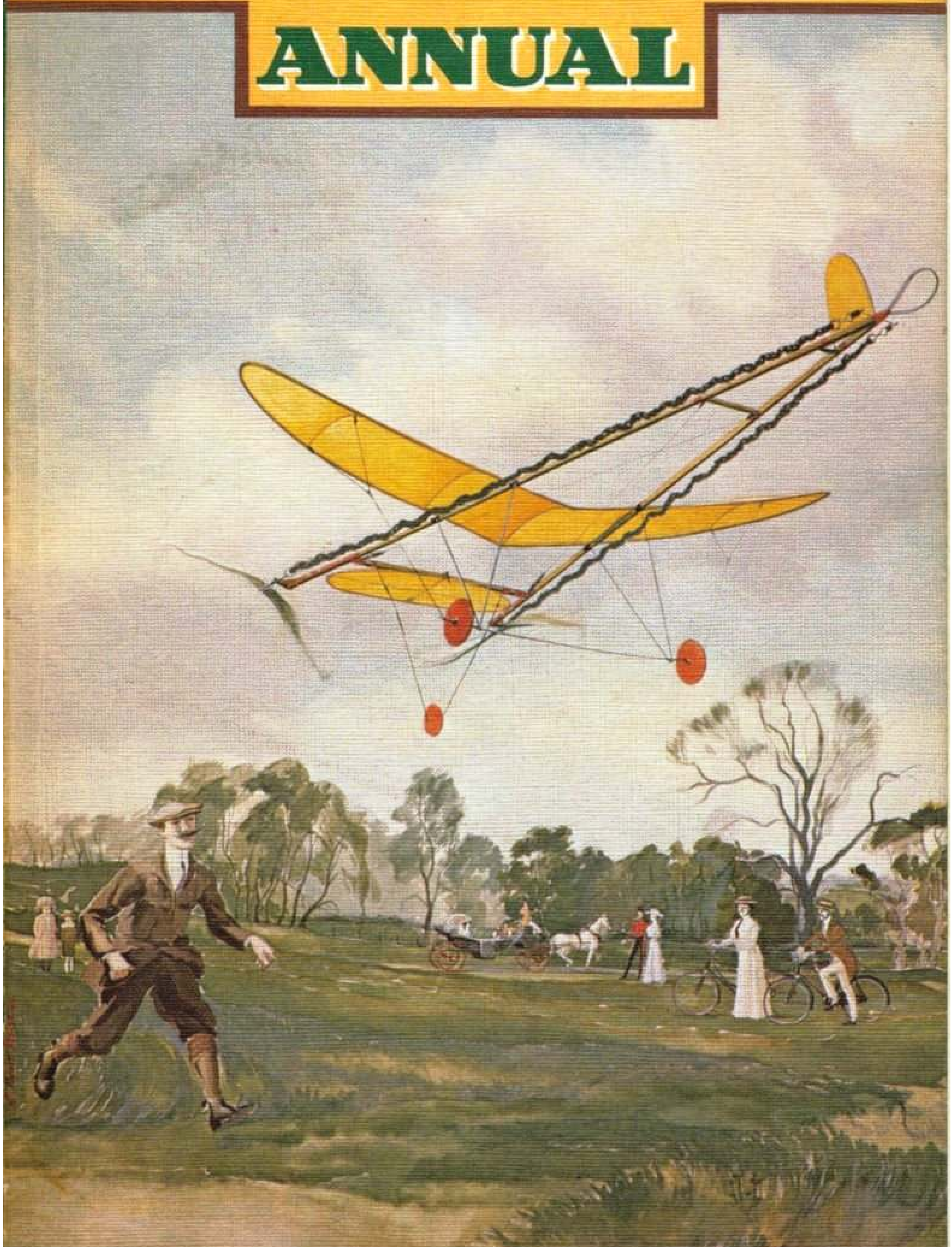
AEROMODELLER ANNUAL



1976-77

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AEROMODELLER ANNUAL 1976–77

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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FRANK ZAIC

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CONTENTS

COVER: 1913 Scene with Mann & Grimmer A-Frame captured by C. Rupert Moore

INTRODUCTION

THE MARVEL of modelling is in its perpetual rosy tinted optimism and continuous growth in prosperity. Last year we were afflicted by inflation of astronomic proportions and in the U.K., a virtual collapse of the International value of the pound sterling. Yet through all these bothers, the model trade and its many customers have shone like prosperous stars, shrugging off the woes of the world. True the trends have changed. The helicopter craze has tapered and in its place came a bigger boom for radio-controlled gliders. In many clubs, the activity changed completely from power models to gliders which is a reflection on the ecological movement of the nation.

Noise pollution is a universally sensitive subject and when in April the Act became law, and the Department of the Environment issued its Draft of a Code of Practice for aeromodellers, then the emotions ran riot. The Code was misinterpreted as an instrument of law. Time alone will tell how wise will be its eventual terms and restrictions. Of one thing we are sure. The Code of Practice will establish better standards of Public Relations and a commonsense approach to the acceptability of noise in all its forms. Silencing, or muffling of exhaust notes is a subject that has occupied many qualified brains over the past two decades. Some excellent designs have appeared. Inevitably, the better silencers are bulky, and expensive by comparison. But they have to come, and must be used universally if the hobby of aeromodelling is to continue its prosperous pattern. Exceptions are also essential for the purposes of International competitions where it would be foolhardy and wholly unfair to handicap a British Team in its endeavour to compete.

Postponement of the British Nationals from the traditional public holiday in May to a mid-August two day weekend was a bitter blow, the effect of which was a general slowing down of activity early in the year. The 'Nats' is a tremendous stimulant and simply has to be timed as the first major event of the season if it is to fulfil its popular purpose. The problem was one of obtaining a suitable venue and though suggestions for several last moment substitutes were offered, none were taken up in the limited time remaining after airfields in Gloucester and Yorkshire had fallen through. Thus, for the first time in many years, modellers were without an attraction for the Spring holiday. It was a strange experience. A feeling of hollowness prevailed, and even the local club fields failed to attract much activity. Then followed the hottest, calmest months in our memory. Who will ever forget those hot, dry and dead still evenings of late June, July and August? One could have even flown a microfilm covered model outdoors on some of those windless clear evenings—if only there had been any guarantee of ever getting the model back to earth again!

Indoor Championships at Cardington are always good. The airship shed at this Bedfordshire balloon centre is the finest in the world for good model performance. 15 Nations competed and standards were higher than ever before with new National records set for Sweden, Japan, Yugoslavia, Australia among others. Deserving new Champion Bud Romak pulled the U.S. team to a narrow victory over Britain in spite of our high placings at 3rd, 4th and 7th. Other Championships of the year were for Scale at Dala in Sweden, where the British team returned victorious with the Eddie Keil Memorial Trophy for leading nation in R/C Scale. Control line was still very much the province of Poland and the Soviet Union where the intricate detail of the leading models is excessively professional.

Holland was host nation for Control line Championships at Utrecht, preceded by a Combat Internats at Rotterdam, where Britain won top individual honours. Team Race once more the class where U.S.S.R. leads the field, had its upsets with many disqualifications, as also did Speed with several engines found to have been made oversize. West Germany produced Speed leaders, and yet again, the U.S.A. dominated Stunt with a resounding 1, 2, 3 placing.

Another event of note, though not in any way competitive, was the RAFMAA contribution to the 1976 Royal Tournament in London. Performing twice daily, to capacity crowds for three whole weeks, the team of four flyers and their ultra-violet sensitive painted semi-scale WWI fighters put up a stirring finale in the darkened Earls Court arena. It was the hit of the show, and a fine credit to the Royal Air Force modellers and the all-British equipment they were using.

And so to the Annual. This time with an 'Old Time' theme, reflecting back on early days through the memories of long serving model enthusiasts, Juste van Hattum and Bob Gosling. It is the opportune moment to look back on those days of early achievement and to make comparison with the sophistication of the all-moving, all singing 'flappers' which produce sensational performance in power during flying. Time also to follow Martyn Pressnell's views on the potential for a new type specification. There's always room for a variation of the faithful rubber model, if only the rubber itself remains in good supply!

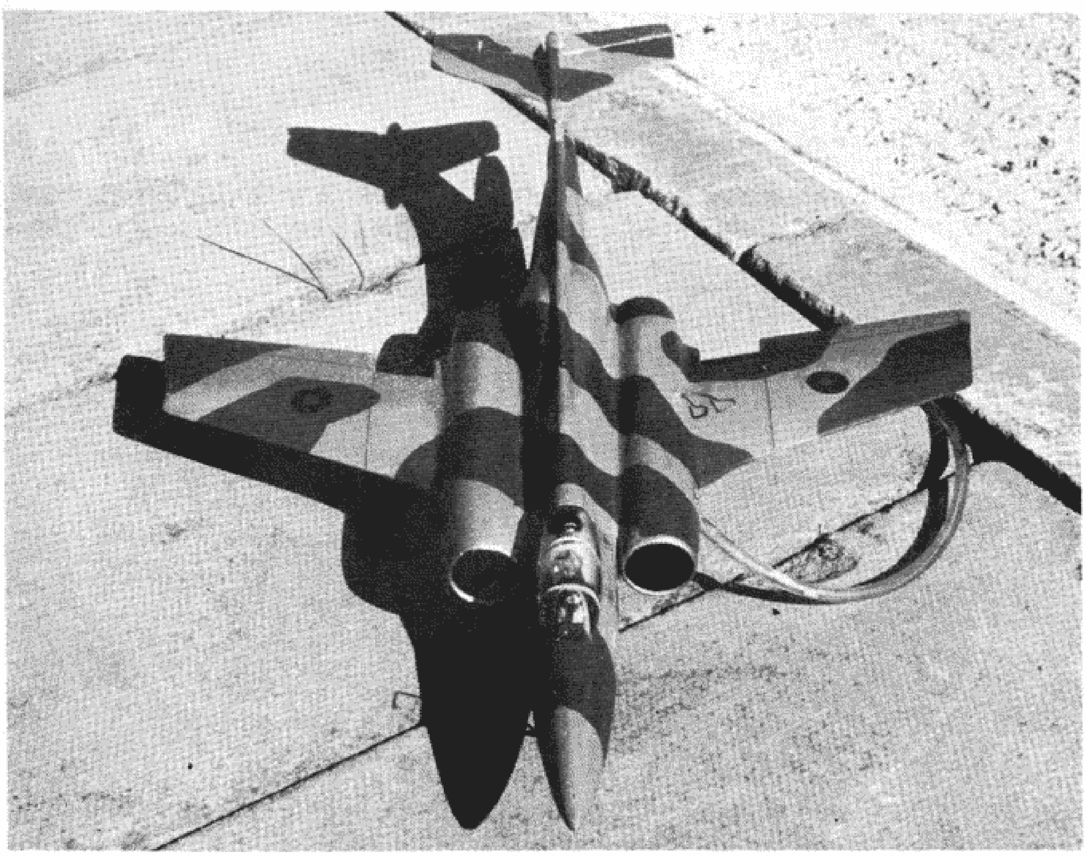
R.T.P. SCALE MODELS ON COMPRESSED AIR SPEEDS UP TO 120 M.P.H.

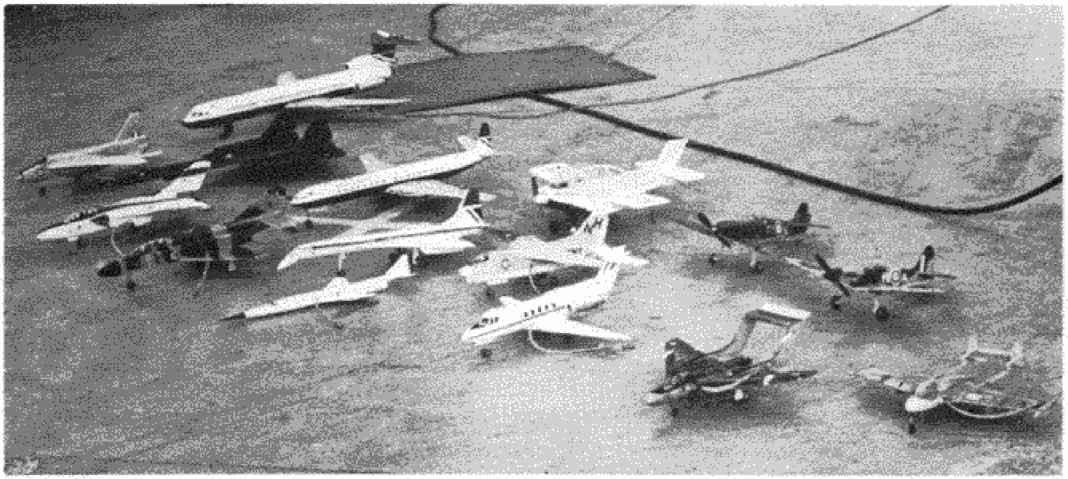
by P. C. Bower and L. Furby

OVER the years of aeromodelling, I always had a yearning to fly scale jets. Jetex and ducted fan free-flight models were tried, with mixed degrees of success, but there was a lot to be desired from these forms of flying. My idol was the late P. E. Norman, who had such great success with his ducted fan designs [and now carried on by his son Marcus—see *Aeromodeller Annual 1974–75*—ED.]. With flying fields becoming scarcer in the London area, I turned to electric R.T.P., but my mind was still on those scale jets.

I had seen a demonstration in the mid-fifties of two Hawker Hunters flying round the pole on compressed air at the *Model Engineer* exhibition. When I moved my place of employment, I was confronted one lunchtime by what could be claimed as a dream come true: a scale Sea Vixen flying R.T.P. on compressed air! The chap who was flying it said that he had been doing this type of flying for about 20 years! Needless to relate this was the beginning of a long session of learning, the outcome of which is this feature on how to go about it.

HSA Buccaneer 2 has ideal proportions, looks great on compressed air thrust.



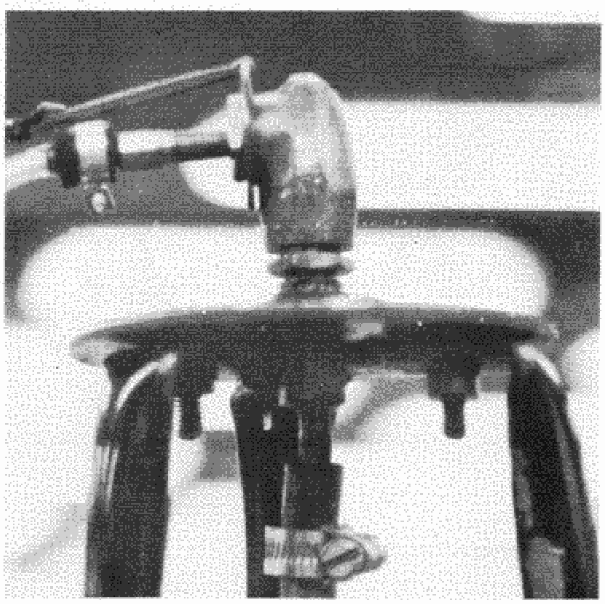


Fifteen of the models from Spitfire to Concorde, including the SR71 Blackbird, MRCA Tornado and Corsair.

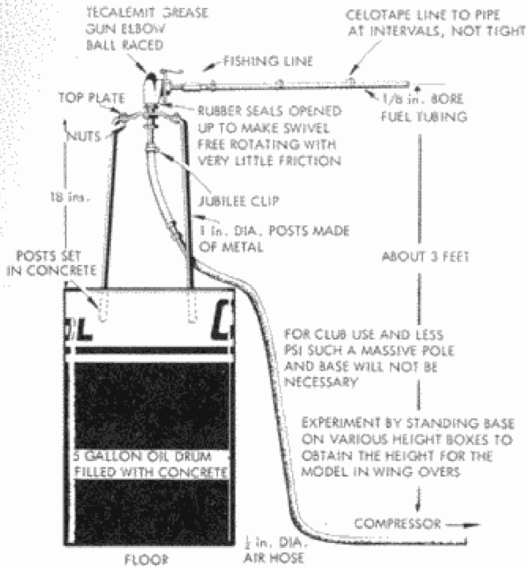
The equipment required for this form of flying is:

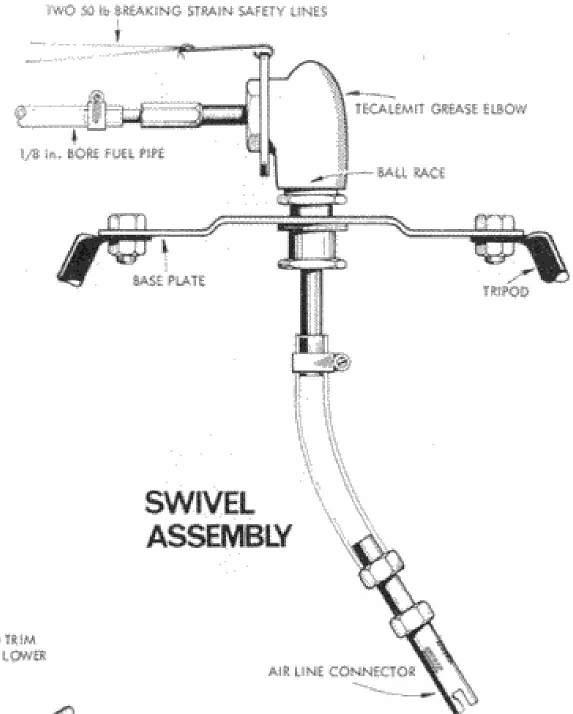
1. An industrial airline giving a pressure of 120 p.s.i.
2. $\frac{1}{2}$ in. diameter airline.
3. A pole in a weighted base—i.e. a 5 gall. oil drum filled with concrete with a post set in it.
4. A Tecalemit grease elbow with the oil seals freed—to make it free rotating.
5. About 1 in. of $\frac{1}{8}$ in. bore piping.
6. About 12 ft. of $\frac{1}{8}$ in. bore fuel tubing.
7. Two lengths of 50 lb. fishing line.
8. A male and female threaded connector.
9. A small rubber washer.

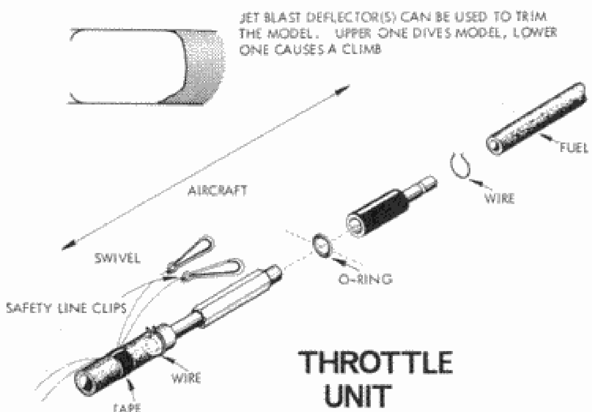
This is all assembled as shown in the diagram, with the fishing line loosely taped at intervals to the $\frac{1}{8}$ in. tubing as a safety line. The models

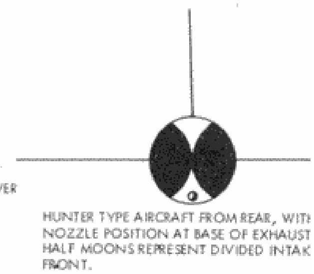


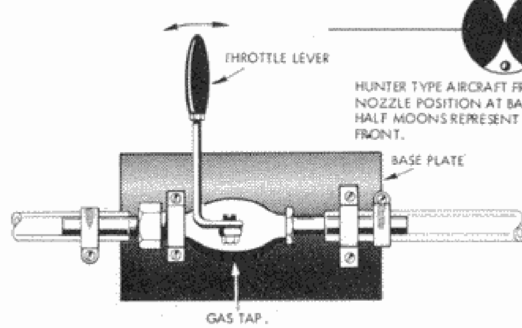
Vital head on the pylon made from a Tecalemit grease elbow, mounted securely and rotating freely.

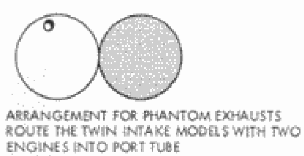


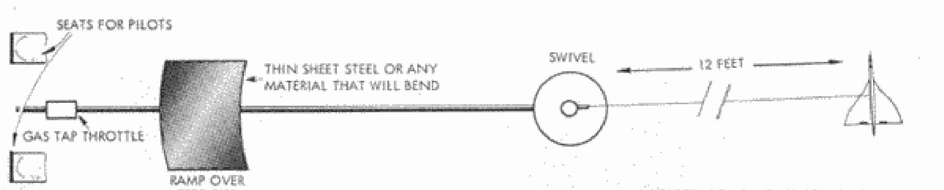




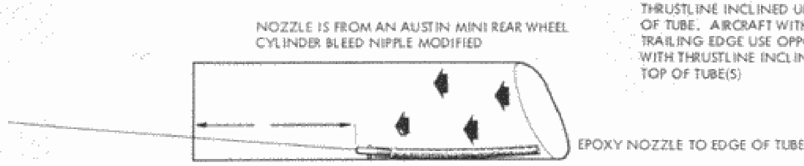


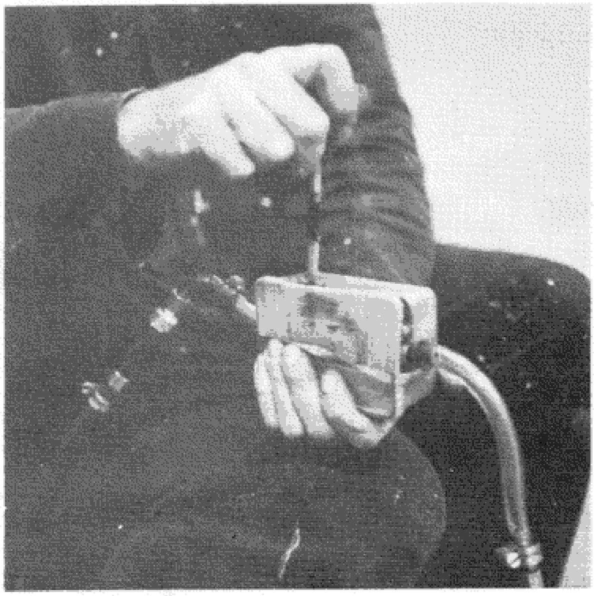






AIRCRAFT WITH EXHAUST AT REAR (HUNTER) USE THRUSTLINE INCLINED UPWARDS FROM BOTTOM OF TUBE. AIRCRAFT WITH EXHAUST NEAR WING TRAILING EDGE USE OPPOSITE ARRANGEMENT WITH THRUSTLINE INCLINED DOWNWARDS FROM TOP OF TUBE(S)



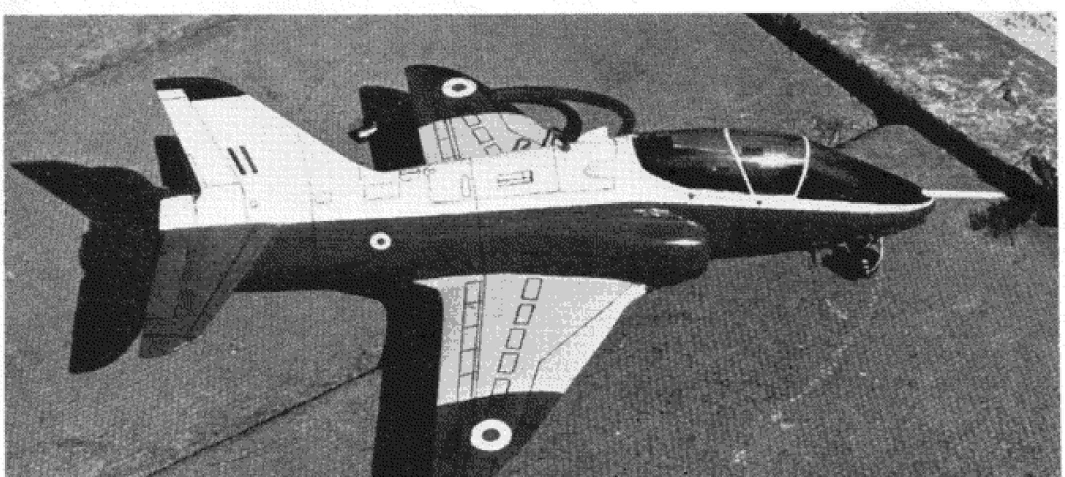


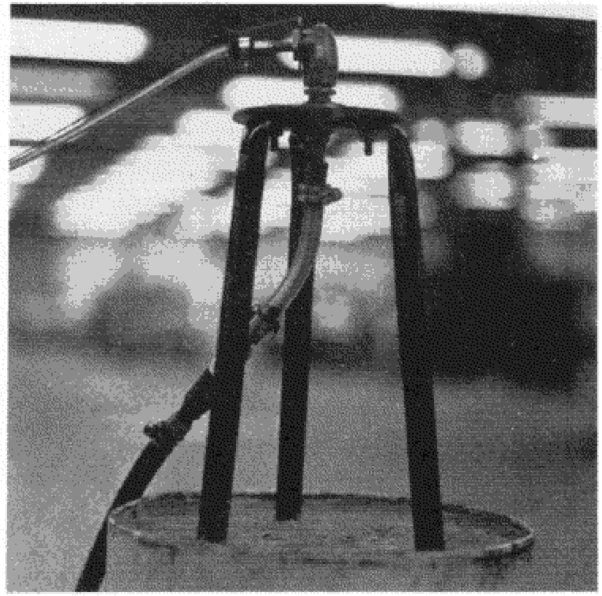
Control box "Throttle" is simply a gas tap with handle extension.

Hawker Hawk, topical and good looking in its trainer markings of vivid red and white.

are constructed from solid balsa wood, with a good lift section on the wing. Be sure to use a P.V.A. glue and not balsa cement as these models get the same treatment as a control line team racer. Into the basic model is fitted an $\frac{1}{8}$ in. bore pipe through the port side of the fuselage. Attached to this is a $\frac{3}{32}$ diameter nozzle. Feed down tube, and epoxy it about $2\frac{1}{2}$ in. in from the exhaust outlet and pointing about 5° up from the horizontal—this will give a good NOISE to POWER ratio.

Essential things to do in building the models are: Attach the tether point at the C. of G., but either near the wing root or actually on the fuselage—this will give the model a slight bank in flight (use about 1 in. long piano wire, epoxied on, so that it can be bent to trim out any problems). An elevator is a *must*, and should be mounted on soft wire so that it stays in position when moved. The undercarriage must be strong to stand up to the landing speeds—so use piano wire—bolt or epoxy to model. Solder aluminium hubbed rubber wheels to undercarriage and give the nose wheel





The complete pylon, with its three legs firm in the concrete set in top of a 5 gallon oil drum.

MRCA Tornado really does have swing wings on the compressed air propelled model.

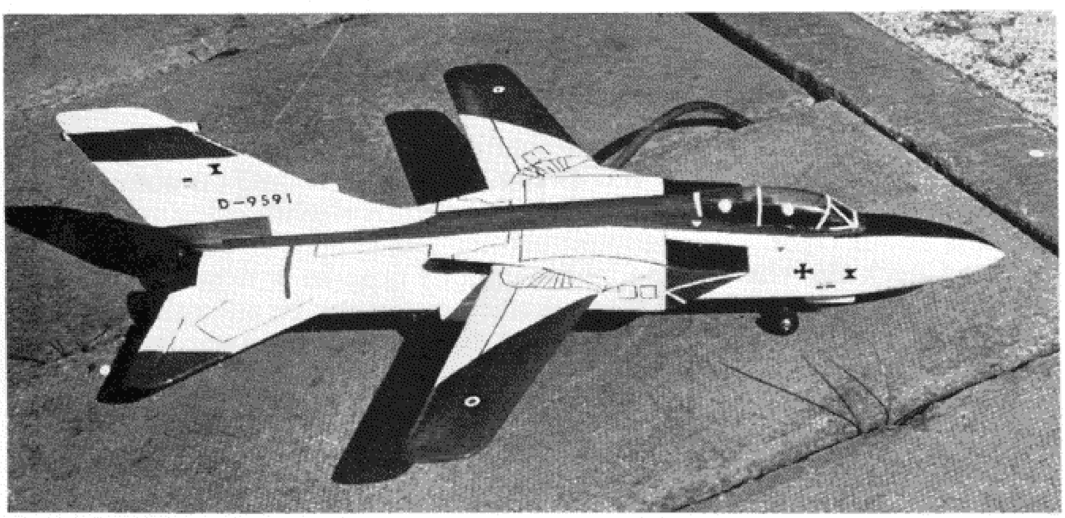
a slight left bias (to go round the circuit). Always fit a wire tail-skid. Build into the model a $1\frac{1}{4}$ in. diameter tube made of cartridge paper or light aluminium for the ducting.

This last item will be familiar to those of you who fondly remember the Jetex augmented models. In fact, the Keil Kraft scale Jetex models would, with ingenuity, convert well for this kind of flying.

To adapt this system for club flying it is suggested that a small portable compresser (i.e. the type used for paint spraying), preferably with a storage tank and giving about 20–30 p.s.i., should prove satisfactory.

The models will have to be very light as the air pressure will be a lot lower, and some experimentation will have to be carried out to ascertain the ideal nozzle diameter for this lower pressure.

A smaller diameter circuit will increase the speed of the aircraft. Here again experiment to find the optimum diameter to give suitable speed in respect of the lower pressure.



HSA Trident 3 is ambitious but perfectly feasible for compressed air. Note position of air take near leading edge and mid-chord anchor point for RTP cable.

A word of warning: with the high speeds that can be achieved, give this system the same respect as for C/L team racing!

However, flying two models together is not successful as this halves the power to each model, because there is only one airline, also the complication of a double swivel is more trouble than it is worth.

Use an ordinary gas tap for the throttle and make sure that all pipe connections are firm; chips should be used where possible.

The weight of the models, at $\frac{1}{32}$ scale, should not exceed 3–4 oz. on 20–30 p.s.i. (We have managed to get a Trident model weighing 20 oz. airborne on 120 p.s.i. and in fact it flies quite well.)

With these small, lightweight models, they have to be gently whipped by a helper, whilst the pilot opens the throttle gradually. Once the model is trundling round the circuit, the helper steps out of the circle, centrifugal force takes over, and the pilot has control.

Because of the rather heavy feed pipe to the model, the undercarriage should be given a wider track than scale, to stop the port wing tipping over on to the ground whilst taxiing slowly.

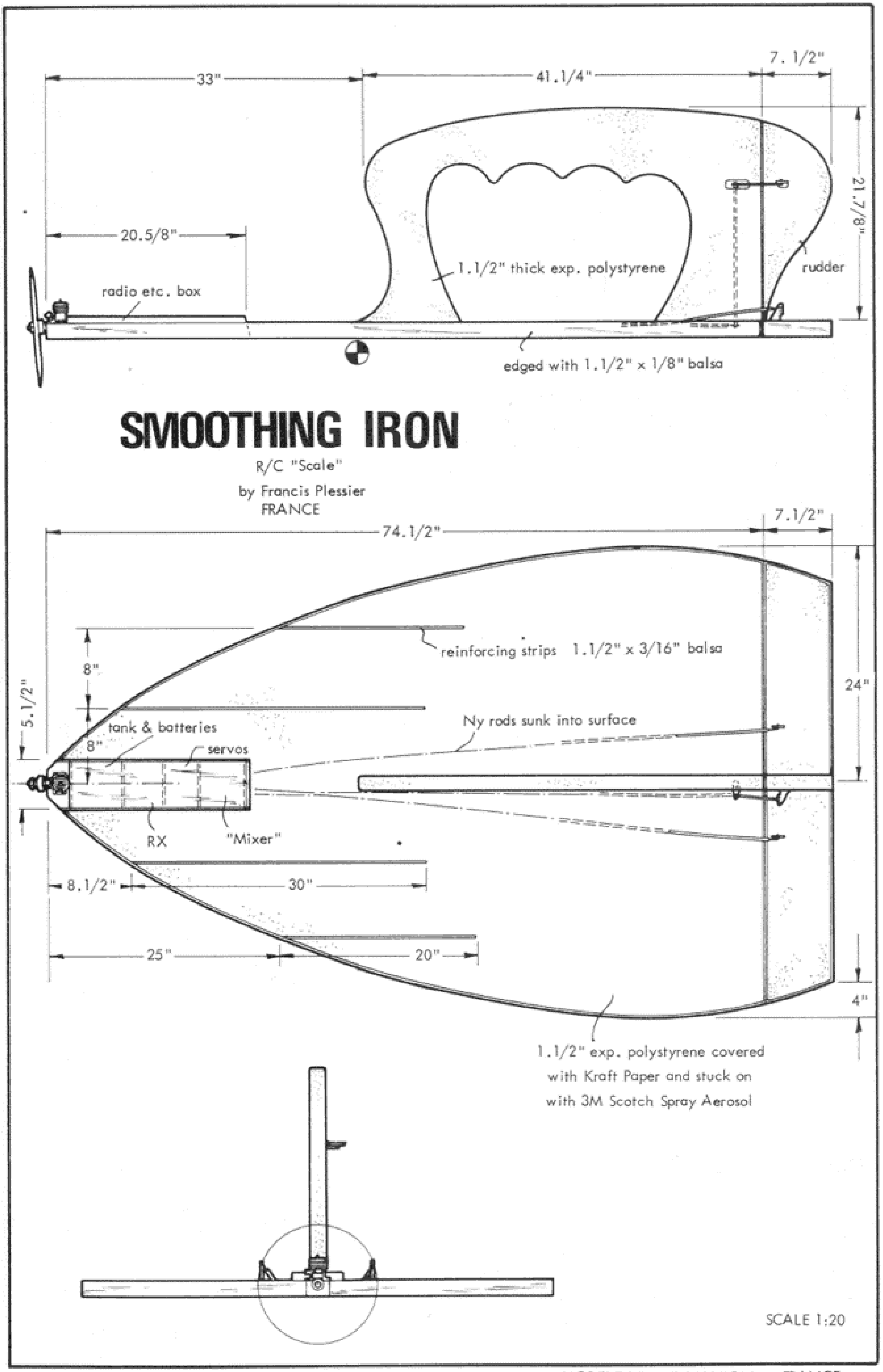
Two very important points for successful flying are:

1. A swivel that is very free and does not leak air.
2. The weight of the model should not exceed its thrust, i.e. outside limit of a 4 to 5 power/weight ratio.

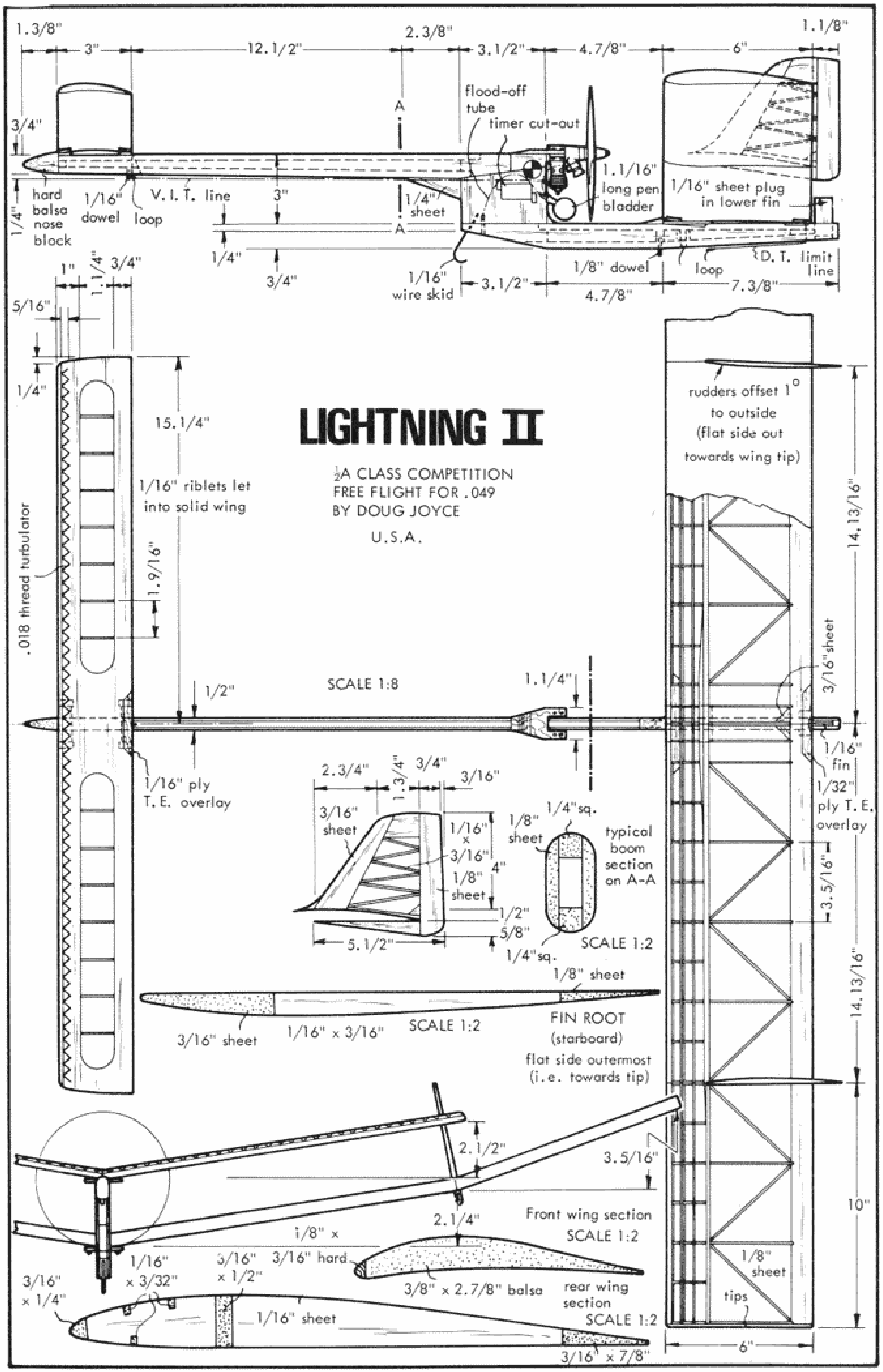
The best way to find the tether point after establishing the C. of G. is to find an open space and swing the model round on about 10 ft. of fishing line; try whipping and if model climbs slightly then your tether point is about right.

Check also that the model does not fly nose-in or nose-out and that the bank is not too much. All these characteristics can be adjusted by bending the 1 in. long tether wire up, down, forwards or backwards, until you achieve a good glide attitude.

The model capabilities are limited, but with use of the throttle, i.e. by switching it on and off, low wing-overs, diving and climbing can be achieved. Another good point for climbs would be carrier landing competitions.



MODELE REDUIT D'AVION FRANCE



MODEL BUILDER U. S. A.

THE PIONEER MODEL AEROPLANES. THE TWIN-PUSHERS

by R. F. L. Gosling, F.S.M.A.E.

Reflections on the very beginnings of aeromodelling in Britain

IT WAS in 1908 that model aeroplanes became popular as a hobby, stimulated by the early attempts at flying by the Wright Brothers in America; Voisin, Farman and Blériot in France; and Cody and Roe in England.

The first models were often scaled down versions of the aeroplanes of these early pioneers. It is obvious that most must have disappointed their constructors, in not being able to fly. Then simple canard models with a single propeller appeared. These did manage to fly hand-launched for short distances, but more often than not the rubber motor gave them no more than a prolonged glide. Since the extreme torque of the propeller had to be compensated by trimming when the prop. stopped, they just spun to the ground. Then, late in 1909, C. Fleming-Williams and W. G. Aston individually produced the first A-frame pushers with twin contra-rotating propellers.

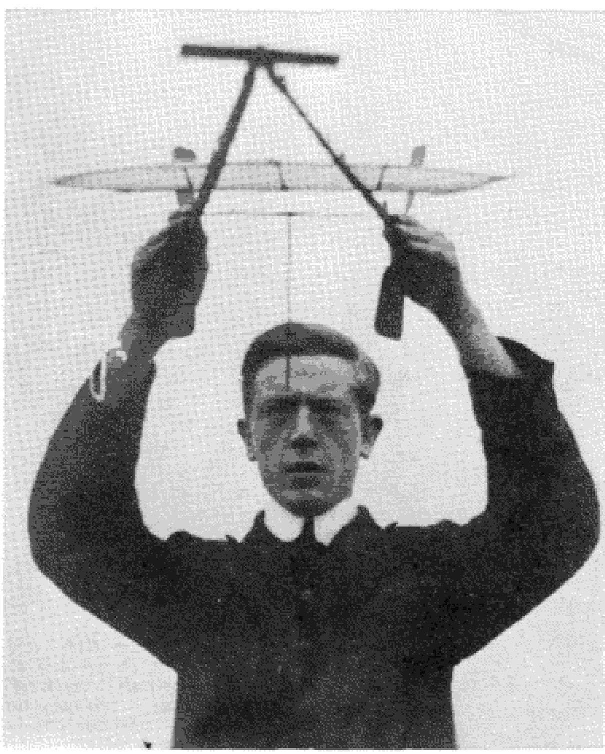
From then on, the model scene was dominated by this type until well into the late 1920s. There were four variations of the twin-pushers: (1) canard A frame; (2) canard T frame; (3) tail type A frame; (4) tail type T frame.

Early in 1909 the first British Aero Show was held at Olympia. There was a model section and it attracted 86 exhibits. But it is doubtful

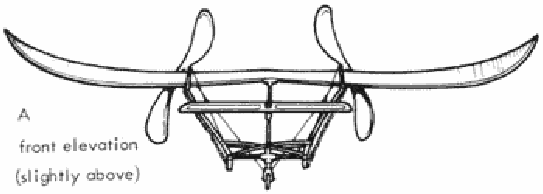
Bob Gosling and his 1914 Twin A-Frame pusher (1-1-1-2p) at the first British National Championships, Gravesend 1947, when demonstration flights took place.

whether more than a handful were capable of flight. On July 25th, 1909, Louis Blériot flew over the Channel. This event really fired the enthusiasm of many to build models—including the writer. It was in September 1909 that the first big model meeting was organised by the Aerial League and the Aeroplane Club at Wembley. There were four classes for the competitions: (1) models of 1 sq. ft. and under; (2) models between 1 sq. ft. and less than 5 sq. ft.; (3) and (4) for larger surfaces, for which no entries were received. H. Burge-Webb was winner in Class 1 with a single propeller pusher. W. G. Aston was second with one of the early twin-pushers. This was the first time this type had appeared. The contest consisted of separate flights for distance, steering and height. W. G. Aston flew over 100 yds.—which was the longest flight recorded—but was last in other categories. Later, he was to become well known for his articles on models and also on full size aeroplanes with excellent drawings. Incidentally it is rather interesting that many of the successful designers of models were artists. In Class 2 the winner was G. P. Bragg-Smith with a single-prop. pusher biplane in which the lower plane curved up at the tips to meet the upper plane, which gave it particularly good stability. This model was later built commercially, and sold by Gamages.

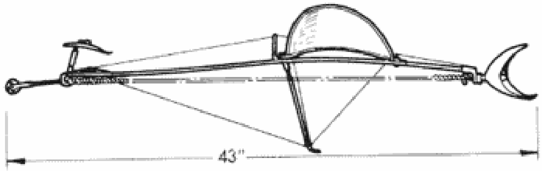
At this time model clubs sprang up in many parts of the country, especially around London. Performances began to improve and later that year it was reported that C. Fleming-Williams had made regular flights of a quarter of a mile. His model was a very well constructed twin-pusher of 40 in. span with a length of 43 in. The A frame was constructed of magnalium tube, the wings of wire covered with proofed silk. The two props were each 13 in. dia. and driven by 34 strands of $\frac{1}{16}$ in. sq. elastic for each propeller. This model can truly be said to be the first successful



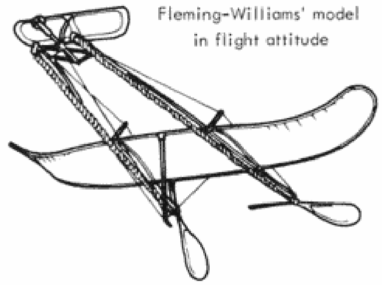
(Sir) Richard Fairey with his 1913 "A" Frame model, a memorable photograph from the collection of Alwyn Greenhalgh.



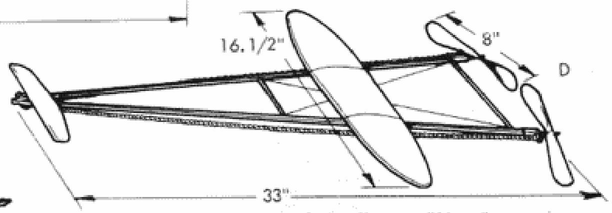
A
front elevation
(slightly above)



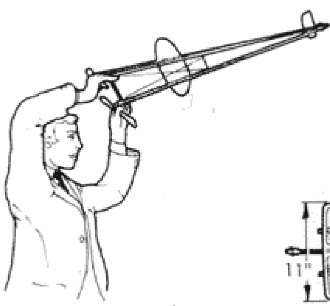
B side elevation



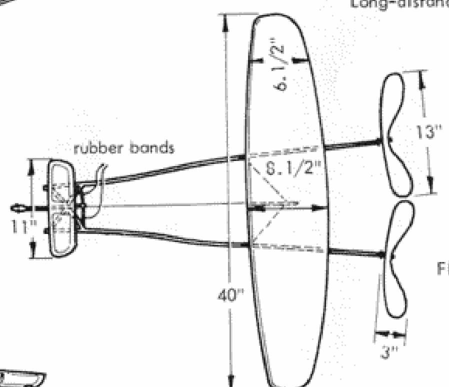
C
Fleming-Williams' model
in flight attitude



D
Long-distance "Mann" monoplane



E
R. F. Mann with monoplane
in launch position

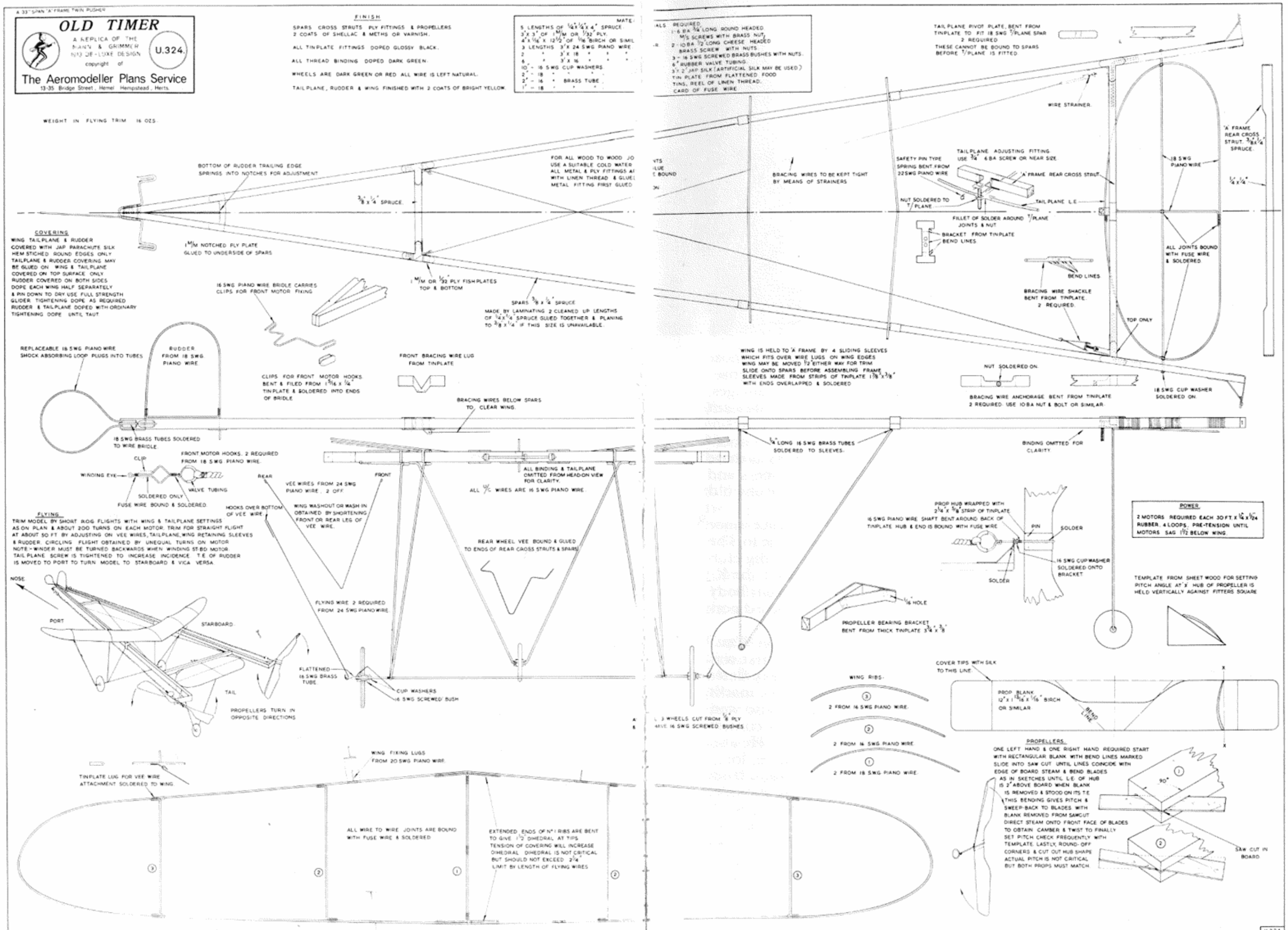


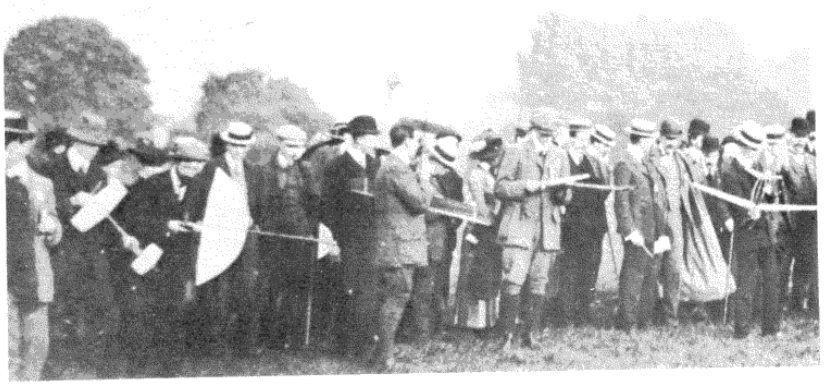
F
plan view
Fleming-Williams' monoplane

G
Fleming-Williams' monoplane
in launch attitude

'A' FRAMES BY FLEMING-WILLIAMS

also long distance R. F. Mann monoplane, from *Flight* of June 1911


A 33" SPAN 'A' FRAME TWIN PUSHER
OLD TIMER
A REPLICA OF THE MANN & GRIMMER 1913 DE-LUXE DESIGN
copyright of
The Aeromodeller Plans Service
13-35 Bridge Street, Hemel Hempstead, Herts.
U.324.
FINISH
SPARS CROSS STRUTS PLY FITTINGS & PROPELLERS 2 COATS OF SHELLAC & METHS OR VARNISH.
ALL TINPLATE FITTINGS DOPED GLOSSY BLACK.
ALL THREAD BINDING DOPED DARK GREEN.
WHEELS ARE DARK GREEN OR RED. ALL WIRE IS LEFT NATURAL.
TAILPLANE, RUDDER & WING FINISHED WITH 2 COATS OF BRIGHT YELLOW.
MATERIALS REQUIRED
5 LENGTHS OF 1/4" x 1/4" x 4' SPRUCE.
3" x 3" OF 1 M/M OR 1/32" PLY.
4" x 1/16" x 12 1/2" OF 1/16" BIRCH OR SIMILAR
3 LENGTHS 3' x 24 SWG PIANO WIRE
2 " 3' x 18 " "
6 " 3' x 16 " "
10 - 16 SWG CUP WASHERS
2" - 18 " "
2" - 16 " BRASS TUBE
1" - 18 " "
1 - 6 BA 3/4" LONG ROUND HEADED M/S SCREWS WITH BRASS NUT
2 - 10 BA 1/2" LONG CHEESE HEADED BRASS SCREW WITH NUTS
3 - 16 SWG SCREWED BRASS BUSHES WITH NUTS.
6" RUBBER VALVE TUBING.
3' x 2' JAP SILK (ARTIFICIAL SILK MAY BE USED)
TIN PLATE FROM FLATTENED FOOD TINS, REEL OF LINEN THREAD, CARD OF FUSE WIRE
WEIGHT IN FLYING TRIM 16 OZS.
BOTTOM OF RUDDER TRAILING EDGE SPRINGS INTO NOTCHES FOR ADJUSTMENT
3/8" x 1/4" SPRUCE.
FOR ALL WOOD TO WOOD JOINTS USE A SUITABLE COLD WATER GLUE. ALL METAL & PLY FITTINGS ARE BOUND WITH LINEN THREAD & GLUED, METAL FITTING FIRST GLUED ON.
COVERING
WING TAILPLANE & RUDDER COVERED WITH JAP PARACHUTE SILK HEM STICHED ROUND EDGES ONLY. TAILPLANE & RUDDER COVERING MAY BE GLUED ON. WING & TAILPLANE COVERED ON TOP SURFACE ONLY. RUDDER COVERED ON BOTH SIDES. DOPE EACH WING HALF SEPARATELY & PIN DOWN TO DRY USE FULL STRENGTH GLIDER TIGHTENING DOPE AS REQUIRED. RUDDER & TAILPLANE DOPED WITH ORDINARY TIGHTENING DOPE UNTIL TAUT.
1 M/M NOTCHED PLY PLATE GLUED TO UNDERSIDE OF SPARS
16 SWG PIANO WIRE BRIDLE CARRIES CLIPS FOR FRONT MOTOR FIXING
1 M/M OR 1/32" PLY FISHPLATES TOP & BOTTOM
SPARS 3/8" x 1/4" SPRUCE
MADE BY LAMINATING 2 CLEANED UP LENGTHS OF 1/4" x 1/4" SPRUCE GLUED TOGETHER & PLANING TO 3/8" x 1/4" IF THIS SIZE IS UNAVAILABLE.
REPLACEABLE 16 SWG PIANO WIRE SHOCK ABSORBING LOOP PLUGS INTO TUBES
RUDDER FROM 18 SWG PIANO WIRE.
CLIPS FOR FRONT MOTOR HOOKS. BENT & FILED FROM 1 5/16 x 1/4" TINPLATE & SOLDERED INTO ENDS OF BRIDLE
FRONT BRACING WIRE LUG FROM TINPLATE
BRACING WIRES BELOW SPARS TO CLEAR WING.
18 SWG BRASS TUBES SOLDERED TO WIRE BRIDLE.
FRONT MOTOR HOOKS. 2 REQUIRED FROM 18 SWG PIANO WIRE.
CLIP
WINDING EYE
VALVE TUBING
SOLDERED ONLY
FUSE WIRE BOUND & SOLDERED.
REAR
FRONT
VEE WIRES FROM 24 SWG PIANO WIRE, 2 OFF
HOOKS OVER BOTTOM OF VEE WIRE
WING WASHOUT OR WASH IN OBTAINED BY SHORTENING FRONT OR REAR LEG OF VEE WIRE.
ALL BINDING & TAILPLANE OMITTED FROM HEAD-ON VIEW FOR CLARITY.
ALL U/C WIRES ARE 16 SWG PIANO WIRE.
FLYING.
TRIM MODEL BY SHORT R.O.G. FLIGHTS WITH WING & TAILPLANE SETTINGS AS ON PLAN & ABOUT 200 TURNS ON EACH MOTOR. TRIM FOR STRAIGHT FLIGHT AT ABOUT 50 FT. BY ADJUSTING ON VEE WIRES, TAILPLANE, WING RETAINING SLEEVES & RUDDER. CIRCLING FLIGHT OBTAINED BY UNEQUAL TURNS ON MOTOR. NOTE:- WINDER MUST BE TURNED BACKWARDS WHEN WINDING ST.BD MOTOR. TAIL PLANE SCREW IS TIGHTENED TO INCREASE INCIDENCE. T.E. OF RUDDER IS MOVED TO PORT TO TURN MODEL TO STARBOARD & VICA VERSA.
REAR WHEEL VEE BOUND & GLUED TO ENDS OF REAR CROSS STRUTS & SPARS
NOSE
PORT
STARBOARD
TAIL
PROPELLERS TURN IN OPPOSITE DIRECTIONS
FLYING WIRE 2 REQUIRED FROM 24 SWG PIANO WIRE.
FLATTENED 16 SWG BRASS TUBE.
CUP WASHERS
16 SWG SCREWED BUSH
ALL 3 WHEELS CUT FROM 1/8" PLY & HAVE 16 SWG SCREWED BUSHES
TINPLATE LUG FOR VEE WIRE ATTACHMENT SOLDERED TO WING.
WING FIXING LUGS FROM 20 SWG PIANO WIRE.
ALL WIRE TO WIRE JOINTS ARE BOUND WITH FUSE WIRE & SOLDERED.
EXTENDED ENDS OF No. 1 RIBS ARE BENT TO GIVE 1 1/2" DIHEDRAL AT TIPS. TENSION OF COVERING WILL INCREASE DIHEDRAL. DIHEDRAL IS NOT CRITICAL BUT SHOULD NOT EXCEED 2 1/4". LIMIT BY LENGTH OF FLYING WIRES.
TAIL PLANE PIVOT PLATE, BENT FROM TINPLATE TO FIT 18 SWG T/PLANE SPAR 2 REQUIRED. THESE CANNOT BE BOUND TO SPARS BEFORE T/PLANE IS FITTED.
WIRE STRAINER.
BRACING WIRES TO BE KEPT TIGHT BY MEANS OF STRAINERS
SAFETY PIN TYPE SPRING BENT FROM 22 SWG PIANO WIRE
TAILPLANE ADJUSTING FITTING. USE 3/4" 6 BA SCREW OR NEAR SIZE.
'A' FRAME REAR CROSS STRUT
NUT SOLDERED TO T/PLANE
TAIL PLANE L.E.
FILLET OF SOLDER AROUND T/PLANE JOINTS & NUT
BRACKET FROM TINPLATE
BEND LINES.
18 SWG PIANO WIRE
'A' FRAME REAR CROSS STRUT. 3/8" x 1/4" SPRUCE.
1/4" x 1/4"
ALL JOINTS BOUND WITH FUSE WIRE & SOLDERED.
BEND LINES.
BRACING WIRE SHACKLE BENT FROM TINPLATE. 2 REQUIRED.
TOP ONLY
WING IS HELD TO 'A' FRAME BY 4 SLIDING SLEEVES WHICH FITS OVER WIRE LUGS ON WING EDGES. WING MAY BE MOVED 1/2" EITHER WAY FOR TRIM. SLIDE ONTO SPARS BEFORE ASSEMBLING FRAME. SLEEVES MADE FROM STRIPS OF TINPLATE 1 7/8" x 3/8" WITH ENDS OVERLAPPED & SOLDERED
NUT SOLDERED ON.
BRACING WIRE ANCHORAGE BENT FROM TINPLATE 2 REQUIRED. USE 10 BA NUT & BOLT OR SIMILAR.
18 SWG CUP WASHER SOLDERED ON.
1/4" LONG 16 SWG BRASS TUBES SOLDERED TO SLEEVES.
BINDING OMITTED FOR CLARITY.
PROP HUB WRAPPED WITH 2 1/4" x 5/8" STRIP OF TINPLATE.
16 SWG PIANO WIRE SHAFT BENT AROUND BACK OF TINPLATE HUB & END IS BOUND WITH FUSE WIRE
PIN
SOLDER
16 SWG CUP WASHER SOLDERED ONTO BRACKET
SOLDER
POWER.
2 MOTORS REQUIRED EACH 30 FT. x 1/4" x 1/24" RUBBER, 4 LOOPS, PRE-TENSION UNTIL MOTORS SAG 1 1/2" BELOW WING.
TEMPLATE FROM SHEET WOOD FOR SETTING PITCH ANGLE AT 'X' HUB OF PROPELLER IS HELD VERTICALLY AGAINST FITTERS SQUARE
1/16" HOLE
PROPELLER BEARING BRACKET BENT FROM THICK TINPLATE 3 3/4" x 3/8"
COVER TIPS WITH SILK TO THIS LINE.
PROP BLANK 12" x 1 13/16" x 1/16" BIRCH OR SIMILAR.
BEND LINE
X
WING RIBS.
2 FROM 16 SWG PIANO WIRE.
2 FROM 16 SWG PIANO WIRE.
2 FROM 18 SWG PIANO WIRE.
PROPELLERS.
ONE LEFT HAND & ONE RIGHT HAND REQUIRED. START WITH RECTANGULAR BLANK WITH BEND LINES MARKED. SLIDE INTO SAW CUT UNTIL LINES COINCIDE WITH EDGE OF BOARD. STEAM & BEND BLADES AS IN SKETCHES UNTIL L.E. OF HUB IS 2" ABOVE BOARD WHEN BLANK IS REMOVED & STOOD ON ITS T.E. THIS BENDING GIVES PITCH & SWEEP-BACK TO BLADES. WITH BLANK REMOVED FROM SAWCUT DIRECT STEAM ONTO FRONT FACE OF BLADES TO OBTAIN CAMBER & TWIST. TO FINALLY SET PITCH CHECK FREQUENTLY WITH TEMPLATE. LASTLY, ROUND-OFF CORNERS & CUT OUT HUB SHAPE. ACTUAL PITCH IS NOT CRITICAL BUT BOTH PROPS MUST MATCH.
90°
SAW CUT IN BOARD
U.324



and reliable model aeroplane made. Here again we have an artist whose illustrations were often used by full size aircraft firms in their advertisements. This model was also produced commercially, and sold by Gamages.

Fleming-Williams also claims to have originated rubber lubricant and prop winding by geared drillbrace.

During the next year, 1910, the hobby grew to quite large proportions. Various types were tried out, but the bulk were twin-pushers as these gave by far the best performances. The clubs increased in numbers and their reports appeared *each* week in *The Aero* and in *Flight* (price one old penny each!).

The Kite Flying Association, which had been in existence since the beginning of 1909, decided in February 1910 to change its name to The Kite & Model Aeroplane Association (K. & M.A.A.). The other big club formed about this time was the Aero Models Association. In 1911 the K. & M.A.A. was appointed by the Royal Aero Club as the paramount body to govern model aeroplane activity in the U.K. and to register record performances.

The first competition organised by the K. & M.A.A. was on Wimbledon Common in June 1910. There were three contests. The first was for distance with marks for stability. This was won by C. R. Fairey (later Sir Richard Fairey). He made a flight of 153 yds. and gained 85 marks out of 100 for stability. The second, a steering competition, was also won by Fairey. His model was a twin A frame pusher. Third was a contest for youths—won by R. F. Mann for length of flight and stability. He also came third in the first contest. His model was 24 in. span and 30 in. long, with two 10 in. props, elliptical wing made from wire, and the elevator from thin sheet wood. He was a member of the first school club—the Arundel House School Aero Club. Later, he was to go into partnership with R. P. Grimmer to produce his models and they were sold all over the world.

Nearly all the successful models were produced commercially—Bragg-Smith, Fleming-Williams, and Fairey were all sold by Gamages. T. W. K. Clark and E. W. Twining marketed their own models; they were

Combined meeting of the Aerial League with the Aeroplane Club at Wembley Park, September 11th, 1909. R. Burge-Webb is at left (with beard), T. W. K. Clarke in centre stooping with boater, and C. P. Bragg-Smith is behind organiser.

also manufacturers of man-carrying gliders. Ding & Sayers also produced and sold their models. Later, R. Ding became a pilot and took over the Northern Aircraft Co.'s Waterplane School at Windermere, and finally became a test pilot for Blackburn of Leeds.

In August the Aero Models Association organised a big competition at the Crystal Palace grounds. Here for the first time all the winners used twin-prop. pushers. The winners and runners-up were all the well known names: Bragg-Smith, Burge-Webb, Twining, Ding & Sayers, and Mann. The overall winner of the Silver Cup was C. R. Fairey.

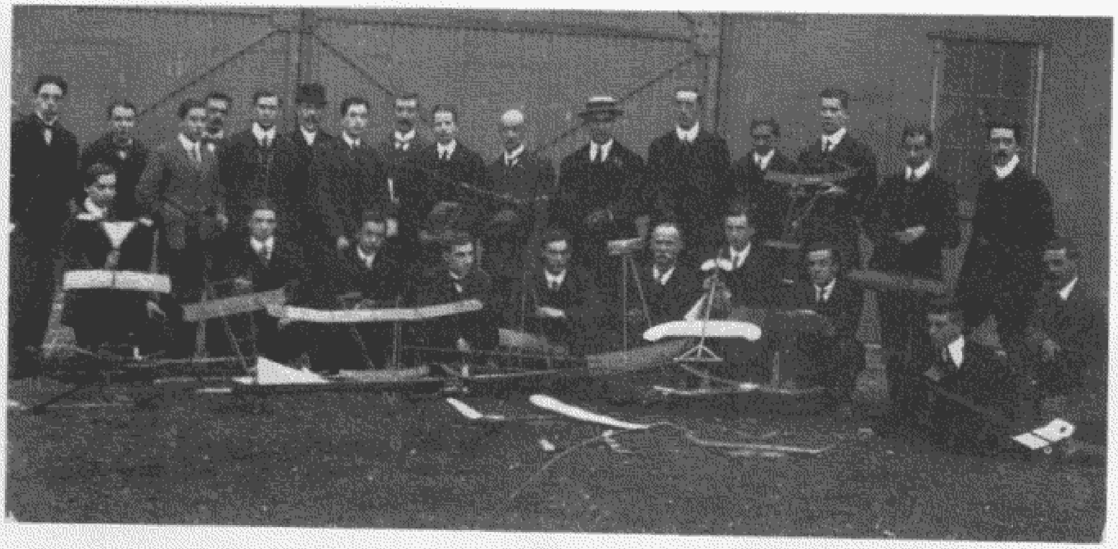
Later that year Fleming-Williams produced one of the first T frame, tail type twin-pushers and was getting a duration of 60–70 secs. This had no elevator in front, but the space between the propeller spar, the main spar and bracing strut was covered, and made a triangular tail.

The K. & M.A.A. held competitions in August for the Gamage Cup, which was won by C. Ridley of the Arundel House School Aero Club flying a twin A frame pusher, with a flight of 560 yards. On the same day Mr. Rowlands won the K. & M.A.A. Cup, making a flight of 364 yards. plus marks for stability, again with twin-screw pushers. [Just try to copy these straight line flights these days—Ed.]

During this year there was a further increase in club activity. Often there were over 15 club reports in the weekly columns in *Flight*.

In November 1911 the K. & M.A.A. issued a set of rules for officially recognising record performance. Up to this time there had been considerable controversy over record claims, so it was decided to arrange one day a month at different club venues in the London area when record attempts would be made. Official time keepers were appointed. Two classes were at first recognised:

1. Distance: (a) hand-launched; (b) rise off the ground.
2. Duration: (a) hand-launched; (b) rise off the ground.



Bristol Club in 1913 at Bristol Aeroplane Co. Aerodrome, Filton. Three characters identified by Alwyn Greenhalgh are Messrs. Tivy, House and Smallcombe.

Three flights were allowed for each record attempt. The first "record" trials took place on February 17th, 1912, on Wimbledon Common, with results as follows:

Duration H.L.	C. R. Fairey	60·4 secs.
Distance H.L.	R. F. Mann	320 yds.

Details of their machines

Fairey: twin-prop. A frame, total area 132 sq. in., 2 × 9 in. props, 8 str. $\frac{1}{8}$ in. rubber, total weight of model 4 oz.

Mann: twin-prop. A frame, total area 94 sq. in., 2 × 10 in. props, 14 str. $\frac{1}{8}$ in. rubber, weight $1\frac{1}{2}$ oz., total weight 5 oz.

About this time the special weekly section for "Models" was published in *Flight*, conducted by V. E. Johnson, M.A., in addition to the usual club reports, which often covered two pages.

In March 1912, A. F. Houlberg, a member of the Ealing and District Aero Club, appeared for the first time as a winner, in a competition organised by the Aero-Models Association, making flights of 68 secs. and 550 yds. Later he became Chairman of the S.M.A.E. and the F.A.I. International Models Commission for many years. Other names also appear of modellers who became well known in later years—including C. A. Rippon and D. A. Pavely. Also L. H. Slatter of the Blackheath Aero Club, whose performances over the next few years were often in the forefront—he later became Air Vice Marshal Slatter.

In June 1912 the contest for the *Model Engineer* Cup was decided on a formula:

$$\frac{\text{Duration of flight} \times \text{total weight of machine}}{\text{weight of rubber}}$$

This was won by C. Ridley, with A. F. Houlberg third. The Gamage Cup was won that year by R. G. Noorduyn of the Rotterdam Club, Holland—the first time there was an international competition! The Wakefield Gold Cup winner was R. F. Stedman with a twin-pusher biplane. In May A. F. Houlberg set up the official record of 89 secs. hand-launch with his twin-pusher T frame, tail type model.

In the 1913 Aero show at Olympia, 171 models were exhibited. Among these was a twin-prop canard pusher by S. Camm, later to become famous as the designer of Hawker aircraft, including the Hurricane. Three models were shown by A. F. Houlberg—one, a twin-pusher T frame hydro monoplane. His models showed great attention to detail and all had hollow spar construction for the T frame. The L.E. of the wings were made from umbrella rib, and the rest of the wings of wire. After the show, flight tests had to be made before awards were allocated. In these A. F. Houlberg made 54 secs. h.l., L. H. Slatter won the R.O.G. prize—his model had a span of 33 in., area 180 sq. in., A frame weight $8\frac{1}{4}$ oz., 2×9 in. props, 20 in. pitch, 8 str. each $\frac{3}{16}$ in. rubber, weight 2 oz.

Shortly afterwards a new H.L. distance record was set up by R. Lucas with a "Mann" monoplane of 590 yds. H.L. This record stood till well into the 1920s. A. F. Houlberg's H.L. duration record of 89 secs. was beaten by J. E. Louch with a flight of 100 secs. The Wakefield Cup was won by L. H. Slatter with a flight of 135 R.O.G., setting up a new record for this class. In official trials a few weeks later, A. F. Houlberg regained the H.L. duration record with 129 secs.

At the 1914 International Aero Exhibition at Olympia there were 38 twin-screw pushers exhibited. After the flight trials there was a tie:

G. Heydon

Design & construction 53, Stability 52, Duration 113. *Total* 218.

A. F. Houlberg

Design & construction 63, Stability 65, Duration 90. *Total* 218.

By the end of 1914 the British record stood as follows:

Twin-screw	H.L. distance	R. Lucas	590 yds.
	H.L. duration	T. D. C. Chown	145 secs.
	R.O.G. distance	L. H. Slatter	365 yds.
	R.O.G. duration	J. E. Louch	169 secs.

Until well after the 1914–18 war there was little activity until F. J. Camm, the brother of S. Camm, tried to reform the K. & M.A.A. in 1919, but it was not until 1922 that the London Aero Model Association took over the assets of the old K. & M.A.A. and changed its name to the Society of Model Aeronautical Engineers (S.M.A.E.). At this time twin-pushers were still being built and flown, although there is no record of outstanding performances except that in 1923 S. C. Herson increased the twin-pusher R.O.G. duration record to 247 secs., which is the last official record for this type. From then on, more and more interest began to be shown in single-prop fuselage types, as the performance of these began to improve over the next years.

The twin-pushers had a large innings in the development of model flying from 1909 to 1924. Even after this date they occasionally made their appearance—one instance was at the first British Nationals at Gravesend in May 1947 when demonstration flights were made by Alec Houlberg with his T frame model and by the writer with his 1914 A frame model.

It is very fortunate that several specimens of original T and A frame twin-pushers have been preserved in the collection of historic model aircraft by Lt. Cdr. Alwyn Greenhalgh. These consist of the following:

Date	*Name*	*Frame*	*Span in.*	*Length in.*	*Total wt. oz.*	*Rubber wt. oz.*	*Prop. dia. in.*
1910	Twining	A	24	47	10	4	8
1912	Fairey	A	24	35	8	4	9½
1926	Pavely	A	28	36	8	3	10½
1912	Houlberg	T	32	42	10	6	12
1912	Gosling	T	22	42	7	3	9
1914	Gosling	A	24	42	8	3	10

A PERSONAL VIEW ON THE "OLD TIMER"

(Refer to the cover by C. Rupert Moore and drawing reproduced on pages 16/17)

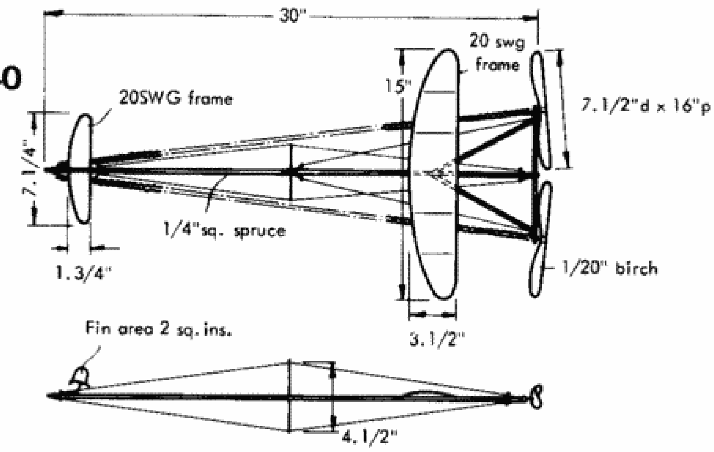
I REMEMBER, at the time the plans and description of the 1913 Mann and Grimmer A frame pusher were published in the *AeroModeller* of July 1949, thinking that this model had very little resemblance to the "Mann" monoplanes which were so popular and successful from 1911 to 1914, and which were produced from 1913 by the firm of Mann & Grimmer of Surbiton. Alwyn Greenhalgh assures me that is an accurate replica of the "Monoplane de luxe" priced at Five Guineas in 1913.

Most "Mann" monoplanes were of the A frame *canard* type and most were for hand launching without undercarriage. This particular model is of A frame *tail* type and I find that the bracing from the undercarriage is rather elaborate and unnecessary, although I admit it does keep the wing tips from any tendency to warp, but in those days it was hardly considered. Also the very large straight dihedral of the mainplane is quite uncharacteristic of all twin-pushers of the period, which were mostly flat or only had very slight dihedral. Sometimes the tips were turned up a little. The torque of the contra-rotating propellers seemed to take care of stability.

If I were to build this model, I think I would do without the undercarriage, unless one wants to R.O.G. I would certainly omit the wing bracing, as these all cause a great deal of unnecessary drag. I would make the wings flat with a very slight turn up of the tips from the outer rib—and stick to hand-launching.

Then I think one would get some really excellent flying, especially with modern techniques for the rubber motors. It would certainly be very interesting to see a competition, these days, for reproductions of former twin-pusher types. I think it would be great fun. Full-size plans are available price £1 including post from Aeromodeller Offices.

ABC Nº40



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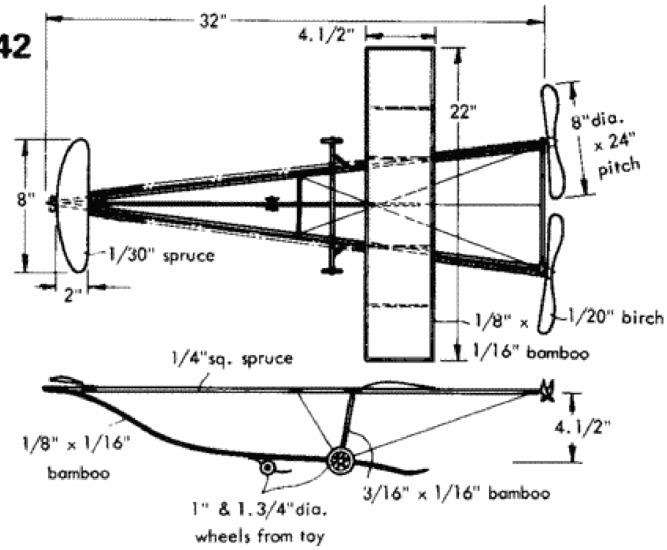
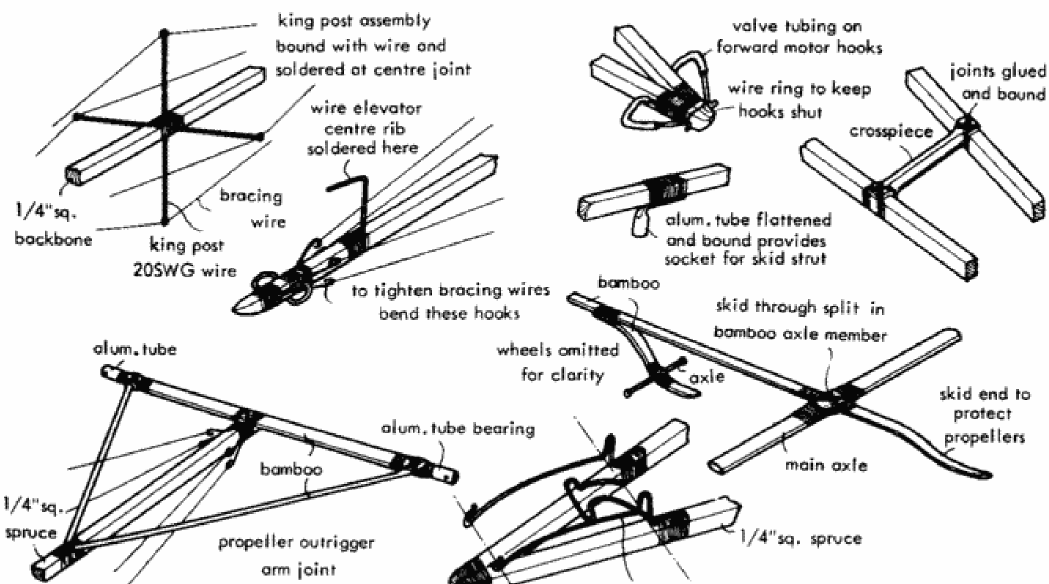
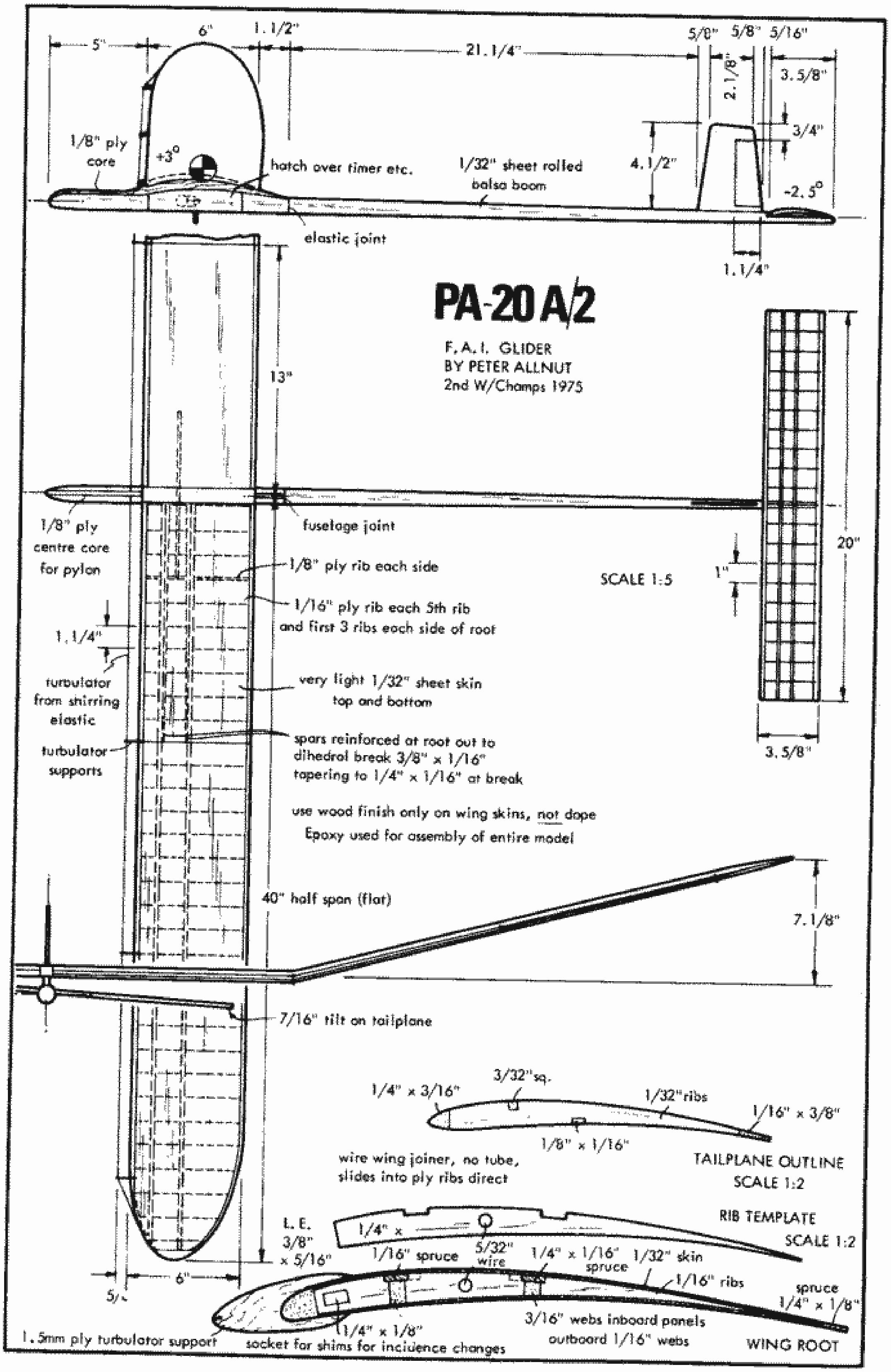


Clark Monoplanes from *Flight* of February 1912

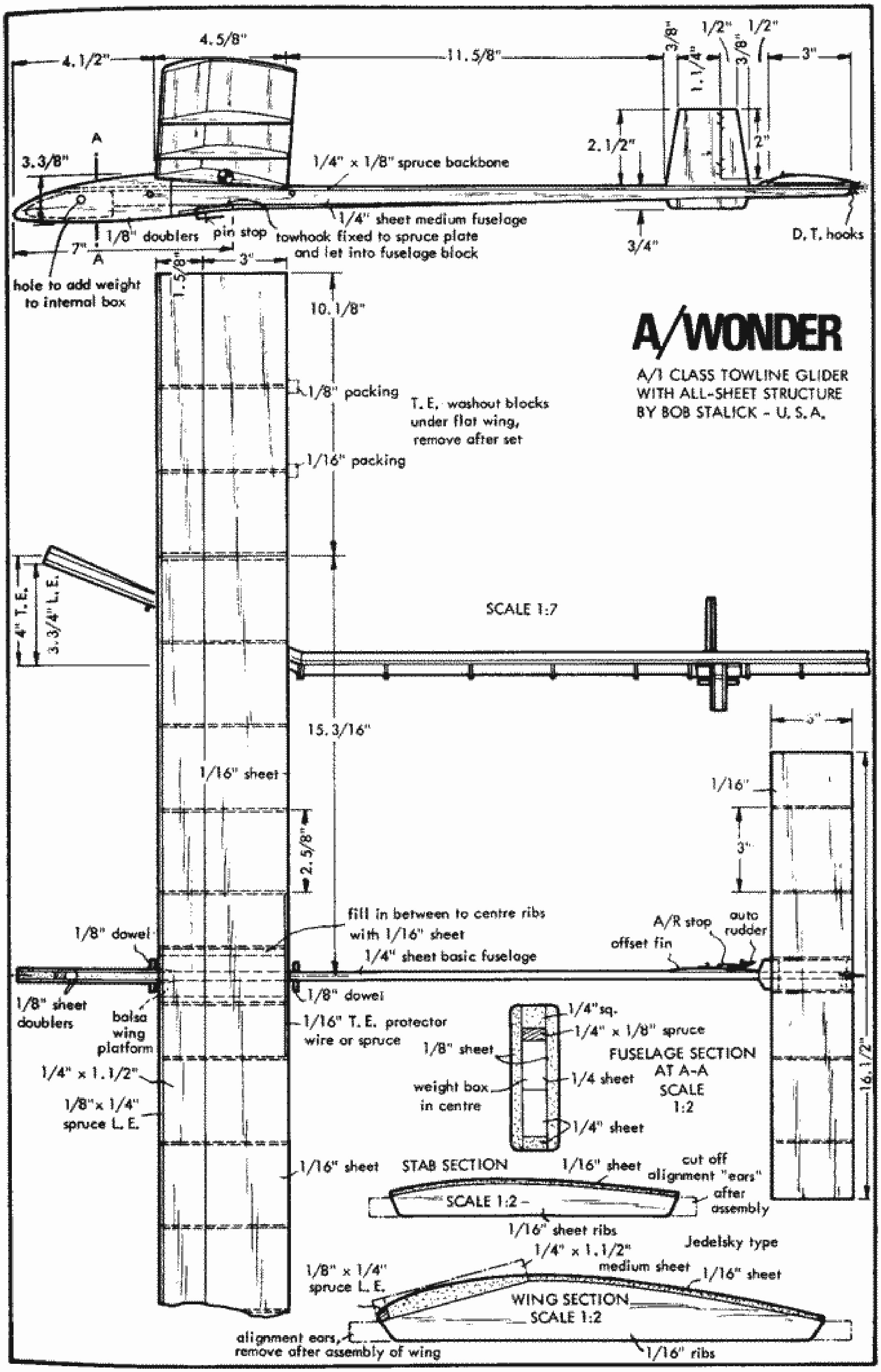


CONSTRUCTION DETAILS NO. 40 MONOPLANE

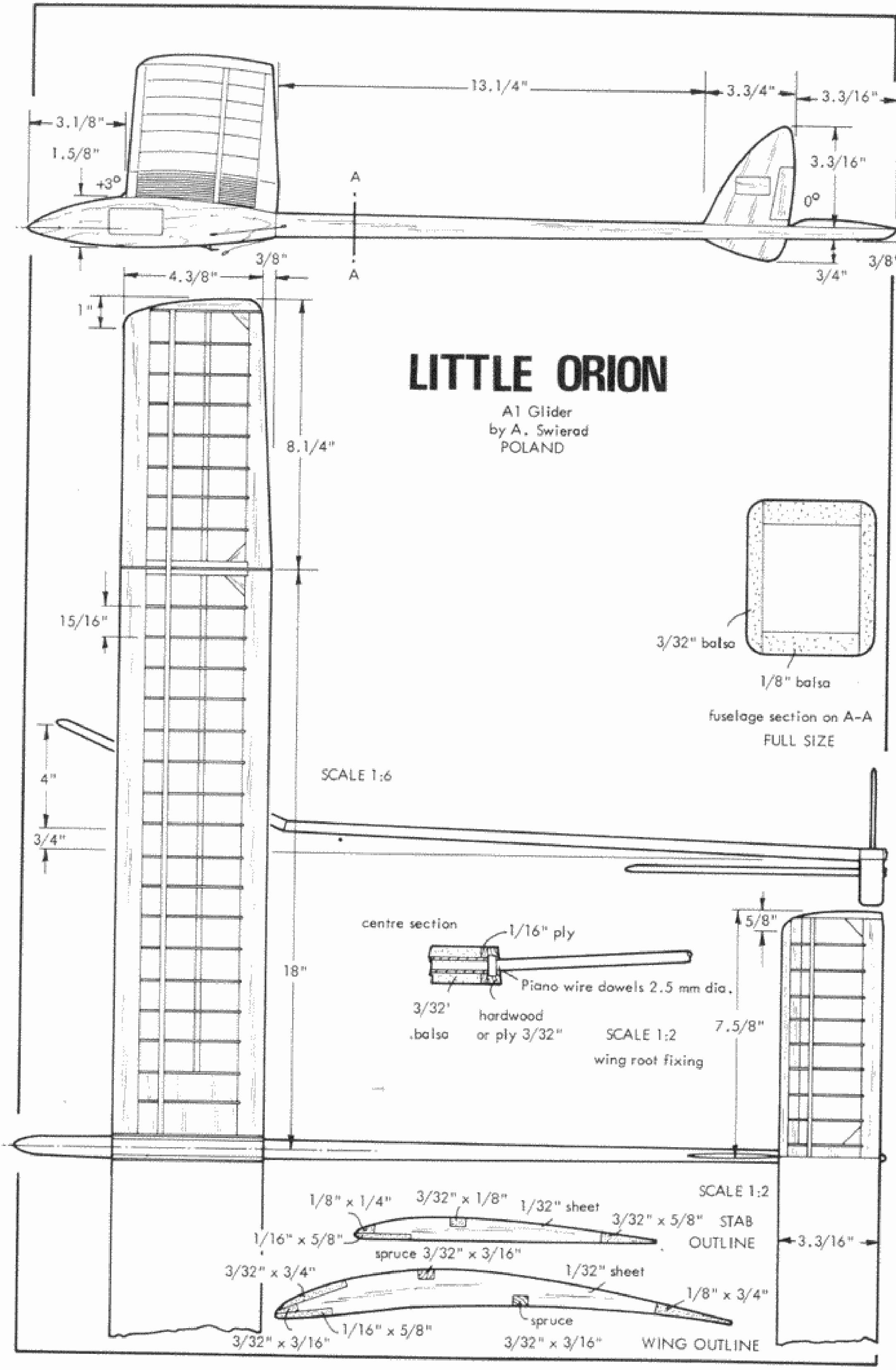
CONSTRUCTION DETAILS NO. 42 MONOPLANE



DESIGNER'S SKETCHPAGE DRAWING

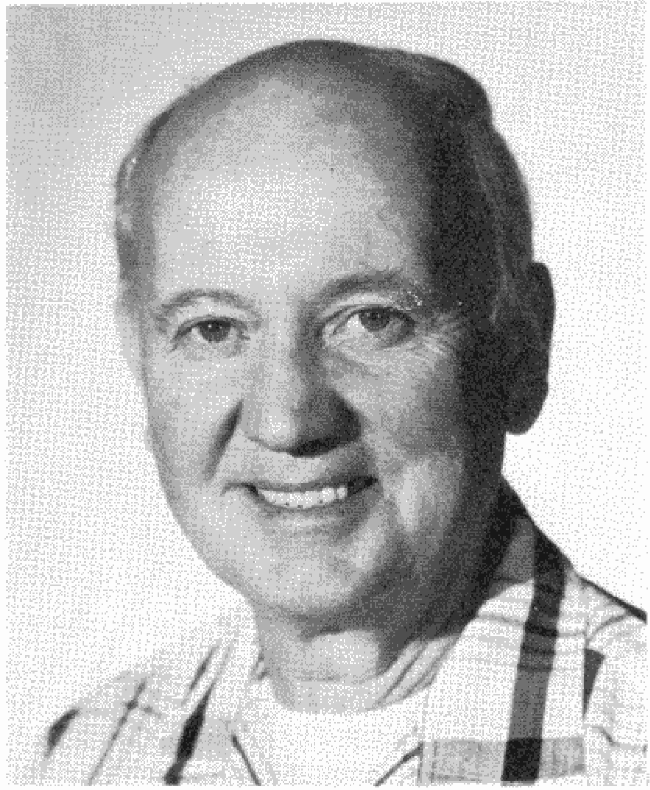


WILAMETTE MODELERS BULLETIN U. S. A.



MODELARZ POLAND

To many, the name of Frank Zaic is legendry. His Yearbooks set standards of technical publishing on aeromodelling that have influenced hundreds of thousands throughout the world. This feature is typical of Frank's approach and the X-18 represents his genius in the art of simplification.



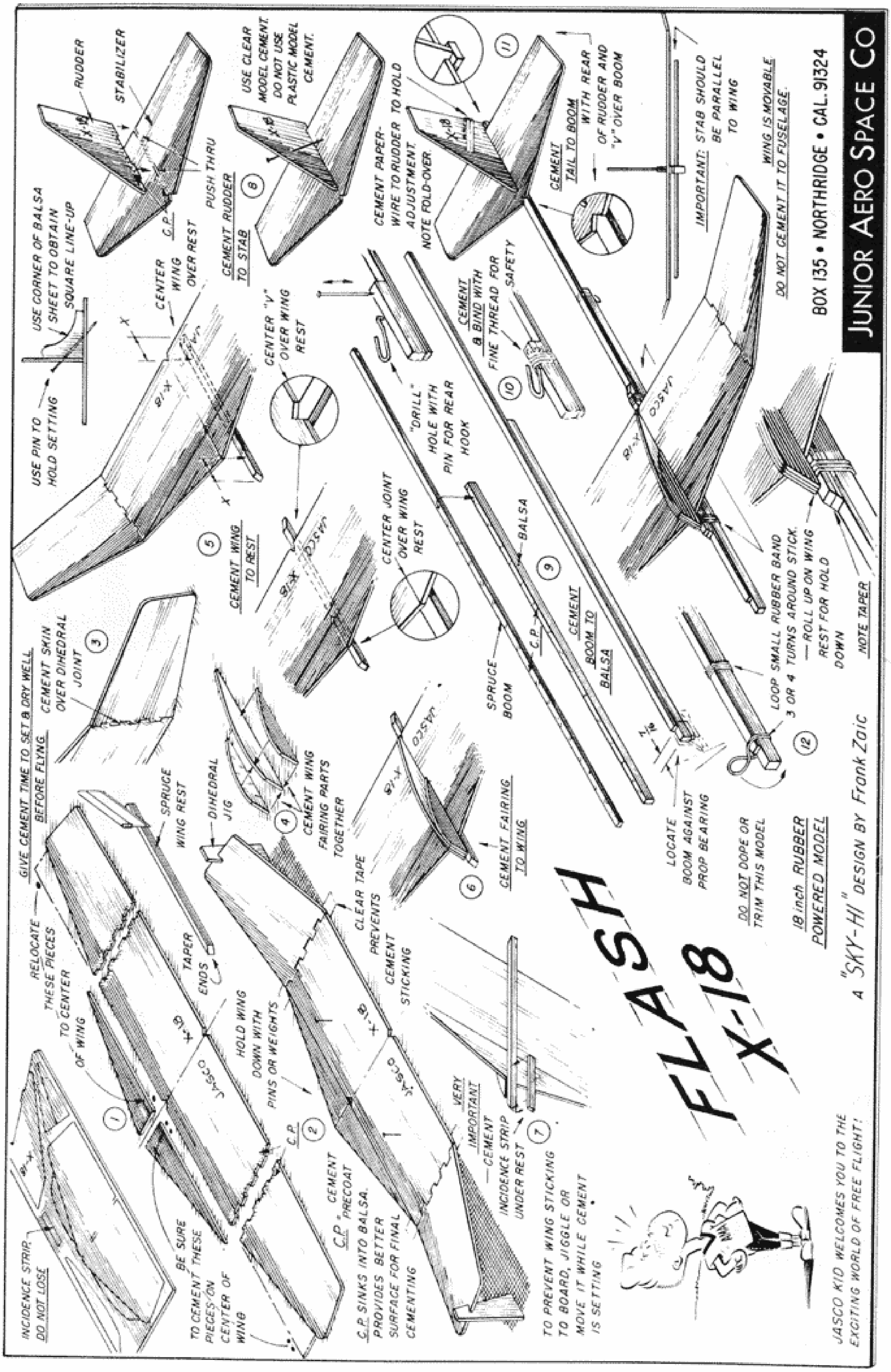
DEVELOPMENT OF FLASH X-18

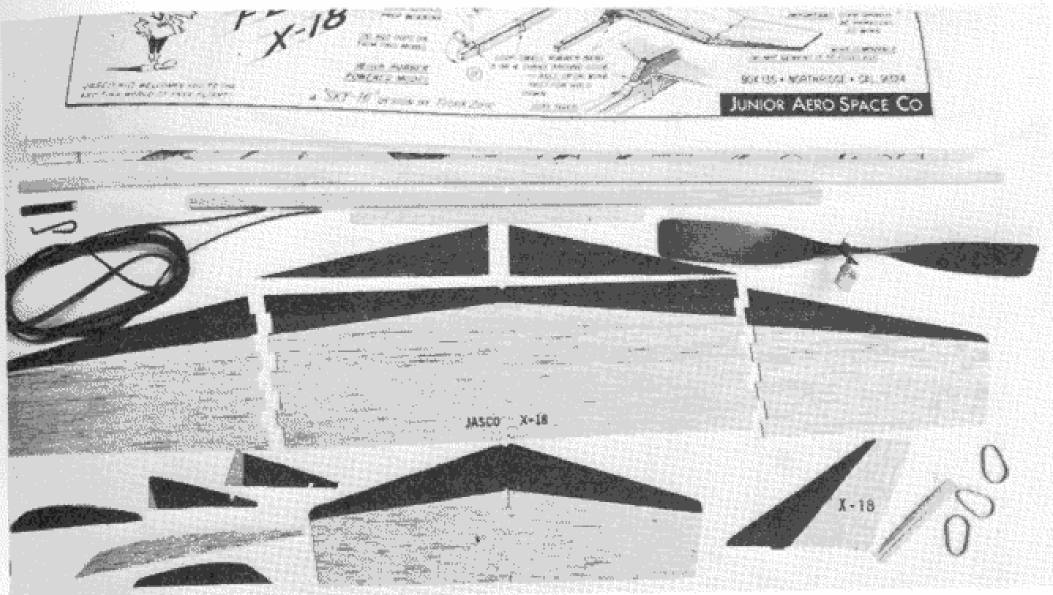
by Frank Zaic

How a simple yet efficient all-balsa model was produced to achieve a fast climb pattern—from N.F.F.S. 8th Annual Symposium papers

THE INITIAL objective of the development of X-18 was to provide for youngsters a model which would be similar in action and behaviour as the fast climbing free flight models. By giving the kids a taste of free flight and thermal hunting excitement and exhilaration, they may become candidates for future internationals. But as the programme progressed, a second objective arose which in the end proved to be especially interesting: How to determine the rudder or fin area?

In designing free flight models for the beginner (whose age may be between 8 and 10 years and whose father is not a model builder) we have to assume that the price of the kit must be relatively low so that the father will not hesitate to "risk" his money to find if his youngster would like the model 'plane building. Also, the construction time should be limited to one or two evenings, and assembly as easy and simple as a plastic model to prevent boredom and frustration. The construction time element eliminates framework and paper covering. (It is sad but true that most of the scale model kits begun by youngsters are never completed.) The low price and building time spell out a simple stick type of model for the beginners. How to convince the youngsters to start with such a model is another story.


FLASH X-18
18 inch RUBBER POWERED MODEL
A "SKY-HI" DESIGN BY Frank Zaic
JUNIOR AERO SPACE Co
BOX 135 • NORTHRIDGE • CAL. 91324
JASCO KID WELCOMES YOU TO THE EXCITING WORLD OF FREE FLIGHT!
DO NOT DOPE OR TRIM THIS MODEL
INCIDENCE STRIP DO NOT LOSE
BE SURE TO CEMENT THESE PIECES ON CENTER OF WING
RELOCATE THESE PIECES TO CENTER OF WING
GIVE CEMENT TIME TO SET & DRY WELL BEFORE FLYING
SPRUCE WING REST
TAPER ENDS
HOLD WING DOWN WITH PINS OR WEIGHTS
C.P. - CEMENT PRECOAT
C.P. SINKS INTO BALSA. PROVIDES BETTER SURFACE FOR FINAL CEMENTING
CLEAR TAPE PREVENTS CEMENT STICKING
DIHEDRAL JIG
CEMENT SKIN OVER DIHEDRAL JOINT
CEMENT WING FAIRING PARTS TOGETHER
VERY IMPORTANT — CEMENT INCIDENCE STRIP UNDER REST
TO PREVENT WING STICKING TO BOARD, JIGGLE OR MOVE IT WHILE CEMENT IS SETTING
CEMENT FAIRING TO WING
USE PIN TO HOLD SETTING
USE CORNER OF BALSA SHEET TO OBTAIN SQUARE LINE-UP
CENTER WING OVER REST
CEMENT WING TO REST
CENTER JOINT OVER WING REST
CENTER "V" OVER WING REST
SPRUCE BOOM
BALSA
CEMENT BOOM TO BALSA
"DRILL" HOLE WITH PIN FOR REAR HOOK
LOCATE BOOM AGAINST PROP BEARING
CEMENT & BIND WITH FINE THREAD FOR SAFETY
LOOP SMALL RUBBER BAND 3 OR 4 TURNS AROUND STICK. — ROLL UP ON WING REST FOR HOLD DOWN
NOTE TAPER
RUDDER
STABILIZER
PUSH THRU
CEMENT RUDDER TO STAB
USE CLEAR MODEL CEMENT. DO NOT USE PLASTIC MODEL CEMENT.
CEMENT PAPER-WIRE TO RUDDER TO HOLD ADJUSTMENT. NOTE FOLD-OVER.
CEMENT TAIL TO BOOM WITH REAR OF RUDDER AND "V" OVER BOOM
IMPORTANT: STAB SHOULD BE PARALLEL TO WING
WING IS MOVABLE DO NOT CEMENT IT TO FUSELAGE.



Layout of the kit parts for Flash X-18.

Since we hope to interest the youngster in free flight, we must provide him with a model that has spectacular, rocket-like, flight performance—practically the same features we want for ourselves and which we achieve with a lot of petty adjustments. While the only adjustment we should expect from the youngsters, at the most, is to move the wing back and forth and warp the rudder for a turn. Of course, the model should be structurally strong to survive the initial "get acquainted" period, and easily repaired on the field.

Finally, the building and flying instructions should supply all of the information needed so that father and son can build and fly the model without going to anyone else for help. We should realise that newcomers are in a strange world when it comes to model planes. The kit should be self-sufficient in all respects.

How did X-18 meet all these requirements?

The plans for the model, taken directly from the kit, are illustrated with this article.

Structurally, the motor stick is reinforced by a spruce strip which also serves as a tail boom. This laminate removes the insecurity of balsa strength variations and provides stiffness needed for relatively high power. The wing utilises the full area of a $\frac{1}{20} \times 3 \times 18$ in. sheet by die-cutting. It has the rigidity of a tapered wing. Note the dovetail dihedral joints. This provides extra cement areas as well as clamping effect during assembly. The dihedral breaks are also angled to provide wash-in and wash-out on the appropriate sides of the wing. Tail parts are also die-cut with rudder jigged to stab for true line-up. Thanks to Bill Warren, the rudder warp is held in position by a paper-wire wrap strip.

Aerodynamically, the X-18 has a flat wing surface so that, with just a slight help from "circular airflow" during the spiral climb, the wing has practically zero lift. The only need for the wing is to provide lift when it comes time for slow glide. The wing has right wash-in and left

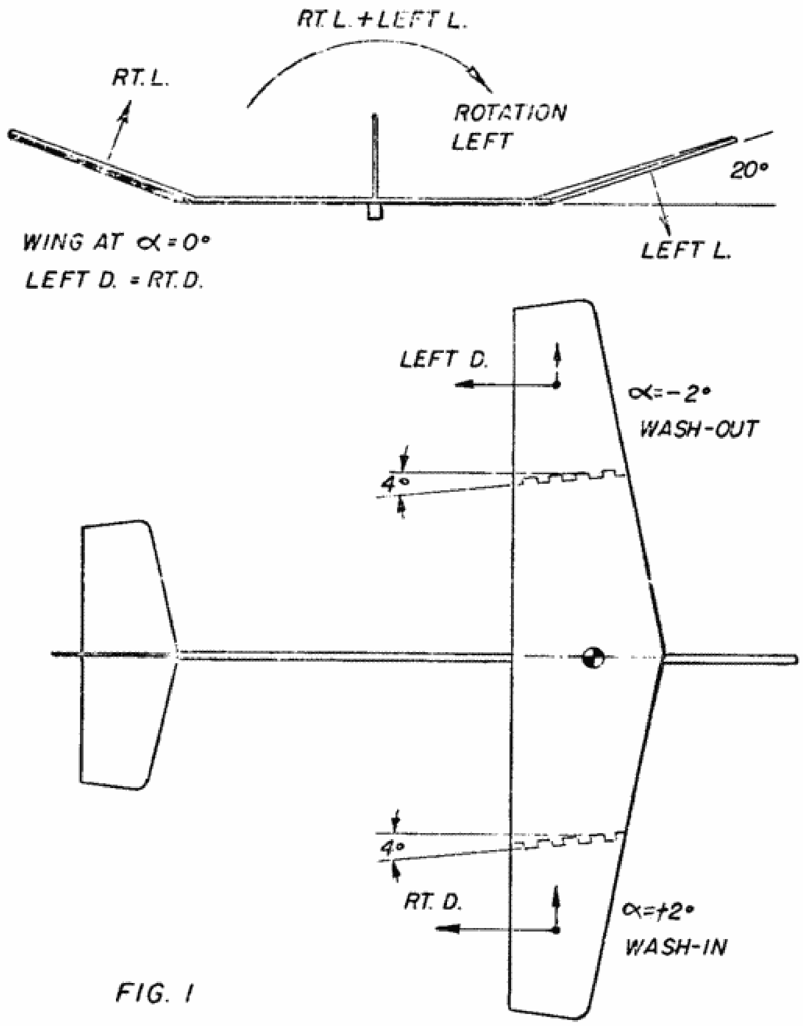


FIG. 1

wash-out of about 2° each. (4° angled dihedral break and 20° dihedral give 2° wash-out or wash-in. See *Fig.* 1.)

Besides having low lift under power, the flat wing also makes it possible to have the wing plus or minus ½ in. from the optimum position.

For the spectacular climb the North Pacific 7 in. plastic prop is powered by a loop of ¼ in. or 4 strands of ⅛ in. Pirelli. It runs in a nylon bearing which has down and right thrust built in. The 7 in. prop and a loop of ¼ in. Pirelli is a combination that is capable of pulling X-18 straight up for 10–15 secs. This high power–weight ratio is more than most of us use on rubber or engine powered models. And we are going to hand this "powerful" machine to a youngster who may have never flown a model. It should now be obvious why it is essential that all basic control settings must be built in.

During the testing stage I found that X-18 had to be launched at about 70°. A launch straight ahead might end up with the model biting the dust. The logic behind high launch, if you have enough power, is that as long as the model points up, it can gyrate all it wants without getting into crashing trouble.

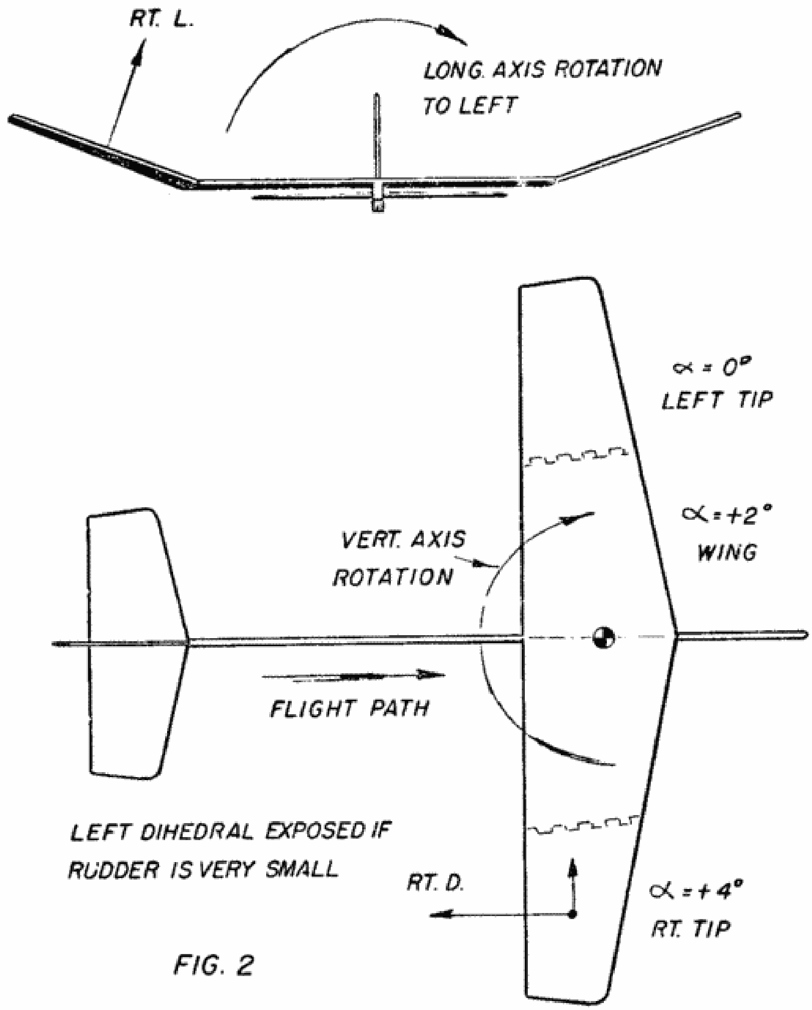


FIG. 2

Of particular interest to me was the check testing to determine the correct rudder size by trimming or adding to its area to see what happens with different sizes. At one time, with relatively small rudder, X-18 was determined to catch its tail right after launch, or it would dive after a turn or so. At first I thought to cure the problem by moving the wing forward to increase the wing moment around the C.G. and so cause a zoom up. But this adjustment did not work, even when the wing was almost at the prop. Then I recalled using a very large rudder to offset the right glide rudder setting. I tried this approach gradually, adding more area with each succeeding flight. The spiral dive disappeared. Then I got flights which were just right—smooth spiral with good transition. But I did not stop there, but kept adding more area until X-18 was looping after launch. The normal rudder turn warp was not effective with extra large rudder.

So, here we had a model on which the only change made was rudder area, and the flight pattern of the model changed from spiral dives with small rudder to looping with larger rudder area. In the meantime I was also intrigued by seemingly complete lack of help from the wing wash-in and wash-out. Where was right wash-in's lift to prevent right spiral

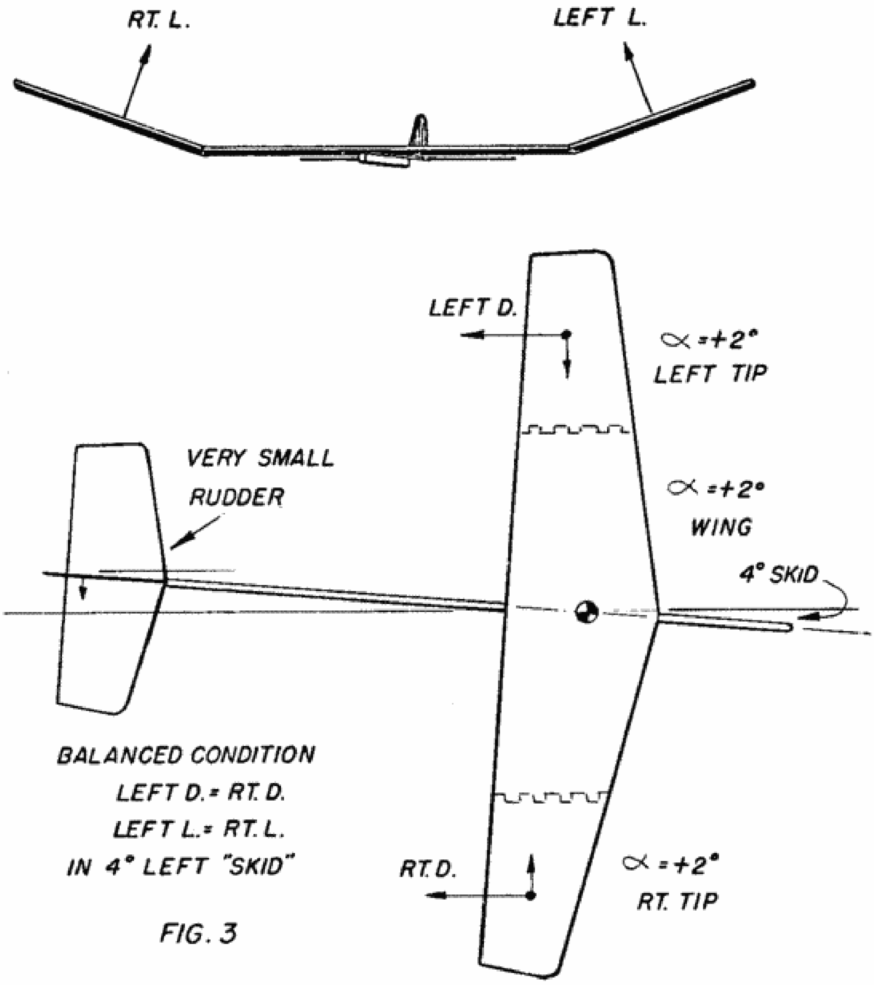


FIG. 3

dives? Why was change of rudder area so effective in bringing about changes almost at will?

The correct rudder area for X-18 was finally determined. The model has a steep right spiral climb under full power of $\frac{1}{4}$ in. loop of Pirelli. It has enough right turn rudder setting to transition the model into a smooth, fair size, right circling glide. Let us now cover the second objective:

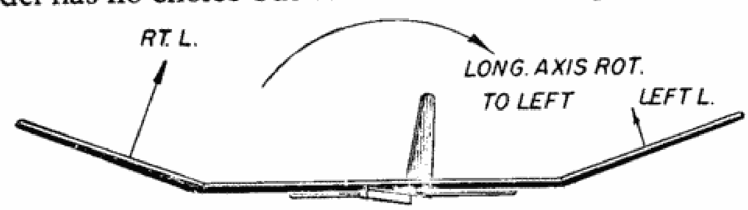
Why did X-18 behave as it did when rudder area was changed?

Before we go further, we should review the effect of rudder area in relation to a wing which has right wash-in and left wash-out configuration. The basic purpose of the rudder is to give the model a sense of facing the prevailing wind or relative airflow—the familiar weather vane effect. When both wing halves have equal values of lift and drag, the rudder area may not be critical. As long as the "centre" of side area is behind the C.G. the model will face the wind. But change the lift and drag values of the wing by warps, wash-in and wash-out, and the rudder area becomes critical. For example:

When a wing with right wash-in and left wash-out faces an airflow, its reaction is to create greater lift and drag forces on the right side (see

Fig. 2). The lift will tend to rotate the wing into a left bank, while the higher drag will tend to rotate the wing in the vertical axis to the right. As the wing rotates to the right due to higher drag value, it exposes the left side to greater angle of attack due to the dihedral. This in turn creates more lift and drag on the left side. The rotation on the vertical axis continues until both sides have equal drag values, which also indicates that their values are similar. Hence, it is quite possible that we may have a model, which has exceptionally small rudder area, gliding straight ahead with the fuselage at an angle to the flight path (see *Fig.* 3). It seems that the drag acts to rotate the model in the vertical axis before the lift rotates it on the longitudinal, so that we do not have the bank to left, before rotation to right.

Let us now assume that we have a tremendous rudder area (see *Fig.* 4). As the higher drag force of the right half rotates the model in the vertical axis, it exposes the left side of the rudder. The slight angle of attack on the rudder produces enough side lift (which tends to rotate the model to the left) to balance the greater wing drag force. So now we have produced a balance condition about the vertical axis and the model no longer can rotate to the right. But we still have higher lift on the right than on the left. The model has no choice but to rotate on the longitudinal axis, and



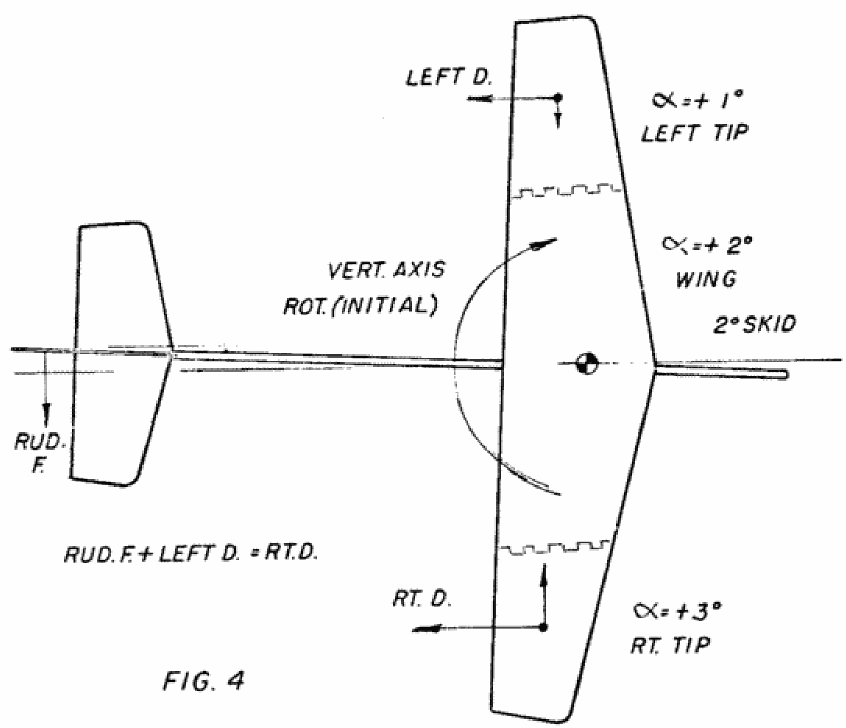
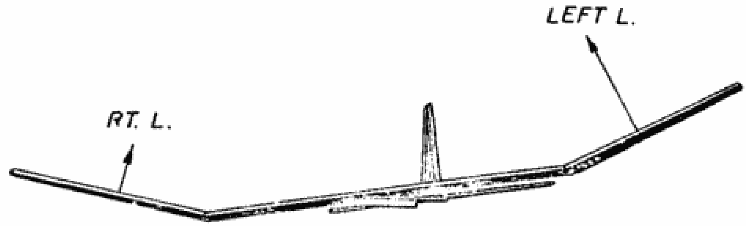


FIG. 4



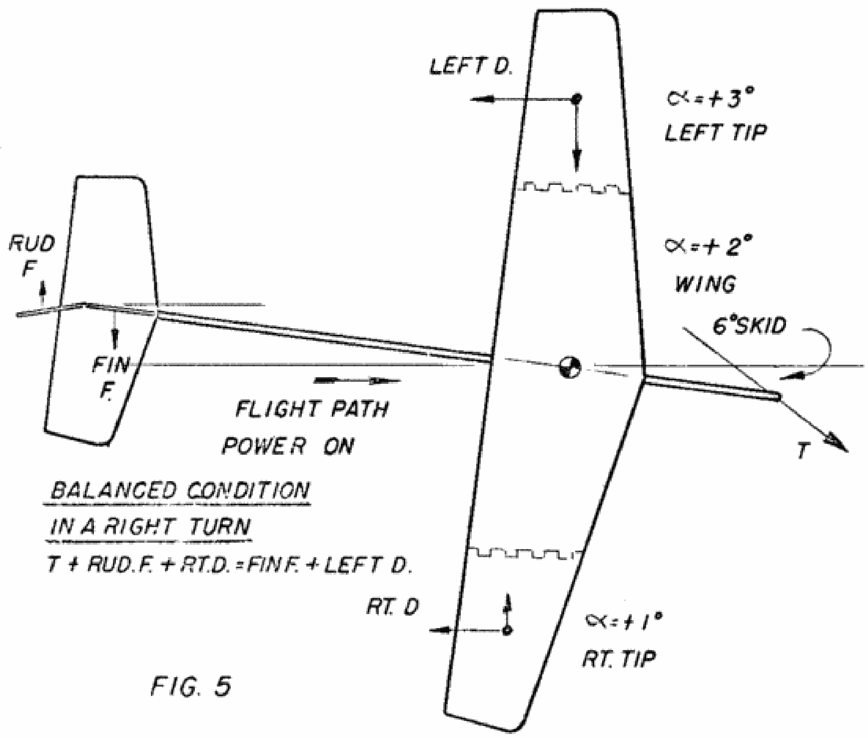


FIG. 5

here is nothing to stop it from doing so. If the axis was fixed, it would rotate like a prop. In practice, this would be a spiral dive to the left.

From this, one can see the effect of rudder area in relation to the wing which has wash-out and wash-ins or warps. A small rudder area will tend to produce a turn to the right, and a larger rudder, turn to the left. If the small rudder also had a right turn setting, the model may spiral down to the right.

Now let us introduce right side thrust into these situations.

Why do we need side thrust if it seems to be working against the rudder? Side thrust is used to produce safe circling patterns during power run. As we know, circling is needed to produce "circular airflow" effect in which the lift is reduced to minimal values. Under power, right thrust will tend to rotate the model about the vertical axis and counteract the rudder effect, which may normally balance the higher drag of the right side with its wash-in. The angled thrust line force should be allowed by the rudder area to swing or rotate the model until the lift due to dihedral effect of the left is greater than the right side (see *Fig.* 5). This greater lift will bank the model into the right turn and so determine the right spiral climb pattern. So that now, we have a condition in which the wing lift and drag are almost similar on both halves, with left having slight edge in lift. The extra drag of the left side is now controlled by the side thrust. In case of X-18 which has 2° wash-in and wash-out, the model has to be rotated on vertical axis by the side thrust 4°, plus whatever the left dihedral needs (say 1°) to provide the right bank. This also means that the rudder has 4° plus angle, which tends to rotate the model to the left. This left rudder force has to be balanced by side thrust to maintain a balanced right turn. This demonstrates the interaction or dependence of rudder area and side thrust as well as the value of wash-in and wash-out forces.

If, by chance, the rudder area is too small to balance the side thrust, the side thrust force will rotate the model so that the left dihedral effect will be greater than the lift of the right side. The result will be the familiar spiral power dive (see *Fig.* 6). And if the rudder area is too large, the side force may not be able to bring about the extra lift needed on the left side, and you may have looping or an undermined or unsatisfactory pattern. You may spend days making hopeful adjustments without achieving the right combination.

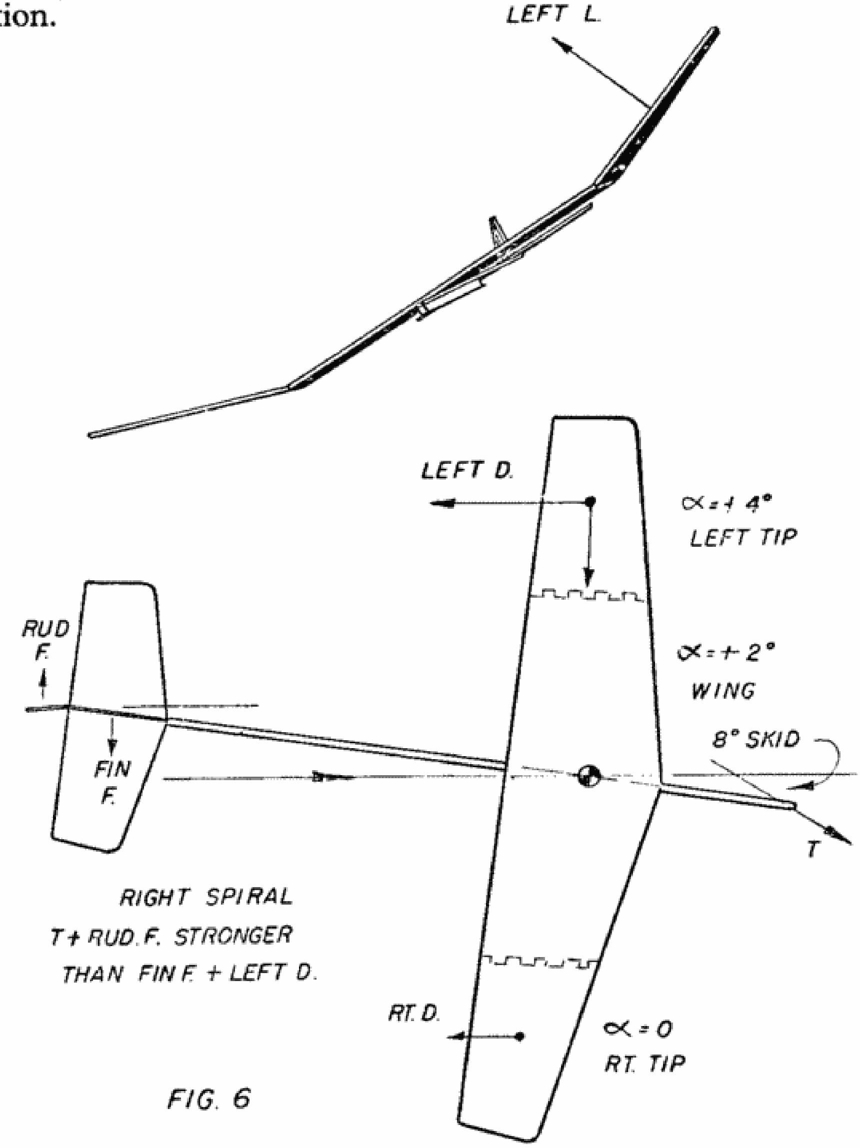
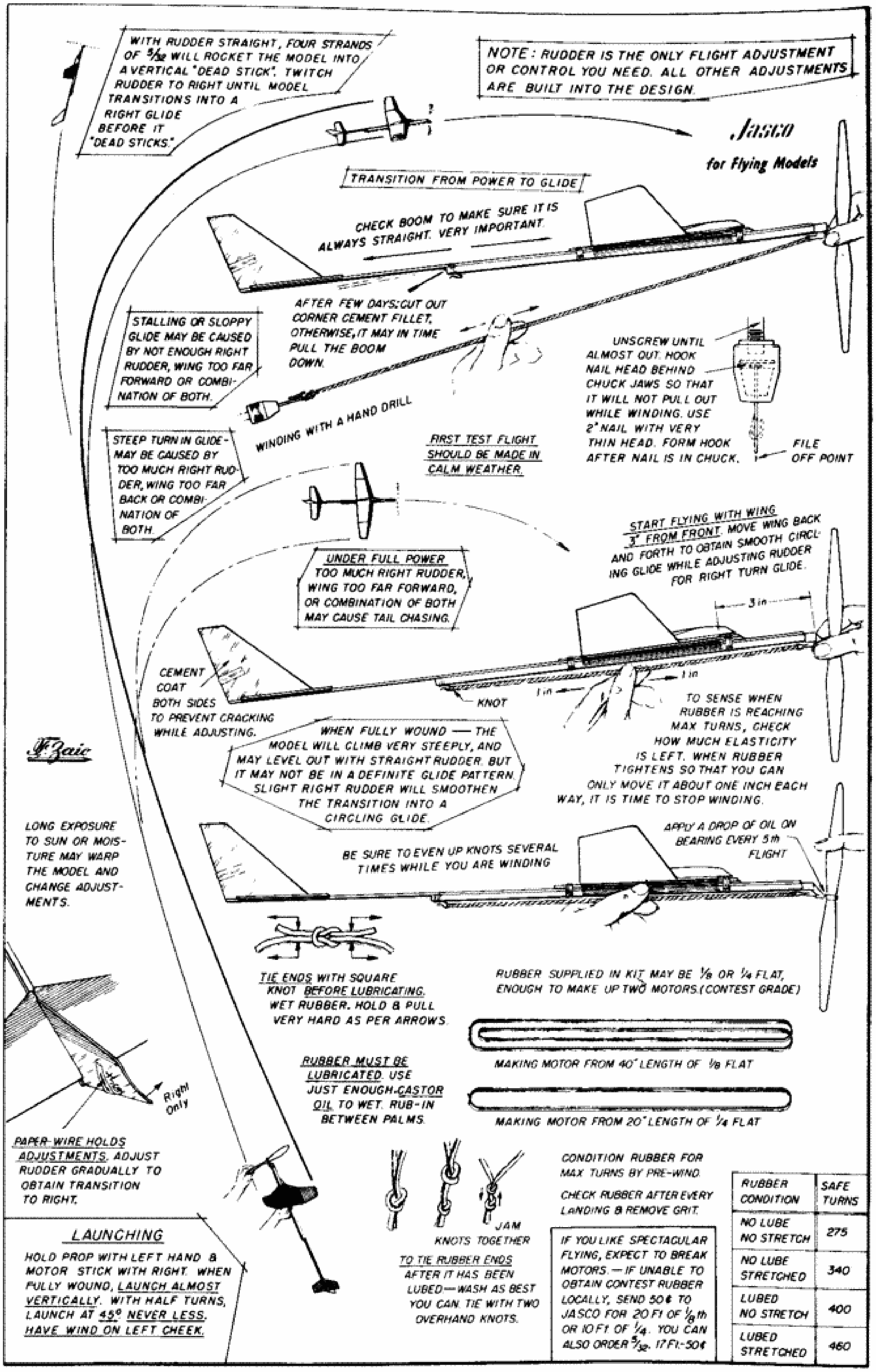


FIG. 6


WITH RUDDER STRAIGHT, FOUR STRANDS OF 3/32 WILL ROCKET THE MODEL INTO A VERTICAL "DEAD STICK". TWITCH RUDDER TO RIGHT UNTIL MODEL TRANSITIONS INTO A RIGHT GLIDE BEFORE IT "DEAD STICKS."
NOTE: RUDDER IS THE ONLY FLIGHT ADJUSTMENT OR CONTROL YOU NEED. ALL OTHER ADJUSTMENTS ARE BUILT INTO THE DESIGN.
Jasco
for Flying Models
TRANSITION FROM POWER TO GLIDE
CHECK BOOM TO MAKE SURE IT IS ALWAYS STRAIGHT. VERY IMPORTANT.
AFTER FEW DAYS: CUT OUT CORNER CEMENT FILLET, OTHERWISE, IT MAY IN TIME PULL THE BOOM DOWN.
STALLING OR SLOPPY GLIDE MAY BE CAUSED BY NOT ENOUGH RIGHT RUDDER, WING TOO FAR FORWARD OR COMBINATION OF BOTH.
UNSCREW UNTIL ALMOST OUT. HOOK NAIL HEAD BEHIND CHUCK JAWS SO THAT IT WILL NOT PULL OUT WHILE WINDING. USE 2" NAIL WITH VERY THIN HEAD. FORM HOOK AFTER NAIL IS IN CHUCK.
FILE OFF POINT
WINDING WITH A HAND DRILL
STEEP TURN IN GLIDE - MAY BE CAUSED BY TOO MUCH RIGHT RUDDER, WING TOO FAR BACK OR COMBINATION OF BOTH.
FIRST TEST FLIGHT SHOULD BE MADE IN CALM WEATHER.
START FLYING WITH WING 3" FROM FRONT. MOVE WING BACK AND FORTH TO OBTAIN SMOOTH CIRCLING GLIDE WHILE ADJUSTING RUDDER FOR RIGHT TURN GLIDE.
UNDER FULL POWER TOO MUCH RIGHT RUDDER, WING TOO FAR FORWARD, OR COMBINATION OF BOTH MAY CAUSE TAIL CHASING.
3 in
CEMENT COAT BOTH SIDES TO PREVENT CRACKING WHILE ADJUSTING.
KNOT
1 in
1 in
TO SENSE WHEN RUBBER IS REACHING MAX TURNS, CHECK HOW MUCH ELASTICITY IS LEFT. WHEN RUBBER TIGHTENS SO THAT YOU CAN ONLY MOVE IT ABOUT ONE INCH EACH WAY, IT IS TIME TO STOP WINDING.
F. Zaic
WHEN FULLY WOUND — THE MODEL WILL CLIMB VERY STEEPLY, AND MAY LEVEL OUT WITH STRAIGHT RUDDER. BUT IT MAY NOT BE IN A DEFINITE GLIDE PATTERN. SLIGHT RIGHT RUDDER WILL SMOOTHEN THE TRANSITION INTO A CIRCLING GLIDE.
LONG EXPOSURE TO SUN OR MOISTURE MAY WARP THE MODEL AND CHANGE ADJUSTMENTS.
APPLY A DROP OF OIL ON BEARING EVERY 5th FLIGHT
BE SURE TO EVEN UP KNOTS SEVERAL TIMES WHILE YOU ARE WINDING
TIE ENDS WITH SQUARE KNOT BEFORE LUBRICATING. WET RUBBER. HOLD & PULL VERY HARD AS PER ARROWS.
RUBBER SUPPLIED IN KIT MAY BE 1/8 OR 1/4 FLAT, ENOUGH TO MAKE UP TWO MOTORS. (CONTEST GRADE)
RUBBER MUST BE LUBRICATED. USE JUST ENOUGH CASTOR OIL TO WET. RUB-IN BETWEEN PALMS.
MAKING MOTOR FROM 40" LENGTH OF 1/8 FLAT
MAKING MOTOR FROM 20" LENGTH OF 1/4 FLAT
Right Only
PAPER-WIRE HOLDS ADJUSTMENTS. ADJUST RUDDER GRADUALLY TO OBTAIN TRANSITION TO RIGHT.
LAUNCHING
HOLD PROP WITH LEFT HAND & MOTOR STICK WITH RIGHT. WHEN FULLY WOUND, LAUNCH ALMOST VERTICALLY. WITH HALF TURNS, LAUNCH AT 45° NEVER LESS. HAVE WIND ON LEFT CHEEK.
JAM KNOTS TOGETHER
TO TIE RUBBER ENDS AFTER IT HAS BEEN LUBED—WASH AS BEST YOU CAN. TIE WITH TWO OVERHAND KNOTS.
CONDITION RUBBER FOR MAX TURNS BY PRE-WIND.
CHECK RUBBER AFTER EVERY LANDING & REMOVE GRIT.
IF YOU LIKE SPECTACULAR FLYING, EXPECT TO BREAK MOTORS.—IF UNABLE TO OBTAIN CONTEST RUBBER LOCALLY, SEND 50¢ TO JASCO FOR 20 Ft OF 1/8th OR 10 Ft OF 1/4. YOU CAN ALSO ORDER 3/32. 17 Ft.-50¢
RUBBER CONDITION | SAFE TURNS
NO LUBE NO STRETCH | 275
NO LUBE STRETCHED | 340
LUBED NO STRETCH | 400
LUBED STRETCHED | 460

The observation of needing extra lift on the outside wing can also be applied to models which have different area on the two halves, asymmetricals. A good example is the indoor model, on which the left wing has greater length or span. The standard setting is to set the rudder for left turn. This setting tends to rotate the model so that it exposes the right tip to dihedral effect, and lowers the left. If both sides of the wing had equal areas, the model may bank too steeply or the control may be too delicate. But with asymmetrical areas, the larger left area balances the greater right dihedral effect and so produces a balance of lift on both sides while the model is in a circling mode. Some may attribute the need of a larger inside area to the difference in air travel distance swept by inside and outside tips. This would be valid if the wing was flat and had no dihedral effect. It may contribute some help, but not as much as is thought. Perhaps some day someone will make a true asymmetrical area wing. I can just see a flat wing with a 5 in. chord on the inside tip and a 3 in. chord on the outside tip with the turn determined by rudder only.

In summary: A balanced model should allow its side thrust to balance the effect of the rudder to the extent that the left dihedral angle will be exposed enough to allow the required bank to the right to produce the spiral climb. (Rudder can be set for a right glide if the overall rudder or fin area is increased to offset this help to the side thrust.)

The desired situation is to have both sides with almost equal lift with enough extra lift on the left side to produce a bank for the right climb. This particular arrangement is also needed for gliders. When the circle is developed we need similar lift values on both wing halves. Yet to make it turn, the glider needs more lift on the outside wing to produce the bank. Without the wash-in and wash-out, the rudder adjustment can be very delicate. This can be observed very nicely on R/C gliders on which the wash-in and wash-out are not used. All you need is to touch the rudder, on a model having polyhedral, and the glider will turn into steep turn or even spiral. Of course, having the elevator control, it is easy to force the glider into higher angles of attack and thus obtain more lift and thus sustain a steady turn. Wash-in on the inside wing will let you make turn adjustments with greater safety.

Incidentally, the discourse so far should also help explain why small rudders are so essential for Nordic or towline gliders. A small rudder area lets the wing adjust itself to the difference in drag and lift values of the two halves and allows a straight tow. And the small rudder also lets you have the wash-in on the inside wing for turning. And since the auto-rudder kicks on after the tow, it brings the outside dihedral into play. At the same time, you had better watch out for cross wind launching. The small rudder may not be able to swing the glider into the wind fast enough to prevent the wind from catching the wing from the side and rotating the model into ground.

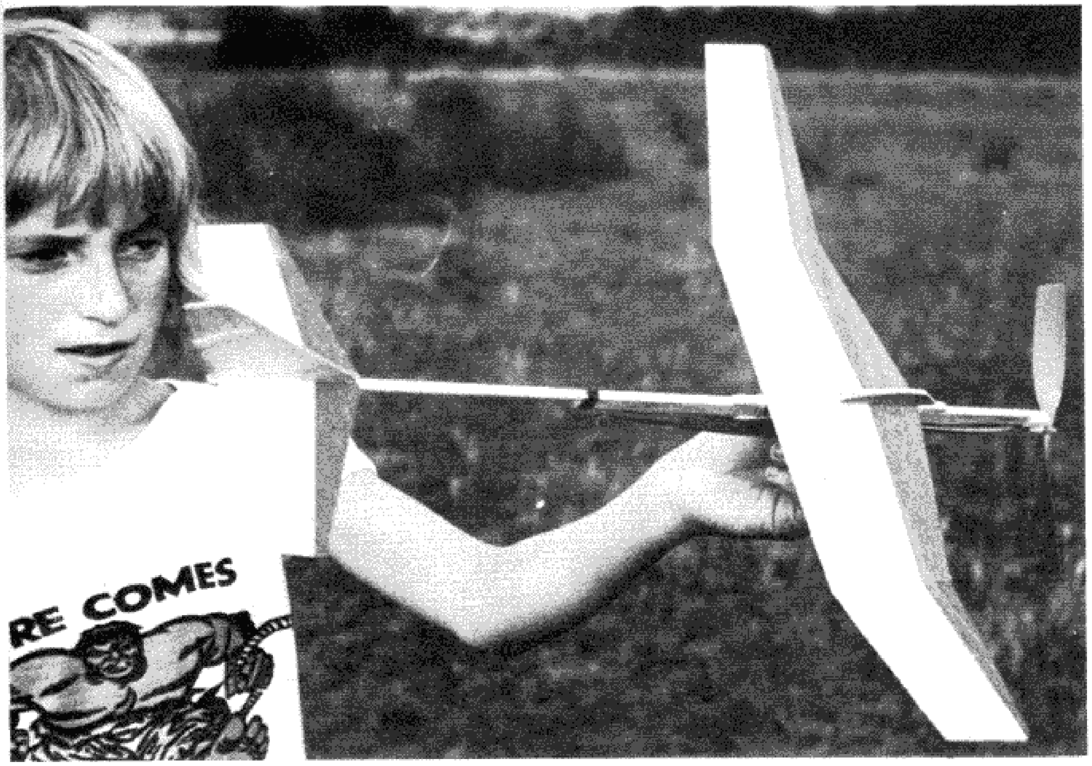
Back to the X-18. To check the correlation of the rudder area, setting, etc., I wanted to know if the X-18 could be made to fly a left pattern if the flight adjustments were reversed. That is, all adjustments except the prop rotation or torque effect. I took an X-18 die-cut wing stock and placed it upside down so that now the dihedral breaks gave me a right wash-out and left wash-in. The nose bearing was twisted to give left thrust; same size rudder with left warp for left glide; worked up to full power.

Jonathan and Reynard make a simultaneous launch and demonstrate the power model type climb angle of the Flash X-18. At right, the ultra simple model shows off its angled dihedral joints, short motor, long tail moment arm and small rudder

Sure enough, the model climbed in a left spiral and transitioned into a left glide as though it was a mirror image of the original right pattern. Surprisingly, torque did not seem to have any effect.

Up until now the X-18 power was high-grade Pirelli. But with prices going up and delivery uncertain I tried domestic products. I checked F.A.I. Supplies rubber and found that it had a higher initial torque than Pirelli. Higher initial torque also meant that the side thrust force was greater than Pirelli for which the X-18 was designed. This showed up in the right spiral power dive tendencies of tail chasing.

The fix was to increase the rudder area. The change, however, is slight enough so that X-18 can still handle Pirelli without tendency to loop. The right rudder warp can be increased with Pirelli but not for F.A.I. Supplies. This indicates that the model should be designed or adjusted for the highest expected power.

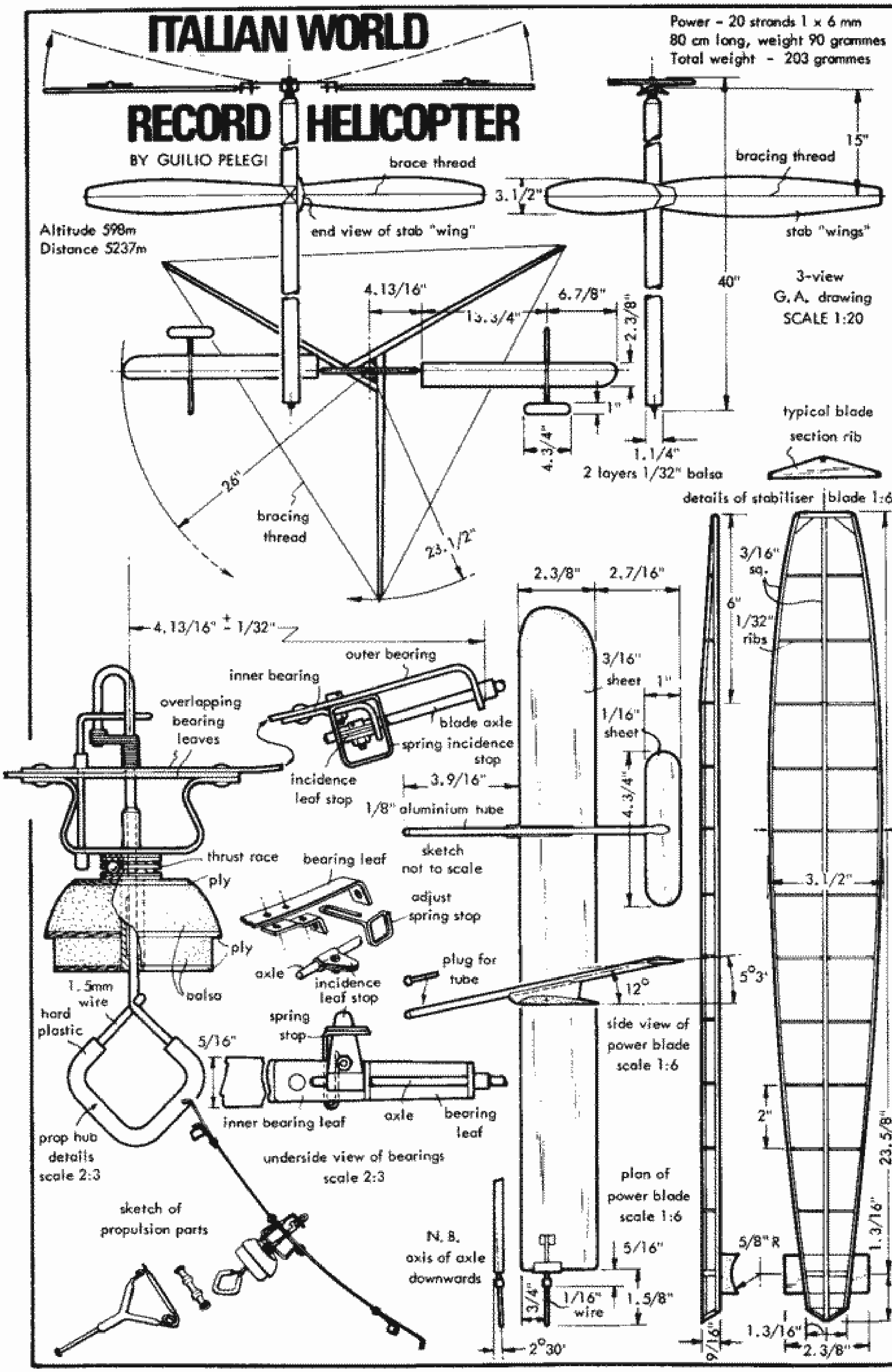


The last statement might be a hint why some of the models which fly well for the original builder do not behave as well for others. The power used on the original model might be less than on models built by others. If you build from plans or kits, it is well to keep in mind that if your model does not behave like the original, you might have more power than the original. So, find the power level at which the model behaves and don't force it into phase for which it was not designed. Of course, if you were able to follow the article so far, you *might* do better than the original!

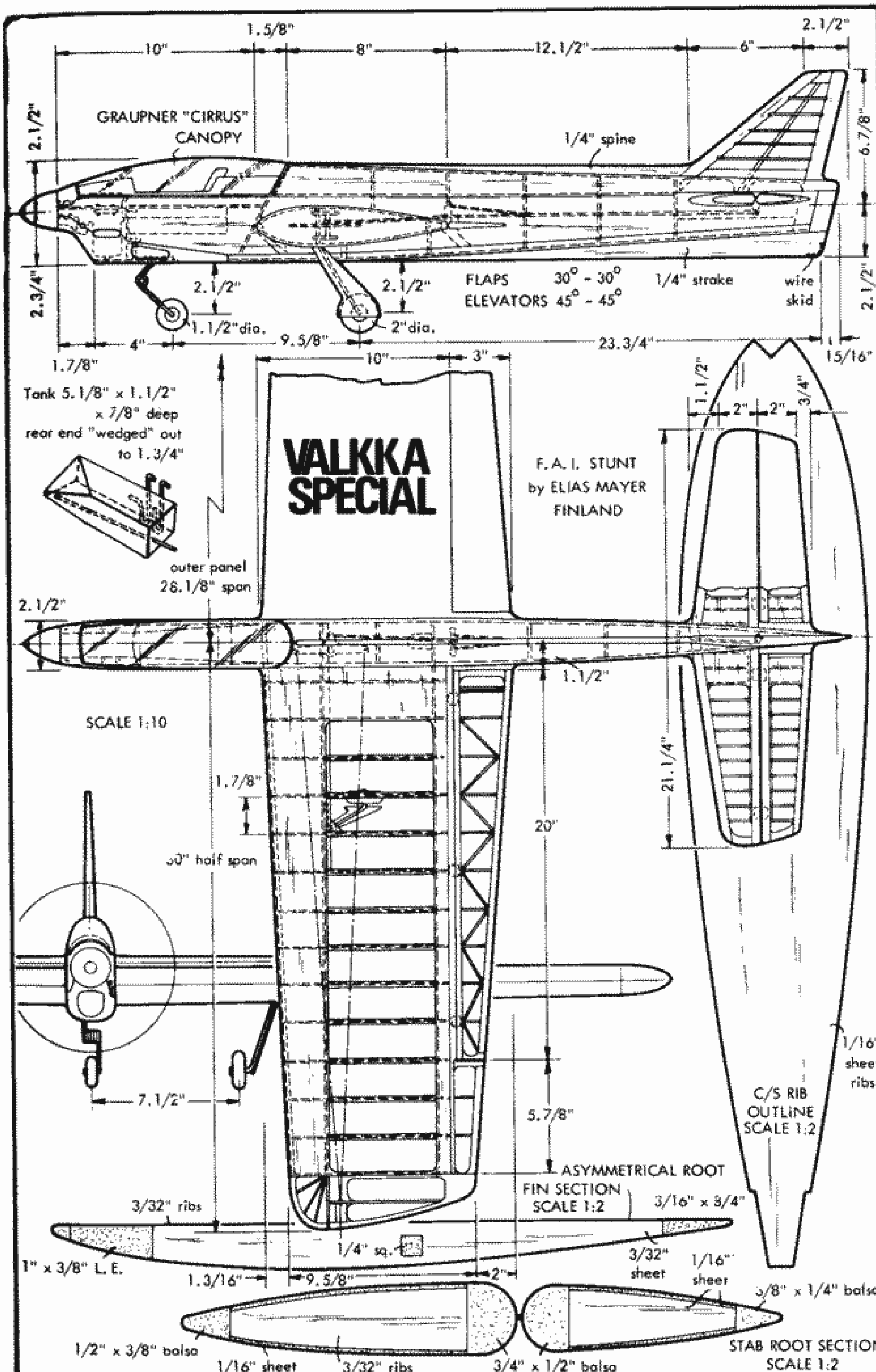
So far, over 15,000 youngsters have made and flown Flash X-18. No complaints so far. Have reports of 10 min. thermal flights and schoolgirls almost winning contests. It looks like X-18 met the basic objective, a model with spectacular climb when flown by beginners.

To me, X-18 has a very special significance. Ever since 1926 I have been wondering how the rudder area is determined. Now, I think that I know how it is done, or at least how when the rudder is too large or too small. This knowledge in combination with the Circular Airflow concept rounds out the basic design requirements of model aircraft. Now that we know (?) how to design the complete free flight model with inherent or built-in controls, is it still necessary to have gadgets? Gadgets mean pre-programmed flight, not free flight. To me a free flight model is on its own the moment you release it into the sky. To me, now, gadgets mean that one is not sure of what he is doing. It is a crutch. Some may call it insurance.

The joy of free flight comes only when your model is on its own, fighting in a three-dimensional world with your intelligence. It is a partnership that is wonderful beyond words!



MODELLISTICA ITALY



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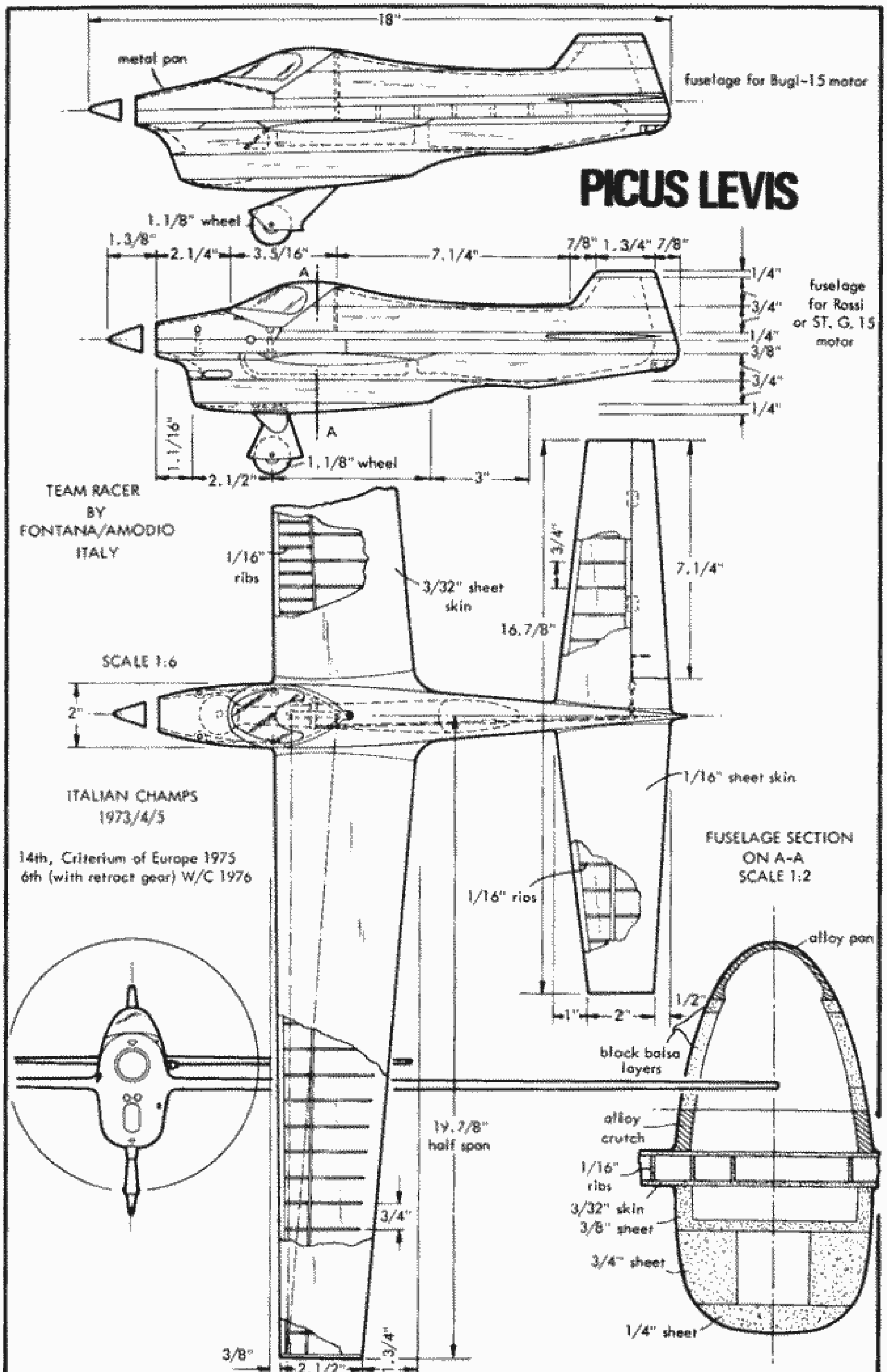

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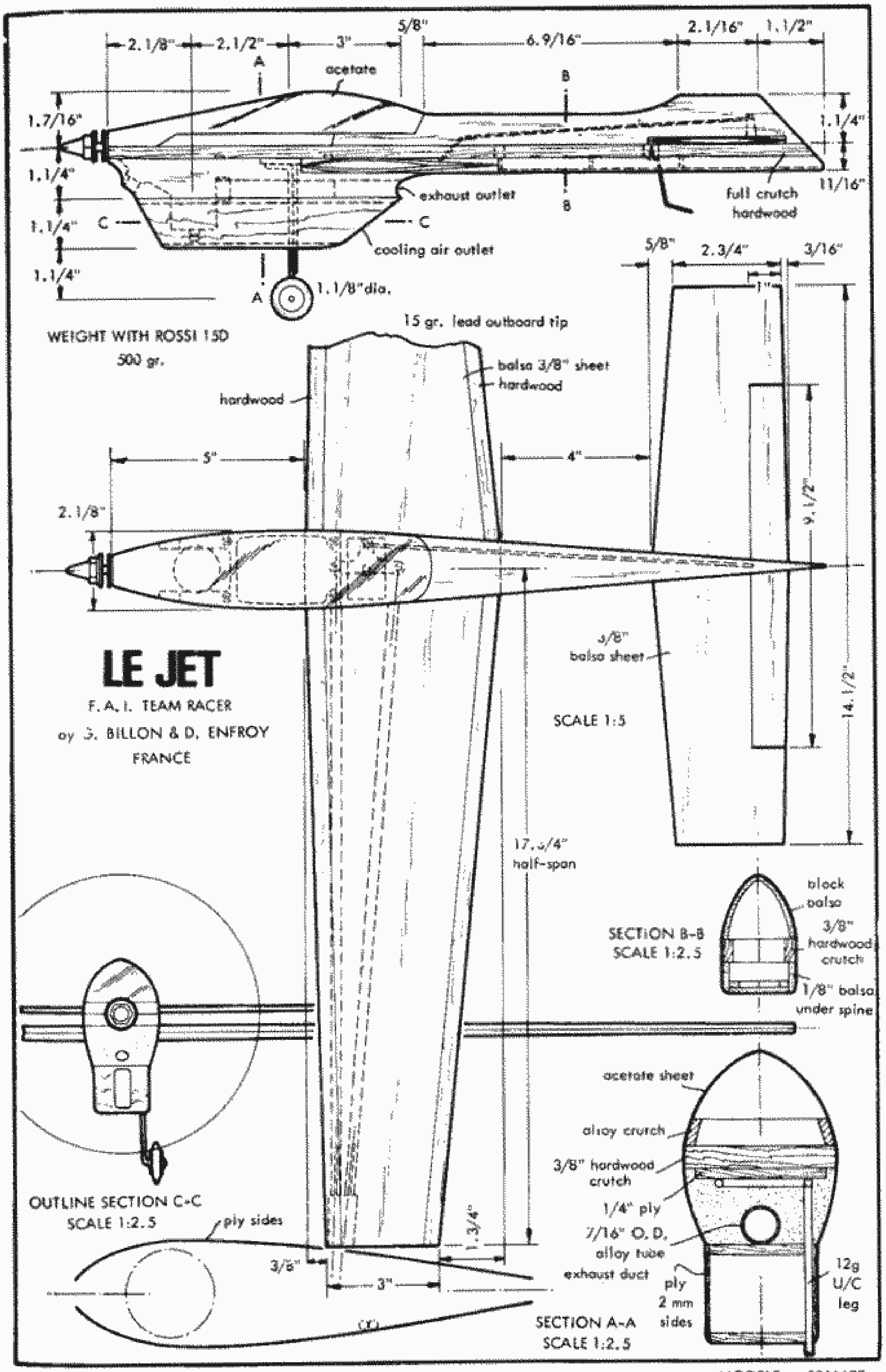
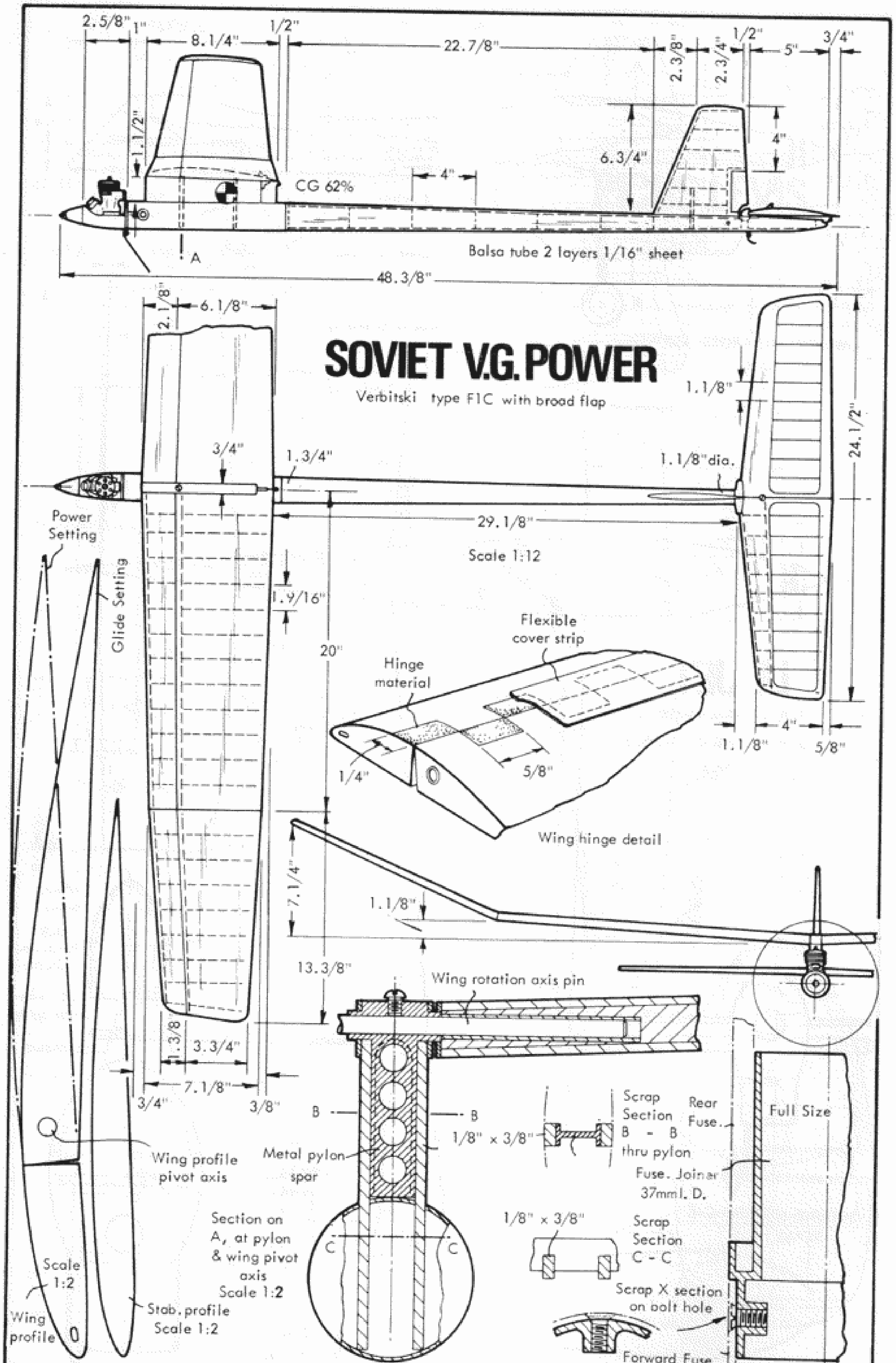
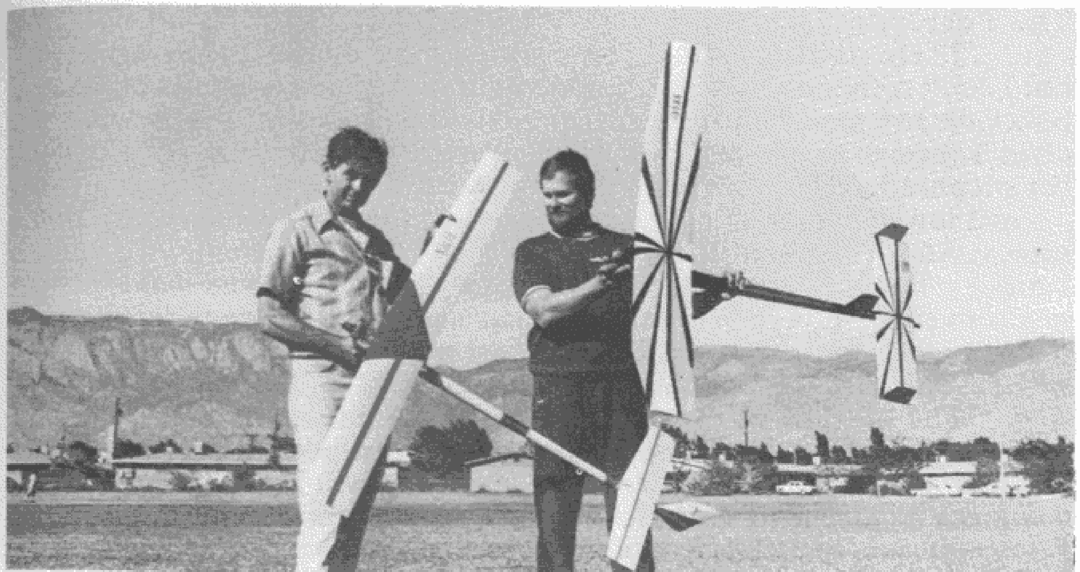


MODELE FRANCE



Wings of the Fatherland USSR



Jim Taylor (left) with his earlier design and the author, Bill Gieskieng (right), at their Denver flying field.

FLAPPERS

by Bill Gieskieng Jr., Denver, Colorado

(From "Scatter", the Journal of the Southern California Aero Team. A frank appraisal of the practical aspects in design and operation of variable camber wing surfaces on power models.)

THE BEST way that I know to describe a typical flapper is to start at the nose and work back . . .

The variable camber wing is the major part of the story, but we have to start at the beginning to understand all the aspects.

The Nose

The only major difference between a flapper nose and conventional nose is that the flapper sometimes can benefit from downthrust. There are many conventional models that use a so-called zero-zero setting between the wing and thrust-line. Actually, the fact that the bottom of the wing and the thrust-line are on the same angular line is rather misleading. The angular setting which is important, is the one between the Z.L.A. (zero lift angle) of the wing and thrust-line. A high-powered model does not "fly on the thrust-line". It flies on or near the zero lift angle of the wing. If the wing has a zero lift angle of, say, minus four degrees, then there is a built-in factor of 4 degrees downthrust with a so-called "zero-zero" setting. Some flapper designs have extremely low-cambered wing airfoils in the climb setting and to use a zero thrust-line would be comparable to using several degrees of up-thrust on a conventional design. All this is not to say one cannot use zero-thrust on a flapper. But if climb trim turns out to be unsafe, then moderate downthrust may be the needed cure. The flapper wing is by nature less consistent than a conventional wing and it is more difficult to maintain razor edge trim. I play it safe with a few degrees downthrust and a conservative c.g. for given terminal velocity.

The Fuselage

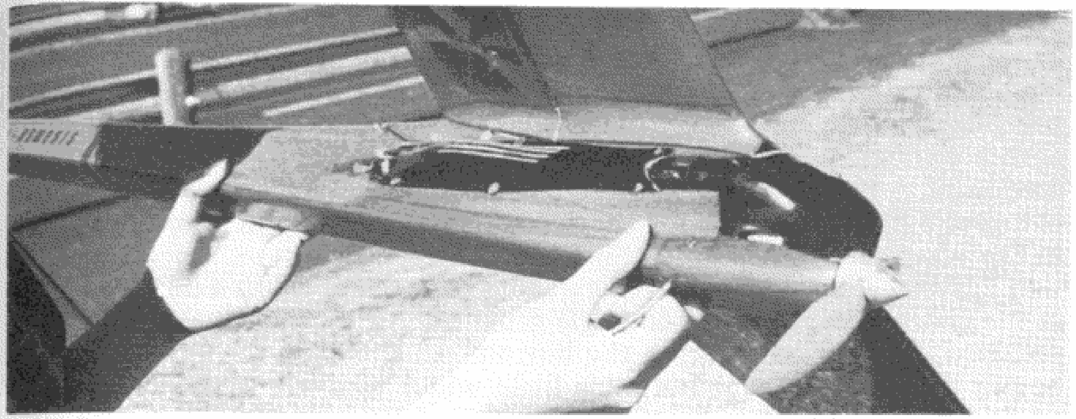
There are successful flappers that use the shoulder wing principle, but I don't recommend them. A moderately high pylon is a great insurance policy on any model and a flapper needs all the help it can get. Every so often I receive an inquiry from an interested modeller, with a sketch of the proposed design. Invariably the projected designs have pretty lines ... and low-mounted wings. And cowls. And special pans. And hidden timers. And ... well, in R.C., they call it the B-36 syndrome. The point I make is that a flyer should stick close to what has worked well for him as a conventional configuration. If there is a strong desire to pull out all the stops, the design should be tried first as a non-flapper ... that way, when it splatters the flap principle can't be held to blame.

The baseline of my various flapper designs is the bottom of the fuselage. The front of the wing (the non-flapped part) is parallel to this baseline. When the flap comes down, the wing will be at approximately 6 degrees incidence to the baseline. This angle is about right to place the fuselage in-line with the glide path. If the forward part of the wing already had some incidence built in, the model would glide with a nose-down attitude. According to some test results that I read years ago a slight positive angle of the fuselage to the flight path is not all bad. It seems the extra drag generated is balanced by the good effects of the lift produced. The net result is *no* decrease in glide duration. Thus my straight-bottomed fuselages should have little effect in the glide. But in the climb they may actually reduce drag.

Since the F.A.I. power designs travel in a climb angled along Z.L.A. of the airfoil the proper attitude of the fuselage should be on this line also. In practice this would call for a streamlined, symmetrical fuselage having the wing set at several degrees *negative* incidence! By sloping down the top of the fuselage the proper condition is approximated. Beyond that, there must be a sharp drop of the fuselage behind the tail platform, to accommodate the tail dropping down to the proper glide incidence. The straight bottom and curved top feature lends itself to this requirement.

The Wing Mount

An easy and very satisfactory way to hold a wing to a fuselage is by using rubber bands. Unfortunately, a flap for a trailing edge complicates the issue. Rubber bands can be used, but the results are messy. The flap has to have a large section cut out at the hinge line and in a hard landing the bands can tear up the flap before they can get free. So, it seems the only practical approach is to use nylon screws to mount the wing to the body. A one-piece wing is not too bad, since just two screws will do the job and double as wing keys. If the wing is a two-piece type, such as the "Siren-Dipity", the installation work becomes complicated. A regular wing uses either 6–32 or 8–32 screws going straight into the core of the pylon. Tapping plywood is rather chancy so it is best to use the proper sized T-nuts anchored *securely* into the pylon. If you would prefer to tap into wood, then insert sections of *rock hard* maple. Much of the maple sold as motor mount stock is too soft. If mounted on a pylon, there must be a platform thick enough to take the T-nuts. On the "Siren-Dipity" the screws exit just to the side of the rather thick, streamlined pylon. Lining up four pairs of holes is a task I don't like to face with every new model. So, I'm content with one-piece wings.



Meta-Nemesis was shoulder wing—no longer recommended though well flown by Annie Gieskieng several years back.

Nylon screws have a bad habit of failure at awkward moments. A typical flapper might have only a 3 or 4 in. distance between the fore and aft screws. This means that the leverage exerted on them during a hard landing is considerable. 6–32 nylon screws will fail enough to make you swear to use 8–32 the next time around. But the 8–32 screws offer less protection for really hard nose-bumping. Incidentally, the two-piece wing will shear screws more readily than a one-piece wing even though it has four screws instead of two. Screws fail in two ways. Most often they are sheared off as though cut. The other type of failure is a head popping off. Some of the excessive shearing tendencies can be alleviated by radiusing the point of contact between the wing and platform. This lets the screw bend more before it lets go. For the popping problem a thick rubber washer under the head might help. I don't tighten the screws down too tight. Getting the stubs out after they shear can be tedious. If you use blind nuts be sure to run a tap through them to clean them out. If the threads are on the loose side then the stub usually can be removed by using a T-pin and worrying the side of the embedded screw. A proper tool would be a sharp, wedge-shaped device that can be heated on the end, then forced into the stub. Just remember to always carry some extra screws, removing tool and a screwdriver when chasing your model in the outfield. It should go without saying that you should always make doubly sure that the screws are still intact before making the next flight.

Mounting the Wing

The rear screw should be next to the rear trailing edge spar. The front one as close to the leading edge with enough depth to offer support. A wing using nylon screws must be designed for this feature. Don't take a finished wing and just drill a couple of holes through the centre. Rubber bands spread the load across the whole chord, but screws put the load on localised areas. What has worked well for me is having two centre ribs of $\frac{1}{16}$ in. plywood about an inch apart. Wedged in at the bottom of these two ribs is a rectangular piece of $\frac{3}{32}$ in. or $\frac{1}{8}$ in. plywood running fore and aft. If there is a spar in the way, then the base must be in two pieces. This is all right as long as reinforcements and lots of glue are used.

Screw locations should be built up to the proper depth by small blocks of hardwood. Drill the holes, then fill around the top with soft balsa to support the planking. If you feel ambitious you can use a section of large aluminium tubing to line the well. This is a good idea, since under contest pressure one is likely to get shaky hands and bang up the recesses with a wandering screwdriver. Another good idea is to recess a tapered section of $\frac{1}{16}$ in. ply in the bottom planking under the screw holes. This will give a hardwood exit for the screws and also provide a solid surface to the wing platform.

Note: The above describes a flat centre panel. With a dihedral joint in the centre the plywood rectangle must be split in the centre or thicker ply used and angled to fit on the bottom. In this case the $\frac{1}{16}$ in. ribs can be put much closer together ... a little wider than the screw head. But additional flared plywood gussets must be added to tie in the centre ribs to the spar and the leading and trailing edges; otherwise the leverages will be too great on the close-set ribs and screw platform.

Wing Planform

What about the shape of a flapper wing? Many of the past flappers have had double tapered wings. This seemed a proper design feature because of the difficulty in making a flapper wing strong enough. If a flapper wing has a 10:1 aspect ratio and the flap is 50% of the wing chord then the effective load-carrying part of the wing has an aspect ratio of 20:1! A tapered wing will get more meat into the centre portions and will considerably increase the torsional rigidity. Also, it moves the centre of load inboard and this reduces the load moments. The disadvantages of tapered wings is that they are difficult to build and there is a considerable range of Reynolds number variation from root to tip. But it is not as bad as it might first seem. True, the main wing may have a very high aspect ratio; but then—unlike an A/2 wing—it can have a very thick "trailing edge", and this feature stiffens it up considerably. I am reluctant to build complicated wings and will try to stick with rectangular centre sections in conjunction with tapered tips. I have tried a variety of flap percentages—ranging from 25%—and believe that the best all-around flap width is between 35% to 40% of wing element chord. This leaves enough meat in the main wing to carry loads and the flap is still stiff enough to do its job. As far as aspect ratio goes, I'm leaning more to the conservative side. I would hesitate to build a flapper with more than a 68 in. projected span and an aspect ratio beyond nine or ten to one. For a first flapper project I would recommend not going over 66 in. projected.

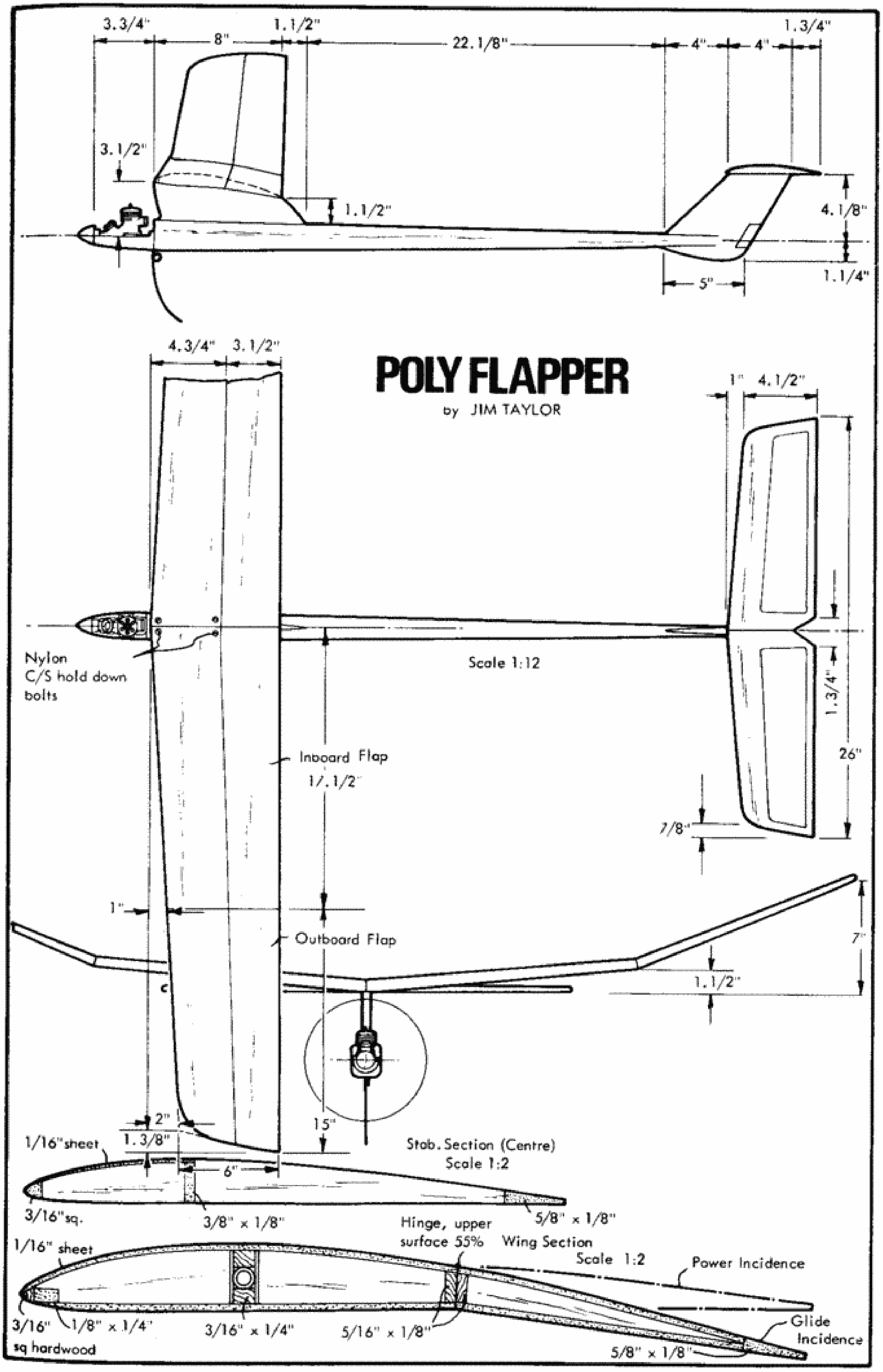
The Dihedral Problem

Occasionally I see drawings of projected flapper designs using straight dihedral. Straight dihedral makes sense from a structural viewpoint. But it hasn't proven out in flying ability. I tried models with a straight dihedral ranging from 10 degrees each panel, to a high of 15 degrees. My suggestion is to stick with polyhedral or perhaps a flat centre section with tip dihedral.

The flat centre section offers something in the ease of building not only the wing but simplifying the wing mount.

Wing Construction

The current vogue for all-sheet wings seems to offer a lot of advan-



3.3/4"
8"
1.1/2"
22.1/8"
4"
4"
1.3/4"
3.1/2"
1.1/2"
4.1/8"
1.1/4"
5"
4.3/4"
3.1/2"
POLY FLAPPER
by JIM TAYLOR
1"
4.1/2"
Nylon
C/S hold down
bolts
Scale 1:12
Inboard Flap
17.1/2"
1.3/4"
26"
7/8"
1"
Outboard Flap
7"
1.1/2"
2"
15"
1/16" sheet
1.3/8"
6"
Stab. Section (Centre)
Scale 1:2
3/16" sq.
3/8" x 1/8"
5/8" x 1/8"
Hinge, upper
surface 55%
Wing Section
Scale 1:2
1/16" sheet
Power Incidence
3/16"
sq hardwood
1/8" x 1/4"
3/16" x 1/4"
5/16" x 1/8"
Glide
Incidence
5/8" x 1/8"

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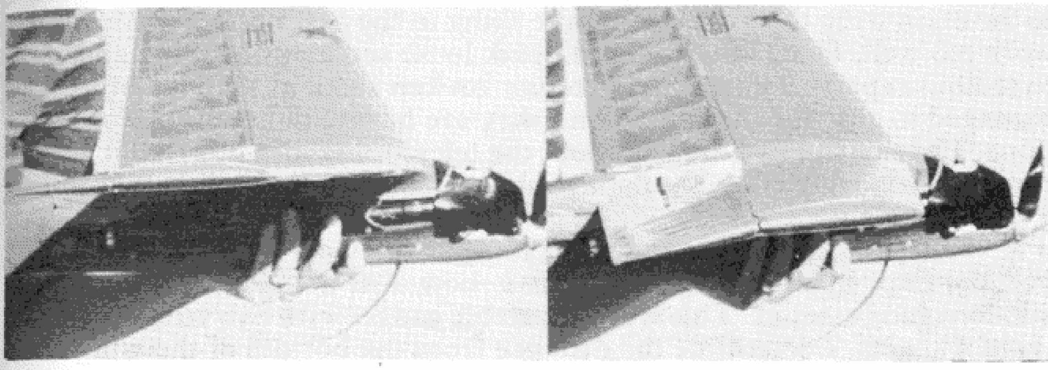
tages if you can find good sheet balsa! I use heavier spars than most designers because the flapper wing is the most time-consuming part of the model to build and I want to carry a little more insurance on it. Happiness is having a d/t under power and the wing *staying in one piece!* The front, main part of the wing can be built using standard techniques. The only difference will be the "trailing edge". The flap takes a different handling. I usually use $\frac{1}{32}$ in. sheet for the flap rather than $\frac{1}{16}$ in. If available I use "C" grain for its better torsional characteristics. The disadvantage with such thin sheet is that it leaves little room for sanding to match the main wing, so building tolerances have to be close. The main wing has enough depth so that parallel ribs sandwiched between $\frac{1}{16}$ in. sheet will give great torsional rigidity. But the flap is a different animal. The flap has an airfoil close to a thin triangle and it lacks the "D" box characteristic that stiffens the wing. I believe the answer here lies in using a medium heavy flap leading edge; sufficient depth, about 5% of total chord, plus a lot of diagonal ribs as with so-called Union Jack construction. The problem to be avoided is not flutter itself, but torsional displacement under load which can affect power trim. Naturally the closer to the razor-edge you are flying your model, the greater will be the effect on trim from any unwanted flap displacement. Let's clarify this: small variations in the flap angle can be tolerated, such as sloppy linkage, as long as the flap is free from binding. The problem arises with torsional stress accompanying the displacement. In the first situation the flap simply finds its own level without affecting the trim to any measurable degree. In the second condition, displacement accompanied by a torsional stress acts like sudden wash-in or wash-out, and *that* affects trim!

Hinges

The most troublesome part of building a flapper seems to be the hinging of the flap. I have used Rand "scale" hinges, regular Monokote, Super Monokote, the small Klett hinges, telescoping aluminium tubing as a piano hinge and even Scotch tape in conjunction with some of the above. Jim Taylor has used a special Mylar sandwiched between sections of light ply. The sandwiches are fitted into slots in the main wing and flap. Thomas Koster goes all the way with special Mylar with double-sided thermo-set adhesive. His sandwich structure is the whole trailing and leading edge at the flap joint. With his typical genius he milled a jig that allows him to line up the various components—stuck in an oven to set the adhesive—into a nearly perfect hinge line. This, frankly, is an approach beyond most modeller's abilities, patience and resources. Ken Phair uses a round dowel-like hinge that seems to work well (Robart Mini-hinge point). He uses the smaller of the two available sizes. The advantage with the round hinge is that it can be installed by simply drilling matching holes. The disadvantage is that the installation is permanent and that out near the wing tip the needed hole may be wider than the spar on thin airfoils. The original, bigger, round hinge was impossible, but the new, smaller ones could be a good fit. Ken angles the hinge holes to get the hinging point at the top.

My first hinges were the Rand Scale hinges. Because they are offset it was possible to mount the flanges in near-centre of the spar height yet have the hinging point at the top or the bottom of the spars. The Rand



Flap up for climb, down for glide on Meta-Nemesis.

hinges are rather bulky and recesses were cut into the spars to get the two elements closer together. To seal the gap I used regular Monokote and in one instance, Scotch tape. Naturally, the hinging point had to be on the same level as the sealing material to avoid binds. On some designs I didn't recess the hinges and simply covered the bottom gap with Super Monokote. The gap at the top was covered by the main wing sheeting continuing past the end of the spar. It looked like a good idea on paper but was lousy in practice. The top sheeting had to be just right to overlap correctly, and it always seemed to be warping or getting in the way. The gap covering Monokote on the bottom was also a pain. It was always shrinking or stretching and changing the tension on the flap in the "up" position.

Then I tried Super Monokote hinges by themselves. I simply butt-jointed the wing and flap and ironed on strips over the top—very simple, quick installation. I thought I had it made! But I soon discovered the material "creeped" and didn't have enough rigidity to keep the elements aligned. If I set the flapper up for flight and left it for a while I would come back to find the hinge alignment all out of place. I tried re-arranging the gimmicks so as not to put a strain on the joint, but it was never satisfactory. Incidentally I found that the chrome finish Super Monokote came the nearest to being satisfactory. I would smear Duco glue on the bare wood on either side of the hinge joint. After sanding I would cover the flap and main wing separately. The glue helped the adhesion of the Monokote to get the hinging strips to stick to the underlying Mono. Then I would align everything in the climb-setting, and iron on the strips of chrome. The chrome Mylar is stiffer than ordinary colours and has much greater tear resistance; it is also much heavier. I used two layers. Another problem: if there was a slight bow to the wing the full span hinge would bind and cause resistance. I just gave up on this "easy" way.

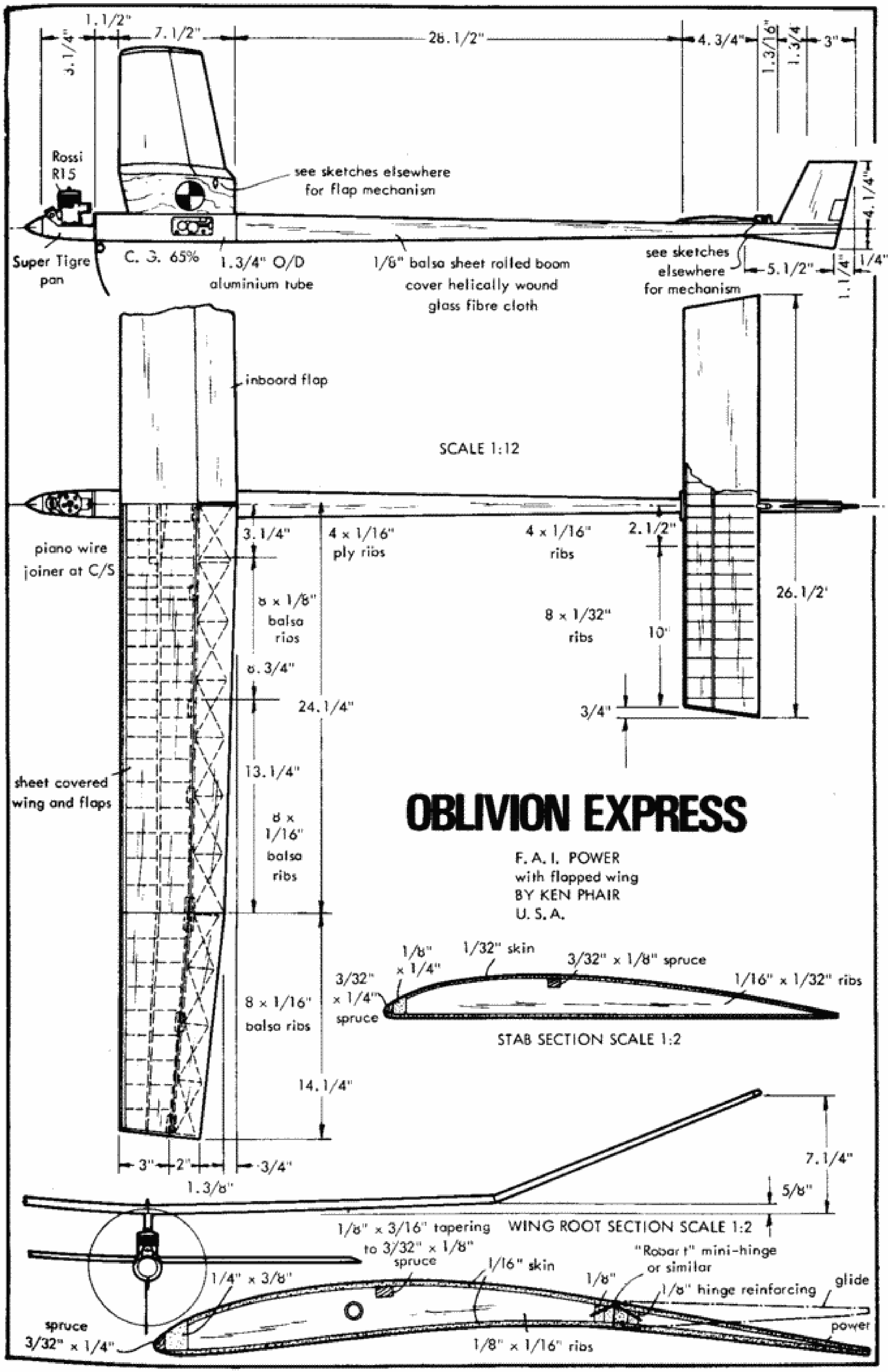
Then I tried Klett nylon hinges. Because they are straight, they had to be mounted near the centre of the joint. I went on to something else.

The something else was sections of telescoping aluminium tubing. For a while I thought, "This is it!" But they are time-consuming to install. A rounded slot has to be grooved into the matching sides of the joint, then sections of tubing have to be cut and radiused. They have to be carefully glued, one by one, into place ... hell, I spent more time joining the flaps to the main wing than in building the thing in the first place! And it didn't work too well. Hard knocks could break loose sections of tubing and lead to tedious repairs. I once tried to repair broken sections via Hot Stuff and managed to glue the flap solid! And they are heavy, those aluminium sections. The two things I did like about the telescoping idea was that it sealed the gap fairly well. Also, the flaps could be removed in seconds by pulling the centre elements.

I then went back to the Klett hinges. They are light and I can still pull the flaps in an emergency. This is how I'm doing it: I use part of a Tatone hinge slotter. This is an adjustable gadget with two strips of metal at right angles. I determine the distance from the bottom of the wing that will catch the centre of the spar near the tip. This allows the same guide setting over the entire wing. I use an X-ACTO key-hole saw and, using the guide, make a generous slot every 4 in. or so across the entire span. I do the same on the flap, making sure the holes will match. I then go over the slots with a rounded tool that will allow the bulky part of the hinge to recess evenly with the spar surface. I prepare the nylon hinge flange by puncturing it with a heavy T-pin. This allows better glueing to the wood.

I'm careful that I puncture only from the same side, since the blistered edges of the pin holes will force the flange to the far side of the slot. If I keep all the "blisters" either up or down on both the main wing side and on the flap, the alignment will match up pretty well. One by one I install the hinges in the main wing using the water-based glue, Titebond. I use a long section of 0·025 in. music wire to align the hinge holes with each other and to determine that the hinge line will be flush to the spar. After they are set, I try the flap on for size *without* glue. I make sure that the slots are pretty sloppy. Then comes the critical part, the glueing of the flap. Titebond is generally too thick so it must either be thinned for this operation or another brand of glue selected (Sig Aliphatic resin). The problem is this: the glue will soak up in the slots and they will swell and get tight. The glue gets very sticky and it is impossible to force the flange in. So, when the moment of truth arrives, take a glue gun and fill the slots generously, then wipe off the excess. Start on one end of the flap or the other and start forcing in the flanges one by one, just far enough so that there is enough clearance to get the next one in line started. Get them in, and the flap aligned in its proper position. It will be helpful if you can then lay the wing and flap on a level surface so that the bottom will be aligned. Within a few minutes, after the flap glue has firmed up a bit, pull the 0·025 in. music wire. (If you wait too long you might not get it out.) Using a small, rounded sliver of wood, carefully wipe excess glue away from the areas where the two sections of hinges mate. If you don't do this you may have trouble getting the sections to mesh.

After the glue is dried, put the flap back on to the main wing. (It will take a bit of careful fiddling to get the wire through the holes in the hinges. Just be patient and guide the wire with slivers of wood—naturally, have the end of the wire rounded.) With the flaps installed comes the final sanding to conformity. Set the flaps in the power phase position and "scrub" across the gap with a flat sanding block. Put the flaps in the glide position and sand carefully across the top gap to get the smoothest line possible. Use fine sandpaper within the gap to relieve points that may jam



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7.1/2"
28.1/2"
4.3/4"
1.3/16"
1.3/4
3"
Rossi
R15
see sketches elsewhere
for flap mechanism
4.1/4"
1/4"
Super Tigre
pan
C. G. 65%
1.3/4" O/D
aluminium tube
1/8" balsa sheet rolled boom
cover helically wound
glass fibre cloth
see sketches
elsewhere
for mechanism
5.1/2"
1.1/4"
inboard flap
SCALE 1:12
piano wire
joiner at C/S
3.1/4"
4 x 1/16"
ply ribs
4 x 1/16"
ribs
2.1/2"
8 x 1/8"
balsa
ribs
8 x 1/32"
ribs
10"
26.1/2"
8.3/4"
24.1/4"
3/4"
sheet covered
wing and flaps
13.1/4"
8 x
1/16"
balsa
ribs
OBLIVION EXPRESS
F.A.I. POWER
with flapped wing
BY KEN PHAIR
U.S.A.
1/8"
x 1/4"
1/32" skin
3/32" x 1/8" spruce
1/16" x 1/32" ribs
3/32"
x 1/4"
spruce
8 x 1/16"
balsa ribs
STAB SECTION SCALE 1:2
14.1/4"
7.1/4"
3"
2"
3/4"
1.3/8"
5/8"
1/8" x 3/16" tapering
to 3/32" x 1/8"
spruce
WING ROOT SECTION SCALE 1:2
"Robart" mini-hinge
or similar
1/16" skin
1/8"
1/8" hinge reinforcing
glide
power
1/4" x 3/8"
spruce
3/32" x 1/4"
1/8" x 1/16" ribs

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the flap. Allow a movement considerably in excess of what is actually needed. This is because when you cover there will be a build-up of dope, etc.; also you will find that when the model d/t's the flap will flex downward and you don't want a bind that can lever the hinges out. I would suggest 5 degrees leeway on the downward movement; 2 degrees or so on the upward movement. Except for one operation, the wing is ready to dismantle for covering. The above operations may seem too thorough, and maybe they are. Some, like Don McGhee, simply jam the works together, sand, cover, and break up—hopefully—any adhesions by brute force. The final phase is to arrange for the coupling of the polyhedral flaps to the inner flaps. Naturally, the fitting of the flaps should also include the spacing at the dihedral and polyhedral breaks. Because of dihedral the gap between the flap elements increases as the flap comes down. On a typical flapper the gap will be about $\frac{1}{4}$ in. Obviously, the gap closes when the flap is reflexed in the climb position. The surface between flaps must be trimmed down for a near-perfect fit when the flap is in the up position. Because the angulation changes the space between the flaps, it is possible to jam the flaps to achieve wash-in effects—a separate subject. Incidentally, it is wise to use very thick ribs at the flap extremities; it is embarrassing to sand away for a fit, only to cut right through a rib. If you know what you are doing, use $\frac{1}{8}$ in. ribs. If you are unsure and are not building on a jig, use up to $\frac{3}{8}$ in. thickness.

With the components separated, use your favourite covering techniques. If you are using tissue just use enough dope to tack things in place and seal, *except* on the leading and trailing edge portions that form the flap joint; finish them. Extra dope and epoxy should be done *after* the flaps are reassembled to the main wing. Just don't dribble anything down the crack! If you are using Super Monokote, do not attempt to cover the trailing edge of the main wing or the leading edge of the flap. Just slice it off without attempting to bend it around anything. Seal exposed balsa with dope. If you attempt to seal the whole works with Monokote, by going around the corners, you will be sorry.

Monokote cannot go around a right angle and hold. It will later bulge, creep or detach altogether. It is better to cut it off to begin with, rather than have to perform a Monokodectomy later. But in any case do not use Monokote unless you have a very strong, stiff structure to begin with. Use silk or *good* Japanese tissue for its greater pre-stressing characteristics.

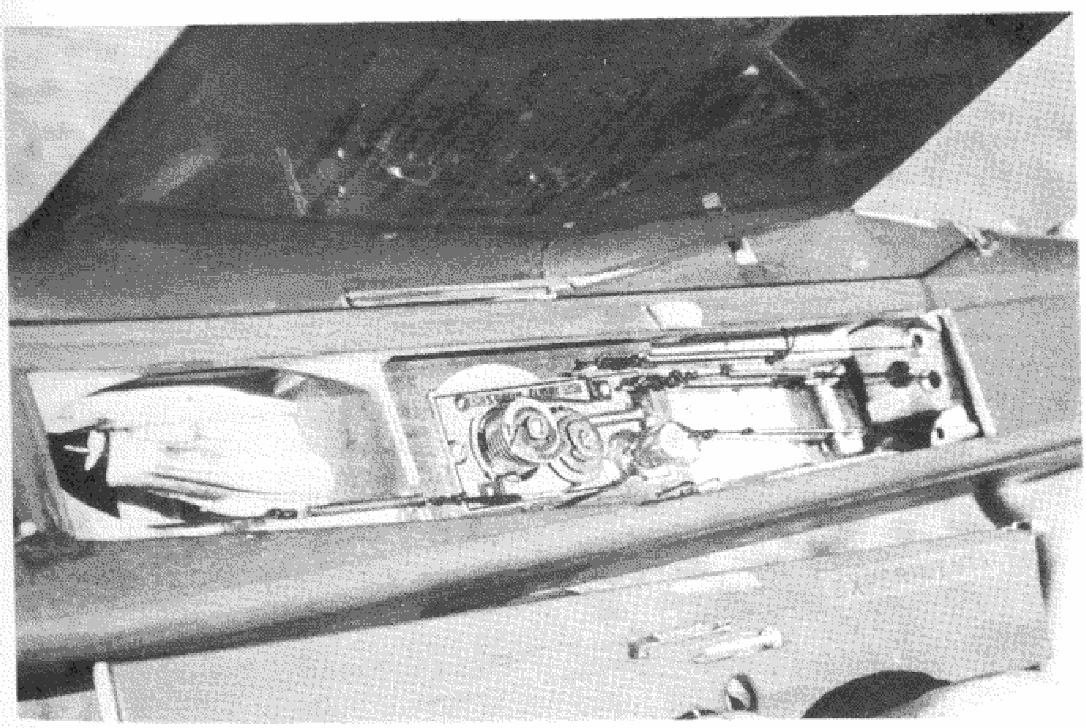
Coupling of the Flap Joints and Other Tit-bits

One of the most aggravating mechanical problems of a flapper is how to join the flaps at the polyhedral joint. Sure, there are many ways to do it, but not with elegance. The first polyhedral Flapper (the "Ruptured Raven") used a piece of music wire that was mounted on the inner flap and passed through an eyelet secured to the outer flap. It worked well, but looked crude. Later versions had the music wire passing through a sort of open-ended eyelet, a slotted piece of aluminium or magnesium. At one time I thought the answer lay in sort of a sandwich coupling. The gap between the flaps was covered by triangular sections of aluminium sheet on top and bottom. With the aluminium triangles bent in the centre to the correct polyhedral angle and only glued to the inner flaps, the tip flap was captured and had to go along, when the inner flap moved. A nice touch to all this was that the gap sealed even though the flap-gap was going through its usual gyrations. Another nice touch was that a 2-56 nylon screw could be hidden underneath the overlapping aluminium to provide flap jamming for wash adjustment. To add or subtract wash, the outer flap was removed by pulling the joint pin . . . turn the screw in or out and replace the flap. But like all good things there was a hitch. Getting the bottom triangles to fit was easy. But the top triangle is difficult. First, the flaps must be a perfect match or the fit will be too sloppy. Second, if there is camber on the flap topside the aluminium triangle has to be bent carefully in some sort of compound curve. Getting a good fit throughout the flap range of travel is enough to drive you up a wall. So, you finally get a good fit. Then what happens? You fly for a while and the nicely fitting surfaces get full of grit and cause mechanical drag where it should be all loose.

A section of wire on the trailing edge is certainly an eyesore, but it is the simplest way to couple flaps. If you want to seal the flap by the sandwich method, then use flexible triangles of light Mylar across the gap (glued to one side, sliding on the other) along with the bridging wire that focuses the load to a specific area.

Before you start spending time trying to figure out a more aesthetic flap coupling, let me point out some of the advantages of having everything hanging out in the open . . . and the joining wire passing through a finite coupling point. My friend and very able compatriot, Ken Phair, uses a wire coupling mounted in the interior of the flap body. He runs the wire from the inner flap to a section of tubing mounted in the outer flap. It is such a smooth installation that I have a hard time telling whether he

Complex Seelig timer connections are a pre-requisite for flappers. Left is bladder tank housing, centre the timer and right the leads to tail and flap controls.



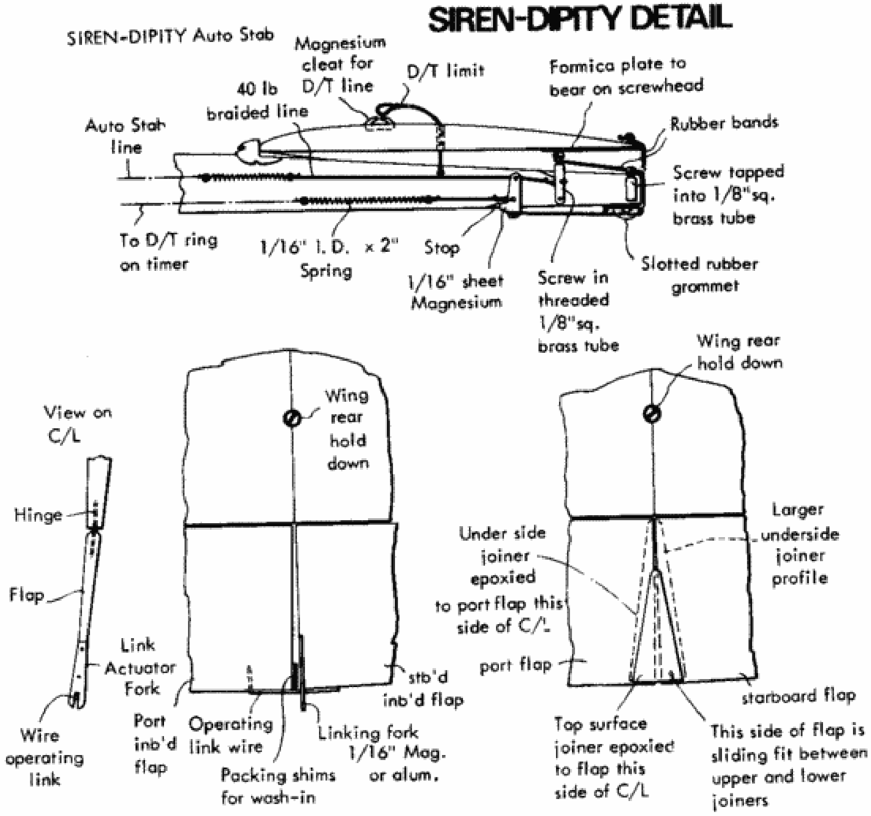
is flying a flapper or a conventional model. Such refinement can be tough to install and, unwittingly, can limit possible trim adjustments that are unique to flappers. The advantage of a finite coupling surface such as an eyelet on the outer flap engaging a wire supportive member is that the angle of the wire in relationship to the polyhedral is not critical. The advantage of a finite point of contact is that the angle of the joining wire does not have to match the flap plane of travel. The joining wire can be straight, it can be bent upwards, or bent downwards. It doesn't make any difference since, with point contact, everything will slide along in fine style. There is a problem with an eyelet. If the coupling wire joiner is out of alignment fore or aft, it will bind. The eyelet had freedom of fore and aft travel ... it would move forwards and backwards, tracking the joining wire, so there was no problem in this seeming limitation. If this seems like a far-out mechanical miracle, relax.

Koster's wire-capturing device was a piece of aluminium with a rectangular slot in it. It is just like the eyelet except the rectangular slot allows the wire to slide along the slot rather than pulling the circular eyelet along with it. Anyway, if the coupling is out in the open, the actual joining wire angle is not critical at all ... anything goes! This brings us to the trimming possibilities mentioned above. Normally, if we wanted the flap deflection angle to be the same across the span, the wire joiner should be at a particular angle (slightly less than the polyhedral angle). But, if we wanted the relative flap angle to be greater than the centre we could leave the wire straight ... because of the peculiar geometric angulations the tip flap would be deflected several degrees more than the inner flap. If we wanted less deflection in the tip flaps we could bend the joining wire sharply upwards and the end result would be considerably less tip flap deflation.

Trim

So, here are some of the tools we can use for flapper trim: in the climb phase with the flap up, we can "jam" the flap at the polyhedral joint by using a screw adjustment or pieces of shim stock between flap joinings. This adjustment is very close to "wash-in". That is, we can increase the lift coefficient of one panel or the other by deflecting the flap. It is not quite the same as wash-in since we are increasing both camber and incidence angle rather than incidence alone. But it is close enough.

The glide adjustment possibilities are mind-bending in their versatility. All of us are somewhat familiar with the effects of wash-in and wash-out as stability and thermal-seeking factors, but unfortunately, or fortunately, flap-bending is a thing unto itself. When we add wash-in to the right pinion on a pylon model we know pretty much what to expect. The model will have a certain degree of anti-spin insurance because the right wing will operate at a higher lift factor than if the wing were on a symmetrical plane. But we also know that the design will have a tendency to glide to the right because the drag coefficient will probably be higher on the right side and will be more of a factor than the higher lift. Also, we expect the right wing to stall first in a longitudinal disturbance (because it is already set several degrees higher than its twin on the left side) and help tighten up the right-hand glide. All this we know and utilise with various degrees of success. But the flapper is a different animal. We know about



FLAP JAMMER FOR WASH-IN SIREN-DIPITY

FLAP JOINER SIREN-DIPITY

wash-in (and out). Not through any native intelligence, but through the heritage of experience gathered on the field. But the flapper is different, at least as far as changing flap angles rather than changing set airfoil angles. Our cumulative aeromodelling knowledge gets left behind with flappers, because not only is it possible to change the angle of a given airfoil, but by changing the angle of attack we come up with an entirely new, strange airfoil. A conventional model is rather simple to trim. Increase the angle of attack and you increase values of lift and drag. With a flapper, you could end up in different situations. Or . . . and this is what has bugged me many times . . . the right wing *doesn't* stall out sooner when the flap is lowered. The airfoil hangs into and *past* the stalling point and forces the model into the opposite turn desired! Believe me, the trimming of flappers can be fun!

Start with the coupling wire set at the polyhedral angle. This will result in the flap-up position being in-line with the rest of the wing. When the flap comes down the angle for the tip flap will be slightly less than that of the inner panels. Generally, this will be like a slight wash-out on the tips. Once you get used to flappers, you can bend the coupling wire to see just what effect can be had for the glide phase. You will start out with something better than the conventional configuration . . . it is up to you to try and find something, in trimming technique, that is vastly superior.

I feel that flap jamming gives the easiest control for power. Building wash into a flapper wing is very difficult and is best avoided. If you desire wash-out at the tip panels, I would suggest that you use a toed-out joint, as is popular on H.L. glider designs. This allows building flat surfaces, yet gives favourable tip stalling characteristics associated with lower angles of attack at the extremities.

Now for some specific mechanical details.

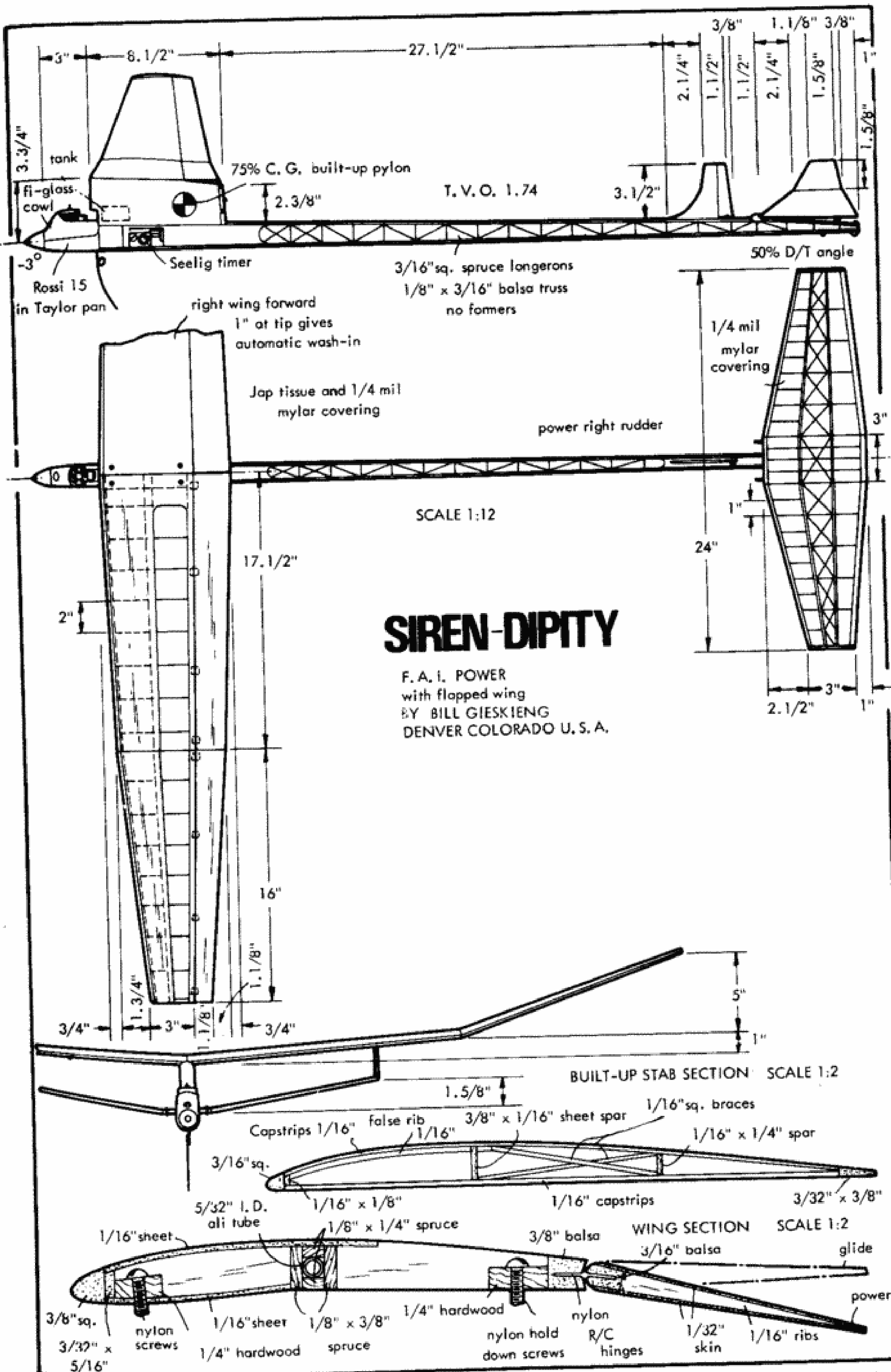
The wire bridging the flaps must be fairly stiff. Just to make sure, I would suggest 16 gauge piano wire. This may seem on the heavy side. but it must be remembered that the shock of d/t will put great loads on the wire joiner. If it were to be accidently bent, it could play havoc with the trim. Better safe than sorry! Since the wire joiner will be under torsional stress it will need a strong anchoring to the inner flap. To get such anchoring, I bend the root of the wire in a right angle and embed it into the inner flap. Once it is glued into place I reinforce by folding over a piece of glass cloth well smeared with modelling glue. Needless to say, the yoke on the tip flap must be strongly secured. I have used yokes that were extended root tips, anchored with epoxy *and* pins (for mechanical support). Here you must use your modelling skill. Anything that will engage the wire without friction through its range of movement will work—just be sure it won't fall off. Now for a *warning*.

The wire must extend past the yoke, slot, eyelet. It is not enough that it barely engages the outer flap when the flap is down and thus extended away from the inner flap at the wire-joining point. Allowances must be made for *further* deflection/separation under d/t shock. You really can't believe until you have a disengaged flap that has to be put back into place. If you allow ½ in. overlap of the wire through the yoke you won't have too much excess. The yoke itself must not be too short. Allow ¼ in. to overlap the wire.

At the centre of the flap, on the trailing edge, there must be placed a hard surface to ride on the flap cam, the flap plunger, or whatever you might feel inclined to call it. Also, there must be a hook of some sort to capture the rubber bands that keep the flap under tension during the climb phase, and pull it down tight and secure for the glide setting. The hook can be on the flap or the main wing. If it is on the main wing section it will be pretty secure. If it is on the flap proper there can be danger of pulling out the flap hinges if the wing "takes off" during a hard landing.

Sour Cream and Siren-Dipity

The Siren-Dipity was designed in 1971–72 as a fair weather flyoff model. I was getting tired of shoulder wing designs and decided to hoist the wing up into the air for a change. I wanted something stable and forgiving but yet capable of high performance. Originally the airfoil was meant to be the Got. 81, but a section that I had drawn up for Don McGhee's first flapper looked so good that I decided a switch was in order. The thin section with a relatively blunt and well-rounded nose was derived from the Got. 400. The 400 is one of the very few sections tested with a flap at various angles. The thing that drew my interest was that the drag with the flap "up" was very low compared to other under-cambered sections. In fact I had never seen another under-cambered airfoil that had its lowest drag point near the zero lift angle. The Siren-Dipity version was thickened slightly by decreasing the under-camber. The flap hinging position was changed from 40% to 35% for structural reasons. The flap angle used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75% C.G. built-up pylon
2.3/8"
T.V.O. 1.74
3.1/2"
-3°
Seelig timer
3/16"sq. spruce longerons
1/8" x 3/16" balsa truss
no formers
50% D/T angle
Rossi 15
in Taylor pan
right wing forward
1" at tip gives
automatic wash-in
1/4 mil
mylar
covering
Jap tissue and 1/4 mil
mylar covering
power right rudder
3"
SCALE 1:12
1"
17.1/2"
24"
2"
SIREN-DIPITY
F.A.I. POWER
with flapped wing
BY BILL GIESKIENG
DENVER COLORADO U.S.A.
3"
2.1/2"
1"
16"
1.1/8"
1.3/4"
5"
3/4"
3"
1/8"
3/4"
1"
BUILT-UP STAB SECTION SCALE 1:2
1.5/8"
1/16"sq. braces
Capstrips 1/16"
false rib
1/16"
3/8" x 1/16" sheet spar
1/16" x 1/4" spar
3/16"sq.
1/16" x 1/8"
1/16" capstrips
3/32" x 3/8"
5/32" I.D.
ali tube
1/8" x 1/4" spruce
3/8" balsa
WING SECTION SCALE 1:2
1/16"sheet
3/16" balsa
glide
power
3/8"sq.
nylon
screws
1/16"sheet
1/8" x 3/8"
spruce
1/4" hardwood
nylon
R/C
hinges
1/32"
skin
1/16" ribs
3/32" x
5/16"
1/4" hardwood
nylon hold
down screws

SCATTER U.S.A.

on the model for glide is much more than that found on the basic Got. 400 and corresponds to one of the flap angles tested. In the N.A.C.A. chart showing relative merits, the flapped Got. 400 comes out "average" in gliding ability compared to similar "Nordic like" sections. It is far inferior to the Got. 81, but then the '81 is impossible for the power phase without double flaps. The under-camber in the main wing makes for difficult construction and I would prefer a flat section for that reason.

The model was originally designed without fins on the tail. From calculations it seemed feasible to use the "V" stab in making up the needed area. But it didn't work out that way. On an early test flight the model made a sudden divergent move and flipped over on its back. Fins were added pretty quick!

The long body is a pain in the neck. It is a built-up boom and it is very tedious to build. Because of the great length the tail had to be very light and fragile and was constantly getting cracked spars changing the trim. Recently I removed the light Mylar covering and, besides sticking in some spruce spars, covered it with synthetic Japanese tissue. It is now quite strong, but the c.g. has moved back. The model is more erratic now in gusty winds and although there is sufficient longitudinal stability the rearward c.g. may call for more fin area.

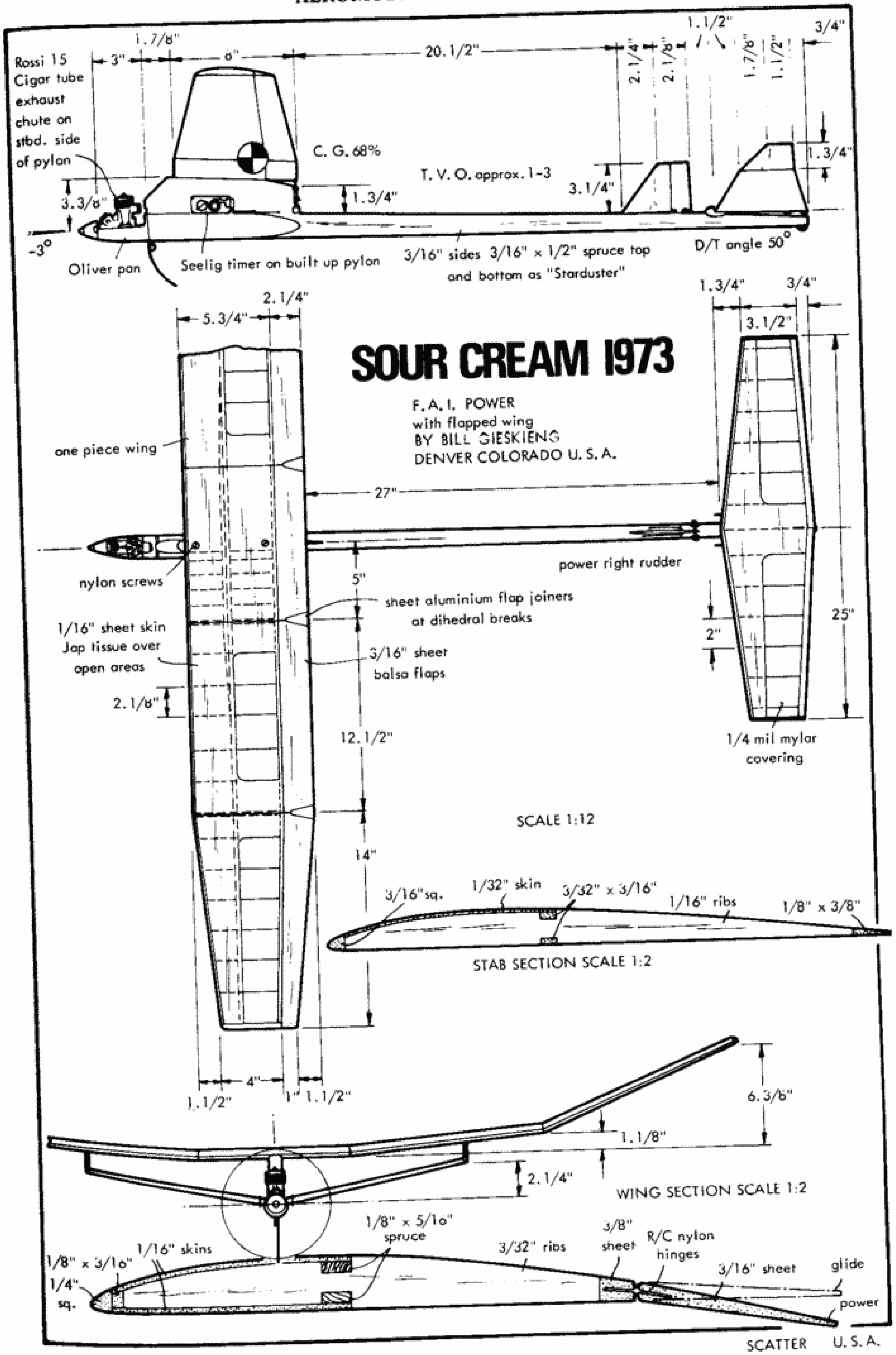
Originally, the model was fitted with a pacifier tank underneath a bubble canopy, but are a mess to handle and were suspected of blowing pistons and rods due to their unlimited flood-off action. A hard tank was fitted and it worked out much better except for the fact that all the needed tubing hanging out makes the nose of the model look like it is being strangled by a squid.

The Siren-Dipity has done a good job over the years, but I would never build another without considerable change. I would use a stronger tail without so much taper (I suspect that too much taper hurts the efficiency). I would definitely not use dihedral in the tail as it is more work and I think that it can cause some erratic tendencies under power if the model starts to wiggle. The short nose is a good design feature, but it is just too difficult to keep the c.g. where it should be. I would use a less fancy pylon, move the timer out of its recess onto the side of the body or pylon and get the engine out further towards the front.

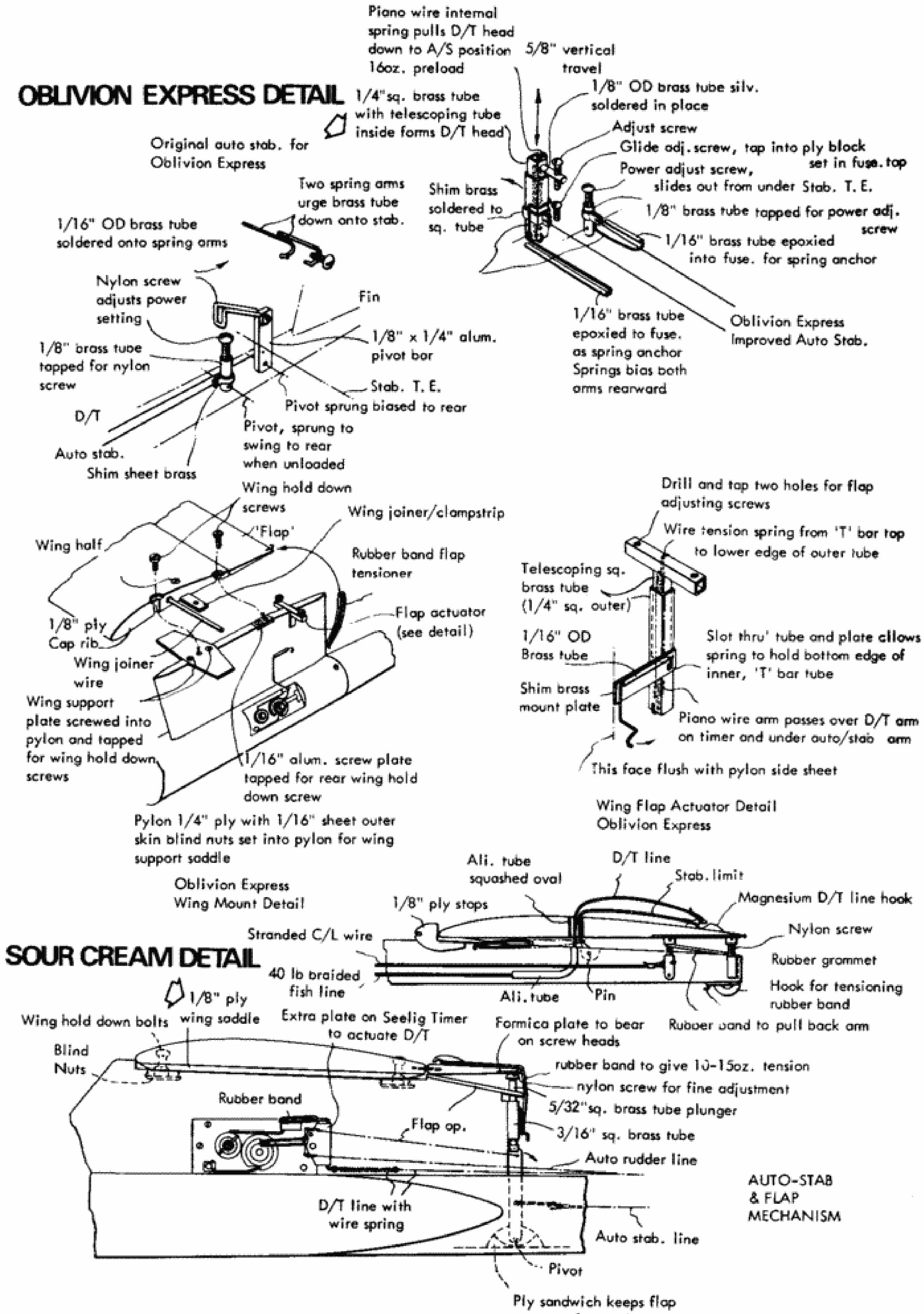
The Siren-Dipity has been my best flapper to date and on its good days is very impressive. Its continuing success around the Denver area has inspired several of the locals to come out with flappers of their own—some of which probably have greater potential.

Sour Cream

If the Siren-Dipity's name was meant to tweek Charlie Sotich then the name Sour Cream is aimed at Koster and his endless Cream series. This model is really a mixed up design. The wing was meant to test a fibreglass fuselage idea that did not materialise, so a special quickie body was built. I wanted to keep it simple and conventional. The wing was designed around some nice pieces of wood meant for R/C ailerons. The solid flaps were easy to fabricate but lack torsional strength. A very bad feature of the "five sectioner" is the flap coupling so close in to the body. There is a certain amount of sliding allowed by flap couplings and being in so close to the centre the flap loads are not well handled. In Taft's soupy


SOUR CREAM 1973
F.A.I. POWER
with flapped wing
BY BILL GIESKIENG
DENVER COLORADO U.S.A.
Rossi 15
Cigar tube exhaust chute on stbd. side of pylon
C. G. 68%
T. V. O. approx. 1-3
Oliver pan
Seelig timer on built up pylon
3/16" sides 3/16" x 1/2" spruce top and bottom as "Starduster"
D/T angle 50°
-3°
3.3/8"
1.3/4"
3.1/4"
1.7/8"
3"
6"
20.1/2"
2.1/4"
2.1/8"
1.1/2"
1.7/8"
1.1/2"
3/4"
1.3/4"
5.3/4"
2.1/4"
3.1/2"
one piece wing
27"
nylon screws
power right rudder
5"
sheet aluminium flap joiners at dihedral breaks
1/16" sheet skin Jap tissue over open areas
3/16" sheet balsa flaps
2.1/8"
2"
25"
12.1/2"
1/4 mil mylar covering
SCALE 1:12
14"
3/16"sq.
1/32" skin
3/32" x 3/16"
1/16" ribs
1/8" x 3/8"
STAB SECTION SCALE 1:2
4"
1.1/2"
1"
1.1/2"
6.3/8"
1.1/8"
2.1/4"
WING SECTION SCALE 1:2
1/8" x 5/16" spruce
1/8" x 3/16"
1/16" skins
1/4" sq.
3/32" ribs
3/8" sheet
R/C nylon hinges
3/16" sheet
glide
power

SCATTER U.S.A.


OBLIVION EXPRESS DETAIL
Piano wire internal spring pulls D/T head down to A/S position 16oz. preload
5/8" vertical travel
1/4"sq. brass tube with telescoping tube inside forms D/T head
1/8" OD brass tube silv. soldered in place
Adjust screw
Glide adj. screw, tap into ply block set in fuse. top
Power adjust screw, slides out from under Stab. T. E.
Original auto stab. for Oblivion Express
Two spring arms urge brass tube down onto stab.
Shim brass soldered to sq. tube
1/8" brass tube tapped for power adj. screw
1/16" OD brass tube soldered onto spring arms
1/16" brass tube epoxied into fuse. for spring anchor
Nylon screw adjusts power setting
Fin
1/8" brass tube tapped for nylon screw
1/8" x 1/4" alum. pivot bar
Stab. T. E.
Pivot sprung biased to rear
D/T
Auto stab.
Shim sheet brass
Pivot, sprung to swing to rear when unloaded
1/16" brass tube epoxied to fuse. as spring anchor Springs bias both arms rearward
Oblivion Express Improved Auto Stab.
Wing hold down screws
Wing joiner/clampstrip
'Flap'
Wing half
Rubber band flap tensioner
1/8" ply Cap rib
Flap actuator (see detail)
Wing joiner wire
Wing support plate screwed into pylon and tapped for wing hold down screws
1/16" alum. screw plate tapped for rear wing hold down screw
Pylon 1/4" ply with 1/16" sheet outer skin blind nuts set into pylon for wing support saddle
Oblivion Express Wing Mount Detail
Drill and tap two holes for flap adjusting screws
Wire tension spring from 'T' bar top to lower edge of outer tube
Telescoping sq. brass tube (1/4" sq. outer)
1/16" OD Brass tube
Slot thru' tube and plate allows spring to hold bottom edge of inner, 'T' bar tube
Shim brass mount plate
Piano wire arm passes over D/T arm on timer and under auto/stab arm
This face flush with pylon side sheet
Wing Flap Actuator Detail Oblivion Express
SOUR CREAM DETAIL
Ali. tube squashed oval
D/T line
Stab. limit
Magnesium D/T line hook
1/8" ply stops
Nylon screw
Stranded C/L wire
Rubber grommet
40 lb braided fish line
Hook for tensioning rubber band
1/8" ply
Ali. tube
Pin
Wing hold down bolts
wing saddle
Extra plate on Seelig Timer to actuate D/T
Formica plate to bear on screw heads
Rubber band to pull back arm
Blind Nuts
rubber band to give 10-15oz. tension
nylon screw for fine adjustment
Rubber band
5/32"sq. brass tube plunger
Flap op.
3/16" sq. brass tube
Auto rudder line
D/T line with wire spring
AUTO-STAB & FLAP MECHANISM
Auto stab. line
Pivot
Ply sandwich keeps flap cam arm from twisting

air the model became uncontrollable. It would dodge to the right, then to the left. I just lost touch with it. I think the basic design is good for a utility flapper concept but without the "V" stab and the extra dihedral break. Solid flaps may be all right, but they should be thicker than the Sour Cream's, also to add some more structural rigidity they should be somewhat wider. The glide on this model is not in the same class as the Siren-Dipity, but then it was never expected to be such with its lower camber. Something like the Sour Cream would make a good beginner-in-flappers model. I would be tempted to try a flat centre with just tip dihedral of about 24 degrees; a slightly larger tail flat, with a rectangular shape. The flaps could be built-up or solid but wider, such as 35%.

Flap Gimmicks

For some reason the whole *mystique* of flappers seems to be centred around flap-actuating gimmicks. Observe a few rules.

Rule One. The device has to give positive support. It has to lock into place so that no frantic movement of the flap will budge it. This means that the flap can't be suspended by some contraption of wires, etc. It has to be a solid, post-like device.

Rule Two. The supporting device must be easily removed from the scene of action. When it is time to "pull the plug" it has got to go. There can be no hesitation or balking.

Rule Three. It can't fall down before it is supposed to. This means good mechanical integrity, which depends a great deal on the modeller's instinctive feel for mechanical relationships. If you can strap on a wing without it falling off then you have a good instinctive feel. Setting up a flapper gimmick is akin to strapping on a wing ... you have to have an appreciation of the forces involved and the actions required. But the most perfectly designed gimmick won't work if it's misused. Have you ever caught the rough edge of a finger nail on a knit shirt? If so, you know what I'm getting at. Everything has to work as smooth as silk. Take the extra time needed to do it right.

A common mistake is to limit the travel on springs or rubber bands. The longer the spring or rubber band the more uniform is the tension over a given travel. It is a big mistake to tidy things up by shrinkage. Make the rubber bands pulling the flap down as long as possible. Also don't forget the rule of the "straight pull". Any time you compromise mechanical integrity by pulling at an angle you are losing force. The force pulling down the flap must operate at a right angle to the plane movement. If because of some unusual design feature there is limited space for rubber bands to pull straight down, then use a pulley directly below the flap to get the needed rubber band action.

The amount of tension needed to hold down the flap depends on the individual design. Generally, though, a tension of between 15 and 20 oz. will suffice. Don't increase the tension to the point where the slap takes a beating slamming down or the load on the flap gimmick mechanism is great enough to interfere with its smooth operation. Test how close you are coming to this point by adding finger pressure on top of the flap. If just a few ounces extra pressure will jam the operation then the situation is too marginal for safe operation.

Some may be surprised that I use rubber bands so extensively. I like the rubber bands because I can use multiples to get just the relative tension needed. Also, on some of the auto-stab applications, the bands are flexible enough to angle across corners and can be made to lie flat and out of the way. As for reliability, I have had more spring failures, as a matter of fact. Springs are somewhat brittle and repeated engine vibration, corrosion, etc., can take a toll. If you decide to use rubber bands then try to get Eberhard Faber "Star" rubber bands. They have good resistance to fuel and sun effects. Try to locate them at stationery stores. Get boxes of 8, 10, 12 and 16. With this range of lengths you should have something for any situation.

The Flap Platform

When the flap slams down into the glide position it needs a broad, flat space to land on. I don't advise using screws for the flap setting in the glide position, it is just asking for trouble. I use shim stock such as $\frac{1}{64}$ in. ply or that international shim standard, pieces of matchbook cover. Actually, once found, the flap glide setting is one of the last adjustments to be changed. In fact, the climb setting isn't altered very much. Like a conventional model, most of the daily trim-tweaking is done back at the stab and rudder.

The Timer

The question of where to put the timer has had most of us pulling hair at one time or another. I have stuck it at various times on the body, in the body, upside down in the body and on the pylon. I still haven't found a place that I like. I would strongly advise, however, that on your first few flappers that you do not bury it away under a hatchover ... it complicates things enormously! If you do hide it away, make sure that the timer recess compartment is long enough so that there will be no question about the lines having sufficient travelling length to allow the various gizmos to operate. It is most humiliating to have a line released from a timer trigger, only to slam up against an eyelet in a bulkhead without accomplishing anything. Everybody seems to have their own individualistic touches when it comes to rigging lines and modifying timers and I'm no exception. I spend a great deal of time on a new timer before I'm ready to use it. I take off all the discs, enlarge the slots, to give a longer release time in case something hangs up momentarily. Polish the backsides and remove any grooves that may be found in the plastic separators. (I once crunched two models using the same timer, before I found that the timer trigger was occasionally hanging up in a groove on the plastic separator—a very expensive lesson.) I also very carefully round the ends of all triggers and polish them. If the ends are left sharp they can easily gouge into the plastic and aluminium problem. The flood-off trigger I modify by cutting off the end about $\frac{3}{32}$ in. I started to do this after I had some rare flood-off failures. It seems the trigger managed to get captured by the disc above it. This meant that the flood-off trigger wouldn't be released until the auto-stab slot came around to do the job a second time. I'm pretty well convinced that this particular type of flood-off failure occurs regularly. By cutting off the trigger it makes it impossible for the next disc to capture it. I don't like the standard trigger hooks so I change them. I cut off the hooks so there is just a straight stub sticking up. I take sections of $\frac{1}{32}$ in.

wire and make small "L's" out of them. I hold them in place on the stubs by wrapping them with very fine copper wire. Then I solder hell out of them. This modification serves two purposes. One, it gives a higher post so I can cram a lot of line loops over them. Two, the bottom of the L keeps the loops from working down close to the pivot of the trigger and thus jamming up the operation. Naturally, I'm careful to get the proper "lean" on the new posts and to have the bottom of the L fit flush against the timer case when the trigger is in the captured position. Another modification I use concerns the little nut that tightens down the release cams. I have had trouble trying to change the cam timing then get it to stay in the proper relationship while I get the nut tightened down again. If the timer is buried it can be very frustrating. Part of the answer is to solder a short section of $\frac{3}{16}$ in. square tubing to the nut (pressed over it) sticking out about $\frac{1}{4}$ in. I originally had a little tool for tightening and untightening but soon found that the tubing could be grasped by the fingers and turned directly.

There is sometimes a serious fault in the locking device that holds the d/t spool in place. The problem is that not enough threads are engaged before it snubs down tight. Check to make sure that it takes three turns on the threads. If it doesn't then cut off the end of the root nut to where the machined threads start. The wings on the end will then have to be filed down so they won't hit the spool.

A source of trouble that seems quite common is found on the end of the d/t spiral. In stock condition the spiral suddenly comes to an end where the d/t trigger escapes. The thin section of aluminium at the end of the spiral is very vulnerable to being accidently bent over and in, thus jamming the trigger and stopping the timer just before it is supposed to d/t. An answer is to file off the corner at a sharp angle to avoid any exposed edges.

Whatever kind of lines to the timer you use, there must be sufficient tension on the triggers to effect immediate swivelling and release. This may seem a point too obvious to mention, but I recently got caught in this trap. On a new type of flap mechanism I tried to avoid clutter by running a line directly to the timer without a spring between. Evidently it made for a marginal condition as on one flight the stab came down but not the flaps. Very terrifying! The model did an outside loop and tried to glide on its back; the dihedral rolled it over and it did another outside loop, etc. Luckily it landed in the only high patch of weeds around and emerged unscathed. It just doesn't pay to take short cuts; I put a spring in the line near the timer after that.

Lines to the Rear

The line to the autostab is relatively straightforward. Just to make sure that there is enough release travel to allow the gimmick to swivel clear of the stab. On some designs such as the Sour Cream the stab gimmick is connected directly to the flap cam. With this situation the stab can't drop down until the flap is released. It is a safety factor and does eliminate the chance to try exotic transitions. The d/t line is a bit more touchy as it not merely pulls the stab down tight. It must also pull the stab down further when the stab gimmick operates. To get the most even pull I use a 2·5 in. long spring made from 0·018 dia. music wire. The long spring gives a good even tension over a broad range. I locate it in the body rather than on the timer. If there is a direct shot from the stab to the timer then having it on the timer would be okay. But if the line goes through grommets, around corners where it might drag a bit, then it should be located on the stab side of any such friction points. I don't use tubing for line guides. Since I don't use bulkheads in my fuselages the rear of the body is just one great big tube anyhow. I do stagger the springs on the different lines so that they are not alongside each other. There hasn't been any trouble with the lines becoming tangled.

Not a great deal of tension is needed to pull down the rear of the stab. Fifteen oz. as measured at the trailing edge of the stab will be more than enough.

Stab Gimmicks

The auto-stab post must be set close to the vertical. Use a hard stop of some material that won't wear. If the stop wears or gives enough to let the post come forward beyond the vertical then its ease of release will be interfered with and in marginal cases might fail to operate. There should be a generous distance between the post and the glide adjustment screw.

If you try to call it too close there may be an embarrassing situation where there isn't enough room to allow the post to come down far enough. Don't fail to use some sort of hard, slick surface on the bottom of the stab where the post will support it. I use a rectangle of phenolic resin sheet about $\frac{1}{64}$ in. thick. The friction between this sheet and the nylon screw is very low and very little pull is needed to operate it even when extreme pressure is applied experimentally to the top of the stab.

The Stab Platform

A stab platform on a flapper has to be approached differently. Since the trailing edge will be coming down instead of going up as a conventional model either it has to be mounted extra high or the rear of the body must slope sharply down to get the needed clearance. It is better to be too high than too low for obvious reasons. Whatever style of platform you use, it should be angled on top to fit the glide setting rather than that for the climb. If it is not, you will encounter a "see-saw" condition with the stab riding on the back of the platform fighting the d/t pulldown. Since the flapper stab uses the front of the platform as a pivot for its movements care must be taken that there is little friction and no binding. If there is, then the front of the stab can "creep" out of position. Also there must be a very positive hold-down effect at the leading edge. If you can easily pry up the leading edge, and worse, it stays in its new position, you've got troubles! To hold down the leading edge, a certain portion of the rubber bands must arc across the leading edge, curving downwards. Ideally, the leading edge can be raised up from the stop with only a great deal of effort. On release it must snap back down into the proper position.

Airfoils

Everybody seems to have their pet theories on what makes a good airfoil. Part of the fascination is the opportunity afforded to try all sorts of weird combinations. I wouldn't think of spoiling anybody's fun in this

John O'Donnell's camera caught the two leading European exponents of flappers together. Thomas Koster (left) and Eugene Verbitski represent Denmark and the Soviet Union. Each has developed sophisticated mechanical approaches to the VG power model.

realm. But whatever airfoil you decide on for the wing, the stab *must be matched* to it for the climb setting. The stab should never have a greater camber factor than the wing otherwise speed-sensitivity may result. On a recent design my wing airfoil in the climb position looks much like a semi-symmetrical section with a mean camber of only 1·5%. To match it I had to use a near-symmetrical stab section having a mean camber of a meagre 1·25%. But for the "Siren-Dipity", for example, there is still a generous camber in the airfoil even with the flap up and that permits the use of a more conventional stab section. A way around this problem is to use an elevator rather than an autostab but that gets complicated.

Test Gliding

The first part of test flying consists of test gliding. But with a flapper you must always keep in mind that you have two-models-in-one. You must test-glide for the glide and test-glide for the climb. With a conventional model one can pretty well judge where to start the power setting, by the glide setting. But not so with a flapper. For the glide testing the thing to avoid is throwing too hard or else the model may balloon up and stall. If you have been used to fast-gliding models then be extra careful. Assume for the stab setting that you have about 6 degrees incidence with the flap down. Going by that first try it with about 2 or 3 degrees positive in the stab. I would rather have the model dive slightly than to take a chance on a stall. Incidentally, the c.g. for a flapper should be more forward than on a comparable conventional model. The more highly cambered wing will be more erratic in pitch and needs the extra margin. Pulling a figure out of a hat I would suggest about a 5% move forward. If the glide seems unduly sluggish or mushy then that is a good indication that the flap angle has been pushed too far. Try shimming up the flap a few degrees, re-adjust the stab, and see if it helps. For safety's sake I prefer a positive stall in the glide for the first few power-glide tests.

Testing the glide using the power setting is a demanding task. Generally, the wing is close to 0 degrees incidence with the flaps up so start off with about 3 degrees negative on the stab. After getting used to the gentle toss required for the glide setting it takes some doing to change over to a fast run and a powerful heave. Of course different flapper designs glide in different manners. The "Siren-Dipity" won't glide much faster than a conventional model with the flaps up, but others can be real sonic-boomers. It all depends on the mean camber involved.

Test Flying

The big rule with flappers is to go slow and check everything with extra care. You will know that your mind is safely conditioned when you find yourself repeatedly trying to put the flaps up on your conventional ships.

Start with very short runs of about 1·5 secs. I tie off the auto-rudder line so there is no chance of it kicking in. I put the d/t line, the flaps and autostab all on the same trigger. There is about a second delay on the d/t. I run the engine on the rich side and launch as nearly straight up as possible. After I grow more confident, I extend the engine time second by second. At this point delay the d/t more but still not attempting a glide although I may drop the flaps and stab to help slow it down.

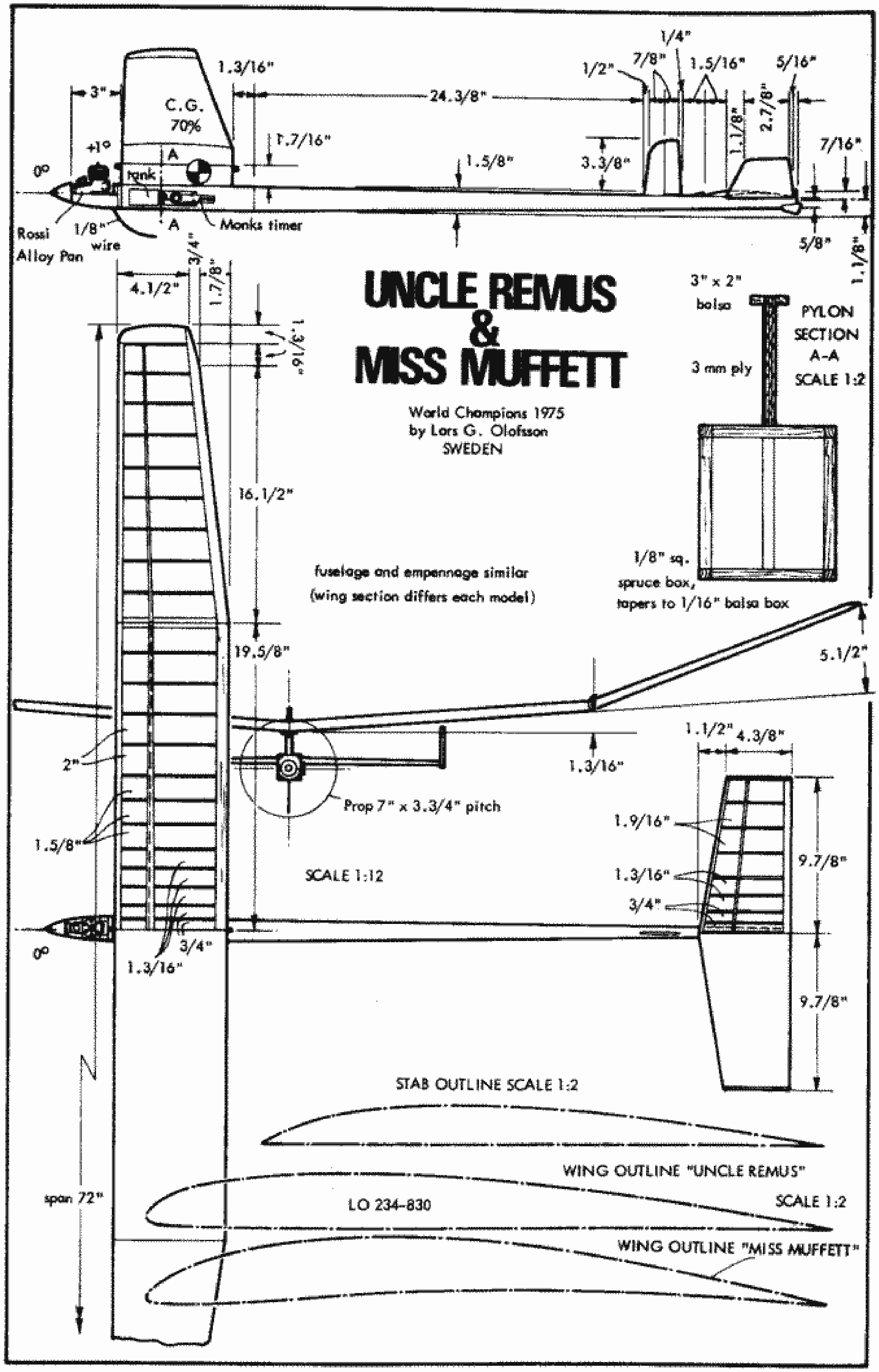
Once I get the power phase sorted out for a full engine run, I start thinking about the glide. *I* don't always do it. But it is best to start out with a very short d/t of around 10 or 20 seconds. From then on it's just like trimming a conventional ship. Just remember to adjust the right screws!

What Happens When You Make A Mistake

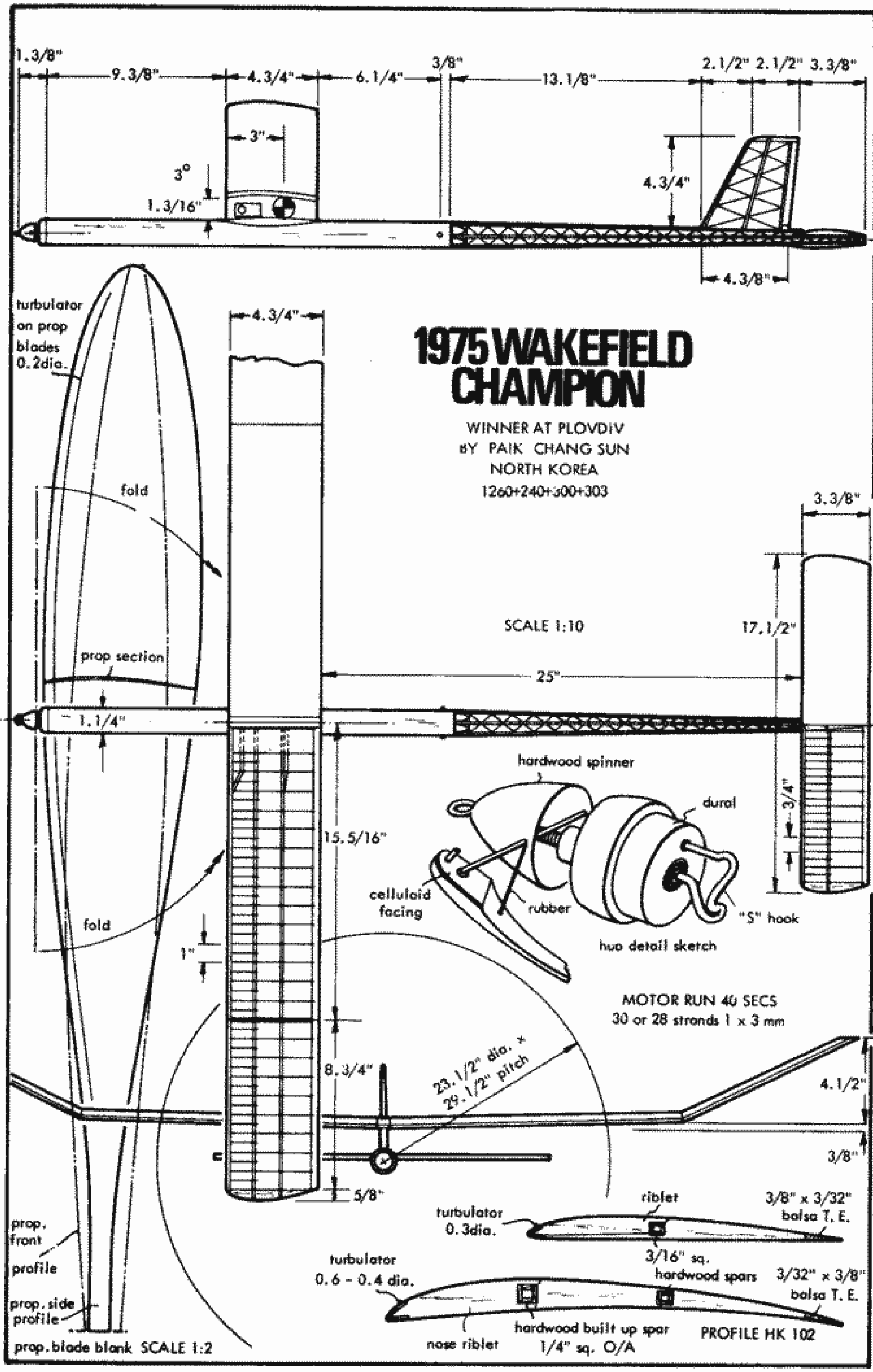
All of us are subject to human error as we are constantly reminded. The best way to avoid making a mistake with a flapper is to be very familiar with it. This means many sessions at home re-cycling the gimmicks and drilling into your mind the principles you are triggering. For the power phase you have to know without thinking: flaps up, stab up. I check my planes three times. Once when I set the timer and hook up the gizmos.

A second time just before starting the engine, or at least just before getting into my thermal-seeking stance. A third time I give a cursory glance at the flaps, stab and auto-rudder prior to launch. Because: If you try with your flaps down and the stab up you will immediately find a Rossi spinner digging into your buttocks! If you launch with the flaps down and the stab down it will zoom all over the sky in fantastic manoeuvres. If the power phase is all right but something happens to the glide settings, you can have the following: The stab comes down without the flaps means either a vicious dive or a series of hammerhead stalls. If neither the flaps, or stab comes down, but remain in the power setting, anything can happen depending on the decalage. Some flappers will glide, if rather steeply. Others particularly if they miss the transition will dive straight in. If one of the flaps comes down but the other doesn't you will have to use your imagination, as it's never happened to me!

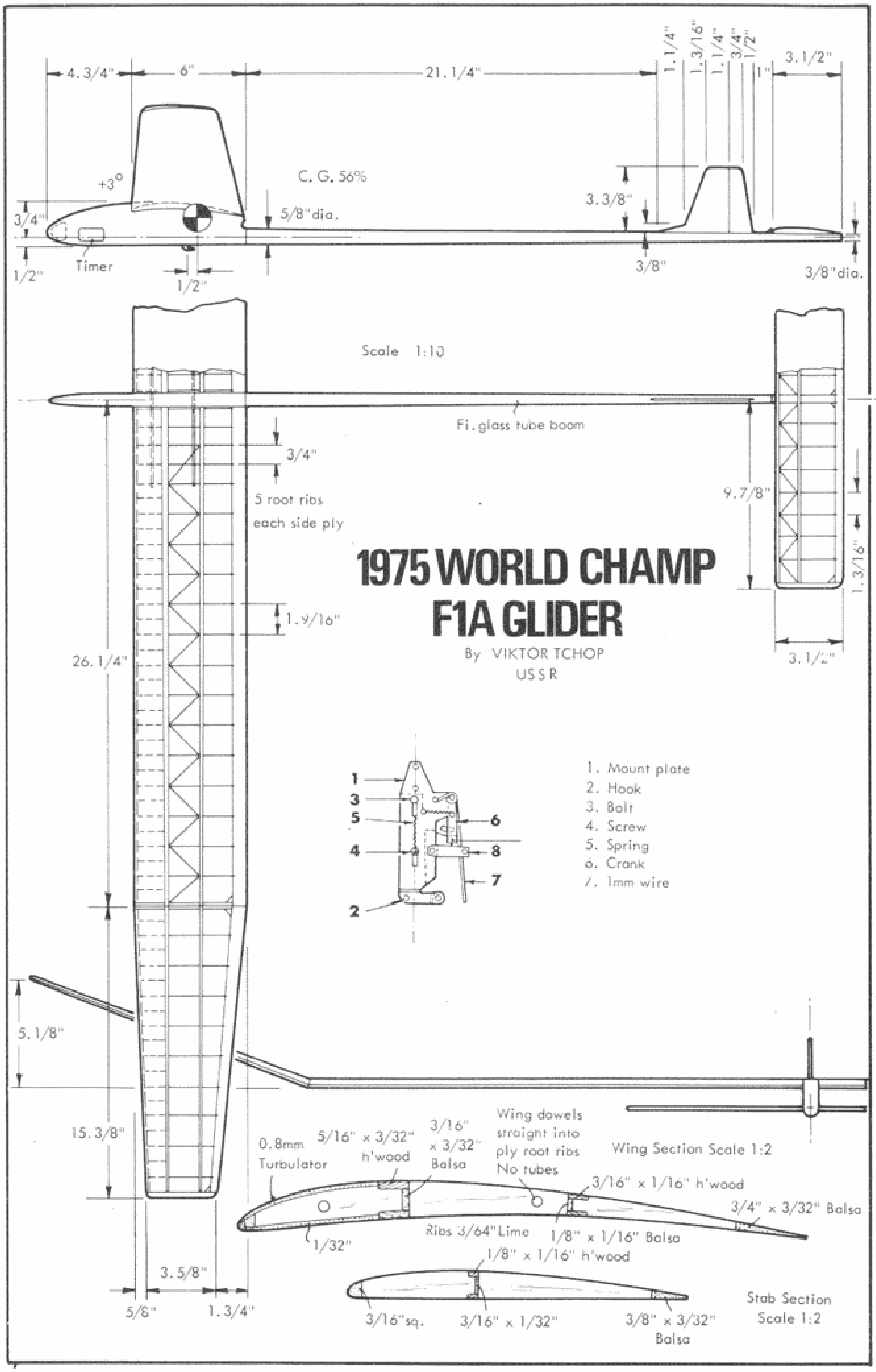
"I know it came down around here somewhere."



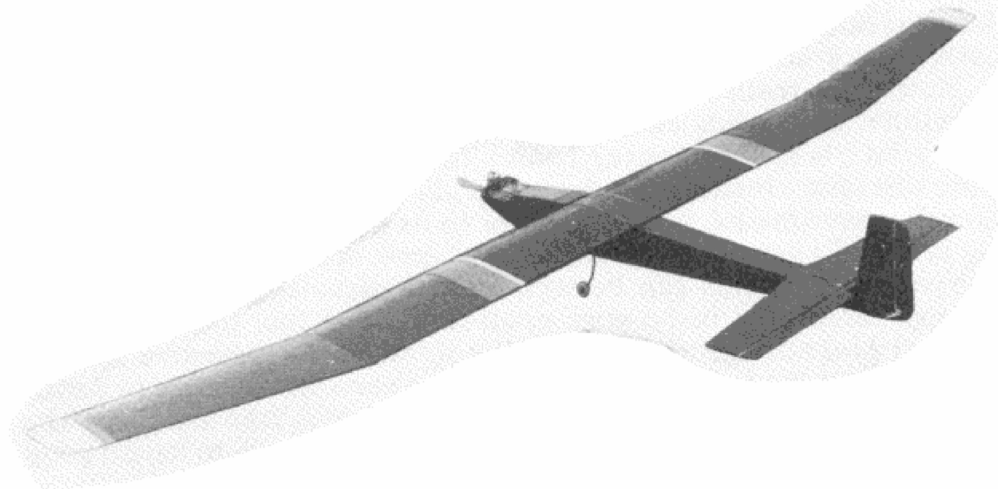
ALT OM HOBBY SWEDEN



MODEL ARZ POLAND



Modelar Czechoslovakia



GLIDE ASSISTED POWER

Harry Stillings elects to take it easy with a U.2 style floater for fun at his Alicante (Spain) home.

HAVING HAD my fill over the years of thirsty, fast-flying R/C aerobatic models (don't blink or you'll lose it) and with fuel costs soaring to unprecedented heights, I decided I'd had enough. All I really wanted, most of the time, was to have a model flying high overhead, slow and serene, and needing little attention from the carbon box, so that I could roam the surrounding countryside without effort or stress. I might even turn away for a few moments to chat with a friend without fear that, on turning my attention back to the model, it would be in a totally different part of the sky, or worse still, diving earthward towards self-destruction.

The obvious answer, of course, was a large and graceful glider, either for slope-soaring or tow-line, or both. I duly tried this for a time and found it very close to what I wanted. But there were too many disadvantages—slope-soaring needed a suitable accessible slope, not miles away, and an exacting direction and strength of wind. All too often I would set out from home, only to find conditions had changed during the trip and frequently continued to worsen, so that the whole operation became abortive and frustrating. Tow-line operation raised other problems, such as the need for a reliable, long-suffering and dedicated helper (it's surprising how hard they are to find just when you want one!). Even when I found the helper it was still essential to have available a pretty large area of good open ground for the tricky launch procedure, and the line always managed to get itself tangled in ever present undergrowth at least a couple of times at each session.

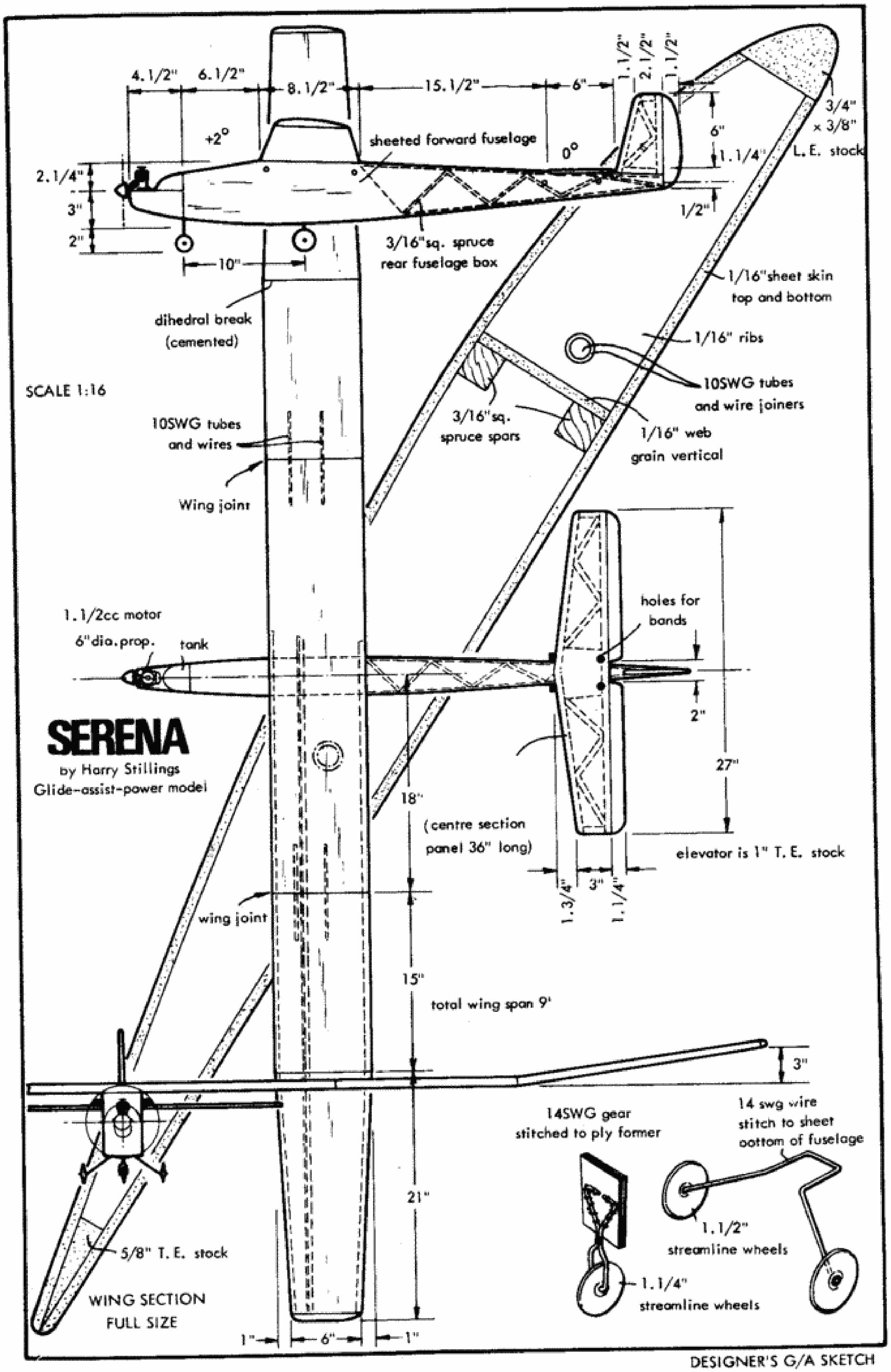
To overcome these objections I eventually added a power-pod over the wing centre. This made it possible to fly from relatively small areas. I no longer needed a helper, presence of good natural lift was no longer a pre-requisite, and I was thus able to set out for a couple of hours of satisfying flying whenever conditions were at all reasonable. I carried on happily with this arrangement for quite some time, but increasingly found little niggling doubts entering my mind and rather taking the shine off my enjoyment. For one thing, I felt a bit of a cheat—I wasn't really "gliding" but flying power-sport; it also seemed rather sacriligious to adulterate the clean graceful lines of the glider with an ugly alien power pod—so obviously "stuck on after".

Slowly the truth dawned—what I really wanted was not a power assisted glider, but a glide assisted power model. What, you may ask (as I asked myself!) is the difference? I think that a glance at the illustrations will make this clear. Instead of a degraded glider we have an interestingly "different" power model, with the motor in its proper place at the front, landing gear and a general all-round "right" look about it. And it's a very *large* power model which can be seen at long distances, yet needs only a very small motor and just a very small amount of fuel for a half-hour flight. Other practical advantages are that it will make attractive looking landings and stay level on coming to rest. It is very much easier to hand-launch than most orthodox power models, and will take off from the ground in slow majestic style whenever one is lucky enough to have a good tarmac area.

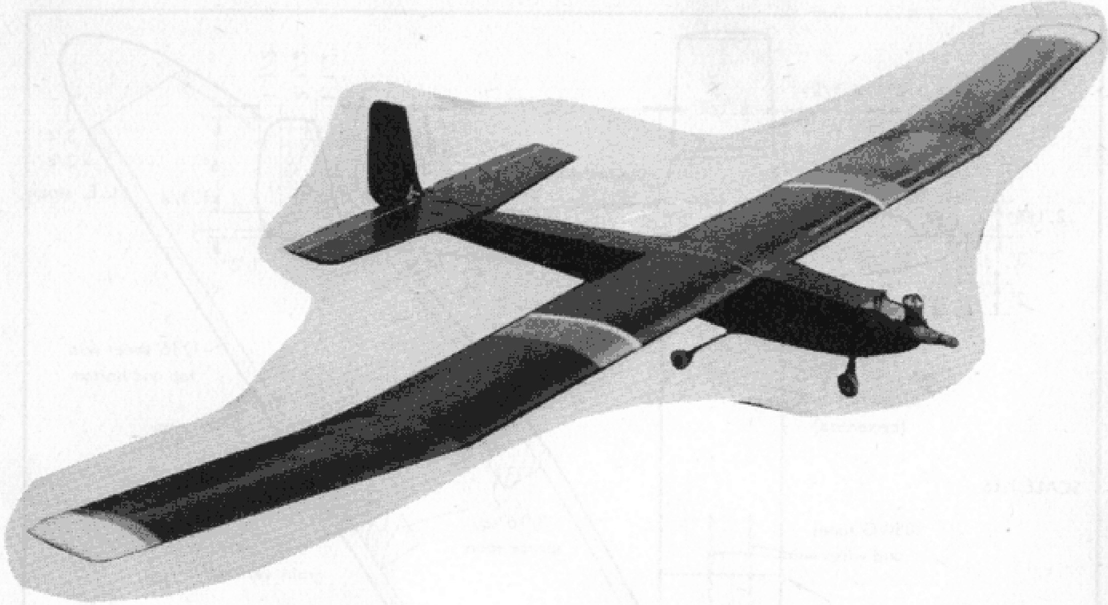
I have found it to be the complete answer to my present flying objectives (lots of enjoyable time in the air with least effort and cost). It may well appeal to a lot of modellers who may appreciate a quieter yet fulfilling flying session as a change from the tensions and high speeds of beefy aerobatic models, with their thirst for expensive fuel. Handling characteristics are good. There is positive directional response from the well-extended positioning of fin and rudder, and immediate effect from the closer-coupled elevator. For initial flights (and beginners), minimum control movement of the elevator is recommended, and not too much on the rudder. The latter can be more generously increased later if desired, to induce rolls or half-rolls off the loop, although I must emphasise that "Serena" was never intended as an aerobatic model as such. Only occasionally do I force the lady to indulge in such flightly departures from her more becoming level and graceful demeanour. If I find I am in aerobatic mood any day I leave "Serena" at home and take one or other of the two models I keep operational for such occasions.

Only two channels are required, which is another cost advantage, and very small wheels ($1\frac{1}{4}$ in. diameter, or at most $1\frac{1}{2}$ in.). The fuel tank I fitted to the prototype gives me a good 15–20 minute engine run, by which time the model is up to a thousand feet or more, from which height at least an equal duration is obtained on the glide. This makes each flight between half an hour and forty minutes, at only a few pence cost. If good lift is present, and the pilot is sufficiently adept to take full advantage of it, Serena will stay aloft still longer—I have enjoyed flights of nearly an hour when conditions were favourable. Any good $1\frac{1}{2}$ cc motor will provide the required motive force—less could be rather tricky, while more is unnecessary and would defeat the major objective of slow, serene flight.

Construction is traditional and straightforward. The only point which needs to be stressed is that it is essential to get the C.G. (more correctly point of balance) absolutely right—half an inch either way will effectively give you an unflyable model—remember that you haven't got a big powerful motor to overcome rigging faults by sheer brute force! Because of its 9 ft. span and $45\frac{1}{2}$ in. long fuselage "Serena" is eminently easy to follow in flight at considerable distances, and to add to this I deliberately chose virtually all red for the wings (except for white under the dihedralled tips) and plain bright yellow without decoration for the fuselage, tail and



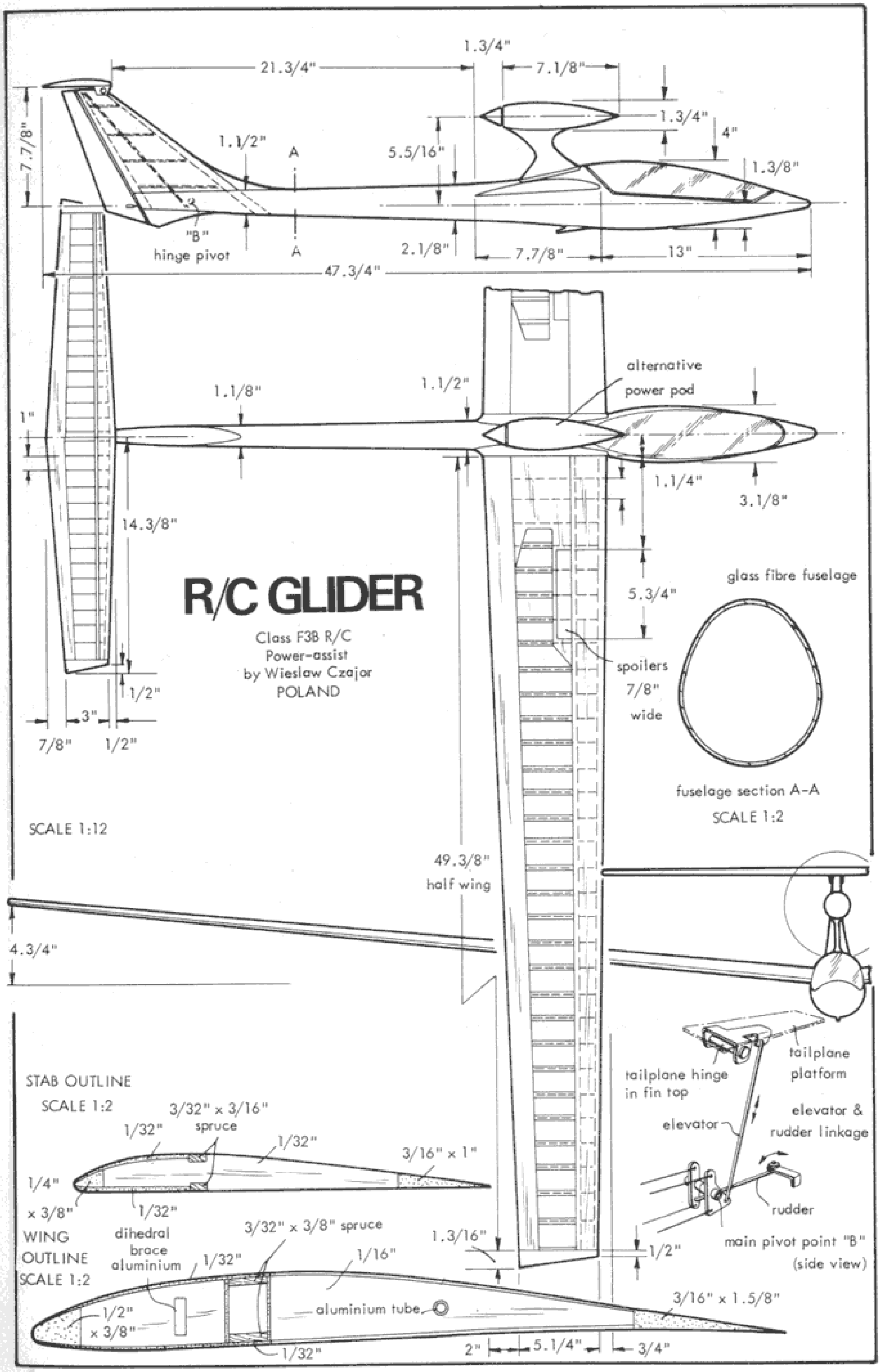
DESIGNER'S G/A SKETCH

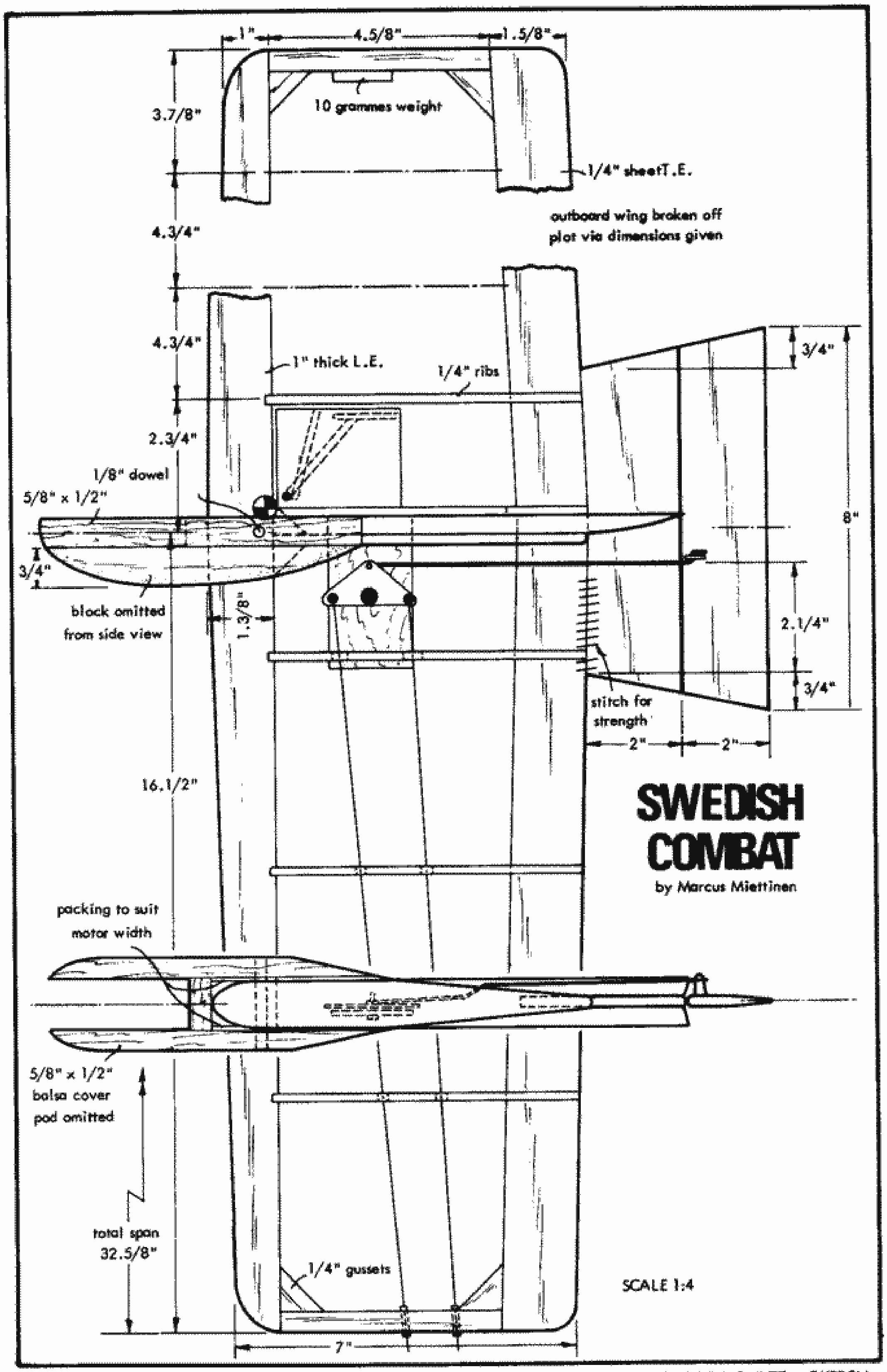


Harry Stillings' "Serena" (also on page 73) re-introduces a kind of fun-fly attitude which is ideal for those situated in areas where winds average less than 10 m.p.h. Span is 9 ft. and power need only be an "average" $1\frac{1}{2}$ cc. (·15) engine.

fin. This ensures that, however variable the sky background may be during a flight, either the wing or the fuselage can be easily seen—even both. The white under tips reflect instantly any change in wing attitude, even at long distances, and are a great help in getting oneself re-oriented if ever in the slightest doubt.

The three-piece wing is light but strong for its wide span, even easier to transport than a much shorter one piece, and the method of rubber band threading for the tailplane ensures that it retains its position in flight, yet readily "gives" in the event of impact. Because of its low wing loading, "Serena" is delightfully easy to hand launch, provided a short brisk sprint is immediately followed by a *dead-level* thrust forward; on no account must the nose be angled upward or you will risk a nasty stall with dire results. It pays to discipline yourself to get the launch right every time, when you will be rewarded with a gracefully smooth transition from hand to air. Leave the model alone for the first 20 seconds or so (unless corrective control is essential) while it settles into its slow shallow climb. Afterwards you can start a slow turn by a small deflection of the stick holding it until the quarter-turn has fully developed and then neutralising—the model will complete a further quarter-turn and thus be facing back towards you. Whatever you do, don't use the elevator control viciously in panic—all that is needed is more a "squeezing" of the stick rather than a stick movement. Take it as easy as you can for the first initial flight until you have plenty of altitude, when you can experiment safely with more control movement; but aim all the time for the smoothest *least-controlled* flight pattern, which shows the model off at its best. Throwing this type of model all around the sky will only deprive you of its most enjoyable characteristics.

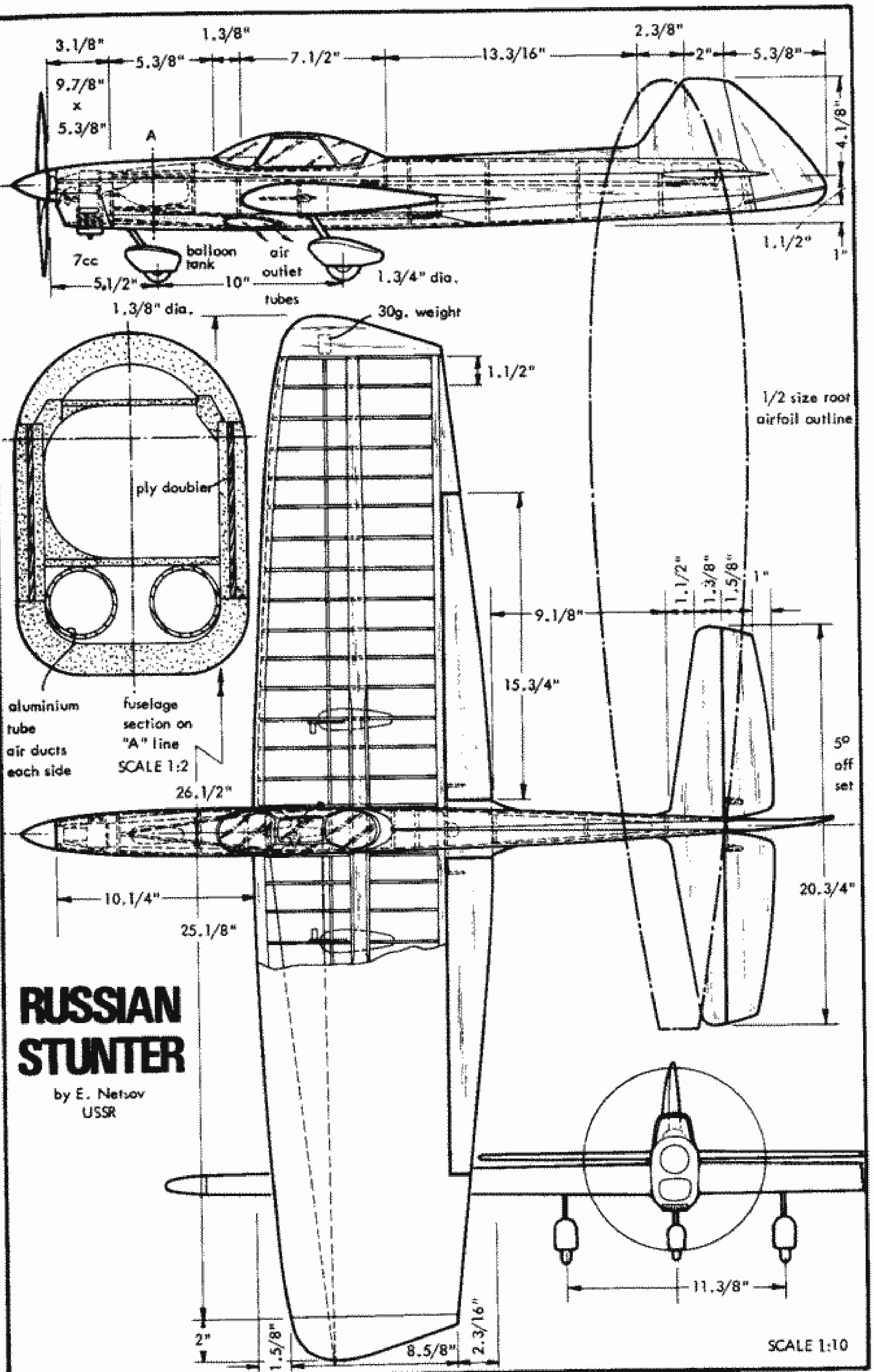

R/C GLIDER
Class F3B R/C
Power-assist
by Wieslaw Czajor
POLAND
21.3/4"
1.3/4"
7.1/8"
7.7/8"
1.1/2"
A
5.5/16"
1.3/4"
4"
1.3/8"
"B"
hinge pivot
2.1/8"
7.7/8"
13"
47.3/4"
alternative
power pod
1.1/8"
1.1/2"
1"
1.1/4"
3.1/8"
14.3/8"
5.3/4"
glass fibre fuselage
spoilers
7/8"
wide
1/2"
3"
7/8"
1/2"
fuselage section A-A
SCALE 1:2
SCALE 1:12
49.3/8"
half wing
4.3/4"
tailplane
platform
tailplane hinge
in fin top
elevator &
rudder linkage
elevator
rudder
main pivot point "B"
(side view)
STAB OUTLINE
SCALE 1:2
3/32" x 3/16"
spruce
1/32"
1/32"
3/16" x 1"
1/4"
x 3/8"
1/32"
WING
OUTLINE
SCALE 1:2
dihedral
brace
aluminium
3/32" x 3/8" spruce
1/32"
1/16"
1.3/16"
1/2"
1/2"
x 3/8"
aluminium tube
3/16" x 1.5/8"
1/32"
2"
5.1/4"
3/4"



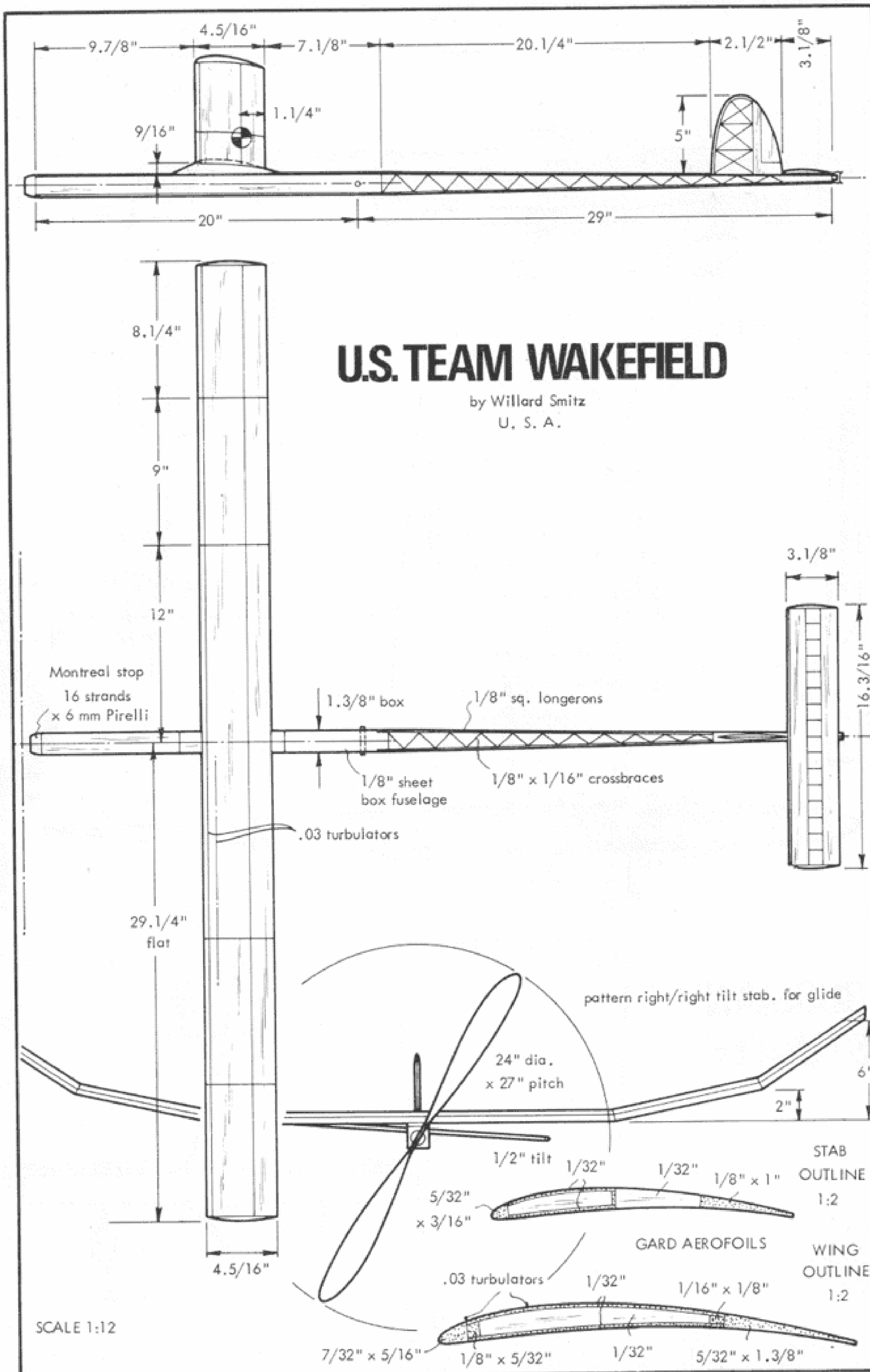
SWEDISH COMBAT

by Marcus Miettinen

MODELLFLYGNYTT SWEDEN

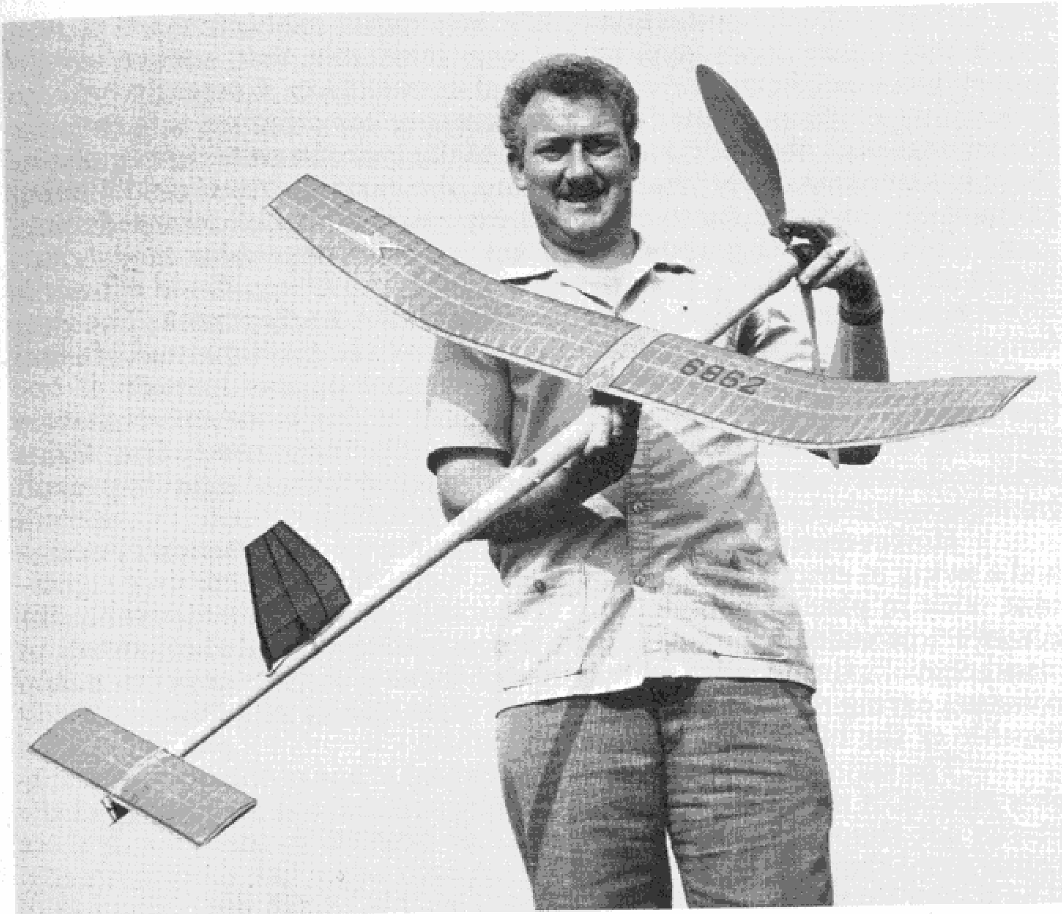


WINGS OF THE FATHERLAND USSR



U.S. TEAM WAKEFIELD
by Willard Smitz
U. S. A.
9.7/8"
4.5/16"
7.1/8"
20.1/4"
2.1/2"
3.1/8"
1.1/4"
9/16"
5"
20"
29"
8.1/4"
9"
12"
29.1/4"
flat
4.5/16"
3.1/8"
16.3/16"
Montreal stop
16 strands
x 6 mm Pirelli
1.3/8" box
1/8" sq. longerons
1/8" sheet
box fuselage
1/8" x 1/16" crossbraces
.03 turbulators
pattern right/right tilt stab. for glide
24" dia.
x 27" pitch
6"
2"
1/2" tilt
1/32"
1/32"
1/8" x 1"
5/32"
x 3/16"
STAB
OUTLINE
1:2
GARD AEROFOILS
WING
OUTLINE
1:2
.03 turbulators
1/32"
1/16" x 1/8"
7/32" x 5/16"
1/8" x 5/32"
1/32"
5/32" x 1.3/8"
SCALE 1:12

SCATTER USA



Martyn Pressnell with one of his Wakefields to the current 40 gm. rubber weight rules. It features a variable incidence wing with curved dihedral and slight taper. The whole fin is an "auto-rudder".

RUBBER DRIVEN MODEL AIRCRAFT

An Analysis by Martyn Pressnell

RUBBER DRIVEN model aircraft have maintained a remarkable popularity over the years and for many still represent the ultimate challenge in free-flight competition aeromodelling. Their zenith of popularity and enthusiasm is held to be the 1950 era when the Wakefield contest was the premier international competition. As a teenager and newcomer to competition flying one still remembers the aura of those days. Pirelli rubber was a new word, used only by the top competitors and presumably only available to them. Watching the National Champion John Gorham, as he eased twin motors into his model, wound them and executed a brisk take-off from the ground for a faultless 5 minute flight, was an impressive experience.

The potential performance of unrestricted rubber models is well above that figure nowadays, and it was inevitable that rubber weight needed to be restricted for international competition. Currently only 40 grms. (1·41 oz.) is permitted, but performance has crept up to 3 minutes or more through constant development of the type. In terms of popularity there has unquestionably been a decline, the rubber driven model being eclipsed by the more spectacular and expensive forms of aeromodelling.

Yet the challenge remains—to get the best from rubber models embraces advanced skills in design, construction and flying. Good rubber is a prerequisite, and testing techniques are under development. The performance of the unrestricted model is such that a large proportion of competitors reach the final fly-off, which is decided by the duration of one final flight in the latter part of the day. This is felt to be unsatisfactory by many, and experimental alternative rules have been tried. The Wakefield model with its restricted performance has encouraged effort in propeller design, and sleek efficient models have resulted.

However, the biggest effect has been in a standardisation of design and a swing in emphasis to tactical flying. Certainly there are very significant skills in placing a model into favourable air, but this inevitably has the effect of reducing the status of the model to that of the football or cricket bat. In time modellers may tire of these types of competition, and some are saying that international competition should be between models capable of the highest outright performance.

The way in which models are developed is one of the many remarkable aspects of the hobby. The engineering science and technology of the matter are almost entirely disregarded, yet because so many models are constructed they can be reproduced from each other like thoroughbreds. The model press plays an important part in this by the dissemination of information about the most successful machines. Development is rapid initially and leads arguably towards the optimum solution. However, this eventually stagnates and only a change of context rules or some innovative breakthrough can revitalise the process.

A knowledge of the fundamental factors affecting potential duration are necessary to anyone considering new rule proposals and desirable to anyone developing rubber driven models within the scope of the current rules. Many detail considerations have a bearing on the matter, but this analysis is concerned in the main with the overall situation, and more particularly tries to draw conclusions from past experience.

The Duration Equation

A duration equation for the potential performance of rubber driven models has been known for many years, and its origin is often accredited to Arvid Palmgren. This relates the duration (D secs.) to the rubber motor weight (Wr oz.), the total airborne weight (W oz.), the wing area (A in.^{2}) and introduces a duration factor (F) such that:

$$D = \frac{F.\ Wr/W}{(W/A)^{1/2}}$$

Thus we see that duration depends essentially on three terms, the rubber to total weight ratio (Wr/W), the wing loading (W/A) and the duration factor (F). At first sight this relationship is misleadingly simple and over the years some confusion has arisen in its interpretation and application.

Noting that the airborne weight combines the rubber weight and the airframe weight, some analysts have deduced from the equation that the maximum duration occurs when the rubber weight is two-thirds of the total. However, unrestricted models are usually designed with rubber weight equal to about half the total. If one increases the proportion of rubber it is soon apparent that the optimum is not being approached. Although the motor run may be increased, the glide suffers due to the increased wing loading. Flight becomes laboured, and the structure is frequently damaged due to the increased momentum of the model.

The explanation seems to depend on the complicated inter-relation between rubber weight, wing area and airframe weight. Consequently any mathematical treatment of the duration equation which fails to recognise these practical constraints must inevitably give misleading results. Further, it is observed that in the design process rubber weight and wing area are primary decisions from which all other decisions follow.

The Duration Factor F

In his original work Palmgren quoted a value of F = 88 for a model with a medium pitch free-wheeling propeller. If we take the weight ratio $Wr/W = 0{\cdot}50$, and a typical wing loading $W/A = 0{\cdot}03$ oz./in.^{2}, the duration is found to be:

$$D = \frac{88 \times 0{\cdot}5}{0{\cdot}03^{1/2}} = 254 \text{ secs. (nearly } 4\tfrac{1}{4} \text{ min.)}$$

Better durations are available today because the free-wheeling propeller has been superseded by the folding propeller, and many other refinements have occurred. It is therefore best to get at F by working backwards from the known performances of different types of model. This has been set out in *Fig.* 1 where duration factors ranging from 94 to 189 are recorded.

The small lightweight rubber model, popular in the immediate post-war years, *Fig.* 2, possessed a remarkable performance potential for its size, but possibly due to the fashion in single bladed propellers has the lowest duration factor (F = 94). The current Coupe d'Hiver model comes next with its higher aspect ratio wing, but still suffers from small size (F = 99). The late Fred Boxall's type of model, *Fig.* 3, comes next

Model type	*Lightweight O'Rubber*	*Coupe d'Hiver*	*O'Rubber Boxall*	*1952 Wake Zombie*	*O'Rubber Bailey*	*Wakefield F1B*
Duration D (secs.)	300	105	360	270	525	180
Rubber Wr (oz.)	1·33	0·35	3·30	4·0	3·50	1·41
Weight W (oz.)	2·87	2·82	5·50	8·0	6·30	8·11
Area A (in.^{2})	140	205	185	203	262	244
Loading W/A (oz/in.^{2})	0·021	0·0137	0·030	0·039	0·024	0·033
Ratio Wr/W	0·463	0·124	0·60	0·50	0·556	0·174
DURATION FACTOR F	94	99	103	107	146	189

Fig. 1. **Duration factors for various types of rubber driven model aircraft, computed from typical durations and arranged in ascending sequence of F.**

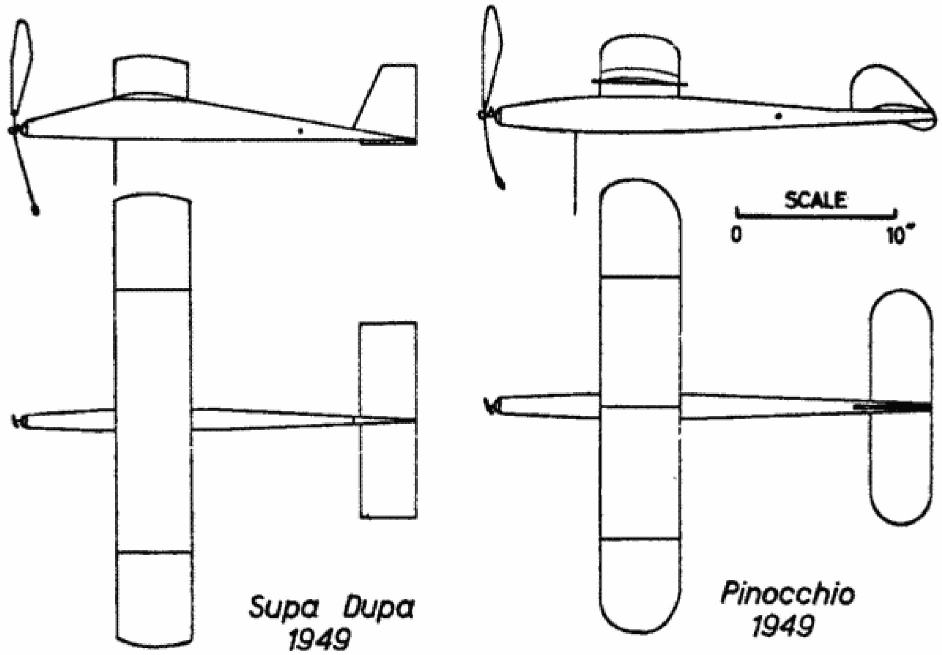


Figure 2. Small lightweight models popular in late 1940's and early 1950's.

with its small free-wheeling propeller but larger overall size (F = 103). Although Ron Warring's Zombie Wakefield, *Fig.* 4, used a free-wheeler and had a fixed undercarriage, streamlining and other refinements helped it (F = 107). Next a typical modern unrestricted rubber model by Bob Bailey, *Fig.* 5, which uses a folding propeller, shows a marked improvement (F = 146). Finally a modern Wakefield, with its folding propeller, high aspect ratio wing, sleek fuselage and other refinements, is the best of all (F = 189).

In technical terms, the duration factor contains the specific energy of rubber (Er ft. lbf/lb. rubber), the efficiency of the propulsion system (e), and a term involving the lift and drag coefficients (C_L, C_D) which expresses the efficiency of the model in gliding flight,

$$F = \frac{e \cdot Er}{87} \frac{C_L^{3/2}}{C_D}$$

Tests on strip rubber, loading it in pure tension, show that the energy stored is about 3000 ft. lbf./lb. However, the energy available from a wound motor must be less than this because of friction between the strands, hence the need for effective lubrication of the rubber. The energy available also depends almost certainly on the number of strands in the motor (and their section if this could be varied). Some tests by Chris Matsuno, comparing different types of rubber, were recently reported in *Free Flight News*. This information is presented differently in *Fig.* 6 and throws light on the effect of the number of strands. The indication is that a small number of strands, 6 or 8, will usefully liberate most of their energy, but 16 strands provide only about 2300 ft. lbf./lb. This is supported by some test results of Baxter and Takagi taken from Frank Zaic's 1957–58 Year Book.

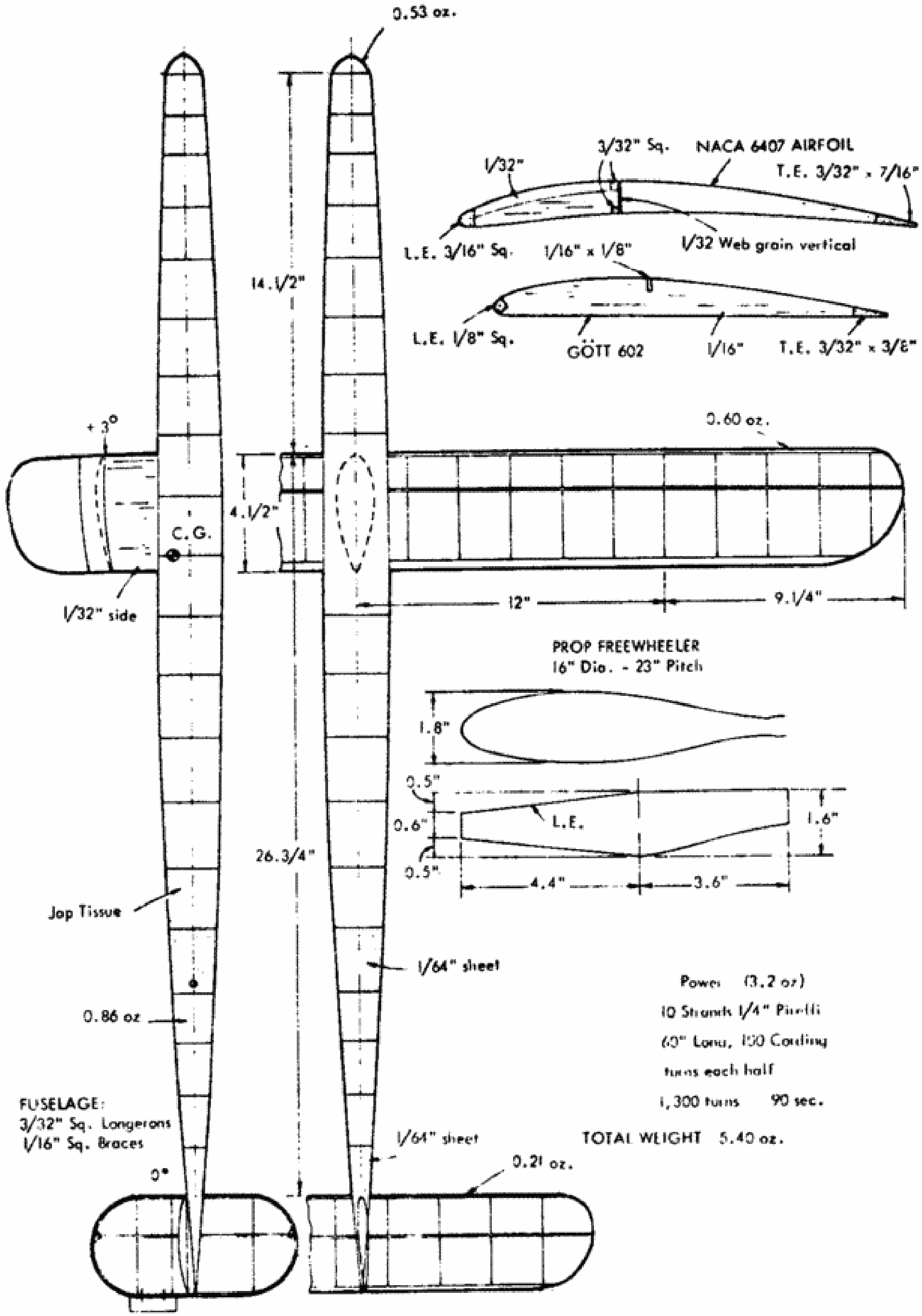


Figure 3. Fred Boxall's unrestricted model used a small free-wheeling propeller.

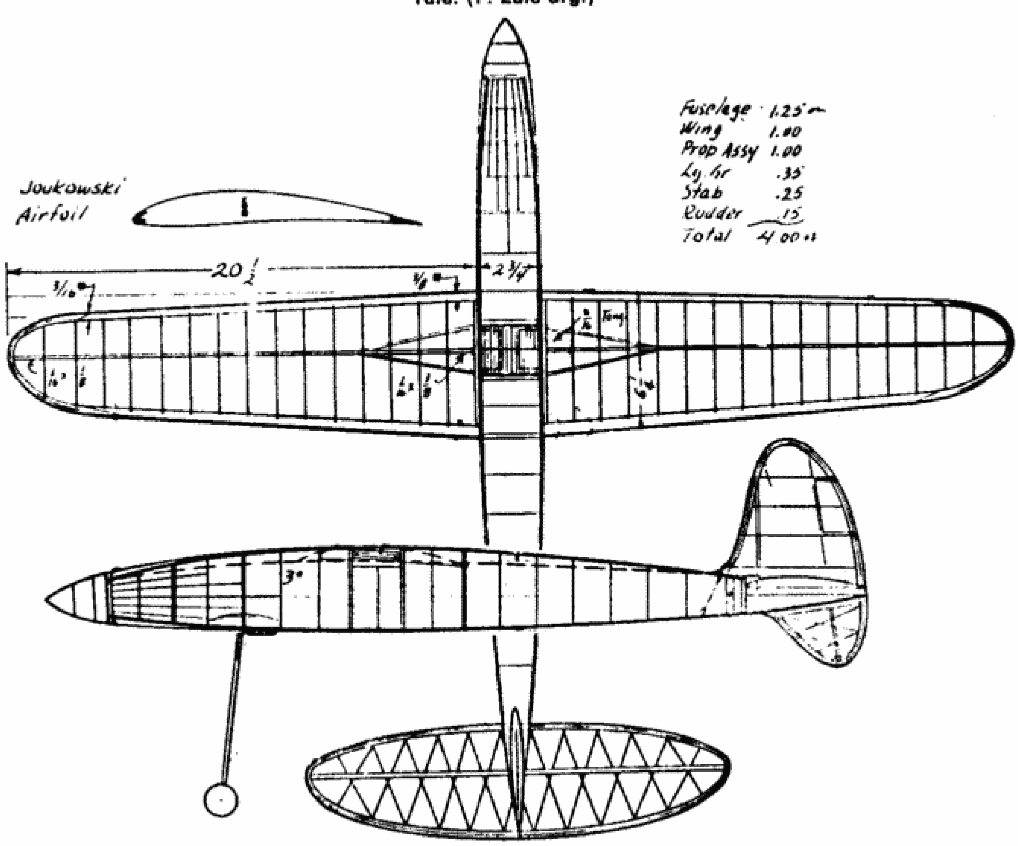
These results are insufficient to be conclusive, but if the evidence is proven correct, the implications for Wakefields may prove most significant. An improvement in performance could result from using a single 8 strand motor driving a slender propeller at a higher than normal R.P.M., or a normal propeller through gears. Further, if internal friction is of such significance, perhaps the motor could run in a bath of low viscosity lubricant.

The efficiency of the propulsion system (e) is rather difficult to assess by any direct method. Certainly propellers can be designed which achieve 80% efficiency at one particular combination of R.P.M. and air-speed. However, the propeller on a rubber driven model operates through a range of speeds and R.P.M. as the torque from the motor varies, and a lower overall efficiency must occur. The remaining term $C_L^{3/2}/C_D$ can be assessed, so that one may work backwards to the efficiency e. The lift coefficient C_L is typically about 1·0, and from observation of the angle of descent along the gliding flight path, the drag coefficient C_D is put at about 0·08 for an open rubber model. Taking F = 146 and Er = 2400 (both appropriate to a 14 strand motor) leads to an estimate for the efficiency of only 42%.

$$e = \frac{0{\cdot}08 \times 87 \times 146}{2400 \times 1{\cdot}0^{3/2}} = 0{\cdot}423$$

There must surely be scope for improving this low figure, but at this time propeller design is one of the least understood topics in aeromodelling. Although some theoretical approaches are made, propellers are still essentially based on a helical distribution of pitch. Flaring propellers which increase their pitch at high torque are in use, but it is not clear how to adjust these for optimum effect. Certainly propeller pitch angle is critical, and two or three degrees of adjustment can make a discernible difference.

Figure 4. Ron Warring's Zombie Wakefield circa 1950, subject to fuselage cross-section/length rule. (F. Zaic drg.)



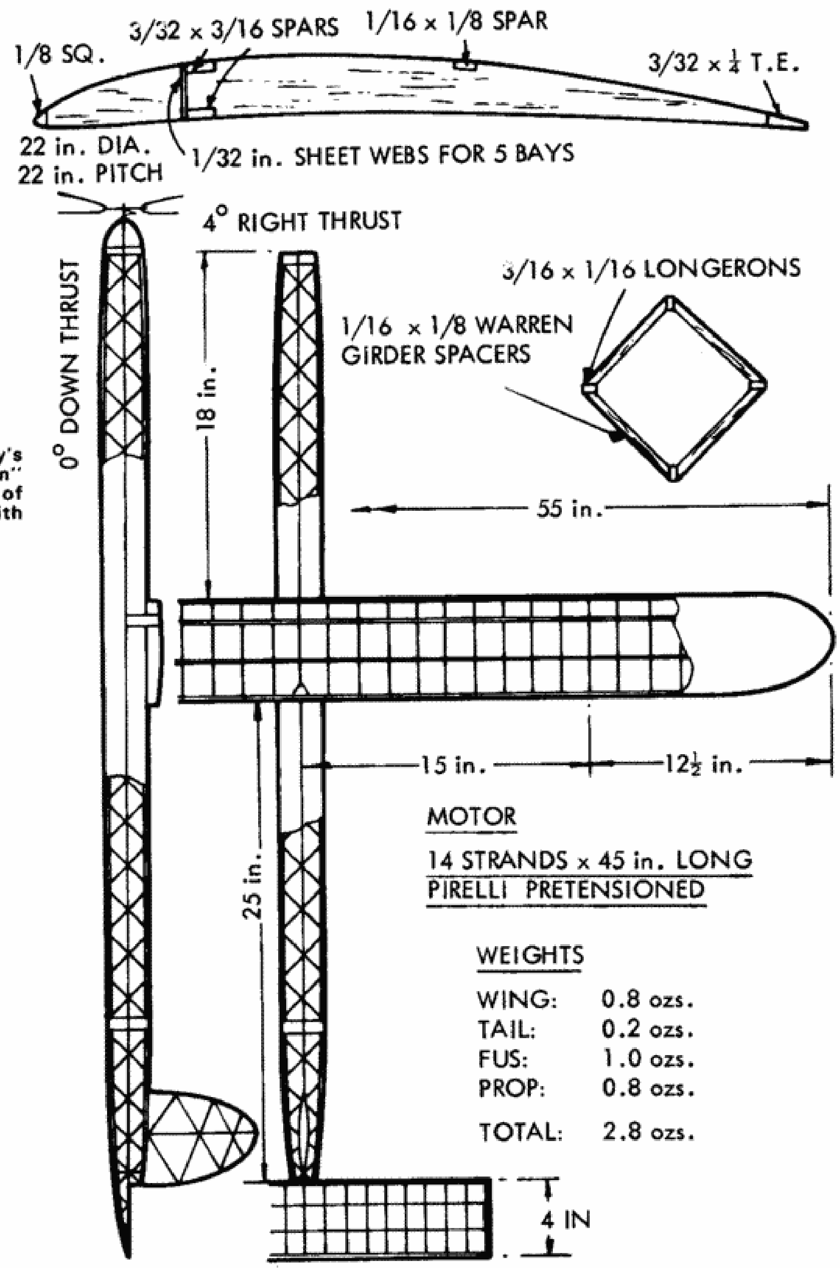
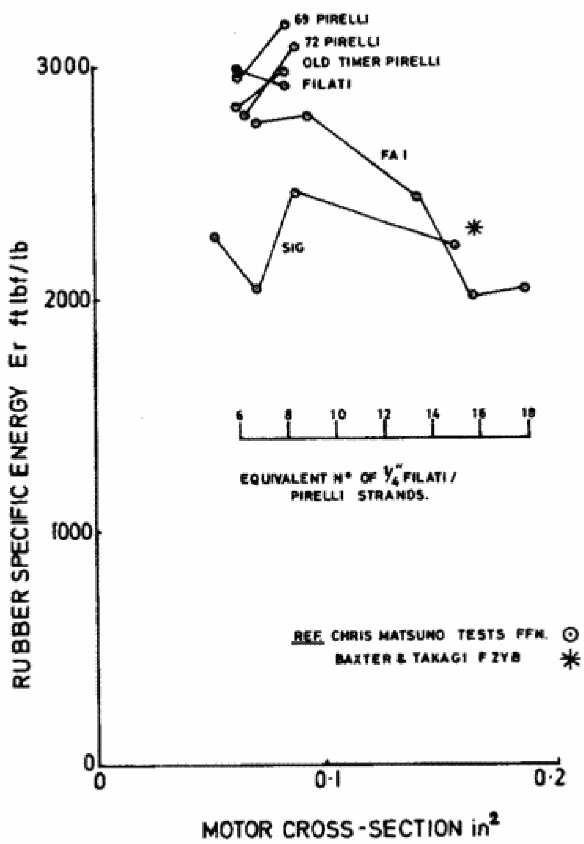


Figure 5. Bob Bailey's unrestricted "open" model typical of modern practice, with 8¾ min. potential.

Rubber Weight Ratio and Wing Loading

The Wakefield rules have always fixed a minimum total weight and a maximum total area, so that wing loading was effectively fixed within a small range. After 1953 a restriction was placed on rubber weight, and prior to 1952 the fuselage minimum cross-section was related to the overall length of the model $(\text{length}/10)^2$. The performance at that time was therefore directly proportional to the rubber/total weight ratio (Wr/W), and the design trend was to cram as much rubber as possible into a short fuselage. Some of the best models used twin motors driving through return gears situated at the rear of the model. Such machines won the world championship in 1949, 1950 (Ellila, *Fig.* 7) and in 1951 (Sune Stark).

FIGURE 6 VARIATION OF RUBBER SPECIFIC ENERGY AVAILABILITY WITH MOTOR CROSS-SECTION.



For the 1952 and 1953 contests the fuselage minimum cross-section was fixed independent of length and many extraordinary models of about 6 ft. in length emerged, *Fig.* 8. These contained up to 6 oz. of rubber in a single motor. They were capable of fine performances, but their stability was suspect due to their large pitching inertia. The contests were hailed as a great challenge between the types. In 1952 the winner (Blomgren) used the same design as the previous winner. The 1953 contest was won by Joe Foster with a moderate length model with twin motors, *Fig.* 9. However, honours were fairly evenly shared between the types and the best approach was not conclusively resolved.

Up to that time the Wakefield had been entirely competitive in unrestricted national competitions, but subsequently the open model has been unfettered in its development as an independent type. The trend has been for an increase in wing area and consequent reduction in wing loading, while the rubber weight ratio has dropped slowly. Weight and other data have been collected together for some 50 models of various types and the rubber weight ratios and wing loadings may be compared in *Fig.* 10.

The Weight of Model Components

The weights of components and hence the potential performance of a rubber driven model may be traced back to the fundamental choice

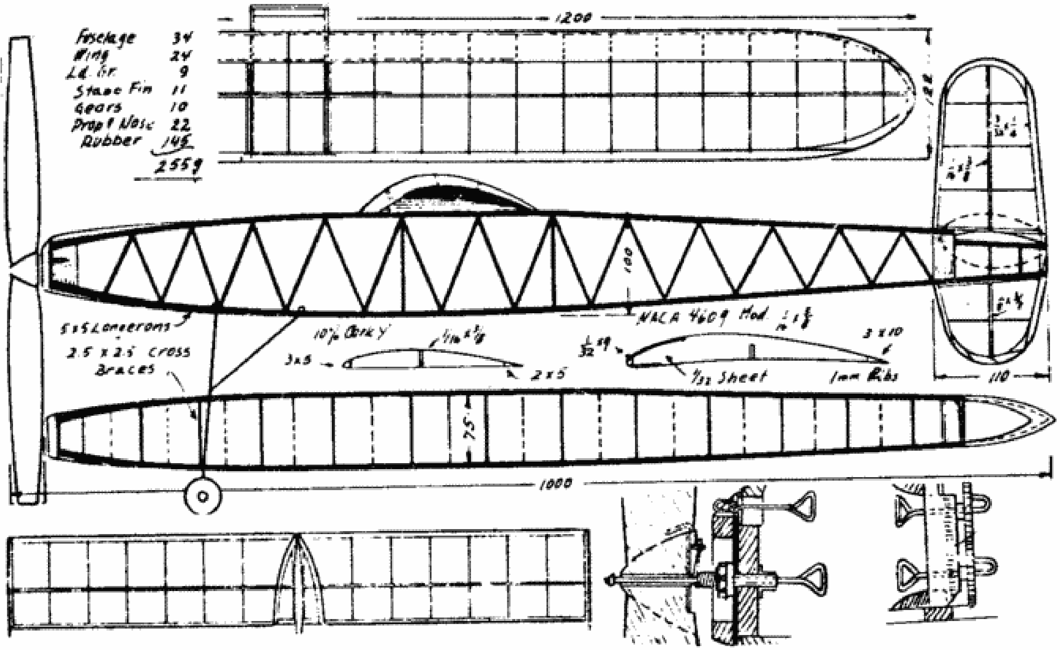
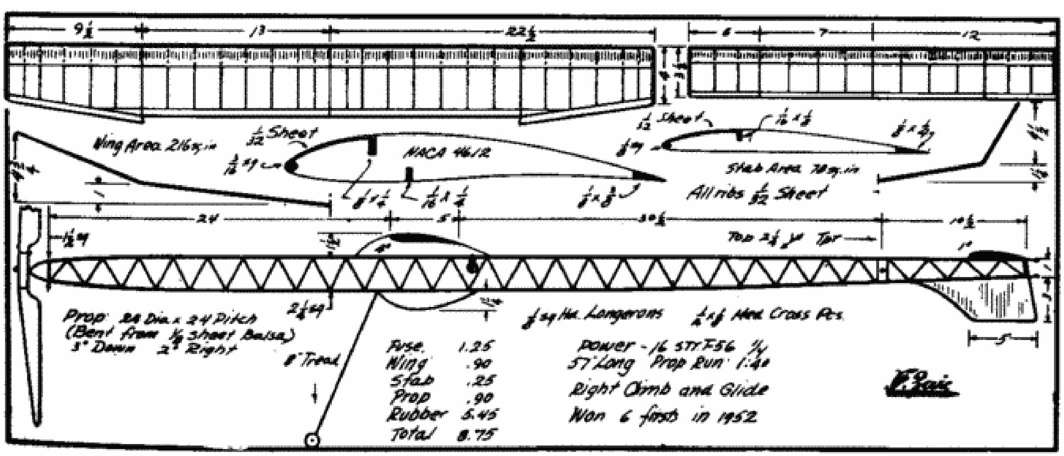


Figure 7. Aarne Ellila's (Finland) Wakefield won the World Championship in 1949 and 1950. the first winner to use twin motors and return gears. (F. Zaic drg.)

of rubber weight and wing area. All too often these vital weight data are missing from published plans; however, by collecting them together over many years sufficient data are now to hand for a meaningful analysis.

For the purpose of this analysis we want to subdivide these weights into two categories, those dependent on rubber weight, known as the energy system (We), and those dependent on wing area, known as the aerodynamic system (Wa). Clearly the energy system contains the motor itself, the propeller assembly (Wp) and most of the fuselage designed to house the motor. The aerodynamic system contains the wing (Ww) and the tail unit (Wt), comprising tailplane, fin and fuselage aft of the rubber anchorage. The weight data available usually include the fin and wing

Figure 8. Typical of the very long Wakefields to emerge in 1952. This is designed by George Perryman (U.S.A.). (F. Zaic drg.)



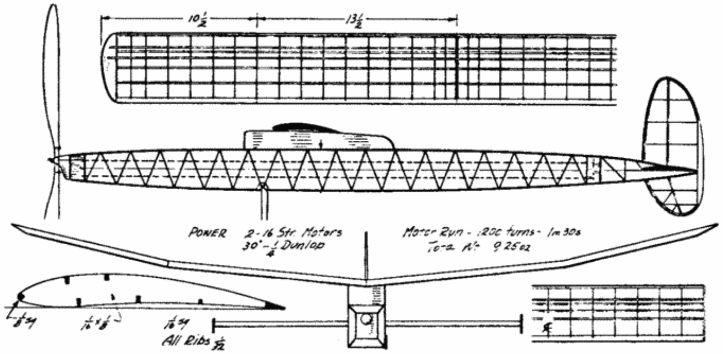


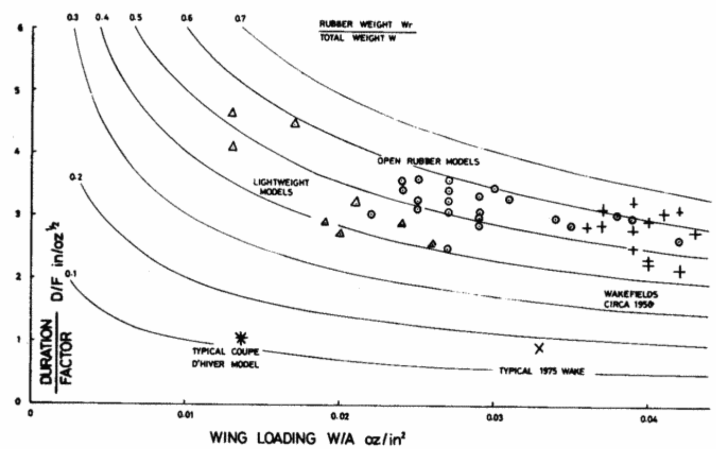
Figure 9. Winner in 1953, W. Forster (U.S.A.) used twin motors and appropriately named his model "Power/Weight". (F. Zaic drg.)

mount weights in the fuselage, and in order to proceed it was found necessary to assume the fin weight equal to half the tailplane weight and assume that the fuselage containing rubber is 90% of the fuselage weight after the fin weight is removed from it (Wf). Thus we have:

$$We = Wr + Wp + 0{\cdot}9\ Wf$$
$$Wa = Ww + Wt$$

In *Fig.* 11 some typical examples of these weights are given for the various types of model under discussion. In *Fig.* 12 fuselage weight, and *Fig.* 13 propeller assembly weight are plotted against rubber weight. In *Fig.* 14 wing weight and in *Fig.* 15 tail unit weight are plotted against wing area. In each case there is a good deal of scatter as one might expect, but

FIGURE 10. POTENTIAL DURATION FOR VARIOUS TYPES OF RUBBER DRIVEN MODELS.



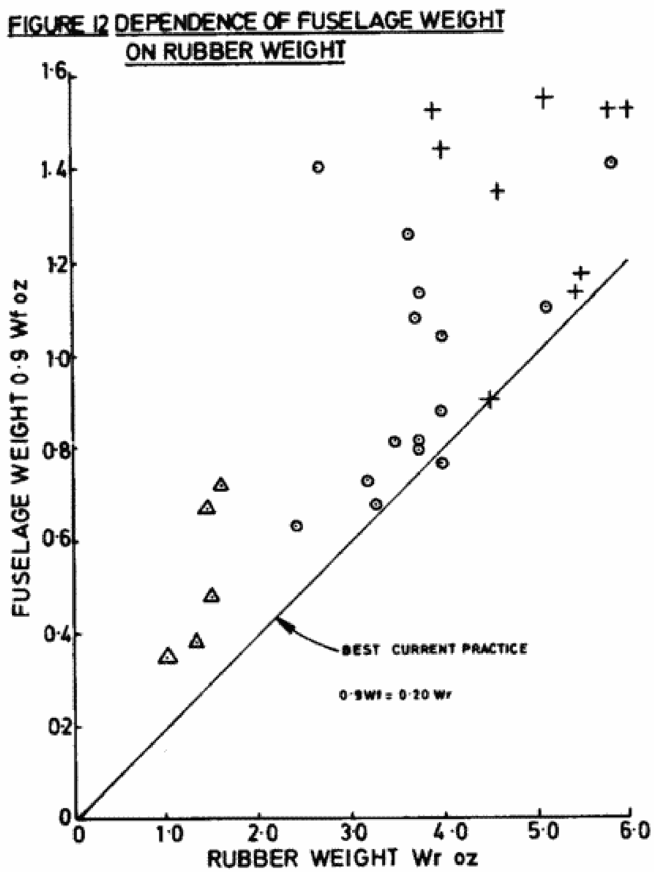
it has been found possible to draw a line representing the lowest weights which have been successfully achieved and this is termed the "best current practice". In many instances it was found that while one component was close to best current practice, other components of the same model were unduly heavy. These diagrams, therefore, are potentially useful to modellers for checking their own components against these achievable standards.

The Optimum Model

Having established this practical information, we can relate the

TYPE	Lightweights		Single motor Wakes		Double motor Wakes			Unrestricted models		
DESIGN	*Pinocchio*	*McGillivray*	*Zombie*	*Perryman*	*Ellila*	*Maibaum*	*Drifter*	*Boxall*	*Bailey*	*Lorimer*
Wing area A	140	162	203	216	195	227	216	185	262	240
Motor size	8×30"	6×30"	16×45"	16×57"	2×14×32"	2×14×33"	2×30×31"	10×60"	14×45"	16×42"
Rubber Wr	1·33	1·00	4·00	5·45	5·11	5·29	6·00	3·30	3·50	3·75
Prop. Assy. Wp	0·35	0·38	1·00	0·90	0·78	0·78	0·75	0·53	0·80	0·60
Fuselage 0·9 Wf	0·38	0·35	1·44	1·13	1·68	1·52	1·52	0·68	0·81	0·81
Energy system We	2·06	1·73	6·44	7·48	7·57	7·59	8·27	4·51	5·11	5·16
Wing Wf	0·56	0·26	1·00	0·90	0·85	0·99	0·60	0·60	0·80	0·77
Tail unit Wt	0·25	0·14	0·56	0·37	0·58	0·42	0·38	0·39	0·39	0·47
Aero. system Wa	0·81	0·40	1·56	1·27	1·43	1·41	0·98	0·99	1·19	1·24
Total W	2·87	2·13	8·00	8·75	9·00	9·00	9·25	5·50	6·30	6·40
Loading W/A	0·021	0·013	0·039	0·041	0·046	0·040	0·042	0·030	0·024	0·027
Ratio Wr/W	0·463	0·469	0·500	0·623	0·568	0·588	0·649	0·600	0·556	0·586
Duration D/F	3·237	4·094	2·519	3·095	2·640	2·952	3·134	3·480	3·583	3·600

Fig. 11. Typical examples of the data compiled for 50 models of various type to aid the analysis. Weights are given in oz. units, loading in oz./in.².



weights of the energy system (We) and the aerodynamic system (Wa) to the rubber weight (Wr) and wing area (A) respectively:

$$We = (1\cdot0 + 0\cdot15 + 0\cdot20)\ Wr = 1\cdot35\ Wr$$
$$Wa = (0\cdot003 + 0\cdot0017)A = 0\cdot0047\ A$$

This result is introduced into the duration equation by noting that the total weight W = We + Wa, and we thus obtain:

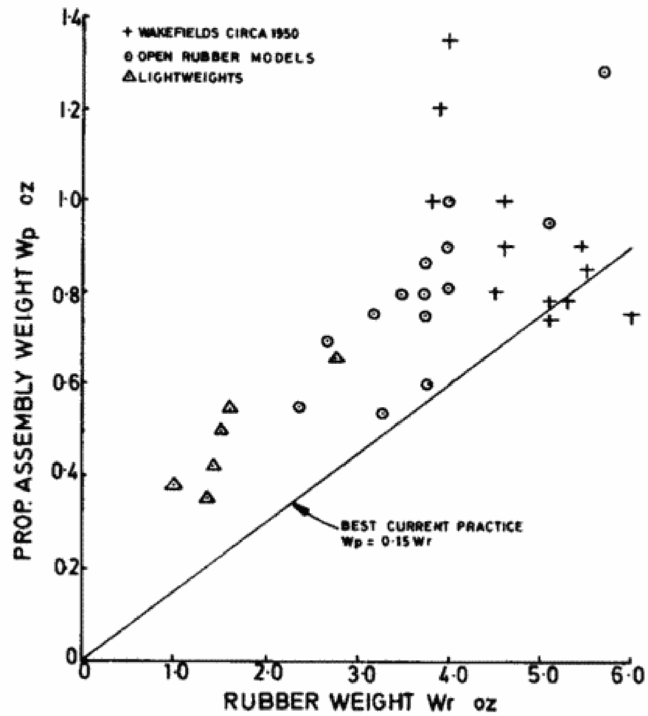
$$\frac{D}{F} = \frac{Wr/(1\cdot35\ Wr + 0\cdot0047\ A)}{(1\cdot35\ Wr/A + 0\cdot0047)^{1/2}}$$

If this equation is examined, the result emerges that for maximum D/F the energy system should be two-thirds of the total weight and therefore will be twice the weight of the aerodynamic system. For optimum conditions it then follows that:

Optimum wing area	Ao	$= 143\cdot6$ Wr in.^{2}
Rubber weight ratio	Wr/W	$= 0\cdot494$
Wing loading	W/A	$= 0\cdot0141$ oz./in.^{2}
Duration/Factor	D/F	$= 4\cdot159$ in./oz.$^{1/2}$

Referring to *Fig.* 10 again, the optimum model within best current practice is found to lie well to the left of the diagram amongst the lightweight models. Remarkably one existing model almost coincides with the optimum (McGillivray, *Fig.* 16) and two existing models better it (Supa Dupa

FIGURE 13 DEPENDENCE OF PROP ASSEMBLY WEIGHT ON RUBBER WEIGHT.



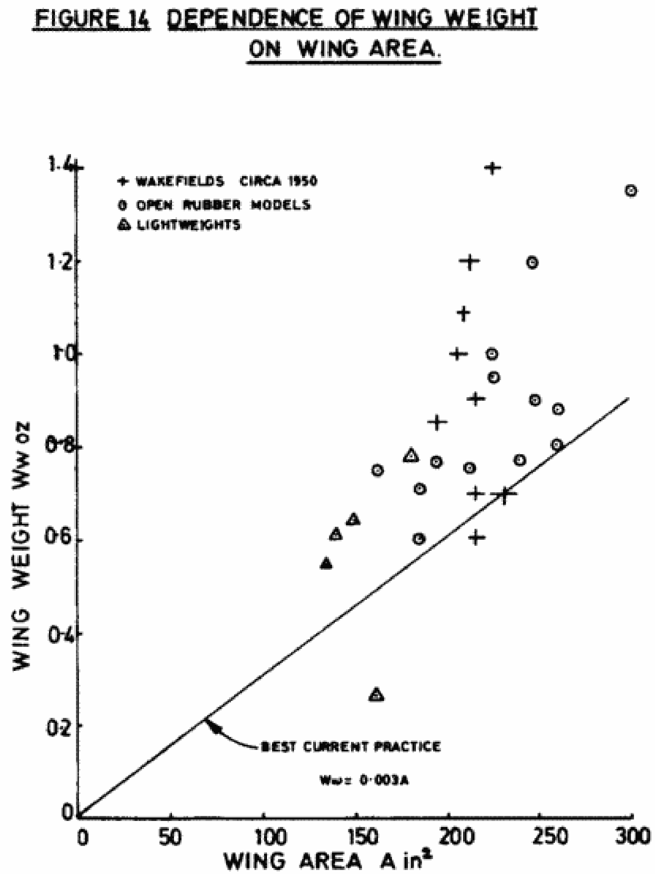
and Thermal Bug, *Fig.* 17). Of course these lightweight models suffer on account of visibility and are knocked about somewhat by turbulent air, so that the optimum model must be rather larger, and would have a double bladed folding propeller, etc. Taking a value of F = 146 as representing good current open model practice, the maximum potential duration is estimated to be:

$$D = \frac{146 \times 0{\cdot}4946}{(0{\cdot}0141)^{1/2}} = 607 \text{ secs. (about 10 min.)}$$

Off Optimum Models

Although the optimum model could be constructed within the bounds of "best current practice", it would be large, light and flimsy. Its wing loading is low, so that it would fly very slowly and would only really be suitable for fly-offs in calm conditions. The typical unrestricted model, e.g. *Fig.* 18, would certainly have less wing area, compensated by a slightly higher proportion of rubber, and may be constructed to a standard a little heavier than best current practice. Indeed values of D/F = 3·60 are attained by existing models, compared with the optimum D/F = 4·159. In order to investigate this it was found necessary to introduce two further factors:

"m" a number defining the airframe weight in relation to best current practice, e.g. m = 1·1 refers to an airframe weight 10% above best current practice.



"p" a number defining the wing area in relation to the optimum area at the appropriate value of m, e.g. p = 0·40 means the wing area is 40% of optimum.

It then follows that the rubber/total weight ratio and wing loading are related to m and p by the expressions:

$$\frac{Wr}{W}=\frac{2}{(1+0{\cdot}35m)\,(2+p)}\,,\quad \frac{W}{A}=\frac{0{\cdot}0047(2+p)\,.\,m}{p}$$

These may then be introduced into the duration equation and solved for a range of values of "m" and "p". This has been done and the result is shown in *Fig.* 19, which is a plot similar to *Fig.* 10, with which it should be compared. The curve for best practice (m = 1·0) runs across the diagram just embracing the existing Wakefield, open model and lightweight model data. Models coming closest to this are the Wakefields of Bilgri (Drifter, *Fig.* 20) and Maibaum, *Fig.* 21, open rubber models of Boxall, Lorimer, Christie and Bailey, and the lightweights already mentioned.

Performance varies rapidly with airframe weight factor (m) and rather slowly with wing area factor (p). This is precisely in line with practical experience and indeed the "m" and "p" factors of a model could be used to describe its potential in much the same way as pitch and diameter are used to describe propellers. The quickest way to determine "m" and "p" for a model is to use the duration equation to calculate D/F and plot this on *Fig.* 19, then read off the factors from the curves given there.

FIGURE 15 DEPENDENCE OF TAIL UNIT WEIGHT ON WING AREA

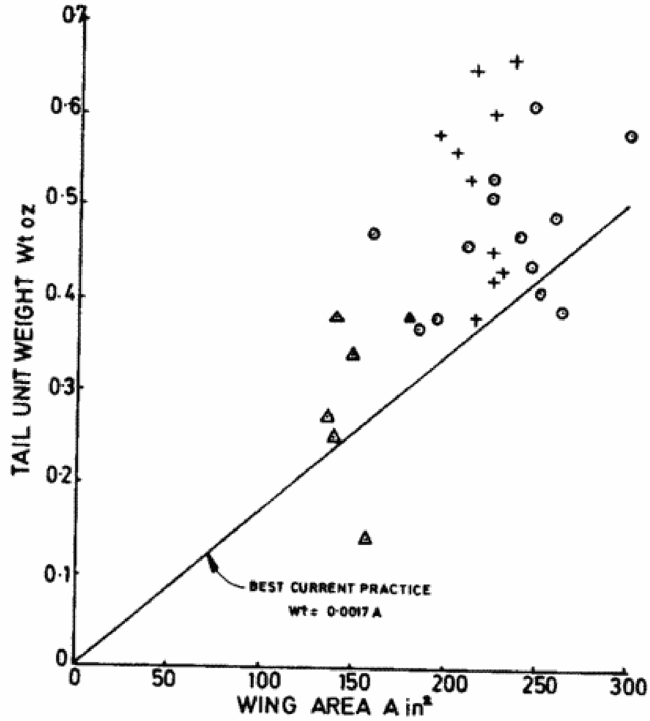
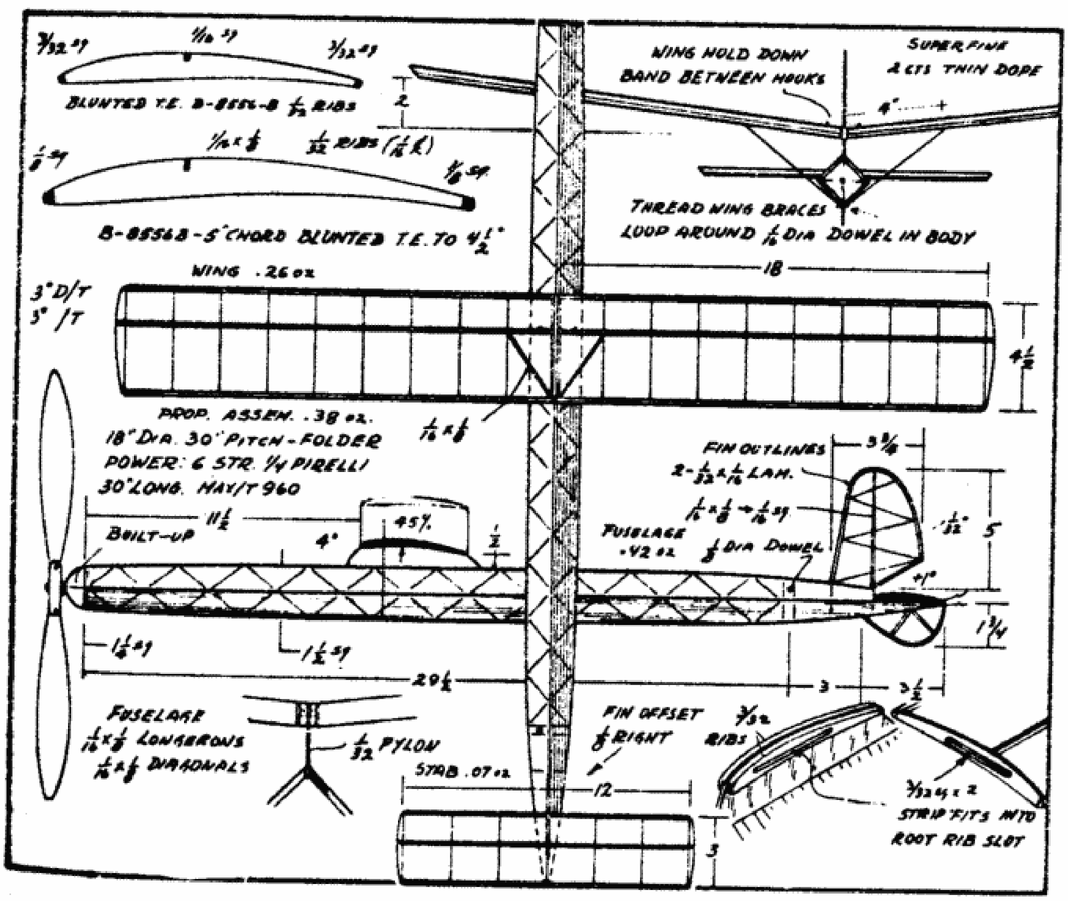


Figure 16. (Below) this very light model by McGillivary of Canada coincides almost exactly with the optimum model predicted by the analysis (F. Zaic drg.)



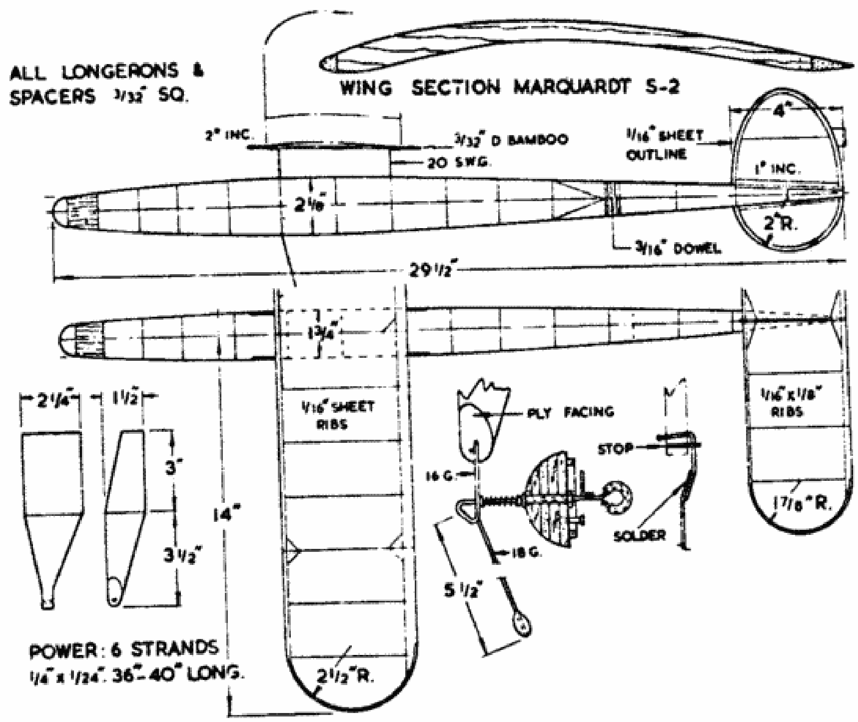


Figure 17. Thermal Bug by Brian Lewis, together with Supa Dupa, recorded the highest duration potential of all the models for which data is known.

Current open rubber models typically have m = 1·1 and p = 0·5. For values of p greater than unity, performance drops rapidly and this region of the curves is only of academic interest.

Future Developments

A gradual improvement can be anticipated by continuing the trend to reduce wing loading associated with a drop in the proportion of rubber. Skill is necessary to ensure all components are built down to current best practice or better. The current trend to use 16 strand motors is possibly wrong; it may be better to reduce the strands in the interest of better specific rubber energy, with consequent reduction in model size. Larger but less potential models seem appropriate for fly-offs in strong wind conditions.

As an example let us deduce the characteristics of a model which takes a moderate step in this direction. Best current practice will only be obtainable by the very best designers and constructors, but competent modellers can probably get within 5%, so we take m = 1·05. We now put the wing area factor a little above current practice at p = 0·60 and proceed to calculate the rubber/total weight ratio and wing loading:

$$\frac{Wr}{W} = \frac{2}{(1 + 0{\cdot}35 \times 1{\cdot}05)\,(2 + 0{\cdot}60)} = 0{\cdot}5625$$

$$\frac{W}{A} = \frac{0{\cdot}0047 \times (2 + 0{\cdot}60) \times 1{\cdot}05}{0{\cdot}60} = 0{\cdot}0214 \text{ oz./in.}^2$$

Now a decision about the size of the model must be made by fixing the rubber weight or wing area. In this case we choose wing area $A = 200$ in.^{2}, a little smaller than current trends.

$$\text{Total weight } W = 0{\cdot}0214 \times 200 = 4{\cdot}280 \text{ oz.}$$
$$\text{Rubber weight } Wr = 0{\cdot}5625 \times 4{\cdot}28 = 2{\cdot}408 \text{ oz.}$$

Target weights for the various components can now be predicted:

Fuselage	$0{\cdot}9Wf = 0{\cdot}20 \times 1{\cdot}05 \times 2{\cdot}408$	$= 0{\cdot}506$
Propeller	$Wp = 0{\cdot}15 \times 1{\cdot}05 \times 2{\cdot}408$	$= 0{\cdot}379$
Rubber	Wr	$= 2{\cdot}408$
Energy system	We	$= 3{\cdot}293$
Wing	$Ww = 0{\cdot}003 \times 1{\cdot}05 \times 200$	$= 0{\cdot}630$
Tail unit	$Wt = 0{\cdot}0017 \times 1{\cdot}05 \times 200$	$= 0{\cdot}357$
Aerodynamic system	Wa	$= 0{\cdot}987$ oz.
Check total weight	$W = We + Wa$	$= 4{\cdot}280$ oz.

Now a decision regarding the details of the rubber motor is necessary. The model compares with Boxall's design, although it has a little more area and less rubber. Therefore a 10 strand motor as he used would seem adequate, its length being about 43 in. The duration factor can be tenta-

Figure 18. Another typical but smaller unrestricted model design, Goblin Able by N. P. Elliott. (F. Zaic drg.)

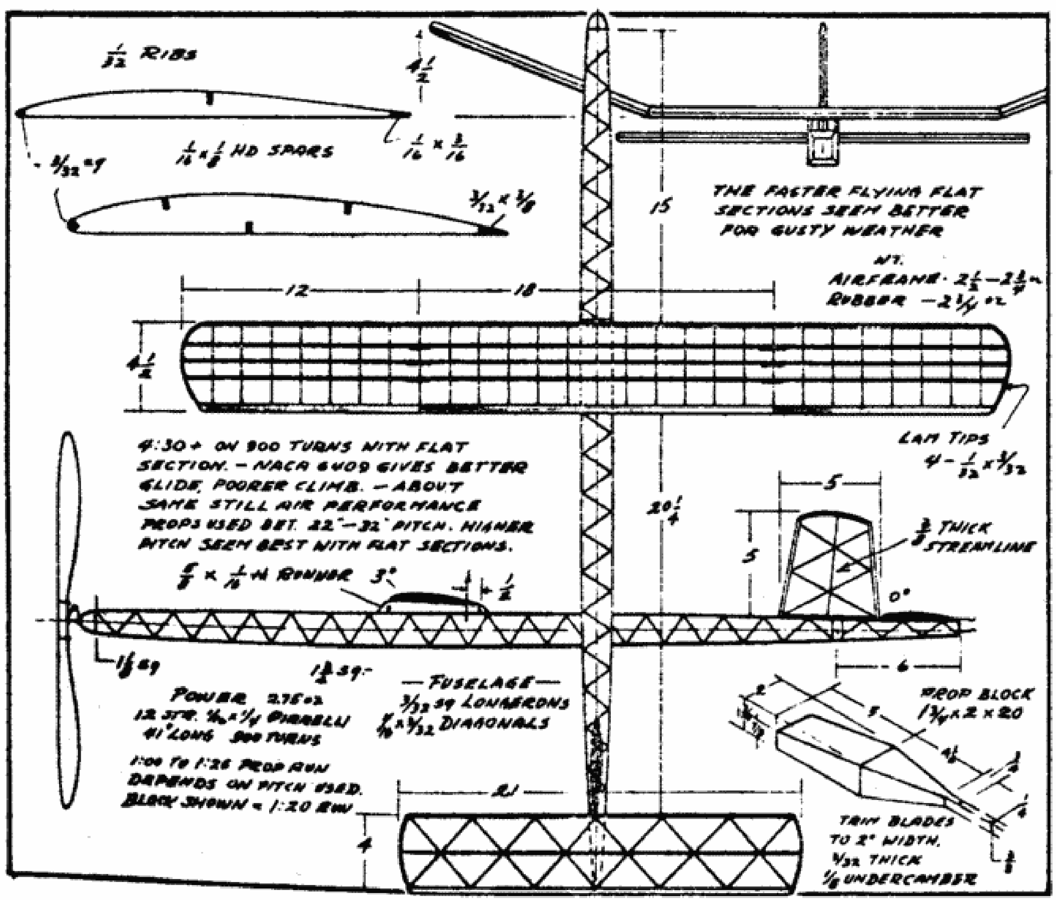
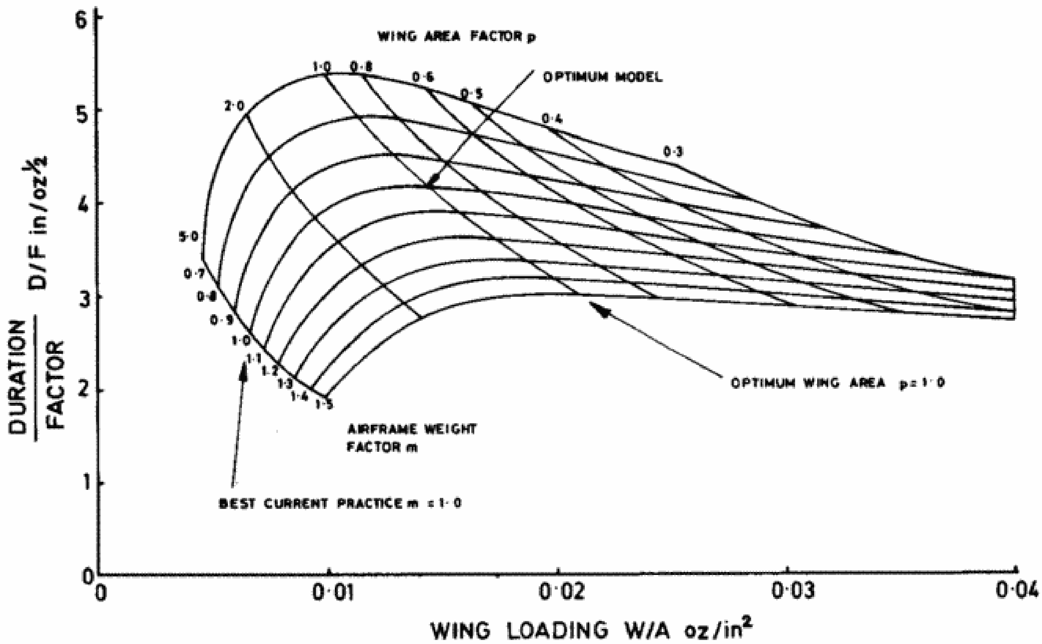


FIGURE 19 POTENTIAL DURATION VARIATION WITH AIRFRAME WEIGHT AND WING AREA.



tively scaled to take account of the number of strands (2700 ft. lbf./lb. energy available compared with 2400 ft. lbf./lb. at 14 strands), and the duration equation used thus:

$$D = \frac{146 \times 2700 \times 0{\cdot}5625}{2400 \times 0{\cdot}0214^{1/2}} = 631 \text{ secs. } (10\tfrac{1}{2} \text{ min.})$$

New Model Class

The unrestricted model is unique amongst the outdoor classes of models in its promotion of real skill in the design and construction of lightweight airframes. Duration potential alone is not the only design criterion; visibility, ruggedness, expendability and cost are other factors which are frequently taken into account.

The analysis reveals the small effect which wing loading has on duration when the designer is permitted to vary the proportion of rubber in compensation. This makes for equitable performance between models of various sizes and encourages the selection of the model most suited to the prevailing conditions, i.e. smaller high potential models for days of good visibility and recovery, larger models of lower potential for conditions of poor visibility, fly-offs, etc.

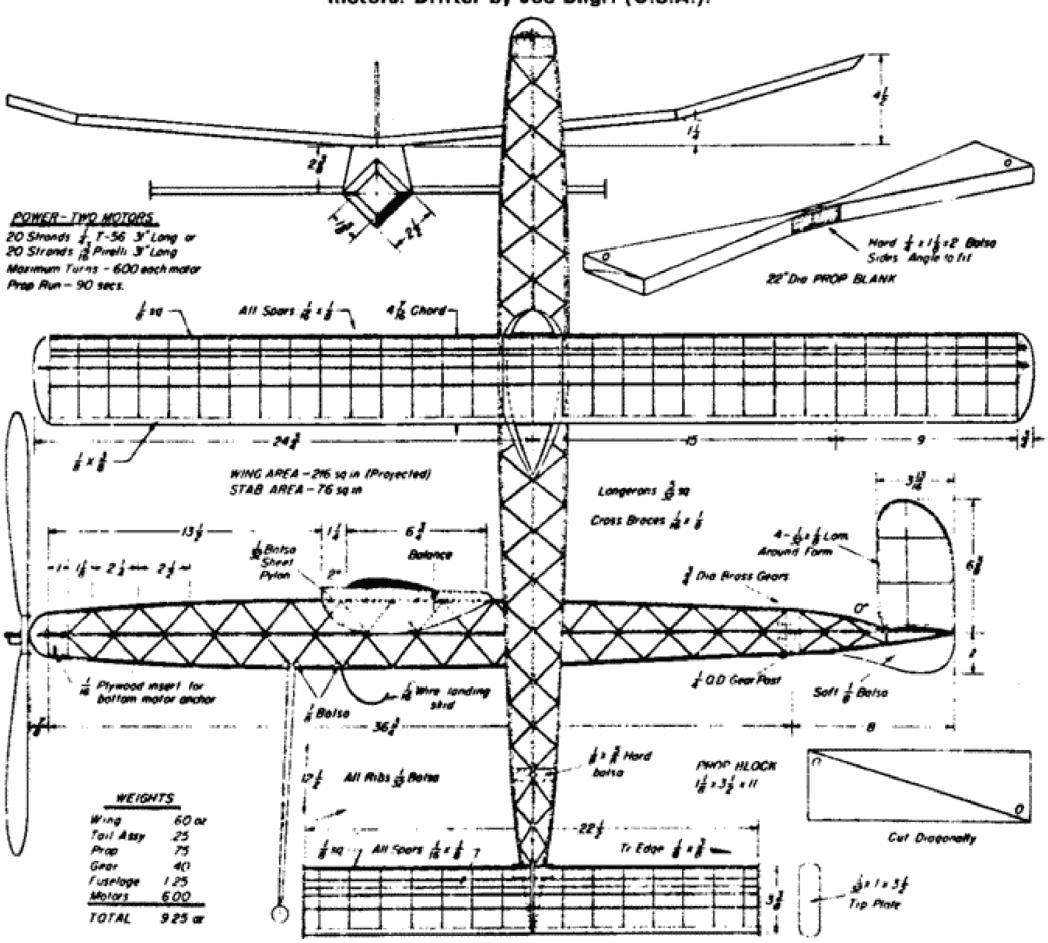
Yet this freedom is gained at the expense of producing models which are too good for the open spaces in which we can normally operate them. On the other hand the current Wakefield Specification seems far too restrictive (effectively fixing W/A and Wr/W) and permitting development in a narrow field (associated with F). It would seem desirable then to seek a specification which results in an intermediate model with a duration potential of say 4 to 5 minutes, which is not restricted in wing loading nor discourages structural or aerodynamic development.

To be acceptable any specification must be easy to check on the flying field. We are accustomed to rules which are concerned with weights and wing areas, but even these are troublesome to deal with in practice. The simplest check that one can specify is the measurement of certain linear dimensions. To be attractive to modellers new rules should lead to models which are sufficiently unlike those to which we are accustomed to be recognisable as a distinctive new class.

No simple formulation of weights and wing areas will meet these needs and I conclude that any new rules should seek to limit the duration factor F primarily. If one could specify the rubber specific energy one need look no further; this of course is impractical unless it is forced on us by good quality rubber strip ceasing to be available. Ballast could be regarded as rubber of zero specific energy, but this has not proved popular (P.A.A. contests). Yet a solution remains of which the following is a proposal for discussion and evaluation.

1. The propeller must be of the free-wheeling type and may not be less than 400 mm. diameter.
2. The fuselage must have dimensions not less than 75 mm × 75 mm at its maximum cross-section.

Figure 20. One of the best Wakefields, meeting "best current practice" and using double motors. Drifter by Joe Bilgri (U.S.A.).



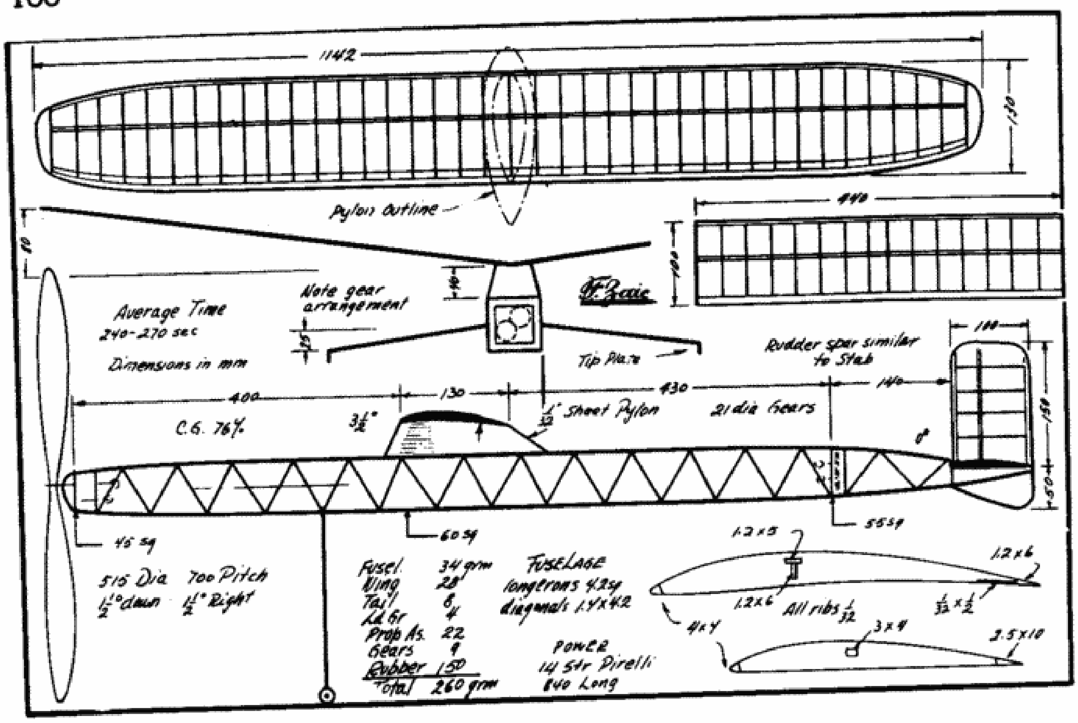


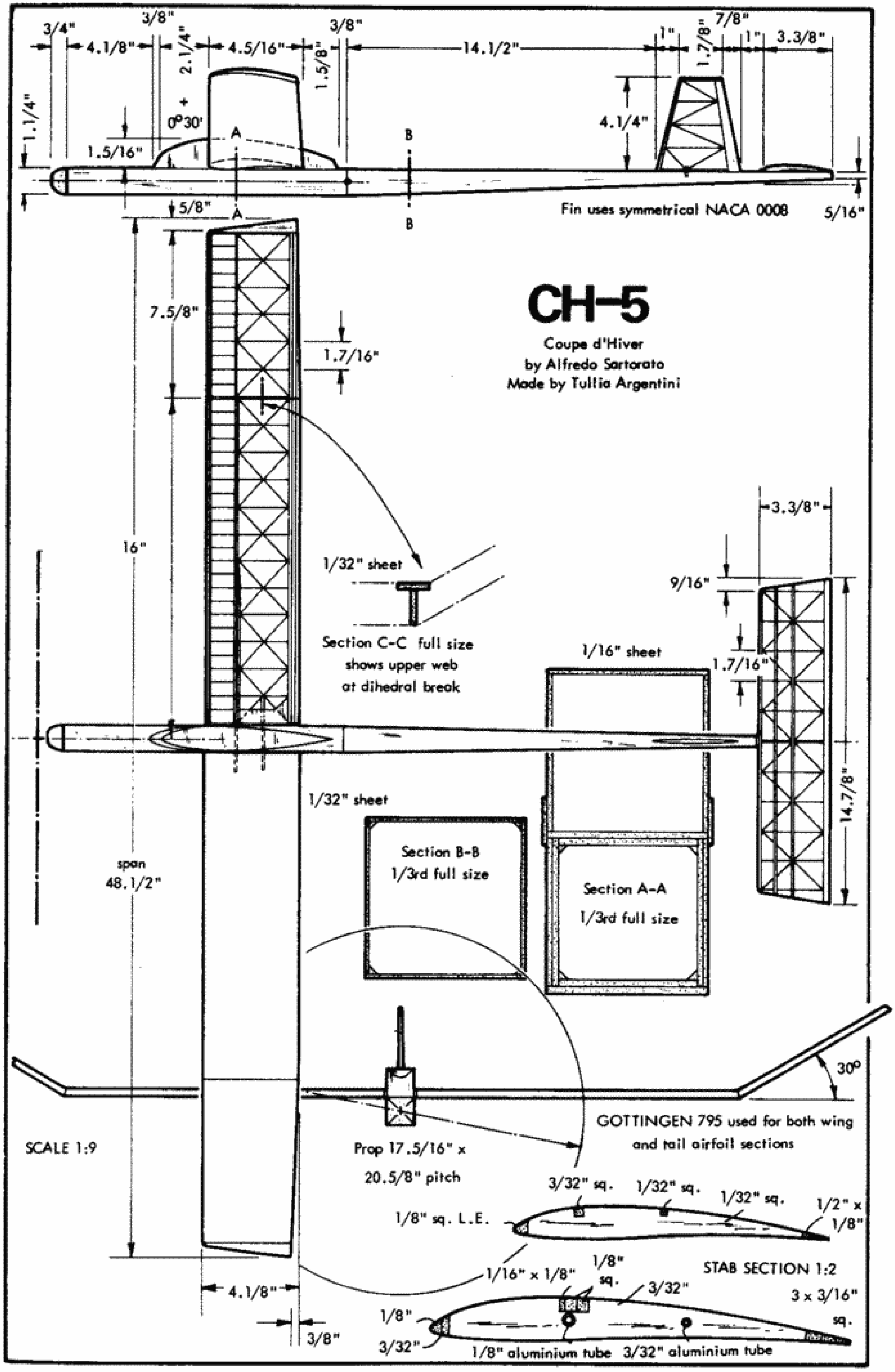
Figure 21. Another top Wakefield of its day, by Gunther Maibaum of Germany. (F. Zaic drg.)

3. The rubber motor must be a single skein housed in the fuselage, the length of which does not exceed 500 mm. from nose to rear anchorage.
4. The maximum flight time to be 3 minutes, etc., in accordance with current S.M.A.E. rules.

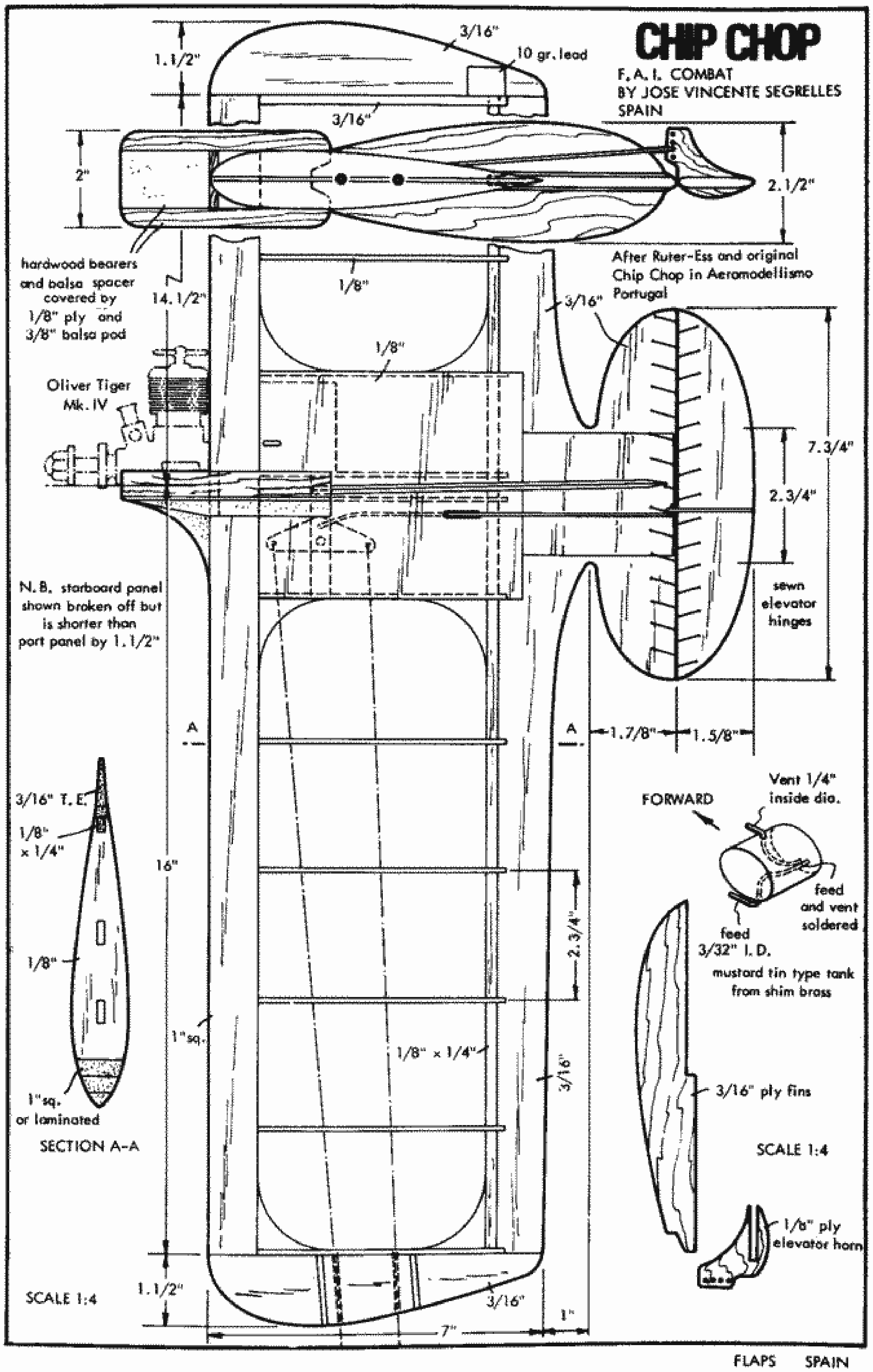
It is reasoned that the duration potential should be pitched a bit beyond the maximum to ensure that the model is an attractive performer while not making it essential to resort to tactical flying. This is achieved by rules which influence model drag directly and limit rubber and structural weight indirectly. It is conceived as a simple gadjet-free model which could initially appeal to novice and expert alike.

The analysis does not predict the performance of this type of model or its variation with size; this would only be possible later on after models have been built and data collected. However, the duration factor F must be at least halved relative to current open models on account of rules 1 and 2. Propeller weight will probably increase to avoid frequent breakages, and rule 2 will increase fuselage weight while giving the models a chubby appearance. Good aerodynamic and structural design of these components will be at a premium. Rule 3 does not limit rubber weight but introduces some restriction on its length. A large number of strands (16 to 18) would call for a larger propeller with consequently poorer glide and risk of landing damage. Most of the variables are left to the designer's discretion, and compliance with the rules may be checked by any competitor with a tape measure.

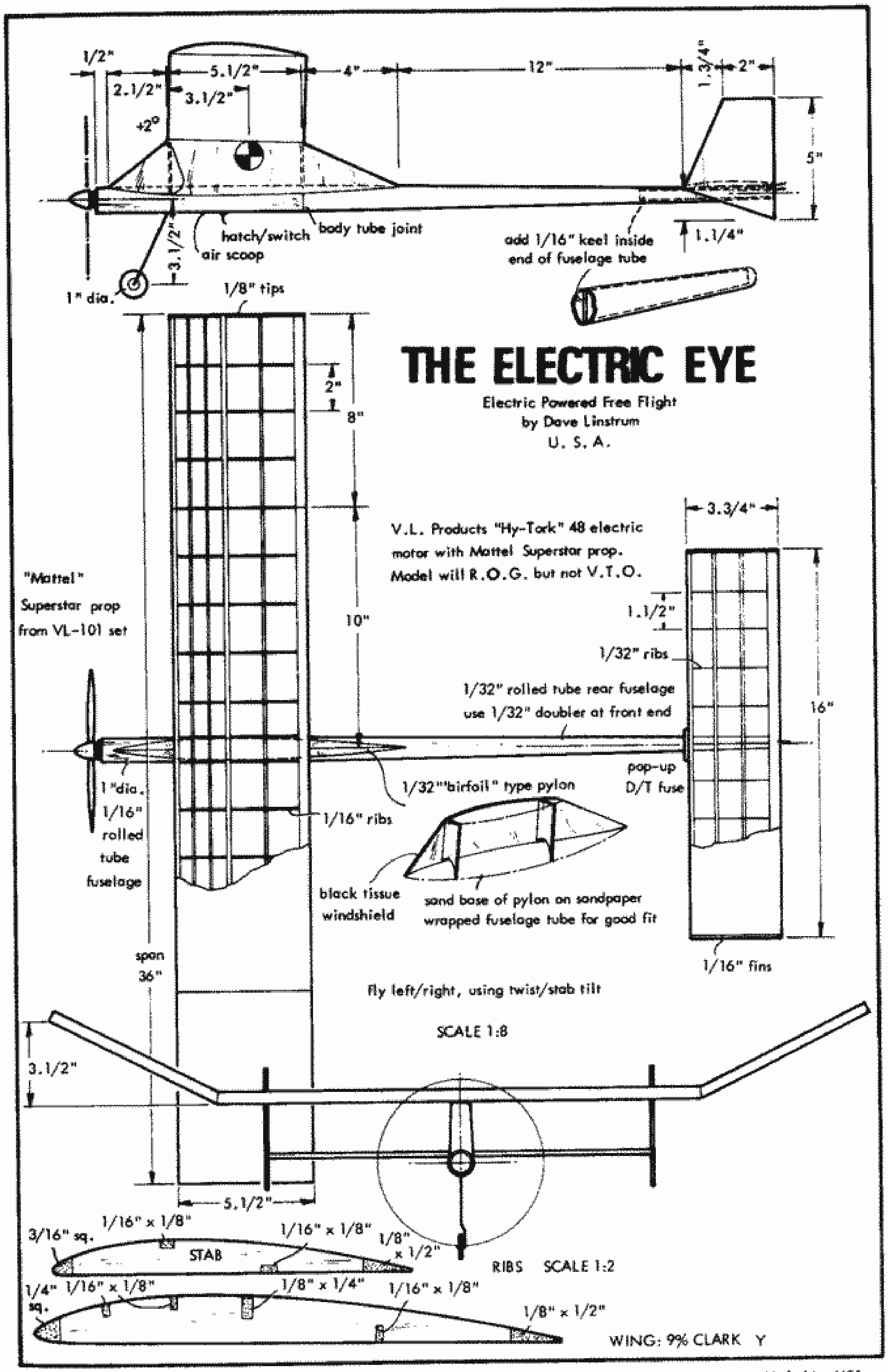
It is time we tried something new!



AEROMODELLISMO ITALY


CHIP CHOP
F.A.I. COMBAT
BY JOSE VINCENTE SEGRELLES
SPAIN
After Ruter-Ess and original Chip Chop in Aeromodellismo Portugal
1.1/2"
3/16"
10 gr. lead
3/16"
2"
2.1/2"
hardwood bearers and balsa spacer covered by 1/8" ply and 3/8" balsa pod
14.1/2"
1/8"
1/8"
3/16"
Oliver Tiger Mk. IV
7.3/4"
2.3/4"
sewn elevator hinges
N.B. starboard panel shown broken off but is shorter than port panel by 1.1/2"
A
A
1.7/8"
1.5/8"
3/16" T.E.
1/8" x 1/4"
1/8"
1"sq. or laminated
SECTION A-A
16"
1"sq.
1/8" x 1/4"
2.3/4"
3/16"
FORWARD
Vent 1/4" inside dia.
feed and vent soldered
feed 3/32" I.D.
mustard tin type tank from shim brass
3/16" ply fins
SCALE 1:4
1/8" ply elevator horn
SCALE 1:4
1.1/2"
3/16"
7"
1"

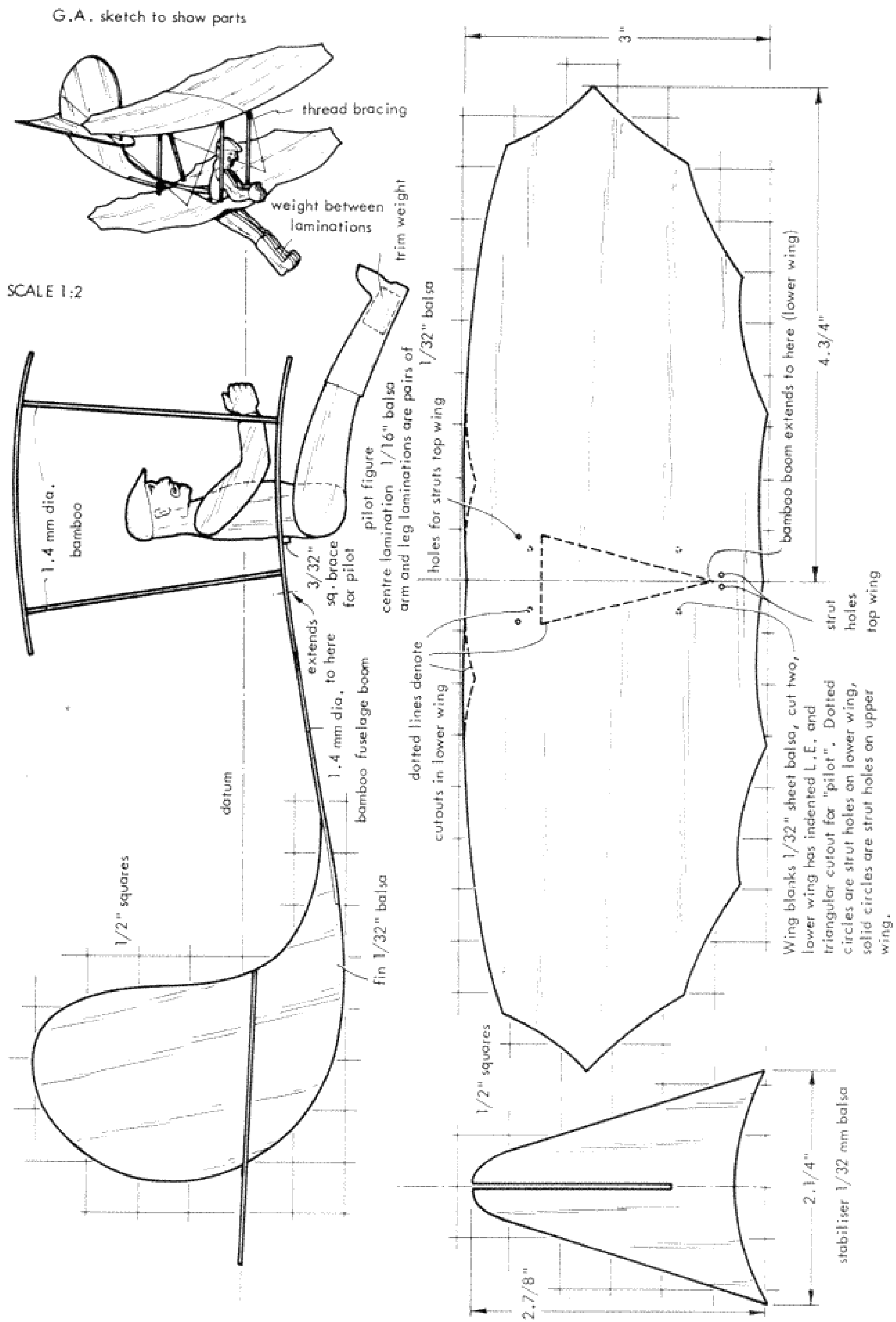
FLAPS SPAIN


THE ELECTRIC EYE
Electric Powered Free Flight
by Dave Linstrum
U. S. A.
V.L. Products "Hy-Tork" 48 electric motor with Mattel Superstar prop. Model will R.O.G. but not V.T.O.
1/2"
5.1/2"
4"
12"
1.3/4"
2"
2.1/2"
3.1/2"
+2°
5"
hatch/switch
body tube joint
air scoop
add 1/16" keel inside end of fuselage tube
1.1/4"
1" dia.
1/8" tips
2"
8"
10"
3.3/4"
"Mattel" Superstar prop from VL-101 set
1.1/2"
1/32" ribs
1/32" rolled tube rear fuselage use 1/32" doubler at front end
16"
pop-up D/T fuse
1"dia.
1/16" rolled tube fuselage
1/32""birfoil" type pylon
1/16" ribs
black tissue windshield
sand base of pylon on sandpaper wrapped fuselage tube for good fit
1/16" fins
span 36"
Fly left/right, using twist/stab tilt
SCALE 1:8
3.1/2"
5.1/2"
3/16" sq.
1/16" x 1/8"
STAB
1/16" x 1/8"
1/8" x 1/2"
RIBS SCALE 1:2
1/4" sq.
1/16" x 1/8"
1/8" x 1/4"
1/16" x 1/8"
1/8" x 1/2"
WING: 9% CLARK Y

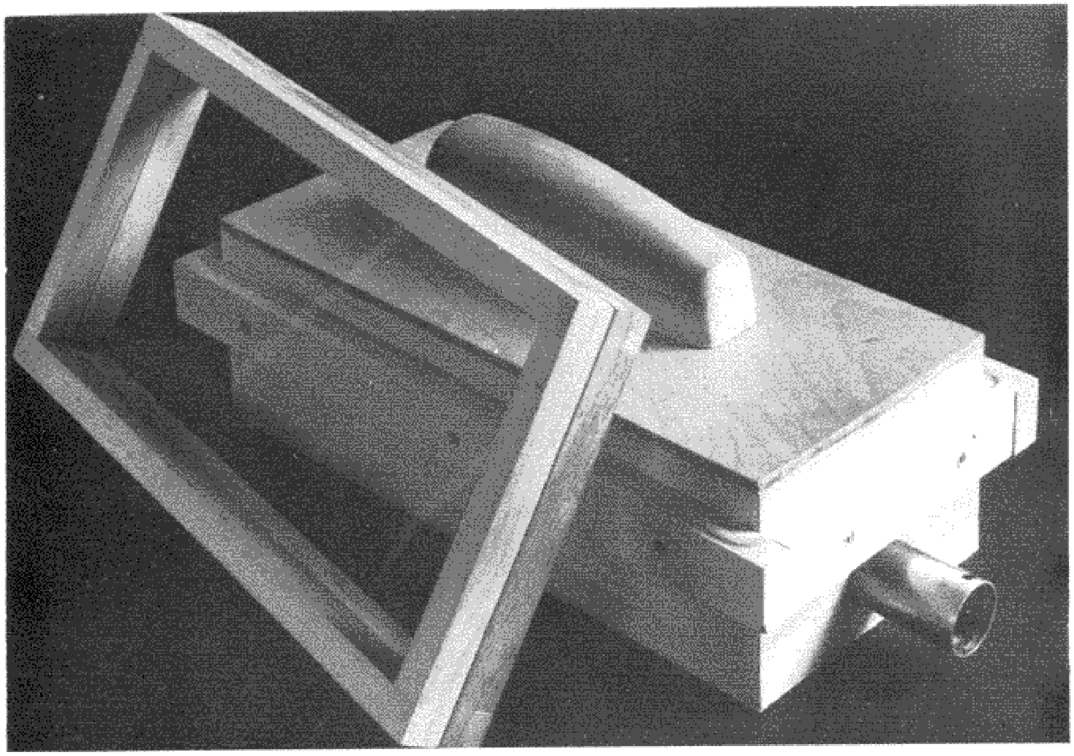
M.A.N. USA

LIL' LILIENTHAL

Novelty Chuck Glider by O. Saffek
CZECHOSLOVAKIA



MODELAR CZECHOSLOVAKIA



The vacuum forming table with film holding frames and film. Plug in position on table. Note adapter tube on right, vacuum holes in table top and surgical tube vacuum seal. Photography by Thorney Leiberman.

MAKE YOUR OWN VACUUM FORMING TABLE

by Ron Williams

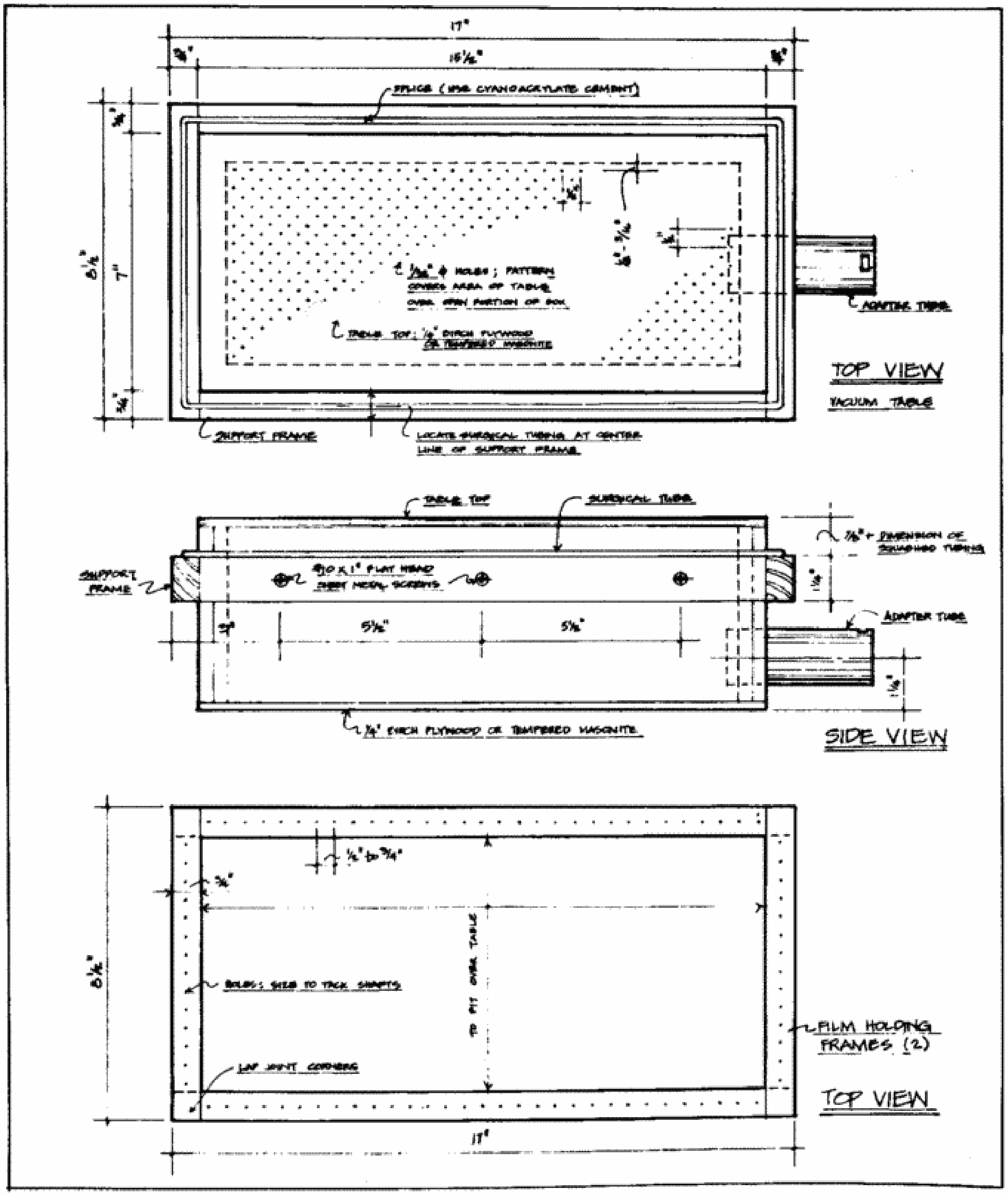
A feature from "Model Builder" which has international application to a broad range of modelling

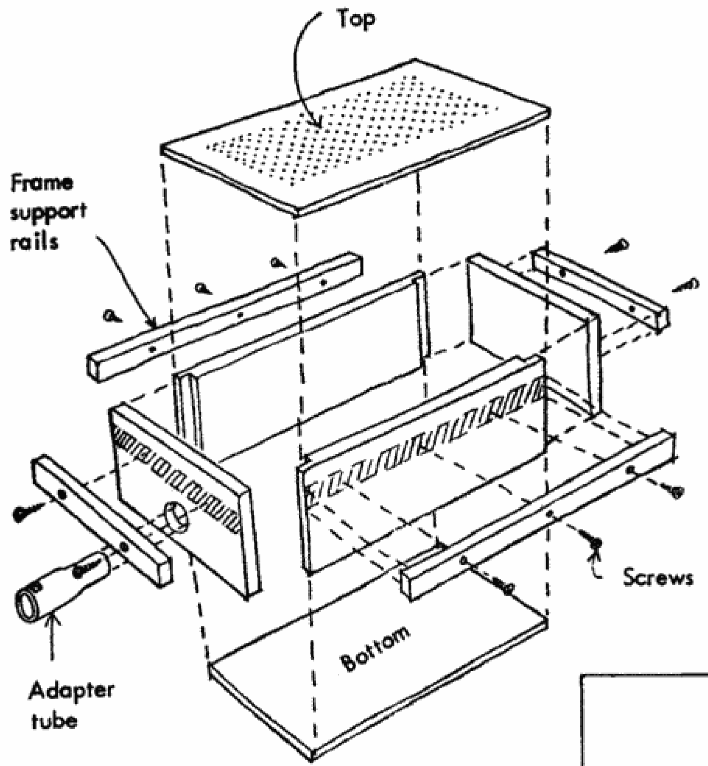
ONE HAS to read a few how-to articles on C/L or R/C scale (or semi-scale) to realise how often the question of canopy, cowl or wheel spats arises. Free-flight scale often requires lightweight wheels and canopies as well. What to make them of . . . a thin, light plastic shape; but how to get it? Articles often mentioned "vacu-forming" the part. The Mattel Toy Company manufactured a "vacu-form" toy some years ago which has become a valued tool for many scale modellers. This toy had a small hot plate next to a vacuum chamber with a frame that hinged between the two. Small sheets of plastic held in the frame could be heated on the hot plate, flipped over to the vacuum table and pulled and formed over a small object by a hand-pumped vacuum. It was quite well designed and works very efficiently. For builders of larger models, however, the Mattel unit has limited capabilities due to its small table size (approx. 3 × 5 in.). Canopies and cowlings for a large stunter or R/C model require much larger equipment.

These dimensions seemed reasonable for the development of a useful unit. Smaller sheets of plastic can be handled by bringing them up to the larger size with the addition of heavy bond paper taped to a small sheet.

I decided to start with our family vacuum cleaner. It is a cylinder type of unknown vintage. I have seen similar machines going cheaply in local repair shops, second hand of course. Your local repair shop should have an adapter tube which, though not entirely necessary, will facilitate the attachment of the cleaner hose to the vacuum table.

The vacuum table was made with scraps of birch plywood and masonite. Some straight clear pine is also required. The box sides were made with $\frac{3}{4}$ in. birch ply, the top with $\frac{1}{4}$ in. birch ply, the bottom with $\frac{1}{4}$ in. masonite (tempered) and the frame members with $\frac{3}{4}$ in. clear pine ripped to $\frac{7}{8}$ in. wide. P.V.A. glue was used, and the frame supports attached with 10 No. 10 flat-head screws, $1\frac{1}{2}$ in. long. Some 50 drawing pins are



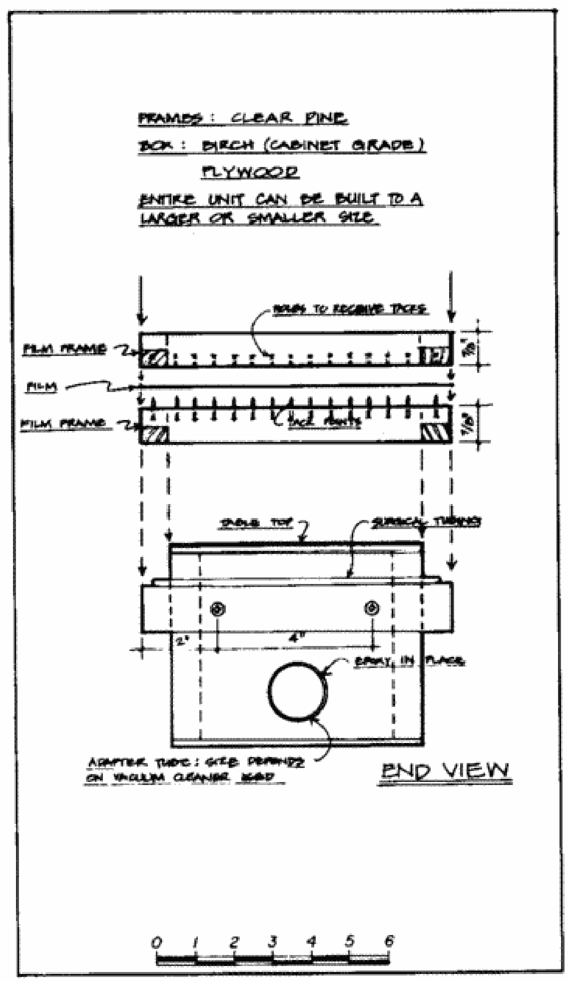


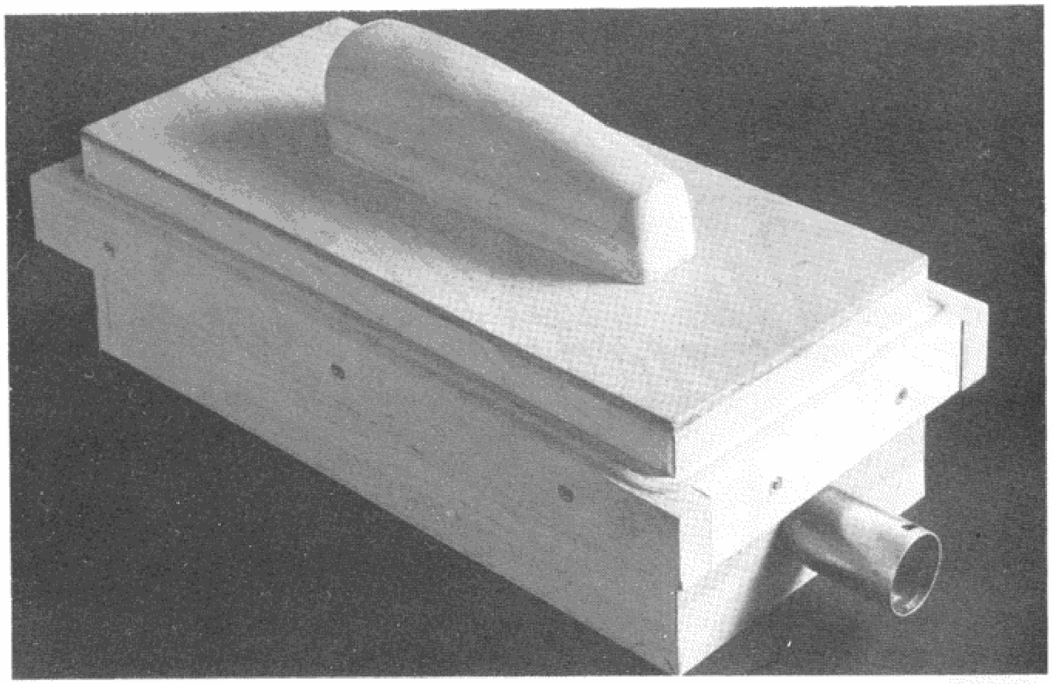
Exploded view of the vac-former showing its easy construction. Plans (No. 4763) are from Model Builder Magazine, 621 West Nineteenth Street, Costa Mesa, California 92627. Price $1.50 (U.S.A.) or £1 incl. overseas mail.

required (they hold the plastic film in place in the film frame). I used $\frac{1}{8}$ O.D. surgical tubing (about 54 in. long) as a vacuum seal between the film frame and the support frame.

Tools required are a few $\frac{1}{32}$ in. drills, a drill the size of the tack shafts, and one half again as large. It's nice to have more than one of the $\frac{1}{32}$ in. drills, as they are likely to break with all those holes to be drilled. A high-speed drill is a great time-saver. Gluing is facilitated with an assortment of clamps, but if they are not available, the joints can be screwed as well as glued. Don't leave the glue out, it acts as a vacuum seal.

Begin construction by cutting the wood to size. Lay out the hole pattern on the table top (plywood or masonite) and drill the holes. My table top had 578 holes. Sand the top very carefully after drilling smooth with 600 paper, and clear all the holes. Glue the outside frame of the box



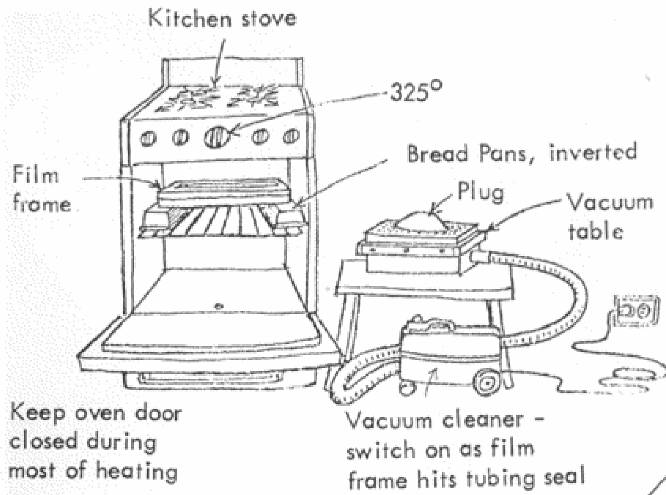


Vacuum table with plug in position. Note built-up plug. Note holes in table top, surgical tube seal, masking tape seal around bottom edge and general construction. Photo by Thorney Leiberman.

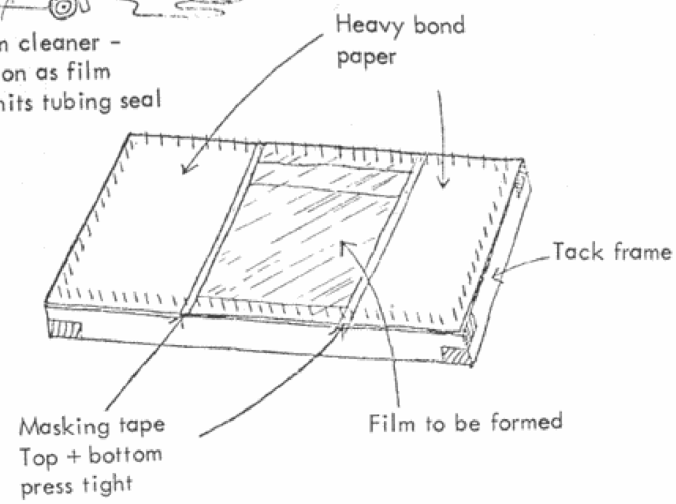
together, making sure the top and bottom surfaces of the frame are as flush (even) as possible. Glue the top and bottom onto the frame, pressing them to the frame so that the joints will be as air-tight as possible. If you haven't yet drilled the hole in the end of the box for the vacuum cleaner adapter, do it now. The hole should be such that the adapter can be epoxied into place firm and tight. A hole which is a snug fit for the tube on the vacuum cleaner hose can be substituted for an adapter tube, tape being used to seal it.

It is essential that the film contacts the vacuum table top when its frame is pressed upon it. Squash the surgical tube between two pieces of wood and measure the thickness when pressed firmly by hand (lean on it). Add this dimension to the $\frac{7}{8}$ in. dimension of the pine frame material; the resultant dimension is the measurement from the vacuum table top to the top surface of the support frame. Position the support frame pieces; drill and screw them to the box. Loosen the screws, glue generously, then re-screw. Glue the surgical tube to the support frame. Locate the tubing at the centre of the support frame so that the tubing can spread freely when the film frame is pressed upon it. Spot-glue the tubing at first to locate it, glue the splice, and then glue the rest of it in place.

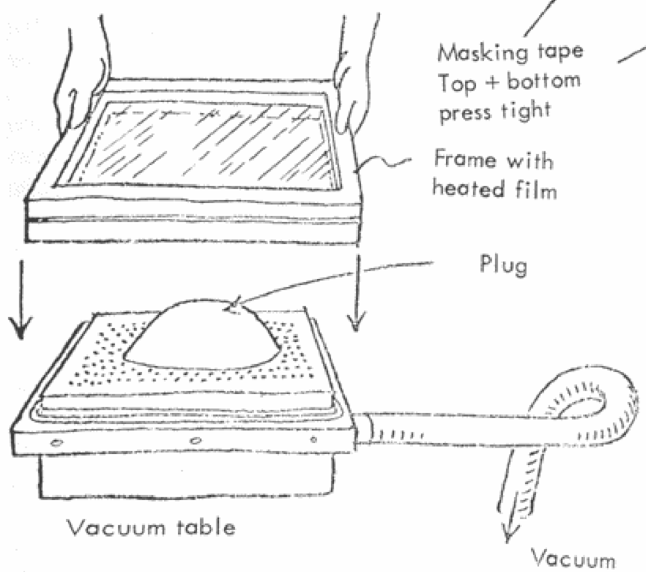
Make the film frames from the rest of the $\frac{3}{4} \times \frac{7}{8}$ in. pine pieces. The frames should be able to be slipped snugly, easily ... *easily* down over the table and onto the support frame. Keep the faces of the frames as flush (in a single plane) as possible by matching the pieces before gluing. Mark the two surfaces which match best when the frames are held together, and on one of them, mark off the positions for the tacks.



Kitchen vac-forming arrangement. Use a foot operated switch on the vacuum cleaner if possible.



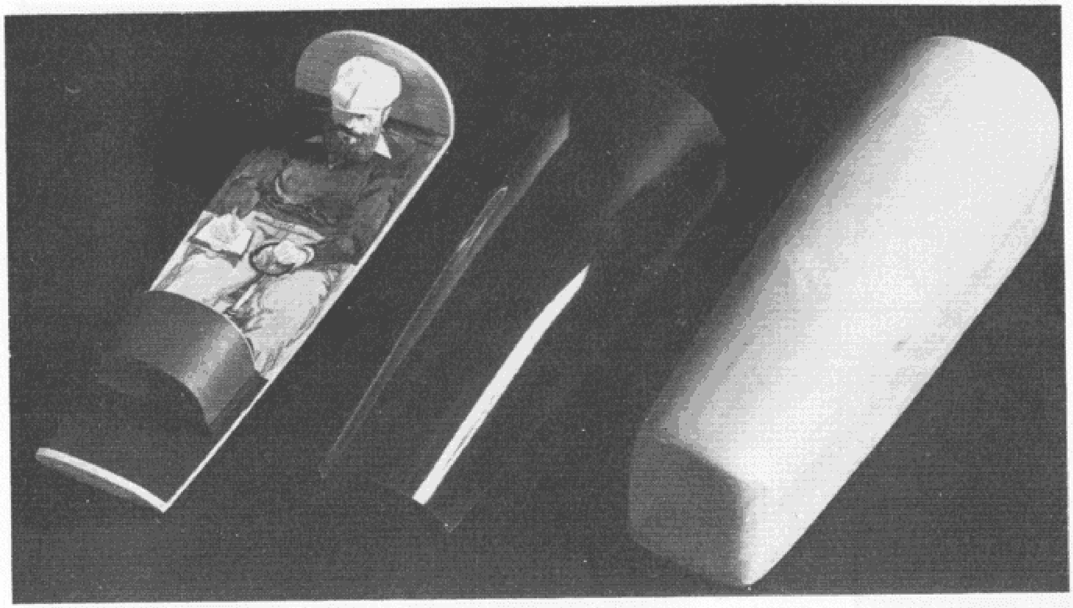
To make small parts, tape heavy bondpaper to the plastic to build it up to size of the tack frame.



Making the mould. Press frame down over the plug, with vacuum running, and plastic heated—be quick!!

Cut the heads from 50 drawing pins. Drill holes which will leave about $\frac{1}{8}$ in. of the cut tack shaft protruding from the surface of the frame. A piece of masking tape wrapped around the drill can indicate the depth to which the hole is drilled. Rub some balsa dust or baking soda into the holes, insert the pin shafts, point up, and add glue. A more satisfactory method might be to drill holes the size of the pin *heads* and drop the entire pin into the hole, then point up and back fill the holes with epoxy or wood filler.

When the tack frame is ready, put it against the second film frame and press them together so the tacks marks the second frame. Drill holes



A sailplane cockpit cover, trimmed canopy of ·030 acetate and plug for forming canopy on vacuum forming table. Plug size 8"×2½"×2½". Photograph by Thorney Leiberman.

slightly deeper and a half-size larger than the tack shafts, at each of the marks in the second frame. The frames should fall together easily. The assembled frame should drop over the table onto the support frame no matter which way it is turned (up, down, right or left).

The table is now ready to begin forming. It's time for a dry run. Hook up the vacuum cleaner; it should fit snugly. Tape the connection to make it air-tight. Lay a couple of sheets of bond paper on the table top and turn on the cleaner. The paper should be pulled *tight* to the table. Seal any joints of doubtful air-tightness with masking tape, rubbing it down tight. Fill the corner joints of the frame support.

When you are ready to form film, start the oven (heat source). About 325° F. is good for forming the type and thickness of plastic likely to be used here. I place the box to the immediate right of the oven door (I'm right-handed) on a low (24 in. high) table. The vacuum cleaner is placed where I can start and stop it with my foot on the switch. The oven shelf goes in the middle of the oven and two bread loaf pans are positioned upside down at either side of the shelf to support the film frame.

Stretch the film in the frame by placing it on the side with the holes, and pressing it firmly against the tack frame until the tacks are through the film and the two frames fit tightly together. This can take quite a bit of pushing with 0·040 in. film. With the frames together snugly, run a piece of ½ in. or wider masking tape around the frame to seal it air-tight.

Position the "plug" to be formed on the vacuum table after warming it slightly in the oven (not too hot to touch and hold).

Put the film frame in the oven and, while it is heating, test the vacuum cleaner, on and off.

Open the oven door after about 30 secs. and inspect the film. It will buckle and sag, steam and pull tight again. When acetate steams or "smokes" it's about ready to form. I find that about 50 secs. at 325° F., with the oven door open and closed a few times, works fine with 0·030 in. acetate. Experimenting with other film types and thicknesses will improve technique. Remove the frame from the oven and swiftly press it down over the form and table onto the support frame. As the film frame is pressed against the surgical tube seal, kick on the vacuum cleaner. The film will be sucked down upon the table top, and *voila!* the canopy. Wait 20 or 30 secs. for things to cool and, after turning off the vacuum, lift the frame and remove the plug from the plastic. The plastic can now be removed from the frame and cut to fit the model.

Easy, eh? Not really so. The most time-consuming and fussy part of each forming job is the preparation of the core, form or "plug" used to make the final plastic part. The plug should be wider at the bottom than the top, having no undercuts which make the film difficult to remove from the plug. It should be very flat and smooth on the bottom. The plug should be higher than required for the finished object so the formed film can be trimmed exactly to fit the model. Wheels, wheel-pants and other symmetrical parts have to be formed in two pieces and cemented together to form the whole part.

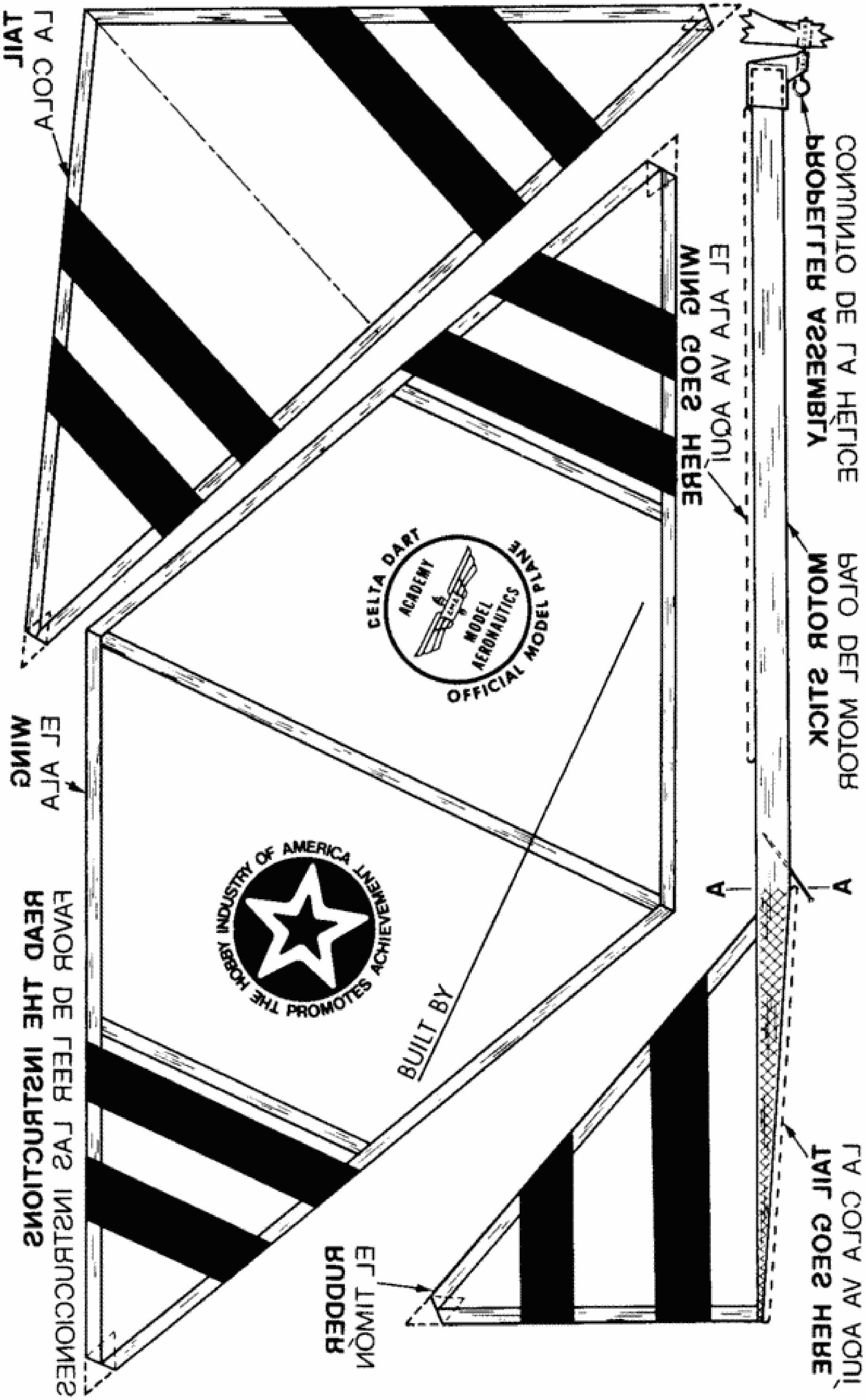
Plugs can be made of balsa, pine or bass wood. The finish of the final plastic piece will only be as good as the finish on the plug. The wooden plug can be finished with a 600 paper smoothness, or smoother with steel wools. Do not use wax on the plug.

Another type of plug can be made using plaster. This is done by pouring model casting plaster into a plastic form made from the original wooden plug. The plastic form should be well supported to prevent deforming by the heavy wet plaster. Tap the plastic form rapidly and gently to prevent bubbles from forming on the surface of the plug. After removing from the plastic form, the plaster can be finished with sanding, and details can be added with tapes and carving.

Four plastics are generally available for vacuum forming. They are—in order of their "formability"—butyrate, styrene, vinyl and acetate. Butyrate is fuel-proof, somewhat unstable over long periods, hard and clear. Styrene is usually hard to find, tends to be fragile . . . smells horrible. Acetate and vinyl are tough, but as susceptible to some fuel ingredients and cleaning solvents. Acetate tends to fog when cooled too quickly or not heated enough; it tends toward brittleness. Vinyl is obnoxious (an unclear description, but if you use it you'll know) and the original dust collector, but is more resilient than the others; it requires lower temperatures.

Smaller objects and pieces of film can be accommodated by adding heavy bond paper edge-to-edge to the smaller plastic sheet. Use masking tape on both sides of the joint, pressing the tape firmly to make a strong connection. More than one small object can be formed on the table at the same time. Just leave a generous space between each object for clean forming and ease of trimming.

Small parts can be formed from 0·0075 in. to 0·015 in. film, and larger parts can be formed with 0·020 in. to 0·040 in. film. Film of up to 0·050 in. thickness can be formed, but it is difficult to work with. However, the results can be outstanding on the larger size model. The maximum pull I've attempted with the unit described here is about 3 in., with a 2 × 8 in. plug, and 0·040 in. film. Experience is, as usual, the best teacher.



Midwest kit for the Delta Dart as printed on the plan—which is also the tissue for covering!

"SRPSM"—SIMPLE RUBBER POWERED STICK MODELS

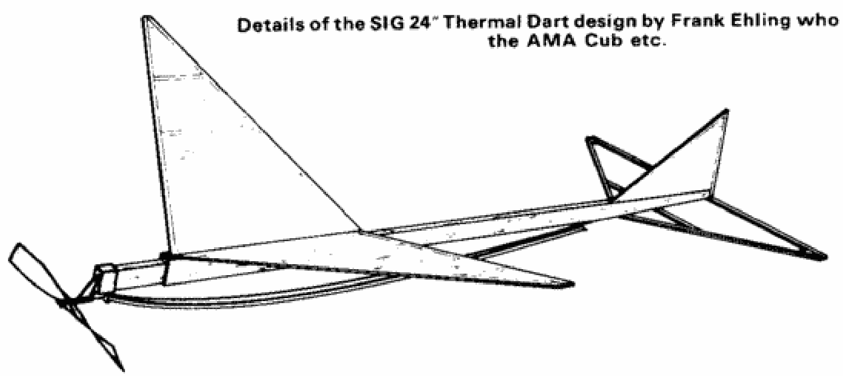
by Ed Whitten, editor of "Star Skippers"

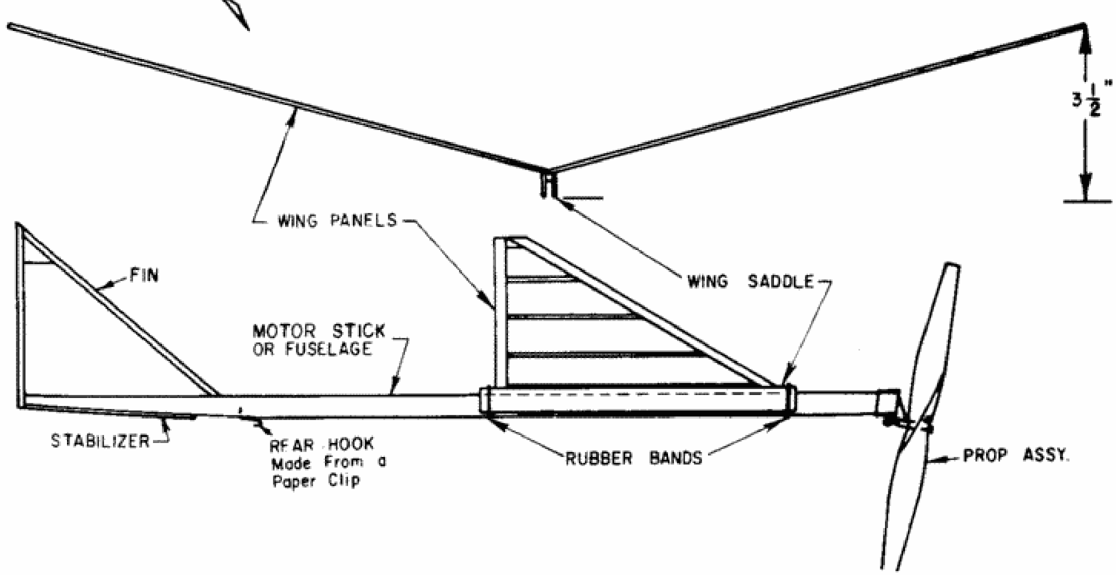
[*AT THE beginning of 1976 our attention was drawn to a report on a Simple Rubber Powered Stick model contest run on a postal basis in the U.S.A. We asked for more details—here is an explanation.*]

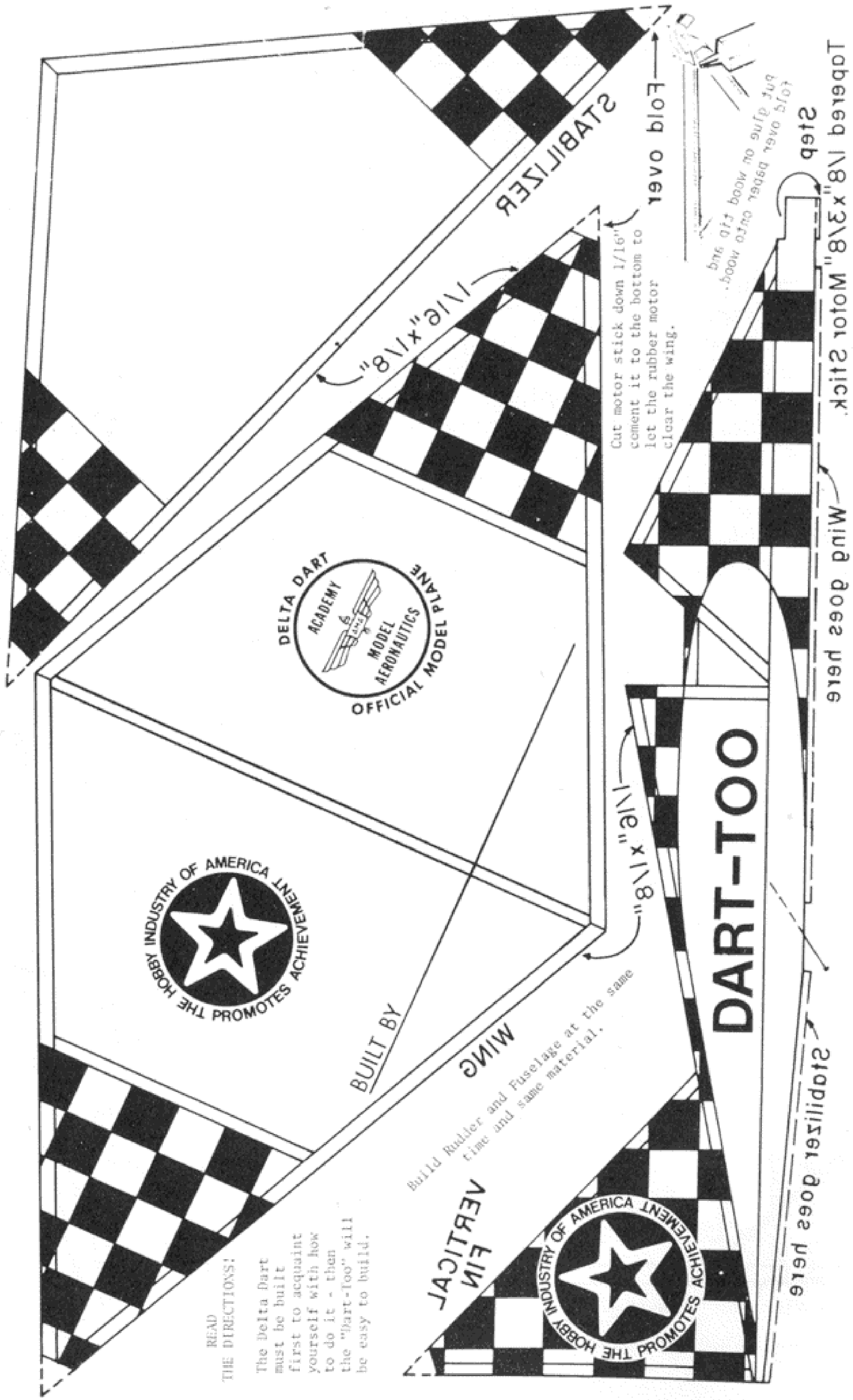
Actually, we have no such thing here in the U.S.A. as a "Simple Rubber Powered Stick Model Event". In our (NFFS Junior) postal meets we list it as such, primarily to try to describe our "Stick" event as an event in which the most basic models, including "AMA Cub", are not only eligible, but expected and encouraged. We do so in order that no one should be embarrassed by entering such a model. Of course, we always try to list the models flown in order to give an idea to prospective entrants regarding what is flown. We have had some built-up models flown in MINI (ages 12 and under) Postals, and we consider them satisfactory. In the MAXI (ages 15 and under) where the stick event is described as "*AMA Unlimited Rubber Models*" most models flown are *still* "SRPSMs".

This is also satisfactory. In the MAXI we are really not looking for a full blown unlimited model packed with $10.00 worth of rubber. That's for experts—ones with strength to wind it. However, in the MAXI

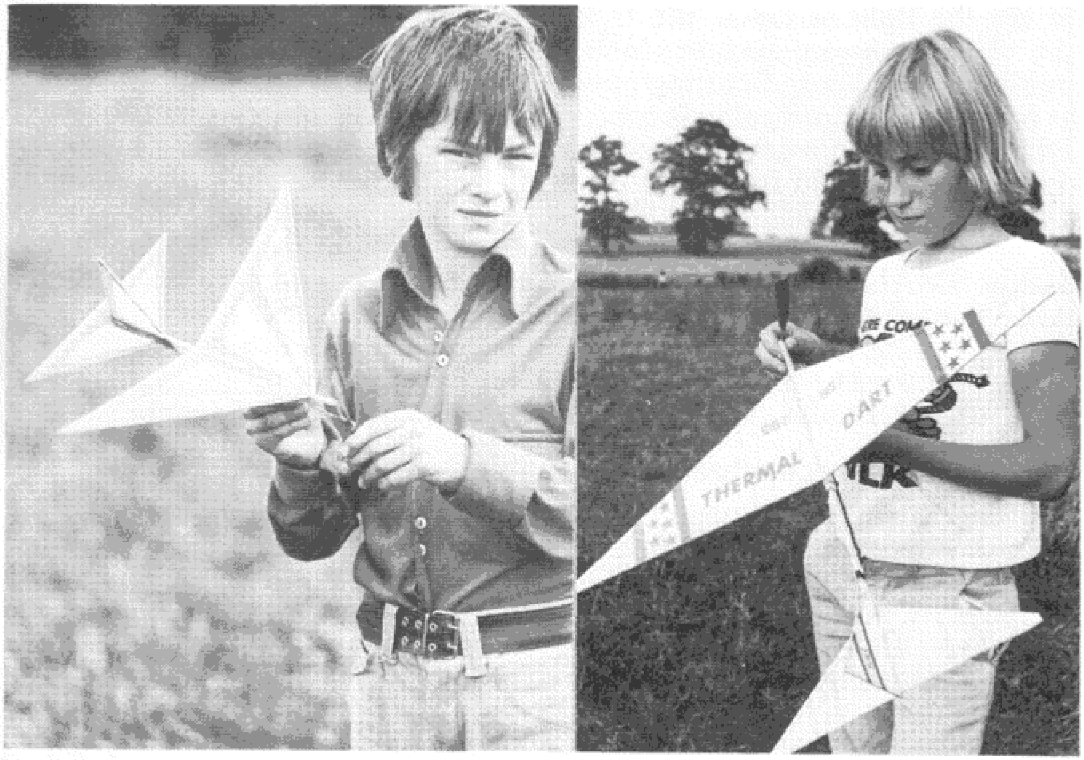
Details of the SIG 24" Thermal Dart design by Frank Ehling who created the AMA Cub etc.







The Midwest Dart-Too tissue plan has novel changes.



Gerald with the British BBC TV Hawk (from the "Model World" series) and Jonathan with the 24" Sig Thermal Dart—both good SRPSM's for young enthusiasts.

we do *suggest* more advanced designs, but an "AMA Cub" is very acceptable. AMA sanctioned contests with "Unlimited Rubber" events can still have an AMA Cub entered.

The Saint Louis, Missouri, flyers have an event that comes pretty close to "SRPSM". The rules are 24 in. wing span, exposed rubber, with a manufactured prop. Extremes tend toward square tipped Penny Planes style with 24 in. × 12 in. double surfaced wings, giant Pawlowina props and rather heavy weight and lots of rubber—not really simple models. One supposes, however, that this is still pretty close to an SRPSM event—unless this SRPSM event had a maximum weight limit (excluding rubber—including rubber). Chicago also has such an event.

Some years ago, when I was chairman of the judges for the NFFS Design contest to pick a follow-up design to the "AMA Cub", we had quite a variety of entrants—ranging from small indoor EZB type, to sport fuselage models—to stand way off scale. Some would qualify as "SRPSM"—including the best design, the "AMA MAXI JR" by Dick Miller. Mostly, we found that very few people *know* what a beginners model *is*, or how it should be designed!

A well thought-out SRPSM Event for Juniors is a good idea as an official (AMA or SMAE) event. I do not believe it should be limited to a single design or kit. For specific contests the event could, probably, be so limited. The AMA has their "AMA Cub" and something called "Special Rubber" as "Supplemental events". These "events" are listed as suggestions for local contests, but the AMA, however, does not seem to see the light as far as the U.S. Nats go. They had a programme at the '76 Nats where youngsters built and flew AMA Cubs. The event attracts publicity, and a lot of patting of backs, but, the effort has doubtful value as far as lasting promotion is concerned. If National contests had SRPSM Events for Juniors (any and all), and did help beginners build for it the day before, it could have a little benefit if included on the programme as a regular event.

Hopefully it could also be included in local contests with AMA and/or SMAE encouragement. More experienced juniors could also enter AMA Unlimited Rubber in the combined J/S or J/S/O Event.

Trying to say who is, and who is not, a novice is a nasty business. So, I would just limit the SRPSM Event to Juniors of under 16 years.

What should the rules be for a good "SRPSM" Event?

Elements to be considered

1. *Wing:* Span (max./min.) *vs.* area. Chord (max./min.) *vs.* area. Airfoil and whether single or double surfaced. Built up or all-sheet construction.
2. *Body:* Solid *vs.* built-up *vs.* tube. Empenage boom, or no boom.
3. *Rubber:* Fully exposed or enclosed.
4. *Prop:* Homebuilt or manufactured. Plastic or wood. Fixed, freewheel *vs.* folding.
5. *Weight:* Any maximum?—with, or without, rubber.

The following are desirable points

Wing: 30 in. max. span (projected), no limit on chord, no limit on airfoil. Either single or double surfaced. Built-up or all sheet.

Body: Solid only—but may be of more than one piece of material. Boom allowed with similar restrictions.

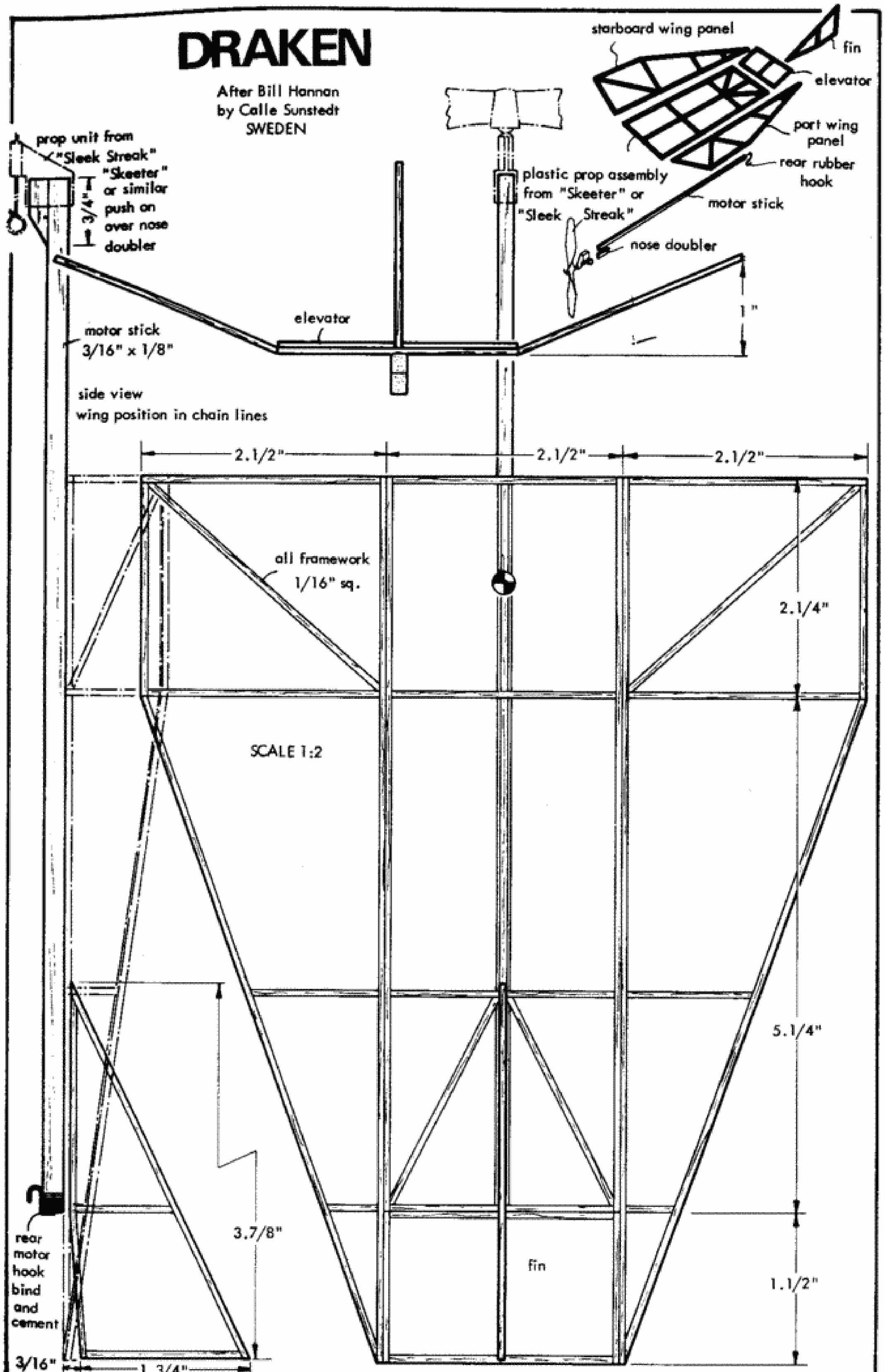
Rubber: Fully exposed.

Prop: Limited to plastic, manufactured. Limited to 8 in. dia. (possibly some others—7 in. or 10 in.?). Limited to fixed or free wheeling (no folders).

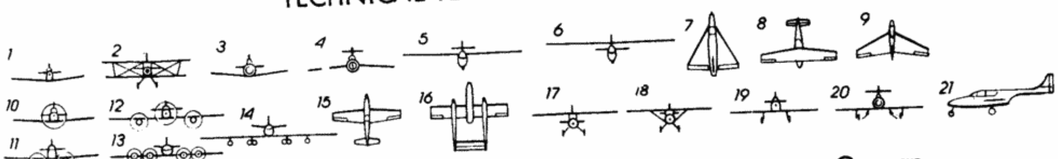
Weight: Favour max. airframe weight limit (without rubber), but would have to experiment to determine maximum.

Take a look at our MINI Hall of Fame in the U.S.A. Nine of the top ten times are SRPSMs. In the MAXI Hall of Fame for AMA Unlimited all but one, Ferrer's "*dadson*", (a Coupé) are SRPSMs. The other MAXI events all have more advanced designs.

SRPSMs are easier than HL Glider, Towlines or Scale to get to fly well. They are the basic starting points for all types of models—from R/C up to Free Flight. *SRPSMs should be promoted!*


DRAKEN
After Bill Hannan
by Calle Sunstedt
SWEDEN
prop unit from "Sleek Streak" "Skeeter" or similar push on over nose doubler
3/4"
starboard wing panel
fin
elevator
port wing panel
rear rubber hook
motor stick
nose doubler
plastic prop assembly from "Skeeter" or "Sleek Streak"
elevator
1"
motor stick 3/16" x 1/8"
side view
wing position in chain lines
2.1/2"
2.1/2"
2.1/2"
all framework 1/16" sq.
2.1/4"
SCALE 1:2
5.1/4"
3.7/8"
fin
1.1/2"
rear motor hook bind and cement
3/16"
1.3/4"

TECHNICAL TERMS IN FOUR LANGUAGES



Polish

Układy samolotów

1 — jednopłat
2 — dwupłat
3 — dolnopłat
4 — średniopłat
5 — górnopłat
6 — grzbietopłat
7 — delta
8 — kaczka
9 — bezogonowiec (latające skrzydło)
10 — jednosilnikowy
11 — dwusilnikowy
12 — trójsilnikowy
13 — czterosilnikowy
14 — wielosilnikowy
15 — jednokadłubowy
16 — dwukadłubowy
17 — wolnonośny
18 — zastrzałowy
19 — z podwoziem stałym
20 — z podwoziem chowanym
21 — z kołem przednim

English

Aircraft Layouts

1 — monoplane
2 — biplane
3 — low-wing monoplane
4 — mid-wing monoplane
5 — high-wing monoplane
6 — shoulder-wing monoplane
7 — delta-wing
8 — canard, tail-first
9 — tailless (flying wing)
10 — single-engined
11 — twin-engined
12 — three-engined
13 — four-engined
14 — multi-engined
15 — single-fuselage
16 — twin-fuselage, twin-boom
17 — cantilever
18 — braced
19 — with fixed landing gear
20 — with retractable landing gear
21 — with nose wheel

Russian

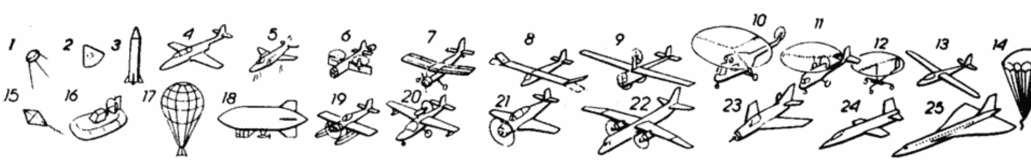
Компоновка самолетов

1 — Моноплан
2 — Биплан
3 — Низкоплан
4 — Среднеплан
5 — Высокоплан парасоль
6 — Высокоплан
7 — Дельта, самолет с треугольным крылом
8 — Утка
9 — Бесхвостый самолет (летающее крыло)
10 — Одномоторный (с одним двигателем)
11 — Двухмоторный
12 — Трёхмоторный
13 — Четырёхмоторный
14 — Многомоторный
15 — Однофюзеляжный
16 — Двухфюзеляжный
17 — Свободнонесущий
18 — Подкосный
19 — Неубирающееся шасси
20 — Убирающееся шасси
21 — Шасси с передним колесом (шасси с носовым колесом)

German

Flugzeugen Bauarten

1 — der Eindecker
2 — der Doppeldecker
3 — der Tiefdecker
4 — der Mitteldecker
5 — der Hochdecker
6 — der Schulterdecker
7 — das Deltaflugzeug
8 — das Entenflugzeug
9 — das Nurflügelflugzeug
10 — einmotorig
11 — doppelmotorig, zweimotorig
12 — dreimotorig
13 — viermotorig
14 — vielmotorig
15 — einrumpfig
16 — doppelrumpfig
17 — freitragender
18 — abgestrebter
19 — mit festem Fahrwerk
20 — mit einziehbarem Fahrwerk
21 — mit Bugrad



Statki latające

1 — sztuczny satelita
2 — statek kosmiczny
3 — rakieta
4 — samolot
5 — pionowzlot
6 — przemiennopłat
7 — samolot krótkiego startu
8 — skrzydłowiec
9 — mięśniolot
10 — śmigłowiec
11 — wiatrakowiec
12 — wiroszybowiec
13 — szybowiec
14 — spadochron
15 — latawiec
16 — poduszkowiec
17 — balon
18 — sterowiec
19 — wodnosamolot
20 — amfibia
21 — samolot śmigłowy
22 — samolot turbośmigłowy
23 — samolot odrzutowy
24 — samolot rakietowy
25 — samolot naddźwiękowy

Aircraft

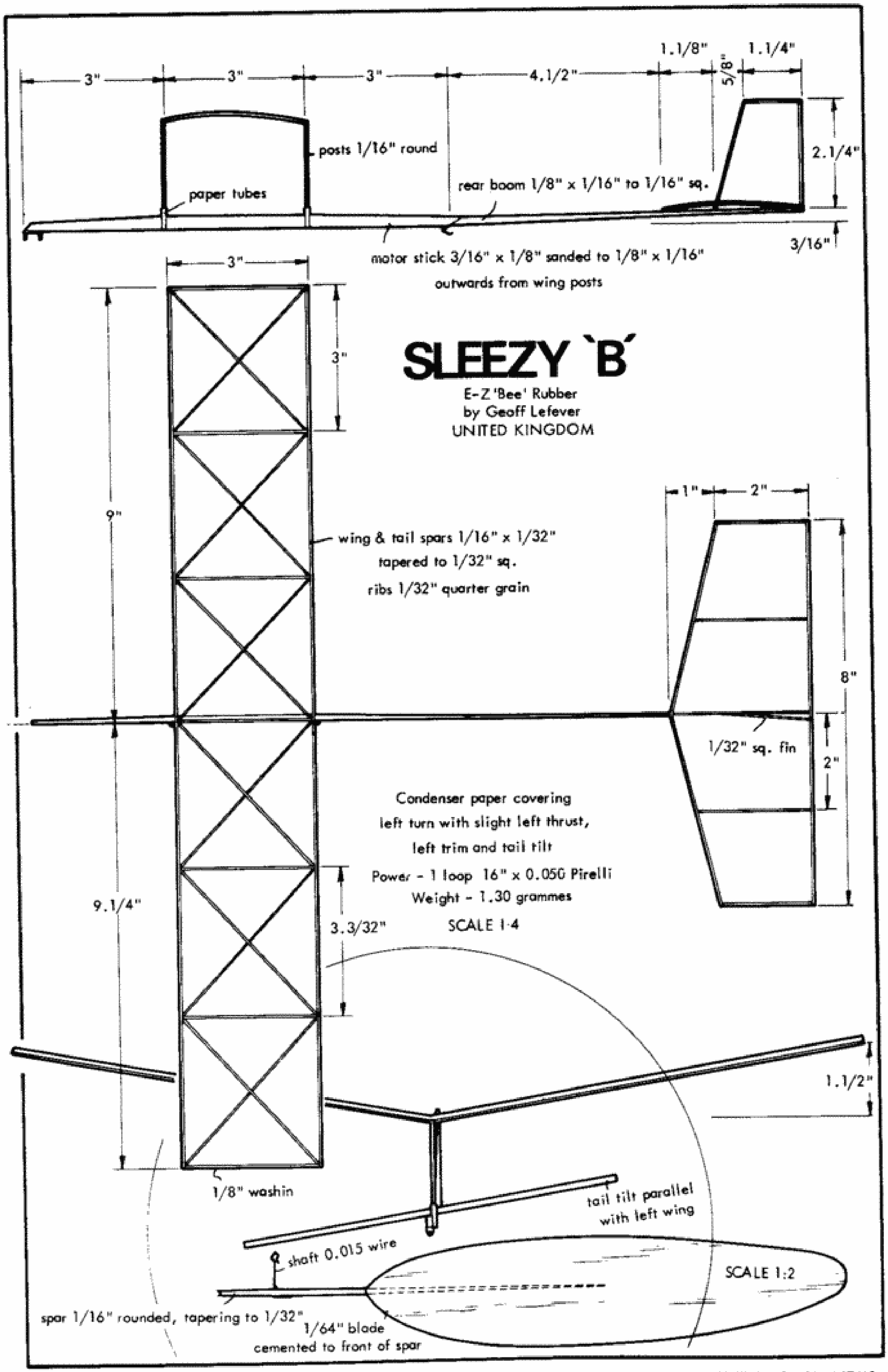
1 — artificial earth satellite
2 — spacecraft
3 — rocket
4 — airplane, aeroplane, aircraft
5 — V/TOL (Vertical take off and landing)
6 — convertiplane, tilt-wing
7 — STOL (Short take off and landing)
8 — ornithopter
9 — man-powered aircraft
10 — helicopter
11 — autogiro
12 — gyroglider
13 — glider, sailplane
14 — parachute
15 — kite
16 — hovercraft, air cushion vehicle
17 — balloon
18 — airship
19 — hydroplane, seaplane
20 — amphibian
21 — propeller-driven airplane
22 — turboprop airplane
23 — jet airplane
24 — rocket airplane
25 — supersonic airplane

Летающие корабли

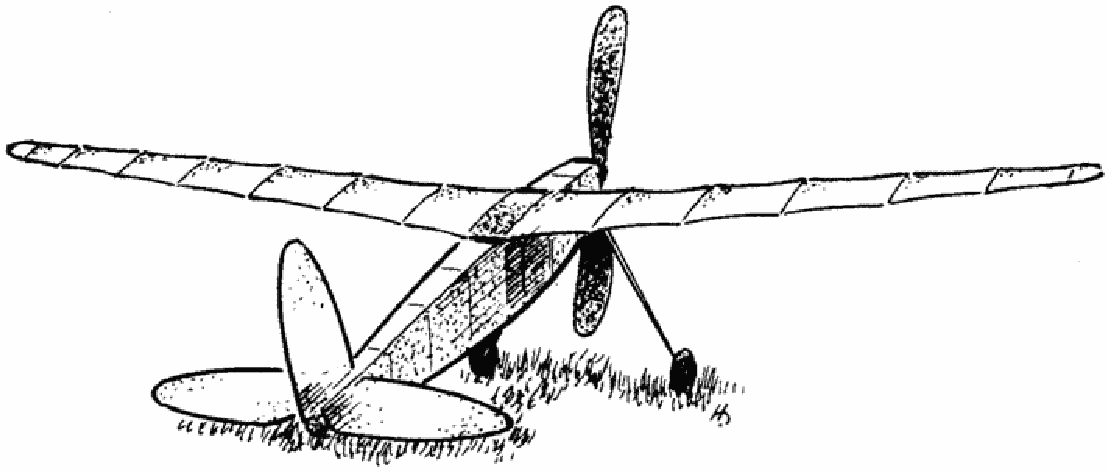
1 — Спутник, искусственный сателлит
2 — Космический корабль
3 — Ракета
4 — Самолет
5 — Самолет вертикального взлета
6 — Самолет с поворотным крылом
7 — Самолет короткого взлета и посадки
8 — Орнитоптер, махолет, птицелет
9 — Мускулет
10 — Вертолет
11 — Автожир
12 — Винтокрылый планер
13 — Планер
14 — Парашют
15 — Воздушный змей
16 — Судно на воздушной подушке
17 — Баллон
18 — Дирижабль
19 — Гидро-самолет
20 — Самолет-амфибия
21 — Винтовой самолет
22 — Турбовинтовой самолет
23 — Реактивный самолет
24 — Ракетный самолет
25 — Сверхзвуковой самолет

Flugapparate

1 — der Sputnik
2 — das Raumschiff
3 — die Rakete
4 — das Flugzeug
5 — das Senkrechtstart- und -Landeflugzeug
6 — das Schwenkflügelflugzeug
7 — das Kurzstart- und Landeflugzeug
8 — das Schwingenflügerflugzeug
9 — das Menschenkraftflugzeug, das Muskelkraftflugzeug
10 — der Hubschrauber
11 — der Tragschrauber, das Autogiro
12 — das Rotorsegelflugzeug
13 — das Segelflugzeug
14 — der Fallschirm
15 — das Drachen
16 — das Luftkissenfahrzeug
17 — der Ballon
18 — das Luftschiff
19 — das Wasserflugzeug
20 — das Amphibienflugzeug
21 — das Propellerflugzeug
22 — das Propeller-Turbinen flugzeug
23 — das Düsenflugzeug
24 — das Raketenflugzeug
25 — das Überschallflugzeug



EAST ANGLIAN NEWS



"Wapiti II" was built in England around 1930. All hardwood, three-ply and piano wire, even to the trailing edge of the wing. With powerful twin-skein rubber motor, the climb was most impressive and the high aspect-ratio very flexible wing bent up in an alarming arc. The stressing instructor at the de Havilland Aeronautical Technical School would have said: strength adequate, but deflection excessive. Despite furtive hopes it never broke. Span 38 inches, weight 5 ounces.

ONLY HALF A CENTURY AGO ...

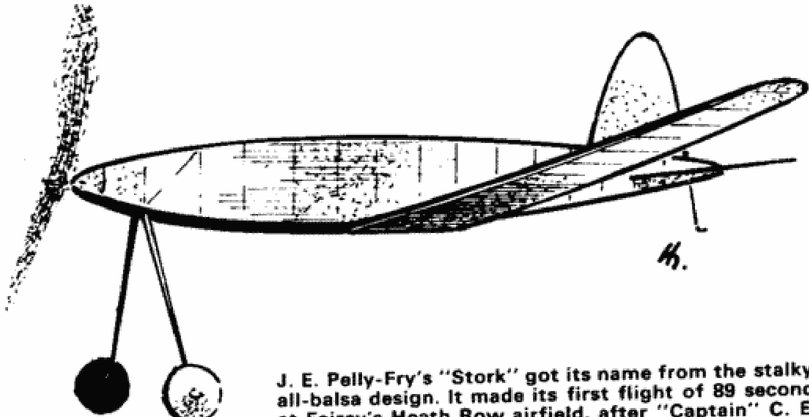
by J. van Hattum

WHEN you are committed to write about the dim and distant past, how is it that so much that bubbled up in your memory only yesterday, such amusing stories, those interesting happenings, all seem to fade into a meaningless jumble that could not possibly be of any importance to the most forgiving reader?

Maybe there's still something worth telling about those 50-odd years of building models. Back to the roots then, back to how it all began. Not back to those very early days, those of the real pioneers. We, who started in the early twenties, had a lot already laid on for us. There was advice, there were materials. In those days there was the know-how, there was a state-of-the-art quite well established. You need not necessarily go wrong. You did go wrong, inevitably, because you were headstrong and knew better than your teacher. Maybe that's how experience is gained. Anyway, it was by no means the jungle you had to hack your way through, like the real old-timers, such as my friend Bob Gosling had to do, bless him.

Actually it started by an almost imperceptible bite by that bug called *Aviation*, or "The Aeroplane" to be more precise. There was hardly such a thing as aviation when the only flying things were warplanes, converted for passenger carrying at the best. They necessarily had to be duplicated in cardboard, might have glided a few metres, but didn't because there was an unknown factor called Centre of Gravity. Later they took the shape of bizarre three-ply biplanes.

The next thing was a small booklet in a hobby series, actually describing a flying model, which must have been waiting for me in the window of a hobby-shop: a stick-and-string tractor monoplane, very well illustrated and described. It was the real thing and a local firm that stocked British materials soon had a new customer. Being headstrong—see



J. E. Pelly-Fry's "Stork" got its name from the stalky undercarriage. Modern all-balsa design. It made its first flight of 89 seconds on Whit Sunday 1932 at Fairey's Heath Row airfield, after "Captain" C. E. Bowden set up a new British duration record of 71 seconds, cracking Mr. Stanger's record that had stood since 1914.

above—the model was immediately modified, but some wise spirit must have counselled us not to overdo it. Then, on a mild March evening, my father and I went with the Thing on our bikes to a nearby field and prepared for the worst. So much work in it, my mother had said, and your homework to do as well . . . Homework? There had hardly been time for it, but only an aeromodeller would have seen the logic of that. The rubber motor was wound by hand, the model pointed into the wind and . . . it flew! Some minor god of Aeromodelling had apparently taken over all responsibility for the c.g., rigging angles and gyroscopic moment; there was no stall, no wild swerve into the ground, no, it flew and climbed away—right into a tree which was unwise enough to bring this epoch-making event to an end. The light was failing and the model could not be spotted, so we decided to let it be and come back the next morning.

It says much for the sporting spirit shown by my father that he turned out again at the crack of dawn to help retrieve the model, had a quick breakfast, and caught his train for Rotterdam, where he assumed the dignified role of shipowner. Remember that in those days aviation was the playground for curiously twisted characters, a sphere of enterprise where inspired but crazy people squandered other people's money, where you could easily kill yourself, go bankrupt or be without a job at the best. No career in a family where the son should succeed the father. But no pressure was ever brought to bear, and what use would an unwilling horse have been at the plough anyway?

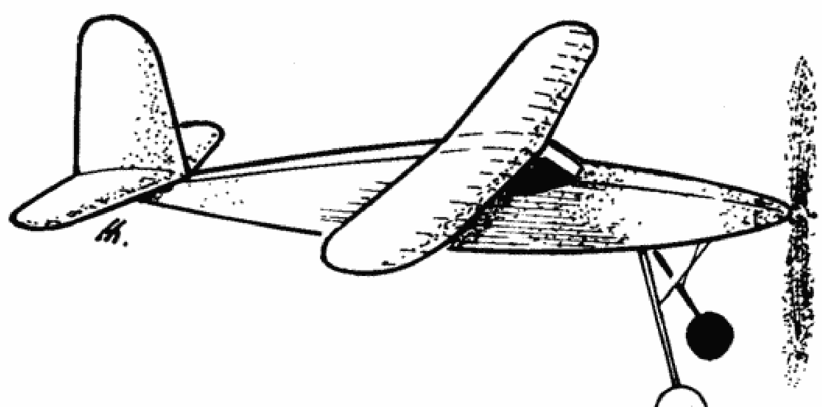
Back to models. That little god of aeromodelling clearly thought he had done enough, for the next experiments hardly deserved to be regarded as successful. But once more there was help in sight. There was a real model aeroplane club in the town nearby, with astoundingly experienced builders, some of whom even held national records. It was magic to sit in the corner of the big man's little workshop and hear the clever sayings, the wisecracks and understatements; to see a model being prepared for a record attempt the next day. A new model was not such a difficult undertaking when you know how: one picked an A-frame from nails on the wall, selected a suitable wing, a front elevator, there were plenty of bentwood props to choose from, rubber was cleaned, knotted and lubricated. Maybe the builder was bold enough to put it on wheels. On the

Sunday morning the air was filled with twin-pushers, tractors, even biplanes. One of the most memorable events was a head-on collision between two twin-pushers. They clanged together in a deadly embrace and slowly rotated earthwards, props vainly pushing in opposite directions. Their motors unwinding frantically on the ground, they twisted and jumped about like giant prehistorical insects.

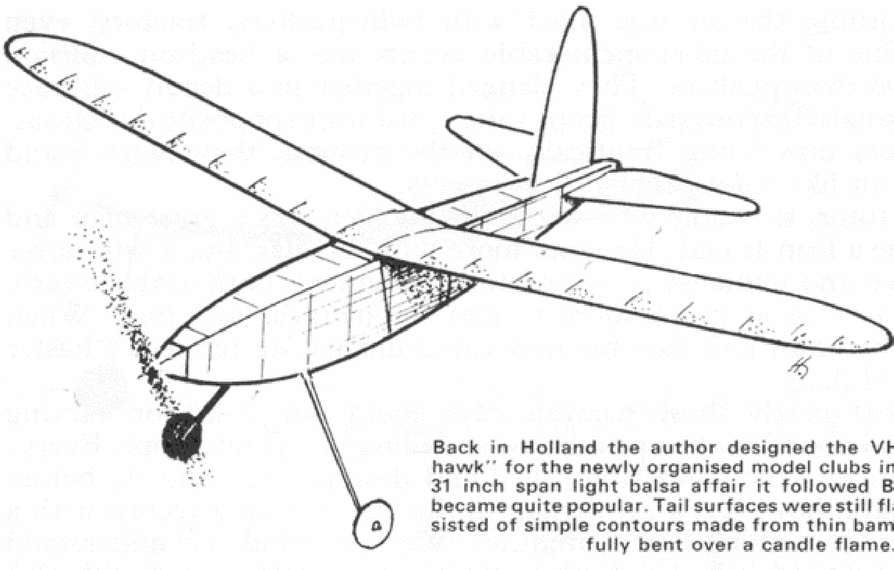
My tutor, the same who wrote the booklet, was a great man and later became a firm friend. He is no more with us, alas, but I will never forget his wit and immense power of understatement, both in those early modelling days or at much more formal aeronautical meetings. When someone asked him how fast his new car could go, he replied: "Faster than I would dare."

Unfortunately those halcyon days could not last. For varying reasons the old band broke up and aeromodelling just petered out. Everywhere in Holland the clubs languished and disappeared. Shortly before those sad days, however, a gentleman in the East set up a record with a twin-pusher: something like 2½ minutes. We just could not understand it. True, those models had a climb in the modern fashion, but with that built-in headwind the glide back was poor and that's praising it. What did we know about thermals when even the gliding people in Germany still had to discover them?

There were few left to talk with about models, but the bug had bitten too deeply for the disease to let go, so I just kept on building models, which did not exactly help me with my work at school. Model followed model, but there was one faint light shining from a distance: the short notes and occasional small plans of models in *Flight*. By that time I had saved up money for a flight from Rotterdam to Amsterdam and back. Up in an old Fokker F-III and back in the brand new F-VII. So when in 1926 I had a fair correspondence going with English friends the time seemed ripe to visit the people who ran the Kite and Model Aeroplane Association. There would be a meeting at Sudbury and the Chairman, W. E. Evans, kindly invited me to come over and fly. By air, of course, with a man-sized box which held my latest but by no means best. From Rotterdam it took a couple of hours to Croydon, following the Belgian



After Pelly-Fry had flown proxy for the American Gordon Light in the Wakefield 1933 contest, he produced his version of a cabin duration model which varied greatly from his current design thinking. Both P.-F. and the author were firm disciples of the low-wing protagonist, Ralph Bullock.



Back in Holland the author designed the VH-64 "Sparrowhawk" for the newly organised model clubs in 1936. A simple 31 inch span light balsa affair it followed British lines and became quite popular. Tail surfaces were still flat and only consisted of simple contours made from thin bamboo strip, carefully bent over a candle flame.

and French coasts to Cap Gris Nez and then right-about to Dover, over Penshurst and Sevenoaks. It was amazing to see so many faces at Sudbury, all famous because the names had actually been printed in *Flight*. My model was dutifully praised for its looks, but it never took the air. What an inspiration, though, and how stimulating to mix with people doing the same thing, who advise, help and promise to go on helping. Like Ralph Bullock with whom I kept up a lively correspondence and who was my second mentor. It was he who flew my next model as proxy and scored a win in the Freshman's Competition, a feat I would probably not have pulled off myself. He sent the model back with a very full report on its behaviour and suggestions for improvements.

What came next? A very ambitious biplane, doomed to failure on account of the innumerable aluminium fittings with which it was literally pinned together so they sheared off like paper. Looking at old photographs always makes me wonder why we used so little dihedral when a little more would have given us proper lateral stability with no loss of lift—that's only a fairy-tale. And so few ribs that any section we chose never did its work in the wing. True, you had to cut out three-ply ribs with a fretsaw and they weigh something, but if you spend so much time on the model, why not just that bit more? And if that little weight means success or disaster, you're underpowered—or overweight—anyway.

Sometimes one thinks of the chances one has missed in this game. Ideas that, if they had been developed a bit further, might have changed the face of aeromodelling. I had at least two of those chances and failed to take them. There was a very simple glider and that was at a time when all gliding took place from hills, and in my case from sand dunes. Having to fly by myself I wondered if you could tow a model up like a kite, so I bound a hook near the nose of the fuselage spar and pulled, but the silly thing only followed me like an airborne dog, no more than a few feet up. There was the idea, right in front of me. That hook should have been right back below the wing and it would not have been Horst Winkler who gave us the towline launch, but this writer. Oh, well, it did teach me to look a little further than my nose. But not enough, it seems, for some 20 years ago I played with the idea of using steel wire (actually knitting needles) in tubes to join the wing halves of an A/2 and so eliminating those complicated tongue-and-slot designs. Tried it? No, only sketches, and there went another chance. Anyway it would be nice to know who *did* use the idea first.

To get back to the past. School finished and an engineering course ahead, and that meant England. At last I came where I had always wanted to be, and were those delightful years! That funny meeting between Jim Pelly-Fry and myself, both thinking that the other was some elderly—well, anyway, over 30—bloke, for didn't we have articles published in various magazines? There was James, somewhere around 18, and myself a few years older. "Mr. Pelly Fry, I presume?" Even now we are amused when we think of it. Anyway it started a partnership that has by now lasted for very nearly 50 years and the chances are that P-F has vetted this very article. (Must bring him back to aeromodelling some day ...)

I brought to England a low-wing fuselage monoplane, the VH-36, not such a very successful design, but highly suitable for further development. Just for fun Pelly, dear Richard Langley and I tried it out with a tiny veneer wing he had, strapped on top of the fuselage, packed in a lot of rubber to drive the twin gears and let it go. It went over Handley Page's old aerodrome at Cricklewood at the devil of a lick, so there was an idea. When I came back from a holiday in Holland, there was the "36" after a spot of surgery by Pelly-Fry: a very neat small tapered low wing and even fairings—called "spats"—on the wheels. Named "The Ghost", it became somewhat of a terror at the flying fields. It was fully described in *The Model Engineer*, that wonderful paper run by kindly Mr. Percival Marshall, who always offered generous space to the aeromodelling fraternity.

We carted a big box about, first by bus and tube, later on the small car I had, and hardly ever missed a "Wimbledon Sunday". One thing to remember is that there was only one class of model: *rubber* powered. There may have been tandems and canards and such odd fowl, but you all had models that could compete against each other; you had the same problems.

In the same year as the "Sparrowhawk" 1936, the author acted as project engineer for the Koolhoven FK-53 "Junior", side-by-side light plane with 60 h.p. Walter "Mikron" four cylinder in line engine. Unfortunately, it was not a success; only two prototypes being built.

During 1975, a resurgence of interest in kite flying led to a meeting at Old Warden, Beds. for models of 'K. & M.A.A.' vintage. This group of Bob Kinroy, Alwyn Greenhalgh, Evelyn Barrett, C. Rupert Moore, Peter Spence and Howard Boys were among the oiled silk and spruce model flyers.

That so much of this would change was something nobody could foresee. Mind you, if there had been small internal combustion engines, or radio-control for that matter, we would have been delighted to use them. Cross-country running after a fly-away was not such a popular pastime as all that. "Capt." Bowden turned up with his petrol-driven "Kanga" and a new class was born.

Where were the bureaucrats? The Council of the S.M.A.E., successor to the K.M.A.A., consisted almost entirely of "working members", that is members who were active in aeromodelling and knew what they talked about. If anyone had told me only four years before that I would actually be on that Council and made Competition Secretary, I would have doubted his sanity. After meetings at the Y.M.C.A. we went to Mr. "Joe" Lyons' Corner House and had coffee and a snack. Wherever we went, Bullock, Pelly-Fry and I, we left a trail of designs on paper napkins behind. ... Later, at the de Havilland Technical School, I learnt to fly. My instructor was young Geoffrey de H., later to be killed on the DH-108 tailless jetplane. A fine instructor and the 80 hours or so I clocked up during '33 were wonderful. But, as so often happens, a P.P.L. led to a swollen head and flying became the thing. That particular affliction did not last long, for one thing because I had to return to Holland and the eye-test there was too severe. That my flying had been without incident did not alter officialdom's opinion that I was unfit to control an aeroplane.

Back in Holland I found that interest in aeromodelling was reviving, so I offered my services as adviser. I took the Delft M.A.C. under my wing, and when we arrived at the first contest with very light balsa models on British lines, the self-styled experts, nurtured on twin-pushers, couldn't believe their eyes. This again was fun, rubber models were joined by gliders and soon there were more petrol engines. Diversification had started in earnest.

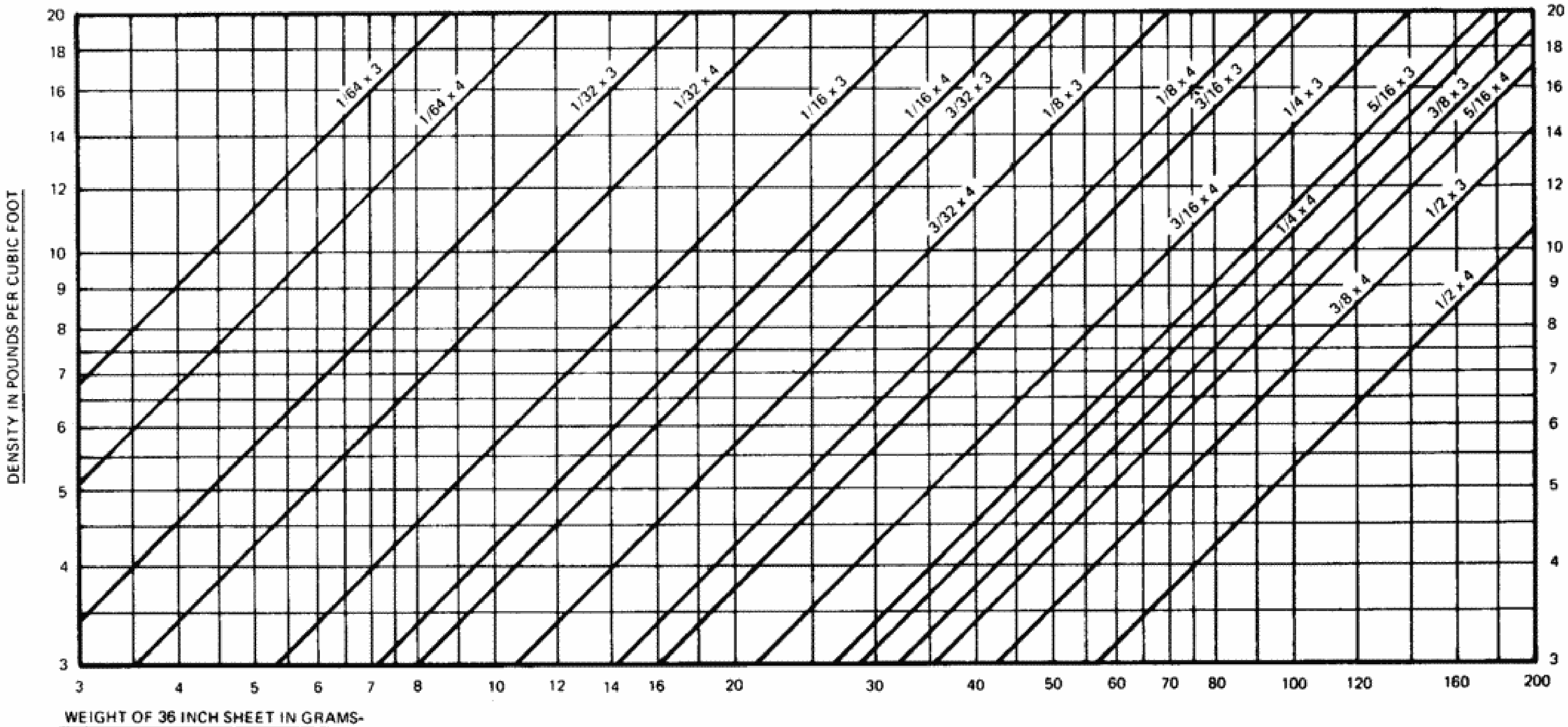
After a spell in the Koolhoven aircraft works design office I joined the Royal Netherlands Aero Club as Technical Officer for aeromodelling. At Koolhoven's one learnt to tackle any job that was going; one day it might be tail-wheels, the next controls or an engine mounting. Wood or metal, it was all the same. It did teach one to accept any challenge, to break down a problem to its essentials. But work for the Aero Club meant that full-size design was over. A wise choice? Maybe the desire to be a small king in a small castle, but a king all the same. Memories play tricks. Was the weather always so fine, was it always warm and sunny on Wimbledon Common? Well, if I believe it was, why worry? Nostalgia for the Good Old Days implies dissatisfaction with the present and distrust of the future and that is obviously nonsense. I have just come back from a contest where it was cold and windy, but how nice to chat with old friends and argue technical points. Nothing has changed, really.

The funny thing, though, is that I have continued designing and building models ever since. When this little job is done I will return to my drawing board, copy the side of a fuselage on my building board, get out the one-eight square balsa strips, the hobby-knife and glue and start on the fuselage of a rubber driven sports model. Wonder if I will fix the undercarriage in that way? Some day you may see what I've decided when the plan appears in the *Aero Modeller*.

The bite of that bug, 50 and more years ago, must have gone quite deep.

There were many exciting experiments during the post-war years with flying wings. Since they never shed any tails, the term "Tailless" always seemed a misnomer. From fairly conventional layouts, with 30 degrees sweepback angle and plano-convex airfoils, they developed into sophisticated high aspect-ratio designs with thin concave airfoils over about 3/4 span, the airfoil changing from that point to symmetrical with washout at the tips. With little or no fin area they flew beautifully, but suffered from the same disadvantage as their full-sized brethren; they had to be lightly loaded or they became too fast and sinking speed increased accordingly. Many international contests were held at the Terlet Gliding Centre near Arnhem, with British, Dutch and German teams as the most faithful supporters.

BALSA WOOD DENSITY VS. WEIGHT FOR STANDARD STOCK SIZES



EQUIVALENT SIZES

1/64 x 3	1/64 x 4	1/32 x 3	1/32 x 4	1/16 x 3	1/16 x 4	3/32 x 3	3/32 x 4	1/8 x 1
1/8 x 3/8	1/4 SQ	1/8 x 1/4(3)	1/4 x 1/2	1/8 x 1/2(3)	1/4 x 1	3/16 SQ(8)	3/8 x 1	1/2 x 1
3/16 x 1/4		3/16 x 1/2		1/4 x 3/4	1/2 SQ	3/8 x 3/4	1/2 x 3/4	
1/8 SQ(3)		1/4 x 3/8		3/8 x 1/2		3/8 SQ(2)		
1/8 x 3/16(2)								

by John Ferrer

FREE FLIGHT

The National Free Flight Society

F.A.I. WORLD RECORDS (as at 1-7-76)

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 25th, 1973 .. .. .. 173·45 km/h

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

No. 46 **Seaplane Altitude**
M. Sulc (*Czechoslovakia*), October 3rd, 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**
P. Motekaitis (*U.S.S.R.*), August 30th, 1975 .. .. .. 812 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 (*Czechoslovakia*), 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**
Cat 4 K. H. Rieke (*W. Germany*), September 22nd, 1962 .. .. .. 45m. 40s.

No. 32a Cat 1 **Less than 8 m. ceiling**
Duration
T. F. Vallee (*U.S.A.*), August 22nd, 1975 .. .. .. 22m. 45s.

No. 32b Cat 2 **8–15 m. ceiling**
Duration
Jiri Kalina (*Czechoslovakia*), August 26th, 1970 .. .. .. 30m. 7s.

No. 32c Cat 3 **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**
R. Weber (*U.S.A.*), August 16th, 1975 .. .. .. 428 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**
L. Aldochine (*U.S.S.R.*), & V. Myakinine October 10th, 1975 .. .. 388 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**
B. Peterson (*U.S.A.*), September 14th, 1975 .. .. .. 246 km.

R/C GLIDERS
Class F-3-B

No. 24 **Duration**
E. Miakinine (*U.S.S.R.*), September 30th–October 1st, 1973 .. .. 25h. 44m. 8s.

No. 25 **Distance in a straight line**
J. R. Hiner (*U.S.A.*), May 24th, 1975 .. .. .. 51·28 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 13th, 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

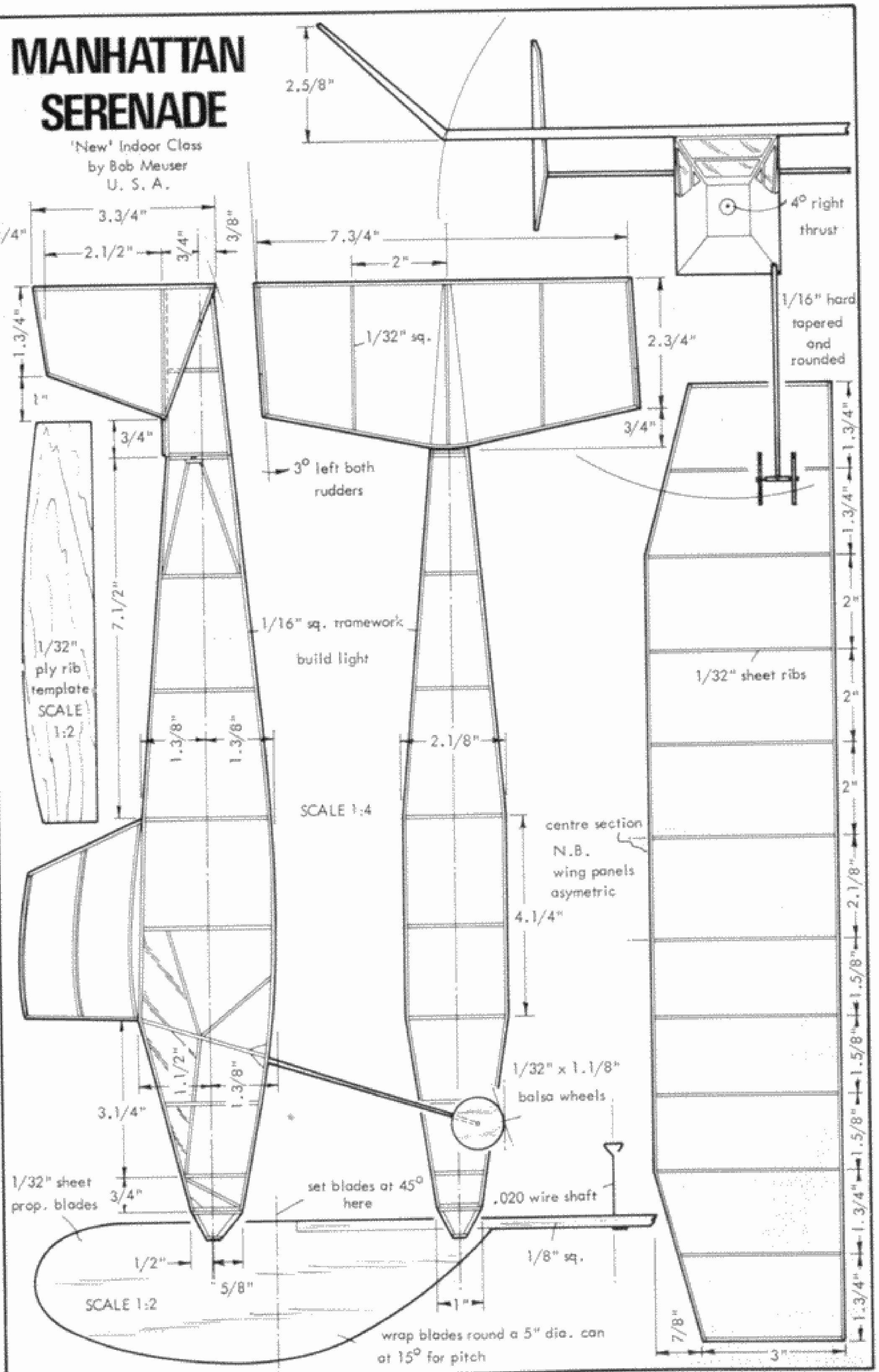
No. 27 **Speed (2·5 c.c.)**
S. Jidkov (*U.S.S.R.*), September 22nd, 1975 .. .. .. 290·30 km/h.

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

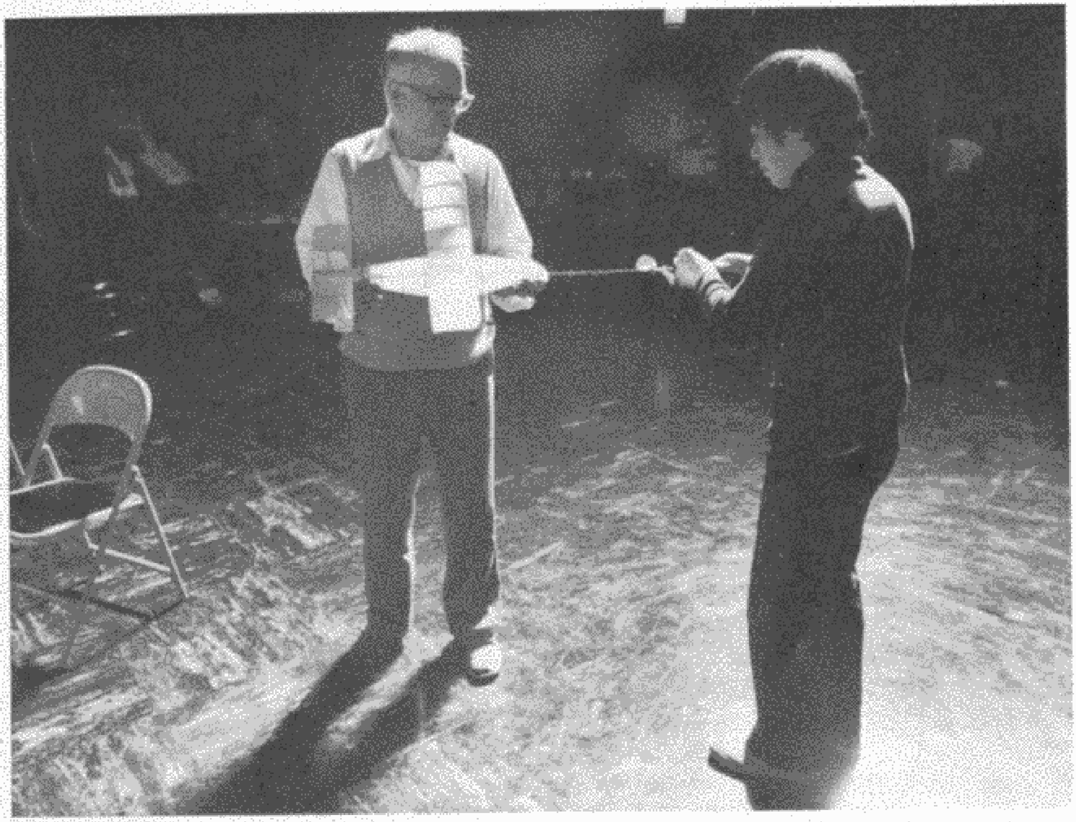
No. 29 **Speed (5–10 c.c.)**
V. Kouznetsov (*U.S.S.R.*), September 30th, 1962 .. .. .. 316 km/h.

JET MODELS

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



STAR SKIPPERS USA



Stu Chernof's photo shows Pioneer Manhattan flier, Ed Whitten, holding his "Riversider" Manhattan Formula model as son Richard is winding, at Columbia University, N.Y.C., March '76. It made several flights over 2 minutes. Its best time was almost 4 minutes at Lakehurst. Model placed 7th at M.I.A.M.A. Manhattan Cabin unofficial Nationals event. Columbia Site is 105 ft. high, about 75 ft. diameter.

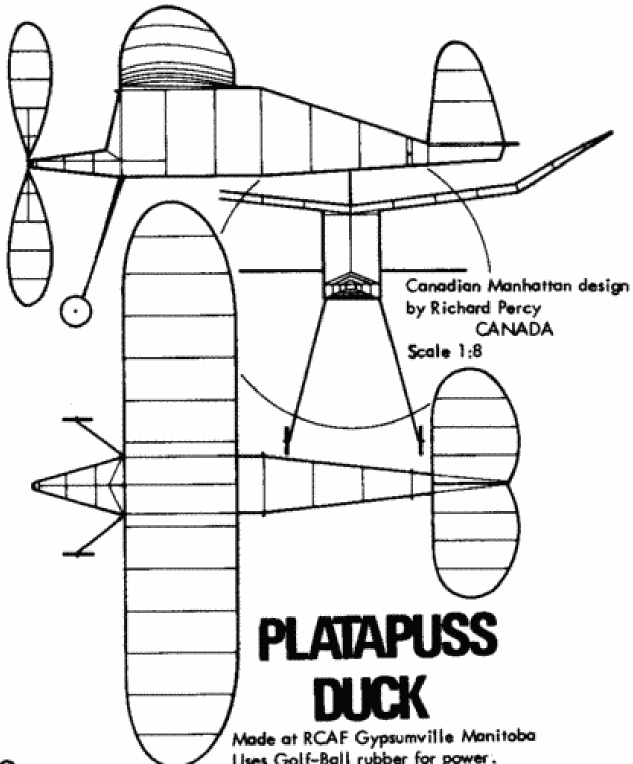
WHAT'S A MANHATTAN?

Fuselage type Indoor Model Class, fast-growing sport in the U.S.A., could well achieve worldwide popularity

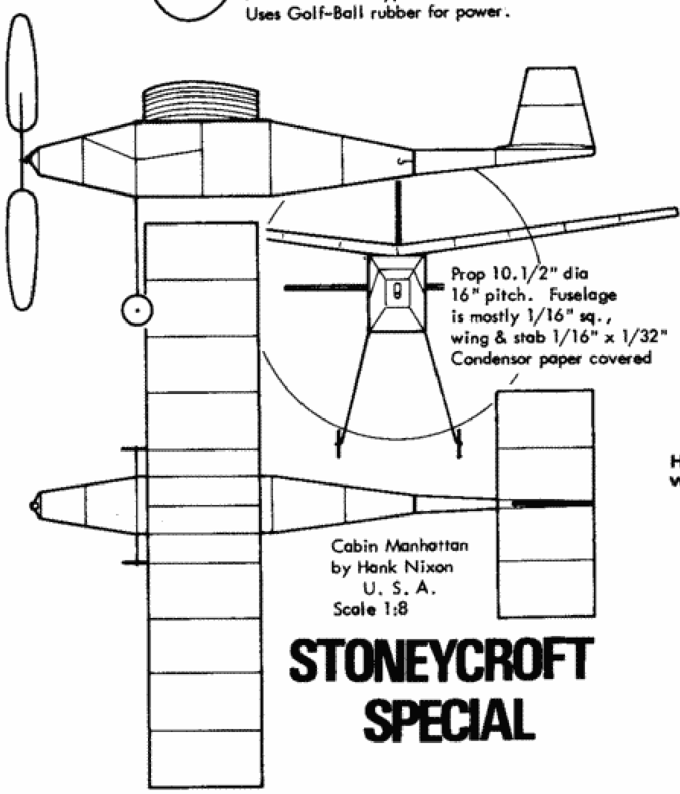
MANHATTAN ... no, it isn't the name of a cocktail in this instance, the title owes its origin to the fact that it came from Ed Whitten, who lives in those parts, and who has stimulated so many ideas for Indoor Sport and Contest modelling. The Class dates back to Ed's original proposals over 10 years ago, which were submitted to the National Free Flight Society as the "Manhattan Formula".

Sporadic enthusiasm at localised centres of activity has produced a fascinating variety of design and names—"Manhattan Serenade", "East-sider", "Big Apple", "Flea Bag" are just a few of the catchy names which well-known characters in the U.S. Indoor fraternity have applied to their lightweight box cars. After Ed set a formula in motion, it was picked up by a number of Club groups, notably the M.I.A.M.A. Indoor Club, who applied small mods to the rules.

Bud Tenny ran a condensation of the first rules in an article in the November 1965 issue of "Indoor News and Views". In quick review these



Dick Percy's Platapuss Duck was the first known Manhattan Formula model. Name comes from the front end appearance.



Hank Nixon's Stoneycroft Special was widely publicised, aimed at the novice modeller.

were a minimum TOTAL weight including rubber of 0·3 oz., a minimum BOX incorporated in fuselage of $2 \times 3 \times 5$ in. with no maximum fuselage length, a monoplane only, with a maximum flat span of 20 in. with max. chord of 4 in., a max. stab span of 8 in. with max. chord of $3\frac{1}{2}$ in., model to R.O.G. with min. wheels of 1 in. diameter. There were other restrictive rules intended to limit model to a somewhat Curtis Robinish look and to cut down arguments with Contest Directors.

Dick Percy possibly built the first Manhattan Cabin. It ran heavy at possibly 0·5 oz. Ed Whitten's first was designed heavy enough for beginners to handle, since there was a comment afoot that the Manhattan would be a suitable beginner design. Construction was mostly $\frac{1}{16}$ in. sq., superfine tissue covered, and sported cabin windows and wire landing gear. And heavy it was, in fact running 0·74 oz. with the rubber used on its 2:47·7 flight. Not really an indoor model and not really what was wanted! Furthermore, it was not compatible with microfilm.

Whenever a Manhattan is flown, attention is attracted from both the flying scale advocates and from the F.A.I. microfilm fans. At Lakehurst in June '67 where Whitten made a new mark of 3:40·8 with his heavy version, "The Riversider", Bill Bigge suggested that the minimum weight requirement should follow indoor practice and be based on airframe alone ... excluding rubber. Rules then called for a minimum weight of 0·300 oz. including rubber. Bill suggested that this be changed to 0·200 oz. excluding rubber.

This suggestion had come before from other modellers, and it makes sense. One of the most important ways to adjust a model is to change size and length of motor, and to have to worry about whether or not the total weight is still above the minimum is not practical. Especially difficult is the problem of adjusting a Manhattan for a low ceiling after having flown it in a high hall. Here the main way to adapt would be to reduce the size and weight of rubber.

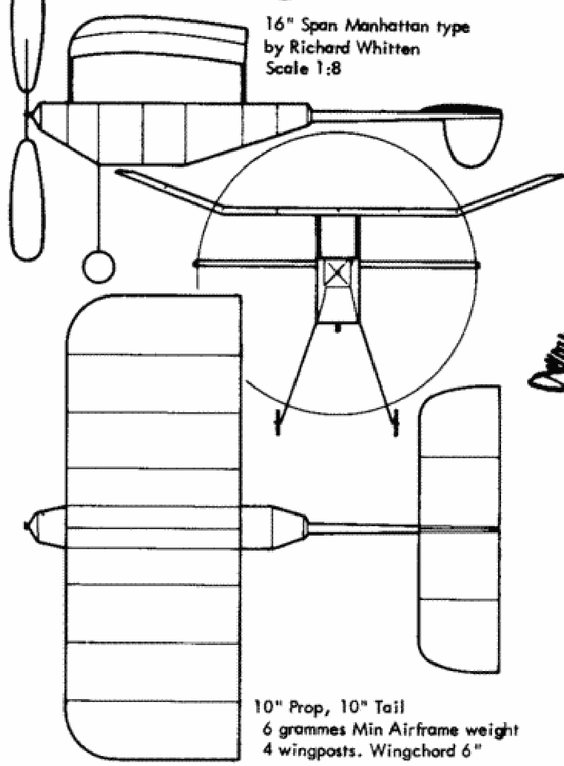
0·200 sounded about right for the minimum weight of airframe alone, but the eventual suggesion was 4 grams, about $\frac{2}{3}$ of 0·200 oz.

Hank Nixon's brand of Manhattan, the "Stoneycroft Special", has its airframe weighing a mere 0·1602 oz. Hank's design follows rather closely the original layout for a Manhattan and uses light outdoor wood in construction. He feels that, if rules required $\frac{1}{16}$ in. square construction and paper covering, the beginner would be less likely to have trouble while the pro could still try a few tricks.

The M.I.A.M.A. Group held an unofficial event for the Formula at the 1976 U.S. Nats, Dayton, Ohio. Their version of rules for a Manhattan Formula model basically requires a 20 in. max. fuselage length excluding prop, the fuselage must be able to enclose a theoretical $2 \times 2\frac{1}{2} \times 4$ in. box, windshield and side windows are required, 20 in. max. flat wing span with 4 in. max. chord, 8 in. max. stab with $3\frac{1}{2}$ in. max. chord, paper covering, and a minimum airframe weight of 4 grams (0·14 oz.). There are other refinements. Among the drawings of Manhattan Formula models here, Richard Whitten's "Eastsider" and Bob Meuser's "Manhattan Serenade" conform to M.I.A.M.A. rules and were flown at the U.S. Nats. Bob's design follows more of a combination of scale and indoor cabin practice, while Richard's is more completely in the tradition of strictly indoor practice.

The third design, Richard Whitten's "Westsider", does not con-

WESTSIDER



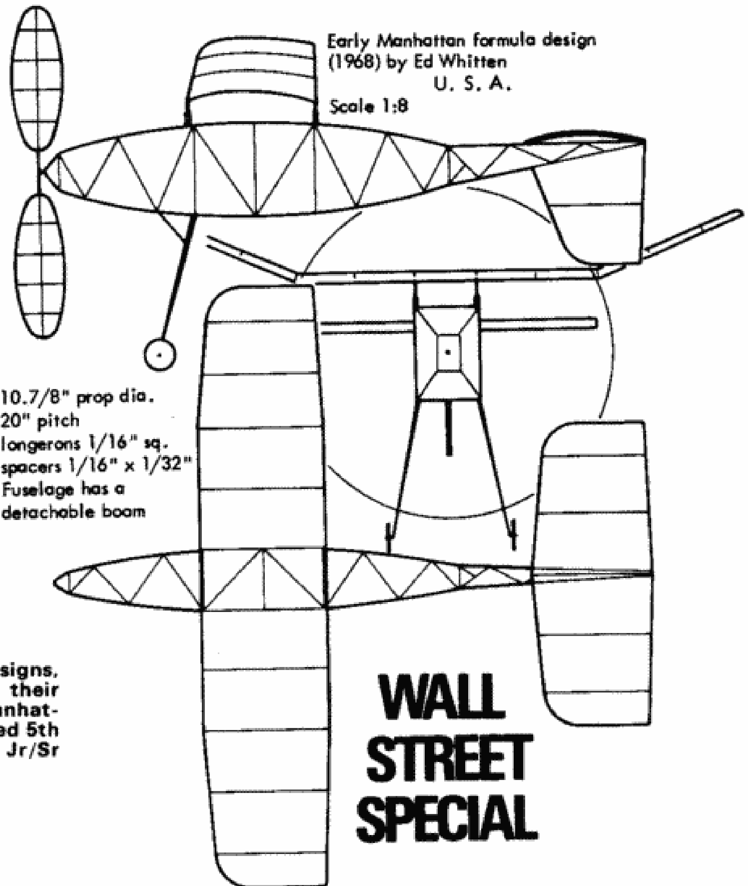
Dave Linstrum's caricature of the formula (above) sums up the major requirement for fuselage cross section.

form to M.I.A.M.A. rules. It does, however, reflect advanced thought on the direction in which the Manhattan Formula may go. First, because most Manhattan flying will probably be in Category I or small Category II sites, the model is smaller. It has a 16 in. PROJECTED wing span (easier to judge and does not penalise dihedral), a 16 in. overall length excluding prop, has no max. wing chord, max. stab span (except 16 in.) or max. stab chord requirements, has a smaller $1\frac{1}{2} \times 2 \times 3$ in. minimum fuselage box requirement, does not require windows or windshield, does not exclude any kind of bracing anywhere, and allows any kind of covering including microlite and microfilm. Minimum airframe weight is set at 6 grams (4 grams is considered light for the M.I.A.M.A. size requirements).

There are restrictions possible that would make the "Westsider's" parameters more scale-like. The most important one would be to restrict maximum wing chord. The prop diameter could be limited to, say, 7 in. The O.A.L. could be shortened to around 14 in., making a hollow boom less practical; and the boom could be banned altogether. The minimum airframe weight could be increased, and paper covering required. It all depends on which end of the design spectrum would prove more popular and useful.

The M.I.A.M.A. rules do, however, make for a nicely proportioned indoor cabin model. For maximum duration, however, it will still require the complicated winding procedure outside the fuselage. The fragile 4 grams and such cumbersome winding precludes the M.I.A.M.A. version from ever being anything but an experts' model if anything near maximum duration is desired.

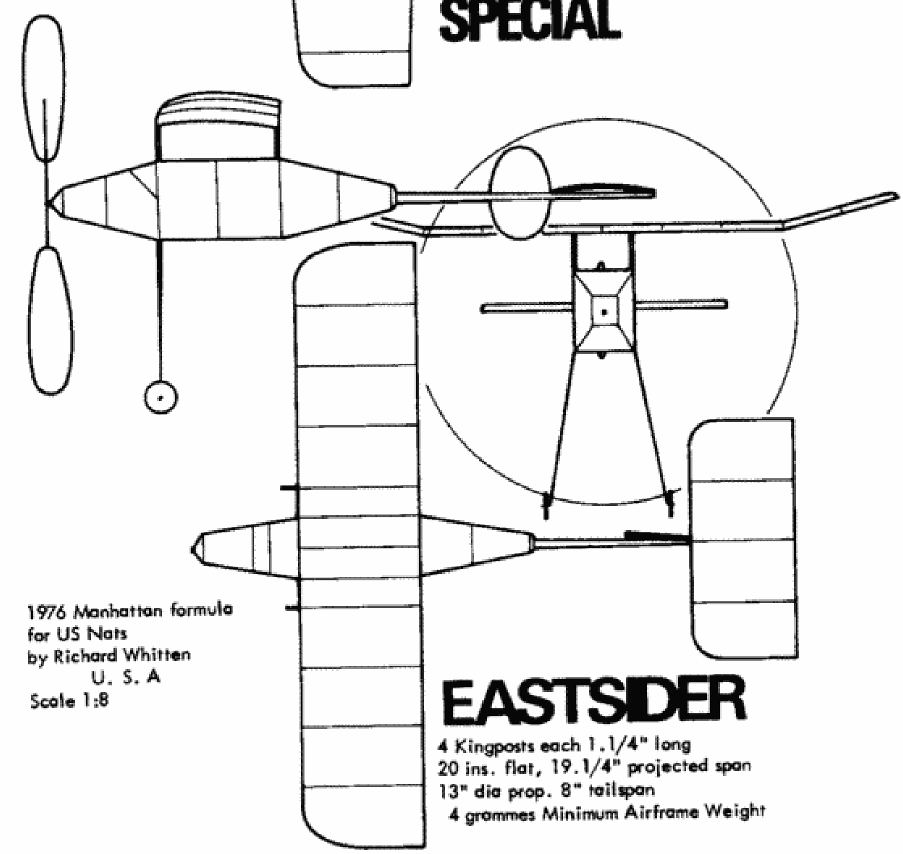
Early Manhattan formula design (1968) by Ed Whitten
U. S. A.
Scale 1:8



10.7/8" prop dia.
20" pitch
longerons 1/16" sq.
spacers 1/16" x 1/32"
Fuselage has a detachable boom

WALL STREET SPECIAL

Two more Whitten designs, appropriately named as their home is in the heart of Manhattan Island. Eastsider placed 5th in the Nats event to gain Jr/Sr First prize.



1976 Manhattan formula for US Nats
by Richard Whitten
U. S. A
Scale 1:8

EASTSIDER

4 Kingposts each 1.1/4" long
20 ins. flat, 19.1/4" projected span
13" dia prop. 8" tailspan
4 grammes Minimum Airframe Weight

It is expected that many different kinds of flyers will find the Manhattan Formula attractive, and our invitation to come indoors is made directly to Free Flighters, Radio Control and Countrol Line flyers. This Formula is for the fellow who has always thought he would like indoor flying, but has shied from microfilm and ultra-lightness. It is for the old-timer who has been away from modelling for some time and is afraid all his fingers have turned to thumbs. It is for both the junior and adult beginner; and it is for the ladies who will find that indoor flying has most of the comforts of home. Part of the fun in flying Manhattans comes from the fact that rules are still evolving and designs still developing. So, join in; give indoor flying a try and start with a Manhattan.

Is a Manhattan Formula still needed? Ed Whitten thinks so. A.M.A. Cabin rules fail to produce adequate interest. F.A.I. Stick has a minimum weight rule that has proved a boon rather than a detriment, so has Penny Plane; both have similar limiting parameters. Indoor Peanut Scale has problems ... very short on scale and very long on duration. The Manhattan can fill a very definite niche ... a definite need.

Both beginners and experts can find the Manhattan an excellent event. Both Easy ('B') and Penny Plane became popular by this route ... A neat little model that looks like a scale job without all the detail ... an endurance model that takes off, flies and looks like an airplane.

He thinks that, perhaps, the rules still can use some improvement, as witness his 16 in. span/length idea in "Westsider"—what say you?

Rules

Fuselage: Max. length 20 in. from tip of nose to rearmost structure. Must be able to enclose a box $2 \times 2\frac{1}{2} \times 4$ in. Must have transparent cabin windows and a windshield of 2 sq. in. min. No motor sticks, or diamond fuselages. The motor will be enclosed in the fuselage and supported by it.

Prop: Fixed pitch, solid wood, E.Z.B. type.

L.G.: Rigid and fixed. Two wheels of 1 in. min. dia. Must support plane—may be trike. All flights are R.O.G.

Wing: Monoplane, unbraced, max. span 20 in. (measured by the flat method). Max. chord 9 in.

Stabiliser: Max. span 8 in., max. chord $3\frac{1}{2}$ in.

Rudder: May not extend beyond T.E. of stab. Size optional.

Covering: Paper (condenser, tissue, etc.). No plastic or poured films.

Flying: Unlimited attempts to record 5 flights. Less than 20 secs. is an attempt. Best flight counts.

Weight: Min. 4 grams, less rubber.

M.I.A.M.A. Manhattan Event a Big Success!

NINE models actually made official flights at the 1976 U.S. Nats unofficial Manhattan event. For one reason or another, others did not get timed. We heard reports of models not completed, eaten by cats, or mailed and not received in the postal entry.

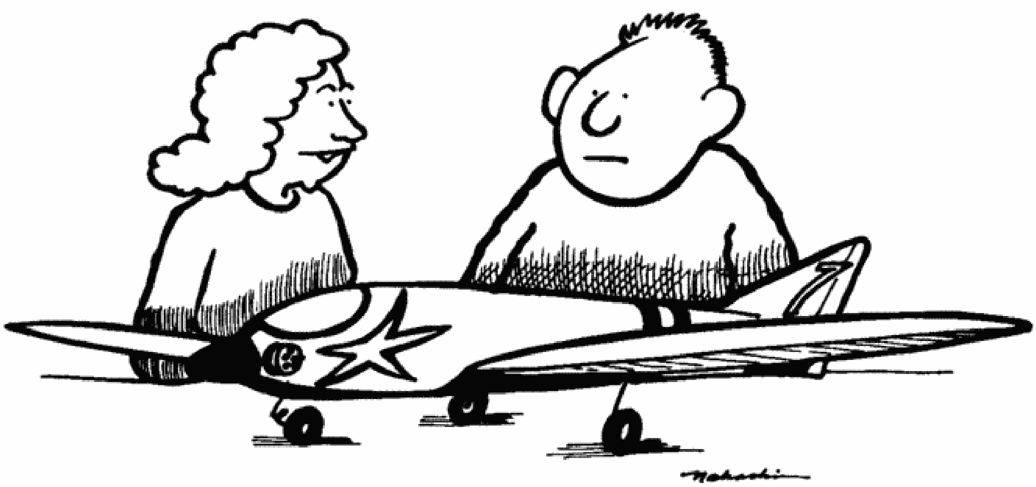
John Triolo's model, already well trimmed at Lakehurst with 8 minute flights, was masterfully proxy flown by Dan Domina. No one else came close to his 8 : 09·7 time. Weight was right on the 4·0 gram minimum. A pretty model with wood dyed orange-red, using mercurichrome, it did its job well.

The battle for second place was close, with only 30 seconds separating the next 4 places. Hardy Brodersen did a great job proxy flying Bob Meuser's "Manhattan Serenade", establishing an early 5 : 26·5, Bob Clemens was 9 seconds behind, then 2, then ahead by above 1·5 seconds! Bucky Servaites, who was limited by time in flying his West Baden winner, was fourth with 5 : 17·7. Richard Whitten, who placed second at West Baden, won the Junior/Senior top prize with 4 : 58·4. He flew his "Eastsider".

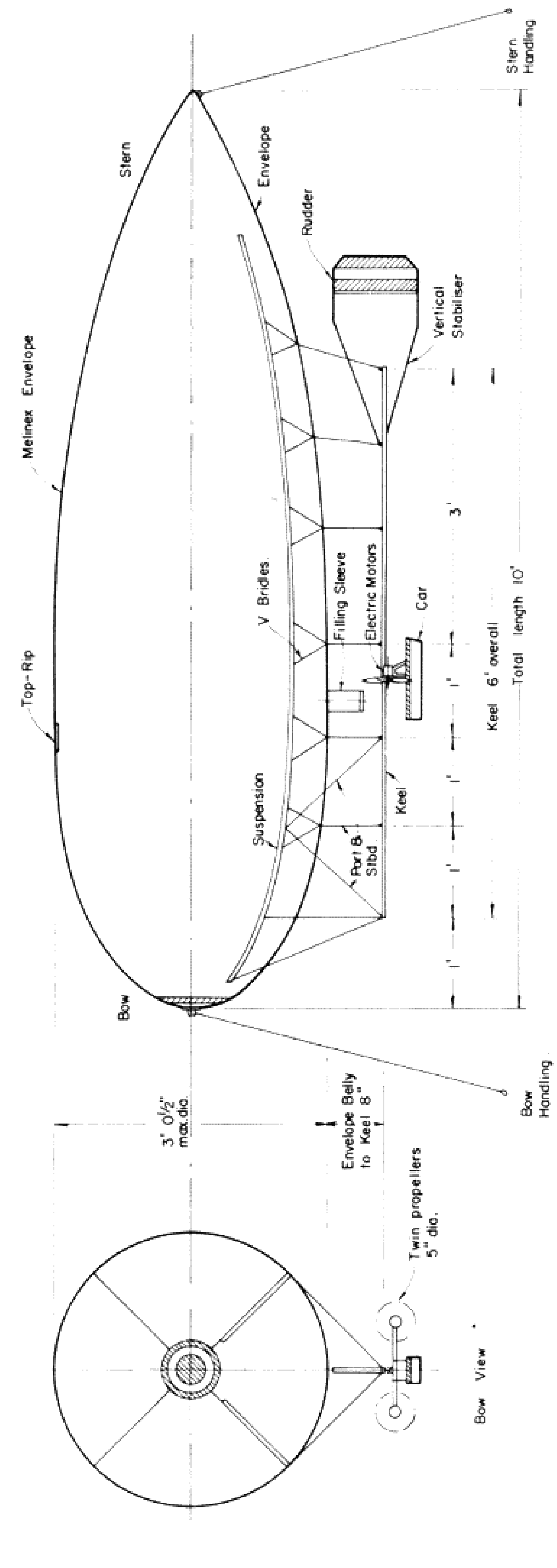
No doubt, even more entries would have made an even better contest; but it was still considered very successful—the greatest boost to the Manhattan Formula since it was first proposed in 1965. The contest proved the usual that an expertly built model, weighing only the minimum, thoroughly tested and expertly flown—would win—and it did.

What direction now? The M.I.A.M.A. rules produce a very nice indoor cabin model. We did hear comments on raising the minimum weight, however, to shift emphasis more towards scale.

Both the Miami Club and Ed Whitten would appreciate comments, via the editor.

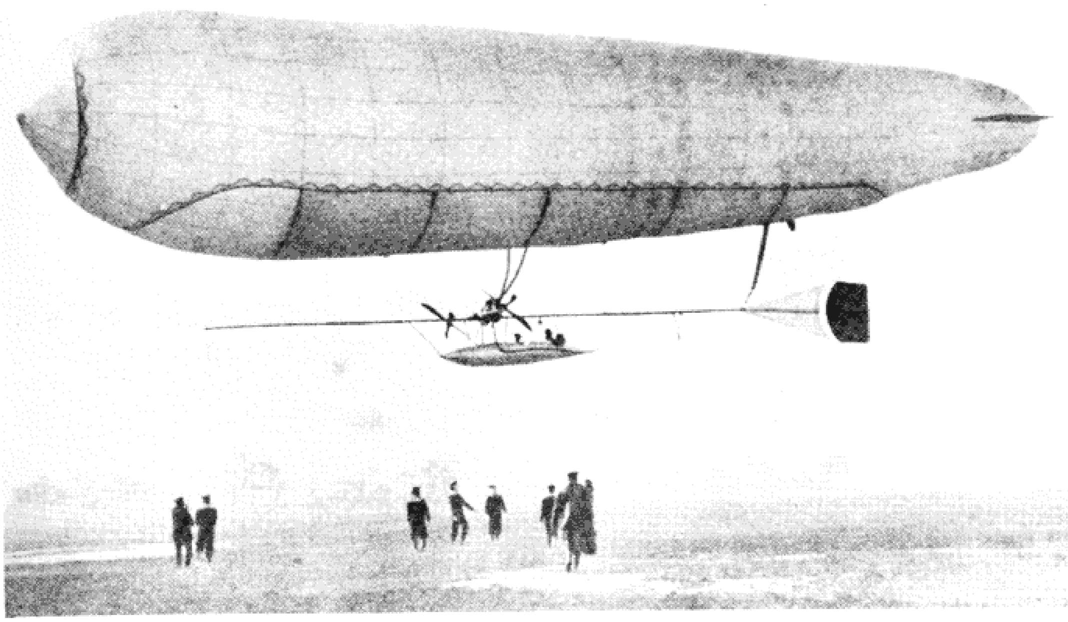


"If the kit really cost $57.50, how come it only had twelve parts?"



Opposite, the actual Willows 4 photographed in September 1912 with its 20,000 cu. ft. envelope, 90 ft. long and 20 ft. diameter. Power was a 35 h.p. Anzani which gave a speed of 32 m.p.h. In 1913 a much larger envelope was fitted—this became the envelope for the SSI.

Drawing of the flying Airship model illustrates its general similarity to the Willows 4.



A RADIO CONTROLLED MODEL AIRSHIP

by Lord Ventry

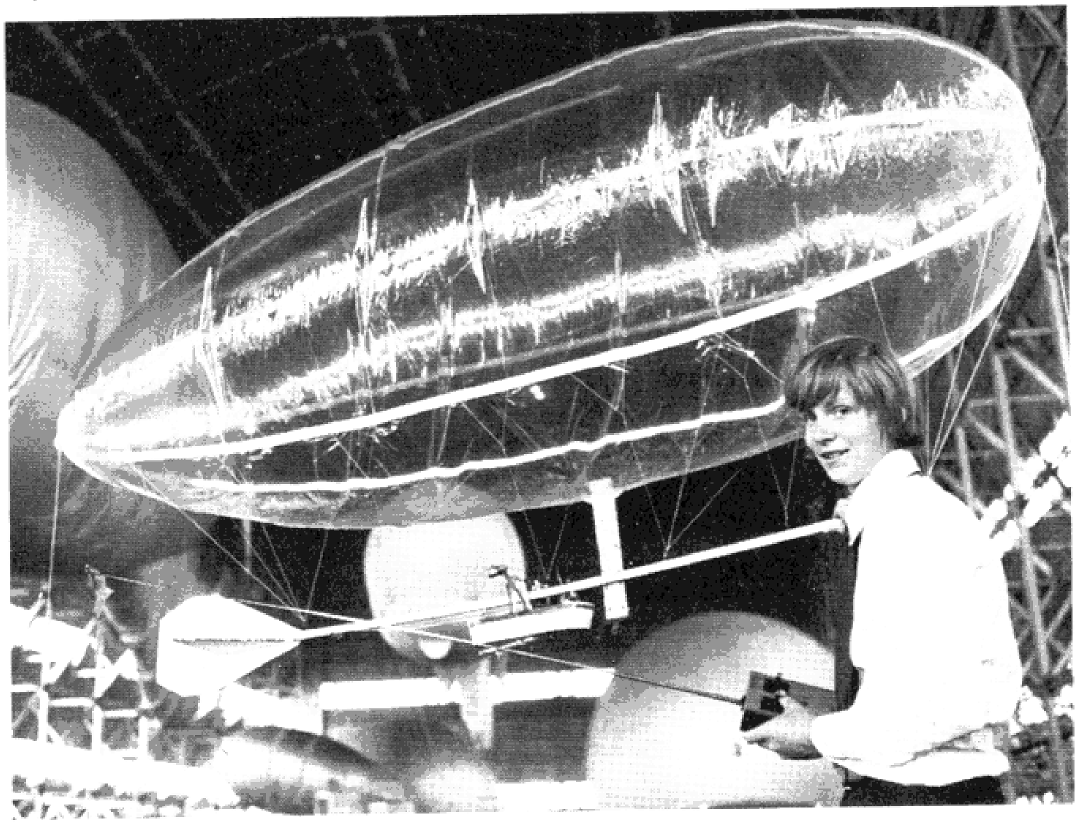
IN THE *Aeromodeller Annual* of 1957, I described some experiments with a model airship of 34 cu. ft. and hydrogen filled. The ship was made by Raymond Morse of Repps, Norfolk. Morse indeed is one of the few with experience of model airships, and the late Wing Commander R. S. Booth, Captain of R100, was very impressed. The article concluded with a suggestion that radio control might be fitted, and this has at last been done, though in quite a new model, this time of 37 cu. ft., and helium inflated.

The envelope was again made by Ray Morse, of transparent Melinex. But the original car, boom, and planes with the swivelling electric motors were made and fitted out by Squadron Leader H. Whalley, R.A.F. (Retd.). My great nephew, R. Barnes Gorell, fitted the radio control and it works very well.

Whereas the first ship, *Bournemouth II*, had a Goodyear type car, fixed directly to the envelope, and *Zodiac*, biplane surfaces, attached to the envelope, the present ship, known as *Bournemouth III*, is based on the *Willows 4*, in her original form, when she first flew at Farnborough in September 1912, 64 years ago.

The car, containing the radio control, batteries and swivelling electric motors, is attached to a long boom. For ease of trimming, this car can be moved fore and aft along the boom, when it is then locked into the correct position. The original Willows car was also fixed to the boom, the 35 h.p. Anzani engine being located over the car. Just as in the Willows, our stabilising planes and rudder are attached to the stern of the boom, the latter distributing the weight of the car over the envelope, which keeps its shape well, even when not up to pressure.

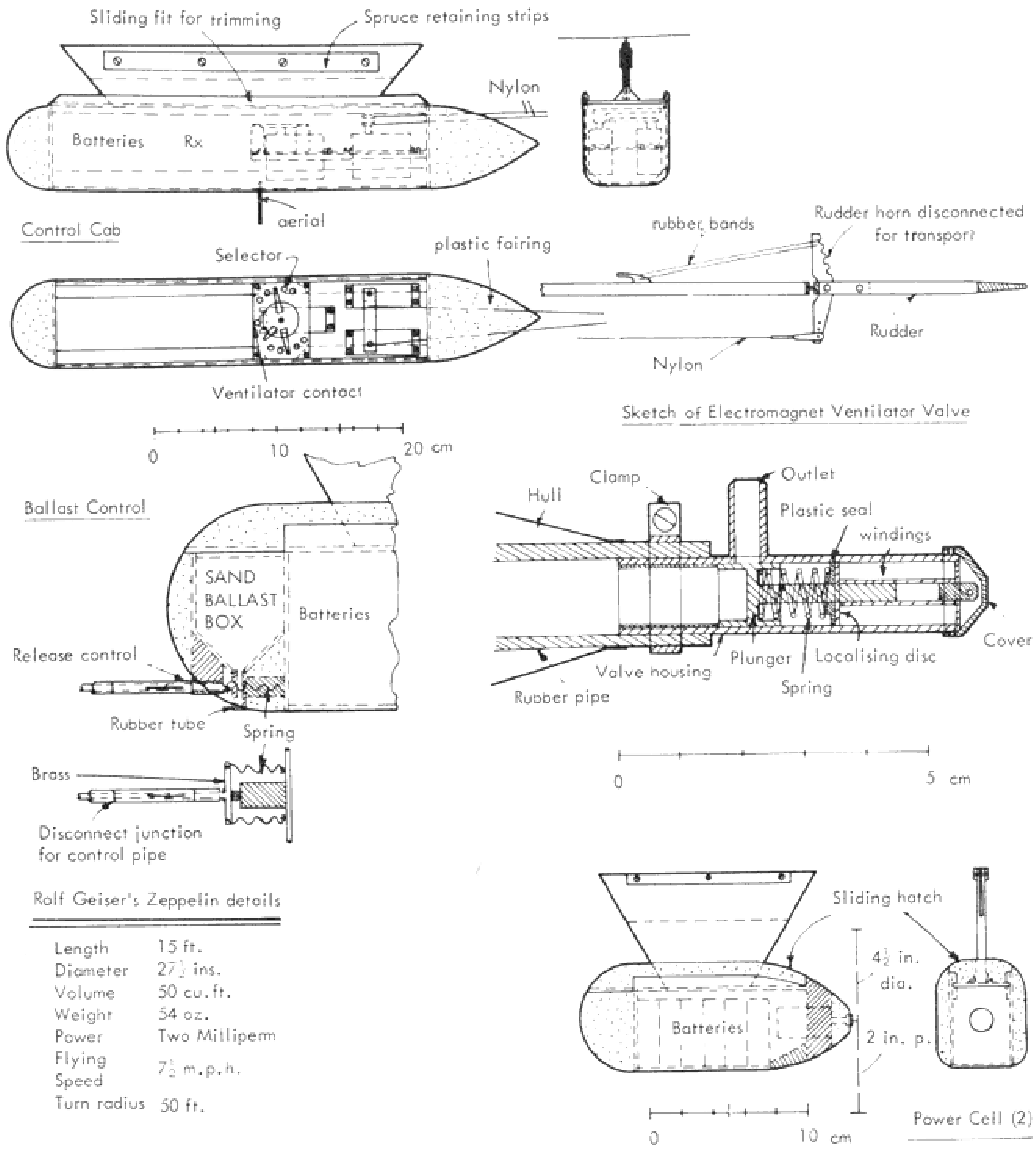
When designing the ship, I did not have the Willows ship in mind, the reason for this very antique design being chiefly to make it possible



Richard Barnes-Gorell controls the "Bournemouth 4" in the airship shed at R.A.E., Cardington. It takes 43·5 cu. ft. of Helium to fill the Melinex envelope. Propellers swivel for thrust vector control. C.O.I. photo.

to develop the radio control, for swivelling and steering, without having to inflate the envelope. If the planes and rudder had been located, as of course they really ought to be, on the envelope, it would have been at least necessary to inflate with air, and then the envelope would have to be supported, etc.

It was only after rough sketches had been made that I realised that the late E. T. Willows, whom I knew, had inspired me! Indeed, I saw the ship at Farnborough in 1914, but by then she had a larger envelope, and all the fins were on its stern. A minor reason for our primitive design was curiosity to see how controllable she would be. In practice this Willows design proved ideal for a model airship, for when Barnes Gorell wished to adjust things we just unrigged the boom, complete, rigging a temporary boom which he had made up, so the ship could be left floating. She was inflated on Wednesday, September 4th, 1974, and deflated on the following Monday. During this period she was airborne, moored out on a mock-up of the old three-wire mooring system, as used by R34 in the U.S.A. in 1919. In this way she was safe from the assaults of mice and rats! We used one 40 cu. ft. tube of helium, supplied by Air Products. Each day she was topped up in the morning, as during the night the temperature fell, but it was only on September 9th that the tube was exhausted, so the envelope was an excellent gas holder, taking roughly $\frac{1}{2}$ cu. ft. per diem.



Details of a radio controlled "Zeppelin" by Rolf Geiser which made many demo's in Switzerland and Germany during 1976—courtesy "Flug + Model Technik". Note the electro-magnetic control valve.

We actually had a spare tube of 40 cu. ft., so the ship could have been kept flying for at least a couple of months, at a cost of £6 for the helium.

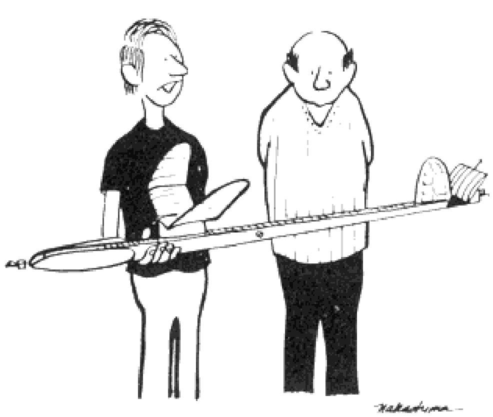
One of the drawbacks of an electrically propelled model is the slow speed (roughly a fast walking speed), and so she must fly indoors. We were fortunate as Richard Barnes Gorell's father (my nephew) allowed us to use a fine barn, 58 ft. in length, 27 ft. in width and some 18 ft. in height. It proved quite ideal, and after the fixed vertical fin area was reduced, she proved capable of turning within the width of the barn. Due to the swivelling engines she could be made to rise and fall as desired. With the propellers set for a direct climb or descent, steerage way is lost, but this did not matter much, as these vertical movements lasted only a few seconds.

The vital importance of accurate trimming was shown, for it was only when the ship was in horizontal trim that the full benefit of her swivelling powers was realised. At one time she was allowed to float, in equilibrium but slightly nose down. So she had a tendency to dive, and the propellers had to be swivelled with an upward thrust to counteract this. Once, however, that she was made to float in horizontal trim, all was well. She was usually kept in equilibrium, but she could leave the ground up to at least 1 oz. heavy, and flew well, though owing to her lack of speed her dynamic lift could not amount to much.

Air Cadets and Scouts, and model flying clubs, could learn a lot from operating model airships, provided they had a large enough hall. But to get the best results it should be possible to keep accurate records of barometric pressure and air temperature. Ideally, too, one ought to know the gas temperature, and perhaps if full use is made of all modern know-how even this might be possible. If lift tables are available, then if pressure and temperature are known, plus the weight of the ship, some idea of the gas purity could be obtained. All this of course also applied to a full sized airship, and so a model airship, if proper records are kept, would indeed prove useful from a training point of view.

If, however, the shed or hall has to be used for other purposes, some sort of small airship shed would have to be built, to house the ship. I have seen a model kite balloon towed in a small vehicle, like a miniature horse box, behind its owner's car. So perhaps this might be one solution.

I would suggest a slightly larger ship, say 40 to 44 cu. ft. volume, would be preferable, as this would give sufficient margin of lift to make it easier to experiment with varying forms of fins, and so on. Ideally, too, it should be possible to stop and start the engines whilst airborne. But even with the present ship, landing practice, for instance, is possible. Due to swivelling of the propellers, there is more than one way by which the ship can land, and quite a bit of judgement can be exercised. In addition to landing in equilibrium, it would be interesting to see how heavy or light successful landings could be made, and it would appear that landing parties could gain some experience, for the ship could be made to land on the guys, or make trail rope landings, or descend straight into the hands of the landing party!



"Well, I started with a Frank Heeb design. Then I put on a Bob White pylon and wing. Next came a Parmenter fuselage and later a Xenakis torque tail.

You know what?

It doesn't fly worth a darn."