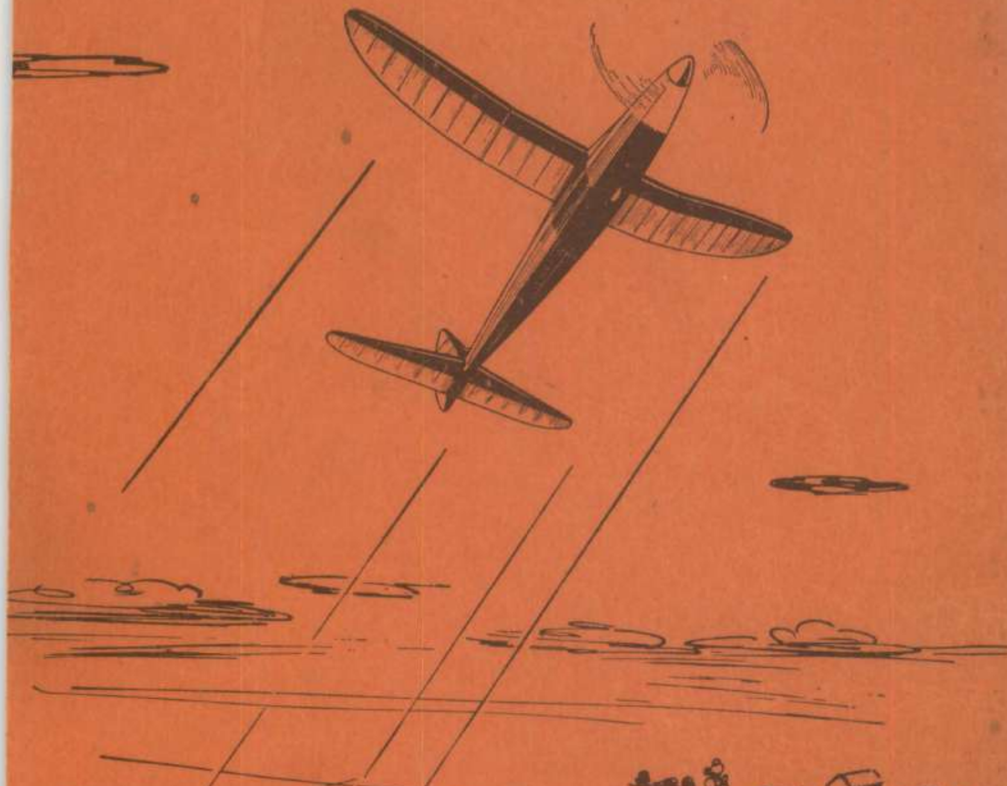


MODEL AERONAUTIC
encyclopedia vol. 1

BY FRANK ZAIC

MODEL AERONAUTIC ENCYCLOPEDIA

VOLUME ONE

Edited By

Frank Zaic

MODEL AERONAUTIC PUBLICATIONS
NEW YORK

FOREWORD

One of the greatest tools of scientific men is the record of past discoveries, experiments and inventions. Just think of the number of hours, effort and money that are saved in knowing what has been done in the past in a particular field. Not only can an experimenter start where others have left off, but he can also co-relate facts of many researchers and by applying his own experience discover new ideas that will benefit mankind. We wonder where we would be today or what we would be doing if it were not for the millions of books that contain the records of man's achievement in science and other fields.

It is hoped that this first volume of MODEL AERONAUTIC ENCYCLOPEDIA will be the beginning of data collection in the model aeronautics field. Those of us who have been making and flying models for a long time know how often similar ideas and designs are presented under the impression that they are original developments.

Another purpose of this book is to try to give credit for the original work. It is about the only recognition that a researcher in model aeronautics receives for his efforts. In this respect, please mention the originators of the ideas which you may be reviewing or incorporating in your design articles.

Major portion of the following material was taken from the 1934, 1935-36 and 1937 MODEL AERONAUTICS YEAR BOOKS. It was during this period, 1932-1937, that model aeronautics as we know it today was developed. So that besides being a scientific resume of that era, this book may also be considered as a roster of pioneers of model aerodynamics.

January, 1947
New York, N. Y.

Frank Zaic

PRINTED IN U.S.A.

THEORY

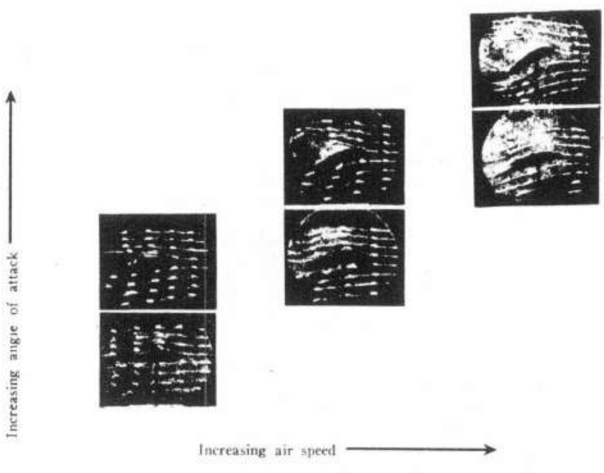
LOW SPEED AERODYNAMICS

The goal of the contest model builder is to have his models remain in the air for the longest possible time. To obtain maximum duration from the pure merits of the model, he must know just how the air acts on models at their relatively low speeds. By knowing just how the air behaves at low speeds he can pattern his model to conform to a shape most efficient for low speeds. The results of such procedure will be the possibility of flying models very economically, which in turn will prolong their limited power.

Although interest in low speed aerodynamics is expressed by most model builders, very little testing has been done. However, the desire for facts is spreading, and several clubs are constructing slow speed wind tunnels. It is quite possible that by next year we will have some positive results. Until then, we can only review the present thought about the subject.

It might be mentioned here that a great deal can be learned about low speeds from early Aerodynamics books, dated from 1900 to 1914. Unfortunately, most of the formulas were assumed for speeds over 30 miles per hour. The real low speed tests (2-10 miles per hour) are presented as comparisons, to show that certain laws do not hold to specific bounds throughout the whole range of speeds.

One of the best proofs that we cannot accept the present airfoil chart values for model work, without modifications, is presented by the following photographs from an article appearing in the Journal of Aeronautical Sciences, Aug., 1936, prepared by H. C. H. Townend, National Physical Laboratory, England. The light lines showing the air flow are streams of electrically heated air which were photographed through the use of certain optical properties of heated air.



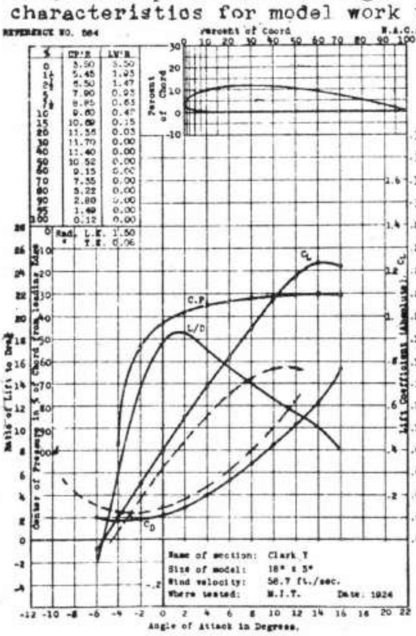
In Photograph 1. the airfoil is at zero degrees angle of attack. The close spacing of the spark dots shows that the air speed is comparatively slow. In this position the lift of the airfoil is small. You all know that to increase the lift, the angle of attack (the angle between the airfoil and the airflow) must be increased, and that the greater the angle, the greater is the lift. However, there is an end to this happy conincidence. After a certain angle is reached, the air refuses to flow smoothly (see Photograph 2.), and it spills over the leading edge and becomes turbulent. When such a condition arises the lift drops off, and consequently the plane stalls because there is not enough lift to keep it up. The stalling angle depends upon the air speed and also upon the airfoil.

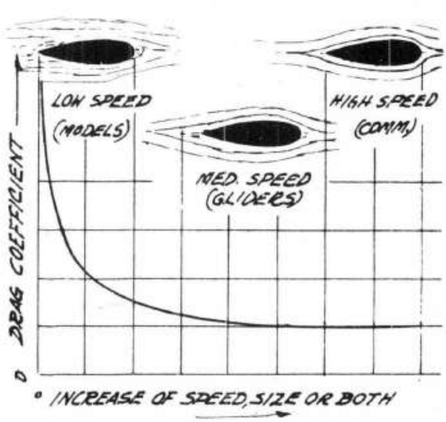
In Photograph 2. we see the airfoil in a stalled position. The air speed is the same as that in Photograph 1. Note the low angle of attack and also the rolling action of the air behind the wing. In this position the effect of the upper camber is lost and we can only depend upon the lower surface to lift. It would be very unwise to try to pull the wing through the air in this condition, as the power necessary to overcome the drag of the turbulent air would be tremendous. This might explain why certain models with improper line-up refuse to gain altitude no matter how much power is applied.

Photograph 3. shows the airfoil at the same angle of attack as in Photograph 2., but with the air speed increased. Notice how the burbling or stalling air has straightened out, and so has restored the lift of the upper camber. From this illustration we can see that a high speed plane can fly at higher angles of attack than a low speed job, without stalling. Photos 4., 5., and 6. amplify the principle.

Special note should be made of the fact that by judging from the spacing of the spark dots, the air speed in Photographs 5. and 6. is about three times that of Photographs 1. and 2. Also note that the angle of attack is 10° in Photograph 2., 18° in Photograph 4., and 28° in Photograph 6.

It has also been proved that the lift coefficient is much smaller at low speeds than at high. Therefore we can assume airfoil characteristics for model work to be approximately as shown in Fig.A



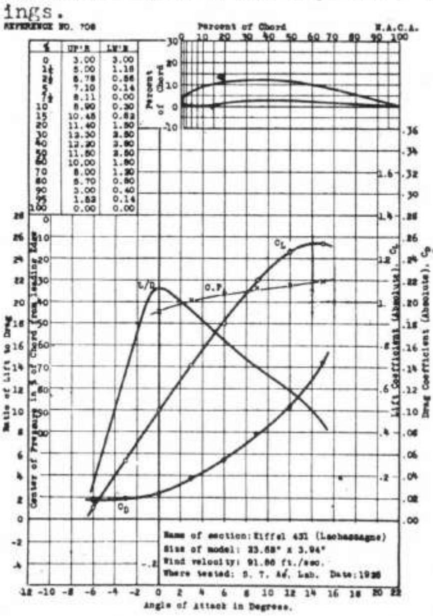


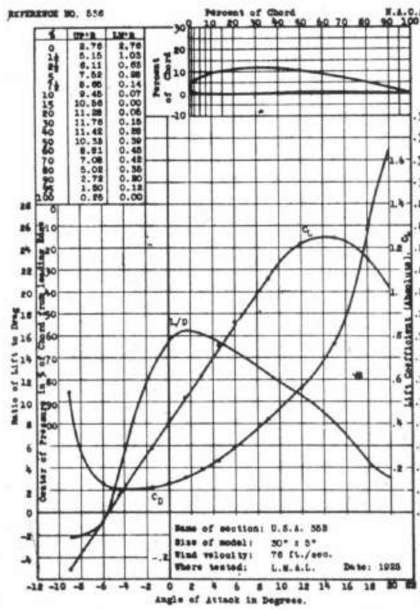
The drag will also be found to be actually greater for models than that calculated from the standard drag coefficients. This can also be explained by the photographs. Since the drag is the result of disturbing the airflow, and the airflow is easily disturbed at low speeds, the drag coefficients are much greater for low speeds than for higher speeds. See Fig. B. for the coefficient difference and also Fig. A. which shows the drag curve assumed for model work.

These proofs should convince the most sceptical that it pays to streamline at low speed. We should not use the record list as a basis for an argument against streamlining as the record flights were almost all made with the aid of thermal currents. What we want is a much higher average flight. The chances of getting a ten minute flight are about 1 in 50, and a five minute flight, about 1 in 20. The odds are getting better year by year, as we pay more heed to low speed aerodynamics.

Just where does the drag come in on all this? Well, the point is that if, for example, it requires 2 oz. of thrust to fly a model, at least one oz. of this thrust is used up in overcoming the drag of the fuselage, landing gear, and tail. If we did not have all these things, it would be possible to fly the model twice as long for the same power, thereby doubling our duration in calm air, as well as doubling our chances of catching a thermal. With this in mind, let us remember how the airflow behaves at low speeds, so that we may pattern the model to conform to the shape most suitable for low drag.

The best possible shape for each part, as well as the effect of streamlining on stability, will be considered under their own headings.





ADDITIONAL AIRFOIL SECTIONS may be found in N.A.C.A. Reports Nos. 93, 124, 182, 244, 286, 315, and 460. These reports may be seen in your library or be purchased on application to the --- Superintendent of Documents,---Government Printing Office, --- Washington, D.C. For further information write to the National Advisory Committe for Aeronautics, Navy Building, Washington, D.C.

AIRFOILS

The first step in designing a contest model is to decide upon the size desired. After this is done an approximation of the weight should be made. From the weight estimate, the area of the wing should be determined. Before the final decision is made, remember that the performance of the model depends a great deal upon its wing loading, so crowd in as much area as the rules allow. The next and perhaps the most important step is to select the airfoil.

Since airfoils stall at lower angles, at low speeds, we must select a section that has sufficient lift at low angles of attack. The sections having this quality are those whose thickness exceeds 8% of the chord and whose lower portions are flat or undercambered (concave). Although lift increases with an increase in thickness, an excessive increase in drag and other disadvantages become evident with the use of section of over 15% chord thickness, at low speeds. A thickness of 12% of the chord seems to be the best compromise.

Fig. 1.

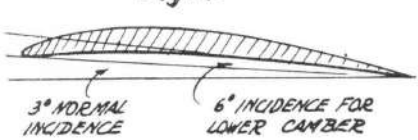
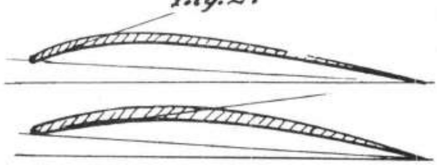


Fig. 2.



One way of increasing the lift without the addition of too much drag is to use an undercambered airfoil. The reason that the undercambered section develops more lift than a similar section with a flat bottom is that the airflow acts at a greater angle against the lower portion of the airfoil. See Fig. 1. Thus we can increase the angle of attack of the lower portion of the airfoil, without increasing the angle of the upper portion. (Remember that it is the air going over the upper camber which burbles at high angles of attack.) This increase of lift becomes especially prominent at angles greater than 0°. Since we usually set the airfoil at about 3° positive we can use the undercamber advantageously. The undercamber may be quite deep, but we must keep in mind that too much of it will cause appreciable drag by the eddy behind the leading edge. See Fig. 2. From this diagram we can see that the highly undercambered section should have the maximum height at about 40% of the chord to minimize the eddy tendencies. The undercambered sections have a greater center of pressure travel and also a lower lift-drag ratio. However, these points should not be used as criterions in selecting the airfoil. What we want is enough lift, even at the expense of a bit of additional drag (which is very small in comparison with the rest of the model). The center of pressure travel is taken care of by the abnormal size of stabilizer used on models.

Every so often someone asks why a stable section like an M-6 should not be used instead of an RAF 32. Then the fact that the RAF 32 lifts as much at 0°, as the M-6 does at 7° is pointed out. "But why don't you set the M-6 at 7° and get the same lift as the RAF 32, and get the advantages of a more stable section?" --Well, the fallacy here is that most sections stall within a few degrees of each other. The M-6 with 7° setting will stall much sooner than the RAF 32. For example; if the M-6 stalls at 20° it has 13° leeway, and if the RAF 32 stalls at 18° it has 18° leeway. These figures, by the way, are for full size work. The stalling angle is much lower for model sizes-- possibly half of the above figures, and the leeway is that much smaller.

In choosing the airfoil, the structural requirements of the particular model must be kept in mind. The best airfoil is useless if the wing does not keep its shape, or if it breaks at the slightest collision. In fact, all the advantages of the finest airfoil can be spoiled by poor balance, improper incidence, and high total drag.

After considering structural requirements of airfoils, the following standard sections will be found suitable for model work: RAF 32, Eiffel 400, U. S. 35B, Gottingen 392, Eiffel 431, Gott. 496, Gott. 529, ISA 923b, and Clark Y. (Also see sections developed by model builders.) The specific recommendation is made under the individual report. On these reports you will also find the approximate values for model work. Use them and check their accuracy.

The Editor believes that the best practical section is the RAF 32 which was introduced to use on models by him several years ago. Its characteristics are very good, as it has all the desirable points. It may be used in thinner or thicker form for light or heavy models. The Eiffel 400 almost matches it in characteristics, but the thin trailing edge, and the comparatively high leading edge place it second.

Airfoil Characteristics Charts

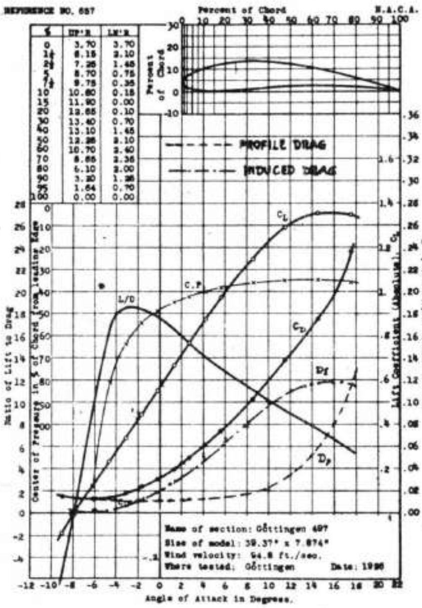
Airfoil characteristics charts show the wind tunnel results, translated so that they can be used for power planes and gliders. Eventually we will have such charts for model work, and therefore a short summary of the chief curves will give an inkling as to what they are all about, to those who do not know how to use them. The curve labeled C_L shows the coefficient of lift at different angles of attack. Note that the slope of the graph is almost the same for all airfoils. The only difference is that the curves cross the 0° line at different points. Notice that the airfoils chosen for model work have this line quite high. The higher this crossing, the better the section, providing that it is not too thick. The termination of the upward trend just before the slope downward indicates that the section has reached its maximum lifting point, and that it is close to the burbling point if not actually in it. This stalling point occurs sooner at low speeds, and also occurs slightly sooner for high aspect rations. The method of using lift graph for calculations is as shown in the example.

The next curve is the C_D line. This shows the drag values at different angles of attack. For best results this line should be as close to the .00 mark as possible, providing that the section has enough lift. The C_D line is the result of two kinds of drag, the parasitic and the induced. Parasitic drag is that part of the resistance which is caused by moving objects disturbing the airflow. It is the drag with which we are all familiar when streamlining is talked about. The induced drag is evident mostly on inclined planes such as wings and tail surfaces. It is caused by the airflow from the compressed air area under the airfoil into the rarefied upper portion. See Fig. 3. At the tips this equalizing flow is especially great. The degree depends upon the size of the tip. The larger and blunter tips will have a greater flow, while the small and gradually tapered tip will have a comparatively small spill-over with consequent smaller disturbance of the air. The drag is calculated as shown. (The topic of induced drag brings us right into the Aspect Ratio question, but as we are on chart reading, the Aspect Ratio will be discussed later.)

The curves that remain are the C. P. (center of pressure) and the L/D (the lift divided by the drag). The C. P. line shows the center of all lifting components at the particular angle. For example, in the airfoil shown, the center of lift at zero degrees is 45% behind the leading edge.

The lift over drag ratio is an indicator of how much the lift is greater than the drag. Remember the L/D line should not be the only deciding factor in the selection of an airfoil.

The formulas used to calculate lift and drag are as follows, as per the N. A. C. A. reports:



LIFT FORMULA

Lift (in lbs.) = $C_L \frac{p}{2} S V^2$

DRAG FORMULA

Drag (in lbs.) = $C_D \frac{\rho}{2} S V^2$

C_L = Lift Coefficient
C_D = Drag Coefficient
ρ = Density of air .00237
(at 15°C & 760mm
S = Surface area in sq.ft.
V = Air Speed in Ft. Sec.

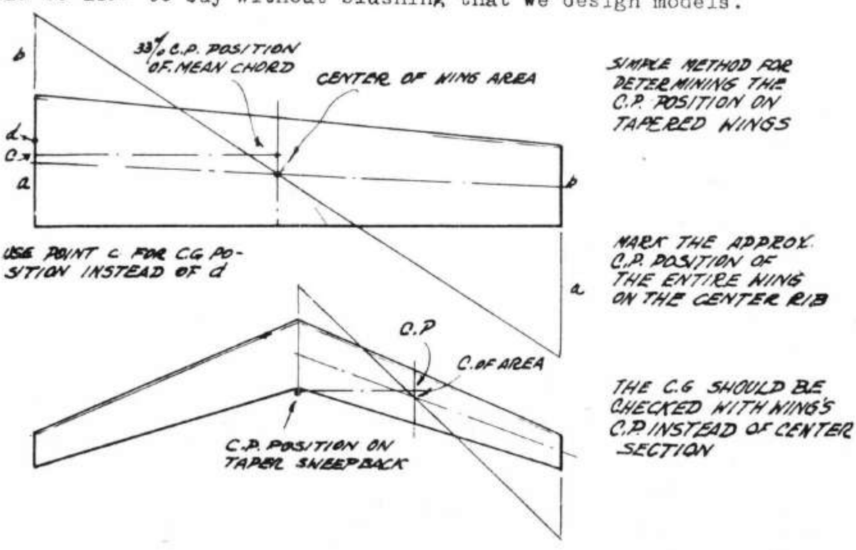
EXAMPLE

To find lift and drag of a wing whose area is 8 sq.ft., section Gött. 497 at 2° pos. Air speed 20mph (29.33 ft.sec.)

Lift = .7 X .001185 X 8 X 29.33^2
Ans, 5.268~~558640~~ lbs.

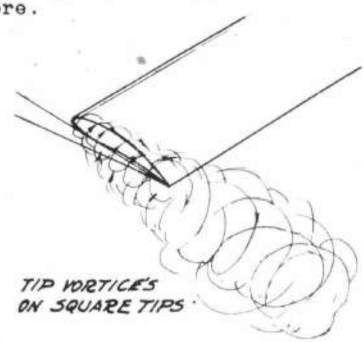
Drag = .045 X .001185 X 8 X 29.33^2
Ans. .3669~~7838400~~ lbs,

When we have charts for low speed work, we will be able to find out the minimum speed at which the wing will lift the weight of the model. The calculation of total drag can be based on this speed, and once the drag is known, the proper design of the propeller can be easily selected. When we will make models in this way, we really will be able to say without blushing that we design models.



Aspect Ratio seems to be the favorite topic of most writers. The only difficulty is that some recommend high aspect ratio and others recommend low. Sometimes opposite recommendations appear in the same issue of a magazine, which is rather confusing, to say the least. Well, let's see just what aspect ratio is, and how it affects the wing efficiency.

Aspect ratio is the ratio expressed by dividing the span by the average chord. Its effect upon the wing's efficiency, is that it determines the size of the tip whorls and other whorls caused by the pressure differential between the upper and lower cambers. A low aspect ratio wing will naturally cause greater tip losses than a high aspect ratio wing. These losses result in less lift and greater drag. The drag is called induced drag, and has been described before.



As previously mentioned, the drag shown on a regular airfoil report is composed of two parts, that due to tip losses, induced drag, and the profile drag which is due to the friction of the airflow by the passing wing. The formula for induced drag is:

$$\text{Induced Drag} = \frac{C_L^2}{\pi \times \text{Aspect Ratio}}$$

As can be ascertained from the formula, an increase in the aspect ratio decreases induced drag. From this we can see that high aspect ratio is especially important in soaring gliders where the lift coefficient is very high because of the thick airfoils used. On a model the lift coefficients are comparatively low because of the low air speed and comparatively low angles of attack, and the section or parasite drag is comparatively very high, also due to the low speed. For the reason that the parasite drag is more important in models than the induced drag, it is best to reduce the parasite drag by using a large section, which of course with a limited area means a lower aspect ratio. It is just one of the minor differences between models and power ships.

The exact aspect ratio depends on the design of the model. If the model is large the aspect ratio may be fairly high as the airfoil is wide, but for small designs the aspect ratio should be low enough to provide an airfoil shape sufficiently large for aerodynamical effect. Judging from experience, airfoils with a chord of under 3" are seldom of true shape, and have results approaching flat plate characteristics. Therefore, no matter what the aspect ratio is, the tip airfoil should never be smaller than three inches. By using three inches as the minimum tip chord, the aspect ratio can be very easily decided upon if the wing area is know. An aspect ratio of about 7 to 10 will take care of most models, both in overcoming the torque and in providing stability.

The shape of the tips should be carefully designed, especially on low aspect ratio designs. An elliptical outline starting at a distance of about twice the tip chord from the tip, is about the best. When making tips, be sure that they are smooth and do not offer a resistance turning moment to be overcome by the rudder.

Aerodynamic Characteristics of Wing Tips

It is a known fact that the tips on a tapered wing stall before the center section, and that on a straight wing the center portion stalls first.

The tip stall on a tapered wing is explained by the fact that on such wings we have two extreme sizes of airfoils, the large at the center and the small at the tips. It is this difference in size that causes the early tip stall on a tapered wing. The small airfoils do not hold the airflow as well as the larger sections at high angles, with a consequent early stall for the small airfoils. This can be substantiated by noting that the smaller the airfoil becomes, the closer it approaches the flat plate in its characteristics (the break of airflow at low angles). It may be noted here that the airflow breaks away very easily from sharp corners, and since small airfoils have very little curvature, the early stall effects are especially prominent.

The reason that the center portion of a straight wing stalls first is that the tips have a relatively continuous flow of air from underneath the wing at all angles. When the wing does stall, the overflow over the center breaks away from the airflow, while the tips still get a fairly smooth flow from the pressure differential, thereby increasing the tip stalling angle.

The question, "Why does not the same phenomenon hold true for tapered wings?", can best be answered by noting that on a tapered wing the airfoil gradually decreases in size, so that the tip sections are comparatively small for quite a distance near the tip and that the pressure differential is also smaller because of the gradual taper.

The advantages of having the tips stall last are apparent when we consider that in a stall the tip portion of the wing is behind the C. G., and therefore will help to restore the model to a level or flying position. See Fig. 4. The tips may be washed out to decrease incidence and stall later than the center section, but this gives us a loss of lift. A much better method, which has been recently introduced by engineers, is to thicken the tip airfoil, especially the leading edge, as shown. See Fig. 4a. This provides the needed rib curvature for a late stall.

Fig. 4a.

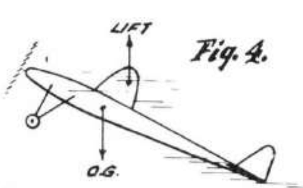
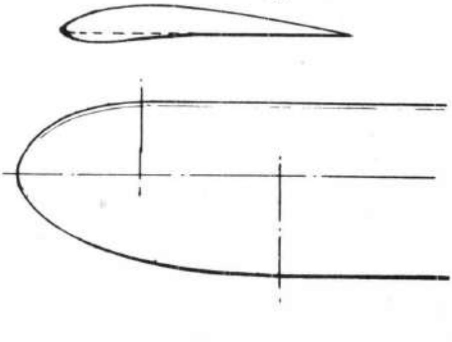


Fig. 4.



MAKING GOOD TIPS BY A SERIES OF ELLIPSES
By Henry Stiglmeier

STABILITY

The stability of a model may be divided into several divisions: longitudinal or "up and down" stability, rolling or rotating stability, and directional stability. The longitudinal stability is taken care of by the proper position of the C. G. and the stabilizer. The rolling stability is obtained by the proper dihedral and side area, plus the correct position of the C. G. The directional stability is taken care of by having the center of side area behind the C. G., to enable the model to swing into the wind in case of sudden gusts.

Longitudinal Stability and the Stabilizer

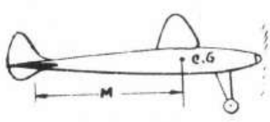
Longitudinal stability seems to be well under control because of the present tendency to use large stabilizers, which keep the wing well within the narrow safety margin of angle of attack, caused by low speed. Another present tendency is to use slightly lifting tails to help lower the wing loading. The lifting tail can be used to advantage, providing the builder knows how to use it.

The area of the stabilizer may vary a great deal without affecting the performance of the model, except for finer adjustments for smaller areas, and a slight increase of drag for larger areas. The present trend in stabilizer design is to use from 30% to 40% of the wing area for the stabilizer area. In figuring this area, the moment arem the weight of the model, and the chord and area of the wing should be taken into consideration. The light model and the model with a small chord wing may use a smaller stabilizer because light models are subject to less violent displacements. For heavier models and for models with large chord wings, the full 40% may be used to enable the tail to dampen out the upsetting forces. The area of the stabilizer is also determined by the tail moment arm. A short moment arm necessitates large area, while a long moment arm can stabilize the model with a much smaller stabilizer. The size of the fuselage in front of the wing also has a slight bearing on the final area. The longer portion requires a larger stabilizer to dampen out any possible oscillations caused by the large inertia distance.

The ideal stabilizer keeps the model just below the stalling point and has a higher stalling angle than the wing, to bring the model level without loss of altitude after the wing stalls. One way of raising the stalling angle of the stabilizer is to use a low aspect ratio on the stabilizer, with the trailing edge almost straight and the leading edge swept back. In case of a lifting stabilizer, use an airfoil that stalls later than the wing. Wallace McBride of Winnepeg, Canada, reports that tip rudders help in recovery by preventing the tip airflow from spilling over the end of the tips at high angles of attack, thereby giving the stabilizer extra high lift at large angles, just when it is needed most.

Since it is a poor practise to approximate important areas, we would benefit a great deal if we were to formulate a simple equation for the stabilizer area. The formula used by aeronautical engineers is:

$$\text{Stabilizer Area} = \frac{\text{Wing Area} \times \text{Coefficient} \times \text{Average Chord}}{\text{Stabilizer Moment Arm}}$$



The coefficients vary for different designs. The coefficient used for transports is about .35, while for light planes, the coefficient is sometimes as much as .50. For model work, use 1.00 for light ships and 1.35 for heavier jobs. A good procedure to follow is to record the wing area, average chord, stabilizer area, and the moment arm of every model we make. If we know these figures we can very easily determine the coefficient for later reference by using the following equation.

$$\text{Coefficient} = \frac{\text{Stabilizer Area x Moment Arm}}{\text{Wing Area x Average Chord}}$$

After a while we will have a complete set of coefficients for each type of model, and also for stabilizers using different airfoils.

Although a flat or symmetrical stabilizer may lift if it is set at a positive angle, the practical difference between the lifting tail and the flat or symmetrical tail is that the lifting tail contributes lift and brings the C. G. back, sometimes even behind the wing, while for a non-lifting tail the C. G. is not more than 30% of the chord of the wing behind the leading edge.

To adjust a non-lifting stabilizer model, the C. G. should be 30% of the chord behind the leading edge. The wing should be left at this point no matter how the model flies. All the adjusting should be done with incidences. The incidence of the wing should be about 3° positive and the stabilizer should be set at zero, or even slightly plus, to take care of the downwash. Now if the model dives with this setting, increase the incidence of the wing very slightly, if a thick wing section is used; and increase the incidence of the stabilizer if a thin wing section is used. Always keep in mind that the wing must have enough lift to fly the model with the C. G. at the 30% of the chord position. As soon as the position of the wing is changed complications set in and adjusting becomes difficult for maximum efficiency. It is quite possible to adjust for fair flying and gliding by moving the wing back and forth, but what we want is the best that the model can do.

The stabilizing action of the non-lifting tail is shown in Fig.5.

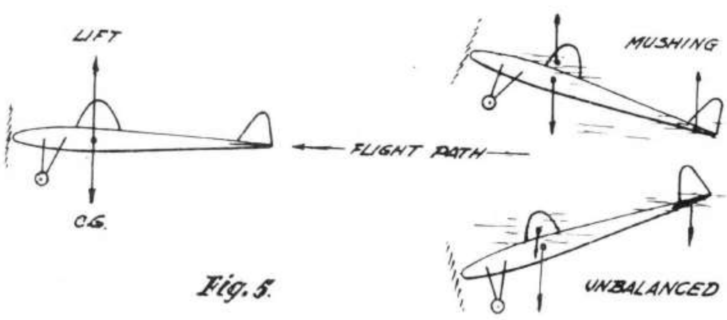


Fig. 5.

The lifting tail carries part of the total load of the model as well as providing longitudinal stability. The C. G. can be almost any place behind the wing, the exact position depending upon the size and incidence of the stabilizer. However, most model builders seem to favor the position of the C. G. just behind the trailing edge of the wing. To adjust for flying this design, have the wing at 3° positive incidence and the C. G. behind the trailing edge, then do all adjusting by varying the stabilizer's incidence until a satisfactory flight is obtained.

The sections used in the stabilizer vary from symmetrical for non-lifting tails, to single surface cambered sections for lifting tails. In selecting airfoils for lifting tails, keep in mind the fact that the stabilizer may develop too much lift and keep the model flying low and fast, or may force the model into a dive from which there is no recovery. See Fig. 6.

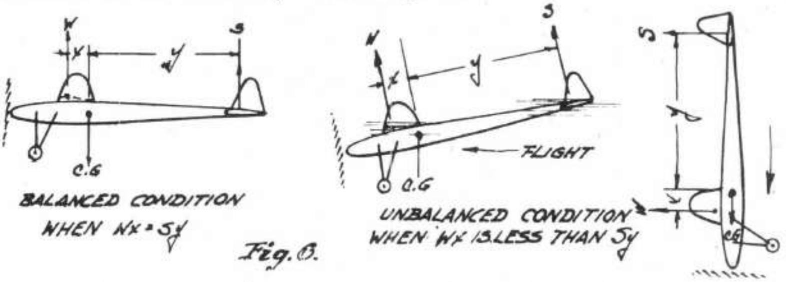


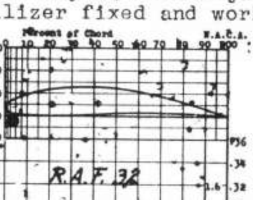
Fig. 6.

The ideal wing-tail combination for a lifting tail model is to have the force of the wing's lift x its moment arm, greater than the force of the stabilizer's lift x its moment arm, when the angle of attack is from negative to about 3° positive. At greater positive angles, the stabilizer should have a larger force, to keep the wing within the safety zone. If the stabilizer's force is larger than that of the wing at angles below 3° positive, the model will have a tendency to fly tail high, or even dive. See Fig. 6 . It is therefore evident that the stabilizer should be so designed that the airfoil will have relatively little lift at zero degrees angle of attack. The safest sections that will fulfil this requirement are of the M-6 variety. The flat bottom or Clark Y type should be about the limit in the direction of undercamber. The heavily undercambered stabilizers work well so long as the incidence is positive and the wing is able to take care of its side of the load, but as soon as the model gets into a negative angle of attack, the undercambered sections will force the model into a dive because of their "lift at low angles" characteristics, which provide the stabilizer with more force and overbalances the wing/tail ratio.

The above longitudinal stability suggestions will suffice if the model flies on an even keel and in a straight line, and also for models having the thrust line at the center of drag, so that such flight adjustments will be the same as those in the glide. However, since the power flight is usually of a circular or spiral type, the final flight adjustment depends upon the rudder and counter torque adjustment. Whatever may be such adjustments, keep the position of the wing and stabilizer fixed and work only on the turning controls

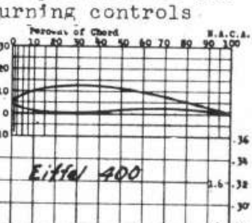
REFERENCE No. 606

%	UP'R	LW'R
0	3.4[illegible]	3.42
1¼	[illegible].56	1.9[illegible]
2½	6.52	1.50
5	7.84	0.88
7½	8.85	0.50
10	9.[illegible]	0.30
15	11.0[illegible]	0.06
20	11.92	0.0[illegible]
30	12.[illegible]	0.3[illegible]
40	13.10	0.70
50	12.46	1.10
60	11.06	1.46
70	9.10	1.60
80	[illegible]	1.46
90	3.[illegible]	0.92
95	1.[illegible]	0.4[illegible]
100	0.[illegible]	0.0[illegible]



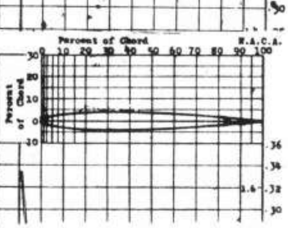
REFERENCE No. 703

%	UP'R	LW'R
0	4.80	4.80
1¼	6.63	3.38
2½	7.48	2.88
5	8.77	2.03
7½	9.79	1.41
10	10.90	1.00
15	11.88	0.42
20	12.80	0.10
30	13.10	0.10
40	12.80	0.80
50	11.60	1.30
60	9.90	2.00
70	8.00	2.40
80	5.80	2.20
90	3.10	1.30
95	1.89	0.71
100	0.00	0.00

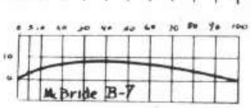


REFERENCE No. 507

%	UP'R	LW'R
0	0.00	0.00
1¼	1.30	-1.30
2½	1.74	-1.74
5	2.33	-2.33
7½	2.74	-2.74
10	3.05	-3.05
15	3.40	-3.40
20	3.78	-3.78
[illegible]	4.03	-4.03
[illegible]	4.00	-4.00
[illegible]	3.74	-3.74
[illegible]	3.30	-3.30
70	2.71	-2.71
[illegible]	1.90	-1.90
[illegible]	1.15	-1.15
[illegible]	0.80	-0.80



%	CAM
0	0.0
5	2.35
10	4.40
20	6.70
30	7.80
40	8.30
50	7.90
60	6.90
70	5.60
80	3.90
90	2.00
100	0.0



SPIRAL STABILITY

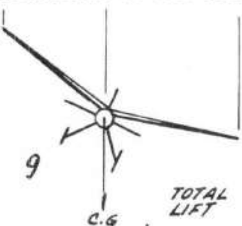
Dihedral and Rudder

Most stability problems are caused by the lack of knowledge concerning the forces that tend to roll (barrel roll, bank) or turn the model. On a stable model these forces are kept under control by the dihedral and rudder or fin. On an unstable model these controls are usually poorly proportioned with respect to each other. In designing these elements, keep in mind that they must remain within certain bounds, and that the "little extra to be on the safe side" usually causes most of the trouble.

The purpose of the dihedral is to keep the model in its most effective flying position. To accomplish this, it must perform a large variety of corrective functions, such as counteracting the torque and preventing excessive side slipping and banking on the turns. All of these things must be done with the minimum of dihedral, to keep the wing efficiency high. See Fig. 8 for comparison.

Fig. 8.

The general impression among the model builders is that the dihedral functions as in Fig. 9. This is the old theory, and does not explain why some models with little dihedral possess certain definite stability factors. To explain the modern theory, we must realize that the lift of the wing elements is always perpendicular to the wing surface, and that the resultant of lift is passing through the C. G. See Fig. 10. Now if the model is upset as shown in Fig. 11, the lift of the wing and the weight of the model produce a side force. This side force induces a side slip, so that the airflow now affects the wing as shown in Fig. 12. From this figure it can be easily perceived that the lower wing has more lift than the upper by virtue of its greater angle of attack. This tends to raise the model into a level position. The important point to remember here is that every such corrective tendency is brought about when the model is side slipping, and that side slipping affects the surfaces seen in a side elevation of the plane.



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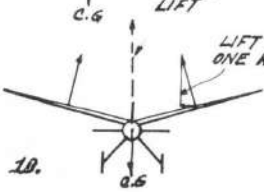

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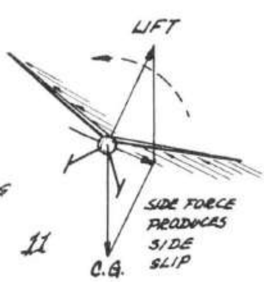

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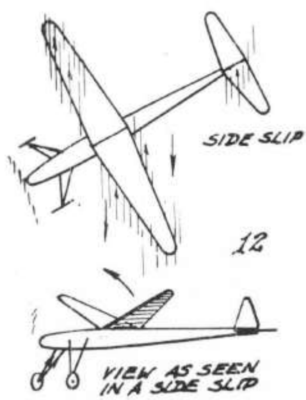


12

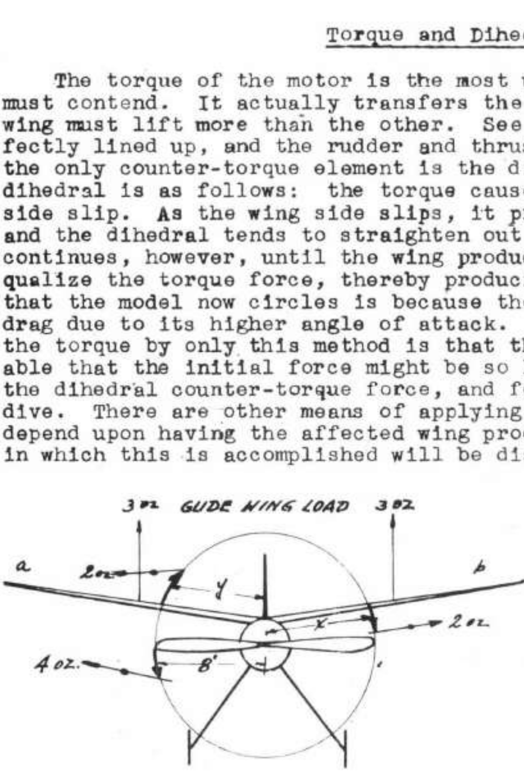
Effect of a High Fin on Stability

Another method of obtaining stability is to mount the wing on a fin. The stability is obtained when the model side slips, because this fin area exerts a leveling force as shown in Fig. 13. However, it is not as effective as the normal dihedral which makes use of the lift to bring the model level. The high fin may be used, in which case the dihedral may be decreased, but not entirely eliminated. When using a fin, remember that it acts as a rudder also, so be sure to check its position before every flight.

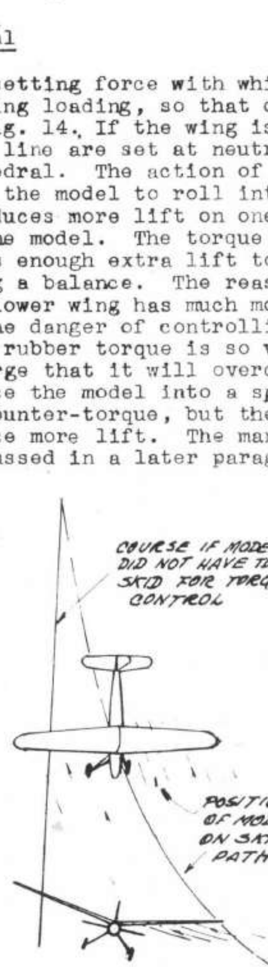
Fig. 13.

Torque and Dihedral

The torque of the motor is the most upsetting force with which we must contend. It actually transfers the wing loading, so that one wing must lift more than the other. See Fig. 14. If the wing is perfectly lined up, and the rudder and thrust line are set at neutral, the only counter-torque element is the dihedral. The action of the dihedral is as follows: the torque causes the model to roll into a side slip. As the wing side slips, it produces more lift on one side and the dihedral tends to straighten out the model. The torque roll continues, however, until the wing produces enough extra lift to equalize the torque force, thereby producing a balance. The reason that the model now circles is because the lower wing has much more drag due to its higher angle of attack. The danger of controlling the torque by only this method is that the rubber torque is so variable that the initial force might be so large that it will overcome the dihedral counter-torque force, and force the model into a spiral dive. There are other means of applying counter-torque, but they all depend upon having the affected wing produce more lift. The manner in which this is accomplished will be discussed in a later paragraph.



EXAMPLE TOTAL WING LOADING . 6 oz.
EACH WING " 3 oz.
TORQUE PRODUCES UP FORCE
ON WING "a" THEFORE REDUCING
ITS LOAD BY 2oz.y: WHILE PRODUCING
A DOWN LOAD 2oz.x ON WING "b"
TO SUSTAIN LEVEL POSITION, WING
"b" MUST CARRY ITS ORIGINAL 3oz.
PLUS 2oz.y and 2oz.x



So far, we know that the only time that the dihedral comes into play is when we get a side slip and a consequent side airflow. This side airflow affects the side of the model, and the reaction of the model depends upon the manner in which the side area is proportioned around the center of gravity. It is apparent that if the areas are balanced nothing will happen, but the moment that the balance is disturbed, the side that has the most area will tend to swing into its least resistance position. See Fig. 16. For our purpose, it is best to have the tail portion of greater area so that the model will tend to point into the airflow whenever a side gust occurs. However, it must not be too great or the wing will have but a small chance to recover by the dihedral-side slip effect, since the tail portion will always be trying to point the model into the newly formed airflow, and so eliminate the needed side flow for the dihedral to take effect. The ideal situation is that in which a slight side slip does not affect the side area proportion.

Rudder

In a side gust or cross wind the model with a small rudder will be turned so as to fly with the wind, and the model with a large rudder will point into the wind. Of the two, the large rudder is preferable, as a gust is liable to upset the small rudder model while it is turning. See Fig. 16. In a side slip with its accompanying side airflow, the model with a small rudder will tend to increase the side slip by having the tail portion drop. It is also possible that such lowering of the tail portion will increase the angle of attack to a stalling position in which case the entire model will be out of control. The larger rudder model will tend to face the side airflow, preventing the model from side slipping, and banking it instead. However, remember that the rolling tendency due to the torque is still present and continues to produce the side slip, forcing the model into a tight banking circle, with a consequent spiral dive. A rudder of the correct area will allow the wing to have a slight side slip, and when that is exceeded, will bank it into a slipping turn. See Fig. 17.

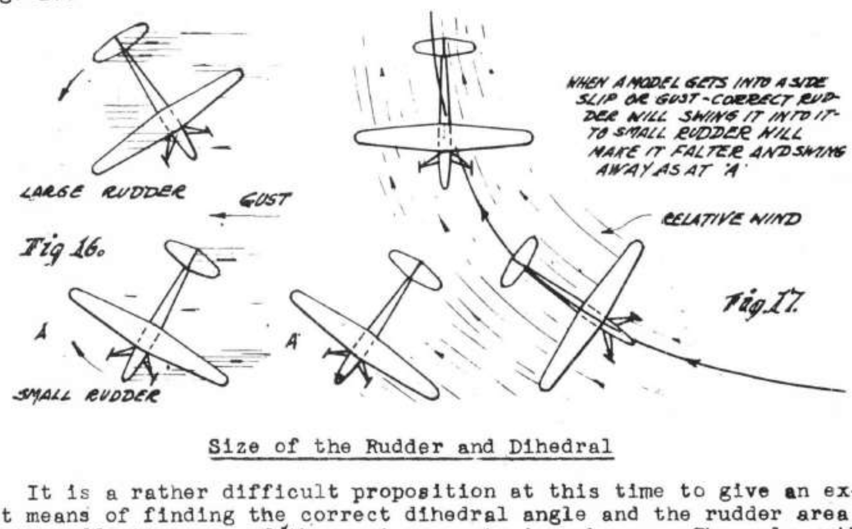


Fig 16.

Fig 17.

Size of the Rudder and Dihedral

It is a rather difficult proposition at this time to give an exact means of finding the correct dihedral angle and the rudder area, as the effectiveness of the various parts is unknown. The only method is to approximate as closely as possible from experience, and then to watch the performance of the model, noting its actions. If we can tell which forces are dominating the situation, it is then a simple matter to make the necessary corrections, if something is wrong.

For the average model, the dihedral depends upon the span and area of the wing, as well as the power used and the size of the propeller. The dihedral should be large if the span is small or the area is small, and the motor powerful and the propeller large. For these extremes as much as $2\frac{1}{2}$" may be used at each tip for every foot of span. At the other extreme we have large area and span, and low power and a small prop. (Almost glider characteristics.) For such models, $1\frac{1}{4}$" dihedral at each side for every foot of span, is sufficient. These angles will allow for torque as well as other upsetting forces. For models between these extremes the angle may be small if the torque is small, or if it is neutralized by twin props.

The correct rudder area depends upon its distance from the C. G., the shape of the fuselage, the size of the prop and the wheels, and the dihedral. The effect of the distance from the C. G. is self-evident. The effect of other elements can be best seen in Fig. 18, in which the model is seen from the sliding or airflow direction. Since we know that we must have slightly more area behind the C. G., we therefore can assume that the center of side area is slightly behind the C. G. Now, the aim of the builder should be to have the areas on each side of the vertical line balance each other. This can best be done by drawing a side view of the model and then calculating the area-distance forces.

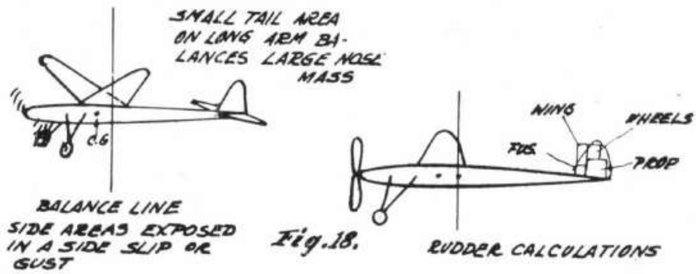


Fig. 18.

Since the size and shape of the elements other than the rudder have already been determined, we can slowly build up the rudder while we are calculating. In calculating side area-distance, we should assume a full side view of the propeller, $1\frac{1}{2}$ times that of a single wheel, $1\frac{1}{2}$ times that of the total dihedral, and a full size fuselage if a square or diamond shape is used. A round fuselage, because of its low drag at various angles, may be considered as a stick, while the elliptical fuselage should be about 1/2 of its height, and an octagonal one almost full size. In using this procedure, the rudder should not exceed its calculated size for that "just to be on the safe side" reason. The above mathematical procedure is simple, but if you want to, you can make a side view cardboard pattern of the model with the areas as recommended. The rudder portion is left large and balance is obtained by trimming it cautiously. If the calculations are exact, you should have the correct rudder area. Check by flying the model, and note if any changes are necessary. The above methods favor a generously sized rudder, providing that the propeller effect is not greater than its side view. For the average model, assume the center of side area to be a few inches behind the C. G.

Requirements for Ideal Spiral Stability

To have a model possess spiral stability, we must have enough dihedral to straighten it when it begins to roll or side slip, the rudder should be just large enough to bring the center of side area behind the C. G. and so always tend to turn the model into a gust, and the dihedral and rudder should be so proportioned that they will work in harmony. The exact combination is hard to get, but we can easily detect a model without it by the following flight examples.

If the rudder area or the area behind the C. G. is too large or if the dihedral is too small, a side gust will tend to turn the model into the wind. As it turns, the outside wing travels faster and produces more lift with a consequent bank. The moment the wing banks, we get a side slip in which the whole side of the model is affected. The greater side area behind the C. G. noses the model still further into the bank, and this is followed by more side slipping until eventually the model is in a vertical turn, and finally a tight spiral dive. The above cycle may also be started by setting the rudder for a sharp turn, which is almost equivalent to the side gust effect. Torque also rolls the ship into a side slip. The conclusion that may be drawn is that if the center of side area is too far behind the C. G. and the dihedral is small, the model will be very unstable or easily affected by side airflows, and in great danger of spinning. The cure for this is to decrease the rudder area or the side area behind the C. G. or to increase the dihedral.

With the present tendency to make all controlling surfaces extra-large, it is unlikely that the rudder area will ever be too small, or the Center of Side Area in front of the C. G. However, if the model tends to bank one way, and then the other, or if it slips from side to side, the indications are that the dihedral must be too large or that the side area is just on or is in front of the C. G. Check the side area position, and if it is behind the C. G. decrease the dihedral, and if it is in front of the C. G., increase the rudder area.

Position and Shape of the Rudder

It has been noted that the rudder has a powerful effect and that it should be so placed and shaped so that its action will be gradual If the rudder is of high aspect ratio and placed above or below the fuselage, the slightest side airflow will tend to upset the model. Of the two, the upper position is preferable, as it tends to keep the model on an even keel, while the lower design tends to overturn the model. The logical solution to the problem is to make the rudder of low aspect ratio, and to divide the area above and below the fuselage as shown in Fig. 19.

Fig. 19.

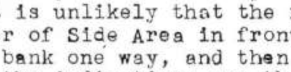
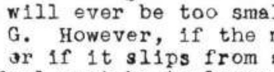


Fig. 20.



Round or elliptical fuselages offer comparatively small resistance when exposed to the side airflow and they are not very effective with respect to side area control. In such cases, it is recommended that fins be made on the front of the fuselage and that the rudder be made as shown in Fig. 20. In a side slip, such an arrangement will tend to slow down the sliding motion and also present forces of similar strength, due to the flat fins in the front and rear.

Twin Rudders

Twin rudders seem to be aerodynamically sound, and it is quite possible that they are more effective than the single rudder design, because of their smaller fuselage interference. They also benefit the longitudinal stability by raising the stabilizer's stalling angle. Their total area should be slightly greater than that calculated for a single rudder. When using double rudders, be sure that the line-up is identical for both, and that they are well fixed to a strong stabilizer.

Counter-Torque Adjustments

As previously shown, the propeller torque transfers part of the wing loading to one side of the wing and causes the model to roll, unless corrective measures are applied. One of these corrective measures is the dihedral, but since a large amount of dihedral lowers the wing efficiency, the dihedral must necessarily be as small as possible. Another measure used is to change the incidence of the wing so that one half has more than the other, with a consequent increase of lift. A modification of this method is to increase the area of one half of the wing. The only objection to these methods is that as soon as the power is expended the counter-torque setting produces spiral instability if the adjustments are excessive. Recently, the side thrust control of torque has been used successfully when used with moderation. The principle here is that the angle of thrust produces a turning tendency which causes the torque wing to travel relatively faster and so produce the needed counteracting lift. While the model is under the side thrust influence, it is in a skidding turn, and it is here that the danger lies. If the center of side area is not properly balanced, the model may become unstable. See Fig. 21, for force diagram. The rudder may also be used but its effect will not be as pronounced as the thrust. However, the principle is the same-- that of forcing the model to turn in order to produce the needed counter-torque lift. The rudder effect depends upon the power and propeller, and the speed of the model. It is small on low power ships, and large on high power ships such as gas jobs.

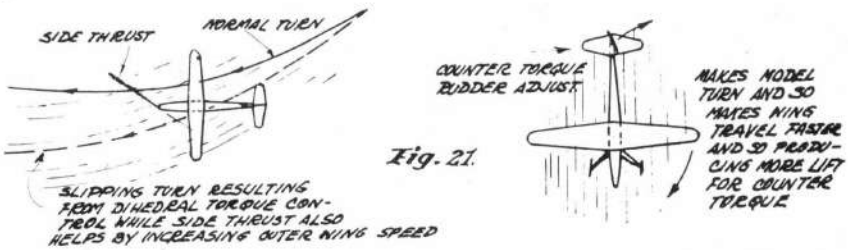
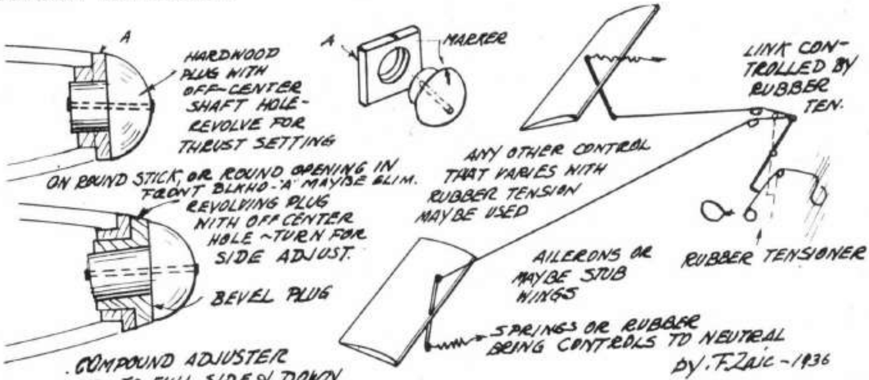


Fig. 21.

The logical solution of the counter-torque adjustment problem is to use a small amount of each type of adjustment and to allow the model to turn with the torque, so that when the power is completely expended, the model will turn in the opposite direction with no upsetting tendency. Another method is to have an automatic aileron control, self-adjustable by the motor torque. Whichever method you use to counteract the torque, remember that it is the wing that actually produces the result.



THE THREE CENTERS

The Center of Gravity, the Center of Drag, and the Thrust Line

To enable us to get a good glide while using the power flight adjustments, we must consider the position and effect of the various forces. The center of gravity and the thrust line can be fixed, but the center of drag keeps wandering with every change in the relative airflow. It is this varying position which often makes adjusting difficult. The strength of these three forces depends upon their relation to each other, as well as upon the flying conditions.

The vertical position of the C. G. is usually determined by the rubber motor line, the weight of the wing, and the weight of the landing gear. Since the weight of the landing gear does not often equal that of the wing, we can assume the C. G. to be slightly above the rubber line. The fore and aft position also depends upon the center of the rubber line. Since the weight of the tail surfaces usually balances the weight of the prop, we have only to consider the wing and landing gear. Since these two are in front of the rubber motor center we can assume the final C. G. to be in front of this center, with the exact position determined by the weight of each item. You may test this premise for yourself by balancing a completed model.

The thrust line depends upon the axis of the propeller shaft, and can be made independent of the rubber line by the use of a suitable plug. In making these plugs, remember that there is side friction at the rear of the junction of the shaft and the plug, and that this friction should be minimized by the use of a metal tube, and eyelets and washers.

The center of drag is the point at which the drag of the individual parts is balanced. Since the drag changes with the speed and shape presented to the airflow, the center keeps shifting under different flying conditions. On a normal model, the C. D. is high because of the high wing. The forces on a normal model are as shown in Fig. 22, and the action of the various centers is as follows:

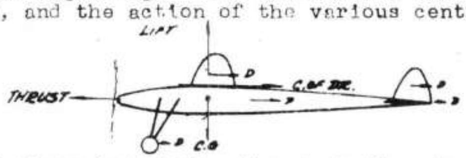


Fig. 22.

During power flying the thrust is the strongest forward force. Gravity, acting through the C. G., contributes slightly when the ship in a diving position, but it also detracts in a climb. The reaction of the center of drag with the thrust line usually determines the position of the model in respect to the flight line. A high center of drag has a tendency to increase the angle of attack, and if no counteracting force is applied will eventually stall or loop the model. However, we do have a counteracting force in the stabilizer, which tries to keep the angle of attack within safe bounds and so preserve stability. See Fig. 23. Note that the stabilizer's corrective force must take care of the drag force as well as the lift of the wing.

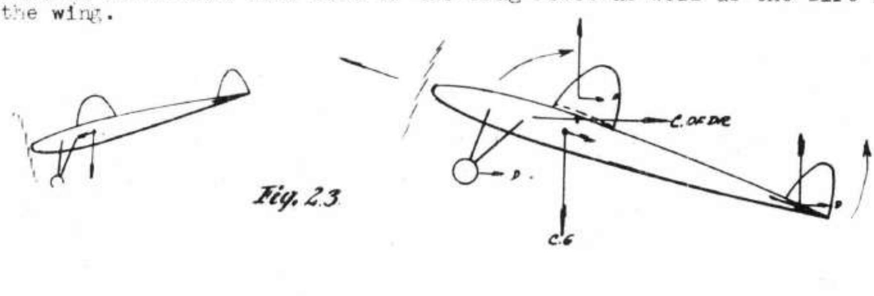


Fig. 23

The objection to this arrangement is that with an increased angle of attack, a greater frontal area is introduced which adds to the total drag. The setting of the stabilizer required to counteract the drag force is that of increased incidence or the use of a high lift airfoil. This setting tends to dive the model in the glide, as the drag force is decreased at lower speeds. To offset this, the wing must be moved forward, which adds an additional corrective load to the stabilizer while in power flight. The setting is now as shown in Fig. 24. Note that this arrangement is the one used on almost all of the present types of models. From the above we can see why we use such large, and very often lifting, stabilizers, and why the C. G. is almost at the trailing edge, when a high wing is used.

Fig. 24.

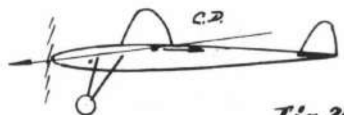


Fig. 25.

Another way to counteract the high center of drag is to have the thrust line pass through the C. D. as shown in Fig. 25. This relieves the stabilizer considerably, but not altogether, as the center of drag shifts from the thrust line, at different speeds and angles. During the glide of a down thrust model, the stabilizer controls the situation as described.

We have seen that a high center of drag requires balancing with other forces, and that a greater frontal area is exposed, with consequent lowered total efficiency. The ideal theoretical combination would be to have these forces meet at one point. Such a design calls for a low or midwing. Comparatively few low-wing or midwing models have been made, and the results have been merely average. It is quite possible that a more thorough practical investigation will eventually bear out the above theory for model work. At the present time it would seem that a high center of drag provides an automatic adjuster of the angle of attack, i.e. when the speed is great, the angle is increased, and when the speed is low, the angle is low. However, this setup places adjusting in the cut and try class, and is also responsible for many longitudinal stability problems.

The effect of having the center of drag below the C. G. and thrust line is evident from Fig. 26. The stabilizer corrections will be just the opposite of those recommended for the high C. D.

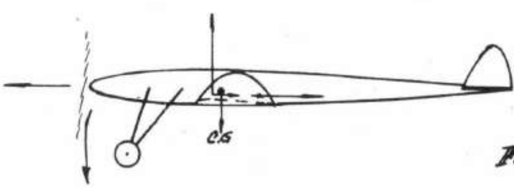


Fig. 26.

The degree of downthrust and stabilizer setting depends upon the particular model. The first adjustments should be made to obtain a good glide by setting the wing and the stabilizer. Then the power flight should be adjusted with the aid of downthrust. If the required downthrust is too great, increase the stabilizer's incidence and move the wing forward slightly, and then try again with this combination. To obtain a fine downthrust gradation use a variable nose plug as shown in Fig. 27.

PROPELLERS

The present tendency of using a standard size propeller for a particular type of model gives us very little opportunity to learn exactly how the propeller operates. Although the subject is well covered in technical books, popular explanation still leaves us in doubt about several important points. Several of the most important are: What determines the slip of the prop? What effect has the airfoil and what effect has the blade area? When should the pitch be high or low? How is the angle of attack of the prop determined? What pitch-diameter ratio is best? What is the best prop for a particular model?

Explanations that can be found in technical books are based on the wing or airfoil theory. That is, it is assumed that the propeller blades are a set of wings which are rotated in order to produce lift. As such, they are subject to all of the reactions attributed to the regular wing. (We should therefore be careful to use the most efficient blade outline and airfoil, just as for an ordinary wing, especially since the propeller is the only means of converting our limited power into forward motion.) The following text will describe the forces acting on the propeller while it is in various positions, and is presented in the wing principle theory.

Assuming that a rotating propeller has no load to pull and that the airfoil is symmetrical, its path would follow the line of least resistance. See Fig. 28. You will notice that the path of that particular prop portion is along the line of the geometrical pitch, and that the lift is zero while the drag is at its minimum value. (If a cambered section were used the resulting pitch would be as shown by the dotted line, due to the lift of such airfoils at zero angles of attack.) Very little power is required to rotate the propeller when it is in this position. However, no work is being done since the lift is zero. The distance such a propeller travels in one revolution depends upon the angle of the blades. It is evident that a high angle will give a greater distance than a smaller one.

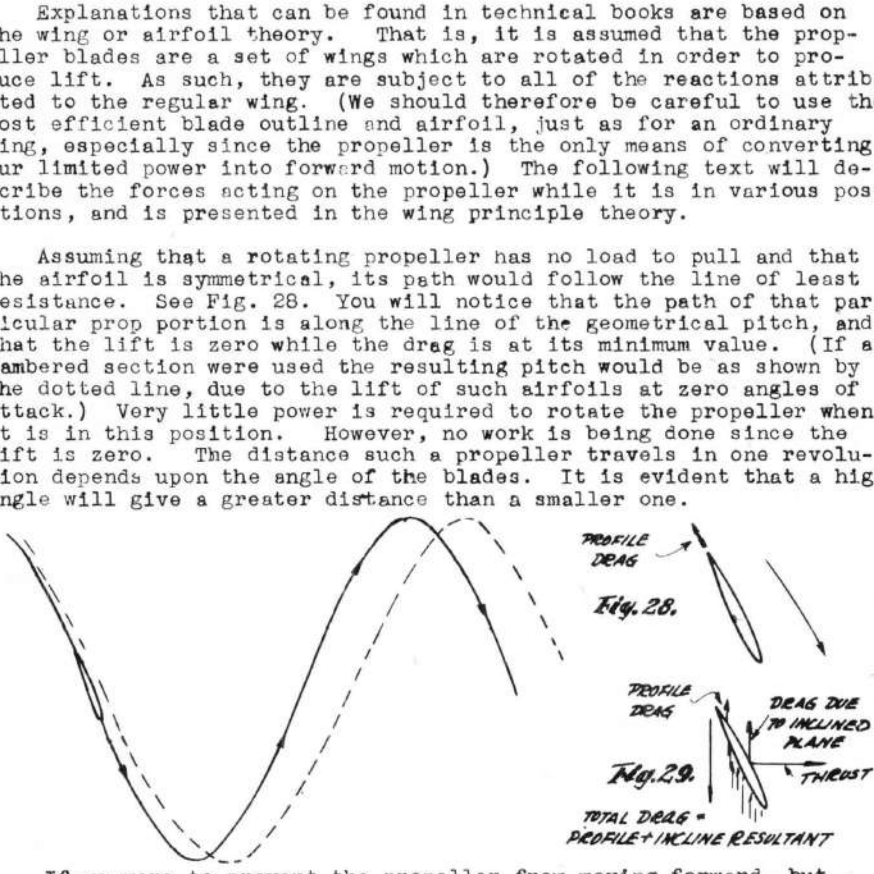


Fig. 28.
Fig. 29.

If we were to prevent the propeller from moving forward, but still permitted it to rotate, the reaction of the blades upon the air would be as shown in Fig. 29. The path of the blade is now perpendicular to the center line, and the angle of attack is very high, with consequent high lift and drag. The exact value of these two forces can be calculated by breaking up the blade into several segments and by calculating with formulas, the lift and drag of the entire prop while it is revolving at a certain speed. The important point to remember is that the rotating action of the angled blade is producing a forward force and also an anti-rotating force. To get the forward force we must overcome the anti-rotating force. We do this by furnishing the necessary power.

The above two examples showed the extreme positions in which the propeller may be. In both positions, the useful work is nil; in the first case, the propeller had no load to pull, and in the second case it was held stationary by a force greater than its thrust or lift. Useful work is accomplished somewhere between these two extremes.

If, for example, the propeller were fixed to a trolley with a load which requires a force of 10 pounds to start it and keep it in motion, a one pound thrust will not budge it. To move the trolley we must either increase the thrust or reduce the load, or perform some sort of compromise. Assuming that we compromise, and the load is now 5 pounds and the thrust is also 5 pounds at a specific r.p.m., the trolley will still remain stationary as the forces are only neutralized, because the propeller is still spinning with the blade path at right angles to the center line. Now if the speed of the propeller is increased ever so slightly, the increase of thrust will be greater than the load, and the trolley will move forward. At the instant that the trolley begins to move forward, the angle of attack is decreased and the thrust is the same as it was before, when the trolley was at a standstill. The difference is that the r.p.m. are higher and that the path of the propeller blades is in a forward direction. Consequently, with every prop turn, the trolley advances forward. The exact distance it travels forward depends upon the angle of the path of the blades, the diameter of the prop, and the number of revolutions per minute.

If the conditions do not change, the trolley will travel forward at a uniform rate for an indefinite period of time. However, let us suppose that part of the load drops off the trolley so that the load is decreased. At the moment that the load decreases the trolley speeds up because the thrust is greater. But as mentioned above, the angle of attack also changes with the speed, until the angle is reached at which the thrust is equal to the load. These conditions are represented in Fig. 30. Here we see that the angle of the path of the propeller blades has been increased and that the distance now covered in one revolution is much greater, so that if the number of revolutions per minute remain the same, the speed of the trolley increases.

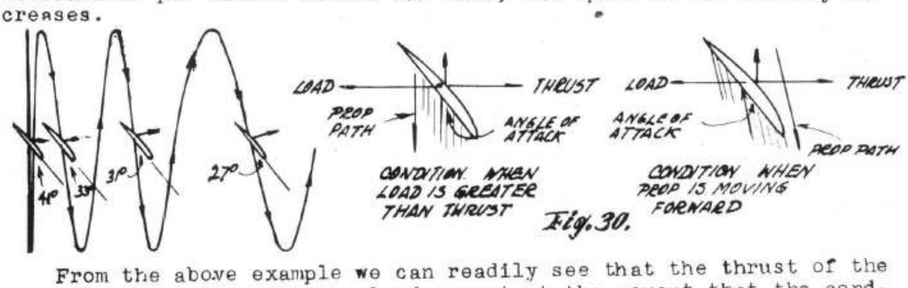


Fig. 30.

From the above example we can readily see that the thrust of the propeller always equals the load except at the moment that the conditions change, that the distance covered in one revolution depends upon the angle of the blade path, and that the speed depends upon the number of revolutions made within a certain time.

To clarify the statement that the thrust and load are almost always equal, let us explain it by the use of the analogy of the trolley. If the load is greater than the thrust it will tend to slow down the trolley. But as soon as the forward speed is reduced the angle of attack is increased with its consequent increase of lift, for the increase of thrust, except that in this case the angle of attack is lowered with an increase of forward speed, with a consequent lowering of thrust, until it is equal to the load. The whole thing may be boiled down to the fact that the propeller blades, in wishing to go forward, are hindered by the drag of the model, and that this drag must be neutralized by the thrust.

It is evident that the trolley may be replaced with a plane, and that as soon as the forward motion is fast enough for the particular model the flight will begin. Note that the thrust of the propeller always equals the drag of the model, regardless of the speed the model may be travelling. It can also be seen that enough thrust must be developed to produce the necessary flying speed.

The above are fundamental principles, and we should keep them in mind when designing a propeller. From them we can see that a comparatively small propeller must be revolved at high speed, and that a large propeller may go slower. The choice of the propeller pitch rests upon the power available. With gas engines we may use small pitch, high speed props, and for rubber we must use the larger pitch, slowly rotating type. To get the utmost efficiency from a propeller, we must make it so that we get the maximum output for the power we use. To achieve this end we must go into more detailed propeller operation description.

The more exact force diagram of the propeller segments is shown in Fig. 31. The most important point to consider is the direction of the lift force. Notice that if it is placed into a force diagram it produces an anti-rotation force. This force becomes greater as the angle of the blades is increased. Besides the anti-rotation force produced by the lift, the power must also overcome the ordinary airfoil drag. Thus the total torque is equal to the anti-rotation force produced by the lift and the airfoil drag. From this we can see that low pitch props with large angles of attack will produce the most favorable lift forces, but that in such positions the props may produce enough thrust only at high speed prop revolutions, which are undesirable for rubber models.

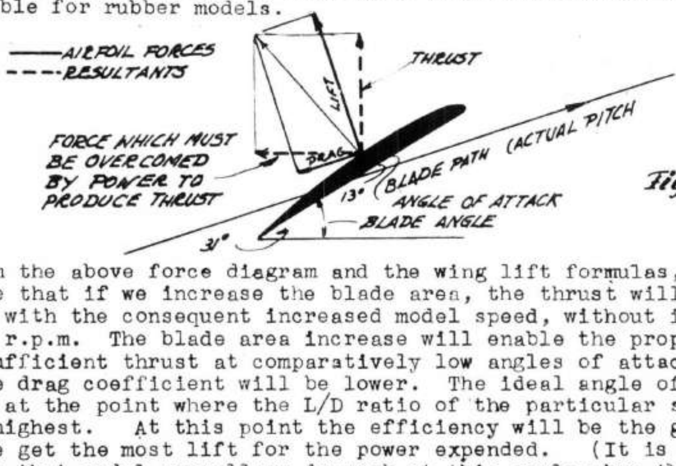


Fig. 31.

From the above force diagram and the wing lift formulas, we can also see that if we increase the blade area, the thrust will be increased with the consequent increased model speed, without increasing the r.p.m. The blade area increase will enable the prop to develop sufficient thrust at comparatively low angles of attack, so that the drag coefficient will be lower. The ideal angle of attack will be at the point where the L/D ratio of the particular section is the highest. At this point the efficiency will be the greatest since we get the most lift for the power expended. (It is quite possible that model propellers do work at this angle when the prop rotates at high speed under the initial burst of power of the rubber motor. However, as the power slackens, the model slows down until there is just enough power to produce the needed thrust for flying speed, and the angle of attack is then quite high in order to produce the needed thrust.) To remain at this ideal angle of attack the propeller must continue developing enough lift to keep it in that position. If the total drag or load of the model is high, the thrust must be great, while low drag or streamlined models can fly with a smaller thrust. From this we can conclude that a high drag model requires a larger prop area than does the low drag design. The exact areas can be calculated if we know the flying speed, the diameter and pitch of the prop, the drag, and the power at the cruising point. However, some of these factors are still incalculable and for the present we must be content with what experience has shown.

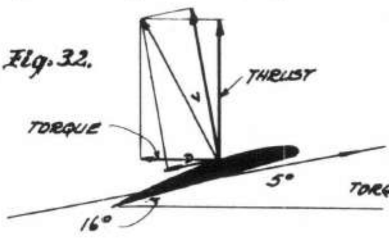
Pitch and Diameter

We have seen that the forward speed depends upon the distance that a segment travels in one revolution of the prop and its relation to the angle of attack. The forward speed can be increased by increasing the distance that the segment travels, as well as by setting it at a steeper angle. Both of these are accomplished at the expense of drag, and of the two, the increase of the distance of segment travel (or diameter) is the most economical. However, if the diameter becomes excessive for practical purposes, and we still have power to spare, we can increase the angle or the pitch. These facts become very useful when we are designing a model. If the model is intended for high speed, the propeller should be of such diameter and pitch that the power will revolve it at high speed at the maximum efficiency. These conditions call for a prop whose angle of attack would be such that most of the lift is in the flight direction, and whose diameter would be as large as the power would allow for the speed. This means that the P/D ratio should be small (pitch 20"/diameter18", 1.1). See Fig. 32.

If the model is intended for cruising then the prop should conserve the power for as long as possible. This can be accomplished by using a large diameter as well as large blade angles. This type of prop will revolve slowly but it will still give the needed thrust for the flying speed. In this case the P/D ratio is high (pitch 36"/diameter 18", 2.0). See Fig. 33.

The drag of the model should also determine the P/D ratio. It can readily be seen that a streamlined model can have a high speed with a slow but high pitch prop, since the needed thrust is lower than for the blunter ship. However, the prop does not work at its best efficiency point, and if it is possible to increase the motor length, do so by all means, and decrease the pitch of the propeller.

Fig. 32.



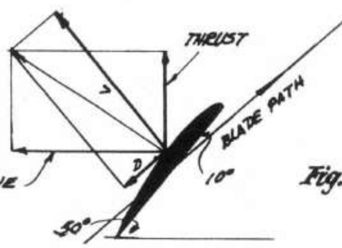


Fig. 33.

From this text, you should know just what type of propeller will be the best for your particular conditions. Although a list of standard prop sizes is given, keep the following points in mind, and try to fit the most suitable prop to the model.

1. Thrust equals load. If the drag of the model is great, the thrust must be large.
2. The speed of the model depends upon the r.p.m. and the distance that the prop travels in one revolution.
3. Thrust is the result of the lift force, and a part of the lift force produces an anti-rotating force.
4. The power required must be equal to the drag of the propeller's airfoil at the particular angle of attack, plus the anti-rotating force produced by the lift.

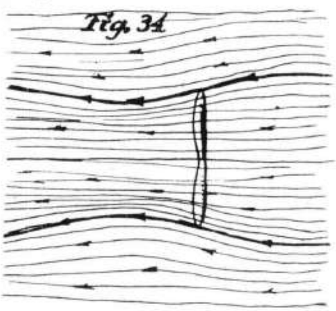
Blade Outline and Construction Hints

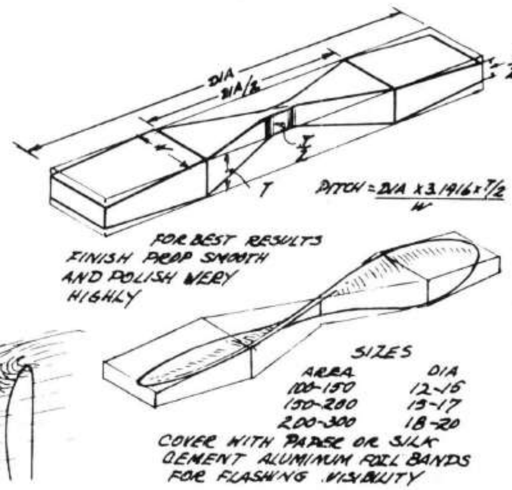
The volume of air influenced by the rotating propeller is shown in Fig. 34. Notice that the airflow begins quite a distance in front of the propeller, and that the increase of airspeed behind it reduces the air pressure so that the slip stream is actually of smaller diameter than the propeller. However, the peculiar flow formation near the tips should not beguile us into believing that the tips are unimportant. The tip losses or eddies are still there, and the tip shape and aspect ratio are just as important on the propeller as on ordinary wings. Conclusive proof of the fact that losses occur at the tips was made by the Editor. The experiment was performed as shown in Fig. 35. The interesting part is that the silk thread actually moved forward into the blades while held behind the propeller. This effect was especially strong on a square tip design propeller.

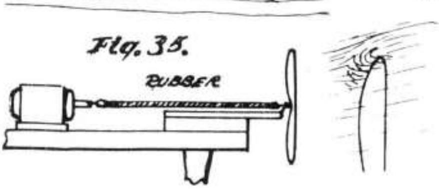
The elliptical tip blade outline seems to be about the best. The blade area should be concentrated at the one half point so as to minimize tip losses and high drag at the hub. In fact it is desirable to cut the blank so that the pitch angle will be about the same at the hub vicinity. The blank layout, blade outline, and the recommended sizes of propellers are shown in Fig. 36.

For balsa props, use balsa blanks of about 10 lbs./cu. ft. hardness. If it is at all possible, try to have the grain crisscrossing parallel with the width of the blank. This will provide identical grain on both blades, and also give a strong hub.

Very little can be said about carving for the youngsters, except that practice makes perfect. However, no trouble should be experienced if the blank is well laid out and carving is done slowly with a sharp knife.







Camber

Since the propeller works on the regular airfoil principle, the airfoil section of the propeller has reactions similar to those of the main wing. Therefore, the camber should be decided by the design of the model. Fast and short motor propellers may have a Clark Y section while slow, duration propellers may be very deeply undercambered. Just remember that undercamber gives greater lift at a given incidence than a flat-bottom section, but that the drag is also greater. If you have plenty of power which you want to be used up slowly, use plenty of undercamber.

Aerodynamic Reactions of Freewheeling Propellers

"To freewheel or not to freewheel..." has been the question for quite a while. The best way to settle this soliloquy is to analyze a propeller while it is standing still and while it is freewheeling. The action of the airflow on a still propeller is shown in Fig. 37. Note that the angle of attack varies with the point on the blades. That is, it is high at the tips and low at the hub. The forces set up are relatively great, due to the large angle of attack. The lift force tends to rotate the model via the prop shaft, and tries to upset it unless counter adjustment is provided. This is an especially bad feature since the force is in the counter-torque direction, which is also favored by the normal model adjustments. The drag force is directly backwards which make the total prop drag calculations comparatively simple.

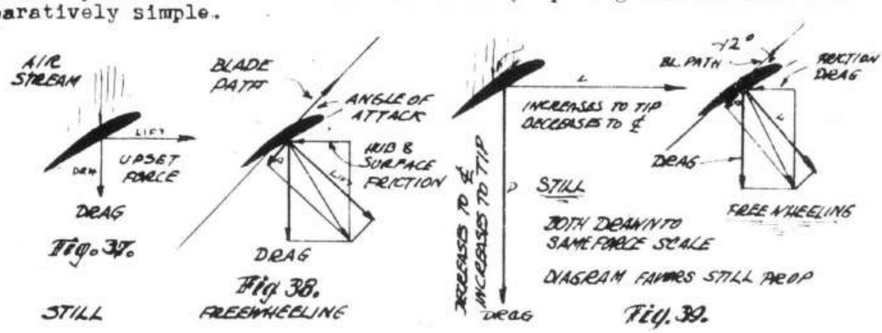


Fig. 37. STILL

Fig 38. FREEWHEELING

Fig. 39.

The airflow reaction on a freewheeling propeller is shown in Fig. 38. The angle of attack here is much lower. The exact angle depends upon the component of lift needed to overcome the drag of the propeller. Of one fact we can be sure, and that is that the angle is negative to the normal airfoil to such a degree that the lift is also negative. If the angle were above that point, the propeller would revolve in a counterpower turn direction. Since the zero angle is determined by the center line of the airfoil we can see that undercambered props will have much more drag than symmetrical or flat bottom sections. This increase of drag will require a larger lift component to overcome it, and since both the drag and lift forces are in a backward direction, they both constitute drag. There is nothing that we can do about this except to minimize drag as much as possible so that the total will be reduced. This can be done by having a very smooth finish on the blades, by using the best ball bearing washers, and by having a freewheeling that does not depend upon a spring for its operation. If a spring is used, the pressure it exerts against the hub causes additional friction which must be overcome by the lift force. The logical solution is to use a freewheeling of the spiral type or any similar type, and a rubber tensioner to spring the shaft out.

Note from the diagram that we have no rotating force trying to roll the model. The only rotating force is the one which neutralizes the drag, which in turn has a very slight rolling effect at the hub caused by the friction. The exact drag of both types of propeller action can be only estimated. An attempt was made (see Fig. 39), t this should not be considered conclusive.

From the above it would seem that the freewheeling propeller is better, as it usually has lower drag and does not affect the model adjustments. The drag may be slightly higher than that of a still prop on certain occasions (such as in the case of very high pitch), but it still seems better. The fixed position will be all right if the blades can be made to straighten out and conform to the airflow. Of course, a perfect folding prop would solve the whole problem.

THE GLIDE

Although it is the usual procedure to describe the glide at the conclusion, the Editor deemed it advisable to present it at this early point, to emphasize the fact that the greater part of the duration of the model depends upon it. Since it is so important, it is worth our while to design the model with the idea of increasing the glide as much as practically possible.

Once the power is exhausted the only thing left to produce propulsion is the weight of the model. Gravity exerts a downward force on the model equal to its weight, and the aerodynamic balance changes this force into a sloping movement known as the glide. It is evident that the model which uses this force most economically will remain in the air longest. This can be done by having a well balanced and streamlined model. The following example shows why an efficient ship has a better glide than an inefficient design.

We have two models of identical wing loading. The wings and tails are identical, and the balance is perfect in both. The only difference between the models is that one has smooth lines, while the other is about as aerodynamically efficient as the cowcatcher on a locomotive. Both models must fly at the same speed to produce the same lift. It is therefore evident that the model with poor lines will need more power to keep up with the streamlined job. Now when the models go into a glide, the streamlined ship will dip only slightly to keep up its flying speed, while the high drag model will have to point down quite a bit to get to its flying speed. The conclusion drawn is that the inefficient ship will come down much more steeply, with a consequent loss of duration.

The gliding angle can be very easily predicted if the lift and drag of the model are known. For example, if the lift of a model is four ounces, and it requires one half ounce of thrust to keep its flying speed, the lift over drag (L/D) ratio is 8-1, That is, the lift is eight times the drag. This means that for every foot the model has to descend to keep up flying speed, it will travel eight feet and the gliding ratio will therefore be 8-1. From this example we evolve the following formula:

$$\text{Gliding Ratio} = \frac{\text{Lift of the Model}}{\text{Drag of the Model}}$$

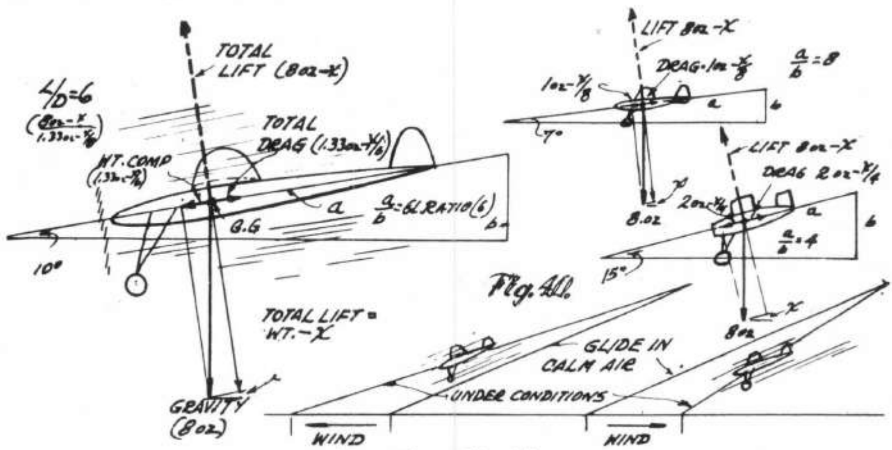
We can see from this simple relation that an increase of lift will improve the glide, and that an increase of drag will detract from it. The ideal model should have a minimum of drag and the lowest possible wing loading. (This allows the model to fly slower, thus reducing the drag.) The low drag can be obtained by using streamlining at all practical points. If the model must confrom to the weight rules do not make it heavier than necessary, and use high-lift airfoils, as recommended in the airfoil chapter. A small additional amount of weight may be used if streamlining is impossible without it.

A steep glide is caused by low lift, high drag, or a combination of both. (It is assumed that the adjustments are as recommended in the "Stability" text.) Lack of lift can be easily corrected if a fairly high-lift airfoil is used, by increasing the incidence of the wing and tail. This will increase the lift greatly without increasing the drag very much. However, if the model stalls or mushes with such an adjustment, the glide can be improved only by decreasing the drag.

For maximum efficiency, unless an automatic variable control is used, the glide adjustments must be flight adjustments. How to obtain this combination will be explained later.

Since gliding requirements usually necessitate a well designed model, we should remember the following facts about gliding.

1. The gliding angle depends upon the lift and drag (L/D) ratio.
2. The speed of the model is controlled by its wing loading; a model with a light wing loading attains sufficient lift at low speed, and one with a high wing loading needs high speeds to get sufficient lift. If the gliding angle is the same, the wing loading determines the duration.
3. It is a poor policy to increase the angle of attack or incidence too much for improved glide, as at low speeds this procedure places the model in a critical position in relation to the stalling point.
4. The distance that a model travels with relation to the ground depends upon the air conditions. Therefore the gliding ratio cannot be determined by estimating the height at which the glide started, and the distance traveled from that point. See Fig. 40. Nor should the gliding ratio be assumed to be that distance between the point of launching from hand to the landing point, as the initial speed is greater than the normal glide, and the closeness of the ground also has a cushioning effect, because of the compression of the air between the wing and the ground.



For Clarification

"The angle of incidence is the angle between the chord line and the thrust line".
"The angle of attack is the angle between the chord line and the path of relative wind".

The above definitions are official for power plane use. Since the construction and position of the elements of models vary greatly from one design to another we might accept the following definitions for model work:

"The angle of incidence is the angle between the chord line and the line drawn from the center of the prop to the rear hook". Let us make this definition semi-official, so that we will know what is meant when we mention "two degrees downthrust" or "one degree positive", etc.

"The angle of attack in smooth air is the angle between the chord line and the path in which the model is moving". Sudden gusts change the angle of attack until the model readjusts itself to the new flow, when it will again be about the same.

PRACTICE

OUTDOOR

Fuselage

The four longeron type of framework construction still dominates fuselage construction. The simplicity and ease of construction make it a favorite among builders, especially those who have little time for model work. This type has served well under the prevailing weight rules, because the low wing loading of the model has helped to offset many of the disadvantages. However, the expected change in weight rules will put it into the discard and new types of construction will become popular.

The official 1937 Wakefield rules require a minimum weight of 8 ounces for the 190-210 sq. in. model. The N. A. A. rules are almost sure to be jumped up to 3 oz. per 100 sq. in. (just multiply the wing area by .03 to obtain the required weight in oz.). It is highly improbable that these rules will ever be lowered. The heavier wing loading will not change the general design very much except that the various points of junction will be cleared up, and the fuselage will have to be strengthened to take more power. The builder who makes the most efficient use of the high power ratio will undoubtedly win the contest.

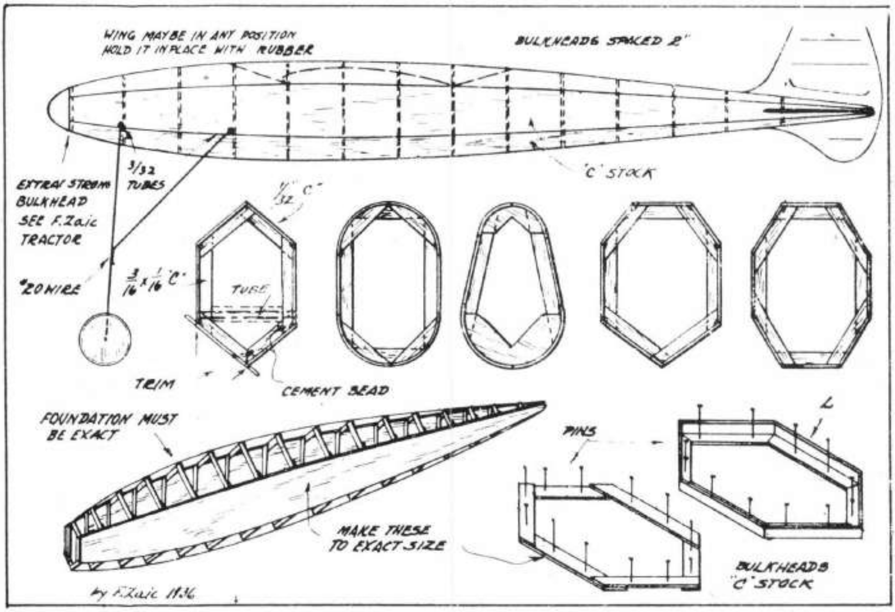
The strength of the regular longeron type of fuselage can be greatly by using larger and stronger balsa and covering it two ply or with bamboo paper. However, the mortality rate will still be high--mainly because of rubber breakage and collisions. We must remember that the increase in weight will speed up the model and endow it with plenty of kinetic energy.

It is problematical how well the removable motorstick will fare with this change. The removable motor stick has its points, and it is possible that a well made built-up stick will hold up under the 20 odd strands. It is amazing how strong balsa can be if it is used correctly. The next proposition is the all-balsa fuselage design, and it is the opinion of the Editor that this type deserves most attention for the coming era of half-pound jobs.

There are several different types of fuselage constructions described in the plans or individually, and there is no need for describing them here. Therefore this particular section will deal with only the sheet balsa design

There are many forms of the all-balsa fuselage, ranging anywhere from the elliptical to the square section. Of course, the elliptical one is best from all viewpoints, with the exception of the time required to construct it and the necessity of using high grade supplies The next best is the round cross section type. This is much simpler to make as the bulkheads are round, and the covering balsa can be made in patterns. On such fuselages the work will be simplified if the model has straight lines. On all circular jobs the bulkheads should be of "C" stock and the covering of "A". The other forms consist of variations of the several flat-sided type, and also those with curved tops and bottoms.

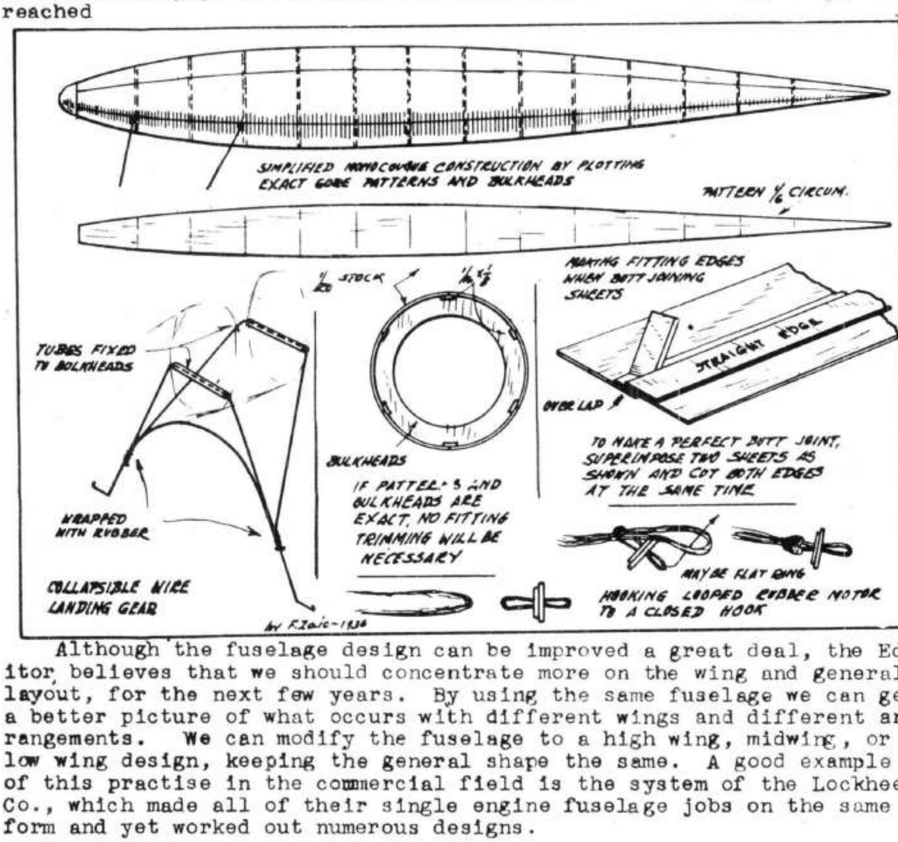
The Editor has made the several models shown in sketches during the past summer, and all of them have held up well under all conditions. The secret here is to use "C" or quarter-grained stock throughout. By using this grain the sheet need not be more than true 1/32" thick for any model using up to 20 strands. 8-9 lb. balsa should be used. The corner type of joints give a stringer effect, making longerons unnecessary. The beauty of this construction is that the weight compares favorably with the ordinary type of fuselage with a much greater safety factor. It is quite possible to have a big section knocked out of a side without losing stiffness, and the repair work is a matter of minutes, as the model can be flown as soon as the patch is set for a hold-on, while a broken longeron calls for a major operation with splints and upsets the adjustments as well. The construction time with balsa sheet is less, providing that the layout and material are on hand.



The balsa sheet construction requires very accurate work and exact bulkheads and patterns. If the parts are well made, it is a real joy to see everything just click into place and the whole fuselage smooth throughout. Before starting to work, decide on the cross section shape desired, making sure that 2" sheets can be used throughout. A wider section calls for joining, as 3" stock is expensive as well as difficult to obtain in the required grain and weight. Now draw the side wiew on a piece of stiff white paper, and lay out the bulkheads. The side pattern should be transferred to a template or directly to the balsa. Coat the bulkhead outlines with wax and begin to assemble them. There are several forms shown, and you can use the one most suitable to your own particular conditions. Be sure to make them exact and do not spare the cement.

The assembly is quite simple. Cement the end bulkheads first, and then cement the center to the sides. Be sure to cement them on the exact spots. After all of the bulkheads are in place, the landing gear tubes can be fixed in place. The remaining sides are cemented on without the aid of a pattern. The surplus is trimmed off after the cement is set. In joining the balsa sheets, use a generous amount of cement to from a bead along the joint. The final finish is to sand and dope. For super-strength, cover with paper.

The above covered the polylateral fuselage. If a square or a triangular fuselage is used, the bulkheads can be made while assembling is taking place. Cut to size the side patterns and cement them in the proper places. If the fuselage is absolutely square or equilateral, all strips can be cut at one time and set aside. The sides are assembled by cementing the upper and lower strips and then covering with sheet. This method is especially recommended for enclosed rubber stick models. It compares well with the tubular type of construction. This type of construction lends itself very well to mass production. This idea should be especially appealing to clubs as the side patterns and bulkhead jigs can be passed around, once a satisfactory design is reached



Although the fuselage design can be improved a great deal, the Editor believes that we should concentrate more on the wing and general layout, for the next few years. By using the same fuselage we can get a better picture of what occurs with different wings and different arrangements. We can modify the fuselage to a high wing, midwing, or low wing design, keeping the general shape the same. A good example of this practise in the commercial field is the system of the Lockheed Co., which made all of their single engine fuselage jobs on the same form and yet worked out numerous designs.

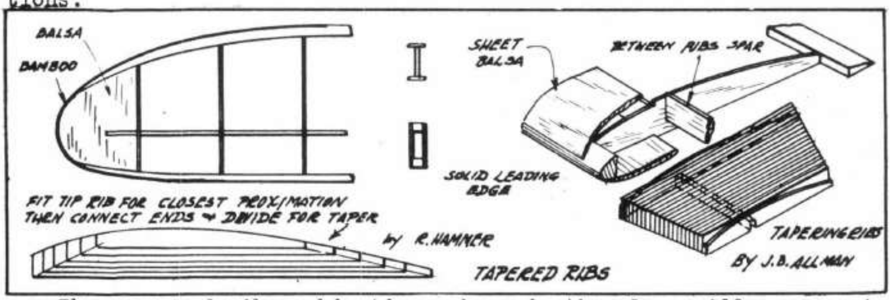
Aerodynamical Notes

The main consideration in fuselage models is to have the fuselage as much as possible in line with the flight path. It is here that the round and elliptical jobs shine above the square section. The square job of streamlined outline is fair if kept in line, but the moment it becomes angled the drag increases tremendously. It is for this reason that a fuselage set on edge is better than one which is level. Try to come as close as possible to the ellipse by breaking up the perimiter into numerous sides or else by rounding off the top and bottom. Design the models so that the thrust line will go through the center of the fuselage, or at least adjust it so that the fuselage will be in line in the glide. All of these points will mean a great deal when the wing loading is increased during the coming year. Other aerodynamical points are covered in the Theory chapter.

The most common wing failure is the breakage of the spars when an excessive up or down force is applied. A head-on collision usually only dents or cracks the leading edge. From this we see that we must improve the vertical structure, as the horizontal structure is sufficiently strong due to the rib and covering combination. It has also been noticed that the wings with many small spars of almost square cross section have a higher breakage rate than those wings in which the spars are deep and narrow. It therefore seems advisable to follow regular aircraft practice, by using deep and narrow spars.

The strength of a deep spar can be increased without additional weight if quarter-grained or "C" stock balsa is used. This cut is very stiff and when the spar is under pressure, will tend to keep the spar in line instead of crinkling. The moment the spar wood rolls, its value as a spar is lost.

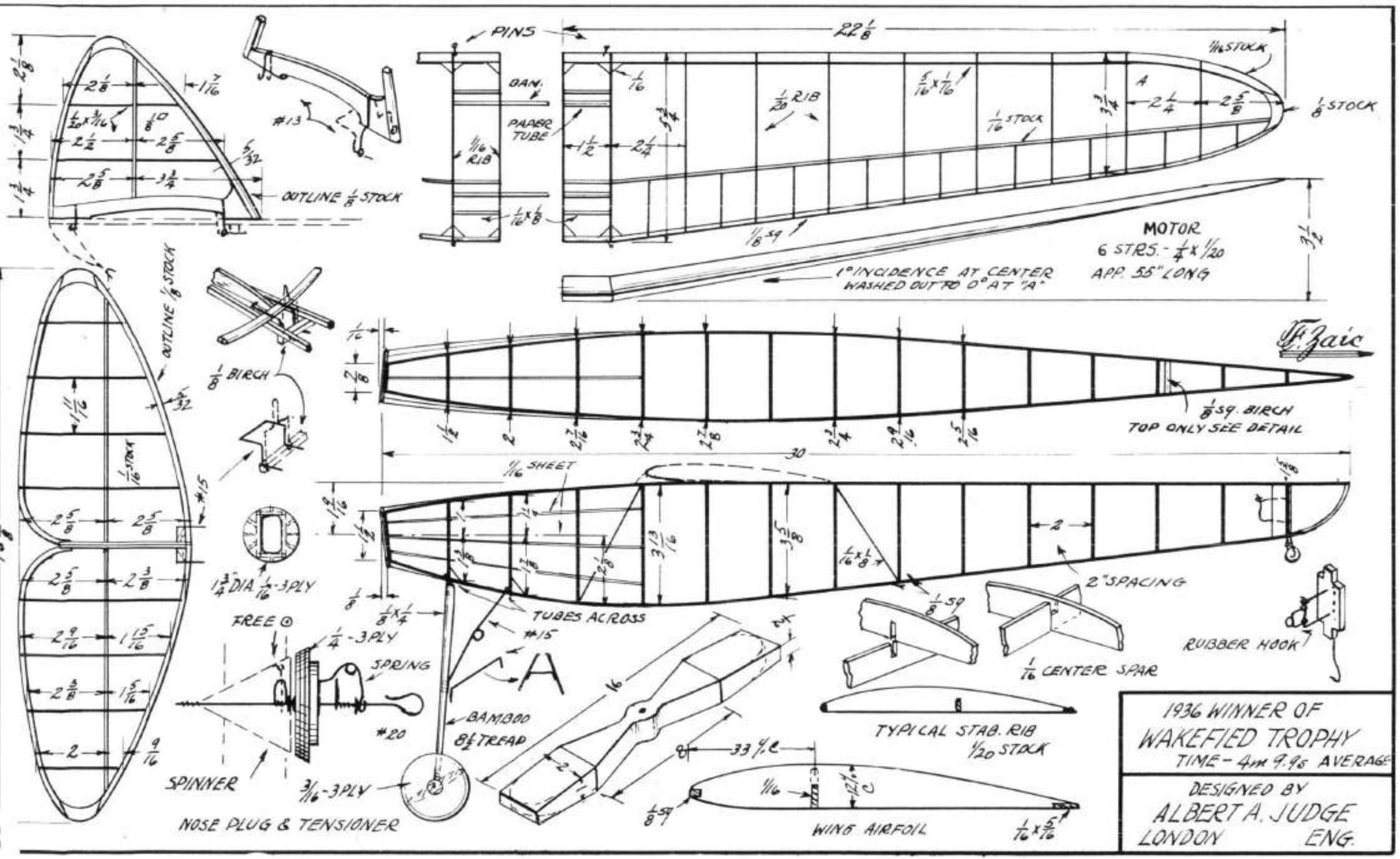
On a normal model a single spar will be sufficient for models having a chord of not more than five inches. A larger chord necessitates more spars or a strong single spar with a built up leading edge to serve as a box spar. Structural sections also give a high strength-weight ratio. If they are unobtainable ready made, the simplest to make are the box spar and the I section. It is surprising how strong parts can be made with the use of these sections.

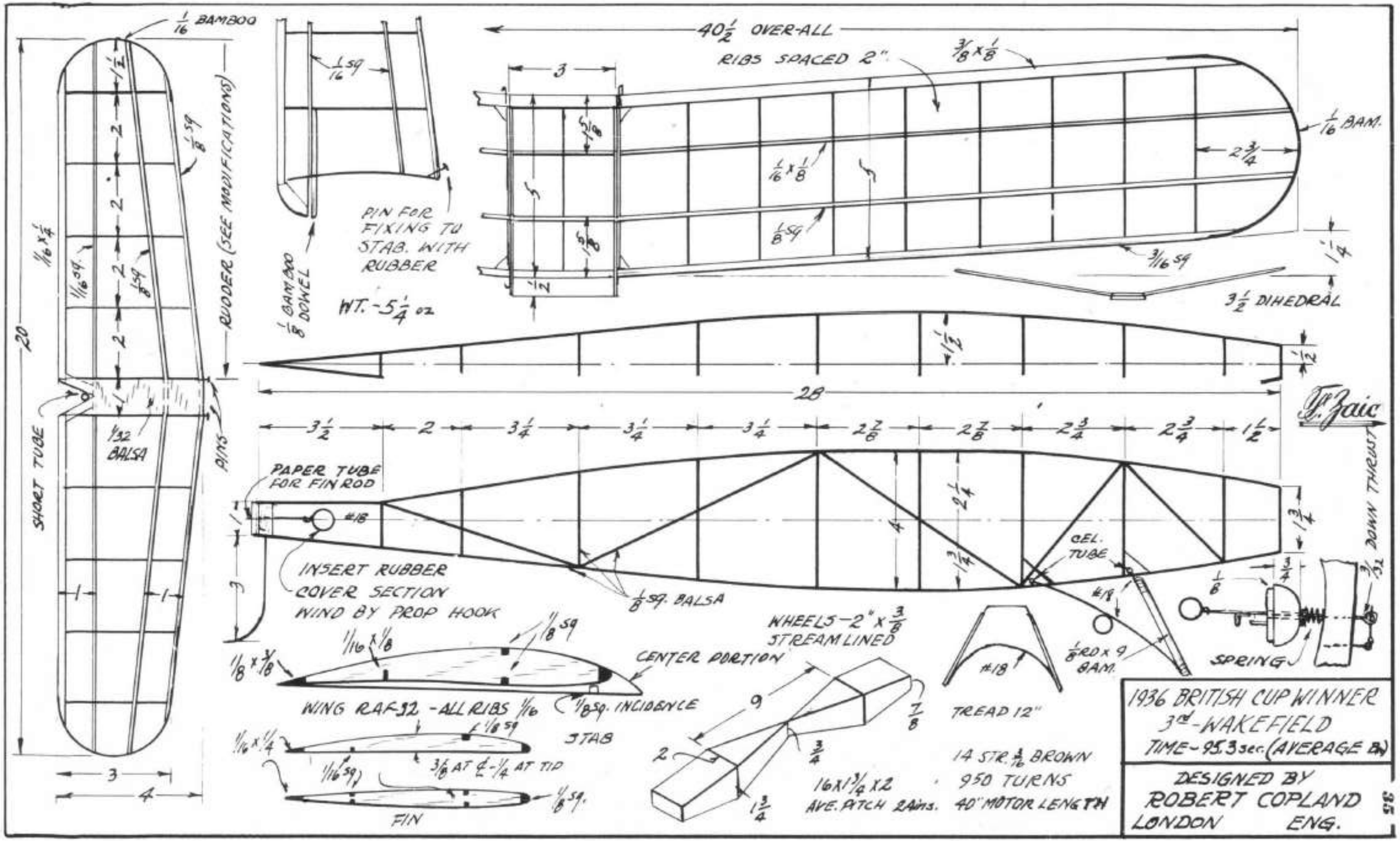


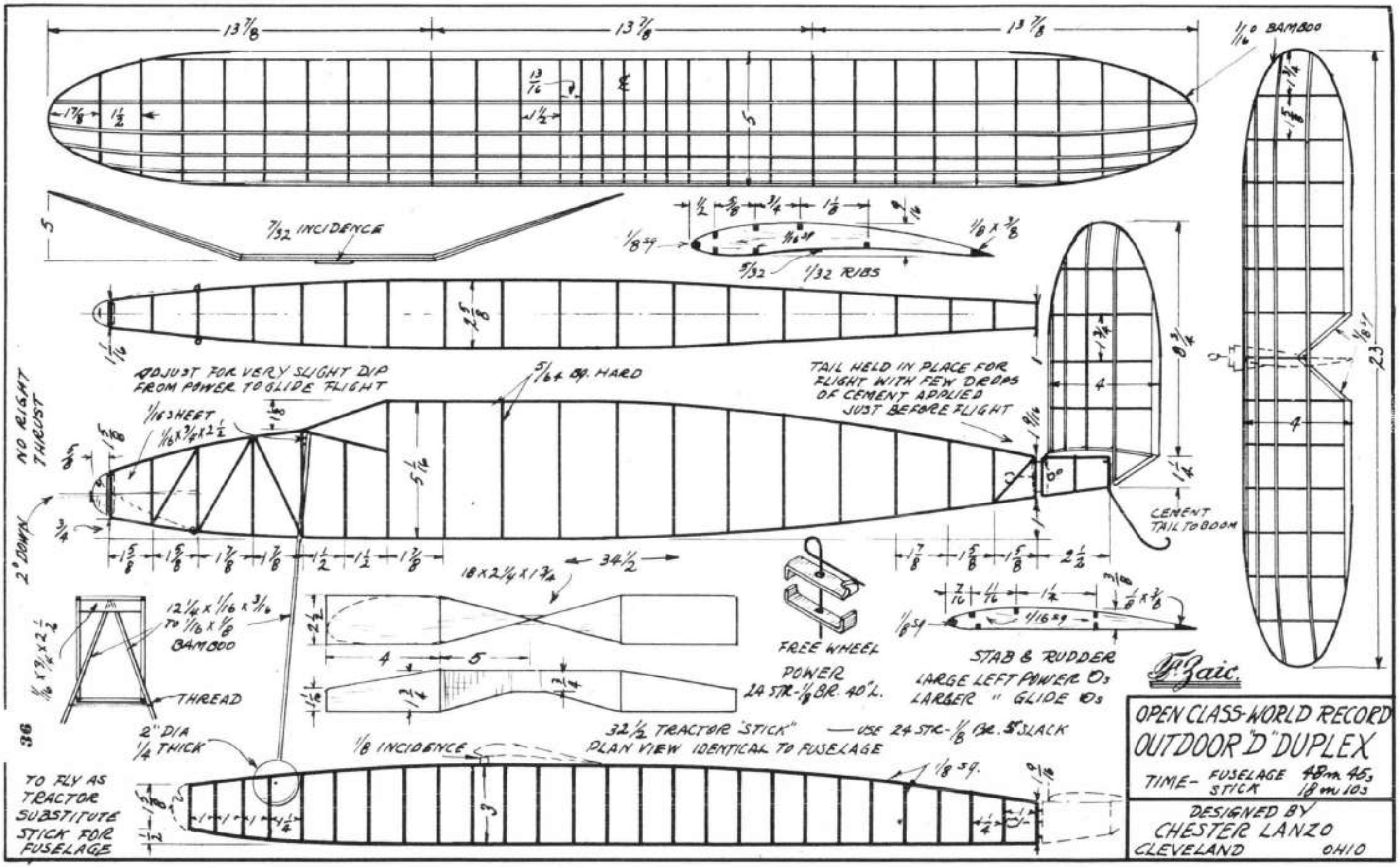
The spar and rib combinations shown in the plans will prove satisfactory for the increased wing loading, except that the spars will have to be strengthened on some. In the opinion of the Editor, the construction shown on the sketch should prove to be the most satisfactory, as all points are taken care of. The leading edge does not have any sag, and at the same time the weakness of an ordinary sheet leading edge is removed by the addition of a solid spar. Note that the rib is continued for the full chord length. The construction procedure is simple providing that the ribs are accurately cut. The between-rib spar is usually fitted in by individual sections.

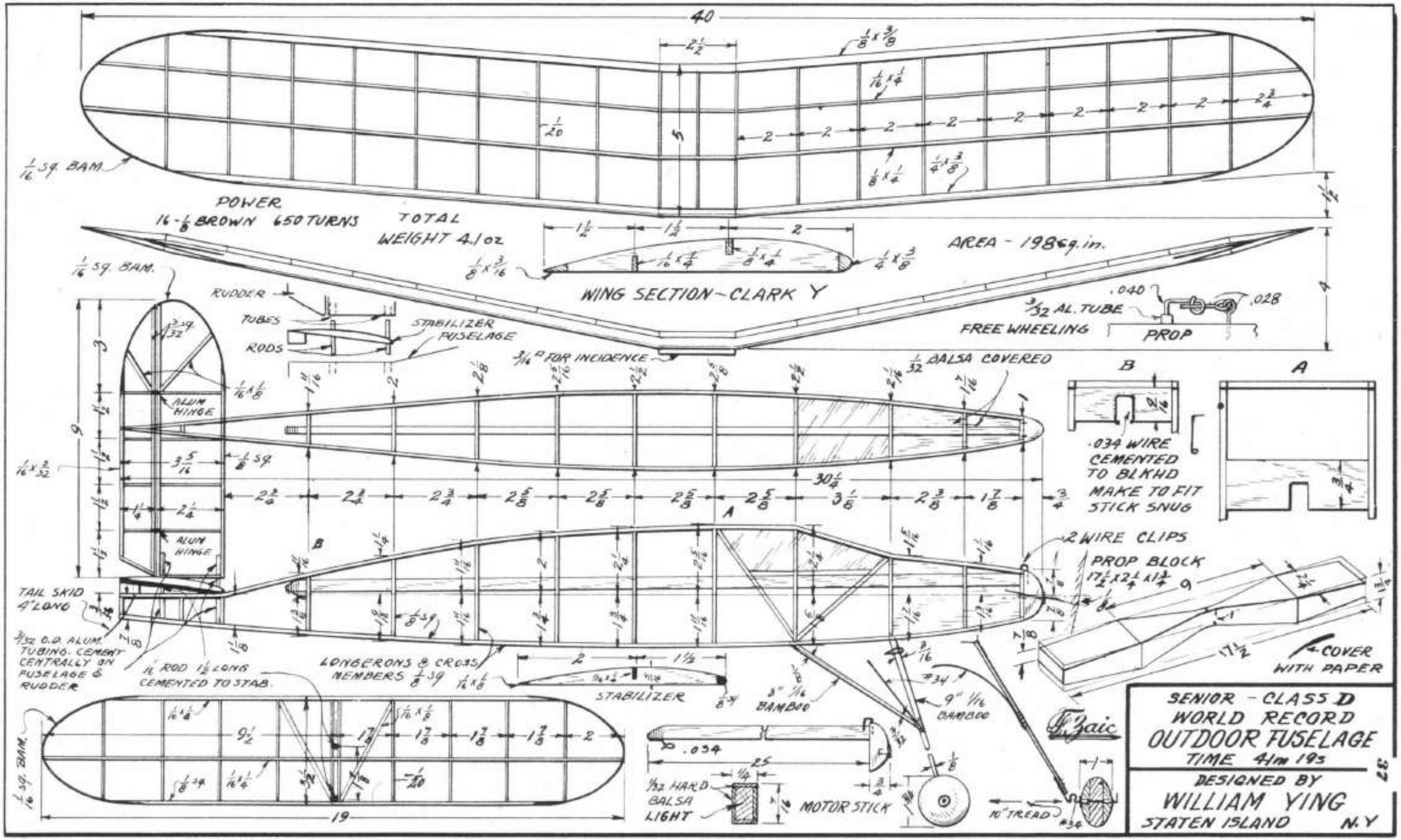
The ribs must be made of "C" stock to obtain the greatest benefit from the weight of the wood. Here again the grain serves the purpose of keeping the desired airfoil section and also provides adequate torsional strength. In designing the wing structure always be sure to have a full chord rib. Such ribs keep their shape well and also lessen the chances of having the leading edge rip off. If the rib is cut in two to provide for the spar structure, the cement and covering are the only things that keep the structure together.

Another point to keep in mind is to use strong ribs at the center and tip. The tip rib should receive special consideration as it takes the brunt of most collisions. If the tip rib and the tip itself are weak, it takes a comparatively small force to break them, and once they are gone, the rest of the ribs and spars just crumble as the force is now concentrated on each individual item, and not on the wing as a unit.

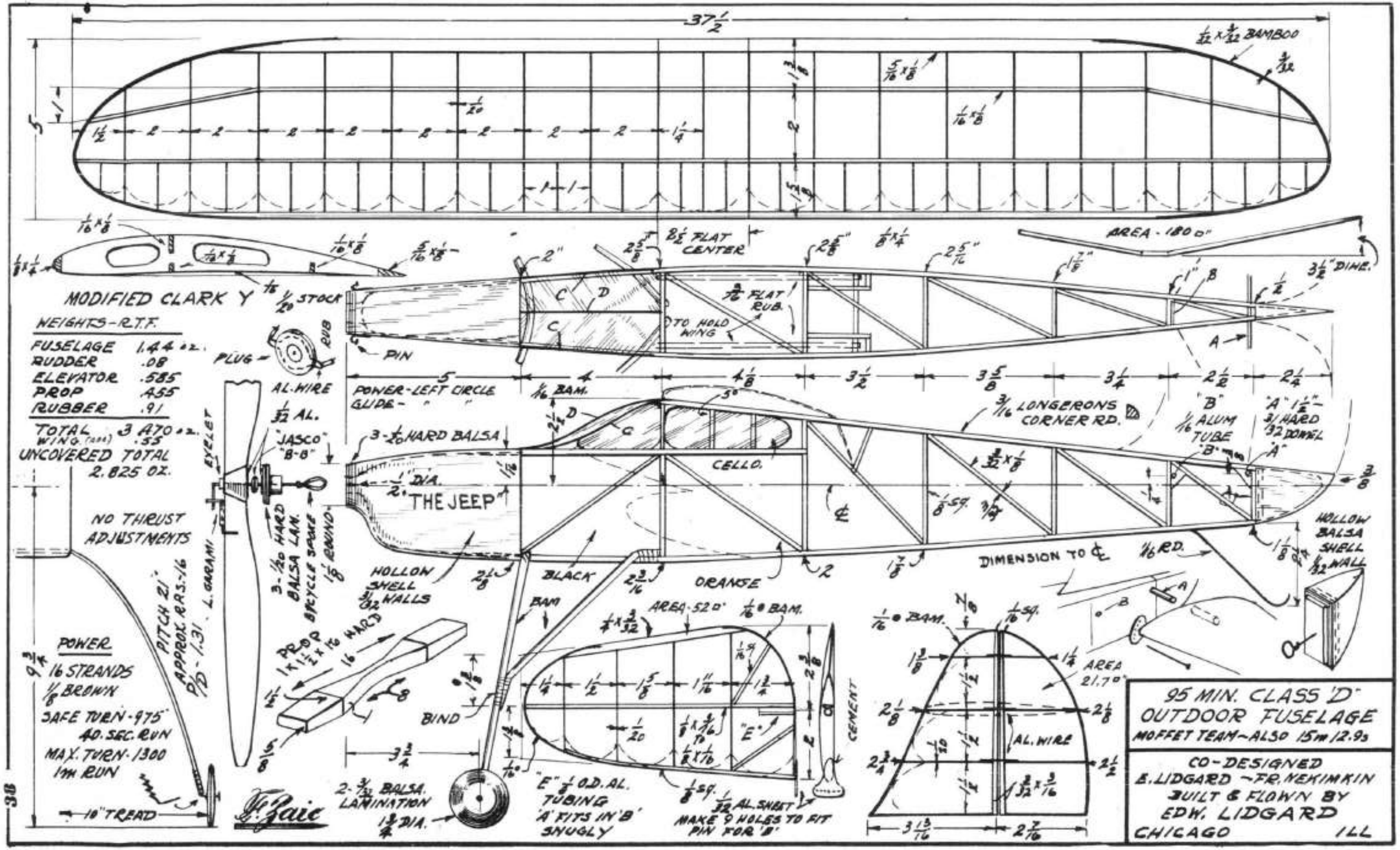

1936 WINNER OF
WAKEFIED TROPHY
TIME - 4m 9.9s AVERAGE
DESIGNED BY
ALBERT A. JUDGE
LONDON ENG.
PINS
DAN.
PAPER TUBE
1/16 RIB
1/16 x 1/8
1/20 RIB
1/16 STOCK
1/16 STOCK
1/8 STOCK
1/8 SQ
OUTLINE 1/8 STOCK
#13
MOTOR
6 STRS. - 1/4 x 1/20
APP. 55" LONG
1° INCIDENCE AT CENTER
WASHED OUT TO 0° AT "A"
1/8 BIRCH
1/8 SQ. BIRCH
TOP ONLY SEE DETAIL
1/16 SHEET
#15
1 3/4" DIA. 1/16 - 3PLY
FREE
1/4 - 3PLY
SPRING
#20
SPINNER
3/16 - 3PLY
NOSE PLUG & TENSIONER
BAMBOO
8 1/2 TREAD
TUBES ACROSS
1/8 x 1/4
2" SPACING
1/8 SQ
1/16 CENTER SPAR
RUBBER HOOK
TYPICAL STAB. RIB
1/20 STOCK
33 1/3 C
12% C
WING AIRFOIL
1/16 x 5/16
F. Zaic


1936 BRITISH CUP WINNER
3rd-WAKEFIELD
TIME-95.3sec. (AVERAGE 3)
DESIGNED BY
ROBERT COPLAND
LONDON ENG.
40½ OVER-ALL
RIBS SPACED 2"
3/8 x 1/8
1/16 BAM.
1/16 x 1/8
1/8 SQ
3/16 SQ
3½ DIHEDRAL
PIN FOR FIXING TO STAB. WITH RUBBER
1/8 BAMBOO DOWEL
WT. -5¼ oz
1/16 BAMBOO
RUDDER (SEE MODIFICATIONS)
SHORT TUBE
1/32 BALSA
PINS
28
PAPER TUBE FOR FIN ROD
INSERT RUBBER
COVER SECTION
WIND BY PROP HOOK
1/8 SQ. BALSA
CEL. TUBE
3/32 DOWN THRUST
SPRING
1/8 RD x 9 BAM.
WHEELS-2" x 3/8 STREAMLINED
CENTER PORTION
1/8 SQ. INCIDENCE
WING RAF-32 - ALL RIBS 1/16
STAB
3/8 AT ℄ - 1/4 AT TIP
FIN
TREAD 12"
14 STR. 3/16 BROWN
950 TURNS
40" MOTOR LENGTH
16 x 1¾ x 2
AVE. PITCH 24ins.
F. Zaic

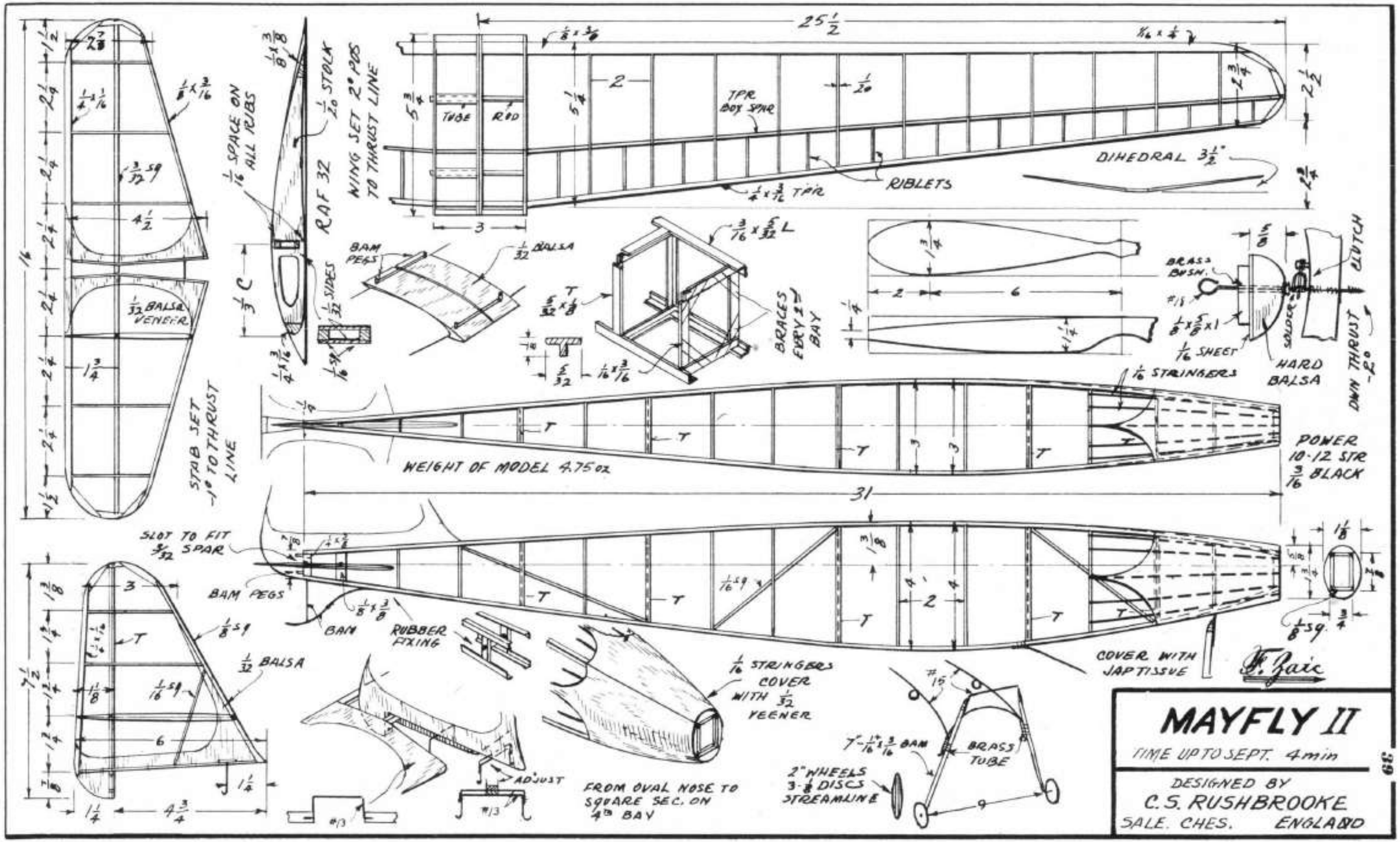

13 7/8
13 7/8
13 7/8
1/16 □ BAMBOO
7/32 INCIDENCE
1/8 sq.
1/16 sq.
5/32
1/32 RIBS
1/8 x 3/8
ADJUST FOR VERY SLIGHT DIP FROM POWER TO GLIDE FLIGHT
5/64 sq. HARD
TAIL HELD IN PLACE FOR FLIGHT WITH FEW DROPS OF CEMENT APPLIED JUST BEFORE FLIGHT
NO RIGHT THRUST
2° DOWN
1/16 SHEET
1/16 x 3/4 x 2 1/2
CEMENT TAIL TO BOOM
23
34 1/2
18 x 2 1/4 x 1 3/4
12 1/4 x 1/16 x 3/16 TO 1/16 x 1/8 BAMBOO
1/16 x 3/4 x 2 1/2
THREAD
FREE WHEEL
POWER
24 STR.-1/8 BR. 40" L.
STAB & RUDDER
LARGE LEFT POWER ⊙s
LARGER " GLIDE ⊙s
2" DIA
1/4 THICK
1/8 INCIDENCE
32 1/2 TRACTOR "STICK" — USE 24 STR.-1/8 BR. 5" SLACK
PLAN VIEW IDENTICAL TO FUSELAGE
TO FLY AS TRACTOR SUBSTITUTE STICK FOR FUSELAGE
OPEN CLASS-WORLD RECORD
OUTDOOR "D" DUPLEX
TIME- FUSELAGE 48m 45s
STICK 18m 10s
DESIGNED BY CHESTER LANZO
CLEVELAND OHIO

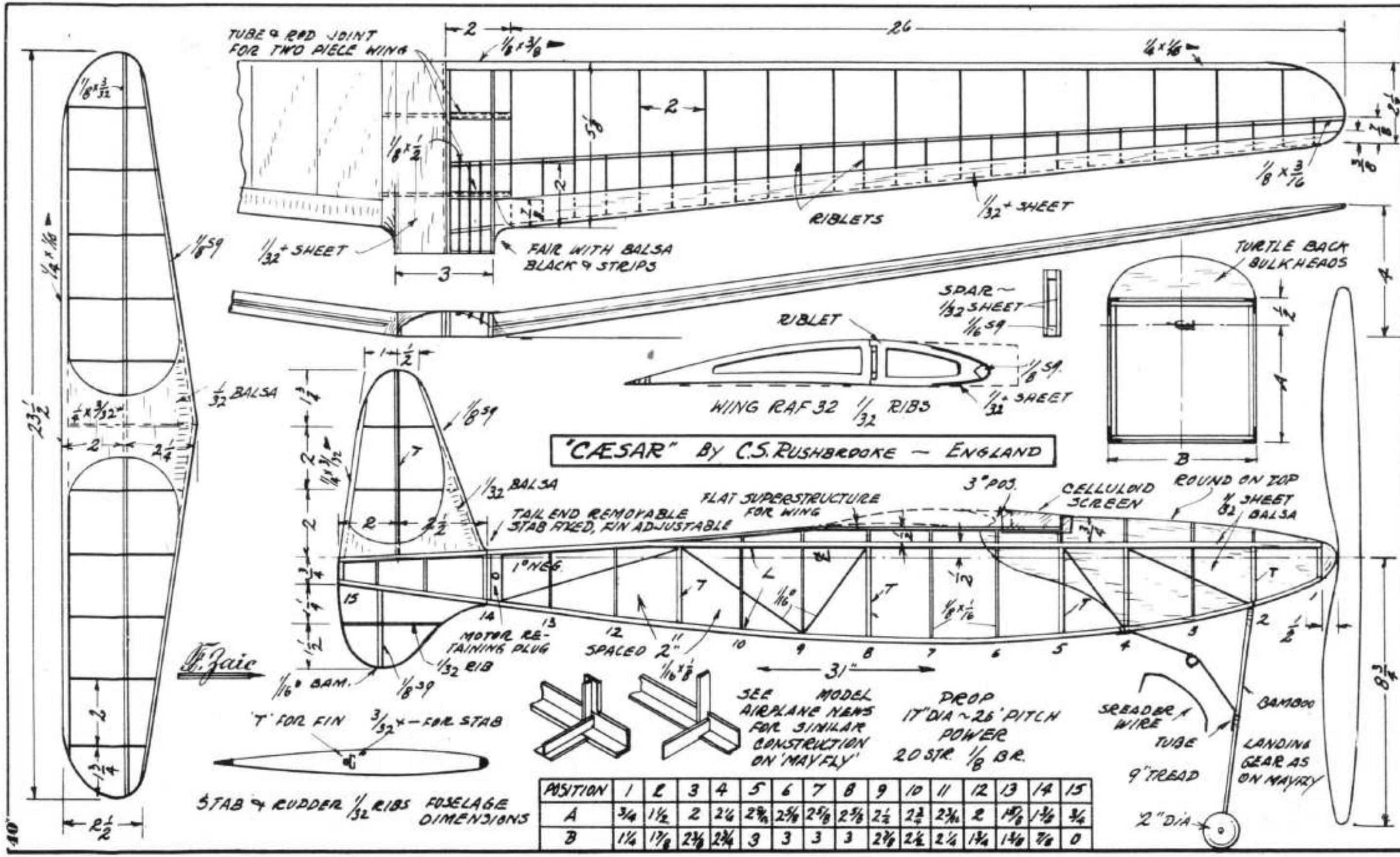


SENIOR - CLASS D
WORLD RECORD
OUTDOOR FUSELAGE
TIME 41m 19s
DESIGNED BY
WILLIAM YING
STATEN ISLAND N.Y.
F. Zaic
POWER
16 - 1/8 BROWN 650 TURNS
TOTAL WEIGHT 4.1 oz
AREA - 198 sq. in.
WING SECTION - CLARK Y
1/16 SQ. BAM.
RUDDER
TUBES
RODS
STABILIZER
FUSELAGE
3/16" FOR INCIDENCE
1/32 BALSA COVERED
3/32 AL. TUBE
FREE WHEELING
PROP
ALUM HINGE
.034 WIRE CEMENTED TO BLKHD
MAKE TO FIT STICK SNUG
2 WIRE CLIPS
PROP BLOCK
17 1/2 x 2 1/4 x 1 1/4
COVER WITH PAPER
TAIL SKID 4" LONG
3/32 O.D. ALUM. TUBING. CEMENT CENTRALLY ON FUSELAGE & RUDDER
1/16 ROD 1 1/2 LONG CEMENTED TO STAB.
LONGERONS & CROSS MEMBERS 1/8 SQ
STABILIZER
8" 1/16 BAMBOO
9" 1/16 BAMBOO
1/32 HARD BALSA LIGHT
MOTOR STICK
10" TREAD



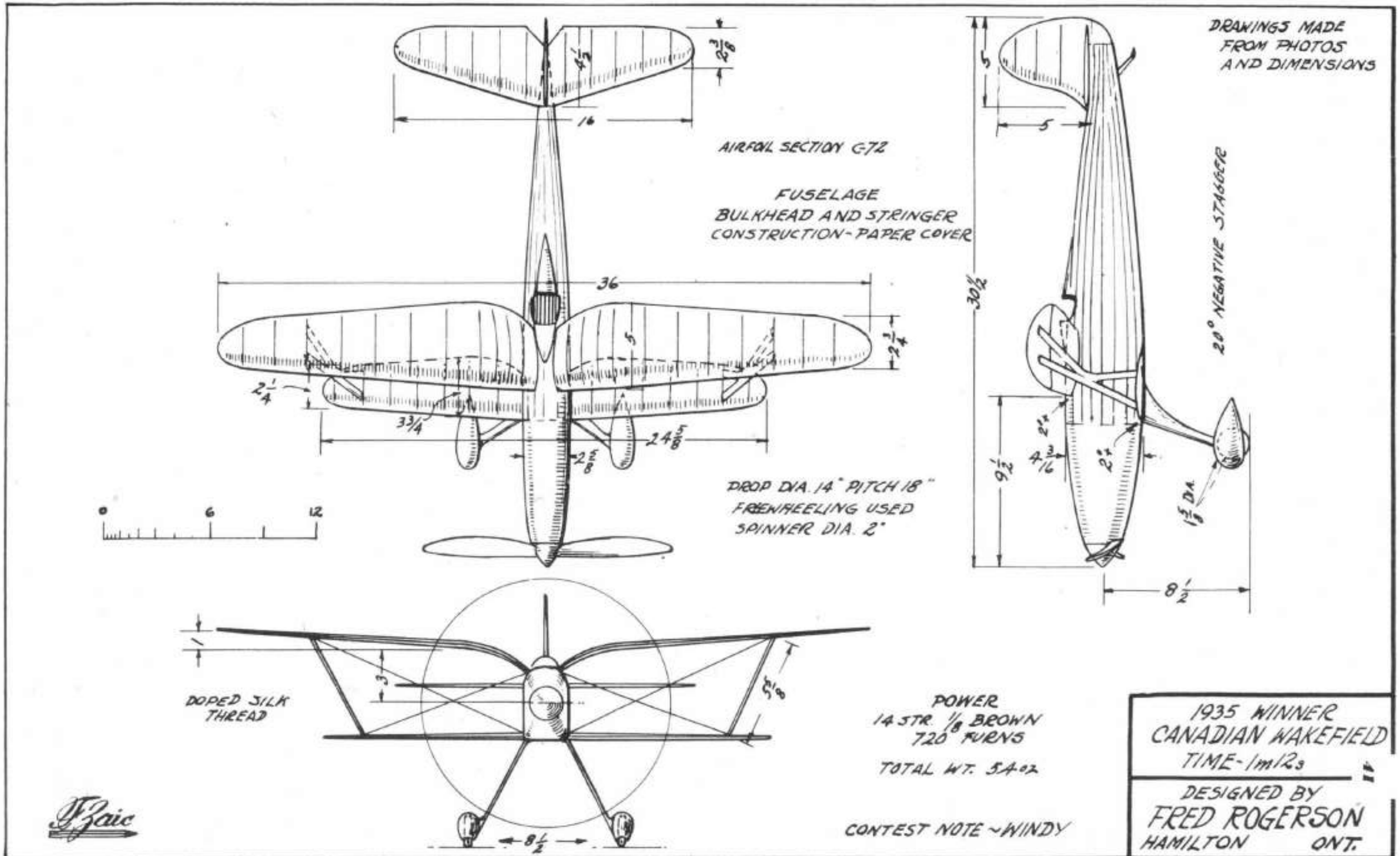
37 1/2
1/32 x 3/32 BAMBOO
5/16 x 1/8
1/16 x 1/8
AREA - 180 □"
3 1/2" DIHE.
2 1/2 FLAT CENTER
MODIFIED CLARK Y
1/20 STOCK
WEIGHTS - R.T.F.
FUSELAGE 1.44 oz.
RUDDER .08
ELEVATOR .585
PROP .455
RUBBER .91
TOTAL 3.470 oz.
WING (tiss) .55
UNCOVERED TOTAL 2.825 OZ.
NO THRUST ADJUSTMENTS
PLUG
RUB
PIN
AL. WIRE
1/32 AL.
"JASCO" "B-B"
EYELET
L. GARAMI
3 - 1/20 HARD BALSA LAN.
BICYCLE SPOKE
1/8 ROUND
POWER-LEFT CIRCLE
GLIDE - " "
3 - 1/20 HARD BALSA
1/16 BAM.
TO HOLD WING
3/16 FLAT RUB.
3/16 LONGERONS CORNER RD.
"B" 1/16 ALUM TUBE
"A" 1 1/2" - 3/32 HARD 3/32 DOWEL
1" DIA.
"THE JEEP"
CELLO.
BLACK
ORANGE
DIMENSION TO ℄
1/16 RD.
HOLLOW BALSA SHELL 1/32 WALL
HOLLOW SHELL 1/32 WALLS
PITCH 21" APPROX. R.P.S. - 16 P/D - 1.31
POWER
16 STRANDS 1/8 BROWN
SAFE TURN - 975
40. SEC. RUN
MAX. TURN - 1300
1m RUN
10" TREAD
PROP 1 x 1 1/2 x 16 HARD
BIND
BAM
AREA - 52 □"
1/16 □ BAM.
"E" 1/8 O.D. AL. TUBING
'A' FITS IN 'B' SNUGLY
2 - 3/32 BALSA LAMINATION
1 3/4 DIA.
1/32 AL. SHEET
MAKE 9 HOLES TO FIT PIN FOR 'B'
CEMENT
AL. WIRE
AREA 21.7 □"
95 MIN. CLASS 'D' OUTDOOR FUSELAGE
MOFFET TEAM - ALSO 15m 12.9s
CO-DESIGNED
E. LIDGARD ~ FR. NEKIMKIN
BUILT & FLOWN BY
EDW. LIDGARD
CHICAGO ILL

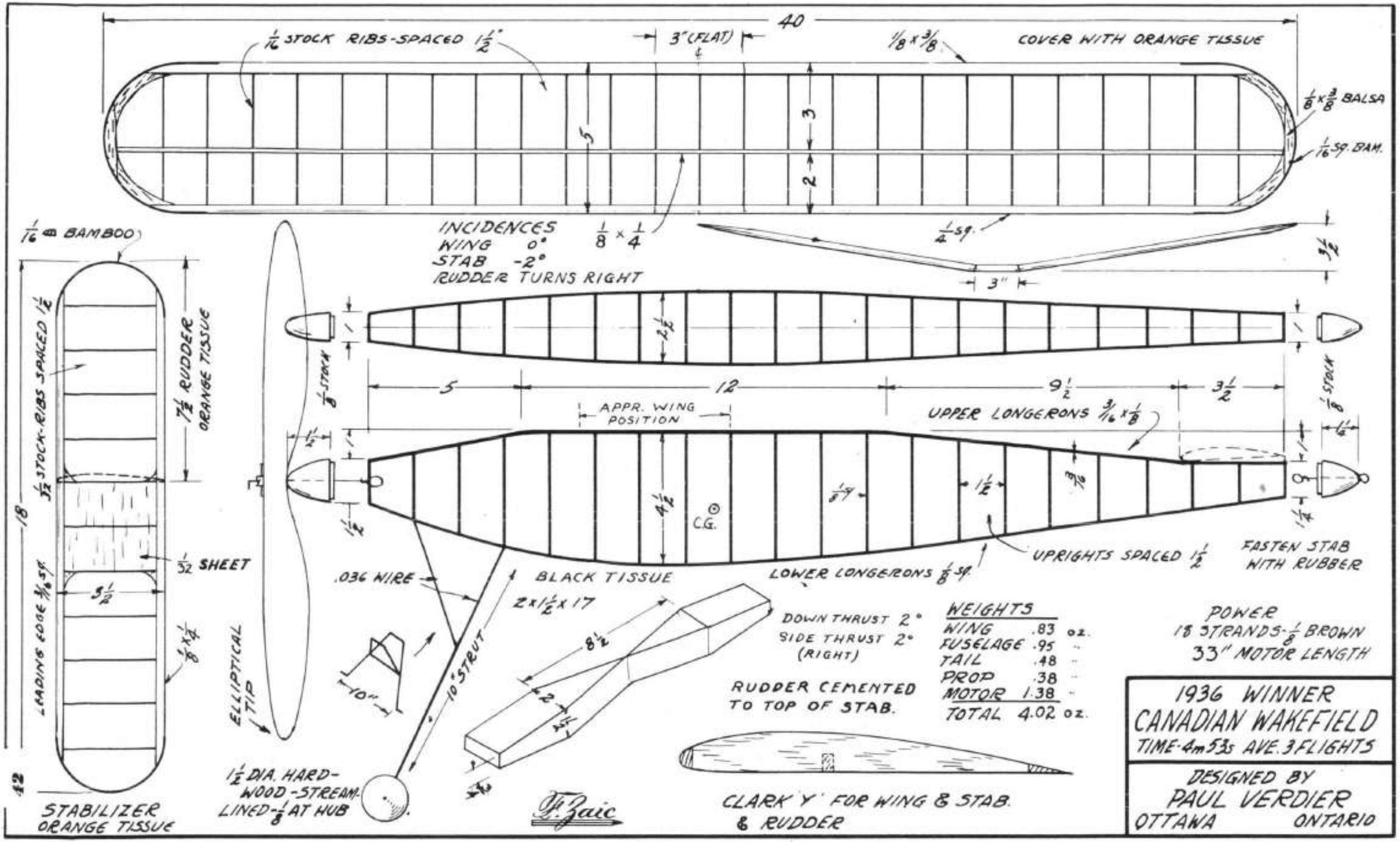

MAYFLY II
TIME UP TO SEPT. 4 min
DESIGNED BY
C.S. RUSHBROOKE
SALE. CHES. ENGLAND
WEIGHT OF MODEL 4.75 oz
POWER 10-12 STR 3/16 BLACK
COVER WITH JAP TISSUE
DIHEDRAL 3½"
RIBLETS
TPR BOX SPAR
WING SET 2° POS TO THRUST LINE
RAF 32
1/16 SPACE ON ALL RIBS
STAB SET -1° TO THRUST LINE
1/32 BALSA VENEER
BAM PEGS
1/32 BALSA
BRACES EVERY 2ND BAY
BRASS BUSH.
CLUTCH
SOLDER
1/16 SHEET
HARD BALSA
DOWN THRUST -2°
1/16 STRINGERS
SLOT TO FIT 3/32 SPAR
RUBBER FIXING
ADJUST
FROM OVAL NOSE TO SQUARE SEC. ON 4TH BAY
1/16 STRINGERS COVER WITH 1/32 VEENER
2" WHEELS 3-1/8 DISCS STREAMLINE
BRASS TUBE
25½
31

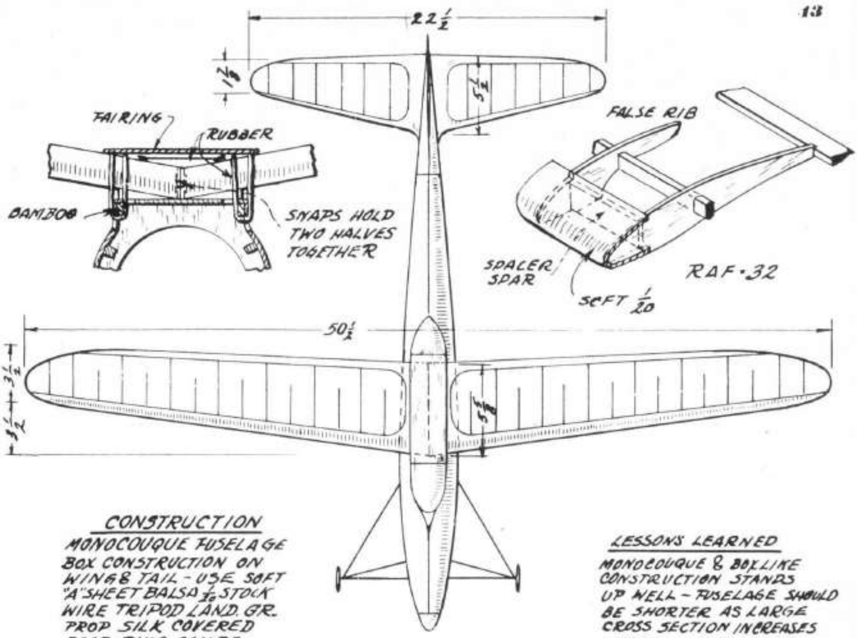


FUSELAGE DIMENSIONS

POSITION	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A	3/4	1 1/2	2	2 1/4	2 9/16	2 5/8	2 5/8	2 5/8	2 1/2	2 3/4	2 3/16	2	1 15/16	1 3/8	3/4
B	1 1/4	1 7/8	2 3/8	2 3/4	3	3	3	3	2 7/8	2 1/2	2 1/4	1 3/4	1 3/8	7/8	0


DRAWINGS MADE
FROM PHOTOS
AND DIMENSIONS
AIRFOIL SECTION G-72
FUSELAGE
BULKHEAD AND STRINGER
CONSTRUCTION - PAPER COVER
20° NEGATIVE STAGGER
PROP DIA. 14" PITCH 18"
FREEWHEELING USED
SPINNER DIA. 2"
DOPED SILK
THREAD
POWER
14 STR. 1/8 BROWN
720 TURNS
TOTAL WT. 5.4 oz
CONTEST NOTE ~ WINDY
1935 WINNER
CANADIAN WAKEFIELD
TIME - 1m12s
DESIGNED BY
FRED ROGERSON
HAMILTON ONT.
F. Zaic


40
1/16 STOCK RIBS-SPACED 1 1/2"
3" (FLAT)
1/8 x 3/8
COVER WITH ORANGE TISSUE
1/8 x 3/8 BALSA
1/16 SQ. BAM.
5
3
2
INCIDENCES
WING 0°
STAB -2°
RUDDER TURNS RIGHT
1/8 x 1/4
1/4 SQ.
3"
3 1/2
1/16 BAMBOO
1/32 STOCK-RIBS SPACED 1 1/2
7 1/2 RUDDER
ORANGE TISSUE
18
1/32 SHEET
3 1/2
LEADING EDGE 3/16 SQ.
1/8 x 1/4
42
STABILIZER
ORANGE TISSUE
ELLIPTICAL TIP
1/8 STOCK
1
2 1/2
5
12
9 1/2
3 1/2
APPR. WING POSITION
UPPER LONGERONS 3/16 x 1/8
4 1/2
C.G.
1 1/2
3/16
1 1/4
BLACK TISSUE
LOWER LONGERONS 1/8 SQ.
UPRIGHTS SPACED 1 1/2
FASTEN STAB WITH RUBBER
.036 WIRE
2 x 1 1/2 x 17
10" STRUT
10"
8 1/2
2
1 1/2 DIA. HARD-WOOD-STREAM-LINED-1/8 AT HUB
DOWN THRUST 2°
SIDE THRUST 2° (RIGHT)
RUDDER CEMENTED TO TOP OF STAB.
WEIGHTS
WING .83 oz.
FUSELAGE .95
TAIL .48
PROP .38
MOTOR 1.38
TOTAL 4.02 oz.
POWER
18 STRANDS-1/8 BROWN
33" MOTOR LENGTH
CLARK 'Y' FOR WING & STAB. & RUDDER
F. Zaic
1936 WINNER
CANADIAN WAKEFIELD
TIME-4m 53s AVE. 3 FLIGHTS
DESIGNED BY
PAUL VERDIER
OTTAWA ONTARIO

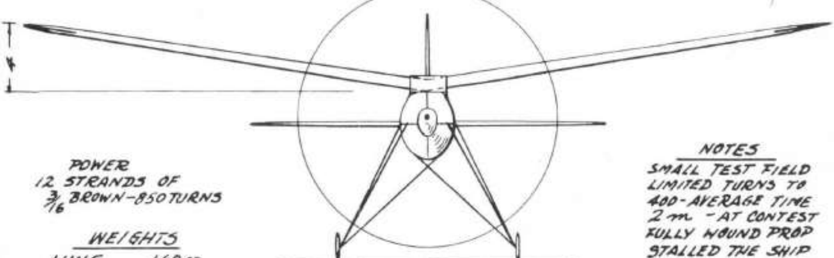


CONSTRUCTION

MONOCOUQUE FUSELAGE BOX CONSTRUCTION ON WING & TAIL - USE SOFT "A" SHEET BALSA 1/20 STOCK WIRE TRIPOD LAND. GR. PROP SILK COVERED REAR PLUG CAN BE SUBSTITUTED WITH GEAR ASSEMBLY - WING IN TWO PIECES

LESSONS LEARNED

MONOCOUQUE & BOXLIKE CONSTRUCTION STANDS UP WELL - FUSELAGE SHOULD BE SHORTER AS LARGE CROSS SECTION INCREASES WEIGHT - WING LOWER - POSSIBLY A MIDWING - USE OF A DOUBLE MOTOR TO SHORTEN FUSELAGE



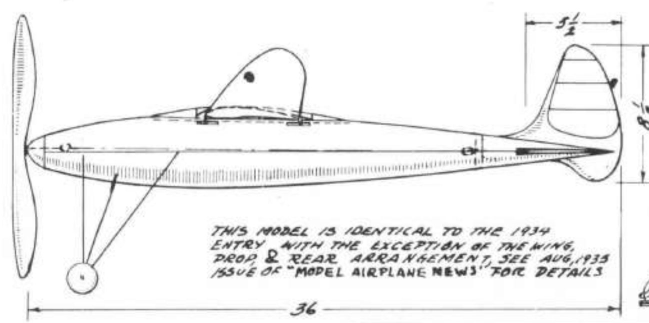
POWER
12 STRANDS OF
3/16 BROWN - 850 TURNS

WEIGHTS

WING	1.60 oz
FUSELAGE	2.65
STABILIZER	.40
PROP	.60
MOTOR	.75
TOTAL	6.00 oz

NOTES

SMALL TEST FIELD LIMITED TURNS TO 400 - AVERAGE TIME 2 m - AT CONTEST FULLY WOUND PROP STALLED THE SHIP KILLING THE INITIAL CLIMB - LIKELY CAUSE EXCESS SPEED INCREASED WING DRAG POSSIBLE CURE - DOWN THRUST



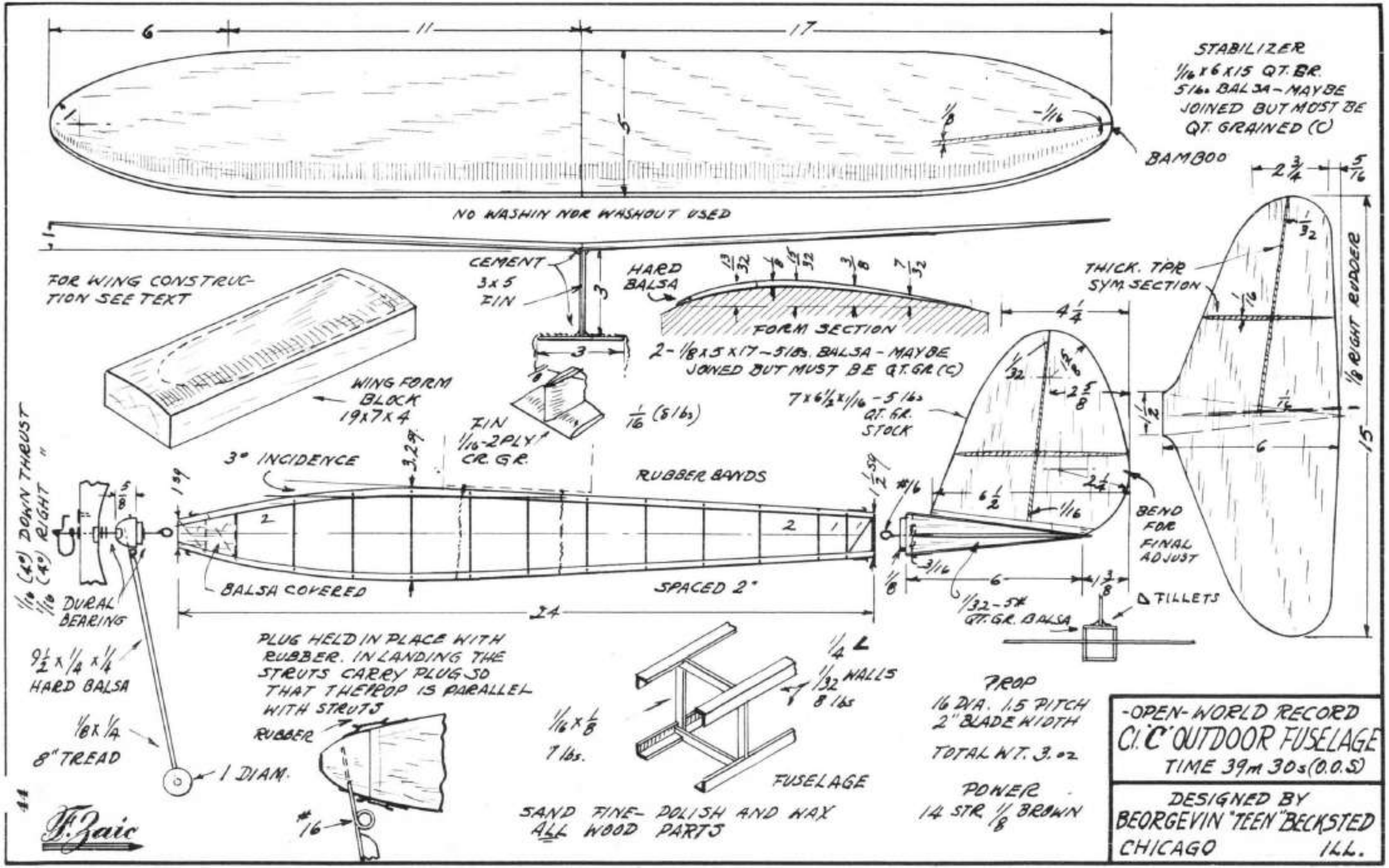
PROP
16×2×1 3/4
24" PITCH

THIS MODEL IS IDENTICAL TO THE 1934 ENTRY WITH THE EXCEPTION OF THE WING, PROP & REAR ARRANGEMENT, SEE AUG, 1935 ISSUE OF "MODEL AIRPLANE NEWS" FOR DETAILS

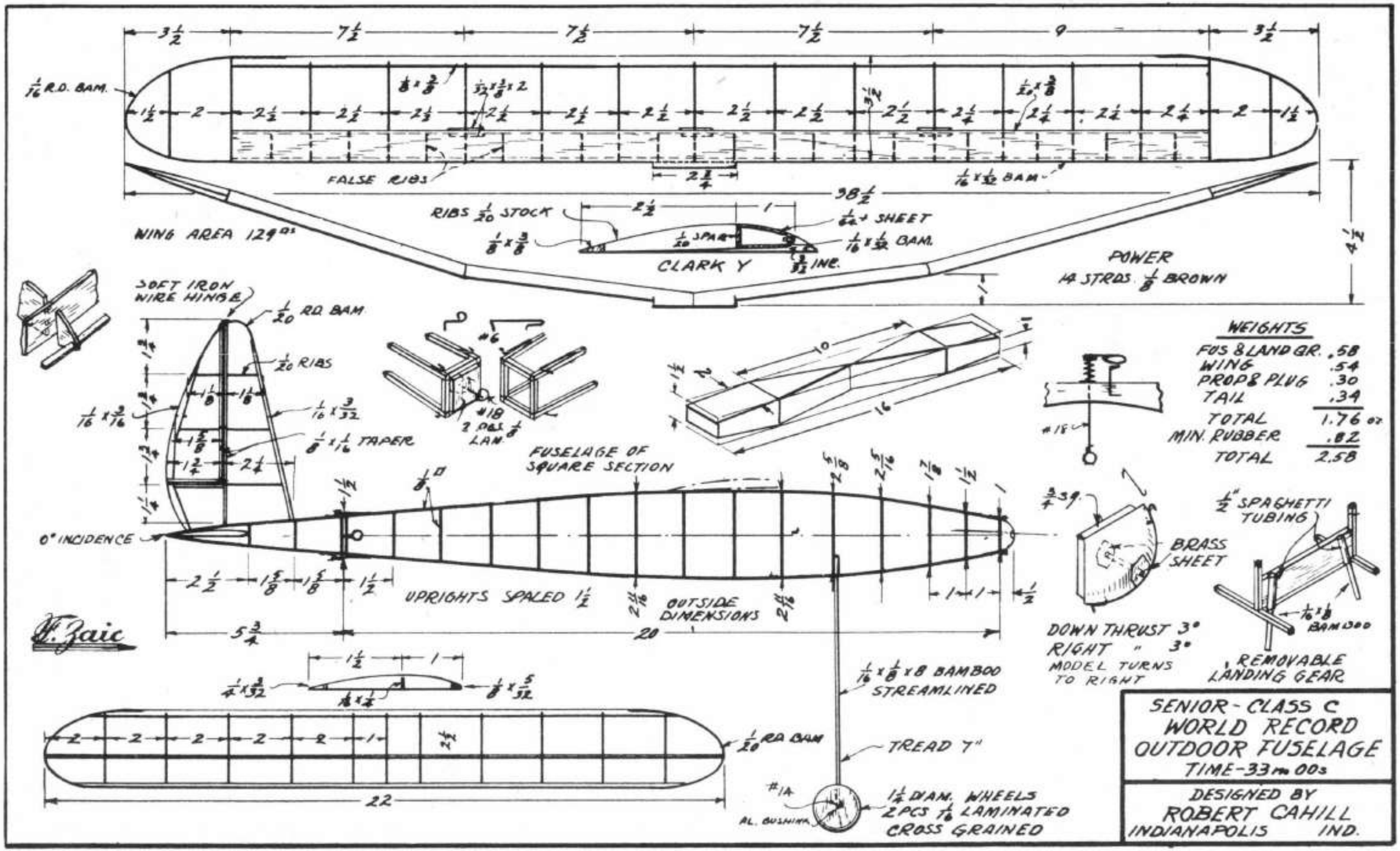
F. Zaic

CONTEST AVERAGE TIME - 1m 46s

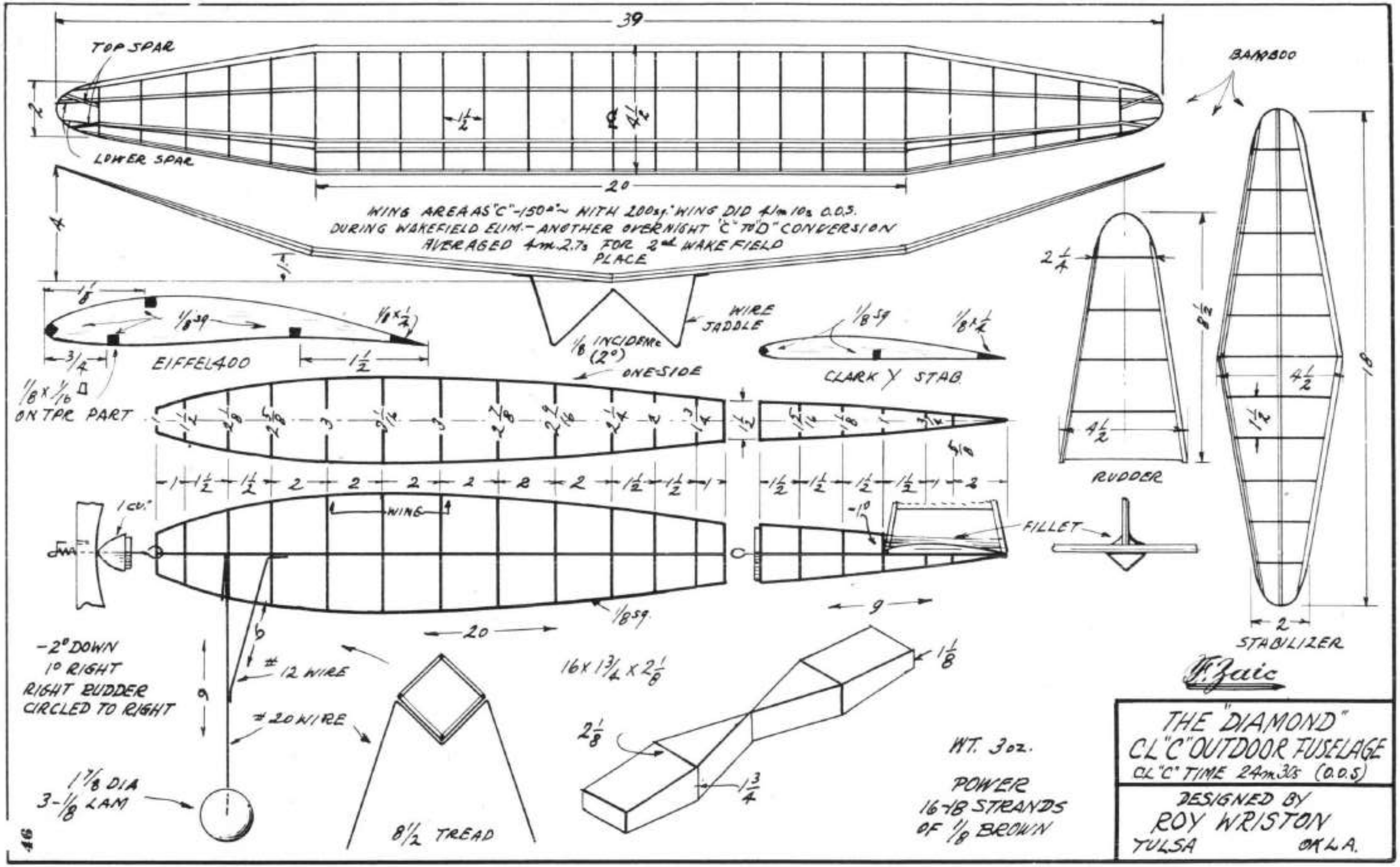
A 1935 WAKEFIELD ENTRY by Frank Zaic

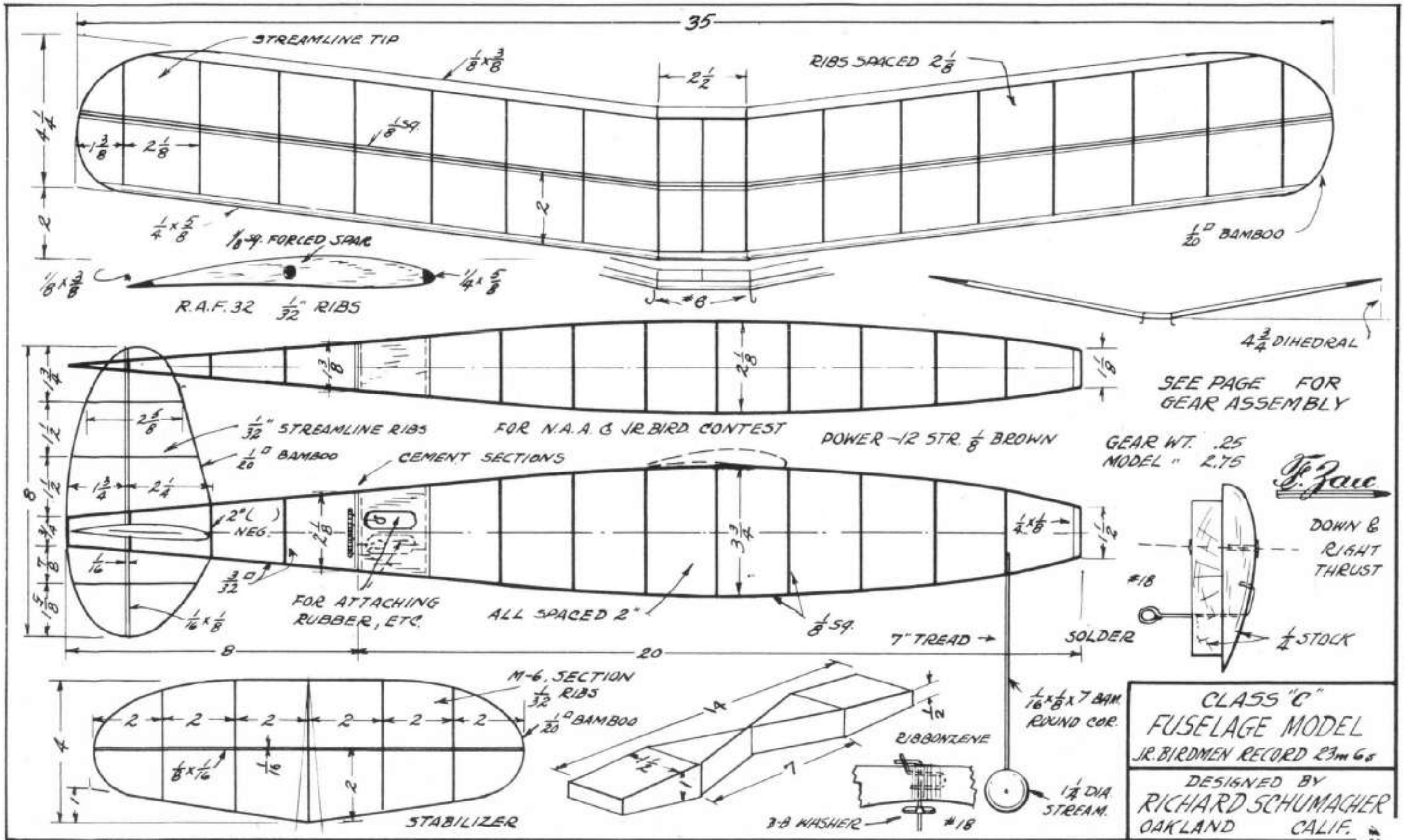


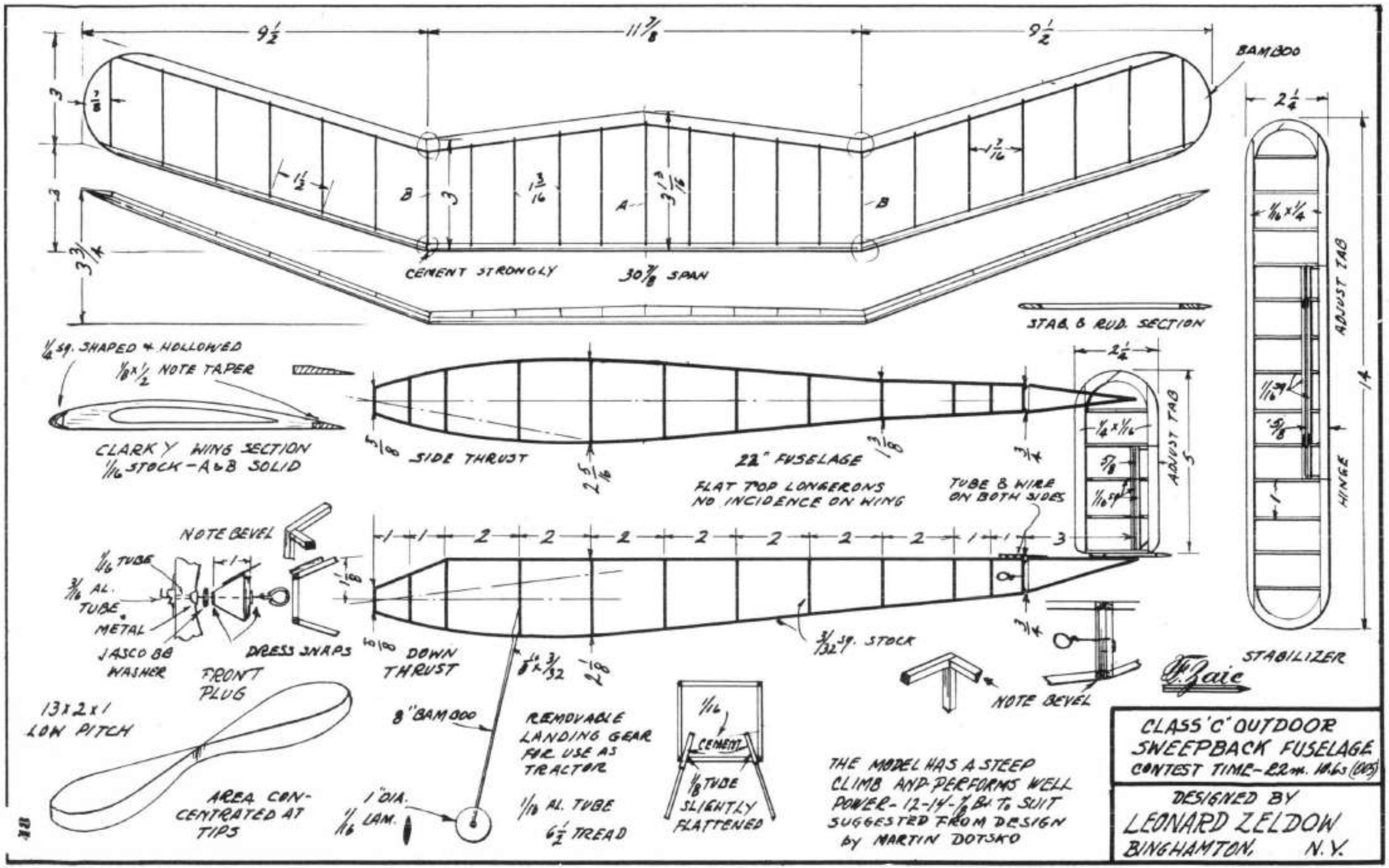
STABILIZER
1/16 x 6 x 15 QT. GR. 5 lbs. BALSA - MAYBE JOINED BUT MUST BE QT. GRAINED (C)
BAMBOO
NO WASHIN NOR WASHOUT USED
FOR WING CONSTRUCTION SEE TEXT
WING FORM BLOCK 19 x 7 x 4
CEMENT
3 x 5 FIN
HARD BALSA
FORM SECTION
2 - 1/8 x 5 x 17 - 5 lbs. BALSA - MAYBE JOINED BUT MUST BE QT. GR. (C)
THICK. TPR SYM SECTION
1/8 RIGHT RUDDER
7 x 6 1/2 x 1/16 - 5 lbs QT. GR. STOCK
FIN 1/16 - 2 PLY CR. GR.
1/16 (8 lbs)
3° INCIDENCE
RUBBER BANDS
1/16 (4°) DOWN THRUST
1/16 (4°) RIGHT
BALSA COVERED
SPACED 2"
BEND FOR FINAL ADJUST
1/32 - 5# QT. GR. BALSA
TILLETS
DURAL BEARING
9 1/2 x 1/4 x 1/4 HARD BALSA
1/8 x 1/4
8" TREAD
1 DIAM.
PLUG HELD IN PLACE WITH RUBBER. IN LANDING THE STRUTS CARRY PLUG SO THAT THE PROP IS PARALLEL WITH STRUTS
RUBBER
#16
1/16 x 1/8
7 lbs.
1/4 L
1/32 WALLS
8 lbs
FUSELAGE
SAND FINE - POLISH AND WAX ALL WOOD PARTS
PROP
16 DIA. 1.5 PITCH
2" BLADE WIDTH
TOTAL WT. 3. oz
POWER
14 STR. 1/8 BROWN
-OPEN- WORLD RECORD
Cl. "C" OUTDOOR FUSELAGE
TIME 39m 30s (O.O.S)
DESIGNED BY
BEORGEVIN "TEEN" BECKSTED
CHICAGO ILL.
F. Zaic



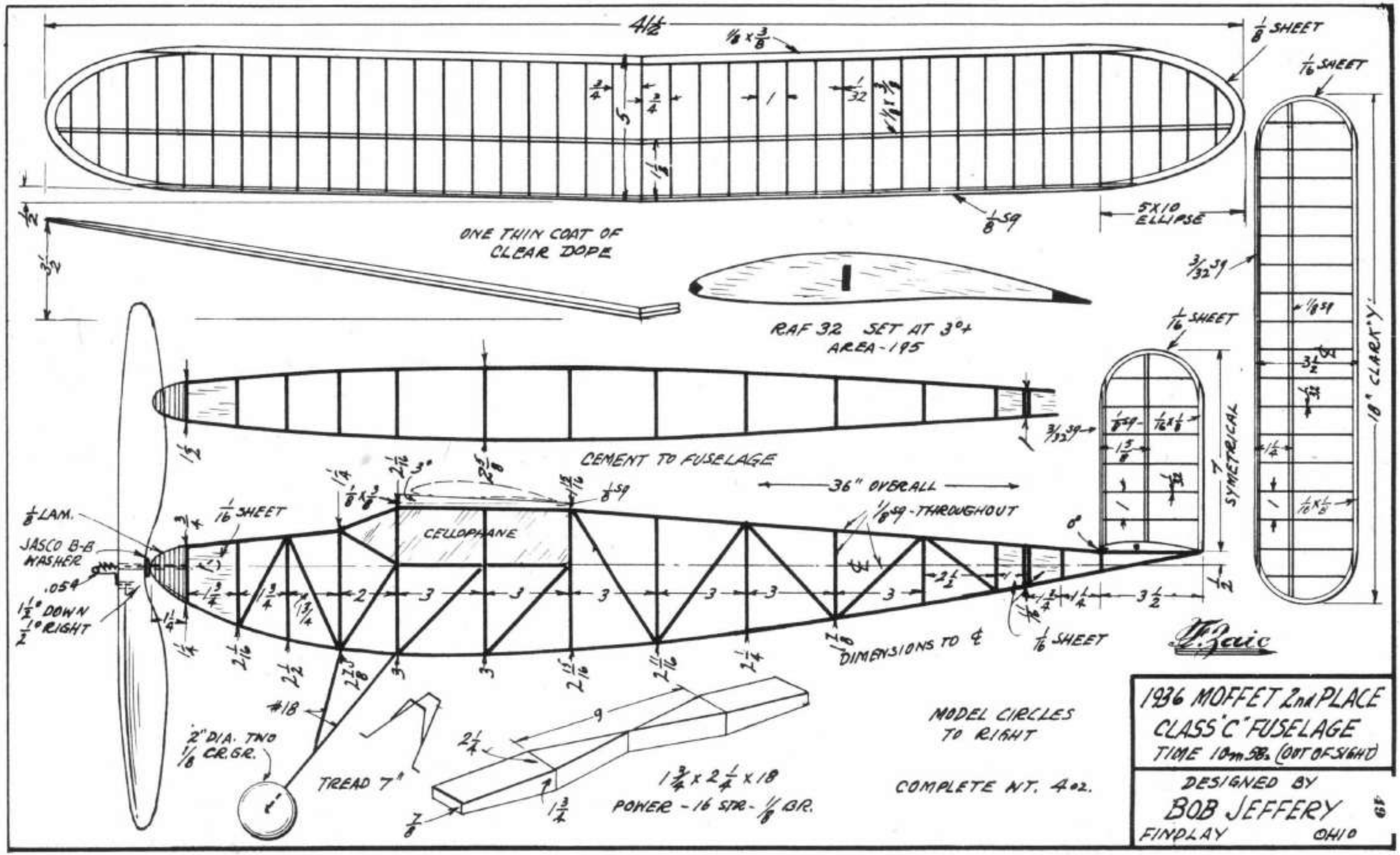
WING AREA 129 SQ. IN.
FALSE RIBS
RIBS 1/20 STOCK
1/20 SPAR
1/64 SHEET
1/16 x 1/32 BAM.
CLARK Y
1/16 R.D. BAM.
1/16 x 1/32 BAM.
POWER
14 STRDS. 1/8 BROWN
SOFT IRON WIRE HINGE
1/20 RD. BAM
1/20 RIBS
1/16 x 3/32
1/8 x 1/16 TAPER
FUSELAGE OF SQUARE SECTION
0° INCIDENCE
UPRIGHTS SPACED 1 1/2
OUTSIDE DIMENSIONS
WEIGHTS
FUS & LAND GR. .58
WING .54
PROP & PLUG .30
TAIL .34
TOTAL 1.76 oz
MIN. RUBBER .82
TOTAL 2.58
BRASS SHEET
1/2" SPAGHETTI TUBING
1/16 x 1/8 BAMBOO
DOWN THRUST 3°
RIGHT " 3°
MODEL TURNS TO RIGHT
REMOVABLE LANDING GEAR
1/16 x 1/8 x 8 BAMBOO STREAMLINED
TREAD 7"
1/20 RD BAM
AL. BUSHING
1 1/4 DIAM. WHEELS
2 PCS 1/16 LAMINATED CROSS GRAINED
SENIOR - CLASS C
WORLD RECORD
OUTDOOR FUSELAGE
TIME - 33m 00s
DESIGNED BY
ROBERT CAHILL
INDIANAPOLIS IND.


TOP SPAR
LOWER SPAR
BAMBOO
39
20
WING AREA AS "C" -150□" - WITH 200 sq." WING DID 4 1/2 m 10s O.O.S.
DURING WAKEFIELD ELIM. - ANOTHER OVERNIGHT "C" TO "D" CONVERSION
AVERAGED 4m 27s FOR 2nd WAKEFIELD
PLACE
EIFFEL 400
1/8 x 1/16 □
ON TPR PART
WIRE
SADDLE
1/8 INCIDENCE
(2°)
ONE-SIDE
CLARK Y STAB.
RUDDER
STABILIZER
WING
FILLET
1 CU."
-2° DOWN
1° RIGHT
RIGHT RUDDER
CIRCLED TO RIGHT
12 WIRE
20 WIRE
1 7/8 DIA
3-1/8 LAM
8 1/2 TREAD
16 x 1 3/4 x 2 1/8
WT. 3 oz.
POWER
16-18 STRANDS
OF 1/8 BROWN
F. Zaic
THE "DIAMOND"
CL "C" OUTDOOR FUSELAGE
CL "C" TIME 24m 30s (O.O.S)
DESIGNED BY
ROY WRISTON
TULSA OKLA.
46

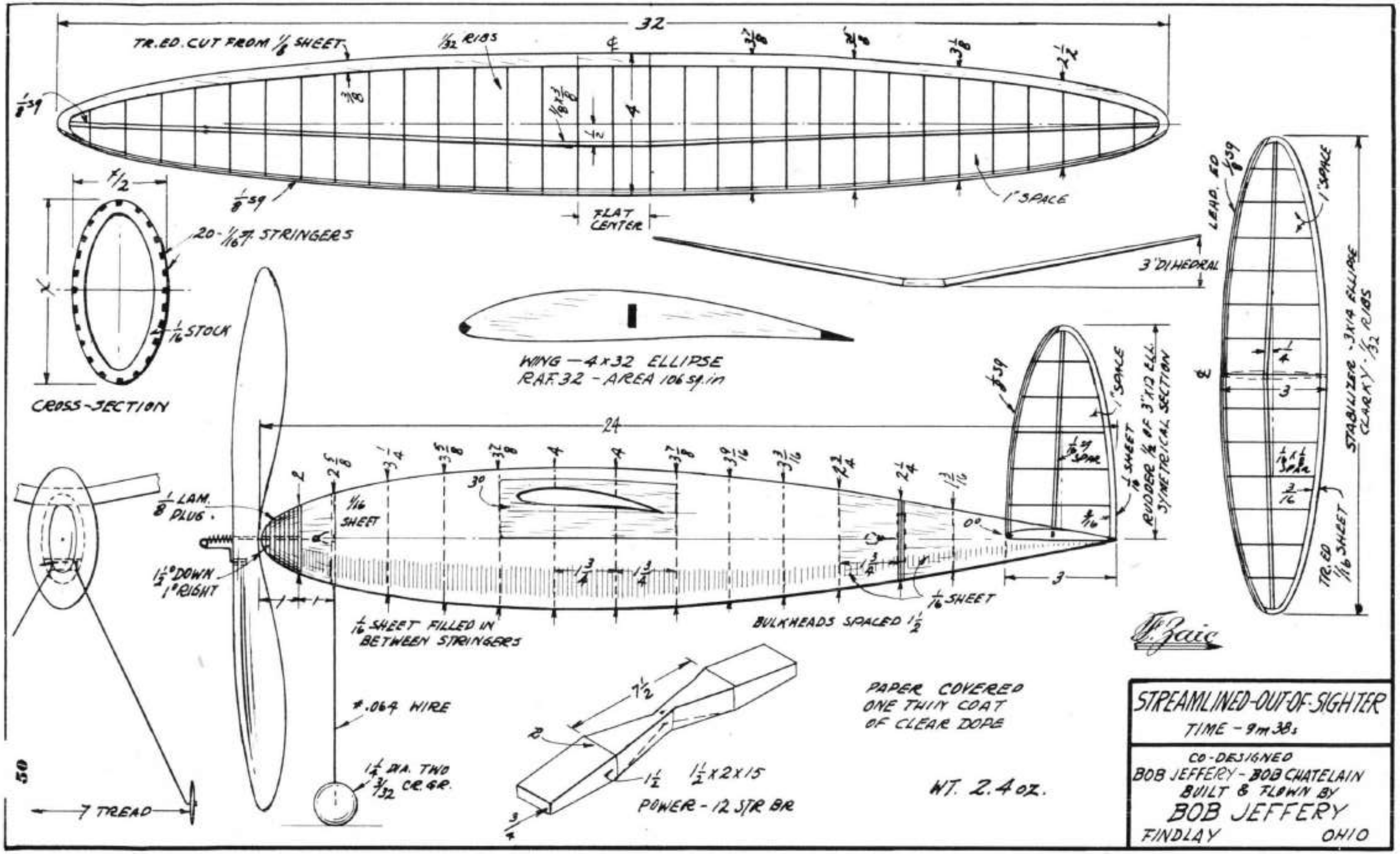

35
STREAMLINE TIP
1/8 x 3/8
RIBS SPACED 2 1/8
2 1/2
4 1/4
1 3/8
2 1/8
1/8 SQ.
2
1/4 x 5/8
1/8 SQ. FORCED SPAR
1/20 D BAMBOO
1/8 x 3/8
1/4 x 5/8
R.A.F. 32
1/32" RIBS
#8
4 3/4 DIHEDRAL
1 3/4
2 5/8
1 3/8
2 1/8
1/8
SEE PAGE FOR
GEAR ASSEMBLY
1/32" STREAMLINE RIBS
FOR N.A.A. & JR. BIRD. CONTEST
POWER - 12 STR. 1/8 BROWN
GEAR WT. .25
MODEL " 2.75
1 1/2
1/20 D BAMBOO
CEMENT SECTIONS
8
1 1/2
1 3/4
2 1/4
2°( )
NEG.
2 1/8
3 3/4
1/4 x 1/8
1/2
DOWN &
RIGHT
THRUST
7/8
1/16
3/32 □
#18
5/8
FOR ATTACHING
RUBBER, ETC.
ALL SPACED 2"
1/8 SQ.
1/16 x 1/8
7" TREAD
SOLDER
1/4 STOCK
8
20
M-6, SECTION
1/32 RIBS
1/20 D BAMBOO
2
2
2
2
2
2
4
14
1/2
1 1/2
1
7
1/8 x 1/16
1/16
2
1
STABILIZER
RIBBONZENE
3-8 WASHER
#18
1/16 x 1/8 x 7 BAM.
ROUND COR.
1 1/4 DIA.
STREAM.
CLASS "C"
FUSELAGE MODEL
JR. BIRDMEN RECORD 23m 6s
DESIGNED BY
RICHARD SCHUMACHER
OAKLAND CALIF.

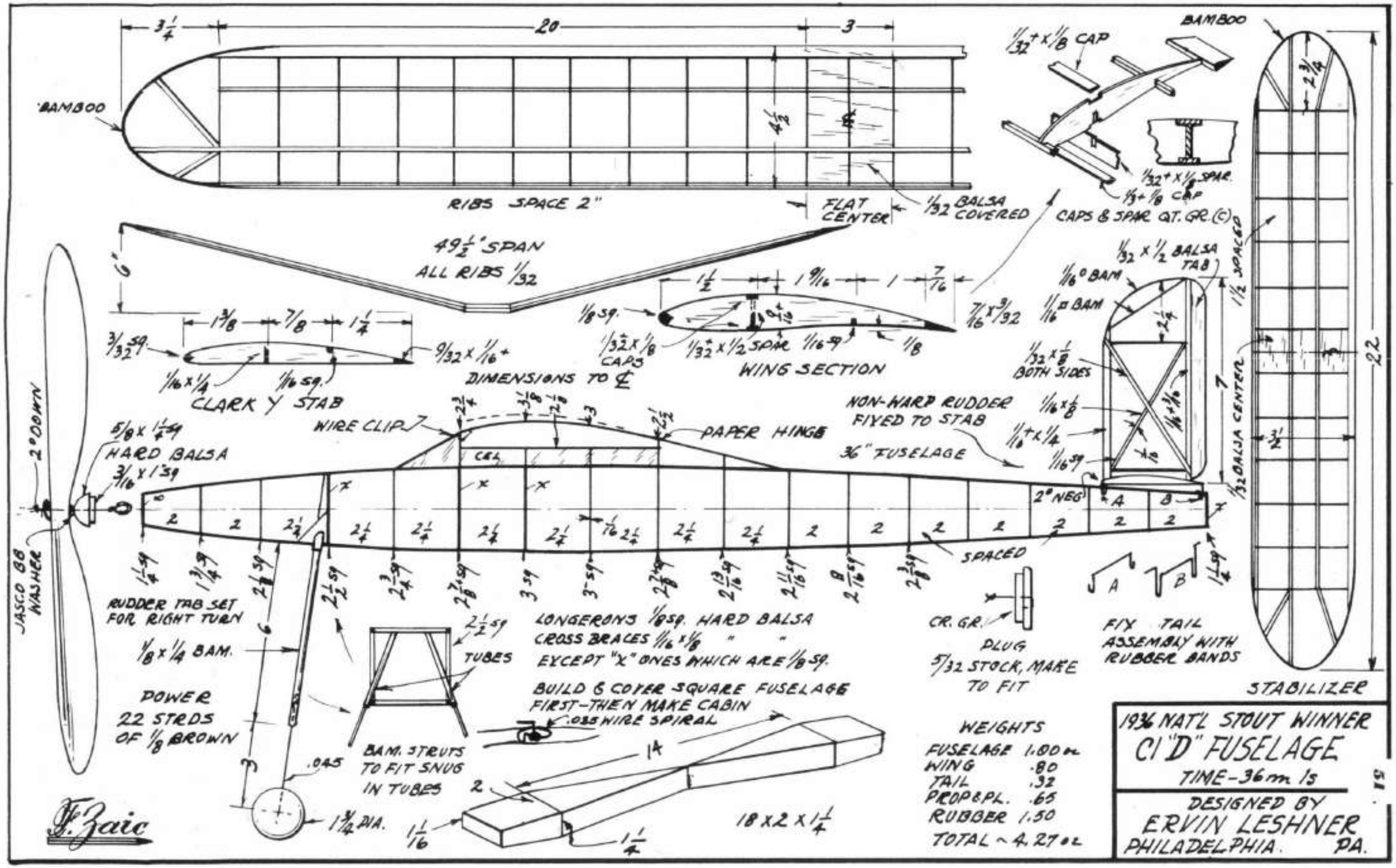


BAMBOO
CEMENT STRONGLY
30 7/8 SPAN
STAB. & RUD. SECTION
1/4 SQ. SHAPED & HOLLOWED
1/8 x 1/2 NOTE TAPER
CLARK Y WING SECTION
1/16 STOCK - A & B SOLID
SIDE THRUST
22" FUSELAGE
FLAT TOP LONGERONS
NO INCIDENCE ON WING
TUBE & WIRE
ON BOTH SIDES
ADJUST TAB
HINGE
NOTE BEVEL
1/16 TUBE
3/16 AL. TUBE
METAL
JASCO BB
WASHER
DRESS SNAPS
FRONT
PLUG
DOWN
THRUST
3/32 SQ. STOCK
STABILIZER
13 x 2 x 1
LOW PITCH
AREA CON-
CENTRATED AT
TIPS
8" BAMBOO
1" DIA.
1/16 LAM.
REMOVABLE
LANDING GEAR
FOR USE AS
TRACTOR
1/16 AL. TUBE
6 1/2 TREAD
CEMENT
1/8 TUBE
SLIGHTLY
FLATTENED
THE MODEL HAS A STEEP
CLIMB AND PERFORMS WELL
POWER - 12-14 - 1/8 BR. TO SUIT
SUGGESTED FROM DESIGN
BY MARTIN DOTSKO
CLASS 'C' OUTDOOR
SWEEPBACK FUSELAGE
CONTEST TIME - 22 m. 10.6 s (OOS)
DESIGNED BY
LEONARD ZELDOW
BINGHAMTON, N.Y.



1936 MOFFET 2nd PLACE
CLASS "C" FUSELAGE
TIME 10m 58s (OUT OF SIGHT)
DESIGNED BY
BOB JEFFERY
FINDLAY OHIO
ONE THIN COAT OF CLEAR DOPE
RAF 32 SET AT 3°+
AREA-195
5X10 ELLIPSE
1/8 SHEET
1/16 SHEET
18" CLARK "Y"
SYMETRICAL
CEMENT TO FUSELAGE
36" OVERALL
1/8 SQ.-THROUGHOUT
CELLOPHANE
1/8 LAM.
JASCO B-B WASHER
.054
1 1/2° DOWN
1/2° RIGHT
DIMENSIONS TO ℄
#18
2" DIA. TWO 1/8 CR.GR.
TREAD 7"
1 3/4 x 2 1/4 x 18
POWER - 16 STR. - 1/8 BR.
MODEL CIRCLES TO RIGHT
COMPLETE WT. 4 oz.


STREAMLINED-OUT-OF-SIGHTER
TIME - 9m 38s
CO-DESIGNED
BOB JEFFERY - BOB CHATELAIN
BUILT & FLOWN BY
BOB JEFFERY
FINDLAY OHIO
TR. ED. CUT FROM 1/8 SHEET
1/32 RIBS
32
FLAT CENTER
1" SPACE
3" DIHEDRAL
CROSS-SECTION
20-1/16 SQ. STRINGERS
1/16 STOCK
WING - 4 x 32 ELLIPSE
RAF 32 - AREA 106 sq.in
LEAD. ED
STABILIZER - 3X14 ELLIPSE
CLARK Y - 1/32 RIBS
TR. ED 1/16 SHEET
RUDDER 1/2 OF 3"X12 ELL.
SYMETRICAL SECTION
1/16 SHEET
24
1/8 LAM. PLUG.
1/16 SHEET
1 1/2° DOWN
1° RIGHT
1/16 SHEET FILLED IN BETWEEN STRINGERS
BULKHEADS SPACED 1 1/2
#.064 WIRE
1 1/4 DIA. TWO 3/32 CR. GR.
7 TREAD
POWER - 12 STR BR
1/2 x 2 x 15
PAPER COVERED
ONE THIN COAT
OF CLEAR DOPE
WT. 2.4 oz.


BAMBOO
RIBS SPACE 2"
FLAT CENTER
1/32 BALSA COVERED
49 1/2" SPAN
ALL RIBS 1/32
1/32+ x 1/8 CAP
1/32+ x 1/8 SPAR
1/8+ 1/8 CAP
CAPS & SPAR QT. GR. (C)
1/8 SQ.
1/32+ x 1/8 CAPS
1/32+ x 1/2 SPAR
1/16 SQ.
7/16 x 3/32
WING SECTION
DIMENSIONS TO ℄
3/32 SQ.
1/16 x 1/4
1/16 SQ.
9/32 x 1/16+
CLARK Y STAB
2° DOWN
5/8 x 1 1/4 SQ. HARD BALSA
3/16 x 1' SQ.
JASCO BB WASHER
WIRE CLIP
PAPER HINGE
NON-WARP RUDDER FIXED TO STAB
36" FUSELAGE
1/32 x 1/2 BALSA TAB
1/16 □ BAM
1/16 □ BAM
1/32 x 1/8 BOTH SIDES
1/16 x 1/8
1/16+ x 1/4
1/16 SQ.
2° NEG
SPACED
1 1/2 SPACED
1/32 BALSA CENTER
RUDDER TAB SET FOR RIGHT TURN
1/8 x 1/4 BAM.
POWER
22 STRDS OF 1/8 BROWN
TUBES
BAM. STRUTS TO FIT SNUG IN TUBES
LONGERONS 1/8 SQ. HARD BALSA
CROSS BRACES 1/16 x 1/8 " "
EXCEPT "X" ONES WHICH ARE 1/8 SQ.
BUILD & COVER SQUARE FUSELAGE FIRST—THEN MAKE CABIN
.035 WIRE SPIRAL
.045
1 3/4 DIA.
18 x 2 x 1 1/4
CR. GR.
PLUG
5/32 STOCK, MAKE TO FIT
FIX TAIL ASSEMBLY WITH RUBBER BANDS
STABILIZER
WEIGHTS
FUSELAGE 1.00 oz
WING .80
TAIL .32
PROP & PL. .65
RUBBER 1.50
TOTAL ~ 4.27 oz
1936 NAT'L STOUT WINNER
CL "D" FUSELAGE
TIME—36m 1s
DESIGNED BY
ERVIN LESHNER
PHILADELPHIA PA.
F. Zaic

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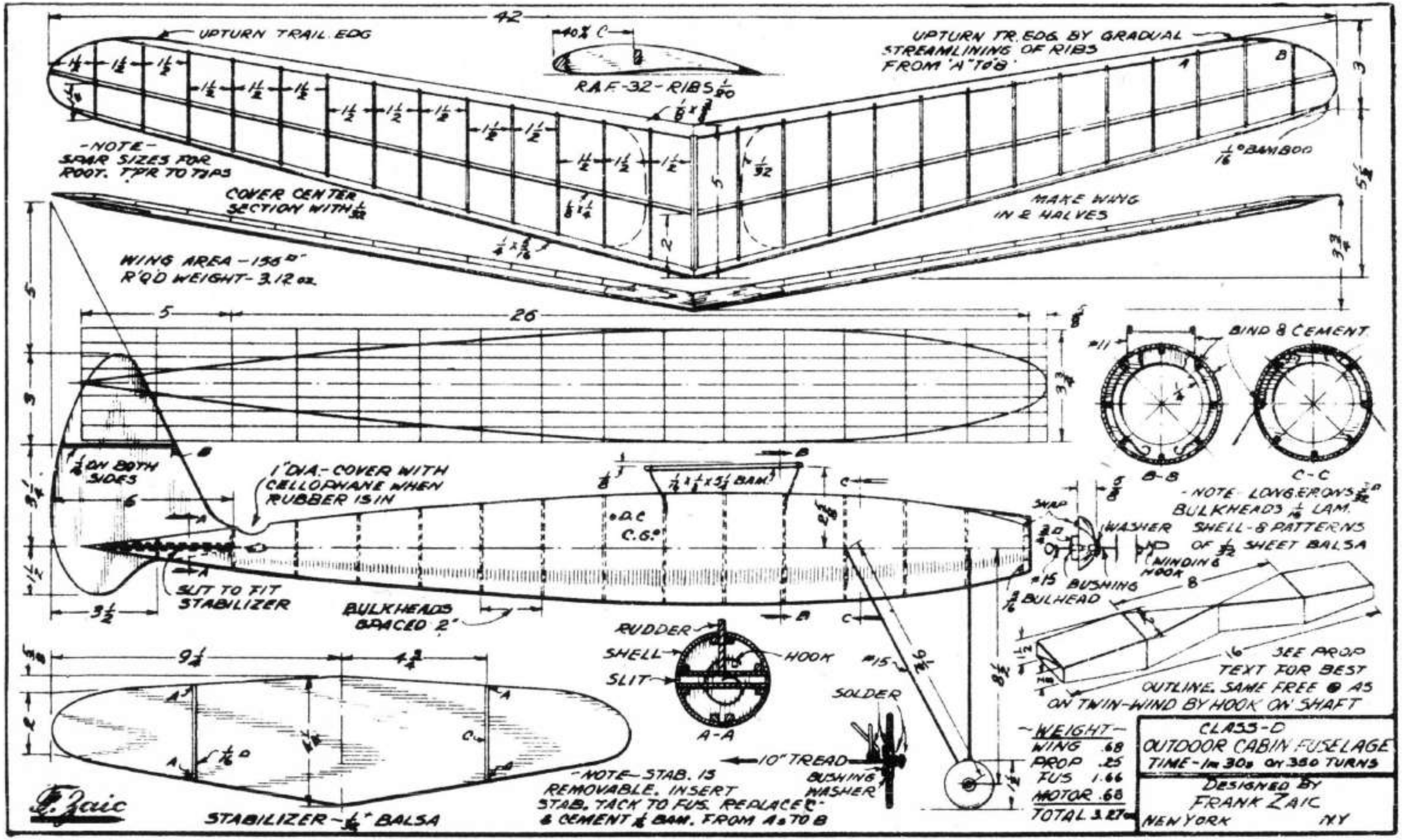
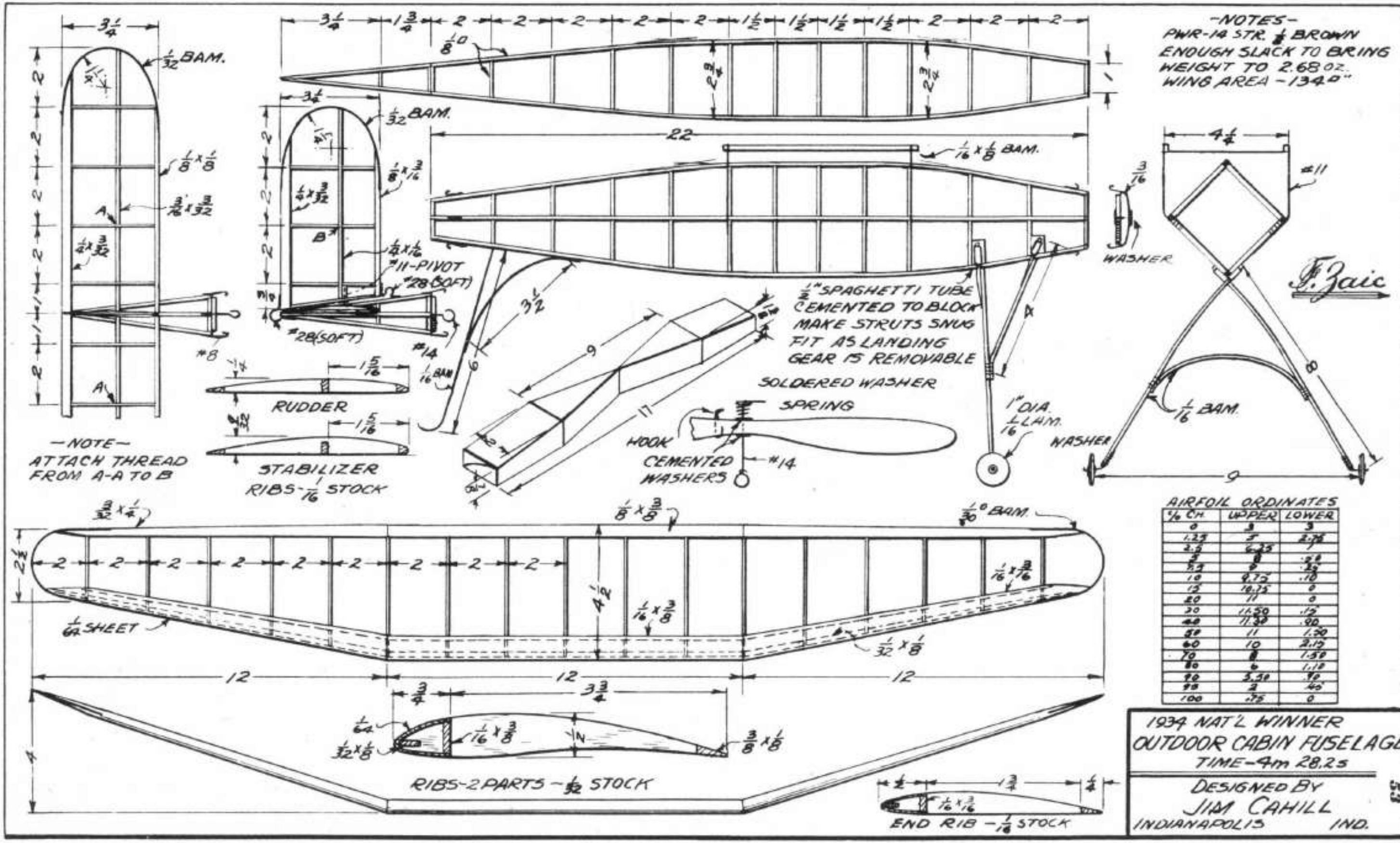
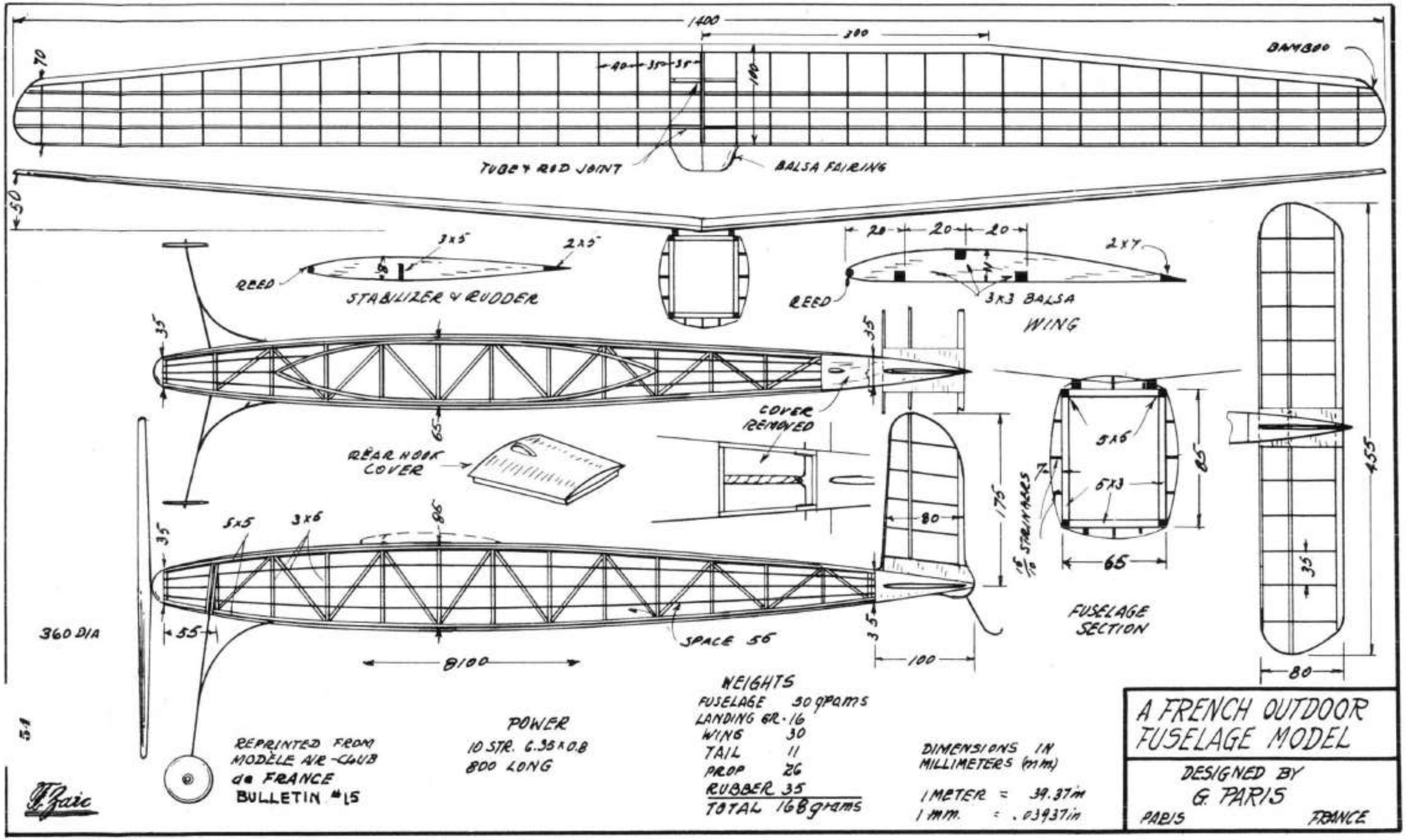

UPTURN TRAIL EDG
40% C
RAF-32-RIBS 1/80
UPTURN TR. EDG. BY GRADUAL STREAMLINING OF RIBS FROM "A" TO "B"
-NOTE- SPAR SIZES FOR ROOT. TPR TO TIPS
1/16 BAMBOO
COVER CENTER SECTION WITH 1/32
MAKE WING IN 2 HALVES
WING AREA - 156 □"
R'Q'D WEIGHT - 3.12 oz.
42
26
BIND & CEMENT
B-B
C-C
-NOTE- LONGERONS 3/32
BULKHEADS 1/16 LAM.
SHELL-8 PATTERNS OF 1/32 SHEET BALSA
1/16 ON BOTH SIDES
1" DIA.- COVER WITH CELLOPHANE WHEN RUBBER IS IN
1/4 x 1/8 x 5 1/4 BAM.
C.G.
SNAP
WASHER
WINDING HOOK
#15 BUSHING
3/16 BULHEAD
SLIT TO FIT STABILIZER
BULKHEADS SPACED 2"
RUDDER
SHELL
HOOK
SLIT
A-A
SOLDER
SEE PROP TEXT FOR BEST OUTLINE. SAME FREE @ AS ON TWIN-WIND BY HOOK ON SHAFT
-WEIGHT-
WING .68
PROP .25
FUS 1.66
MOTOR .68
TOTAL 3.27 oz
CLASS-C
OUTDOOR CABIN FUSELAGE
TIME - 1m 30s ON 350 TURNS
DESIGNED BY FRANK ZAIC
NEW YORK N.Y.
10" TREAD
BUSHING WASHER
-NOTE- STAB. IS REMOVABLE. INSERT STAB. TACK TO FUS. REPLACE "C" & CEMENT 1/8 BAM. FROM A TO B
STABILIZER - 1/16" BALSA
F. Zaic

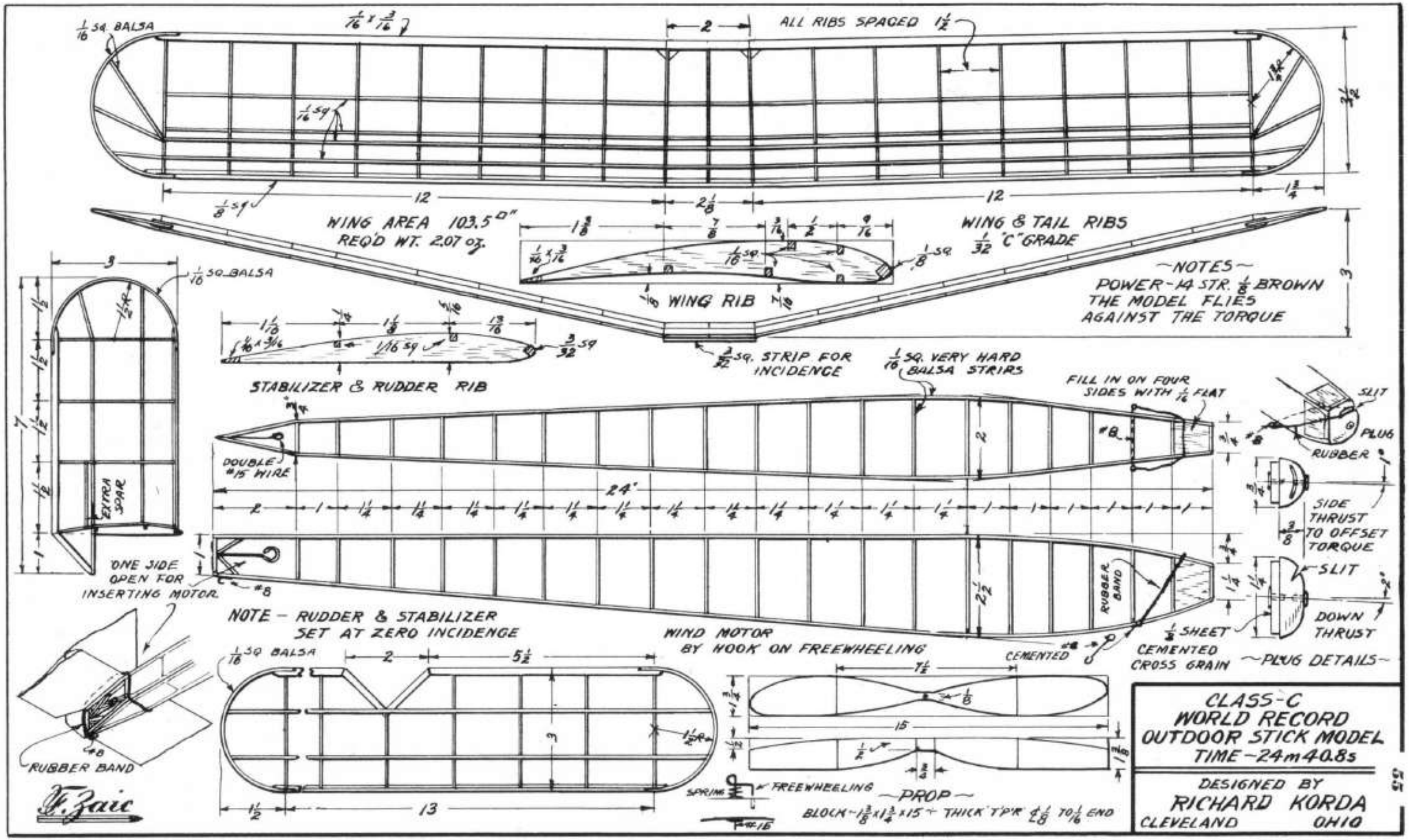


AIRFOIL ORDINATES

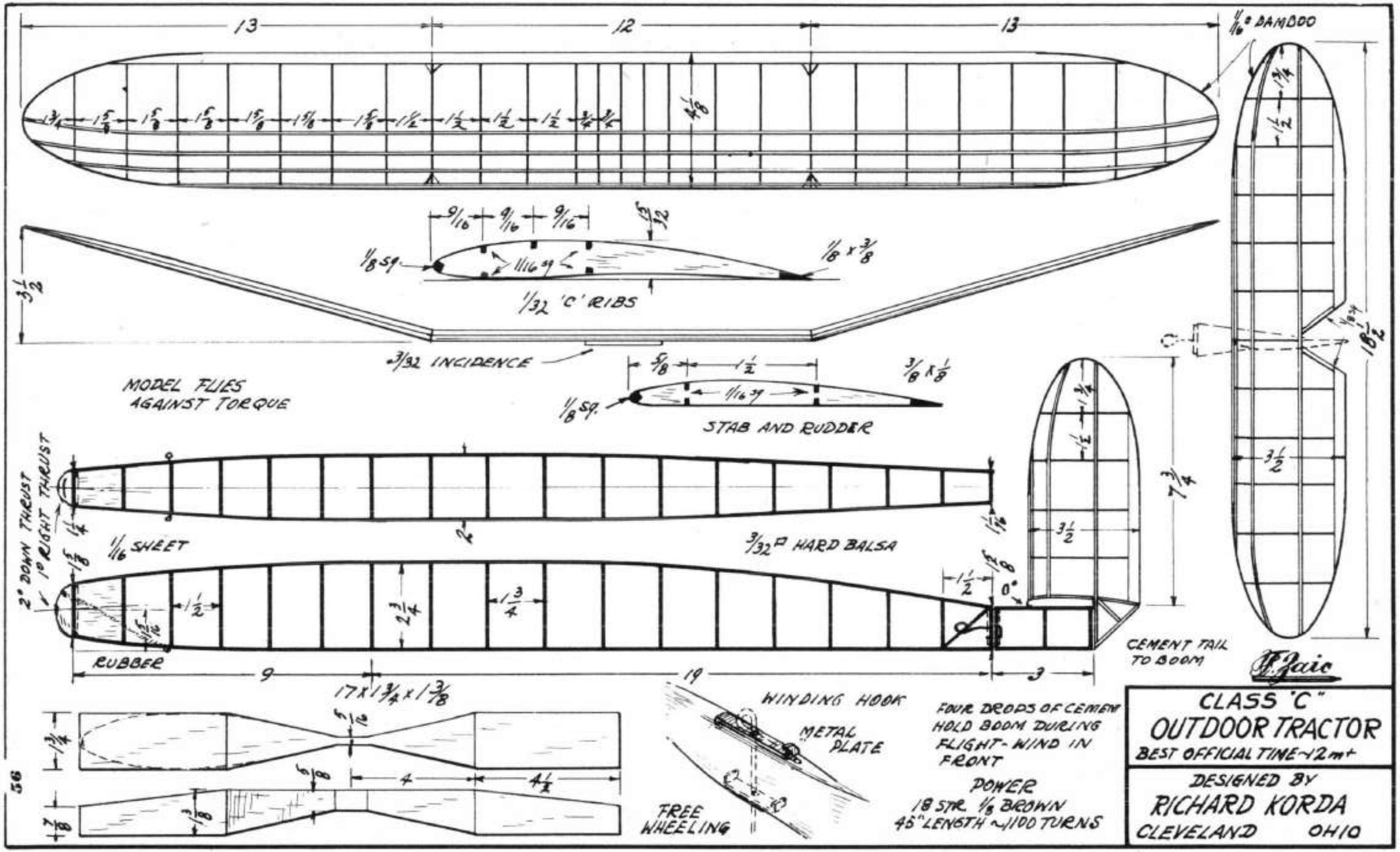
% CH	UPPER	LOWER
0	3	3
1.25	5	2.75
2.5	6.25	1
5	8	.28
7.5	9	.25
10	9.75	.10
15	10.75	0
20	11	0
30	11.50	.15
40	11.30	.90
50	11	1.30
60	10	2.15
70	8	1.50
80	6	1.10
90	3.50	.90
95	2	.45
100	.75	0

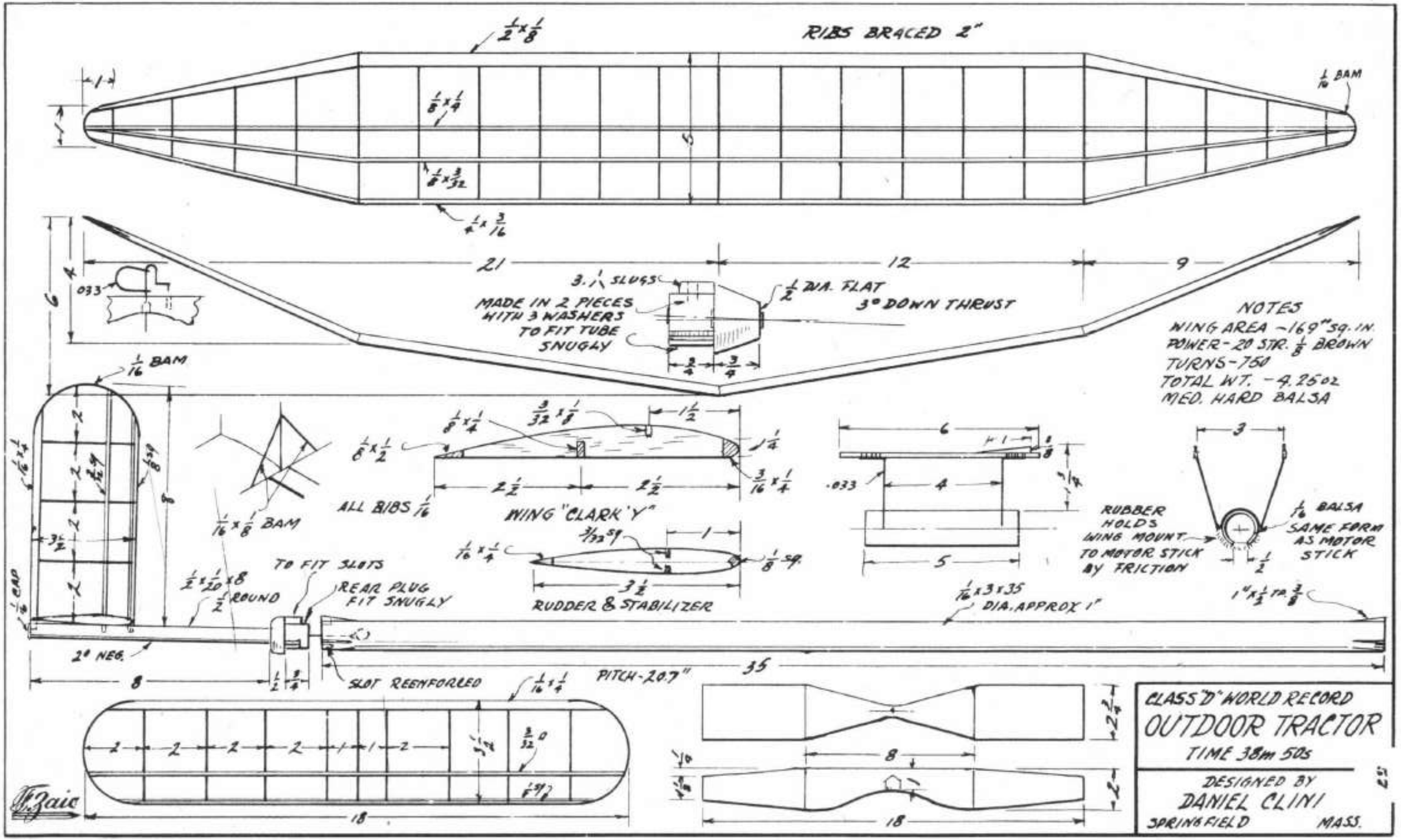


1400
300
BAMBOO
70
40
35
35
100
TUBE & ROD JOINT
BALSA FAIRING
50
3x5
2x5
REED
STABILIZER & RUDDER
20
20
20
2x7
REED
3x3 BALSA
WING
35
35
COVER REMOVED
65
REAR HOOK COVER
175
80
5x6
6x3
85
455
15/10 STRINGERS
65
35
5x5
3x6
86
35
55
360 DIA
SPACE 56
3 5
100
FUSELAGE SECTION
8100
80
WEIGHTS
FUSELAGE 30 grams
LANDING GR. 16
WING 30
TAIL 11
PROP 26
RUBBER 35
TOTAL 168 grams
POWER
10 STR. 6.35 x 0.8
800 LONG
REPRINTED FROM
MODÈLE AIR-CLUB
de FRANCE
BULLETIN #15
DIMENSIONS IN
MILLIMETERS (mm)
1 METER = 39.37in
1 mm. = .03937in
A FRENCH OUTDOOR
FUSELAGE MODEL
DESIGNED BY
G. PARIS
PARIS
FRANCE
51

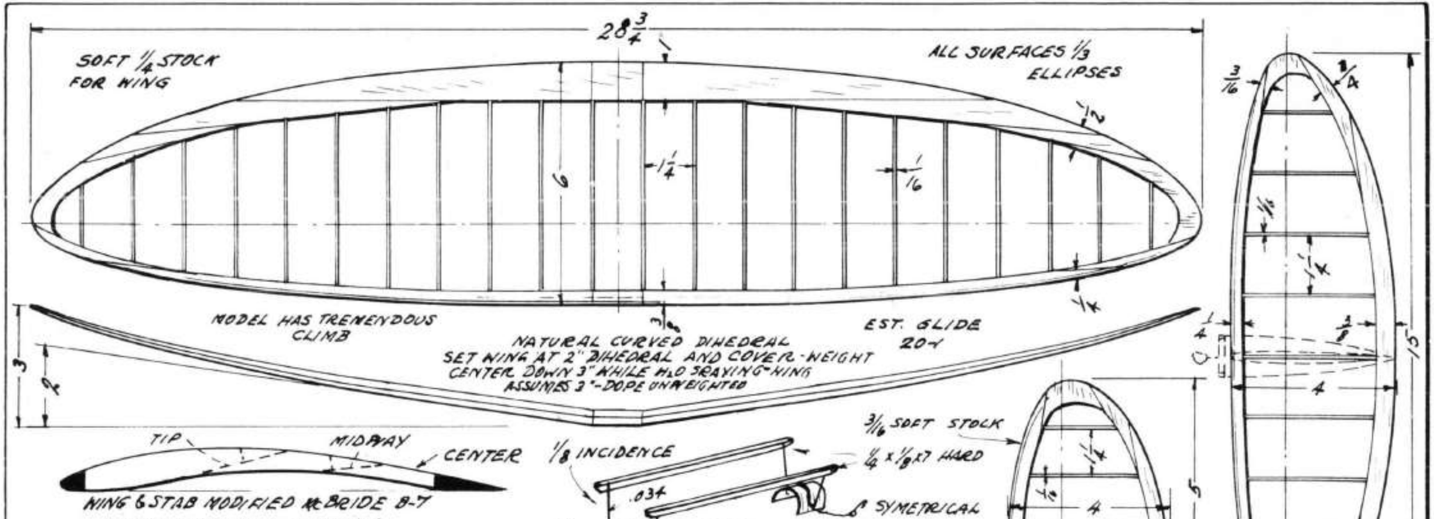


1/16 SQ. BALSA
1/16 x 3/16
ALL RIBS SPACED 1 1/2
1/16 SQ
1/8 SQ
12
2 1/8
12
1 3/4
3 1/2
WING AREA 103.5 □"
REQ'D WT. 2.07 oz.
WING RIB
WING & TAIL RIBS
1/32 "C" GRADE
—NOTES—
POWER – 14 STR. 1/8 BROWN
THE MODEL FLIES
AGAINST THE TORQUE
3/32 SQ. STRIP FOR INCIDENCE
STABILIZER & RUDDER RIB
1/16 SQ
3/32 SQ
1/16 SQ. VERY HARD BALSA STRIPS
FILL IN ON FOUR SIDES WITH 1/16 FLAT
DOUBLE #15 WIRE
24"
EXTRA SPAR
ONE SIDE OPEN FOR INSERTING MOTOR
NOTE – RUDDER & STABILIZER SET AT ZERO INCIDENCE
WIND MOTOR BY HOOK ON FREEWHEELING
RUBBER BAND
CEMENTED
1/8 SHEET CEMENTED CROSS GRAIN
SLIT
PLUG
RUBBER
SIDE THRUST TO OFFSET TORQUE
DOWN THRUST
~PLUG DETAILS~
#8
RUBBER BAND
1/16 SQ BALSA
13
SPRING
FREEWHEELING
~PROP~
BLOCK – 1 3/8 x 1 3/4 x 15 – THICK T'P'R 1/8 TO 1/16 END
#16
CLASS-C
WORLD RECORD
OUTDOOR STICK MODEL
TIME – 24m 40.8s
DESIGNED BY
RICHARD KORDA
CLEVELAND OHIO
F. Zaic


MODEL FLIES AGAINST TORQUE
2° DOWN THRUST
1° RIGHT THRUST
1/16 SHEET
3/32 HARD BALSA
RUBBER
17 X 1 3/4 X 1 3/8
3/32 INCIDENCE
1/32 'C' RIBS
1/8 SQ.
1/16 SQ
1/8 X 3/8
3/8 X 1/8
STAB AND RUDDER
1/16 BAMBOO
1/64
CEMENT TAIL TO BOOM
WINDING HOOK
METAL PLATE
FREE WHEELING
FOUR DROPS OF CEMENT HOLD BOOM DURING FLIGHT - WIND IN FRONT
POWER
18 STR. 1/8 BROWN
45" LENGTH ~1100 TURNS
CLASS "C"
OUTDOOR TRACTOR
BEST OFFICIAL TIME ~12 m+
DESIGNED BY
RICHARD KORDA
CLEVELAND OHIO

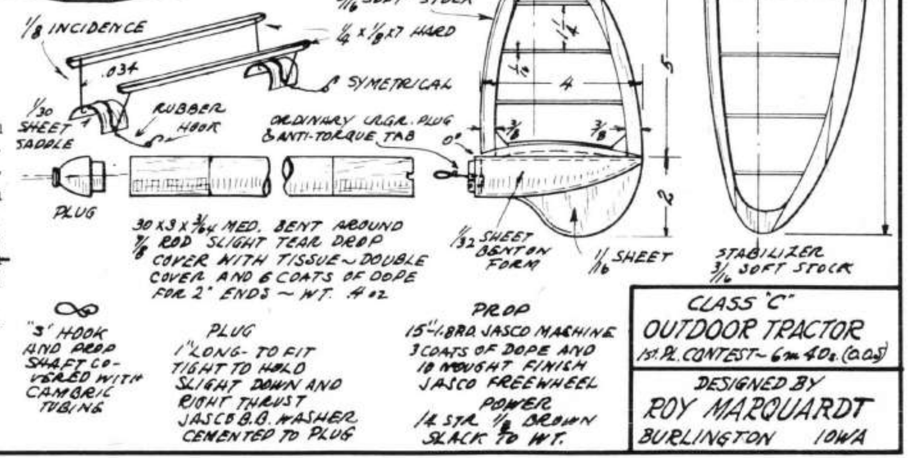

RIBS BRACED 2"
NOTES
WING AREA -169" SQ. IN.
POWER - 20 STR. 1/8 BROWN
TURNS - 750
TOTAL WT. - 4.25 OZ
MED. HARD BALSA
3° DOWN THRUST
MADE IN 2 PIECES WITH 3 WASHERS TO FIT TUBE SNUGLY
WING "CLARK 'Y'"
ALL RIBS 1/16
RUDDER & STABILIZER
RUBBER HOLDS WING MOUNT TO MOTOR STICK BY FRICTION
1/16 BALSA SAME FORM AS MOTOR STICK
TO FIT SLOTS
REAR PLUG FIT SNUGLY
SLOT REENFORCED
PITCH - 20.7"
DIA. APPROX 1"
2° NEG.
CLASS "D" WORLD RECORD
OUTDOOR TRACTOR
TIME 38m 50s
DESIGNED BY
DANIEL CLINI
SPRINGFIELD MASS.

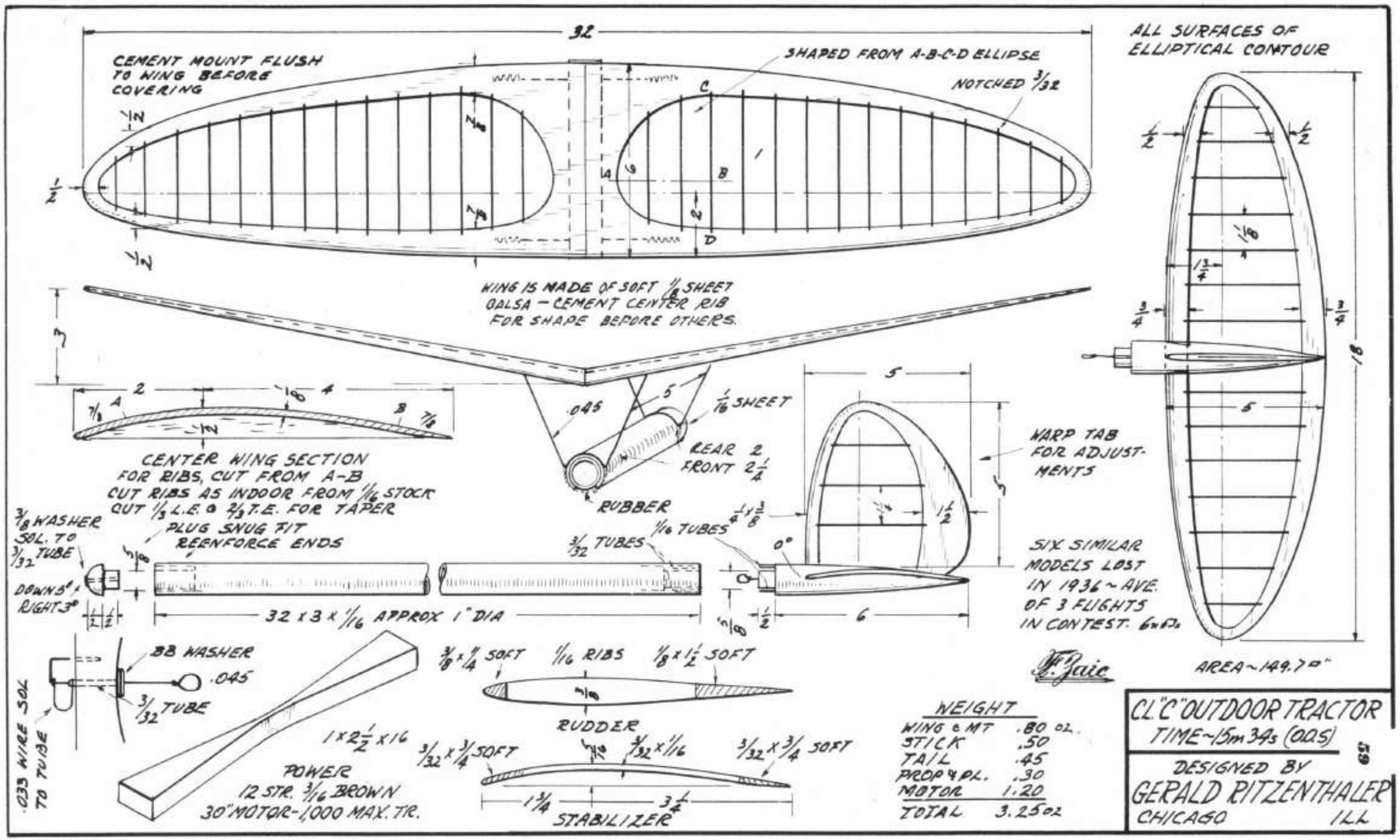
57

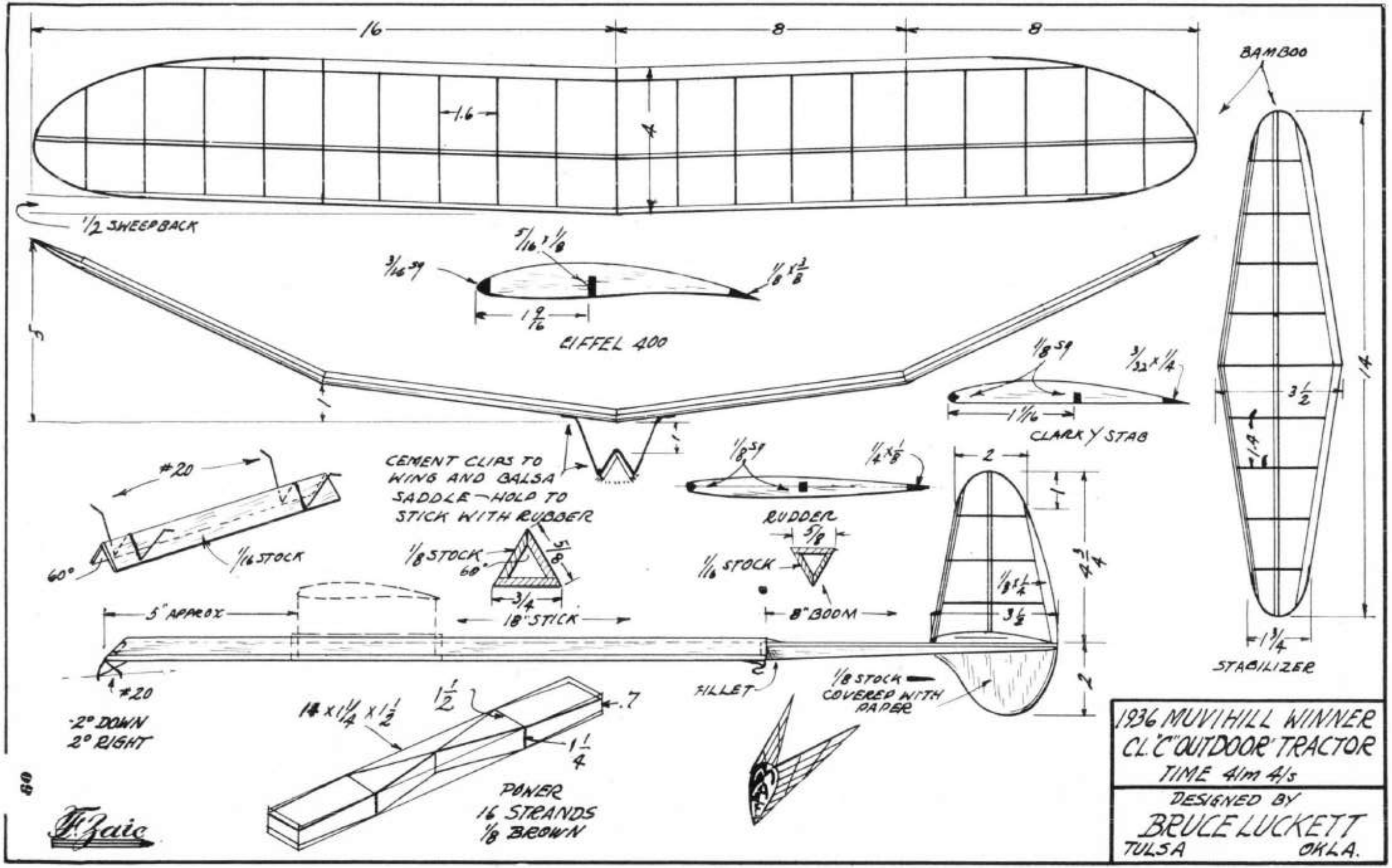


MARQUARDT S-1 AIRFOIL

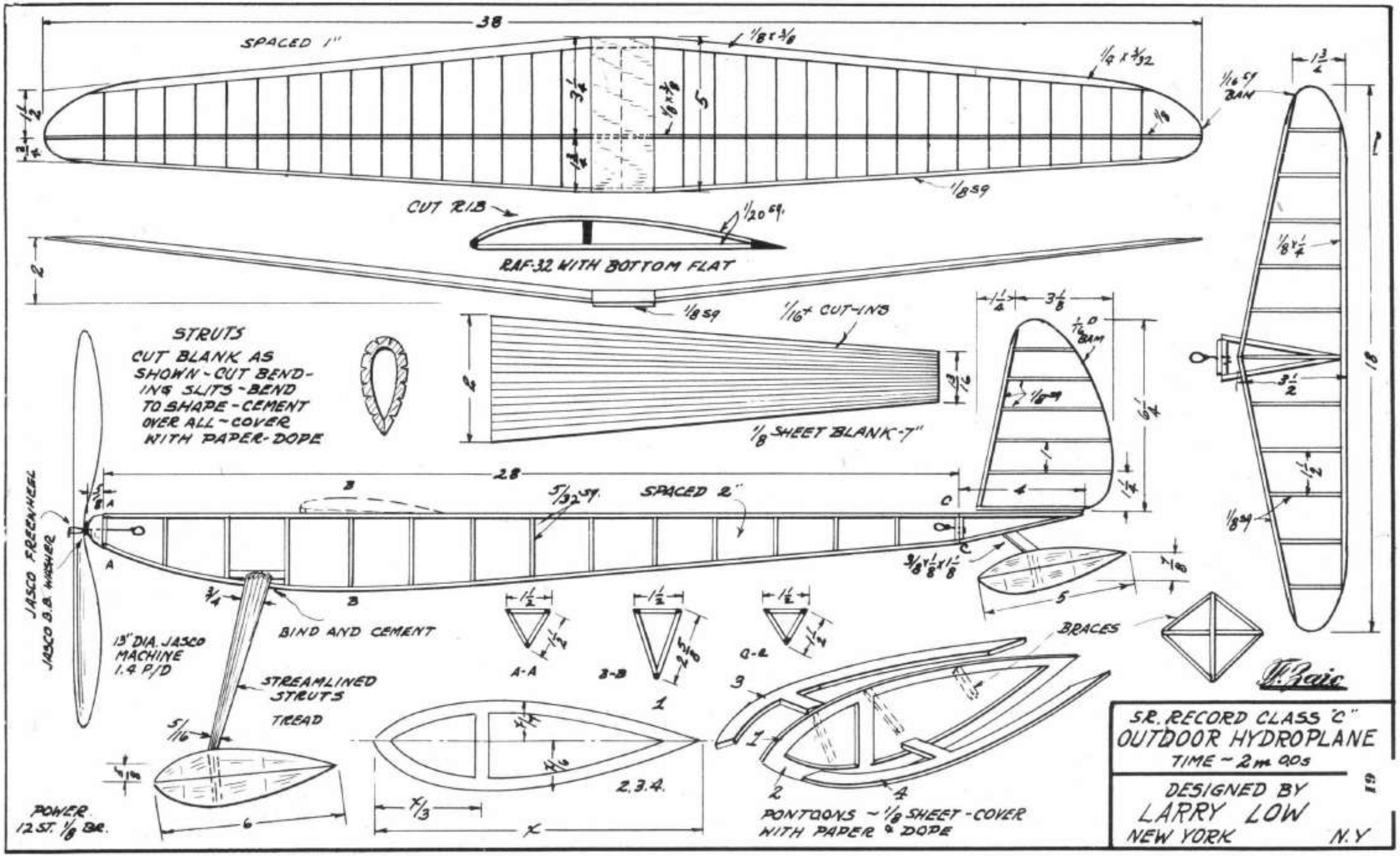
Cut to shape with band or jig saw from balsa block. Slice off 1/16 thick sections with stripper. Cut off for leading edge spar according to position on the span. Cut trailing edge for taper. The upper curve is B-7 and the lower is as shown to provide deep camber in center, a near R.A.F. 32 near mid-way and a streamlined tip. Notice that there is sufficient thickness over the whole span. Section flown in numerous contests to a first place. The idea of using a McBride B-7 for outdoor use originated with one of the Chicago boys.

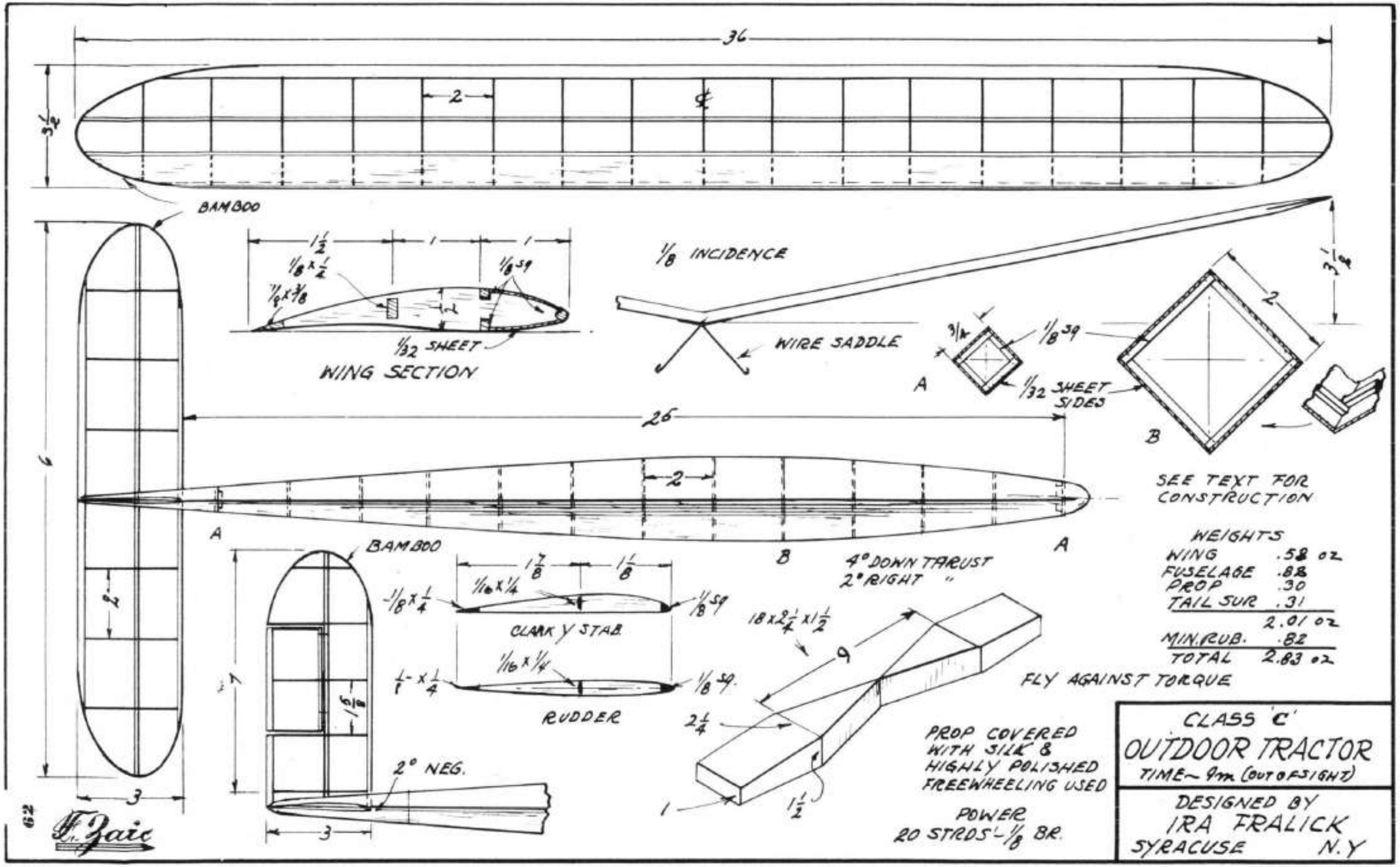



ALL SURFACES OF ELLIPTICAL CONTOUR
CEMENT MOUNT FLUSH TO WING BEFORE COVERING
SHAPED FROM A-B-C-D ELLIPSE
NOTCHED 3/32
WING IS MADE OF SOFT 1/8 SHEET BALSA — CEMENT CENTER RIB FOR SHAPE BEFORE OTHERS.
CENTER WING SECTION
FOR RIBS, CUT FROM A-B
CUT RIBS AS INDOOR FROM 1/16 STOCK
CUT 1/3 L.E. & 2/3 T.E. FOR TAPER
1/16 SHEET
REAR 2
FRONT 2 1/4
RUBBER
WARP TAB FOR ADJUSTMENTS
SIX SIMILAR MODELS LOST IN 1936 ~ AVE. OF 3 FLIGHTS IN CONTEST. 6m 5s.
AREA ~ 149.7 □"
3/8 WASHER SOL. TO 3/32 TUBE
PLUG SNUG FIT
REENFORCE ENDS
DOWN 3°, RIGHT 3°
3/32 TUBES
1/16 TUBES
32 x 3 x 1/16 APPROX 1" DIA
BB WASHER
3/32 TUBE
.033 WIRE SOL. TO TUBE
1 x 2 1/2 x 16
POWER
12 STR. 3/16 BROWN
30" MOTOR - 1,000 MAX. TR.
3/8 x 1/4 SOFT
1/16 RIBS
1/8 x 1 1/2 SOFT
RUDDER
3/32 x 3/4 SOFT
3/32 x 1/16
3/32 x 3/4 SOFT
STABILIZER
WEIGHT
WING & MT .80 oz.
STICK .50
TAIL .45
PROP & PL. .30
MOTOR 1.20
TOTAL 3.25 oz
CL. "C" OUTDOOR TRACTOR
TIME ~ 15m 34s (0.Q.S)
DESIGNED BY
GERALD RITZENTHALER
CHICAGO ILL
59

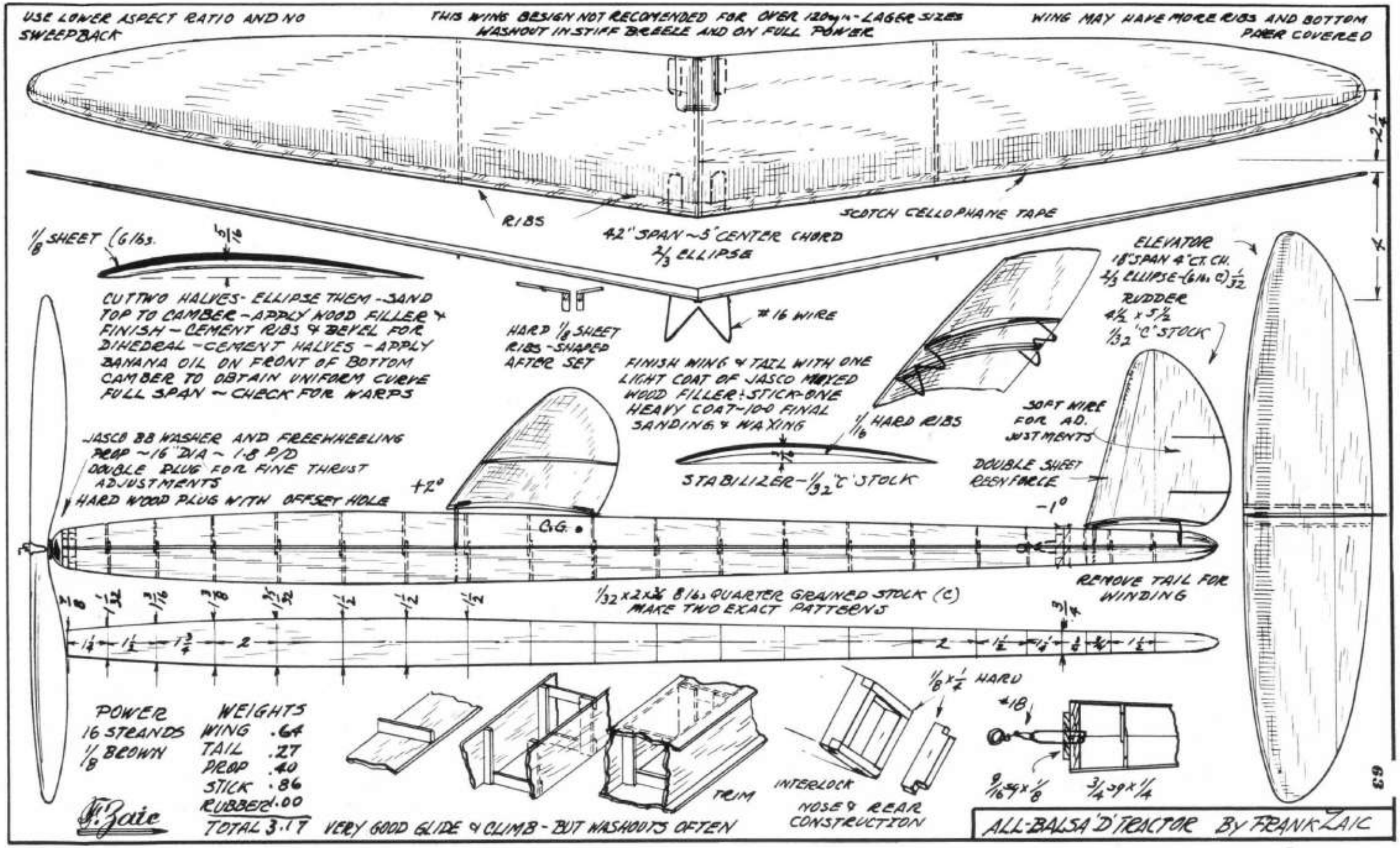


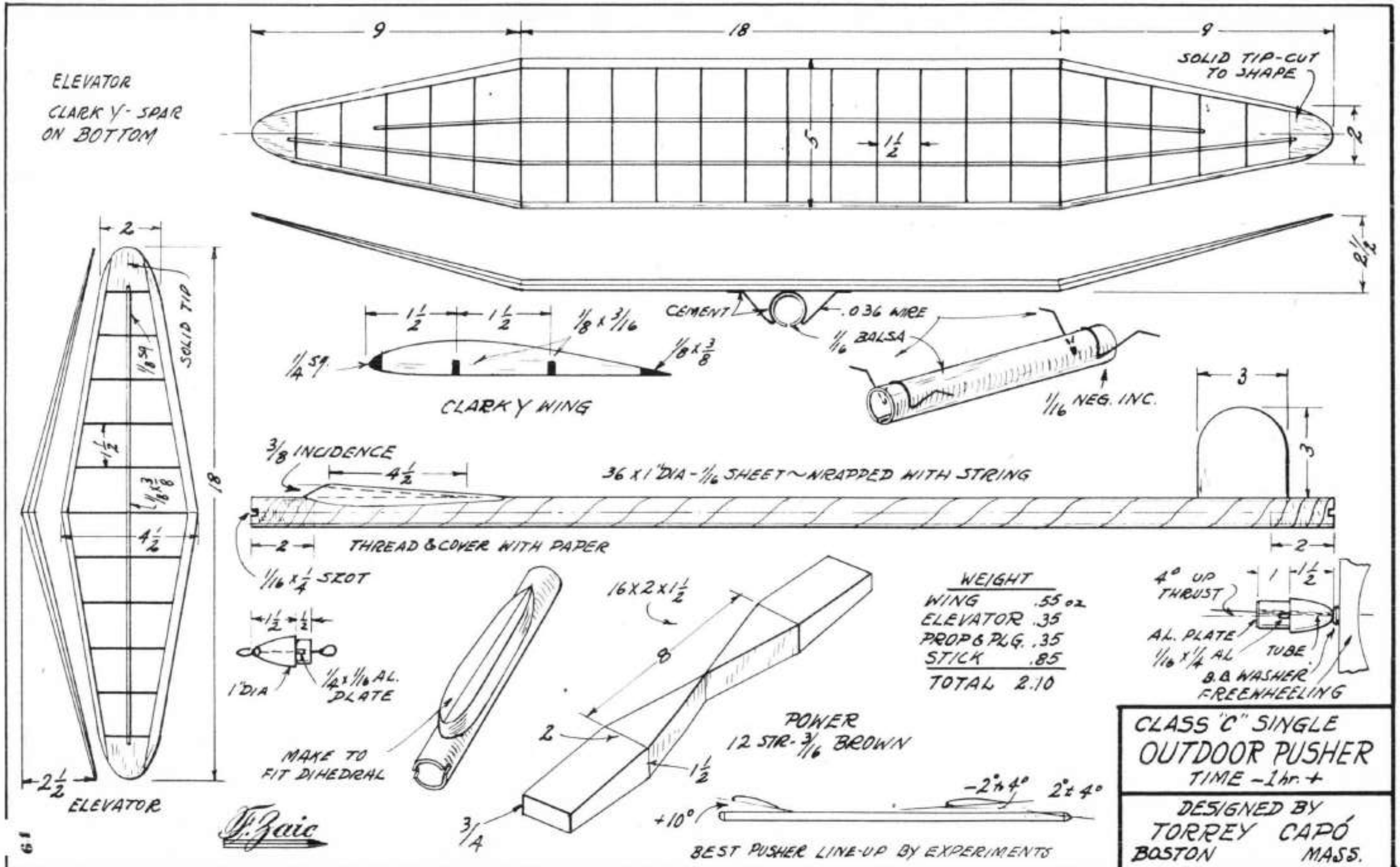
16
8
8
1.6
4
BAMBOO
1/2 SWEEPBACK
5/16 x 1/8
3/16 sq
1/8 x 3/8
1 9/16
EIFFEL 400
5
1
1/8 sq
3/32 x 1/4
1 1/16
CLARK Y STAB
3 1/2
14
1.4
1
1/8 sq
1/4 x 1/8
CEMENT CLIPS TO
WING AND BALSA
SADDLE—HOLD TO
STICK WITH RUBBER
#20
1/16 STOCK
60°
1/8 STOCK
60°
5/8
3/4
RUDDER
5/8
1/16 STOCK
2
1
4 3/4
1/8 x 1/4
3 1/2
5" APPROX
18" STICK
8" BOOM
1 3/4
STABILIZER
#20
FILLET
1/8 STOCK
COVERED WITH
PAPER
2
-2° DOWN
2° RIGHT
14 x 1 1/4 x 1 1/2
1 1/2
.7
1 1/4
POWER
16 STRANDS
1/8 BROWN
1936 MUVIHILL WINNER
CL. "C" "OUTDOOR" TRACTOR
TIME 4 1/m 4/s
DESIGNED BY
BRUCE LUCKETT
TULSA OKLA.
60


SPACED 1"
38
1/8 x 3/8
1/4 x 3/32
1/16 SQ BAM
1/8 SQ
CUT RIB
1/20 SQ
RAF-32 WITH BOTTOM FLAT
STRUTS
CUT BLANK AS SHOWN - CUT BENDING SLITS - BEND TO SHAPE - CEMENT OVER ALL - COVER WITH PAPER - DOPE
1/16 + CUT-INS
1/8 SHEET BLANK - 7"
28
5/32 SQ
SPACED 2"
JASCO FREEWHEEL
JASCO B.B. WASHER
13" DIA. JASCO MACHINE 1.4 P/D
BIND AND CEMENT
STREAMLINED STRUTS
TREAD
BRACES
A-A
B-B
C-C
POWER 12 ST. 1/8 BR.
PONTOONS ~ 1/8 SHEET - COVER WITH PAPER & DOPE
S.R. RECORD CLASS "C"
OUTDOOR HYDROPLANE
TIME ~ 2m 00s
DESIGNED BY
LARRY LOW
NEW YORK
N.Y.



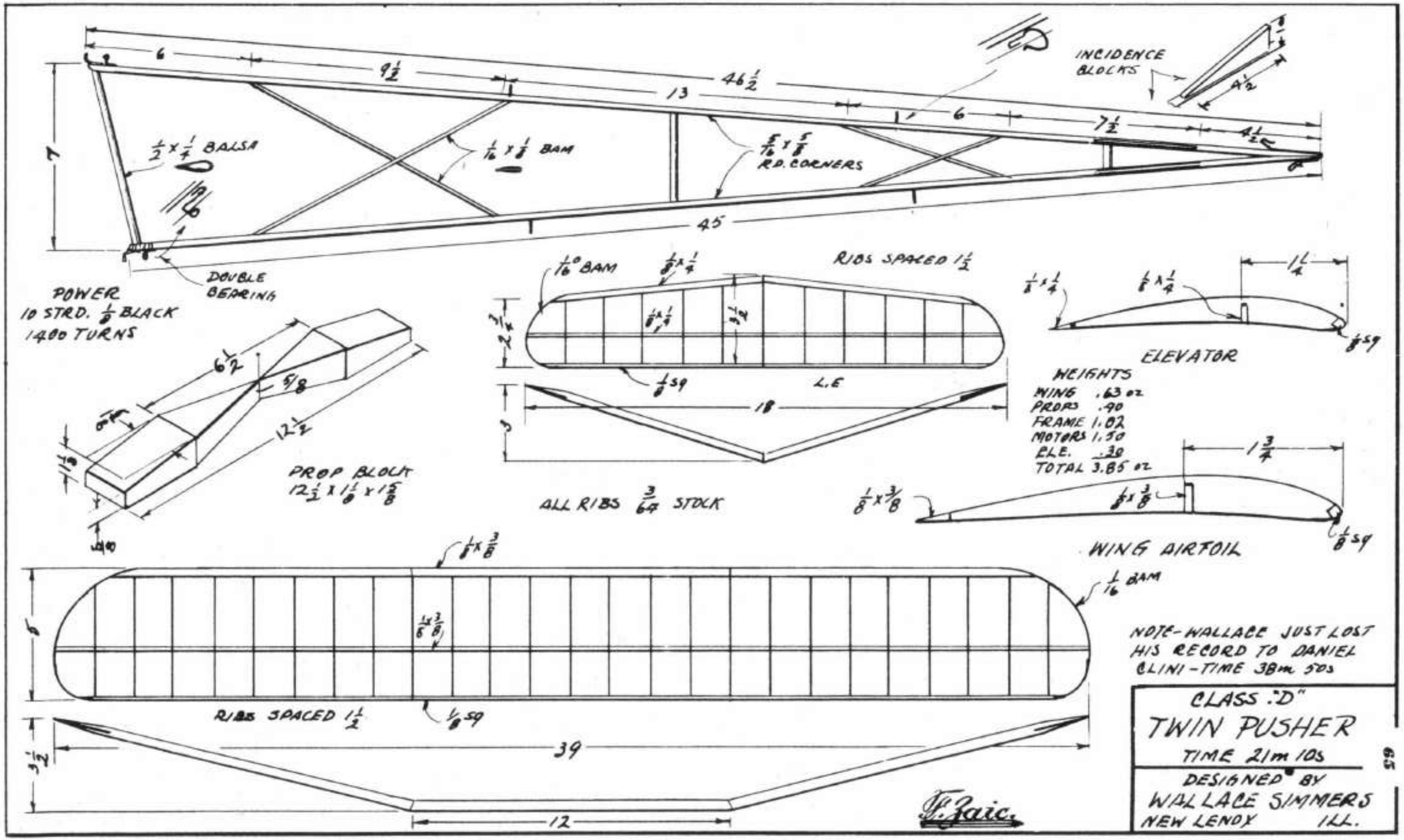
36
2
℄
3 1/2
BAMBOO
6
2
3
1 1/2
1
1
1/8 x 1/2
1/8 x 3/8
1/8 SQ
1/32 SHEET
WING SECTION
1/8 INCIDENCE
WIRE SADDLE
3 1/4
3/16
1/8 SQ
1/32 SHEET SIDES
A
B
2
26
2
A
B
A
SEE TEXT FOR CONSTRUCTION
BAMBOO
1 7/8
1 1/8
1/16 x 1/4
1/8 x 1/4
1/8 SQ
CLARK Y STAB.
1/16 x 1/4
1/8 x 1/4
1/8 SQ.
RUDDER
7
1 5/8
2° NEG.
3
4° DOWN THRUST
2° RIGHT "
18 x 2 1/4 x 1 1/2
9
2 1/4
1 1/2
1
WEIGHTS
WING .58 OZ
FUSELAGE .88
PROP .30
TAIL SUR .31
2.01 OZ
MIN. RUB. .82
TOTAL 2.83 OZ
FLY AGAINST TORQUE
PROP COVERED WITH SILK & HIGHLY POLISHED
FREEWHEELING USED
POWER
20 STRDS 1/8 BR.
CLASS 'C'
OUTDOOR TRACTOR
TIME ~ 9m (OUT OF SIGHT)
DESIGNED BY
IRA FRALICK
SYRACUSE N.Y
F. Zaic

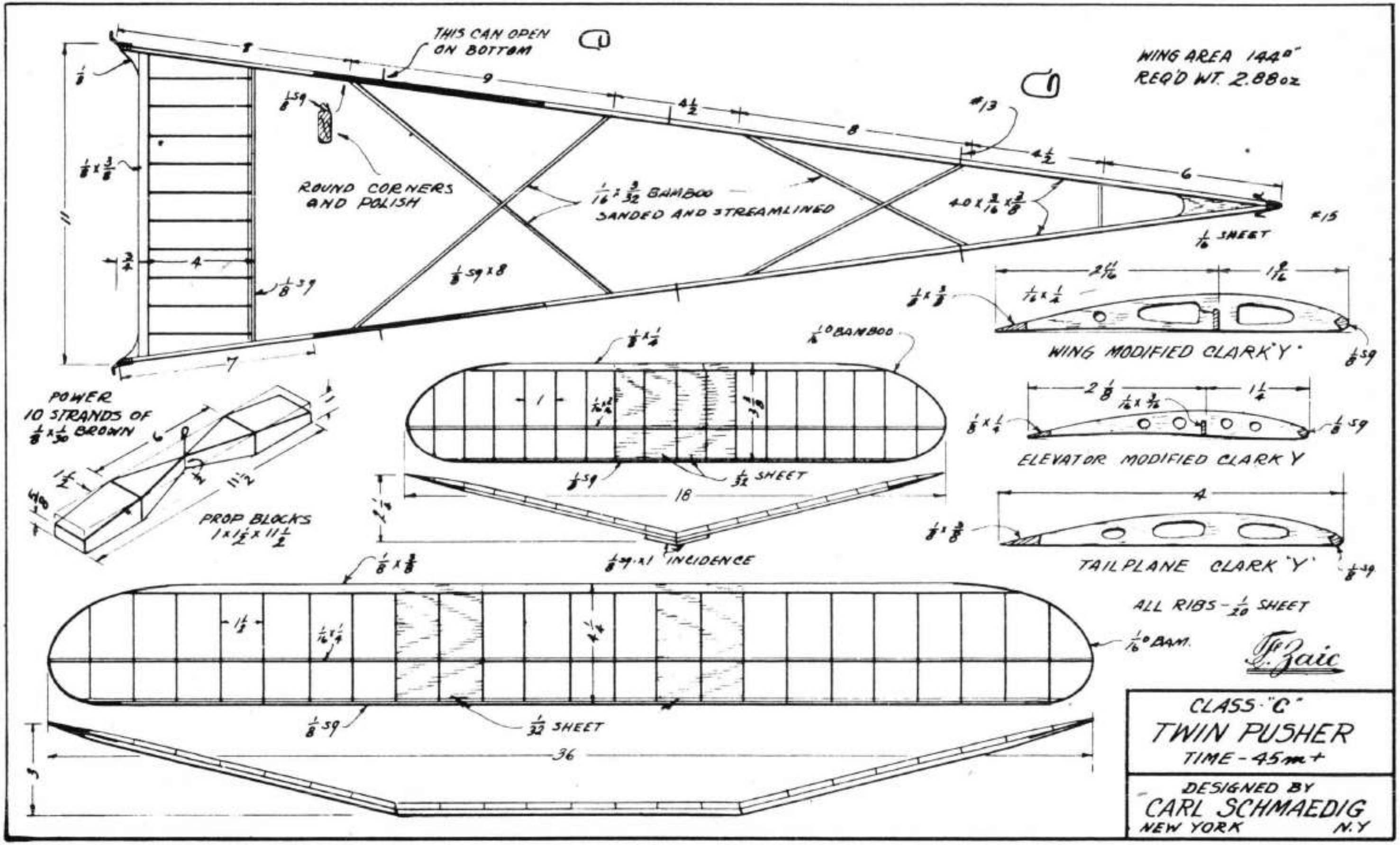

USE LOWER ASPECT RATIO AND NO SWEEPBACK
THIS WING DESIGN NOT RECOMENDED FOR OVER 120 sq in - LAGER SIZES WASHOUT IN STIFF BREEZE AND ON FULL POWER
WING MAY HAVE MORE RIBS AND BOTTOM PAPER COVERED
RIBS
SCOTCH CELLOPHANE TAPE
1/8 SHEET (6 lbs.
42" SPAN ~ 5" CENTER CHORD
2/3 ELLIPSE
CUT TWO HALVES - ELLIPSE THEM - SAND TOP TO CAMBER - APPLY WOOD FILLER & FINISH - CEMENT RIBS & BEVEL FOR DIHEDRAL - CEMENT HALVES - APPLY BANANA OIL ON FRONT OF BOTTOM CAMBER TO OBTAIN UNIFORM CURVE FULL SPAN ~ CHECK FOR WARPS
HARD 1/8 SHEET RIBS - SHAPED AFTER SET
#16 WIRE
FINISH WING & TAIL WITH ONE LIGHT COAT OF JASCO MIXED WOOD FILLER - STICK - ONE HEAVY COAT - 10-0 FINAL SANDING & WAXING
ELEVATOR
18" SPAN 4" CT. CH.
2/3 ELLIPSE - (6 lb. C) 1/32
RUDDER
4½ x 5½
1/32 "C" STOCK
1/16 HARD RIBS
SOFT WIRE FOR AD. JUSTMENTS
JASCO BB WASHER AND FREEWHEELING PROP ~ 16" DIA ~ 1.8 P/D
DOUBLE PLUG FOR FINE THRUST ADJUSTMENTS
HARD WOOD PLUG WITH OFFSET HOLE
+2°
STABILIZER - 1/32 "C" STOCK
DOUBLE SHEET REENFORCE
-1°
C.G.
REMOVE TAIL FOR WINDING
1/32 x 2 x 36 8 lb. QUARTER GRAINED STOCK (C)
MAKE TWO EXACT PATTERNS
POWER
16 STRANDS
1/8 BROWN
WEIGHTS
WING .64
TAIL .27
PROP .40
STICK .86
RUBBER 1.00
TOTAL 3.17
VERY GOOD GLIDE & CLIMB - BUT WASHOUTS OFTEN
TRIM
INTERLOCK
NOSE & REAR CONSTRUCTION
1/8 x 1/4 HARD
#18
9/16 sq x 1/8
3/4 sq x 1/4
F. Zaic
ALL-BALSA 'D' TRACTOR BY FRANK ZAIC

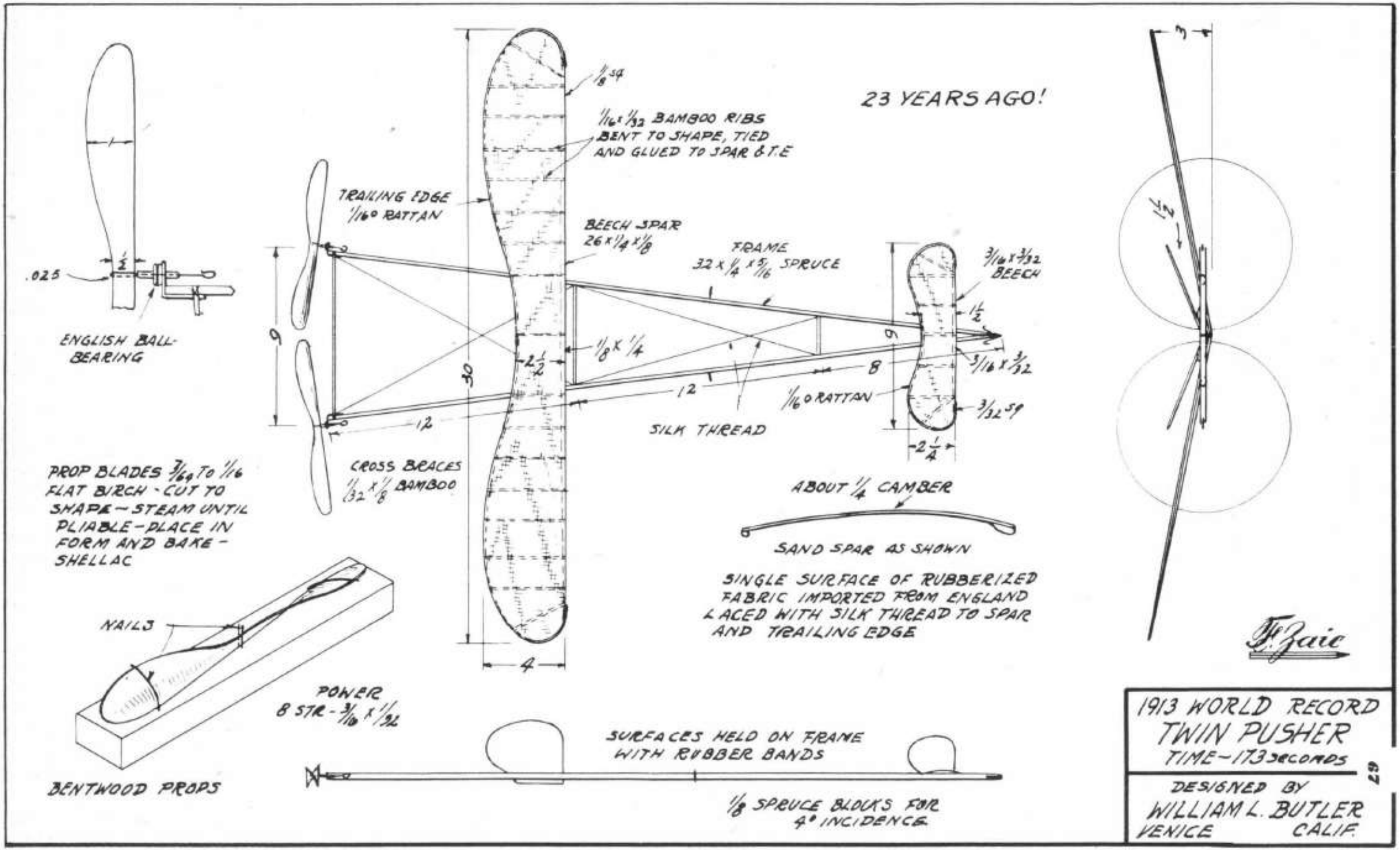


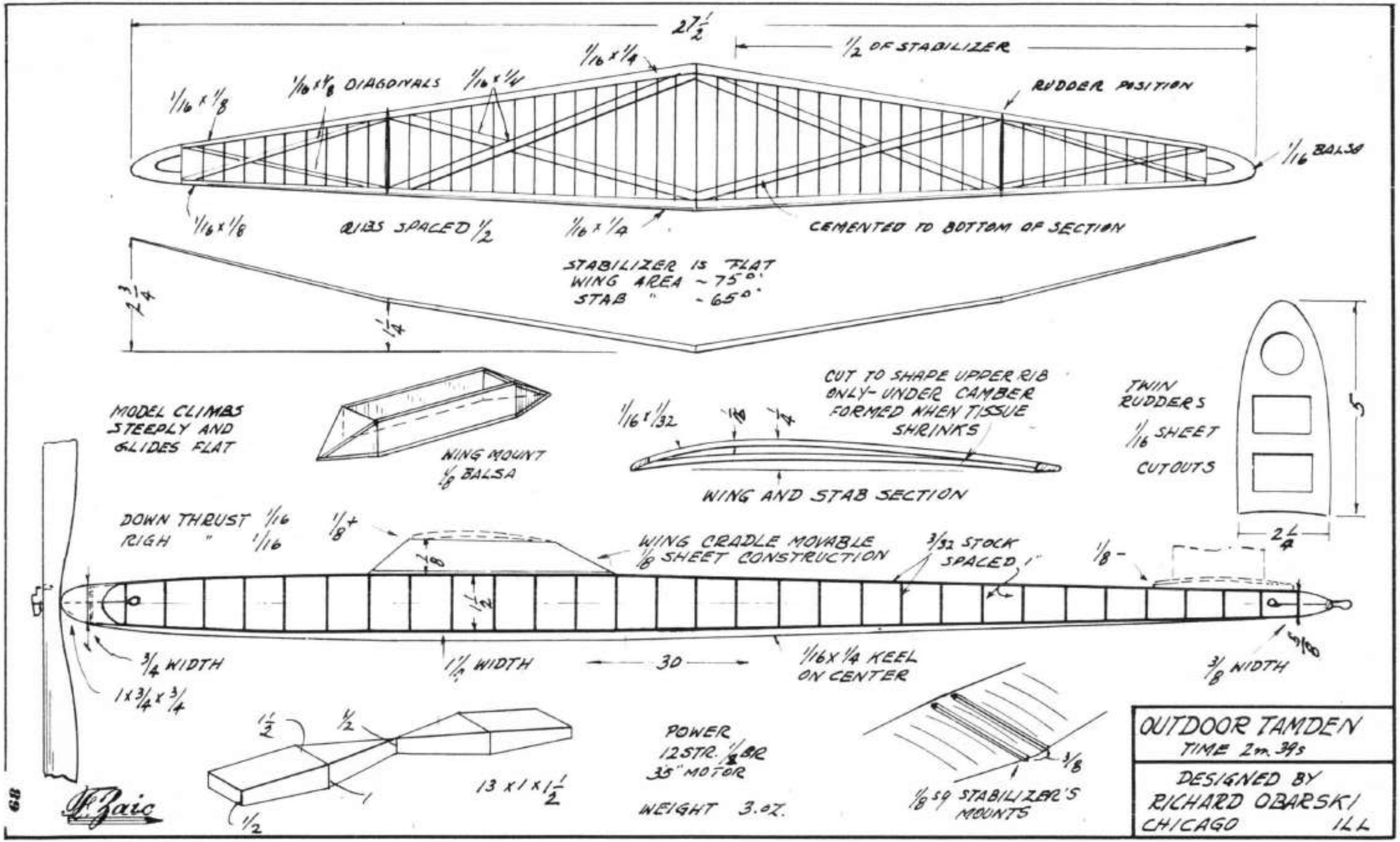
CLASS "C" SINGLE
OUTDOOR PUSHER
TIME - 1 hr. +

DESIGNED BY
TORREY CAPÓ
BOSTON MASS.


INCIDENCE BLOCKS
46 1/2
6
9 1/2
13
6
7 1/2
4 1/2
1/2 x 1/4 BALSA
1/16 x 1/8 BAM
5/16 x 5/8 RD. CORNERS
45
DOUBLE BEARING
POWER
10 STRD. 1/8 BLACK
1400 TURNS
6 1/2
5/8
12 1/2
PROP BLOCK
12 1/2 x 1 1/8 x 1 5/8
1/16 BAM
1/8 x 1/4
RIBS SPACED 1 1/2
1/8 SQ
L.E
18
ALL RIBS 3/64 STOCK
ELEVATOR
1 1/4
1/8 SQ
WEIGHTS
WING .63 oz
PROPS .90
FRAME 1.02
MOTORS 1.50
ELE. .30
TOTAL 3.85 oz
1 3/4
1/8 x 3/8
WING AIRFOIL
1/16 BAM
RIBS SPACED 1 1/2
39
12
NOTE-WALLACE JUST LOST
HIS RECORD TO DANIEL
CLINI-TIME 38m 50s
CLASS "D"
TWIN PUSHER
TIME 21m 10s
DESIGNED BY
WALLACE SIMMERS
NEW LENOX ILL.
F. Zaic.


THIS CAN OPEN ON BOTTOM
WING AREA 144□"
REQ'D WT. 2.88oz
ROUND CORNERS AND POLISH
1/16 x 3/32 BAMBOO SANDED AND STREAMLINED
1/8 SQ x 8
1/16 SHEET
WING MODIFIED CLARK "Y"
1/16 BAMBOO
ELEVATOR MODIFIED CLARK Y
TAILPLANE CLARK "Y"
POWER 10 STRANDS OF 1/8 x 1/30 BROWN
PROP BLOCKS 1 x 1 1/2 x 11 1/2
1/32 SHEET
INCIDENCE
ALL RIBS - 1/20 SHEET
1/16 BAM.
F. Zaic
CLASS "C"
TWIN PUSHER
TIME - 45m +
DESIGNED BY
CARL SCHMAEDIG
NEW YORK N.Y


23 YEARS AGO!
1/8 SQ
1/16 x 1/32 BAMBOO RIBS
BENT TO SHAPE, TIED
AND GLUED TO SPAR & T.E
TRAILING EDGE
1/16° RATTAN
BEECH SPAR
26 x 1/4 x 1/8
FRAME
32 x 1/4 x 5/16 SPRUCE
3/16 x 3/32
BEECH
.025
1/2
ENGLISH BALL-BEARING
1/8 x 1/4
1/16 O RATTAN
3/32 SQ
SILK THREAD
CROSS BRACES
1/32 x 1/8 BAMBOO
PROP BLADES 3/64 TO 1/16
FLAT BIRCH - CUT TO
SHAPE - STEAM UNTIL
PLIABLE - PLACE IN
FORM AND BAKE -
SHELLAC
ABOUT 1/4 CAMBER
SAND SPAR AS SHOWN
SINGLE SURFACE OF RUBBERIZED
FABRIC IMPORTED FROM ENGLAND
LACED WITH SILK THREAD TO SPAR
AND TRAILING EDGE
NAILS
POWER
8 STR - 3/16 x 1/32
SURFACES HELD ON FRAME
WITH RUBBER BANDS
BENTWOOD PROPS
1/8 SPRUCE BLOCKS FOR
4° INCIDENCE
F. Zaic
1913 WORLD RECORD
TWIN PUSHER
TIME - 173 seconds
DESIGNED BY
WILLIAM L. BUTLER
VENICE CALIF.



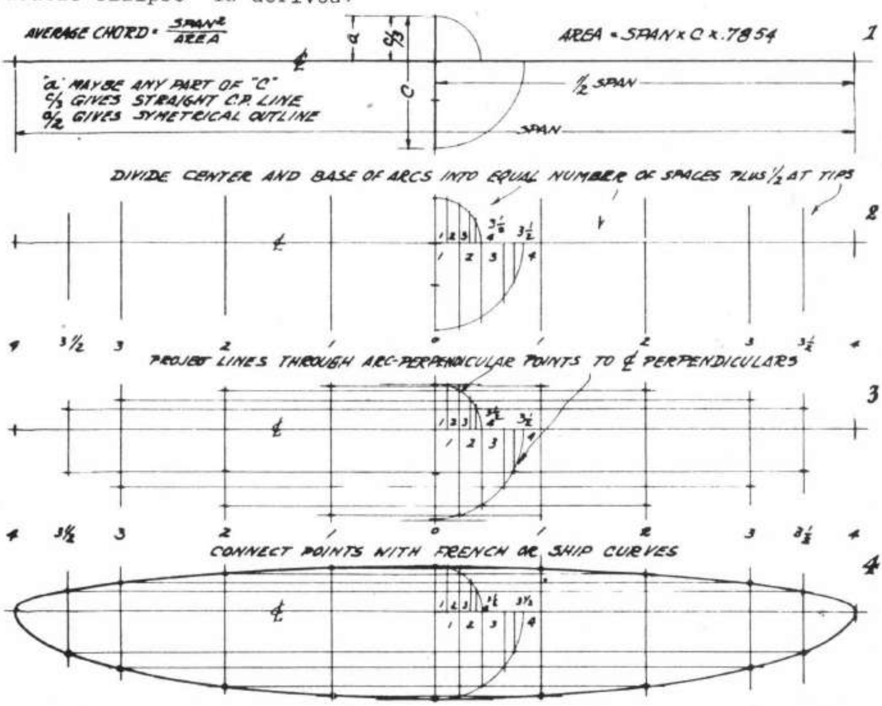
27 1/2
1/2 OF STABILIZER
1/16 x 1/4
1/16 x 1/8 DIAGONALS
1/16 x 1/4
1/16 x 1/8
RUDDER POSITION
1/16 BALSA
1/16 x 1/8
RIBS SPACED 1/2
1/16 x 1/4
CEMENTED TO BOTTOM OF SECTION
STABILIZER IS FLAT
WING AREA ~ 75 □"
STAB " ~ 65 □"
2 3/4
1 1/4
CUT TO SHAPE UPPER RIB ONLY- UNDER CAMBER FORMED WHEN TISSUE SHRINKS
MODEL CLIMBS STEEPLY AND GLIDES FLAT
WING MOUNT 1/8 BALSA
1/16 x 1/32
WING AND STAB SECTION
TWIN RUDDERS
1/16 SHEET
CUTOUTS
5
2 1/4
DOWN THRUST 1/16
RIGH " 1/16
1/8+
7/8
1 1/2
WING CRADLE MOVABLE 1/8 SHEET CONSTRUCTION
3/32 STOCK SPACED 1"
1/8-
3/4 WIDTH
1 x 3/4 x 3/4
1 1/2 WIDTH
30
1/16 x 1/4 KEEL ON CENTER
3/8 WIDTH
1/2
1
13 x 1 x 1 1/2
POWER
12 STR. 1/8 BR
35" MOTOR
WEIGHT 3.OZ.
1/8 sq STABILIZER'S MOUNTS
3/8
OUTDOOR TAMDEN
TIME 2m. 39s
DESIGNED BY
RICHARD OBARSKI
CHICAGO ILL
68

The construction and the flying procedure of the indoor model have been well covered in the preceding Year Book and in numerous articles appearing in the model magazines. Therefore only new hints of the last year have been sketched.

Success in indoor building and flying depends mostly upon the individual. High time can only be attained by knowing how to adjust, as well as how to make strong models with the minimum weight. Fairly good duration may be achieved by most builders, providing that they build a smooth steady model and pay particular attention to adjusting so that the counter forces will be at a minimum.

The most important point to remember when making a model from a plan, is to have all parts the same weight as shown on the plan. An accurate scale is indispensable. But remember, there is a difference between the contest model and the record model. In most cases, the record model was flown under the most favorable conditions, while a contest model usually has to overcome many difficulties, mainly low ceilings and drafts. Therefore, the contest model should be built and designed to meet any expected conditions. For wintry days, the model should be strong, so that it can be handled with stiff, cold fingers. For a low ceiling don't forget to let out turns, and use plenty of slack rubber. By keeping in mind that a contest model does not necessarily have to be a record-breaking one, you should be able to develop a cup-getter suitable for your particular conditions.

The speediest method of laying out the ellipse is to use the method shown by J. P. Glass in the 1935-36 Year Book. Just consider the final double ellipse as being a combination of two halves of the same length but of different widths. It is from this fact that the name "double ellipse" is derived.



A satisfactory microfilm solution can be made from standard good clear lacquer, model dope or a mixture of the two, and the right amount of castor oil or tricresyl phosphate. The last two mentioned are called plasticisers and are used to give the film flexibility. Without flexibility, the film is brittle and breaks very easily and when a tear is made, it spreads very rapidly.

Before pouring any solution on the water it is advisable to check the following points:

The film should be made, if possible, in a tank used exclusively for microfilm. If a bathtub is used, be sure that it is scrupulously clean, as the slightest trace of soap will break up the cohesion of water molecules. If the air is too humid or the water too cold, the film will become smoky, by collecting moisture before drying. A cold draft will also cause this. The water should be of normal summer temperature. Hot water will spread the film, and cold water will retard it.

The lifting hoop should be made of 1/8" diameter aluminum wire. (Costs about 2¢ per foot.)

Have at least six inches of cleared space around the hoop, so that the film spreads evenly over it.

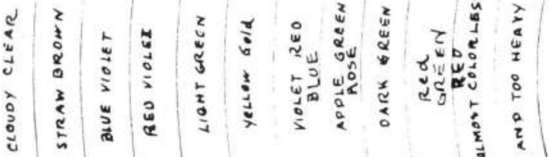
Divide the tank into small portions for small size frames. An unlimited water surface area will tend to spread the film until it is too thin for practical purposes.

It is advisable to have some way of measuring the amount of solution used, as it is possible to get film of the same color time after time, providing the same amount of solution is used on similar space.

Now that we have the proper equipment we can try our solutions. The first solution should be of just clear lacquer. Pour a short, steady stream on the water and watch the film spread. After a while the edges will begin to crinkle and the whole film will begin to contract. This is a sign that not enough plasticiser is present in the solution. More plasticiser is added in small quantities with trial tests in between. The satisfactory solution proportion will be reached when the edges do not contract and the film is not tacky after 3 mins. of drying.

Now that we have the solution we can begin to make the sheets which can be used on the model. The following table shows the colors of the film which should be used on different classes of models.

Blue Violet--ROG tail
Red Violet--ROG wing
Violet Red--Class B and C tails
Apple Green Class B and C wings
Dark Green--Fuselages



The color depends on the amount of solution used and on the water area upon which it is poured.

To make small sheets, the solution can be poured on one spot. For large and long sheets the solution must be poured in a long continuous stream.

Films can be removed from the water by hoop under or above it. Just be sure that the film overlaps the wire and that it does not slip once it is on the hoop. The narrower the hoop, the easier it is to remove the film in one piece. Beginners should not use a hoop more than 10" wide. The film should be removed by gently lifting one side, until it begins to clear the water, and then raising it rapidly, edge first, so that the opposite edge of the hoop leaves the water last. Most of the film that is lost is done so by lifting it too slowly. Never raise the hoop on a level plane, as the water will break or crease the film in the middle.

The film is normally used when the water has evaporated but if you are in a hurry, it can be placed right on the wing frame. The best adhesive is saliva, which is applied only to the outline of the wing or tail surface. A fair adhesive solution can be made from 1 part of rubber cement to 5 parts of benzine. However, this increases the weight as it does not evaporate as completely as the saliva.

The film is applied either by placing the surfaces on it, or by placing the film on the surfaces. The last method is recommended for the beginner. Be sure to have the table area around the wing frame or other parts to be covered, moist so that the film sticks to it and naturally presses on the wing frame.

There are two methods of trimming the film. One is with banana oil or dope on a small brush. The other is with a hot wire or electric soldering iron.

Do not use a very liquid solvent such as acetone as it is liable to run over the spars ruining the covering. The trimming stick or wire should be held about 3/8" from the side of wing frame. The film should melt before the stick, and the edge of it should form a small bead along the spar. Replenish the trimming liquid, or reheat the wire as soon as the film stops melting and touches the trimming medium.

Wings are usually covered in sections, especially if they are large. Smaller wings, such as R.O.G's, can be covered in one operation by the following methods:

1. Cover the wing first and then make the dihedral and crease the surplus film with the breath or water.

2. Divide the film on the hoop and remove the side nearest to the handle. The remaining film is applies as shown on the sketch.

3. Bend the hoop into the dihedral and place the wing on it. In this case the hoop is bent after the film is placed on it. In this case the film is removed from the water by placing the hoop on top of it.

To cement wing sections together, it is best to cement the center portion of the ribs first, and then to bring the spars together.

Microfilm jobs can be transported on long trips by using the packing methods shown below.

12 Nitrate Dope	4 Collodian
1 Castor Oil	2 Amyle Acetate

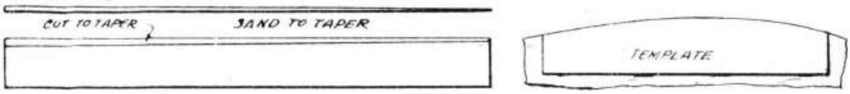
Microfilm Formula used by Mayhew Webster

Note – Lifting film by placing hoop on top was suggested by Joe Hervat Wis.

The sizes of the particular components are shown in the drawings of the record ships.

The spars are tapered by sanding the whole balsa sheet into a taper. The strips or the spars are tapered by slicing them off the sheet at an angle. The final shaping should be done with fine sandpaper.

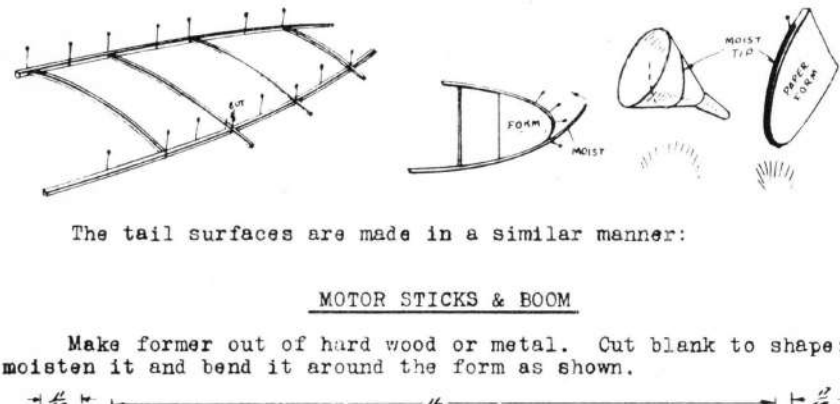
The ribs are sliced from "C" stock balsa sheet, sanded to the required thickness. Use an aluminum, fiber or a bristol board for a template. The ribs are cut to size while assembling the wing.



ASSEMBLING THE WING

Draw the full size plan of the wing on a piece of corrugated board. Stick pins on the spar line just opposite the rib lines. Place the spars on the outline and hold them in place with pins. Cement all the ribs to the leading edge. When dry, trim the ribs by snipping off the part that overlaps the rear spar. Cement in place.

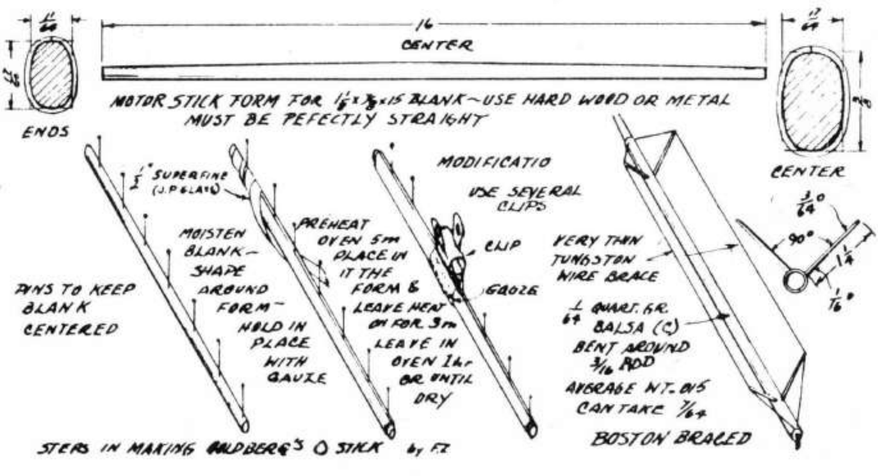
Tips are made by the method shown:

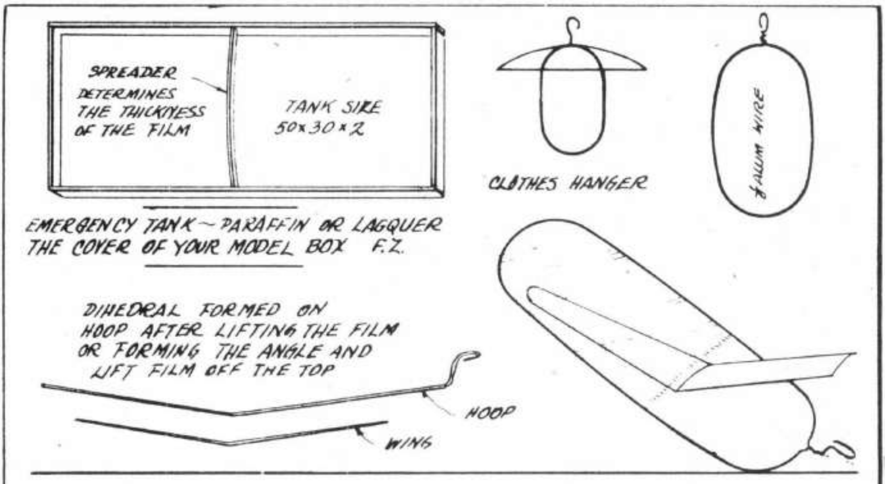


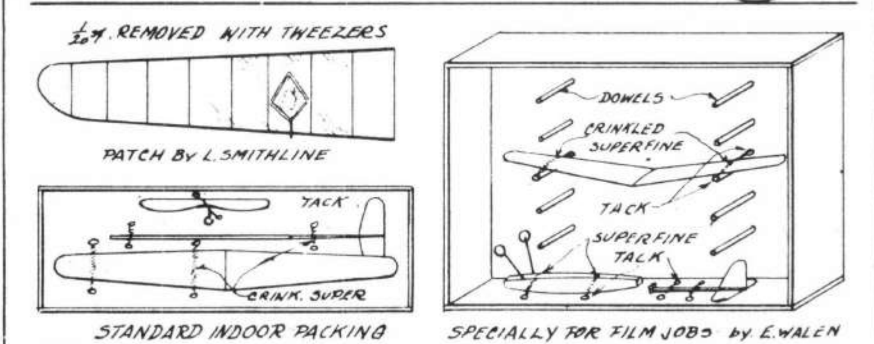
The tail surfaces are made in a similar manner:

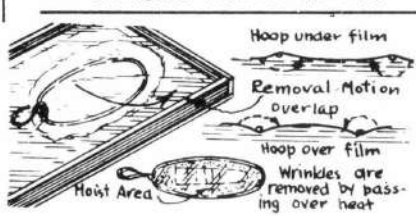
MOTOR STICKS & BOOM

Make former out of hard wood or metal. Cut blank to shape; moisten it and bend it around the form as shown.

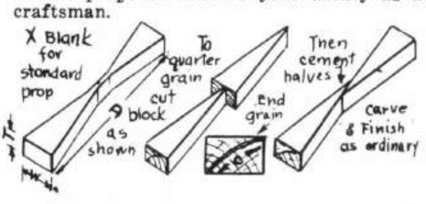






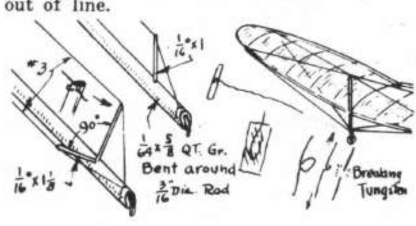


A perfect indoor propeller can be successfully used for years. It should be in balance by weight, blade area, shape and flexing. Carving should never be rushed. Four to six hours is not too long. Cut block to "X" blank and follow the carving system as shown for outdoor props. Use a very sharp knife and carve in long thin slices. Constantly inspect for thinness and avoid "windows". Use every bit of will power to sand away. Your workmanship on the propeller mirrors your ability as a craftsman.



Tungsten Wire has amost twice the strength of ordinary steel wire. It is rustproof; will not stretch under strain and can be obtained in sizes small enough for indoor work. It only has about 1/10th the drag of finest thread.

Successful application requires experience. Use the following suggestions: Work on white paper so you can see the wire. Cement ends to balsa strips for ease in handling. A kink will break wire when pulled. Double end for larger cementing surface. When applying diagonals on mike fuselage do not pull tight or you will get it out of line.

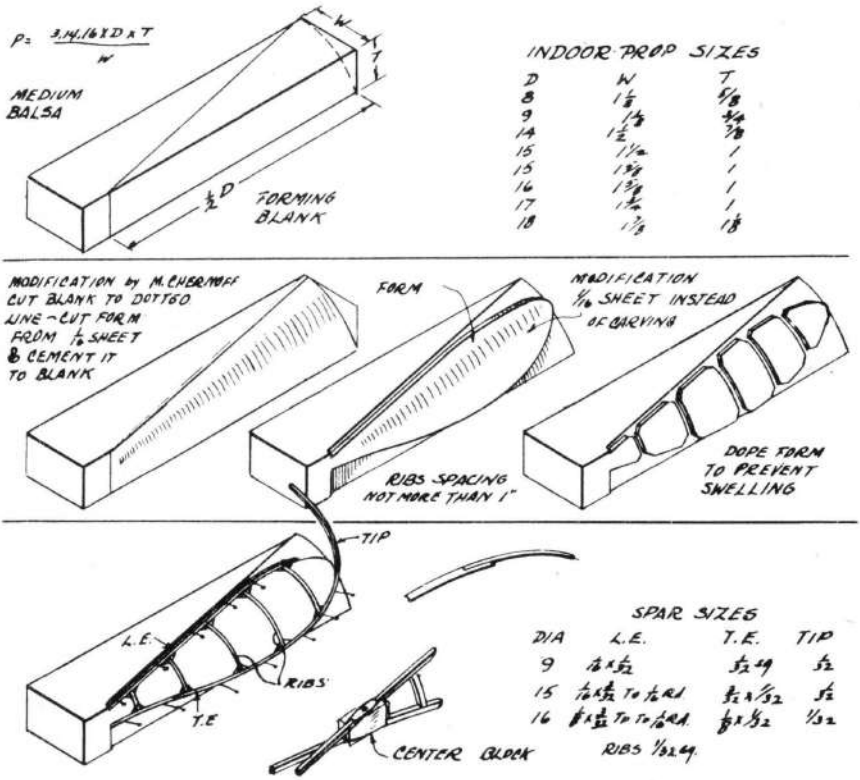


MICROFILM PROPELLERS

Developed By Lawrence Smithline

The advantages of microfilm props are evident, and there is no doubt that they will be used more extensively in the future. The highest time made, up to date, with microfilm prop is the 22m 11s flight which Herbert Greenberg made at the 1935 National in St. Louis.

The method of constructing microfilm props, as shown below, has been used for several years and has been proven to be dependable.



ASSEMBLING PROCEDURE

1. Place the L.E. spar as shown and hold it in place with pin. Moisten it so that it will retain its shape when removed.

2. Position the T.E. spar. Moisten the tip and bend it around the form by holding it at the extremity. Always have pressure on it or it will kink and spoil the job. Hold it in place with pin.

3. Let the spars dry and cut ribs while waiting. All the ribs can be of the same chord.

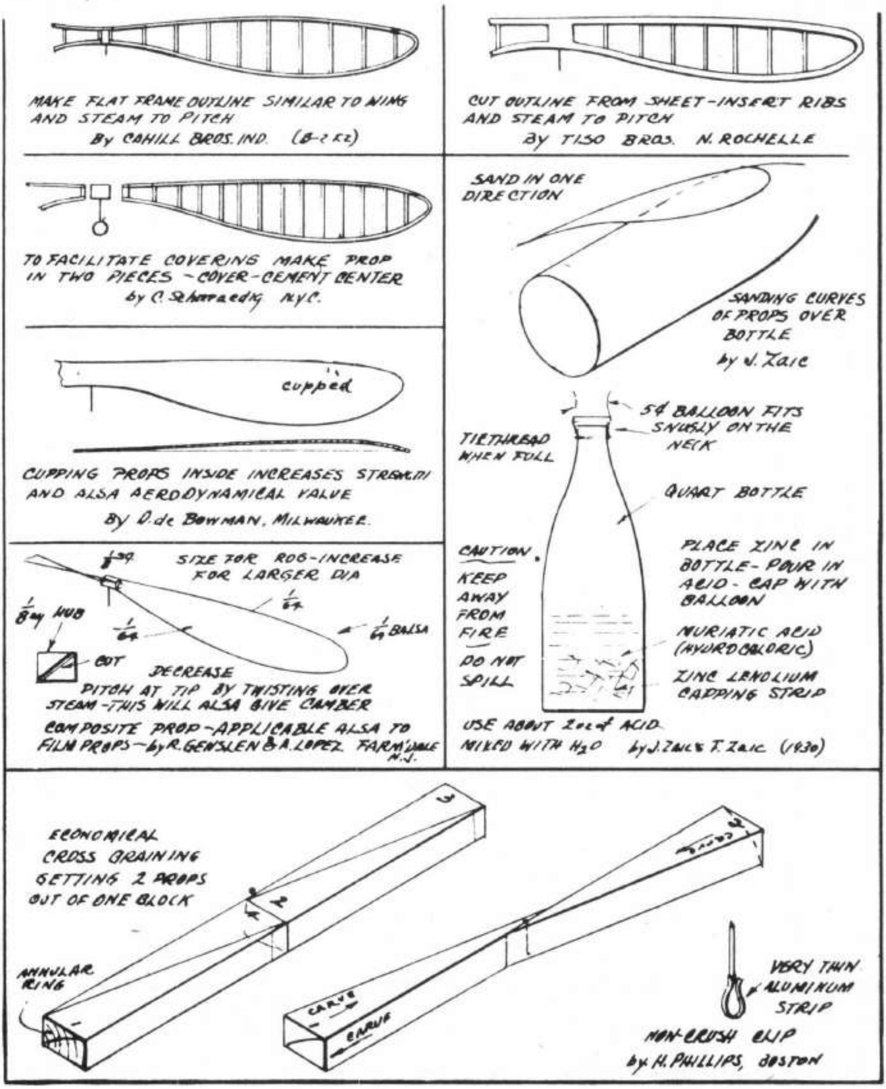
4. Cement the ribs to the L.E. When set, trim the excess at the T.E. with razor or curved scissors. Cement and let dry.

5. Remove the outline and prepare the other blade in similar manner.

6. Attach the two blades to the center block as shown.

Make a rectangular frame of balsa strips. Cover it with film by transferring the film from a regular hoop. (Four hands required for the following operation.) Twist the frame, equivalent to the prop pitch, and have your partner contact the saliva moistened prop outline on the concave side of the frame. (The prop is covered on the outside or convex side. Trim with hot wire or banana oil. Use the same procedure in covering the other blade. Wrinkles can be removed by passing the prop over an electric bulb, soldering iron, or a hot stove.

While using the prop be careful to hold it at the center at all times. It can be patched up by transferring film to it from small hoop of spare film. Superfine will also do in a pinch. Just moisten the area around the break and the film or the paper will adhere to it.



Indoor Pusher ....by Jimmy Throckmorton

There has not been very much written about pusher models, and the hints listed below were found by the tedious but practical "test and try" method, during six years of experimenting with indoor pushers.

1. Have a sturdy elevator and boom. More ships are erratic and unsuccessful because of this than from any other cause. The motor sticks must also be straight and strong, or the ship will almost impossible to adjust.

2. It is of the utmost importance to have the Center of Gravity near the elevator end of the model. This calls for the prop to be as light as possible. The wing, you will find, can be made lighter than a tractor wing, and will still stand up.

3. I have seen dozens of pushers fly well for a minute or two and then begin to spin or settle down prop first. I found that by placing a rudder in front, the flight is normal throughout and is definitely improved. The rudder is needed in the front to balance the side areas caused by the wing and prop. The dihedral of the elevator is usually to small. The rudder in front and below has better control with less area with a consequent saving in weight and a lowering of the C. G. A high Center of Gravity is usually the main fault of most pushers.

4. I balance the torque by offsetting the thrust line and I get my turn with the use of the rudder.

I believe that the pusher stands an equal chance with the tractor. The model shown would tick off 15 minutes consistently. With redesigning and the incorporation of the latest ideas, maximum areas, and a good microfilm prop, the pusher will be able to fly more slowly and will come into the 20 minute class. I hope to demonstrate this fact in the Open class, if time permits.

AERONUTTICS

COPY RIGHT by MAP

"And when I die, I want to go where lubbed knots stay tied."

"The only tree in the place and my model had to hit it!"

Poor Chap; so young; calm most of the time but keeps muttering, "Why! oh why! did I back stroke!"

Air Molecule Altimatum from the city of Airmoleculistia:
"Tit for Tat. You mess us and we will mess you."

"I owe it all to Assco," said Mr. Peguin after his first solo.

It's always swear weather when model builders compete together.

A contestant's greatest asset is his lie-ability.

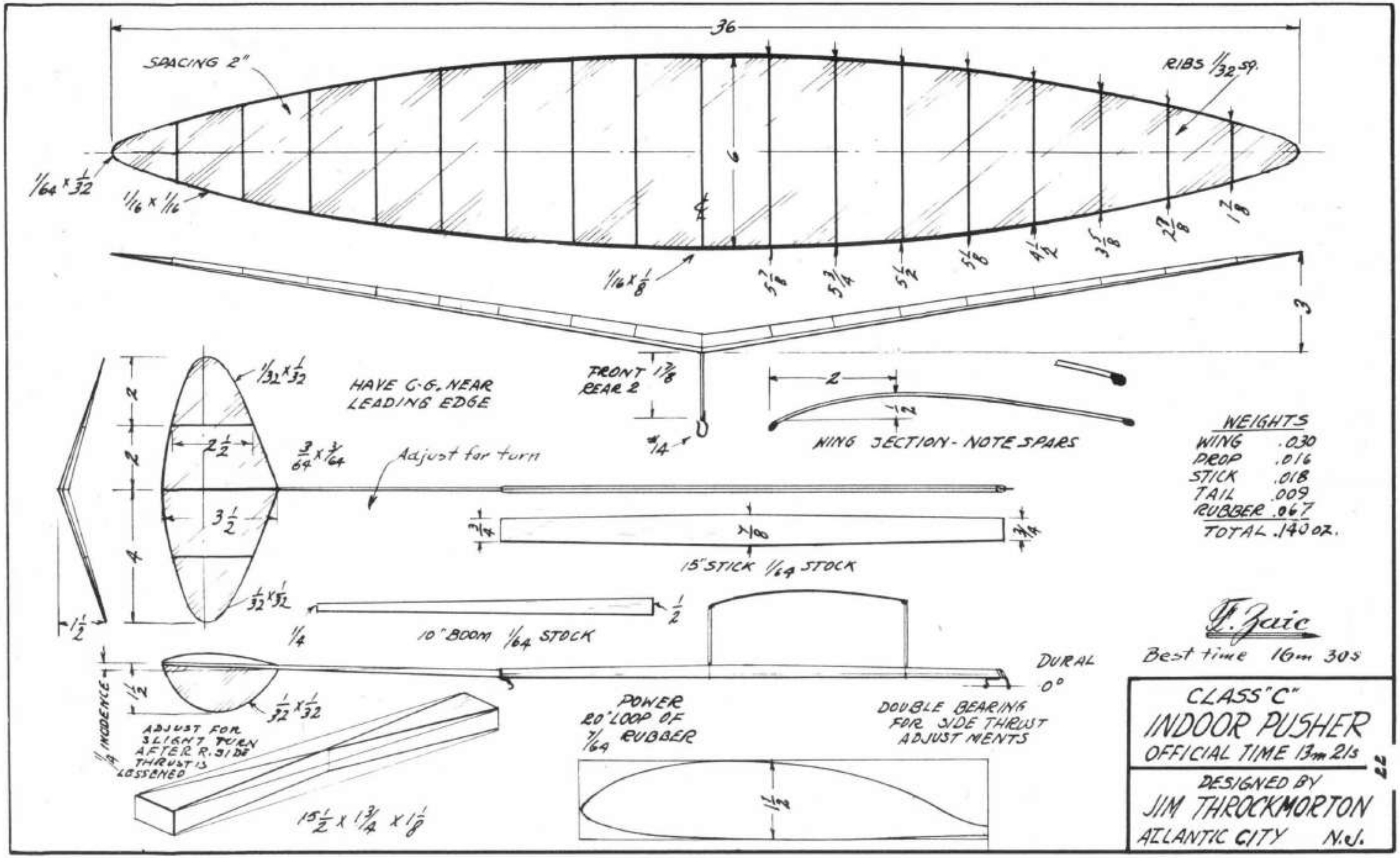
Statiscally speaking: If all model builders were laid end to end, a steam roller would come very handy.

"Oh, so that's dope! I always thought dope was something the pilot had to take before going up."

"All I said was,'It looks nice with all that lacquer but will it fly?' Then his eyes went queer."

Correction: Substitute'GUESSTIMATED' for Scientic Design.
(Merrifield)

"How do you like the new 'ANTI-AIRCRAFT' rules?
(Schumacher)


36
SPACING 2"
RIBS 1/32 SQ.
1/64 x 1/32
1/16 x 1/16
1/16 x 1/8
6
3
FRONT 1 7/8
REAR 2
#14
WING SECTION - NOTE SPARS
HAVE C.G. NEAR
LEADING EDGE
1/32 x 1/32
2 1/2
3 1/2
3/64 x 3/64
Adjust for turn
15" STICK 1/64 STOCK
10" BOOM 1/64 STOCK
WEIGHTS
WING .030
PROP .016
STICK .018
TAIL .009
RUBBER .067
TOTAL .140 OZ.
F. Zaic
Best time 16m 30s
DURAL
0°
1/8 INCIDENCE
ADJUST FOR
SLIGHT TURN
AFTER R. SIDE
THRUST IS
LESSENED
POWER
20" LOOP OF
1/64 RUBBER
DOUBLE BEARING
FOR SIDE THRUST
ADJUSTMENTS
15 1/2 x 1 3/4 x 1 1/8
CLASS "C"
INDOOR PUSHER
OFFICIAL TIME 13m 21s
DESIGNED BY
JIM THROCKMORTON
ATLANTIC CITY N.J.
22

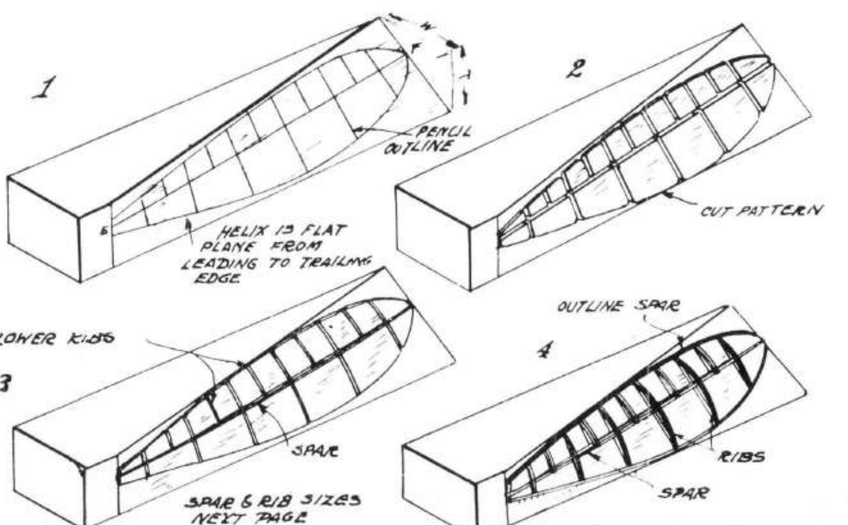
Double-Surfaced Monospar Microfilm Prop

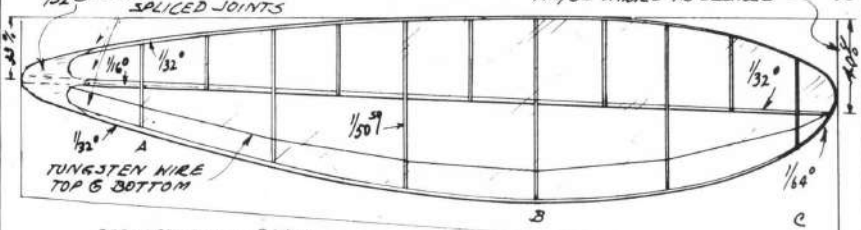
Developed by Sidney Axlerod
Suggested by Carl Goldberg

The propeller design as shown is the sixth of the experimental series. It is $16\frac{1}{2}$" in diameter and weighs only .007 oz.; with a variable pitch device it weighs .015 oz., which is still below the average of the wooden propeller. It has had numerous flight tests and it has proved to be superior to the ordinary microfilm prop. The center spar and the double surfacing remove all the disadvantages formerly attributed to the microfilm prop.

The construction procedure is similar to wing construction, and is comparatively simple if directions are followed faithfully. The result will be a perfectly true and sturdy prop.

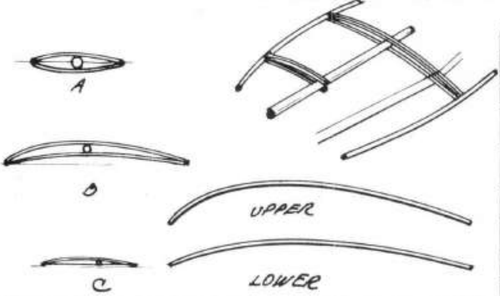
1. Make the form from a block of wood with the desired pitch and diameter dimensions. Cut the helix perfectly flat from the leading to the trailing edge. This is important and should be done carefully.
2. Draw the prop outline and cut the pattern in the wood.
3. Cut the spars and ribs to specification. Note the curve of the center spar to accomodate the undercamber variations. Also note that the ribs are of quarter-grain stock, and that the curve given will fit all points on the diameter.
4. Position the spars on the E-F line, and begin to cement the lower ribs into place. After the lower ribs are set, the upper ones can be cemented. Trim the ends to the outline line.
5. The leading and trailing edges are made of one piece, which is cemented onto the center and leading edge ribs first and then rolled around the form and cemented to the trailing edge ribs.
6. Reenforce the hub with 1/32" balsa as shown, and also cement tungsten to the top and bottom of the ribs to keep the film from sticking together. The prop half is now ready to be removed from the form.
7. Make the other half. Assemble by lapping the hubs for extra strength. Insert the prop shaft and cover with film. After covering let the water adhesive set and dry before trying the prop out. The construction time is about 4 hours, in comparison to the 5-6 hours required for the carving of a wooden propeller.



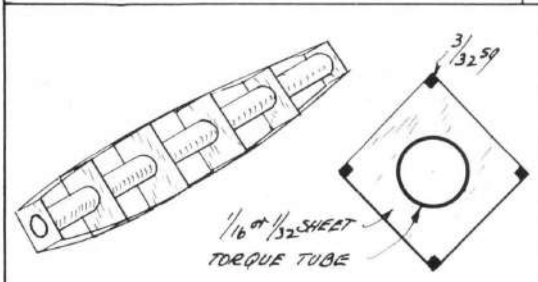


PROPORTIONAL PLAN

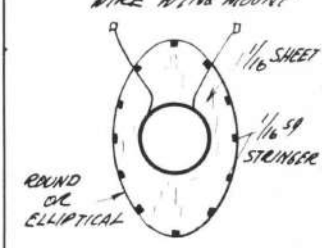
SIDE VIEW OF MAIN SPAR - CURVE NECESSARY FOR CAMBER



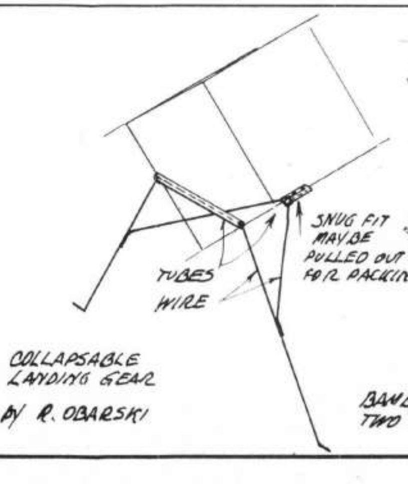
WT. & SIZES FOR 16" DIA PROP		
OBJECT	SIZE	WT.
MAIN SPAR	8×1/16□ to 1/32□	.0015
MAIN RIBS LOWER	1/50□ QT GRAINED	.0003
FALSE RIBS LOWER	1/50□ QT.GR.	.0001
MAIN RIBS UPPER	1/50□ QT.GR.	.0003
FALSE RIBS UPPER	1/50□ QT.GR.	.0001
LEAD. EDGE	8×1/32□ to 1/64□	.0003
TR. EDGE	8×1/32□ to 1/64□	.0003



OUTDOOR FUSELAGE BY JOHN KUBILIS

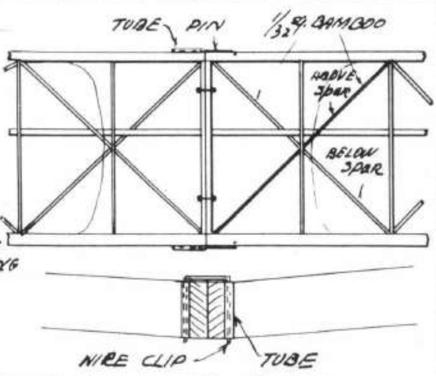


MODIFICATION BY G. RITZENTHALER



COLLAPSABLE
LANDING GEAR

BY R. OBARSKI



BAMBOO BRACED WING & JOINT FOR
TWO PIECE WING BY J. OBARSKI

FLYING AND ADJUSTING INDOOR MODELS

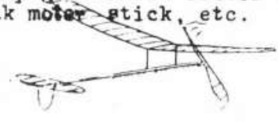
By Carl Goldberg

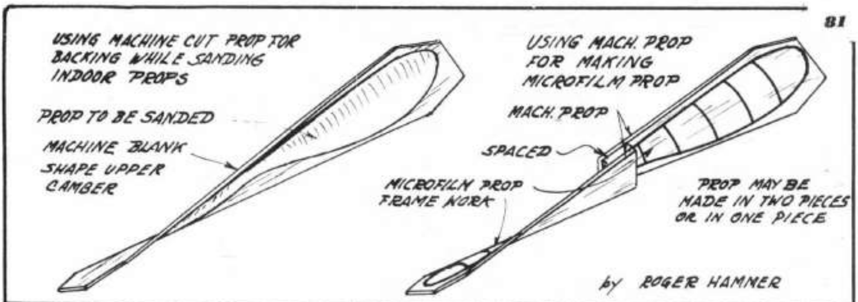
When launching an Indoor Tractor, hold the model in your natural writing hand, placing the thumb and the first finger on the spot where the wire saddle of the rear wing clip encircles the motor stick. The wire will keep your fingers from crushing the stick, and at the same time allow you a firm grip. Inspect the prop shaft to see that there are no knots of rubber which might make the prop wobble in flight. Usually such knots are present when the motor is tightly wound. Pull them toward the center of the shaft hook and grip the rubber with your free hand about $\frac{3}{4}$" from the hook, allowing the rubber in front of your fingers to unwind until the knots disappear. Loosen your grip slowly, letting the winds from the rear come into the front part of the motor, allowing the prop to spin meanwhile. When it is apparent the knot will no longer give trouble, hold the model up in launching position, which is banked over about 10° in the direction in which the model will normally bank, and with the nose pointing up at exactly the same angle at which you expect the model to climb; then push it gently into the air along the line the motor stick is pointing, and at about the speed at which the model flies.

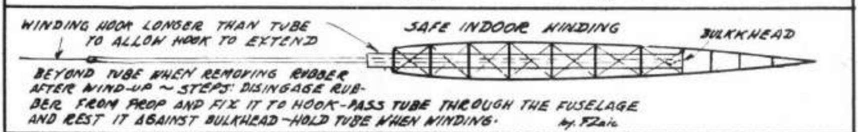
The best method for adjusting that I know is to set the wing in such a position that the model glides well, and flies smoothly on a few hundred turns. Then make a series of test flights starting with about 800 winds, and adding 200 to each flight. If the model shows any stalling tendency on one of the flights bend the bearing slightly so that the prop leans forward very slightly then try again, on the same number of winds. If it works all right, on the next flight again begin adding 200 winds, until you run into more stalling difficulty, which requires a little more of the same medicine. Eventually, by this method you will approach and reach full winds. If the model dives then, bend the bearing back towards its original position a trifle and also turn it so that the prop faces just a shade in the direction in which the ship is to turn.

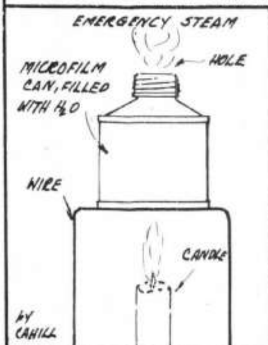
The writer has been asked a great many times about the advantages of a cambered stabilizer as compared with a flat stabilizer. When using a camber, as the angle of attack is increased, the lift developed is greater than the lift for a flat section, providing the areas are equal. For this reason, it is apparent that a cambered stabilizer will have better "anti-stalling" qualities.

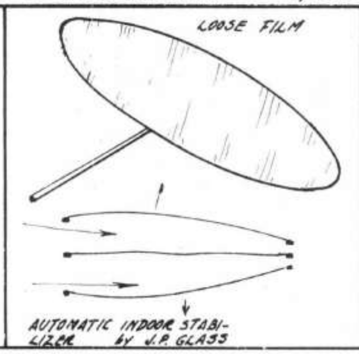
But another, and even more valuable asset of the cambered stabilizer is its use in pulling the ship out of a dive. When a cambered section is set at zero angle or a few degrees negative in the air stream, the section tends to dive. A flat section set at negative angle tends to straighten out to zero degrees. So cambered stabilizers are made with the leading edge just weak enough so that whenever the ship's speed increases, no matter how shallow the dive, the leading edge will bend down, increasing the negative angle of the stabilizer, thus slowing down the ship, and bringing it out of the dive. However, you must be careful to make the leading edge strong enough to withstand the pressure of diving, and rigid enough to maintain its angle when the ship is in normal flight. The proper strength can be found only by experience, as it must not only be strong enough to remain at the proper angle in normal flight, but must also be delicate enough to start assuming a larger negative angle whenever the ship goes a bit faster due to drafts getting under the tail, a weak motor stick, etc.

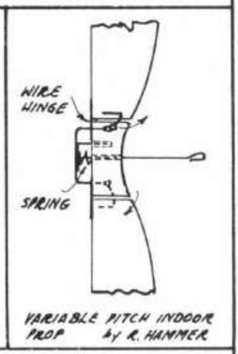


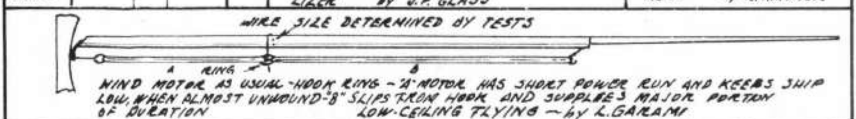

USING MACHINE CUT PROP FOR BACKING WHILE SANDING INDOOR PROPS
PROP TO BE SANDED
MACHINE BLANK
SHAPE UPPER CAMBER
USING MACH. PROP FOR MAKING MICROFILM PROP
MACH. PROP
SPACED
MICROFILM PROP FRAME WORK
PROP MAY BE MADE IN TWO PIECES OR IN ONE PIECE
by ROGER HAMMER

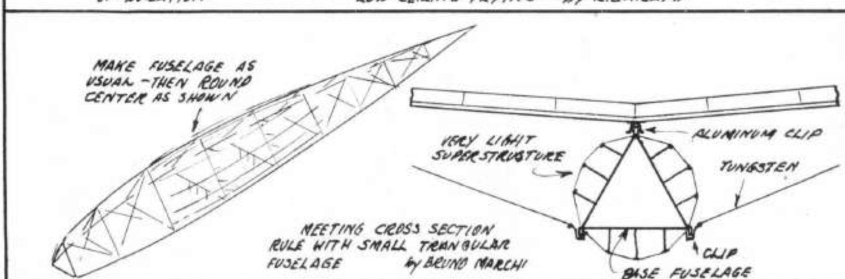

WINDING HOOK LONGER THAN TUBE TO ALLOW HOOK TO EXTEND
SAFE INDOOR WINDING
BULKHEAD
BEYOND TUBE WHEN REMOVING RUBBER AFTER WIND-UP ~ STEPS: DISINGAGE RUBBER FROM PROP AND FIX IT TO HOOK-PASS TUBE THROUGH THE FUSELAGE AND REST IT AGAINST BULKHEAD-HOLD TUBE WHEN WINDING.
by F.Zaic

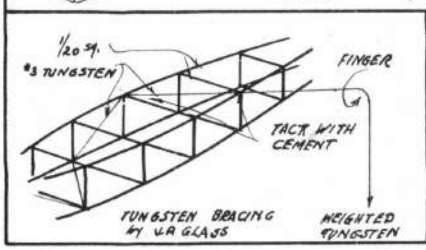

EMERGENCY STEAM
HOLE
MICROFILM CAN, FILLED WITH H2O
WIRE
CANDLE
by CAHILL

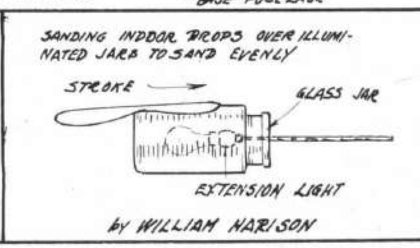

LOOSE FILM
AUTOMATIC INDOOR STABILIZER by J.P. GLASS

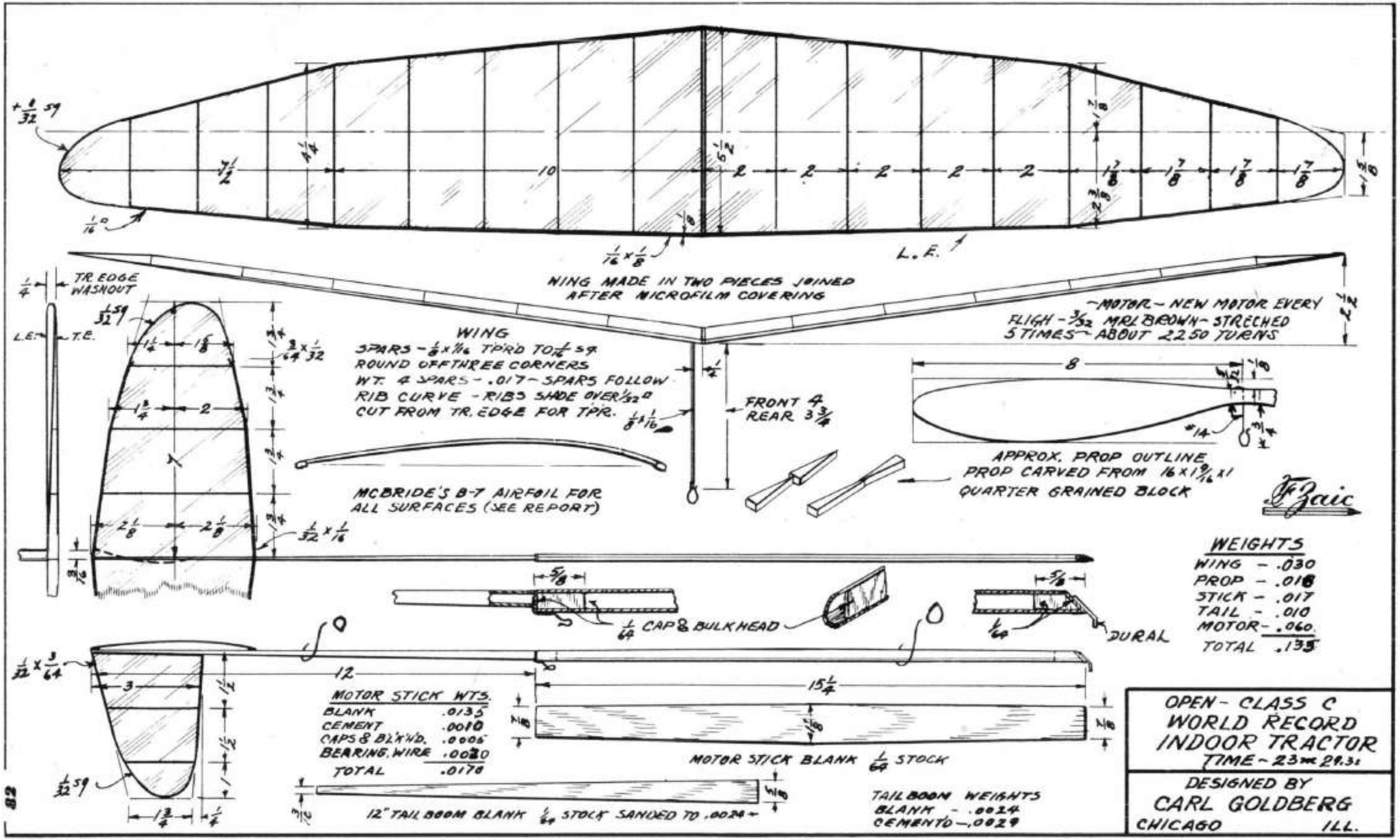

WIRE HINGE
SPRING
VARIABLE PITCH INDOOR PROP by R. HAMMER


WIRE SIZE DETERMINED BY TESTS
A
RING
B
WIND MOTOR AS USUAL-HOOK RING - "A" MOTOR HAS SHORT POWER RUN AND KEEPS SHIP LOW, WHEN ALMOST UNWOUND-"B" SLIPS FROM HOOK AND SUPPLIES MAJOR PORTION OF DURATION
LOW-CEILING FLYING - by L. GARAMI

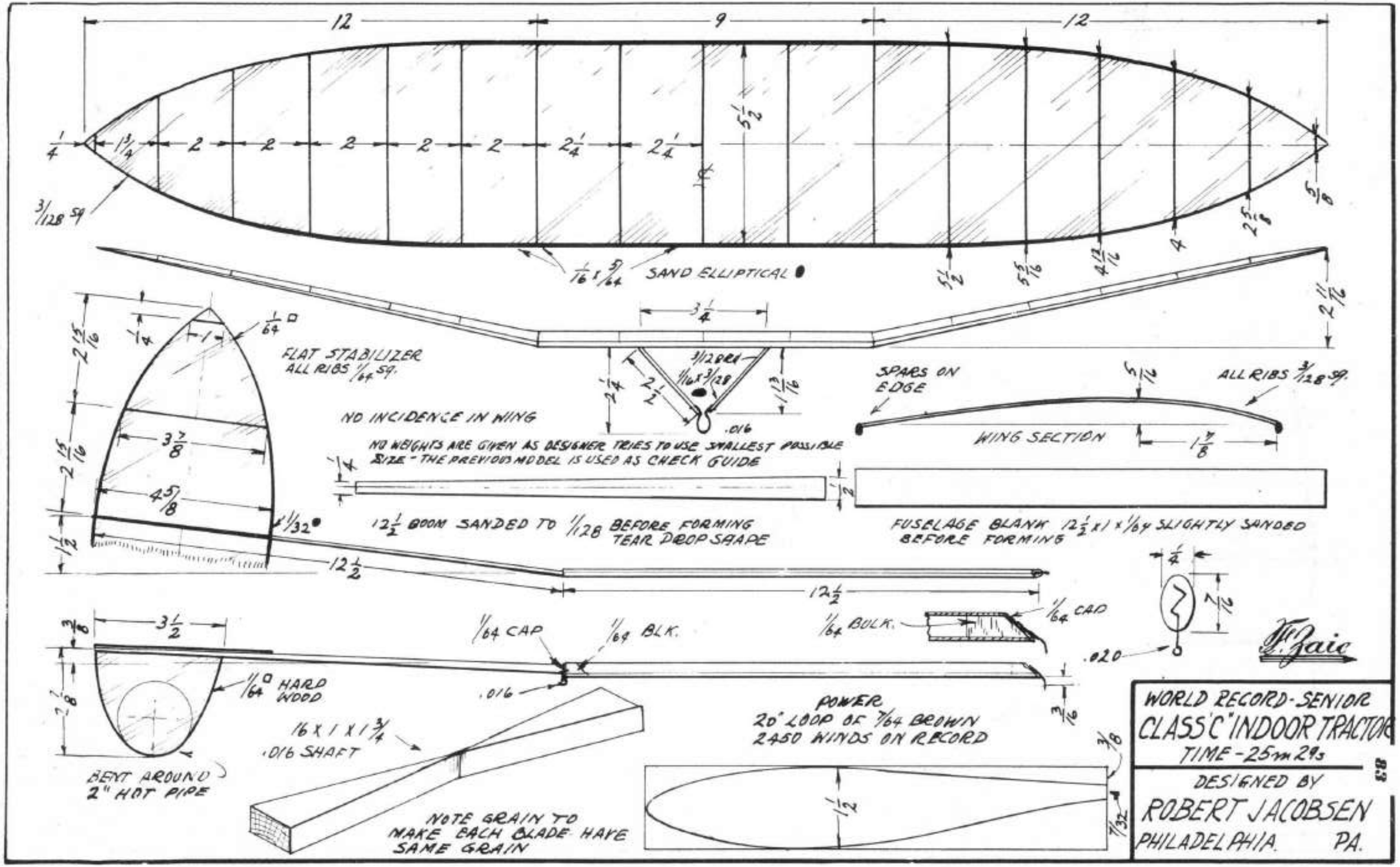

MAKE FUSELAGE AS USUAL - THEN ROUND CENTER AS SHOWN
ALUMINUM CLIP
VERY LIGHT SUPERSTRUCTURE
TUNGSTEN
MEETING CROSS SECTION RULE WITH SMALL TRIANGULAR FUSELAGE by BRUNO MARCHI
CLIP
BASE FUSELAGE


1/20 sq.
#3 TUNGSTEN
FINGER
TACK WITH CEMENT
TUNGSTEN BRACING by J.P. GLASS
WEIGHTED TUNGSTEN

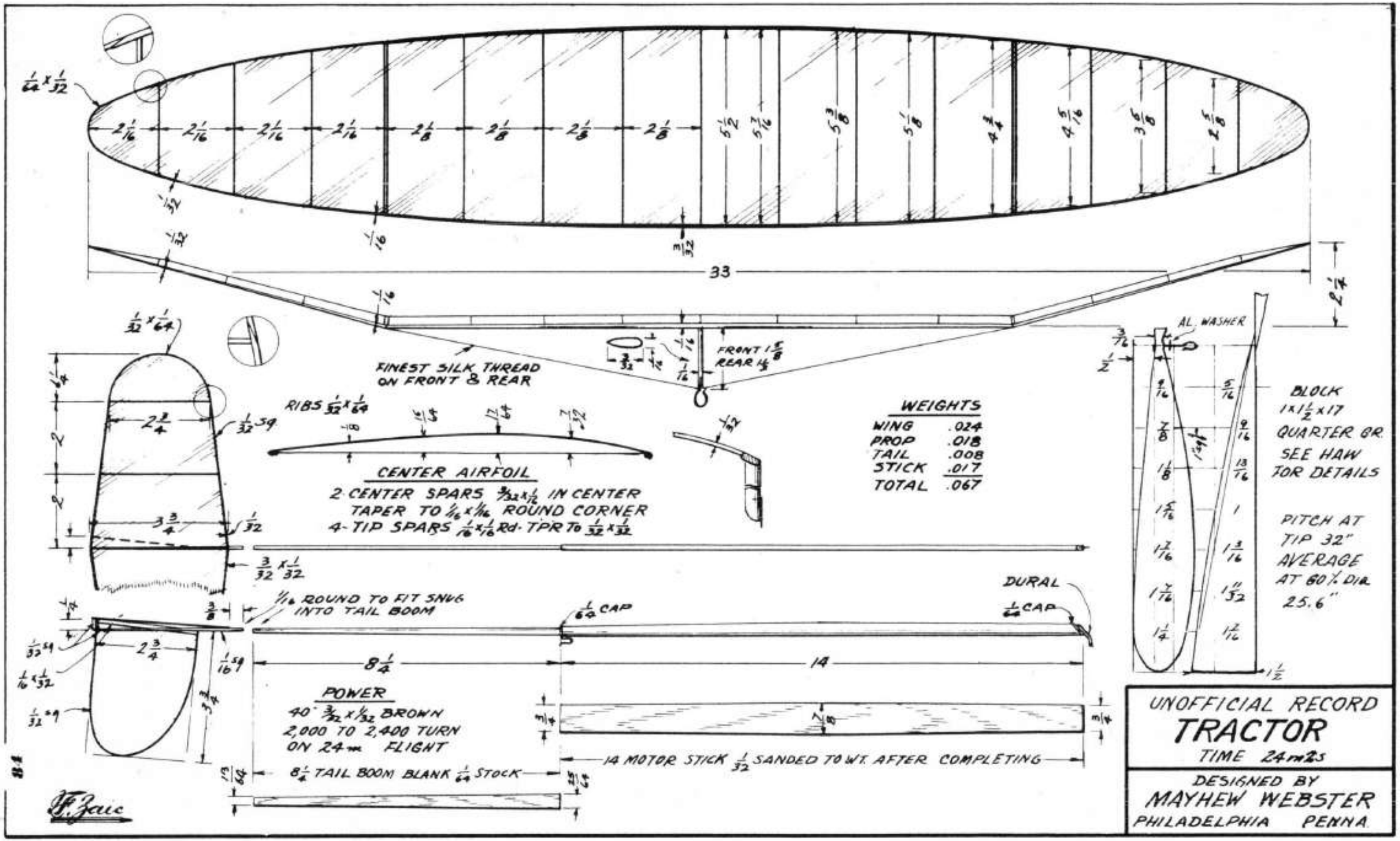

SANDING INDOOR PROPS OVER ILLUMINATED JARS TO SAND EVENLY
STROKE
GLASS JAR
EXTENSION LIGHT
by WILLIAM HARISON



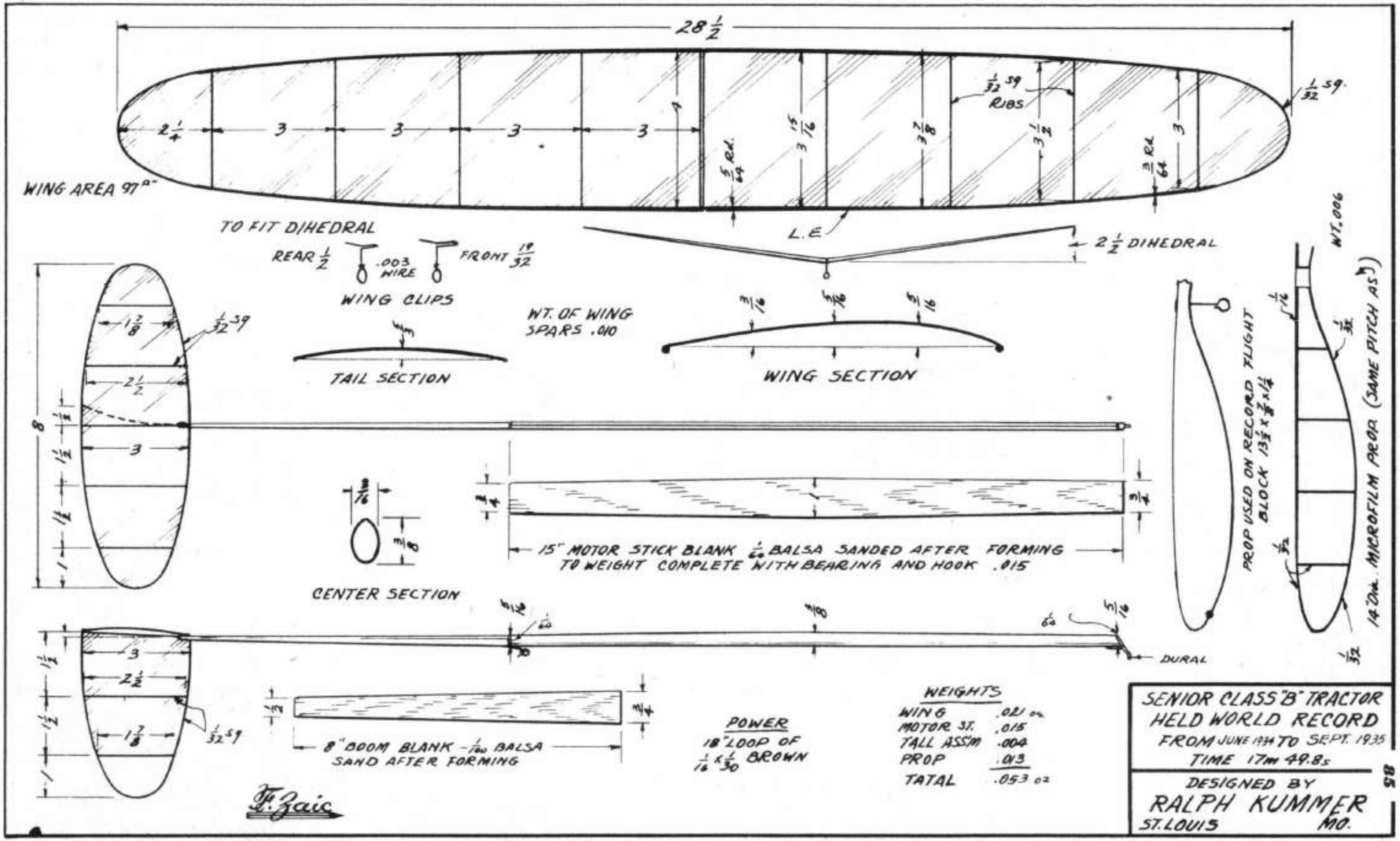
WING MADE IN TWO PIECES JOINED AFTER MICROFILM COVERING
L. E.
TR. EDGE WASHOUT
WING
SPARS - 1/8 x 1/16 TPR'D TO 1/16 SQ.
ROUND OFF THREE CORNERS
WT. 4 SPARS - .017 - SPARS FOLLOW RIB CURVE - RIBS SHAVE OVER 1/32 SQ. CUT FROM TR. EDGE FOR TPR.
FRONT 4
REAR 3 3/4
~MOTOR~ NEW MOTOR EVERY FLIGH - 3/32 MRL BROWN - STRECHED 5 TIMES ~ ABOUT 2250 TURNS
MCBRIDE'S B-7 AIRFOIL FOR ALL SURFACES (SEE REPORT)
APPROX. PROP OUTLINE
PROP CARVED FROM 16 x 1 9/16 x 1 QUARTER GRAINED BLOCK
#14
1/64 CAP & BULKHEAD
DURAL
WEIGHTS
WING - .030
PROP - .018
STICK - .017
TAIL - .010
MOTOR - .060
TOTAL .135
MOTOR STICK WTS.
BLANK .0135
CEMENT .0010
CAPS & BL'K'HD. .0005
BEARING WIRE .0020
TOTAL .0170
MOTOR STICK BLANK 1/64 STOCK
12" TAIL BOOM BLANK 1/64 STOCK SANDED TO .0024
TAIL BOOM WEIGHTS
BLANK - .0024
CEMENT TO - .0029
OPEN - CLASS C
WORLD RECORD
INDOOR TRACTOR
TIME - 23 MIN 29.3 S
DESIGNED BY
CARL GOLDBERG
CHICAGO ILL.
82



SAND ELLIPTICAL
FLAT STABILIZER
ALL RIBS 1/64 SQ.
NO INCIDENCE IN WING
NO WEIGHTS ARE GIVEN AS DESIGNER TRIES TO USE SMALLEST POSSIBLE SIZE - THE PREVIOUS MODEL IS USED AS CHECK GUIDE
SPARS ON EDGE
ALL RIBS 3/128 SQ.
WING SECTION
12 1/2 BOOM SANDED TO 1/128 BEFORE FORMING TEAR DROP SHAPE
FUSELAGE BLANK 12 1/2 x 1 x 1/64 SLIGHTLY SANDED BEFORE FORMING
1/64 CAP
1/64 BLK.
1/64 BULK.
1/64 CAP
1/64 HARD WOOD
BENT AROUND 2" HOT PIPE
16 x 1 x 1 3/4
.016 SHAFT
NOTE GRAIN TO MAKE EACH BLADE HAVE SAME GRAIN
POWER
20" LOOP OF 7/64 BROWN
2450 WINDS ON RECORD
WORLD RECORD-SENIOR
CLASS "C" INDOOR TRACTOR
TIME - 25m 29s
DESIGNED BY
ROBERT JACOBSEN
PHILADELPHIA PA.
83



UNOFFICIAL RECORD
TRACTOR
TIME 24m 2s
DESIGNED BY
MAYHEW WEBSTER
PHILADELPHIA PENNA
WEIGHTS
WING .024
PROP .018
TAIL .008
STICK .017
TOTAL .067
CENTER AIRFOIL
2 CENTER SPARS 3/32 x 1/2 IN CENTER
TAPER TO 1/16 x 1/16 ROUND CORNER
4-TIP SPARS 1/16 x 1/16 Rd. TPR TO 1/32 x 1/32
RIBS 1/32 x 1/64
FINEST SILK THREAD
ON FRONT & REAR
FRONT 1 5/8
REAR 1 1/2
AL. WASHER
BLOCK
1 x 1 1/2 x 17
QUARTER GR.
SEE HAW
FOR DETAILS
PITCH AT
TIP 32"
AVERAGE
AT 60% DIA
25.6"
33
POWER
40" 3/32 x 1/32 BROWN
2,000 TO 2,400 TURN
ON 24m FLIGHT
1/16 ROUND TO FIT SNUG
INTO TAIL BOOM
1/64 CAP
DURAL
8 1/4 TAIL BOOM BLANK 1/64 STOCK
14 MOTOR STICK 1/32 SANDED TO WT. AFTER COMPLETING
F. Zaic


28 1/2
WING AREA 97 □"
1/32 SQ. RIBS
1/32 SQ.
TO FIT DIHEDRAL
REAR 1/2
.003 WIRE
FRONT 19/32
WING CLIPS
L.E.
2 1/2 DIHEDRAL
WT. OF WING SPARS .010
TAIL SECTION
WING SECTION
CENTER SECTION
15" MOTOR STICK BLANK 1/60 BALSA SANDED AFTER FORMING TO WEIGHT COMPLETE WITH BEARING AND HOOK .015
8" BOOM BLANK - 1/100 BALSA SAND AFTER FORMING
DURAL
PROP USED ON RECORD FLIGHT BLOCK 13 1/2 x 7/8 x 1 1/4
14" DIA. MICROFILM PROP (SAME PITCH AS)
WT. .006
POWER
18" LOOP OF 1/16 x 1/30 BROWN
WEIGHTS
WING .021 oz
MOTOR ST. .015
TALL ASS'M .004
PROP .013
TATAL .053 oz
SENIOR CLASS "B" TRACTOR
HELD WORLD RECORD
FROM JUNE 1934 TO SEPT. 1935
TIME 17m 49.8s
DESIGNED BY
RALPH KUMMER
ST. LOUIS MO.
F. Zaic

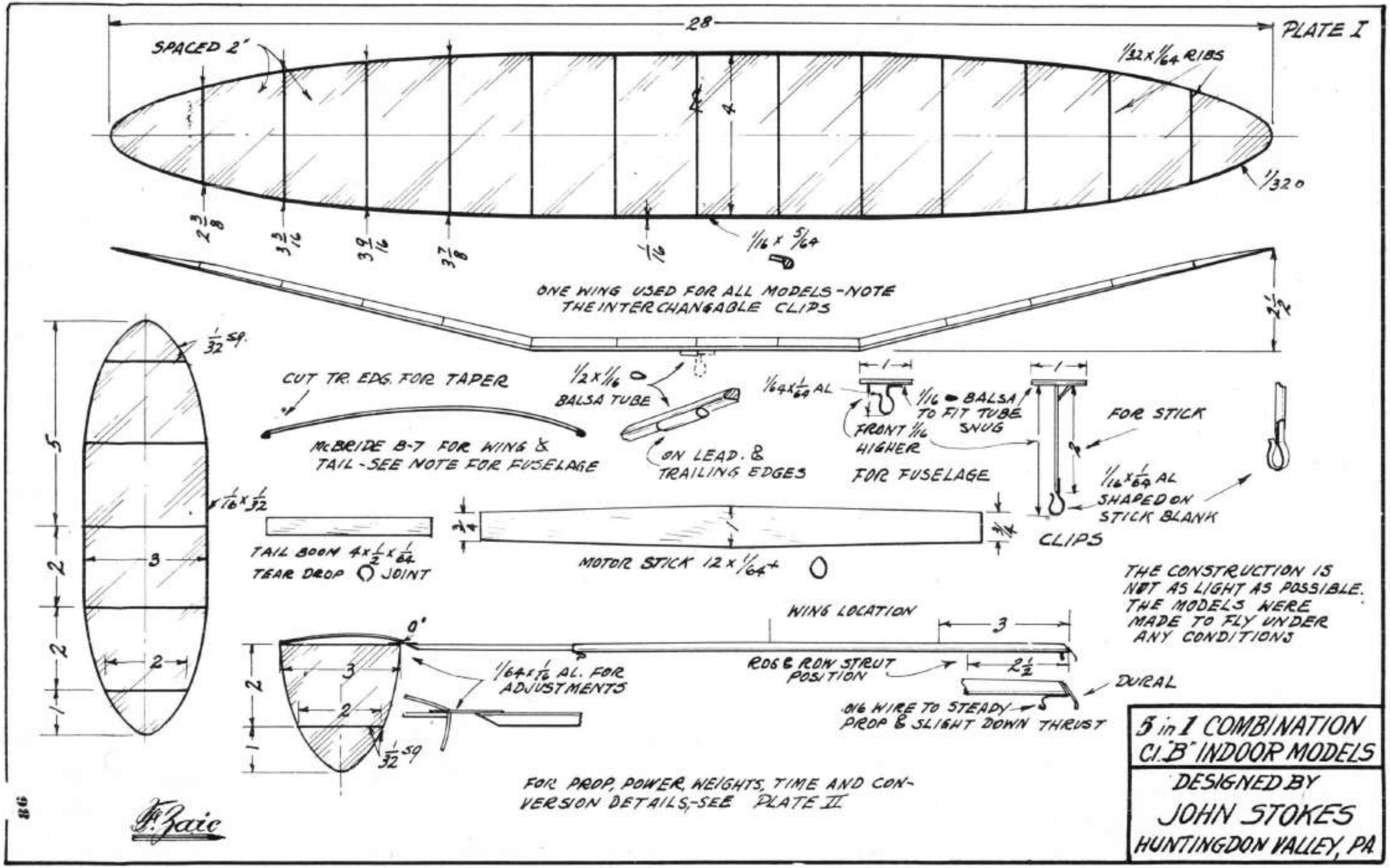
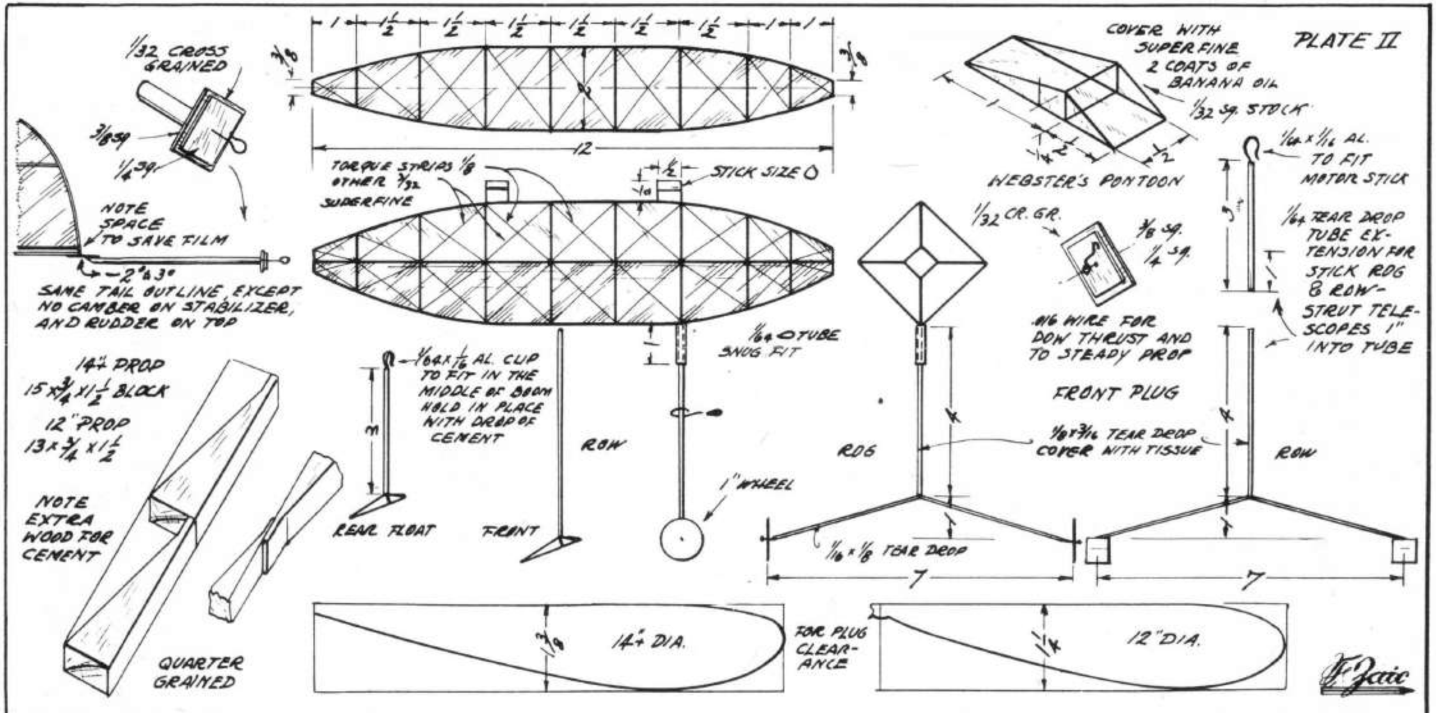


PLATE I
28
SPACED 2"
1/32 x 1/64 RIBS
1/32 O
4
2 3/8
3 3/16
3 9/16
3 7/8
1/16
1/16 x 5/64
ONE WING USED FOR ALL MODELS-NOTE
THE INTERCHANGABLE CLIPS
2 1/2
1/32 SQ.
5
CUT TR. EDG. FOR TAPER
McBRIDE B-7 FOR WING &
TAIL - SEE NOTE FOR FUSELAGE
1/2 x 1/16
BALSA TUBE
ON LEAD. &
TRAILING EDGES
1/64 x 1/64 AL
1/16 BALSA
TO FIT TUBE
SNUG
FRONT 1/16
HIGHER
FOR FUSELAGE
FOR STICK
1/16 x 1/64 AL
SHAPED ON
STICK BLANK
CLIPS
1/16 x 1/32
TAIL BOOM 4 x 1/2 x 1/64
TEAR DROP JOINT
MOTOR STICK 12 x 1/64+
1/4
THE CONSTRUCTION IS
NOT AS LIGHT AS POSSIBLE.
THE MODELS WERE
MADE TO FLY UNDER
ANY CONDITIONS
3
2
2
1
WING LOCATION
0°
1/64 x 1/16 AL. FOR
ADJUSTMENTS
ROG & ROW STRUT
POSITION
2 1/2
DURAL
.016 WIRE TO STEADY
PROP & SLIGHT DOWN THRUST
1/32 SQ
FOR PROP, POWER, WEIGHTS, TIME AND CON-
VERSION DETAILS,-SEE PLATE II
F. Zaic
5 in 1 COMBINATION
Cl. "B" INDOOR MODELS
DESIGNED BY
JOHN STOKES
HUNTINGDON VALLEY, PA

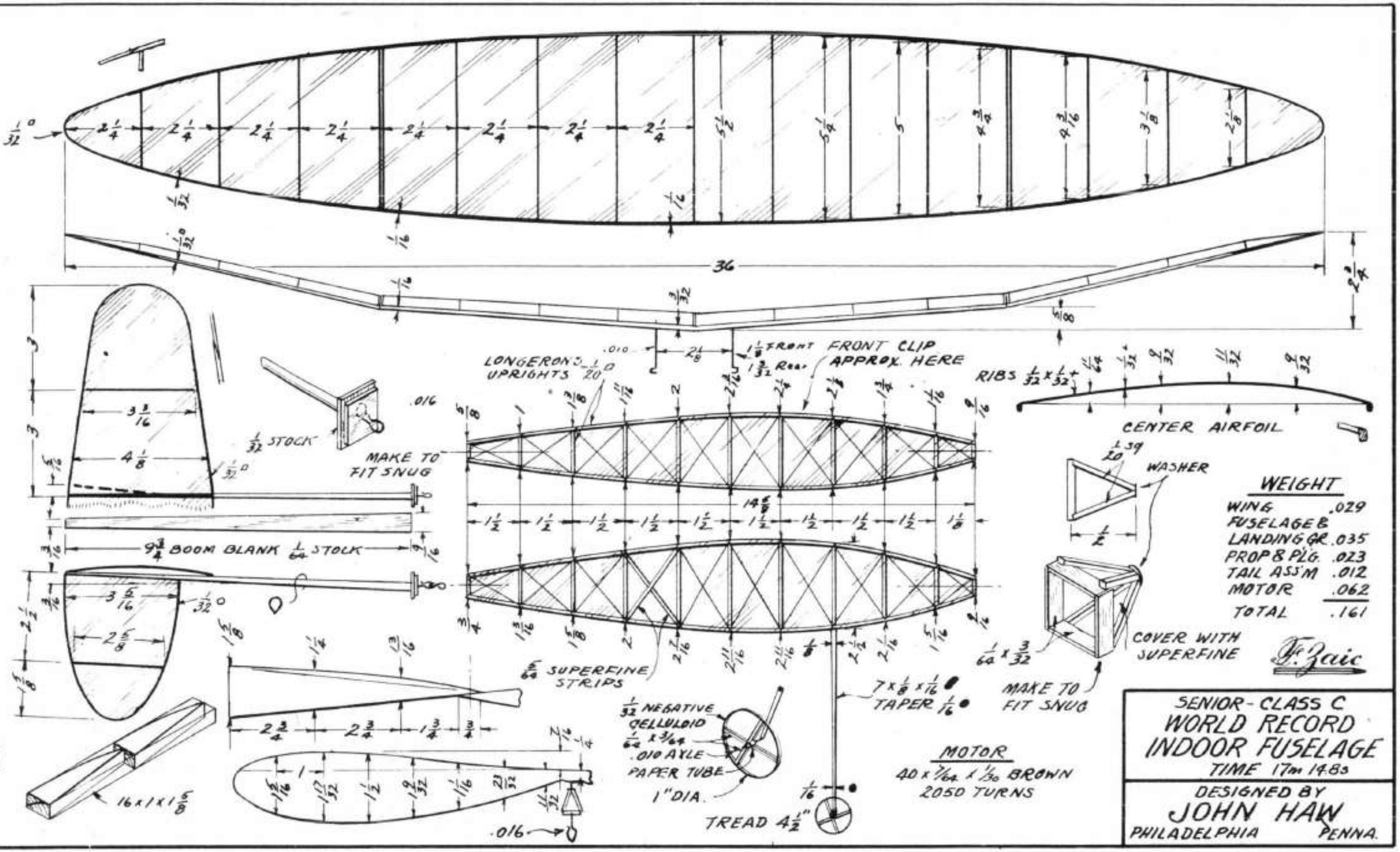


WTS. – FUSELAGE		STICK		NOTES
FUSELAGE	.020 oz	STICK	.016 oz.	PONTOON ASSEM' .011
WING	.020	WING	.020	LANDING GR. STICK .003
TAIL ASSEM'	.010	TAIL	.006	25" (OR MORE) LOOP USED
PROP	.011	PROP	.014	(TO FIT FLYING CONDITIONS ~ 1/30 GAGE
LANDING GR	.005	TOTAL	.056 oz	BROWN RUBBER
TOTAL	.066 oz			

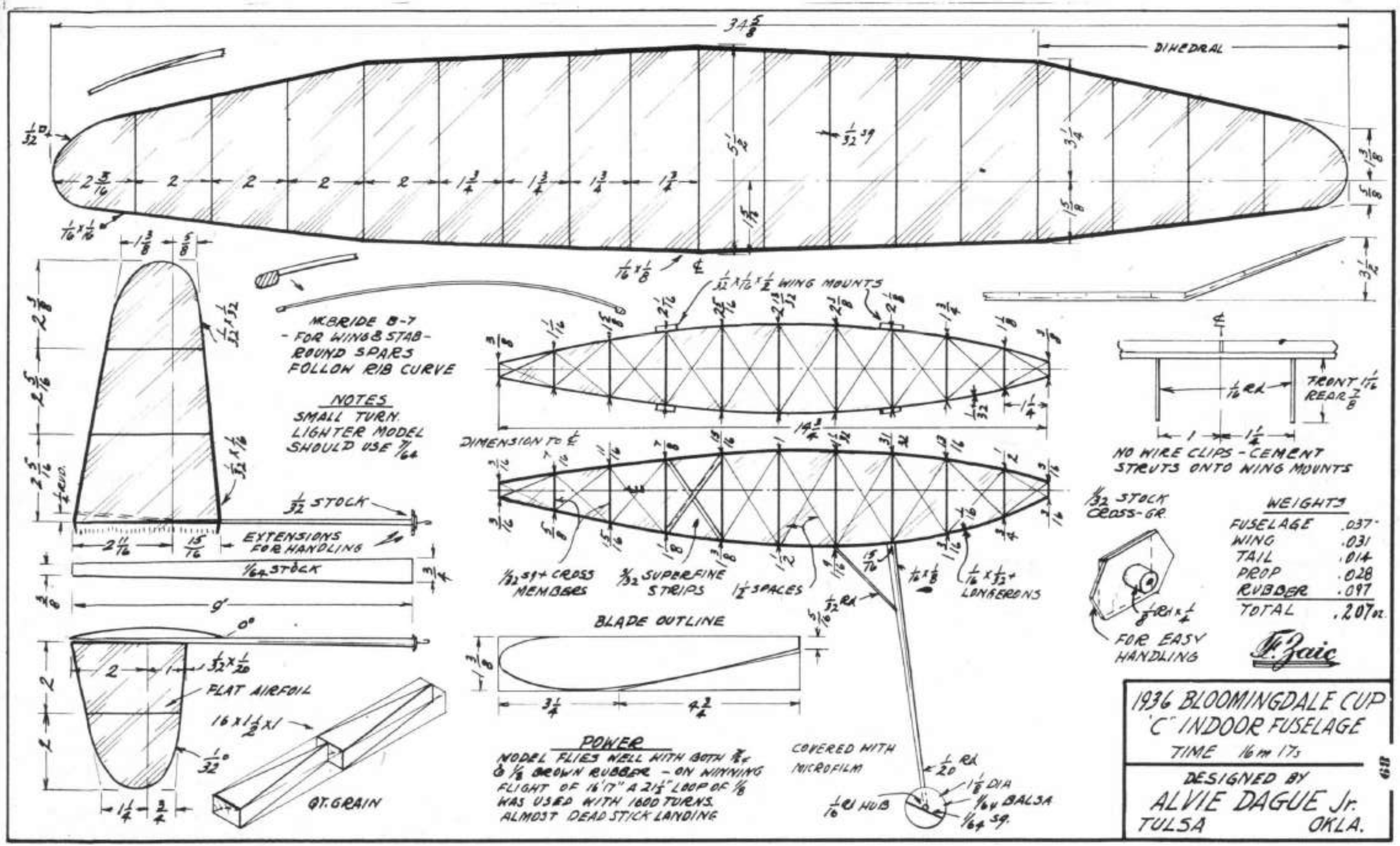
DESIGN	PROP	POWER	FLIGHT	TIME
FUSELAGE ROG	12	1/16 or 5/64	JR. RECORD	14m 15.3s
" ROW	12	5/64		
STICK H.L.	14"	1/16 or 5/64	JR. RECORD	18m 12.2s
" ROG	14"	5/64	JR. RECORD	17m 19.3s
" ROW	12	1/16 or 5/64	TEST	7m 47.8s

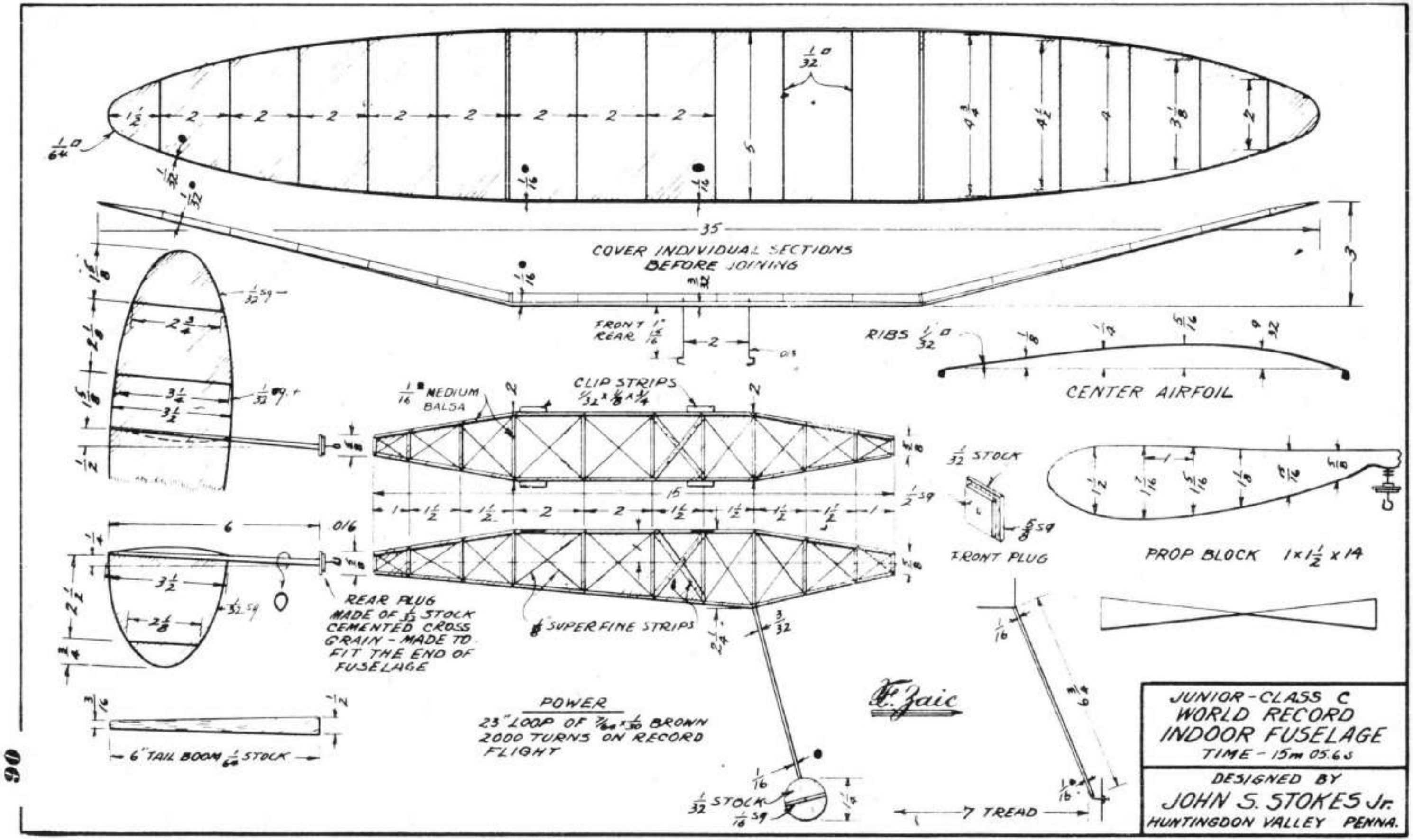
5 in 1 COMBINATION
Cl. "B" INDOOR MODELS

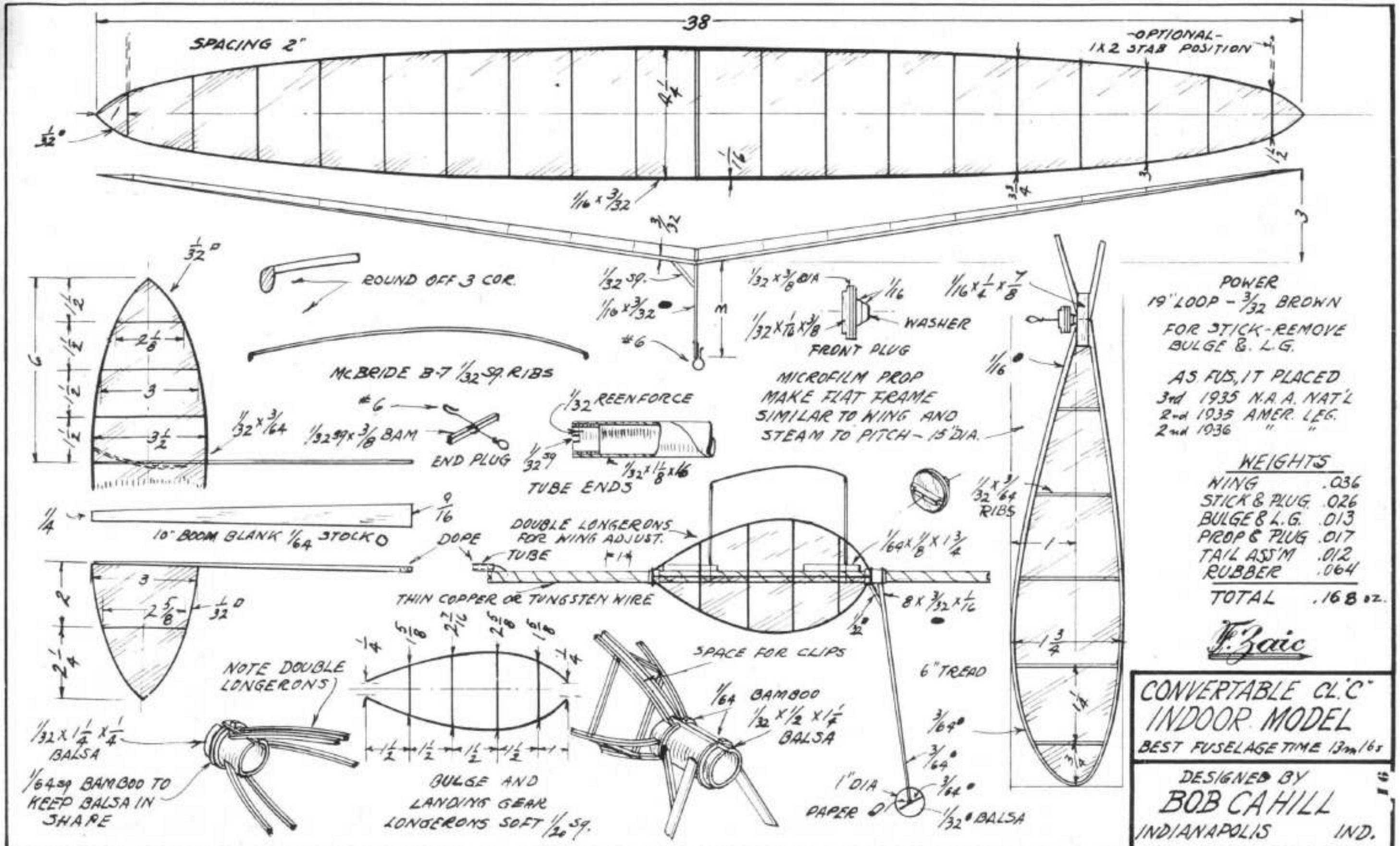
DESIGNED BY
JOHN STOKES
HUNTINGDON VALLEY, PA.



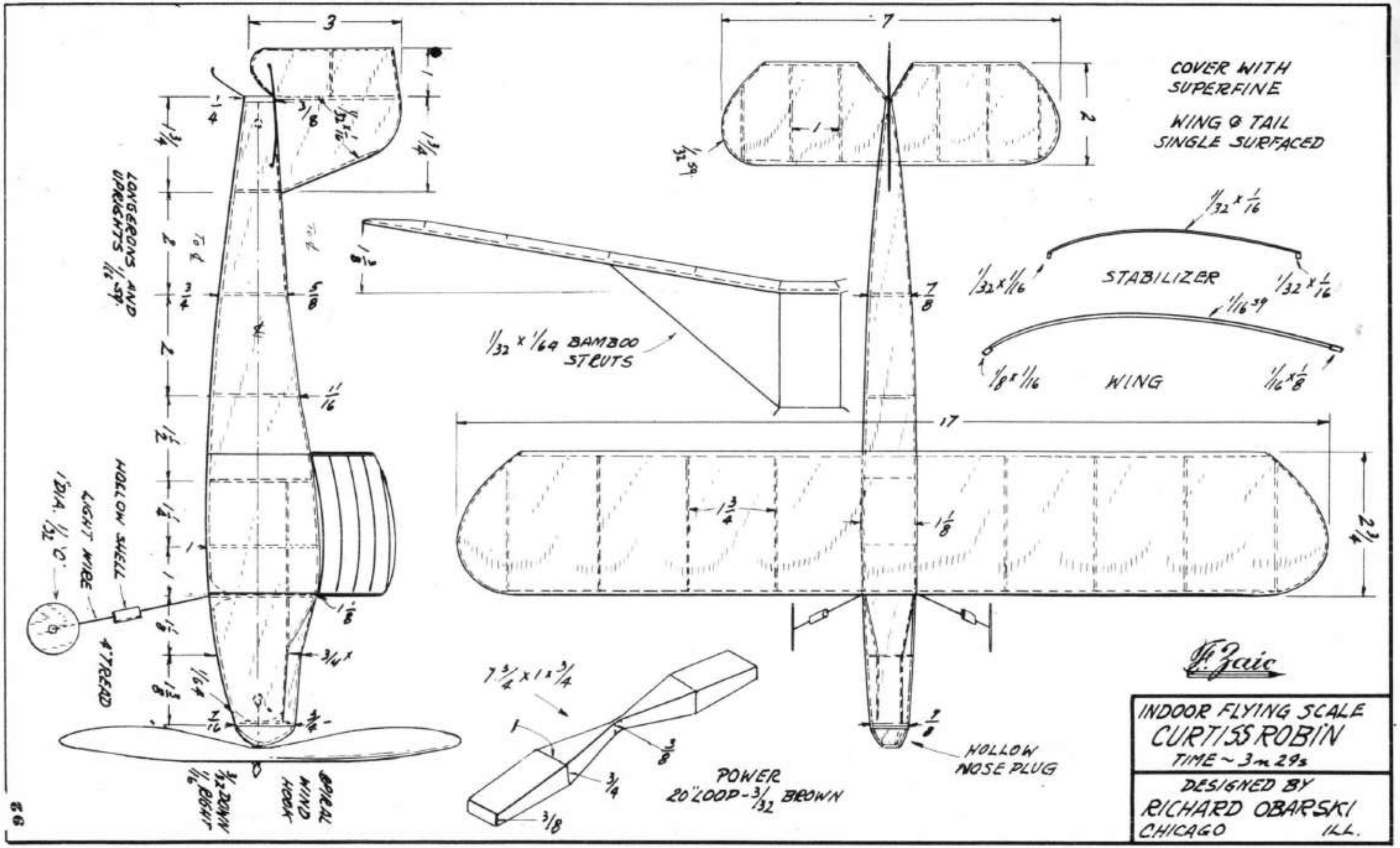
36
LONGERONS 1/20 □
UPRIGHTS
FRONT CLIP APPROX. HERE
1 1/8 FRONT
1 3/32 REAR
RIBS 1/32 x 1/32 +
CENTER AIRFOIL
1/32 STOCK
MAKE TO FIT SNUG
9 3/4 BOOM BLANK 1/64 STOCK
14 5/8
WASHER
WEIGHT
WING .029
FUSELAGE & LANDING GR. .035
PROP & PLG. .023
TAIL ASS'M .012
MOTOR .062
TOTAL .161
5/64 SUPERFINE STRIPS
COVER WITH SUPERFINE
1/64 x 3/32
MAKE TO FIT SNUG
1/32 NEGATIVE CELLULOID
1/64 x 3/64
.010 AXLE
PAPER TUBE
1" DIA.
TREAD 4 1/2"
7 x 1/8 x 1/16
TAPER 1/16
MOTOR
40 x 7/64 x 1/30 BROWN
2050 TURNS
16 x 1 x 1 5/8
.016
F. Zaic
SENIOR - CLASS C
WORLD RECORD
INDOOR FUSELAGE
TIME 17m 14.8s
DESIGNED BY
JOHN HAW
PHILADELPHIA PENNA.

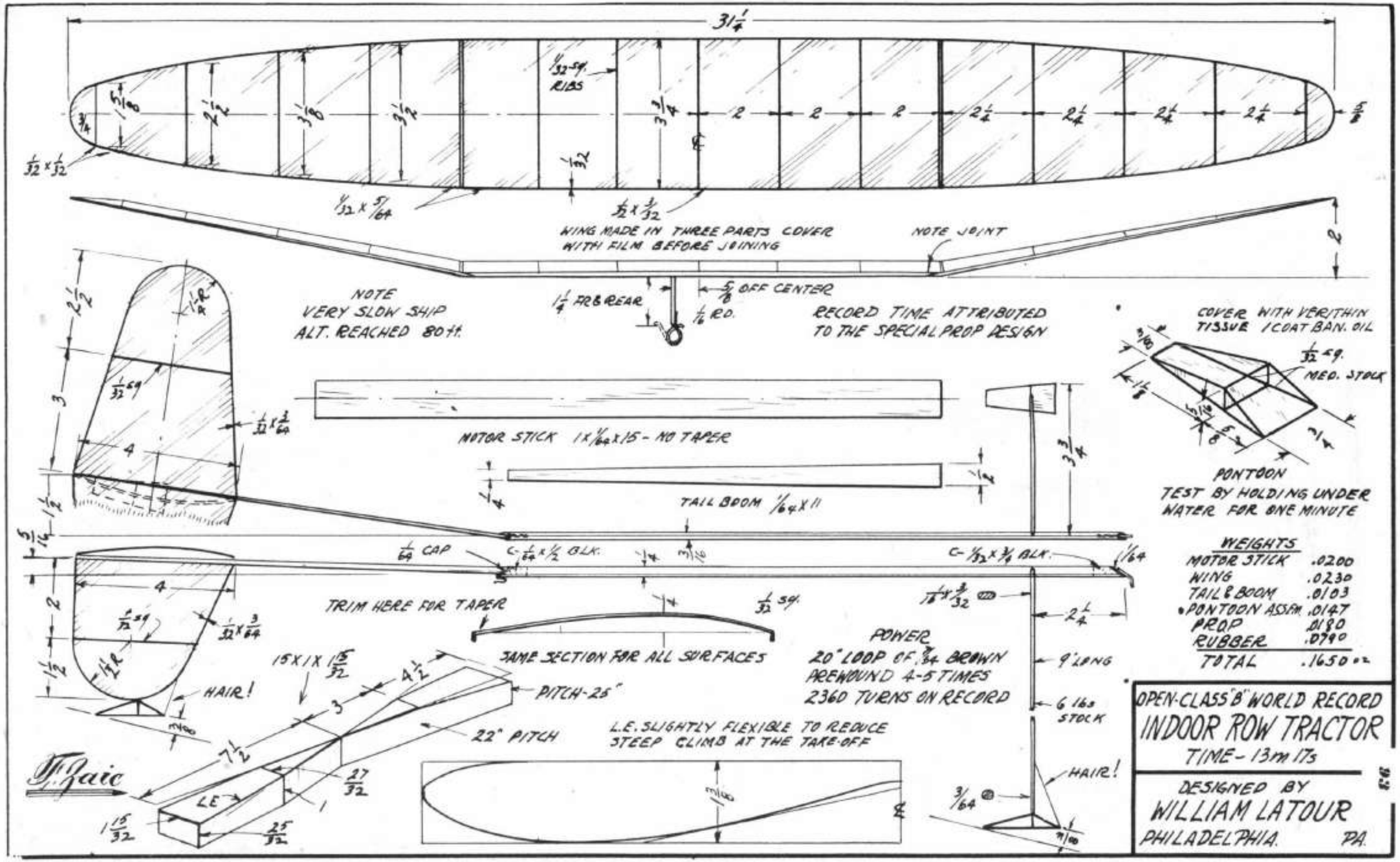

DIHEDRAL
MCBRIDE B-7
- FOR WING & STAB -
ROUND SPARS
FOLLOW RIB CURVE
NOTES
SMALL TURN.
LIGHTER MODEL
SHOULD USE 7/64
WING MOUNTS
DIMENSION TO ℄
1/32 STOCK
EXTENSIONS FOR HANDLING
1/64 STOCK
FLAT AIRFOIL
QT. GRAIN
1/32 SQ + CROSS MEMBERS
3/32 SUPERFINE STRIPS
1 1/2 SPACES
LONGERONS
BLADE OUTLINE
POWER
MODEL FLIES WELL WITH BOTH 3/32 & 1/8 BROWN RUBBER - ON WINNING FLIGHT OF 16'17" A 21 1/2" LOOP OF 1/8 WAS USED WITH 1600 TURNS. ALMOST DEAD STICK LANDING
COVERED WITH MICROFILM
1/16 RD HUB
1/64 BALSA
FRONT 1 1/16
REAR 7/8
NO WIRE CLIPS - CEMENT STRUTS ONTO WING MOUNTS
1/32 STOCK CROSS-GR.
FOR EASY HANDLING
WEIGHTS
FUSELAGE .037
WING .031
TAIL .014
PROP .028
RUBBER .097
TOTAL .207 oz.
F. Zaic
1936 BLOOMINGDALE CUP
"C" INDOOR FUSELAGE
TIME 16m 17s
DESIGNED BY
ALVIE DAGUE Jr.
TULSA OKLA.

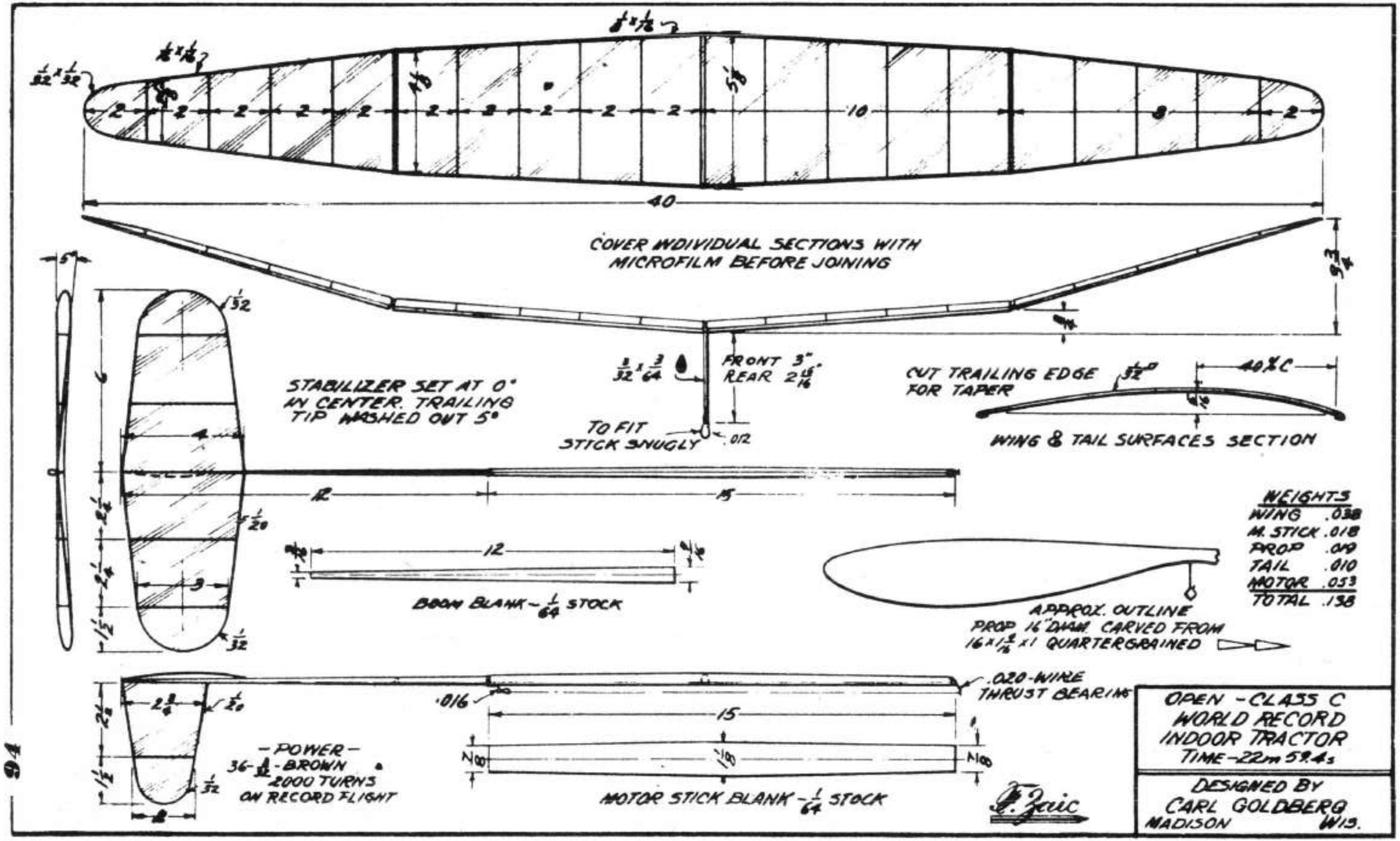

COVER INDIVIDUAL SECTIONS
BEFORE JOINING
35
FRONT 1"
REAR 15/16
RIBS 1/32 □
CENTER AIRFOIL
CLIP STRIPS
1/32 x 1/8 x 3/4
1/16 □ MEDIUM
BALSA
15
1/32 STOCK
FRONT PLUG
PROP BLOCK 1 x 1 1/2 x 14
REAR PLUG
MADE OF 1/32 STOCK
CEMENTED CROSS
GRAIN - MADE TO
FIT THE END OF
FUSELAGE
1/8 SUPERFINE STRIPS
6" TAIL BOOM 1/64 STOCK
POWER
23" LOOP OF 7/64 x 1/30 BROWN
2000 TURNS ON RECORD
FLIGHT
1/32 STOCK
1/16 SQ
7 TREAD
F. Zaic
JUNIOR - CLASS C
WORLD RECORD
INDOOR FUSELAGE
TIME - 15m 05.6s
DESIGNED BY
JOHN S. STOKES Jr.
HUNTINGDON VALLEY PENNA.

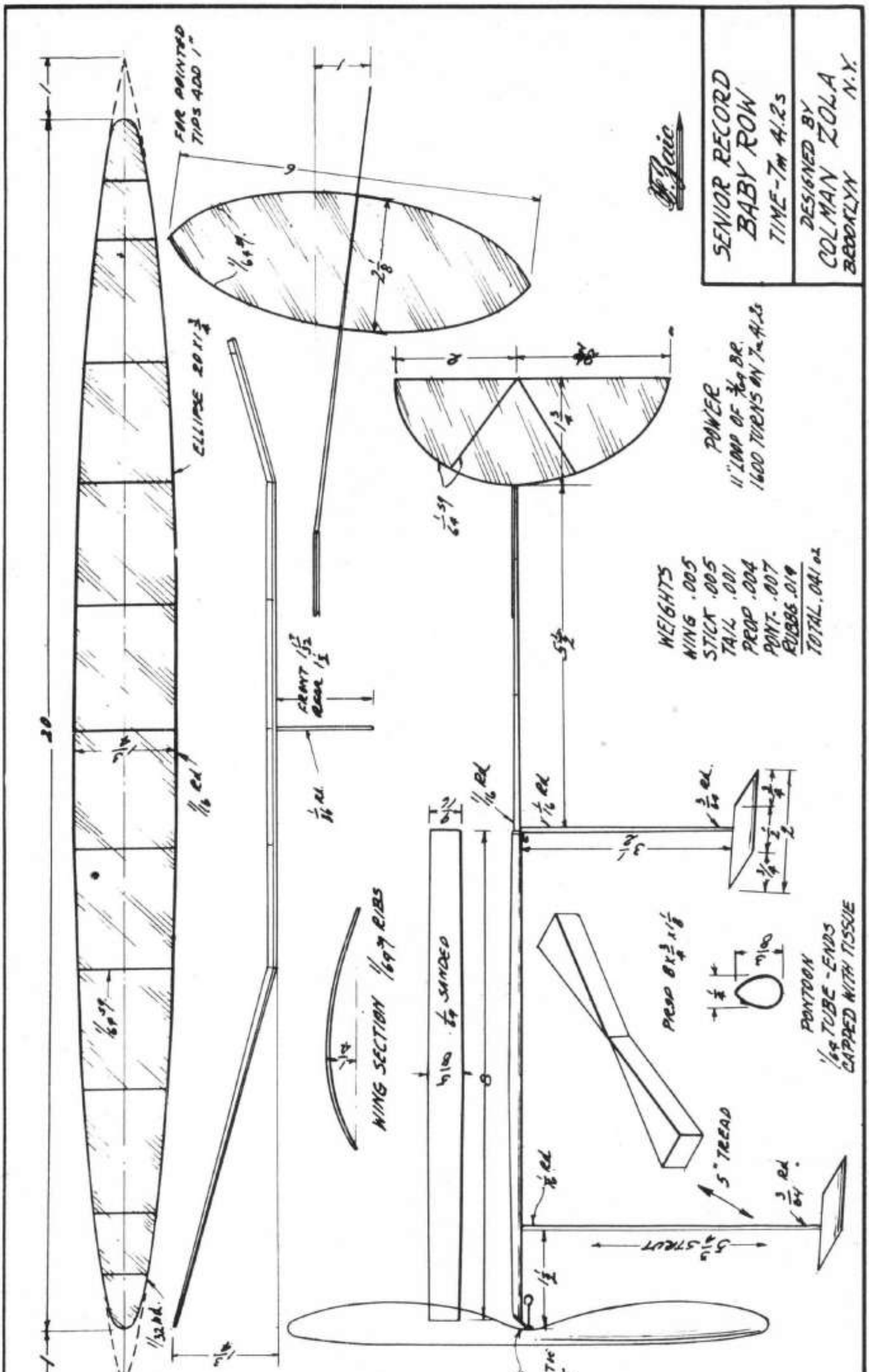


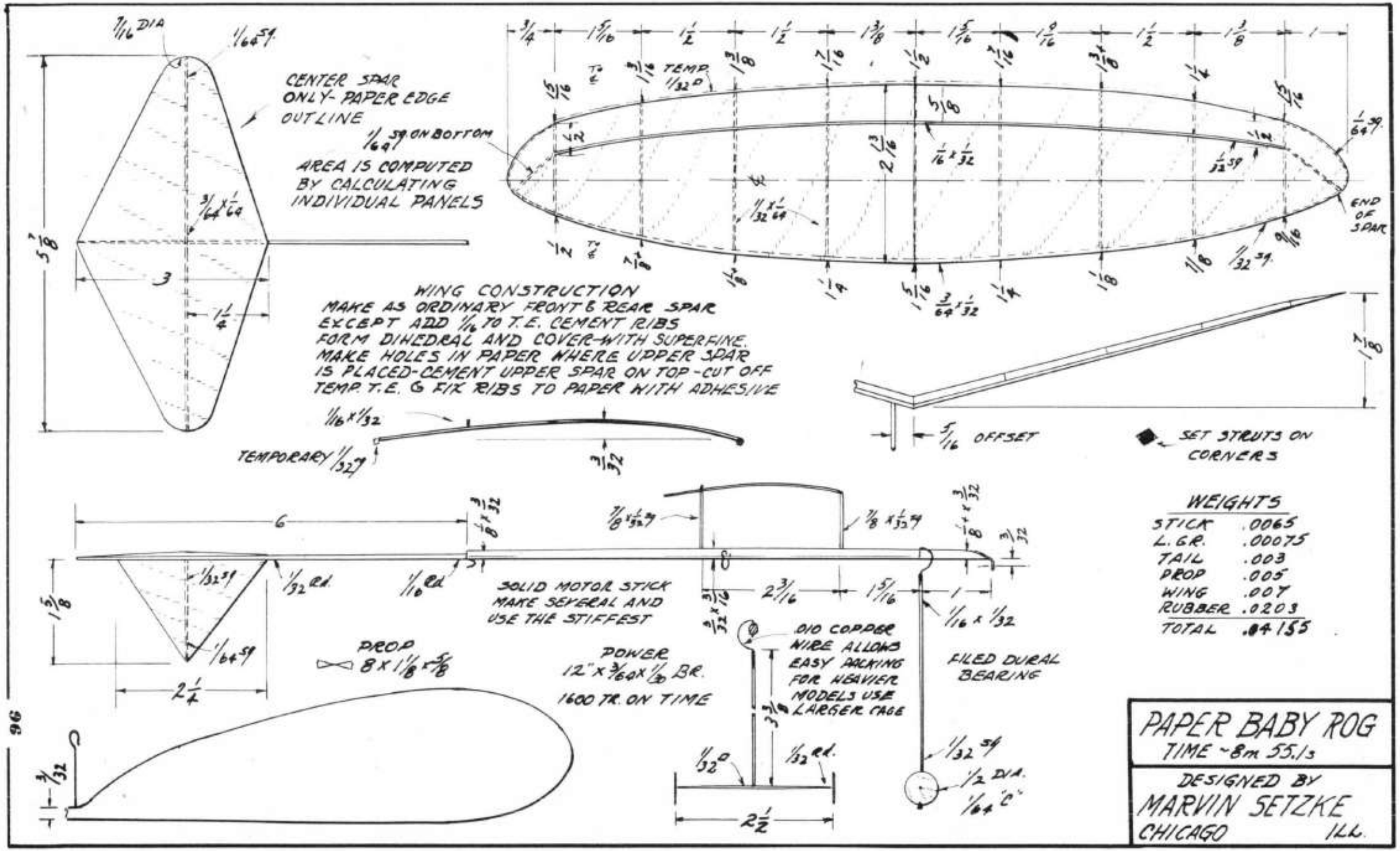
38
SPACING 2"
-OPTIONAL-
1X2 STAB POSITION
ROUND OFF 3 COR.
McBRIDE B-7 1/32 SQ. RIBS
#6
END PLUG
1/32 REENFORCE
TUBE ENDS
FRONT PLUG
WASHER
MICROFILM PROP
MAKE FLAT FRAME
SIMILAR TO WING AND
STEAM TO PITCH – 15" DIA.
POWER
19" LOOP – 3/32 BROWN
FOR STICK-REMOVE
BULGE & L.G.
AS FUS, IT PLACED
3rd 1935 N.A.A. NAT'L
2nd 1935 AMER. LEG.
2nd 1936 " "
WEIGHTS
WING .036
STICK & PLUG .026
BULGE & L.G. .013
PROP & PLUG .017
TAIL ASS'M .012
RUBBER .064
TOTAL .168 oz.
10" BOOM BLANK 1/64 STOCK
DOPE
TUBE
DOUBLE LONGERONS
FOR WING ADJUST.
THIN COPPER OR TUNGSTEN WIRE
RIBS
NOTE DOUBLE
LONGERONS
SPACE FOR CLIPS
1/64 BAMBOO
1/32 x 1/2 x 1/4
BALSA
6" TREAD
1/32 x 1 1/4 x 1/4
BALSA
1/64 sq. BAMBOO TO
KEEP BALSA IN
SHAPE
BULGE AND
LANDING GEAR
LONGERONS SOFT 1/20 SQ.
1" DIA
PAPER
1/32 BALSA
F. Zaic
CONVERTABLE CL. "C"
INDOOR MODEL
BEST FUSELAGE TIME 13m 16s
DESIGNED BY
BOB CAHILL
INDIANAPOLIS IND.
16

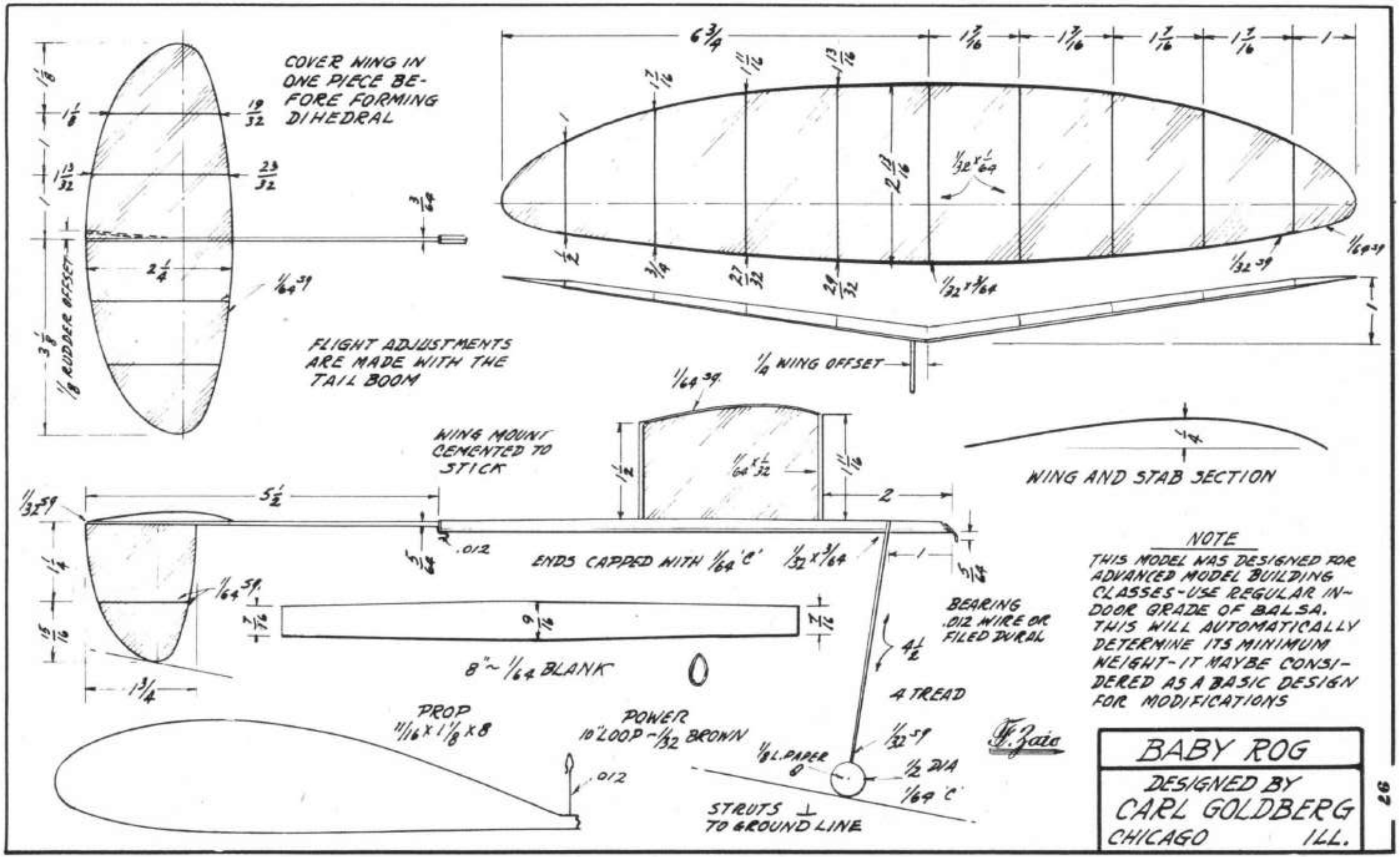

COVER WITH SUPERFINE
WING & TAIL SINGLE SURFACED
STABILIZER
WING
1/32 x 1/64 BAMBOO STRUTS
LONGERONS AND UPRIGHTS 1/16 SQ.
HOLLOW SHELL
LIGHT WIRE
1" DIA. 1/32 'C'
4" TREAD
SPIRAL WIND HOOK
3/32 DOWN 1/16 RIGHT
POWER 20" LOOP - 3/32 BROWN
7 3/4 x 1 x 3/4
HOLLOW NOSE PLUG
F. Zaic
INDOOR FLYING SCALE
CURTISS ROBIN
TIME ~ 3m 29s
DESIGNED BY
RICHARD OBARSKI
CHICAGO ILL.

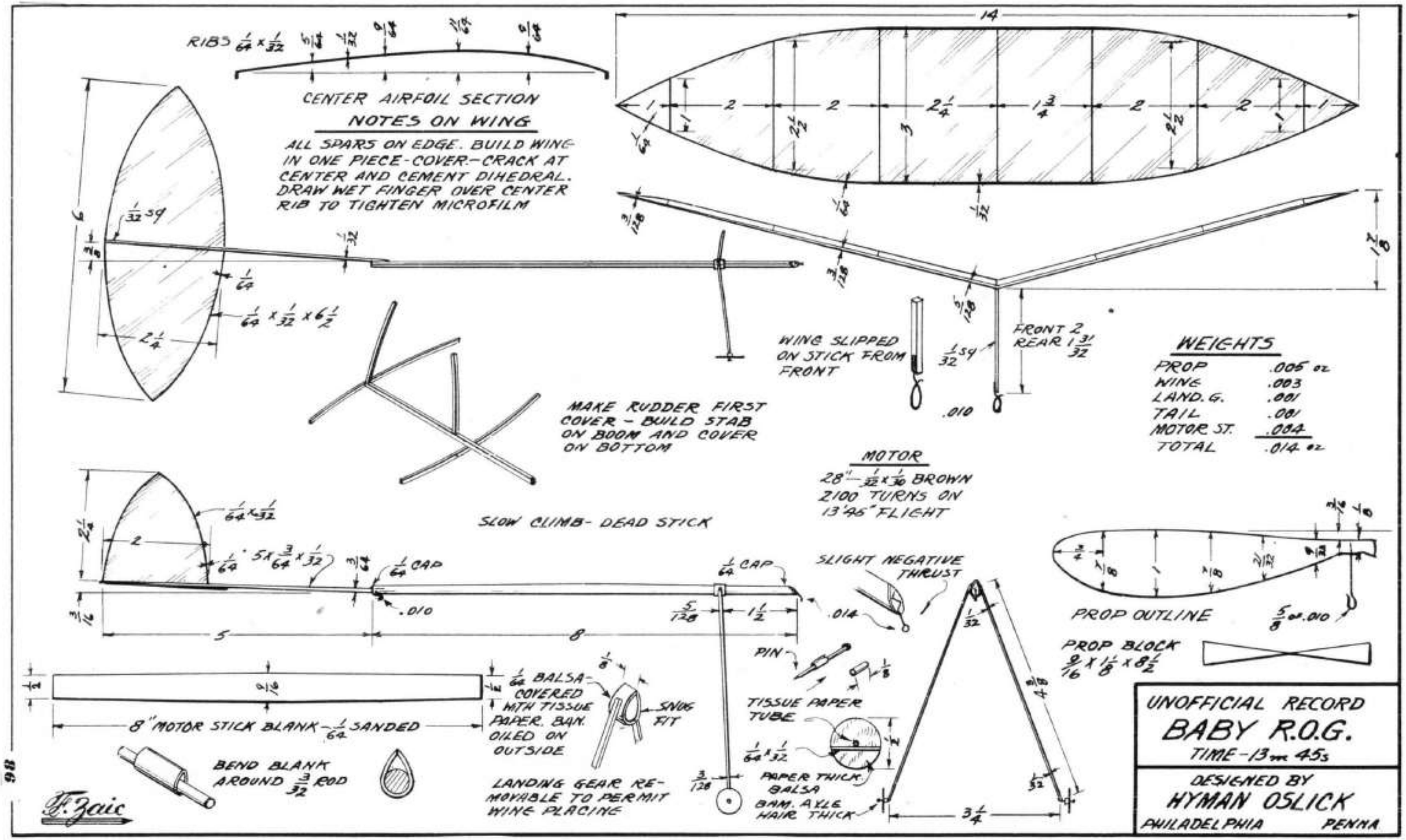


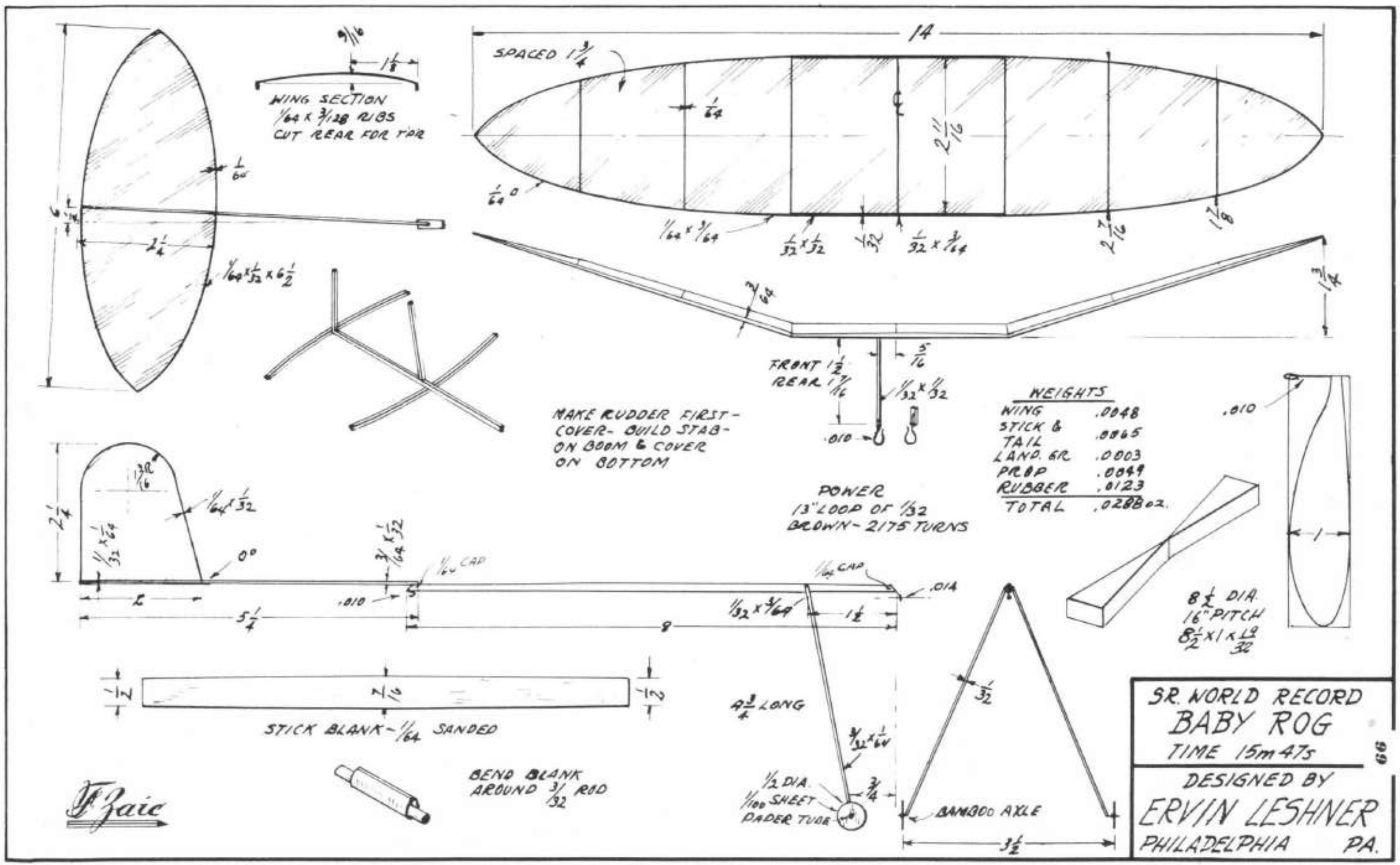

COVER INDIVIDUAL SECTIONS WITH MICROFILM BEFORE JOINING
STABILIZER SET AT 0° IN CENTER. TRAILING TIP WASHED OUT 5°
FRONT 3" REAR 2 15/16"
TO FIT STICK SNUGLY
CUT TRAILING EDGE FOR TAPER
WING & TAIL SURFACES SECTION
BOOM BLANK - 1/64 STOCK
WEIGHTS
WING .038
M. STICK .018
PROP .019
TAIL .010
MOTOR .053
TOTAL .138
APPROX. OUTLINE PROP 16" DIAM. CARVED FROM 16 x 1 9/16 x 1 QUARTERGRAINED
.020-WIRE THRUST BEARING
-POWER- 36-1/8-BROWN 2000 TURNS ON RECORD FLIGHT
MOTOR STICK BLANK - 1/64 STOCK
OPEN - CLASS C WORLD RECORD INDOOR TRACTOR TIME-22m 59.4s
DESIGNED BY CARL GOLDBERG MADISON WIS.


SENIOR RECORD
BABY ROW
TIME-7m 41.2s
DESIGNED BY
COLMAN ZOLA
BROOKLYN N.Y.
POWER
WEIGHTS
WING .005
STICK .005
TAIL .001
PROP .004
PONT. .007
RUBBER .019
TOTAL .041 oz
ELLIPSE 20 x 1 3/4
FOR PRINTED TIPS ADD 1"
WING SECTION
PROP 8 x 3/4 x 1 1/8
PONTOON
CAPPED WITH TISSUE
5" TREAD
DURAL
1° POSITIVE THRUST


CENTER SPAR ONLY- PAPER EDGE OUTLINE
AREA IS COMPUTED BY CALCULATING INDIVIDUAL PANELS
1/64 SQ. ON BOTTOM
TEMP. 1/32 D
END OF SPAR
WING CONSTRUCTION
MAKE AS ORDINARY FRONT & REAR SPAR EXCEPT ADD 1/16 TO T.E. CEMENT RIBS FORM DIHEDRAL AND COVER-WITH SUPERFINE. MAKE HOLES IN PAPER WHERE UPPER SPAR IS PLACED-CEMENT UPPER SPAR ON TOP-CUT OFF TEMP. T.E. & FIX RIBS TO PAPER WITH ADHESIVE
TEMPORARY 1/32 SQ.
5/16 OFFSET
SET STRUTS ON CORNERS
WEIGHTS
STICK .0065
L. GR. .00075
TAIL .003
PROP .005
WING .007
RUBBER .0203
TOTAL .04155
SOLID MOTOR STICK MAKE SEVERAL AND USE THE STIFFEST
PROP 8 x 1 1/8 x 5/8
POWER 12" x 3/64 x 1/30 BR.
1600 TR. ON TIME
.010 COPPER WIRE ALLOWS EASY PACKING FOR HEAVIER MODELS USE LARGER CAGE
FILED DURAL BEARING
1/2 DIA.
1/64 "C"
PAPER BABY ROG
TIME ~ 8m 55.1s
DESIGNED BY
MARVIN SETZKE
CHICAGO ILL.


COVER WING IN ONE PIECE BEFORE FORMING DIHEDRAL
FLIGHT ADJUSTMENTS ARE MADE WITH THE TAIL BOOM
1/8 RUDDER OFFSET
1/4 WING OFFSET
WING MOUNT CEMENTED TO STICK
WING AND STAB SECTION
ENDS CAPPED WITH 1/64 'C'
8" ~ 1/64 BLANK
PROP 11/16 x 1 1/8 x 8
POWER 10" LOOP ~ 1/32 BROWN
BEARING .012 WIRE OR FILED DURAL
4 TREAD
1/8 L. PAPER
1/2 DIA 1/64 'C'
STRUTS ⊥ TO GROUND LINE
NOTE
THIS MODEL WAS DESIGNED FOR ADVANCED MODEL BUILDING CLASSES - USE REGULAR INDOOR GRADE OF BALSA. THIS WILL AUTOMATICALLY DETERMINE ITS MINIMUM WEIGHT - IT MAYBE CONSIDERED AS A BASIC DESIGN FOR MODIFICATIONS
BABY ROG
DESIGNED BY CARL GOLDBERG
CHICAGO ILL.
F. Zaic


RIBS 1/64 x 1/32
CENTER AIRFOIL SECTION
NOTES ON WING
ALL SPARS ON EDGE. BUILD WING IN ONE PIECE-COVER.-CRACK AT CENTER AND CEMENT DIHEDRAL. DRAW WET FINGER OVER CENTER RIB TO TIGHTEN MICROFILM
14
1/32 SQ
1/64 x 1/32 x 6 1/2
WING SLIPPED ON STICK FROM FRONT
1/32 SQ
FRONT 2
REAR 1 31/32
.010
WEIGHTS
PROP .005 oz
WING .003
LAND. G. .001
TAIL .001
MOTOR ST. .004
TOTAL .014 oz
MAKE RUDDER FIRST COVER - BUILD STAB ON BOOM AND COVER ON BOTTOM
MOTOR
28" - 1/32 x 1/30 BROWN
2100 TURNS ON
13'45" FLIGHT
SLOW CLIMB- DEAD STICK
1/64 x 1/32
.5 x 3/64 x 1/32
1/64 CAP
1/64 CAP
.010
SLIGHT NEGATIVE THRUST
.014
PROP OUTLINE
5/8 or .010
PROP BLOCK
9/16 X 1 1/8 X 8 1/2
8" MOTOR STICK BLANK - 1/64 SANDED
1/64 BALSA-COVERED WITH TISSUE PAPER. BAN. OILED ON OUTSIDE
SNUG FIT
PIN
TISSUE PAPER TUBE
PAPER THICK BALSA
BAM. AXLE HAIR THICK
BEND BLANK AROUND 3/32 ROD
LANDING GEAR REMOVABLE TO PERMIT WING PLACING
UNOFFICIAL RECORD
BABY R.O.G.
TIME - 13m 45s
DESIGNED BY
HYMAN OSLICK
PHILADELPHIA PENNA
F. Zaic


SR. WORLD RECORD
BABY ROG
TIME 15m 47s
99
DESIGNED BY
ERVIN LESHNER
PHILADELPHIA PA.
14
SPACED 1 3/4
WING SECTION
1/64 x 3/128 RIBS
CUT REAR FOR T.&R.
9/16
1 1/8
1/64 x 3/64
1/32 x 1/32
1/32 x 3/64
2 11/16
2 7/16
1 7/8
1 3/4
FRONT 1 1/2
REAR 1 7/16
5/16
1/32 x 1/32
.010
1/64 x 1/32 x 6 1/2
2 1/4
6
MAKE RUDDER FIRST-
COVER- BUILD STAB-
ON BOOM & COVER
ON BOTTOM
WEIGHTS
WING .0048
STICK & TAIL .0065
LAND. GR. .0003
PROP .0049
RUBBER .0123
TOTAL .0288 oz.
POWER
13" LOOP OF 1/32
BROWN- 2175 TURNS
8 1/2 DIA.
16" PITCH
8 1/2 x 1 x 19/32
.010
1/64 x 1/32
3/16 R
1/32 x 1/64
3/64 x 1/32
1/64 CAP
.014
1/32 x 3/64
1 1/2
2
5 1/4
8
STICK BLANK- 1/64 SANDED
7/16
1/2
BEND BLANK
AROUND 3/32 ROD
2 3/4 LONG
3/32 x 1/64
1/2 DIA.
1/100 SHEET
PAPER TUBE
3/4
1/32
BAMBOO AXLE
3 1/2
F. Zaic

Petrol Model Hints

by Captain C. E. Bowden

General

The testing period is the most dangerous period of the life of the petrol model. It is therefore worthwhile thinking out a system that ensures the maximum amount of success that can be achieved.

The method I have adopted for several years now has proved itself very satisfactory and has been also used by a number of my friends, with very little damage to their models.

Before describing the actual method itself, I would like to describe certain features that I incorporate into all my gas models, whether they are high wing, low wing, or biplane. These features I consider a help toward testing and subsequent flying without damage.

Firstly, all of my models have a detachable nosepiece upon which the engine is mounted. This nosepiece is held into the nose of the fuselage by rubber bands to wire hooks, in the same way that the nosepiece of many rubber models is attached. The engine on striking any object can therefore be knocked out and the rubber bands give to the blow instead of the crankshaft. Again, this method allows slight alteration of the thrust line and offset of the thrust to counteract engine torque, by the simple method of inserting slips of packing wood between the detachable mounting and the fuselage. Fig. 1. is a sketch of the method.

All of my models have their cantilever wings and tailplanes attached by rubber bands to wire hooks that protrude from the fuselage. Thus the rubber bands hardly show, and yet allow the wings, etc. to be knocked off in the event of a crackup.

Thirdly, I always fit a type of undercarriage that assures a backward movement twist followed by an upward movement. This takes up the blow of gliding into the ground, for a gas model is naturally not "flattened off" and stalled to a three point landing by a pilot. It glides <u>into</u> the ground. The undercarriage <u>must</u> therefore be well forward and give backwards first.

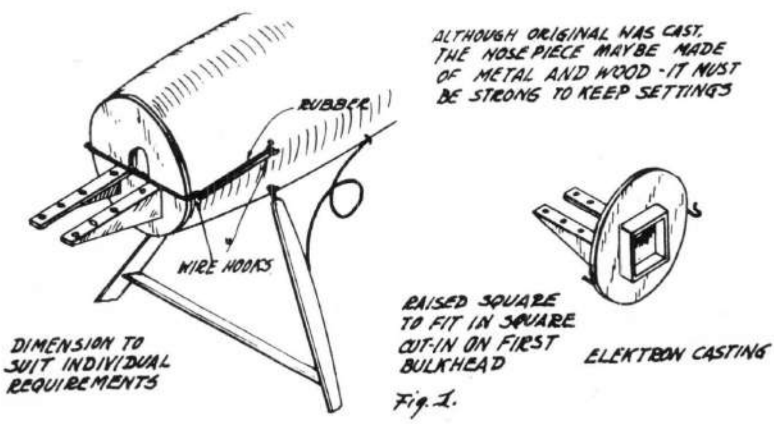


Fig. 1.

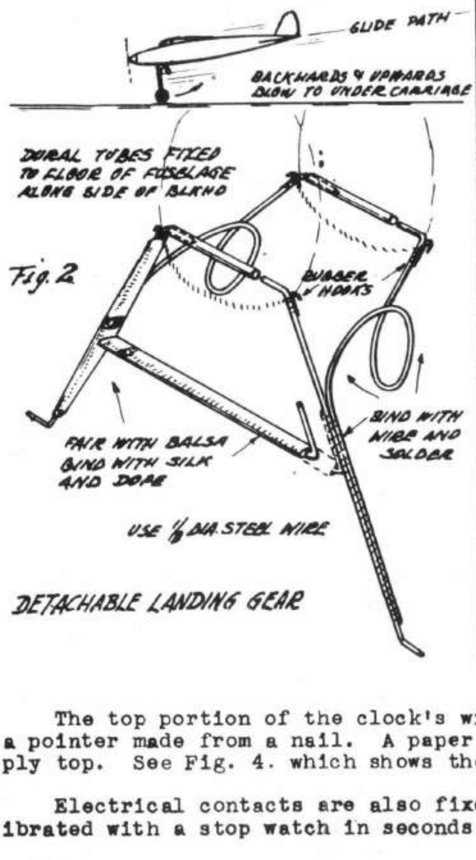
Fig. 2. shows the type of undercarriage I fit. I have never known one of these to become damaged and seldom do they allow any damage to a fuselage, owing to their large range of travel in the right direction.

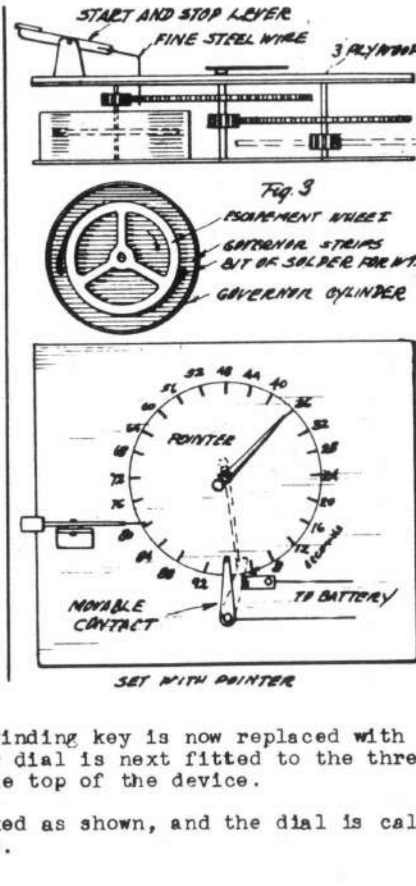
Fourthly, I consider it essential to fit a model with a device that will definitely control the duration of flight to within seconds. This is both a safety device and a great help in test work as the reader will shortly see.

The best control device I know of is made from the "works" of a half-dollar small clock. The mechanism operates an ignition switch and cuts the current from one of the battery leads after any predetermined time.

The mechanism is extracted from the case of a cheap clock, and the case, the hands, and the dial are scrapped. The escapement movement is next removed and discarded with the exception of the escapement wheel which is converted into a governor. Little metal strips are attached at one end to the escapement wheel opposite each other and the other ends of the strips are left free but have blobs of solder attached. A small tin cylinder is then made for the escapement wheel to revolve inside with its weights on the ends of their strips of sheet metal, but not touching the tin cylinder which is soldered into position in the works of the clock. The above is a governor which at a certain speed whirls the strips with their weights out into a light frictional contact with the walls of the cylinder.

A small starting and stopping device is next fitted to a three ply top to the clock. See Fig. 3., which is a side elevation of the clock timer.





The top portion of the clock's winding key is now replaced with a pointer made from a nail. A paper dial is next fitted to the three ply top. See Fig. 4. which shows the top of the device.

Electrical contacts are also fixed as shown, and the dial is calibrated with a stop watch in seconds.

To operate the time switch, the top and start lever is raised and the pointer wound up to the required number of seconds as shown on the dial. The switch is connected and the engine is started up. Just before releasing the model, the clock starting lever is pressed and the time switch will stop the engine after the correct time as set on the dial.

With this device it is possible to test out a model with complete safety, starting with a short hop of, let us say, five seconds, and gradually increasing the duration until perfect trim is obtained.

It is also possible to fly a model in a small field. Mr. Allman, a former winner of the Wakefield Cup, designed this device. This clock device can be made detachable and fitted into various models.

Testing a Gas Model

I invariably carry out the following procedure when trying out my new models, and as a result of this procedure and the methods of design already described, I very seldom indeed do any damage during this critical period.

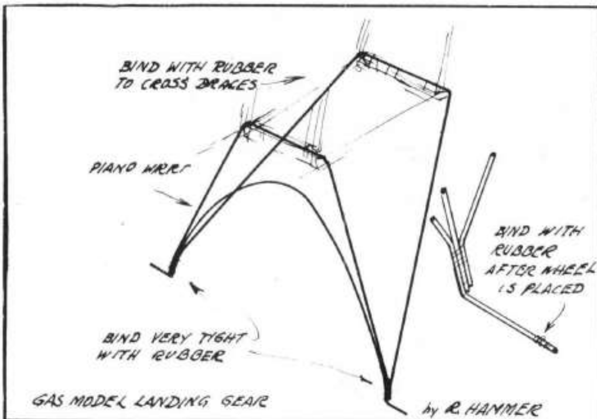
Having obtained the correct wing position in relation to the Centre of Gravity of the model, i. e. the C. G. at about 1/3 from the leading edge of the wing, and having also allowed for the correct angles of incidence of the wing and tailplane in the design, the model should be glided carefully by hand into a slight wind, and any small adjustments made so that the model makes good flat glides. The model must be a good glider if good landings after power flight is completed, are to be obtained.

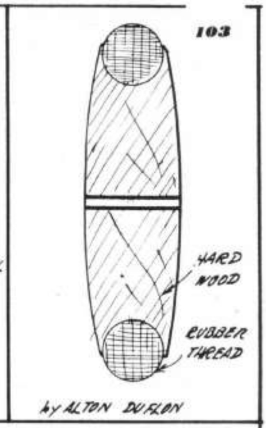
Now a five second hop can be tried under power, controlled by the clock mechanism. But before this is tried, the detachable nosepiece must be tilted downward (i. e. "downthrust") by packing wood slips between the detachable engine mount and the fuselage nose. The nosepiece must also have a slight offset to counteract the engine torque. Release the model, and if it will not rise during its five second run, reduce the downthrust a little at a time until the model just starts to get off the ground. Now try a longer flight and if all is well and a good landing is obtained, as it should be after a good glide, the wood packings between the detachable nosepiece and fuselage can be permanently glued into position and covered over with silk and doped to keep into position.

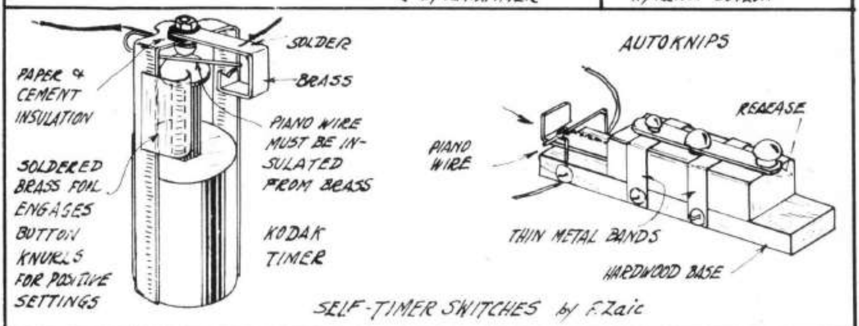
If you have never tried the above method, just give it a trial and give up crackups!

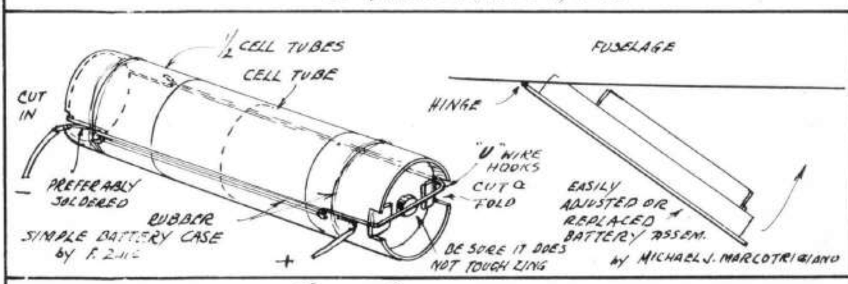
As the reader will probably know, if the wing is placed very high in relation to the engine thrust line (as in a parasol or high wing model), then there will be a tendency for the engine to pull the nose up around the very high centre of pressure of the wing and so cause a stall. Many people first test their models under power and in order to stop stalling under these circumstances they move the wing back a little. When the power ceases the model becomes nose heavy and dives to a crackup.

The correct method is to give the right amount of downthrust to counteract the stalling tendency and to leave the wing in its correct gliding position over the C. G. Good landings and glides will then be obtained. The detachable nosepiece allows this to be obtained very easily.

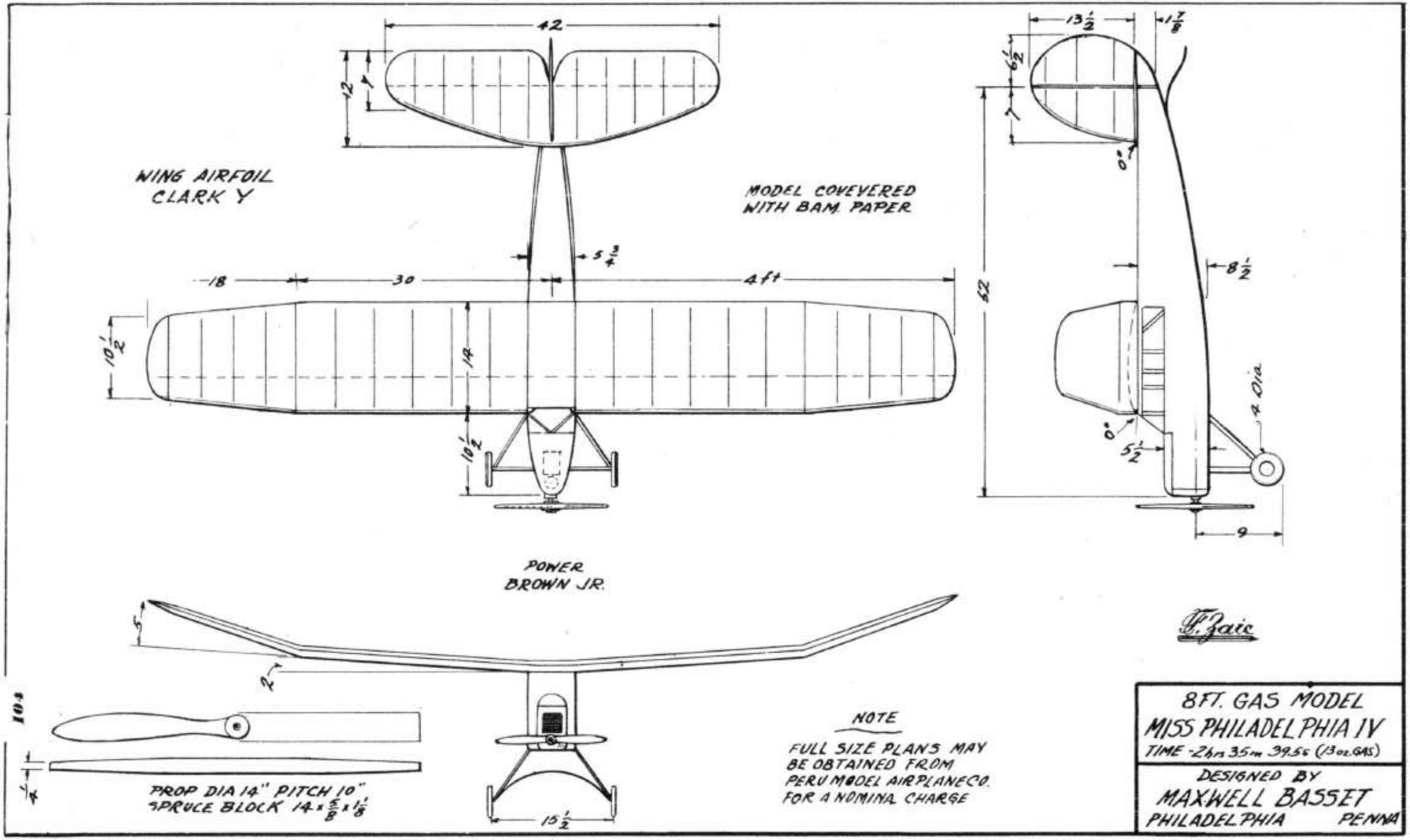

BIND WITH RUBBER TO CROSS BRACES
PIANO WIRE
BIND WITH RUBBER AFTER WHEEL IS PLACED
BIND VERY TIGHT WITH RUBBER
GAS MODEL LANDING GEAR
by R. HAMMER

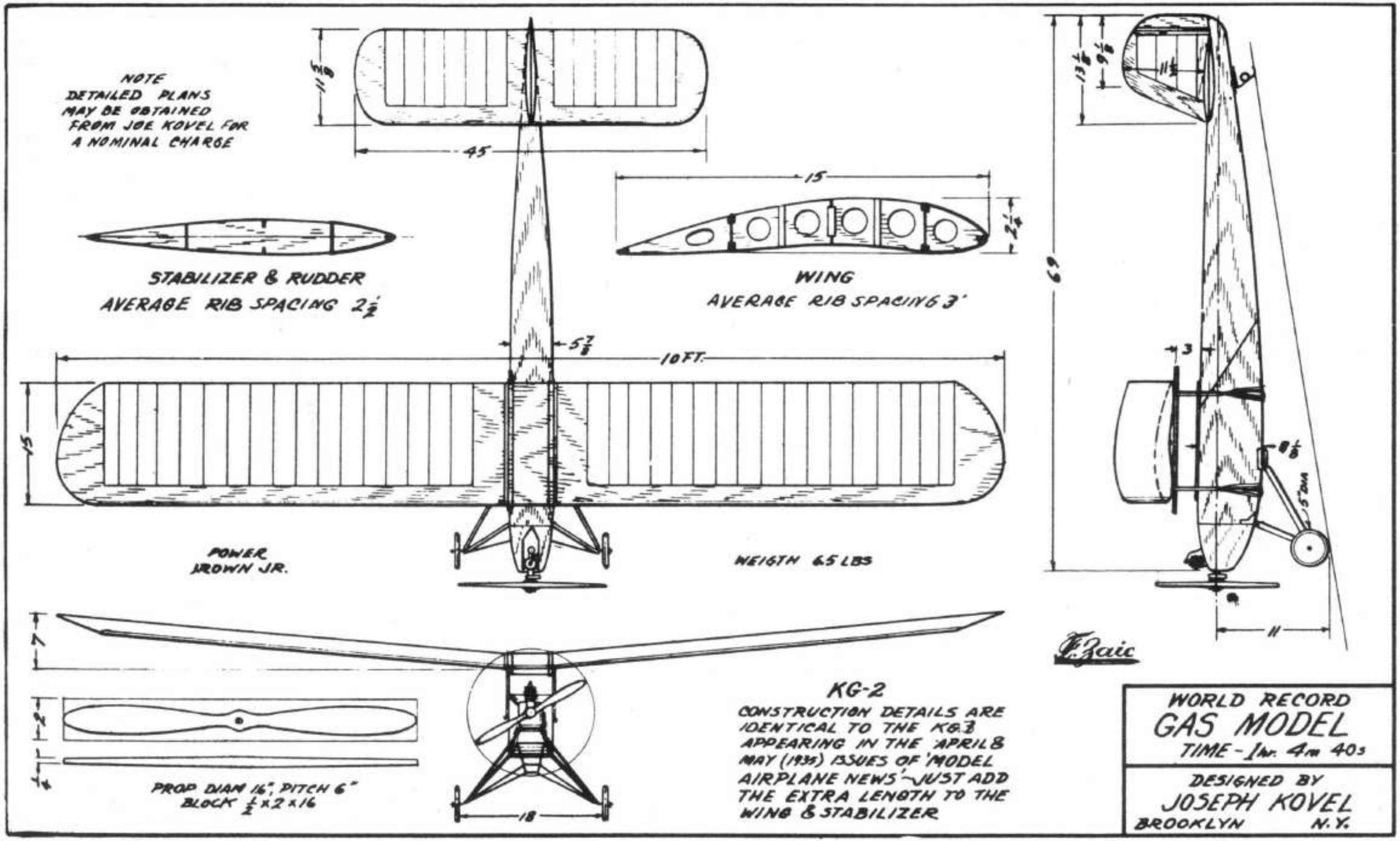

HARD WOOD
RUBBER THREAD
by ALTON DUFLON

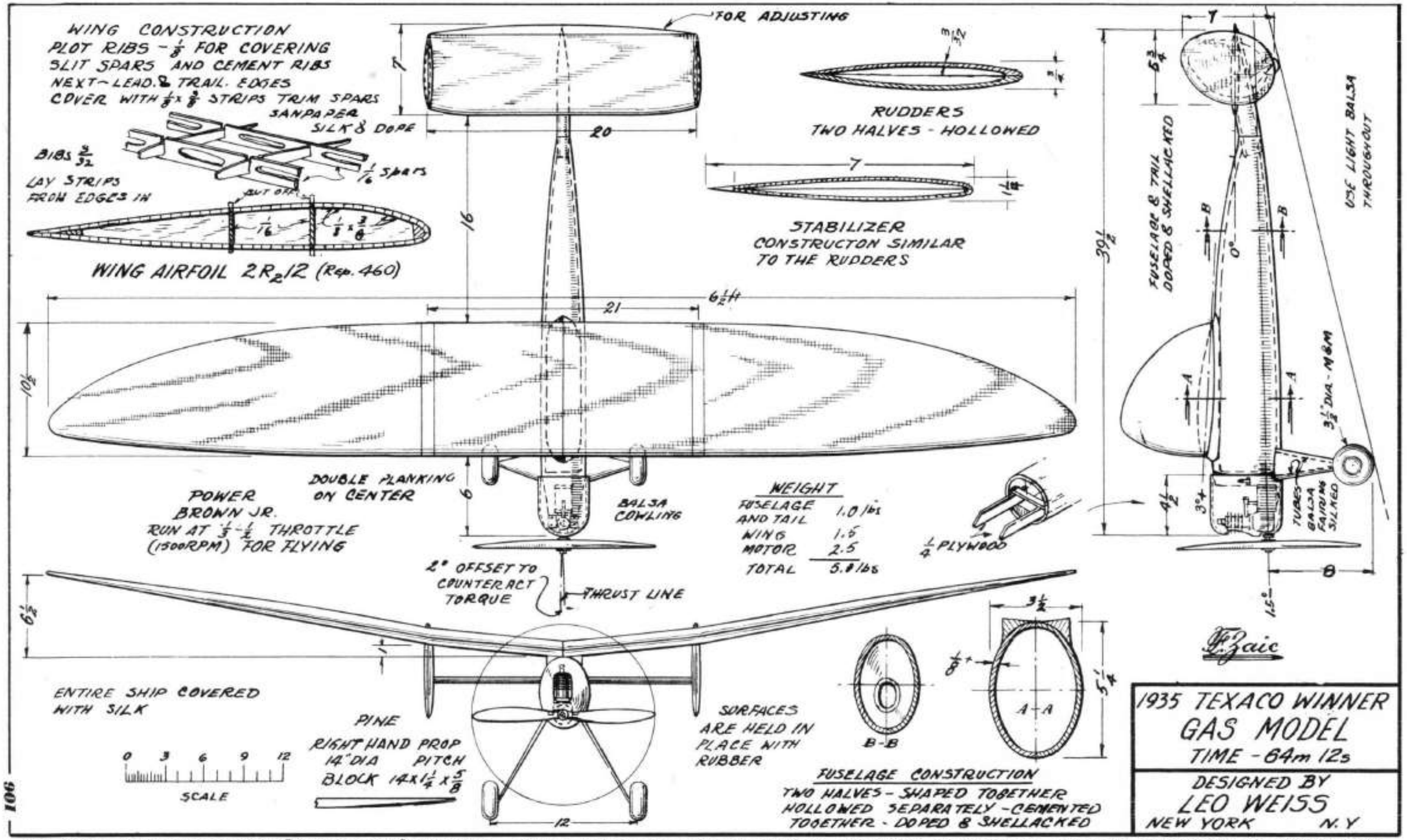

SOLDER
PAPER & CEMENT INSULATION
BRASS
PIANO WIRE MUST BE INSULATED FROM BRASS
SOLDERED BRASS FOIL ENGAGES BUTTON KNURLS FOR POSITIVE SETTINGS
KODAK TIMER
AUTOKNIPS
RELEASE
PIANO WIRE
THIN METAL BANDS
HARDWOOD BASE
SELF-TIMER SWITCHES by F. Zaic


1/2 CELL TUBES
CELL TUBE
CUT IN
PREFERABLY SOLDERED
RUBBER
"U" WIRE HOOKS
CUT & FOLD
SIMPLE BATTERY CASE by F. Zaic
BE SURE IT DOES NOT TOUCH ZINC
FUSELAGE
HINGE
EASILY ADJUSTED OR REPLACED BATTERY ASSEM.
by MICHAEL J. MARCOTRIGIANO

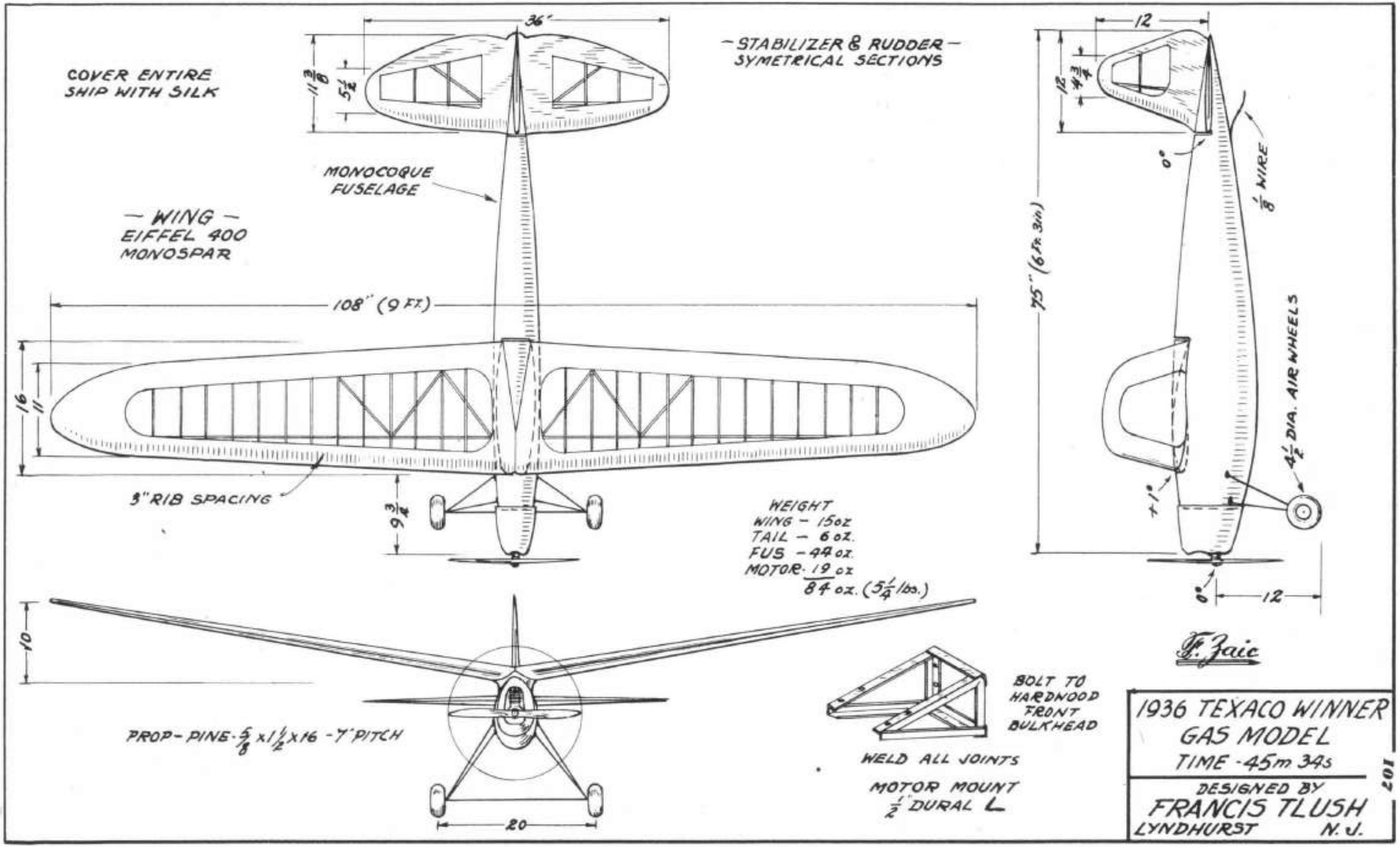

BAMBOO PAPER STRIP FILLETING
by TED FOTI
PAPER
RUBBER
BALSA
PLACING BABY CYCLONE TANK IN LINE WITH ENGINE
SIMPLE PLOTTING FOR 2-3 RATIO ELLIPSES-ARCS USED THROUGHOUT
INDICATE STEPS
#1
#2
#3
#4
#5
#6
FLOW-IN WITH FRENCH CURVE
ARRANGED by F. Zaic

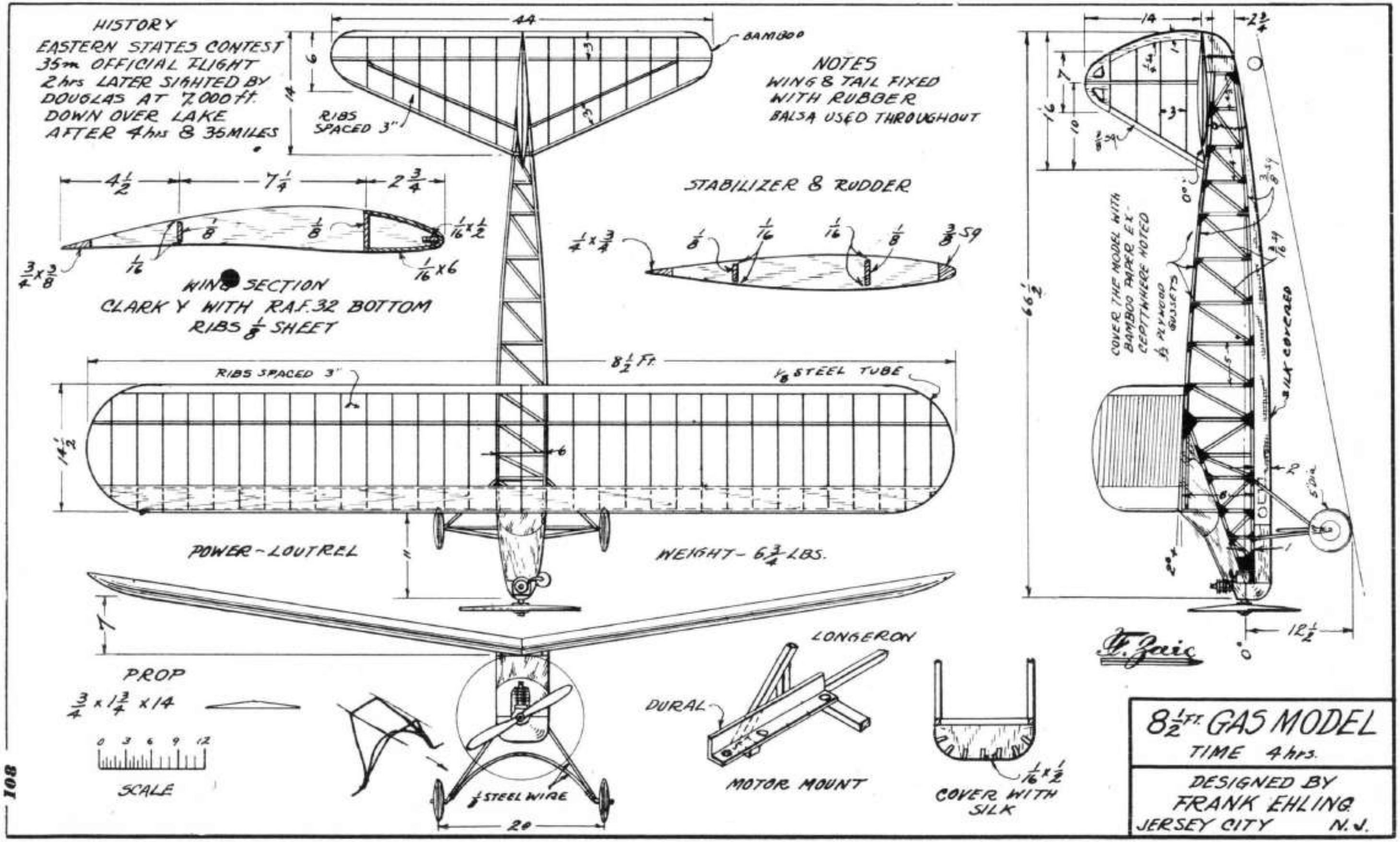

WING AIRFOIL
CLARK Y
MODEL COVEVERED
WITH BAM. PAPER
POWER
BROWN JR.
42
12
7
18
30
4 ft
14
$10\frac{1}{2}$
$10\frac{1}{2}$
$5\frac{3}{4}$
52
$13\frac{1}{2}$
$1\frac{7}{8}$
$6\frac{1}{2}$
7
0°
0°
$5\frac{1}{2}$
$8\frac{1}{2}$
4 Dia
9
5
2
$\frac{1}{4}$
$15\frac{1}{2}$
PROP DIA 14" PITCH 10"
SPRUCE BLOCK $14 \times \frac{5}{8} \times 1\frac{1}{8}$
NOTE
FULL SIZE PLANS MAY
BE OBTAINED FROM
PERU MODEL AIRPLANE CO.
FOR A NOMINA CHARGE
8 FT. GAS MODEL
MISS PHILADELPHIA IV
TIME - 2hrs 35m 39.5s (13oz. GAS)
DESIGNED BY
MAXWELL BASSET
PHILADELPHIA PENNA

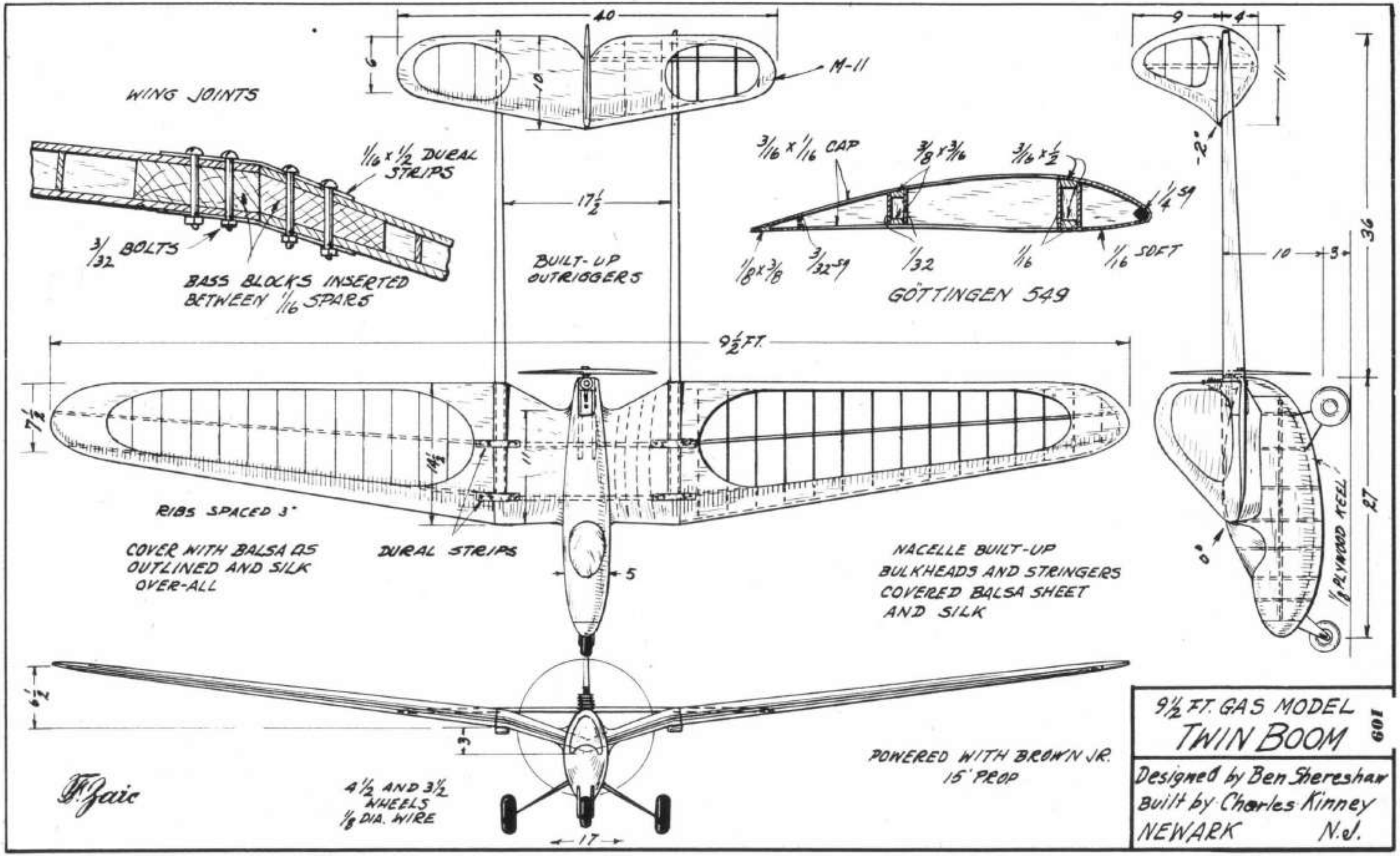

NOTE
DETAILED PLANS
MAY BE OBTAINED
FROM JOE KOVEL FOR
A NOMINAL CHARGE
45
STABILIZER & RUDDER
AVERAGE RIB SPACING 2½
15
WING
AVERAGE RIB SPACING 3"
10 FT.
69
POWER
BROWN JR.
WEIGTH 6.5 LBS
PROP DIAM 16", PITCH 6"
BLOCK ½ x 2 x 16
18
KG-2
CONSTRUCTION DETAILS ARE
IDENTICAL TO THE KG-3
APPEARING IN THE APRIL &
MAY (1935) ISSUES OF 'MODEL
AIRPLANE NEWS' — JUST ADD
THE EXTRA LENGTH TO THE
WING & STABILIZER
WORLD RECORD
GAS MODEL
TIME - 1hr. 4m 40s
DESIGNED BY
JOSEPH KOVEL
BROOKLYN N.Y.

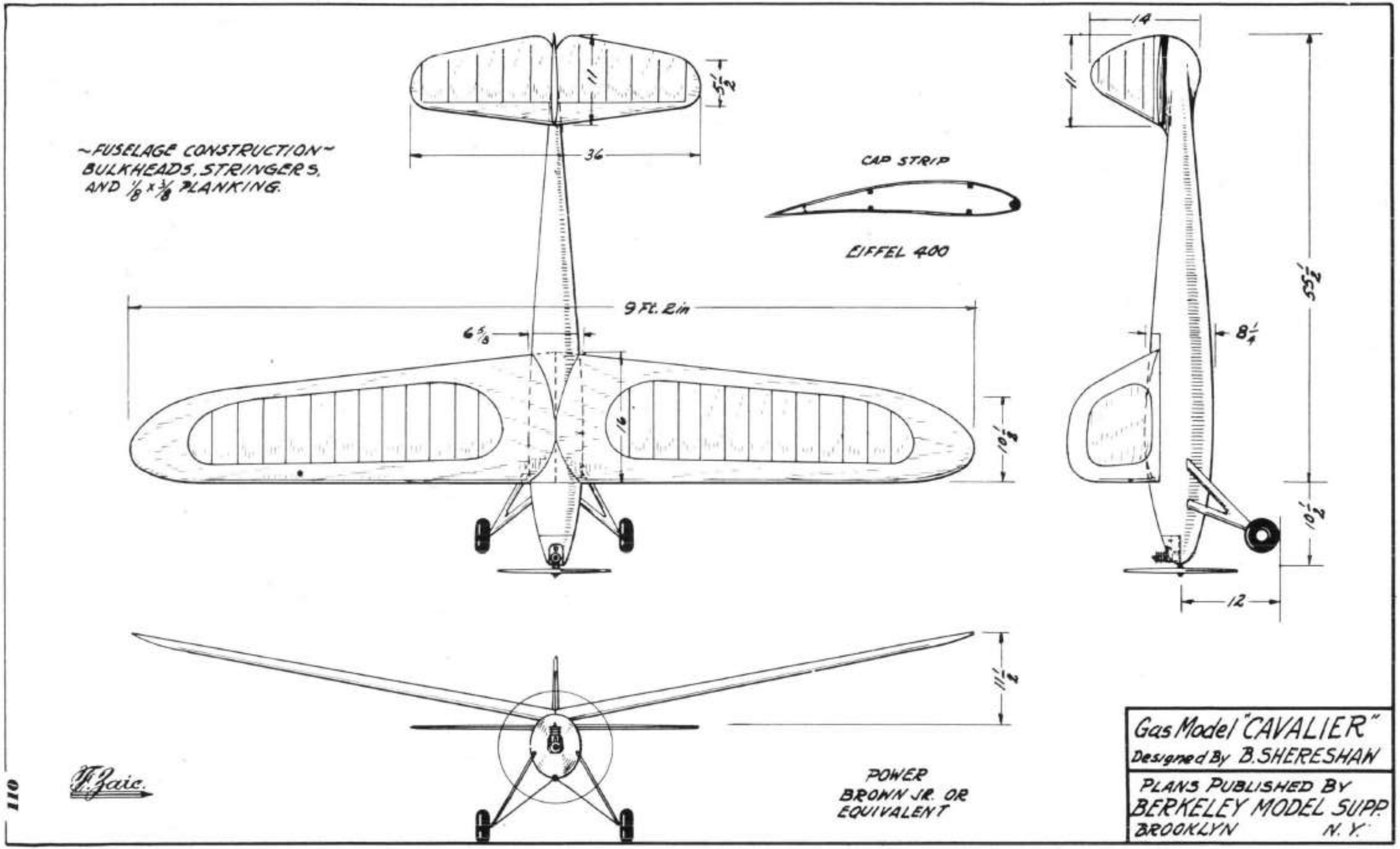


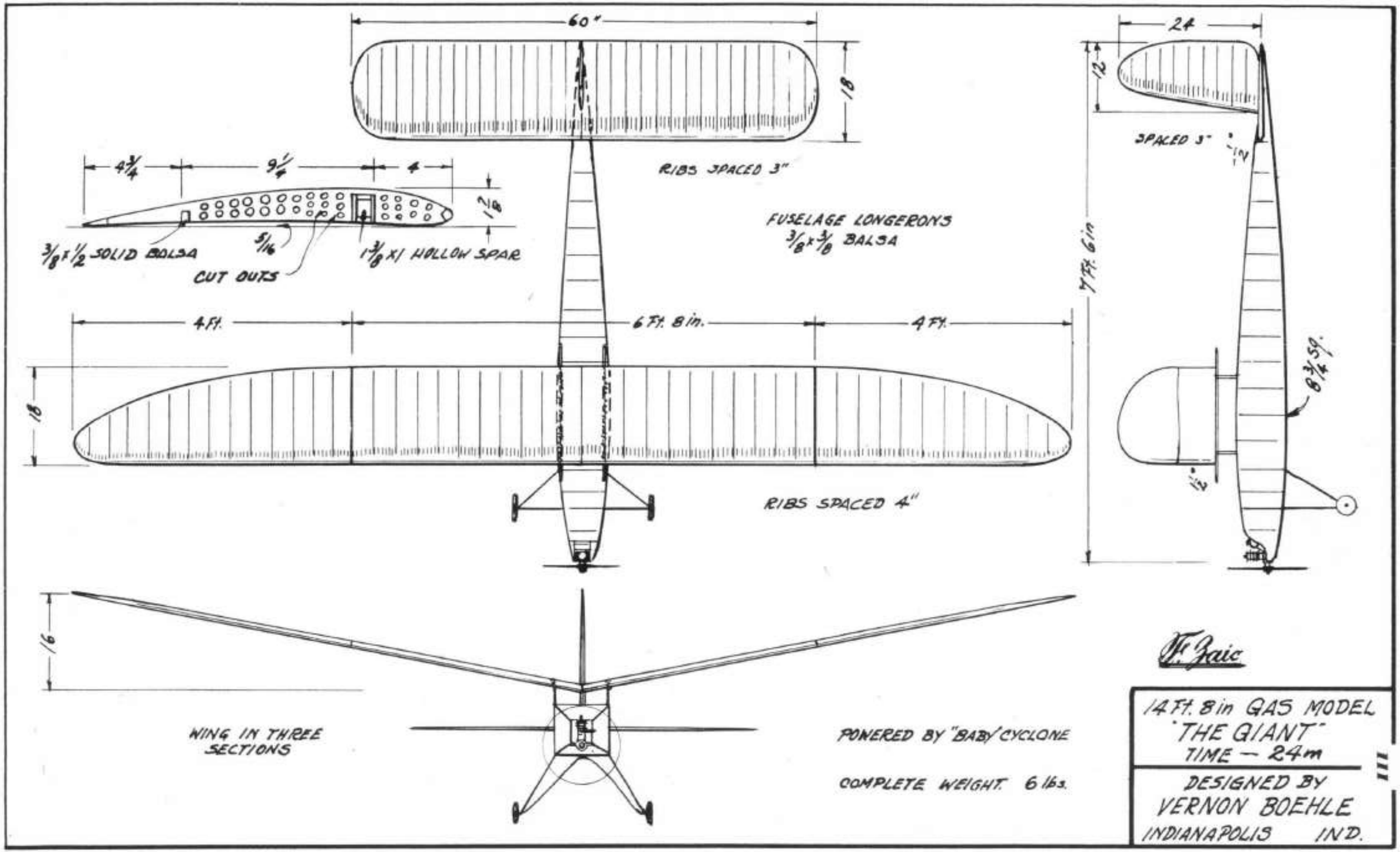
LEO WEISS IS A CONTRIBUTOR TO "FLYING ACES" MAGAZINE. ABOVE MODEL WILL BE DESCRIBED IN DETAIL IF THERE IS ENOUGH REQUESTS TO THE EDITOR


COVER ENTIRE SHIP WITH SILK
36"
$11\frac{3}{8}$
$5\frac{1}{2}$
— STABILIZER & RUDDER —
SYMETRICAL SECTIONS
MONOCOQUE FUSELAGE
— WING —
EIFFEL 400
MONOSPAR
108" (9 FT.)
16
11
3" RIB SPACING
$9\frac{3}{4}$
WEIGHT
WING – 15oz
TAIL – 6 oz.
FUS – 44 oz.
MOTOR 19 oz
84 oz. ($5\frac{1}{4}$ lbs.)
12
$4\frac{3}{4}$
0°
$\frac{1}{8}$ WIRE
75" (6 Ft. 3 in)
$4\frac{1}{2}$ DIA. AIR WHEELS
+1°
0°
12
10
PROP - PINE $\frac{5}{8} \times 1\frac{1}{2} \times 16$ - 7" PITCH
20
BOLT TO HARDWOOD FRONT BULKHEAD
WELD ALL JOINTS
MOTOR MOUNT
$\frac{1}{2}$" DURAL L
F. Zaic
1936 TEXACO WINNER
GAS MODEL
TIME - 45m 34s
DESIGNED BY
FRANCIS TLUSH
LYNDHURST N. J.

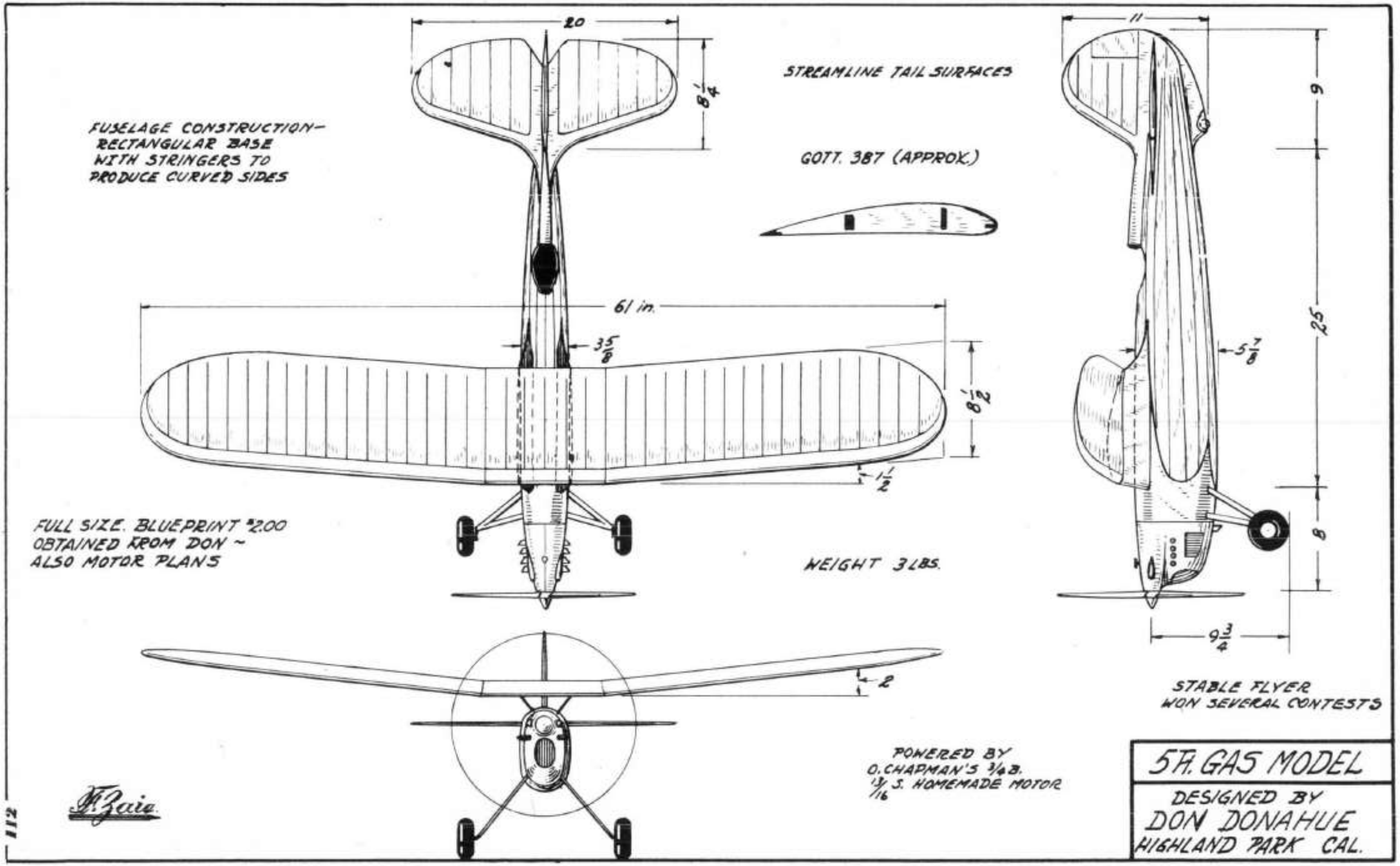

HISTORY
EASTERN STATES CONTEST
35m OFFICIAL FLIGHT
2 hrs LATER SIGHTED BY
DOUGLAS AT 7,000 ft.
DOWN OVER LAKE
AFTER 4 hrs 8 35 MILES
NOTES
WING & TAIL FIXED
WITH RUBBER
BALSA USED THROUGHOUT
BAMBOO
RIBS SPACED 3"
STABILIZER & RUDDER
WING SECTION
CLARK Y WITH RAF.32 BOTTOM
RIBS 1/8 SHEET
RIBS SPACED 3"
8 1/2 Ft.
1/8 STEEL TUBE
COVER THE MODEL WITH BAMBOO PAPER EXCEPT WHERE NOTED
1/8 PLYWOOD GUSSETS
SILK COVERED
POWER - LOUTREL
WEIGHT - 6 3/4 LBS.
PROP
3/4 x 1 3/4 x 14
SCALE
1/8 STEEL WIRE
LONGERON
DURAL
MOTOR MOUNT
COVER WITH SILK
F. Zaic
8 1/2 FT. GAS MODEL
TIME 4 hrs.
DESIGNED BY
FRANK EHLING
JERSEY CITY N.J.


WING JOINTS
1/16 x 1/2 DURAL STRIPS
3/32 BOLTS
BASS BLOCKS INSERTED BETWEEN 1/16 SPARS
40
6
10
M-11
17 1/2
BUILT-UP OUTRIGGERS
3/16 x 1/16 CAP
3/8 x 3/16
3/16 x 1/2
1/4 SQ
1/8 x 3/8
3/32 SQ
1/32
1/16
1/16 SOFT
GÖTTINGEN 549
9
4
11
-2°
10
3
36
9 1/2 FT.
7 1/2
14 1/2
11
RIBS SPACED 3"
COVER WITH BALSA AS OUTLINED AND SILK OVER-ALL
DURAL STRIPS
5
NACELLE BUILT-UP BULKHEADS AND STRINGERS COVERED BALSA SHEET AND SILK
27
0°
1/8 PLYWOOD KEEL
6 1/2
3
4 1/2 AND 3 1/2 WHEELS
1/8 DIA. WIRE
17
POWERED WITH BROWN JR. 15" PROP
F. Zaic
9 1/2 FT. GAS MODEL
TWIN BOOM
601
Designed by Ben Shereshaw
Built by Charles Kinney
NEWARK N.J.

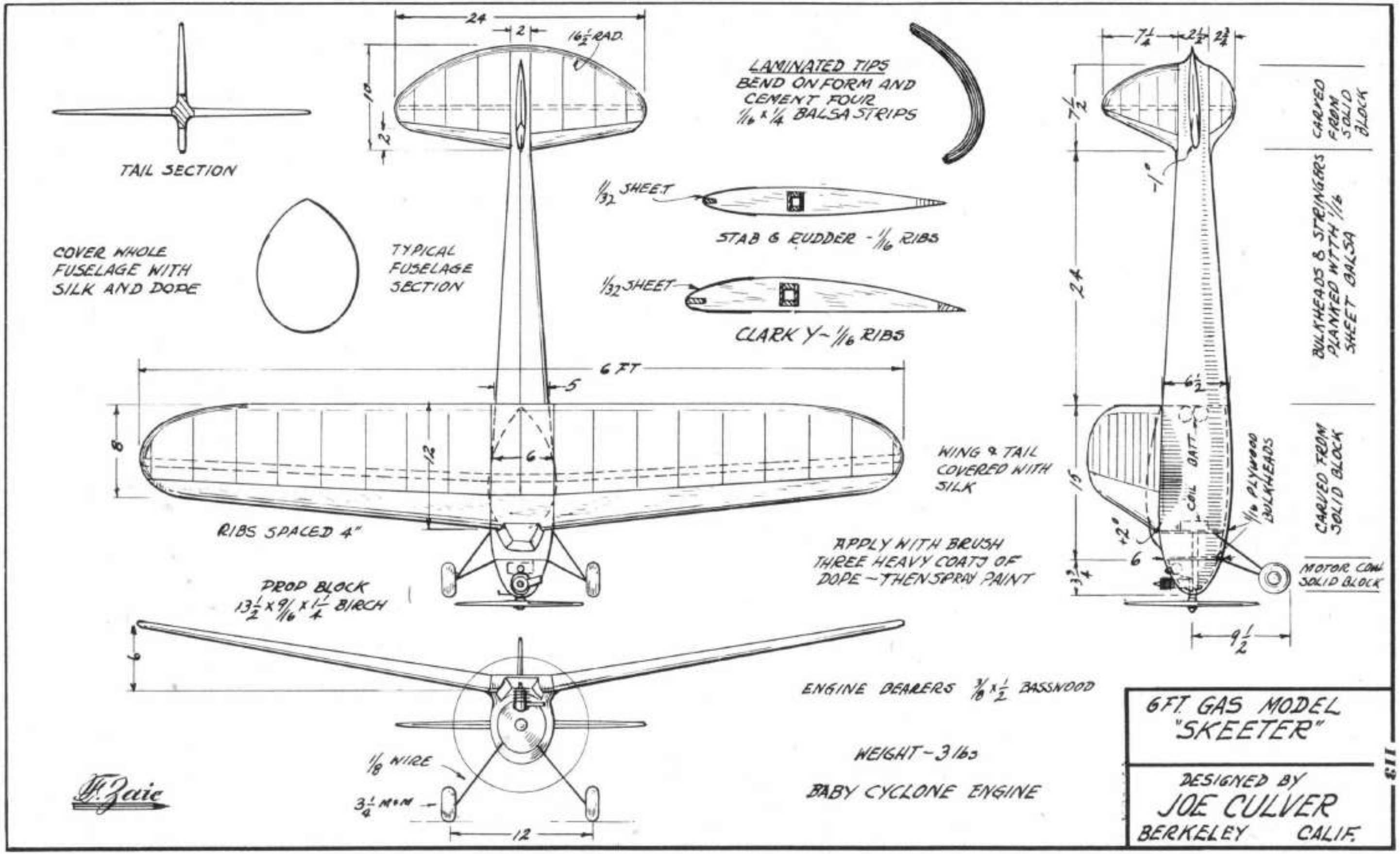

~FUSELAGE CONSTRUCTION~
BULKHEADS, STRINGERS,
AND 1/8 x 3/8 PLANKING.
36
11
5 1/2
CAP STRIP
EIFFEL 400
9 Ft. 2 in
6 5/8
16
10 1/8
11 1/2
POWER
BROWN JR. OR
EQUIVALENT
14
11
55 1/2
8 1/4
10 1/2
12
Gas Model "CAVALIER"
Designed By B. SHERESHAW
PLANS PUBLISHED BY
BERKELEY MODEL SUPP.
BROOKLYN N. Y.
W. Zaic.

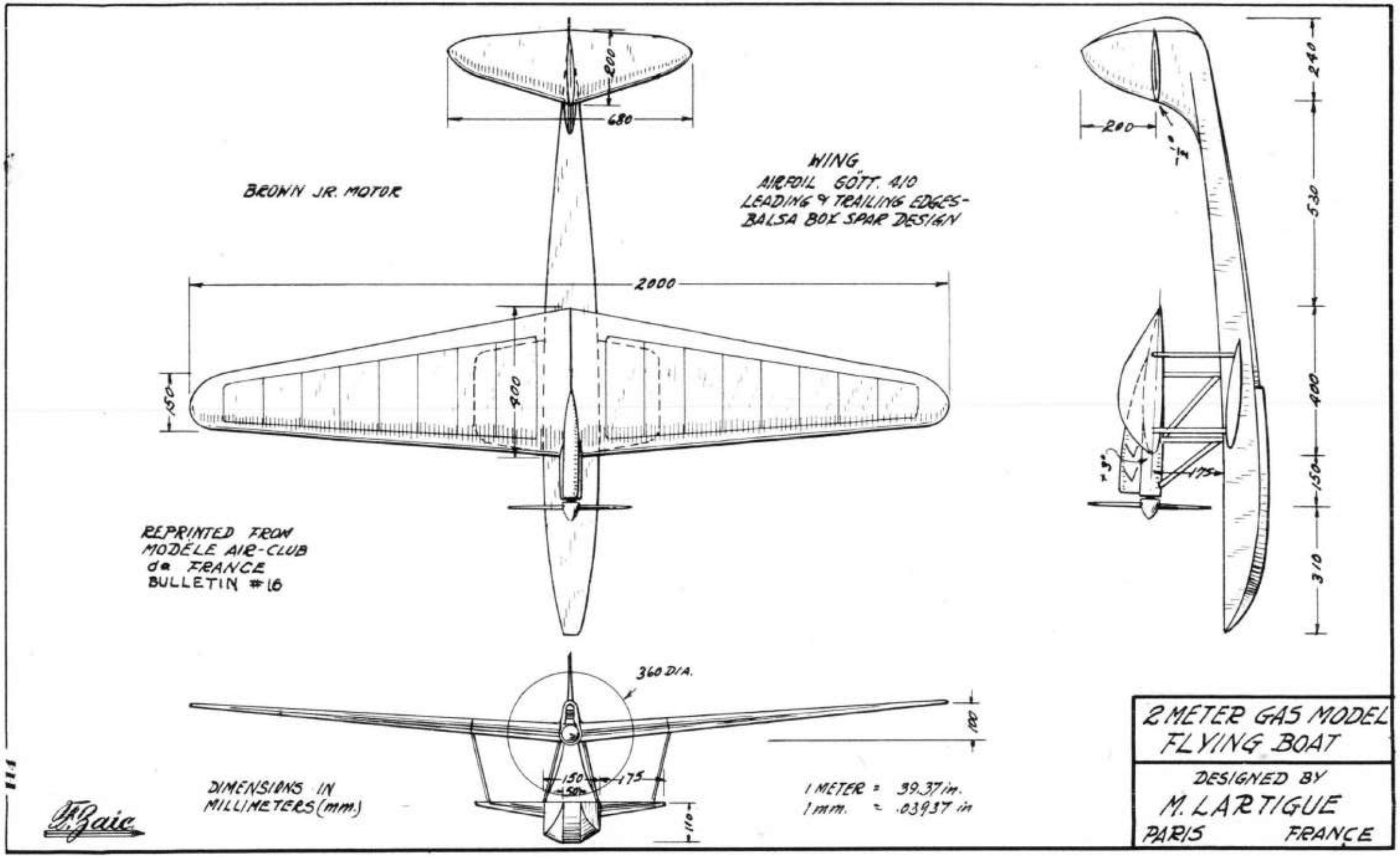


60"
18
24
12
SPACED 3"
RIBS SPACED 3"
4 3/4
9 1/4
4
1 7/8
3/8 x 1/2 SOLID BALSA
5/16
CUT OUTS
1 3/8 x 1 HOLLOW SPAR
FUSELAGE LONGERONS
3/8 x 3/8 BALSA
7 Ft. 6 in
4 Ft.
6 Ft. 8 in.
4 Ft.
18
8 3/4 SQ.
RIBS SPACED 4"
16
WING IN THREE
SECTIONS
POWERED BY "BABY CYCLONE
COMPLETE WEIGHT 6 lbs.
Fr. Zaic
14 Ft. 8 in GAS MODEL
"THE GIANT"
TIME — 24m
DESIGNED BY
VERNON BOEHLE
INDIANAPOLIS IND.
111

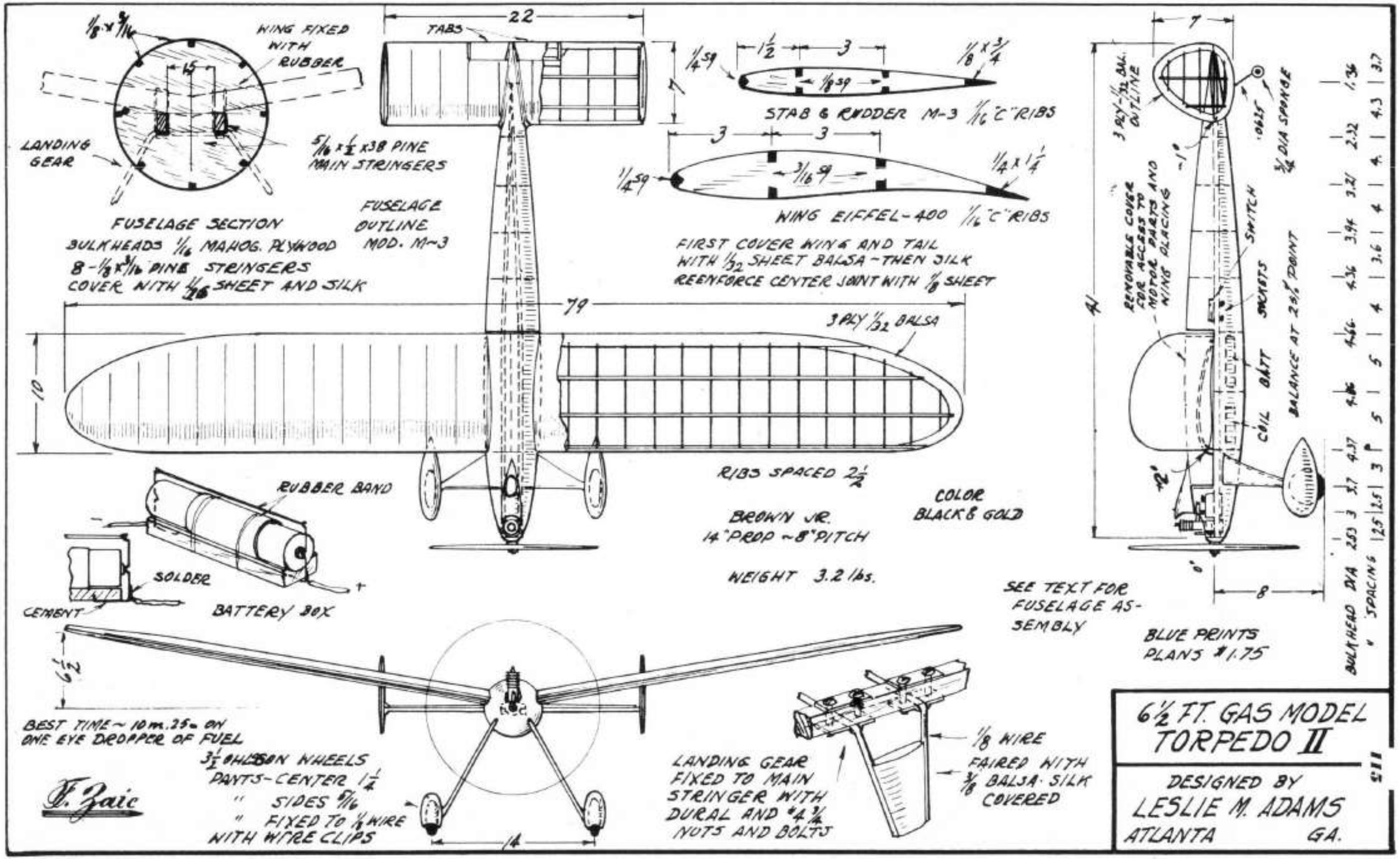


20
8 1/4
STREAMLINE TAIL SURFACES
11
9
FUSELAGE CONSTRUCTION—
RECTANGULAR BASE
WITH STRINGERS TO
PRODUCE CURVED SIDES
GOTT. 387 (APPROX.)
61 in.
3 5/8
25
5 7/8
8 1/2
1 1/2
FULL SIZE. BLUEPRINT $2.00
OBTAINED FROM DON ~
ALSO MOTOR PLANS
WEIGHT 3 LBS.
8
9 3/4
2
STABLE FLYER
WON SEVERAL CONTESTS
POWERED BY
O. CHAPMAN'S 3/4 B.
13/16 S. HOMEMADE MOTOR
5 Ft. GAS MODEL
DESIGNED BY
DON DONAHUE
HIGHLAND PARK CAL.

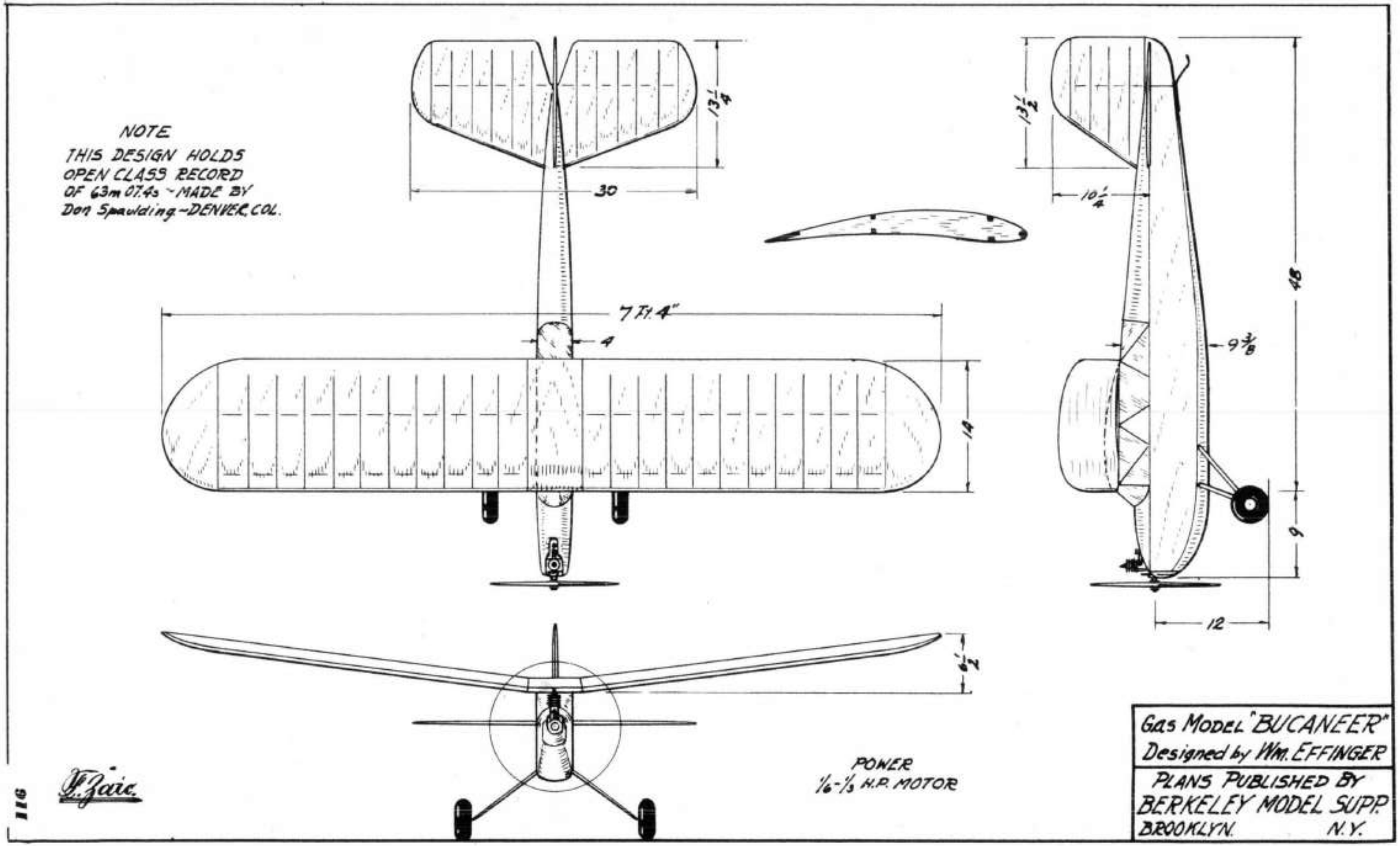

TAIL SECTION
16 1/2 RAD.
LAMINATED TIPS
BEND ON FORM AND CEMENT FOUR 1/16 x 1/4 BALSA STRIPS
1/32 SHEET
STAB & RUDDER - 1/16 RIBS
COVER WHOLE FUSELAGE WITH SILK AND DOPE
TYPICAL FUSELAGE SECTION
1/32 SHEET
CLARK Y - 1/16 RIBS
6 FT
CARVED FROM SOLID BLOCK
BULKHEADS & STRINGERS PLANKED WITH 1/16 SHEET BALSA
WING & TAIL COVERED WITH SILK
CARVED FROM SOLID BLOCK
COIL
BATT.
1/16 PLYWOOD BULKHEADS
RIBS SPACED 4"
APPLY WITH BRUSH THREE HEAVY COATS OF DOPE - THEN SPRAY PAINT
MOTOR COWL SOLID BLOCK
PROP BLOCK
13 1/2 x 9/16 x 1 1/4 BIRCH
ENGINE BEARERS 3/8 x 1/2 BASSWOOD
1/8 WIRE
3 1/4 M&M
WEIGHT - 3 lbs
BABY CYCLONE ENGINE
F. Zaic
6 FT. GAS MODEL
"SKEETER"
DESIGNED BY
JOE CULVER
BERKELEY CALIF.
113

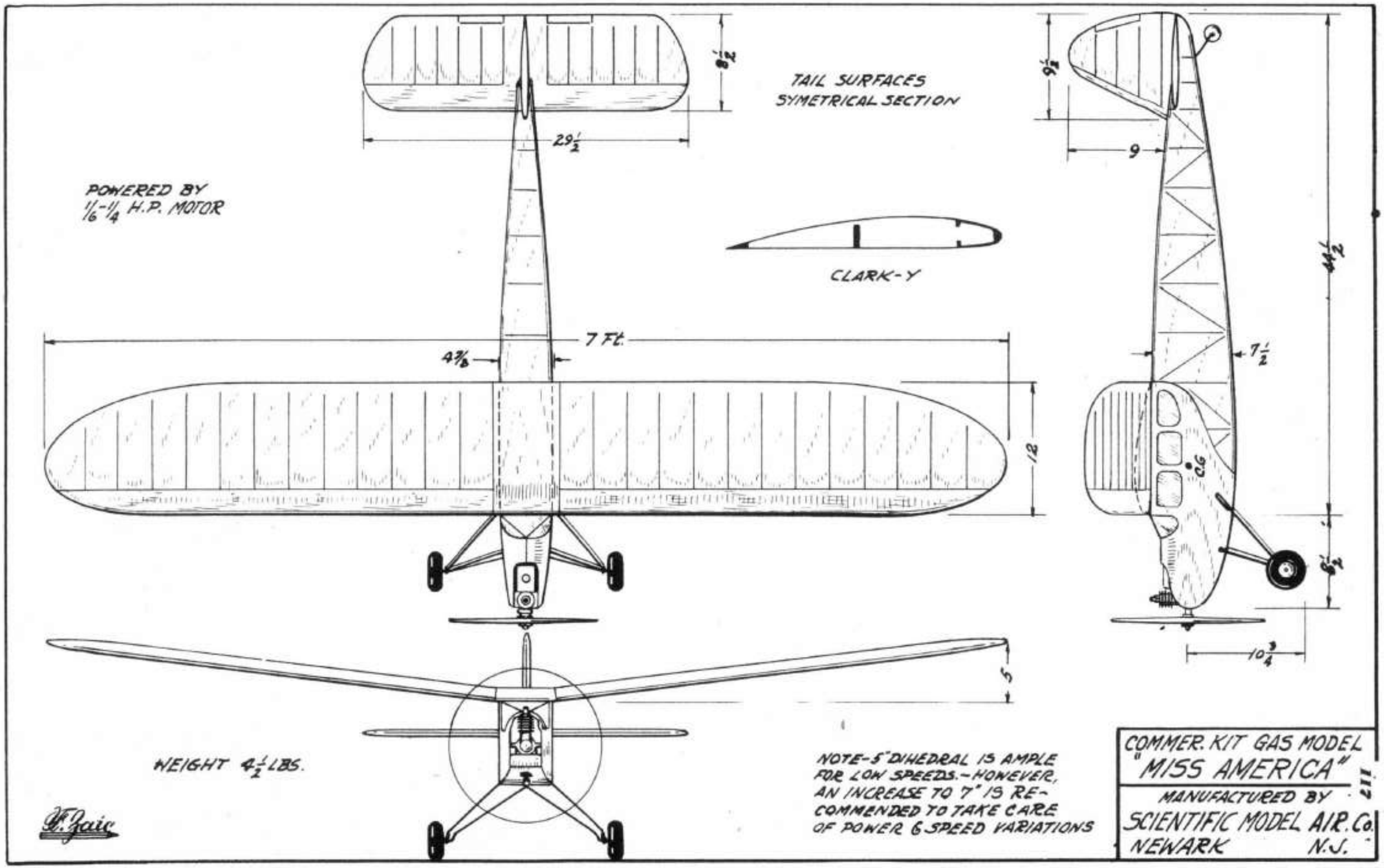


BROWN JR. MOTOR
WING
AIRFOIL GÖTT. 410
LEADING & TRAILING EDGES-
BALSA BOX SPAR DESIGN
680
200
2000
150
400
REPRINTED FROM
MODÈLE AIR-CLUB
de FRANCE
BULLETIN #16
360 DIA.
DIMENSIONS IN
MILLIMETERS (mm.)
150
175
110
100
1 METER = 39.37 in.
1 mm. = .03937 in
240
530
400
150
310
200
+3°
175
2 METER GAS MODEL
FLYING BOAT
DESIGNED BY
M. LARTIGUE
PARIS FRANCE

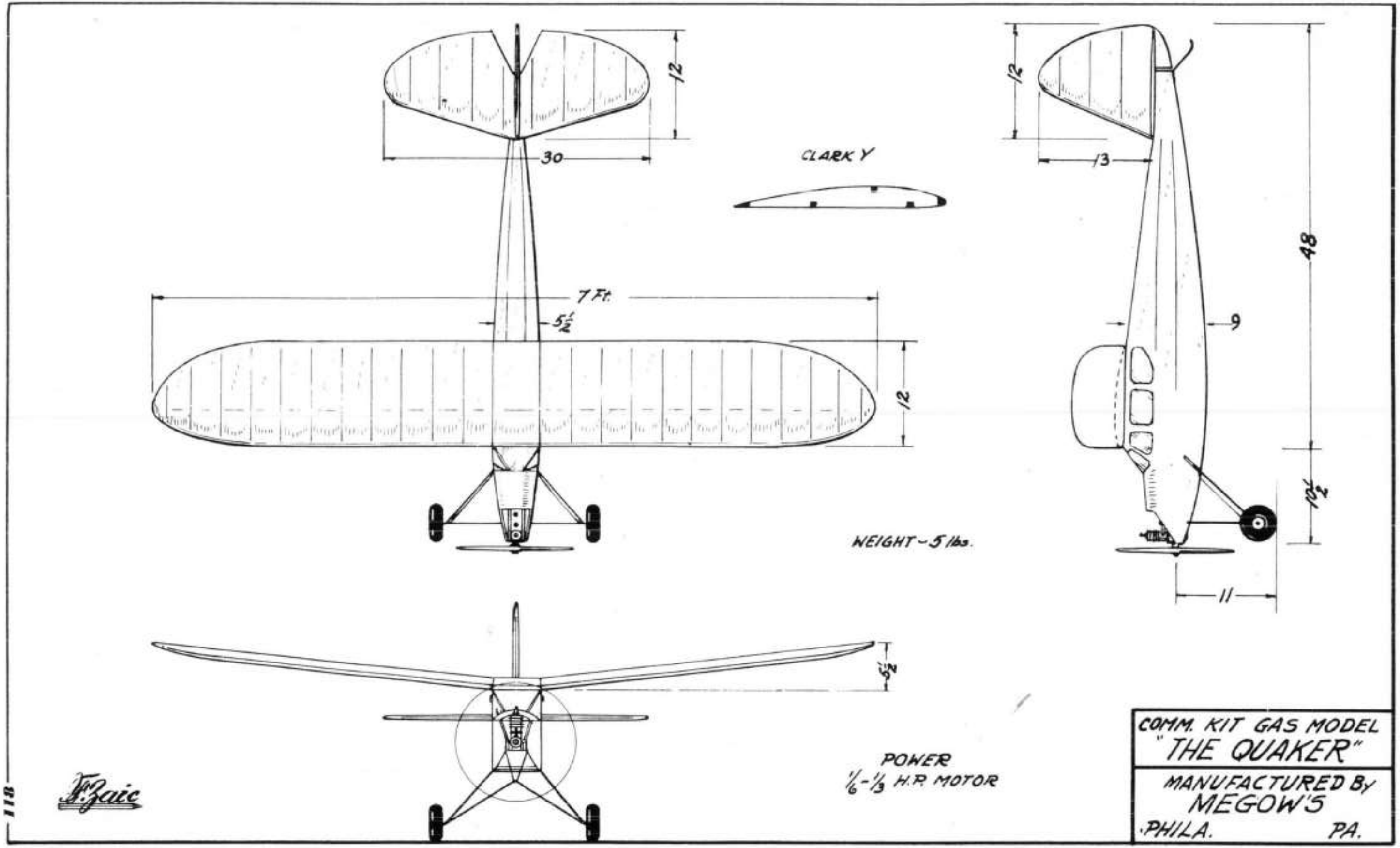


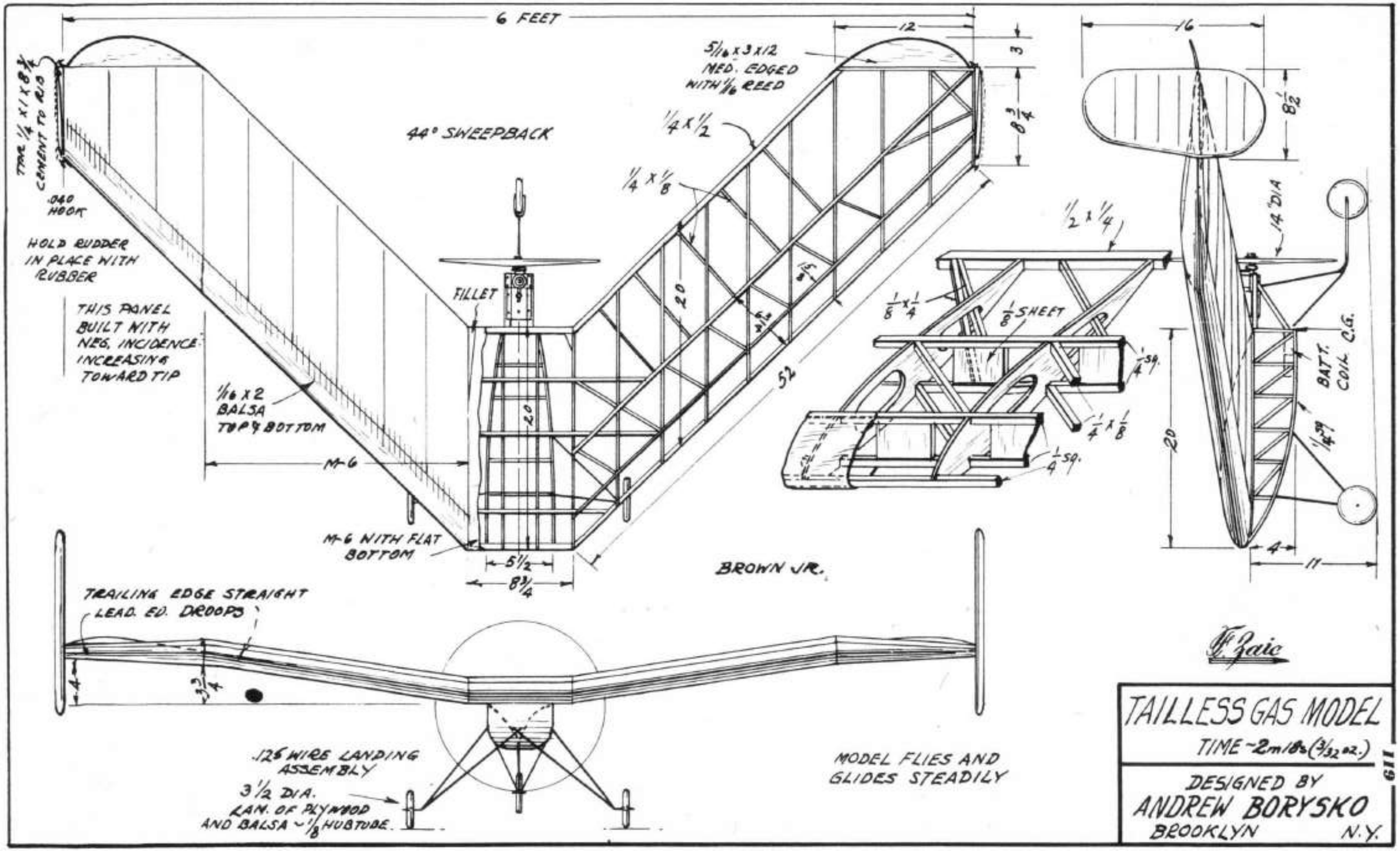
FUSELAGE SECTION
BULKHEADS 1/16 MAHOG. PLYWOOD
8 - 1/8 x 3/16 PINE STRINGERS
COVER WITH 1/16 SHEET AND SILK
WING FIXED WITH RUBBER
LANDING GEAR
5/16 x 1/2 x 38 PINE MAIN STRINGERS
FUSELAGE OUTLINE MOD. M-3
TABS
22
STAB & RUDDER M-3 1/16 "C" RIBS
WING EIFFEL-400 1/16 "C" RIBS
FIRST COVER WING AND TAIL WITH 1/32 SHEET BALSA - THEN SILK
REENFORCE CENTER JOINT WITH 1/8 SHEET
79
3 PLY 1/32 BALSA
RIBS SPACED 2 1/2
RUBBER BAND
SOLDER
CEMENT
BATTERY BOX
BROWN JR.
14" PROP ~ 8" PITCH
WEIGHT 3.2 lbs.
COLOR BLACK & GOLD
SEE TEXT FOR FUSELAGE ASSEMBLY
BLUE PRINTS PLANS $1.75
3 PLY-1/32 BAL. OUTLINE
REMOVABLE COVER FOR ACCESS TO MOTOR PARTS AND WING PLACING
SWITCH
SOCKETS
COIL
BATT
3/4 DIA SPONGE
BALANCE AT 25% POINT
BULKHEAD DIA
" SPACING
BEST TIME ~ 10 m. 25 s. ON ONE EYE DROPPER OF FUEL
3 1/2 OHLSSON WHEELS
PANTS - CENTER 1 1/4
" SIDES 5/16
" FIXED TO 1/8 WIRE WITH WIRE CLIPS
LANDING GEAR FIXED TO MAIN STRINGER WITH DURAL AND #4 3/4 NUTS AND BOLTS
1/8 WIRE FAIRED WITH 3/8 BALSA - SILK COVERED
F. Zaic
6 1/2 FT. GAS MODEL
TORPEDO II
DESIGNED BY
LESLIE M. ADAMS
ATLANTA GA.


NOTE
THIS DESIGN HOLDS
OPEN CLASS RECORD
OF 63m 07.4s ~ MADE BY
Don Spaulding ~ DENVER, COL.
30
$13\frac{1}{4}$
$13\frac{1}{2}$
$10\frac{1}{4}$
7 Ft. 4"
4
14
48
$9\frac{3}{8}$
9
12
$6\frac{1}{2}$
POWER
1/6 - 1/3 H.P. MOTOR
Gas Model "BUCANEER"
Designed by Wm. EFFINGER
PLANS PUBLISHED BY
BERKELEY MODEL SUPP.
BROOKLYN N.Y.
116



TAIL SURFACES
SYMETRICAL SECTION
POWERED BY
1/6-1/4 H.P. MOTOR
CLARK-Y
7 Ft.
29 1/2
8 1/2
4 3/8
12
9 1/2
9
44 1/2
7 1/2
8 1/2
10 3/4
5
WEIGHT 4 1/2 LBS.
NOTE-5" DIHEDRAL IS AMPLE
FOR LOW SPEEDS.-HOWEVER,
AN INCREASE TO 7" IS RE-
COMMENDED TO TAKE CARE
OF POWER & SPEED VARIATIONS
C.G.
COMMER. KIT GAS MODEL
"MISS AMERICA"
MANUFACTURED BY
SCIENTIFIC MODEL AIR. Co.
NEWARK N.J.
117


12
30
CLARK Y
12
13
48
7 Ft.
5 1/2
12
9
10 1/2
WEIGHT – 5 lbs.
11
5 1/2
POWER
1/6 – 1/3 H.P. MOTOR
W. Zaic
COMM. KIT GAS MODEL
"THE QUAKER"
MANUFACTURED BY
MEGOW'S
PHILA. PA.



6 FEET
12
3
8 3/4
5/16 x 3 x 12
MED. EDGED
WITH 1/16 REED
44° SWEEPBACK
1/4 x 1/2
1/4 x 1/8
TRE 1/4 x 1 x 8 3/4
CEMENT TO RIB
.040
HOOK
HOLD RUDDER
IN PLACE WITH
RUBBER
THIS PANEL
BUILT WITH
NEG. INCIDENCE
INCREASING
TOWARD TIP
1/16 x 2
BALSA
TOP & BOTTOM
M-6
FILLET
20
52
M-6 WITH FLAT
BOTTOM
5 1/2
8 3/4
BROWN JR.
1/2 x 1/4
1/8 x 1/4
1/8 SHEET
1/4 SQ.
1/4 x 1/8
16
8 1/2
14" DIA
BATT.
COIL
C.G.
4
11
TRAILING EDGE STRAIGHT
LEAD. ED. DROOPS
3 3/4
.125 WIRE LANDING
ASSEMBLY
3 1/2 DIA.
LAM. OF PLYWOOD
AND BALSA ~ 1/8 HUBTUBE
MODEL FLIES AND
GLIDES STEADILY
F. Zaic
TAILLESS GAS MODEL
TIME ~ 2m 18s (3/32 oz.)
DESIGNED BY
ANDREW BORYSKO
BROOKLYN N.Y.
119

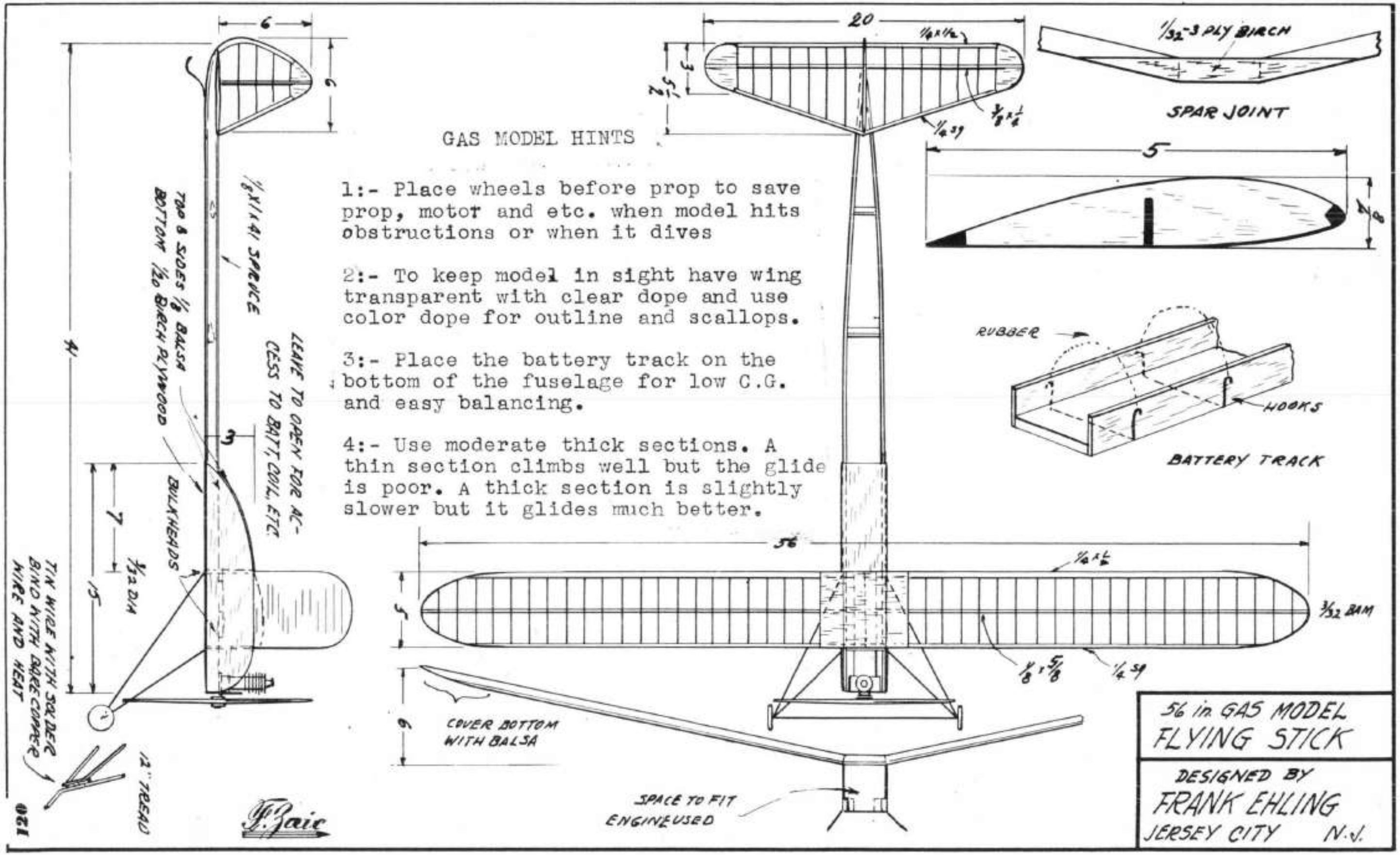
GAS MODEL HINTS

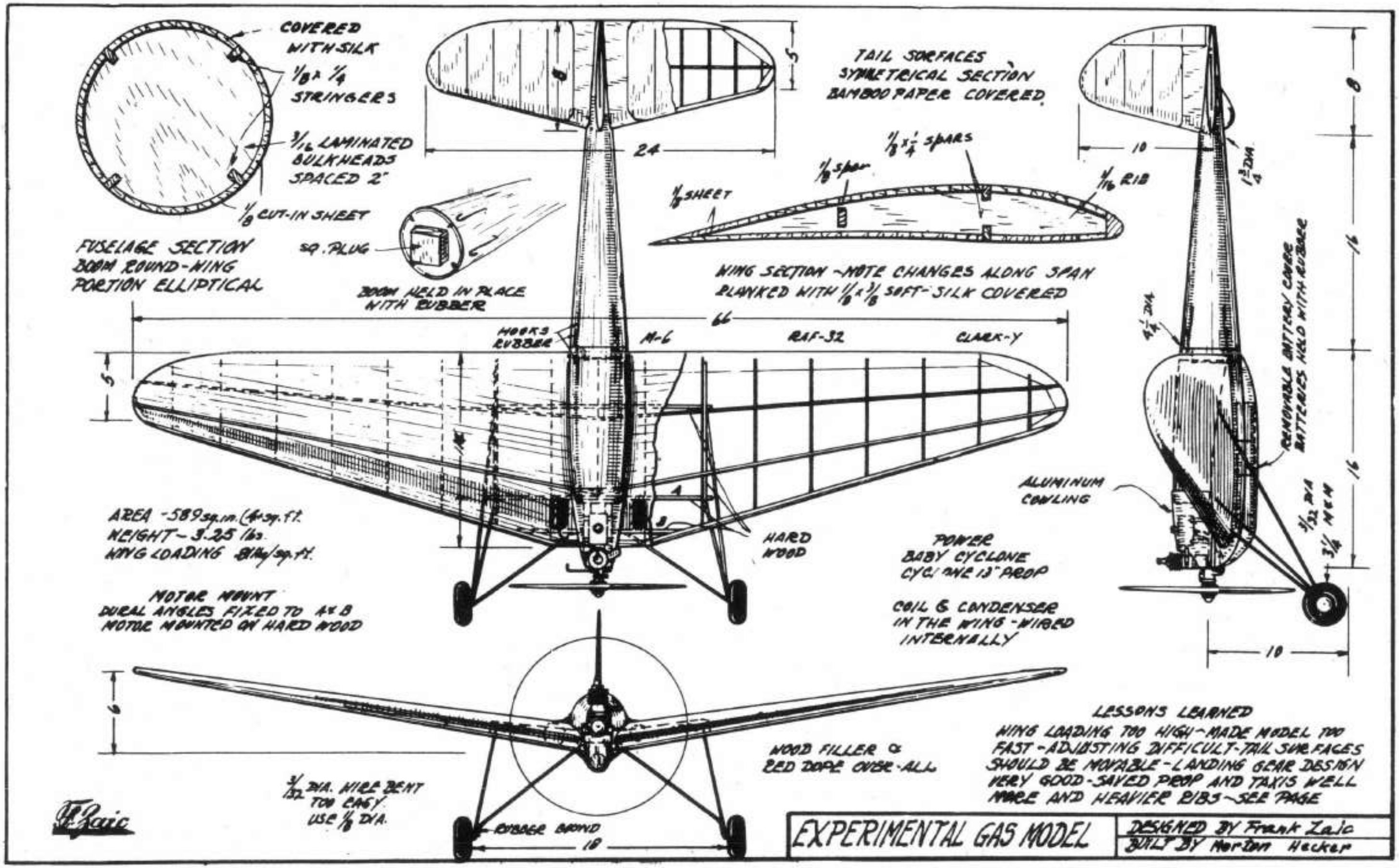
1:- Place wheels before prop to save prop, motor and etc. when model hits obstructions or when it dives

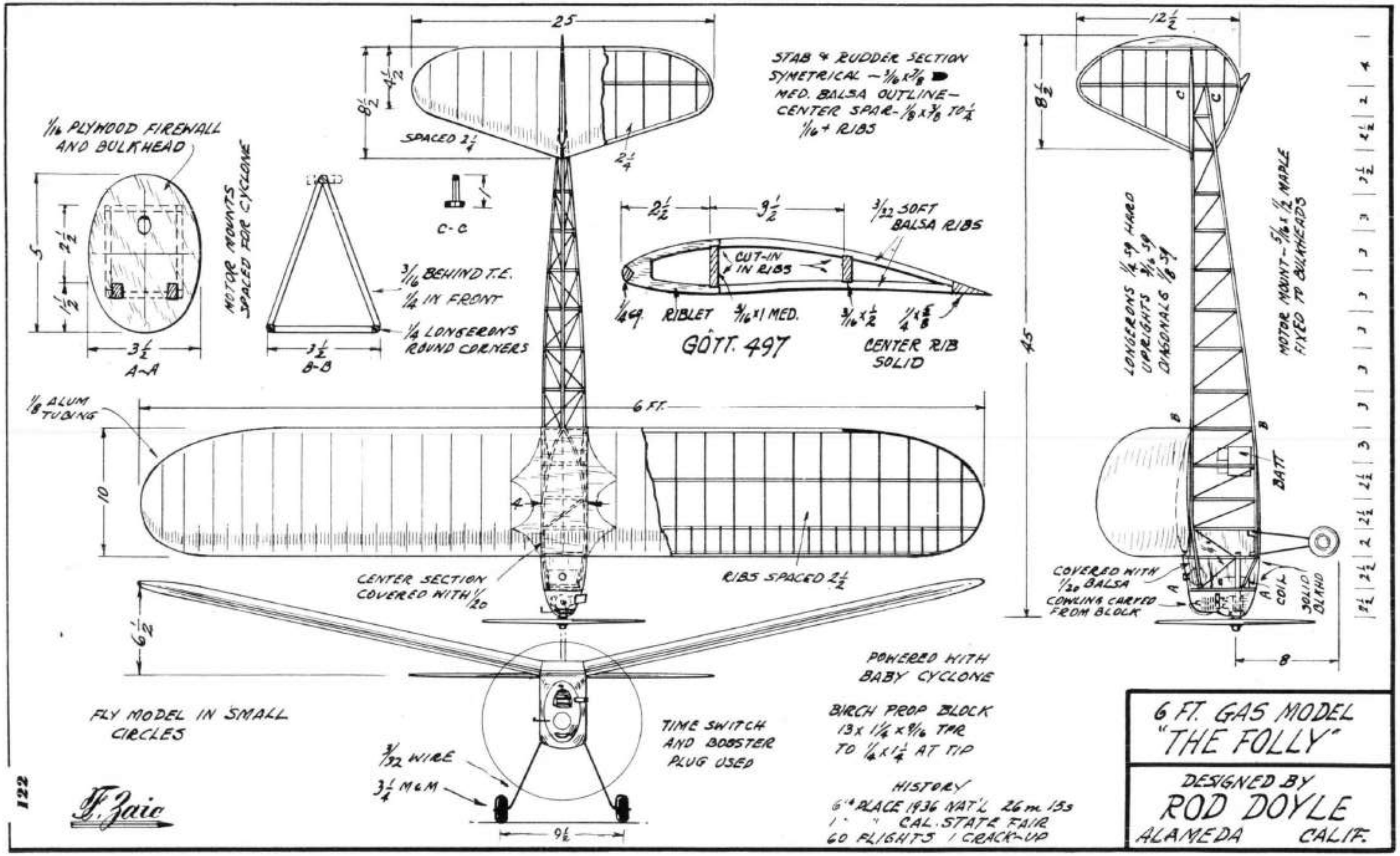
2:- To keep model in sight have wing transparent with clear dope and use color dope for outline and scallops.

3:- Place the battery track on the bottom of the fuselage for low C.G. and easy balancing.

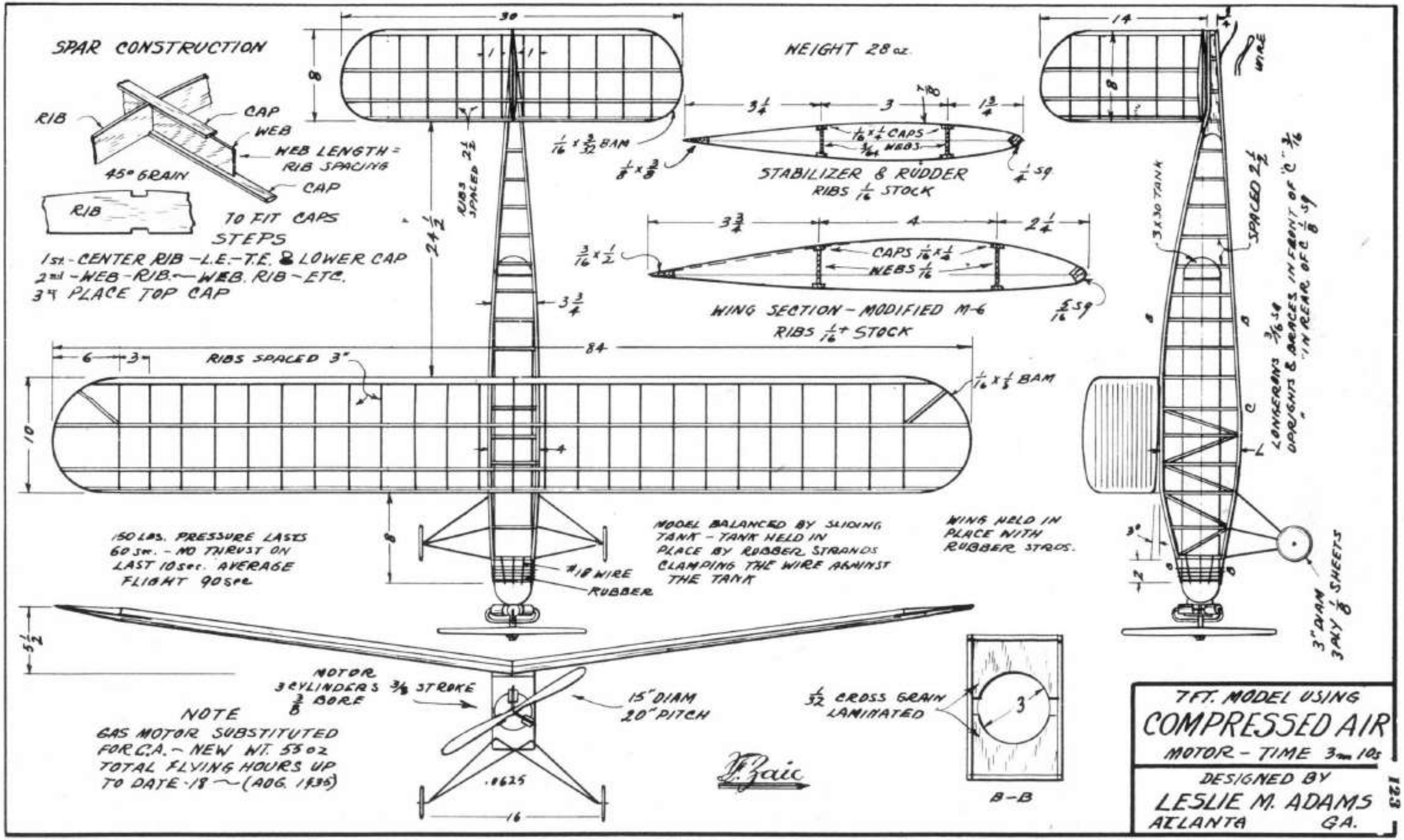
4:- Use moderate thick sections. A thin section climbs well but the glide is poor. A thick section is slightly slower but it glides much better.




COVERED WITH SILK
1/8 x 1/4 STRINGERS
3/16 LAMINATED BULKHEADS SPACED 2"
1/8 CUT-IN SHEET
FUSELAGE SECTION
BOOM ROUND-WING PORTION ELLIPTICAL
SQ. PLUG
BOOM HELD IN PLACE WITH RUBBER
24
5
TAIL SURFACES
SYMMETRICAL SECTION
BAMBOO PAPER COVERED.
1/8 x 1/4 spars
1/8 spar
1/8 SHEET
1/16 RIB
WING SECTION ~ NOTE CHANGES ALONG SPAN
PLANKED WITH 1/8 x 3/8 SOFT-SILK COVERED
10
1 3/4 DIA.
8
16
16
4 1/4 DIA.
REMOVABLE BATTERY COVER
BATTERIES HELD WITH RUBBER
ALUMINUM COWLING
3/32 DIA
3 1/4 M & M
10
66
HOOKS RUBBER
M-6
RAF-32
CLARK-Y
5
AREA - 589 sq.in. (4 sq. ft.
WEIGHT - 3.25 lbs.
WING LOADING .81 lbs/sq.ft.
MOTOR MOUNT
DURAL ANGLES FIXED TO A & B
MOTOR MOUNTED ON HARD WOOD
HARD WOOD
POWER
BABY CYCLONE
CYC. ONE 13" PROP
COIL & CONDENSER
IN THE WING - WIRED INTERNALLY
6
3/32 DIA. WIRE BENT TOO EASY.
USE 1/8 DIA.
RUBBER BAND
18
WOOD FILLER & RED DOPE OVER-ALL
LESSONS LEARNED
WING LOADING TOO HIGH ~ MADE MODEL TOO FAST - ADJUSTING DIFFICULT - TAIL SURFACES SHOULD BE MOVABLE - LANDING GEAR DESIGN VERY GOOD - SAVED PROP AND TAXIS WELL
MORE AND HEAVIER RIBS ~ SEE PAGE
EXPERIMENTAL GAS MODEL
DESIGNED BY Frank Zaic
BUILT BY Morton Hecker
F. Zaic



6 FT. GAS MODEL
"THE FOLLY"
DESIGNED BY
ROD DOYLE
ALAMEDA CALIF.
1/16 PLYWOOD FIREWALL AND BULKHEAD
MOTOR MOUNTS SPACED FOR CYCLONE
A-A
B-B
C-C
3/16 BEHIND T.E.
1/4 IN FRONT
1/4 LONGERONS ROUND CORNERS
SPACED 2 1/4
STAB & RUDDER SECTION SYMETRICAL — 3/16 x 3/8
MED. BALSA OUTLINE—
CENTER SPAR—1/8 x 3/8 TO 1/4
1/16 + RIBS
3/32 SOFT BALSA RIBS
CUT-IN IN RIBS
1/4 SQ. RIBLET 3/16 x 1 MED. 3/16 x 1/2 1/4 x 5/8
GÖTT. 497
CENTER RIB SOLID
1/8 ALUM TUBING
6 FT.
CENTER SECTION COVERED WITH 1/20
RIBS SPACED 2 1/2
LONGERONS 1/4 SQ HARD
UPRIGHTS 3/16 SQ
DIAGONALS 1/8 SQ
MOTOR MOUNT—5/16 x 1/2 MAPLE FIXED TO BULKHEADS
BATT
COVERED WITH 1/20 BALSA
COWLING CARVED FROM BLOCK
COIL
SOLID BLKHD
POWERED WITH BABY CYCLONE
BIRCH PROP BLOCK 13 x 1 1/4 x 9/16 TPR TO 1/4 x 1 1/4 AT TIP
HISTORY
6TH PLACE 1936 NAT'L 26 m 15 s
1ST " CAL. STATE FAIR
60 FLIGHTS 1 CRACK-UP
FLY MODEL IN SMALL CIRCLES
TIME SWITCH AND BOOSTER PLUG USED
3/32 WIRE
3 1/4 M&M
F. Zaic


SPAR CONSTRUCTION
RIB
CAP
WEB
WEB LENGTH = RIB SPACING
45° GRAIN
CAP
RIB
TO FIT CAPS
STEPS
1st - CENTER RIB - L.E. - T.E. & LOWER CAP
2nd - WEB - RIB - WEB. RIB - ETC.
3rd PLACE TOP CAP
30
8
RIBS SPACED 2 1/2
1/16 x 3/32 BAM
24 1/2
3 3/4
WEIGHT 28 oz.
3 1/4
3
1 3/4
1/16 x 1/4 CAPS
3/64 WEBS
1/8 x 3/8
1/4 SQ.
STABILIZER & RUDDER
RIBS 1/16 STOCK
3 3/4
4
2 1/4
3/16 x 1/2
CAPS 1/16 x 1/4
WEBS 1/16
5/16 SQ.
WING SECTION - MODIFIED M-6
RIBS 1/16+ STOCK
14
8
WIRE
3 x 30 TANK
SPACED 2 1/2
LONGERONS 3/16 SQ.
UPRIGHTS & BRACES IN FRONT OF "C" 3/16
" IN REAR OF C 1/8 SQ.
6
3
RIBS SPACED 3"
84
1/16 x 1/8 BAM
10
4
8
150 LBS. PRESSURE LASTS 60 sec. - NO THRUST ON LAST 10 sec. AVERAGE FLIGHT 90 sec.
#18 WIRE
RUBBER
MODEL BALANCED BY SLIDING TANK - TANK HELD IN PLACE BY RUBBER STRANDS CLAMPING THE WIRE AGAINST THE TANK
WING HELD IN PLACE WITH RUBBER STRDS.
3"
3" DIAM 3 PLY 1/8 SHEETS
5 1/2
MOTOR 3 CYLINDERS 3/8 STROKE 3/8 BORE
15" DIAM 20" PITCH
1/32 CROSS GRAIN LAMINATED
3
B-B
NOTE
GAS MOTOR SUBSTITUTED FOR C.A. - NEW WT. 55 oz
TOTAL FLYING HOURS UP TO DATE - 18 ~ (AUG. 1936)
.0625
16
Zaic
7 FT. MODEL USING
COMPRESSED AIR
MOTOR - TIME 3m 10s
DESIGNED BY
LESLIE M. ADAMS
ATLANTA GA.
123

Low Speed Airfoils

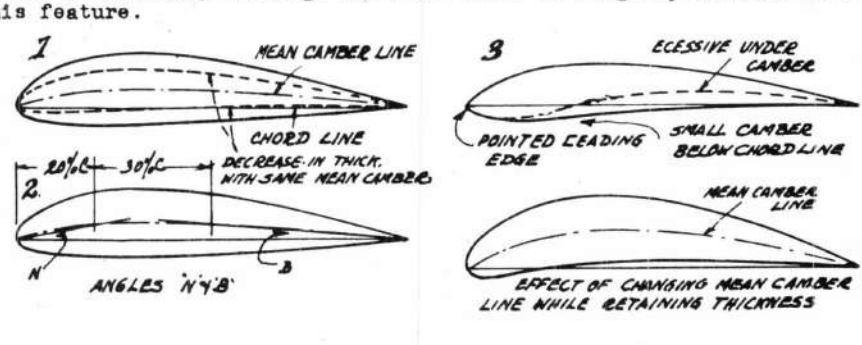
by Fred J. Rogerson
Reprint from "Canadian Aviation"

Realizing that we have been handicapped by lack of data concerning low speed airfoils, I decided to make a series of free flight tests. I built a weight rule model and a number of wings with identical plan forms, areas, and weights, but with different airfoil sections. Then with the aid of a stop watch, a 100 foot tape line, and plenty of blue sky, I proceded to make some tests.

Early in the experiment, I found that the Reynolds number is not a reliable measure for comparing airfoil sections at low speed. The rule adopted by the Germans for comparing glider sections seems more suitable for our purpose, especially since the speed of soaring gliders is reasonably slow, and the prime requisite of a model is to soar well. This comparison rule is based on the median line (mean chord line). The greater the arching of this line, the maximum thickness remaining the same, the slower will be the sinking velocity and greater the soaring ability. See Fig. 1. This I found to hold true with the airfoils tested.

The above rule serves gliders very well, since they are continuously gliding down, but for power model work we must consider other factors, mainly, that of getting the greatest height with the limited power. Although airfoils with a thickness relation of 1:5 have proved successful, it would be next to impossible to design a propeller of reasonable proportions that would fly such a wing to sufficient altitude for the mean camber to get in its work. I found that the power required depends a great deal upon the angle (N) at which the leading edge meets the air, and also the maximum thickness of the airfoil. See Fig. 2. A "Phillips" entering edge can be used to reduce the value of N and yet retain the good mean camber. See Fig. 3. In the tests, pointed leading edges, and those of very small radius showed up reasonably well for this purpose. They also provided better stability at large angles of attack. I believe that the reason for this latter characteristic is that the dividing line between the upper and lower airflow is determined by the form of the leading edge. The blunter edge will tend to change the C. P. gradually, while the pointed edge delays the shifting, until at large angles of attack it shifts suddenly, causing a stable moment.

The airspeed of a model airfoil is too low to build up high pressure at the leading edge, as in commercial practise. The absence of this condition causes a very heavy boundary layer of turbulent air about the airfoil which reduces the lift/drag value. However, the pointed airfoils cut their way cleanly through the air, causing very little resistance, although the lift value is slightly reduced with this feature.



AIRFOIL	N in Degrees	B in Degrees	Max. Thick. % of Chord
St.Cyr 52 Caudron	8.0	3.5	10.
Gottigen 436	9.0	4.0	11.08
C-72	9.0	4.5	11.73
G. Light	9.5	5.25	11.7
U.S.A. 40	8.5	4.5	13.72
Driggs	11.0	3.5	13.72
N.A.C.A. 6409	13.0	6.75	9.0
Eiffel 385	8.0	3.5	13.3
Grant	11.5	6.0	13.4
Gottigen 81	16.0	7.0	7.3
R.A.F. 32	10.4	6.25	12.7
Martin 40	11.5	6.3	22.1
Clark Y	12.0	5.0	11.7

The lift of an airfoil is in proportion to the maximum thickness and the angle (B) made by the chord line and the mean camber line at a point 50% from the trailing edge. See Fig. 2. The chord is defined as the line between the extreme leading edge and the trailing edge. It should not be confused with the datum line, from which the airfoil is layed out. Undercamber carefully applied is an efficient method of increasing lift

These are the most important airfoil characteristic requirements, and can be applied to any section we choose. Table I shows the angle of the leading edge to the airflow (N), the angle between the chord and mean camber lines (B), and the airfoil. The choice will be left to the reader as the requirements depend upon the wing loading of the model.

The test wing construction consisted of a 3/32" x 1/4" leading edge, a 1/16" x 1/8" top spar, a 1/16" x 1/4" trailing edge, and rib spacing of $1\frac{1}{2}$". The grain of the tissue was parallel with the chord and the wing was doped with water and two coats of clear dope. On a highly cambered section, the sag in the covering was found to be as much as 1/8" at a point about 20% from the leading edge. After the first tests these wings were covered with 1/64" sheet balsa from a point 30% from the leading edge on the upper surface to a point 20% on the lower surface. This gave an average increase in duration of 25 to 30%. Still greater improvement should be obtained from wings covered entirely with balsa

Speaking generally, an airfoil should have:

1. A general pleasing streamlined appearance, without any very abrupt changes in the curvature.
2. A leading edge of small radius, or one that is pointed.
3. The maximum height of the mean camber line at a point 40 to 50% from the leading edge.
4. No excess upper camber or under camber, as this may mean excessive drag with no compensating increase of lift.
5. No excessive camber below the chord line of the "M" type of airfoils, as this will decrease the lift.
6. A mean camber of .045 to .055 of the chord, as this seems to give the best performance.

To predict or calculate the performance of any wing, the finished wing must have no sag in the covering. I might add that in tests a .1 oz. greater wing loading per sq. ft. makes the difference between soaring and a straight glide in. I have found that the "Grant Section", as used on C. H. Grant's twin pusher and twin tractor, a very good all-around section. The greatest draw-back is that it absorbs considerable power from a single motored job.

Twin Pusher

by Edward I. Manulkin

You old timers will remember that in the days before 1934, twin pushers were winning almost every contest, bringing to their builders every sort of prize, from kits to trips to Europe. Usually the winning flight time was about three minutes. Very few of the pre-1934 tractors compared well with twins in performance.

This state continued until about two years ago, when the experienced builders began to understand more thoroughly the importance of streamlining, of design, and of proper adjusting. Since the single tractor was the easiest to streamline and to adjust, the twin pusher was greatly neglected, so that at present most of the records are held by tractors. You will note that it was the application of streamlining and adjusting that caused the increase of tractor time. Of the two, probably adjusting is the more important.

Some reasons why the tractor has superseded the standard twin pusher are:

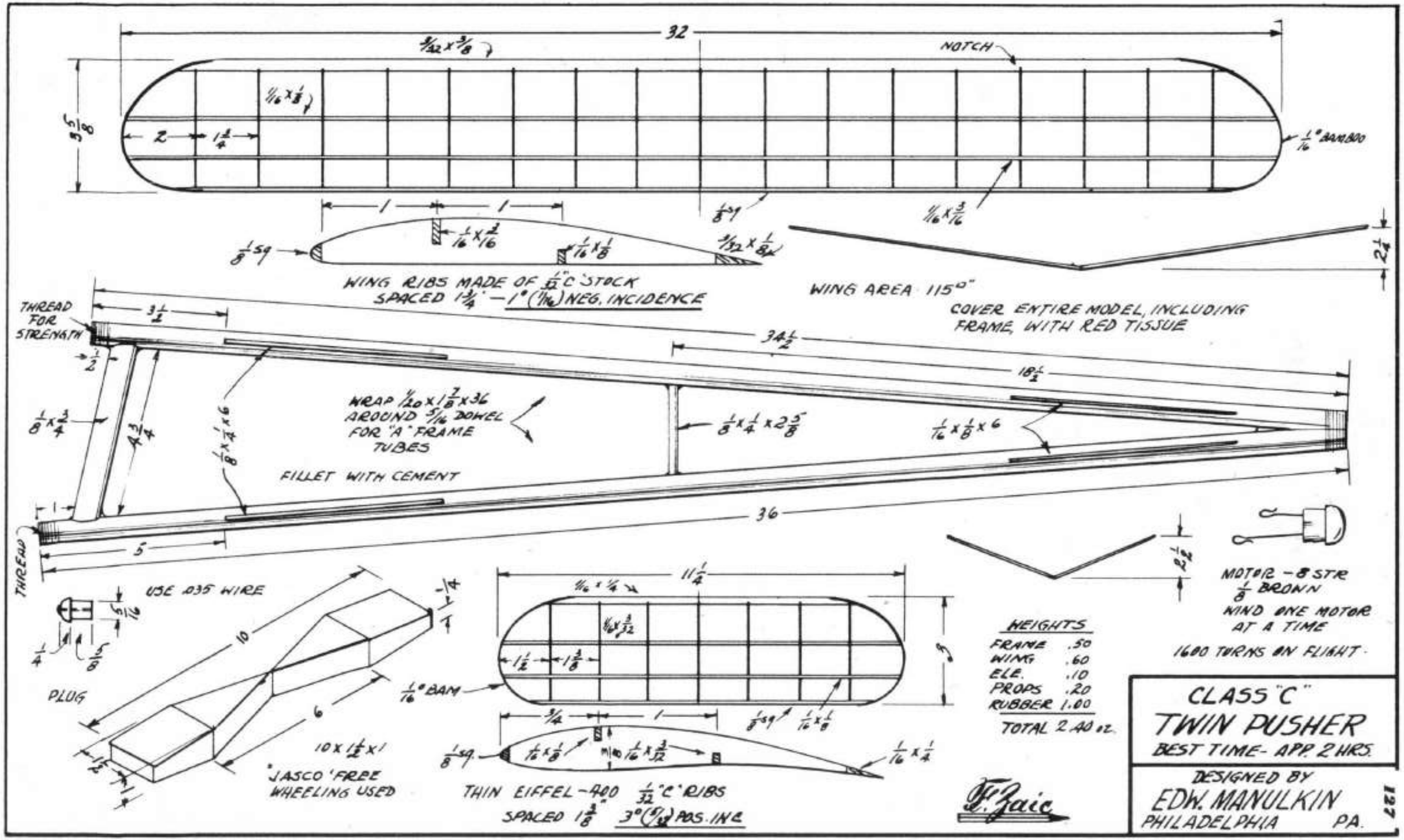
1. The enclosing of the rubber motor, thereby eliminating that source of drag in glide and flight, as well as eliminating rubber shifting.
2. The use of soaring airfoils.
3. The use of larger and slower props, permitted because of the decrease of drag.

It can readily be seen that the standard "A" frame with exposed rubber is at a disadvantage against the slick tractor. Such twins fly by the use of sheer brute power, and it is this feature that is their downfall, as in the case of all brutes. However, new streamlined versions of the twin pusher began to appear early in 1934, but not very much attention was paid to them in the grand rush to get on the tractor's bandwagon. Those who did build these new designs were pleasantly surprised when they found that these streamlined models would fly with less power and larger props, as well as have a flatter glide.

I have been building outdoor twin pushers for about five years. I obtained durations of up to 12 minutes with the orthodox designs, after patient surface layout and numerous adjustments. However, when I designed and built my first streamlined twin, my duration increased tremendously. My first official flight in a contest resulted in an out-of-sight flight. It was recovered a few days later, about 3 miles from the starting point. During the second contest, it climbed like an elevator until the power was exhausted and then soared out of sight after about 17 minutes. This time it was recovered after I was informed of its whereabouts by mail. The distance of this flight was about 15 miles from the starting point. This flight strengthened my belief that tractors were not as superior as some would have us believe. The combination of a staggered "A" frame and enclosed motors seems to point the way toward wresting the duration record from tractors, especially when the new weight rules are put into effect. A conservative estimate of the duration of that remarkable flight is two hours or more. The point to keep in mind though, is that every flight was of top-notch quality.

I have never had any real difficulties with twin pushers. However, I have found the following adjusting hints handy, and they may prove of value to other twin pusher flyers.

1. If the model flies well under power but stalls in the glide, check the relative incidences. The cause is usually excessive incidence. 1° negative for the wing and 3° positive for the elevator is just about right.



32
3/32 x 3/8
NOTCH
1/16 x 1/8
3 5/8
2
1 3/4
1/16" BAMBOO
1/8 sq.
1/16 x 3/16
1/8 sq.
1/16 x 2/16
1/16 x 1/8
3/32 x 1/8
WING RIBS MADE OF 1/32" C STOCK
SPACED 1 3/4" — 1° (1/16) NEG. INCIDENCE
2 1/4
WING AREA 115 □"
COVER ENTIRE MODEL, INCLUDING
FRAME, WITH RED TISSUE
THREAD FOR STRENGTH
3 1/2
34 1/2
18 1/2
1/8 x 3/4
4 3/4
1/8 x 1/4 x 6
WRAP 1/20 x 1 7/8 x 36
AROUND 5/16 DOWEL
FOR "A" FRAME
TUBES
1/8 x 1/4 x 2 5/8
1/16 x 1/8 x 6
FILLET WITH CEMENT
36
5
THREAD
2 1/2
MOTOR — 8 STR
1/8 BROWN
WIND ONE MOTOR
AT A TIME
1600 TURNS ON FLIGHT
USE .035 WIRE
5/16
1/4
5/8
PLUG
10
6
10 x 1 1/2 x 1
"JASCO" FREE
WHEELING USED
11 1/4
1/16 x 1/4
1/16 x 3/32
1 1/2
1 3/8
3
1/16" BAM
3/4
1
1/8 sq.
1/16 x 1/8
1/16 x 3/32
1/16 x 1/4
1/8 sq.
1/16 x 1/8
THIN EIFFEL-400 1/32" C RIBS
SPACED 1 3/8" 3° (5/32) POS. INC.
WEIGHTS
FRAME .50
WING .60
ELE. .10
PROPS .20
RUBBER 1.00
TOTAL 2.40 oz.
F. Zaic
CLASS "C"
TWIN PUSHER
BEST TIME — APP. 2 HRS.
DESIGNED BY
EDW. MANULKIN
PHILADELPHIA PA.

2. If the model refuses to turn, the trouble may be caused by too much dihedral in the wing or elevator. A safe rule to follow is to use 1 inch per foot of wing span for the wing, on each side, and 1½ inches per foot of elevator span for the elevator, on each side.

3. Use freewheelings that work every time. You never can tell which flight will use them most.

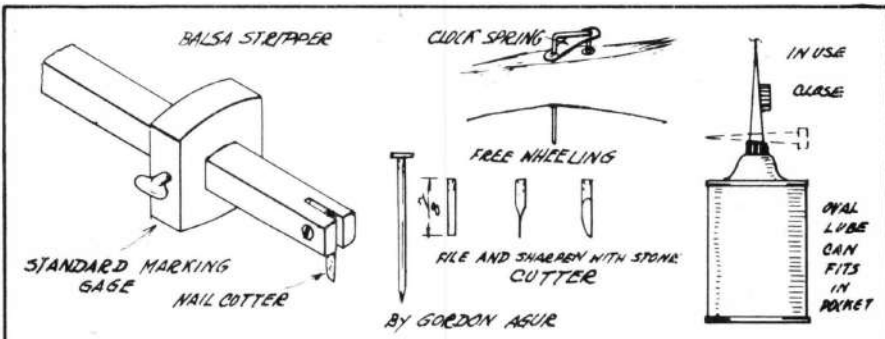
4. Props should spin very freely and not grind at the bearing. Ball bearing washers are excellent for eliminating such friction.

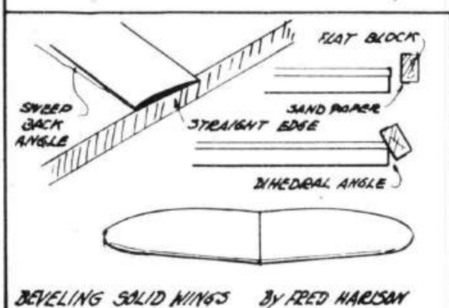
5. Make sure that props are in line and do not hit each other under power or in the glide. Use double bearings to prevent this and also to insure true running.

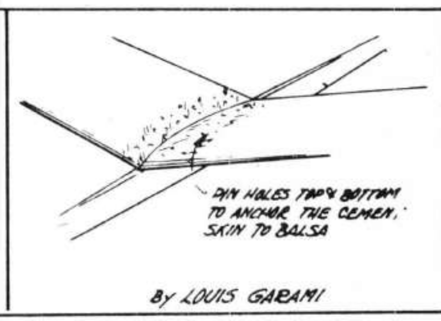
6. The "A" frame should be very rigid. When your twin does a half-roll-loop into the ground, you can be sure that the torque has twisted the frame.

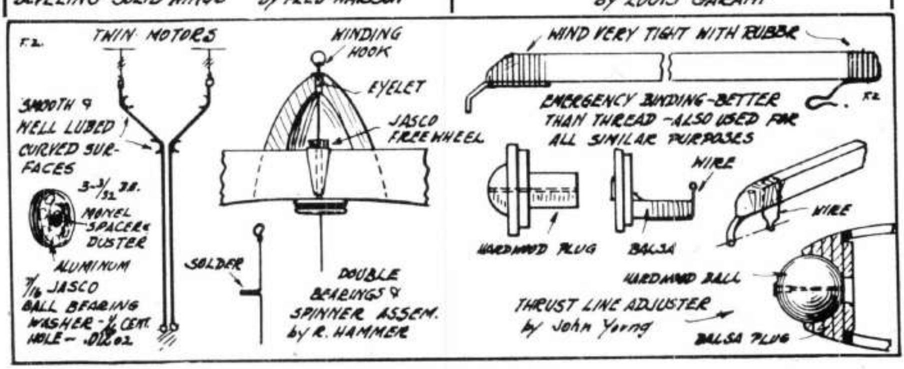
7. Use plenty of power and have a light, streamlined ship. This combination has broken many records.

If the above remarks are kept in mind at the next contest or while making a new model, you may be reasonably sure of seeing your handiwork "a slight speck in the blue ceiling", giving those tractor boys something to worry about. (Ed. note: and anyway it takes a <u>man</u> to wind up a powerful twin!)





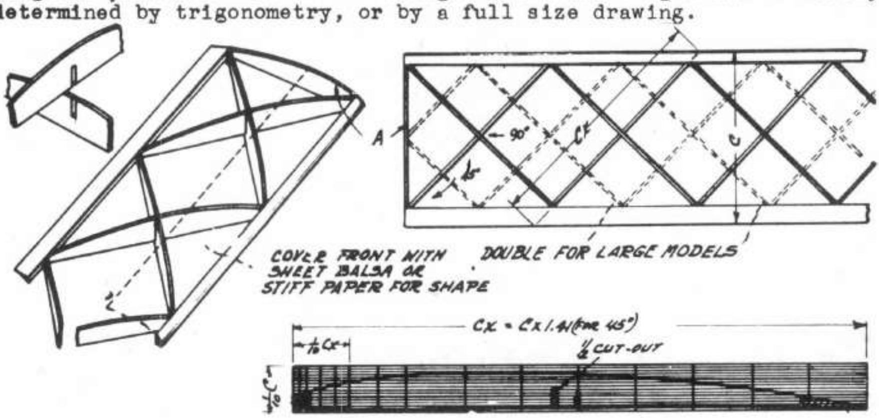




"X" Ribbed Wing — by John Whitehouse

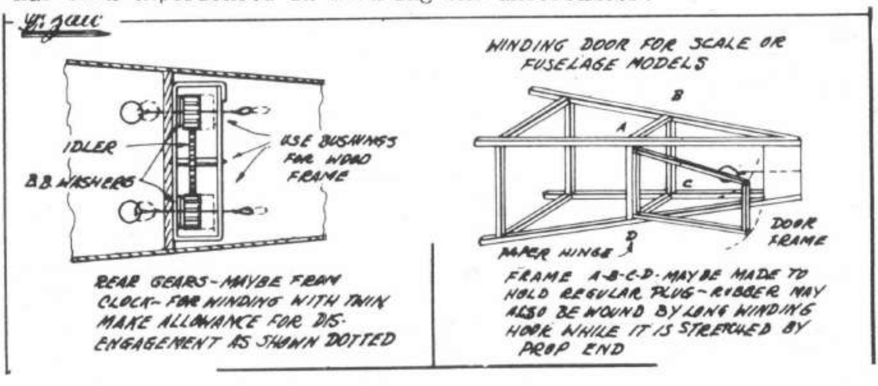
After seeing an article in a magazine on the geodetic system of wing construction, I made a simplified design for model use. I tested it on a contest model and the results were better than I expected Although the aspect ratio was 12 to 1 the strength equalled that of a 7-1 wing of the same spar and rib sizes. Below is shown a sketch of the principle. By placing the ribs at 45°, they assume several functions. First, they provide the airfoil curvature; secondly, they assume part of the spar load; and thirdly, they also provide a diagonal brace effect.

The construction is as follows: rib "A" is normal while the rest of the ribs are so plotted that the chord thickness is the same as used on a normal curve while the length is increased because of the diagonal position. See the drawing. The exact length can be easily determined by trigonometry, or by a full size drawing.



Although 45° diagonals are best, the angle may be changed if the chord is too wide. For larger models and gas jobs, the number of ribs may be increased. The size of the leading and trailing edge spars should be slightly greater than on a normal multi-spar wing. The leading edge can also be covered with sheet balsa or stiff paper to prevent sagging at the triangle.

The wing mentioned above had a 1/8" sq. leading edge and a 1/8" by 1/4" trailing edge. The span was 44" with a 4" center chord tapering to a 2" tip. The span of the gas model wing is 15 feet and is made up of three 5 foot sections. The leading edge is 1/2" square, and the trailing edge is $1\frac{1}{2}$" x 3/8". The ribs are built up of 1/8" sq. A capped channel beam $1\frac{1}{2}$" x $\frac{1}{2}$" is placed close behind the leading edge, which is covered with 1/16" balsa sheet. To date, no trouble has been experienced in covering the undercamber.



Papier-Mache Model

by Fred Mayfield

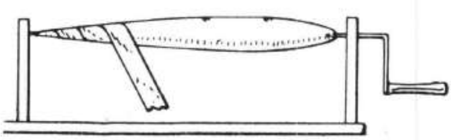
Usually papier-mache work is made by soaking paper in water until it becomes pulpy and then making a mixture from this pulp and a small amount of Plaster of Paris. This mixture is plastic enough to be worked with the hands or moulded from patterns, into any desired shape. When the water evaporates, the result is a light and fairly strong form. For model work the procedure used is slightly different, in that the paper is not reduced to a pulp, but is used in sheet form.

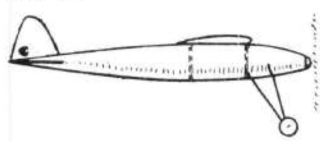
The first step in preparing the parts of a papier-mache model is to carve a form or a pattern of the part to be constructed. This form can be made of white pine or balsa. The flat wing mounting of a fuselage can be carved to shape or built up with clay. Any other protuberances (such as headrests, wing fillets, etc.) can also be built up of clay. The pine form should then be sanded smooth and varnished. If balsa is used, several coats of shellac should be applied. The form should also be rigged up so that it can be rotated on its lateral center line as shown. The papier-mache construction procedure is as follows:

Cut a sheet of bamboo paper into strips approximately 2" x 8". Cut up only one sheet at a time until you know just about how many you will need. Grease the form well with Vaseline, cold cream, or some other greasy substance. Be sure to apply it liberally so that the paper will not stick to the form. Next, mix a bowl of wallpaper paste. (Common library paste may be used if it is mixed with water until creamy. However, it is quite expensive.) Now drag one of the paper strips through the paste. Wipe off the excess. Apply this coated paper strip to the form in a spiral direction by rotating the form. Repeat this process with other strips until the form is completely covered with one coat of paper. Be sure to have a slight overlap at the junction of the strips.

Another layer of paper is to be applied in the same manner, except that the spiral should run in the opposite direction. We need still another layer to obtain a safe margin of strength. This third coating is applied in the same direction as the first. For normal work, three coats will suffice. Use more layers if greater strength is desired. Let the completed job dry for about 24 hours to allow the paste to set and dry.

To remove the fuselage from the form, cut the fuselage on the bottom either in front or in the back and slide it off the form. If it sticks, or if the shape does not allow the removal to be made in this fashion, cut it full length. If it sticks too hard to the form it may be necessary to cut it along the top as well. I found that two bulkheads situated directly beneath the wing mounts are the only necessary internal supports. These should be made first of cardboard and fitted in and then cut out of laminated 1/16" sheet. After the bulkheads have been glued in place, the seam should be glued and sealed with a 1/2" strip of bamboo paper.





STREAMLINERS

COWLINGS

The tail surfaces and the landing gear may be cemented in place in the usual manner, except that the landing gear should be fixed so that it contacts a large area. The front and rear portions of the fuselage should be reenforced with balsa bulkheads to accomodate the plugs.

The use of papier-mache in model work is practically unlimited. I have found that excellent cowlings may be made for gas models with this method. Mould a clay form right onto the nose. When this is dry, remove it from the plane and apply paper, using the above process. Instead of using three coats of bamboo paper, however, use from three to five layers of newspaper and one or two coats of bamboo paper. The final finish is the standard one of sanding well and doping

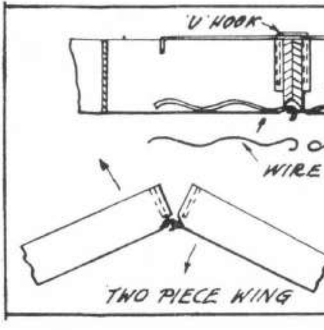
All-Balsa Wings ———————————— by Teen Becksted

A sheet of quarter-sawed, 5 lb./cu. ft., 1/8" thick balsa is needed for the wing. (If the exactly specified wood in unobtainable, use the best you can get. The width may be built up by cementing two or more sheets.) Cut to outline and sand the bottom free from saw marks. Next, sand the upper camber to the desired wing section. In the case of a tapered wing, be sure to taper the thickness evenly from the center to the tip. A hard balsa leading edge, and a bamboo tip are advisable in order to save the efficiency of these highly important edges. They should be cemented in place before the top surfaces are worked down. It is an easy job to finish balsa wings if three grades of sandpaper are used, finishing with ten nought.

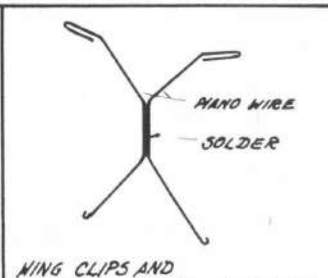
The wing is made in two halves, and the halves are bent on the same form, one after the other. To bend for the lower camber, moisten the top only, and bind the half on the form with 1/2" gauze. It may be left to dry overnight, or it may be baked in an oven. When dry, carefully sand the raised grain on the top surface, while the wing is still on the form. Dope twice with thin shrinkless dope, sanding between coats, and wax with Simoniz or a similar wax, except in the center where a cement skin of about 1" is applied. Make the other half in the same manner.

Before cementing the two halves together, set them at the desired angle and carefully sand the edges for a perfect joint. Cement them together and hold in place with pins. When the unit is dry, coat the joint well with two or three coats of cement. Be sure that the initial joint does not lossen with the fresh cement.

If the work is done carefully, the balsa wing will be more efficient and will also stand up better than any paper covered wing of the same size. The method has been used on several ships, and has been thoroughly tested.



By Edward Lidgard



WING CLIPS AND THE LIKE ~ by Marvin Setzke

Co-Axial Propeller

by Jim Haffey

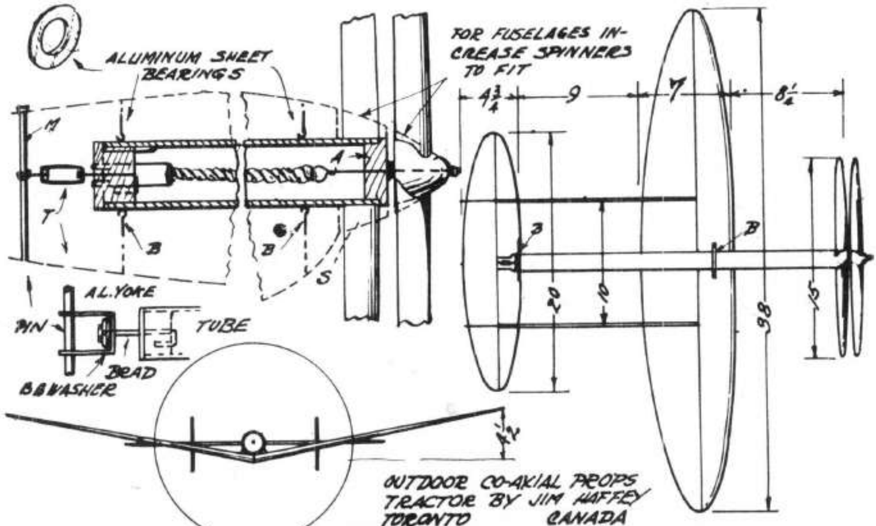
The torque problem in models is very important due to the large propeller and relatively powerful rubber motor. It is a source of surprise to me to see that more model builders are not interested in this solution of the torque problem.

The main drawbacks of co-axial props are the weight, the difficulty of making suitable gears, and also the difficulty of winding the rubber with a winder when a torque tube in heliocopter form is used. The method which I have used successfully for over a year is to use a torque tube, but with modifications, to enable me to wind the motor with a winder. Incidentally, flight results have been more than satisfactory. The above method may be used on all types of models. The only change is in the sizes of the component parts.

The torque tube system is used by providing a bearing in the front and rear and a revolving anchorage. There is very little bearing friction, and the prop pull is taken care of by the ball bearing washer.

Construction: The torque tube is made of 3/64" sheet balsa. For extra powerful models it is advisable to use two or three 1/32" sheets, rolled one on top of each other. The front portion consists of plug "A" which fits snugly in the spinner "S" which is cemented to the tube. The two bearings "B" are made of sheet aluminum. The holes are made to allow the tube to rotate freely without vibration. The holes should be finished with a blunt reamer to provide a round contact surface. Coat the tube with 5 or 6 coats of cement where it contacts the bearings. Do this every 30 or 40 flights to make up for wear. The rear plug is not cemented to the tube because of replacement of rubber, but is made to fit snugly. The spinner "T" must be very smooth in operation. For light jobs a light trout fishing troll will do, but for heavier motors make as shown in the sketch. If the model is of the fuselage type, the whole assembly can be made removable by providing the anchor pin "M".

The rubber is wound by the front prop shaft, and may be stretched by removing the plug "A". Freewheeling need be applied to only the front prop in the usual manner. Be sure to use plenty of Vaseline on the torque tube bearings as well as all other revolving points.



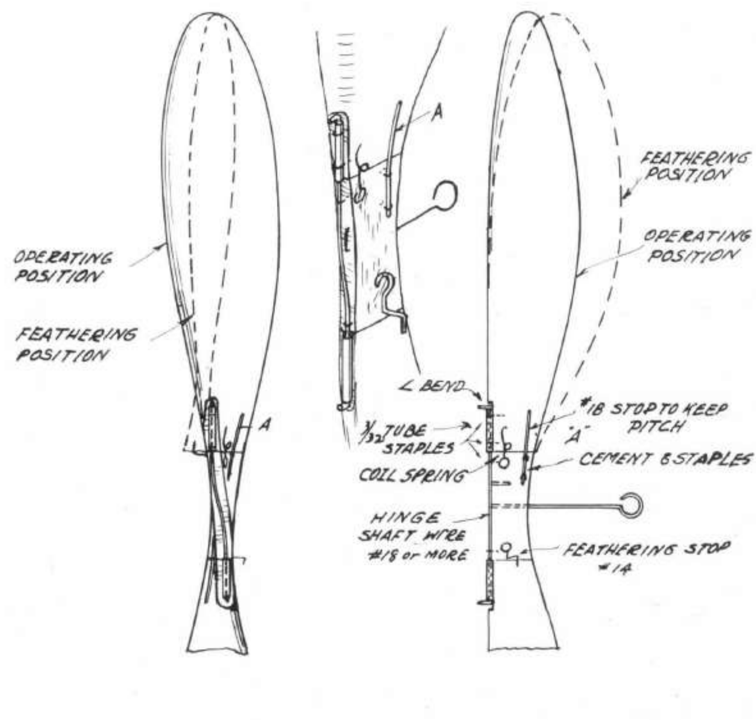
Feathering Propeller

Developed by Marvin Setzke
Suggested by Carl Goldberg

"Feathering: the ability of a pivoted or free surface to automatically assume its best L/D position or present minimum frontal area."

The propeller as shown in the plans is the third of the experimental project to determine the value of feathering props. The first one, hinged but without a spring and with only the main stop, fluttered but it nevertheless improved the glide beyond my expectations. Since then, I have made numerous excellent flights when using the feathering prop. One evening at about 7 o'clock with the temperature close to 60°, I wound up the rubber about 340 turns for a test flight. The model rose to approximately 250 feet with a 30 second prop run. The glide lasted for 3 minutes, turning in a flight of 3m. 30s. under still air conditions. The prop may be used in conjunction with freewheeling to facilitate removal as well as to take care of any possible accidental failures. It may be stopped in any desired position by using the rubber tensioner and any appropriately placed stop. The exact combination can best be determined by individual requirements. The best duration obtained to date with a feathering prop is 2 hours and 30 minutes, with an 18" prop with 18 strands on a 2.8 oz. N. A. A. Cabin Fuselage job.

1. Carve the prop in usual manner. Determine and mark the hinge point. Cut in 3/32" for the wire and tube parts. Cut and shape the needed hardware. Be sure to slip the aluminum tubing into the hinge wire before bending the ends as shown.
2. Cement the tube to blades and wire to the hub. Reenforce with staples and tissue or silk covering.
3. Cement the wire stop "A" and reenforce it with staples and silk.
4. Cut the blades at the pivot points. Cement the coil spring to assure positive action.
5. Face the prop and equalize the upper and lower areas. Fix them in position temporarily with pins and cement .014 wire stops.



Finishes and Flying Scale

by Roger Hammer

Flying Scale Models

It is possible to make almost exact scale models fly well provided that care is taken so that they will be adjusted properly. Before attempting the initial flight, check the incidences, which should be the scale settings. Remove all unintentional warps. The C. G. position should correspond with that of the full size ship; that is, it should be at a point 30% of the chord behind the leading edge. If necessary, weight the nose with lead or clay.

The first step in testing is to place the model on smooth ground, raise the tail until the model is in a horizontal position, and then to give the model a sufficiently strong shove to make it clear the ground. Make any necessary corrections with intermediate flights until a smooth glide and a slight right turn are obtained. If the model stalls, weight the nose, and if it dives set the stabilizer at negative. The turn is obtained by the rudder adjustment. The model is now ready for the next test.

Launch the model with a strong and straight forward throw from a three foot altitude at a 10° negative angle. If the model is correctly adjusted, it will remain at the 10° negative angle and have a slight right turn. The next step is to wind the motor about ¼ of its maximum turns and to launch the model about 12" from the ground down about 10°. If the model is underpowered, the glide will just be prolonged and the model will land with winds. If it is overpowered, it will zoom and stall. The model that is correctly powered will rise about one foot and then gradually assume the gliding position. Notice the turn carefully at this stage. If it is excessive, the model will spiral dive when full power is used. If the model behaves correctly, the same testing procedure may be carried through ½ turns and ¾ turns, until the maximum wind up is reached. If the model does not climb, increase the power and recheck from the beginning for the C. G. and other points. For the zooming model, remove a bit of rubber and try again after checking the balance. If it now mushes to the ground, the trouble probably lies in the thrust line. Replace the rubber and set the prop to point down until a satisfactory flight is obtained.

Be sure to go through this test procedure before attempting full turn flights. Many good models are ruined just because the builder is too impatient to take his time in ironing out the kinks.

Flight Characteristics of Different Designs

PARASOL MONOPLANES should be capable of tight and steeply climbing turns with the torque and should obtain good altitude. Ex.: Fairchild 22.

CONVENTIONAL MONOPLANES should circle with the torque in circles of about 40 to 60 feet diameter, with very shallow banking but climbing rapidly. Ex.: Fairchild 24, Cessna and others.

MIDWINGS are a bit more tricky to obtain satisfactory results. These models should turn in large diameter circles of about 100 feet with medium climb so that the climb will be comparatively shallow to prevent a stalling tendency at the end. The midwing adjustments should be for a slight zoom at the beginning, turns of about 100 feet and flat climb. Ex.: Bull Pup, Corbin Racer, Art Chester Racer.

LOW WINGS usually take a straight run and begin to bank after they reach about 20 feet altitude. Low wings made by the writer have climbed fairly steeply in large circles. No difficulty was experienced with stalling when the power was exhausted. Ex.: Howard Ike and Pete, and numerous commercial and military designs.

BIPLANES have the same flight characteristics as the conventional monoplanes. The adjustments are practically the same as mentioned at the beginning of the article. Double check for incidences and any warps. Note: the right turn should occur on all models after the power has been expended.

Flying Scale Propellers

Since the diameter is restricted by the scale landing gear, the needed thrust is obtained by making the blades very wide, almost a paddle shape. For example, a 7" diameter prop should have blade width of about 1½". The blade section should be a regular airfoil section with about 1/4" undercamber. The props should be made of very hard balsa (15 lbs./cu. ft.) or pine especially since weight is usually needed at the front.

Paint and Lacquer Finishing

The method of finishing depends upon the surface upon which the finish is to be applied. However, the pores of the surface must be filled in first, in all cases. Several coats of clear dope will do the trick for paper, which has a rather poreless but absorbing surface. On wood and silk, which has deep pores, use Jasco Prepared Wood Filler. It has a nitro-cellulose base upon which dope, lacquer, or paint can be applied without fear of the filler rising from under the finished surface. It also contains the lightest possible filler ingredients obtainable and which no standard commercial filler has. It is of a clean white color, and is plasticised to prevent the warping of thin surfaces. It can be sanded smooth with ordinary sandpaper without fear of clogging the sandpaper. It should be applied with a brush.

The pain or lacquer should be flowed on the surface with a good soft brush, preferably a red sable brush. For a paper finish, one or two coats will be sufficient. For wood and silk, the number of coats depends upon the type of model. If lightness is desired, about two coats will do, but for the best possible finish, add as many coats as are necessary to completely hide the surface normally seen through the lacquer and paint. After several coats have been applied, they should be rubbed down with 320 "Wet or Dry" paper. Add several more coats and rub down with 400A "WoD" paper. For the final finish, rub down with a polishing compound such as Valspar Rubbing and Polishing Compound. For additional weather and moisture protection apply two coats of Simonize. Apply it with a wet cloth to prevent the burning of the finish. A high gloss may be obtained by rubbing briskly with a soft cloth like flannel.

NOTE: Be sure to let the lacquer, paint, or dope dry thoroughly between each coat, and allow it to harden before rubbing.

For a glider finish, just use one or two coats of Jasco Prepared Wood Filler, sand very smooth with 10 Nought and finish with Simonize For weight rule gliders, several coats of plasticised dope should be applied before Simonizing. Be sure to apply the Filler evenly, first with the grain and then against it. The surface should be sanded until the paper begins to scrape the top of the wood.

Thermals

by Dick Everett

Thermals utilized by models are mostly of the convection type. Such currents are developed by the differences of air temperature. As you all know, heated air expands and increases in volume and so tends to rise above the colder air. Such phenomena occur whenever there are ground spots that have different rates of heat absorption. For example, bodies of water require a large amount of heat to raise their temperature, while concrete requires a relatively short exposure to the sun before becoming heated and acting as a mirror to the sun's heat.

The following types of terrain have a quick heat-saturation period, after which the air in immediate contact with the ground is warmed: concrete, asphalt, sand, hard ground, plowed fields with a hard-crusted surface, ripened grain fields, and the like. Bodies of water, green fields, trees, and objects which keep on absorbing the heat, do not heat the surrounding air.

From the above explanation we can see that for best results we should fly the model in such thermal-producing areas. On the airport, the best spot is in the center of the runway or the large circle of concrete or asphalt. The tops of administration buildings and the concrete aprons in front of the hangars also give up hot risers. However, these risers have a limited altitude and it is best to wait for cumulus clouds if there are any in the sky. These cumulus clouds are the peaks of upward convection currents formed somewhere and carried over the countryside by the wind. Therefore our objective is to have the model raised high enough by the local thermals to have it contact the cloud thermals. The rest is up to your eyesight and possible horizontal velocity.

If the clouds are high, release the model just when the clouds are approaching the field, to enable the model to rise to its highest point just when the cloud is passing over it. For low clouds, release the model when they are about across the field. In this manner the model will not be drawn up into the clouds too fast, as it will more or less be on the outskirts of the thermal. Thermals can be found as late as 6 o'clock in the afternoon, and on many occasions we have clocked over 12 minutes on risers over Pittsburgh Airport at this time.

On windy days there are few ground thermals as the wind cools the ground and at the same time sweeps them away in case they are forming. On such days we should also be careful where we launch the model. The behaviour of the wind is such that it provides an upcurrent in front of an obstacle and a down current behind it. (This current is utilized by soarers to glide in front of a hill.) Therefore we should launch the model away from such obstacles unless the model is a powerful climber, in which case the upcurrent would be rather helpful. This upward deflection of wind can be used advantageously for towline or hand launched gliders.

General Hints

Place clay on the bottom of your glider wings at the C. G. to get the gliders up higher, outdoors. This increases the speed which in turn flattens the glide considerably. For best result have the glider highly polished. Dope propellers silver for visibility. The shining propeller reflects the light. Also cover the fuselage silver or yellow. Cover the wing red and the stabilizer yellow, and dope three times to obtain a colored transparency.

Hand Launched Gliders

by Tex Rickard

In my experiments with gliders, I have found that there are two types of designs which are dissimilar but which can be made to give almost identical performance indoors. The first type and the one most often used, is the one with a short elevator arm and a long nose. I have used as high as a 2-1 ratio; that is, a 4" elevator arm and an 8" nose length. I find this to be an excellent arrangement for low ceiling flying, although altitudes of up to 100 feet may be obtained with it if it is adjusted correctly. The second type uses just the opposite ratio relation; i.e., an elevator arm of 8" and a 5" or 6" nose. The tail surfaces can be made much smaller because of the longer moment arm. Such gliders seem to get up higher, and also have better floating tendencies. When using these gliders, it is necessary to wash in the elevator. If this is not done, the glider will require too much clay for balancing at the 1/3 chord position.

I still use cambered rudders on all my gliders. They give a much more uniform circle and make adjusting easier during the contest. The thicker section also provides a larger cementing surface to take care of the terrific launching heaves.

I have made several tests with the fuselage sizes, and I find that 1/8" hard balsa stock will stand up better than the 1/4" stock. There is very little weight difference, and in practice the hard balsa is a bit lighter. I was definitely convinced of this fact when I made two .46 oz. gliders whose fuselages were of 1/4" stock. One ship lost its tail portion when lauched and the other flew into a post and snapped the stick. Then I rebuilt the gliders using the 1/8" stock. The weights decreased to .44 and .45 oz., showing that there is some difference in the weight even though the wood is as hard as oak. The new fuselages stood the knocks better than any 1/4" stock I have seen. It seems that the hard wood bends and absorbs the shock much more readily while the softer but thicker stock shatters.

It takes me about 2 or 3 hours to finish a wing, and I use all the latest tricks to get the utmost out of the throw. I undercamber the wing slightly for low ceiling flying and use a flat bottom for high climb. I use three coats of polish until the wing has a smooth glass-like surface, with intermediated 10 nought sandings. I make certain that the wing and fuselage junction is strong by applying several layers of cement until the joint has cement fillets. For a final finish I use Cedar Wax Floor Polish. This is rubbed on the completed model with a soft cloth. Remember that the cement will not hold to waxed surfaces.

My wing is set at zero incidence but the right wing is given a slight washin (wash in the left wing for a left hand throw). The camber on the rudder is set for a left turn, and the trailing edge of the stabilizer is warped down about 1/32". This gives the elevator a positive angle which will tend to make the model go over the hump at the peak of the throw without dipping. The exact warping has to be determined experimentally. Too much of it will dive the model and too little will make the model dip and stall. The best launch for this setting is to launch the glider as straight up as possible without banking it at all. By launching the glider without much bank, all the speed and momentum are saved for the climb. It also lessens the strain ordinarily applied to wings on vertical climbing turns. You cannot imagine the difference that the positive elevator adjustments will have on your glider until you have actually tried it out.

From Experience

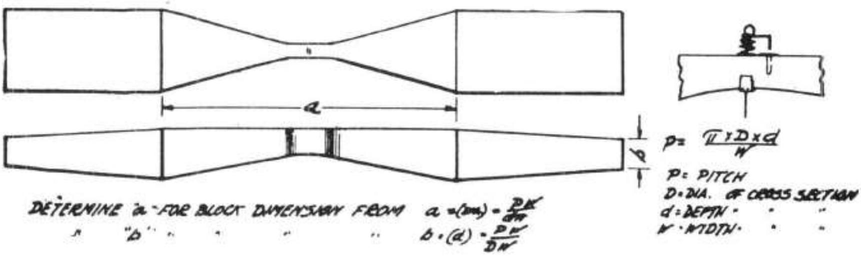
by Henry Stiglmeier
President of the Centinela M. A. C.

Airfoils

I have tried all types of airfoils and I find that the undercambered type, especially the Eiffel 431, is best for duration models. I used that airfoil on a 150 sq. in. cabin job which did not fly less than 20 minutes for three Sundays in a row. It did 46, 32, and 20 minutes and eventually flew out of sight. I find that the Clark Y is not so good for weight rule models.

Power and Propellers

In general I use two less strands of 1/8" flat rubber than the diameter of the propeller in inches. Large diameter, low pitch props seem to work best for me. A pitch-diameter ratio of 1¼:1 is good. (Example: 16" diameter, 20" pitch.) My props range in diameter from 42 to 45% of the wing span. I find that a 1¼" x 2" block is very good for 16", 17", and 18" props. I cup the back side of a two inch blade from 1/16" to 3/32". The prop layout that I use is as shown:.



Pusher v. Tractor

I have made many pushers and almost as many tractors. I find that tractors are easier to adjust, and I am sure that they climb as well as pushers. I dislike pushers for three reasons:-- first, it is difficult to make them circle satisfactorily throughout the entire flight; second, it is hard to determine the correct amount of elevator dihedral to prevent the model from swinging; third, since the leading airfoil in either a pusher or a tractor should be of higher camber than the following airfoil, the main wing of a pusher cannot have as high a camber as is desirable without overcambering the elevator section. In all, I believe the tractor to be just as stable as the pusher, and that it rides the thermals better.

Rudder and Stabilizer

For the average cabin or stick model, I found that rudders having an area of about 14% of the wing area are very satisfactory. A small rudder will allow the model to spin when side thrust is used. The area of a lifting tail should be about 40% of the wing area, when the model balances at the trailing edge of the wing.

Aspect Ratio

The aspect ratio of lifting tails may be as high as 7 with good results. High aspect ratio rudders are not good. I have tried several high aspect ratio wings and I believe that 12-1 is about as high as one should use. It seems to me that the model will not soar or fly very well when using wings of more than 12-1 aspect ratio. For all-around performance, I prefer an aspect ratio of 10-1 or 11-1.

Tapered Wings and Sweepback

I have built many tapered wings and have not as yet been able to see any aerodynamical advantage over straight wings of medium and high aspect ratio. The sweepback design seems to make the models bank and circle excessively.

Incidence

I once had the idea that if I increased the angle of incidence of the wing and tail, keeping the difference in angle the same, I would need less down thrust. However, after much experimenting, I found the opposite to be true. It is best to use about 2° to 3° incidence on the main wing.

Nose Plug and Freewheeling

The use of dress-snaps for fastening noseplugs cannot be over-emphasized. Besides having the nose readily removable, the props will not break, nor will the shafts bend (as they tend to do if pins are used), because the nose merely snaps off. Be sure to use a little judgment in using the right strength snap.

The freewheeler shown has been in use for a long time, and failures have been rare. The most important factor is to make it work freely before the model has been flown. I wind all my models from the front, hooking the winder on to the freewheeler.

Visibility

I believe that I have done about as much chasing of models that were almost in the clouds as anyone, and I find that the use of colored tissue is very satisfactory. Red, yellow, and white combined can be seen in any weather. The thing that makes models covered with colored tissue so visible is that the sun shines right through the paper. Colored tissues are strong enough if the grain runs spanwise. The specific color combination that I use is a red wing and rudder, a yellow stabilizer, and a white fuselage. Use two coats of three to one dope. More dope makes the paper brittle and warps the surfaces.

Balance

One thing that is missing in the majority of plans, is the exact position of the wing and the C. G. I contend that if any two similar models balance at the same point, they will have the same difference in angle between the wing and tail surfaces when each model is properly adjusted. Therefore, please give the balancing point whenever you have occasion to draw plans. Then, regardless of whether or not the surfaces are warped, when the ship is finally adjusted, it must have the same effective differences in angle between the surfaces.

Flying Scale Models

Since I build flying scale models primarily for duration, I attempt only those that have flying possibilities, and I also modify the model to suit this purpose. Scale models with cowlings (radial engines) and round or oval fuselages make good flyers (45 s. to 1 m. 10 s. average without thermals). The best size for biplanes seems to be from 20" to 24" wing span, and for monoplanes, 24" to 30" wing span. The construction is strong to be on the safe side, so that I can fly the model in any afternoon breeze. Quite often I come up to the weight rule requirements.

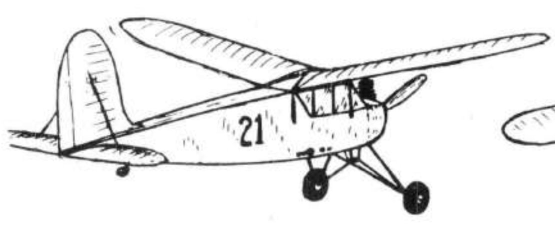
The main deviations from scale are the sizes of the stabilizer, the rudder, and the prop. The stabilizer area is about 30% of the wing area and the rudder is about 10% to 12% of the wing area. The dihedral is also slightly increased; about $\frac{1}{2}$" for every foot of span. The wings are fixed normally and the model is balanced at 50% of the chord. If weight is needed for balancing, most of it should be in the form of heavy wheels and a little extra in the nose. The wing sections used were mainly the M-6 and Clark Y, but I recently tried the Eiffel 431 on a Fairchild "24" with good results.

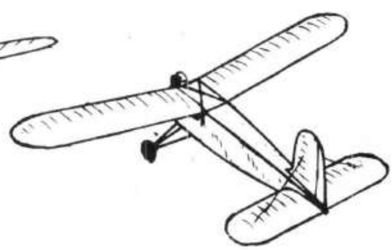
The propellers are slightly larger than 1/3 of the wing span, and are made to freewheel. I wind all of my models from the front by use of the loop on the freewheeler. In case of rubber breakage; much less damage is done if the rubber goes through the front part of the fuselage. I use enough rubber to fly the model well. If a scale model needs so much rubber in order to fly, that an excessive amount of weight is required to balance the model, it is wise to reduce the pitch of the propeller.

My best scale monoplane is a Fairchild "24" with an in-line engine. The fuselage was lengthened slightly in all directions. The rubber increase required enough balancing weight to bring the model up to weight rule. The span was 30" and the prop 11". I used 12 strands of 1/8" flat brown rubber. The wing had $1\frac{1}{2}$" of dihedral, and the weight of the wheels was 1/4 oz. each. The stabilizer was 30% and the rudder 10% of the wing area. A Clark Y was used with many full and false ribs. The model had a fast and steep climb and picked up thermals best when gliding in fast right circles. I believe that a fast circle is one way of getting the model up high. My best times with this model are: 17 m., 10 m. out of sight in a haze, and 14 minutes. My best time with a 27" Udet Flamingo biplane using an airfoil similar to the M-6 is 17 minutes out of sight.

Gas Models

My second and best gas model has the following specifications:





WING
Area 530 sq. in.
Span 60 in.
Chord 9 in.
Dihedral 5 in.
Airfoil Gott. 398
($\frac{1}{4}$"under camber)

Weight $3\frac{3}{4}$ lbs.

STABILIZER
Area 160 (30%)
Span 25 in.
Chord 7 in.
Airfoil Clark

ENGINE
Brown Jr.
Neg. 2° - Right $\frac{1}{2}$°

RUDDER
Area 53 (10%)

FUSELAGE
Length 43 in.
Tail M.A. 28 in.
D.C. $17\frac{1}{2}$% Fuselage behind the C.G.
Climb 650 ft/min

GOOD WING CONSTRUCTION

Performance: Almost perfect stability in the glide, and under power the longitudinal stability is excellent. If the engine stops with the nose up, the galloping oscillations (Very appropriate--Ed.) are reduced to nothing very quickly. Climbed to 5,000 feet in 9 minutes (checked from a following plane), with the spark adjuster in the center. Glides from three to five times the motor run. Can fly well in 18 m. p. h. wind as well as take off in a cross wind. The only weakness is that it won't circle in circles of less than approximately 75 feet, without slowly spiral diving. But in spite of this, it has spiraled only once, when the rudder was warped, and that was the first broken prop in 136 flights. To date I have had 150 flights with only three broken props. The most flights that I've had in any one day is 27.

General Gas Model Hints

Airfoils: I have found the Gott. 398 with undercamber to be very good. The Eiffel 431 gives a good glide.

Dihedral: In general, one inch on each side for every foot of span is sufficient.

Stabilizer and Rudder: A lift-section stabilizer is excellent in my opinion. It is very effective and strong. An adjustable rudder is good, but the tabs must not be too big, or they will be supersensitive. Use small screws for setting the tabs. A moment-arm length of from 40 to 50% of the wing span is good.

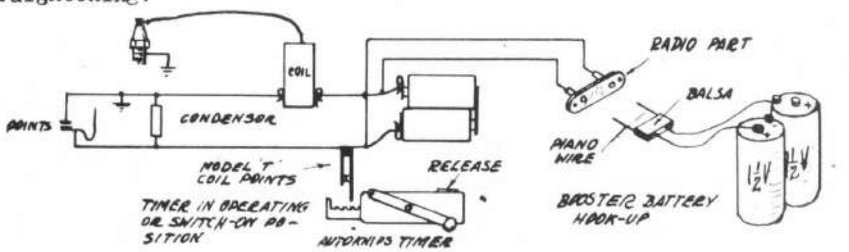
Covering: Bamboo paper is strong enough and takes paint well.

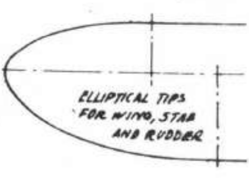
Time Switch: Almost all models in Southern California are equipped with them. For hookup, see the diagram. The flashlight cells are connected when the switch is set, which should be done before the boosters are disconnected. Allow about 7 seconds for launching time.

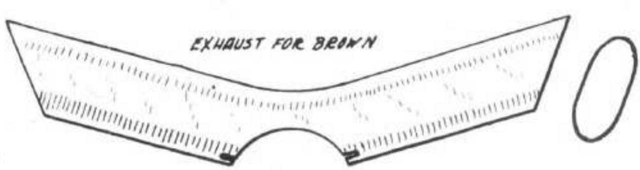
Tail Wheel or Skid: I prefer a small doughnut wheel. The tail supports should be soldered to a sheet of metal before wrapping and cementing to the fuselage.

Exhaust for Brown: A piece of ½" aluminum tubing makes an excellent exhaust. Just bend a radius in the middle of the tube, flatten, and file to fit the cylinder. Cut two small slots for the first fin. The exhaust fits over the bottom fin.

Motor Mounts: I recommend wood for mounts. Dural or 24SO will stand up for a short while, if not in too many smashes which require some straightening.







How to Operate a Brown Motor

I always leave the spark lever in the vertical position. Why advance it unless you have a 10 ft. job? I adjust the needle valve and forget about it. All I use for adjustment is the choke nut. When it is wide open the engine is running full speed for that particular spark setting, and closing the air intake slows the engine down until it just chugs over. It runs at any speed between maximum and minimum depending upon the choke setting. With this arrangement I can get 23 minutes on the ground with a full tank of fuel and the choke nut open.

Testing and Adjusting

Be sure you have your plane completely finished, especially in regard to paint or dope. Surfaces are apt to warp after painting, putting your ship out of adjustment. The C. G. should be somewhere between 30% and 50% of the mean chord of the wing. If the tail surfaces are non-lifting or less than 25% of the wing area, the C. G. should be at 30%. After a final check on fastenings and line-up you are all set for testing.

The first step is to shove the model on the ground to determine if you have made any bad mistakes in adjustments. The shove should be hard enough to just about lift the model. The model should be stable in that it does not stall or bank sharply. If it does, make the necessary corrections before attempting the next step. The next step is to glide the model. If you cannot glide it, get someone who can. Run with the ship and then throw it straight at a point on the ground about 50 feet in front of you. It must not swoop or stall but should glide slightly under-elevated. The corrective adjustments are made by changing the wing or stabilizer settings or by changing the balance slightly. Do not give the wing less than 1° nor more than 3° incidence. Sharp banking should be corrected before attempting power flight.

Start the engine and get it running perfectly before attempting any flights. Set the timer for a 20 second motor run. With the engine running slowly and the model adjusted for what you think will give a straight flight; shove the ship moderately into the breeze. In all probability, it won't fly straight. Immediately adjust the ship for a circle and an even glide. Make all test flights short and run the engine slow. If the plane stalls under power it is because of the thrust line setting. By all means, don't allow you ship to fly under power to the right. Adjust the rudder for a left turn and set the thrust line right or left until the ship flies to the left. I have tested and flown five gas models ranging in size from 4 ft. 8 in. to 8 ft., all with 1/5th H. P. motors, by this method. All tests were successful.

Editor's Note: Henry has been building models since 1928. He has made over 192 models, of all types, to date. He has been a consistent contest winner. His best durations are as follows:

	Less than Wt. Rules	Wt. Rules
Cabin Model	36 min.	46 min.
Stick Model	27 "	19 "
H. L. Glider	15 "	
Flying Scale	17 "	18 "

SOME TECHNICAL NOTES ON THE PRESENT INDOOR AIRFOIL

Being the results of Aerodynamic experiments with eight single surface airfoils.

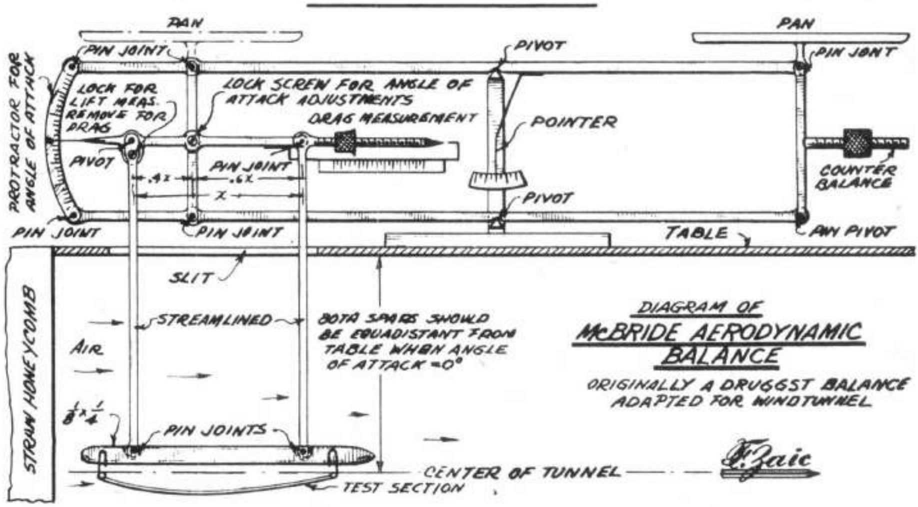
by J. Wallace McBride

The National Advisory Committe for Aeronautics (N.A.C.A.) has published numerous reports on the aerodynamic characteristics of airfoils, none of which are acceptable to the present indoor expert. (R.E.F. 1) Endeavoring to remedy this situation the author began in 1931 to test the single surface airfoils of the "Seven Outstanding Tractors of 1930." (R.E.F. 2) Work was begun using free flight tests but the method was soon abandoned because of the larger number of variables involved. In an attempt to eliminate some of these a small windtunnel was built and placed in operation.

Power for the tunnel was supplied by a one-sixteenth horsepower, rheostat controlled, electric fan. Air was forced through a stiff paper transition piece, going from 13 inches in diameter at the fan to a honeycomb 14 x 5 inches at the entrance to the working chamber. One and one- half inch lengths of soda straw piled and glued on top of one another formed the honeycomb, the purpose of which was to bring the air into the working chamber in parallel streams. (See drawing.)

The aerodynamic balance mounted on the top of the working chamber was of the pin jointed parallelogram type. Lift was measured by an old druggist's balance which had the drag balance mounted on one upright arm. The drag arm was so mounted that its position could be varied at will and then locked in position. The angle of attack which was controlled by this movement was read off a protractor attached to the same upright. Thus one could control the angle of the test section without disturbing it. (See drawing of the balance.)

The test sections were constructed according to current model building practice. Weight being no objection the sections were built very substantially. The tissue covering was supported by, one inch spaced, hard balsa ribs faired into one-sixteenth diameter (being the mean size of the average indoor tractor spar) pine spars. Sag at the tips was prevented by airfoil braces similar to those now used in multiple covered microfilm wings. The very low aspect ratio 3.44 was necessary in order to get a chord large enough to give a Reynold's number approaching that of flight.



The test sections were mounted inverted on the drag balance clip arm (1/8 x 1/4, cross section) by Pond type double grip clips. The lift balance was then counterbalanced for the weight of the section with the power off. The test section was then tested to see if it was on the same plane as the top of the test chamber, by taking offset measurements from the spars, when the angle of attack indicator read zero. The power was then turned on and the airspeed obtained. There being no micro-manometer available the airspeed was obtained by mounting a square flat plate normal to the airstream and then recording the drag. Speed was obtained by solving the equation:- $Drag = C_d \frac{\rho}{2} S V^2$ (Use of this type explained later.) with the drag coefficient (C_d) taken as 1.040 for a plate 10 cms. square. (REF. 3 & 4) The test section was then replaced and its angle of attack again checked. Readings were taken for lift with the drag arm locked. The process was repeated for every two degrees throughout the working range. The power was then shut off and the incidence of the test section again checked, If the test section was found to have shifted the process was then repeated.

The tests were carried out either in the mid afternoon or about 4 A.M. in an effort to reduce the error resulting from variations in airspeed due to changes in the power loads on the power line. Comparison of the results with those of the N.A.C.A. have led the author to believe that the airspeed of 7 f.p.s. is a little too great. Although the error may be largely due to the low Reynold's Number. A free flight test with another single surface airfoil gave a C_l of 1.4 at 1°. so the error is probably not great. He, however, hesitates to guarantee the accuracy and suggest that the reader test his own airfoil in flight by obtaining speed. It is then possible to calculate the lift coefficient for the angle at which the wing was flying. With this data it is only necessary to transpose the lift curve so it passes through the point obtained by the flight test. The drag curve will also be transposed but the L/D ratio will remain the same. Should anyone carry out such a test the author will be glad to hear the results or if information is desired as to the method he will be glad to be of assistance.

The sections treated were those supplied by the A.M.L.A. in their booklet (Ref. 2). There are in addition two sections developed by the author and two others tested elsewhere that will be of interest, and are included for comparison. The sections are called by the names given them in the booklet although correspondence with some of the gentlemen have shown that the section flown by them were considerably different.* For example, the section shown to be that of Carl Goldberg varied by more than 3/32. The section had a thinner maximum ordinate and was somewhat more bulbous at the entering edge.

The centre section airfoil of Fay Stroud and that of Samuel Balkan were practically identical and gave such a poor showing in the free flight tests that they were left out of the test program. The airfoil known as the B-6 was an airfoil used by the author in 1931 and was the forerunner of the B-7 which was developed as a result of these tests. The aerodynamic characteristics of these airfoils are presented in the standard form. It should be noted though that the Göttingen section and the Flat Plate are plotted to one half the other scale.

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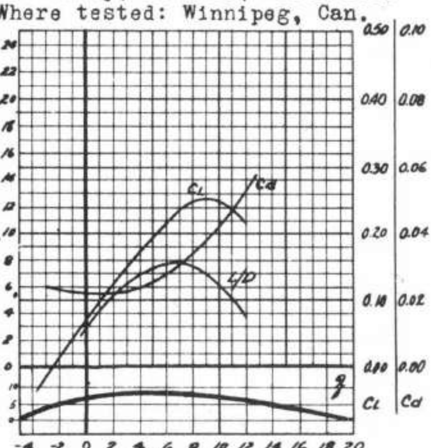
* The author wishes to thank Ray Thompson and Carl Goldberg for their aid and courtesy.

TABLE OF GEOMETRIC CHARACTERISTICS OF THE AIRFOILS

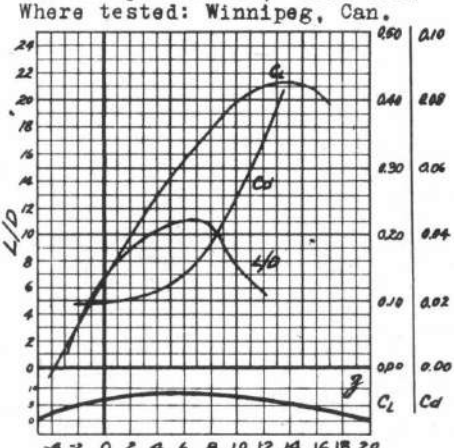
Name	Ordinates and Positions in Percent of Chord											
	0.	5.	10.	20.	30.	40.	50.	60.	70.	80.	90.	100.
Ray Thompson	0.0	2.30	4.00	6.20	7.50	7.75	7.40	6.75	5.75	4.10	3.60	0.0
Carl Goldberg	0.0	2.70	4.60	6.80	8.00	8.40	8.00	7.00	5.90	4.30	2.30	0.0
Fay Stroud (tip)	0;0	3.00	4.60	7.00	8.10	8.20	7.90	7.00	5.70	4.10	2.30	0.0
L. Hankammer	0.0	3.90	4.75	6.80	8.00	7.95	7.20	6.25	4.90	3.50	1.90	0.0
Jack Fisher	0.0	4.25	5.00	7.80	9.00	9.20	8.80	7.20	5.80	4.00	2.30	0.0
Ernie McCoy	0.0	2.70	4.50	6.80	7.90	8.10	8,00	7.20	6.00	4.60	2.75	0.0
McBride B-6	0.0	2.90	5.10	7.40	8.25	8.30	7.90	6.90	5.60	3.90	2.00	0.0
McBride B-7	0.0	2,35	4.40	6.70	7.80	8.30	7.90	6.90	5.60	3.90	2.00	0.0
Göttingen 417a	0.6	2.86	4.28	5.70	6.48	6.53	6.10	5.38	4.38	3.10	1.60	0.0
Flat Plate	0.5	0,50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50

AERODYNAMIC CHARACTERISTICS OF SINGLE SURFACE AIRFOILS

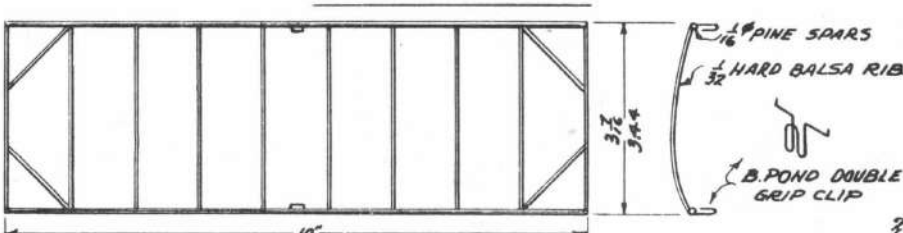
Name of section: Ray Thompson
Wind velocity: 7 f.p.s.
A.R. test section: 3.44
Tested by; McBride, March 1932
Where tested: Winnipeg, Can.



Name of section: Carl Goldberg
Wind velocity; 7 f.p.s.
A.R. test section: 3.44
Tested by: McBride, March 1932
Where tested: Winnipeg, Can.

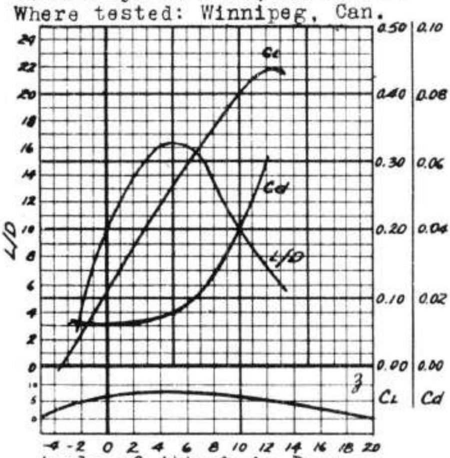


Coefficients are Absolute



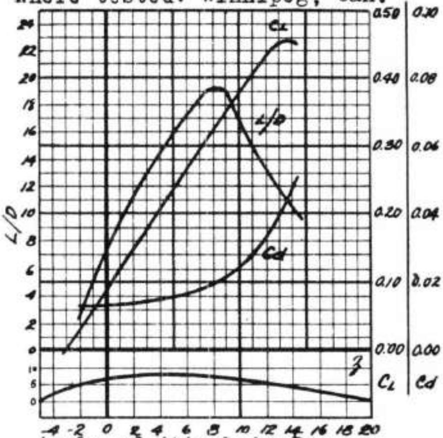
TEST SECTION CONSTRUCTION

Name of section: Fay Stroud
Wind velocity: 7 f.p.s.
A.R. test section: 3.44
Tested by: McBride, March 1932
Where tested: Winnipeg, Can.



Angle of Attack in Degrees

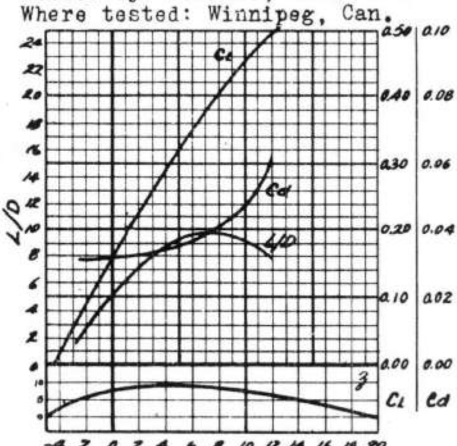
Name of section: L. Hankammer
Wind velocity: 7 f.p.s.
A.R. test section: 3.44
Tested by: McBride, March 1932
Where tested: Winnipeg, Can.



Angle of Attack in Degrees

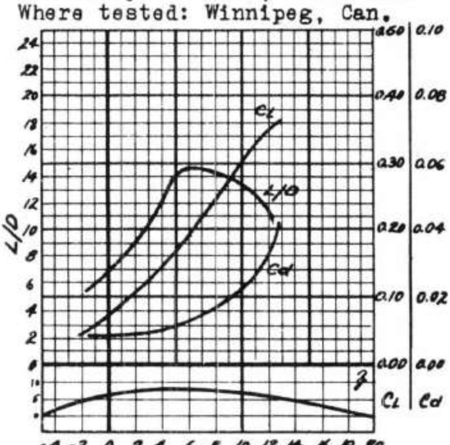
Coefficients are Absolute

Name of section: Jack Fisher
Wind velocity: 7 f.p.s.
A.R. test section; 3.44
Tested by: McBride, March 1932
Where tested: Winnipeg, Can.

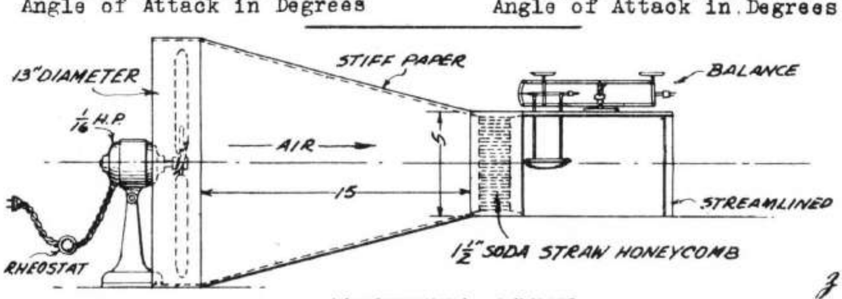


Angle of Attack in Degrees

Name of section: Ernie McCoy
Wind velocity: 7 f.p.s.
A.R. test section: 3.44
Tested by: McBride, March 1932
Where tested: Winnipeg, Can.

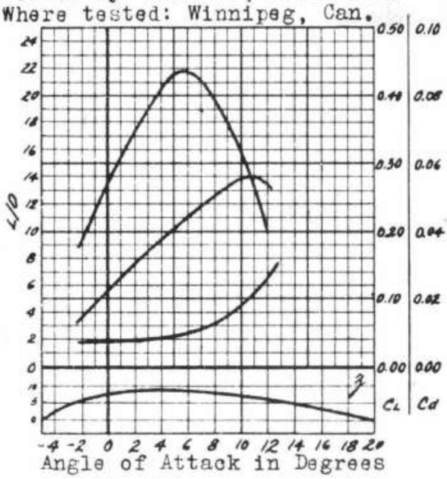


Angle of Attack in Degrees

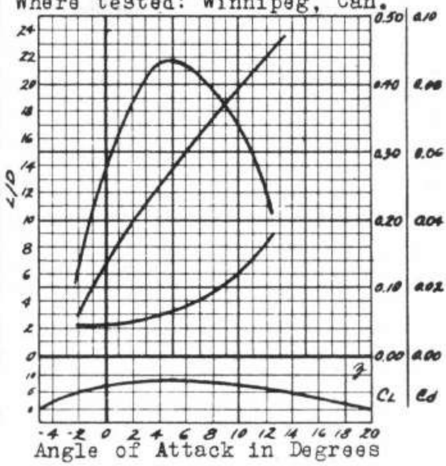


WINDTUNNEL LAYOUT

Name of section: McBride B-6
Wind velocity: 7 f.p.s.
A.R. test section: 3.44
Tested by: McBride, March 1932
Where tested: Winnipeg, Can.

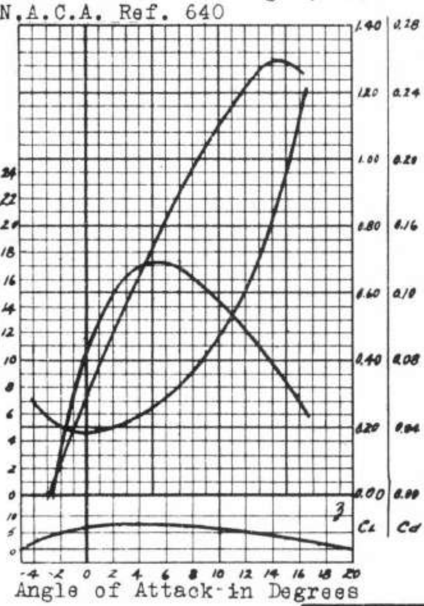


Name of section: McBride B-7
Wind velocity: 7 f.p.s.
A.R. test section: 3.44
Tested by: McBride, March 1932
Where tested: Winnipeg, Can.

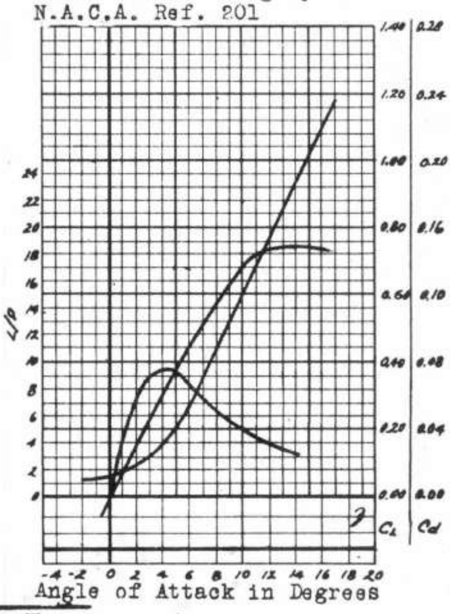


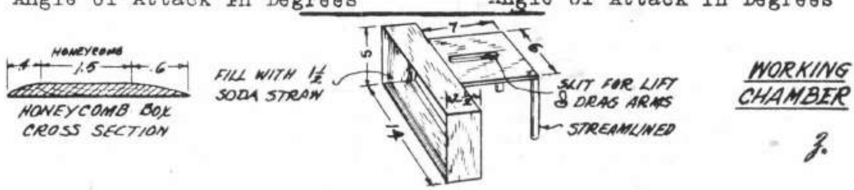
Coefficients are Absolute

Name of section: Göttingen 417a
Wind velocity: 98.4 f.p.s.
A.R. test section: 5/1
Where tested: Göttingen, 1926
N.A.C.A. Ref. 640



Name of section: Flat Plate
Wind velocity: ?
A.R. test section: 5/1
Where tested: Langley Field
N.A.C.A. Ref. 201





Some of the readers may not be familiar with this system of coefficients. The system is that used by the N.A.C.A. and is known as the Absolute system. The coefficient of lift is denoted as Cl and the coefficient of drag Cd.

The lift equation for this system is: $\text{Lift} = Cl \frac{p}{2} S V^2$

The drag equation for this system is: $\text{Drag} = Cd \frac{p}{2} S V^2$

Where p = .002378. The density of the air.
S = the effective area of the wing, square feet.
V = the speed of the air, feet per second. (f.p.s.)

It should be noted that this system of coefficients hold for any consistent system of units, such as the English or the Metric.

Conversion factors are presented here in case one wishes to compare the airfoils with those published using other systems.

$Cl = 2\ Lc = 391\ K_L = .01$ German system
$Cd = 2\ Ld = 391\ K_D = .01$ German system

For the benefit of those not acquainted with the use of Absolute Coefficient Systems the following design is given.

EXAMPLE 1.

Type of aircraft: Indoor Tractor, weight complete .08 oz.
Effective wing area: 100 square inches.
Wing section ie. airfoil: Göttingen 417a.
Angle of attack: 8 degrees 40 mins.

Note the angle of attack is the angle of incidenee between the wing and the airflow. The angle of incidence is the angle of inclination between the wing and a fixed line in the aircraft usually the line of thrust.

Lift Coefficient by chart: 1.00=Cl
Air density 0.002378 at 59 degrees F. and 29.92 inches of mercury.

As the conditions mentioned above are the average of the conditions in the temparate zone one will not be greatly in error it density corrections for change in temperature and pressure are not made.

$$\text{Lift} = \left[1.00 \times .0012 \times \frac{100}{144} \times V^2\right] = \left(L = Cl \frac{p}{2} S V^2\right)$$

It is assumed that there is no down or up load on stabilizer at this angle of attack.

$$\text{Therefore-}\ .08 \times .0625 = 1.00 \times .0012 \times \frac{100}{144} \times V^2$$

(.08 oz.=weight of the model) (.06251lbs.=Cd at 8^{0} 40')

Solving for V one gets:- V=Root of 6.26 or 2.5
Therefore speed in level flight at 8 degrees 40 mns. is 2.5 f.p.s.

Many model builders will question the use of data of this kind in the design of indoor models, and in an endeavor to answer them, these last paragraphs are written.

One of the major uses of scientific information of this kind is that one may compare wing sections and find the effect of making small changes. Thus he will know that flattening out a section between 0 and 30% of the chord will, if carried out within reasonable limits.

increase lift and efficiency, thus producing a better endurance airfoil (B-6 and B-7) while humping an airfoil at the 40% station will increase at the expense of efficiency. (Jack Fisher.) Thus by careful comparison of the characteristics of section one may finally develop a very superior airfoil.

Data of this kind is most useful in design work as it is possible to make preliminary endurance calculations, calculate changes in possible duration due to changes in wing area, incidence etc. An example of its use in this kind of work is given below.

EXAMPLE 2.

An indoor tractor of 100 square inches of area was being flown at 6 degrees attack. A check of values of $\frac{Cd}{Cl}$, (One of the criteria for an endurance airfoil. Should be a minimum. (REF.5) of the airfoil has shown that 9 degree is a better angle for the airfoil Would this setting improve duration?

Area: 100 sq. in.	Cd of stick etc.: 0.0824 (this includes area.)
Airfoil: Gött. 417a.	
Flying weight: 0.10 oz.	Available energy: 35.0 ft.oz.

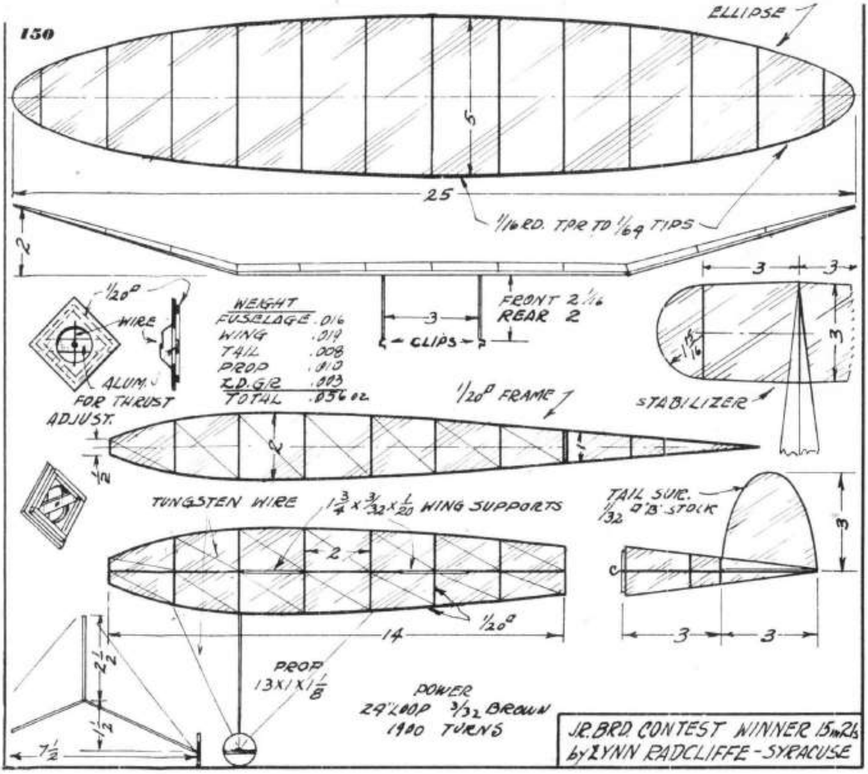
6 degrees attack	9 degrees attack
$V^2 = \frac{(0.10 \times 0.0625 \times 100 \times 2)}{(0.8 \times 144 \times 0.0024)}$	$V^2 = \frac{(0.10 \times 0.0625 \times 100 \times 2)}{(1.02 \times 144 \times 0.0024)}$
V = 2.12 f.p.s.	V = 1.88 f.p.s.
Cl at 6 degrees being 0.08	Cl at 9 degrees being 1.02
L/D at 6 degrees is 15.2	L/D at 9 degrees is 14.1
Motor and stick drag $\frac{(0.0824 \times 0.0024 \times (2.12)^2}{(0.0625 \times 2)} = 0.00715$ oz.	Motor and stick drag $\frac{(0.0824 \times 0.0024 \times (1.88)^2}{(0.0625 \times 2)} = 0.00578$ oz.
Wing drag is $\frac{0.10}{15.2} = 0.00658$ oz.	Wing drag is $\frac{0.10}{14.1} = 0.00707$ oz
Total drag 0.01373 ox	Total drag 0.01283 oz
Power used for flight $0.01373 \times 2.12 = 0.02911$ ft.oz. per sec.	Power used for flight $0.01283 \times 1.88 = 0.02412$ ft. oz. per sec
Possible duration $\frac{35.0}{0.01373 \times 2.12} = 1202.4$ secs.	Possible duration $\frac{35.0}{0.01283 \times 1.88} = 1452.3$ secs.

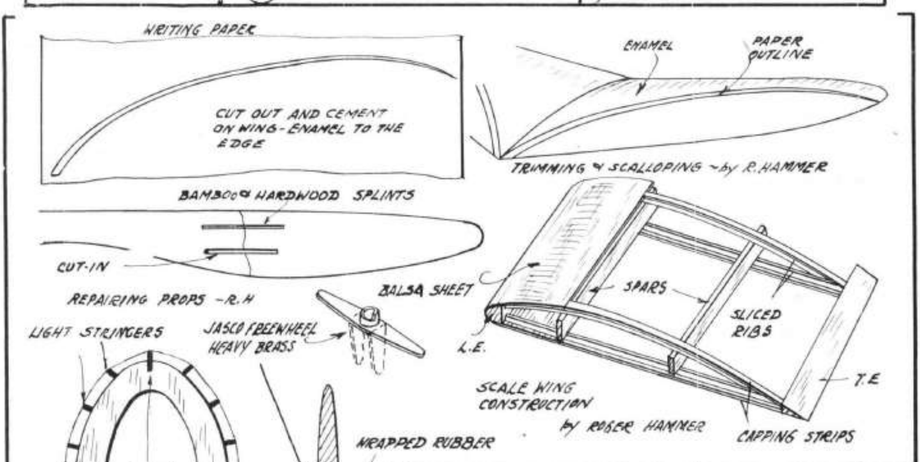
This is an improvement of 20.7% resulting from using the proper wing adjustment. This is an interesting calculation in view of the present trend to reduce the angle of attack in order to reduce resistance coefficient forgetting that the power required depends greatly on the aircraft's speed.

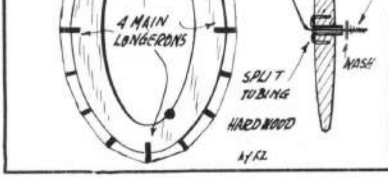
In conclusion the author wishes to state that he believes that flights of an hour or more will be possible in a few years if the model designer pays careful attention to the science of low speed aerodynamics, to which he hopes this article will be a contribution.

REFERENCES

1. N.A.C.A. Technical Reports Nos. 93, 124, 182, 244, 286, 315, 460.
2. "The Seven Outstanding Tractors of 1930." Airplane Model League of America data published by Geo, D. Wanner, Dayton, Ohio. Page 7.
3. Eiffel, "Resistance de l'air at Aviation", Hunsakar translation. Page 38.
4. Engineering Aerodynamics, Diehl. Page 65.
5. Simple Aerodynamics, Carter. Chapter on airfoil selection.

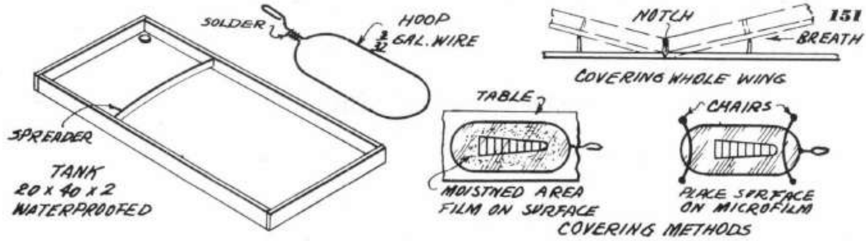


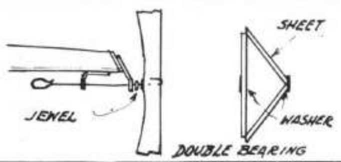




Use wet paper for covering round fuselages, as it can be easily shaped to round surfaces, and much more area can be covered at one time, without cutting narrow strips.

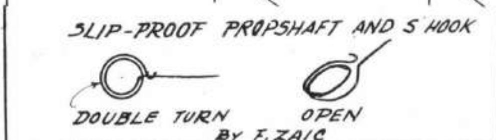
Farrin Bunker

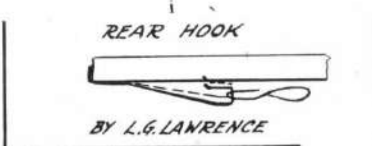


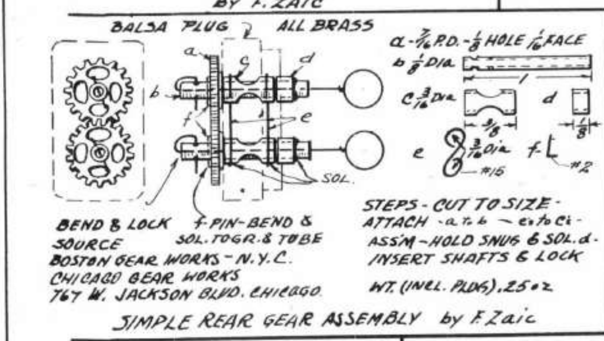


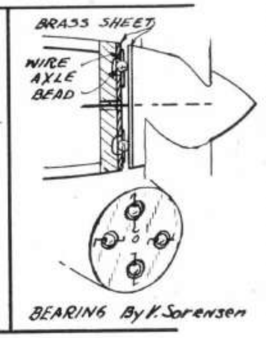
Double Bearings stop prop vibrations. Permit side and up or down adjustments. By using side thrust the prop is pulling in circle line instead of on a tangent, requiring less rudder and make tighter circles possible.

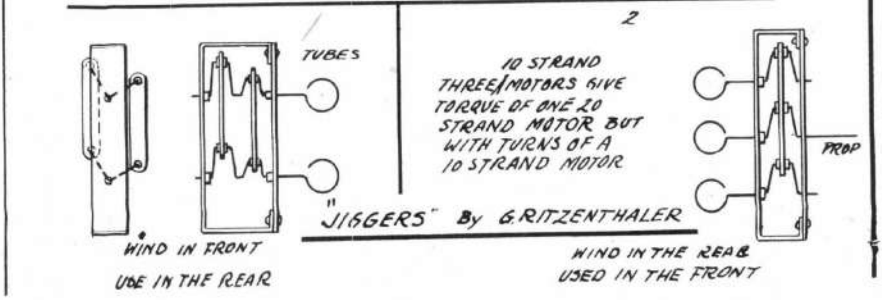
By Don Donahue

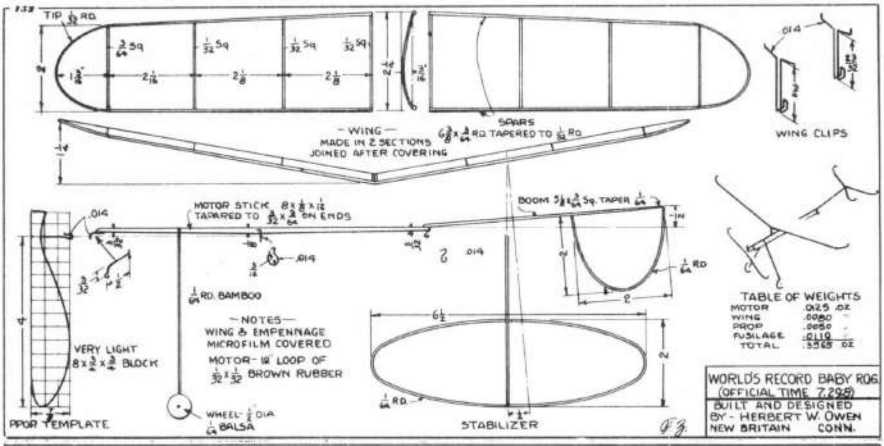


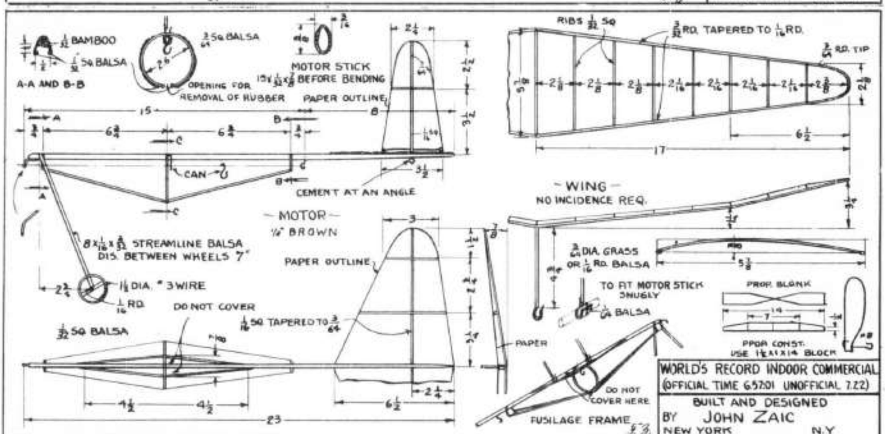


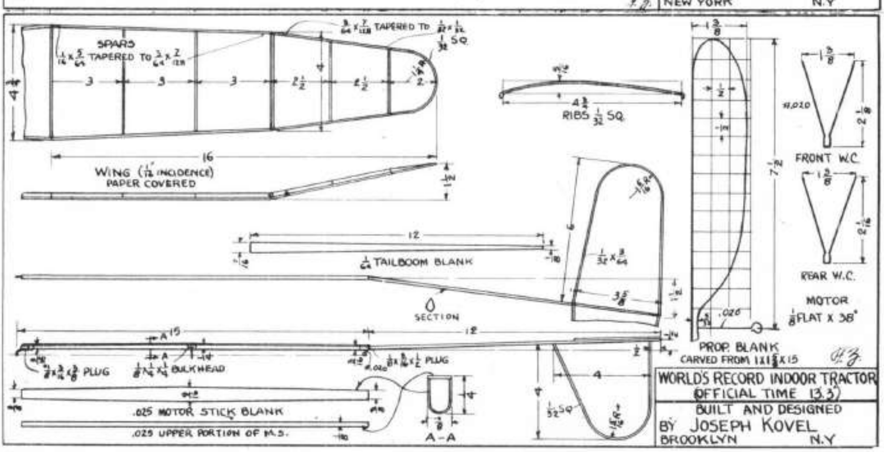


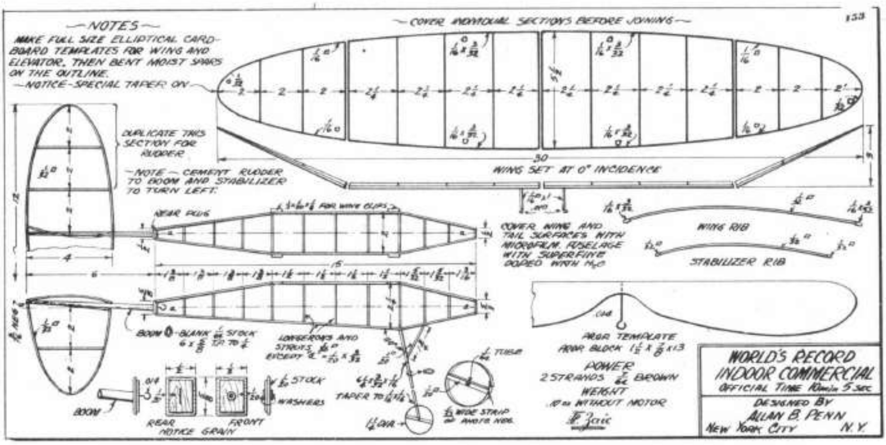


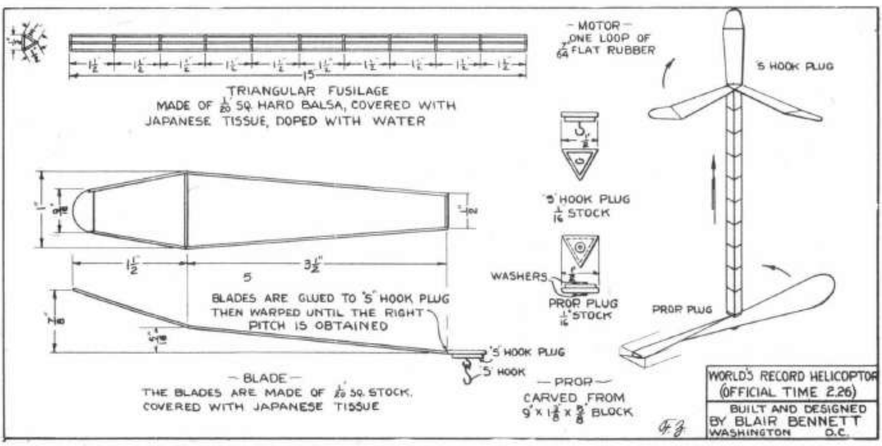


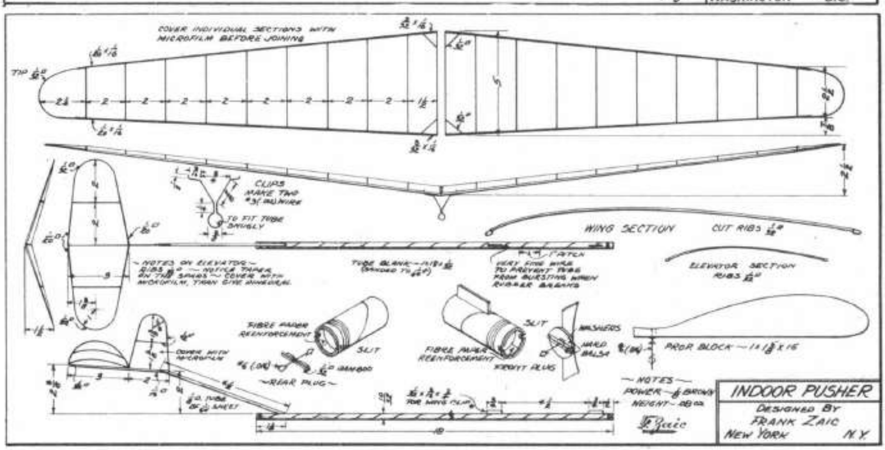

TIP $\frac{1}{32}$ RD.
— WING —
MADE IN 2 SECTIONS
JOINED AFTER COVERING
SPARS
$6\frac{3}{8}$ x $\frac{3}{64}$ RD. TAPERED TO $\frac{1}{32}$ RD.
WING CLIPS
MOTOR STICK 8 x $\frac{1}{8}$ x $\frac{1}{16}$
TAPERED TO $\frac{3}{32}$ x $\frac{3}{64}$ ON ENDS
BOOM $5\frac{1}{4}$ x $\frac{3}{64}$ SQ. TAPER $\frac{1}{64}$
$\frac{1}{64}$ RD. BAMBOO
— NOTES —
WING & EMPENNAGE
MICROFILM COVERED
MOTOR - 12" LOOP OF
$\frac{1}{32}$ x $\frac{1}{32}$ BROWN RUBBER
VERY LIGHT
8 x $\frac{3}{4}$ x $\frac{3}{4}$ BLOCK
PPOR TEMPLATE
WHEEL - $\frac{1}{2}$ DIA
$\frac{1}{64}$ BALSA
STABILIZER
TABLE OF WEIGHTS
MOTOR .025 OZ
WING .0080
PROP .0050
FUSILAGE .0119
TOTAL .3565 OZ
WORLD'S RECORD BABY ROG.
(OFFICIAL TIME 7.29.8)
BUILT AND DESIGNED
BY - HERBERT W. OWEN
NEW BRITAIN CONN.

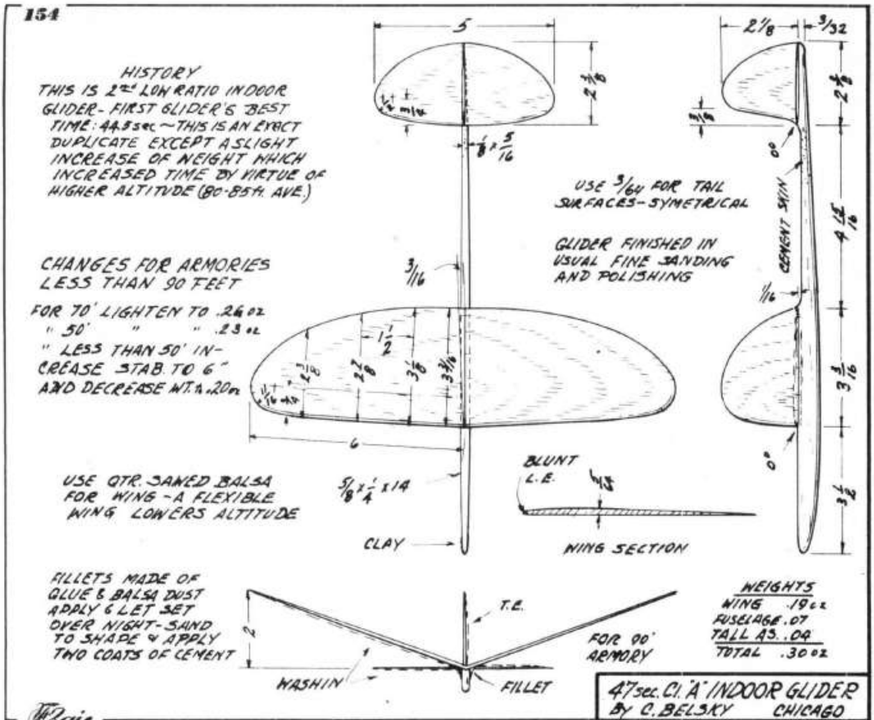

$\frac{1}{32}$ BAMBOO
$\frac{1}{32}$ SQ. BALSA
A-A AND B-B
$\frac{3}{64}$ SQ. BALSA
OPENING FOR
REMOVAL OF RUBBER
MOTOR STICK
15 x $\frac{1}{32}$ x $\frac{3}{8}$ BEFORE BENDING
PAPER OUTLINE
CAN
CEMENT AT AN ANGLE
— MOTOR —
$\frac{1}{8}$" BROWN
8 x $\frac{1}{16}$ x $\frac{3}{32}$ STREAMLINE BALSA
DIS. BETWEEN WHEELS 7"
$1\frac{1}{8}$ DIA. # 3 WIRE
$\frac{1}{16}$ RD.
DO NOT COVER
$\frac{1}{32}$ SQ. BALSA
$\frac{1}{16}$ SQ. TAPERED TO $\frac{3}{64}$
PAPER OUTLINE
RIBS $\frac{1}{32}$ SQ.
$\frac{3}{32}$ RD. TAPERED TO $\frac{1}{16}$ RD.
$\frac{3}{64}$ RD. TIP
— WING —
NO INCIDENCE REQ.
$\frac{3}{64}$ DIA. GRASS
OR $\frac{1}{16}$ RD. BALSA
TO FIT MOTOR STICK
SNUGLY
$\frac{1}{64}$ BALSA
PROP. BLANK
PPOR CONST.
USE $1\frac{1}{4}$ x 1 x 14 BLOCK
PAPER
DO NOT
COVER HERE
FUSILAGE FRAME
WORLD'S RECORD INDOOR COMMERCIAL
(OFFICIAL TIME 6.57.01 UNOFFICIAL 7.22)
BUILT AND DESIGNED
BY JOHN ZAIC
NEW YORK N.Y

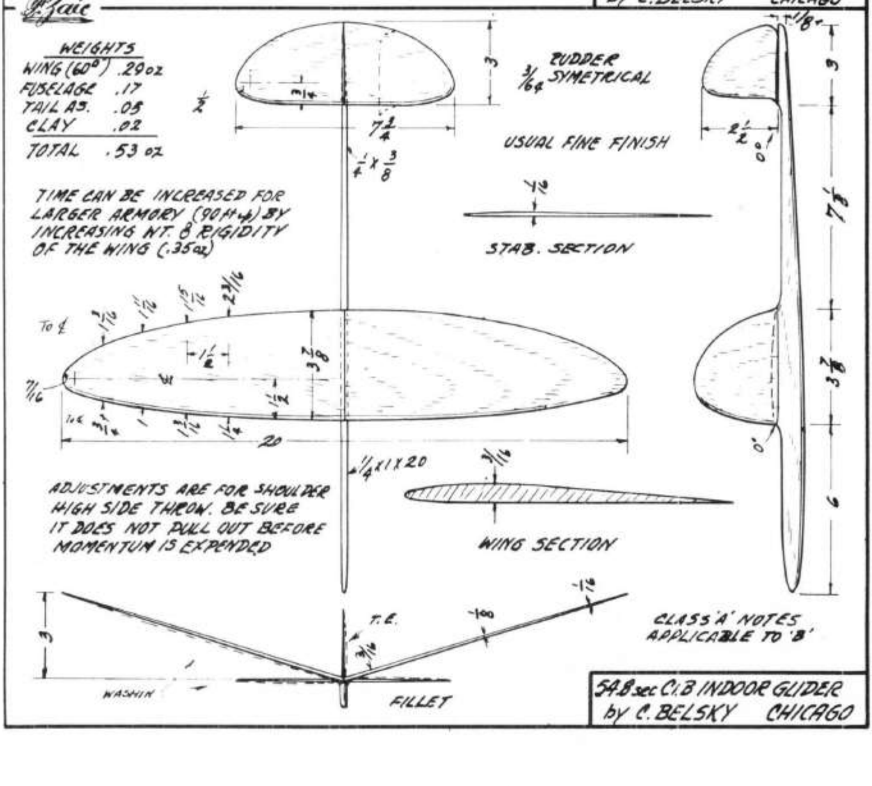

SPARS
$\frac{1}{16}$ x $\frac{5}{64}$ TAPERED TO $\frac{3}{64}$ x $\frac{7}{128}$
$\frac{3}{64}$ x $\frac{7}{128}$ TAPERED TO $\frac{1}{32}$ x $\frac{1}{32}$
$\frac{1}{32}$ SQ.
RIBS $\frac{1}{32}$ SQ.
WING ($\frac{1}{16}$" INCIDENCE)
PAPER COVERED
$\frac{1}{64}$ TAILBOOM BLANK
SECTION
FRONT W.C.
REAR W.C.
MOTOR
$\frac{1}{8}$ FLAT X 38"
PROP. BLANK
CARVED FROM $1 \times 1\frac{3}{8} \times 15$
$\frac{1}{8}$ x $\frac{3}{16}$ x $\frac{3}{8}$ PLUG
$\frac{1}{8}$ x $\frac{1}{4}$ x $\frac{1}{4}$ BULKHEAD
$\frac{1}{8}$ x $\frac{3}{16}$ x $\frac{1}{2}$ PLUG
.025 MOTOR STICK BLANK
.025 UPPER PORTION OF M.S.
A-A
$\frac{1}{32}$ SQ.
WORLD'S RECORD INDOOR TRACTOR
(OFFICIAL TIME 13.3)
BUILT AND DESIGNED
BY JOSEPH KOVEL
BROOKLYN N.Y

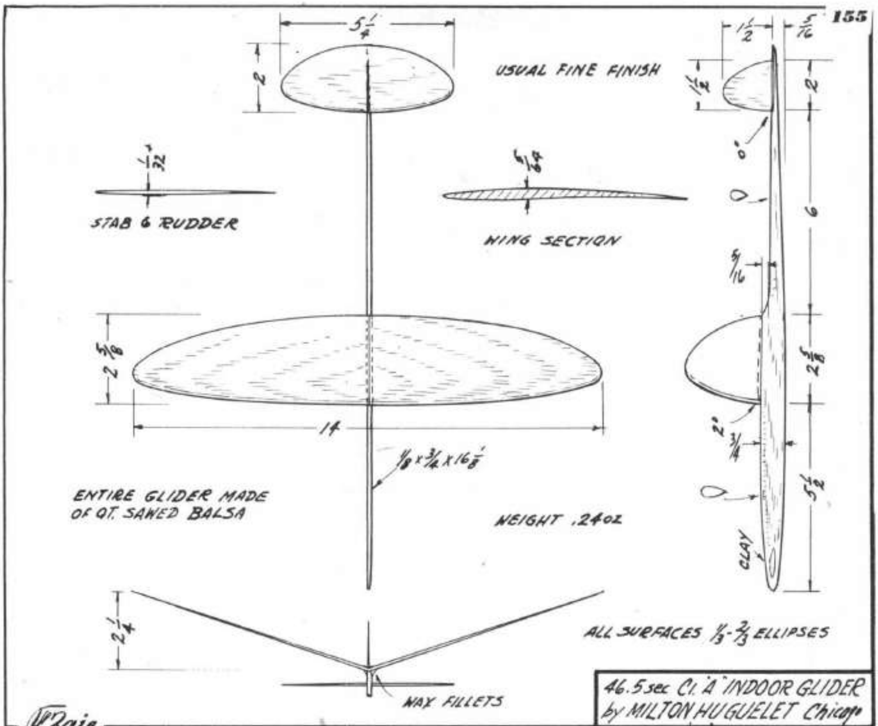

— NOTES —
MAKE FULL SIZE ELLIPTICAL CARDBOARD TEMPLATES FOR WING AND ELEVATOR. THEN BENT MOIST SPARS ON THE OUTLINE.
— NOTICE - SPECIAL TAPER ON —
— COVER INDIVIDUAL SECTIONS BEFORE JOINING —
DUPLICATE THIS SECTION FOR RUDDER
— NOTE — CEMENT RUDDER TO BOOM AND STABILIZER TO TURN LEFT.
30
WING SET AT 0° INCIDENCE
REAR PLUG
COVER WING AND TAIL SURFACES WITH MICROFILM. FUSELAGE WITH SUPERFINE DOPED WITH H_2O
WING RIB
STABILIZER RIB
15
PROP TEMPLATE
PROP BLOCK $1\frac{1}{2} \times \frac{7}{8} \times 13$
POWER
2 STRANDS $\frac{?}{64}$ BROWN
WEIGHT
.10 oz WITHOUT MOTOR
TAPER TO
TUBE
REAR
FRONT
NOTICE GRAIN
WASHERS
BOOM
WORLD'S RECORD
INDOOR COMMERCIAL
OFFICIAL TIME 10 min 5 sec
DESIGNED BY
ALLAN B. PENN
NEW YORK CITY N.Y.

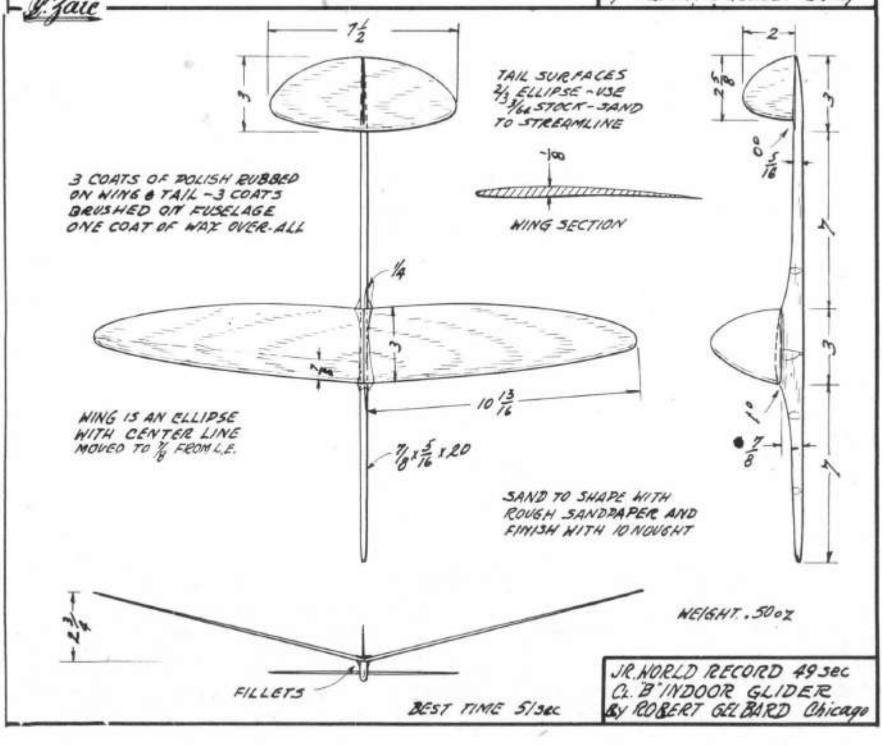

— MOTOR —
ONE LOOP OF
$\frac{1}{64}$ FLAT RUBBER
'S HOOK PLUG
15
TRIANGULAR FUSILAGE
MADE OF $\frac{1}{20}$ SQ. HARD BALSA, COVERED WITH
JAPANESE TISSUE, DOPED WITH WATER
'S' HOOK PLUG
$\frac{1}{16}$ STOCK
WASHERS
PROP PLUG
$\frac{1}{16}$ STOCK
PROP PLUG
$1\frac{1}{2}$
5
$3\frac{1}{2}$
BLADES ARE GLUED TO 'S' HOOK PLUG
THEN WARPED UNTIL THE RIGHT
PITCH IS OBTAINED
'S' HOOK PLUG
'S' HOOK
— BLADE —
THE BLADES ARE MADE OF $\frac{1}{20}$ SQ. STOCK,
COVERED WITH JAPANESE TISSUE
— PROP —
CARVED FROM
$9'' \times 1\frac{1}{8} \times \frac{5}{8}$ BLOCK
WORLD'S RECORD HELICOPTOR
(OFFICIAL TIME 2.26)
BUILT AND DESIGNED
BY BLAIR BENNETT
WASHINGTON D.C.


COVER INDIVIDUAL SECTIONS WITH MICROFILM BEFORE JOINING
CLIPS
MAKE TWO
WING SECTION
ELEVATOR SECTION
FIBRE PAPER REENFORCEMENT
SLIT
REAR PLUG
FRONT PLUG
WASHERS
HARD BALSA
PROP BLOCK — $1 \times 1\frac{1}{8} \times 16$
— NOTES —
INDOOR PUSHER
DESIGNED BY
FRANK ZAIC
NEW YORK N.Y.


HISTORY
THIS IS 2ND LOW RATIO INDOOR GLIDER - FIRST GLIDER'S BEST TIME: 44.5 sec ~ THIS IS AN EXACT DUPLICATE EXCEPT A SLIGHT INCREASE OF WEIGHT WHICH INCREASED TIME BY VIRTUE OF HIGHER ALTITUDE (80-85 ft. AVE.)
CHANGES FOR ARMORIES LESS THAN 90 FEET
FOR 70' LIGHTEN TO .26 oz
" 50' " " .23 oz
" LESS THAN 50' INCREASE STAB. TO 6" AND DECREASE WT. to .20 oz
USE QTR. SAWED BALSA FOR WING - A FLEXIBLE WING LOWERS ALTITUDE
USE 3/64 FOR TAIL SURFACES - SYMETRICAL
GLIDER FINISHED IN USUAL FINE SANDING AND POLISHING
CEMENT SKIN
BLUNT L.E.
WING SECTION
CLAY
5/8 x 1/4 x 14
FILLETS MADE OF GLUE & BALSA DUST APPLY & LET SET OVER NIGHT - SAND TO SHAPE & APPLY TWO COATS OF CEMENT
WASHIN
T.E.
FILLET
FOR 90' ARMORY
WEIGHTS
WING .19 oz
FUSELAGE .07
TAIL AS. .04
TOTAL .30 oz
47 sec. Cl. "A" INDOOR GLIDER
BY C. BELSKY CHICAGO


WEIGHTS
WING (60°) .29 oz
FUSELAGE .17
TAIL AS. .05
CLAY .02
TOTAL .53 oz
3/64 RUDDER SYMETRICAL
USUAL FINE FINISH
STAB. SECTION
TIME CAN BE INCREASED FOR LARGER ARMORY (90 ft +) BY INCREASING WT. & RIGIDITY OF THE WING (.35 oz)
1/4 x 1 x 20
ADJUSTMENTS ARE FOR SHOULDER HIGH SIDE THROW. BE SURE IT DOES NOT PULL OUT BEFORE MOMENTUM IS EXPENDED
WING SECTION
WASHIN
T.E.
FILLET
CLASS 'A' NOTES APPLICABLE TO 'B'
54.8 sec Cl. B INDOOR GLIDER
by C. BELSKY CHICAGO


USUAL FINE FINISH
STAB & RUDDER
WING SECTION
ENTIRE GLIDER MADE OF QT. SAWED BALSA
WEIGHT .24 oz
CLAY
ALL SURFACES 1/3 - 2/3 ELLIPSES
WAX FILLETS
46.5 sec Cl. "A" INDOOR GLIDER by MILTON HUGUELET Chicago
F. Zaic


TAIL SURFACES 2/3 ELLIPSE - USE 3/64 STOCK - SAND TO STREAMLINE
3 COATS OF POLISH RUBBED ON WING & TAIL - 3 COATS BRUSHED ON FUSELAGE ONE COAT OF WAX OVER-ALL
WING SECTION
WING IS AN ELLIPSE WITH CENTER LINE MOVED TO 7/8 FROM L.E.
SAND TO SHAPE WITH ROUGH SANDPAPER AND FINISH WITH 10 NOUGHT
WEIGHT .50 oz
FILLETS
BEST TIME 51 sec
JR. WORLD RECORD 49 sec Cl. "B" INDOOR GLIDER By ROBERT GELBARD Chicago

RUBBER

The turn tables given were first calculated from the par and coefficient formula and then checked with actual winding. The number of turns given will prove to be a bit on the safe side and can be achieved on a day of normal temperature providing that the rubber is stretched as much as possible. An excessively hot or cold temperature will materially decrease the possible number of turns. The number of turns can be brought close to the normal if the rubber is kept under shade, wrapped in moist paper on hot days, or in a pocket or near a radiator on cold days.

Straight green soap slightly thinned with glycerine will serve as a good lubricant. Be sure to spread and rub it in evenly. After every wind up check for cracks and grit, and relube the motor. Since lube messes up the handkerchief considerably, it is much better to wear white athletic cotton socks for cleaning your hands whenever they get dirty.

The actual number of turns that can be obtained from a motor depends upon your strength and will power. After a prewind of 75% and 90% of the maximum, the wind-up should be made by stretching the rubber at least five times its length (17 feet for a 40" motor). Wind about one half of the maximum at this length and then slowly come in so that there is at least 2" or 3" of elasticity left. The best way of knowing just when the motor has enough is to practise so that you will get the feel of the rubber just before it is about to break.

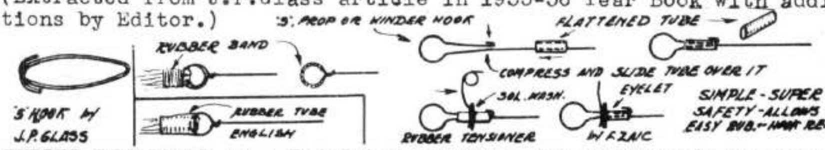
Turns per inch on Two Strands--Weight per inch of Single Strand

Size	1/32	3/64	1/16	5/64	3/32	7/64	1/8	5/32	3/16	1/4
Turn	225	189	163	145	130	124	115	108	94	80
Wt. oz.	.0005644	.0008466	.0011288	.0011411	.0016932	.0019756	.0021576	.0028220	.0033864	.0043152

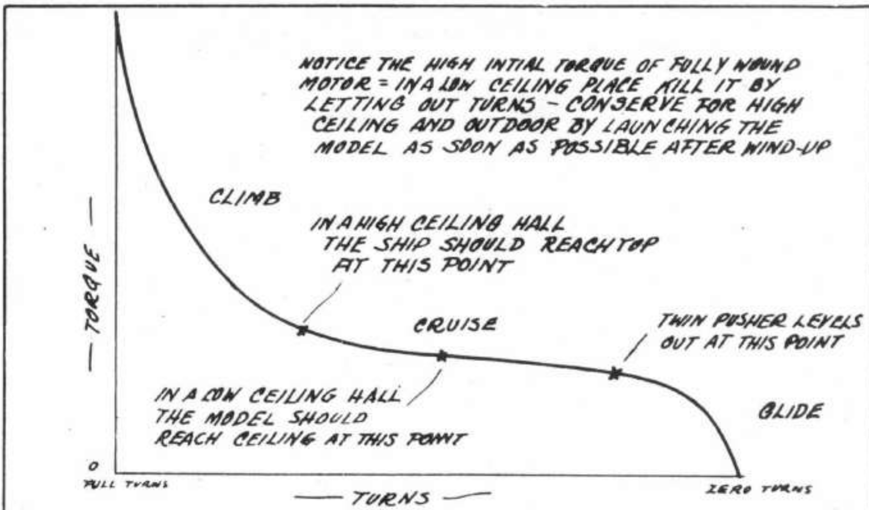
Turns per inch on Multiple Strands

No.Str.	4	6	8	10	12	14	16	18	20
1/8	80	64	55	50	44	40	36	34	32
5/32	68	59	50	46	41	38	34	29	24
3/16	60	54	46	42	38	35	32	27	24
1/4	56	44	37	33	29	27	25	23	21

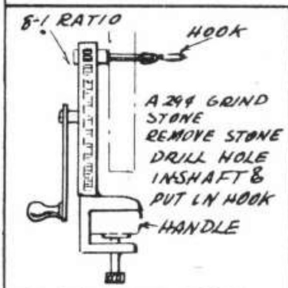
The tables are for 1/30 Gage Special Brown Rubber (MRL, T56). A complete table of all numbers of strands and lengths of motors would require too much space. Make your own chart for the motors which you usually use most, and paste it in your model box. The 1/4 motors of over 14 strands are hard to handle. It is advisable to wind the motors before begining a design using this size. (Extracted from J.P.Glass article in 1935-36 Year Book with additions by Editor.)



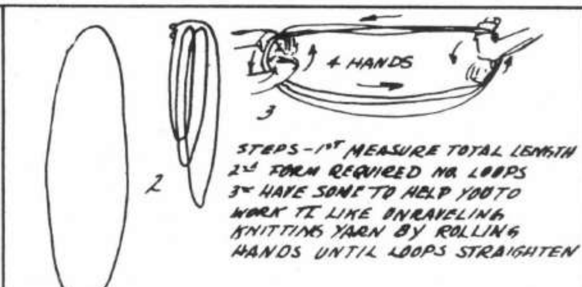
RUBBER TENSIONER is a British invention. Its purpose is to prevent a long motor from unwinding completely and so prevent shifting.



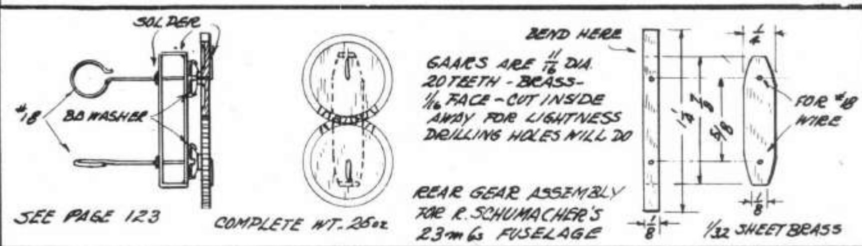
TORQUE CHART OF UNWINDING MOTOR by J. P. GLASS



INDOOR WINDER by F. ZAIL

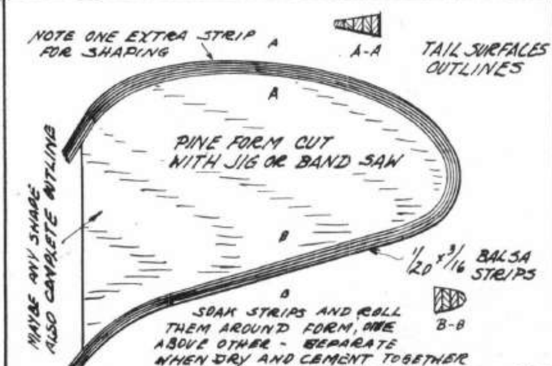


STRAIGHTENING MOTORS by T. BOLAND (1928)

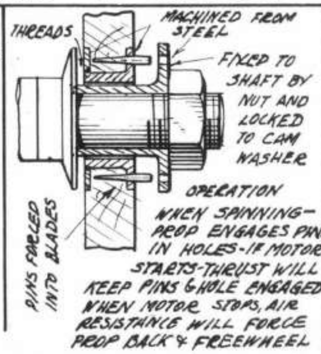


SEE PAGE 123 COMPLETE WT. .25 oz

REAR GEAR ASSEMBLY FOR R. SCHUMACHER'S 23 m Gs FUSELAGE



TAIL SURFACES OUTLINES



GAS MODEL HINTS By DON DONAHUE

OFFICIAL LIST OF UNITED STATES MODEL AIRCRAFT RECORDS
Approved by Contest Board of the N.A.A. Sept. 30, 1936.

INDOORS (No weight restriction)

STICK — CLASS A (30 sq. in. or under)

Rise off Ground		
Junior: William Wert	Philadelphia, Pa.	10m 26.4s
Senior: Ervin Leshner	Philadelphia, Pa.	15m 47.4s
Open : Joseph Matulis	Chicago, Illinois	9m 59.0s
Rise off Water		
Junior: William Wert	Philadelphia, Pa.	7m 19.4s
Senior: Colman Zola	Brooklyn, N. Y.	7m 41.1s
Open : Beorgevin Becksted	Chicago, Illinois	5m 38.2s

CLASS B (30-100 sq. in.)

Hand Launched		
Junior: John S. Stokes Jr.	Huntington Valley, Pa.	18m 12.2s
Senior: Wilbur F. Tyler	Boston, Mass.	20m 50.1s
Open : Ernest A. Walen	Springfield, Mass.	18m 46.5s
Rise off Ground		
Junior: John S. Stokes, Jr.	Huntington Valley, Pa	17m 19.3s
Senior: Hyman Oslick	Philadelphia, Pa.	17m 03.8s
Open : Ernest A. Walen	Springfield, Mass.	17m 42.8s
Rise off Water		
Junior: William Wert	Philadelphia, Pa.	9m 27.6s
Senior: Mayhew Webster	Philadelphia, Pa.	11m 55.0s
Open : William Latour	Philadelphia, Pa.	13m 15.0s

CLASS C (100-150 sq. in.)

Hand Launched		
Junior: John S. Stokes, Jr.	Huntington Valley, Pa.	20m 53.0s
Senior: Robert Jacobsen	Philadelphia, Pa.	25m 29.0s
Open : Carl Goldberg	Chicago, Illinois	23m 29.3s

CABIN FUSELAGE — CLASS B

Rise off Ground		
Junior: John S. Stokes, Jr.	Huntington Valley, Pa.	14m 15.3s
Senior: Charles Heintz	Philadelphia, Pa.	13m 12.2s
Open : Beorgevin Becksted	Chicago, Illinois	11m 26.0s
Rise off Water		
Junior: John S. Stokes, Jr.	Huntington Valley, Pa.	3m 23.0s
Senior: Sidney Axelrod	Chicago, Illinois	6m 32.2s
Open : William Latour	Philadelphia, Pa.	5m 42.0s

CLASS C

Rise off Ground		
Junior: John S. Stokes, Jr.	Huntington Valley, Pa.	15m 05.6s
Senior: John Haw	Philadelphia, Pa.	17m 14.8s
Open : William Latour	Philadelphia, Pa.	12m 31.8s

GLIDERS — CLASS A

Hand Launched		
Junior: M. Hugelot	Chicago, Illinois	34.6s
Senior: Wallace Simmers	New Lenox, Illinois	43.6s
Open : Joseph Matulis	Chicago, Illinois	38.8s

CLASS B

Hand Launched		
Junior: Robert Gelbard	Chicago, Illinois	49.2s
Senior: Wallace Simmers	New Lenox, Illinois	58.4s
Open : Carl Goldberg	Chicago, Illinois	47.5s

AUTOGIRO

Junior: Raymond Steinbacher	Ridgefield, N. J.	57.2s
Senior: Alton H. DuPlon, Jr.	Ridgefield, N. J.	2m 01.2s

(Min. Fuselage Section $\left(\frac{\text{Length}}{10}\right)^2$

OUTDOORS (Min. Wing Load. 50 sq. in./ 1 oz.

STICK — CLASS C (100-150 sq. in.

Hand Launched		
Junior: Junior Dague	Tulsa, Oklahoma	21m 04.0s
Senior: Harry Cornish	Denver, Colorado	61m 09.0s
Open : Joseph Frady	Tulsa, Oklahoma	27m 07.0s
Rise off Water		
Senior: Larry Low	New York, N. Y.	2m 00.0s

CLASS D (150-300 sq. in.)

Hand Launched		
Junior: Fred Skafec	Akron, Ohio	8m 21.6s
Senior: Daniel Clini	Springfield, Mass.	38m 50.0s
Open : Chester Lanzo	Cleveland, Ohio	18m 10.0s
Rise off Water		
Senior: Larry Low	New York, N. Y. (tie)	1m 12.0s
Senior: Malcom Abzug	New York, N. Y.	1m 12.0s

CABIN FUSELAGE — CLASS C

Rise off Ground		
Junior: Fred Smith	Denver, Colorado	27m 40.0s
Senior: Robert Cahill	Indianapolis, Ind.	33m 00.0s
Open : Beorgevin Becksted	Chicago, Illinois	39m 30.0s
Rise off Water		
Senior: Alan Orthoff	New York, N. Y.	1m 07.0s

CLASS D

Rise off Ground		
Junior: Arthur Koslow	Philadelphia, Pa.	9m 47.0s
Senior: William Ying	Rosebank, S.I., N. Y.	41m 19.0s
Open : Chester Lanzo	Cleveland, Ohio	48m 45.0s
Rise off Water		
Senior: Louis Milowitz	New York, N. Y.	1m 14.3s

CLASS E (300 sq. in. and over)

Gasoline Engine		
Senior: Joseph Kovel	Brooklyn, N. Y.	64m 40.0s
Open : Don Spaulding	Denver, Colorado	63m 07.4s

GLIDERS — CLASS B

Hand Launched		
Junior: Walter Weitner	New York, N. Y.	46.5s
Senior: Harry D. Soper, Jr.	Rockford, Illinois	2m 52.0s
Open : Willis C. Brown	Arlington, Mass.	33.1s

CLASS C

Hand Launched		
Junior: Horace Smith	Jacksonville, Fla.	36.0s
Senior: Colin Edwards	Oswego, New York	6m 30.4s
Open : James McPheat, Jr.	New York, N. Y.	31.5s
Tow Launched		
Junior: Ralph Brown	Arlington, Mass.	9m 32.0s
Senior: Bob File	Columbus, Ohio.	23m 13.0s
Open : Everett Tasker	Boston, Mass.	4m 25.0s

CLASS D

Hand Launched		
Senior: Edward L. Smith	Jacksonville, Fla.	38.0s
Tow Launched		
Junior: Paul Durup	Boston, Mass.	57.8s
Senior: Dick Everett	Elm Grove, W. Va.	2m 38.0s
Open : Roland Buhrig	Canastota, New York	1m 18.0s

CLASS E

Tow Launched		
Senior: Jack Smith	Dayton, Ohio	1m 23.4s

AUTOGIRO

Senior: Ralph Kummer	Saint Louis, Mo.	2m 06.0s

GAS MODEL PLANS

OUTDOOR FUSELAGES PLANS

OUTDOOR STICK PLANS

INDOOR STICK PLANS

R.O.W.

R.O.G.

INDOOR FUSELAGE PLANS

HAND LAUNCHED GLIDERS

HELICOPTER

CONTRIBUTIONS