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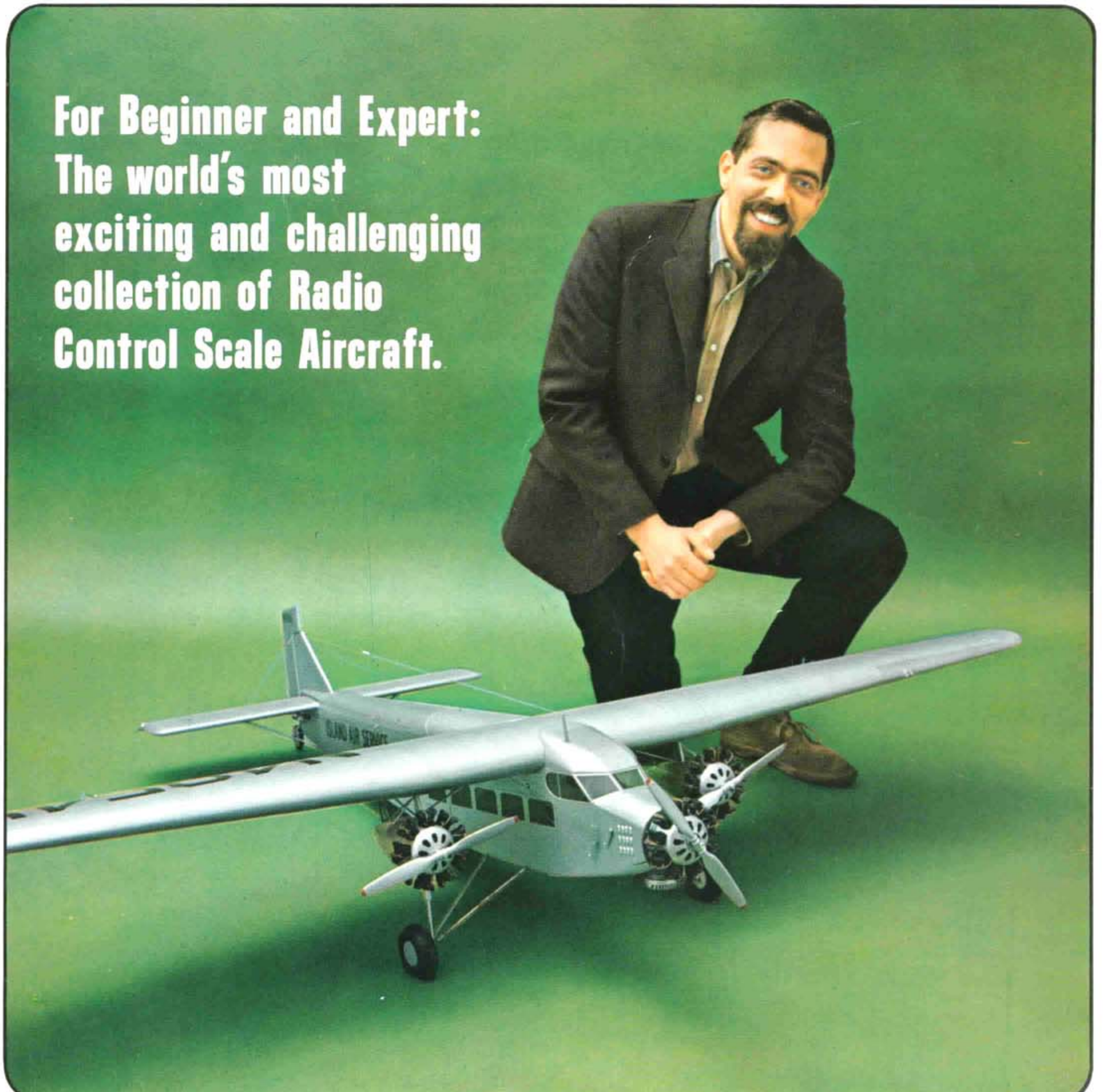
the challenge of
RADIO CONTROL SCALE



EDITED BY DON DEWEY AND THE R/C MODELER STAFF

Why use <u>twenty-seven</u> hand rubbed coats?

Bill King used only <u>three</u> coats of Hobbypoxy on his scale winner!

Bill King says this about Hobbypoxy:

“In scale models especially, a good finish is important. I used Hobbypoxy exclusively on my Fleet I. Hobbypoxy 'Stuff' was used on all areas to be covered with fabric to seal the wood before the silk was put on. After the silk was in place, and sealed with dope, 'Stuff' was again brushed on to fill any balsa grain still showing. I chose 'Stuff' because it sands easily and you run little risk of cutting into the fabric. I put Hobbypoxy Filler on all sheeted and block areas of the fuselage to provide a tough base for Hobbypoxy colors. The final step was to spray the entire plane with three coats of Hobbypoxy White. The Orange and Blue trim colors were masked off and sprayed with one coat.”

Hi there! *I thought I would add my two and one half cents worth to what Bill King said about Hobbypoxy. What he didn't say was that the Fleet I has won five firsts in scale competition! And the picture you see here was taken after a full year and a half of competition and sport flying. Sure, it's been bent a few times, but you'd never know it . . . Hobbypoxy repairs are spotless repairs. Remember this, scale birdmen (and you who are not so scale): Hobbypoxy can give you a finish that looks like countless coats of hand-rubbed greasy kid stuff. Three coats of Hobbypoxy and you are ready to fly. And only Hobbypoxy adds strength with beauty, gives you 'controlled gloss' with Satin Hardener, and is totally fuelproof, warp-proof, shrinkproof and has super covering power. What more can you ask for? Try Hobbypoxy on your next scale sensation. . . .*

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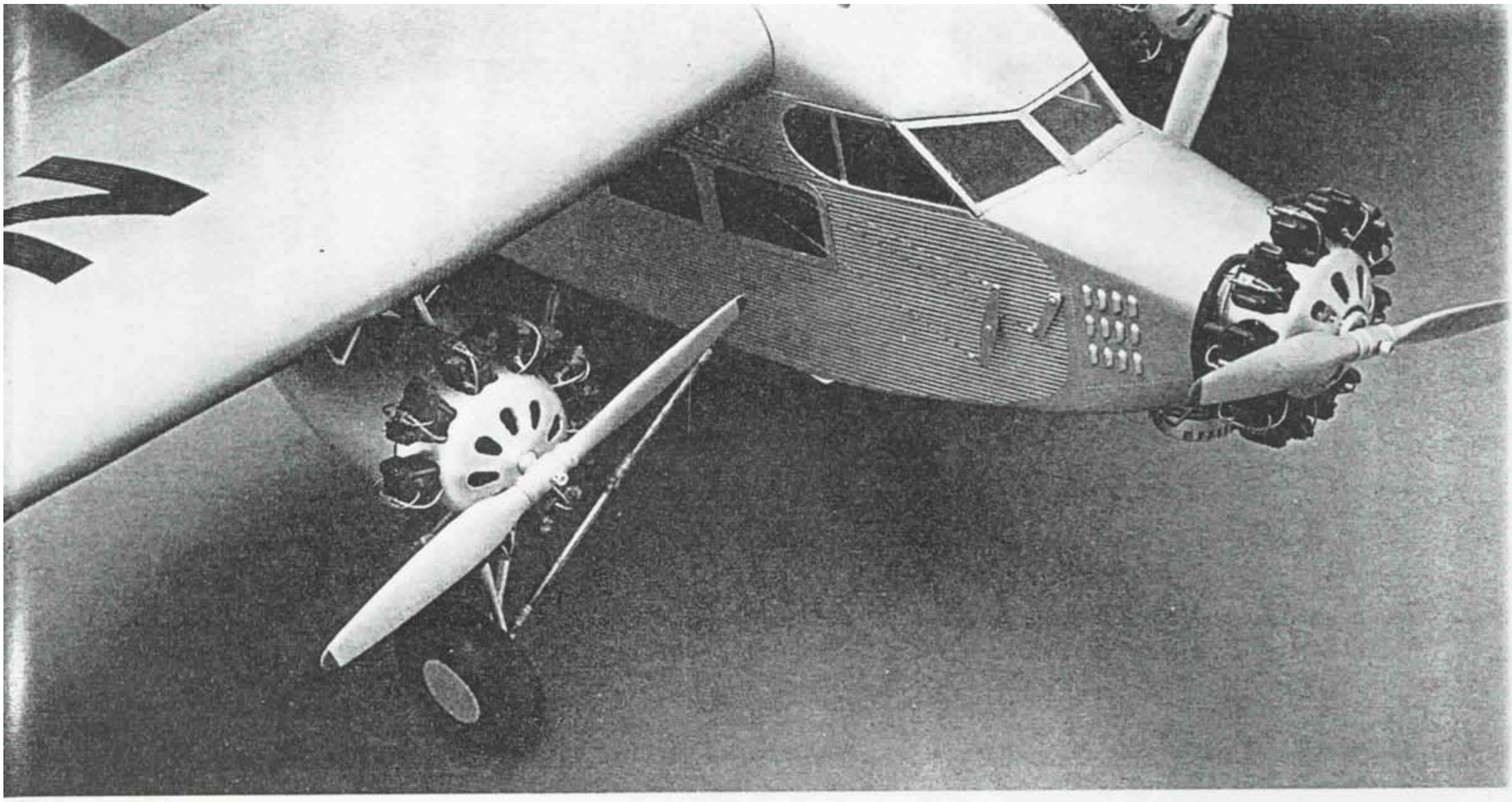

the challenge of

RADIO CONTROL SCALE

THIS book is dedicated to every modeler who ever thrilled to the sight of a scale WW II fighter, or daydreamed about the wind singing in the rigging wires of the fully scale antique biplane he would someday build.

That someday is here now, as RCM presents a collection of some of the finest scale models available throughout the world. With today's reliable radio equipment, true scale R/C is a reality – and whether you are a beginner or expert modeler, there is something for you in The Challenge Of Radio Control Scale.

I would like to extend my personal thanks to the authors of the various articles included in this book – each of them has contributed in no small fashion to the advancement of the state of the art.

We, at R/C Modeler Magazine, have enjoyed preparing this book for you. We hope you will accept the challenge offered by radio control scale.

Don Dewey

Editor & Publisher

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RCM

the challenge of RADIO CONTROL SCALE

• THE COVER

Charles W. Smith with his 3rd place scale winner at 1966 Nationals. This is a Ford 4AT B Trimotor to 1" scale and an all up weight of 8.75 pounds. Outboard props windmill . . . engines are dummies. One half mile of 1/32" trim tape to simulate corrugations. Model demonstrates excellent flight characteristics and has been looped, rolled, and flown inverted.

TABLE OF CONTENTS

S. K. Babcock
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The Challenge of Radio Control Scale is published by R/C Modeler Corporation, 49 South Baldwin Avenue, Sierra Madre, California 91024.

How SCALE is

A popular choice, the Japanese 'Tony' often suffers at the hands of the outline changers. This one is right, has bolt-on wings, sliding canopy with detail, and retracting landing gear.

I REALLY don't know who the fellow was who first used the phrase "If a job's worth doing — it's worth doing well," but he sure was a guy who knew how to make a lot of work for everyone else! Never was this more true than in R/C Scale. The end result is directly proportional to the effort expended. Not that I want to put anyone off scale — quite the contrary — but the radio controlled **fully** scale model is, and always has been, acknowledged among all aeromodellers as the ultimate form of model aeroplane, and quite naturally, this high prestige is not easily gained.

This, really, is obvious to us all the time. We quickly recognize the thoroughbred dog, car, or painting, and see them differently from the cheap shams which, on the surface, perform the same function equally well. I expect there are some of you who could have put down in words this abstract "feeling" much better than I, but I hope I've imparted the idea.

I have tried to make this point right at the start because I truly believe that until this element is realized and **accepted** by the would-be scale modeler, his models will always lack that special something — "air," "character," call it what you will — that is only felt in the presence of a genuine work of art.

How can we ensure that our R/C scale model, which starts as a germ of interest in one subject, becomes such a thoroughbred?

First, I would say that it is enough to tackle one model a year. I have several reasons for this plan. Most important of all, it is necessary and vital for the scale modeler to build and fly ordinary R/C models, because only by constantly gaining flying experience will he become sufficiently expert on the transmitter to give his scale model its best chance. Once upon a time it used to be said that modelers who build scale models couldn't handle them, and those who could handle a model couldn't build scale. And, let's admit it, this was, all too often the truth!

Happily this "image" that scale models are clunkers has now disappeared, due in no small measure to reliable multi-channel R/C gear, and it is quite conceivable that a well-designed scale could outperform the average multi! So, in order that the man can measure up to the machine, a high degree of flying skill is a must.

I find it takes me about one-third of my years' activities to build my competition scale model. Although it is spread over the whole year this means four months solid work in all. This is including information-gathering, designing, building, detailing and trimming.

Personally I think that a really beautiful scale job is worth half-a-dozen ordinary models; I have a suspicion that most fellows agree with this even if they won't take on a scale ship themselves! Therefore I believe that this four months work is very well spent.

Possibly more fellows would take up scale if they realized just how much time it does take to build a top-class model. Many get put off by wild stories about one model being two years' work. This is rubbish! About the only way a model could take this long is if the builder spends six evenings a week watching Idiot's Lantern!

This programme leaves me with eight months to build other models and to fly, fly, fly. Quite often one of these multi's incorporates some experiment which may later find its way into a scale job. Take a look at the photo of the flapped multi and you'll see what I mean.

Many features of a scale model conflict accuracy with practicality, and one great benefit that comes from doing a lot of flying is that, in such cases, we can bias our ideas toward accuracy.

Two cases in point spring to mind. First, the question of how we hold the model together. Instead of using rubber bands to hold on a wing, for example, we can safely bolt these items together, and the gain in appearance and authenticity is immeasurable. The true scale modeler will never use bands. Secondly, the undercarriage design can benefit from a reasonable guarantee that the model will not be landed in sloppy fashion. No longer do we need unsightly coil springs etc., and it is quite practical to have a rigid undercarriage. Again, we get a more accurate result.

Lest any reader regards these opinions as those of a madman, let me reassure him. Of course, any model **can** crash, but after awhile one gets to a flying standard where a really bad landing that would extensively damage the rigid model is a rarity. And let's be fair about this — if the R/C gear is going to fail, that model is going to be matchwood anyway! Rubber bands are not going to save an

SCALE?

The author goes in search of a dream — the happy compromise between performance and accuracy.

BY DAVE PLATT

8 lb. plus model heading to earth out of control!

I don't believe there are too many modelers around who could make more than one model in a year without the standard of the model or the flying skill of the builder deteriorating.

My other reasons for this one-model-a-year philosophy are that, since one is not to be enslaved utterly by scale the interest in the branch is maintained; also it is undeniably a long-winded task to accumulate enough information for the high-quality model we are considering.

Lastly, I always feel that, while to make such a superb creation for one's own satisfaction is a fine and noble thing, the pleasure is greatly increased if the result can be seen and appreciated by all of our friends in the modeling field. In practice this means flying it in the National Championship, and one can only enter one model a year!

I'd agree that only one model is putting all our eggs in one basket, but at least the basket is of the best quality!

To summarize our thoughts so far toward the thoroughbred scale model, we have:

1. Make one model per year and give it your all.
2. Spend the rest of the time improving in flying skill.
3. Use this skill profitably by accuracy-increasing points in scale model design.

SUBJECT SELECTION

Along about 1958 it was realized that the control imparted by 10 channel R/C equipment would enable us to successfully fly models of questionable stability — scale models. Radio Controlled Scale — the dream of a lifetime! At first, modelers naturally concentrated their efforts on the most glamorous subjects which had eluded them so long on these stability grounds. A veritable rash of Spitfires, Hurricanes and Mustangs appeared, to name but a few. Many of these were, by present day standards, appalling in detail design and the great majority were extensively altered from true scale.

However, a very few modelers did really show what could be done. Well-known English bod, Dennis Bryant, designed a Spitfire and a Hurricane which, in outline, were exactly scale. When these models flew successfully the point had been made. Though lacking the refinements of a modern scale R/C, his models in this period were a significant contribution to the state of the art: the rest would follow.

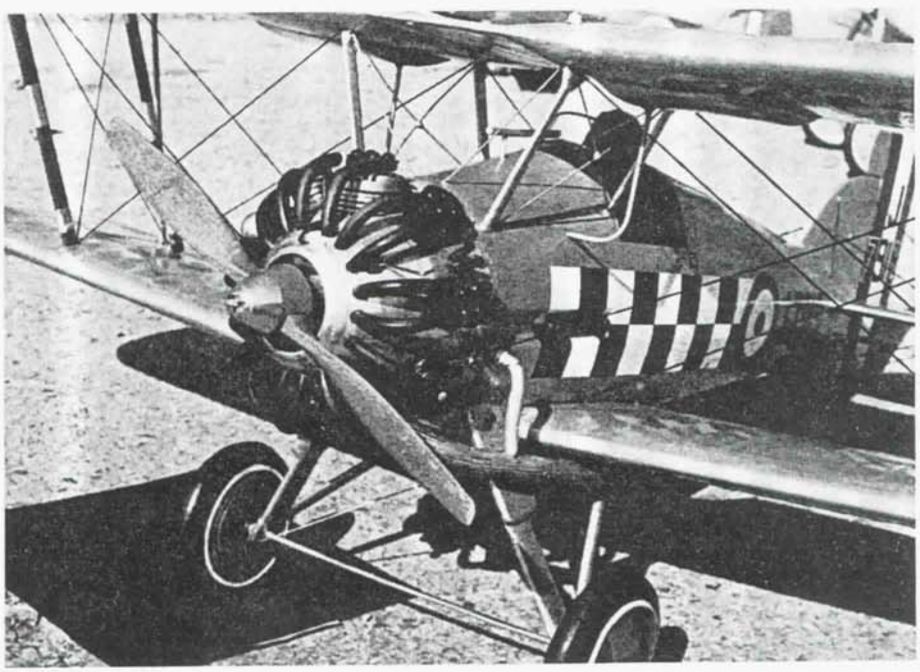
Sad to say, the other variety of R/C scale common in the early days, the altered abortion, taught nobody anything, and in fact, may have damaged the art. To this day, unfortunately, we still see this type of design. Competition is probably the most important single factor for improvement of the breed, and competition has pointed out the futility of this approach.

In these early days it was widely held that almost any aircraft could be flown as a model. As far as aerodynamic design is concerned this is about right. However, for the pukka scale model that today's standards demand, other factors must be considered.

These factors really funnel into one specific question: "If I make a model of 'X' aircraft, have I got to change something important; something that will show; something that will change the essential **character** of this subject?" Let's list some of the things which would be frowned upon in a contest and we will get a pretty accurate picture, for the rules are tight.

Wing span, chord, taper, area, dihedral, tail dimensions and area, fuselage dimensions — all of these MUST be

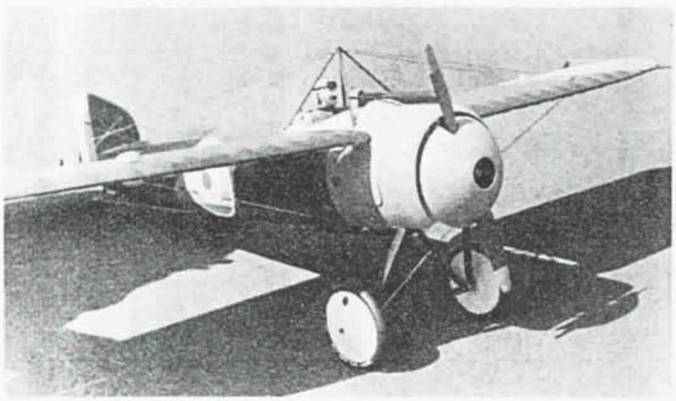
Gloster Gamecock by Jack Morton has rigid landing gear (no springing) and bolt-on wings. Note clever camouflage of the motor.

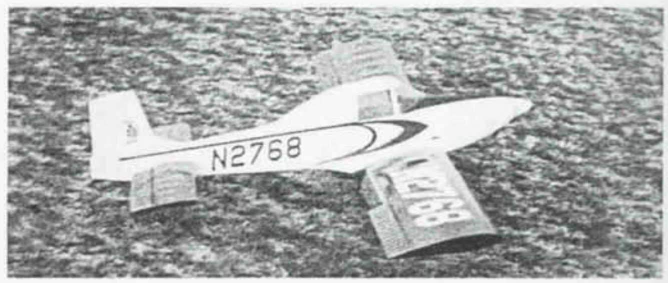


Old timers like this 1912 Blackburn have considerable charm; unfortunately they need calm conditions, by no means a guarantee at a contest!

Arthur Lalley's famed Corsair featured truly astounding flight performance. Twice placed third at British Nationals, was of correct outline, but needed retracting landing gear.

Bristol M1 Monoplane placed second in 1966 British Nationals and was the classic example of serious problems successfully overcome.





Author's latest multi (loosely based on homebuilt Turner T.40) built to gain flying experience with flaps.

right. Also the (model) engine should be fully enclosed so not to show at all. Likewise, the R/C equipment should not be visible. The undercarriage, if of a retracting U/C aircraft, should retract, close up/and flaps need to be used if appropriate.

Supposing after checking this short list we get a satisfactory answer to our question, we can look further at our subject. Other, less important considerations such as wing section, tail section, incidences, control surface area, and wheel tires may present a problem and though we would still be penalized in a competition for any alterations to these, it may be necessary and we probably would be justified in one or two changes if vital to the success of the model. In particular, full-size wing and tail incidences are often incompatible with models and must be changed; this is due to the un-scale flying speeds attained by models and the fact that we cannot fly models in, say ⅛ scale air!

Now at this time it is becoming clear that, far from having the whole world of aircraft to choose from, there are one hell of a lot of subjects that are just no good for a thoroughbred scale model. A great number of civilian aircraft of the Cessna/Piper type are useless to us, as we can find no place for the R/C equipment where it will not show. If, that is, we respect our old enemy the C.G.! Again, many fighters present a problem with nose lines which will not contain the motor, though this type of aircraft usually gives good scope for placement of servos etc. leaving the cockpit area clear. However, if the motor comes near enough flush with the nose lines and we invert the engine the effect is not at all bad. Refer to the photo of the "Tony" and this will be clear. From all normal angles this engine would be invisible, and this is a quite acceptable technique.

AERODYNAMICS FOR SCALE DESIGN

Quite often a modeller about to embark on a scale model for the first time will ask about wing sections, C.G. placement, rigging angles, tail area and similar consideration with an aerodynamic flavour.

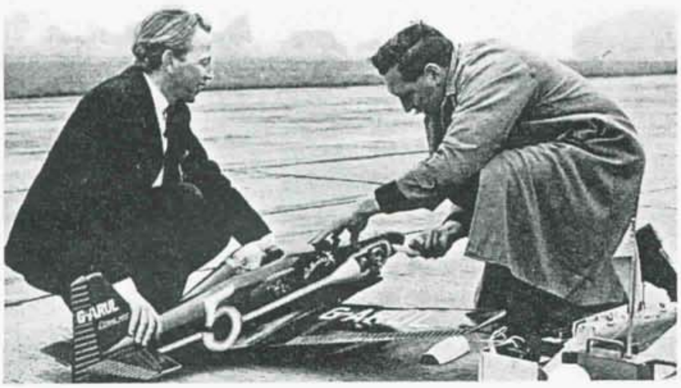
Actually, tail area and C.G. position are bound together. **As a practical minimum** we can accept a tail area percentage of 10% - 12% of the wing area. If the tail area meets this requirement, the tail should be made exactly scale. However, a tail of less than 10% would be a good case for scrapping the subject and looking elsewhere. On no account should the area be tampered with if too small — remember we are making a **thoroughbred** model!

Once we know the tail area percentage the C.G. position can be determined. Basically, bear in mind that a more-forward C.G. will help stability and is useful for small tails. If tail area is very good, say 20%, we can safely use a C.G. around 37% and gain maneuverability. With a 12% tail, C.G. needs to be around 30%. In-between points can be arrived at quite easily from these limits.

These figures are suggested for a normal monoplane configuration. Not being a biplane expert I'd better leave those limits to someone else who knows them better.

The best wing section to use is the one on the aircraft. It is very doubtful if a change of section will be of any

Sopwith 1½ Strutter built by the author in 1961. Note the lack of dummy engine and the bands used for wing attachment, common mistakes of the period.



Cosmic Wind 'Ballerina' by John Wingate was one of the finest scale RC models yet seen in England. This model was difficult to fault.

Though otherwise ideal, private-owner types usually show RC equipment in the cabin. Cessna 172 by Peter Anderson.

benefit to a model, and we can thus ensure no loss of points in this area. About the only time when an alteration is indicated is if we need a **very small** increase in thickness to accommodate a retract-gear mechanism. Large increases though, as when trying to get a servo into a thin biplane wing, would be ruled out, and some other answer found to the problem.

Rigging incidences, or decalage if you like, often present a serious problem. If we have an aircraft with a decalage of more than 1% we MUST change something, or disaster may well befall the model! My normal practice here is to leave the wing incidence alone and make the tail angle the same, or 1 degree less. This way the change doesn't notice.

SIZE AND POWER

For many reasons it is a good idea to make a model as large as possible. Naturally, the detail work will be easier in a bigger scale and the finished result will be better. Visualize, for a moment, the detail of a large bomber reproduced in 3/16 scale and compare with this the possibilities existing with a 1/4 full size homebuilt. For another thing, a large model is more impressive, and there will be more wing area to support the weight of the R/C junk, which is constant with any size of model.

When we are considering a single-engine monoplane there seems little point in settling for less than the most power we can get. In a scale model I always use a beefy 10cc rear-disc engine because the extra power available is always worth the couple of ounces or so increase in motor weight, which is an insignificant proportion of total model weight anyway.

Come to think of it, I don't think I ever saw a model fail because it was overpowered. But I've seen many a heart-stopper with a rough engine run or insufficient horses being delivered!

In my experience these seemingly conflicting requirements of large model and plenty of power find a reasonable compromise at around 60″-66″ span and area about 700-730 sq. in. The weight should be about 10-11 lbs. for a well-detailed model, and any motor giving 1 b.h.p. +, such as a McCoy 60, Rossi, or O.S. 60H will be found a pleasant combination. But put an ordinary 8-10 cc sport R/C engine in such a bird and you could have problems. So always err on the side of too much power, if there is any such thing. Personally, I don't think there is.

RADIO EQUIPMENT

I suppose it is entirely inevitable that I'm going to recommend the scale fan to proportional equipment. But let me qualify this statement because, on the face of it, there might seem a good case for reed gear. Consider, there must obviously be a greater risk to our costly gear when it's installed in a scale job. After all, if we built a **Taurus,** we'd have an exceedingly high percentage possibility of success, chances which no scale job, however well designed, can match. Also, it might well be argued that great perfection of maneuver shape is not required to such a critical extent. Lastly, reed gear has reached such a high standard of reliability, such as only several years of constant manufacture and improvement will give, that it could seem wise to commit this result of so much loving work to this mode of control.

So, in the face of all this, why proportional?

Several reasons, all good. You remember we earlier said that improvement to personal flying skill is vital in scale. With proportional control this skill will reach a higher standard than it ever could with reeds. In particular, excellent landings, which are so necessary to a scale ship, are much easier to come by. And in take-offs too, with propo we can use a 2-wheel type VC with much less worry, because instead of having to hold full 'up' elevator to prevent a nose-over, with its consequent high risk of stalling the model right off the ground, we can now hold the **slight** 'up' needed for a clean, straight takeoff.

As far as the flight goes, inasmuch as the actual maneuvers may be less important than in F.A.I. multi, the in-between flying is much **more** so with a scale job, in fact the flight of a scale model is considered by the judges as a whole, and points are awarded for flight realism. I'm certain most fellows would agree it takes a whale of a good reed flyer to make a whole ten-minute flight without showing a few aileron and elevator "twitches!"

Another benefit of propo, perhaps depending on the type of subject you like, is the additional control offered. With no extra weight or trouble we have aileron, rudder and elevator trim that's only the start. With 12 channel reeds, allowing that elevator trim takes one function, we have only five functions to use, so only one additional control can be added to the basic four needed by the model. A 7 channel proportional rig will give **three** additional functions and while this may not impress the multi-freelance boys, for scale it's just what the doctor ordered. Few scale jobs can use more than 7 functions anyway.

If the editor will allow me to digress for a moment on a personal opinion, I'd like to say that my own choice, when I went proportional, was a Logictrol 7 2-stick. Since I am a firm believer in flying how it suits me and not how I get told is "best," I have ailerons on the right, with motor, and elevator/rudder on the left. Normally, this set-up is no problem but when reaching for the auxiliary channels it does mean I have to let go of aileron. "One-stick" flyers, of course, could use the left hand for auxiliaries and maintain complete control of the two important flying functions, so I concede their point. However, I have recently found that by hanging the Tx on a saxophone strap and flying with fingers and thumbs instead of just thumbs, I can use the auxiliaries with my right-hand fourth finger.

Anyway, like I said, I got a Logictrol. This was because (a) I prefer the Orbit-type servo which, apart from being in my book, the finest and most crashproof servo offered, has the advantage of multi-function output arms. This can be, and is, very handy in a scale job; and (b) I think that the centering-accuracy of the stick units on a propo rig is very important, and I find the Logictrol units very good in this respect.

Having had experience with a Micro-Avionics outfit, which, sadly, has only five channels, I'd say their stick unit is also excellent, so I would have been quite happy with an Orbit 7-14D which uses this same unit.

One unexpected advantage with propo, discovered recently while flying a flap-equipped multi, was that the airborne position of the flaps can be seen on the transmitter. Even though my flaps are of considerable size it is not until the model is quite close that it can be visually determined whether they are up or down. A proportional transmitter, however, shows the exact degree of flap we have; this cannot be done with reeds.

FINISH REALISM

Since the final finish and coloring of the model is about all we can really see on the end product, it is vital to spend a good deal of time on this aspect and proceed with caution. Three points which are guaranteed to ruin a good model, to my mind, are 1) A shiny finish on an aircraft which should be semi-matte or matte; 2) Having the canopy frames picked out in black. (Don't laugh — I've seen this done times without number!) 3) Areas of fabric covering where sheet metal or wood were used on the original, and vice-versa. Quite often flying surfaces of aircraft are sheet covered, with control surfaces of built-up construction covered in fabric. This, then, becomes the rule for the model of this type.

If at all possible a color sample of the paint used on the original should be obtained. Of course this often is impossible, so try to get some good color photos. These need using with caution as shades can be altered enormously by the film used.

Probably the models needing greatest care in coloring are the camouflaged WW II aircraft. Any slight discrepancy of shade (notice I said **shade**, not tone) in camouflage colors will show up badly and can easily spoil an otherwise good model. I must inject here a word of warning — some books carry a color shade chart of camouflage and other military aircraft colors. Don't trust them. They are seldom, if ever, accurate. The method I use is to get a sample patch of fabric or panel of metal, but I'll readily agree that this is not always easy. Failing this, for wartime aircraft the **Profile** publications can be relied upon as being of no discernible difference from the truth.

Having mentioned **Profiles**, I'd like to

(Continued on Page 95)

Mike Kendrick and his winning Chipmunk at recent New Zealand Nationals. An example of a scale model that does all aerobatic maneuvers.

What could be a more natural subject for a first attempt at R/C scale than a vintage Air Camper? Simple in construction with enough detail to challenge the expert. By G. I. Joe, as told to Fred Angel.

NOW dig this scene, Clyde: You arrive at the field (preferably later than the gang), dressed in your knickers, kneesocks and large, floppy scarf. Casually you open the rumble seat of your vintage car. Out pops the little "Air Camper." Forgotten now are the hot multi-ships with their universal look-alike style, gone is the hero worship of Hot Shot Charlie with his 90 mile an hour mortar shell. The air is charged with that magical feeling that true miniature classics always bring.

As the fingers point and the comments start, nonchalantly you light your pipe and graciously permit the boys to carry your field box to the starting line. All the hubbub stops as you start filling the tank through THE TOP OF THE RADIATOR! To be a little sneaky, you have to remove all the labels from the fuel can and neatly letter the can: WATER.

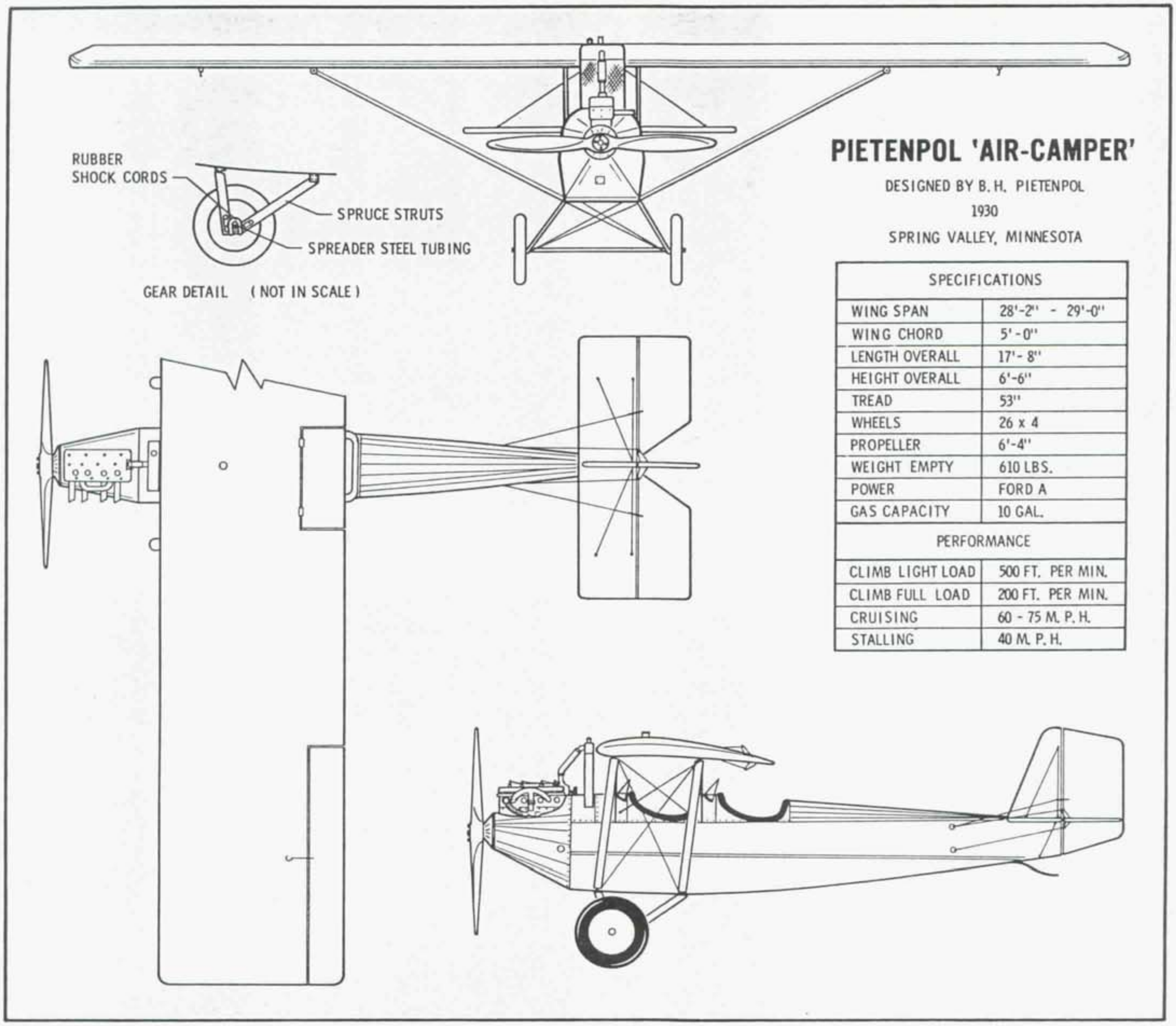
Two flips of the prop, the engine catches and you taxi into position. With a brief wave to the helmeted pilot in the rear cockpit, you gun the throttle and off you go. The tail lifts, the exhaust streams out, and the little ship lazily climbs into the blue. (Now, the next part requires a bit of practice beforehand in front of a mirror.) The trick is to look extremely modest as the applause breaks forth from the crowd.

So much for the dramatics. Let's have a go at it, Clarence.

Early in the 30's, B. H. Pietenpol designed a ship that could be built by anyone. Power for this plane was a standard, inexpensive, slightly modified Model A Ford engine. This two-place homebuilt cruised anywhere from 60 to 70 miles per hour and developed about 40 horse power on the water-cooled Model A. Rate of climb was about 200 to 500 feet per minute. No great performer, but a stable, relaxing aircraft that could take you up and land with forgiving qualities. Factory production stopped in 1939, but Mr. Pietenpol still has plans available for the early Air Camper and is presently modifying and testing an "Improved Air Camper" which features an improved landing gear, steerable tail wheel, brakes, radio, and modern power plants.

There is a certain appeal to a scale model with open cockpits, big old wheels, bulky looking engines and old-fashioned lines. I guess you'd call it irresistible. The model presented here is scaled two inches to the foot. The only deviation from scale is the enlarged stab, hinge lines of the tail surfaces and the small amount of dihedral. It lends itself to a natural scale ship for the beginner and can be successfully flown on single channel. While simple in construction, there is enough detail to challenge the experts. In addition, certain deviations from plans are permissible with home-builts, so if you vary a little bit in scale, who's to say you are wrong? This model is ideal for the light-weight three channel systems such as "Digitrio" or "Spar-Trio." We outfitted the original with "Spar-Trio" and had room to spare. The big wing could have lifted even more.

A quick look at the plans will tell you at what stage you can ignore the text and start building. I think all of us do this with plans, but since I started out to present a beginner's ship, I'll run through the highlights of the building sequence. While building, I think every modeler should be able to discuss projects with a buddy. I was fortunate to have G. I. Joe home on leave and as the photos show, Joe proved to be one of the best A & E mechanics I have ever seen. Joe was all over the model . . . he even gave



SPECIFICATIONS	
WING SPAN	28'-2" - 29'-0"
WING CHORD	5'-0"
LENGTH OVERALL	17'-8"
HEIGHT OVERALL	6'-6"
TREAD	53"
WHEELS	26 x 4
PROPELLER	6'-4"
WEIGHT EMPTY	610 LBS.
POWER	FORD A
GAS CAPACITY	10 GAL.
PERFORMANCE	
CLIMB LIGHT LOAD	500 FT. PER MIN.
CLIMB FULL LOAD	200 FT. PER MIN.
CRUISING	60 - 75 M. P. H.
STALLING	40 M. P. H.

the test pilot a couple of last minute pointers on the test flight. Wherever possible I'll try to pass on his building tips. For example:

JOE'S BUILDING TIP #1: Forget that jazz about using ¾" plywood or a hollow-core door for a building board. Haven't seen a straight one yet. Pick up a piece of sawdust board known in the building trade as Flakeboard or Timblend and used extensively for underlayment for Formica counter tops. Bond a piece of building board such as Homasote or Celotex Ceiling Tile to this with contact cement and your building board troubles are over. O.K., let's build the wing first.

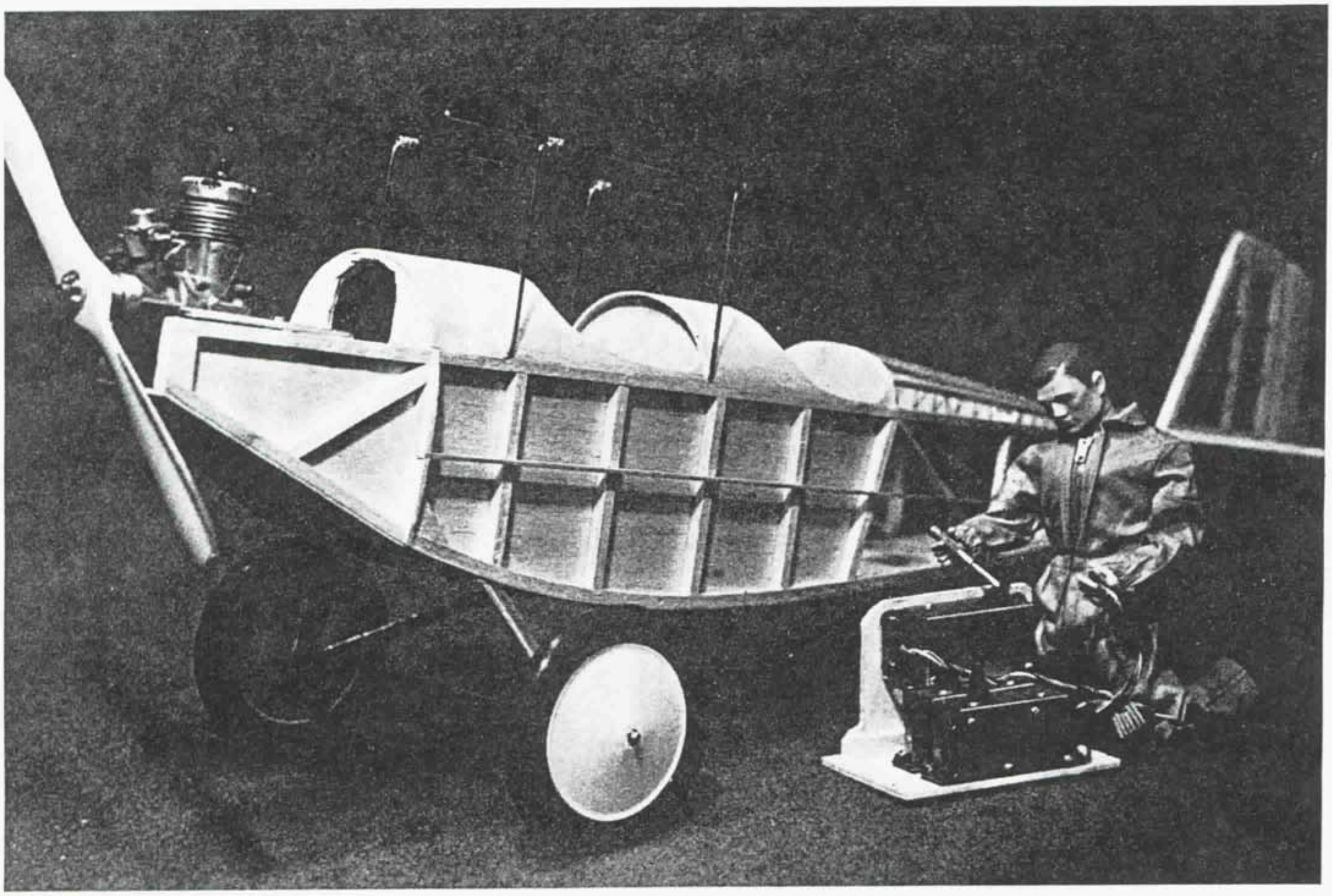
THE WING. Cut out all ribs. They are the exact number and spaced the same as on the real ship. Note that the center ribs have been trimmed to receive the sheet planking. Start by pinning down the leading edge bottom sheet to which you glue the ¼" square spar. Also pin down the rear spar. Now glue the ribs to this. We used white glue for this.

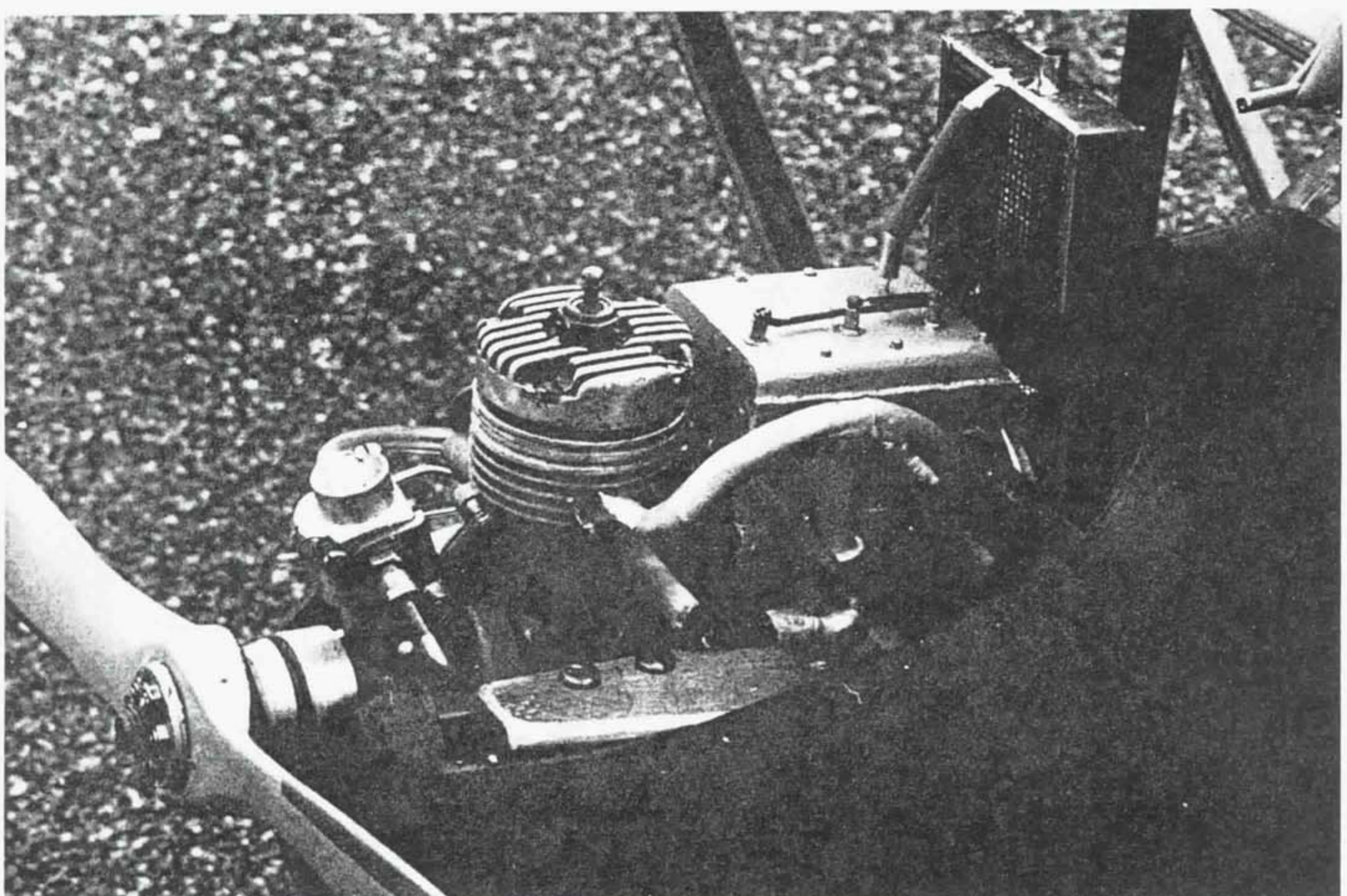
JOE'S BUILDING TIP #2: Use white glue everywhere except where sanding to contour is required. Most white glues dry harder than the material glued and leave ridges when sanded. For example, white glue to attach sheeting to ribs, but where the sheeting joins the leading edge, use standard model cement.

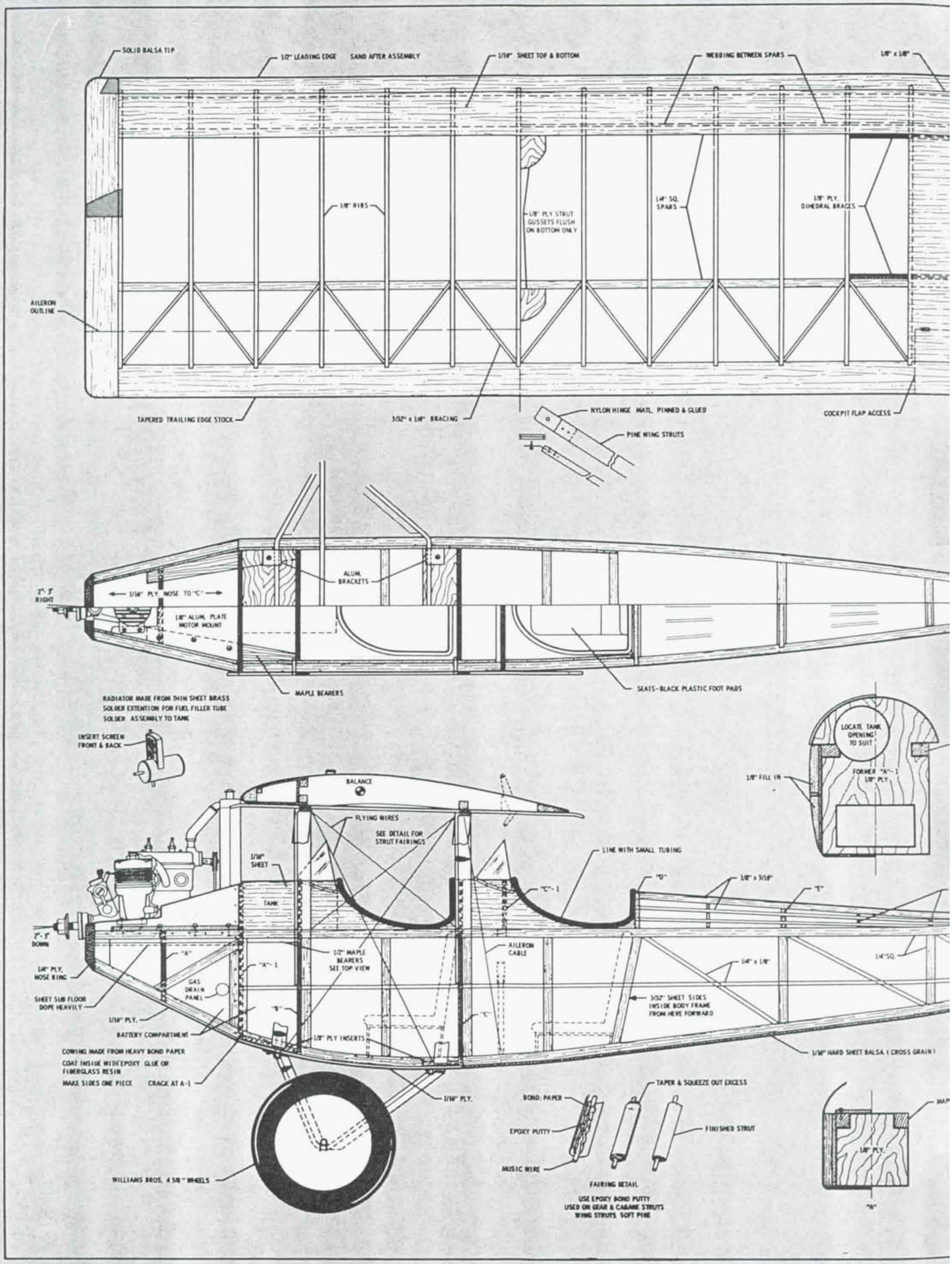
Now for the leading and trailing edge, use JOE'S BUILDING TIP #3: To notch leading and trailing edges, clamp three hack-saw blades together front and back and saw the notches on the edges. Limit the depth by a piece of masking tape. Glue these edges to the ribs. Remember not to cover the top with sheeting until both wing halves are joined and reinforced with the dihedral braces. The tips are solid balsa. Make sure you put in the trailing edge diagonal bracing. You'll be surprised at the fine job they do in stiffening the trailing edge and preventing warps. After the framework is top-sheeted, center sheeted and dried thoroughly (and, oh yes, don't forget the plywood strut-holders), you can sand. I'm one of those nuts who, while despising the job of sanding, can't wait to see the finished form. So, if you feel the same way, go ahead and sand and set aside for final covering.

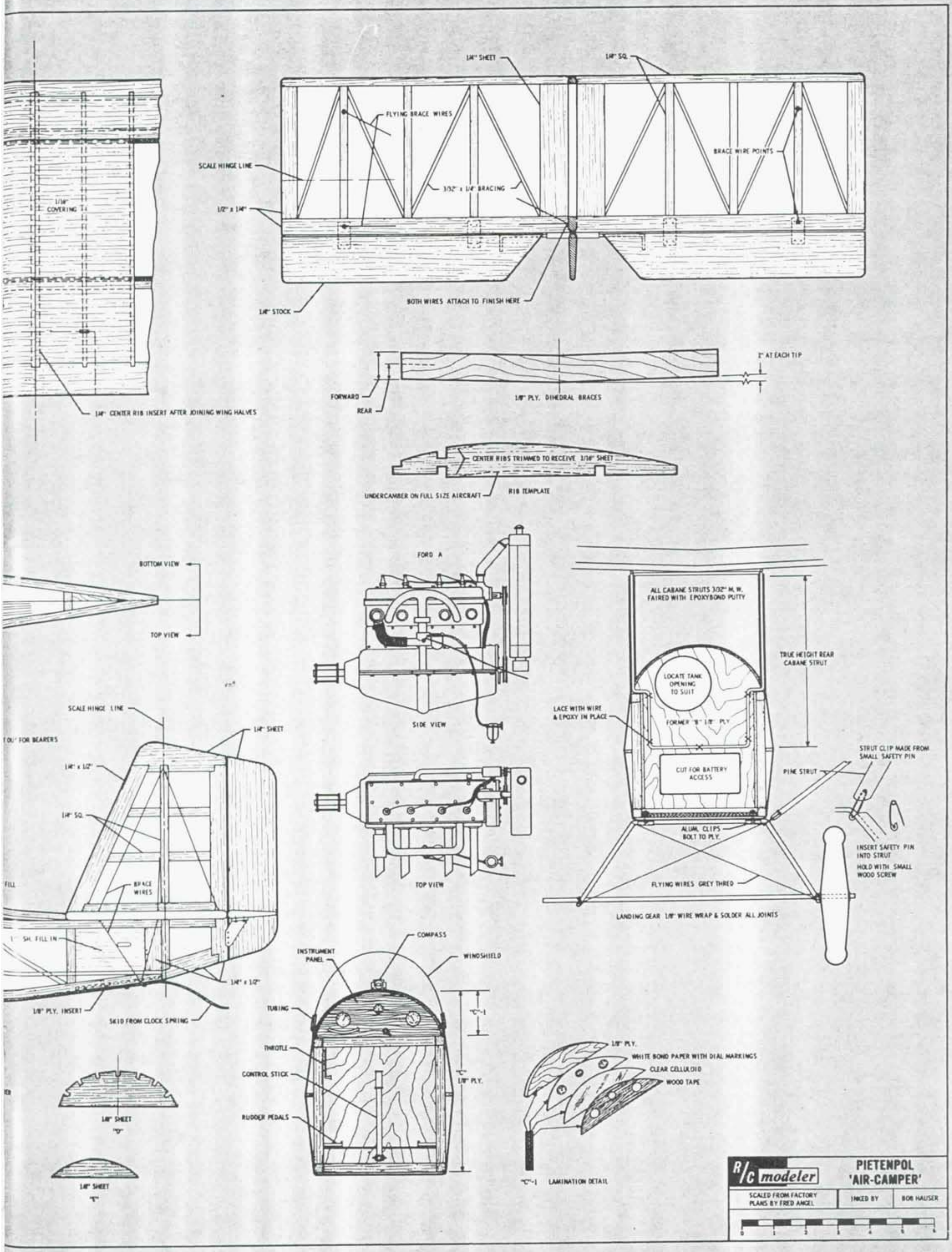
JOE'S BUILDING TIP #4: To avoid the mess involved with sanding dust, attach a large funnel or box to the nozzel of your vacuum cleaner, clamp to your work bench and sand over it. Balsa dust will wisk into the opening rather than up your nose, all over the floor and into that precious receiver.

TAIL SURFACES: We used open framework on the fin and stab to conform to scale appearance and to keep the tail light. Select straight, medium stock for this. Use white glue and wipe off any excess globs. Sand to shape after dry and join fin and stab together. Use a 90-degree drafting triangle for alignment and check periodically while drying to make sure everything is true. The movable surfaces are made of medium balsa. Do not attach until all the painting has been completed. More on this later.






SOLID BALSA TIP
1/2" LEADING EDGE SAND AFTER ASSEMBLY
1/16" SHEET TOP & BOTTOM
WEBBING BETWEEN SPARS
1/8" x 1/8"
1/8" RIBS
1/8" PLY STRUT GUSSETS FLUSH ON BOTTOM ONLY
1/4" SQ. SPARS
1/8" PLY. DIHEDRAL BRACES
AILERON OUTLINE
TAPERED TRAILING EDGE STOCK
3/32" x 1/4" BRACING
NYLON HINGE MATL. PINNED & GLUED
PINE WING STRUTS
COCKPIT FLAP ACCESS
2°-3° RIGHT
1/16" PLY. NOSE TO "C"
1/8" ALUM. PLATE MOTOR MOUNT
ALUM. BRACKETS
MAPLE BEARERS
SEATS-BLACK PLASTIC FOOT PADS
RADIATOR MADE FROM THIN SHEET BRASS
SOLDER EXTENTION FOR FUEL FILLER TUBE
SOLDER ASSEMBLY TO TANK
INSERT SCREEN FRONT & BACK
LOCATE TANK OPENING TO SUIT
1/8" FILL IN
FORMER "A"-1 1/8" PLY.
BALANCE
FLYING WIRES
SEE DETAIL FOR STRUT FAIRINGS
1/16" SHEET
TANK
LINE WITH SMALL TUBING
"C"-1
"D"
1/8" x 3/16"
"E"
2°-3° DOWN
"A"
"A"-1
1/2" MAPLE BEARERS SEE TOP VIEW
AILERON CABLE
1/4" x 1/8"
1/4" SQ.
1/4" PLY. NOSE RING
GAS DRAIN PANEL
SHEET SUB FLOOR DOPE HEAVILY
1/16" PLY.
"B"
"C"
3/32" SHEET SIDES INSIDE BODY FRAME FROM HERE FORWARD
BATTERY COMPARTMENT
1/8" PLY INSERTS
1/16" HARD SHEET BALSA (CROSS GRAIN)
COWING MADE FROM HEAVY BOND PAPER
COAT INSIDE WITH EPOXY GLUE OR FIBERGLASS RESIN
MAKE SIDES ONE PIECE
CRACK AT A-1
1/16" PLY.
TAPER & SQUEEZE OUT EXCESS
BOND PAPER
EPOXY PUTTY
FINISHED STRUT
MUSIC WIRE
FAIRING DETAIL
USE EPOXY BOND PUTTY
USED ON GEAR & CABANE STRUTS
WING STRUTS SOFT PINE
WILLIAMS BROS. 4 3/8" WHEELS
1/8" PLY.
"A"



1/4" SHEET
1/4" SQ.
FLYING BRACE WIRES
BRACE WIRE POINTS
SCALE HINGE LINE
3/32" x 1/4" BRACING
1/16" COVERING
1/2" x 1/4"
1/4" STOCK
BOTH WIRES ATTACH TO FINISH HERE
1" AT EACH TIP
FORWARD
REAR
1/8" PLY. DIHEDRAL BRACES
1/4" CENTER RIB INSERT AFTER JOINING WING HALVES
CENTER RIBS TRIMMED TO RECEIVE 1/16" SHEET
UNDERCAMBER ON FULL SIZE AIRCRAFT
RIB TEMPLATE
BOTTOM VIEW
TOP VIEW
FORD A
SIDE VIEW
TOP VIEW
ALL CABANE STRUTS 3/32" M.W. FAIRED WITH EPOXYBOND PUTTY
TRUE HEIGHT REAR CABANE STRUT
LOCATE TANK OPENING TO SUIT
LACE WITH WIRE & EPOXY IN PLACE
FORMER "B" 1/8" PLY.
CUT FOR BATTERY ACCESS
PINE STRUT
STRUT CLIP MADE FROM SMALL SAFETY PIN
ALUM. CLIPS BOLT TO PLY.
INSERT SAFETY PIN INTO STRUT
HOLD WITH SMALL WOOD SCREW
FLYING WIRES GREY THREAD
LANDING GEAR 1/8" WIRE WRAP & SOLDER ALL JOINTS
SCALE HINGE LINE
1/4" SHEET
OUT FOR BEARERS
1/4" x 1/2"
1/4" SQ.
BRACE WIRES
FILL
SH. FILL IN
1/4" x 1/2"
1/8" PLY. INSERT
SKID FROM CLOCK SPRING
1/8" SHEET
"D"
1/8" SHEET
"E"
COMPASS
INSTRUMENT PANEL
WINDSHIELD
TUBING
"C"-1
THROTLE
CONTROL STICK
RUDDER PEDALS
"C"
1/8" PLY.
1/8" PLY.
WHITE BOND PAPER WITH DIAL MARKINGS
CLEAR CELLULOID
WOOD TAPE
"C"-1 LAMINATION DETAIL
R/C modeler
PIETENPOL 'AIR-CAMPER'
SCALED FROM FACTORY PLANS BY FRED ANGEL
INKED BY
BOB HAUSER

FUSELAGE: Like the real ship, the body is made up of square longerons, reinforced with sheet stock up forward. Apply this sheet to the inside of each body frame. We found it easier to build the nose section as an integral part and then to cut at former A after the frame has dried. Cut all bulkheads to shape and cut out for the tank and the battery pack. A four-ounce deBolt clank tank is just right for size, fuel consumption, and permits soldering of the radiator to it. Attach wire cabane struts to bulkheads B and C before gluing to the sides. JOE'S BUILDING TIP #5: Attach wire to bulkhead by lacing with thread or fine wire and putting a dob of Epoxybond Putty at each point. This putty has the consistency of modeling clay and sticks everything to everything. It should be available at your hobby shop. If not, drop me a line. Note that the body has the same width from bulkhead A-1 to C. This makes for easy alignment and a square structure. After the tail is drawn together and glued you may add the rear cross pieces top and bottom, curved turtle deck formers, and the top and side stringers. Make sure to fill in between the aft formers with chunks of scrap balsa to prevent stringer-sag when the covering is applied. Sheet the bottom with cross-grain 1/16. The forward section is sheeted with plywood to support the landing gear. Install the maple engine bearers, bulkhead A, and the sub-floor to prevent fuel leaking down into the battery compartment.

JOE'S BUILDING TIP #6: Pack the nose with styrofoam so that your batteries fit snugly. An ideal source for sheet styrofoam is your local lumber dealer. Ask for the material used in suspended ceiling. They usually come in panels 2 foot by 4 foot. Now you can mount the nose piece, turtle deck and the 1/8 plywood pieces for the landing gear.

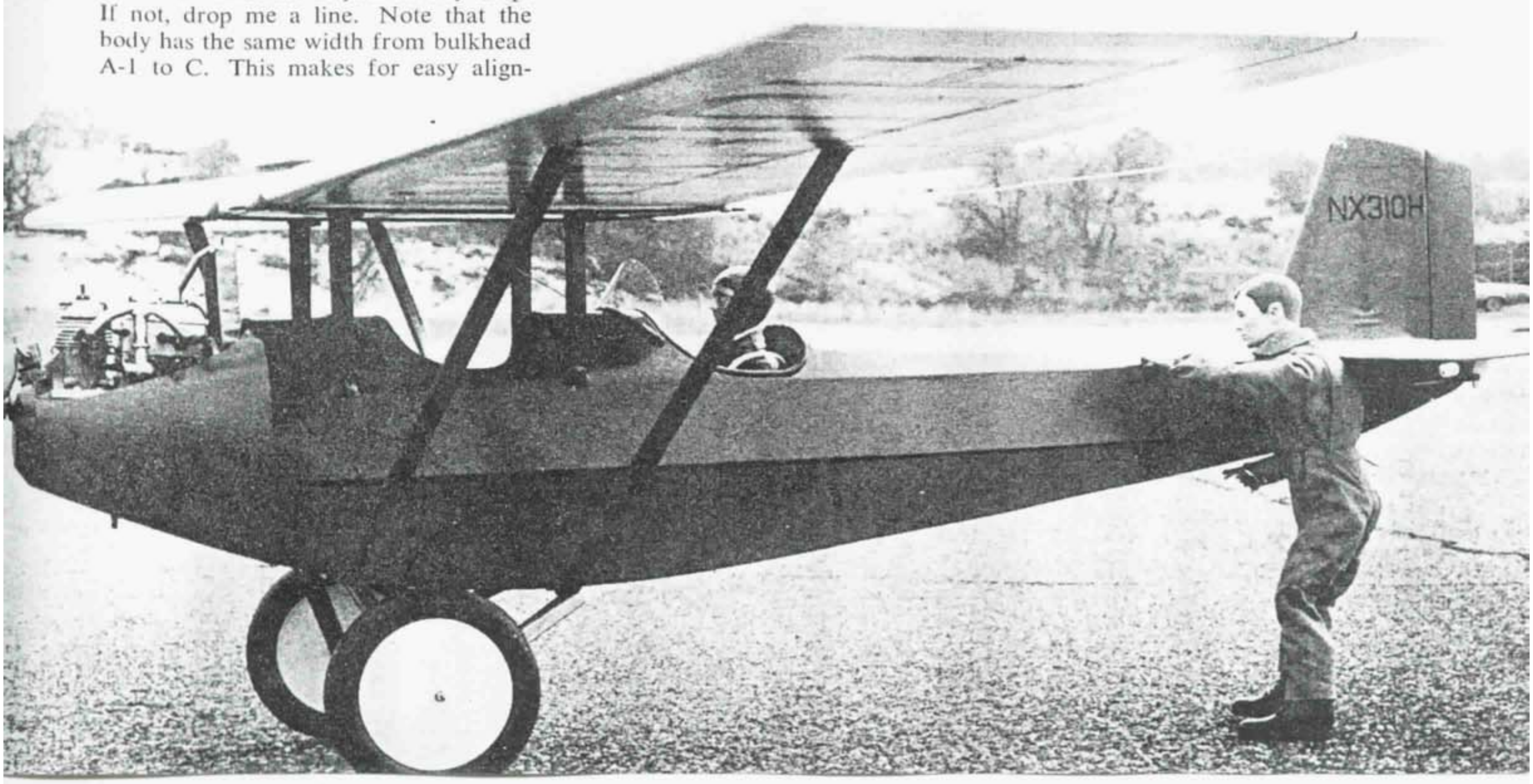
One thing about this model, you don't have to worry about radio installation since everything is accessible from the two big roomy cockpits. We built an "L"-shaped servo tray, placing the motor control servo above the other two brought it in line with the engine linkage. Speaking of engines, a .23 is ideal for Class II operation, while a .19 would be just right for single channel. JOE'S BUILDING TIP #7: Mount the engine on 1/8" aluminum and then screw this plate to the hardwood bearers using sheet metal screws. This permits a fast, safe way of adjusting thrust and makes engine removal a snap.

Well, now, you are all set to cover. We mounted the tail surfaces permanently to the body to avoid the bulky look of rubber bands and dowels on the tail. Everyone has his own pet covering technique. We happen to like "Silron" for a fabric and we find that four coats of clear butyrate fills all the pores to permit spraying two additional coats followed by color. If you are all covered, you're ready for the fun of scale detail.

JOE'S SCALE DETAILS:

1. **Prop.** Made from an 11" — 4 wood prop, trimmed and sanded to shape. Face plate was a round plastic disk with sub-miniature nuts mounted directly through into the wood with small brass nails.
2. **Cowl.** Use heavy bond paper, cut to shape and coat the inside with Epoxy glue or Fiberglass resin then immediately affix to the nose and hold in place with rubber bands until dry. Overlap both edges and when dry, cut for the engine compartment.
3. **Model A Engine.** Make from balsa blocks. Lugs were slices of solder pinned to the blocks. Spark plugs were eyelets held in place with small screws with the ignition wire soldered to the top. Exhaust stacks are wooden dowels burned to a scale appearance with a match. The manifold and carburetor were made from Epoxybond Putty. Attach the dummy engine to the aluminum plate using "wings" glued to the bottom. Paint the crankcase grey and the head silver to match the color of the glow engine.
4. **Radiator.** Use thin brass sheet bent to form a channel. Solder copper insect wire inside to simulate the grill. Solder an extension tube to your tank and solder the radiator to

(Continued on Page 93)

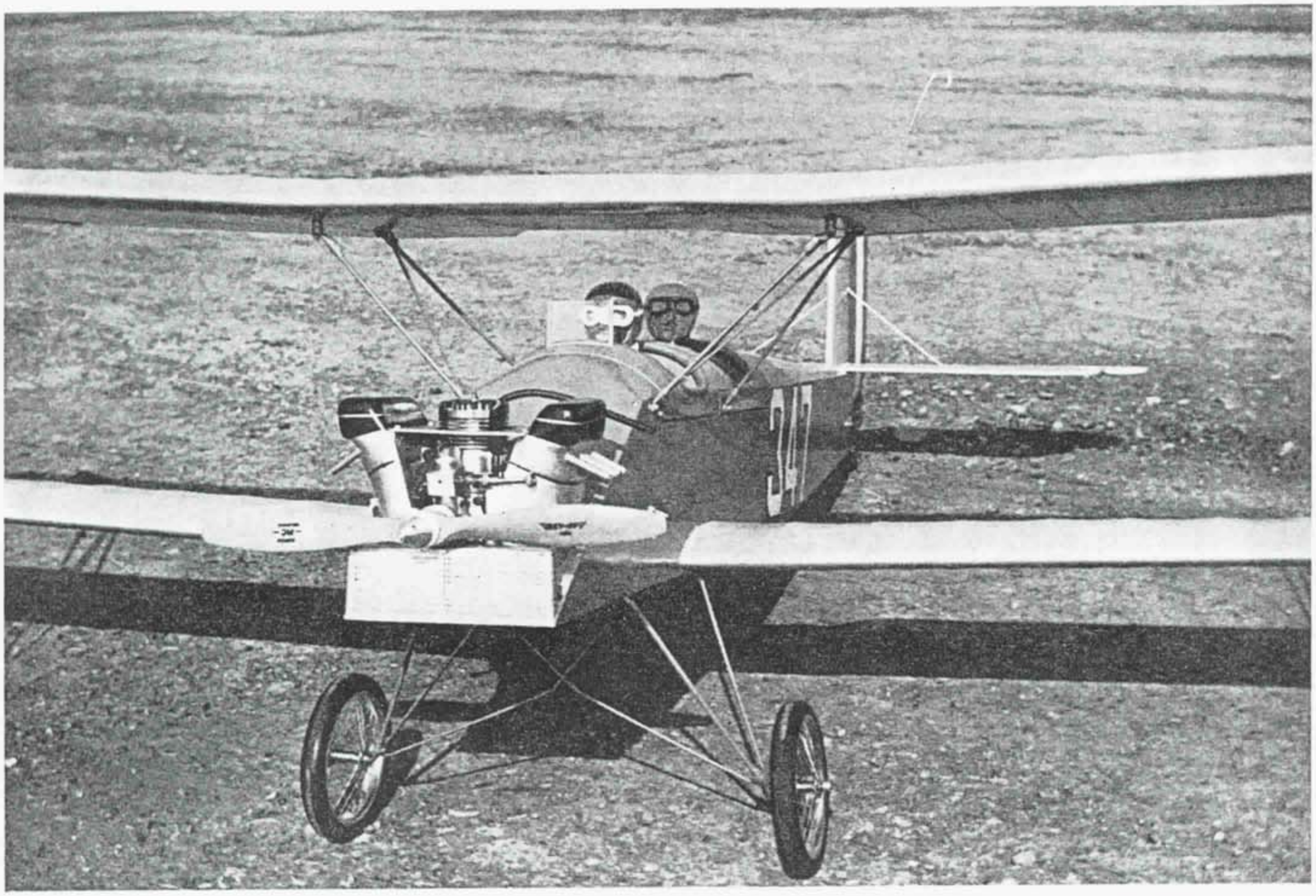


D. F. ETCHINGS'

CONSOLIDATED PT-1

Photos and Text By

GEORGE HARRIS



Engine details of Witty Etchings RC version of the first Air Corps standard primary trainer. Note excellent detail.

IN the San Diego phone book is a listing for D. F. Etchings, better known as Witty to fellow members of the San Diego Drones. When he has nothing else to do he likes to build beautiful R/C scale models — mostly old biplanes — that really fly. I mean they are flown every week like most people fly sport models! They have all kinds of detail such as instruments, pilots, deadly looking machine guns on some, and a host of other goodies. His latest is the Consolidated PT-1, first of the trainers for the Army Air Corps to have the PT trainer designation. The model is one-sixth full size, but it loops, rolls, snap rolls and does all kinds of weird things in addition to flying very well. However, Witty would rather build and fly than draw and write, so I was enlisted to brag about his new toy.

First a little history of the full size bird. When Consolidated Aircraft Co. was founded in 1923, the company owned the design rights to the Dayton Wright TW-3, which was a primary trainer with side by side seating. Consolidated built approximately 20 of these for the Army Air Corps but the visibility for the pilot and instructor was poor. Modifications were made to improve the plane, including tandem seating, which allowed both occupants to see from both sides of the cockpit. The first 50 had water cooled Wright built engines, while subsequent aircraft (about 220) were fitted with Wright radial engines. This aircraft was designated the PT-1 and, in 1927, was the standard primary trainer for the Air Corps. Wing span was 34 ft. 7½ ins., length 27 ft. 8½ ins., with a top speed of 100 mph and a cruising speed of 85 mph.

The markings shown on the drawings are of the first numbered primary trainer, a photograph of which can be found in the Air Museum Historical Aircraft Series titled "Training Aircraft of the U. S. Air Force 1925-1965." Good drawings of the PT-1 seem to be as scarce as knee socks for a rattlesnake, so details were obtained from Nieto drawings of the PT-3 which was developed directly from The PT-1. The main differences are in the vertical tail surfaces, elevators, nose and engine.

All surfaces in the model are scale except the ailerons, which have been enlarged because the model is just too sluggish with the very small scale-size ailerons. The model is detailed enough to collect good scale points, but has been compromised a little in the hair splitting features to make it more attractive to a larger number of builders. No photo could be found of the actual PT-1 instrument panel, but a PT-3 panel and details of the rigging wires can be found in drawings of the PT-3 in Air Progress for October/November 1963, for those who want to go all out. The fuselage is big enough to hold any gear and most of the big engines will fly the bird. All of the pieces are held together by screws, but if you don't care what it looks like, the attachments can easily be modified to use rubber bands. At the time of writing the model had completed more than 75 flights in a variety of wind conditions without anything coming adrift. Anyhow, if you dork a big biplane like this, rubber bands aren't going to help very much!

Now to the building. If you don't like wings go ahead and build the fuselage first. If you really don't like wings, turn the page, this machine has lots of them! The full length plywood sides of the fuselage make a very rugged structure and are quite light. Glue all the longerons, braces and doublers to the sides first, then insert the formers and join the sides. A couple of the bottom fill pieces of sheet installed at this time will hold the thing square. The tail end is then pulled together and the top decking installed. It is advisable to get the engine mounting and all control layouts setttled before buttoning up the structure. Wherever parts are secured to hardwood pieces you can use wood-screws if the stresses are low, or sheet metal screws, or machine screws and blind nuts. Sheet metal screws hold very firmly in maple and can be used for the parts which will not be dismantled very often.

The landing gear and cabane struts are just a matter of careful bending and assembly. Accurate sizing of the struts will simplify rigging later. Wire wheels by Boling add a nice touch. Actually the tires are thinner than scale, but how fussy do you want to be? For best handling a tailwheel coupled to the rudder is advisable, although the near scale skid shown is O.K. on a hard surface.

The removable top hatch can be assembled on the flat floor or built up in place on the fuselage, small key blocks keeping it lined up. The hatch can be held by screws as shown, or by your favorite hatch latch. Windshields are simply flat plastic held between side posts.

A very realistic engine can be built up from blocks without going into vast detail. Exact shaping and clearances will depend on the noise box concealed in the middle. The tie plate between the two sides stabilizes the blocks against vibration. Leave good clearance for cooling around the engine.

The tail surfaces are very simple and rugged and can be built up on one side on a flat board, then turned over and repeated. Small ply scabs may be glued over the screw holes in the tailplane center section to prevent the heads from pulling through. Details like this and such things as gussets at various places have not been shown on the drawings, since this kind of thing is instinctive to the more experienced builders, who will be tackling this project. It becomes a case of pointing up the background so much that the foreground goes underground. Most elaborate scale jobs are largely a matter of cut, fit and improvise, anyway. The struts, from the fin to the tailplane, carry the loads of that big barndoor rudder flapping around, which would soon break off an unsupported fin.

The good old flat bottomed airfoil makes the wings easy to build and the hardwood spars provide all the necessary strength. Note that the leading edges are bigger than the notches in the ribs and the cap strips butt up against them. Use good hard sheet for the trailing edges. All of the basic wing structure is very conventional. The pre-drilled maple blocks are epoxied to the ribs and spars at the proper locations and can be reinforced by gussets if you want to play safe. Small sheet corner pieces over the lug positions will hold the covering around the holes.

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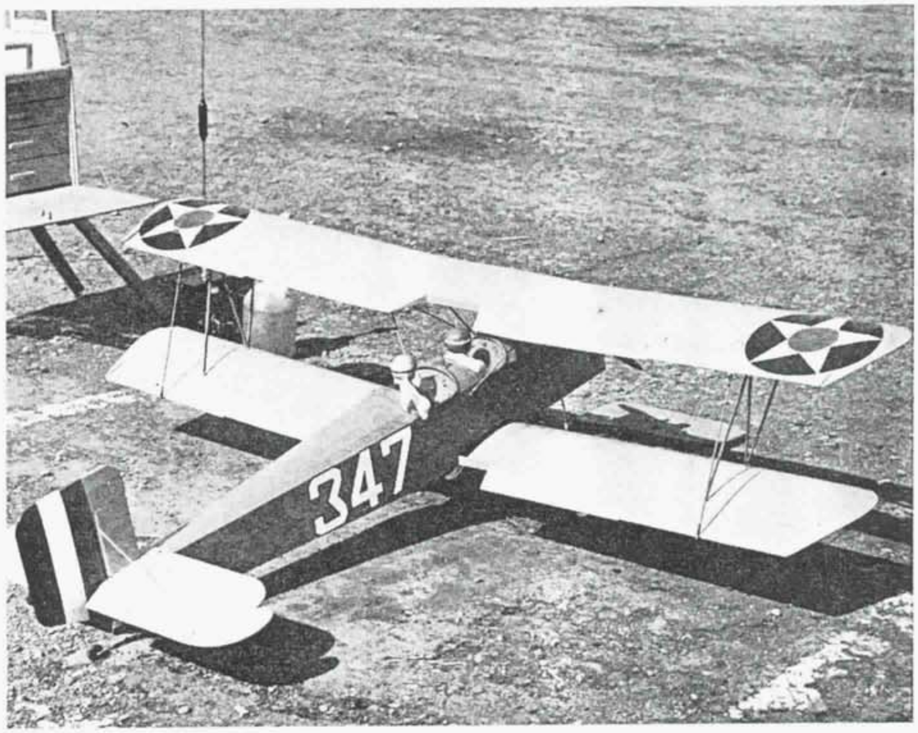
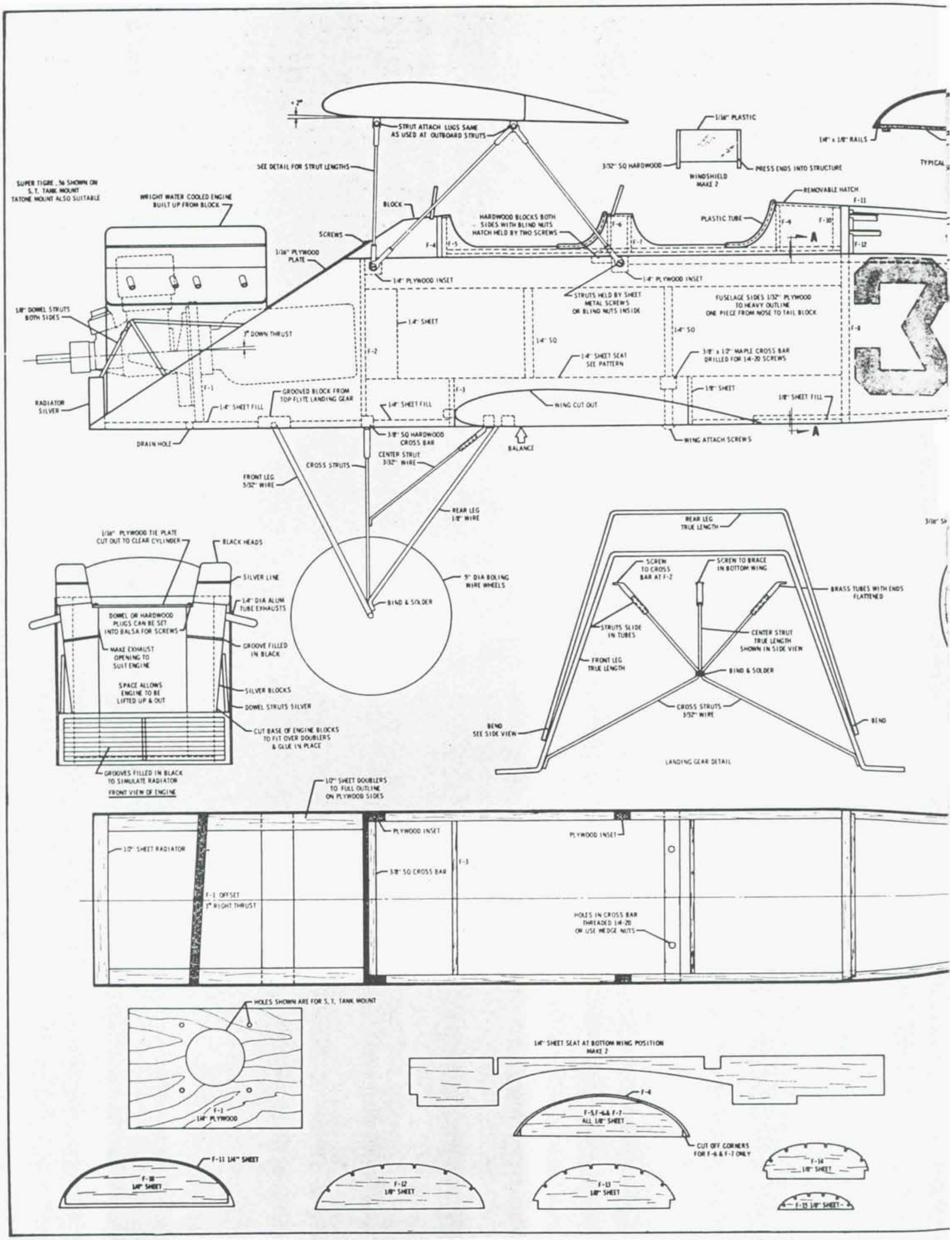
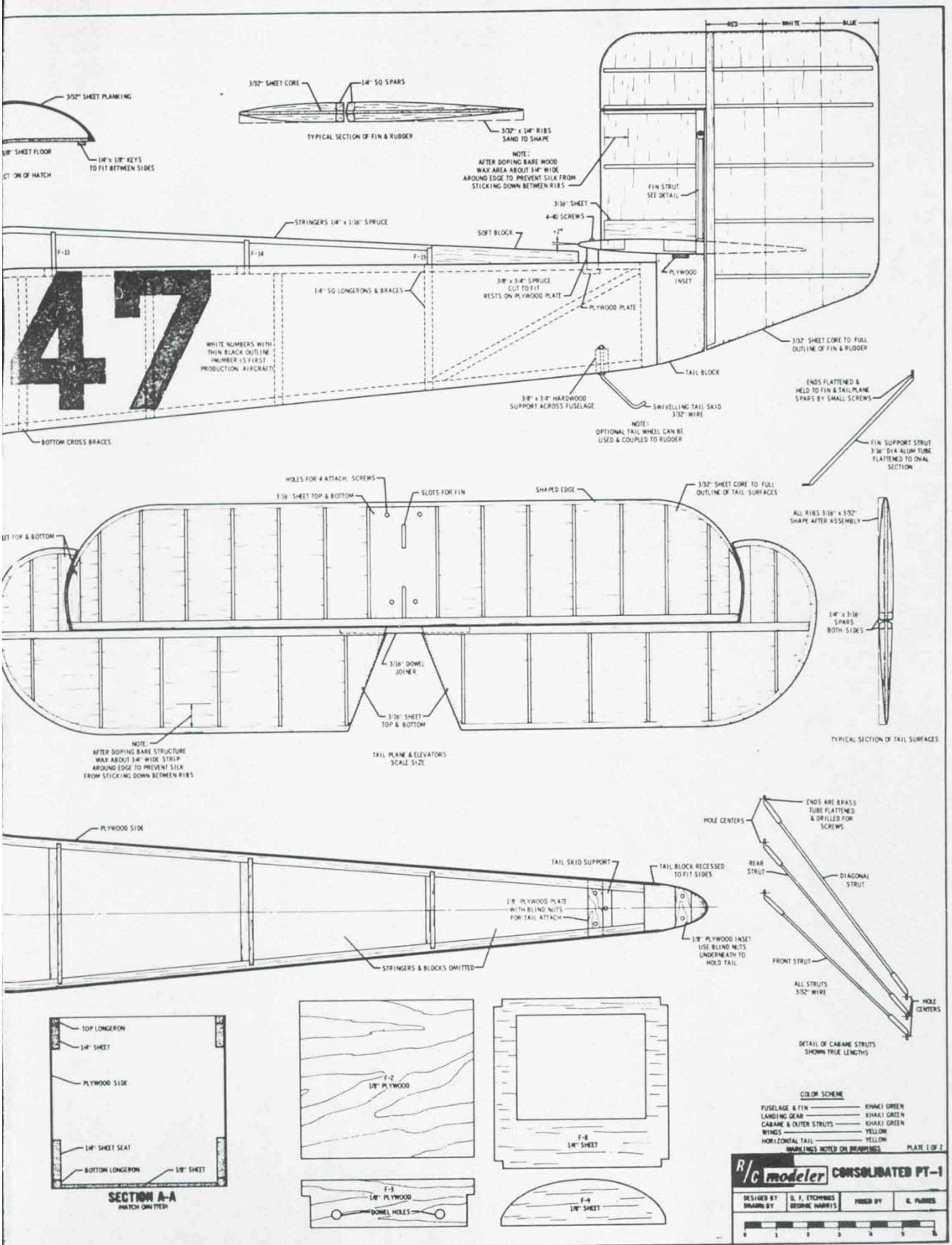


LIST OF MATERIALS

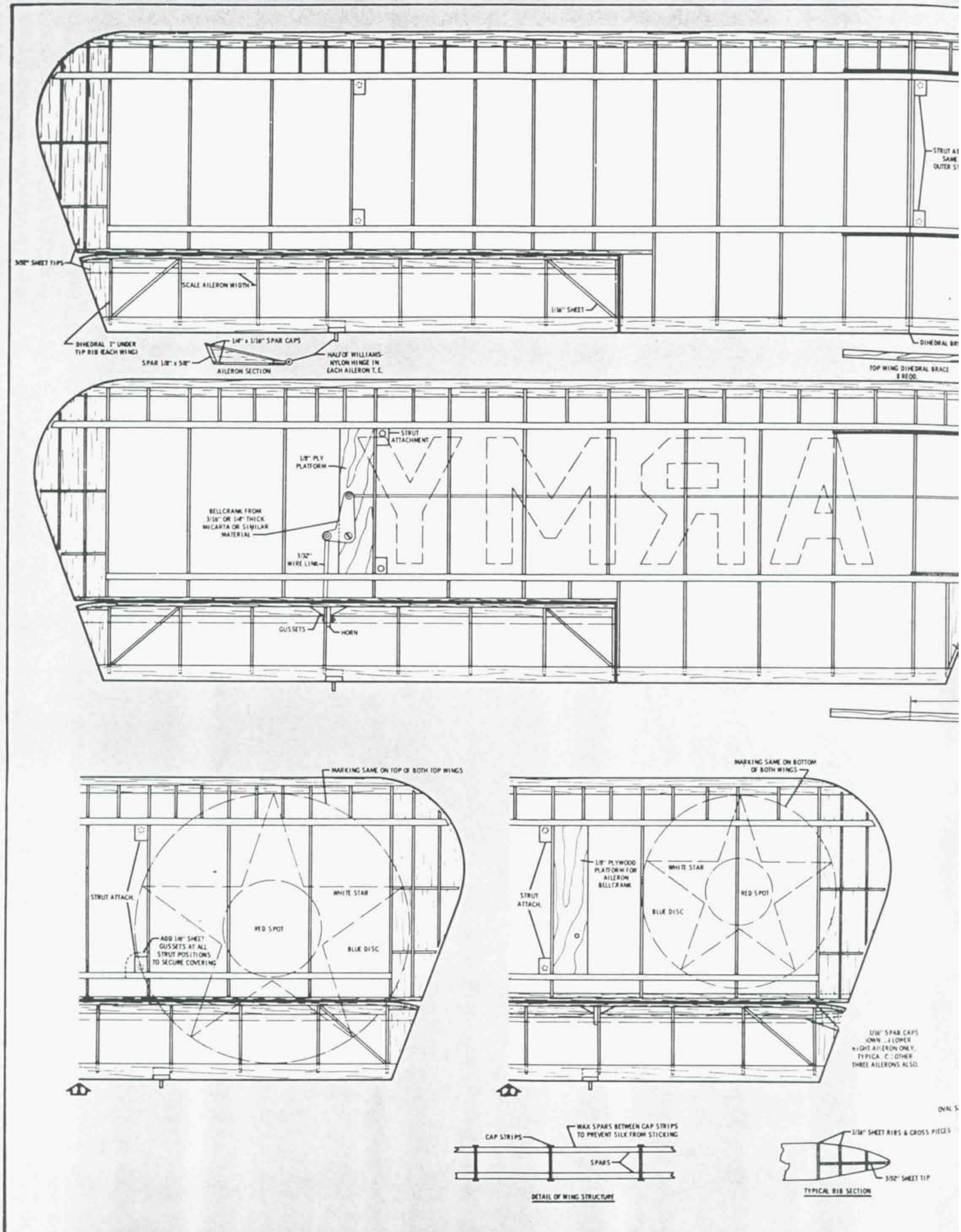
SHEET BALSA	
1 — 1/16 x 4 x 36 HARD	Trailing edges.
7 — 1/16 x 4 x 36	Ribs, sheeting, caps.
4 — 3/32 x 4 x 36	Tail surfaces, ribs, tips.
3 — 1/8 x 4 x 36	Formers, spars, hatch, fill sheeting.
1 — 3/16 x 4 x 36	Spar reinforcing, tail parts.
2 — 1/4 x 4 x 36	Doublers, formers.
1 — 1/2 x 4 x 36	Doublers.
STRIP BALSA	
3 — 1/4 x 3/16 x 36	Tail spars.
10 — 1/4 x 1/4 x36	Fuselage framing, tail spars.
5 — 3/8 x 3/8 x 36	Leading edges.
BLOCK BALSA	
2 x 2 x 4	Tail block.
3/4 x 3 x 5	Top rear deck.
1 1/2 x 3 x 36	Top nose, engine.
PLYWOOD	
1/32 x 12 x 48	Fuselage sides.
1/16 x 6 x 6	Nose plate, reinforcing.
1/8 x 12 x 24	Dihedral braces, former, plates.
1/4 x 6 x 12	Former, inserts.
HARDWOOD	
3 — 1/16 x 1/4 x 36 Spruce	Top stringers.
20 — 3/16 x 3/16 x 36 Spruce	Wing spars.
2 — 3/8 x 3/8 x 12 Maple	Landing gear mounts.
2 — 3/8 x 1/2 x 12 Maple	Strut & wing attachments.
3/8 x 3/4 x 2 Maple	Tail skid mount.
4" of 3/16 dowel for elevator joiner.	
4" of 1/4 dowel for wing pins.	
HARDWARE	
1 — 3/16 Dia. x 12 Alum. tube	Tail brace.
6 — 1/4 Dia. x 12 Alum. tube	Wing struts, exhausts.
2 — 1/16 I.D. x 12 Brass tube	Aileron couplers.
1 — 3/32 I.D. x 12 Brass tube	Strut & landing gear ends.
1 — 7/32 I.D. x 12 Brass tube	Strut lugs.
1 — 7/32 O.D. x 12 Brass tube	Strut lugs. (Optional)
1 — 5/32 x 36 Piano wire	Landing gear.
1 — 1/8 x 36 Piano wire	Landing gear.
2 — 3/32 x 36 Piano wire	Landing gear, cabane struts.
1 — 1/16 x 36 Piano wire	Tip skids.

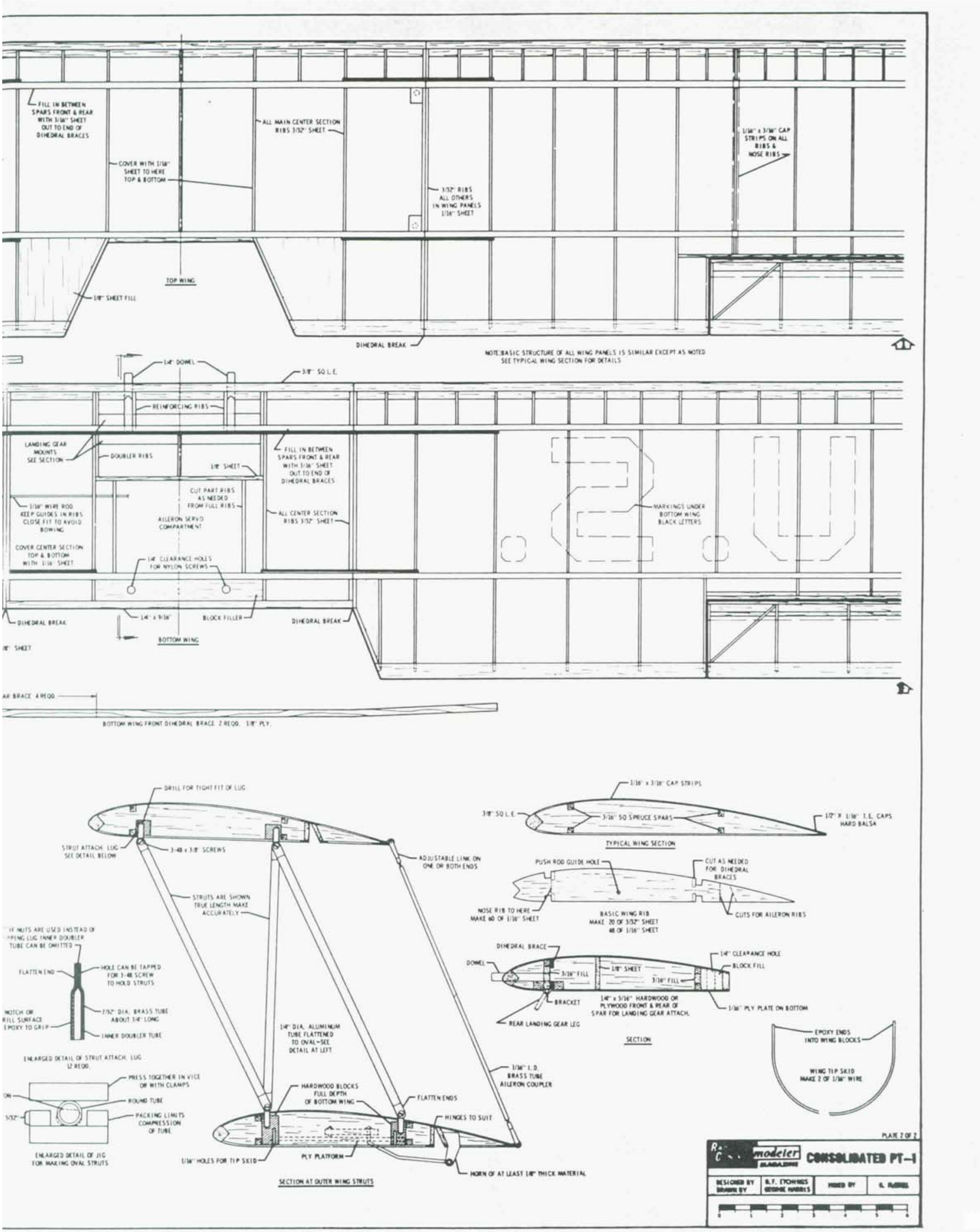
Control linkage and small hardware as noted on drawings or to suit.


+2°
STRUT ATTACH LUGS SAME AS USED AT OUTBOARD STRUTS
SEE DETAIL FOR STRUT LENGTHS
1/16" PLASTIC
3/32" SQ HARDWOOD
PRESS ENDS INTO STRUCTURE
WINDSHIELD MAKE 2
1/4" x 1/8" RAILS
TYPICAL
SUPER TIGRE .56 SHOWN ON S.T. TANK MOUNT TATONE MOUNT ALSO SUITABLE
WRIGHT WATER COOLED ENGINE BUILT UP FROM BLOCK
BLOCK
SCREWS
1/16" PLYWOOD PLATE
HARDWOOD BLOCKS BOTH SIDES WITH BLIND NUTS HATCH HELD BY TWO SCREWS
REMOVABLE HATCH
PLASTIC TUBE
1/4" PLYWOOD INSET
1/4" PLYWOOD INSET
1/8" DOWEL STRUTS BOTH SIDES
STRUTS HELD BY SHEET METAL SCREWS OR BLIND NUTS INSIDE
FUSELAGE SIDES 1/32" PLYWOOD TO HEAVY OUTLINE ONE PIECE FROM NOSE TO TAIL BLOCK
1/4" SHEET
1/4" SQ
1/4" SQ
3° DOWN THRUST
1/4" SHEET SEAT SEE PATTERN
3/8" x 1/2" MAPLE CROSS BAR DRILLED FOR 1/4-20 SCREWS
RADIATOR SILVER
GROOVED BLOCK FROM TOP FLITE LANDING GEAR
1/4" SHEET FILL
1/4" SHEET FILL
1/8" SHEET
1/8" SHEET FILL
WING CUT OUT
DRAIN HOLE
3/8" SQ HARDWOOD CROSS BAR
BALANCE
WING ATTACH SCREWS
A
CENTER STRUT 3/32" WIRE
CROSS STRUTS
FRONT LEG 5/32" WIRE
REAR LEG 1/8" WIRE
9" DIA BOLING WIRE WHEELS
BIND & SOLDER
1/16" PLYWOOD TIE PLATE CUT OUT TO CLEAR CYLINDER
BLACK HEADS
SILVER LINE
1/4" DIA ALUM TUBE EXHAUSTS
DOWEL OR HARDWOOD PLUGS CAN BE SET INTO BALSA FOR SCREWS
MAKE EXHAUST OPENING TO SUIT ENGINE
GROOVE FILLED IN BLACK
SPACE ALLOWS ENGINE TO BE LIFTED UP & OUT
SILVER BLOCKS
DOWEL STRUTS SILVER
CUT BASE OF ENGINE BLOCKS TO FIT OVER DOUBLERS & GLUE IN PLACE
GROOVES FILLED IN BLACK TO SIMULATE RADIATOR
FRONT VIEW OF ENGINE
REAR LEG TRUE LENGTH
SCREW TO CROSS BAR AT F-2
SCREW TO BRACE IN BOTTOM WING
BRASS TUBES WITH ENDS FLATTENED
STRUTS SLIDE IN TUBES
CENTER STRUT TRUE LENGTH SHOWN IN SIDE VIEW
FRONT LEG TRUE LENGTH
BIND & SOLDER
CROSS STRUTS 3/32" WIRE
BEND SEE SIDE VIEW
BEND
LANDING GEAR DETAIL
1/2" SHEET DOUBLERS TO FULL OUTLINE ON PLYWOOD SIDES
PLYWOOD INSET
PLYWOOD INSET
1/2" SHEET RADIATOR
3/8" SQ CROSS BAR
F-1 OFFSET 3° RIGHT THRUST
HOLES IN CROSS BAR THREADED 1/4-20 OR USE WEDGE NUTS
HOLES SHOWN ARE FOR S.T. TANK MOUNT
F-1 1/4" PLYWOOD
1/4" SHEET SEAT AT BOTTOM WING POSITION MAKE 2
F-4
F-5, F-6 & F-7 ALL 1/8" SHEET
CUT OFF CORNERS FOR F-6 & F-7 ONLY
F-11 1/4" SHEET
F-10 1/4" SHEET
F-12 1/8" SHEET
F-13 1/8" SHEET
F-14 1/8" SHEET
F-15 1/8" SHEET
F-2
F-3
F-8
F-9
F-11
F-12
3/16" SH



RED
WHITE
BLUE
3/32" SHEET PLANKING
1/8" SHEET FLOOR
1/4" x 1/8" KEYS TO FIT BETWEEN SIDES
3/32" SHEET CORE
1/4" SQ SPARS
3/32" x 1/4" RIBS SAND TO SHAPE
TYPICAL SECTION OF FIN & RUDDER
NOTE: AFTER DOPING BARE WOOD WAX AREA ABOUT 3/4" WIDE AROUND EDGE TO PREVENT SILK FROM STICKING DOWN BETWEEN RIBS
FIN STRUT SEE DETAIL
3/16" SHEET
4-40 SCREWS
STRINGERS 1/4" x 1/16" SPRUCE
SOFT BLOCK
F-13
F-14
F-15
PLYWOOD INSET
1/4" SQ LONGERONS & BRACES
3/8" x 3/4" SPRUCE CUT TO FIT RESTS ON PLYWOOD PLATE
PLYWOOD PLATE
3/32" SHEET CORE TO FULL OUTLINE OF FIN & RUDDER
47
WHITE NUMBERS WITH THIN BLACK OUTLINE (NUMBER IS FIRST PRODUCTION AIRCRAFT)
TAIL BLOCK
ENDS FLATTENED & HELD TO FIN & TAILPLANE SPARS BY SMALL SCREWS
3/8" x 3/4" HARDWOOD SUPPORT ACROSS FUSELAGE
SWIVELLING TAIL SKID 3/32" WIRE
NOTE: OPTIONAL TAIL WHEEL CAN BE USED & COUPLED TO RUDDER
BOTTOM CROSS BRACES
FIN SUPPORT STRUT 3/16" DIA ALUM TUBE FLATTENED TO OVAL SECTION
HOLES FOR 4 ATTACH. SCREWS
3/16" SHEET TOP & BOTTOM
SLOTS FOR FIN
SHAPED EDGE
3/32" SHEET CORE TO FULL OUTLINE OF TAIL SURFACES
SHEET TOP & BOTTOM
ALL RIBS 3/16" x 3/32" SHAPE AFTER ASSEMBLY
1/4" x 3/16" SPARS BOTH SIDES
3/16" DOWEL JOINER
3/16" SHEET TOP & BOTTOM
NOTE: AFTER DOPING BARE STRUCTURE WAX ABOUT 3/4" WIDE STRIP AROUND EDGE TO PREVENT SILK FROM STICKING DOWN BETWEEN RIBS
TAIL PLANE & ELEVATORS SCALE SIZE
TYPICAL SECTION OF TAIL SURFACES
PLYWOOD SIDE
ENDS ARE BRASS TUBE FLATTENED & DRILLED FOR SCREWS
HOLE CENTERS
TAIL SKID SUPPORT
TAIL BLOCK RECESSED TO FIT SIDES
REAR STRUT
DIAGONAL STRUT
1/8" PLYWOOD PLATE WITH BLIND NUTS FOR TAIL ATTACH
1/8" PLYWOOD INSET USE BLIND NUTS UNDERNEATH TO HOLD TAIL
FRONT STRUT
STRINGERS & BLOCKS OMITTED
ALL STRUTS 3/32" WIRE
HOLE CENTERS
DETAIL OF CABANE STRUTS SHOWN TRUE LENGTHS
TOP LONGERON
1/4" SHEET
PLYWOOD SIDE
1/4" SHEET SEAT
BOTTOM LONGERON
1/8" SHEET
SECTION A-A
(HATCH OMITTED)
F-2 1/8" PLYWOOD
F-8 1/4" SHEET
F-3 1/8" PLYWOOD
DOWEL HOLES
F-4 1/8" SHEET
COLOR SCHEME
FUSELAGE & FIN — KHAKI GREEN
LANDING GEAR — KHAKI GREEN
CABANE & OUTER STRUTS — KHAKI GREEN
WINGS — YELLOW
HORIZONTAL TAIL — YELLOW
MARKINGS NOTED ON DRAWINGS
PLATE 1 OF 2
R/C modeler
CONSOLIDATED PT-1
DESIGNED BY D. F. ETCHINGS
DRAWN BY GEORGE HARRIS
0
1
2
3
4
5
6


3/32" SHEET TIPS
SCALE AILERON WIDTH
1/16" SHEET
DIHEDRAL 1" UNDER TIP RIB (EACH WING)
1/4" x 1/16" SPAR CAPS
SPAR 1/8" x 5/8"
AILERON SECTION
HALF OF WILLIAMS NYLON HINGE IN EACH AILERON T. E.
TOP WING DIHEDRAL BRACE 8 REQD.
STRUT ATTACHMENT
1/8" PLY PLATFORM
BELLCRANK FROM 3/16" OR 1/4" THICK MICARTA OR SIMILAR MATERIAL
3/32" WIRE LINK
GUSSETS
HORN
MARKING SAME ON TOP OF BOTH TOP WINGS
STRUT ATTACH.
WHITE STAR
RED SPOT
BLUE DISC
ADD 1/8" SHEET GUSSETS AT ALL STRUT POSITIONS TO SECURE COVERING
MARKING SAME ON BOTTOM OF BOTH WINGS
1/8" PLYWOOD PLATFORM FOR AILERON BELLCRANK
THREE AILERONS ALSO.
CAP STRIPS
WAX SPARS BETWEEN CAP STRIPS TO PREVENT SILK FROM STICKING
SPARS
DETAIL OF WING STRUCTURE
1/16" SHEET RIBS & CROSS PIECES
3/32" SHEET TIP
TYPICAL RIB SECTION


FILL IN BETWEEN SPARS FRONT & REAR WITH 3/16" SHEET OUT TO END OF DIHEDRAL BRACES
ALL MAIN CENTER SECTION RIBS 3/32" SHEET
1/16" x 3/16" CAP STRIPS ON ALL RIBS & NOSE RIBS
COVER WITH 1/16" SHEET TO HERE TOP & BOTTOM
3/32" RIBS ALL OTHERS IN WING PANELS 1/16" SHEET
TOP WING
1/8" SHEET FILL
DIHEDRAL BREAK
NOTE: BASIC STRUCTURE OF ALL WING PANELS IS SIMILAR EXCEPT AS NOTED SEE TYPICAL WING SECTION FOR DETAILS
1/4" DOWEL
3/8" SQ L.E.
REINFORCING RIBS
LANDING GEAR MOUNTS SEE SECTION
DOUBLER RIBS
1/8" SHEET
FILL IN BETWEEN SPARS FRONT & REAR WITH 3/16" SHEET OUT TO END OF DIHEDRAL BRACES
CUT PART RIBS AS NEEDED FROM FULL RIBS
1/16" WIRE ROD KEEP GUIDES IN RIBS CLOSE FIT TO AVOID BOWING
AILERON SERVO COMPARTMENT
ALL CENTER SECTION RIBS 3/32" SHEET
MARKINGS UNDER BOTTOM WING BLACK LETTERS
COVER CENTER SECTION TOP & BOTTOM WITH 1/16" SHEET
1/4" CLEARANCE HOLES FOR NYLON SCREWS
DIHEDRAL BREAK
1/4" x 9/16"
BLOCK FILLER
DIHEDRAL BREAK
BOTTOM WING
SHEET
AR BRACE 4 REQD.
BOTTOM WING FRONT DIHEDRAL BRACE 2 REQD. 1/8" PLY.
DRILL FOR TIGHT FIT OF LUG
STRUT ATTACH. LUG SEE DETAIL BELOW
3-48 x 3/8" SCREWS
ADJUSTABLE LINK ON ONE OR BOTH ENDS
STRUTS ARE SHOWN TRUE LENGTH MAKE ACCURATELY
IF NUTS ARE USED INSTEAD OF TAPPING LUG INNER DOUBLER TUBE CAN BE OMITTED
FLATTEN END
HOLE CAN BE TAPPED FOR 3-48 SCREW TO HOLD STRUTS
NOTCH OR DRILL SURFACE EPOXY TO GRIP
7/32" DIA. BRASS TUBE ABOUT 3/4" LONG
INNER DOUBLER TUBE
1/4" DIA. ALUMINUM TUBE FLATTENED TO OVAL—SEE DETAIL AT LEFT
ENLARGED DETAIL OF STRUT ATTACH. LUG 12 REQD.
PRESS TOGETHER IN VICE OR WITH CLAMPS
ROUND TUBE
PACKING LIMITS COMPRESSION OF TUBE
5/32"
ENLARGED DETAIL OF JIG FOR MAKING OVAL STRUTS
HARDWOOD BLOCKS FULL DEPTH OF BOTTOM WING
FLATTEN ENDS
3/16" I.D. BRASS TUBE AILERON COUPLER
HINGES TO SUIT
1/16" HOLES FOR TIP SKID
PLY PLATFORM
HORN OF AT LEAST 1/8" THICK MATERIAL
SECTION AT OUTER WING STRUTS
1/16" x 3/16" CAP STRIPS
3/8" SQ L.E.
3/16" SQ SPRUCE SPARS
1/2" X 1/16" T.E. CAPS HARD BALSA
TYPICAL WING SECTION
PUSH ROD GUIDE HOLE
CUT AS NEEDED FOR DIHEDRAL BRACES
NOSE RIB TO HERE MAKE 60 OF 1/16" SHEET
BASIC WING RIB MAKE 20 OF 3/32" SHEET 48 OF 1/16" SHEET
CUTS FOR AILERON RIBS
DIHEDRAL BRACE
DOWEL
3/16" FILL
1/8" SHEET
3/16" FILL
1/4" CLEARANCE HOLE
BLOCK FILL
BRACKET
1/4" x 5/16" HARDWOOD OR PLYWOOD FRONT & REAR OF SPAR FOR LANDING GEAR ATTACH.
1/16" PLY PLATE ON BOTTOM
REAR LANDING GEAR LEG
SECTION
EPOXY ENDS INTO WING BLOCKS
WING TIP SKID MAKE 2 OF 1/16" WIRE
PLATE 2 OF 2
R/C modeler MAGAZINE
CONSOLIDATED PT-1
DESIGNED BY DRAWN BY
B.F. ETCHINGS GEORGE HARRIS
0 1 2 3 4 5 6

CLAUDE MC

MARTIN “MAU

One of America's top R/C
R/C version of the Navy's

CULLOUGH'S

AM-1

LER"

scale competitors presents his "ABLE MABEL" of WWII.

NAVY torpedo bombers are nearly always excellent scale model subjects. Necessarily big airplanes in order to lift the load, this gives a reasonable amount of wing area for any selected span without having a barrel-like fuselage to drag along, as is usually the case with a fighter type. Then, too, the handling requirements of landing on a pitching carrier deck dictates the use of large tail surfaces and thick wing sections for good low speed characteristics — all tailor made items for R/C scale work.

"Able Mabel," as the Martin AM-1 was dubbed by carrier crews, has the best of the usual torp bomber features and is attractive and colorful as well. Designed around the 4-row 3,000 h.p. Pratt and Whitney R-4360 Wasp Major in the closing days of World War II, the first production model was flown in November 1946. Built for the same sort of mission as the Douglas AD, postwar cuts in Navy budget money forced a choice between the two and the Skyraider won the toss. More than 3,000 "Super-Spads" were subsequently built and they went on to become the ageless stars of the Korean War and the Viet Nam action. The relatively few Maulers built (149) before cancellation were soon retired to reserve status and were familiar sights at various NAS's for years. But as a model the Mauler has it all over the Skyraider, with smaller frontal area and considerably more wing area when built to the same scale.

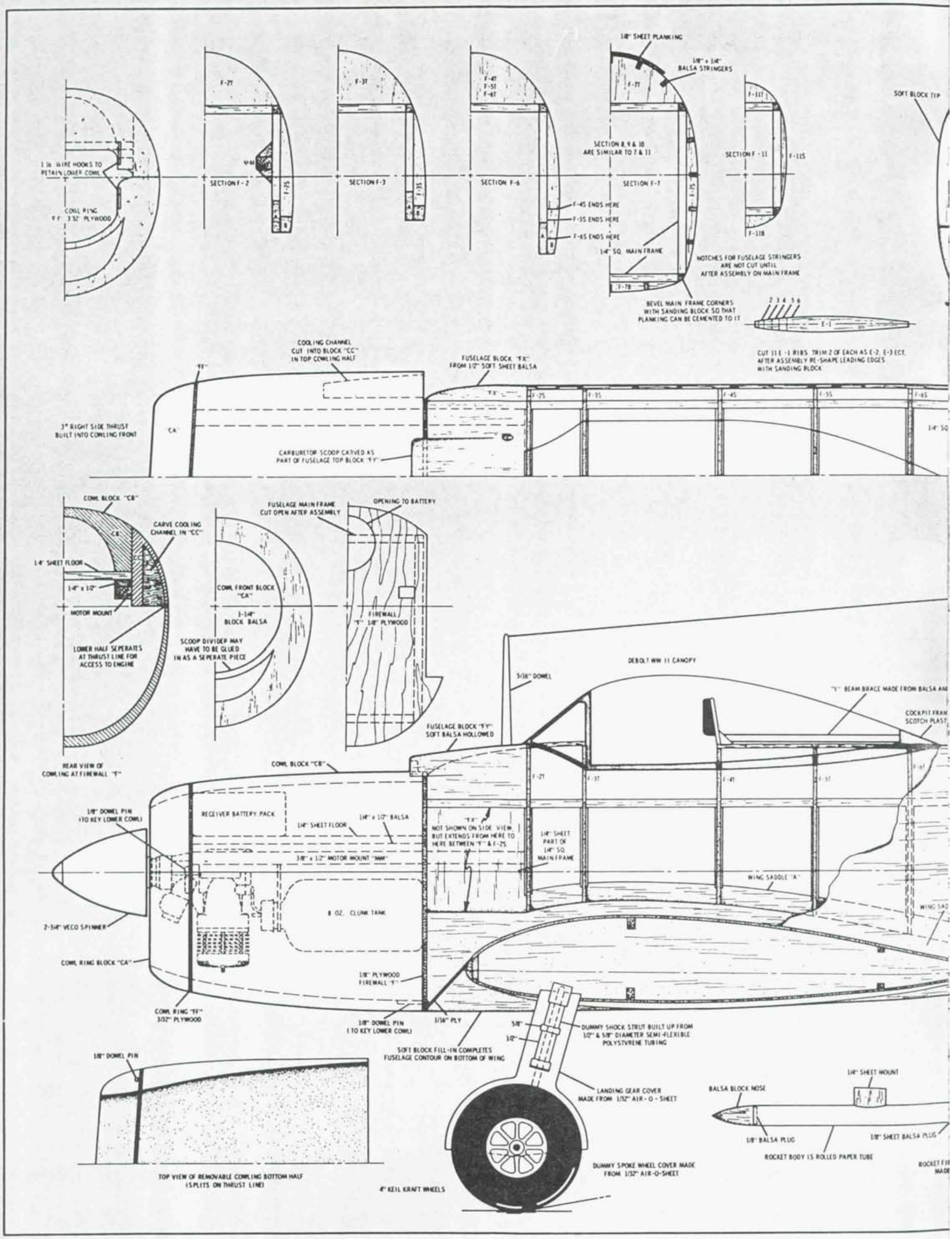
My version of Mabel was built in 1959 and has been periodically flown since at contests, R/C picnics, demonstrations and for fun. Though a real veteran model, practically an "Old-Timer" in the fairly young event, it can still hold its own in competition. Most recent win was at the 1966 McDonnell R/C Club's Annual Meet Scale Event in St. Louis, August 27-28. Like the prototype (which lifted off nearly 11,000 lbs.), the model will lug all kinds of garbage under the wings in the form of rockets, bombs, torpedoes, tanks, etc. — all good for appearance and scale operations point. There's 950 squares of good thick area there and my AM-1 has been loaded down to over 12 pounds and taken off, flown and landed easily. It can get off most any kind of runway, rough or smooth, and stability and control response are very good. Until 1966 it was flown with reeds, then Bonner propo was installed.

The first thing any good scale builder should do when beginning a model is to do a little research work and round up an assortment of photos. No plan can show the various little details and shapes as well as pictures and you just can't give your project that touch of reality without plenty for reference. They will also be handy in preparing your scale presentation for the judges and worth points in this category.

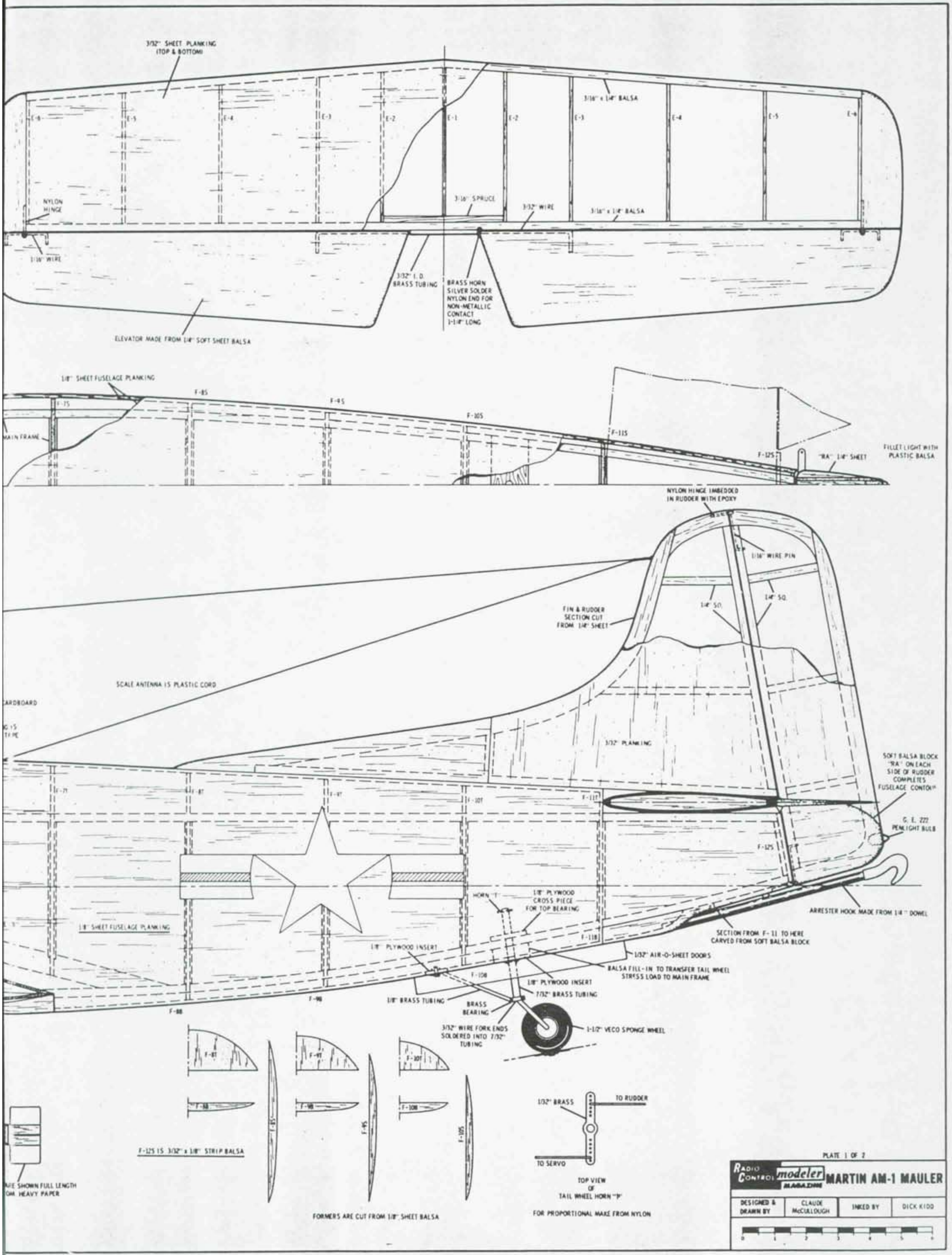
Here are some good sources on the Mauler:

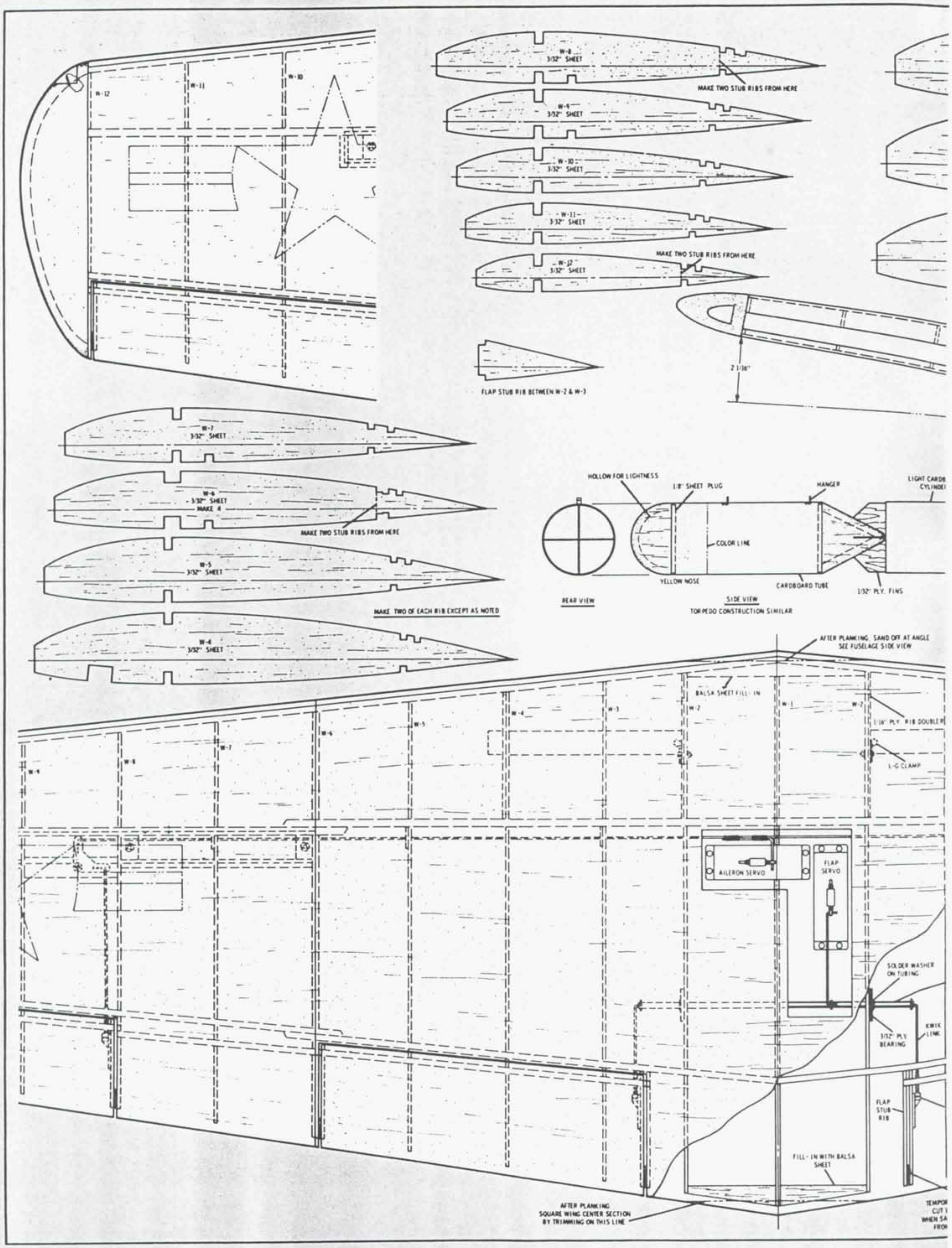
1.) Air Trails, August 1949. Double page spread of photos, showing all kinds of underwing stores.

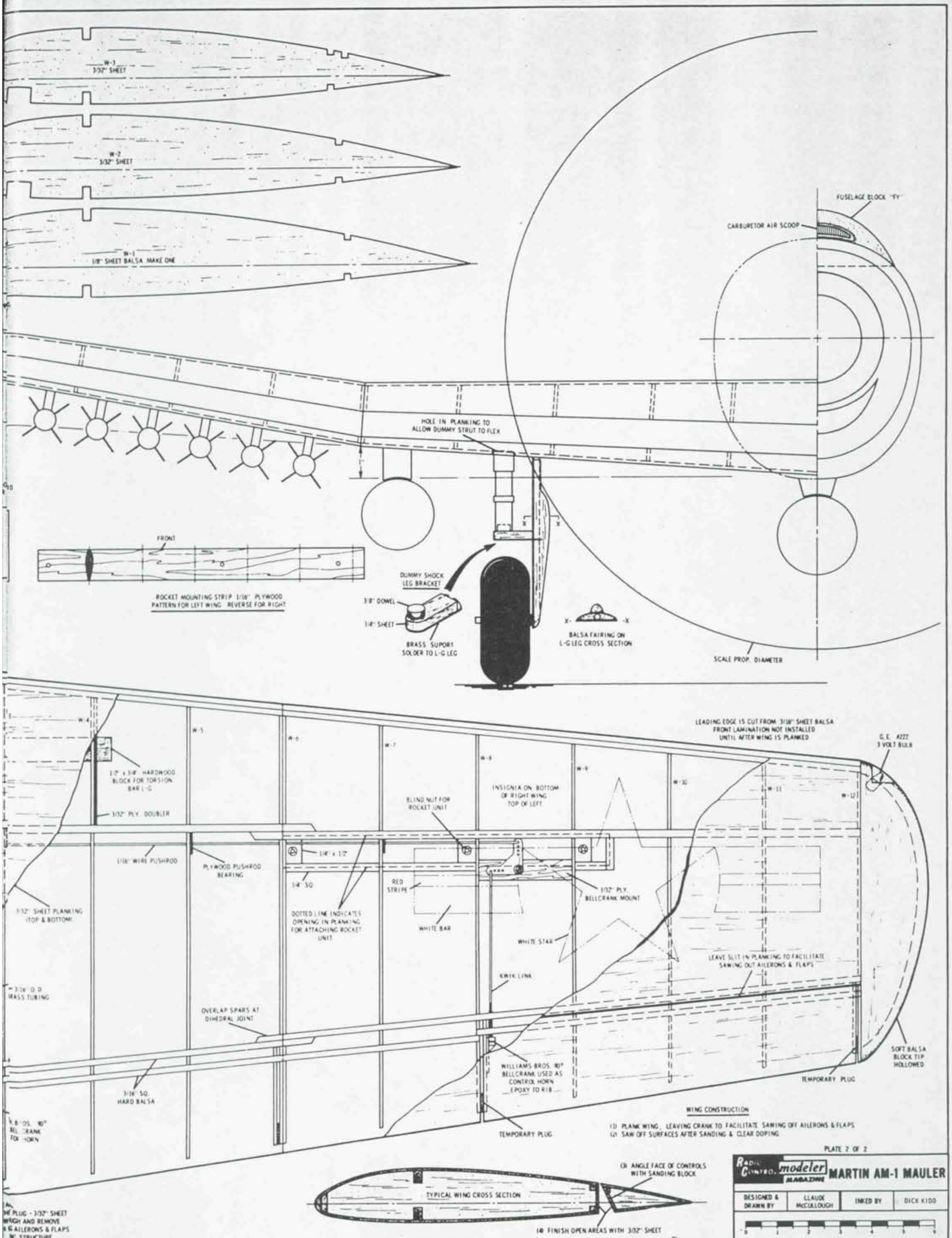
2.) U. S. Navy Photos 417044, 404910, 706607. Shows it with a variety of markings and views. Write to: U. S. Naval Photographic Center, U. S. Naval Air Station, Anacostia, Washington, D. C. 20390. Send certified check or money order, 55 cents for each 8 x 10 glossy print. They also have other shots, but you will have to take potluck on those — describe the type of picture you prefer and they'll pick accordingly.



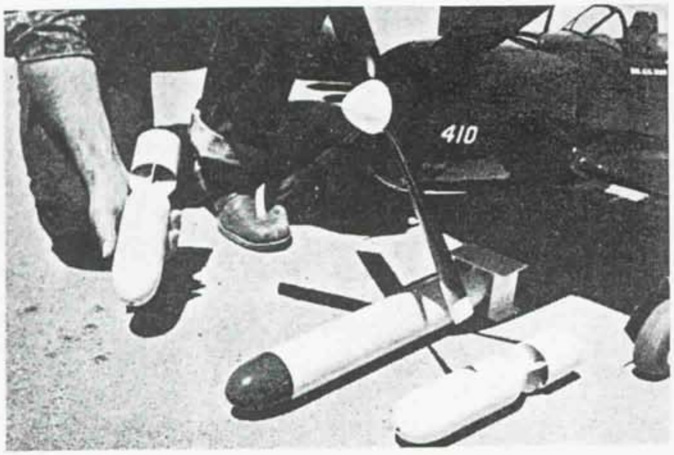
1/8" SHEET PLANKING
1/8" x 1/4" BALSA STRINGERS
SOFT BLOCK TIP
SECTION F-2
SECTION F-3
SECTION F-6
SECTION F-7
SECTION 8, 9 & 10 ARE SIMILAR TO 7 & 11
SECTION F-11
F-4S ENDS HERE
F-5S ENDS HERE
F-6S ENDS HERE
1/4" SQ. MAIN FRAME
NOTCHES FOR FUSELAGE STRINGERS ARE NOT CUT UNTIL AFTER ASSEMBLY ON MAIN FRAME
BEVEL MAIN FRAME CORNERS WITH SANDING BLOCK SO THAT PLANKING CAN BE CEMENTED TO IT
CUT 11 E-1 RIBS. TRIM 2 OF EACH AS E-2, E-3 ECT. AFTER ASSEMBLY RE-SHAPE LEADING EDGES WITH SANDING BLOCK
COWL RING "F" 3/32" PLYWOOD
COOLING CHANNEL CUT INTO BLOCK "CC" IN TOP COWLING HALF
FUSELAGE BLOCK "FX" FROM 1/2" SOFT SHEET BALSA
3° RIGHT SIDE THRUST BUILT INTO COWLING FRONT
CARBURETOR SCOOP CATVED AS PART OF FUSELAGE TOP BLOCK "FY"
COWL BLOCK "CB"
CARVE COOLING CHANNEL IN "CC"
1/4" SHEET FLOOR
1/4" x 1/2"
MOTOR MOUNT
LOWER HALF SEPERATES AT THRUST LINE FOR ACCESS TO ENGINE
FUSELAGE MAIN FRAME CUT OPEN AFTER ASSEMBLY
OPENING TO BATTERY
COWL FRONT BLOCK "CA"
1-1/4" BLOCK BALSA
FIREWALL "F" 1/8" PLYWOOD
SCOOP DIVIDER MAY HAVE TO BE GLUED IN AS A SEPERATE PIECE
REAR VIEW OF COWLING AT FIREWALL "F"
DEBOLT WW II CANOPY
5/16" DOWEL
"I" BEAM BRACE MADE FROM BALSA AN
COCKPIT FRAM SCOTCH PLAST
FUSELAGE BLOCK "FY" SOFT BALSA HOLLOWED
1/8" DOWEL PIN (TO KEY LOWER COWL)
RECEIVER BATTERY PACK
1/4" SHEET FLOOR
1/4" x 1/2" BALSA
3/8" x 1/2" MOTOR MOUNT "MM"
"FX" NOT SHOWN ON SIDE VIEW BUT EXTENDS FROM HERE TO HERE BETWEEN "F" & F-2S
1/4" SHEET PART OF 1/4" SQ. MAIN FRAME
WING SADDLE "A"
8 OZ. CLUNK TANK
2-3/4" VECO SPINNER
COWL RING BLOCK "CA"
1/8" PLYWOOD FIREWALL "F"
COWL RING "FF" 3/32" PLYWOOD
1/8" DOWEL PIN (TO KEY LOWER COWL)
1/16" PLY
SOFT BLOCK FILL-IN COMPLETES FUSELAGE CONTOUR ON BOTTOM OF WING
DUMMY SHOCK STRUT BUILT UP FROM 1/2" & 5/8" DIAMETER SEMI-FLEXIBLE POLYSTYRENE TUBING
1/8" DOWEL PIN
LANDING GEAR COVER MADE FROM 1/32" AIR-O-SHEET
TOP VIEW OF REMOVABLE COWLING BOTTOM HALF (SPLITS ON THRUST LINE)
DUMMY SPOKE WHEEL COVER MADE FROM 1/32" AIR-O-SHEET
4" KEIL KRAFT WHEELS
BALSA BLOCK NOSE
1/4" SHEET MOUNT
1/8" BALSA PLUG
1/8" SHEET BALSA PLUG
ROCKET BODY IS ROLLED PAPER TUBE


3/32" SHEET PLANKING (TOP & BOTTOM)
3/16" x 1/4" BALSA
NYLON HINGE
3/16" SPRUCE
3/32" WIRE
3/16" x 1/4" BALSA
1/16" WIRE
3/32" I.D. BRASS TUBING
BRASS HORN SILVER SOLDER NYLON END FOR NON-METALLIC CONTACT 1-1/4" LONG
ELEVATOR MADE FROM 1/4" SOFT SHEET BALSA
1/8" SHEET FUSELAGE PLANKING
MAIN FRAME
"RA" 1/4" SHEET
FILLET LIGHT WITH PLASTIC BALSA
NYLON HINGE IMBEDDED IN RUDDER WITH EPOXY
1/16" WIRE PIN
1/4" SQ.
1/4" SQ.
FIN & RUDDER SECTION CUT FROM 1/4" SHEET
SCALE ANTENNA IS PLASTIC CORD
3/32" PLANKING
SOFT BALSA BLOCK "RA" ON EACH SIDE OF RUDDER COMPLETES FUSELAGE CONTOUR
G. E. 222 PENLIGHT BULB
ARRESTER HOOK MADE FROM 1/4" DOWEL
SECTION FROM F-11 TO HERE CARVED FROM SOFT BALSA BLOCK
1/8" SHEET FUSELAGE PLANKING
1/8" PLYWOOD CROSS PIECE FOR TOP BEARING
1/8" PLYWOOD INSERT
1/32" AIR-O-SHEET DOORS
BALSA FILL-IN TO TRANSFER TAIL WHEEL STRESS LOAD TO MAIN FRAME
1/8" PLYWOOD INSERT
7/32" BRASS TUBING
1/8" BRASS TUBING
BRASS BEARING
3/32" WIRE FORK ENDS SOLDERED INTO 7/32" TUBING
1-1/2" VECO SPONGE WHEEL
F-125 IS 3/32" x 1/8" STRIP BALSA
FORMERS ARE CUT FROM 1/8" SHEET BALSA
1/32" BRASS
TO RUDDER
TO SERVO
TOP VIEW OF TAIL WHEEL HORN "P"
FOR PROPORTIONAL MAKE FROM NYLON
ARE SHOWN FULL LENGTH
OM HEAVY PAPER
PLATE 1 OF 2
RADIO CONTROL modeler MAGAZINE
MARTIN AM-1 MAULER
DESIGNED & DRAWN BY
CLAUDE McCULLOUGH
INKED BY
DICK KIDD


W-12
W-11
W-10
W-8
3/32" SHEET
MAKE TWO STUB RIBS FROM HERE
W-9
3/32" SHEET
W-10
3/32" SHEET
W-11
3/32" SHEET
MAKE TWO STUB RIBS FROM HERE
W-12
3/32" SHEET
FLAP STUB RIB BETWEEN W-2 & W-3
2 1/16"
W-7
3/32" SHEET
W-6
3/32" SHEET
MAKE 4
MAKE TWO STUB RIBS FROM HERE
W-5
3/32" SHEET
MAKE TWO OF EACH RIB EXCEPT AS NOTED
W-4
3/32" SHEET
HOLLOW FOR LIGHTNESS
1/8" SHEET PLUG
HANGER
COLOR LINE
YELLOW NOSE
CARDBOARD TUBE
1/32" PLY. FINS
REAR VIEW
SIDE VIEW
TORPEDO CONSTRUCTION SIMILAR
AFTER PLANKING, SAND OFF AT ANGLE
SEE FUSELAGE SIDE VIEW
BALSA SHEET FILL-IN
W-9
W-8
W-7
W-6
W-5
W-4
W-3
W-2
W-1
1/16" PLY. RIB DOUBLER
L-G CLAMP
AILERON SERVO
FLAP
SERVO
SOLDER WASHER
ON TUBING
3/32" PLY
BEARING
FLAP
STUB
RIB
FILL-IN WITH BALSA
SHEET
AFTER PLANKING
SQUARE WING CENTER SECTION
BY TRIMMING ON THIS LINE



W-3
3/32" SHEET
W-2
3/32" SHEET
W-1
1/8" SHEET BALSA MAKE ONE
FUSELAGE BLOCK "FY"
CARBURETOR AIR SCOOP
HOLE IN PLANKING TO ALLOW DUMMY STRUT TO FLEX
FRONT
ROCKET MOUNTING STRIP 1/16" PLYWOOD PATTERN FOR LEFT WING REVERSE FOR RIGHT
DUMMY SHOCK LEG BRACKET
3/8" DOWEL
1/4" SHEET
BRASS SUPORT SOLDER TO L-G LEG
BALSA FAIRING ON L-G LEG CROSS SECTION
SCALE PROP. DIAMETER
LEADING EDGE IS CUT FROM 3/16" SHEET BALSA FRONT LAMINATION NOT INSTALLED UNTIL AFTER WING IS PLANKED
G.E. #222 3 VOLT BULB
1/2" x 3/4" HARDWOOD BLOCK FOR TORSION BAR L-G
3/32" PLY. DOUBLER
INSIGNIA ON BOTTOM OF RIGHT WING TOP OF LEFT
BLIND NUT FOR ROCKET UNIT
1/4" x 1/2"
1/16" WIRE PUSHROD
PLYWOOD PUSHROD BEARING
3/4" SQ.
RED STRIPE
3/32" PLY. BELLCRANK MOUNT
3/32" SHEET PLANKING (TOP & BOTTOM)
DOTTED LINE INDICATES OPENING IN PLANKING FOR ATTACHING ROCKET UNIT
WHITE BAR
WHITE STAR
LEAVE SLIT IN PLANKING TO FACILITATE SAWING OUT AILERONS & FLAPS
KWIK LINK
OVERLAP SPARS AT DIHEDRAL JOINT
WILLIAMS BROS. 90° BELLCRANK USED AS CONTROL HORN EPOXY TO RIB
SOFT BALSA BLOCK TIP HOLLOWED
TEMPORARY PLUG
3/16" SQ. HARD BALSA
TEMPORARY PLUG
WING CONSTRUCTION
(1) PLANK WING, LEAVING CRANK TO FACILITATE SAWING OFF AILERONS & FLAPS
(2) SAW OFF SURFACES AFTER SANDING & CLEAR DOPING
(3) ANGLE FACE OF CONTROLS WITH SANDING BLOCK
TYPICAL WING CROSS SECTION
(4) FINISH OPEN AREAS WITH 3/32" SHEET
PLATE 2 OF 2
RADIO CONTROL modeler MAGAZINE
MARTIN AM-1 MAULER
DESIGNED & DRAWN BY
CLAUDE McCULLOUGH
INKED BY
DICK KIDD



Above, left: If you really go all out, a full load of armament can be accommodated. Caution! Don't have torpedo trigger jam. Landing with torp aboard, it will hit runway — may explode! Above, right: Flaps, arrester hook are also good for scale operation points.

3.) Air Photos, Box 1117, Jamestown, N. Y. Photos Number 1905, 2640, 2641, 2642, 3561, 3562. 15 cents each for 2¾" x 4½" prints plus 5 cents postage for orders under $1.00. The 2600 series are a choice subject for markings, plastered all over with "NAVY," "GLENVIEW," "V" on the rudder and various plane numbers plus a wide orange Naval Reserve band around the fuselage. If that won't brainwash the Nats judges, nothing will!

The markings on my version came from photos by noted aviation historian and author, William T. Larkins. (Another airplane of the same squadron appears in Navy photo 706607.) A color photo of the ship appears in the book "The Pratt and Whitney Story." The airplane is all gloss dark blue (Corsair blue), standard for naval airplanes of the period. Armament is light grey with red noses on rockets and torpedoes, yellow noses on bombs. Red stripe on the white insignia bars. Two types of props are seen on Maulers, paddle blades with square tips and rounded tip with cuff near the hub — color matt black with gloss yellow tips.

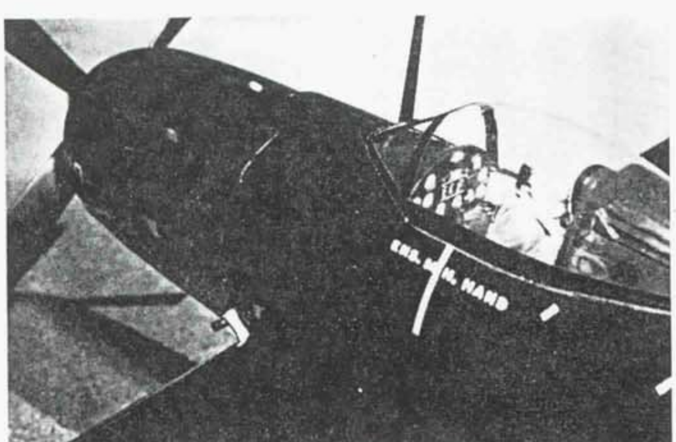
A three view appears in the August 1948 Model Airplane News and also a Flying Models of the same period. Since there were detail variations in the general arrangement drawings (a very common problem), photos were used as final authority for landing gear, arrestor hook, built-in right thrust, etc. I was able to borrow the pilot's handbook — a real rarity — (Thank you, Ron Gerdes!) and made copy photos of the cockpit detail and will be glad to provide these at cost of prints. Also I would be glad to answer any question about the model — enclose SAE and write to me at Rural Route 5, Ottumwa, Iowa 52501.

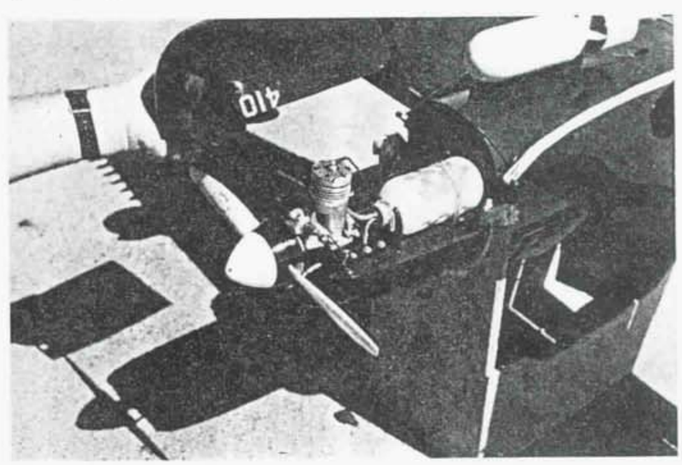
The original version was built from that well known Iowa product, Sig Balsa. Though not as hard to get balanced out (C.G. — 33 to 35% of average chord) as many scales, be careful not to pile a lot of rock hard balsa in the tail end! In fact, given the strength of the deep, full planked structure, the whole ship can be built from Contest weight wood except for wing spars and stringers. Looking critically at a 7 year old model, only two changes were necessary to bring it fully up to date. Standard setup way-back-when was dowels and rubber bands, but with our present selection of cam-locs and nylon screws you will no doubt want to dispense with that appearance spoiling feature. Likewise the part open silkwork with capstrips. Since the glue is already there the only thing saved by this expedient was the wood between the ribs — an inconsequential amount of weight when you consider how it compromises the scale effect. It also makes it hard to sand the finish with all those edges, so full planking is specified on the plans.

I am assuming that no beginners are

(Continued in Page 89)

Below, left: That instrument panel was drawn in 1959 "B.T." (Before Tatone!) Now it will be much easier to duplicate. Below right: Installation of Merco .61 in the Mauler. Note "under cowl" details. Since motor is fully cowled, leadouts for glow plug must be taken to an outside socket.

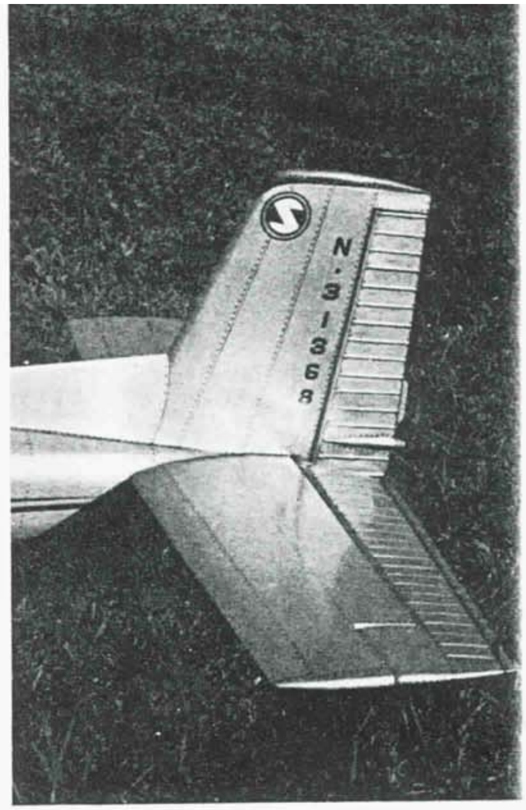


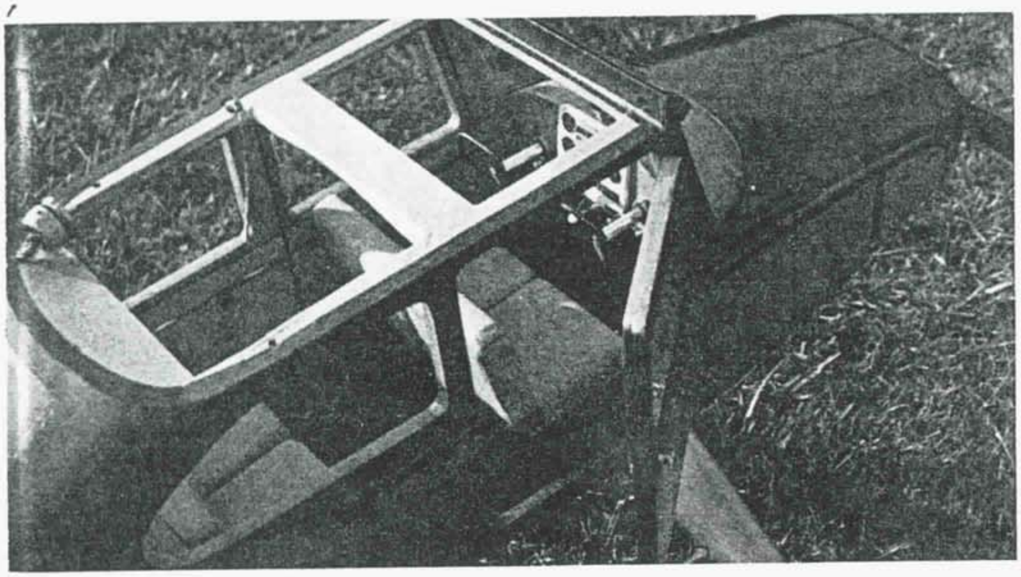


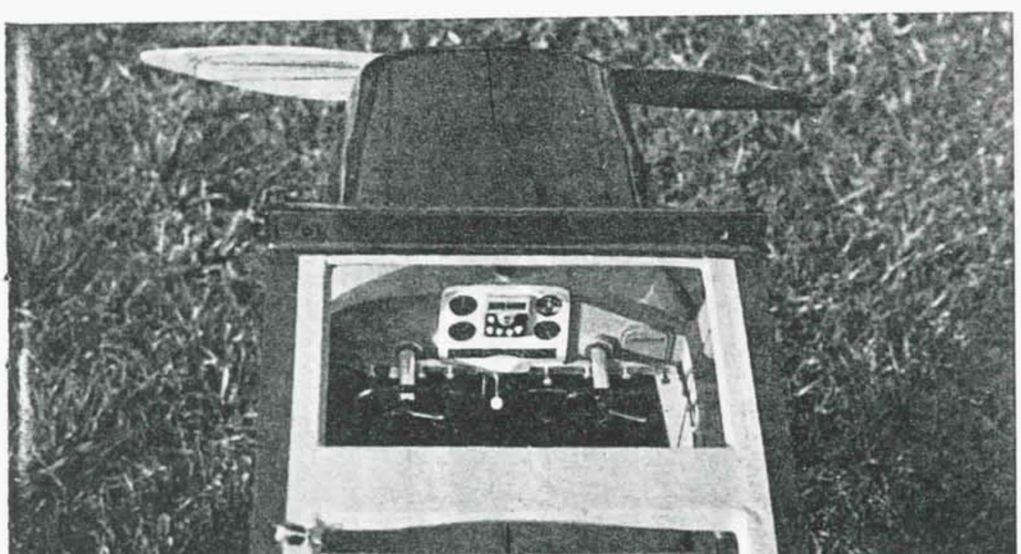
LET'S TAKE AN INSIDE LOOK

AT SCALE MODELING

BY REYNOLD VAN DYKE







Part I Introduction:

THROUGH the years in which I have been building models I have always had a strong interest in Scale. There have been many disappointments, but in general I have had very good success with scale models.

I have placed second and fourth in two Nationals, and First in a State meet. Since these three are the only attempts at scale competition, I believe this is a pretty good record.

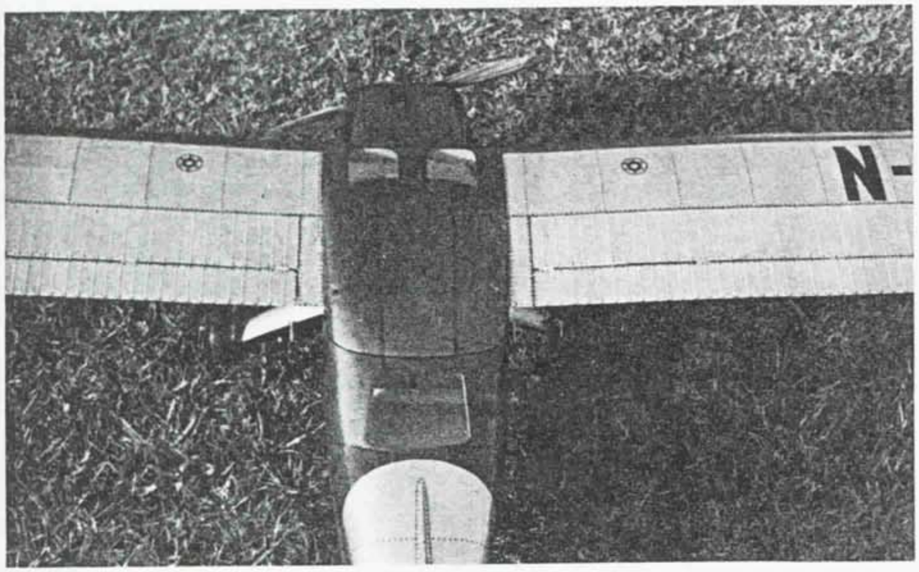
Now that we have good, dependable proportional equipment available to us, which offsets a few of the aerodynamic shortcomings of scale models such as shorter tail moments, and the need for more precise control movement, it seems to me that almost true scale and very flyable airplanes are now within the capabilities of the average serious model builder.

I know from past experience that there are enough modelers interested in scale; however, this segment of the hobby doesn't seem to be growing as it should. I feel that this is because most modelers fear being unsuccessful.

May I suggest that you give scale a try. There is no greater satisfaction in this hobby than a successful scale airplane. If you doubt this go to a scale meet or watch the people when a scale model flies at your field.

It is my intention in this article to be helpful to anyone who is building a scale ship.

I will concentrate mainly on the aerodynamics in regards to scale with a few points on details and construction, also a little about surfaces and trim. I feel it is the aerodynamics and trim in which



most modelers need information, since there is a wealth of information in the other phases of our hobby.

When I speak of scale, I am referring to models which are scale dimension-wise and **not** modified pattern airplanes with scale-like profiles and enlarged stabilizers.

Part II Configuration:

One myth I want to dispel right off is the idea that true scale models are unstable and hardly flyable except by the experts, and that it is necessary to change everything.

Experience has proven that the more accurately you duplicate a real airplane the better it will fly, provided, of course, that everything is correct such as power and trim and reasonable wing loading. There are exceptions of course, such as rubber powered models and speed machines which are hard to control. Our large radio models, however, closely parallel real aircraft in that the aerodynamics are very similar.

You cannot, however, usually duplicate an aircraft to the point of exact power and wing loading, simply because it would be hard to control. We must almost always compromise a little, since we would need geared engines in many cases. Also an airplane could be dangerous if it weighed much more than our models do.

Since it is my intention that you understand and follow my thought, I will explain my ideas by comparison rather than by the use of mathematics.

The first mistake most modelers make, in my opinion, is to change the wing airfoil and other dimensions of a scale airplane. For instance, changing the wing to a more desirable Clark-Y type, or enlarging the supposedly inadequate stabilizer area . . . etc. This upsets the workable combination of original aerodynamics of the real aircraft and more often than not the poor flying qualities of scale models are due to the changes made to it, and not because of the aerodynamics of the original design!

When the engineers and designer design a real aircraft they settle on a list of requirements which the aircraft must meet. These are things such as size, load capacity, speed, economy and price. When these are decided upon, they choose or originate an airfoil-wing area combination to best suit the set requirements. The balance of the machine is designed not only to complement and control this wing, but also to suit other requirements such as number of passengers, size of engine required, speed, appearance and economy of construction.

The propeller is designed to best suit the engine-airplane combination.

After testing the airplane, changes are made, if necessary to meet the foregoing requirements, or to improve stability or performance.

Now, when we decide to duplicate an aircraft to a given scale size, if we change the wing to a design which will fly slower, the stabilizer becomes inadequate because of this change and so on down the line. We have then a real conglomeration of incorrect aerodynamics and no end of problems.

I am not trying to imply that we should not change anything, however the changes should be workable combinations which will provide enough stability and control for a good flying model.

Since the point system for scale is a compromise of flying points against scale points, all the changes found necessary for a given model should be aimed at the lowest possible loss in scale or fidelity points.

You may not be interested in competition, however, the close duplication of the real aircraft in my opinion, makes it much more realistic.

There is nothing more obviously not-scale than a fat winged Mustang or a Spitfire with a stabilizer twice the size of the original. Also a World War I bi-plane with a symmetrical wing or one without wing wires!

You are probably already hollering 'Scale Nut', or 'Perfectionist', however this is not the point at all. The point is that some of these airplanes fly exceptionally well with the scale wing and often all that is needed to make the stabilizer effective is a better center-of-gravity location, along with sharpening the stabilizer leading edge and a wee bit more power. Wing stability can be enhanced by moving the maximum high camber point of the last few ribs rearward. These changes are hardly visible unless you know they are there.

There are aircraft, of course, which are real problems and require a lot of planning. The scale job which cannot be made to fly however, is very rare or doesn't exist at all.

Part III Scale Effect:

The only real aerodynamic difference between a scale model and a real airplane is the velocity at which the air travels over its surfaces.

Lift in relation to wing loading changes as an airplane is reduced in size because it is reduced by all its dimensions. In other words, reducing the thickness of the wing as well as the area. A square foot of wing area on a real plane is capable of many times the lift of a square foot of area on the model because lift is the product of the curvature and thickness as well as the area on a square foot basis.

This same situation exists in regards to weight, also, because as mass is reduced, it is reduced by all its dimensions, so the weight of the model drops much more on a pound basis than the scale ratio of its dimensions.

In order to keep this from being confusing try to picture a flesh and blood man weighing 180 pounds. Reduce him dimension-wise on the same ratio as the airplane model. Using a 2 inches to one foot scale of 1/6 scale as an example, he should weigh 30 pounds. If you could do this however, you would find that he would only weigh 5 pounds or less.

Again, to keep from going into mathematics, suffice it to say as did Einstein, that all things are relative. A pound to me or you would in proportion to our size be less than an ounce to this little man.

When we scale down the airplane, we must figure everything on the same basis. This also relates to the wind. A twenty mile-per-hour wind is as effective in regards to our model as a hurricane would be to a piper cub. I hope I am making my point here.

Let us take speed as another example. Using the same scale as before, or 1/6 scale, the airplane would only be going about twenty miles-per-hour which is actually about the stall speed for most models. The model would have to fly at almost full scale speed in order to obtain the air velocity over the wing to create enough lift to carry the airplane if it were true scale weight.

Actually true scale weight would be whatever a mass of the same materials would actually weigh when reduced to scale by all their dimensions. True scale thrust would be whatever thrust would actually be produced by an exact four cycle scale engine turning a scale propeller at the full scale engine R.P.M. As you can see, we cannot scale everything, only the dimensions of the real airplane.

I really believe that a true scale airplane could be built, with scale engine dimensions, material, and trim and it would fly with sufficient power and speed if you could control this hot and heavy little machine. I doubt if you will ever see one however, simply because it is not practical.

So, as you can conclude from all this, we must compromise, but we should only compromise on the things which do not lose points or detract from the realism of the aircraft.

Part IV Airfoils And Their Characteristics:

I won't present a lot of technical stuff here as much material has already been printed on airfoils and wind tunnel data and lift coefficients and so on.

I have found that the general characteristics of full size airfoils are about the same when scaled down. For instance, a thin section with a sharp leading edge will be low drag and very sensitive in pitch as they are when full size. While lift and drag values change a little the characteristics of the airfoil remain the same as full scale.

Following are some airfoil characteristics:

A) Rounding the leading edge of an airfoil softens the stall and causes it to begin sooner.

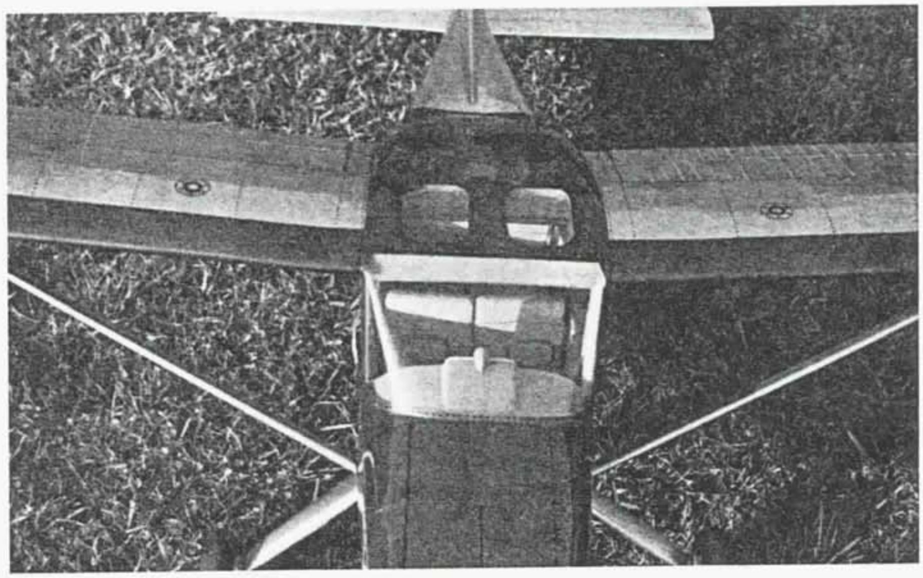
B) Airfoils with high camber points close to the leading edge stall at a lower angle of attack than do airfoils with more rearward high camber points.

C) Thinner airfoils stall sooner or at lower angles of attack than the thicker sections.

D) Sharp leading edges on an airfoil also tend to delay the stall.

Since we do not generally want a sensitive wing which results from thin leading edges, the way to get a stable wing without too much sensitivity is as follows: Use the scale airfoil for the main part of the wing. Round the edge a little if it has a sharp leading edge. Modify the section near the tips by moving the high camber point rearward on the ribs near the tip and lessen the entry angle curve. Also sharpen the leading edge at the wing tips.

Undercambered wings, such as those used on World War I Bi-planes will often lift to almost 3 degrees negative incidence angle so allow for this when you set up your trim. Since these types of airfoils usually develop excess lift when used with model wing loading, increase loading or limit top speed.



Contrary to what is believed by many modelers, a low drag-high efficiency type airfoil is not the answer to a critical power loading. Since these sections are low-drag simply because they do not produce as much lift as thicker sections which have a higher factor, they must fly at a higher speed in order to carry the weight of the plane and this requires **more** power. Although these sections are just right to get a lot of speed for a little more power, as in pylon racing, they are not as good for a slow flying scale job. The only alternative for power that I know is thicker high lift-high drag type sections, or more wing area, or a lighter wing loading.

So, if the scale section is a low-drag section as used on a Mustang you must use a little more power and fly it faster to get sufficient lift.

If you doubt any of the preceding material, I suggest you build a Mustang model and a Piper Cub model, each with exactly the same wing loading, and see which requires the most power!

Part V Force Arrangement And Trim:

There are a set of conditions possible in a scale model and other types which can cause disastrous effects. Since I have lost a few airplanes to the spiral dive I have made quite a study of this condition. It is possible for the dihedral effect combined with pendulum effect, because of a low center-of-gravity location and a large rudder, to force the airplane into a nose down spiral dive from which the airplane will not recover unless there is sufficient aileron recovery control.

If you are not quick witted enough to do the exact right thing in this emergency, such as giving full aileron and slow engine, you will be building yourself another airplane!

Increase in incidence angle will not necessarily cure this and usually makes it worse due to increase in centrifugal force in the turn.

The answer, of course, is to make sure the force arrangement and center-of-gravity are such that these conditions do not exist.

Contrary to popular belief, dihedral in the wing usually has little or no corrective effect unless the angle is so great that the wing is almost vertical, such as on a polyhedral free flight model. Dihedral is used by the designer mainly to aid turning ability of the airplane.

So as you can see, the balance and force arrangement are the important thing and the solution to a good flying ship.

I regret that there is not a set rule for force arrangements, or trim, simply because all aircraft are different, with different forces acting upon them, so what may be correct for one may be wrong for another. Since most modelers lack understanding of what to do in each case I will try to present a few examples.

Since scale models have dimensions to suit full-size craft and their respective needs, it is often difficult to get the center-of-gravity in the best location. This is especially true when you finish the interior and you have to put radio equipment in whatever space is left.

As an example, let's assume you are building a high wing Cessna with trike gear. This is a pretty good choice; however, when you start construction, try everything possible to get all the weight high in the airplane. Since many high wing types come out with too low a center-of-gravity, the pendulum effect is too great in high speed turns. A small degree of this, however, helps stability at slow speeds.

If you can get the C.G. in the right place this will make a beautiful flying multi. In this case it should be about two inches below the wing on the vertical plane and approximately 28% of

(Continued on Page 82)

MIRA SLOVAK'S BÜCKER JUNGMANN

Story and Photos By
GERALD C. LEAKE

A SMALL white swept-wing biplane with black and gold trim rolls down the runway. The plane gathers speed and gently lifts from the runway. Flying a few feet above the macadam, it skims along, gathering speed for almost 2000 feet, then lifts gracefully into the clear blue sky until it is going straight up. Suddenly the plane rolls onto one side, snaps inverted and tumbles end over end backwards! The crowd stands, gaping, and holding their breath. The plane levels out inverted, rolls upright, and climbs again into the sky.

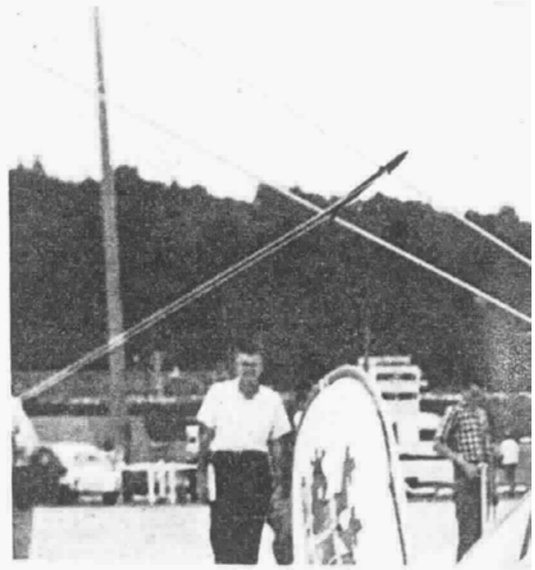
The Lumcevak is unbelievable until seen with your own eyes — a series of snap rolls, loops with snaps on the top or bottom follow, along with maneuvers which my memory still fails to piece together in a satisfactory sequence. N121 then makes a long swooping dive toward the end of the runway and rolls inverted just 50 feet above the ground. Mira Slovak with a big smile on his face, waves to the crowd with both hands hanging over his head out of the cockpit. He skims the ground the full length of the runway — inverted! As the end of the runway approaches, the hands disappear back into the cockpit; the plane rolls upright, the nose is pulled up, and a tight 180 degree turn is executed. With smoothness and precision N121 is set down on the runway. It rolls for a short distance and then taxies over to the tie-down area. Mira Slovak then climbs out of the cockpit of

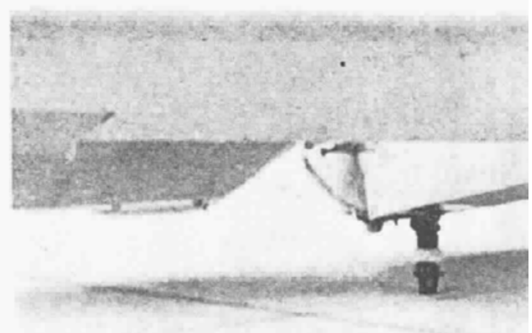
Gerry Leak's R/C version of world famous Mira Slovak's Aerobatic Bucker Jungmann. The model, presented here is one of the finest models ever presented, and a true challenge to the expert R/C scale enthusiast.

his Bucker Jungmann to accept the handshakes of the admiring crowd.

This is a typical performance of a man who in the past 13 years has been unassumingly carving a niche for himself in aviation and hydroplane history. His exploits started in 1953 when, as Czechoslavakia's youngest airline pilot at 23, he flew an airliner routed from Prague to Brno to a U. S. base in West Germany — complete with a full load of fighting security men and unwilling passengers. Nothing like doing it the hard way! Shortly after, he came to the United States. A few short stints at odd flying jobs, including crop dusting in Mexico in 1955, and then to work for Bill Boeing Jr.'s Aero Copter Inc. organization in Seattle. With Bill Boeing's encouragement, he got his first taste of unlimited hydroplane racing in Bill's "Miss Wahoo." In 1956 Congress passed a special bill on Mira's behalf which enabled him to obtain a radio license and go to work for Continental Airlines as a pilot. While with Continental Airlines, he continued his interest in unlimited hydroplanes and became interested in unlimited racing planes. The next thing you knew he was racing the big ones under the sponsorship of the late Bill Stead of Reno, Nevada (Miss Smirnoff entries) at some of the major unlimited boat and racing plane races throughout the country and making a name for himself as a go-getter. About 1963 a Bucker Jungmann (pronounced, young man) JU131 Aero C-104 in Spain was carefully crated and shipped to Mira Slovak.

The Bucker Jungmann JU131 is the predecessor of the airplane which has delighted the hearts and teased the aerobatic fingers of every aerobatic flyer and enthusiast the world over, the Bucker Jungmeister (pronounced, young master) JU133. The two airplanes look very much alike. The Bucker Jungmann was designed and built in Germany about 1934 by Herr Karl Bucker as a primary aerobatic trainer. Its small size and good aerobatic performance on somewhat limited power soon indicated a desire for an advanced model built along

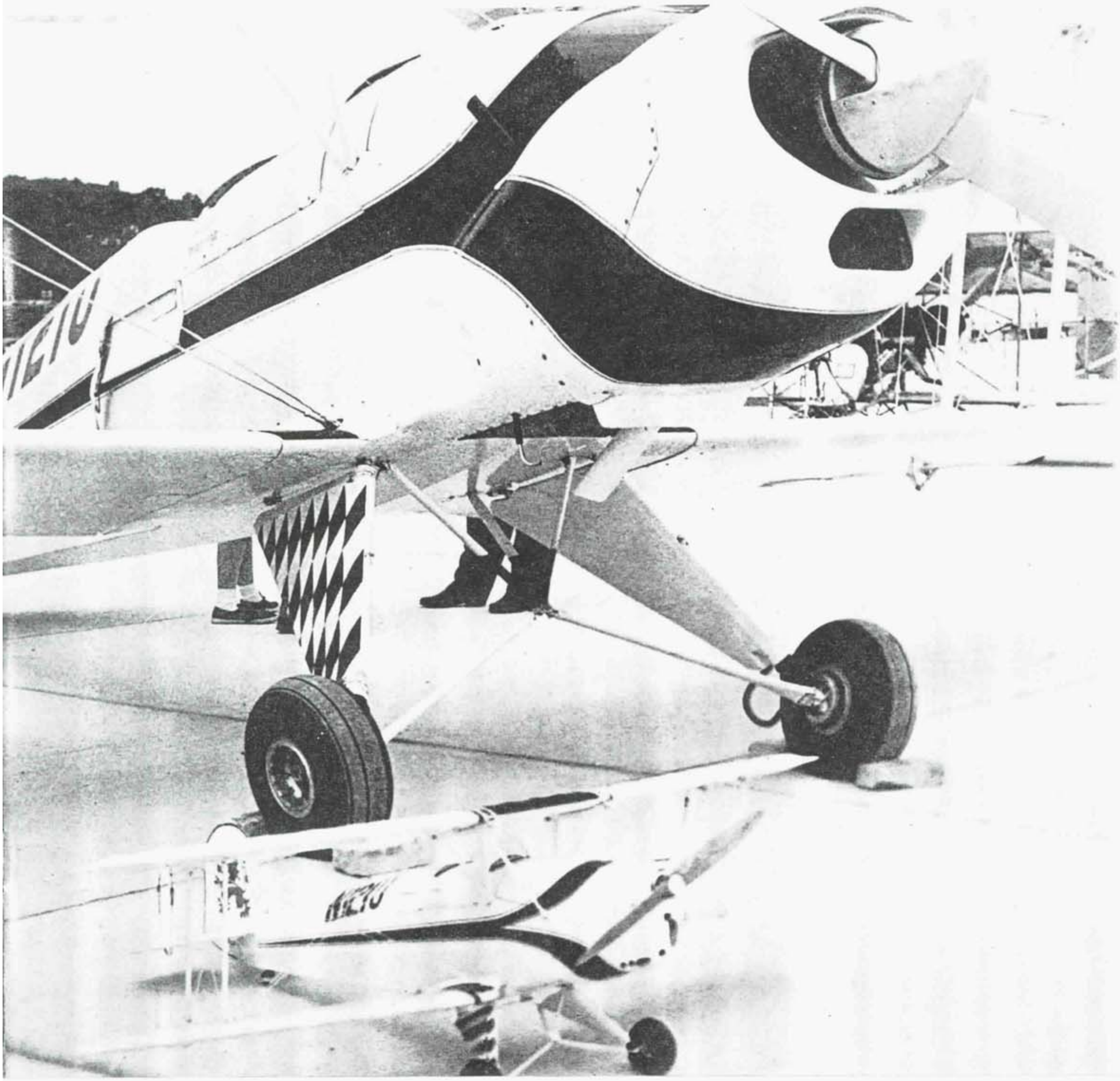


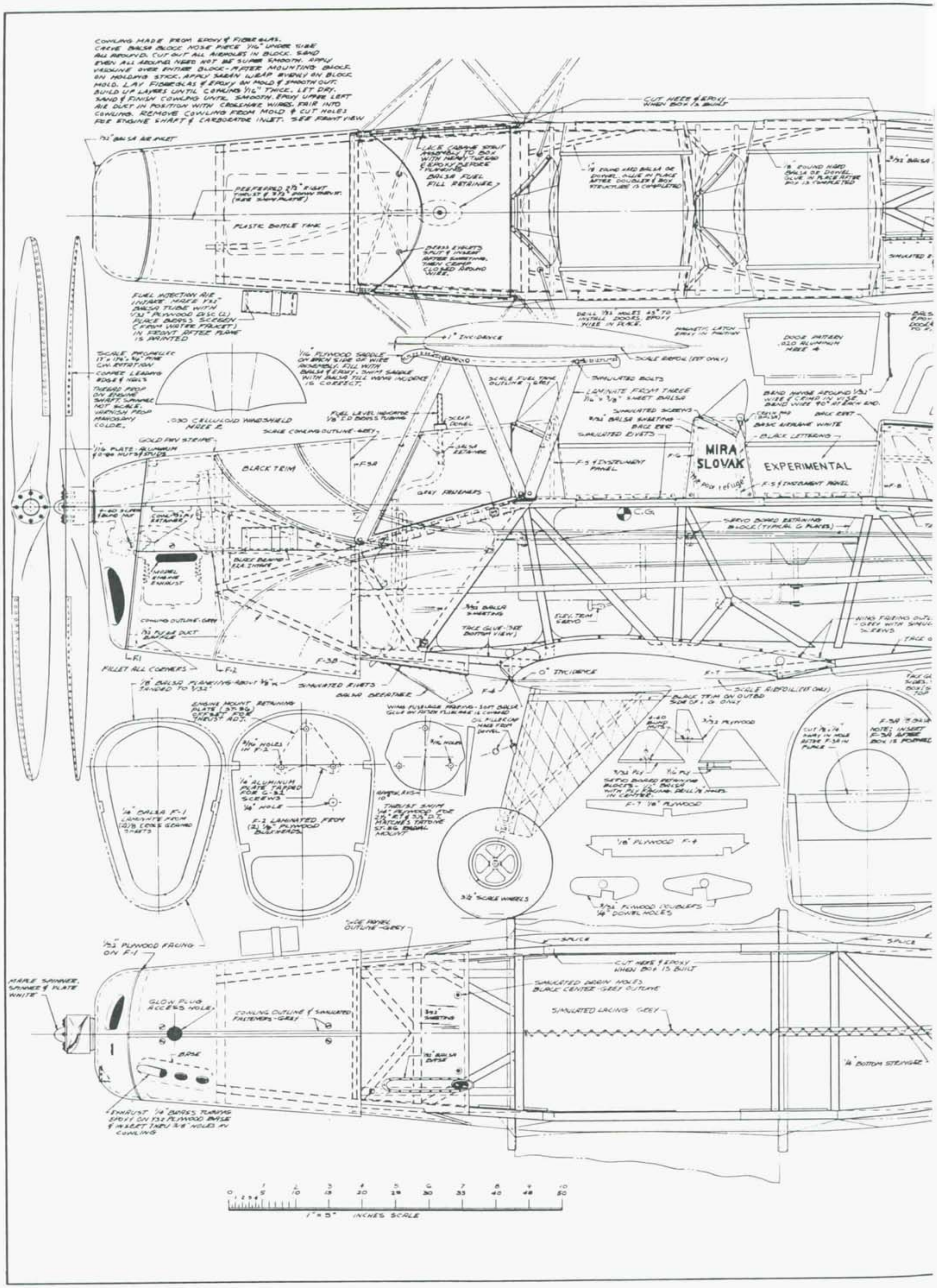


MIRA SLOVAK'S BÜCKER JUNGMANN

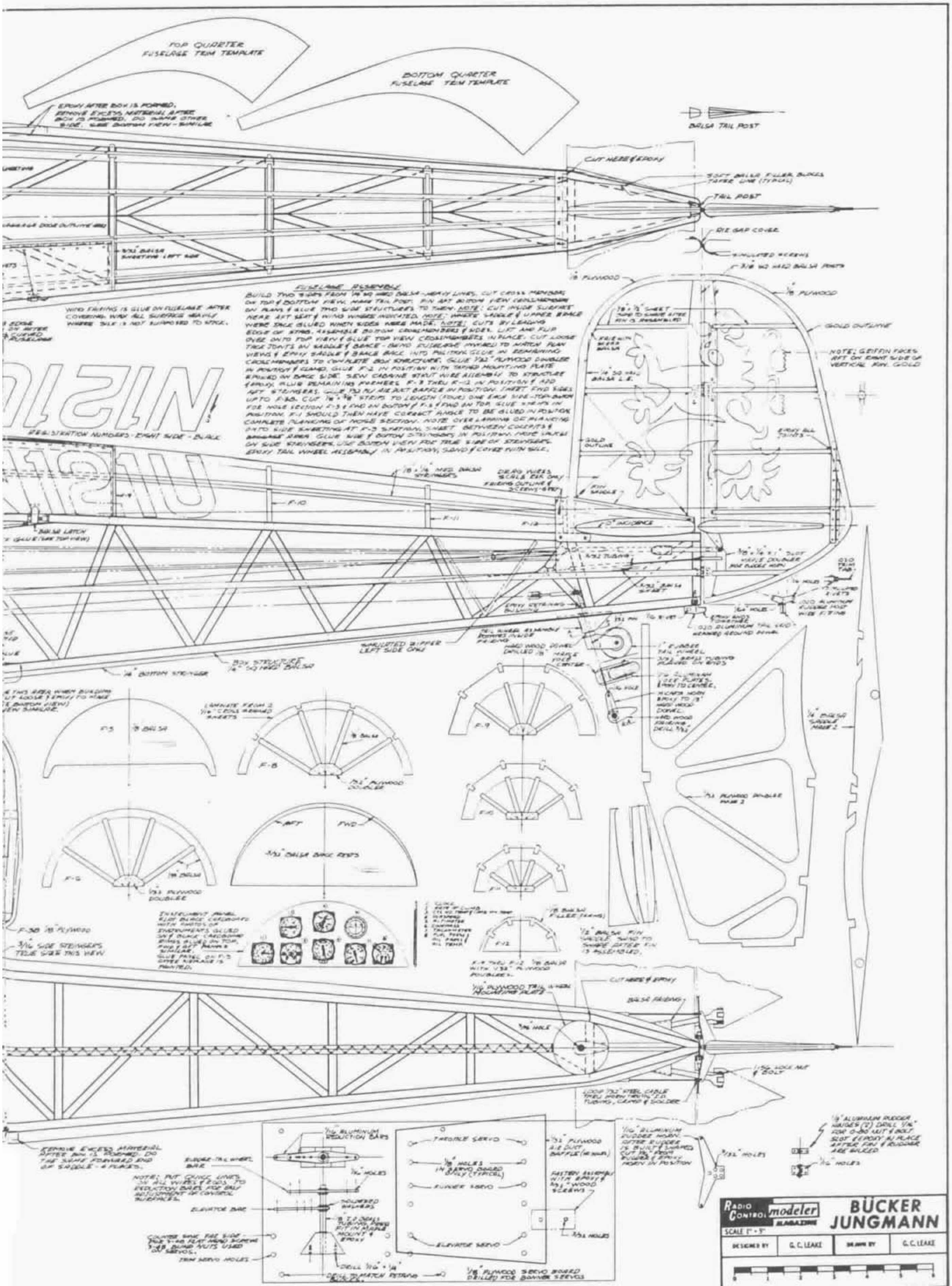
BY GERALD C. LEAKE

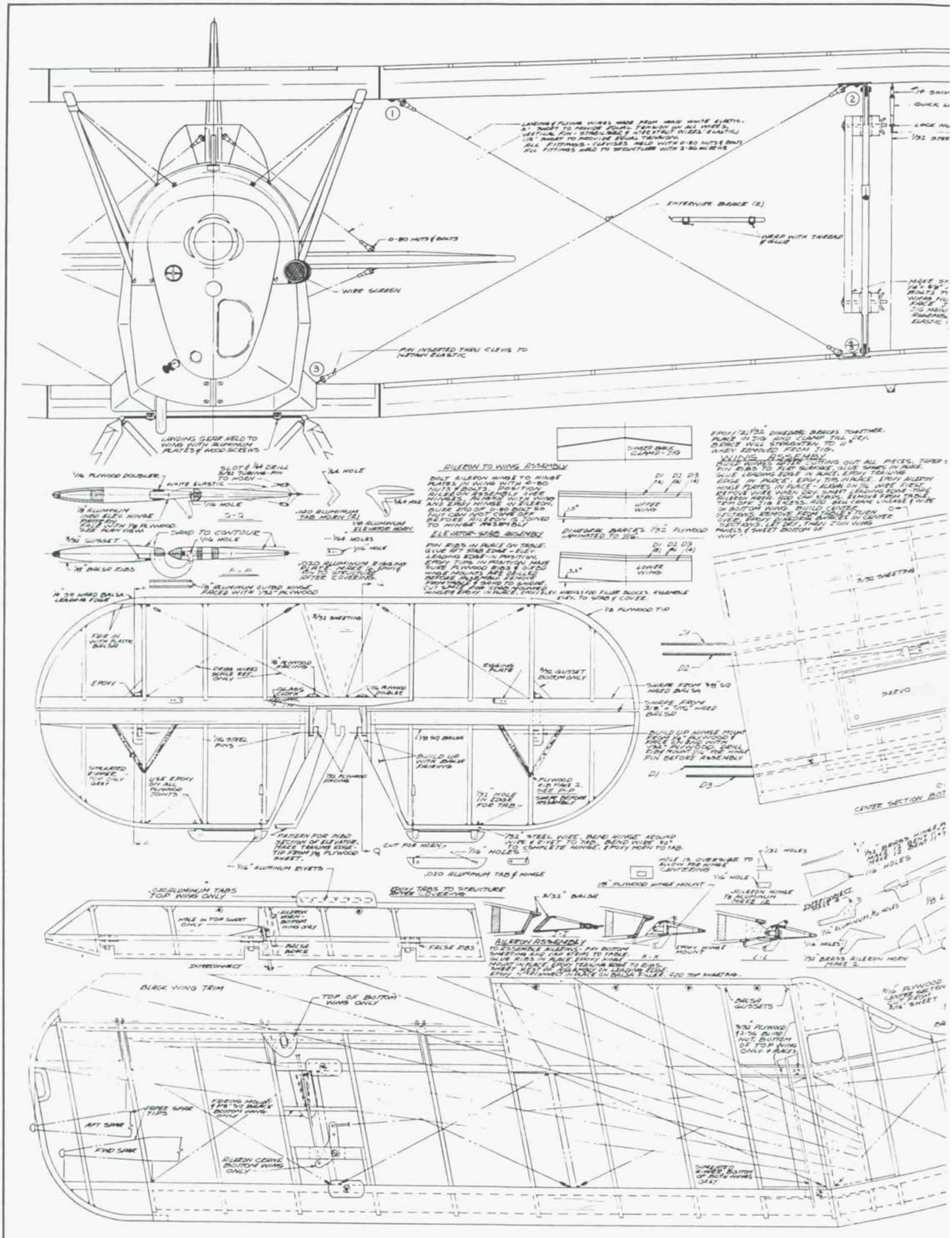
Right: Closeup of nose section of Gerry Leake's version of Mira Slovak's Bucker Jungmann (pre 1964). Below: The 1964 version model versus the 1966 conversion at Boeing-Renton Field in Renton, Washington. Insert: Mira Slovak holds Gerry's Bucker in front of the modified Jungmann.

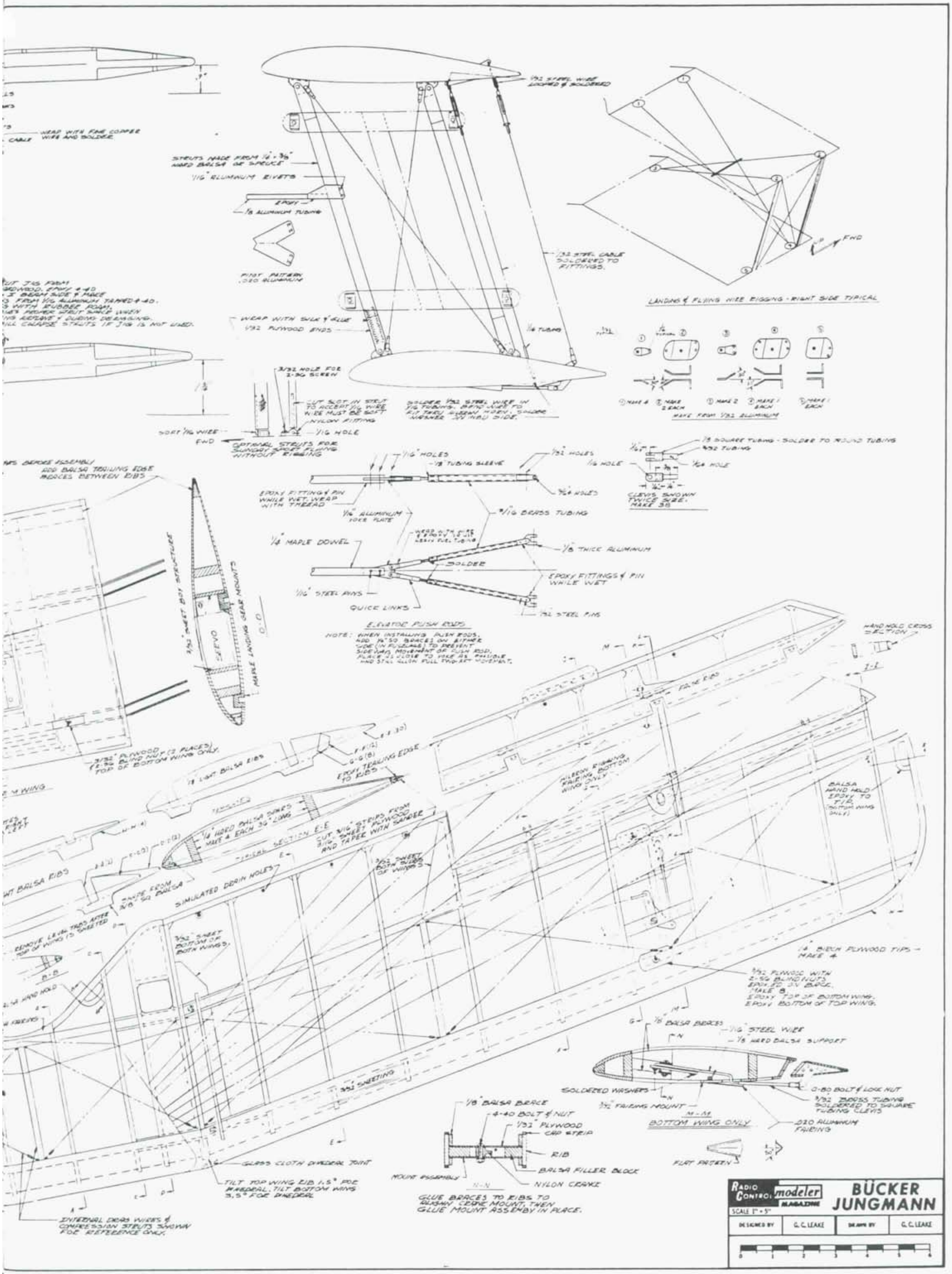


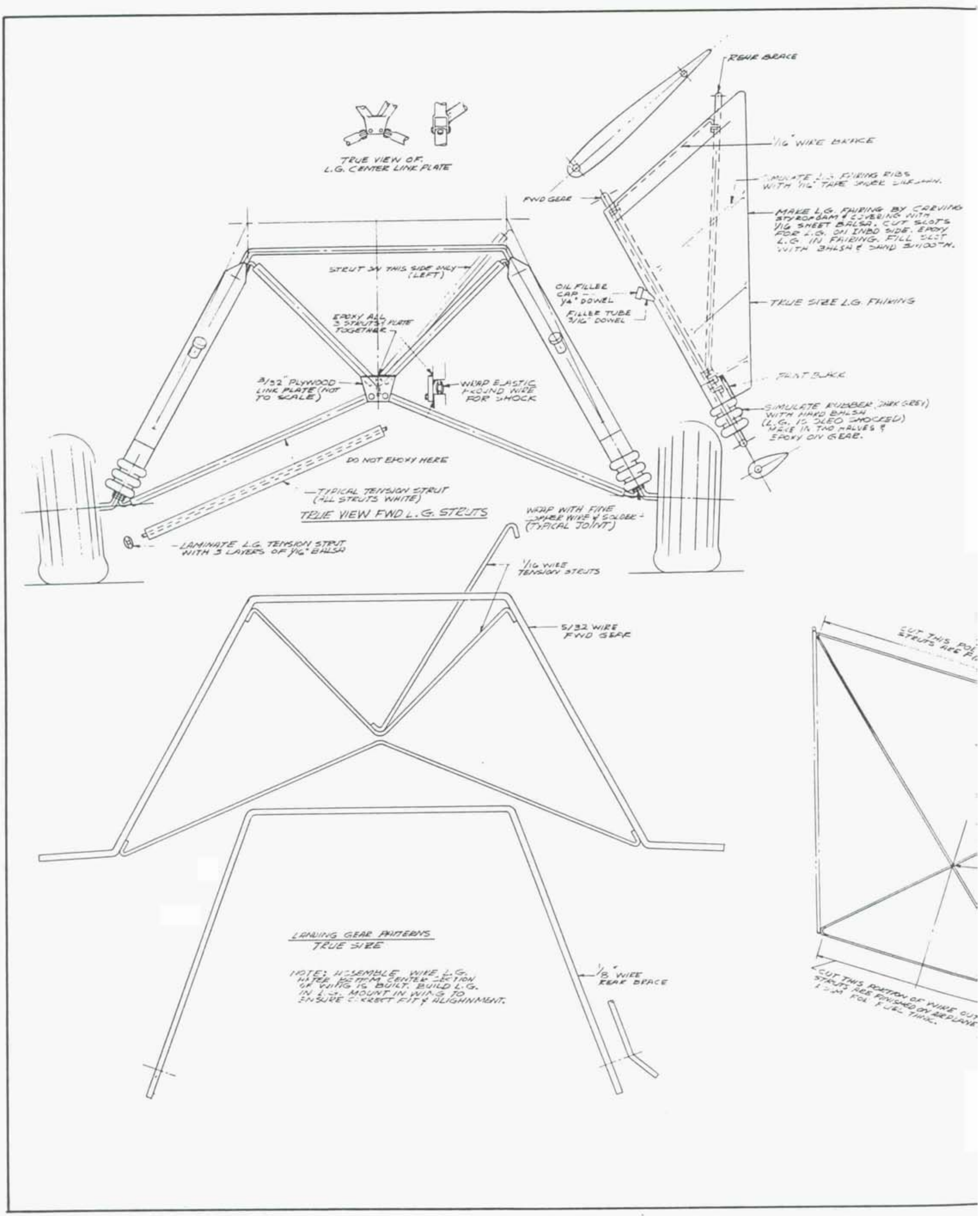


PREFERRED 2½" RIGHT THRUST
PLASTIC BOTTLE TANK
BALSA FUEL FILL RETAINER
CUT HERE & EPOXY WHEN BOX IS BUILT
1° INCIDENCE
SCALE AIRFOIL (REF ONLY)
SIMULATED BOLTS
LAMINATE FROM THREE 1/16" x 1/8" SHEET BALSA
SIMULATED SCREWS
SIMULATED RIVETS
DOOR PATTERN .020 ALUMINUM MAKE 4
BASIC AIRPLANE WHITE
BLACK LETTERING
MIRA SLOVAK
EXPERIMENTAL
.030 CELLULOID WINDSHIELD MAKE 2
GOLD PIN STRIPE
BLACK TRIM
C.G.
SERVO BOARD RETAINING BLOCK (TYPICAL 6 PLACES)
GREY FAIRINGS
FILLET ALL CORNERS
F-1
F-2
F-3B
F-4
F-7
0° INCIDENCE
SIMULATED RIVETS
BALSA BREATHER
SCALE AIRFOIL (REF ONLY)
BLACK TRIM ON OUTBD SIDE OF L.G. ONLY
F-2 LAMINATED FROM (2) 1/8" PLYWOOD BULKHEADS
1/8" PLYWOOD F-4
3½ SCALE WHEELS
3/32 PLYWOOD DOUBLERS 1/4" DOWEL HOLES
1/32" PLYWOOD FACING ON F-1
GLOW PLUG ACCESS HOLE
BASE
SIMULATED DRAIN HOLES BLACK CENTER-GREY OUTLINE
SIMULATED LACING GREY
SPLICE
1/4" BOTTOM STRINGER
1" = 5" INCHES SCALE


TOP QUARTER
FUSELAGE TRIM TEMPLATE
BOTTOM QUARTER
FUSELAGE TRIM TEMPLATE
BALSA TAIL POST
CUT HERE & EPOXY
TAIL POST
FUSELAGE ASSEMBLY
REGISTRATION NUMBERS - RIGHT SIDE - BLACK
GOLD OUTLINE
BOX STRUCTURE
1/4" SQ HARD BALSA
1/4" BOTTOM STRINGER
SIMULATED ZIPPER
LEFT SIDE ONLY
F-3
1/8" BALSA
F-8
F-9
F-10
F-11
F-12
3/32" BALSA BACK RESTS
F-3B 1/8" PLYWOOD
3/16 SIDE STRINGERS
TRUE SIZE THIS VIEW
THROTTLE SERVO
RUDDER SERVO
ELEVATOR SERVO
ELEVATOR BAR
1/8" PLYWOOD SERVO BOARD
DRILLED FOR BONNER SERVOS
RADIO CONTROL modeler MAGAZINE
BÜCKER
JUNGMANN
SCALE 1" = 3"
DESIGNED BY
G. C. LEAKE
DRAWN BY
G. C. LEAKE


O-80 NUTS & BOLTS
WIRE SCREEN
PIN INSERTED THRU CLEVIS TO RETAIN ELASTIC
INTERWING BRACE (2)
WRAP WITH THREAD & GLUE
LANDING GEAR HELD TO WING WITH ALUMINUM PLATES & WOOD SCREWS
AILERON TO WING ASSEMBLY
ELEVATOR-STAB ASSEMBLY
DIHEDRAL BRACES 1/32" PLYWOOD LAMINATED TO 1/8"
UPPER WING
LOWER WING
WING ASSEMBLY
SAND TO CONTOUR
3/32 GUSSET
1/16 HOLE
1/16 PLYWOOD DOUBLER
WHITE ELASTIC
.020 ALUMINUM TAB HORN (2)
1/8 ALUMINUM ELEVATOR HORN
1/8 PLYWOOD TIP
3/32 SHEETING
EPOXY
1/16 STEEL PINS
USE EPOXY ON ALL PLYWOOD JOINTS
BUILD UP WITH BALSA FAIRINGS
1/16 HOLE IN EDGE FOR TAB
CUT FOR HORN
.020 ALUMINUM TAB & HINGE
1/16" ALUMINUM RIVETS
.020 ALUMINUM TABS TOP WING ONLY
FALSE RIBS
INTERCONNECT
AILERON ASSEMBLY
EPOXY HINGE MOUNT
3/32" BALSA
1/8 PLYWOOD HINGE MOUNT
1/32" HOLES
1/16 HOLES
3/32 BRASS AILERON HORN MAKE 2
BLACK WING TRIM
TOP OF BOTTOM WING ONLY
BALSA GUSSETS
AFT SPAR
FWD SPAR
AILERON CRANK BOTTOM WING ONLY
CENTER SECTION BOT
ELEVO


1/32 STEEL WIRE LOOPED & SOLDERED
WRAP WITH FINE COPPER WIRE AND SOLDER
STRUTS MADE FROM 1/4 x 3/8" HARD BALSA OR SPRUCE
1/16" ALUMINUM RIVETS
EPOXY
1/8 ALUMINUM TUBING
FIRST PATTERN .020 ALUMINUM
1/32 STEEL CABLE SOLDERED TO FITTINGS.
WRAP WITH SILK & GLUE
1/32 PLYWOOD ENDS
1/16 TUBING
LANDING & FLYING WIRE RIGGING - RIGHT SIDE TYPICAL
MAKE FROM 1/32 ALUMINUM
FWD
3/32 HOLE FOR 2-56 SCREW
CUT SLOT IN STRUT TO ACCEPT 1/16 WIRE WIRE MUST BE SOFT
NYLON FITTING
1/16 HOLE
SOFT 1/16 WIRE
OPTIONAL STRUTS FOR SUNDAY SPORT FLYING WITHOUT RIGGING
1/16" HOLES
1/8 TUBING SLEEVE
1/32" HOLES
1/16 HOLE
3/32 TUBING
1/8 SQUARE TUBING - SOLDER TO ROUND TUBING
CLEVIS SHOWN TWICE SIZE. MAKE 38
EPOXY FITTING & PIN WHILE WET. WRAP WITH THREAD
1/16" ALUMINUM YOKE PLATE
9/16 BRASS TUBING
9/64 HOLES
1/4" MAPLE DOWEL
1/8 THICK ALUMINUM
SOLDER
EPOXY FITTINGS & PIN WHILE WET
1/16" STEEL PINS
QUICK LINKS
1/32 STEEL PINS
ELEVATOR PUSH RODS
ADD BALSA TRAILING EDGE BRACES BETWEEN RIBS
3/32" SHEET BOX STRUCTURE
MAPLE LANDING GEAR MOUNTS
SERVO
O-O
HAND HOLD CROSS SECTION
FALSE RIBS
BALSA HAND HOLD EPOXY TO TIP. (BOTTOM WING ONLY)
3/32" PLYWOOD 2-56 BLIND NUT (2 PLACES) TOP OF BOTTOM WING ONLY.
1/8 LIGHT BALSA RIBS
EPOXY TRAILING EDGE TO RIBS
1/4" HARD BALSA SPARS MAKE 4 EACH 36" LONG
TYPICAL SECTION E-E
CUT 1/16" STRIPS FROM 3/32" SHEET PLYWOOD AND TAPER WITH SANDER
3/32 SHEET BOTH SIDES OF WINGS
SIMULATED DRAIN HOLES
SHAPE FROM 3/8" SQ BALSA
3/32" SHEET BOTTOM OF BOTH WINGS.
1/4" BIRCH PLYWOOD TIPS - MAKE 4
3/32 PLYWOOD WITH 2-56 BLIND NUTS EPOXIED ON BRACE. MAKE 8. EPOXY TOP OF BOTTOM WING. EPOXY BOTTOM OF TOP WING.
1/8 BALSA BRACES
1/16 STEEL WIRE
1/8 HARD BALSA SUPPORT
SOLDERED WASHERS
3/32 FAIRING MOUNT
M-M
BOTTOM WING ONLY
0-80 BOLT & LOCK NUT
3/32 BRASS TUBING SOLDERED TO SQUARE TUBING CLEVIS
.020 ALUMINUM FAIRING
FLAT PATTERN
3/32 SHEETING
1/8 BALSA BRACE
4-40 BOLT & NUT
1/32" PLYWOOD CAP STRIP
RIB
BALSA FILLER BLOCK
NYLON CRANK
MOUNT ASSEMBLY
N-N
GLUE BRACES TO RIBS TO ALIGN CRANK MOUNT, THEN GLUE MOUNT ASSEMBLY IN PLACE.
GLASS CLOTH DIHEDRAL JOINT
TILT TOP WING RIB 1.5° FOR DIHEDRAL; TILT BOTTOM WING 3.5° FOR DIHEDRAL
INTERNAL DRAG WIRES & COMPRESSION STRUTS SHOWN FOR REFERENCE ONLY.
RADIO CONTROL modeler MAGAZINE
BÜCKER JUNGMANN
DESIGNED BY G.C. LEAKE
DRAWN BY G.C. LEAKE


TRUE VIEW OF L.G. CENTER LINK PLATE
REAR BRACE
1/16" WIRE BRACE
SIMULATE L.G. FAIRING RIBS
FWD GEAR
MAKE L.G. FAIRING BY CARVING STYROFOAM & COVERING WITH 1/16 SHEET BALSA. CUT SLOTS FOR L.G. ON INBD SIDE. EPOXY L.G. IN FAIRING. FILL SLOT WITH BALSA & SAND SMOOTH.
STRUT ON THIS SIDE ONLY (LEFT)
OIL FILLER CAP 1/4" DOWEL
FILLER TUBE 3/16" DOWEL
TRUE SIZE L.G. FAIRING
EPOXY ALL 3 STRUTS & PLATE TOGETHER
3/32" PLYWOOD LINK PLATE (NOT TO SCALE)
WRAP ELASTIC AROUND WIRE FOR SHOCK
PAINT BLACK
SIMULATE RUBBER (DARK GREY) WITH HARD BALSA (L.G. IS OLEO SHOCKED) MAKE IN TWO HALVES & EPOXY ON GEAR.
DO NOT EPOXY HERE
TYPICAL TENSION STRUT (ALL STRUTS WHITE)
TRUE VIEW FWD L.G. STRUTS
WRAP WITH FINE COPPER WIRE & SOLDER (TYPICAL JOINT)
LAMINATE L.G. TENSION STRUT WITH 3 LAYERS OF 1/16" BALSA
1/16 WIRE TENSION STRUTS
5/32 WIRE FWD GEAR
LANDING GEAR PATTERNS TRUE SIZE
NOTE: ASSEMBLE WIRE L.G. AFTER BOTTOM CENTER SECTION OF WING IS BUILT. BUILD L.G. IN L.G. MOUNT IN WING TO ENSURE CORRECT FIT & ALIGNMENT.
1/8" WIRE REAR BRACE

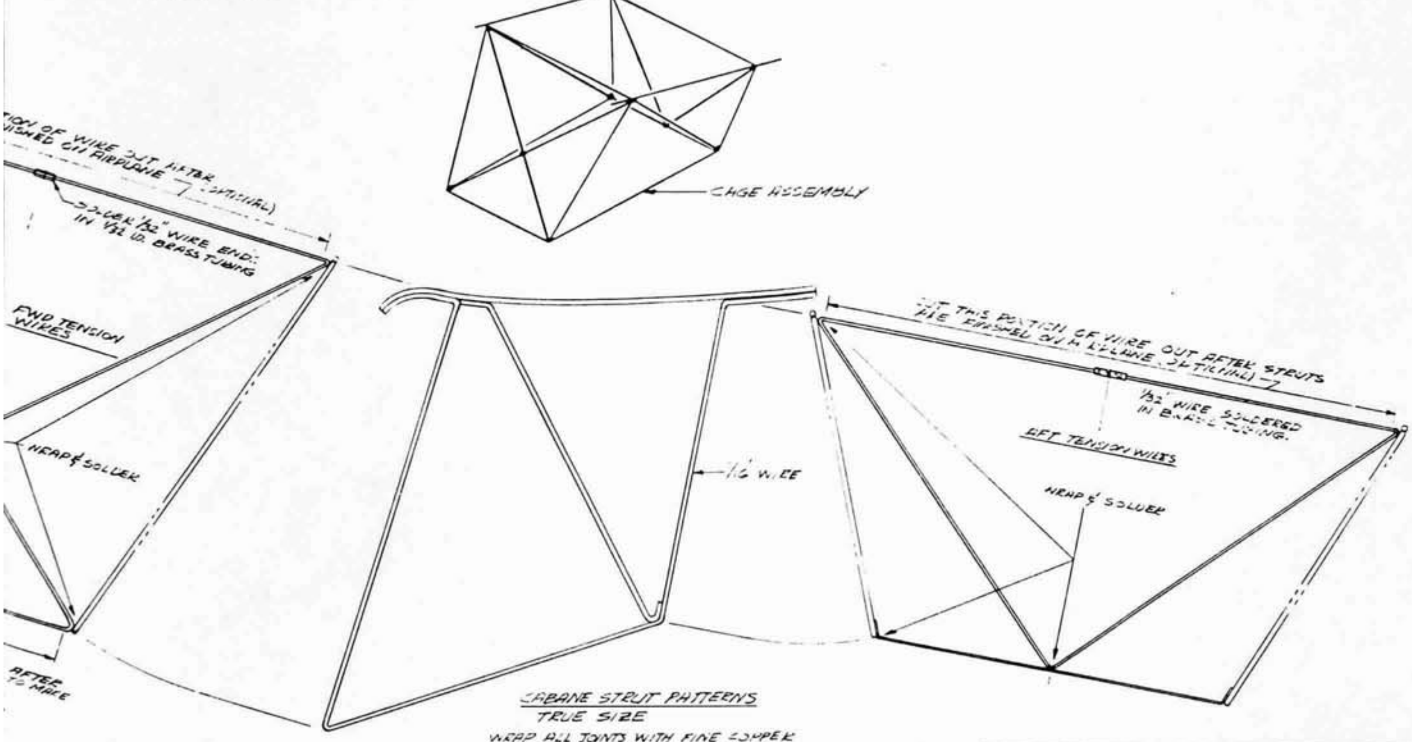
MIKA SLOVAK'S BÜCKER JUNGMANN (PRE 1964)

MANUFACTURER:	AERO (VYSOCANY CZECHOSLOVAKIA)
MODEL:	C.104
ENGINE:	WALTER MINOR 4-III
H.P.	105
SPAN	24 FEET 3 INCHES
WING AREA	143.1 FT²
WING CHORD	37.37 INCHES (R.A. TO L.E)
SWEEP BACK	11°
INCIDENCE & DIHEDRAL - UPPER WING	+1° INC. 1.5° DIH
- LOWER WING	0° INC 3.5 DIH
STABILIZER	-1° INC.
LENGTH	21 FEET 8 INCHES
HEIGHT (APPROX)	7 FEET 5 INCHES
WEIGHT (EMPTY)	836 POUNDS
GROSS WEIGHT	1470 POUNDS
MAXIMUM SPEED	112 MILES PER HOUR
CRUISE SPEED	105 MILES PER HOUR
STALL SPEED	51 MILES PER HOUR
RATE OF CLIMB	630 FEET PER MINUTE
CEILING	13000 FEET
RANGE	400 MILES

MODEL SPECIFICATIONS

ENGINE	S.T. 56 TO 61
SPAN	58.2 INCHES
WING AREA	835 IN²
WING CHORD	7.9 INCHES (RA. TO L.E.)
SWEEP BACK	11°
INCIDENCE & DIHEDRAL - UPPER WING	+1° INC. 1.5° DIH.
- LOWER WING	0° INC 3.5° DIH.
STABILIZER	0°
LENGTH	51.5 INCHES
HEIGTH (APPROX)	17 INCHES
WEIGHT (GROSS)	7.5 POUNDS
WING LOADING	20 OZ. PER FT²

ALL STRUCTURE SPACING IS SCALE.
WOOD SIZES APPROXIMATE SCALE AS CLOSE AS POSSIBLE AND STILL MAINTANE STRUCTURAL INTEGRATY.
ALL HINGING IS SCALE.
SCALE LANDING GEAR & TAIL WHEEL ASSEMBLIES.
THIS MODEL IS COMPLETELY SCALE TO THE BEST OF MY KNOWLEDGE AND ABILITIES. COCKPIT INFORMATION IS LACKING DUE TO DIFFICULTY OF PHOTOGRAPHING IN LIMITED SPACE. THE COCKPIT INSTRUMENTS ARE AS ACCURATE AS POSSIBLE; HOWEVER, SOME ARE OF EUROPEAN ORIGIN AND ACCURATE INFORMATION IS NOT AVAILABLE.
DEVIATIONS FROM SCALE ARE NOTED. AIRFOIL WAS CHANGED IN THE INTEREST OF GOOD FLYING. SCALE AIRFOIL MAY BE USED, BUT AILERON RIB DEPTH & CABANE STRUTS WILL HAVE TO BE REPLOTTED. IT IS RECOMMENDED THAT ALL METAL HINGES OR METAL TO METAL JOINTS BE MADE WITH MICARTA OR NYLON IF PROPORTIONAL EQUIPMENT IS USED.

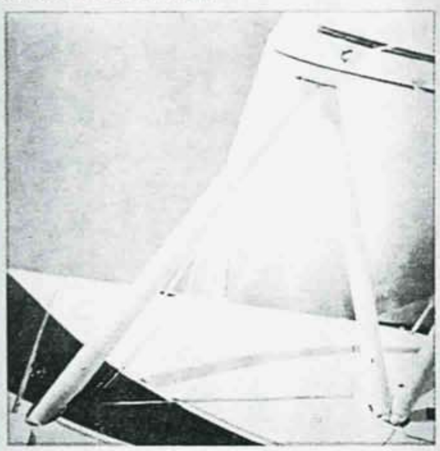


CABANE STRUT PATTERNS
TRUE SIZE
WRAP ALL JOINTS WITH FINE COPPER WIRE AND SOLDER.

RADIO CONTROL modeler MAGAZINE	BÜCKER JUNGMANN		
SCALE 1" = 5"			
DESIGNED BY	G. C. LEAKE	DRAWN BY	G. C. LEAKE

Landing gear detail (1964).

Strut fittings (1964).



Cabane strut & gas tank.

Mira's Jungmann (1964).

the same lines but with more power and a single seat. The Bucker Jungmeister then came into the world, sired by a man with a genius for designing good aircraft. Incorporated into the design of these two aircraft was all the knowledge and skill that the state of the art would allow at that time. Even the steel tubing in the fuselage is of unequal diameter as it moves back along the fuselage to the tail structure — an all-out effort to provide adequate strength without overbuilding and associated overweight. The empennage is of steel tubing and the wings of tubing with wood main spars. The covering has access zippers in it for quick maintenance and dismantling. The covering on the bottom of the fuselage is laced together at the center, thus enabling any portion of the fuselage to be quickly inspected.

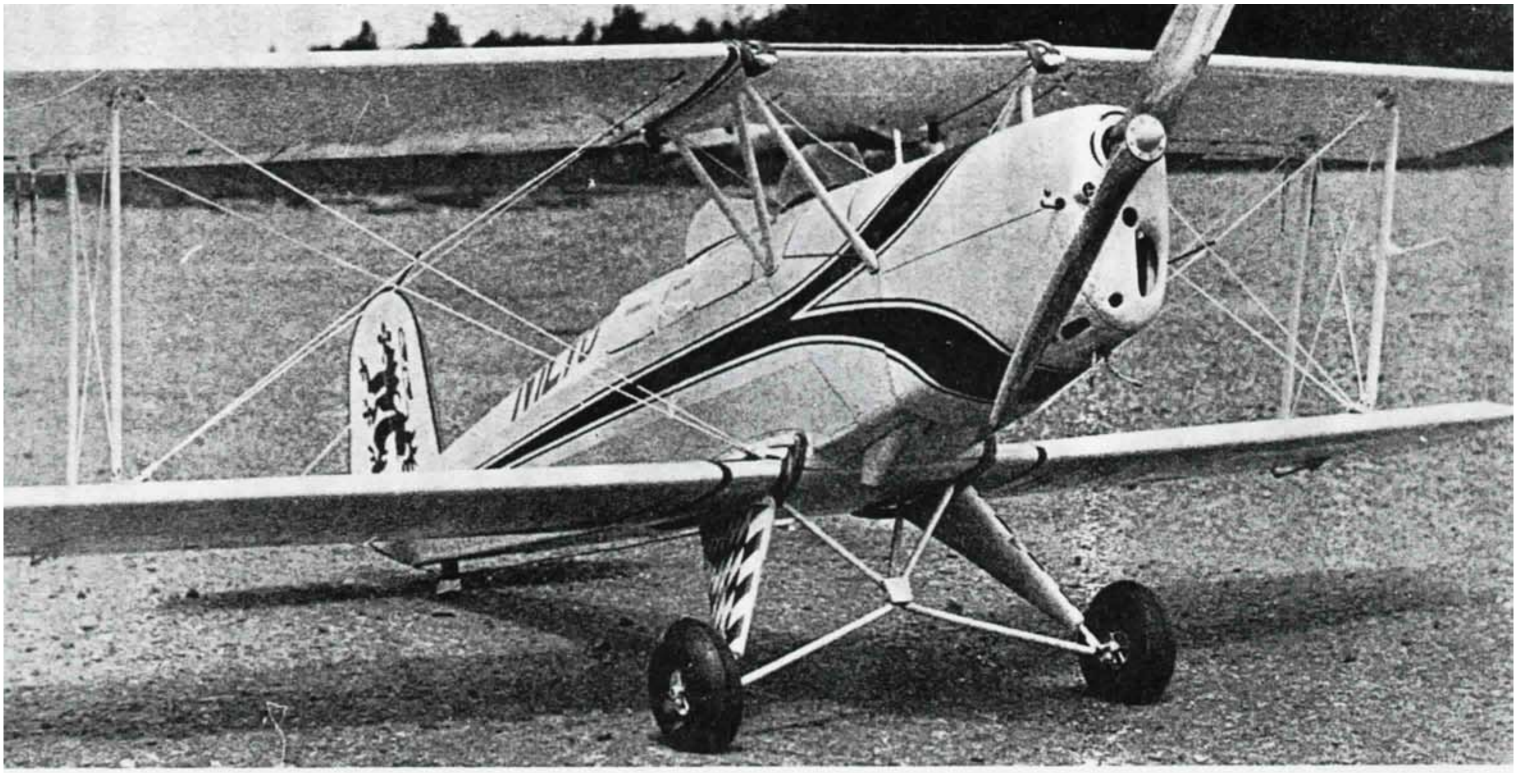
The Jungmann and the Jungmeister have been coveted prizes ever since they first proved their aerobatic capabilities. Of the two, the Bucker Jungmeister is the most well known in the United States. Mike Murphy, in 1938 to 1941, and Bevo Howard, after 1948, flew to fame in a Bucker Jungmeister all over the country in hundreds of airshows and aerobatic contests. Mike Murphy's (later Bevo Howard's) Jungmeister was a rebuild of the same airplane which Captain Alex Papana brought over from Germany in the Zeppelin Hindenburg and flew in hundreds of air shows here in the United States in 1936 to 1938. In 1938, another airplane landed on top of Papana's Jungmeister while he was taxiing on the runway. Papana escaped with minor injuries, but the airplane was pretty badly mangled. The Jungmeister was then acquired by Mike Murphy and friends who restored the aircraft. Papana's Jungmeister has a sunburst on both wings. When Mike Murphy and friends rebuilt the Jungmeister, the sunburst was retained, a sweeping split stripe down the side of the fuselage was added, and checks added on the bottom of the lower wing, tail and landing gear. Bevo Howard retained the basic paint job and added more horses.

It seems traditional that all Jungmeisters and Jungmanns in the United States must have a sunburst on the wings, and so what does Mira Slovak do? Why refinishes his newly acquired Jungmann with a sunburst on the wings of course, also a sweeping split stripe down the side of the fuselage and checks on the landing gear, a la Howard. A Lowenbrau beer label inspired the griffin on the tail. (You can tell where he spends his evenings!) When Mira first obtained the Jungmann, it had a Walter Minor engine of 105 hp with fuel injection. The plane was conventionally covered, complete with zippers and lacing. With one man in the aft cockpit, it was a nice handling aerobatic airplane, but nothing spectacular by today's standards. With another man in the front cockpit, it would just about fly, and not much more, unless it had a real head of steam up. So Mira had a few modifications made in late 1964-65. Things like: putting a 205 hp Lycoming up front, eliminating all the zippers, lacing and replacing them with conventional access panels, a new paint job and griffin on the tail, a gold pin stripe along the edges of the sunburst on the wings and a black pin stripe outlining the gold on the tail, and hydraulic brakes added. Man! Now there is a flying machine. But look at it. All the old world character is gone. That lycoming and sloping front end does absolutely nothing for me. Hence presentation of Mira Slovak's Bucker Jungmann a la 1963, complete with zippers and lacing. Now that takes me back to the way a Jungmann should look. True, it doesn't climb straight up. But, by golly, it's still got the old world flavor in it!

Mira is flying his modified Jungmann around the country in numerous airshows and competing as a top driver in the unlimited hydros anywhere there is purse money. He is no longer flying for Continental Airlines. He is doing the things he likes and does best, thrill the crowds, whether it's in an airplane doing a Luncevak or racing a hydro at 180 mph down the straightaway. If you ever get a chance to see him or his airplane, don't miss it. If you ever get a chance to talk to him, you'll find he is a modest and personable man with a gift for enjoying life.

Biplanes have always been a little bit special with me. My first multi ship was a deBolt Custom Bipe. The Bucker bug bit hard about 1965. I built a R/C single channel version of the Bucker Jungmeister prototype which was published as a free flight in the September 1963 issue of MAN. I was really hooked then. So off I went on a research project, little realizing that not too much information was available on the Bucker Jungmann. Why the Jungmann instead of the Jungmeister? That big cowling, that's why! Also, I'm chicken, and I like two seats when I fly!

Information was gleaned from old articles of the Jungmann and Jungmeister. Plans of a 125 hp conversion version made in Sweden were obtained from Don Davidson of Seattle, David Gauthier (1966 President of Chapter 26 of the EAA) is building a Jungmann from scratch (as well as tubing). Much of the information I obtained was generously furnished by them, including copies of the fuselage measurements taken from factory drawings. Plans and photographs made by Frank Price of Waco, Texas of his Jungmeister furnished additional data. An all-out effort was made to duplicate the internal structure of the Jungmann as accurately as possible. Photographs of



Only the rubber bands give it away as being a model. Note starting wires hanging from glowplug access hole.

Mira Slovak's Jungmann and photos from Peter Bower's files of prewar Jungmanns furnished information on external details. Incidentally, the Jungmanns were built by several different manufacturers and so no two Jungmanns seem to be exactly alike. Also as planes are flown, many modifications take place during the lifetime of the airplane. The only way to get accurate information is to concentrate on just one airplane and track down its life history. I hope I'm reasonably accurate with Mira Slovak's airplane. Keep in mind that this is a model of the 1964 version and earlier. Many modifications were made to the airplane after 1964.

The airplane has generous tail area and moments, thereby ensuring smooth flying. The model is no exception. It flies extremely well, no hot rod, but good stable flying with the ability to do most of the AMA maneuvers. It's been flown in 20 mph winds safely. Well, maybe not so safely, but at least I got it down for a good landing without any bounce. For me, that's safe! I can't say that I've won umpteen trophies with it; I'm not long distance minded and so it's only been entered in contests in the Washington-Oregon area, and there are doggone few scale contests around here. It placed first in the Annual RAMS (Radio AeroModelers of Seattle) R/C Symposium in February 1966 (prior to first flight) and placed third in the Annual Sand Point Naval Base contest in May of 1966. That was the 20 mph wind one. In Oregon on September 19, 1966 at Delta Park, I learned something. Don't move the landing gear back! On my model the landing gear was moved back one inch to, quote, "ensure good take-off characteristics." On cement it worked fine. At Delta Park on grass — oboy! The movies taken by George Hickson of the RAMS are a riot. That plane made so many nose-overs in the grass I lost count. The judges were extremely patient. By the time I was frustrated enough to hand launch it, the vertical fin was broken and so back to the drawing board. I moved the landing gear back to the scale position and there it will stay. The correct location is shown on the plans.

The Jungmann is a ball to fly and a lot easier to build than you might think at first glance. Don't let all the plywood scare you. It's not as heavy as you might think and provides good strength. It has to be strong to survive my crash-er-landings. The plane is surprisingly strong and should weigh out at no more than $7\frac{1}{2}$ pounds ready to fly. I do suggest that you have a jig-saw available. The jig-saw can be used to cut out all the parts including the turtle deck formers and the metal fittings. Various blades can be obtained for the saw. I recommend a 28 or 32 tooth to the inch blade for good clean cuts. Since my radio gear is reed equipment, the hinges are of metal. If you expect to use proportional, I highly recommend that a good grade of cloth Micarta be used for the hinges and where possible, nylon fittings be made to avoid metal to metal contacts. I also recommend that all parts for any one project be cut out ahead of time before actual construction is undertaken. That way, the fuselage — for example — can be glued or epoxied together and while drying, the tail feather components can be cut out. While one component is drying, you can cut out the parts for the next component. Construction goes quite fast this way. Study the plane carefully and fix in your mind exactly what order each part must be assembled before beginning construction.

FUSELAGE: Build the two fuselage sides from hard straight-grained balsa. Watch for the tack glue joints at the aft cockpit gusset and on both ends of the lower wing saddle. This area is split and then reglued permanently when the two sides are joined together to complete the basic box as shown on the top and bottom views. The fuselage is not a square box so make sure you build the box assembly first on the bottom view and then flip it over onto the top view and glue in the top cross braces. The wing saddle and aft cockpit gusset are glued permanently after the box is formed, and the extra wood shaved off the sides. This ensures the sides are straight and not bowed. Glue the plywood doublers inside the fuselage box. Epoxy the firewall in place after the basic box is completed, then build up the remaining portions of the fuselage with very light balsa. Don't forget to attach the engine mount retaining plate before the firewall is installed. Install the 1/32" plywood air duct plate and sheet the

(Continued on Page 80)

MILES M

From England, Dave Platt's Magister is an able comp

PHOTOS AND TEXT

ONE of the surest things to happen to any RC'er is that, sooner or later, the bug to make a scale model will bite. With a great many flyers it never gets past this point due to the work involved and the slice taken out of the season's building time. This particularly applies if the model will be an original design as well. Nevertheless it's an undeniable fact that ALL modellers love to see a good scale ship fly, and even those with no time to build one are quick to stand and watch. The following remarks are applied to Multi Channel Scale models and will not necessarily hold good for single channel.

Just so we are on common ground as to the understanding of these terms we'll explain that, although any number of channels over two could be called multi, when we say Multi-Channel we mean at least 10 channels of reeds or 4 channels proportional. Similarly when we say Scale, we mean just that — not semi-scale with a tilt at one plane in particular.

Those who build scale models all have their own way of choosing a subject to model. This is how we work: —

First and foremost we are making a FLYING scale model and we need a subject to have good suitability in an aerodynamic sense. For example, we set a lower limit of 15% of the wing area for the horizontal tail surfaces. Lower than this we reject on stability grounds and look at other aircraft. Bearing in mind our previous remarks about scale, we **don't** alter the areas to suit.

The difficult problem of undercarriages comes in here. If the subject has a retracting gear so should the model. If this is impractical the design is rejected. Fixed-gear aircraft are obviously easier and conform to our principles. Balance is another number one consideration. Many exciting airplanes are difficult or impossible in this respect. The Sopwith Camel springs to mind. To get the CG in the right place with so short a nose would be a miracle without 3 lbs. of lead in the cow!

Next, we need to consider the availability of good accurate information on the subject. A good scale drawing, several photos, and details of construction and cockpit detail will be needed. Without them we cannot make a start. A bit of patient hunting through authoritative books could be necessary. Museums may assist. A letter to the manufacturer screaming for help is often well worth a postage stamp.

Another consideration is the 'appeal' factor of the subject. We all have our favorites among full size airplanes. Some fellows go for jazzy-colored subjects, others for struts and rigging wires. Some for military planes of the wars, others for pretty home-builts. A Curtiss P40 or a Stitt's Playboy? The choice is all yours and there are thousands upon thousands to look at.

We chose the Magister for many good reasons. It has fixed gear. The layout of the plane is perfect for a flyer, with ample wing area and a generous tail moment. The tail area is quite adequate and the nose length gives a correct CG automatically. The UC is well placed in a useful forward position. It would be hard indeed to find a feature of the Magister which could be put in the 'Disadvantage' side of the scales. While we're about listing the virtues we nearly forgot the totally enclosed motor in a deep cowling, a big help in the U.K. where we have to use mufflers (You, too, in U. S. soon?)

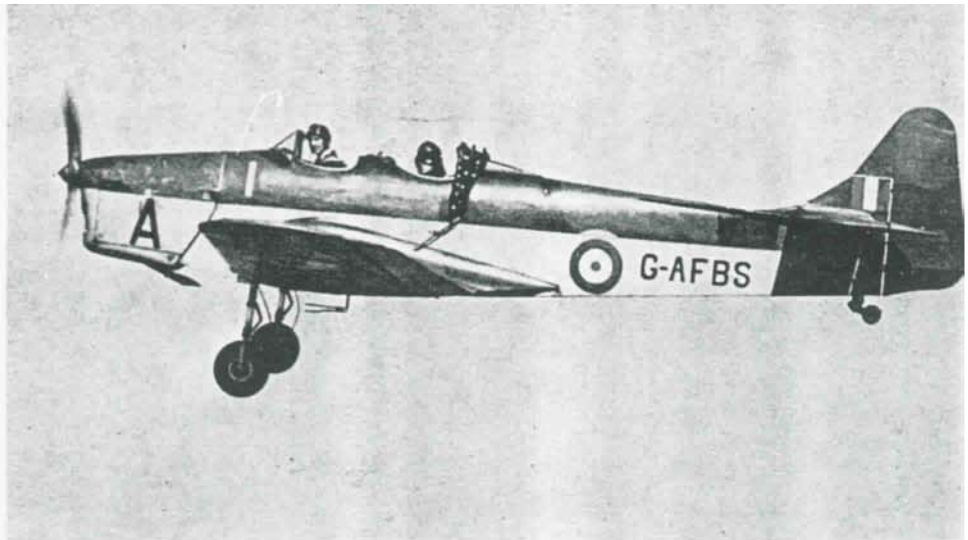
The full size machine has a span of 33' 10". Scale chosen was 2"=1' or ⅙th full size. This gives a span of nearly 68" and an area of 726 square inches.

In many ways the Miles M14A Magister could be called the British equivalent of the PT19. It was an attractive two place inline **ab initio** trainer of all-wood construction. Provision was made for instruction in blind flying in the shape of a pull-over hood for the rear cockpit. Designed a few years before WW II the Magister taught thousands

AGISTER

award winning Miles M14A
etitor in R/C scale circles.

BY DAVE PLATT



of pilots to fly during the entire period of the war. It was also a delightful machine to fly, and after the war the surplus aircraft found ready sales on the civil market, going to flying clubs and schools. It will be seen that a great variety of paint schemes can be used to personal preference. The one we chose is the military scheme used on the wartime aircraft, as follows: —

Undersurfaces and fuselage sides up to demarcation line — Trainer Yellow, Wing undersurface Roundel is red, white and blue.

Upper surfaces in standard camouflage, Dark Earth and Dark Green.

Roundel on upper wing surface is Red and Blue only, no White. Notice how the yellow continues round the red, white and blue fuselage roundel, cutting into the camouflage. The flash on the fin is also red, white and blue.

Serial number on fuselage side aft of roundel is Black, as is the letter on the cowl.

Individual aircraft number on upper decking is white and should be painted rather streaky.

All divisions between the brown and green of the camouflage must be sprayed soft lines — not hard paint lines. Another common mistake often made with camouflage is to spray haphazard shapes. It is not always realized that camouflaged aircraft has a definite pattern of shapes. Thus, all Magisters will be alike, all Spitfires alike and so on — a scheme being worked out for each type of plane to conceal its own particular shape. The divisions for this airplane are shown on the plan.

The shade of red used on the Roundel is a rather drab color, more like tan brown. The camouflage shades are drab also, the green containing a good deal of red, making it a "greeny shade of brown" to be exact.

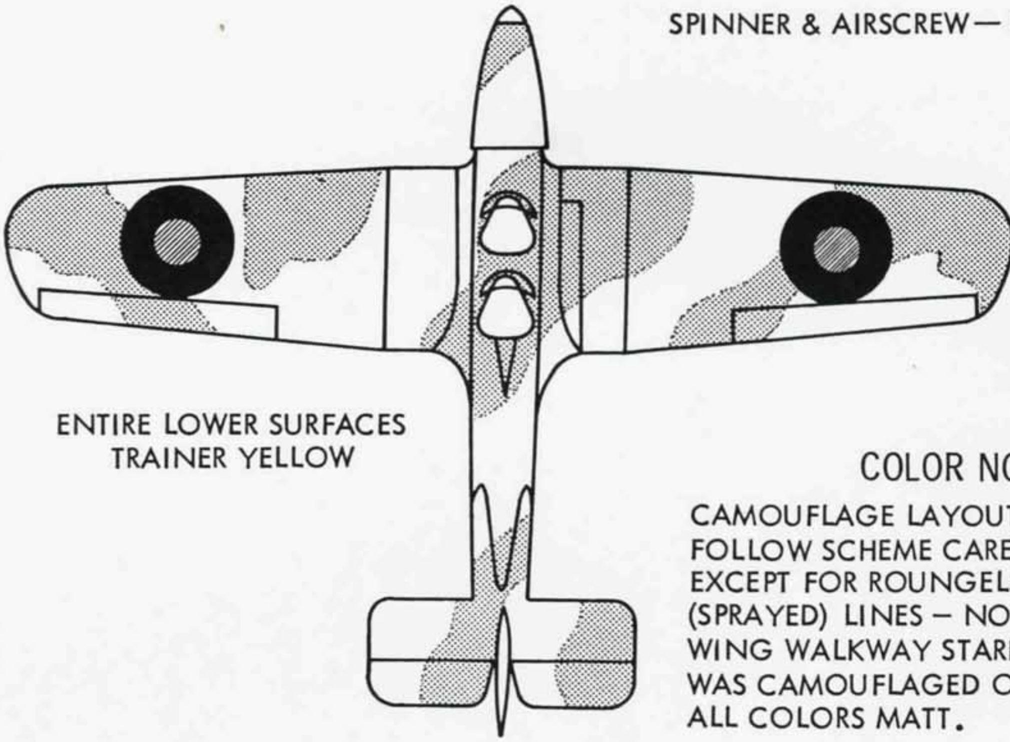
The model is not hard to build. Construction-wise there are no irregular or difficult features, and anyone who could build a Candy can make this one. Therefore only those points needing care will be discussed.

The wing is made first. This is not only preference; the wing will be needed at a later stage in fuselage construction. As with any multi channel RC model, only the very best workmanship of which the builder is capable will do. Most importantly, the wing MUST be free of any warp or twist. On an all-sheet covered wing of this type it will be found that the wing can be twisted slightly by hand **until** the point where the last sheet to complete the box is added. Therefore when you have just one 3" or 4" width of sheet to add, carefully inspect the wing and make any corrections required NOW, because when the box is complete it will be a more irksome job to remove a warp.

For the benefit of those who, by accident, do build any fully sheeted wing complete and then discover a twist, here is the way to correct it:

Make an incision into the sheet of either the upper or lower (preferably lower) surface of the wing. The cut should run at about 50% chord for the entire length of the incorrect panel. It is essential to run the knife along a straight edge, say a metal rule. Now it will be found that the wing can be twisted by hand with the forward and rearward sections of sheeting skidding against each other. While holding the wing in correct alignment by some means, run cement into the incision to stick the sheeting together again. Keep the wing firmly held, in the correct position, for AT LEAST six hours for the cement to thoroughly set, before removing the device you are using to hold the wing.

The undercarriage assembly is now completed with all the small details which add refinement to a model of this type. On the original model a section of chromium tubing (actually a bit of an old transmitter antenna) was slipped over the UC legs before the wheel forks were soldered on. This tubing was then



COLOR NOTES

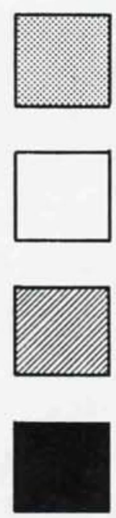
CAMOUFLAGE LAYOUT DOES NOT VARY. FOLLOW SCHEME CAREFULLY. DIVISIONS EXCEPT FOR ROUNGELS ARE "SOFT" (SPRAYED) LINES – NOT HARD DIVISIONS. WING WALKWAY STARBOARD SIDE ONLY WAS CAMOUFLAGED OVER. ALL COLORS MATT.

PLAN VIEW

NOTES:

SPAN (FLAT) IS 68" PROJECTED SPAN 67 - 5/6"
SPAN OF FULL SIZE MAGISTER 33'-10"

COLOR KEY

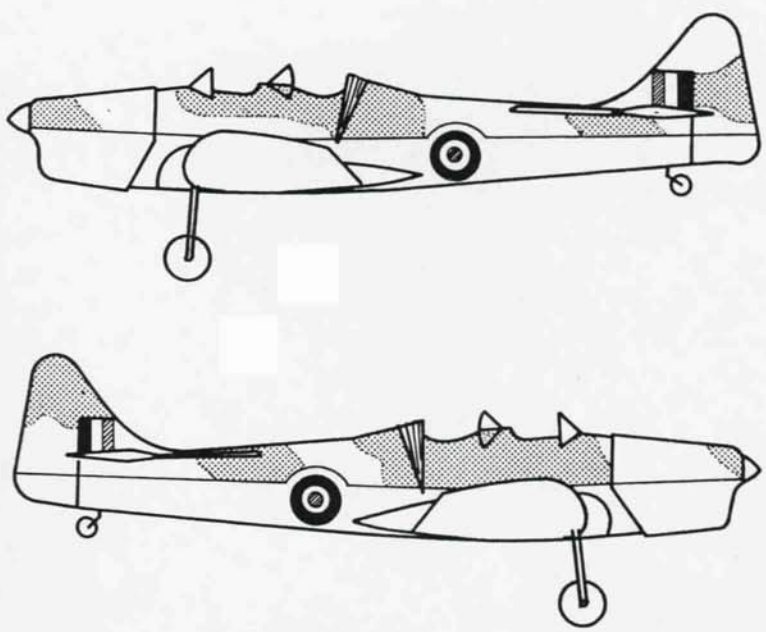


DARK GREEN

DARK EARTH

IDENTIFICATION RED

IDENTIFICATION BLUE



FUSELAGE CAMOUFLAGE PATTERN

(Flat) is 68″ projected span 67 5/6″ span of full size Magister 33′-10″ presenting an exact scale model to 1/6 full size. (2″ = 1′) of the Miles M.14A Magister. For 8-10 CC motors (.45 to .60) and multi channel radio control (10 channel reeds or 4 channels proportional). Information for scale judges: There is only one slight deviation from full scale and this is that the wing incidence of 2 deg. in the full size Magister has been removed. All areas and sections throughout are correct as designed.

painted black everywhere except between the V-shaped dummy shock-absorber. This section was left in bright polished metal, giving a remarkably realistic effect of a working shock-absorber. Dummy brake cables are of ordinary black RC hook-up wire of a rather thick variety.

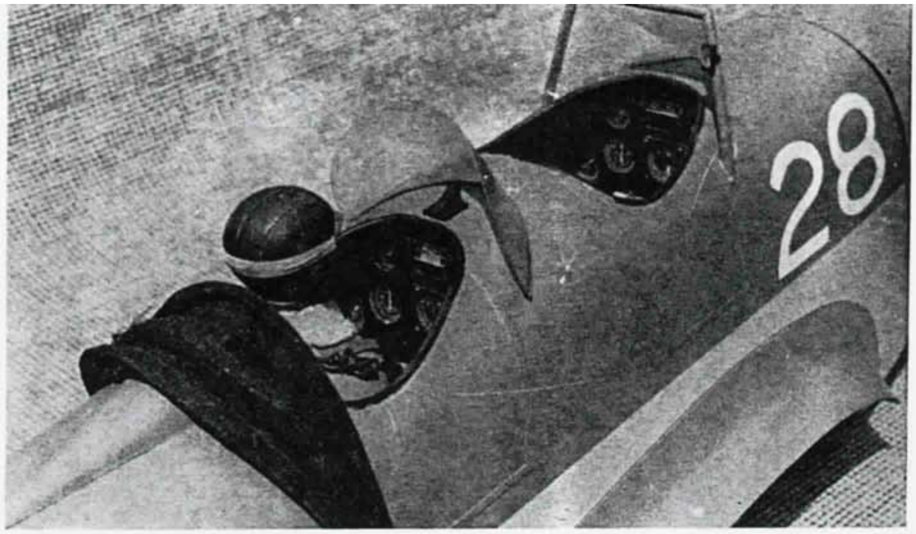
The ailerons, which, of course, should be very free-moving as on any other RC model, are only worthy of comment in one area — that is, like the tailplane, elevators and rudder, they were built up and fabric covered on the real job. We must represent this, and after a good deal of experiment involving genuine built up replicas of the original construction and a couple of other ideas, the best and most realistic way get the required effect was found to be to make the ailerons etc. in conventional sheet construction, then after the two coats of primer (see later for fuller details of finishing process) strips of thick paper (try blotting paper) 1/16" —3/32" wide are cut and gummed to the surface in the scale rib positions. The aileron is afterwards covered with model tissue. The usual further finishing is continued over the paper and the final effect is so life-like you'll chuckle with glee!

When the wing is completed, give two coats of auto primer. When thoroughly dry, **at least** 24 hours later, sand smooth and cover with heavyweight Silkspan, applied wet, using clear nitrate dope as adhesive. Let this do for the time being.

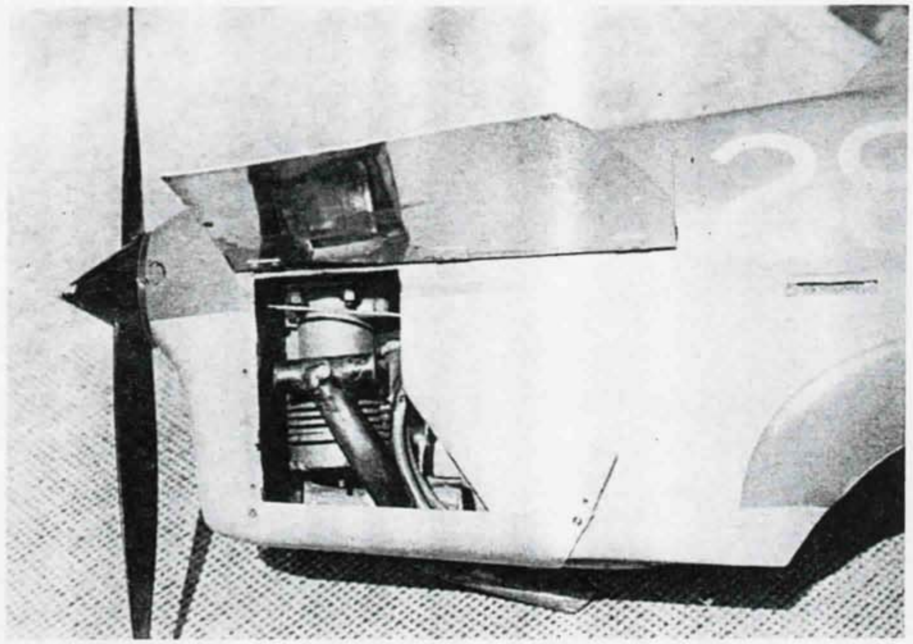
While that primer was gassing off we weren't watching the Telly! It is a good idea to get the tailplane and elevators built. These are simple structures of no artistic merit. Don't forget the "ribs" of gummed paper.

The motor used to power the original model was a Merco .61 which was very suitable. The Super Tigre .56 will provide somewhat more power if this is needed — say if the model gets well overweight. A good .45 will do the trick on a light version. The weight of the finished model can range from 7 lbs. or so which is the lightest it could be built, to about 9½ lbs., above which it could be a bomb. Ours weighs 7 lbs. 13 oz. and this includes 3 oz. for the muffler. Obviously a .45 motor can be used in the model regardless of its weight, but the guide given is right if we presume the builder wants fully aerobatic performance.

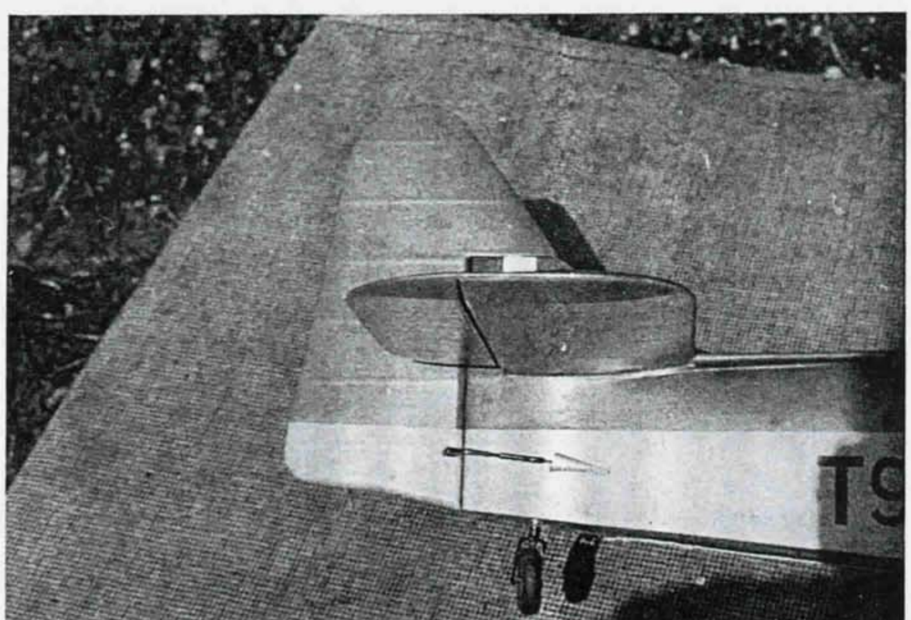
Mention of the muffler is in order. Quite apart from the fact that they are obligatory here in England, a muffler can help in another way. Glow engines are likely on occasion to spit flames and set light to loose fuel in the vicinity, and in short order the airframe is well under way. The muffler is especially useful in the Magister in preventing this from happening, since the cowl would prevent the flyer doing the usual hefty



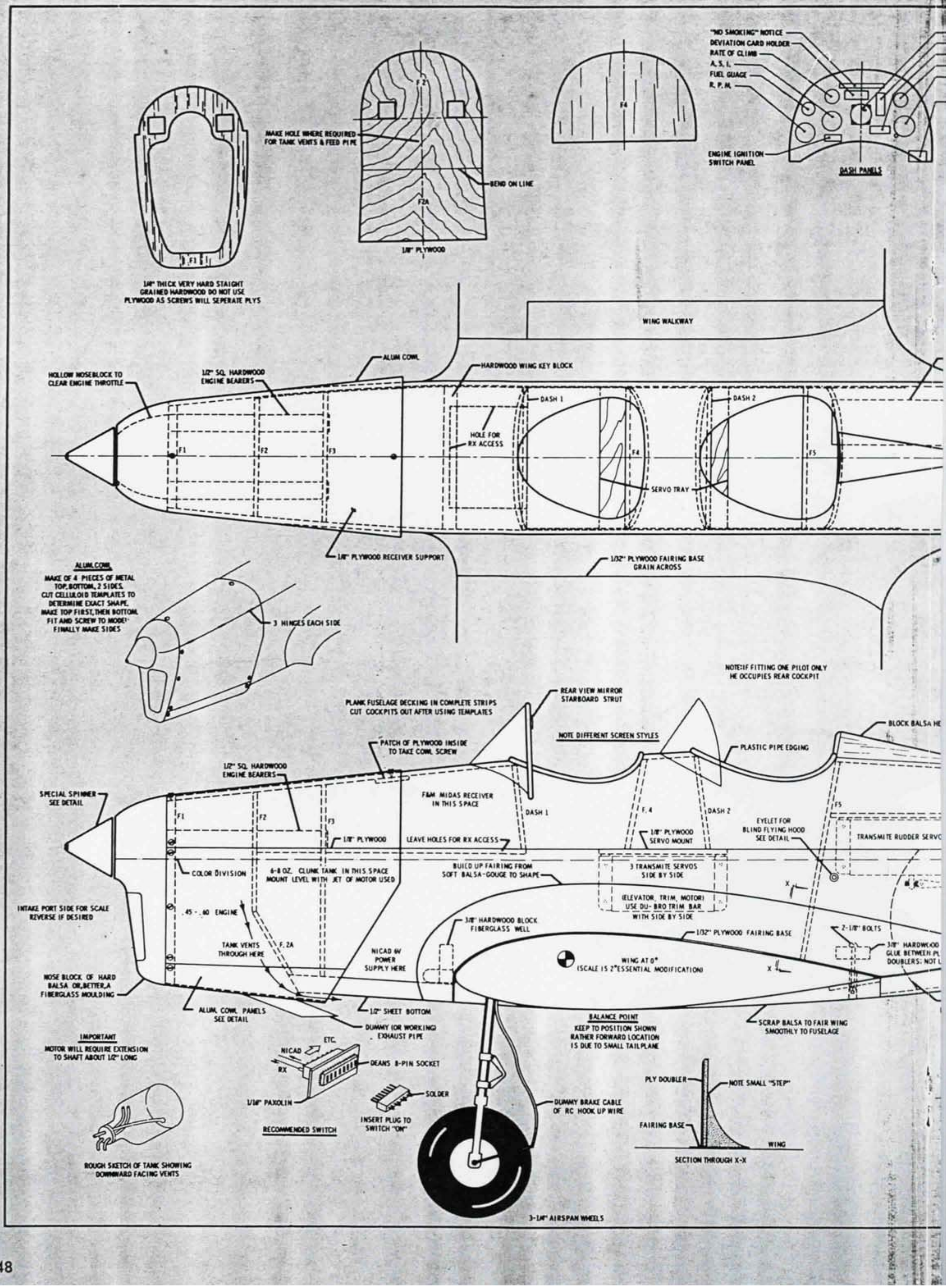
Cockpit view. Note rear view mirror on front strut and blind flying hood behind rear cockpit.

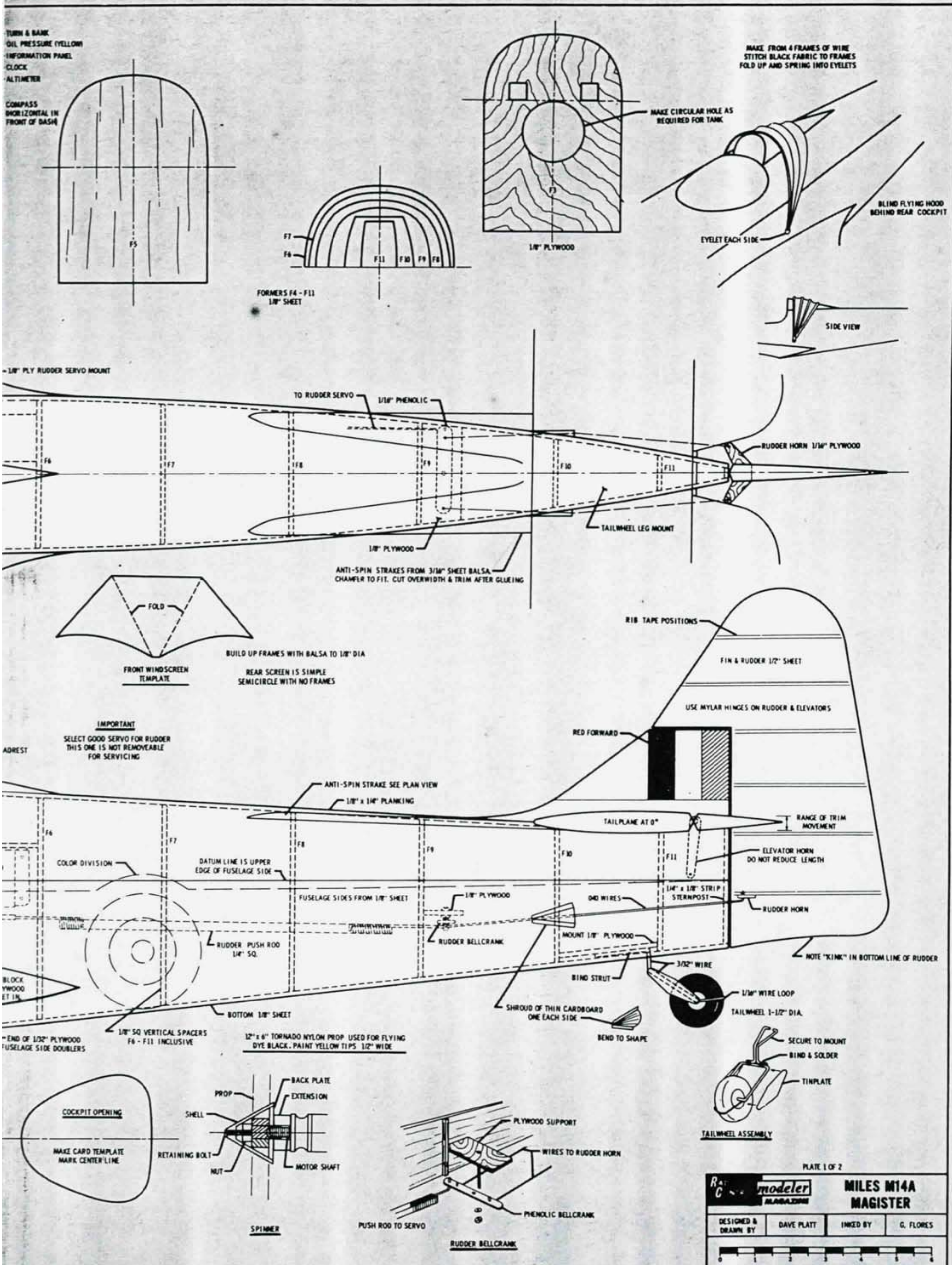


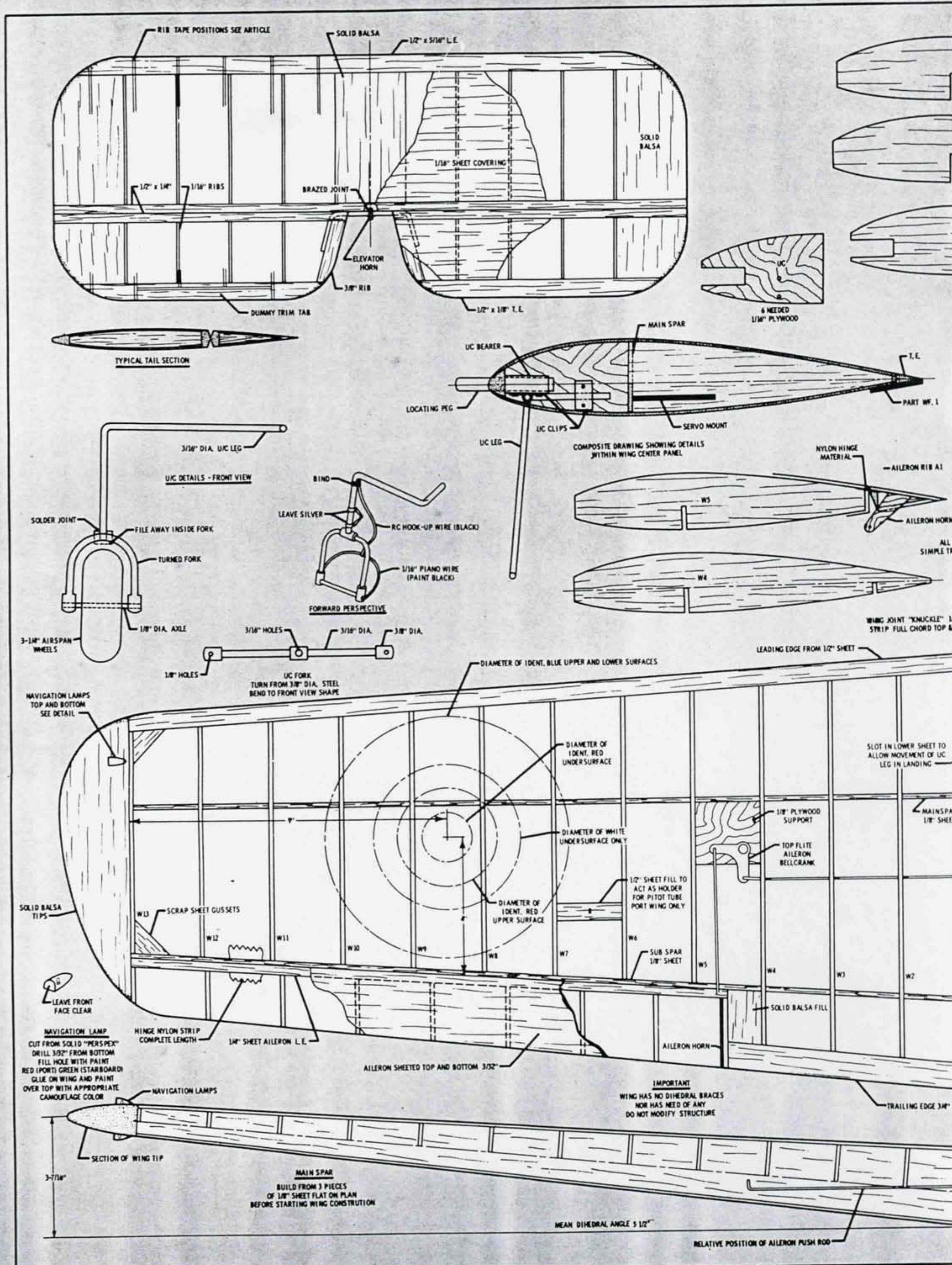
View of engine and internal silencer. Metal cowling.



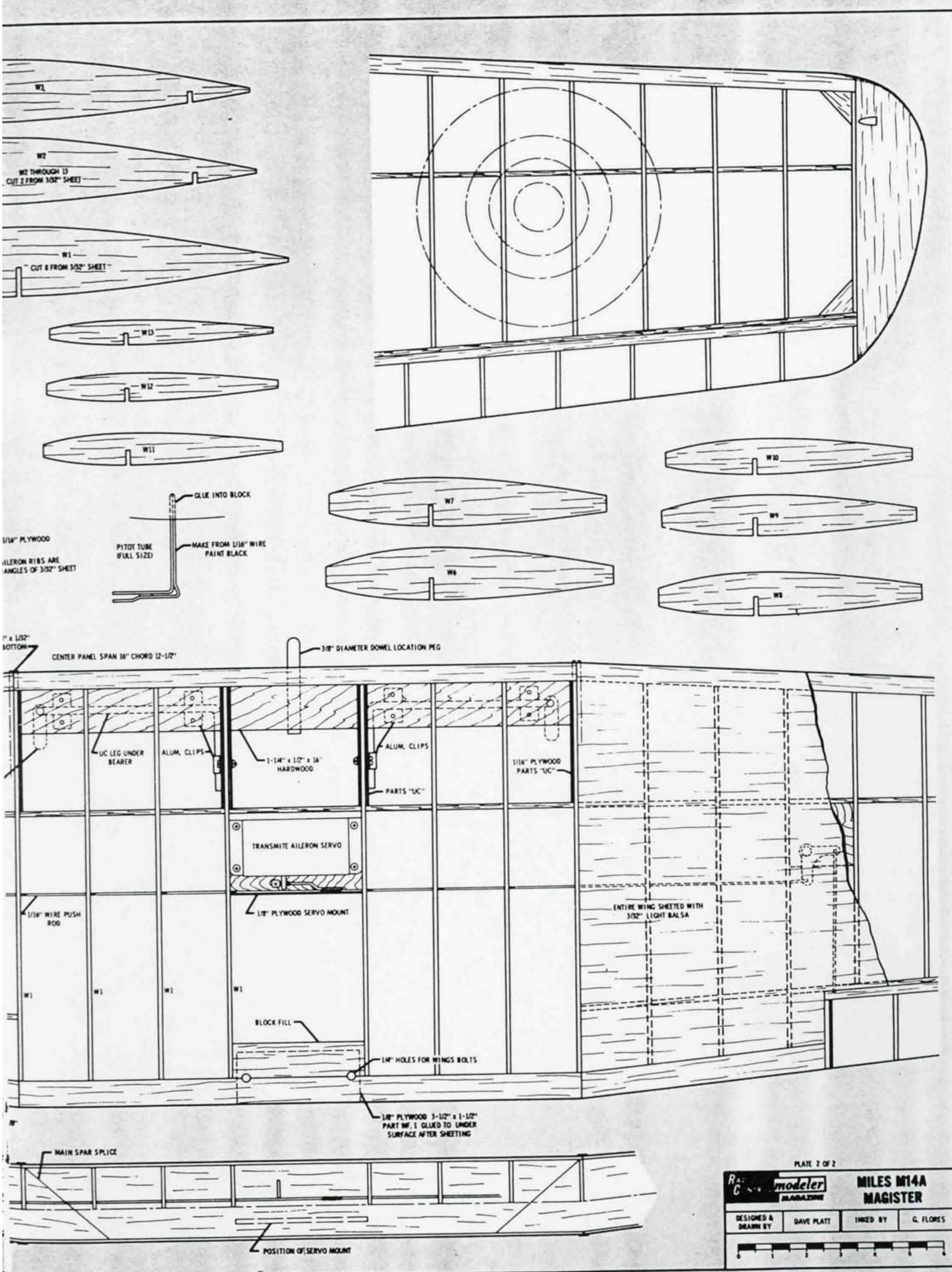
Tail assembly showing rib tapes and rudder pushrods.

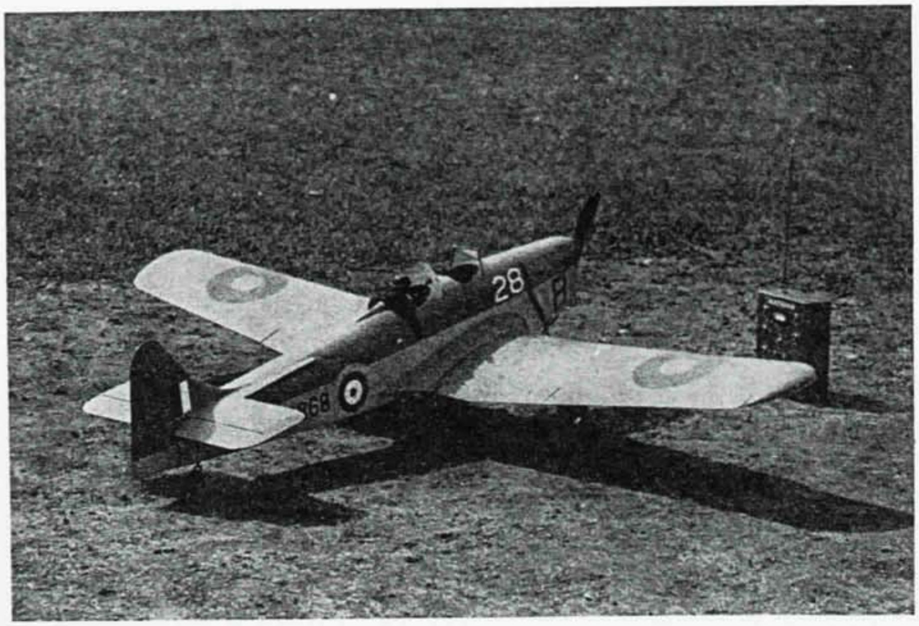

"NO SMOKING" NOTICE
DEVIATION CARD HOLDER
RATE OF CLIMB
A. S. I.
FUEL GUAGE
R. P. M.
ENGINE IGNITION SWITCH PANEL
DASH PANELS
F4
F2
MAKE HOLE WHERE REQUIRED FOR TANK VENTS & FEED PIPE
BEND ON LINE
F2A
1/8" PLYWOOD
F1
1/4" THICK VERY HARD STAIGHT GRAINED HARDWOOD DO NOT USE PLYWOOD AS SCREWS WILL SEPERATE PLYS
WING WALKWAY
ALUM COWL
HARDWOOD WING KEY BLOCK
HOLLOW NOSEBLOCK TO CLEAR ENGINE THROTTLE
1/2" SQ. HARDWOOD ENGINE BEARERS
DASH 1
DASH 2
HOLE FOR RX ACCESS
F3
F5
SERVO TRAY
1/8" PLYWOOD RECEIVER SUPPORT
1/32" PLYWOOD FAIRING BASE GRAIN ACROSS
ALUM.COWL
MAKE OF 4 PIECES OF METAL TOP, BOTTOM, 2 SIDES. CUT CELLULOID TEMPLATES TO DETERMINE EXACT SHAPE. MAKE TOP FIRST, THEN BOTTOM. FIT AND SCREW TO MODEL FINALLY MAKE SIDES
3 HINGES EACH SIDE
NOTE: IF FITTING ONE PILOT ONLY HE OCCUPIES REAR COCKPIT
REAR VIEW MIRROR STARBOARD STRUT
PLANK FUSELAGE DECKING IN COMPLETE STRIPS CUT COCKPITS OUT AFTER USING TEMPLATES
NOTE DIFFERENT SCREEN STYLES
BLOCK BALSA HE
PATCH OF PLYWOOD INSIDE TO TAKE COWL SCREW
PLASTIC PIPE EDGING
1/2" SQ. HARDWOOD ENGINE BEARERS
SPECIAL SPINNER SEE DETAIL
F&M MIDAS RECEIVER IN THIS SPACE
F. 4
EYELET FOR BLIND FLYING HOOD SEE DETAIL
1/8" PLYWOOD
LEAVE HOLES FOR RX ACCESS
1/8" PLYWOOD SERVO MOUNT
TRANSMITE RUDDER SERVO
COLOR DIVISION
6-8 OZ. CLUNK TANK IN THIS SPACE MOUNT LEVEL WITH JET OF MOTOR USED
BUILD UP FAIRING FROM SOFT BALSA-GOUGE TO SHAPE
3 TRANSMITE SERVOS SIDE BY SIDE
(ELEVATOR, TRIM, MOTOR) USE DU-BRO TRIM BAR WITH SIDE BY SIDE
INTAKE PORT SIDE FOR SCALE REVERSE IF DESIRED
.45 - .60 ENGINE
3/8" HARDWOOD BLOCK FIBERGLASS WELL
1/32" PLYWOOD FAIRING BASE
2-1/8" BOLTS
TANK VENTS THROUGH HERE
F. 2A
NICAD 6V POWER SUPPLY HERE
WING AT 0° (SCALE IS 2° ESSENTIAL MODIFICATION)
3/8" HARDWOOD GLUE BETWEEN PL DOUBLERS: NOT L
NOSE BLOCK OF HARD BALSA OR, BETTER, A FIBERGLASS MOULDING
ALUM. COWL PANELS SEE DETAIL
1/2" SHEET BOTTOM
DUMMY (OR WORKING) EXHAUST PIPE
BALANCE POINT
KEEP TO POSITION SHOWN RATHER FORWARD LOCATION IS DUE TO SMALL TAILPLANE
SCRAP BALSA TO FAIR WING SMOOTHLY TO FUSELAGE
IMPORTANT
MOTOR WILL REQUIRE EXTENSION TO SHAFT ABOUT 1/2" LONG
NICAD
ETC.
RX
DEANS 8-PIN SOCKET
1/16" PAXOLIN
SOLDER
INSERT PLUG TO SWITCH "ON"
RECOMMENDED SWITCH
DUMMY BRAKE CABLE OF RC HOOK UP WIRE
PLY DOUBLER
NOTE SMALL "STEP"
FAIRING BASE
WING
SECTION THROUGH X-X
ROUGH SKETCH OF TANK SHOWING DOWNWARD FACING VENTS
3-1/4" AIRSPAN WHEELS


TURN & BANK
OIL PRESSURE (YELLOW)
INFORMATION PANEL
CLOCK
ALTIMETER
COMPASS (HORIZONTAL IN FRONT OF DASH)
F5
F7
F6
F11 F10 F9 F8
FORMERS F4 - F11 1/8" SHEET
MAKE CIRCULAR HOLE AS REQUIRED FOR TANK
F3
1/8" PLYWOOD
MAKE FROM 4 FRAMES OF WIRE STITCH BLACK FABRIC TO FRAMES FOLD UP AND SPRING INTO EYELETS
BLIND FLYING HOOD BEHIND REAR COCKPIT
EYELET EACH SIDE
SIDE VIEW
1/8" PLY RUDDER SERVO MOUNT
TO RUDDER SERVO
1/16" PHENOLIC
RUDDER HORN 1/16" PLYWOOD
TAILWHEEL LEG MOUNT
1/8" PLYWOOD
ANTI-SPIN STRAKES FROM 3/16" SHEET BALSA. CHAMFER TO FIT. CUT OVERWIDTH & TRIM AFTER GLUEING
FOLD
FRONT WINDSCREEN TEMPLATE
BUILD UP FRAMES WITH BALSA TO 1/8" DIA
REAR SCREEN IS SIMPLE SEMICIRCLE WITH NO FRAMES
RIB TAPE POSITIONS
FIN & RUDDER 1/2" SHEET
USE MYLAR HINGES ON RUDDER & ELEVATORS
RED FORWARD
IMPORTANT
SELECT GOOD SERVO FOR RUDDER THIS ONE IS NOT REMOVEABLE FOR SERVICING
ADREST
ANTI-SPIN STRAKE SEE PLAN VIEW
1/8" x 1/4" PLANKING
TAILPLANE AT 0°
RANGE OF TRIM MOVEMENT
ELEVATOR HORN DO NOT REDUCE LENGTH
COLOR DIVISION
DATUM LINE IS UPPER EDGE OF FUSELAGE SIDE
FUSELAGE SIDES FROM 1/8" SHEET
1/8" PLYWOOD
040 WIRES
1/4" x 1/8" STRIP STERNPOST
RUDDER HORN
RUDDER PUSH ROD 1/4" SQ.
RUDDER BELLCRANK
MOUNT 1/8" PLYWOOD
NOTE "KINK" IN BOTTOM LINE OF RUDDER
BIND STRUT
3/32" WIRE
1/16" WIRE LOOP
TAILWHEEL 1-1/2" DIA.
SHROUD OF THIN CARDBOARD ONE EACH SIDE
BEND TO SHAPE
BOTTOM 1/8" SHEET
1/8" SQ VERTICAL SPACERS F6 - F11 INCLUSIVE
END OF 1/32" PLYWOOD FUSELAGE SIDE DOUBLERS
12" x 6" TORNADO NYLON PROP USED FOR FLYING DYE BLACK. PAINT YELLOW TIPS 1/2" WIDE
SECURE TO MOUNT
BIND & SOLDER
TINPLATE
TAILWHEEL ASSEMBLY
COCKPIT OPENING
MAKE CARD TEMPLATE MARK CENTER LINE
PROP
BACK PLATE
EXTENSION
SHELL
RETAINING BOLT
NUT
MOTOR SHAFT
SPINNER
PLYWOOD SUPPORT
WIRES TO RUDDER HORN
PHENOLIC BELLCRANK
PUSH ROD TO SERVO
RUDDER BELLCRANK
PLATE 1 OF 2
R/C modeler MAGAZINE
MILES M14A MAGISTER
DESIGNED & DRAWN BY
DAVE PLATT
INKED BY
G. FLORES
0 1 2 3 4 5 6



RIB TAPE POSITIONS SEE ARTICLE
SOLID BALSA
1/2" x 5/16" L.E.
SOLID BALSA
1/16" SHEET COVERING
1/2" x 1/4"
1/16" RIBS
BRAZED JOINT
ELEVATOR HORN
3/8" RIB
DUMMY TRIM TAB
1/2" x 1/8" T.E.
6 NEEDED
1/16" PLYWOOD
UC
TYPICAL TAIL SECTION
MAIN SPAR
UC BEARER
T.E.
LOCATING PEG
PART WF. 1
UC CLIPS
SERVO MOUNT
UC LEG
COMPOSITE DRAWING SHOWING DETAILS WITHIN WING CENTER PANEL
3/16" DIA. U/C LEG
U/C DETAILS - FRONT VIEW
BIND
LEAVE SILVER
RC HOOK-UP WIRE (BLACK)
1/16" PIANO WIRE (PAINT BLACK)
FORWARD PERSPECTIVE
SOLDER JOINT
FILE AWAY INSIDE FORK
TURNED FORK
1/8" DIA. AXLE
3-1/4" AIRSPAN WHEELS
NYLON HINGE MATERIAL
AILERON RIB A1
W5
AILERON HORN
W4
3/16" HOLES
3/16" DIA.
3/8" DIA.
1/8" HOLES
UC FORK
TURN FROM 3/8" DIA. STEEL
BEND TO FRONT VIEW SHAPE
LEADING EDGE FROM 1/2" SHEET
DIAMETER OF IDENT, BLUE UPPER AND LOWER SURFACES
NAVIGATION LAMPS TOP AND BOTTOM SEE DETAIL
DIAMETER OF IDENT, RED UNDERSURFACE
SLOT IN LOWER SHEET TO ALLOW MOVEMENT OF UC LEG IN LANDING
9"
MAINSPAR 1/8" SHEET
1/8" PLYWOOD SUPPORT
DIAMETER OF WHITE UNDERSURFACE ONLY
TOP FLITE AILERON BELLCRANK
1/2" SHEET FILL TO ACT AS HOLDER FOR PITOT TUBE PORT WING ONLY
DIAMETER OF IDENT, RED UPPER SURFACE
SOLID BALSA TIPS
W13
SCRAP SHEET GUSSETS
W12
W11
W10
W9
W8
W7
W6
SUB SPAR 1/8" SHEET
W5
W4
W3
W2
SOLID BALSA FILL
LEAVE FRONT FACE CLEAR
NAVIGATION LAMP
CUT FROM SOLID "PERSPEX"
DRILL 3/32" FROM BOTTOM
FILL HOLE WITH PAINT
RED (PORT) GREEN (STARBOARD)
GLUE ON WING AND PAINT
OVER TOP WITH APPROPRIATE
CAMOUFLAGE COLOR
HINGE NYLON STRIP COMPLETE LENGTH
1/4" SHEET AILERON L.E.
AILERON HORN
AILERON SHEETED TOP AND BOTTOM 3/32"
IMPORTANT
WING HAS NO DIHEDRAL BRACES
NOR HAS NEED OF ANY
DO NOT MODIFY STRUCTURE
NAVIGATION LAMPS
TRAILING EDGE 3/4"
SECTION OF WING TIP
3-7/16"
MAIN SPAR
BUILD FROM 3 PIECES
OF 1/8" SHEET FLAT ON PLAN
BEFORE STARTING WING CONSTRUTION
MEAN DIHEDRAL ANGLE 5 1/2°
RELATIVE POSITION OF AILERON PUSH ROD


W1
W2
W2 THROUGH 13
CUT 2 FROM 3/32" SHEET
W1
CUT 8 FROM 3/32" SHEET
W13
W12
W11
W10
W7
W9
W6
W8
GLUE INTO BLOCK
PITOT TUBE (FULL SIZE)
MAKE FROM 1/16" WIRE PAINT BLACK
1/16" PLYWOOD
AILERON RIBS ARE ANGLES OF 3/32" SHEET
CENTER PANEL SPAN 16" CHORD 12-1/2"
3/8" DIAMETER DOWEL LOCATION PEG
UC LEG UNDER BEARER
ALUM. CLIPS
1-1/4" x 1/2" x 16" HARDWOOD
ALUM. CLIPS
PARTS "UC"
1/16" PLYWOOD PARTS "UC"
TRANSMITE AILERON SERVO
1/8" PLYWOOD SERVO MOUNT
1/16" WIRE PUSH ROD
ENTIRE WING SHEETED WITH 3/32" LIGHT BALSA
W1
W1
W1
W1
BLOCK FILL
1/4" HOLES FOR WINGS BOLTS
1/8" PLYWOOD 3-1/2" x 1-1/2" PART WF. 1 GLUED TO UNDER SURFACE AFTER SHEETING
MAIN SPAR SPLICE
POSITION OF SERVO MOUNT
PLATE 2 OF 2
modeler MAGAZINE
MILES M14A MAGISTER
DESIGNED & DRAWN BY
DAVE PLATT
INKED BY
G. FLORES
0 1 2 3 4 5 6



Gear installation. Cut-off legs visible.

blow-out. It's certainly worth the consideration of anyone making this model to fit a muffler, even if only as insurance against these fires. The one we made was of brass tubing in two sizes, ½" O.D. for the pickup on the motor and the outlet pipe, and 1" diameter for the expansion chamber. The chamber fits inside the cowl against the starboard side and below the motor. The outlet pipe from the chamber is exactly scale. The muffler also keeps the model clean and very little exhaust is found on the bottom of the model after several flights.

Radio gear was F&M Matador/Midas 10 channel using Bonner servos with home-made amplifiers. All have functioned perfectly and reliability is of the highest order. If the reader will bear with me I'd like to have a little moan. Along about the time when we were bringing models home in one piece after several flying sessions, a couple of mystery crashes occurred to consecutive models, after they had been flown for some time. No cause could be found. Curiously, though, both crashes occurred while the model was flying straight and level inverted about 6-10 feet altitude and only some 5 yards away. What happened both times, was that, suddenly all contact was lost and the models went in—hard! Two Candies in three weeks!

The gear was working perfectly after the prangs. Batteries were not flat or even down. Pilot error was not a factor.

So what the hell?

Eventually a more knowledgeable clubmate provided the answer. We were holding the transmitter flat in the hand so the antenna was paralleled with the ground. Seems there's a dead spot from the transmitter out in a line with the antenna. Now we hold the box so the antenna is at about 45% with the ground, a good compromise between comfort and reliable transmission. No more trouble has been had. The moan is this — why wasn't this in the instructions? And why is this point never put across in the mags?

But we're supposed to be telling you about the Magister.

The points requiring explanation or instructions on the fuselage may be best dealt with by taking them in order from the front to the tail. A diagram of the spinner is given on the plan. Actually the spinner of the Maggie is a wooden arrangement blended into the airscrew, and this is the only point where our model differs from true scale. The metal one shown is a good compromise between scalish appearance and practical usefulness on the field. Get a lathe-owning friend to turn it up for you, or, as a last resort, use a normal bullet-nose type. If anything, to leave off the spinner altogether might be better than this, however.

An extension piece will be needed for the prop driver to get the engine far enough back to enclose the throttle assembly in the noseblock. This block must be of very hard balsa or even hardwood and extensively hollowed out.

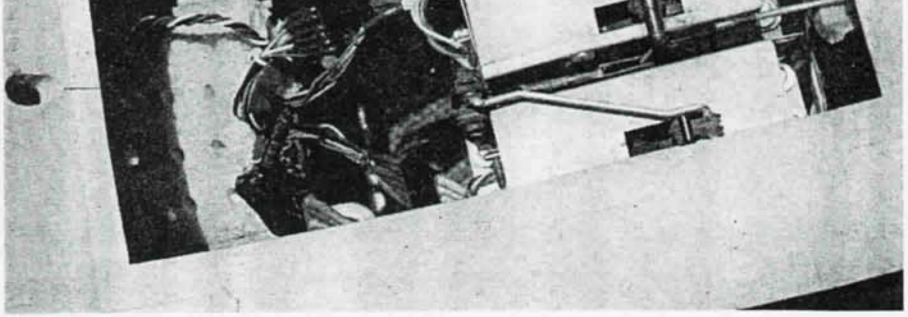
The engine cowling is a good deal easier to make than it would appear to be. The thickness of metal we used was 24 swg (about .15"). Soft aluminum is ideal and can be easily formed in the fingers. No compound curves are present. The small hinges may be found in toy shops dealing in doll-house accessories.

One of the most difficult problems with a scale model is often to find room for the RC gear without encroaching upon the cockpit area. In this model, 3 of the servos were placed in the area between the two cockpits with the last (rudder) servo immediately behind the rear cockpit. You'll need your most trusted servo for rudder, since once the model is made it would need cutting the bottom open to service it.

A DuBro trim bar was arranged side by side for the elevator and trim servos — see photo. With the receiver in the front turtledeck and the DEAC (Nicad) pack below it, the balance worked out OK and the cockpits were left clear for pilot and detail. Remember that when the Magister carried one person only, he sat in the rear cockpit.

Sid, the pilot in our model, was made by using a 2" = 1' scale Granger Williams plastic pilot and completing his body with balsa block sculptured in our best Da Vinci style. It's well worth an evening's work for a good pilot. Certainly the model would look incomplete without him. Summon the nerve to go

RC equipment is F&M Midas/Matador, Bonner servos.



into a ladies corsetry store and buy some ⅛" — 3/16" wide elastic. Painted, this makes realistic parachute harness. An old brown leather ladies glove can be cut into sections and glued to the head for a flying helmet. It's unfortunate for Sid, but unavoidable, that he has no legs below the knee. Otherwise his feet, inside the Bonners, might easily stop them working properly.

The rest of the fuselage construction is quite conventional and will give no difficulty. The wing root fairings are made by cementing the 1/32" ply base to the sides, using the wing in the correct position offered up to the fuselage. This is done so that the ply will exactly follow the wing upper surface. When this is dry the fairing parts are glued on in vertical laminations to the necessary width. When properly set the wing may be removed again. A ½" gouge is used to shape the concave shape of the fairings.

The wings of the original model were bolted up at the rear, with a ¼" dowel peg engaging the LE. Possibly Cam-Loks would be a better way of doing it, but these were hard to find at the time in Britain. The chicken-hearted may prefer to use normal dowels and rubber bands, but, although admittedly safer, the appearance of the finished model will suffer a good bit.

The tailwheel of the full-size Magister is fully castoring and so the model is likewise; details on the plan cover this adequately.

When the fuselage has been completed the usual auto-primer is applied, rubbed down smooth and paper strips applied to represent the pilot's entrance doors and the luggage trunk. After the tissue covering has been applied the finishing process is continued as follows: two or three coats of auto-primer or grain filler are applied with careful sanding between each. A good grain filler may be made by adding Boracic (Boric Acid) powder to clear nitrate dope to the density preferred. This powder is better than the more commonly used talcum since it is softer in texture and therefore cuts down more easily with the sandpaper.

When the whole plane is smooth the color is applied by spray gun, starting with the yellow, then the brown (take the brown all over the camouflaged upper surface) followed by the green. Finally the markings are applied, again using nitrate dope. When quite dry the model may be sprayed with fuel-proofing varnish and left to dry out for a few days.

We now have an unwanted high gloss on the model. Wartime aircraft were painted in matte dopes and we need a way of killing the gloss. On our model we gave one thin coat of Eggshell Flat Varnish obtainable in home decorators' stores. This varnish takes about six hours to become touch-dry and it would not be advisable to fly the model for two or three days after its application.

Meanwhile the pilot, cockpit details and the rest of the R/C gear can be installed.

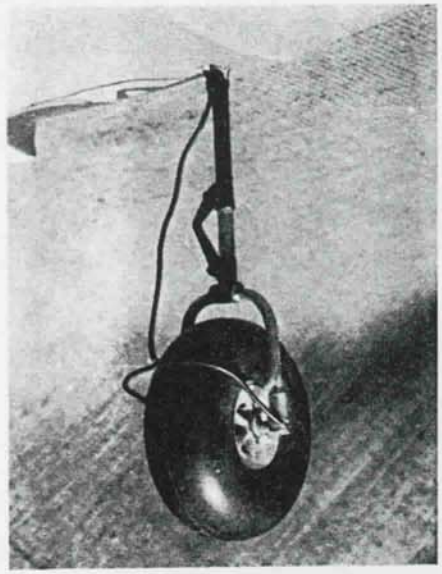
Now that the model is finished a preflight check must be made. (Now don't look away Joe — this is a damned serious business.) Assemble the model and pack up the rear of the fuselage until the wing is exactly parallel with the workbench, that is, equal measurement on the middle of the LE and the trailing edge point. At the middle trim position the tail and elevator should make another equal measurement, in other words a zero-zero alignment. It will help to have quite a large range of trim movement on the elevator at first until the model's trim is known.

The balance is now checked and the position given on the plan is regarded as a rearward limit. The CG may, however, stray forward by up to half an inch. It is not generally realized, but is logical if you think about it, that an aeroplane with a small tailplane needs a more forward CG to compensate and provide sufficient stability. Accuracy of balance on this model must be treated as **vital.**

Flying the Magister is very much the same as a regular multi R/C model. The two-wheel landing gear makes it necessary to apply pulses of "up" elevator during the take-off run, but once airborne there should be no problems at all. The full size plane is highly aerobatic and the model looks marvelous in maneuvers. My particular favorites with this model are inverted flight and the spin. I have an overdrive board in my elevator servo to assure the latter maneuver. The ground angle of the model, being quite high, means that landing approaches need a good deal more care than a contest multi craft. A really superb landing requires a high degree of flying skill, but the model is quite substantial enough to take the other sort of landing.

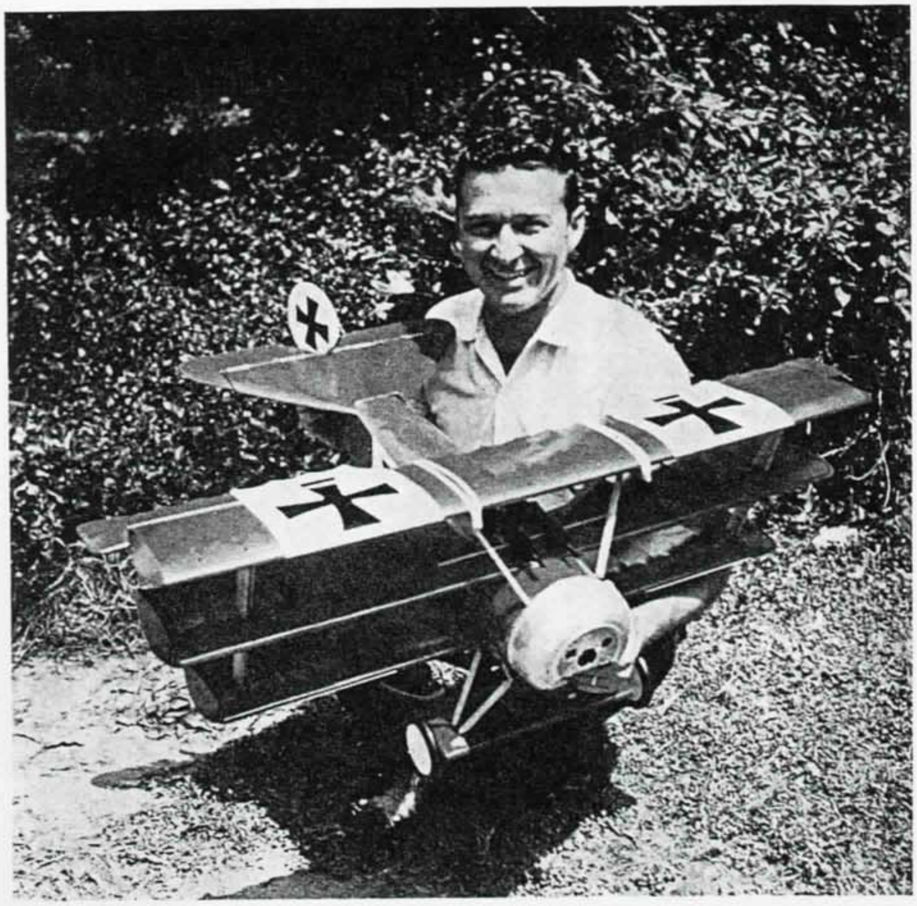
This model has been a satisfying project. The accuracy and flyability of the design as drawn make it an excellent model for scale competitions. It's also quite possible that it could be far from disgraced in a Multi Aerobatics Competition.

Anyone care to try?



Close-up of landing gear leg showing dummy shock absorbers and brake cable.

The Miles Magister, completed and ready for takeoff.



FRANK CROTHERS

FOKKER DR-1

Scale R/C version of WWI ace Baron Von Richthofen's personal triplane

WORLD War I was really responsible for the first big push on military aircraft. One of the best known to emerge from this war was the Fokker DR 1, or better known as the Fokker Triplane. A relatively small plane of only 23 ft. 7 in. wingspan, it was powered by a German copy of the LeRhone 110 hp. engine. However, when placed in the hands of a man like Baron Von Richthofen, and pitted against other planes of the time, it was every bit as deadly as the Mustang of World War II. The top speed was 120-130 mph and a service ceiling of just over 15,000 ft. Our model is built and finished after Richthofen's own personal Triplane which he used only for special occasions such as trips to the Fokker factory.

If you've never attempted to build a scale model before, this one is just for you. We have purposely left out the details of the radio gear and the engine, as these will vary too much with the individual builder. The plane is designed to be fast building, lightweight, and solid. By carefully selecting the materials used, weight can be kept to less than three pounds. The majority of builders will finish the model with silkspan, but by using a lightweight contest silk, only a few ounces will be added to the finished weight and the extra durability will more than make up for it.

WINGS

Let's start with the wings as they can be a bit of a problem. The ribs are only 1/32" sheet balsa, but they are used only to give shape to the capstrips which really have the strength. This method of construction results in a very light and strong structure, featuring knock-off wings which helps both on extra heavy landings and transporting to and from the local flying field.

The only problem you should experience is the shaping of the scalloped trailing edges. We overcame this by marking off the scallops on the 1/16" birch, or pine stock, and grinding them with a 2½" grinding wheel attached to a ¼" electric drill.

FUSELAGE

This is probably the easiest part of the model to construct. If you've ever built a stick model, you'll be able to build it in one evening. Covering it is something else again! Since the forward part of the fuselage contains compound curves, much difficulty can result. We cured this problem by using a needle and thread, much the same as rib stitching on modern full-size light aircraft.

The cowling is cut from a solid balsa block on a lathe, using a small cutting gouge for the rough shaping and regular sandpaper for the finish. Since the cowl is finished in natural aluminum you can either paint it or glue aluminum foil all over it. To achieve the "hammered" effect, push 6 or 8 common pins into the end of a 6" length of soft ½" sq. balsa, press the pin end against the foil and presto, a hammered finish.

TAIL

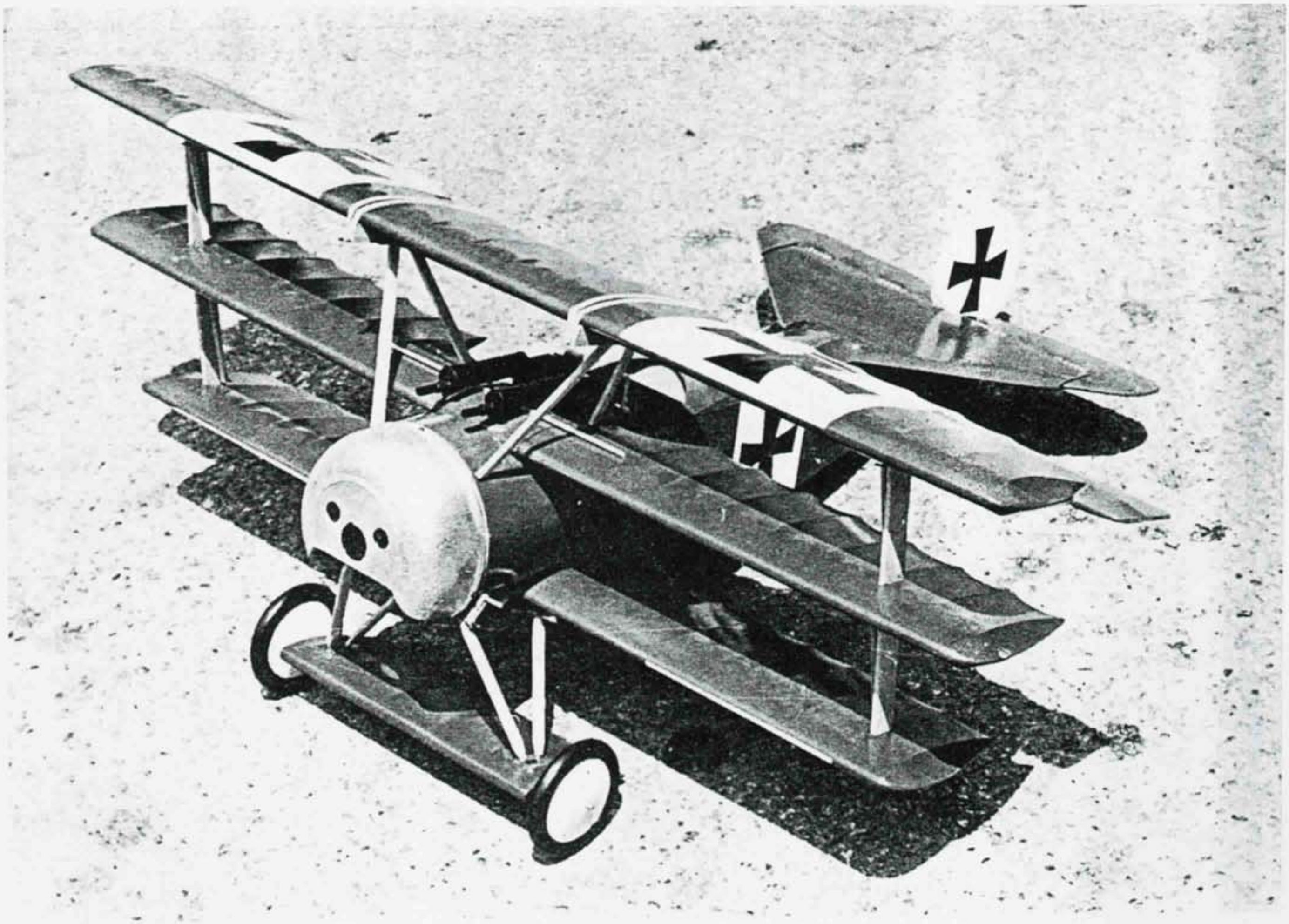
The tail assembly can be built in either of two ways. The easiest is to cut them out of 3/8" medium sheet balsa and sand to the airfoil shown. However, if you're weight conscious and want the scale effect, use the built up method. Trace the outlines of all the tail surfaces onto 1/16" hard sheet balsa. Glue the leading and trailing edges in place, then add the sheet ribs as specified on the plan, and trim and sand to shape. Silk and dope well before gluing in place. Caution — make sure the tension of the silk is even on both the top and bottom surfaces before doping or warps will result.

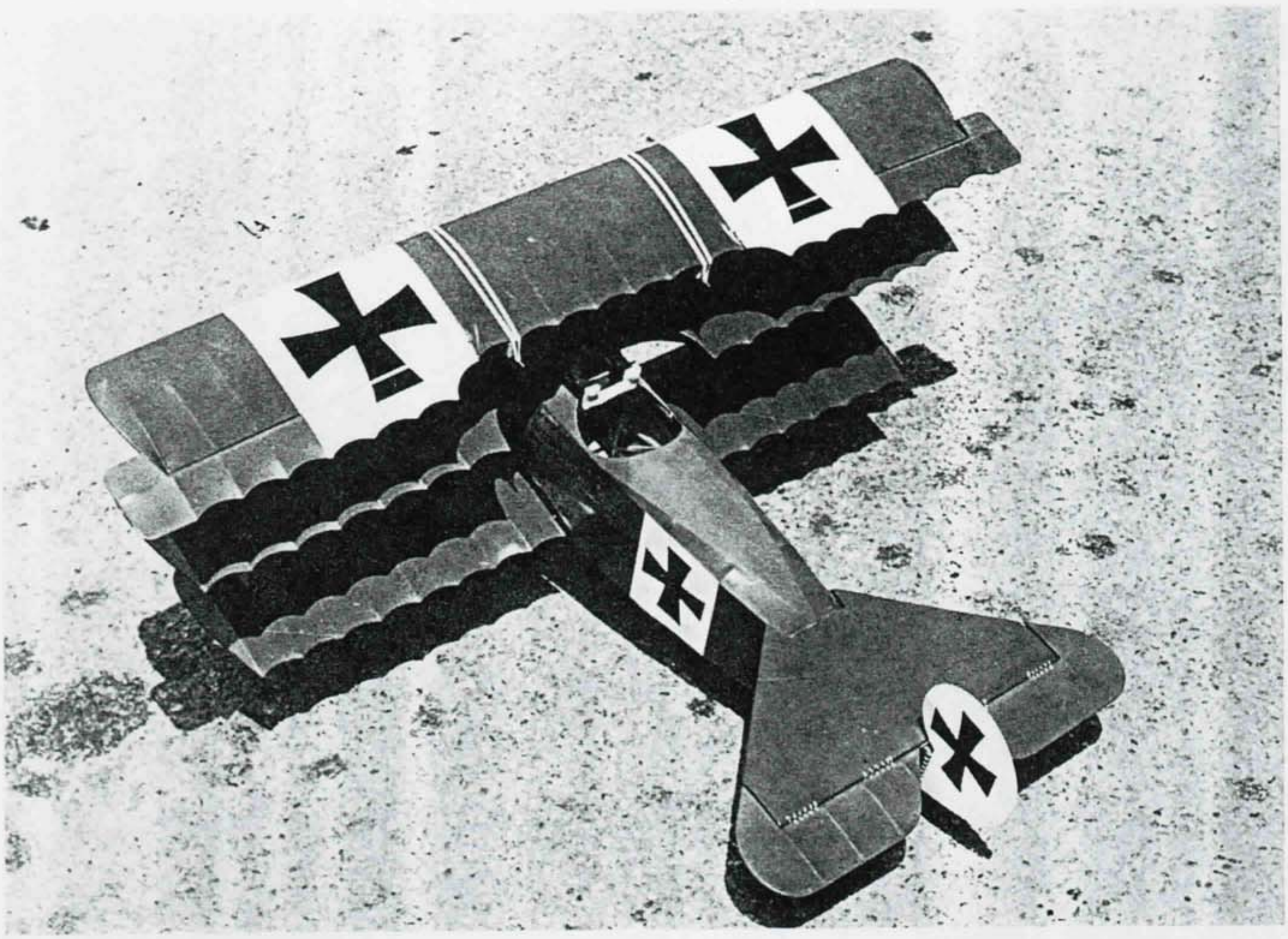
LANDING GEAR AND PYLON

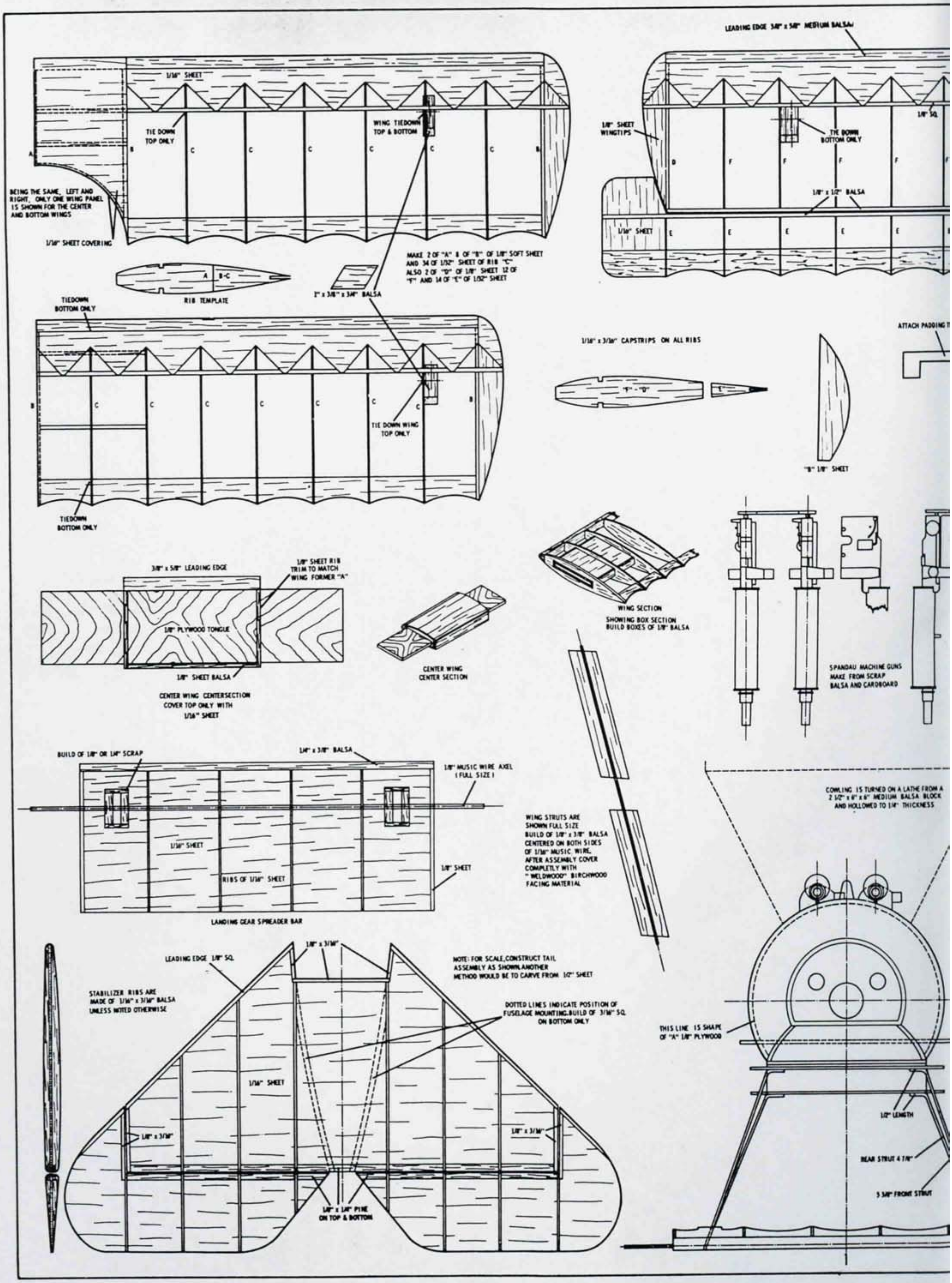
The pylon and landing gear assemblies are formed of 3/32" music wire. Bind the ends with a soft copper wire and solder securely. Glue 3/32" or 1/8" balsa strips to the leading and trailing edges and cover with Weldwood Birch veneer. Use contact cement instead of model glue for a neater job. You can always paint over the veneer for fuelproofing.

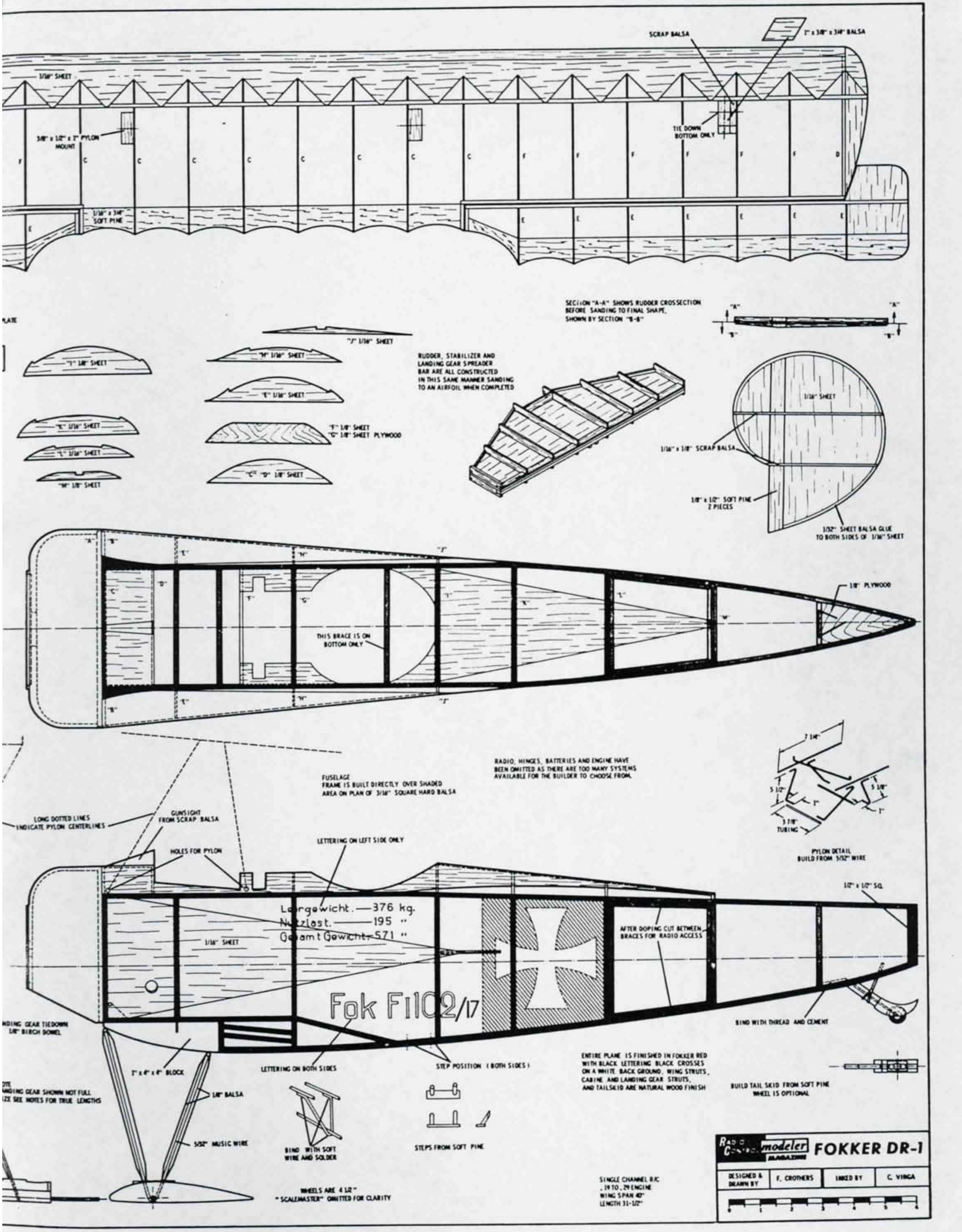
FINISH

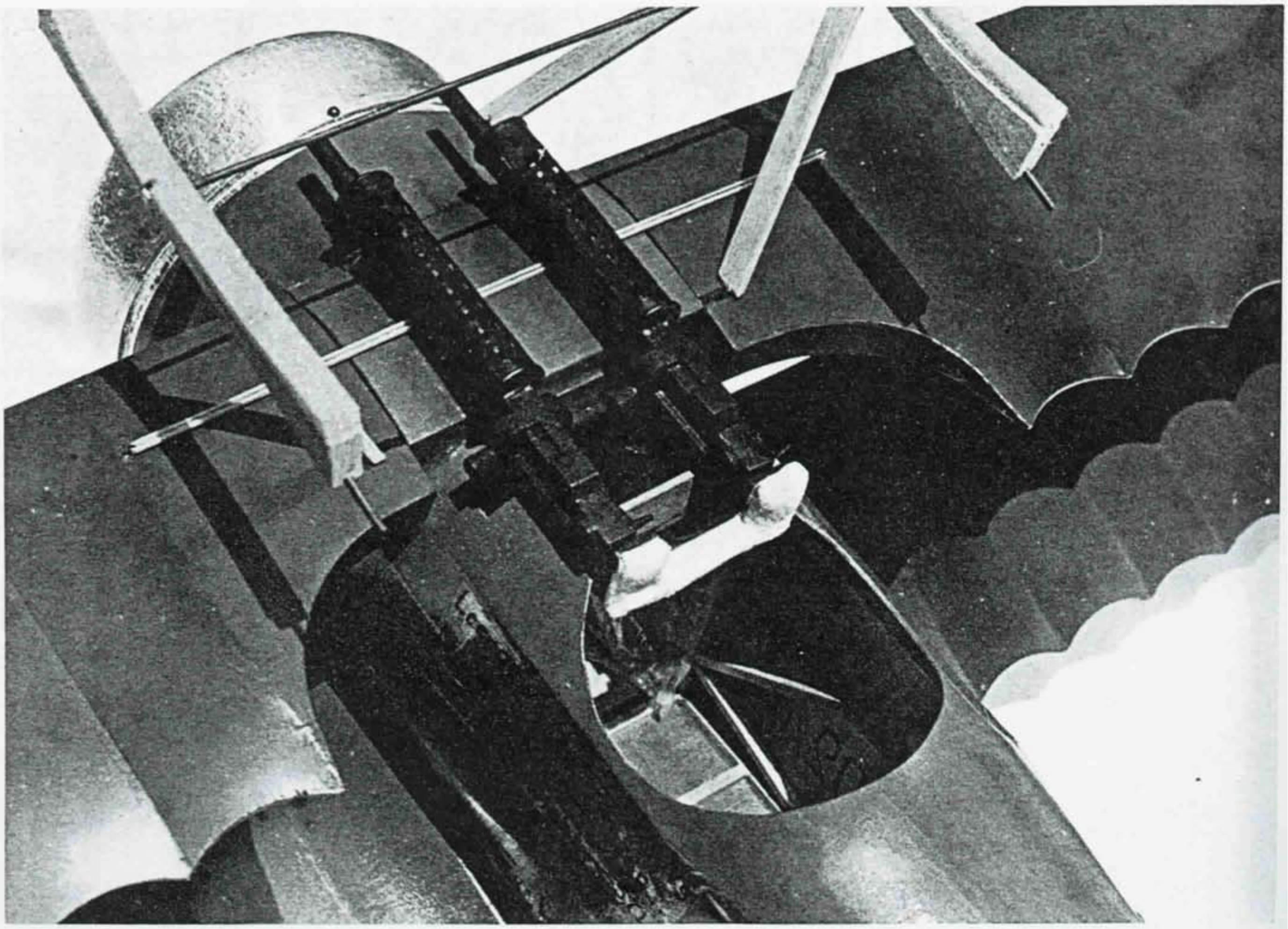
All of the lettering and the crosses are black. The rudder and the background for the crosses are white. The cowl is natural aluminum while the wing struts, pylon and landing gear struts are natural birch. You guessed the rest of the plane, of course, Fokker Red.

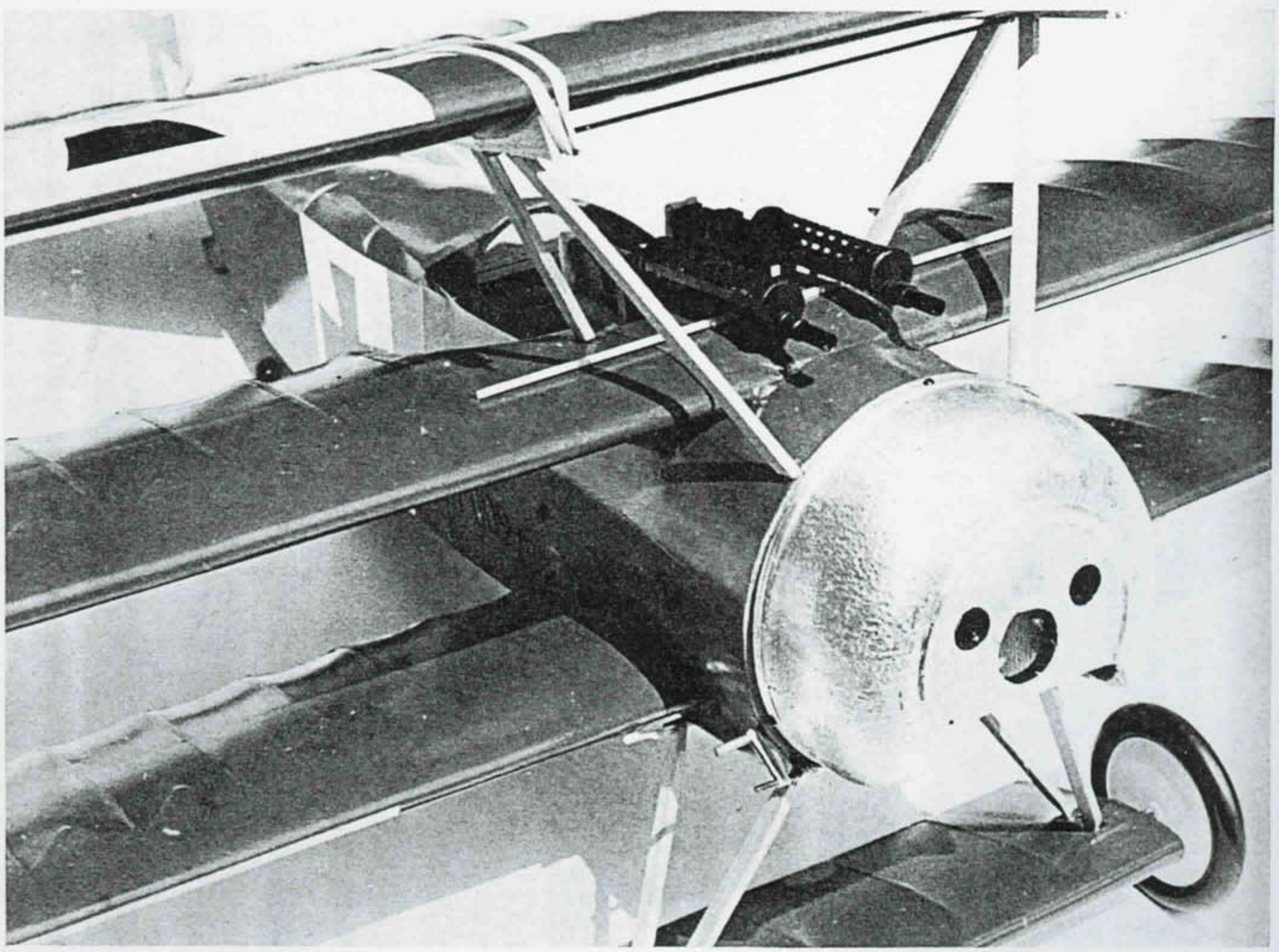


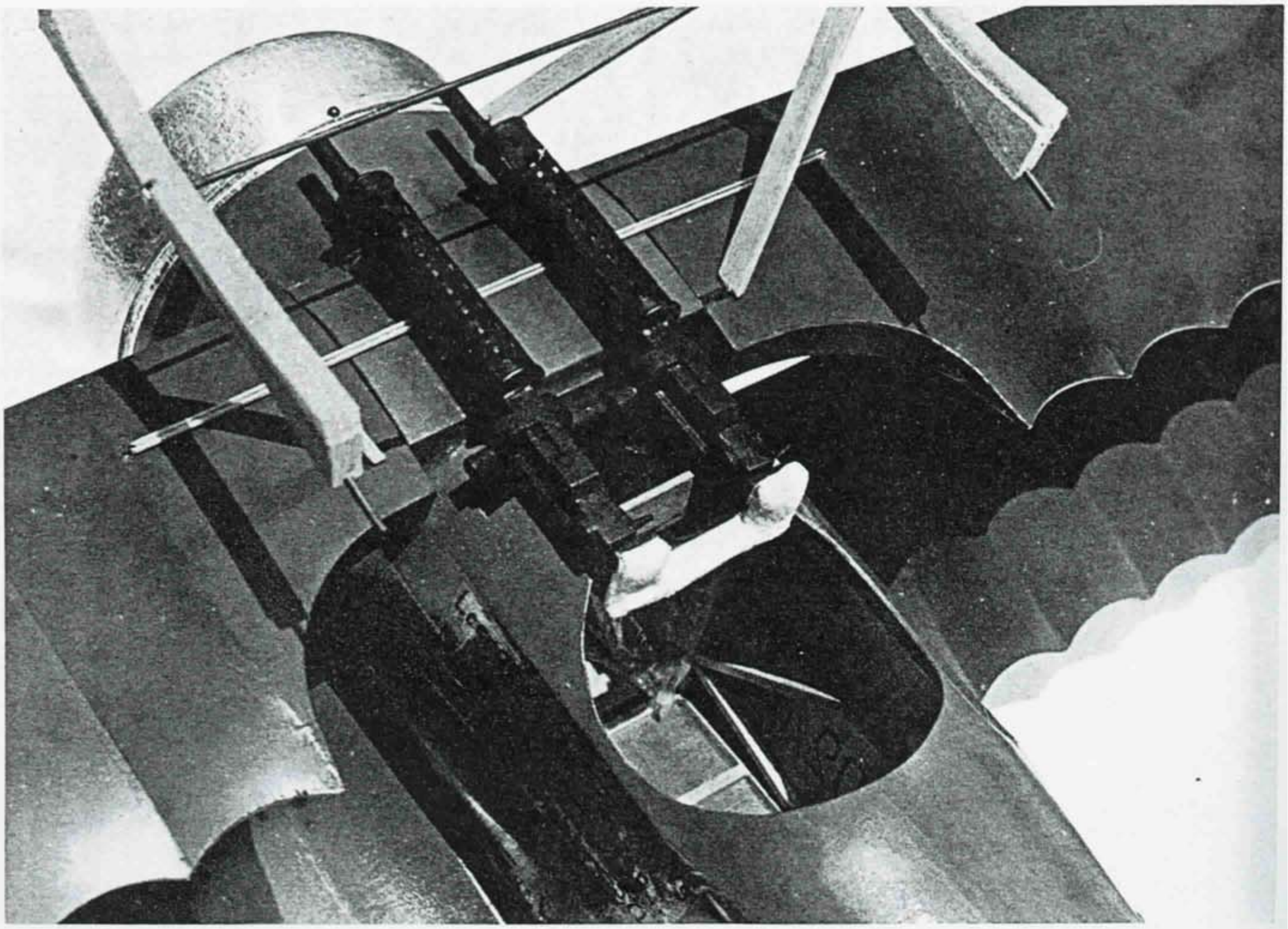


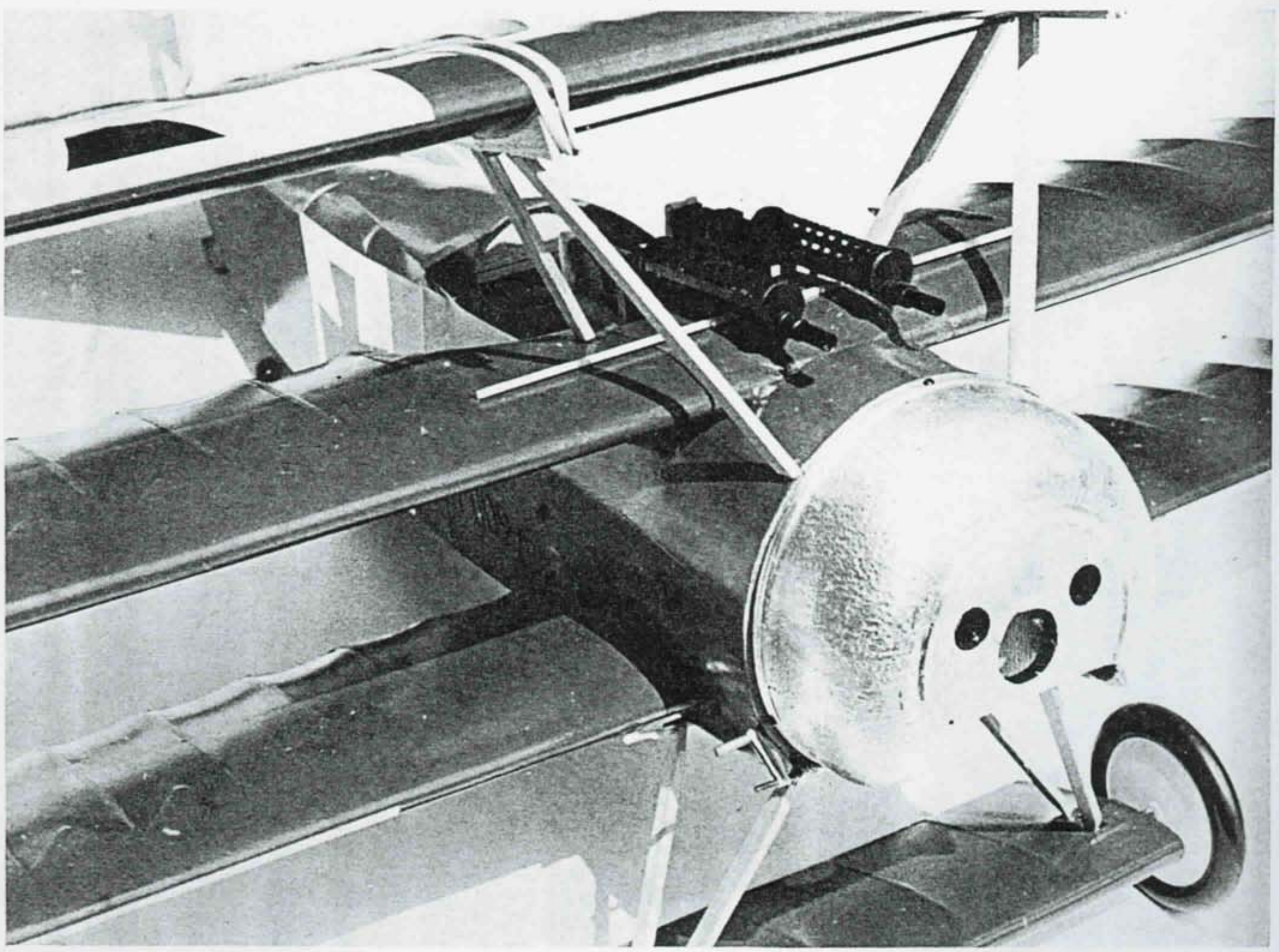

LEADING EDGE 3/8" x 5/8" MEDIUM BALSA
1/16" SHEET
TIE DOWN TOP ONLY
WING TIEDOWN TOP & BOTTOM
1/8" SHEET WINGTIPS
TIE DOWN BOTTOM ONLY
1/8" SQ.
BEING THE SAME, LEFT AND RIGHT, ONLY ONE WING PANEL IS SHOWN FOR THE CENTER AND BOTTOM WINGS
1/8" x 1/2" BALSA
1/16" SHEET COVERING
MAKE 2 OF "A" 8 OF "B" OF 1/8" SOFT SHEET AND 34 OF 1/32" SHEET OF RIB "C" ALSO 2 OF "D" OF 1/8" SHEET 12 OF "F" AND 14 OF "E" OF 1/32" SHEET
RIB TEMPLATE
1" x 3/8" x 3/4" BALSA
TIEDOWN BOTTOM ONLY
1/16" x 3/16" CAPSTRIPS ON ALL RIBS
ATTACH PADDING T
TIE DOWN WING TOP ONLY
"B" 1/8" SHEET
TIEDOWN BOTTOM ONLY
3/8" x 5/8" LEADING EDGE
1/8" SHEET RIB TRIM TO MATCH WING FORMER "A"
1/8" PLYWOOD TONGUE
1/8" SHEET BALSA
CENTER WING CENTERSECTION COVER TOP ONLY WITH 1/16" SHEET
CENTER WING CENTER SECTION
WING SECTION SHOWING BOX SECTION BUILD BOXES OF 1/8" BALSA
SPANDAU MACHINE GUNS MAKE FROM SCRAP BALSA AND CARDBOARD
BUILD OF 1/8" OR 1/4" SCRAP
1/4" x 3/8" BALSA
1/8" MUSIC WIRE AXEL (FULL SIZE)
1/16" SHEET
RIBS OF 1/16" SHEET
1/8" SHEET
LANDING GEAR SPREADER BAR
WING STRUTS ARE SHOWN FULL SIZE BUILD OF 1/8" x 3/8" BALSA CENTERED ON BOTH SIDES OF 1/16" MUSIC WIRE, AFTER ASSEMBLY COVER COMPLETLY WITH "WELDWOOD" BIRCHWOOD FACING MATERIAL
COWLING IS TURNED ON A LATHE FROM A 2 1/2" x 6" x 6" MEDIUM BALSA BLOCK AND HOLLOWED TO 1/4" THICKNESS
LEADING EDGE 1/8" SQ.
1/8" x 3/16"
NOTE: FOR SCALE, CONSTRUCT TAIL ASSEMBLY AS SHOWN. ANOTHER METHOD WOULD BE TO CARVE FROM 1/2" SHEET
STABILIZER RIBS ARE MADE OF 1/16" x 3/16" BALSA UNLESS NOTED OTHERWISE
DOTTED LINES INDICATE POSITION OF FUSELAGE MOUNTING. BUILD OF 3/16" SQ. ON BOTTOM ONLY
THIS LINE IS SHAPE OF "A" 1/8" PLYWOOD
1/16" SHEET
1/8" x 3/16"
1/8" x 3/16"
1/2" LENGTH
REAR STRUT 4 7/8"
5 3/8" FRONT STRUT
1/8" x 1/4" PINE ON TOP & BOTTOM

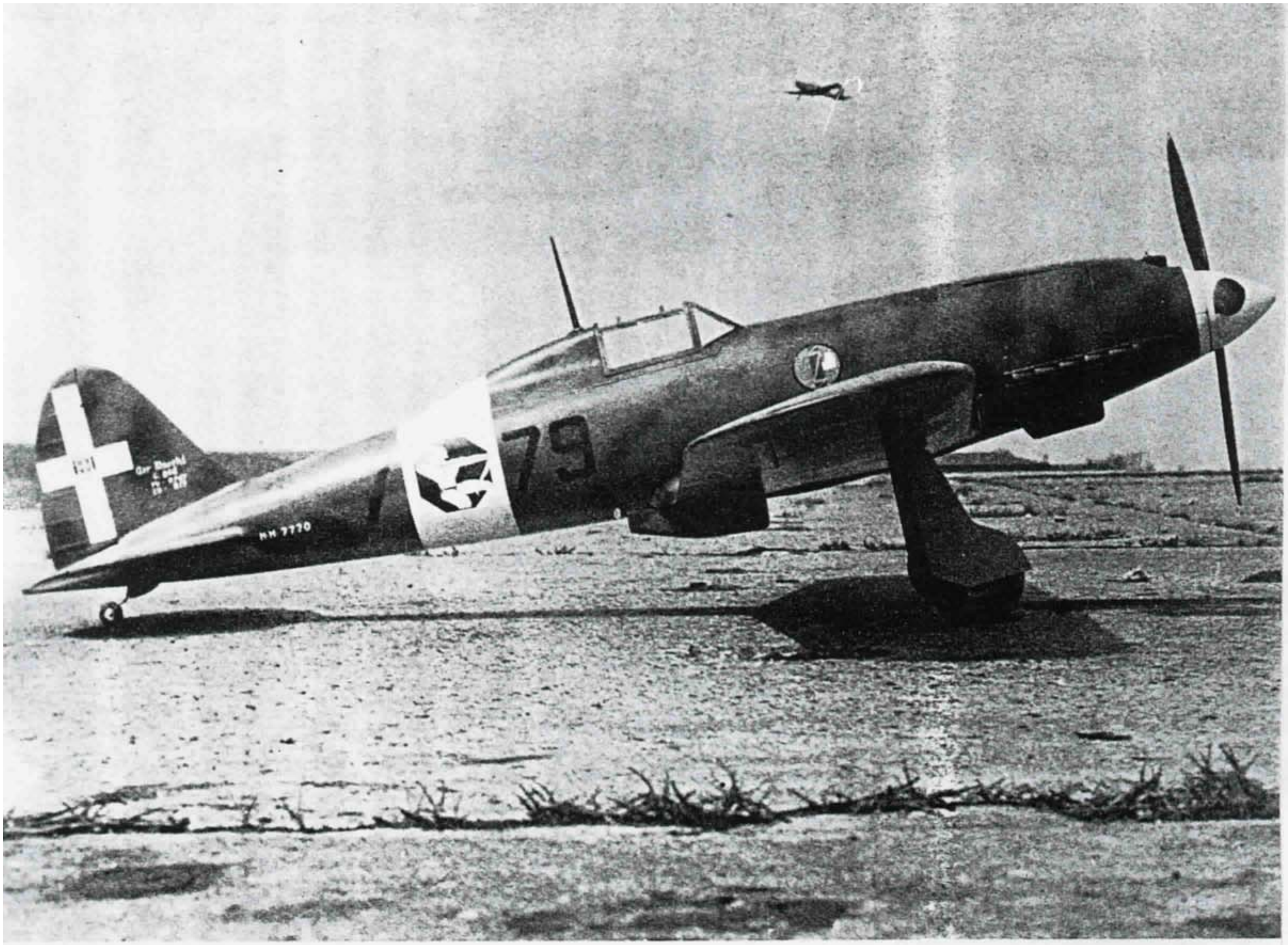

SCRAP BALSA
1" x 3/8" x 3/4" BALSA
1/16" SHEET
3/8" x 1/2" x 2" PYLON MOUNT
TIE DOWN BOTTOM ONLY
1/16" x 3/4" SOFT PINE
SECTION "A-A" SHOWS RUDDER CROSSECTION BEFORE SANDING TO FINAL SHAPE, SHOWN BY SECTION "B-B"
"J" 1/16" SHEET
"I" 1/8" SHEET
"H" 1/16" SHEET
"E" 1/16" SHEET
"K" 1/16" SHEET
"L" 1/16" SHEET
"M" 1/8" SHEET
"F" 1/8" SHEET
"G" 1/8" SHEET PLYWOOD
"C" "D" 1/8" SHEET
RUDDER, STABILIZER AND LANDING GEAR SPREADER BAR ARE ALL CONSTRUCTED IN THIS SAME MANNER SANDING TO AN AIRFOIL WHEN COMPLETED
1/16" SHEET
1/16" x 1/8" SCRAP BALSA
1/8" x 1/2" SOFT PINE 2 PIECES
1/32" SHEET BALSA GLUE TO BOTH SIDES OF 1/16" SHEET
1/8" PLYWOOD
THIS BRACE IS ON BOTTOM ONLY
RADIO, HINGES, BATTERIES AND ENGINE HAVE BEEN OMITTED AS THERE ARE TOO MANY SYSTEMS AVAILABLE FOR THE BUILDER TO CHOOSE FROM.
FUSELAGE FRAME IS BUILT DIRECTLY OVER SHADED AREA ON PLAN OF 3/16" SQUARE HARD BALSA
LONG DOTTED LINES INDICATE PYLON CENTERLINES
GUNSIGHT FROM SCRAP BALSA
HOLES FOR PYLON
LETTERING ON LEFT SIDE ONLY
PYLON DETAIL BUILD FROM 5/32" WIRE
1/2" x 1/2" SQ.
Leergewicht.—376 kg.
Nutzlast.—195 "
Gesamt Gewicht.—571 "
1/16" SHEET
AFTER DOPING CUT BETWEEN BRACES FOR RADIO ACCESS
Fok FI102/17
BIND WITH THREAD AND CEMENT
1/8" BIRCH DOWEL
1" x 4" x 4" BLOCK
LETTERING ON BOTH SIDES
STEP POSITION (BOTH SIDES)
1/8" BALSA
5/32" MUSIC WIRE
BIND WITH SOFT WIRE AND SOLDER
STEPS FROM SOFT PINE
WHEELS ARE 4 1/2" "SCALEMASTER" OMITTED FOR CLARITY
ENTIRE PLANE IS FINISHED IN FOKKER RED WITH BLACK LETTERING BLACK CROSSES ON A WHITE BACK GROUND. WING STRUTS, CABINE AND LANDING GEAR STRUTS, AND TAILSKID ARE NATURAL WOOD FINISH
BUILD TAIL SKID FROM SOFT PINE WHEEL IS OPTIONAL
SINGLE CHANNEL R/C
.19 TO .29 ENGINE
WING SPAN 40"
LENGTH 31-1/2"
modeler MAGAZINE
FOKKER DR-1
DESIGNED & DRAWN BY
F. CROTHERS
INKED BY
C. VINGA











Scale RC or full size Macchi 202? Only the cylinder head gives away this beautiful scale multi by Dennis Bryant. For color details and photos obtain Profile Publication #28.

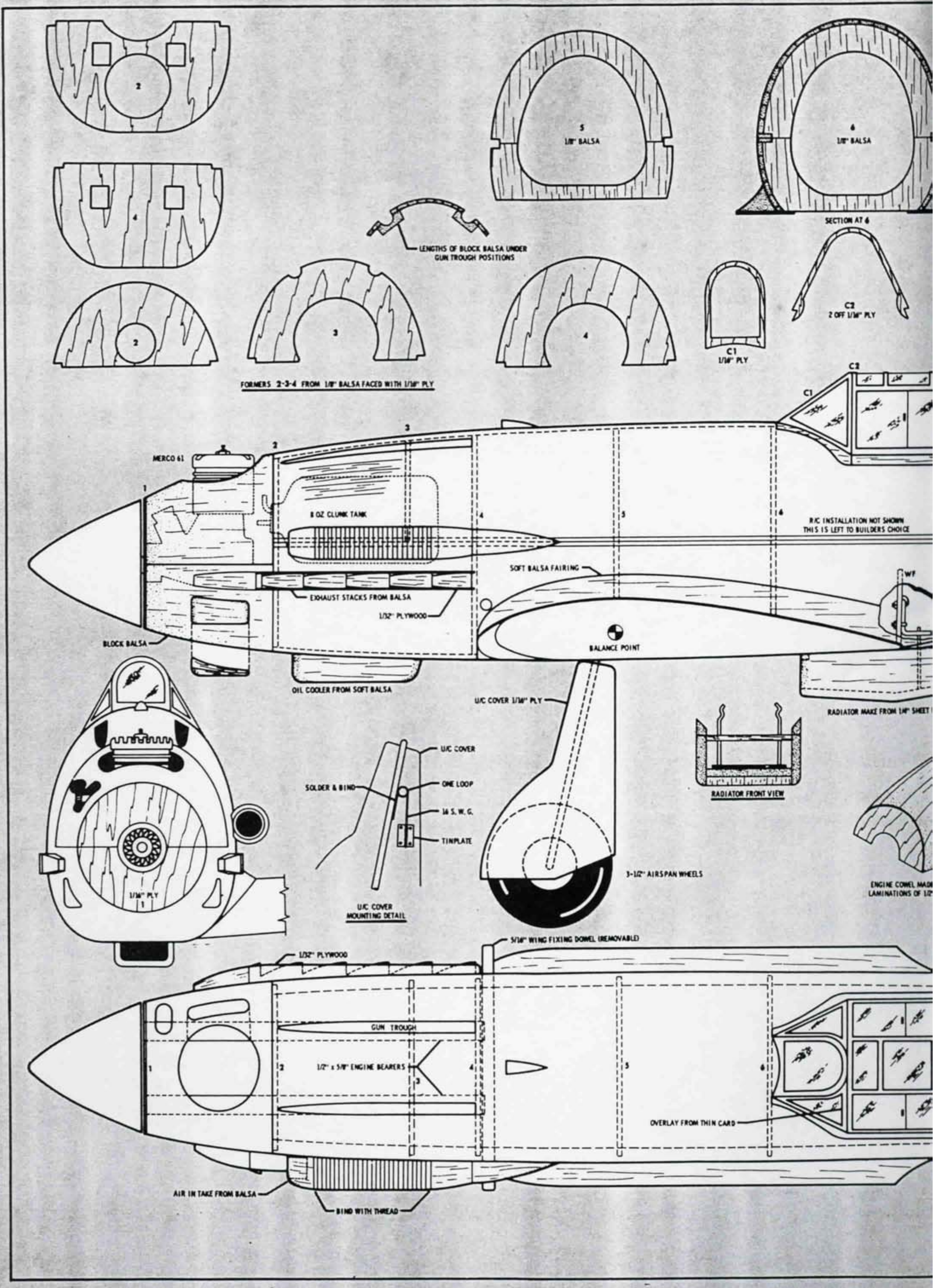
MACCHI 202

BY DENNIS BRYANT

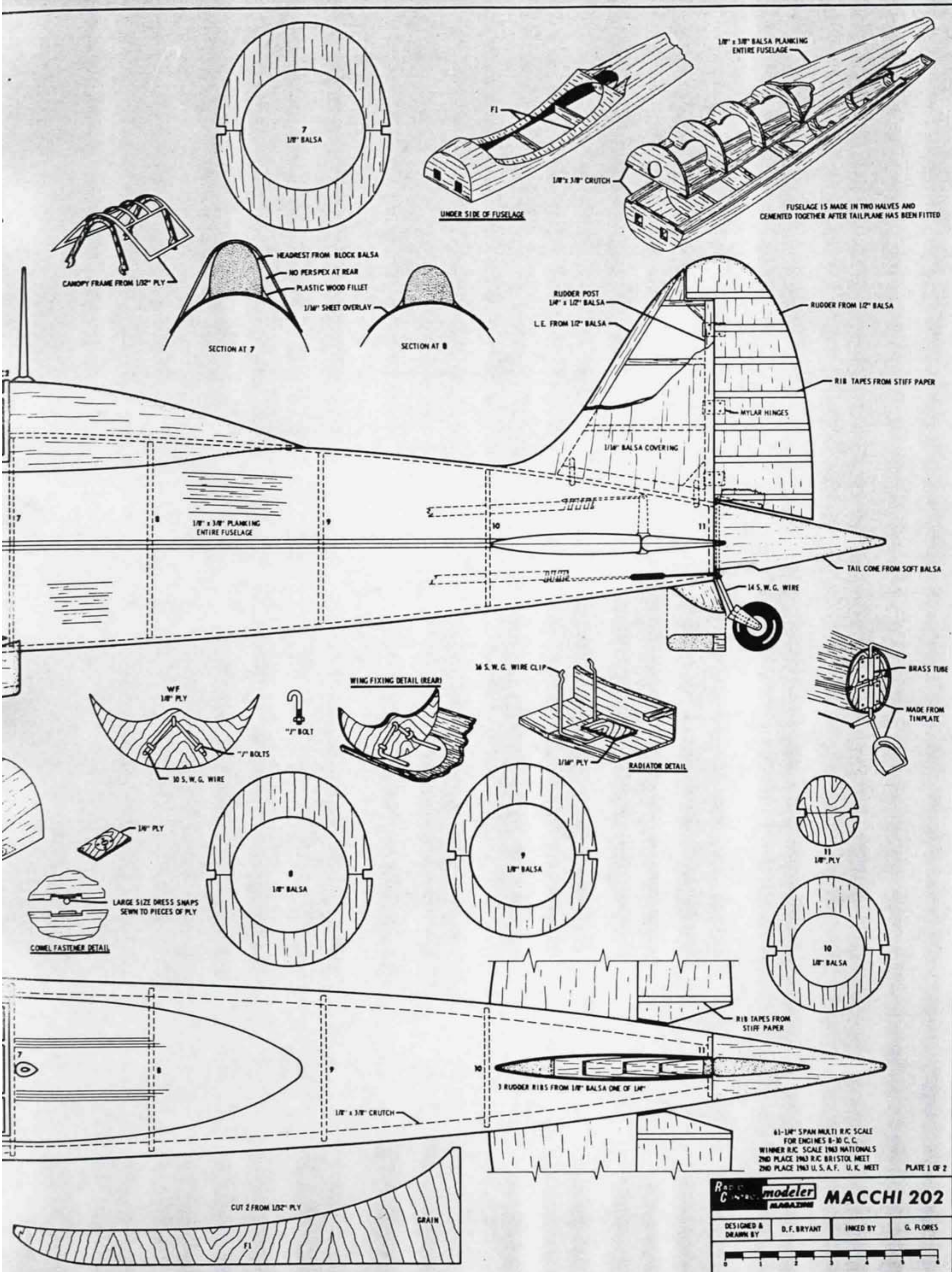
Winner of the 1963 British Nationals, the Macchi 202 is a must for the serious, advanced scale builder demanding absolute fidelity to scale.

IN 1963 I purchased a copy of Famous Fighters of World War II, Volume II by William Green, which contained, among other things, photographs and three view drawings of the Macchi 202. I fell for the latter immediately, deciding that it would make an ideal subject for R/C scale. I had previously known about the Macchi 202, but had never seen a decent three view drawing of it until I had obtained a copy of Famous Fighters. Until then I had not realized what a handsome airplane it was. To my eyes, it rivals the Spitfire and Mustang for the title of best looking fighter of World War II, and it is in the hope that others will agree with me in this, that I have decided to submit this plan and article.

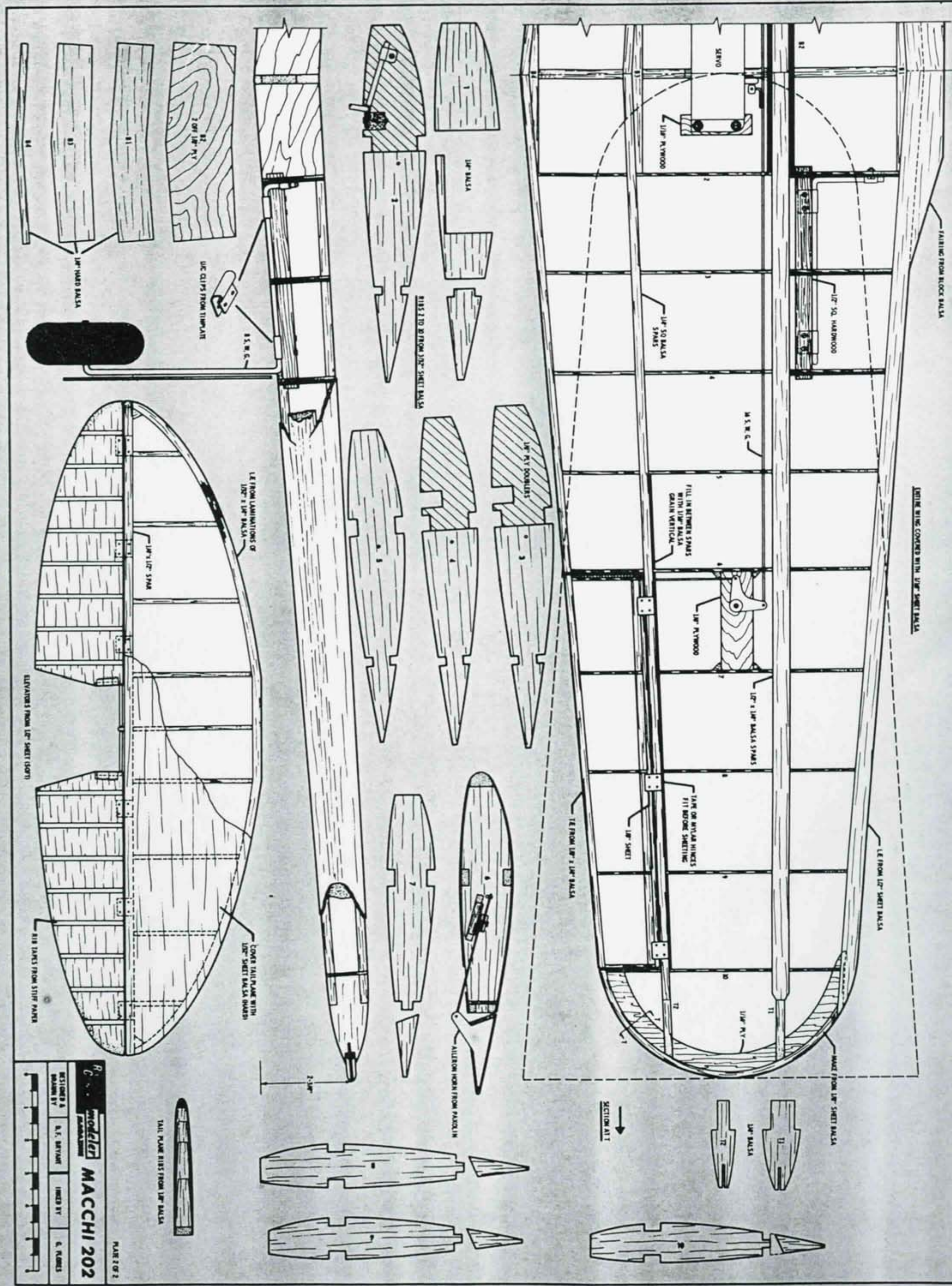
I soon had the plans drawn and the model under way, as I was anxious to have the model flying in order to show that there were other possibilities for R/C scale than the ubiquitous models



5
1/8" BALSA
6
1/8" BALSA
SECTION AT 6
LENGTHS OF BLOCK BALSA UNDER GUN TROUGH POSITIONS
C1
1/16" PLY
C2
2 OFF 1/16" PLY
FORMERS 2-3-4 FROM 1/8" BALSA FACED WITH 1/16" PLY
MERCO 61
8 OZ CLUNK TANK
R/C INSTALLATION NOT SHOWN
THIS IS LEFT TO BUILDERS CHOICE
SOFT BALSA FAIRING
WF
EXHAUST STACKS FROM BALSA
1/32" PLYWOOD
BLOCK BALSA
BALANCE POINT
OIL COOLER FROM SOFT BALSA
U/C COVER 1/16" PLY
U/C COVER
SOLDER & BIND
ONE LOOP
16 S.W.G.
TINPLATE
U/C COVER MOUNTING DETAIL
3-1/2" AIRSPAN WHEELS
RADIATOR FRONT VIEW
1/16" PLY
5/16" WING FIXING DOWEL (REMOVABLE)
1/32" PLYWOOD
GUN TROUGH
1/2" x 5/8" ENGINE BEARERS
OVERLAY FROM THIN CARD
AIR IN TAKE FROM BALSA
BIND WITH THREAD



1/8" x 3/8" BALSA PLANKING ENTIRE FUSELAGE
F1
7
1/8" BALSA
1/8" x 3/8" CRUTCH
UNDER SIDE OF FUSELAGE
FUSELAGE IS MADE IN TWO HALVES AND CEMENTED TOGETHER AFTER TAILPLANE HAS BEEN FITTED
HEADREST FROM BLOCK BALSA
NO PERSPEX AT REAR
PLASTIC WOOD FILLET
1/16" SHEET OVERLAY
CANOPY FRAME FROM 1/32" PLY
SECTION AT 7
SECTION AT 8
RUDDER POST 1/4" x 1/2" BALSA
L.E. FROM 1/2" BALSA
RUDDER FROM 1/2" BALSA
RIB TAPES FROM STIFF PAPER
MYLAR HINGES
1/16" BALSA COVERING
1/8" x 3/8" PLANKING ENTIRE FUSELAGE
TAIL CONE FROM SOFT BALSA
14 S.W.G. WIRE
BRASS TUBE
MADE FROM TINPLATE
WF 1/8" PLY
"J" BOLT
"J" BOLTS
10 S.W.G. WIRE
WING FIXING DETAIL (REAR)
16 S.W.G. WIRE CLIP
1/16" PLY
RADIATOR DETAIL
1/16" PLY
LARGE SIZE DRESS SNAPS SEWN TO PIECES OF PLY
COWL FASTENER DETAIL
8
1/8" BALSA
9
1/8" BALSA
11
1/8" PLY
10
1/8" BALSA
RIB TAPES FROM STIFF PAPER
3 RUDDER RIBS FROM 1/8" BALSA ONE OF 1/4"
1/8" x 3/8" CRUTCH
61-1/4" SPAN MULTI R/C SCALE
FOR ENGINES 8-10 C.C.
WINNER R/C SCALE 1963 NATIONALS
2ND PLACE 1963 R/C BRISTOL MEET
2ND PLACE 1963 U.S.A.F. U.K. MEET
PLATE 1 OF 2
CUT 2 FROM 1/32" PLY
GRAIN
F1
Radio Control modeler MAGAZINE
MACCHI 202
DESIGNED & DRAWN BY
D.F. BRYANT
INKED BY
G. FLORES


MACCHI 202
PLAN 2 OF 2

of the Spitfire, Mustang and P63 that everyone seemed to be flying at that time (1963).

The model was first test flown by Harry Brooks on a very cold and windy "Summer" day, and apart from over sensitive ailerons, no trouble was experienced, and I knew that I had a winner. The next weekend, after having modified the gearing of the ailerons, I flew the model myself. I was delighted to discover that it was very pleasant to fly and as such, emulated its full size counterpart.

The 1963 British Nationals was but six weeks away and I decided to enter the Macchi 202 for the R/C Scale event. On the day of the Competition, a howling gale was blowing which grounded everything but R/C multi. The scale entry was quite large that year but they were mainly single channel types and it would have been suicide to fly them in the high wind. Only three of us, who had multi, elected to fly, and at the end of the event, I was overjoyed to discover that I had won by a reasonable margin.

To those of you wishing to build this model, I would like to point out that I am presenting it exactly as built in 1963 except for the engine which was a Veco 45. If I were to build this model today, it would have retractable u/c, bolt on wings and frise ailerons but I thought it only fair to show the model as built by me at that time and leave the improvements to those with an experimental nature.

As it is not a beginner's model, there is no point in making this a stick-this-piece-to-that-piece type of article. There are one or two points, however, that I would like to call to your attention. To those of you who have not made a planked fuselage before, I would like to point out that they are not as difficult as they look. In addition, they are very light, very strong, and when made on the crutch system, it is impossible to end up with banana shaped fuselage as often happens with slab siders. Try to make the planks a good fit without too many gaps. I find it a great help to bevel the edges of the planks with a sanding block before assembly, any remaining then filled in with small pieces of balsa. The whole thing will look a frightful mess until the final sanding down with a sanding block. I always find it a most enjoyable experience to see the fuselage taking shape through the sanding dust.

Before the two halves of the fuselage are joined permanently, the tail plane must be made and fitted to the top half. In addition, the elevator pushrod must be installed as the elevator horn will be inaccessible once the two halves are joined.

Finally, cover the fuselage with nylon and treat with your favorite filler. The steerable tail wheel is not strictly necessary, but I found this a convenient method of connecting the pushrod to the rudder without the usual ugly pushrod sticking out of the top of the fuselage.

Next, we come to the wing. This is a completely conventional sheet covered structure and requires no particular instructions, but I would like to confess to a deviation from scale of the ailerons. These should go right to the wing tip, but with the type of hinge used, this would result in an unsightly V shaped gap at the wingtip, so if you want to be dead scale you will have to use a scale type hinge or put up with the gap.

On the original, the wings are retained with rubber bands as shown on the plans, but in light of later experience and if you can guarantee good landings, camlocks would be an improvement. With the latter the radiator could then be glued on to the wing instead of the clip arrangement which I used.

The cockpit canopy is fairly straightforward and does not require a mould. It is sufficient to cut out the 1 mm. plywood frame as shown on the plan and cover with acetate sheet on the inside of the frame. This gives a reasonable simulation of a full size canopy, but a word of warning here — when finishing the model please, oh please, do not pick out the canopy frames in black; this is a common error which I have seen on every type of scale model from plastics to R/C, and I always froth at the mouth whenever I see it! It is never done on full size aircraft. Canopy frames are always the same as the surrounding camouflage color but for some strange reason, many modelers seem to think that there is a man at the end of the aircraft factory assembly lines with a pot of black paint and a brush, busy painting in the canopy frames!

You may by this time, be wondering what to do about that $3\frac{1}{8}$" diameter spinner. I made mine from fiberglass, using a method which I have found very successful, but one which would require quite a long article to explain. Perhaps I may be able to twist Don Dewey's arm for future publication, however, I believe that the selection of spinners available in the U. S. is much greater than here in England, and you may be lucky enough to obtain one in the correct size. With the correct dimensions, but for those of you who own lathes, you have no problem and the shape shown on the plan is the correct one.

While we are at the front end of the about the method of fastening the cowl-model, I would like to say a few words ing. I use dress snaps and have always found them very reliable; these are best fitted while the cowling is in the rough state and slightly oversize. Obtain a pair of No. 5 dress snaps and sew each part to a piece of $\frac{1}{16}$" ply, $\frac{1}{2}$" square, fit the male halves of the dress snaps to the detachable part of the cowl by recessing the ply flush with the bottom of the cowl and glue in place with epoxy cement. Place the cowl in position and push on to the bottom half. This will

The author and the Nationals winning Macchi 202. Note the matte finish on model.

cause the male dress snap to leave a depression in the balsa, which will then act as location points for the female press stud, which in turn is then fitted in the same way as the male press stud. When all is dry, the cowl is snapped in place and sanded to conform to the fuselage contours. You will then have a perfect fitting cowl which can be removed and replaced with ease, and which will not come off in flight. An added plus — no ugly rubber bands to mar the scene!

The trickiest part to make on the whole model is the wing root fairing. This should be left until the wing has been sheeted. First of all, try to obtain as perfect a fit as possible between the wing and the fuselage by trimming the fuselage sides. Then attach the wing to the fuselage with a large rubber band right around the fuselage so that it is held firmly to the wing, then slide the ply fairing gussets, marked F1 on the plan, between the wing and fuselage making sure that it touches the wing along its whole length from L/E to T/E then cement to the fuselage. When dry, remove the wings and you are then ready to fit the balsa fairing blocks; these require very careful carving to obtain a good fit between the fuselage and the ply gusset. When you are satisfied with the fit, cement the blocks in place and carve them to the concave section shown on the plan and then sandpaper to a smooth blending curve from the edge of the ply to the fuselage.

As the tail unit is so easy to make, I will not insult your intelligence by telling you how to make it, but I will say a word about the control surfaces. On the full size aircraft these are fabric covered, and if you like a bit more work these could be built up and covered with nylon and would possibly be a bit lighter than the solid ones I used.

As that just about covers all the components I will mention the finishing process. The model is covered with nylon doped on, followed by about four coats of sanding sealer. You will need a spray gun to get an authentic finish, one that will adjust to a fine spray, which is required to spray the dark green patches over the light sand color which is the color scheme of the upper surfaces; the lower surfaces are a pale blue gray. For more detailed information on color schemes, cockpit details, and photographs, I strongly recommend that you obtain Profile No. 28 from Profile Publications. Any scale modeler who has not heard of these is missing out on a good thing. I know that these are available in the U. S., as I have seen them advertised in your magazines, so you should have no trouble in obtaining them.

On seeing the large three bladed air screw in the photographs, you may be thinking that I have something special in the way of a power plant, but I am sorry to say that it was made for photographic purposes only and the model is flown on the usual 12 x 6 two blade nylon prop.

When it comes to flying this model, you should have no trouble at all as it is as easy to fly as a conventional multi. No side or down thrust was required on the original model when powered with the Veco 45 and, later on, when the Merco 61 became available, I fitted one to the 202, and apart from a half ounce of lead on the tail, no other adjustments were necessary and the performance was much improved.

When fitted with the F & M Midas, Bonners, and Veco 45, the model weighed 6½ lbs., but over the years, the model, like its owner, has put on a little weight, due to the larger engine, silencer, oil soakage and various repairs and the model now tips the scales at 8 lbs. At this weight the landings are a bit hectic and although the general performance is still quite good, I have retired the model as I feel that I have had my money's worth from it, and there are other projects I wish to pursue.

LOCKHEED XH-51A

By JOHN M. BURKHAM

For the RC'er who wants the ultimate, here's a scale 70" diameter rigid rotor helicopter for full house proportional. The author's text and engineering drawings will provide you with a sound basis for advanced experimentation.

I. INTRODUCTION

HERE'S one for the fellows who are bored with things like multi-engine carrier landings and piggy-back sailplane launchings. It's an eight pound, four control, 70-inch diameter rigid rotor helicopter. It can be flown as a rectangular fuselage section experimental job and then finished up with a fuselage shell of balsa or fiberglass to be a scale model of the Lockheed XH-51A helicopter. Here's a model you can literally fly in your own backyard.

The model was made as small as possible to carry full quad proportional gear and still have light enough disk loading for safe vertical autorotational capability. One of the design objectives was to keep the machine work as simple as possible. Well, all I can say is you should have seen it before it was simplified. The model is about one order of magnitude more difficult than a multi-engine scale airplane, and should be attempted only by an experienced and clever machinist. Estimated time to build is about six months, spending most of your spare time on it. It took two such full months to design the thing. First came the preliminary specs and some aerodynamic calculations to determine size, hovering power, rotor rpms and autorotation capabilities. Then some preliminary designing and weight and balance estimates. Next came detail designing and working out the many technical problems, along with a little stress work. The C.G. was kept track of during the many changes. Finally came the work part, putting the design on Mylar so that other people could build it.

II. DESIGN FEATURES

A. Rotor

The rigid rotor and stabilizer bar were chosen not only to give stability in the air but also to minimize roll over on landing. A teetering or flapping rotor could have been made stable in the air by a gyro stabilizer bar, but they give no roll or pitch damping to the fuselage in the event of a sidewise or forward speed landing. The aircraft would bounce once and roll over, creaming the blades. The rigid stabilized rotor tends to hold the fuselage attitude constant regardless of external influences.

B. Controls

This model has more coupled controls than most full scale single rotor helicopters have. Not only is the throttle coupled to the collective pitch of the main rotor but also to the tail rotor pitch. When the pilot gives an up-collective control motion, the engine throttle is also opened a little and the tail rotor thrust is increased to take care of the added torque. Another servo is connected to the tail rotor control like a trim servo to give independent yaw control. The lateral and longitudinal servos serve the purpose of exerting a tilting moment or force on the stabilizer bar, not a displacement. The bar then precesses or tilts in the direction 90° later around the azimuth from the point where the force was exerted. The pitch links from bar to blades then change the blade pitch cyclically and the rotor responds immediately, tilting the fuselage also.

C. Radio Gear

Although proportional gear has been shown, a reed system should work very satisfactorily, using trim type servos for throttle-collective and yaw and self-neutralizing for the lateral and longitudinal control servos. The antenna extends out in front like a yaw boom on a real helicopter. This position gets it away from interference-producing mechanisms, puts it near the receiver, and helps get the C.G. forward. For nearby flying, hovering and slow forward flight, the antenna could be shorter than three feet.

D. Performance

Calculations indicate that only ¼ horsepower from the engine is required for hovering at 8 pounds gross weight, out of ground effect. Of this ¼ horsepower, only .168 is required by the main rotor, the rest going into transmission and cooling losses and tail rotor power. At full power from the Veco .45 engine, the helicopter should be able to lift over 15 pounds total!

E. Tail Rotor Drive

The tail rotor is driven by a flexible shaft (3/16 diameter music wire) supported at four places by Teflon tubing. This system keeps the drive train within the envelope of the scale helicopter and eliminates one gear box or universal joint at the bend in the tail boom. Torque limiting clutches connect the shaft to the gear box at each end and prevent twisting off the shaft in case the tail rotor strikes something while the main rotor is turning. The tail rotor incidentally is two inches larger in diameter than scale size because a suitable pair of 6:1 ratio bevel gears could not be found. If the builder wishes to drive the tail rotor at six times main rotor speed by suitable changes in gearing, the diameter may be reduced to 12 inches and the blade chord reduced in proportion.

F. Flywheel and Clutch

A centrifugal clutch is built into the flywheel whose inertia is approximately equal to that of a 15 inch propeller. Engage speed is set at something above idle speed (say 3,500 rpm) so that the engine can be started without turning the rotors. Assuming needle valve adjustments have been previously made, the engine is started in idle position, and the pilot retreats to a respectable distance with transmitter in hand. The throttle is advanced slowly, the rotor comes up to speed, the aircraft becomes light on the skids, the pilot checks the trim of the cyclic controls as he watches the model, and then as the throttle is advanced still further, the model lifts off the ground. Autorotational descents with engine running can be performed merely by closing the throttle (slowly). The tail rotor is driven directly from the main rotor and downstream of the free wheeling clutch so that directional control is maintained during autorotation. Recovery from autorotation while engine is running can be made by advancing throttle slowly, to avoid large shock torque as the engine catches up with the rotor.

III. CONSTRUCTION

Hard balsa, hard aluminum and hard plywood should be used in construction. Where an aluminum bracket has bends in it, half hard should be used. Where set screws are used to hold gears and hubs to shafts, Loctite or epoxy should be used to hold them in. In many cases links and levers are connected by means of washers epoxied to the wire on either side of the link. To prevent rust all exposed steel surfaces should be painted with epoxy paint or zinc chromate primer. It is suggested that due to the extreme complexity and large number of parts involved, construction be done in an order such that parts can be assembled soon after they are made. Also, partial assemblies can be tested and if necessary changed before the complete helicopter is assembled. Such an order of construction and testing is as follows:

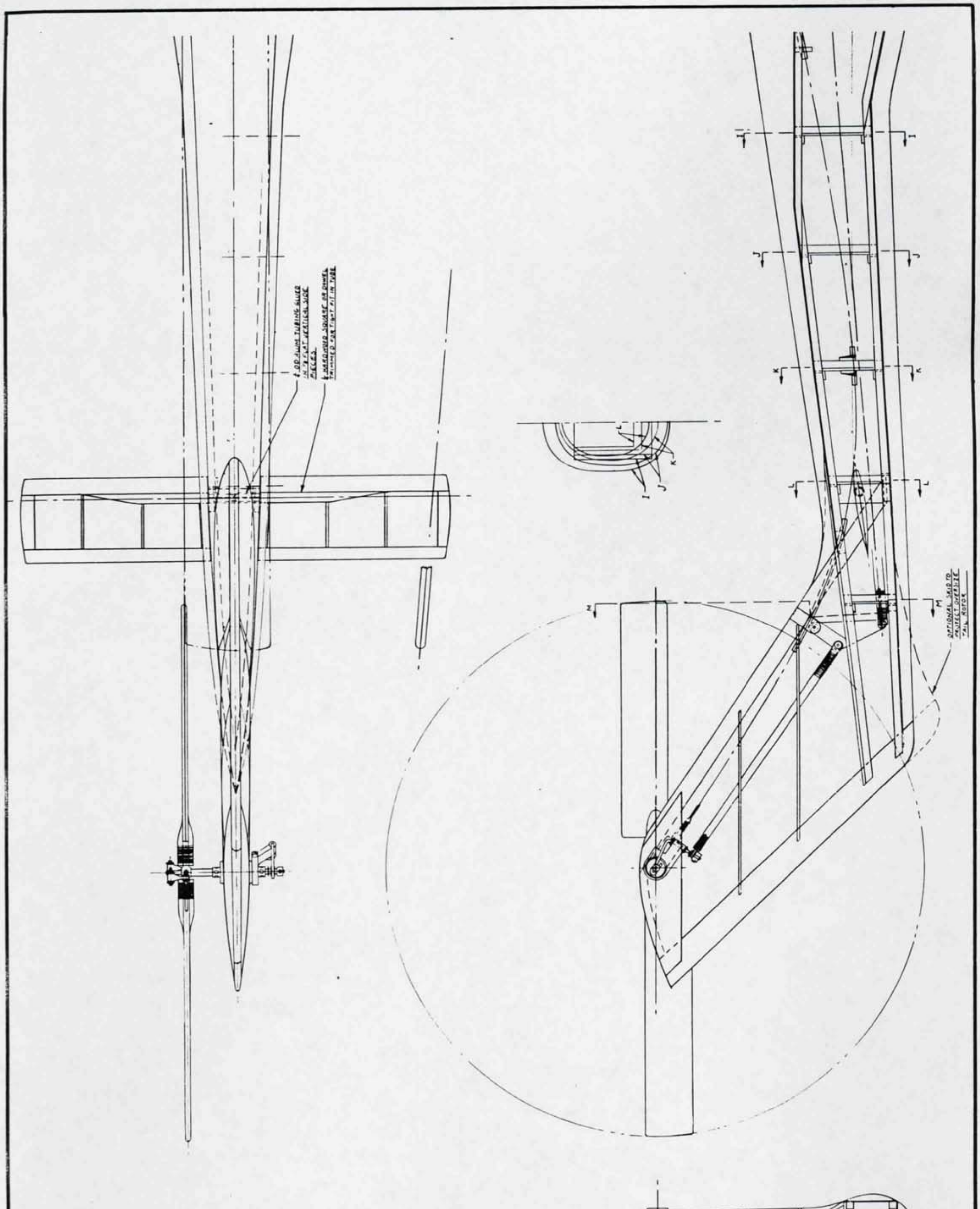
Construction

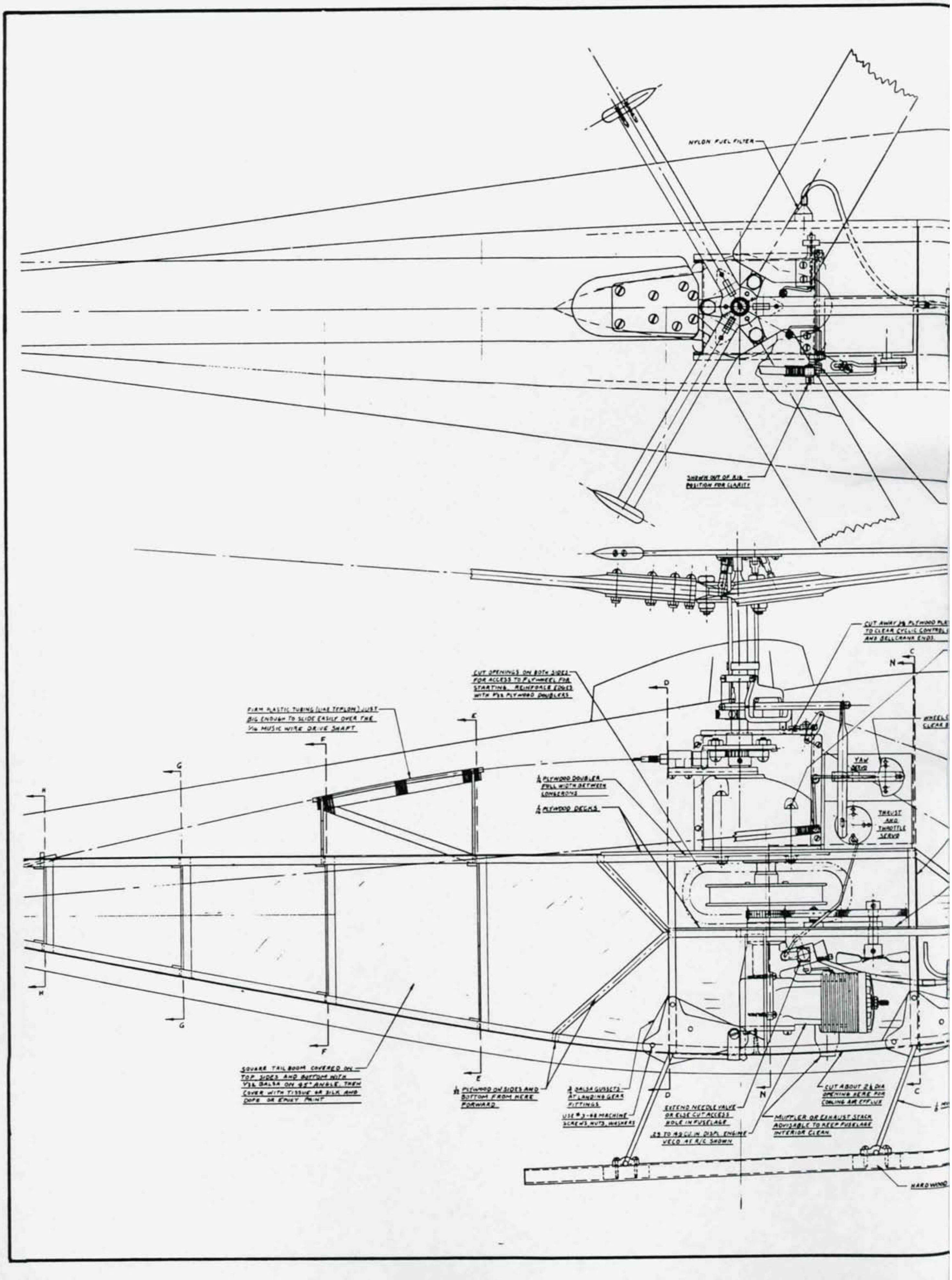
1. Fuselage and landing gear
2. Engine mounting
3. Flywheel-clutch
4. Cooling fan drive
5. Fuel tank
6. Transmission
7. Free wheel clutch and shaft
8. Tail rotor take-off
9. Pylon and upper controls
10. Swashplate and push rods
11. Main rotor and stab. bar
12. Radio and Servo instll.
13. Tail rotor drive shaft
14. Tail rotor gear box
15. Tail rotor
16. Tail rotor controls
17. Horizontal stabilizer
18. Covering

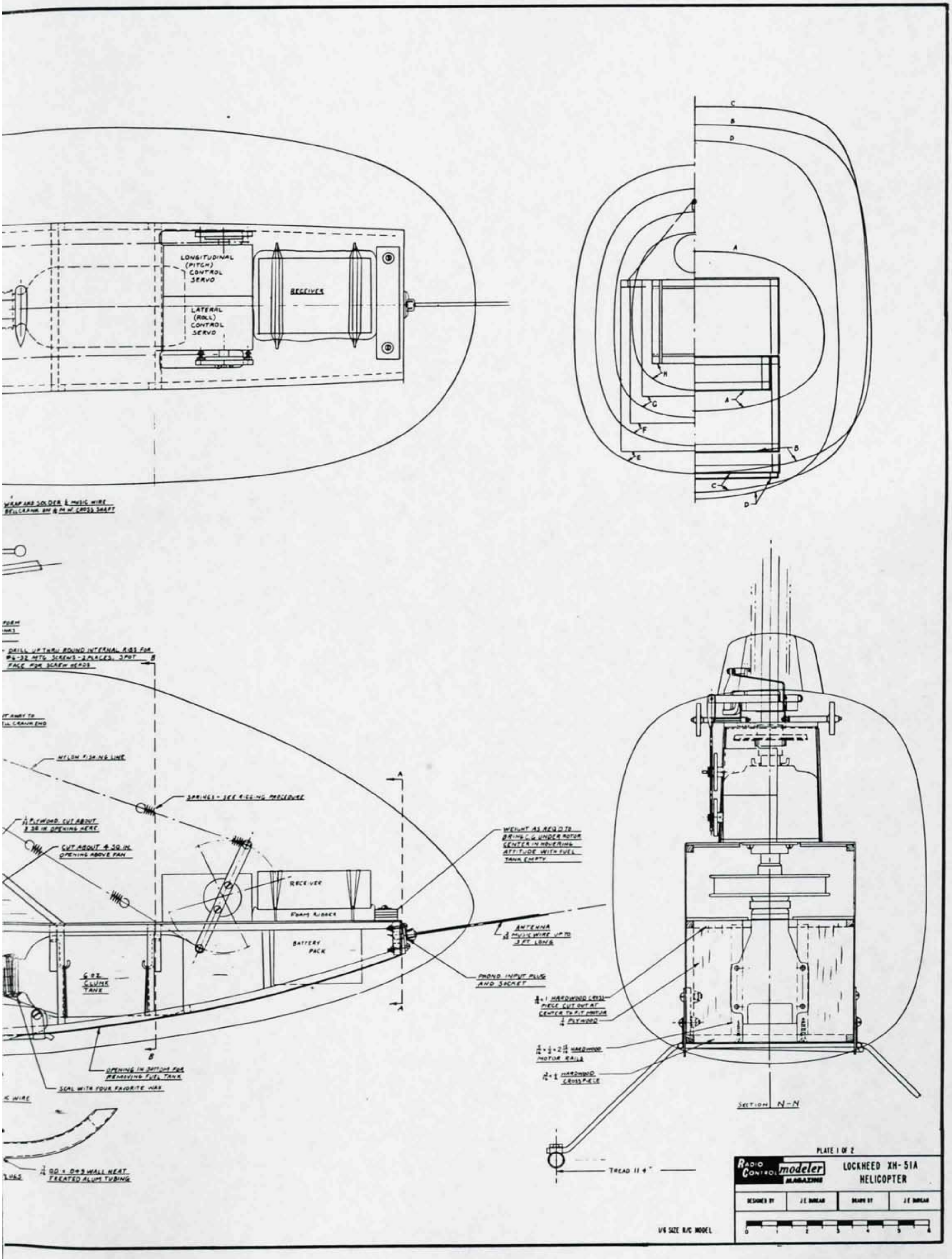
The following are suggestions for specific construction problems of the model:

1. Fuselage and landing gear: The crosspieces in the tail boom are mostly 1/16 x 1/4 balsa strips cemented on the inside surface of the longerons. Then 1/16 x 3/16 strips are cemented edgewise to the 1/16 x 1/4 strips to strengthen the latter and support the covering. Larger glue area and much better strength-to-weight ratio result from this type construction. Some covering can be done to strengthen the fuselage for interim testing.
2. Engine mounting: Pre-drill the hardwood for wood screws to avoid splitting. Epoxy cement is also advised. Take care to get crankshaft perpendicular to plywood top deck for smooth running coupling between the clutch and transmission.
3. Flywheel-Clutch: Accurate balancing is essential for smooth running. Balance each part before assembly and then balance on assembly, piece by piece. By calculation, if 1/8 diameter solder in pieces 3/16 long, is closely packed in the coil spring with no gaps, and if the preload in the connected spring is 1½ pound tension when slipped over the inner ring of the pressure plate, engagement should occur at 3,000 rpm. It may be desirable to set this speed higher by increasing spring tension.
4. Cooling Fan Drive: Gears should have a few thousandths of backlash. Pre-lubricate teeth and shafts with Lubriplate light grease. It will be thrown off the teeth but the surfaces will be plated somewhat.
5. Fuel Tank: Fasten in with several wraps of soft copper wire and twist ends, unless you can find some fuel-proof rubber bands. Fill by removing fuel line from nylon filter.
6. Transmission: Since ample power is available, a sleeve bearing drill gear reduction could be used in place of the ball bearing one shown. The ratio should be about 20:1, which is about what most 3/8" drills run. Two-stage reduction is essential to turn the rotor the right direction. Be sure the input shaft (part of the armature of the drill motor) is supported against cocking by two bearings. Quite a bit of weight can be pared off the case with saw and rotary file and hand file, depending on ambition.
7. Free Wheel Clutch and Shaft: The brass bevel gear is clamped to the main rotor shaft rather than set-screwed to it, to avoid distorting the thin tubing and binding the sleeve bearing. That bearing should be a close fit to minimize wobbling of the rotor shaft. Try to get nearly equal pressure on both pawls of the ratchet.
8. Tail rotor takeoff: Be sure the spring one-way clutch is wound the right direction to tighten up when the engine is driving the tail rotor. Limit the maximum driving torque to about twice normal driving torque by limiting the number of turns wound on each side of the parting line between 1/8 shaft and 1/8 sleeve over the drive shaft.
9. Pylon and Upper Controls: The pylon is attached by screws into the transmission case and screws through flanges resting on the plywood deck of the fuselage. The upper controls should move freely in the direction to tilt the swashplate by at least 4 or 5 degrees. It is important that the resistance to tilt felt by the stabilizer bar be kept to a minimum to avoid feeding back unwanted precessional forces into the bar. Otherwise the bar would have to be made larger. Small rubber washers are used in various places to prevent side play of links and yet allow some angular motion. The special screws have unthreaded lengths where links ride on them, for more bearing area and longer life of the links.
10. Swashplate and Push Rods: The heart of the swashplate, its ball bearing, may have to be ordered from the manufacturer, Split Ball Bearing, since most jobbers don't carry that line. Be sure screws are cemented in before extensive running is done. A lost screw here in flight could be disastrous.
11. Main Rotor and Stabilizer Bar: Balance each part individually before assembly. Be sure all blades have the same built-in coning angle. Assemble blade spindles and set at exactly 120° angles to each other before drilling 1/16 rivet hole. This rivet shears if a blade strikes something. Then attach blades and pattern at 120° to each other before drilling screw holes in blade retainers. Stabilizer bar should pivot freely on ball joint in the center, but also have very little looseness. Lubricate well with Lubriplate grease. Balance rotor by adding weight to the blade tips. Balance bar by removing weight from the tip (by drilling into the nose of the tip weight and filling with balsa).
12. Radio and Servo Installation: The Micro-Avionics system dimensions were used for the drawings. Any good quad-proportional system could be used, or even a reed system, using trim type servos for throttle and tail rotor and self-neutralizing for the lateral and longitudinal controls. Whichever system is used should fail-safe with lateral, longitudinal and tail rotor controls in neutral and throttle in idle position. Model should then autorotate at a vertical rate of descent of 13 ft./sec. or less and at a forward speed depending on the C.G. position and cyclic control trim.
13. Tail Rotor Drive Shaft: If only three foot lengths of 1/16 music wire are available, solder two pieces together with a split sleeve available in hobby shops. Put the joint outside of the supporting tubes. Have a slight compression in the shaft to hold the ends in their sockets. Wire should be as straight as possible to start with.
14. Tail Rotor Gear Box: Cement assembled gear box in place in holes cut in the balsa side pieces at the top of the tail fin.
15. Tail Rotor: Assemble blades and pitch links by first screwing on blades to proper position. Put wide ends of pitch links on Z-shaped wire bracket which is not yet cemented to 1/8 control tube. Slide Z-bracket one way and slip that link over blade pitch arm. Slide other way and slip the other one on. Some bending of the Z-bracket will be necessary.

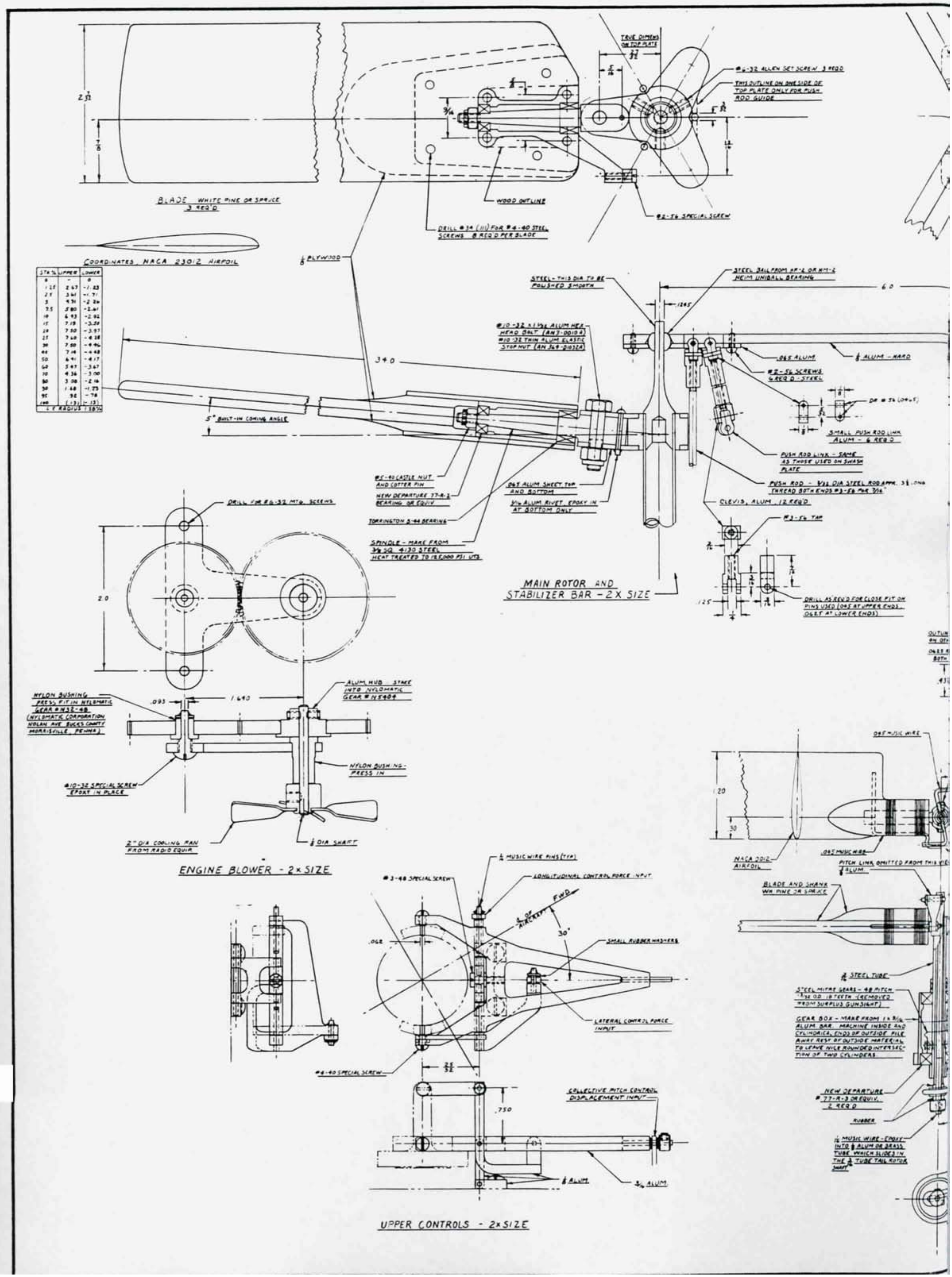
(Continued on page 72)


HARDWOOD SQUARE OR DOWEL TRIMMED FOR TIGHT FIT IN TUBE
OPTIONAL SKID TO PROTECT OVERSIZE TAIL ROTOR

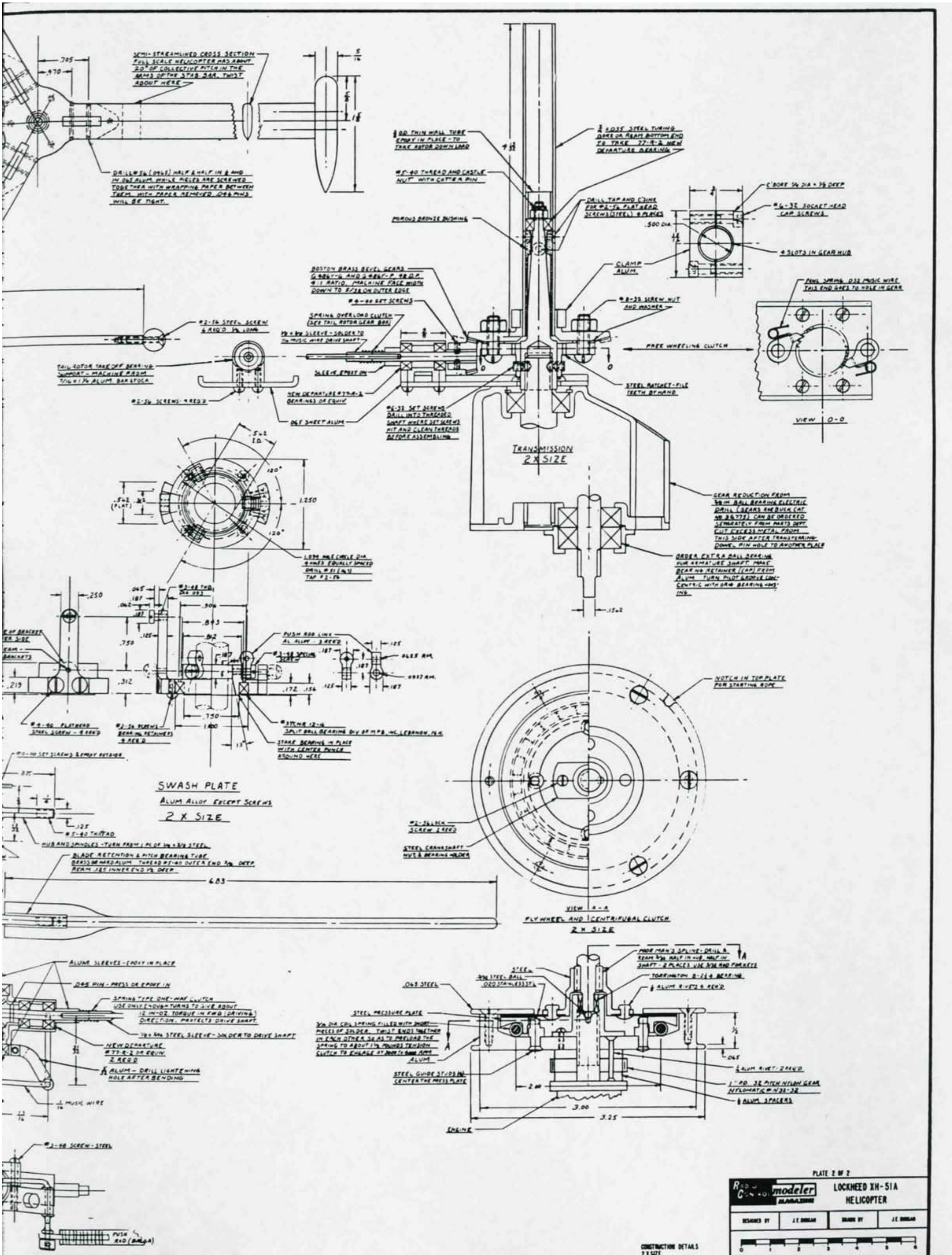

NYLON FUEL FILTER
CUT OPENINGS ON BOTH SIDES FOR ACCESS TO FLYWHEEL FOR STARTING. REINFORCE EDGES WITH 1/32 PLYWOOD DOUBLERS
FIRM PLASTIC TUBING (LIKE TEFLON) JUST BIG ENOUGH TO SLIDE EASILY OVER THE 1/16 MUSIC WIRE DRIVE SHAFT
1/8 PLYWOOD DOUBLER FULL WIDTH BETWEEN LONGERONS
1/8 PLYWOOD DECKS
YAW SERVO
THRUST AND THROTTLE SERVO
SQUARE TAIL BOOM COVERED ON TOP, SIDES AND BOTTOM WITH 1/32 BALSA ON 45° ANGLE. THEN COVER WITH TISSUE OR SILK AND DOPE OR EPOXY PAINT
1/32 PLYWOOD ON SIDES AND BOTTOM FROM HERE FORWARD
1/8 BALSA GUSSETS AT LANDING GEAR FITTINGS
USE #3-48 MACHINE SCREWS, NUTS, WASHERS
EXTEND NEEDLE VALVE OR ELSE CUT ACCESS HOLE IN FUSELAGE
.29 TO .49 CU.IN. DISPL. ENGINE VECO 45 R/C SHOWN
MUFFLER OR EXHAUST STACK ADVISABLE TO KEEP FUSELAGE INTERIOR CLEAN.
CUT ABOUT 2 1/4 DIA OPENING HERE FOR COOLING AIR EFFLUX



LONGITUDINAL (PITCH) CONTROL SERVO
LATERAL (ROLL) CONTROL SERVO
RECEIVER
WRAP AND SOLDER MUSIC WIRE BELLCRANK ON M.W. CROSS SHAFT
DRILL UP THRU ROUND INTERNAL RIBS FOR #4-32 MTG SCREWS - 2 PLACES, SPOT FACE FOR SCREW HEADS
NYLON FISHING LINE
SPRINGS - SEE RIGGING PROCEDURE
PLYWOOD, CUT ABOUT 3 SQ IN OPENING HERE
CUT ABOUT 4 SQ IN OPENING ABOVE FAN
WEIGHT AS REQ'D TO BRING C.G. UNDER ROTOR CENTER IN HOVERING ATTITUDE WITH FUEL TANK EMPTY
RECEIVER
FOAM RUBBER
BATTERY PACK
6 OZ CLUNK TANK
ANTENNA MUSIC WIRE UP TO 3 FT LONG
PHONO INPUT PLUG AND SOCKET
OPENING IN BOTTOM FOR REMOVING FUEL TANK
SEAL WITH YOUR FAVORITE WAX
TREATED ALUM TUBING
HARDWOOD CROSS-PIECE CUT OUT AT CENTER TO FIT MOTOR
PLYWOOD
HARDWOOD MOTOR RAILS
HARDWOOD CROSSPIECE
SECTION N-N
TREAD 11"
PLATE 1 OF 2
RADIO CONTROL modeler MAGAZINE
LOCKHEED XH-51A HELICOPTER
DESIGNED BY
DRAWN BY
1/6 SIZE R/C MODEL



STA %	UPPER	LOWER
0	-	0
1.25	2.67	-1.23
2.5	3.61	-1.71
5	4.91	-2.26
7.5	5.80	-2.61
10	6.43	-2.92
15	7.19	-3.50
20	7.50	-3.97
25	7.60	-4.28
30	7.55	-4.46
40	7.14	-4.48
50	6.41	-4.17
60	5.47	-3.67
70	4.36	-3.00
80	3.08	-2.16
90	1.68	-1.23
95	.92	-.70
100	(.13)	(-.13)
L.E. RADIUS 1.58%		



SEMI-STREAMLINED CROSS SECTION FULL SCALE HELICOPTER HAS ABOUT 20° OF COLLECTIVE PITCH IN THE ARMS OF THE STAB BAR. TWIST ABOUT HERE
DRILL #56 (.0465) HALF & HALF IN & AND IN .065 ALUM. WHILE PIECES ARE SCREWED TOGETHER WITH WRAPPING PAPER BETWEEN THEM. WITH PAPER REMOVED DOWEL PINS WILL BE TIGHT.
OD THIN WALL TUBE EPOXY IN PLACE - TO TAKE ROTOR DOWN LOAD
#5-40 THREAD AND CASTLE NUT WITH COTTER PIN
POROUS BRONZE BUSHING
DRILL, TAP AND C'SINK FOR #2-56 FLAT HEAD SCREWS (STEEL) 4 PLACES
C'BORE 5/16 DIA x 1/8 DEEP
#6-32 SOCKET HEAD CAP SCREWS
.500 DIA.
4 SLOTS IN GEAR HUB
CLAMP ALUM.
BOSTON BRASS BEVEL GEARS 4:1 RATIO. MACHINE FACE WIDTH DOWN TO 5/32 ON OUTER EDGE
#4-40 SET SCREWS
#8-32 SCREW, NUT AND WASHER
SPRING OVERLOAD CLUTCH (SEE TAIL ROTOR GEAR BOX)
1/8 x 1/32 SLEEVE - SOLDER TO MUSIC WIRE DRIVE SHAFT
FREE WHEELING CLUTCH
PAWL SPRING .032 MUSIC WIRE THIS END GOES TO HOLE IN GEAR
#2-56 STEEL SCREW 6 REQ'D 3/8 LONG
TAIL ROTOR TAKE-OFF BEARING SUPPORT - MACHINE FROM 7/16 x 1 1/4 ALUM. BAR STOCK
SLEEVE - EPOXY ON
NEW DEPARTURE #77-R-2 BEARINGS OR EQUIV.
STEEL RATCHET - FILE TEETH BY HAND
#2-56 SCREWS - 4 REQ'D
.065 SHEET ALUM.
#6-32 SET SCREWS DRILL INTO THREADED SHAFT WHERE SET SCREWS HIT AND CLEAN THREADS BEFORE ASSEMBLING
VIEW 0-0
TRANSMISSION 2 X SIZE
GEAR REDUCTION FROM BALL BEARING ELECTRIC DRILL (GEARS AND BUCK CAT CAN BE ORDERED SEPARATELY FROM PARTS DEPT. CUT EXCESS METAL FROM THIS SIDE AFTER TRANSFERRING DOWEL PIN HOLE TO ANOTHER PLACE
ORDER EXTRA BALL BEARING FOR ARMATURE SHAFT. MAKE BEARING RETAINER (CAP) FROM ALUM. TURN PILOT GROOVE CONCENTRIC WITH ORIG. BEARING HOUSING.
.542 I.D.
120°
1.250
.542 (FLAT)
4 HOLES EQUALLY SPACED DRILL #51 TAP #2-56
.250
.045
.187
.062
.906
.843
.750
.125
.812
.312
.219
PUSH ROD LINK AL ALUM - 3 REQ'D
.125
.0625 RM.
.0937 RM.
.172
.156
#4-40 FLATHEAD STEEL SCREW - 4 REQ'D
#2-56 SCREWS BEARING RETAINERS 4 REQ'D
.750
1.500
13°
SPLIT BALL BEARING DIV OF MPB, INC LEBANON, N.H.
STAKE BEARING IN PLACE WITH CENTER PUNCH AROUND HERE
NOTCH IN TOP PLATE FOR STARTING ROPE
SWASH PLATE
ALUM ALLOY EXCEPT SCREWS
2 X SIZE
#5-40 THREAD
HUB AND SPINDLES - TURN FROM 1 PC OF 3/4 x 3/4 STEEL
BLADE RETENTION & PITCH BEARING TUBE
6.83
#2-56 LOCK SCREW 2 REQ'D
STEEL CRANKSHAFT NUT & BEARING HOLDER
VIEW A-A
FLYWHEEL AND CENTRIFUGAL CLUTCH
2 X SIZE
ALUM. SLEEVES - EPOXY IN PLACE
.045 PIN - PRESS OR EPOXY IN
SPRING TYPE ONE-WAY CLUTCH USE ONLY ENOUGH TURNS TO GIVE ABOUT 12 IN-OZ TORQUE IN FWD (DRIVING) DIRECTION. PROTECTS DRIVE SHAFT
1/8 x 1/64 STEEL SLEEVE - SOLDER TO DRIVE SHAFT
NEW DEPARTURE #77-R-2 OR EQUIV. 2 REQ'D
ALUM - DRILL LIGHTENING HOLE AFTER BENDING
MUSIC WIRE
#2-56 SCREW - STEEL
PUSH ROD (BRASS)
.063 STEEL
STEEL
STEEL BALL
.020 STAINLESS STL.
TORRINGTON B-2 1/2 4 BEARING
ALUM. RIVETS 4 REQ'D
STEEL PRESSURE PLATE
ALUM.
STEEL GUIDE STUDS (4) CENTER THE PRESS PLATE
.065
ALUM. RIVET - 2 REQ'D
1" PD. 32 PITCH NYLON GEAR
ALUM. SPACERS
2.00
3.00
3.25
ENGINE
PLATE 2 OF 2
Radio Control modeler MAGAZINE
LOCKHEED XH-51A HELICOPTER
DESIGNED BY J.E. DUNLAP
DRAWN BY J.E. DUNLAP
0 1 2 3 4 5 6
CONSTRUCTION DETAILS 2 X SIZE

LOCKHEED XH-51A

(Continued from page 66)

Then center it, check that both blades are at same pitch and (epoxy) cement Z-bracket in control tube.

16. Tail Rotor Controls: Keep backlash to an absolute minimum, yet make controls easy to operate.
17. Horizontal Stabilizer: It may be desirable to add some hooks to the leading edges and use fish line to hold the stabilizer halves on, especially if the dowels become loose in the sockets. Stabilizer is needed only in high speed forward flight, to aid stability and improve longitudinal control.
18. Covering: Cover main fuselage with 1/32 plywood with suitable cut-outs for tank, batteries, cooling, starting, needle valve, etc. Cover tail boom with 1/32 balsa with grain at 45°. Cover that with silk and then dope or Hobbypoxy. Keep tail boom and all parts back there light to avoid having to add four times that excess weight at the nose.

IV. RIGGING AND TESTING

A. Test clutch and flywheel on an electric motor with some kind of tachometer. Hold the output hub and check speed at which clutch engages. Spin the flywheel at 15,000 rpm (no higher) to check its ability to hold together. (Maybe eight screws are needed instead of six.)

B. After enough controls are completed to hold the main rotor at any given collective pitch, check the power and collective pitch setting required to give 8 pound thrust at 562 rpm. Also check throttle settings for idle at 2,200 engine rpm, driving the rotor at 535 rpm in flat pitch, and developing 8 pound thrust at 562 rpm and required collective pitch. These settings are used in coordinating throttle and collective pitch.

C. After the throttle servo has been installed juggle the wheel position and length of slot in the collective pitch link to satisfy the settings found in B above. The pin should travel from one end of the slot to the other while engine speed increases from idle to 9,500. Then both collective pitch and throttle should increase to the settings for 8 pound thrust and 10,000 engine rpm.

D. After tail rotor controls have been installed for tentatively 10° tractor thrust and 20° pusher thrust, find tail rotor pitch settings to equalize main rotor torque at 0° collective, 535 rpm, and 8 pound main rotor thrust at 562 rpm. Juggle point at which the bellcrank end enters the mixing lever between collective pitch link (to main rotor) and tail rotor servo. Movement of main rotor collective from 0 to 8 pound thrust setting should change tail rotor pitch from position to position required to keep main rotor torque balanced while tail rotor servo is held stationary. Then choose pin position in tail rotor servo wheel which gives about plus or minus 10° tail rotor collective pitch while main rotor collective is held stationary.

E. After installing lateral and longitudinal control servos select tension springs of a length and strength that will give an increase in tension from say 16 oz. minimum to 21 oz. more or 37 oz. maximum when stretched by the distance traveled by the end of the servo arm. When both springs and fishlines are connected from servo to bellcrank and the servo is rotated to end of travel one way, the moment exerted on the stabilizer bar should be about 8 inch ounces. This will give a bar precession rate and aircraft pitch or roll rate of about one radian per second.

F. After model is fairly complete, check rotor stability as follows. Hold model overhead while engine is running and main rotor collective pitch is set for hovering. Gently tilt the model forward and backward while noticing whether it wants to tilt sidewise of its own accord. Also notice how much resistance to tilting it offers. If it offers lots of resistance to fore and aft tilt and wants to precess or tilt 90° to the way you tilt it, it means that the blades will have to be swept forward slightly relative to the spindles. Remove all but one blade retention screw from each blade root, move blade tip forward a quarter of an inch, redrill holes if necessary and reinstall screws. Check rotor balance roughly by checking blade pattern (distance from tip-to-tip). Again hold model overhead and tilt it gently. When the model stops wanting to precess and still offers some resistance to tilting, it should be stable in the air. The larger and heavier the bar, the more stable it will be in the air.

G. Check rotor response to lateral and longitudinal control input by holding it overhead loosely while it is practically supporting itself. Have someone slowly move the longitudinal control only. If the model pitches forward or backward only, you are lucky. Similarly for the lateral control. If the model tilts forward slightly while it is tilting laterally, you can either always put in a little longitudinal control with your lateral to get pure lateral response, and put in a little lateral with your longitudinal to get pure longitudinal response. Or you can reposition (rotate) the upper controls on top of the pylon by the amount necessary to give pure unmixed control response. I hope I guessed right for the necessary amount of lead and precession when I laid out the drawings.

H. Theoretical or calculated control ranges are as follows:

Main rotor — Autorotation at +2½° collective 8 lb. thrust at +8° and 562 rpm.

Tail rotor — Balance main rotor in flat pitch and 535 rpm by +2½° tail rotor pitch (in pusher direction). Balance main rotor in hovering by +10° of tail rotor collective. Allow additional +10° for directional control.

Engine throttle—Unknown. (Not time to find out experimentally.)

V. FLIGHT TESTING

It is suggested that a practice landing gear be used for training and test flights. This consists of bamboo or aluminum tube extensions tied with rubber bands to the model's own landing gear. These extend the effective length and width of the landing gear out to about ¾ of the rotor diameter and help prevent turnovers. Also tie the model down to a steel or aluminum plate weighing about ten pounds, allowing about one foot of slack in the line. The line should be fastened near the C.G. of the aircraft and also of the plate. Testing should be done on smooth concrete or macadam so that the plate will slide if the model gives a jerk on the line. As proficiency and confidence increase, the length of the line can be increased. Judging by the length of time required to learn to fly a real helicopter, probably twenty hours of tie-down time are reasonable before attempting a solo or free flight. Many bugs will need eliminating also; which might have caused a crackup if they were not discovered during tie-down.

Thought for the future: Rigid rotor helicopters have the potential capability for sustained inverted flight. This would require changing the collective pitch controls to give as much negative pitch capability as it now has positive. This may stimulate the modeler to imagine other exciting world's firsts for radio-controlled helicopter models.

SCALE AIRCRAFT PLANS: 1940-1966

By FRANK B. BAKER

One of the most vexing problems of a scale builder is that of locating plans. Often he can remember that a plan for a given airplane was published, but can't remember the magazine, month, or year. Thus, many tedious hours are spent thumbing through magazines in hopes of stumbling onto the desired plan. I used the above procedure until my frustration level was exceeded once too often. Therefore, I resolved to end the problem altogether. I laid out some worksheets and systematically recorded every scale plan, three view, and solid model plan, published in Model Airplane News, American Modeler, and RCM from 1940 until 1966. The data on the work sheets was key punched into IBM cards and sorted and tabulated. There are minor omissions due to plans of unattestable quality but these are few in number. The code scheme used is self evident except for the accuracy rating. A three point scale was used, where 'A' indicates I thought it was authentic (drawn from factory plans or historical sources). Plans such as those prepared by Wylam and Nieto received this rating. 'G' means that I thought the plan represented the aircraft accurately enough to build a radio control model from the plan. The lowest rating, 'Q' means I questioned the accuracy of the plan. Many so-called scale U-control models received this rating. A large number of 3-views also received a 'Q' rating if they presented no cross sections or were obviously figments of the draftsman's imagination.

LISTING OF SCALE AIRCRAFT PLANS: 1940-1966

COMPILED BY FRANK B. BAKER

CODING SCHEME USED

Source

MAN	Model Airplane News
MANA	Model Airplane News Annual
AT	Air Trails
ATA	Air Trails Annual
AM	American Modeler
AMA	American Modeler Annual
RCM	Radio Control Modeler
RCMA	R/C Modeler Annual

Size

F	Full Page
M	Multiple Page
S	Less than Page

Type

W	Wylam
N	Nye
U	U-Control
R	R/C
T	Three view
F	Free flight
S	Solid model

Detail

E	Excellent
X	Cross sections
C	Construction
N	None

Accuracy

A	Authentic
G	Good
Q	Questionable

Abbreviations used on tabular headings: S = source; I = issue; P = page; S = size; T = type; D = detail; A = accuracy.

No.	Aircraft	S	I	P	STDA
1	100 THREE VIEWS WORLDS AIR	AT	12/51	25	S T X G
2	100 THREE VIEWS WWII	AT	4/42	14	N T N G
3	ABC ROBIN	MAN	2/56	21	F F C G
4	AEG BOMBER	MAN	9/43	35	F T N Q
5	A.E.G.	MAN	12/45	52	S T X G
6	AERONCA C 3	AT	2/49	42	F U C G
7	AERONCA C3	AM	2/62	35	F T E A
8	AERONCA C-3	MAN	10/66	26	F R C A
9	AERONCA K	AM	5/58	14	F R C G
10	AERONCA TRAVELER 7FC	MAN	8/59	11	S F C G
11	AERONCA CHAMPION	AT	8/46	55	F F C G
12	AERONCA CHAMPION	MAN	/59	51	S F C G
13	AERONCA CHAMPION	MAN	3/57	21	F F C G
14	AERONCA CHAMPION	AT	8/47	69	F T X G
15	AERONCA TANDEM	AT	12/42	22	F F C G
16	AERONEER	MAN	4/41	27	F F C G
17	AERO COMMANDER	MAN	9/53	20	F U G A
18	AERO FLIGHT STREAK 125	MAN	7/48	20	F T X G
19	AIR TRANSPORT P2	MAN	5/42	12	M F C G
20	AIRSPEED AMBASSADOR	AT	4/49	47	F T X G
21	ALBATROS C-5	MAN	12/50	30	T N N A
22	ALBATROSS D-1, D-2	MAN	5/ 46	32	M W E A
23	ALBATROSS D-3, D-4	MAN	6/46	28	M W E A
24	ALBATROS DVA	RCM	1/65	26	M T X G
25	ALBATROS DVA	AM	1/61	31	S U C G
26	ALBATROS D.VA	MAN	6/60	21	F T X G
27	ALBATROS TRIPLANE	AT	2/49	50	M U C G
28	ALBATROS FUSELAGE	MAN	11/46	28	M W E A
29	ALEXANDER EAGLEROCK	MAN	6/53	32	M N E A
30	ALL AMERICAN ENSIGN	AT	4/47	56	M F C G
31	AM AG 1	AT	8/52	40	F U C G
32	AMERICAN MOTH V 1	MAN	1/65	40	F T X G
33	AMERICAN EAGLE A129	MAN	9/62	19	F T X G
34	ANDERSON GREENWOOD -14	MAN	3/49	18	F T X G
35	ANDREASSON BA 6	AM	7/61	31	S U C G
36	ANDREASSON BA-7	AM	4/60	15	S T N G
37	ANDREASSON BA 7	AMA	/60	7	F R C G
38	ANTOINETTE VII	MAN	3/54	32	F T E G
39	ARADO AR 68	MAN	12/61	13	F R C Q
40	ARADO 95S	MAN	8/41	36	S T X G
41	ARGANDER SPECIAL	MAN	7/57	11	S T N G
42	ARMSTRONG WHITWORTH FK 10	AM	7/63	23	F T X G
43	ARMSTRONG WHITWORTH FK 8	MAN	1/62	31	F T X G
44	ARMSTRONG ALBERMARLE	AT	8/44	54	S T N G
45	ATLAS H-10	MAN	1/49	16	F T X A
46	AUSTER B.4	MAN	2/52	14	S T N G
47	AVIONS TIPSY NIPPER	AM	12/60	17	F U C Q
48	AVIONS TIPSY NIPPER	MAN	12/60	19	F F C Q
49	AVIONS HD 32	MAN	7/54	50	S T X Q
50	AVRO BIPLANE	AM	10/59	58	S T N G
51	AVRO LANCASTER	MAN	6/44	12	F W X A
52	AVRO YORK	AT	4/44	60	S T N G
53	AVRO MANCHESTER	MAN	7/43	52	F T X G

No.	Aircraft	S	I	P	STDA
54	AVRO MANCHESTER	AT	7/42	33	F T X G
55	BEBE-JODEL D-9	MAN	4/52	14	F T X A
56	BEBE JODEL	AM	12/57	17	F U C G
57	BEECHCRAFT G17S	AM	10/58	18	F U C G
58	BEECHCRAFT 17 A17	MAN	3/62	26	M W E A
59	BEECHCRAFT 17-A17	MAN	4/62	26	M W E A
60	BEECHCRAFT B17 C17	MAN	7/62	24	M W E A
61	BEECHCRAFT B17 G17 DETAILS	MAN	10/62	26	M W E A
62	BEECHCRAFT B17 G17 DETAILS	MAN	12/62	26	M W E A
63	BEECHCRAFT D17 G17	MAN	3/63	26	M W E A
64	BEECHCRAFT D17 G17	MAN	5/63	26	M W E A
65	BEECH T 34A MENTOR	AM	11/60	23	M U C G
66	BEECHCRAFT MENTOR 45	AT	1/50	55	F T X G
67	BEECHCRAFT BONANZA	MAN	12/49	20	F T X G
68	BEECHCRAFT BONANZA 35	AT	6/49	40	M T E A
69	BEECHCRAFT BONANZA	AT	3/47	60	F T X G
70	BEDE BD-1	RCM	3/66	29	M R C A
71	BELL P-39	AT	5/40	40	F T X G
72	BELL P 39	MAN	6/41	13	M F C Q
73	BELL P 39	AT	1/43	38	F T X G
74	BELL P 39D	MAN	7/44	13	F T X G
75	BELL P 39Q	MAN	12/49	34	S T X G
76	BELL P 39	AT	6/54	31	S U C Q
77	BELL P 59A	MAN	1/45	16	F W X A
78	BELL AIRACOMET P-59	AT	3/46	55	F F C G
79	BELL XP59	AM	1/56	32	F T X G
80	BELL P 63 A KINGCOBRA	MAN	3/45	14	M W E A
81	BELL P 63 KING COBRA	AM	3/62	30	S R C G
82	BELL P 63 KINGCOBRA	AM	1/59	21	S U C G
83	BELL XP 77	MAN	8/45	16	F T X G
84	BELL XS 1	MAN	3/47	24	F T X G
85	BELL X 1	MAN	9/58	13	F T X G
86	BELL X 5	AT	7/52	37	S T X Q
87	BELL YMF 1A	MAN	5/41	28	F T X G
88	BELL HELICOPTER	AT	5/47	59	F T X G
89	BELLANCA YO 50	MAN	11/42	8	F T X G
90	BELLANCA PACEMAKER	AT	/51	45	F U C Q
91	BELLANCA COLUMBIA	MAN	4/53	30	M N E A
92	BELLANCA BOMBER	MAN	2/56	43	S T N Q
93	BELLANCA MONOPLANE	MAN	7/59	13	F U C Q
94	BELLANCA CRUISEMASTER	MAN	7/50	20	F T X A
95	BIRD BIPLANE	MAN	9/55	24	M N E A
96	BLACKBURN MONOPLANE	MAN	8/56	11	F F C G
97	BLACKBURN BOTHA	AT	9/42	21	S T X G
98	BLACKBURN ROC	MAN	1/41	16	F T X G
99	BLACKBURN BOTHA	MAN	9/41	36	S T X G
100	BLACKBURN FIREBRAND(GOOD RC)	AT	1/46	61	F T X G
101	BLERIOT XI 1910	MAN	7/47	34	F W E A
102	BLOHM AND VOSS BV 138	AT	9/43	67	S T N G
103	BLOHM AND VOSS ASYMETRICAL	MAN	7/43	22	F T X G
104	BLOHM AND VOSS BV 141 ASYM	AT	9/42	18	S T X G
105	BLOHM AND VOSS BV 226 6ENG	AT	9/42	18	S T X G
106	BOEING MB 3A	MAN	1/52	30	F N E A
107	BOEING FB-1-FB-4	MAN	10/66	18	M W E A

No.	Aircraft	S	I	P	STDA
108	BOEING FB-5	MAN	5/52	46	S T N G
109	BOEING F3B 1	MAN	2/65	26	M W E A
110	BOEING F3B 1	MAN	5/65	22	F W E A
111	BOEING F2B 1	MAN	7/64	24	M W E A
112	boeing F2B 1	MAN	12/64	28	M W E A
113	BOEING P 12C	AT	7/49	39	F U C Q
114	BOEING F4B P 12	MAN	12/54	26	M W E A
115	BOEING F4B P 12	MAN	10/54	16	M W E A
116	BOEING 15,XPW-9	MAN	2/66	20	M W E A
117	BOEING 15,XPW-9	MAN	5/66	20	M U E A
118	BOEING 40	MAN	7/56	18	M N E A
119	BOEING 40	MAN	6/56	18	M N E A
120	BOEING P 26A	AT	3/54	23	F T X G
121	BOEING P 26	MAN	11/60	31	F T X G
122	BOEING P 26A	MAN	3/65	13	S U C G
123	BOEING XB19A	AT	5/50	21	S T X G
124	BOEING B 17 E	MAN	4/42	14	M T X G
125	BOEING B 17D (BRITISH)	MAN	4/43	8	F T X G
126	BOEING B 17G	MAN	8/44	18	M W F A
127	BOEING B 17G	AM	7/63	18	M U C G
128	BOEING B 29	AT	12/44	49	F T X G
129	BOEING B 29	MAN	9/44	8	M W E A
130	BOEING AT 15	AT	9/43	67	S T X G
131	BOEING AT 15	MAN	10/48	60	S T X G
132	BOEING XL 15	MAN	9/48	18	F T X G
133	BOEING PT 17 KAYDET	AM	10/61	24	M T E A
134	BOEING C97 STRATOCRUISER	MAN	4/45	20	M W E A
135	BOEING XPBB 1	MAN	10/42	20	F T X Q
136	BOEING XPBB SEA RANGER	AT	3/43	42	S T X G
137	BOEING XB 47	AT	8/50	41	F T X G
138	BOEING B 47 PROP	MAN	5/58	10	F U C G
139	BOEING 707	AT	12/54	42	M T X G
140	BOEING 707	MAN	5/56	27	F T X G
141	BOOMERANG	AT	2/44	56	F T X G
142	BOULTON PAUL PARTRIDGE	MAN	6/62	18	M T E A
143	BOULTON PAUL R.111	AT	2/51	48	F T X G
144	BOULTON PAUL DEFIANT	AT	7/42	39	F F C G
145	BOWLUS BUMBLEBEE	MAN	5/46	29	F T X G
146	BREDA 65	MAN	2/41	36	F T X G
147	BREGUET	MAN	6/48	64	S T E G
148	BREWSTER BUFFALO	MAN	7/60	13	S U C Q
149	BREWSTER BERMUDA	AT	11/41	53	F T X G
150	BREWSTER BERMUDA	AT	4/42	38	F F C G
151	BREWSTER BUFFALO	MAN	5/41	18	F T X G
152	BREWSTER B40	MAN	10/41	24	F T X G
153	BRISTOL M.1C 1917	AM	11/65	37	F T X G
154	BRISTOL 170 FREIGHTER	AMA	/61	46	M U C G
155	BRISTOL BROWNIE	AM	4/59	37	S T N G
156	BRISTOL M.1C	AM	8/57	16	S U C Q
157	BRISTOL BRITANNIA 100	MAN	12/54	24	F T X Q
158	BRISTOL BLENHEIM	MAN	2/44	58	F T X G
159	BRISTOL BEAUFIGHTER	MAN	11/41	22	F T X G
160	BRISTOL BEAUFIGHTER	AT	1/42	30	F T X G
161	BRISTOL BEAUFORT	MAN	6/42	25	F T X G
162	BRISTOL BEAUFORT	AT	7/43	41	S T N G
163	BRISTOL F-2B	MAN	11/45	11	M W E A
164	BRISTOL F-2B	MAN	12/45	18	M W E A
165	BRISTOL F.2B	MAN	7/51	12	S T N G
166	BUCKER JUNGMEISTER BU133	MAN	11/58	36	F T X A
167	BUCKER JUNGMEISTER	AM	10/56	24	S U C G
168	BUHL BULL PUP	AT	10/50	43	F F C G
169	BURNELLI RB2	MAN	1/57	49	S T N Q
170	CAB MINICAB	MAN	2/52	38	F T X A
171	CANT Z 1018	AT	2/46	90	S T N G
172	CAPRONI F.5	AT	11/53	36	F T X G
173	CAPRONI CAMPINI DUCT FAN	AT	8/42	23	S T N Q
174	CASPAR CJ14	AM	7/63	34	S T X Q
175	CASSUTT SPECIAL	AM	5/65	34	S U C G
176	CAUDRON	MAN	12/61	20	F F C Q
177	CAUDRON C460	MAN	4/58	13	S T X G
178	CESSNA OE 2	AM	2/57	21	F T X G
179	CESSNA OE 2	AM	7/62	16	M R C G
180	CESSNA L 19	AT	10/52	30	S F C Q
181	CESSNA L 27A	AM	12/57	14	F T X A
182	CESSNA XT 37	AT	6/55	45	S T X G
183	CESSNA UC 78 BOBCAT	RCM	8/64	21	M R C A
184	CESSNA UC 78 BOBCAT	RCM	8/64	19	F T X A
185	CESSNA 140	MAN	3/53	25	F T X G
186	CESSNA 180	MAN	7/56	11	F F C G
187	CESSNA 182 SKYLANE	RCM	5/64	17	M R C A
188	CESSNA 195	MAN	4/49	18	F T X G
189	CESSNA 310	MAN	9/56	11	F U C G
190	CESSNA 320D	MAN	1/65	11	F U C G
191	CF-100	MAN	3/52	18	S T N Q
192	CHANCE VOUGHT VE-7-9,UO-1	MAN	3/57	24	M N E A
193	CHANCE VOUGHT VE 7 9,UO 1	MAN	4/57	24	M N E A
194	CHANCE VOUGHT SBU 2	MAN	12/57	23	F U C G
195	CHANCE VOUGHT	MAN	11/53	23	F T X G
196	CHANCE VOUGHT XFSU 1	MAN	1/47	28	F T N Q
197	CHANCE VOUGHT F40	MAN	5/57	14	F U C G
198	CHANCE VOUGHT F7U	MAN	8/55	27	F T X G
199	CHANCE VOUGHT F8U	MAN	8/60	10	S U C A
200	CHANCE VOUGHT F8U 1	MAN	8/57	22	F T X G
201	CHESTER JEEP	MANA	/62	55	S F C G
202	CHESTER JEEP	MAN	11/60	21	F F C G
203	CHESTER JEEP	AT	1/52	28	S U C G
204	CHESTER SWEET PEA	MAN	2/48	18	F T X A
205	COLUMBIA XJL 1	MAN	4/47	27	F T X G
206	COMMONWEALTH CA 12 BOOMERANG	MAN	10/63	45	S T X G
207	COMPER SWIFT	MAN	1/58	13	F F C G
208	COMPER SWIFT	MAN	2/56	32	F T X G
209	CONSOLIDATED PT-3	MAN	8/50	26	N T N A
210	CONSOLIDATED PT-3	MAN	9/50	22	F N E A
211	CONSOLIDATED PB 2A	AT	3/52	38	F U C G
212	CONSOLIDATED PBY	MAN	9/58	9	S U C G
213	CONSOLIDATED PBY 5A	MAN	4/44	16	F W X A
214	CONSOLIDATED PB2Y-2	AT	9/41	33	F T X G
215	CONSOLIDATED B-24	AT	5/41	44	F T X Q
216	CONSOLIDATED B 24E	MAN	2/44	18	F T X A
217	CONSOLIDATED B 24	AT	8/54	22	S U G Q
218	CORVAIR XP 81	MAN	4/64	19	F U C Q
219	CONSOLIDATED XP-81	MAN	4/50	22	F U C G
220	CONVAIR XF 92A	MAN	1/50	19	F T X G
221	CONVAIR F 102	MAN	2/57	52	S T X G
222	CONVAIR F 102	AT	1/55	53	F T X G
223	CONVAIR XFY 1	AT	7/55	37	F T X G
224	CONVAIR XC 99	AT	2/49	48	S T X G
225	CONVAIR B 46	MAN	12/48	20	F T X G
226	CONVAIR 240	AT	3/50	52	F T X G
227	CONVAIR CHARGER COIN	AM	1/65	36	P U C G
228	COPPINGEN III MINIMOA	MAN	6/59	24	S F N G
229	CORBEN BABY ACE	MAN	2/60	38	S T N G
230	CORBEN SUPER ACE	MAN	9/56	16	F F C G
231	CORBEN SUPER ACE	AT	8/50	51	F F C G
232	CP.30 EMERAUDE	MAN	5/56	38	S T X G
233	CULVER V	AT	4/47	65	F T X G
234	CULVER V	MAN	3/46	15	F U C G
235	CULVER V	MAN	3/46	18	F T X G
236	CURTISS MODEL A	MAN	5/49	24	F W E A
237	CURTISS JN 4 JENNY	MAN	10/52	30	M N E A
238	CURTISS JN 4 JENNY	MAN	11/52	30	M N E A
239	CURTISS JN4D	AT	4/50	56	F T X G
240	CURTISS JENNY	MAN	8/52	13	F F C G
241	CURTISS JENNY	AT	4/53	36	F U C G
242	CURTISS NC-4	MAN	4/57	11	S T N G
243	CURTISS TRIPLANE	MAN	11/46	32	S T X G
244	CURTISS NC 4	MAN	10/57	20	M N E A
245	CURTISS NC 4	MAN	11/57	24	M N E A
246	CURTISS RACER	AT	5/52	28	F F C G
247	CURTISS R3C-1 RACER	MAN	5/52	31	F N E A
248	CURTISS R 6	MAN	7/57	16	F U C G
249	CURTISS CONDOR NBS-4	MAN	7/52	48	S T N Q
250	CURTISS CONDOR BOMBER	MAN	7/50	35	M F C Q
251	CURTISS ROBIN	AT	4/46	54	M F C Q
252	CURTISS ROBIN	MAN	2/52	26	M N E A
253	CURTISS ROBIN	MAN	1/55	19	F F C G
254	CURTISS ROBIN	MAN	9/61	19	F F C Q
255	CURTISS TRIAD	MAN	10/61	11	F F C Q
256	CURTISS HAWK P 1	MAN	11/47	26	F W E A
257	CURTISS HAWK P 1	MAN	12/47	22	M W E A
258	CURTISS SEAHAWK BIPLANE	MAN	7/47	28	M F C G
259	CURTISS WRIGHT JUNIOR	MAN	7/57	20	S T X G
260	CURTISS FALCON	MAN	9/56	22	M N E A
261	CURTISS FALCON	MAN	10/56	26	M N X G
262	CURTISS A 12 SHRIKE (GOOD R/C	AM	7/56	20	F T X G
263	CURTISS F7C 1	MAN	9/63	22	M W E A
264	CURTISS F8C-1	MAN	7/50	16	M U C G
265	CURTISS F8C 4/020CI	MAN	11/63	26	M W E A
266	CURTISS F8C 4/020CI	MAN	12/63	24	M W E A
267	CURTISS F9C 2 SPARROWHAWK	MAN	3/64	26	M W E A
268	CURTISS F11C 2 P 6E	MAN	6/55	24	M W E A
269	CURTISS F11C 2 P 6E	MAN	7/55	22	M N E A
270	CURTISS HAWK F 11 C	AT	10/46	58	F F C G
271	CURTISS P6-E HAWK	AM	11/57	16	F U C A
272	CURTISS P11C 2 GOSHAWK	AM	10/62	34	M T X A
273	CURTISS XPW 8	AT	6/50	51	F U C Q
274	CURTISS YIP 36	MAN	3/44	54	F T X Q
275	CURTISS HAWK	MAN	1/53	18	M U C G
276	CURTISS HAWK	MAN	2/54	12	F U C Q
277	CURTISS HAWK 75	AM	7/60	26	M T X A
278	CURTISS KITTYHAWK I	MAN	3/57	19	S T X G
279	CURTISS P-40	AT	1/41	37	M F C Q
280	CURTISS P-40	MAN	5/62	22	F T C G
281	CURTISS P-40D	MAN	1/44	22	M W E A
282	CURTISS P-40F	AMA	/63	12	F U C G
283	CURTISS P-40F	MAN	2/42	15	F T X G
284	CURTISS P-40F	AT	3/43	30	M U C G
285	CURTISS P-40N	MAN	3/55	24	F T X G
286	CURTISS P-40Q IDEAL R/C	MAN	3/57	58	S T X G
287	CURTISS XP-42	MAN	3/40	22	F T X G
288	CURTISS SBC-2	AT	7/46	59	F S X G
289	CURTISS SBC-3	MAN	8/41	10	M W E A
290	CURTISS XSBC-3	MAN	6/42	26	F T X G
291	CURTISS XSB2C 1	MAN	7/41	14	F T X G
292	CURTISS SB2C 1	AT	12/41	48	F T X G
293	CURTISS SB2C 3	MAN	7/44	18	F W X A
294	CURTISS SB2C 3 HELLDIVER	MAN	8/63	24	M N E A
295	CURTISS SB2C 3 HELLDIVER	MAN	7/63	24	M N E A
296	CURTISS CW 23 EXPORT	MAN	8/40	11	F T X G
297	CURTISS AT 9	AT	3/42	28	S T X G
298	CURTISS AT 9	MAN	12/45	60	S T X A
299	CURTISS 052	MAN	9/42	17	F F C G
300	CURTISS 052	AT	12/41	42	F F C Q
301	CURTISS 052	AT	2/43	45	S T X G
302	CURTISS XP-55 ASCENDER	MAN	7/45	18	F T X G
303	CURTISS SEAHAWK SC-1	AT	4/46	59	F S X G
304	CURTISS SEAHAWK	AT	3/49	62	M F C Q
305	CURTISS C 76 CARAVAN	AT	11/43	58	S T N G
306	CURTISS WRIGHT C 46	MAN	8/41	26	F T X G
307	CURTISS XF13C	AM	3/58	16	F T X G
308	CURTISS XF15C 1	MAN	10/47	18	F T X G
309	DART KITTEN	AT	5/52	38	F U C G
310	CASSULT MD 450	AT	7/51	51	F T X G

No.	Aircraft	S	I	P	STDA
311	CASSULT MIRAGE IV 01	MAN	10/61	48	F T X G
312	DB 3F RUSSIAN	AT	6/43	39	S T N Q
313	DEHAVILLAND TRAINER	AT	7/50	49	F U C Q
314	DEHAVILLAND D 4	AT	5/49	58	M U C G
315	DEHAVILLAND BEAVER	MAN	2/52	13	F U C Q
316	DEHAVILLAND COMET RACER	AT	9/50	45	S U C G
317	DEHAVILLAND COMET	AT	6/51	35	F T X G
318	DEHAVILLAND DH 88 COMET	MAN	12/59	18	F T X G
319	DEHAVILLAND MOTH	AT	11/50	49	F F C G
320	DEHAVILLAND LEOPARD MOTH	AT	6/53	35	S U C Q
321	DEHAVILLAND HORNET MOTH	MAN	2/59	18	S F C G
322	DEHAVILLAND DHC 3 OTTER	AT	11/52	41	F T X G
323	DEHAVILLAND DHC 3 OTTER	AM	3/62	33	M T X A
324	DEHAVILLAND DEH 1	MAN	10/48	26	F W E A
325	DEH-1	MAN	3/49	33	M W E A
326	DEH-1	MAN	1/49	24	M W E A
327	DEH-4	MAN	2/46	26	M W E A
328	DEH-4	MAN	1/46	30	M W E A
329	DEHAVILLAND PUSS MOTH	MAN	7/57	25	F F C A
330	DEHAVILLAND DH-5	MAN	2/51	36	F N N A
331	DEHAVILLAND MOSQUITO	AT	2/43	28	F T X G
332	DEHAVILLAND MOSQUITO	MAN	4/43	22	F T X G
333	DEHAVILLAND DRAGONFLY	MAN	9/43	31	F T N A
334	DEHAVILLAND VAMPIRE	MAN	5/46	17	F T X G
335	DEHAVILLAND DHC-1 CHIPMUNK	MAN	5/50	20	F T X A
336	DEHAVILLAND CHIPMUNK	MAN	7/53	36	F T X G
337	DEHAVILLAND DHC-1 CHIPMUNK	MAN	8/66	38	F T X A
338	DENIGHT SPECIAL	RCM	3/65	24	M R C Q
339	DEWOITINE D 27C1	MAN	4/62	29	F T X G
340	DEWOITINE D 510	AM	10/62	33	S U C Q
341	DFS 230AA GLIDER	AT	9/42	19	S T X G
342	D.H. MOTH MINOR	MAN	1/41	24	S T X G
343	DORNIER DO 217 E.2	AT	3/43	42	S T N G
344	DORNIER 215	MAN	6/42	18	S T X Q
345	DORNIER DO 217E1	MAN	8/42	26	F T X G
346	DOUGLAS MAILPLANE	AT	11/51	36	F F C G
347	DOUGLAS DWC WORLD CRUISER	MAN	1/56	24	M N E A
348	DOUGLAS 0-43A	MAN	7/51	32	M W E A
349	DOUGLAS 0-43A	MAN	3/66	21	F F C G
350	DOUGLAS 0-46A	AM	9/58	16	M T X A
351	DOUGLAS TBD 1	MAN	5/42	24	F T X G
352	DOUGLAS TBD 1 DEVASTATOR	AM	2/59	29	S U C Q
353	DOUGLAS B-22	MAN	1/40	12	F T X Q
354	DOUGLAS B-23	MAN	6/41	8	S T X G
355	DOUGLAS 8A 5	MAN	10/41	26	M F C G
356	DOUGLAS SBD 1	MAN	1/41	26	F T X G
357	DOUGLAS SBD 3 DAUNTLESS	MAN	5/43	22	F T X A
358	DOUGLAS SBD 3	MAN	7/45	36	S T X G
359	DOUGLAS DB-7	AT	4/40	33	F T X G
360	DOUGLAS A 20	MAN	1/41	8	F T X G
361	DOUGLAS P 70, A 20	MAN	12/43	24	F T X A
362	DOUGLAS A-20 HAVOC	AT	5/42	29	F T X G
363	DOUGLAS A-20 HAVOC	AT	3/44	49	F T X A
364	DOUGLAS A-20 HAVOC	MAN	3/60	28	M N E A
365	DOUGLAS A-20 HAVOC	MAN	4/60	28	M N E A
366	DOUGLAS B 19	MAN	11/40	14	F T X G
367	DOUGLAS DC-4, C54	MAN	10/45	20	M W E A
368	DOUGLAS DC 6	AT	9/50	48	F T X G
369	DOUGLAS DC 6	MAN	5/48	16	F T X A
370	DOUGLAS SUPER DC-3	AT	9/49	47	S T N G
371	DOUGLAS AD 1	MAN	3/56	11	F U C G
372	DOUGLAS A-26	MAN	2/45	14	F T X A
373	DOUGLAS B 26	ATA	/53	9	F U C G
374	DOUGLAS F4D	MAN	5/51	14	S T X Q
375	DOUGLAS X 3	AT	6/54	39	F T X G
376	DOUGLAS B 66	MAN	4/57	21	F F C G
377	DOUGLAS B 66A	AT	3/55	28	M T X G
378	DOUGLAS AD2	AT	6/51	32	M U C G
379	DOUGLAS AD2 SKYRAIDER	AMA	/65	76	M R C Q
380	DOUGLAS A2D-1	MAN	12/50	16	F U C G
381	DOUGLAS A2D-1	MAN	12/50	18	F T X G
382	DOUGLAS A2D	AT	6/52	56	S T X Q
383	DOUGLAS D 558	MAN	9/47	62	S T N Q
384	ERCOUPE	AT	2/47	71	F T X G
385	ERCOUPE	MAN	9/47	10	M F C G
386	ERCOUPE	MAN	3/43	12	M F C G
387	FAIRCHILD F 24	AM	7/61	29	S F C Q
388	FAIRCHILD C 119G PACKET	MAN	4/57	29	F T X G
389	FAIRCHILD PT 19	AM	8/56	24	S R C G
390	FAIRCHILD 22	MAN	11/52	15	F F C G
391	FAIRCHILD C 119 B	AT	3/49	51	F T X G
392	FAIRCHILD AT 21	AT	8/43	63	S T N G
393	FAIRCHILD T-31	MAN	7/49	18	F T X G
394	FAIRCHILD M 62 P T	MAN	5/41	31	F T X G
395	FAIRCHILD SPORTSMAN AMPHIP	MAN	10/42	12	J F C G
396	FAIREY F.D.1	AT	9/51	28	S T X G
397	FAIREY ALBACORE	MAN	7/44	17	F T X G
398	FAIREY ALBACORE	MAN	9/45	19	M F C G
399	FAIREY BARRACUDA	AT	7/44	55	S T N G
400	FAIREY BARRACUDA	MAN	12/45	62	S T X A
401	FAIREY FULMAR	MAN	7/43	8	F T X G
402	FAIREY FULMAR	MAN	1/41	24	S T X G
403	FAIREY SWORDFISH	MAN	8/41	36	S T X G
404	FARMAN 1914	MAN	4/48	36	S T X G
405	FIAT CR.42B	MAN	1/61	35	F T X G
406	FIAT G.46	MAN	3/50	20	F T X G
407	FIAT G 50	AT	9/42	21	S T X G
408	FIESELER FI 156 STORCH	AT	4/53	45	F F C G
409	FLEET F 10 G	AM	6/60	13	M R C G
410	FLEET TRAINER	AT	5/51	37	F U C G
411	FLEET CANUCK	MAN	3/48	22	M F C Q
412	FLEETWING BT-12	MAN	5/50	31	F T X A
413	FLETCHER FL 23	AT	10/54	45	S F C G
414	FLETCHER BT 22	AT	4/52	49	S T X G
415	FOCKE WULF KURRIER	MAN	4/43	9	F T X Q
416	FOCKE WULF FW 187	AT	11/43	59	S T N G
417	FOCKE WULF 189	MAN	6/42	18	S T X Q
418	FOCKE WULF 190	AT	8/42	21	S T X G
419	FOCKE WULF FW 190	MAN	11/42	22	F T X G
420	FOCKE WULF 190	MAN	5/51	53	S T X G
421	FOCKE WULF FW 190	AT	9/53	28	S U C G
422	FOCKE WULF FW 190A3 A5	MAN	1/57	18	F T X A
423	FOGA CM 170R MAGISTER	AT	8/53	38	F T X G
424	FOKKER C 2	MAN	12/64	21	F T C G
425	FOKKER E.1	MAN	10/51	21	F N E A
426	FOKKER E 1	AT	6/52	46	F U C Q
427	FOKKER E3 EINDECKER	MANA	/62	57	F U C Q
428	FOKKER EIII	MAN	6/58	11	F F C G
429	FOKKER E III EINDECKER	MAN	2/61	12	F U C G
430	FOKKER G 1	MAN	8/43	28	M W E A
431	FOKKER DR-1	MAN	7/52	26	M N E A
432	FOKKER DR-1	MAN	9/57	26	M T E A
433	FOKKER DR-1 TRIPLANE	AM	3/60	20	S U C Q
434	FOKKER DR 1 TRIPLANE	MAN	5/60	12	F T X G
435	FOKKER DR 1 TRIPLANE	MAN	7/63	61	F T X G
436	FOKKER D 7	MAN	12/53	16	M U G A
437	FOKKER D 7	MAN	8/57	24	M T E A
438	FOKKER DVII	MAN	7/61	18	F T X G
439	FOKKER D.VIII	MAN	9/51	34	M T E A
440	FOKKER D VIII	AM	3/58	27	F R C G
441	FOKKER D VIII	MAN	/59	17	M R C G
442	FOKKER D VIII	MAN	2/60	19	F T X G
443	FOKKER F VIIB 3M TRIMOTOR	MAN	2/60	12	F T X G
444	FOLKERTS 1937	MAN	4/58	13	S T X G
445	FOLKERTS RACER	AT	9/51	38	F U C G
446	FOLLAND MIDGE GNAT	MAN	3/56	42	S T N G
447	FORD TRIMOTOR	AM	1/65	42	M R C G
448	FORD TRIMOTOR	AM	3/65	34	M R C G
449	FORD 5ATC TRIMOTOR	MAN	5/54	24	M U E A
450	FORD 5ATC TRIMOTOR	MAN	6/54	18	M W E A
451	FOUGA CYCLONE SAILPLANE	AT	5/50	30	S T N G
452	FOUGA CYCLONE GLIDER	MAN	2/50	20	F T X G
453	FOUGA CYCLONE GLIDER	MAN	2/50	26	M F C G
454	FOURNIER RF 01	MAN	2/62	16	F F C G
455	FRANKLIN SPORT A	MAN	4/64	26	M T E A
456	FRENCH REP MONOPLANE	MAN	2/49	38	S T X Q
457	FRIEDRICHSHAFEN G3	MAN	7/54	26	M N E A
458	FULTON AIRPHIBIAN	AT	5/52	27	S T X G
459	GALLAUDET PW 4	MAN	2/62	21	F T X G
460	GEE BEE	MAN	/59	50	S U C G
461	GEE BEE R 1	MAN	3/58	11	S T N G
462	GEE BEE	MAN	5/58	14	F T X G
463	GEE BEE SUPER SPORTSTER	MAN	10/51	33	F U C G
464	GLOBE SWIFT	MAN	1/47	24	M F C G
465	GLOBE SWIFT	AT	12/46	53	F F C G
466	GLOSTER SEA GLADIATOR	MAN	1/64	34	F T X G
467	GLOSTER GOLDFINCH 1928	MAN	11/63	19	F T X G
468	GLOSTER GAMECOCK 11	MAN	4/61	38	F T X G
469	GLOSTER GLADIATOR	MAN	12/55	50	S T X G
470	GLOSTER JAVELIN	AT	2/53	47	F T X G
471	GLOSTER GA 5	MAN	12/52	19	F T X Q
472	GLOSTER METEOR	MAN	10/48	30	F T X Q
473	GLOSTER METEOR	MAN	7/46	46	S T X G
474	GLOSTER METEOR IV	AT	12/46	54	F T X G
475	GOODYEAR F2G COOK CLELAND	MAN	4/58	27	F T X A
476	GOODYEAR RACERS (SMALL 3VW)	AT	1/52	22	S T N G
477	GOODYEAR RACERS (24)	AT	2/50	36	S T N G
478	GOODYEAR MINNOW	AT	1/49	42	M U C G
479	GOODYEAR SHOESTRING	AT	9/52	30	F U C A
480	GOODYEAR SHOESTRING	RCM	1/66	20	M R C G
481	GOODYEAR SHOESTRING	MAN	8/66	26	M R C G
482	GOODYEAR GA-2 DUCK	MAN	11/47	15	F T X G
483	GOTHA GO5	MAN	1/58	28	M N E A
484	GOTHA GO5	MAN	2/58	22	M N E A
485	GOTHA 242 GLIDER	AT	9/42	19	S T X G
486	GRANVILLE GEE BEE R 1	AM	7/58	15	F T X G
487	GREAT LAKES 2T 1A	MAN	9/57	12	F U G G
488	GREAT LAKES TRAINER	AT	7/46	55	M F C G
489	GREAT LAKES TRAINER	AM	6/58	14	F R C G
490	GREAT LAKES TRAINER	MAN	5/56	22	M W E A
491	GREGOR FDB 1	AT	3/50	43	F U C G
492	GREGOR FDB 1	MAN	12/43	20	F T X G
493	GRUMMAN F2F 1	AM	9/57	14	F U C Q
494	GRUMMAN F2F 1	MAN	12/60	34	F T X G
495	GRUMMAN F3F 3	MAN	12/55	22	F U C Q
496	GRUMMAN GULFHAWK G-22	RCM	4/66	17	M R C G
497	GRUMMAN WIDGEON	AT	12/42	36	M F C G
498	GRUMMAN WIDGEON	MAN	3/45	18	F W E A
499	GRUMMAN WIDGEON	MAN	3/45	20	F W E A
500	GRUMMAN MALLARD	MAN	9/47	17	F T X G
501	GRUMMAN G 36A F4F	MAN	12/40	18	F T X G
502	GRUMMAN F4F-4	MAN	6/42	16	F T X G
503	GRUMMAN F4F-4		9/53	31	S U C G
504	GRUMMAN F4F WILDCAT	MAN	7/60	26	M N E A
505	GRUMMAN F4F WILDCAT	MAN	8/60	26	M N E A
506	GRUMMAN F4F 3 WILDCAT	AM	5/63	28	F U C G
507	GRUMMAN SKYROCKET XF5F 1	MAN	8/40	26	F T X Q
508	GRUMMAN SKYROCKET	AT	9/41	47	F F C Q
509	GRUMMAN F6F 3	MAN	1/44	17	S T X E
510	GRUMMAN F6-F	AT	8/46	59	F S X G
511	GRUMMAN F6F	MAN	7/57	38	S T X G
512	GRUMMAN F6F HELLCAT	MAN	6/59	26	M N E A
513	GRUMMAN F6F HELLCAT	MAN	7/59	22	M N E A
514	GRUMMAN F7F-1	MAN	9/45	24	F T X G

No.	Aircraft	S	I	P	STDA
515	GRUMMAN F7F	AT	6/46	58	F S X G
516	GRUMMAN F7F TIGERCAT	AM	6/57	18	F U C G
517	GRUMMAN F7F 1 TIGERCAT	MAN	4/61	26	M N E A
518	GRUMMAN F7F 1 TIGERCAT	MAN	5/61	24	M N E A
519	GRUMMAN F8F	AT	2/46	28	F T X G
520	GRUMMAN F8F	AT	5/46	48	S U C Q
521	GRUMMAN F8F-1 BEARCAT	MAN	6/46	20	F T X G
522	GRUMMAN F8F 2 BEARCAT	AT	11/52	30	F U C G
523	GRUMMAN F8F BEARCAT	MAN	10/60	24	M N E A
524	GRUMMAN F8F BEARCAT	MAN	11/60	24	M N E A
525	GRUMMAN F8F	AM	2/61	19	S U C G
526	GRUMMAN F9F 2	MAN	4/48	14	F T X Q
527	GRUMMAN F9F 2	AT	/51	36	F T X G
528	GRUMMAN F9F 9	AT	5/55	26	F T X G
529	GRUMMAN F9F COUGAR	MAN	5/56	11	F F C Q
530	GRUMMAN F9F COUGAR	AM	5/56	38	F T X G
531	GRUMMAN TBF-1	MAN	9/42	26	F T X G
532	GRUMMAN TBF AVENGER	AT	1/43	27	F T X G
533	GRUMMAN TBF-1 AVENGER	AT	3/46	59	F S X G
534	GRUMMAN TBF AVENGER	MAN	7/57	38	S T X G
535	GRUMMAN TBM 3 AVENGER	MAN	8/62	26	M N E A
536	GRUMMAN TBM 3 AVENGER	MAN	9/62	26	M N E A
537	GRUMMAN XTB3F 1	MAN	6/48	18	F T X G
538	GRUMMAN SEF 1	AT	9/55	31	F T X G
539	GRUMMAN AF 2S	AT	9/51	28	S T X G
540	GRUMMAN AG CAT	AM	4/61	24	M U C Q
541	GRUMMAN AO 1 MOHAWK	AM	10/60	16	F T X G
542	GRUMMAN AO 1 MOHAWK	AM	10/60	15	F U C G
543	HALBERSTADT CL 2	MAN	4/48	38	S T X G
544	HALBERSTADT D1	MAN	1/41	33	F T X G
545	HALBERSTADT D-II	AM	3/66	8	S T X G
546	HALL RACER	MAN	11/45	18	F T X A
547	HALL RACER BULLDOG	AM	11/57	28	F T X A
548	HANDLEY PAGE 0/400	MAN	4/55	20	M N E A
549	HANDLEY PAGE 0/400	MAN	5/55	22	M N E A
550	HANDLEY PAGE VICTOR	MAN	4/54	9	S T X Q
551	HANDLEY PAGE	MAN	1/45	50	S T X Q
552	HANDLEY PAGE HAMPDEN	AT	7/43	41	S T N G
553	HANDLEY PAGE HAMPDEN	MAN	6/41	24	F T X G
554	HANDLEY PAGE HALIFAX	AT	2/42	35	S T N G
555	HANDLEY PAGE HARROW	MAN	9/41	36	S T X G
556	HANNOVER CL.111A	MAN	7/61	36	F T X A
557	HANSA BRANDENBURG	MAN	8/55	16	M N E A
558	HAWKER FURY	MAN	10/54	18	F T X Q
559	HAWKER FURY 11	MAN	5/63	70	F T X G
560	HAWKER SEA FURY	AT	7/47	72	F T X G
561	HAWKER SEA FURY 11 FB 11	MAN	1/63	28	M N E A
562	HAWKER SEA FURY 11 FB 11	MAN	2/63	26	M N E A
563	HAWKER SEAHAWK	MAN	2/53	38	F T X G
564	HAWKER HURRICANE	MAN	9/41	26	M F C G
565	HAWKER HURRICANE	AT	9/53	28	S U C G
566	HAWKER HURRICANE MK 11C	MAN	9/64	28	M N E A
567	HAWKER HURRICANE MK 11C	MAN	10/64	24	M N E A
568	HAWKER HURRICANE	AMA	/64	24	F U C Q
569	HAWKER HURRICANE	RCM	2/65	18	M R C G
570	HAWKER TYPHOON	MAN	10/43	26	F T X G
571	HAWKER TYPHOON	AT	8/43	62	F T X G
572	HAWKER TYPHOON	AT	2/44	42	M U C G
573	HAWKER TYPHOON	ATA	/44	16	M U C G
574	HAWKER TYPHOON	AT	4/54	37	S U C Q
575	HAWKER TEMPEST	AT	11/44	51	F T X G
576	HAWKER TEMPEST	MAN	8/53	36	F T X G
577	HAWKER TEMPEST	AM	3/62	27	S U C G
578	HAWKER TEMPEST +1	MAN	1/49	26	F T X G
579	HAWKER HUNTER	AT	10/52	37	F T X G
580	HAWKER HUNTER	MAN	6/53	34	F T X G
581	HAWKER HUNTER	AT	9/53	26	F T X G
582	HAWKER HUNTER TMK 7 8	AM	4/62	32	M T X A
583	HAWKER P.1081	AT	8/51	30	F T X G
584	HAWKER P1127	AM	8/61	30	F T N Q
585	HEATH BABY BULLET	AM	1/64	42	M T E A
586	HEATH BABY BULLET	AM	5/59	31	S T N G
587	HEATH PARASOL/MIDWING	AT	12/50	42	F U C G
588	HEINKEL 219	AM	12/64	42	M U C G
589	HEINKEL HE 51	AM	3/63	20	F U C Q
590	HEINKEL 60	MAN	8/41	36	S T X G
591	HEINKEL HE.111K	MAN	9/41	37	F T X G
592	HEINKEL HE 111 GLIDER TUG	AT	8/44	54	S T N G
593	HEINKEL HE-112	AT	4/40	37	F T X G
594	HEINKEL HE 112 U	MAN	1/41	30	F T X G
595	HEINKEL HE 113	MAN	11/41	17	S T X G
596	HEINKEL HE. 113	MAN	6/42	24	F T X G
597	HEINKEL 114	MAN	8/41	36	S T X G
598	HEINKEL HE 116P	AT	5/43	45	S T N Q
599	HEINKEL 177	AT	8/42	22	S T X G
600	HEINRICH 1909 MONOPLANE	MAN	6/60	13	S T X A
601	HEINRICH VICTOR SCOUT	MAN	6/53	17	F U C G
602	HELIOPLANE	AT	2/53	36	S F C G
603	HENSCHEL 129	AT	9/42	19	S T X G
604	HOTSPUR II GLIDER	MAN	3/44	24	M F C G
605	HOTSPUR II GLIDER	MAN	3/43	34	F T X Q
606	HOWARD IKE	MANA	/62	13	F U C Q
607	HOWARD IKE	AM	3/61	31	S U C G
608	HOWARD PETE DGA 3	MAN	3/58	11	S T N G
609	HOWARD GH 1	MAN	7/42	29	M F C G
610	HOWARD DGA 125 TRAINER	MAN	8/41	28	M F C G
611	HUGHES h 1	MAN	11/63	20	M U C Q
612	HUREL DUBOIS HD 10	AT	4/53	38	F T X G
613	I 26 RUSSIAN	AT	8/43	63	S T N G
614	IL 2 STORMAVIK	MAN	3/43	20	F T X G
615	ISAACSON ASYMETRICAL	AT	7/44	55	S T N G
616	JAMIESON JUPITER	MAN	10/49	18	F T X G

No.	Aircraft	S	I	P	STDA
617	JAPANESE ARMY TYPE 98	MAN	6/42	12	F T X Q
618	JAPANESE TT	AT	10/53	74	S T X Q
619	JOCELYN PARSONS AEROBATIC	AM	5/61	15	S T N G
620	JUNKERS JU 86P	AT	5/43	45	S T N Q
621	JUNKERS JU 52K	AT	11/43	59	S T N G
622	JUNKERS JU 86	MAN	9/43	34	F T X Q
623	JUNKERS JU87B-D	MAN	12/55	19	F T X A
624	JUNKERS JU87D	AT	5/58	26	F T X A
625	JUNKERS JU 88A1	MAN	1/41	28	F T X Q
626	KAWANISHI GEORGE	MAN	7/57	38	S T X G
627	KAWANISHI H 02 EMILY	MAN	1/45	6	S T X G
628	KAWASAKI TONY	AM	8/59	18	S U C G
629	KAWASAKI S 97	MAN	10/43	17	F T X Q
630	KI 83 RANDY	AM	2/57	13	S T X G
631	KINNER B 2 SPORTSTER	MAN	6/57	45	S T N Q
632	KNIGHT TWISTER JUNIOR	AT	7/49	35	F T X A
633	KNIGHT TWISTER	MAN	10/44	12	M U C G
634	KNIGHT TWISTER	AM	3/66	18	M U C A
635	KYUSHU SHINDEN	MAN	6/64	66	F T C G
636	LAIRD L RT	MAN	7/47	10	S T X G
637	LAIRD L RT	MAN	4/58	13	S T X G
638	LAIRD SOLUTION LC DW300	MAN	3/58	10	S T N G
639	LAIRD SOLUTION	MAN	11/58	28	S U G G
640	LAIRD SOLUTION	MAN	7/47	41	F T X G
641	LAIRD TURNER LTR 14	MAN	1/45	28	F T X G
642	LAVOCHKIN LA 7	AM	5/64	35	F U C G
643	LAVOCHKIN LA 17	AT	7/52	27	F T X G
644	LA 17	AT	9/51	27	S T X G
645	LEDUC 0.2	MAN	6/60	54	S T X Q
646	LEIGHNOR SPECIAL	AM	7/57	29	S U G G
647	LINN MINI MUSTANG	AM	7/63	65	S T X G
648	LOCKHEED ORION	AT	2/50	42	F U C Q
649	LOCKHEED SIRIS ALTAIR ORION	MAN	2/56	24	M W E A
650	LOCKHEED SIRIUS	MAN	1/59	12	F T X G
651	LOCKHEED VEGA	MAN	12/52	17	F U C Q
652	LOCKHEED VEGA	MAN	11/55	20	M W E A
653	LOCKHEED VEGA	AM	3/65	12	F U C G
654	LOCKHEED ELECTRA	MAN	3/59	22	M S X G
655	LOCKHEED HUDSON	MAN	2/43	22	M W E A
656	LOCKHEED VENTURA	MAN	6/43	30	F T X Q
657	LOCKHEED PV 1 VENTURA	MAN	9/65	20	M N E A
658	LOCKHEED PV 1 VENTURA	MAN	12/65	28	M N E A
659	LOCKHEED P-38	AT	3/41	30	F T X G
660	LOCKHEED P-38	MAN	7/43	24	M T X G
661	LOCKHEED P-38	AT	2/46	26	F T X G
662	LOCKHEED P-38	AT	2/46	59	F S X G
663	LOCKHEED P-38 J	MAN	11/56	16	F T X G
664	LOCKHEED P-38	AM	12/56	32	S U C Q
665	LOCKHEED P-38	MAN	6/65	13	M U E A
666	LOCKHEED RC 121C CONNIE	AT	12/55	56	F T X G
667	LOCKHEED PV 2	MAN	2/49	32	F N X A
668	LOCKHEED XFU 1	AT	9/54	30	F T X G
669	LOCKHEED U 2	MAN	2/58	34	F T X Q
670	LOCKHEED U 2	MAN	8/60	30	F T X Q
671	LOCKHEED U 2	AM	8/60	15	F T X A
672	LOCKHEED P-80	MAN	12/45	21	F T X A
673	LOCKHEED F-90	MAN	2/51	30	F T X A
674	LOCKHEED F-94	MAN	11/49	20	F T X G
675	LOCKHEED F-94	AT	3/52	28	F T X G
676	LOCKHEED XF 104	AM	11/56	18	F T X G
677	LOCKHEED C 130 HERCULES	AM	6/56	34	F U C G
678	LOENING PA 1	MAN	7/62	23	F T X G
679	LOENING AMPHIBIAN	MAN	6/58	22	M N E A
680	LOENING AMPHIBIANS	MAN	7/58	24	M N E A
681	LOENING AMPHIBIANS	MAN	9/58	26	M N E A
682	LOENING AMPHIBIANS	MAN	10/58	26	M N E A
683	LONG MIDGET MUSTANG	MAN	6/49	20	F T X A
684	LONGSTER WIMPY	MAN	9/54	13	F F C G
685	LOIRE 46	MAN	3/49	20	M F C G
686	LOVING WAYNE WR 1	AT	1/51	27	S T N G
687	LUSCOMBE SILVAIRE	AM	6/59	30	M T X A
688	LUSCOMBE SEDAN	MAN	3/48	18	F T X A
689	MACCHI CASTOLDIA	ATA	/58	18	F U C Q
690	MACCHI C.202	MAN	3/57	19	S T X G
691	MACCHI MB. 323	AT	2/54	27	F T X G
692	MACCHI C 202	AT	9/54	26	S U C G
693	MACCHI MB 308	AT	9/49	48	S F C G
694	MACCHI C.202	AT	6/43	39	S T N Q
695	MACCHI C.202	MAN	2/43	26	F T X G
696	MARTIN BAKER MB 5	MAN	1/54	30	F T X G
697	MARTIN SC-1	MAN	5/52	41	S T N G
698	MARTIN A 22 MARYLAND	MAN	4/44	20	M W E A
699	MARTIN BALTIMORE	MAN	12/42	11	F T X G
700	MARTIN B-26	AT	6/41	24	F T X G
701	MARTIN B 26D	MAN	9/44	28	F T X Q
702	MARTIN B 26D	MAN	11/44	14	M W E A
703	MARTIN B 26	AT	3/53	34	M U G G
704	MARTIN XPBM 1	MAN	7/42	22	F T X G
705	MARTIN PBM 1	AT	1/42	31	F T X G
706	MARTIN PBM 3	AT	9/43	62	M T X G
707	MARTIN PBM 3C MARINER	MAN	1/64	26	M N E A
708	MARTIN PBM 3C MARINER	MAN	2/64	26	M N E A
709	MARTIN SPB2M 1	AT	3/42	38	S T X G
710	MARTIN PGM 1 SEAMASTER	AM	12/56	40	F T X G
711	MARTIN XP4M 1	MAN	7/47	24	F T X G
712	MARTIN 202	MAN	12/47	18	F T X G
713	MARTIN CANBERRA MK 1	MAN	7/51	25	S T X G
714	MARTIN XB-51	MAN	4/50	20	F T X G
715	MAX HOLSTE MH-152	MAN	3/52	18	S T N G
716	MAX HOLSTE MH-152	AT	9/52	36	F T X G
717	MCDONNELL F 101 VOODOO	AT	8/55	37	F T X G
718	MCDONNELL F3H 1N DEMON	AT	8/54	56	F T X G

No.	Aircraft	S	I	P	STDA
719	MCDONNELL FD 1 PHANTOM	MAN	6/49	34	F T X Q
720	MCDONNELL F2H 1 BANSHEE	AT	5/49	47	F T X G
721	MCDONNELL XF 85 PARASITE	MAN	10/48	18	F T X G
722	MCDONNELL F-88A	MAN	2/52	14	S T N Q
723	MESSERSCHMITT ME-109	MAN	11/40	24	M F C G
724	MESSERSCHMITT ME-109	AT	12/52	41	S U C Q
725	MESSERSCHMITT ME-109	AM	8/61	19	S U C Q
726	MESSERSCHMITT ME-109E	MAN	3/57	19	S T X G
727	MESSERSCHMITT ME-109E	MAN	8/60	16	F T X A
728	MESSERSCHMITT ME-109J	MAN	5/41	8	M W E A
729	MESSERSCHMITT ME-110	AT	1/41	33	F T X G
730	MESSERSCHMITT ME-110	ATA	/43	43	S T X G
731	MESSERSCHMITT ME-110	AM	4/58	15	F U C G
732	MESSERSCHMITT BF-110D	AM	5/66	35	F U C G
733	MESSERSCHMITT ME-163B	AT	8/46	37	S T N G
734	MESSERSCHMITT ME-210	AT	2/43	45	S T X Q
735	MESSERSCHMITT ME-210	MAN	8/43	26	F T X A
736	MESSERSCHMITT ME-262	MAN	1/47	40	F T N Q
737	MESSERSCHMITT 410 A1	AT	7/44	55	S T N G
738	MEYERS LITTLE TOOT	AMA	/65	80	S R C Q
739	MEYERS LITTLE TOOT	AM	12/61	18	M U C G
740	MIG 3	AM	4/59	31	F U C Q
741	MIG 3, I-18	MAN	1/43	24	M F C Q
742	MIG UTKA	AT	5/52	27	S T X G
743	MIG 15	AT	10/53	22	M T X G
744	MIG 15	MAN	1/57	11	F U C G
745	MIG 15 TWO SEAT	AT	5/53	38	F T X G
746	MIG 17	MAN	8/60	34	S T X Q
747	MIG 19	AT	7/52	26	S T X G
748	MIG 19 FARMER	MAN	8/61	35	F T X G
749	MILES MASTER	MAN	4/43	24	M F C G
750	MILES MASTER II	MAN	1/41	24	S T X G
751	MILES MAGISTER	MAN	2/42	17	M F C G
752	MILLER SPECIAL LITTLE GEM	AT	1/51	27	S T N G
753	MISC FRENCH WWII	AT	10/43	60	S T N G
754	MISC WWII FIGHTERS	AT	11/42	38	S T X G
755	MITSUBISHI JACK	MAN	4/49	25	F T X G
756	MITSUBISHI RUFE	MAN	11/45	64	S T X G
757	MITSUBISHI ZERO	MAN	1/63	35	F T X G
758	MITSUBISHI ZERO	AT	2/54	29	F U C G
759	MITSUBISHI ZEKE	MAN	7/53	38	F T X G
760	MITSUBISHI OB 31 BETTY	MAN	3/44	18	F T X G
761	MITSUBISHI S OO FLOAT	MAN	8/44	11	F T X G
762	MITSUBISHI O MK2	AT	1/44	54	F T N G
763	MITSUBISHI OO	MAN	1/43	18	F T X G
764	MITSUBISHI KB 9805	MAN	9/43	56	F T N Q
765	MISS LOS ANGELES	MAN	3/49	10	F U C G
766	MONOCOUPE	AMA	/65	86	S R C Q
767	MONOCOUPE 1948	AT	/55	61	S R C Q
768	MONOCOUPE 9AL 15	MAN	3/53	24	F T X G
769	MONOCOUPE	MAN	10/48	10	M F C G
770	MONOCOUPE 90AF	AT	10/42	26	M F C G
771	MOONEY MITE	MAN	1/56	10	F F G G
772	MOONEY MITE	AT	12/49	43	F U C G
773	MOONEY M 18 MITE	MAN	11/48	24	F T X G
774	MORANE SAULNIER	AMA	/62	96	S U C Q
775	MORANE SAULNIER N BULLET	MAN	2/61	39	S T X A
776	MORANE SAULNIER MS 880	MAN	9/61	35	S T X G
777	MOSCA 1 16	AT	12/41	46	F T X G
778	MR MULLIGAN	MAN	6/48	36	S T X G
779	MXY 8	AM	2/57	13	S T X G
780	NAKAJIMA KI 84 FRANK	MAN	6/62	32	F T X G
781	NAKAJIMA MYRT	MAN	7/57	38	S T X G
782	NAKAJIMA 19	AT	3/42	18	S T X G
783	NAKAJIMA 91	MAN	1/41	25	F T X G
784	NAKAJIMA 19 BOMER	MAN	3/42	23	F T X G
785	NELSON HUMMINGBIRD	AM	11/56	26	S F C Q
786	NESMITH COUGAR	AM	2/59	24	M T X A
787	NIEUPORT 24BIS	AM	1/65	28	M U C G
788	NIEUPORT 27	MAN	7/63	11	M R C G
789	NIEUPORT 24 27	MAN	12/56	24	M T E A
790	NIEUPORT 24 27	MAN	1/57	35	M T E A
791	NIEUPORT 28	MAN	10/50	32	F N E A
792	NIEUPORT 28	MAN	11/50	27	F N E A
793	NIEUPORT 28	MAN	3/56	26	M T E A
794	NIEUPORT 28	MAN	4/56	30	M T E A
795	NIEUPORT NIGHTHAWK	MAN	7/53	30	M N E A
796	NIEUPORT TRIPE	MAN	7/44	21	F T X G
797	NOORDUYN NORSEMAN	MAN	11/44	8	M F C G
798	NORTH AMERICAN NA 68	MAN	3/41	9	F T X Q
799	NORTH AMERICAN NA 73, P 51A	MAN	3/43	28	F T X Q
800	NORTH AMERICAN P 51B	MAN	5/44	24	F W X A
801	NORTH AMERICAN P-51B	AT	6/46	54	F F C G
802	NORTH AMERICAN P-51B	AM	5/62	19	S U C G
803	NORTH AMERICAN P-51H	MAN	5/55	11	F U E A
804	NORTH AMERICAN P-51K	AT	12/52	36	S U C Q
805	NORTH AMERICAN P-82	AT	/51	12	M U C G
806	NORTH AMERICAN F-82	MAN	2/62	24	M N E A
807	NORTH AMERICAN B-25	AT	8/41	51	F T X Q
808	NORTH AMERICAN B-25	MAN	8/42	24	F T X G
809	NORTH AMERICAN B-25	MAN	10/62	13	F U C A
810	NORTH AMERICAN XB 21	MAN	6/41	8	S T X G
811	NORTH AMERICAN AT 6	AT	1/50	40	M U E A
812	NORTH AMERICAN AT 6	ATA	/52	42	M U C A
813	NORTH AMERICAN SNJ	MAN	5/60	9	S U C G
814	NORTH AMERICAN XP-86	MAN	2/50	32	F T X Q
815	NORTH AMERICAN F 86D	MAN	9/53	15	F F C G
816	NORTH AMERICAN F 86F	AMA	/57	8	S U G A
817	NORTH AMERICAN F 86D F86K	AM	6/62	34	M T X A
818	NORTH AMERICAN FJ 4	AM	2/56	33	F T X G
819	NORTH AMERICAN FJ 3	MAN	4/62	12	M U C A
820	NORTH AMERICAN NAVION	MAN	7/46	18	M F C G
821	NORTH AMERICAN NAVION	MAN	7/46	22	F T X G
822	NORTH AMERICAN NAVION	AT	9/47	55	F T X G
823	NORTH AMERICAN T 28A	AT	5/50	31	F T X G
824	NORTH AMERICAN T-28	MAN	9/50	20	F T X A
825	NORTH AMERICAN B 45	AT	5/50	49	F T X G
826	NORTH AMERICAN B 45	AT	/51	48	F T X G
827	NORTH AMERICAN B 45	MAN	4/64	26	M N E A
828	NORTH AMERICAN F 100	MAN	6/55	19	F T X G
829	NORTH AMERICAN NA300 COIN	AM	1/65	34	S T N G
830	NORTHROP A 17A	MAN	12/43	26	M W E A
831	NORTHROP FLYING WING TWIN	AT	1/42	29	S T X Q
832	NORTHROP FLYING WING	MAN	1/41	20	F T X Q
833	NORTHROP F 61	MAN	10/44	8	F W X G
834	NORTHROP P 61	ATA	1/46	72	F T X G
835	NORTHROP P 61	MAN	6/65	22	M N E A
836	NORTHROP P 61	MAN	7/65	22	M N E A
837	NORTHROP T 38	AM	2/61	55	S T N G
838	NORTHROP SM 62 SNARK	AM	1/57	19	F T X G
839	NORTHROP X 4	MAN	9/49	20	F T X G
840	NORTHROP F 89	AT	9/51	27	S T X G
841	NORTHROP F89 D SCORPION	MAN	10/56	34	F T X G
842	NORTHROP C 125 TRIMOTOR	AT	11/50	53	F T X G
843	NORTHROP N 156F	AM	1/62	34	M T C A
844	NORTHROP N 156F	AM	2/61	55	S T N G
845	NUFFIELD NAPIER HESTON RACER	MAN	10/43	34	F T X G
846	NUMEROUS JAP 3 VIEWS	AT	6/44	40	M T N Q
847	NUMEROUS WWII FIGHTERS	ATA	/43	42	S T X G
848	OPEL RAK 1 ROCKET GLIDER	AT	8/51	46	F F C G
849	ORENCO D	MAN	3/63	21	F T X G
850	PARNALL PIXIE	AM	6/59	18	S T N G
851	PERCIVAL P.56 PROVOST	AT	2/53	38	F T X G
852	PFALZ D 3	MAN	8/47	22	F W E A
853	PFALZ D 3	MAN	9/47	18	M W E A
854	PFALZ D 3	MAN	10/47	26	F W E A
855	PFALZ D 12	MAN	5/48	26	F W E A
856	PFALZ D 12	MAN	6/48	28	M W E A
857	PFALZ D 12	MAN	1/49	27	M U C G
858	PIEL EMERAUDE	MAN	4/60	14	S F C G
859	PIETENPOL AIR CAMPER	AM	3/61	37	M T E A
860	PILATUS PORTER	AM	9/63	16	M R C Q
861	PIPER J 3 CUB	MAN	10/41	28	F T E A
862	PIPER CUB J 3	AM	10/58	18	M T X A
863	PIPER J3 CUB	MAN	9/59	20	F F C G
864	PIPER J3 CUB	AM	6/61	38	F R C G
865	PIPER SUPER CRUISER	AT	6/47	67	F T X G
866	PIPER VAGABOND	AT	8/49	40	F F C Q
867	PIPER SKYCYCLE	MAN	11/45	16	F T U G
868	PIPER SKYCYCLE	MAN	11/45	23	F T X A
869	PIPER PA 8 SKYCYCLE	AM	1/60	20	M T X A
870	PIPER TRIPACER	MAN	3/52	21	F U C G
871	PIPER PAWNEE	MAN	10/61	18	F U C G
872	PIPER COMMANCHE	MAN	6/62	12	M U C G
873	PIPER COMMANCHE	AM	5/66	13	M R G A
874	PIPER APACHE	MAN	2/64	13	F U C G
875	PITCAIRN MAILWING	AM	1/59	19	M T X A
876	POETZ 63 11	MAN	1/41	24	S T X G
877	PORTERFIELD COLLEGIATE	MAN	6/60	15	S F C Q
878	POU DU CIEL	AT	7/50	21	S T N G
879	PZL P 11C	MAN	3/61	37	F T X G
880	REARWIN SPEEDSTER	MAN	3/55	11	F F C G
881	REARWIN TRAINER	MAN	4/45	30	M F C G
882	REGGIANE RE 2001	AT	6/43	39	S T N Q
883	REPUBLIC GUARDSMAN	MAN	2/41	18	F T X G
884	REPUBLIC YB 43	AT	1/42	29	S T X G
885	REPUBLIC P 47	MAN	12/42	20	F T X G
886	REPUBLIC P 47B	ATA	/43	41	F T X A
887	REPUBLIC P 47D PHOTOS	AM	10/61	31	
888	REPUBLIC P 47D	MAN	12/44	10	M W E A
889	REPUBLIC P 47D	AM	9/61	19	S U C Q
890	REPUBLIC P 47D	MAN	3/62	18	F T X G
891	REPUBLIC P 47D,N	AT	/54	30	M U C G
892	REPUBLIC P 47N	MAN	10/65	24	M R P Q
893	REPUBLIC XF 91	AT	/51	65	F T X G
894	REPUBLIC XP 84	MAN	11/46	18	F T X Q
895	REPUBLIC F 84F	MAN	5/51	34	F T X G
896	REPUBLIC F 105B THUNDERCHIEF	AM	1/58	28	F T X G
897	REPUBLIC RC-3 SEABEE	MAN	1/46	23	M T X A
898	REPUBLIC SEABEE	AT	8/46	48	F F C G
899	RERWIN SKYRANGER	AT	3/43	43	M F C G
900	REARWIN SPEEDSTER	MAN	1/40	14	M F C G
901	REARWIN SPEEDSTER	AT	7/40	36	F F C G
902	REARWIN SPEEDSTER	MAN	5/41	12	M F X G
903	REX MONO	AM	7/66	33	F F C G
904	ROLAND C11 WAHLFISCH	AM	9/62	20	S U C Q
905	ROLAND D 2 WAHLFISCH	AT	9/49	53	F U C Q
906	ROLAND D 2	MAN	6/50	34	F N E A
907	ROLAND D 2, D 2A	MAN	7/50	26	F N E A
908	ROSE PARAKEET	MAN	1/49	18	M F C G
909	RUMPLER TAUBE	AT	10/51	35	F F C G
910	RUMPLER C-3	MAN	6/50	17	M F C G
911	RUMPLER C-IV	MAN	12/50	44	S T N G
912	RUMPLER D 1	MAN	5/51	26	F T X G
913	RYAN M 1	MAN	5/65	17	F T X G
914	RYAN NYP	AT	4/54	80	S T X G
915	RYAN NYP	AM	6/57	16	M T X A
916	RYAN NYP SPIRIT OF ST LOUIS	MAN	3/59	26	M T E A
917	RYAN ST	MAN	2/44	29	F T X G
918	RYAN ST	MAN	9/60	12	F R C G
919	RYAN ST	AM	7/62	34	M T X A
920	RYAN PT-22	MAN	7/66	12	F U G A
921	RYAN YPT 16	MAN	1/41	32	F T X G
922	RYAN PT 22	MAN	3/59	14	F U C G

No.	Aircraft	S	I	P	STDA
923	RYAN pt 22	AM	7/62	33	F T X A
924	RYAN XF2R 1 FIREBALL	MAN	5/47	25	F T X G
925	SAAB 105	MAN	9/61	35	S T X G
926	SAAB J 35	MAN	2/60	18	F T X G
927	SAAB 91C SAFIR	AM	2/58	30	F U C G
928	SAAB A 32	AT	4/58	58	S T X G
929	SAAB 210 DRAKEN	AT	1/53	46	F T X G
930	SAAB J 29	AT	4/51	34	F T X G
931	SABLAR SPECIAL	MAN	5/59	24	S T N G
932	SAF U 1 L 28	AT	4/53	37	F T X G
933	S.A.I. KZ-10	MAN	3/52	31	F T X A
934	SALMSON SAL 2-A2	MAN	3/49	5	S T N G
935	SALMSON 2A2	MAN	5/62	20	M T X A
936	SALVAY STARK SKYHOPPER	MAN	6/59	34	S T N G
937	SASEBO O PETE	MAN	5/44	31	F T X Q
938	SAVIOA S 55	MAN	11/60	16	F T X G
939	SB 3 RUSSIAN	AT	6/43	39	S T N Q
940	SCHWEIZER TG 2 GLIDER	MAN	12/42	14	M F C G
941	SE 4 RACER	MAN	5/48	24	M F C Q
942	SE 5	AM	1/60	33	M U C Q
943	SE 5	MAN	2/60	34	F T X A
944	SE 5	MAN	5/59	12	F F C G
945	SE 5	MAN	1/55	11	F R C Q
946	SEKORSKY S 29A	MAN	2/64	19	F T X G
947	SEVERSKY AP 7	MAN	9/59	12	F T X G
948	SEVERSKY P 35	AT	4/55	38	F T X G
949	SEVERSKY P 35	MAN	11/40	10	M W E A
950	SHORT STERLING	MAN	3/43	36	F T X G
951	SIEMENS D 4	MAN	1/47	30	M W E A
952	SIKORSKY YR 4B	MAN	2/47	6	S T X G
953	SIM TEXAN	MAN	10/59	34	S T N G
954	SIPA S901	MAN	12/53	52	S T X G
955	SIPA 200	AT	12/52	35	F T X G
956	SITTS PLAYBOY	AM	1/57	26	S U C G
957	SITTS SPECIAL	AT	5/51	51	S T N G
958	SITTS JR	AT	6/51	38	F U C G
959	SITTS SPECIAL BIPE	AT	9/50	39	F U C G
960	SITTS SPECIAL	MAN	8/50	20	F T X A
961	SITTS SPECIAL	MAN	8/50	10	M U G A
962	SKIMMER XC-1	1	10/50	20	F T X G
963	SKYFARER	MAN	11/41	24	M F C G
964	SMITH MINIPLANE	AM	1/61	23	S U C G
965	SMITH MINIPLANE	AM	3/60	22	M T X A
966	SNCASO TRIDENT	MAN	1/56	23	F T N Q
967	SNCASO SO 4050	MAN	1/54	8	S T X Q
968	SNCASO S07060	MAN	11/50	22	F T X G
969	SNECMA C 450	MAN	1/59	30	F T X G
970	SOPWITH 1-1/2 STRUTTER	AM	3/66	8	S T X G
971	SOPWITH PUP	AM	12/62	14	M R C Q
972	SOPWITH TRIPE	MAN	7/45	28	M F C G
973	SOPWITH TABLOID SCOUT	MAN	12/49	38	S T X Q
974	SOPWITH SNIPE	MAN	10/45	33	M F C G
975	SOPWITH SNIPE	MAN	11/49	13	F F C Q
976	SOPWITH SNIPE 7F-1.	MAN	4/52	32	M N E A
977	SOPWITH CAMEL	MAN	2/48	22	F W E A
978	SOPWITH CAMEL	MAN	3/48	24	M W E A
979	SOPWITH SE 5 A	MAN	12/44	18	J W E A
980	SOPWITH DOLPHIN 5F.1	MAN	4/47	31	M W E A
981	SOPWITH DOLPHIN 5F.1	MAN	5/47	22	F W E A
982	SOPWITH DOLPHIN 5F.1	MAN	6/47	33	F W E A
983	SOPWITH DOLPHIN	T	1/51	51	F U C G
984	SOPWITH ATLANTIC BIPLANE	MAN	7/59	14	F T X G
985	SPAD S.VII	MAN	3/46	20	M W E A
986	SPAD S.VII	MAN	4/46	24	F W E A
987	SPAD S.VII	MAN	9/63	18	F T X G
988	SPAD 13	AM	8/60	21	S U C Q
989	SPAD S XIIIC.1	MAN	7/46	30	M W E A
990	SPAD 13C. 1	MAN	3/42	6	F T X G
991	SPERRY MESSENGER	AM	5/62	34	M T X A
992	STANDARD E-1	MAN	2/50	36	S T N G
993	STANDARD MODEL J	MAN	1/55	28	M N E A
994	STEARMAN PT 17	MAN	2/62	11	M U C A
995	STEARMAN PT 17	AT	4/50	42	M U C A
996	STEARMAN XA 21	MAN	6/41	8	S T X G
997	STINSON TRIMOTOR	MAN	6/49	23	F F C Q
998	STINSON DETROITER	AT	12/49	53	F F C Q
999	STINSON JUNIOR SM 2	MAN	1/59	22	M W E A
1000	STINSON JUNIOR S	MAN	11/59	28	M W E A
1001	STINSON JUNIOR S	MAN	12/58	20	M W E A
1002	STINSON MODEL R	MAN	2/59	24	M W E A
1003	STINSON AIRLINER MODEL T	MAN	10/61	24	M W E A
1004	STINSON AIRLINER MODEL 1	MAN	11/61	24	M W E A
1005	STINSON AIRLINER MODEL U	MAN	12/61	24	F W E A
1006	STINSON S	MAN	1/60	19	F R C A
1007	STINSON RELIANT SR 5	MAN	2/60	24	M W E A
1008	STINSON RELIANT	MAN	5/60	24	M W E A
1009	STINSON RELIANT SR 6 10	MAN	12/60	26	M W E A
1010	STINSON RELIANT SR	MAN	12/59	26	M W E A
1011	STINSON RELIANT SR 6	MAN	6/60	28	M W E A
1012	STINSON RELIANT GULL WING	MAN	1/61	28	M U E A
1013	STINSON RELIANT GULL WING	MAN	3/61	26	M W E A
1014	STINSON RELIANT GULL WING	MAN	6/61	26	M W E A
1015	STINSON 0-49	MAN	2/50	10	M F C A
1016	STINSON 105	AT	4/40	39	F T X G
1017	STINSON 105	AT	11/41	43	M F C G
1018	STINSON VOYAGER	MAN	6/48	16	M F C G
1019	STINSON 125	ATA	/46	47	F F C G
1020	STINSON 150	AT	1/47	57	F T X G
1021	STINSON STATION WAGON	MAN	5/53	16	S T X G
1022	STINSON 0 49	MAN	7/41	16	M F C G
1023	STINSON L 49	AT	2/43	45	S T X G
1024	STORMAVIK IL 2	MAN	6/44	14	M F C Q
1025	SUD VJ 101C	MAN	9/66	38	F T X G
1026	SUD-OUEST SO 4000	MAN	7/51	12	S T N Q
1027	SUPERMARINE SPARROW	MAN	4/56	21	F F C G
1028	SUPERMARINE S 6B	MAN	3/59	18	F T X G
1029	SUPERMARINE S 6B	MAN	1/59	19	F U C G
1030	SUPERMARINE SPITFIRE	MAN	6/43	22	F T X A
1031	SUPERMARINE SPITFIRE	AT	12/52	40	S U C Q
1032	SUPERMARINE SPITFIRE	MAN	11/58	12	F T X G
1033	SUPERMARINE SPITFIRE	AM	5/59	23	F U C Q
1034	SUPERMARINE SPITFIRE MK V	MAN	8/66	20	M N E A
1035	SUPERMARINE SPITFIRE MK V	MAN	9/66	20	M N E A
1036	SUPERMARINE SPITFIRE V	MAN	3/57	19	S T X G
1037	SUPERMARINE MK VIII	AM	7/66	27	M U C G
1038	SUPERMARINE SPITFIRE 9	AM	2/62	17	M R C G
1039	SUPERMARINE SPITFIRE MK II	MAN	2/41	10	M W E A
1040	SUPERMARINE SPITFIRE MK 12	AT	8/44	54	S T N G
1041	SUPERMARINE E10/44	MAN	2/47	20	F T X G
1042	SUPERMARINE ATTACKER	AT	5/52	50	F T X G
1043	SUPERMARINE ATTACKER	MAN	3/53	30	M F C Q
1044	SVENSKA J-22	MAN	11/45	68	S T X G
1045	TAYLOR CRAFT	MAN	10/55	11	F F C G
1046	TAYLORCRAFT L 2B	MAN	5/43	18	M F C G
1047	TAYLORCRAFT 0 57	MAN	4/42	22	M F C G
1048	THOMAS MORSE TM 22	MAN	7/63	21	F T X G
1049	THOMAS MORSE S4B,S4C	MAN	5/57	34	M N E A
1050	THOMAS MORSE S4B,S4C	MAN	6/57	16	M N E A
1051	THOMAS MORSE SCOUT	AT	4/52	44	F U C G
1052	THOMAS MORSE MB 3	MAN	12/51	28	F T X A
1053	THOMAS MORSE SCOUT S 4C	AT	5/50	46	M T E A
1054	THORP SKY SKOOTER	MAN	8/47	18	F T X G
1055	THORP TIGER	AM	9/66	16	F R C A
1056	THUNDERBIRD W 14	MAN	8/64	19	F T C G
1057	TIME FLIES	AM	10/57	22	S U C Q
1058	TIPSY JUNIOR	MAN	1/52	34	F T X G
1059	TIPSY JUNIOR	MAN	11/52	21	F F C G
1060	TRAVEL AIR 2000	MAN	6/56	11	F U C G
1061	TRAVEL AIR 2000	MAN	2/53	32	M N E A
1062	TRAVEL AIR 2000	MAN	11/65	26	M R C G
1063	TRAVEL AIR 4000	AM	8/62	31	F T N G
1064	TRAVEL AIR 6000 MONOPLANE	MAN	11/53	26	M N E A
1065	TRAVEL AIR	MAN	1/52	19	F U C G
1066	TRAVELAIRE MYSTERY SHIP	AT	7/50	37	F U C G
1067	TRIMMER AMPHIBIAN	AT	1/54	31	F U C G
1068	VELIE MONCOUPE	AT	4/50	49	F F C Q
1069	VERVILLE PW 1	MAN	1/63	17	F T X G
1070	VICKERS MACHINE GUN 30 CAL	MAN	4/46	25	F W E A
1071	VICKERS VISCOUNT	MAN	2/56	44	S T X G
1072	VOUGHT SBU 1	MAN	1/41	22	M W E A
1073	VOUGHT SB2U 1	MAN	3/43	8	M W E A
1074	VOUGHT SB2U 2	MAN	11/41	17	S T X G
1075	VOUGHT OS2U 1	AT	2/43	40	M T X G
1076	VOUGHT OS2U 1	MAN	3/54	12	F U C G
1077	VOUGHT-SIKORSKY XF4U-1	AT	4/41	26	F T X Q
1078	VOUGHT CORSAIR	MAN	11/43	26	F T X A
1079	VOUGHT CORSAIR F4U	AT	1/46	51	M U C Q
1080	VOUGHT F4U 1A CORSAIR	AM	11/63	21	S U C Q
1081	VOUGHT CORSAIR	MAN	12/44	16	F T X G
1082	VOUGHT F8U 1	AM	8/56	19	F T X G
1083	VULTEE XP 54	MAN	6/45	14	F W X G
1084	VULTEE BT 13 VALIANT	MAN	6/43	24	M F C Q
1085	VULTEE VANGUARDS	MAN	1/41	27	F T X G
1086	VULTEE VANGUARD	AT	11/41	48	F U C Q
1087	VULTEE VENGEANCE	AT	11/41	39	F T X G
1088	VULTEE VENGEANCE	MAN	9/43	12	F T X G
1089	VULTEE V11GB	MAN	2/41	32	F T X G
1090	WACO TEN	AM	6/61	29	F T N G
1091	WACO CG 4A GLIDER	MAN	10/59	11	S F C G
1092	WACO CABIN	MAN	1/56	14	F F C G
1093	WACO TAPERWING	AT	11/53	33	F U C G
1094	WACO 240A	MAN	1/53	31	F N E A
1095	WACO N	AT	11/46	62	F U C G
1096	WACO C 6	MAN	4/41	8	F T W G
1097	WAGTAIL	MAN	9/51	19	F U C G
1098	WEDELL WILLIAMS	MAN	3/58	10	S T N G
1099	WEE BEE	AT	11/50	42	M U C G
1100	WESTLAND WIDGEON	MAN	6/61	11	M R C G
1101	WESTPREUSSEN GLIDER	MAN	6/59	24	S F N G
1102	WESTLAND LYSANDER	MAN	3/58	26	M W E A
1103	WESTLAND LYSANDER	MAN	4/58	22	M W E A
1104	WESTLAND WYVERN	MAN	12/51	43	F T X G
1105	WESTLAND WHIRLWIND	AT	1/43	33	F U C G
1106	WESTLAND WHIRLWIND	MAN	7/42	26	F T X G
1107	WIBAULT 170 Ci TROMBE	MAN	4/65	20	F T X G
1108	WINTER ZAUNKONIG	MAN	3/56	38	S T X G
1109	WHITMAN TAILWIND	AMA	/64	10	M R C Q
1110	WHITMAN SUPER TAILWIND	MAN	9/62	13	F F C G
1111	WITTMAN BUTTERCUP	MAN	12/59	12	S F C G
1112	WITTMAN BUTTERCUP	AT	7/53	52	S R C Q
1113	WITTMAN BUTTERCUP	MAN	5/51	29	F F C Q
1114	WITTMAN SPECIAL BUSTER	AT	12/47	54	M U C G
1115	WITTMAN BONZO	AT	7/53	28	F U C G
1116	WITTMAN BIG X	AT	8/51	39	S T N G
1117	WRIGHT JJ WHIRLWIND ENGINE	AMA	/60	53	F T E A
1118	WRIGHT BIPLANE	ATA	53	31	F T X G
1119	WRIGHT BROTHERS MODEL B	MAN	3/47	34	M W E A
1120	WRIGHT FLIER	MAN	1/44	10	F W E A
1121	YAK 3	AM	9/65	33	F U C G
1122	YAK 25	AM	7/57	15	S U C Q
1123	YAK 18	AT	2/52	16	F T X G
1124	YAK 4	AT	8/42	21	S T X G
1125	YAK 25	AT	7/52	26	S T X G
1126	YAK 15	AT	12/52	34	F T X_G

The author, after a demonstration flight at EAA fly-in. RAMS (Seattle) RC club hat.

BUCKER JUNGMANN

(Continued from Page 43)

sides from F5 to F3. The wire cabane strut assembly is then sewn into the airplane with heavy thread and epoxied. The forward nose section ring is attached when nose planking is begun. Measure the length of four 3/8" x 1/8" planks from the nose section outlines shown on the top view and side views. Line these carefully up on F2, F3 and F5 and glue in position. The correct angle for nose ring F1 is then established. Glue in F1 and complete the rest of the planking. Note that the planking on the side of the nose sections overlaps the sheet between F3 and F5. This simulates the area where the cowling sticks out from the fuselage and should be painted black or dark grey later. The cabane struts fairings and upper wing saddle can then be added. The tail wheel assembly is then mounted on the mounting plate and epoxied in position.

EMPENNAGE: The tail feathers are assembled on top of the plans and then sanded to airfoil shape after removal from the plans. Make sure that the plywood ribs and L-shaped plywood hinge pin retainers for the outboard elevator hinges are cut to shape and drilled before assembly. The metal elevator hinges are roughed with 220 sandpaper and faced with epoxy and plywood to ensure good bonding to the stabilizer and to provide the correct hinge shape. Cut slots in stabilizer for the hinges. Connect all four hinges to the elevator sections with 1/16" steel pins and align with the stabilizer slots. Jig the assembly so that it can't move and epoxy the hinges in the stabilizer. This must be accurate to avoid twisted elevators. The rudder hinges are assembled and then slots cut into the fin and rudder. The rudder horn is then epoxied in place and the rudder hinges epoxied and pinned in place. The stabilizer-elevator assembly is then epoxied to the fuselage and the fin-rudder assembly epoxied in position. Soft block fairings are then carved and added at the tail. Control linkage can be added at anytime prior to covering.

WINGS: The wing assembly is next. Use the lightest balsa you can find for the ribs. Cut out all ribs, wing tips and shape the main spars. Notice the taper on the bottom and top of all main spars. If your jig-saw has a tilt table, the main spars can be quickly cut out of 1/4" hard balsa sheet, complete with taper. Measure the angle from the plans. Cut the spars to length making sure you keep the forward spars separate from the aft spars. Both wing panels can be built at the same time on the plans. You can build up almost the entire wing in one night. Pin the ribs in position, drop in the main spars, and glue in place. Don't forget to tilt the inboard rib for dihedral. Block up and epoxy the tips and trailing edge strips to the ribs. The trailing edge strips can be tapered with a Moto Tool sander after the wing is lifted from the plans. Add the sheeting on top and the sheeting in between the ribs at the aileron cutout. Glue on the top sheeting by the aileron cut out. Add top cap strips and remove from plans when dry. Add the bottom sheeting by the ailerons and set aside till the center sections are built.

Laminate the dihedral braces with epoxy and clamp in the jig shown on the plans. Making more than one jig will speed up this process. Build the center sections similar to the wing panels and lift from plans, flip over and cut 1/16" out of the end ribs against the main spars and epoxy the dihedral braces in position. Then cut 1/16" out of the end ribs against the spar on the wing panels. Block the center section up the correct amount for upper or lower wing directly over the wing plans, and that the wings are not twisted. When dry, sand down the bottom of the wing, sheet and add cap strips. Add the aileron control linkage before sheeting the bottom wing.

AILERONS: Build the ailerons by first laying the bottom sheeting directly on the plans. Glue on all ribs, spacers, and trailing edge. Sheet the vertical leading edge and then add the top leading edge sheeting. Lift from plans and cut out the hinge slots in the leading edge with a razor saw. Epoxy the aileron control horns on all ailerons and also the aileron pushrod horn on the bottom wing ailerons. Epoxy the plywood hinge mounts in each aileron. Cut a 1/32" slot in the trailing edge sheeting against the hinge ribs in the aileron cutouts in each wing. String 6 brass aileron hinge plates onto a piece of 1/16" wire cut to the length of an aileron. Carefully align and epoxy the hinge plates to the wing ribs, making sure the wire is centered with the aft main spar. Remove the wire when the plates are dry and fasten the aileron hinges to the hinge plates with 0-80 nuts and bolts. Slip the hinge through the slots in the plywood aileron retaining plates and epoxy the ailerons in position. The aileron pushrods can then be added in the lower wing as well as the plywood rigging plates which have 2-56 blind nuts on the back side.

LANDING GEAR: Build the landing gear directly in the slots on the bottom wing landing gear mount. This ensures proper alignment while wrapping and soldering the gear. The gear is made removable since this part of the airplane takes more of a beating than any other part and seems to need continual repair if hard landings are made. The slot can be covered over, after assembly, with silk, then doped. Only the mounting screws will show.

RIGGING: The wing struts and rigging plates can be made during any spare moments between main component construction. Notice that a strut rigging jig is required. This keeps the struts at the proper spacing for removal and installation. Without it, the elastic rigging pulls the struts together and you'll have a devil of a time installing them. To install the rigging, the lower wing inboard fittings are screwed tightly in place, then the lower wing is rubber banded to the fuselage. The upper wing is rubber banded on, and then the struts (in the jig) are put in position at the wing tips and held there by a buddy while you add the 2-56 screws which hold the strut fittings to the wings. Your friend can then let go of the struts. Remove the jig and fasten the upper wing inboard fittings with 2-56 screws. Removal of the rigging is the opposite sequence. If you use a heavy white elastic for the rigging, there will be very little rigging vibration when the plane is in the air. A spare set of struts without rigging fittings should be made for Sunday sport flying. These I use for most of my flights. I save the fancy rigging for contests.

DOORS: The cockpit doors and scale goodies can be made at any convenient time since they can be completed very quickly. The model shows magnetic latches for the doors. This is not scale, but it's a whale of a lot simpler than the spring loaded pin latches I used on my model!

FINISHING: Install all controls before covering. The airplane can be covered with silron or very light silk and dope. Wax all surfaces heavily in those areas where you don't want the silk to stick. Plasticize your dope heavily, or better yet, use the non-shrink dopes available. I won't go into finishing such as adding the griffin on the tail, etc. since this was covered in the September and October 1966 issues of MAN. The airplane is first painted all white and then the black and gold trim is added. Notice that the black checks on the landing gear fairings are only on the outboard side of the gear. The registration numbers and experimental numbers slant forward on both sides of the airplane. The griffin faces forward on the left side and aft on the right side. Templates are included on the plans to provide the correct curves for the black trim on the fuselage nose section. All cowling lines, gas tank lines, zippers, lacing, drain holes and screws were simulated with dark and light grey dope in the appropriate locations. The whole thing is then sprayed with clear dope and rubbed.

FLYING: Install your radio gear and check the C.G. My airplane came out right on the money with no shifting required. Keep the C.G. within a ¼ inch of what is shown on the plans for a good stable airplane and don't let the swept back wings scare you. The plane absolutely will not snap unless deliberately put into one while going full bore. It's the finest flying biplane I've ever had and I'm sure you'll enjoy flying it on weekends as well as at contests.

If additional information is required feel free to write me at 15837 28th Ave. So., Seattle 88, Washington 98188.

INSIDE LOOK AT SCALE

(Continued from Page 31)

chord on the horizontal plane. This is assuming you use scale decalage and about 2 degrees down thrust and about 3 degrees right thrust. Do **not** attempt rudder only control with this trim set-up.

How do you achieve correct C.G. location? In this case it should be possible with trim and flap servos in the wing, and rudder and elevator servos in top portions of fuselage rear of the cabin. Side mount the engine, put engine servos in front of instrument panel, receiver below it and use light wheels.

Also, use fish line cable instead of pushrods. I have used fish line as far back as eight years ago and it works fine.

If you go more than the usual distance with your wiring be sure to use a larger size to prevent voltage drop.

Although this is probably not necessary you can put the power pack in the wing center and use epoxy fuel tanks in the wing draining into a small tank behind the engine.

This may sound like scale is awfully complicated, however I have described an extreme case and these things are not usually necessary. I just want to show what is possible if you will make the effort.

Now, let's assume that you want to fly this same plane with just rudder and engine and you couldn't care less about finishing the interior. Okay, put the radio in the cabin keeping all weight as high as possible. Set the wing at 5 degrees positive incidence, the elevator at O. Balance it at 20% of chord not over 2½ inches below the wing. Put in about 4 degrees down thrust and about 3 degrees right. Use next size larger propeller of same pitch. Power, naturally depends on size of plane.

Now, let's take a World War I bipe for instance. These can be a problem because of the inherent upward-pitch tendency. Since nose moments are usually short, downthrust usually has little effect other than to control propeller blasts, and in some cases aggravates this upward tendency because of blast under the wing.

So, setting the wings correctly is important. Put 4 degrees negative in the stabilizer, 3 degrees negative on the top wing, zero degrees on the bottom wing and 3 degrees right thrust in the engine.

Put in sufficient downthrust to cause the shaft line of the engine to extend to the top of the rudder to give some prop blast on the right side of rudder to counteract initial thrust and offset ground looping.

This, coupled with a 25% balance average of both wing chords and about midway between wings on the vertical plane, should be about right for a full house airplane.

For a rudder and engine only job, set stabilizer at 1 degree negative, bottom wing 2 degrees positive, and top wing at zero degrees. Also, about 4 down and 3 degrees right engine thrust.

Use ample power for size of plane with lower pitch or larger diameter prop to limit speed.

Because these bipes, especially the ones with undercambered wings, have a surplus lift buildup aggravated by ample wing area, they usually fly better with ample power and heavier wing loading. Limiting the top speed is important on these types.

I feel the best choices for scale ships are probably the low wing types with trike gear, those which are not designed to fly fast such as the Aircoupe. This type of scale is easy to duplicate because equipment can be placed to get a good force arrangement without any sweat.

Since I cannot go on and on with this I hope you get the general idea by now. The trim adjustments should balance out any unwanted tendencies in the aircraft — this is the real point I am trying to make here.

Always remember that center-of-gravity location is just as important on the vertical plane as it is on the horizontal plane.

As scale airplanes usually have maximum high camber points closer to the leading edge of the wing you must balance them accordingly. You cannot balance them as you would a kit or pattern airplane because scale wings seldom have a rearward high camber point. Also they do not have the oversize elevators as do pattern airplanes and you cannot load the elevator in the same manner.

A scale ship should **never** balance rearward of 30% of chord. By the same token do not ever go forward of 18% of chord and beyond 6 degrees incidence angle in the wing. Higher angles of attack put the flying speed so close to the stall speed that the model will sometimes stall just turning downwind.

In summing up this part I would like to add a standard rule I have regarding scale.

This is to move the center-of-gravity forward 2% of chord for every degree of increase in positive wing incidence. For instance, say you have zero degrees positive incidence and a 30% balance and you increase incidence to 2 degrees positive incidence, then you move the C.G. 4% forward to 26%. This is assuming of course, that you stay within limits previously mentioned.

Also, I suggest that you use multi controls whenever the budget allows, since aileron controls afford more recovery control and allow a safer and generally better flying airplane.

Part VI Scale Problems and Solutions:

A) Ground Looping:

This tendency is due to several causes. The location of the landing gear, the elevator at a high angle of attack in relation to ground attitude, ground effect of propeller blast under elevator and also critical power-to-weight ratio. The best overall solution to this is ample power. Moving gear rearward, and changing engine thrust to put the blast off ground on the proper part of rudder and a more negative ground angle also help. I recommend more power however, because most ships will take off with scale gear location provided thrust line is correct and power is sufficient.

B) Pendulum Effect In Turns:

This is due to too low a center-of-gravity location. The solution is to raise center-of-gravity location. A small amount of this force aids recovery in straight flight, however if this effect is too severe, it will cause a spiral dive in high speed turns. Contrary to popular opinion, increasing dihedral in the wing aggravates this condition rather than correct it due to the increased angle of attack of the high wing.

C) Uncontrolled Snap Rolls:

This is usually caused by too high a center-of-gravity location in conjunction with center-of-gravity being located too far rearward. Lack of wing tip stability or over control will start this action at slow speeds usually on approach to landing. The solution to this condition is to move center-of-gravity forward and lower and improve wing tip stability if possible.

D) Wing Tip Stalls:

The problem here is self explanatory. The solution is to increase stability by a more rearward high camber point on end ribs or by washout or any other method which will delay stalling or cause the tips to stall at a higher angle of attack. I prefer the rearward high camber point method because there is no loss in lift and it works the same way inverted.

Blunting the leading edge does not delay the stall, and while it softens the stall, it also causes it to happen sooner. It does, however, make the wing less sensitive in pitch and usually results in an increase in lift.

Sharpen the leading edge near the tips and round it near the center so the center tends to stall first.

E) Power Stalls:

This is usually due to rearward center-of-gravity location, high incidence in the wing, excess lift buildup in a wing or a combination of all three.

(Continued on Page 84)

INSIDE LOOK AT SCALE

(Continued from Page 83)

The solution is usually to move center-of-gravity forward, limit speed under power by engine speed and propeller selection or reducing excess lift buildup in wing by slightly modifying the airfoil.

I do not recommend reducing incidence angle on a rudder airplane unless all other means have been exhausted, since you will lose your recovery control.

A semi-symmetrical scale size elevator might be the only solution in extreme cases, although this is not likely to be necessary.

F) Spiral Instability:

This is usually the result of tip stalling in conjunction with too slow a flying speed. This is aggravated by a large rudder which is usual on a scale airplane. When the rudder becomes horizontal in a turn it acts as a stabilizer and has a certain amount of lift.

The solution to this problem is to increase flying speed and improve wing tip stability. Moving center-of-gravity higher helps in some cases.

G) Insufficient Stabilizer Area:

In most cases the stabilizer usually gets the blame for different problems connected with scale airplanes, however this condition is really rare and is usually the result of incorrect aerodynamics and trim in the aircraft configuration or because of a change made from the full size craft. If you can find no other aerodynamic reason for apparent lack of sensitivity in the elevator it is probably a case of insufficient flying speed. In all but a few cases where planes have very small stabilizers I recommend only to sharpen stabilizer leading edge and leave it scale size.

The reason for this is because, on a scale model at least, the scale stabilizer is usually superior to one which has been enlarged because stall recovery is much quicker.

I know this may seem contrary to much material previously published, however I have found no advantage in enlarging the stabilizer on a scale ship and this usually makes the airplane even more sensitive to control movements due to tail moments which are usually quite short.

The material in this article is based not only on model flying experience but also on many years of study in regards to aerodynamics. All the aerodynamic theory in the world is useless if it doesn't work in practice.

I recognize what works and what looks good, however I find the opinions and theories of others very interesting and I like to test these ideas. Also I think all model builders regardless of their opinions contribute much to our hobby.

In summing up this part I want to say this, 'the proof of a good pudding is in the eating.' The proof of a good airplane is in the flying.

Part VII Wing Loading:

Before discussing construction, I want to make a comparison in order to support my section on construction weight.

If you take a ping pong ball and throw it upward into a 30 M.P.H. wind it will be blown off its course by the effects of the wind. If you take a steel ball bearing of the same size and throw it upward into the same wind it will hardly be affected in its flight path. This proves that a heavier weight mass is less affected by a given wind velocity than a lighter mass, again a matter of relativity. This supports the general consensus of opinion of most multi experts which is that a heavier machine is smoother through the pattern. This I believe is correct. However, do not misinterpret this to mean that a lighter and slower aircraft is inferior competition-wise.

I feel that this type of airplane has advantages over heavier and faster machines in other portions of the pattern, such as landing perfection, spot landing, touch and go and also a few aerial maneuvers, provided of course, that the pilot has the skill to take advantage of these differences. I personally prefer the lighter and slower type because they are easier to fly.

This may seem to be off the subject of scale but I inserted this to show that a heavy wing loading, while it could be detrimental to a pattern airplane, is not necessarily a disadvantage to a scale aircraft and many seem to fly better with a heavier loading. This is probably because they have airfoils chosen for heavier wing loadings.

This may seem contrary to the previous statements, but watching weight on a scale ship is even more important than on a free flight simply because there are just as many 'Goodies' that a given model will carry, as many disappointed modelers have found (me included!)

So this means, simply, that the more carefully you watch weight during construction the more details and extra point options you can include before you reach the weight limit.

Part VIII Construction Methods and Detail:

I never draw plans before construction, I simply scale down dimensions and draw these in the form of simple lines on a building board. Then I figure out the structure from my estimates of required strength and the placement of controls and equipment.

I have found that sometimes you must repeat the process before you reach the best solution.

Since I cannot cover all parts of all airplanes I will give an example to explain my point. On my Luscombe I wanted the doors to open as on the real airplane and I could see that this would result in a cabin structure with insufficient strength. My solution was to laminate the door posts with plywood and balsa and piano wire inserts. This eventually proved to be the strongest part of the plane when it went into the hard ground under power.

Do not use wood which is heavier than necessary on parts which do not require high stress, since you will soon be overweight. Select different grades of balsa and plywood, and also epoxies, to suit the strength required in a given area. Make all parts which do not lend strength to the structure from the lightest possible materials. Example: Details such as interior parts and doors which open.

Fishline control cables are real weight savers. Foam plastics make good seat cushions and balsa, painted the proper color, will serve for small details etc.

Another point on construction is in the selection of proper wood. On a wing, always turn the heaviest part of a piece or sheet toward the center. This not only makes the tip lighter but also puts the strongest part in the center where it is needed. Wood selection is more important than the type of structure used because a weak spot near the center of a wing, for instance, defeats the purpose of the construction. Also, it is generally better to use a lighter structure which is progressively stronger toward the nose, with plywood gussets at points of stress, than to use an overall heavier framework.

Do not hesitate to build a scale plane with equal chord wings however, because there is no aerodynamic advantage. Other than strength and appearance they are just as good and easier to build. Since about 95% of aeronautical engineers agree with this I feel it must be correct!

I want to add that all the previous written material on building true with proper alignment is as important on a scale airplane as on any other type of model.

I tackle each part of an airplane, one at a time, thinking only of this part until I have completed it to my satisfaction, then proceeding to the next project.

Don't be worrying about the whole airplane all at once or it may seem overwhelming. This is sort of like living life a day at a time and not worrying about the future. This makes the project more enjoyable, and this is the real purpose of a hobby.

If you like to draw plans you can do so after completion and by this time you will have the bugs worked out and they will be right.

The airplane in the photos is a Lus-

(Continued on Page 86)

INSIDE LOOK AT SCALE

(Continued from Page 85)

combe Silvaire Sedan. It has cowled engine, complete detailed interior with opening doors. Also it has landing lights, navigation lights, interior light, reserve fuel tank and shut off. Controls are as follows; Rudder, elevator, engine speed, ailerons, and working wing flaps. It has wheel brakes on a separate servo, also a parachute compartment operating on a separate servo and also carries a 'chute.' Even with all this it weighs eight pounds and flies with a reworked .35 with a wing loading which figures out to be 28 ounces per square foot. Also, it is nine years old!

This proves you can keep the weight within reasonable limits. This airplane is true-scale, dimension-wise, except for the thrust line.

I am sure there are enough ingenious model builders around to solve the little problems connected with scale. This can be quite satisfying. I have never been to the flying field a time when I have not been amazed at the ingenuity of modelers in solving the problems in connection with this hobby, and I realize that these are a source of satisfaction to others as well as myself.

I make control wheels, rudder pedals and so on from piano wire bent to shape and covered with fuel line tubing which is glued and painted. These are surprisingly realistic and weigh very little.

Make all details which do not require high strength from balsa and paint the proper color.

Get your wife, mother, grandmother, sister or girl friend to sew seat covers from material and cover foam plastic seats. Use material glued over cardboard for the side panels and you have an upholstered interior. Use satin, velvet, or felt for carpet for the floor.

You can even duplicate rivets if you are a real nut with a drafting pen and clear dope over them to make them permanent.

I duplicated all the corrugated control surfaces by cutting plastic broom straws and gluing them to the surfaces and painted them. Believe me this can be a real time consuming project. The accompanying photos show the idea.

Part IX Power To Weight Ratio:

There is a theory about gyroscopic effects of propellers on model performance, however I have found no evidence of this at all on a single engine airplane and I don't think this really exists. I feel this theory grew from resulting turn tendencies under power which are the effects of the circular column of air striking the rudder coming from the propeller. This force is probably one of the strongest air forces affecting an airplane, and while it can have bad effects, it also can be used to advantage. Actually this is the correct way to trim out turn tendencies under power, rather than setting the rudder off neutral as many modelers do. This puts the airplane out of trim on approach and low power settings.

To use this force to advantage, make up or down or side thrust adjustments which will cause the shaft line of the engine to intersect the rudder in the correct spot (which is usually near the top), and you will be able to control turn trim under power by the amount of propeller air which strikes either side of the rudder.

This is also a strong deterrent to ground looping, because as power is increased, you will have good rudder control.

Since many do not seem to understand the relationship between power and performance I want to show this here. As the horsepower-to-pound ratio is the key to auto performance so is the power-to-weight ratio the key to airplane performance.

Always remember when deciding on the correct engine size that it is the **absolute total** weight which determines the power necessary for good performance.

Many people seem to feel that aerodynamic efficiency is an alternative for power. This is not generally true for our purposes. Admittedly, on speed models such as pylon racers, and on full size craft where speed and economy are important, airplane efficiency becomes very important. On models such as our scale R/C planes however, which fly in very slow speed ranges, efficiency has very little **useful** effect and the only real alternative to power is increased wing area or reduced wing loading, or airfoils which develop more lift at very slow speeds.

To state this another way, the production of lift required to offset the weight causes drag. If the plane is heavier the production of more lift required to offset the additional weight results in more drag. This is true regardless of which type of airfoil or angle of attack you may use. Wing efficiency counteracts this slightly, however not enough to decrease power requirements any significant amount at model speeds. So, to go faster with a heavier machine always requires **more** power. This should explain why some of those boxy jobs you have seen often go up like a rocket and sometimes make a clean airplane look bad. Therefore, if your engine seems a little below par, or you are doubtful as to power loading, always go to the next size larger engine.

More airplanes have crashed from lack of power than from too much, and if your airplane has warps, or is out of trim, a critical power loading sure won't increase its chances of better performance.

One conclusion I have come to is this.

The physical and aerodynamic laws like gravity and the sun don't change for anybody. We must accept them as they are and design accordingly.

Part X Control Surfaces:

The following is an explanation of control surfaces and what they do.

1) Rudder —

This is essentially a yaw or attitude control which creates yaw in either direction, which in turn, sideslips the wing and causes the airplane to fly crabwise. This is assuming there is a neutral force arrangement.

Rudder yaw will result in a turn, however, when one or both of two other factors are present. One is wing dihedral which causes a bank by the outside, or faster, wing creating more lift than the inside, or slower, wing because of the higher angle of attack of the outside wing in relation to the airstream. When the plane banks, and the rudder force still existing follows through, this results in the airplane turning. The airplane will also turn without dihedral if the other force exists, which is when the greater mass of airplane weight is below the wing. When rudder yaw deflects the rear of the plane, it swings this weight outward in a pendulum type motion, banking the wing, and again the rudder follows through, resulting in a turn.

Since low wing airplanes do not usually have this force to correct it in straight flight rudder only, low wing airplanes are, as a rule, quite risky arrangements, and the only corrective force they usually have is wing dihedral, which usually has little effect at scale settings. The rudder, in opposite yaw position, is hardly effective as a corrective force.

The complete unit consisting of rudder and fin also serves another purpose. This is in lending more stability to the wing by dampening wing tip oscillation caused by turbulence and other forces. Large rudders on an airplane usually indicate an unequal thrust setup or a short tail moment or unstable wing design.

The rudder, when in conventional position, also provides directional stability to the wing when it is in a fully stalled position, since it is the only surface which does not support airplane weight. As a result, it is the last control to lose its effectiveness and leaves a certain amount of control through the stall period until the wing regains lift.

2) Elevator —

This is also essentially an attitude control. Its job is to change the angle of attack of the wing. It does this by creating lift on its surfaces in either direction forcing the attitude of the wing in the opposite direction.

An airplane climbs as the result of increase in lift of the wing. This is brought about by either or both of two factors. An increase in angle of attack resulting from elevator action, or an increase in speed and angle of attack brought about by an increase in thrust.

When the engine thrust is fixed below the drag center of the airplane, engine speed alone will elevate the airplane, since it is increasing the speed and lift of the wing and also the angle of attack since this power is pulling below the wing. This results in a climbing tendency. During this condition the stabilizer-elevator unit operates as a simple stabilizer or fin.

The airplane will not continue upward for any length of time by elevator action alone unless there is sufficient thrust to prevent loss in speed. This elevates the airplane only temporarily when it is not used in conjunction with power.

An airplane should fly without any elevator movement. However, landings, stall recovery and other maneuvers usually require some elevator action.

As you can see, all three factors are necessary on an airplane, which is why they are all there!

How about a glider? A glider must also have some source of energy or power, direct or indirect to get to altitude. This can be the result of a tow by an automobile and the warm thermal air which takes it the rest of the way up.

In addition to what we have discussed, the elevator, when in conventional position, controls the stability of the wing as it begins to stall. As the airplane starts to drop, the resultant air pressure under the elevator noses the plane downward in the direction necessary to make the wing regain effective lift. If it were not for the elevator, the wing would tumble backward in a full stall and spin violently.

As you can see, the tail surfaces, when located in the conventional position, serve many purposes. Even when controls are not moving, the tail surfaces provide the wing with stability through turbulent air in the same manner as the feathers on an arrow.

The conventional arrangement has proven to be the best and safest all around aerodynamic configuration and will be with us for a long time.

3) Ailerons —

These are also attitude controls. What they do is to change the attitude of the wing on its third axis by increasing lift and drag and by decreasing lift and inducing drag. The purpose of ailerons is to put the wing in the correct attitude to fly through the intended maneuver. An airplane, by the way, turns by flying through the turn on the wing.

Ailerons also serve to keep the wing in lateral trim, serving as a recovery force whenever the wing is upset, so that it will not lose its lift. In addition, ailerons aid in turning an airplane by inducing a bank to coordinate with the yaw produced by the rudder. Ailerons

(Continued on Page 88)

INSIDE LOOK AT SCALE

(Continued from Page 87)

alone will turn an airplane if the designer puts in enough mechanical differential movement between up and down. This, however, does not suit all maneuvers, so differential is usually set so that rudder control is also necessary.

There are exceptions to the above in the methods of control used such as the way multi pattern ships are usually set up. This method is really pylon style and turns are made with aileron and elevator. You use aileron to bank the plane to a high angle and up elevator, which at this point is almost vertical, to crank it on around.

Since you can use almost any type of control method you want you should use the method which best suits the type of airplane you have. On scale ships flying the entire pattern is not necessary so I recommend you use the conventional aileron-rudder method which will produce much nicer shallow turns as are full scale.

I strongly recommend that ailerons be used on a scale R/C ship whenever the budget allows since this is the best possible recovery device you can have on a scale ship. If equipment is limited, coupled ailerons and rudder are usually better than rudder alone.

4) Engine Speed —

This is essentially a power or thrust control, however it is also an attitude control whenever the engine thrust line is not located exactly on the center-of-drag of the airplane. Since this is more often the rule rather than the exception, this arrangement causes either an upward or downward change in angle of attack as power is increased, depending on whether the engine is located above or below the drag center.

The engine speed also serves as a lift increase control in that, as speed is increased, the wing produces more lift.

Engine speed also controls the effectiveness of the rudder and elevator by controlling the amount of propeller air which strikes these surfaces and allows different degrees of control of these by coordination of these factors with engine speed.

Many modelers, including myself, often fail to use engine speed to full advantage. Thrust, in combination with correct angle of attack control, is the key to good spot landings and touch and go's.

Another thing which I have often done is to try to trim out climb tendencies under power when engine speed was really the best solution.

5) Trim Tabs —

In regards to trim tabs the real purpose of these on full-scale aircraft is to center the control stick when balance is changed by passengers or load. Without them the pilot would have to hold stick pressure continually in order to keep the airplane in trim.

Trim tabs are not necessary on a scale model and should be duplicated only for the purpose of realism since we use servos on the control surfaces.

Part XI Control Movement:

In regards to control movement the main things to remember are the general characteristics of different types of wing designs. Airplanes with thin airfoils, sharp leading edges, or very short tail moments are more sensitive and require less movement than airplanes with thick airfoils with round leading edges or long tail moments. Biplanes are also usually more sensitive than other types.

Since even the same airplane will vary in the amount of surface movement required, depending on wing loading and speed, I cannot give you a definite setting for a given airplane. I have found, however, that ¼" of up-down movement on elevator, about ⅜" each way on rudder, and about ⅜" up and ¼" down on aileron, will suffice as a starting point on almost all scale ships.

Part XII Multi Engines:

I won't go into multi engine scale to a large degree since they are expensive and I do not recommend them unless you are a wealthy playboy. Besides an idea such as this can have your wife reminding you that the only difference between men and boys are the price of their toys!

Since addition of a second engine doubles the risk of malfunction, and since these are a critical part of the aerodynamic configuration, the odds of continued success change quite rapidly. They can be flown with success of course, but I feel a single engine is enough challenge for the average modeler entering scale. However, if you **must** build one, make it a Fokker Tri Motor with a large center engine and small side engine. This will give you a good understanding of multi engine problems with very little risk.

Part XIII Conclusion:

It has not been my intention to make scale seem complicated because it really isn't once you understand the aerodynamics. The object of this material has mainly been to help you get close enough to correct trim on the first flights. In order to correct, or improve, on an airplane you must have something left to improve on besides "little bitty" pieces!

I have heard much about expert model builders and their secrets. However if there is any secret, other than little aerodynamic tricks to improve stability, it would be a thorough understanding of the aerodynamic forces acting on a scale model so that you could tell by watching first flights just what it needs and how to improve on it. It would take a whole book to cover all the forces acting on such a model, however I think I have covered the basics which are important to most modelers.

Also I want to say that in the years I have been building models, whenever I have needed the answer to a given problem, I have had to go to other sources or rely on experience for the solution since I usually could not find the correct information in the magazines I have read.

I think this is a situation which is gradually changing and there are more and more informative articles being printed.

I still feel there are voids in certain areas and I think most articles lean too heavily toward construction methods and small talk. I feel most modelers are quite capable when it comes to construction and what most really need is more usable, easy-to-understand information on aerodynamics and trim since this is where most fail.

I submit this article in anticipation that it might start a trend toward articles by more experienced modelers who might be willing to share the knowledge they have gained from experience in regards to flight methods and thus help our hobby to grow.

I'll conclude this with a question — Why don't you start that perfect scale ship you have always been thinking about?

You **can** be successful with a little effort!!!!!

MARTIN AM-1 MAULER

(Continued from Page 28)

contemplating making Mabel as a start, so will confine my remarks to special features, since the basic construction is fairly standard and detailed on the plan.

The notches for the fuselage stringers are not cut out until the formers are all assembled on the ¼" sq. main frame — this way they are sure to line up. Pin the ⅛" x ¼" stringers in place and mark the proper spots for notches with a razor blade. Install the tail wheel and do other inner fuselage work while it is still unplanked for easy access. Body planking can be done in fairly large sections if the wood is well soaked and relief cuts are made in any bulges caused by compound curves. The front section between the firewall and F-2 is soft balsa block to provide for carving in the cooling exhaust depressions and the carburetor scoop.

The upper half of the cowling is an integral part of the fuse and is built up around the motor mounts from blocks. The lower half is removable for access to the engine compartment. This is carved from a block of balsa, but don't use a full block, balsa prices being what they are now, but glue up a special "U" shaped in the proper size to minimize the waste of expensive chips on the floor. Cover the outside of the cowling, top and bottom halves, with a layer of fiberglass cloth and give several coats of resin. The bottom half should also be glassed on the inside to prevent warping and give it plenty of strength. Although the cowl on my Mauler has been occasionally scratched by bad landings on concrete, it has never been broken in some hard pile-ups. So don't skimp on the fiberglass because you would only have to put the nose weight on later as lead.

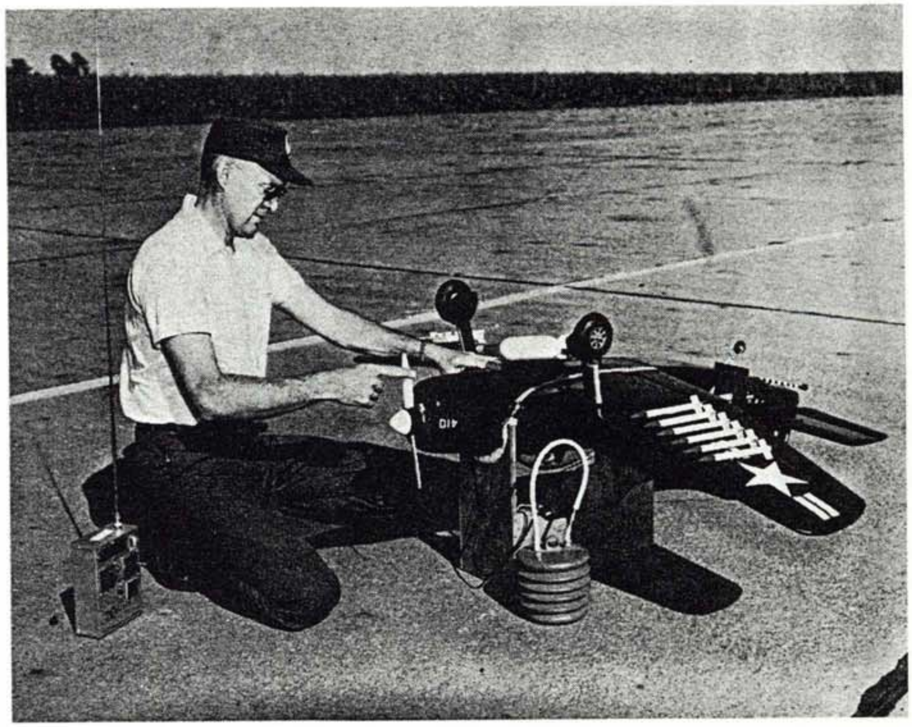
However, here's a tip for those who don't like the thought of marring their handiwork when points are not at stake. I made a birdcage of wire with a nosewheel that bolts into the motor mount holes that hold the engine breakaway plate in place. This contrivance weighs about as much as the lower cowl it replaces and I used it for practice and test flights. This gives you a chance to get the feel of the ship without taking the chance of ski-snooting the cowl. This is not to imply though, that the Mauler is nose-over prone. Quite the contrary, it is as manageable a 2-wheel configuration as you have ever tweaked a thumb at.

Four Bonner servos can be mounted abreast in one row across the fuselage. To keep the C.G. in place with my customary oversupply of dope on the tail, my ship had only a half cockpit, with the servos mounted below and the receiver in the area of the fuse just ahead of the instrument panel. If you want a full cockpit you will have to be especially careful about tail weight and move the servos back to just behind the cockpit. The fourth servo is used for dropping the extra armament and lowering the tail hook.

The only unusual point to note about the tail surfaces is the block that is glued to the outside planking on both sides of the bottom part of the rudder so that a cone-like shape to the navigation light can be carved to complete the fuselage contour. Blend into the rudder lines with plastic balsa. Power lines for the tail light will have to run through the hinge sections with very flexible wire and are buried in the balsa of the rudder. I originally had metal to metal hinges with the juice fed through these, but proportional with its static bug-a-boo made it necessary to drop this method — will be OK for reed however. It should be noted that rule changes are in the works eliminating lights as a scale operation since they couldn't be seen in flight in the daytime. Turning them on and off on the runway doesn't prove much and didn't seem in harmony with the intent of scale operations. A working system of lights is still worth points in scale judging and you should have the bulbs installed anyway for full scale appearance. If night contests get popular, you'll be ready!

As a concession to practicality, the flaps were only taken to the dihedral break. I'm not sure I'd do that now and you may want to consider the scale point advantages and extend them all the way to the ailerons. Just add the stub ribs in the proper spot. Before wing is planked, provide blind nut mountings for the stores pylons so they may be removed for practice flying. The model can take up just as much armament as the prototype — if you don't try to make the bombs scale weight! But you want them off except for contests, being lightly built

(Continued on Page 90)



The secret of reliable starting for inverted engines. Plywood stand also serves as a stand for working in the fuselage, and as a handy box for having tools close by the runway.

MARTIN AM-1 MAULER

(Continued from Page 89)

and hanging below, they are easily subject to damage. Be sure and drop them on the grass — impacting on concrete can make a mess of the finish on a bomb or drop tank. Besides you should demonstrate you **can** aim them. Don't fly out into the boondocks to jettison — it's easy to lose even a fairly big bomb in tall weeds. (Any volunteers to beat the bushes at Richards-Gebaur AFB in K.C. for my best display bomb? Seems that just past that golf-green neat ridge on the runway edge was Lower Slobbovia.)

I always carry at least the rockets for appearance sake and a bomb for scale operations points. This load makes a minimal change in flight trim. Going to more and bigger items like torpedoes, a bit of care should be taken and work up to the full load a piece at a time.

The rockets are made from paper tubes with balsa nose and tail, fins are heavy paper. To produce the tube, coat a sheet of typing paper with thin glue and roll on a dowel. Tape the end lap and pull out the dowel before the glue dries. The rocket pylons are made from 1/4" sheet and glued to a strip of 1/16" plywood. Check for parallel alignment to the thrust line with the wing mounted on the fuselage. The rocket unit is retained in the opening in the bottom planking by blind nut mountings. Fill the hole with an unloaded strip when not packing rockets.

Despite the fact that they are not heavy and of fairly flimsy construction, in use the H. V. A. R.'s have proven surprisingly sturdy — or lucky! The set on the airplane is the original, and though individual rockets have been knocked off on occasion, separation is nearly always at the glue joint to the plywood mounting strip and repairs are quickly made. The wing is planked with the ailerons and flaps as integral parts. Leave a crack in the planking to provide access to saw off the control surfaces with a blade removed from an X-acto saw. Epoxy in the control horns, which are made from Williams Bros. bellcranks. Angle the face of the flaps and ailerons with a razor blade and sanding block. Face with 3/32" sheet as well as the opening in the wing left by their removal. Hinge back on to the wing with the same basic hinge used throughout the model, 1/16" wire pin on nylon strip hinge cut from a W. B. bellcrank. These are strong and static proof.

After sanding and sealing, the entire model is covered with silk. My Mauler was finished in butyrate dope but you might want to try some of the newer lacquer, Hobbypoxy or MonoKote styles. All of the insignia and markings were applied to the model with a ruling pen filled with dope. Small lettering, such as the pilot's name, was done with the help of Wrico lettering guides and white ink. The whole signboard was then well buried under a dozen coats of clear butyrate. The advantage here is that when Mabel gets to looking a little tacky from being dragged around in a

That's elastic cord for the scale antenna. It stretches easily out of the way for inverting the model onto the starting stand or if it is accidentally bumped.

car trunk, all you need to do to make her brand new again is fine sand with 400 wet or rub down with steel wool and spray on a coat of clear. This is not so easily accomplished with all of the finishing details on top. Also little color is needed — two coats — the main finish being the clear topcoat.

I've seen far too many scale models snap rolled in on first flights because the builder, probably taken aback at his project ending up heavier than he had planned (par for the course), thought he could get by without adding nose weight to correct tail heaviness. No matter how much lead must be added to bring the C.G. to the proper location — **put it in!** You are far better off with the correct balance, even at higher wing loading, than trying to fly with an aft C.G. Shouldn't be much of a problem with the Mauler, which has a reasonable length nose, but this is the most important preflight check.

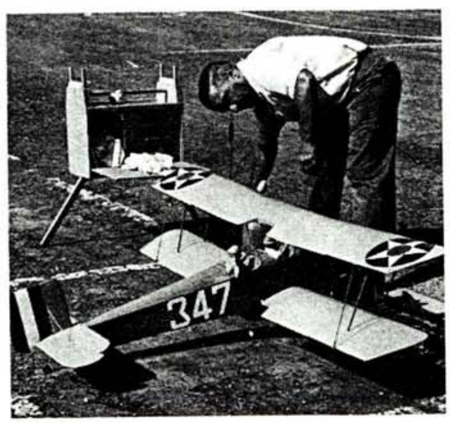
I find also many scale builders too much like myself. They spend more time building and polishing than they do practice flying. In this case, dignity be hanged. Put the arm on the local Class III expert, sign a release form, give him a banana pellet and the box. A fraction of a second's difference in reaction time on the first flight can be the difference between getting it trimmed out without a scratch and a major repair job. The only thing that went wrong with this procedure with the Mauler was that the test pilot liked to fly it so much, I had quite a time getting the transmitter out of Maxey's hands!

CONSOLIDATED PT-1

(Continued from Page 17)

A special word must be said about the aileron linkage. Only the bottom ailerons are driven, the top ones being coupled by rods at the trailing edges. Due to the load hanging on the linkage, any slop or give in the coupling from the aileron to the bellcrank will cause sagging and fluttering. For this reason the bellcrank is made from thick material which will not twist. The push rods are thicker than usual and connect to thick horns. All pivots must be free but with as little play as possible. The regular wire connections to the servo are satisfactory if the guide holes in the ribs are kept small in order to prevent the wire from bowing. With the proportions shown in the linkage the ailerons will have the required range of motion with the average throw between limits of present servos. The movement may seem excessive to some people but is a compromise between much larger ailerons and a sluggish response. It works fine in flight.

Rigging is best left until after covering so you won't have to cover over all those strut lugs. The entire model is silk covered. One little trick makes the wings and tail an easy job. With the sheet cores used in the tail the silk is certain to try and stick down between the ribs, making horrible looking pockets. To avoid this the wood is first given the usual one or two coats of clear dope to lay the grain. Then, when this is dry, the edge areas where the silk might stick down are given one or two coats of wax. A liquid wax is very good and can be applied with a brush to the exact



areas required. Don't forget to leave the very edge clear of wax so the covering will stick where it is supposed to. The same thing applied to the wings, the spars being waxed between the cap strips to prevent the silk from pulling down. As you can see from the photographs the results are worth the effort. There is not a sign of "pocketing" or sagging of the covering.

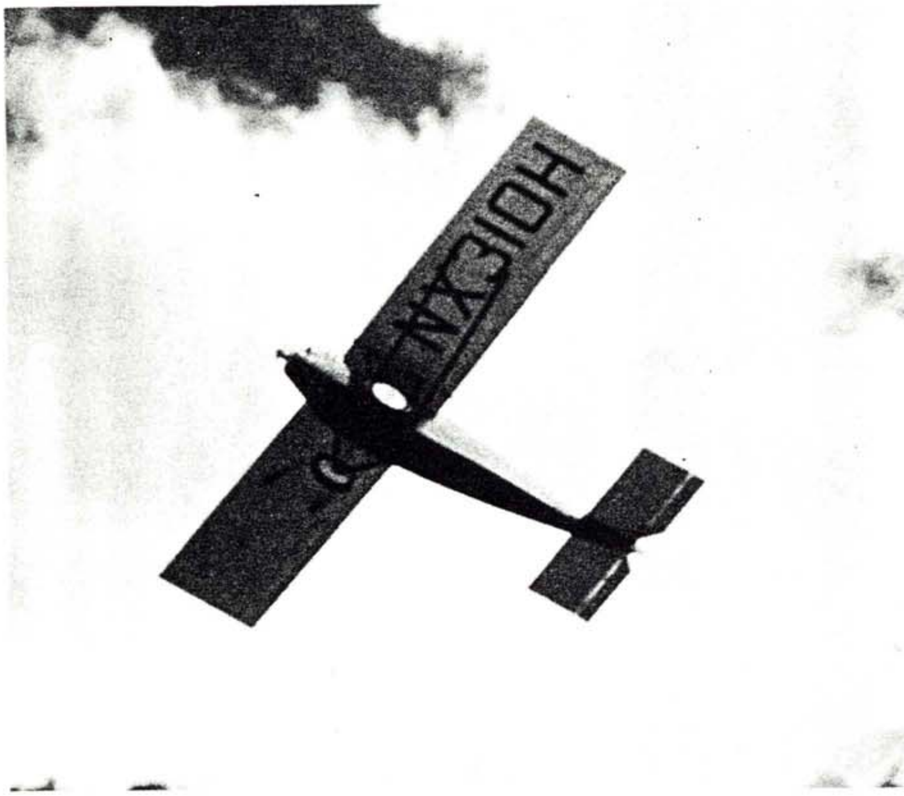
Rigging the wings is not difficult if you get the initial set up well organized. Secure the bottom wing in place and rest the model on two identical strips of wood under the center section so the wing sits flat. The top wing is then attached to the cabane struts and cardboard jigs used or measurements made to set the top wing at the 2 degrees positive angle of incidence. The trick here is to epoxy the lugs into the maple blocks with a slow setting epoxy and get the rigging adjusted before the goop hardens. This way the lugs can slip a little in their sockets to make up for any little goofs in construction, the rigging angles being the important thing. The same thing applies to the outer struts. With the bottom wing supported level on blocks under the strut positions the lugs are inserted with wet epoxy and the struts attached. The top wing is then adjusted to the proper incidence angle and held in any suitable manner until the epoxy sets. Once fixed, the whole mess can be torn down and rebuilt any number of times without disturbing the rigging.

While the wings are all blocked up it is a good idea to mount the tail assembly and get the leading edge packing block right. Then you will be sure everything lines up.

The authentic color scheme is quite simple. The fuselage and fin are the standard army khaki-green (ugh), while the wings and horizontal tail surfaces are trainer yellow. Scale markings are shown full size in position on the drawings, so you won't have to do a lot of measuring and calculating from small 3-views. No scale model looks like much without a pilot and the PT-1 looks better with two. The largest plastic ones available are not bad, but even better are hand carved ones like Lou Proctor shows in his Antic kit. It is a real sight to see the PT-1 cruise by at ten feet with pilots' scarves fluttering in the breeze.

Other than the usual ground handling characteristics of a narrow wheel track biplane with large wing area, flying is no real problem. Even with the small tail area the tail will come up nicely on the take-off run and the bird will lift off in a short distance. Do not expect class 3 contest performance, but it will do a lot more than just putter around at low speed. With all that wing area it may tend to float when landing into a stiff breeze, so keep it well down on the approach. It is very stable at low speed and will not tuck under unexpectedly.

So, chocks away and watch out for Snoopy.



PIETENPOL AIR CAMPER

(Continued from Page 14)

the tank. Seal all around the tank with Epoxy Putty where it fits into the forward bulkhead.

5. **Struts**: Wing struts are fashioned from soft pine. Slit one end and pin a strip of nylon hinge material — this end will screw onto the wing plywood gussets. Attach a small safety pin on to the butt end. This makes for a simple, sure method of locking to the gear. The cabane and landing gear music wire struts were faired with Epoxy Putty and wrapped with bond paper. What an easy way to build them!

6. **Cockpit Tubing:** Small neoprene tubing dipped in contact cement and applied to the edges which were given a coat of contact also. You can dope directly over the contact cement skin nicely. How about them apples, Hiram!

7. **Instrument Panel:** Make from a sandwich of celluloid, paper and wood tape which is a thin veneer used for furniture or plywood edging and is available at hardware stores or lumber yards.

8. **Hinging:** We used thin nylon sheet hinges. Cut pins to length and put a dob of white glue on them before pushing in place. You'd be surprised how white glue sticks to them.

9. **Painting and Trim Color:** To match the cream color used on the hubs of Williams Bros. scale wheels mix two tablespoons of Aerogloss Taylorcraft Cream to one quart of Aerogloss Swift White. Spray on all color. The cream wings and tail will require a coat of clear to bring out the gloss. The body was painted with Aerogloss Stearman Red and all trim is Jet Black. Use cellophane tape to trim rather than masking tape — no bleeding or ridges. We used the experimental designation, "NX" for the license numbers. Remember, top right, bottom left, and on both sides of the tail.

We've hit the highlights of the scale features. Workmanship counts just as much as the material used. Spend time with details, this is where the scale points build up. Now, Bruce, LET'S GO FLY!

FLYING: Balance the model as shown. Chances are, because of the short nose moment you'll have to add weight to the nose. Do it right under the glow engine and lock in place . . . yep, you guessed it . . . with Epoxy Putty. Don't bother with a test glide. I'm a firm believer in the theory that more models meet their doom, especially scale, because of a faulty test glide. Give it power, note any out of trim conditions and correct immediately. No, my "Air Camper" didn't fly right off the old drawing board — but it did from the old blacktop down at the airport! It is slow and graceful and for Joe's sake treat her gently.

Just remember your knickers, scarf and pipe!

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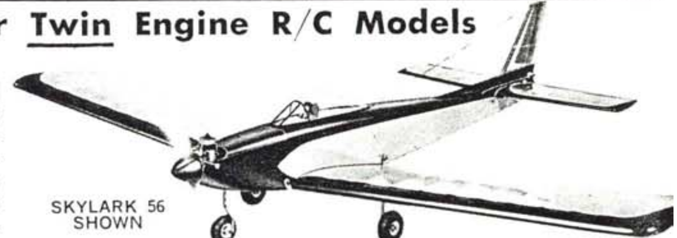

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HOW SCALE IS SCALE?

(Continued from Page 8)

recommend that, if a subject is chosen which is covered by these excellent little publications, the copy be obtained. For the low cost involved, the coverage of the subject and the information it will provide are of the greatest value. In similar view, if it is possible to get a plastic kit of your subject, this should be done, as it will help significantly both in the design stage (for determining cross-sections, etc.), and as a test-bed for coloring. Most aircraft can be built in various color schemes and a plastic kit is a cheap way of making up your mind on the one most pleasing.

Many a good scale ship falls down as a real thoroughbred by a lack of, or badly executed, cockpit detail. Possibly the two biggest offenders in this area are instrument panels and pilots. Though a board of white-faced instruments is often seen on a model, almost without exception full-size instruments have black faces. My method for dashboards is to use artist's scraper board, with a fine-pointed pair of dividers for marking the rims and a needle for the divisions. After a layer of thin ply to give "depth," an acetate layer with all but the dials painted out with matt black enamel completes a very realistic board. Get a look at a real ship's board and notice the small patches of color here and there — red band in the top end of the rev-counter and so on. These are the little touches that give a model true class.

Never use a babyfaced toy doll for a pilot — this type of figure always shows for what it is! The Aurora and Airfix plastic kit people make a range of figures with suitably adult faces which can be re-worked successfully.

The rest of the cockpit furniture may be made of thin card rolled, boxed-up or what-have-you. This material is light in weight and easy to use.

For rivet lines, the best trick is to mount a watch gear wheel on a stick of wood with a free-running bearing. Run alongside a straight edge, the wheel will give evenly spaced rivets of very good realism. It is a good plan to have two or three such sticks with gears having differently spaced teeth as rivets are never of the same spacing all over an aircraft.

One final thought on finish realism. Full size aircraft are seldom clean; in fact combat aircraft of the war periods very quickly became exceedingly scruffy. The top-class R/C scale modeler realizes this and, on completion of the model, will spend many hours of work messing up the slick look of a newly built aircraft. This consists of chipping off bits of paint, oil-staining the finish in the fueling regions, painting dirty marks here and there, putting dummy "patches" in the fabric covering, exhaust burns and so on.

I would say that this process of giving a model a realistic "used" look is just about the most difficult art going. But when mastered, the improvement in realism is wonderful and makes all the difference between a "model" of an aircraft and a true **replica**. What we're really after, of course, is to make the model look just like someone has put a real ship in some science-fiction-type reducing agent that has shrunk it to a fraction of its size!

Here then are a few thoughts which I earnestly hope will be of some value to those already involved in scale, and some encouragement to those who fancy scale but have perhaps been frightened off. Don't believe it! There's plenty of worse things than R/C scale — jail, the Army, hospital . . .

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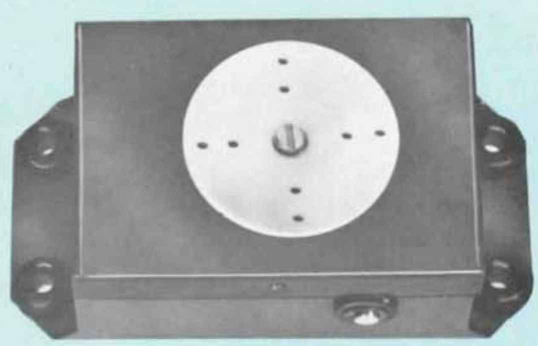

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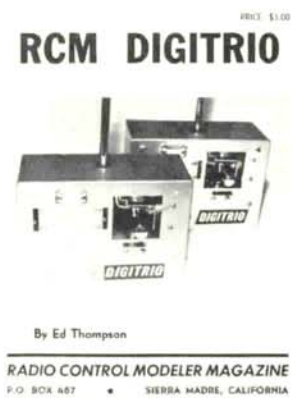

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