1953 MODEL AERONAUTIC YEAR BOOK by Frank Zaic

1953
MODEL AERONAUTIC
YEARBOOK

Edited by

Frank Zaic

MODEL AERONAUTIC PUBLICATIONS
New York

FOREWORD

This edition is more or less devoted to the "gathering of the clan." It is intended to show that there are still many of us all over the world who like the old fashioned "Model Aeronautics"—to start from scratch and to create something that has never been seen before.

In a sense, we are in a peculiar position. Our models are not toys, nor are they full size aircraft. Yet, they give us enough trouble to make us think that they are a worthwhile effort for other keen minds. And with the overall model airplane activities being classified on toy or juvenile level, it is a problem how to attract new members to our circle.

Ii is hoped that this book will give an "adult" sense of feeling for the hobby to the readers who may see this book for the first time; and make them realize that "Model Aeronautics" can be a lifelong hobby that will bring many new adventures to that which otherwise be a "normal" life.

The make-up of this book goes back to the former Year Books in which the contributions played a major part. The basic idea is to provide an outlet for individual effort in stabilizing the science of model aeronautics; and also to assure the contributor that his material will be read by his "peers", who may have similar interests and troubles, and can really sympathize with him.

FRANK ZAIC.

May, 1953
Ithaca, N. Y.

MODEL AERONAUTICS PUBLICATIONS

Box 333, Sta. D, New York 3, N. Y.

1953 YEARBOOK

In the 1951-52 Year Book we presented our version of Model Aerodynamics. The basic purpose was to show what we knew or thought we knew about the subject. By doing so we hoped that we would be corrected, or additions would be made to what we had. We are happy to say that the readers cooperated and made the idea work. We can now go ahead and tell you more about this subject, knowing that we are on the right track.

Since we are limited with space in this book, we will only present a portion of the subject in detail. However, by combining the corrections and suggestions shown in this book with the text in the 1951-52 Year Book, the reader will be able to find reasonable and true answers to almost any question he may have on model aerodynamics. It is, of course, necesessary that he knows what he is looking for to recognize the situation when he sees it.

LONGITUDINAL STABILITY

After all these years of studying theory and practice of model airplanes we have come to the conclusion that the Longitudinal Stability is the major element in the model's make-up. By knowing the function of Longitudinal Stability and its limits, it is possible to keep the model from getting into other type of instability troubles. Actions which we may have been blaming on Spiral Stability could actually belong in the Longitudinal Stability field. If a misadventure happens while a model is circling, it does not mean it happened because of Spiral Instability. It could be because Longitudinal Balance was disturbed.

A model is Longitudinally Stable if it returns to its basic trim after it is upset. For example: If you trim or adjust a model to glide at 6°, it will be Longitudinally Stable if it returns to 6° glide after it was upset to lower or higher angles.

TRIMMING OR ADJUSTING MODELS

Most of the things that an aerodynamacist does on the drawing board are done on the flying field by the model builder. The first flight of a full size aircraft must be almost 100% assured. But it is not so with models. The builder finds a patch of tall grass and starts to move the wing back and forth, change incidence angles or other changes which eventually develop or evolve a model which has slowest possible glide without stalling.

We know this procedure as "Adjusting" for which another word could be "Trimming". To describe what the model builder is doing, while he is adjusting the model, would take a thick book if we were to take into consideration all of the possible combinations he brings about. You will realize this after you finish reading this chapter.

While the model builder is adjusting or trimming his model for the slowest safe glide, he is actually hunting for a combination between lift and drag of the model that will give him the maximum duration for minimum of drag. This combination can be found by calculations; using the (Ca/GD) facto. By using this term at various angles, it is possible to find at what angle of attack the model will have the desired glide.—However, as it should be obvious to all of us, we do not know the drag or lift values of our models so that we have to use the trial and error system of test glides. Still, it is important to know what goes on during these test glides so we will know what sort of a model we have, and then fly it accordingly.

Most of us acquire a feel by which we know when the model is giving us the best time in a glide. We also know that if we set the model so that it will fly at lower angles, it may actually go greater distance but it will come down faster. So that reducing the drag by reducing the angles does not help as the lift value is also reduced.—On other hand, increasing the angles to increase the lift may also cause so much drag that the model will slow down too much and making it impossible for the wing to do any lifting.—Somewhere between these two extremes the best "duration glide" setting is found. The sad part is that very few of us have any ideas what values this "duration glide angle" actually has.

"DURATION GLIDE ANGLE"

From the few experiments that we made to determine the "duration glide angle" we found it to be in the neighborhood of 5° to 6° for the models we were using. It may be plus or minus on other models. The exact angle depends on too many factors to mention here.—The main thing is to realize that there is such a thing as a "duration glide angle" and that it occurs when the model is adjusted so that minimum of drag is used for maximum duration, and that for average model design it is fairly safe to assume that it will be in the neighborhood of 5°.

In the 1951-52 book we were wrong in saying that this "duration glide angle" occurs just below the stall of the wing. The wing may actually be capable of producing lift without stalling beyond 10°, if we provided enough power to overcome the drag produced at such angles at a given speed. We were misled in making the statement by the fact that during the glide tests the model would stall as soon as we adjusted it to go a bit slower than the speed at which the best "duraion" glide" occured. The adjustments would increase the drag without increasing the lift in same ratio. This would set up a chain reaction which usually ends up in a "mush".—So that, when all is said and done, we cannot deduce from this type of test that the wing actually stalls just a bit above the "duration glide" angle.

For our purpose of clarifying the LONGITUDINAL STABILITY we will assume that the best "duration glide" angle occurs when the wing is gliding at 6° angle attack. We can now go ahead and present a few examples which will cover most of the designs now being flown.

ELEMENTS IN LONGITUDINAL STABILITY

While we are adjusting a model for the best "duration glide" we make all sorts of adjustments with incidence angles and C.G. locations. The final outcome is that the wing glides at 6° angle of attack, while the other elements; stab area and angle, tail moment arm and C.G. position are so arranged or balanced to enable the wing to maintain this position, or return to it, after it is upset from the outside. In other words, the model has Longitudinal Stability because it returns to the "trim" angle after it is upset.

In practice the location of the C.G. can vary from the Leading Edge to several inches behind the trailing edge. It all depends on the actual design. Although we will admit that C.G. at the Leading Edge is not common, a design could be made to glide with C.G. at this location. (Under power, speed control models have C.G. at the leading edge.) The location of the C.G. will depend mainly on the stabilizer area, its angle setting and distance from the C.G. This can be best understood by realizing that C.G. is a pivot point for all the forces involved during the flight. And, basically, the Longi-tundinal Stability depends on the balance between the wing and the stabil-izer about the C.G. pivot. Also, the basic difference between model designs is almost entirely based on their difference in the C.G. locations.—Without telling us nothing else but the C.G. location we could give you a fair ap-proximation as to how your model behaves in flight, or how it should behave.

We would also like to point out that one reason why we have so little data on model design is that the full size aircraft designers stop with C.G. at 35% of the Chord, while we just begin at this point. To full size design-ers, the 35% point is on verge of being unsafe. While we have to go on into the region where a change of angles by thickness of a hair could mean disaster.—Why do we go beyond the 35% point? That is a very interesting question. We will give you the answer in due time, but you may not be able to comprehend it at first. So, if you do not find the answer at first reading, do not blame us but look into the mirror, and try again.

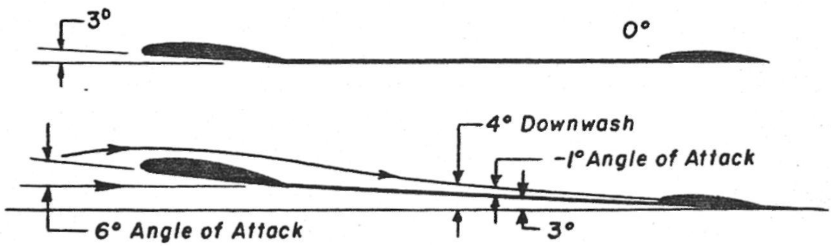
SPECIFICATIONS OF EXAMPLE MODELS

In the examples which will follow we will use a 200 sq. in. wing which has a Clark Y airfoil. The size of the Stabilizer will vary as will the location of the C.G. The distance between the trailing edge of the wing and the leading edge of the stabilizer will be same for all, but the Moment Arms of the wing and stab will vary with the C.G. location.

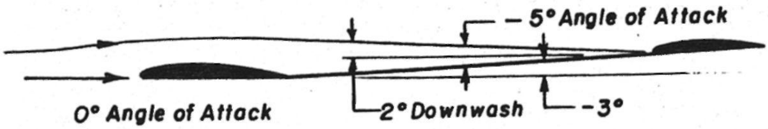
The force values were taken from the 1951-52 Year Book, and are shown in graph form which may make it easier to visualize the situation than table style as in the book. If you have the 1951-53 book, it might be well to con-sult it for details.

The wing force values were found by using wing area, lift coefficient at the particular angle of attack, and distance between the wing's "Center of Lift" and C.G. position.

The force values of the stabilizer are found in a more complex manner, because the stabilizer works in the region of wing's downwash and turbu-lent air produced by the fuselage. For example: Let us assume that we have a model whose wing's incidence is 3° and the stabilizer is set at 0°. When



this model is adjusted for best "duration glide" the angle of attack on the wing is 6°, but on the stabilizer it is -1°. This happens because the "down-wash" behind the wing is 4° while the wing is flying at 6°. This downwash angle changes as the wing's angle of attack changes. For example: If the model was shifted to make the wing fly at 0°, the downwash angle would now be 2°, and the angle of attack on the stabilizer would be —5°. You can now see that while the wing's angle of attack may have changed 6°, the actual angle of attack on the stabilizer only changed 4°. Luckily, we made the necessary calculations so that you can go ahead and enjoy yourself.



To repeat, the stabilizer's force values were found by using its area (minus its loss in efficiency), lift coffiecient corrected for "downwash" and the distance between the stab's "Center of Lift" and C.G. position.

On the graphs we showed the Downwash Angles, the Angles of Attack of the wing and the Lift Coefficients, and the Angles of Attack of the stabilizer at particular wing's angle of attack.—The force values on the graphs are to be used only for comparison. To obtain actual forces in ounces, it is necessary to use the complete Lift Formula, which includes air speed and air density factor.

C.G. LOCATIONS

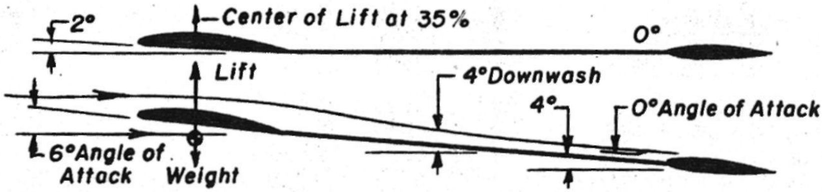
If the areas of the wing and the stabilizer, and the distance between them are fixed, the location of the C.G. will be determined by the angular setting of the two surfaces. We can also say that if the area and angle of the wing, and the C.G. location are fixed, the area of the stabilizer will depend on its distance from the C.G. and the. angle at which it is set. In the following examples we will vary the location of the C.G., and make corrections with the stabilizer area and angular placement to bring about Longitudinal Balance which is supposed to give the model Longitudinal Stability.

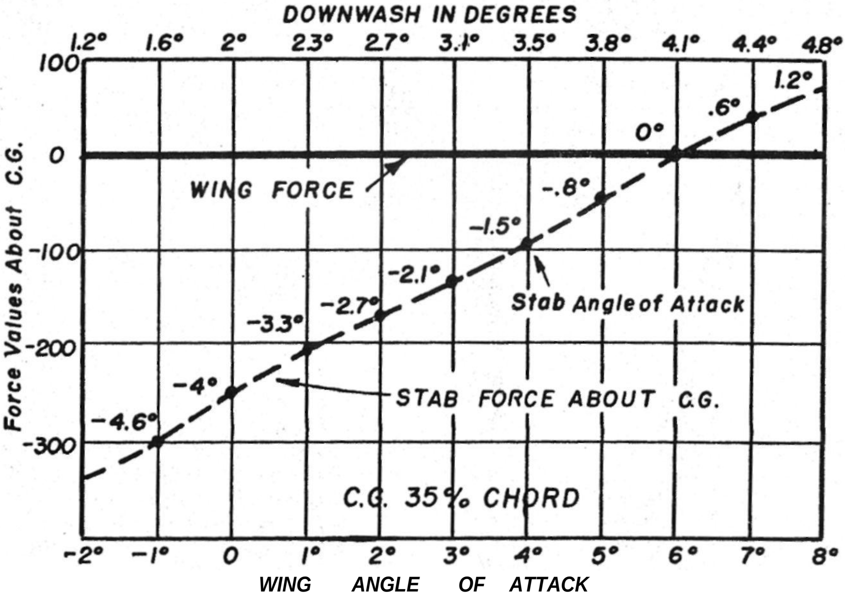
C.G. AT 35% CHORD

If we fix the C.G. at 35%, and then make adjustments to bring about the 6% angle of attack for the best "duration glide," we will find that the stabilizer must have no force, up or down in this situation. This can be explained by noting that when Clark Y is at 6°, its Center of Pressure or Lift is at the 35% spot. This means that the wing's lift is directly over the C.G. and that it has no force about the C.G. To keep it at this setting, the stabilizer must also not have any force about the C.G. But to take care of possible upsets, some sort of a stabilizer is needed to bring the wing back to the "trimmed" 6° angle of attack.

For our example we assumed a 50 sq. in. stabilizer with a streamlined airfoil. So that it will not develop lift when the wing is at 6°, we set it at 0° while the wing has 2° incidence. That 4° downwash will give the stab 0° angle of attack while the wing has 6°. In our calculations we assumed the stab to be 70% efficient.—The force graph is shown, calculations taken from the 1951-52 book.

As you can see, when the wing is at 6", the stabilizer has no load, up or down. But if the wing should be upset to 4°, the stabilizer has a force value of 96 units downward with which to bring the wing back to 6°. And if the wing is forced to 8°, the stab has an upward force of 70 units to bring it back home.

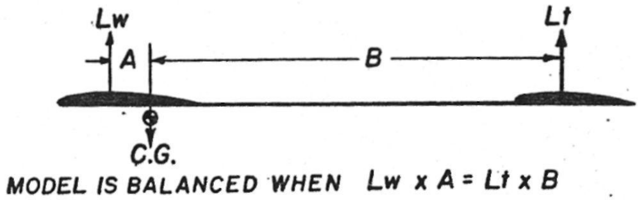


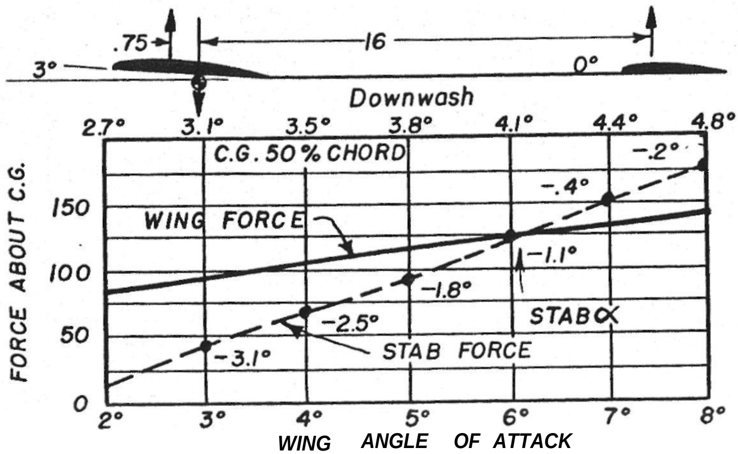


It should be evident that when the C.G. is located at 35% point, the Longitudinal Stability is exceptionally good. And it is so. Just a slight upset change in the wing will be promptly corrected by the ever watchful stab with its abundance of corrective force. Why don't we use this C.G. location on our models? That is an interesting question!

C.G. AT 50% CHORD

When we move the C.G. to center or 50% of the Chord we find that we have a see-saw balance system. On a 5" chord wing the wing has a moment of .75" from its 35% Center of Lift or Pressure location. To balance this force we need a counter force from the stabilizer. To be specific, the situation is graphed. Note that we now use a regular airfoil on the stab as we need lift from it when the wing is at 6° "duration glide."





While examining the graph you will note that the wing now has a force about the C.G. at all angles of attack, and that the stabilizer has it likewise. — Also note that there is only one angle of attack situation at which these two forces are in balance, and that is at 6°, which is determined while we adjust or trim the model. Now, if the model is upset to bring the wing to 4°, the balance is upset. The wing has 105 force units, and the stabilizer has 67. It is obvious that the wing will tend to bring the nose up higher with its extra 38 units. If the model is upset to higher angles, say 8°, the stabilizer now has greater force than the wing, and it will bring the tail up until the model is again in balance at 6°.

We still seem to have ample "stabilizing" force in the 50% C.G. design. But note that the value of the "correcting" forces has decreased by, roughly, 30 units when compared with the 35% C.G. design. Incidentally, this 50% C.G. location is used and recommended for tow line gliders. Why don't -we use it for other types? That is an interesting question!

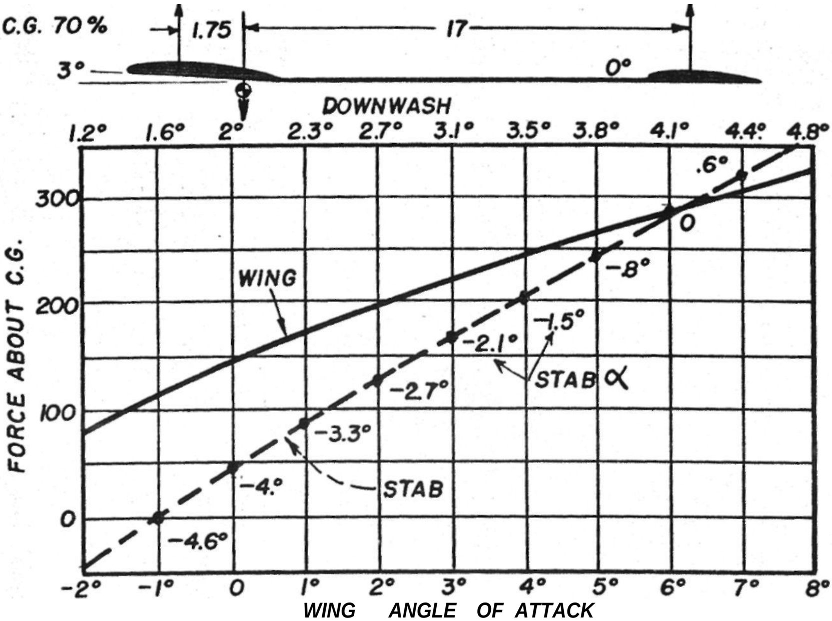
C.G. AT 70% CHORD

Moving the C.G. further back to the 70% spot we find that we had to use Clark Y on stab and increase its area to 66 sq. in. We also set the wing at 3° and stab at 0° incidence setting. The layout seems to be close to what we are using on some power models. Assuming that we adjusted the model to the 6° "duration glide," we find that the balance situation is as shown on the graph.

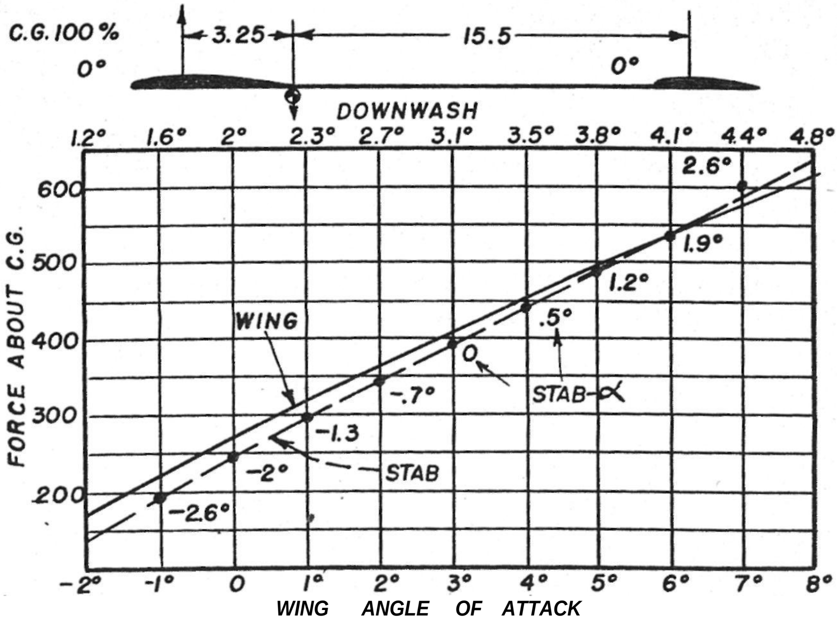
It is interesting to note that if the model was upset to the 4° position, the wing has 58 force units with which to bring the model back to the 6° "stable condition." If the model is upset to 8°, the stabilizer has 25 units with which to recover the model.—As you can see, the recovery force values are getting less and less as we move the C.G. backward towards the trailing edge. Why don't we stop here? Now, that is an interesting question!

C.G. AT 100% CHORD

Having the C.G. close to 100% of the Chord should make many of us feel at home as most of the high power gas models and long fuselage Wakefields have this particular C.G. location.—In our example we use the layout used in practice: Wing and stab set 0-0 and 45% stab. So that what we say now about this arrangement should check with practice, and with vengeance.



So, say that the model is upset to 4° (assuming that we went through the trial and error method of finding the 6° "duration glide" angle). The wing only has 5 force units with which to bring the model back to 6°. And an upset to 8° gives the stabilizer 18 units for corrections.—Rather small, don't you think?



To make it interesting we did a bit of calculations and found approximate values for the force units used. The calculations were made with assumption that the model weighs 8 oz. Roughly, one Force Unit equals .04 in. oz. So, in the 35% C.G. example, the stabilizer has 96 units or 3.84 in. oz. force with which to bring the wing back to 6°; but on the 100% C.G., the wing only has 5 units or .2 in. oz. force to bring the model back to 6°. Roughly, the corrective force on the 35% C.G. model is 20 times greater than on the 100% C.G. Which one would you say has better Longitudinal Stability?

POWER FLYING AND C.G. LOCATION

Rough calculations show that if our example models were gliding at about 12.5 m.p.h. they would lift around 8 oz., which is a normal weight for a 200 sq. in. model. By applying power so that the speed has been increased to about 18 m.p.h. the lift of the models would be increased to 16 ozs. if they are held in the "duration glide" angle of attack of 6°.

Now, if a model, which weighs 8 oz., develops 16 ozs. of lift, something will happen. And that something is a loop whose diameter is such that the Centrifugal Force will be equal to the excess lift. Don't ask us to go into details. The main thing to remember is that if the model develops more lift than its weight, its tendency will be to loop. The loop itself may take all sorts of shapes and sizes, large, small, horizontal, vertical or helical. The model may never actually complete a loop but fly in a curve path of some sort.

To reduce the looping tendencies under power, a logical step would be to reduce the lift of the model to lower values. For example: If we could reduce the wing's angle of attack to 0°, while the model is flying at 18 m.p.h., the new lift would be about 8 ozs. instead of 16 ozs. which occurs at 6°. The next question is: How can we make the wing fly at 0° when the model is trimmed to fly at 6°?

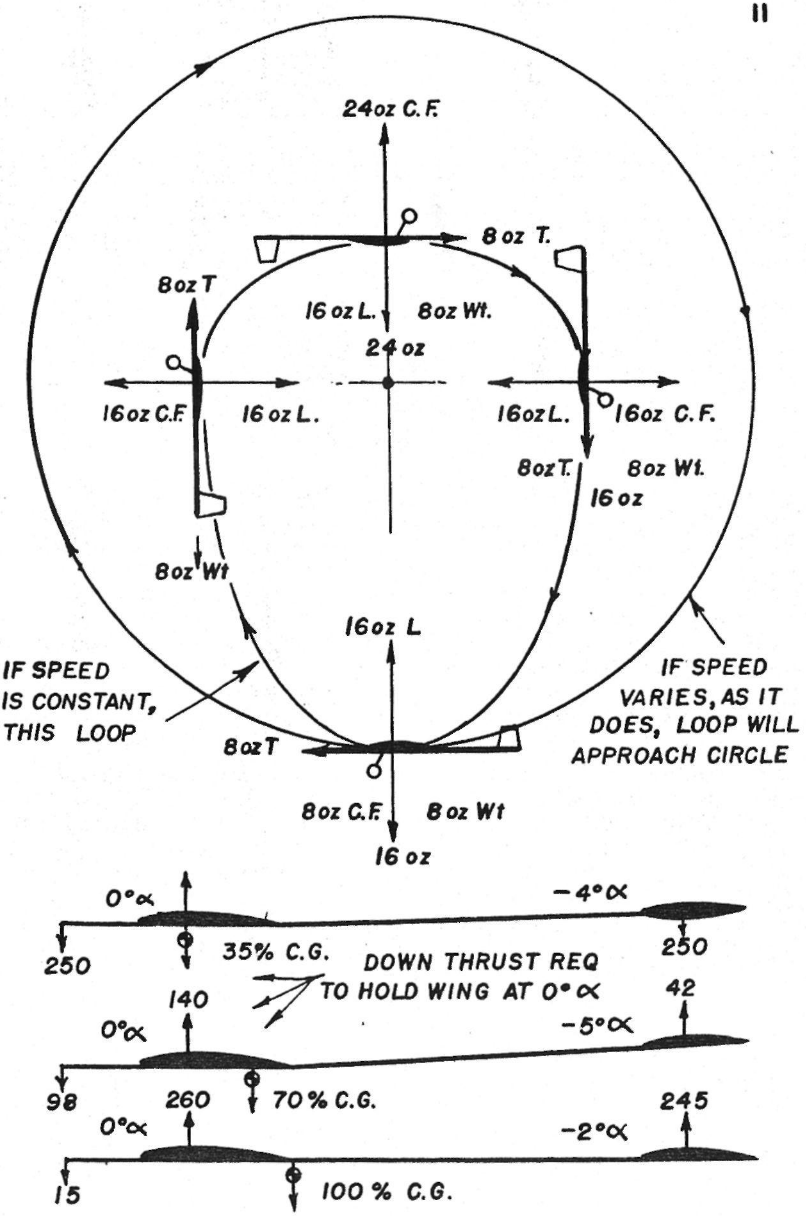
On the 35% C.G. graph we can see that if the wing is brought to 0°, the stabilizer will try to bring it back with a force of 250 units or 10 in. oz. All that is needed to make the wing fly at 0° is to produce a counter-stab force of 250 units. Downthrust or thrust above the C.G. could do it. From experience, this may mean a downthrust of 10 to 20 degrees.

On the .100% C.G. graph we note that if the wing is brought to 0°, the wing has only 15 force units or .6 in. oz. which is trying to bring it back to 6°. It is obvious that practically no downthrust is required, and actually none is used in practice.

The 70% location requires some downthrust as the force which is trying to bring the wing back to 6° has 100 units or 4 in./oz. As you may have had experience in this type, you know that some downthrust is needed. Now you know why. The downthrust is simply bringing the wing down to lower angles so that it will not lift more than is needed.

SUMMARY ON C.G. LOCATIONS

We now know that the 35% C.G. location will give maximum Longitudinal Stability with smallest stabilizer. But it will also require exceptionally large downthrust to make it usable for power flying. Consequently, this position is used almost exclusively by gliders such as A/2 Nordics. It is especially useful for this design as the rules include total areas of wing and stab in the requirement. So that small stabilizer will mean larger wing where the area will do most good.—



We also now know that the 100% C.G. is also the most touchy in sense that the lay-out has very little plus or minus stabiliy factors. This makes adjusting very touchy. But it has the advantage that no matter how high the power may be, the 100% C.G. design can be easily made to climb without looping or tight spiralling characteristics.

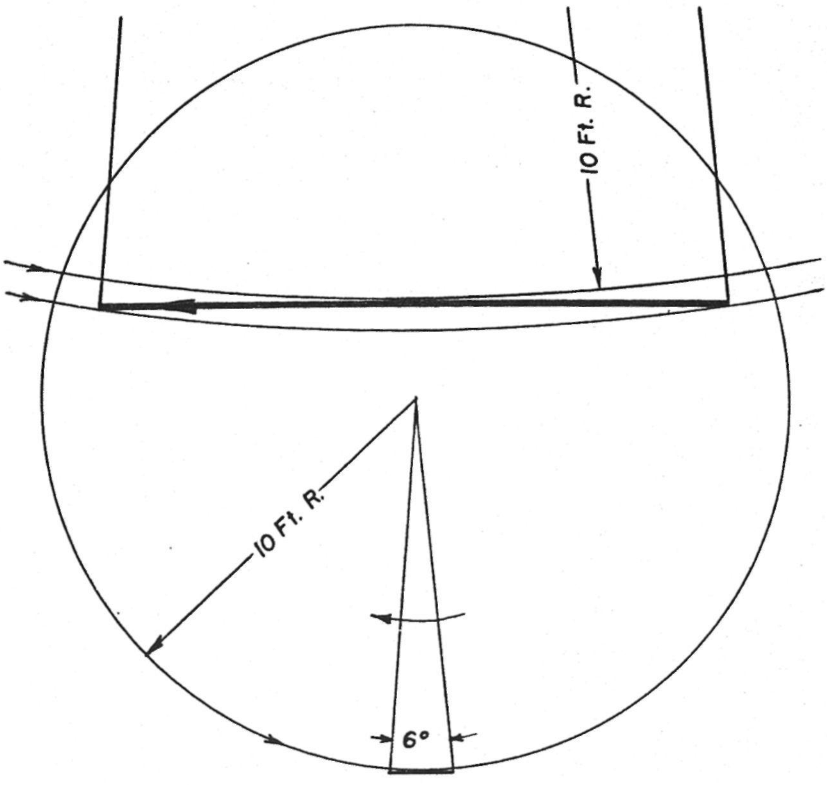
The other two locations, 50% and 70%, are a good compromise: 50% for gliders, and 70% for power models which are not extra high powered and which can use downthrust.

So far we have assumed that the flight or glide path is straight ahead. In this type of flight it is easy to imagine how the Longitudinal Stability works. However, a straight path in model flying is rare. Circling of some sort is the rule. And so we reach the "Circular Airflow" part of the model's flight.

Frankly, if your ideas about the Longitudinal Stability or Balance are vague, it would be best to go back to the beginning of the book and start all over again, and study the subject until you know what we are trying to show. It is simply impossible to understand the part that "Circular Airflow" plays in flight unless one has a clear picture of Longitudinal Stability.

While a model is circling, the angles on the wing and tail change so that the initial "trim" angle is no longer in power. Without you doing a thing, the stabilizer may acquire few degrees of greater angle of attack while the model is flying in a circular path. By knowing just what happens, it is possible to take advantage of this situation. But if you are in dark————.

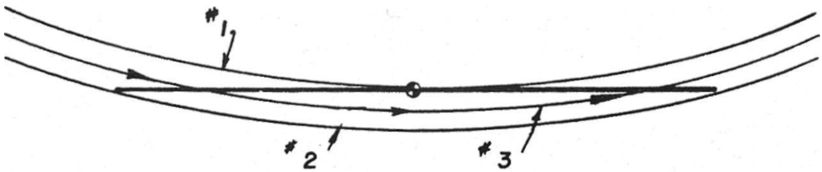
We are at loss how to explain the development of the "Circular Airflow." So, suppose we assume that we have a one foot long piece of iron rod. To the rod ends we attach 10 ft. strings. We grasp the end of the strings together and begin to whirl the rod around in a 20 ft. diameter circle. Diagramatically the situation will be as shown.—The center of the rod will follow the 20 dia. circle, while the rod ends will extend beyond the 20 ft. circle, and form a larger diameter circle.

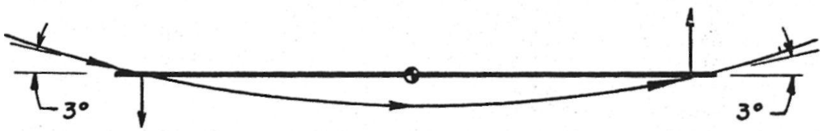


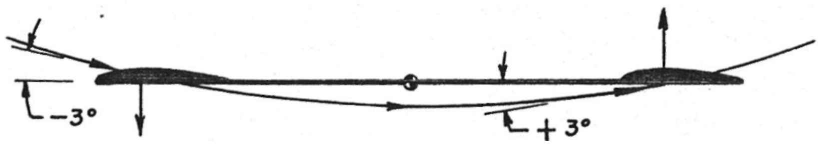
The next step is to imagine two air molecules, one on the 20 ft. diameter orbit and the other on the larger orbit. As the rod is swung around it is easy to imagine that the center of the rod and the tips just skim by the two molecules. And nothing happens.

Now, let us place a third molecule between the two circles. What happens now? As the rod reaches the #3 molecule the point of impact will be on the "upper" surface of the rod. As the rod continues around, the #3 molecule will again inpinge on the rod, but this time on the "lower" surface.

Forgetting about the restraining forces of the two end strings, which way do you think that the rod would rotate if the two "impacts" were powerful enough to make the rod pivot about the C.G.? To us it looks like counter clockwise.







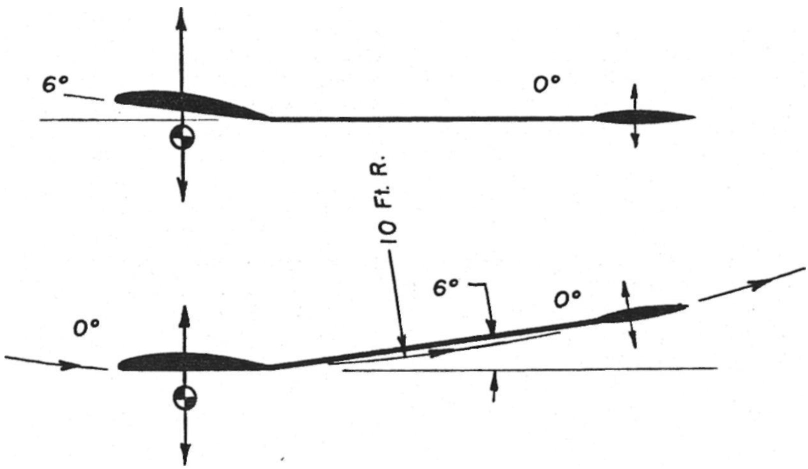
By doing a bit of calculation we can also determine at what angle the #3 molecule "attacked" the rod. To simplify the situation let us assume that the attack occurred at the tip of the rod so that we will have an even one foot value. Well, it just so happens that one foot in a 20 ft. diameter circle takes up 6° of the circumference's 360°. This would resolve into 3° for each side of the rod.

To bring the problem closer to home, let us suppose that we had a wing on each end of the rod, set at 0° to the rod and each other. It can also be seen that, if we forget about the downwash from the front wing and CP. locations, the two would be in balance. Then we begin to whirl this combination around so that the wings are vertical. A look from the top is shown on the diagram.—Is it asking too much to make you believe that the front wing now has a 3° negative angle of attack while the rear one has a 3° positive angle of attack?

If we were to remove the strings from the ends of the rod and tie them to the center or C.G. of the rod, which way would the combination rotate? To us it looks like counter clockwise.

Let us now change the whirl, from horizontal to vertical, to represent looping. This gives us a more familiar condition in which the Longitudinal Stability plays a part. In a straight flight our tandem arrangement may be in a balanced condition, but in a loop it is obviously no longer in balance. The angle of attack has decreased in front and increased in the rear. The angular difference between the two wings has increased by 6°. If you followed the logic so far, we can move to practical problems.

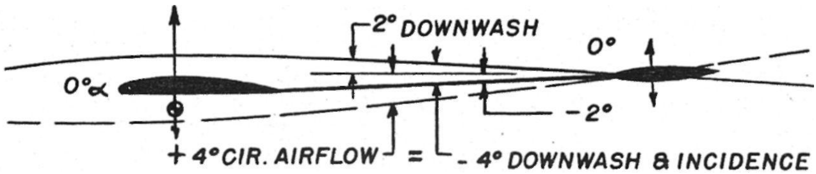
The C.G. location which will show the effect of the "circular airflow" most clearly is the 35%.—Here the C.G. is at the wing's C P. so that whatever angular changes will come about due to looping will be shown directly on the stabilizer. Say that the model is in a 20 ft. dia. loop, and that the distance from the wing's C P. and stabilizer's C P. is one foot, and that the stabilizer is placed outside of the downwash. In a straight glide the wing would be at 6° angle of attack and stab at 0°. But if we place this lay-out in a 20 ft. dia. loop, the 6° "angular change in one foot" will act on the stabilizer so that it will bring the wing to 0° angle of attack.



So, by actually making no physical changes, except to make the model fly fast enough to generate enough lift to cause a 20 ft. loop, we brought the angle of attack from 6° to 0°. We now get into ever widening area of explanation as to what happens as the angle of attack is decreased, and with it, a decrease of lift which originally started or caused the 20 ft. loop. - Well, the outcome depends on the power, if it is great enough to make the wing develop 16 oz. at 0° angle of attack, the loop will be balanced at 20 ft. Dia. -

Actually, this is no place to worry about minutae. The basic purpose for all this talk is to make as many of you see the action of "Circular Airflow" so that it will be easier to understand what goes on. At present we are trying to show how the curved flight path can change the "Longitudinal Balance." This condition can be very handy in providing an automatic system for changing the balance for glide and power. If you grasp the basic idea you will sit back and say, "What do you know?" And you will also realize that models have been flying despite all we did or do to keep them from flying.

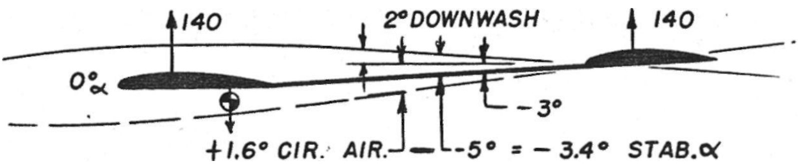
To find out how much of positive angular airflow is needed to bring the 35% C.G. design from 6° to 0° we place the wing at 0° to the base line, and the stabilizer at —2.°. The downwash is 2° which makes the stabilizer act at —4°. Normally, this would swing the nose upward back to 6°. But if we produced 4° of positive angular airflow, the stab would be at 0° at which it will not produce any up or down force. .So, to balance the 35% C.G. design, while the wing is at 0°, we need a curved path that will produce 4° positive angle on the stab.



CIRCULAR AIRFLOW AND 70% C.G.

The problem, in bringing the wing from 6° "duration glide" to 0° "power flight" angle when the C.G. is at 70%, is a bit more complicated or confused. —It is obvious that when the wing is at 0° the two surfaces must be in balance. The graph simplifies the situation. By drawing a horizontal line from the wing's 0° position across the stab curve we can see at what angle the stab will produce same force as the wing. It is about —3.4°.—The next step is to bring about "Circular Airflow" condition which will bring the stab to —3.4°. A flight curve that will produce about *V/₂*° of angular change will do the trick.

How did we determine this angle? Well, place the wing at 0° to the base line, and the stabilizer at —3°. This is the physical set-up. Now place 2° downwash in the picture. The stabilizer is now operating at —5° at which its force value is only 42 units in contrast to wing's 140 units.—To make the stabilizer develop 140 units we have to "increase" its angle to —.3.4°. To do this we need a positive angular airflow of 1.6°. And this positive angular airflow of 1.6° can only be produced by a curved flight. (Or, if you like, by deflected prop wash.)

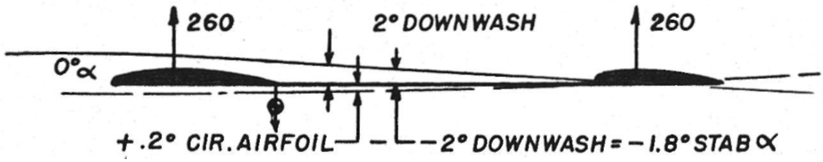


CIRCULAR AIRFLOW AND 100% C.G.

Here is where fun begins, because it is under this arrangement that the "Circular Airflow" becomes a matter of dollars and cents. And it is under this 100% C.G. condition that the "Circular Airflow" theory works to perfection. You can see it in action. So—.

To bring the wing to 0° angle of attack, we see by the graph that the stabilizer should have —1.8° angle of attack. How much of a curved flight path is needed to bring about a balanced condition between the wing and stab? Again, place the wing at 0° and stab at 0° and then add the 2° downwash. This places the stab at —2° which gives it 245 force units against wing's 260 units. If nothing is done, the wing will tend to bring the model

Now you can see why such models can climb without looping, spiralling or generally corkscrew upward. Just a slight curving path is needed to kill excessive lift. Of course, there is a penalty attached to this; it's "eternal vigilance" as you can see in the 1951-52 Book.



back to 6°. But if we produce a .2° positive angular airflow we "increase" the stab angle from —2° to —1.8° at which its force value equals wing's.— So, just by placing the model in a curve path that produces .2° of positive angle, we are able to bring the 100% model from 6° to 0°.

LOOPS DIAMETERS FOR BALANCE

By using the formula which gives angular change due to circling and assuming 1.5 ft. moment arms for our examples, we find that the 4° needed for the 35% C.G. example will be developed in a 45 ft. dia. loop. The 70% C.G. requires a 120 ft. dia. loop. And the .2° change required in the 100% C.G. model is produced in a 900 ft. dia. loop. It should be obvious that these curves can be obtained by helical climb. The loop simplifies the explanation.

SUMMARY

We have shown that the C.G. position determines the value of the Longitudinal Stability, and also determines the type of flight the model will make under power. Also, we adjust the models to have best "duration glide" angle. This angle is in the neighborhood of 5°. But while the model is under power, the angle of attack on the wing must be reduced so that the wing will not lift more than is needed. This can be done by using downthrust, deflected prop wash or letting the "natural" design of the model develop its own flight path which is almost invariably of curve type.

Some formulas in the 1951-52 YEAR BOOK were home-made. A request to L.Licher for check resulted in the following corrections:

PAGE 17 Angular Change, $\Delta\alpha = \dfrac{360^\circ \times \text{M.A.} \times \text{Bank Angle } (\phi)}{3.14 \times \text{Dia.} \times 90^\circ}$

The angle 90° is in question. It should be:

57.3° for small angles, ϕ less than 10°

60° for ϕ = 30° 70° for ϕ = 60°

64.3° for ϕ = 45° 90° for ϕ = 90°

PAGE 31 ANGLE OF ATTACK (Increased) $= \dfrac{\text{Drift Angle} \times \text{Dihedral Angle}}{90^\circ}$

The angle 90° is in question. It should be 57.3°

TILTED STAB FOR CIRCLING

Frank Bethwaite brought to our attention the lack of information on the action of the tilted stabilizer. Please read his letter before going on so that you will have an idea of the problems involved.

The basic purpose of the tilted stabilizer is to provide a turning tendency during glide without effecting the power setting: An automatic turn adjuster that will vary in our favor when speed is changed.

As we have seen, to retain longitudinal stability about the C.G., both surfaces must have similar moment forces. In a glide this may take place while the wing is at 6° angle of attack. The turning force of the tilted stabilizer depends on the side component of its lift. On a 35% C.G. model, the side component is zero since the stabilizer is not required to contribute any force while the wing is at 6°. But on the 100% C.G. model, the lift of the stabilizer is considerable so that the side force would naturally be proportional, depending on the tilt angle.

When we apply power to increase speed by 1½, the lift doubles. If the model is kept at 6° trim, the side force of the tilted stab would still be zero on the 35% C.G., but it would be doubled on the 100%. (If the rudder had a turn set, its force would also be doubled.)

Since excessive lift tends to produce looping in which the model tends to reduce its angle of attack, there is a change in the trim or balancing situation.—See graphs.—The 35% C.G. model now requires considerable "upload" on the stabilizer to keep the wing, say, at 0°. So that any tilting that we may have given the stabilizer will now be very strong in contrast, to its "no force" in the glide. The stabilizer on the 100% C.G. needs a very slight edge on the wing to keep it at 0°. So that its actual force value may be same as it was under 6° condition. That is, if its new over-all lift is similar to glide value.

The above situation shows that the value of the tilted stabilizer depends on the C.G. location. Roughly, it can be said that the "force" value varies from maximum with C.G. at 35% towards minimum as the C.G. moves backward. As far as actual usefulness to us is concerned, the value will be just the opposite. We can use it best when the C.G. is in the 100% neighborhood: We can make glide turn adjustments by tilting the stabilizer, knowing that they will not increase in force during power run. But with C.G. at 35%, stab tilting is like rudder setting, it will vary with speed.

"Power flight pattern is a good indicator of how much tilt to use. A long curved path shows that over all lift is not excessive, so that you can use as much tilt as you may need for a glide turn. But if the flight has tight spiral characteristics, use tilt sparingly, and in combination with other aids, such as side thrust.

CONCLUSION OF THEORY

This is about all we can say in this book. The 1951-52 Year Book can carry you on from here. We will see what is needed during the coming year, and include it in the future year books—Your comments and suggestions will decide the topic.

Experience has shown that successful r-c practice differs from the unsuccessful largely in accordance with the amount of attention paid to details. The finer points of model design, construction and flying, plus radio equipment adjustment and operation, are usually required for success yet the degree of skill involved is apparently not so important. It has often been noted that some beginners start right off without trouble while others can't seem to get away from it.

Good practice does not require skilled workmanship but it does call for good habits and features of construction. The most beautifully-built mechanism can be full of bugs and poor design features while a comparatively sloppy affair may perform perfectly. The point, then, is that there are right and wrong ways of doing things and some education may be in order to raise the standard of performance.

Study of the situation has confirmed that there is a need to publicize the details of good practice as a guide to better results. The following information has been sifted from discussion, observations, and correspondence to present a condensed cross-section of thoughts concerning control system installations, for it is in this phase of the field that attention appears to be most needed.

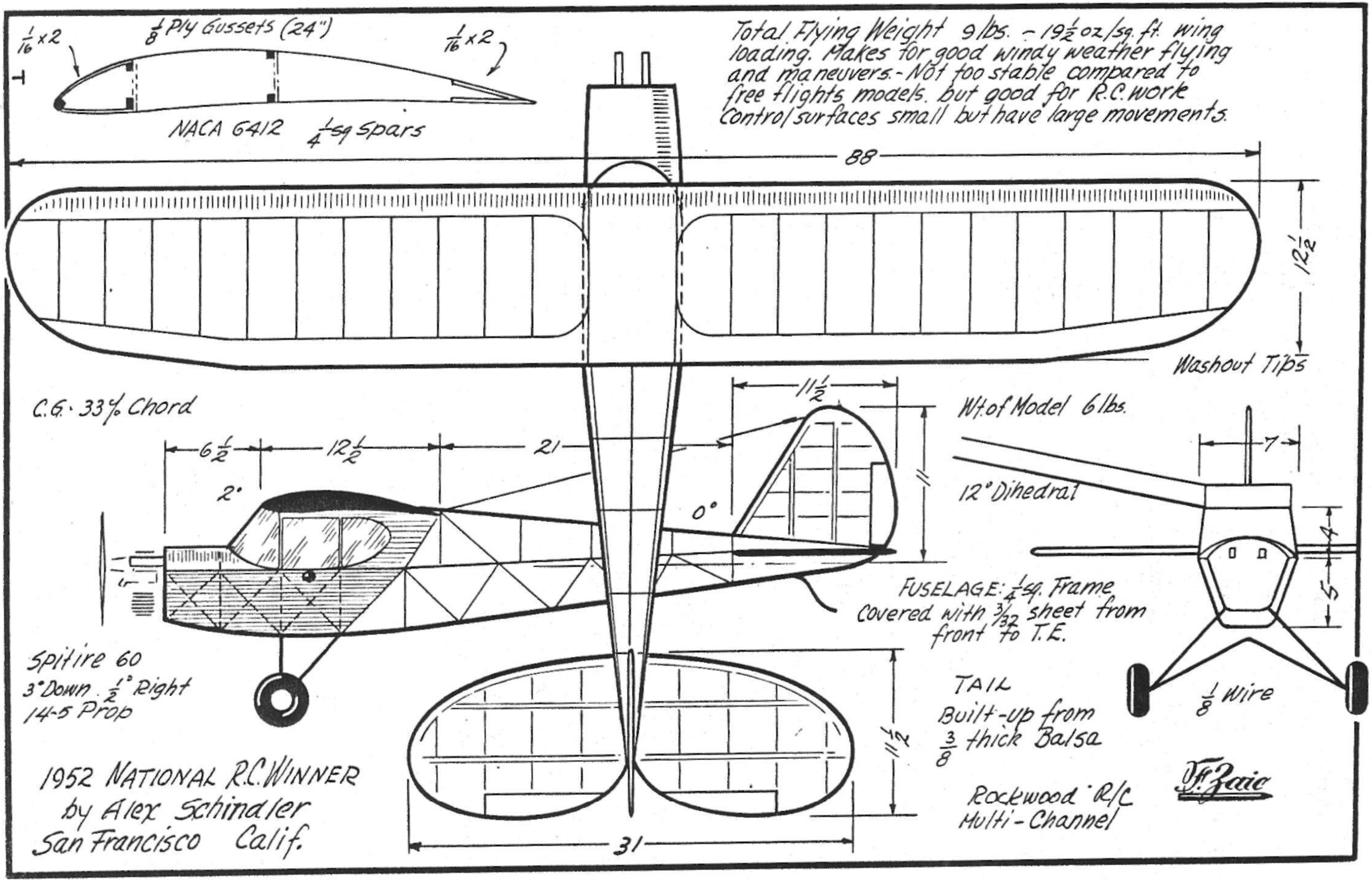
A freely pivoted control surface is very important to the performance of a reliable control system. Whatever the method of pivoting used, the surface should be free to flop easily from one extreme to the other when the actuator linkage is disconnected. It is even preferable for the control surface installation to be more sloppy than tight, although the more slop the greater is the loss of effective control.

Free movement of the surface should not depend upon lubrication for smooth operation. In other words, a surface that does not move freely without lubrication should be reworked until it does. Cases have been seen where a drop of oil loosened up a control surface, but in the heat and dust of summer flying loss of lubrication resulted in the original binding condition. Lubricating a freely pivoted surface is good to help out the actuator, but it should not be used as a cure.

Lubrication can also be the cause of trouble if done carelessly. A drop of oil on exposed balsa next to the pivoted surface can swell the wood and cause interference with movement—exactly the opposite result from that intended Lubrication does have an important purpose other than that of reducing friction as it helps to prevent corrosion and eventual sticking if music wire or steel fittings are used in the control system.

After being assured that the control surface pivots freely without the linage hooked up, care should be taken to see that the connection of the linkage does not introduce binding. If the linkage must be sprung or twisted to make the hookup, it should be reworked until this is not necessary. The linkage should connect naturally with no force being exerted to mate the connecting fittings. After the connection is made, the linkage should be moved from one extreme to the other several times to see whether the total action is free from binding.

Many control linkages which check out okay with the model in a horizontal position do not operate at all when the model is held vertical. This is an important consideration because we need positive control most when the model is in this dangerous attitude. Particularly with push-pull linkages and pulsing systems is this important. This simple test can be very revealing. Along with this check of the action in various attitudes, a weak



1/16 x 2
1/8 Ply Gussets (24")
1/16 x 2
T
NACA 6412
1/4 sq Spars
Total Flying Weight 9 lbs. - 19 1/2 oz/sq. ft. wing loading. Makes for good windy weather flying and maneuvers.- Not too stable compared to free flights models. but good for R.C. work Control surfaces small but have large movements.
88
12 1/2
Washout Tips
C.G. 33% Chord
6 1/2
12 1/2
21
11 1/2
11
2°
0°
Wt. of Model 6 lbs.
12° Dihedral
7
4
5
FUSELAGE: 1/4 sq. Frame Covered with 3/32 sheet from front to T.E.
Spitire 60
3° Down 1/2° Right
14-5 Prop
TAIL
Built-up from 3/8 thick Balsa
1/8 Wire
11 1/2
31
1952 NATIONAL R.C. WINNER
by Alex Schindler
San Francisco Calif.
Rockwood R/C
Multi-Channel

set of batteries should be tried. If the control system will operate horizontally with weak batteries and it works as well in a dangerous attitude the chances are that the system will be reliable under all conditions. A control system that operates with weak batteries no matter what the attitude of the model is what to strive for.

A good check on control system response should be made by rapidly switching the actuator on and off. The control system should follow snappily without lag or skip. A sluggish action will show up immediately under this test and is usually caused by too much mass that must be moved or too much friction in the system.

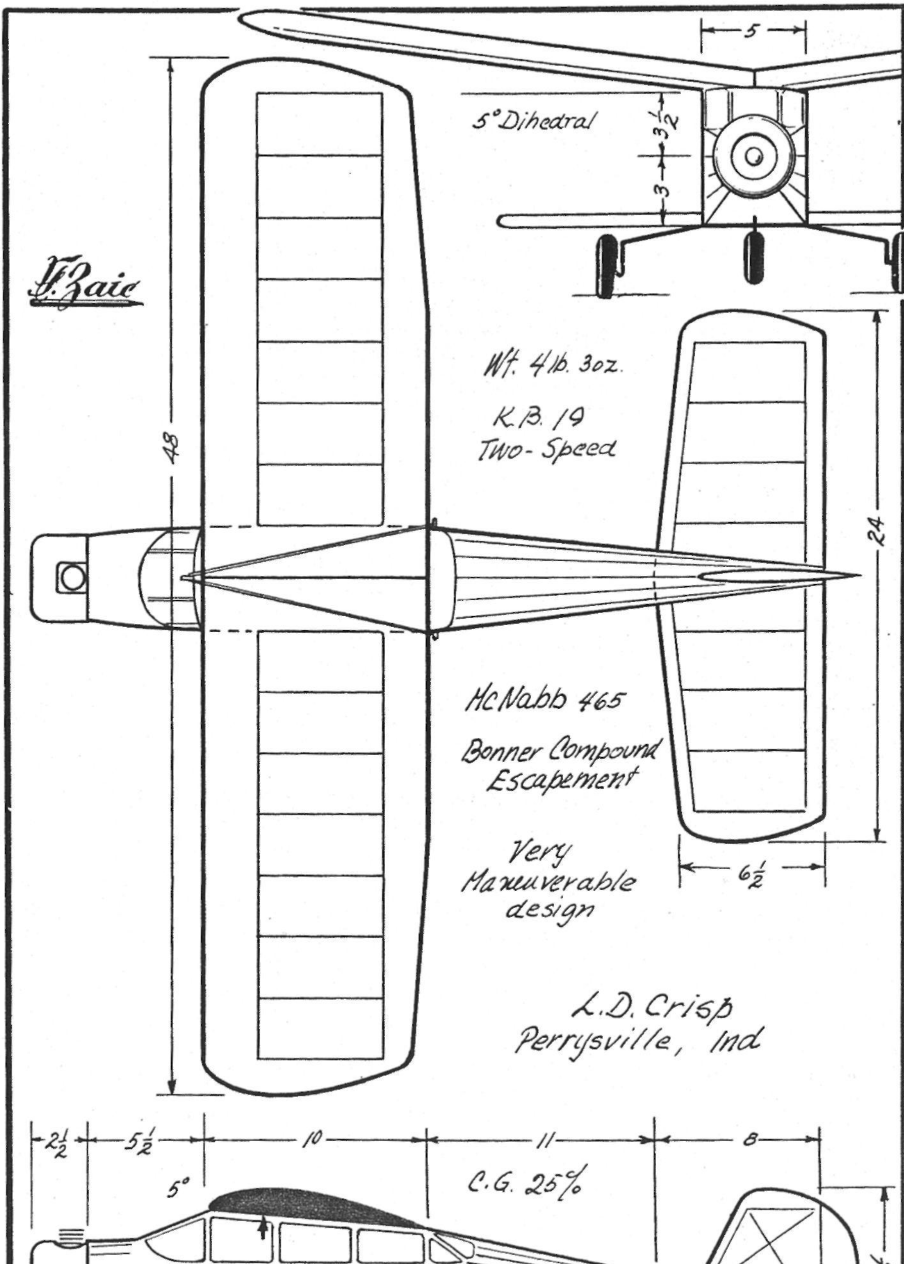
For escapement systems, the size of the rubber required to operate the system may be a good guide to performance. A model up to six feet in span should not require more than 1/8" flat rubber for completely reliable and snappy control system action if the system is properly designed and built. Incidentally, an escapment design which uses a ball-bearing type washer to reduce the friction caused by the loading of the wound rubber will usually operate better to drive large or heavy control systems. The smallest of the commercially available escapments have been used to operate control systems in large ships such as the Super-Buccaneer, but it takes attention to the finer points of construction to do the job properly.

The rubber should also unwind until it hangs slack with hardly any twist left. This is positive proof that the control system requires little power for operation. Many times control system trouble is cured by using heavier rubber, up to 3/16" or flat, but this usually leads to troubles later on. The problem is that the heavier rubber results in the escapment pawl taking more of a beating under the increased torque and pretty soon beats itself out of adjustment. Also, the increased torque puts more pressure on the pawl in signal off position so that more actuator battery power is required to pull in the escapement armature. This in turn results in the need for fresh batteries for reliable operation or more voltage. If the batteries get weaker, the operation becomes erratic. If too much voltage is used initially, the current drain goes up so that battery life is shortened. All these things add up to eventual trouble that can be avoided completely by more care in the beginning.

In the design of control linkage, consideration should be given to the mass to be moved. For instance, if either a torque rod or a push-pull rod can be used there is a lot in favor of the torque rod. The relative motion involved in a torque rod installation is small since the rod pivots on an axis along its length. The push-pull rod, however, must be shoved back and forth and this may require as much power or more from the actuator than is required to move the control surface itself.

One of the common practices noted in control linkages is the use of small diameter music wire for push rods or torque rods. If the wire is being pushed or twisted, its flexibility can result in considerable lost motion that never gets to the control surface. What is needed is a material with a reasonably large cross section but light in weight.

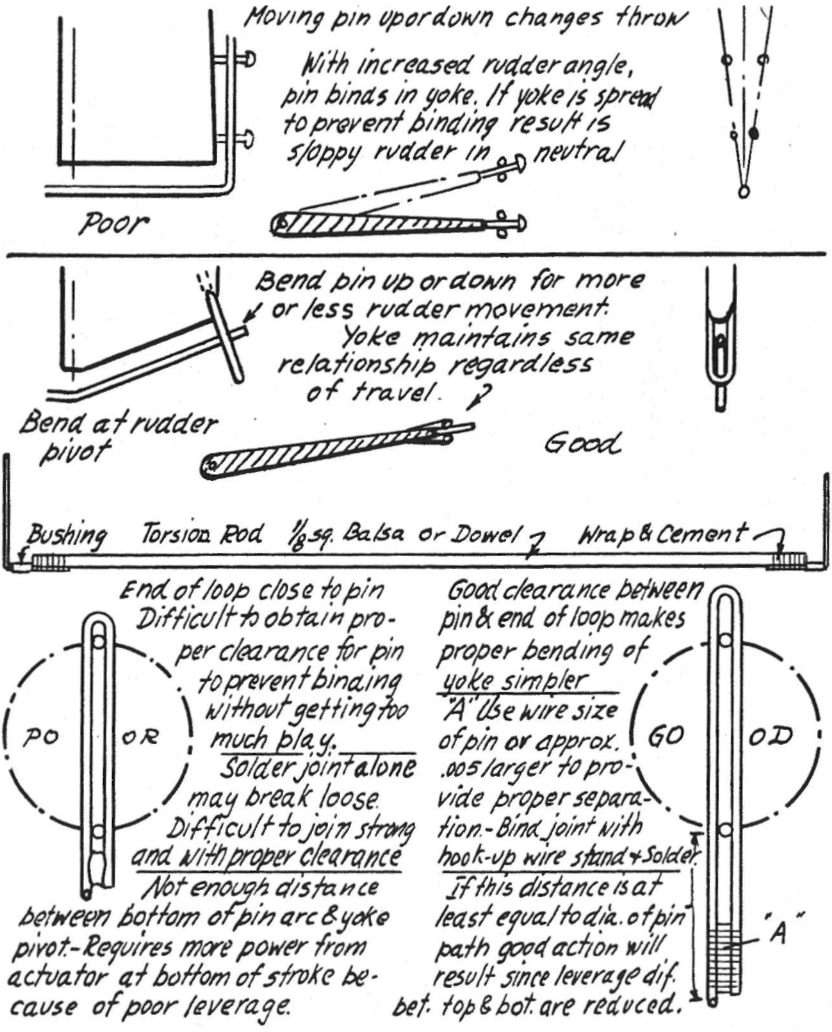
Where -032" or .040" wire might be used, it may be better to use 1/8´ sq. balsa with wire fittings on the ends. The balsa is sufficiently stiff—if selected from good close grained stock—so that it resists twists and bending yet is light enough so that the power of the actuator is not expended in driving the control linkage. For large models, 3/16" sq. balsa, 1/16" o.d. aluminum tubing, or l/8" dowel may be used. Whatever is used, the main idea is to get all the motion and power of the actuator to the control surface with as little loss as possible in the connecing linkage.

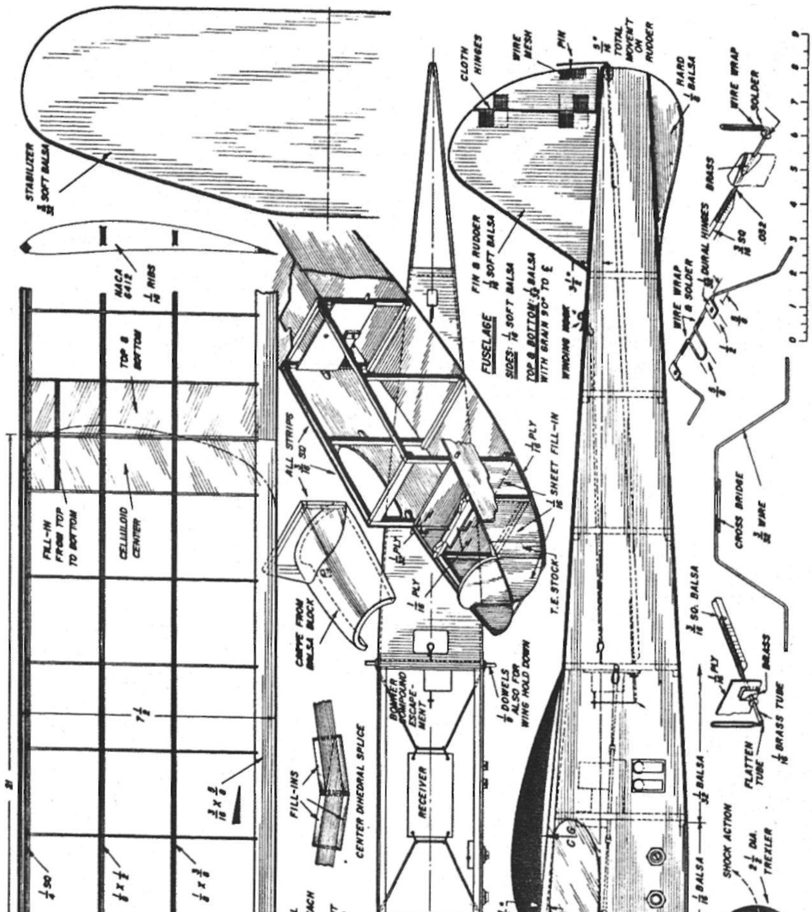


5
5° Dihedral
3 1/2
3
F. Zaic
48
Wt. 4 lb. 3 oz.
K.B. 19
Two-Speed
24
McNabb 465
Bonner Compound
Escapement
6 1/2
Very
Maneuverable
design
L.D. Crisp
Perrysville, Ind
2 1/2
5 1/2
10
11
8
5°
C.G. 25%
7 1/2
+3°

Where a sliding yoke is used over an escapement pin, binding may occur at some point in the yoke—usually at the end of the loop—if the contact edges of the yoke are not parallel and free sliding along the full distance of pin travel. If music wire is used for the yoke and if the end of the loop is soldered the joint must be a good one, preferably bound with light wire, as a cold solder joint may break loose during regular pounding of escapement operation and cause the escapement to jam or at least result in sloppy operation due to the opened yoke.

Cases have been noted where the model flies under perfect control under power but misses signals in the glide. This can be caused by a system which works okay under the influence of engine vibration but not without it. The explanation is that the vibration keeps the system loosened up so that parts do not bind, but in the comparative smoothness of the glide the fittings settle into gummy or sticky action.





from May, 1953 AIR TRAILS

R "LIBERTY BELLE" - by Dick Schumacher - Van Nuys, Calif.

Several cases of escapement skipping, which occurred only with the engine running—sometimes only after the model was launched—were traced to vibration caused by a given engine and prop combination. Changing the prop to a different make, pitch or diameter produced different vibration characteristics which eliminated the skipping.

Skipping can also be caused by improper relay adjustment or mounting. Some relays are more sensitive to vibration than others. The Sigma 4F or 5F relays are almost immune to vibration when correctly adjusted and usually may be mounted solidly in a model or on a simple rubber padding. Others, such as the Kurman or similar types without a pivoted armature or rugged contact supports must be suspended loosely from rubber bands or otherwise provided adequate isolation from vibration effects.

To differentiate between skipping caused by relay or engine vibration, the relay armature may be held by hand in the "on" position while the engine speed is varied. If the escapement skips, the trouble is probably not with the relay but with the engine/prop setup or the escapement adjustment. Usually the cure requires only the changing of the type prop used. In those rare cases where the skipping occurs only after launching of the model the trouble may be a bit more difficult to trace but changing the prop will generally solve the problem.

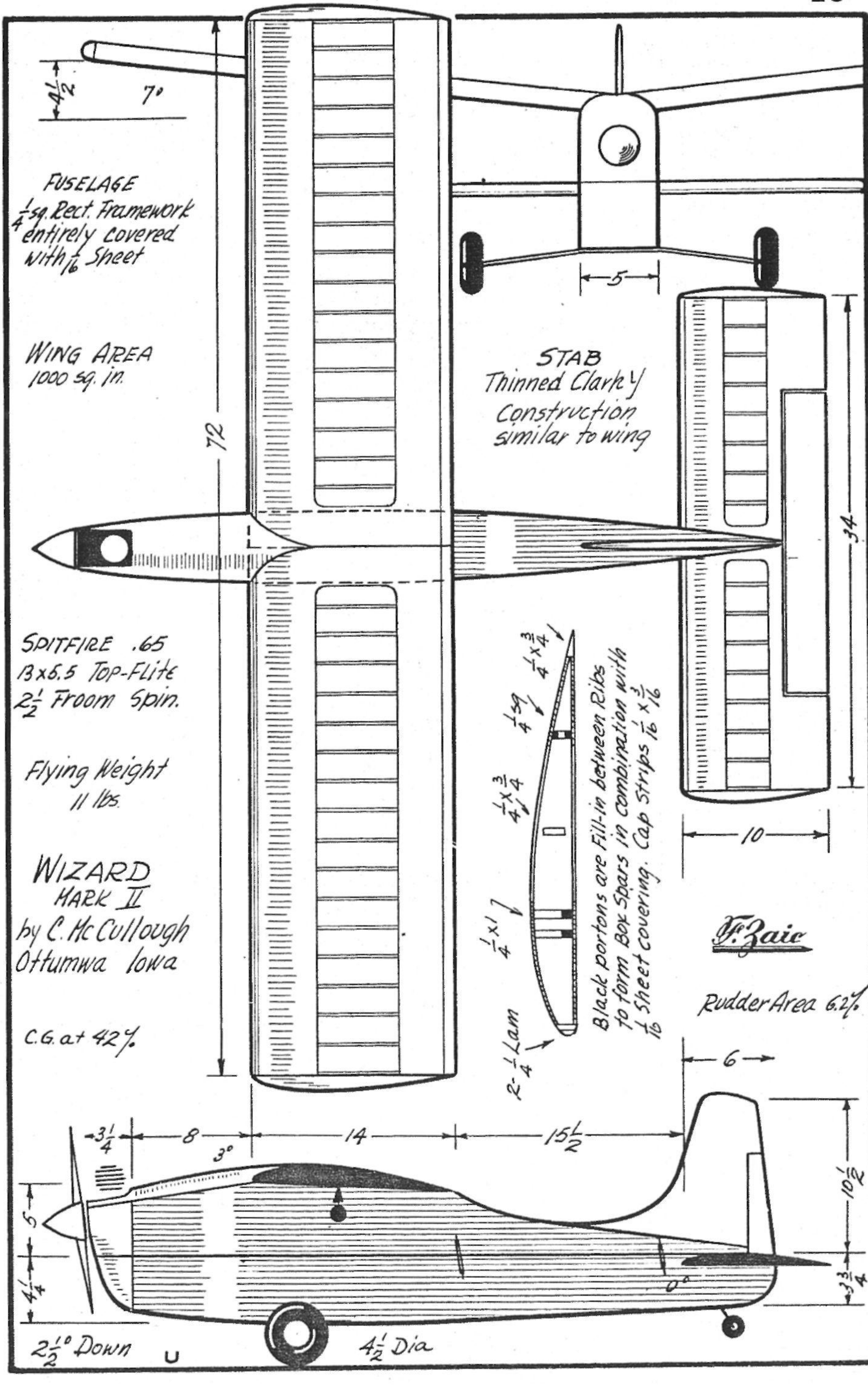
If holding the armature "on" cures the skipping, then improper relay mounting or adjustment is probably the cause. In general, the best relay adjustment is a compromise between the most spring tension possible and the closest contact spacing which will provide pull-in at just under the normal maximum current available. If relay action is snappy and positive when not under vibration the chances are that the adjustment is o.k., but the mounting must be made less stiff so as to better absorb the vibration.

There are no cut and dry rules of good practice—the subject is broad enough to require a book in itself—but the information presented offers a background to provide a steer in the proper direction. Just as a chain is only as strong as its weakest link, so is the performance of an r-c model dependent upon the attention given to the smallest details. If the end result is a product of accumulated good features, the chances are that successful r-c flying will be achieved and maintained.

CLAUDE—McCULLOUGH—THE ANVIL CHORUS—

One of the most intriguing aspects of radio control flying is that it has not yet reached the point where all the rules have been laid down and a formalized style of design developed, as has been the case with free flight gas and U-control speed for example. With so many avenues of thought available for exploration, it is to be hoped that some time will elapse before r-c flying will be in any danger of getting into a rut and grow less interesting from too much "sameness".

Most of the ideas r-cers began with were inherited from free flight, indeed early attempts (and many since) at remote control were far more free flight than radio directed—the usual course being to first test, adjust and fly the airplane without any equipment and then add it as a sort of extra thumb that permitted a certain degree of maneuvering. Now that a little confidence has been developed in the reliability of the radio sets, considerable strides have been made toward developing design practices that consider control the primary rather than secondary factor. With excessive dihedral proven to have been a sacred cow and something beside deep undercambered airfoils now flying, one wonders if perhaps more of the norms of current flying technique are not profitably susceptible to amendment.



4 1/2
7°
FUSELAGE
1/4 sq. Rect. Framework entirely covered with 1/16 Sheet
WING AREA
1000 sq. in.
72
STAB
Thinned Clark Y
Construction similar to wing
5
34
10
SPITFIRE .65
13 x 6.5 Top-Flite
2 1/2 Froom Spin.
Flying Weight
11 lbs.
WIZARD
MARK II
by C. McCullough
Ottumwa Iowa
C.G. at 42%
1/4 x 3/4
1/4 sq.
1/4 x 3/4
1/4 x 1
2-1/4 Lam
Black portions are Fill-in between Ribs to form Box Spars in combination with 1/16 Sheet covering. Cap Strips 1/16 x 3/16
F. Zaic
Rudder Area 6.2%
6
3 1/4
8
14
15 1/2
3°
10 1/2
5
4 1/4
3 3/4
0°
2 1/2° Down
4 1/2 Dia

After a season of flying a ship that was somewhat higher powered and considerably heavier than the average R-C, it is my opinion that the development of the ideal radio ship—rugged, smooth flying and with all-weather performance—lies in the direction of the application of what Dick Schumacher has called "Brute Force.'.'

The "Wizard" in its original form gained a certain degree of fame (or infamy!) as the only radio controlled payload ship at the '52 Nationals. Rushed to final completion the week before the Nats, the hurried installation of the many mechanisms and batteries required for a 3-control airplane played havoc with the C.G. position, getting it so far back that several total failure test flights proved without doubt that there was only one thing to do—weight the nose.

Since the ship had a short nose this required some doing, but thanks to C. O. Wright—who believes in coming to a contest *equipped*—a lead weight weighing 1 lb. 11 ounces was turned up. It was my intention to cut off part of it to try, since the whole amount seemed to be an experiment that could only result in a really sensational bash. But deciding that desperate situations call for desperate measures, the entire chunk was placed in the nose.

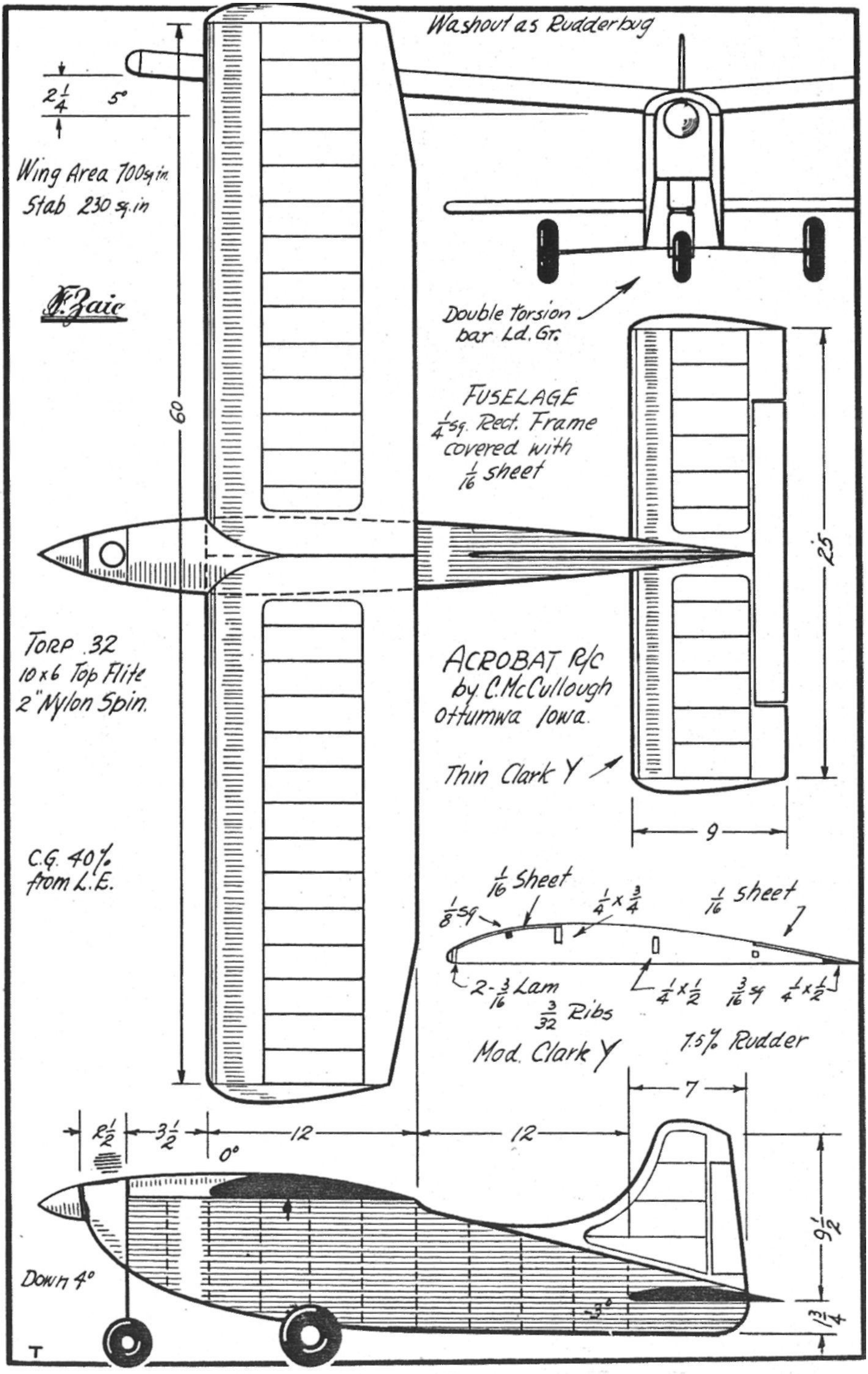
The plane was heavy to begin with and now weighed in at 11% lbs. on 7 sq. ft. of wing area—a wing loading of 27 ounces per sq. ft.

Since the only free on-the-air time available for testing was when the regular afternoon California hurricane was blowing, the worst was expected. But with the feeling that it would be best to get it over with, the Atwood .49 was cranked and with Jack Williams heaving, up the flying anvil went to turn in about as successful and smooth a test flight as could be asked for, culminating in a perfect landing on the runway.

While such ill-considered innovations as a 5-wheel landing gear, badly placed, proved to be a good deal of a handicap in the competition, still the airplane performed very creditably for its first 30 minutes of flying life, particularly in the wind, which had very little effect on it.

After the Nats", modifications and further test and contest flights were made and the ship has evolved to Mark II as shown in the three view. Changes included a lengthened and re-shaped nose, two wheel landing gear with tail wheel and increased rudder area. The longer nose was mainly to permit moving equipment forward so as to "get the lead out." But much to our surprise the airplane proved to have been a much smoother, all round ship at the heaviest weight than after lightening. So back in with a payload! Smoother turns, no bouncing on recovery and no wind could be turned up that could keep it from completing a quarter mile cross country, at times when no other job could do it. A small, 4 oz. weight is placed in the nose for especially high wind conditions.

One thing that was noticeable was that neither the climb or glide seemed to be affected to any degree by increasing the weight. The glide in any case was almost too good for making approaches to spot landings; flat and floating, almost unbelievable considering the wing loading. The control response was so good and the stability seemed so ample, that one of the main changes planned for the ship is to increase the power plant to a .65 to give more reserve capacity for takeoffs and climbing to alitude, making use of the motor control to keep it at the altitude you want it. It is felt that the ship will be able to fly in any weather in which a contest can be held. The payload is being made useful by installing some heavier batteries and a new more reliable elevator mechanism.



Washout as Rudderbug
2 1/4 5°
Wing Area 700 sq.in.
Stab 230 sq.in
F. Zaic
Double torsion bar Ld. Gr.
FUSELAGE
1/4 sq. Rect. Frame covered with 1/16 sheet
60
25
ACROBAT R/C
by C. McCullough
Ottumwa Iowa
Torp .32
10 x 6 Top Flite
2" Nylon Spin.
Thin Clark Y
9
C.G. 40% from L.E.
1/16 Sheet
1/8 sq
1/4 x 3/4
1/16 sheet
2 - 3/16 Lam
3/32 Ribs
1/4 x 1/2
3/16 sq
1/4 x 1/2
Mod. Clark Y
7.5% Rudder
7
2 1/2
3 1/2
12
12
0°
9 1/2
1 3/4
Down 4°
T

To further test the flying and maneuvering ability of high wing and power loadings along with several other features, a new ship is now a'building. This has hopefully been christened "Acrobat" and is shown in three-view. It is a 3-control 5 footer with proportional pulse rudder, sequence elevator and motor speed and shutoff control. It is thought that this is not only an optimum size but also the smallest practical one for this number of controls. The main design features are low aspect ratio (5 to 1) and a short moment arm, selected with an eye toward maneuverability rather than stability, and tending to confirm E. L. Rockwood's comment that I was drifting designwise to "U-control stunt jobs."

The ship has an ample rudder, particularly necessary on short moment arm ships but also an aid in avoiding "wanderitis" on a cross-country, every gust of wind bringing a new flight path. Using proportional pulse, such an airplane can be flown in a perfectly straight line cross country in a cross wind, simply by setting the stick for the correct crabbing angle.

This small, high powered, heavily leaded ship will be flown against the large etc. etc. Wizard to determine which is the most successful size for contest work. It is probably a foregone conclusion that the smaller ship cannot be quite as heavy in wing loading as the large ship for equivalent reactions, if Mr. Reynolds and his number be right.

Please don't misunderstand me on this weight question. I am not advocating that everybody carry a lead weight just to be packing it. But what I am saying is that perhaps the popular trend to a light wing loading, low power airplane is not the best way to the ideal R-C design. Particularly light weight at the expense of radio reliability or structural strength, just to keep down impact forces or flatten the glide.

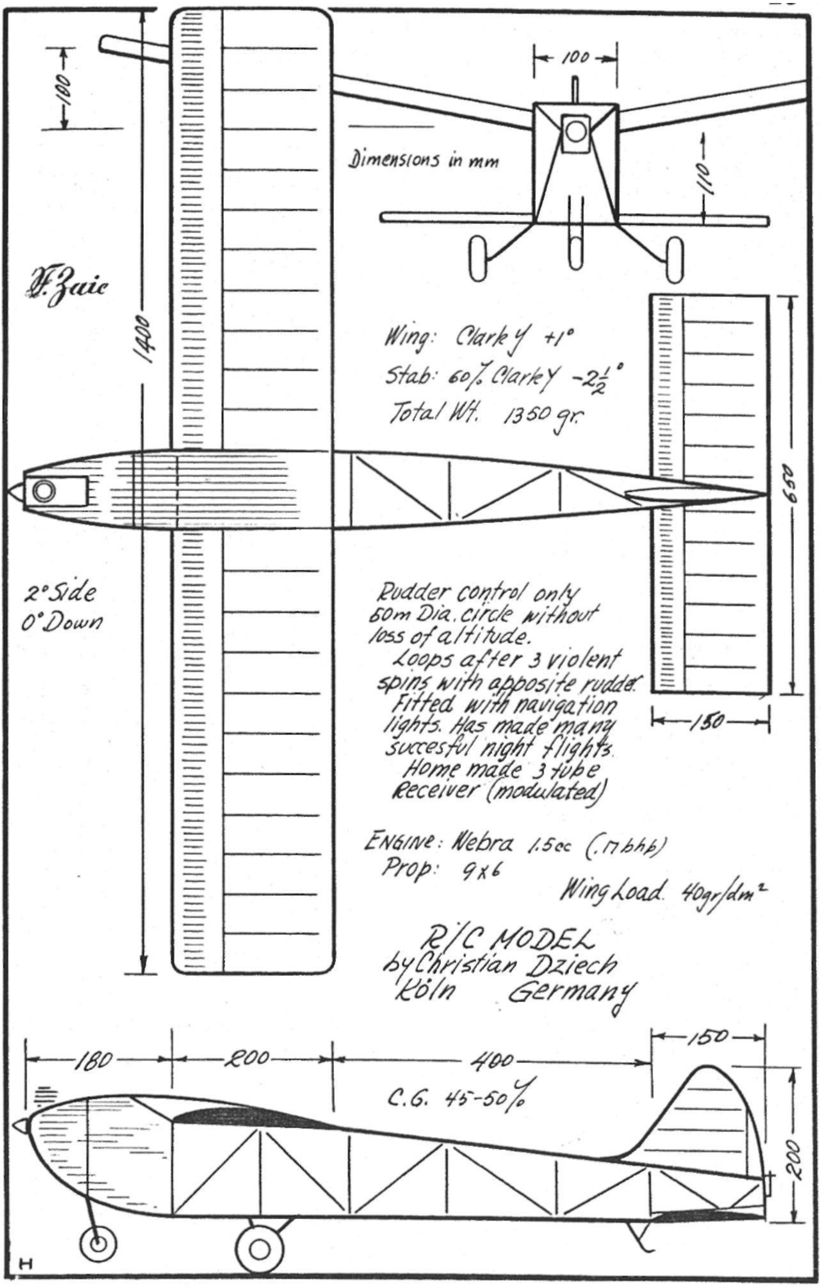
I hink it is throwing in the towel for modelers to decide that structures cannot be built of balsa to really take the punishmen dealt out by heavier weight and fast flying. Sensible wood selection, generous spar depth (an r-c wing should be able to support twice the weight of the ship when held by the tips!), liberal planking and free flight knock-off attachment of the parts plus arrangement of equipment to absorb shock, can produce a ship that will take any average "prang", without damage.

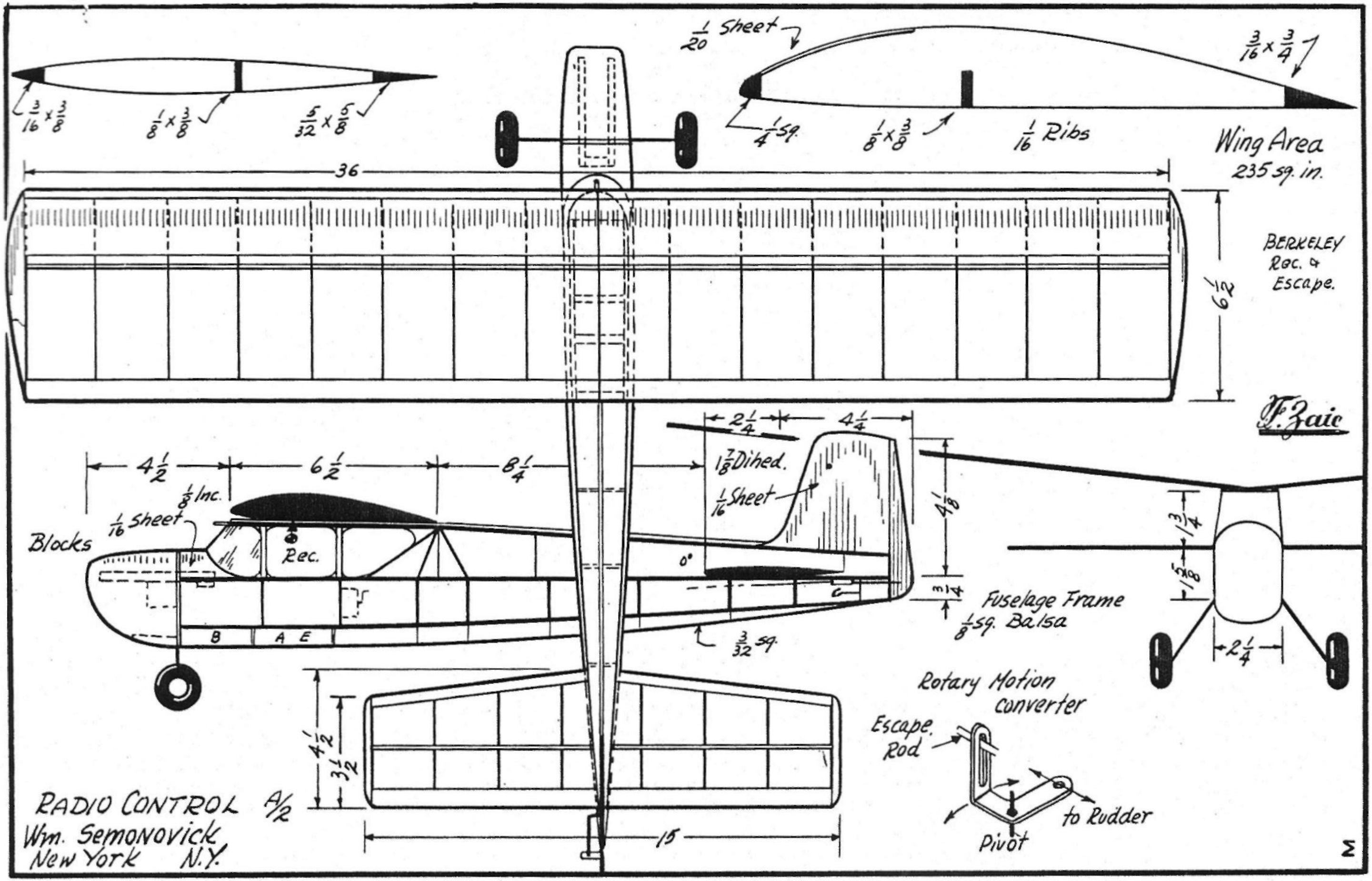
At the Des Moines meet my electronic pulser began kicking up its heels, spinning my ship in from a high altitude under power, not once, but *three* times. Each time the only repairs were a new prop, straightening the 1. g. and replacing rubber bands. This is a pretty drastic way of testing out a structure, but it does show the balsa deserves its reputation for having the highest strength to weight ratio of any wood.

The objection may well be raised that the lighter airplane should be more maneuverabie. My thought is that as far as maneuverability is concerned, given plenty of power, 25 ounce loadings do not appear heavy enough to adversely affect maneuvering and do smooth out the more sedate flying considerably.

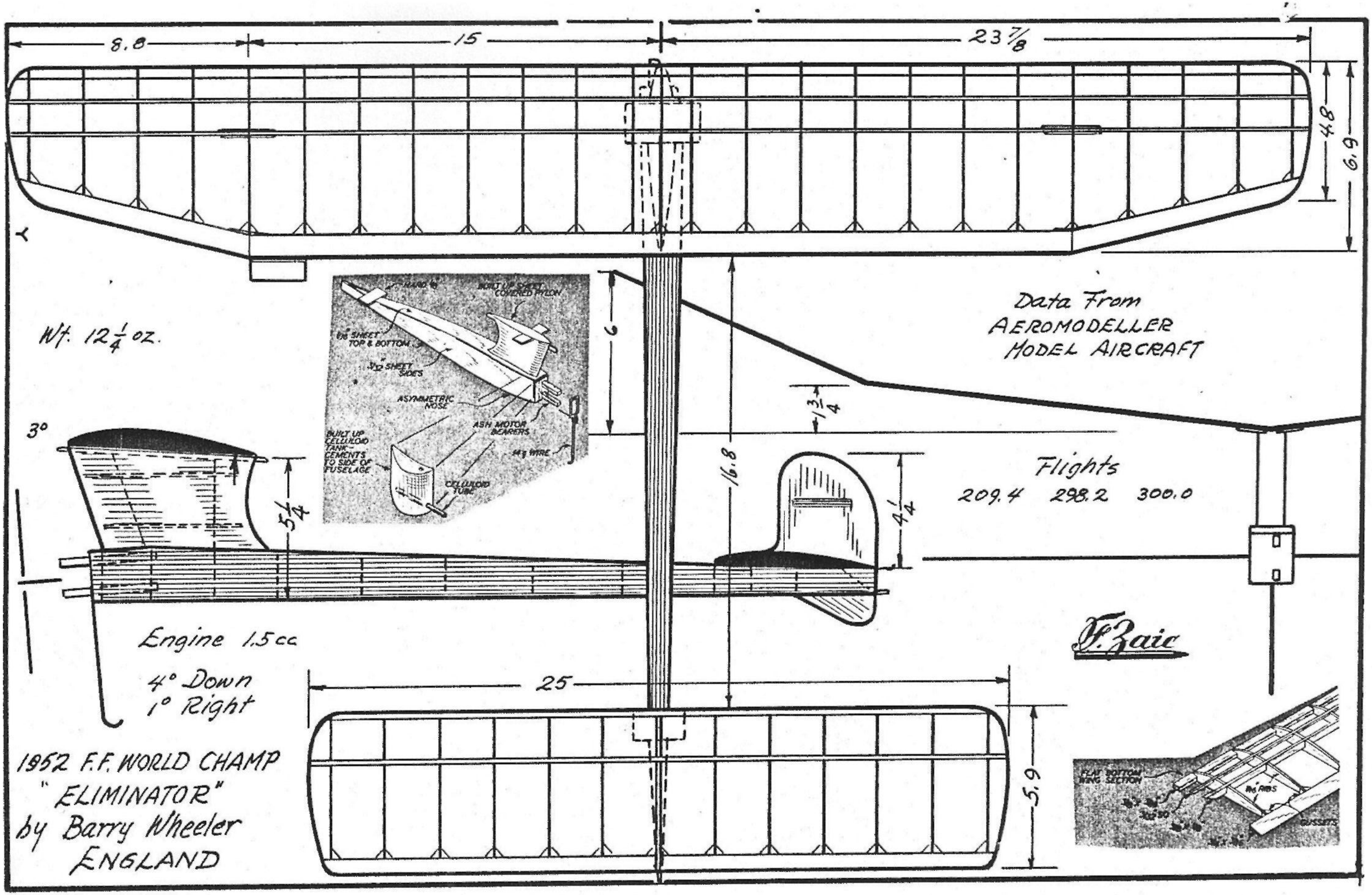
But regardless of the pro and con of it, the inevitable march of progress will soon make the lighter low-powered ships the trainer for the novice and heavier higher powered ships a must for contest work. For it seems quite evident that the day of ascendancy of the rudder only airplane is coming to an end. Alex Schneider and the San Francisco Mustangs are flying proof that multiple control will now be necessary.

Placing the equipment needed for this type of operation in a light airplane will produce results of a most positive nature. The first time the ship hits an obstruction, it will stop and the batteries and radio will keep right on going!


100
100
Dimensions in mm
110
F. Zaic
1400
Wing: Clark Y +1°
Stab: 60% Clark Y -2½°
Total Wt. 1350 gr.
650
2° Side
0° Down
Rudder control only
50m Dia. circle without
loss of altitude.
Loops after 3 violent
spins with apposite rudder.
Fitted with navigation
lights. Has made many
succesful night flights.
Home made 3 tube
Receiver (modulated)
150
ENGINE: Webra 1.5cc (.17 bhp)
Prop: 9x6
Wing Load. 40gr/dm²
R/C MODEL
by Christian Dziech
Köln Germany
180
200
400
150
C.G. 45-50%
200
H



1/20 Sheet
3/16 x 3/4
3/16 x 3/8
1/8 x 3/8
5/32 x 5/8
1/4 sq.
1/8 x 3/8
1/16 Ribs
Wing Area
235 sq. in.
36
6 1/2
BERKELEY
Rec. & Escape.
F. Zaic
2 1/4
4 1/4
4 1/2
6 1/2
8 1/4
1 7/8 Dihed.
1/16 Sheet
1/8 Inc.
1/16 Sheet
Blocks
Rec.
0°
4 1/8
3/4
1 3/4
1 5/8
Fuselage Frame
1/8 sq. Balsa
B
A
E
3/32 sq.
2 1/4
Rotary Motion
Converter
Escape.
Rod
Pivot
to Rudder
4 1/2
3 1/2
15
RADIO CONTROL
A/2
Wm. Semonovick
New York N.Y.



8.8
15
23 7/8
4.8
6.9
Wt. 12 1/4 oz.
6
1 3/4
16.8
3°
5 1/4
4 1/4
HARD 1/8
BUILT UP SHEET COVERED PYLON
1/16 SHEET TOP & BOTTOM
3/32 SHEET SIDES
ASYMMETRIC NOSE
ASH MOTOR BEARERS
BUILT UP CELLULOID TANK - CEMENTS TO SIDE OF FUSELAGE
CELLULOID TUBE
14 g WIRE
Data From
AEROMODELLER
MODEL AIRCRAFT
Flights
209.4 298.2 300.0
Engine 1.5cc
4° Down
1° Right
F. Zaic
25
5.9
FLAT BOTTOM WING SECTION
1/16 RIBS
GUSSETS
1952 F.F. WORLD CHAMP
"ELIMINATOR"
by Barry Wheeler
ENGLAND

J. K. QUERMANN—NOTES ON *V2* A DESIGN—

Some idea of how the design came to be may be of some interest. The layout is based on my concepts of stability and the ability to trim for both the high power climb and for a glide. The size, airfoil and general streamlining are, of course, all aimed at high performance.

1. For longitudinal stability and control a model should have the following:

a) A large tail volume coefficient, $\frac{S_t \, l_t}{S_w \, c}$ • This provides plenty of damping (Zaic circular flow concept) and makes a rear center of gravity location necessary. The damping in pitch makes the exact location of the center of gravity less critical, damps oscillations, and generally takes up the slack caused by other errors. The rear center of gravity helps the lateral stability indirectly. On the debit side, the large tail costs drag. The small amount of lift it can produce when the center of gravity is located for proper stability doesn't begin to pay for the drag. I believe the stability is worth the price. S_t = Tail Area S_w = Wing Area

b) The center of gravity must be far aft for easy adjustment of power on as well as power off flight, (a glider can have a forward center of gravity). The center of gravity should be slightly ahead of the aerodynamic center during the glide and on or even behind during the climb. During a steep climb the model is more of a helicopter than a conventional airplane. For the helicopter the center of gravity should be below the aerodynamic center of the side forces, in this case lift.

c) An unrestricted propeller slipstream which passes over or very close to the horizontal tail. The effect of the slipstream on the tail is the big item in changing the trim from power off to power on flight. Downthrust changes the direction of the flow at the tail as well as adding some down load at the nose. The moment caused by the up load at the tail a long distance from the C.G. is more powerful in trimming to a lower lift coefficient, i.e. preventing loops. A pylon which puts the wing above the propeller seems about right. Higher pylons probably don't help much. C = Average Wing Chord

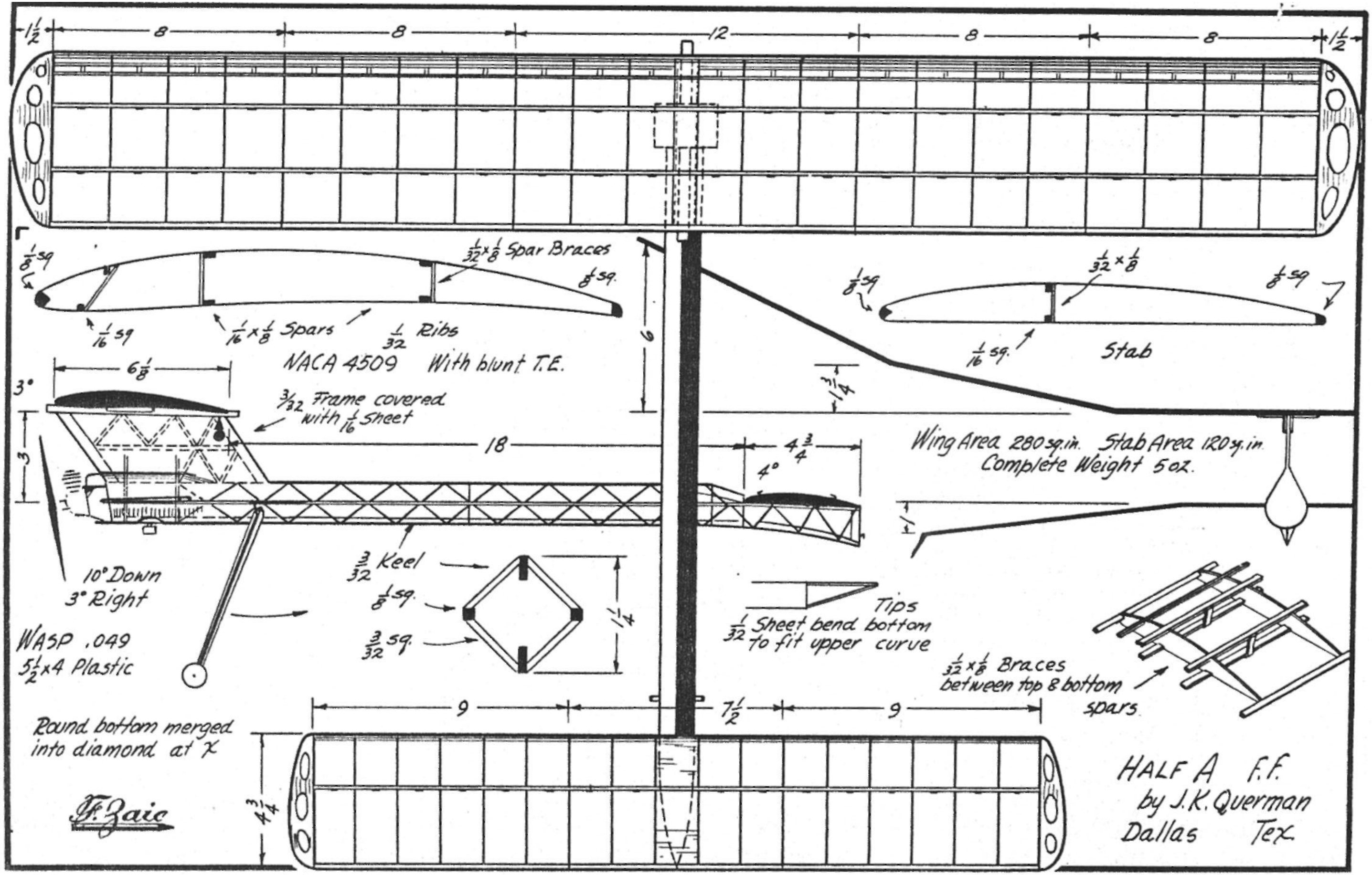
d) Some downthrust measured relative to the normal flight path in the glide. Necessary to change the trim. l_t = tail length from C.G. tail $\frac{1}{4}$ Chord

As a passing note it might be pointed out that while the rear C.G. location is needed, it is easy to get into real trouble by putting the C.G. too far back. For the beginner a good way to avoid over shooting is to put the C.G. a little farther forward than the experts. Use a moderate amount of downthrust and then start flight tests. Trim for the glide then try power. If the model dives under power or shows only slight looping tendencies a change in thrust adjustment is in order. However, if it shows violent looping tendencies move the center of gravity back and retrim for the glide (by changing the tail incidence). As the center of gravity is moved back the looping tendency should disappear. If you want to see how far out the window you can lean, take out some of the intial downthrust and try again.

2. For lateral stability and trim:

a) Plenty of dihedral. Dihedral is like money in the bank. It is difficult to have too much as far as stability is concerned. The more dihedral the less fussy you have to be with some of the other items. There is a price. The useful lifting wing area decreases. Not much is lost for moderate angles tho.

b) A small vertical tail. My model has no vertical tail as such, but the drooped outer panels act as a vertical tail. The effective area is the total area of the panels times the sine squared of the dihedral angle or about %



1/8 sq
1/32 x 1/8 Spar Braces
1/8 sq.
1/16 sq
1/16 x 1/8 Spars
1/32 Ribs
NACA 4509 With blunt T.E.
1/8 sq
1/32 x 1/8
1/8 sq
1/16 sq.
Stab
6 1/8
3°
3/32 Frame covered with 1/16 Sheet
18
4 3/4
4°
Wing Area 280 sq.in. Stab Area 120 sq.in.
Complete Weight 5 oz.
10° Down
3° Right
WASP .049
5 1/2 x 4 Plastic
3/32 Keel
1/8 sq.
3/32 sq.
1 1/4
Tips
1/32 Sheet bend bottom to fit upper curve
1/32 x 1/8 Braces between top & bottom spars
Round bottom merged into diamond at X
HALF A F.F.
by J.K. Querman
Dallas Tex.
F. Zaic

of the projected area. There is a fairly wide range of satisfactory tail sizes for wings with plenty of dihedral, particularly for the glide. For the climb the tail must be small so the center of gravity is very close to or behind the aerodynamic center of the side forces. The helicopter concept must be kept in mind. A model whose tail is too small will dutch roll or in extreme cases, spin—not a spiral drive, but a classical spin with the surfaces stalled. My model, even with the apparent lack of tail has never shown any hint of dutch roll.

c) Moderate aspect ratio. A low aspect ratio is generally good for stability, but begins to cost in terms of performance. A moderate aspect ratio around 7 seems a good compromise.

d) Positive dihedral ahead of the center of gravity, negative dihedral behind the center of gravity. This provides a favorable rolling moment due to yawing velocity. (Sort of a circular air flow in yaw). If the angle of yaw is taken as zero at the center of gravity, then the turn produces a side flow in one direction ahead of the C.G. and in the opposite direction behind it. With the positive dihedral of the wing ahead of the C.G.,and the negative of the tail behind, the rolling moment caused by the turn tends to cause the model to roll out of the turn.

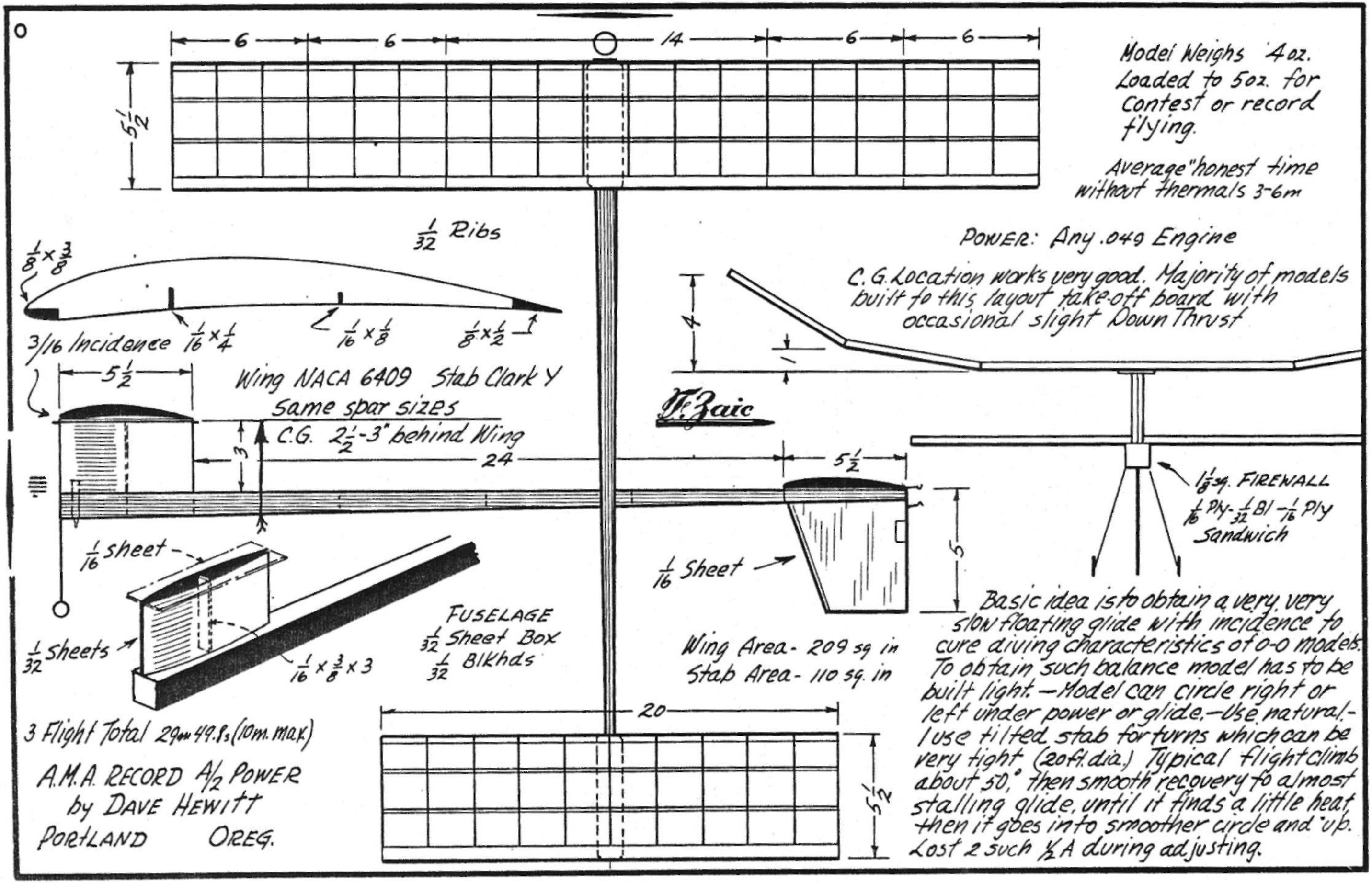
e) On this particular model with no vertical tail for the slipstream to act on, side thrust is not very effective. The slipstream twist acting on the pylon tends to cause a right turn. Wih a low vertical tail the twist also causes a right turn. To avoid this difficulty the tail droop is started beyond the normal slipstream. The model climbs right, glides left.

3. The size may be of some interest since the model is larger than most *y<l* A models. The idea is simply this: The model should be as large as possible, yet it should weigh no more than the absolute minimum. With a full tank of fuel my model barely tips 5 oz. For the craftsman who can make them larger and still strong enough I recommend larger wings. The logic is simple. The rate of climb depends mostly on the weight and engine power. Drag is a secondary factor. Since there is little to lose in climb and much to gain in the glide make them big, but light. There is a price. First the structure is weaker. Second, it is more difficult to trim properly for both power on and power off flight. The reason is that the forces due to the engine are relatively smaller compared to those due to the surfaces. It becomes more necessary to place the center of gravity properly than in the smaller airplane with the same engine.

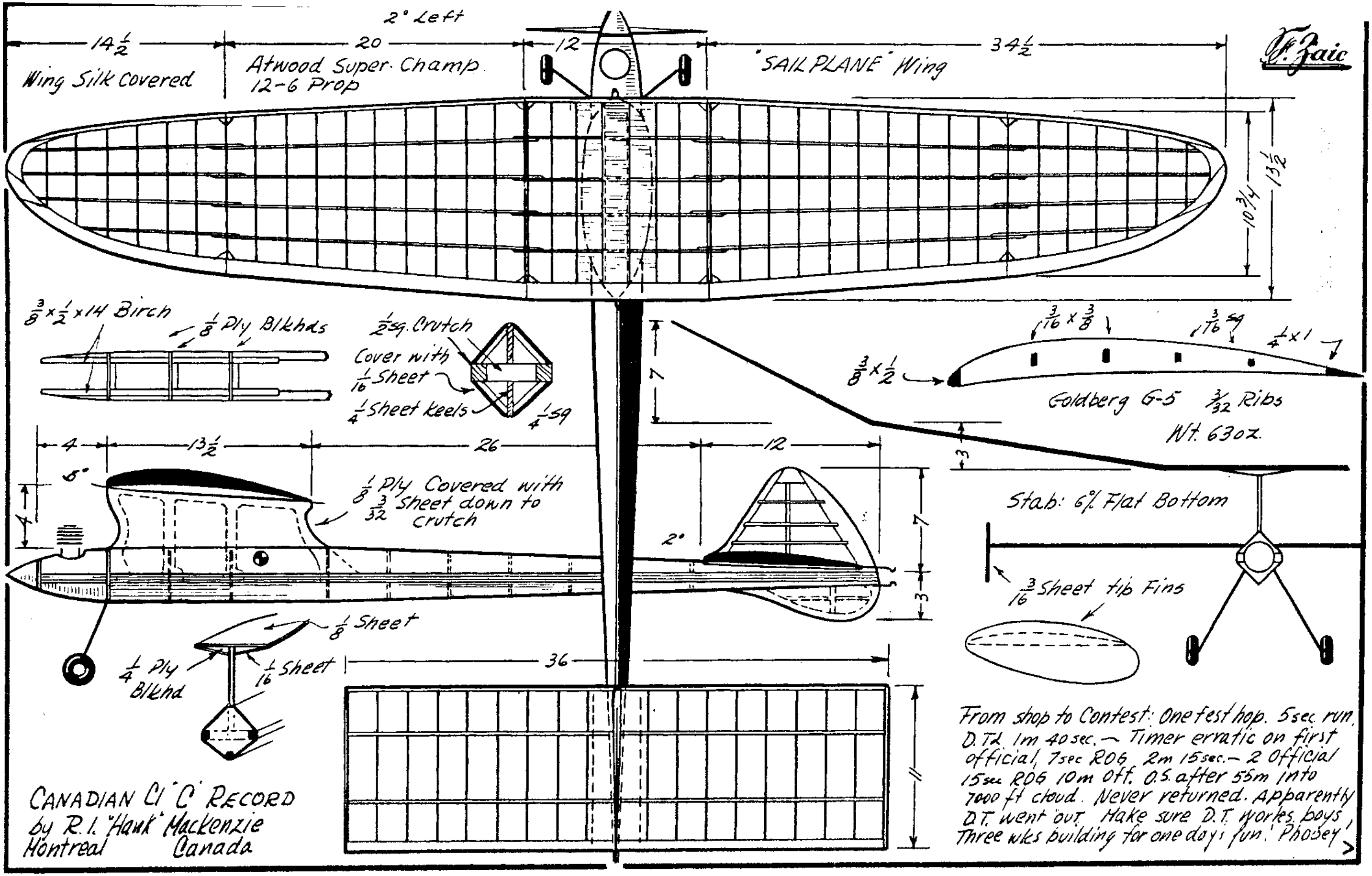
4. The airfoil. The blunt trailing edge may startle you. The airfoil is similar to an NACA 4509 with a thinned down leading edge and a thickened trailing edge. The airfoil was designed to have low drag at a lift coefficient of 0.8. Glide tests on other wings showed this to be the normal gliding CL. The lower surface is designed for a laminar boundary layer—at least the pressure gradient is favorable for one. The blunt trailing edge tend to increase the maximum lift coefficient and takes into account the fact that at the low Reynolds numbers the flow has probably started to separate slightly at the trailing edge on most airfoils. Thus the drag is probably small. The small structural member at the trailing edge helps keep the weight down.

5. The landing gear is almost an after thought. It is shown on the drawing as it is. It works, but I would recommend moving it about 1" further forward.

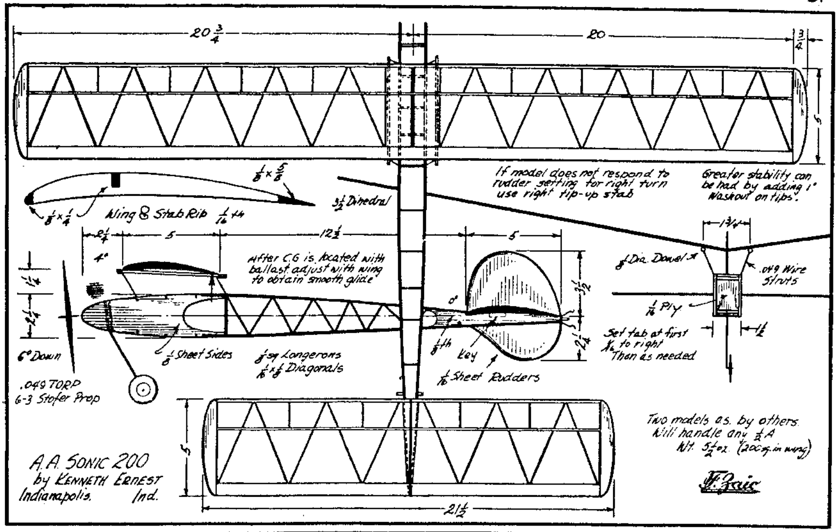
6. The exhaust deflector on the fairing behind the engine keeps most of the goo from splashing on the wing.

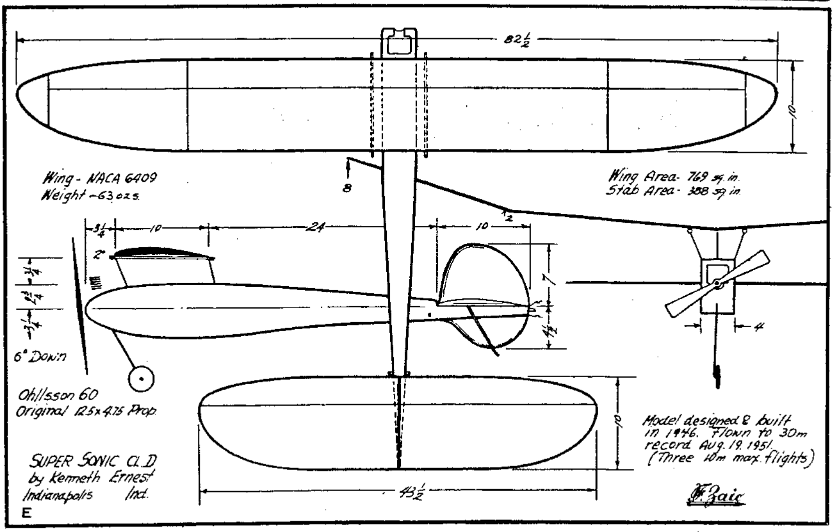


6
6
14
6
6
5 1/2
Model Weighs 4oz.
Loaded to 5oz. for
Contest or record
flying.
Average "honest time
without thermals 3-6m
1/32 Ribs
1/8 x 3/8
1/16 x 1/4
1/16 x 1/8
1/8 x 1/2
3/16 Incidence
POWER: Any .049 Engine
C.G. Location works very good. Majority of models
built to this layout take-off board with
occasional slight Down Thrust
4
1
5 1/2
Wing NACA 6409 Stab Clark Y
Same spar sizes
C.G. 2 1/2-3" behind Wing
3
24
F. Zaic
5 1/2
1 1/8 sq. FIREWALL
1/16 Ply - 1/32 Bl - 1/16 Ply
Sandwich
1/16 sheet
1/16 Sheet
5
1/32 Sheets
1/16 x 3/8 x 3
FUSELAGE
1/32 Sheet Box
1/32 Blkhds
Wing Area - 209 sq in
Stab Area - 110 sq. in
Basic idea is to obtain a very very
slow floating glide with incidence to
cure diving characteristics of 0-0 models.
To obtain such balance model has to be
built light. — Model can circle right or
left under power or glide. — Use natural. -
I use tilted stab for turns which can be
very tight (20 ft. dia.) Typical flight climb
about 50°, then smooth recovery to almost
stalling glide, until it finds a little heat,
then it goes into smoother circle and up.
Lost 2 such 1/2A during adjusting.
20
5 1/2
3 Flight Total 29m 49.8s (10m. max.)
A.M.A. RECORD A/2 POWER
by DAVE HEWITT
PORTLAND OREG.



2° Left
14½
20
12
34½
Wing Silk Covered
Atwood Super Champ
12-6 Prop
"SAILPLANE" Wing
F. Zaic
10¾
13½
⅜ x ½ x 14 Birch
⅛ Ply Blkhds
½ sq. Crutch
Cover with 1/16 Sheet
¼ Sheet keels
¼ sq
7
3/16 x ⅜
3/16 sq
¼ x 1
⅜ x ½
Goldberg G-5 3/32 Ribs
Wt. 63 oz.
3
4
13½
26
12
6°
4
⅛ Ply Covered with 3/32 Sheet down to crutch
2°
7
3
Stab: 6% Flat Bottom
3/16 Sheet tip Fins
⅛ Sheet
¼ Ply Blkhd
1/16 Sheet
36
11
From shop to Contest: One test hop. 5 sec. run, D.T.'d 1m 40 sec. — Timer erratic on first official, 7 sec ROG 2m 15 sec. — 2 Official 15 sec ROG 10m Off. O.S. after 55m into 7000 ft cloud. Never returned. Apparently D.T. went out. Make sure D.T. works, boys, Three wks building for one day's fun! Phooey!
CANADIAN Cl "C" RECORD
by R.I. "Hawk" Mackenzie
Montreal Canada



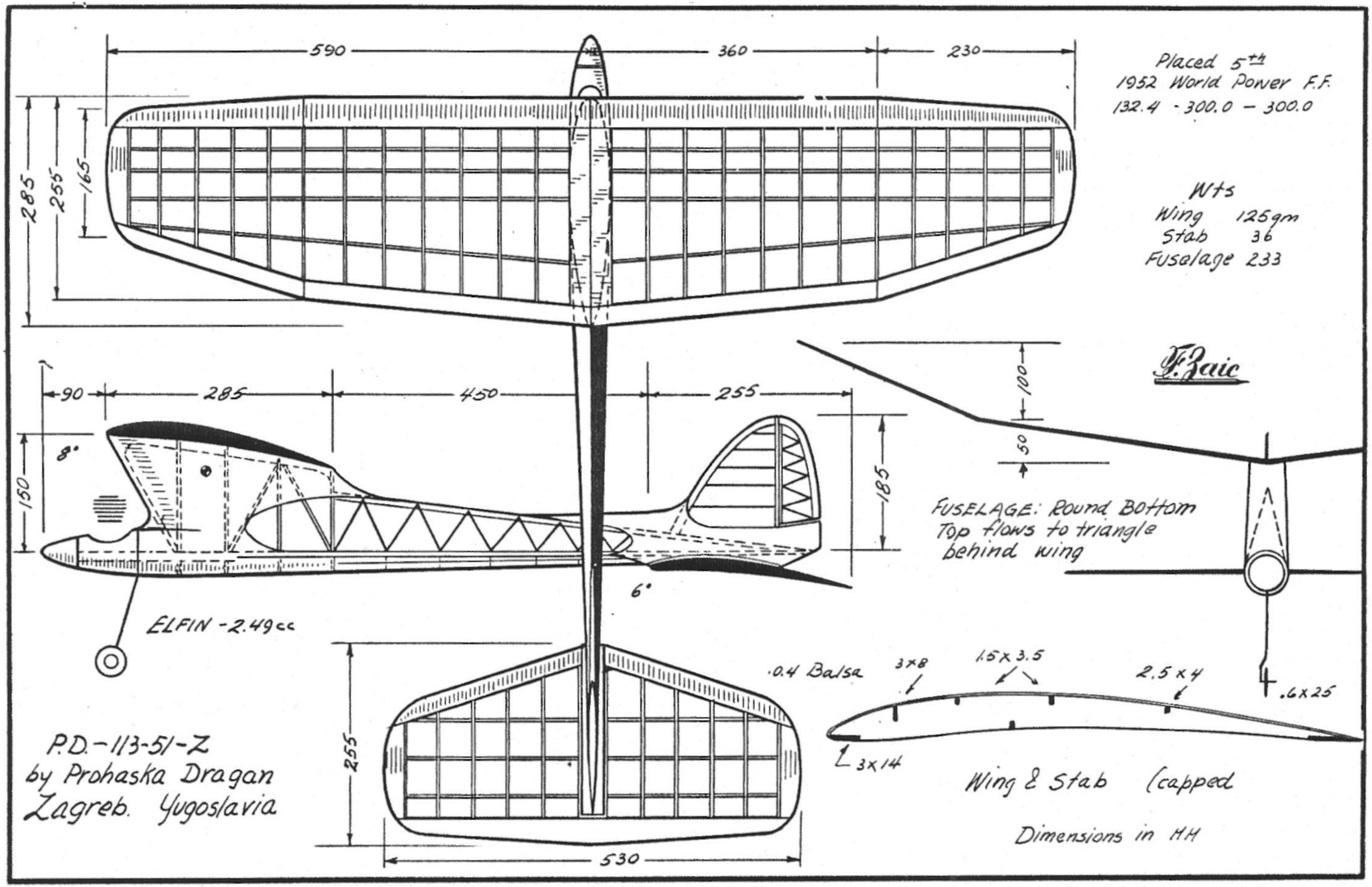


—(Mar. 1953)—

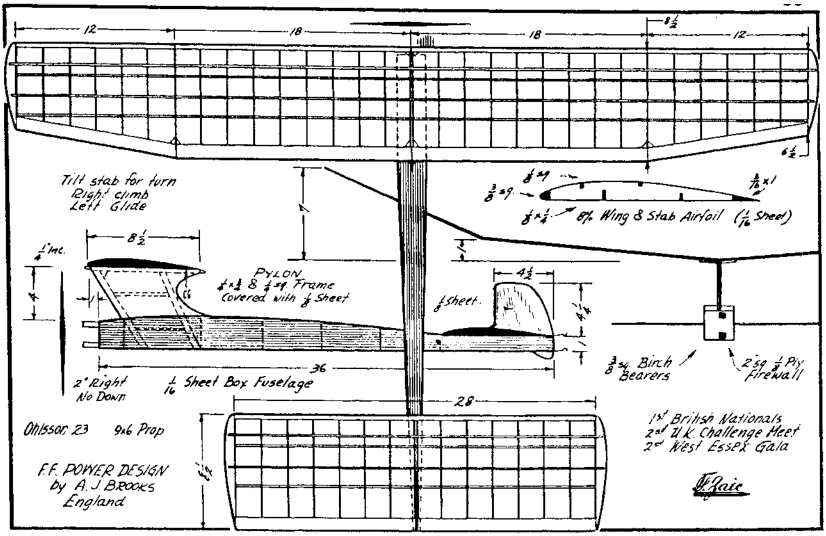
Sorry I haven't been able to write earlier. Your letter got here while I was in the middle of a rush project at CVA. See. if these answers satisfy you.

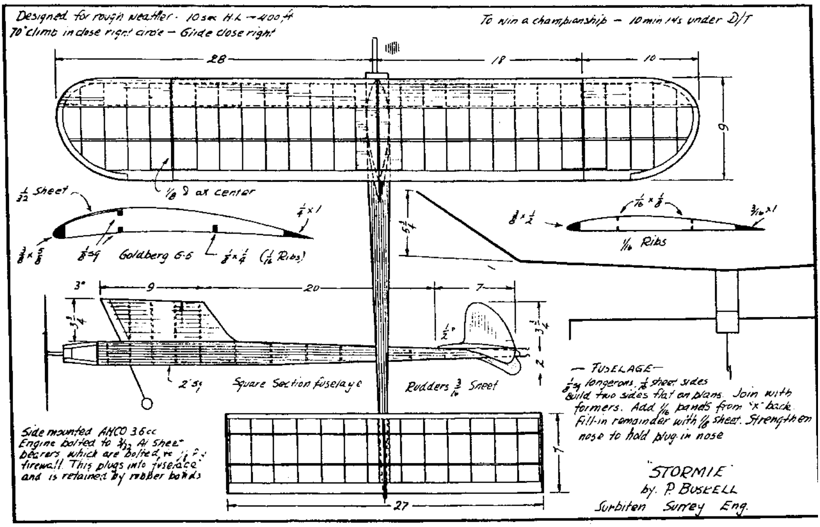
1. Performance of the model: I am reluctant to make specific performance claims without extensive tests to determine an accurate figure. Most published figures smell like fish stories anyway. I can say that it will out glide any 1/2 A I have ever seen and the climb is good.

2. Center of gravity ahead of aerodynamic center: The distance between the center of gravity and the aerodynamic center is a measure of the static stability or the restoring force following a disturbance from a trimmed

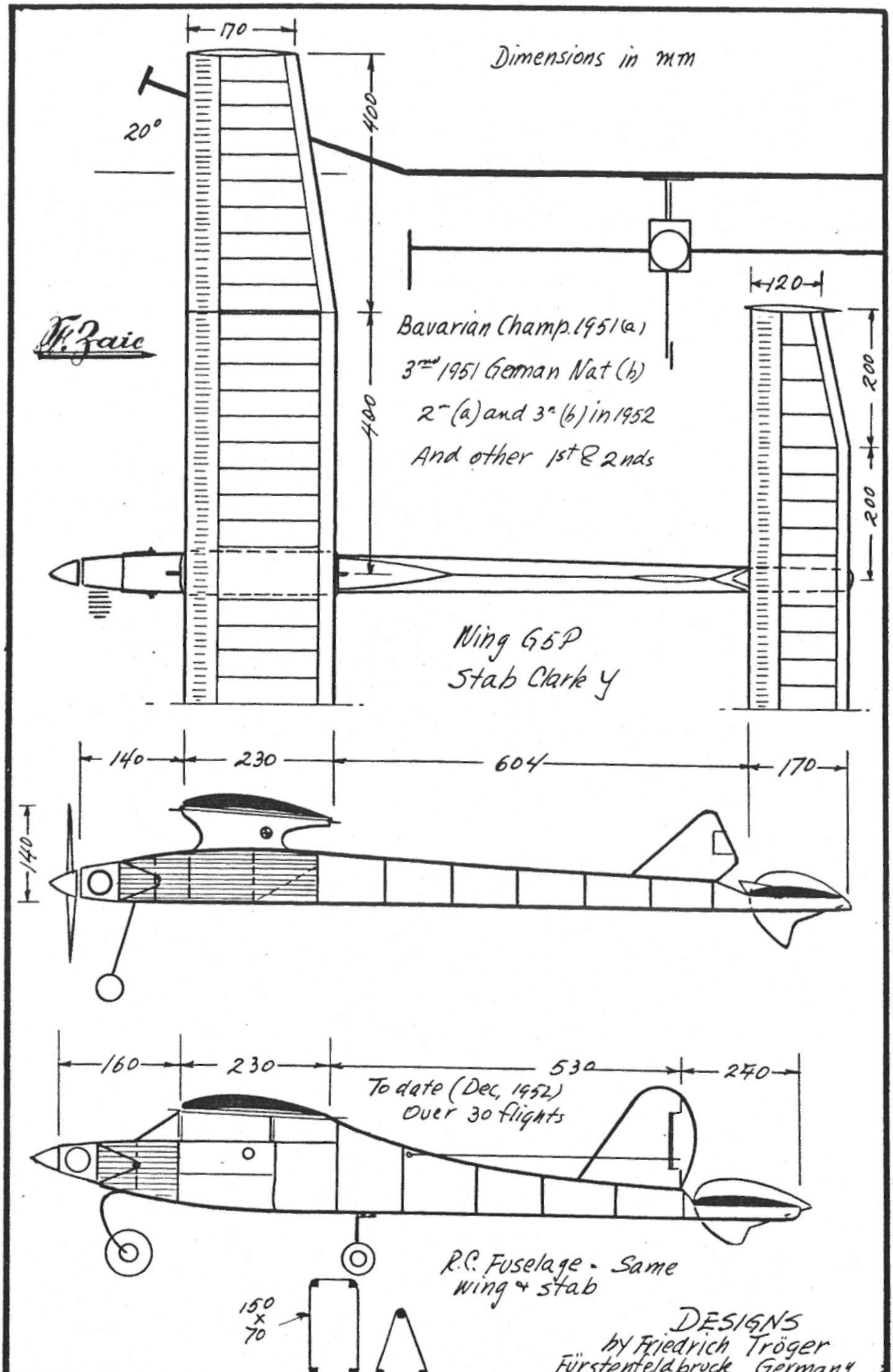


590
360
230
Placed 5th
1952 World Power F.F.
132.4 - 300.0 - 300.0
285
255
165
Wts
Wing 125gm
Stab 36
Fuselage 233
90
285
450
255
150
8°
6°
185
100
50
FUSELAGE: Round Bottom
Top flows to triangle
behind wing
ELFIN - 2.49cc
.0.4 Balsa
3×8
1.5×3.5
2.5×4
.6×25
3×14
Wing & Stab (capped
Dimensions in MM
P.D.-113-51-Z
by Prohaska Dragan
Zagreb. Yugoslavia
530

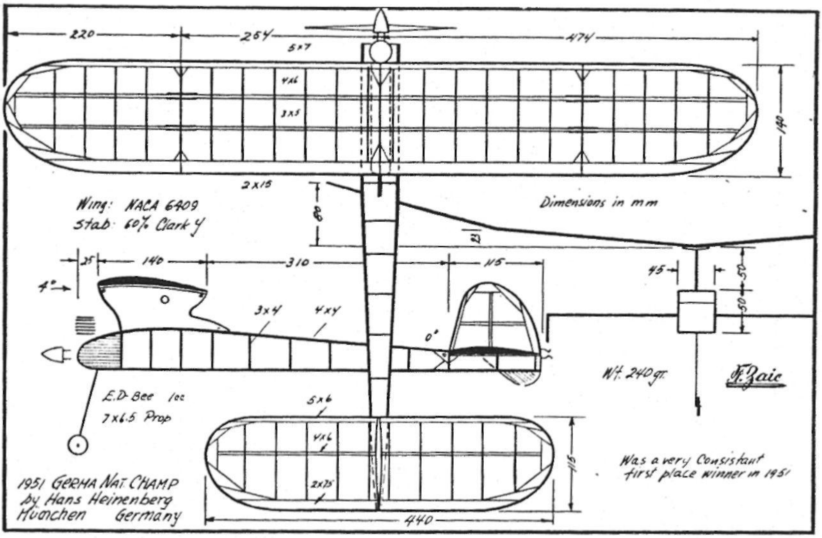


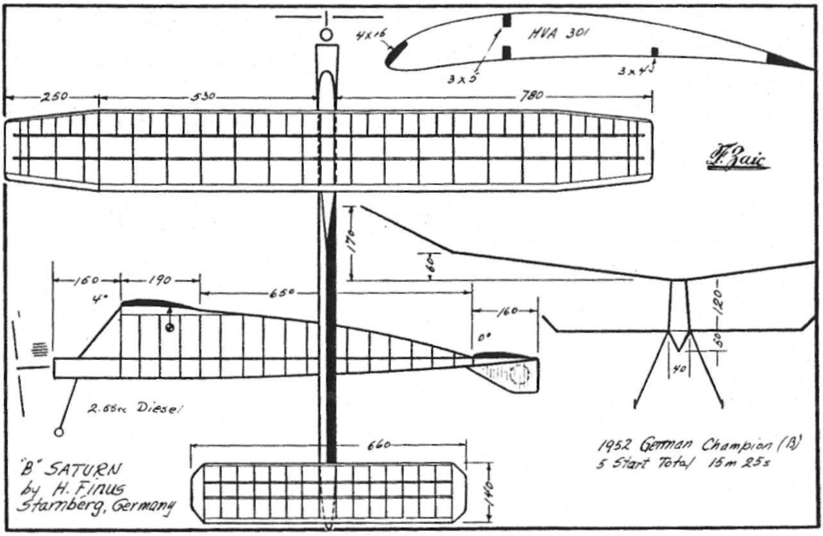


condition. You are probably used to thinking in terms of the center of pressure. When a model is flying along trimmed, there is no pitching moment, hence, the resultant force passes thru the center of gravity, i.e. the center of pressure lies at the C.G. The Aerodynamic Center is a slightly different animal. If the trimmed model is disturbed, for example by a gust, the total lift will be changed. The center of pressure of the additional load is the aerodynamic center. Keep in mind that it has no direct connection with the overall center of pressure location either before or after the disturbance; only the incremental load. If the change in load produces a moment tending to rotate the model back to the trimmed angle of attack, then the aerodynamic center is behind the center of gravity. An up gust will produce an additional load which produces a diving moment, but only until trim is restored. A down gust produces a momentary nose up moment.

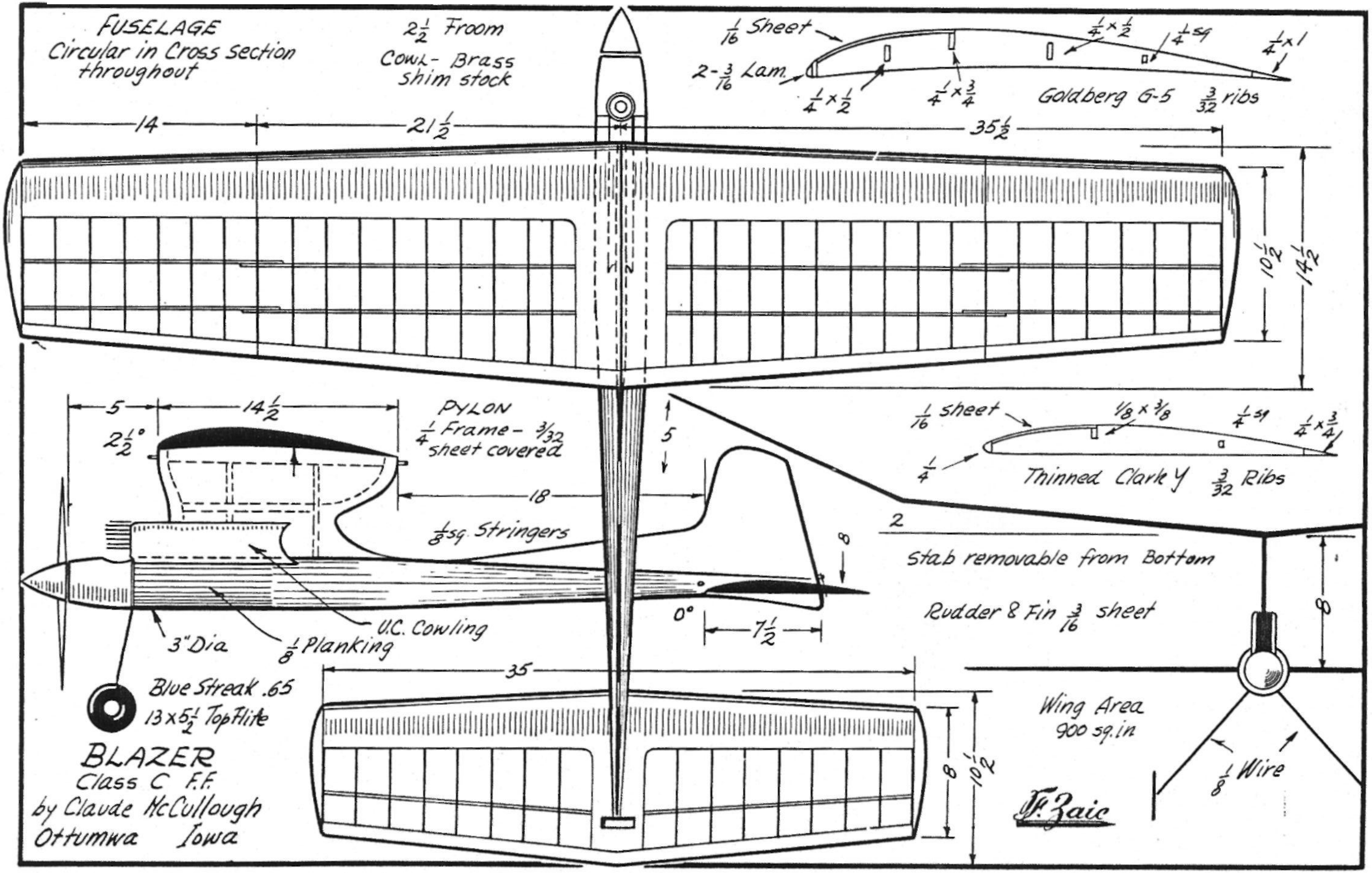


170
Dimensions in mm
20°
400
400
F. Zaic
Bavarian Champ. 1951 (a)
3rd 1951 German Nat (b)
2nd (a) and 3rd (b) in 1952
And other 1st & 2nds
120
200
200
Wing G5P
Stab Clark Y
140
230
604
170
140
160
230
530
240
To date (Dec, 1952)
Over 30 flights
R.C. Fuselage - Same
wing & stab
150
×
70
DESIGNS
by Friedrich Tröger
Fürstenfeldbruck Germany

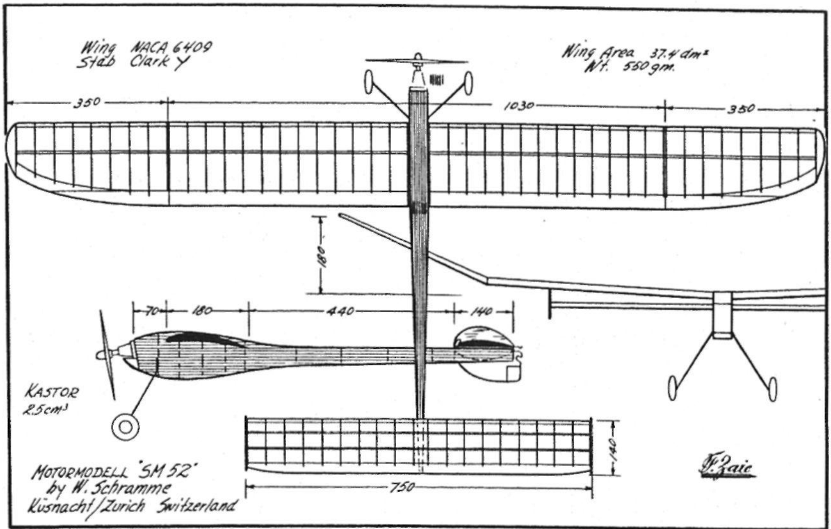


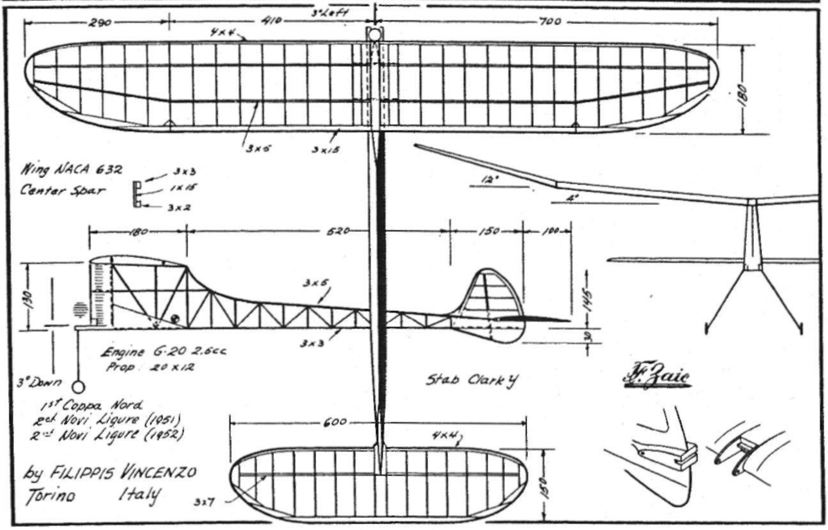


3. **Difference between skid and yaw: To clear up the sideslip, (skid) yaw confusion, let's look for a minute at the sinking speed, angle of attack, airplane attitude situation. It may be easier to see. To start with assume a symmerical model constrained so that its horizontal axis remains parallel to the ground. Fire it from a catapult in this position. Since it is symmetrical it has no lift. Hence, it will start downward, developng a sinking speed as it goes. At the same time, the resultant wind is no longer along the axis (model still constrained to have its axis parallel to the ground). You will recognize the generation of an angle of attack—the angle between the center line of the model and the resultant wind. In this case, sinking speed and angle of attack are two ways of saying the same thing. It is not always so, of course. Level flight, for example, requires an angle of attack without a**



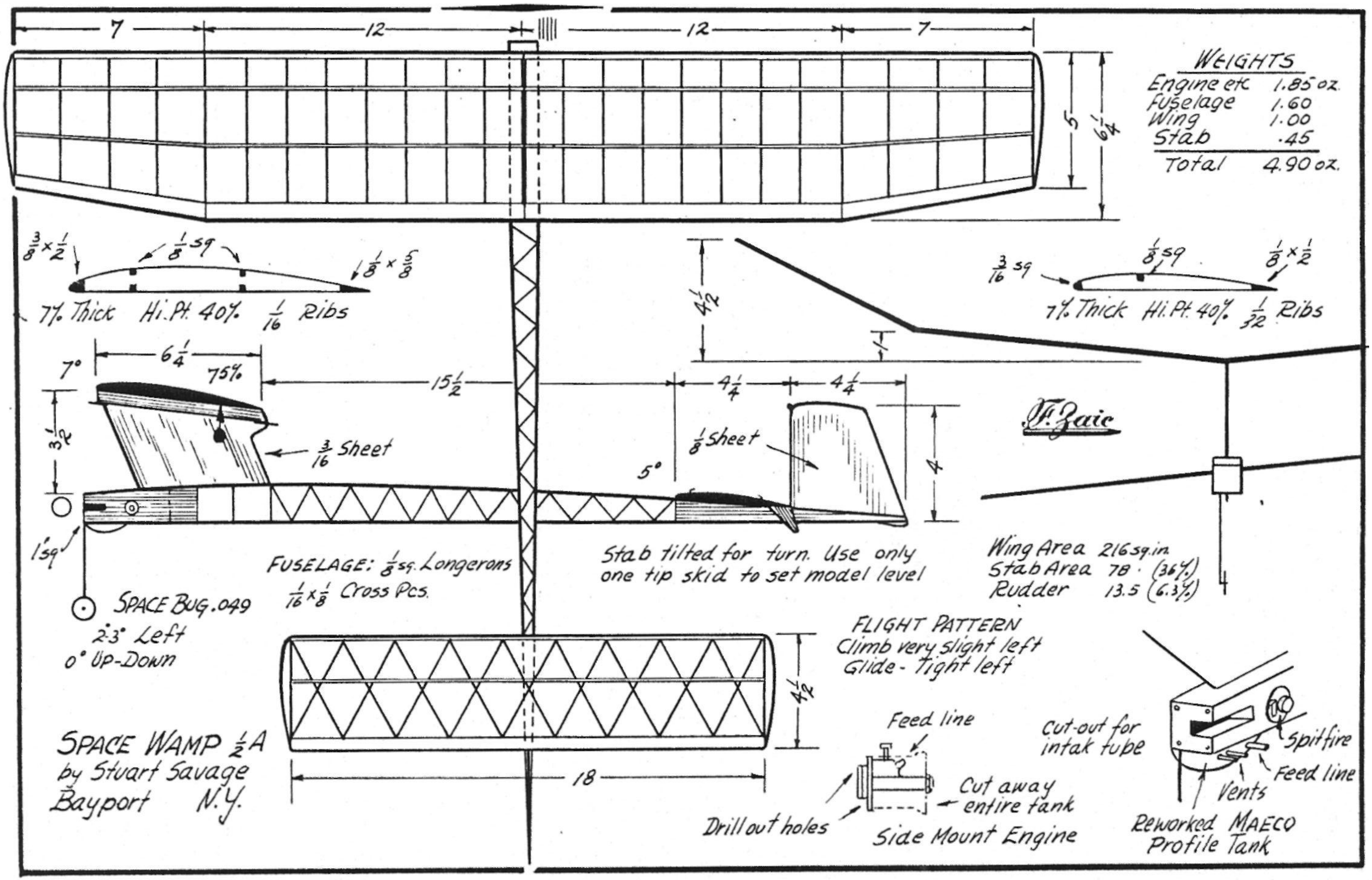
FUSELAGE
Circular in Cross section throughout
2 1/2 Froom
Cowl - Brass shim stock
1/16 Sheet
2-3/16 Lam.
1/4 x 1/2
1/4 x 3/4
1/4 x 1/2
1/4 sq
1/4 x 1
Goldberg G-5 3/32 ribs
14
21 1/2
35 1/2
10 1/2
14 1/2
5
14 1/2
2 1/2°
PYLON
1/4 Frame - 3/32 sheet covered
18
1/8 sq. Stringers
1/16 sheet
1/8 x 3/8
1/4 sq
1/4 x 3/4
1/4
Thinned Clark Y 3/32 Ribs
2
Stab removable from Bottom
Rudder & Fin 3/16 sheet
8
0°
7 1/2
3" Dia
1/8 Planking
U.C. Cowling
Blue Streak .65
13 x 5 1/2 TopFlite
BLAZER
Class C F.F.
by Claude McCullough
Ottumwa Iowa
35
8
10 1/2
Wing Area
900 sq. in
1/8 Wire
F. Zaic



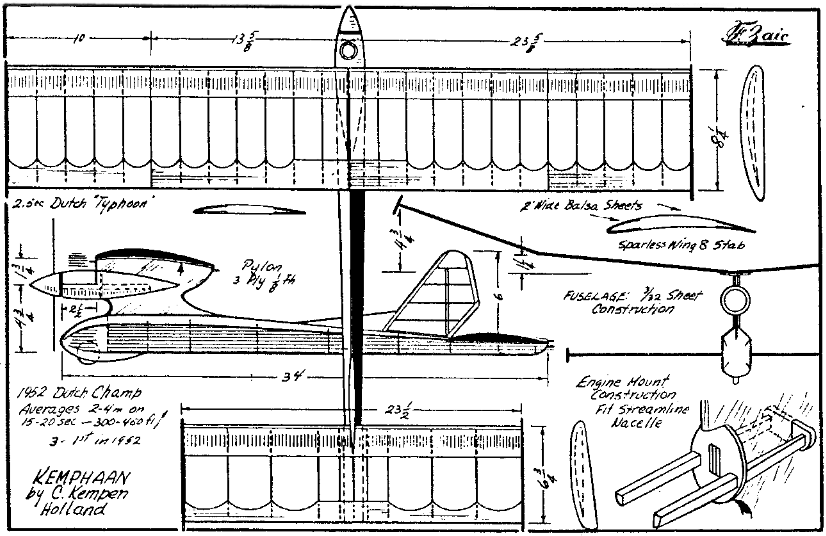


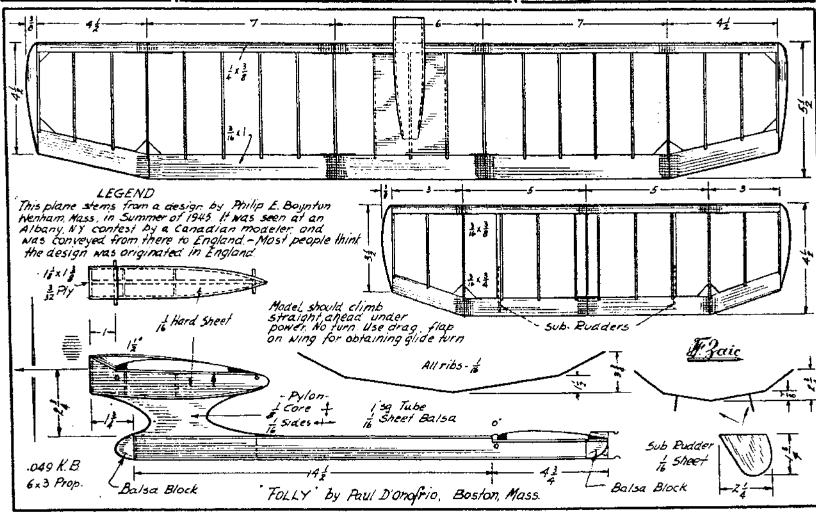
sinking speed. The general case of a model gliding can be described by the sinking speed and one angle or two angles, the angle of attack (angle between the center line and the wind) and the attitude relative to the ground (angle between the center line and the horizontal).

The same sort of a situation exists in the directional case. Constrain a model to keep its center line pointing along a compass direction, say due North. Catapult it in this direction. Now pull it sidewise, but leave the center line on the "north heading. The model is obviously skidding. Equally obvious is the fatt that there is an angle between the center line and the resultant wind. The situation is entirely analogous to the symmetrical model with the sinking speed. Since most airplanes are symmetrical about the vertical plane, yaw and sideslip are the same thing in a different lan-



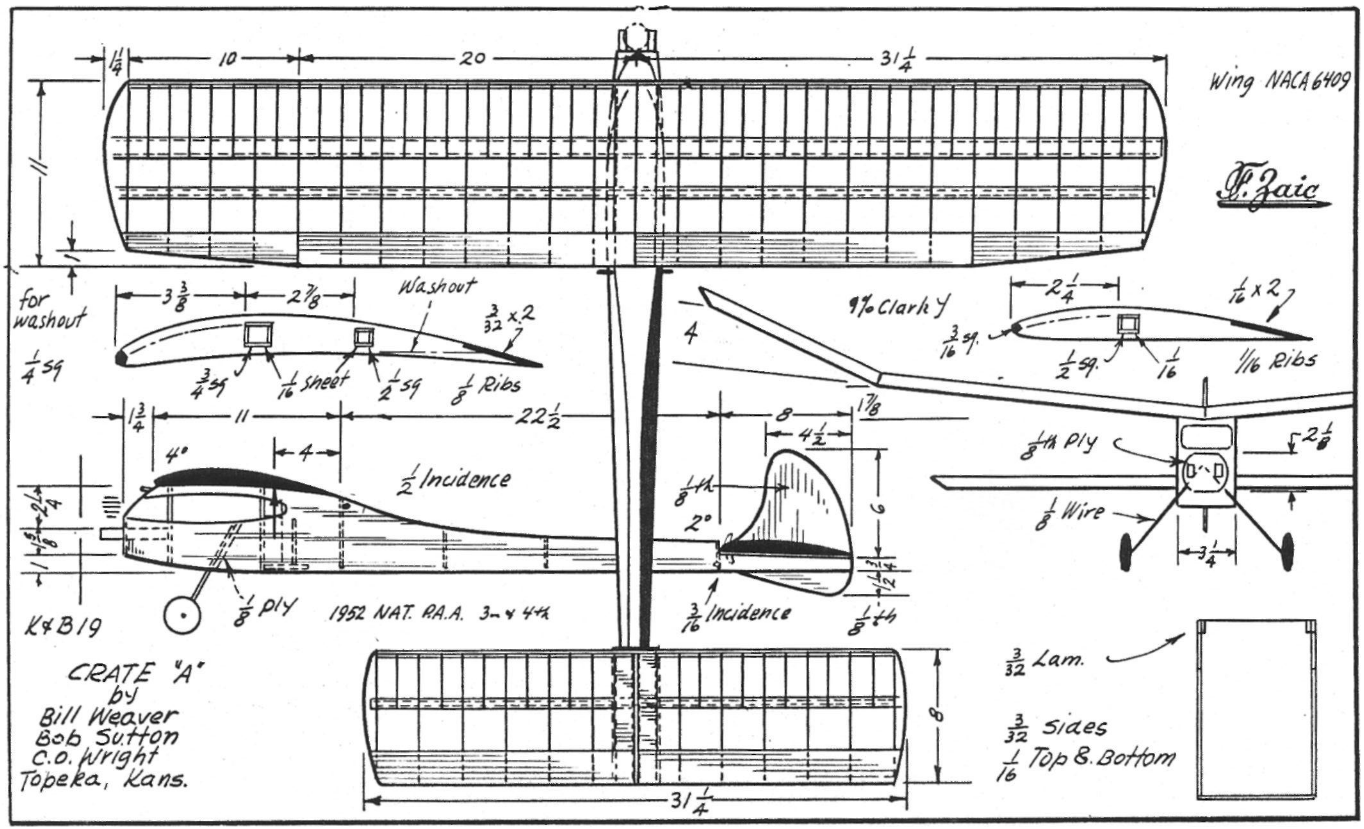
WEIGHTS
Engine etc 1.85 oz.
Fuselage 1.60
Wing 1.00
Stab .45
Total 4.90 oz.
7% Thick Hi.Pt. 40% 1/16 Ribs
3/8 x 1/2
1/8 sq
1/8 x 5/8
7% Thick Hi.Pt. 40% 1/32 Ribs
3/16 sq
1/8 sq
1/8 x 1/2
FUSELAGE: 1/8 sq. Longerons
1/16 x 1/8 Cross Pcs.
3/16 Sheet
1/8 Sheet
SPACE BUG .049
2-3° Left
0° Up-Down
Stab tilted for turn. Use only one tip skid to set model level
Wing Area 216 sq.in.
Stab Area 78 (36%)
Rudder 13.5 (6.3%)
FLIGHT PATTERN
Climb very slight left
Glide - Tight left
SPACE WAMP 1/2 A
by Stuart Savage
Bayport N.Y.
Feed line
Cut away entire tank
Drill out holes
Side Mount Engine
Cut-out for intak tube
Spitfire
Feed line
Vents
Reworked MAECO Profile Tank
F. Zaic



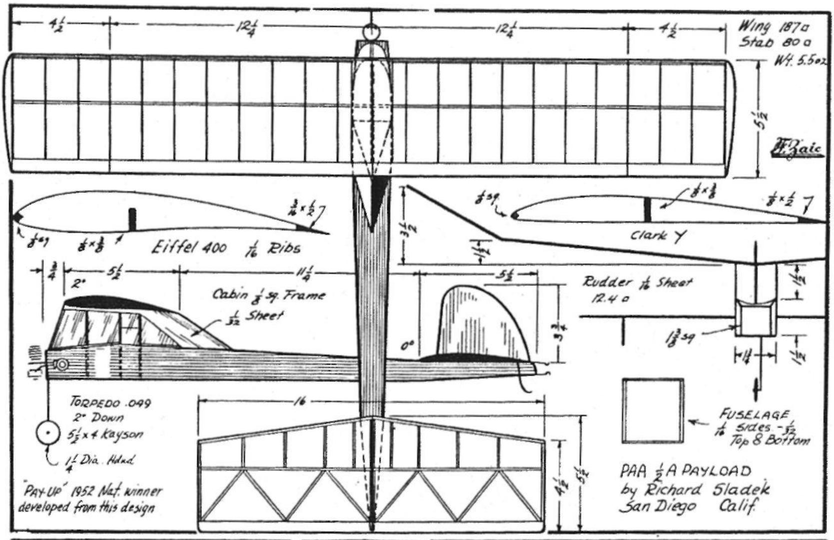


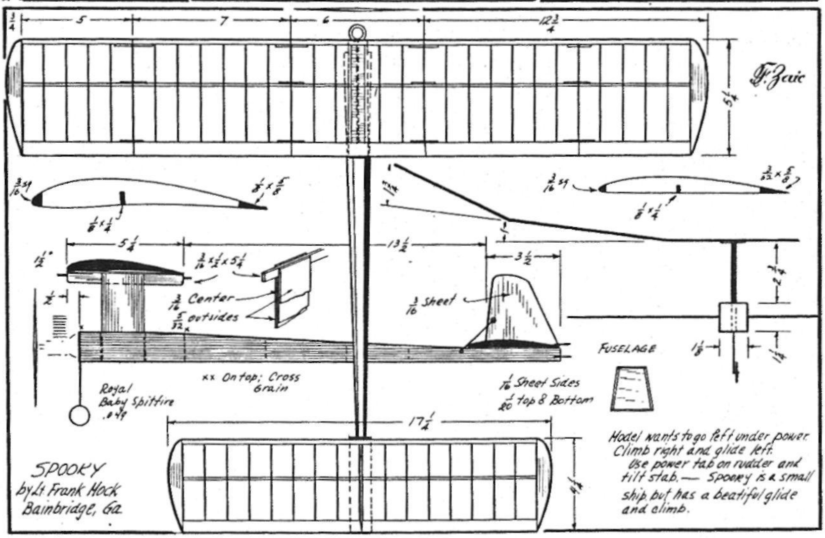
guage. It does not have to be so, however, for if the model were flying level rotated 90° to be on its side (a difficult feat I admit but for illustration only) there would be a yaw angle but no sideslip.

4. Torque and slipstream. I don't share your concern over torque. This is one of the most overrated forces in the business. You contend that a model under power is in a left skid. Not necessarily! Maybe it is, and maybe it is not. It certainly varies from plane to plane, altho the odds may favor a left skid in level flight. Actually, the question is academic. As far as *stability* is concerned it doesn't make any real difference. It is a matter of trim only. In other words as long as I can find a rolling moment to balance the engine torque without stalling any surface I am in business. What are some of the possibilities?



Wing NACA 6409
F. Zaic
for washout
1/4 sq
Washout
3/32 x 2
3/4 sq
1/16 sheet
1/2 sq
1/8 Ribs
9% Clark Y
1/16 x 2
3/16 sq.
1/2 sq.
1/16
1/16 Ribs
4°
1/2 Incidence
1/8 ply
K&B 19
1952 NAT. P.A.A. 3rd & 4th
2°
3/16 Incidence
1/8 th ply
1/8 Wire
3/32 Lam.
3/32 Sides
1/16 Top & Bottom
CRATE "A"
by
Bill Weaver
Bob Sutton
C.O. Wright
Topeka, Kans.





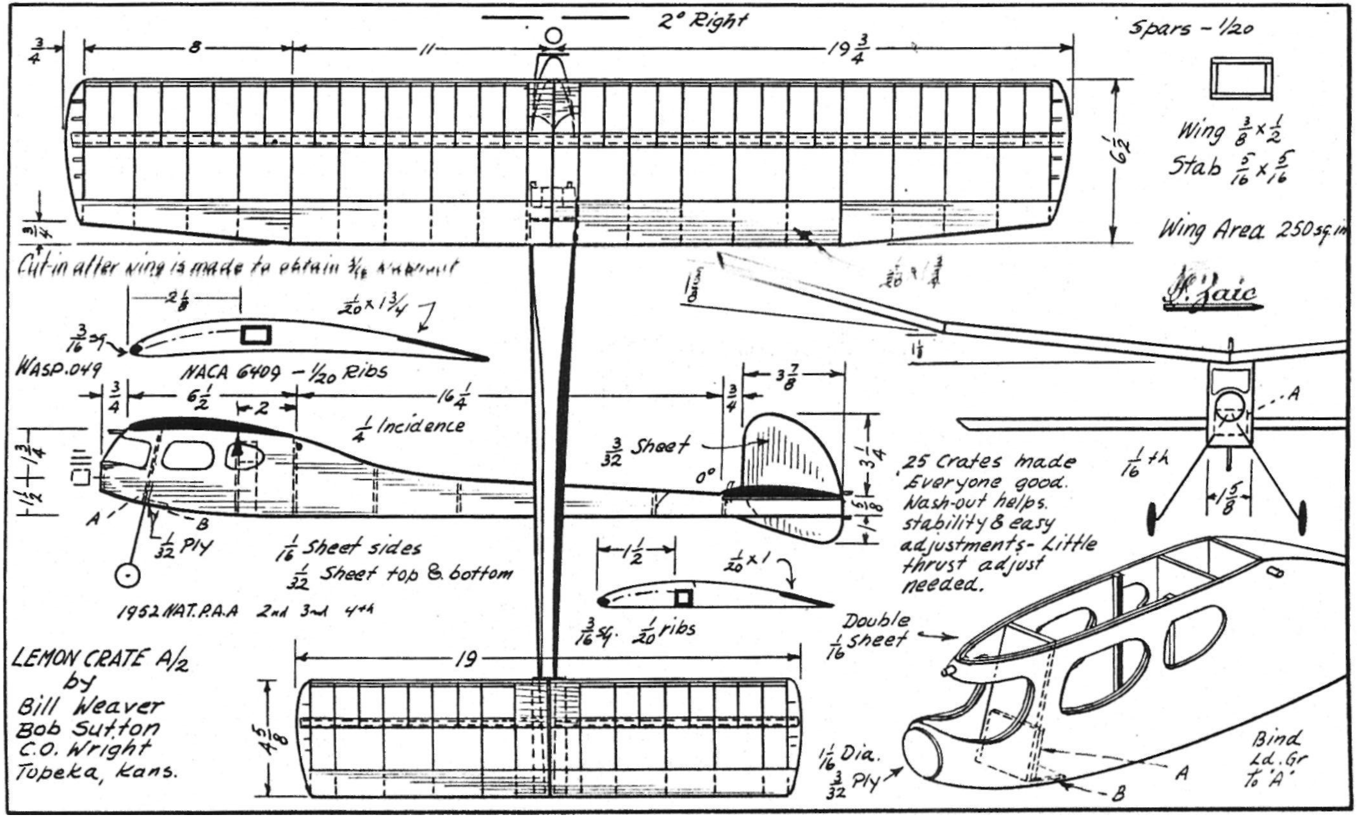
(1) Sideslip (or yaw). Rolling moment is produced by the dihedral.

(2) Circling flight (yawing velocity). The rolling moment is produced by the outside wing traveling faster than the inside wing and by the action of dihedral ahead of or behind the center of gravity.

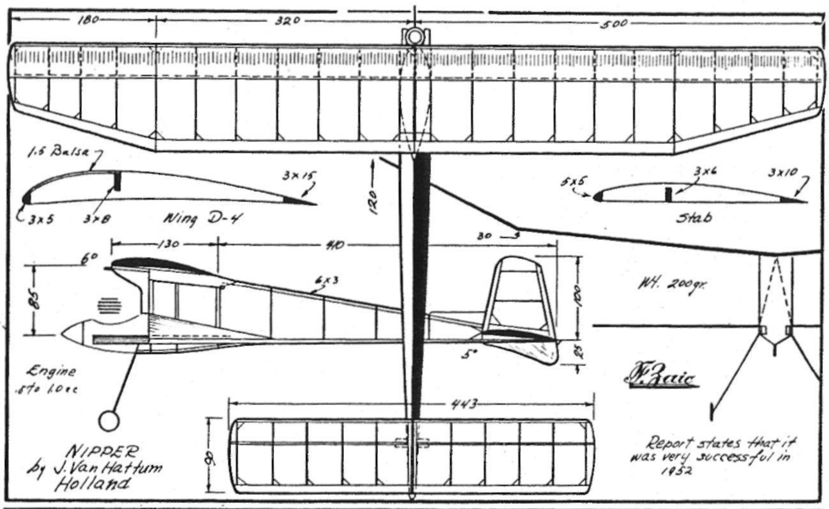
(3) Rolling velocity. Keep in mind that a model which is climbing or diving always has a rolling velocity if there is any steady turn. Consider a " straight up climb to clinch the point.

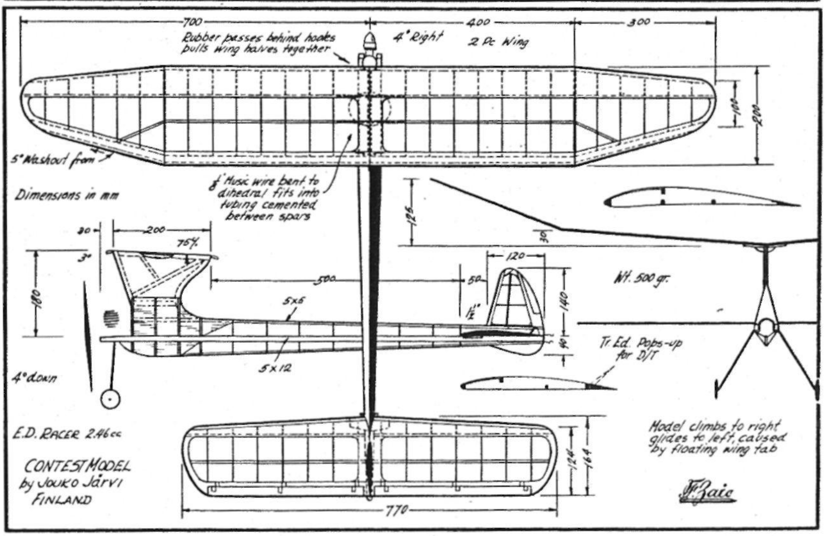
(4) Ailerons'—or warps in the wing.

Take a look at that last force to see why some models don't have a left side slip. Suppose we consider power on flight as the normal state of affairs,

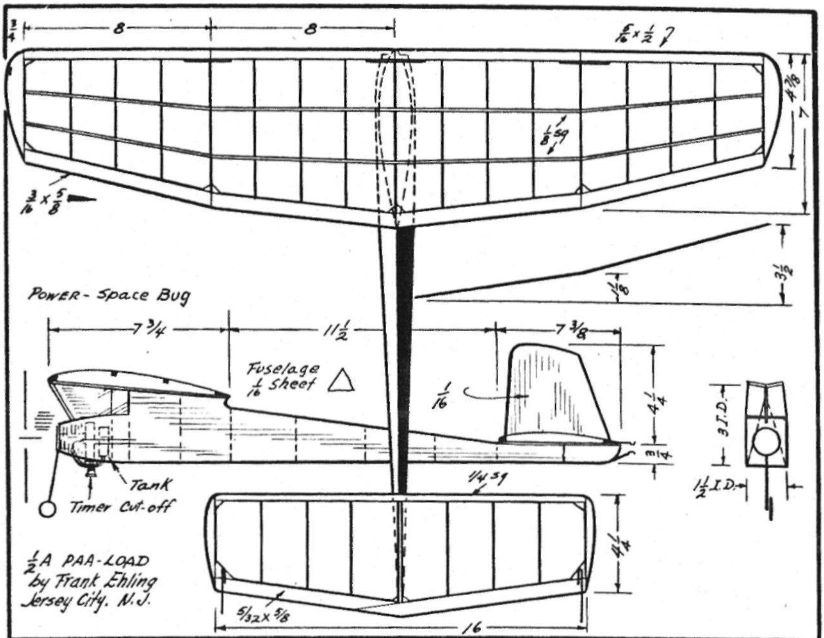


2° Right
Spars - 1/20
Wing 3/8 x 1/2
Stab 5/16 x 5/16
Wing Area 250 sq. in
Cut-in after wing is made to obtain 3/16 washout
NACA 6409 - 1/20 Ribs
WASP .049
1/4 Incidence
3/32 Sheet
1/16 Sheet sides
1/32 Sheet top & bottom
1/32 Ply
1952 NAT. P.A.A 2nd 3rd 4th
3/16 sq. 1/20 ribs
25 Crates made Everyone good. Wash-out helps stability & easy adjustments - Little thrust adjust needed.
Double 1/16 Sheet
1/16 Dia.
3/32 Ply
Bind Ld. Gr To 'A'
LEMON CRATE A/2
by
Bill Weaver
Bob Sutton
C.O. Wright
Topeka, Kans.

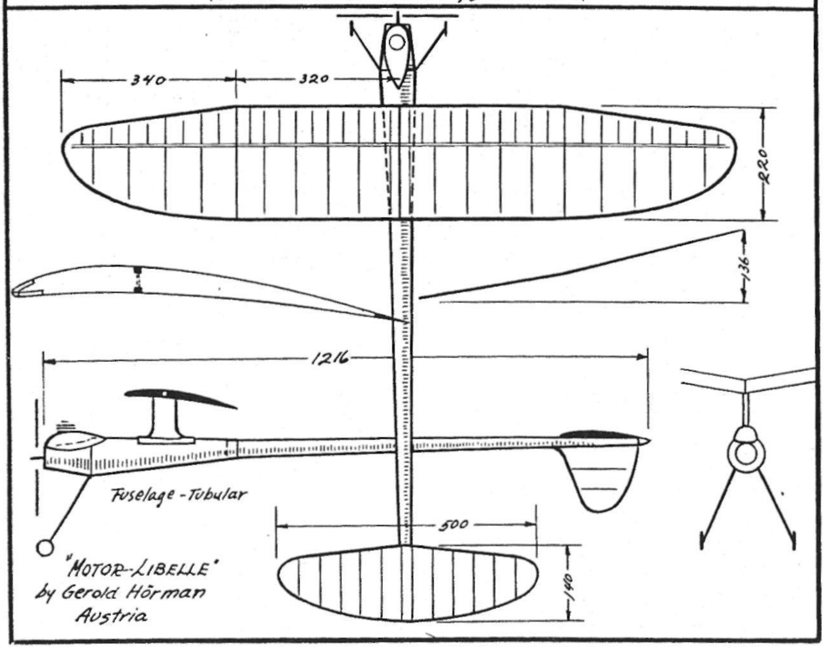




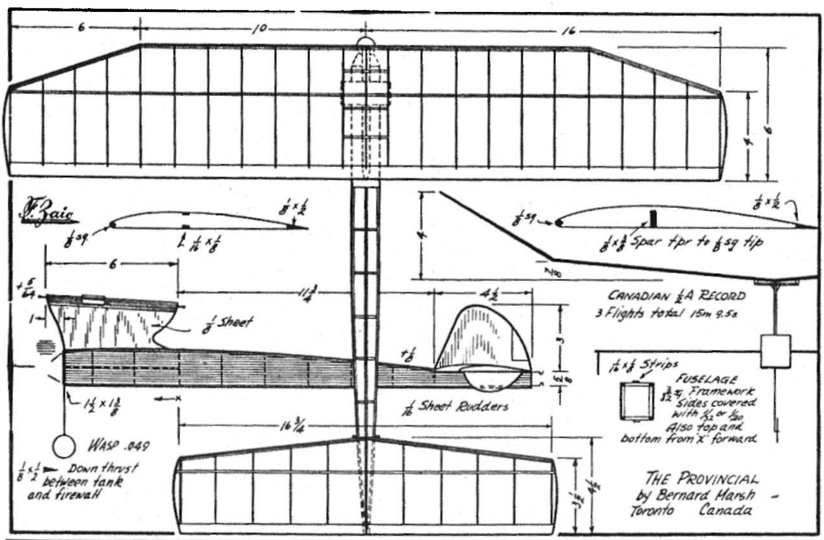
and let's assume that we have a device for measuring the sideslip. Now during the first few flights we adjust the ailerons (wing warps), rudder, and side thrust so that there is zero sideslip and the flight is straight. Since it is easy to overpower the torque with ailerons, we could just as easily have trimmed for a right sideslip. Will it glide? Sure! It may have a circle and it may have some sideslip, but it will glide and very nicely. You know as well as I do that everybody has some warps no matter how well he builds. Chances are that these are more important than the torque; at least the torque that remains after the flow is sraightened out by all the various surfaces, pylon, wing, horizontal tail, vertical tail, and friction on the fuselage.

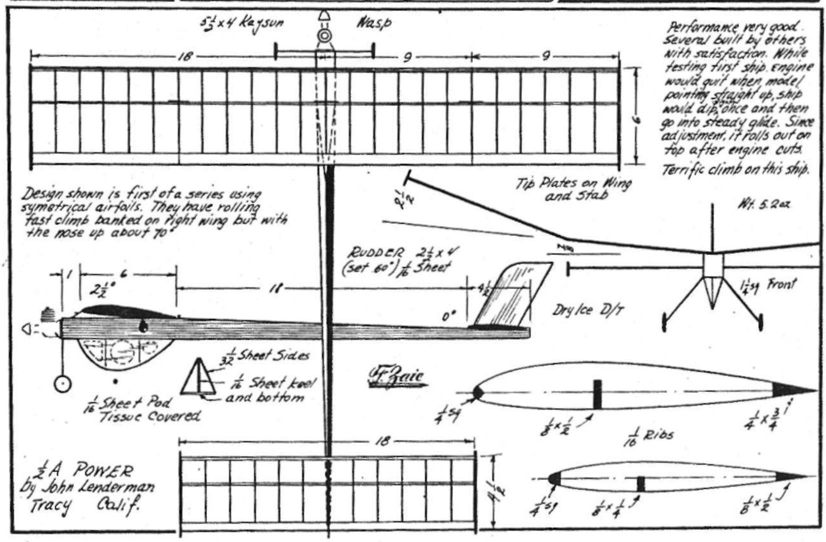


POWER- Space Bug
Fuselage 1/16 Sheet
Tank
Timer Cut-off
1/2 A PAA-LOAD
by Frank Ehling
Jersey City. N.J.
3 I.D.
1 1/2 I.D.



Fuselage - Tubular
"MOTOR-LIBELLE"
by Gerold Hörman
Austria





The effect of the slipstream twist on yawing moments is probably more important. The vertical tail is a long way from the center of gravity. A small force produces a large moment. Note that with a reasonable amount of downthrust the bottom part of the slipstream can act even on a vertical tail above the fuselage. The force on the tail is then in the opposite direction from that on the pylon, but the moments are in the same direction.

As I read model publications I am forced to conclude that the thing most needed is a clear understanding of the fundamental difference between stability and trim. Think about that for a while.

PARNELL SCHOENKY—PAA CLIPPER CARGO DESIGN NOTES—

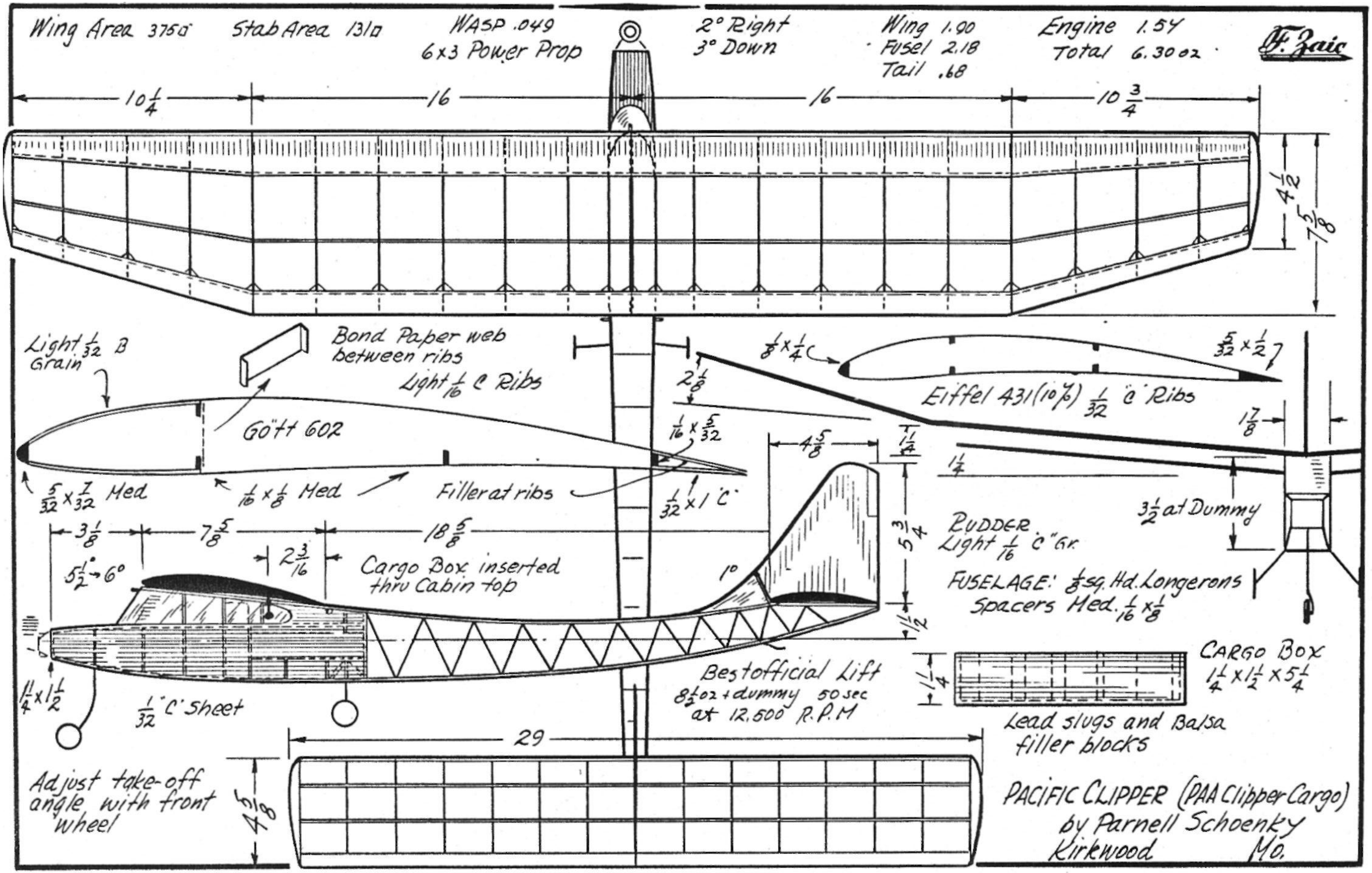
In many model categories, a well-designed and structurally-excellent model has little, chance to prove its worth against the field of standardized designs with hot engines—for thermals are indeed blind and they sweep all manner of debris into the clouds. Happily, the Clipper Cargo is not among these unfortunate events; though it goes without saying that a Clipper Cargo must have a powerful engine, the elements of luck take a back seat to the skills of the designer and the craftsman.

A Clipper Cargo model should be built of light, carefully selected wood in order to keep the dead weight down, for only payload means points! Light construction does not mean flimsy construction if the builder puts the balsa, cement, and wire where the loads are the greatest (as is so well-illustrated by the modern Wakefield and indoor models) and, further, if the ship is designed to bend, twist, or to shed parts where it is impractical from a weight standpoint to build in the strength and rigidity necessary to absorb shocks head on. The aerodynamic design of the Clipper must give good take-offs in both wind and calm, and the rate of climb and the stability at high angles of attack must also be sufficient to enable the Clipper to lift 15 to 20 ounces of lead or other payload to a height from which the model may glide for about 25 seconds before landing—all this within the structural limitations necessary to. produce both a light model and a rugged model capable of meeting the undamaged landing requirements.

The "Pacific Clipper" present just one solution to this intriguing design problem, in the form of a fairy conventional and realistic model. There are other avenues of approach which the modeler may desire to investigate, particularly the Burnell type of craft and the pure flying wings —of which the Broggini "Cargowing" is an excellent example.

It may be said that the "Pacific Clipper" was designed around the wing and the landing gear. The 375 sq. in. wing is suited to a model of 20 to 25 oz. over-all weight and has been proven sufficiently rugged by plenty of rough landings. The paper shear web used to complete the "D" spar works fine—and it saves both time and balsa. A two-wheel landing gear which is placed far enough forward to protect the fuselage in steep landings is in the worst possible position so far as preventing ground loops is concerned. Hence the use of the tricycle gear—which also offers the distinct advantage of permitting the take-off angle of attack to be adjusted for flights off of short runways and for those situations where the Clipper Cargo's best friend, the wind, fails to show up. The stabilizer is place'd high and dihedraled in order to protect it in landings and also in an effort to minimize the tricky effects of the turbulent wing wake.

Heavily loaded as they are, Clippers still fly fast enough for drag to be important, and this model was made as "clean" as possible. Speaking of drag, the Clipper builder who designs his own should avoid the super high-lift airfoil sections unless he really knows his aerodynamics, for the drag of such sections is likely to be high; the danger in this is that the total drag may be so great as to slow the model down to where props of 3 to 4 inch pitch may be partially stalled out. The engine for your "Pacific Clipper" must swing a 6-3 or 5y₂-4 prop at 13,500 RPM or better to put you in the race. For the newer engines, rated at 18 to 20,000 RPM, enlarge the wing area to 450-465 sq. in., fin and stab, proportionately, and increase nose gear wire gauge to .050."



Wing Area 375□
Stab Area 131□
WASP .049
6x3 Power Prop
2° Right
3° Down
Wing 1.90
Fusel 2.18
Tail .68
Engine 1.54
Total 6.30 oz
F. Zaic
10 1/4
16
16
10 3/4
4 1/2
7 5/8
Light 1/32 B Grain
Bond Paper web between ribs
Light 1/16 C Ribs
Gött 602
5/32 x 1/32 Med
1/16 x 1/8 Med
Filler at ribs
2 1/8
1/16 x 5/32
1/32 x 1 'C'
1/8 x 1/4 C
5/32 x 1/2
Eiffel 431 (10%) 1/32 'C' Ribs
1 7/8
4 5/8
1 1/4
1/4
3 1/2 at Dummy
3 1/8
7 5/8
18 5/8
2 3/16
5 1/2° → 6°
Cargo Box inserted thru Cabin top
1°
5 3/4
RUDDER Light 1/16 'C' Gr.
FUSELAGE: 1/8 sq. Hd. Longerons
Spacers Med. 1/16 x 1/8
1/2
1 1/4 x 1 1/2
1/32 'C' Sheet
Best official Lift
8 1/2 oz + dummy 50 sec
at 12,500 R.P.M
1 1/4
CARGO BOX
1 1/4 x 1 1/2 x 5 1/4
Lead slugs and Balsa filler blocks
29
4 5/8
Adjust take-off angle with front wheel
PACIFIC CLIPPER (PAA Clipper Cargo)
by Parnell Schoenky
Kirkwood Mo.

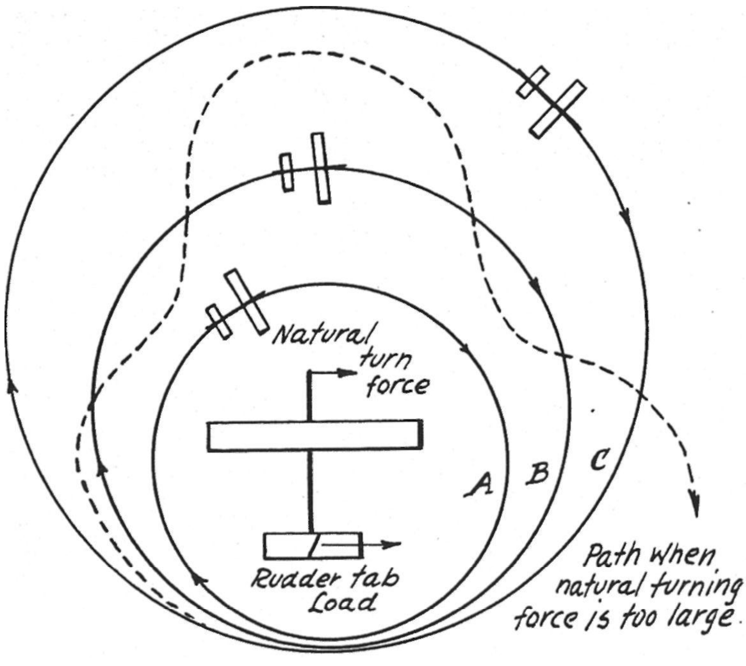
G. R. NOLIN—ADJUSTING FOR CLIMB—

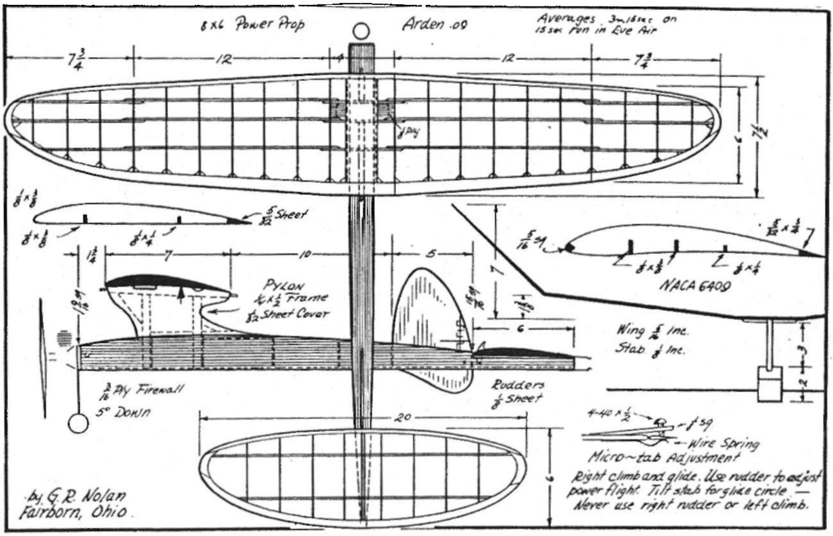
A model can be made spirally stable if it is proportioned so that it flies in a natural power circle which is slightly smaller than the desired circle. The desired circle should be obtained by setting the rudder tab against the natural power circle. That is, the model climbs right with left rudder, or vice-versa. This set-up is based on the belief that the force exerted by the rudder tab varies directly with the airspeed, and that the natural turning force remains nearly constant when the airspeed increases.

For example: A model which flies under power in a "natural" circle of radius "A" is forced into circle "B" by the use of left rudder. The model will then climb steeper, and at lower airspeed (Circular Airflow Theory). It cannot approach circle "A" without an increase in airspeed, and a corresponding increase in rudder tab load. The added rudder tab load will then correct the model toward circle "B".

In the event that the model moves into an even larger circle "C" the airspeed will diminish due to the increased angle of climb (Circular Airflow again). The rudder tab will then have less force with which to oppose the natural turning force. The natural power turn will then correct the model towards circle "B". Thus we now have both maximum and minimum limits on the size of the power circle.

When put into practical test the set-up will often seem unsatisfactory because of the fact that the model will in many cases travel back and forth between the circular limits. In other words, a model when launched into a breeze will attempt to fly circle "C". An excessive correction toward circle "B" will result, and the model will pass through circle "B" and approach circle "A". An excessive correction towards circle "C" will follow with the model again passing through circle "B" and approaching "C". Etc. Etc. (See diagram.)





When this difficulty is encountered it is easily corrected by decreasing the natural turn of the model so that the opposing rudder tab deflection can be safely decreased. The rudder tab load will then vary at a lesser rate when the airspeed varies, and the oscillation between circular limits will diminish or disappear.

If a model has little natural turn (that is, requires right rudder to turn right), a variation in the thrust line will usually correct the difficulty. However, enlarging a power turn which is too tight by adding sidethrust does not appear to be satisfactory in practice.

Generally speaking, enlarging the fin will increase the left turning forces of a model, and decreasing the fin will improve the right turning ability. It should be noted that because of fundamental spiral stability considerations an increase in fin area moment is often undesirable.

I have found that the right turning capabilities can be decreased by moving the fin forward, and increased by moving the fin rearward while maintaining a minimum fin moment value (Area x Distance from C.G.) *Note:* When using this approach to the spiral problem the glide circle adjustments must be made by tilting the stabilizer'.

Frank Heeb and I have been running some interesting tests on prop wash theory. We hung a piece of thread in the slipstream and noted that it blew straight back and vibrated rapidly. Had an idea that the air between the blades was coming thru the prop quite straight, but the air from the blades themselves was moving at an angle.

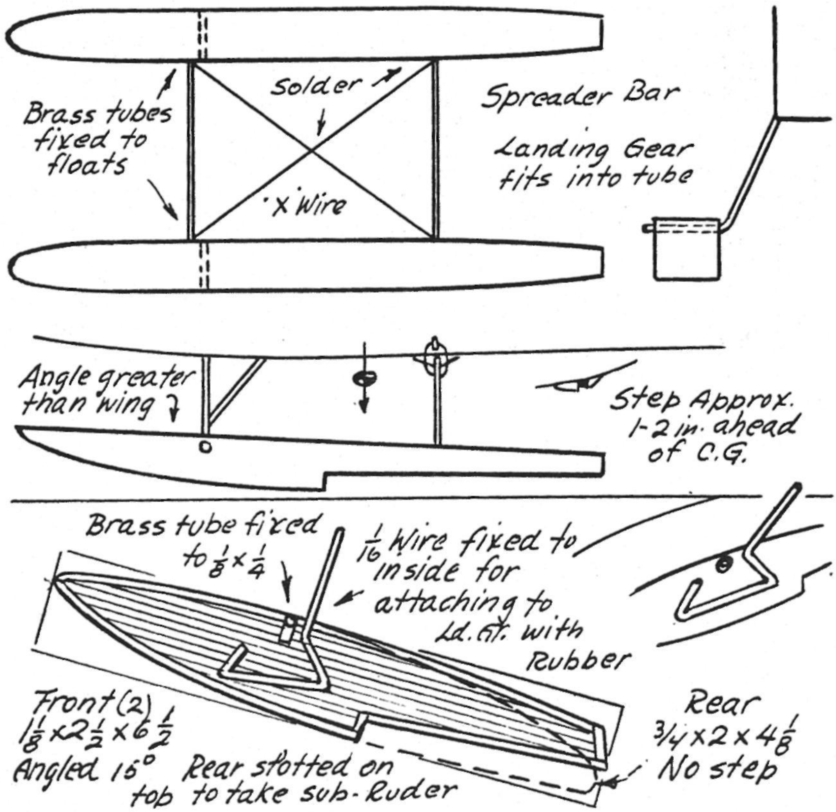
We "stopped" the blade with a stroboscope and the string no longer vibrated, but hung back at the expected angle—approx. 20°. Higher pitch increased the angle, and the angle gradually diminished as the distance from the prop increased.

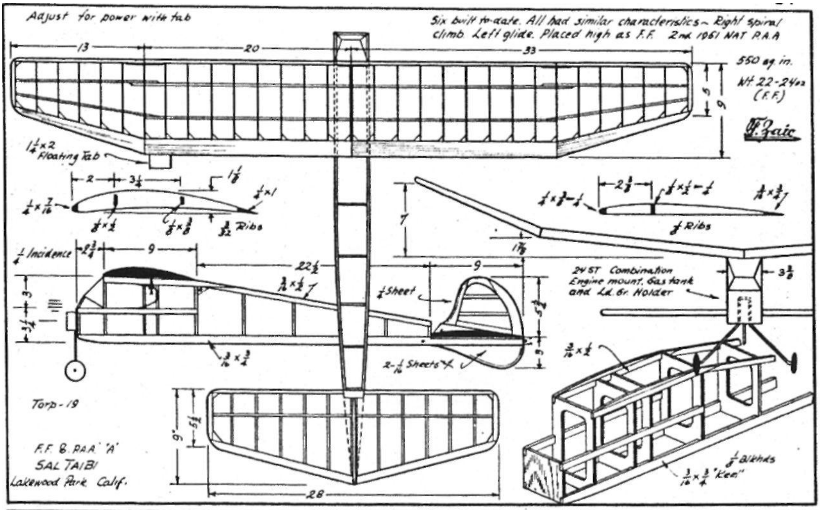
SAL TAIBI—FLOATS—

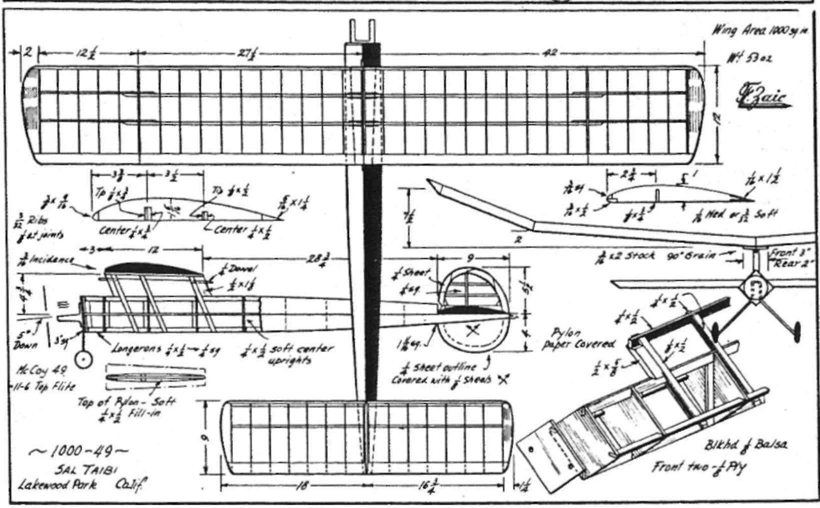
I personally like two Edo type floats best but have found out in the past five years of flying ROW that it just does not pay off, the drag and weight seem to handicap the model too much. But for flying-for-fun I think they are tops. I like to watch the long run which is so realistic, and also the real appearance of the model in the air. I usually set Edo floats so that the top of the float, which is straight, is approximately 1/4" positive to the wing, not to the thrustline or centerline of the fuselage, but to the angle of the wing. These floats must be fixed very rigid. I usually make the landing gear as short as possible so that the planning action on the water will be better. Allow about 2" clearance from prop to the top of the float.

The float must be very rigid. It should be "Xd" with light wire and soldered. The rear float support is also soldered to the rear spreader bar and fastened to the fuselage with small rubber bands around a small hook. The main landing gear is pulled together and then slid into brass tubing in the float: No fastening necessary as the spreading action of the gear will hold wire in tubing. It is best to cement small hardwood wedges in place where rear float support is fastened to the body so that the support will not slide back or forward. If this happens, it will change angle of attack of the float.

CONTEST TYPE FLOATS—I am enclosing full size layout of the floats I used at the 1951 Nats. Had them on an .099 Arden powered Zenith

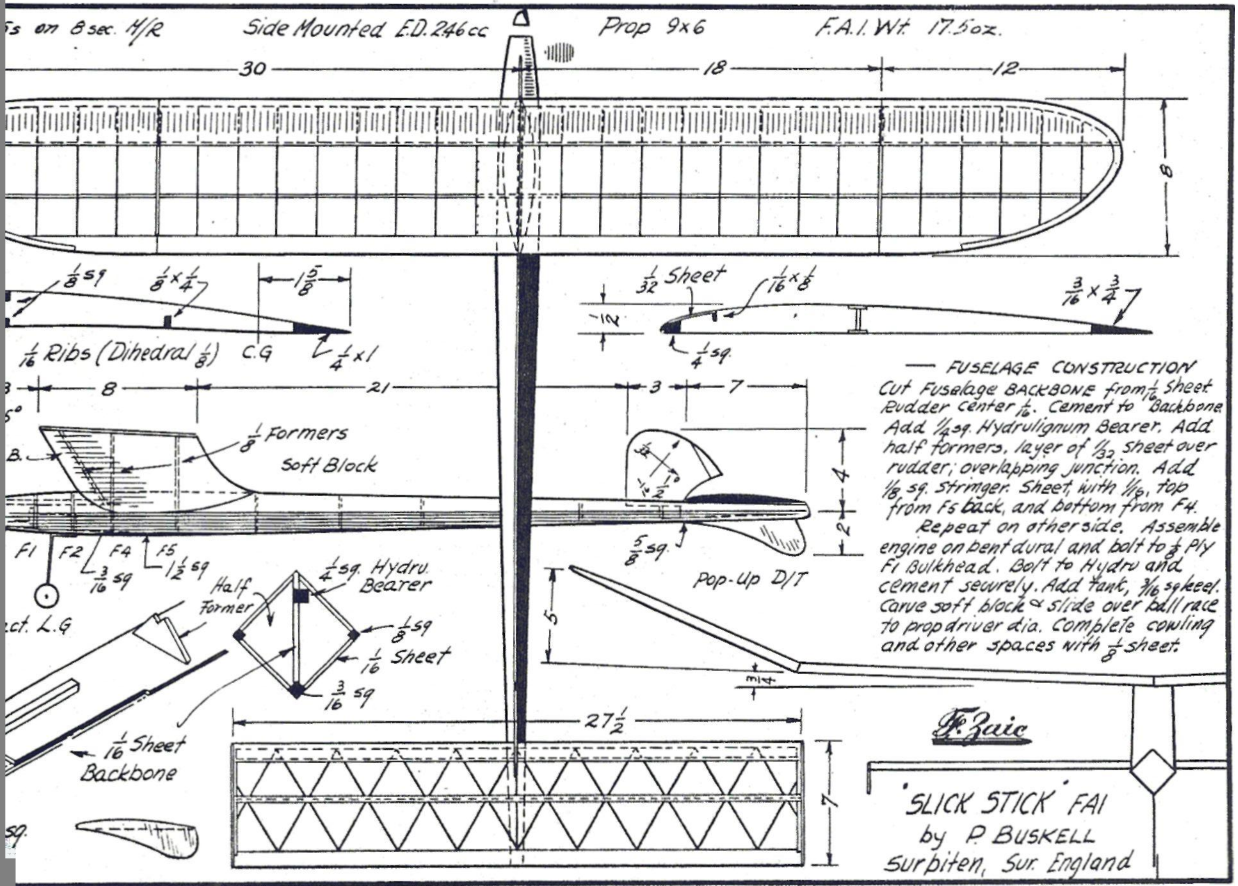




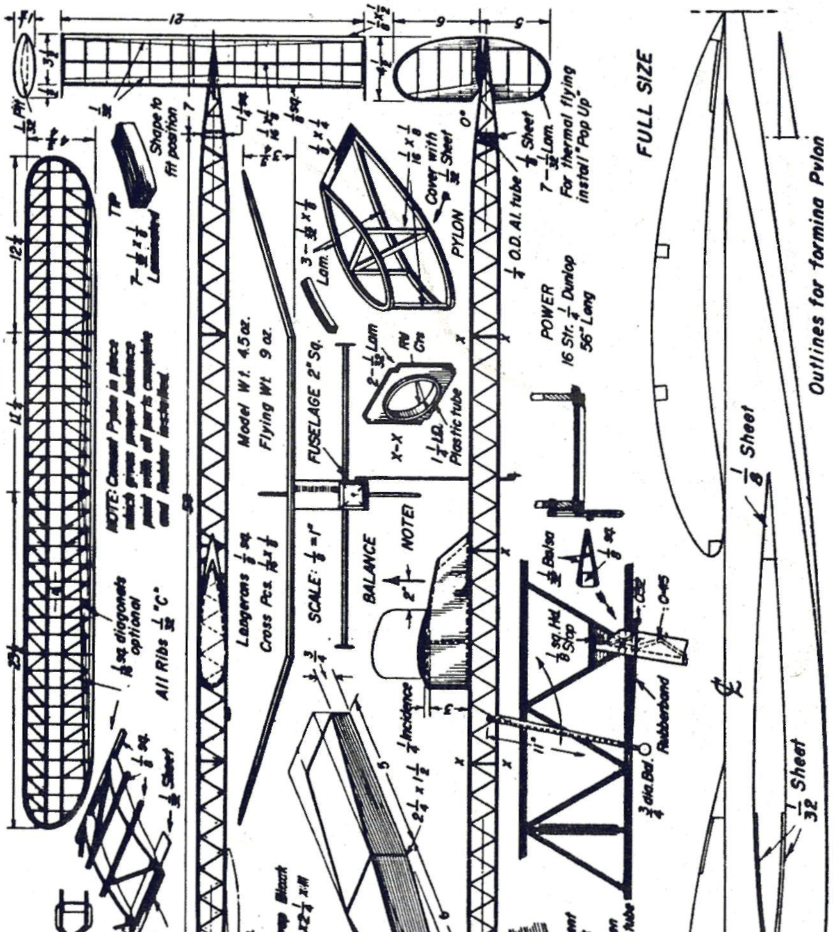


model whose weight was 11 oz. with floats, and had an area of 365 sq. in. It placed second. There is no internal construction, just sides and covering. Sides are cut from 3/32 soft balsa, and covered also with soft 3/32. Brass tubing was wrapped and cemented to a balsa and cemented in the float. A 1/16 wire piece is cemented to the side of the float. It is fixfed to the landing gear, which is slipped into the brass tubing, with rubber bands.

The models these days are so highly overpowered that with the sled type floats they require practically no take-off run; as soon as they are released they just jump off the wetar, especially if there is a 5 to 10 m.p.h. breeze. This is not "my idea of a seaplane, rather, it's an excuse to enter a good flying model in a seaplane event. I tried flying a seaplane for four years, and then saw the futility of it and built a pair of sled type floats for my Zenith.

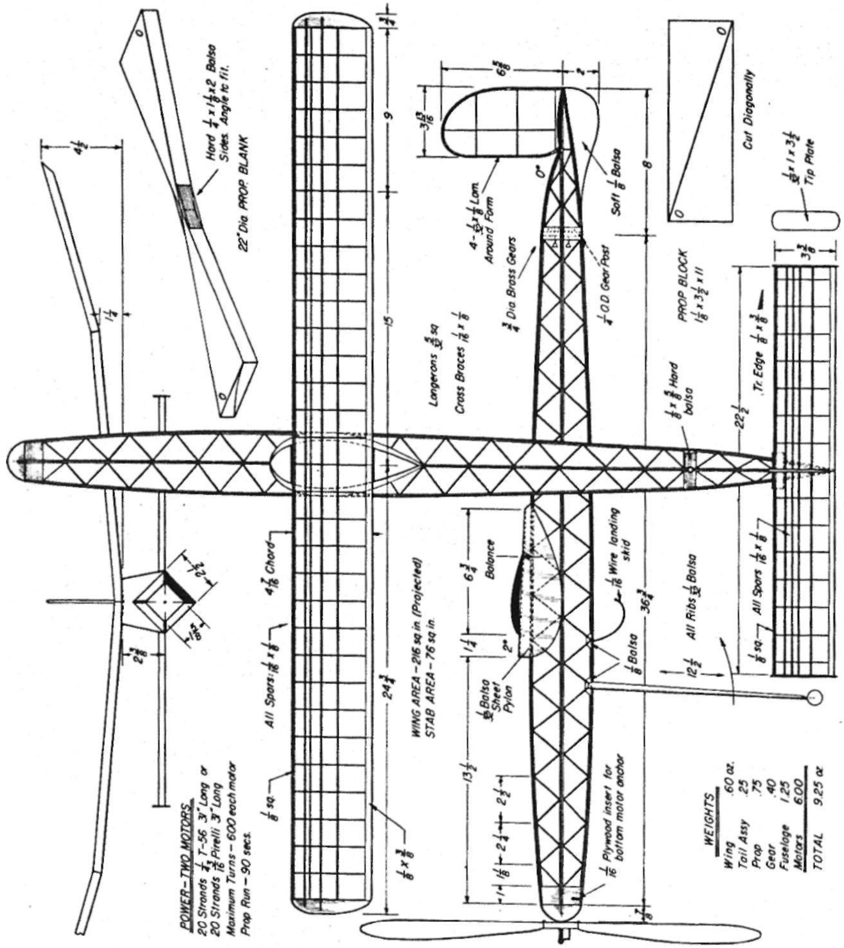


s on 8 sec. H/R
Side Mounted E.D. 2.46 cc
Prop 9×6
F.A.I. Wt. 17.5 oz.
30
18
12
8
1/8 sq
1/8 × 1/4
1 5/8
1/16 Ribs (Dihedral 1/8)
C.G
1/4 × 1
1/32 Sheet
1/16 × 1/8
3/16 × 3/4
1/4 sq.
8
21
3
7
1/8 Formers
Soft Block
F1
F2
F4
F5
3/16 sq
1 1/2 sq
Half Former
1/4 sq. Hydru. Bearer
1/8 sq
1/16 Sheet
3/16 sq
1/16 Sheet Backbone
5/8 sq.
4
2
5
Pop-Up D/T
27 1/2
7
— FUSELAGE CONSTRUCTION
Cut Fuselage BACKBONE from 1/16 Sheet. Rudder center 1/16. Cement to Backbone. Add 1/4 sq. Hydrulignum Bearer. Add half formers, layer of 1/32 sheet over rudder; overlapping junction. Add 1/8 sq. Stringer. Sheet with 1/16, top from F5 back, and bottom from F4.
Repeat on other side. Assemble engine on bent dural and bolt to 1/8 Ply F1 Bulkhead. Bolt to Hydru and cement securely. Add tank, 3/16 sq keel. Carve soft block & slide over ball race to prop driver dia. Complete cowling and other spaces with 1/8 sheet.
F. Zaic
"SLICK STICK" FAI
by P. BUSKELL
Surbiten, Sur. England

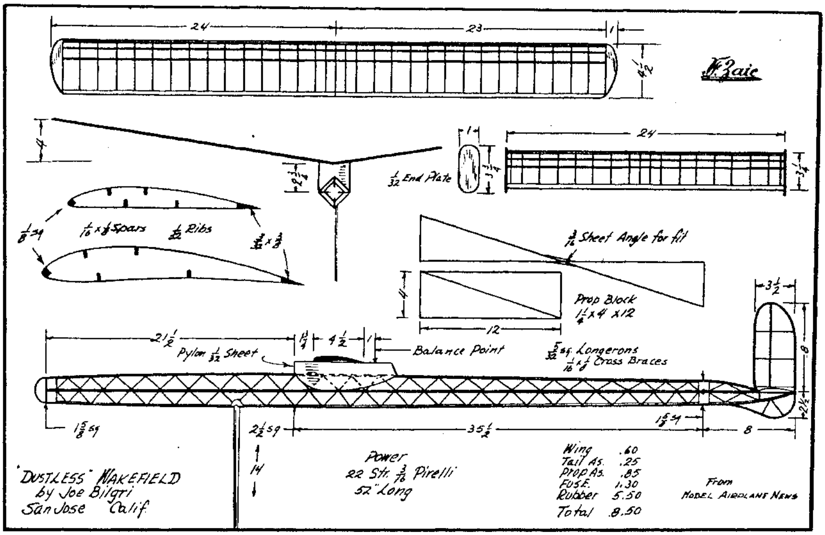


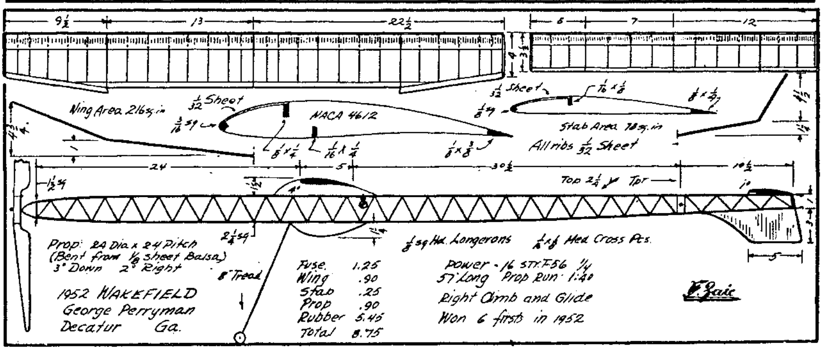
from March, 1952 AIR TRAILS

"OSOLONG" Wakefield - by Hank Cole ~ Palo Alto, Calif.



"THE DRIFTER" from Feb. 1953 AIR TRAILS by Joe Bilgri San Jose, Cal.

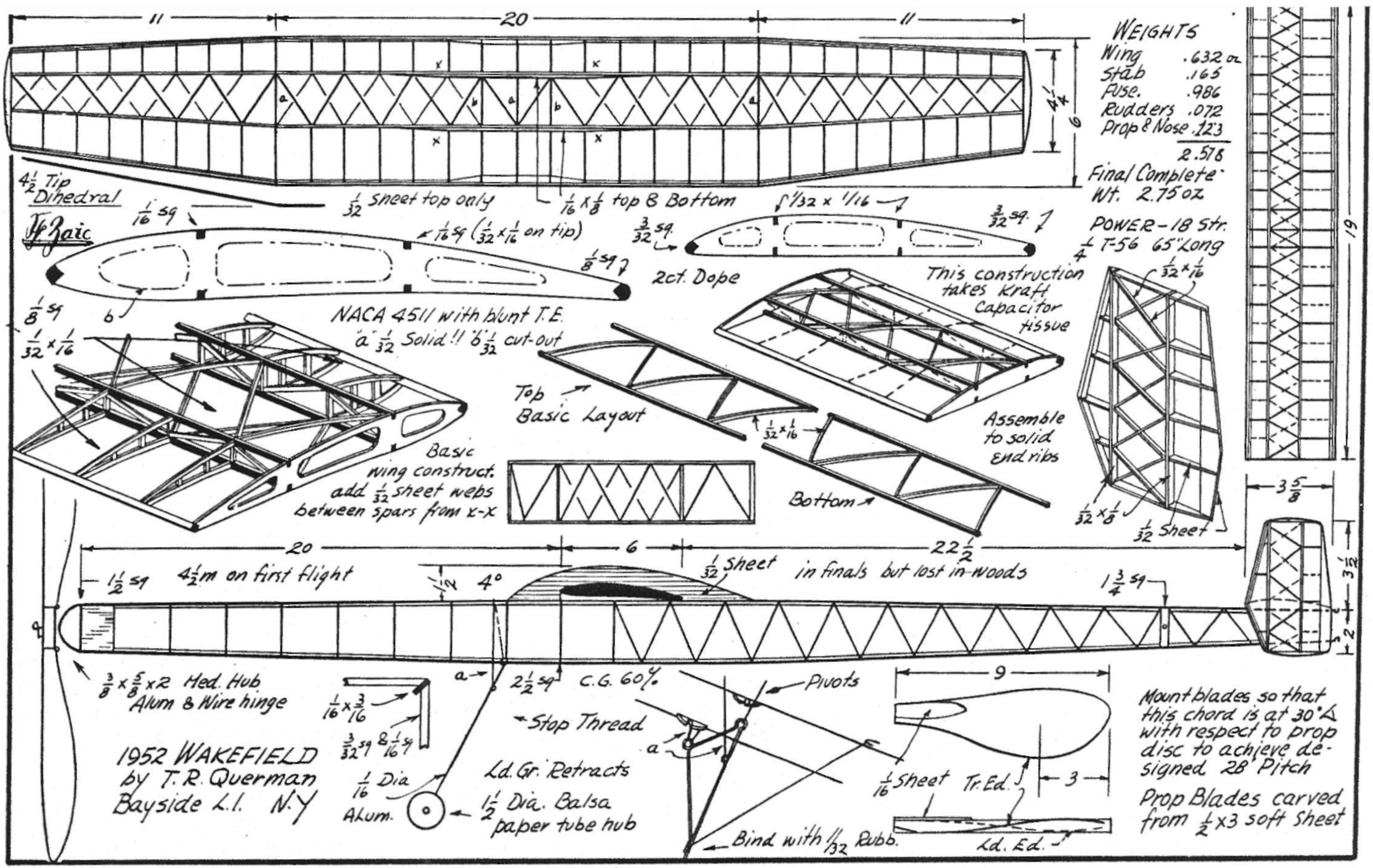




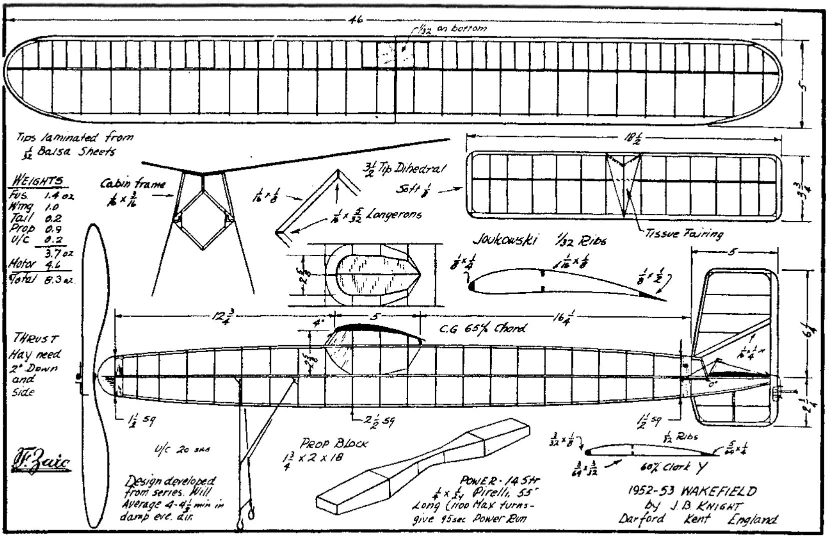
JOE BILGRI—RUBBER MOTOR—

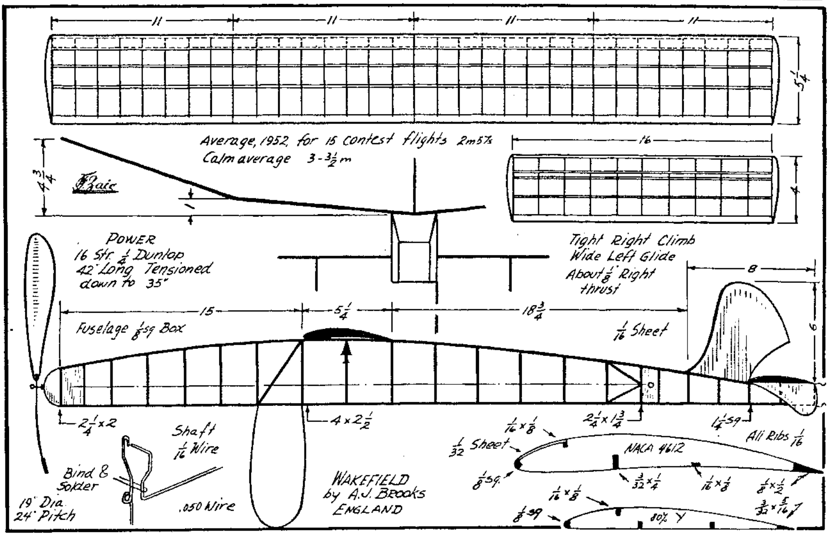
As for rubber; I don't have any special treatment but after I make up a motor I wash it well with cold water, dry it out thoroughly and saturate it well with Castor Oil, and then prewind it, starting with about 50%, then *60%,* 70%, 80% and finish out with about 90% of capacity winds. I figure that capacity for 16 strands of Dunlop is about 20 turns per inch, for over that the rubber tears apart fast. After it is prewound I wash some of the excess oil off, dry it out and put it away until I am ready to use it. On hot days I also use lots of excess oil on the motors for I would rather have an oily model than a busted one.

I usually stretch the motor out between 3 to 3y$_2$ times it soriginal length and put in approximately 75% before coming in.



WEIGHTS
Wing .632 oz
Stab .165
Fuse. .986
Rudders .072
Prop & Nose .123
2.578
Final Complete Wt. 2.75 oz
POWER – 18 Str. 1/4 T-56 65" Long
4 1/2 Tip Dihedral
1/32 sheet top only
1/16 x 1/8 top & Bottom
1/16 sq
1/16 sq (1/32 x 1/16 on tip)
1/8 sq
1/32 x 1/16
3/32 sq.
2 ct. Dope
NACA 4511 with blunt T.E.
"a" 1/32 Solid !! "b" 1/32 cut-out
This construction takes Kraft Capacitor tissue
Top Basic Layout
Bottom
Assemble to solid End ribs
Basic wing construct. add 1/32 sheet webs between spars from x-x
1/32 x 1/8
1/32 Sheet
20
6
22 1/2
11
19
3 5/8
3 1/2
2
1/2 sq
4 1/2 m on first flight
1/32 Sheet in finals but lost in woods
1 3/4 sq
4°
2 1/2 sq
C.G. 60%
3/8 x 5/8 x 2 Hed. Hub Alum & Wire hinge
1/16 x 3/16
3/32 sq & 1/16 sq
1/16 Dia Alum.
1 1/2 Dia. Balsa paper tube hub
Stop Thread
Ld. Gr. Retracts
Pivots
Bind with 1/32 Rubb.
9
3
1/16 Sheet
Tr. Ed.
Ld. Ed.
Mount blades so that this chord is at 30° with respect to prop disc to achieve designed 28" Pitch
Prop Blades carved from 1/2 x 3 soft Sheet
1952 WAKEFIELD by T. R. Querman Bayside L.I. N.Y



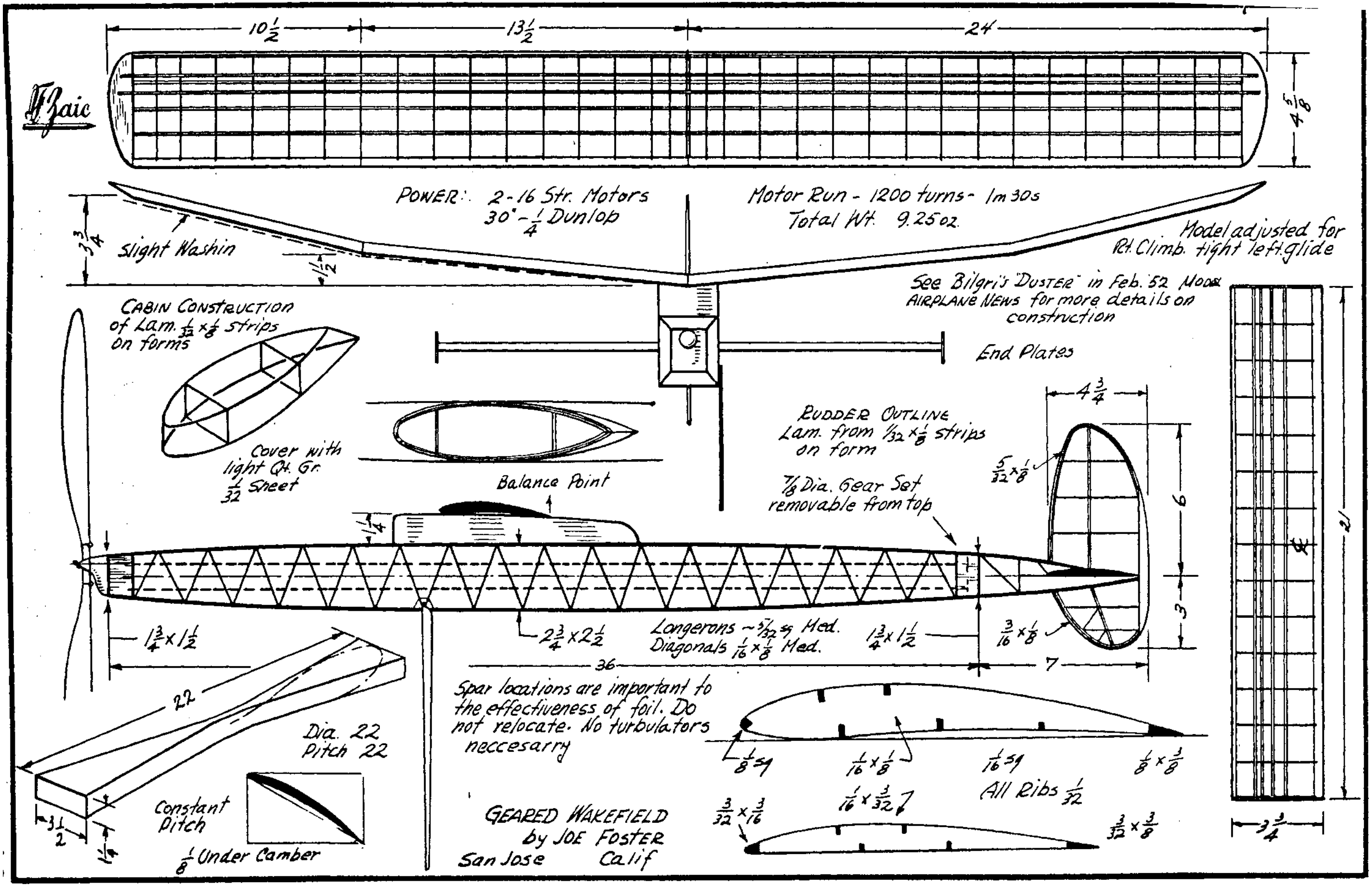


DICK BAXTER—END PLATES—RUBBER TESTS—

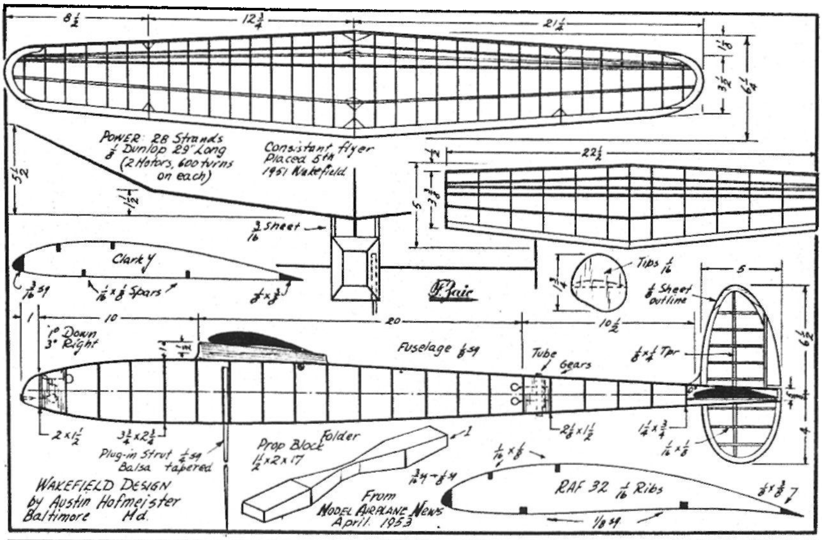
The weather ought to be pretty awful in Ithaca by now so I will tell that I went flying Sunday morning—dead calm—75° and had a fine time flying my Wakefield. The only sore spot is that theory let me down in the public eye.

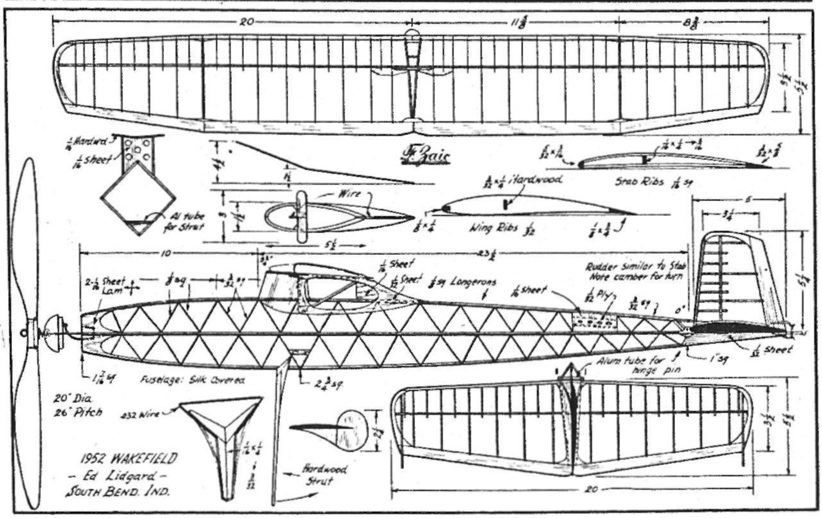
When you get my Wakefield plans you will discover the tip plates on the prop. I always wondered what would have happened, so—I made six flights, three with tip plates and three with identical prop minus tip plates. Same number of turns—props were alternated on consecutive flights.

Motor about 2/3 wound. Sure proved nothing that time except that the plates did not do any damage maybe! (Phooie on Science!)



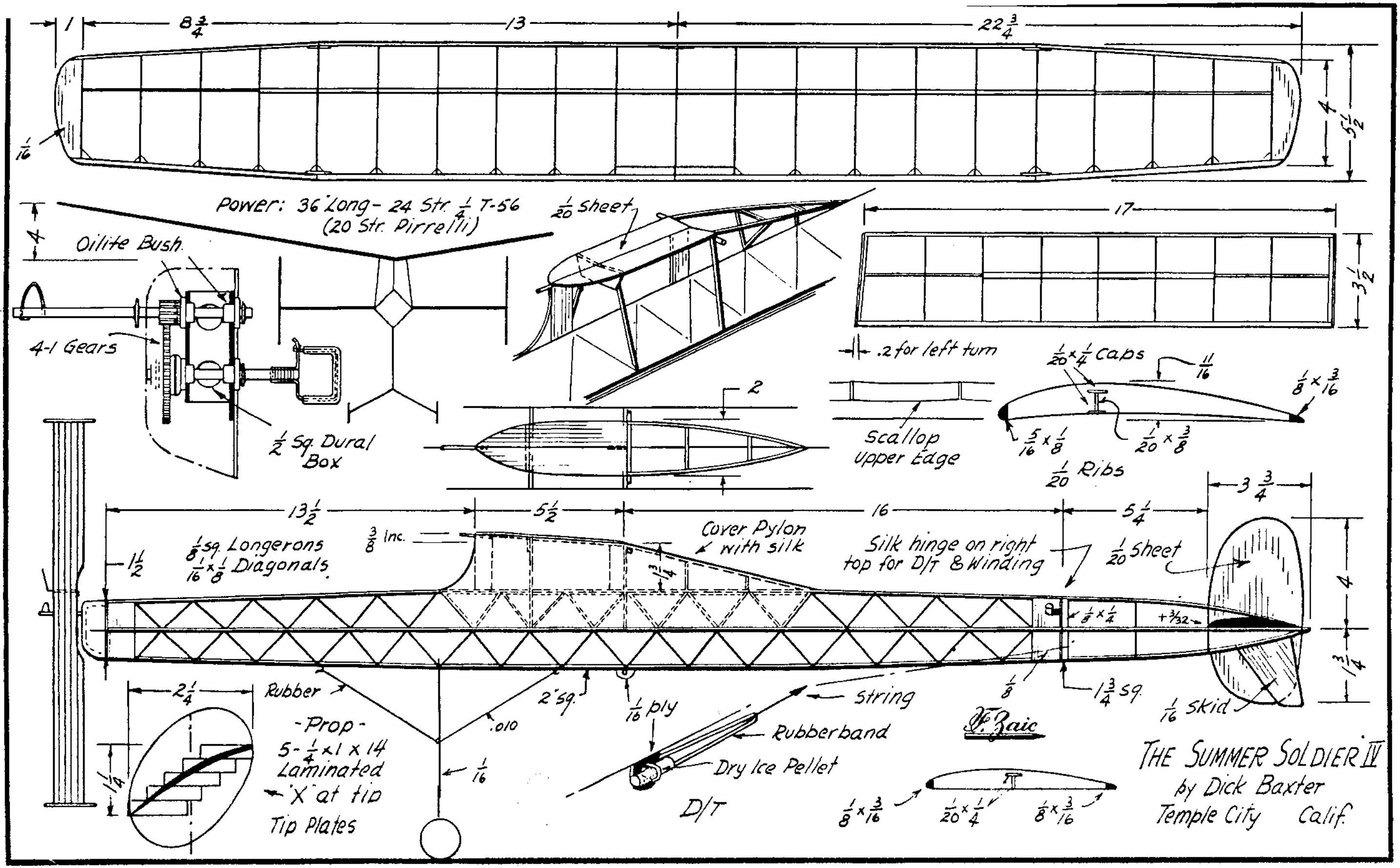
10 1/2
13 1/2
24
4 5/8
F. Zaic
3 3/4
Slight Washin
1/2
POWER: 2-16 Str. Motors
30" - 1/4 Dunlop
Motor Run - 1200 turns - 1m 30s
Total Wt. 9.25 oz.
Model adjusted for
Rt. Climb. tight left glide
See Bilgri's "DUSTER" in Feb. 52 MODEL
AIRPLANE NEWS for more details on
construction
End Plates
CABIN CONSTRUCTION
of Lam. 1/32 x 1/8 strips
on forms
Cover with
light Qt. Gr.
1/32 Sheet
Balance Point
1/4
RUDDER OUTLINE
Lam. from 1/32 x 1/8 strips
on form
7/8 Dia. Gear Set
removable from top
4 3/4
5/32 x 1/8
6
3
3/16 x 1/8
21
1 3/4 x 1 1/2
2 3/4 x 2 1/2
Longerons ~ 5/32 sq Med.
Diagonals 1/16 x 1/8 Med.
1 3/4 x 1 1/2
36
7
22
Dia. 22
Pitch 22
Constant
Pitch
1/8 Under Camber
3 1/2
1/4
Spar locations are important to
the effectiveness of foil. Do
not relocate. No turbulators
neccesarry
1/8 sq
1/16 x 1/8
1/16 sq
1/8 x 3/8
All Ribs 1/32
3/32 x 3/16
1/16 x 3/32
3/32 x 3/8
GEARED WAKEFIELD
by JOE FOSTER
San Jose Calif
3 3/4

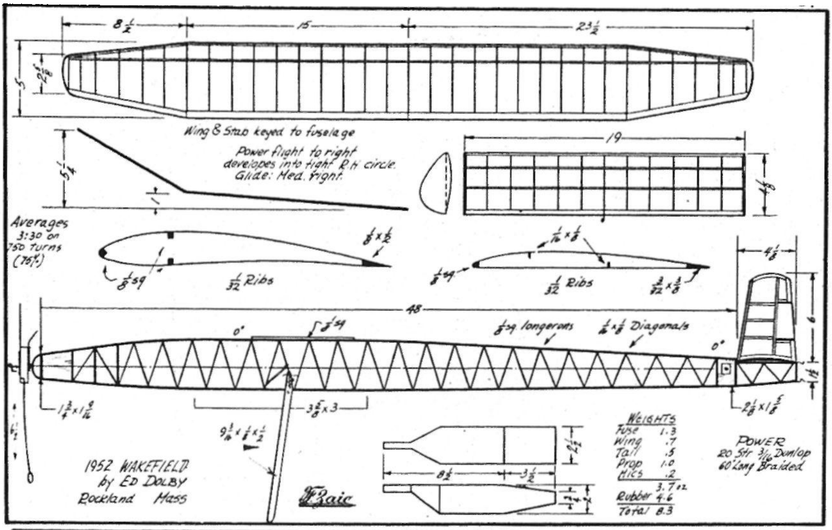


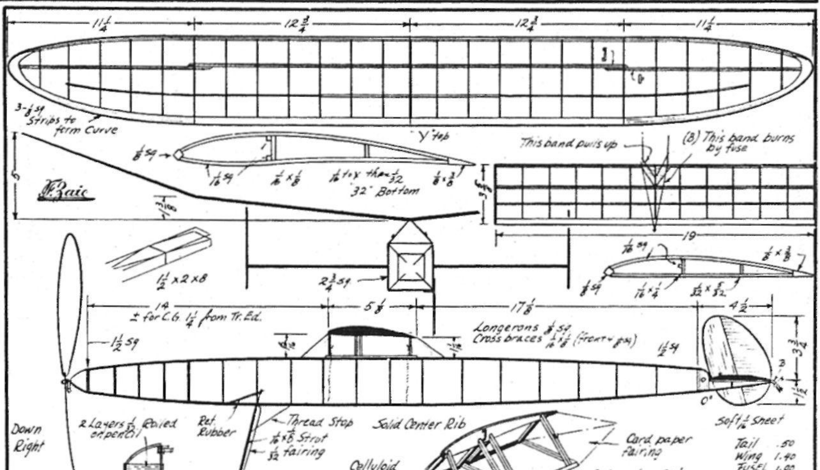


As for true confessions—try this: At MIT and out here in California I've spent a few evenings trying to find out which rubber is best for Wakefields. The criterion I picked was maximum useful energy storage per unit weight. This you get by integrating the load-stretch curve, ((obtained as the rubber relaxes) and dividing by the weight of the sample. H. Paruchenian, W. Roberts and H. Jex did as much of work as I did and here is how we went about it.

Samples were stretched horizontally, using expensive spring scale—not completely accurate—but easy. Load was observed at various lengths and work done by the rubber in contracting was measured by the (graphical) integration mentioned above. Weight of the samples was accurate to 1%. The relaxing and stretching was done slowly—about 5 minutes per cycle with a 10 to 15 min. rest between runs. Several runs were taken on each


Power: 36" Long - 24 Str. 1/4 T-56
(20 Str. Pirrelli)
Oilite Bush.
4-1 Gears
1/2 Sq. Dural Box
1/20 Sheet
.2 for left turn
1/20 x 1/4 Caps
Scallop Upper Edge
1/20 Ribs
1/8 sq. Longerons
1/16 x 1/8 Diagonals.
3/8 Inc.
Cover Pylon with silk
Silk hinge on right top for D/T & Winding
1/20 Sheet
Rubber
-Prop-
5 - 1/4 x 1 x 14
Laminated
"X" at tip
Tip Plates
2" sq.
.010
1/16 ply
String
Rubberband
Dry Ice Pellet
D/T
1/16 Skid
1 3/4 sq.
THE SUMMER SOLDIER IV
by Dick Baxter
Temple City Calif.





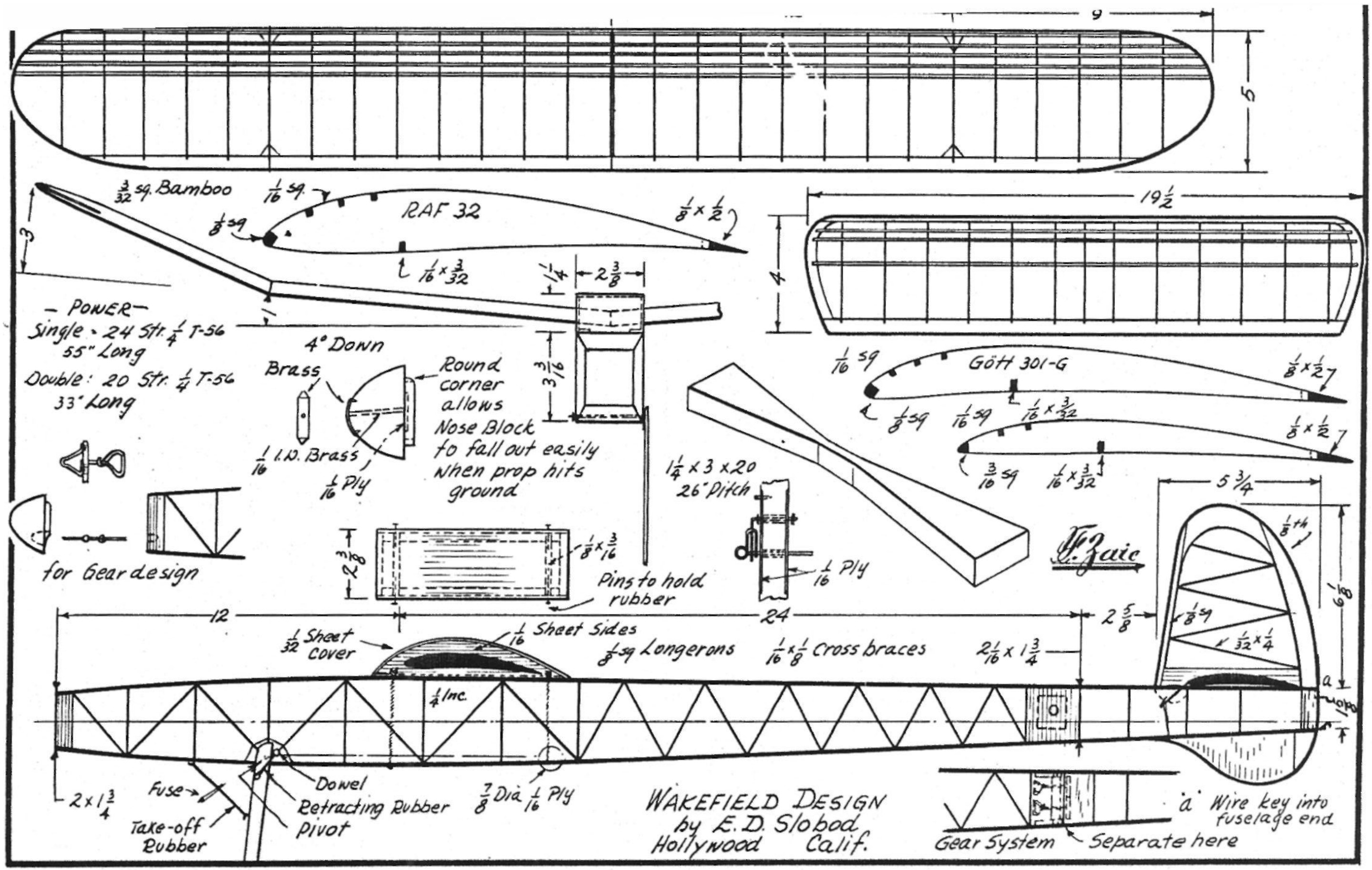
sample and first few were thrown out to take care of the break-in period.

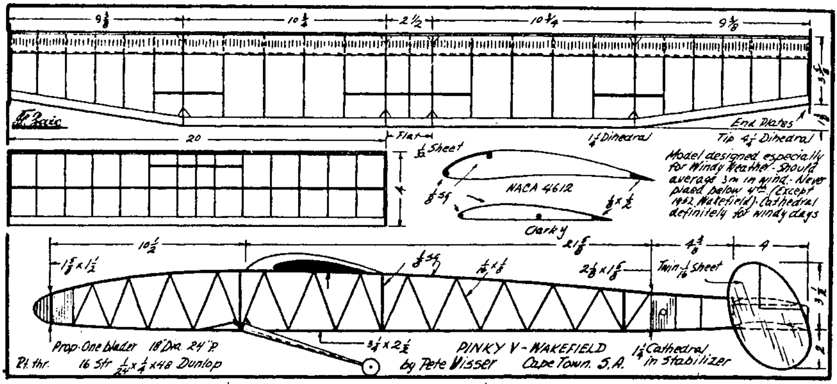
The results are qualitatively that T-56 is worst of the present crop. Pirelli's best and Dunlop Type 6010 is second. Numbers are about as follows: T-56 *2,^00* Dunl6p 2,700 Pirelli 3,000 (£c(, Memory)

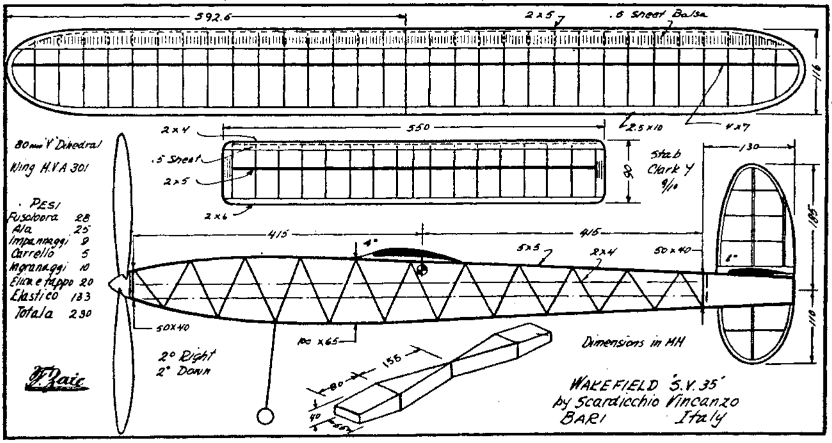
Note that if the energy in the rubber could be converted entirely to altitude a piece of rubber (Pirelli) could shoot itself up to 3000 ft.

These results quoted above are not the exact values we obtained. I can't give you those because I let the data get away from me. But they are I think within 100 lb. ft./lb. of what we got on several tests ran at widely different times.

My question: Why can't U.S. Rubber Co. sell rubber as good as the European—20% more turns goes a long way up.


3/32 sq. Bamboo
1/16 sq.
1/8 sq
RAF 32
1/8 x 1/2
1/16 x 3/32
- POWER -
Single - 24 Str. 1/4 T-56
55" Long
Double: 20 Str. 1/4 T-56
33" Long
4° Down
Brass
Round corner allows Nose Block to fall out easily when prop hits ground
1/16 I.D. Brass
1/16 Ply
for Gear design
1 1/4 x 3 x 20
26" Pitch
1/16 Ply
Pins to hold rubber
1/8 x 3/16
GÖTT 301-G
1/16 sq
1/8 sq
1/16 sq
1/16 x 3/32
3/16 sq
1/8 x 1/2
1/8 th
1/8 sq
1/32 x 1/4
19 1/2
5 3/4
6 1/8
2 5/8
12
24
1/32 Sheet Cover
1/16 Sheet Sides
1/8 sq Longerons
1/16 x 1/8 Cross braces
2 1/16 x 1 3/4
1/4 Inc.
2 x 1 3/4
Fuse
Take-off Rubber
Dowel
Retracting Rubber
Pivot
7/8 Dia 1/16 Ply
WAKEFIELD DESIGN
by E.D. Slobod
Hollywood Calif.
"a" Wire key into fuselage end
Gear System
Separate here





E. D. SLOBOD—TO FREE WHEEL OR FOLD—

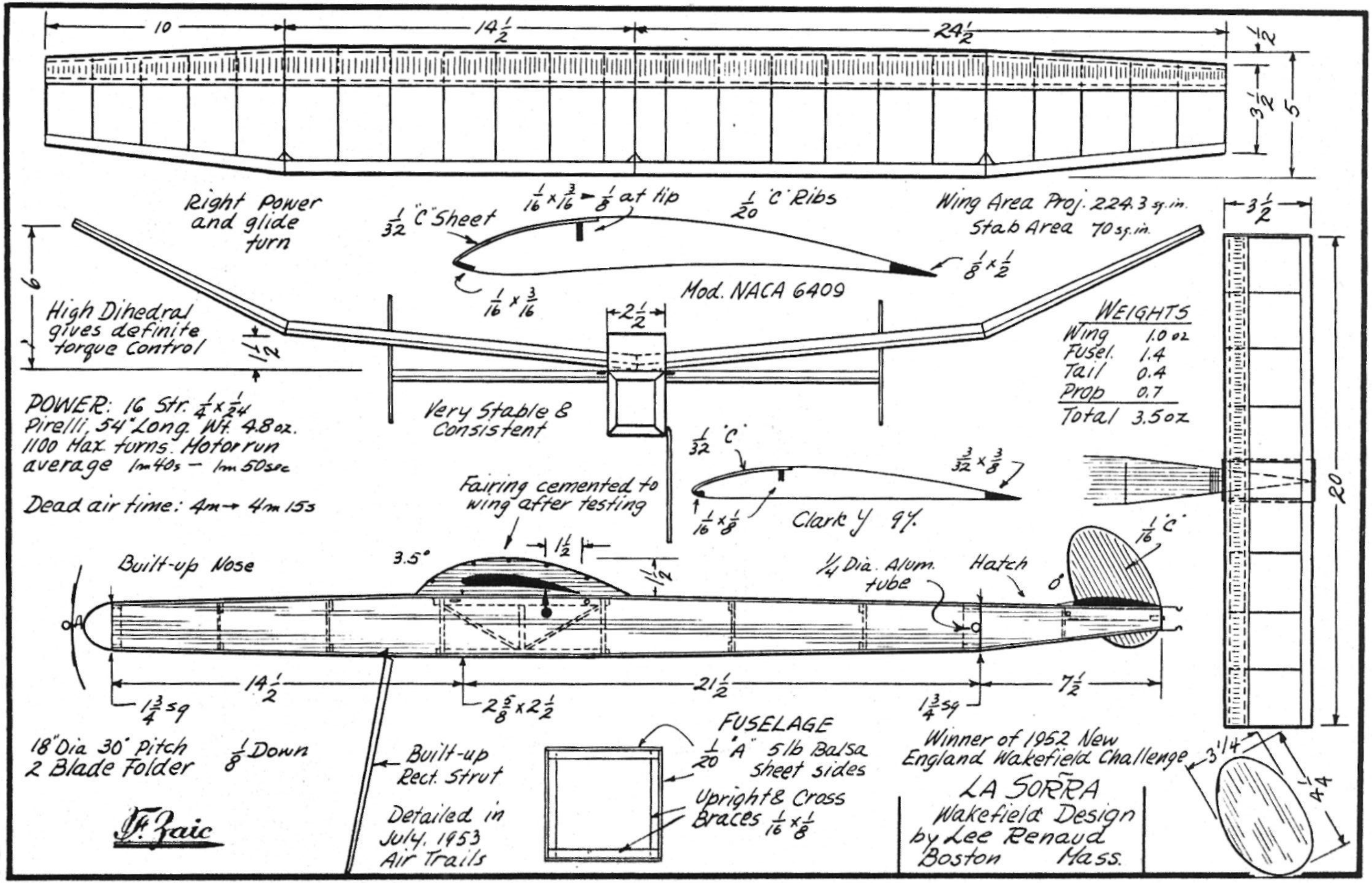
I do not wish to enter the free-wheel vs. folder debate which is often carried on by people who have not used both enough to know what they are talking about, but instead would like to list what I think are the advantages and disadvantages of both.

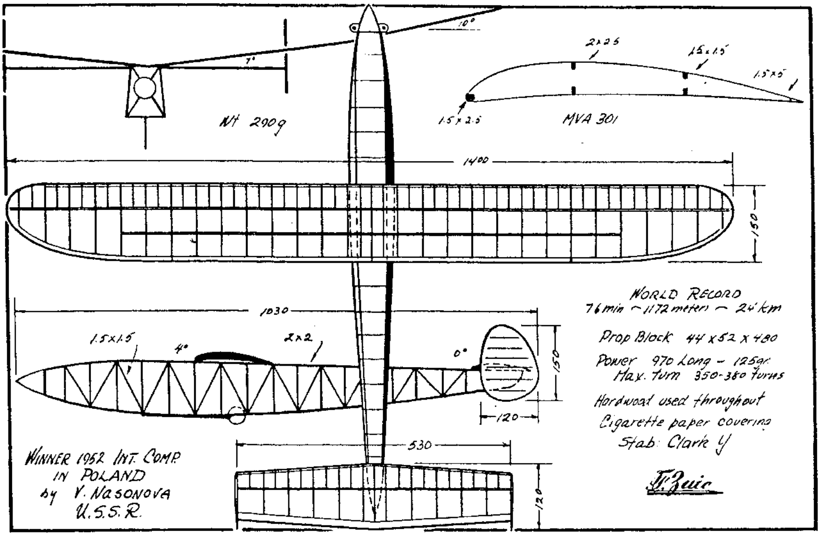
1—The first consideration is drag. Of course the folder offers less resistance. Can there be any doubt about that. We do not know how much, but a ship with free-wheel flies slower than the same ship with a folder, and there can only be one reason for that. (Here, however, we may have a blessing 'in disguise, because if there is not a great difference in sinking speed, the slower ship is more thermal susceptible.) No one knows just how much additional drag a free-wheeler offers, but the results of the Wakefield finals these past few years seem to indicate that the free wheeler is not ready for the ash-can.

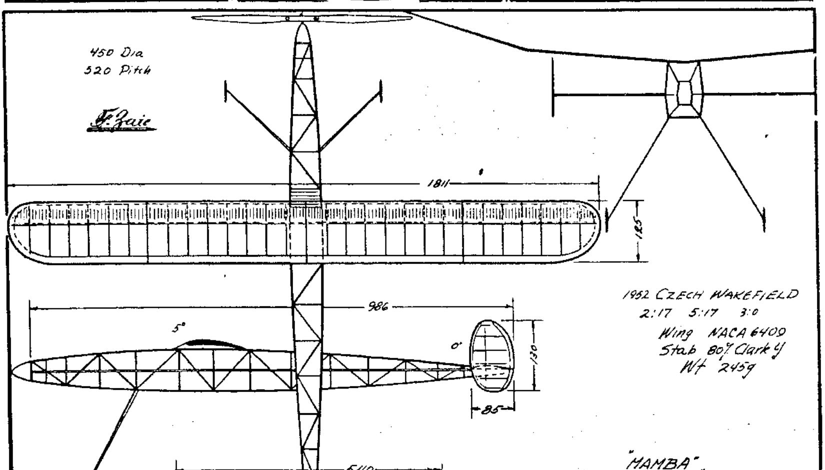
2. Free wheeler may be built- lighter-

3—There are no. hinges to bend or loosen, hence the blades will remain at the angle carved.

4—Take-off release is simpler as the opposite blade does not dangle precariously within fouling distance of the fuselage.


10
14 1/2
24 1/2
1/2
3 1/2
5
Right Power and glide turn
1/32 "C" Sheet
1/16 x 3/16 → 1/8 at tip
1/20 "C" Ribs
Wing Area Proj. 224.3 sq.in.
Stab Area 70 sq.in.
8 1/8 x 1/2
1/16 x 3/16
Mod. NACA 6409
6
High Dihedral gives definite torque Control
1 1/2
2 1/2
WEIGHTS
Wing 1.0 oz
Fusel. 1.4
Tail 0.4
Prop 0.7
Total 3.5 oz
POWER: 16 Str. 1/4 x 1/24 Pirelli, 54" Long. Wt. 4.8 oz. 1100 Max turns. Motor run average 1m 40s – 1m 50sec
Dead air time: 4m → 4m 15s
Very Stable & Consistent
1/32 "C"
3/32 x 3/8
Fairing cemented to wing after testing
1/16 x 1/8
Clark Y 9%
20
1/16 "C"
3.5°
1 1/2
1/2
Built-up Nose
1/4 Dia. Alum. tube
Hatch
0°
14 1/2
21 1/2
7 1/2
1 3/4 sq
2 5/8 x 2 1/2
1 3/4 sq
18" Dia 30" Pitch 2 Blade Folder
1/8 Down
Built-up Rect. Strut
FUSELAGE
1/20 "A" 5 lb Balsa sheet sides
Upright & Cross Braces 1/16 x 1/8
Winner of 1952 New England Wakefield Challenge
3 1/4
4 1/4
LA SORRA
Wakefield Design by Lee Renaud Boston Mass.
Detailed in July, 1953 Air Trails
F. Zaic



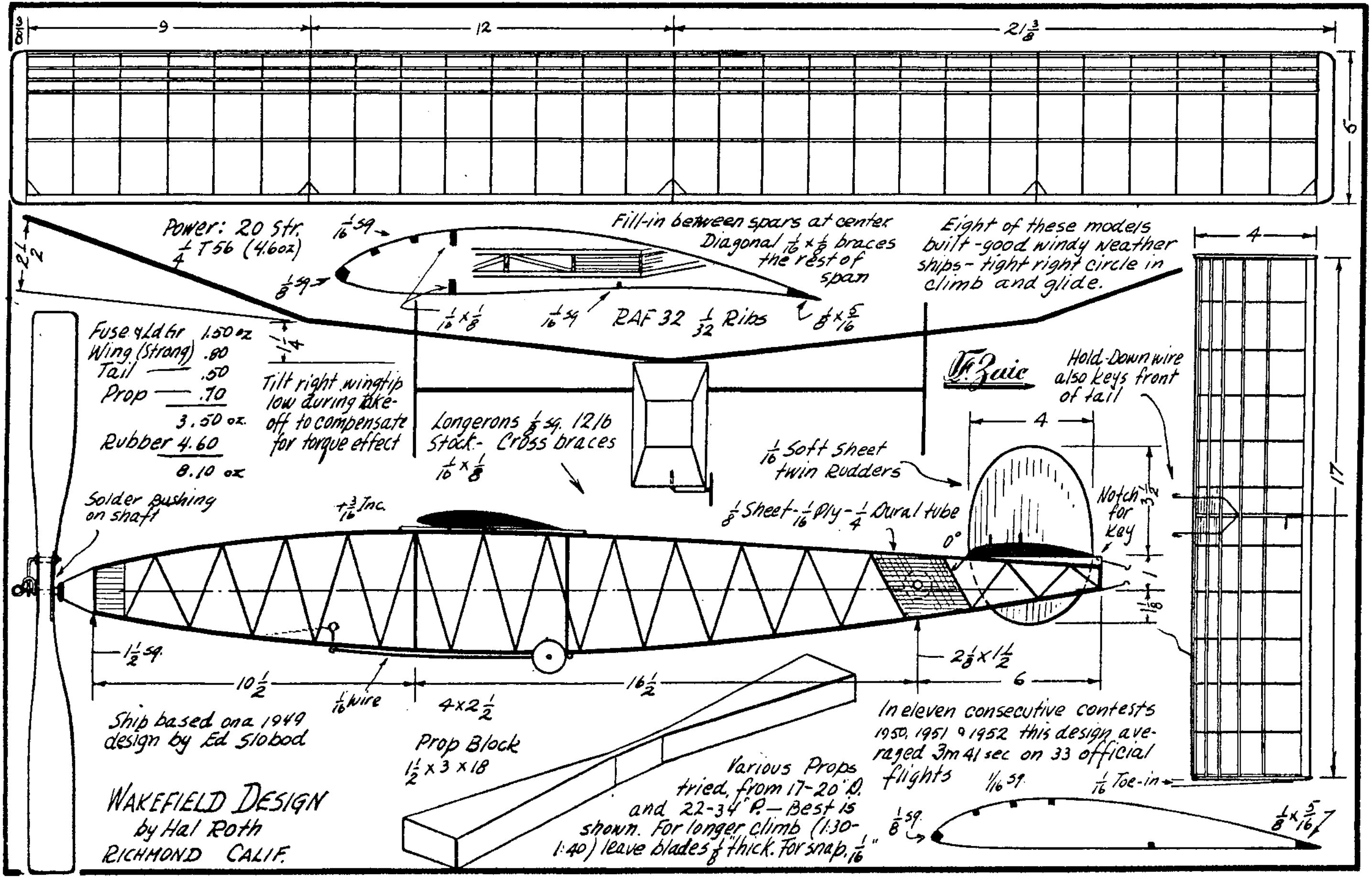


5—The free-wheeler cannot fold improperly, resulting in either a too wide glide circle or spin.

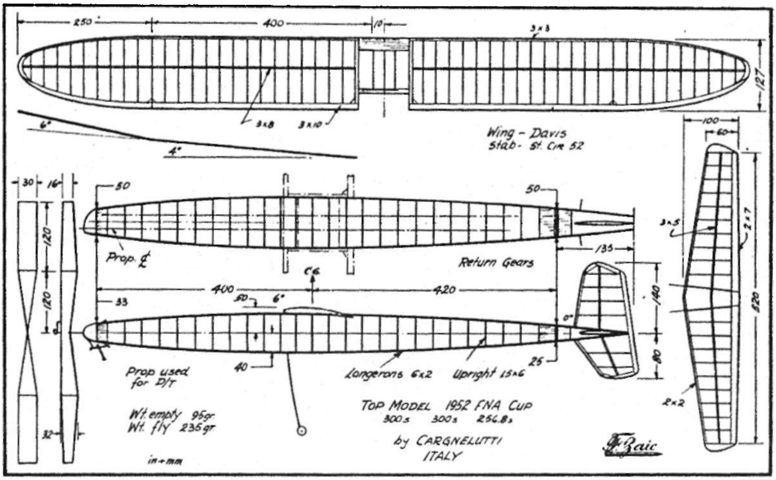
6—When properly tensioned, much more slack can be used with a free-wheeler equipped without fear of stalls due to the formation of knots. (I safely flew a ship that used a 43" motor with only 23" between hooks for several seasons.)

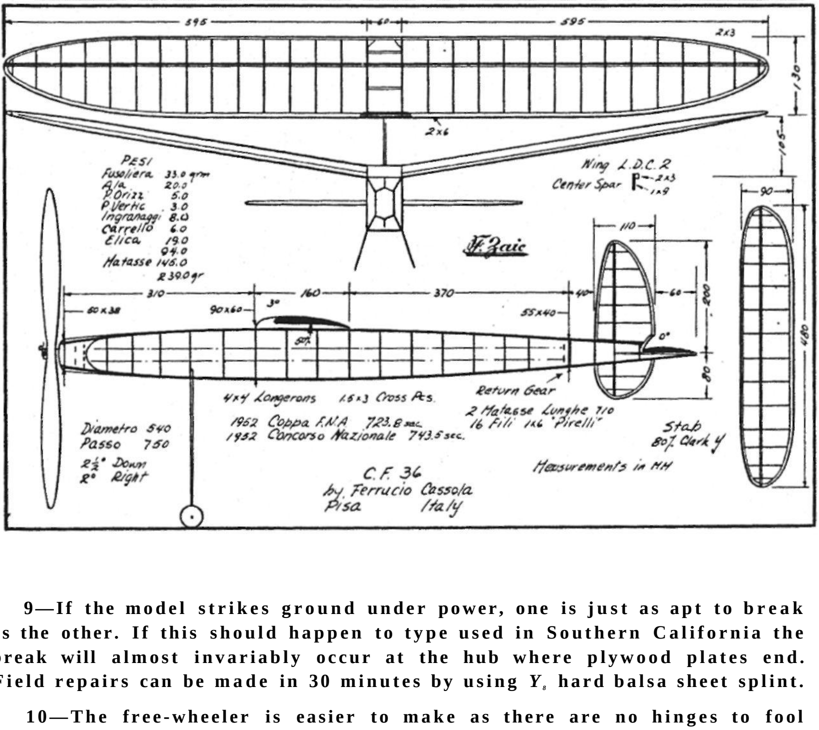
7—The free-wheeler dampens out slight longitudinal out of trim stall tendencies. (This is an observed characteristic—I cannot explain why).

8—The argument that free wheelrs are prone to breakage is not a valid one. If the upper corner of the inserted portion of the nose plug is rounded, the nose plug will tip forward when the prop tip strikes the ground thereby absorbing the shock.



Power: 20 Str. 1/4 T56 (4.6oz)
Fill-in between spars at center. Diagonal 1/16 x 1/8 braces the rest of span
Eight of these models built - good windy weather ships - tight right circle in climb and glide.
1/16 sq.
1/8 sq.
1/16 x 1/8
1/16 sq.
RAF 32 1/32 Ribs
1/8 x 5/16
Fuse & Ldg Gr 1.50 oz
Wing (Strong) .80
Tail .50
Prop .70
3.50 oz.
Rubber 4.60
8.10 oz
Tilt right wingtip low during take-off to compensate for torque effect
Longerons 1/8 sq. 12/16 Stock - Cross braces 1/16 x 1/8
Hold-Down wire also keys front of tail
1/16 Soft Sheet twin Rudders
Solder bushing on shaft
+3/16 Inc.
1/8 Sheet - 1/16 Ply - 1/4 Dural tube
0°
Notch for Key
1 1/2 sq.
10 1/2
1/16 wire
4 x 2 1/2
16 1/2
2 1/8 x 1 1/2
6
Ship based on a 1949 design by Ed Slobod
Prop Block 1 1/2 x 3 x 18
Various Props tried, from 17-20" D. and 22-34" P. - Best is shown. For longer climb (1:30-1:40) leave blades 1/8" thick. For snap, 1/16"
In eleven consecutive contests 1950, 1951 & 1952 this design averaged 3m 41 sec on 33 official flights
1/16 sq.
1/16 Toe-in
1/8 sq.
1/8 x 5/16
WAKEFIELD DESIGN by Hal Roth RICHMOND CALIF.



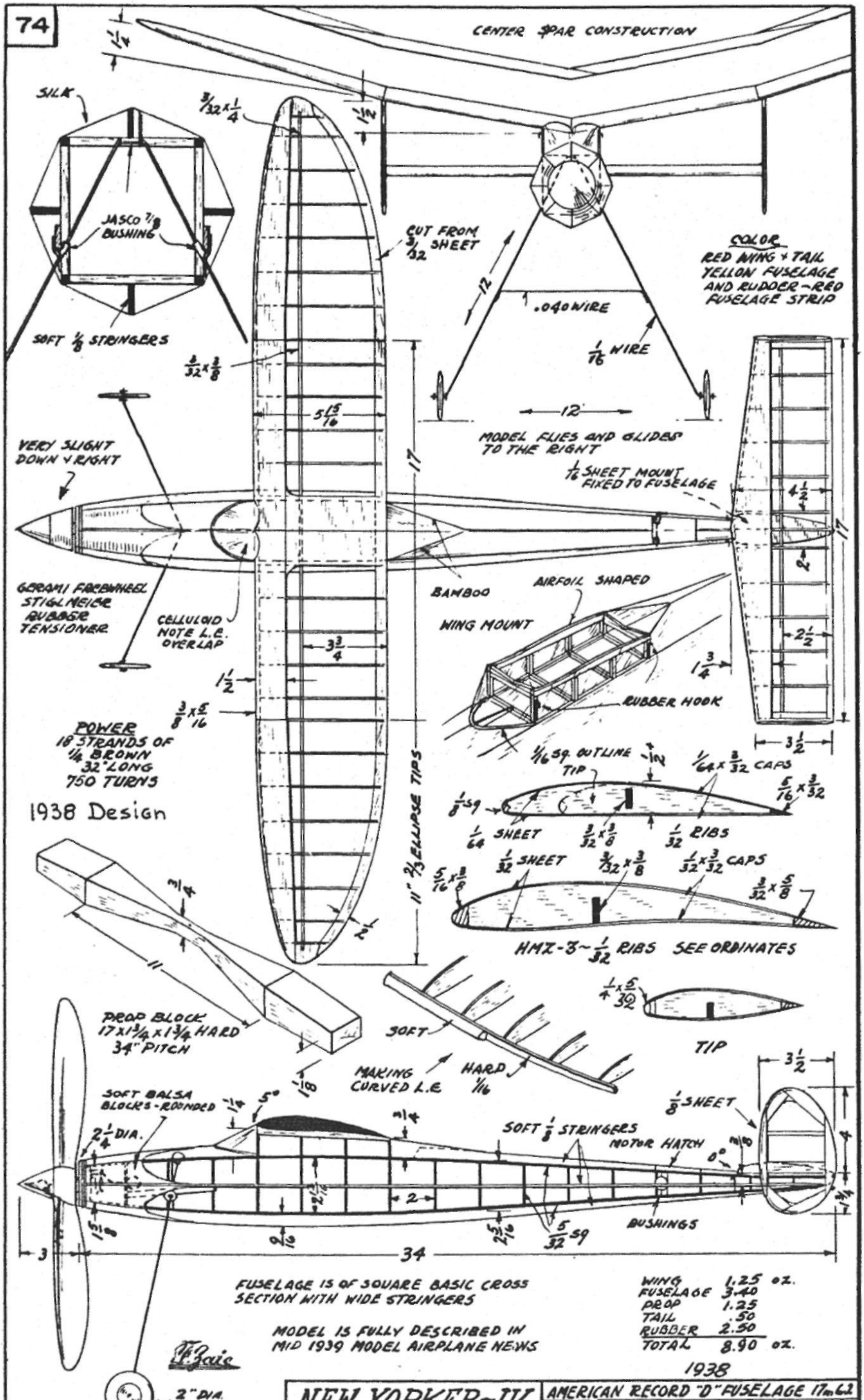


9—If the model strikes ground under power, one is just as apt to break as the other. If this should happen to type used in Southern California the break will almost invariably occur at the hub where plywood plates end. Field repairs can be made in 30 minutes by using Y_8 hard balsa sheet splint.

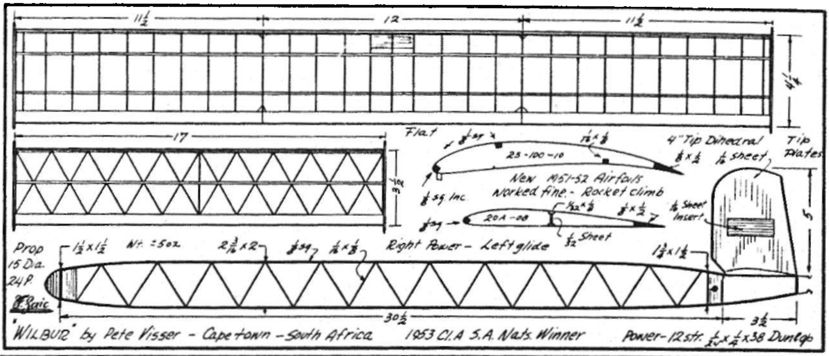
10—The free-wheeler is easier to make as there are no hinges to fool with and no worries about getting the best fold position.

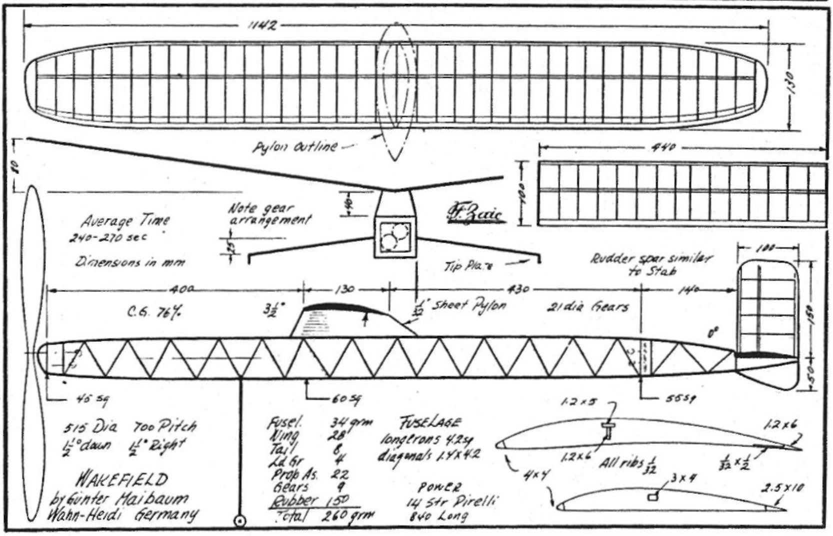
11—When winding a free wheeler equipped ship, only the rubber is wound and the prop is not given a free ride.

While on the subject of props I might add that we have been up and down the scale and have found no simple rule for determining what diameter, blade area and pitch a prop should have. Only through experience can these factors be arranged efficiently, and at that, it's a "first guess."



74
CENTER SPAR CONSTRUCTION
SILK
3/32 x 1/4
JASCO 7/8 BUSHING
CUT FROM 3/32 SHEET
COLOR
RED WING + TAIL
YELLOW FUSELAGE
AND RUDDER - RED
FUSELAGE STRIP
.040 WIRE
1/16 WIRE
SOFT 1/8 STRINGERS
3/32 x 3/8
5 15/16
17
12
MODEL FLIES AND GLIDES
TO THE RIGHT
1/16 SHEET MOUNT
FIXED TO FUSELAGE
VERY SLIGHT
DOWN + RIGHT
4 1/2
2 1/4
GERAMI FREEWHEEL
STIGLMEIER
RUBBER
TENSIONER
BAMBOO
AIRFOIL SHAPED
CELLULOID
NOTE L.E.
OVERLAP
WING MOUNT
3 3/4
2 1/2
1 3/4
1 1/2
3/8 x 5/16
RUBBER HOOK
POWER
18 STRANDS OF
1/4 BROWN
32" LONG
750 TURNS
3 1/2
1/16 SQ. OUTLINE
TIP
1/64 x 3/32 CAPS
5/16 x 3/32
1/8 SQ
1/64 SHEET
3/32 x 3/8
1/32 RIBS
1938 Design
11" 2/3 ELLIPSE TIPS
1/32 SHEET
3/32 x 3/8
1/32 x 3/32 CAPS
5/16 x 3/8
3/32 x 5/8
3/4
HMZ-3 ~ 1/32 RIBS SEE ORDINATES
11
1/4 x 5/32
PROP BLOCK
17 x 1 3/4 x 1 3/4 HARD
34" PITCH
SOFT
TIP
MAKING
CURVED L.E.
HARD 1/16
1/8 SHEET
SOFT BALSA
BLOCKS - ROUNDED
5°
SOFT 1/8 STRINGERS
MOTOR HATCH
2 1/4 DIA.
0°
4
2
BUSHINGS
5/32 SQ
3
34
FUSELAGE IS OF SQUARE BASIC CROSS
SECTION WITH WIDE STRINGERS
MODEL IS FULLY DESCRIBED IN
MID 1939 MODEL AIRPLANE NEWS
WING 1.25 oz.
FUSELAGE 3.40
PROP 1.25
TAIL .50
RUBBER 2.50
TOTAL 8.90 oz.
F. Zaic
1938
2" DIA.
BALSA
NEW YORKER ~ IV
AMERICAN RECORD "D" FUSELAGE
by Frank Zaic
New York, N.Y.





PETE BUSKELL—AIRFOIL TEST FLIGHTS—

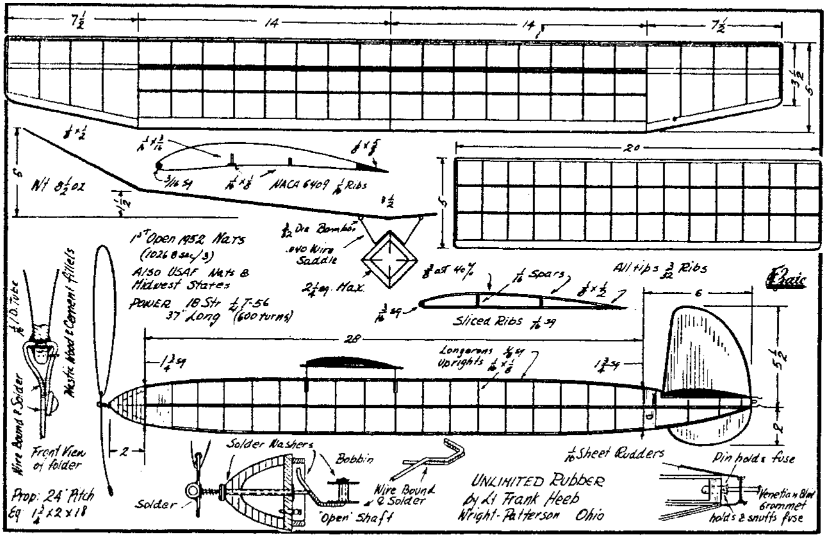
Your query on Don Butler's A/2, NACA 6409 is the only section which has been thoroughly tested on this model to date, but a wing to the same section as on "Slick Stick" is in the course of testing.

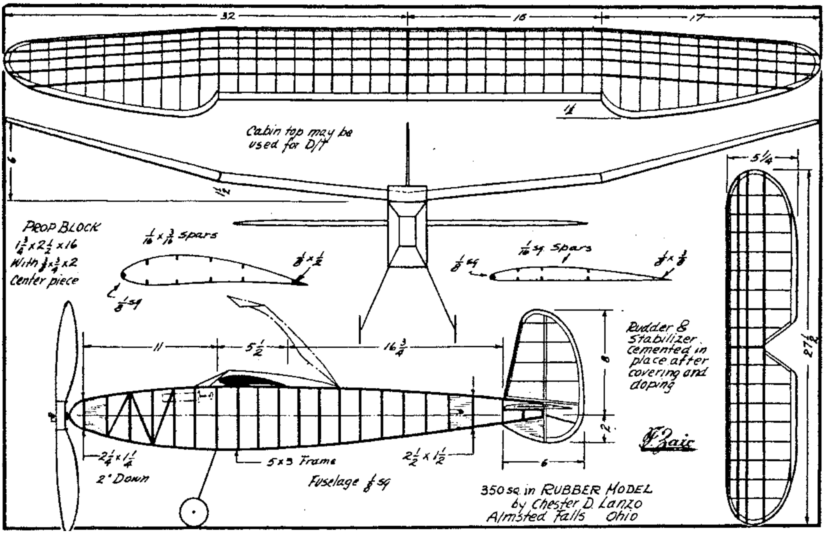
The long A/2 was developed from a medium coupled 1/ tailplane A/2 designed by Don, the original of which had a Goldberg G5 wing, as this section had proved good on gas models of similar weight.

Performance was about 3 min. from 300 ft. line which did not satisfy Don. So he followed with a medium thickness Davis version which had similar performance, and then a NACA 6409 version, which yielded 3 min. 45 sec.

Around the same time I decided to carry out a few tests on sections that were claimed the tops, and figured that a rubber model of around 36" span would be the best indicator, the reasoning being that the wing is used on climb as well as glide, and an improved section would make quite a difference to total time.

I was using such a model at the time, so built the following wings for it: NACA 6409, Davis (Med. Thick.) Jakowsky (Ron Warring's Pet), five of the most suitable Benedek Sections which the Swedes claimed were the goods, and the "Slick Stick" section, which is a French curve and ruler effort from one of Don's earlier lightweight designs.



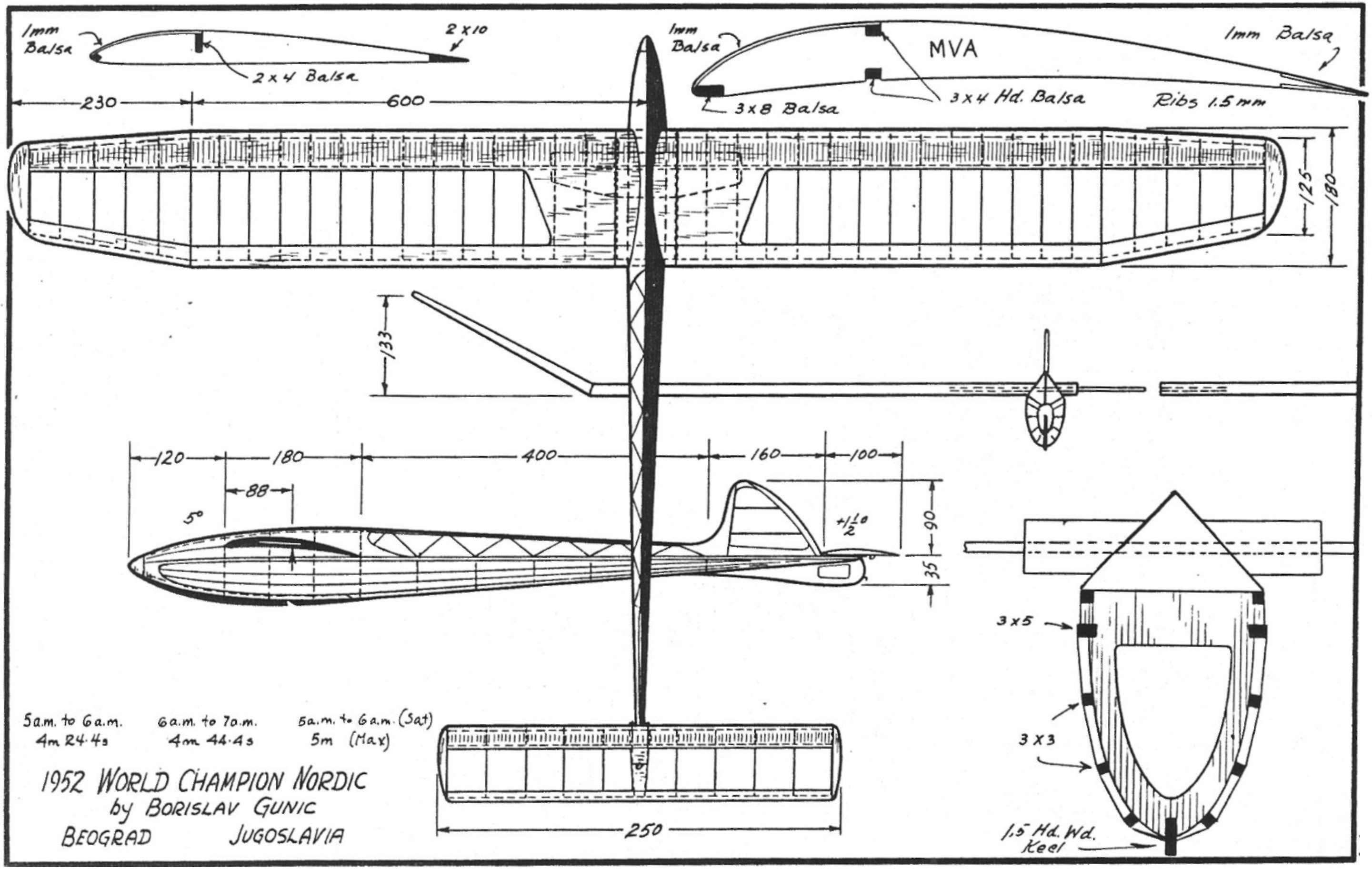


The Benedeks gave times between 2 min. 30 sec. and 2 min. 50 sec. Stability not being very bright, in fact the best of them had to be rigged at 5° to get the glide and this made things very touchy.

The Davis came out around 3 min. mark, stability good. Jakowsky and NACA level pegged at 3 min. 15 sec. Stability good for NACA and excellent for Jokowsky. Flight characteristics were entirely different however, the Jokowsky *looks* much inferior to the NACA.

Way out in front came Don's French curve and ruler section, giving around 4 min. 10 sec, and as if the improved lift figures were not enough, the stability was nothing short of amazing.

I checked by building a wing for my Wakefield and got the same results. So built "Slick Stick" with it but found stability of same high order, but the glide the same as for NACA. However, the glide is quite fast so I think thickening the section may improve things.



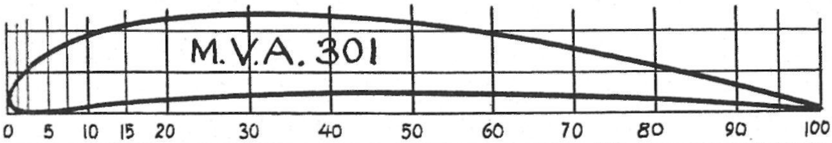
1mm Balsa
2 x 10
2 x 4 Balsa
1mm Balsa
MVA
1mm Balsa
3 x 8 Balsa
3 x 4 Hd. Balsa
Ribs 1.5 mm
230
600
125
180
133
120
180
88
400
160
100
5°
$+1\frac{1}{2}^{0}$
90
35
3 x 5
3 x 3
1.5 Hd. Wd. Keel
250
5a.m. to 6a.m.
4m 24·4s
6a.m. to 7a.m.
4m 44·4s
5a.m. to 6a.m. (Sat)
5m (Max)
1952 WORLD CHAMPION NORDIC
by BORISLAV GUNIC
BEOGRAD JUGOSLAVIA

MAX HACKLINGER—ARTIFICIAL TURBULENCE—

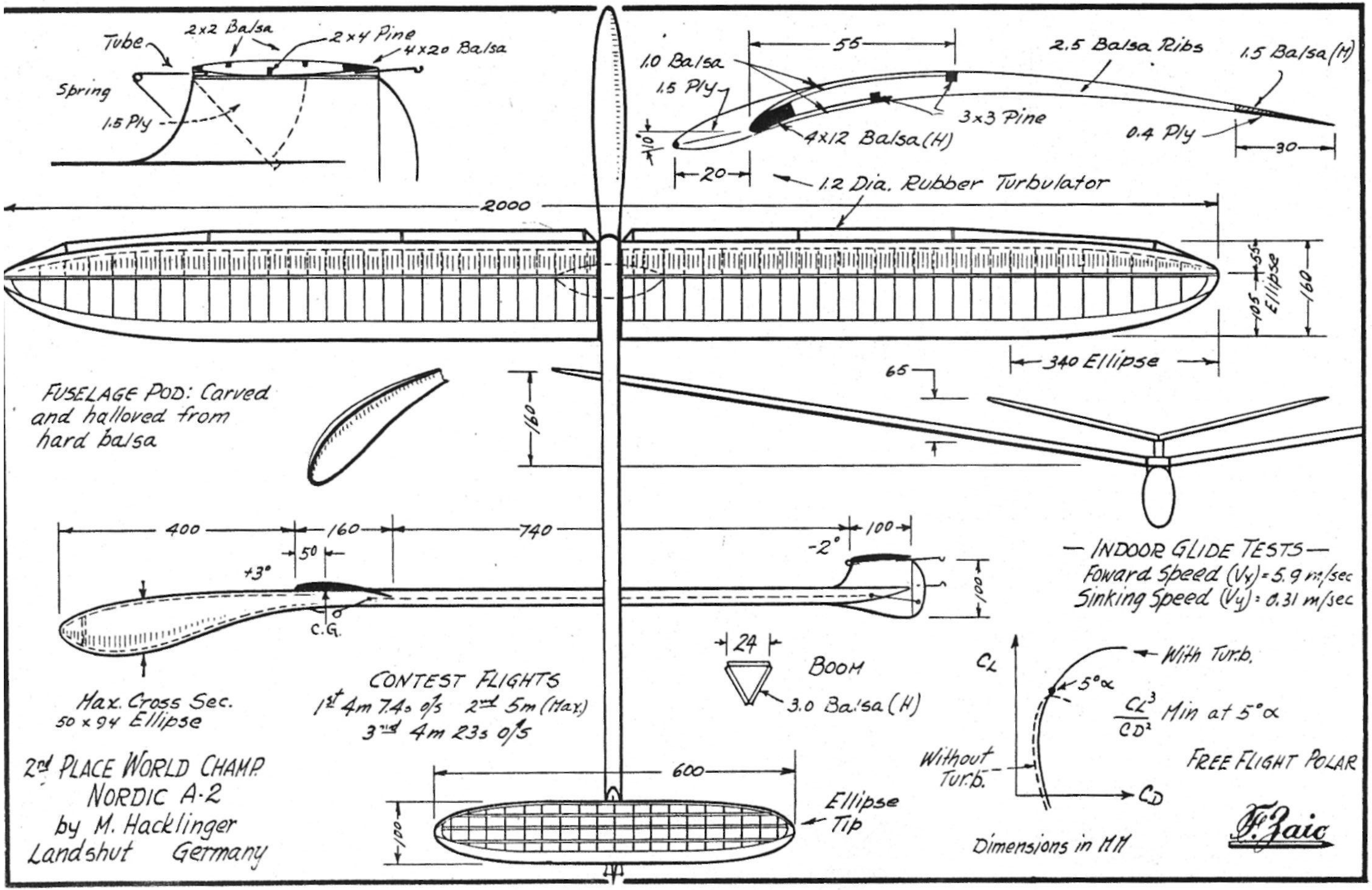
The Reynolds Number of our A/2 models varies from 60,000 to 45,000, the effective one of the rubber powered models is somewhat, but only slightly, smaller. At these RN numbers our thin, cambered airfoils are throughout "overcritical", but they stall at rather a small angle of attack and this the sooner, the smaller RN and the greater the camber are. This development is not, as we might think, linear, but square or even cubic. If the stall occurs so early that the normal ca3 maximum is no longer reached at all, (graph) artificial turbulence must be applied to obtain the best achievement. Its application is often suitable even with higher RN numbers for the purpose of improving the longitudinal stability, because thereby the Ca-Cw curve (Polar) becomes much rounder. We know from practice that airfoils, in case of Vy (sinking speed) being small, have a greater camber (f ops- 8%). The latter, however, involves very bad stability, and in such cases an articicial means of turbulence is often the only, welcome tescue.

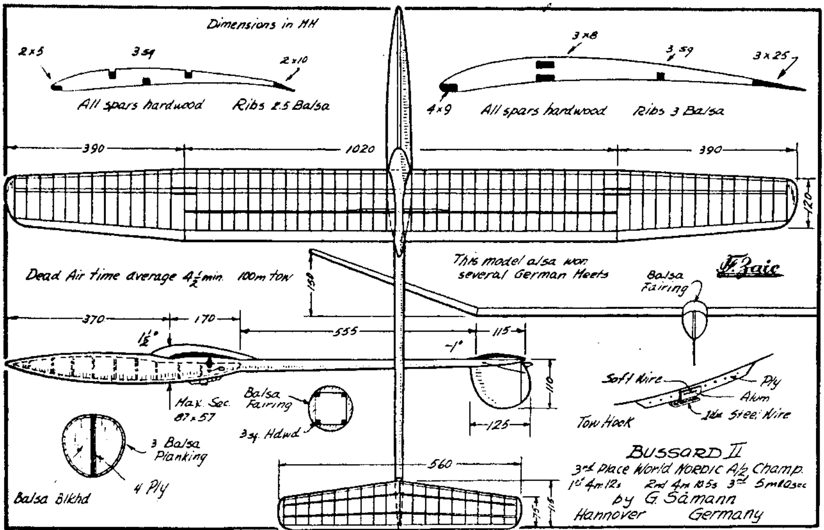
There have been tested the most varied types of artificial turbulence: A rough surface of the airfoil in the upper third influences the marginal zone (greuzschides), it is true, but it also results in most case, in disagreeable stalling phenomena. A turbulence-strip on the upper side shortly behind the nose (ca. 1/16 sq.) is frequently used because it is easy to mount. Its effect is similar but slightly inferior to that of a thin wire in front of nose. The effect of the elastic of turbulence, however, is stronger than all these means. The distance from the nose, the angle formed with the front-tangent and the frequency (as fixed by the tension and by distance of the holding wire) are unfortunately unknown facts that will have to be determined from time to time by experiments. Such experiments are very easy, if you prick through the silk-round spun rubber (we call it heat-rubber) and then into the nose of the wing with long pins. An approximate value for similar airfoils is given by the drawing of the 2nd winner model at Graz, which contains specific values. (Its frequency corresponding to that of the bass C). The effect of this "turbulence-rubber" is often amazing, especially with thick, roundnosed airfoils. The connection between the vibration of the marginal zone and the vibration of the turbulator is of vital importance and must not be overlooked.

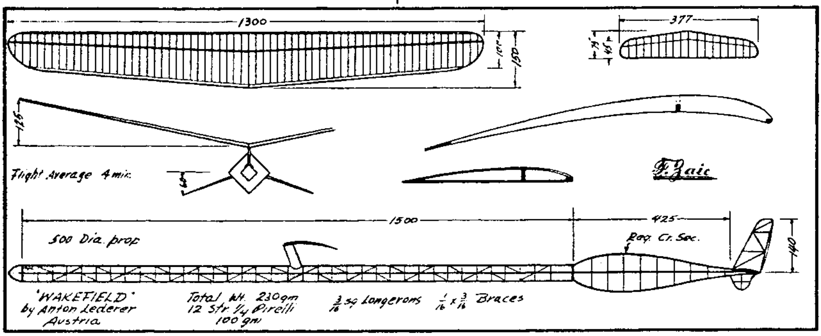
SUMMARY—The application of an artificial means of turbulence need not always result in an improvement of the achievement. In any case, however, the longitudinal stability gets better, and, thereby, the flight more quiet at RN of 55,000. The best results so far have been produced by an elastic tightened in front of the nose of the wing, whose position and tension can easily be determined by experiments. If you can get a quiet flight and reach the angle for the best Vy (sinking speed) without such a "wire entanglement," your model will glide a little longer as a wire in any case results in additional drag. But our best airfoils with the needed great aspect ratio are without artificial turbulence very difficult.

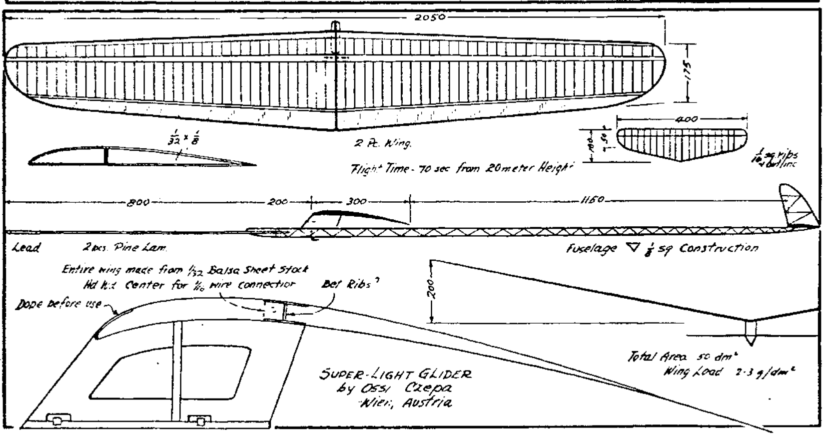


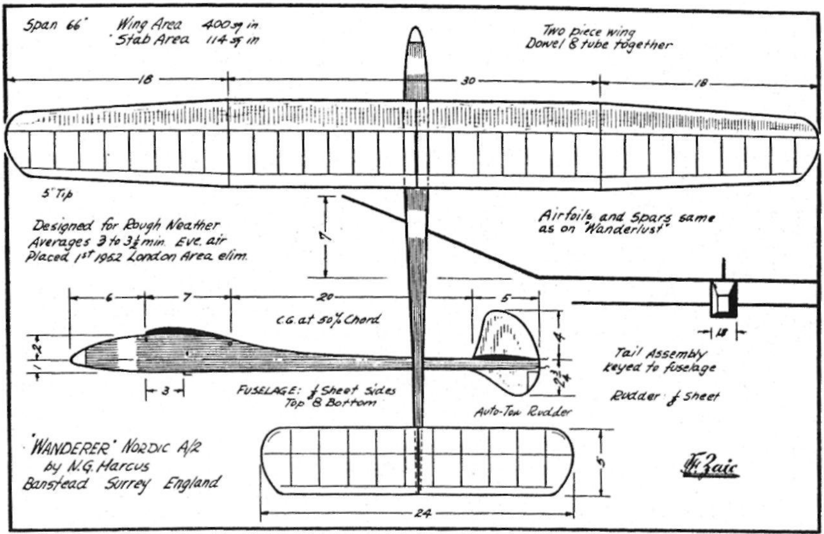
STA.	0	1.2	2.5	5	7	10	15	20	30	40	50	60	70	80	90	95	100
UP.	1.2	4.0	5.2	6.8	8.0	8.9	10.3	11.1	11.8	11.6	10.8	9.4	7.7	5.5	3.1	1.8	0.4
LR.	1.2	0.2	0	0.2	0.4	0.6	1.1	1.5	2.1	2.3	2.2	2.1	1.8	1.2	0.7	0.3	0.1

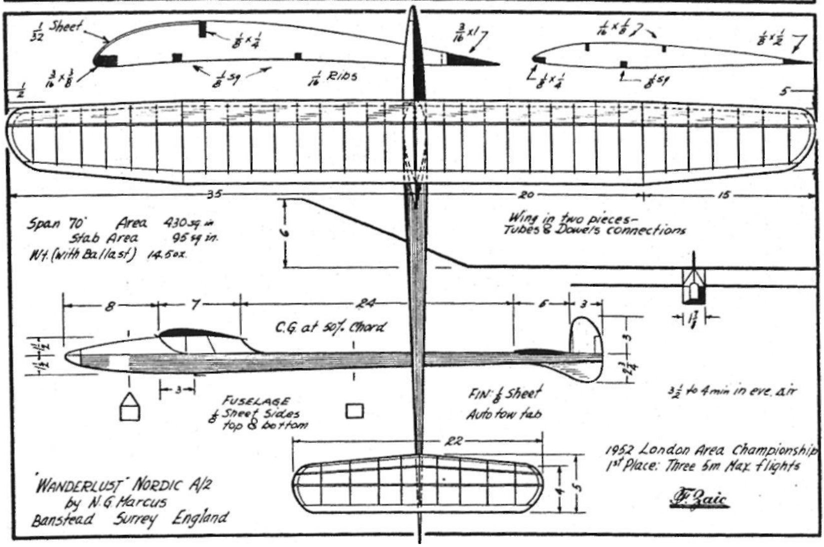

Tube
2x2 Balsa
2x4 Pine
4x20 Balsa
Spring
1.5 Ply
1.0 Balsa
1.5 Ply
55
2.5 Balsa Ribs
1.5 Balsa (H)
3x3 Pine
4x12 Balsa (H)
0.4 Ply
10
20
30
1.2 Dia. Rubber Turbulator
2000
55
105
Ellipse
160
340 Ellipse
65
FUSELAGE POD: Carved
and hallowed from
hard balsa
160
400
160
740
100
50
+3°
-2°
C.G.
100
— INDOOR GLIDE TESTS —
Foward Speed (Vx) = 5.9 m/sec
Sinking Speed (Vy) = 0.31 m/sec
24
BOOM
3.0 Balsa (H)
Max. Cross Sec.
50 x 94 Ellipse
CONTEST FLIGHTS
1st 4m 7.4s o/s 2nd 5m (Max.)
3rd 4m 23s o/s
CL
With Turb.
5°α
CL³/CD² Min at 5°α
Without Turb.
CD
FREE FLIGHT POLAR
2nd PLACE WORLD CHAMP.
NORDIC A-2
by M. Hacklinger
Landshut Germany
600
100
Ellipse Tip
Dimensions in MM
F. Zaic


Dimensions in MM
2×5
3 sq
2×10
All spars hardwood
Ribs 2.5 Balsa
3×8
3 sq
3×25
4×9
All spars hardwood
Ribs 3 Balsa
390
1020
390
120
Dead Air time average 4½ min. 100m tow
150
This model also won several German Meets
Balsa Fairing
F. Zaic
370
170
555
115
1½°
-1°
Max. Sec. 87×57
Balsa Fairing
3 sq. Hdwd
110
125
Soft Wire
Ply
Alum
1/16 Steel Wire
Tow Hook
3 Balsa Planking
4 Ply
Balsa Blkhd
560
75
115
BUSSARD II
3rd Place World NORDIC A/2 Champ.
1st 4m 12s 2nd 4m 10.5s 3rd 5m 10sec
by G. Sämann
Hannover Germany


1300
150
377
125
Flight Average 4 min.
F. Zaic
1500
425
500 Dia. prop
Req. Cr. Sec.
140
"WAKEFIELD"
by Anton Lederer
Austria
Total Wt. 230gm
12 Str. ¼ Pirelli
100 gm
3/16 sq Longerons
1/16 × 3/16 Braces


2050
175
400
1/32 × 1/8
2 Pc. Wing
Flight Time - 70 sec from 20 meter Height
800
200
300
1160
Lead
2 pcs. Pine Lam.
Fuselage ∇ 1/8 sq Construction
Entire wing made from 1/32 Balsa Sheet Stock
Hd Wd Center for 1/16 wire connection
Bal Ribs
Dope before use
200
Total Area 50 dm²
Wing Load 2.3 g/dm²
SUPER-LIGHT GLIDER
by Ossi Czepa
Wien, Austria

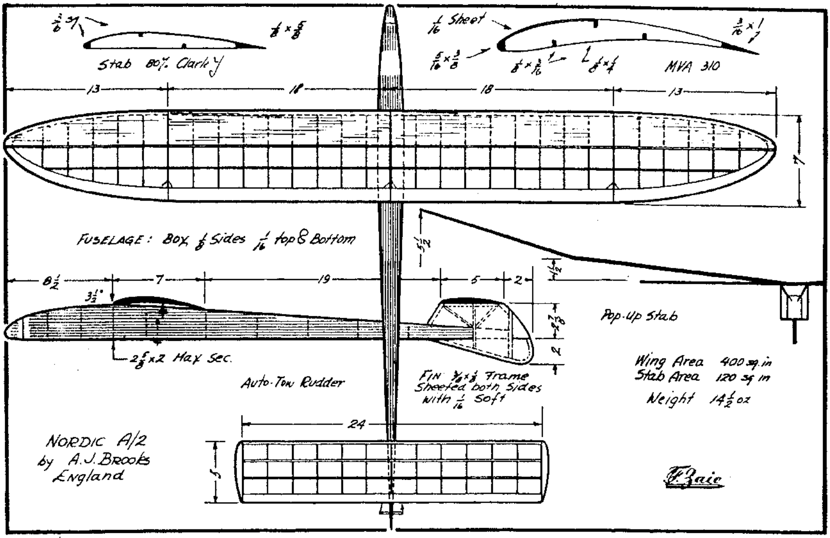


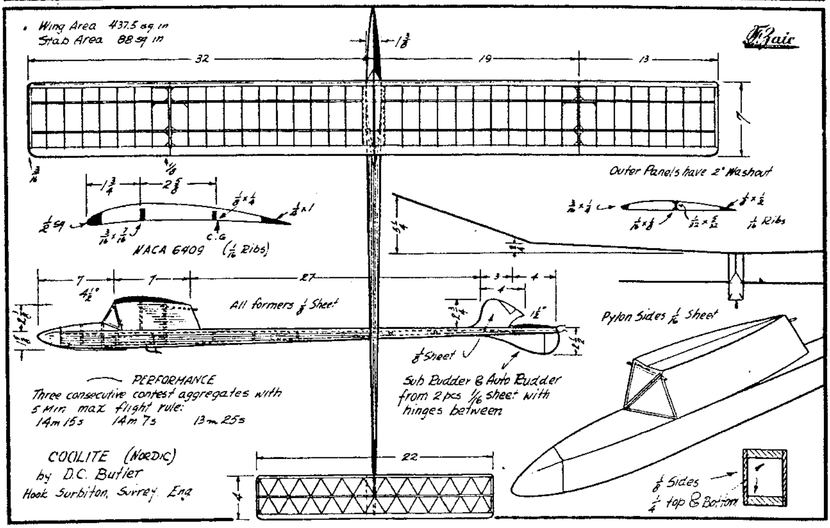


CARL HERMES— STRESSED SKIN WINGS

While the writer can see no worthwhile aerodynamic or structural advantages in sheet balsa wings as applied to free-flight or radio-controlled models, they do have the distinct advantage of being extremely easy to put together. These wings have been used successfully over the past five years on all types of models. The method described, while extremely simple, involves a few fine points that are worthy of consideration.

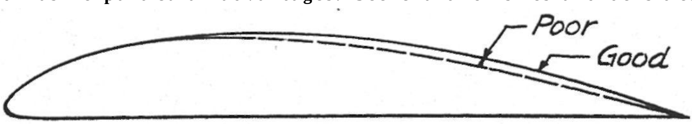
The plan form can *be* most anything considered pleasing. Curved outlines become slightly more involved, however, since a "cut from sheet" or laminated trailing edge is usually required. The airfoil selection is critical from a structural standpont. Since the sheet becomes the span in a wing of this type, the more camber that is applied to the sheet itself th<- better off

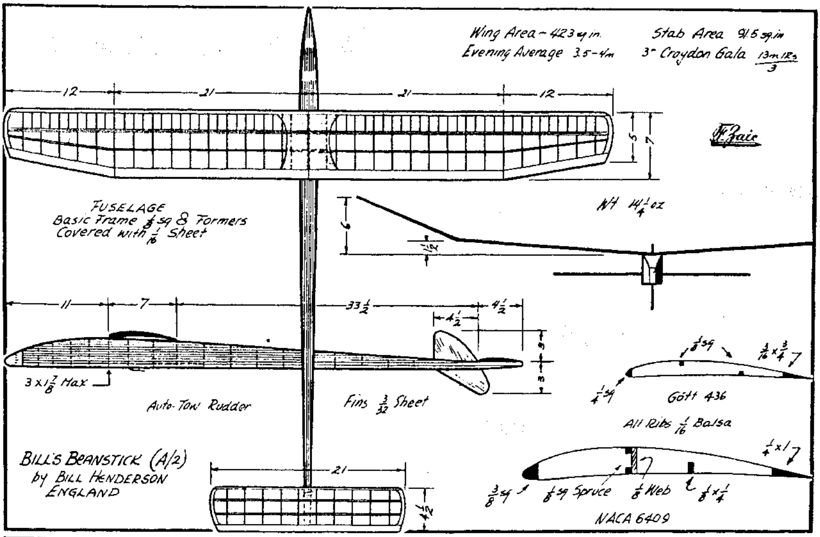


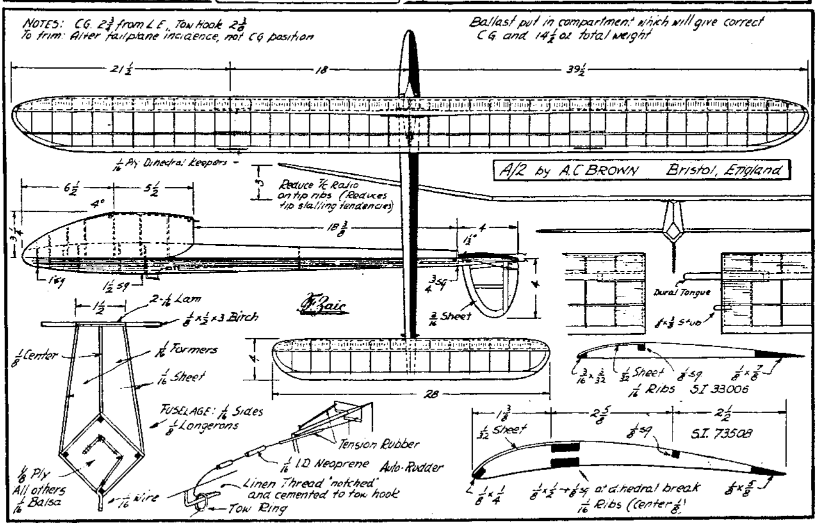


you are from a strength and rigidity standpoint. Most airfoils have a sufficient amount of upper surface camber near the leading edge but on many the upper camber near the trailing edge is very nearly a straight line. With this type the sheet does not have a chance to do much good in the aft area and usually results in warped or bowed trailing edges.

The type of wood selected is not too critical except from a weight standpoint. Quarter grained material is not recommended since it is harder to bend and has no particular advantages. See chart for sizes and densities.



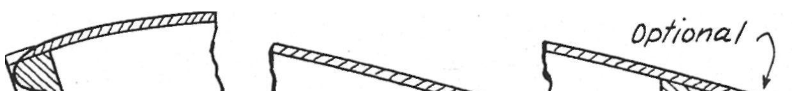


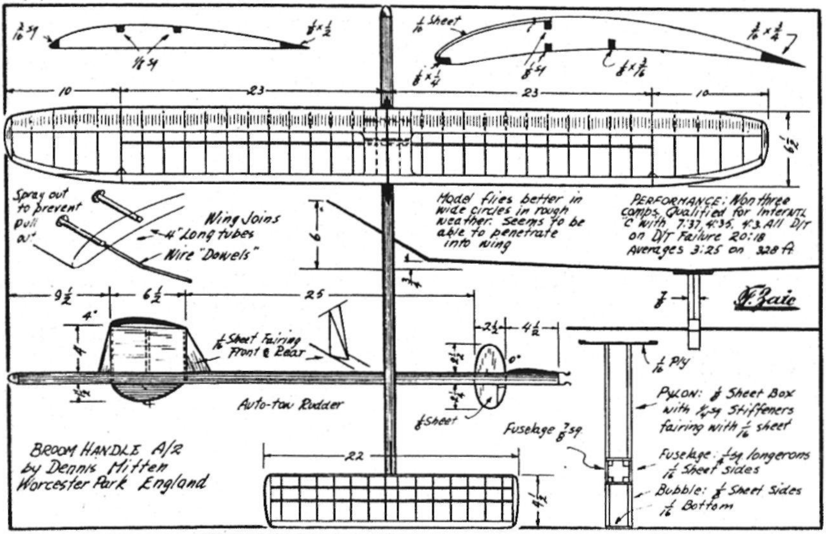


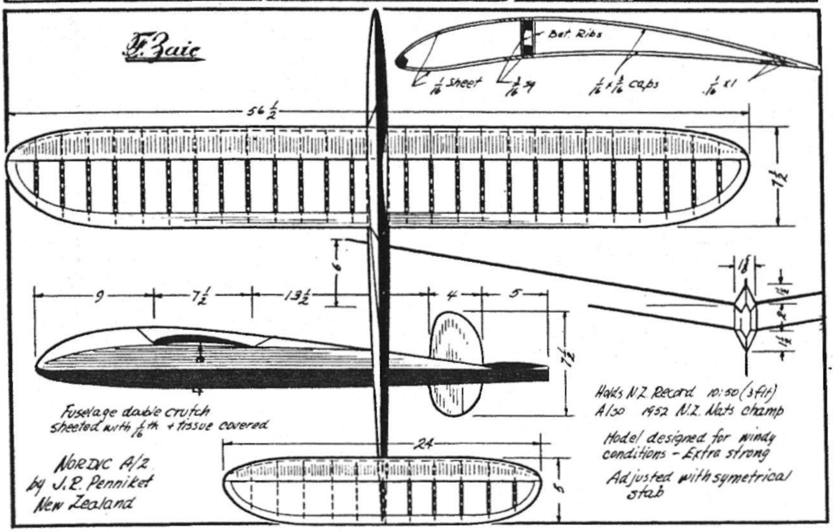
The angled leading edge is simplest since it involves no pre-shaping. The exact dimensions will depend on the airfoil, the sizes given being only approximate. The general idea is as shown below:

On the y_2 A wings no trailing edge is required, just bevel the sheet. The center section wil need to be reenforced to take the elastic, however.

On the larger wings, try to design so that standard trailing edge stock may be used. If you want to be fancy an extra piece of T. E. stock may be used to finish it off. •

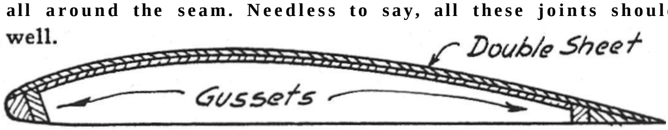


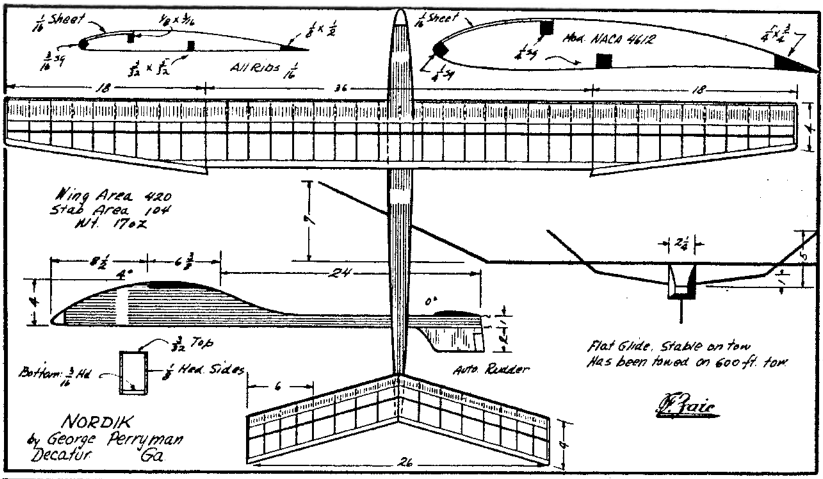


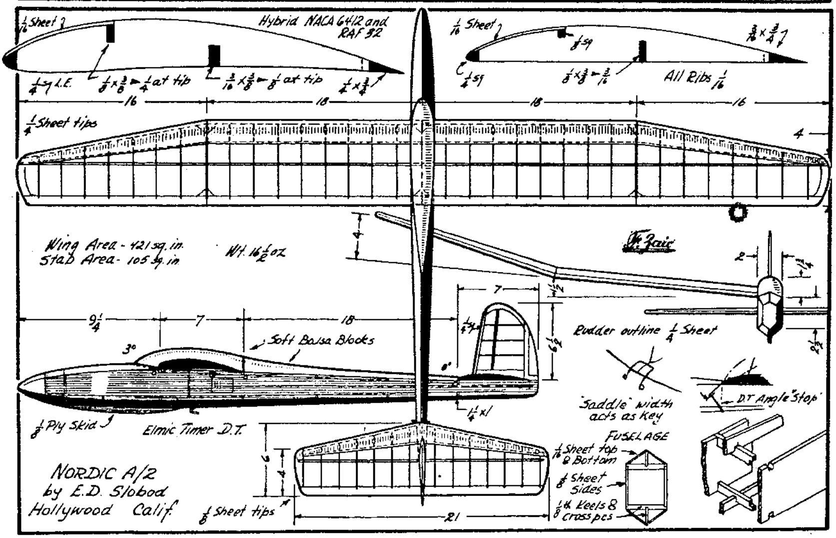


Dibedral joints are handled in the usual manner with heavy leading and trailing edge gussets.

The rib at the dibedral break should on the larger wings (400 si and up) be twice the normal rib thickness since it takes quite a load. We also double sheet the area for one rib space on either side of the break, likewise the bottom surface in this area. A narrow piece of nylon or crinoline is then cemented all around the seam. Needless to say, all these joints should be cemented well.

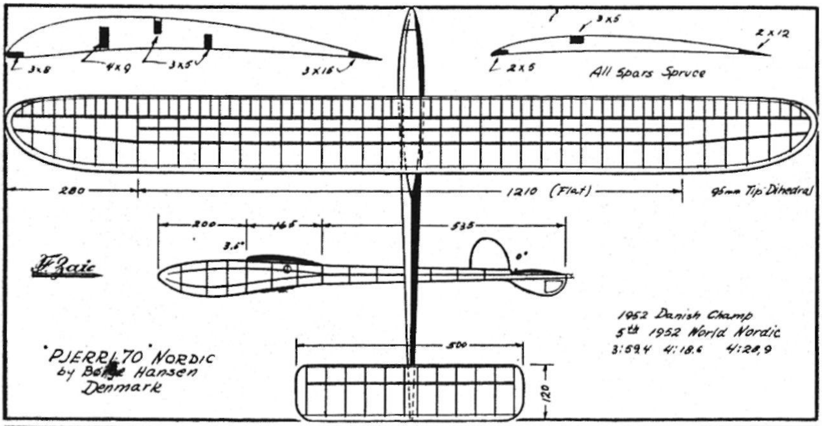


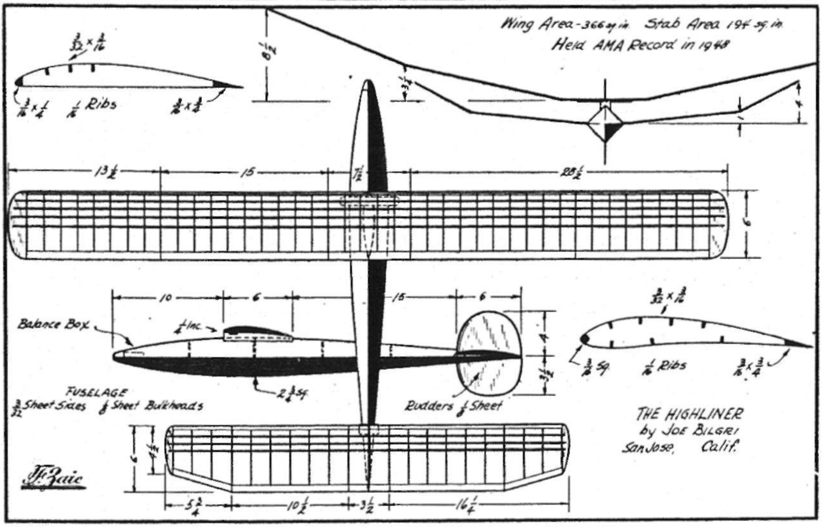




The following is the assembly procedure:

1. Glue sheets together taking pains to see that the seams are closed.
2. Lay out wing plan on the sheet with a soft pencil. Draw in rib locations. (No full size plans are required with this method). Be sure to lay out the chordwise "flat pattern" dimensions. This can, best be done by bending a thin strip of wood over the top of the metail rib template and marking the true length.
3. Cut out sheet.
4. Cut ribs using template.
5. Remove any "permanent set" from the leading and trailing edges by steaming. Cement to sheet and watch carefully while drying for any "bows" which might creep in.

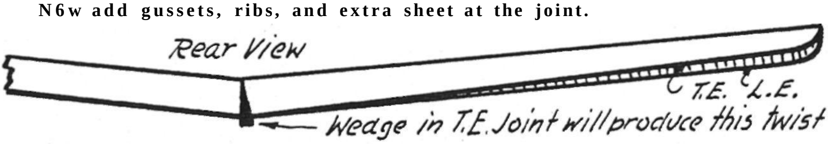


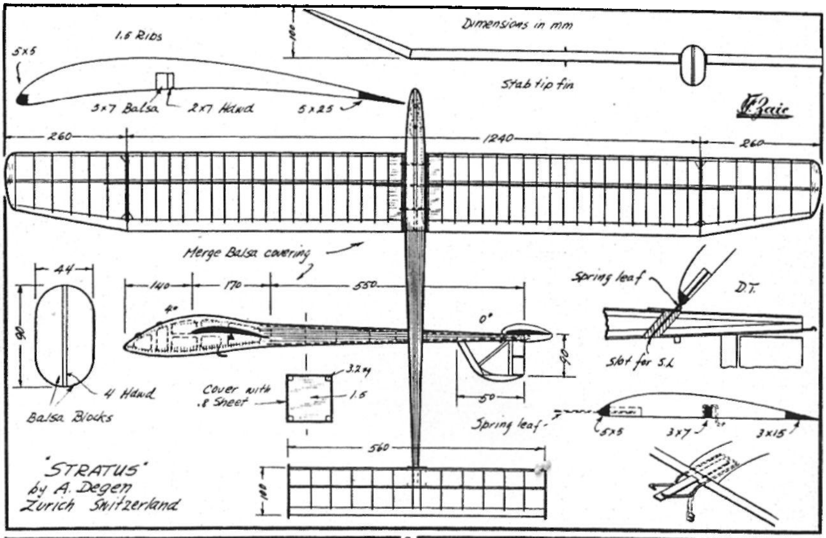


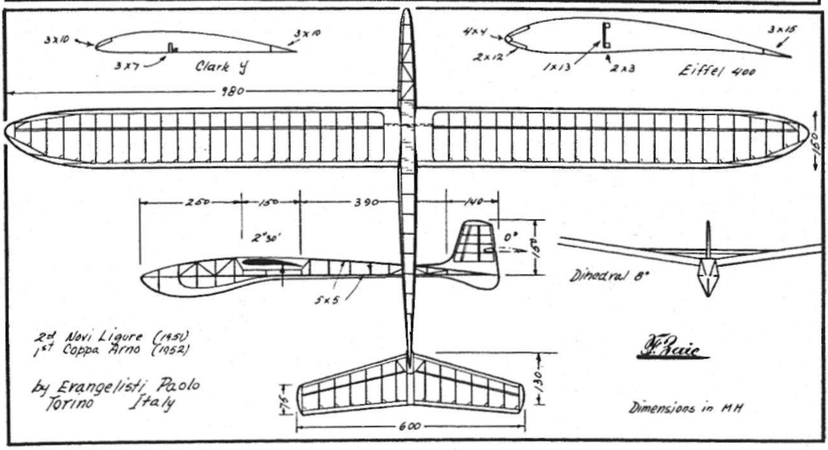
Cut ribs at rear to proper length and cement in place. Trim bottom of ribs as necessary after cementing.

Cement panels together with proper dibedral. *Important':* Before adding gussets check to see that wing has desired wash-out. To adjust, crack either leading or trailing edge joint (not both) and trim joint or add small balsa wedges until wing panels are as you want them and then recement.

N6w add gussets, ribs, and extra sheet at the joint.





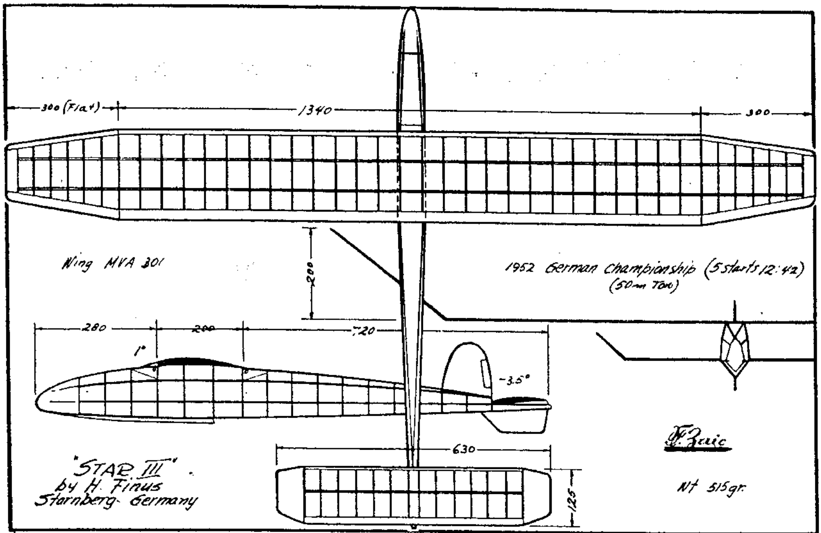


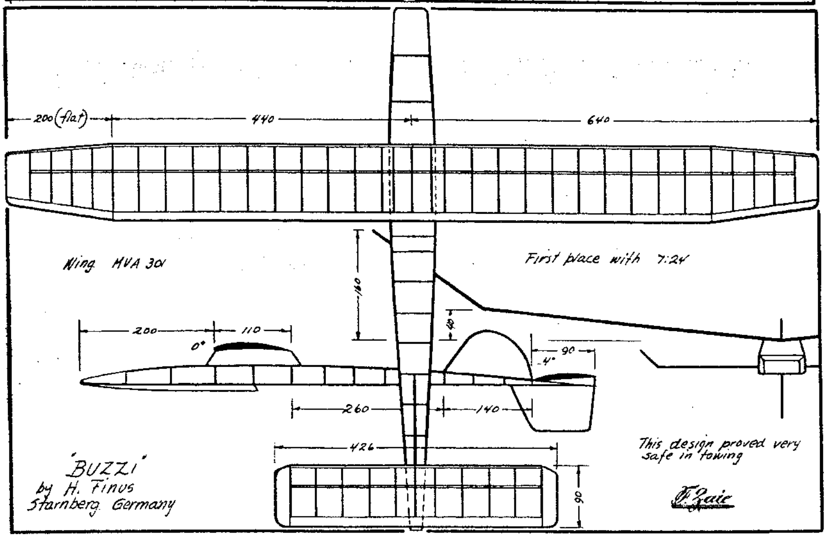
JOSEPH BOYLE—INDOOR GLIDERS—

We generally flew indoor gliders every Sunday morning and found that our average time was increased by about 5 seconds every week. After each session we would discuss the flights and in a general way decide on a change or changes we could make for the next week flying.

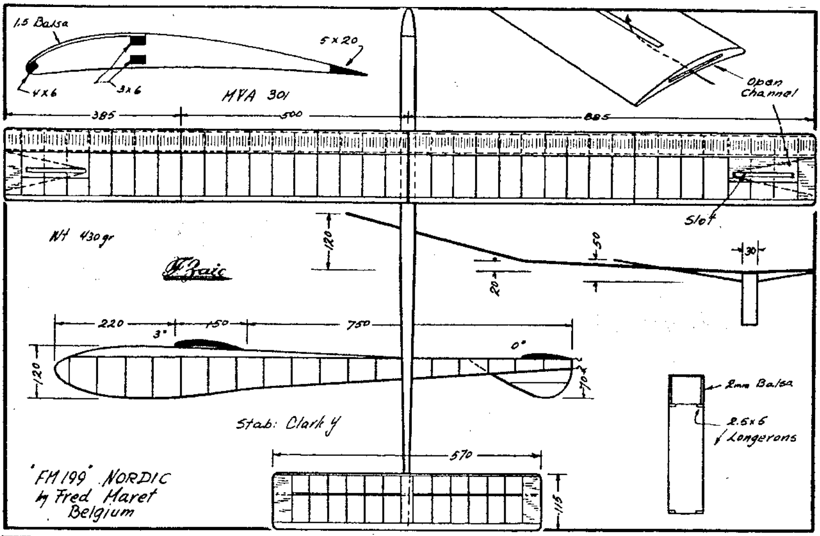
We would build three or four gliders alike as to weight and airfoil. Out of each week's output of gliders, one or perhaps two would show promise. The others, for some unknown built-in error would simply not perform well. These we just threw away and concentrated on the best ones.

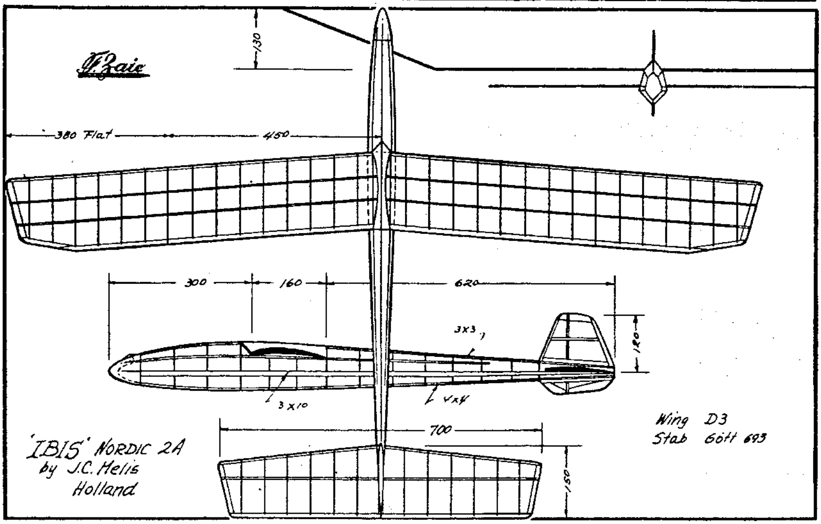
Usually, about 10 seconds could be added to a good glider's performance by careful adjustments and perhaps slight modification here and there. One of the tricks which I discovered was that a tighter circle could be obtained without apparent loss of time or launching control by simply reducing the rudder area. This was an advantage to us as we were flying in a long but narrow balloon hanger,





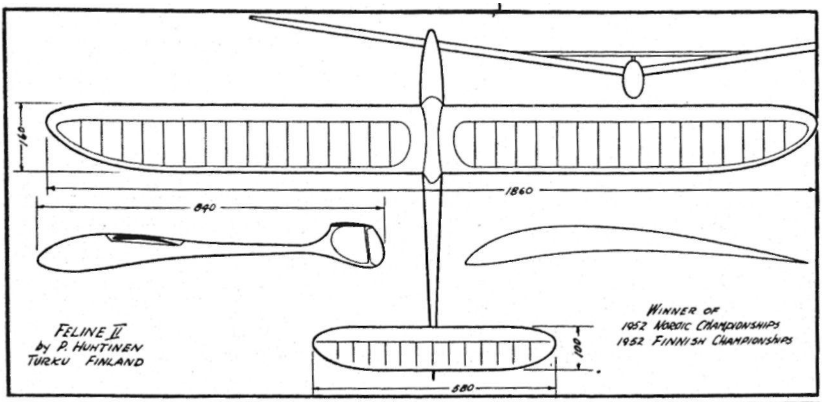
When I started to fly gliders in this hanger I doped my gliders just as *1* had done for outdoor gliders. Generally, in order to fly a glider more than one week a new rudder and stabilizer had to be made due to the dope warping the very thin sections, and they also quickly became brittle. Lacquer and glider polish were tried next with better results but still a little warpage occurred. So I tried several gliders with no finish at all. This was rather unusual but it kept the surfaces from warping. The model was sanded very thoroughly with 6-0 sandpaper before each session of flying. Occasionally I rubbed the model with a piece of wax paper, but it did not seem to make any difference. I still have a three year old model on which the wing, stab

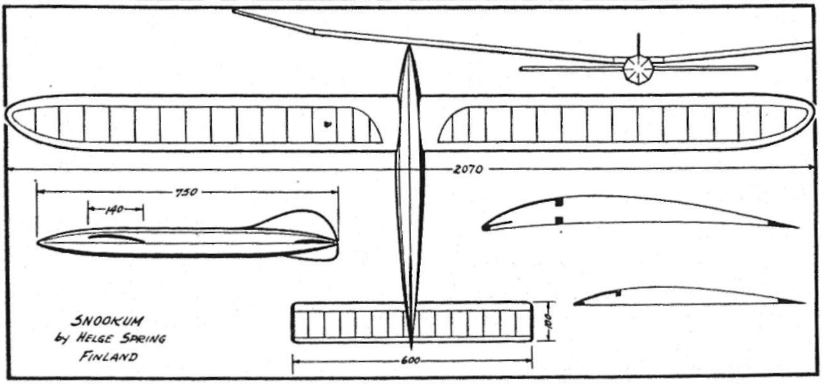




and rudder are still straight and warp free. I believe that the increase in drag is more than offset by the warp free surfaces that are so important to efficient gliding model.—(Since gliders move at such slow speed after the initial launch, the drag may not be most important item.)

In general we found low dihedral and fairly long tail moment arm a must. Almost everyone at the "Brainbusters" used fairly small stabilizer and rudder with short nose moment arm. Fuselages were usually *V/4* times longer than the span of the wing. Stabilizer had about 15% of the wing area and the rudder approximately 5%. My wings were made from light 3/6 x 4" stock, were undercambered about 1/16 and had a blunt leading edge.



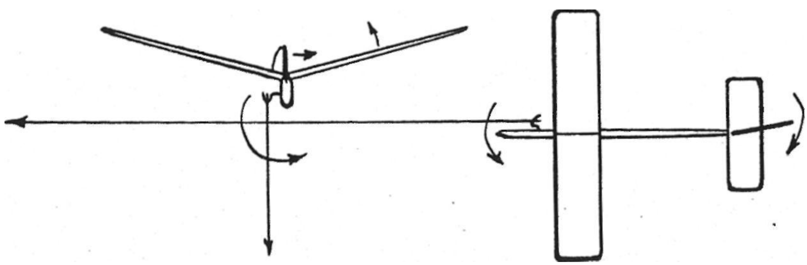


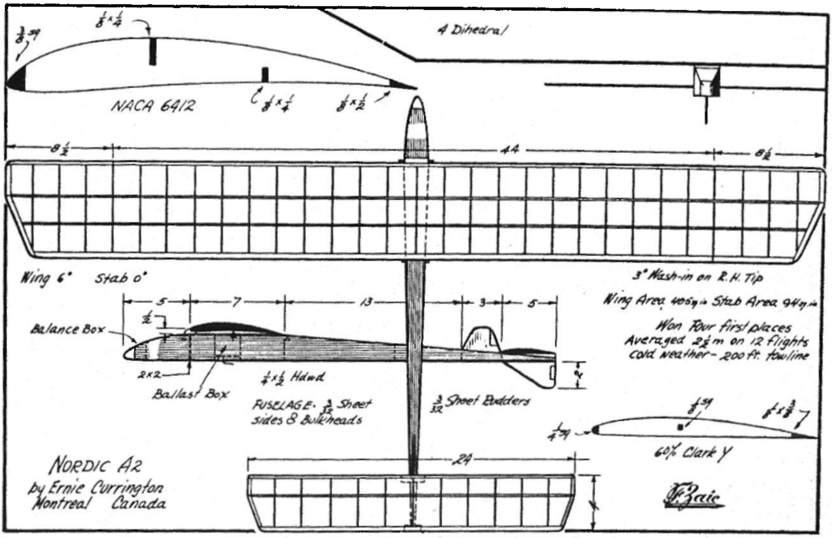
ALAN C. BROWN—GLIDER TOW—

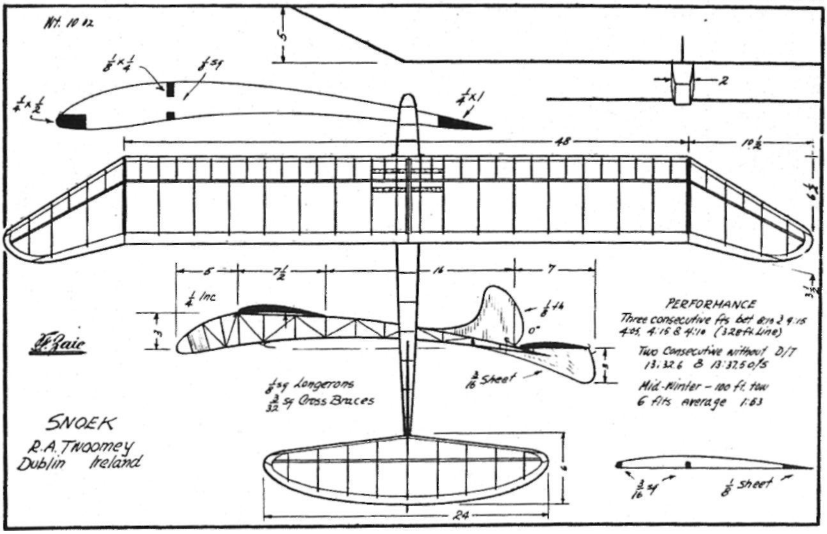
Please find enclosed the plans of my A/2 Sailplane.

It has several points of interest. First of all, the wing and the tail sections are Sigurd Isaacson's turbulent flow airfoils. As they are only effective above a certain critical Reynold's Number, the thickness/chord ratio is reduced at the tips, to prevent laminar breakaway and hence tip stalling. This has been proved quite effective, and so a fairly small dihedral can be safely used.

Offset tow hooks seem to be often used in America, but these are not the answer for this reason: At the beginning of the tow the position is as shown. Tow hook on right hand side of fuselage counteracts right rudder







setting. When the plane is getting towards overhead, the tension on the line tends to roll the aircraft in the same way as the rudder is turning, and the aircraft's turn is generally aggravated so much that it is impossible to get overhead launch, the turn pulling it off the line of tow right into a spiral launch at a tow line angle of about 60°.

Regarding your wedged rudder, I have decided to go over to the system myself now. Previously I had used tthe tow hook operated auto rudder because it gives a slight amount of extra control in that you can slacken off or tighten the line to a certain extent on the tow, and so put the rudder where you want it. However, I have decided that the limitations of this method on gusty weather or on the point of release when you are waiting for a thermal far outweighed the slight control advantage.

WALTER ERBACH—THE PALMGREN FORMULAS—

Arvid Palmgren has worked out a set of useful formulas for rubber powered model power plants but unfortunately they are in metric units and based on black rubber characteristics. For more ready use we have converted them to English units and graphed several of them. Herewith this information is presented together with suggestions and illustrations for its usage. As you will see from our examples later on the black rubber is a very small handicap, in fact seems to cancel itself out. The results are still, as Palmgren stated, "approximately valid for single skein rubber powered model airplanes of standard design," and certainly worth the little effort to use the formulas.

FORMULAS

1 — Maximum Strands 1/8: $N = 0.64\,(W^2S^2)^{\frac{1}{3}}$

2 — Motor Torque: $T_M = 0.0554 \times N^{\frac{3}{2}}$

3 — Motor Torque: $T_{max} = 0.123 \times N^{\frac{3}{2}}$

4 — Work per revolution $= 0.348 \times N^{\frac{3}{2}}$ (based on mean torque).

5 — Prop rpm $= 123{,}000\sqrt{\frac{T}{PBD^3}}$

6 — Prop rps $= 2050\sqrt{\frac{T}{PBD^3}}$

7 — Thrust, $F = 1.3\frac{T}{P}\sqrt{\$ - 10}$ ($\$ = 15\%$ for T_M, $\$ = 52\%$ for T_{max})

8 — Min. horizontal velocity $= 104\sqrt{\frac{W}{A}}$

9 — Min. Prop Pitch, in. $= 0.74\frac{\sqrt{N^3}}{W}$

10 — Mean Prop Pitch, in. $= 1.11\frac{\sqrt{N^3}}{W}$

11 — Max. Prop Pitch, in. $= 1.48\frac{\sqrt{N^3}}{W}$ (moderate altitude, H.L. only, & indoor sticks)

LEGEND

A = Projected wing area, sq.in.

B = Max prop blade width, inch.

d = Drag, ounces

D = Prop diameter, inches

F = Prop thrust, ounces

L = Lift, ounces

N = Strands of 1/8

P = Prop pitch, inches

R = Rubber weight, ounces

\$ = Prop slip, percent

T = Motor torque, inch-ounces

t = Flight time, seconds

W = Total model weight, including rubber, ounces

Prop pitch	Max. alt., ft.	Motor run, sec.	Time, sec. free wheel.	Time, sec. free wheel., ret. ld.gr.
P min.	$573\,\frac{R}{W}$	$28.5\,\frac{R\sqrt{A}}{W^{\frac{3}{2}}}$	$66.7\,\frac{R\sqrt{A}}{W^{\frac{3}{2}}}$	$85.7\,\frac{R\sqrt{A}}{W^{\frac{3}{2}}}$
P mean	$426\,\frac{R}{W}$	$43.0\,\frac{R\sqrt{A}}{W^{\frac{3}{2}}}$	$72.5\,\frac{R\sqrt{A}}{W^{\frac{3}{2}}}$	$88.0\,\frac{R\sqrt{A}}{W^{\frac{3}{2}}}$
P max.	$344\,\frac{R}{W}$	$57.0\,\frac{R\sqrt{A}}{W^{\frac{3}{2}}}$	$78.5\,\frac{R\sqrt{A}}{W^{\frac{3}{2}}}$	$90.5\,\frac{R\sqrt{A}}{W^{\frac{3}{2}}}$

The easiest way to show the worth of this material is through an illustration. Let us design the power plant for a typical outdoor model having a 40 in. span wing of 200 sq. inches area with an overall weight of 8 ounces. Formula (1) or the span power loading graph show that 30 strands of 1/8 should be the top power used. Formulas (9) or (10) or the outdoor prop pitch graph give the appropriate pitch to which the prop should be carved. For a high climbing ship the minimum pitch indicated, IS^fa '"-> should be used. For more satisfactory all around performance the mean pitch (which is always 1% times the minimum) of 23l/, in. should be used. A check of the better American outdoor ships for which we have information shows that the mean pitch graph closely represents our practise.

Now there are two ways in which we can proceed and these two ways should check each other. Method One: We have a formula (No. 8) telling us how far the model will fly each second under cruising conditions and so by using the propeller value for mean torque, we can calculate the necessary prop rps. Method Two: Formula (6) gives prop rps directly and by deciding upon suitable propeller dimensions we can use it.

— METHOD ONE —

The velocity graph gives $V = 21$ ft/sec for a wing load of $8/200 = 0.04$ oz/in^2

With 15% slip for the prop, each turn will pull the model 85% of the pitch so each revolution will pull the model $0.85 \times 23\frac{1}{2}$ or $19\frac{1}{2}$"

To pull the model 21 ft. each second, the prop must turn 13 rps. 21 ft/sec = 252 in/sec so

$$rps = \frac{252}{19\frac{1}{2}} = 13$$

— METHOD TWO —

The customary prop would be about 16 in. dia. and have a $2\frac{1}{4}$ in. blade width.

The mean torque (also necessary for RPS formula) is $0.0554\sqrt{N^3} = 0.0554\sqrt{30^3} = 9.2$ in.oz.

Substituting the above values into prop rps formula

$$rps = 2050\sqrt{\frac{T_M}{PBD^3}}$$

$$rps = 2050\sqrt{\frac{9.2}{23 \times 2{,}25 \times 16^3}}$$

$$rps = 13.4 \text{ rps}$$

Surely this is a close enough check. (To be most scientific the methods should have been combined. By using the answer from method one and assuming a suitable prop diameter, we can solve the prop rps formula backwards to find the needed blade width. Trying this for odd odiameters gives a 5% in. blade width for a 12 in. prop and a 1% in. blade width for a 20 in. prop, both awkward but reasonable for 30 strands of

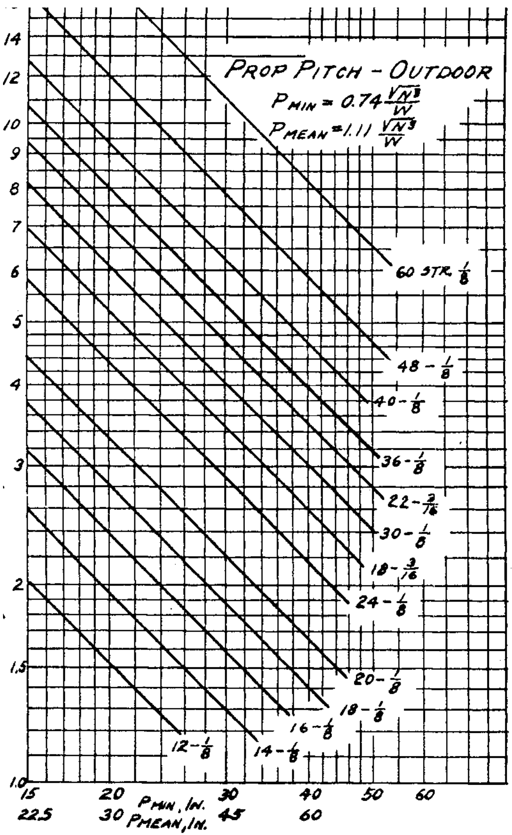
As a final step we can compute the approximately, at mean torque or cruising conditions. The thrust with 15% propeller slip is

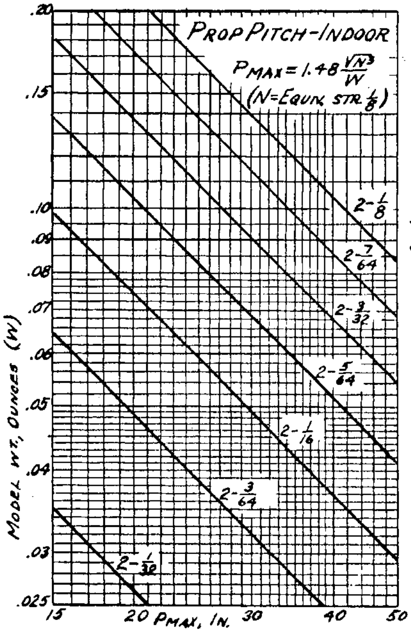
$$F = 1.3\frac{T}{P}\ \overline{IS - 10} = 1.3 \times \frac{9.2}{23}\ \overline{115 - 10} = 1.1 \text{ ozs.}$$

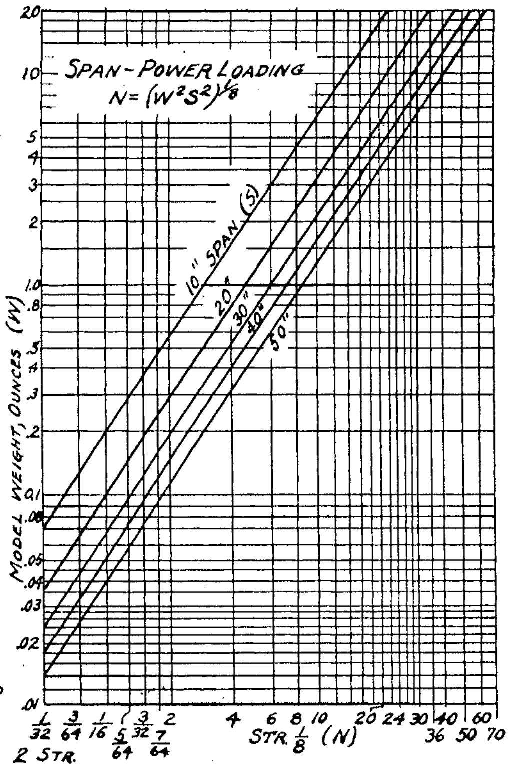
$$\text{Then } \frac{L}{D} = \frac{W}{F} = \frac{8}{1.1} = 7.4 \text{ Reasonable}$$

(Note: Palmgren ahs in his original thrust formula but in all of my calculations this gives apparently erroneous results; coming closer in my opinion to actuality. The L/d calculation using gives 3.1 which certainly seems low.)

While the rest of the formulas, those for altitude, motor run and flight time are perfectly straightforward and not needed for the design they

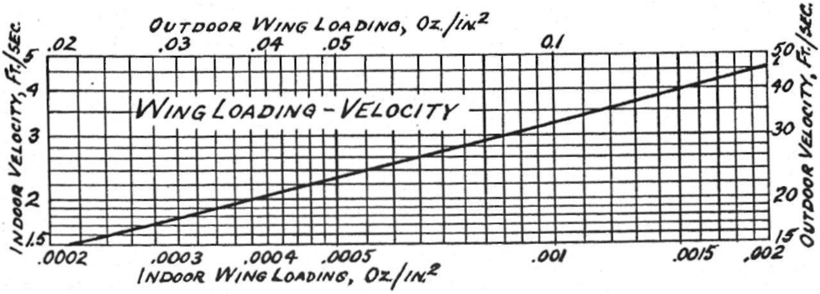

PROP PITCH - OUTDOOR
$P_{MIN} = 0.74 \frac{\sqrt{N^3}}{W}$
$P_{MEAN} = 1.11 \frac{\sqrt{N^3}}{W}$
60 STR. 1/8
48 - 1/8
40 - 1/8
36 - 1/8
22 - 3/16
30 - 1/8
18 - 3/16
24 - 1/8
20 - 1/8
18 - 1/8
16 - 1/8
14 - 1/8
12 - 1/8
PMIN, IN.
PMEAN, IN.


PROP PITCH-INDOOR
$P_{MAX} = 1.48 \frac{\sqrt{N^3}}{W}$
(N=EQUIV. STR. 1/8)
2-1/8
2-7/64
2-3/32
2-5/64
2-1/16
2-3/64
2-1/32
MODEL WT, OUNCES (W)
PMAX, IN.

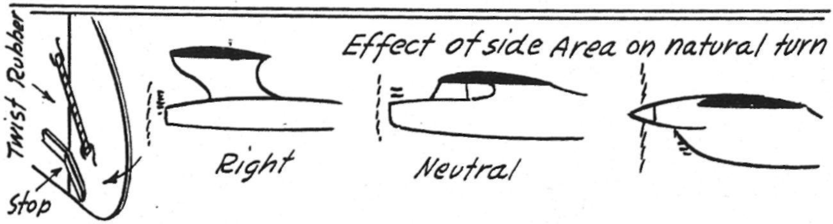

SPAN-POWER LOADING
$N = (W^2S^2)^{1/8}$
10" SPAN (S)
20"
30"
40"
50"
MODEL WEIGHT, OUNCES (W)
STR. 1/8 (N)
2 STR.

should be studied carefully for an understanding of the basic factors which affect the performance and dead air endurance.

For indoor models the procedure outlined above can also be carried through, using the maximum pitch prop formula. The maximum flight time for indoor stick jobs is given very closely by the free wheeling prop formula



Of nine record indoor sticks which we felt had done about all that could be expected of them six had coefficients within



FRANK BETHWAITE—THERMAL RUDDER—

(Re: A/2 Sailplane in the 1952 Year Book.) Turn was by a spring-loaded rudder tab. Do not think I mean automatic rudder, she had that too, of course. But the tab was biased to the "turn" position by the torsion of an unstretched rubber bend, twisted slightly. Method was to put a turn or two in the bend, and hand glide the model. The tab would blow straight as she flew. So, put another turn in, and another, until the tab just holds against the turn "stop" at normal speed. This way I obtained very tight circles with a big "84" model, and yet when she hit turbulence and tried to spiral, the rudder just blew straight as soon as speed built up a knot or two, and she simply zoomed, and turned again of the top of it. It all worked very well, and times was around 230-240 sees off 300 feet in calm air.—I do not rate it as a good model now. Reasons: Sinking speed should be lower, penetration and buoyancy in rough air should be better, and hunting circle should be larger.

A LATER SAILPLANE—Its chief virtues are its ability to hunt thermals in very wide circles, and tighten its circle instantly any turbulence is encountered. It took a long time to develop this. Principally, a very small rudder is combined with slight tilt in the stabilizer, the whole being on a model with large radius of gyration. (That is, the weight is not concentrated, but is well spread out in the ends) and a smallish stabilizer is operated at at a small wing-tail difference and a far-back C.G. position (relatively). The tail moment arm is long enough to take care cf any stability troubles that would normally be expected with this sort oi set-up. In flight, the whole affair works like this:

The slight tilt to the tail does not effect the tow at all. After release in calm air, the auto rudder deflects the tab a trifle—about an eighth of an inch—and a very wide left circle results of about 150 and 200 yards diameter. As soon as any turbulence shows up, however, the nose runs higher, but the larger inertia prevents "nose light" stalling, and the extra load on the tail, which promptly tightens the turn, also checks any stall. The whole effect is uncanny. She's hunted like this in front of big crowds and had them speechless. First time through may not be quite centre, but it turns her enough to connect more quickly next time, and it's not long before she's in and away. The probability of hooking one is obviously much higher than that of the fixed radius model. Diameter in turubulence, by the way, would be about 40 to 50 yds.

ACTION DURING CIRCLING—You ask specifically about that power job of mine. To understand that one I will have to start a long way further back.—First, turning and spiral stability. Any turn, induced by rudder (or aileron) works like this: (Assume the model to be level and the rudder then deflected). The deflected rudder crabs the ship a little, dihedral then rolls the model because "air gets under the advanced tip," the lift force of the banked wing then has a horizontal component, and this is the force which actually turns the model. Also, as the turn develops, the model tends to slip in a little, such that dihedral is now tending to roll it level again.

The turn will stabilize at that point where the overbanking tendency (because the outer wing is travelling faster than the inner, and therefore lifting more) and the tendency of the nose to slip down, (because the side-slip is resisted largely by the rudder at the back); are exactly counter-balanced by the tendency of the model to run straight and resist turning (because it has vertical surfaces, actual or effective, both fore and aft) and the tendency of the dihedralled wings, slipping, to roll the model level. The action is complex. Your "Circular Airflow" will predict the lift coefficient at which the model will finally trim, and this may be a spiral dive.

However, the important fact is this—a model may be trimmed perfectly safely to a slow, gliding turn. Let the speed build up, for any reason whatsoever, and the angle of bank increases—it must then come to a point where the deflected rudder drives the nose down, and you are away in a spiral dive. This is fundamental. Thus, for any model which may at some stage be travelling very fast, turn by rudder is potentially dangerous, and is therefore to be avoided.

It is clear that some method of turning other than a positively deflected rudder is required. The weighted "drag-flap" used out near the wing tip, blows straight at high speed, is quite satisfactory. A very lightly spring-loaded rudder tab, which just holds its deflection at design glide speed, and will blow straight thereafter, is another very satisfactory method. Or one can use a tilted tail. The reason why a tilted tail is safe is not generally appreciated, and I have never seen it in print, so here it is.

The turn, of course, arises from the horizontal component of the tail's lift force (an aft C.G. position and positive tail load, are fundamental to the tilted tail method). Now, as speed builds up for any reason at all, the wing angle of attack decreases. There is always some wing-tail angular difference, with the tail a little less positive than the wing. Thus, as the wing angle of attack decreases, the tail angle of attack tends to approach zero, or more specifically, the no-lift angle. Once there is no lift from the tail, there is nothing, no lift, no side force, so the turn stops. Analyzed right out, this means that any model trimmed with a tilted tail will have one definite speed, and radius of turn, at which it will be stable. Faster or slower spiralling or otherwise upset, it will always revert to this flight path. For this reason I prefer it.

SPIRAL POWER CLIMB—Now for the power side of the picture. At high thrust-weight ratios it is almost impossible to prevent a model from looping (using normal trim methods), and so what must be done is to arrange that the model rolls in phase with its loop, thus producing an upward helix. Clearly, the greater the radius of loop, the greater will be the time in which to arrange the model rolls. And a left hand turn, with a really fast motor, produces a useful nose-up gyro moment.

To combine all this, the model in question intercepts the lower, left-going swirl of the prop-wash, and the low mounted wing lets the upper swirl go over unchecked. Net result is to drive the nose left.

At low speeds, prop wash (blast and spin) is at a maximum hence the left-turning effect is considerable—as is also, therefore, the gyro force lifting the nose up. As speed builds up the prop wash becomes relatively less effective, hence the turn opens out and the nose-up force decreases. The effect is for the model to accelerate in an opening spiral or helix. It settles after four or five seconds into a flight path inclined upward about 50-60° banked left about 45°, and travelling extremely fast. Once the motor cuts, it usually does a half a loop, and rolls off the top into its right-hand glide turn. If at any time the speed builds, it tends simply to run straight and loop—both, intercepted prop-wash and tilted tail, as methods of turn tend to zero at speed, and all that is left is loop, be it vertical, oblique or horizontal. Hence the model tends to be safe, if sensibly handled.

It took me a little while to understand the principle of the opening spiral after launching. As mentioned in that Aeromodeller article, a launch, wings level and nose up, tends to settle into a final helix the axis of which is inclined some 30-40° from the vertical. A launch to the North, for example, would result in the model climbing away, rolling around a helix inclined about the S.W. horizon. Finally, I realized the method and now a launch, fuselage level and banked steeply right will resultin the helix going straight overhead. Ratios, of course, are improved.

I think that is about all. The model did work as planned and its performance really was terrific—ratios about 20-22 were the best I can estimate. I washed it out completely one calm evening. Thoughtlessly I changed the brand of prop. The post mortem disclosed that the old head had broader, thicker, higher pitch tips than the new one of the same nominal dimensions. As a result I lost some of the turn, and the ship did one loop to an incomplete roll—the phasing had been altered. Sheer carelessness.

The lower forward fin works, but definitely. A pylon job, dead true and straight, tends to go right, of course. As the relative position of the prop-washing is shifted, the tendency to turn shifts through zero to a left tendency.

I have demonstrated this on a model with a moveable motor. You note the C.G. position and angular difference. Actually, I started out with C.G. at about 90% and a small angular difference. But, although the ship was stable in the glide, it had so huge a radius of recovery after a dead stall that it frightened me. So the wing went back and some more angle went with it. Certainly the loop was now tighter, but still open enough to be easy and safe. Adjustments were not touchy. But .looking back on it, I now realize that the first few seconds during which it was turning tightly, accelerating and establishing its proper helix were pretty critical, solely because of the terrific power and the tight turns. As speed built, everything opened out, and the ship perfectly docile.

HANK COLE—DEAR FRANK—(Oct. 1951)—

Noted your interest in the C_{l_r} stability term. This is the rolling moment resulting from rotational velocity in coefficient form. The most prominent part of this term arose from the fact that the rotation causes the outbroad tip to travel faster than the inboard tip. Since this generates more lift on the outboard tip than the inboard one, the result is a rolling moment into the turn. This is the major effect contributing to spiral instability and as you can see indicates that high aspect ratio jobs are more suscepible to spiral dives than low aspect ones. I am sure you are already familiar with the effect, but not in the terminology I use. The above effect can be counter-acted by cathedral in the tail, a large subrudder, or by moving the center of gravity back. The long job Wakefield of mine uses a combination of large sub rudder and rearward location of C.G. Incidentally, the above effect has a stabilizing influence in turns by reducing the angle of bank if the turn tightens which tends to raise the nose as the turn tightens. This is especially desirable for wind soaring.

By the way, model design may be carried out in the same way as full scale design. I could sit down and in about two months of full time work could for instance design the optimum Wakefield. This is just to give you an idea of how much work would be involved. The procedure of optimizing is far from simple. I did carry it through for an indoor model once and came up with a design which has consistently done over 20 min. For its weight, the job outperforms anything I've seen indoors. But, as you well know, in indoor work, light weight contributes to performance as well as efficiency. Although the actual design procedure is much too complicated to carry through for practical purposes, I usually rpake rough preliminary design calculations on endurance, by estimating parasite and induced drag and available lift coefficients. From this you can calculate, the
which is proportional to endurance. It was on this basis that I designed my long job. Rough calculations proved that this layout would have a 15% edge in endurance over the conventional layout and about a 5% edge over the canard layout.

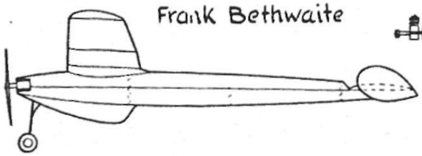
—Jan. 1952—

Never seem to settle down to write this thing on spiral stability. Went on a long skiing trip the first part of this month and the latter part of December. Have to get in condition because I am racing this year. I guess

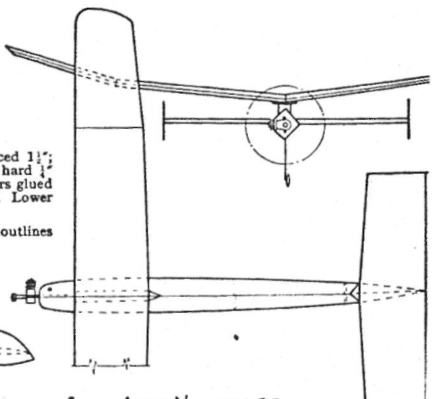
Power :	ETA ·29.
Propeller :	" Tru-cut " (balanced, thinned) 10×4 ins.
Weight :	32 ozs.
Wing :	N.A.C.A. 4612 (not 6412) at +2·75°*
Stabilizer :	9% Clark " Y " at −0·6°*
	* measured tangent to lower surface.
c.g. :	75% M.A.C.
Thrust :	Down 5·0°. Side 3·0° left.

Fuselage; 1/4" sq. longerons, 1/16" sheet covering, Braces spaced 1 1/2"; 1/4" sq. back to T.E. then 1/4"×1/8", then 1/4"×1/16" to tail. Very hard 1/4" sheet, grain vertical, let into nose with 3/8"×1/2" motor bearers glued and sewn on to it. Wing saddle 1/8" sheet, fairing 1/16" sheet. Lower fin 1/4" sheet.

Wings and slab 1/16" sheet, 1/8"×1/4" top and bottom rib outlines spaced 1 1/4".



Frank Bethwaite



from AEROMODELLER

this competition business gets in your blood after awhile. Anyway, I thought it was about time to send you some more details on the ideas I mentioned. This work on spiral stability has been done by many in the full-scale field, but, as you say, nobody has actually made a comprehensive study in regards to models. The reason is quite obvious. The equations of motion are much too difficult to understand unless one is well trained in aerodynamics and mathematics. If you ever have the time, it might be worth your while to go through some of the early British Research Memorandums, particularly the work of Glauert. Also Zimmerman's NACA reports.

Since the work would be much too lengthy to present in its entirety, I will give you only the main points which I have found in this work. The spiral stability only will be considered here, and should not be confused with Dutch roll. The first requirement for spiral stability is static directional stability. This merely means that the neutral point in yaw must be aft of the center of gravity. If this condition is satisfied, then spiral stability is satisfied if

$$E > 0 \quad \text{Where } E = \mu \frac{C_L}{2} \left(\ell_v n_r - \ell_r n_v \right) + \text{Terms in } \operatorname{Tan} \gamma$$

Always Pos. Usually Pos. Angle of climb usually neglected

Hence we se that Spiral Stability depends on $\ell_v n_r > \ell_r n_v$

ℓ_v = Rollins' Moment due to sideslip K (increases with increase in dihedral^

n_r = Yawing Moment due to Yawing velocity (Increases with rudder area and side area and fuselage length)

ℓ_r = Rolling Moment due to yawing velocity (increases with Aspect Ratio, forward movement of C.G., increase in , wins incidence, raising of side area above fc aft of C.G.,

n_v = Yawins Moment due to sideslip (static Stability term increase with rudder area and tail length)

That's the situation. Now let's see what we can do about it from the design standpoint. First let us consider the terms n_r and n_v . We see that most of the things which increase one increase the other except for one thing. The damping in yaw, that is n_r , may also be increased by increasing side area and fuselage length. Since n_r is on the positive side, we see that these things contribute to spiral stability. This agrees well with experience. Models with large fuselages seem to be more insensitive to spiral dives than the pencil bombers and streamlined jobs. This damping term is the reason. If may be easily seen that increasing the rudder area or tail length will not increase the spiral stability because both n_r and n_v are increased.

We see that large dihedral is on the positive side and increases spiral stability. No wonder such large dihedrals are in evidence on high-powered gas models. Dihedral is no cure-all though, for if it is carried into excess another instability arises, namely Dutch Roll. The answer to spiral stability, then, lies in the remaining term

This term l_r can by careful design be made equal to zero, and, when this is done, spiral stability is assured.. (If ℓ_v & $n_r > 0$) To be more specific, I will explain this term carefully. This is the rolling moment which arises due to the rotational velocity (angular velocity) in yaw. The most powerful effect in most models arises from this yawing velocity causing the outer wing tip to travel faster than the inner wing tip, thus causing the model to roll "into the turn and go into a spiral dive. We note immediately that a low aspect ratio wing would keep this effect to a minimum, and this too agrees well with experience. However, for performance reasons, low aspect ratio wings are not desirable so we must seek other means to counteract this effect. One thing which helps is to reduce the incidence of the wing. This inclines the principal longitudinal axis of the airplane to the airstream with the result that the cross products of inertia oppose the roll into the turn. Another, but smaller effect is to lower the area behind the center of gravity and to raise the area forward of the center of gravity. Here again theory agrees with practice for the beneficial effects of pylon and subrudders is well known. It should be mentioned that the farther these areas are from the center of gravity, the more effective they are. Hence, if the CG is moved back the pylon becomes more effective in improving spiral stability. However, rearward movement of the C.G. requires a larger stabilizer to maintain longitudinal stability (or longer mom. arm.)

There are other and more effective means of increasing spiral stability. Negative dihedral in the stab, is very effective. In a canard, the same thing is accomplished by dihedral in the forward tail, a must because of the poor spiral stability of canards. We can also see that rearward movement of the C.G. causes the wing dihedral to have a beneficial effect on conventional types.

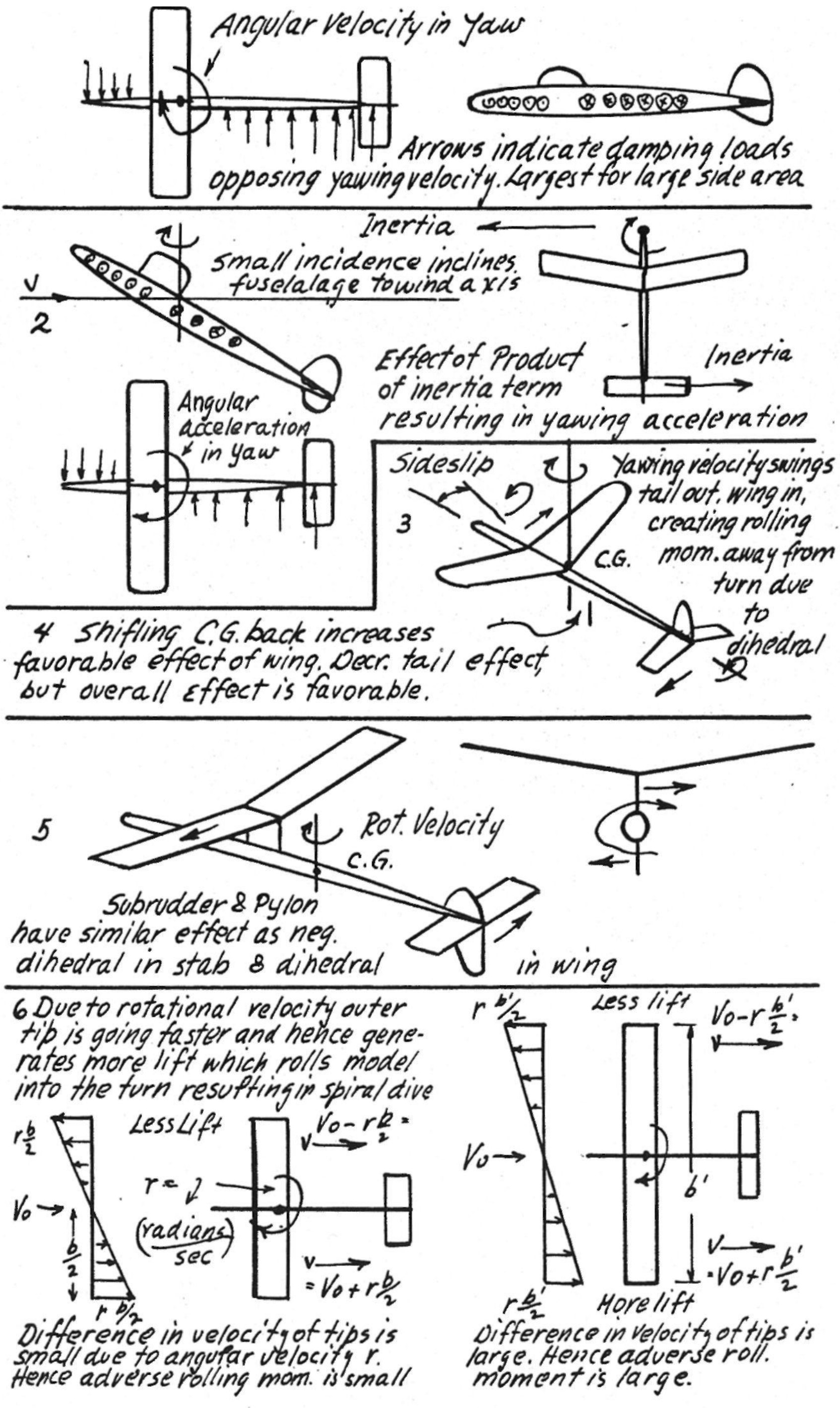
The terms in Tan should be mentioned. These arise from the flight path angle and are in general small. In general, they show that a model is more spirally unstable in a climb than in a dive. Have you ever noticed that some models seem to be going into a spiral dive from the climb, but when they get the nose down to level flight they maintain altitude just buzzing around in a circle. This happens because the spiral stability increases as the nose drops. There are a lot of models in this category. Just go to a contest some time and you will see a half dozen models that go round and round at u-control speed without gaining altitude, but which do not spiral in.

I will now summarize the desirable features to obtain spiral stability:

1 — Large side area. 2 — Small wing incidence.
3 — Large wing dihedral, negative stab dihedral.
4 — Rearward position of Center of Gravity.
5 — Pylon and subrudders. 6 — Low Aspect ratio.

By the way, Frank, you can see where my long job gets its exceptional spiral stability. The long fuselage gives high rotary damping . Low incidence gives product of inertia terms which roll away from turn. Pylon and subrudder also contribute. C.G. is 2 in. aft of trailing edge giving favorable dihedral effect. No wonder the job can climb and glide in such tight circles.

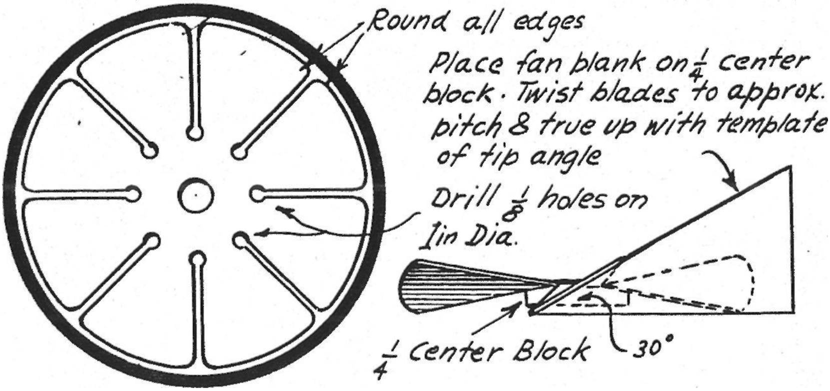
Well, Frank, roughly there's your spiral stability. Hope I've cleared up a few points, and let me know if you have any questions. Am including some sketches to illustrate the ideas. There are a number of effects which I have not included (i.e. slipsteam, sidewash, etc.), but if careful attention is paid to the above design features spiral stability is assured.



Angular Velocity in Yaw
Arrows indicate damping loads opposing yawing velocity. Largest for large side area
Inertia
Small incidence inclines fuselalage towind axis
V
2
Effect of Product of inertia term resulting in yawing acceleration
Inertia
Angular acceleration in Yaw
Sideslip
Yawing velocity swings tail out, wing in, creating rolling mom. away from turn due to dihedral
3
C.G.
4 Shifling C.G. back increases favorable effect of wing. Decr. tail effect, but overall effect is favorable.
5
Rot. Velocity
C.G.
Subrudder & Pylon have similar effect as neg. dihedral in stab & dihedral in wing
6 Due to rotational velocity outer tip is going faster and hence generates more lift which rolls model into the turn resulting in spiral dive
$r\frac{b}{2}$
Less Lift
$V_o - r\frac{b}{2}$ =
V
r = (radians/sec)
V_o
$\frac{b}{2}$
V
$= V_o + r\frac{b}{2}$
$r\,b/2$
Difference in velocity of tips is small due to angular velocity r. Hence adverse rolling mom. is small
$r\,b'/2$
Less lift
$V_o - r\frac{b'}{2}$,
V
V_o
b'
V
$= V_o + r\frac{b'}{2}$
$r\frac{b'}{2}$
More lift
Difference in velocity of tips is large. Hence adverse roll. moment is large.

R.I. "Hank" MACKENZIE—GEN ON DUCTED FANS—

As far as I know from information accumulated from many different sources and my own experiments the 3" fan made of .040 to .051 24 SO Aluminum Alloy is about the best size for 1/2A motors of "Good Torque." I use Diesels for most of my jobs now, as I can get fuel ingredients easily and cheaply, and no batteries to lug around, a speed range almost equal to ignition engines, top speeds equal to Glo-Plugs and more power per displacement than either, in small sizes. (Up to .20 cu. in.) Glo Plug Engines seem to be better at higher displacements.



Getting back to the fan! A 30° Pitch Angle at the tip of the blade is approximate. You may change it up or down depending on revs, obtained. Revs, necessarily must be high. 16,000 with finer pitch would be more efficient than 12,000 with higher pitch. My fooling about has not been done with anything in mind except sport, so I have no figures on thrust or efficiency or ducted fans.

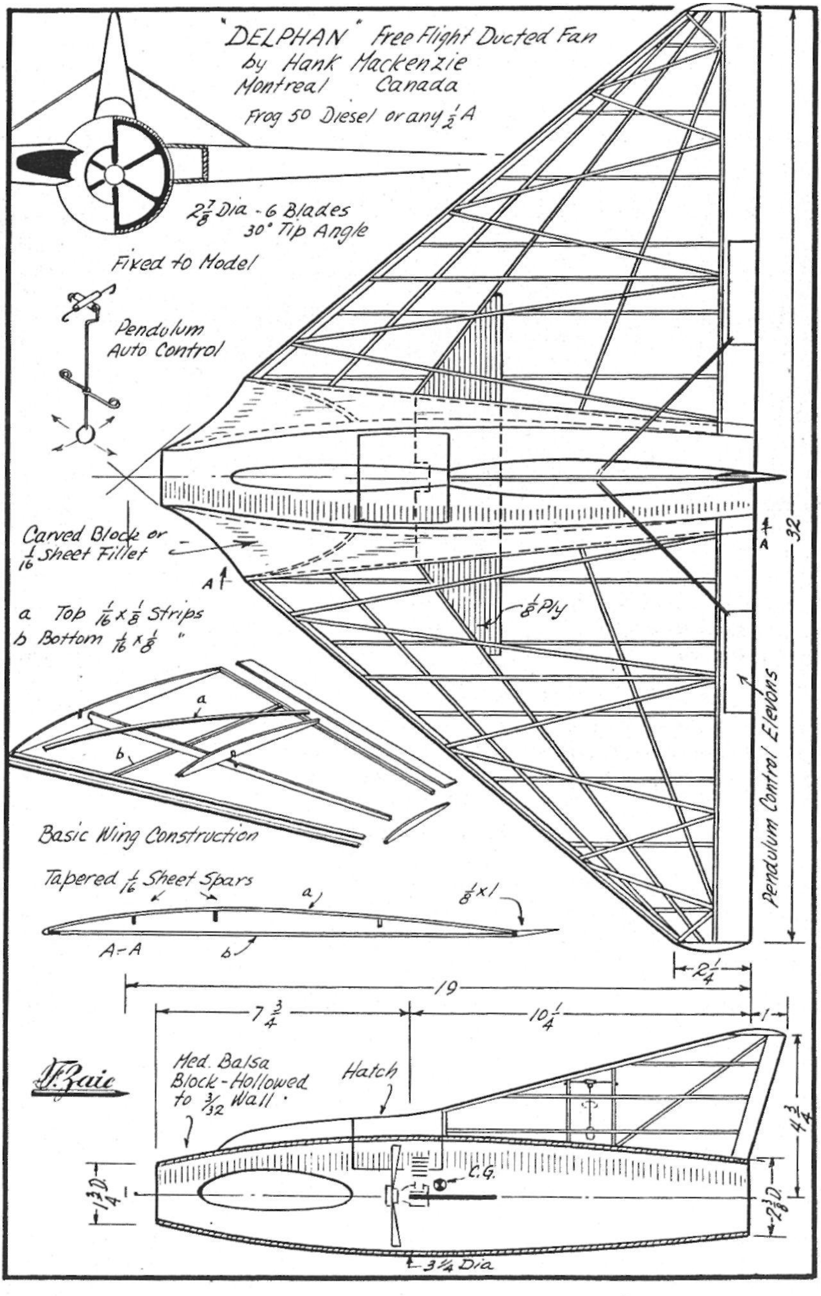
Articles by Phil Smith of England in "Model Aircraft" and A«ro-modeller" and by Tom Purcell if "Model Airplane News" have mor»-«# less led 'me to:

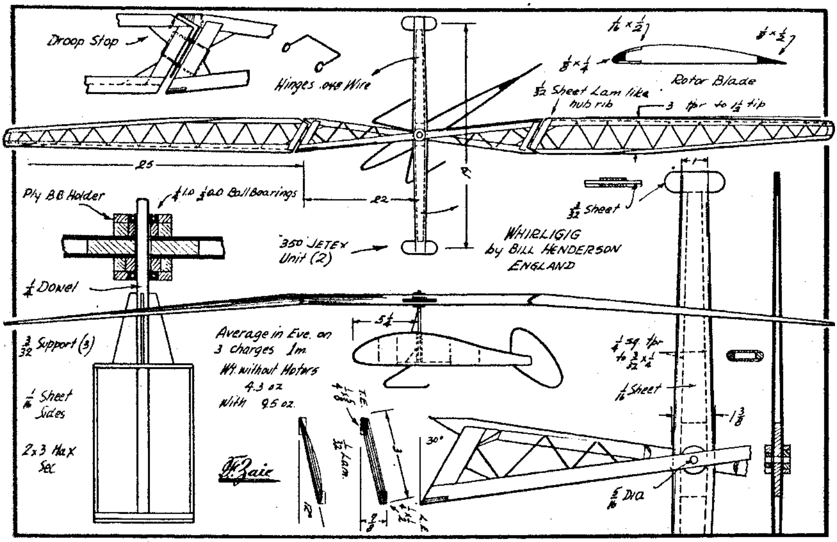
Apparently, Inlet Area must be larger than the Exit Area. And the Exit Area at least l/2 the Fan Area (Not Dia.).

$$\frac{\text{INLET}}{\text{EXIT}} = 1.2 \text{ Min. or } 1.3 \text{ Optimum}$$

$$\frac{\text{EXIT}}{\text{FAN AREA}} = .5 \text{ Min. or } .9 \text{ Optimum}$$

.5 for 10,000 revs, up to .8 for 16,000 revs. min. Try to keep weight under 11 ozs. or 8 oz./Sq. Ft. wing. Maximum clearance of fan in duct: 1/16" for efficiency. Less if possible. Carved blocks is not very strong but light and simple to make. Laminated paper I tried was heavy and tended to lose shape. Build up hexagon tube used by Phil Smith; light but not so efficient as a duct. Too much clearance. Carved block O.K. if nose is not open.


"DELPHAN" Free Flight Ducted Fan
by Hank Mackenzie
Montreal Canada
Frog 50 Diesel or any 1/2 A
2 7/8 Dia - 6 Blades
30° Tip Angle
Fixed to Model
Pendulum
Auto Control
Carved Block or
1/16 Sheet Fillet
a Top 1/16 x 1/8 Strips
b Bottom 1/16 x 1/8 "
1/8 Ply
Basic Wing Construction
Tapered 1/16 Sheet Spars
1/8 x 1
A-A
Pendulum Control Elevons
32
2 1/4
19
7 3/4
10 1/4
1
Med. Balsa
Block-Hollowed
to 3/32 Wall.
Hatch
C.G.
4 3/4
1 3/4 D.
2 3/8 D.
3 1/4 Dia
F. Zaic



BILL HENDERSON—JETICOPTER DESIGN—

Opinion varies as to the various sizes and weights etc. that are most suitable for each size of motor but the table below gives a general idea of the majority opinion.

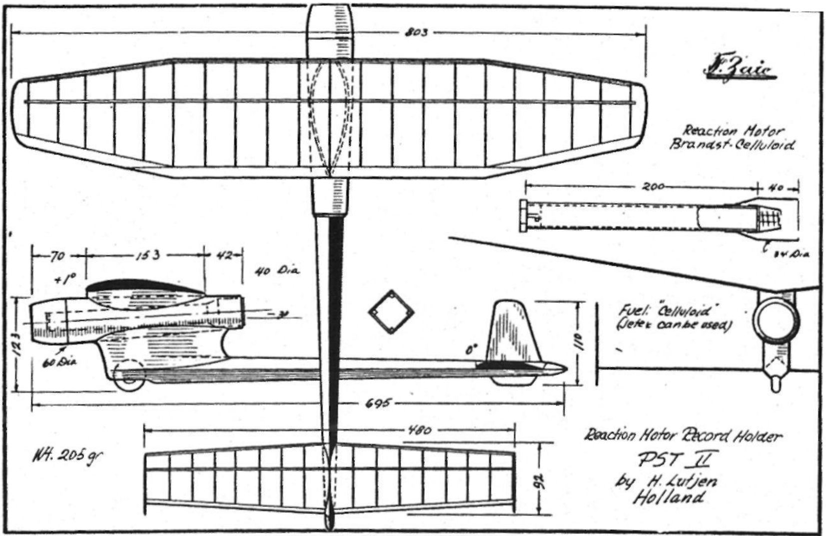
ENGINE	50	100	200	300
Rotor Diameter	24 in.	36 in.	50 in.	72 in.
Wt. without motors	0.56 oz.	1.5 oz.	2.75 oz.	5 oz.
Wt. with motors	1.0 oz.	2.75 oz.	5.0 oz.	9.5 oz.
Area of one blade	9 in²	21 in²	32 in²	64 in²
Span Loading	0.5 oz/ft	0.92 oz/ft	1.2 oz/ft	1.9 oz/ft

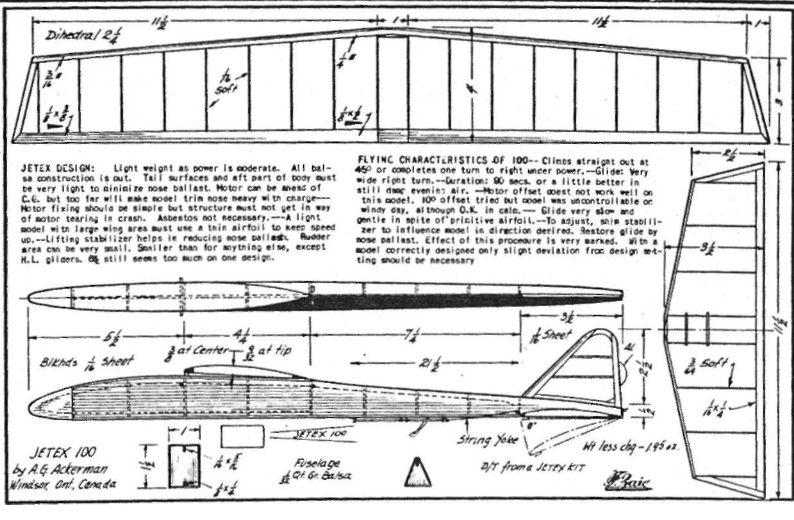
It is obvious with this form of modelling as with every other, that power/weight ratio is important and with fixed power motors, weight must be cut down as much as possible to get a better contest performance.

The Span Loading is taken so it is proportional to the disc loading and is in figures more easily comprehended.—The Rotor Center Section is usually about 28-35% of the Rotor Diameter.—The Pitch Angle varies from model to model but generally use 15° on "50" and "100" models, and 12° on "200" to "350" models.—The "delta 3" (full-size parlance for the system of skew hinge system for producing auto-rotation angle can vary between 30° and 35°.

The rotor centre section can be made from ply with hinges mounted in blocks at ends at approximate pitch angle. This is easier than building it up but it is heavier.

Should anyone be a stickler for helical pitch they can build the outer rotor baldes on a pitch angle jig, but generally flat ones set at the approximate angle by the hinges on the centre section will be quite effective.





These models will ascend fairly quickly and should descend on auto-rotation much more slowly, in fact in good thermal conditions they should be able to soar slightly and thus greatly enhance their performance.

Ball races are not necessary in the head bearings but are strongly recommended on "200" and "350" models, they being much more friction free than an ordinary journal bearing.

The hinges used are universal on all sizes of jeticopters and so far no other satisfactory one has been thought of, but some improvements could possibly be made to lock hinge wire in place and yet allow it to be taken out for ease of transportation.

BRUCE LESTER—JETEX POWER—

My first "Jetex" designs for the "100" unit were really in the fast moving "Dynamic-soaring" class with as little as 34 sq. ins. of wing area. With the information from these "hot" little jobs the "Meteor" was eventually developed by careful wing design and rocket motor setting, with over double the wing area of the originals and still sacrificing nothing of my near vertical climb.

Since the greater part of the duration of flight is made in the glide, the glide is therefore established first, and automatically the center of graviy.

As I had no desire to add ballast to the nose when the "dead" motor is ever present in the glide, I found it best to fix the motor on rather temporarily with rubber bands so that it could be moved a very slight distance fore and aft in an effort to find where the model showed signs of "planing" on as little wing incidence as possible.

This I eventually found was best accomplished by completing all component parts, covering and doping them to final state, completing the tail assembly, making sure the stab is set at Zero degrees incidence, and that the rudder is on with no turn.

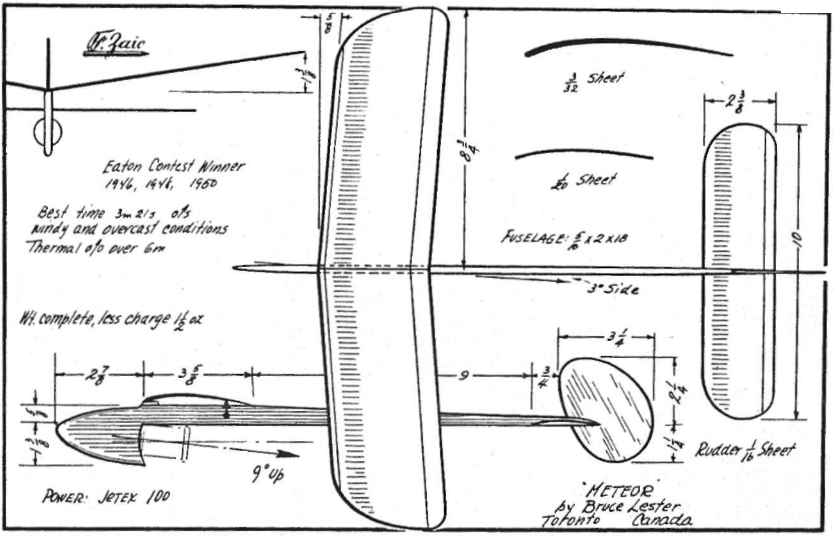
Step by step here are the final points of adjustment. The glide is established first.

With the "100" motor and motor attachment clip lightly lashed on in the desired position, and with no respect at this time for offset or downthrust of any kind, the motor is clipped on *without* a charge in it, and the wing is next rigged on. The quickest way to do this is to spot glue the trailing edge of the wing down onto the boom at the correct fore and aft location, but use a balsa wedge and a large pin for the front fixing. Several shoulder level glides should now be made all the time varying the front wing incidence fixing up and down a degree or so at a time until a spot can be found where the model settles away in a straight forward planing type of sink. Once turn is applied you will have then a perfect windy weather set-up. The "Meteor" has won several times in wind when most other models had disintegrated on the runway due to poor aerodynamic set-up.

Once satisfied with the sink then apply glue above and below the wedge, and make this setting secure for all time. You will find you can depend on it, and if it is correct you will never have to vary it. The motor clip can now be taken off, and the rear screw-nail hole elongated sideways so that "right-thrust" can be applied to the rocket. Before re-mounting is atttempted another angular wedge should be made that will straddle the rear hold-down screw, allowing the equivalent of "Down-thrust" on a "rubber-powered" model to be easily varied, and setting made secure during actual preliminary flight tests. All rubber-powered "fans" know the value of applying "downthrust" to hold the nose down during power burst which on the "100" unit is near the end of the motor-run and the model has got up to ultimate velocity inversely allowing the unit to deliver it's best output.

Start testing over tall grass with quarter-size pellets, watch for signs of looping, swinging to half-sized ones as soon as possible lest you misinterpret the symptom on a quarter-pellet, as it gives you precious little time to decide at best, yet enough to get an idea of what the model is going to do.

Since the glide and the center of gravity have already been decided, your next step is to perfect your final "air pattern" or 'thermal circle." Keep applying right thrust until you can apply a fine amount of left rudder to get about a 200' left.circle. To the "Rubber-powered fan that means



"right climb, left glide." Coupled with the long moment arm of the model and the nice taper-off of power on the "Jetex" motor, you will probably be surprised at the quick response, and right about then if a bouncing "thermal" is under you, you are away for a 6 or 7 minute flight or out-of-sight as I have had happen to me many, many times. Right about now you will be thinking about dethermalizers, and believe me they are necessary, a "pop"-up one would be best due to the light weight involved, but before putting it on try to perfect your model first, then add it later. I realize this is risky in good weather but one has to take that chance. This is the way all my winning models have been trimmed, and in that precise order.

Now a few other pointers.

First that of colour—I use yellow on all upper surfaces, red on all under surfaces, and black on sides of fuselages as it hastens your chances of picking it up on gras or in the air when it becomes small in the sky.

I have had most superior results out of all-balsa models rather than the built-up variety, and ease of handling in competition means a lot, and with "all-balsa" you can make a quick, easy repair and do a fast back-into-the-air comeback in record style.

Avoid thick airfoils if you want to get high performance and still design models of a good relative size. In all "Jet" planes using the "reaction" principle for propulsion, the "drag" factor is one of the greatest performance killers even full-scale designers have to contend with. There is a compromise point, and, after changing around incidences, airfoils, nose and tail moments, rocket settings etc. on over a dozen of successful models, the "Meteor" has paid off in reliability and in "air seconds," and after all that's what counts.

S. B. PFEfFFER—DEAR FRANK—

Your ideas on "Circular Airflow" look O.K., although I did not get through all the applications you made of it. One point that you discovered was that ships with good longitudinal stability don't spin in as easy as ones with less stability. This is definitely true and can be proved from a more orthodox approach.

Your method of presenting your material is most disturbing to a person trained in aerodynamics. The result of this is that many technical people may dismiss your ideas as erroneous unless they take the time to ferret out the basic ideas.

My personal feeling is that you could do everybody more good and make faster progress if you would acquaint yourself with the standard method of approaching incompressible flow aerodynamics. It is not complicated! And it provides an easy way to grasp theories once you get it. Also shows what to do research on. Mainly polars (Cl vs Cp) by glide tests is my suggestion.

Your work on trim, for example, actually brought out how the C.G. shifted aft (for a given model) actually decreased STABILITY and thereby lead to various trouble. However, you never mentioned it as stability, and consequently lost some insight into the problem.

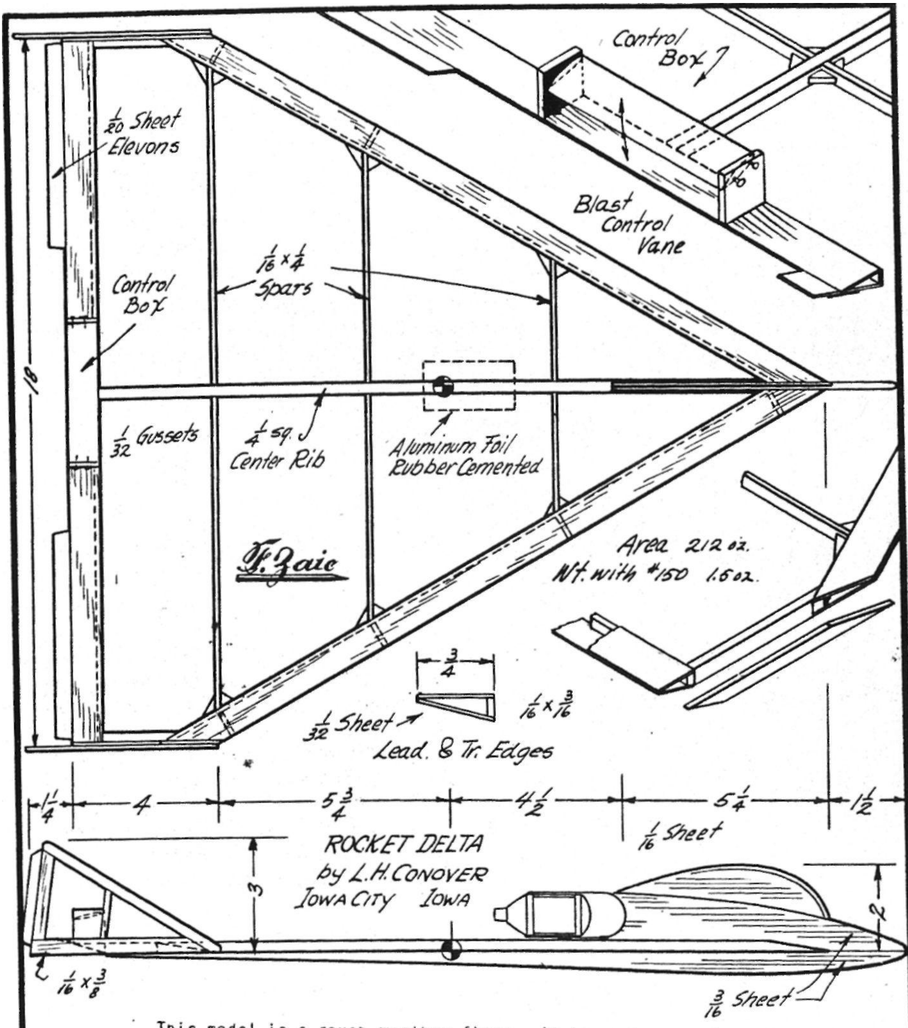
I hope you do not feel offended by my criticism. The value of your book and the effort you have expended on it justify some straight from the shoulder remarks in order to possibly improve it.

Incidentaly, Fred Younger, whom you may know, and I, feeling the basic need for fundamental information at model Reynolds Numbers, started an airfoil glide test program. We only finished the work at R.N. 14,000 which is only of use to indoor models. Fred is a member of the Low Speed Aero. Research Assoc. so published it as one of their reprts. It might be useful to you in indicating the type and amount of data that can be found from glide testing. Unfortunately Fred moved back to Boston so our glide test program at the R.N. of the Wakefield models was only just started. As well as testing the airfoil we calculated the theoretical pressure distribution and listened to the boundary layer by stethescope to determine changes from laminar to turbulent (which is THE thing).

At the typical R.N. of a Wakefield wing it is touch and go with establishing sufficient turbulence to develop the full potential of the airfoil. Our stethescope findings checked out presence of the turbulence and what caused it (i.e., it came not only from the airfoil shape but stringer bumps from the Cleveland type construction were very effective in producing it).

The situation on airfoils is very cloudy. Our tests showed that most of the researches are off the beam. Things like balsa covered L.E. (or smooth—you want rough), camber exceptionally far forward and especially laminar flow shapes are poor for minimum sink.

Incidentally you should read (or you probably have) Schmitz's book on airfoils at low R.N. It is very good on the nature of what is happening. Schmitz only spent about a year getting the turbulence out of his tunnel so don't be mislead by taking *anything* from the NACA tunnels as being what they are said to be at the R.N. they say. Turbulence factors are available for all major tunnels but the tunnels were never intended to give results at R.N. even close to 45,000 so they are all too turbulent .for these R.N. It is very possible that when the NACA lists a test for 50,000 R.N. it might take a free flight model flying at a R.N. of 100,000 to get comporable results. You might have a chat with them on effective R.N. versus calculated R.N.



This model is a rough weather flyer. It is most succesful for contests in thermal weather. Its advantage over conventional designs is its terrific rate of climb --- especially with #150--200.

The #350 makes it extremely high powered. When calculating glide angle for a Delta work with span loading rather than area loading. The flat plate "section" is very stable on this model.

For normal flying use strong wood and cover with Silkspan. For high performance make model very light and cover with tissue. Never use too tight a covering. Warps are dangerous. Any high speed model is susceptible to this.

Make box spar outline members first. Construct wings on board. Large built up edges help eliminate warps. Needed here!

Balance with empty motor shell. Best flights so far are with #200. Gets #:30 on full charge. 400 ft. plus.

Use 5" Silk parachute dethermalizer streched forward in a slim bundle. Stow this along fuselage under wing. Fuse operated.

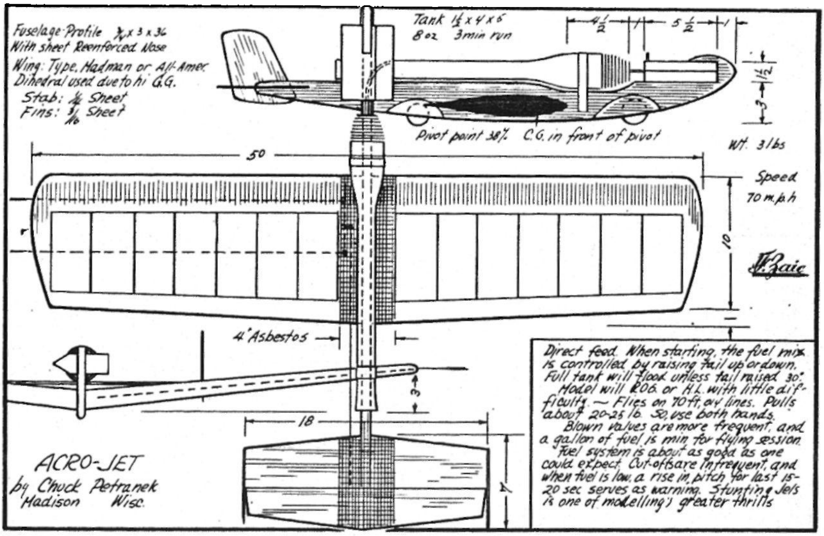
This ship is sturdy. Full scale T; Craft ran directly oger it. The tail wheel thumping across one wing panel. Only damage was a small tear and impression of the runway forced into the lower surface.

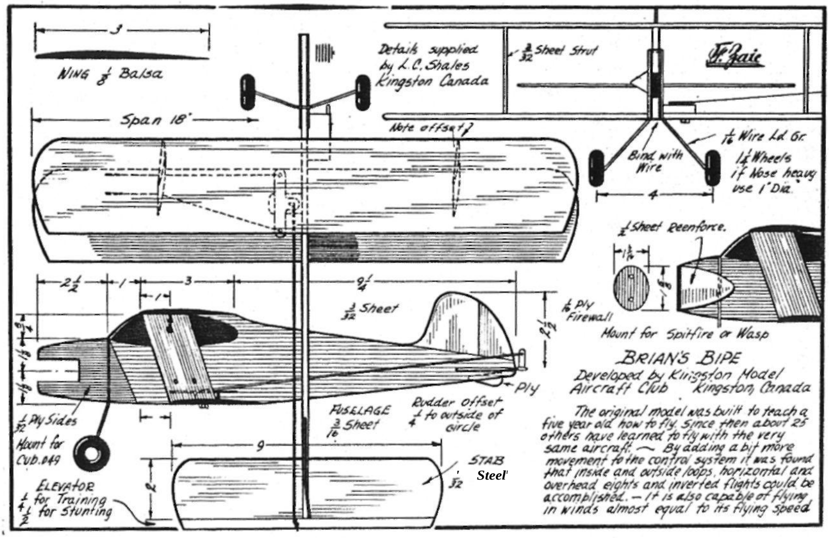
CURTIS JANKE—DEAR FRANK—(Dec. 1952)—

You have, perhaps, in a way solved without trying a problem that most people don't really know exists, so that they make a laborious circle to get back to where they started. A lot of money is desirable only as a means to an end, but what end? To get the things you want, but what do you want? Leisure?—you can have that without money, and the very effort needed to get money destroys it. Enjoyment?—what constitutes enjoyment?—yachts, Cadillacs, buckets of champagne?—not for me. It's a very ancient rat-race, and the "American way of life" in some of its facets is merely an exaggerated example of one of the symptoms of one of the many things wrong with the whole world. No doubt you'd feel prouder in the eyes of others if your books made you a million, but what would you do with the million? Probably just what you're doing now. Maybe you'd LIKE to have a piano and a house, but the sum total of your happiness wouldn't be increased as much as you might think. Pleasure in possessions and even talents or developed abilities soon wears off. You're doing nicely as you are, it's as *you* say; the act of making money itself is often the chain that you wanted to be rid of in the first place. I've been thinking over this deal myself, asking myself questions (in Dianetics we call it straight-wiring yourself). If I had a little more money on hand, I might buy a new bass fiddle—why?—to make it easier on myself to play while I'm earning more money—hey, that's where we came in! Anyway, maybe I can build one—I've been thinking of it. It'd be out of second grade balsa, planked over ribs and stringers, with a cross-grain laminated layer for greater strength, and if it was successful I'd get a big charge out of it—more than if I'd bought one. Well, anyway, I could still use some cash to go down to Phoenix for a while to pick up on the latest Dianetic techniques and get a further boost on the way to being "clear". On the other hand, there's no good reason why I can't do it myself at home and maybe learn a few things in the process that no one else knows about yet. Hmmm—well, anyway, I'd like to get to a few indoor meets, which would take money and time—but then I don't feel too ambitious about building anything anyway.

It all boils down to this—people want money for what they think of as various reasons, but the reasons are all the same—pleasure of some sort or another. And strange as it may seem to you, the ONLY pleasure is that of creation—all others are phony, without exception—this is one of the many discoveries of Dianetics, by the way. This is hard to believe, because there are so many obscuring factors, but it has been proved, at least subjectively, over and over. So you are, right now, just about as well off as money can ever make you, every time you turn out a book or build a ship of new design or any of your other activities. So don't worry about your apparent lack of financial success unless at the point of actual deprivation of some sort.

Your computation concerning slanting your books at the adults is O.K. as far as it goes, but remember that these adults are a vanishing breed, being the young fellows of fifteen or so years back, whose numbers are not being replenished from the ranks of the present youngsters. And I don't know what can be done about it. Everything you say about thekit-builders is true, and more. About the only ray of light in the darkness is this; the activity is very much expanded over the era that produced us, so if even a relatively small percentage of the greater number of participants in the sport can be persuaded to a more serious view, the ultimate result will not be a sort of collapse, which is what it sometimes looks like now. After all, even though the sport has been commercialized almost to the point of ruin, there couldn't have been a basic change in the human race. I doubt that our generation is





so much cleverer or nobler than the present one—we were merely forced to develop our own resources and some of us decided that we preferred it that way.

Frankly, because I've lost the ambition or whatever it is that I used to have, I don't look forward to spending a lot of time and energy building something that can be lost or smashed as easily as can an outdoor rubber job, so that I myself might become a kit-chauffeur, except for these facts: There are no good rubber kits, if there were I'd still think they weren't good enough, the time and energy saved probaly wouldn't be great enough to make a big difference anyway, I don't like being just one of the crowd, I have ideas of my own not shared by the probable designer of the kit, and finally I have too great a contempt for other guy's designs to lower myself to build their silly things. But under the present set-up you can't blame the kids too much. In a thermal you don't NEED' to squeeze out the last possible bit of superlative performance—a rotten kit-job has nearly as good a chance as the finest original, and is so much easier in many ways, because you've not had to putter around changing things to get out the bugs. I guess the only thing to do is to go on as you have, and don't worry about crusades. I hope dropping the price makes a difference, but it's not too likely—the fellows who want it will buy it at $2.00, and the ones who don't won't buy it at $1.00. Enjoy yourself, and don't worry, it's NOT later than you think, it's much earlier.

I don't have Glass's address—send it to me one of these days. I don't doubt that he'd enjoy hearing about my tribulations with film. I may have gone farther than he did in some ways because there weren't as many things to try in his day, but on the other hand I do not have the methodical, scientific approach, so that he probably found out things that I didn't. Your pre-war film was good—I can mix stuff like it or better at will, but it's no longer good enough. The stuff you mixed for Andrews, on the other hand, I've never been able to duplicate. Maybe I can find out more about it from the name. Price is no longer a factor, by the way—a good film with the right properties will fetch any price within reason, because indoor builders who stuck it out this long had to be fanatics. You should see some of them drool over Erbach's indoor stock!—they'd trade their favorite wives for it! Some of the west coast glider boys who want what they want are willing to pay incredible prices for it. However, Erbach isn't getting rich on it any more than you did—I'm merely mentioning that there's no need to cut the quality of film solution to get down to a price.

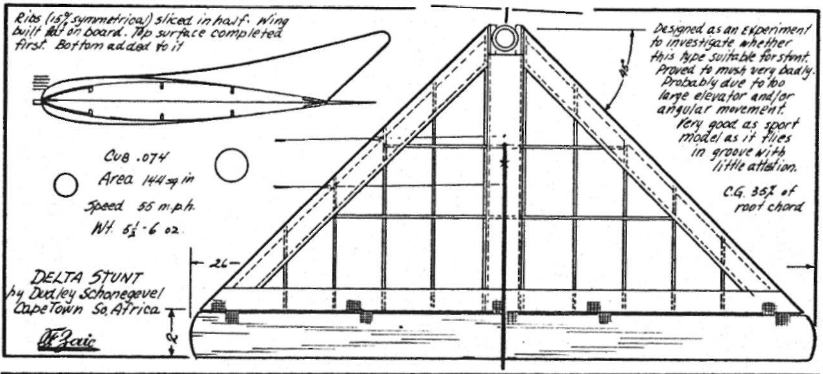
There's no mystery about the water-proof dope I mentioned—if you ever go into the business I'll let you know how to mix it yourself. If you make any money on it you can pay me a small royalty on it; it might amount to as much as $1.25 per annum. I doubt that it's patentable or copyrightable or anything else.

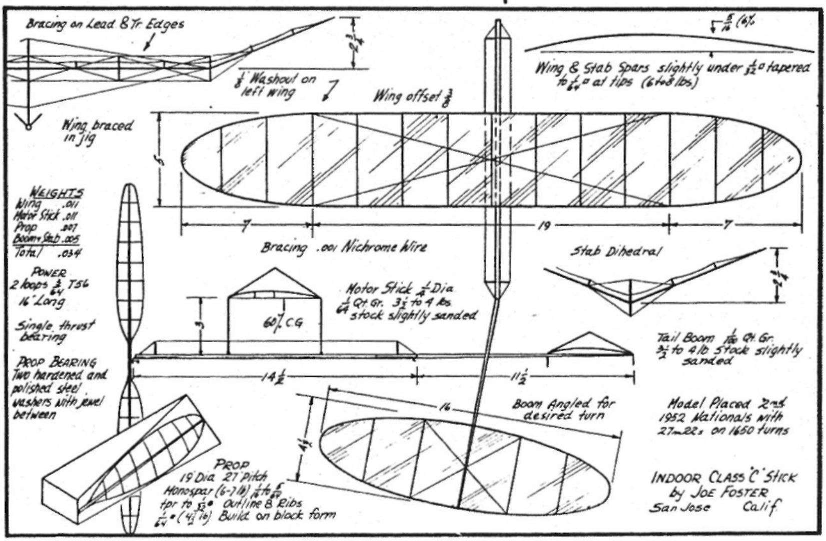
Out side of stuff like that, I find myself not too ambitious about models. Not only do I lack ambition, but I don't know WHAT to build, for indoor sticks, and even then I'm shaky—I can build 'em light, but the rubber quality worries me, as well as what to build for what conditions. As for indoor cabin, I'm completely at sea. Wakefield stumps me because, in addition to the craftsmanship apparently necessary—gears, retractible landing gear, and what have you, I've never had either the brute strength or the technique to wind to capacity a big motor—either they break or my arm does, and to compete you need every last second you can get. Then there's another thing—in indoor events—what if wishing out of the rafters or into staying up another extra minute actually worked?—it'd take the kick out of things—and strange as it may sound to you, it's not at all impossible to do just that when you've recovered the use of certain powers sometimes considered psychic (they ain't) and which all Dianeticists are working toward.

—(March 1953)—

The family here is in the throes of filling out the whole damn town's income tax returns, so I seldom have the time or ambition for writing, but your letter probably needs an answer some time this year, so I'm doing it now.

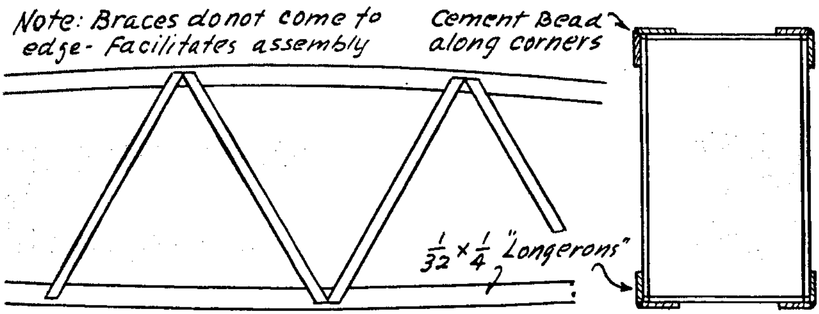
That brings me to the letter of mine you want to print. It's O.K. by me, though I'd have preferred to make it more impressive in the way of syntax if I'd known. I hope I haven't given the wrong impression. I don't consider models a childish toy that I've outgrown—they're merely toys that I now





consider do not return a sufficient amount of pleasure for the effort expended, and I now prefer to spend more of my time with toys that give me better odds. Actually, I never did get real pleasure from staying up several nights in a row, driving 300 miles down to a meet, running around like an idiot all day, then driving back 300 miles the same night chewing caffeine pills all the way. Looking back, I now realize that somehing was driving me to do things that weren't worth it. It's not that I consider models beneath me as a mature human—I think it's just as silly to go two thousand miles to watch a Rose Bowl game, or to slosh around in freezing swamps before dawn in order to get a chance to shoot at a duck, or any of the other ridiculous things that are known as s,port or pleasure. So I don't intend to give up models entirely, just refuse to knock myself out over them, unless it's for a ten thousand dollar first prize or something of the sort. It's not that I'm a tired old man, either; at thirty seven I feel as well or better than I remember ever having felt, and I intend to improve.

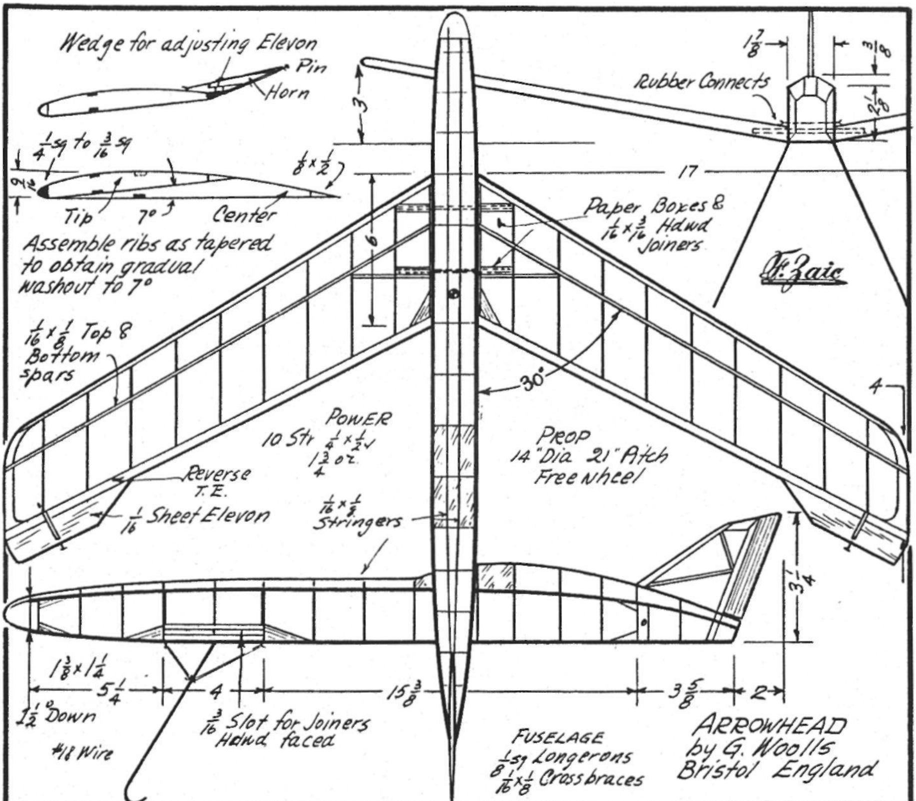
I do have an idea for the book, however. I haven't tried it but will use it on my next outdoor rubber job. You may have noticed how, when strapping a wing to the fuselage in the absence of fancy wing mounts, the rubber has a tendency to distort the longerons. This bothers me. So why not use an L section? O.K., but it's work. Then there's another thing. I KNOW you've noticed how it's almost impossible to prevent distortion when gluing the two sides of a fuselage together—no matter how carefully you've selected the wood the longerons don't match perfectly in stiffness. So try this—build it as four sides, then glue them together, as you would a sheet sided job. For the same weight as y$_8$ sq. use 1/8 by I'll use truss construction, as it is impossible for the side to distort when picked off the board when it is used. The cross pieces must be trimmed to leave a space at the edge of the longerons equivalent to the width of the braces themselves so they don't interfere with each other when joining the sides. Needless to say, this won't be very practical on anything but symmetrical, square fuselages. Other types could be used, but would require rather expert draftsmanship because of different projection ratios of more deeply curved tops and bottoms. You'll have to be careful that you don't have all the braces running in one direction, too, with any design. I'll enclose a rough sketch.



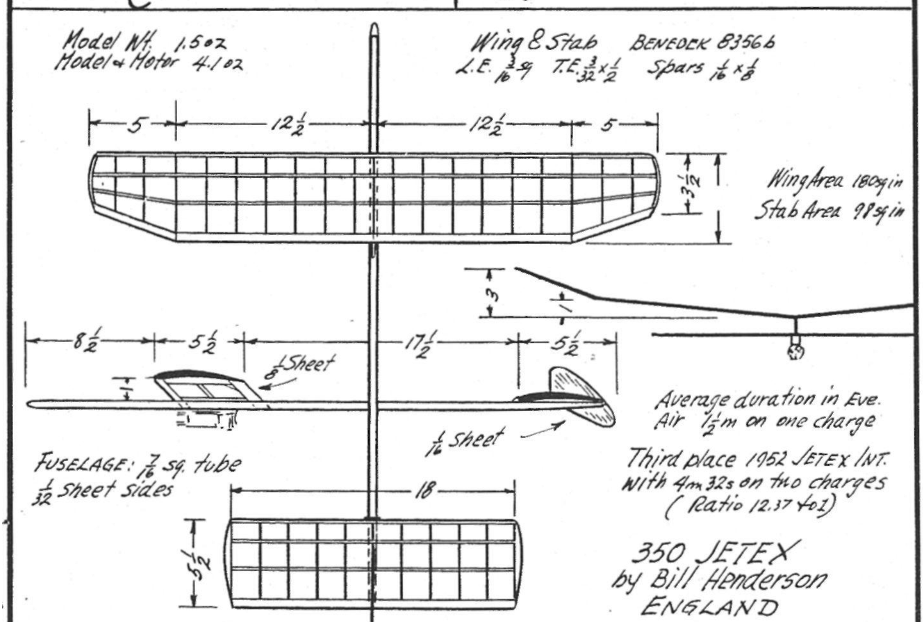
LEE RENAUD—DEAR FRANK—(Dec, 1952)—

Glad to read that you liked the Wakefield so much. I don't know if you realized it, but this airplane is actually designed. Everything there is my idea of the best theory, combined with my own experience. Some of the things are not aerodynamically perfect, but it is all practical..This is a refinement of several different designs and I consider it to be the best Wakefield that can be built. I think that someone who really knew how to adjust and fly rubber could easily win in Sweden with this model.

I found that 1/20 "C" stock for the fuselage sides splits too easily on landing. When the model hits the ground the rubber tends to go out through the sides and can really do a job. At the beginning of the season I was using 1/32 "C" cut sides and building airplanes which weighed from 2% to 3 oz. without rubber. However these planes just were not strong enough for prolonged flying. Every flight means a repair somewhere. The morning of the Wakefield eliminations I was testing my spare model. This glided in for a perfectly normal landing and seemed perfectly all right. When I walked over and picked it up, however, the fuselage collapsed in my hands. Found "A" stock resisted split better and had more than adequate strength. The only finish on the sheet is two coats of dope rubbed in with the fingers both inside and out before assembly. I have discovered a trick of



Wedge for adjusting Elevon
Pin
Horn
1/4 sq to 3/16 sq
1/8 x 1/2
Tip
7°
Center
Assemble ribs as tapered to obtain gradual washout to 7°
1/16 x 1/8 Top & Bottom spars
Rubber Connects
Paper Boxes & 1/16 x 3/16 Hdwd Joiners
30°
POWER 10 Str 1/4 x 1/2 1 3/4 oz
PROP 14" Dia 21" Pitch Free Wheel
Reverse T.E.
1/16 Sheet Elevon
1/16 x 1/8 Stringers
1 3/8 x 1 1/4
1 1/2° Down
#18 Wire
3/16 Slot for Joiners Hdwd faced
FUSELAGE 1/8 sq Longerons 1/16 x 1/8 Crossbraces
ARROWHEAD
by G. Woolls
Bristol England



Model Wt. 1.5 oz
Model & Motor 4.1 oz
Wing & Stab BENEDEK 8356 b
L.E. 3/16 sq T.E. 3/32 x 1/2 Spars 1/16 x 1/8
Wing Area 180 sq in
Stab Area 98 sq in
1/8 Sheet
1/16 Sheet
Average duration in Eve. Air 1 1/2 m on one charge
Third place 1952 JETEX INT. With 4m 32s on two charges (Ratio 12.37 to 1)
FUSELAGE: 7/16 sq. tube
1/32 Sheet sides
350 JETEX
by Bill Henderson
ENGLAND

making the dope waterproof with only light coats, so that this is adequate protection. I subscribe to the theory that a" little extra weight is worthwhile—too many of the ligh models are never adjused because of structural failures or handling difficulties..

I was pleased to read your comments on the overall picture of the model aviation. It really is too bad that such a condition prevails, but I must agree with you completely. None of the kids ever think of designing their own models. It is too easy for them to buy a kit. In fact I very seldom see a model which was built from magazine plans—too much work to cut out ribs, etc. Kits are good in that they ensure a reasonable chance of success, where an original may be a complete flop (I know). I think that a great deal of the fault lies with the magazines. They never have an article which presents good design fundamentals and theories. This is why I think you are the only hope. As long as one fellow bothers to explain things and to present new ideas, originality will never be dead. If the general modeler rejects your new book as being over his head, I don't know where the answer lies.

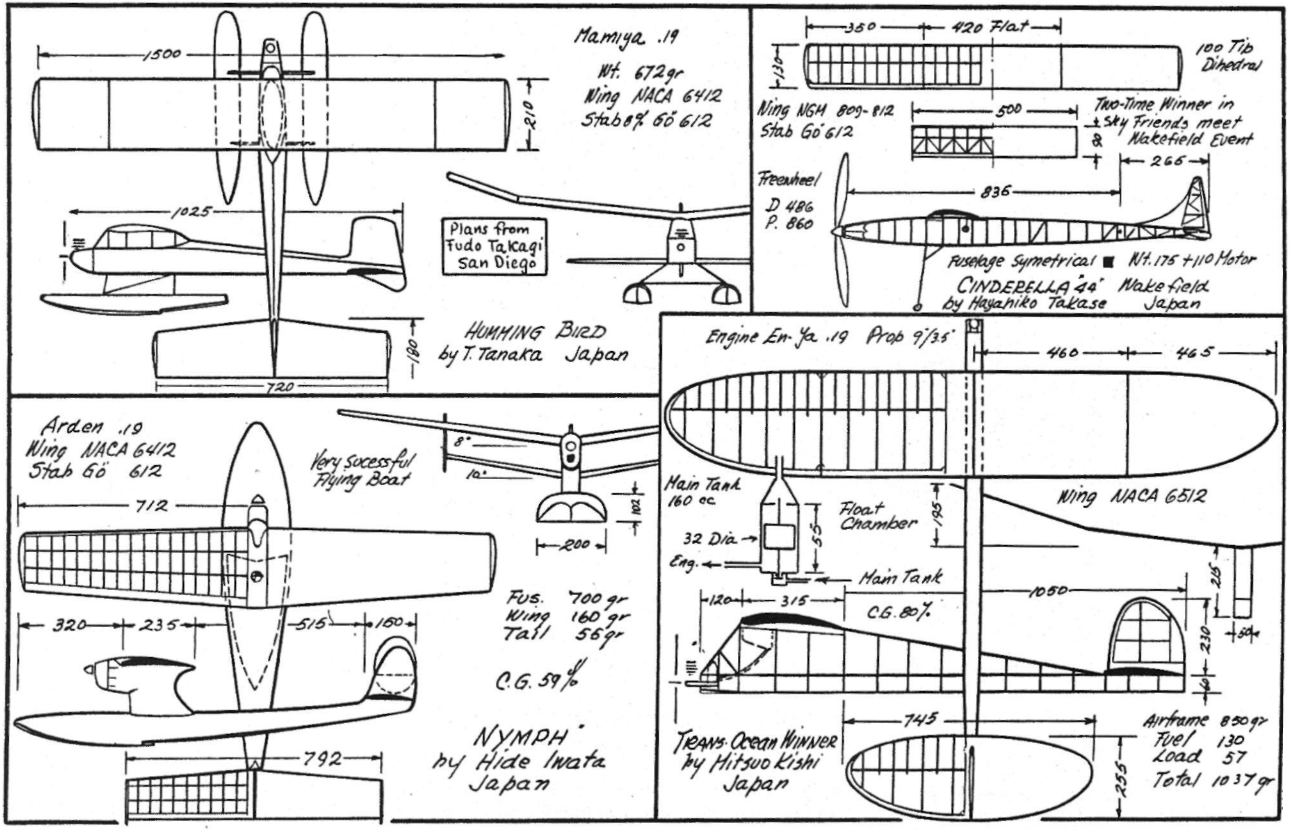
PARNELL SCHOENKY—DEAR FRANK—(Nov. 1952)—

It was certainly nice to hear from you again, and particularly to hear that you are planning to continue your series. I suppose that it is difficult for us to realize how much change there has been in the habits and attitudes of the American model builder since the thirties. In my own mind I see not only the effects of the War and its interruption of the norarril big-brother'-teaches-little-brother indoctrination process, but also the advent of the large, well-organized business interests which have functioned to divert the beginning modelers' thoughts away from the gradual process of learning and creating and towards the flashy ready-bilts and the more profitable lines.

About all that we of the "good old days" can do at present, I'm afraid, is keep the flame going while we feel about for the best approach to the modern modeler. I'm hoping that, much as half-A engines and Wakefield swept freeflight modeling back into the picture, some new factor or situation will arise that will encourage several thousand modelers to delve into design.

I really shouldn't presume to be telling you what any significant cross-section of aero engineers and former model-builders think about the fext and calculations in your book, because I haven't been able to find many here at McDonnell who still care about models. Bill Netzeband has been devouring the material in your book—and applying the methods to checking his past models and to designing some new stunt models. If the new creations perform well, he'll have a pretty good idea why. Bill is an Electrical and makes no prentensions of knowing it all about aerodynamics, so he can refer to a model encyclopedia with no loss in pride.

It's my feeling that some of the aero degree boys can't get over the feeling that they have mastered some classroom courses in the fundamentals of full-scale design and therefore are qualified to design and to evaluate the. small, slow-speed, inherently stable aircraft which we call "models." Several have pointed out to me the fragmentary references to circular airflow, etc., which can be found in aerodynamics texts—with the usual remark "that stuff isn't new." Of course, the important thing is that while circular airflow may be only of academic interest to designers of full-scale craft it appears to be of great importance to the "science" of model design—an<i that nowhere else in model literature is there available a treatise on the subject.



1500
210
1025
720
180
Mamiya .19
Wt. 672gr
Wing NACA 6412
Stab 8% Gö 612
Plans from
Fudo Takagi
San Diego
HUMMING BIRD
by T. Tanaka Japan
350
420 Flat
130
100 Tip
Dihedral
Wing NGM 809-812
Stab Gö 612
500
Two-Time Winner in
Sky Friends meet
Wakefield Event
266
Freewheel
D 486
P. 860
836
Fuselage Symetrical ■ Wt. 175 + 110 Motor
CINDERELLA "44" Wakefield
by Hayahiko Takase Japan
Arden .19
Wing NACA 6412
Stab Gö 612
Very sucessful
Flying Boat
8°
10°
102
200
712
Fus. 700 gr
Wing 160 gr
Tail 56 gr
320
235
515
160
C.G. 59%
792
NYMPH
by Hide Iwata
Japan
Engine En-Ya .19 Prop 9/3.5
460
465
Main Tank
160 cc
32 Dia
Eng.
Float
Chamber
55
195
Wing NACA 6512
Main Tank
120
315
1050
C.G. 80%
215
230
50
745
255
TRANS-OCEAN WINNER
by Hitsuo Kishi
Japan
Airframe 850 gr
Fuel 130
Load 57
Total 1037 gr

We know that in a science as lacking in accurate data and as poorly integrated as is our "Microaeronautics," empirical relationships must be accepted and used in great numbers; here, then, is the catch—the fellows adept at mathematics and used to more exact formulas tend to shy away from empiricisms. Where we expect to postulate, then experiment, and then repeat theprocess to learn more about our field, some of the engineers want to take up what can be covered by clear-cut equations and to neglect the rest. The few ex-modelers whose qualifications as aerodynamicists I really respect are just too busy to devote enough time to modeling to give us the benefit of their experience by checking experiments and calculations to weed out errors and to suggest further lines of endeavor. I must conclude that for awhile we must depend upon those engineers whose primary interest (and ego drive) are fixed upon model aircraft for the work that lies ahead.

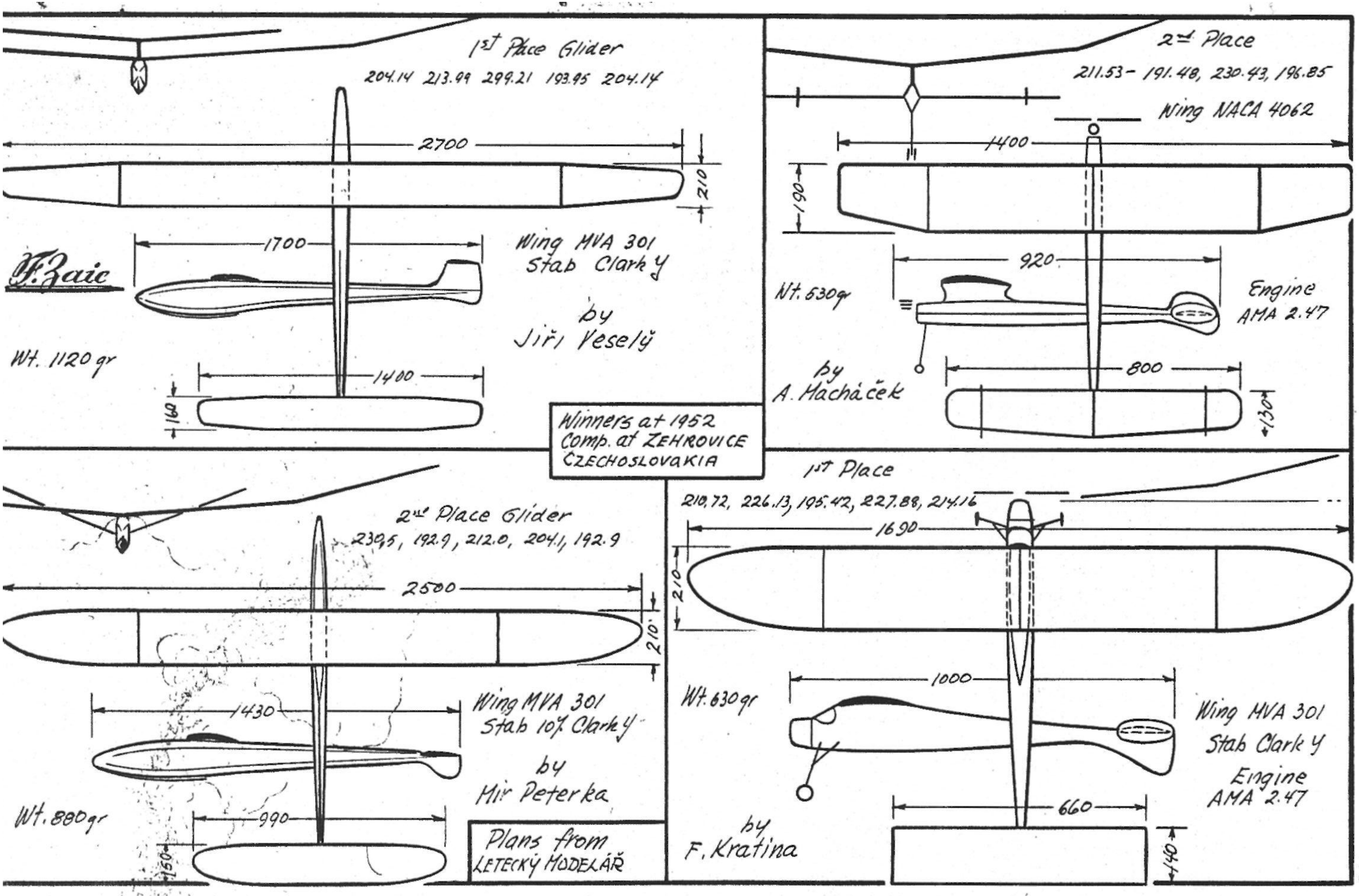
You seem to have the right idea by your prescription for "lessening the dose, increasing the flavoring, and stretching out the cure!" Even though $2.50 is easier to come by today than was a dollar in 1937, there are just an awful lot of modelers who pass up that book because it sounds expensive and they aren't conditioned to looking forward to it—or even to refering to ANY book on the subject. To "talk sense to the American modeler" you will first have to dress up the package and tone down your approach until you can sell large numbers of the books to the eager 16-year old and to those who've been diverted initially towards control-line.

I know that the youngsters around here who need the Yearbooks most are simply not aware either of their value—or possibly of HOW to use them. I would concur with some of the comments you have received to the effect that a few paragraphs of clear directions about each plan or type of model presented will go far to bridge the gaps for the novice. You know, there doesn't seem to be anything on the dealers' shelves in the way of a "How to do it" book, and I have been wondering if it would not help the circulation of the Yearbooks to devote sufficient space to fundamentals to hit at that market . . . with our technical material and advanced designs going along on the same bus.

(If you are still with me after all of that wordage, you must be patient indeed. It must be that I am as starved as the rest for an opportunity to talk with anyone about models as something worthy in themselves . . . I'll sign off for tonight and write some more as soon as I have the time . . .)

,—^ ' 14 January 1953

Several months have slipped by . . . we're still working 48 to 54 hours per weeltf at McDonnell .\. I've been using the few hours when I feel better to work on.my radio course (looking to R/C in 1953) and to set in order my hundreds of color slides of the Nats, etc., which I have to mount by hand ... it may be that I've.failed you on this trip with my tardiness—though I surely hope not. Made another check with the designers among the Thermaleers,today; Ne|z/eban'd's latest experiment in the C-L stunt field (designed with \he aid' pf'51-52 Yearbook) isn't ready for unveiling (needs rebuilding!) i .^DjWg^MoiJan is still flying- his 1951-52 designs and couldn't come up with any contributions tfiat he felt were significant. John Cochrane is stilPcooped up in his tiny apartment with no space to lay out balsa or drawing paper. Earlier this fall I thought I had a hot outdoor helicopter in the works, but it twisted 'out of $hape so badly as I wound it up for the first time that I didn't dare launch it—needs a complete structural overhaul, designwise, and then—Frank Ehling might have some competition.


1st Place Glider
204.14 213.99 299.21 193.95 204.14
2700
210
1700
Wing MVA 301
Stab Clark Y
by
Jiří Veselý
Wt. 1120 gr
1400
160
F. Zaic
Winners at 1952
Comp. at ZEHROVICE
CZECHOSLOVAKIA
2nd Place
211.53 - 191.48, 230.43, 196.85
Wing NACA 4062
1400
190
920
Wt. 530 gr
Engine
AMA 2.47
by
A. Macháček
800
130
2nd Place Glider
239.5, 192.9, 212.0, 204.1, 192.9
2500
210
1430
Wing MVA 301
Stab 10% Clark Y
by
Mir Peterka
Wt. 880 gr
990
150
Plans from
LETECKÝ MODELÁŘ
1st Place
210.72, 226.13, 195.42, 227.88, 214.16
1690
210
1000
Wt. 630 gr
Wing MVA 301
Stab Clark Y
Engine
AMA 2.47
by
F. Kratina
660
140

LLOYD LICHER—DEAR FRANK—(Dec. 1952)—

Enclosed on separate pages are the comments you asked for regarding some formulas from the books.

I'm sorry to hear that sales are so poor. It can be mighty sickening and discouraging in a way and seems to stem from your very words, the younger minds have been led astray by the Pied Piper of Kits. About all I have to go on here in this "modern era" is what I see about me here in the Boston area, and that's not much. There is little or no free-flight work, even in the summer. About all the die-hards have bound together in the NEWG, New England Wakefield Group, and only two of us are under 21 (not me). And everyone doesn't build Wakefields by any means, but it sort of gives a purpose to the organization.

When I go in one of the few hobby shops around here I'm always struck by the decreasing emphasis being put on the airplane line, particularly the free-flight jobs, hardly any kits and they don't even bother keeping a varied stock of wood on hand for original ships. I guess livings are made off railroads and toys, ships, etc.

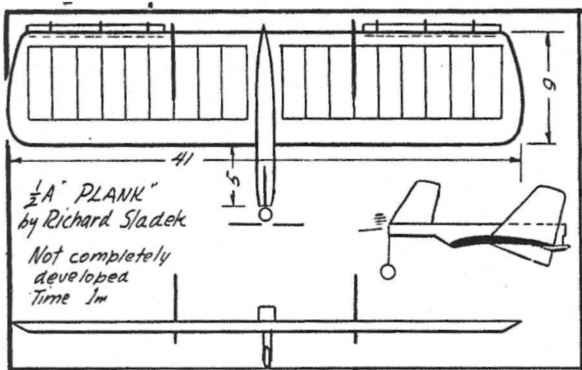
But yet I can't help retain the feeling that there's a powerful, latent undercurrent of free-flight potential, no doubt brought on by my education and understanding of the theory and practice and knowing that at least you are trying to practically hand it to the kids on a platter. It's like religion I think, you can lead 'em to it and have them read on it but some sort of faith is necessary, faith in what other, experienced, people tell you you need and how to get it. Maybe a Billy Graham technique, ha? Somehow we have to sell the idea after we ourselves understand and have faith which we no doubt have now. The best way is by practicing what we preach and setting good examples—which means use of and credit given for the ideas you have so graciously compiled to convince the skeptics and show the "know-it-alls" what confidence we have in what we are saying and doing.

CARL HERMES—DEAR FRANK—(Nov. 1952)—

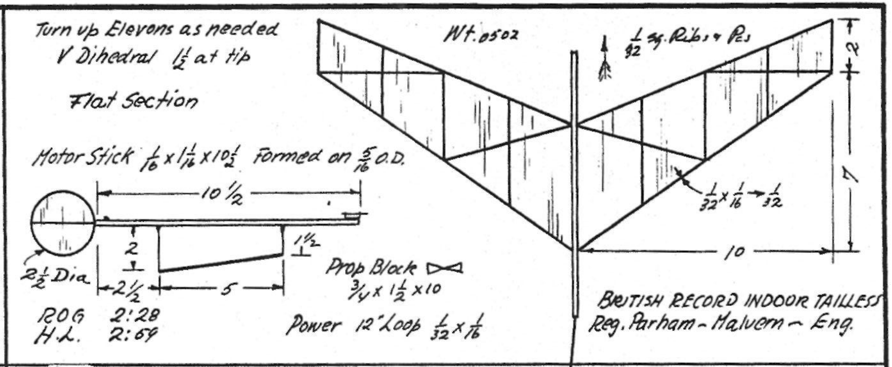
I feel ashamed in not having written as soon as I received the books. In fact every time I used the book I would be reminded of the fact that I owed a letter,but somehow it just kept putting off.

The book is, I believe, the best yet. I still, after all these months, go back and find things I hadn't noticed before—more of that later.

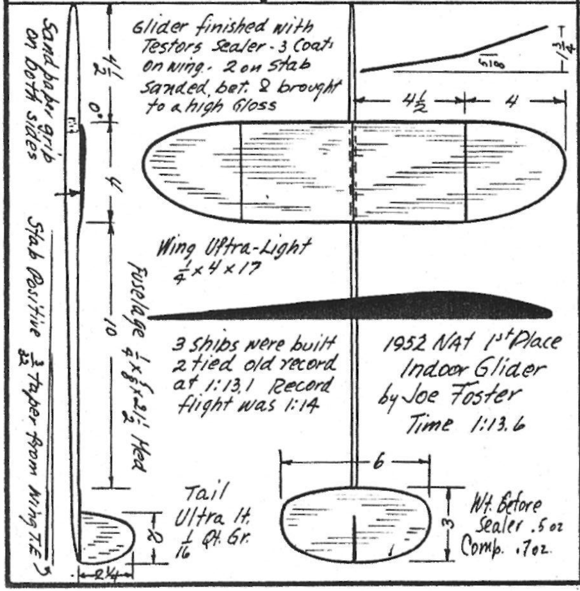
I took the extra five copies and distributed them where I thought it would do the most good. Each one of the persons I gave them to promised faithfully to write and give you their comments but I have a hunch none of them did. One copy went to Jim Stewart of Grand Prairie who has a copy of every one of the others. Jim is one of those fellows who has a garage full of airplanes, sailplanes, Westerners, V^As, giant Gools, rubber etc.—but only free-flight. He has every book and magazine that has been published in this country and England since 1936 or so. He is the collector type—has dozens of engines including English diesels. He is not too concerned with the whys and wherefores of model behaviour except to a very limited degree—things like downthrust, big or little rudders on the sailplane etc. He loves to talk models, run contests, form clubs and the like. He has read the new book from cover to cover. He liked mostly the collection of plans. He couldn't see how all the rest couid be applied. It was nice to know but couldn't be used to win contests. He did find it very interesting, however, and we have had several good discussions since. Jim is the C. O. Wright type of model builder if you know what I mean.



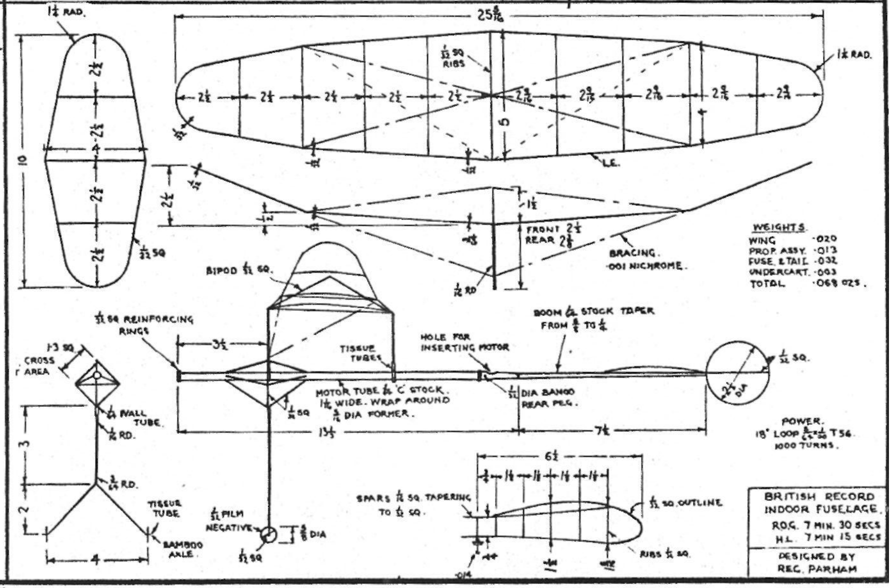
41
6
5
1/2A" PLANK"
by Richard Sladek
Not completely
developed
Time 1m



Turn up Elevons as needed
V Dihedral 1 1/2 at tip
Flat Section
Motor Stick 1/16 x 1 1/16 x 10 1/2 Formed on 5/16 O.D.
10 1/2
2
1 1/2
2 1/2 Dia
2 1/2
5
Prop Block
3/4 x 1 1/2 x 10
ROG 2:28
H.L. 2:59
Power 12" Loop 1/32 x 1/16
Wt. .05 oz
1/32 sq. Ribs & Pcs
1/32 x 1/16 → 1/32
10
7
2
BRITISH RECORD INDOOR TAILLESS
Reg. Parham - Malvern - Eng.



Glider finished with
Testors Sealer - 3 Coats
on wing - 2 on Stab
Sanded, bet. & brought
to a high Gloss
4 1/2
4
Wing Ultra-Light
1/4 x 4 x 17
Fuselage 1/4 x 5/8 x 21 1/2 Med
3 Ships were built
2 tied old record
at 1:13.1 Record
flight was 1:14
1952 NAT 1st Place
Indoor Glider
by Joe Foster
Time 1:13.6
6
3
Tail
Ultra lt.
1/16 Qt. Gr.
Wt. Before
Sealer .5 oz
Comp. .7 oz.
Sand paper grip
on both sides
Stab Positive 3/32 taper from Wing T.E.
10
2 1/4



1 1/4 RAD.
25 5/16
1/32 SQ RIBS
L.E.
FRONT 2 1/4
REAR 2 1/8
BRACING.
.001 NICHROME.
WEIGHTS.
WING .020
PROP. ASSY. .013
FUSE. & TAIL .032
UNDERCART. .003
TOTAL .068 OZS.
BIPOD 1/32 SQ.
1/32 SQ REINFORCING RINGS
CROSS AREA
TISSUE TUBES
HOLE FOR INSERTING MOTOR
BOOM 1/32 STOCK TAPER
MOTOR TUBE 1/64 'C' STOCK.
1 1/2 WIDE. WRAP AROUND
3/8 DIA FORMER.
DIA BAMBOO REAR PEG.
13 1/2
7 1/2
POWER.
18" LOOP TS6
1000 TURNS.
WALL TUBE.
RD.
TISSUE TUBE
BAMBOO AXLE
FILM NEGATIVE
DIA
SPARS 1/32 SQ. TAPERING TO 1/64 SQ.
1/32 SQ. OUTLINE
RIBS 1/64 SQ.
6 1/2
BRITISH RECORD
INDOOR FUSELAGE.
R.O.G. 7 MIN. 30 SECS
H.L. 7 MIN 15 SECS
DESIGNED BY
REG. PARHAM

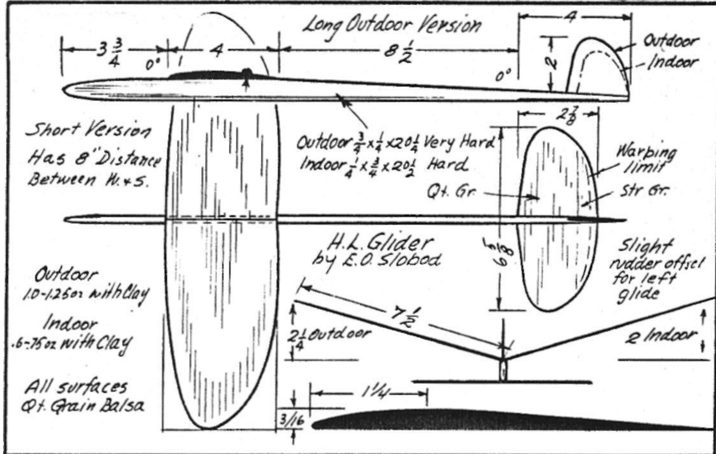
The second copy went to Ken Querman who is an aerodynamicist here at Chance Voight. You might know his brother Dick of the Prop Spinners. Ken is a fellow I enjoy talking to—keenly interested in low speed aerodynamics and has done quite a bit of research on the subject of airfoils. He still feels there is much to be done and has some pretty good reasons for believing that way. I am going to try and talk him into writing for the next book. If he won't I will write down what he says and send it on. He and I have had big discussions about Cheeseman's airfoils—he says "maybe". We have also argued over Jim Horton's changeable trim idea. The only thing concluded was that if a free-wheeler can do 4½ minutes, a folder should do 5½ or 6. We don't know exactly how, but there is a way.

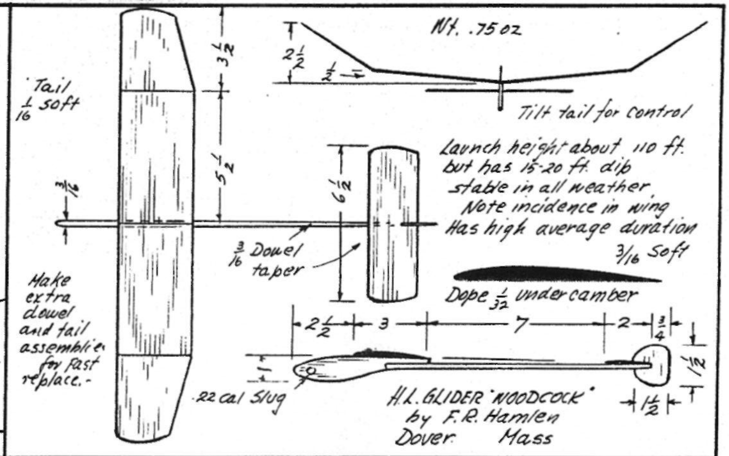
Herb Kothe (PAA Load Winner 1948-1951) got the third copy. Herb still has the "old feeling" toward models that you seem to lose as you get on in years. What I mean—models to him are the most important thing in life. I remember I felt that way many years ago. What a wonderful world that was—so simple—nothing to worry about except whether to use the RAF-32 or the EIFFEL 400. High School was the only distraction (not even girls!) which didn't bother me too much. I remember I purposely took a summer job on a milk truck so I could spend the days building and flying. It seems as you get older you reluctantly admit to yourself that the models must take second place to things like college, marriage, earning a living etc. I always felt that if I could work up as much enthusiasm for a job as I could for models I should not do so badly. It seems you only have so much "enthusiasm" to spend each day. I know now that it must be used at work—the models can only be to think about. I do also know that just before the Wakefield eliminations each year the job suffers considerably. I remember something I read in Model Aeronautics (I think that was its name), the little magazine you put out once or twice. It was, I believe, in answer to a letter from Joe Herwat and it was along these same lines. When I first read it I thought "What a silly thing to say!" but as the years went on I realized how right you were.

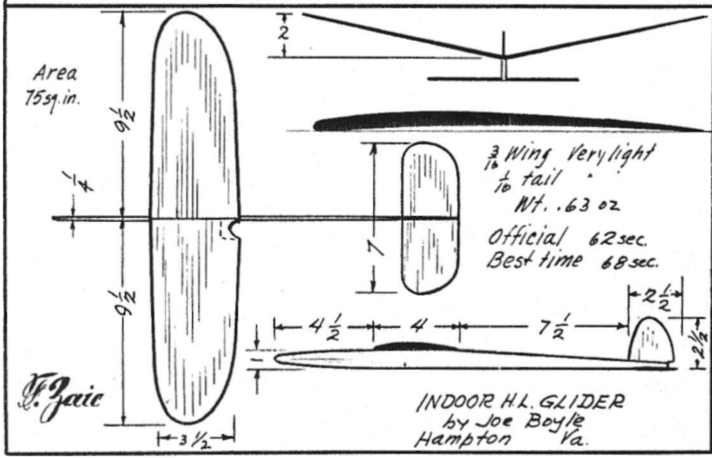
The fourth copy went to Wit McCormick who works in Development here (he actually *designs* airplanes). Wit is like me, married etc. but manages to turn out a Wakefield each year.

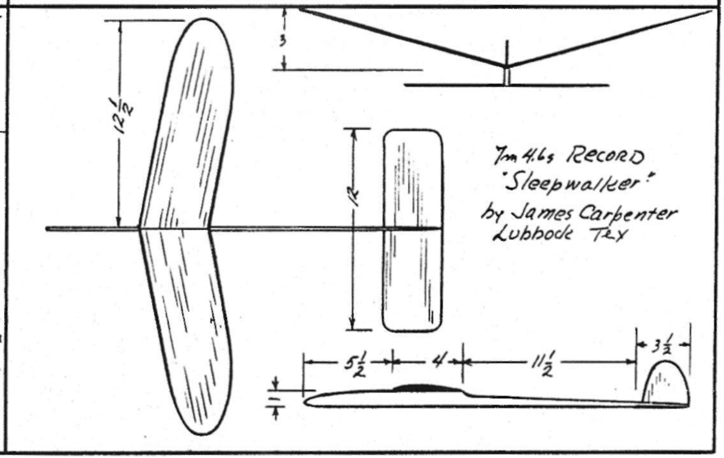
The fifth copy went to Dick Swenson who is an old free flighter now flying speed only. He has some nice speed designs I can send if you are interested. Dick talked to you at L. A. last summer. I asked him to get you to stop by Texas but he told me later about your flying.

About the book itself—I liked the text very much. Just about all of it seemed to make sense besides providing some good mental exercise. I suspect however that there are too few people who are really interested. The reason I say this is that of all the good model builders I have known I can count the ones who would be interested in the "whys" on one hand. After all, knowing *exactly* what is happening during flight is a study in itself, a very interesting one to me I will admit, but not too many other people, I fear. For instance—the good contest flier knows that the more he can "load up" the stab the lower the sinking speed will be. He also knows that this tends to "flatten out" the power climb, which is good. He *also* knows that this is a touchy situation and too much will result in a dive from which there is no recovery. This he knows and he copes with the situation using 1/16 sheet, ⅛ squares, clay, etc. He usually does not know what the incidences are and doesn't care particularly. I don't mean to belittle this guy because he knows *plenty.* He warps wings, tilts tails to get the effect he wants. He is mainly interested in developing consistently good fliers—he


Long Outdoor Version
Outdoor
Indoor
Short Version
Has 8" Distance
Between W. + S.
Outdoor 3/4 x 1/4 x 20 1/4 Very Hard
Indoor 1/4 x 3/4 x 20 1/2 Hard
Qt. Gr.
Warping limit
Str Gr.
H.L. Glider
by E.O. Slobod
Slight rudder offset for left glide
Outdoor
1.0-1.25 oz with Clay
Indoor
.6-.75 oz with Clay
All surfaces
Qt. Grain Balsa
2 1/4 Outdoor
2 Indoor


Wt. .75 oz
Tail
1/16 soft
Tilt tail for control
Launch height about 110 ft.
but has 15-20 ft. dip
stable in all weather.
Note incidence in wing
Has high average duration
3/16 Soft
3/16 Dowel taper
Make extra dowel and tail assemblies for fast replace.-
Dope 1/32 undercamber
.22 cal Slug
H.L. GLIDER "WOODCOCK"
by F.R. Hamlen
Dover Mass


Area
75 sq. in.
3/16 Wing Very light
1/16 tail "
Wt. .63 oz
Official 62 sec.
Best time 68 sec.
INDOOR H.L. GLIDER
by Joe Boyle
Hampton Va.
F. Zaic


7m 46s RECORD
"Sleepwalker"
by James Carpenter
Lubbock Tex

knows this is the way to do it. Now the other type, of which there are so few, usually never wins contests—always seems to be "test flying." This guy gets his kick out of watching the stab correcting for a sudden gust or the like. He has a pretty good idea what the angle of attacks are at all times, knows what to expect before each launch. I frankly believe that there is a lot of personal satisfaction to be had through the type of experimentation, but there just are not enough people interested today. Maybe the book will start something. I hope so. I will say, Frank, that I enjoyed the text immensely and intend to read it many more times.

I believe the articles on how to do specific things nave more interest to the average builder. By these I mean, Murphy's gears, Shumacher's R/C which was very good, Joe Boyle, Jim Horton.

I must admit I find the plans the most interesting of all. I don't care too much for the "outline" type. The details are the all important part of each drawing as far as I am concerned. I can realize the trouble you must have had collecting what you did and I thought it was well worth it. I will really try to help from this end but most of the older guys are just plain lazy. Building the model is about all they can do. Drawing sketches seems to be too much. I can understand this when your free time is strictly limited.

I feel one reason why the books are selling slowly, or at least slower than in 1938, is that the hobby has. advanced to the point where we seem to have all the answers. In 1938 the big problem was to get the thing to move through the air properly and come down in one piece. I feel that the use of dethermalizers marked the end of an era, so to speak. We all know how to make a model stay up 10 minutes under the present rules. The best "retrievers" seem to end up as the experts. In 1938 we all dreamed of designing the one "super" model which would run off with all the contests. Each person paid attention to airfoils, streamlining, finishes in the hope that his model would be "it". I don't think we realized it at the time, but none really believed that such a thing was possible. Meanwhile we proceeded to have the time of our lives building and flying always with this theoretical goal in mind. Of course Carl Goldberg came along and did it with an ugly little model that put all the Shereshow type beauties to shame when it came to flying. I feel this sort of shocked us all out of our little wonderful dream world with the result that many dropped out never to return. The 1939 Nats was the end of model building as the '38 Book pictured it. I don't believe this "golden era" will ever return. We have mastered the thermal.

Maybe a rule change would help. I believe the British have the idea on Wakefields. With the time up around five minutes they are considering limiting rubber weight, etc.

Many of the old boys have turned to R/C. Perhaps concentrating on that phase would help. Most of these fellows will buy anything on the subject and who knows, they might be pleasantly surprised! There is a lot to be done here. R/C soaring has tremendous possibilities.

Frank, I hope you have been able to figure out what I've been trying to say through all this. I've been writing during lunch hours and sometimes I guess it seems rather discontinuous.

Louise was glad to hear about the house—says it is a trend in the right direction. Actually there is a lot to this marriage business. Our little boy, Bill, is three now and I find myself reliving my boyhood to a certain extent—wouldn't trade it for anything.

We both hope to get up to see you next summer when we visit the folks in Connecticut.

OFFICIAL RESULTS
1952 WORLD CHAMPIONSHIP COMPETITIONS

WAKEFIELD CUP July II Norkopping, Sweden

1st A. Blomgren Sweden 810 sec. 2nd J. Nilborn Sweden 789 sec.

SWEDISH CUP Aug. 15-16 Graz, Austria

1st B.Gunic Yugoslav. 848.8 s 2nd M.Hacklinger Ger 810.4 s

ENGINE POWER F.F. Sept. 13-14 Dubendorf, Switzerland

1st B.Wheeler Gr.Br. 807.6 s 2nd H.Lauchli Swiss. 745.8 s

ENGINE POWER Control Line Brussells, Belgium

Speed Class I (2.5 cc)	Speed Class III (10 cc)
1st Wright Gr.Br. 158.69 km/h	1st Battistella Ita. 233.766M'
2nd Serensen Den. 155.844fc/ʰ	2na Davenport Gr.Br. 225.00
Speed Class II (5.0 cc)	**Acrobatics**
1st.Dr.Millet Fr. 198.395 k/h	1st Ridsway Gr.Br. 632 pts.
2nd Wright Gr.Br. 193.648 K/b	2nd Janseems Bel. 597 pts.

NOTE: Wakefield, Towline Gliders and Free Flight Engine Power flights are timed to 5 min. max. Duration total is for "Three Flights". Speed given is an average of two runs.

F.A.I. RULES FOR INTERNATIONAL MODEL AIRCRAFT COMPETITION

Wakefield Cup — Rubber Power

Total surface area between 263.5 and 294.5 sq. in. Minimum fuselage cross section area 10 sq. in. Minimum total weight 8.113 oz. Rise off Ground. Max. Rubber 2.8loz.

Swedish Cup — Towline Gliders

Total surface area between 495.3 and 526.3 sq. in. Minimum fuselage cross sectiori=Total Area/100. Minimum weight 14.5 oz. Maximum towline 100 meters?

Engine Power Free Flight

Maximum engine displacement 2.5 cc. (0.15 cu. in.) Minimum weight 200 grams per cu.cm. of engine displacement. Minimum surface loading 12 grams per sq. dcm. (2.75 oz. per 100 sq. in.) Fuselage cross section=Total Area/80. Rise off Ground.

NOTES: **Total area includes wing and stabilizer. Area is assumed to be effective area or "look down," interruptions in the surface to count as area. Flights limited to five minutes. The final score to be average of three flights.**

I.

COVER by Björn Karlström, Sweden

CONVERSION TABLES

2.54 x In. = Cm.	28.35 X Ounces = Grams	0.68 x Ft.Sec = M.P.H.
.394 X Cm. = In.	.0355 X Grams = Ounces	1.467 x M.P.H. = Ft.Sec.
6.45 x Sq.In. = Sq.Cm.	16.4 x Cu.In. = Cu.Cm.	.011 x Ft.Min.= M.P.H.
.155 X Sq.Cm. = Sq.In.	.06 x Cu.Cm. = Cu.In.	88 x M.P.H. = Ft.Min.

CONTRIBUTIONS

Our basic need is for experimental .material which may prove or disprove certain notions. In the 1951-52 YEAR BOOK we presented many new ideas on MODEL AERODYNAMICS which need checking on the field by the active flyers.^Plans and reports of experimental models are always welcomed. Our original drawing size is 9 in. x 14 in.--You can send full size drawing of small models, but large models should be drawn to 1/4 (English) or 1/5 (metric) scale. Always try to include full size airfoil so that we may draw it full size on our drawings. Be sure to include C.G. position as well as incidence angles. All these thines will help the theory boys in their work.-—All correspondence will eventually be answered.

MODEL AERONAUTIC ENCYCLOPEDIA *3 ?? Spirit was willin? but the purse was weak after the 1951-52 book was published.; Perhaps this edition will be more successful in the financial field and provide the extra money to print *fi.* We will let you know. It will be published someday as it has worthwhile information.

Dear Friends:

As you may have realized by now, this book is intended to be circulated among friends; and its readers and contributors constitute an informal international club. So that if portions of book seem strange for a "text book", remember that informality is the keynote of this club.

Frankly, this book was prepared under very discouraging conditions; almost like those that call for another flight right after coming down in a tail spin.—The 1951-52 YEAR BOOK required about about $4,000.00 of cash outlay. So far very little of this cash has found its way. home. (Wish you. would tell your friends about the 1951-52 book in case they do not have it.)

On other hand, we were encouraged to keep on by the letters we received from readers who said, "Now I know why--------------?

With this edition we are going back to our pre-war price of $1.00 per book. However, the law of economics limited us to 129 pages.. We doubled up some plans to make up for this..

In the near future we expect a more stringent application of the economic law to our personal requirements so that there may not be as many plans in the future books as we would like to see.

Would like to hear from you. Let us know what you are doing to advance model aerodynamics.. Your opinions and suggestions will be appreciated.

Frank Zaic

P.S. Thanks to all who helped.—The cartoon below is the last one we have from Fred Colbus. He used to draw them on bottom of his pre-war letters. Anyone know where he is now?