Full Size Plans of a CESSNA FLYING SCALE MODEL, By McEntee

15¢ ★

MODEL AIRPLANE NEWS

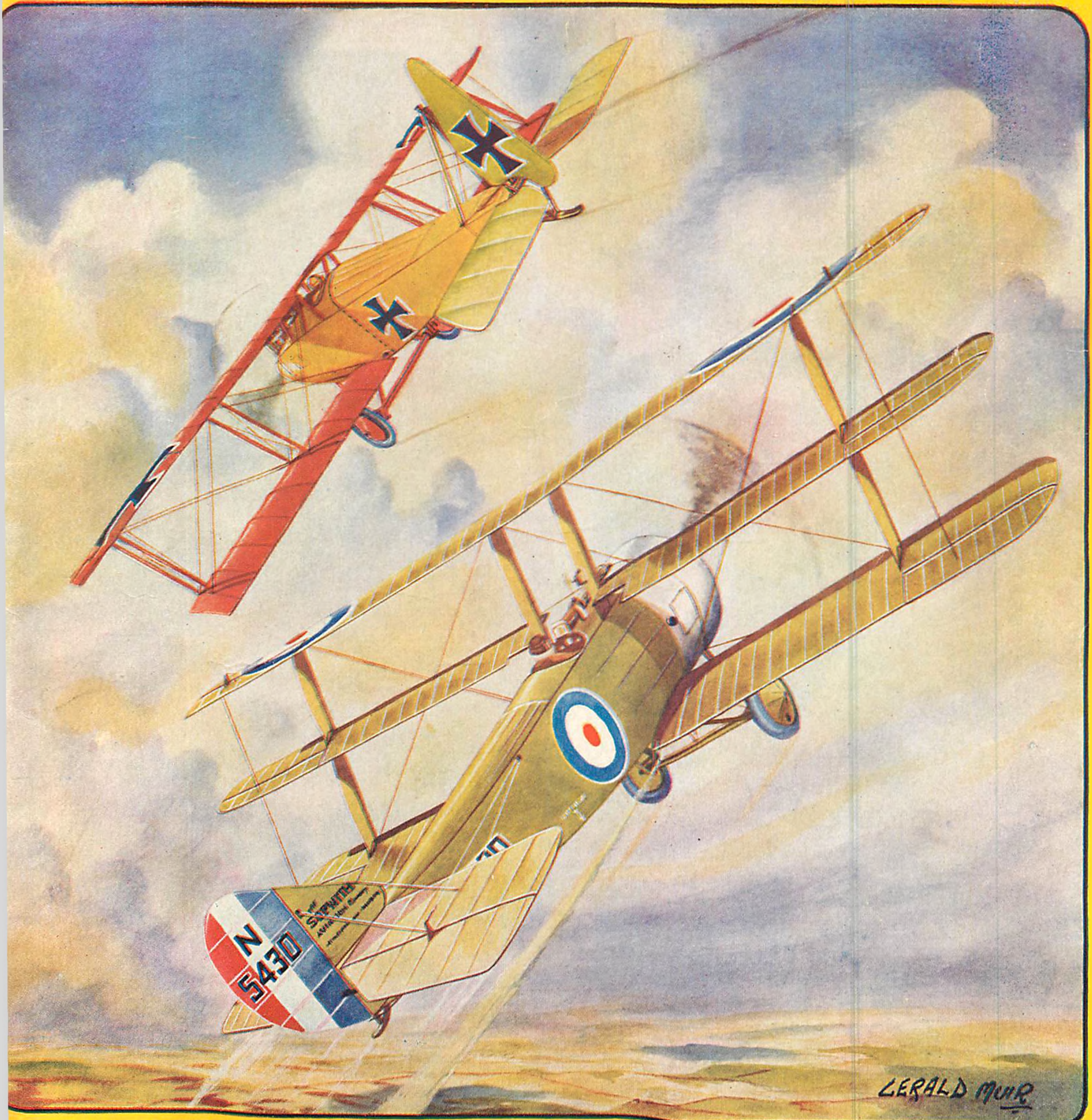
Two—3-View Layouts

A Hell Diver, Solid Scale Model

More on Engines—Applied Design

APRIL, 1932

"A COURSE IN AVIATION FOR FIFTEEN CENTS A MONTH!"



A *Sopwith* Triplane in Pursuit of a German

GIVEN!

Each Kit Packed in Its Own, Big, Strong Box!

3 Kits $2.00 POST PAID

We'll give you one sling-shot all-balsa Glider FREE with each Dart, Dipper and Pursuit you buy! How it soars, loops, glides. Fun galore! Get 3 gliders FREE by ordering all 3 Kits for the special $2 price. Act now. ORDER!

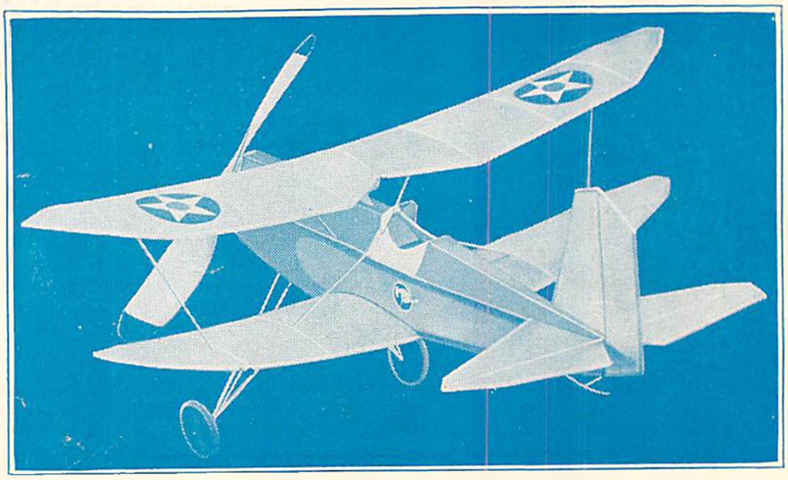
COMET DART
Span: 22″
Length: 16½″

For a short time only can we make you this special 3-Box-Kit offer; send $2 only and we'll ship you immediately by return mail, prepaid, the Dart, Pursuit and Dipper Kits, each one packed in its own sturdy, handsome box. We'll also enclose FREE 3 wonderful sling-shot Gliders. Remember, this isn't an offer to send you three kits in one box. No, you get three separate, different Kits in three different boxes! Thousands of Model Airplane News readers have already ordered one or more of these great models. Act now—get all three for only $2, post-paid. These Comet Kits give extraordinary value for the money. And Boy, how they fly! They give you the Most and the Best at Lower Cost, so hurry! Tell your pals to order too! Snap this up quick! Order.

THE DART FLIES 2640 FEET!

The Comet Dart flies one-half mile, is easily worth $2.25 yet costs you only $1 post-paid! How you'll thrill flying this speed demon—how your friends will envy you! Build this beautiful big plane now! Glider comes Free with Dart. Colored box containing everything needed to build and fly Comet Dart—$1 post-paid. Order! **Post-Paid $1.00**

KIT CONTENTS: Printed bal. parts, wing, body insignia, sandpaper, reed, bal. body strips, strip bamboo, bal. wing spars, all wire parts, bal. headrest and nosepiece, bal. prop blank, celluloid wheels, cement, banana oil, full-size drawing, instructions, Japanese tissue, rubber motor.

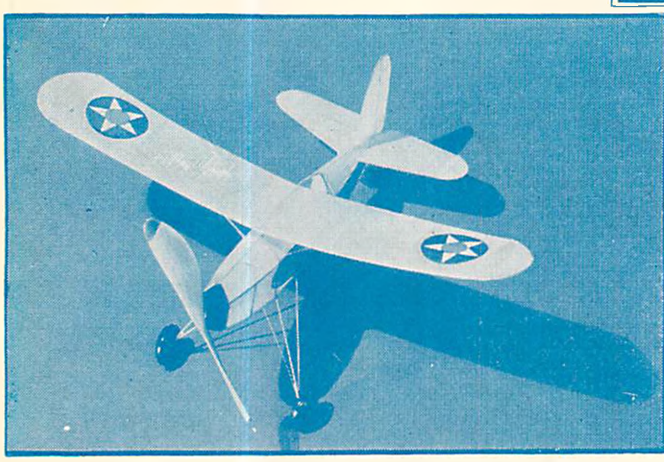


C-1-PURSUIT Span, 15″, Length, 12¼″.

NEW! C-1-Pursuit, Post-Paid: 75c

Looks like real army fighter with brown fuselage, orange wings. And can she fly? Man alive! Takes off ground, spirals gracefully, glides to perfect 3-point landing. Hurry—be first in your neighborhood to fly this remarkable plane model. Kit is complete as are all Comet kits. Free Glider comes with kit. Complete Kit in beautiful box. Special: 75c post-paid. Order Quick!

KIT CONTENTS: Stamped ribs and bulkheads, spec. bal. noseblock, celluloid wheels, sized bal. strips, strip bamboo, all wire parts. Army colors Japanese tissue, body insignia, sandpaper, banana oil, cement, bal. prop block, full-size drawing, instructions, rubber motor.



THE DIPPER Span, 12½″; Length, 9½″.

DIPPER Flies 600 Feet: Postpaid 50c

This amazing Dipper weighs less than one-half ounce, yet flies 600 feet . . . also takes off ground! Thousands sold and built and flown past few months. Biggest kit value you ever saw at 50c! Glider included free. Complete in sturdy yellow box. . . . 50c post-paid. Build it! Fly it! Order now!

KIT CONTENTS: Japanese tissue, strip blue tissue, printed bal. ribs, formers, bal. prop block, spec. bal. nosepiece, tailblock, insignia, sandpaper, wheels, bamboo strips, cement, banana oil, all wire parts, rubber motor, full-size drawings, instructions.

ORDER NOW Before We Withdraw Special Offer!

We'll ship immediately prepaid! Wonderful service. Kits give famous Comet satisfaction. Beginners all over are building and flying the Dipper! Others like the Pursuit. Still others enjoy building the beautiful Dart. Why not get all three big, *complete* Kits individually packed in 3 boxes, and 3 Free Gliders—for only $2, and get the biggest bargain thrill of your life! Fellows! We guarantee you'll never spend two bucks to greater advantage! ORDER NOW! BUT HURRY Before We Withdraw Special 3-Box-Kit Offer!

Comet Model Airplane & Supply Co.

3114 HARRISON STREET Dept. M-4-2 CHICAGO, ILL.

See for Yourself the Extra Value of CLEVELAND • DESIGNED Kits—Now!

If you want to see thoroughbred CLEVELAND-DESIGNED Models sold for $1.00 to $2.00 per Kit, show your interest by ordering one or more of these models. . . Tell your friends of this offer, too! •

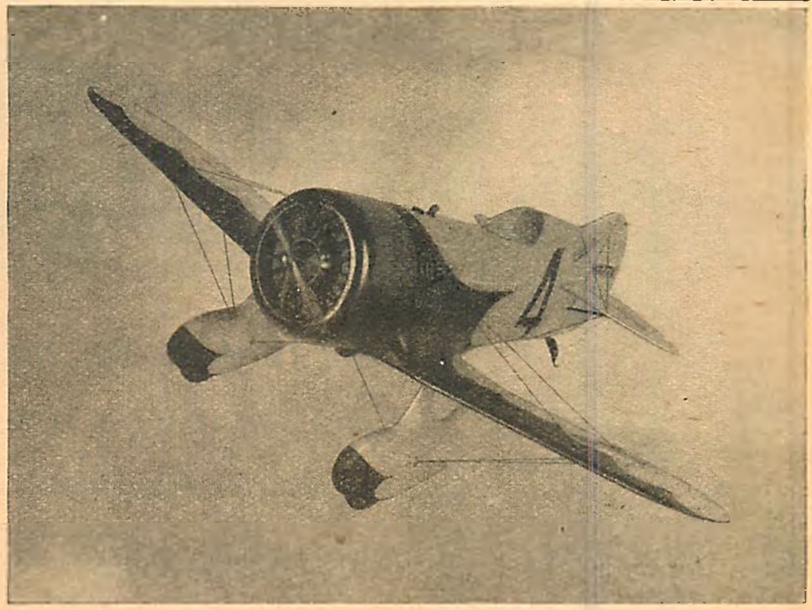
Here are two models designed especially for those who have never built Cleveland-Designed Models. The Kits are COMPLETE and contain standard Cleveland quality parts—wood, tissue, turnings, cement, colored model dopes, full size completely detailed drawings, etc., etc.

HOWARD RACER

Standard ¾″ scale. model of Ben Howard's race winner at Chicago. Colored with Cleveland's new white dope. Span 15″; length 13¼″; weight 1.3 oz. Kit SF-18.

GEE BEE (at right)

Standard ¾″ scale model of the Thompson Trophy Winner of 1931 at Cleveland. Colored yellow and black. Instructions for all lettering (not shown on photo) supplied. Span 17½″; length 12″; weight 1.5 oz. Kit SF-17.



EACH ONLY $1

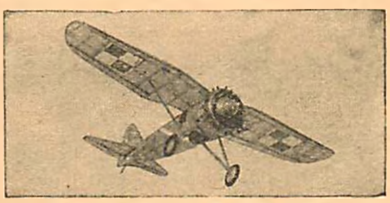
Price after April 30, 1932, will be $1.50 each. Build a fleet of 3 famous racers! These two ships and our famous Laird Super Solution (price $2.50) for only $4.00—think of it! Average $1.33 per kit. Only until April 30, 1932, no later. (Sold only in gross lots to dealers).

TO acquaint more model enthusiasts with Cleveland's extra value, we have lowered the price on these two wonderful new kits until April 30, 1932—so if you ever expect to build either of these famous models—order at once. We're equipped to handle any amount of orders you may send, and in the same speedy time that helped make Cleveland's name a lot more than a myth! Just think of it—an authentic Cleveland-Designed ¾″ scale flying model for only $1.00. Newly designed details and construction methods, too! Don't delay a minute—order yours now! If you wish to take advantage of these extremely low prices, send $2 and receive both Kits or send for the 3 racer kit for $4.00, saving you $1.50 on the regular price.

Do You Know what makes a Leader and why there are imitators?

Well, for the first thing, when one is being closely imitated he may consider himself a leader and few will dispute the fact. To term oneself a leader or claim it without background or proof of imitation is false pride. Then, people imitate others because they openly acknowledge leadership by their copying, believing it worthwhile to follow in the leader's footsteps. We did not believe we would ever have to be so severe, but before the situation gets beyond reasonable comprehension, we are giving you some

"INSIDE DOPE" ON MODELS



This Polish Fighter model, SF-6, we advertise and sell for $2.95—a complete kit, colors and all for a 25″ model. Another Polish Fighter model (and Laird too) has been recently advertised by a competitive firm, photographed in almost the same exact position. We wonder why? They flatter our photography, to say the least.

Take, for instance, one firm which sells a Fokker D-7 model. Their catalog illustrates a photograph of a Cleveland-Designed model built by a man in Connecticut (photo is slightly retouched). Another uses the original photograph (copied of course) of our Fokker Triplane on their catalog sheet. (Our photograph probably looked so real to them they thought it was Richthofen's own "Tripe"—quite a compliment to us indeed).

One copied one of our models as near as they dared, but enlarged it slightly and offered it at less than half our price. Quite unjust competition after all our months of designing.

Another copied so closely when producing a much cheaper kit, that they even duplicated our mistakes! On one model the radiator tube went to the center instead of the side of a war plane radiator (a mistake we made because of insufficient available data) and on the other, the insignia on the left fuselage side faced the wrong direction! Yes, our mistake originally, for we too are human, but—we were copied even on that!

We have not even scratched the surface of the possibilities in model aircraft designing yet, for there are greater things coming—but why must others copy instead of carrying on their own research work? Is it that their cheap prices will not allow it? If so, those who buy from them must suffer the consequences. We must pay the full price for experimental work, and can only afford to sell complete kits. Model builders only help to keep the price of good kits up when they lend or sell plans to friends who buy cheap materials from other sources. We are constantly striving to develop new and better and easier ways to make finer models. Your business will be appreciated, we assure you.

7 Quick Facts on CLEVELAND'S Popularity!

1. Models are correct to proportion (¾″ scale).
2. Models are as authentic as available data at the time of designing makes it possible.
3. Models look just like the real ship due to colored model aircraft dope supplied (not impractical pigmented aircraft dopes) and because of their being detailed so minutely. Our military machines even have detailed machine guns, sights, etc., etc.
4. All parts supplied are of unusually high quality; all work requiring machine work (such as turnings, etc.) completed. ALL Kits advertised are complete.
5. Cleveland-Designed drawings are full size, detailed and accurate. (Full size drawings alone do not help make good models if they are not accurate and detailed).
6. When completed, models are not only beautiful for exhibition purposes, but are also capable of unusual flights (our Trainer No. SF-1 at $2.50 has flown 3,608 feet and our DH-4 No. SF-3 at $3.50 was recently reported flying unofficially for 3,908 feet—300 feet farther!). Much of this success is due to the new and efficient, indestructible fibre propellers designed by "Cleveland." Simple to make, too.
7. Cleveland's honesty in advertising, coupled with years of honest customer dealings and legitimate pricing, have made many thousands of model enthusiasts turn to "Cleveland" when they wanted to build better models.

Free to Anyone! We will send, free, to anyone interested in model aircraft, information of vital interest if you have never received literature from us previously. It will cost you absolutely nothing unless you do wish to send a 2c stamp to help cover mailing costs. (If you wish to write a letter instead of sending coupon, do so). Tell all your friends of this, too, for we want to know of everyone interested in models.

We Congratulate the manufacturers who have chosen and produced their own designs. Keep up the good work! Oh, yes, there are many whom we admire for the good work they have done and the legitimate prices charged for good kits and drawings—but we have no sympathy for those who produce only something with the name of a famous airplane and send a vague and unauthentic drawing, of which there are so many available today, or an incomplete kit, after advertising it as complete, at "come-on" prices.

Tell Us just what you would like to see us design for you and to what scale or size—if calls are great enough, we'll produce it—then watch who will imitate us.

CLEVELAND MODEL & SUPPLY COMPANY,
1866-N4 West 57th St., Cleveland, Ohio.

Gentlemen: Kindly send me your free model information.

☐ You (will) (will not) FIND 2c STAMP ENCLOSED. I enclose..........for the following kits: (No C.O.D's.)

☐ Kit SF-1 ☐ Kit SF-3 ☐ Kit SF-6
☐ Kit SF-17 ☐ Kit SF-18 ☐ 3 RACERS

PRINT NAME ....

ADDRESS ....

CITY ....STATE ....

Age................yrs.; Model Exp..................yrs.

I am pinning to this coupon a list of the models I would like to see you design in the order of those I like best at the head of the list.

CLEVELAND MODEL & SUPPLY CO.

Model Engineers Since 1919

1866-N4 W. 57th St., Cleveland, Ohio, U. S. A.

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and JUNIOR MECHANICS — *Vol. VI* *No. 4*

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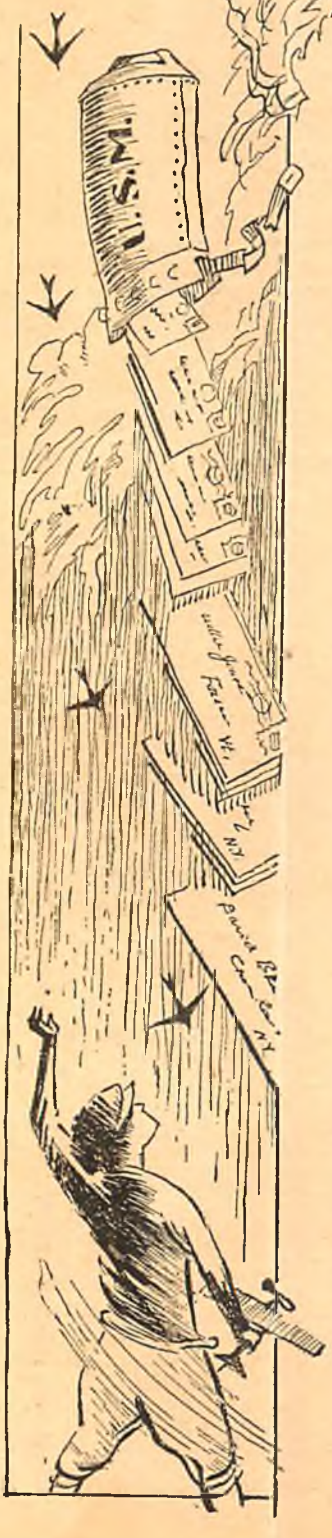

CONTENTS

APRIL - 1932

In Our Next Issue

Due to unforseen and unavoidable circumstances, it has been impossible for Model Airplane News to publish "The Special Course in Aerial Radio," Chapter 11, in this issue, as promised in the March number. It will appear in the columns of May Model Airplane News.

Those of you who have built the planes designed by Howard McEntee, which have appeared in previous issues, will be pleased to hear that he is presenting another beautiful Flying Scale Model, The Polish Fighter, P.Z.L.—(P.1) in May Model Airplane News.

Another feature is a solid scale model of The Supermarine S.6 B, the fastest airplane in the world. This should prove to be very interesting.

For readers who are interested in Contest ships, Jerome Kittel presents instructions and plans to build an Indoor R.O.G. that has flown for more than six minutes.

The regular courses, The Airplane Engine, by Lt. (jg) H. B. Miller, A Special Course in Aerial Radio, by Capt. Leslie Potter, and The Aerodynamic Design of the Model Plane by Charles Hampson Grant, will continue. The next installment of the Course in Airplane Designing by Ken Sinclair will appear in the June issue.

Thanks to the many readers who have answered our Questionnaire, and, a revised Editorial Policy, we will be able to make each succeeding issue of Model Airplane News more helpful and more interesting.

If aviation is one of your hobbies, or your profession, you cannot afford to be without every issue of Model Airplane News.

Subscribe Now!

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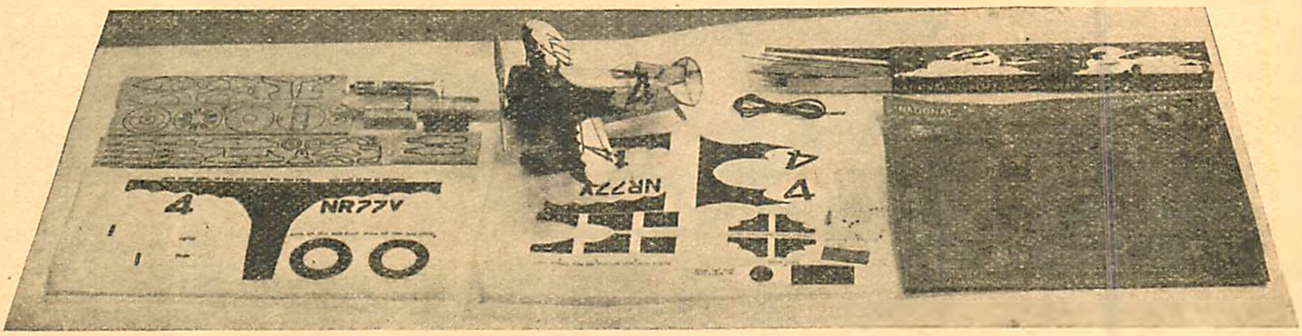
REAL VALUE IN NATIONAL KITS

The large illustration below pictures in detail all parts of the National construction set to build your Midget Model of the famous Gee-Bee sportster.

The many printed parts in color are an exclusive National feature. All wood parts are plainly marked out or cut to exact size. These features enable you to make a perfect model with correct colors and insignia.

MIDGET GEE-BEE SPORTSTER
12″ Wingspread
as built from Nat. Constr. Kit.
Each Kit, $1.10 postpaid.

Know What You Are Ordering!

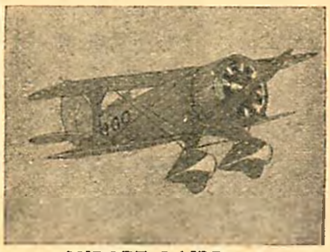


Examine carefully large illustration showing all parts of National construction set to build a Midget Model of the Famous Gee-Bee Sportster.

Note its many printed parts, which National makes exclusively to make building easy and enables you to make a perfect colored model.

This is exactly what you get if you buy a National Construction set. All National kits are equally complete. Any Midget Construction Set only $1.10 postpaid.

BUY DIRECTLY FROM US, OR FROM OUR APPOINTED AGENTS. DEPARTMENT STORES IN MANY CITIES HANDLE NATIONAL SETS.



MIDGET LAIRD—400
12″ Wingspread
Construction Set, $1.10 postpaid

WHAT A NATIONAL KIT CONTAINS

For example, in Midget Gee-Bee Sportster, it contains: Fullsize blueprint with instructions; 2 sheets of tissue with complete trimmings and numerals in maroon color; waxed paper; 4 sheets of balsa with ribs, stations, pants, and other parts clearly printed on; sticks of 1/16 sq. balsa, other pieces of balsa, bamboo, reed, etc. as needed; rubber motor; envelope, containing washers, beads, shaft, rearhook, pins, lead for balancing, propeller hub, and other parts; cellophane; tube cement; sandpaper; odd sizes of wood.

Midget Models with pants have wood wheels. All other models have celluloid wheels.

MIDGET POLISH P-6
12″ Wingspread
Construction set, $1.10 postpaid

BUILD NATIONAL MIDGET MODELS. TWENTY-ONE DIFFERENT MODELS AVAILABLE

NOW READY
18″ Midget Curtiss Constr. Bomber.
Complete Constr. Set $1.65 Postpaid

OTHER MIDGET MODELS

12″ Wing Spread

Spad	Sikorsky	Curtiss Robin
Nieuport	Fokker D-7	Lockheed Vega
Pfalz	Curtiss Hawk	Sopwith Camel
Texaco	Albatross	Fokker Triplano
S. E. 5	Bellanca	Curtiss Falcon
Heath	Boeing P-12	Lockheed Sirius

ANY MIDGET MODEL—$1.10 Postpaid

AGENTS WANTED

We want one dealer or agent in every town to handle National Model Airplane Sets and Supplies. Because of their proven quality, a National model dealer with sets and parts to supply immediate wants can make big money. Write for full details.

Name ....

Address ....

2 FT. CURTISS ARMY HAWK
Complete Construction Set $3.00

2 FT. BOEING P-12
Complete Construction Set $3.75

Seventeen Different 24″ Flying Scale Models

Each Construction Set is Complete.

Gee-Bee Sportster	$3.00
Lockheed Sirius	3.00
S. E. 5	3.00
Fokker D-7	3.00
Albatross	2.00
Texaco	3.50
Laird-400	3.00
Spad	3.00
Nieuport	3.00
Fokker Triplane	3.00
Vought Corsair	3.75

Any Model Ready to Fly - only $12.00

A few words about NATIONAL'S line of 24″ flying scale models and complete line of high quality supplies.
There are seventeen models in the 24″ line: All are good flying models. Their construction is simple. Try one! You will be as pleased with them as are many others.

National carries only the best in supplies. Our line is complete. We carry all kind of insignias to make your models a perfect miniature of the big ship itself.

Some National supplies may be slightly higher in price than offered by others—but the quality you receive will give you far more satisfaction than the saving of pennies. Constant repeat orders prove this.

Send Today 5c for our latest Catalog "E". All Orders are Shipped Same Day as Received.

NATIONAL MODEL AIRCRAFT & SUPPLY CO.

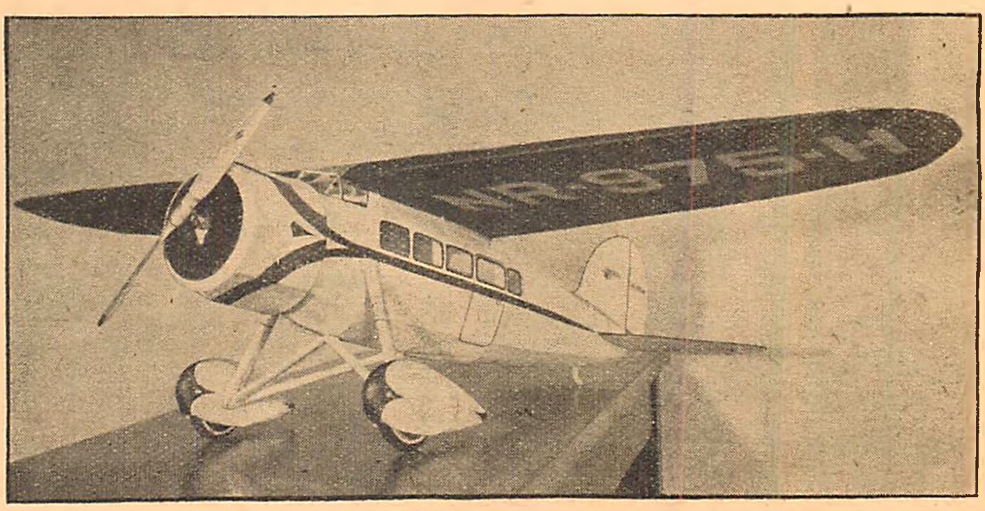
299 North Ave. New Rochelle, N. Y. Dept. A–23

AIR—WAYS
HERE and THERE

Get busy and "Air" your "Ways" of building and flying model planes. In each issue of Model Airplane News, space will be devoted to the activities of our readers.

Let OTHERS know what YOU are doing

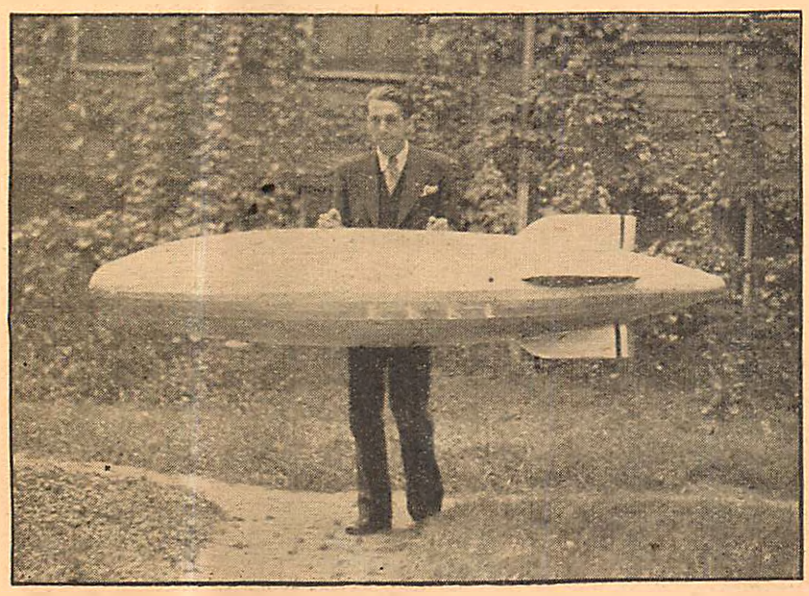
MANY of our readers have written us saying how much they enjoyed hearing what the other fellows are doing throughout the country. We are trying to create a get-together feeling among all our readers by giving them details of machines built by other young fellows and their general model flying activities. This is bound to keep everybody on their toes. This month we have, as usual, a number of very interesting items to present. Here we have one from Howard Earp of Payette, Idaho. He sends us a picture of his true scale flying Lockheed model shown in picture No. 1. It is 1/13 the measurements of the real Lockheed. The wing span is 31½ inches, weight 1¾ ounces. It is finished in white with red wing trimmings and black outlining. The prop is silver. You can imagine that this model presents a very beautiful picture in flight. Perhaps the builder will send us a picture of the model while flying to put in our next issue.



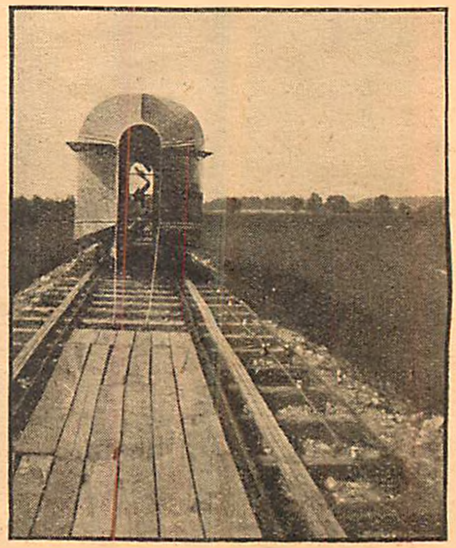
Picture No. 1.

——::oo::——

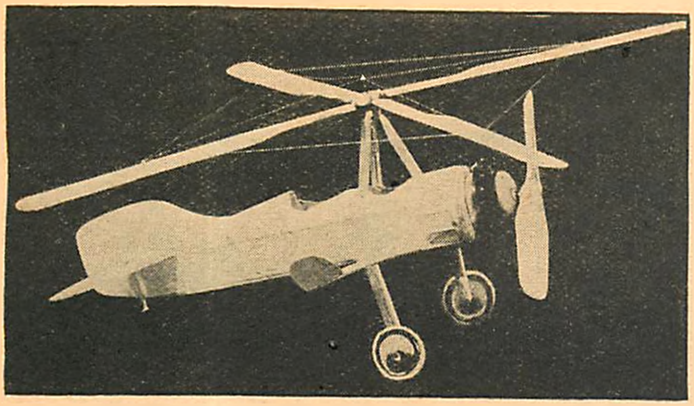
Picture No. 2 shows a beautiful 8-foot model of the Akron and its builder, Henry Projansky. This model is a work of art. It is made entirely of balsa wood, covered with silk, and the lateral construction is the same in detail as in the large ship. It took 168 hours to build complete and is a remarkable example



Picture No. 2.



Picture No. 8.

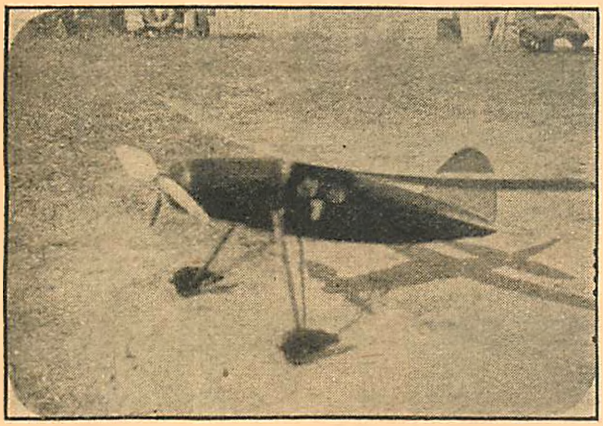


Picture No. 3.

of workmanship. No doubt, the builder learned a great many interesting points about dirigible construction in the research work that was required in order to finish the model successfully.

——::oo::——

Many of the young aeronauts have been struggling with the problem of building a successful Autogiro. It is one thing to build a good looking ship and another thing to build a correct mathematically designed ship. Here is one



Picture No. 4.

that performs (Picture No. 3). Its builder is Ernest Pizzigati of Cedarhurst, N. Y., who says it has flown 300 feet. The span of the rotor is 24 inches.

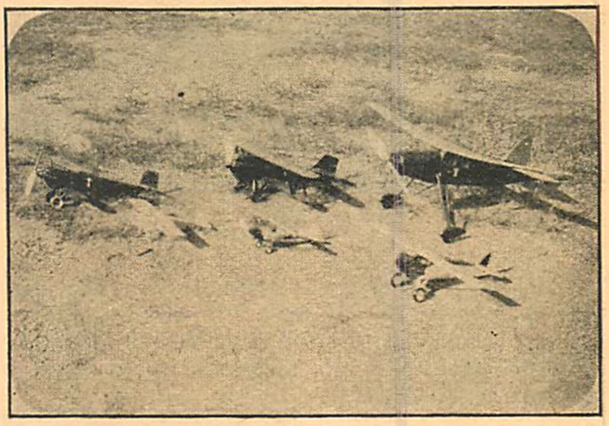
——::oo::——

Here we have some interesting dope from Harold Maschin of Westfield, Mass. Picture No. 4 shows a Lockheed Vega flying model which he has built and flown very successfully. It has a 35 inch wing span, 28 inch fuselage and a 10 inch propeller. The fuselage is built with 1/32 inch plywood bulkheads, covered with 1/32 inch balsa. There are rubber band shock absorbers attached to the upper end of the landing struts within the fuselage, that take the shock of landing.

Picture No. 5.

Picture No. 5 shows the builder launching one of his Twin Pusher models at the Avio contest.

Picture No. 6 shows a group of planes exhibited at the Eastern States Exhibit, September 26, 1931. This

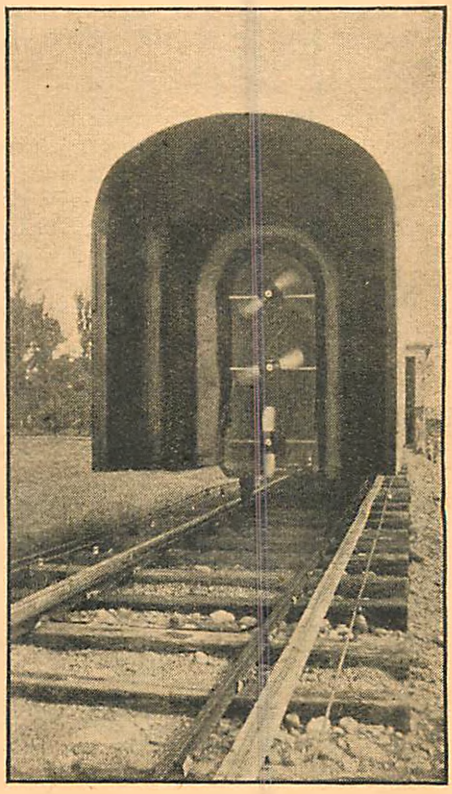


Picture No. 6.

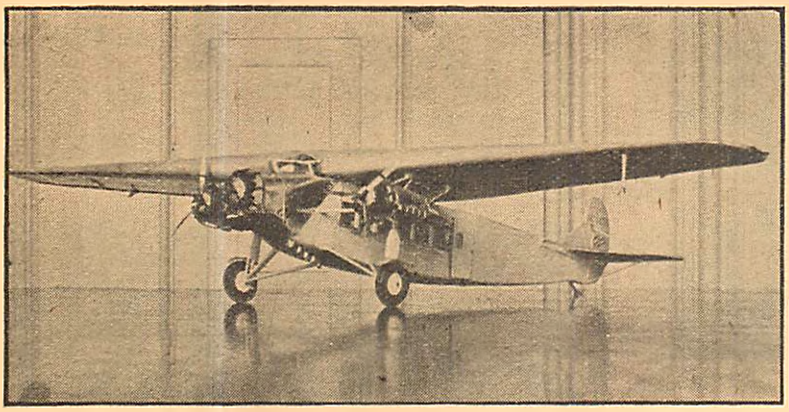
group took first prize. It consists of two Curtiss Hawks, a Lockheed Vega, a Spirit of St. Louis, a Heath Parasol and a Ryan. This was evidently a family contribution for Barbara Maschin, the sister of Robert Maschin, built the Heath and the Ryan. We wish to commend her especially and also give the young masculine model builders a word of warning that, if you don't look out you are going to have strong competition among the girls.

——::oo::——

A very interesting contribution comes from C. A. Arms. It is in the form of two pictures (No. 7 and 8) of a new type of dirigible which has been tested at the Wassillon Airport near Canton, Ohio. Picture No. 7 shows the front end of the dirigible with the propellers driving the air through a long shaft which runs the whole length of the ship, front to back. Picture No. 8 shows the rear view. The designers claim many superior features in this type of dirigible construction, especially in the power speed ratio. To prove their theory, they equipped it with 7 2/10 h.p. G.E. motors and attained a speed of about 35 miles per hour when placed on a 2,000 foot track. This performance, it is claimed, is due to the peculiar shape of the front end of the dirigible. The approxi-



Picture No. 7.



Picture No. 9.

mate length is 60 feet, the width 10 feet, the height 12 feet. It is made 1 to 10 scale and weighs 1,800 pounds. The gas capacity of the full scale ship is intended to be 6,500,000 cubic feet. Its theoretical speed is about 200 miles per hour with 100 passengers. It is said that it will be powered with twelve 500 h.p. Packard engines.

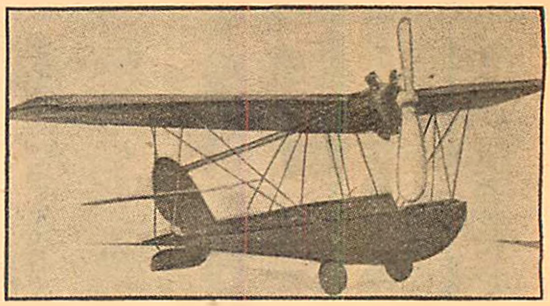
——::oo::——

Herbert W. Owen, 50 Mason Drive, New Britain, Conn., writes us that they have a young, but very active air club, that is hammering away constantly at the national records. Mr. Shade is their director. He says that they have made a duration tractor that will fly for 8 minutes and 45 seconds, and a flight of 5 minutes and 10 seconds by a Baby R. O. G. I understand that these are indoor flights. They are truly remarkable.

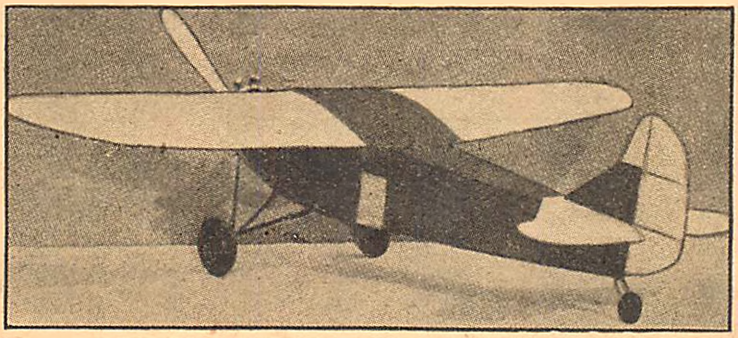
Picture No. 9 shows Fokker F-10. A scale model which was built by Owen. Every detail has been carried out carefully, even to a hat-rack, a mirror and lavatory in the cabin. We are very glad to see that Owen is an American Sky Cadet. We hope that he keeps up this very excellent work and will look forward in the future to further contributions from him.

Picture No. 10 shows a very neat model of the Lockheed Vega by Alfred Van Wymersch. The workmanship is to be commended.

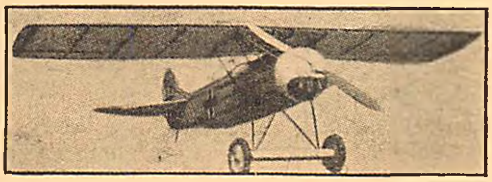
Picture No. 11 shows a Fokker Triplane constructed by Forest Bruxelles. We must say that the picture, as far as we can see, shows very excellent workmanship, as a triplane is usually the most difficult type of plane to build. Mr. Bruxelles deserves a lot of credit.



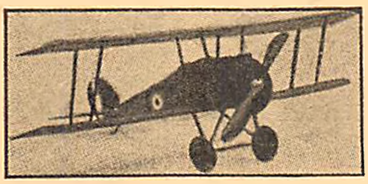
Picture No. 12.



Picture No. 15.



Picture No. 14.



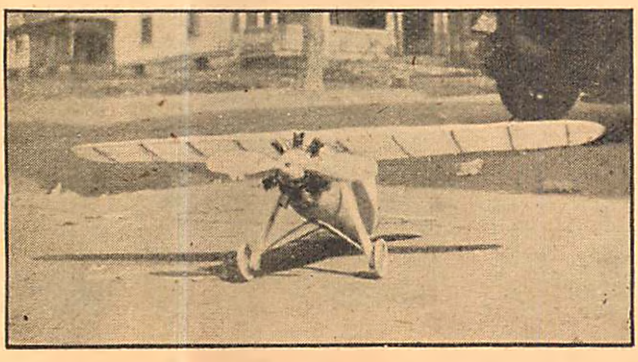
Picture No. 13.

Don't Forget the Prize Picture Contest

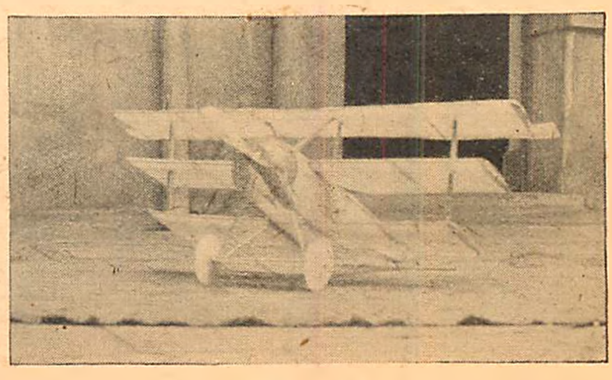
——::oo::——

For Model Building Readers Only

All my aeronautical friends will be very much interested to hear what we are about to propose. In order to get a greater understanding of the amount and type of work that our readers are accomplishing, we will publish each month a list of names of young men and the models that they complete, so do not forget to take advantage of this offer. All of you who read this item get busy and write to us. Tell us what model or models you have built in the past month, listing the interesting characteristics of each one. We are anxious to see how much activity there is in model building among our young friends. You can encourage others by letting them know how active you are in this field. If you have not built any models, but just wish to register, send in your name so that we can list it. Then, after you have completed your first model, write to us and, if you wish, send us a picture of it. Your name will then be published in "Air-Ways." Let us know what your activities are with each succeeding month. This is a sort of race. See what you can do (*Continued on page* 46)



Picture No. 10.



Picture No. 11.

BUILD THIS "CESSNA" MODEL THAT SLEW A JINX

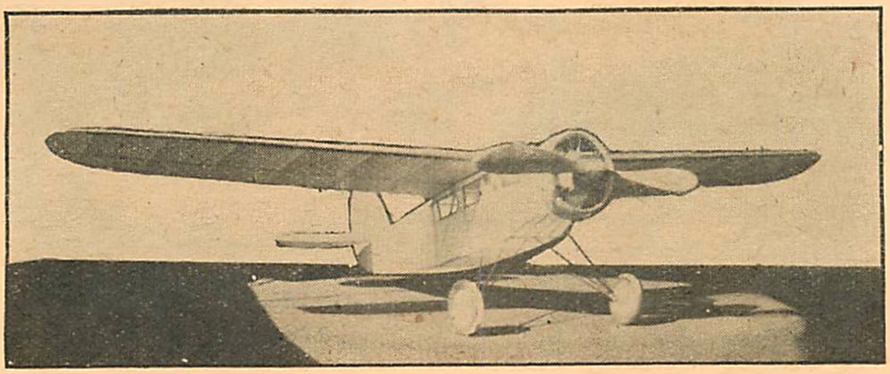
By Howard McEntee

The author was told by his friends "A Scale Model cannot be built that would fly in perfectly stable flight." He built this Model and proved them wrong.

Here it is for you to Build and Enjoy.

THE Cessna Cabin Monoplane offers us a very interesting flying model project. One of its greatest advantages is the absence of all wing support struts, making it very clean in line and removing a big difficulty from a model builder's viewpoint.

The large Cessna Monoplanes of this design carry from two to four people depending on the power plant, which may be any from 120 h.p. up to about 300 h.p., giving a high speed of 120 m.p.h. to about 165 m.ph. The wing span is a bit over 40 feet. In the real ship the main wing is flat on top, that is, there is no dihedral, except that which is caused by the tapering of the wings.



The Completed Model Built From These Plans.

These cleanly designed machines are favorites with sportsmen who wish high top speed and also with those who like to enter races, as they have won numberless prizes for speed, efficiency and general performance.

LIST OF MATERIALS
Necessary for Construction

10 ft. 3/32" sq.—longerons, cross pieces, uprights and top wing spar
3 ft. 1/8" x 1/4"—rear wing spars (O, T)
3 ft. 1/8" x 5/16"—front wing spar (Q, U)
3 ft. 1/8" x 1/6"—trailing edge
2 ft. 1/32" x 3/16"—top fuselage pieces (H)
1 ft. 1/32" x 2"—ribs
4" x 2" x 1/8"—nose pieces (G, N)
8" x 1/16" x 2"—ribs, landing gear support piece (L)
8" x 1 1/2" x 5/8"—propeller
1" x 1" x 1"—spinner
(All above pieces are of balsa)
16" x 1/8" x 1/4" *spruce*—motor stick
Five 15" lengths *bamboo*—wing tips, tail surfaces, fairing etc.
1 aluminum cowl 2 1/2" diameter
5 celluloid cylinders 5/8" x 5/8"
12 ft. 1/8" flat rubber
1 pair lightweight wheels 1 7/8" diameter
1 sheet white tissue
1 sheet orange tissue
Three 1/4" brass washers
1 1/2 ft. No. 12 music wire
2" No. 8 music wire
Banana oil, glue, paint, small rubber bands, thread.

Fuselage

The fuselage has a main frame made entirely of 3/32" square medium balsa. The sides are laid out on a board and the strips held with pins while glue is applied. There is quite a curve in the lower longeron so be sure the glue is completely dry before removing each side from the board.

The window outlines are built up from 3/32" x 1/16" soft balsa and should be put in place while the side is still on the board. Do not cut any of the main fuselage pieces, but put the window pieces in, a section at a time. Some of the braces will show through the windows, but this is unavoidable, since our model, for simplicity, is trussed quite differently from the original ship. As the top longerons are straight from front to rear, lay the completed fuselage sides on a board with the bottom longerons uppermost, and put in the cross pieces shown on the drawings as A, B, C, D, E and F. These are all 3/32" square by 1 13/16" long.

When these pieces have dried, all the others going to the rear may be put in. When dry, remove the fuselage from the board with a razor blade. The nose piece, G, comes next. It is made of 1/8" balsa and should have the hole cut before fastening onto the fuselage. The bamboo nose fairing strips, 1/32" x 1/64" may now be put on. The ends only are shown on the drawings so as not to confuse them. There are three on each side, top and bottom, but they are of different lengths, so cut them carefully.

Two strips, H, 1/32" x 3/16" which give a bevelled effect to the fuselage top in the rear may now be installed. The rudder post, I, of 1/16" x 1/32" bamboo is cut and glued in place. To the bottom of this is glued the combination rear motor stick pin and tail skid, J, bent as shown on Fig. 1. The front motor clip, K, is also put in place and this completes the fuselage. The center section and cockpit cover will be described in the section on wings.

Landing Gear

The landing gear on our model differs widely in operation from that used on the large Cessna, as the latter is made to absorb only vertical shocks and ours will take up blows to the rear as well.

A PIECE of balsa, L, 1/16" x 1/2" x 2, forms the basis of the landing gear. The struts are 3/32" x 1/32" bamboo rounded on all edges. The front struts are 3 1/2" long and the rear 4 inches. The front struts are bent over a flame where they fasten to L. The joint of the two struts is glued and bound. The axle is of music wire and the center is glued to L. The ends rest inside the Vee of the struts. When the struts and axle are firmly glued, a small rubber band is wrapped several times around the lower ends. This is the shock absorber, so it must not be too tight. The wheels, 1 7/8" in diameter, should be light in weight.

Propeller and Motor

The motor stick is a 1/8" x 1/4" piece of spruce, 15 5/8" long. It could be of balsa, but would then have to be larger, about 3/8" x 3/16". The rear hook, M, is glued and bound to one end. A small hole 1/2" deep is in the same end for the pin, J, to go into. The propeller hanger is of aluminum 1/8" x 1/16" x 3/4". A hole for the propeller shaft is drilled in one end. Any ready-made hanger of correct size may be used. A circular piece, N, shown on Figure 3 is cut from 1/8" balsa. A hole and slot are cut in it as in the diagram, and it is glued to the forward end of the motor stick. When doing this, cut the slot deep enough so that the hole in the propeller hanger is in the exact center of the balsa disk.

This Remarkable Exact Scale Model Has Made a Flight of 65 Seconds.

The propeller is made from a bock of balsa 8" x 1 1/2" x 5/8". It is shown in detail on Figure 7. After carving, the tip edges are rounded off as usual. The spinner is 1" long by 1" diameter. If an old electric fan is available, it may be turned as follows: Remove the guard and fan; glue the balsa block to the shaft, first making a hole in the block, and use plenty of glue; after allowing several hours for drying, the spinner may be turned out with the point of a knife blade. Sand paper is also very useful and should be used for smoothing. The grain of the balsa should run parallel to the shaft and the glue must be dry. The work may be cut off by holding a hack saw blade against the revolving piece. The wheels for this model may be made the same way, in fact the author makes all wheels, spinners, cowls, etc., by this method.

Six strands of 1/8" flat rubber are used with a removable hook at the rear. While on the subject, we may as well install the dummy motor on the nose. Five regular celluloid cylinders are used. They are notched on the bottoms to fit over stringers, longerons, etc., and glued on. The drag ring used on this model is of aluminum 2 1/2" diameter and fastens directly to the cylinders, so be sure to cut them down enough. Of course, the ring and motor may be omitted, but then a small lead weight must be added to the nose.

Tail Surfaces

These are made entirely of bamboo. The horizontal tail is assembled and glued on a board first. Then it is removed and glued in one piece onto the strips designated H. Small struts of 1/32" x 1/64" bamboo brace it from the leading edge and from the main spar, where the ribs connect with the latter, to the lower longeron on each side. It is best, however, to leave these off until the fuselage is covered.

The rudder is assembled right on the model, putting on the outline first and the ribs later and gluing all around.

Wings and Center Section

The center section is assembled on a board and installed in one piece. The ribs are 1/16" thick and of No. 1 curve. The rear spar, O, is 1/8" x 1/4" x 2" balsa. Slots are cut and the wing pins, P, of 1/32" music wire put in. They are glued and tightly bound All four pins, P, are the same. Be sure to bend back 1/4" on the end of each so it will not turn in its slot. The front spar, Q, is made of 1/8" x 5/16" x 2" balsa, and its pins are glued and bound in slots also. First, however, it is sanded to a shape which conforms to the rib as shown on the No. 1 rib drawing. The trailing edge is 1/8" x 1/16" x 2" and the spacer, R, on top is 3/32" square. The whole center section rests on four blocks of 1/8" x 1/4" balsa shown as S which are glued to the fuselage first. Be sure the spars are parallel with the top of the fuselage and with each other.

The cockpit cover is entirely of 1/32" square balsa and is assembled as shown on Figs. 1 and 3.

The rest of the ribs should now be cut, making two alike of each curve. The largest wing ribs are of No. 1 curve and are identical with the center section ribs and are of 1/16" balsa as are the No. 2 ribs. All others are 1/32" balsa. This makes a total of 16 ribs, 7 in each wing and 2 in the center section.

The rear spars, T, are of 1/8" x 1/4" balsa. They taper from 1/4" at the center section to 3/32" at the outer ribs. They are 1/8" wide the whole length. From the large end of each, drill a hole 1" deep, with a No. 60 drill, into which the wing pins fit. Wrap the spar over the hole for an inch and a quarter with thread and coat with glue.

THE front spars, U, taper from 9/32" to 1/8" at the outer ribs. They are also 1/8" wide the whole length. In addition, they must be rounded off on the forward edge to carry out the wing curve. The drawings show the proper shape at the respective rib. The larger ends are drilled and wrapped just as the rear spars were. Care must be taken to drill as nearly parallel to the axis of the spars as possible, so as not to break through the sides. The 3/32" spar, V, on top of the wing does not taper either way. It is continuous to the No. 7 rib where it is cracked so it can bend down to the wing tip. Its main function is to prevent warping when the paper is tightened up.

The wings are built up on a board. First draw the bare outline with marks for the ribs. Then pin down spars T and U, and No. 1 and No. 7 ribs and glue. Also pin down the trailing edge of (*Continued on page* 38)

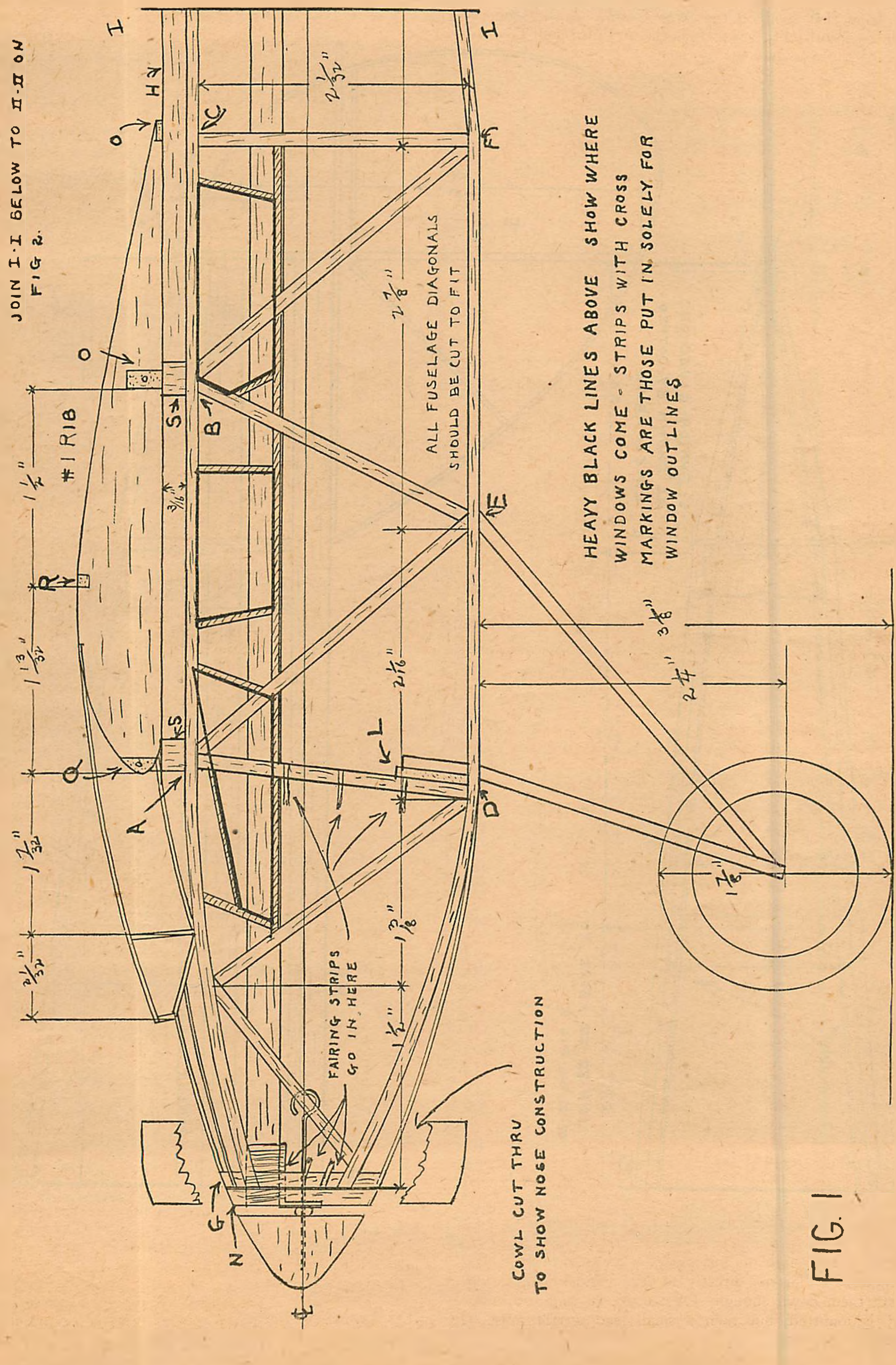

JOIN I·I BELOW TO II·II ON FIG 2.
HEAVY BLACK LINES ABOVE SHOW WHERE WINDOWS COME - STRIPS WITH CROSS MARKINGS ARE THOSE PUT IN SOLELY FOR WINDOW OUTLINES
ALL FUSELAGE DIAGONALS SHOULD BE CUT TO FIT
FAIRING STRIPS GO IN HERE
COWL CUT THRU TO SHOW NOSE CONSTRUCTION
#1 RIB

FIG. I

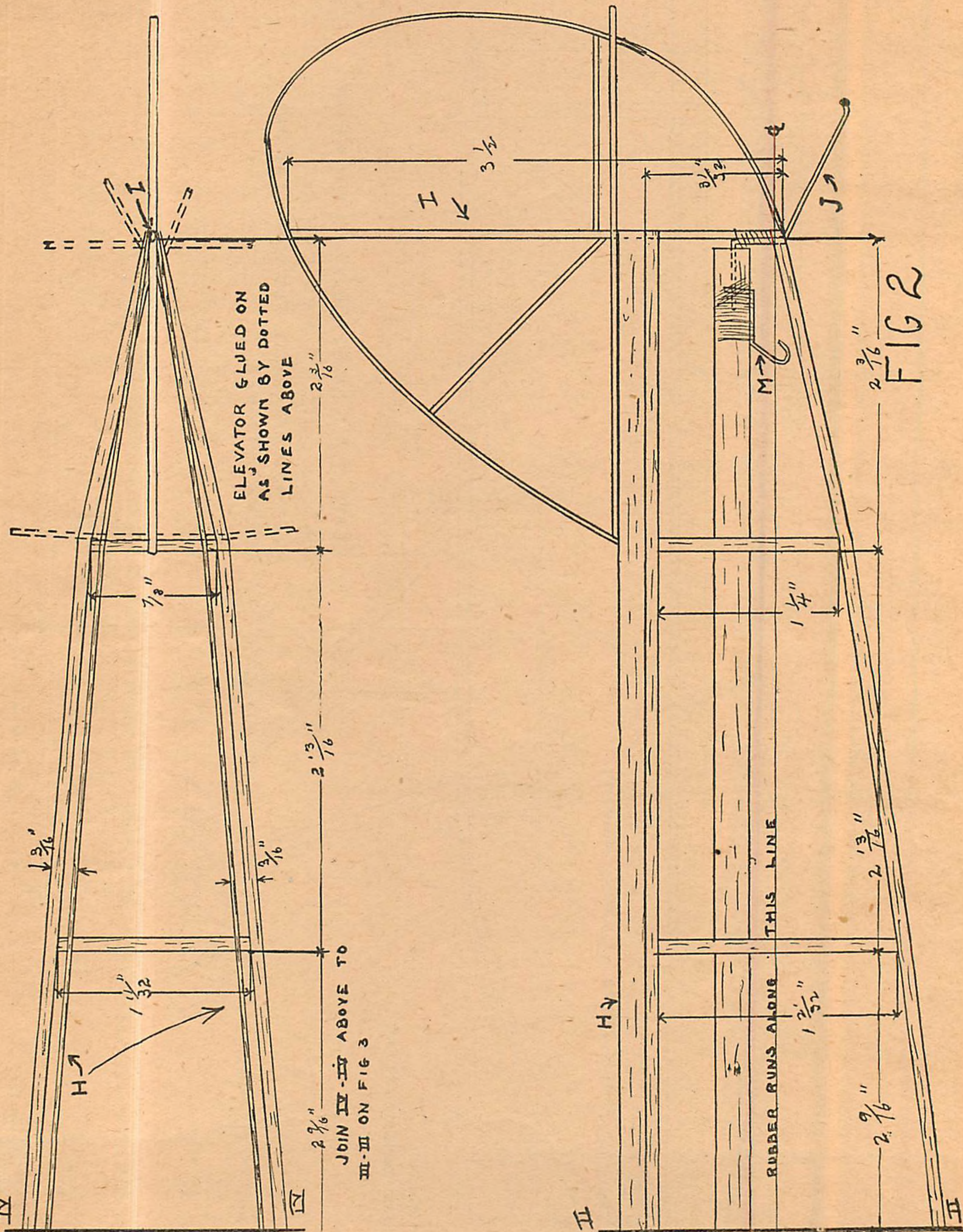

ELEVATOR GLUED ON AS SHOWN BY DOTTED LINES ABOVE
JOIN IV-IV ABOVE TO III-III ON FIG 3
RUBBER RUNS ALONG THIS LINE

FIG 2

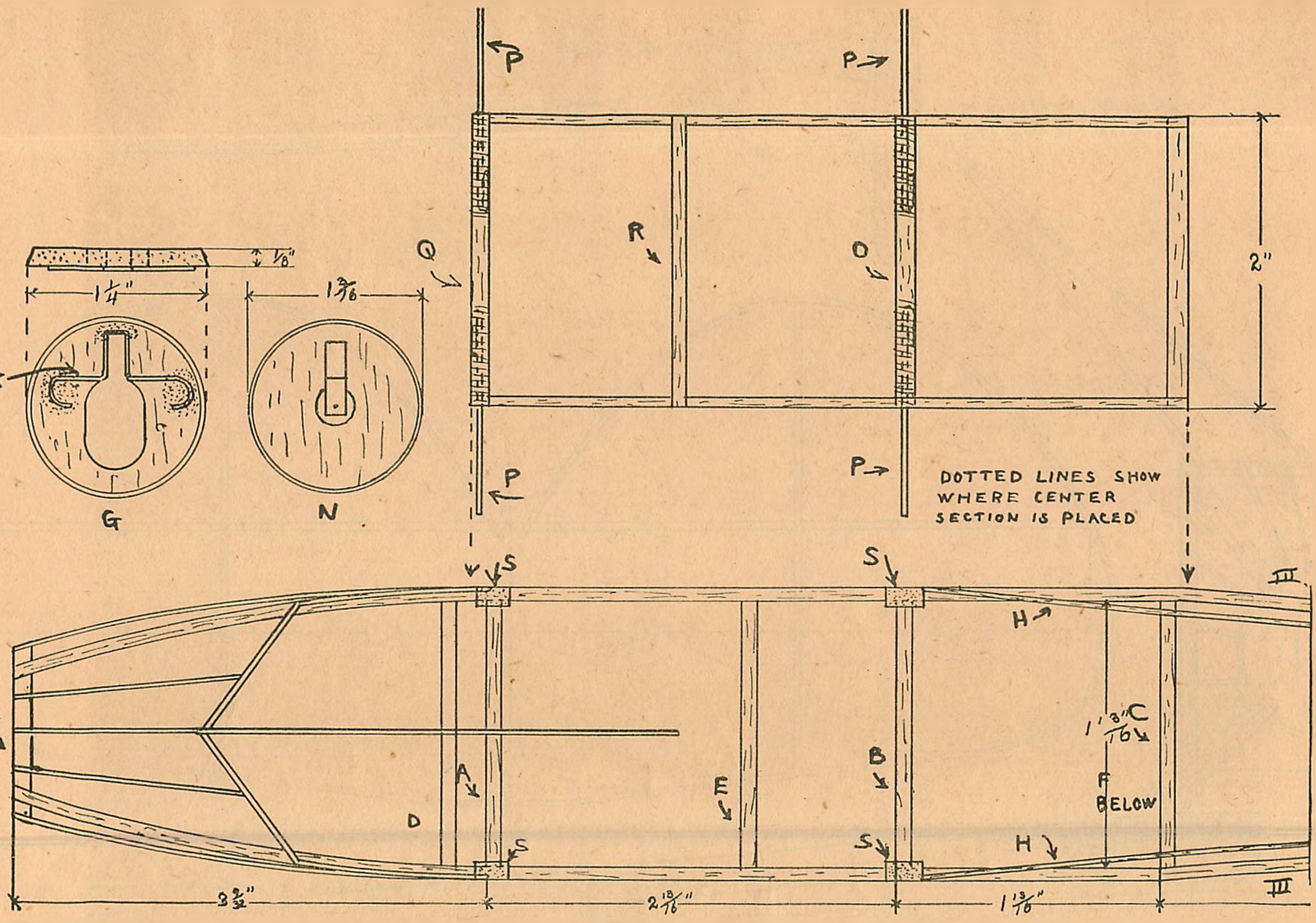

P
P
P
P
Q
R
O
2"
1/8"
1 1/4"
1 3/16
K
G
N
DOTTED LINES SHOW
WHERE CENTER
SECTION IS PLACED
S
S
S
S
III
III
H
H
G
A
D
E
B
C
F
BELOW
2 13/16"
1 13/16"

FIG. 3

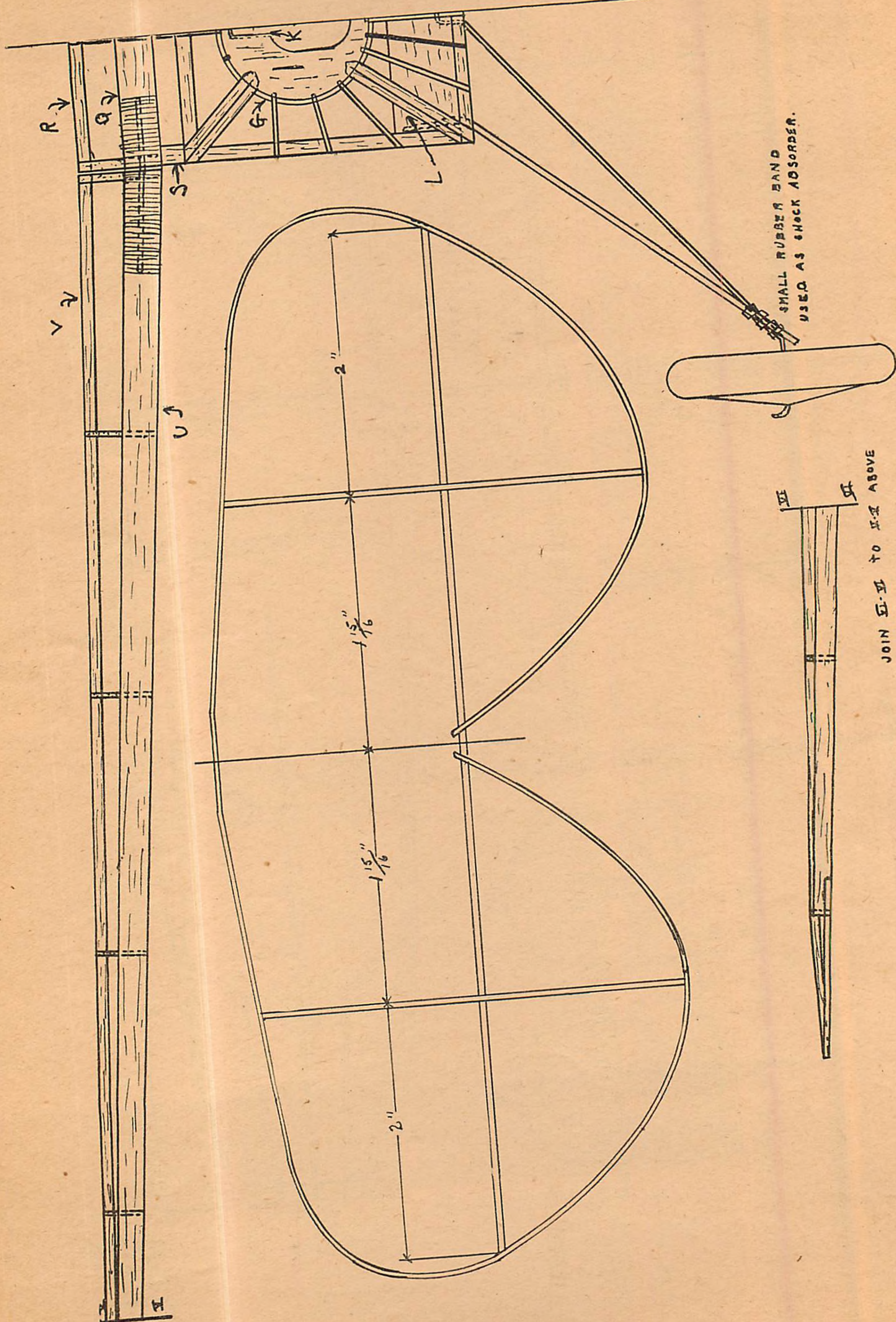

R
Q
S
G
K
L
V
U
2"
1 15/16"
1 15/16"
2"
SMALL RUBBER BAND
USED AS SHOCK ABSORBER.
JOIN II-II TO II-II ABOVE

FIG 4

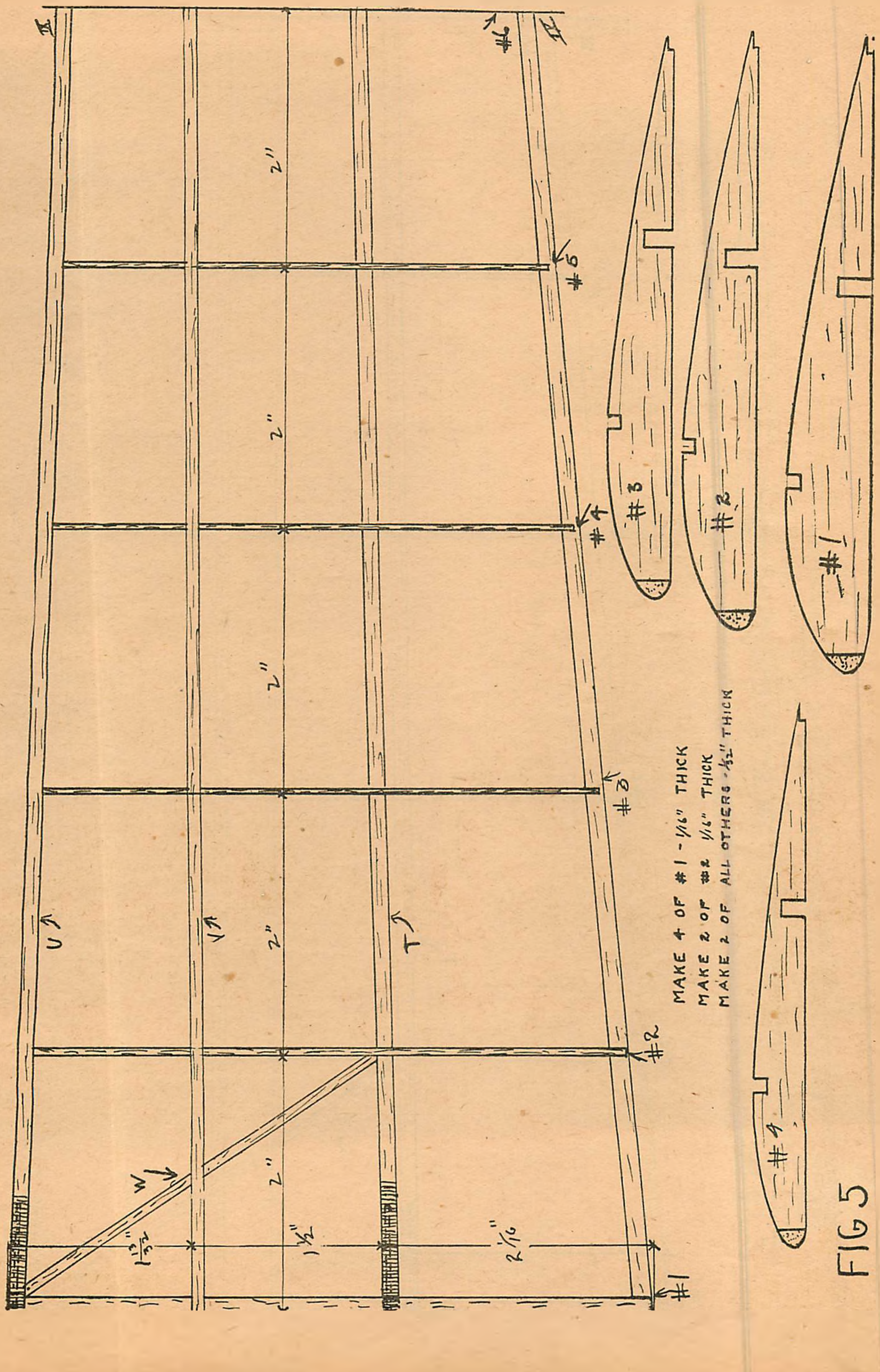

MAKE 4 OF #1 - 1/16" THICK
MAKE 2 OF #2 1/16" THICK
MAKE 2 OF ALL OTHERS - 1/32" THICK
#1
#2
#3
#4
#5
#6
U
V
T
W
2"
1 1/2"
2 1/16"
1 13/32"

FIG 5

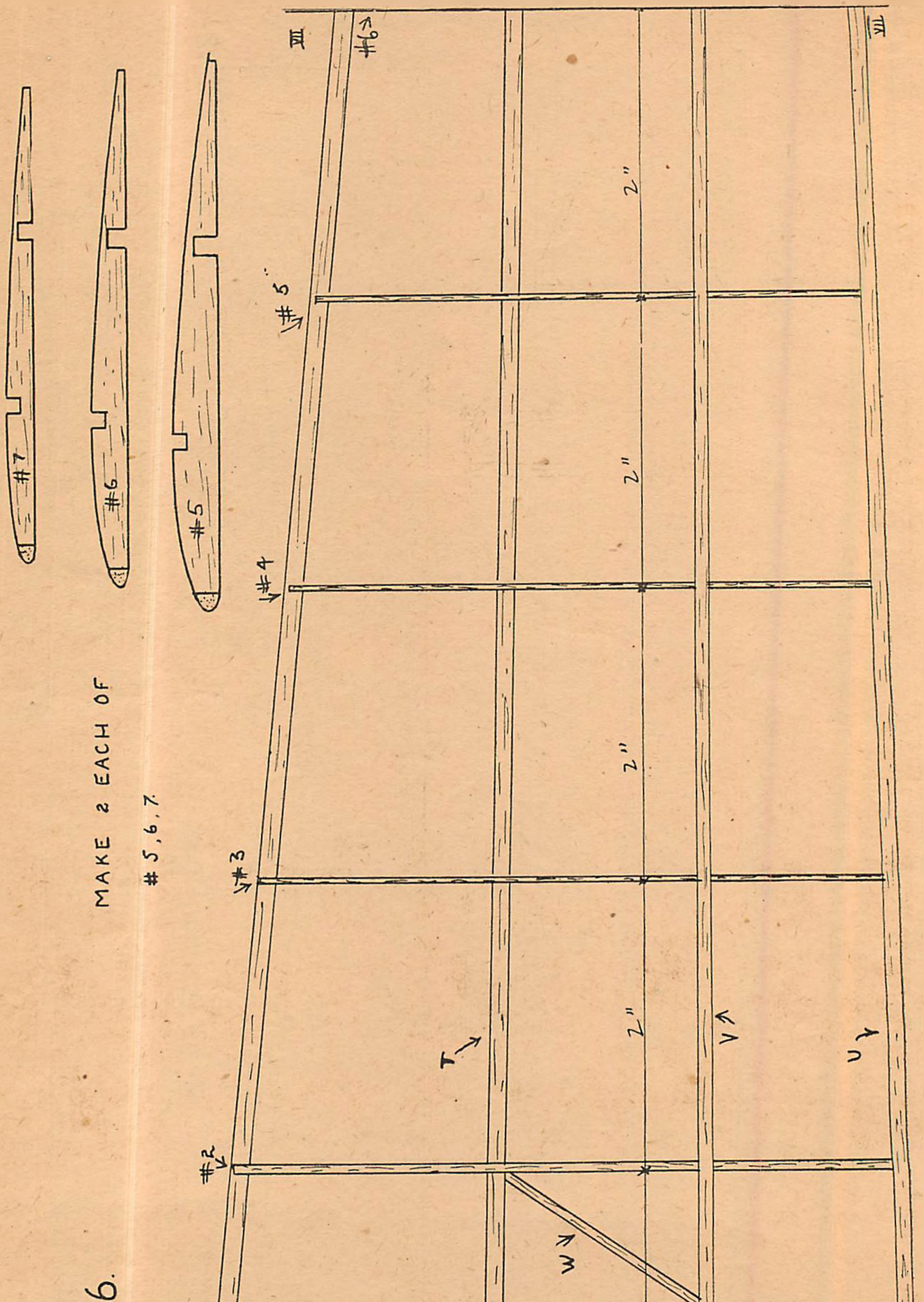

MAKE 2 EACH OF
5, 6, 7
#7
#6
#5
#1
#2
#3
#4
#5
#6
T
V
U
W
2"
2"
2"
2"
2"
$2\frac{1}{16}$"
$1\frac{1}{2}$"
$1\frac{13}{32}$"

FIG 6.

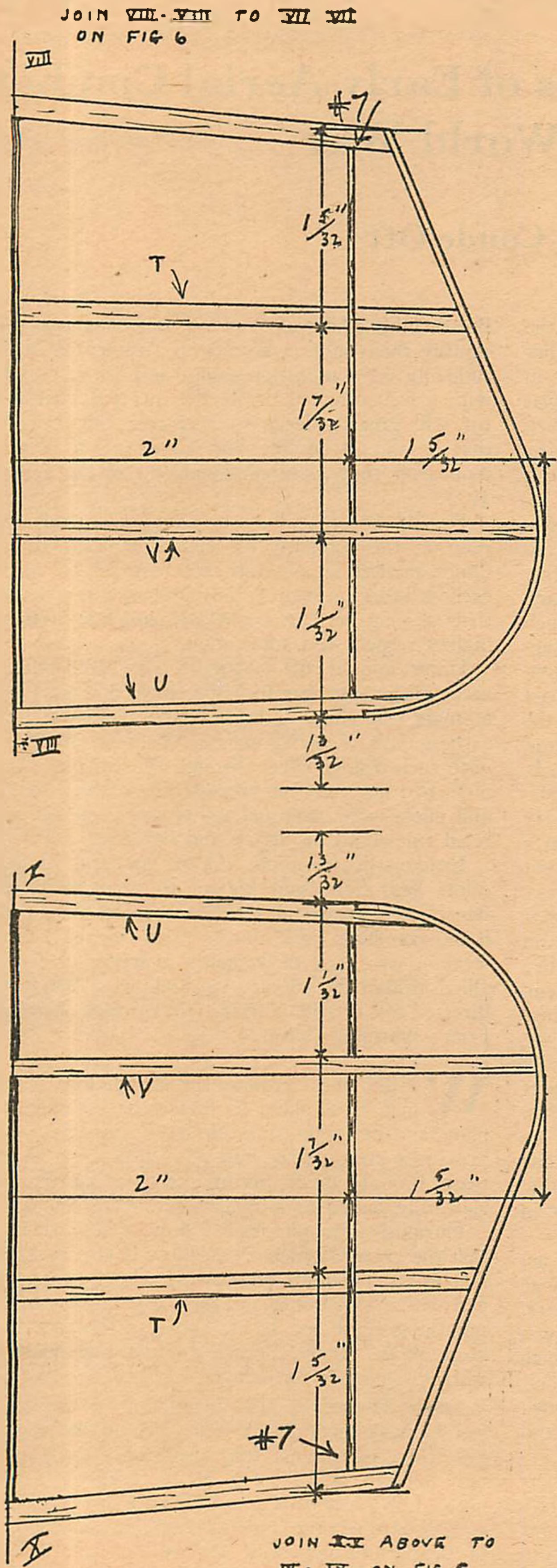
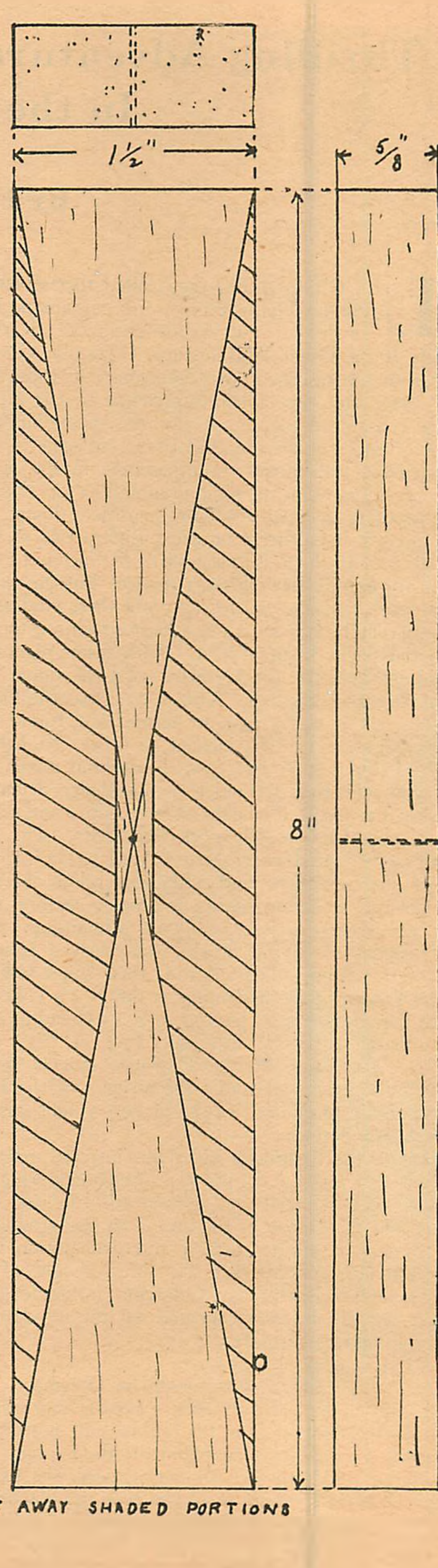


FIG 7



CUT AWAY SHADED PORTIONS

MARS' FIRST BROOD

Thrilling Adventures of Early Aerial Combat In the World War

By F. Conde Ott

LES CIGOGNES, they called themselves, the famous Flying Storks, and perhaps no other single air unit stands out more clearly in the annals of the Great War history. Certainly none was more dear to the hearts of the Frenchmen in those black days of 1915 and 1916 when supremacy of the air was becoming recognized as one, if not the most important, factor of ultimate victory in that titanic struggle.

The airplane was already indispensable to the service. Scouting enemy movements, photographing sectors that held valuable military secrets, bombing munition dumps, factories, railroads and other strategic positions out of reach of artillery fire; all this fell to the lot of the intrepid French airmen in the earliest days of their service. But the willingness and desire they showed to carry out these vital assignments were matched by an equal determination on the part of the hated Boche to prevent it. With faster planes, the justly famous Fokkers, the Germans held the upper hand and controlled the situation. Thus it was, that the French, desperately reliant upon their air service and found stalemated by superior aircraft, turned to other channels for relief,—and found it in their own hearts and minds, in a spirit if you will, that refused to acknowledge defeat but swept instead to inspired heights of fame, glory and success.

It was thus that the Cigognes were born. The finest flyers of France were drawn together April 1, 1915, to form a unit of such excellent and audacious pilots that they literally swept a better equipped enemy before them, through the sheer force of brilliant airmanship. Their name, Cigognes or Flying Storks, was derived from the emblem of this figure which adorned their ships. Officially they were known in the beginning as the N 3's (Nieuport 3) which designation was changed to S 3's (Spad 3) when France adopted this trim little speedster in 1917 as its battlecraft. The fame of the Cigognes quickly became legendary and enrollment under the insignia of the Flying Storks was early recognized as the highest sought honor in the French Air Service.

But despite the hazardous tasks this intrepid group accomplished so brilliantly, despite the unrestrained vengeance with which they plunged into their death—defying work, every act and movement in the air or on the ground was marked by a painstaking caution and deliberation which proved invaluable and cut their casualties, in spite of their gruelling labors, to a surprising minimum. In fact, in everything they did, the beloved Cigognes, set the standard and pattern for fighting aircraft.

It was this remarkable squadron in which Capt. Albert Heurteaux found himself in command in December, 1916. The able captain had already seen a goodly share of war service himself. Serving from the outbreak of hostilities in the Huzzars, a noted cavalry regiment, the captain asked for transfer in 1915, to the Air Service and was soon attached to the N 23's where, as an observer and bombardier, he saw duty with such outstanding aviators as Roland Garros, Eugene Gilbert, Marc Pourpe, Pinsard and others. But thrilling as it was to sweep over enemy strongholds and capture their military secrets on a camera plate, or to drop suddenly on a munition dump and see it blown to pieces with a well directed bomb, the intrepid Heurteaux looked for still greater deeds to perform. Small wonder, then, that he should become "un Cigogne," a "Flying Stork," soon after they were commissioned in the early spring of 1915.

He did not take long to establish himself as a leader, even in the company of such distinguished compatriots. Quiet, modest, simple and conscientious, he went about his earliest tasks in such a thorough and understanding way that he soon became a marked man, but marked with the highest respect and admiration.

Upon joining the Cigognes, one of Heurteaux's first accomplishments was to bring down a German plane with a single rifle shot. It must be borne in mind that in the earliest days of aerial warfare the machine gun that fired with such deadly effect through the whirling "prop" at its nose, had not yet been successfully adapted to the airplane and pilots were often obliged to use revolvers or short barreled rifles both on attack and defense.

Incidentally, it might not be amiss to state here that pilots had even been known to carry good sized stones which they hurled at the propeller of an enemy machine if the two ships came close enough together. Crude as this weapon was, it is nevertheless a matter of record that an allied airman did succeed in disabling a Boche with a well directed toss of half a brick right through the dumbfounded Fritz's whizzing "prop."

WHEN one considers the tremendous wind pressures met by a plane in flight, the bobbing of both the plane and its target, one can easily appreciate the difficulty of scoring even indirect hits with small arms, so when Heurteaux brought down his prey with a solitary shot, it was rightfully hailed as a remarkable achievement.

Curiously enough, it was only a very short time later that the great Guynemer, a fellow Cigogne, duplicated this feat in an encounter with two Fokkers, bringing down the first with a lone bullet and then, a few moments later, sending the second one to its ultimate destruction with two more shots. Truly, France did not pay homage to these valiant Cigognes for naught.

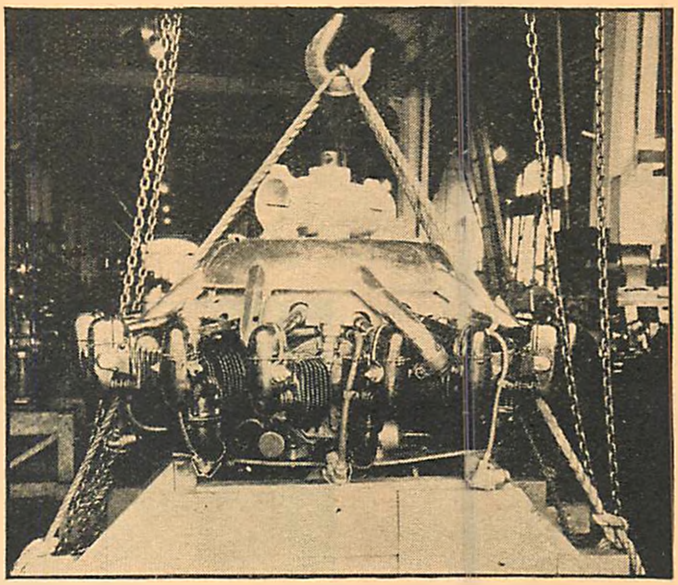
Albert Heurteaux also introduced another novel feature into his aerial combats. Often when an enemy airman came into close proximity, this inspiring French officer would bow politely, doff his cap or, on occasions even thumb his nose. Obviously this required both the coolest of nerves as well as unerring control. It epitomized complete disdain of death and generally achieved exactly the results the calculating Heurteaux was playing for. Furious rage most often surged in the breast of the Teuton at this form of greeting and rage and precise control do not go hand in hand. Thus, in the fraction of a second that the Boche, flushed with hatred at (*Continued on page* 40)

THE AIRPLANE ENGINE

Important Points Regarding Overhauling, Testing and Installation

By
Lieut. (jg) H. B. Miller

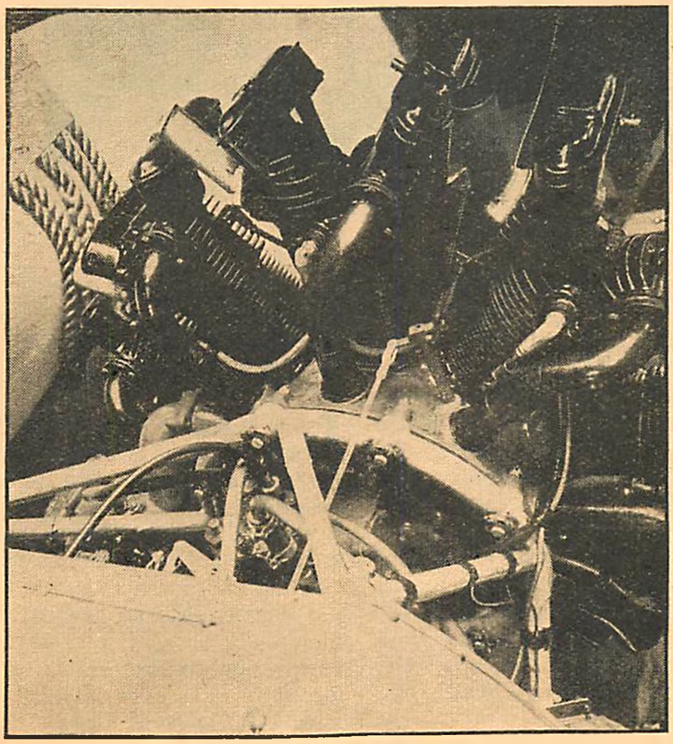
CHAPTER 11


Preparing the Engine for Overhaul

ENGINE overhaul is fundamentally a process of inspecting all parts, replacing those that are broken or badly worn, cleaning the individual units, and adjusting the complete structure. There are different degrees of checking such as (1) top overhaul, and (2) major overhaul, depending upon the requirements of the particular powerplants.

No iron clad rules can possibly be made regarding the necessity for tearing down an airplane engine. The use to which it will be put in the future, and its operations at the time will be important factors in deciding whether or not it should be overhauled. Naturally the failure of some part will demand immediate action if the engine is needed to maintain a flying schedule. In a case of that sort a major overhaul is generally made, not only to replace the part, but to insure that no broken gear teeth or the like have fallen into some nook or corner. At some later date the metal particles may clog up an oil line or even cause more serious difficulties which will result in a forced landing. The exception to this is, of course, the breakdown of some accessory which is mounted externally on the engine where no broken particles could fall within the engine.

Generally, however, the decision to overhaul the airplane engine must be made at a time when it is functioning in a perfectly normal manner. The first indication that a powerplant needs a thorough cleaning and adjusting is the gradual loss of power after a fairly long period of operation. A distinction must be made between a gradual and a sudden loss of revolutions. In the latter case some very definite trouble has come up which when remedied will eliminate the difficulty and permit the attainment of full power once again. An improperly adjusted carburetor may cause this type of trouble.

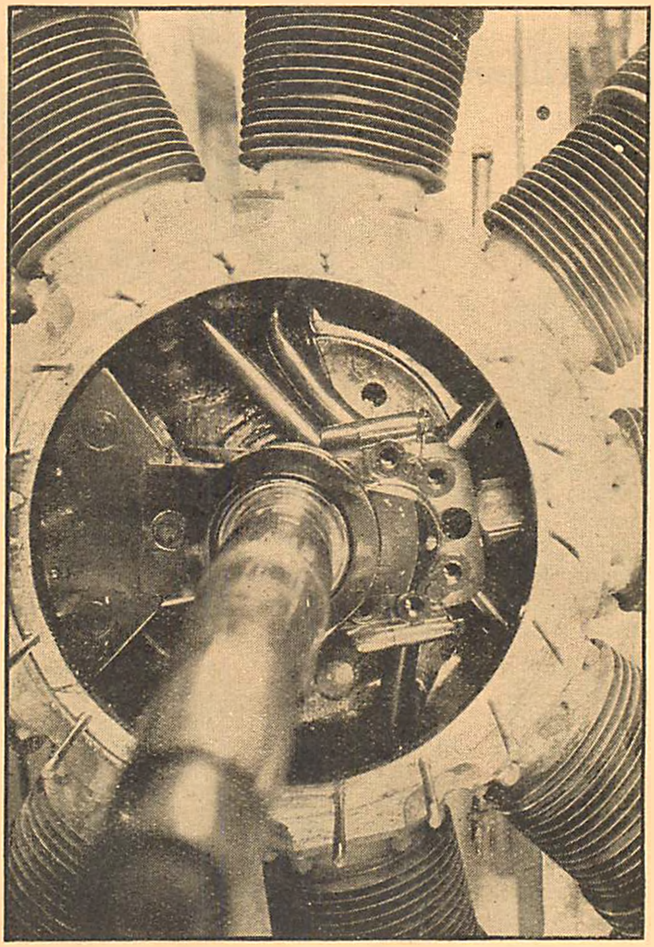

Engine Mounted in Fuselage

IN THE former case the loss of revolutions comes from many sources after long hours of running. The valves will fail to seat properly, due possibly to warping following too sudden cooling. Or, carbon particles may have collected on the valve seat, thus preventing a perfect seal as the valve is pulled home by its spring. Possibly the valve guide has worn to such an extent that compression is lost along the valve stem. The piston rings may be worn so that they permit the fuel vapor to escape into the crankcase. The valve springs may have weakened so that they do not properly close the valves.

All of the difficulties mentioned above lead to what is commonly known as loss of compression, but how this affects engine performance is not so well understood. It means that there are leaks in the combustion chamber and fuel vapor is being forced outside to the atmosphere. Consequently this mixture is lost to the resulting cylinder explosion. Naturally since there is less fuel to be burned there will be reduced power. In addition, the compression of the remaining charge will be proportionately reduced and there will be a further reduction of power from this lack of intimate molecular contact between the fuel and the oxygen. This gives the same effect as a low compression engine.

Aside from the dropping in revolutions the loss of fuel vapor is considerable and must be considered by a company which is forced to extreme economies. Again, worn piston rings will result in excessive oil pumping. That is, instead of being scraped off the cylinder side walls and so into the sump the oil will work its way upward through the increased ring clearance, and find itself in the combustion chamber, where it will be burned. With lubricating oil costing from thirty-five to forty cents a quart it is extremely uneconomical to permit this condition to continue before overhauling the engine.

Moreover, a high rate of oil consumption might easily restrict the cruising range of the plane which mounts that particular engine. Suppose an engine is burning but one gallon of oil per hour Obviously an eight gallon supply would permit the ship to fly for the entire eight hours so far as lubrication were concerned. However, if the oil consumption jumps up to three gallons per hour, the ship will be forced down from lack of oil before it has flown three hours. This particular point is not given the emphasis that its importance warrants.



A Broken Counter-Weight Causes an Overhaul Necessary on This Engine

ANOTHER indication of oil pumping, and, consequently worn piston rings, is the continual fouling of spark plugs. These will normally get caked with carbon after a reasonable time, say fifty hours of operation, but when this time is cut down to around ten hours or sometimes even less, it is an excellent indication that an overhaul is necessary.

As an overhaul is a somewhat expensive procedure the longer an engine can operate between them the cheaper is its maintenance, providing, of course, that it is giving efficient and reliable service. Obviously, a reasonable amount of daily care and checking will aid in providing the desired reliable operation of the powerplant and will increase the time between necessary tear-downs. Transport companies pay particular attention to this detail and after a ship has completed its run for the day it goes to a hangar where the engines are carefully checked over. Of course, the passengers' safety makes this procedure mandatory, but the matter of economical operation follows closely upon the heels of the first factor.

Each engine that leaves the factory is accompanied by a log. This is a book which becomes a permanent record of that particular power plant. In it are recorded all adjustments, changes, and repairs made. The running time and the date of operation of the engine are carefully written down. In short, it is a complete history which can be used as a reference whenever desired.

In the early days of aviation it was seldom that forty hours of successful operation could be obtained from an engine. This time was increased so that at the beginning of the war sixty to seventy hours intervened between overhauls. It is interesting to note that at one time during the World War, due to the shortage of experienced overhaul men, it was contemplated replacing all worn Liberty engines with new ones. The production rate of this famous power plant had reached such a high rate that a new engine could be produced much easier and more satisfactorily than an old engine could be overhauled. The period of usefulness of the early Libertys frequently reached one hundred hours.

With the advent of the radial air-cooled engine, increased reliability was had and the overhaul interval soon jumped up to two hundred hours. This has steadily increased and now one of the transport lines is keeping its power plants in its planes for five hundred hours before pulling them for a complete overhaul. This same company has several engines with over 2500 hours of operation.

It must be remembered that the type of service which the engine is called upon to perform will be one of the prime factors in determining whether or not it should be given an overhaul. For instance, the Navy has the unusual task of flying great numbers of landplanes over the waters for hours at a time. Naturally great reliability is necessary to safeguard the operations. Moreover, these engines are required to run smoothly in spite of unusually severe service.

Dives of many thousands of feet force an engine to turn up at high rates of speed. Dog fights with full gun are most strenuous and hard on engines. Flying off a carrier or a battleship naturally results in more or less contact with salt water or spray. This is notorious for its corrosive effect upon aluminum alloys which go to make up individual units of the modern power plant. As a result of these extreme conditions the Navy ordinarily overhauls its engines between two hundred and fifty and three hundred hours.

IT IS WELL to have a check-off list for a mechanic in order that he will not overlook anything. The daily inspection includes such things as testing compression, making certain that all ignition wires, particularly those to ground, are secure, ascertaining that the spark plugs are secure in their bushings, checking fuel and oil pressures, running the engine to insure that operation is normal, testing engine on both magnetos, and inspecting the intake manifolds for air-tightness. It takes but a short time to run through a list of this sort and if after the flight the mechanic talks over its operation with the pilot, he will have a fairly good idea of the attention it needs.

It should be emphasized that a great deal of difference exists between the standard of upkeep of the airplane engine and that of the automobile power plant. In the latter

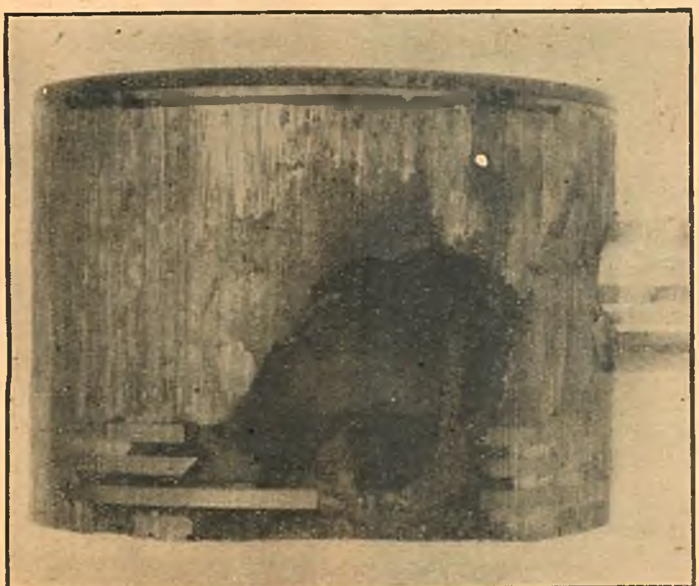
Wear Is Shown Here In Many Typical Forms

case if a repair is made the car is run around the block to see if the trouble is eliminated. If it suddenly stops, the car merely draws up to the curb. This condition is not to be tolerated in aviation engineering. When a repair is made the engine is to operate as it did before, and until then it is not to be flown. A forced landing has too many possible dire results to invite them. Moreover, a much higher standard of daily upkeep is required and nothing can be slighted either carelessly or intentionally.

The pilot and the mechanic should keep in close touch with each other. An intelligent handling of the engine by the aviator will help greatly in maintaining it in good shape. For instance, it is seldom that a wide open throttle need be used for any length of time. A careful warming-up is also important as is a slow cooling-down of the hot engine. Under no conditions should the mechanic permit the pilot to fly an engine if there is any doubt about the mechanical perfection of it without giving him a detailed account of the trouble that might occur.

After ten hours of operation the oil is generally changed and the valve clearance is adjusted, although there is a distinct tendency to carry these over to the twenty-hour check. This inspection, as its name indicates, follows twenty hours of running and is exceedingly important if forced landings are to be eliminated. Minor failures and adjustments will frequently result in major casualties which could have been prevented by a few minutes care from time to time.

This check is more detailed and thorough than the daily inspection. The plane structure is generally given a twenty-hour check also and the two inspections are done at the same time. It is usual to place the ship out of commission for one day during which it is carefully gone over and all parts accurately adjusted. Transport companies find it economical to make as many flights as possible with the fewest number of planes. To do this it is essential that the various checks be made between runs. This means that much of the work is done at night.



For Sale! One Piston Slightly Used. Heat and Friction Have Taken This Toll

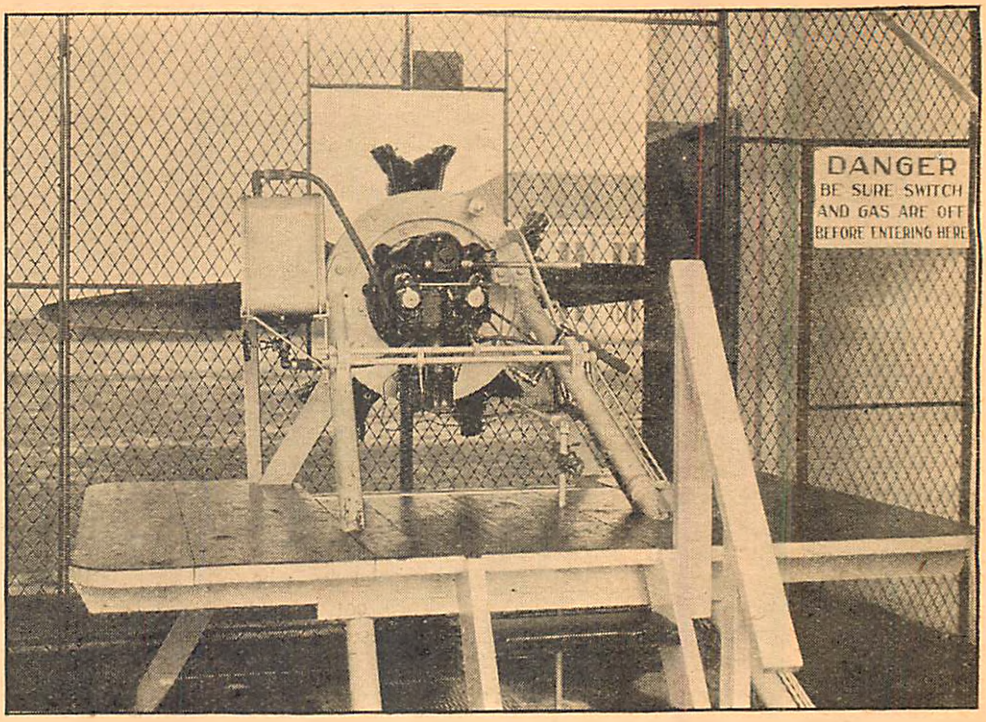
In the twenty-hour check the propeller will be examined for alignment. A saw horse or some object is placed so that it just touches one blade of the propeller. The prop is then turned and the other blade should also just touch the stationary object. A variation of one-eighth of an inch is allowable. The propeller hub nut must be checked for tightness. All spark plugs are to be removed from the cylinders, cleaned, and adjusted with the proper gap of fifteen thousandths of an inch. Make sure the cylinder hold-down nuts are secure and safety-wired, as well as the engine mounting bolts. Insure that the intake system remains air tight, particularly when the pipes are secured to the cylinder.

Pull the pushrods and inspect the ball ends for wear and replace after a heavy coating of grease has been applied. Make sure there are no broken valve springs. Adjust valves with proper clearance, depending upon the type of engine being checked. Make sure there are no leaks in either the fuel or oil lines. Remove all strainers from both systems and clean thoroughly.

CHANGE oil. On the face of it, frequent changes of oil may appear an expensive procedure. However, the lubricating oil picks up small particles of metal which are scraped from the sliding surfaces. If these small particles are permitted to continue through the lubricating system they act as an abrasive, rapidly increasing the wear of all moving parts. Consequently, more frequent and more expensive overhauls result. Therefore, it is really economy to keep the lubricating oil clean. Filters are not used because it is practically impossible to get one with sufficient capacity. Moreover, it would add weight and complicate the system considerably.

It must not be thought that the larger companies throw away the crankcase drainings. Instead it is reclaimed by a process of refining. We have seen in a previous article that frequently as much as 85 per cent. of the original volume can be recovered and used over again. This process can be carried on indefinitely, and the reclaimed oil is as good as the fresh oil.

The magneto points are checked for cleanliness and the proper gap of twelve thousandth of an inch set. The magnetos are to be oiled. The throttle and spark control levers must be tested to insure that the pilot can obtain full action from them at the cockpit.

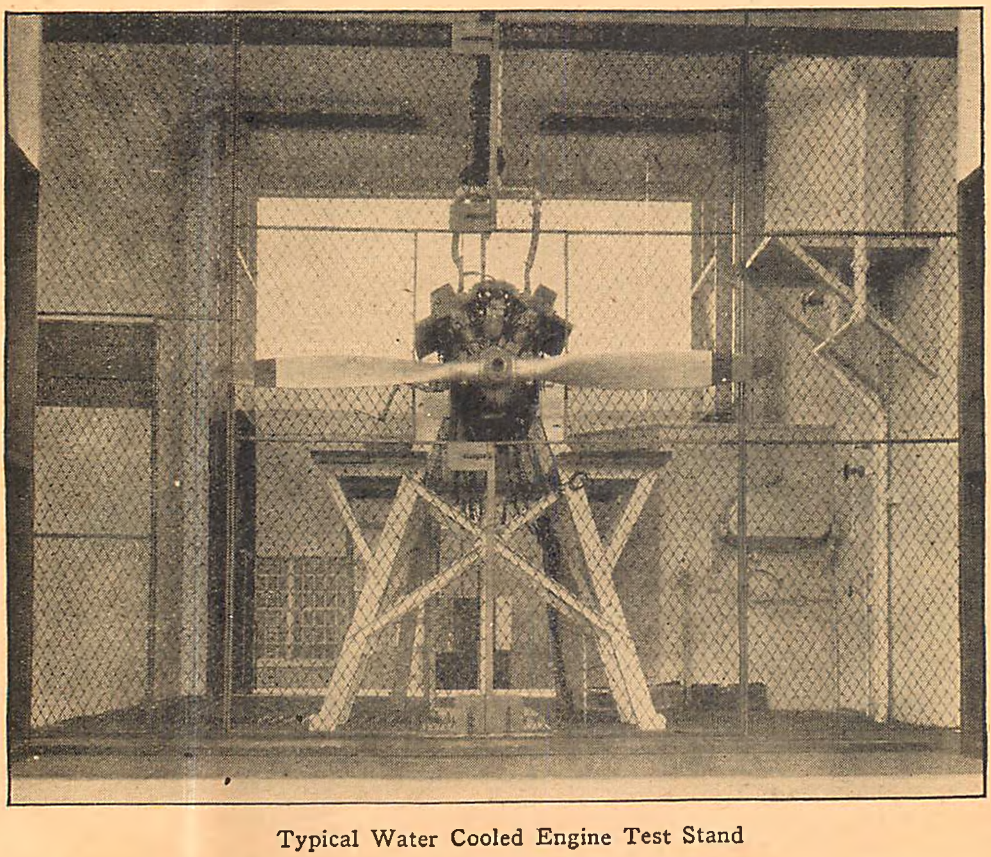


Modern Test Stand for "Breaking-In" Air Cooled Engines

The top overhaul goes still further in its efforts to provide better engine operation. It is really more than a check as it is used to provide a remedy for certain defects that may have appeared. Indications of the need for a top overhaul are loss of compression, pumping of oil, and constant fouling of spark plugs when the engine has been operated only a relatively short time, say 150 hours. This condition might arise if the plane has been flying off a very dusty field. The dust and dirt are drawn into the carburetor scoop and taken into the cylinders. Here it forms a grit which assists in wearing down the cylinder walls, piston rings, and valve seats, causing the difficulties mentioned above.

FIRST the plane is placed within a hanger where it is free from dust. The engine cowling is removed in order that the mechanic may easily get to all parts of the engine. Then the entire structure is thoroughly washed down with gasolene in order to remove free dirt and grease that might fall inside the engine when it is opened up. The cylinders must then be made ready for removal. The pushrods and intake pipes are pulled off and stacked on the table in order. This clears the cylinders and they may now be removed. In the radial type engine it is essential that Number One cylinder be removed last and installed first because it locates the master connecting rod.

It is to be noted that each piston should be brought up to its top dead center before pulling the cylinder. If this is not done, the oil scraper ring may be broken when trying to remove the piston from the crankcase. As each cylinder is pulled, the piston should be removed from its connecting rod. If the wrist pin does not drive out easily, the piston may be heated with a blowtorch. This will expand the aluminum piston away from the steel pin and make it possible to remove it.



Typical Water Cooled Engine Test Stand

While the engine is opened up in this fashion the connecting rods are carefully inspected for possible fractures. They should be checked also for clearances around the knuckle pin which secures them to the hub of the master rod. If more than three thousandths clearance exists they must be rebushed.

The cylinders are next overhauled. The valves are removed, and the carbon removed from the combustion chamber. Any burrs on the valve stem must be removed by means of a stone or fine file. The valves are then ground in to insure good

(*Continued on page 38*)

The "Hell-Diver"

Build this Solid Scale Model of One of Uncle Sam's Latest Fighters

By WILSON RUSS

NO BETTER name than "Hell-Diver" could have been used for this Curtiss Fighter. It seems to send the blood tingling through one's veins, inspiring the thought of a destructive thing capable of lightning speed.

There is no doubt about the Hell-Diver upholding its name. It has proven its worth over and over again, and has gained a reputation as an outstanding performer in the new type of air war tactics, "dive-bombing." Perhaps the best illustration of dive-bombing is a current motion picture which depicts the effective method of aerial warfare.

On the ground or in the air, the Hell-Diver is pleasing to the eyes. It is a beautiful ship and well designed. The model which we submit here for you to build, faithfully reproduces its lines and none of its beauty is lost. It must be mentioned here that extreme care should be exercised at all times during the construction if a good model is desired. However, it is not difficult to build. On the contrary, it is quite simple, but one can imagine the results of careless workmanship.

Some readers may not care to build this model because of its solid construction. While it is comparatively new to most model builders, the solid construction type of model building is fast becoming popular. Try it.

The first step toward the construction of a good model, is a careful study of the plans printed in this issue, which are full size. To facilitate your work you may combine the four pieces. This is simply and effectively done by the use of the transparent gummed paper which may be purchased at any stationery store. Fit the parts together carefully.

Now study the plans and picture thoroughly until you are well acquainted with the model. When you have done this, you are ready to make the templates. To do away with the necessity of reading long and drawn out directions, there is a list of general steps. Then follows a list of parts and how to make them. These parts are not listed in the general steps.

1ST STEP—Make your templates. To make a template is not difficult. It is simply taking the outline of a part of the model, pasting it on some cardboard or heavy paper, and then cutting it out with scissors. Most builders trace the various parts from the plan to avoid the cutting up of the drawing. To assure an accurate model, make templates of the top and side view of the fuselage, top wing, bottom wing, pants, propeller, stabilizer and rudder.

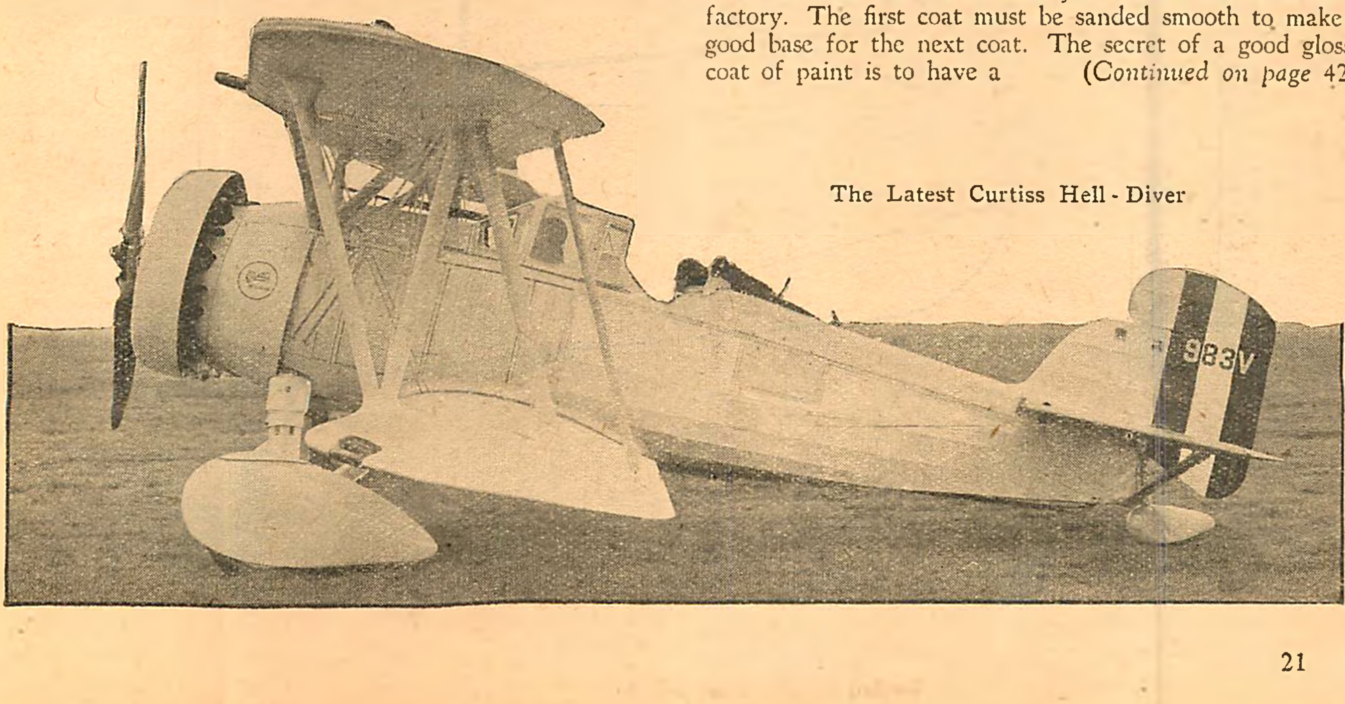
2ND STEP—Select your fuselage block from your balsa stock. Now take the side view template and place it on top of the wood. Trace around it with a sharp pencil, and when you take off the template there will be a clear and accurate outline drawing of the fuselage. Repeat this process on the other side, making sure that both outlines are horizontal to each other. With a sharp knife shave away the surplus wood above the pencil line.

3RD STEP—Repeat the whole operation as described in the second step to shape the top and bottom of the fuselage, using the top view template and working on the top of the fuselage.

4TH STEP — Round off the corners of the semi-shaped fuselage block to conform to the curves shown in the picture.

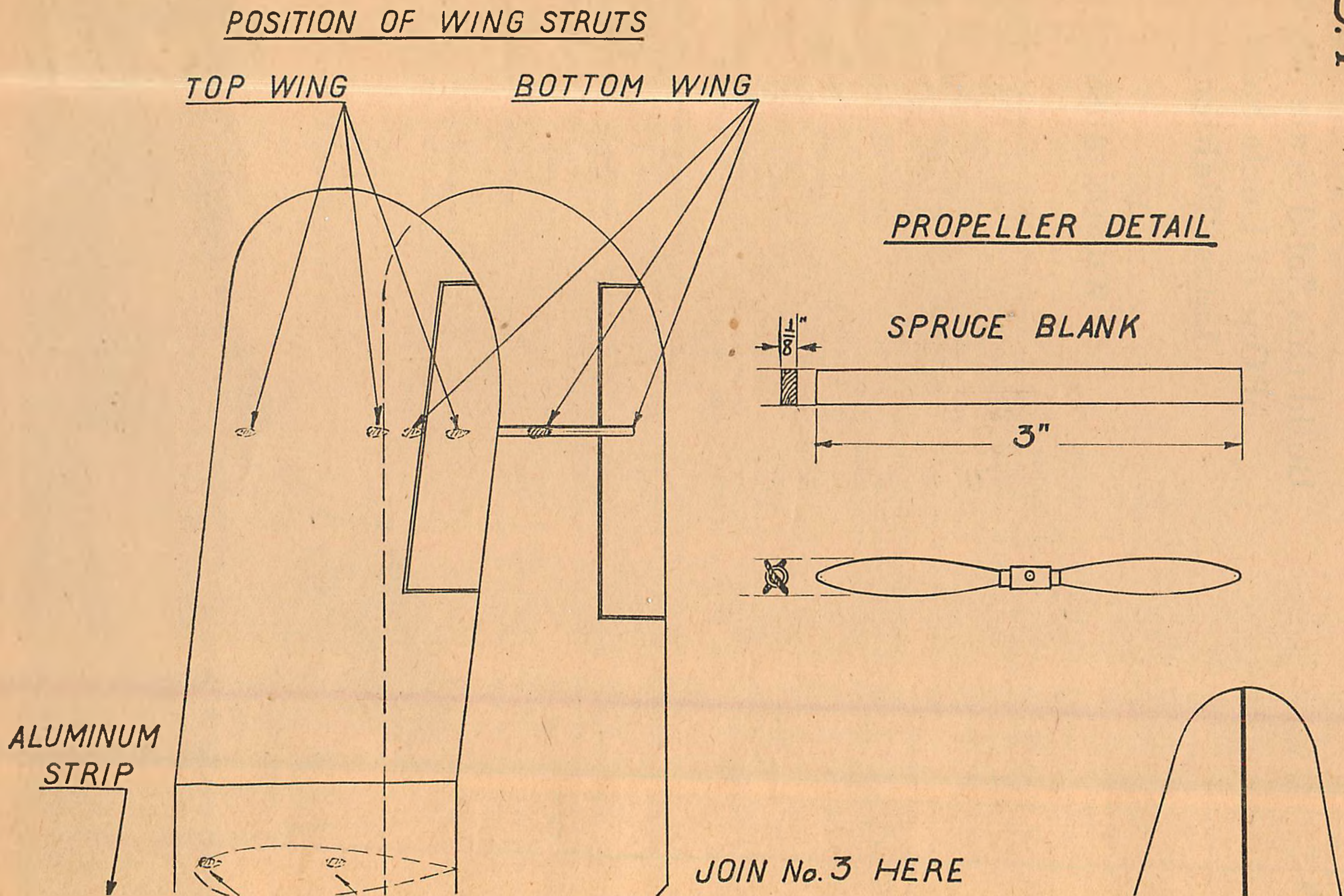
5TH STEP—Cut out the rest of the wooden parts using the templates. Sand these parts carefully and smoothly. When this is done, the model is ready for assembly. *See notes on page 42 for other parts.

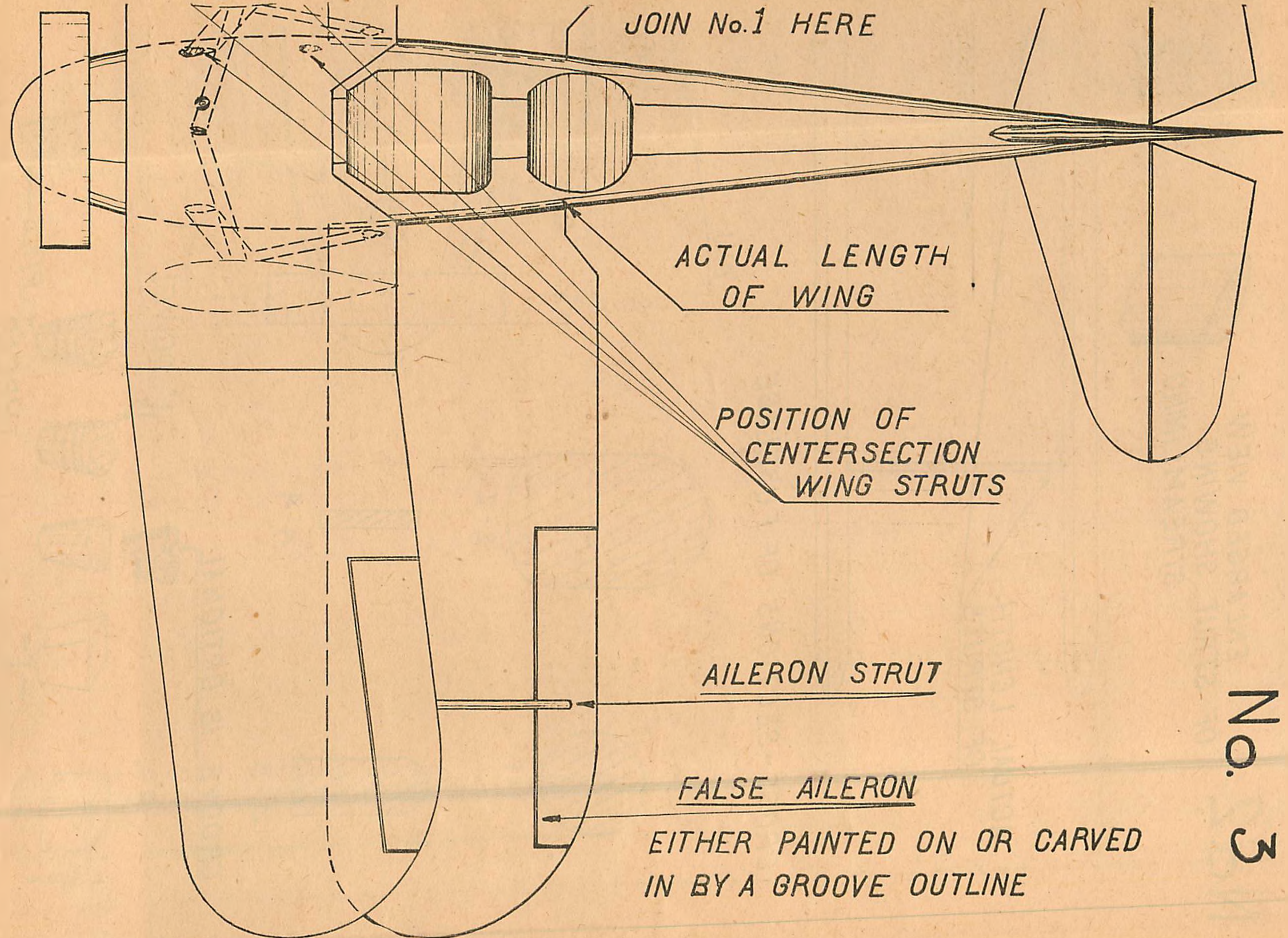
6TH STEP—The model is now ready to be painted, but before starting, a word of precaution is necessary. To get a glossy finish is not as simple as it seems. Great pains must be taken or the finished job will be far from satisfactory. The first coat must be sanded smooth to make a good base for the next coat. The secret of a good glossy coat of paint is to have a (*Continued on page* 42)

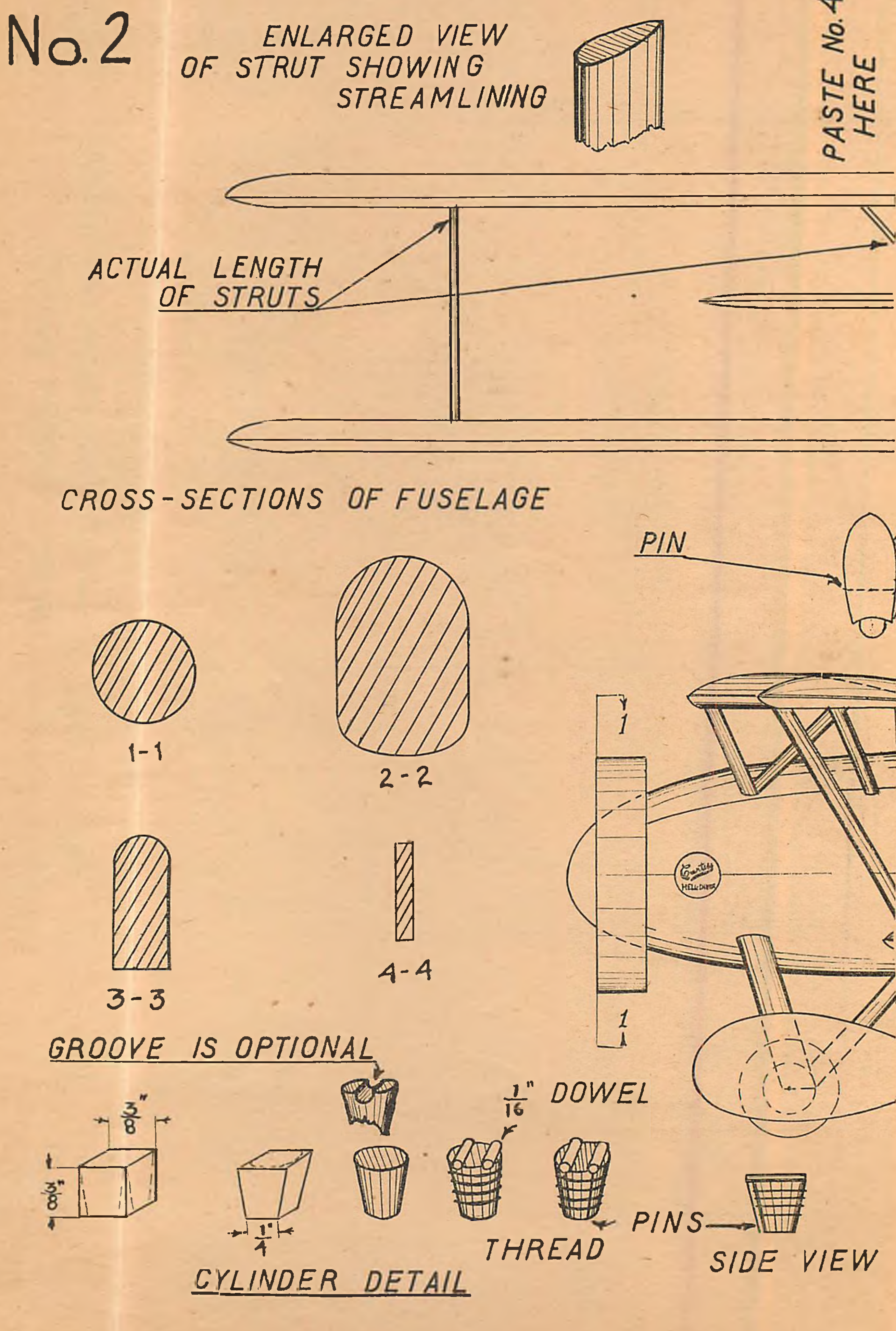


The Latest Curtiss Hell-Diver

No. 1


POSITION OF WING STRUTS
TOP WING
BOTTOM WING
PROPELLER DETAIL
SPRUCE BLANK
1/8"
3"
ALUMINUM STRIP
JOIN No. 3 HERE

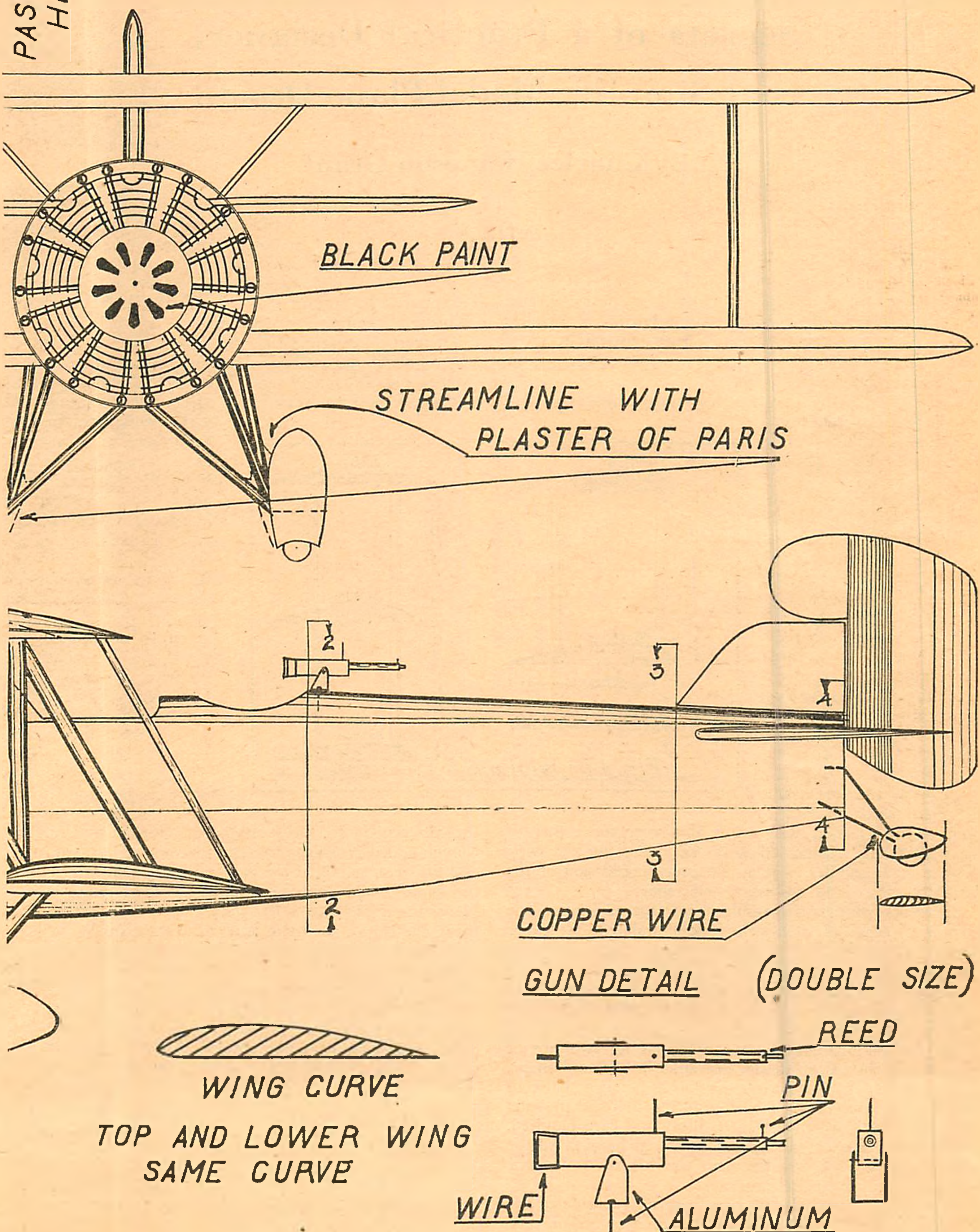

JOIN No.1 HERE
ACTUAL LENGTH OF WING
POSITION OF CENTERSECTION WING STRUTS
AILERON STRUT
FALSE AILERON
EITHER PAINTED ON OR CARVED IN BY A GROOVE OUTLINE
No. 3


No. 2
ENLARGED VIEW
OF STRUT SHOWING
STREAMLINING
PASTE No. 4
HERE
ACTUAL LENGTH
OF STRUTS
CROSS-SECTIONS OF FUSELAGE
PIN
1-1
2-2
3-3
4-4
1
1
GROOVE IS OPTIONAL
3/8"
3/8"
1/4"
1/16" DOWEL
THREAD
PINS
SIDE VIEW
CYLINDER DETAIL

PASTE No. 2 HERE

No. 4

NOTE: USE TRANSPARENT TAPE TO JOIN ALL PARTS OF PLAN



w.r. 193

The Aerodynamic Design of the Model Plane

Secrets of a Practical Designer, that Simplify Model Plane Design

By Charles Hampson Grant

(ARTICLE 3)

HERE we are again with another installment of facts. Let us hope they will tear down a few more of the barriers to a complete understanding of *how to apply* aerodynamic principles to your Model Plane.

Why Taper the Wings?

This is a question that many model builders have asked me. It can show only one thing, and that is a lack of understanding of aerodynamic principles. However, our knowledge must take root and start to grow somewhere, sometime. As the old saying goes, "there is no time like the present."

The answer to this question may suggest itself to those who have read the text under the heading—"Aspect Ratio." The diagram showing Tapered Wings was published in the March issue. From what is said about this characteristic of the wing, it is obvious that the greatest lift and also the greatest efficiency occurs at and near the center of the wing. The air spills out of the tips. The wing area near the tips consequently produces less lift per square foot, and is less efficient.

It is logical, therefore, to cut away the area near the tips, which is inefficient, and replace it with wing area near the center of the wing which is more efficient. By doing this the wing tips are made smaller, with a consequent reduction of the "spilling" effect, and increase of efficiency.

Another advantage also results from tapered wings. The "center of area" of each wing (right and left), is closer to the point at which it joins the fuselage. There is, therefore, less bending moment due to the lift on the wings, or breaking tendency. Thus, the wings may be made lighter without sacrificing their ability to carry the weight of the fuselage and other heavy parts.

The one disadvantage, is the fact that no two ribs of the wing, from center to tip, are alike in size and shape. This makes it a harder and longer job as far as actual construction is concerned, but the resulting increase in wing efficiency is well worth the extra effort and care required.

The lift of a tapered wing as described herein, will be from 10% to 15% greater than the lift of a wing of uniform chord and equal area.

In our first two articles we have carefully considered the characteristics of Lift and Drag on single aerofoils of various shapes and at different angles of attack. (Angle at which the air flow meets the chord of the wing.) It is now essential that we consider the reaction of the air on combinations of two or more surfaces.

The most common arrangement is one in which two aerofoils are used, one disposed directly above the other. We call this a Biplane combination. It is illustrated in Fig. No. 16. The prefix "Bi" means "Two." Thus we get the word "Biplane," meaning "two planes."

The vertical distance, that the leading edge of the upper wing is above the leading edge of the lower one, is called "Gap," Fig. No. (16) and No. (21). The amount of Gap between the two aerofoils effects their efficiency and Lift. It is usually most convenient to place them as close together as possible, but the nearer they are to one another, the less lift they will produce as a combination, and the lower the efficiency will be. If the upper wing is arranged above the lower one, so that the gap is equal to three times the chord, then there will be no loss of lift or efficiency. However it is inconvenient, usually, to place the wings with a gap greater than 1½ times the chord. The general custom is to make the gap equal to the wing chord. By making the gap very large, the struts are lengthened and produce enough added resistance to neutralize any gain in efficiency and lift. I suggest that *the gap be made equal to 1½ times the chord* when applying this principle to your models. *Never use a gap that is less than once, or more than three times, the chord,* for there is no advantage in doing so.

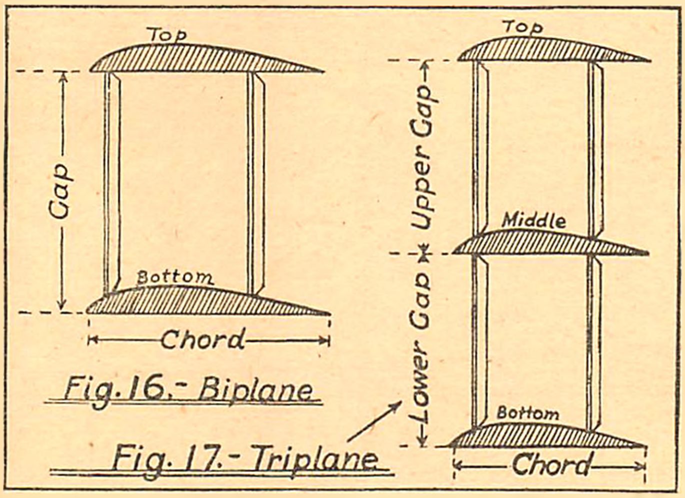


Fig. 16.- Biplane

Fig. 17.- Triplane

Now let us see the effect of the "gap" on the efficiency of the lifting surfaces. If we consider that the lift and efficiency of a monoplane wing is "One," then the relative lift and efficiency of biplane combinations with various "gap" values in terms of chord, is given by the following table. This table also shows values for different angles of attack, the chord remaining constant:

Gap X Chord	Lift				Lift/Drag			
	4°	6°	8°	10°	4°	6°	8°	10°
0.75	.74	.75	.76	.77	.75	.78	.82	.855
1.0	.80	.81	.82	.825	.78	.81	.83	.87
1.25	.86	.865	.87	.875	.825	.845	.855	.855
1.5	.88	.885	.89	.89	.855	.87	.885	.905

From the table we see that a biplane combination gives (.80) as much *lift* as a single aerofoil of the same area, when the gap is equal to the chord and the angle of attack is (4°). The *efficiency* under these conditions is only 78% of that of the monoplane. A biplane in other words, lifts from 4/5 to 7/8 as much as a monoplane per square foot of wing area, depending upon the angle of attack.

Having determined this, it is interesting to know how much of the total load is lifted by each wing of the biplane combination. The upper wing actually lifts about 60% of the total load, and the lower wing only 40%. Or, the lower wing lifts only 2/3 as much as the upper wing, under average conditions. From this we can see that the upper wing is 95% as efficient as a monoplane wing, while the lower one has only 65% of the efficiency of the monoplane.

If it is desired to equip a model with wings in biplane combination, the total amount of area of the two wings should be about 25% greater than the amount of area used for wings of the monoplane type. This is to take care of the loss of lift incurred in a biplane arrangement.

For example, if the proper amount of wing area for a certain model is 100 square inches of monoplane area, then the area of the two wings of biplane combination, correct for this model should be 125 square inches; each wing having an area of 62½ square inches if both are to be of equal size. The upper wing is made larger than the lower one, very often, as it is the most efficient one. In this way greater efficiency and lift is gained, as the greatest amount of area is in the more efficient position. This is often the case in full size planes. The lower wing in such cases acting as a means to brace the whole structure properly to give strength and lightness. Very often, the lower wing is merely a horizontal stream-lined strut or spar.

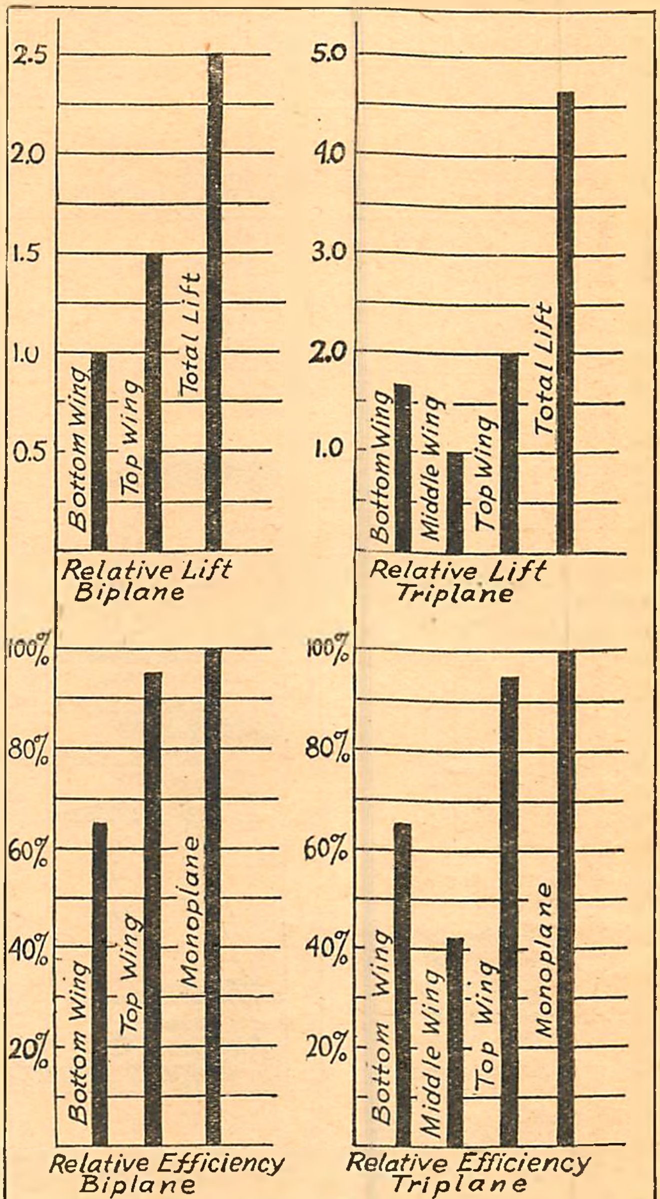


Fig. 18

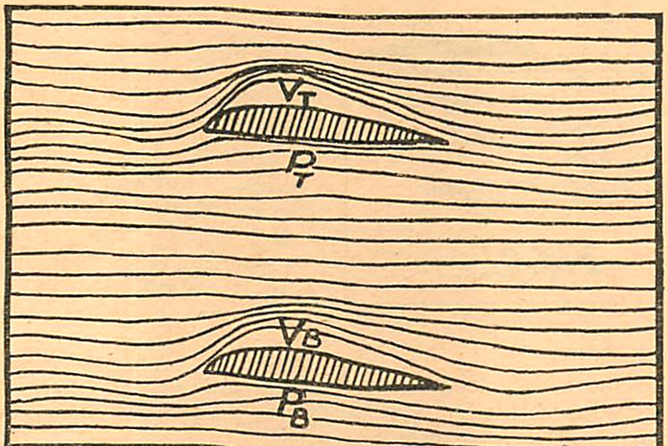


Fig. 19.

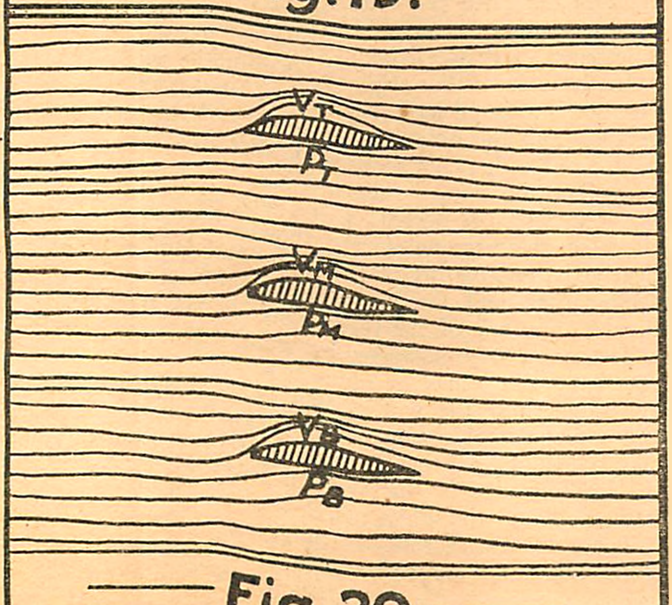


Fig. 20.

Occasionally three wings are used in combination, one above the other. When they are arranged in this manner the aeroplane is called a triplane. The word "triplane" meaning "three planes." This type of ship is not as common as the monoplane, or biplane, chiefly because of the inefficiency of the lifting surfaces. A triplane arrangement is shown in Fig. No. 17.

The gap between the lower and middle wing, the *lower* gap, is usually made the same as the upper gap, between the middle and upper wings. The customary amount of gap, as in the case of the biplane, is a distance equal to—one, to one and one-quarter times the chord of the wing. It is advisable to use a gap of *not less* than ¾ or *more* than 1½ times the chord. Of course, the larger you can conveniently make the gap between the wings, the more efficient the wings will be, and the greater the resulting lift.

The following table shows the relative amount of *Lift* produced by the three customary wing combinations, at various angles of incidence, when the gap is 1¼ times the chord:

RELATIVE LIFT—GAP = 1¼ x CHORD

Incidence	Monoplane	Biplane	Triplane
0°	1.00	.895	.837
2°	1.00	.845	.76
4°	1.00	.86	.765
6°	1.00	.865	.77
8°	1.00	.87	.78
12°	1.00	.88	.82

A table showing the relative efficiencies of the three types of wing arrangement, follows:

RELATIVE EFFICIENCY=L/D
GAP = 1¼ x CHORD

Incidence	Monoplane	Biplane	Triplane
0°	100%	74%	71.5%
2°	100%	76%	70.5%
4°	100%	82.5%	76.5%
6°	100%	84.5%	81%
8°	100%	85.5%	83%
12°	100%	96%	90%

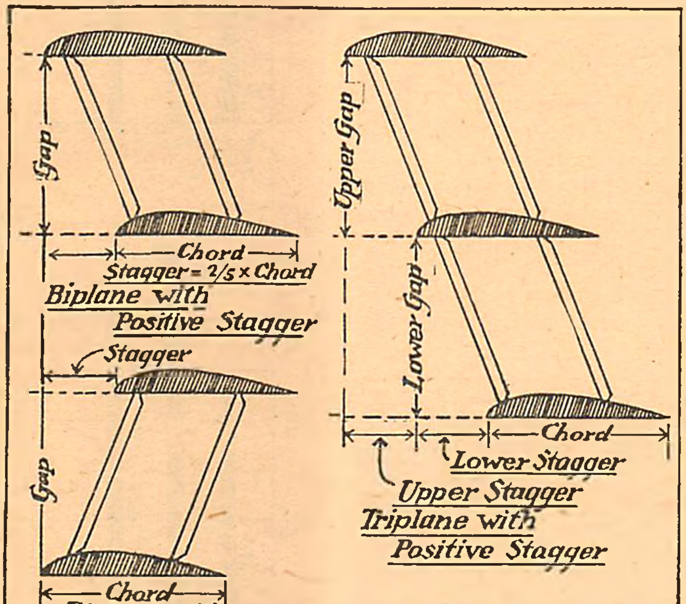


Fig. 21.

According to the above table, the triplane lifts only 76.5% or ¾ as much as a monoplane at 4° angle of attack. As can be seen, the relative amount of lift of the triplane to the monoplane, increases with the angle of attack. At 12° angle of attack the triplane lift increases to 82% of the lift on a monoplane. The efficiency at (4°) is 76.5% and increases rapidly as the angle of attack increases, until at 12°, it is 90% of the monoplane efficiency. This means that the stalling tendency of the triplane does not occur as suddenly as the monoplane. Therefore it is a more stable combination, though less efficient.

IN ORDER to have a model fly properly with triplane wings, it is necessary that the wings have 35% more total area than would be required if monoplane wings were used, provided no change in weight occurred. For example if (100) square inches will fly a model properly when this area is used in monoplane form, then 135 square inches of area will be required when used in triplane form. If all the three wings are to have the same amount of area, then each wing should have 45 square inches of area, in order to give a total area of 135 square inches.

Now let us see what percentage of the total load each wing carries. At normal flying angles, from 2° to 4° the lift on each of the three wings is approximately in the following proportion: The upper wing=2, the middle wing=1, and the bottom wing=1.7. This means, when the middle wing lifts (1) pound, the top wing lifts (2) pounds, and the bottom one (1.7) pounds. The efficiency or L/D, of the three different wings is in the ratio of (2.2) for the top, (1) for the center, and (1.5) for the bottom wing. This means that the middle wing is the least efficient and also gives the smallest amount of lift. The bottom wing comes next in effectiveness and the top wing gives the most lift and has the greatest efficiency, the same as in the case of the Biplane.

Diagram No. 18 shows the relative amount of lift produced by the various wings, and their relative efficiencies, in biplane and triplane combinations. These values are for normal flying angles, about 2° to 6° angle of attack.

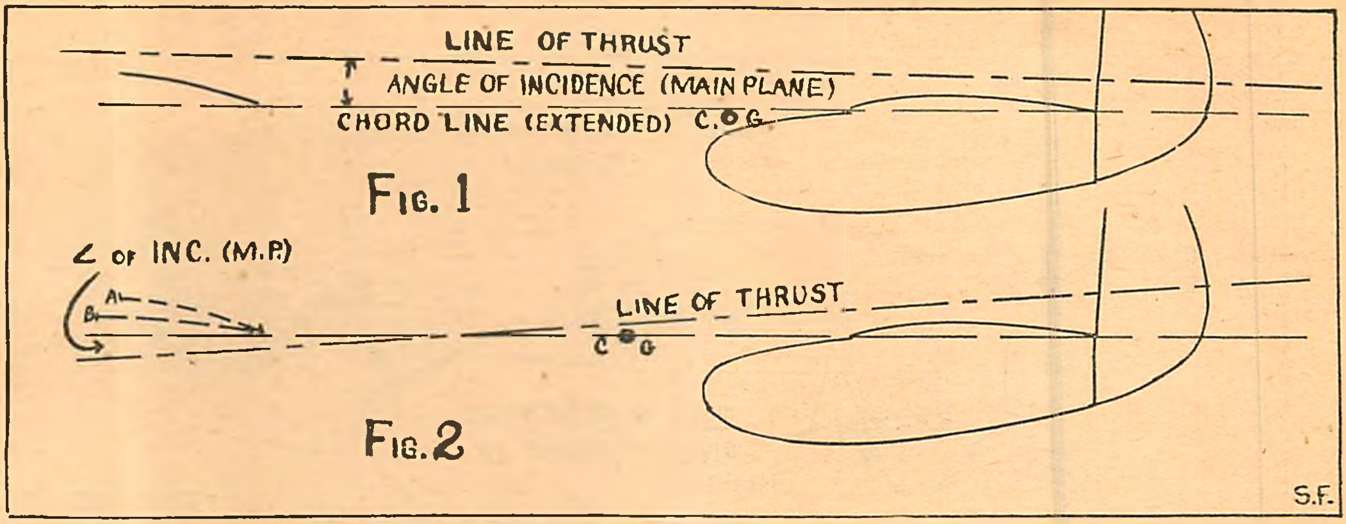
So far it has been shown that aerofoils combined in biplane or triplane form have not the lifting effect or the efficiency of the monoplane type. A certain amount of the lift and efficiency is lost. There must be a reason for this loss. What is it? In order to determine the reason, it will be necessary to consider the action of the flow of air against these two aerofoil combinations. Suppose we look carefully at Fig. No. 19. This shows how the air flows around the wings of a biplane. By close observation we can see that there is a vacuum formed above the upper and lower surfaces, indicated by Vt and Vb. Also that an increase in pressure exists directly under each of the two wings. Thus we have a condition existing where a point of high pressure Pt and a point of low pressure (Vacuum) are next to one another. It is easy to see therefore that the air tends to flow from the high pressure area Pt into the low pressure area Vb. Both the pressure under the top wing and the vacuum over the lower wing are thereby diminished. Through this action, the lift on the wings is lessened, for it is this pressure and vacuum created respectively under and over the wings, that causes lift.

Under these conditions it is easy to understand why considerable lift is lost if the gap is small. The regions of high and low pressure are comparatively close together, and the lifting effect of one is nullified by the other. On the other hand, by moving the wings farther apart, (increasing the gap), the distance between the high and low pressure points is increased and their effect on each other is lessened. Greater lift and efficiency result.

In the case of the triplane, the middle wing (B) Fig. No. 20, is affected more than either one of the other two, because both the pressure, under it, and the vacuum over it, are reduced. This reduces the lift to a very large extent. The top wing is affected least because the pressure under it, which is decreased, has only about ¼ the lifting effect of the vacuum (Vt), above. Fig. No. 18 shows clearly the relative lift of the different wings of a triplane combination, and the lift of a monoplane wing of area equal to any one of the three wings of the triplane.

There is a way, however, by which the interference between the wings may be reduced to some extent. That is, by "staggering" the wings. Fig. No. 21 shows a biplane and triplane combination with staggered wings. "Stagger" may be defined as, that state of relative position in which the leading edge of one wing is located forward of the leading edge of the other, not in the same horizontal plane.

There are two forms of "Stagger," negative and positive. When the upper wing is forward of the one immediately below it, the wings have a positive stagger. When the lower wing is forward of the upper one, they have negative stagger. Fig. No. 21. (Continued on page 44)



"Power" For Your Two Way Glider

By Stockton Ferris, Jr.

THIS being a purely experimental venture no precise details will be given. At the end however you will be told just what was done to the original.

As the glider is already completed when the power is applied, the power must be adapted to the model rather than the other way around.

Looking at Fig. 1, we see the glider as it is assumed to be. Now we take a motor stick and merely fasten it on top of the wings. You will see that as a glider we had no incidence on the main plane. This was because we had no standard to measure it from. We say that the main plane had no incidence and that the elevator had perhaps 5°. We might just as well have said however, that the elevator had none, and that the main plane had -5°. That is, the main plane was nosed down that much.

But now, when we apply a motor, we find that the main wing has a minus incidence in relation to the line of thrust. Also the thrust comes quite high above the center of gravity. Both of these things tend to nose the plane down more and more the greater the thrust is. Thus instead of the model climbing when it is first launched and then coming down in a glide, it will try to reverse the process, diving at first.

Figure 2 shows a different arrangement. Here we have the motor stick passing over the main plane but *under* the front one. This is equivalent to giving an angle of incidence to the wing, without making the thrust come any higher above the C. G. In fact, one way of getting the thrust to come even nearer to passing through the center of gravity is to make the front plane larger, (or give it more incidence, A and B Fig. 2) and ballast the model to bring the C. G. further foreward.

This is what was done with the original. A larger elevator was made, and the motor stick passed under it, and over the main plane. The fin at the rear was not disturbed, the motor being offset to pass it. Offsetting the motor in this manner did away with most of the effects of the torque. The motor stick was ⅛" square hard balsa, 10" long, and held a motor of four strands of 1/32" square rubber. This was held into place by rubber bands for the first tests, and later glued.

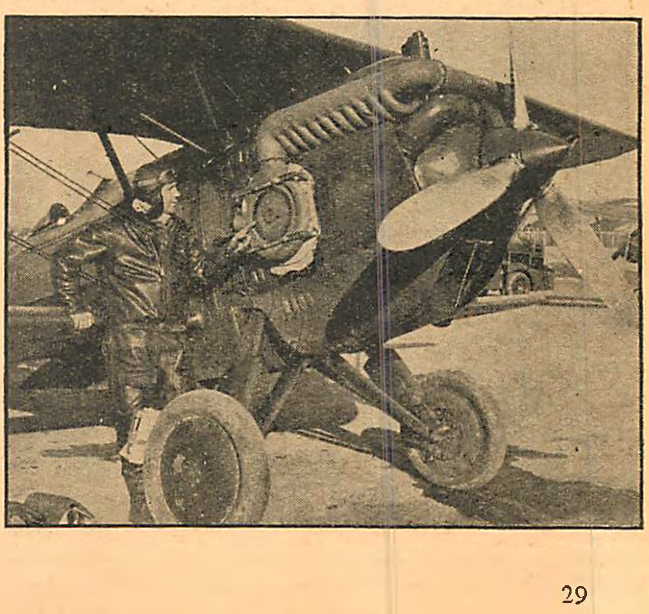
When completed the model flew at a slightly greater speed than that at which it normally glided. It was able to gain about fifteen feet or so of altitude and to fly about 200 feet. The propeller was carved from a block, 5" x ⅜" x ⅝". With a larger prop and more power it ought to give even better results.

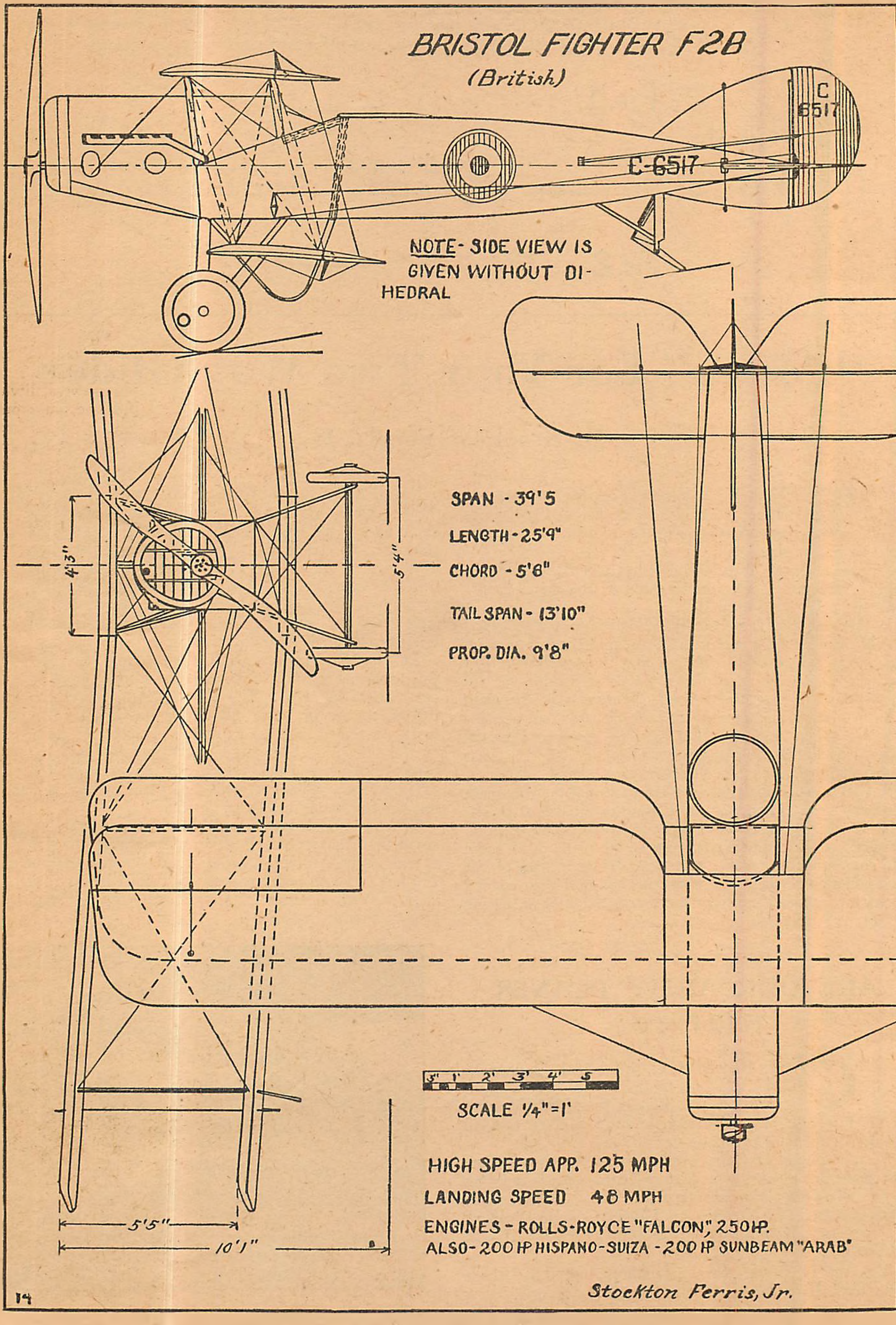
ARE OUR ARMY PLANES FAST ???

CAPT. REUBEN C. MOFFAT of Wright Field, Dayton, Ohio, recently flew from Wright Field to Bolling Field, Washington, D. C., in one hour and twenty-six minutes at an average speed of 266 miles per hour.

Photograph shows Capt. Moffat beside the Curtiss Pursuit plane in which he made the record. He is pointing to the side type turbo-exhaust driven super-charger which made it possible for the 600 h.p. Curtiss Conqueror engine to operate efficiently at an altitude of 25,000 feet at which he flew.

Yes, the U. S. A. has the Quality, but, how about Quantity? *Help Boost Our Air Fleet!!*




BRISTOL FIGHTER F2B
(British)
C 6517
C-6517
NOTE- SIDE VIEW IS GIVEN WITHOUT DIHEDRAL
4'3"
5'4"
SPAN - 39'5
LENGTH - 25'9"
CHORD - 5'6"
TAIL SPAN - 13'10"
PROP. DIA. 9'8"
SCALE 1/4"=1'
HIGH SPEED APP. 125 MPH
LANDING SPEED 48 MPH
ENGINES - ROLLS-ROYCE "FALCON," 250 HP.
ALSO - 200 HP HISPANO-SUIZA - 200 HP SUNBEAM "ARAB"
5'5"
10'1"
Stockton Ferris, Jr.
14

The World War Bristol Fighter and The Laird "Super Solution"

How to Build Them from the Three View Drawings

By Stockton Ferris, Jr.

HERE is Jimmy Doolittle's fast ship. Although its high speed is not given, it is 31 miles an hour faster than last year's ship, and that *averaged* 201 m.p.h. plus. The high speed would probably be about 250.

Like most racing planes the engine is highly "souped up." It is a Wasp Jr., and while this engine normally gives only 300 h.p., the one in the Laird is supposed to give 510.

But to get on with the model. (Plans Page 32.)

In the first place, if you want a scale model that *is* a scale model (and who doesn't) it is not advisable to build it the same size as the plans published here, as they are necessarily small. Although you might be skillful enough to get the model highly accurate, it will lack the small details that make a scale model so interesting.

In building a scale model you should try to obtain as many different pictures of the plane as possible. These will help immeasurably in building any model, both in giving detail, and to show the correct assembly.

The hardest part of the Laird to build, perhaps, is the fuselage, because of its peculiar shape. The broadest dimension across the fuselage is at the top longeron. The distance separating the two bottom longerons is equal to the separation between the two lower wing panels, as shown in the top view. The fuselage is not round at any point, and because of this, two cross sections are given. Immediately behind the cockpit the section is somewhat similar to "B" but smaller, and gradually develops into a vertical edge at the stern post. The aileron and elevator controls are so constructed that there are no parts on the outside, but the rudder has two small horns and cables.

Now the wings. These having an M-6 section, are slightly convex on the lower surface, with the sharpest curve near the trailing edge. The struts are of the "I" type, and can be made of sheet balsa. However, if the model is to be of any size, it would be best to make them in the form of three plies, the two outer ones having the grain lengthwise to the strut.

The landing gear is quite difficult to build strongly. Probably the easiest way is to carve the pants out of solid balsa, then split them and hollow the space for the wheels. After cementing them together again, put the wheels in place, using a pin for an axle. This should be cut so that it does not quite extend through the opposite side. Hold it in place by putting a generous coat of cement over the head. When the wheel assemblages are completed, it is time to attach them to the landing gear struts. (These can be made of flat balsa.) Small bamboo slivers should be inserted in both ends of these in addition to a copious use of glue.

All points where two surfaces join are supplied with fillets.

The windshield will have to be put in place after the wing is fastened. On the real plane this slides, but will probably have to be glued fast in the model.

The cockpit sides are *not* transparent but have small windows near the front.

Details of the engine can best be gotten from pictures.

The paint job is green and yellow. Notice the odd way the "400" is placed on the sides. This and the lettering are yellow.

The Bristol Fighter F2B

THIS was one of the truly remarkable ships of the World War. It had the speed and maneuverability of a single seater and was actually more of a two-seater pursuit than a reconnaissance machine. It was equipped with one Vickers gun (under the cowling) for the pilot, and either one or two Lewis guns on a Scarff ring in the rear. As an example of the good design of this ship, although the original came out in 1917, they still have a squadron of "Brisfits" in England at the present time (or did have a short time ago) for advanced training purposes.

But on to the model.

This is another thin winged plane, and so the wings could better be made of solid wood except in a fairly large model. All of the wing panels are of the same size as are the two center sections, so this makes for easy construction.

The fuselage can profitably be built up. In a large model with longerons and struts, in a small model by making the sides of flat balsa, and covering the top and bottom with paper. However, the forward end, including the motor and cowling immediately in front of the pilot will have to be carved of solid balsa because of the intricate shape.

Note the side view was merely *drawn* without dihedral for clarity, and should not be constructed this way. You can determine the correct amount of dihedral from the front view.

The lower wing is separated from the fuselage by several small struts of various sizes. These can be measured by using the small scale at the bottom of the drawing.

Notice that the front struts of the landing gear are set into the leading edge of the wing. Next is a little "V" strut supporting the front spar of the wing. The rear landing gear struts pass right through the wing, but are of smaller width between the wing and the fuselage.

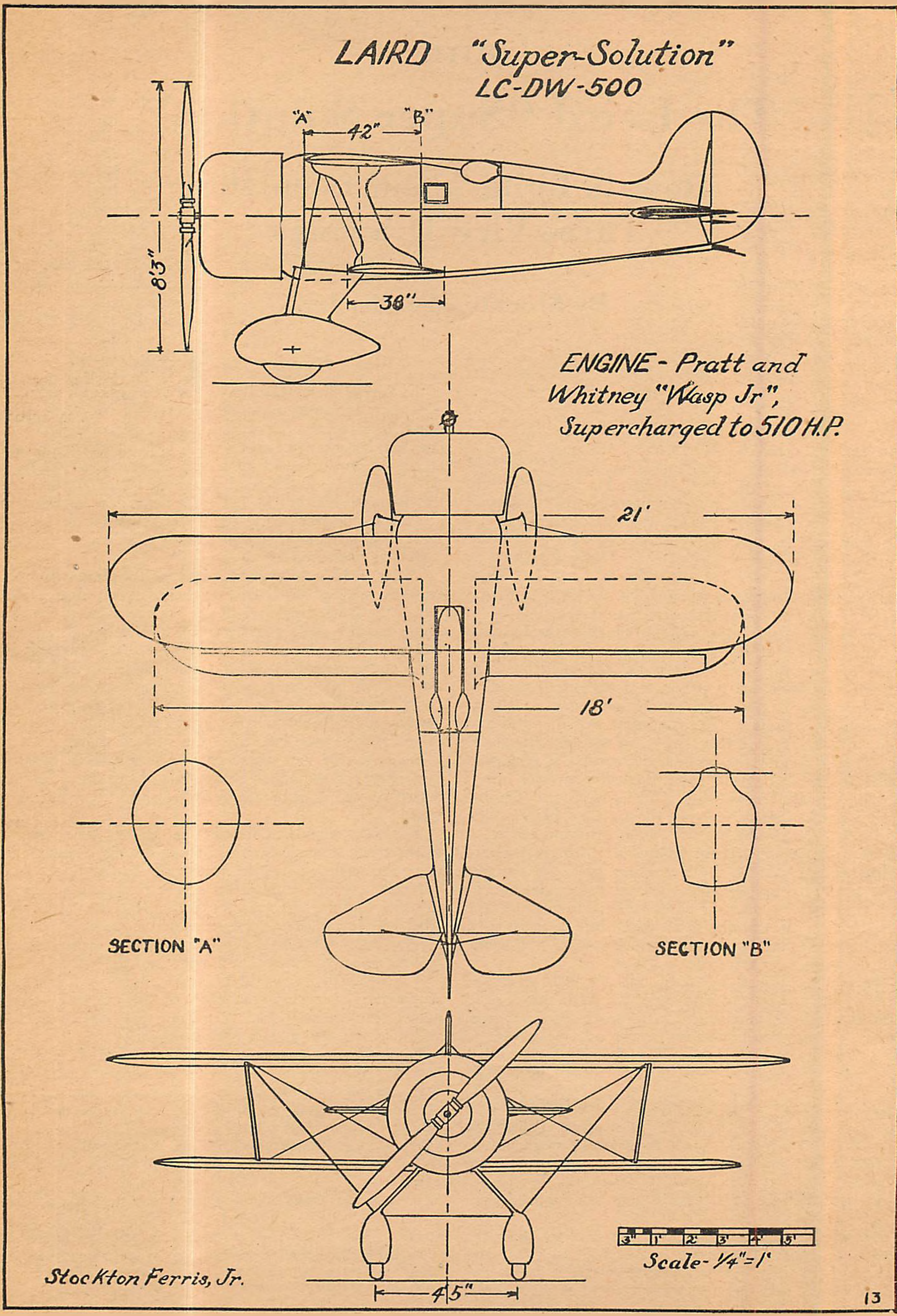
The tail skid is supported at the end of a four-legged pyramid. The two front struts of this are considerably lighter than the rear ones. The heavy lines are shock cord which allows the skid to spring properly.

From the front view it can be seen that the ship has two bays, the inner struts being dotted where the two views cross for the sake of clarity. A drag wire goes from an opening in the engine cowling near the radiator, to the top of the first front interplane strut.

All of the interplane struts are of the same size and shape. Note that they are larger in the middle than at the ends.

Because the wings of this plane are so near the ground, a wing tip skid is provided at a point under the outer struts. This, being steel tubing, can best be duplicated with round wire bent to the required shape, forced into the wing and cemented in place.

Most Bristols were painted (*Continued on page* 42)


LAIRD "Super-Solution"
LC-DW-500
"A"
"B"
42"
8'3"
38"
ENGINE - Pratt and Whitney "Wasp Jr", Supercharged to 510 H.P.
21'
18'
SECTION "A"
SECTION "B"
4'5"
Scale- 1/4"=1'
Stockton Ferris, Jr.
13

A Course In Airplane Designing

By Mastering This Valuable Course, the Model Builder of Today Lays the Cornerstone for His Career as the Aeronautical Engineer and Designer of Tomorrow

By Ken Sinclair

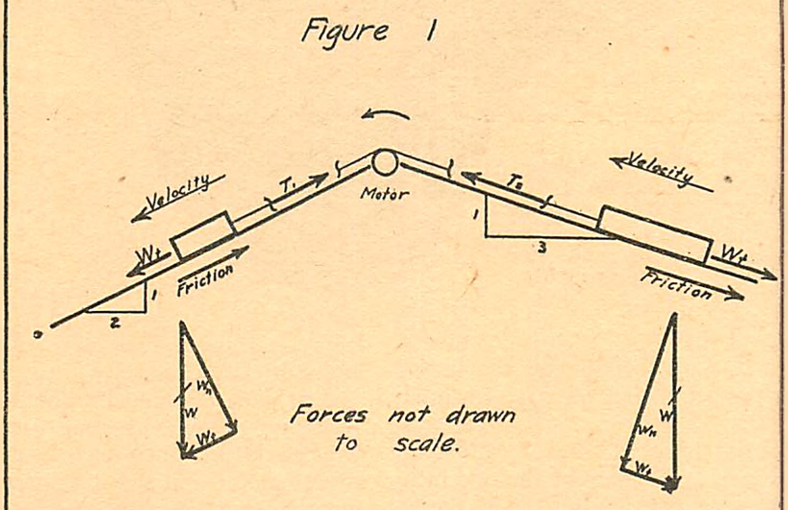
ARTICLE 29

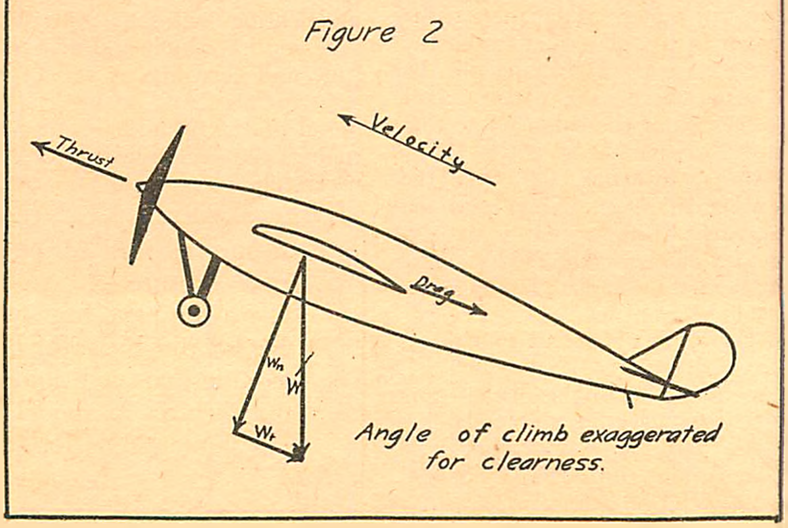
IN RAPID airplane maneuvers inertia forces are very important, since they throw greatly increased stresses on the structure of the ship and necessitate pretty close figuring on the part of the designer who wishes to make sure his ship is safe. It is known that inertia forces have a great deal to do with tailspinning; and the matter is now being investigated more thoroughly than ever before. Inertia forces, we said, are due to changes in velocity. We have just spoken of those due to changes in *amount* of velocity. But there are inertia forces also that arise from changes in *direction* of velocity. These are the ones that are most important in airplane maneuvers, etc.

When a bucket of water is swung rapidly in a circle at the end of a rope, it is found possible to swing the bucket in a vertical plane without spilling a drop of the water.

Centrifugal force holds the water in the bucket. But what causes centrifugal force? It is really inertia.

Any body resists change in its motion. If it is at rest it wants to remain at rest. If it is moving it wants to continue moving *in a straight line*. But when an object is moving in a circle it is certainly not traveling in a straight line; its direction of motion is being changed constantly. Since the term velocity means both magnitude *and direction* of motion (speed implies magnitude only) the body is really being *accelerated* when its *direction* of motion is changed. The acceleration is toward the center of the circle. Therefore the inertia force—or centrifugal force—acts in the opposite direction and pushes outward from the center.





It must be balanced by a *centripetal* force pulling the object in toward the center.

When flying, one notices the force with which he is pushed down into the seat, if he levels the ship off suddenly from a steep dive, or if he banks in a vertical turn. This is an inertia force, due to the sudden change in the direction of motion. The feeling of lightness that comes when a ship is nosed over suddenly is due to inertia too; one's body tries to go right along in a straight line while the ship is changing direction. Remember that when you fly: and be sure to buckle your safety belt.

These effects are very important in airplane design, and also on actual flying. Besides the powerful stresses that they throw upon the ship, they cause some remarkable phenomena on the bodies and minds of pilots. Take, for example, the case of the racing pilot who rounds a pylon in a vertical bank at two or three hundred miles an hour.

The inertia force here, due to change in direction of motion, is terrific. It pulls the pilot down against the seat, and draws his blood from his head down into his body. As a result, his brain goes blank for the few moments that the ship is turning, and all of his actions must be planned beforehand and acted out by his muscles without command from his brain. Pilots are very careful never to turn or zoom the Schneider Cup racers too suddenly because of the terrific inertia effects that might result either in the death of the pilot or the breaking-up of the ship in the air.

This month we will finish our discussion of forces and put our (Continued on page 43)

The "Midget" Takes The Air

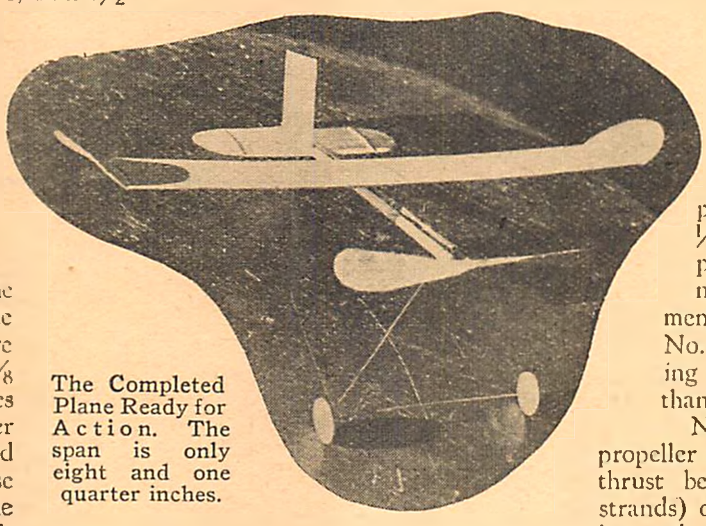
A Small Indoor Plane With a Great Big Performance.

By Cyril Robert Green

THE little model described here, while having only an 8¼ inch wing span, will outperform many models of several times its size. By merely varying the amount of power, the model may be made to fly slowly and steadily around your parlor or to stunt and climb in an amazing way. Before beginning to build this model, study the plans carefully, for the instructions can only supplement the plans.

First let us begin with the motor stick. This is a piece of balsa ⅛ x 1/16 x 4½ inches, sanded until smooth. Now cement your rear hook and thrust bearing in place on the stick. The thrust bearing should be cut down to the size shown on the plans, and the rear hook should be bent from No. 2 music wire.

Now for the tail group. The fin has a balsa frame, made from balsa strips 1/32" square and 1⅜, 1¼, 1⅛ and ⅞ inches respectively. The pieces should be cemented together as shown on the plans, and when dry, cover with Japanese tissue, using banana oil as the adhesive. Note that the fin is butt-joined to the motor stick; that is, a notch is cut in the motor stick and the piece of balsa making up the lower part of the frame, which projects about ¼", is cemented in the notch.



The Completed Plane Ready for Action. The span is only eight and one quarter inches.

Now cut one piece of balsa 1/32 x 1/32 x 3", and two pieces 1/32 x 1/32 x 1". Mark the centers of the one inch pieces, and mark points ½" from each end of the 3" piece. The 1" pieces are cemented at right angles to the 3" piece, as shown in the plans. Now cut a piece of Japanese tissue exactly like the outline shown in the plan, and fasten the paper to the tail frame by means of the banana oil. Be careful not to get any banana oil on the paper except where the paper is to be cemented to the balsa. Note that the stabilizer has no outline. Now cut a notch 1/32" square in the bottom of the motor stick, ¼" from the rear, and cement the stabilizer in place. Now bend the landing gear from No. 2 music wire, cement two balsa wheels 5/16" in diameter to a bamboo axle 1/32" square and 2½" long, and then cement the complete landing gear to the motor stick, ½" from the front.

We are now ready for the wing. First cut two pieces of balsa 1/16 x 1/32 x 7", and 5 pieces 1/32 x 1/32 x 1⅜". Cement the pieces together, as shown in the plans, being careful to have the completed wing frame absolutely flat. Now, take 2 pieces of balsa 1½" long, ¾" wide, and 1/64" thick. See that the grain runs ACROSS, not lengthwise. With a compass, describe a semicircle with a ¾" radius, and cut out the semicircle with a razor blade These are your wing tips. They are cemented to the end ribs of your wing.

Make sure that the outside edges of the wing tips are ½" higher than the wing itself. This may readily be seen from the plans. When the cement is dry, cover the wing, again using banana oil as the adhesive. Now, from No. 4 music wire bend two wing clips like the ones shown on the plans, one being ⅜" from top to bottom, and the other 9/16". Cement the LARGE clip to the bottom of the FRONT wing spar, and the small clip to the rear spar.

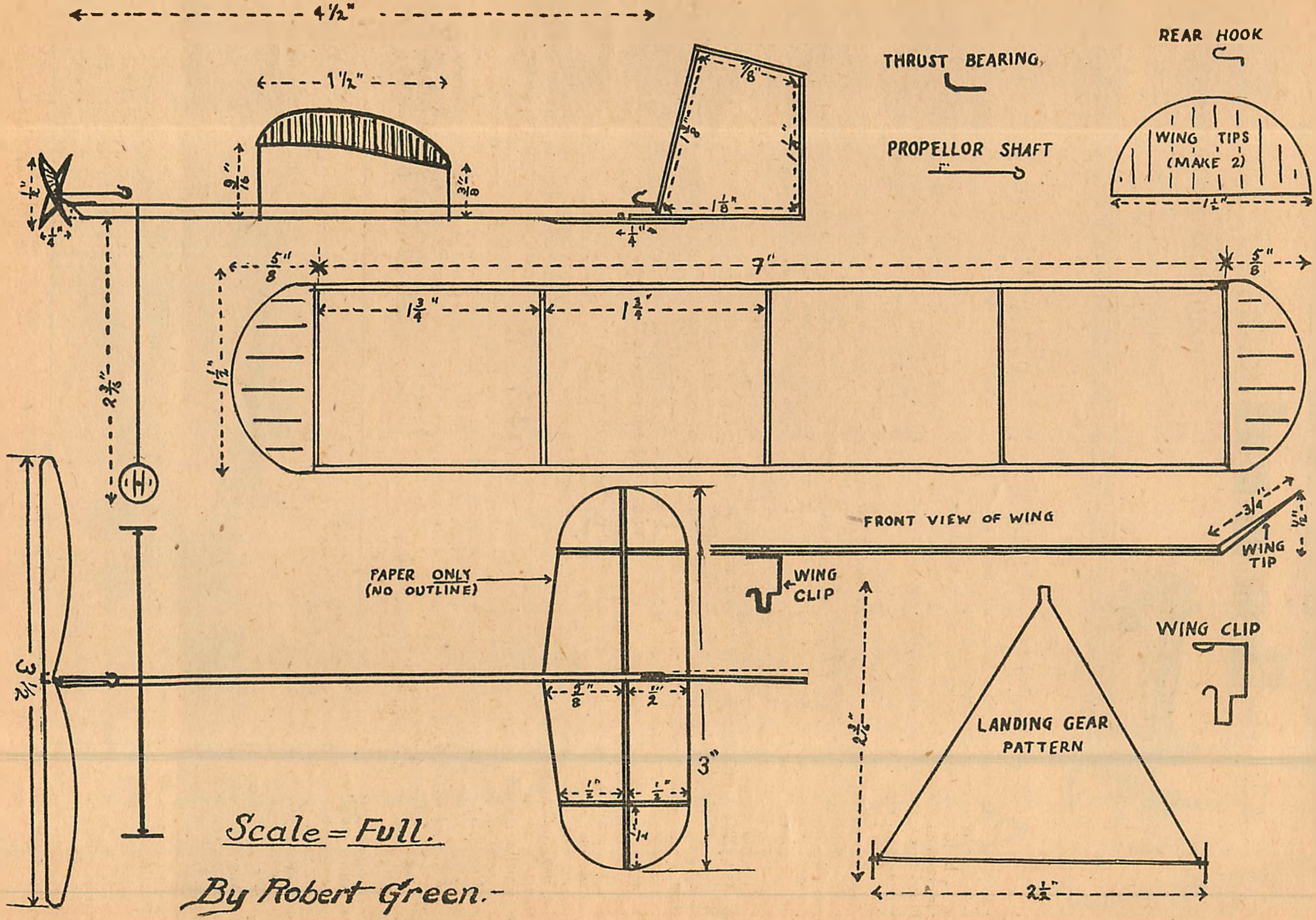
While the wing clips are drying, carve the propeller from a balsa block ¼ x ½ x 3½". The thickest part of the propeller should not be more than 1/32". Cement a propeller shaft made from No. 2 wire to the propeller, seeing that the shaft is no longer than ¾".

Now place a small bead on the propeller shaft and place it in the thrust bearing. Make one loop (2 strands) of 1/32" or .035" square rubber and stretch it between the propeller shaft and the rear hook. Then place the wing on the motor stick and you are ready to test your model.

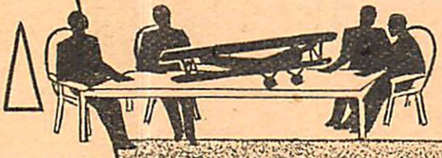
First glide the model without winding the rubber motor. If it dives, move the wing forward; if it stalls, move the wing backward until it glides steadily. Now, wind up the rubber motor and try it again. If it dives or stalls, re-adjust the wing. It may be necessary to give the wing "wash-in" and "wash-out" to keep the model level. A little experimenting will show you what will need to be done.

If you have built and adjusted this model airplane carefully and correctly, it will take off, fly around the room several times, and make a landing that will make you proud of it. By adding one more strand (3 strands), of rubber, you will transform your model into an extraordinary stunt plane.

Be sure to read MODEL AIRPLANE NEWS' New Feature — "Air Ways — Here and There" on page four of this issue. In addition to the News of American Sky Cadet activities, you will find interesting accounts and pictures of model meets, new models and Junior Aviation doings all over the country.


4½"
1½"
REAR HOOK
THRUST BEARING
PROPELLOR SHAFT
WING TIPS (MAKE 2)
7"
FRONT VIEW OF WING
WING TIP
WING CLIP
PAPER ONLY (NO OUTLINE)
WING CLIP
3"
LANDING GEAR PATTERN
2½"
3½
Scale = Full.
By Robert Green.

Aviation Advisory Board



Conducted by
CHARLES HAMPSON GRANT
Formerly of
The Technical Section, Air Service, U. S. Army.
Chairman of the Board.

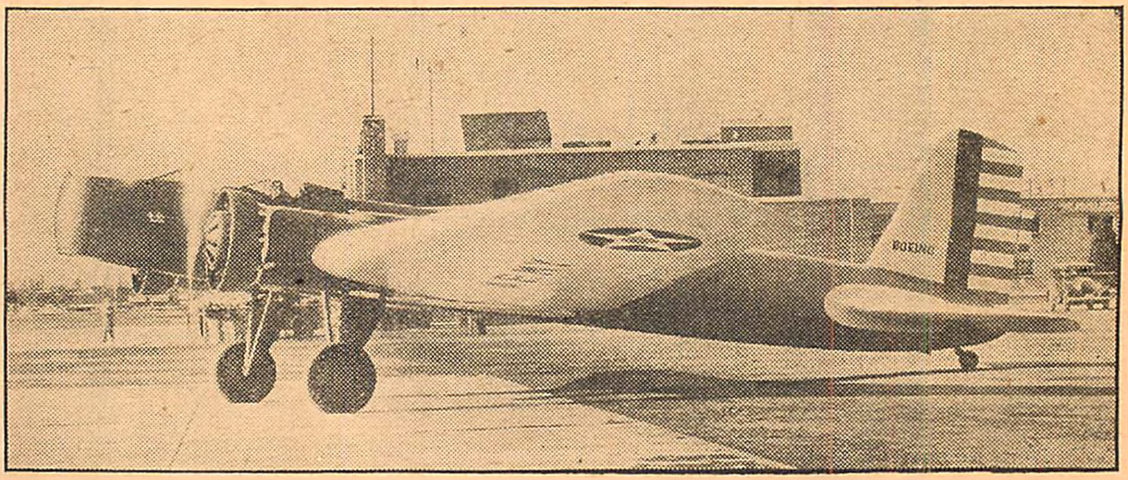
AS USUAL, questions about model building are swarming in on us every day. We find, however, that many of them are very similar, the majority apparently running to the question of design. In consideration of this fact, we will take up several of the most important ones and will try to shed a little light where there seems to be a great deal of darkness at the present time.

One of our young friends writes us that he has been unsuccessful in doping the wings of his model. He says that after applying the dope and the wings start to dry, they curl up or are distorted from their true shape. It is evident, from the circumstances, that the frame is very light and the dope entirely too strong. I would suggest either one of two things, namely, use banana oil in place of the dope or use the method that is quite common among model builders in which no dope is used at all. It is as follows: When the paper is in place on the wings or fuselage, spray them slightly and evenly over their entire surface with water. This may be accomplished by using the sprayer that comes with "Flytox," or some other similar device. Now, while the wings are drying, place your wing in such a position that it will have the proper form when the paper has thoroughly dried. Probably it will be necessary to place small weights along the front and rear edges of the wings in order to hold them in place. The paper should not be allowed to dry too quickly. This may cause distortion. Let it dry very slowly and evenly. When it is done, you will find that you have a beautifully smooth surface. The advantages of this method are: First, no added weight of dope; second, less chance of frame distortion. As we suggested above, banana oil may be used. However, this has a greater tendency to warp the frame and also adds a certain amount of extra weight.

Here we come to another important question. In the February issue we gave a formula for the correct area of the propeller blade. It was as follows:

$$a = \frac{\sqrt{(d^2+w^2)} + d}{2} (0.8)\ D$$

Robert Jolie of Marlboro, Mass., writes and tells me that he has had trouble in working it out. Well, Robert, if you tried to work out the formula as you have written it in your letter I can understand where difficulty would arise. You have left out the *D* at the end of the formula. This *D* represents the diameter of the propeller. However, it is quite possible that you have been trying to solve the equation with two unknowns, *d* and *w*, as you say in your letter. The equation, as given, does not allow for this condition. *d* and *w* or the "depth" and the "width" of your block, also its "length," must be known. Then you can solve for the area of the propeller blades that would be given by such a block. On the other hand, if you wish to design a propeller with a certain definite area or value of *a*, then it will be required to find the value of *d* and *w*. To do this, we must first know what pitch and diameter our propeller is going to be. For the sake of example, suppose we select a diameter of 10 inches for our propeller and a pitch of 15¾ inches. A good rule to follow is to make the pitch about 1½ times the diameter. Now, our problem is to find what this has to do with the size or dimensions of our block from which we cut the propeller. We know that the pitch of the propeller is the distance that it moves forward in one revolution. In this case it will be 15¾ inches. We also know the distance that the tip of the blades travel around in one revolution is, (π times 10 inches) or 10 (3.1416). This gives you the circumference of the circle traveled by the propeller tip. Now, let us review the situation. The propeller moves forward 15¾ inches and travels (*Continued on page 47*)



LATEST ARMY WAR BIRD: This is the newest military aircraft developed for the U. S. Army Air Corps. Developed as a bombing plane, this Boeing Hornet - powered metal monoplane flies faster than any other aircraft of its type in the world; nearly 200 miles per hour. Its landing wheels fold back into the wings, increasing the flying speed of the plane.

Build "Cessna" Model

(Continued from page 8)

1/8" x 1/16" balsa. Be sure the No. 1 ribs slant properly so the dihedral used will bring them flush with the No. 1 center section ribs. The tips of 1/32" x 3/64" bamboo may be put on and glued. Now the remaining ribs can be glued on. A tiny bit of cutting will probably be needed on some of the ribs, as it is quite difficult to get a set of tapered ribs which all fit exactly the first time.

The top spar, V, is put in last, and the cracked outer end glued to the bamboo tip. A 1/8" x 1/16" balsa diagonal brace, W, is put in place in each wing at the large end as shown on Figs. 5 and 6. This is to strengthen the wing against the twists and pulling of assembling and removing.

The wings are now complete, except touching up with sand-paper on the leading and trailing edges, when the wings are dry and off the board. Incidentally, an old drawing board makes a perfect assembly table for all glue operations including fuselage sides, wing, and tail.

COVERING

The windows and cockpit cover are put on first. Cut from cellophane two strips to cover all the windows on each side. Each strip should be about 1" x 6". Then coat all the sills with glue and, starting at one end, run a knife blade or the end of a pencil along over the glue to press cellophane on tight. Allow 15 minutes to dry and cut off the excess with a sharp razor blade. The cockpit cover is done the same way, using a separate piece for each section.

When this has been completed, the papering may be started, working from the nose back. It is better and a lot quicker to use a number of small pieces rather than try to use a large piece with cuts made for obstructions. This is especially true around the nose and the windows.

Cover the entire fuselage first, then the horizontal tail surfaces, the rudder and fin and lastly the wings. In covering the top of the fuselage from the center section back, use one piece from one top longeron over pieces H and down to the other top longeron. Then cover the sides and leave the bottom until last. For the wings, use one piece for each lower surface. On the tops use two pieces, one from ribs No. 1 to No. 7 and one from No. 7 to the tip. Use pure banana oil for all paper sticking.

When all covering is finished, spray the entire model lightly with water, using an ordinary household atomizer. If any part does not tighten sufficiently, spray it again.

DECORATING

The original model made from these plans has orange wings, white body, stabilizer and fin, and orange rudder and flippers. The paper comes in several colors so any number of combinations may be worked out.

All struts and the wheel tires should be painted black. The wheel centers and the propeller are aluminum as is the nose, back to the first window. The windows should be outlined in black and doors drawn on. Black India ink is good for this. The spinner is bright red.

Your model is now complete and if you have followed directions carefully, you will have a beauty.

FLYING

This model flies well on six strands, but more or less may work better on some particular model, so try five or seven. The weight of the model has an important bearing on this. The original model weighs about 1.45 ounces, ready to fly. Any weight up to 2 ounces is good, although the more weight there is, the less duration it will have. The little ship will probably be a bit nose heavy if the cowl and motor are used. A small piece of strip solder on the rear of the motor stick will allow good adjustment of this, as it may be slid back and forth.

For exhibition use, the wing pins may be bent so the tops of the wings are level, as in the large Cessna. For flying, however, a dihedral of at least an inch at each tip is necessary.

By using a winder and rubber treated with a good lubricant, remarkable flights will result. Many good flights of about 20 to 25 seconds have been made hand wound. With a winder, the flight will be much longer.

Incidentally, in closing, I might mention that this model makes a beautiful glider, especially if the motor stick and cowl are removed. By adjusting the tail properly, excellent flat glides may be had, and in favorable locations, soaring flight would undoubtedly result.

Airplane Engine

(Continued from page 20)

seating and thus a good seal. The springs must be measured for strength in order that all valves will be securely drawn home at the proper time.

Carbon is removed from the pistons and new rings installed where necessary. Care must be taken to have approximately twenty-five thousandths of an inch end clearance for the piston rings. If more is allowed, a good seal will not be made. If less clearance is permitted trouble will result. As the rings expand when the cylinder fires, the ends will butt together and finally, as no more volume is available for expansion, the rings will break. Obviously, this results in a loss of compression and in a high oil consumption.

The engine is then reassembled in the order of tearing-down. It is wise to install new gaskets in all joints where used. Particular care must be taken to eliminate any possible oil leaks. Another point is that air leaks in the lubricating system will prevent the pump from maintaining a proper oil pressure.

After a top overhaul it is wise to run the engine at reduced throttle for at least three hours. If time is available, five hours is even better. The speed of the engine can be increased as the running-time increases. This is to permit the new rings and the reground valves to adjust themselves to their new seating and sliding surfaces. It is also well to adjust the valves once more after running as the pushrods may have bedded themselves in more firmly.

THE symptoms of the need for a major overhaul are somewhat the same as those of the top overhaul. A gradual loss of power results generally from loss of compression which can be corrected by the methods used in a top overhaul. In addition, however, loose bearings and bushings may be noticed by a certain amount of noise. We have noted that the usual operating time between major overhauls is from 300

(Continued on page 42)

BOYS! PRICES SHOT WAY DOWN LIKE A BOMBSHELL FROM THE AIR

We weren't satisfied with offering the world's lowest prices, so we have cut them still deeper—down to the bone—just as if a huge torpedo had been dropped and shattered them beyond recognition. No one can afford to miss the sensational offerings which are presented on this page. Every item is a tremendous saving and the same guarantee of absolute satisfaction, highest quality, and perfect design and workmanship goes with every sale, in spite of these slashing, daring price cuts.

SCIENTIFIC BALSA

Scientific Balsa Wood is the lightest and best Balsa grown. It is kiln-dried, straight-grained stock, especially prepared and cut to convenient usable sizes.

1/16x1/16	$.01	7 for $.05
1/16 x 3/32	.01	7 for .05
1/16 x 1/8	.01	7 for .05
1/16x3/16	.01½	6 for .05
1/16 x 1/4	.01	6 for .05
1/16 x 1	.04	4 for .15
3/32 x 3/32	.01	6 for .05
1/8 x 1/8	.01	6 for .05
1/8 x 3/16	.01½	6 for .08
1/8 x 1/4	.02	6 for .10
1/8 x 3/8	.02½	5 for .10
1/8 x 1/2	.03	6 for .15
1/8 x 1	.05	6 for .25
3/16x3/16	.02½	5 for .10
3/16 x 1/4	.02½	5 for .10
3/16 x 3/8	.02½	5 for .15
3/16 x 1/2	.04	6 for .20
3/16 x 1	.06	3 for .15
1/4 x 1/4	.03	6 for .15
1/4 x 3/8	.03½	5 for .15
1/4 x 1/2	.04½	4 for .15
1/4 x 1	.06	3 for .15
5/16x5/16	.03½	3 for .10
3/8 x 3/8	.05	5 for .20
3/8 x 1/2	.05	5 for .20
3/8 x 3/4	.07	4 for .20
3/8 x 1	.09	6 for .50
1/2 x 1/2	.07	3 for .20
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1/2 x 1	.15	4 for .50
1 x 1	.18	2 for .35

SHEET BALSA
18" lengths

1/64 x 2 .... .05

SHEET BALSA
36" lengths

1/32 x 2	.05
1/32 x 3	.09
1/20 x 2	.06
1/16 x 2	.06
1/16 x 3	.10
3/32 x 2	.07
1/8 x 2	.07
1/8 x 3	.12
3/16 x 2	.09
3/16 x 3	.15
1/4 x 2	.11
1/4 x 3	.18
3/8 x 2	.16
3/8 x 3	.25

SCALE MODEL TISSUE
For models that are to be covered with colored dope.
Sheet 21" x 25"—2 for .05

PROPELLER BLOCKS

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3/8 x 3/4 x 6	.02
1/2 x 3/4 x 5	.02
1/2 x 3/4 x 6	.02
5/4 x 3/4 x 7½	.03
5/8 x 3/4 x 7½	.03
5/8 x 1 x 7	.03
5/8 x 1 x 8	.03½
7/8 x 1 1/8 x 10	.06
3/4 x 1 1/8 x 8	.04
3/4 x 1 1/8 x 10	.06
3/4 x 1 1/8 x 11	.07
7/8 x 1 1/2 x 11	.08
5/8 x 1 1/4 x 12	.08
1 x 1 3/8 x 12	.09
7/8 x 1 1/2 x 12	.09
1 x 1 5/8 x 13	.10
7/8 x 1 1/2 x 14	.11
5/8 x 1 3/8 x 16	.12
1 x 1 1/2 x 16	.15

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36" lengths

1 x 1½	.28
1 x 2	.30
1 x 3	.35
1 x 6	.65
2 x 6	.95
3 x 3	1.00
3 x 6	1.90

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Per pint .... .95

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1⅞" diam. Pair.... .16
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Bushings for wheels—
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New design. Each. .25

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1/8" O.D. per ft... .07
3/16" O.D. per ft... .11
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12" wide
.005 per ft......... .12
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Per Doz. .... .20
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1/8 diam. 4 ft. .... .05

DOWELS
1/8 diam., 36" long, 3 for .... .05
3/16 diam., 36" long, 3 for .... .05
1/4 diam., 36" long 2 for .... .05

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1/32 x 1/4 x 8, each .00½
Per doz. 05
1/16 x 1/4 x 12" each..01
Per doz. 07
1/16 x 1/4 x 15" each..01
Per doz. .... .08
1/16 x 1/4 x 18" each.1½
Per doz. 15

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1/16 x 1/16 x 8, doz....03
1/16 x 1/16 x 10, doz.. 04
1/16 x 1/16 x 12, doz...05

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Scientifically prepared by the world's largest manufacturer of model aeroplane rubber. Five sizes.
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For twin pushers and all heavy models. Twin gears.
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For small twin pushers and all indoor models. Twin gears.
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Three-cylinder finished motor, ready to use and run. The completed motor tested.
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3 x 3 x 24........ 4.50
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6"	.25	2.50
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8"	.35	3.75
10"	.40	4.25
12"	.45	4.75

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Mars' First Brood

(*Continued from page* 16)

Heurteaux's calm insult, tried, perhaps, to find a suitable rejoinder, the Frenchman found the opportunity he sought to create. Catching his adversary momentarily off guard, he swept into a fierce attack that generally ended in another score for the Allied Ace.

These little pleasantries aided Heurteaux more than a little in rolling up his impressive total of fallen foes but on one occasion it also ended in a minor disaster for the gentleman who so loved to engage in them. Sighting a lone Fokker one day, as he was patrolling the skies over the battle front, M. Albert wheeled in to the attack. Characteristically he advanced, streaming lead and steel into the foe. The latter swerved sharply to the left and let go a healthy blast of his own that sent bullets whistling by the Frenchman's ears.

Temporarily out of position to return the fire, Heurteaux replied in his best style. Leaning out of the cockpit, he drew his fingers to his nose in gay gesture but this time he drew them back still more quickly as a chance shot from the angry Fritz's gun went through his hand. It was fully in keeping with his sportsmanship that Heurteaux returned to camp to tell this story on himself and join in the laughter that his comrades had at his expense.

As Heurteaux's total of fallen Fokkers began to assume sizeable proportions, he soon found himself in a lively competition with a fellow Cigogne, "Pere" Dorme, for premiere honors of the Escadrille. Day by day these two would start out and when another foe was vanquished, calmly return home and watch the new total marked upon the chart. Later, as official recognition of the deed arrived from Headquarters in the form of another palm, the two friendly rivals, Heurteaux and Dorme, would nonchalantly receive them and sit side by side, sewing the new emblems to the ribbons of their Croix de Guerre. Their actions were typical of their attitude. To them the rewards were of but little significance compared to the accomplishments for which they stood.

The morning of May 5, 1917 was cloudy and gray when, Heurteaux, roaring through the early mist in his little Spad, suddenly came upon a group of five enemy planes, headed for the French lines. Undaunted by the odds, the captain drove into the formation, singled out a plane and sent it to earth in flames after a brief exchange of shots. Making certain that the falling Boche was really vitally hit, the Frenchman turned about for further prey. But the Germans had anticipated his return and before the lone Ally could maneuver himself into position, two Fokkers darted from a cloud behind him and riddled the tricolor Spad with bullets.

Two of them took effect on the ambushed captain himself, one piercing the leg and another tearing a painful wound through his arm. Stunned and hurt, the intrepid Heurteaux quickly put his plane into a nose dive and headed straight toward the earth below. His ship dropped steadily for a full six thousand feet, when the enemy, certain that he would crash eventually, relaxed their vigilant pursuit for an instant. It was the moment Heurteaux was praying for. Despite his aching body and fast weakening condition as the loss of blood from his open wounds began to take its toll, the Frenchman pulled his ship to an even keel and set sail for the friendly allied lines 30 miles to the south. But the Germans were not so easily shaken off and, bent upon making his destruction certain, returned to the attack.

In his crippled condition, Heurteaux was unable to make any effectual reply and so streaked for home as fast as his trustworthy Spad could carry him. Harassed as he was by the vengeful enemy and his own precarious plight, the brave Cigogne brought all his marvelous flying art into full play and succeeded, through sheer nerve and dexterity at the controls, in affecting a safe landing behind the Allied lines.

After two months in a hospital convalescing from wounds and shock, Capt. Heurteaux was back once more in his beloved Escadrille where, on July 9, 1917 he was bestowed with the Medal of the Legion of Honor. In less than twelve months, this valiant French Ace had brought down officially twenty-one enemy planes, besides a goodly number that could not be verified for recognition.

Later on a new type of machine gun was brought to the airport for trial and on the morning of September 3, 1917, Capt. Heurteaux mounted it on his plane to take aloft and try out. Climbing to an altitude of over 20,000 feet, the captain was just beginning his experimental work with the new gun when a huge Fokker zoomed upon him from nowhere. Well to the rear of his own lines and engrossed in his labors, the attack came upon him with such sudden fury that the officer was taken completely off guard.

However, battles were always to his liking and what better target could he wish for on which to try this new weapon of his than a plane with its cross-embellished wings. Accepting the battle challenge, Heurteaux flew at his foe and let loose a blast of steel from his new gun. Strangely enough the Fokker swept through the line of fire without the trace of a hit and then banked sharply to attack the little Spad. The latter adroitly side-slipped away and then, quickly coming up again underneath the German, Heurteaux let loose another volley at the very vitals of the enemy craft. Consternation suddenly came over the steel nerved French veteran as he perceived his usually well directed shots going astray. Despite his excellent maneuvering, he had not yet scored a single hit in this unlooked for encounter.

As he twisted away desperately to avoid another sudden charge from the onrushing Boche, he felt his plane being riddled with bullets. Undaunted, he wheeled in a sharp bank and once more drew bead as he flew in on the German, only to see his efforts again wasted as the enemy airman flew unscathed through his line of fire. Working his gun frantically in this unhappy plight, Heurteaux succeeded only in jamming it, thus ending completely what little use it may have been to him.

Quick to sense his helpless predicament, the veteran Frenchman started down in a spin to avoid further pursuit but the pilot of the big Fokker was equally alert to his adversary's difficulties and followed him with

(*Continued on page* 44)

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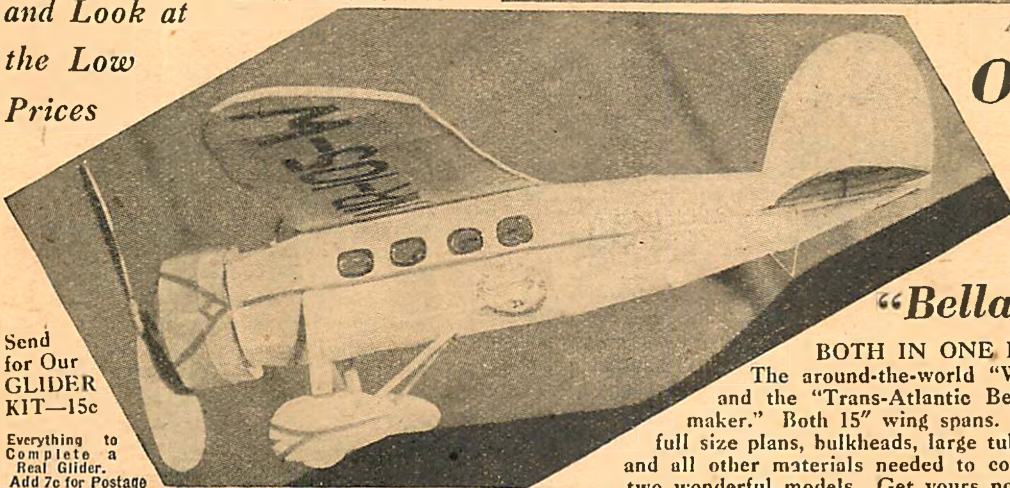

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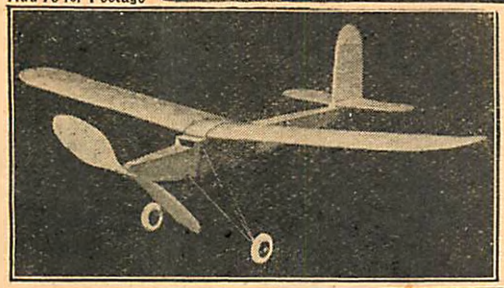

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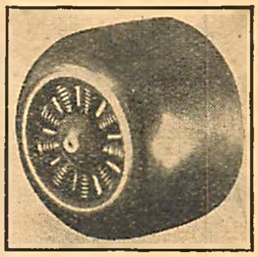

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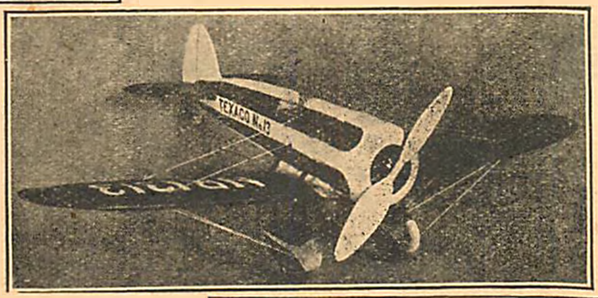

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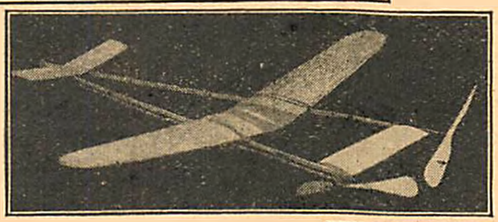

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Airplane Engine

(*Continued from page* 38)

to 400 hours although careful operation and checking may make it entirely possible to prolong this interval.

A close watch must be kept of the lubricating system, however, for the oil may be deposited in the various small oil passages. Eventually this may solidify into a sort of slush which will effectually close up the passage. Grit and metal particles in the crankcase drainings will give warning of impending trouble. A burned out and seized bearing will result, causing a forced landing.

It is well to remove the engine from the plane when it is to be completely torn down. Generally it is mounted on a stand which permits full horizontal motion, thus the engine can be turned over or in any angle desired. Much time can be saved if special bins are available. For instance, all parts of each cylinder will be placed in one compartment which is numbered. Parts are not lost or misplaced when this system is used.

One general rule to remember is that tapping or hammering with metal hammers will become expensive as more and more parts are broken. Use nothing but fibre hammers and drifts. If a unit fails to come free, it will invariably be a forgotten bolt or nut that is holding it, and hammering will not free it.

Remove the cylinders and pistons in a similar manner to that used in the top overhaul. The front or nose section then may be removed by backing off on the proper nuts. It is interesting to note that gaskets are not used between the various sections as the aluminum alloy is sufficiently soft to draw them together in an oil-tight fit. However, for this reason never insert a screw-driver between sections to pry them apart. An indentation will result which will cause an oil leak.

If the two-piece type of radial crankcase is used, it may now be separated and the crankshaft removed. The accessory section is next pulled off.

Another make of engine is best disassembled by working from the rear end forward. In any event, it is wise to use the detailed plans as offered by the manufacturer.

The crankcase sections are taken apart in detail. The various parts are now collected in the proper bins after having been thoroughly cleaned of grease and dirt.

A thorough inspection is made of each part for possible weaknesses and rough spots, especially where a moving contact is made, such as a gear tooth or a knuckle pin. Any rough spots are smoothed down with a stone for these will eventually result in scratching and increasing clearances thus permitting oil leaks.

PARTS with excessive clearance and wear must be renewed. Cylinder barrels out of round, or tapered more than three-thousandth should be replaced. These can be rebored and fitted with over-sized pistons but this is best done at the factory. If pistons are replaced, the new ones must weigh within one-half ounce of the old one. This is to prevent the unbalancing of the engine.

In assembling the power plant care must be taken that no dirt or fragments of metal fall into the structure. Many forced landings have resulted from carelessness in this matter. All parts are liberally greased and oiled as they are fitted into place. Caution must be taken to insure that all safety wires and similar devices are secured in place as the part is assembled. Otherwise they are apt to be forgotten and trouble will result.

When once assembled, the engine is given a belting-in run. That is, it is turned over for an hour or so by means of an electric motor. This gives all replaced parts an opportunity to fit themselves into place. The engine is then turned over by its own power for from five to ten hours depending upon the number and kind of replacements. It must be run in slowly at first though the speed can gradually be worked up. Often after this period the engine is torn down again for possible adjustments. This, however, is not mandatory.

Checked over thoroughly, it is installed in the plane. Extreme care must be taken to make tight all connections of fuel, oil, and instrument lines. The engine is then run and the various pressures observed. If the ground test proves successful, the engine is ready for flight. The pilot can help materially if he will take unusual precautions to warm up slowly while the power plant is in the process of being broken up. Nor should he use full throttle except when it is absolutely necessary. Care and common sense will greatly increase the operating time between overhauls.

3-View Drawings How to Build Them

(*Continued from page* 31)

olive-drab on the fuselage and upper surfaces of the wings, while the cowling was silver or light gray. The under sides of the wings should be either silver or the color of unpainted fabric, i.e., very light cream.

The cockade was left off the wing in the drawing to simplify it. However it should be about an inch and a quarter in diameter, and an inch in from the tip, if it were to be to the same scale as the rest of the plane.

Being British it should have a red center and blue outer ring, with a white ring between them. The rudder has the blue next the tail post then white with the red at the trailing edge. When the cocades were placed against a dark background they were usually surrounded by a white ring as shown in the side view.

Hell-Diver

(*Continued from page* 21)

smooth base for the paint before applying. Paint in one direction and use a good brush. If the paint "blushes" (turns white in spots) paint over the spots with banana oil.

7TH STEP—This, the last and finishing step. Put on the machine gun or any other little details you may have made up. Paint on the rudder stripes and aileron markings.

*SPECIAL NOTES:

Top Wing—Use templates as in the construction of the fuselage. Make sure the camber is put into the wing.

Bottom Wing—Same as top wing. Due to fuselage contour, a small part of the wing cannot be shown in the plan, except by a dotted line. Make allowance for this extra length.

Rudder and Stabilizer—Use templates as before and streamline well.

Pants—Templates brought into play

again. Cut pants from one piece of wood and scoop out hole for wheel. If desired the pants can be made from three-ply balsa. After pants have been mounted to the landing gear struts, streamline the joint with some plaster of paris. Experiment until right consistency is obtained before applying.

Drag Ring—Drag ring is made from a strip of aluminum. Wrap it around the motor, cut it to size and push a pin through it to hold it to the motor.

Machine Gun—Explained in drawing. Use aluminum for swivel.

Propeller.—Use template and cut from spruce.

Paint—Paint ship entirely white except rudder strips which are red and blue. Red is nearest the fin. Motor black.

Motor—See drawing. After shaping the ⅜" square wood into cork shape, wrap thread around it for cooling fins. Put two pieces of 1/16" dowel on top, cement on fuselage, and then place two pins under each dowel for rods.

Struts—Wing struts are made of 1/8 x 1/16" spruce streamlined. Landing gear struts 1/8 x 1/4" and 1/8 x 1/16" streamlined.

I believe the above directions and a list of materials, printed here, will enable you to go ahead with construction after you have secured the necessary materials. If you run into any difficulty, send in a self-addressed envelope, and I will be glad to help you out. I should also like to hear how you like this model. The MODEL AIRPLANE NEWS is striving to give you what you want and you can help them greatly, and yourself too, if you will write in.

LIST OF MATERIALS.

Part, Size and Material.

Fuselage, 1 3/4 x 1 1/2 x 8 1/2", Balsa.
Top Wing, 1/4 x 2 3/8 x 12", Balsa.
Bottom Wing, 1/4 x 2 x 12", Balsa.
Rudder, 1/8 x 1 7/8 x 2 1/4", Balsa.
Stabilizer, 1/8 x 2 x 5", Balsa.
Pants, 3/8 x 1 x 2", Balsa.
Propeller, 1/8 x 1/4 x 3", Spruce.
Wing Struts, 1/8 x 1/16 x 36", Spruce.
Land. G. Struts, 1/8 x 1/4 x 12", Spruce.
Drag Ring, 3/8 x 6", Aluminum.
Wheel, 3/4" dia., Celluloid or Metal.
Paint : White, Red, Blue, Black; Lacquer.
1/16 x 12", Dowel.
Tailskid, heavy wire, Copper Wire.

MISCELLANEOUS.

Thread, Pins, Cement, Plaster of Paris.

A Course in Airplane Design

(*Continued from page* 33)

knowledge to work on some more practical problems of designing.

The best way to understand a thing is to make use of it. One may understand all of the principles involved in the use of the hand saw, but, until he actually takes a saw in hand and tries to use it—probably making a mess of things the first few times—he cannot really understand and remember how to saw a board square. That is true with everything.

Now, therefore, we will take up the discussion of forces applied to practical cases. It may seem that such things as "friction" and "inertia" have but little to do with airplane designing, least of all when illustrated by as simple a device as a block sliding down an inclined plane. But things are not always as they seem. Friction and inertia have a very great deal to do with airplane design. When friction is better understood we will fly airplanes at unheard-of speeds: when inertia forces are completely analyzed and used to advantage we shall have conquered the deadliness of the tailspin.

For those reasons it will be a good idea to try to get as much from the following simple examples as possible.

Example 1.

A block, such as we have illustrated in earlier articles of this course, is sliding down an incline at a uniform speed, being let down by a rope. The block weighs one ton and the slope of the incline is 1 in 2. The coefficient of friction is 0.25. Find the tension in the rope.

This is largely a review example. But, as in all engineering work, the first thing to do is to get the thing down on paper in the form of a clear, concise sketch. Turn to the two previous articles of this course, if they are handy, and follow the method used there in setting up the sketch. In those articles, too, we explained the method of handling this problem.

Resolving the weight of the block—two thousand pounds—into components, one parallel to the incline and the other normal to it, we find the tangential component to be about 895 pounds and the normal component about 1800 pounds.

Knowing that the friction force is always opposite to the direction of motion and equal to the normal force mutiplied by the coefficient of friction, we draw it pointing up the incline. Multiplying 1800 by 0.25, we

(*Continued on page* 44)

Mars' First Brood

(*Continued from page* 40)

open throttle and blazing machine gun. One after the other the Boche's bullets found their mark on the game little Spad until finally her heroic pilot, too, began to feel their sting. A final shot in the hip practically cost Heurteaux the control of his lower limbs but despite the shock and pain of his wounds and the ensuing loss of blood that streamed from the gaping holes, he managed to escape from the frightfully uneven encounter and through the mastery he maintained at the controls of his little Spad, he finally succeeded in bringing the riddled craft to a safe landing behind the British lines.

His battle and subsequent dive to earth had been witnessed by scores of men who rushed to his aid as he landed. Sorely in need of aid, the blood-spattered captain was tenderly helped from his ship and rushed to a hospital for immediate care.

So ended the active fighting career of one of the truly great in a host of mighty warriors of the sky. It did not end that love of service he so gladly extended to his beloved France nor did it dim his value in his chosen field of aviation. It was only logical then, that later, when the French government found need to send an expert on military aeronautics to America with a highly important mission, that the man she should choose once more was Captain Albert Heurteaux.

Aerodynamic Design

(*Continued from page* 28)

The lift and efficiency increase materially with the amount of stagger. When the wings are staggered positively an amount equal to (2/5) or (0.4) of the chord, both the life and efficiency is *increased* about five per cent. A negative stagger of (0.4) the chord will *reduce* the lift and efficiency about this same amount. I suggest that you use about this value of stagger on model planes.

The increase in lift and efficiency when stagger is used, is due to a reduction of the interference between the wings. The air seems to flow around the surfaces without the top air flow effecting the flow around the wing below it to as large an extent, as under the conditions existing when there is no "stagger" to the wings.

Well, dear readers, it may seem that you have been laboring through a great deal of technical matter. However, absolute numerical values have been given here which you may apply to your model planes and be assured of proper results, especially regarding their flying capacity. So have you not been truly compensated for your pains? This added knowledge may make "The Old Crates" fly just a little better.

However, in order to make it easy for you to take in and use all of the old facts which have been given in the first three articles, a complete summary of all the outstanding points will be given in next month's issue, and in addition a few points about Propeller Design. You might say that this is like getting a full course dinner in the form of a small pill; taken quickly and easily, and always handy. Let us hope also that considerable brain nourishment will be the inevitable result.

Course in Airplane Design

(*Continued from page* 43)

find that the value of the friction force is 450 pounds.

There being no acceleration, there are no inertia forces to consider in this case.

Now, applying the principle of equilibrium of forces, we find that there are two forces—the tension in the rope and the friction force—acting up the incline in opposition to one force—the component of the weight parallel to the incline—acting downward. Since these forces must be balanced when the block is moving uniformly, the tension plus the friction force must be equal to the tangential component of the weight. By subtraction, the tension required is found to be 445 pounds.

THAT is the simplest case. Now suppose the block were being pulled *up* the incline, by the rope, at a constant speed. What tension must now be applied by the rope?

Graduate engineers have lost good jobs merely because they jumped to conclusions on a little thing like this and wrote out specifications for cable under the impression that the tension will be the same whether the block moved upward or down, as long as it moves with uniform speed.

Through hurry, they failed to consider that, since the direction of motion is reversed, the direction of the friction force is also reversed, and that it is now helping the tangential component of the weight buck the pull of the cable.

That error actually occurred. Several miners were killed because an engineer was in too big a hurry to make a two-minute equilibrium sketch and put down all of the forces, comparing the velocity and friction arrows to see that they point in opposite directions.

To find the tension in this case, we *add* the *two* downward forces, and find that the tension is about 1345 pounds, or a great deal more than it was for uniform downward motion. This great increase is due entirely to the fact that the friction, instead of helping hold the block, is now working against the cable.

In the next case, acceleration must be taken into consideration as well as friction. Suppose the same block is moving down the incline with constantly accelerated motion. The rate of gain of speed, or the acceleration, is four feet per second per second.

What is the tension in this case?

It is best to make another sketch, showing, this time, the direction of the acceleration and drawing in the inertia force arrow in the opposite direction. The acceleraton, being downward along the incline, must produce an inertia force that will act upward and thus will help the cable. Therefore we have one force—the tangential component of the weight—acting downward and three forces—tension, friction and inertia—opposing it.

We find the amount of the inertia force by comparing the force (its weight) which will give the block the acceleration of a freely-falling body—31 feet per second per second—and set up a proportion.

200 : 32 :: F : 4

Whence F, the inertia force, is 125 pounds.

And, by equilibrium of forces, we find that the tension in the rope is considerably smaller than before, since it now has the inertia force helping it. It is about 320 pounds.

It is excellent practice to think of these examples in terms of everyday experience. We know from practice, for example, that less force need be exerted in a rope holding such a block or car going down an incline when the block is allowed to speed up as it coasts than when the block descends at uniform speed.

Example 2.

In Figure 1, there are two blocks, one on each side of a hill. This is a practical case. The block on the left is a counterweight for a mine car, having such a mass that the tangential component of its weight is equal to that of the mine car when the car is empty. When the car is loaded, therefore, the motor at the top of the shaft need pull only the weight of the coal, plus the friction forces. This system, when it can be used, results in a very considerable saving of power per year, as may easily be seen.

The slope of the mine shaft is one in three. The slope of the counterweight track is one in two. The weight of the coal skip, loaded, is three tons. The weight of the counterweight is seven hundred and fifty pounds. The motor at the top is pulling the coal car up the shaft with constant velocity. The coefficient of friction, both for the car and the counterweight, is 0.1. Find the constant force the motor must exert in the cable.

IN THIS case we can apply exactly the same methods as before. First of all we resolve the weights of the car and the counterweight into components parallel to and normal to their respective track slopes. Then we find the friction forces, and draw the velocity arrows on the sketch; then put the friction arrows on the paper as opposite to the velocity arrows.

The counterweight, having a component parallel to its track of about 336 pounds, which is equal to the tangential component of the car when empty, will exert that force to help the motor now, minus the force needed to overcome friction in the counterweight itself. Thus we find that there is a force of about 270 pounds helping the motor.

On the other side, the loaded car is moving up the track. Hence its friction force must act in a downward direction, and must be overcome by the tension in the rope. Since the tangential component of the weight of the car and its load is about 1900 pounds, the tension must be 1900 plus 570, which is the friction force. And the force supplied by the motor must be equal to the difference between the tensions of the car and the counterweight, or 2470 minus 270, or 2200 pounds.

In the practical instance, the weight of the mine car empty and therefore of the counterweight would work out much larger than we have shown here. Hence the saving in power would be greater even than that indicated by this example.

The problem may be worked also if there is an acceleration to be considered. In that case, however, the accelerating force must be found by comparing the tangential components of the two weights after friction has been deducted, and the effect of this *total* accelerating force upon the *total* mass found.

Example 3.

In designing a light airplane which is to climb at the rate of eight hundred feet per minute while flying at a speed of seventy-five miles per hour, it is necessary to find the required maximum thrust so that a suitable power plant may be chosen. The ship is estimated to weigh one thousand pounds loaded. The drag force at seventy-five miles an hour, as estimated from wind-tunnel tests, is about one hundred and fifty pounds.

To solve this problem we have only to consider the airplane as a block on an inclined plane as before. We have the necessary vertical speed and the flying speed. Drawing these in a triangle to scale, we find that the slope of the plane is about 13 in 109. This may be checked by using the methods of squares on the sides of the right triangle.

Having found the slope, we can easily find the tangential component of the ship's weight to be about 121 pounds. This, added to the drag or friction force, gives us the thrust force that must be developed by the propeller, about 270 pounds.

SO FAR we have dealt with forces alone. But now we need some method of measuring the effect of forces. We need some standard to compare the work done by one machine with that done by another.

To do this we use units of *work*.

The unit of work on our system is called the foot-pound. This is the amount of work done by a force of one pound acting through a distance of one foot.

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Airplane Design

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It must be understood, though, that a foot-pound of work can be done by a force of a tenth of a pound pushing something a distance of ten feet, or by a force of ten pounds acting through a distance of a tenth of a foot. The term *work* places no restrictions upon the magnitude of the force. It merely states this: that the force, whatever may be its magnitude and direction, has worked through such a distance that it has performed so many foot-pounds of work.

A force of fifty pounds acting through a distance of one hundred feet does five thousand foot-pounds of work. A force of one thousand pounds acting through five feet does exactly the same amount of *work*.

Nor does the term work have anything to do with speed and time. It speaks of *forces* and *distances* measured parallel to the lines of action of those forces *only*. And, whether the force be acting upon a marble tombstone or an ice-cream cone, the work done is the same, provided the magnitude of the force and the distance move have the same product.

Suppose a weight is being lifted from the bottom of a well. The mass weighs, let us say, one hundred pounds. If the well is fifty feet deep, then, five thousand foot-pounds of work must be done to lift the weight to the top. And, since the time element does not enter, the work may be done in a day or a week.

But suppose we do not care to lift the full hundred-pound force. We get a block and tackle with which we have to exert only a quarter as much force as before. The force exerted is certainly smaller now—but the work done is still the same, neglecting friction, because, although we apply a *smaller* force we have to apply that force through a proportionately *greater* distance than before.

A barrel of oil, weighing two hundred pounds, is to be lifted into a truck body. The floor of the truck is four feet above the ground. To lift the drum directly, eight hundred foot-pounds of work must be done. To roll the barrel up an incline, a smaller *force* may be exerted, but in every case the length and angle of the incline figure out so that the *work* done is eight hundred foot-pounds, neglecting friction.

It is important, when speaking of work done, to make sure that the force which is doing the work be parallel to the direction in which the distance is measured. A barrel might be rolled up an incline by pushing parallel to the ground rather than parallel to the incline. But, to multiply that applied force by the length of the incline which is not parallel to that force would be foolish. First the component of the force that *is* parallel to the incline must be found. In all cases of work, the force to be considered is only that force or component of a force which is parallel to the distance measured.

Work can be done against friction, as well as against gravity or other forces. When work is done against friction, it is lost as heat. When it is done against gravity, it is stored up in the body as *energy*.

The next installment of Airplane Design will appear in the June issue of MODEL AIRPLANE NEWS.

Air-Ways—Here and There

(*Continued from page 6.*)

to have the *greatest number of models* listed *after* YOUR NAME. All must be different of course, and two adults must sign your statement before you send it in to us, that the model has been built by you on the date or dates mentioned.

CLUB NEWS

One of the clubs that is showing great interest and activity in the model field is the National Advanced Model Engineers of Dayton, Ohio. They are carrying on work on a real scientific basis, and all boys should be interested in affiliating themselves with this organization thereby securing the latest scientific knowledge on subjects pertaining to model engineering. The national headquarters of the club were recently at Cleveland, Ohio. However the transfer of the location of this organization was just effected through the efforts of Major J. H. Doolittle, the well known speed pilot, and the president of the national organization, Donald F. Chase, who is also a director of the Dayton Model Airplane Club.

There are chapters of the National Advanced Model Engineers in most of the large cities, with an estimated membership of about 40,000 model builders. As Spring nears, the model activities give promise of increasing and it is hoped that many new members will join this young army of aeronautical scientists. The Dayton home unit has 1400 boys enrolled. These boys are not merely novices in the art. Many have been studying the problem of model design for a considerable time. It is reasonable to expect therefore that some very startling accomplishments will be forthcoming from Dayton. Mr. Chase, the director, has promised that Model Airplane News will have interesting data and pictures to publish in each issue. We are looking forward to showing what the boys of Dayton can really do.

We have some very interesting and helpful information from Frank A. Robinton of the Model Research Laboratory of America, Stratford, Conn. He tells us that, "extensive model research is being carried on by the laboratory under the direction of two trained aeronautical engineers of long experience in model plane work dating back to the World War. Information and aid to model builders will be furnished without cost to all readers of Model Airplane News. Our files contain complete and authentic information on every wartime and modern plane, and our file of wartime photos, taken at the front by both German and Allied flyers, is one of the finest in existence." Many of our readers will probably find this service offered by Mr. Robinton of great value to them. He will welcome inquiries from anyone. Pictures Nos. 12, 13, 14 and 15 show models that were built at the laboratory.

The Bamberger Aero Club Hears the Famous and Beloved "Casey" Jones

"Casey" Jones addressed the club at their regular meeting on February 6th and gave several interesting accounts of his numerous experiences. A considerable number attended. In celebration of Mr. Jones' visit, the boys had an exhibition of models of Curtiss-Wright planes.

Mr. Polk, director of the club, tells us that experiments with model autogiros are successfully progressive. Donald McDougal and Al Gross have built a stick model following Alton Du Flon's design with smaller tail surfaces and a 9 inch wing without upturned tips, but with 1½ inches dihedral at each tip. This seems to improve the performance.

Stephen Faynor built a scale Kellet Autogiro, using a Du Flon vane hub. This flies about 50 feet.

As there will be an autogiro event in the Bamberger Indoor Contest, all members are on "pins and needles" trying their best to work the bugs out of this pioneer model field.

Advisory Board

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around sideways 31½ inches. Thus, the pitch is $\frac{P}{\pi D} = \frac{15\frac{3}{4}}{31\frac{1}{2}} = \frac{1}{2}$, where *P* is equal to the pitch and *D* is equal to the diameter of the propeller.

Now, let us look at the block from which our propeller is to be cut. The side of the block which runs parallel to the pitch or forward and back is the side *d* which represents the depth. The side which is parallel to the direction of the sideways propeller motion is the side *w* which represents the width. Therefore, we may say that $\frac{P}{\pi D}$ is equal to $\frac{d}{w}$ for they are in the same proportion. As you can see, we may obtain a value for d from its equation. (*d*) in this case equals $\frac{P w}{\pi D}$. The next step is to take the value of (*d*) and substitute it in our original equation for our propeller area. As you can see now, we have but one unknown and that is *w*. The equation would be,

$$a = \frac{\sqrt{\left(\frac{W P}{\pi D}\right)^2 + w^2} + \frac{w P}{\pi D}}{2} (0.8)\ D$$

Now, let us consider what we have in respect to actual numerical values for the various quantities. We know that $P = 15\frac{3}{4}$, $D = 10$, $\pi = 3.1416$, (*a*) is the area of our propeller blades. As an example, we will say that we wish our blades to have an area of 10 square inches. What we wish to find are the dimensions of a block from which we may cut such a propeller. The next step is to substitute the numerical values in the equation for the various unknown quantities. When this is done, simplify and solve for the value of *w*. Thus, you may calculate what the width of the block should be for 10 square inches of area, a diameter of 10 inches and a pitch of 15¾ inches. It is simple to calculate the value of *d*, for above we find that $d = \frac{w P}{\pi D}$. Solving this equation gives you the value of (*d*.).

Well, my friends, now that I have waded through this long explanation, it is possible that you may see the practical use of algebra. As we sit through the long tiresome hours of school, we do not always realize that some time in the future the many boresome subjects may prove of extreme value in solving our problems and, incidentally, helping us to bring home the bacon. Here we have an algebraic problem which is interesting because it solves a situation which actually gives us pleasure. I trust that all who read this will understand it.

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Advisory Board

(*Continued from page 47*)

We have boys who have found difficulty in securing proper longitudinal stability when they have built and flown low-winged airplanes. A common occurrence is for the machine to nose down at the start of the flight and nose upward at the end of it when the desired performance is directly the opposite. To cure this difficulty, the tail should be given a greater negative angle. When this is done, you will also find that the main wings are set too far forward in order to have the ship balance properly, so it will be necessary to move them back slightly. This greater negative tail angle will depress the tail more at the start of the flight, thus letting the model climb and allow it to nose over to a greater extent into an efficient glide at the end of the flight.

My young friend Roy Lee of Marietta, Minn., has written me asking several interesting questions which I will answer here and I wish to congratulate him upon the extreme intelligence which he shows. The first question is regarding the solution of the formula which we have already given. The second question is in respect to covering wings. He asks: "Is it better to cover a wing with one sheet of paper first on the bottom, wrapping it around and then covering the top, or, is it better to cover the bottom and then the top with two separate sheets of paper?" I should say, Roy, that the latter method is the better way and by using water, as suggested above, to tighten your paper, no wrinkles should result. The third question: "Do both propellers on the 'Twin Pusher' turn in the same direction?" No, they turn in opposite directions and, after many tests, I personally prefer to have them turn outward at the top, the right propeller turning clockwise and the left propeller counter-clockwise. The fourth question is: "How does the propeller torque act on a model?" The propeller torque is the result of the resistance to the turning of the propeller. This resistance is transmitted through the propeller to the rubber band, then to the machine itself. It tends to turn the machine in a direction opposite to that of which the propeller turns. In other words, if your propeller turns to the right, the machine will have a tendency to turn over to the left. Usually, when this torque is exaggerated or very large, it is due to the fact that the propeller is too small for the airplane and the blades are causing too much resistance. It might be corrected by increasing the area of the propeller blades. This will reduce it to a minimum. If the trouble still exists after doing this, increase the size of the vertical fin. You will find that either one of these two things, or both, will cure difficulties resulting from propeller torque.

Well, it seems that this month we have taken a pretty good sock at "Old Man Ignorance" and, at this rate, it will not be long before he will be "flattened out" on the canvas. Whatever you do, do not let him get the better of you. If you have problems that are worrying you, write to us and give us a chance to help you out.

CHARLIE GRANT,
Chairman

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1/8 x 1/4	.02	5 for	.09
1/8 x 3/8	.02	5 for	.09
3/16 x 3/16	.02	5 for	.09
3/16 x 1/4	.02	5 for	.09
1/4 x 1/4	.03	5 for	.12
1/4 x 3/8	.03	5 for	.12
1/4 x 1/2	.04	5 for	.18
3/8 x 3/8	.05	5 for	.22
3/8 x 1/2	.06	5 for	.25
1/2 x 1/2	.08	5 for	[illegible]
1 x 1	.17	2 for	.30

40″ Strips

1/8 x 3/8	.04
1/8 x 1/2	.04
3/16 x 3/8	.04
3/16 x 1/2	.05

Sheet Balsa

1/32 x 2 x 36	.04½
1/16 x 2 x 36	.05½
1/8 x 2 x 36	.06½
3/16 x 2 x 36	.09
1/4 x 2 x 26	.11

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5/8 x 1 x 8	2 for	.05
3/4 x 1 1/8 x 8	2 for	.07
3/4 x 1 1/8 x 10	2 for	.09
3/4 x 1 1/8 x 11		.06
7/8 x 1 1/2 x 11		.07
5/8 x 1 1/4 x 12		.07
7/8 x 1 1/2 x 12		.08
7/8 x 1 1/2 x 14		.10

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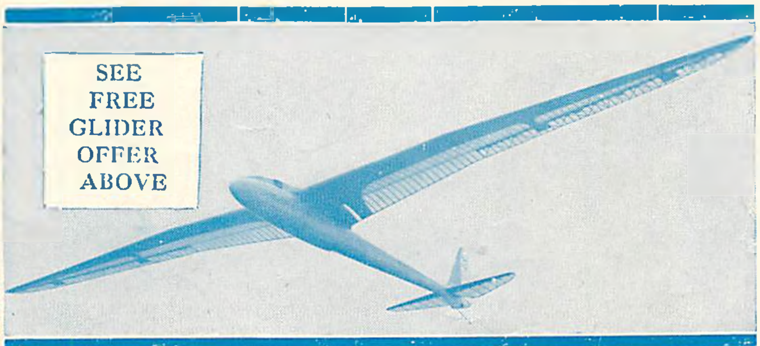

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3/32 flat	[illegible] ft. for	.01
1/8 flat	3 ft. for	.01
3/16 flat	2 ft. for	.01

Celluloid Wheels

3/4 diam.—Pair		.06
1 diam.—Pair		.08
1 3/8 diam.—Pair		.11
1 7/8 diam.—Pair		.17
Bushings	4 for	.02

Dummy Radial Engines

Celluloid, 9 cylinders, 3 in. diam. Each .... .20

Music Wire

Strong, light and stiff. Sizes: .014, .020, .028, .034. 5 ft. packages.. .02

Aluminum Tubing

1/8 Outside diam. per ft.	.07
3/16 Outside diam. per ft.	.11
1/4 Outside diam. per ft.	.13

Sheet Aluminum

12 inches wide
.005 per ft. .... .12
.010 per ft. .... .19

Thrust Bearings

Strong and light. Large size.... .02
.035 hole. Each .... .02
Per Doz. .... .20
Small size, .025 hole. Each .. .02
Per Doz. .... .20

Washers

1/8 O. D. Brass for light indoor models. Per Doz. .... .01½
1/4 O. D. Copper for outdoor models Per Doz. .... .01½

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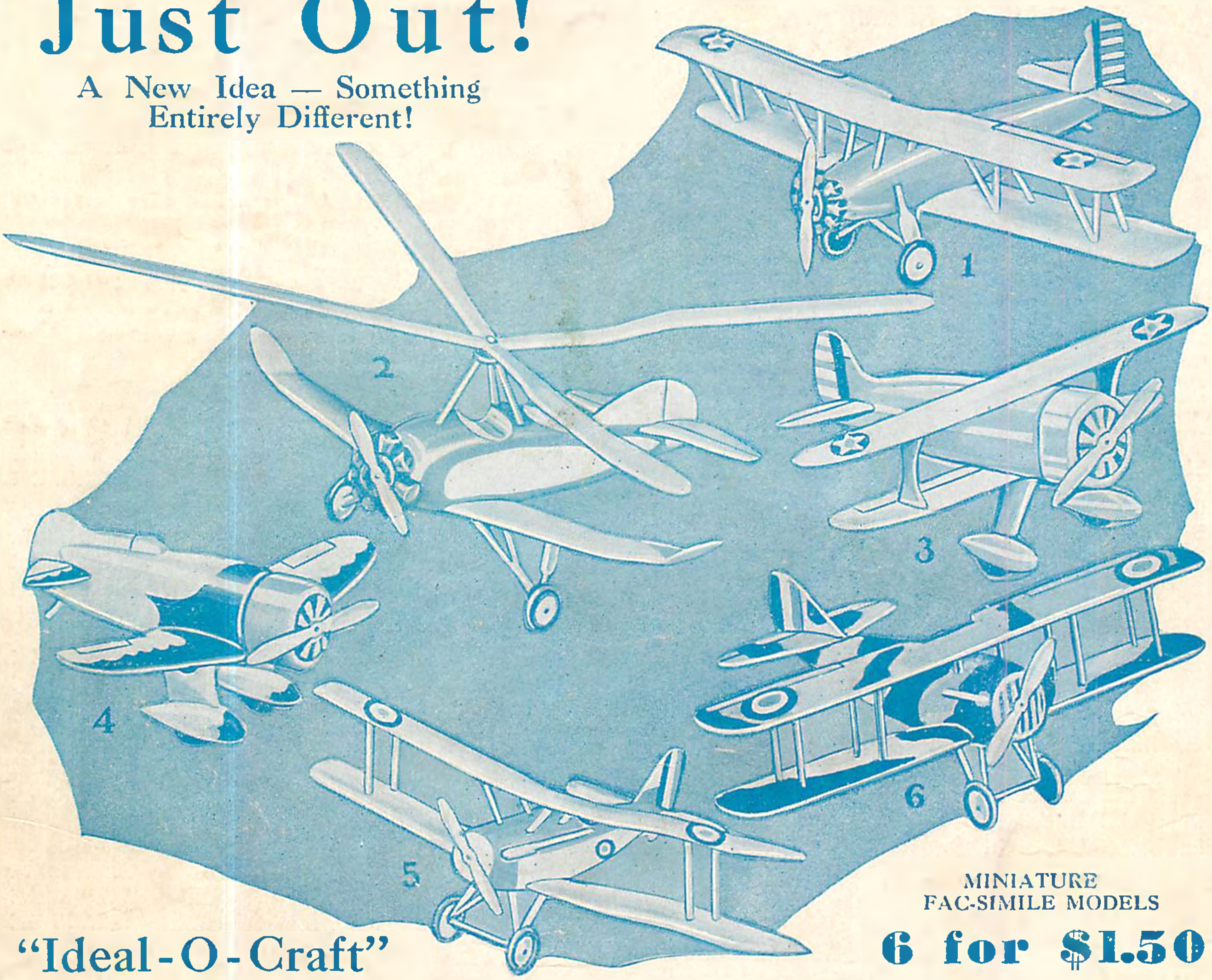

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1— Curtiss Fledgeling
2— Pitcairn Autogiro
3— Laird Biplane
4— Gee-Bee Sportster
5— British S. E.-5
6— Spad

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