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AND JUNIOR MECHANICS

IN THIS ISSUE:

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Two More Pictures to Unscramble

More on Airplane Engines and Radio

OCTOBER, 1931

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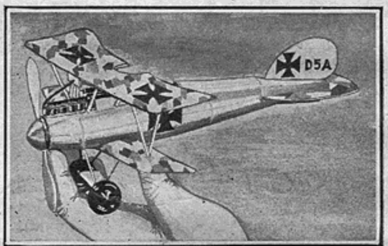

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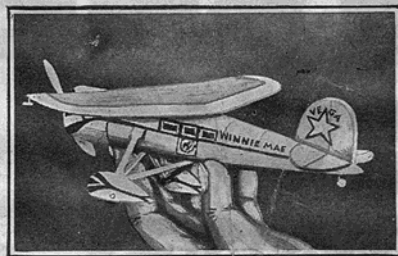

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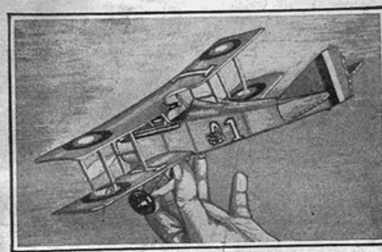
(Round the World Plane)



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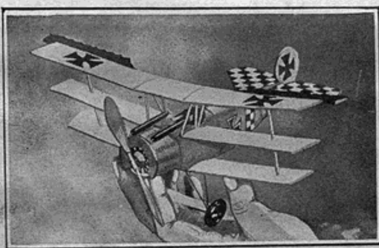

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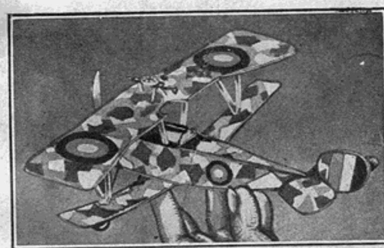

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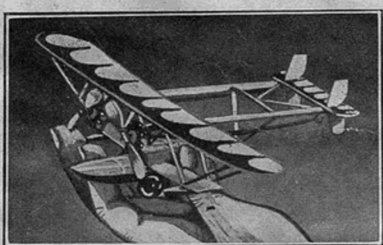

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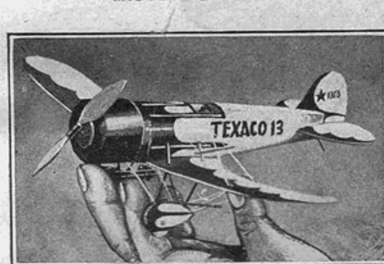

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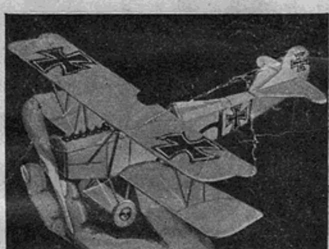

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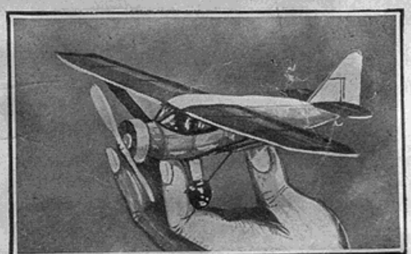

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6. *Japan*
7. *Russia*
8. *Hawaii*
9. *Vancouver Island*
10. *Alaska*
11. *Yukon Territory*
12. *Canada*
13. *Mexico*
14. *Great Britain*
15. *Germany*
16. *France*
17. *Switzerland*
18. *Italy*
19. *India*
20. *West Africa*
21. *Brazil*
22. *British Guiana*
23. *Trinidad*
24. *Virgin Islands*
25. *Porto Rico*
26. *Jamaica, B. W. I.*
27. *Cuba*
28. *Canal Zone*
29. *Turkey*
30. *Sweden*
31. *Newfoundland*

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and JUNIOR MECHANICS

Vol. V — No. 4

Published by Harold Hersey

Edited by Capt. H. J. Loftus-Price

CONTENTS

OCTOBER, 1931

In Our Next Issue

A SCOOP!!!—Full-sized plans for a solid scale model of the monster German *DO-X* FITTED OUT FOR MILITARY PURPOSES with 15 machine-guns, one-pounder guns, torpedoes and bombs!!

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Editorial and General Offices, 570 Seventh Avenue, New York City.
Harold Hersey, President. Pauline Sandberg, Treasurer. Frank Moran, Secretary.
J. W. LeBaron, Advertising Manager, 570 Seventh Avenue, New York, N. Y.
Entered as second-class matter June 5, 1929, at the Post Office at Springfield, Mass., under the Act of March 3, 1879.

Price 15c a copy in U. S. and in Canada. Subscription price $1.50 a year in the United States and its possessions; also Canada, Cuba, Mexico and Panama.
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1/16 x 3/4	.03	8 for .20
1/16 x 1	.04	8 for .25
3/32 x 3/32	.02	6 for .05
3/32 x 1/8	.02	6 for .05
3/32 x 1/4	.03	6 for .10
3/32 x 1	.05	8 for .20
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1/8 x 5/32	.01	6 for .05
1/8 x 3/16	.01½	11 for .15
1/8 x 1/4	.02	6 for .10
1/8 x 5/16	.02	6 for .10
1/8 x 3/8	.02	6 for .10
1/8 x 1/2	.03	6 for .12
1/8 x 3/4	.03½	6 for .12
1/8 x 1	.05	8 for .30
5/32 x 5/32	.02	6 for .10
3/16 x 3/16	.02	6 for .10
3/16 x 1/4	.02	6 for .10
3/16 x 5/16	.02	6 for .10
3/16 x 3/8	.03	6 for .10
3/16 x 7/16	.03½	8 for .20
3/16 x 1/2	.04	8 for .20
3/16 x 3/4	.05	4 for .15
3/16 x 1	.06	6 for .25
1/4 x 1/4	.03	6 for .10
1/4 x 5/16	.03	8 for .20
1/4 x 3/8	.04	8 for .30
1/4 x 1/2	.04	8 for .30
1/4 x 3/4	.04½	5 for .20
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1/8 x 3/4	.05	4 for .15
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1/16 x 2"	.06
1/16 x 3"	.10
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"	.19
3/8 x 2"	.16
3/8 x 3"	.30
3/32 x 2"	.07
3/32 x 3"	.12

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½ x ⅝ x 6	.02
½ x ¾ x 5	.01½
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⅞ x 1½ x 12	.07
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1 x 1⅜ x 16	.13
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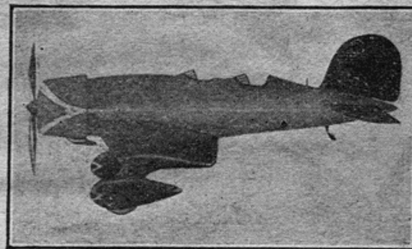

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The Latest in "Flying Windmills"

Kellett Autogiro Embodies Many Novel Features

Above, a side view of the newest in Autogiros (the Kellett K-2), and at the right, a three-quarters' rear view showing the side-by-side seating.

On the opposite page are two more enlarged views of the machine; the lower one illustrating clearly the power plant and the Rotor pylon

IN LINE with our policy of keeping our readers informed of the latest developments in the aviation world, we feel that a description of the new Kellett autogiro will be of great interest, both from an educational and a technical point of view.

It has been known for more than two years that the Kellett Aircraft Corporation, affiliated with the Ludington group in Philadelphia, has been developing an autogiro under the Cierva patents, to supply the modern demand for an aircraft that could be flown by almost anyone and would not require the use of an airport for its operation.

The Kellett autogiro, although designed and built by a group having long experience in the airplane industry, is not an airplane and is not intended to replace the airplane, nor to compete with it on a speed-performance basis.

The present models are not designed for high speed, having a top speed of only 100 m.p.h., but their real utility lies in their ability to land with practically no forward speed, to fly slowly and at low altitude with security, and to operate out of fields not accessible to airplanes.

Although the K-2 has an excellent gliding angle, this is not of great importance. Its ability to descend vertically permits the operator to fly at high altitude right up to the edge of his landing place, select the exact spot on which he will land and glide to it at a very steep angle if he so chooses, and to correct or alter that angle depending on weather conditions and to land deliberately with ample time for observation of all details.

This is of great importance in all cross-country flying, but of particular importance to the person who has not the time or opportunity to get and maintain the skill necessary for landings at high speed.

K-2 is a two-seater, where the passenger and driver sit side by side as in an automobile—a sociable arrangement—with dual control system, making it a simple matter for one to learn how to fly this ship. Before the days of the autogiro, learning to fly consisted of acquiring caution in avoiding the "stall" and the undesirable tail-spin, which often resulted from loss of control due to stalling. However, most of the training consisted in getting and maintaining skill necessary to bring a rapidly moving vehicle into smooth and accurate contact with the earth.

With the autogiro it is different. The wings (or rotating blades) always have flying speed and control. The autogiro cannot stall and cannot be spun, and in landing the approach to the ground is so deliberate and there are so many ways of doing it properly that it is logical to conclude that the average person can operate an autogiro about as readily as he learns to drive a car. It must be remembered also that for the present, there is far less traffic congestion in the air than there is on the ground.

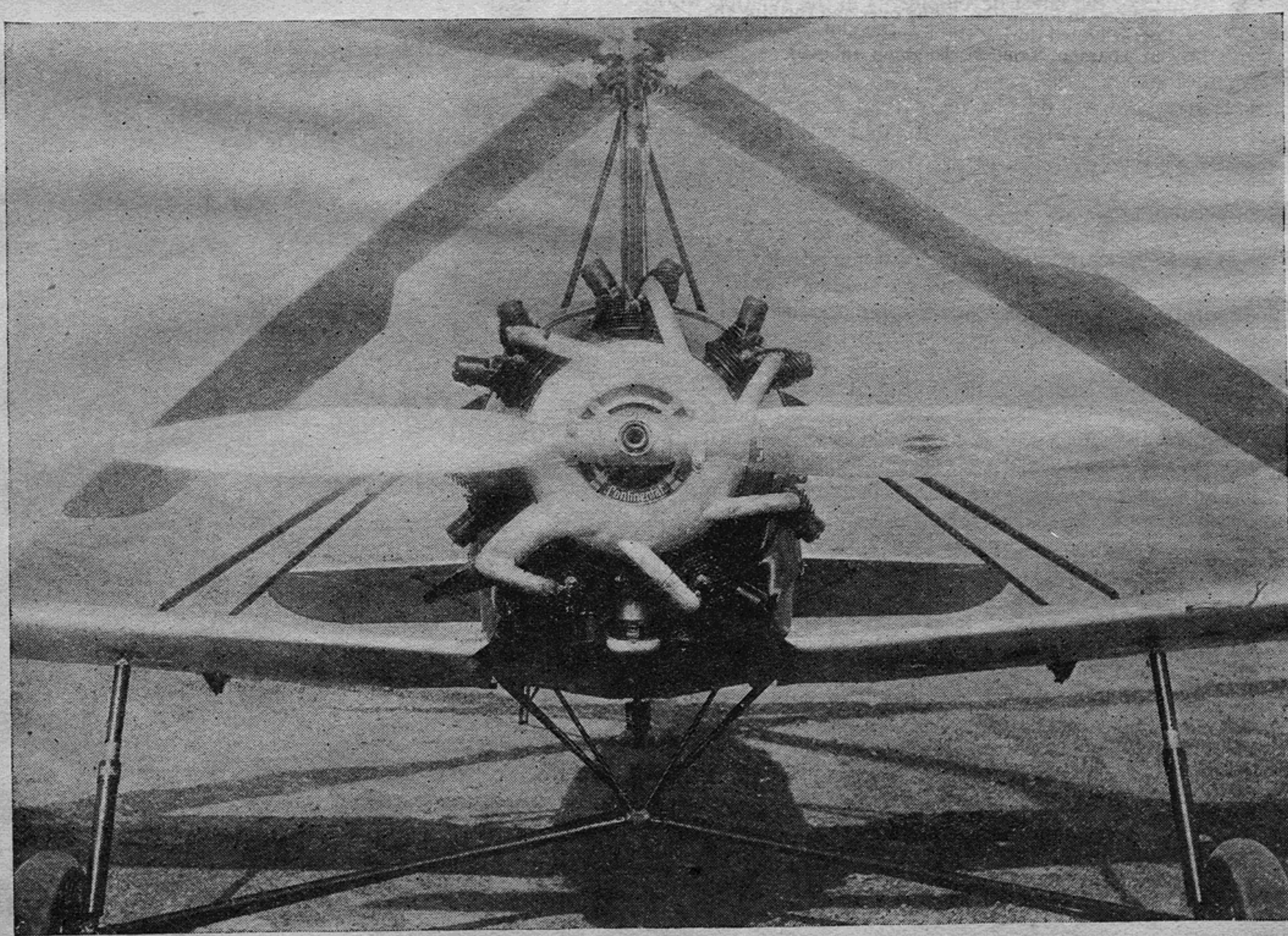
THE cockpit of the autogiro is about as wide as the front seat of the average automobile and one immediately feels at home in it. The cockpit is so cowled in that one is very well protected from the wind and conversation can be carried on very nicely.

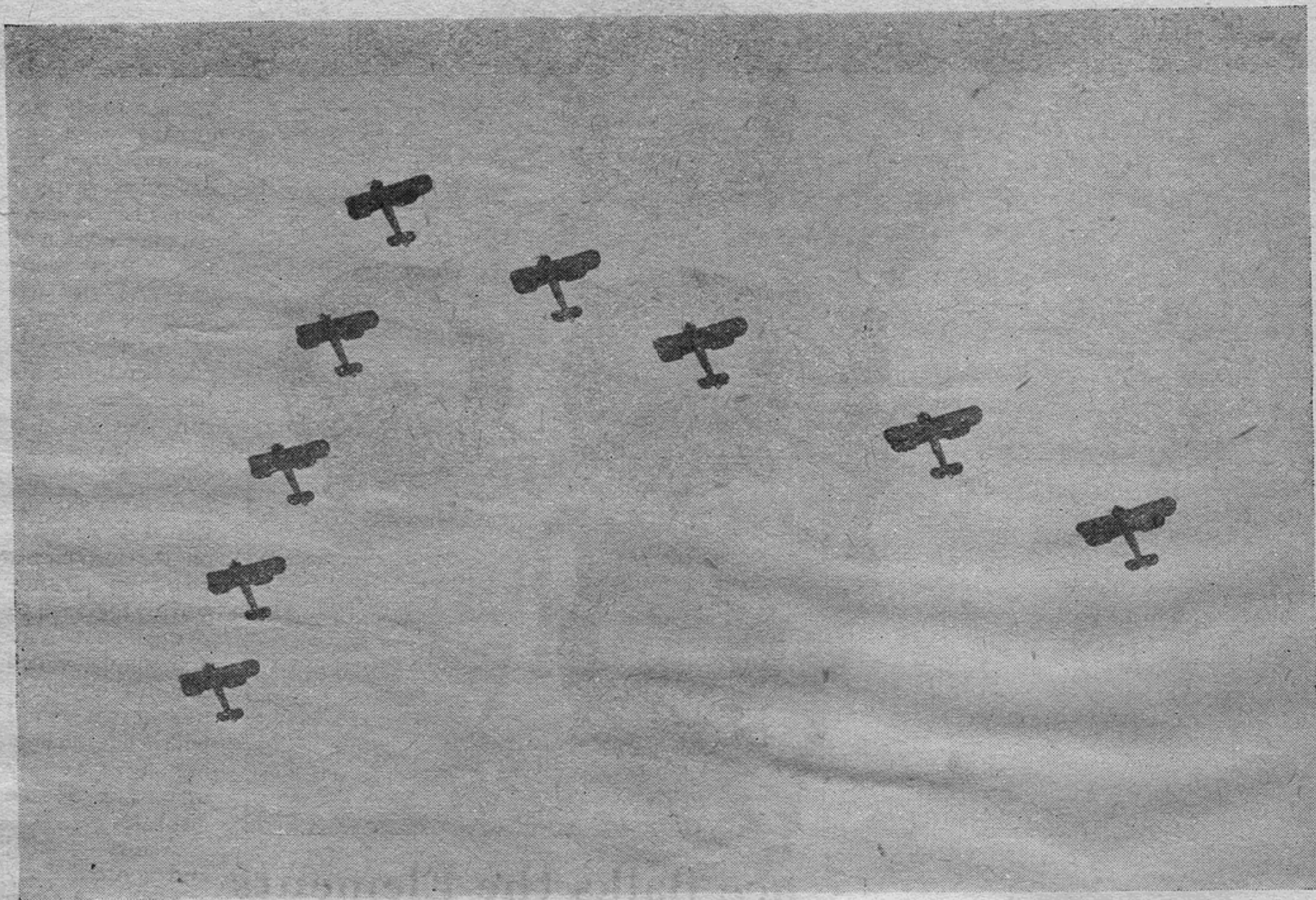
Although the Kellett autogiro follows very closely the fundamental Cierva theory, the result of much development is seen in many items of the structure. For instance, the under-carriage and fixed wings are supported entirely by steel struts without the use of any external wires. The wheels are set twelve feet apart and are provided with long-travel Oleo shock absorber struts which cushion the landing forces so that even vertical landings may be made.

Even the tail wheel is provided with a long-travel Oleo shock absorber strut and a pneumatic tire, so that when landings are made on lawns or golf course fairways no damage is done to the sod by either the landing or tail-wheels.

Of course, brakes are provided so that forward speed can be checked very rapidly.

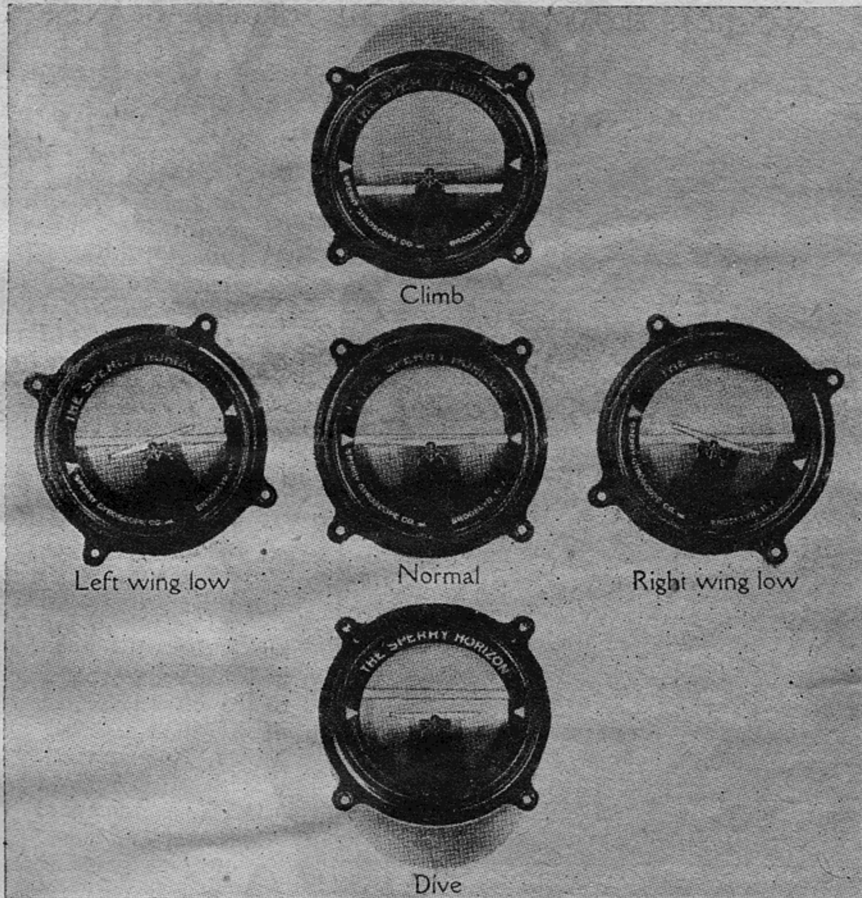
Vertical landings are considered more or less as stunt or emergency landings. Normal autogiro landing involves gliding to the earth at an (*Continued on page* 40)





An imposing display of British single-seater fighters in formation, flying over and thrilling the great crowd during the Royal Air Force pageant at Hendon, London, England (above)
—*Acme*

At left in picture below is the familiar Autogyro, and at right a *Pterodactyl*, an English tailless monoplane, which has developed from a single-seater to a three-passenger machine
—*Acme*



A SMALL rotating wheel, which until recently was known to the public chiefly as an interesting toy, to a large extent made possible the world flight in record time of Wiley Post and Harold Gatty.

The rotating wheel, supported in such manner as to be free to move on all its axes, is known as the gyroscope.

It was not a simple gyroscope such as children delight in playing with, of course. More particularly, it was a new and practical application of the gyroscope in aerial navigation and known to all pilots as the Sperry gyro artificial horizon. This instrument afforded the only means the world-flyers had of keeping their plane right side up and speeding onward, even though the fog over Russia and the Bering Sea was at times so thick they could not see the nose of their ship.

Modern Science Balks the Elements

Sperry Horizon and Directional Gyro Important Factors in Success of Post-Gatty World Flight

As a result of the credit which the fliers attributed to their instruments, aeronautical engineers and scientists who for years have been devoting much attention to the perfection of the new instruments of navigation which the globe-girdling aviators gave so strenuous a test, concluded that one of the chief problems in aviation has been solved.

It was recalled that when the United States Army Air Corps made the first world flight in 1924 it took 175 days, and that the plane carrying the flight commander crashed blindly into an Alaskan peak hidden by a snow storm. That was before the development of the gyroscopic blind flying instruments.

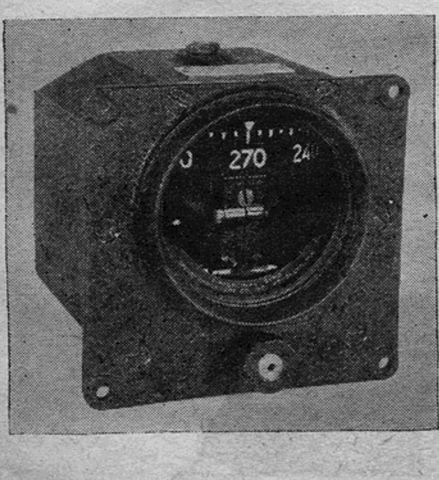
The artificial horizon, as its name implies, actually provides an absolutely accurate substitute horizon when fog or other natural elements obscure the pilot's vision of the natural horizon. As the natural horizon is the reference which a pilot heretofore has had to use to be sure that his ship is not slipping sidewise, the Sperry horizon was designed to provide on the instrument board an attitude indicator which works instantly and simply, which requires no interpretation and which immediately registers every movement of the airplane.

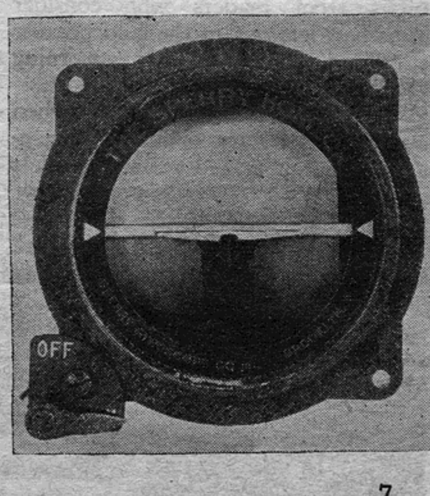
Across a dial and controlled by a small gyroscope so that it is always independent of the actions of the plane is a white bar which represents the horizon. Stationary on the dial is the silhouette of a tiny airplane in the same position as the real plane.

Thus when the ship climbs, dives, tips to the right or to the left, the sensitive mechanism moves the horizon in reference to the tiny silhouette airplane and the pilot knows that his ship is getting into a dangerous position. He at once works his controls until the craft is on a level keel, as indicated when the little plane on the dial again appears level with the white horizon bar.

The Sperry directional gyro is an airplane navigating instrument for indicating to the pilot the compass course of his plane. It has no meridian seeking properties and therefore must be occasionally checked and re-set in accordance with the heading as given by the magnetic compass. Unlike the magnetic compass it does not oscil-

(*Continued on page* 40)





Illustrations at top of page show indications of the Sperry Horizon for five attitudes of flight. All indications show the plane's relation to the horizon as if pilot were observing the natural horizon. Below, left, the Directional Gyro; right, the Sperry Horizon

WIN A

Mr. C. S. (Casey) Jones seated in the cockpit of a Curtiss-Wright *Junior*

WHAT YOU DO!

In brief—Unscramble the two scrambled pictures at the bottom of these pages, paste them neatly together and then thoroughly identify the planes they represent. Hold these two pictures until you have six in all—two from the September issue of Model Airplane News and two in the November issue. Then send in all six pictures for judging, remembering that NEATNESS and ACCURACY will play a large part in your success. Read the full details in this article!

TO THE merry tune of "Clip, clip, clip and paste, paste, paste," the rush to enter the monster *Scrambled Picture* contest is on! Entry blanks are pouring into this office in such numbers as to make us proud not only of ourselves but also of the avid interest in flying which is indicated by our loyal followers.

You've simply no idea how pleased the editor of a magazine feels when his readers respond so quickly to something that is offered to them for their amusement and education. It's great. Keep it up, please. The more, the merrier!

We're not going to pretend to you that every such effort is so perfect that everybody is simply tickled pink. Far from it. So with our *Scrambled Picture* contest.

Coupled with the great number of entries we also have received many inquiries from readers who consider themselves left out in the cold because of one of the stipulations governing the contest.

"What am I to do," they ask, "when you say that I must obtain my teacher's signature, and I've already left school?"

Well, that's easily answered. We are sorry not to have been a little bit more explicit in announcing the fact that readers who have left school naturally can dispense with the teacher's signature.

For the benefit of new readers, we'll repeat that. If you have left school you need not obtain the signature of your school teacher to the entry blank, the filling in and mailing of which is essential to bona fide entry in MODEL AIRPLANE NEWS *Scrambled Picture* contest.

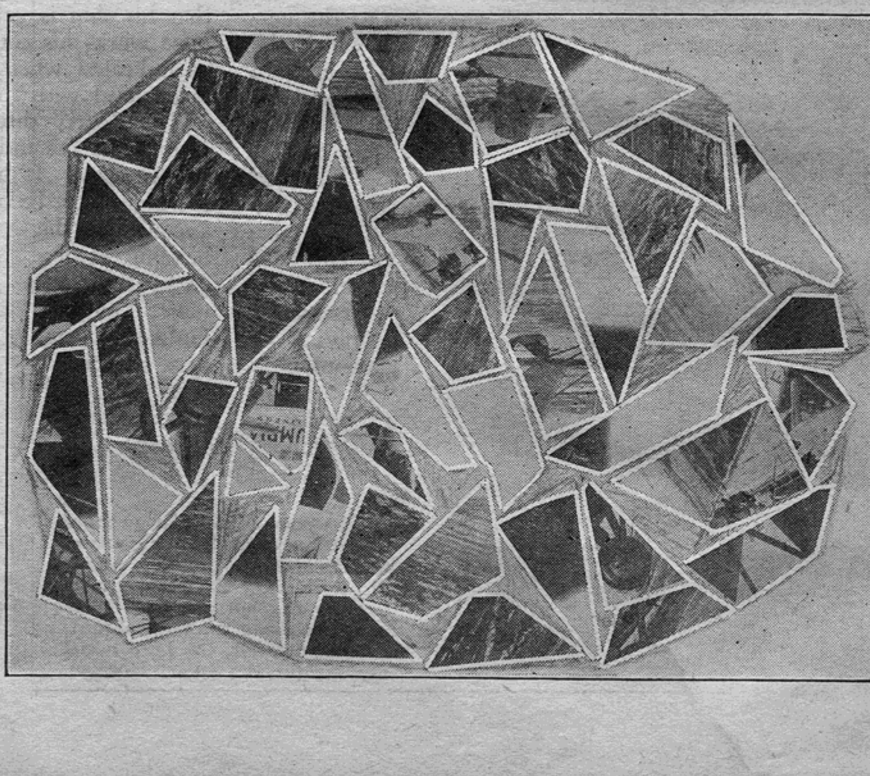
There, is that clear?

ANOTHER point arises in connection with new readers. This great contest started with the September issue of MODEL AIRPLANE NEWS. If you are unable to obtain a copy from your local newsdealer, you can obtain one by sending into this office twenty cents in stamps with a letter outlining your request. The magazine will be forwarded to you immediately. Do not fail to give your FULL postal address.

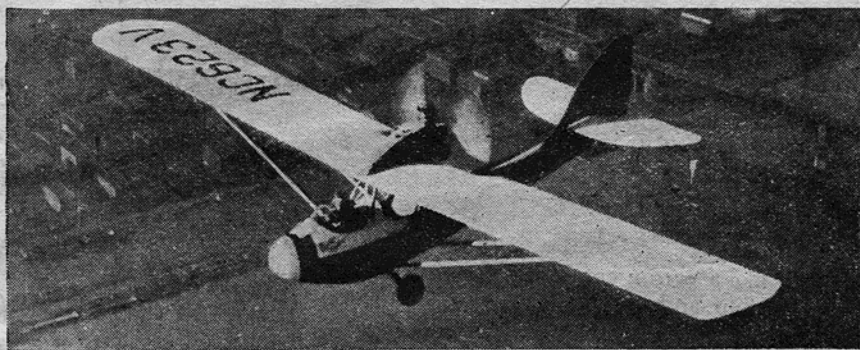
Now about the contest itself.

We're willing to bet that you are finding it just as easy as we said you would. Right? Isn't it great fun to fill in the odd five minutes leisure by clipping the pieces of the photograph and pasting them in the proper positions,

Scrambled Picture No. 3 ⟹



FREE FLYING Course!



The type of plane in which the winner will be trained

and then testing your knowledge of airplanes by identifying them?

Sure it is. Isn't it worth it, too, when you consider that the lucky winner of the first prize is to receive such a valuable Flying Course, and the second prize, a complete Ground Course, and that third prize—a 200-mile cross-country flight with Mr. C. S. (Casey) Jones?

Don't forget what we said about not hurrying yourself. Many of you, no doubt, thinking that time means everything, will paste the photograph together and then rush them to the Contest Editor without their proper identifications.

Study them well. Plan everything carefully so that you will fully identify each plane. Remember that neatness counts. This does not necessarily mean beautiful art work. Just get your information together neatly and leave the rest to us.

WHAT YOU WIN!

A 10-hours Flying Course, or to be more exact—sufficient flying time to enable you to sit for a Private Pilot's license—is the First Prize in this Monster "Scrambled Picture" Contest. Second Prize is a Complete Ground Course; and Third Prize, a 200-miles cross-country flight with Mr. C. S. "Casey" Jones as your host-pilot. Three extraordinary great prizes, for some extraordinary effort! Start right in, now!

BE SURE, however, that you do identify the planes. Remember, as we warned you last month, that just to say "This plane is a Curtiss *Condor,* or this is a Keystone *Air Yacht,*" doesn't mean anything in the counting of points for the winners.

Every plane, as we said, has a definite identification which stamps it as only that type of plane. That's what we want.

Now, just to intrigue you a bit concerning the thrill of learning to fly, we are publishing on another page a story entitled "*Winning My Wings.*" It is by Mr. Ken Sinclair, our expert who has been delving into the mysteries of aviation for you and explaining to you in understandable language all about airplane designing.

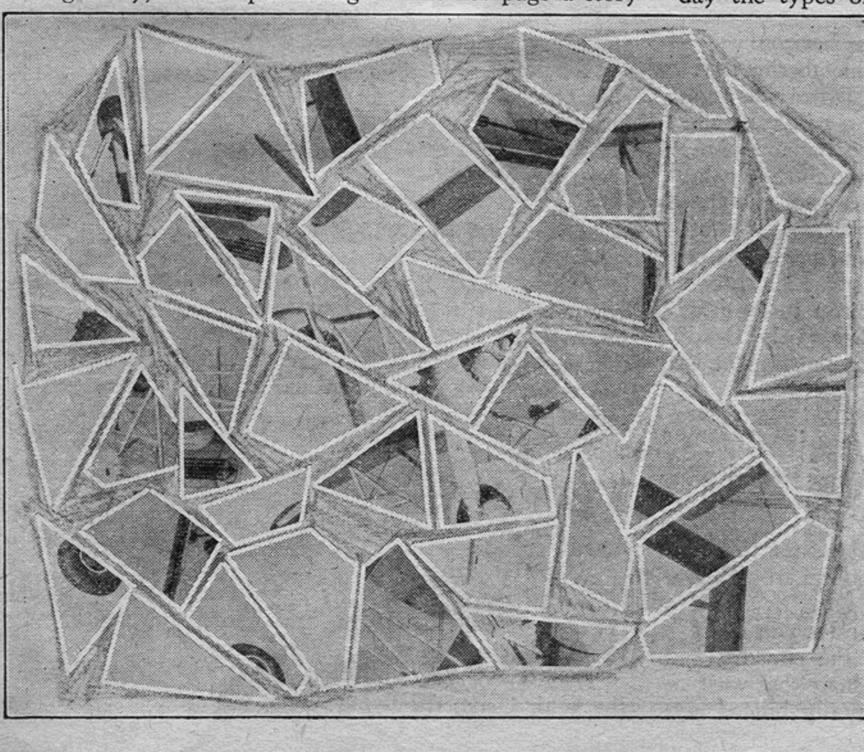
Read that story through, and if at the end you don't double your efforts to paste these photos together and identify them, then we're crazy!

You really should have no difficulty whatsoever as every day the types of planes depicted in the photographs fly overhead. Some are used by the U. S. Army and U. S. Navy, and there is no boy who does not know his military and naval planes.

Now, for the benefit of those who did not enter the merry gathering last month, we are again publishing both the rules and the entry blank for the contest.

Read the rules carefully, and remember that they are rigid. They mean exactly what they say. Be sure to fill in the entry blank and mail it immediately to us. We must have your name on file before we can consider you as a bona fide competitor.

Above all, don't forget that this monster *Scrambled Picture* contest opens the door for you to a career in aviation—something, we know, that you have dreamed about for a long time. It is a great opportunity, and no boy with the real interest of aviation at heart (*Continued on page 44*)



← Scrambled Picture No. 4

Winning My Wings

By
Ken Sinclair

I FELT like a person entering a new world as I climbed in the ship and settled myself beside the instructor. I was about to learn to fly! True, I had been up before, but never had I had my hand on the stick. This was the day!

We were sitting in an Arrow Sport, side by side, with a set of controls for each of us.

"Ever been up before?" asked Gene Meyhering, my flying instructor.

"Yes."

"Good. Get that safety belt. We'll try some air work today, and if you get along well, some shallow turns. I'll take her up and then you'll try to fly her straight."

Throttle and stick went forward simultaneously. The nose went down, then raised a little and the bumping stopped. We were in the air and after two circles of the field, we were at a sufficient altitude for me to try my hand at the stick. Gene leaned toward me.

"Now just try to keep that nose on the horizon. Take her!"

Somewhat cautiously, I took hold of the stick and held it. Nothing happened!

"Don't forget about the rudder!"

I placed my feet in the rudder stirrups. Still nothing happened. Great guns, was it this easy?

"Get that right wing down!"

I had not noticed that it was up! I pushed tremulously on the stick in the direction of the high wing, remembering that I had read somewhere that the controls were very delicate. Nothing happened! I pushed harder and got results. The wings levelled.

"GET that nose down! Keep it on the horizon!"

I pushed forward on the stick, remembering that it took quite a push. Down went the nose! Down was right! To me it seemed to be nearly vertical. In a panic, I pulled back vigorously. Up came the nose! Too high. Again I pushed forward. Again it went down too far. Up and down, up and down. Finally I got the hang of the thing sufficiently to keep it in a fairly steady position.

"The controls are very sensitive forward," explained Gene. "Don't forget to keep a little right rudder to overcome slipstream. You are making a big circle to the left."

After a few minutes I could hold her fairly steady. This was great. I looked over the side of the ship at the green fields below.

"Get that nose down!"

Rats, I hadn't felt it go up!

"Well," I thought. "I better lay off the scenery and watch that nose."

"Good. Now try a right turn."

Cautiously, I kicked right rudder, at the same time applying some inside stick. We started going around like a comet.

"Hey! Too steep. Take out some bank and some rudder."

After several more turns Gene took the controls and we started down. Gee, what a short half hour that was!

When we were on the ground, I mentally braced myself for a thorough bawling out covering all the bum work I had done.

"Well, you got along all right," said Gene. "You made some good turns and you don't squeeze the stick as most beginners do. It is better for beginners not to bank so steeply, though. Keep your turns shallow."

My second experience at the stick found me more at home. It was easier for me to hold the ship level without having to keep a constant watch on the nose, giving me more time to look around and enjoy myself. Before we went up my instructor said:

"Now today we'll try some approaches to the field. We will dive down to about twenty feet above it and then give her the gun and fly around again."

ONCE in the air, I managed to get the ship headed for the field and held her there, wondering when to cut the gun. Gene, my instructor, settled my doubts by cutting it for me. Everything seemed all right. We glided along smoothly.

"Get that nose down. As soon as you cut the gun, you must put the nose well below the horizon to keep flying speed."

Down we went, picking up speed. Too steep. I raised the nose a trifle. Nearer and nearer came the ground. I thought it was about time to level off and I did, giving the ship the gun at the same time.

"Good! Now next time try to land her."

Around the field we went. Again we glided down. As the field slipped under us I levelled off. Then I looked down. There was the field twenty feet below us! No good. Another try.

This time I did not level off too soon, and we skimmed along just above the ground.

"Keep the stick coming back slowly, but don't let the ship climb."

I eased back. Still we glided on. Then we dropped a little, I heard a scratching sound as the tail skid hit, and there we were.

"Good, give her the gun!"

Many times I asked Gene how I was getting on. "All right. You'll solo in ten hours." That was all he could be coaxed to say. Well, at times I doubted that I would ever solo. Gene had said that he would not solo anyone in anything under ten hours, but I was beginning to think that I would need a hundred. Then one day, after we had come down from my usual series of circles and landings, Gene said:

"Let's go into the office and check up on your time."

WE DID. I had nine and a half hours!

"Well," said Gene, "Next time we'll do a spin, and then you solo!"

"Huh, why the spin?" I asked.

"You have to know how to get out of one. You might get into one flying alone, and knowing how to get out of it will come in handy."

The day of my solo finally arrived. When I reached the field, Gene, the flying (*Continued on page 36*)

How to Build
A Super-Light Wing

Truss Bracing System Adds Strength and Rigidity

By Major H. W. Landis

THE construction of a super-light model wing is shown in drawing No. 1. The internal structure consists of a rather peculiar truss system of bracing, making for extreme strength and rigidity and yet of a lightness that cannot be compared with any of the older types used in model construction.

A most radical departure from the old type wing is that the new wing requires no external bracing of any sort. Only the wooden structure is in compression, the two steel wires A and B are the main tension members.

These wires are No. 40 B and S gauge tempered music wire. This size is suitable to incorporate in a wing from three to five feet total span, or in other words each wing being two and one-half feet long from side of fuselage to the tip. The ends must have compression members located as shown to transmit the push to the spars.

The dotted lines represent cotton thread stretched taut and doped. Be sure to dope the threads together at the intersections marked C as this is where the diagonals cross. This makes rigidity and prevents the ribs from canting, which would result in the collapse of the entire wing structure.

Ribs 1 and 2 are shown in sketch No. 2. Sketch No. 3 shows all other ribs with the exception of the end rib, which is illustrated in drawing No. 4. Drawing No. 5 presents ribs 1 and 2 assembled with the dowels for sliding into aluminium tubes placed across the fuselage.

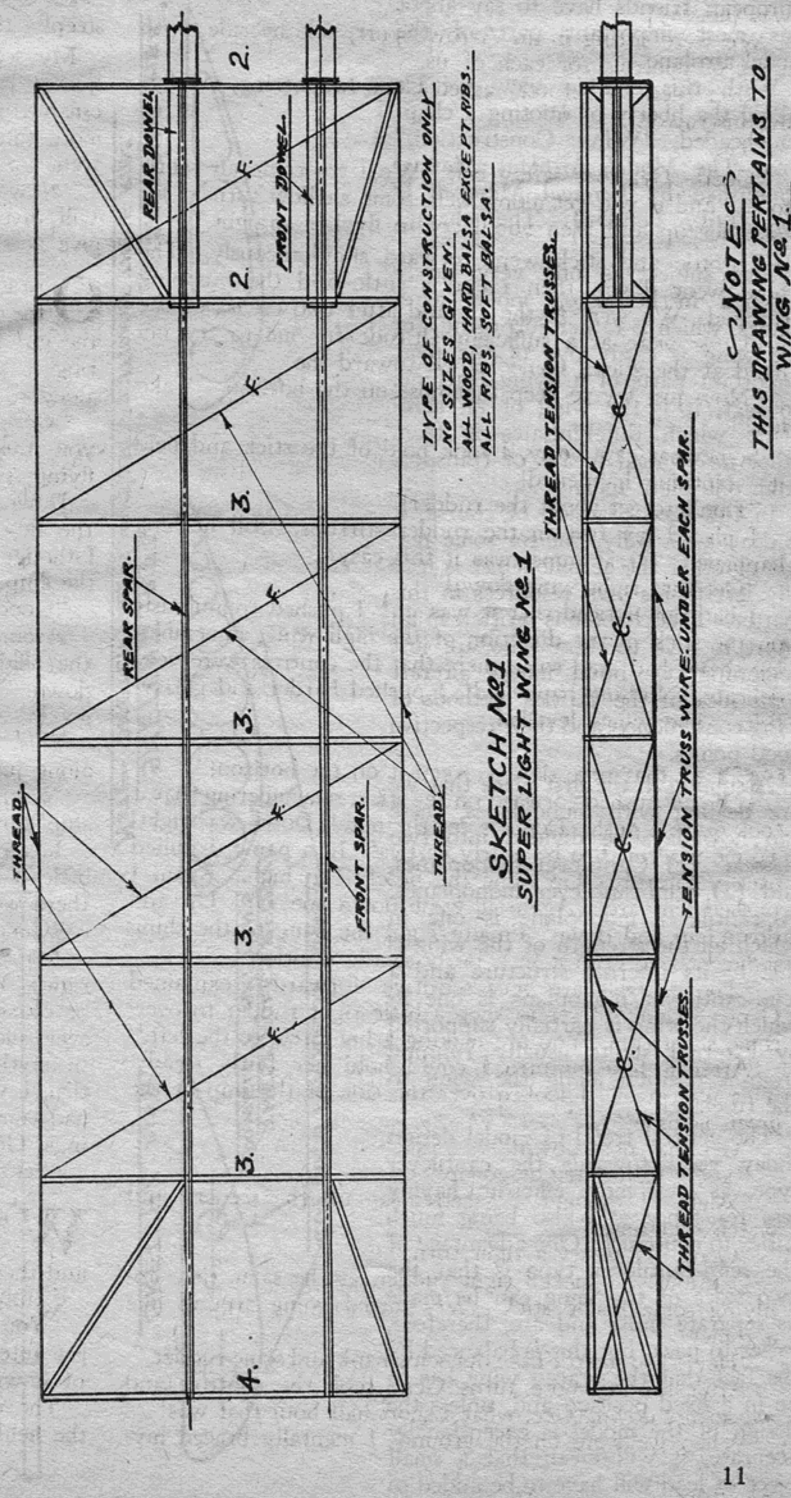
It will be very necessary to supply the corner brackets marked A, B, C, and D in the positions shown. These brackets prevent the ribs 1 and 2 from canting when the tension members pull on them.

Sketch 5 shows the fastening of the tension wires at the fuselage side of the wing, and point A in drawing No. 6 shows the fastening of this tension member at the wing tips.

The wing tip is well stiffened with short compression struts as shown in drawings Nos. 1 and 6. The thread in the leading edge is a tension member and takes care of a great percentage of the binding moment caused by the drag of the wing. The balance of this force is taken care of by the tension members F. All tension members are cotton thread pulled taut in position and doped with a very thin airplane dope.

The sizes given are suitable for a model using a four foot span. It would be much more desirable to use elliptical-shaped aluminum tubes for the wing attachments, and substitute 3/8″ elliptical-shaped dowels in place of 1/4″ round ones, shown at positions A and B in sketch No. 2, and at F in sketch No. 5.

After wings are in place on the fuselage, pass a thin wire around the main tension wire at point X and lead it taut to the corresponding point in the opposite wing, passing it through the fuselage. This should be done at both the forward and aft wing beams. It can



readily be understood how this tension member relieves the bending movement on the dowels F.

Wire the wings together from one main beam to the same beam on opposite wing to relieve the dowel pins of the landing shocks. This is a true cantilever wing and much lighter in weight than other cantilever types employing full length spars on top and bottom sides of the ribs with some necessary diagonals.

(Other methods of building light truss wings for models will be described in the next issue of MODEL AIRPLANE NEWS.)

Editor's Note: Since the subject of wing construction is one of such wide interest and controversial nature, it is perhaps fitting to present what our European friends have to say about this most important part of the model airplane.

With this end in view, we are taking the liberty of quoting a chapter headed, "Wing Construction," from *The Model Airplane Manual (published by Percival Marshall & Co., Ltd., London)*. The chapter reads:

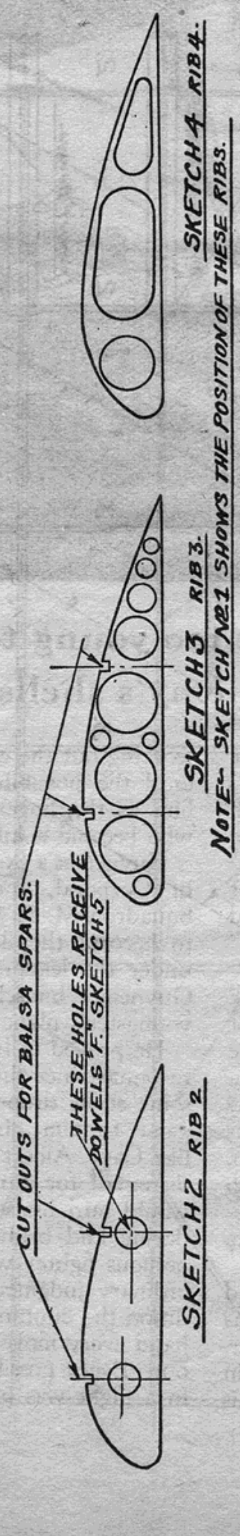
This subject is one very rarely touched in books on model aeroplanes, which is rather surprising, for the wing is easily one of the most important parts of a flying machine. In fact, it is the wing of an aeroplane which differentiates it from other mechanical means of transport from one place to another.

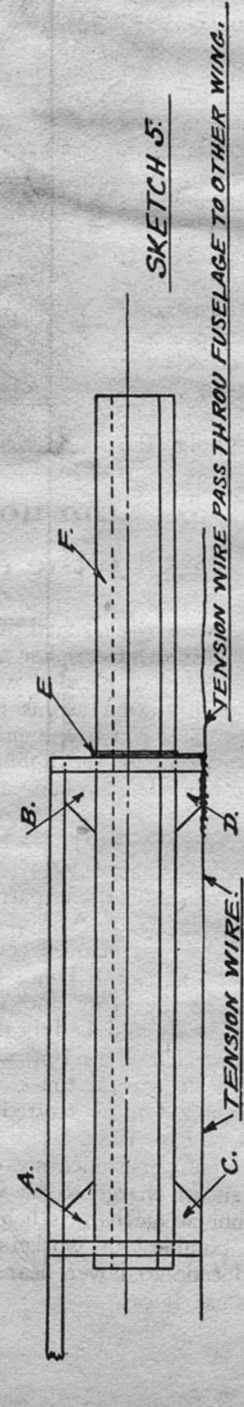
In full-sized practice, of course, it is dealt with fully, but for some reason or other the aeromodellist is usually left to his own resources in this matter. This chapter is written in an effort to give to those who are just beginning to build model aircraft some idea of the various methods of wing construction and their respective good points.

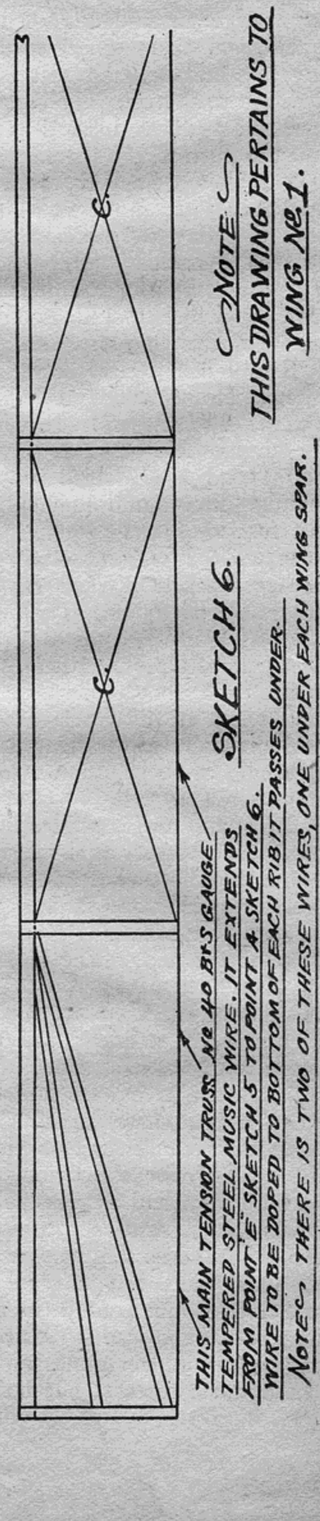
Assuming in the first place that we are dealing with monoplanes, these can nowadays be divided into two classes: (1) Cantilever monoplanes, and (2) semi-cantilever monoplanes. A cantilever monoplane is one in which all the strength of the wing is due to its internal structure and a semi-cantilever monoplane is one in which the wing is partially supported by external struts, usually running from a position along the wing to the fuselage.

The general trend of model design today veers towards the cantilever type, as it is more efficient, having less resistance and also being much easier to construct. One advantage of the semi-cantilever type is that the two sides of the wing can be made as separate units and are, therefore, easier to pack, but this is balanced by the fact that the braced wing has to be in a fixed position and, unless the design of the model is exceptionally accurate, it will mean that a small piece of lead will have to be added to the model in order to get the correct balance. This, of course, is where the cantilever wing scores, as it is only necessary to slide the wing along the fuselage to get the true position without adding any unnecessary weight. The last few remarks will, perhaps, explain why one sees so many non-braced models today.

Having outlined the two types of wing used on aeroplanes, let us now turn to the construction of cantilever wings. In the first place, the wing span and the weight of the model complete largely determine the strength of wing necessary, but one of the most important factors to take into consideration is the aspect ratio. This is obtained by dividing the span by the chord, or, if it is a tapering wing, the mean chord. Thus, a wing with a span of 48 inches and a chord of *(Continued on page 37)*







Guynemer of France

By

L. Elsen

AVIATION experts all over the world are stressing the importance of physical fitness for flying—and rightfully so—yet not so very long ago as one counts time in retrospect, a boy of nineteen, thin, sickly, with weak lungs and nervous temperament, astounded the world with his aerial prowess and proved himself a brilliant exception to the rule.

It must have been the tension and the stress of the day, and the desperate need to try oneself beyond one's utmost, but whatever it was, it took Georges Guynemer, a semi-invalid, from a coddled existence in a well-to-do home in Compiegne into the seething currents of war and created an immortal hero in the history of France.

The World War was responsible; and when the meteoric career of Guynemer as chief of the French Escadrille was over and it was left to Rene Fonck to carry on in his place, Guynemer's official record of fifty-three enemy airplanes downed was the memorial he left behind.

"....I am not too young to be hit by the enemy's shells."

Some time before the shadow of war had darkened over Europe, the youthful Guynemer, born on December 24, 1894, and just out of Stanislas College, had pleaded with his parents for permission to choose aviation as his life work. They were aghast. Aviation! It was a toy, a plaything, and not to be considered seriously in the light of one's future career! Guynemer was heartbroken and abandoned all his dreams.

HOWEVER, fate in the shape of the events of 1914 took a hand. To the elder Guynemer, an ardent patriot and himself a retired officer of the French Army, the dangers which now suddenly threatened his beloved country warranted the sacrifice of his fragile son. Twice the boy offered himself as a volunteer in the army and was refused because of his extreme youth and bad health. Then, one day in November, 1914, a chance meeting with a pilot who had secretly taken him up several times, decided him. Why not the air service? Off he trotted to try to enlist in the aviation corps at Pau.

There the need was great and his persistence swayed the better judgment of the officials in charge so he was accepted—not as pilot, however, but as mechanic's helper. Georges Guynemer was now the humblest of workers in the great airdrome, but he found time to hover near his beloved airplanes and to learn all he could from whomever he could cajole into talking about them. He would beg to be taken up whenever practice flights were in progress—and so a natural curiosity, a great will power, and a devouring interest in mechanics soon taught him all there was to know about aviation.

The promotion from student mechanic to student pilot was a speedy one for him, and on March 11, 1915, Guynemer earned his pilot's certificate on a Bleriot machine equipped with a 6-cylinder, 50 h.p. engine.

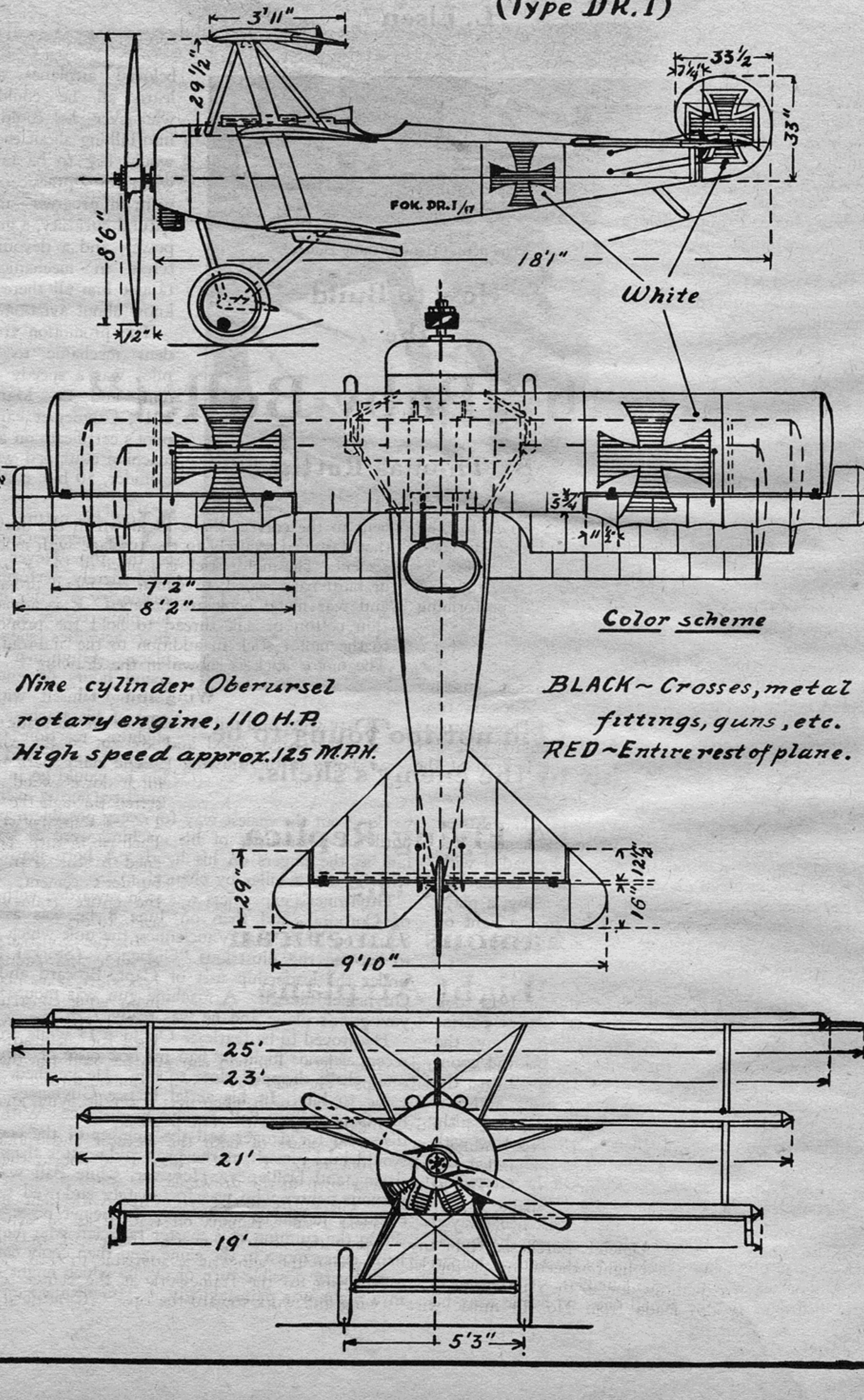
NOW his natural cunning and perseverance came to the top. Never content with merely performing the customary practice flights in his plane before actual warring activities should take place, Guynemer would spend hours on end familiarizing himself with every part of his machine, and its slightest reaction to every angle of ascent and descent. Up he would go in constant practice, noting every detail, working out the easiest way for every possible maneuver—until the possibilities of his machine were as familiar to him as the fingers on his hands. A born mathematician who became a killer by chance!

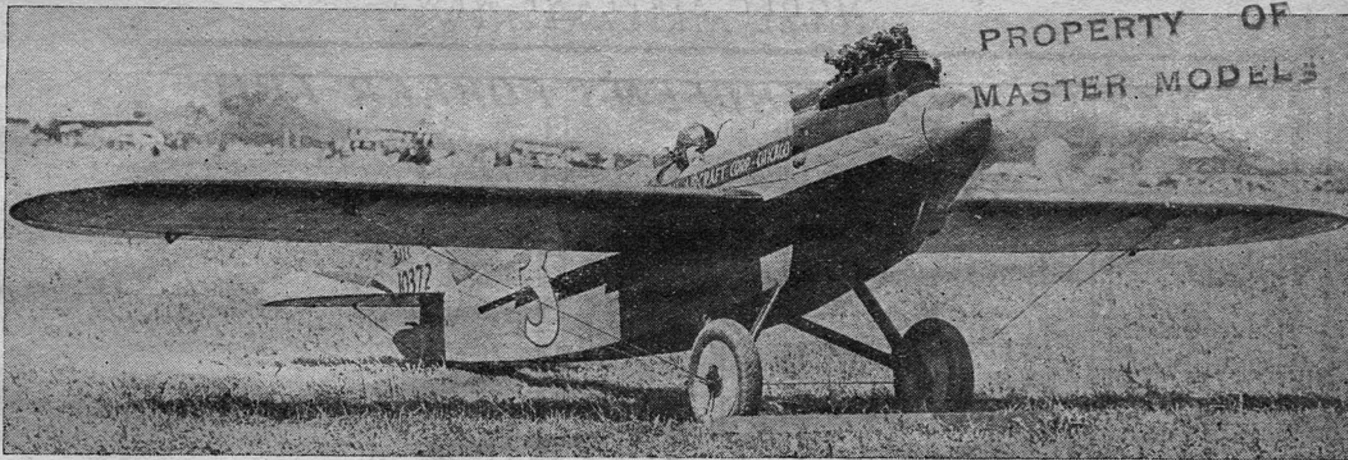
Guynemer's expertness was soon rewarded with the rank of Corporal, and then on June 8 he was assigned to Squadron M. S. 3 at Vauciennes, the unit which was later to become the illustrious "Cigognes" (Storks) Squadron under the leadership first of Capt. Brocard and later of Guynemer himself. A machine gun was mounted on the youngster's plane and he was ready.

He proved to be fearless. On June 15 while on his third reconnaissance flight he had his first taste of danger when some shells dropped close to him. He laughed. It was a game to him. In his aerial tactics Guynemer was very like Capt. Albert Ball, famous English ace. With the same disregard for danger and the number of the enemy, each would hurl himself at the prey and scatter them by sheer daring and brilliancy. However, while Ball was the impetuous fighter who was fortunately endowed with extraordinary judgment under fire, Guynemer possessed in addition the cunning of a master tactician who plans beforehand every move in the game, and then cooly carries them out. Every possible turn of events which might take place in a flight was painstakingly (*Continued on page 45*)

BARON von RICHTHOFEN'S FOKKER TRIPLANE

(Type DR. I)





The actual Heath "Baby Bullet"

How to Build the

Heath "Baby Bullet"

By Thomas Rettig

A Flying Replica of the Famous American Light Airplane

THE "Baby Bullet" was designed and flown for the American light plane speed records by the late Edward Heath, one of America's greatest light airplane designers. During the Cleveland National Air Races this small airplane caused a sensation by out-performing nearly every light airplane on the field.

Fuselage

To start the construction of the "Baby Bullet" fuselage we must first cut to the correct sizes all the necessary fuselage formers as shown in the drawing 2. These formers are all cut from 1/16″ sheet balsa wood, making sure that the wood grain runs from the top to the bottom of the formers. The formers shown in drawing 2 are all full-sized drawings.

The main longerons are all made of 1/8″ square balsa wood and are cemented to the formers as shown in the drawing, the stringers are made from the bamboo which is split to 1/16″ square pieces with a sharp knife. The fuselage *drawings* shown are all *half size* with *full size dimensions.*

Special note must be taken of the "R" tubing that extends through the fuselage and acts as the wing supports, and 1/8″ tubing should be used for these mountings.

The motor stick clip "Z" is fastened with model builder's cement to the front former No. 1. The landing-gear struts are made of 1/8″ x 3/8″ balsa wood sanded into a stream-line shape as shown in the drawing 2. The axles are made of No. 14 music wire bent to shape, as shown in the drawing.

Celluloid wheels, 1 3/8″ in diameter, purchased from any local supply store, make good light wheels for the model and add to its flying qualities due to their lightness.

The tail skid is also made from No. 14 music wire bent to the correct shape as shown in the drawing and is then fastened securely to the fuselage with model builder's cement. The motor stick is a piece of 1/8″ x 3/16″ spruce or hard balsa wood, to which the metal propeller hanger and rear metal hook are fastened. It is advisable to use thin cotton or silk thread to hold the propeller hanger to the motor stick in addition to the ambroid or cement. The motor stick is shown in the drawing 2.

Wing and Tail

THE wing and tail surface ribs are all made from 1/16″ sheet balsa wood and are cut to the correct shapes as shown in the drawing 1. The main spars are of 3/32″ birch dowel wood, and are inserted through the ribs. Allow 1 1/2″ spacing between each rib. Each rib in turn should be fastened to the spar with model builder's cement, after which the entire framework is put aside to dry.

In the construction of the elevator and rudder the same procedure takes place as in the main wing construction except that 1/16″ square bamboo is used for the leading and trailing edges. Bamboo can also be used for the main wing tips. The best way to bend bamboo into any desired shape is to heat the bamboo over a candle flame and keep bending to shape with your fingers..

The spars of both the elevator and rudder are made from 1/32″ x 3/32″ balsa wood cut to the correct size as shown in the drawings.

The entire model is covered with light superfine Japanese tissue. Banana oil is used as an adhesive in fastening the covering to the framework of the model. In covering the wings it is advisable to start fastening your covering to the framework at the center section of the wing and work toward the tips. (*Continued on page* 38)

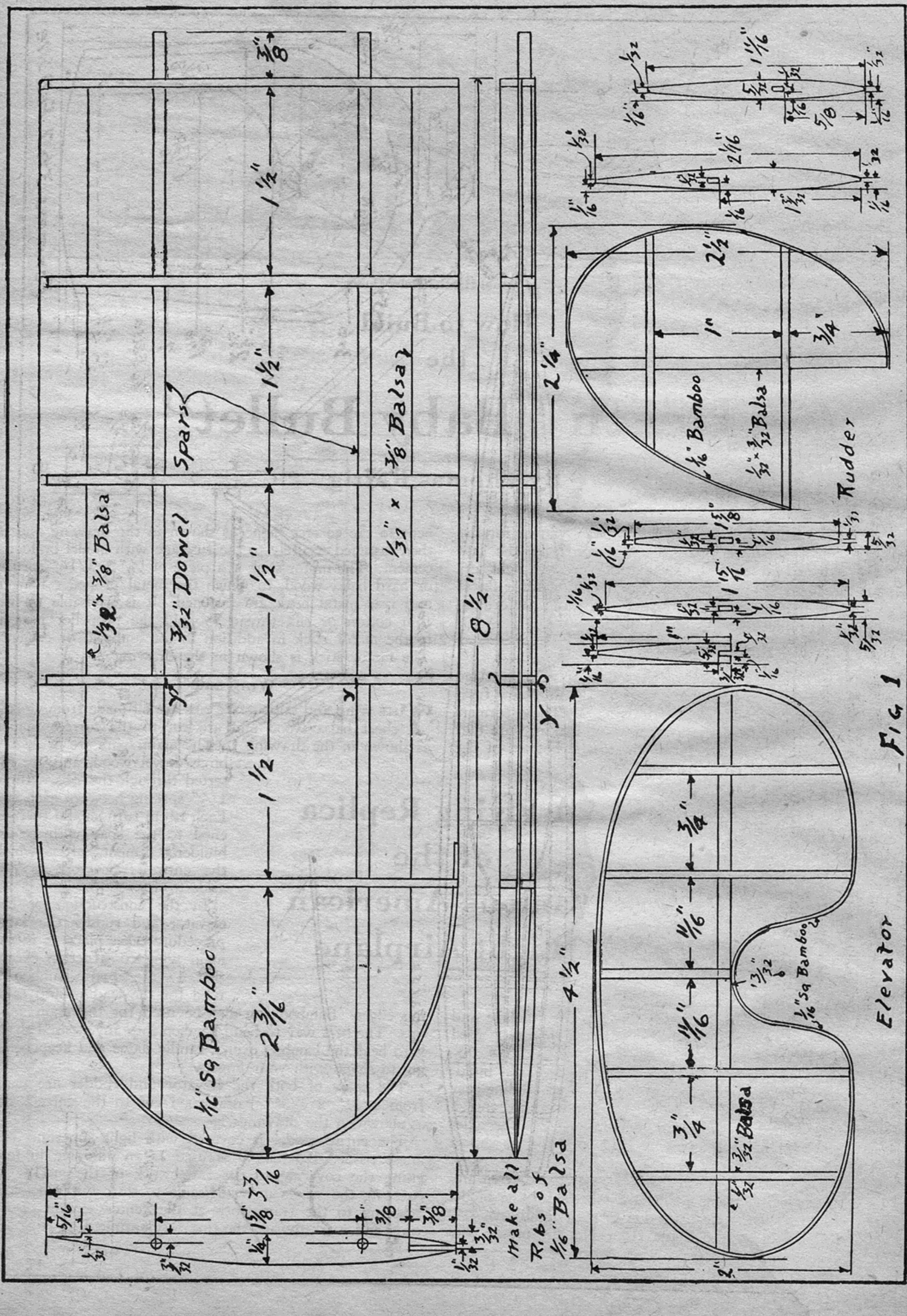
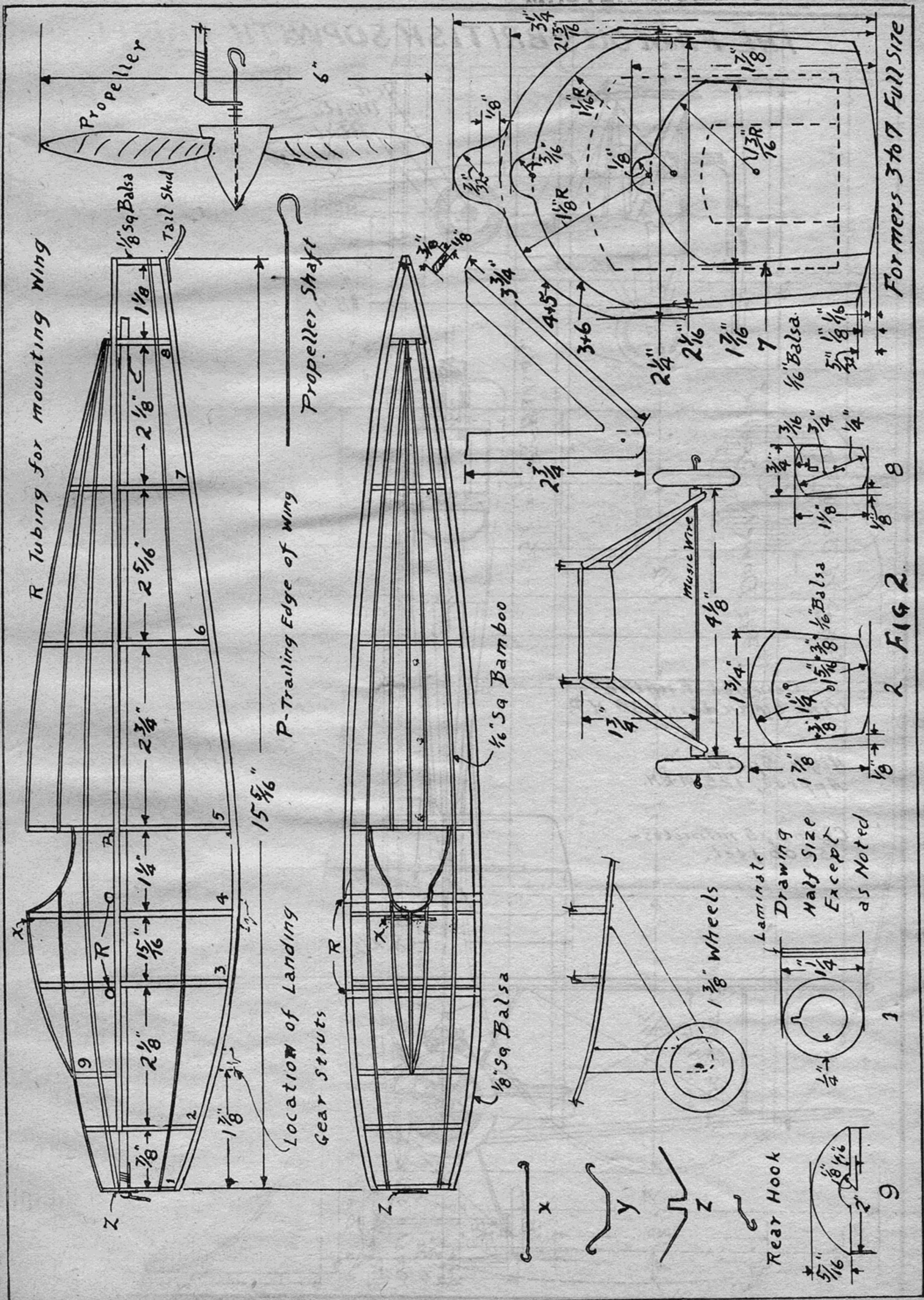
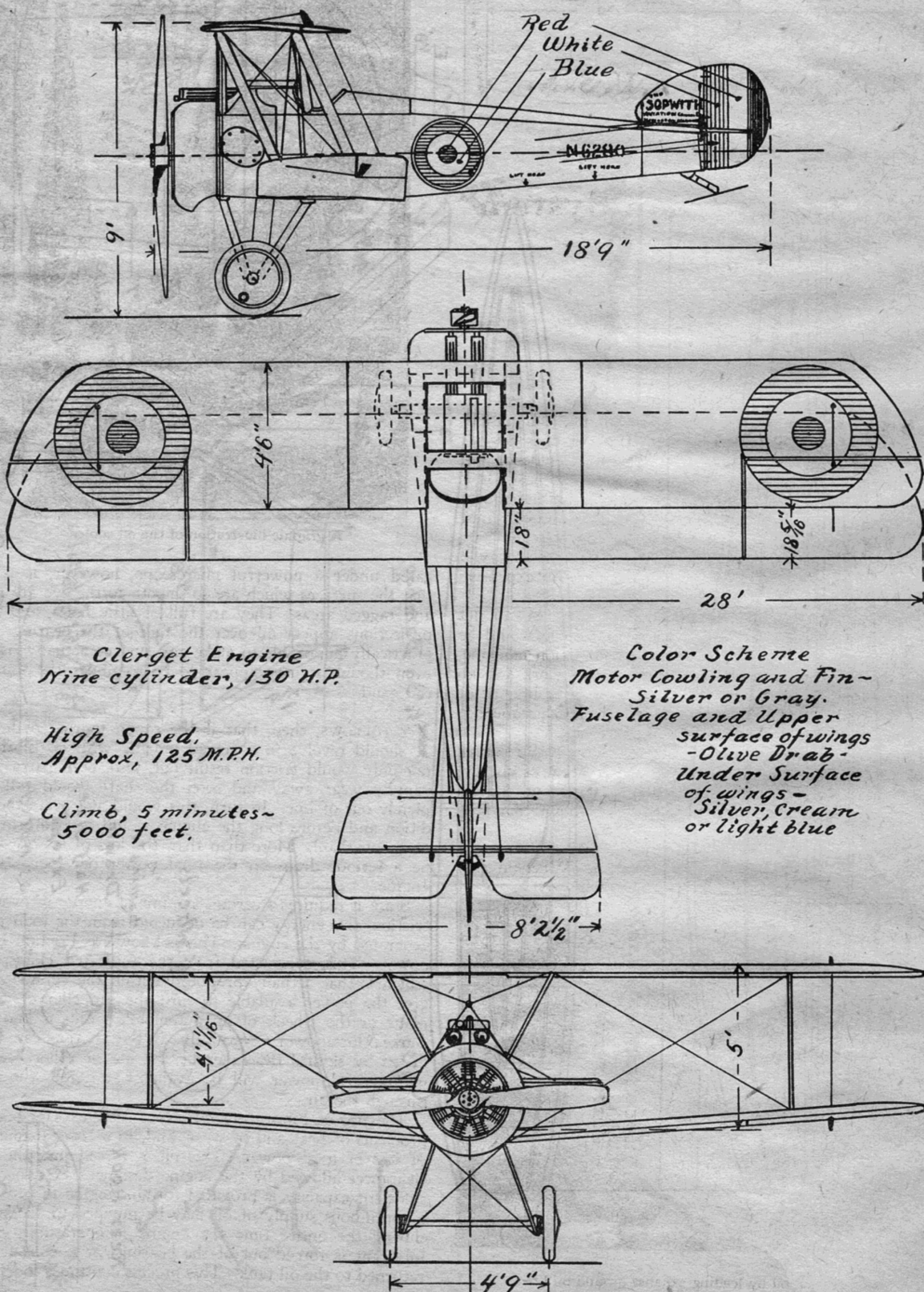

Spars
1/32" x 3/8" Balsa
3/32" Dowel
1/32" x 3/8" Balsa
1/16" Sq Bamboo
8 1/2"
1 1/2"
2 3/16"
Make all Ribs of 1/16" Balsa
2 1/4"
2 1/2"
1/16" Bamboo
1/32" x 3/32" Balsa
Rudder
4 1/2"
1/16" Sq Bamboo
3/32" Balsa
Elevator

Fig 1


Propeller
6"
Propeller Shaft
R Tubing for mounting Wing
P-Trailing Edge of Wing
Tail Skid
1/8" Sq Balsa
1/16" Sq Bamboo
Location of Landing Gear Struts
15 5/16"
Formers 3 to 7 Full Size
1/16" Balsa
Music Wire
1 3/8" Wheels
Laminate
Drawing Half Size Except as Noted
Rear Hook
X
Y
Z
FIG 2.

THE FAMOUS BRITISH SOPWITH CAMEL



The Airplane Engine

By

Lt. H. B. Miller, U. S. N.

The Lubrication System

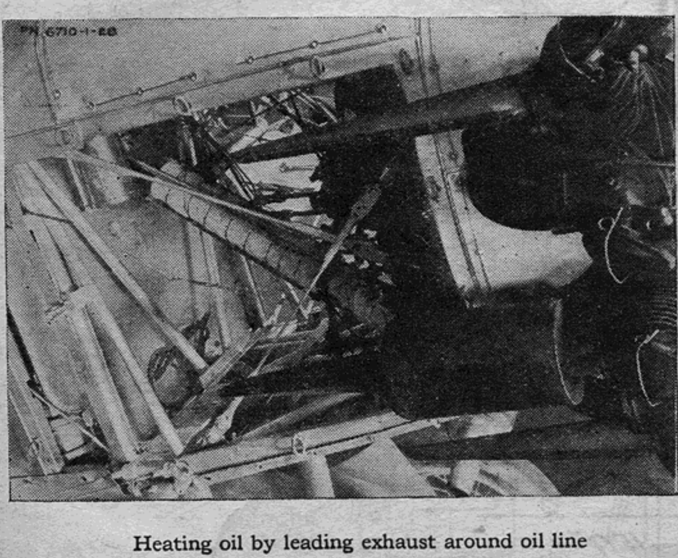
(*CHAPTER 5*)

MOST of us normally think of the function of lubricating oil in terms of friction elimination. This is true as far as it goes, but it does not tell the whole story by any means. The first evidence the engineer has of friction is in the appearance of heat. It is essential that this heat be carried away from its source and dissipated quickly. Otherwise, it will accumulate until the temperature of the bearing or other affected part reaches such a high degree that the bearing metal will actually melt and thus "freeze" the engine. An expensive overhaul will result.

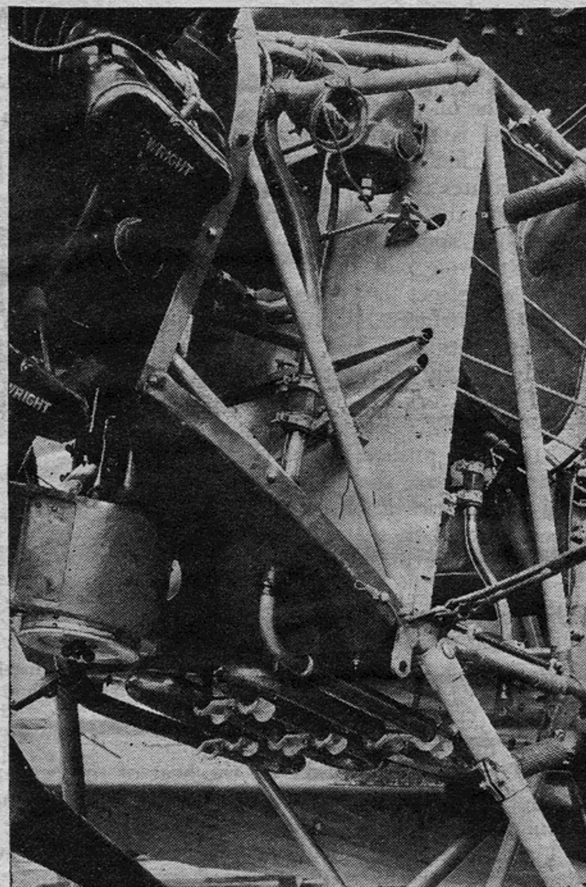
Friction between two moving metallic surfaces can not be entirely eliminated. If this were possible, it would be a simple matter to construct a perpetual motion machine, for if such a machine were doing no useful work and no energy were being lost in friction, the original amount of energy stored up would remain unchanged. Consequently, the machine would continue moving forever.

Friction, thus, is a loss of useful energy. We know, however, from nature's law of the conservation of energy, that there can be no complete disappearance of energy. It will appear in the form of heat at the point that friction occurs.

The surfaces of bearings and journals may appear to be very smooth with no rough spots on them. When investigated under a powerful microscope, however, it is seen that the surfaces which are so smooth to the eye are rough and ragged areas. They are full of little holes, and sharp projections appear all over the face of the bearing. It is practically impossible to make any surface actually smooth, even though it may appear to be so under the touch of the hand.



Heating oil by leading exhaust around oil line



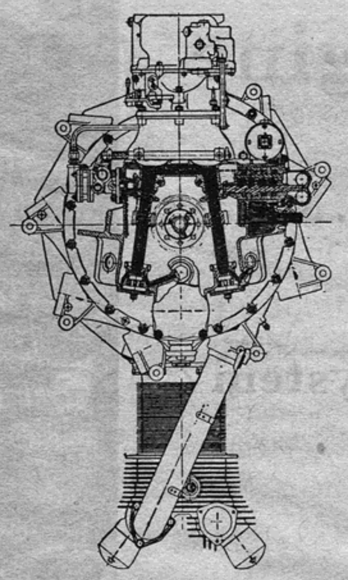
A graphic illustration of the oil cooler

IT FOLLOWS, then, that if the rough journal of a shaft should revolve in a jagged bearing with no lubricants, not only would friction result but, also, both parts would rapidly wear away and soon the shaft would fall completely out of line. In turn, this would aggravate the condition and before long the engine would be badly in need of an overhaul. More than that, the loss of energy would be a serious drain on the total power developed by the engine.

Since it requires a certain amount of energy to overcome friction, this energy can be deducted from the total power generated by the engine. This is known as Friction Horsepower. This, subtracted from the Indicated Horsepower, which is that actually produced within the cylinders, will give the power available to turn the propeller of an airplane or the wheels of an automobile. This is known as Brake Horsepower. Naturally, if the friction can be reduced by skillful design or by the use of roller bearings, more useful power will be available to pull the plane through the air.

The use of lubricating oil solves satisfactorily both the problems of heat and of wear, and, to a lesser extent, that of loss of total power. This oil is forced into the slight clearances allowed by the engine designer. A reservoir of sufficient capacity is provided for the engine in order that a continuous supply of oil may be pumped to all bearings during the entire time the engine is operating. As the lubricant is forced out of the bearings, it is collected and returned to the oil tank. This process continues indefinitely as long as the engine is turning over and as long as the oil supply is maintained.

As the oil is forced into the bearings, it provides a film or cushion which completely separates the two bearing surfaces and prevents their contact. This oil fills in the rough spots on the surfaces. In addition, the oil will build up so that there is a distinct layer separating the two metal surfaces. Consequently, if proper lubrication is had, bearings will wear only slightly even after hundreds of hours of hard work.



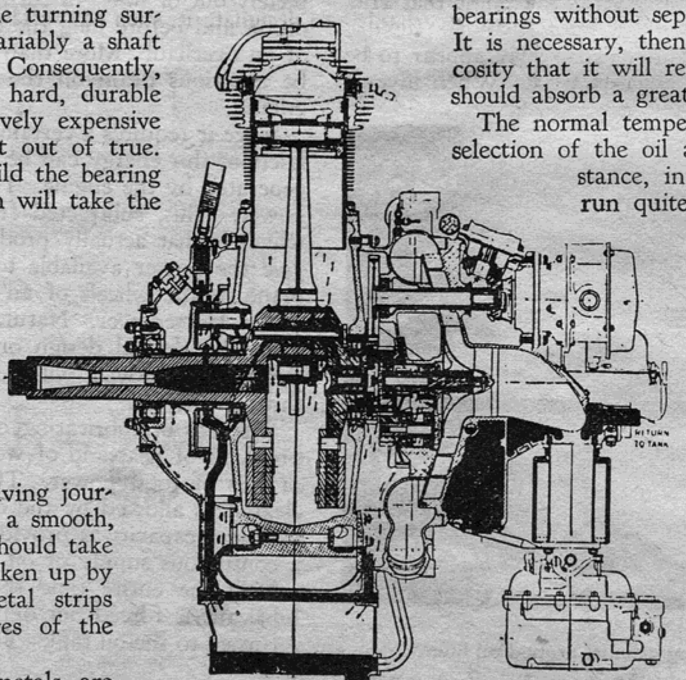
Above, method of oiling accessory section, and, below, the lubrication chart (*Wasp*)

As the oil is pushed through the bearings it absorbs the heat that is being created and carries it off. The lubricant will be collected in the sump of the engine and be returned to the oil tank where it will be given an opportunity to cool before it is required to again circulate through the lubrication system. If the oil collects an excessive amount of heat, it may be necessary to provide some form of an oil radiator or cooler in order that the in-going oil will be of sufficiently low temperature to take up the heat of the bearings.

It might appear that all friction could be eliminated providing the two metal surfaces are separated by the oil film. Unfortunately, this is not so. As the journal revolves, a layer of the oil film will adhere to its surface and will turn with it. Likewise, part of the film will remain stationary along with the bearing surface. It is seen, then, that the oil is being constantly torn apart and separated. Since lubricating oil has a thick body, it resists this continuous breaking up. This is known as internal friction and can not be eliminated.

The amount of pressure necessary to maintain the protective film between the two bearing surfaces is dependent on the design. It is essential to keep this pressure well within the capabilities of a reliable oil pump. The load per square inch will decrease as the bearing area is increased.

For economy of upkeep it is a general practice in engineering to anticipate a certain amount of wear at the bearings. The turning surface, or the journal, is invariably a shaft which is transmitting power. Consequently, it must be constructed of a hard, durable metal. It would be prohibitively expensive to permit this surface to get out of true. It is possible, however, to build the bearing out of some soft metal which will take the wear and which can be easily replaced. There are various types of babbitt or white metals, but in the main their major constituent is tin. This may be alloyed with such metals as nickel and copper.



Not only will the bearing take the wear but being softer it will permit the revolving journal to wear the bearing into a smooth, snug fit. If too much wear should take place, this clearance can be taken up by removing shims, or thin metal strips from between the two halves of the bearing.

The babbitt or bearing metals are generally built up as a layer inside a hard bronze or steel backing. Thus, the soft metal will have a firm foundation. If too much wear occurs, it may become necessary to melt the softer babbitt out. It will then be replaced by spraying the hot metal on the backing as it is revolved in a lathe. After it cools, it may be turned down to the required dimensions. Thus, it is relatively inexpensive to renew a bearing surface.

The roller or ball type of bearing construction uses a somewhat different principle than the sliding bearings we have just discussed. We all are aware of the fact that it is much easier to roll a box on wheels than it is to slide it along the ground. The roller bearing takes advantage of this fact and reduces friction considerably.

Practically all radial types of engines use roller or ball races on their main gearings. Having only one crank on its crankshaft, this engine is ideally fitted to make use of this system. It is more difficult, however, to fit ball races to the long irregular crankshaft of a liquid-cooled type of engine, and for this reason it is seldom done.

In this type of construction extremely hard steel balls or cylindrical rollers are contained within concentric circular cages or races. A portion of the ball or roller projects from the race both on the inside and on the outside. It is this projecting surface that takes the rotating load and permits the journal to turn inside the bearing surface.

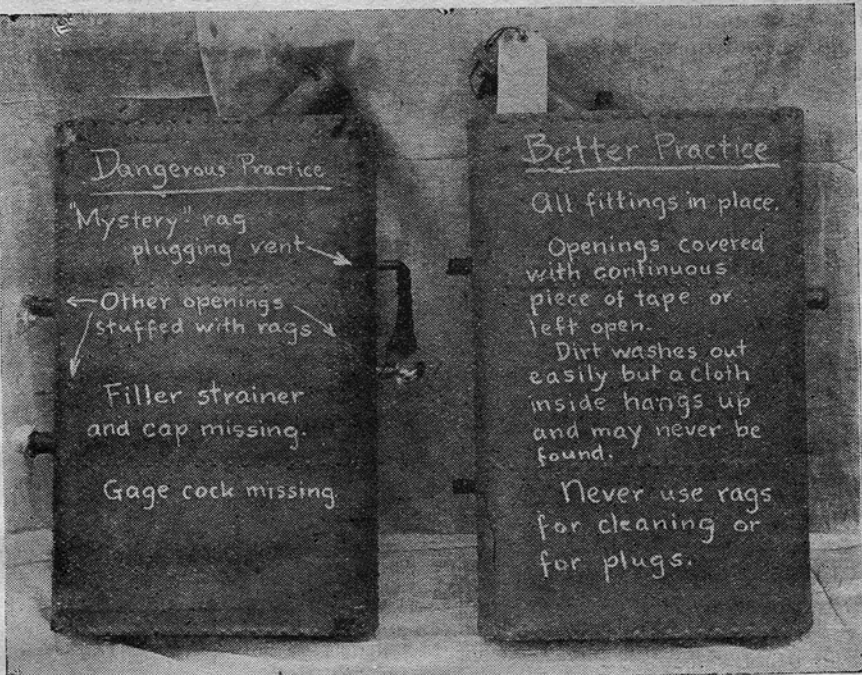
In selecting a lubrication oil for use in the airplane engine many properties must be carefully considered. Of these, perhaps the most important is viscosity. This is the ability of the oil to flow. It is well known that as oil is heated it becomes more fluid—in which property it is analogous to molasses, and everyone has heard the expression "as slow as molasses in the winter time."

In a previous article we discussed the tremendous heat that is generated within the internal combustion engine. If the lubricating oil were to get too hot, it might become so fluid that it would pass quickly through the bearings without separating the moving surfaces. It is necessary, then, to use an oil of such viscosity that it will retain its body even though it should absorb a great amount of heat.

The normal temperature of the air affects the selection of the oil as regards viscosity. For instance, in the winter the engine will run quite cold. Consequently, as the oil circulates through the system it will absorb little heat. As a result, the oil will not thin out even though the engine is operating. For this reason, relatively thin oils are used by aeronautical operators during the cold, winter months.

On the other hand, the natural heat of the engine is considerably increased by the heat of the summer and the heated oil would thin out considerably, thus affording poor lubrication at the best. For summer use, then, a much heavier oil must be used. For extremely hot weather, such as the tropics, a still heavier grade of lubricating oil is necessary. These three grades are practically standardized throughout the aviation and oil industries.

The Flash Point of oil is a second important consideration. This is the lowest temperature at which oil will give off a combustible vapor. In other words, if a low flash point is permitted the lubricating oil will be a dangerous fire hazard. To raise the flash point it becomes necessary for more vapors to be driven off by heat during the distilling process at the refinery. A low flash point will also be produced if gasoline vapors pass by the piston rings and saturate the lubricant.



It is essential that the lubricating oil contain no acids or any foreign matter that might result in acids. This factor also affects the selection of the fuels. Suppose, for instance, that the fuel contained sulphur. As it burned, it would form sulphur trioxide (SO_3). We have already seen that complete combustion of the fuel will result in the formation of water within the cylinder. The water (H_2O) will combine with the SO_3 to make sulphuric acid (H_2SO_4).

If this acid condenses, as it might in a cold engine or after the engine was stopped, it would eventually work its way down the cylinder walls and fall into the crankcase and combine with the oil. It is obvious that as the oil circulated when the engine was again operated, the acid would score and etch the smooth bearing surfaces until the erosion was sufficient to necessitate a complete overhaul of the entire engine.

The heavy loads placed on the airplane engine result in an extremely difficult problem of lubrication. Only the finest oil should be used if the best results are to be expected. On the other hand, even though the highest quality of oil is poured into the engine, it takes only a relatively short time before it will gather up grit and particles of carbon that have worked down from the cylinders. Minute particles of metal will be worn from the various cylinders and bearings. All of this residue will be circulated over and over.

If the piston rings are not in good condition drops of this metal-laden oil will eventually find its way once more above the piston and will finally be deposited upon the electrodes of the sparkplug. There it will short-circuit the plug by offering a conducting path of metal across the gap. Consequently, no arc will take place and the cylinder will fail to fire.

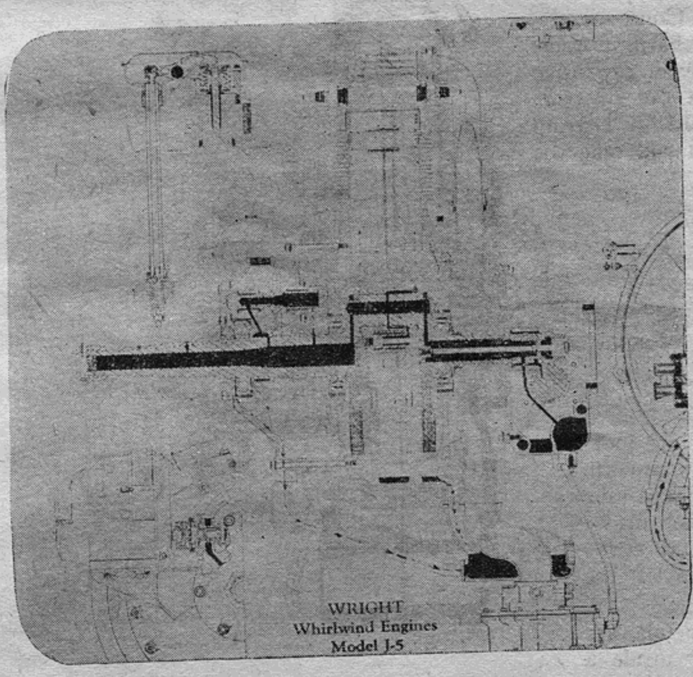
Moreover, the grit contained in the oil will form an abrasive compound which will tend to scratch and erode the steel cylinder liner. The most satisfactory thing to do when the lubricating oil becomes saturated with gasoline or water, and when it gathers up a load of residue, is to drain the oil and replace it with a fresh supply.

An oil filter, while effective when clean, would be able only with difficulty to handle the large quantities of oil that the airplane engine demands. Besides, its weight is a factor. Both the Army and the Navy consider this point of sufficient importance that their regulations provide for an oil change after every ten hours of engine operation.

In this connection it is interesting to note that it is perfectly feasible to work over used oil almost indefinitely. The used crankcase oil is allowed to settle. Many of the impurities drop to the bottom and are drawn off. After boiling and acid treatments a product is obtained that is as good as new, unused oil. Eighty-five per cent of the original volume can be recovered. Various names are used to designate it, such as "reclaimed oil" and "re-refined oil."

Efforts have been made to market such a lubricant, but have met with no success for the uninformed person doubts its quality. Several companies that operate fleets of automobiles and cabs have adopted this system and are saving thousands of dollars a year, and at the same time getting satisfactory service.

We ordinarily think of all lubricating oils as a mineral oil. This is not necessarily true. There are the organic oils which are derived from animal and plant life. The animal (*Continued on page* 47)



Above, precautions in removing oil tank

Left, oil system of the Wright "J-5"

Donnie Crawford, five years old, who solo-ed in a Waco glider and won the Goldsborough Trophy, at Ashtabula Air Meet. Note the extra rudder bar for short legs

The American Sky Cadets

THE following contribution by Dr. Don Crawford, Chairman of the Aviation Committee, Ohio Affiliated Exchange Clubs, Cleveland, Ohio, is worthy of your interest.

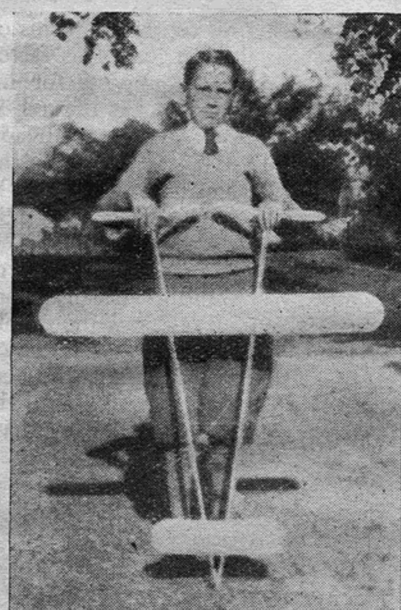
Here it is:

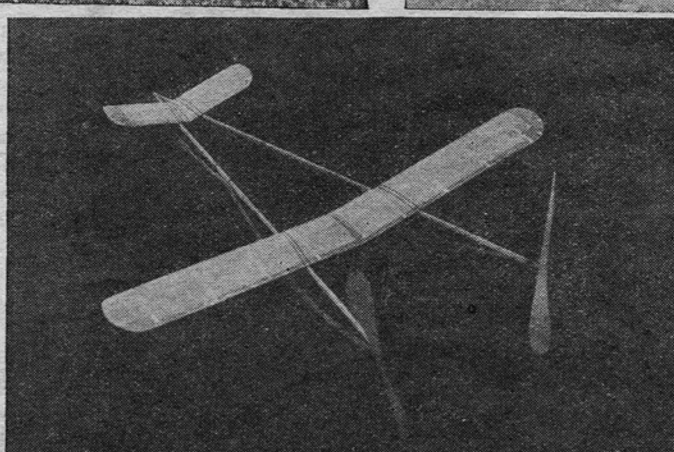
Did your dad or mother, or possibly grandma, ever say "Boys—what next?" to you? If they did not, I am sure they thought about it many times since you first began creeping around on the floor on all-fours. You know all boys are subject to that very communicable disease "what next." Every boy is looking around for something new and exciting. So in this article, I'm going to tell you about a new "what-next" which comes between the making of flying models and the actual flying of a glider.

I know lots of boys who have built models until they are weary of it—they are not yet old enough to become glider pilots and yet they are a little too big for models any more. These are the fellows to whom this stunt will appeal. The fellow who is just itching to get into a glider seat and feel out the controls, wiggle the rudder a bit, and jerk the joy-stick back just to see what happens. This is the very thing that you all can do easily and safely, and have a barrel of fun if you follow out the plans as laid down and accomplished by the East End Exchange Glider Club of Cleveland, Ohio.

The Ohio Affiliated Exchange Clubs have adopted as one of their objects, the advancement of aviation. In addition to holding meetings, showing movies, installing air beacons, air-marking roads, opening landing fields and other promotional enterprises, the sponsorship of flying clubs, glider clubs and model airplane clubs has been a huge success. The flying clubs, of course, are for men; the gliding clubs for boys sixteen and older, and the model clubs for younger boys.

Below are winners in the New England Championship Contest. Left (reading from left to right), Carl Harvey who took fourth place. Paul Nordman who created a national record of 3 mins. 47-2/5 secs., and 5,000 ft. distance; and Leslie Jenkins who took first place. Right, Leslie and his prize winner. Bottom, a close-up of the Grant Twin-Pusher that carried off the Mulveyhall Trophy for Leslie Jenkins





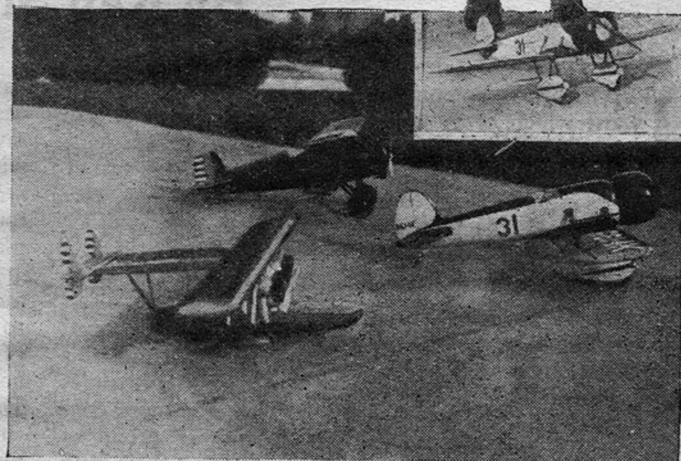
In the case of the East End Gliding Club it was found necessary to admit boys younger than the average. In fact, we had one little fellow of five years of age and another of twelve to whom we just had to allow the privilege of membership. Moreover, it turned out to be the younger boys' participation which caused us to find out how to use a "glider-trainer"—a real "what-next" for you fellows who are now building models and want to do advance work.

We purchased a light primary glider early and before we got along very far in the actual art of flying, we had our glider all smashed up. It was not so greatly damaged from flying accidents but we ruined the thing completely by towing it on a home-made trailer for 120 miles to an air meet. The wings were so badly damaged it was necessary to rebuild the whole thing.

While this was in process of repair the idea of using Glider No. 1 for training came to us, and we purchased a Waco all-steel pri-

Ohio Affiliated Exchange Clubs Promote Novel Air Training Idea

At right, Adrian Wallace with the Travel Air "Mystery Ship" that won third place in the New York Evening Graphic Contest; and below, some more of his models. At bottom is the famous boy pilot, Robert Buck, who holds several junior flying records



mary for the man who was more advanced. The slower ones were destined to fly the trainer—and in so doing derived more fun and experience out of it than the other man. The trainer was made by suspending the glider on a cable which was placed between two sixty-foot trees, located about 100 yards from the hangar at the East End Gliderport.

THE glider containing the student could be put in flying position by adjusting the supporting rope toward or away from the center of gravity and when a wind was blowing, all the sensations of gliding were experienced while the glider was safely suspended between the trees. The rudder controls responded with all the alertness of a thirty-five-miles-an-hour flight; the ailerons could lift up a wing on the slightest pressure and the flippers would surprise you at the lifting power when you pulled the stick back to your stomach.

So here was a device which a fifty-pound boy or a 200-pound man could sit in for an hour and really learn to fly. It proved much less costly than any other method of trainer; it allowed the student plenty of time to master the controls, especially the co-ordination of rudder and stick, which every student seems to do wrong at first. It is hard, after sled riding in a flexible flyer, to turn your airplane to the right by pushing your right foot forward. However, in this trainer you can soon get the "feel" and there your solo flight in a shock-cord release is made a whole lot easier.

When there is no wind an airplane propeller can make plenty for you—have the pilot stand the ship in front of you while he's warming up his motor—you'll get flying experience, I assure you.

This glider trainer is a wonderful asset in training; it is a dandy way to get non-flying, contributing members of your glider club more interested because they, too, can have a "feel" of the stick. The biggest and best thing is the fact that without any danger of damaging the wings or control surfaces, you can master the technique of control, the co-ordination of stick and rudder, and have a lot of real pleasure doing so.

The East End Exchange Gliding Club has been flying every Wednesday afternoon and Sunday morning since May and has never had an accident to any of its flyers. Moreover, it has a flock of gold and silver plaques, cups and money to show that in competition it was able to "bring home the bacon." We have used shock-cord launching—wore out two 150-feet shock cords, and are still at it, especially with the glider-trainer device hanging between the trees.

So that's the story of a new "what-next." Whether you're five or fifty you can fly this safely. You can get a glider trainer in three ways: Build one; get a cracked-up one that some club has discarded, or borrow your big brother's real glider and hang it up in your back yard. Try it—you will have lots of fun.

Seventeen years old, holder of the junior transcontinental record both ways, also of the junior record for a flight to Havana and back, and with over 350 flying hours to his credit, Robert Buck, known the country over as "Bobby," has achieved the ambition of every boy who reads this magazine.

What gave Bobby his first interest in flying? He was asked this question when interviewed at his home in Hillside, N. J. "Model airplanes," was his reply. He went on to say how he built his first R. O. G. at the age of twelve. What is more, he is still building models and has just finished an autogyro. You might think that a young fellow who flies around breaking records would not bother with models, but Buck says that the finest way to learn about aviation is through models—and he is still learning.

Many boys consider them-

(Continued on page 48)

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

EFFICIENCY, combined with safety, is the goal toward which every aircraft designer is striving. He tries to make his ships more and more efficient; which includes such matters as payload, speed, comfort of passengers, economy of construction and operation, etc. He tries to make them safe, which requires among other things an ample factor of safety against stresses, a low landing speed, freedom from dangerous stalling and spinning characteristics, and so on.

In the two articles previous to this we have discussed the work of various designers who are trying to attain this goal by building machines that differ, either in principles of operation or in methods of control, from the more conventional airplane. However, there is another group of engineers—a very large group—who are pinning their faith to the accepted type of airplane, claiming that it is the only practical solution to the problem.

It has often been said in recent years that modern airplanes show little or no improvement over the ships that were built during and immediately after the World War. The designers who are sticking to the conventional type of ship, however, point out that, payload and power considered, the modern airplane is greatly superior to its predecessor.

For example, a modern two-place light ship with a sixty horsepower motor shows a high speed that is comparable to that of a single-seater wartime pursuit job that had twice the power! This modern ship, too, is stronger in every detail; it lands much slower than did the wartime bus; and it is, when compared to almost any of the older planes, a dream to handle.

That is just one example. Airplanes today, through painstaking research and designing skill, have been developed into machines that are a great deal more satisfactory than were their older brothers.

The engineers who are sticking to the conventional airplane and developing it further build their arguments on this fact. They contend that in view of the tremendous development that has already taken place, the accepted type of airplane is our best bet. They say that the airplane can be developed from its present state of safety and efficiency into a machine that will have all of the characteristics that are sought after by the designers of the more or less "freakish" machines; and they say that the airplane will combine these characteristics with operating efficiency and low cost.

In this article we will discuss the work of those men, touching on the highlights of modern development in airplane design.

Perhaps the most outstanding of recent developments in airplane design is the light plane. It is not quite accurate, to call the light plane a recent development, as the history of the type goes back into the old days of rotary motors and castor-oil lubrication and pusher "flying kites." Santos-Dumont built the first featherweight ship. He called this tiny monoplane the *Demoiselle;* and, being a small man, he managed to make some very remarkable flights in it. Other pilots flew it too, but it was rather tricky and hard to manage. In fact, its antics at a British flying meeting caused it to be called the "Infuriated Grasshopper."

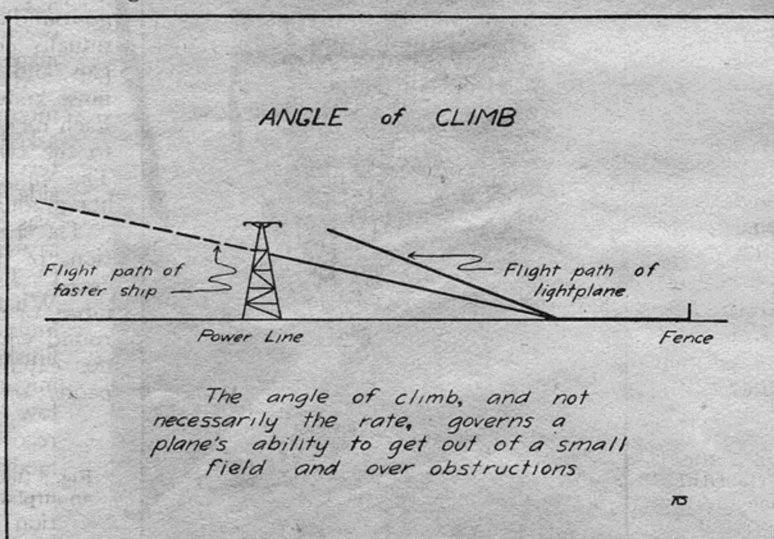
THE *Demoiselle* was the first ship that was built with the express idea of constructing a small, light plane that could be used by the average man.

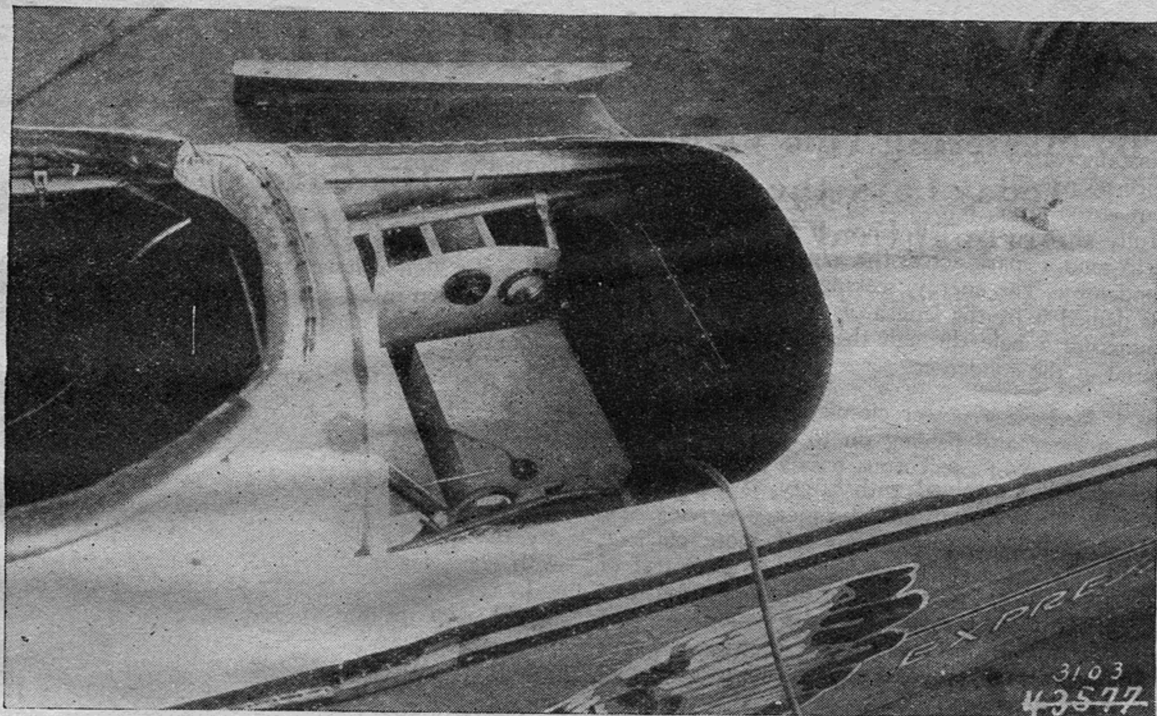
In more recent years, aircraft manufacturers have just come to realize that the greatest market for airplanes lies in the general public. Thus, after a long period of almost total extinction, the light airplane has come to the fore, being developed into a machine that is both cheap and thoroughly airworthy.

What is the purpose of the light airplane? Who is to use it, and what will he use it for? Its purpose is this: to supply the average man with a machine for air travel—*and to do this at a price that he can afford to pay.*

The average man will find the light airplane extremely useful. As a sport machine it is unexcelled, increasing as it does man's range of existence and changing his viewpoint. In an automobile, even on the best of roads, it is difficult to average — with safety — more than forty miles an hour on a long trip. However, in a light airplane speeds of from seventy to ninety miles per hour are easy, and the airplane is not troubled by slow traffic and winding roadways that cover twenty miles or more to go a

(*Continued on page* 41)





Special Course in Aerial Radio

By Capt. Leslie S. Potter

(*CHAPTER 5*)

CONDENSERS built for radio purposes have to be built to withstand high voltages. When used for transmitting they are commonly named high potential condensers. The insulating material, whatever medium is used, is called the dielectric.

If we connect a condenser with a battery and transmitting key, the moment the latter is pressed and the circuit completed, a current will flow into the condenser. The plate in the condenser that is connected to the positive terminal of the battery will become positively charged, and the plate connected to the negative terminal will become negatively charged. Owing to the insulation between the plates, no current can pass through the condenser, so the difference of potential between the plates increases as the current continues.

Owing to the law of like repelling and unlike attracting, when condensers are made up (as they usually are) of several plates, a positive charge on one plate will cause a negative charge on the next, and this, in turn, will cause a positive charge on the one after, and so on.

Fg. 8 (above). Western Electric transmitter and receivers installed in fuselage of mail plane

When the key is released and the charging circuit broken the condenser will discharge round the circuit providing the outlet, and these series will continue until the energy is worn down by the resistance of the circuit. The current that is sent round a circuit following the discharge of a condenser is called an oscillating current.

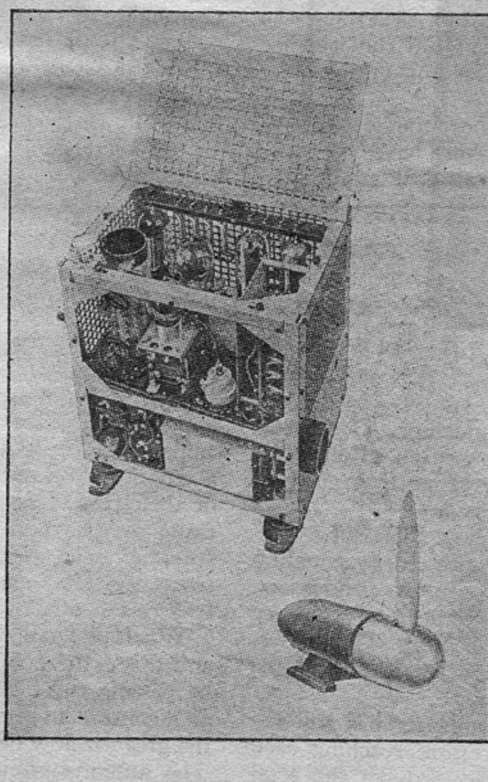


Fig. 4 (left). A view of the interior of an airplane transmitter showing the component parts

When a spark gap is included in a discharge circuit from a condenser, the latter will charge until the difference of potential is high enough to break the resistance offered by the air between the electrodes of the spark gap. Then a spark will jump the gap and oscillations will go round and round the circuit, continually crossing and recrossing the gap and producing the crackling noise known as the spark discharge. Each oscillation is somewhat similar to the twanging of a harp string. The vibrations are violent at first but gradually die down.

The speed with which the oscillations of an oscillating current decrease is determined by the resistance, or the damping in the circuit round which they are passing, and the extent of the oscillations depends on the rate of damping.

Now the length of a spark gap determines the amount of resistance at this point. The gap can be made larger and the resistance increased or the gap can be reduced and the resistance decreased.

If the gap is too large, however, so that when the condenser is fully charged the difference of potential is still insufficient to send a spark across the gap, it will probably ruin the condenser. The energy, seeking to find some outlet which is denied it by the length of the spark gap, will probably puncture a hole through the dielectric, or insulating material of the condenser.

IN Figure 1 we have a power circuit being stepped up by a transformer and passing on to a condenser. A discharge in the form of oscillations passes from the condenser across the spark and on to the inductance. The smaller coil is the primary coil, and the larger is the secondary coil of an oscillation transformer. It will be noticed that neither coil has an iron core, and for this reason it is sometimes called an air core transformer. The secondary coil is connected to the antenna and ground as shown.

The oscillations following the condenser discharge are transferred by induction from the primary to the secondary coil, and on to the antenna. Several thousand oscillations cross the spark gap and pass round the circuit in rapid succession, causing vibrations to be set up similar to the harp string. The reading of this explanation would suggest the process just described was a lengthy one, but in reality each train of oscillations occupies only an infinitesimal fraction of time. Figure 2 will help to make the picture of oscillations clear.

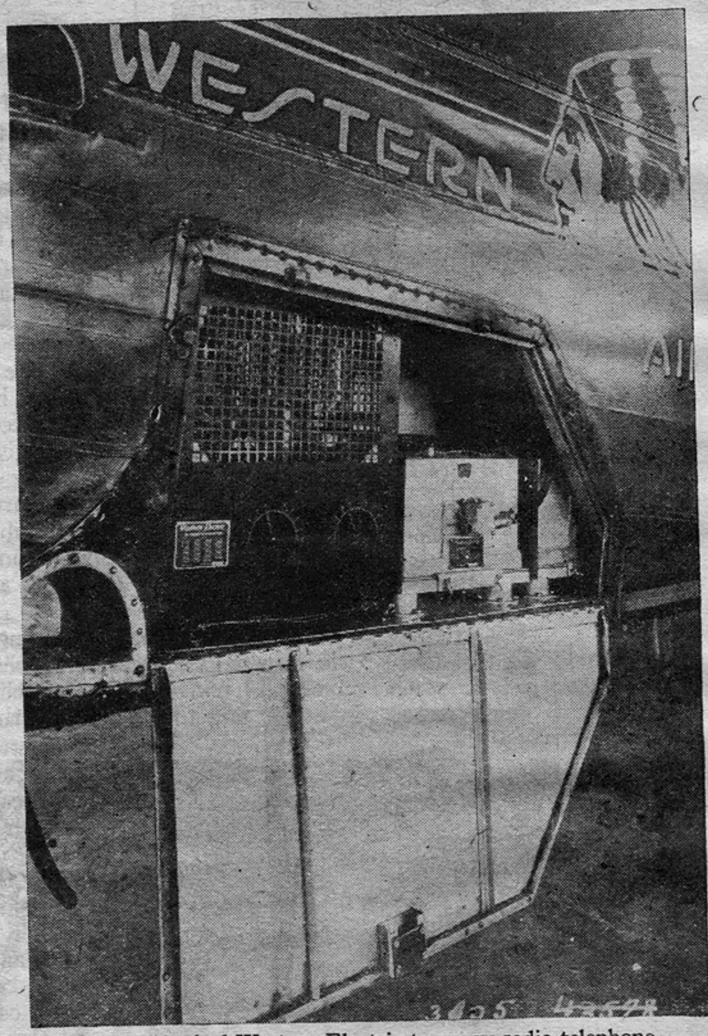


Fig. 7. Typical Western Electric two-way radio-telephone in mail plane

Capacity of Condensers

THE capacity of a condenser depends on the size of the plates used and the thickness of the dielectric. Increase the thickness of the dielectric and you will increase the capacity of the condenser. Condenser capacity is measured in microfarads, written mfd. Condensers used in transmitting generally range from .001 to .1 mfd.

We spoke, in an earlier article, of how the total capacity of batteries and resistance coils is affected by coupling them in different ways. The same applies to condensers. Condensers connected in parallel have a total capacity equal to the sum of their individual capacities. Condensers connected in series have a total capacity less than the capacity of one.

Look at (a) in Figure 3. Each condenser has still the same individual capacity, but the pressure reaching each has been reduced, and this, of course, reduces the total capacity. Each has an individual capacity of .004 mfds., but by connecting them in series the combined capacity is reduced to .002 mfds. If, however, they are connected in parallel as shown in (b), the total capacity will be the sum of the capacity of each.

Sometimes the voltage may be too strong to permit the condensers being connected in parallel, and if we do not want to reduce their capacity, but want to protect them against the high voltage, we can connect them in parallel series as shown in C. Here the total capacity has not been sacrificed but the total resistance strength has been increased.

The frequency of a condenser discharge is regulated by the condenser capacity and the inductance in the circuit. The greater the capacity of a condenser, the longer it will take to discharge and the frequency will be correspondingly less. Reduce the capacity of a condenser and you reduce the time needed to discharge, and consequently increase the frequency. Therefore, by connecting condensers in parallel their capacity is increased and the frequency reduced. By connecting them in series the capacity is reduced and the frequency increased.

IT IS similarly with inductance. The greater the inductance, the longer it will take for a given amount of current to flow through it, and the frequency will be reduced. The smaller the inductance, the less time will be taken by a given amount of current flowing through it and the greater will be the frequency. These are important points in the study of radio and should be committed to memory. Questions bearing on them are often included in the examinations. They are set out again below for the sake of greater clearness.

Increase capacity, increase inductance—Decrease frequency.

Decrease capacity, decrease inductance—Increase frequency.

Capacity and inductance not only influence the frequency, they also influence the amperage, that is the quantity of current flowing through a circuit. Both capacity and inductance have a reactance of their own, but these, fortunately, offset each other because they have opposite effects on the frequency. Therefore, at some particular point of adjustment these two reactances can be compensated to a point where each neutralizes the other and the effective reactance is zero.

When this happens, the circuit is said to be in resonance, and this is the point when the greatest flow of current will be passing through it. It can be determined by including an ammeter in the antenna circuit. When this indicates the greatest flow of current the circuit will be in resonance. The antenna circuit must be in resonance with the oscillatory circuit. A receiving aerial must be in resonance with a sending aerial to get the strongest signals.

It has already been explained how frequency affects wave length. We have now seen how frequency is affected by capacity and inductance. From here it is an easy step to see how intimately the latter are connected with the wave length. Increase the inductance and longer wave lengths are possible. By adding condensers in series and so reducing the capacity (see Fig. 3), the wave length is shortened.

Tubes

Hitherto we have dealt solely with spark sets because they have defined more simply the problems under discussion. Spark sets, however, are rapidly dwindling in numbers, and the use of certain types after a given date has already been forbidden. The vacuum tube is now used in practically all receiving sets. Its compactness has made possible the installation of radio apparatus in airplanes which would have been otherwise impossible, and as we are concerned in this article primarily with aerial radio, a knowledge of the vacuum tube becomes essential..

The first tubes were invented by Dr. A. J. Fleming of London in 1904 and were known as valves. In England they are still known as valves.

To understand the principles underlying the construction of the vacuum tube we must get back to the theory of electrons discussed in the first article in this series. It will be remembered that atoms contain minute particles known as electrons, and that these electrons are of two types, negative and positive. The tendency of electrons is always to maintain a state of equilibrium,—negative electrons will be attracted by a positively charged atom — one that has less than its normal complement of negative electrons.

When a piece of metal or wire is heated to a sufficient intensity it will throw off millions of negative electrons, and this will leave the wire positively charged. If this takes place inside a glass tube, the electrons hurtle back and forth at tremendous speeds, being alternately attracted and repelled by the heated wire. Their numbers and the speed of their movements will be regulated by the intensity of the heat and the length of the wire.

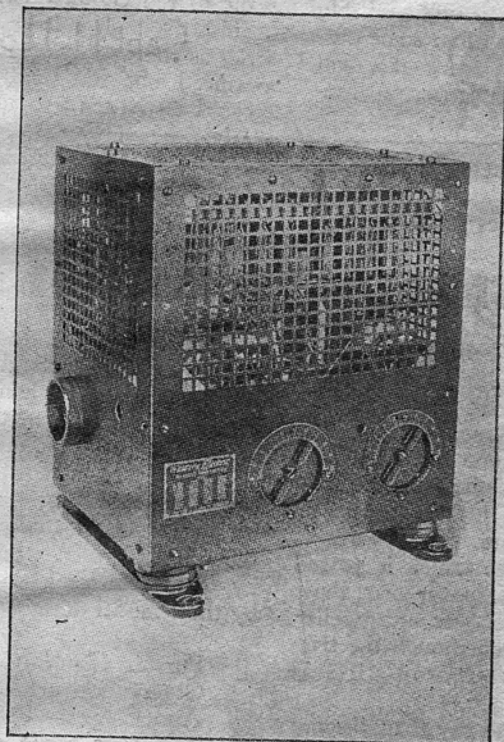


Fig. 5. Airplane transmitter designed for remote control

If we call this wire a filament and insert a piece of metal into the glass tube, giving it a positive charge from a battery, these free electrons, instead of hurtling back and forth, will be attracted to the positively charged piece of metal, called the plate, and an electric current will be created. The positive charge on this plate must, of course, be greater than the positive charge remaining on the filament.

Following the production of the original Fleming valve, various improvements have taken place. The addition of the "Grid" is probably the greatest of these. The grid is a small coil of wire inserted into the tube so as to intercept the electron flow from filament to plate. If the grid is positively charged from another source, this will increase the positive charge being exercised on the negative electrons and cause a consequently increased flow of current. The grid current can be altered to regulate the flow of current from filament to plate.

The capacity of the tube will depend on the size of the plate and the size of the filament, and also on how completely it has been evacuated. Tubes nowadays have been given varied titles such as audions and amplifiers, but whatever particular purpose they serve, the principles of construction remain unchanged. The filament is often called the cathode and the plate the anode.

The use of tubes in receiving sets is dealt with in articles devoted to reception problems. It will suffice for the moment to remark that their chief functions lie, perhaps, in amplifying the volume of the signals received and in rectifying the direction of flow of an alternating current. A two-electrode tube will pass on an alternating current in one direction only, and for this reason is often used in charging storage batteries from an alternating current supply.

So far as increasing the power of signals is concerned, this will be easily understood if it is remembered that there is already a current flowing through the plate from a separate source before the alternations created by

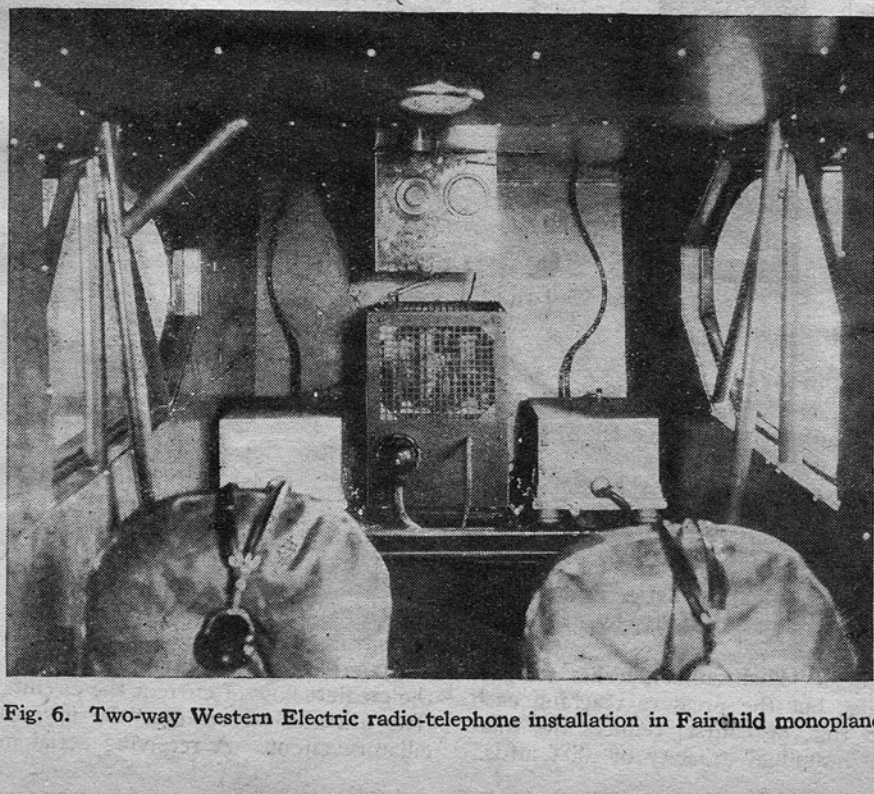
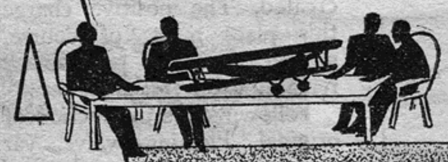


Fig. 6. Two-way Western Electric radio-telephone installation in Fairchild monoplane

(Continued on page 36)

Aviation Advisory Board



Conducted by
Capt. H. J. Loftus-Price
EX-ROYAL AIR FORCE
CHAIRMAN OF THE BOARD

THIS month some of our readers have asked such interesting questions I deem it worth while to go into them in this department for the benefit of the rest.

The subject of armament deserves a little explanation. Guns which shoot through the propeller are those weapons which are firmly mounted on the airplane, just forward of the pilot, and which shoot in the same direction that the airplane flies. Were these aerial machine guns to shoot a continuous stream, the bullets would hit the propeller, as the blades pass through the line of fire.

However, through an ingenious device which is geared to the engine, called the gun gear or interruptor gear, these guns are prevented from firing whenever a propeller blade comes about in the line of fire, even though the trigger (which is on the end of the pilot's control stick) is being pressed by the pilot.

A better way to phrase it would be to say that, instead of the gun "shooting through the propeller," there is a device which prevents the gun from firing when the propeller gets in the way.

Were this device to malfunction and a half-dozen or so bullets go through one propeller blade tip, this tip would tear off. The propeller, so unbalanced and whirling around at about 1,700 revolutions per minute, would vibrate the engine off its bed before the pilot could pull back the throttle and idle the engine down. This has actually happened.

On one occasion, while testing a synchronized gun at the gun butts, the rod which holds the gun at a fixed distance from the engine, buckled, and this allowed the gun to fire a bit prematurely. Several bullets went through the propeller blades and both tips tore off, one of the latter being hurled more than 100 yards and ended up by sliding across the floor of the woodworking shop, the door of which had been left open.

Now let us take up the question of how Army Air Corps planes are designated. These airplanes are divided into eight classes, according to the type or model. Although these planes are invariably known to the layman by their commercial names, the Air Corps knows them by their model designation, viz.:

	Model Designation
Pursuit (fighting planes)	P
Observation planes	O
Attack (ground straffing) planes	A
Transport, cargo, ambulance, workshop planes	C
Bombardment planes	B
Primary training planes	PT
Basic training planes, used in transition from primary type to service type planes	BT
Photographic planes	F

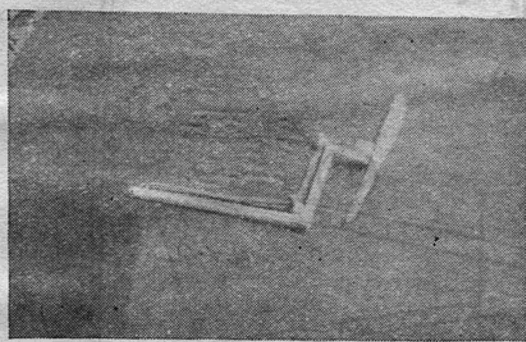
Airplanes on experimental and service test status are prefixed by the letters "X" and "Y". Thus a pursuit type developed either at a factory or at the Air Corps Material Division at Wright Field, Dayton, Ohio, would be labelled "XP", followed by a number (*Continued on page* 38)

A famous artillery observaton plane of the Great War, the British R. E. 8

Official photograph, U. S. Army Corps.

How to Build the Curtiss-Wright "Junior"

By Prof. T. N. de Bobrovsky



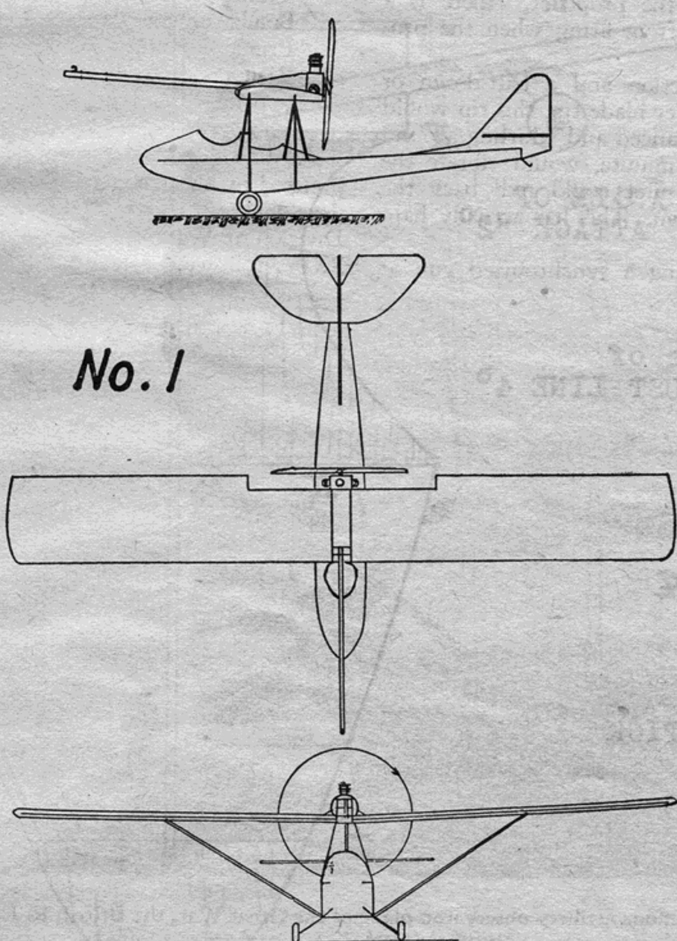
A Scale Flying Model of America's Popular Light Plane

THIS is an unusual type of airplane for America, although it was a popular and much used type in Europe. The famous Pischoff *Autoplane* was really the first of this category, designed with the propeller working behind a monoplane wing, with pilot seat under the wing, while the tail group is held by either covered or free outriggers, which can also be classed as a "fuselage."

In 1910 the Pischoff monoplane performed well and was accepted as the official type by the Austro-Hungarian Army. The flying model of this plane was excellent and was considered one of the best models for using gear transmission for the propeller.

The first all metal airplane in the world, the French Ponche-Primard, which was exhibited in 1911 in the Paris Aero-Salon was also of this type. In Germany before the war, Dorner (not Dornier) also designed a few airplanes of this type. During the past years the German firm "Albatros," built and manufactured sport airplanes with the same lines and characteristics as the Curtiss-Wright *Junior* of today.

While in Holland the Koolhoven F. K. 30 sport airplane is also from the same category. The advantages of this type of airplane are the stability, free view of the pilot, pusher propeller and other minor points equally important. The flying model of these is a great deal better than the ordinary tractor model.



No. 1

The Curtiss-Wright *Junior* also gave the same good performance and the model shown in the pictures made a take-off with just sixty propeller revolutions. This model is very simple to build and can be completed in a very short time. The first model was finished and ready in eight hours, half of which time was taken up in drying. The drawings were made from some published photos and all data available.

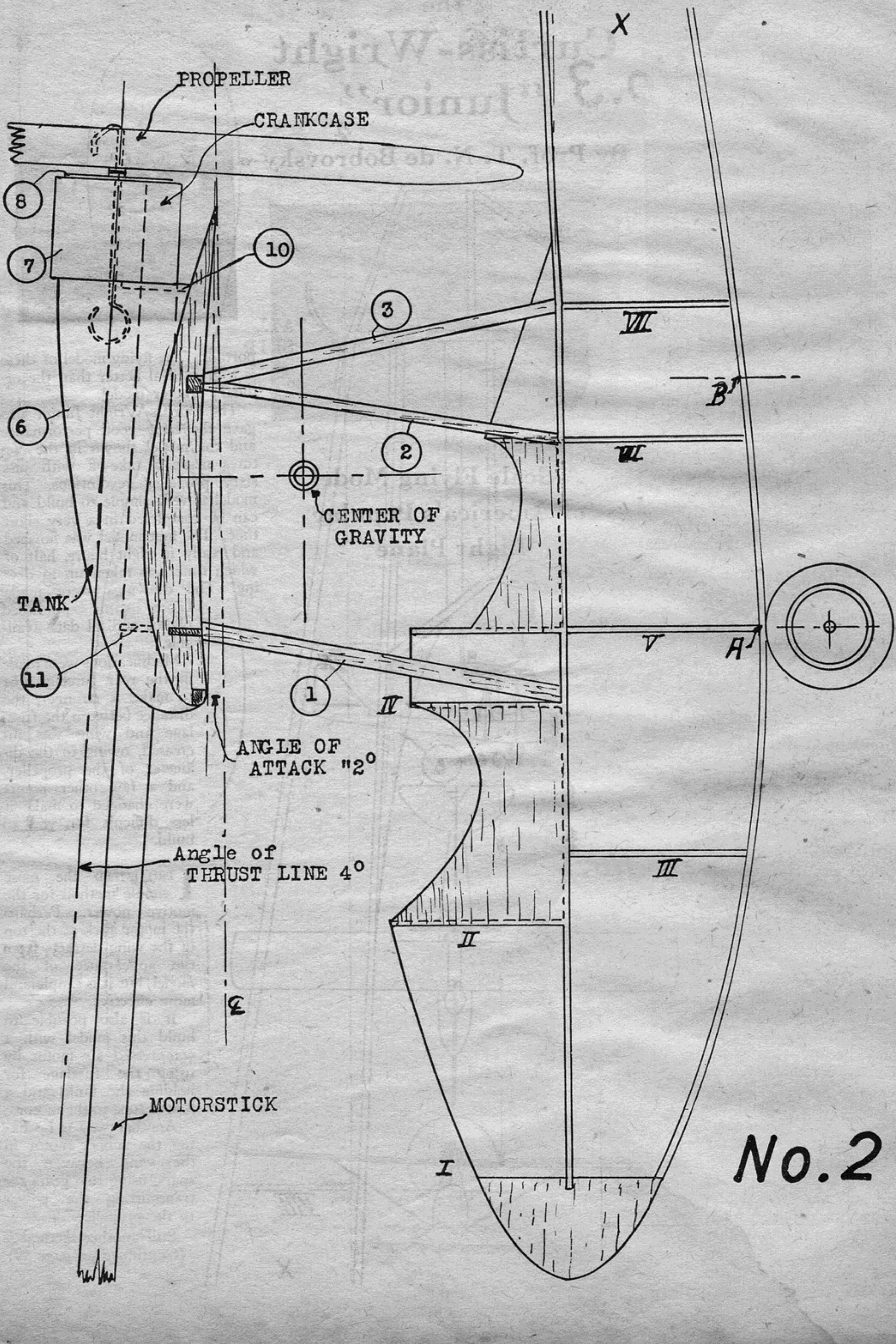
Modifications were made in the rear fuselage line to make it stronger, the distance between the fuselage and wing was increased, owing to the diameter of the propeller, and a few other points were changed to make it less difficult for you to build.

I PROJECTED the most simple method for the motive power. Perhaps the motor stick at the top of the wing detracts from the appearance of the model, but it is simple and more effective.

It is also possible to build this model with a compressed air motor by using the fuselage for holding the tank, and a longer tube to the motor.

Another way is by fixing the rubber motor in the wing between the spars, using two gears for transmitting the power to the propeller.

Still another method is (*Continued on page* 39)


PROPELLER
CRANKCASE
8
7
10
3
6
2
CENTER OF GRAVITY
TANK
11
1
ANGLE OF ATTACK "2°
Angle of THRUST LINE 4°
MOTORSTICK
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IV
III
II
I
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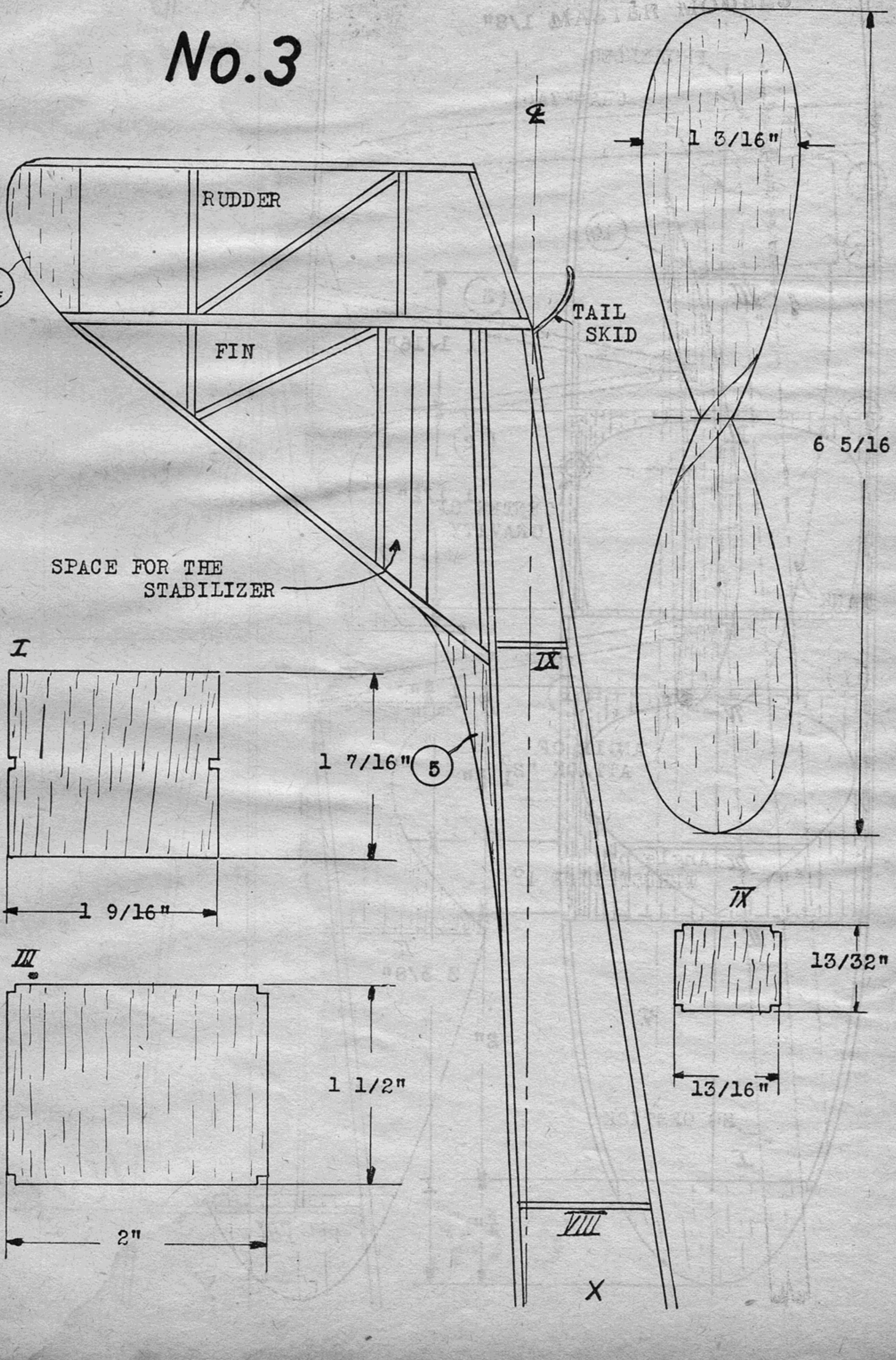
No.3
RUDDER
FIN
4
TAIL SKID
SPACE FOR THE STABILIZER
5
I
1 7/16"
1 9/16"
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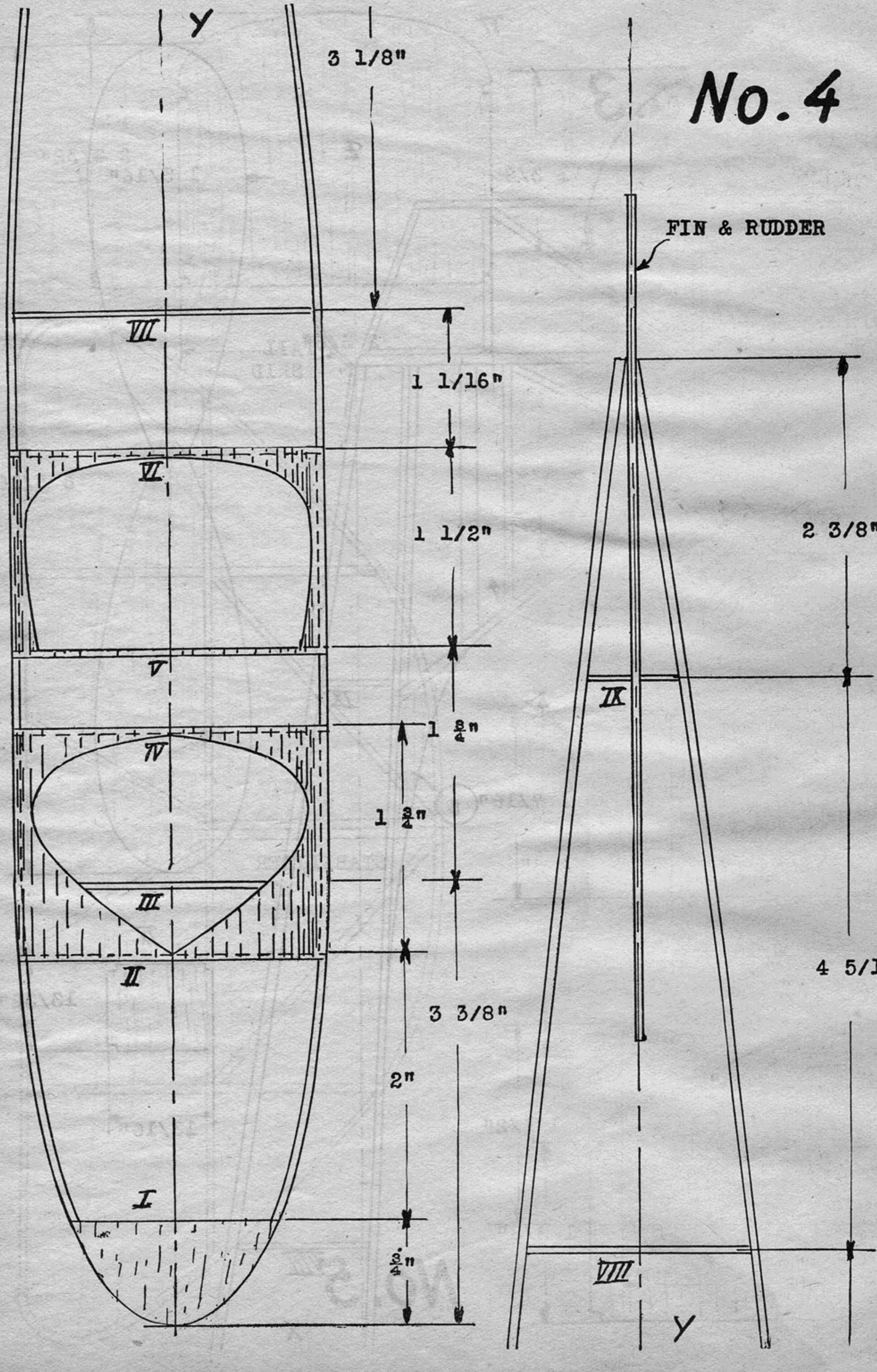
1 1/2"
2"
IX
VIII
X
1 3/16"
6 5/16
IX
13/32"
13/16"


No. 4
FIN & RUDDER
Y
3 1/8"
VII
1 1/16"
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V
1 3/4"
IV
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I
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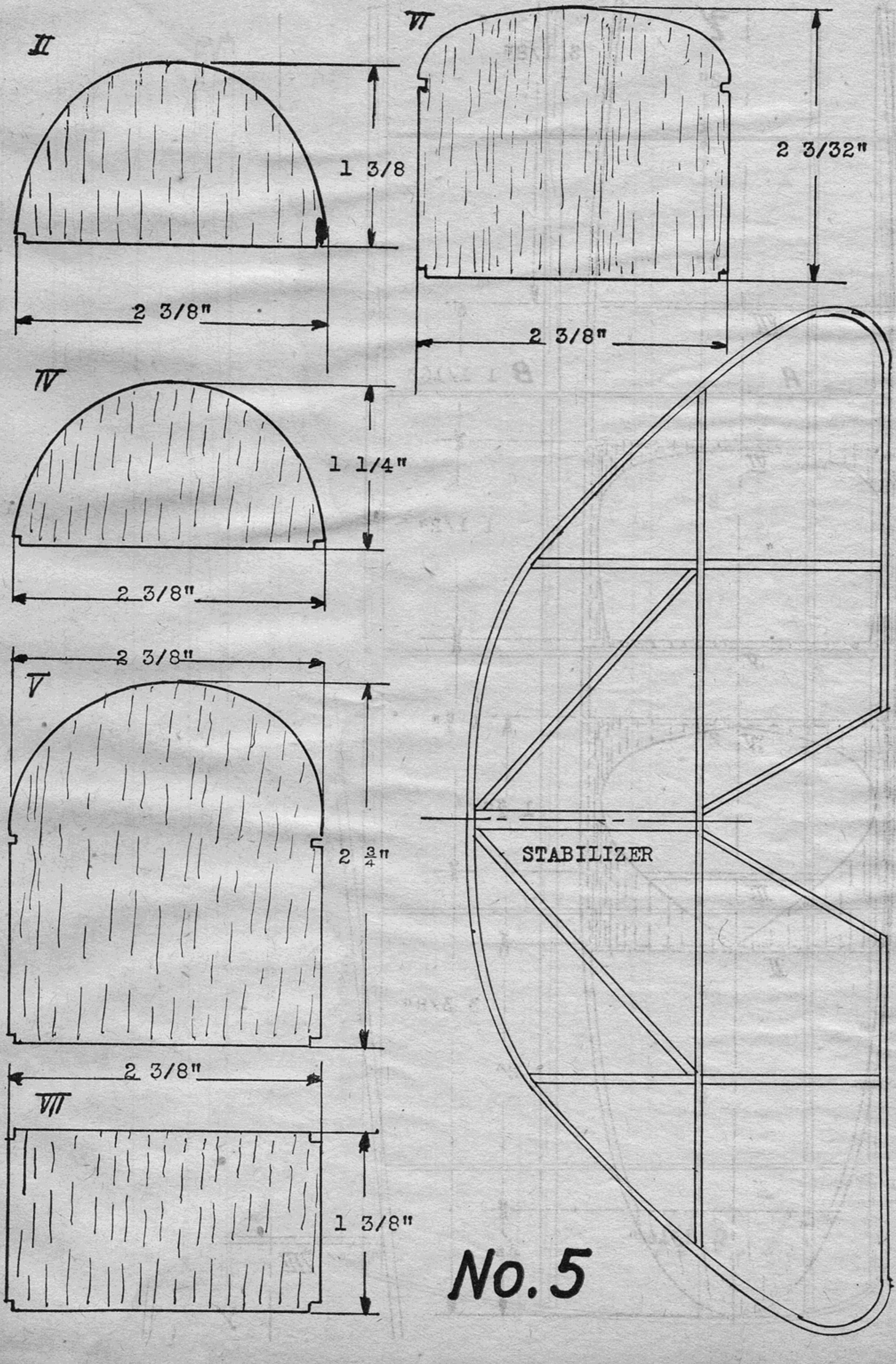
2 3/8"
IX
4 5/16"
VIII
Y


II
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VI
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V
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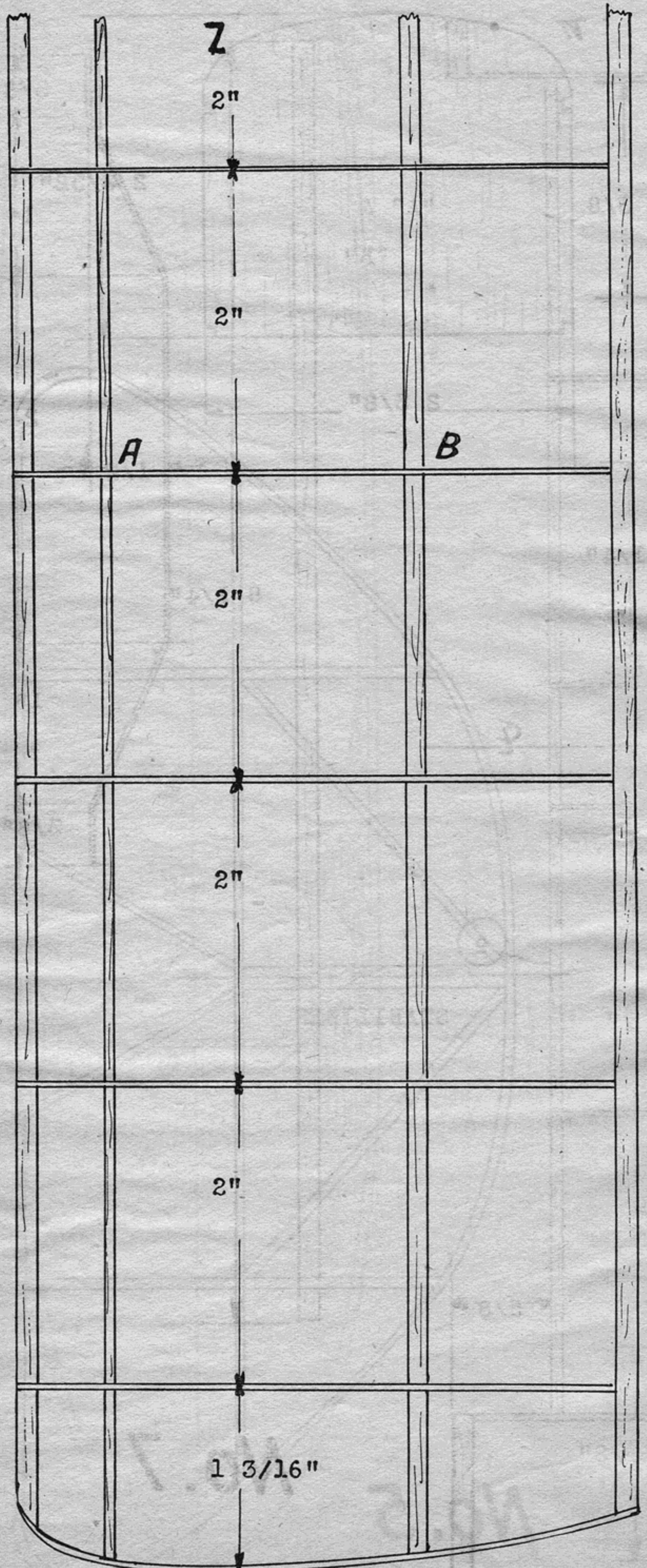
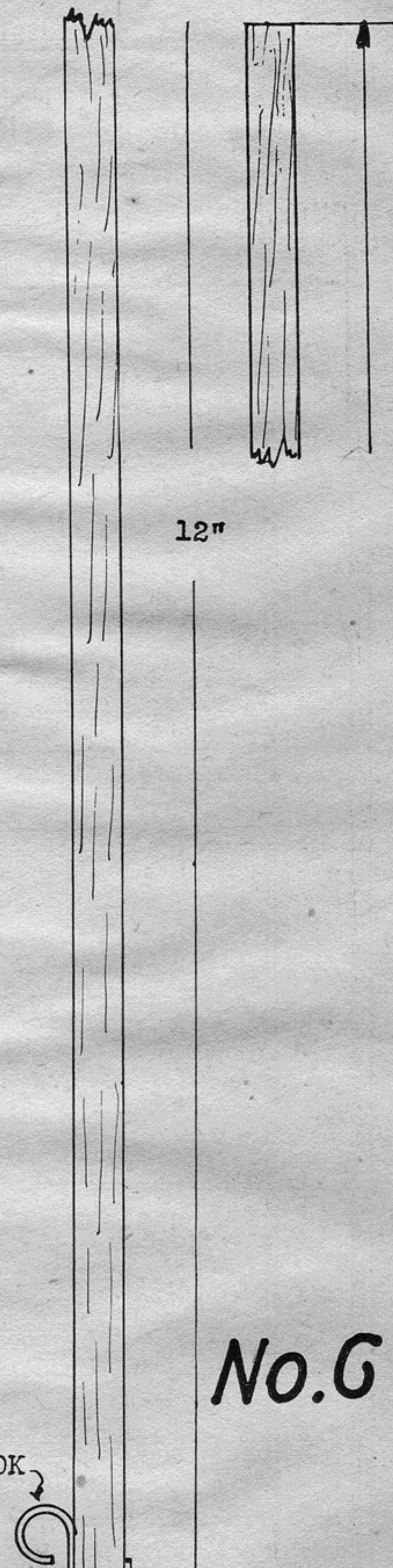
VII
1 3/8"
STABILIZER
No. 5





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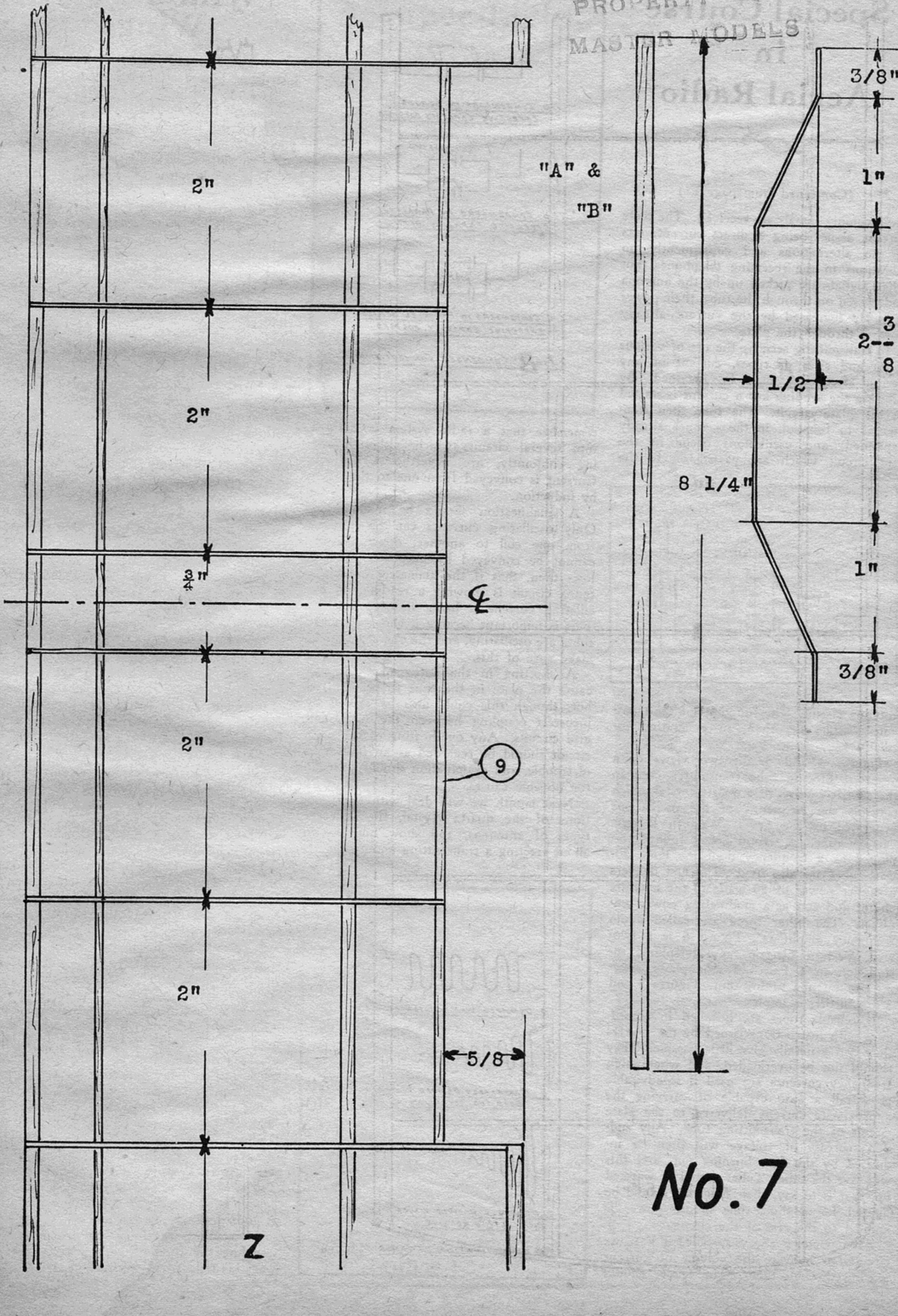
2"
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9
Z
"A" &
"B"
8 1/4"
3/8"
1"
2-3/8
1/2
1"
3/8"
No.7

Special Course in Aerial Radio

(Continued from page 27)

the incoming signals are received. The plate current alone, being a direct current, sets up no alternations and consequently no vibrations in the receiving telephones, but when signals are picked up by the antenna and passed on through the tube, their power is vastly increased by the current already flowing through the plate.

In transmitting sets, by the use of various types and sizes of tubes, current of any desired frequency may be obtained. By pressing the sending key a current is started in the plate circuit. The tube then commences to function in the manner already explained, and oscillations occur in the grid circuit which are passed on to the

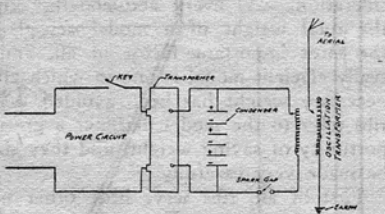

Fig. 1 - Wiring Diagram with Oscillation Transformer

antenna circuit. The functions of the transmitting tube lie, then, in generating oscillations.

Figures 4 and 5 are two views of a Western Electric tube transmitter used in the air. It consists of a quartz crystal which controls the frequency of the oscillations generated by the 5-watt Western Electric vacuum tube. A second 5-watt tube is employed as a frequency doubler. Four 50-watt tubes are also used. The first delivers a carrier power of 50 watts to the antenna circuit and acts as a modulating power amplifier. The other three are called audio frequency amplifiers.. Figure 6 is a two-way Western Electric radio telephone installation in a Fairchild monoplane showing the antenna tuning unit. Figures 7 and 8 are further examples.

If reliable tubes are installed in accordance with instructions issued by the makers they will generally give little trouble. They should not be overloaded, and where high frequency currents are used it is advisable to install a fuse capable of carrying the approximate current delivered to the plate circuit of the transmitting tube. Any sudden increase of voltage will then be indicated by the fuse burning out, and this will save the tube. Tubes should be warmed up, that is to say, their filaments should be lighted for a short time before power is applied to the rest of the circuit.

An ammeter is always installed in antenna circuits to indicate the volume of current passing through them. The reader should

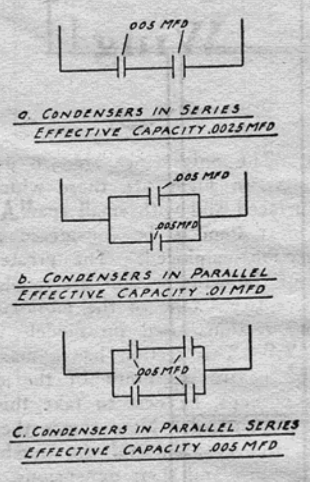

Fig. 3 - Condenser Connections

remember that a radio system is divided into several circuits which, although acting conjointly, are nevertheless distinct. Current is conveyed from one to the other by induction.

A qualification should be made here. Only oscillating currents can be induced from one coil to another, direct current cannot be conveyed by induction. It follows then, that if the ammeter in an antenna circuit is showing a reading, an oscillating current is being induced into it. This is important because it shows that the tubes are oscillating, and the operator should make sure of this.

A shorting in the antenna circuit will cause the plate in the tube to become red hot, though this could also be caused by incorrect coupling between the plate and grid circuits. Any overheating of the plate circuit should be regarded as an indication of trouble, and examination should be made for possible causes.

Next month we will deal with the functions of the quartz crystal, the different types of antennas, and show how to go about erecting a transmitting antenna.

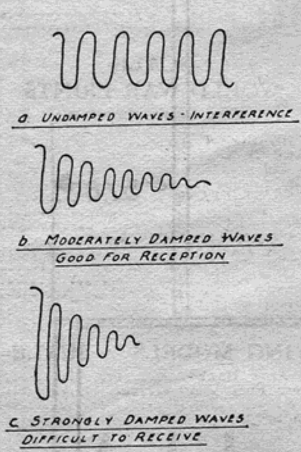

Fig 2 - Oscillation Trains

Winning My Wings

(Continued from page 10)

instructor, looked at me keenly and asked:

"How do you feel?"

"Great," I answered.

"Well, we'll go up and see how well you feel."

As we started off Gene said:

"You' re taking me for a ride today. Go to it!"

I did. After making three fair landings I followed Gene's instructions and climbed to 2,200 feet. Gene leaned over to my ear.

"Know how to get out of a spin?"

"Yes.

"Neutralize the stick and kick opposite rudder."

"Good. I'll put her in, and when I tell you to, you take her out."

I nodded. Gene took the stick. Up went the nose. Up. Up. We stalled. Then the left wing went down. The whole ship fell off to the left. What a feeling! Then, without an appreciable lapse of time, we were spinning, nose down, the earth whirling around. I hardly blame pilots for failing to get out of spins!

"Take her out!"

Viciously, I kicked right rudder and pushed the stick to neutral. We stopped spinning. We were diving almost vertically. I pulled back on the stick, levelling us out so rapidly that my head was pulled down to my chest by the force of the quick change of direction.

We flew level again!

"Good," said Gene. "Land her. You don't need to be in such a hurry to level her out. It doesn't hurt to get a little speed."

I landed, taxied up to the hangar, and stopped. Gene unfastened the safety belt. I wasn't going to solo after all! I started to climb out.

"Stay here," said Gene, "I'll get Johnny to go up with you for a check flight."

My heart bounded. Johnny climbed in after a moment.

"Take me for a ride!" he said. As I taxied off Gene waved his hand.

I made two landings, climaxing the last one with a ground loop. John climbed out.

"Tighten up the safety belt if you like. Keep an eye out for other ships and go to it!"

I opened the motor wide, and away I went! I looked down, to see Gene and a group of pilots and students watching me. This was my time! I made the usual circle, coming around to land. I cut the gun. The glide was satisfactory, but the edge of the field slipped under me when I was still nearly a hundred feet up. The ship glides much farther with only one in it. I gave it the gun again and went around, this time going into my glide sooner. Up came the field. I concentrated all my attention on landing. This had to be right! I levelled off gradually, holding the ship off. Back went the stick, up went the nose. Crunch! Tail skid and wheels struck at once and, believe it or not, I did not bounce an inch! A good landing, my first alone!

I taxied up to the group triumphantly, waggling the rudder like a pleased puppy wags his tail. I had won my wings!

A Super-Light Wing

(Continued from page 12)

6 ins. has an aspect ratio of 8.

Of the half a dozen odd stresses set up in the wing of an aeroplane, we need only consider three. (1) Lift stresses due to the lifting force equal to the weight and carried by the main spars running from tip to tip. (2) Drift stresses, taken account of by the fabric covering of the wing and if any internal wire cross bracing. (3) Landing stresses, due to the shock of alighting. Of the three, the first and the last are the most important stresses to consider, as the second is amply taken care of by the wing covering, no further strengthening being necessary, except in the case of very large models, and even then it is hardly necessary.

Sometimes, though, a wing is weak in this second item before covering, and one has found cases where the covering of the wing has disfigured the shape of the wing in plain view due to stretching the silk unevenly. Of course, the finished article was strong enough in all conscience, but just a trifle crooked! However, careful wing covering will soon eliminate trouble there.

As the lifting forces and the landing forces are more or less running together, it is usual to make one set of spars serve both purposes, or, rather to counteract them. One might add at this point that with the average model weighing not more than a pound (or even more), and with a medium thickness wing section, there is very little tendency for wing-flutter to set in as here, again, the wing covering (in the case of double-surfaced wing, *i.e.*, covered both top and bottom) take all the stresses. The only wings able to develop wing-flutter in flight are those which are single-surfaced and with small spars.

The next item to be considered is the wing section employed. The greater the camber of the wing section the smaller the spars necessary. One of the most successful wing sections used on models is the "Clark Y." This section has a maximum depth of nearly one-ninth of the chord. It will, perhaps, be best to take this section as a standard. Now comes the next problem, the position and the number of the wing spars and their dimensions. One type of wing has one spar on the leading edge and one on the trailing edge. This type of construction is quite useful in wings of a chord less than 3 ins., but for larger chords is rather weak.

A better system is where the leading and trailing spars are retained with an additional one inserted at the point of maximum camber. Here, again, the wing will not be very strong and also will be heavier than the two-spar system. Another step further onward and used by some aero-modellists is one that has the advantage of being adapted to low-wing models, where the camber is reduced at the fuselage to the thickness of the spars in the center section. It also has the advantage of allowing a smooth surface of the top portion of the covering which is sometimes spoilt by a spar on top of the camber.

There is yet another alternative wing construction, and that is the use of a wire leading and trailing edge, either or both. Aerodynamically, a wire trailing edge is better than a wooden one, for the simple reason that it is thinner and does not cause so much air-eddying behind the wing. Similarly, a wire leading edge has the effect of reducing the total resistance of the wing. Pointing the nose of an aerofoil to a streamline shape (often called a "Phillips Entry") is advantageous in decreasing the resistance slightly at high speeds; which means at small angles of attack.

Thus a wing with a wire leading edge and trailing edge is more efficient than with corresponding wood spars, and it seems that the best form of wing construction is one with two main spars, one above the other at the point of maximum camber, and a wire leading and trailing edge. The size of the wire is largely dependent on the distance between the ribs, but usually is 24 S.W.G. steel wire.

Having outlined the principal ways of spacing the wing spars, let us now turn to the wing as a complete unit. The ribs, or fore and after members that form the wing section, should be given careful consideration. As every aeromodellist knows, the total weight of a model aeroplane is the most important factor of all, and the really efficient model is one in which all unnecessary weight has been avoided. Wing ribs offer to the model designer a great opportunity of saving weight, and they should be made very carefully.

First of all, ribs serve little other useful purposes than that of maintaining the correct wing section, and as they have to take only the slightest load, they should be made as light as possible. The principal material used is three-ply, either 1/16 in. thick or, for lighter and smaller models, 1/32 in. thick. It is strongly advisable to lighten them by fretting out the inside portion as much as possible, even though it may entail a certain amount of work.

Some model-makers have successfully used Balsa wood for wing ribs. A notable example of this wood being used for this purpose is in the low-wing monoplane designed by Mr. R. N. Bullock. This model was the winner in 1929 of the International Cup presented by Lord Wakefield. In this model the Balsa wood ribs are about 1/8 in. thick and spaced about every 2 ins. along the wing. They have been lightened by cutting away that portion of the rib where the wing surface is quite flat, *i.e.*, the rear portion of the under surface.

This particular wing, by the way, is fitted with a wire leading and trailing edge. The three-ply rib is, of course, much stronger than the Balsa wood rib, but is not nearly so light. It is better to use many Balsa ribs closely spaced than a few three-ply, as this does not allow the silk to sag to such a marked degree. In this connection a very useful addition to a finished wing is the use of riblets or small ribs running from the leading edge to the main spars. They are especially handy when the main ribs are rather far apart.

The wing tips offer a variety of ways of construction. The simplest, of course, is the square tip consisting of one of the ribs. This is both ugly and bad from an aerodynamical point of view. It is much better to taper the tips either by a piece of wire (or thin wood), connecting the leading and trailing edges, or by a piece of three-ply suitably lightened, glued on to the underside of the end rib and spars. The wire method is the one which has been most widely used, and is strongly recommended. The wire—steel, of course—also acts as a shock absorber in the event of a bad landing on a wing tip. The main spars may be of birch or spruce. The latter is lighter though not so strong, and must be of larger section than birch if the same strength is to be obtained.

And now, last, but by no means least, comes the subject of wing covering. It is almost unnecessary to state that for a wing to attain any efficiency at all, the fabric must be taut, with a minimum of sagging between the ribs. This is a golden rule, and should be followed carefully. For material, proofed silk is quite satisfactory, but far better results are obtained by covering the framework of the wing with Japanese silk (the finest possible), and giving it a coating of dope. It is really remarkable how strong a wing becomes when once it has been covered in this way. One has to be careful, though, not to give too many coats of dope, as this may cause the wing to warp on warm days. Two coats are usually ample.

Just a word on fixing the wing to the fuselage. It is inadvisable to fix a wing permanently by nuts and bolts. The most successful method is to make two wire saddles bound to the leading and trailing spars and bent to fit the fuselage at the widest point. The wires run about halfway down the depth of the fuselage and hooks are formed in the ends so that the wing can be held in position by rubber bands, which pass under the fuselage. This system serves two purposes. Firstly, the wing can be moved along the fuselage to get the correct position. Secondly, the rubber bands act as shock absorbers when the machine makes a wing-tip landing.

Aviation Advisory Board

(*Continued from page* 28)

which would classify it according to its style, such as "XP-6" which was the experimental stage of a pursuit plane made by the Curtiss Company somewhat on the style of the Curtiss "Hawk." If this experimental model proves to be of an acceptable type, a small lot is then bought and sent to some active station for service test; in other words, they are used in the service along with other pursuit machines to test their serviceability and desirability. Such experimental planes would then be labelled "YP-6."

There are still some airplanes in the service which are known by an earlier system of model designation, such as the DH—DeHaviland, and the PW—Pursuit Water-cooled, but these are either obsolete or obsolescent.

The following are some examples of model designations and the planes they describe:

P1-A—Curtiss "Hawk" Pursuit plane with Curtiss D-12C, 430 h.p. engine.

P1-B—Improved P1-A and improved motor (Curtiss D-12-D); larger landing wheels.

P1-C—Same as P1-B, except motor has new type of gun synchronizer and wheels have brakes.

P-6—Same as P1-B, except for 600 h.p. Curtiss motor, guns moved forward, instrument board revised, Oleo landing gear and different brake pedals.

P-12—Boeing No. 89 Pursuit plane, Pratt-Whitney "Wasp" engine.

P-12-B—Modified P-12 with improved landing gear and tail surfaces, Frieze ailerons, metal constructed.

COA-1—Corps Observation Amphibian; Loening amphibian plane equipped for military observation purposes.

O1-B—Curtiss Falcon Observation plane, with Curtiss D-12, 420 h.p. engine, wheel brakes and dumpable main fuel tank, and droppable auxiliary fuel tank.

O1-E—Same as O1-B, except for Frieze ailerons, Oleo landing gear, new gun synchronizer.

O2—Douglas Observation plane, Liberty engine.

O2-A—O2 equipped for night flying.

O2-C—Improved O2-A, improved gunner's cockpit.

O2-H—Improved O2-C, tanks in fuselage instead of in wings, new tail surfaces.

O-11—Curtiss Falcon Observation plane with Liberty engine.

O-19—Thomas Morse Observation plane, all-metal, except for wing, elevator and fin covering; Pratt-Whitney "Wasp" engine.

O-25—Same as Douglas O2-H, except for replacement of Liberty engine with geared Curtiss 600 h.p. engine.

A-3—Curtiss Falcon Attack plane, a modied O-1 for attack purposes. Gun and bomb racks inside lower wings.

A-3B—Modified A-3 with Frieze ailerons, Oleo landing gear, new gun synchronizer and simplified gun installation.

C-1—Douglas Cargo (Transport) plane, one direct-drive Liberty engine.

C-3—Ford Trimotor Transport plane, Wright "Whirlwind" engines.

C-9—Improved C-3, with Wright J-6 (300 h.p.) engines.

C-6—Sikorsky Model S-38A Amphibian plane, two Pratt-Whitney "Wasp" engines.

C-7—Fokker Trimotored Transport, with J-6 engines.

B-2—Curtiss "Condor" Bomber, two geared 600 h.p. Curtiss engine, 4,000 lb. bomb capacity.

LB-7—Keystone Light Bomber, two Pratt-Whitney "Hornet" (525 h.p.) engines, 2,000 lb. bomb capacity.

PT-1—Consolidated Primary Training plane, 180 h.p. Wright V-type E engine.

PT-3—Same as PT-1, except for wing modification and Wright "Whirlwind" engine.

BT-1—Douglas Basic Training plane, O2-H with dual controls and no military equipment.

BT-2—Similar to BT-1, but with Pratt-Whitney "Wasp" engine.

YF-1—Fairchild 71 Model, photographic plane put out for service test.

Heath "Baby Bullet"

(*Continued from page* 15)

After the model has been covered, the wings are set into place and rigged with No. 32 gauge soft annealed rigging wire, which is also known as "tie wire."

These tie wires circle the entire landing gear and fuselage starting at one axle hook and to the underside of the wing, then from the upper side of the wing to the special fitting, designated as "X" located in front of the cock-pit as shown in drawing 2.

The propeller is cut to shape from a regular 1/2" x 3/8" x 6" propeller block which is easily obtained from your local model airplane supply dealer, as it is a standard size propeller block. White pine or balsa wood can be used. The block is then laid out with the regular diagonal line markings and cut to shape as a regular straight X propeller with trimmed ends, leaving enough material at the hub in order to shape it to resemble a spinner.

All metal fittings except those mentioned in this article are to be made from No. 10 music wire.

Use 1/8" flat rubber strand for motive power. The writer found that four loops gave plenty of power to make the model fly nicely. Should the model stall it is advisable to add a little weight to the nose of the model. A small B-B shot as used in air rifles makes an excellent balance in this case, and can be held into place by using a drop of cement.

THE CURTISS-WRIGHT "JUNIOR"

(*Continued from page 29*)

to use a rubber motor in the fuselage, with rubber or thread transmission to the propeller. I have already written about this in a previous issue of MODEL AIRPLANE NEWS.

I constructed an entirely new device especially for the *Junior*, which is shown in the picture, but as this is rather complicated for an inexperienced model builder I abandoned it, although this method made a better looking model. In answer to the curiosity of our readers, this device is also a motorstick with rubber motor. The motorstick, however, is made of three pieces, arranged so that one piece is above the wing and is covered with the "tank"; second piece through the wing entering the fuselage vertically, and the third is in the fuselage.

By looking at the picture it can be seen that the rubber is parallel with the stick, having three lines and two corners. In these corners I have used revolving rings, which means that the rubber bands pass through these celluloid rings. The rings are placed in a wooden box to permit free revolution.

If you wind up the rubber, the revolving rubber will revolve the ring at the same time. This method permits the rubber motor, despite the fact that it is in a double broken line, to be wound up completely and released. It would be very interesting for you to try this device.

Now for the model with the regular motorstick. In the first drawing we have three views, showing the most important details for you to know before you start building. Drawings 2 and 3 show side views of the fuselage also how to assemble the cabane, motor, wing, landing gear and rudder. Drawing 4 is a top view of the fuselage. Drawings 3 and 5 show the bulkheads and cockpit formers I to IX.

The fuselage was built with four 1/16" sq. longerons. We call your attention to the fact that after the bulkhead No. VII, the top longerons are bent slightly upwards. The noseblock I is made of soft balsa (25/32" thick). The other bulkheads are of 1/16" sheet balsa. No cross-bracings are used. The cockpits are formed of 1/64" sheet balsa, as shown in drawings 2 and 4.

When your fuselage skeleton is ready, cover with superfine tissue and give one coat of light natural dope.

Drawing 7 shows you next job, the landing gear. Make this of wire (.034). The wheels used are 1" diam. celluloid. To make the landing gear stronger glue pieces of ovaled 1/1" x 1/8" strips behind the wire arms. Now, look at drawing 2 and you will see that the landing gear is ambroided to the bottom of bulkhead No. V. The tailskid is made of wire (.034). See drawing 3.

Next, make the rudder and fin, of 1/16" sq. and 1/16" x 1/8" strips. (See drawing 3.) Nos. 4 and 5 are cut from 1/16" sheet balsa. The rudder must be covered on both sides. Glue to the end of the fuselage as shown in drawing 3. The stabilizer (drawing 5) is made of the same material as the rudder, but use 1/16" square bamboo for leading edge. Cover both sides of this and glue to the spar of the fin only. The leading edge of the stabilizer can be glued to the leading edge of the fin, as needed during the tests.

Now, cut from 1/16" sheet balsa sixteen ribs (see drawing 2). With these form the wing. The leading edge of this is ⅛" square strip rounded as necessary. For the front spar, use 1/16" x 1/4" strip; for the rear spar ⅛" square and 1/16" x 1/8" strip for trailing edge. This must be tapered in chord. The wing tips are made of 1/16" square bamboo. To make a nice neat job, with bamboo, for the stabilizer and wing, do not bend the bamboo with heat, a better method is to fix the wing to the table, with pins and with pins fix the bamboo direct to the wing in the right shape. Ambroid the whole bamboo piece and allow to dry for fifteen minutes. Then remove the pins. When bent by heat the bamboo loses elasticity and cannot be used to good advantage.

Before you cover the wing with superfine tissue, allow for dihedral, which is 2°25′ for this model. The dihedral starts from the center section, but the space between the two center ribs remains intact. It is necessary also (see drawing 7) to cut ends of the four central ribs and glue a 1/18" square false trailing edge (9).

The finished wing must be attached to the fuselage with six pieces of struts. See Figs. 1 and 2. Be careful that the wing has 2° angle of attack. The struts are made of 1/16" x 1/8" strips (1), (2) and (3). The wing is also braced on the outside, with four oval struts "A" and "B". These are made of 1/16" x 1/8" hard strips (see drawing 7) and glued in place. In the fuselage drawing (2) and the wing drawing (6) the capital letters "A" and "B" are used to mark the joining points for these.

The last step is to prepare the motor parts. First, make the motorstick (drawing 6). To this glue the usual kind of hook to the front. At the rear end glue the motor crankcase (7). This is made of ¾" soft balsa and has 1" diam. Behind this, glue a ¾" diam. 1/32" thick plywood disk (8), bore a hole through the center of these and glue an eyelet in this hole. The propeller shaft will revolve in this.

If you care to, you can glue three celluloid cylinders to the crankcase, in the form of a reversed Y. The original of the model has a Szekely 3-cyl. motor. Drawing 3 shows the propeller form. Considering that the model has only a small diameter propeller (five times smaller than the wing span), it was necessary to use a special form, which is made of ⅜" soft balsa. The propeller is left handed. The shaft is the usual type. Motive power is eight loops of .045 square rubber. Make two motorstick holders (10) and (11) of 1/16" sheet hard balsa. Glue one to the false trailing edge and the other to the center-ribs (drawing 2).

Be careful that the propeller thrust-line has 4° angle to the fuselage center line. Glue the motorstick to these. Make the "tank" from 1/64" sheet balsa. For this

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you will need two sides (6). Glue these to the center ribs and crankcase and cover the top also with balsa sheet, leaving only the necessary opening for the free movements of the rubber motor.

When all this work has been done give the wing, stabilizer, rudder and struts one coat of light dope.

Give the bearing a few drops of oil and wind up the motor. Give it seventy revolutions at first. Place the model on a smooth surface (ground) and release the model. If it stalls, place a small piece of wood between the lower part of stabilizer leading edge and fin. This will give the stabilizer a positive degree of incidence. If in the next attempt the model, with the same revolutions taxies but does not climb, fix the stabilizer at 0°.

If the model is built according to instructions, 0° is needed for the stabilizer. After this, you can wind the motor full. The model will give a good performance in flying and gliding, and will not stall at the end of the flight.

Sperry Gyroscope

(Continued from page 7)

late on turns or in rough air.

If used in connection with the Sperry horizon, the directional gyro allows a pilot to perform all essential maneuvers without exterior visibility. It can also be used as an extremely accurate index of turn for flight purposes. These are characteristics not obtainable with any of the usual aviation instruments or combinations of instruments.

The determination and maintenance of the heading of an airplane has always been one of the most difficult problems of flying. Due to the low directive force of the earth's field, the magnetic compass can only be relied on when the airplane is steady in the air, not only directionally but also with respect to disturbances produced by rough air.

In general, the practice with the magnetic compass is to steady the airplane near the desired compass heading, wait until the compass card has come to rest, and then attempt to correct for any discrepancy. This procedure involves exterior marks or the use of some gyroscopic turn index; for magnetic compass oscillations will not dampen out as long as the airplane is moving in azimuth.

If the magnetic compass could be held on its azimuth without swinging or oscillation, the problem would be simple, and a desired course could be picked up and maintained simply by keeping the lubber line opposite the desired heading. For all practical purposes, the Sperry directional gyro allows this method of course keeping and flying to be employed. It therefore combines the most desirable qualities of both a flight and a navigational instrument.

In appearance, the Sperry directional gyro resembles a vertical card magnetic compass intended for instrument board mounting. It consists of a case with a round window, through which a compass card may be seen. The window is mounted flush with the instrument board, and directly below it is located a setting knob. The card appears at the top of the window, so that when mounted directly below the Sperry horizon, the eye will have the shortest distance to travel between the two instruments.

Inside the case, and encircled by the card, is an air driven gyroscope with its axis horixontal, operated by suction from a venturi. It is supported in gimbals so that the airplane may turn freely around it in azimuth. Sufficient angular freedom is available in other directions so that the gyro may retain horizontal irrespective of normal bank or pitch variations of the plane.

When the setting knob referred to above is pushed in, it engages a gear on the azimuth circle and at the same time cages the gyro and holds it horizontal. Turning the knob will turn the compass card until it indicates the desired compass course. When the setting knob is released the gyroscope remains with its azimuth in the position at which it was set.

With the airplane in flight, the magnetic compass is steadied until it has ceased oscillating on any arbitrary reading of the directional gyro. The setting knob is then used to make the directional gyro correspond to the desired magnetic compass course or known geographical heading.

In practice it is to be used exactly as a compass which rough air and violent turns cannot affect in any way whatsoever. The directional gyro will maintain any setting with an accuracy of less than three degrees of arc in fifteen minutes of time. At approximately fifteen minutes to one-half hour intervals it should be checked against the compass and reset if it has drifted off.

The purpose of the Sperry horizon is to take the place of the natural horizon when it is obscured by darkness or fog or any other condition which prevents exterior visibility. It does not replace any of the usual aviation instruments.

The "Flying Windmill"

(Continued from page 4)

angle of about 45 , followed by the use of the rotor system as an air brake to reduce speed to approximately ten to twelve miles an hour, so that the use of brakes in landing at this speed brings the craft to a stop usually in about its own length. The speeds mentioned here refer to speed in still air, so that it can be seen that one can make a normal landing, for instance, against a ten mile wind, with no forward speed relative to the ground.

It must be remembered that the Kellett autogiro is not an airplane. It is distinctly a new type of aircraft. It cannot be compared with an airplane, nor can its performance be confused with airplane performance.

With the Kellett autogiro one can come down when and as one will. One can glide down to touch the earth as gently as a bird, or if one prefers, come straight down.

It descends vertically slower than a man in a parachute. Ease of landing is matched by ease of safe flying at either high or very low altitude. One climbs, banks and turns, comes down and lands without regard to flying speed or fine exactness of flying judgment. The rotor cannot stall, it is independent of the engine or you skill, is rotated by natural forces, and provides sustaining power as long as the craft is in the air.

COURSE IN AIRPLANE DESIGNING

(*Continued from page* 24)

cross-country distance of ten miles. The business man, whose time is more or less valuable, finds the airplane a decided asset because it enables him to get from place to place and back again with a minimum of time lost in the process.

Now, keeping in mind these uses, we will take a look at the work that has already been done in this broad field.

At present the light plane industry is booming, especially in this country and in Germany. Manufacturers are getting their eyes open at last to the possibilities of the light plane, experts who sneered at it formerly are now lauding it to the skies. Large factories are turning out machines that are both cheap and practical—and they are selling like the proverbial hotcakes.

Just what is a light airplane? It is hard to make a definite classification, but in this country it is generally accepted that a light plane is a one or two-place ship that has a motor of sixty horsepower or less.

Since the light airplane is to be used mainly by the private flyer, the designer must keep in mind always the requirements and capabilities of the man who is to buy and fly the ship. We can design a plane with a thirty-horsepower motor that will have a high speed of around one hundred and fifty miles per hour, but the average man would find such a ship utterly useless. Why? Because it would be difficult to handle, "tricky" in landing, and it would require a very long, smooth runway for landings and take-offs. In short, too much skill and too ideal conditions would be needed to fly it.

There we have the first and perhaps the most important requirement of the light airplane; ease of operation. The ship must almost fly itself, and here the skill of the designer is brought in full play. He builds in the ship a full measure of stability—without sacrificing too much controllability—and he expends much painstaking effort on the design of the control surfaces, so that the plane will handle nicely on the ground and in the air. He designs a ship that will not go off into a spin on hair-trigger provocation, rather, he designs a ship that practically cannot be spun, no matter how tangled up the green pilot may get himself. Furthermore, the designer of the light plane gives his ship plenty of wing surface.

This last brings two big factors in ease of operation. A ship with a light wing loading (large proportion of wing area for its weight) does not drop like a bullet even if it is stalled. It loses altitude slowly, and gives the pilot plenty of time to right himself and regain flying speed. The modern lightplane lands slowly and easily—a big point, when building a ship for the private-flyer market. We cannot design a ship that will land at fifty or sixty miles an hour, with the private pilot tense in his pit and counting the inches between the wheels and the tarmac as he levels off. The average man has not the skill that comes from thousands, or even hundreds, of hours in the air. He cannot be bothered with ships that have to be flown right down to the ground and then watched like errant bulldogs, while they use up a half-mile of runway getting stopped lest they swing into a disastrous ground loop. The average man wants a ship that he can fly down near the ground, stall in, and make a more or less smooth landing without cracking up. He will make mistakes and errors of judgment, and he wants a ship that will pass off these mistakes as naught and make safe landings, anyway.

This matter of slow landings brings us to the second big requirement of the light airplane. SAFETY. Keep it in mind always. Safety in landing. Safety in taking off. Safety in straight flying, in stunts, and in storms.

In the modern light plane, the light wing loading is a big safety factor. As mentioned before, a light wing loading means only little altitude lost in a stall. It means a low landing speed, and safety from errors in judgment on the part of the pilot.

Just what is the value of a low landing speed? Aside from the matter of making the pilot's task easier, the slow landing is a big step in the direction of safety. For example:

Suppose two airplanes are flying cross-country, and find themselves forced to land immediately due to the rapid approach of a bad storm. One of the ships is a light plane with a landing speed of thirty miles per hour that can be reduced to twenty, in a pinch, by pancaking. The other is a heavier ship weighing, let us say, twice as much as the light plane, and having a landing speed of fifty miles per hour. Both pilots are relatively inexperienced.

The only landing spot in sight is a small meadow which is, unfortunately, very rough and hummocky. The light plane, because of its light wing loading, can be flown very slowly, and can be pancaked and allowed to drop to the ground with very little forward speed. The ship may nose over; but coming down slowly as it is, it will be damaged only slightly.

However, the faster, heavier ship is in a bad fix. When one brings a ship that weighs a ton or more down on rough ground at a speed of more than fifty miles an hour, something highly unpleasant is going to happen. This is, of course, ruling out great skill on the part of the pilot. Most private flyers are decidedly lacking in advanced airmanship and skill.

The point is this; a low landing speed is one of the greatest factors of safety of the modern light airplane. Those little ships can be landed almost anywhere, by almost anyone, in complete safety.

Stalling has been mentioned before. The private flyer, having but few air hours, is quite likely to blunder into a stall. If he does this in a ship that whips off and frightens him out of his senses he is in grave danger; but if he does it in a light plane that merely settles forward, he will keep his head and regain flying speed at once and with no danger of a spin.

Another point that has been built into the modern light plane is angle of climb. Many air-minded persons, when looking over the performance figures on planes, are included to place too much value on the *rate of climb* and too little on the *angle of climb*. Rate of climb, in feet per minute, means the amount of altitude gained in that period. Angle of climb, as shown in the sketch, is the angle of the flight path with the horizontal.

A heavy ship may climb at a thousand feet per minute, flying at one hundred miles per hour, and yet be unable to get out of a field that a light plane, climbing at seven hundred feet per minute and flying at only fifty miles per hour, would easily negotiate.

Take a look at the sketch. Suppose it were necessary to get a ship out of a small field with obstructions on the windward side. (This is a practical case that occurrs every day in cross-country work.) A heavy, fast-flying ship will take a long run to get off the ground. It will cover a whole lot of territory in a minute, going nearly two miles, and in this two miles it will gain, we will say, just a thousand feet of altitude. It is easy to see that its flight path is going to be inclined at a rather slight angle to the horizontal. Hence, it will be unable to clear the obstacle with safety.

However, now the light plane steps in and does its stuff. Even neglecting its quicker take-off, which is greatly to its advantage, we will assume that it takes as long a run to get off the ground as does the heavier ship. The light plane, though, noses into a steeper angle of climb, flying with comparative slowness, and clears the obstacle with ease. Of course, in the practical case the light plane would have an even greater advantage due to its quick take-off, which would enable it to get into the air and climb at a greater distance from the obstruction.

These matters of low landing speed, safety in a stall, and steep angle of climb make the modern light plane eminently safe for the private pilot who knows a little about the game and has sense enough to refrain from wild and impossible stunts. However, all pilots at one time or another make mistakes. Pilots are only human. The transport pilot with thousands of flying hours to his credit has a subsconscious "air sense" and is able, instantly and almost instinctively, to correct any mistake he may make; but the private flyer has not the instinctive flying judgment and the power of making quick decisions that comes from long experience. The designer of the light airplane must take this into account, designing ships that will be safe even when handled in a decidedly unsafe manner.

It is, of course, possible for a man to crash any airplane if he tries hard enough. However, the object in designing an aircraft for private flying is to make a ship that will be, as nearly as is possible in any machine, fool-proof. The light plane, with low landing speed and ease of control and good stability characteristics and a pronounced disinclination toward getting into spins is, perhaps, the best answer to the problem.

Another factor in the safety of the light plane is its tremendous gliding range. In case of motor failure—which is extremely rare in modern, highly-developed motors—a pilot has plenty of time in which to kick a good landing spot. He can glide a very long distance, perhaps even soaring, if necessary, by taking advantage of rising currents of air. This face, coupled with the low landing speed of the light plane, makes for extreme safety in flight.

Ease of operation and safety, then, are the first things to be considered in designing a light plane. About the next most important thing is cost. The ship must not be expensive to build and it must not be expensive to operate.

The modern light airplane is simple, and it is being made simpler every day. This simplicity makes for low construction costs, easy and cheap repairs, and lightness of structure combined with adequate strength.

The private pilot does not want to be bothered with a ship that will get out of order easily. Even though the plane is capable of gliding a very long distance to a safe landing in case of motor failure, the owner wants a motor that does not fail. He wants a ship that is so simple that there is almost nothing to get out of order; and he wants one that he can repair himself if the necessity arises. Simplicity is the answer to all this. Many of the present-day light planes use two and three-cylinder motors. These motors are about the last word in simplicity, and careful, scientific design has made them almost impregnable to motor failure.

In the structure of the ship itself, simplicity is a most decided advantage. A rigid fuselage of steel tubing, well-braced and yet light, has come into pretty general use. There is nothing to get out of order. The plane requires no complicated lining-up and inspection before flight. It needs only a minimum of attention from the owner, and it is ready to take him up on the shortest notice, whether it be for a short joy-ride or for a cross-country trip of several hundred miles.

Hand in hand with simplicity comes durability. A light airplane must be able to take the hard knocks and come up smiling for more. It must withstand all sorts of weather conditions; from sub-zero cold to desert heat and raging storms without trouble. In other words, it must be built to give long, satisfactory, and cheap service.

Modern airplane designers realize these requirements, and in the past three years tremendous strides have been made in the design of the light airplane. Even greater improvement is sure to come; and the man who wishes to become an aeronautical engineer will be wise indeed if he makes a thorough study of the light airplane.

However, say the old-timers, is the light airplane practical? Has it the power to buck headwinds and climb over mountains and fight its way through storms? Has it the ruggedness and durability to stand up under severe punishment? Is it not true that the light airplane is just a toy, an interesting freak that can be made to look perfectly all right on paper but that, when put to the severe test of actual everyday flying, falls down on the job?

There is only one way to answer these

questions. The light plane has to answer them itself in actual service; and, fortunately, this has been done.

Although the greatest strides in light plane design have been made in the past three years, we need only point to a flight that was made by a young German to prove the practicability of the light airplane.

This man, F. K. Baron von Koenig-Warthausen, bought a Klemm monoplane and learned to fly. The ship was a low-wing monoplane, with a twenty-horsepower two-cylinder motor and places for the pilot and one passenger. It was built somewhat like a soaring glider, having a very light wing loading and a landing speed of only twenty miles per hour.

When the young Baron had only seventeen hours of flying time, he decided to make a try for a prize that was offered for a non-stop hop from Berlin to Moscow. Starting at night—it was his first flight in darkness—he left Berlin behind and struck out over unknown country. He reached Moscow and won the prize. Did he stop there? He did not!

This dauntless young German wanted to see the world, and so he refilled the tanks of his little ship and started out again. He flew over Persia, India, China, Japan, covering some of the worst flying country in the world. In Persia he made a forced landing in soft sand. A heavier ship would have nosed over and crashed. The little Klemm settled down at twenty miles per hour, stayed on top of the sand because of its light weight, and was not harmed in the least.

The Baron made long hops—and remember, there was not a bit of advance planning done for the flight! He had no huge stores of gasoline and repair parts scattered along his route. In fact, he didn't know just what his route would be until he started! In any heavier ship, with greater gasoline consumption, such a flight would have been impossible, but the tiny Diamler motor used so little gas that the Baron was able to rely on getting supplies as he went along.

Being a senisble young man, he did not try flying over the oceans in a landplane. He shipped his monoplane across the Pacific, took up the air trails again, crossed North America, and took the steamer again and completed his circuit of the world.

There we have ample proof of the practicability and reliability of the light plane. The young Baron's only accident en route was a taxicab crackup in America. That is rather an interesting fact to consider when talking of the safety of the light plane!

The remarkable part of this young man's flight, perhaps, is his courage. He did something that was considered, up to that time, as utterly impossible. He proved that it could be done—moreover, that long-distance flying over rough and forbidding country is safer in a light plane than in a heavy, expensive ship. Moreover his expenses were surprisingly small, the greatest item being taxi fares to and from airports!

Baron von Koenig-Warthausen has written a book, "*Wings Around the World.*" Every young man who is interested in aviation should read it—doubly so, if he is interested in the design of the light airplane, because the Baron proved, beyond all shadow of doubt, that the light plane is thoroughly practical for the very hardest kind of flying.

Nor is this remarkable round-the-world flight the only case in point. Modern light planes have crossed and recrossed the American continent without a bit of trouble, flying across desert wastes and the ramparts of the Rockies and desolate plains with ease and sureness.

Thus there can be no question as to the practicability of the light plane. It remains for skillful engineers to develop this type further; and in the next article we will go into the matter more fully, discussing the recent developments and methods of design and the improvements that are likely to be made in the future. For it is, after all, the engineer who combines a thorough knowledge of the principles of past and present ships with clear-headed vision and inventiveness who is going to get ahead in this game.

Win a Free Flying Course!

(*Continued from page* 9)

will want to miss it.

Great airmen such as Kingsford-Smith, Byrd, Al Williams, Jimmy Doolittle, Lindbergh, Hawks and the others who have written their names across the skies all had to start by taking instructions in flying—the same thing as a flying course—and it is this very same opportunity to start that we are offering you.

Come on in, and bring in all your friends. Let's all get together to put the contest over in a big way.

Who knows that the winner of this contest himself is not another Kingsford-Smith in embryo?

All you have to do has been explained to you. Start right away. You might be the winner. We hope you are.

Rules

1.—*There is no entry fee.*

2.—*No correspondence will be entered into concerning the contest.*

3.—*This contest is open to all readers of* Model Airplane News, *whether subscribers or otherwise.*

4.—*Members of* Model Airplane News' *staff and/or the employees of Good Story Magazine Co., and/or the Curtiss-Wright Corporation and its subsidiaries are not eligible for entry in the contest.*

5.—*The Judges' decision is final. The judges are Harold Hersey, publisher, and Capt. H. J. Loftus-Price, editor,* Model Airplane News, *and referee, Mr. C. S. (Casey) Jones, the Curtiss-Wright Corporation.*

6.—*The contest closes at midnight November 21, 1931. After that time no entries will be eligible for a prize.*

7.—*The names of the winners will be published in the first possible issue of* Model Airplane News *after the closing date of the contest.*

8.—*Should two or more persons tie for prizes, each will be awarded the prize tied for.*

9.—*In competing for the prizes, each contestant releases* Model Airplane News, *the Good Story Magazine Co., the Curtiss-Wright Corporation and/or their subsidiaries from any and all responsibility insofar as mishap of any kind is concerned.*

10.—*The winners of the first, second and third prizes agree to pay their own transportation and living expenses during the course and flight.*

11.—Model Airplane News *will not be responsible for receipt of entry forms and/or finished contest pictures. Proof of postage does not signify proof of receipt.*

MODEL AIRPLANE NEWS "SCRAMBLED PICTURE" CONTEST
Entry Form

NAME.. AGE..................

Print your name clearly.

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City ....

Nearest Airport ....

For Parent to Fill in:

I,.., hereby agree to let my son (daughter), ..., enter the "Scrambled Picture" Contest conducted by Model Airplane News. He has read and fully understands the rules.

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This is to certify that.. is sufficiently proficient in his studies to be eligible for the "Scrambled Picture" Contest.

(Signed)..

School..

Mail to:
"Scrambled Picture" Contest,
Model Airplane News,
570 Seventh Avenue,
New York City.

GUYNEMER, OF FRANCE

(*Continued from page* 13)

analyzed and practiced by Guynemer, so that no matter what might happen in the twinkling of an eye, he knew what to do next.

Psychologists may have an explanation for the killing instinct so evident in Guynemer once he was in the air—for always he was longing for more victims, more fights, more glory, and the sight of an enemy plane burning or going down fairly intoxicated him. The explanation may lie in the fact that he was a physical misfit, but once in the air, he was strong—as strong as anyone else! He had a brain, he had a machine which he knew, and he had deadly armament! It must have been an understandable retaliation against the fate which had hampered him before glorious war came along to make him like other men.

On June 17 the youngster returned from a flight with eight bullet holes in his plane. As yet no victory had been chalked up but the next month was to witness the first of his great record. This came on July 19.

On that day he went out anticipating battle rather than the usual reconnaissance flight. A German had been reported in the air at Coeuvres, and with a gunner named Guerder, Guynemer went on his trail. At Pierrefonds they caught up with him. They fired and immediately afterward their machine gun jammed. They fixed it quickly but by that time the enemy had fled. On their way back they came upon an *Aviatik* machine. They followed, and Guynemer maneuvered his plane to an advantageous position — about 150 feet underneath the enemy and behind him at the left. In response to their sudden salutation of gunfire, the *Aviatik* swayed and cracked. The German was undaunted, however, and replied with a rifle shot which hit the wing of the Frenchman's machine. The firing continued and suddenly the *Aviatik* went down in flames, after only ten minutes of combat.

Within sight of the German trenches the Frenchmen landed and were bombarded with cannon fire. The twenty-year-old boy, with his customary calmness, sat down on the ground to remove an article of clothing which impeded his walking, placed his machine in a spot out of range, and continued on his own way to safety!

At this stage of the war such a feat was generally the exception rather than the rule, as air combat was still only a possible incident to a reconnaissance flight and not yet an important objective. In recognition of their exploit, the two Frenchmen, Guynemer and Guerder, were awarded the Military Cross. However, since Nieuport fighters were scarce in those days, the men were obliged to take turns in going out after the enemy; so that several months elapsed before Guynemer's next victory.

At last he was given his own Nieuport single-seater fighter for special missions and reconnaissance, but he was forced to give it up for a while and go home for rest and recuperation. It has been said that Guynemer was subject to violent hemorrhages after a strenuous flight, and it is easy to believe it when one notices how many times he had to take to his bed in the midst of battle.

An exciting combat in which Guynemer took part, although it did not lead to another victory for him, contributed greatly to the Allied cause. On November 6 he fought with an *L.V.G.* (*Luft-Verker-Gesellschaft*) machine equipped with a 150 h.p. engine. Again his gun jammed just as he got beneath his quarry, and he was forced to bank. They were so close that they interlocked, and a bullet grazed Guynemer's head, ripping away some of the wing covering. He dived and the German retreated. Much chagrined, Guynemer landed and took his gun apart, studying it with as much concentration as he had studied the first rudiments in his apprentice days. From this grew his development of the deadly one-pounder aerial cannon. Such was the manner in which Guynemer attained success—he never gave up or acknowledged defeat.

His youth soon after prevented his receiving the coveted Legion of Honor. On December 8 an *L.V.G.* with a 165 h.p. engine came down under the fire of his Lewis machine gun, and because he was not yet of age, the award was denied him. "Nevertheless," he replied angrily, "I am not too young to be hit by the enemy's shells." However, when he attained his majority later in the month he was given the Cross; and now his savage joy in the kill knew no bounds.

By the spring the German aerial forces had taken great strides. Their new small single-seater fighters (the *Albatros, Halberstadt,* improved *Fokker* and *Ago,* with fixed motors of 165-175 h.p., usually the Mercedes though sometimes the Benz and Argus and with two fixed machine guns firing through the propeller) had swept their enemies from the air.

Accordingly, a rapid concentration of all French aerial squadrons was ordered to the vicinity of Verdun, among them the Storks Squadron. Guynemer flew with them to the scene of what was to be the longest, most stubborn and cruelest battle of the Great War. On his way his eighth enemy plane went down in flames beneath his strategy. A group of five German planes had ventured into French territory and Guynemer dispersed them, drove another out of Argonne and met two others face to face on his return.

He tackled the first without hesitation, firing from 30 feet underneath. His adversary was not asleep, however, and the air was rent with the staccato shots of his return fire. Guynemer's machine was hit and he was badly wounded. Numerous bits of aluminum and iron lodged in his jaw, his cheeks, his left eyelid, and two bullets pierced his arm. In spite of being blinded by blood, Guynemer was unperturbed and dived at once, while still under the fire of the enemy and yet another plane which had come to the enemy's aid. Guynemer's luck held out and he escaped, landing at Brecourt. Then he was forced to retire to Paris to recuperate.

Midsummer saw the beginning of the Franco-British offensive along both banks of the Somme, and the single-seater Nieuport which had until then been unequalled for pursuit work, was replaced by the Spad. This plane's only defence lay in its capacity for speed and maneuverability, for its rear was badly exposed and its field of visibility very limited. Its armament consisted of fixed machine guns firing through the propeller.

Guynemer, now 2nd Lieut., and Corporal Savage piloted the first two of these planes early in September, 1916, at which time the single-seater machine was supreme. Later their place was to be taken by squadrons in massed attacks.

After July 1 there was a combat every day—so that it becomes difficult to recite tale after tale of Guynemer's victories. They were so numerous and so conclusive of his superiority as a fighter and tactician. He now had a more powerful machine for his own use.

It is worth while to refute the amusing statement that Guynemer once stopped a bullet with his finger, which has often been made by chroniclers of his career. Fortunate and accomplished as he was, he was not a magician. The truth is less dramatic but just as interesting. He once came on an *L.V.G.* and was about to pull the trigger when a bullet ploughed into his index finger. His machine was instantly riddled with shots and his tank burst. In consideration of the circumstances, he made an excellent landing and settled on the ground between two shell holes. In a letter home about the episode, he wrote whimsically, "It could not be said now that I am not strong, I stop steel bullets with the end of my finger." So much for the legend.

On September 23 Guynemer brought down two enemy planes and himself had an almost unbelievable fall from 9,000 feet and lived. He miraculously escaped with only immense fatigue and a gashed knee from his own magneto. He had attacked a group of five planes flying in echelon (three above, two below) and had forced two down. Then he suddenly realized that he was going down, too. Like a mathematician he calculated his chances and switched off his motor. He reached the earth even before his victims. It was in friendly territory and French infantrymen rushed to what they thought must be a dead man. He stood up to reassure them and later collapsed. Off he went again to recuperate.

On October 5 he was in the thick of the fight once more. German tactics in the air had steadily improved and by this time was a worthy menace to be contended with. Guynemer defied their offensive tactics, however, and by January 24 had twenty-nine victories to his credit.

The twenty-ninth victory is worth retelling, for it was in this combat that he fought with nothing but his brains. In turning to surprise an enemy, he inadvertently went into a tailspin. The two-seater came at him. Guynemer fired ten shots and his gun jammed. Luckily for him, the German suddenly became excited (the cause was later explained as a bullet-riddled altimeter and tachometer) and dived with his motor in full. Guynemer decided to stick and use his wits, instead of giving up, as another man might have done, and with good reason. He went after the plane, keeping far enough away so that his useless gun could not be seen by his adversaries. Down they went. Suddenly the German plane righted itself and made a dash, banking away. Guynemer bluffed, rose 1,500 feet, and dropped on him in his favorite fashion. The German was impressed and went down still lower. Then when his several shots at Guynemer had no effect, he lost heart and signalled that he surrendered. He descended while Guynemer circled low over him. In a moment or two the two occupants of the enemy plane were surrounded by French troops, but not before they had managed to set their machine, a magnificent 200 h.p. *Albatros*, afire. Picture their amazement when Guynemer landed and showed the Germans his broken machine gun!

Victory after victory piled on after this until he had reached the goal he had set for himself—a record of fifty enemy planes downed. His rank was now that of Captain and he should have been reasonably happy, but he was a changed man from the moment his fiftieth plane went down. More nervous than ever, he was morose and fatilistic in the belief that since he had accomplished what he had been striving for, his end was near.

However, instead of avoiding battle he sought it more fervently than ever and seemed to want the thing over and done with.

The fifty-first, fifty-second and fifty-third victories were added to his score. Meantime the new airplane of which he was so proud had been damaged in battle and he suddenly determined not to go up in any other machine until its arrival, which was expected hourly. On September 11 (1917) he strolled from his tent to the hangars in moody meditation and there chanced to see his old Nieuport, "Old Charles." Suddenly he decided he could not be idle any longer and he took off with another machine piloted by Lieut. Bozon-Verduraz.

He was very nervous, and obstinately insisted on penetrating the German lines. Then his keen eyes saw a two-seater enemy flying below him. He had to be careful as the enemy was over its own territory and therefore had freedom of movement, so he decided to attack from behind, though the front attack was his favorite position. The day was cloudy; he could not use the sun as his protection, and he dived down to the other without hesitation. The German saw him and expected him to zigzag, but Guynemer recklessly disdained resorting to tricks this time, and fell on him like a shot. He missed, and the German went into a tailspin and escaped. Bozon-Verduraz, who waited below, also missed the German.

Guynemer was irritated and for once flung everything to the winds. He took a dangerous course. He went into a tailspin after the enemy, waiting for a chance to shoot. In the meantime Bozon-Verduraz had noticed eight German single-seaters over the British lines, and since he had agreed with his chief to distract any chance planes so that Guynemer might achieve his fifty-fourth victory undisturbed, the Lieutenant went after the group in the distance. He had no fears for Guynemer who had often tackled great numbers of the enemy alone. Bozon-Verduraz at last succeeded in dispersing the group and flew back to where his chief was no doubt waiting for him. Disturbed when he found no one there, he descended closer to the ground searching for a possible wreck. He saw nothing. He climbed again, circling in a wide radius but always keeping within reasonable distance of the rallying point. His vigilance was unrewarded. Suddenly he saw that his oil was running low, and with a heavy heart he went back alone.

The airdome had no news of Guynemer; no one had seen him or heard of him. Searching parties were started but there was still no trace of their leader when night had come.

At last the news came out. Through particulars furnished by the Red Cross definite proof of Guynemer's death was established. He had been brought down from a height of approximately 2,100 feet north east of Poelcapelle cemetery in the Ypres sector, a region which had been undergoing steady bombardment for several days. Some German soldiers had seen him lying there, shot through the head, with his pilot's certificate giving definite proof of his identity. He could not be removed or buried there as the vicinity could not be approached for several days, and after the fighting was over, the entire district was found to be ploughed up by shells.

His body was never seen again. All that remains of Georges Guynemer is the memory of a never-let-die spirit and a memorial tablet in France's Panthéon.

The Airplane Engine

(*Continued from page* 21)

oils are obtained by rendering. An example of this type of oil is lard. It is evident, of course, that these oils do not have a sufficiently wide range of qualities to make them useful, though tallow is sometimes used as a foundation for blended greases.

Another origin of organic oils lies in vegetable matter. Peanut and cocoanut oils are sometimes used to make certain blends of lubricating oils. Castor oil, however, is the vegetable oil mostly used. Its most highly prized quality is the fact that it is insoluable in gasoline. Ordinarily, when the fuel of an engine comes into contact with the lubricating oil it will mix and destroy the quality of the lubricant. Such a condition would exist in a two-stroke cycle engine or in a rotary type engine where the fuel is fed to the cylinders through the crankcase. This explains the reason why the wartime rotary engines were required to use castor oil. Incidentally, one of its disadvantages is that the exhaust fumes of this oil make the pilots ill.

Castor oil is a very efficient lubricant. However, it is comparatively scarce and, consequently, expensive. It becomes gummy after long exposure to heat and air and may cause sticking valves, and it will deteriorate in storage. One way to make use of its excellent qualities is to use a blend of castor and mineral oil. This type of lubricant has met with high favor throughout Europe, especially in France where many castor-bean trees are cultivated as an industry. It may be stated, however, that equally good results are obtained in this country by using mineral oils.

In the early days of the internal combustion engine there was little need for efficient lubrication. The loads placed on these engines were not large and, as a result, little heat was generated in the bearings. Scoops were placed on the lower ends of the connecting rods. As they revolved with the crank they dipped in the oil supply which was maintained in the sump of crankcase and splashed the oil around inside the engine. This provided sufficient lubrication.

As more power was demanded of the engine from both automobiles and airplanes, it was evident that the lubricant must be distributed in a more positive manner and under suitable pressure. Thus, began the direct or forced feed lubrication system that is used in practically all engines today.

In both the radial and the vee-type of engine, the force feed system is essentially the same. A pump is provided to draw the oil from its reservoir or tank. It is then forced to the main bearings and the connecting rod bearings where the most heat is generated. The crankshaft is drilled hollow to permit the ready passage of oil to the various bearings along it.

Various leads will be taken off the main line to provide lubrication for the many accessories and gears. Other leads will convey the oil to the camshaft and valve mechanisms. As oil is thrown from the rapidly revolving cranks it will form a spray which will properly lubricate the cylinder walls.

As the oil drops from the moving parts it is collected in the sump or crankcase where a second pump gathers it up and returns it to the tank. This second or scavenging pump is of a larger capacity than the pressure pump in order to make sure the oil cannot collect in the sump.

At first thought it would appear that lubrication difficulties would prevent the use of the radial and inverted types of engines. It is a common supposition that all the oil which would ordinarily collect in the sump will fall in the cylinders on the bottom side of the piston and eventually work its way into the combustion chambers of the lower cylinders.

This does not happen. To prevent it, the inverted cylinders have long skirts which project sometimes over an inch into the crankcase. As the oil runs down the sidewalls of the crankcase, its level is maintained always below that, which would permit it to overrun over the skirts and into the cylinder proper. This oil is drawn off by a sump between the two banks in the inverted engine. In the radial engine the sump is at the lowest point of the crankcase, which is between numbers five and six cylinders in a nine-cylinder job.

It is true that part of the oil vapor falls on the back of the piston. However, as the piston travels upward at a high velocity on the succeeding stroke, this oil is again thrown out into the sump. It is inevitable that the lower cylinders of the radial will permit the entrance of more oil than the upper cylinders. It is also true that the inverted engine passes more oil than the normal upright engine. Nevertheless, the oil troubles are not sufficiently obnoxious to prevent the use of these types of engines.

Practically all automobile engines use the bottom of the crankcase or sump as a reservoir for oil. When oil is added it is simply poured into the crankcase. The early airplane engines also used this method which is known as the "wet sump" type of construction. It served very well in the early days when stunting was relatively unknown.

However, as more and more violent maneuvers came into use it was usual for the pilots to become drenched with hot oil which poured out of the breathers when the plane reached an inverted position. These breathers are nothing but crankcase vents to permit the escape of any gas pressure which might slip through the piston rings and therefore can not be eliminated.

The solution of this problem lay in drawing the lubricating oil from the crankcase as soon as it collected there. If a separate oil tank is provided it will serve as the reservoir and at the same time prevent any undue accumulation of oil at any time in the sump. This is known as the "dry sump" type of design and is used in practically all airplane engines.

Its weight will be slightly more, but the benefits to be gained are worth far more than the excess weight. The oil tank is generally mounted slightly above the center line of the engine in order that there will always be a pressure head upon the pump which will never need priming.

The oil pumps in use today are similar in construction to the gear-type fuel pumps which have been discussed in a previous article of this series. The oil is simply pulled into the pump by the teeth of the revolving gear. Pressure is built up on the outlet side as the two gears mesh together. Generally, both the pressure pump and the scavenging pump are mounted on the same shaft and assembled as one compact unit.

A strainer is placed in the line at some point in order to collect any foreign matter that may have entered the system at some point. Because of the heaviness of the oil, the strainer's mesh can not be too small or the circulation will be restricted. It is generally placed in the sump where it is convenient to clean.

While operating a plane in exceedingly hot weather, or with too lean a mixture, the oil temperature will rise above normal and will indicate very quickly that unusual heat conditions are being encountered. It may become necessary to provide some means of cooling the circulating oil. A small radiator may be supplied, but a simpler method is to pass the oil through some copper coils which are projected into the slip stream. In these designs a by-pass valve is provided in order that the oil will not circulate through these cooling devices in cold weather or before the oil has been heated up. This valve will be controlled by the pilot.

On the other hand, in extremely cold weather it takes considerable time to warm up the oil in order that it will circulate properly. A heating element is often inserted in the oil tank for this purpose. It is simply an electric coil which is heated by means of a battery.

By means of the oil pressure gauge and the oil temperature gauge, the pilot is enabled to tell exactly what is happening to his lubrication. These will give him warning of any trouble originating not only in this system but in other parts of the engine as well. Unusual heat is one of the very first symptoms of trouble experienced with the engine. Consequently, the careful pilot will take particular care of, and keep very close watch on his engine lubricating system.

The next article of this series will discuss the relative merits of the many types of cooling possible in the airplane engine. Many people think that the liquid cooled engine is obsolete. This is not so. Then, in addition, there are other means of cooling an engine. Both Prestone and steam may be used to advantage and some day may replace the air-cooled engine which has gained such popularity within the past five years.

American Sky Cadets

(*Continued from page 23*)

selves air-minded give up building models when they reach about sixteen years of age because they consider it "kid's stuff"; whereas at that age they are just beginning to learn the rudiments of the game.

With regard to flying models as against non-flying models, he believes that flying models are necessary as an aid to mastering the theory of flight but that non-flying scale models are also of great help in learning the detail work.

Another point he would like to stress is that young fellows who have gained some knowledge of flying models should experiment with new ideas of their own, applying of course proper principles to these experimental planes.

Now a little of what Bobby Buck has done in flying. He received his flying instruction at the Westfield, N. J., airport, from C. D. Bowyer, who is now chief of operations at Westchester County Airport, Armonk, N. Y. March 15th, 1930, was his red-letter day, for it was on that date that he first solo-ed. In little over a year he has chalked up more than 300 flying hours and broken the junior records for transcontinental flights and the New York-Havana-and-return flights.

The plane he pilots is a Pitcairn, the type used in the air mail service between Richmond, Va., Boston, and from Jacksonville to Miami.

His times on his big flights were:

New York to Los Angeles,	28 hrs., 33 mins.
Los Angeles to New York,	14 hrs., 47 mins.
Newark to Havana	14 hrs., 17 mins.
Havana to Newark	13 hrs., 35 mins.

Cross-country flying is no joke but real hard work. On his first long trip across the continent he set off at 7.10 A. M. on September 29th, 1930. As a mascot he carried a silk handkerchief given to him by his flying instructor, C. D. Bowyer. Wrapjed in the handkerchief was a boot, the property of C. D. Bowyer, Jr., aged five and one-half months!

Things were not too favorable for record breaking. The young aviator encountered strong head winds which at times gave him lots of trouble keeping his plane on even keel.

After leaving Wichita he had to turn back owing to low oil pressure. That trouble was fixed and he was off again. However, engine trouble forced him down at Glenrio, N. M. He returned to Amarillo, Texas, and spent the night there while the engine was fixed. Then on again to Los Angeles and his first record!

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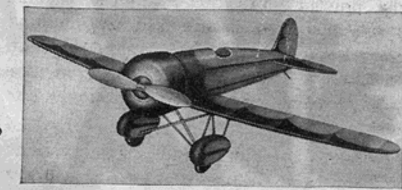

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See Over a Fence, Around Corners, Etc.

LOTS OF FUN AND AMUSEMENT

Strongly Made. Equipped with Mirrors, Sight-Finder and Eye-Piece.

THIS is the same kind of instrument that the soldiers use in the trenches to watch the enemy without risk of being seen themselves, and every submarine has one to project above the surface of the sea to keep a look-out for other vessels, etc. With it you can gaze over a high wall or see around a corner without being seen yourself, or, if you are in a crowd, you can look right over the heads of the tallest men and watch all the fun. Our illustrations will give you some idea as to the numerous uses to which the Periscope can be put. Every Boy Scout should have one for spying and anyone else who wants some rare amusement. The Dandy Periscope is very strongly made, will stand the roughest handling and the hardest wear, and with ordinary use should last a lifetime. It measures 17 inches long, and a little over two inches wide. The Periscope Tube is handsomely decorated with colored designs to show many of its uses, and each Periscope comes complete in box. Price Postpaid to any Address **$1.00**

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Two very novel metal badges, nickel plated, that you can wear, giving you fun out of all proportion to their trifling cost. 10c. each badge, 3 for 25c, or 75c per doz. postpaid anywhere.

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Greatest boys' book written. Tells how to make a Pinhole Camera, a Canoe, model Railroad, a Telephone, Boomerang, Telegraph Instrument, Box Kite, Talking Machine, Microscope, Electric Motor, Electric Door Bell, Water Wheel, Paddle Raft, a pair of Skis, a Dog Sled, Bird House, Rabbit Yard, etc. 64 pages. 150 illustrations. PRICE 10c.

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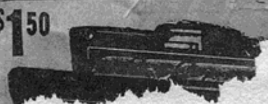
A wonderful little instrument producing optical illusions both surprising and startling. With it you can see what [a]pparently the bones of your fingers, the [lead in] a lead pencil, the interior opening in [a pip]e stem, and many other similar illusion[s. A m]ystery that no one has been able to [ex]plain. Price 10c, 3 for 25c, […] Johnson Smith & Co.

$1.50



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Protection against Burglars, Tramps, & Dogs

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$1.00 Postpaid

You can easily make a highly sensitive detectophone by using this Transmitter Button to collect the sound waves. You can build your own outfit without buying expensive equipment. It is simple and inexpensive. You can install an outfit in your home and hear conversations being held all over the house. You can connect up different rooms of a hotel. This outfit was used by secret service operatives during the war. It is being used on the stage. It is ultra-sensitive and is the greatest invention in microphones. You can mount the button almost anywhere—card board boxes, stove pipes, stiff calendars, on the wall behind a picture frame, etc. Button is so light and small it cannot be detected. Persons can be overheard without suspecting it. You can listen in on conversations in another room. A deaf person in the audience can hear the speaker. Connected to phonograph, piano or other musical instrument, music can be heard hundreds of feet away. Button may be used to renew telephone transmitters; often makes an old line "talk up" when nothing else will. The ideal microphone for radio use; carries heavy current and is extremely sensitive. Amplifies radio signals. Countless other similar uses will suggest themselves. Experimenters find the button useful for hundreds of experiments along the lines of telephones, amplifiers, loud speakers, etc. Many fascinating stunts may be devised, such as holding the button against the throat or chest to reproduce speech without sound waves. PRICE $1.00.

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It is great fun mystifying your friends. Get this Conjurer's Cabinet, and you will be the cleverest fellow in your district. It contains the apparatus for ten first-class tricks, including The MAGIC BALL AND VASE TRICK (a wooden ball is placed inside, and upon replacing the lid has disappeared and is found in someone else's pocket); The HINDOO TRICK CARDS (can be made to change completely no less than five times); DISAPPEARING COIN BOX (a coin, placed in the wooden box, vanishes entirely or changes into a coin of another denomination); The GLASS GOBLET TRICK (a coin is dropped into a glass of water and when the water is poured out the c[oin] has vanished and is found somewhere else); the RIBBON FACTORY FR[OM] THE MOUTH TRICK (a seemingly endless supply of colored paper r[ibbo]ns comes out of your mouth); the DISAPPEARING HANDKERCH[IEF] (a handkerchief held in the hand mysteriously vanishes); the WIZARD'S [RI]NG COIN TRICK; the ENCHANTED BOTTLE (no one but yourself [is] able to make it lay down); the GREAT HAT AND DICE TRICK (a large [die] is placed on top of a hat, disappears, and is found underneath yet no one [ha]s touched the hat); and last, but not least, the GREAT PHANTOM CA[R]D TRICK, or two from five leaves nothing. Full instructions are sent for performing each trick. In addition to the above, a number of other feats and illusions are fully explained for which you can easily make or procure the necessary apparatus. Price complete $1.00 postpaid.

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GREAT CURIOSITY Smallest Bible in the World; Size of a postage stamp, 200 Pages. Said to bring good luck to the owner. A genuine work of art. Must be seen to be appreciated. Make good money selling them to friends, church acquaintances, etc. PRICE 15c each. 3 for 40c, 12 for $1.25, 100 for $7.50. Also obtainable in Leather Binding, with gold edges. Price 50c each, 3 for $1.25, $4.50 per doz. Magnifying Glass for use with Midget Bible, 15c.

Lover's Knot or Friendship Ring

Made of 4 strands of genuine 14K gold filled wire, woven into the True Lover's Knot, symbolic of love or friendship. Very pretty, yet not showy. Each ring is made by hand by gold wire expert. It looks good and it *is* good. Price 50c Postpaid Johnson Smith & Co.

Rubber Chewing Gum

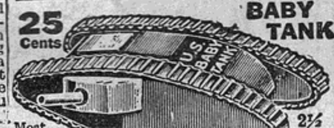
It is just like a regular package of chewing gum and looks so real that it fools everybody. Of course no one suspects it is not genuine until they start to chew it. There's a world of fun in this rubber chewing gum — 5 sticks to the package. Price, 10c Pkg.; 3 for 25c; 12 for 75c postpaid.

Rubber Cigarettes. Price per Box. 20c

Rubber Matches. Price per Pkg. 10c

BABY TANK

25 Cents



Most remarkable toy ever invented. 2½ inches long

By drawing the Tank backward, either with the hand or over the floor or table and then placing it down it will crawl along, overcoming all obstacles, in the same life-like manner as the larger Tank that proved so deadly in the great war. What makes it go is somewhat of a mystery, for there is no mechanism to wind up as is usually understood with mechanical toys, yet this tank will keep plodding along ten times longer than the ordinary run of toys. It will perform dozens of the most wonderful stunts. 25c prepaid.

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This is another good practical joke; the intense discomfiture of your victims to everyone but themselves is thoroughly enjoyable. All that is necessary to start the ball rolling is to deposit a little of the powder on a person's hand and the powder can be relied upon to do the rest. The result is a vigorous scratch, then some more scratch, and still some more. 10c box, 3 boxes for 25c or 75c per dozen. Shipped by Express.

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One of these glass vials dropped in a room full of people will cause more consternation than a limburger cheese. The smell entirely disappears in a short time. 10c. per Box, 3 Boxes for 25c., 75c per doz. Boxes, or $7.50 per gross Boxes. Shipped only by Express.

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Place a very small amount of this powder on the back of your hand and blow it into the air, and everyone in the room or car will begin to sneeze without knowing the reason why. It is most amazing to hear their remarks, as they never suspect the real source, but think they have caught it one from another. Between the laughing and sneezing you yourself will be having the time of your life. For *parties, political meetings, car rides,* or any place at all where there is a gathering of people, it is the *greatest joke out.* Price 10c, 3 for 25c, 75c per dozen. Shipped by Express.

COMICAL MOTTO RINGS

Lots of harmless fun and amusement wearing these rings. Made in platinoid finish (to resemble platinum), with wording on enameloid, as illustrated. Price 25c ea. Postpaid

250 MAGIC TRICKS 10c

An excellent little book containing 250 Parlor Tricks, tricks with cards, coins, handkerchiefs, eggs, rings, glasses, etc. So simple that a child can perform them. Profusely illus. Sent postpd. to any address for only 10c. 3 copies for 25c.

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