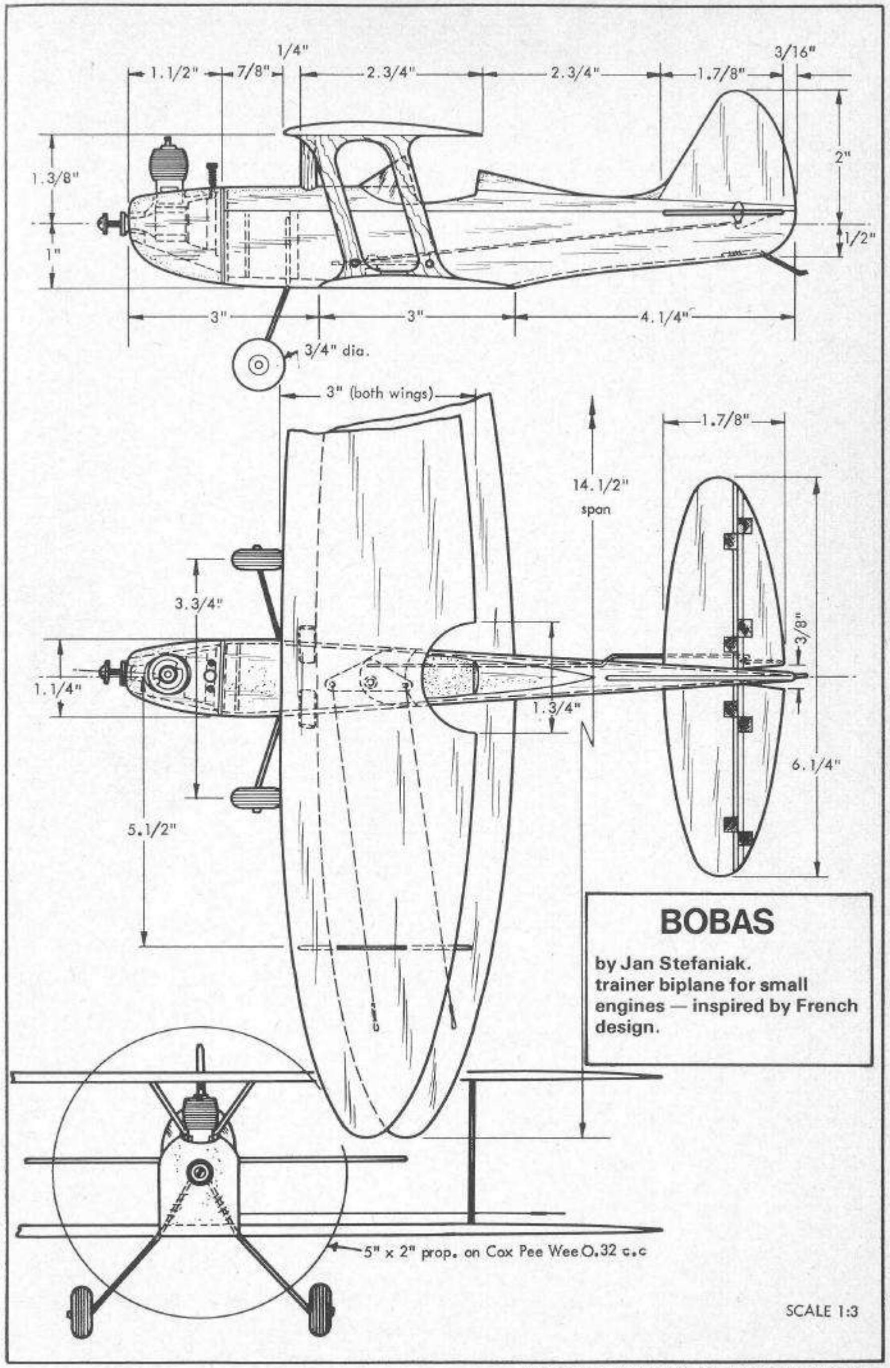
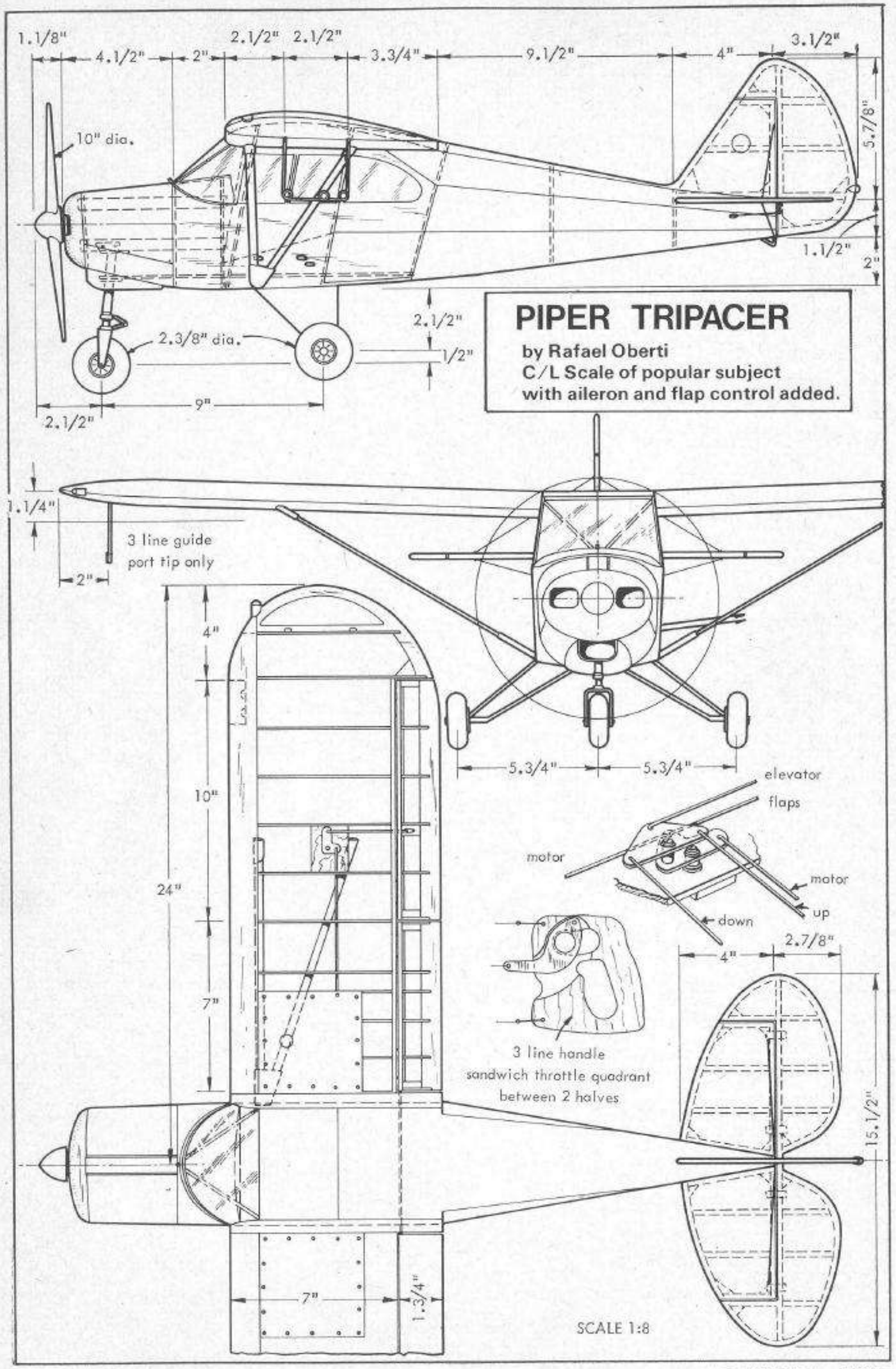


BOBAS

by Jan Stefaniak.
trainer biplane for small engines — inspired by French design.

SKRZYDLATA POLSKA after MODELE FRANCE

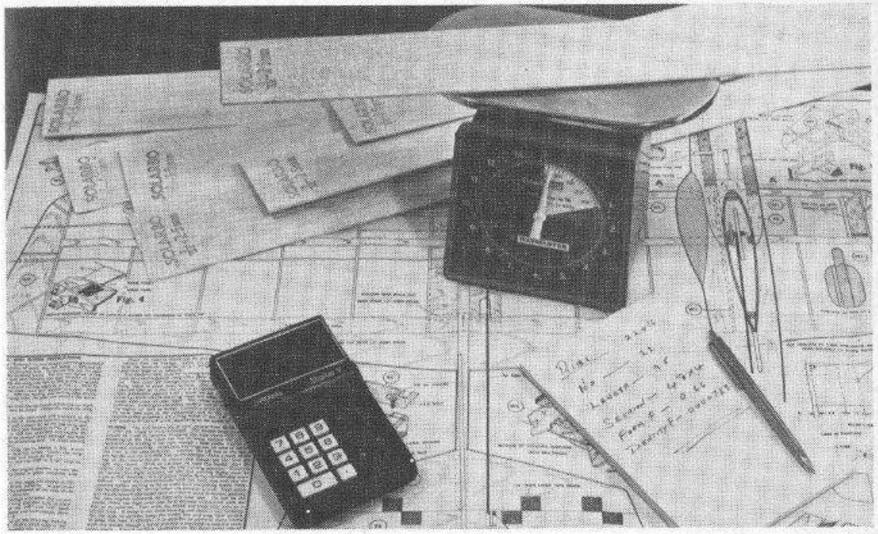


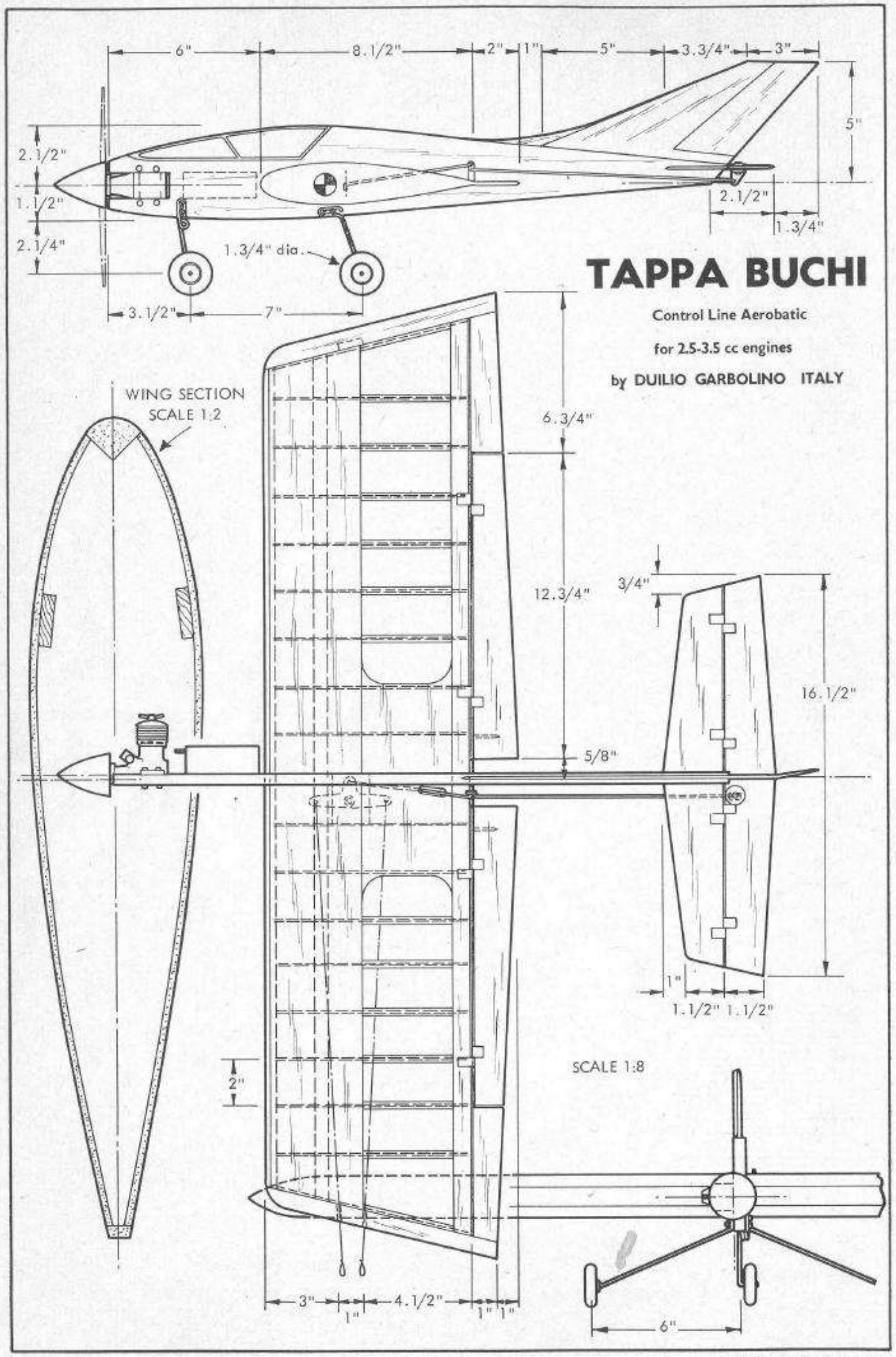
PIPER TRIPACER

by Rafael Oberti

C/L Scale of popular subject with aileron and flap control added.

MODELLISTICA ITALY





TAPPA BUCHI

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for 2.5-3.5 cc engines

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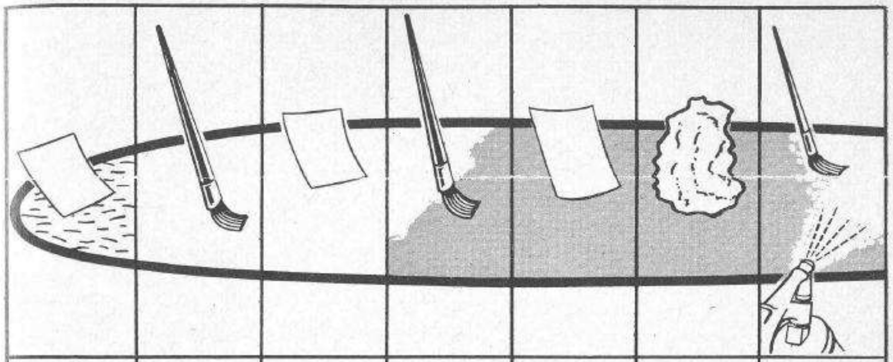
MODELLISTICA ITALY



SAND RAW WOOD	2 OR 3 COATS CLEAR HOBBYPOXY	SAND	FLOW ON 1 COAT THINNED FILLER	WET SAND	CLEAN THOROUGHLY	SPRAY OR BRUSH 2 COATS COLOR HOBBYPOXY

MODEL FINISHING WITH EPOXY, ACRYLICS AND BUTYRATES

To the average British modeller, any form of model finish that breaks away from the traditional cellulose seems to be foreign and difficult to appreciate. Even the word Nitrate on a can of clear dope, can lead to queries as to suitability when bought in the model shop. Yet there are nowadays several new forms of model finish which have found a wide acceptance overseas, especially in the U.S.A. This trio of reprinted features deals with three areas which appear to create most difficulty in understanding. We start with the Epoxy finish, made up with a two part mixture which covers by chemical action rather than solvent evaporation, and since they were among the very first in the field, we quote direct from the very experienced Pettit Paint Company Inc. leaflet on **"Hobbypoxy"** painting pointers:—

Preparing the Surface

Bare balsa should be sanded smooth, and nicks or dents filled with Stuff (a Hobbypoxy filler) and resanded. *The finish begins with the structure.* No amount of filler and paint will hide bad wood joints or uneven surfaces. After all sanding is done, vacuum the model, the room, yourself, and the model again. Put the dog out in the garden.

If your model has fabric-over-wood surfaces (tissue, Silkspan, silk over sheet balsa) you've probably adhered the fabric with dope. Seal the surface with a few more coats of dope, then let it dry for 72 hours. That's *three* days. No kidding, if the dope is still releasing solvents, even though it feels dry, it'll mess up the Hobbypoxy. Let it dry! Meanwhile, let the dog in and feed him. Now sand the dope with finest grade paper.

Painting

At last! Lock the dog outdoors again. Now vacuum the model (carefully, but thoroughly), the model room, yourself etc. Get rid of *all* the dust. (It's been proven by scientific testing methods that most of the dust that destroys your paint job was there *before* you started painting. It didn't sneak in later).

Now mix your Hobbypoxy colours.

Start by stirring **A** (the coloured part) to make sure that the pigment is thoroughly mixed. Do the same with part **B** if it's the Flat Hardener. In fact, even if it's not Flat, stir it anyway to make sure everything is properly mixed. No sense taking chances. Now mix *equal* parts of **A** and **B** together in a glass or metal container. Do *not* mix in a paper or plastic container! And don't think you're going to make the paint cure faster by adding more of part **B** (Hardener). It won't work. In fact, it will *lengthen* the curing time . . . perhaps forever!

Stir the mixture for a while, then let it stand for 45 minutes.

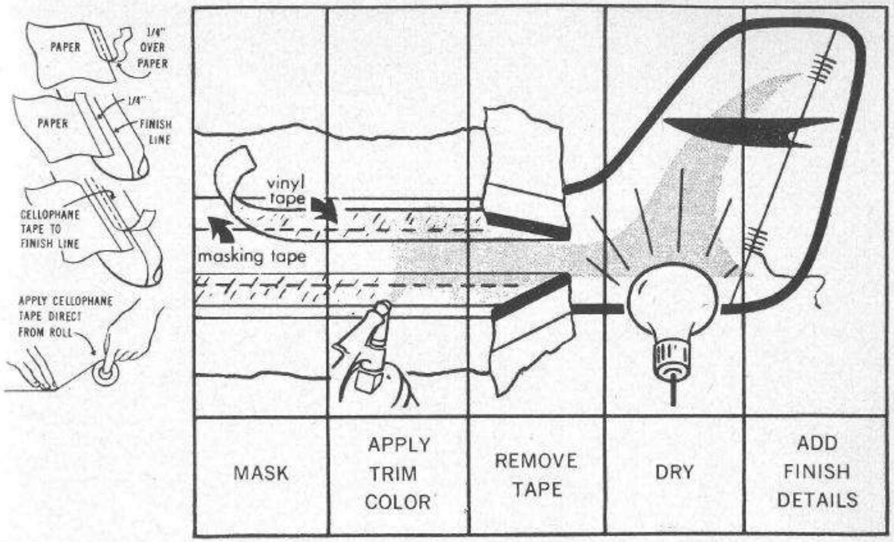
Why wait?

Well, actually you could use the enamel right away. But if you wait for a half hour or so, the chemical mix becomes more complete (in case you got tired while you were stirring and didn't do a thorough job) and the paint will cure just a little bit faster after application. In fact, it's a good idea to add the thinner during mixing so it too will be completely dispersed through the paint during the waiting period. Some people think this waiting time is a terrible disadvantage, but it's not that bad . . . use the time to wipe your model with a tack rag to remove last-minute dust.

You might also want to support the model on some sort of rack or hanger so that you can paint it in one shot without having to handle it. Time not up yet? How about straining the enamel through an old nylon stocking a couple of times to remove any foreign matter that might have fallen in.

Okay, now you're ready to paint. If you're brushing, flow the material on smoothly. Don't brush it out. Let it level out by itself and it'll look almost as good as a spray job. We've found that the new-fangled foam brushes are fantastic for applying Hobbypoxy enamels. They don't leave brush marks, they don't shed hairs, and they're inexpensive enough to throw away after use.

The simplest form of "air-brush", the Badger 250 Mini Spray Gun which is a spray atomizer operating on a suction principle. There is no needle but control can be achieved by variable pressure on the spray button. Opposite: Finishing sequence diagram from "Hobbypoxy Painting Pointers".



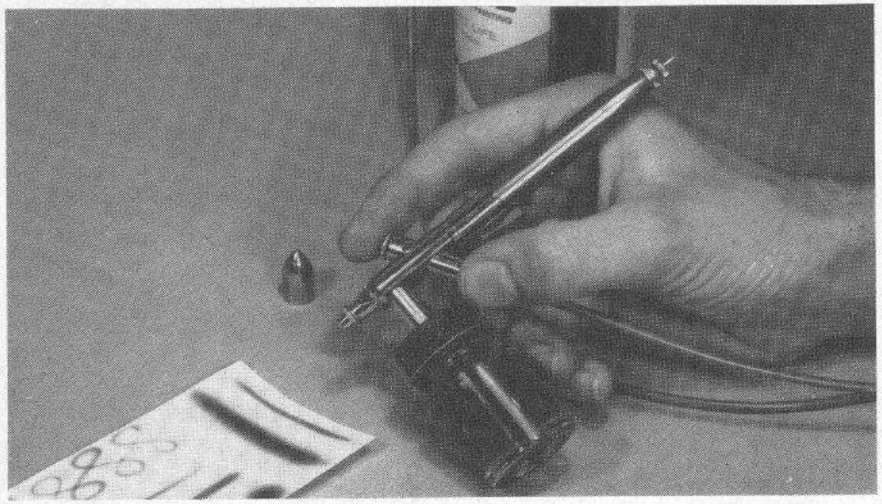
If you're spraying, Pettit Paint have a few suggestions: Be sure to have adequate air pressure for the particular gun you're using. Thin the enamel enough so it will spray properly; if it's too heavy it might spatter and leave excessive orange-peel, if it's too thin it could drip and run. It's always a good idea to test your gun and paint mixture before applying paint to the model. Try spraying a few old tin cans first, adjusting the mixture until you're satisfied with the results. Shoot a light mist coat first, then go over it with a slightly heavier "wet" coat . . . wet enough to flow out, but not so wet that it drips and runs. Spray painting is *all* technique, regardless of the paint being used, and practice is the only way to insure good results.

The Binks "Wren Model B" airbrush or the Badger give good control of the spray with minimum overspray. Best method to use is to spray a light "mist" coat over entire surface, moving in vertical strokes. Then go back over same area with horizontal strokes, applying slightly heavier coat. This method often covers completely in one application. Keep airbrush moving at all times! If you don't, you'll get a big, runny, dripping mess! Spraying goes better if Hobbypoxy is heated no hotter than 140°, near a 100 watt bulb.

Masking

If you're like most modellers, you want more than just a solid-colour model. Trimming with Hobbypoxy is easy because it covers so well; one coat of a contrasting colour should be all that's needed to completely hide the base colour. Of course it helps if you're applying dark colours over light ones, but it's not impossible to put light ones over dark ones.

Masking should not be done until at least 24 hours after the previous coats were applied. Normal masking tape will work, but many builders prefer vinyl electrical tape or Contact for masking. It's thinner and more flexible, has



The Badger 200 displays its quite extensive range of lines, for all kinds of modelling. All brushes are now designed to fit propriety air cans but air compressors would be the best investment in all cases where extensive use is envisaged.

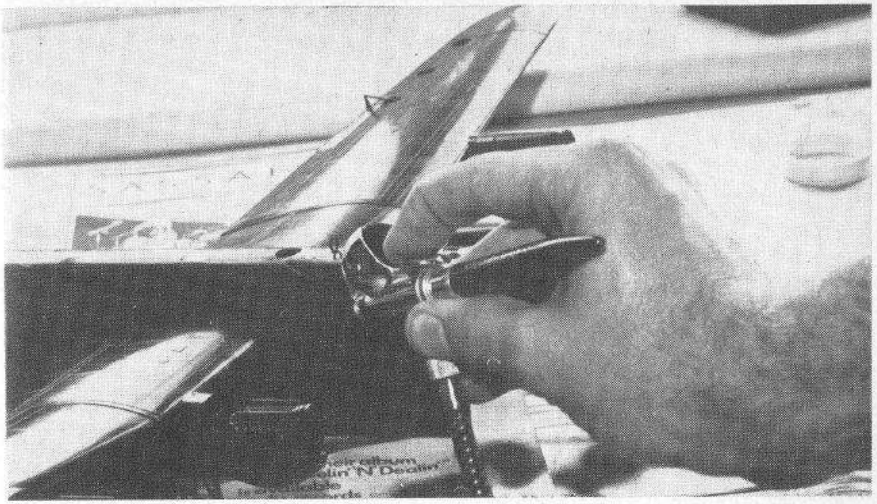
low "tack", and prevents "creeping" better than crepe-textured masking tape does. Cover large areas with wrapping paper, then apply tape over the paper at the edges, and up to desired trim line.

You can brush or spray, your trim colour, but spraying is always better. Now, unlike what you would do with dope, you should remove the tape immediately . . . before the Hobbypoxy begins to set. This technique prevents ridges from forming at the edge of the tape line; the Hobbypoxy will settle down to a smooth surface, but it will not flow beyond the line. You'll be amazed at what a smooth, sharp trim line this produces. Always pull the tape back slowly *over itself*, never straight up from the surface. Again, allow the trim colour to cure for 24 hours before handling or applying another colour.

Rubbing

If you sprayed your topcoat under ideal conditions you shouldn't have to rub the finish. But if you're like 99% of the modellers we know, a few stray specks of dust have probably found their way onto the paint. And maybe a little orange-peel, if things didn't go exactly right. Or brush marks, if you brushed.

The first thing to do is to let the enamel cure COMPLETELY. Give it a week if you can. Rubbing a "soft" finish just produces an overall haze . . . not a brilliant shine. If the imperfections are bad, wet sand with 600 paper, to smooth them down. For rubbing we recommend white rubbing compound. Don't use the brown stuff as it's too coarse. Use the white compound according to instructions on the can and you should get a very shiny finish. If you want to go all-out, you can follow up with a final rubdown with a silverware polish. Incidentally, Brasso metal polish which works on dope, doesn't do a thing to Hobbypoxy except make it very dull.



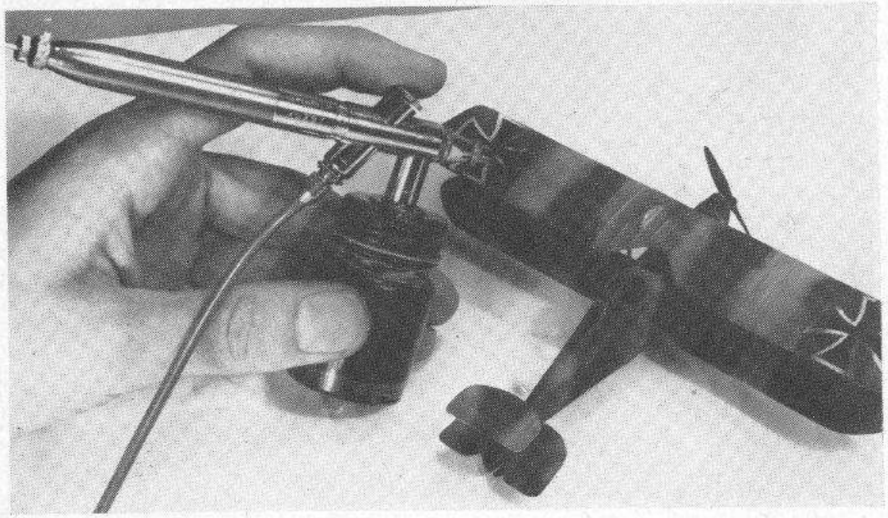
The Aerograph 63, one of the most wellknown and respected air brushes with an adequate bowl for covering larger areas. Very fine control can be achieved, the brush is capable of large area coverage down to fine line artistry on a wide range of model subjects. It is the longest established and most sophisticated of all the studio type air brushes.

Repairs

One of the many advantages of a Hobbypoxy finish is that it can be repaired easily. The primary reason for this is because Hobbypoxy sands beautifully without tearing or shredding. If you've dinged a balsa surface you can sand the Hobbypoxy down to bare wood, fill the dent with Stuff, sand it smooth, and reshoot with colour. If you've ripped unsupported fabric where dope was used under Hobbypoxy, sand through the Hobbypoxy down to the dope. (Actually, you probably won't be able to sand unsupported fabric. The best thing to do is to cut out the ripped panel, then sand through the Hobbypoxy on the edges of the framework.) Apply a new panel of fabric, using dope as an adhesive and to fill the weave. Sand to smooth the edges of the patch, then apply Hobbypoxy colour. If you use a spraygun, try this for refinishing a patched area: Spray the area around the patch with Hobbypoxy thinner just before you apply colour. While the thinner is still wet, spray on the colour. When the thinner evaporates you'll have an almost perfect patch job without the usual oversprayed ring.

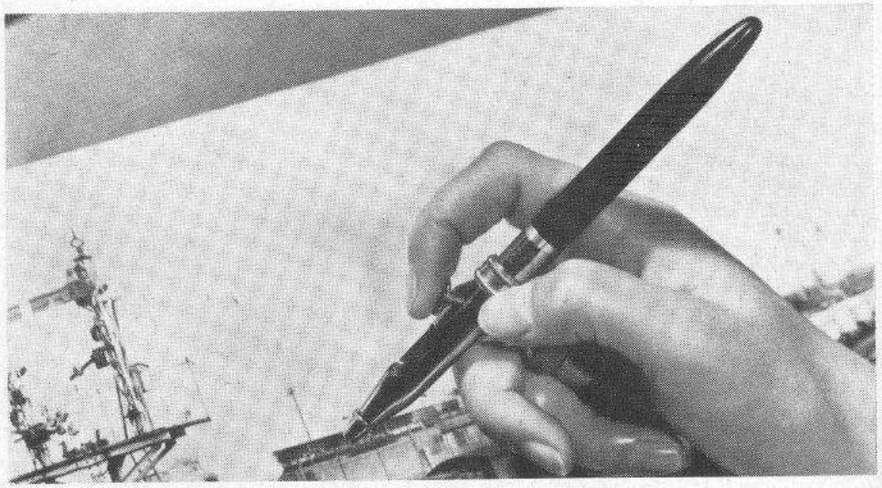
Painting Plastic

Many models have plastic structures which present specific problems regardless of the type of paint used. Most moulded parts have a smooth surface to begin with, and require no special preparation before colour painting other than a good cleaning with alcohol or thinner to remove mould-release lubricant and fingerprints. However, it's best to test a small area to see if it softens in Hobbypoxy thinner . . . if it does, you'll have to wash it with alcohol only and spray paint because brushing will pull the plastic and ruin your finish.



Badger's 200, an air brush manufactured to a price ideal for a modeller, and using suction feed from a standard size jar with pressure from an air canister. Advantage of this brush is its larger needle adjustment and the large capacity paint holder jar.

If the moulded part has flash or mould parting-line ridges, you'll probably want to sand them smooth. Wet sand with fine paper (sometimes soap and water works better than plain water) until the ridges are gone. You'll now have a dull piece of plastic, and, depending upon the type of plastic, it may even have a slight "peach fuzz" texture. A coat or two of Undercoater, followed by wet sanding, will cure this. Again, spraying will be better than brushing.



The Aerograph Super 62, a very well tried tool, that is ideal for touching up photographs and artwork, as can be seen here. The body only carries a brushload of paint, but is the finest instrument for adding final detail on a model.

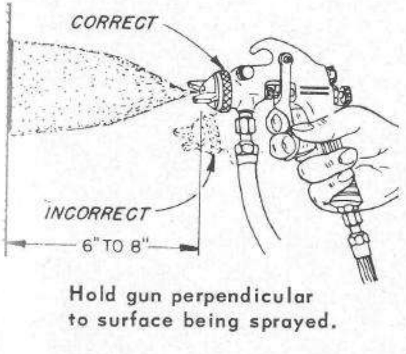
Fibre Glass parts generally need nothing more than a light wet sanding, a thorough wash with Hobbypoxy thinner, followed by Hobbypoxy colour.

A few words about painting styrofoam: If you put Hobbypoxy enamels on bare styrofoam, you will make the styrofoam disappear! The solvents (and in most other model painting products, including polyester resins) will melt styrofoam. (They will not melt urethane foams, so if you don't know what kind of foam you have, test it by putting a little bit of thinner on it. If it melts, it's styrofoam.) Before painting styrofoam you'll have to provide some sort of barrier between the foam and the paint. Balsa sheeting, paper, cardboard, old roof shingles, or . . . Hobbypoxy epoxy glue. Brush on a coat or two of Hobbypoxy Formula 2 glue, sand it, and paint. Unless you've sanded into the foam, in which case apply more glue.

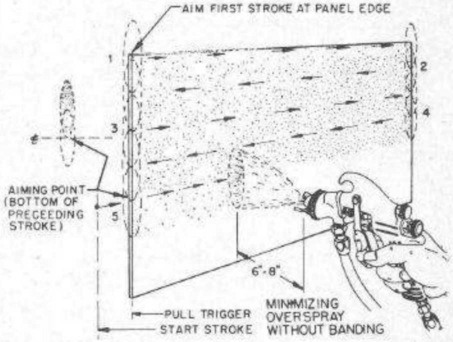
FINISHING MODELS WITH ACRYLIC LACQUERS

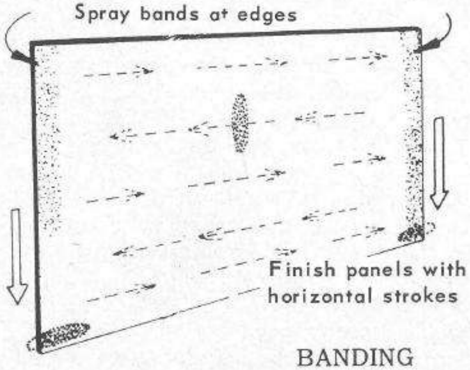
By Tom Carey

THERE are four factors that control the quality of model finish. The *paint* must be of uniform quality, formulated with solvents which provide the correct viscosity and drying time. The *operator* must be trained in the use of the equipment. The *equipment* must be suitable in design for applying the desired paint, and the *surface* to be painted should be properly prepared.



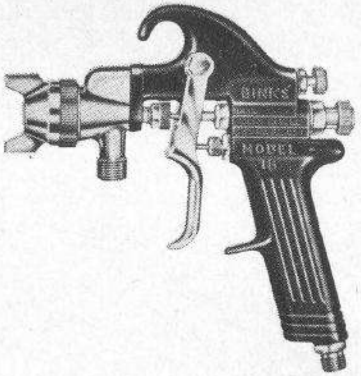
Hold gun perpendicular to surface being sprayed.





BANDING

Diagrams from the Binks "Air Spray Manual" show how to use an air brush properly, also applies to Aerosol or simple spray unit technique.

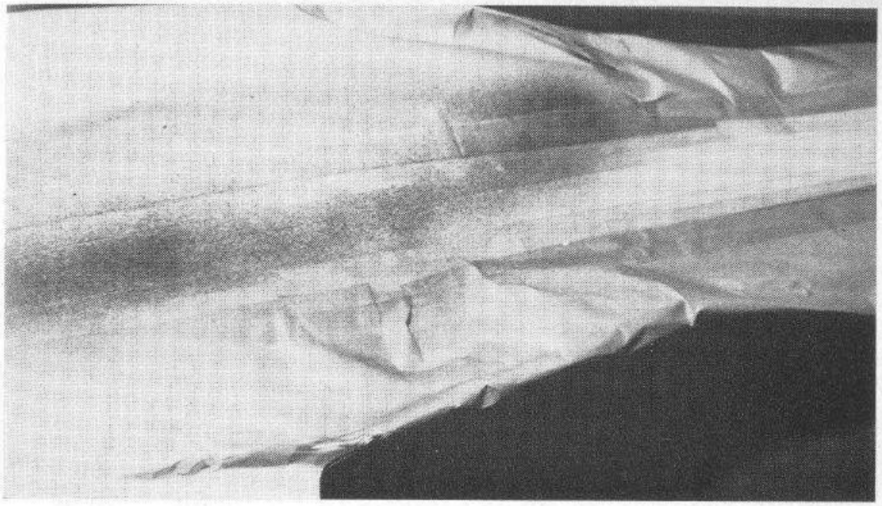


The Binks professional Air Brush with full control over air supply and paint mixture. Binks also supply a simple airbrush unit for modellers in the U.S.A., known as the "Wren", with a full back-up service of miniature compressor, foot-switch, 3 different fluid control nozzles and various container sizes.

Good spray painting is accomplished by the correct motion of the spray gun. The gun should be held six to fourteen inches from the part being sprayed with continuous motion exactly parallel to the work. A natural tendency to move the gun in an arc will result in a varying distance and hence inconsistent paint thickness. Runs or sags will develop at the point where the gun is closest to the work. At the ends of the arc, spray dust, or overspray (caused by paint drying before it contacts the surface) will result. Work with straight uniform strokes, moving back and forth across the surface in such a way that the spray pattern overlaps the previous stroke by 50 per cent. The speed at which the gun is moved is a function of how much paint the operator wants deposited. For example: the first coat, or "mist coat", is usually deposited by rapid motion of the gun across the surface. This mist coat provides a holding surface for the next coats. If the mist coat is not applied, chances are the weavier, final coats will run before drying. When spraying model aircraft, where weight is always a problem, only two coats of paint are necessary—the mist and final coats.

The spray gun trigger controls the action of the gun and should be used during each stroke. To avoid building up the paint at the beginning and end of the stroke, the correct procedure is to begin the stroke, then pull the trigger releasing it before the stroke is completed. Triggering is the key to spraying technique.

Another problem plagueing the painter is overspray—that part of the spray at the edges of the fan that dries *before* it reaches the work, causing a "sandy" surface. To avoid this, keep the surface "wet" so that the overspray is dissolved by the previous strokes. To minimize overspray, spray all corners and edges first. Commence spraying parallel from the edges to cover the flat surfaces, overlapping as previously described by 50 per cent. Overspray can be reduced by proper atomizing pressure. If a painted surface is kept wet enough, most of it will be absorbed. Overspray can also be reduced by careful spraying procedures but it cannot be totally prevented. Two methods are commonly used to remove overspray once it occurs. A final mist spraying of a 9:1 mixture of thinner and retarder will dissolve overspray and flow it into the finish. If this mixture is applied too heavily, runs will result. If applied properly, it will eliminate the necessity of rubbing the finished paint job to achieve a high gloss. This technique is particularly useful for blending spot spray repairs. A spot spray will always be encircled by an overspray which must be compounded out after the paint is dry.



Areas to be painted (trim line etc.), are masked off with tape and remaining areas covered with **BROWN** paper which prevents second application paint seeping through to damage base colour. Seal all folds in paper with tape. Warm the job over an electric fire and then spray 80/20 thinner/paint a little at a time to avoid runs.

Application of this thinner-retarder mixture over the spot repair dissolves the overspray ring, blending it with the surrounding finish.

Another final coating procedure that eliminates overspray and achieves a high gloss is the use of clear acrylic. A thin mixture of clear acrylic adds a super gloss to the base coat and markedly improves the finish. The same gloss can be achieved by rubbing, but it is hard work.

Prior to applying the finish coats, a suitable primer must be used. This serves as a bond between the model and the finish. Primer coats are heavy and should be lightly sprayed and sanded with 400 wet or dry paper. Remember, when spraying acrylics, a plasticizer must be added. This applies to the primer as well as the finish colours.

Below are listed the more common difficulties in spraying acrylics, with their causes and cures.

Problem: "Orange peel"—circular-like crater formations.

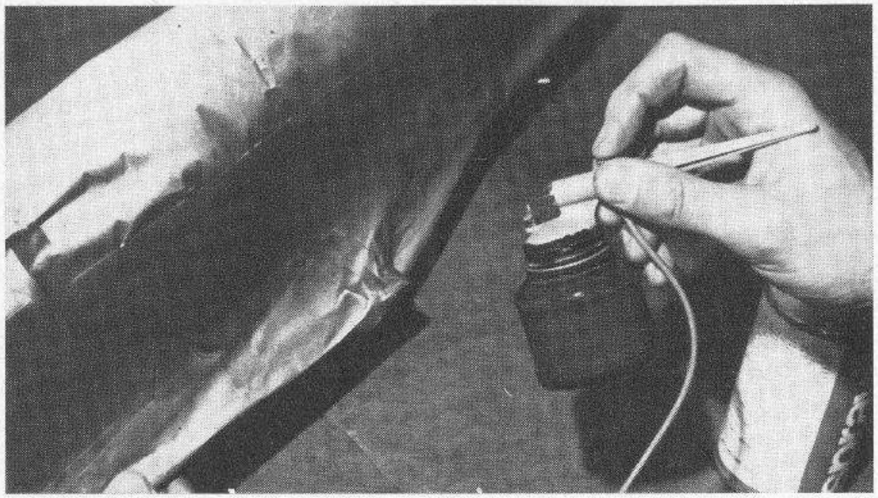
Cause: Improper solvents, insufficient atomization, incorrect viscosity. The solvent retained in the coating after it has been desposited on the surface is insufficient to allow proper flowout. Use only that solvent recommended by the paint manufacturer. On very dry (low humidity) days, even though a proper solvent is used, a high evaporation rate could prevent flow-out. In this case, use more solvent. If the air pressure is too low, improper atomization will result and cause orange peel. Use the recommended air pressure.

CURE: The finish must be sanded smooth and another final coat applied, using the recommendations above.

Problem: Runs or sags.

Cause: Too much thinner, too slow a thinner, too heavy coats, too wet coats.

CURE: Reduce material according to label directions. Regulate the fluid flow of the spray gun to reduce the flow of material. Do not spray too close to the work.

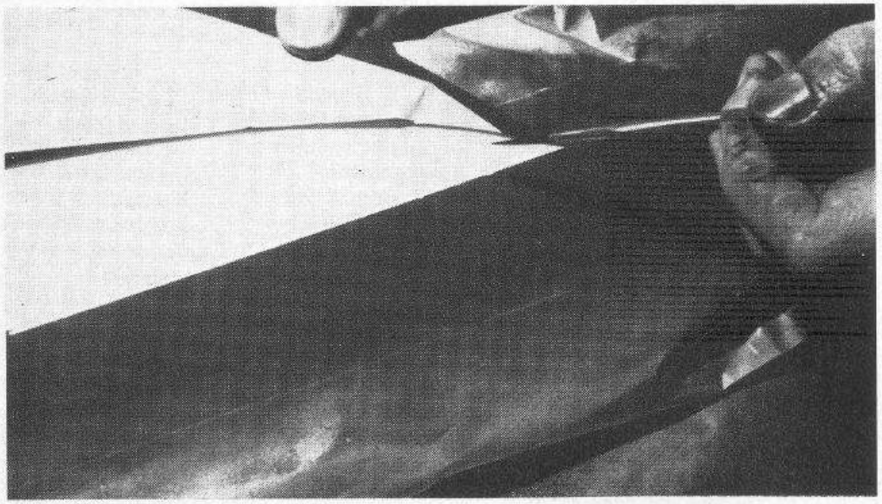


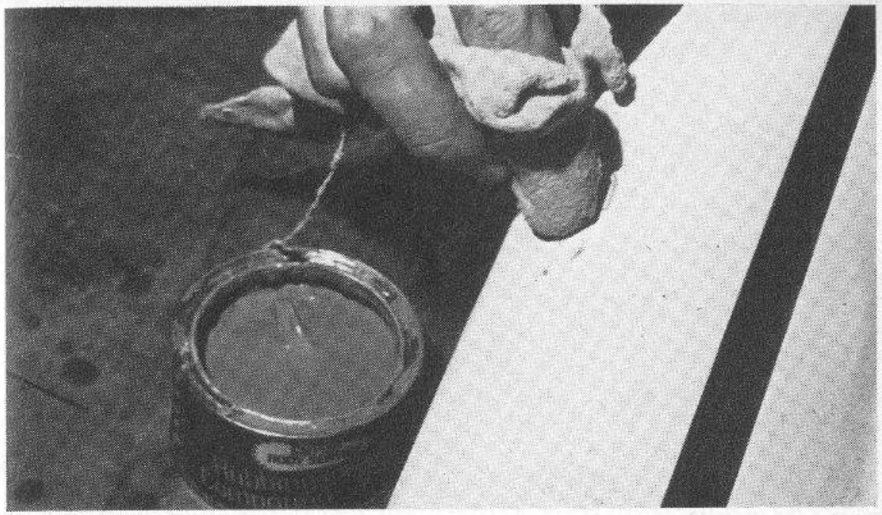
As paint builds up, the risk of runs becomes greater. By warming the job first, the paint dries rapidly, thus minimising the risk of a paint run. If such does occur, it may be possible to just wipe out the run with a finger, followed by a fine blow-out.

Problem: "Fish eyes"—circular-like indentations in the painted surface. Contamination from lubricants, polishes and waxes.

CURE: Remove finish by sanding. Clean work with "prepsol", a DuPont product specially formulated to clean surfaces prior to painting. Respray.

When paint is sufficiently dry, carefully remove masking paper. Work deliberately, using a sharp knife to aid removal of paper. Tape mask to trim line is removed last. It is important when removing tape to peel right back on itself to avoid risk of tearing off base coat paint—which is quite a possibility. However, risk is minimised by this procedure, and by first rubbing fingers along tacky side of tape before masking up.





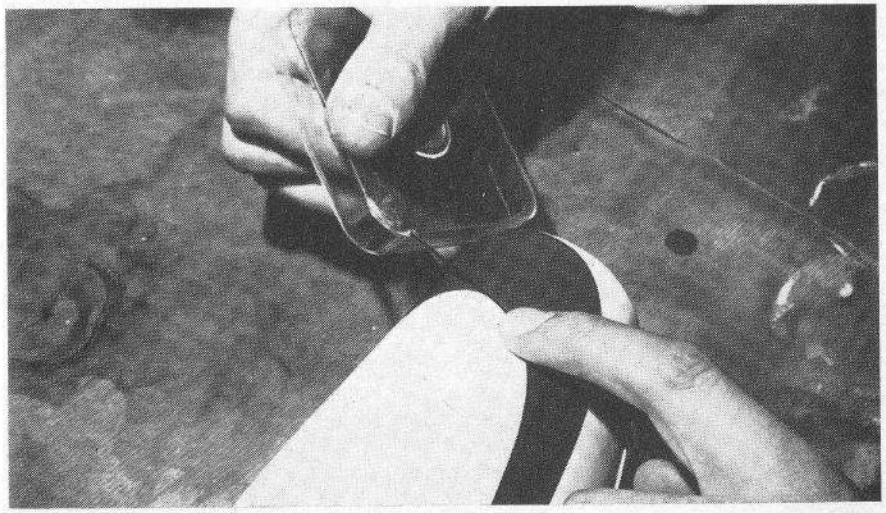
Even after careful masking, it is possible that spray will get through one or two folds in masking paper here and there. These misty patches can be easily removed with fine rubbing compound.

Problem: Blushing.

Cause: Condensation of water in or on paint films which have cooled through evaporation below the dew point.

CURE: Slow the drying process by adding a retarder to the paint mixture and respray the work. In case of very humid conditions—don't spray!

Fine pin-stripe lines are very difficult to apply in paint and one solution is to use fine artists' tapes which are available down to $\frac{1}{32}$" wide. When applying, avoid stretching, as the tapes will thereafter contract back to near original length and will pull away from curved lines as seen being worked here. Tapes will stay in place if generously fuel proofed.



Problem: Blistering.

Cause: Improper undercoat, fingerprints on primer surface or moisture on the surface.

CURE: Sand off the finish and clean surface with Prepsol. Be sure the surface to be sprayed is above the dew point. Use the recommended undercoat.

Much of the material presented in this article, has been extracted from a Binks publication entitled: "*Air Spray Manual*", T.D 10–2, printed by the Binks Manufacturing Co., 3114 Carroll Ave., Chicago. IL.60612, U.S.A.

SOME SUGGESTIONS FOR FINISHING WITH BUTYRATE DOPE

by Bill Battis

A PROPERLY applied butyrate dope finish can be made to have a good gloss with no compounding and with only a little extra effort. There are three important points to consider in trying to get a good finish with butyrate dope. These are:

1. *Apply colour coats over a good base.*
2. *Plasticize the dope.*
3. *Slow the drying time with a good retarder.*

A good base for butyrate colour coats can be obtained on balsa as follows: First, apply two coats of clear dope over well sanded, bare wood. These two coats should be well thinned—about 50%—for good penetration. For these two coats, use either nitrate dope, or non-tautening butyrate. (Keep in mind that butyrate can be applied over nitrate dope, but nitrate cannot be used over butyrate.) The advantage to using the nitrate clear dope for the early coats is that nitrate dope has better adhesion than butyrate. It is usually not necessary to plasticize nitrate dope, but it is desirable to plasticize butyrate to minimize its shrinking tendencies. Plasticizing butyrate dope helps alleviate, to some extent, its adhesion problems. (More about this later.) If non-tautening butyrate is not available, make your own by adding one to two teaspoons of triphenyl phosphate or tricresyl phosphate, or a packaged plasticizer such as Southern RC Products Flexall (U.S.A.) to an unthinned pint of dope. Plasticizing is important to prevent warping or bowing of sheet balsa since unplasticizing butyrate shrinks and continues to shrink for a long period of time after its application.

Following these two coats, sand lightly, and apply silk or silkspan with a *third* coat of clear dope. This coat of dope should be plasticized, but not thinned as much. Continue to build up the surface with clear nitrate or your plasticized butyrate—brushed on—and thinned no more than necessary to facilitate brushing. Sand lightly between coats. You are ready for the colour coats when the doped surface is uniformly dull in appearance after a light sanding. (No tiny pits or low spots that appear shiny when the model is held up to a light, or "sky-lighted".)

Mixing a small amount of talc or corn starch with the clear dope used for the build-up will speed filling the grain of the silk or silkspan. If you choose to use talc, avoid breathing the dust created by sanding as there have been recent warnings about possible respiratory problems which may result.

For open bay structures covered with silk, follow a similar procedure used for the butyrate build-up, but don't plasticize the first coat. Gradually add plasticizer to successive coats as the silk tautens. Again, nitrate won't require any plasticizer here unless you have unusually flimsy wing.

One problem with butyrate dope is low adhesion as mentioned earlier. As an example, consider a 2-in. wide aircraft finishing tape pulled at 90 degrees to a fabric surface. Butyrate dope has a one pound peel strength and nitrate dope has four pounds. Nitrate, however is not as flame resistant as butyrate dope and does not last as long as fabric-covered aircraft, although the latter point is not too important for our models. Butyrate dope is more resistant to methanol-based model fuels than nitrate dope, and, in addition, it dries to a much higher gloss.

If you chose to fuel-proof your aircraft with clear epoxy paint over colour dope, you will have much better luck applying the epoxy over nitrate dope than you will over butyrate. However, nitrate colour dopes are more difficult to find.

About Filleting

One of the bad features of butyrate adhesion (or lack of it) is "filleting". This is the raising of the butyrate film at the junction of surfaces at near 90 degree angles, it is caused by poor adhesion, as mentioned, as well as by excessive shrinkage of the dope film. Observation of the following precautions will help to minimize these problems.

1. The surface should be perfectly clean and free of all sanding dust before applying each coat of butyrate (clear or colour). Use a tack rag!
2. Allow at least an hour between successive coats of butyrate dope. Too fast a build-up will result in the surface of the paint film drying and beginning to tighten before the underlying layer is dry—this allows the paint film to pull up in concave areas.
3. Don't allow the model to set for long periods of time between coats. Successive butyrate coats adhere best when applied before curing is too far along (butyrate solvents continue to evaporate or "gas-off" for a long period of time after application, but this process is most significant during the first few days.)
4. Don't overlap silk or silkspan sections at concave joints such as at the fuselage side and horizontal stabilizer. Leave a small gap (about $\frac{1}{16}$-in.). This will help prevent filleting.
5. *Do* fully plasticize colour coats.

Any irregularities which are visible when you start to apply colour will become more apparent after the finish is applied. A little extra effort exerted at this point to provide a perfectly smooth base for the ensuing coats of colour will pay great dividends when finished.

Spraying is the easiest method for applying coloured butyrate. This is particularly true if you are concerned about weight build-up since the uniform coats obtainable with spraying equipment will provide maximum coverage with minimum build-up. Use a siphon-type gun for the best atomization, and follow the manufacturers recommendations for air pressure (usually above 30 p.s.i.) Thinning will almost certainly be necessary for spraying fifty to one-hundred per-cent will usually be suitable. You will have to experiment here, since these figures will vary with the solid content of the dope that you are using, the type of spray equipment, and the air pressure being used.

Importance of Retarder

For all colour coats, add a good *retarder*. This is important because it will slow the drying time and allow each colour coat to flow out. This results in a much smoother finish, and one with a higher gloss. The amount of retarder varies—a good rule of thumb is to use retarder for $\frac{1}{15}$ of the thinner that you would add. This is for a day of "normal" humidity. For instance, if you thin your paints 50% for spraying, you would add 40% thinner and 10% retarder. The use of retarder will also help prevent the blushing of your finish. On days of high humidity if you must paint, it would be a good idea to increase the amount of retarder that you add. Blushing is a phenomenon that occurs when moisture from the air condenses on a freshly painted surface. This happens because evaporation of the solvents from the dope lowers the temperature of the painted surface, causing the condensation. When blushing occurs, the painted surface looks "chalky" or "milky" after the dope dries. In addition to looking bad, this causes a reduction of the paint film. Some good retarders are: Dupont, R-M, Randolph Universal Retarder No. Y-9910, Ditzler Duracryl DTX-1140, all from the U.S.A.

Believe it or not, if you retard butyrate colour dope adequately, it is possible to brush on the colour and have a finish that is virtually indistinguishable from a sprayed finish.

The retarder allows the dope to really flow out and eliminate irregularities and brush marks which are ordinarily apparent in a brushed-on-finish, and which usually require considerable sanding to eliminate. Flow on the finish when you apply it. You will have a finish which is slightly heavier than that which you get when you spray, because the paint film will be thicker and less uniform, but you won't be able to tell it by looking.

Back to spraying—have you ever tried to paint up to a previously painted section only to find that the dope applied previously has started to dry so quickly that the overlap, or edge, is very apparent? You will be pleasantly surprised when you use a retarder.

After you have completed application of the colour coats, allow the model to set up for a few days for curing. During this time, brush marks and other slight irregularities in the paint film (such as a *slight* tendency to orange peel) will gradually become less apparent as the surface film cures and shrinks. Resistance to hot fuels improves during this time also. After a few days, apply a coat of wax (Johnson's Pledge is good) to enhance the shine and facilitate cleaning.

If you accidentally spill hot fuel on the finish and notice an immediate discoloration, *don't wipe it*! Let it dry, and then apply a coat of wax or castor oil over the spot. It will disappear completely.

If you use fuels that contain only synthetic lubricants, more frequent re-waxing to prevent a dulling of the finish will be necessary. Fuels containing castor oil will help maintain the gloss. Castor oil is good for butyrate finishes.

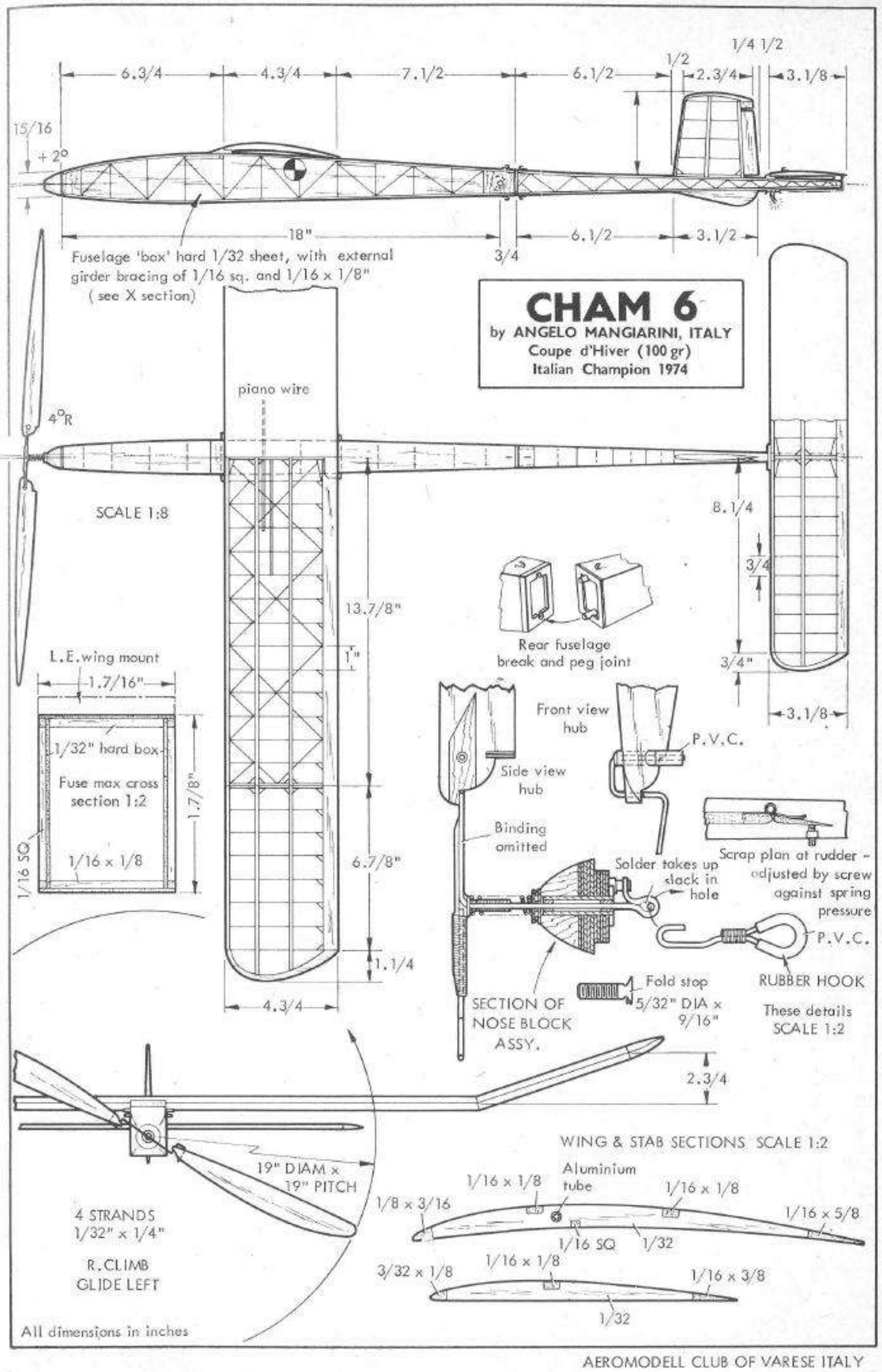
Be sure the dope you buy is really butyrate—it is getting hard to find butyrate dope in hobby shops these days. If it doesn't say butyrate on the label, it probably *isn't*.

An important note—use dopes only in a *well- ventilated* area away from the pilot lights and open flames.

The preceding instructions, when adhered to diligently, will result in a retarded, plasticized, sanforized, Simonized butyrate super finish! *GOOD LUCK*!

Credited to: AMA'S Competition Newsletter and *Flying Scale News and Views, Rockwell International Flightmasters.*

Thanks to these newsletters the Pettit Paint Company and Binks Manufacturing Co. of the U.S.A. for permission to reproduce these useful extracts.

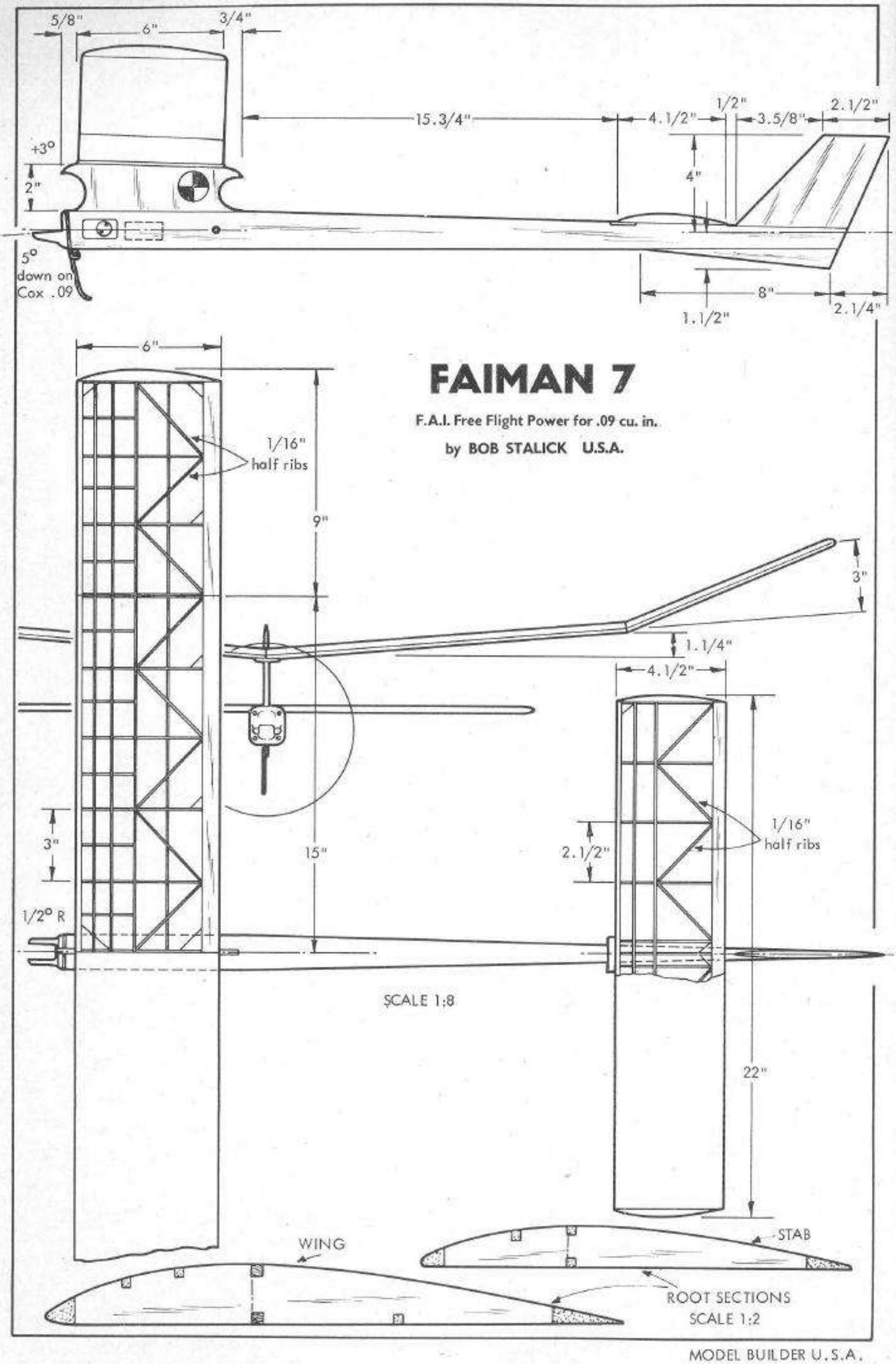


AEROMODELL CLUB OF VARESE ITALY

FAIMAN 7

F.A.I. Free Flight Power for .09 cu. in.

by BOB STALICK U.S.A.

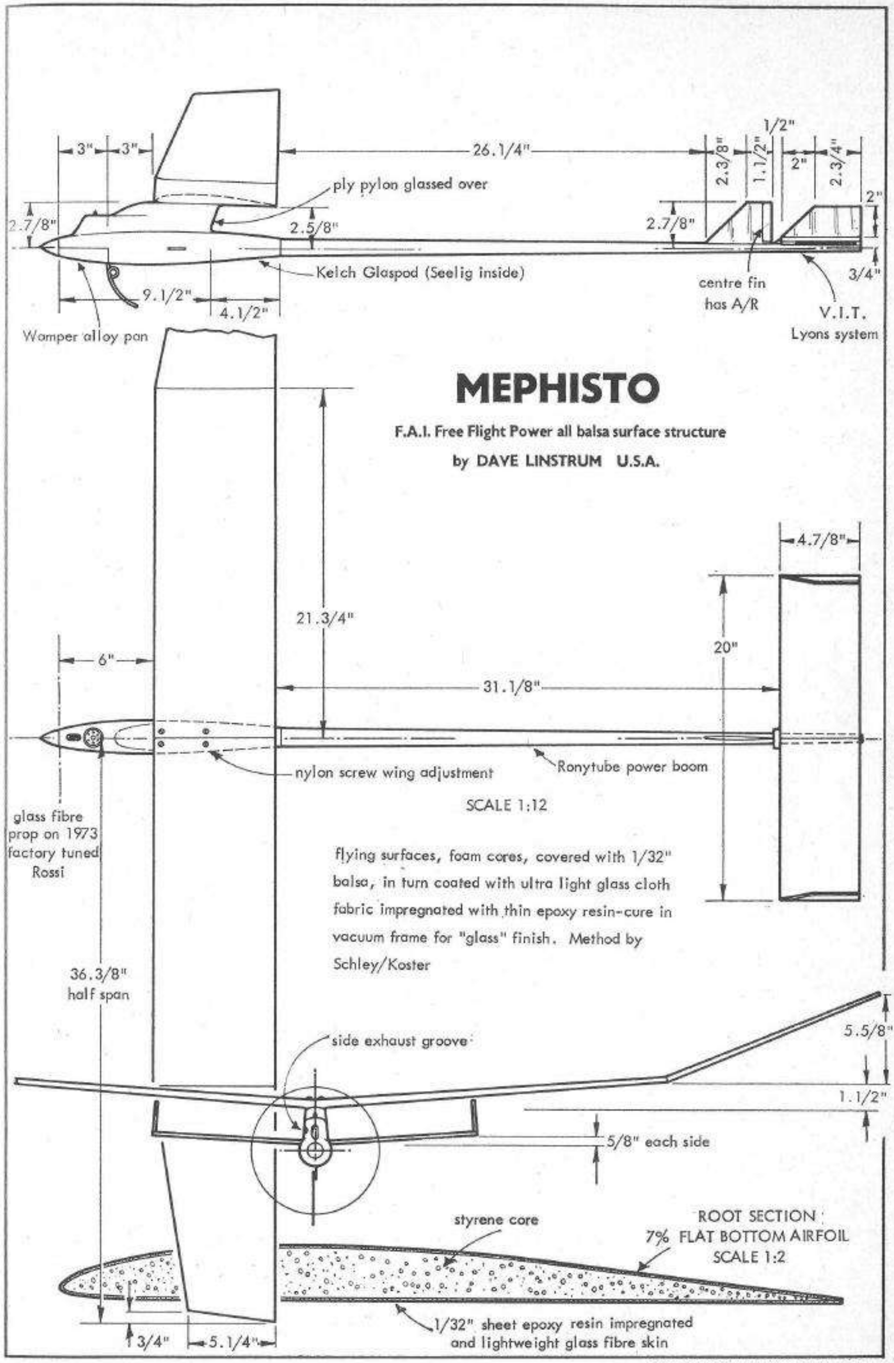


MODEL BUILDER U.S.A.

MEPHISTO

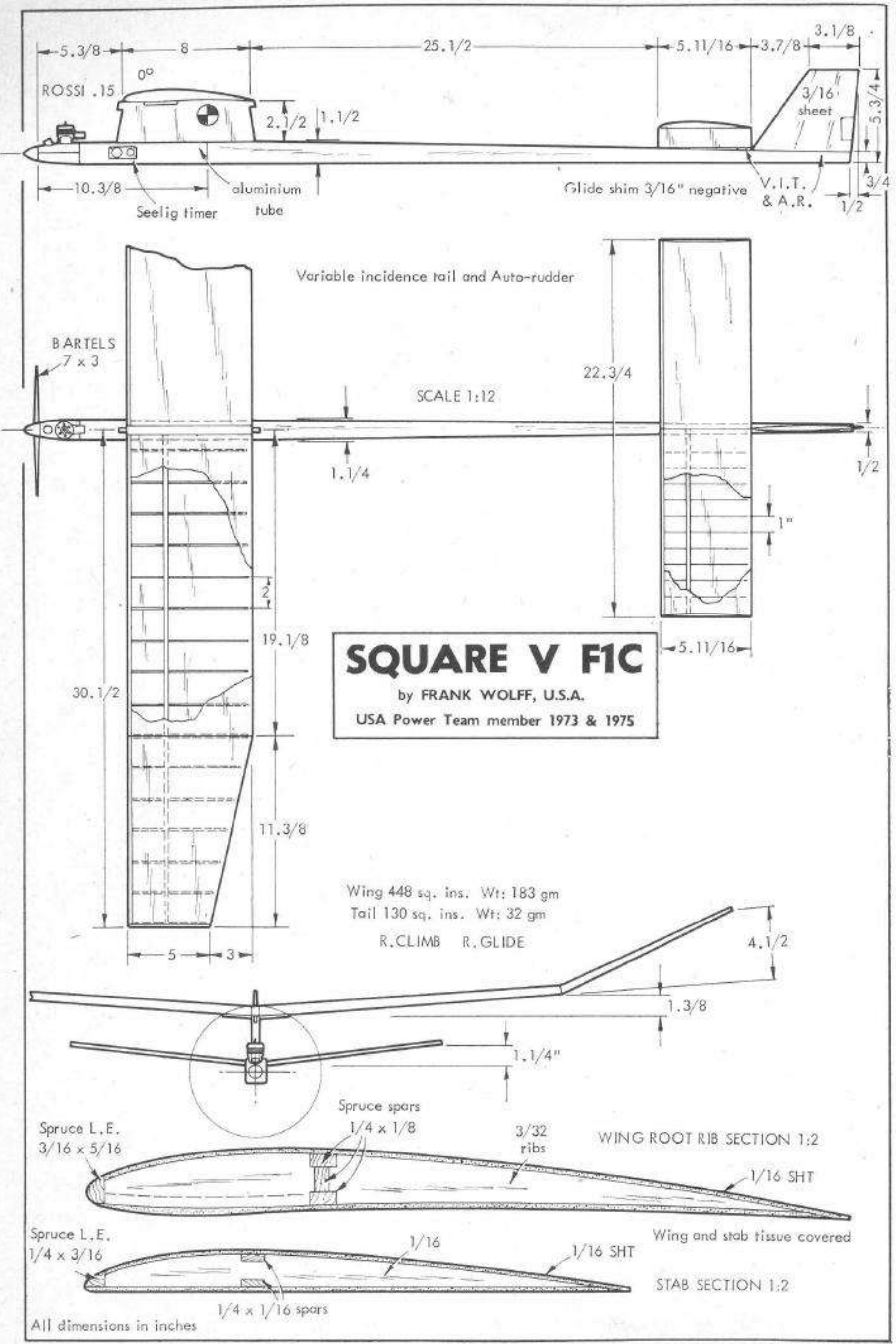
F.A.I. Free Flight Power all balsa surface structure

by DAVE LINSTRUM U.S.A.



flying surfaces, foam cores, covered with 1/32" balsa, in turn coated with ultra light glass cloth fabric impregnated with thin epoxy resin-cure in vacuum frame for "glass" finish. Method by Schley/Koster

CHICAGO AERONUTS U.S.A.

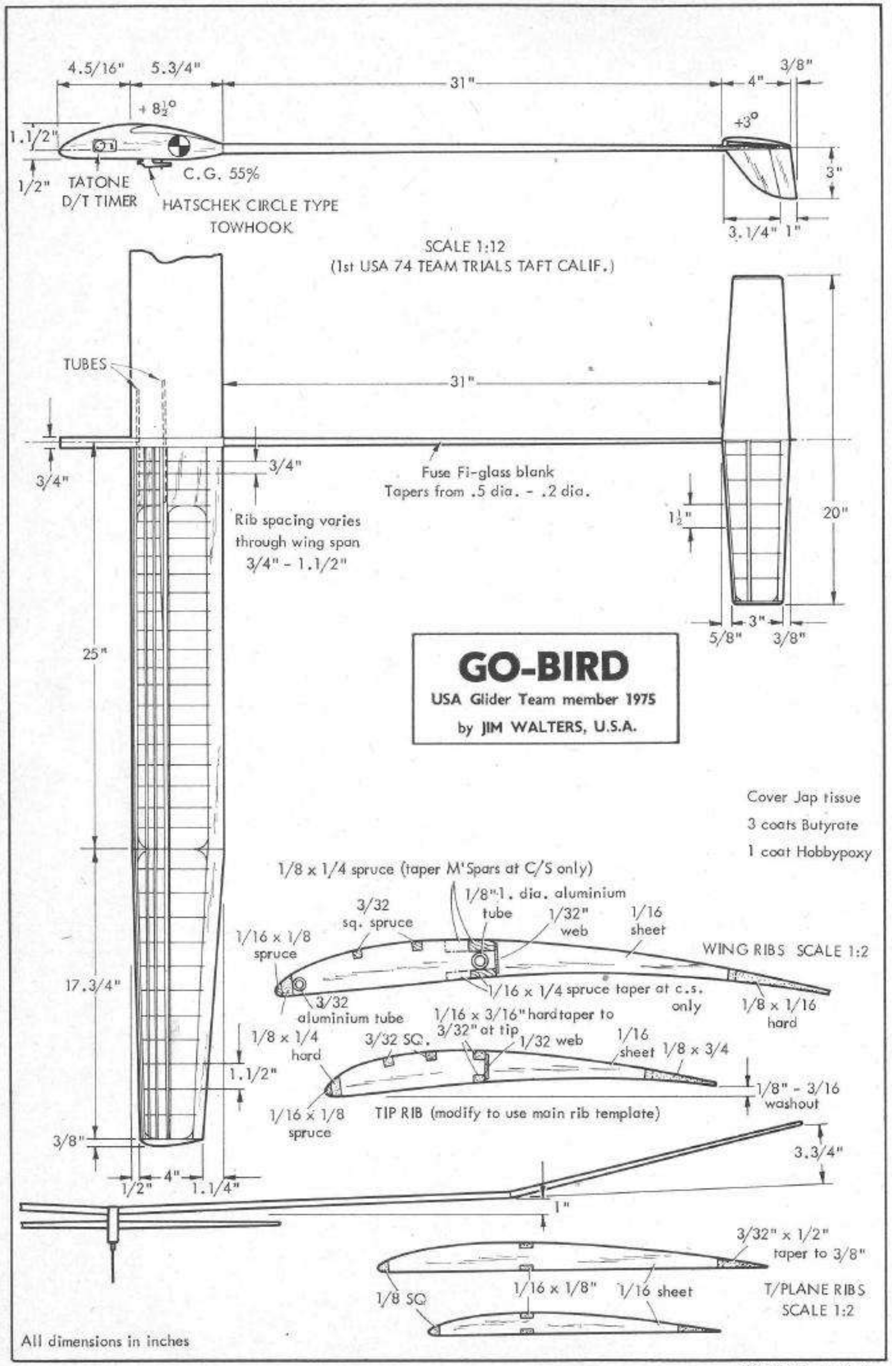


SQUARE V F1C

by FRANK WOLFF, U.S.A.

USA Power Team member 1973 & 1975

SCATTER + VTO, MODEL AIRPLANE NEWS USA

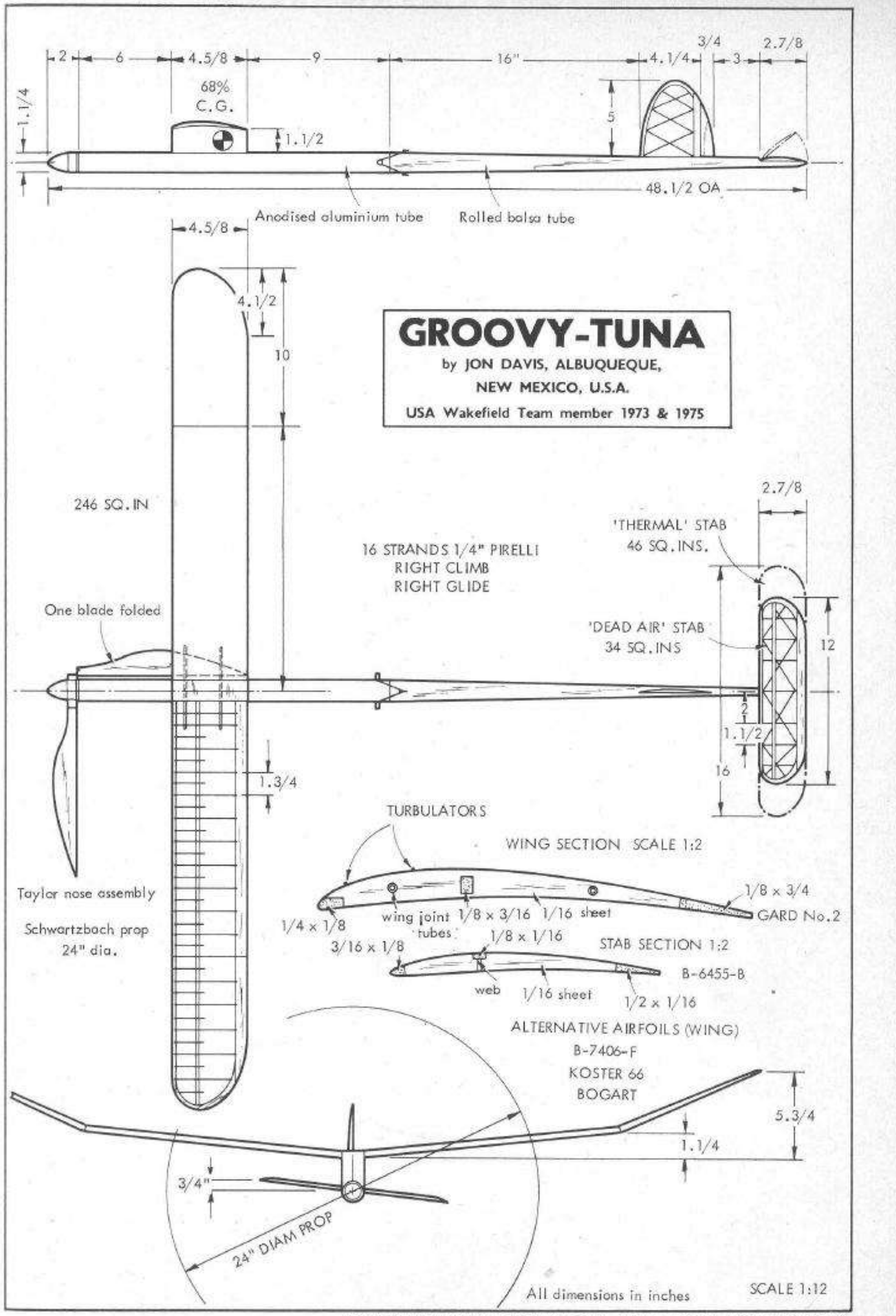


GO-BIRD

USA Glider Team member 1975

by JIM WALTERS, U.S.A.

SCATTER — U.S.A.



GROOVY-TUNA

by JON DAVIS, ALBUQUEQUE, NEW MEXICO, U.S.A.

USA Wakefield Team member 1973 & 1975

SCATTER NEWSLETTER S. CALIFORNIA USA & MODEL AIRPLANE NEWS

"MONOLITH" TEAM RACE MOTOR FROM KIEV

SINCE first revealed early in 1974 this advanced concept of a streamlined integral power unit for team race models, has become recognised as a striking advance in developing techniques. Designed and made by the Samoilenko brothers from Kiev in the Ukraine, the motor is best described in their own words:—

"One of the basic requirements for any contest motor is to ensure efficient cooling. Our engine has a good aerodynamic shape that fits the natural model line; from the appearance and aerodynamic points of view, no motor cowls are required. In order to improve heat transfer, the exposed surfaces of the motor have been anodised black. It is bolted directly to the model fire-wall.

"The motor has three transfer passages and a front exhaust. The front exhaust position means that the *hottest* part of the motor receives the *coolest* air supply, ensuring very uniform cooling. This uniform cooling enables higher operating temperatures to be used, before thermal distortion causes seizure, and therefore the motor's thermodynamic efficiency is increased, and more power results. Comparative tests of two identical motors differing only in the orientation of the exhaust port have shown that a front exhaust position, is distinctly superior. There are some other advantages: in particular, the transfer passages fit very well into the motor design.

"The transfer passages are of minimum length, the main transfers being particularly short, necessitating the use of a full depth slot in the liner. Transfer passages designed in this way give little resistance to gas flow and ensure good cooling and lubrication of the little end, also the piston is more symmetrically cooled than is usual. Timings are 128–130° for the transfer and 144–146° for the exhaust, the actual port widths and directions follow normal Schnuerle design practise.

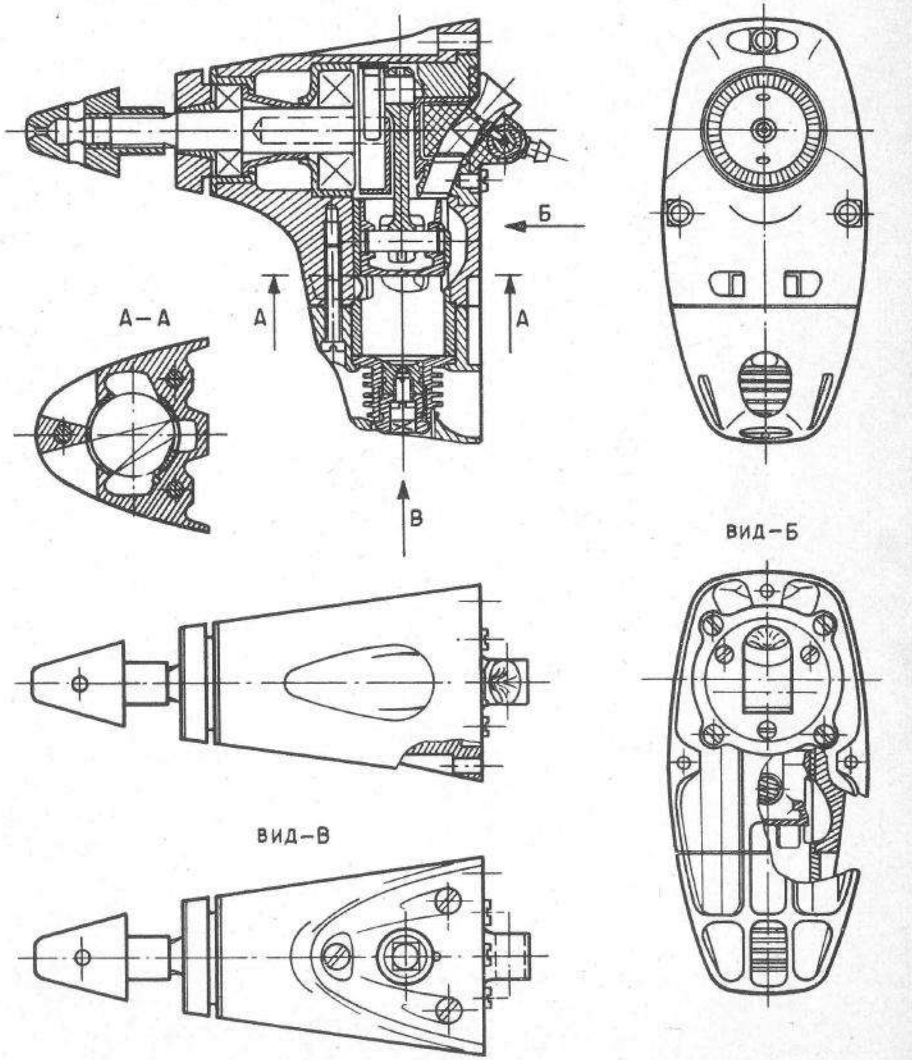
"An especially short and compact rear-induction system is employed, having been developed from the Natalenko Start motor design. The induction period starts at 45° after BDC and continues for 180°. The induction passage is short and only slightly bent and is so directed that the fuel/air mixture goes directly into the space underneath the piston. This is achieved by using a relatively large drum diameter of 12 mm, and the passage continuity is given by a 'Tufnol' insert inside and drum held stationary by bolting it to the back-late. The design was developed after studying and testing numerous designs—for example, the HP-style drum, the K & B style drum, the Super Tigre disc and the ETA-style disc.

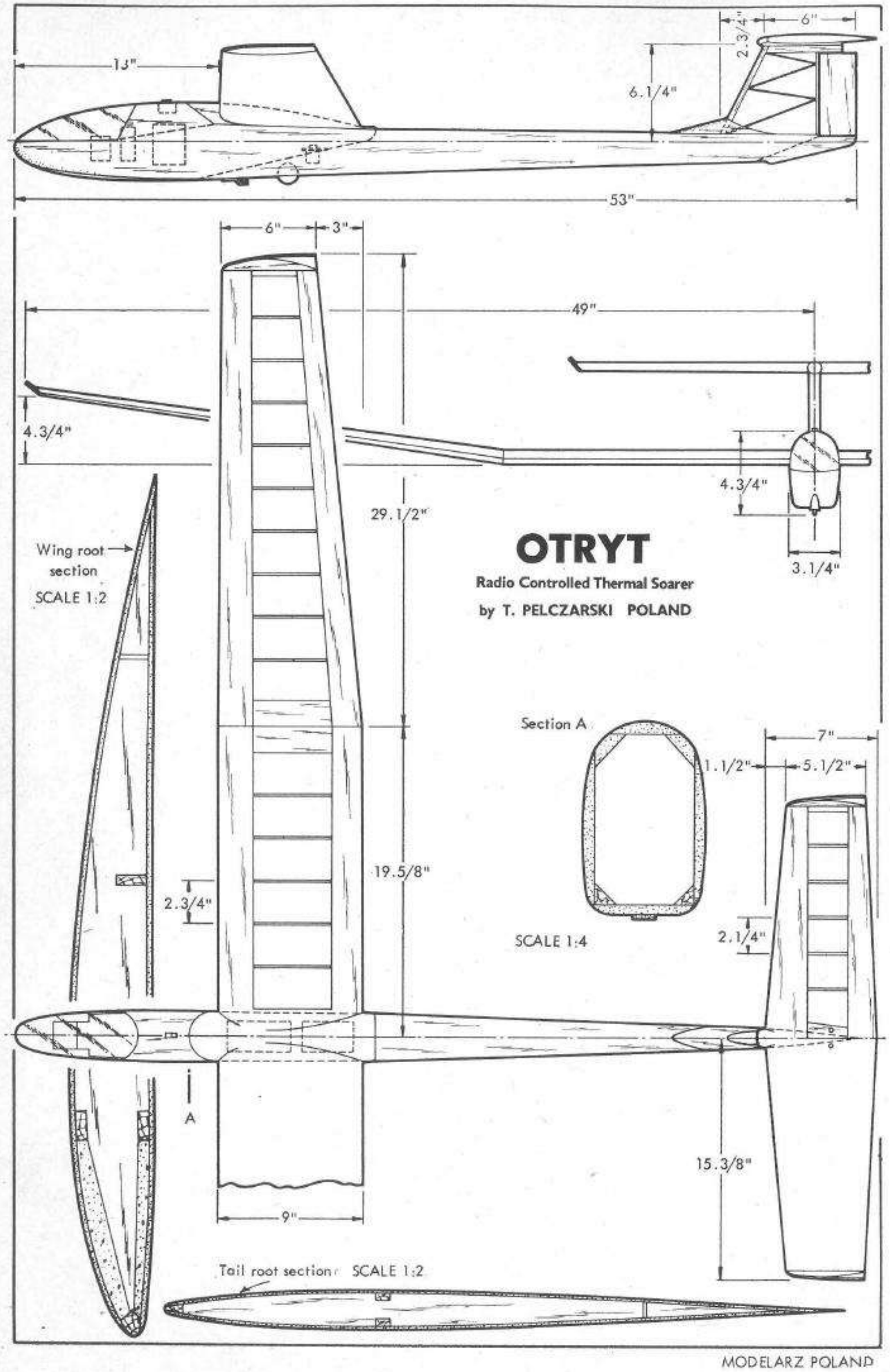
"The cylinder head is designed to give proper cooling and also provide very fine compression adjustment. It consists of a finned fixed portion into which fits the movable contra-piston of 7 mm diameter, and its positioning screw which allows a total movement of 2·5 mm. These parts are constructed in bronze, chrome-plated in places, and are retained by a cast cylinder head which is bolted to the motor. The contra-piston stroke is sufficient for any fine compression variation dictated by weather changes. Coarse variation, required by fuel or prop. changes, is achieved by shimming the whole unit. The outer part of the head has three cooling ducts cast-in to direct air right on to the fixed part of the contra-piston.

"The motor has a cast, heat-resisting aluminium alloy case, a forged aluminium alloy con-rod, a pearlitic grey cast iron piston, a through hardened liner (Rockwell 'C' 60–62) and a case hardened shaft (0·5–0·6 mm. thick case at

Rockwell 'C' 58–60). The shaft is carried on two ballraces, 7 × 17 mm. front and 8 × 22 mm. rear, behind the rear race is a removable seal bush with a 0·010–0·015 mm. clearance around the shaft to prevent gas leakage through the front housing. The all-up weight of the motor, minus prop. and tank, is 200 grammes."

Thanks to "Wings of the Fatherland" and Dave Clarkson's translation in "Aeromodeller" for this data on a most advanced model engine power unit concept.





OTRYT

Radio Controlled Thermal Soarer

by T. PELCZARSKI POLAND

MODELARZ POLAND

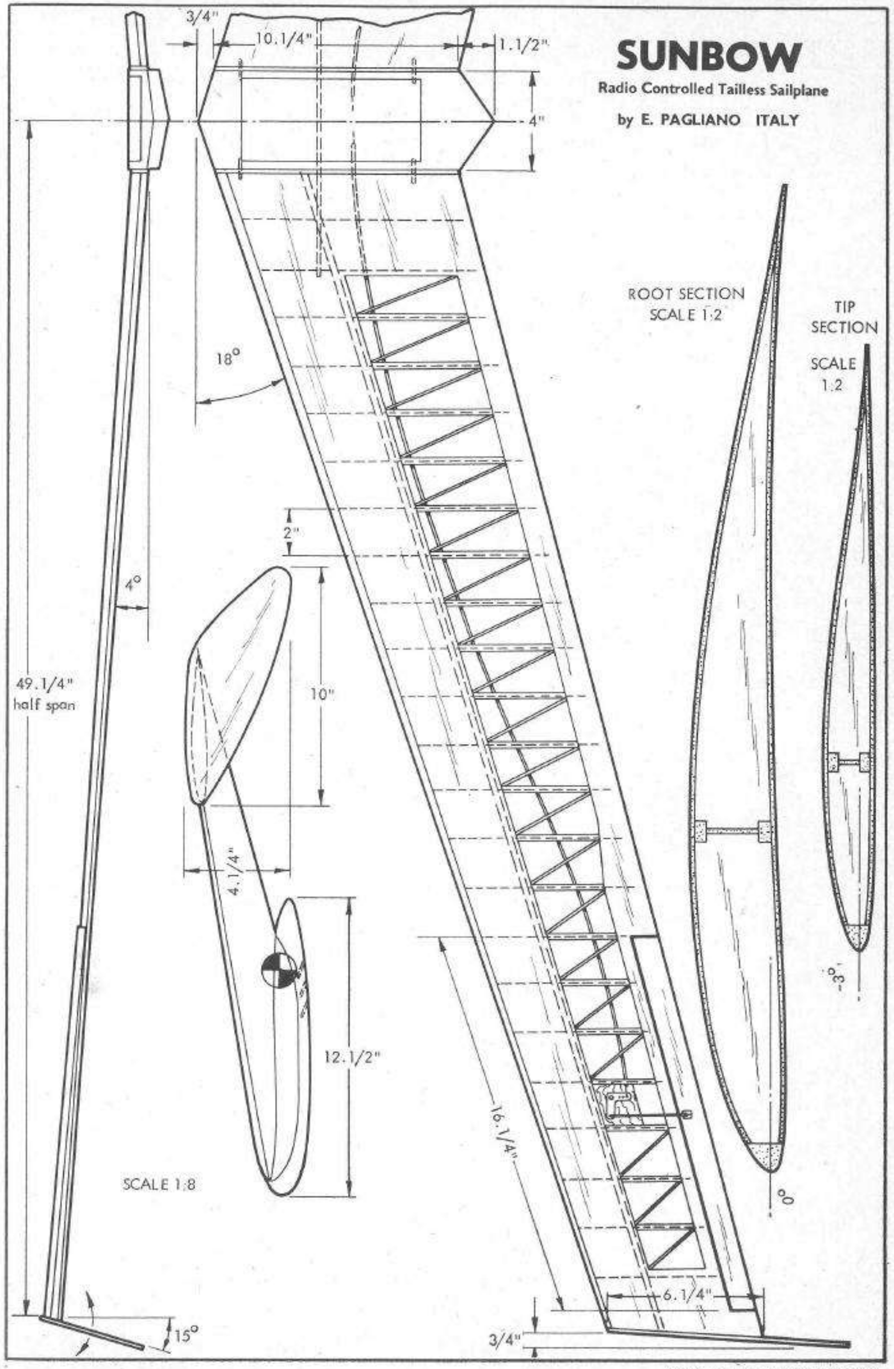
The SKYLEADER Clubman Super

When quality and reliability are important....

This is the 2, 3, 4, 5, & 7 channel, fully convertible Skyleader Clubman Super which we launched into the aeromodelling scene in the early part of 1975. As we expected, the demands for this system were tremendous and since its appearance it has proved to be a real winner amongst amateurs, professionals and aeromodelling clubs throughout Britain. We now have eleven eventful and progressive years of manufacturing experience behind us during which time our equipment has gained a reputation for quality and reliability. This in turn has shown itself by the many officially recorded 'firsts' our equipment has won in international flying events. Here are just a few of the Clubman's winning features.

Transmitter: New high power R.F. output. Meets the requirements of world wide telecommunication authorities. 27, 53 & 72 MHZ bands available. Interchangeable crystals. Fitted with buddy box training system. **Receiver:** New front end gives a better peformance in cross modulation and rejection interference. Interchangeable crystals. Narrow band selectivity for good 20 Khz operation. **Servos:** The SRC-1 rotary/rack servos with all parts supplied. Simple output changeability. Uses new conductive film potentiometer and precision multi-finger wiper. **Servo Amplifier:** A new servo I.C. amplifier integrated circuit designed by ourselves and Ferranti Ltd. **Also included with the Clubman Super:** Neck strap, pennant clip and the SRC-1 single and triple servo trays featuring simple 'snap in' servo catches.

SKYLEADER RADIO CONTROL LIMITED
Airport House, Purley Way, Croydon CRO OXZ, Surrey, England



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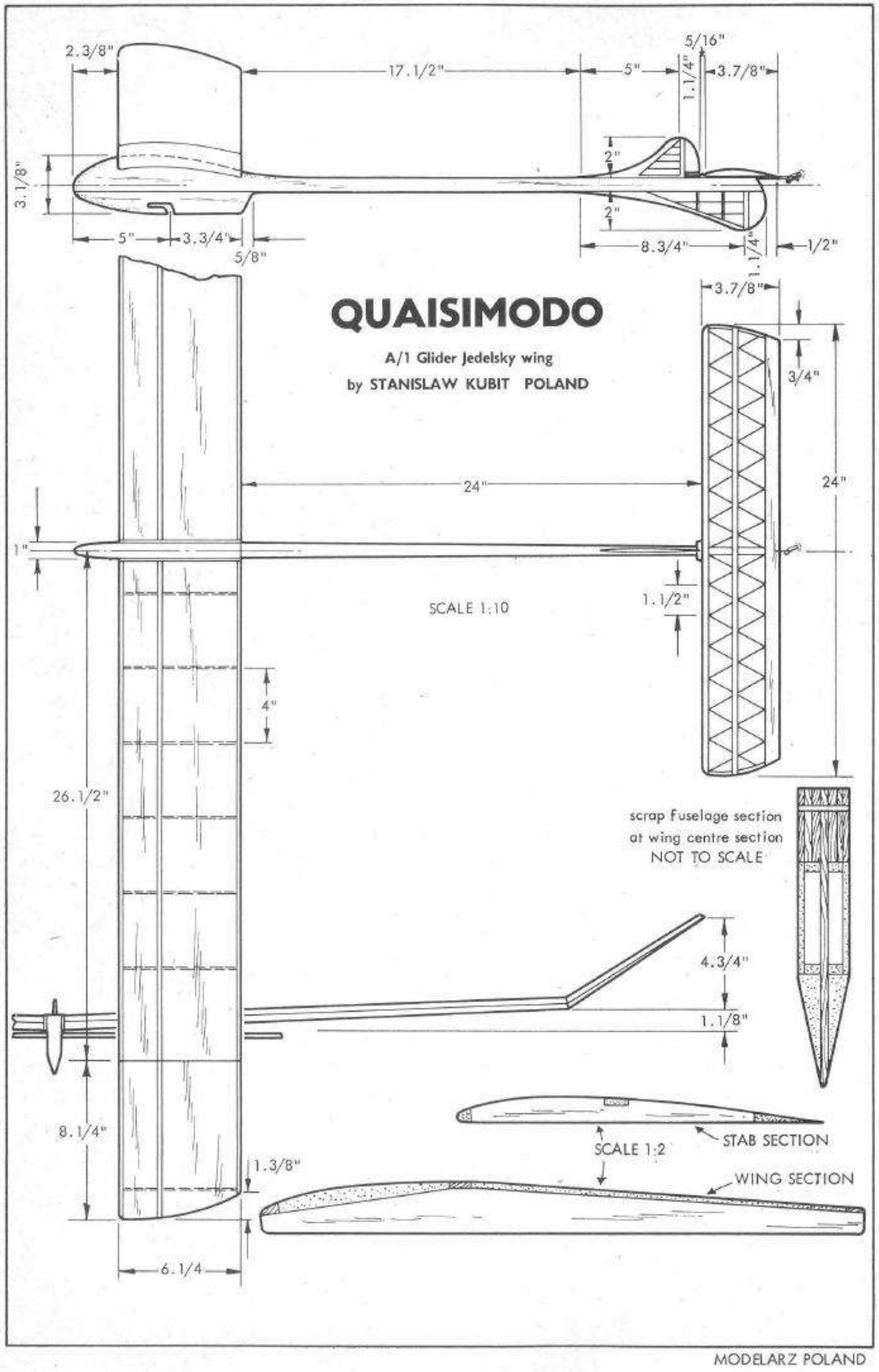
by STANISLAW KUBIT POLAND

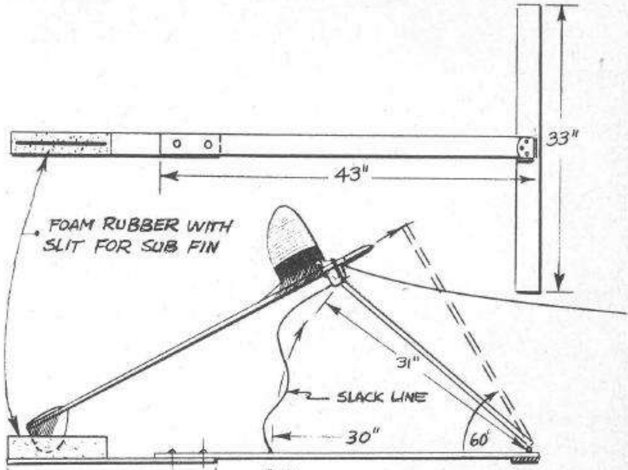


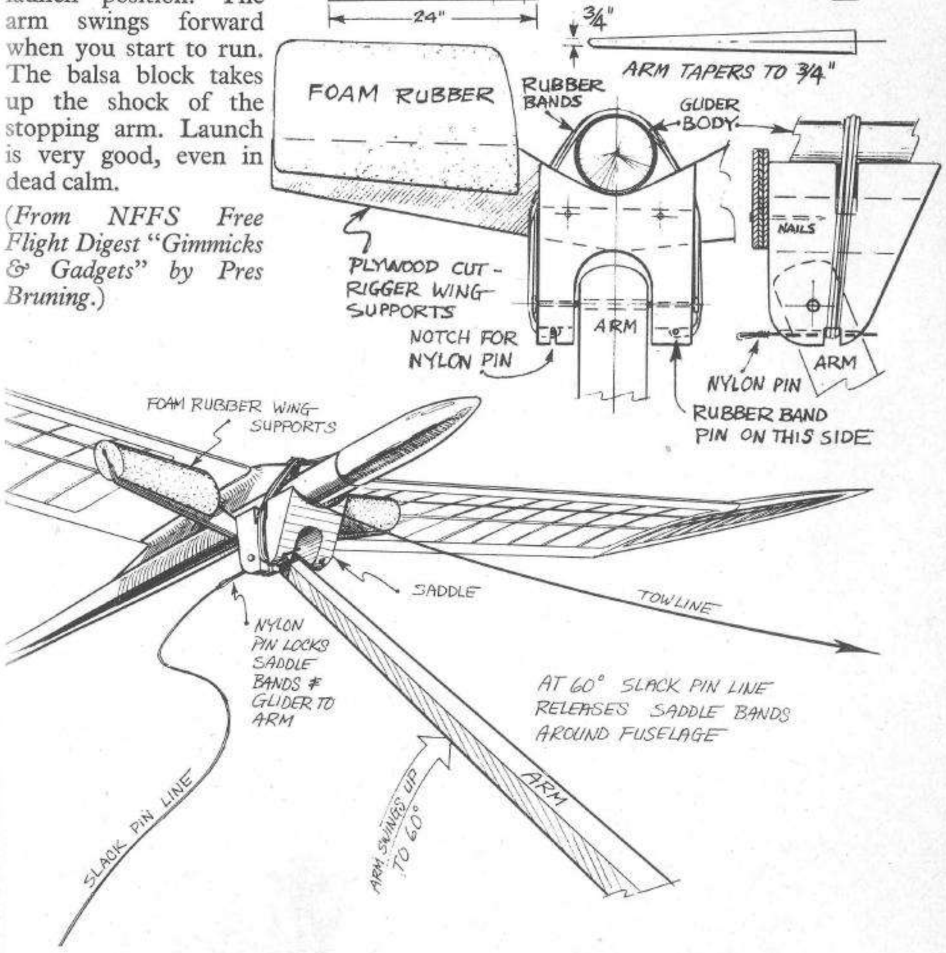
MODELARZ POLAND

SELF-LAUNCH DEVICE FOR GLIDERS

Hank Cole has devised this unique glider-self launcher. It actually throws the model into the air at the right angle and speed to give a trouble free launch. The hinge is a variable spring tension type (spring-loaded door hinge). Tighten the spring so that arm supports the glider in launch position. The arm swings forward when you start to run. The balsa block takes up the shock of the stopping arm. Launch is very good, even in dead calm.

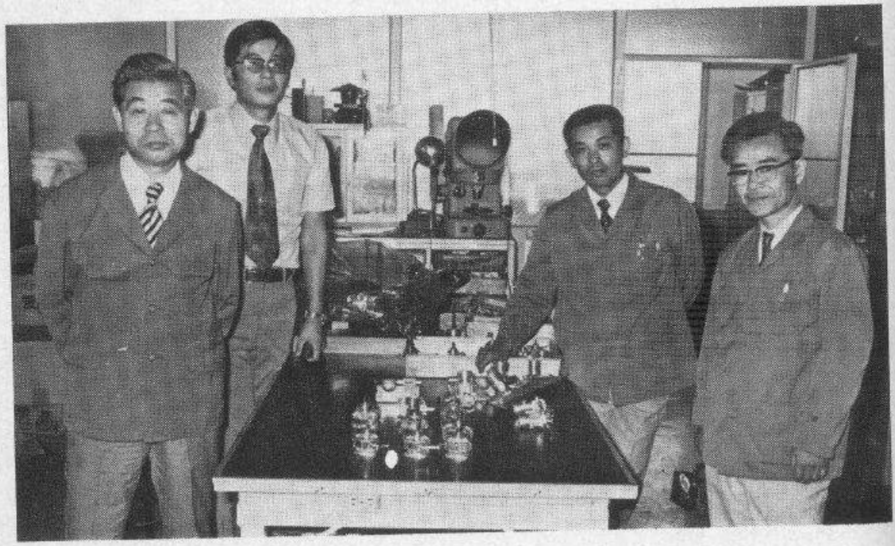
(From NFFS Free Flight Digest "Gimmicks & Gadgets" by Pres Bruning.)



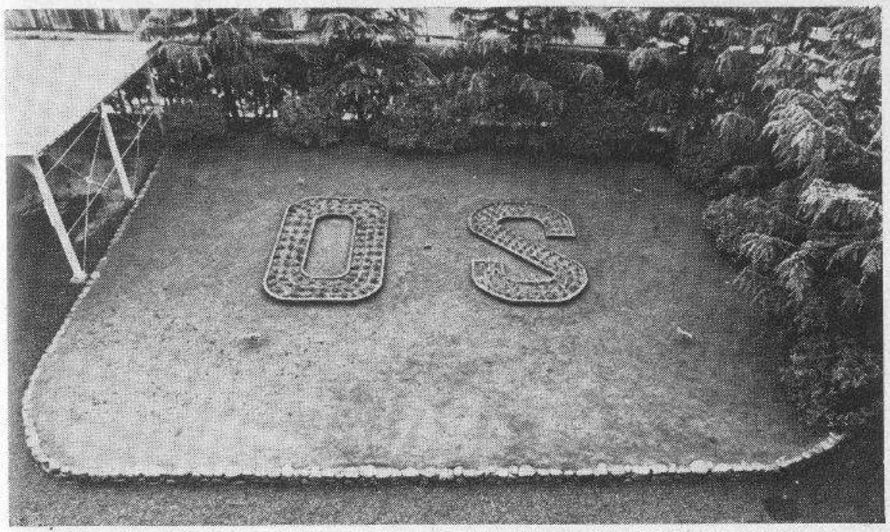


INSIDE THE O.S. ENGINE FACTORY by Ron Moulton

With a production average of 14,000 engines a month and a world wide reputation for value and quality the Ogawa Manufacturing Company of Osaka, Japan is one of the longest established firms in the world's model business. Shigeo Ogawa can still point with pride at the simple lathe which led him to make his first series production model engine surrounded as it is by the very latest in automatically controlled machinery turning out parts for his world famous Wankel engine.



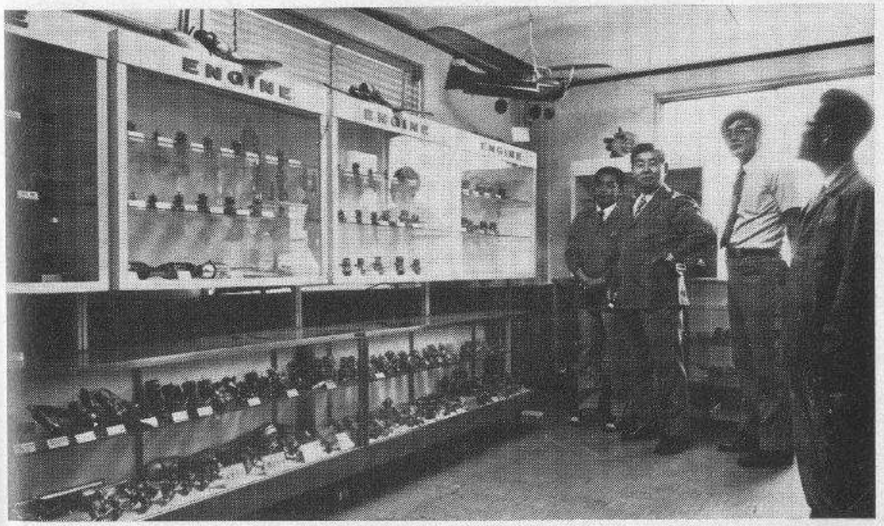
Executive quartet and design leaders in popular model engines, left to right Shigeo Ogawa, Minoru "Joe" Ogawa, Kazuhiro Mihara and Hiroshi Sawada who determine the type of product that OS will produce to meet their world wide demand. They are in the experimental development room, with a selection of Wankel units on the table.

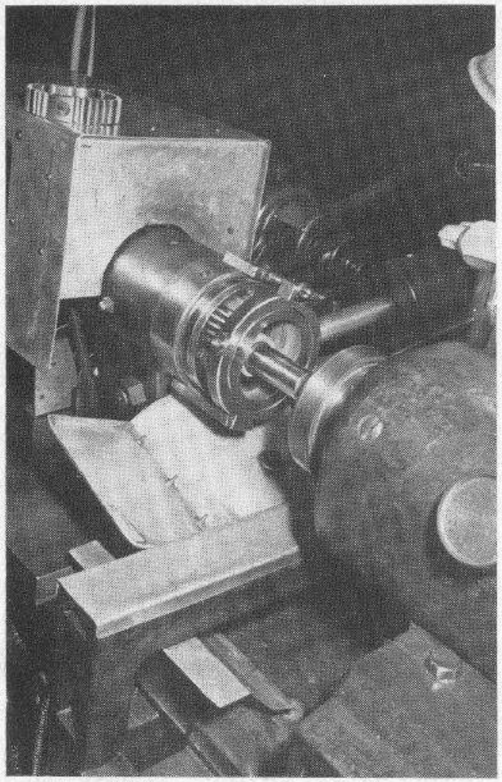


Opposite, the factory courtyard, and above, the view from the second floor roof garden. A hostel for employees is beyond the ornamental garden. Buildings contain recreation facilities and large canteen.

Essentially a family business, with his daughter and son-in-law, "Joe" taking prominent parts in the management, O.S. are also well-known for the long service of their top executives. It is a company where tradition and dedication are respected ideals. Our photo-visit will convey a little of the intense

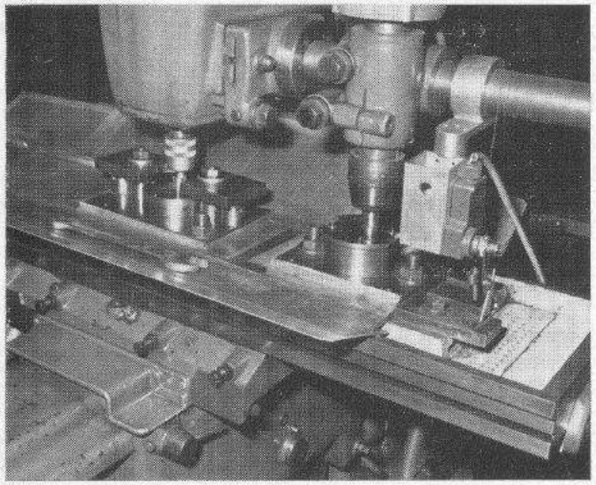
Shigeo Ogawa's treasured engine museum (there is also an R/C equipment section) includes all the classics and many rare Japanese originals, plus of course at least one each of all the O.S. engines ever made, starting with the very first ignition type made by Shigeo's father, the founder of the company.



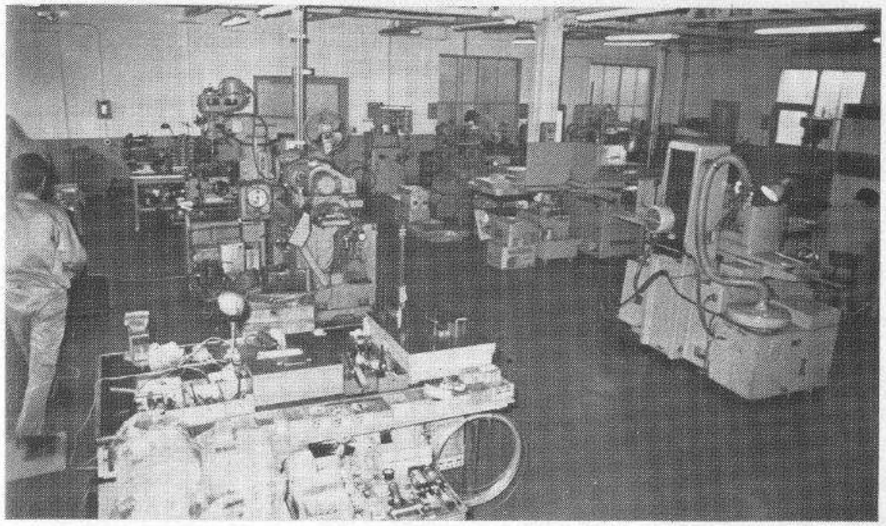


Of all the machining operations undertaken in the O.S. establishment at Osaka, that of shaping the inner face of the Trochoid on the Wankel engine is the most demanding. Special machines had to be devised before O.S. could start manufacture. They were the only company in the world—and still remain the only one, to meet the request to make the engine for Johannes Graupner of Germany.

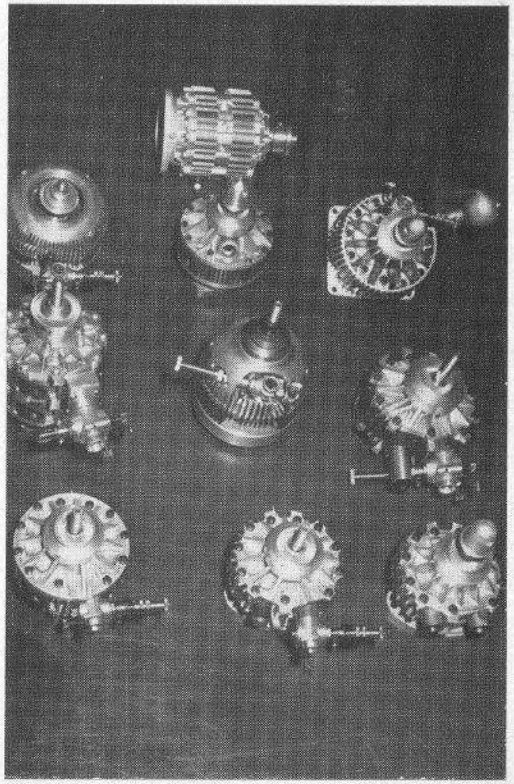
activity which goes to make this famous concern a leader in its field. We hope it will also show how the mass production high performance model engine is a product of the highest standards of engineering, with many complex operations in the process of manufacture—all contrived to make the miniature power units we tend to take for granted.



Another operation in the manufacture of a Wankel engine, where the vertical milling tool is guided by a complicated jig to follow the precise profile. Tolerances for the Wankel are much closer than for the average model engine.



Spacious workshops, with a planned work-flow pattern and highest standards of cleanliness are typified in this view of the machine shop which turns out the Wankel units. Ironically this collection of sophisticated machines has the very first O.S. lathe for company—and it still works well after almost 50 years' service!

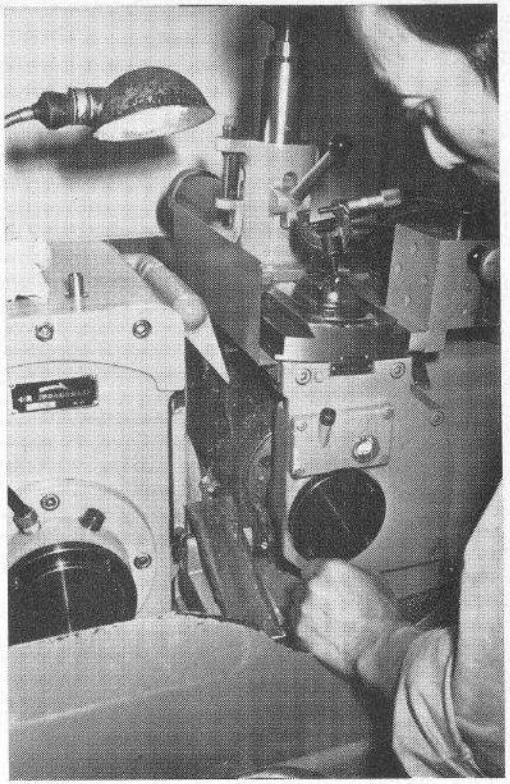


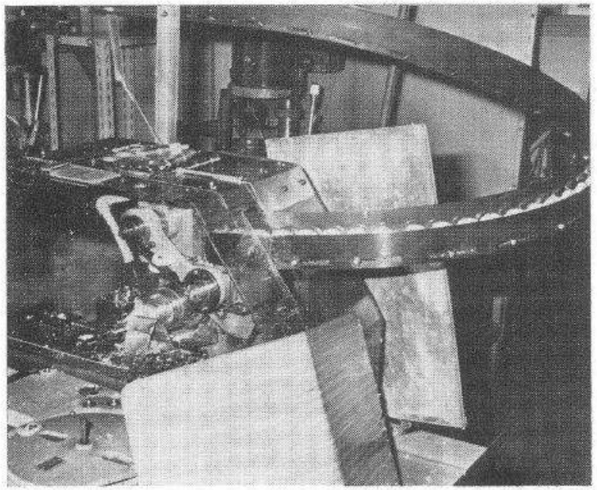
A random selection of ten different working Wankels! They include a few twin rotor units and various forms of cooling fin and induction positions. Few modellers appreciate the vast amount of research behind the present mass-produced and very successful Wankel.

Machine shop engaged in mass production of components such as cylinders, pistons, wristpins and crankshafts, where a high standard of automation is used, and regular inspection of quality is maintained by personnel. A lot of the machinery has been specially designed and made by O.S.

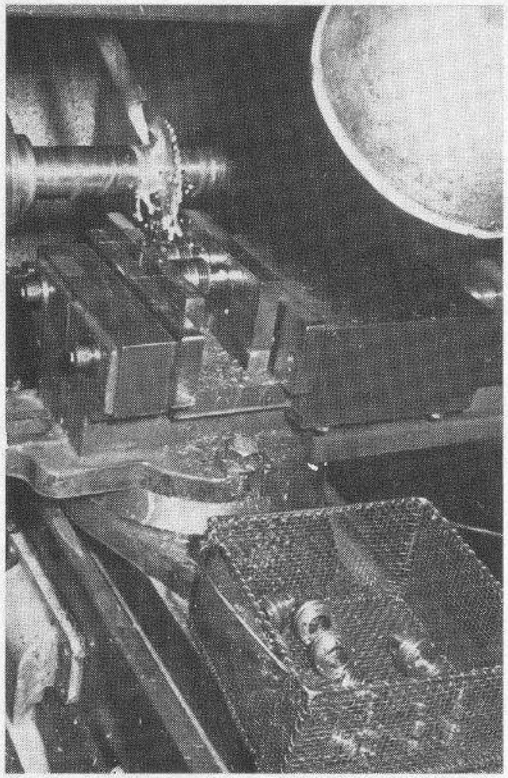
Typical of the automatic operations is the constant feed of "little end" pins (Gudgeon or Wristpins) through a centreless grinder which establishes a perfect diameter, ready for immediate assembly to the connecting rod and piston. Note box load containing thousands of these hollow pins.

A centreless grinder producing a piston with perfect size and finish. This machine is one of many which are continuously occupied to maintain the standards of interchangeability and quality of the O.S. products. With a daily production rate of 400–500 units of all sizes, only a few engines are actually tested at random before despatch yet each comes fresh from its box, ready to start at the hands of the modeller.



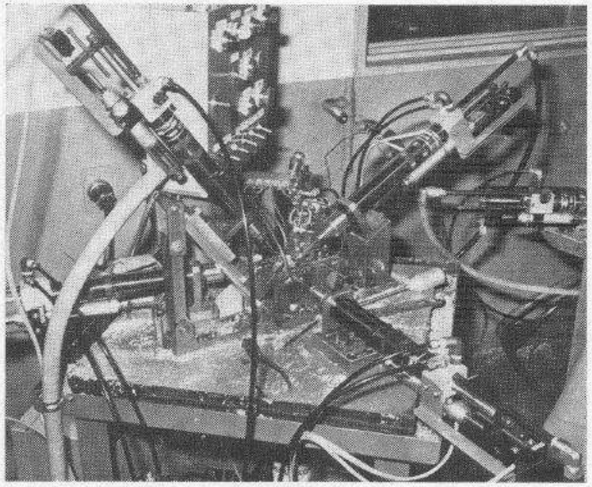


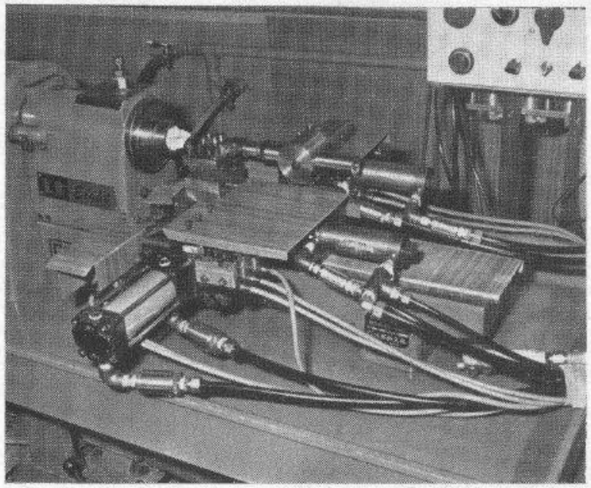
The "rail track" feed contains a long line of shunting cylinder heads, lined up ready for precision facing in the machine which has an enclosed transport cover. Micrometers and gauges are handy by all O.S. machines to check the precision.



A simple jig carries two cylinders and a rotating cutter slices out the ports as it is doused with emulsified coolant and lubricant. This operation is one of the least complex, yet is critical for eventual model engine performance. It is one instance where the parts are hand loaded and taken from the machine.

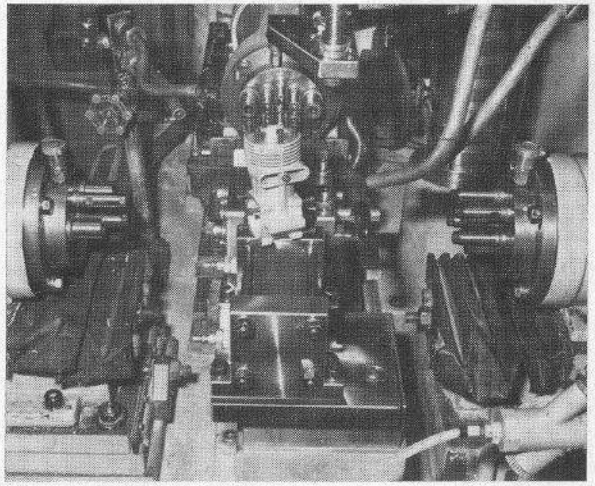
Five separate drilling ops on a carburettor are controlled by these spider like units which act in sequence under a programmed operation. With the arrival of radio control, the carburettor has become as involved as the rest of the engine itself!

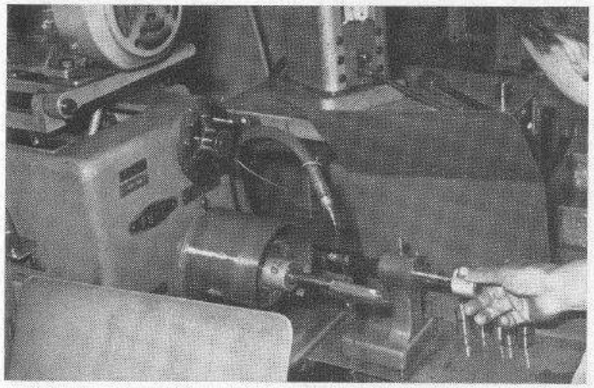




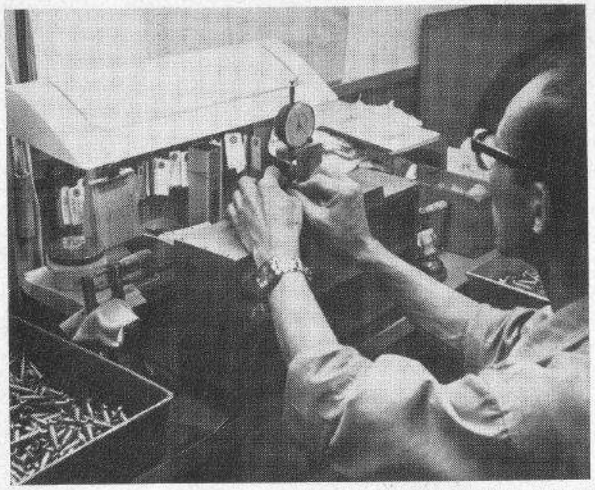
This elaborate programmed machine faces the cylinder head, a critical operation which has to be completed to finest tolerances. It is typical of the pneumatic controlled machinery being installed at the O.S. works.

A machine which drills and taps the cylinder block on its three machined faces for the retaining bolts at the head, front and rear. In this case, fourteen screw threaded holes are completed in one quick operation.





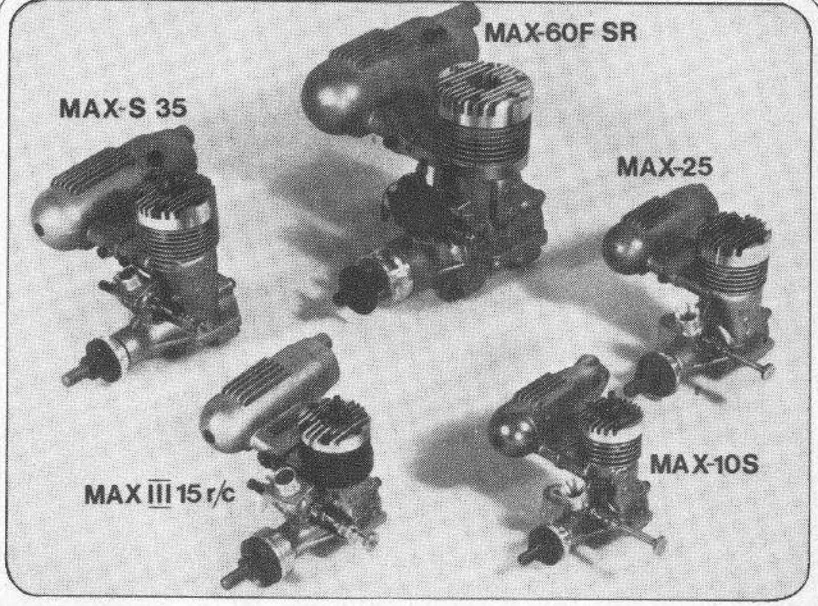
Since the earliest days of model engine manufacture, the cylinder hone has been a man and machine op. which ultimately determines the performance of the product. A cylinder is being checked on the air gauge to establish that it meets required standards.



Impressive feature of the O.S. works is the degree of inspection made between machine operating to maintain quality and accuracy. This dial test indicator is being used to check crankshafts which are then batched according to their slightest variations.

An air gauge indicates the precision of pistons as they are inspected and batched. All reciprocating parts come under this close scrutiny before final assembly. This ensures that pistons and cylinders are well matched.

After all the machining operations that are involved in model engine manufacture, the parts are assembled in a clinically clean area by girls using pneumatic screwdrivers. Supervisors inspect the completed engine before passing to packing dept., and eventual sales under Yasuo Tominaga's dept.—another long serving O.S. employee.



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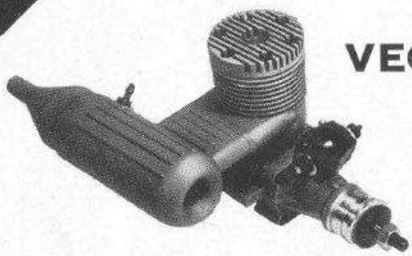

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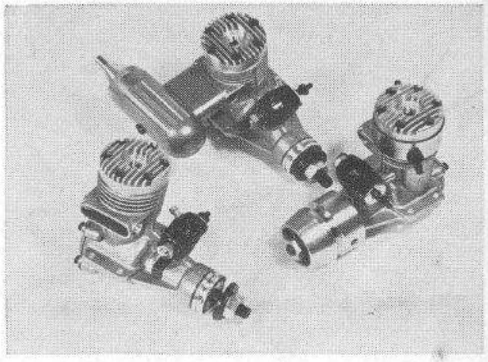

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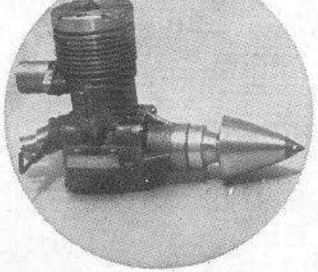

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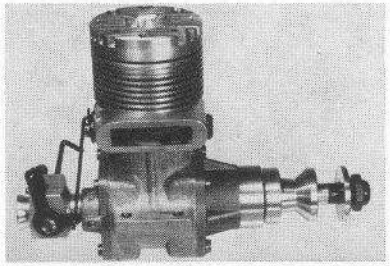
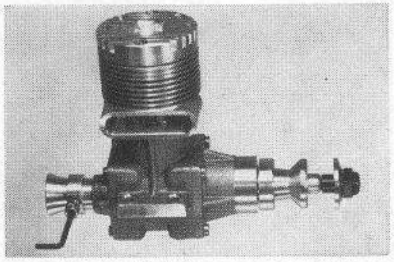


Rossi 60 R/C £48·75



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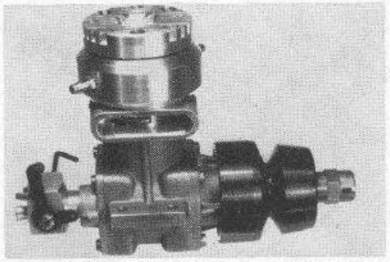

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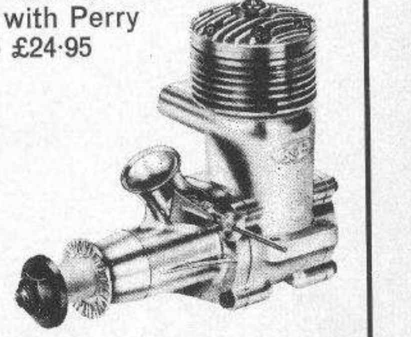

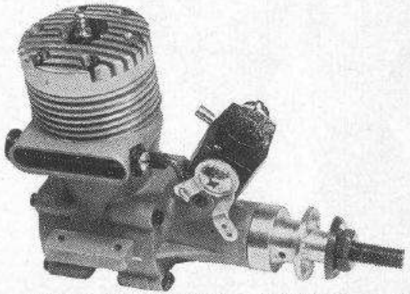

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"SERIES 71"
front intake
Perry carburettor
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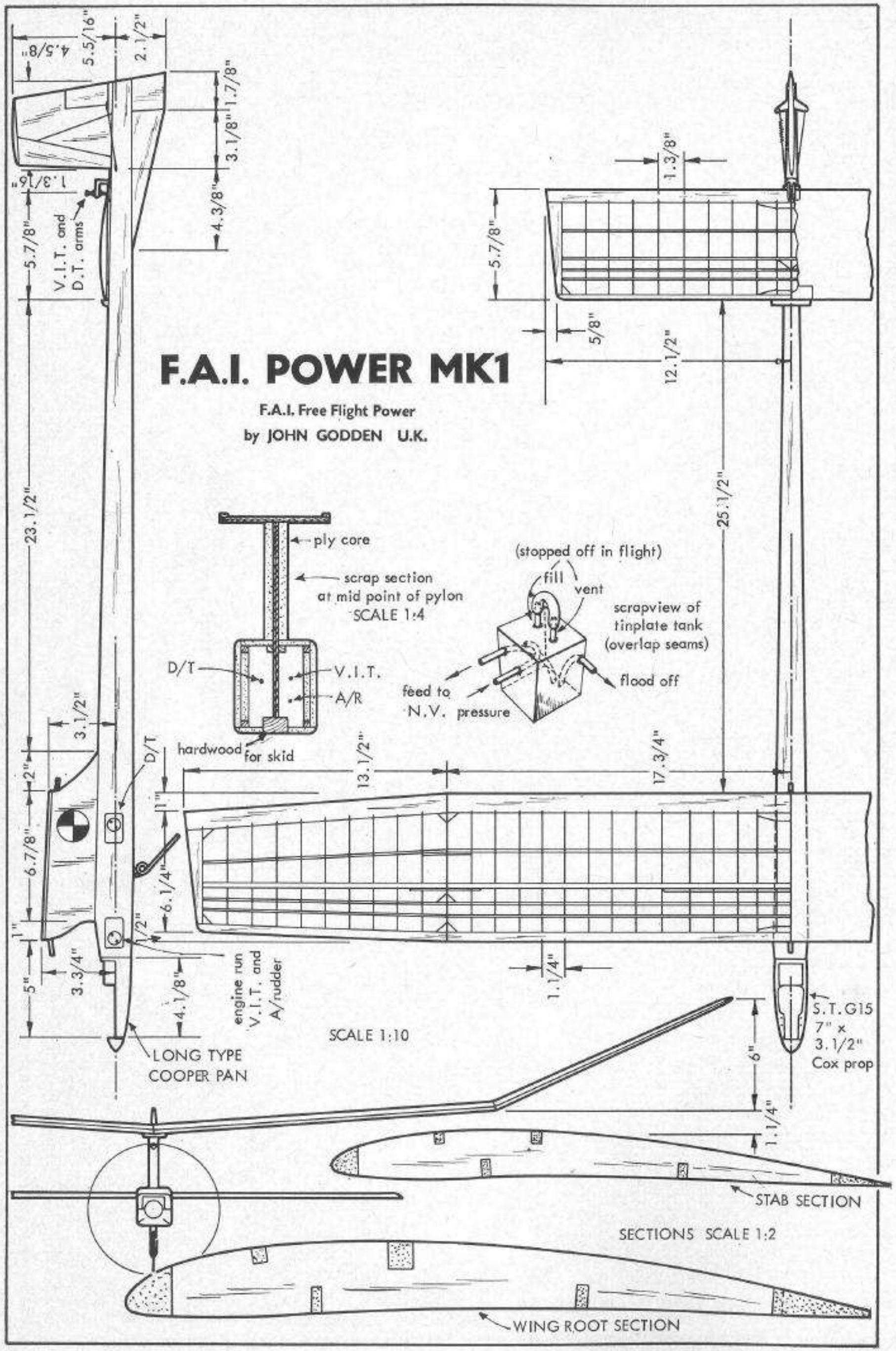
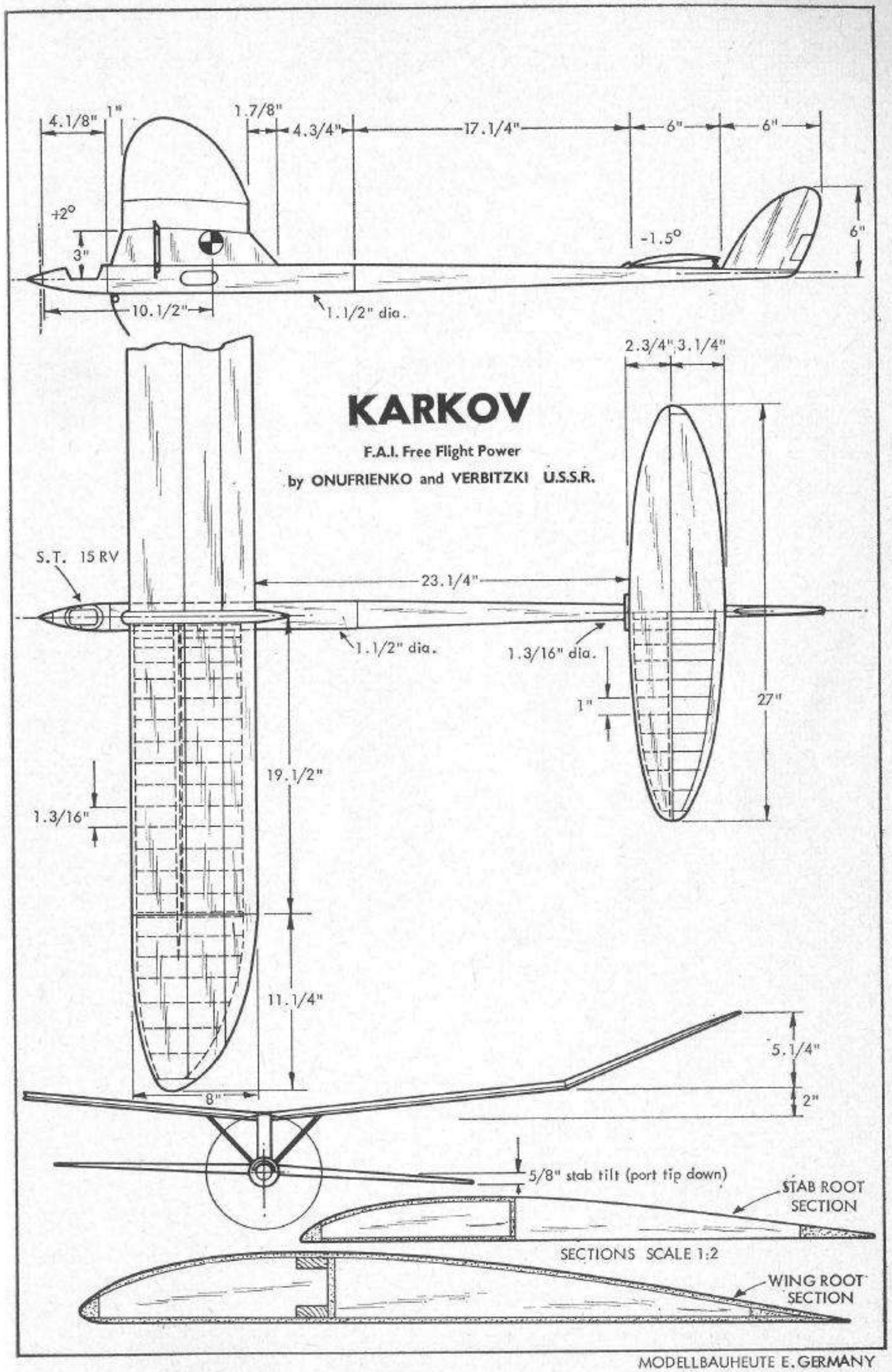


F.A.I. POWER MK1

F.A.I. Free Flight Power

by JOHN GODDEN U.K.

MODEL AEROPLANE GAZETTE U.K.

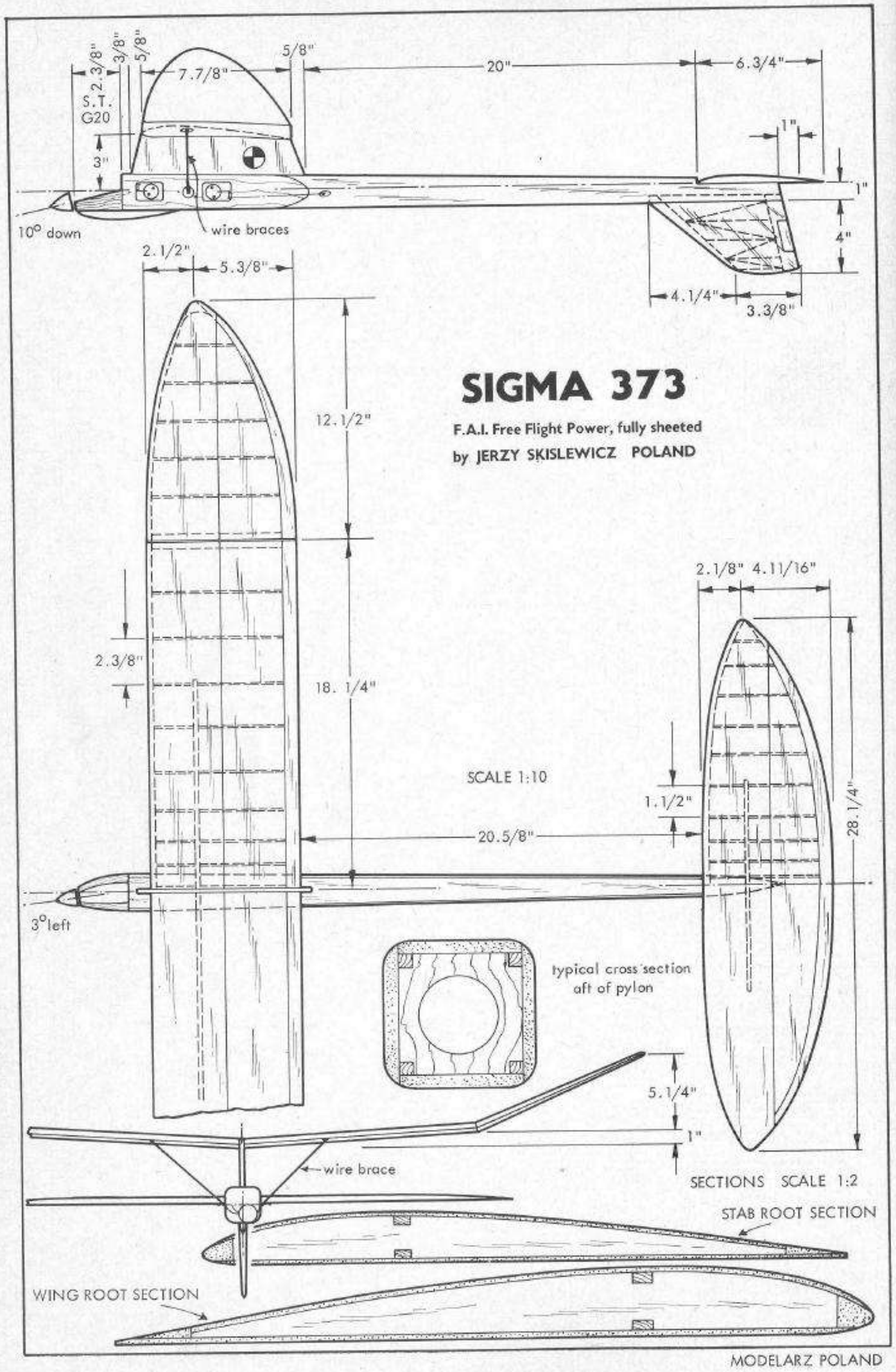


KARKOV

F.A.I. Free Flight Power

by ONUFRIENKO and VERBITZKI U.S.S.R.

MODELLBAUHEUTE E. GERMANY

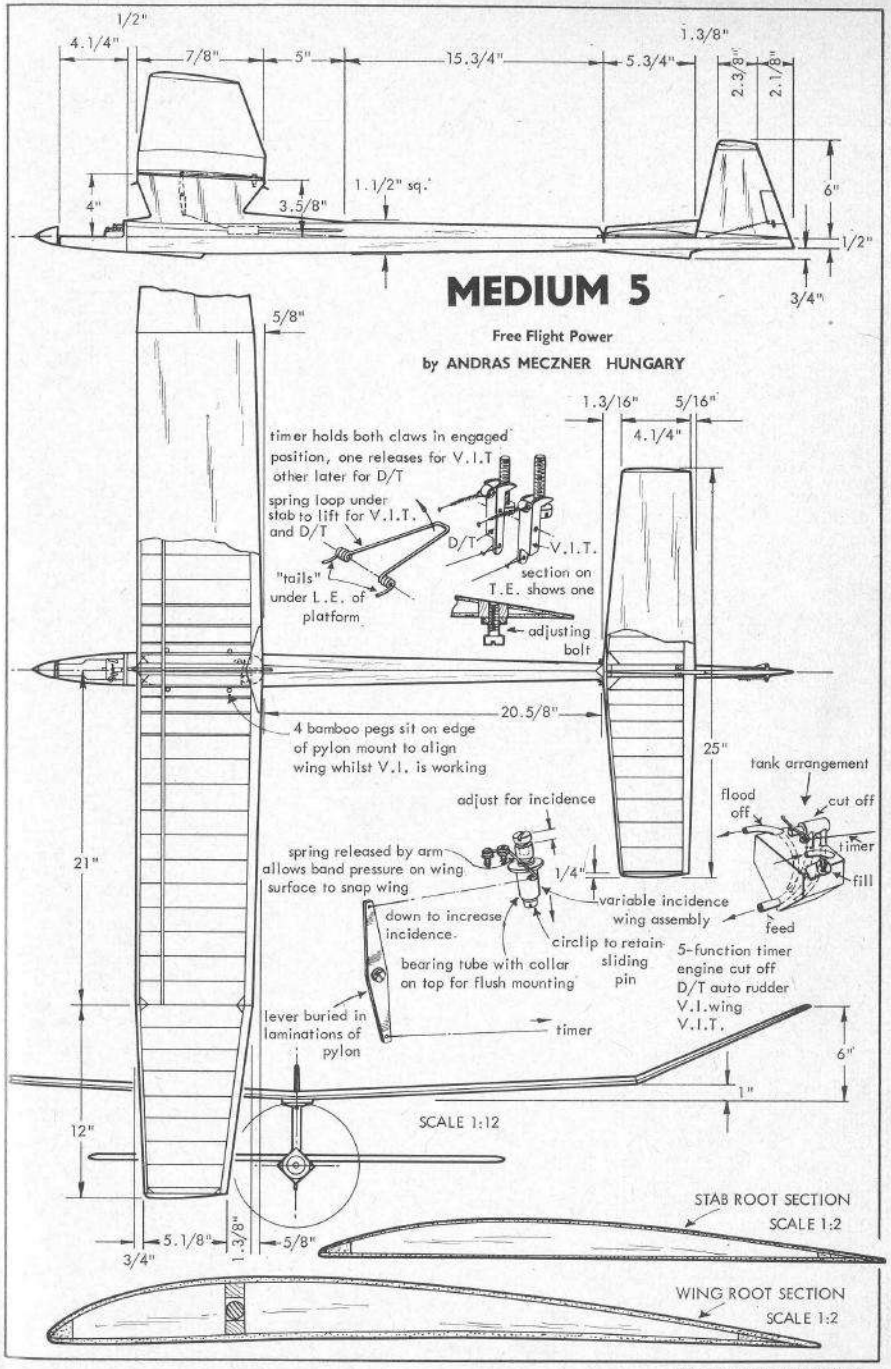


SIGMA 373

F.A.I. Free Flight Power, fully sheeted

by JERZY SKISLEWICZ POLAND

MODELARZ POLAND



MEDIUM 5

Free Flight Power

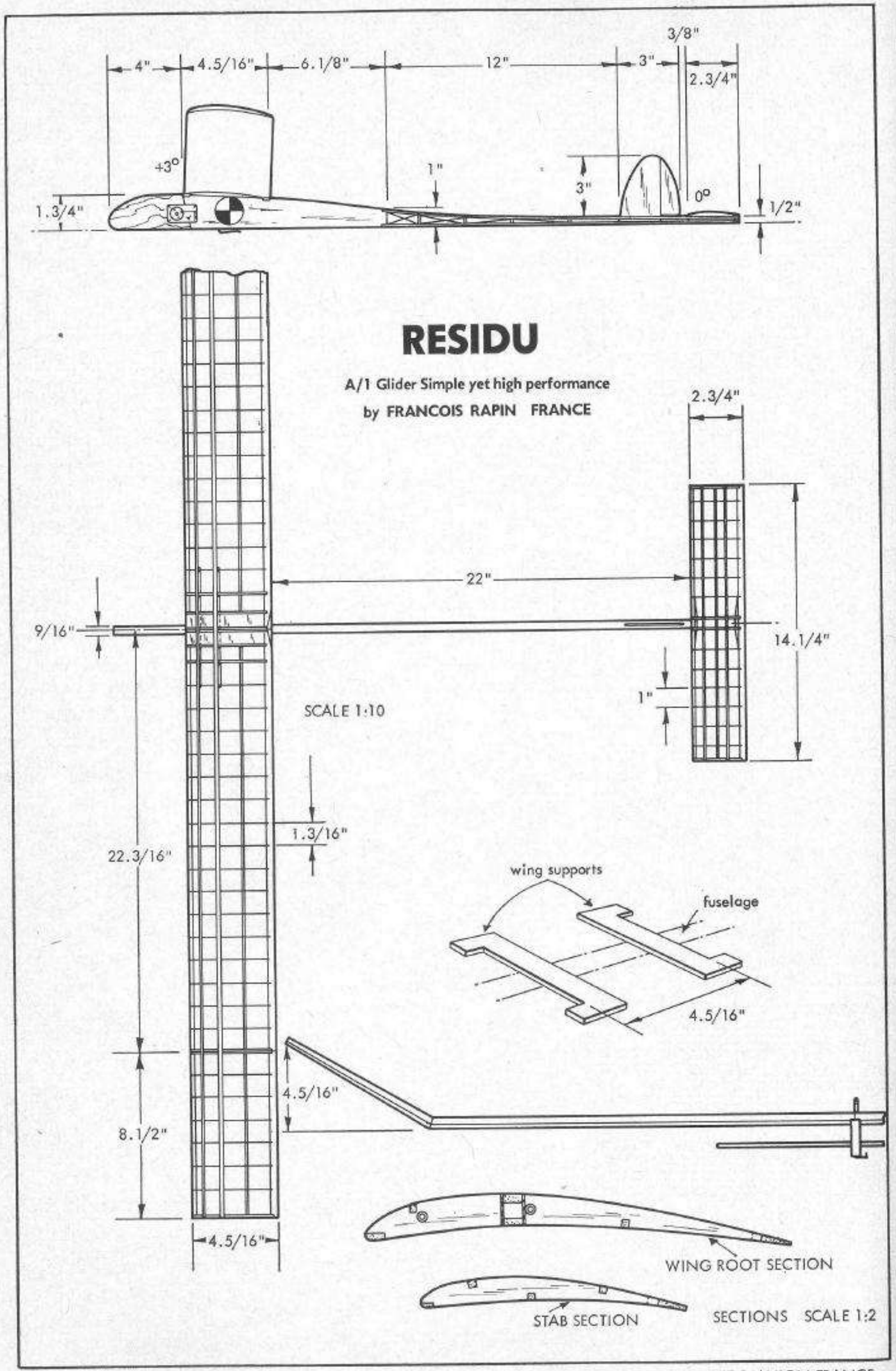
by ANDRAS MECZNER HUNGARY

MODELLEZES HUNGARY

RESIDU

A/1 Glider Simple yet high performance

by FRANCOIS RAPIN FRANCE



LE MODELE REDUIT D'AVION FRANCE

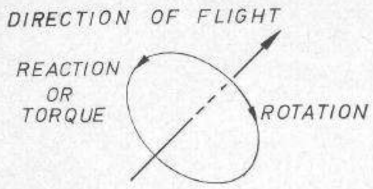


FIG. 1

Diagram illustrates the reaction of torque in opposition to propeller rotation about the line of flight on an aircraft.

PROPELLER TORQUE AND GYROSCOPIC MOMENT

by J. van Hattum

ANYONE who has flown a powered model, whether rubber- or piston-engined, free flight or radio controlled will be familiar with the phenomenon we call propeller torque, and the influence it has on the behaviour of the model. We may regard the fast revolving propeller as a twisted wing whose halves rotate about a common axis. As with a wing the propeller will supply both lift and drag. As a result of accelerating the column of air which is drawn through the propeller disc, thrust is developed. We may compare this to the mass of air which the wing moves downwards to create lift. However, everything has to be paid for: the wing will also have drag and the same applies to the revolving propeller. This produces a torque opposing the direction of rotation and if we have a right-handed propeller according to *Fig*. 1, then the torque reaction will tend to rotate the model in the opposite direction. It will tend to roll to the left which unless trimmed out will result in a slight skid towards the lower wing; the "weathercock" effect of the model would then put the model in a left turn while the dihedral of the wing will produce a compensating torque. It will later be seen that something should be done to counteract this turn, if only to some extent.

Propeller torque—that is the rolling moment acting on the model—goes up with the fourth power of the diameter and the square of the r.p.m. If one uses engines of equal power, then a large, slowly revolving propeller will have a greater torque than a small fast one.

Why should we not just let the torque have its way and accept the (left) turn? Nothing forces us to make the model fly straight, on the contrary: a circling model will have a better chance to contact a thermal. We should, however, realize that it will not just remain a simple turn. We may regard the propeller as a fast revolving flywheel. Quite apart from the fact that the torque-induced turn may prove to be too pronounced, we should also take into account another mechanical phenomenon: the gyroscopic moment.

VT+[illegible]

Gyroscopic Moment

The daring young pilots of World War I who indulged in low-level turns close to the ground often had to pay for their boldness with their lives. When they made a sharp turn against the torque there was a chance that they would dive into the ground, whereas a turn in the opposite direction raised the nose of the plane and that could easily be followed by a stall and a spin. To many it remained a mystery.

冒口[illegible]

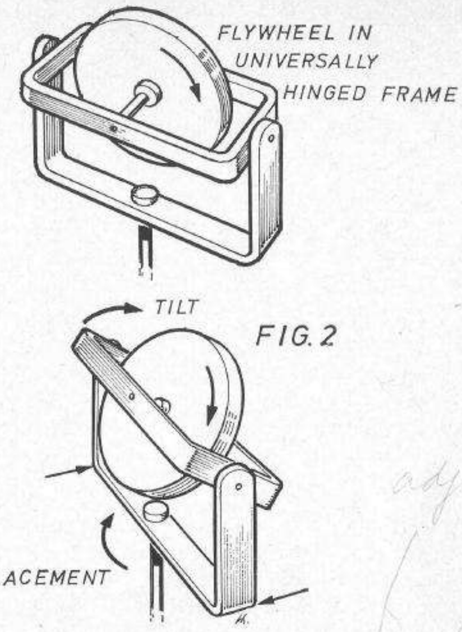


FIG. 2

adj. 面向下的 伏状的 [illegible]

What were the forces that acted so strangely upon the otherwise obedient aircraft? The phenomenon was well known, but not, apparently, to the poor pilots. Aircraft with rotary engines were much more prone to these capers than those with stationary engines, because the former had a considerably greater mass revolving at the nose.

The gyroscope consists of a fast revolving flywheel running in a universally jointed frame allowing it freedom to rotate in all planes as shown in *Fig*. 2. When we apply a couple to the vertical axis to make the flywheel change its attitude in the horizontal plane, we will find that it also tilts in the vertical plane which is normal to the flywheel itself. The frame in which the wheel is running will rotate and tilt. A freely suspended gyroscope will maintain its original attitude and will not be influenced by the attitude of the aircraft in which it is fitted. This characteristic is the basis of directional gyro's, turn indicators and automatic pilots. They have long been used to stabilize and direct torpedo's. *Fig*. 3 shows what happens to the aircraft in a turn, with the propeller rotating clock-

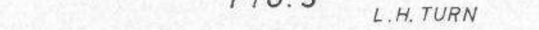


FIG. 3

wise as shown in *Fig*. 2, which would correspond to a turn to the right, it will refuse to move to **a** directly but move towards **c** as well. Similarly, if we try to move the axis towards **b** it will go towards **d** as well. To put it in practical terms: when we make a model turn to the left—with the torque—it will put the nose up, while if we make it turn to the right it will tend to put its nose down. We cannot afford to let the torque have its way, or the model will tend to stall, but we should not trim it to fly a sharp turn in the opposite direction, for that would mean a tendency to fly into the ground. However, let us first see what the gyroscopic moment would be in a particular case. We can calculate it from the equation:

$$M = \frac{0{\cdot}0196\ W_p.n.v.D^2}{R}\ \text{kg.m.}$$

W_p represents the weight of the propeller in kg., n the speed of revolution in revs. per second, v the flying speed in m/sec, D the diameter of the propeller and R the radius of turn both in metres.

Some Examples

It will be evident that the gyroscopic moment will be great when the weight, the diameter and the r.p.m. of the propeller are great and the same applies to the angular velocity of the turn v/R. Similarly the gyroscope effects will be greater in a right turn at high speed. In days long gone by, when Wakefield models, weighing half a pound, had a rubber motor of some 3 to 3½ oz., driving an 18-in. propeller (225 grammes, 100 grammes, 45 cm.), a rise-off-ground take-off with that amount of torque became a dicey affair. If the turn due to torque was not corrected properly, the model took up such an angle of bank that the left wingtip practically dragged over the take-off board, the model either continuing in a climbing roll or looped over on to its back. It might be worthwhile to investigate whether the gyroscopic moment still has an important influence on the behaviour of our models. Let us first take a modern Wakefield (*Fig*. 4b), assuming the following average values: $W_p = 20$ grammes; $n = 20$ revs. per second (initial burst of power); $v = 8$ m./sec.; $D = 500$ mm.; $R = 5$ metres. Remembering that the weight should be expressed in kg and the propeller diameter in metres, the gyroscopic moment will be:

$$M = \frac{0{\cdot}0196 \times 0{\cdot}02 \times 20 \times 8 \times 0{\cdot}5^2}{5}$$

$$= 0{\cdot}00314 \text{ kg.m. OR } 314 \text{ g.cm.}$$

We can represent the effect of this, by pretending there is an additional force F in the plane of the propeller, acting downwards or upwards, and an equal but opposite force at the centre of gravity of the model. This is shown in *Fig*. 4b with a model in a right-hand turn, so there will be a diving moment. When we assume that the propeller lies a distance $d = 30$ cm. in front of the c.g. the force F will be about 10 grammes. This is no negligible force: if we take the chord of the Wakefield at 12·5 cm. the effect may be likened to a forward shift of the c.g. of about 1 cm. which represents 8% of the chord and such a change in the trim of the model is bound to have a significant effect. With the model turning to the left with torque, there will be a climbing moment with an effect similar to a backward shift of the c.g. over roughly the same distance.

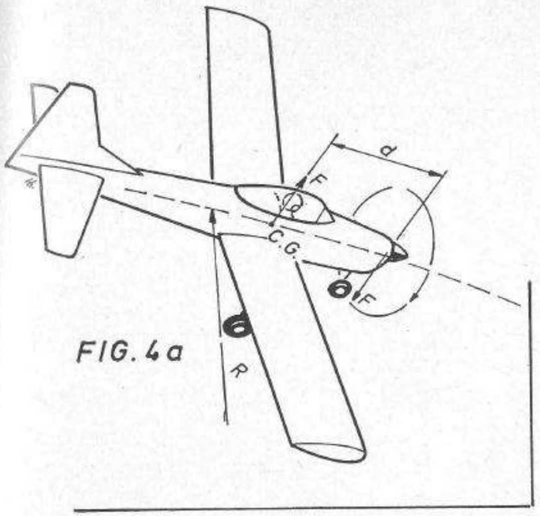


FIG. 4a

The handlaunch has greatly reduced our problem during the take-off as we can point our model in such a way that much of the danger can be eliminated, moreover we launch it at a fair height and at its correct flying speed. Most important of all, we use large diameter propellers which do not have the large initial increase of RPM associated with small ones. All the same, we cannot allow the torque to have all the say. However, before we discuss ways to compensate some of the torque-induced turn, let us see how it will affect a power model (*Fig*. 4a). For the purpose of a rough calculation we assume: $W_p = 20$ g; $n = 300$ revs. per second; $v = 10$ m./sec. (that is the speed at the start; it will build up considerably during the climb); $D = 200$ mm; $R = 5$ metres. We may now write:

$$M = \frac{0{\cdot}0196 \times 0{\cdot}02 \times 300 \times 10 \times 0{\cdot}2^2}{5}$$

$$= 0{\cdot}00932 \text{ kg.m. OR } 932 \text{ g.cm.}$$

We may take the average distance between the c.g. and the plane of the propeller as $d = 25$ cm. and the weight of the model at 750 grammes. Dependent

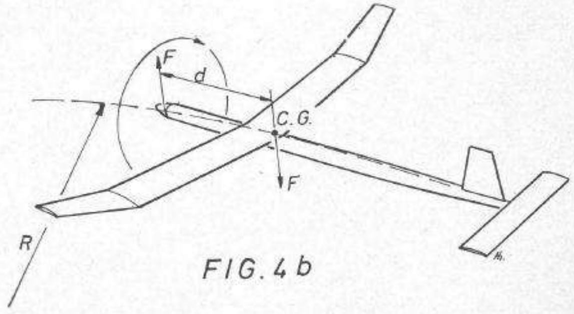


FIG. 4b

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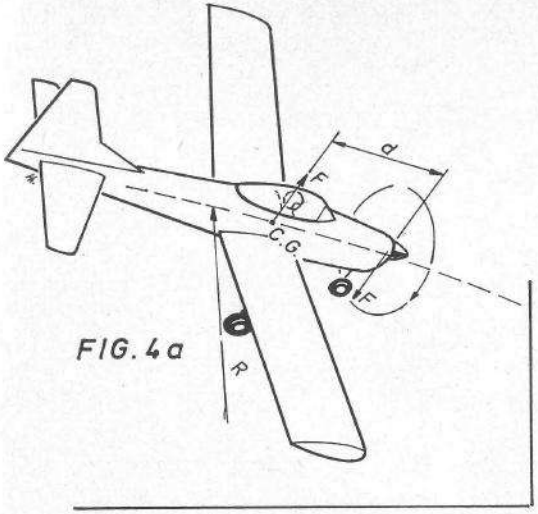

FIG. 4a

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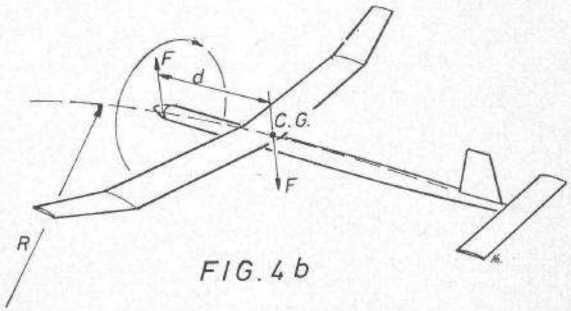


FIG. 4b

on the direction of the 5 m. radius turn, the vertical force at the nose will be 37 grammes either up or down. This is equivalent to a c.g. shift of just over 1 cm. and this will be forward in a righthand turn and aft in a lefthand turn.

With an average wing chord of 20 cm. the shift will be a little over 5 percent and, although this is less than we saw in the case of the Wakefield, it is by no means a negligible factor.

The above does not only apply to the types mentioned, but it holds true for all models and includes R/C, scale and sports models. R/C propeller-driven models in particular may have to fly tight turns at high revolutions and the resulting gyroscopic moment should be allowed for by the pilot. That by itself will be a warning not to stunt close to the ground, over the heads of spectators nor indulge in beat-ups, but none of us do that anyway . . . The foregoing should have made it clear that we should do something to harness the turn induced by the torque, but not to such an extent that the model turns in the opposite direction. A "tame" turn with the torque will still cause a slight climb and that may be just what we want.

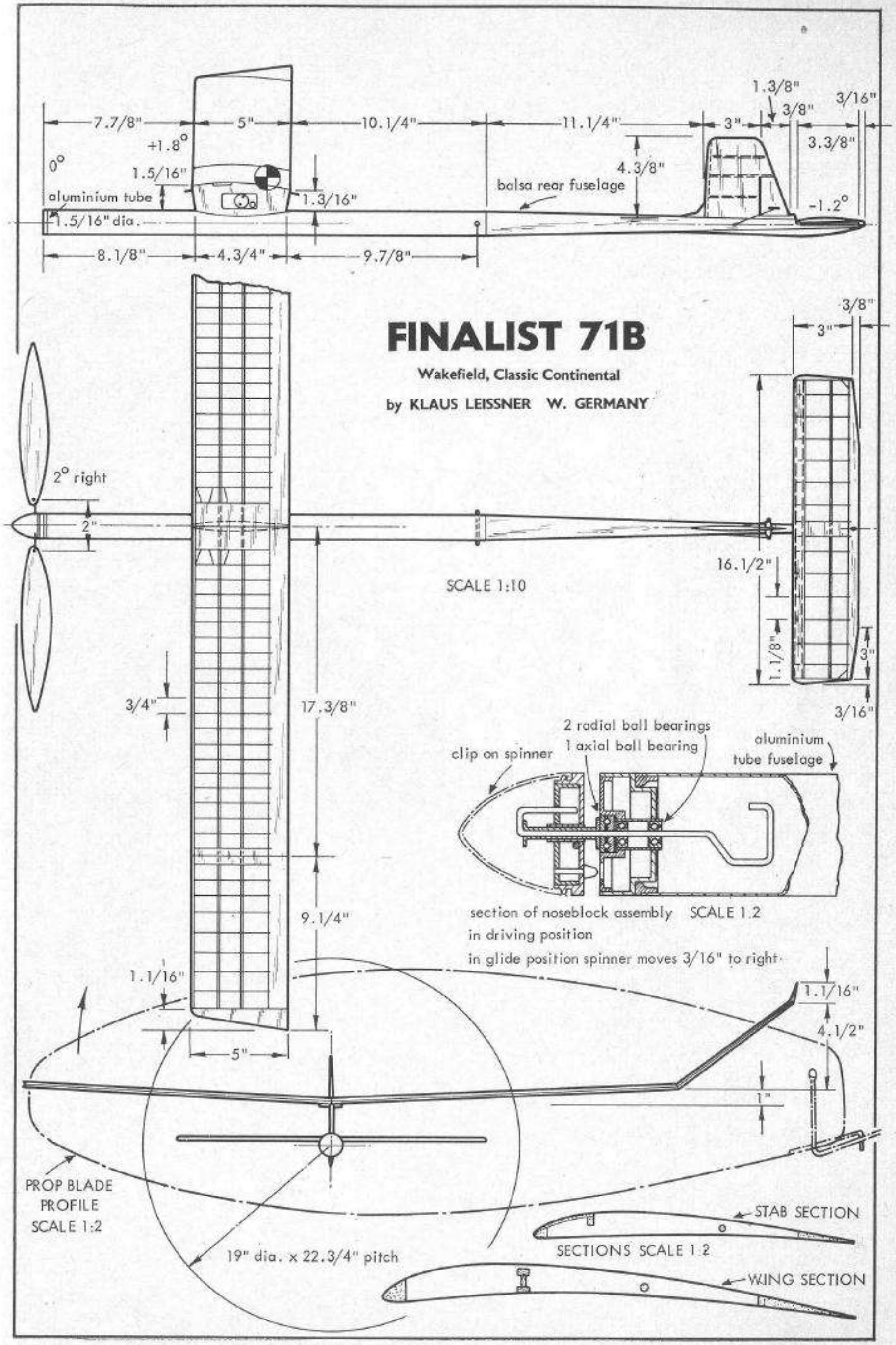
It is common practice to offset the thrustline some 1 or 2 degrees to the right. The thrust will then create a yawning moment to the right and the slip-stream may also strike the fin in such a way that it will cause an additional yawing moment, but this effect may be small in contest models in view of the considerable distance between the propeller and the empennage, the chances being that the slipstream has been more or less straightened out by the time it has reached the tail. As has been mentioned in the beginning, the dihedral does its share in counteracting the torque, but one should note that this is not just a momentary upset but an influence lasting all the time the engine is running.

Off-setting the line of thrust is the only trimming method which does not have an influence on the behaviour of the model in the glide. The following tricks may also be used: Trim tab on fin (dangerous when it may lead to a spiral dive); washout on the righthand wing; tilted tailplane (if it can be combined with V.I.T.). In an emergency one has sometimes resorted to placing the wing askew on the fuselage, but this only works when the wing is a separate unit and it may not be easy to gauge the exact angle after a landing.

The gyroscopic moment is inversely proportional to the radius of turn and in our examples we have taken a fairly small radius to illustrate the point. If the model flies a 10-metre radius, the moment will be halved.

The weight of the propeller is important; the lighter we can make it, the less will be the gyroscopic moment.

When trimming a model it will be wise to reckon with these factors. It is hoped that this explanation will help to solve a problem here and there.



FINALIST 71B

Wakefield, Classic Continental

by KLAUS LEISSNER W. GERMANY

AEROMODELLING MAGAZINES

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MODELLI AND SPORT	Via Cristoforo, Capone N 59-84100, Salerno, ITALY
MODELLISMO	Corso Italia 8, Milan, ITALY
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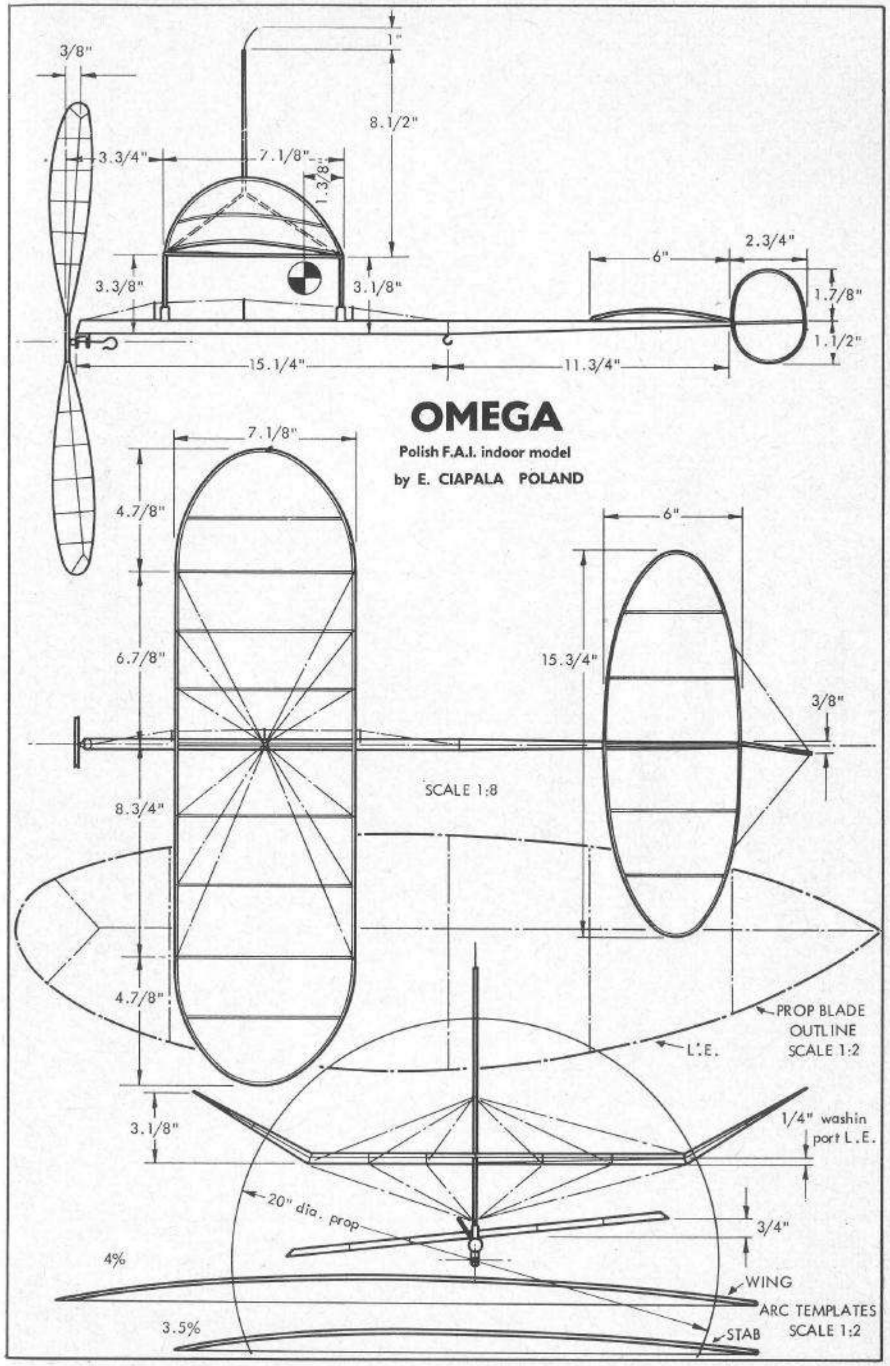
RADIO MODELISME	21 Rue Des Jeuneurs, Paris 2e, FRANCE
R.C.M. & E.	13/35 Bridge Street, Hemel Hempstead, Herts., ENGLAND
SCALE MODELS	13/35 Bridge Street, Hemel Hempstead, Herts., ENGLAND
SKRZYDLATA POLSKA	Ul Widok 8, Warsaw 10, POLAND
SPORT MODELISMO	Rua Lidia Coelho 5, CX Postal 12235, Sao Paulo, BRAZIL
SEA & SKY	Patrio Planning 1–22 Yothuya, Shin Jukuku, Tokyo, JAPAN
WINGS OF FATHERLAND	Moscow B66, New Riadanskia 26, U.S.S.R.
YOUNG MODELLER	Moscow A39, Suczewskaya Ul. 21, U.S.S.R.



OMEGA

Polish F.A.I. indoor model

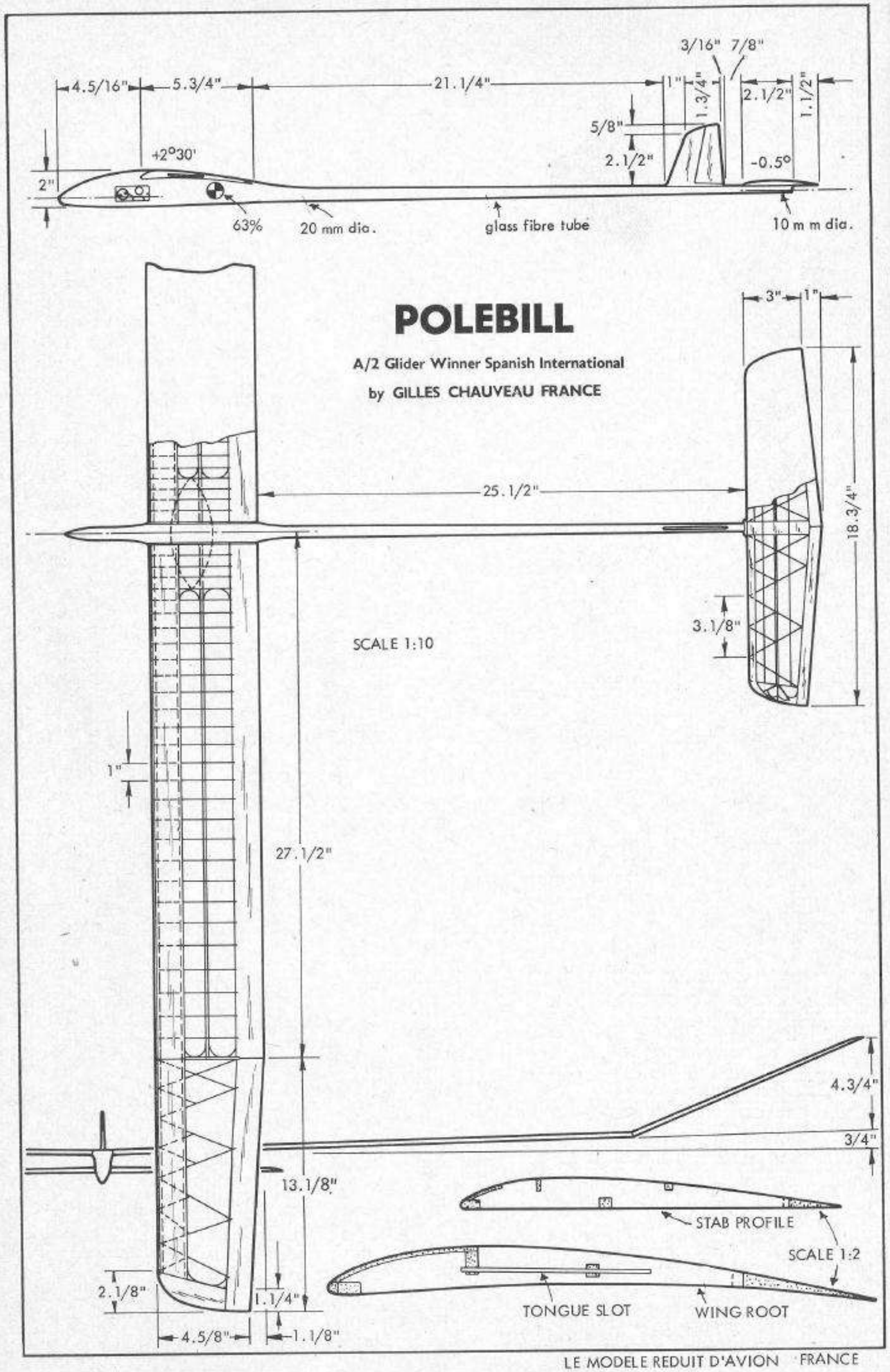
by E. CIAPALA POLAND

MODELARZ POLAND

POLEBILL

A/2 Glider Winner Spanish International

by GILLES CHAUVEAU FRANCE

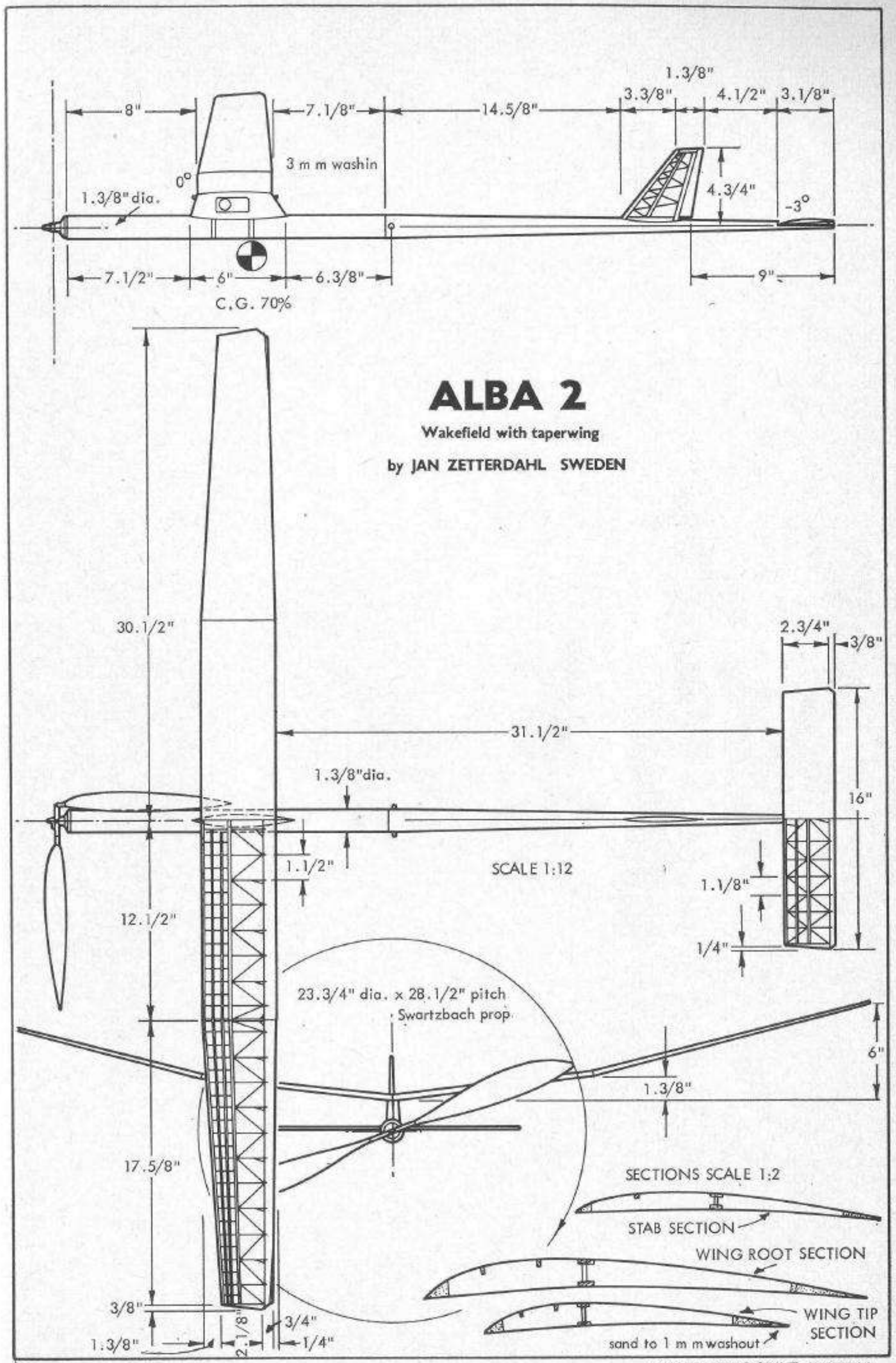


LE MODELE REDUIT D'AVION FRANCE

ALBA 2

Wakefield with taperwing

by JAN ZETTERDAHL SWEDEN

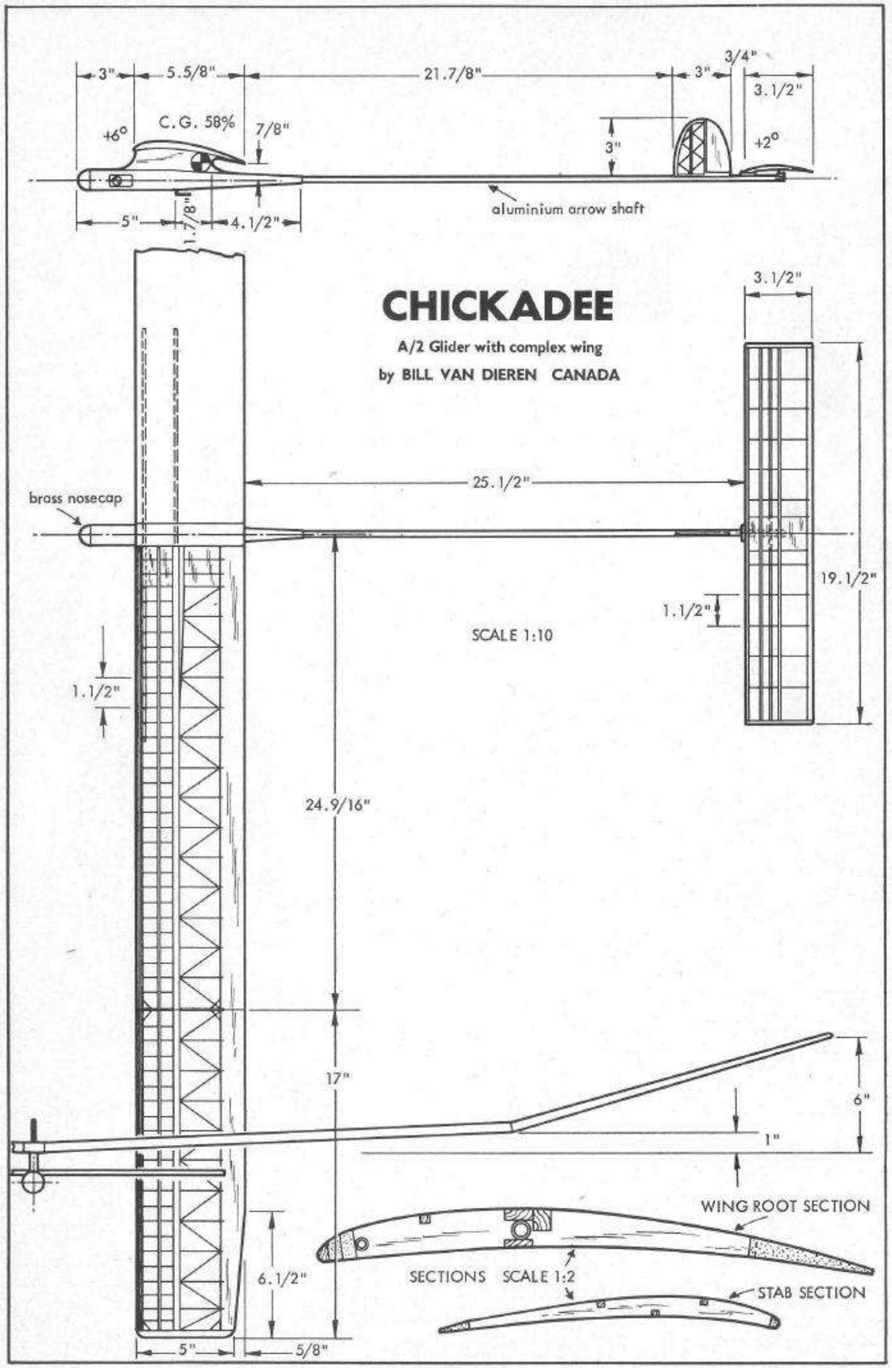


MODELLFLYGGNYT SWEDEN.

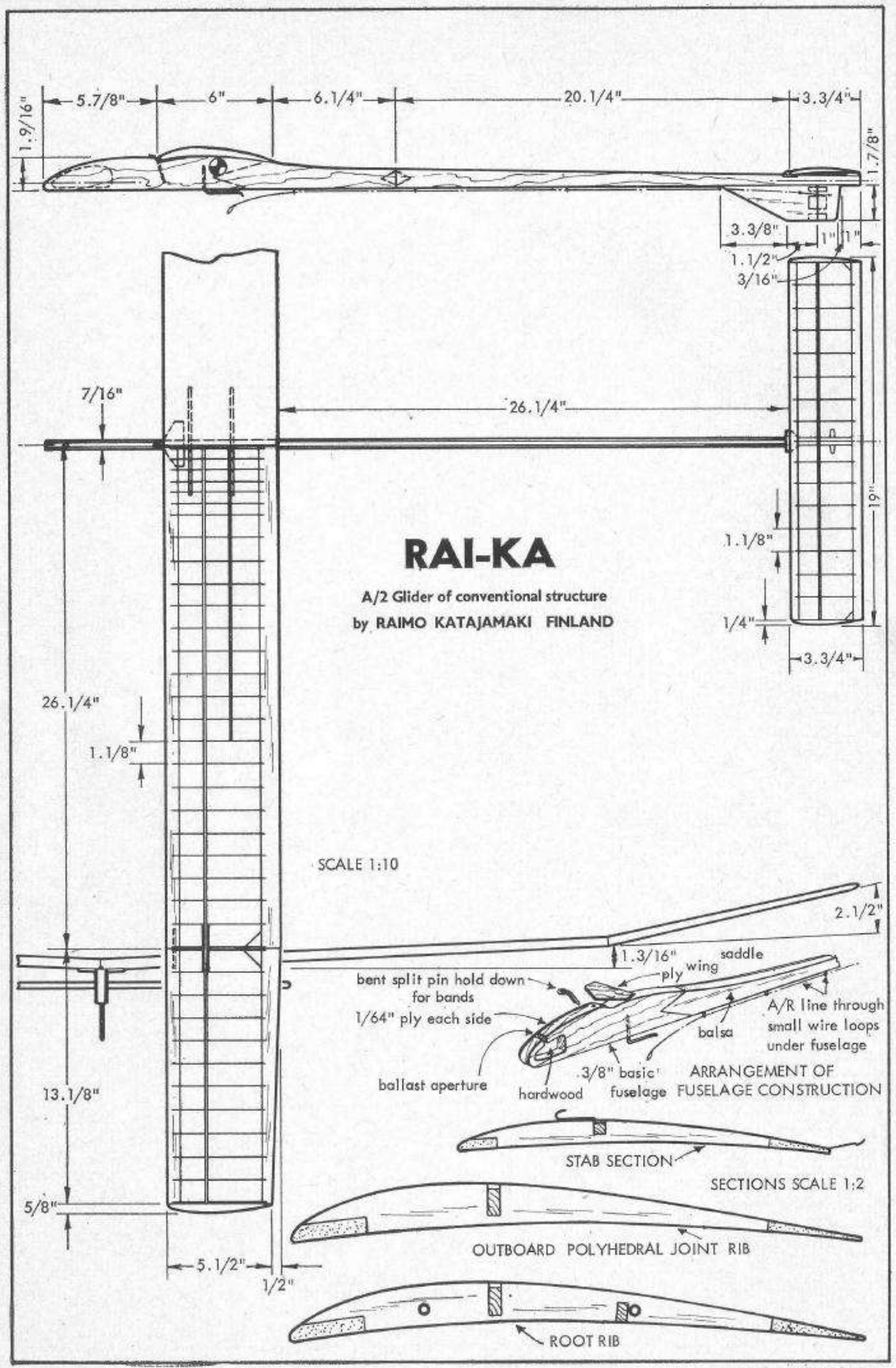
CHICKADEE

A/2 Glider with complex wing

by BILL VAN DIEREN CANADA



VANCOUVER G.M.C. CANADA.



RAI-KA

A/2 Glider of conventional structure

by RAIMO KATAJAMAKI FINLAND

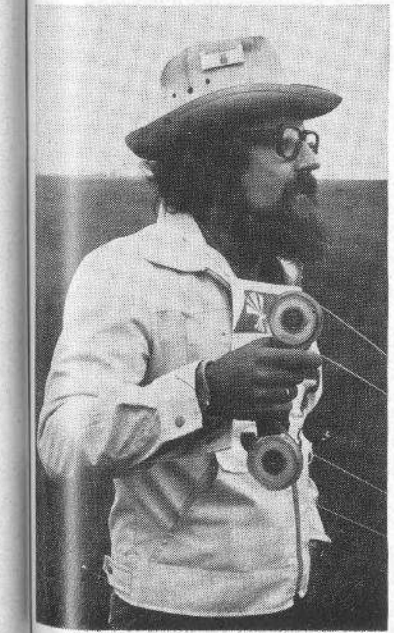
ILMAILU FINLAND

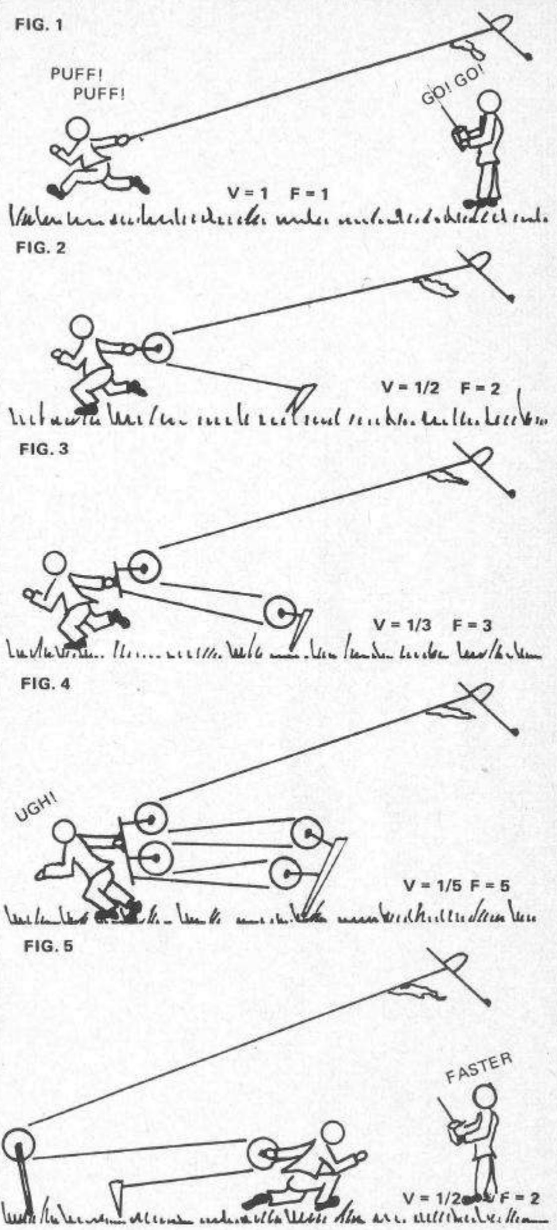
PULLEY LAUNCHING

by Dr. Walter Good, U.S.A.

There is nothing more frustrating in model glider flying than being unable to tow to height, a glider that is too heavy for the prevailing wind speed. Radio gliders on long launch lines are frequently handicapped, hence the development of the powered (electric or internal combustion) winch. The ECCS Soaring Society in the U.S.A. opened a design contest in 1973 for winch and pulley tow ideas which produced many good and practical suggestions, the simplest of which was the sequence of 5 sketches by the R/C pioneer, Walt Good.

Spanish competitor in 1975 Eole Thermal Soaring International with a Scheme 5 pulley block.



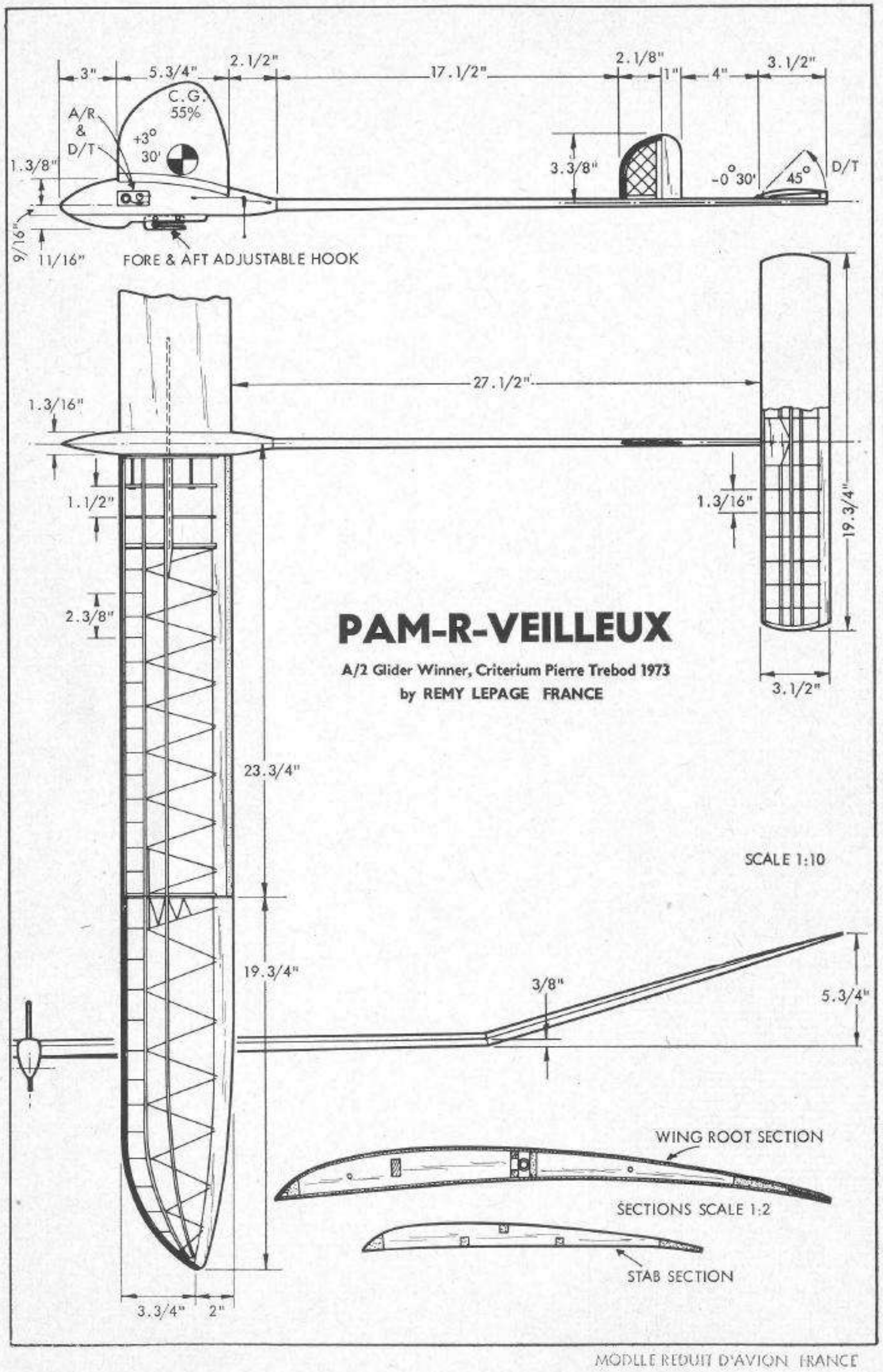


GLIDER TOW METHODS WITH PULLEYS

V = Velocity of Towman vs Sailplane

F = Pull of Towman vs Sailplane

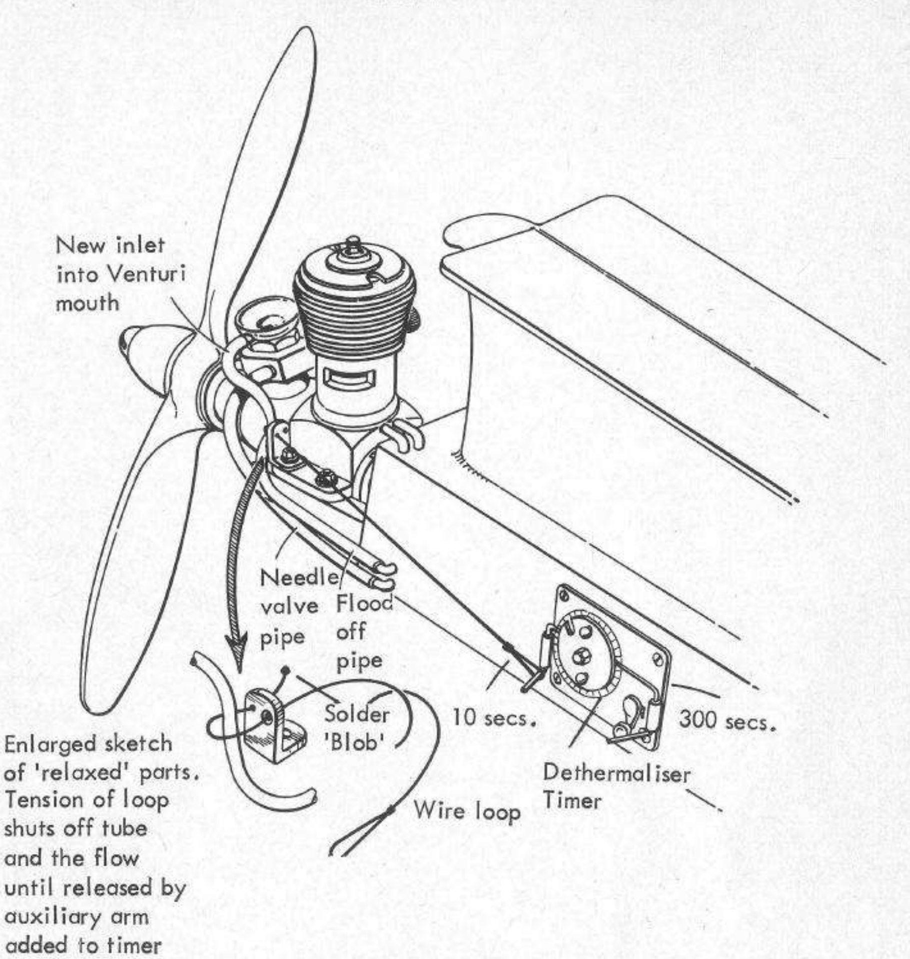
WALT GOOD 11-73



PAM-R-VEILLEUX

A/2 Glider Winner, Criterium Pierre Trebod 1973
by REMY LEPAGE FRANCE

MODELE REDUIT D'AVION FRANCE

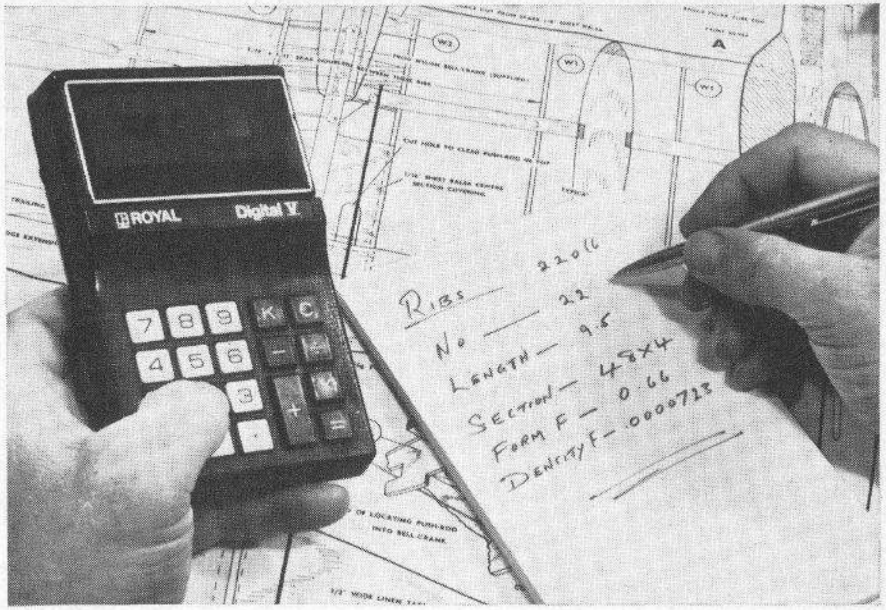


Enlarged sketch of 'relaxed' parts. Tension of loop shuts off tube and the flow until released by auxiliary arm added to timer

JIM CROCKET FLOOD OFF SWITCH

JIM CROCKET, of the Fresno Model Club, U.S.A., has derived a neat way to solve the long fuel line for competition flood off systems. It's a small clip that bolts to the engine mounting lug, and has 2 holes in one ear of the clip. The nylon cord that actually does the job of pinching the fuel flood-off line is routed through these 2 holes and then to the wire tab of the timer. When the timer is in the engine running position, the nylon cord pinches the fuel flood-off line closed. Then, when the timer unwinds to the engine off position, or in other words gets to the slot in the disc, the nylon cord is released, and the tension is taken off the pinched fuel tubing, and the engine is flooded off. Neat and simple, from Jim Crocket Replicas, 1442 N. Fruit St. Fresno, CA. 93728.

With Jim's "Switch", the flood-off line is less likely to let the engine stutter off since the shut off point is close to the venturi, and not back at the timer. *From San Valeers Newsletter, California, U.S.A.*



COMPUTERISED AIRFRAME WEIGHT CHECK —THE EASY WAY!

by Ron Warring

MOST every aeromodeller *must* have a pocket-size electronic calculator by now. So why not put it to good use by weight-check calculations when designing—or before building—your next model. The exercise can be very interesting—and the results most useful. And if you tackle it in a *simplified* manner, it's really very easy.

The trick is to work out 'section' sizes of units of $\frac{1}{32}$″ square. Balsa sizes are still standardised in inch fractions, and using this little trick will save any necessity of converting inch fractions into decimals to enter on your calculator.

The *key* is this little table which follows. It gives the weight in ounces per inch length of $\frac{1}{32}$″ square section for various balsa densities. These are called *density factors* and you will use the appropriate one in each calculation.

balsa density	*density factor*
lb./cu. ft.	
6	0·0000543
7	0·0000633
8	0·0000723
9	0·0000814
10	0·0000904
12	0·0001089
14	0·000127
16	0·000145

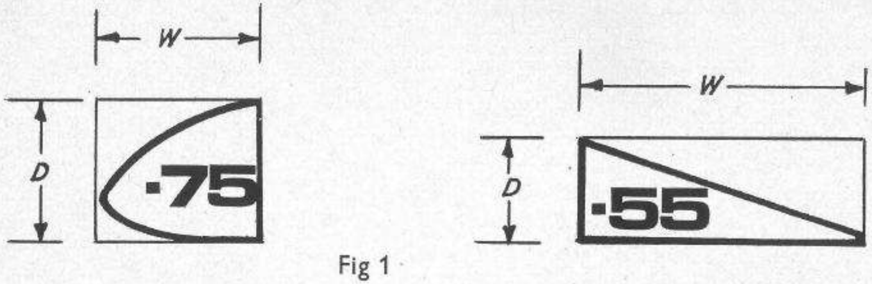


Fig 1

Every weight calculation is then based on *length* of the part concerned, its *section* expressed as so many $\frac{1}{32}''$ square units, and the *density factor* corresponding to the balsa density involved. As a simple example, let's work out the weight of a $36'' \times 3'' \times \frac{1}{4}''$ balsa sheet having a balsa density of 10 lb./cu. ft.

$$\text{Length} = 36''$$
$$\text{Section} = 3'' \times \tfrac{1}{4}''$$
$$= 96 \times 8 \text{ (expressed as } \tfrac{1}{32}'' \text{ units)}$$

Density factor for 10 lb. balsa = 0·0000904. Weight now follows by multiplying length, section and density factor, viz.

$$36 \times 96 \times 8 \times 0{\cdot}0000904 = 2{\cdot}4993792 \text{ oz.}$$

or for all practical purposes, $2\frac{1}{2}$ oz.

There is another little trick we can use, too, to deal with sections or shapes which are not rectangular. Thus in the case of solid leading and trailing edges we can use the nominal *rectangular* ('W' and 'D'—see *Fig 1*) size of the section (in $\frac{1}{32}''$ units again) and correct for the typical section shape by multiplying by a *form factor*. For a typical leading edge the *form factor* is 0·75; and for a solid trailing edge 0·55—*Fig*. 1.

In the case of *ribs*, the chord is taken as the *length* dimension. The section is then taken as the maximum depth (D) of the section (in $\frac{1}{32}''$ units) multiplied by the thickness of the rib (again in $\frac{1}{32}''$ units). Typical *form factors* for ribs are 0·63 in the case of a solid trailing edge section, and 0·66 where a two-piece sheet trailing edge is used—*Fig*. 2.

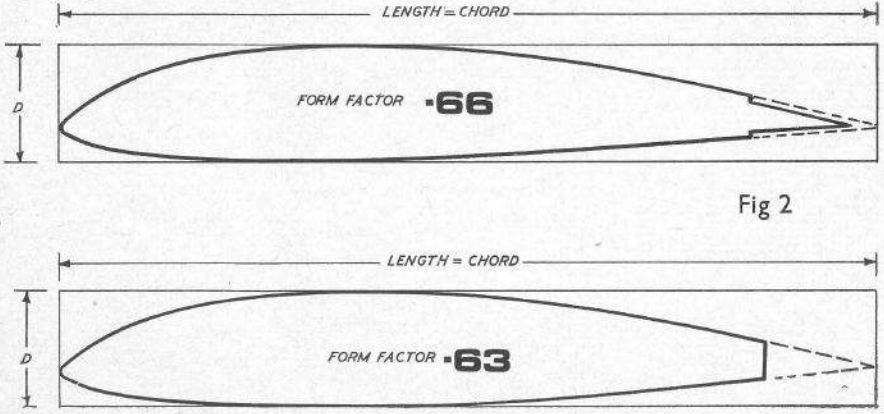


Fig 2

Now weight calculation becomes very simple, as the following worked out example will show. It is based on the wing design shown in *Fig*. 3. Weights are calculated for each of the component members in turn, based on multiplying together the following quantities:

number off
length
section (in $\frac{1}{32}''$ units)
form factor (where applicable, otherwise form factor = I.O.)
density factor

Leading edge—two off $29\frac{1}{2}'' \times \frac{1}{2}'' \times \frac{1}{2}''$—say 9 lb. density number (i.e. one for each wing half) 2
length 29·5
section (in $\frac{1}{32}''$ units) 16×16
form factor (i.e. as *Fig*. 1) 0·75
density factor (for 9 lb. density) 0·0000814
tap out the weight on your calculator *weight = 0·9221 ounces*
Top spar—two off $29\frac{1}{2}'' \times \frac{1}{2}'' \times \frac{1}{4}''$—say 12 lb. density
number 2
length 29·5
section 16×8
form factor I.O (i.e. with rectangular sections the form factor is unity and can be disregarded)
density factor 0·0001085 *weight 0·8194 oz.*
Bottom spar—two off $29\frac{1}{2}'' \times \frac{1}{4}'' \times \frac{1}{4}''$—say 14 lb. density
number 2
length 29·5
section 8×8
form factor 1·0
density factor 0·000127 *weight 0·4800 oz.*
Trailing edge—four off $29\frac{1}{2}'' \times 1\frac{1}{2}'' \times \frac{1}{16}''$—say 8 lb. density
number 4
length 29·5
section 48×2
form factor 1·0
density factor 0·0000723 *weight 0·8190 oz.*
*Ribs**—22 off $9\frac{1}{2}''$ chord (length), $1\frac{1}{2}''$ deep, $\frac{1}{8}''$ sheet—say 8 lb. density
number 22
length 9·5
section 48×4
form factor 0·66 (i.e. from *Fig*. 2)
density factor 0·0000723 *weight 1·9148 oz.*
Capping strips—22 off $4'' \times \frac{1}{4}'' \times \frac{1}{16}''$—say 6 lb. density
number 22
length 4
section 8×2
form factor 1·0
density factor 0·0000543 *weight 0·0765 oz.*

* Note: For a straight tapered wing base length (chord) and depth (D) of rib on *average* size of rib, or mean size between root rib and tip rib

Tips—two off 9½″ × 2″ × 1½″—say 6 lb. density
number 2
length 9·5
section 64 × 48
form factor—difficult to estimate but say 0·75
density factor 0·0000543 *weight 2·3770 oz.*

Write all the individual weights down separately and add them up with the calculator:

leading edges	0·9221
top spars	0·8194
bottom spars	0·4800
trailing edge	0·8190
ribs	1·9148
cap strips	0·0765
tips	2·3770
total	*7·4088 oz*

That is the *design weight,* based on selecting sheet and strip balsa to the specified densities. The final (uncovered) wing weight will inevitably be higher because no account has been taken of the weight of adhesive, or dihedral braces. The latter can be calculated separately if you wish, using a density factor of 0·000435. For adhesive weight an additional allowance of 5% of the total should be adequate, but the 'old-fashioned' or pre-computer days aircraft designer would normally add 10 per cent to his estimated weight figure to be on the safe side. Just as CG positions tend to come out a little aft of the original design position, finished weights tend to work out heavier than estimated weights!

Weight control

The breakdown of weights is also useful to study when you want to save weight. In the worked out example, for instance, the tips are disproportionately heavy. They are decorative rather than functional—yet they weigh more than the ribs. This would point to saving weight by hollowing the tips right out—or using a lighter type of tip construction than carved from solid (particularly as 6 lb. density block might be hard to find for the tips).

It's easy, too, to use this weight breakdown to work out the weight of balsa sheet and strip to select from your stock. For example, 8 lb. density is specified for the trailing edges. A simple calculation will show how much a 36″ × 3″ × ⅛″ sheet of this density will weigh:
length 36
section 96 × 4
density factor 0·0000723
weight 1·0000 oz.

So in addition to your calculator you need an accurate letter balance or weighing machine! And don't forget, it's just as easy to work out estimated weights for fuselages and tail units of virtually any type of construction—provided you can 'guesstimate' or work out realistic form factors, where applicable. The following additional *density factors* will also be useful when using woods other than balsa:

obechi 0.0002198 spruce 0·0002940 birch 0·0003636

Incidentally, now that you are finding your pocket calculator fun to use, an amusing exercise is to calculate the equivalent volume of wood in terms of a 36″ length. A volume figure (not the true volume) is given by multiplying together the following:

number off
length
section
form factor (where applicable).

Using the same wing again as an example, the 'volume calculations' are:

$$\begin{aligned}2\times29{\cdot}5\times16\times16\times0{\cdot}75 &= 11\,328\\ 2\times29{\cdot}5\times16\times8 &= 7\,552\\ 2\times29{\cdot}5\times8\times8 &= 3\,776\\ 4\times29{\cdot}5\times48\times2 &= 11\,328\\ 22\times9{\cdot}5\times48\times4\times0{\cdot}66 &= 26\,484\\ 22\times4\times8\times2 &= 1\,408\\ 2\times9{\cdot}5\times64\times48\times0{\cdot}75 &= 43\,776\end{aligned}$$

Now add together all these individual volumes—

total = 105 652

Divide by 36 = 2934·7.
(This figure gives the cross section, in $\frac{1}{32}''$ squares, of a single equivalent block of wood 36″ long.)
Find the square root of this volume figure = 54·174
Divide by 32 = *1·6929*
This gives the dimensions of a square section, 36″ long, equivalent in volume to all the wood in the frame. In other words, all the wood in the wing amounts to the same as a 36″ length of 1·6929—or say 1 $\frac{11}{16}''$ square balsa block.

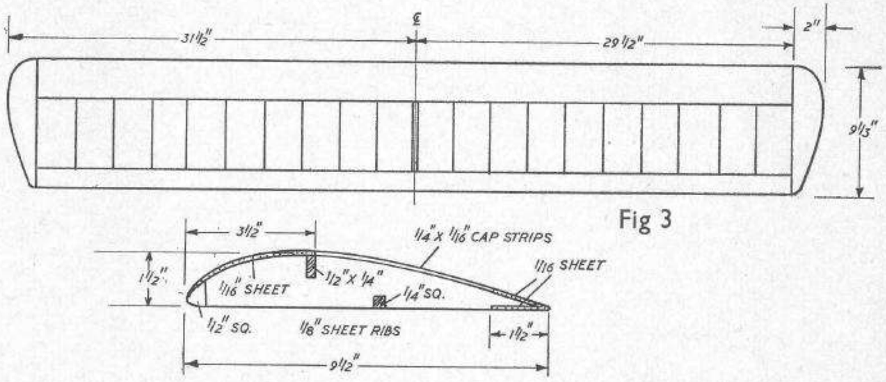
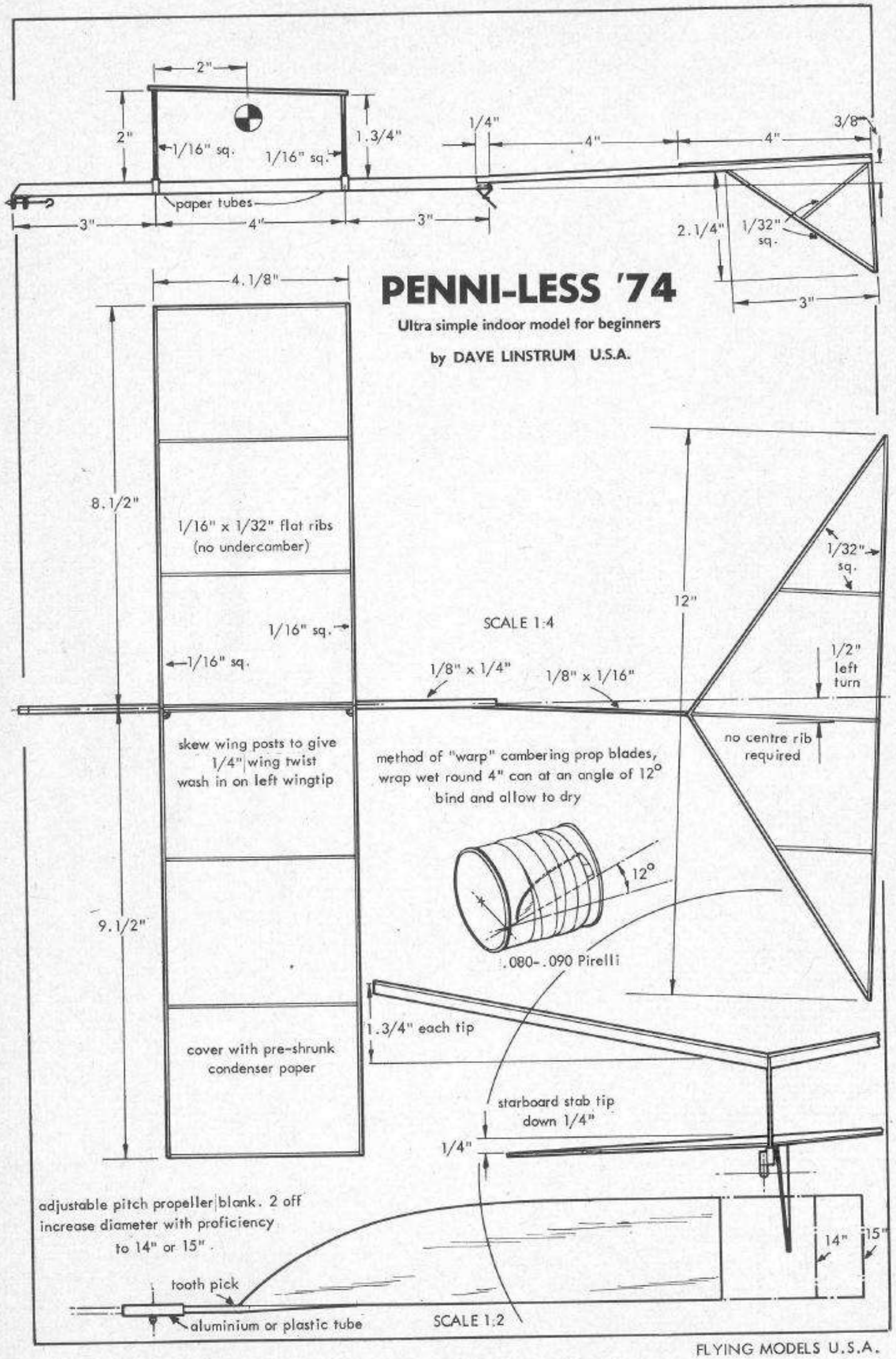
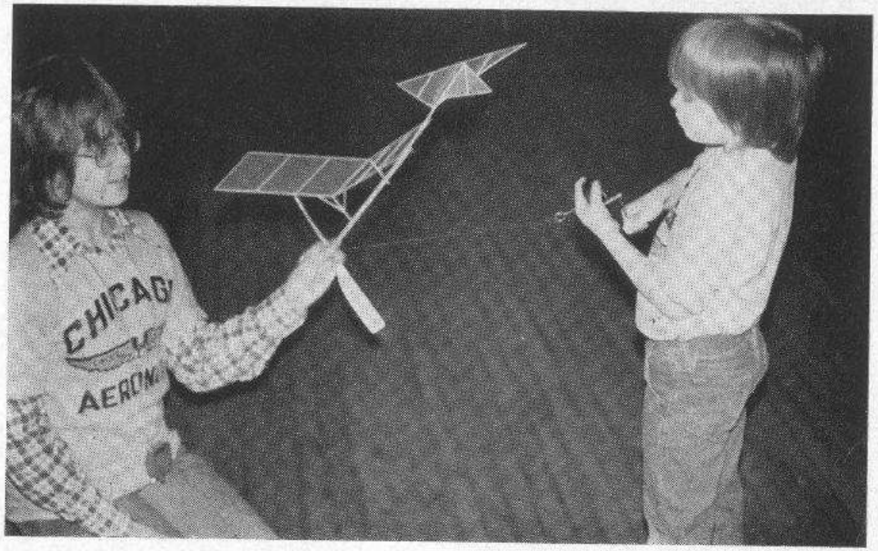


Fig 3



FLYING MODELS U.S.A.



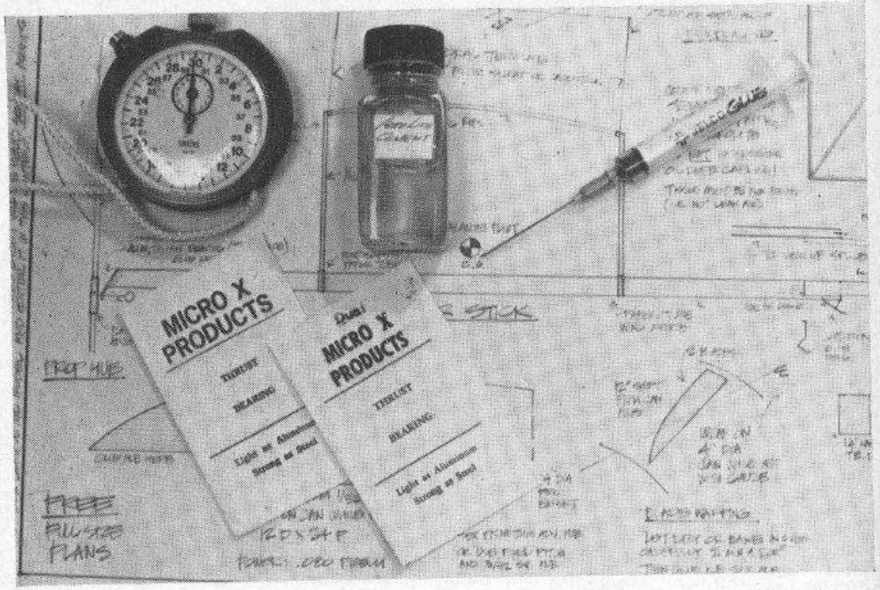
Author's son, Carl, winds his simple 'PENNI-LESS' as sister Mindi holds. Note Club T-shirt. This winding form is typical.

PENNYPLANE POTPOURRI
by Dave Linstrum VTO

THE AUTHOR has been flying Pennyplanes for over half a decade now, and the class is his favourite beyond a doubt. There is no other indoor type rubber model that is so *much* fun to fly with so *little* effort involved. Peanut scale comes a close second, but there the effort involved in building even a "standoff scale" replica is considerably greater than that of making a Pennyplane. Even the slowest of builders can fabricate a simple Pennyplane in a few hours.

The most recent Pennyplane built by the writer was assembled at the dining room table of good friend Pete Cameron of Crawley, Sussex. Pete sat opposite us and built his own version, taking a little longer since it was his first, and we had built over a dozen of the craft. The new models got their baptism at the Crawley Club meeting that evening, and the next day were flown in the Aeromodeller offices. There were sufficient hazards in the latter site to prevent any sort of record being set, except perhaps number of hang-ups on a R/C helicopter body hanging in the office!

Why does Pennyplane provide such fun and fascination, for both neophyte flyer and indoor expert? First you have to understand what a Pennyplane is—simply a very rudimentary paper covered indoor endurance model, with a minimum weight of a bit over 3 grams *sans* motor (the name derives from the weight limit, governed by the U.S. copper penny) and maximum span and length of 18 in. (45·7 cm.). Specifications have purposely been kept simple to allow a certain amount of design latitude that will stimulate experts to try new



Surprisingly, it is easy to go overweight if glue is over-applied (use syringe to apply drops). Light alumn. bearings are best.

concepts for greater endurance. The models are fun to fly because anyone with even a small amount of building skill (the author's son built one when he was six) can put one together with ordinary wood and tools, then get reasonable flights of several minutes without difficult trimming.

Pennyplane may be flown in almost any sort of hall, from a school gymnasium to a hangar, or even Cardington Airship Shed. Models are sturdy, thus easily handled by beginners and easily retrieved from hangups without danger of total destruction. A very real aspect of the fun is watching people who have never built an indoor model get good flights on their first go—there is no satisfaction like seeing beginner success. Meanwhile, the experts still have a challenge in wringing the last bit of time out.

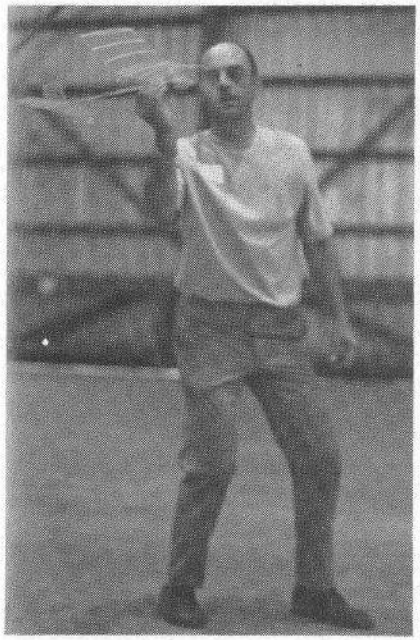
The concept for the event was originated in 1969 by Chicago Aeronut Erwin Rodemsky, who was basically dissatisfied with the results of "EZB" as a beginner event. EZB, or Easy B if you like, has no weight limit but a lot of other restrictions. Models must be built with hard-to-obtain indoor wood to be competitive. "*Captain Pennyplane*" Rodemsky (he is a Captain with American Airlines) thought the answer might be in a minimum weight limit that would allow outdoor balsa, or indoor wood and a bit of ballast for experts. The span and length needed limits to provide some uniformity in competition. Also the motor length, as a function of the distance between hooks, needed a limit to prevent a strong competitive edge gained by extra turns. Yet everything else was left wide open, to help stimulate design innovation. That this simplicity with open-ended rationale has worked is evident in the great variety of designs created in the class. Some of these are illustrated in the drawings, and photos which accompany this article. This is by no means an exhaustive compilation of designs, but merely a representative cross section of the breed.

The official Pennyplane rules, as formulated by the Chicago Aeronuts and used at the First Annual Pennyplane Event at the 1970 Chicago AMA Nationals (where the authors' models were flown by proxy) are as follows:

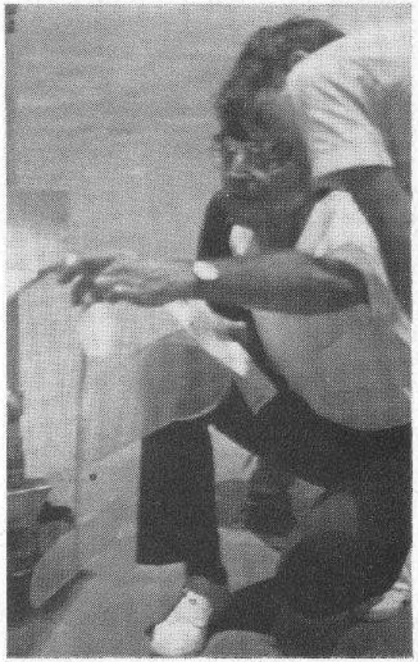
1. Model must weigh at least as much as a new copper penny.
2. Must not exceed 18 in. in length (including propeller) or wingspan.
3. Motor stick must not exceed 10 in. (from front of thrust bearing to rear hook).
4. Single rubber motor and propeller (no gears).
5. Motor must not be enclosed in body or motor stick.
6. Model must be weighed prior to each official flight.
7. Scale can be ⅛in. × 1 in. × 18 in. balsa, with a razor blade pivot in the center. The penny should be glued to one end, the other end projects over the edge of the table and the model is hung on the scale. The timer must make sure that no weight is removed prior to flying; and if model is retrieved, must be weighed after the flight.
8. Five official flights are allowed.
9. Highest single flight time wins.

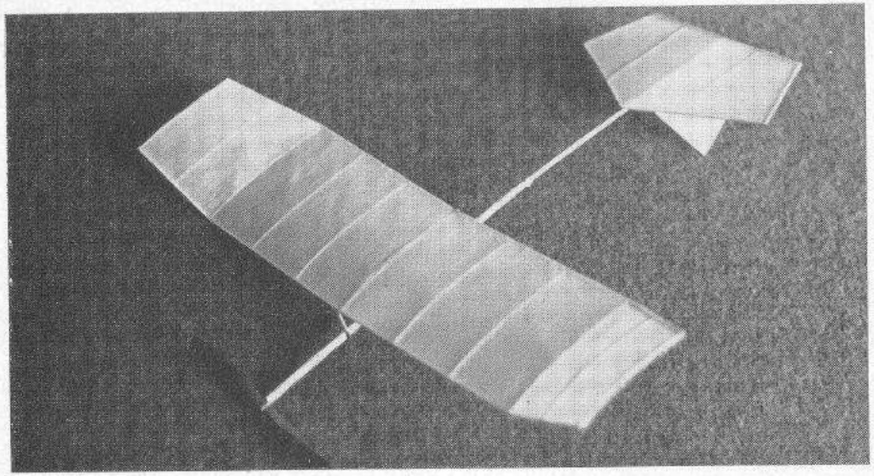
While these rules were very good indeed and stimulated a lot of interest in flying the class, the experience of running the event at the past five Nationals plus uncounted smaller meets (including some in the UK and in Sweden, where the class is known as 25 Ore Plane in deference to the Swedish 3 gram coin) has mellowed opinion to the extent that rule modifications are being considered. The class has been proposed to the Academy of Model Aeronautics for official status by Robert Meuser of Oakland, California. He suggests the following rules, which

Bob Hayes of sponsoring club, Chicago Aeronuts, about to launch his Sotich design "DUFFER DIP".



Stan Chilton weighs in Dan Brown's model (Jaecks' design) on typical scale, deflecting piece of piano wire. Model hung by Shaft/bearing.



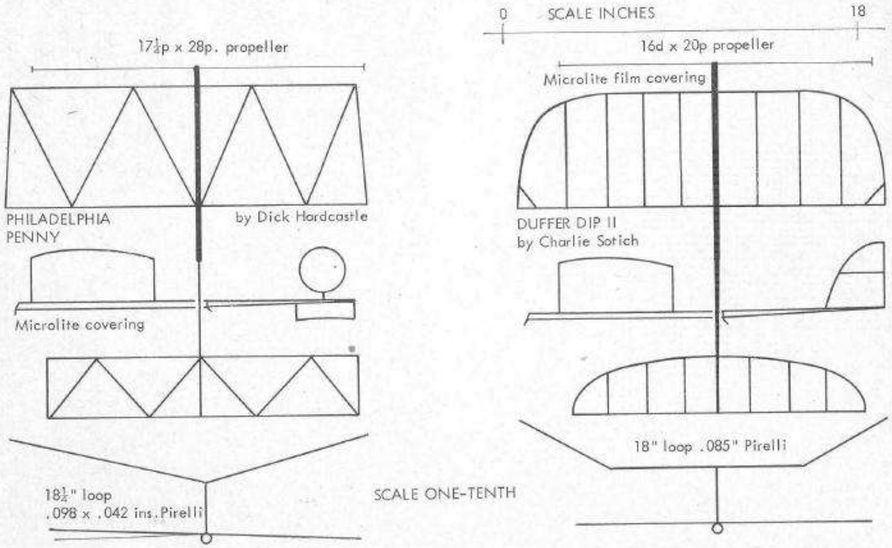


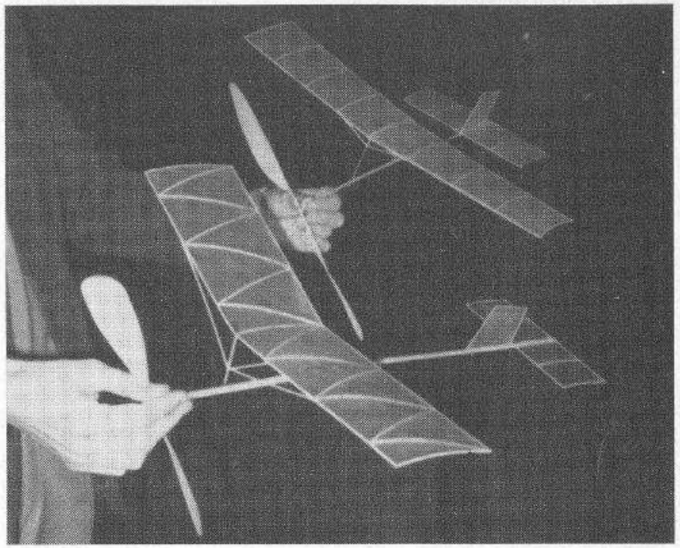
Author's crude Mather design "CALIFORNIA PENNY" built in Beirut weighed 3 cents with plastic prop, but still flew (just). No proper materials were available.

take into account the variation in performance between expert and beginner creations. The rules as currently debated by the AMA Free Flight Contest Board are:

PENNYPLANE
Except as noted below, the rules for FF INDOOR RUBBER, HAND-LAUNCHED STICK MODEL shall apply.

1. The model shall weigh at least 0·109 oz. (3·10 grams), (approximately the weight of a new U.S. copper penny) without the rubber motor.
2. The overall length, excluding the propeller, shall not exceed 18 in. (45·72 cm.).
3. The projected wing span, measured perpendicular to the motor stick, shall not exceed 18 in. (45·72 cm.)
4. The distance from the front of the thrust bearing to the rear of motor hook shall not exceed 10 in. (25·4 cm.). For pushers, interchange the words "front" and "rear".
5. A single direct-drive (ungeared) rubber motor and propeller shall be used.
6. The rubber motor shall not be enclosed.





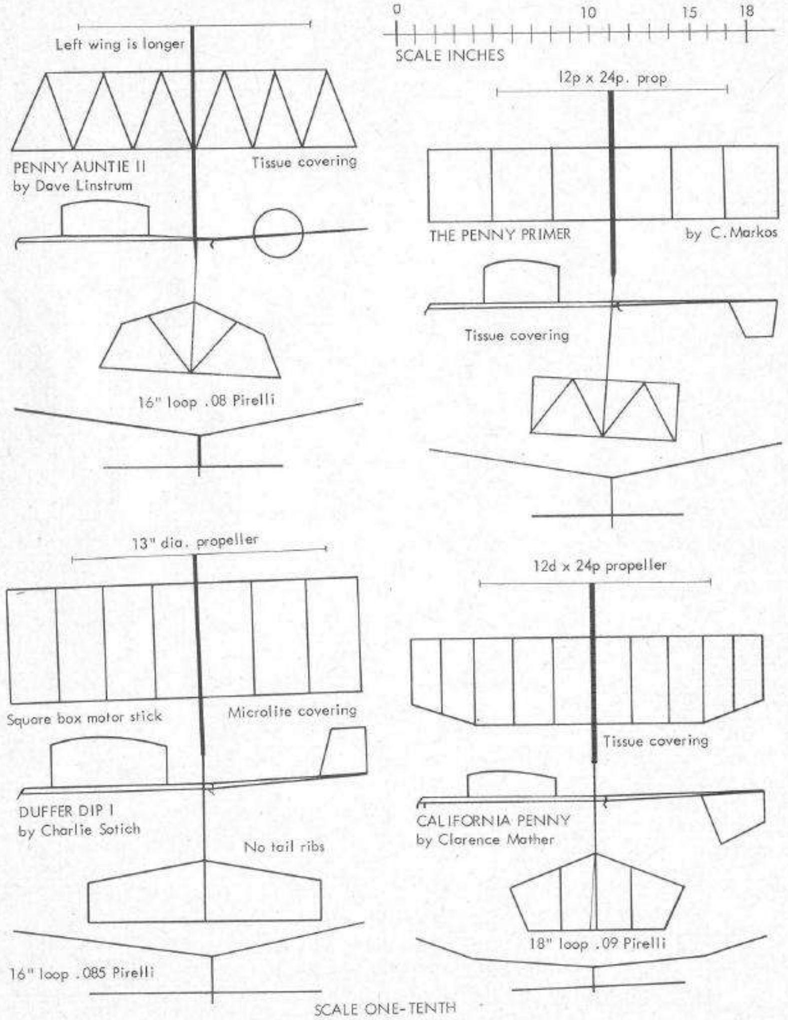
Two British Pennyplanes seen at one of the Cardington Airship Shed meetings organised by the S.M.A.E. at rear, by Brian Kenny, and in foreground by Dave Goodwin.

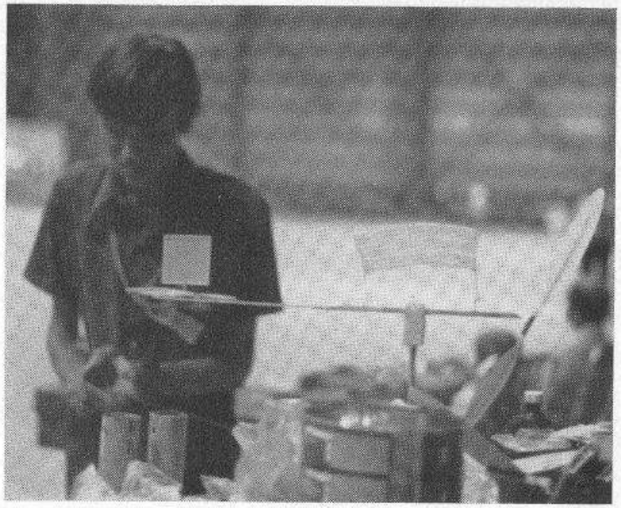
NOVICE PENNYPLANE
EXCEPT AS NOTED BELOW, THE RULES FOR **PENNYPLANE** APPLY

1. The wing chord shall not exceed 5 in. (12·70 cm.).
2. The dimensions of the horizontal stabilizer shall not exceed 4 in. chord by 12 in. span (10·16 × 30·48 cm.).
3. The motor stick shall be solid, and made from a single piece of wood. (The tailboom may be another piece.)
4. The propeller diameter shall not exceed 12 in. (10·16 cm.).
5. No "gadgets" of any kind are permitted on the model. (i.e., variable pitch props, automatic incidence changing mechanisms, etc.)

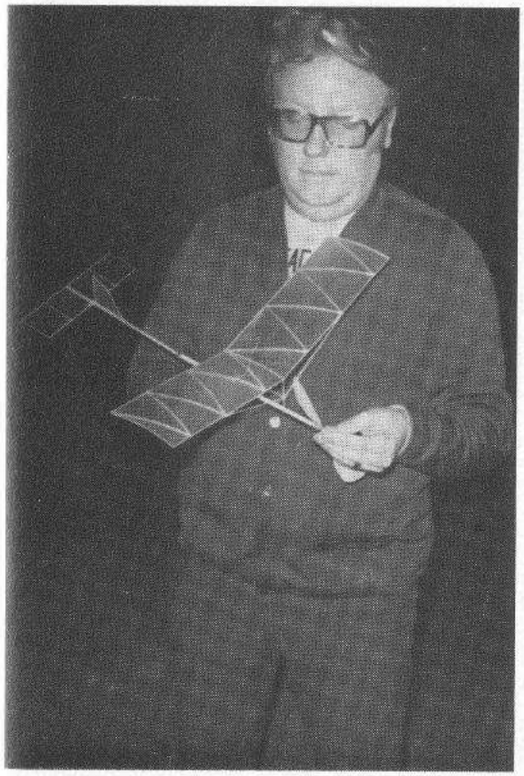
One other fun aspect of the event is the natural opportunity for amusing names used in christening new designs. There has been a strong tendency for designers to make puns on the event title, with such unlikely names as "*Penny Auntie*", "*Penny Wise*" (MAP Plan D 1110) and "*Penny from Heaven*" created by the author, the "*Penny Primer*" by Aeronut Chuck Markos, "*Plain Penny*" by Clarence Mather of the San Diego Orbiteers, and the "*Philadelphia Penny*" by St. Louis flyer Dick Hardcastle. The latter is a numismatist's name—the coin is the one minted in Philadelphia. Probably the most outlandish name—and design—is the one created by wag W. C. Hannan (another Orbiteer) in his "*Square Deal*" Pennyplane. This is 18 inch span, 18 inch length and all wing—simply a big square wing! It has a small vent in the midriff and a reflex trailing edge for stability. Other freak types include the tandems flown by John Kukon and the canards tried by Walt Mooney, Bill Gough, Dick Lyons and others. Colonel Bob Randolph came up with a "*BiPenny*" biplane to round out the unorthodox group.

The above notwithstanding, the normal monoplane tractor configuration has been the most successful for the most flyers. However, evolution here has been considerable. Early designs of the season saw rather narrow wing chords, efforts to achieve rigidity with geodetic structures, and relatively small stabilisers. Props were generally small and high rpm, since a slow moving prop cannot climb a heavy model. As modellers gained more experience with the class, the designs became more attuned to performance. Wing chords increased (even to 18 in. as Hannan showed) to double the original width, prop diameter increased several inches, hollow tube motor sticks became popular, and stabs got bigger, with radically greater spans. These items shot flight times up from about 9 minutes to 12 and 13 minutes in a site with about a 100-ft. ceiling. Personalities involved in this design for ultimate performance crusade included Charles Sotich of the Aeronuts, Tom Sova, and Dennis Jaecks, current Pennyplane record holder. Not to be outdone, Rodemsky came up with an ultimate design with a wing chord equal to the motorstick! One wonders if he could get the thing to fly without the prop nicking the wing LE. While these expert models set the high times, beginners were still learning, and having a ball, with simple, small models with props of about a foot diameter. Adjustable pitch props (pre-set before flying) as developed by Chuck Markos helped beginners to adjust models according to motor and air type.



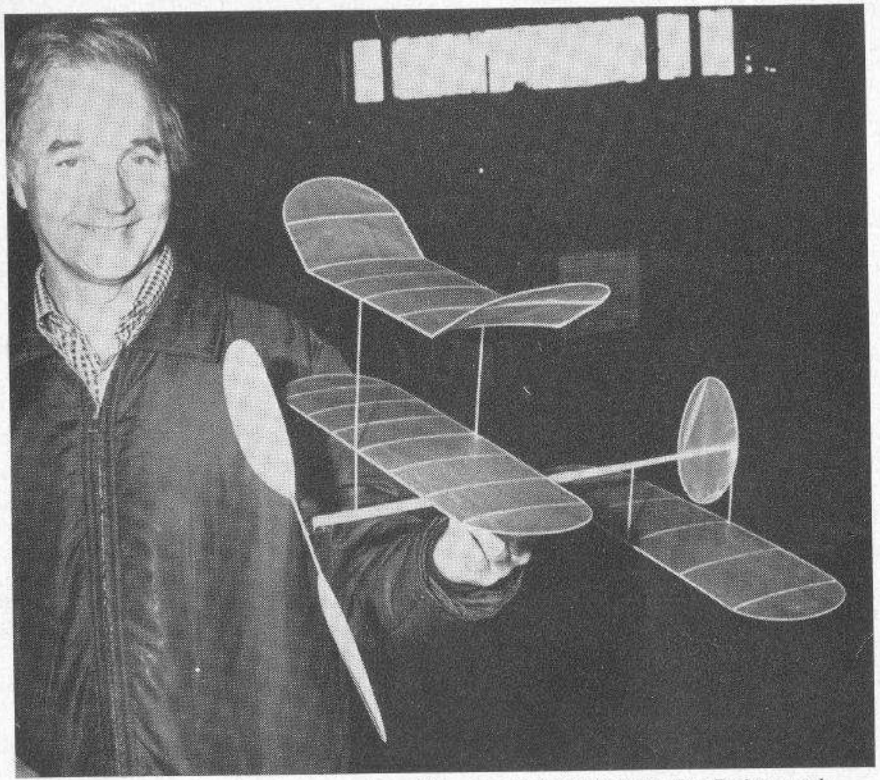


"PENNYPLANE" rests on typical split-sponge-on-a-stick run down stand at 1974 U.S.A. Nats—4th Annual Pennyplane in Blimp Hangar at Houston, Texas. Note strange fin-on-a-stick, adjustable pitch hub prop.



Below, Dave Goodwin of Sheffield with one of his Pennyplanes.

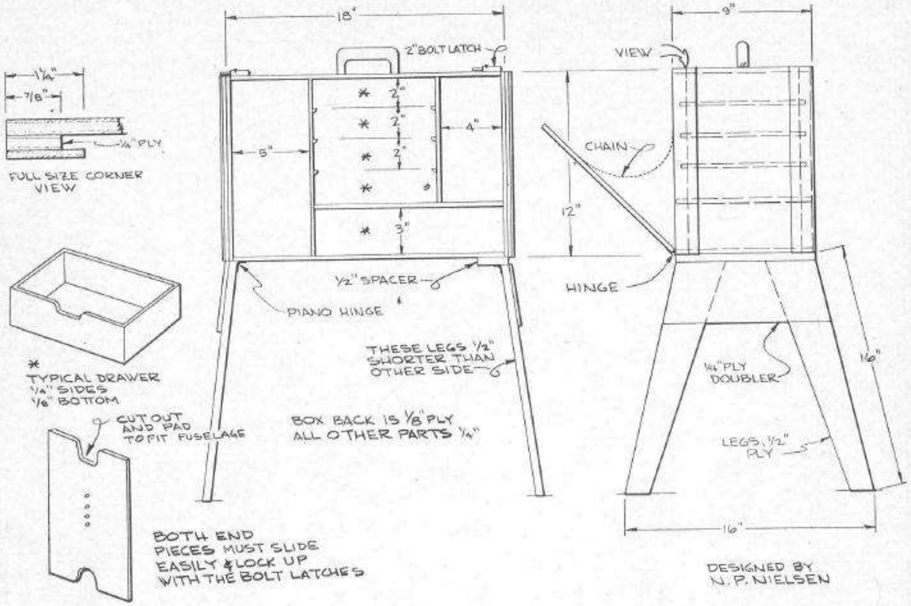
Now that Pennyplane has come of age and is being considered as an Official AMA Event, where do we go from here? The author believes that evolution of the expert class will go toward increasing areas and prop diameter, while keeping component weight to an absolute minimum through use of light wood and light covering such as microfilm or the polycarbonate film Micro-Lite. Ballast added on a very short nose will get the weight up to a penny's worth. Beginner models will tend to become more alike, almost like a one design class, with more simplification of structure and thought given to foolproof construction and trimming technique. The design with the minimum number of pieces, squared off, quick to build from common wood, with a prop adjustable to the motor for good climb and cruise, will give the beginner the most satisfaction.



Inspired by an American interpretation of the rules by Doug McClean, Reg Parham made this Biplane (Triplane?) condensor paper covered large area model, which suggests further permutations.

We hope that we have whetted your appetite to try Pennyplane. While Easy B has been a common enough event at UK indoor contests, Pennyplane is only now taking hold. Expert outdoor flyer Dave Goodwin of Sheffield has tried it—and come back for more. Full size plans are available for the beginner design "Penny Wise" (MAP Plans Service) which appeared in the June 1971 issue of Aeromodeller (Plan price 35p from APS, 13 Bridge Street, Hemel Hempstead, Herts.) A more sophisticated type is the "*Penny from Heaven*" (also by the author) which appeared in the June 1975 Model Airplane News. Full size plans are available by sending $2 to MAN, One North Broadway, White Plains, N.Y. 10601, U.S.A. Indoor supplies such as motors, wire, bearings, etc. may be purchased from Laurie Barr, 4 Hastings Close, Bray, Berks.

One of the nicest things about Pennyplane is the way it develops confidence to try more sophisticated indoor models, particularly the fragile FAI microfilm types such as will be flown at the Indoor World Championships at Cardington in 1976. If you are able to get good time from a simple Pennyplane, you are well on your way to learning how to get 30 minutes from a microfilm model with only one third the all-up weight. Then you will need the info in "Indoor News and Views" edited by Bud Tenny, Box 545, Richardson, Texas 75080, U.S.A. Write to him for subscription rates. You might as well know that he created the last word in Pennyplane names—the "*Tenny Penny*".



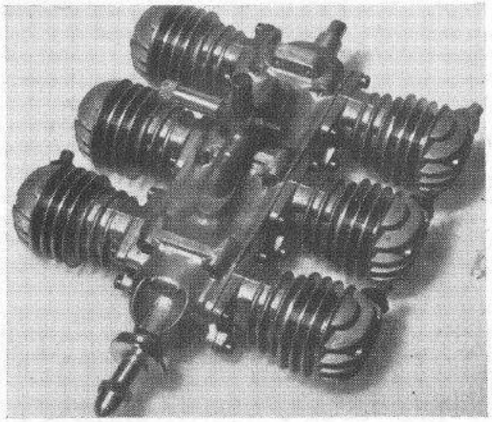
PORTABLE FIELD WORKSHOP *from Northrop RCMAC—USA*

MODEL ENGINE MISCELLANY

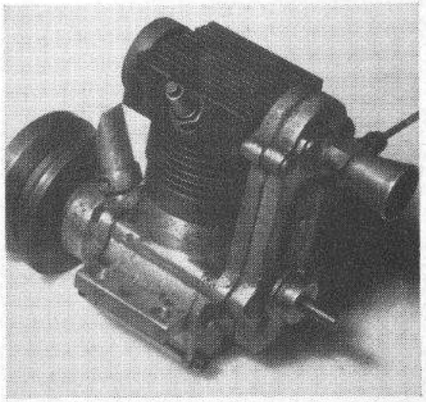
Many moons ago, R. E. Nichol, otherwise known as "Doc the Mad Modeller", set out on the task of preparing a "*Pictorial Model Engine Atlas*". Doc's labours took him throughout the U.S.A. to Japan and Europe. He collected a fantastic variety of photographs and logged thousands of different model aero engines for his task. They included steam, compressed air, diesel, glow plug, carbide, petrol ignition, in fact, every known means of reciprocating action to drive a propeller.

In the end, Doc himself disappeared from view (*where* are you now Doc?), leaving us with a large selection of his collected photos in the hope that one day we might break the price barrier to produce what would be a directory of engines in picture form.

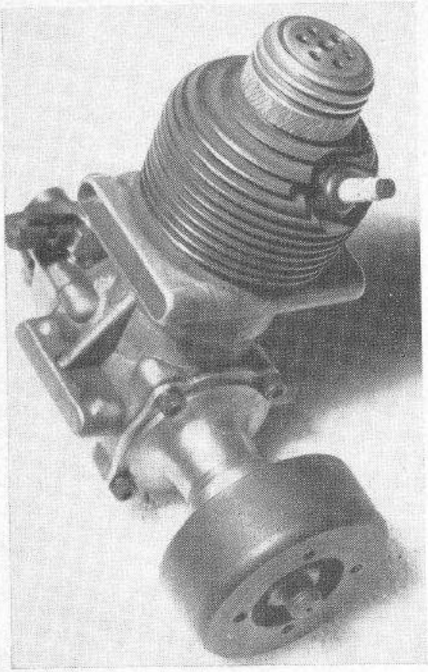
Rather than wait forever, this small group of the unusual among his subjects, is chosen to show that there really is nothing "new" in the world of miniature engine design. Some are of prototypes; others actually went into production but in the main, each effort to seek more efficiency or power output by less than conventional means, ended when it came to trying to sell the product; for despite all his curiosity and clamour for something "different" there's no-one more conservative than a modeller when buying a new engine!



FLAT-SIX Dan Calkins started making Elf engines in Portland, Oregon during 1932. By 1935 he was selling the Elf Corncob and in 1940 had a line of single, twin and four cylinder units that became famous for their extreme power to weight ratio. The "6" was the ultimate. It had a compression ratio of 20:1, used glow plug ignition, sold at 75 dollars and was ·594 cu. in. Induction was by reed valve. But the crankshaft was tough to make so the production was short-lived.

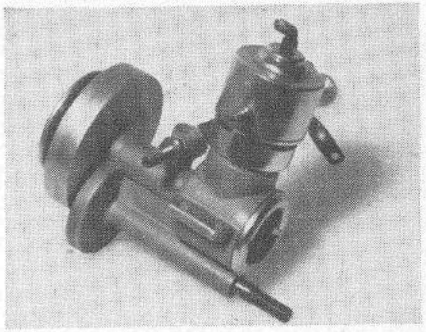


ROTARY VALVE 4-STROKE Tom Dooling, Jr. made model engines from 1936, became involved with race cars for Reginald Denny and after many experiments, made the world beating '29 and '61 racing engines for which his name is best known. Meantime this 4-stroke which has the distinction of an intake in front and exhaust at the rear of the cylinder head, was one of the experiments. It ran up to 28,000 rpm, had a bore of .94 and stroke of ·875 ins. but the rotary valve bearing lubrication was its weakness.

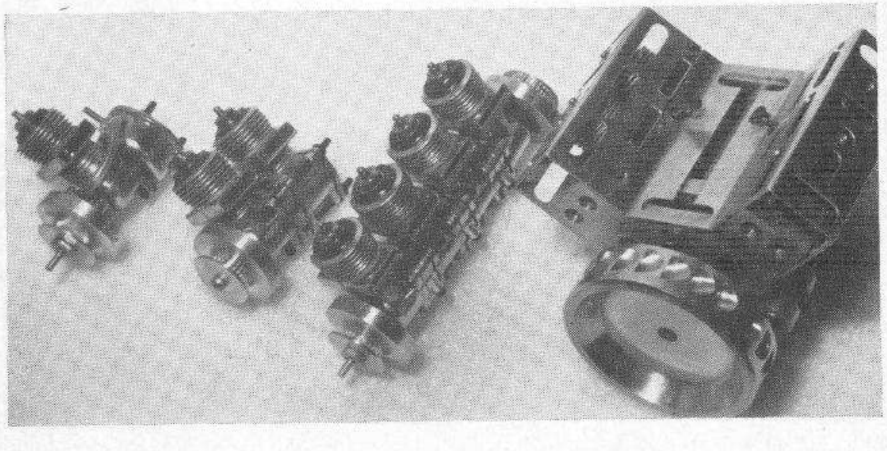


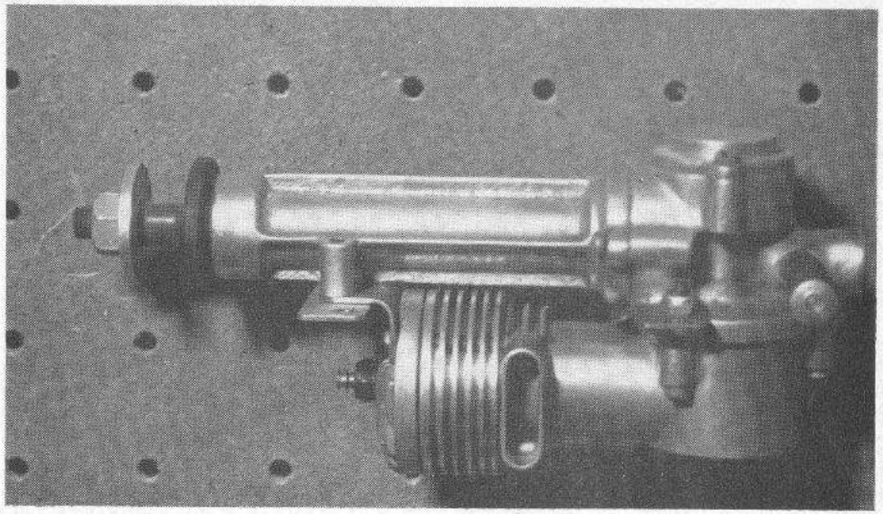
Left: PEPPERPOT HEAD Dooling stepped piston engine which did not work out but was a brave attempt to miniaturise what has been moderately successful in full scale practice.

Below: GEARED MARINE UNIT In 1959, the Hungarian State model engine factory saw the answer to the problems of small marine engines in their 1cc "Seal" diesel. The Crankcase incorporated a second shaft housing for geared drive to the propshaft, leaving the flywheel free of any coupling complications.



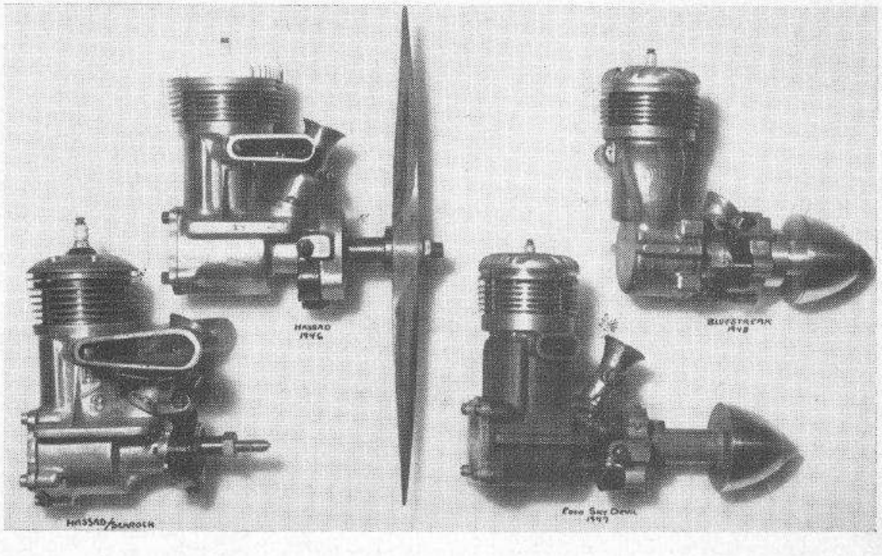
Below: VARIATIONS ON A CYLINDER From 1955 to 1960 the K & B Allyn "Marfury" ·060 unit appeared in many guises. Single and twin cylinder glow plug marine versions were made in quantity and modellers saw the possibilities as in the four-in-line and the vee-four marine examples here.

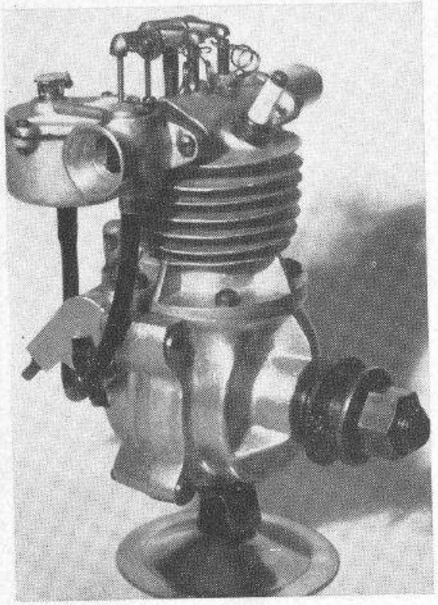




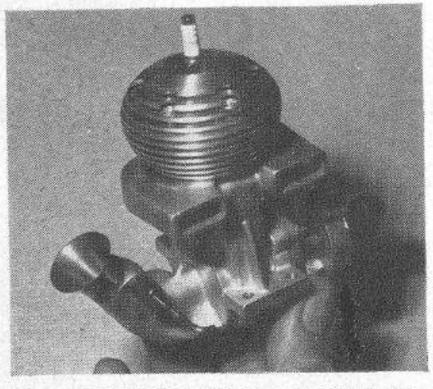
SIDEWINDER Clarence Lee produced custom made engines leading up to the famous Veco 45 and others. In 1952 he made the '29 Sidewinder and in 1954, eight more were made with K & B engines. The means of turning the shaft around a corner is an intriguing solution to streamlining.

HASSADS Ira Hassad designed many engines for production starting here with the Hassad/Schroch c1 1941, a ·605 racer with spark ignition, forward exhaust and rear transfer passage through the EDCO Skydevil series to the Bluestreak (top right) of which 2,000 were made· The contrast in carburettor intake lengths and the change to conventional side exhaust after a significantly prophetic beginning with large manifolds shows how Hassad was obliged to be "ordinary" to sell his products.



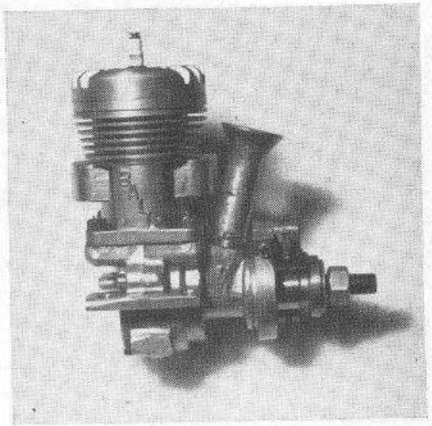


Above: OHV 4-STROKE with a split case, the Feeney was a wartime classic in three sizes, 10cc, 15cc and 20cc, by Jack Feeney and Casimier Leta of Chicago. Sold complete or in kit form the Feeney was the American equivalent of Edgar Westbury's British designs but the market for four-strokes was — and always has been — very limited.

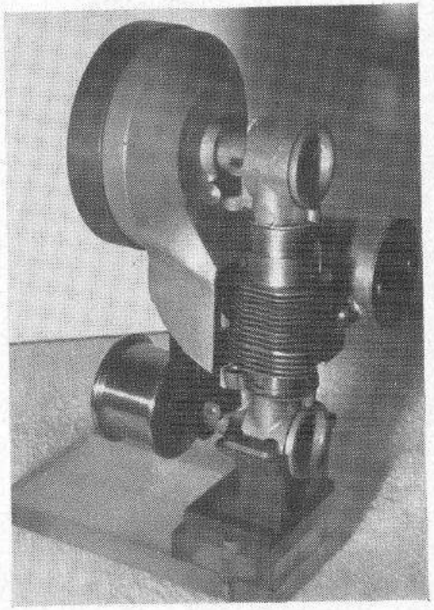


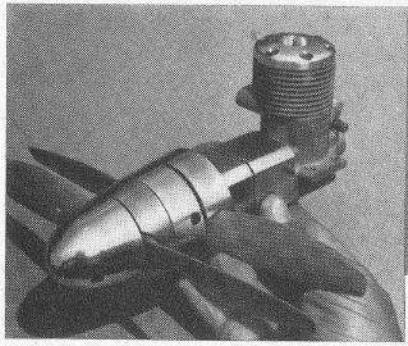
Above: CAVE COBRA 60 One of the first with a form of ducted or directed intake flow from the rear carburettor, the 1947 Cobra was for racing cars but had an attraction for speed control line. Exhaust manifolds collected from ports at front and rear with transfer passages at sides of cylinder.

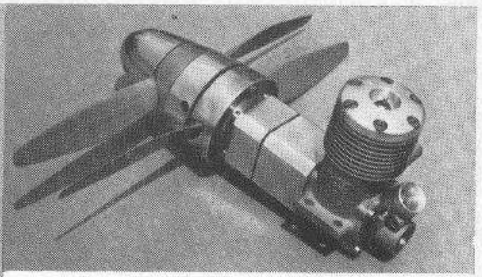
Below: BALL 604. By B & D Racing Engine Labs of Michigan, the massive Ball 60 was all intake and exhaust. It could rev to over 20,000 r.p.m. once started with a small propeller, or flywheel but like most of its 1948 contemporaries was limited by the ignition system.



Below: HEAD TO HEAD Opposed pistons in the Bruce Underwood Yellow Jacket 75 cu. in. prototype with a common combustion cranker. Made with Vivell crankcases it has an impeller cooling fan and a silencer.

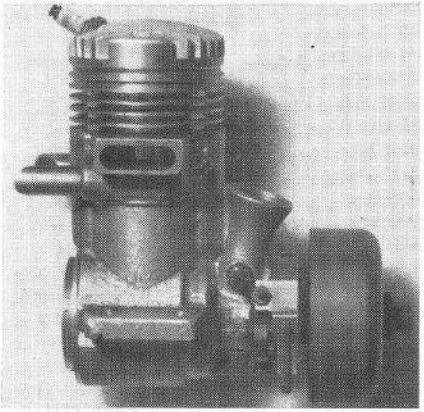


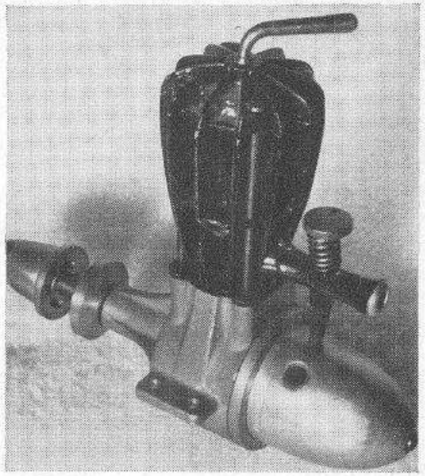




Above: CONTRAPROP Experimental Super Tigre ST24 has a co-axial shaft and gearbox unit on the crankshaft housing, to drive the contra-rotating propellers. Drive losses rarely justify the advantages.

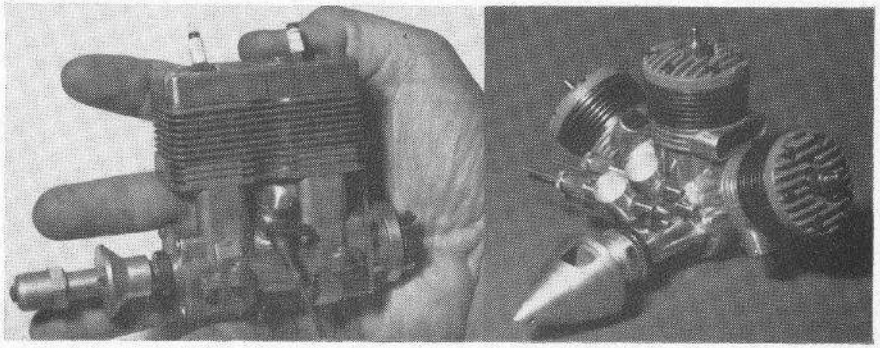
Below: DOOLING DUAL Tom Dooling's two stroke with 2 of everything. Doc Nichol's information reads:— dual pybass porting both intake and exhaust plus dual case relief. Both shaft and rotor induction, a supercharger was to be fitted to the rear, attached to case relief ports, but performance was the same without the supercharger.

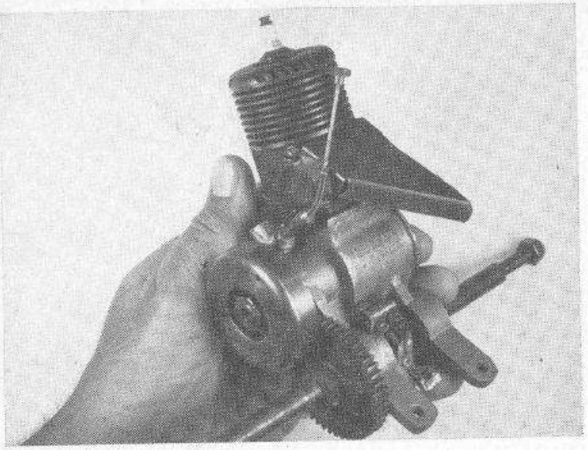




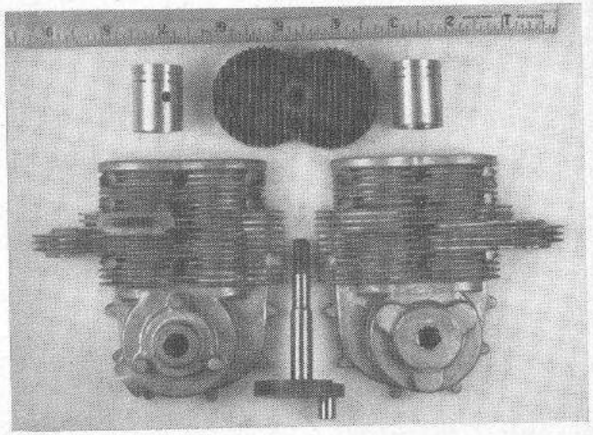
Above: PEARDROP Italian Helium C-6 diesel of 1946 Vintage used an all cast cylinder jacket with vertical fins. Like most large (6 cc.) diesels of this period, the crankshaft was a weak point.

Below: MULTIS Left is the superb Dooling ·604 twin, bore ·719 ins. stroke ·750 ins and right, a K & B "Fake" radial "three" which would not be beyond the bounds of possibility though presenting a distinct challenge of balancing!

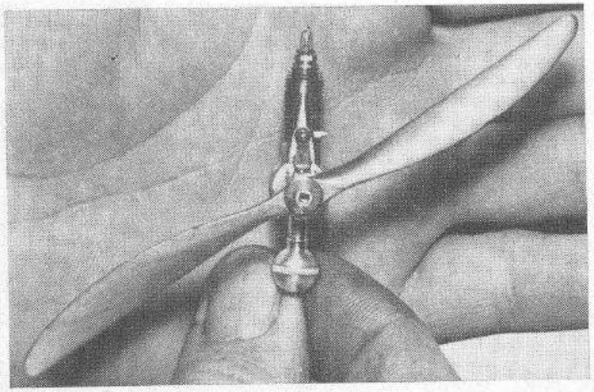




HILLER AXLE DRIVE Made for racing cars, with an incorporated axle/gear/mounting unit, the Hiller Hornet ·647 cu. in. was a petrol ignition engine produced for the Comet car.



SPLIT TWIN Two cylinders with a common combustion chamber as used by the Puch motors for motorcycles. Bores and stroke timing vary in the two cylinders.



MINIATURE One of Ray Arden's little jewels, this has a bore and stroke of ·220 ins. weighs 87 grams and runs at 1,200 r.p.m.! It has spark ignition and over 200 hours of running time, flying a 12 inch wingspan model. The glow plug can be attributed to Ray Arden for model use, so can many model engine design features.

F.A.I. WORLD RECORDS (as at 1-7-75)

Free Flight
Class F-1-B

RUBBER DRIVEN

No. 1 **Duration**
V. Fiodorov (*U.S.S.R.*), June 19th, 1964 .. .. 1h. 41m. 32s.

No. 2 **Distance in a straight line**
G. Tchiglitsev (*U.S.S.R.*), July 1st, 1962 .. .. 371·189 km.

No. 3 **Altitude**
V. Fiodorov (*U.S.S.R.*), June 19th, 1964 .. .. .. 1,732 m.

No. 4 **Speed in a straight line**
P. Motekaytis (*U.S.S.R.*), June 20th, 1971 .. .. 144·9 km/h.

POWER MODELS
Class F-1-C

No. 5 **Duration**
I. Koulakovsky (*U.S.S.R.*), August 6th, 1952 .. .. 6h. 1m.

No. 6 **Distance in a straight line**
E. Boricevitch (*U.S.S.R.*), August 15th, 1952 .. .. 378·756 km.

No. 7 **Altitude**
G. Lioubouchkine (*U.S.S.R.*), August 13th, 1947 .. .. 4,152 m.

No. 8 **Speed in a straight line**
Doubenitsky (*U.S.S.R.*), June 25 1973 .. .. .. 173·45 km/h

No. 45 **Seaplane Distance in a Straight Line**
M. Sulc (*Czechoslovakia*) October 3, 1973 .. ..15,700 m.

No. 46 **Seaplane Altitude**
M. Sulc (*Czechoslovakia*) October 3, 1973 .. 1,960 m.

RUBBER-DRIVEN HELICOPTER
Class F-1-F

No. 9 **Duration**
A. Nazarov (*U.S.S.R.*), June 3rd, 1968 .. .. .. 33m. 26·7s.

No. 10 **Distance in a straight line**
Giulio Pelegi (*Italy*) August 3rd, 1974 .. .. 5,237 m.

No. 11 **Altitude**
Giulio Pelegi (*Italy*), August 3rd, 1974 .... 598 m.

No. 12 **Speed in a straight line**
P. Motekaitis (*U.S.S.R.*), June 12th, 1970 .. .. 144·23 km/h.

POWER-DRIVEN HELICOPTER
Class F-1-A

No. 13 **Duration**
S. Purice (*Rumania*), October 1st, 1965 .. .. 3h. 12m.

No. 14 **Distance in a straight line**
V. I. Titlov (*Hungary*), October 1st, 1963 .. .. 91·491 km.

No. 15 **Altitude**
S. Purice (*Rumania*), September 24th, 1963 .. .. .. 3,750 m.

No. 16 **Speed in a straight line**
A. Pavlov (*U.S.S.R.*), September 20th, 1970 .. .. 116·12 km/h.

GLIDERS
Class F-1-A

No. 17 **Duration**
M. Milutinovic (*Yugoslavia*), May 15th, 1960 .. .. 4h. 58m. 10s.

No. 18 **Distance in a straight line**
Z. Taus (*Czech*), March 31st, 1962 .. .. .. 310·33 km.

No. 19 **Altitude**
G. Benedek (*Hungary*), May 23rd, 1948 .. .. .. 2,364 m.

INDOOR MODELS
Class F-1-D

No. 32 **Duration**
K. H. Rieke (*W. Germany*), September 22nd, 1962 .. 45m. 40s.

No. 32a **Less than 8 m. ceiling**
Duration
Robert J. Platt (*U.S.A.*), December 30th, 1972 .. .. 22m. 10s.

No. 32b **8–15 m. ceiling**
Duration
Jiri Kalina (*Czech*), August 26th, 1970 .. .. .. 30m. 7s.

No. 32c **15–30 m. Ceiling**
Duration
Edward Ciapala (*Poland*), August 19th, 1973 .. .. 33m. 34s.

RADIO CONTROL POWER DRIVEN
Class F-3-A

No. 20 **Duration**
Lars Giertz (*U.S.A.*), July 5–7, 1974 .. .. .. 14h. 29m. 51s

No. 21 **Distance in a straight line**
A. Bellochio (*Italy*), July 25th, 1969 .. .. .. 377·350 km.

No. 22 **Altitude**
M. Hill (*U.S.A.*), September 6th, 1970 .. .. 8,208 m.

No. 23 **Speed in a straight line**
Goukoune and Myakinine (*U.S.S.R.*), September 21st, 1971 .. .. .. 343·92 km/h.

No. 31 **Distance in a closed circuit**
B. Kunce (*U.S.A.*), February 17th, 1968 .. .. 338·04 km.

R/C SEAPLANE

No. 48 **Duration**
W. Kaiser (*W. Germany*), April 15th, 1972 .. .. 6h. 18m. 17s.

No. 49 **Distance in a straight line**
R. D. Reed (*U.S.A.*), February 26th, 1972 .. .. 133·875 km.

No. 50 **Altitude**
M. Hill (*U.S.A.*), September 3rd, 1967 .. .. .. 5,651 m.

No. 51 **Speed in a straight line**
Goukoune and Myakinine (*U.S.S.R.*), October 25th, 1971 294 km/h.

No. 52 **Distance in a closed circuit**
W. Kaiser (*W. Germany*) May 1st, 1972 .. .. .. 238·85 km.

R/C GLIDERS
Class F-3-B

No. 24 **Duration**
E. Miakinine (*U.S.S.R.*), Sept 30–Oct. 1, 1973 .. 25h. 44m. 8s.

No. 25 **Distance in a straight line**
Jerry D. Krainock (*U.S.A.*), September 7th, 1974 .. 43.77 km.

No. 26 **Altitude**
Raymond Smith (*U.S.A.*), September 2nd, 1968 .. .. 1,521 m.

No. 33 **Speed in a straight line**
L. Aldoshin (*U.S.S.R.*), October 9th, 1971 .. .. 182 km/h.

No. 34 **Distance in a closed circuit**
C. Aldoshin (*U.S.S.R.*) October 24th, 1974 .. .. 522 km.

R/C HELICOPTER
Class F-3-C

No. 35 **Duration**
H. Pallmann (*Germany*) July 13, 1974 .. .. .. 1h. 45m.

No. 36 **Distance in a straight line**
N. Rambo (*U.S.A.*) January 26th, 1974 .. .. 2,509 m.

No. 37 **Altitude**
H. Pallmann (*Germany*) July 31st, 1974 .. .. 1058 m.

No. 39 **Distance in a closed circuit**
D. Schluter (*W. Germany*), June 20th, 1970 .. .. .. 11·5 km.

CONTROL LINE
Class F-2-A

No. 27 **Speed (2·5 c.c.)**
Lauderdale McDonald (*U.S.A.*), May 4th, 1963 .. 273·66 km/h.

No. 28 **Speed (2·5–5 c.c.)**
McDonald (*U.S.A.*), November 15th, 1964 .. .. 288·95 km/h.

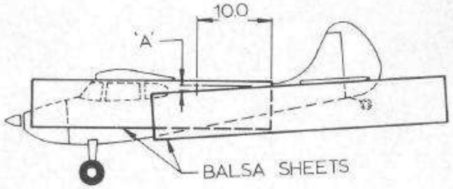
No. 29 **Speed (5–10 c.c.)**
V. Kouznetsov (*U.S.S.R.*), September 30th, 1962 .. 316 km/h.

JET MODELS

No. 30 **Speed**
L. Lipinsky (*U.S.S.R.*), December 6th, 1971 .. .. 395·64 km/h.

TRIO OF TIPS FROM THE FLIGHTMASTERS

famous Californian club for
scale modellers yields useful
features in its regular newsletter



ANGLE DEGREES	'A' INCHES	ANGLE DEGREES	'A' INCHES
1/4°	1/32	2 1/2°	7/16
1/2°	3/32	2 3/4°	15/32
3/4°	1/8	3°	17/32
1°	3/16	3 1/4°	9/16
1 1/4°	7/32	3 1/2°	5/8
1 1/2°	1/4	3 3/4°	21/32
1 3/4°	5/16	4°	11/16
2°	11/32	4 1/4°	3/4
2 1/4°	3/8	4 1/2°	13/16

WHAT'S THE ANGLE?

by John Laycock

Checking the angle of wing and tailplane on a model can be a problem. Often the wing and tailplane angle is sighted, with final adjustments being made during test flying. Here is a method of solving the problem. Using two sheets of balsa, hold one under the wing and the other under the horizontal stabilizer as shown in the sketch. Overlap the sheets and pin or tape together. Find dimension 'A' over the 10" length and using the table, the angle can be found.

The same principle can be used for low wing models and also for checking down the side thrust. Select balsa sheets having *straight* edges!

From: N. American Rockwell Flightmasters Flying Scale News and Views

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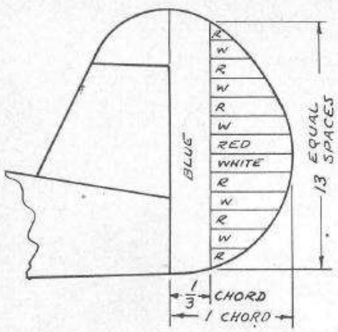
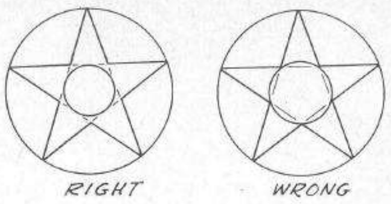




LAYING OUT U.S. ARMY WING AND RUDDER MARKINGS

by Ken Hamilton

The layout of prewar U.S. Army wing and rudder markings are frequently done incorrectly on models, and full size restorations. The red circle inside the five pointed white star should *not* touch the inner corners of the star. Instead, it should *float within* the white star, of such diameter that it would just come tangent to the lines which would be formed if the straight side of the star were extended on across to make a pentagon.

As to the rudder, the vertical blue stripe is always *one third* the maximum rudder chord in width. (Many are made too narrow). Then the rear edge of the blue stripe is divided into 13 equal spaces for 7 red, and 6 white horizontal bars. This formula works regardless of rudder shape, square or rounded.

From: N. American Rockwell Flightmasters Flying Scale News and Views

QUICK COWLS

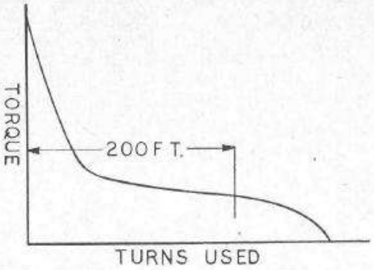
by Harold Osborne

For aircraft of the 1929 through 1938 era, simple lazy mans solution for a Townsend ring for a radial engine is to use the bottoms of the plastic bottles now available on the shelves of your local supermarts. They are unbreakable and look well. Some are pre-coloured and do not even need painting! Painting is difficult but can be accomplished if you lightly scuff with sandpaper or even steelwool, then spray some auto primer. When dry, lightly sand again and paint the colour of your choice.

Some bleach bottles come a deep blue in three sizes. The small size is $3\frac{1}{4}''$ diameter × $\frac{15}{16}''$ chord, the middle size $4\frac{5}{9}''$ diameter × $1\frac{3}{16}''$ chord, and the large size 6" diameter × $1\frac{3}{4}''$ chord. The small size matches a scale of $\frac{3}{4}'' = 1$ ft. for aircraft such as the Vickers Jockey, Grumman FF-1, Boeing F4B4, and the Curtiss Helldiver, etc. The medium size matches $1'' = 1$ ft. for these aircraft. The large size is an odd size matching approximately $1\frac{1}{3}'' = 1$ foot scale.

Other plastic bottles such as Dishwasher soap are ideal for various later aircraft of the 1938–40 period, which used long chord cowls. For inline engines try the oblong section bottles with rounded tops—you'll be surprised at what can be found in the local store!

From: N. American Rockwell Flightmasters Flying Scale News and Views



DESIGN PARAMETERS FOR RUBBER SPEED MODELS

by Charlie Sotich

Once a popular British class, then "relegated" to being only of interest for record purposes, Rubber-driven speed has become a relatively new craze in the U.S.A. This feature helps solve the major design problems.

How do you decide what your new rubber speed model should be like? It's a good idea to first look at other models that have been successful in this event, then go over the rules to see what restrictions are placed on the models. In the case of the NFFS rubber speed rules, one of the big requirements is to have the model fly 200 feet. It must also take off unassisted and not rotate more than 360°.

It is not enough that a model fly just 200 feet. It must be capable of flying farther because as the turns are used up by the propeller the torque decreases and so does the thrust. The model accelerates rapidly to its maximum speed and then slows down as the torque decreases.

It has been reported by a number of people who served as judges at the finish line of speed events that the models were slowing down very noticeably when they crossed the finish line (in addition, to climbing, in most cases).

Instead of designing a model to fly 200 feet it would be better to have it capable of going 300 feet. The length of the rubber motor required to fly a model this distance depends on the number of turns you can put in the rubber and the actual propeller advance per revolution as the model flys.

$$\textbf{Length of Rubber} = \frac{\text{Distance Travelled}}{(\text{Propeller Advance}) \times (\text{Turns/inch in Rubber})}$$

Using this formula and assuming a 300-foot travel distance, about 25 turns per inch (from *Table* 1 for 10 or 12 strands of 6 mm. Pirelli) and a 5-inch advance per revolution (10-in. pitch and 50% slip efficiency) we get:

$$\textbf{Length of Rubber} = \frac{300 \text{ ft.} \times 12 \text{ in./ft.}}{5 \text{ in./rev.} \times 25 \text{ turns/in.}} = 28{\cdot}8 \text{ inches}$$

With 12 strands or less of $\frac{1}{4}$-inch rubber this length, there should be no trouble going well past the finish line at 200 feet. If your model flies with 12 strands and it is possible to handle more power, even with less turns per inch, you should still get the model past the finish line.

If the weight of the model structure is $\frac{1}{2}$ to $\frac{1}{3}$ of the total weight we can get some weight estimates assuming 175 inches of $\frac{1}{4}''$ Pirelli per ounce.

TABLE 1

Strands	6 mm		4 mm	
	Turns	*Torque*	*Turns*	*Torque*
2	59·3	5·4	72·6	2·9
4	41·9	15·3	51·3	8·3
6	34·2	28·1	41·9	15·3
8	29·6	43·2	36·3	23·5
10	26·5	60·4	32·5	32·9
12	24·2	79·4	29·6	43·2
14	22·4	100·1	27·4	54·5
16	21·0	122·2	25·7	66·5
18	19·8	145·9	24·2	79·4
20	19·8	170·8	23·0	93·0

To get the model to take off unassisted within a very short distance, it is necessary to have a wing loading that is fairly light, say 4 ounces per 100 square inches or less. The lighter the wing loading, the easier the take-off. When there is less model weight (mass) to accelerate, a given amount of thrust gives a higher acceleration. The lower total weight also means the model is able to get airborne at a lower speed so will require a shorter take-off run.

Looking over the values in *Table* 2 we see a very wide range of values for weights and wing areas. By keeping the model weight between 2 and 2·6 ounces, the model should be light enough to take-off on 8 strands and, if built properly, be able to handle a 12 strand motor. With 12 strands, a 2·6 ounce model would weigh about 4·6 ounces complete. A wing area of 115 square inches would be adequate to give an acceptable wing loading. If we use an aspect ratio of 5 for the wing, this would mean a span of 24 inches and an average chord of 4·8 inches.

$$\begin{aligned}\textbf{Span} &= \sqrt{\text{Area} \times \text{AR}} = \sqrt{115 \times 5}\\ &= 23{\cdot}98, \text{ say 24 inches}\\ \textbf{Average Chord} &= \frac{\text{Area}}{\text{Span}} = \frac{115}{24}\\ &= 4{\cdot}79, \text{ say } 4{\cdot}8 \text{ inches}\end{aligned}$$

SPEED FT/SEC FOR MPH WITH TIME/SECS FOR 200 Ft

Velocity mph	*Time Seconds*	*Speed ft/sec.*
100·00	1·36	146·67
90·00	1·52	132·00
80·00	1·70	117·33
70·00	1·95	102·67
60·00	2·27	88·00
50·00	2·73	73·33
40·00	3·41	58·67
30·00	4·55	44·00
20·00	6·82	29·33
10·00	13·64	14·67

SPEED FOR 200 FEET SECS/SPEED

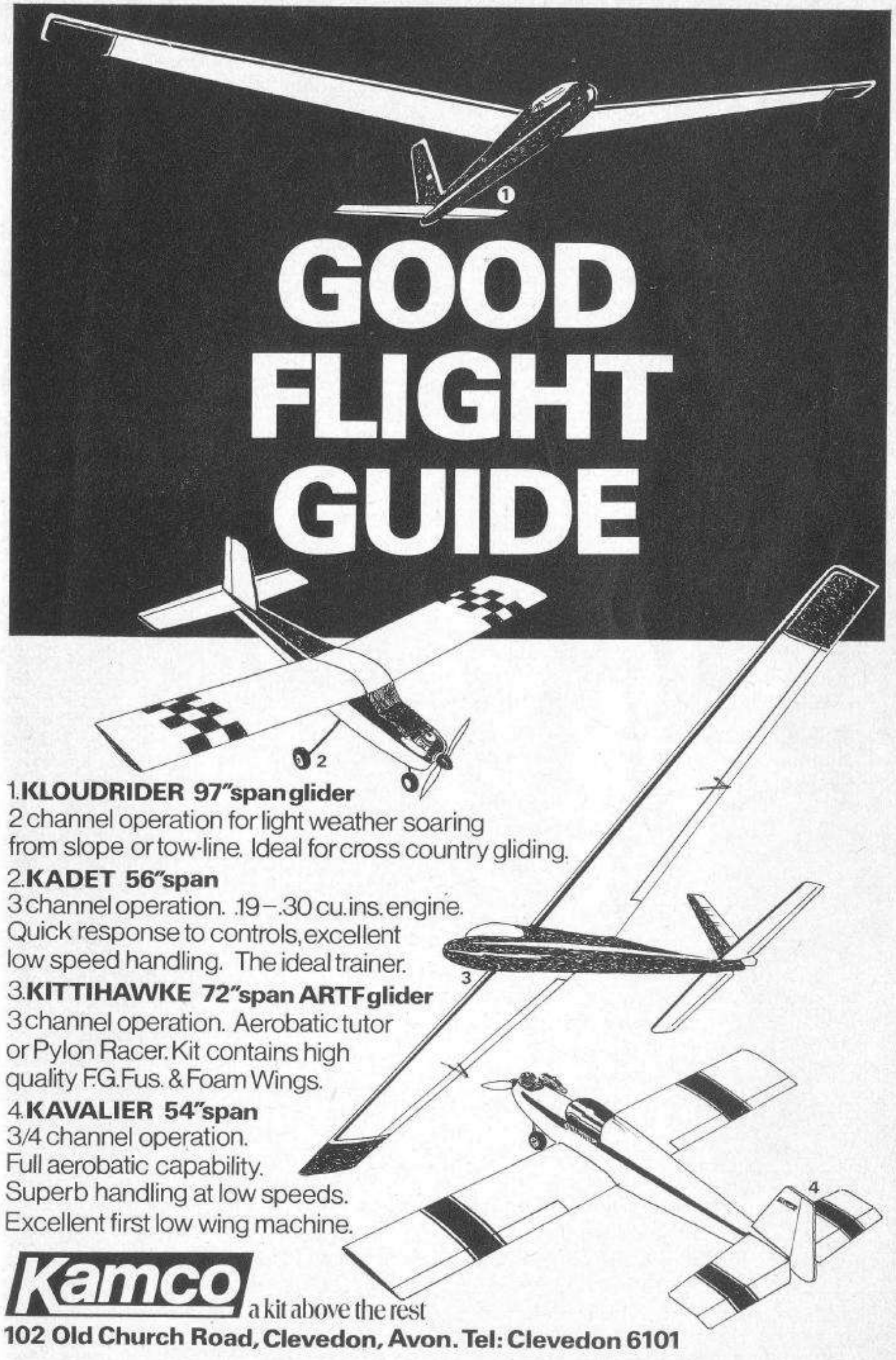
Time seconds	*Speed mph*	*Time seconds*	*Speed mph*
1·00	136·364	3·00	45·455
1·05	129·370	3·05	44·709
1·10	123·967	3·10	43·988
1·15	118·577	3·15	43·290
1·20	113·636	3·20	42·614
1·25	109·091	3·25	41·958
1·30	104·895	3·30	41·322
1·35	101·010	3·35	40·706
1·40	97·403	3·40	40·107
1·45	94·044	3·45	39·526
1·50	90·909	3·50	38·961
1·55	87·977	3·55	38·412
1·60	85·227	3·60	37·879
1·65	82·645	3·65	37·360
1·70	80·214	3·70	36·855
1·75	77·922	3·75	36·364
1·80	75·758	3·80	35·885
1·85	73·710	3·85	35·419
1·90	71·770	3·90	34·965
1·95	69·930	3·95	34·522
2·00	68·182	4·00	34·901
2·05	66·519	4·05	33·660
2·10	64·935	4·10	33·259
2·15	63·425	4·15	32·859
2·20	61·983	4·20	32·468
2·25	60·606	4·25	32·086
2·30	59·289	4·30	31·712
2·35	58·027	4·35	31·348
2·40	56·818	4·40	30·992
2·45	55·659	4·45	30·644
2·50	54·545	4·50	30·303
2·55	53·476	4·55	29·970
2·60	52·448	4·60	29·644
2·65	51·458	4·65	29·326
2·70	50·505	4·70	29·014
2·75	49·587	4·75	28·708
2·80	48·701	4·80	28·409
2·85	47·847	4·85	28·116
2·90	47·022	4·90	27·829
2·95	46·225	4·95	27·548

This procedure gives one approach for determining some of the parameters in the design of a rubber speed model. If different assumptions are made you will get different results. The important thing is to get a model designed and built so you can fly it and find out what might be changed to give you better results.

From: The National Free Flight Society Digest

TABLE 2

RUBBER			MODEL WEIGHT OUNCES		TOTAL WEIGHT OUNCES		WING AREA SQUARE INCHES	
No. of Strands	Total Length Inches	Weight Ounces	50% Total	33% Total	Min.	Max.	4 oz./100 Min. Wt.	3 oz./100 Max. Wt.
8	230	1·31	1·31	2·62	2·62	3·93	65	131
10	288	1·65	1·65	3·30	3·30	4·95	83	165
12	346	1·98	1·98	3·96	3·96	5·94	99	198



FREE FLIGHT SCALE POWERED FLIGHT AND DOWNTHRUST

by Bill McCombs

ONE of the more frustrating things about free flight scale models is that so often when they have been trimmed for a good, slow, glide they will stall in powered flight—or loop if there is enough power. Most real aeroplanes (or R/C models) will do the same thing. That is, if their elevators are set for a good slow glide, or a very slow powered descent with engine idling, and then power is "poured on" they, too, will mush or stall, or loop if there is enough power. The purpose of this article is to summarize for the lesser-experienced modeller the main reasons which cause this troublesome stalling or looping and various means of eliminating it.

Gliding Flight

As modellers know from experience, the gliding speed of a model is controlled, or set, by the horizontal tail incidence. Tilting the trailing edge more downward is like "down-elevator". It makes the model assume a more nose-down attitude and glide faster (and steeper). Tilting the trailing edge *up* is like "up-elevator". and makes the aeroplane assume a more nose-up attitude and glide more slowly. Too much up-elevator will, of course, cause a stall. Anything else which has a nose-up trim effect is like up-elevator and, hence, can cause a stall if large enough.

A model is usually (and preferably) trimmed to glide reasonably slowly, just slightly faster than its stalling speed, particularly rubber models where good gliding duration is important. Therefore, anything which causes a little more nose-up trim change, like up-elevator, will then cause it to stall. It is helpful to remember this since, as discussed later, for typical real aeroplanes and free flight scale models the so-called "propeller effects" usually produce such a nose-up trim change—and a stall for models, unless downthrust or other things are used to prevent this.

Causes of Powered Flight Stalling

There are two main reasons which can cause a model which has been trimmed for a good slow glide to stall in powered flight (or to loop if there is enough power). These are **(1)** *Speed* (a speed faster than the gliding speed) and **(2)** *Propeller Effects*, which can cause a nose-up trim change just as more up-elevator would. The main thing to keep in mind is that to eliminate stalling in powered flight one most needs to provide a nose-down trim change, but *only* during the powered flight, *not* for the glide.

Stalling Due to Speed

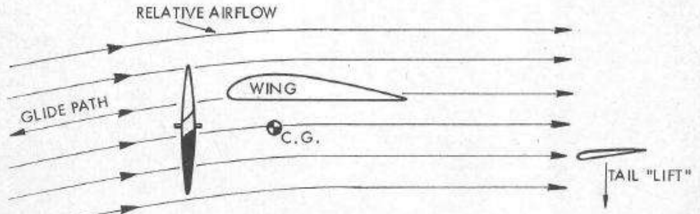
This is easily seen, of course, with a simple hand launched glider which has been trimmed for a good slow glide. When launched forward and slightly downward at its trimmed gliding speed it will glide smoothly and steadily to the ground. If it is thrown harder, faster than its trimmed gliding speed, it will nose up, and stall. If thrown hard enough it will loop. That is, a speed faster than the gliding speed will produce a more nose-up attitude and a climb. When the climb is steep enough and the speed has fallen off, a stall will occur, or there will be a looping if enough speed remains for this. The same thing can happen to an aeroplane in powered flight when its speed is faster than its trimmed gliding speed. Two things are of interest about this stalling or looping due to speed:

(1) The slower the glider (or powered model) is trimmed to glide, the greater, or quicker, will be its tendency to nose-up at a given faster speed. Of course, a "good" glide must be quite slow when duration is important. **(2)** The more forward the c.g. is located (the model tail being adjusted as needed for a slow glide) the more severe will be the nose-up tendency due to speed—and vice versa.

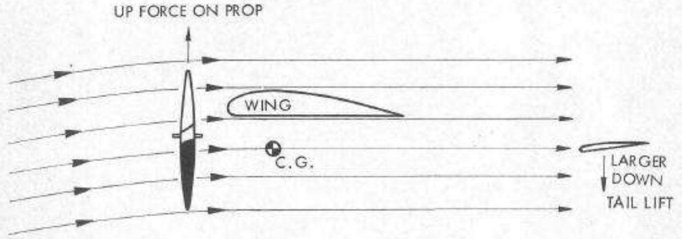
For example. If two identical gliders are trimmed for the same slow gliding speed but one has a much forward c.g., it will do a much "tighter" (smaller) loop when thrown hard than will the one with the more aft c.g. looping due to speed, for gliders or for powered models. However, one cannot have the c.g. too far aft or there will be troubles due to insufficient stability.

Of course, with a glider any stalling or looping can be prevented by throwing it in a banked attitude (banked opposite to its natural or trimmed gliding turn). This converts the loop into an upward spiral which, when thrown properly, goes smoothly into the glide. Stalling or looping due to speed can also be prevented by a turn for powered models, but this alone may not give best duration—or a good scale flight, and can cause other troubles sometimes.

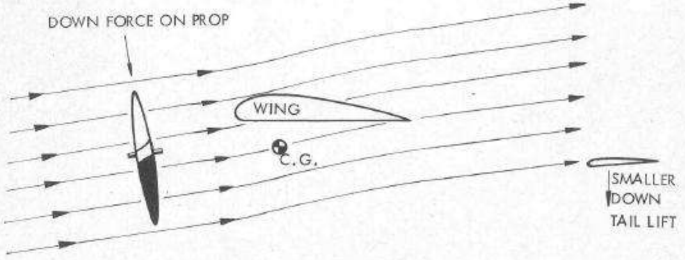
FIG. 1 EFFECTS OF POWER, WITHOUT / WITH DOWNTHRUST



(a) GLIDING FLIGHT (PROP STOPPED)



(b) POWER ON, PROP SPINNING, NO DOWNTHRUST



(c) POWER ON, PROP SPINNING, DOWNTHRUST

Stalling Due to Propeller Effects:

When a typical real aeroplane or free flight scale model has been trimmed for a good slow glide and there is no downthrust, there are three kinds of things due to propeller operation which can produce a more nose-up trim change (like more up-elevator would) and, hence, a stall in powered flight. These three effects are: (**1**) An upward force being generated at the spinning propeller, (**2**) The propeller slipstream causing a larger downward airload on the tail than is present for gliding flight. (**3**) The prop thrust force (which is in-line with the prop shaft) passing below the c.g.—as it must on many models.

The reasons for the first two effects are explained using *Fig.* 1*a* and lb., and the third effect using *Fig.* 2*a*.

Fig. 1*a* shows the model *gliding* down and also the "relative" flow of air which is indicated as flowing upward towards the model. The various angles are exaggerated for better illustration. Note that as the air flows past the wing it is deflected more downward (this produces the wing's upward list force, not shown). The tail is shown "nose-down" slightly, relative to the air flowing towards it, so a downward "lift" is generated by the tail. This downward tail lift is typical of free flight scale models (and real aeroplanes) since they have rather small tails and short aft fuselages.

Fig. 1*b* shows what happens if the propeller is put into operation. First, the oncoming air which passes in the prop region is deflected *downward* as it passes through the propeller "disc" and is forced aft at a much faster speed. This generates an *upward* force at the propeller as indicated. This is a nose-up trim effect on the model. Secondly, because of this downward deflection by the prop the air is seen to be flowing *more downward* (or less upward) at the tail than it was during flight. Hence, this causes a *larger* downward lift on the tail, and this is also increased much more because the air (within the slip-stream) is moving *much faster* than for gliding flight. This larger downward force is indicated and also tends to rotate, or "pitch" the model more nose-up, another nose-up trim effect. (Always consider the aeroplane to be supported only by a single "pin" through its c.g. to see how any force tends to rotate it.)

A third effect is shown in *Fig.* 2*a*. It is due to the propeller thrust force (which is in-line with the prop shaft). If this thrust force is *below* the aeroplane c.g. it tends to rotate the aeroplane *nose-up*, worsening the stalling trouble, and the farther it is below the c.g. the more its effect. However, if the thrust force passes *above* the c.g. it tends to rotate the aeroplane *nose-down* which is "good" as it lessens the stalling tendency. The higher it is above the c.g. the more its effect. This latter effect occurs mainly on low-wing models, particularly those with rather high thrustlines, but is not usually enough to overcome the two bad effects described previously. However, it is why low wings need *less* downthrust than do high wing models.

It can now be seen how downthrust "works" in eliminating the stalling or looping trouble (if enough is used). Using downthrust does three particularly helpful things and if enough is used, the *total* effects of power can be changed from the bad nose-up effect to a "good" nose-down effect, as needed to trim the powered flight as desired. As the prop shaft is tilted downward, the oncoming airflow will be deflected *less* downward as it passes through the prop "disc", and with enough downthrust the airflow will even be tilted *more upward*, as indicated in *Fig.* 1*c*. This produces a *downward* force at the prop, a nose-down effect. The airflow is now seen to be inclined more upward as it passes toward the tail (than with no downthrust) so it results in a smaller down load at the tail, which is most helpful, a *lesser* nose-up trim effect like a bit of down-elevator. The downthrust also raises the thrust force with respect to the c.g., a good effect. Enough downthrust could even raise it above the c.g. giving a good nose-down trim effect—*Fig.* 2*b*. Hence, downthrust in a sufficient amount will produce the needed nose-down trim effect for powered flight. The modeller need only adjust the downthrust as needed to control the powered flight as desired. And, as mentioned previously its, "effectiveness" (how much is needed) can be partly controlled by the c.g. fore-and-aft location (not too far forward).

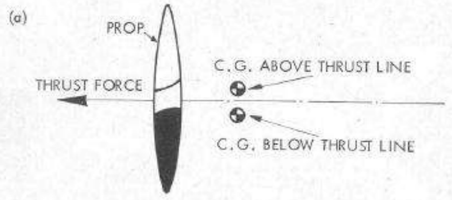
It can be shown that increasing the wing incidence (and *also* the tail incidence to retrim the glide) will have two similar types of effect as does downthrust. This is because the model still glides along the same path, but the fuselage (not the wing and tail), has now a more "nose-down" attitude and so does the propshaft, the same as downthrust with respect to the oncoming air. However, this does *not* raise (tilt) the thrustline upwards relative to the c.g. as downthrust does, so it does not produce the third good effect of raising the thrustline. For this reason, increasing the wing incidence is not as effective as is increasing the downthrust, for a given angular change, but it is a helpful means of trimming the powered flight.

As to *indoor* free flight scale models, these have no "glide" since the model descends with the prop still turning, a few winds always remaining in the motor (or should do this). For these models the slow powered descent would be considered to be the "glide" as far as the discussion of this article is concerned.

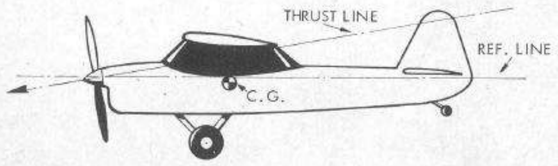
Finally, in comparing different aeroplanes it is also of interest to know that the following geometry items result in *less* downthrust being needed—and their opposites require more:—the larger the horizontal tail; the higher the propshaft (thrustline); the lower the c.g. (low wings), the more the wing incidence angle (and also the more L.E. up or T.E. down the tail incidence angle to trim the glide); and a moderate to long nose length (wing to prop distance).

From N. American Rockwell Flightmasters Flying Scale News and Views

FIG. 2.



(b) DOWNTHRUST "RAISES" THRUSTLINE



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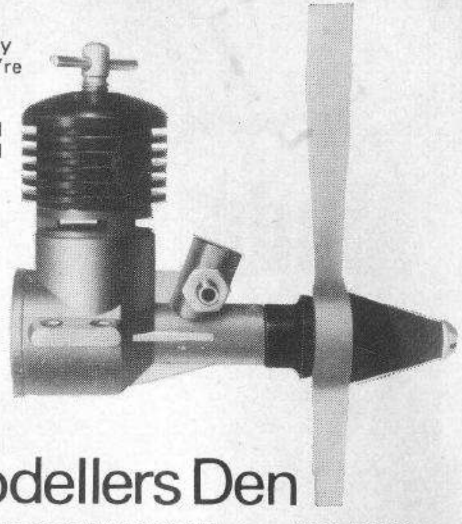

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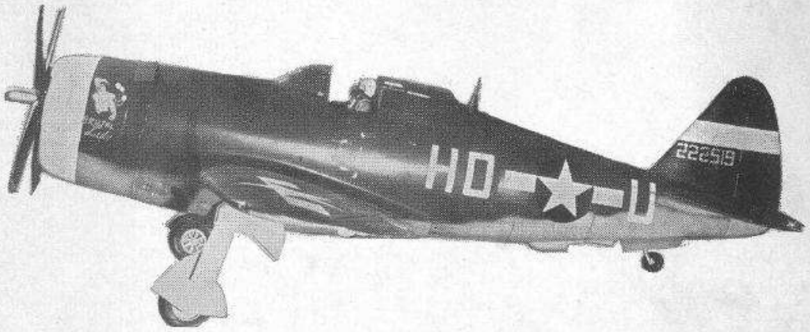

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