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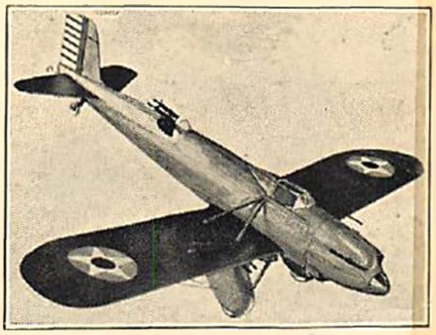

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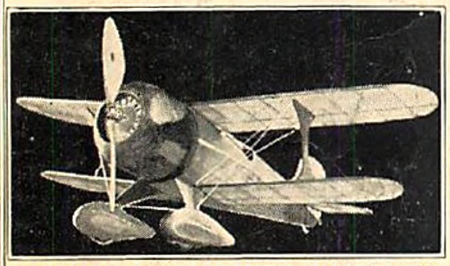

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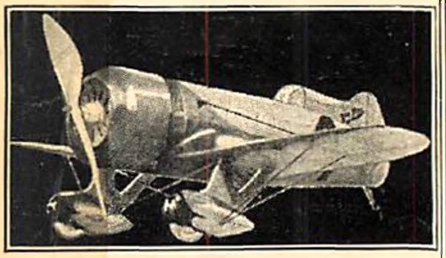

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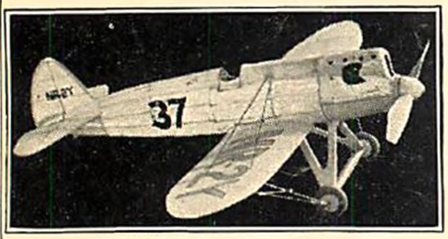

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Frank Vieth, Hinsdale, Ill.

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Paul Mitchell, Y.M.C.A., Decatur, Ill.

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Alvin Wilda, Manitowoc, Wis.

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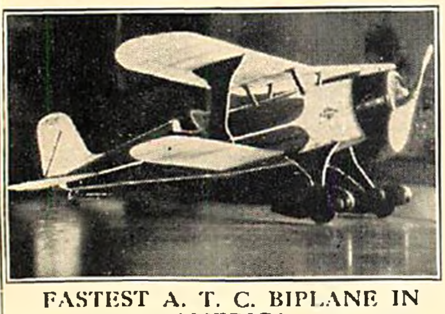

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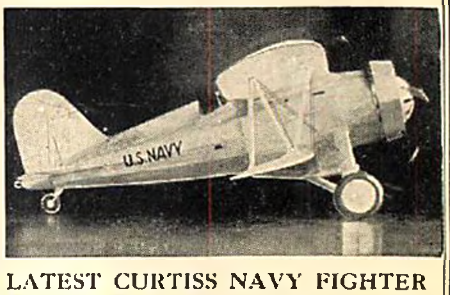

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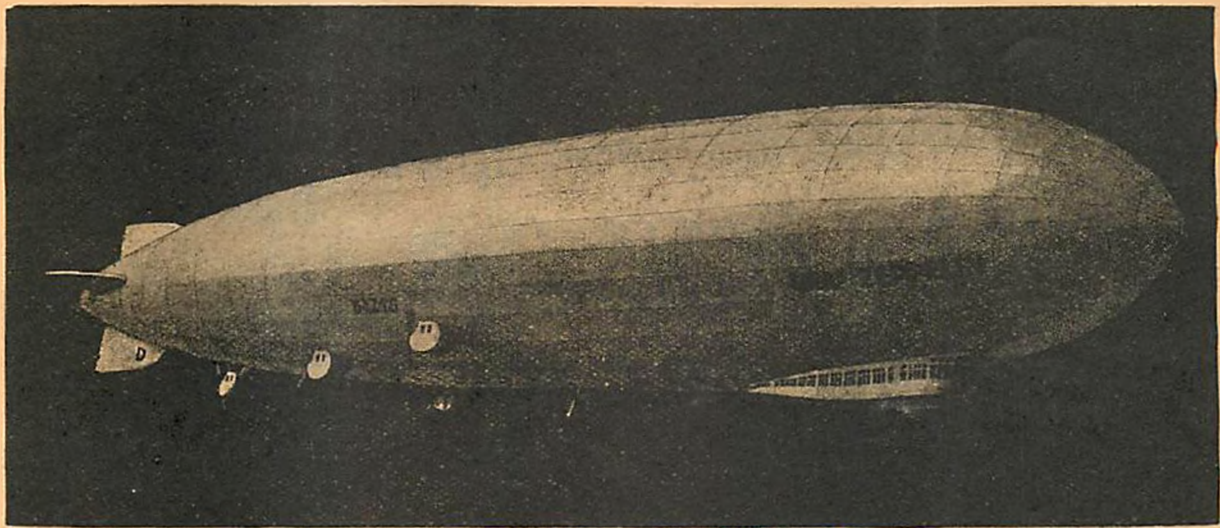

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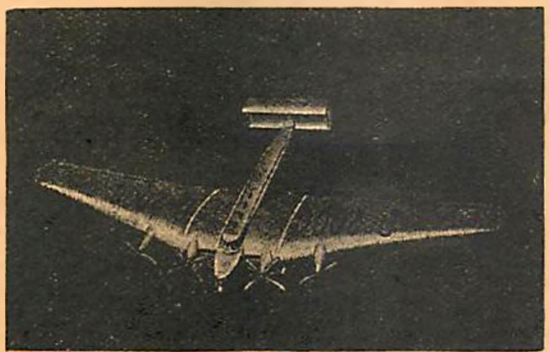

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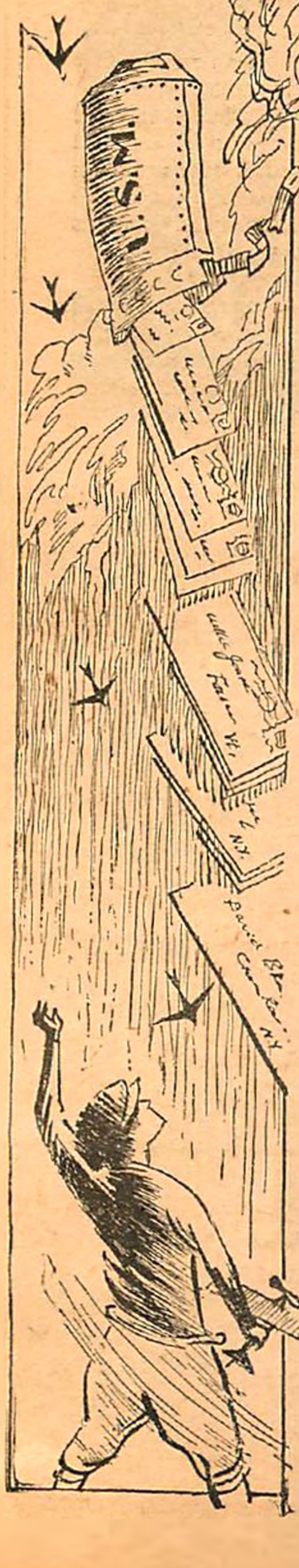
Model Airplane News

and JUNIOR MECHANICS—Vol. VI **No. 3.**

Edited by

Charles Hampson Grant



CONTENTS

MARCH - 1932

In Our Next Issue

Many of our readers have told us how much they like the Three View Drawings, so starting in our next issue we will publish two in each issue. One a wartime plane, and one a modern ship.

Another feature of our next issue will be the plans with instructions, to build three different planes. One is a 28" Flying Scale Model of a Cessna Monoplane, by one of the finest model builders in the country, Mr. Howard McEntee. Another is "The Midget Indoor R.O.G.," a "thumbnail edition" of the standard R.O.G. planes.

The third is the full size plans, with instructions, to build a Solid Scale Model of the Curtiss Hell Diver, by Wilson Russ.

The readers of our War Ace Stories also will not be disappointed, for the April issue will contain another thrilling chapter of Aviation's World War Heroes.

All these will be in addition to the regular installments of the course on the Aerodynamic Design of the Model Plane by Charles Hampson Grant, Aerial Radio by Capt. Leslie Potter, Airplane Engines by Lt. H. B. Miller and Airplane Designing by Ken Sinclair.

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

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

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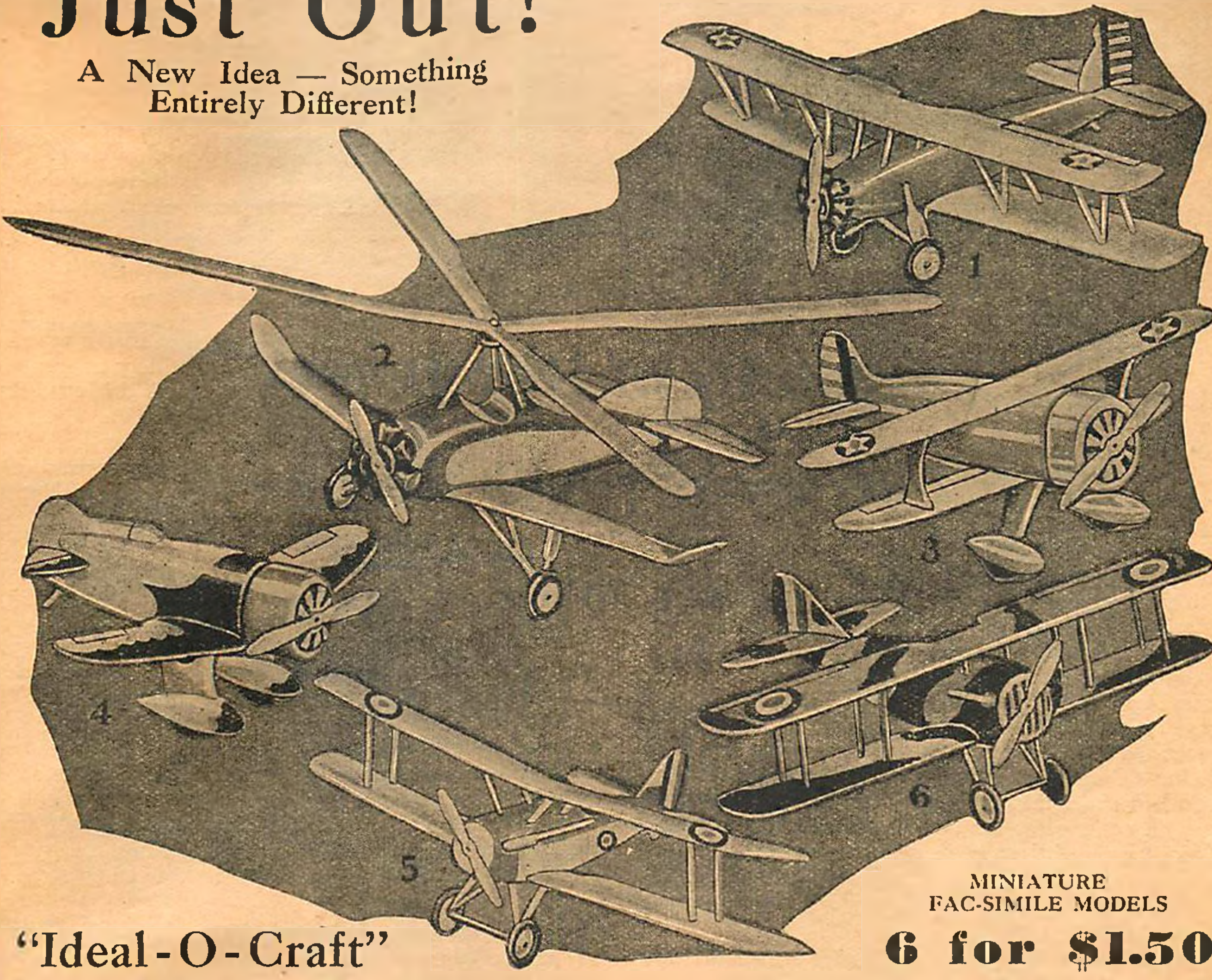
A New Idea — Something Entirely Different!



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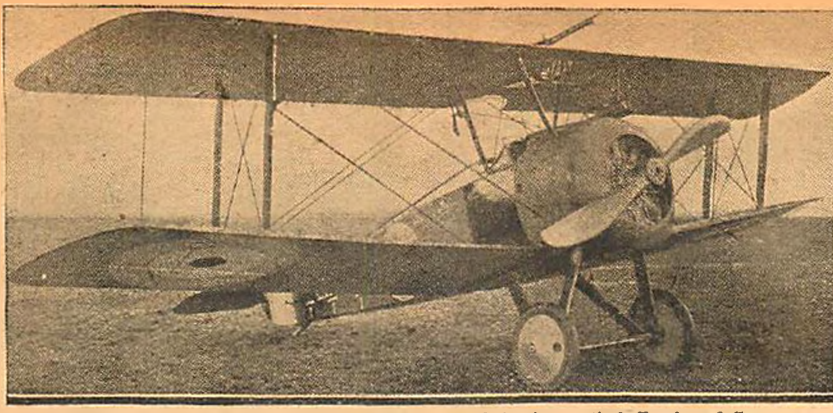


—This picture is furnished through the courtesy of the Aeronautical Chamber of Commerce.
The "Sopwith Camel," flown by Roy Brown in his fight with "The Red Ace."

The Story of Roy Brown

Destroyer of von Richthofen

By J. NOBLE

THE conqueror of Baron Manfred von Richthofen, who was Germany's greatest war ace, lives today in a quiet street in Toronto, Canada, unnoticed by his neighbors, and almost utterly unrecognized by fame. How did this silent, unassuming young man, who is accounted the destroyer of that terror of the air, the Red Knight of Germany, fail to be accorded the honors which a grateful empire should have bestowed? Men who have done far less for their country are today wearing the highest decorations a nation can give a worthy defender. Here is the story of an unrewarded hero, as great as he is unappreciated.

Let us begin at the beginning, March 22, 1918.

Seventeen months of flying, fighting and killing had brought the 209th squadron of the Royal Air Force to the little French village of Tateghem, near the Belgian frontier. Word had come that the Boche planned to start at this point, their last great drive of the World War; a mighty despairing push of the terrible grey lines toward the British Channel, which the Germans hoped would leave the English army scattered, Paris in the hands of the Kaiser, and the world on its knees.

To this final battle place of the armies of half the earth had been summoned the cream of both side's forces—among them the 209th squadron of the Royal Air Force and that most famous of all aerial killers, Baron von Richthofen, and his death dealing Flying Circus. Commanding a flight of five Camels on the British side was Captain A. Roy Brown, a homely, youthful Canadian, yet to bring down his first plane, and hardly heard of outside his own squadron. Hardly a match, these two, it would seem, yet read of the battles which were to follow their first meeting, and of the final thrilling outcome.

Early in the morning of March 22, Brown took off with his flight of five red nosed Camels to escort a bombing expedition across the German lines. Their "eggs laid" the bombing planes streaked for home, but their escort tarried in the air, seeking excitement. It was not long before they got it. At a height of 18,000 feet, Brown sighted a flight of seven enemy planes.

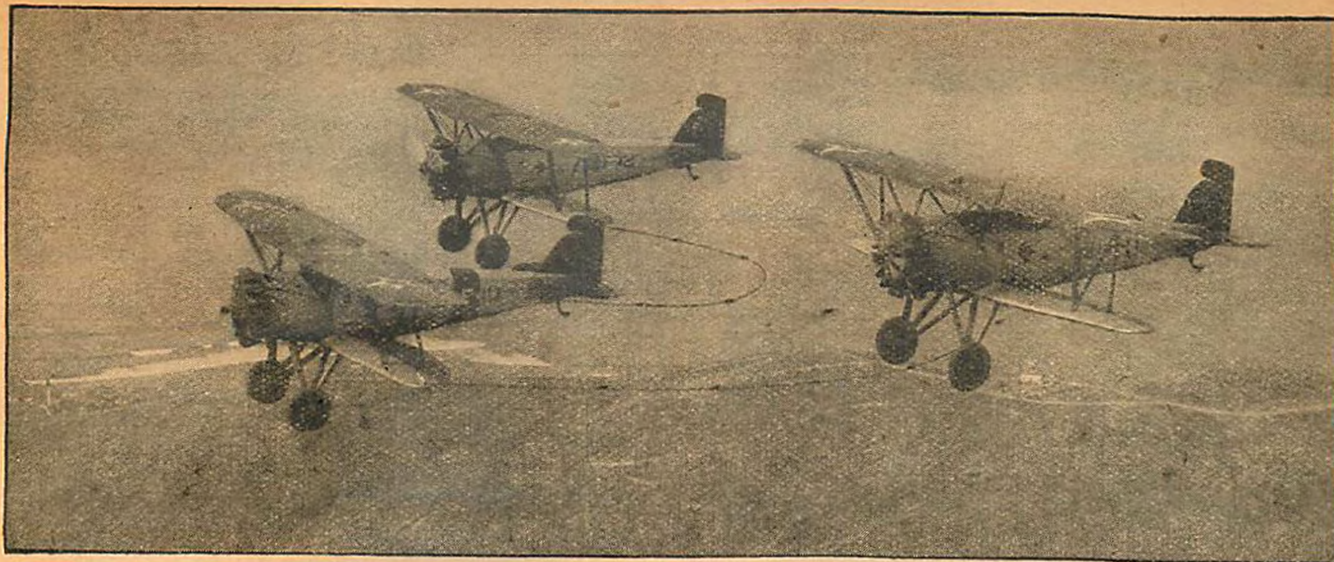
Although outnumbered, Brown signaled for his comrades to start their dive. As they drew nearer, each man among the British recognized by the distinctive markings of the enemy planes that they were about to attack the feared Flying Circus itself. Yet they did not withdraw. Brown himself, dropping like a plummet on the nearest Albatross, opened fire. To his surprise less than one hundred rounds sufficed to send the Hun that he had attacked, flaming to the ground. Anxious to confirm the crashing of his first prey Brown followed the burning ship almost to the ground. When he pulled out of the dive, the air was clear of ships. Almost reluctantly he turned the red nose of his Camel toward home; enough fighting for one day, the famous Flying Circus had been proven vulnerable. If the almost legendary killers themselves could be defeated, why not their leader, Richthofen?

Eight days of continuous rain fell from March 22 to March 29, during which no ship could fly. To the superior artillery of the Germans this condition was a blessing. Without the harassing presence of the British Air Forces, shells could be laid in the Allied territory with the precision and deadly effect of a rifle bullet from a sniper's gun. So at last to the airmen at Tateghem came the order to move, first to Bailleul, then within the hour a further retreat to Marie Clair Nord. To the pilots of the 209th Squadron this meant fifty hours of back straining, nerve destroying labor, loading equipment on huge lorries, taking down lines of communication, and dismantling apparatus that the Germans must never have. And when the rest of the work was done, a jolting trip over shell-torn roads back into Bailleul to climb into their waiting Camels and fly them to safety at Marie Clair Nord.

TO THE five men of Brown's flight who sat like figures of trembling clay at the controls of their planes it seemed no doubt that theirs was a hopeless task. Brown himself had stated that he had but little hope of finishing that flight alive. Sluggishly the little group of weary war birds climbed for altitude, hardly looking for the enemy craft that they knew were waiting to attack them. Five thousand feet, ten thousand feet; at twelve thousand the attack came. Five of the circus descended like bombs on the tired occupants of the red nosed Camels. One Albatross attacked Brown. Like a flash the Canadian flung himself into a dive, looped and zoomed up to find himself above his enemy and literally with "the upper hand."

As he was about to fling himself into the plunge that would send his attacker to the earth he felt his craft wobble under the impact of a second challenger's bullets. No time to dive, the bead was on him, and the tracer bullets were already ripping their way up the length of the fuselage toward his defenseless back. A frantic jerk on the stick, and Brown's nose went up. The Camel flipped in a perfect somersault and once again he was in a position for the kill—thirty yards behind and above his enemy's tail. Both his thumbs pressed long on the triggers of his two machine guns. Two hundred bullets seared into the cockpit of the Boche plane. It was enough. Brown's second victim of the war was dropping toward the earth, a fiery cross in the murky skies.

Once again Brown pulled himself from his following dive to find the air free of planes. At the airdrome, sad news awaited the commander of the little flight of red nosed Camels. All the pilots had (*Continued on page 40*)



Navy Boeing Fighters maneuvering while lashed together.
(Possible only when good engines and fuel are used.)

The Airplane Engine

Fuels, Their Composition and Effect

By-H.B. Miller, Lieut. (jg) U.S.N.

CHAPTER NO. 10

PROBABLY the most desirable quality of a fuel intended for use in the internal combustion engine is to have the maximum number of heat units for the minimum weight and volume. Particularly is this true in the case of the airplane powerplant where more energy per pound of fuel means that a larger payload may be carried. Nor must we overlook the volume of the fuel, for space in the airplane is at a premium at best. These conditions eliminate the possible use of a vaporous gas which might be carried in charged cylinders.

There are many other qualities which influence the selection of a proper fuel for the internal combustion engine. A certain degree of freedom from foreign matter is demanded. Especially is this true of impurities that might become corrosive upon contact with such metal parts as the fuel tank, fuel lines, and the carburetor. Sulphur and other compounds which may be converted into acids are particularly bad. Obviously, the fuel must be chemically stable, that is, it must maintain its proper composition under any conditions of temperature or pressure. Naturally, the fuel must be such that it is readily available throughout the territory in which its use may be expected.

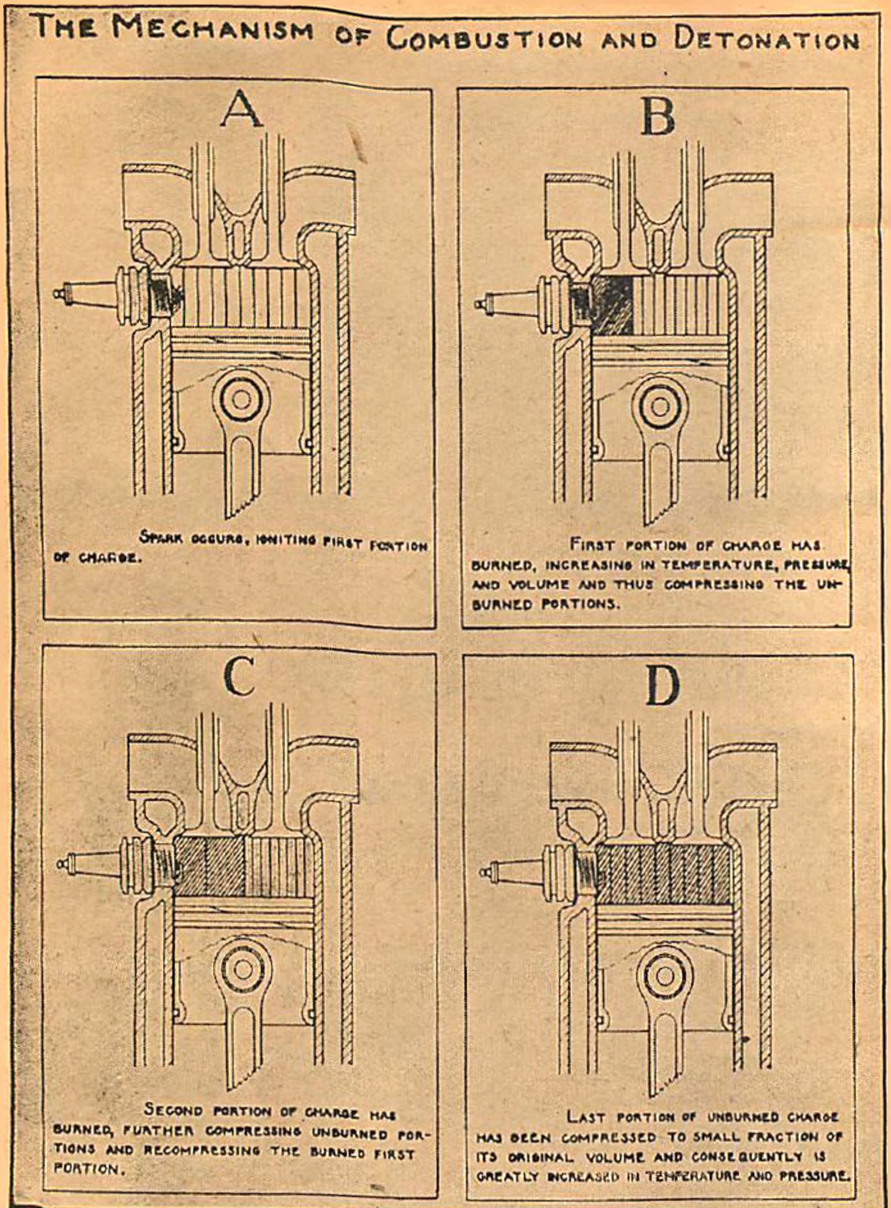
It happens that gasoline fulfills very closely the demands placed upon it by the airplane and automotive industries. It contains an unbelievable store of energy. For example, one gallon of gasoline has the equivalent energy of ninety-six pounds of dynamite! As a matter of fact this derivative of petroleum answers every demand made upon it except one. It will detonate or knock when used under high compression conditions. Even this disadvantage can be alleviated, providing, of course, the operator is willing to pay the additional cost of blending the fuel with some anti-knock substance.

Man is fortunate to have discovered the great pools of petroleum deep in the recesses of the earth. The energy stored within this black, viscous liquid has provided the human race with many of the necessities and with not a few of the luxuries of life. The heat of the sun appears to be responsible for the petroleum which we now enjoy. Originally this oil was in the form of trees or green growing matter that stored up energy due to the heat rays of the sun. Layer after layer of the vegetation decomposed — perhaps in a swamp. As layers of soil were swept over the matter the weight of the earth pressed the vegetation into closer contact. Possibly it took the form of coal and eventually it decomposed further into the oil we now know as petroleum.

First known in this country by the Indians it was collected off the surface of springs and used for medicine. Now it has become one of the most important industries in the world and its by-products are known wherever man lives. Since 1859, when the first well was sunk near Titusville, Pennsylvania, millions of barrels of oil have been raised out of the earth. The struggle is constantly going on. Geologists and field engineers are always on the move in the wildest jungles of the world in an effort to discover potential oil fields for the large companies. In some parts of California successful wells have actually been sunk in the sea. Others are drilled in the swamps of Venezuela.

WE HAVE seen that gasoline was at one time a useless by-product necessarily produced in the manufacture of kerosene. The heavier oil only was desired, for the lighter derivatives, such as gasoline, were so volatile that they readily formed explosive mixtures upon contact with air. Kerosene, however, being heavier, did not vaporize so readily and could be used safely in lamps for illuminating purposes.

As the novelty of the automobile wore off at the beginning of the Twentieth Century, cars gradually became a necessity. This provided a steady market for gasoline, the by-product which had formerly been wasted. Instead of the car owner purchasing his fuel in the drugstore, as he first had been forced to do, livery stables began to carry a supply for the motorist. The demand for gasoline, of course, was proportional to the number of cars in use throughout the country. The continued increase of auto-



(Courtesy of the Ethyl Corporation.)
The Mechanism of Detonation.

mobiles in the world has placed a progressive demand for more fuel. Fortunately, more and more oil fields are being discovered and we frequently find that a state of over-production exists. Also, the methods of extracting gasoline have improved and greater percentages of the lighter oil are now obtained from the crude oil.

VARIOUS estimates have been made as to the amount of petroleum remaining in the earth. It would appear, however, that with reasonable conservation the United States has available many years' supply of crude oil. If, however, our supply should become exhausted, we still will be able to secure suitable fuel of some sort. For example, some of the western states such as Nevada and Utah have millions of tons of shale.

When crushed and heated this rock will give off vapor which can be condensed. The resulting liquid will approximate petroleum gasoline in nearly all respects. This particular process has never been developed commercially because it is unable to compete with the producing cost of gasoline, but nevertheless, it remains as a source of fuel for future generations.

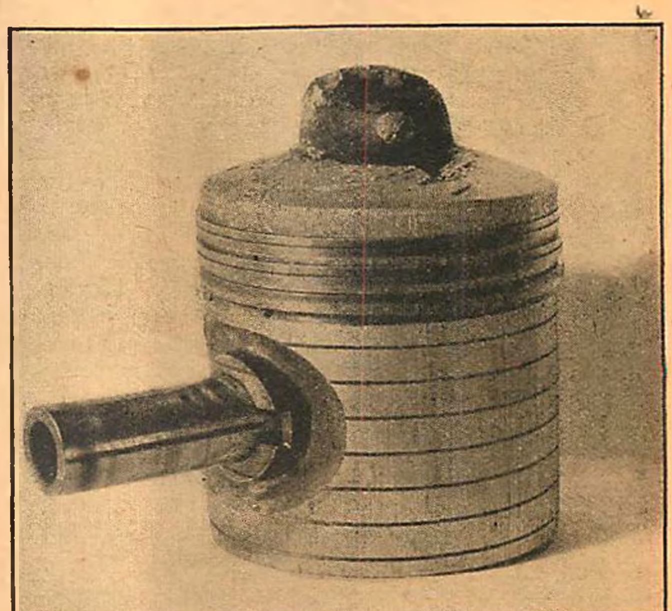
Another ready source of internal combustion engine fuel lies in the huge bituminous coal deposits which exist in the United States. Destructive distillation of this coal results in a great number of by-products, one of which is benzol formerly known as benzene. This hydrocarbon forms a very useful fuel and has a high anti-knock rating. It contains practically as much heat as gasoline and since it does not detonate, more useful energy can be extracted from it. However, it is more expensive than gasoline and is apt to contain undesirable impurities such as sulphur.

It has one decided disadvantage in that it has a high freeze point, approximately 40 degrees F., and for this reason cannot be used in cold weather nor in high altitudes. It is used for the most part as a blend to lend anti-knock qualities to gasoline, but it is to be noted that the atmospheric temperature must be carefully taken into consideration when using this fuel. The blend consists of from thirty to fifty percent benzol depending upon the compression.

The remaining source of fuel is one that will always be present on earth. By distilling the fermentations of vegetation ethyl alcohol is obtained. Wood or methyl alcohol results from condensing the vapors given off by heating wood. While both are poisons, they can and are used as fuels under certain conditions. Like benzol the alcohols offer many good points, though they also have some disadvantages.

While alcohol has an extremely high anti-knock characteristic it is low in heat units. Gasoline has about 21,000 B. T. U.'s per pound, whereas alcohol has but from 9,000 to 13,000. On the other hand, because of the fact that alcohols do not detonate they can be compressed further resulting in increased efficiency.

However, alcohol is hydroscopic. That is, it will absorb moisture from the atmosphere. Water in the fuel of an airplane would have disastrous results and can not be tolerated. Alcohol is often used as a blend to lend anti-knock qualities to fuel used for special purposes, such as racing. In case of national


Piston, which has swallowed a valve which "stuck" due to use of gummy gasoline.

emergency or a shortage of petroleum, alcohol could be used quite successfully in some types of engines as it is now used in Germany.

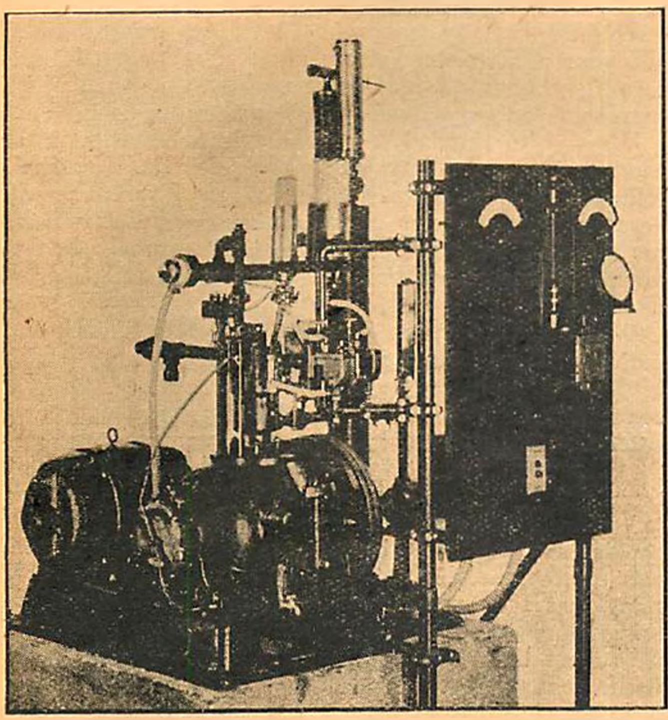
PETROLEUM is a complex compound consisting of many different hydrocarbons. Each of the different constituents have a *different* molecular weight which gives them varying boiling points. Advantage is taken of this to separate the liquids by the process of fractional distillation. If heat is applied to any liquid, the molecules will increase their activity. Eventually they will reach such a state of agitation that they will jump from the surface of the liquid and form a vapor.

The liquid is then *said* to be boiling. Fractional distillation is nothing more than this. As heat is applied to crude oil the lighter molecules will be released from the surface first. As more heat is applied to the petroleum another group of molecules or another class of oil will pass off as a vapor. Thus it is seen that the distillation of the various products of petroleum is controlled by their respective boiling points and it is only necessary to collect the several vapors in separate condensers.

The first group of vapors to be driven off of the raw crude oil is called petroleum ether. It consists of several of the extremely light hydrocarbons, several of which are eventually lost to the atmosphere because of their low boiling point. In this group, however, is the liquid, known as gasoline. It consists of varying proportions of hextane, heptane, and octane, depending upon the characteristics of the original crude oil.

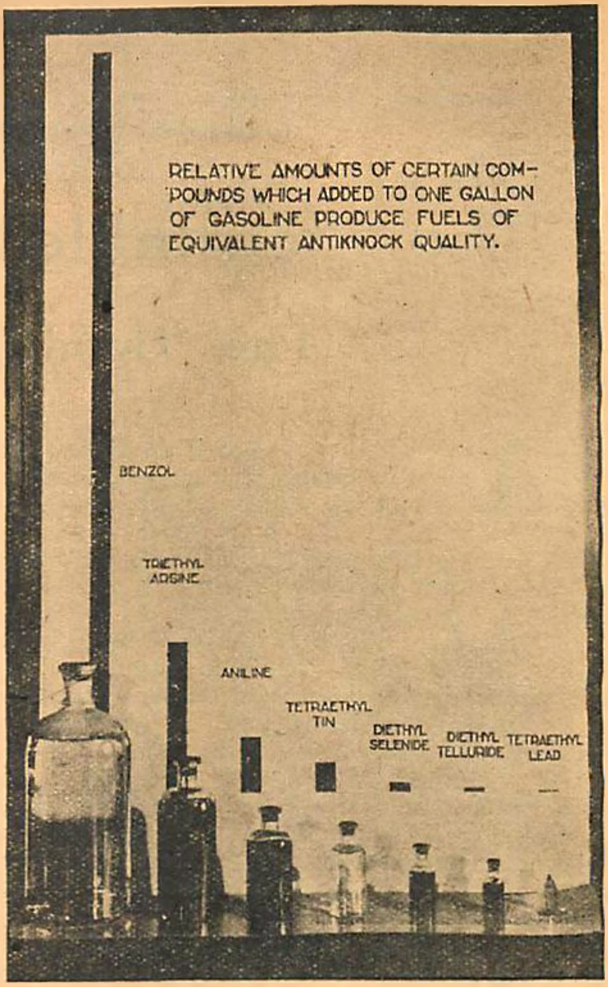
The next liquid to pass off as a vapor is benzine, sometimes called naphtha. Following this in order are kerosene and lubricating oil. The residue is used for many purposes depending upon the type of crude used. Practically all Eastern crudes, notably those of Pennsylvania, have a basic foundation of paraffin, while those of California and some parts of Texas have an asphalt base.

Because of the presence of more aromatic hydrocarbons the gasoline obtained from the western or asphaltic crudes has a better anti-knock value than those refined from the eastern oils. The petroleum from the mid-continental fields of Oklahoma and Kansas will tend to have characteristics of both paraffin and asphalt base crudes.



(*Courtesy of the Ethyl Corporation.*)

Knock Testing Engine.



(*Courtesy of the Ethyl Corporation.*)

Approximately twenty-five percent of the volume of the original crude oil will pass off as gasoline. While this is an appreciable amount, still it is insufficient to supply the tremendous demand for automotive fuel throughout the country. It is essential that more crude be refined or that methods be devised for recovering a larger volume of gasoline. Fortunately, this has been done and the process is called the "cracking method."

WE HAVE seen that the fundamental difference between the various hydrocarbons which make up the crude oil is in their molecular weight. If the larger molecules of the heavier oils which remain after the gasoline has been refined off can be broken down into smaller molecules, they will have characteristics similar to those of the lighter and more volatile oils. Therefore, after the gasoline is distilled off the remaining crude is heated up to 725 degrees F. and placed under a pressure of about seventy-five pounds. This treatment will break down the large molecules chemically and they can then be distilled off as "cracked" gasoline.

These gasolines are generally unsaturated, that is, lack the proper number of hydrogen units and for this reason are more likely to deposit a gummy substance within the combustion chamber of an engine. In addition, they will also contribute to a rapid formation of carbon. Both of these features will tend towards improper valve operation. For this reason "cracked gasolines" are generally blended with naturally refined fuel. Early fuel of this type had a tendency to give off an obnoxious odor but this unpleasantness is being overcome. Cracked gasoline appears to have a better anti-knock value than normal fuel.

By using this method as (*Continued on page* 44)

Here Are the Winners

of

The "Scrambled Picture" Contest

The "Good News" At Last!

AT LAST the winners have been chosen, after much deliberation and mopping of brows. Some of you, I suppose, have been on pins and needles to learn whether or not you have been the lucky one on this great occasion. It has been more difficult than the Manchurian question to decide but we trust greater satisfaction will result than has been produced by this Far East problem. There will be at least three happy young men out of the multitude that submitted answers; and what a time we have had to decide who the three should be. Our estimation of the knowledge of the young men of America regarding aeronautical problems has risen tremendously. Mr. Jones, Mr. Hersey and I wish to congratulate the winners and the near-winners for their remarkable demonstration of aviation intelligence. Many were so excellent that it was very difficult to choose between them, and our regret is that we cannot offer three times as many prizes as we intend to give.

Well, let us get down to business as we don't wish to draw this out too long and keep you in suspense, for the strain is very difficult to withstand, I know.

First Prize To—

For winning the first prize, we wish to congratulate Mr. James E. Morgan of No. 12 N. Seminole Drive, Chattanooga, Tenn. "James, your entry showed remarkable patience and knowledge. It was extremely neat, well set up, and the information that was given was accurate. We should say that you show great promise in the engineering field in general, and aviation in particular. We will watch your progress in aviation with interest. As you know, the first prize is a ten-hour flying course. In order that we may be able to give you particulars regarding where you will take this course and when, we request that you write us immediately so that arrangements may be made that will be convenient both to you and to us."

Second Prize To—

The second prize is a complete ground course. This includes the study of many of the sciences relative to aviation and the servicing and upkeep of a plane. We call this a ground course because it does not include flying. However, it is not only a ground course in this sense but also in the sense that it gives a complete ground work of aviation knowledge. We wish to congratulate Mr. Nels H. Manson, of Sioux Falls, South Dakota, in winning this second prize. "Your entry, Nels, was very excellent. We wish to commend you particularly upon the accuracy of the information which you gave. It is significant of close observation and study. Write to us as soon as possible so that we may make the necessary arrangements for you to take your course. If you have any suggestions as to what you prefer to do or where you wish to take this course, let us know."

Third Prize To—

The third prize, a two hundred mile flying trip with the famous flyer, "Casey" Jones has been won by Mr. James Emmi, 628 North Street, Rochester, New York. "James, your entry was on a par with the winners of the first two prizes." In fact, there is very little difference between these three young men which, as you may understand, has made it a difficult task to choose the winners. "In your case, James, it was necessary for us to consider very small errors in trying to make a fair decision. For instance, the Curtiss King Bird is powered with two 240 h.p. Wright engines. There were many of the contestants who failed to distinguish these engines accurately from the 300 h.p. type. Will you please write to us, James, as we have requested the other two prize winners to do? You will probably have some choice as to where and when you wish to take your ride. Let us know what arrangements would be convenient for you."

THOUGH we have only offered three prizes, we wish to give special mention to Fred Sparrow, Jr., 72 Beckwith Street, New London, Conn., who was scheduled for second place early in the contest but who was nosed out toward the end by one of the later entries. "Fred, you were given fourth place."

We also give honorable mention to Joseph E. P. Battaglia, 1059—2nd Avenue, New York, N. Y., who was given fifth place. "Joseph, you showed great artistic ability and your pictures were neatly put together. Certain mistakes, however, occurred in the information given, which prevented you from receiving a higher rating."

We wish to especially commend Joseph Friedland of 23 Morrell Street, Brooklyn, New York, for the remarkable folder which he entered. "Joseph, your work was extremely neat and accurate from an artistic standpoint. It was by far the most beautiful of the folders submitted. Several mistakes in the information given, however, detracted from its value."

Will the three young men who won fourth, fifth and sixth places communicate with Mr. Grant, the new editor of Model Airplane News, as soon as possible? If it is convenient for any one of the prize winners and these latter three who received honorable mention, to come into the office in person, we will take great pleasure in meeting them.

I suppose there are going to be a great many of disappointed young men throughout the country who entered this contest and did not win a prize. This is the only thing that I do not like about contests of this sort. It bring happiness to a few, but sorrow to many. After all, we cannot be the winner in every game we play. Life, itself, is nothing but a game in which there are many different fields that we may (*Continued on page* 47)

The Aerodynamic Design of The Model Plane

By Charles Hampson Grant

This is the second of a series of articles by a practical designer; a lifetime of experience is put at your service. Here you will find answers to many of the puzzling problems that have mystified the model builders.

THE installment of this course in last month's issue ended with an explanation of the effect of the amount of camber, on the lifting qualities of a curved wing. Let us now investigate our problem further and determine how the lifting effect of the air on the wing changes when the wing passes through the air at different angles of attack. This is a very important point:

Proper Angle of Attack

As we have stated, the angle of attack is the angle at which the wing strikes the flow of air, or angle that the "chord line," which passes through the leading and trailing wing edges, makes to the line of flight. This is shown in Diagram No. 6.

If the line of thrust, which is a line parallel to the propeller shaft and passing through its center, is parallel to the line of flight, then the angle of attack is also the angle of incidence. In other words, the angle of incidence is the angle between the chord line of the wing and the line of thrust.

A wing usually starts to lift at a negative angle of about four degrees. The amount of this negative angle depends upon the type and curve of the wing section. The lift increases steadily as the angle of attack increases, until about an angle of fifteen degrees is reached, at which point it starts to grow less very sharply. This point is called the "burble" or stalling point. At about plus four degrees, the wing is the most efficient, giving the most lift in comparison to the resistance incurred. (Fig. No. 10.)

In the form of a rule, we may say that the lift on a wing increases in proportion with, the angle of attack in degrees, plus four degrees. This quantity of four degrees which is added, takes into account the fact that the wing starts to have a lifting effect at about minus four degrees.

As an example, if the wing is flying at (+2) degrees and we wish to double the lift by increasing the angle of attack, then we would have to double the *effective* lifting angle which is (2°—+4°)=6°. The effective lifting angle of the second wing should then be (12°). As this includes four minus degrees, we must subtract them from this (12°), in order to determine the positive angle of attack. We have then (12°—4°)= + 8°. Eight degrees is therefore the angle at which the lift of the wing would be twice as much, as if the angle of attack was (+2°).

The machine, when in normal flight, should be flying in a direction parallel to the line of thrust, so the wing should be given an angle of incidence (same as angle of attack under these conditions) at which it will be most efficient, or an angle slightly less, so that when the plane climbs and the angle of attack thereby increases, the wing then will be passing through the air at the most efficient flying angle.

This, in most wings as we have just shown, is approximately three to four degrees, so if we give our wing an angle of incidence of two to three degrees, it will give the best results.

To do this, the front edge of the wing should be *raised 1/16 inch for every degree* that you want, for every *four inches* of wing chord. Thus, if our wing chord is four

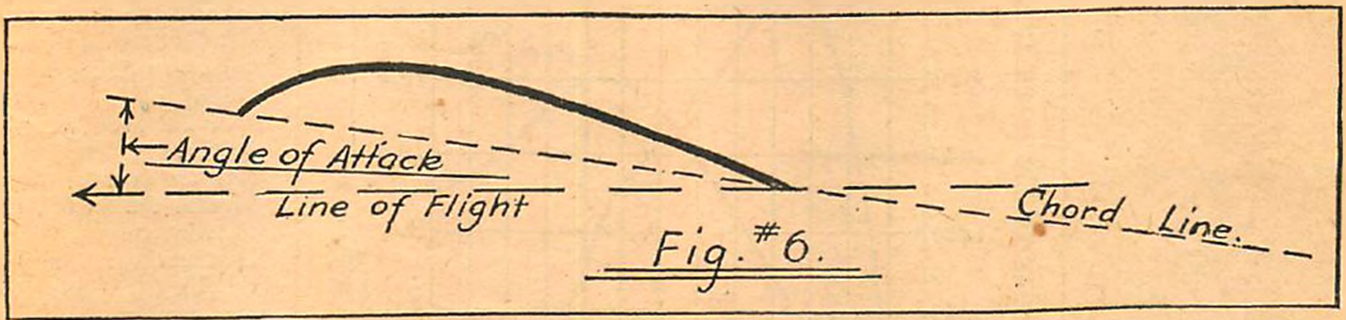


Fig. #6.

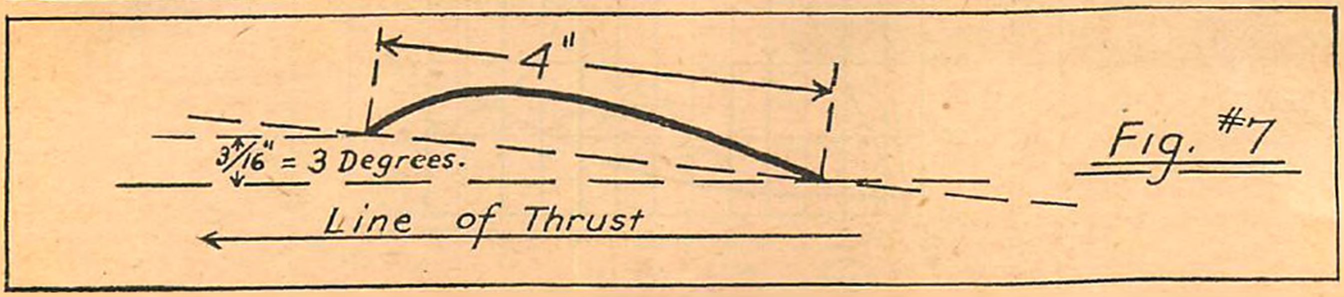


Fig. #7

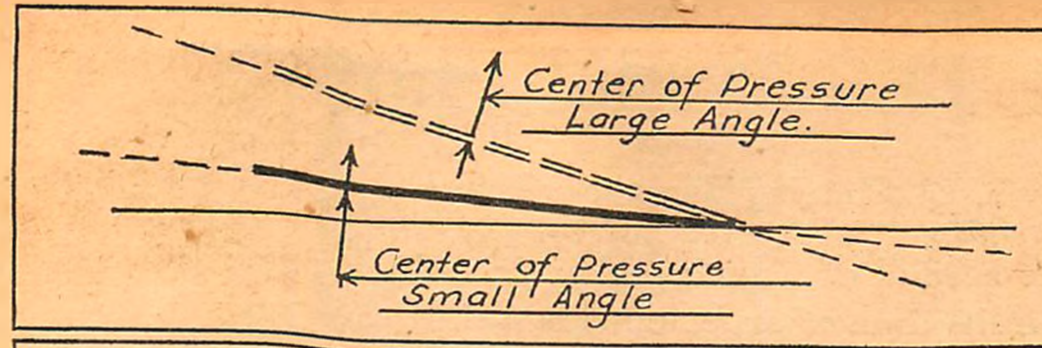


Fig. #8.

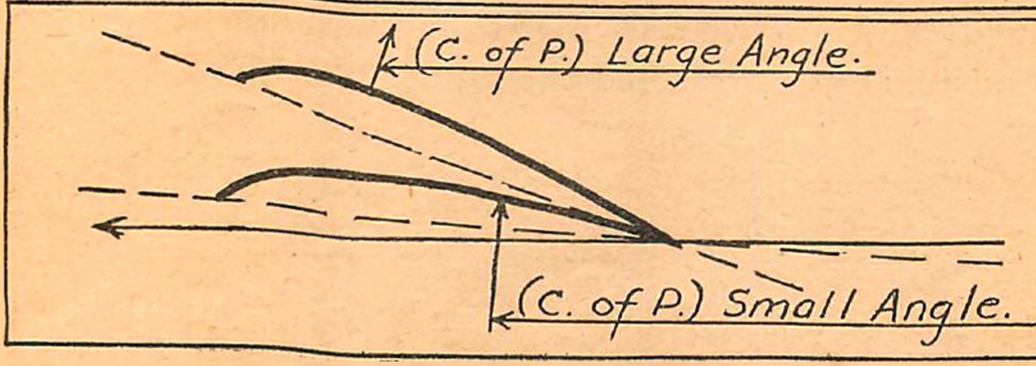


Fig. #9.

inches and we wish to give our wing an angle of incidence of three degrees we would raise the front edge 3/16 inches above a line drawn parallel to the line of thrust, through the trailing edge of the wing, as in Fig. No. 7.

Center of Pressure

WE WILL also need to know what the "center of pressure" is, and how it moves about.

If we could take all the small pressures of every air particle over the entire wing, and concentrate them at one point so they would give the same effect as if they were spread out, then the point at which this force, equal to the sum of all the small pressures, would act, is the center of pressure. In the case of a flat wing, this pressure acts at a point (A) near the front edge, at small angles of attack, and if the angle is increased, it moves *back* toward the center of the wing into position (B), Fig. No. 8.

It can be seen that this condition tends to push up the *low* or rear edge of the wing, as the angle of attack increases, and causes it to *right* itself. It is a stable condition. However, in the case of the curved wing, the (C. P.) acts directly the opposite. (Fig. No. 9).

This causes the curved wing to be unstable and to nose up sharply when once the front edge rises up slightly while in flight. We use the horizontal tail plane, or stabilizer, to overcome this unstable tendency of the wing. This will be explained later under "stability."

Speed

In examining all the factors which effect the lift of a wing, we must not forget the most important one, "speed," or velocity. It is obvious that the *more* air particles that are displaced or deflected by the wing at any given angle of attack, the greater the "*lift*" will be. Also the *harder* each particle strikes the wing, the greater the lift will be. This is just what happens when the speed of the wing increases. If we have a wing that lifts (2) ounces at five miles per hour and we double the wing velocity, what happens? At (10) miles per hour, twice as many particles are striking the wing per minute, thus generating twice the lifting effect because of this fact. Also these particles strike the wing *twice as hard*, which fact again causes the lift to double. So instead of the lift of (2) ounces, generated at (5) miles per hour, we have (2) ounces x 2 x 2, or 8 ounces of lift, at (10) miles per hour. In other words we can say that the lift is proportional to the velocity squared; or, $L=K\,V^2$.

Where L=Lift, V=velocity, and K=(A Constant) which need not be known to show proportional values.

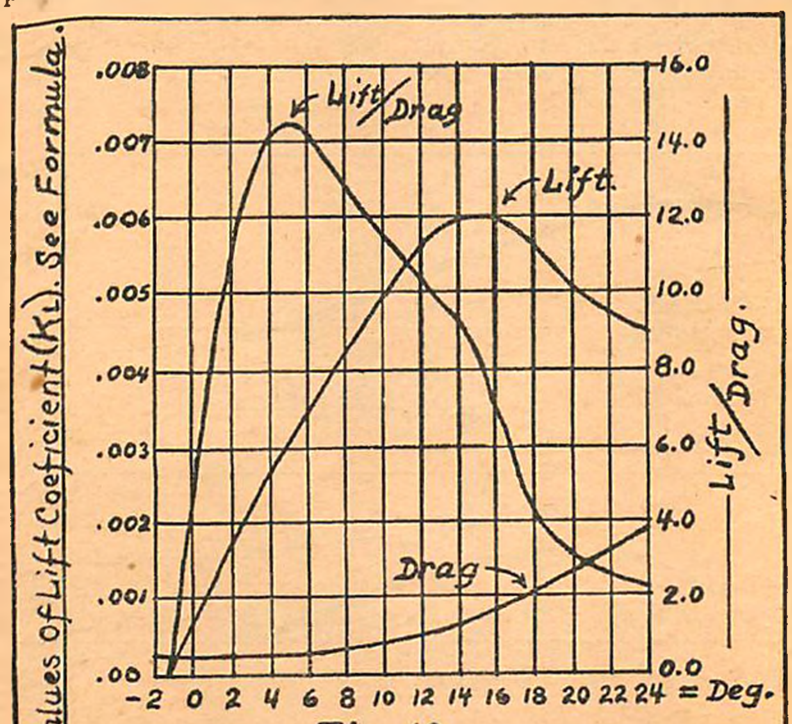


Fig. 10.

So far we have determined the following facts:

1. The greater the wing area, the greater the lift.

2. The "lift" is proportional to the camber, or fineness ratio. This is the height of the wing curve divided by the chord. If the chord is (4) inches and the camber is (½) inch, then the fineness ratio is (⅛).

3. The "lift" is proportional to the square of the speed of the wing through the air.

Taking these points into account we can write a formula for the lift on a wing, for the benefit of our readers who may be technically inclined, as follows:

$$L = K\ C\ A\ (V)^2$$

Where L=Lift in ounces, C=the heighth of camber relative to the chord.

A=the area of the wing in square inches, and V=the speed or velocity in miles per hour. (K) is a constant whose value depends upon the shape of the wing section, the *angle of attack*—and the density of the air. However, for practical purposes, a value of (0.002) may be given to K. This value of, K=0.002, will give approximate results for single surface wings, at a (3) degree angle of attack. The formula may be written, $L = (0.002)\ C\ A\ V^2$.

If we wish a formula that will be correct for double surface wings as well as single surface ones, we should substitute $\frac{(3C^U + C^B)}{4}$ for (C), in the formula, which then will be—

$L = (0.002)\ \frac{(3C^U + C^B)}{4}\ A\ V^2$. (When the angle of attack equals (3) degrees.)

C^U=The camber of the upper aerofoil surface relative to the chord. (Fineness ratio).

C^B=The fineness ratio of the under or bottom aerofoil surface.

If we wish our formula to take into account changes in the angle of attack, it must be multiplied by the quantity, $\frac{(4+I)}{6}$, where (I)= the angle of attack or "*Angle of Incidence.*" (The angle of the wing chord to the line of thrust.)

The formula now may be written,

$$L = (0.002)\ \frac{(3C^U + C^B)}{4}\ A.\ V^2.\ \frac{(4+I)}{6}$$

This formula will give only approximate values for the lift, but will be correct enough for practical purposes.

Below is a table which gives the amount of lift per square foot of wing area, in ounces, for various camber chord ratios, at the speeds indicated. These figures are for an angle of attack of (3) degrees.

For Single Surface Wings Only

Miles Per Hour	Lift. (Camber =1/15)	Lift. (Camber =1/12)	Lift. (Camber =1/10)	Lift. (Camber =1/8)
3	.173 oz.	.213 oz.	.26 oz.	.327 oz.
6	.69 oz.	.852 oz.	1.04 oz.	1.31 oz.
12	2.77 oz.	3.41 oz.	4.16 oz.	5.23 oz.

Multiply above values by (¾), to get correct values for Double Surface Wings.

Fig. No. 10 shows, by means of graphs, how the Lift, Drag and the Lift-Drag (Efficiency) ratio of a wing changes with the angle of attack. Considering the lift-drag curve, we see that in this particular case the efficiency increases, from (-2) degrees, up to about five degrees, at which point the curve is the highest. Then as the angle of attack becomes larger, the efficiency gradually grows less.

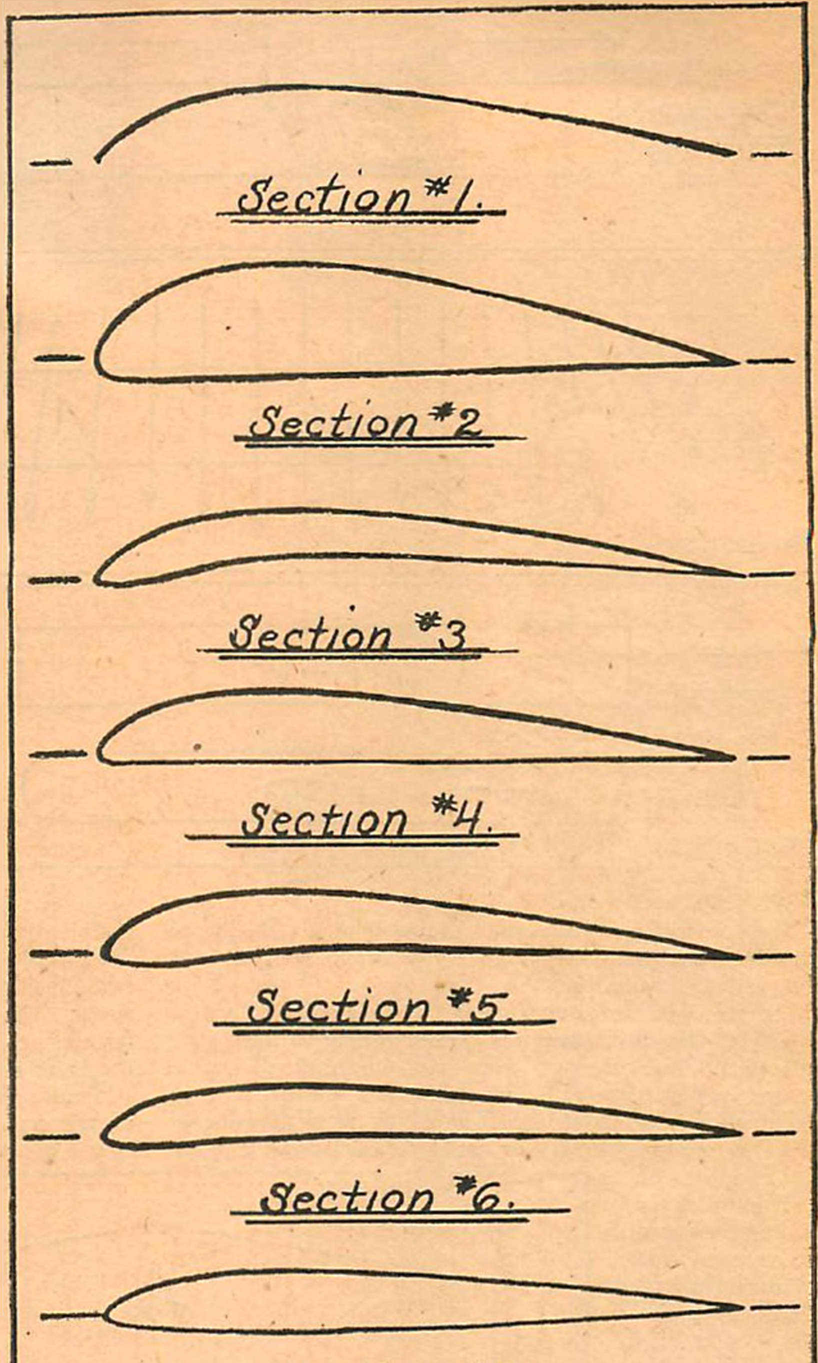


Fig. #11.

The lift curve shows that lift increases uniformly, or nearly so, as the angle of incidence increases, up to about fifteen degrees. Beyond this point the lift drops away rather sharply. The curves shown do not illustrate any one particular wing but are typical for a double surface wing with a flat lower camber and an upper camber of about 1/12 the chord.

A diagram of curves for a single surface wing with a camber of 1/12 the chord, would show the lift and L/D curve starting the rise from a point at (—4) degrees instead of (—2) degrees.

The lift and efficiency would increase at about the same rate but would not reach as high a maximum degree, as in the curves shown. Fig. No. 10.

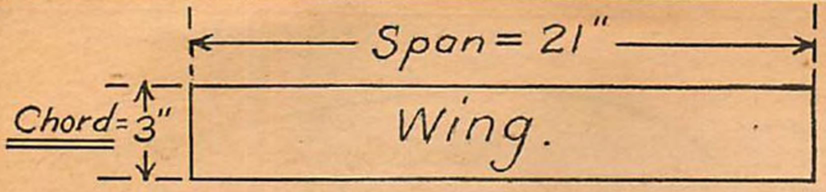


Fig. #12.

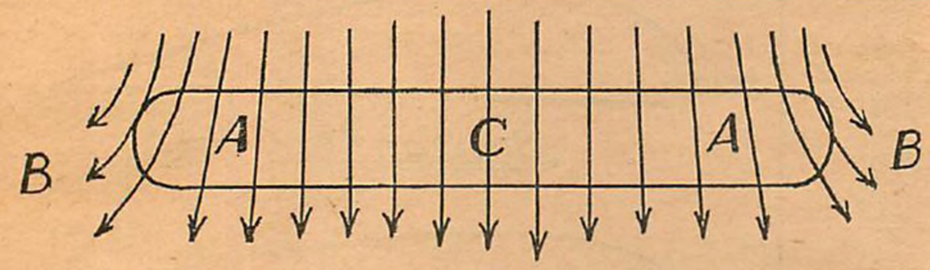


Fig. #13

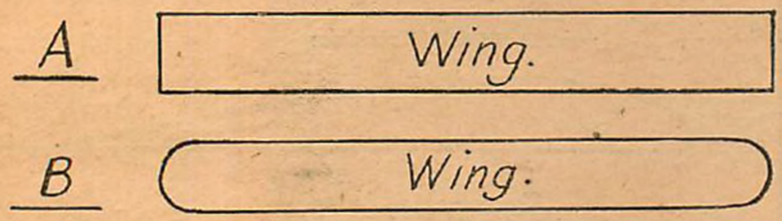


Fig. #14.

The value of the coefficients shown on the left side of the table corresponds with values you should substitute for (K) in the "Lift" formula.

The value used in our formula as an average condition is (.002). The horizontal line corresponding to this figure cuts the "Lift" curve at about (3°) if you will notice. This means that at (3°) angle of attack, the lift may be calculated by means of the formula by using a value of (.0035) in place of (K) in order to calculate the value of the lift at this angle of attack.

Now suppose we summarize the several factors that effect the performance, and therefore the design of the cross section of our wing. This cross section we call an aerofoil. We will see then how we may use this knowledge to design an aerofoil for our model plane wing, that will give us the type of performance we desire.

First the position of the highest point of the upper surface curve effects the efficiency of the wing. It should be from 30% to 35% of the chord from the leading edge.

Second, the heighth of the upper and lower surface cambers effect the lifting capacity of the wing at any given speed. The higher the camber, the slower the wing may fly and yet lift a given load. Also the higher the camber, the greater the lift on the wing at a given speed.

Third, the shape of the aerofoil effects the movement of the center of pressure, and consequently the stability of the model.

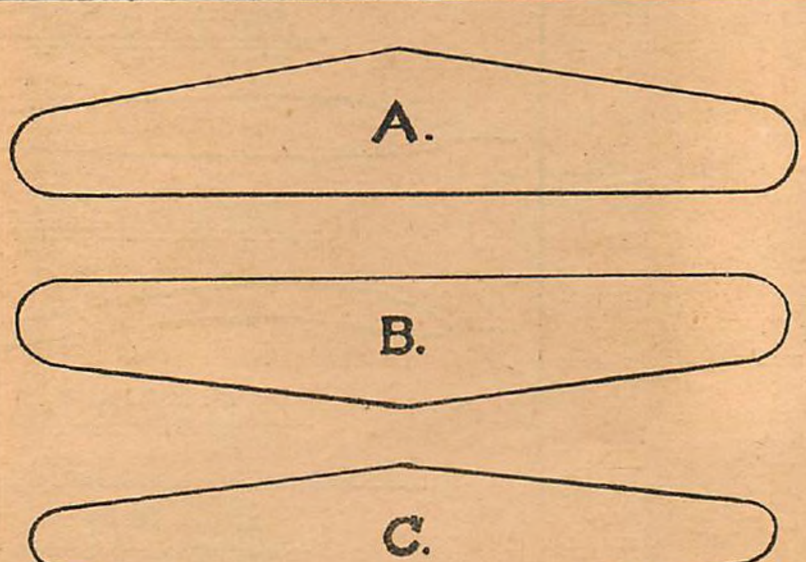


Fig #15

Now suppose we examine curve No. 1, Fig. No. 11. This is a section of a single surface wing. The lower curve is approximately the same as the curve of the upper wing surface. The heighth of the two cambers is comparatively high. This is a section, therefore of a high lift or slow flying wing, as are also sections No. 2 and No. 3. Section No. 2, however derives most of its lift from the fact that the upper camber is high. The lower surface being practically flat, gener-

(*Continued on page 43*)

A FLYING SCALE MODEL OF THE S. E. 5.

A One Ounce Model with Remarkable Flight Characteristics

By HOWARD McENTEE

THE history of the S. E. 5 is fairly well known, but not as widely known as that of the famous SPAD and others. The reason probably is that it was a late development in the World War.

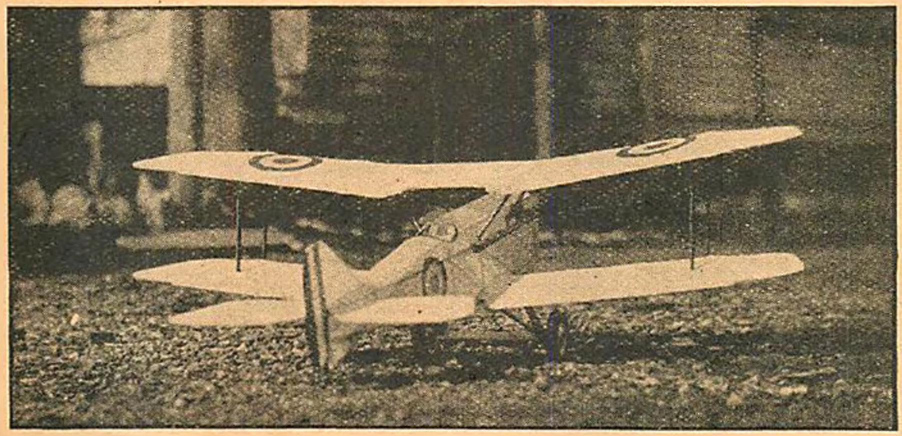
The letters "S. E. 5" mean Sopwith Experimental No. 5. The motor was an Hispano Suiza of 200 H. P. The top speed was over 120 M. P. H., and the climb was exceptional. It was one of the smallest ships used by the Allies, having a wing spread of only a little over 26 feet.

The machine was seldom camouflaged, usually being finished entirely in aluminum. Colored this way or left in white with the proper circles and stripes, it makes a beautiful model.

Incidentally, these fine ships have been used extensively in many parts of the world since the war as sky writers. This strenuous work was an easy matter for the agile S. E. 5.

The model to be described is an exact scale copy, no concessions whatsoever being made, except, of course, for a model size propeller. The S. E. 5 makes an excellent subject for model work due to the long tail, the dihedral, and the simple construction possible. It is also well balanced for flight.

The Completed Model which is difficult to distinguish from a Real Ship.



Good Looks? Yes, and better yet, Excellent Flights.

Most of the balsa used is of the medium variety. Reed is used for tail surface because it permits easy adjustment of performance, and is, besides, very easy to form. The wings are adjustable by a method described in the construction section. This scheme of adjustment makes it easy to counteract propeller torque and control performance of the model.

Now let's begin construction.

NOTE: Construction Drawings are full scale

Fuselage

Secure a flat board and lay out on it the top and bottom longerons from the side view, Figure I, with all connecting uprights and diagonals. Put the 1/16 inch square longerons in place, holding them with pins, and then cut the uprights and glue them in as you go along. Use pins plentifully, but do not put them through any of the wood—only along the sides. Put the three diagonals in last. Make two of these sides exactly the same. Allow three quarters of an hour for the glue to dry, as the sides will spring out of shape if not absolutely dry. This work may be done directly on the board; a razor blade will easily loosen it.

The sides are then set upright and formers 1, 2, 3, and 4 glued in place, together with the corresponding lower cross pieces, making sure the sides are at right angles. The extra lower cross pieces A and B shown on the top view, Figure III, must not be omitted as they take the strains when a lower wing strikes an object in flight.

After the glue has set, the rest of the formers are put in place, one at a time, starting with No. 5 and going back, each with its lower cross piece. All formers are 1/32 inch balsa.

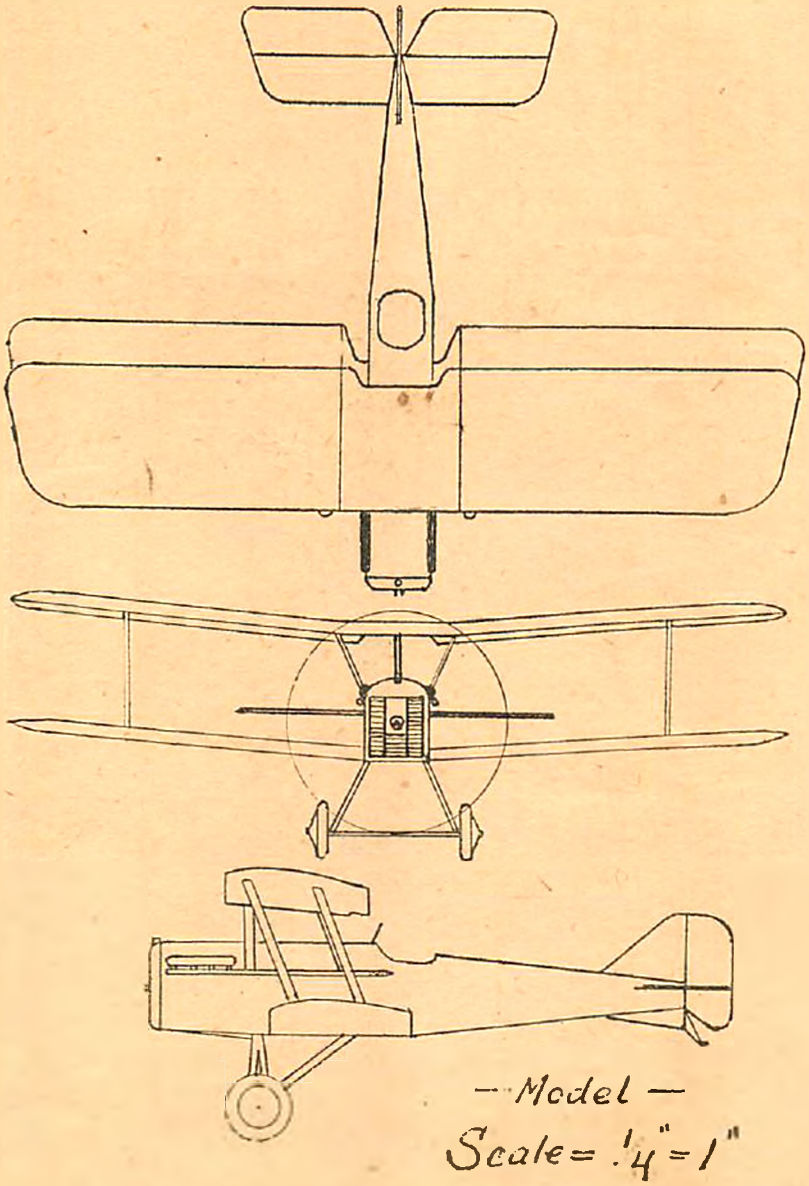
THE radiator can now be cut to size, and glued in place after the hole has been made. The cockpit is outlined with 1/16 inch reed. The stringers are made of 1/16 inch soft balsa and glued in. They are not all shown in the drawings as it would be confusing. Four are needed in front and three in the rear. The short ones from the radiator to No. 8 former should not be forgotten. Do not put in the rudder upright yet.

The front motor clip of .032 music wire is made as shown in full size sketch in Figure I, and glued on back of radiator.

Landing Gear

THE landing gear struts are all of 1/16 inch flat and fairly hard balsa. The edges should be nicely rounded off, but do not cut off too much or they will be weakened. The double front struts are made in one piece, 1½ inches long. They are glued to the bottom of the lower longerons, each being held with a single pin. When the glue is set, the rear struts are similarly put in place. The cross piece is sanded to a streamline or airfoil shape and glued to the bottom of the struts. If this work is done while the glue is set but still plastic, the landing gear may be trued up properly, then held with weights until it is fully dry.

The tailskid and rudder upright are made all in one piece from bamboo, but should be laid aside until the horizontal tail surfaces are in position. The axles are made from .032 music wire. The detail is shown in Figure IV. The single loop gives them more spring to help on bad landings. It is made by bending the wire once around a ⅛ inch nail, held in a vise. The axles are glued and bound to the bottom of the spreader. The wheels are 1¼ inch in diameter and may be of balsa or celluloid They are held by bending the axle end back.



Tail Surfaces

As stated in the introduction, these are made with a reed outline, which is bent as follows: place the magazine page on the flat board—it need not be detached. Lay a sheet of wax paper over it, then outline the inside of all curves with pins, spaced about 3/16 inch apart. None are needed on the straight parts. Soak the reed in hot water for about fifteen minutes, then remove and wipe off excess moisture. Start with one end near the rudder post or upright and run it around the outside of the pins until the other end is again at the rudder post. The reed will bulge out between curves, and more pins should be placed in these places to hold it in the proper shape. These must be put in as you progress around the outline; do not wait until afterwards. If the reed tends to bend upward, two pins crossed over will cure the tendency. Follow this method in making the outline of the rudder.

When the horizontal tail reed is thoroughly dry, the inside bamboo cross pieces are put in, leaving the reed pinned just as it was. The long bamboo spar is 1/16" x 1/32". The ribs are 1/32" x 1/64" bamboo. The reed is cut half through in the center where it crosses the long bamboo spar, so that it will not be so far out of line. When dry, the pins are taken out and the horizontal tail is removed and glued to the underside of the top longerons, making sure it is trued up all ways. Small weights will hold it until the glue dries.

Now the combined rudder post and tailskid is glued in place and the rudder outline glued on. The lower fin outline piece of 1/32 inch square bamboo, and the long tailskid piece may be put in place now. Do not glue the latter at the lower end, only the upper. After the rudder outline has dried, the two ribs of bamboo, 1/32" square, are put in.

The .032 wire pin to hold the motor stick, shown in Figure I, is glued in place. A few turns of thread will hold it while the glue sets. This method of holding the stick is better than a clip, because it allows the rubber to twist the stick and no strain whatsoever is put on the body.

Motor Stick

The motor stick is of medium balsa, 11" x 3/16" x ⅛". The rear hook is fastened by thread and glue to one end. The small pin hole is made in the rear of this same end. The propeller hanger is of 1/16" thick aluminum, ⅛" x ¾" before bending. The hole is punched or drilled ⅛" from one end, and the piece is bent 5/16" from the same end. Any ready made hanger of similar dimension will be equally satisfactory. The hanger is bound and glued to the top of the motor stick. Be sure that the stick fits into the fuselage correctly before proceeding.

Propeller

The propeller is made from a block 5½" x ½" x ⅞". Before carving, it is cut to shape as shown on the figure. When the blades are cut, they (Continued on page 42)

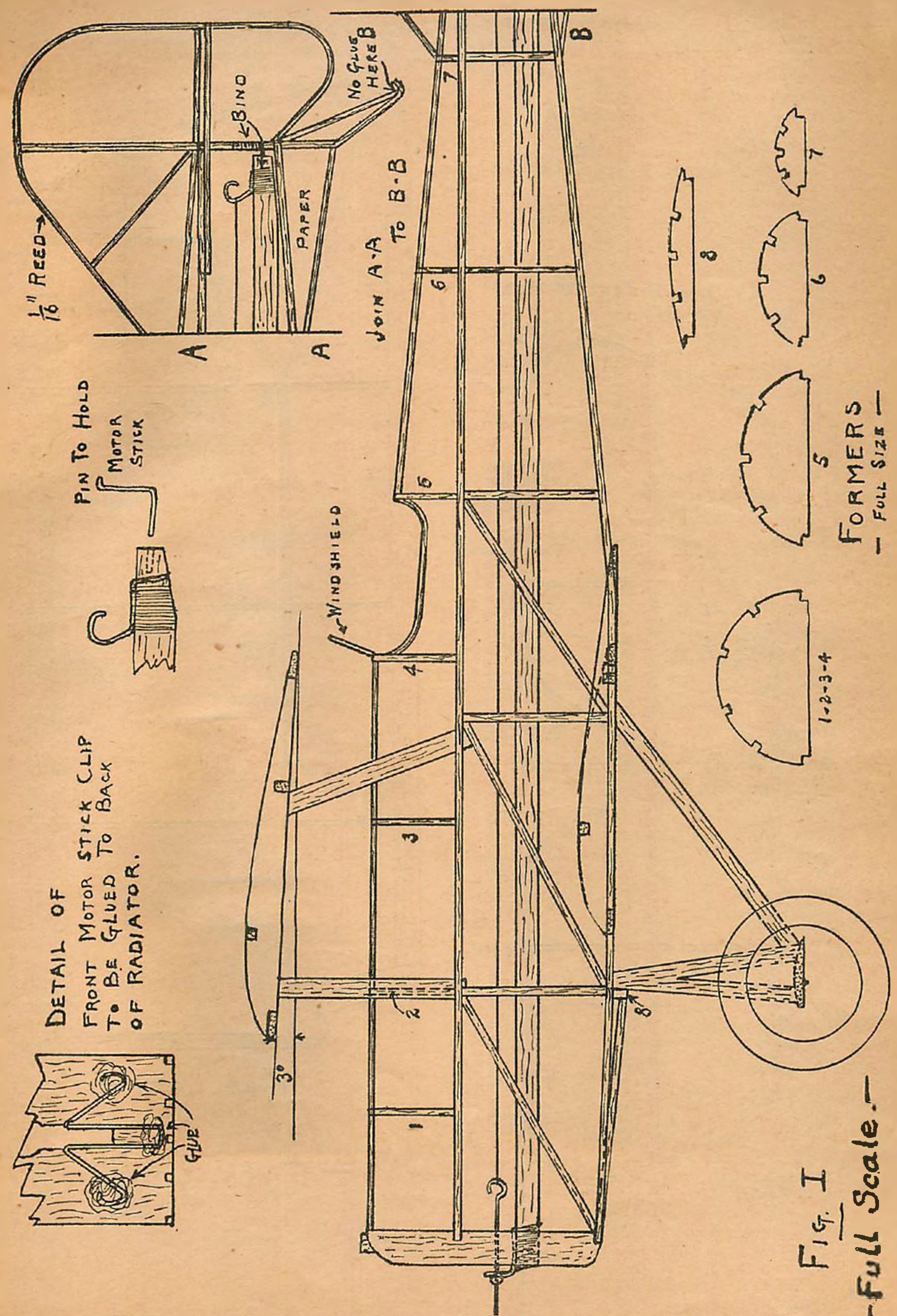


FIG. I
-Full Scale.-

MAKE 2 OF EACH

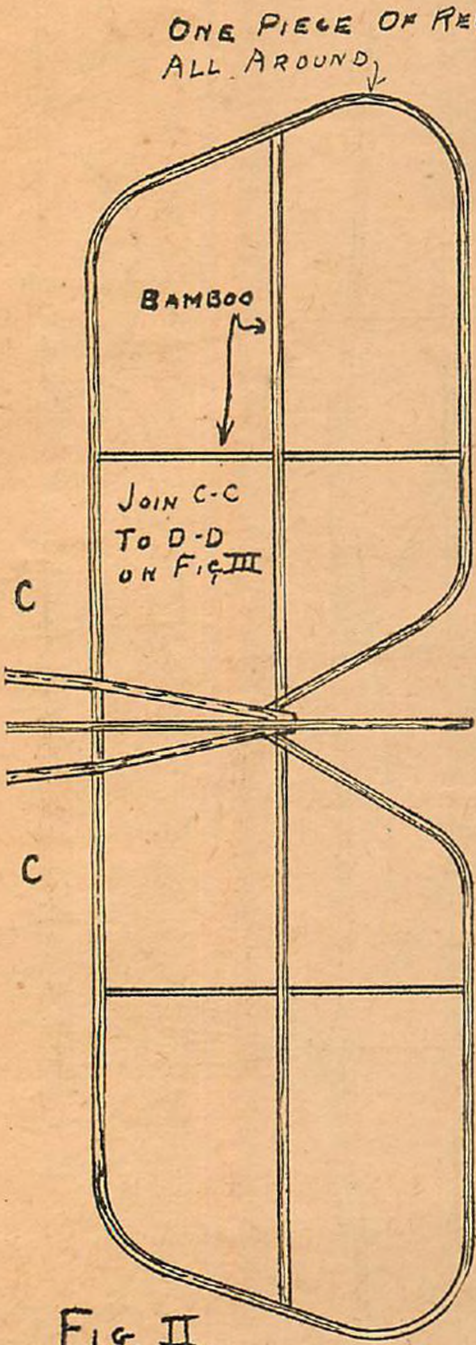


FIG. II.

LOWER LEFT WING.

— Full Scale —

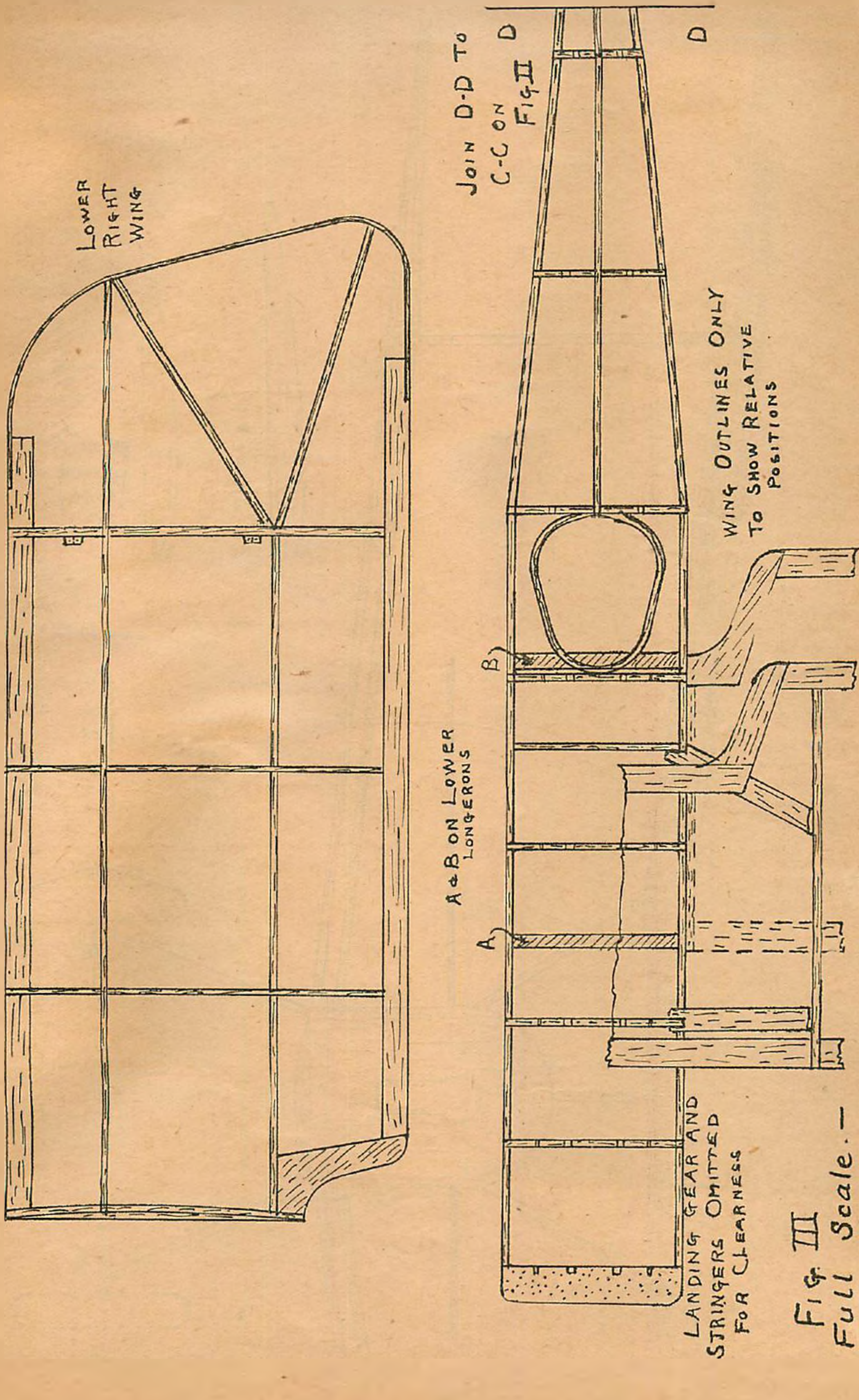


FIG III
Full Scale.—

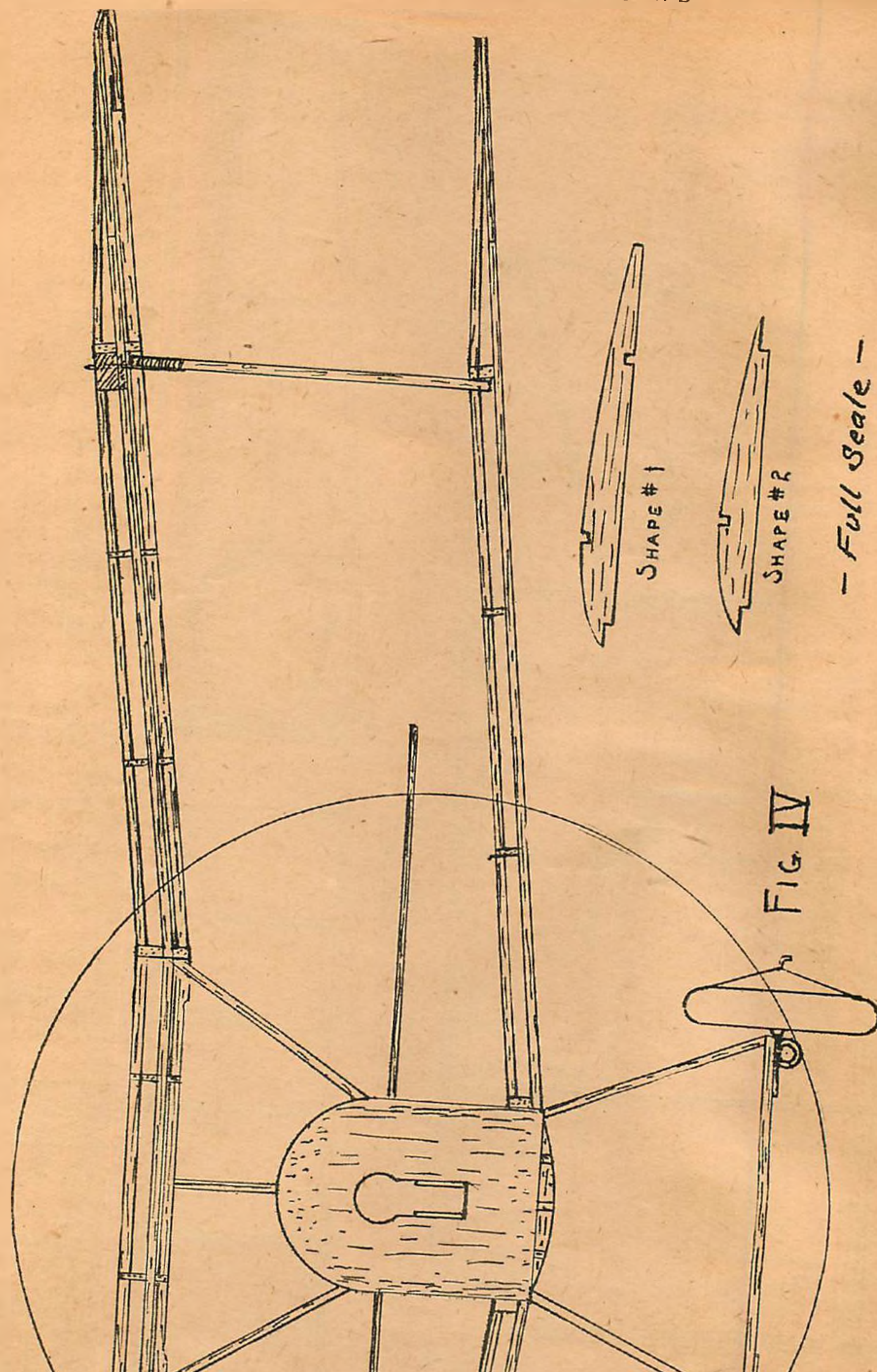


Fig. IV

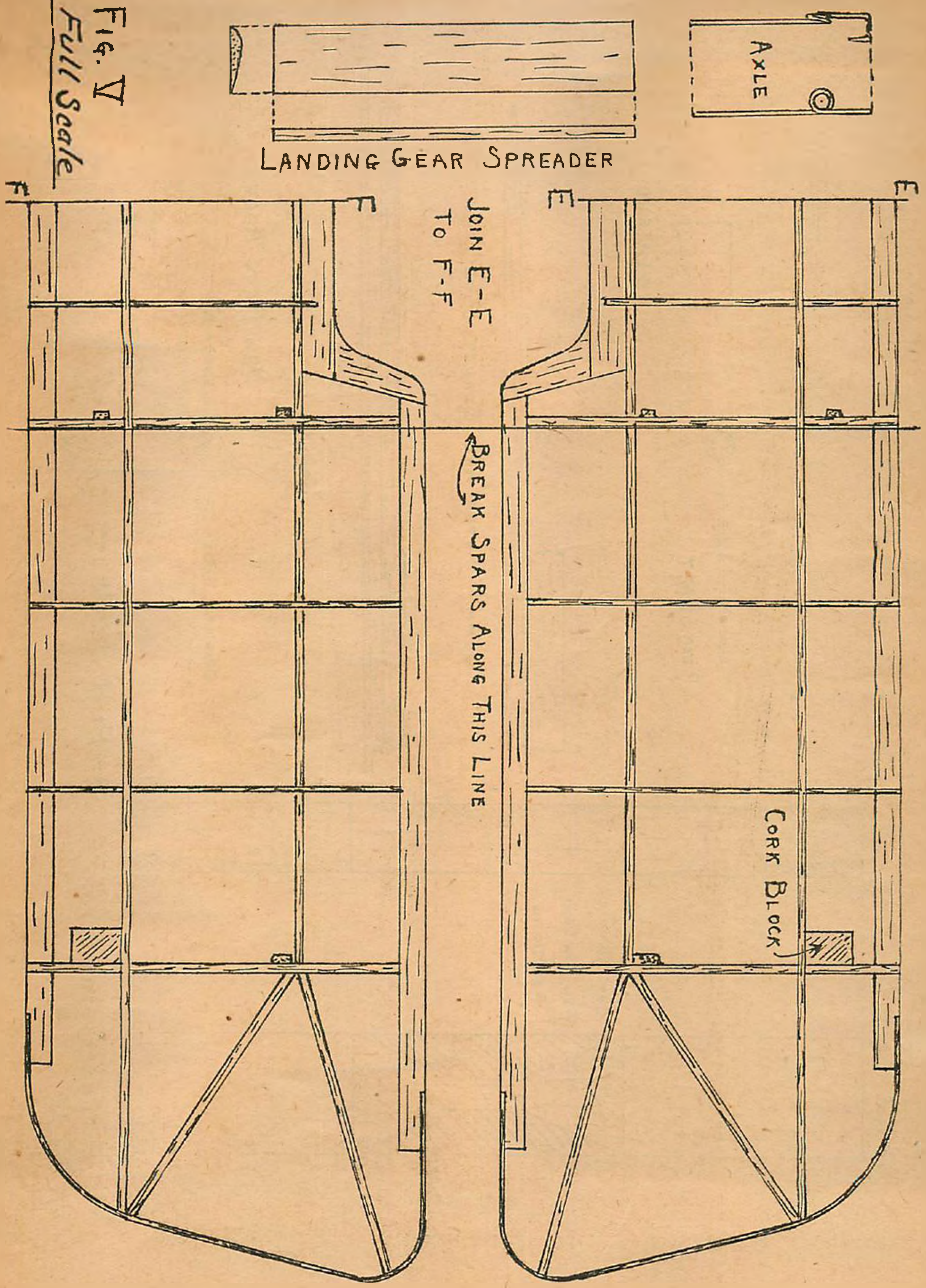
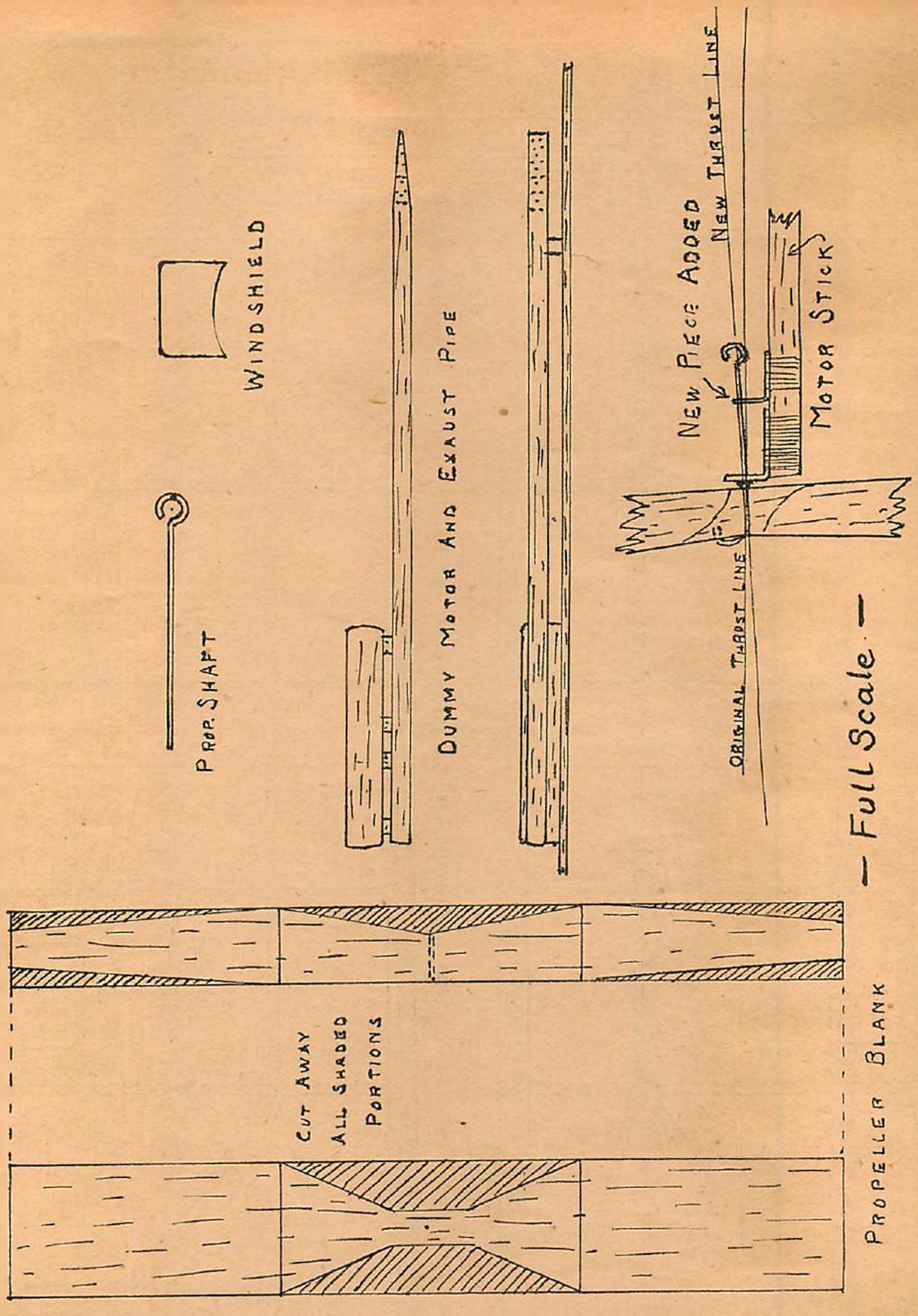


Fig. V
Full Scale



WINDSHIELD
PROP. SHAFT
DUMMY MOTOR AND EXAUST PIPE
NEW PIECE ADDED
NEW THRUST LINE
MOTOR STICK
ORIGINAL THRUST LINE
— Full Scale —
CUT AWAY ALL SHADED PORTIONS
PROPELLER BLANK

FIG VI

Special Cou[r]se In Aerial Radio

[...]cts as An Indispensable Aid to Aviation. Its Installation

By Capt. Leslie S. Potter

(CHAPTER 10)

[...] First the [...]on of weath- [...] aid to navi- [...] means of two- [...]etween plane and plane, and between [...] The limitations of aerial radio are prin- cipal[ly] [...]eight and of ignition interference. This latter was dea[lt] with in a separate article.

Dealing first with the collection of weather reports, it becomes obvious that any success in this direction depends on a highly developed system of ground stations with specially trained observers. This branch of the work falls more properly under a study of meteorology than of radio, but something of its nature must also be understood by the aerial operator. The weather forecasts are made by the Weather Bureau and turned over to the Department of Commerce for dissemination. The Department of Commerce has installed, or is in process of installing about forty radio broadcasting stations along the principal airways of this country.

These stations are inter-connected, either by radio or land line, and are thus able to bring up to the minute all information concerning the weather along the routes covered by them. This information is broadcasted at hourly or half hourly intervals throughout the day. A pilot along the route is kept continuously posted as to the latest weather conditions likely to effect him. In order that this information should be of the greatest value to all, it was decided that telephony should be used in preference to telegraphy in order that small planes, on which only a single pilot was carried, might also be able to get this information. If it were telegraphed, it would be difficult for planes to receive it unless a separate radio operator were carried.

To receive weather information in the air, therefore, a simple receiving set with antenna and headphones must be carried. Figure No. 1 shows a map of the broadcasting stations operated by the Department of Commerce. The circles cover an area of 125 miles round the sending station. This distance is regarded as a reliable minimum daylight range. At night, of course, signals can be heard at greater ranges. In order to keep in constant touch with these ground stations, then, a receiving set must have a reliable minimum

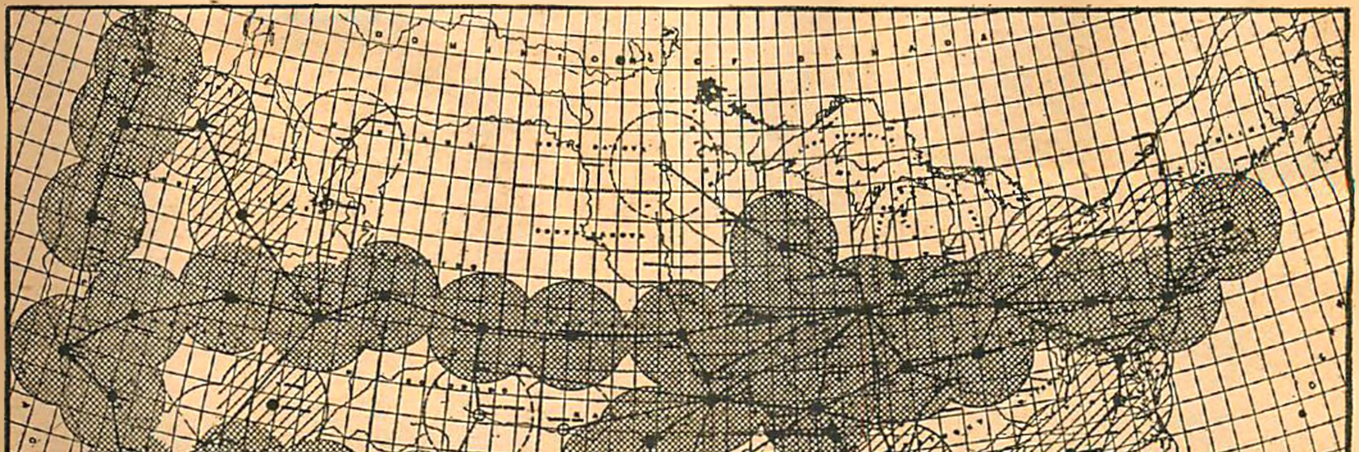


Fig. No. 1. Map showing location and range of aeronautical voice broadcasting stations operated by the Department of Commerce.

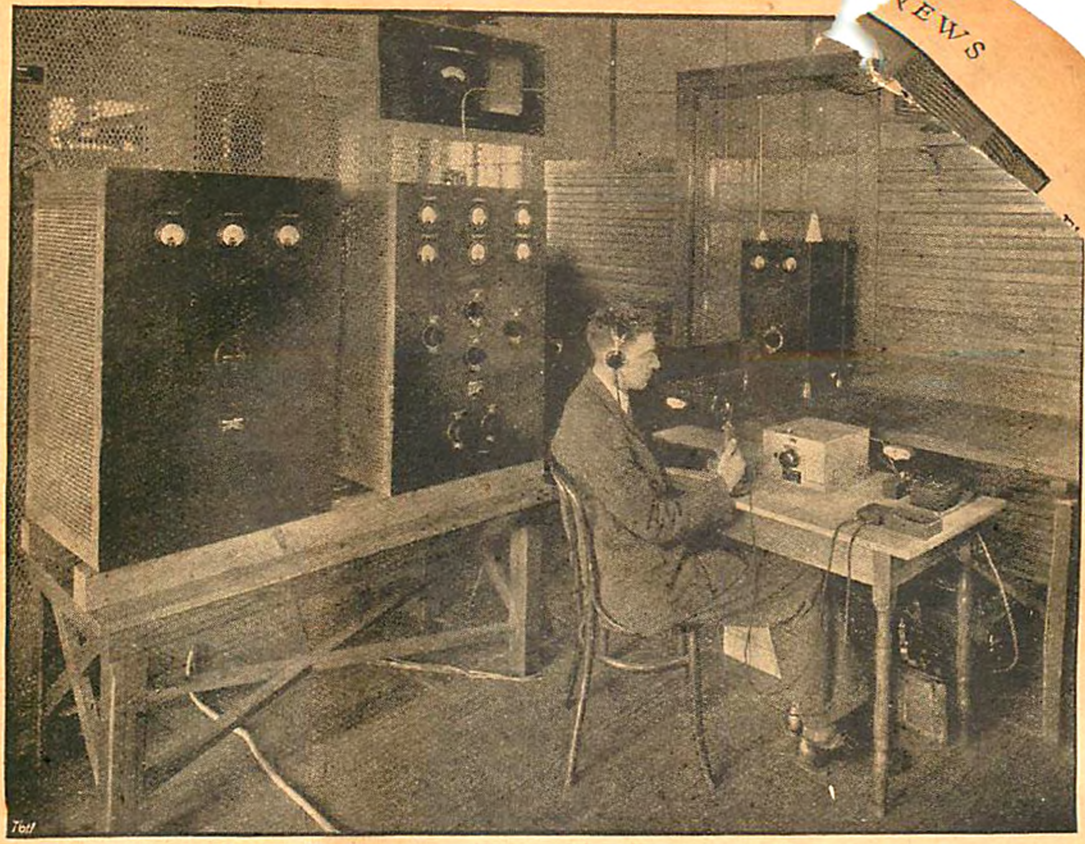


Fig. No. 2. Typical Western Electric Radio-Telephone Ground Station.

sac...
overca...
rain. Cei...
visibility,
Wind modera...
west, tempera...
barometer 30....
tional reports will
probably follow for
further points in the
area, and then, "Th...
airways station at B...
ton is signing off ...
3:10 p.m."

An antenna has been mentioned so far throughout the discussion, as being essential. This is not strictly correct. It is possible for a receiving set to function without an external antenna, but the range will be decreased and the signals will be weaker.

range of 125 miles, and since the stations broadcast on wave lengths of from 800 to 1050 meters, slightly above the ordinary broadcasting range, receivers must be able to listen in on this frequency.

Explained briefly, in order to receive these half hourly weather reports broadcasted by the Department of Commerce stations, a plane must carry a simple receiving set with antenna and headphones capable of receiving up to 125 miles on wave lengths of 800 to 1050 meters. It must be ruggedly built and protected, as far as possible, against shocks and vibrations, and have a reasonably high degree of selectivity. The Western Electric Company, the Stromberg Carlson Company and the Radio Corporation of America all build efficient receivers which comply with these requirements. Figure No. 2 shows a typical Western

Regarding the second function of aerial radio as an aid to navigation, the system used in this country is the directive radio beacon system. Figure 3 shows the radio beacons that have been, or are being installed along the various airways by the Department of Commerce. This phase of radio will be dealt with fully at a later stage. For the present it will suffice to say that the beacon transmits a dot-dash on one side of the airway, and a dash-dot on the other side.

A pilot tunes in his receiving set to the appropriate wave length of the beacon from which he wishes to hear, in exactly the same way as he tuned in for the weather report. If he hears a dot-dash in his receivers, he knows he is to

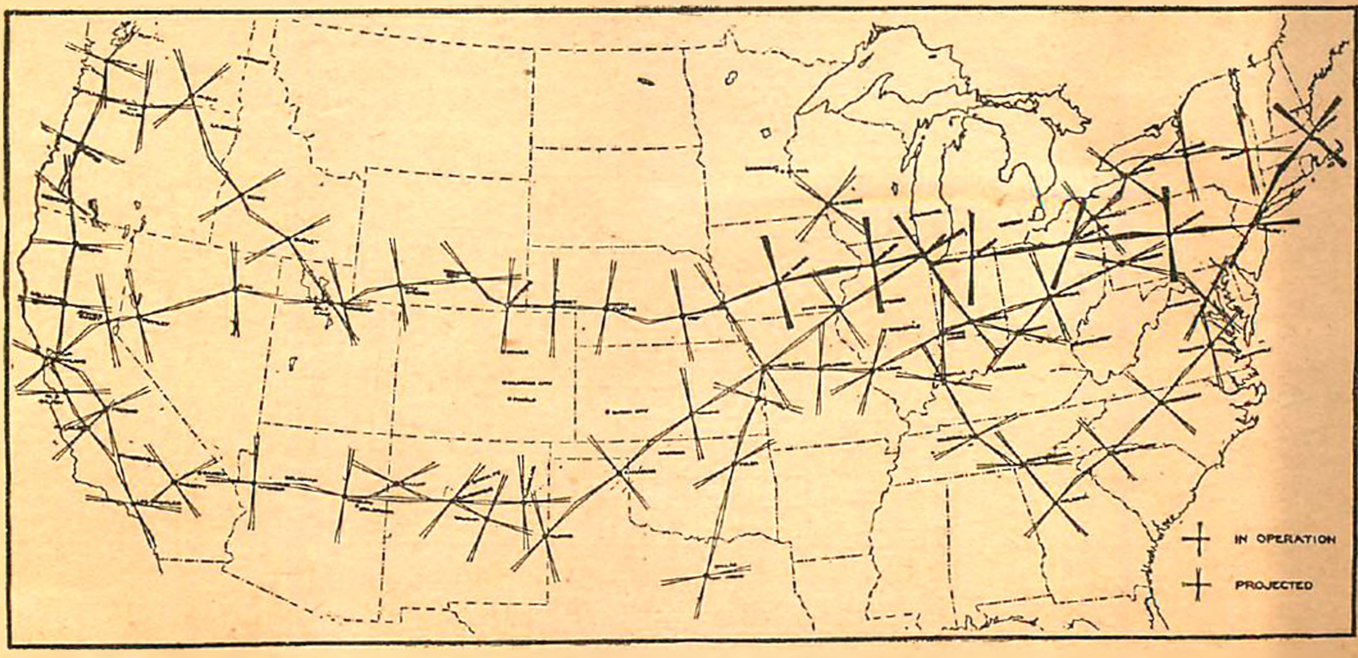


Fig. No. 3. Department of Commerce Airways Division map showing stations of the radio range beacon system.

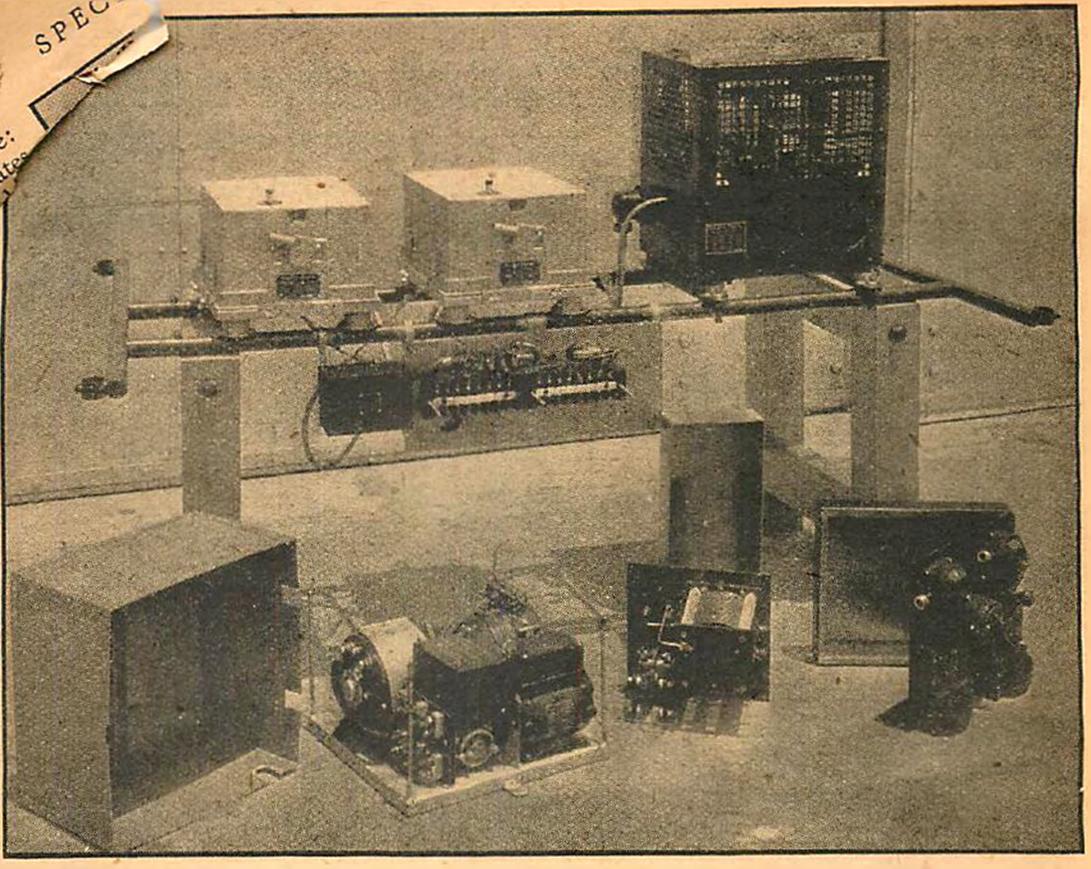


Fig. No. 4. Complete Two-Way Western Electric Radio Telephone Installation for Transport Plane.

the right of his course: a dash-dot indicates that he is to ... v- ... as ... recep- ... Wher re-

... remains the ... ction of aerial ... —communication from plane to plane or from plane to ground.

Radio telephony has been chosen by the majority of air transport companies as a means of communication, because although it is heavier, more expensive and more complicated than telegraphy, it obviates the need for a radio operator which renders the net overall weight and expense actually less. Further, the pilot does not have to be a trained operator, and his hearing of the actual words spoken from the ground is apt to instill more confidence than would be gained by the reception of telegraphed messages. Of course, the range of radio telephony is considerably less than that of telegraphy, so that for flights over long distances where ground stations are widely separated, the latter has a distinct advantage. Pan American Airways use telegraphy over the greater portion of their route. Imperial Airways use telegraphy over all their eastern lines.

Radio telephony is used on short wave bands, mainly because at the time its installation on airways was being considered, most of the long wave channels were already allocated. The actual wave length to be used was determined largely by the range that would be required, and the length of antenna that would be available. Also it was found that different conditions existed by day than by night. Eventually the choice came down to a channel between 80 and 110 meters. This was with a fixed antenna. Better results could be obtained with a trailing antenna, and longer wave lengths up to 200 meters could be used.

The advantages of the fixed antenna are that no aerial has to be reeled out, that it can be used at low altitudes, or on the ground, and that it can be checked over more readily at the airport. In England, the trailing antenna maintains its popularity because of its longer range and better reception, because its length can be varied, and because it is less unsightly. For ground use a collapsible radio mast is carried, to which the aerial can be fastened, which slides between grooves designed for that purpose on the wings.

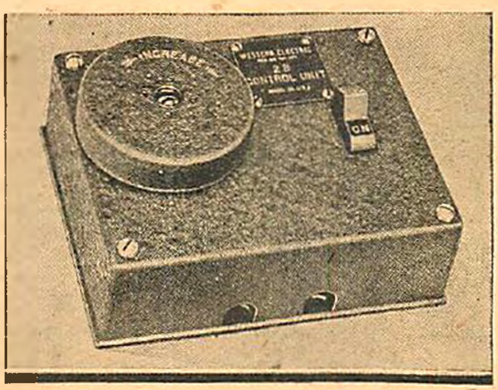


Fig. No. 5. Remote Control Unit.

The larger transport companies maintain their own stations, and have been allocated short wave lengths with which they maintain constant contact with planes flying along their route. For private owners and itinerant flyers who wish to use two-way radio communication, the government has allotted a wave length of 97 meters (3106 Kc.). This is known as the "National Calling Frequency," and any plane may use it. All ground stations, government and private, stand continual watch on this frequency. Figure No. 4 shows a complete two-way Western Electric radio telephone installation for transport planes. It weighs approximately 130 lbs., and has a minimum range of 100 miles. Note the 50 watt transmitter at the top right.

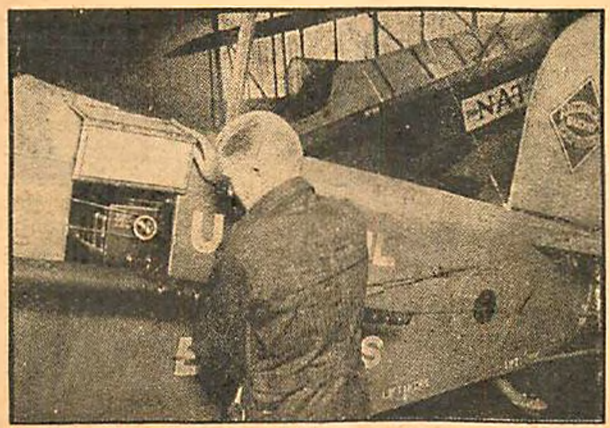


Fig. No. 6. Inspecting RFL Receiver in a mail plane.

Installation

Most radio apparatus today has been designed for remote control, that is to say, the receiver is placed in some portion of the plane and controlled by instruments in the pilot's cockpit. The reasons for this are threefold. A large proportion of the parts are out of the pilot's way, there is less likelihood of ignition interference, and no valuable space is occupied that might have been given over to pay load. The tuning dial in the cockpit actuates the receiver through a flexible cable similar to a tachometer cable. The switches, telephone jack and volume control are connected with the receiver by wires covered with a metal sheath. Copy of a remote control unit which is mounted in the pilot's cockpit is shown in Figure No. 5.

Installing a receiver is a comparatively simple matter and requires only a little ingenuity in selecting the place. In light planes, for example, it would not be advisable to install it way back in the tail. The extra weight would probably effect the fore and aft balance of the plane in flight. In open planes it is best to cut a hatch at the top or side, and then anchor a shelf to which the receiver can be mounted. This is illustrated in Figure No. 6. From here the controls can be run into the cockpit. They are best mounted on the left hand side so that the pilot can manipulate them without taking his hand from the "stick."

Where a fixed antenna is being used a mast of about five or six feet should be erected as nearly as possible directly over the receiver. The masts may be either of wood or dural tubing. The latter will generally have a longer life, but have a tendency to vibrate more than the wooden mast. Furthermore, with the latter there is no need for insulation.

If a trailing antenna is being used, the reel with its brake should be installed in a place most convenient for the pilot. This will naturally vary with the arrangement of the cockpit. The wire used should be of small cross-section so as to reduce wind resistance and weight. Copper clad steel wire or stranded phosphor bronze are the types generally used. The length of the wire will depend on the wave length to be used. The fundamental wave length will be about four times the length of the antenna. For example, the fundamental wave length of a trailing antenna of fifty feet would be approximately 200 meters.

With cabin planes there is usually a door leading from the rear of the passengers' compartment where the base for a receiver may be conveniently fixed. An important point to be remembered in the installation of a radio set is the ease with which it can be inspected or removed. For the last reason it is best to use wing-holding-down screws to secure the set to its platform. Finally, do not forget to protect, as far as possible, with rubber washers and shock absorbers, against heavy landings, excessive vibration, etc. The positions chosen in installing a set will also be governed by the type of power supply. This we will come to next.

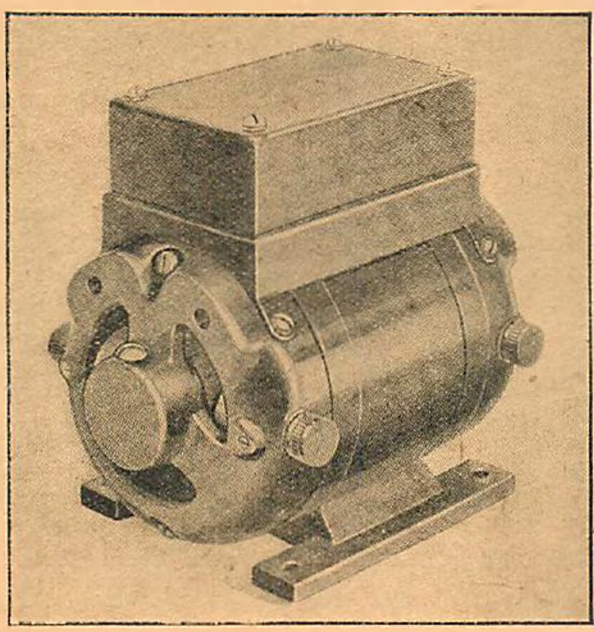


Fig. No. 7. Dynamotor.

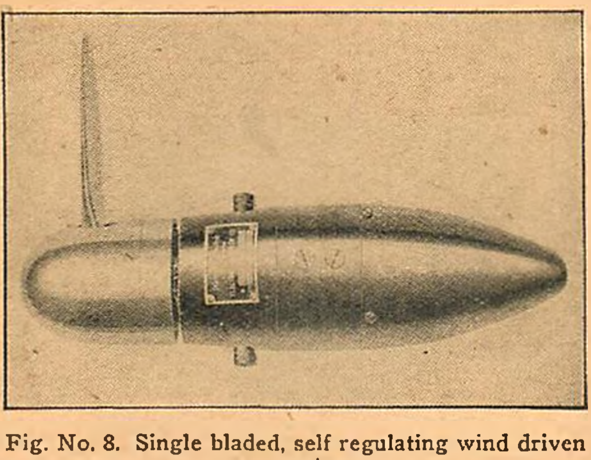


Fig. No. 8. Single bladed, self regulating wind driven generator.

Po...

The power supply for aeria... groups. Storage battery and dry ... supply and B supply respectively, dyna... generators and motor driven generators. ... methods, the first is probably the least used o... the maintenance involved. The dynamotor, see Fig... 7, is operated from a 12 volt battery.

In some sets the dynamotor furnishes plate supply fro... the battery which is then used directly for the excitation of the filament circuit. Where the current drain from the battery is considerable it will need frequent recharging if used to any extent, and in these circumstances it is advisable to eliminate the dynamotor drain by using a dry cell battery for the high voltage supply. Otherwise a generator will be necessary to keep the battery charged. It is claimed that a dynamotor is more reliable than batteries and weighs less.

The wind-driven generator is used extensively in England and in many types of radio installations in this country. With a wind-driven generator, no storage battery is necessary. The generator is mounted outside the fuselage so that the wooden propeller obtains the full force of the windstream.

Voltage is supplied to both filament and plate circuits. With the original two bladed propeller, the speed of which varied with the airspeed of the plane, a varying voltage was often delivered through the circuits. As the vacuum tube needs a constant filament voltage, this was unsatisfactory. The generator was then placed on a bracket by the side of an aperture cut in the fuselage. The design of the bracket enabled an operator in the cabin to change the angle of the generator with reference to the windstream. In this way, the speed of the generator was, to some extent, regulated. An added advantage of having a retractable generator is that it may be swung back into the cabin when the transmitter is not being used, or for repairs.

SOME sort of a braking system is advisable with retractable generators. Later, a wind generator was developed with a single bladed, self regulating fan as shown in Figure No. 8, and this has proved the most satisfactory of any. The one illustrated is manufactured by the Western Electric Company, and will deliver its rated output at any speed in excess of 70 miles per hour. The disadvantage of wind generators lies in the fact that they only function during flight. Their weight is also a further drawback. The one illustrated weighs slightly more than 28 pounds.

The engine driven generator, driven directly from the motor, has been in use for many years in connection with lighting devices, and charging storage batteries in automobiles. Certain types for air use are provided with double

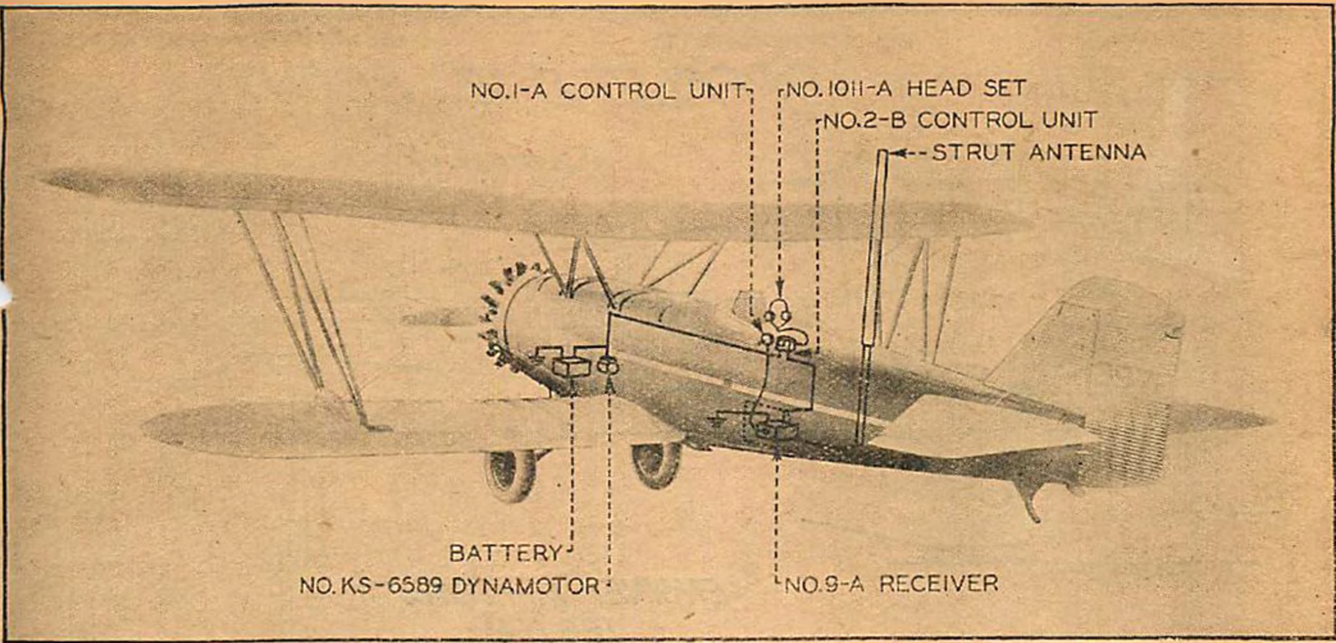
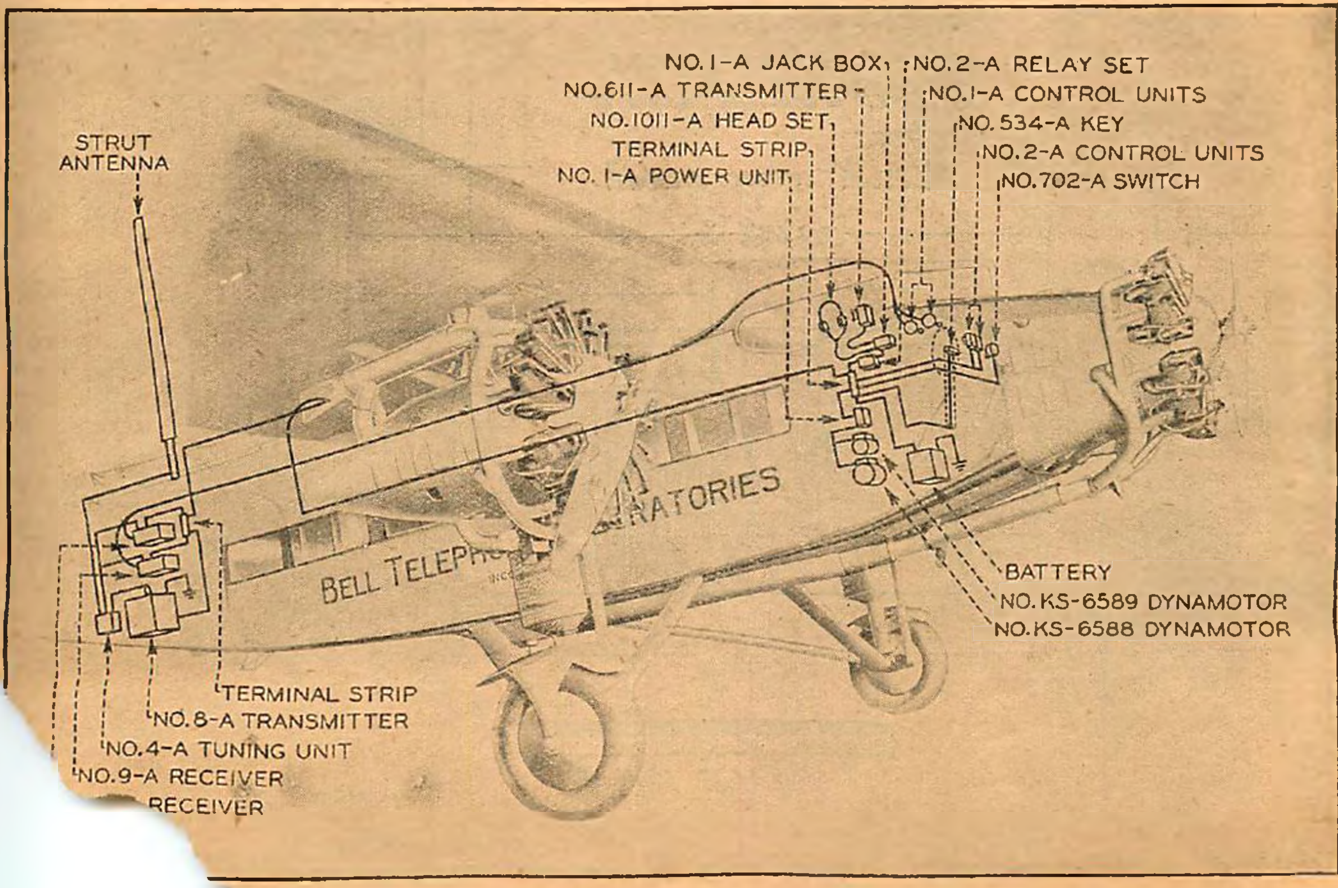


Fig. No. 9. Typical Western Electric receiver installation for Department of Commerce weather and beacon signals.

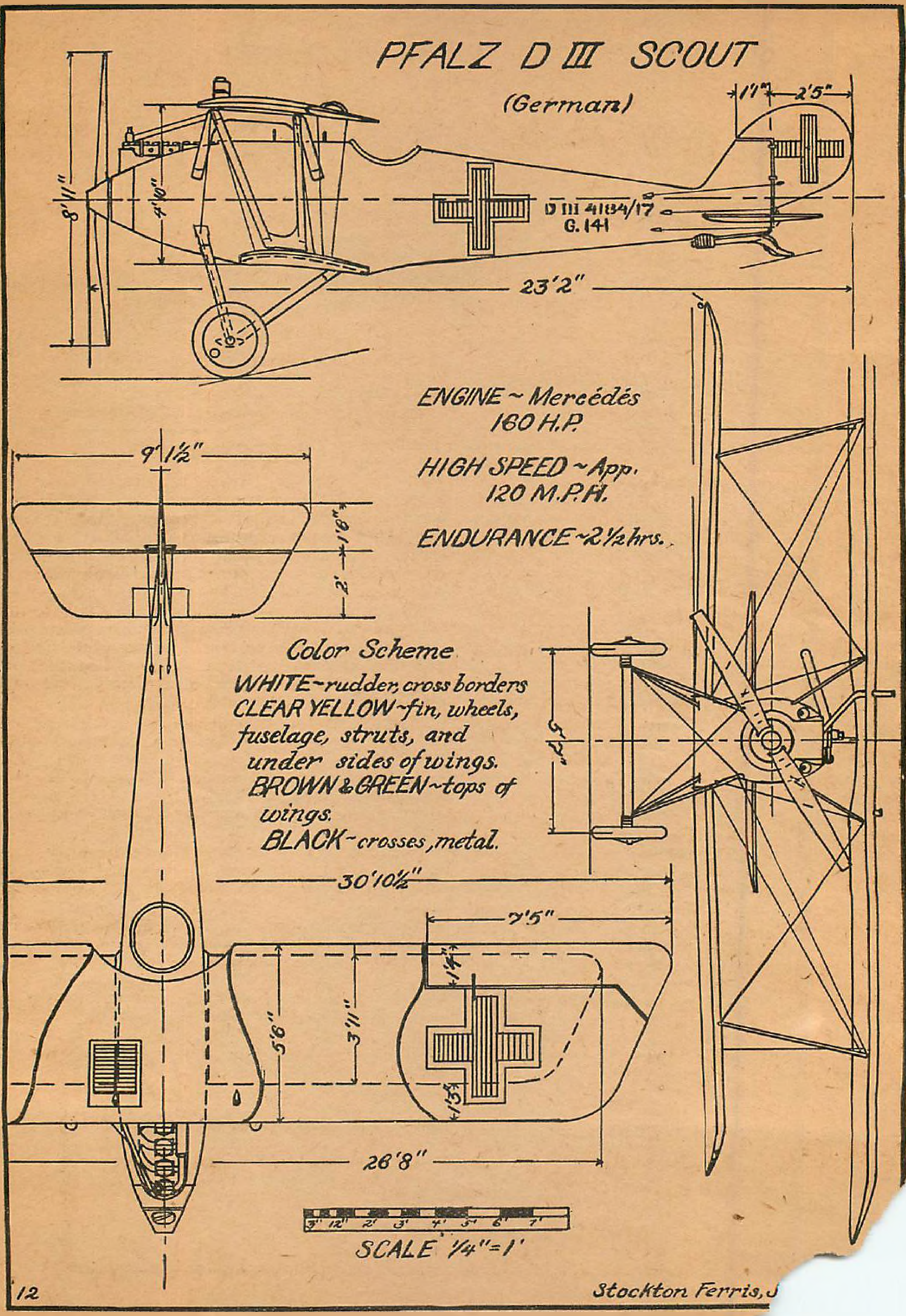
voltage windings, the high voltage end providing the plate current, and the low voltage end supplying the filament. Special control is provided to maintain constant voltage at all engine speeds. The same drawbacks attached to the wind-driven generator apply also here with the addition that the engine driven generator is normally of even greater weight.

An interesting power supply which has not yet been mentioned, but which is carried on all British military planes equipped with radio, is a hand-driven generator for emergency use. These generators are also equipped with double voltage windings for providing both plate and filament supply. They are geared at (140) to (1), so that normal cranking will supply sufficient energy for all normal purposes. I have personally used these hand-driven generators on several occasions and they have always functioned admirably. Certain of the larger air liners in Europe carry small two stroke gasoline motors for driving emergency generators.

Several factors will influence the position selected for the power supply. The position of the motor-driven generator is, of course, obvious. In small planes batteries will have to be placed somewhere near the centre for reasons of stability, and if a dynamotor (*Continued on page* 47)



10 Typical Two-Way Western Electric radio-telephone set-up in transport plane.


PFALZ D III SCOUT
(German)
1'1"
2'5"
8'11"
4'10"
D III 4184/17
G.141
23'2"
ENGINE ~ Mercédés
160 H.P.
HIGH SPEED ~ App.
120 M.P.H.
ENDURANCE ~ 2½ hrs.
9' 1½"
1'8"
2'
Color Scheme
WHITE ~ rudder, cross borders
CLEAR YELLOW ~ fin, wheels, fuselage, struts, and under sides of wings.
BROWN & GREEN ~ tops of wings.
BLACK ~ crosses, metal.
30'10½"
7'5"
5'6"
3'11"
26'8"
SCALE ¼" = 1'
12
Stockton Ferris, J

How To Build The Pfalz Scout

A Solid Scale Model

The Aerofoils, Old and New

How They Are Measured

By Stockton Ferris, Jr.

This is ... of the ... con- ... are characteristically thin, giving ... n large models.

... in cross-section with rounded ... he cockpit, but behind this ... her pointed. The lower ... which are integral with the ... make this take a section of ... gth and fix it to the bot- ... shown in the side view. ... fix some plastic wood of ... mbr... and form the fillets. These ... shown in the front view at the thickest ... but go down under the fuselage and be- ... the leading and trailing edges.

... gine can be built up of small pieces of reed or dow... represent cylinders and various sizes of wire for the tubing. To make the small cowling before the front cylinder, bend a piece of aluminum and force it into the wood.

After the fin has been put in place fill in the hollow between it and the fuselage so that there is no demarcation.

You will notice in the top view, a small box on the *leading edge* of the stabilizer. This is built into the fuselage, the stabilizer sliding into a slot from the rear and fastening to it. If you don't build it that way, at least outline it so that a groove shows on the finished plane.

The radiator can only be seen from the top view, as it is set into center section of the wing. To give the best impression of this, cut a shallow depression into the top of the wing, and glue in cross pieces of wire to look like the cores. On top of the radiator is a small streamlined expansion tank and filler cap. The small projection to the left of this is the filler cap of the gas tank.

Notice that the cabane and interplane struts are connected at one end by a cross piece and do not have any wires between them.

The interplane struts are not connected directly to the lower wing spars, but to a steel tube going from front to rear between them. That is why the landing wires do not join in the same place as the struts.

The rest of the plane follows common practice except for the stabilizer, which is cambered on the bottom, but is flat on the top.

The irregular lines shown in the top view are the boundaries of the colors on the wing. These are dull green and brown. The wing-tips are brown, as is the central band. The other bands are the green. If you so desire, the stabilizer may be painted in the same manner.

Glossy lacquer gives the best finish on all scale models.

AEROFOILS

OBVIOUSLY, for the accurate measurement of an airfoil, some system is necessary, but when understood, does not seem as difficult as might be imagined, by looking at the drawing.

In this, the ordinate system, the thickness of the airfoil is measured as so many percent of the chord, the chord being taken as a unit.

Thus we see, that no matter what the length of the chord, the thickness is always in a definite proportion to it.

In using this system we first divide the chord into ten equal parts, each being of course, ten percent of the chord, so that a line divided in that manner would read: 0%, 10%, 20%, etc., to 100% at the end.

Now such divisions would be allright if there was only a shallow curve to the section, but as the curve is rather sharp near the nose and sometimes at the trailing edge, these graduations are again subdivided (by merely halving), until they read thus; 0%, 1¼%, 2½%, 5%, 7½%, 10%, 15%, 20%, and so by tens to ninety, after which comes 95%, and 100%.

After this comes the depth of the section, which as we have said before is measured in percent of the chord. In other words the unit we use is one-hundredth the length of the chord.

Thus as we read along the chord to a certain *graduation* and then look at a table of ordinates, as the various depths are called, (or they may be printed on a drawing of the section itself), we plot, or draw a series of points. These are then connected with a smooth curve and form the outline of that particular section.

If an ordinate happens to have a minus sign in front of it, it merely means that it should be read below the chord line instead of above.

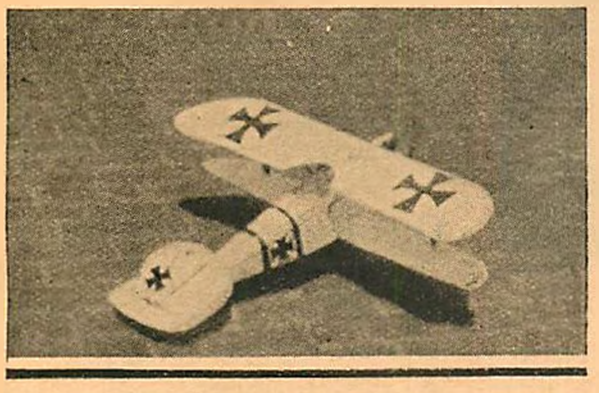
LOOK FOR THE DETAILS OF OUR NEXT BIG CONTEST
IN FOLLOWING ISSUE OF
MODEL AIRPLANE NEWS


SOME AIRFOIL SECTIONS
Early
Present
U.S.A.-1
U.S.A.-2
R.A.F.-3
R.A.F.-6
R.A.F.-15
EIFFEL #32
GÖTTENGEN 314 (Hansa-Brandenburg)
GÖTTENGEN 362
GÖTTENGEN 368
CLARK-Y
CLARK-Y 15
N.A.C.A. MUNK-8
U.S.A.-27
U.S.A.-35 A
U.S.A.-35 B
GÖTTENGEN 387
C-62
Stockton Ferris Jr.

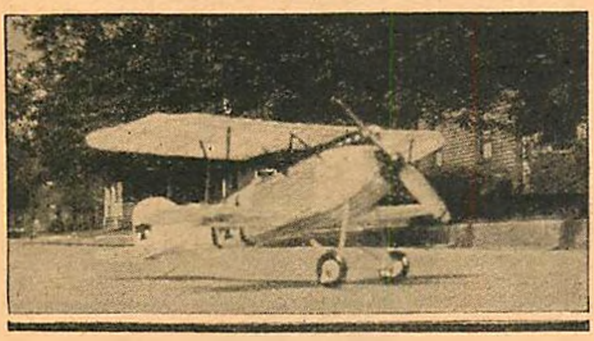
AIR—WAYS
HERE and THERE

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

WELL, fellows, here we are again, ready to tell you what your model flying buddies throughout the country are doing to promote the science of aeronautics. We have heard from a great many of our old friends, as the array of pictures on the following pages of this column will demonstrate, and we hope that many others will respond to our call for news. The fellows here in the East are very much interested in what the Middlewest and the Coast boys are doing, so help us create a bond of good fellowship by contributing your bit to these columns. If you would like to make this space more interesting to others, send in pictures of your models with general specifications as to wing span, wing chord, "prop," tail planes, etc., or any story of your model flying experiences that you think might be interesting reading. Make them as short as possible so that we will have space to say something about *all* of our contributors.

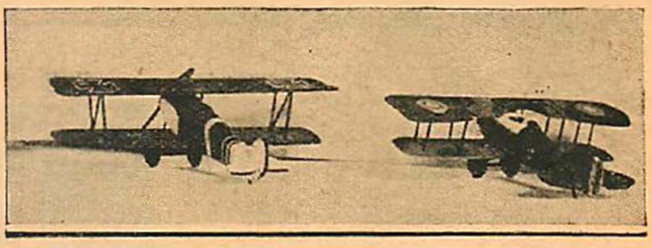


Picture No. 1.

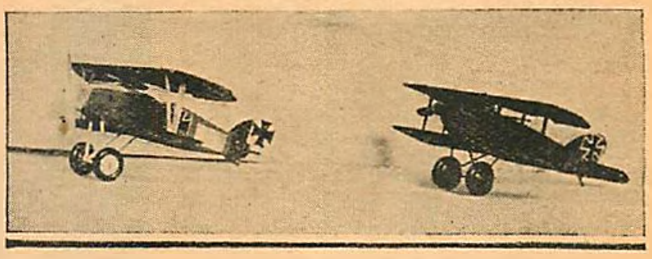


Picture No. 2.

One of our contributions is from Gordon A. Nesbitt, 1722 Central Avenue, Anderson, Ind. He has sent us these two pictures of the 24-inch scale model Albatross D-3. He says he has made some unusual flights with it. It certainly is a nice looking ship. (Pictures No. 1 and No. 2.)



Picture No. 3.



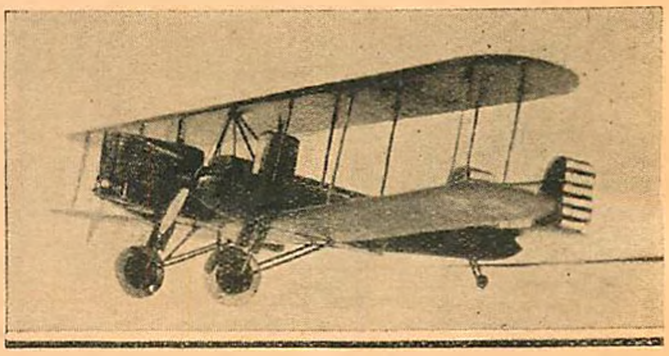
Picture No. 4.

Pictures No. 3 and 4 show the Fokker D-7, the Spad, an Albatross and a German L. V. G., solid scale models which were built by W. A. Peterson, Fraserdale, Ontario, Canada. These models were made from three-view drawings published in the Model Airplane News.

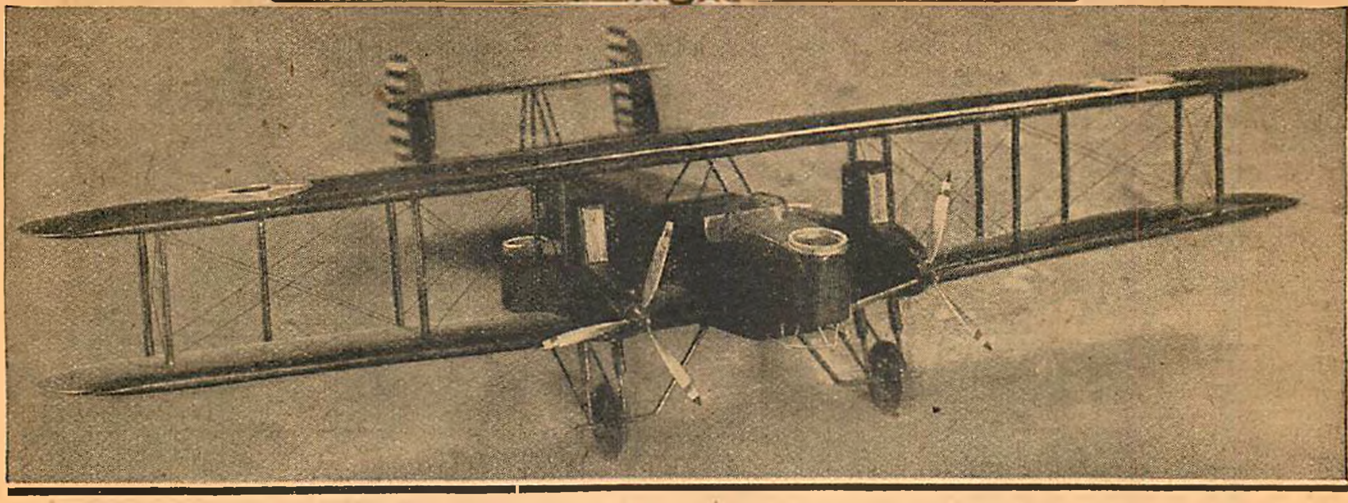
At the top of the following page we have a contribution that comes all the way from New Zealand. Picture No. 5 shows a Curtiss-Condor built from Model Airplane News' three-view drawings by Cliford Grainger Andrews, N. Z. R. Social Hall, Cargill Road, 5th Dunedin Otago, New Zealand.

Picture No. 6 shows Andrews himself.

The Curtiss-Condor seems to be a very popular ship with our model builders for here we have another model built by F. T. Roberts, Jamesburg, N. J. (Picture No. 7.)



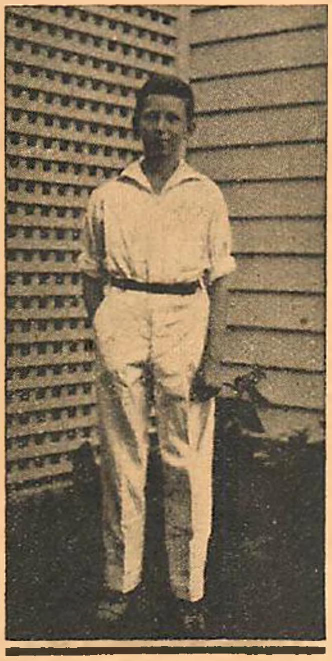
Picture No. 7.



Picture No. 5.

It is a very unusual thing to see a model triplane fly. In fact, I doubt if many of our readers have had success with triplane models. However, pictures No. 8 and No. 9 show a beautiful little triplane model in flight. This model was built by Manley Mills, 1309 S. Main Street, Anderson, S. C. It is very difficult to distinguish this model in flight from a full-sized ship and its builder is to be complimented for his excellent workmanship.

Picture No. 10 shows a group of neat looking models and their builder, Thomas Zeigler, 811 Colfax Street, Toledo, Ohio, is an American Sky Cadet and a student at Parks' Air College at East St. Louis. If all goes well, Zeigler will become a transport pilot when he finishes his course of training.



Picture No. 6.

X. A. Pouch, 83 Low Terrace, New Brighton, N. Y., has sent us two fine pictures (No. 11 and No. 12) of a six-foot model of the Lockheed Vega which he has constructed. It is driven by a 1/6 h.p., six cylinder, compressed air motor and flies well. It might be very interesting to our readers if Mr. Pouch would give further details regarding this very beautiful ship.

Tangle in a Cloud

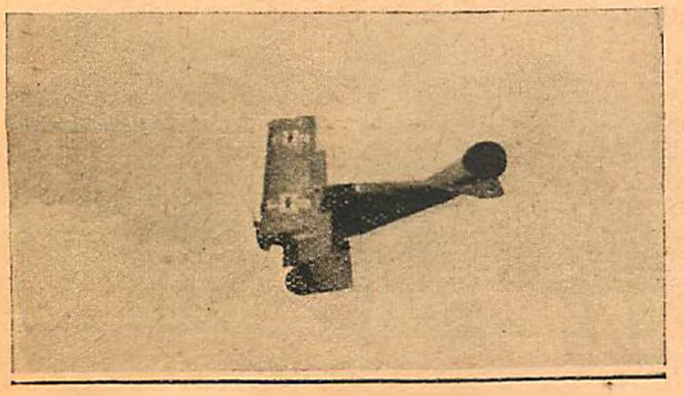
While in the descent of a multiple parachute jump for a motion picture news reel, recently, Sergeant Levi C. Schneider and Sergeant Lloyd T. Burval exchanged greetings in a cloud and, deciding that neither cared for the other's immediate company under the circumstances, parted after strenuous efforts, and meticulously avoided each other during the remainder of the descent.

Sharp Shooting

A tactical exercise was recently held at Fort Shafter, T. H., involving aerial machine gun fire and bombing. Ground targets representing a battalion of Infantry were scattered in open formation, based on actual dispersion of a battalion when warned of the approach of hostile airplanes. The 26th Attack Squadron of Wheeler Field was designated as the organization to perform the mission. Of a total of 270 targets, 232 were struck, many of them having six or eight bullet holes each.

Gas Helmets for "Non-rigid" Use

Request was made of the Material Division, Wright Field, Dayton, Ohio, a short time ago for the design and procurement of a helmet to be worn by persons entering the gas compartments of airships of the internal suspension type for the purpose of making inspection or repairs. Work of this kind has been found necessary in connection with the ZMC-2 airship at Scott Field.

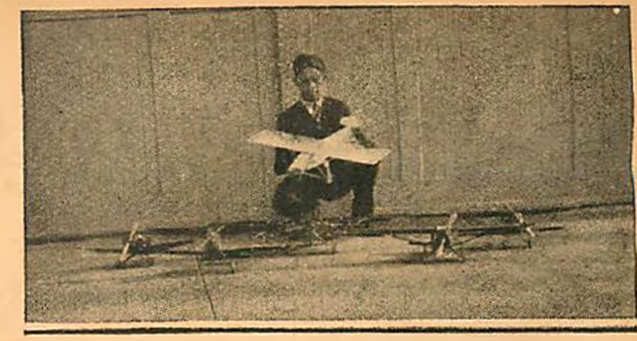


Picture No. 8.

Picture No. 9.

The American Sky Cadets

"Corresponders" Wanted



Picture No. 10.

SEVERAL boys have written to us, asking if we could arrange to have other readers of our magazine correspond with them. This might be valuable to both parties as, very often, an exchange of ideas results in increased knowledge, as well as firm friendship. Here is a London boy who wants a New York City boy to write to him: Wilfred A. Blanche, 133 Lavender Hill, Battersea, London S. W. 11, England. He is seventeen years old and an accomplished model builder.

Cannot some of our readers also write to Bryan R. Southwell, 59 Croyden Avenue, Croyden, Sydney, Australia? He wishes to know what we are doing here in America and, no doubt, there are many things of interest that some of you fellows could tell him.

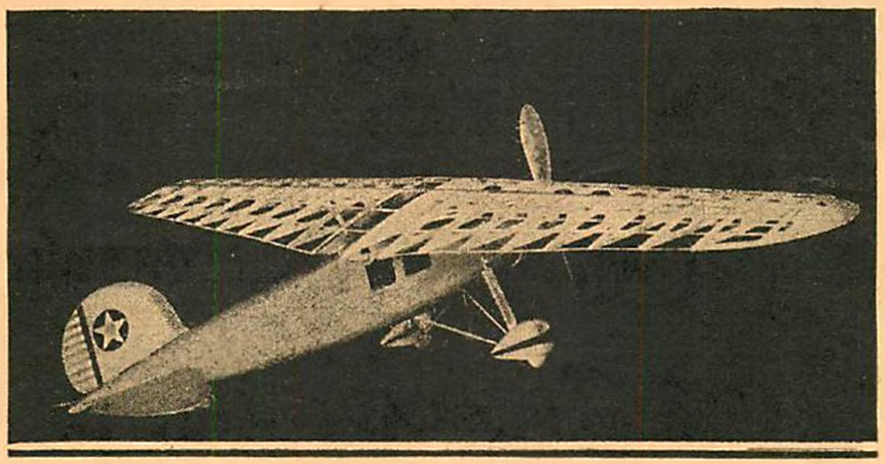
—:oo:—

Another of our Sky Cadets, W. A. Peterson, Fraserdale, Ontario, Canada, would also like some fellow to correspond with him.

—:oo:—

Club News

Bamberger Aero Club began its winter activities with the opening of a new clubroom. The event was celebrated with an exhibition and lecture on Australian Boomerangs, by Dan Baker, an expert boomerang thrower.



Picture No. 11.

John Hulstrunk, Playground Association representative in Newark, presented prizes, won by two members of the Bamberger Aero Club, at the Eastern State Telegraphic Meet, in which Newark placed second.

Welcome Bender won third prize in the Junior Commercial Event. Emanuel Radoff won second prize in the Senior R. O. G. Event. Each received a medal.

Lieutenant H. W. Alden, expert model airplane builder, has been coaching the Contest Team, which consists of the club's better model builders, who officially represent the club at all contests. At present, they are working on a model designed by Lieutenant Alden, which is expected to fly fifteen minutes.

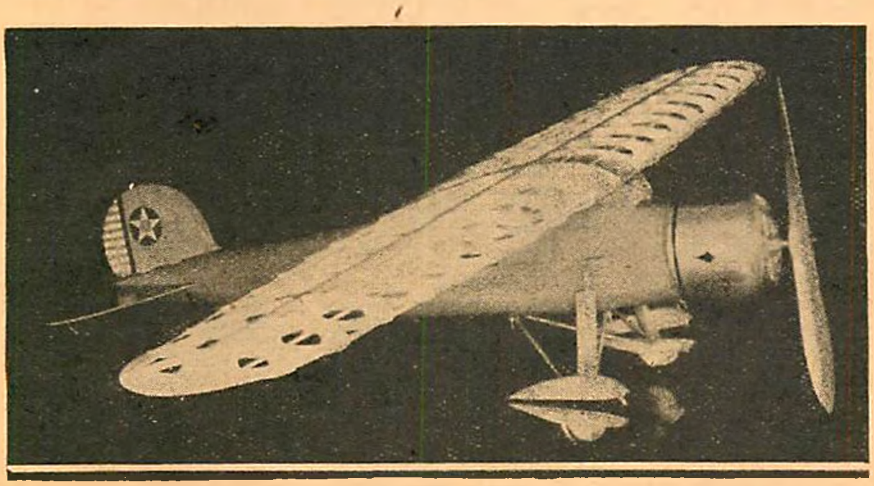
The Bamberger Aero Club will hold a preliminary contest, the latter part of February and the Annual Indoor Contest on March 27th.

There will be many trophies and the holder of the most points, will be representative to the National Contest, with all expenses paid by the Bamberger Aero Club.

Irwin S. Polk, Director of the Aero Club, looks forward to the holding of all records in the Eastern States by the Bamberger Aero Club in the near future. At present, they hold the Scale Model Championship, the Outdoor Duration, the Outdoor Commercial and the Outdoor Glider. In the coming contest, they will hold an Auto gyro Event, which in itself is something new and novel.

—:oo:—

Jerome Kittel has consented to act as Special Correspondent for Model Airplane News and the American Sky Cadets. He will report the activities of the Stern's Unit of the American Sky Cadets at their contests held every Saturday at the 165th Regiment Armory at Lexington Avenue and 25th Street, New York City. We will look forward to some interesting news from him as there are some very fine model builders in this club. Some hold world records.



Picture No. 12.

THE AMERICAN SKY CADET

PRIZE PICTURE CONTEST.

$5.00 Given for Best Picture.

In order to make it interesting and worthwhile for you, Model Airplane News offers a prize of $5.00 for the best picture of a model plane built by an American Sky Cadet, enrolled previous to the (*Continued on page 47*)

A TWO-WAY GLIDER

A plane that can be built to fly tail first or tail behind. Glides of fifteen to one have been made with this ship.

By STOCKTON R. FERRIS, JR.

AS YOU know, a canard is a tail-first, while a penaud is a tail-in-the-rear type plane. This model can be built as either, and both show a remarkably fine gliding angle; about 15 to 1 for the tail in the rear, and slightly less for the canard.

The first step in building is to collect the following materials:

One piece of balsa 18" x 2" x 1/8" for the main wing.

One piece of balsa 5" x 7/8" x 1/16" for small wing (stabilizer).

One piece of balsa 2 3/8" x 1 1/4" x 1/32" for rudder.

Two pieces of bamboo 4 1/2" x 1/16" x 1/32" for outriggers.

Two pieces of bamboo 3 3/16" x 1/32" square for outriggers.

One piece of balsa 3 5/8" x 7/8" x 1/2" for nacelle.

One piece of medium music wire for skid.

Top of medicine capsule 1/2" long x 1/4" dia. for windshield.

Ambroid, razor, knife, ruler, heavy and fine sandpaper.

Start work on the wing first. The chord at the center is 2" but tapers to 1" at the tips, which are not rounded until the wing is finished. You will notice that the wing is flat on the bottom and has no dihedral. The upper surface tapers down to it so that the tips are only 1/32" thick. The reason for having the leading edge only swept back is so the model can balance back farther, and also for simplicity of construction.

To obtain the same results as the original the airfoil shown in the side elevation should be followed closely. This is sanded down to 3/32" thick at the center section, where the thickest part is 3/4" back from the leading edge. At the tips it is 3/8" back.

After the wing is sanded down as smoothly as possible, the tips are rounded as shown.

Nacelle

We now leave the wing aside for awhile and start work on the nacelle for strictly speaking this little ship has no fuselage.

This we make with a flat space on the top 2" long, to which the wing is cemented. Immediately in front of this the block is cut down 3/16" and the cockpit hollowed out. From the top view we can see that the nacelle tapers to 1/32" thick at the rear, while the side is 9/16" high. The nose is made as nicely rounded as possible, depending on your ability. The front view shows the block to be almost triangular, that is, the bottom is a great deal narrower than the top.

The wire skid shown is to take up the landing shocks and prevent the bottom from being worn away, as the model lands very fast.

Also considerable distance can be gained by its use, as the model is not brought to a sudden stop on landing, but rises into the air again if the landing is too fast.

Stabilizer

This is cut out of the piece of 1/16" balsa to the dimensions shown. It is sanded to a thickness of not more than 1/32", and has a lifting airfoil.

Rudder

Make this out of the piece of 1/32" balsa. It is sanded to a streamline shape having a sharp trailing edge. It can also be made of bent bamboo and covered on one side with paper. However this construction is very likely to warp. The shape of the rudder can be changed without affecting the performance providing the area remains the same.

Assembling

The wing should be cemented in place on the nacelle as soon as the latter is finished. Be sure to get them at right angles. This is very IMPORTANT. Use plenty of cement. Enough so that it forms a small fillet between the nacelle and the wing. The rudder can now be put on, and the whole thing drying while you make the stabilizer.

This is put on last, and is fastened to the ends of outriggers. These outriggers are set into two small notches in the under surface of the wing, and glued into position. When these are dry they are sprung to the correct position, if they did not dry that way. The stabilizer is then cemented to these and also allowed to dry before the two outriggers connecting it to the nose of the nacelle are added. These are imbedded a short distance in the nose but merely rest against the bottom of the small wing. Be sure to give these joints a generous coat of cement.

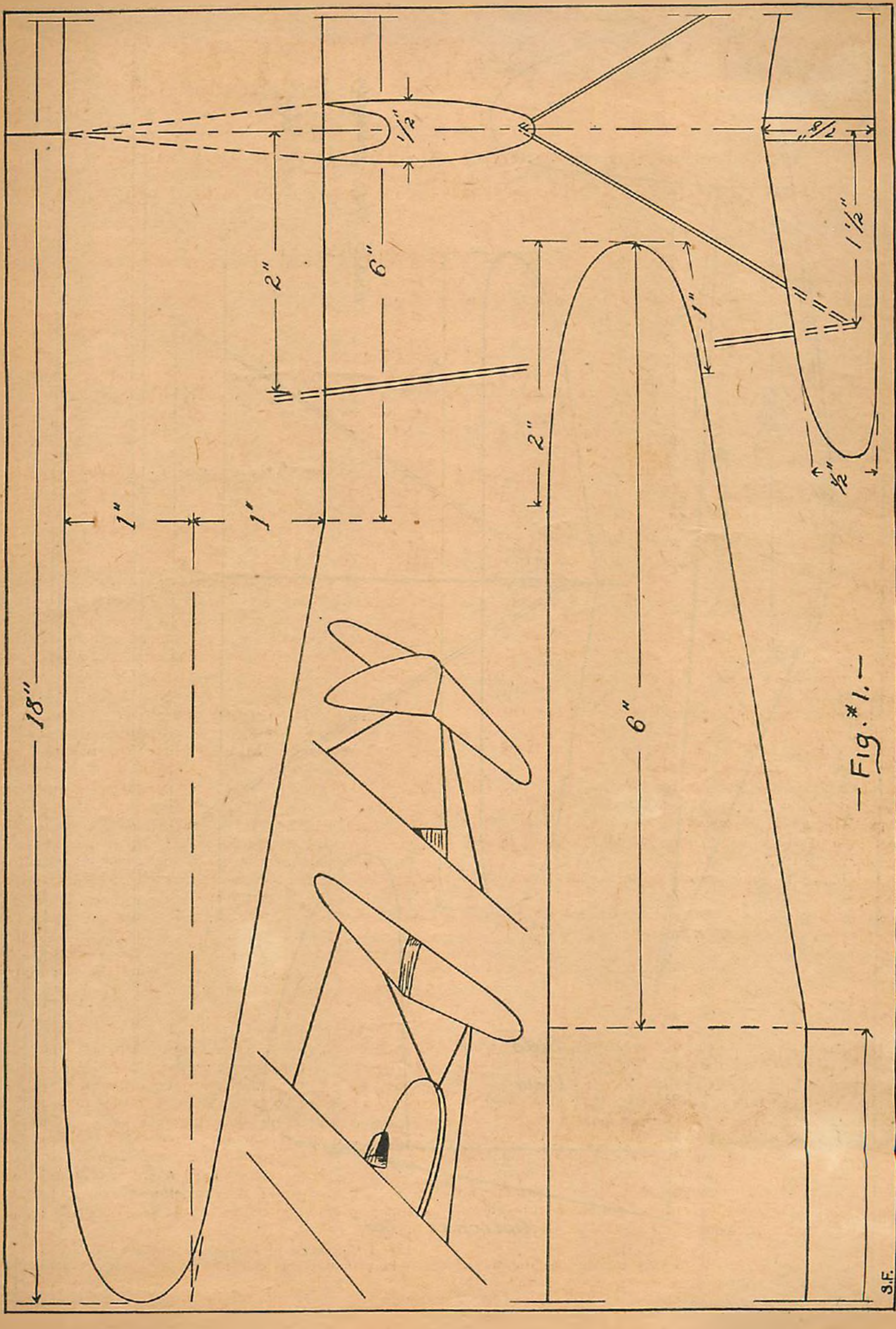
Flying

THE model is now ready to fly. First make sure that the front wing has plenty of incidence. The *exact* amount can only be determined by experiment, as each glider is necessarily slightly different, however as much as is shown in the side view ought to be sufficient.

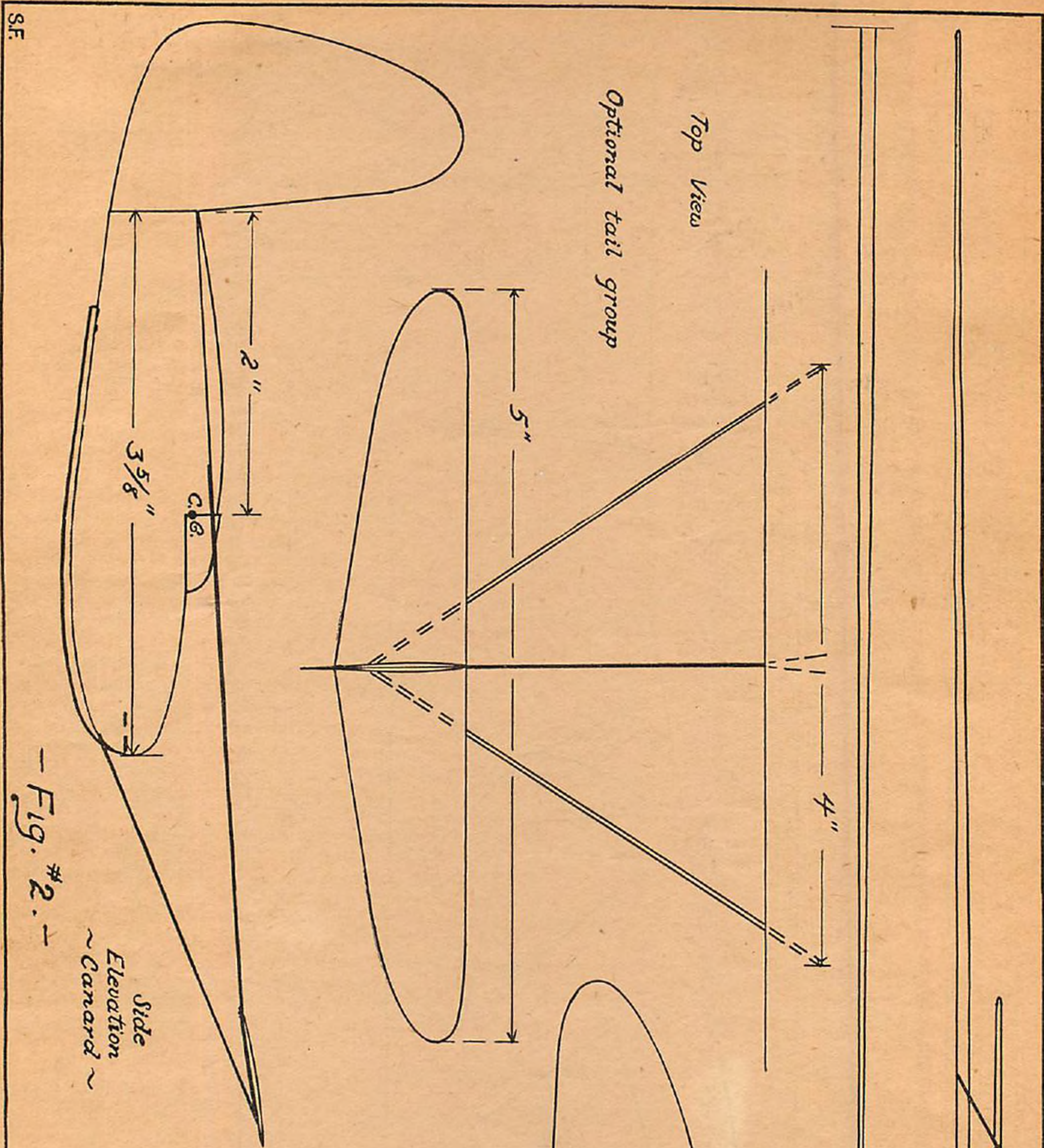
This is not strictly an indoor model, but a large room like a gymnasium is ideal for straight gliding.

When you first try the model it will probably "mush" badly. The ballast for this model is a strip of lead foil wrapped around the center of the small wing and glued in place.

The flying speed of the model is quite high but it sinks so slowly that it was able to soar slightly on a very damp day. (*Continued on page* 47)



— Fig. #1. —



S.F.
Top View
Optional tail group
2"
5"
4"
3 5/8"
C.G.
Side
Elevation
~Canard~
Front
Side
View
Optional tail

- Fig. #2. -

Aviation Advisory Board

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

...LL, friends, here we are on another attempt to penetrate the veil of mystery that surrounds our aeronautical problems. ...ions have *come to* me this month covering every phase of aviation work. However, the questions that predominate are those regarding the design of planes and, as the majority must always rule concerning what we publish in our columns, I will try to throw a little light on some very tricky problems. You probably have had these very same difficulties to contend with.

For instance, Warren Steely of Shillington, Pa., *says:* "I have considerable trouble with my flying scale models in trying to make them fly. Is there really some sort of a trick in it? Please be frank about this."

Well, Warren, this is one of the deepest problems of model building, and *if I may say so, there really is a trick* in making a scale model fly properly. The problem is just this: The usual scale model is an exact replica, or as nearly as possibly so, of a full-sized ship. This is in respect to measurements only in most of the scale models. Herein lies the difficulty. To have your model fly ...

about the vertical and lateral axes. This will tend to keep the ship steady in flight until it is disturbed or thrown over on its side by a gust of wind or *other* disturbing force. Then, this is where your trouble begins. The ship does not right itself as quickly as it should. Sometimes, it never regains its equilibrium. The *weight* of the rubber motor being a considerable distance from the vertical and horizontal axes tends to keep the ship rotating into a still gr... state of inequilibrium. In other words, a greater fo... be applied to the ship to return it to its normal ... tion which is not necessary in the ca... where the weight of the engin... on all airplanes, is produ... It is easy to see now ... ertia of your ship... weight, it is th... tail surface... overcome ... building ... enla...

A Course in Airplane Designing

More about Forces Acting On, and W... the Structure of an Airplane

By Ken Sinclair

(*ARTICLE 28*)

WE have said that nearly all engineering work deals with forces. In last month's article we dealt with forces from the standpoint of what they do and how they may be handled by the engineer, dividing them into components and determining their effects in certain definite directions.

Before going on with that important work of analysis and resolution of forces, it will be wise to spend a little time in studying the nature of the forces themselves, so that when we get through we will have the whole thing fingertips and ready for instant use.

... four kinds of forces that concern us most. ... friction, inertia, and applied forces. ... in turn.

... is the force exerted upon it ... earth. We say that a ball ... mean that, when the ... agent, the string ... to balance the ... held at rest. ... the earth ... elsewhere. ... to

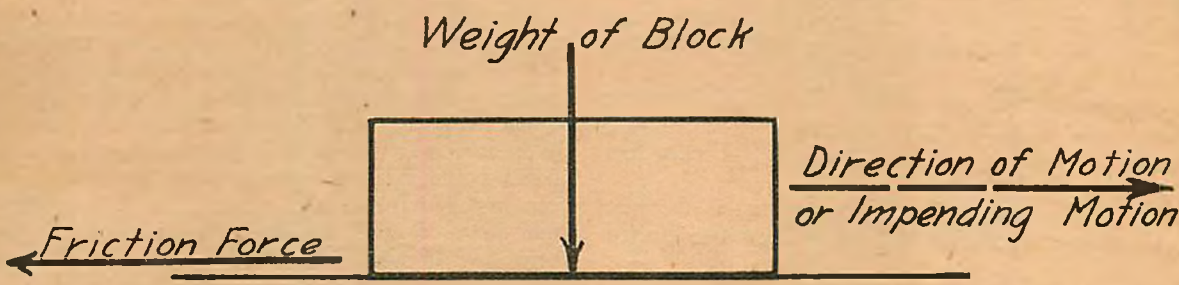
... duced by ... to the grind... these little ridges a... and humps. This grinding takes work and creates heat; thus fires can be built by rubbing two *sticks together* in the right manner. The more friction and the more work done the more heat is generated.

Oil cuts down friction and hence wear *by filling up those* little valleys and coating the ridges *with a film* that covers the irregularities. Thus the wear is largely in the oil, instead of upon the surfaces.

In fluids such as air, friction occurs because tiny *particles* of the fluid catch in the irregularities of the surface passing through and create small whorls and disturbances. This is the true frictional resistance of air; but it is not all of the resistance that is offered by the air to the passage of a wing or other object. An induced drag is also set up by the object's action in pushing the air away from it at the forward edge, forcing it aside, then letting it eddy together after the object has passed.

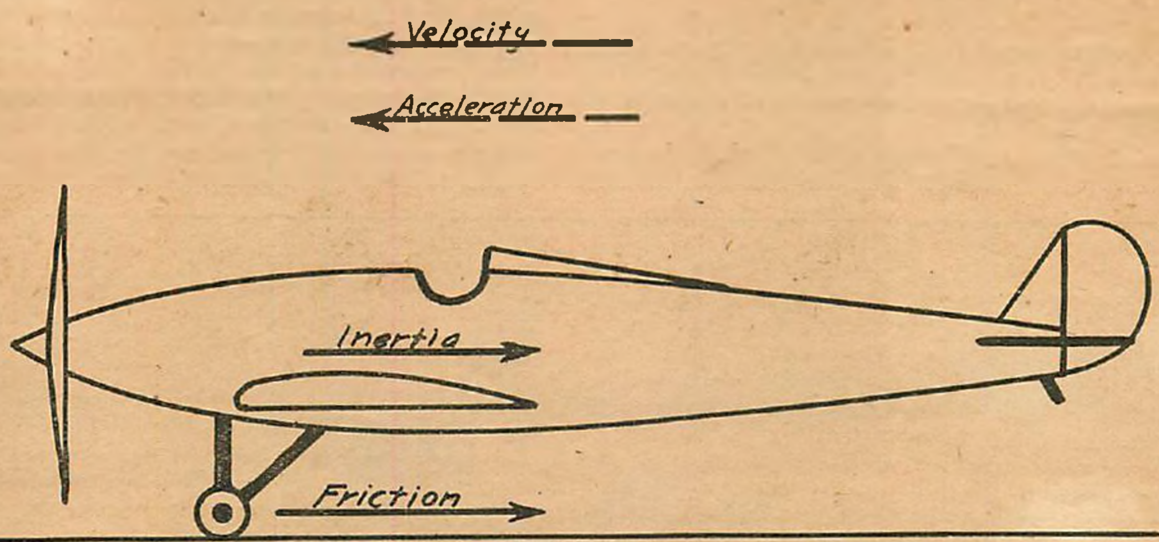
The amount of friction depends, not only upon the roughness of the surfaces, but also upon the force that is pressing the two surfaces together. Thus, if we have two

Figure 1



Amount of friction force depends only on force pressing surfaces together and coefficient of friction (μ) for those surfaces.

Figure 2



Curtiss-Wright in Peace and War

What the Up-To-Date Pilot will fly this year for Sport and Defense

ONE of the most popular light airplanes during 1931, the Curtiss-Wright Junior, has been developed into an amphibian weighing less than 1,500 pounds.

Under the direction of Mr. Walter H. Beech, President of the Curtiss-Wright Airplane Company of St. Louis, experimental flights have been made during the past few months giving gratifying performance.

The new Curtiss-Wright Junior Amphibian is the first of its type to be sold for less than $6,000 in the United States.

Many times during experimental flights landings have been made on bodies of water around St. Louis and on reaching shore the pilot merely lowered the wheels and proceeded to taxi along the beach.

The hull of this new plane is of wood construction with a cloth covering treated with pharoxilon glue making the wood and the cloth waterproof and the hull water tight.

The Curtiss-Wright Junior Amphibian is powered with a 90 horsepower Warner engine. The cruising radius is approximately 400 miles at a cruising speed of 75 miles per hour and a top speed of 100 miles per hour.

This plane can climb 500 feet during the first minute after taking off and will take off from water in 25 seconds with full load and from land in 10 seconds.

It has a length of 22 feet, a wing span of 40 feet, a wing area of 180 sq. ft., and a wing loading ratio of over 7 pounds per sq. ft. The gasoline tank carries 12 gallons and the oil tank 2 gallons. The gross weight is 1,300 pounds. It will carry two passengers and their baggage and can land on water only 12 to 14 inches deep with no danger of hitting bottom.

The Curtiss Aeroplane & Motor Company at Buffalo will deliver forty-six of the fastest standard pursuit planes built when they complete a contract for this number for the U. S. Army Air Corps.

This fast plane is known as the P6E Curtiss Hawk and has a speed of 197 miles per hour and cruises at 160 miles per hour. Its absolute ceiling is 26,500 feet.

Since its inception in 1923, the Curtiss Hawk, single seater pursuit airplane has been adopted as the standard fighting type of the U. S. Army Air Corps. The inherent excellence of the Hawk design has been successfully adapted to meet varying military requirements. No less than seven different power plants in both air, water and chemically cooled types ranging from 170 to 730 horsepower have been installed for various types of military work. During eight years of intensive research and study by the Curtiss Aeroplane & Motor Company engineers, the Hawk has been ready to meet the demands of modern military practice.

The latest type P6E, a development of the P6, is basically the same except that refinements have increased the performance qualities with reductions in weight and head resistance by use of Prestone chemical liquid cooling developed by the engineering section of the U. S. Army Air Corps at Wright Field, Dayton, Ohio. All Conqueror engines are equipped to use Prestone and is the only engine to be so equipped.

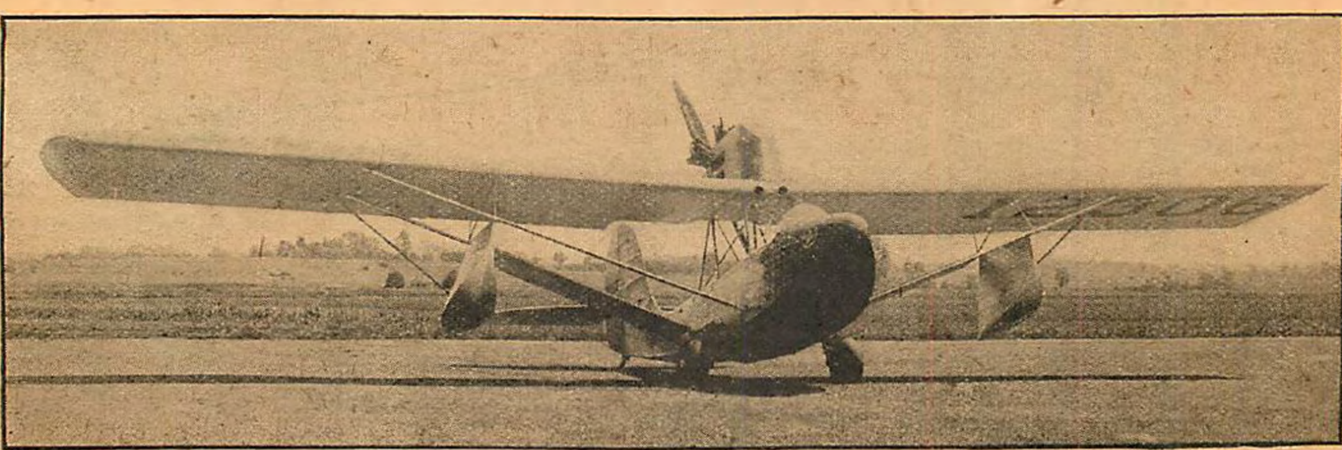
THE successful employment of Prestone has brought the weight of liquid cooled engines down to that of air cooled power plants without sacrificing the advantages of liquid cooling.

The frontal area of the plane, due to rearrangement, has reduced the size of the radiator and is more efficiently streamlined reducing parasitic resistance.

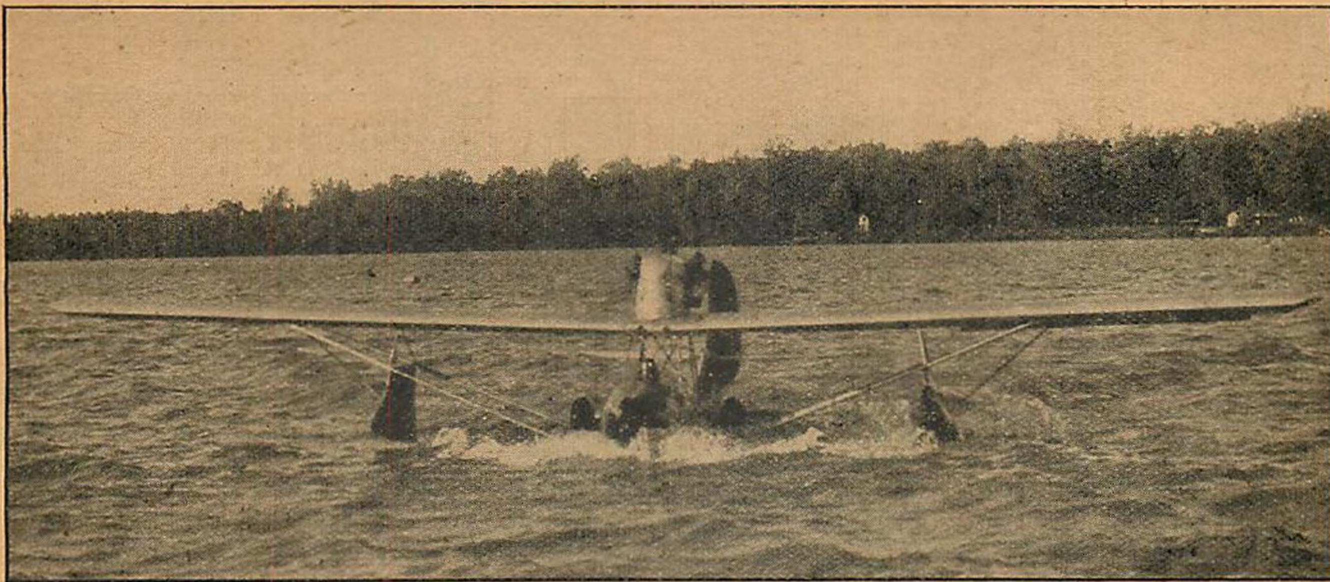
The rate of climb has been increased to 2,100 feet per minute and the plane can climb to 16,000 feet in 10 minutes having an absolute ceiling of 26,500 feet.

The new Hawk makes a striking appearance with its new streamlined landing gear, pants and engine sur-mounted with a three bladed propeller.

The P6 fuselage designed and constructed for this type Hawk represents an advancement over previous Hawk models as chrome molybdenum steel has been substituted for carbon steel in frame work effecting reduction in weight with full fairing and streamlining to increase the speed and efficiency. The single (*Continued on page* 48)

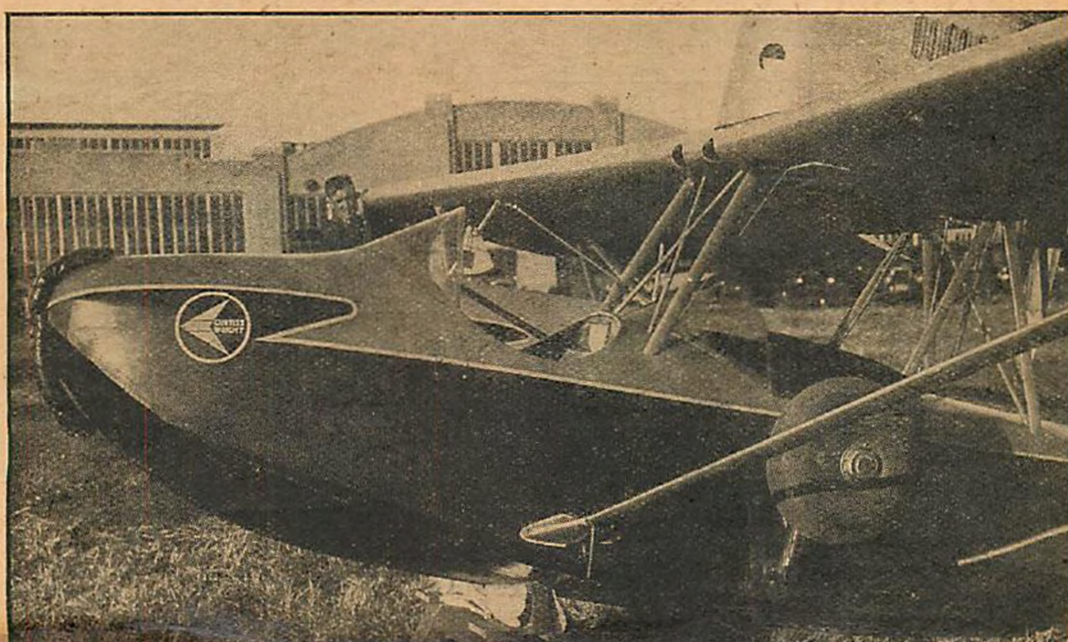


Curtiss-Junior Amphibian Ready for a Pleasure Jaunt.



Such Landing Places Among Nature's Charms are Plentiful.

Details of the "Junior" Amphibian Landing Gear.



The Curtiss-Wright P6E Pursuit Plane. Latest Battle Craft to Join Uncle Sam's Flock.

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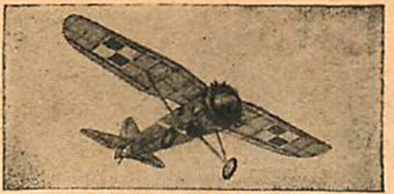
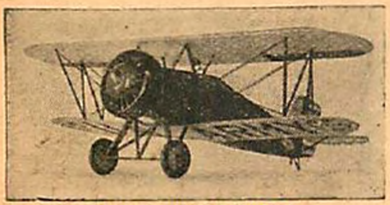
NO NEED of your taking substitutes or imitations— or something "just as good." Don't be dazzled with luringly low prices—unless you want incomplete Kits, pasteboard models, unfinished drawings and the like. Be on the safe side! If you want Cleveland quality—Cleveland performance—Cleveland authenticity—Cleveland beauty—be sure you get Cleveland-Designed models! If your local dealer can't supply you, order direct.

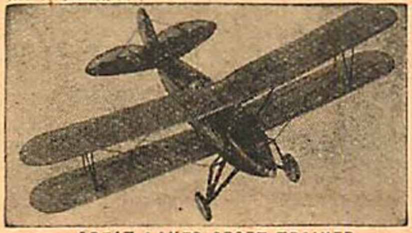
LAIRD SUPER-SOLUTION
Major "Jimmy" Doolittle's transcontinental record-breaker. Clips along at about 55 m.p.h. Flies 500 ft. or more. Span 15½"; length 13¾"; weight 1.7 oz. Colored yellow and green. Complete Kit SF-5, only $2.50 postfree. (Special Delivery, 15c extra).



POLISH P.6. FIGHTER
The graceful gull wing military plane of Poland. A high speed model. Flies 500 ft. or more. Span 25⅛"; length 17½"; weight 2.5 oz. Colored yellow, details black; red and white Polish insignia. Complete Kit SF-6, only $2.95 postfree. (Special Delivery, 15c extra).



NEW BOEING FIGHTER
Sometimes called Boeing's Helldiver. Big, husky, keen. Flies 500 ft. or more. Now used in U. S. air races. Span 22⅜"; length 14¼"; weight 2.0 oz. Colored yellow, green and black. Complete Kit SF-8, only $2.95 postfree. (Special Delivery, 15c extra).



GREAT LAKES SPORT TRAINER
Redesigned—much improved over the original Cleveland-Designed model that has become popular in many countries. Easier to build. Flies 500 feet or more. Span 20"; length 15¼"; weight 1.2 oz. Colored, orange and black. Complete Kit SF-1, only $2.50 postfree. (Special Delivery, 15c extra).

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A transparent quick-setting glue; especially adapted for the manufacture of model airplanes. Trial bottle mailed for 10c to cover mailing charges. Write for further information.
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W. 32nd and Detroit Ave. Cleveland, O.

MODEL—MOTORS
New 4 cylinder compressed air motor develops 1/10 H.P., at 1500 R.P.M., drives 11" to 18" props., $5.90 ready to run. Finest scale models and new supplies. Blue prints for 6 ft. Biplane gas and steam motors. 1932 catalogue 10c.
MINIATURE AIRCRAFT CORP.,
83 Low Terrace, New Brighton, N. Y.

Story of Roy Brown

(*Continued from page 4*)

come through the fight unharmed but one, who, with the thrill of battle over, had succumbed to his tired nerves and fatally crashed on the ground of the home landing field.

Still the hordes of grey clad soldiers advanced, and once more Brown was ordered to move his command further back—to Amiens. At this sector Brown, leading a patrol, sighted an Albatross two-seater. Up went his tail, and as if in a diagonal groove of the sky, Brown swooped at the Hun. But the enemy was too quick. Having escaped the first flight of bullets from the Camel's guns the Boche did not wait for more, but started home into German territory. Again and again, Brown raked the fleeing Albatross without result. Realizing that his position was not right, he drew close to the tail of the Albatross and determined to stay there until either he or the enemy should be hit.

Brave as this strategy was, it was ineffective for, to his horror, Brown found that he had been hit first. The gas line connecting his tank with his engine had been severed and the fuel was flooding the cockpit. Looking down he discovered that he was but two thousand feet over the German reserve trenches. Anti-aircraft shells were exploding all around him. Nothing was left to do but shut off the motor and put the ship into a long slow glide for the Allied lines. Luckily he reached them, landing on a hilltop about a mile inside the front line trenches.

BEFORE dawn the next day he was back at the landing place with an engineer and three mechanics. Looking over the ground, he found that only thirty yards were available for a take-off. The plane was soon fixed, and the five men pushed the ship to a spot at the very edge of the clearing on the hilltop. So far back did they place the plane that its tail hung perilously far out over the edge of a fifteen foot shell hole. Directly in line with the nose of the Camel and thirty yards in front of it yawned another hole.

For a moment Brown stood in thought. When he raised his head the four at his side were ready to follow his orders. He directed the engineers and one mechanic to stand in the shell hole and throw their entire weight on the tail of the ship. The two other huskies he ordered to stand on either side of the fuselage. When Brown gave the signal, the two men grasped the wings and held on for dear life while the flyer jockeyed the motor toward its top speed. When it seemed that the four men holding the plane must be torn from their positions Brown gave the signal to let go. The Camel rolled, slowly gathering speed, toward the crater at the edge of the field. Brown felt the wheels of his ship dip slightly as they rolled into the hole. Suddenly the ship gathered lift and with a thrill of relief and joy the flyer saw his ship clear the farther rim by inches. Turning quickly downhill Brown was off into the moist sky and reached the home airport before eight o'clock that morning.

On April 21st Brown again took off with his little flight. This time he was working under a handicap, for there was a new man in one of the ships behind his tail. Lieutenant May, new at the front, had never before been in a fight. Brown instructed him to fire only once and then streak for home. As an additional safeguard Brown resolved to watch May and protect him from trouble. Strange as it seems, this kindly thought was to be the cause of Richthofen's death.

At ten forty-five on the morning of April 21st, Brown with his flight, found himself well over enemy territory. His keen eyes sweeping the inverted bowl of sky with its flooring of shell pocked earth, the captain of the flight made out two British observation planes surrounded by Fokkers. Like whales wallowing in a school of killer sharks the two English planes were weaving hopelessly among a squadron of twenty-two Fokkers. With a waggle of his wing tips, Brown signaled his fearless corps to follow him into the unequal fight.

First into the fray, Brown found himself attacked by no less than three of the enemy. Immediately he dove, and to avoid a mid-air crash the three planes, which had been firing at him from both sides and above, were forced to draw back. Safe for an instant, Brown, true to his mental promise, looked about for May. There was the newcomer, and closing in rapidly was a pure red triplane. Richthofen at his work!

In an instant Brown had his own red nosed Camel pointed at the tail of the Fokker. Motor roaring at full blast, he set out to overtake the Hun before it was too late. As the red killer was but a matter of yards from the frantic May, Brown dove straight for the Fokker's tail. Down, down, down till his propeller hub was a scant 100 feet from the fleeing rudder. Below him Brown could see the soldiers in the Australian lines, sniping futilely at enemy planes. His two thumbs flashed to the triggers of his guns. A line of tracer bullets began to shear their way through the scarlet fabric of the plane ahead.

Brown saw the pilot turn in his seat to look backward, and caught the flash of his blue eyes. Gently as one would lift a baby, Brown raised the tail of his own ship. Suddenly he saw that his maneuvre had been successful. The figure in the cockpit slumped and collapsed, the red Fokker nosed gently for the ground, not three hundred feet below, and within two minutes had rolled to a stop behind the trenches. Baron Manfred von Richthofen, greatest of war aces, was dead!

Yet, as you know, the man who brought to earth this supreme killer received no credit for the deed. The Australian infantry men who had sniped at the red Fokker had no need to fly to an airport many miles behind the lines before turning in their report. With the eagerness of puny men to snatch credit for victories beyond their power to win, the groundlings stole the honors which should have been Brown's while that gallant airman was still in the air. The claims which they made were already in the hands of the General Officers when Brown's wheels touched the ground. Before the hero's report could be filed, decorations had already been granted to two Australian Tommies.

But in the minds of those who know the true facts, the name of Captain A. Roy Brown will always remain as that of the conqueror of Richthofen, Ace of Aces, Red Knight of the Air.

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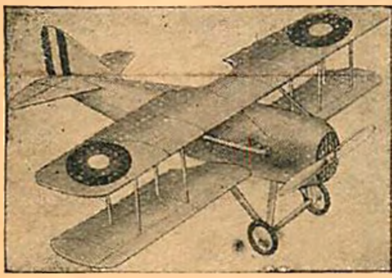

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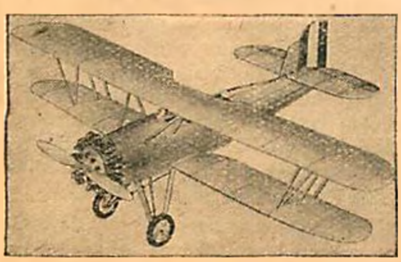

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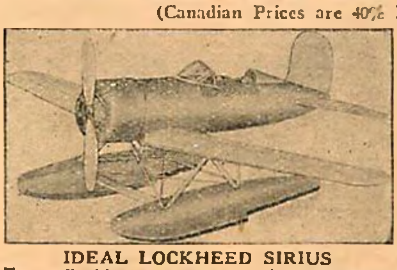

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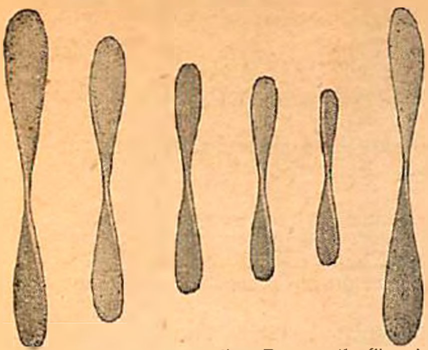

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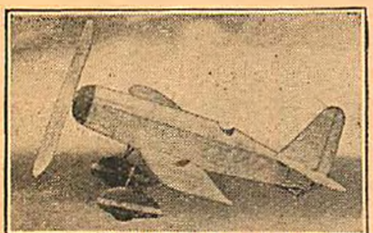

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(*Continued from page* 14)

may be tapered to a shape somewhat pointed at the tips. The propeller is finished with fine sandpaper and it must be carefully balanced. The shaft of .032 wire is glued in place and a small washer is glued to the rear of the propeller.

Wings

The first step is to cut all ribs to correct size. There are 18 of them all told, of four types as follows: 8 of shape No. 1 and 1/32" thick, 6 of shape No. 1 and 1/16" thick, 2 of shape No. 2, 1/16" thick, and 2 of the same shape 1/32" thick. Be sure the ribs of one shape are all of the same curve by piling them up and sanding the whole pile together.

The leading and trailing edges are 1/16" x 3/16" balsa. The tips are of bamboo and are all from a single piece 5/16" x 1/16". After the proper bend is obtained, the piece is split into four parts and these are trimmed down to 1/16" wide and 1/32" thick. You will then have four tips just the same size.

THE wing outlines, with rib positions are laid out on a board and the wings built up. The No. 1 shape 1/16" ribs go where the struts end, and the 1/32" ones go in between where there is not so much strength needed. The No. 2 shape 1/16" ribs are at the inside ends of the bottom wings, while the 1/32" ones go in the center section.

The top wing is made flat on the board and all in one piece, but the top 1/16" square spar is left out. When the glue has dried on the ribs, the two edges and the rear spar are cut half through with a razor blade and the spars carefully cracked. Do not break them completely, just crack them sufficiently to enable the outer rib on each side to be raised 9/16", where it is held by blocks of wood, while glue applied to the cracked spars hardens. Then the top front spar is glued in. When absolutely dry, the edges of all the wings are rounded and smoothed with fine sandpaper.

As shown in the top view of the upper wing, small blocks of cork are glued on. The tops of the forward interplane struts have an ordinary pin glued on each. This pin, stuck in the cork, will hold very well, and the wings may be adjusted for propeller torque or change of performance.

The struts are all of 3/32" x 5/32" balsa with the edges nicely rounded off.

Covering and Assembly

Before covering, the center section struts are fastened in place with glue, being held temporarily with pins. The angles and approximate length can be checked from the drawings.

The model is partly covered before assembling, as this makes both jobs quite a bit easier. The fuselage is covered first. No set rules can be given, but do not try to cover too much with one piece of paper, especially around the nose, where the many struts make the job a little difficult. Also, always run the grain of the paper lengthwise. This rule goes for the wings too. When the entire fuselage and tail surfaces have been covered, the wings are taken up. Cover the bottom of the top wing and the top of the bottom wings only, at this time. Be sure to follow this direction.

Small holes for all strut ends are cut in the paper with a razor blade point. The top wing is glued on first. When it is fairly dry, the bottom wings and connecting struts are put in. Again no rules can be given except to go slowly and with care so the job will be trued up when finished, the much used pins being again employed.

When the assembly work is done satisfactorily, the remainder of the wing coverings may be put on. You will find you have saved yourself a lot of work by following the recommended covering procedure. When all covering is finished, the whole model is sprayed with water. This is done with an ordinary household atomizer. The paper is just lightly sprayed, not soaked, and if done this way, you will have a fine, tight job when it has dried. No dope of any kind is used.

The propeller is assembled on its stick with several flat washers between it and the hanger. Flat rubber, 1/8", is used, the best amount being determined by trial. Start with three strands. It might fly on less if built very light.

Flying

WITH motor in place, it will probably be found that the model is tail heavy, and a small weight must be added to the nose. If the propeller was made of white pine, this would about make up the weight needed. If not, strip solder may be used, held on with a rubber band while testing. When the right weight is found, it may be glued inside on the radiator.

When the model glides steadily with no tendency to stall, the rubber may be wound, about 80 turns for a start. If the model persists in stalling, proceed as follows: remove the motor stick; from a strip of thin metal of any kind, cut a piece 1/8" x 1/2", and make a "V" notch in one end; then bend this piece and bind it on the motor stick, with the propeller shaft in the notch; adjust it so the shaft points slightly downward, the amount of tilt is correct when the model flies without stalling. See the detail in Figure VI to make this clear. This same arrangement can be used on almost any balky model to cure stalling.

Decoration

The British circles are put on upper and lower wings, and stripes on the tail. All struts, landing gear, wheel tires and tail skid are painted black. If the dummy motor and exhaust pipes are put on as shown on the small assembly drawing, these are also painted black. The radiator, wheel centers and axle are white. The propeller may be silver. If the wooden parts are rubbed with ordinary white paste, and, when this is dry, coated with quick drying lacquer, a beautifully shiny job will result. A small celluloid rectangle 5/8" x 3/8" makes a good windshield. By studying any picture of an S.E.5, many details will be seen which will add to the value of the model.

In conclusion, remember this is a lightweight, though strong, model, and should not be flown in bad weather. The model as made by the author weighs a bit less than three-quarters of an ounce. Any weight up to one ounce or a little over is fairly good, for there is plenty of area to support it.

Airplane Designing

(*Continued from page* 36)

Normal being the term used by engineers to indicate that one thing is at right angles to or perpendicular to another.

In Figure 1 we have a block which weighs, we will say, one hundred pounds. It is resting on a fairly smooth table. The coefficient of friction between the two is 0.25. What is the force necessary to move the block along with constant speed?

Knowing that the only force to be opposed is the friction force, we have only to find that force to determine how hard we must push on the block. Multiplying one hundred pounds by 0.25, we find the friction force to be twenty-five pounds, acting opposite to the direction of motion.

Notice that friction acts opposite to the direction of motion *and also* opposite to the direction of what we call impending motion. That is, if a box is placed on the side of a hill, we may find that, although a component of the box's weight is acting parallel to the slope and urging it downward, the box will remain stationary.

What is holding it there? We know, from equilibrium of forces, that there must be some force large enough that the component of the weight cannot equal it. The opposing force is friction, which is acting even when the box is not moving but *trying to move*.

Another interesting point in connection with friction is that it does not depend upon speed to any extent. It is true that starting friction, for cars, trains, etc., is larger than rolling friction; but this is due to the fact that the oil is not well distributed in bearings at the start and to the fact that inertia force in starting is often mistaken for friction by the layman.

WE HAVE discussed two important kinds of forces. We can see, immediately,

(*Continued on page* 45)

Aerodynamic Design

(*Continued from page* 12)

ates very little lift.

This type of section is used on weight carrying planes and has the advantage of large internal space for sturdy spars to carry the load. It is one of the later types.

Section No. 3 is a high lift section of the old type used during the war period. Its upper surface has considerable heighth of camber which develops high lift. Also a fair amount of lift is developed by that curved-under surface. The allowable space for spars, however, is very much less than in section No. 2.

Sections No. 4 and No. 5 have less camber, and illustrate medium lift sections (fineness ratio from (11) to (9)). Section No. 4 derives its lift from a well curved upper surface, a very small amount being contributed by the flat lower one. In the case of section No. 5, the lower surface is slightly curved, and the total lift is created by the combined effects of this lower camber and medium high upper camber.

The next two sections, No. 6 and No. 7, typify those used for speed. They both have comparatively low upper cambers. The lower camber of No. 6 is curved slightly, merely to conform with the wave flow of air as it passes under it. It has very little

(*Continued on page* 46)

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1/8 x 1/4	.02	6 for .10
1/8 x 3/8	.02	6 for .10
3/16 x 1/4	.02	6 for .10
3/16 x 1	.06	6 for .33
1/4 x 1/4	.03	6 for .15
1/4 x 1	.07	3 for .20
1/2 x 1/2	.07	3 for .20
1 x 1	.18	3 for .50
1/8 x 3/16	.01	6 for .05
3/16 x 3/16	.02	6 for .05
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1/4 x 2	.11
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The Airplane Engine

(*Continued from page 7*)

much as forty-five per cent of the original crude oil volume is now recovered as gasolene. It has been estimated that over thirty-five per cent of all the gasolene produced is obtained by this process.

When gasolene is first distilled from the crude oil we have seen that it contains many oils having different characteristics. This crude gasolene distillate is now run through yet another distillation process in order to more closely define the various oils. Three different classifications of fuel are obtained. The first will be known as Grade A or Fighting Gasolene. It is extremely light and volatile and naturally will give a good starting mixture to an engine. On the other hand it is entirely possible that it might vaporize before reaching the carburetor and cause an engine failure. This is called a vapor lock. Then, too, it is so light that not so many heat units could be carried for the volumetric space available in the fuel tanks of the plane. It must be remembered that the heat value of a fuel is measured by weight rather than by volume. This fuel, then, is seldom used except in special cases such as racing planes.

THE next fuel is Grade B, better known as Domestic Aviation Gasolene. The expression D. A. G. is sometimes used to indicate this fuel. While not so volatile as Fighting Gasolene, nevertheless it is satisfactory in this respect, and, besides, it is heavy with heat units that contribute to engine power and performance. It is used by military, naval, and commercial planes throughout the country.

Grade C fuel, of course, is the one having the heaviest molecules. Naturally, it is less volatile than the other two grades and since it begins to approach the lower grade oils, its heat content is not so high. For these reasons this fuel is used exclusively in automobiles. Its lack of volatility makes it unsafe for use in aviation as it might fail to vaporize under cold weather conditions and result in a forced landing. If a low compression airplane engine is hot, it can be made to operate on Motor Gasolene in an emergency.

We have seen that gasolene is not a pure substance. Rather it is a compound of several hydrocarbons. Commercially, it also includes the various types of naphthas. Varying characteristics of the whole result from the proportions of the several ingredients. For our purposes, however, we may consider that it consists of approximately 85% carbon and slightly over 14% hydrogen. The remainder will be impurities of various natures and some oxygen and nitrogen.

Gasolene is an ideal fuel for the internal combustion engine. If combustion is perfect, it burns cleanly, leaving no ash or carbon as do such fuels as coal and wood. Imperfect combustion, of course, will result in the formation of carbon in the cylinder. Moreover, it contains more heat or energy units per pound than any other feasible fuel. For its weight, then, it will supply the greatest possible power to the airplane.

The color of gasolene means very little providing, of course, the discoloration does not indicate foreign matter in the fuel. Gasolene that is perfectly waterwhite when refined will slowly darken or discolor upon long storage. Its heating value, however, is not effected. Nor does the specific gravity indicate a great deal to the purchaser. If the fuels in use today were straight hydrocarbons, the specific gravity would indicate the lighter gasolene and consequently would give some indication of the volatility or ability to vaporize.

Obviously a radical change in the specific gravity of the fuel being used would result in a change in the amount of fuel maintained in the carburetor bowl by the float and trouble might easily result.

We have noted before that the one big disadvantage of the gasolene as a fuel is its tendency to knock or detonate. Especially is this true today when engineers are attempting to gain more power and efficiency for both automobiles and airplanes by increasing the compression ratio of engines. Both of these results are obtained up to a certain point and then a sharp decrease in power follows.

In addition, the metallic knocking or "pinging" that is heard during detonation places tremendous and abnormal pressures upon the cylinder and piston head as well as the main bearings. It is entirely possible that a hole will be blown through the piston head, thus permitting flames to reach the lubricating oil. A fire is the logical result.

Many different theories have been advanced from time to time in an effort to explain detonation. Each theorist can offer several arguments which appear to verify his particular belief, but it is probable that it will be many years before the exact process of detonation is accurately analyzed.

Photographs and observations of actual combustion have been made through quartz windows placed in cylinders and indicator diagrams of cylinder pressures have been taken by many investigators. All research engineers who have worked on this subject agree that detonation occurs only during the latter part of combustion. The early part of the charge burns in a perfectly normal manner.

At this point it might be well to differentiate between pre-ignition and detonation. The first condition is the firing of the charge before the normal ignition point is determined by the breaker points of the magneto. This may be caused by the presence within the cylinder of an incandescent particle of carbon, an extremely hot valve, or spark-plug electrode. This heat combined with the normal rise in temperature of compression may be sufficient to ignite the charge early.

Because of the tremendous heat generated by detonation, this phenomena may lead to the heated conditions favorable to pre-ignition. Due to the early burning of the charge the maximum pressure will be built up within the cylinder before the piston reaches top dead center. This pressure, then, will endeavor to resist the upward motion of the piston. The net result of this will be a great loss of power.

AS COMBUSTION continues more and more pressure is placed upon the remaining fuel mixture. The heat of this internal compression, combined with the heat of combustion, raises the temperature of the unburned portions so quickly that

(*Continued on page 48*)

Airplane Design

(*Continued from page 43*)

that if we were to push a box *up* an incline we would have to buck two opposing forces—assuming a constant velocity—those being friction and the tangential (parallel to plane) component of the weight. But if we were pushing the box downhill we would find the component of the weight helping us, and the box would move much more easily. If the hill were steep enough and the surfaces smooth enough, the weight would take care of friction of its own accord and pull the box down the incline without any help.

The main things to remember about friction are these:

1. Friction always opposes velocity or impending motion.
2. Friction depends upon the normal force and the nature of the two surfaces in contact.

The third type of force that we deal with is inertia force.

This is a little more obscure than the others at first, but is very important.

We have said in previous articles that inertia is the force with which a body resists a change in its motion. This property depends upon two things: the *mass* of the body and the *rate of change* of motion.

The mass, of course, is measured by the weight of the body at the surface of the earth. But the *rate of change of velocity*, which is another way of saying *acceleration*, will have to be explained further.

Suppose an airplane is taking off. It starts from rest at the end of the runway, attaining a velocity of thirty miles per hour in ten seconds. Thirty miles per hour is forty-four feet per second. That is the final velocity. The initial velocity is zero. Therefore the ship has gained a speed of forty-four feet per second in ten seconds; or, assuming the acceleration constant, it has picked up speed *at the rate of* four and four-tenths feet per second velocity *per second*. In each second it gains four and four-tenths feet per second velocity.

That is the acceleration, or rate of change of velocity.

Knowing the mass, then, we may find the force that must be supplied by the propeller to equal the inertia force, which is constant in this case because the acceleration is constant; and by adding this force to the friction force we can find the total pull that must be exerted by the prop.

Right here we must mention that *inertia force always opposes acceleration*. In the case above the acceleration is positive—the ship is gaining speed—and therefore the inertia force opposes the acceleration and acts in the opposite direction.

In the case of a train that is stopping quickly, the acceleration is negative—deceleration, it is sometimes called—and the inertia is acting in the same direction as the velocity but still *opposite to the acceleration*. The inertia, then, is trying to keep the train going forward against the efforts of the brakes. Some of our automobile accidents demonstrate the remarkable strength of inertia forces when a rapidly-moving body is stopped in a very short distance.

It is excellent practice, in all engineering work, to get everything relevant to the problem down on the paper. As shown in Figure 2, which represents the airplane mentioned above, put down the velocity arrow and the acceleration arrow, if any, in-

(Continued on page 47)

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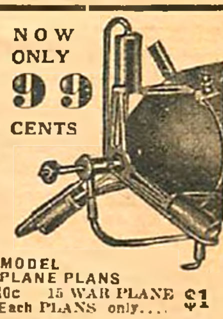

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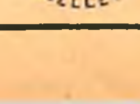

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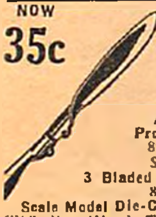

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Aerodynamic Design

(*Continued from page 43*)

lifting effect. The lower surface of No. 7 gives even less, as it is curved downward instead of upward. There is no advantage in using such a section on a model except for speed.

Section No. 8 is similar to the old Eiflle No. 32. The interesting point about this wing curve is its reversed curve trailing edge.

On all of the other sections shown, the movement of the center of gravity is considerable, moving from front to rear of the wing as the angle of attack decreases, and visa versa. However, the reverse curve tends to reduce the movement of the center of pressure. The greater this upward curve at the trailing edge, the less the center of pressure moves about. If sufficient reverse curve is used, the center of pressure will remain stationary throughout the entire useful range of the angle of attack.

This condition enhances the stability of the airplane, but is gained at a sacrifice of wing efficiency. It reduces the lift generated by the section by as much as 15%. The loss in efficiency is proportional to the amount of reverse curve.

On page No. 28 a variety of sections are shown of both past and present type. The figures show the heighth of the respective points of the curves forming the sections. This diagram provides a variety of types from which you may conveniently select one for the model you wish to build.

Aspect Ratio

We have now one or two more points about the design of the wing which are important. For instance, how much span from tip to tip, and how much chord shall we give the wing? If we make the wing with a chord of three inches (Fig. No. 12), the span should be at least six times as great, or 18 inches. If we make it seven times as great, or 21 inches, it will be more efficient. In other words, the greater we make the span compared to the chord, the more efficient our wing will be.

However, it is not advisable to make the span more than *12 times* the chord for then there is very little increase in efficiency and such a wing becomes difficult to build so that it is strong, yet light. This relationship, or ratio, between the span and the chord is called the *Aspect Ratio*. It is, the span divided by the chord, or

$$\text{Aspect Ratio} = \frac{\text{Span}}{\text{Chord}}$$

If the span is 21 inches, and the chord is three inches, the aspect ratio equals, $\frac{21}{3}=7$. In the case of all wings, a part of the air under the wing spills out of the ends. You can readily see that if the span is small and the chord large, that the wing tips are very wide compared to the span. Therefore, more air escaped out of these wide wing ends than if they were quite narrow and the span large. This action of the air reduces the lift, and explains why we make the span large and the tips narrow or, in other words, gives a high "aspect ratio" to our wing. The air will pass across such a wing before it can spill out of the ends, and no loss of lift will occur. Fig. No. 13 shows how the air flows under a wing in flight.

The reason for the air flowing out of the ends in this manner is due to the fact that there is a high pressure under the wing at (A) and a lower pressure at (B) so the air naturally moves from the point of high pressure in the direction of the low pressure point. At the center (C) under the wing, the lift is greatest.

The following table gives the approximate relative efficiency of wings of various aspect ratios, when the efficiency of a wing with an aspect ratio of six is taken as (100%).

Aspect Ratio	(9)	= 113%	efficient.
" "	(8)	= 111%	"
" "	(7)	= 107%	"
" "	(6)	= 100%	"
" "	(5)	= 92%	"
" "	(4)	= 82%	"

Raking the Ends

If we make our wing with square ends as in (A), Fig. No. 13, the four corners will give very little lift, due to the spilling action of the air, yet will cause considerable resistance, so, therefore, we cut them away. rounding the ends neatly, as shown in (B), Fig. No. 14. This will help to reduce weight and resistance. We call this procedure "raking the wing ends."

Tapered Wings

Probably the reader has seen airplane wings that are wide at the center portion near the body, or fuselage, and which taper to a narrower width at each wing tip. Wings of this type are called *Tapered Wings*, Fig. No. 15. They may be tapered in any one of the three ways:

1. The rear, or the trailing edge, may be straight, while the leading or front wing edge slants backward, starting from the center and proceeding towards the tips. (A) Fig. No. 15.

2. The front edge may be straight from tip to tip, and the rear edge slanting forward from center to tips. (B) Fig. No. 15.

3. Both wing edges may converge at the wing tips thus forming a tapered profile. (C) Fig. No. 15.

Amount of Taper

A good rule to follow in order to secure the best results from a tapered wing is to design it so that the "chord" or width of the wing at the tips is *one half* the length of the "chord" at the center. For example: If you wish to build a wing with a (21) inch wing span and an Aspect Ratio of *seven*, the average chord would be three inches, and the area equal to (63) square inches. Then, in order to have the area of your tapered wing equal to (63) square inches and the "chord" at the tips equal to *one half* the "chord" at the center, the "tip chord" must be (2) inches and the "center chord" (4) inches.

The best way to determine the length of the "tip chord," which is to be equal to one half the center chords, is to first decide what the average chord is to be. The "tip chord" then is equal to 2/3, and the center chord to 4/3 the average chord.

Of course, you may wish to use some other degree of taper. You can do so without getting into difficulties if less taper is used. For instance, a taper of such value that the tip chord is 2/3 or 3/4 of the center chord. But, it is to your advantage to put as much taper as possible on your wing provided it does not create any other bad conditions. I would say that the "one to two" chord ratio should be the maximum amount.

If the taper is greater than this, the lateral stability of the ship will be effected, and the propeller torque will react to turn the plane over on its side, to a greater extent, because of lack of wing area near the wing tips. Most of the area of the tapered wing is at or near the center.

Airways Here & There

(*Continued from page* 31)

publication of the February issue. The picture will be judged on the following points:

1. Its likeness to a full-size airplane.
2. The quality of the picture in respect to photographic detail shown.
3. Photographs of planes in flight shall have precedence, the other two points being equal.
4. Two pictures may be submitted, one to show detail and likeness to full-size planes, and one in flight to show flying quality. Such pictures will be considered as one entry and will have precedence provided no one else obtains equally fine results in one photograph, namely, photographic detail, and flying quality demonstrated.
5. In case of a "tie," a prize will be awarded to each tieing contestant.

All pictures, to be eligible for a prize award, must be mailed to this office before March 10th, 1932.

Airplane Design

(*Continued from page* 45)

dicating definitely their direction. Then, looking at the velocity arrow, put down the friction force, making it opposite to the velocity, and the inertia, making it opposite to the acceleration. In this way you can guard against mistakes.

Going back to the inertia problem, we will work out a practical case to get a better grasp of the principles involved.

Suppose the mass of the airplane is one thousand pounds. The acceleration, as before, is four-point-four feet per second per second. (Always say per second *per second* when speaking of acceleration. Acceleration stated in feet per second means nothing: that is velocity.) Our problem is now to find the inertia force.

The easiest way is to use a proportion. We know, by experiment, that the force of gravity, acting on any mass with a force equal to that mass, will produce an acceleration of thirty-two feet per second per second when the body is freely falling. The force of gravity, then, if acting on the whole airplane with air resistance neglected, would produce an acceleration of thirty-two feet per second per second. The mass of the plane is one thousand pounds. Therefore we can say:

$$1000 : 32 :: F : 4.4$$

From which $F = \frac{4400}{32} = 137.5$ pounds.

The proportion means this; that a one-thousand pound force will produce, in our one-thousand pound mass, an acceleration of thirty-two feet per second per second, so the inertia force must be such that it will produce an acceleration of four and four-tenths feet per second per second on the same mass. In other words, the known force (weight of the body) is to the acceleration it will produce, as the accelerating force is to the acceleration it is to produce. Of course the accelerating force and the inertia force, from the law of equilibrium,

(*Continued on page* 48)

Scrambled Picture Contest

(*Continued from page* 8)

enter and win a prize. It is up to us to find the right field and go to it.

Those of you who were unable to win a prize in this contest will, undoubtedly, be pleased to learn that we are going to give you another chance. We are now preparing a second big contest, not a scramble picture contest, but one which will give you great pleasure in working out, and reward you with a complete picture history of aviation. We will not say any more about this now. This is merely a little sample, so to speak. It reminds me of the spoon that we often lick while our sister's fudge is cooling. This proposition, however, is not cooling off. It is getting hotter each minute, so keep your weather-eye peeled and look for a complete announcement in one of the following issues.

CHAS. H. GRANT,
Editor.

Two-way Glider

(*Continued from page* 32)

Changing the Tail to the Rear

This model is very easy to convert from canard to penaud.

The only change in material is a piece of balsa 1⅛" x 2¼" x 1/32" for the rudder and the bamboo tail booms. Two of these are 3⅝" long, and the third is 2¾" long. The stabilizer is attached in the same manner as before, except that it is inverted, that is, the cambered surface is down. It is not necessary to give it a negative angle but at any rate, it should not be positive. After the stabilizer is firmly glued, the rudder is put in place. When this tail is completed, it may seem rather flexible. However, because of this, it is able to take shocks better.

For this type of glider, the model should balance about ½" back on the wing. A neat way of ballasting it is to force a nail into the nose. This should be of a weight slightly greater than necessary. Then to get a fine adjustment, take it out and cut a short piece off the end until the model gives the best possible glide.

A gliding angle of about 16 to 1 has been attained with the tail in rear, and in any case should not be less than 12 to 1.

* * * *

Watch next issue for directions to convert your glider to a powered plane.

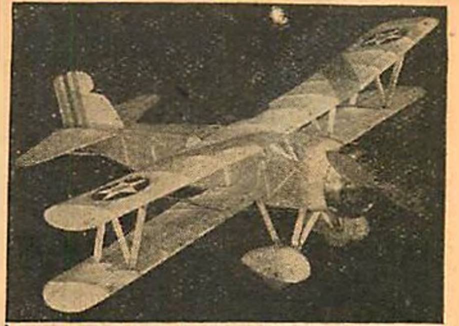
Aerial Radio

(*Continued from page* 25)

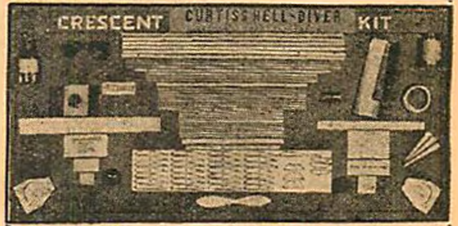
is being used it is advisable to have this as near the battery as possible to minimize leakage along the power leads. The wind driven generator may be mounted almost anywhere, except that undue lengths of power leads should be avoided for the reason just given. Also, if the generator is placed directly in the slipstream of the propeller, it will be possible to test the radio equipment on the ground. Too near the lower half of the fuselage is not a good position for two reasons. The generator may be damaged by stones, etc., thrown up while taxiing, or it may foul the antenna wire if a trailing aerial is used.

Figures No. 9 and No. 10 illustrate complete radio installations on different types of planes.

CURTISS-HELL DIVER



18" wingspan. ⅞ ounce Crescent Flying Scale Model. Flies 300 ft., with new special balsa non-air-resisting propeller. Easy to build, strong, and snappy in appearance.



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Dia.	Open Faced.	Closed Face.	Anti-Drag.
1½"	30	20	25
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2½"	40	40	35
3"	50	50	45
3½"	60	60	55
4"	65	65	60

10c. *Packing and Postage.*

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1¼" dia. 7-cyl. with prop..........$1.00 *Postage 3c*
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.005—6" Wide—	Aluminum—	Brass—	German Silver
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Pursuit type unmounted 15c

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Aviation Advisory Board

(*Continued from page* 35)

should be 30% of the area of the main wing in the monoplane type. It should be 23% of the area of the two main wings in the biplane type. Make the fin area 12% of the wing area in the case of the monoplane and 10% of the area of the main wings in the case of the biplane. These are general figures which will apply to most machines. It is possible to modify the sizes of these surfaces in specific cases. This, however, requires considerable experience.

In your case, Warren, I should say the trouble with your machine is just the point which we have been discussing. Larger tail surfaces with a slight reduction in the negative angle of the stabilizer will probably cure the difficulty.

Important Notice

When submitting drawings, make them in panels (6¾ x 10"), which is the size of our pages. The number of panels necessary is not important.

Several manuscripts and plans have been rejected because it has been impossible to place the drawings properly on our pages.

EDITOR.

Curtiss-Wright in Peace and War

(*Continued from page* 38)

cockpit has been lined with aluminum painted micarta adding to a clean, efficient cockpit.

The gas tank has been moved to provide more leg room for the pilot.

The Curtiss Conqueror engine is the same as those used in the Curtiss Condor Transport and in the DO-X with twelve, they carried the giant plane across the Atlantic ocean. The Conqueror engine develops 650 horsepower and the main gasoline tank has a capacity for 50 gallons of gasoline and an auxiliary tank for 50 more gallons.

The landing gear is of the single strut type and a tail wheel has been added to this model which is steerable with the rudder.

Characteristics.

Span, 31′ 6″. Length, 23′ 1″. High speed, 197 m.p.h. Cruising speed, 160 m.p.h. Landing speed, 63.4 m.p.h. Rate of climb, 2,100 ft. per min. Absolute ceiling, 26,500 ft. Curtiss Conqueror, Prestone cooled, 650 horsepower direct drive. Three-blade propeller. Landing gear—single strut type. Tail wheel steerable with rudder. Cockpit lined with micarta. Gasoline capacity 50 gallons. Gasoline auxiliary capacity 50 gallons.

The Airplane Engine

(*Continued from page* 44)

the heat cannot be passed off to the cylinder head. At last the critical temperature is exceeded and the remaining fuel burns practically instantaneously. This combustion is entirely different from that immediately preceding it. A very fast detonating wave is set up which strikes the cylinder head and causes the metallic "pinging" noise we hear.

While the sharp noise is one symptom it is not the only one by any means. The exhaust will become smoky, the engine will heat up very quickly, and a loss of power will be apparent at once.

Detonation is to be stopped at once if engine damage is to be avoided. The pilot should throttle down until his engine has cooled. By reducing the amount of mixture going into the cylinder less compression of the charge takes place and less energy is released. Consequently, less heat results. Retarding the spark will also tend to reduce detonation as it delays the final act of combustion until expansion of the gases begins to take place. However, a loss of power results, so this becomes a questionable method of preventing knocking.

Fundamentally, the operator must go to the root of the trouble and use a fuel with a better anti-knock value. Certain doped fuels will eliminate this difficulty. Tetraethyl lead is one of the most efficient anti-knock materials yet discovered. While effective in its pure state it will deposit lead oxide or litharge upon the valves and spark plugs. A volatile substance, ethylene dibromide, is added to carry the deposit out the exhaust stacks.

A lubricant, hallowax oil and red dye, is also added and the resulting compound is known as ethyl fluid. Mixed with gasolenes in such a proportion that it has a standard anti-knock rating it is available throughout the country. This gasolene is excellent fuel for the compression ratios used in automobiles of today.

While the doped fuels make it feasible to use a compression ratio of 6:1 in automobiles, this is but a beginning. Aviation power plants are running well above 6:1. As a matter of fact the Rolls-Royce engines used in the recent Schneider Cup Races used a compression ratio of over 8:1. In order to permit this, the fuel used consisted of high-test gasolene, ethyl fluid, and methyl or wood alcohol. As a matter of fact, internal combustion engines have operated successfully with ratios of 10:1. It must be remembered, however, that fuel for these special engines is very expensive and well beyond the purse of the average pilot or drive.

The problem facing engine designers is to build power plants with higher power-weight ratios. To do this it is necessary to go to higher compression ratios and this is limited by the detonation of present-day fuels. The controlling factor of power plant development, therefore, is the anti-knock quality of the available fuel. It is essential that methods be discovered for giving anti-detonating characteristics to present-day fuels, or that new fuels for internal combustion engines be found.

The following article will deal with the overhaul of the airplane engine, its testing and installation. The necessity for careful inspection to eliminate future engine troubles is emphasized.

Airplane Design

(*Continued from page* 47)

must be equal and opposite, so we can use their magnitudes interchangeably.

Knowing that, in any proportion, the product of the means must equal the product of the extremes, we multiply the extremes together and divide by the one mean that is present. This gives us the other mean.

In many cases, such as the starting of a large train, the inertia forces are much greater than the friction forces.

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12" Wingspread
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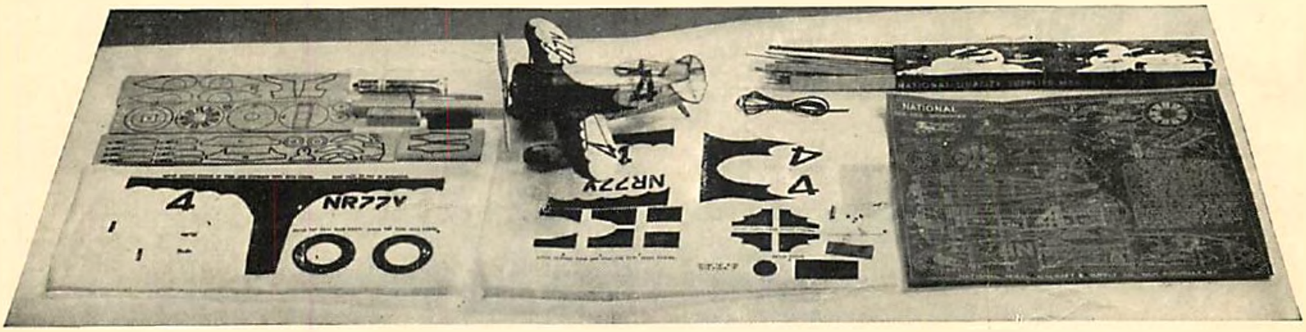

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1/8 x 1/4	.02	5 for	.09
1/8 x 3/8	.02	5 for	.09
3/16 x 3/16	.02	5 for	.09
3/16 x 1/4	.02	5 for	.09
1/4 x 1/4	.03	5 for	.12
1/4 x 3/8	.03	5 for	.12
1/4 x 1/2	.04	5 for	.18
3/8 x 3/8	.05	5 for	.22
3/8 x 1/2	.06	5 for	.25
1/2 x 1/2	.08	5 for	.35
1 x 1	.17	2 for	.30

40" Strips

1/8 x 3/8	.04
1/8 x 1/2	.04
3/16 x 3/8	.01
3/16 x 1/2	.05

Sheet Balsa

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

Plank Balsa

1 x 3 x 36	.33
1 x 6 x 36	.60
2 x 3 x 36	.60
2 x 6 x 36	.90
2 x 5 x 40	.90

Balsa Propeller Blocks

1/2 x 3/4 x 5	3 for	.04
1/2 x 3/4 x 6	3 for	.05
5/8 x 1 x 7	2 for	.05
5/8 x 1 x 8	2 for	.05
3/4 x 1 1/8 x 8	2 for	.07
3/4 x 1 1/8 x 10	2 for	.09
3/4 x 1 1/8 x 11		.06
7/8 x 1 1/2 x 11		.07
5/8 x 1 1/4 x 12		.07
7/8 x 1 1/2 x 12		.08
7/8 x 1 1/2 x 14		.10

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2 oz. can	.13
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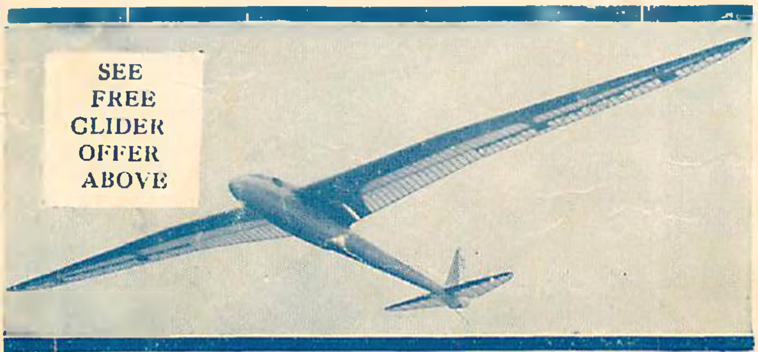
Pint	.90



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4. Postage stamps, Canadian or Foreign Coin not accepted as payment.
5. Remit by check, postal or express money order. Make payment to MADISON MODEL AIRPLANES, INC., 134 Livingston St., Brooklyn, N. Y.
6. Add 5c for insurance against breakage in transit

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1 diam.—Pair		.08
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