AIRPLANE ENGINES: What They Are and Why: by Lt. H.B. Miller, U.S.N.A.C.

Model Airplane News

PRICE 15c

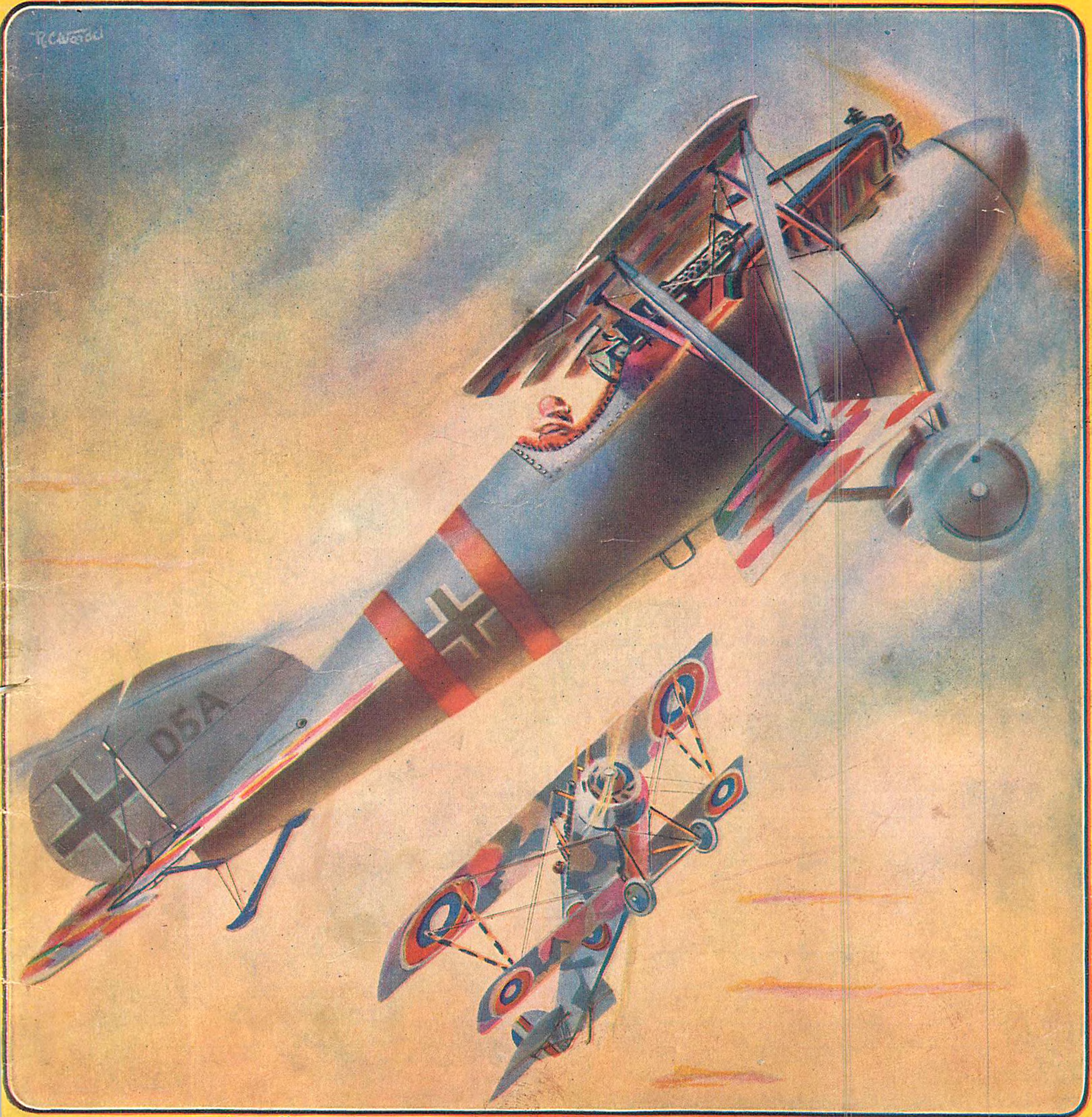
AND JUNIOR MECHANICS

Full Size Plans; Flying Model Curtiss-Bleecker Helicopter

—

Three-view Layout Travel-Air Mystery S

MARCH, 1931



An Albatros D5A (German) in a Scrap with a Nieuport Fighter

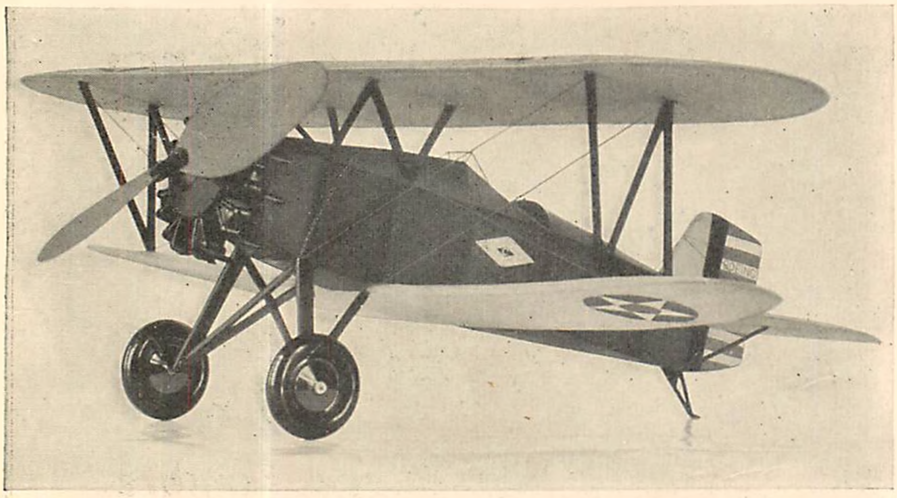
Listen, Aeromodelists!

The best model aircraft maker in the world requires the best materials to do his job with, because he knows that with only ordinary materials he can only expect to produce ordinary results. So whether you're a beginner, or an "old-timer" in building models the sooner you become a Cleveland Model Engineer, just that much quicker do you become a better builder of models. The super-detailed instructions and **engineered** materials that come with each kit enable you to build the model faithfully and with a skill that ordinary builders seldom, if ever, attain.

Your last chance to get this 3/4″ near-scale

BOEING FIGHTER

AT THIS VERY LOW PRICE



The new higher price of $4.00 becomes effective March 10th. Only orders in the mail before that date will be accepted at the present low price. So don't wait too long, if you want to save money on this great new flagship of Cleveland-Designed Class B "CB" line. 22½″ span. Brilliant yellow and olive drab colors. Speedy, long distance flights. Kit contains full size detailed drawings, celluloid motor, wheels, parts for efficient Cleveland-Designed propeller, Redicut balsa ribs, star-in-circle insignia—and everything else needed. Never anything before like it—nor again at this price. Order Kit CB-1C, only $3 postfree (till March 9th only—after that it becomes $4.00).

CLEVELAND MODEL & SUPPLY CO, Inc.
Model Aircraft Engineers — 1866N West 57th St., Cleveland, Ohio

( ) CB-1C...... $3.00	( ) FL-102 ..... $1.10	( ) FL-108..... $1.10
( ) FL-301...... 3.30	( ) FL-103...... 1.10	( ) FL-109..... 1.10
( ) SF-2C 5.50	( ) FL-104...... 1.10	( ) FL-110..... 1.10
( ) SF-1E 5.50	( ) FL-105...... 1.10	( ) FL-111..... 1.10
( ) FL-302...... 3.30	( ) FL-106..... 1.10	( ) FL-112..... 1.10
( ) FL-101...... 1.10	( ) FL-107..... 1.10	( ) 1931 Notebook-Catalog, 25c

PRINT NAME .... AGE...........

ADDRESS .... YRS. MODEL EXP.............

CITY .... STATE ....

Packs of sport ahead this Summer on lakes or ponds for this

Cleveland-Designed

CLEVELAND AMPHIBION

There's double sport in making this masterful yellow and blue Sikorsky-like model. Will either r.o.g. or r.o.w. (wheels instantly retracted). Flies 300 feet or more. 27″ span. Easy to build. Complete kit includes full size drawings and all materials. *Order Kit FL-301.* Only $3.30 postfree.

Up like a rocket goes this

Cleveland-Designed

TRAVEL AIR MYSTERY SHIP

As sensational as the performance of its famous prototype. Its brilliant red and black batlike coloring give it striking beauty. A 3/4″ scale model. 22″ span. Flies at 30 m.p.h. for a distance of 500 feet or more. Full size detailed drawings with all needed Blue Diamond *engineered* parts and supplies complete in kit. Easier to build than Sport Trainer. *Order Kit SF-2C.* Only $5.50 postfree.

"THAT'S WHAT I CALL SPEED!"

I have just finished the Travel Air Mystery Ship. I have been building models for over 11 years, but have never had the pleasure of building one that is as beautifully engineered as yours. The service that you have given me is astounding. It seems that I no more than order something than it is here. I ordered one of your new Boeing Fighter Kits on Dec. 17th, and received it on the 24th. That's what I call speed—and this took place during the Christmas rush. Enclosed find my check for one of your Great Lakes Sport Trainer Kits.

California.

America's most popular model-this Cleveland-Designed GREAT LAKES SPORT TRAINER

If you haven't yet built this marvelous 3/4″ scale model—get it right away. 20″ span; international orange and black. Full size drawings, and everything needed. *Order Kit SF-1E.* Only $5.50 postfree.

All three motors actually pull this

CLEVELAND TRIMOTOR

Keenest model ever. First successful tractor trimotor semi-profile model in entire world. Modeled, with its 29″ span, along Ford lines. Many features including movable control surfaces. Aluminum-like covering beautifully trimmed in blue. Full size detailed drawings with all needed Blue Diamond *engineered* parts and supplies make it easy to build. *Order Kit FL-302.* Only $3.30 postfree.

Get this PROFILE-FUSELAGE AIR LINE

Each model in this FL-100 Airline is easy to build, is exactly in relative proportion to the others, and beautifully colored like its world-famous prototype. Each kit is only $1.10. *Order by number.* FL-101: *Pirmary Glider,* and *Advanced Soarer* (two in one). FL-102: *Great Lakes Trainer.* FL-104: *Boeing Fighter.* FL-105: *Eaglerock Bullet.* FL-106: *Curtiss Hawk.* FL-107: *Travel Air Mystery Ship.* FL-108: *Boeing Mail.* FL-109: *Curtiss Robin.* FL-110: *Vought Corsair.* FL-112: *Curtiss Falcon.*

FLEETSTER HIGHWING MONOPLANE

FL-103 Span 16⅞″; length 12⅛″. Green.

LOCKHEED SIRIUS

FL-111: Span 16⅛″; length 10⅜″. Orange and Black.

New Notebook-Catalog Now Ready

The book every aeromodelist wants. Striking views in color of entire line Cleveland-Designed models, ranging from 49c to $5.50; and famous Blue Diamond *engineered* supplies. Send 25c for it at once.

Honest Quality and Speedy — *Reasonable Price 6-Hour Service*

Model Airplane News

AND JUNIOR MECHANICS

Vol. IV No. 3

Published by Harold Hersey

Edited by Capt. H. J. Loftus-Price

CONTENTS

March, 1931

In Our Next Issue

No need to tell you, of course, that there's another surprise in store for you in the April issue of MODEL AIRPLANE NEWS!

It is nothing less than plans for a flying model of the famous ROTOR plane—an adaption of the Flettner principale to airplanes. It's a peach of a model, and worth every moment of your time spent on it.

Then there is a flying model of the Bowlus Sailplane—the craft in which Hawley Bowlus established the first official American endurance record.

Ray Wardel has painted another pip of a cover, depicting a Sopwith "DOLPHIN" single-seater (British) in a fight with a German FOKKER D7. The coloring and action are amazingly life-like, and every detail is to scale and authentic.

Our famous courses in Gliding and Soaring, Aerial Navigation and Airplane Designing, in which nearly every question you could ever ask is answered, continue, of course.

Don't forget—April Model Airplane News. On all news stands March 23 next, and only 15 cents a copy!

Published Monthly by GOOD STORY MAGAZINE COMPANY, INC., Myrick Bldg., Springfield, Mass.
Editorial and General Offices, 25 West 43rd Street, New York City
Harold Hersey, President Pauline Sandberg, Treasurer Frank Moran, Secretary
J. W. LeBaron, Advertising Manager, Graybar Building, 420 Lexington Ave., New York, N. Y.
Entered as second-class matter June 5, 1929, at the Post Office at Dunellen, N. J., under the Act of March 3, 1879.
Application for transfer to Springfield, Mass., pending.
Additional Entry at New York, N. Y.

Price 15c a copy in U. S. and in Canada. Subscription price $1.50 a year in the United States and its possessions; also Canada, Cuba, Mexico and Panama.
All other countries $2.00 per year.
Chicago Advertising Office: 333 North Michigan Ave., C. H. Shattuck, Manager.
London Agents: Atlas Publishing & Distributing Co., Ltd., 18 Bride Lane, London, E. C.

AVIATION ADVISORY BOARD

(*Continued from page 34*)

Haviland 53; such as the dimensions, size of the fuselage length, wing span and the motor used.

Yours truly,
W. J. HOMER,
1112 Perrine Bldg.,
Oklahoma City, Okla.

Answer:

The manufacturers are no longer making this particular machine and it has been replaced by their Gypsy Moth. Hence, it is impossible to obtain data such as you require.

Dear Sir:

Do you think you would be able to get a job for me somewhere in the line of aviation, so I can make my living and go to night school, as I will be only in the eighth grade at the end of this term?

Yours truly,
BERNHARD LINDEMANN,
New Brigden,
Altoona, Canada.

Answer:

We regret to inform you that we can do nothing for you in the matter of securing a position for you, as we do not have an employment bureau. However, we would suggest that you apply at all the airports or airplane factories in your locality and tell them what you want to do. It is possible that they may have something for you there.

Dear Sir:

What is the wing span and fuselage length of Lindbergh's Lockheed "Dog Star"? What is the high speed of a Vought "Corsair"? What has become of the good old army DM-4's?

Yours truly,
RALPH HOFF,
Box 174,
Oslo, Minn.

Answer:

The total wing area of Lindbergh's Lockheed "Sirius," including the aileron area of 25 square feet, is 305 square feet. The length overall is 27 feet, 6 inches.

The high speed of a Vought "Corsair" is 151 miles per hour.

The old army DH-4's are obsolete, though some are being used in individual cases for passenger carrying.

AIRPLANE ENGINES—

By Lieut. (jg) H. B. Miller

All You Want To Know About Motive Power In Understandable Language

A Curtiss "Hawk"

WHEN discussing aviation, people at first think of planes. The subject of powerplants is brought home, however, when their model plane fails to fly because of lack of power. In the same way, aviation was held back by lack of suitable engines. Even now, plane progress keeps step with that of engine development.

Internal combustion engines are now more or less familiar to us all. Automobiles have been dashing about as far back as we can remember. Due to the recently attained prominence of aviation most boys can distinguish the various types of engines used in planes. Unquestionably, the airplane engine of today is one of the finest pieces of mechanism manufactured.

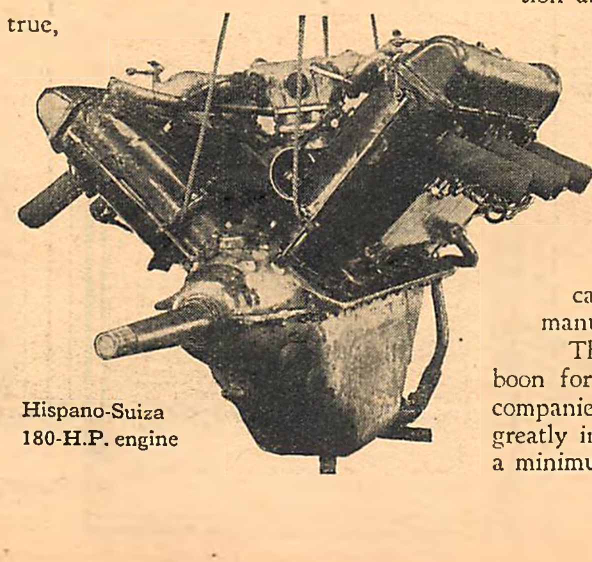
This has not always been true, however, and any study of engines cannot but be helped by a short review of the various stages of development through which the internal combustion engine has passed.

The problem of converting vertical motion to rotary motion has long been understood. How to obtain vertical motion was the problem to be solved and many brilliant minds worked on it. Some people think that it has not yet been solved entirely satisfactorily.

The idea of having an explosive engine is centuries old. Gun powder was first used as the propelling force. It proved too violent, however, and the trials ended in failure.

Work was first obtained from an engine built by an Englishman, Brown, in 1826. After a piston chamber was filled with gases of combustion a jet of water was used to condense these gases. A partial vacuum was thus created. The piston was then moved in the opposite direction by atmospheric pressure.

The idea of compression was developed about 1838. A greater amount of energy can be obtained from a given amount of fuel vapor, if it is first compressed. This is primarily true because a more powerful explosion takes place when the particles of the gases are in close contact. Less energy is used to bring about their chemical combination and thus more work is available.

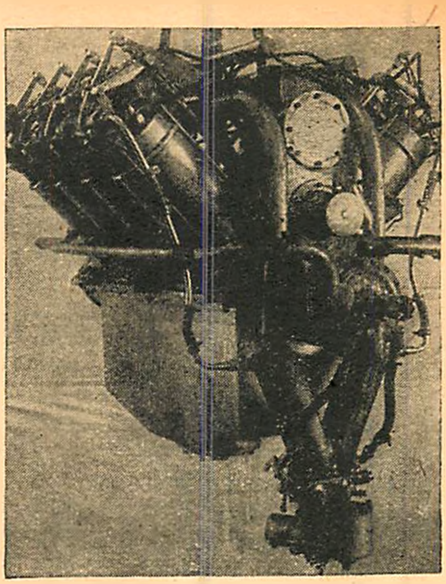


Hispano-Suiza 180-H.P. engine

Progress was slow. The four-cycle idea was advanced in 1862. At about this period efficiency began to be the byword. In the engine industry it was realized that an increase of engine speeds would increase the engine efficiency considerably. From this point on progress was rapid. Details were watched carefully. Precision in design and manufacture became paramount.

The advent of automobiles proved a boon for engine manufacturers. Numerous companies were formed. Engine power was greatly increased. Vibration was reduced to a minimum and economy was seriously con-

WHAT THEY ARE « « « AND WHY!



Curtiss OXX engine

sidered. It must be remembered that in those days gasoline was purchased only in drugstores. Corner lots were used for other things than gas stations.

One important factor was omitted in the gasoline engine development. It was permissable, however, because it was relatively of no importance to the automobile industry. This was the matter of weight.

It is an unquestioned fact that planes would have flown previous to 1903 if an adequate powerplant had been available. The standard engine of that time weighed approximately 100 pounds per horsepower. There was no demand for better performance than this until the possibilities of flight were seriously considered.

Lieut. Miller is Instructor in the Engine Section of the Ground School at the Naval Air Station, Pensacola, Fla. Formerly he was Engineering Officer of VF Squadron Two-B Battle Fleet. What better authority could you wish to instruct you on such technical matters as airplane engines?

Professor Langley and Charles N. Manley were forced to make their own engine and succeeded admirably. They constructed a five-cylinder water-cooled radial engine which produced fifty-two horsepower and weighed 2.4 pounds per horsepower—a heretofore unheard of performance. The Wright brothers also found it necessary to build their own engine. It possessed only 12 horsepower and weighed nearly 15 pounds per horsepower.

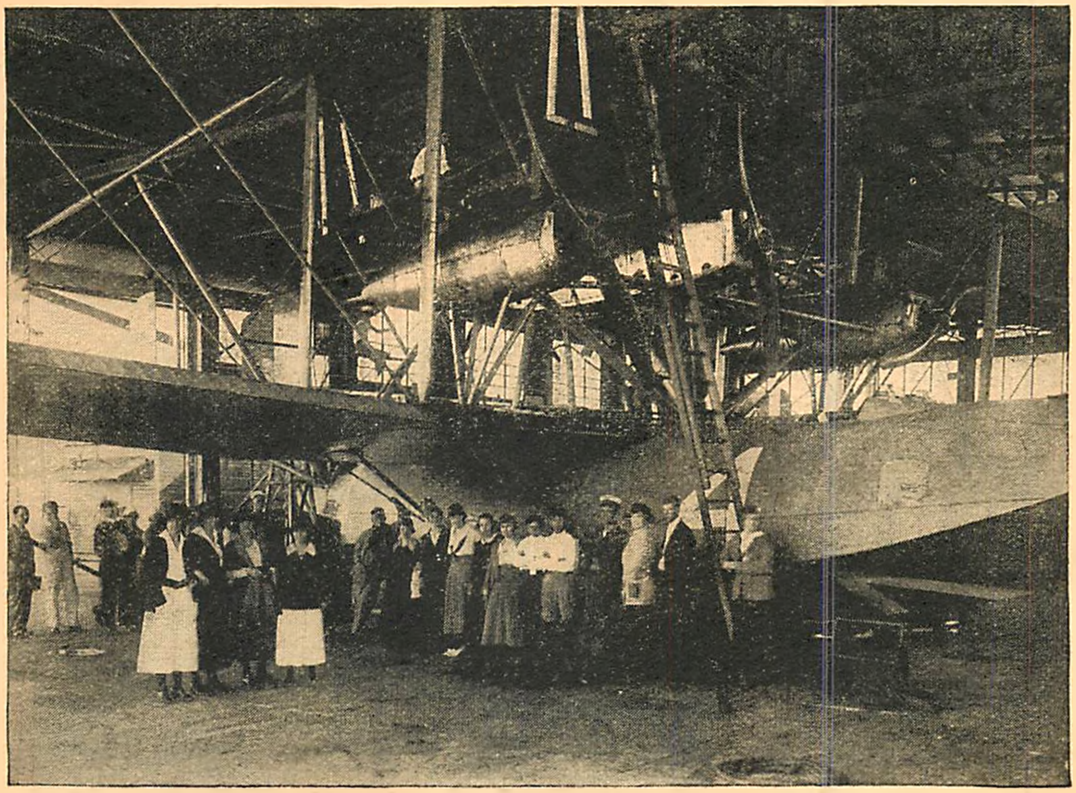
Aviation moved forward just as fast as engine development permitted. As soon as the practicability of flight was proved by the Wrights, engine designers and manufacturers turned their eyes towards this infant industry.

France early began the development of the air-cooled engine while Germany championed the water-cooled job. The 3-cylinder Anzani carried Bleriot across the English Channel in 1909. Considering the time and the stage of development, this flight closely rivals Lindbergh's trans-Atlantic hop.

The World War brought on a demand for higher power. The air-cooled radials could not supply it because of the resulting heat. Thus began the rotary engine. This type of engine revolved around a stationary crankshaft. Sufficient cooling was obtained by the whirling engine. This form of engine is best represented by the Gnome and the Clerget models. The Renault 12-cylinder Vee air-cooled engine was also extensively used.

As the war advanced aviation was driven further and higher into the sky. Still more power was required. The rotary engine had reached its mechanical limits. Air resistance increased rapidly as the centrifugal speed of rotation increased. Besides, the gyroscopic effect of this revolving mass was tremendous. All of us have read about the tricky Camels equipped with Clerget engines. A climbing turn was sure to result in a spin.

The water-cooled models now began to forge ahead. Though heavier per horsepower, they could dissipate heat sufficiently fast to allow the generation of higher power.



The famous Navy Seaplane NC-4 Liberty engines

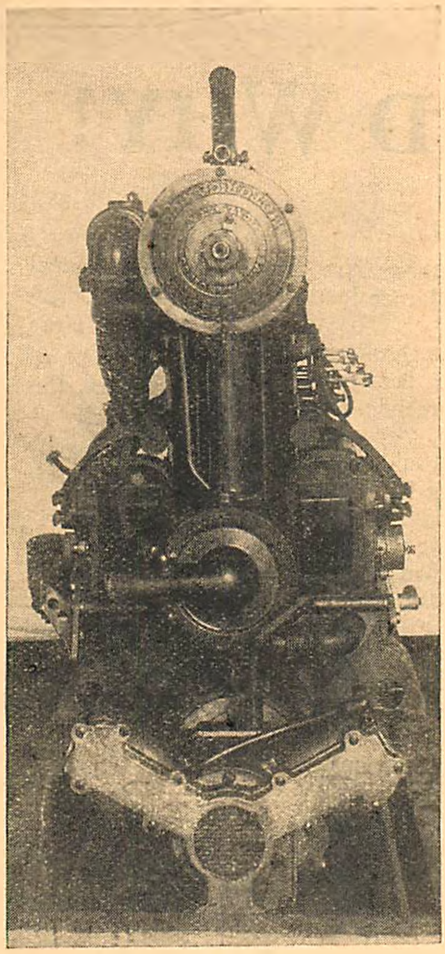
The Allied Hispano-Suiza was probably the best known of this type of wartime engine. The United States produced the OX models and finally brought out the sensational Liberty.

This power plant was originally intended for production in units of 4, 8, or 12 cylinders. The Allies, however, persuaded the government that only the greatest power was useful. Hence, the Liberty was manufactured only in the larger units which generated 410 horsepower.

With the urgency of war over, the aeronautical industry settled down and took a sane survey of the situation. Commercial aviation was interested in low costs and greater efficiency. Aviation soon developed its own peculiar requirements for its engines. Among these are:

Maximum Horsepower per Pound. This is one of the most important requirements, for on this factor depend many things. The pay load of the plane is largely dependent on this item. Since the greatest paying load is extremely desirable in commercial aviation, the best index of an engine, providing all other things are equal, is its pounds of weight per horsepower developed.

Also, less engine weight results in slower landing speeds providing an equal pay load is carried. Further, less weight means a quicker take-off and climb to safe altitudes. A plane is in less danger of getting into trouble if it can gain altitude quickly and so reach a maneuvering height.



Top—A Hall-Scott engine (War-time)

Economy. This factor has come to be a very important element in engines. With commercial operators being forced to figure out to a fraction of a cent the cost of passenger miles, fuel is a major consideration because of its expense. In addition, an economical engine will require a lesser amount of fuel to be carried. This increases the permissable pay load even more.

Reliability. This, naturally, is essential for safety and economical operation. A cracked-up plane is expensive to repair. We have just passed through a series of endurance flights that have attempted to prove the reliability of airplane engines. The desirable thing is that not *one* engine will run 400 hours without stopping but, rather, that all engines will operate reliably for a shorter time, say 40 hours. This will give safe operation to all, instead of to a few specially prepared engines.

The airplane engine must be so constructed that a minor failure, such as a broken magneto, will not cause a complete engine failure. It is seldom that a commercial aviator allows himself to get in such a position that he can not land safely with his engine turning up a thousand revolutions.

Accessibility. This is most desirable. It must be easy to make repairs. The parts which require inspecting must be quickly accessible or else they are apt to be overlooked or ignored. Quick repairs mean further economy. Adjustments are more regularly made when conveniently located.

Cost. This naturally must be low in order to bring aviation within the price range of all possible customers. This particular engine requirement is difficult to reconcile with the other essentials. The necessity for light weight is particularly unfavorable to low costs. It demands expensive alloys and extensive machining. Quantity production is the secret of low initial cost of an engine. Popular interest in aviation will bring this about. Indeed, quantity production may be said to have started in 1928.

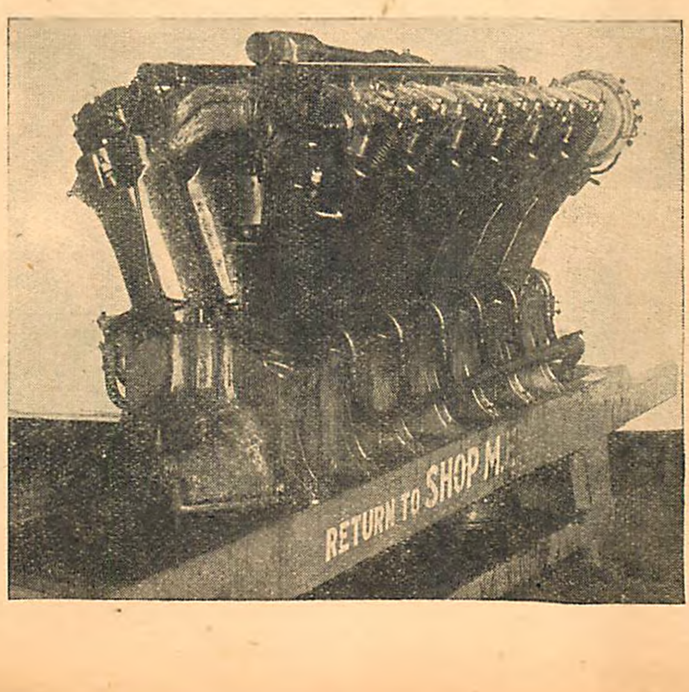
With the above requirements definitely understood, the airplane engine was distinctly on the upward march. The internal combustion engine had been decisively placed in the fore.

Steam has been used for motive power for years but the smaller weight of the internal combustion engines has placed steam on the back seat in aeronautics. There is at present no indication that it will ever be brought up to a competitive strength. Various vapor engines such as mercury have enjoyed a temporary flareup campaign, but they have invariably returned to oblivion.

There are four essential and distinct systems in an internal combustion engine. They are common to all types of airplane engines and will be discussed as generalities.

Fuel System. This includes the gas tanks, gas lines, gas strainers and the carburetors. The various gas lines deliver the liquid fuel from the gas tanks, through the strainers, and on to the fuel pump. The pressure developed by the pump feeds the gas to the carburetor. The function of this device is to vaporize the liquid fuel. In this respect it is similar to the one on your automobile.

However, as a plane gains altitude the air becomes rarefied and less air mixes with the gas. The fuel thus becomes too rich. Provision must be made whereby the mixture of air and gas remains nearly constant. A normal mixture at sea level is (*Continued on page 38*)



Left—A war-time 12-Cylinder Liberty engine

GLIDING and SOARING

A Manual of Motorless Flight

By PERCIVAL WHITE and MAT WHITE

AS WARM air rises, it cools off gradually and finally condenses to form clouds. Wherever there is a cumulus cloud, the pilot may be sure to find an upward current.

Soarer pilots can determine exactly where thermal currents exist by studying the nature of the earth's surface over which they intend to soar, and by learning the relative rapidity with which forests, sand, fields, etc., are heated by the sun. These currents are, of course, found only during that part of the day in which the sun is warm.

Lilienthal's Theory of the Wind. Lilienthal evolved a theory, (the third cause of upward currents) that the wind does not blow horizontally, even over level surfaces, but rises at an angle of three or four degrees. He explained this theory by saying that air in a high pressure region, moving toward a region of low pressure, encounters motionless air in a place of medium pressure.

The cold air from the field of high atmospheric pressure tends to push ahead the air in the medium field; the latter tends to resist this pushing, becomes dense, and escapes upward. This escape causes the wind to diverge from its horizontal course.

Theoretically, if Lilienthal's conclusions are correct, a soarer with a gliding angle of three or four degrees could maintain level flight as long as the wind blew. However, this feat has never been accomplished.

How Upward Currents Are Offset. As long as the sun shines, thermal currents appear daily in the same places, other conditions remaining unchanged. Rising currents are not always caused, however, by irregularities in the earth's surface. Other irregularities may prevent upward currents from being caused by the particular irregularity in question.

For instance, if the wind blew for several days across a plain toward one side of a mountain, the pilot would doubtless find constant upward currents to the windward of its peak. If, however, the wind should then change, so that it blew toward the mountain from across a forest and several low hills, the pilot would find only a very weak upward current.

Some terrain formations cause so many eddies and whirlpools of air that they are dangerous to the uninitiated. Such zones usually exist where chains of hills are ranged in horseshoe shapes so that they catch the wind.

Usefulness of the Various Kinds of Upward Currents. Upward currents, like all wind currents, may be classified according to duration, velocity, and the compass direction of the wind which resolves itself into the upward current. It is obvious that the longer the upward current endures, the more useful it is to the soarer. The current lasts as long as the wind continues to blow from the same direction.

A rising current's effectiveness is supposed to depend largely on its velocity, on the assumption that the greater the velocity the higher the altitude to which it rises. The importance of the wind's compass direction varies with the region in question. The angle of the current to the horizontal must be considerable, in order to prove most effective.

Horizontal Wind Currents. Horizontal currents are useful to the soarer pilot because of their variations. The atmosphere may be considered to consist of layers of air, one above another. These layers move at relatively different speeds. The friction caused by the earth's surface retards the lower strata. With increasing altitude the strata move with greater velocity.

For example, an atmospheric stratum at a height of one hundred or two hundred feet often moves with twice the speed of the layer next to the ground. Every stratum is not necessarily more rapid than the one below it, however, for occasionally a stratum travels much more slowly than the main movement of the air.

Moreover, each individual stratum of air is affected by variations. These variations are caused by the friction between each two layers of air travelling at different speeds. The friction results in whirlpools of air. The condition of the atmosphere in which the presence of these whirlpools is pronounced, is called "gustiness."

Other variations affect the individual stratum of air beside changes in velocity. Near the earth, local winds may blow in directions contrary to the main movement of the atmosphere. Moreover, horizontal gustiness may sometimes be found combined with rising currents.

Soarer pilots have as yet been unable to make full use of frontal gusts of wind. Perhaps this is because of the difficulty of developing means for detecting useful variations of the wind soon enough, and because soarers can not as yet be manoeuvered fast enough for pilots to avail themselves of the full force of frontal gusts.

Conclusion. The conditions of the atmosphere, the degrees to which various forces affect it, etc., are still very much unknown. The Weather Bureau and other government agencies have done most important work in charting large movements and in daily accounting of these. However, as to the minute variations in which the soarer pilot is interested, almost unlimited work still remains to be done. It is the duty of aeronauts of the future to carry the early explorations further.

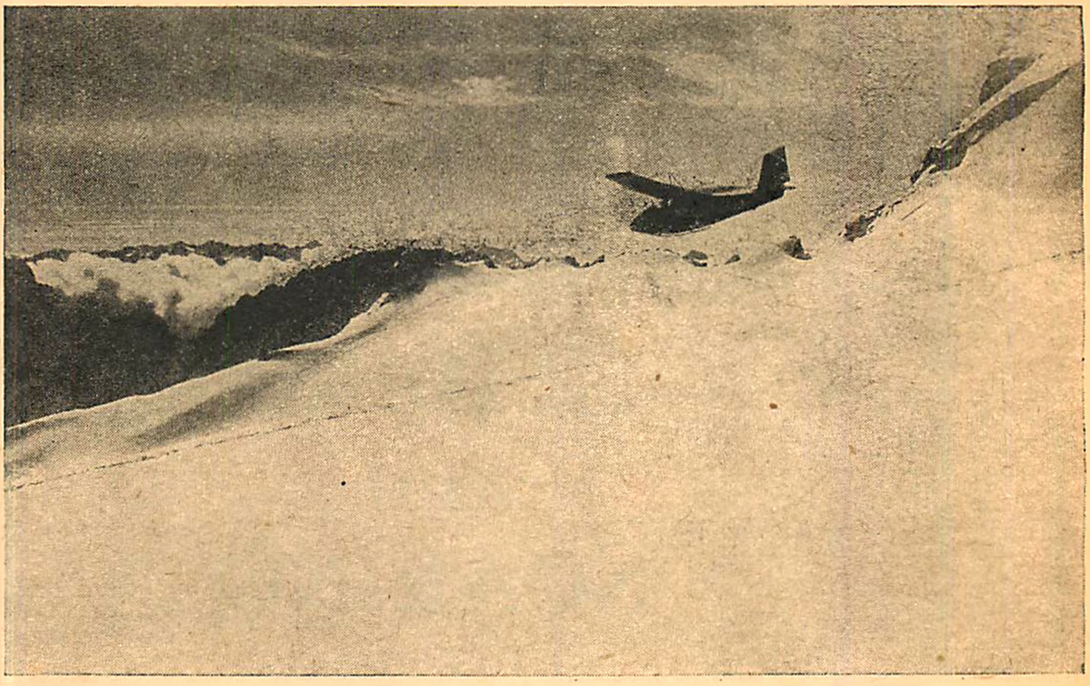
The way in which wind currents may be utilized by soarers next will be discussed.

CHAPTER XVII
HOW BIRDS FLY AND SOAR

For thousands of centuries birds have been exploring the atmosphere, and have acquired an acquaintance with it which would be invaluable to the human pilot. Lilienthal and the Wright brothers, when they first began to experiment with heavier-than-air craft, designed their gliders upon principles which they learned from bird flight.

However, when the airplane was invented, with an application of power entirely different from that of birds, the analogy between birds and airplanes was considered less significant. Now that the glider pilot, however, seems destined to be the greatest scientist in the laboratory of the air, he may learn much about the construction of wings, and about aerodynamics, meteorology, and flight, from the behavior of the birds.

The Motive Power of Birds. The flapping of a bird's wings may to some extent be likened to the revolutions of an airplane's propeller: It supplies the body of the bird or plane with power with which to maintain forward progress and thus to counteract the pull of gravity. The strokes of a bird's wings have two functions; first, they support him in the air; and second, they give him forward movement.



Gliding in the Bavarian Alps

In order to support himself in flight, the bird makes a series of up-and-down strokes with his wings. At the beginning of each stroke, his wings are high above his body. Next, the wings are brought down forcibly through the air, somewhat like an oar in the water. This quick downward movement compresses the bird's feathers, making the wings impervious to the air.

When the wings are raised again, preparatory to another downward stroke, and the movement is more leisurely, the difference between the effective pressure of the quickly descending air-tight wing, and of the same when ascending more slowly and partly previous to that air, represents the power which overcomes gravity and supports the bird in the air.

In order to propel himself, the bird holds the leading edges of his wings at a lower level than the trailing edges on the down-stroke. This has an effect on air similar to that of oars on water.

The bird tilts his wings at this angle with the aid of the resistance of the air, which impedes the movement of their trailing edges, and at the same time tends to push their tips slightly forward. The angle of the wing is changed preparatory to the up-stroke, so that the front edges are at a higher level than the back edges. Consequently, the force of the air helps to raise the wings.

Stability. A bird's controls are more complicated, and at the same time more effective, than those of a glider. Lateral balance is easily maintained, since each wing moves independently of the other, and since the whole wing (not just the ailerons, as on an airplane) is mobile, a hard stroke of one wing, or a change in its angle of attack, serves to bank the bird's body.

The bird controls longitudinal stability chiefly by means of his tail. This he employs as an elevator, raising or depressing it in order to climb or dive. He may give added effectiveness to the tail by spreading the feathers, or by cupping it to prevent the escape of air.

Webfooted birds often use their feet to supplement their tails in maintaining longitudinal control. The bird may affect his upward or downward motion by raising or lowering his head. He is also able to increase or decrease the angle of incidence of his wings by rotating the bones which fasten the wings to his body.

The bird has several methods of controlling directional movement. He bends his body in the direction which he wishes to take; or he banks by means of unequal wing strokes; or he employs his tail as a rudder, twisting its feathers.

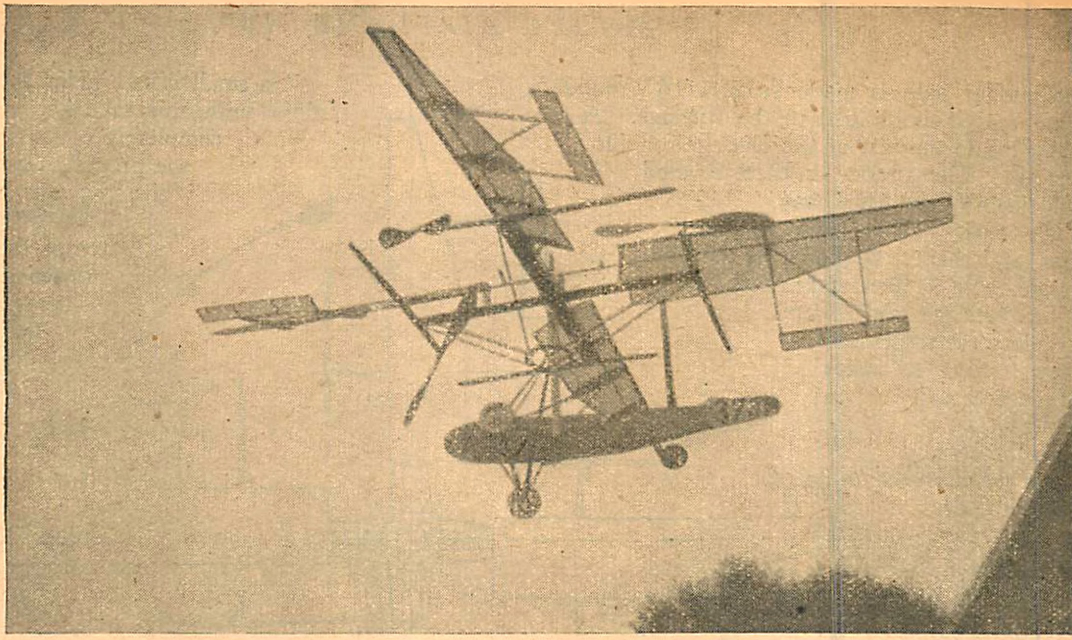
A bird's wings are so built as to make various automatic movements to retain his balance. His wing is cup-shaped, near the body, to increase his lift. If the bird were in a climbing position, it might be expected that any sudden force of the wing against the under side of the wing's trailing edge might send him into a dive.

However, the feathers are so elastic that they yield to the pressure of the wind, and thus prevent an involuntary dive. Similarly, a strong gust of wind impinging on only one of the wings flexes it and does not unduly increase its lift. This prevents loss of balance.

Bird's Method of Landing. (*Continued on page* 41)

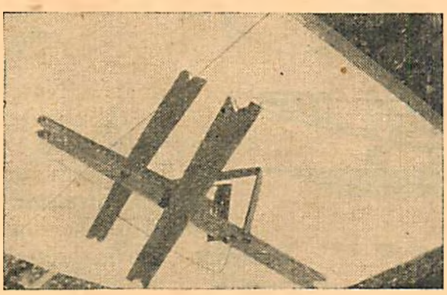
A FLYING CURTISS-BLEECKER HELICOPTER « « MODEL

By Prof. T. N. de Broborsky



THE Curtiss-Bleecker helicopter, though not yet proved to have been a revolutionary success, is by far the most interesting development in aviation in recent times. Mr. Maitland Bleecker, the designer, put in four years of research work and hard labor before he felt satisfied that his invention could be given a public demonstration. This took place in June, 1930, since when the helicopter has been undergoing a number of changes and improvements.

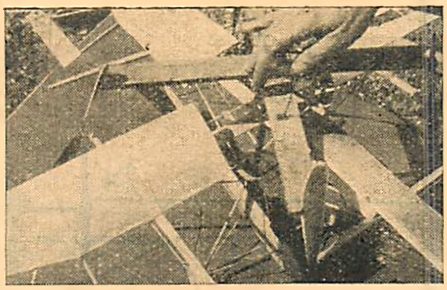
So great have been the efforts by aviation engineers and designers to perfect a helicopter, that it is only fitting that model airplane enthusiasts should be given an opportunity to study this type of aircraft at first hand. For this reason I have carefully prepared these plans and constructional data from actual photographs and drawings of the Curtiss-Bleecker helicopter.



One word of advice — work slowly on the model, which, if built properly, is a perfect flying model. It has been tested in a wind-tunnel and is more than worth every minute spent on its construction. Naturally, the model is modified and simplified in comparison to the helicopter proper.

Before going into details concerning the model helicopter, let me give you some data concerning earlier attempts to build this type of machine. The first to try to solve the problem of vertical flight was an Hungarian engineer, Lewis Ossz, and his son. They built a machine in 1909, very much on the lines of the Curtiss-Bleecker helicopter. The craft rose a few feet from the ground during tests, and was reported to be quite stable. However, it was considered as being impracticable.

Then Hellesen and Kahn, two French inventors, in 1925, also built a machine similar in design to the Curtiss-Bleecker, but with two 70-h.p Anzani engines fitted to the wings, or vanes. Tests of this machine, however, showed that while it rose a few inches vertically from the ground, the lift was too small and the propellers lost their efficiency. Next, an Italian engineer named Issaco experimented with the same type of machine, but the best he could do was to make it rise a few feet from the ground.



Italian experts are now experimenting with a helicopter, for which exceptional claims are being made.

Now to the model.

Chief among the modifications is that of the central motor. This is much too complicated and heavy to reproduce in model form and obtain good results. Our propellers, too, have two blades instead of four.

One important point is to study very carefully the photographs and plans. Note carefully the rudder, which, contrary to usual, is fixed to a horizontal axle. This serves to change the position of the fuselage and to offset the torque.

It is also seen that the fuselage is attached to a vertical mast. A wooden cross, as shown in the drawings, will serve to keep the wings from rotating.

There are four wings, each with two outriggers, each of which carries an elevator. Each wing also has a motor-stick. It is obvious that when the propellers are in motion the wings will rotate, creating lift and thus carry the model vertically in the air until the power is exhausted.

The fuselage (see drawing 2) is made from 1/16" balsa. Rudder ribs 12 and 13, and the other parts, are also cut from this to make a complete balsa rudder as shown in the drawing.

The rudder axle is made from 1/16" round wood, and is ambroided to the fuselage. A hole is cut in the rear of the fuselage for this purpose. The rudder is then covered with tissue in the usual way.

The mast (2) is made of hard balsa, and shaped as shown in the drawing. It is then ambroided to the fuselage and is supported by the struts numbered 3 and 4, which are made from 1/16" round wood.

The struts and axle of the chassis (5 and 8) are made from balsa, oval shaped, as shown in the drawing. In order to make this section more rigid, struts 6 and 7 also are made oval in shape. Two celluloid wheels, 1⅞" in diameter, complete the chassis. The tail-skid wheel is 1⅜" in diameter and is fixed as shown in the plans, the axle fitting into the prongs of a "fork" piece, as shown.

This completes the construction of the fuselage.

In order to construct the movable parts numbered 4, make four of the pieces 16, 17, 18 and 19 and two of 20. Use ⅛" thick balsa for these pieces. The pieces are then glued together to form a cross and a 3/16" hole is drilled through the center (see drawing 4). Pieces 16 and 18 are ambroided at the bottom blades; 17 and 18 at the top. Motor sticks (21) are made from hard balsa.

Fix 3/16" diameter eyelets to the mast as shown in drawing and place the cross support above this. Test it to see that it rotates freely. Another eyelet is then glued to the top side of the mast. Now cut out a circle (27) from 1/32" plywood and also eight pieces of round struts (28) from ordinary balsa. These are used to make the lower members of the supports as shown in photograph.

Next come the propellers. This usually is one of the hardest of jobs for the average model builder. However, be patient and follow the system I have outlined (patented, by the way) which will aid you greatly in making propellers for this and other models.

From 1/16" thick balsa blanks cut four pieces as shown in drawing 5. Prepare a piece of hard wood with a smooth surface.

Mix one part of dope and three parts of thinner and with a small brush, paint both sides of the propeller with this mixture. See that the surface is completely covered with the mixture. Let the propeller stand for a few seconds to give the mixture a chance to soak in. Then with two T pins fix the center of the propeller as shown in drawing and with two more pins arrange the blades (which have a ¾" radius) as shown in drawing. The propeller is now left for six hours to dry, at the end of which the pins can be taken away and it will be noted that the propeller has a pitch as required.

Next take in hand the axle (24), eyelets (25) and beads (26). To the motor stick fix the usual S hook and use eight ⅛" flat rubber bands.

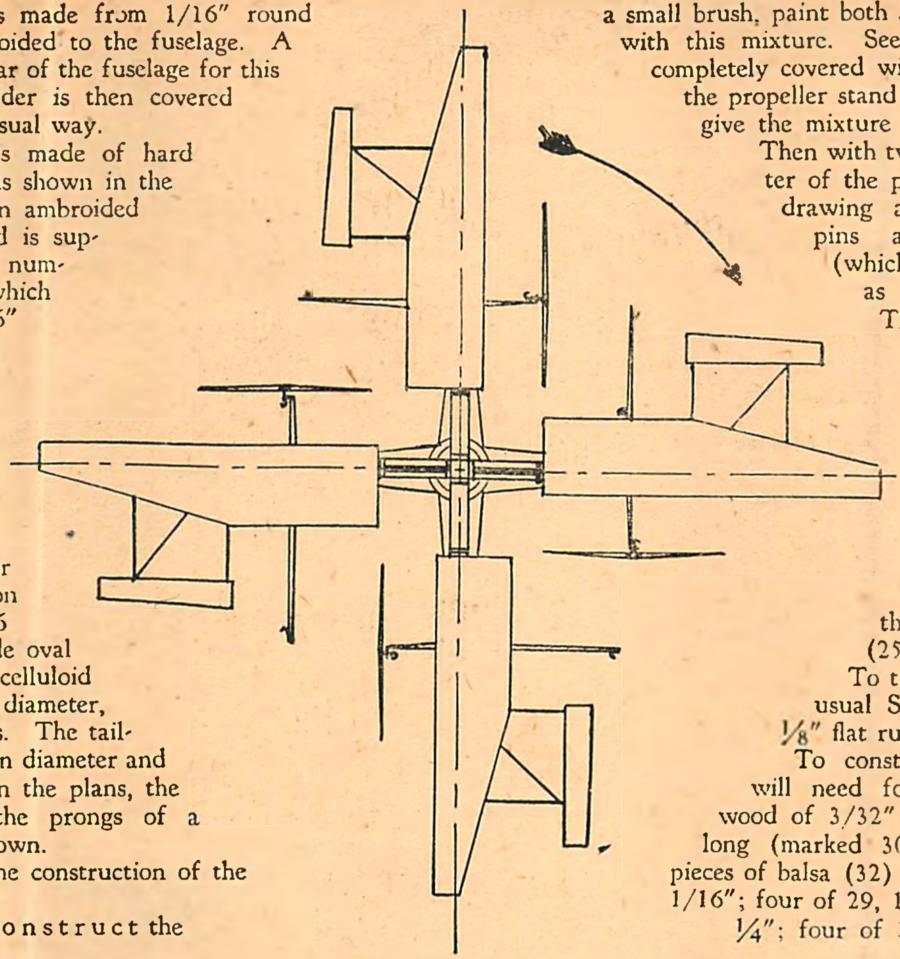
To construct the wings you will need four pieces of round wood of 3/32" diameter and 11¾" long (marked 30 in drawing); four pieces of balsa (32) 9⅝" long by ⅛" by 1/16"; four of 29, 17⅝" long by ⅛" by ¼"; four of 31, made of 1/16" medium balsa; and from 1/16" balsa make four small and four medium ribs (4). All these pieces, numbered as above, are shown in drawings 6, 7 and 8.

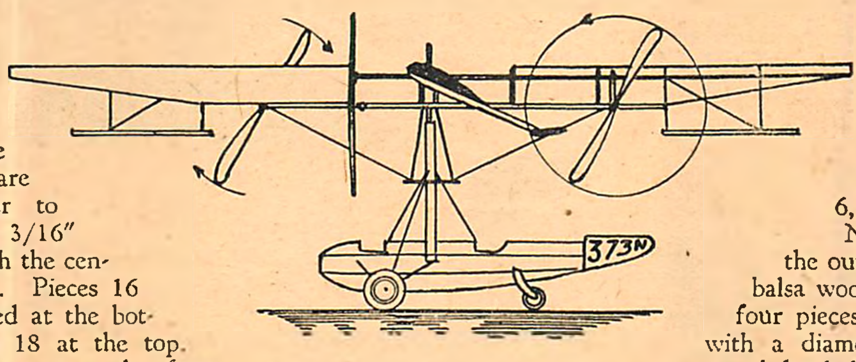
Now cut eight pieces for the outriggers (33) from hard balsa wood 1/16" thick, and also four pieces for round struts (34) with a diameter of 1/16". These are used for holding the elevators.

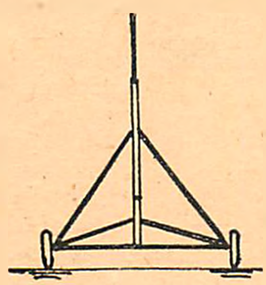
Drawing 7 shows the steps in construction of the entire wing and elevator. An important point to follow is to cover only the *upper* side of the wings with tissue. The elevators are made from 1/16" thick balsa (drawing 8) and are covered on the *lower* side. The elevators are fixed to the outriggers with threads.

Once this has been done the axle for the wings (30) is fitted in the holes 16 and 17. The helicopter—for vertical flight—is now ready.

From 3/32" balsa cut four pieces (35) as shown in drawing 7 and ambroid them to the axle (30) at the spot marked X in drawing 6. Now make piece 36 from ¼" balsa and two of 37 from 1/16" balsa. From 1/32" thick plywood cut a quarter-circle denoted by the number 39. These pieces are ambroided together as shown in drawing 7. The photo-



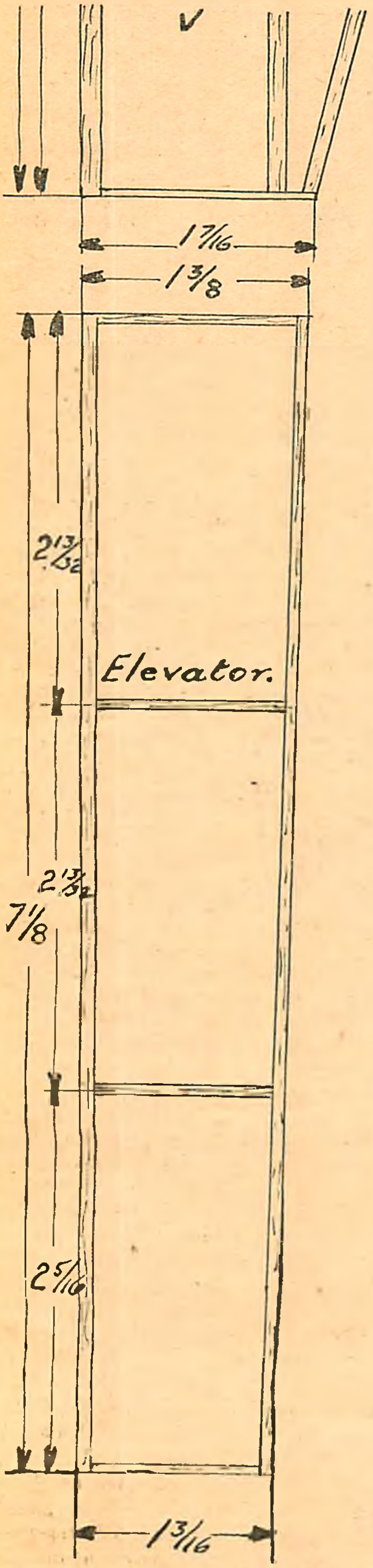




No. 1

A Replica To Test the Skill of All True Air Enthusiasts

graph shows the balsa cross to which the four rubber motors are fitted, and also how this is done. When the motors have been fixed be sure to see that they rotate. Each motor can be wound to 120 turns, although it is much better during the testing period to use only 60 turns.

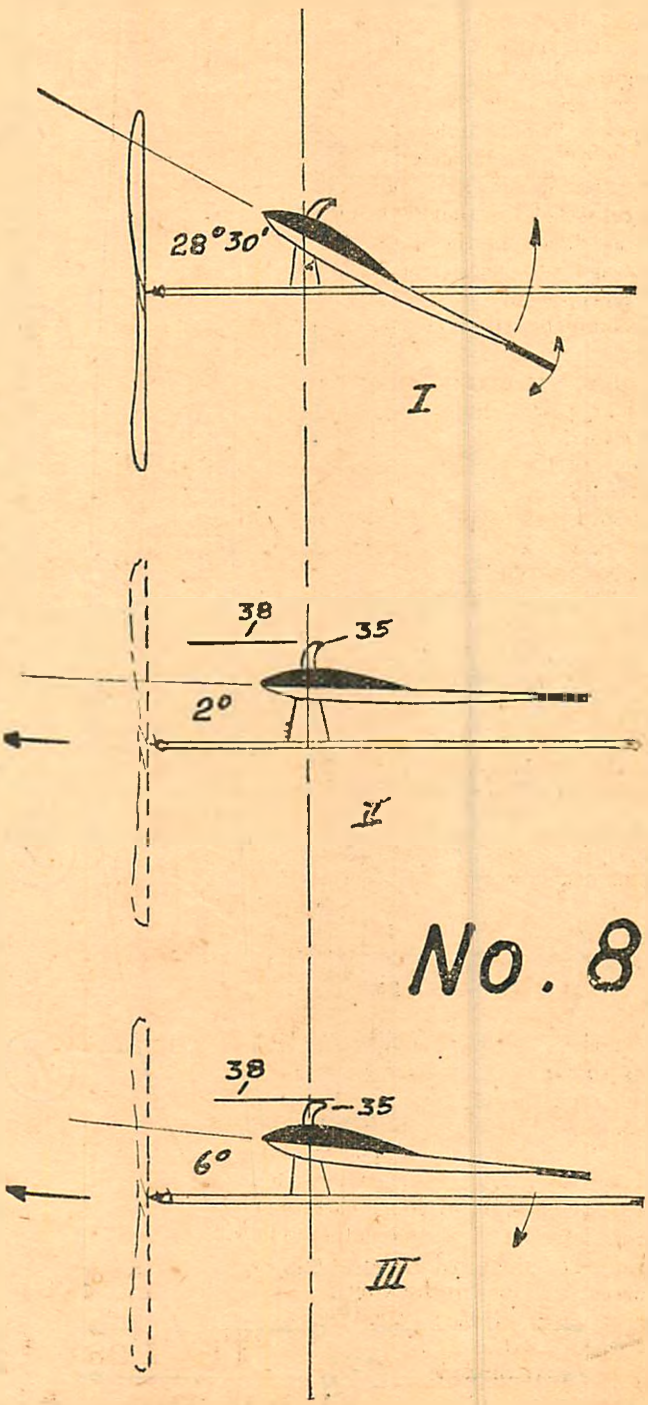


When the starter X is released, the propellers begin to revolve. This causes the wings to rotate at great speed by which the angle of the wings will decrease. The model will then begin to ascend and if the center of gravity is well placed, it will take off easily and land in normal position.

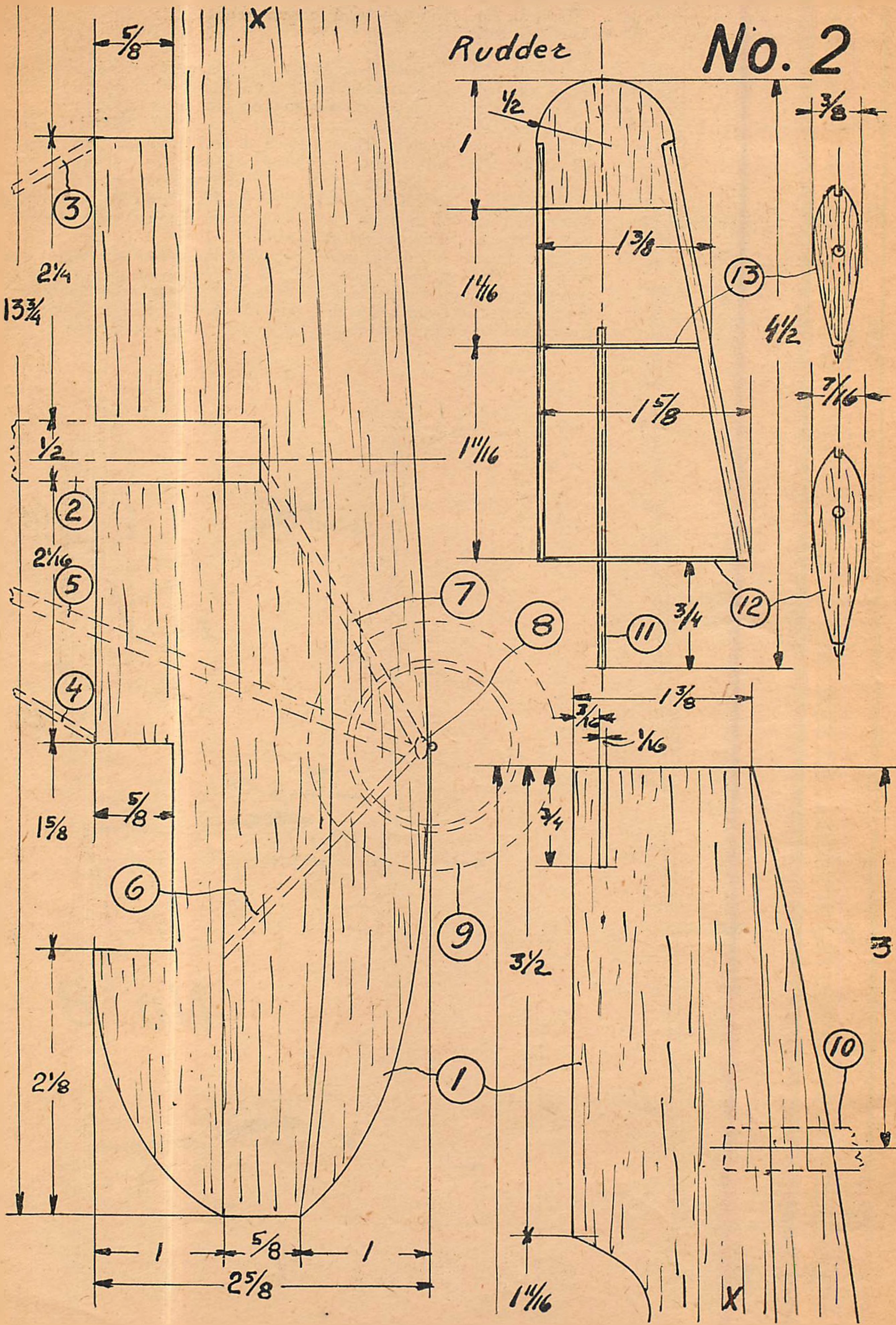
It will be noted that when the craft is in flight the fuselage has a tendency to turn, and in order to overcome this it will be necessary to use a little opposite rudder.

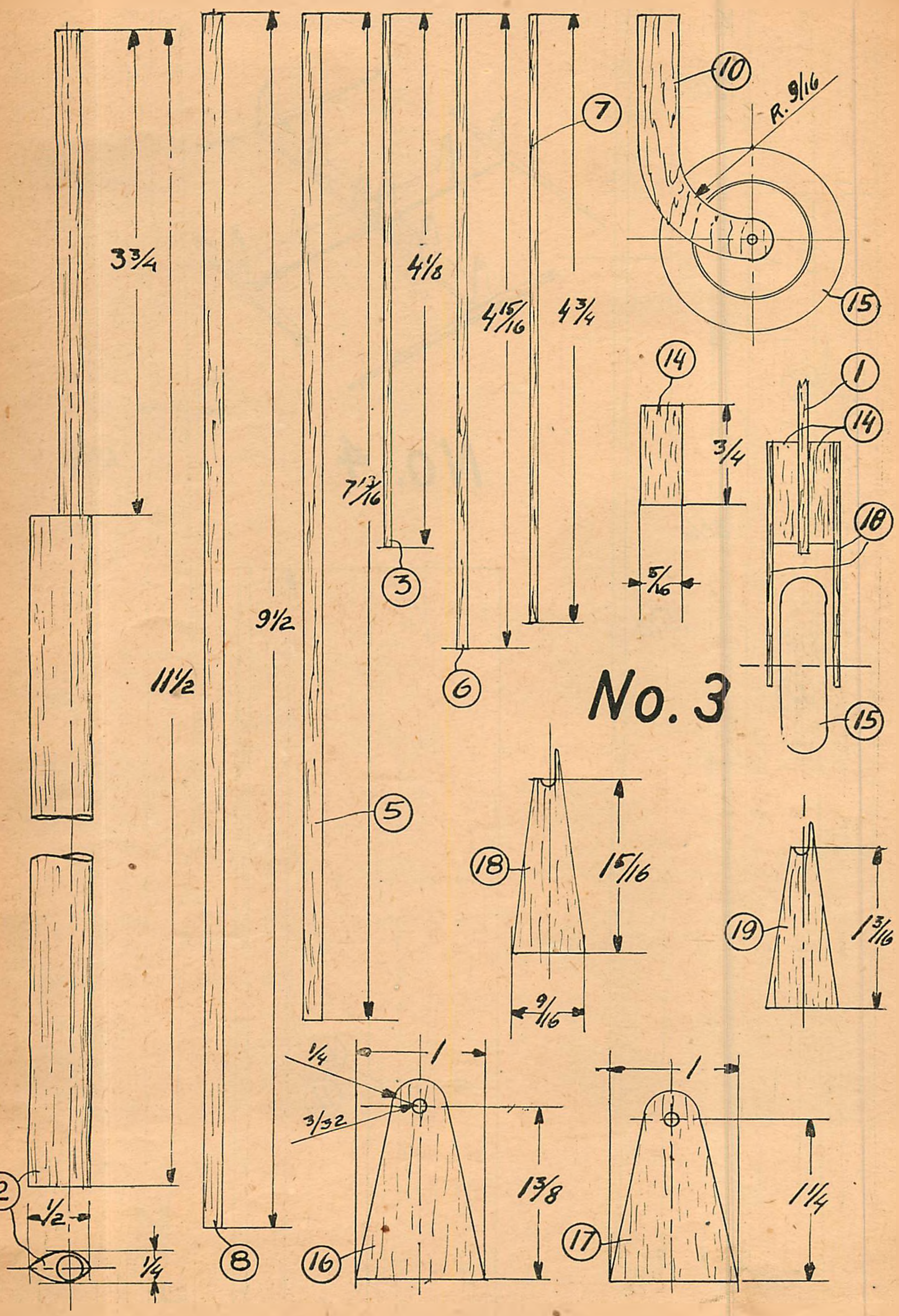
To change from vertical to horizontal flight use the regulator 38. This must be fixed on the mast (2). An example of this is seen when the wing rises to two degrees, as shown in drawing 8 (11), the regulator (38) pushes down the lever (35) shown in drawing III. This changes the angle of incidence. It is natural that the greater the angle of incidence, the greater the lift.

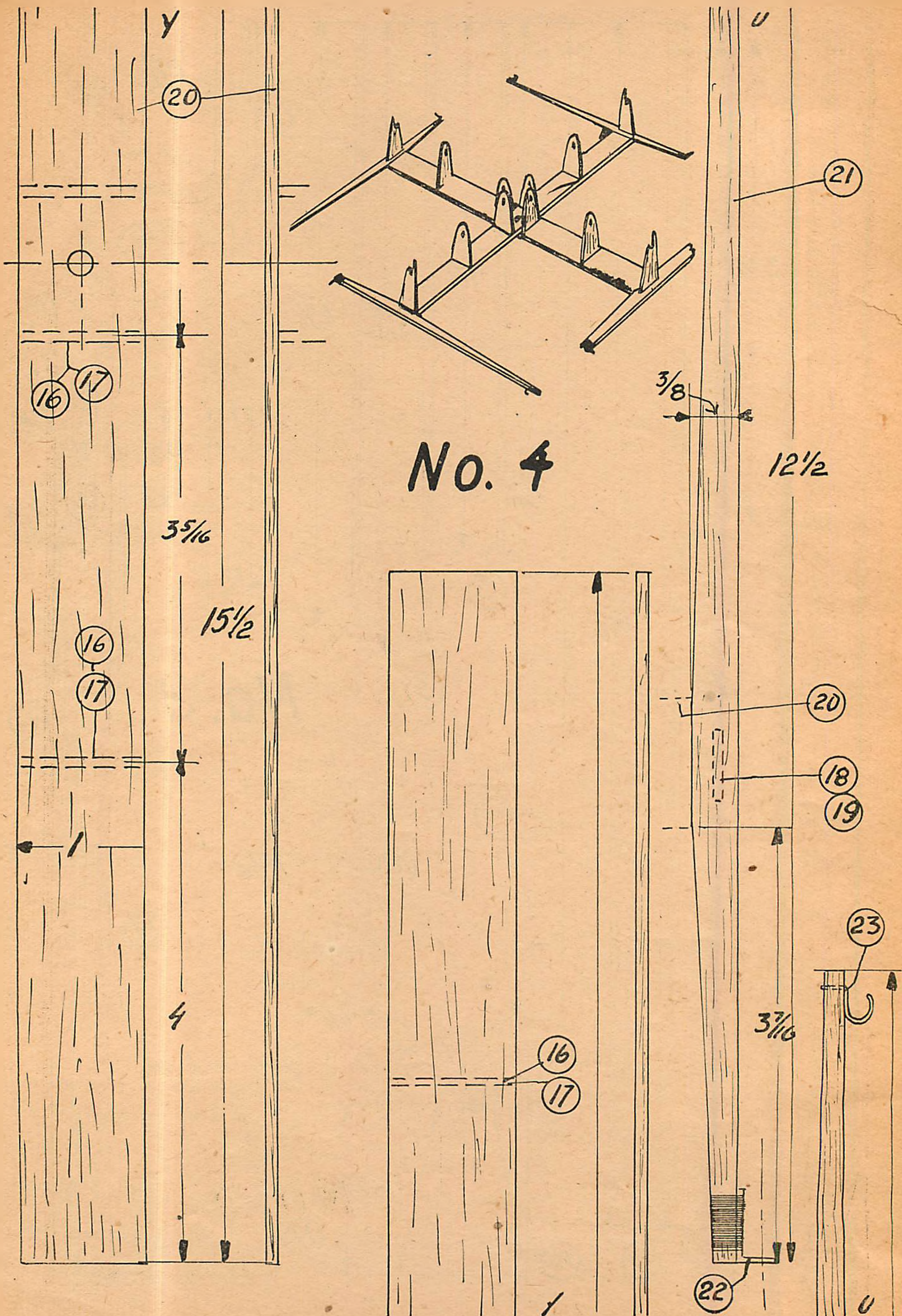
With the model from which these plans have been drawn up and as seen in flight in the photograph at the beginning of this article, I already have made twenty-eight interesting flights and with a little care and patience on your part, there is no reason why you should not do likewise.



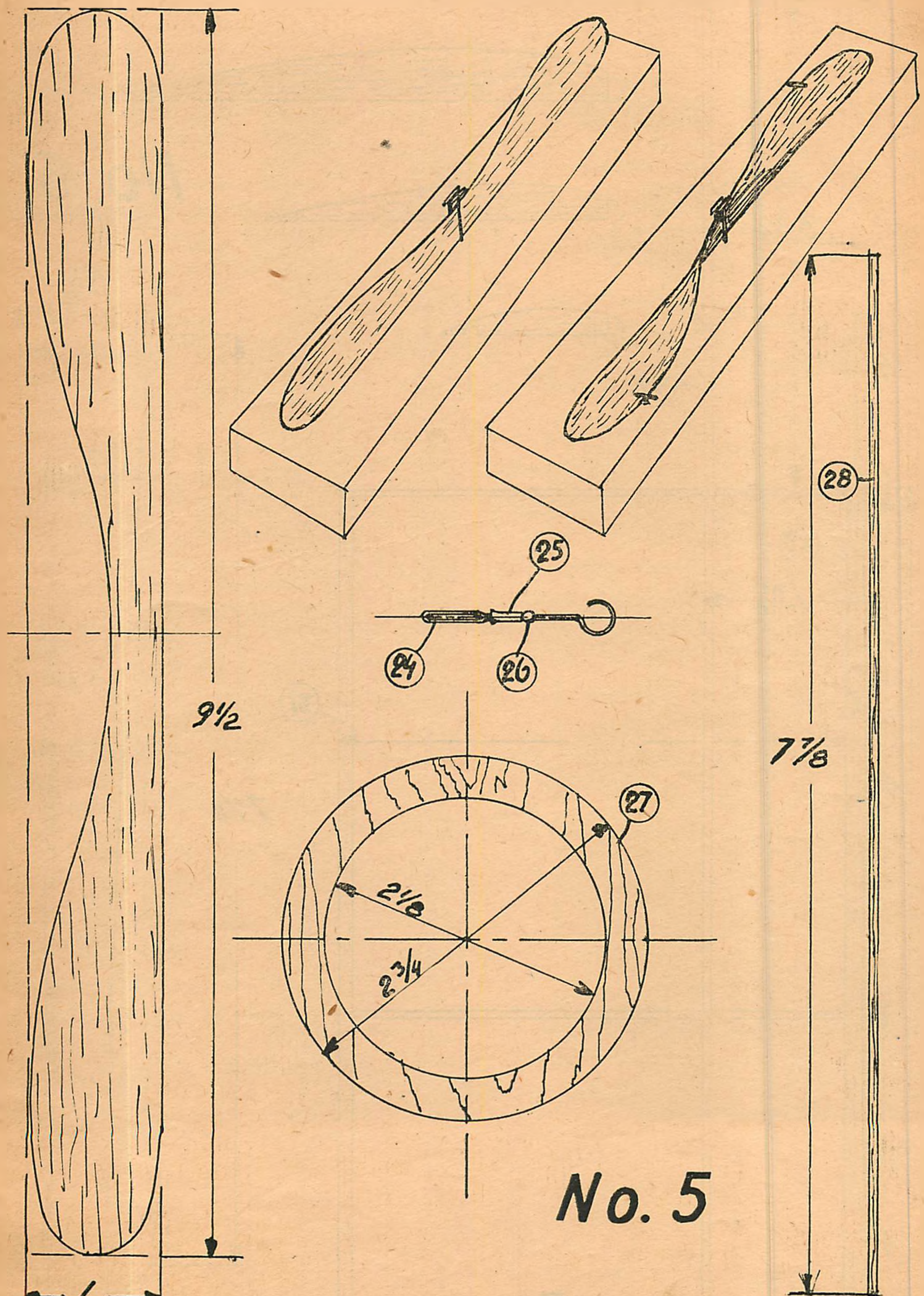
No. 8

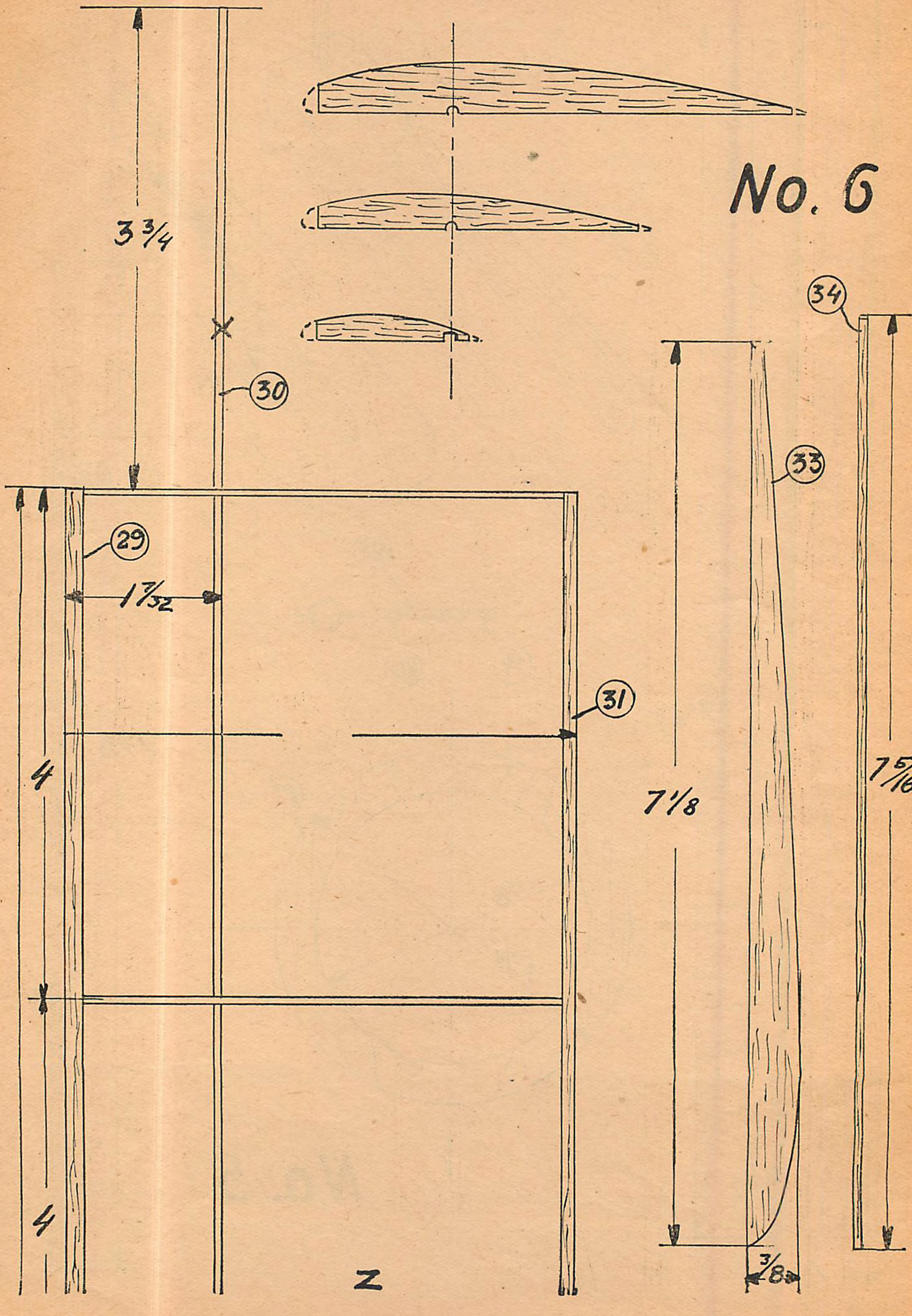

Rudder
No. 2
X
5/8
1/2
1
3/8
3
2¼
13¾
1 1/16
1 3/8
13
4½
7/16
1/2
1 5/8
1 11/16
2
2 1/16
5
12
7
8
11
3/4
4
1 3/8
3/16
1/16
5/8
3/4
1 5/8
6
9
3½
3
10
2⅛
1
1
5/8
1
2 5/8
1 11/16
X


3¾
11½
9½
7 13/16
4⅛
4 15/16
4¾
R. 9/16
¾
5/16
No. 3
1 5/16
9/16
1 3/16
¼
3/32
1
1⅜
1¼
½
¼
1
2
3
5
6
7
8
10
14
15
16
17
18
19

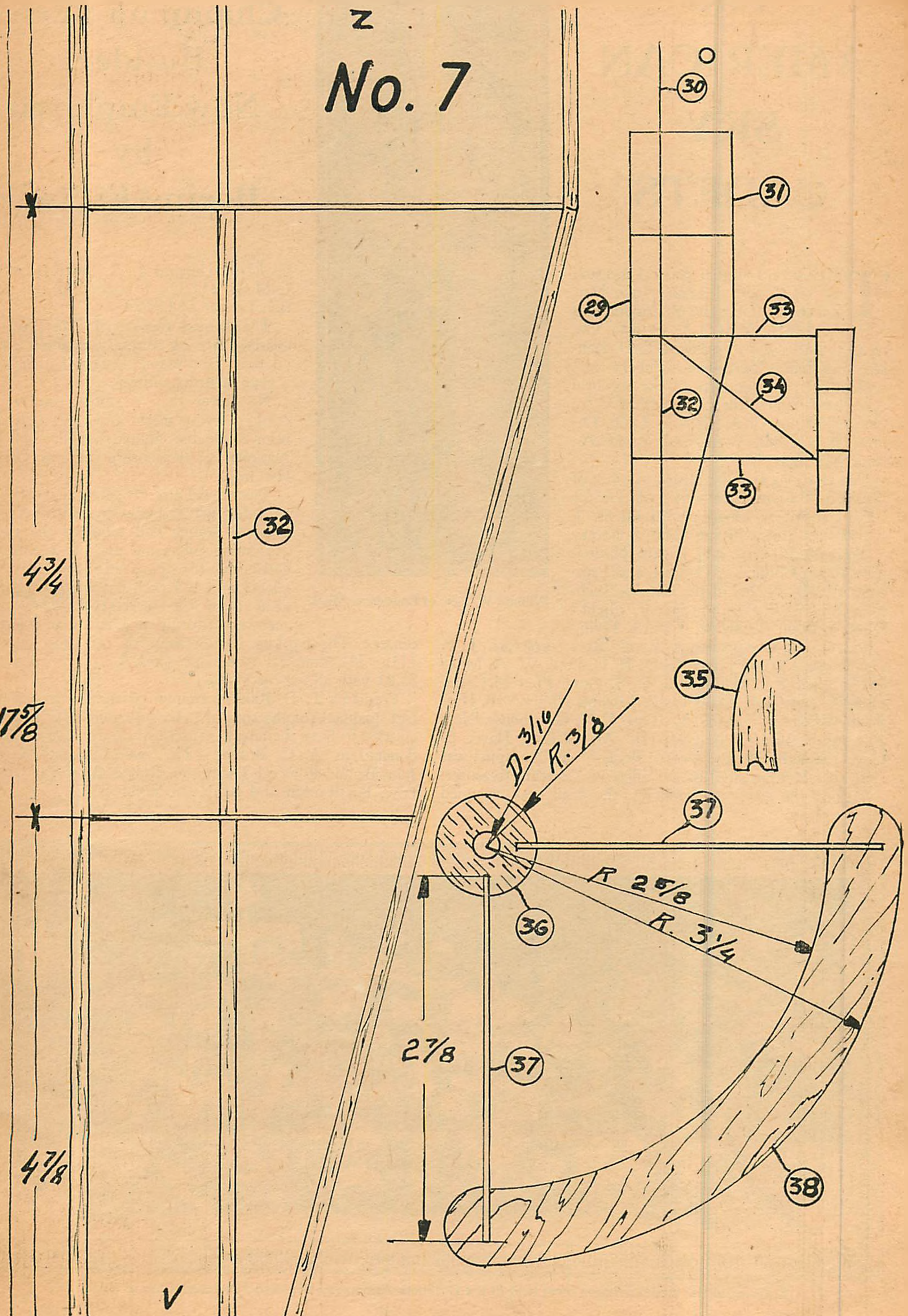


No. 4
Y
20
16
17
3 5/16
15 1/2
16
17
1
4
16
17
1
U
21
3/8
12 1/2
20
18
19
23
3 7/16
22
U


9½
1
25
24
26
27
2⅛
2¾
28
7⅞
No. 5



No. 6
3 3/4
30
29
1 7/32
31
4
4
Z
33
7 1/8
3/8
34
7 5/16


Z
No. 7
30
31
29
33
34
32
33
32
35
4 3/4
17 5/8
D-3/16
R.3/8
37
R 2 5/8
R. 3 1/4
36
2 7/8
37
38
4 7/8
V

The AMERICAN SKY CADETS

Champion Model Builders Now Employed by Boeing Factory

William W. Lee, of Lawrence, Mass.

THE second annual general meeting of the Ottawa Branch of the Model Aircraft League of Canada was held at the Y.M.C.A., Ottawa, Ontario, recently, with President T. D. Rankin presiding. Thirty-five members were present as representatives of the six local aero clubs, namely the Central Y.M.C.A., Ottawa Flying Club, Kiwanis Club, Ottawa Boys Club, West End Y.M.C.A., Rockcliffe Aero Club.

The elections saw the return to office of President Rankin while other officers for 1931 comprise: Honorary president, J. R. Booth, Ottawa Flying Club; honorary vice-presidents, Prof. J. H. Parkin, National Research Council of Canada, and Principal W. W. Nichol of the Ottawa Technical School; first vice-president, Flight.-Lieut. Gordon T. Byshe, Ottawa Flying Club; second vice-president, R. C. Ross; directors, J. P. Henderson, Ottawa Flying Club; H. G. Low, W. A. Milks of the Central Y.M.C.A.; H. R. S. Gow; Fred McCann, Ottawa Boys Club; Ken Cassels, Kiwanis Club; A. B. Horwood, West End Y.M.C.A.; Capt. F. T. Goodhouse, New Edinburgh Aero Club; Capt. W. M. Gladish; Harry B. Gow, Kenneth Low and George Booker. M. A. Appel was subsequently appointed to the office of secretary-treasurer.

During the election of officers, the chair was occupied by Major-General J. H. MacBrien, C.B., C.M.G., D.S.O., President of the Aviation League of Canada.

The annual reports of Capt. W. M. Gladish, retiring secretary-treasurer, showed that the Ottawa League had enjoyed a year of great activity.

No fewer than seventeen indoor and outdoor flying meets and exhibitions had been conducted, apart from the Canadian National Championship meet at Ottawa last July.

Two model aircraft shows had also been held for which prizes were given. The Ottawa Branch had followed the system of issuing pilot and aircraft registration certificates for approved flights in various classes and 115 such licenses had been issued from the secretary's office, many members earning a number of these licenses. The paid-up membership for the year was also 115. The financial statement showed a cash balance of $3.83 with all expenses paid.

President T. D. Rankin announced that seven members had qualified for the title of "Ace" during 1930, and were entitled to have their names inscribed on a handsome shield donated by A. C. Brown. They were: Donald Rankin, John Beilby, Edmond Thompson, Robert Ross, Kenneth H. Low, Ian Rankin and Benjamin Webb.

Entrants in the model aviation meet held in the Elizabeth Armory by the Model Aviation Club of Elizabeth

On the motion of Prof. J. H. Parkin, seconded by Flight-Lieut. G. T. Byshe, the secretary-treasurer was voted the official thanks of the League. A vote of thanks was also given to the many who had assisted the branch during the year, on the motion of Flight-Lieut. Byshe, seconded by John Beilby.

—o—

MODEL CHAMPIONS AT WORK

Othello Dickert (left) and Lewis Proctor at work in the model department of the Boeing Airplane Company at Seattle.

COMBINING pleasure with profit, two young men who gained prominence for themselves by winning championships with airplane models are now playing an important part in the construction of aircraft at one of the largest airplane factories in the United States. Othello Dickert, winner of a civic contest in Seattle in 1928, and Lewis Proctor, 1929 winner of the national airplane model contest sponsored by the Airplane Model League of America, are employed by the Boeing Airplane Company of Seattle to fashion miniature airplanes.

This company has created a model building department in its production organization, and the workmanship of Dickert and Proctor is of great value in the manufacture of airplanes at this plant.

"We build two types of models in our work here," Dickert explained. "They are the wind tunnel model and the exhibition model. The first type is a minutely scaled, perfectly shaped model which is used for testing in wind tunnels, while the other type is a miniature replica of our various models, correct in every detail, even to the coloring, but with a little less emphasis on accuracy of dimensions.

"When the company decides to build a new type of airplane and the engineers complete their plans for the new ship, we get the drawings from which we develop the wind tunnel model. The construction of the wing sections, for example, is perhaps the most important phase of this type of model construction. We must make sure that the wings do not vary 1/2000th of an inch from the scaled dimensions. We use only hard maple for this work.

"Two months are usually required for the building of a wind tunnel model. A great deal of time must be spent in fashioning the small templates and jigs for the model. When it is finished, engineers of the company run tests with it in a wind tunnel, and from the results of the tests, they are enabled to calculate closely the performance of an actual airplane built to the design. Comparison of wind tunnel tests with performance tests of a completed airplane shows a striking similarity.

"The importance of these tests with the wind tunnel model, which reveal accurately what a completed airplane of this design will do in the air, is apparent. If the trials are satisfactory, the company may go ahead and build the airplane with the knowledge that it will fly successfully. On the other hand, if the tests show that the performance of a completed airplane would not be satisfactory, great expense will have been saved by the company which would otherwise proceed with the production of an experimental plane at considerable cost.

"Wind tunnel models are not built when a new plane under design is simply an improved model of a previous type of plane, but are produced when the plane being designed represents an innovation or a radical departure from other types of airplanes.

John E. Frank, Jr. 14, of Clarion, Pa.

"The other type of model that we build is the exhibition, or historical miniature airplane. The company recently commissioned us to build scale models of many types of airplanes produced by the Boeing Airplane Company. Twenty-four different models are being built, and all of them will be faithful replicas of the actual planes, even in the coloring and numbering. They must be accurate to the last detail. For example, if the airplane we are modelling was equipped with a wood propeller, we fashion a small wood propeller for our model; if the plane had a metal propeller, we equip our model with a small steel prop.

"The company is having these models built primarily as a historical and graphic record of Boeing airplane construction. Occasionally one of our models is placed on exhibition, but only in cases where full protection is guaranteed. They are fully covered by insurance, however, whenever they leave the factory.

"In view of the time and labor required in the construction of these models, the company rates them very highly and places considerable value on them. The wind tunnel models are usually valued at $500, while the historical models run around $250."

The model department in which Dickert and Proctor build their miniature ships is completely equipped for the delicate work. The finest tools, instruments and materials are placed at their disposal. When they start construction of an historical model, they are (*Continued on page* 48)

A Course in Airplane Designing

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

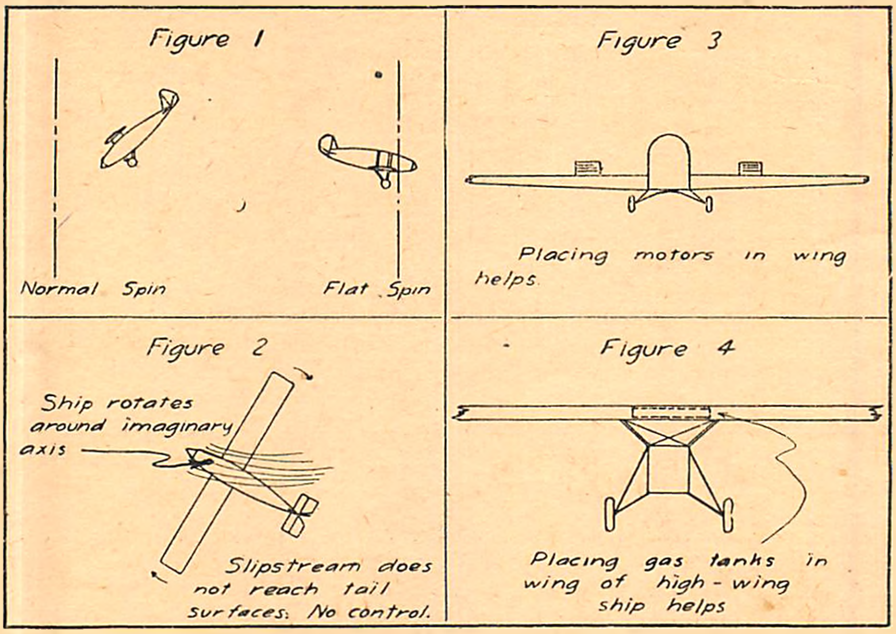
By Ken Sinclair

LAST month we learned that the *tail-spin* is caused by the natural autorotation of a wing, which in turn is caused largely by the loss of lift beyond the burble point. We found that any airplane has to be stalled before it can be made to spin. We also learned that the ship is fully stalled at all times during the spin, and that most ships can be brought out of spins only by pushing the stick forward to overcome the stall.

Much the same conditions apply to the *flat spin*. A *flat spin* is usually a development of a tailspin, and is, in reality, nothing more than a tailspin at a very high angle of attack. Usually, when a ship spins flat, it makes two or three turns of a normal spin; then the nose rises slightly, and the ship is spinning "flat."

Not all ships will flat spin. In fact, no good ship now on the market can be made to go into a flat spin. If it is found in test flights that a ship has tendencies toward flat spinning, the plane is redesigned to overcome those tendencies.

Why is a flat spin important to the designer? Chiefly because, once a plane is in a flat spin, it is very difficult indeed to bring it out again and into normal flight. In fact it is often impossible for the pilot to regain control at all. That means a crash. We see, then, that a knowledge of the flat spin is an important part of the designer's business.



Let's see if we can find out a little about how a ship really acts when in a flat spin. We have said that a flat spin usually begins with a normal spin, after which the nose rises, and the ship is found to be spinning "flat." There is a bit more to it than that.

In Figure 1 we see a plane in a flat spin, and also one in a normal spin. It may easily be seen that the ship in the flat spin is rotating much more closely to the axis than is the other plane, and also that it is descending at a much higher angle of attack.

It will be remembered from the last article that a ship in a spin descends in a spiral fashion, whirling around an *imaginary* axis and losing altitude rapidly. Often the axis about which a ship rotates in a flat spin is actually behind the nose of the plane. It might be said here that the term "axis" is used merely for a reference. There is of course nothing there, but the ship descends in such a fashion that, if there were a vertical rod in the air, it would whirl around that rod. We use the term to have something by which we may determine just what is happening.

Since the axis about which the ship rotates in a flat spin is much closer to the ship, if not actually in the ship, we see that the plane is approaching a top-like rotation, as opposed to the spiral-like rotation of the *true* tailspin. The ship in a flat spin is turning fairly rapidly, but is not losing altitude, in most cases, as rapidly as it did in the normal spin. But this doesn't mean that the flat spin is not the more dangerous of the two.

In a normal spin, with a well-designed ship, the pilot can bring his plane out in a few moments, while in a flat spin it is found that the controls do not respond at all, or that they are difficult to move.

In the flat spin, at times, the inside wing tip is actually moving backward. This may be a little hard to grasp. Figure 2 shows a ship in a flat spin, as viewed from directly above. We can see here that, since the whole ship is rotating around the axis, the inner wing tip, in this case the right, is actually moving backward through the air. This hampers aileron action.

More important than that, the ship is rotating so tightly that the slip-

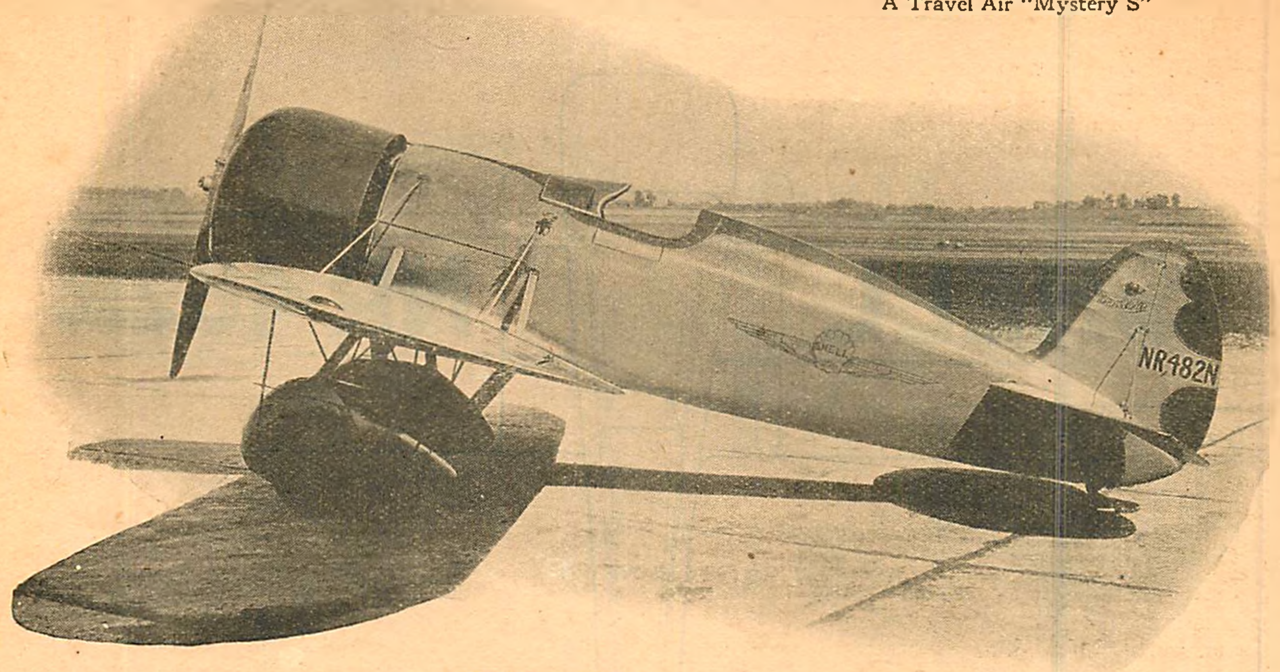
(*Continued on page 42*).

IN presenting this course, MODEL AIRPLANE NEWS *wishes to stress the fact that model building is more than a mere sport. If the builder of model airplanes learns the fundamental principles underlying airplane flight and design, he prepares himself for a future career in the most profitable phase of aviation.*

The policy of MODEL AIRPLANE NEWS *is not to encourage or teach its readers to become pilots, but rather to become aeronautical engineers, designers, salesmen, manufacturers, or equip themselves for any other positions which require the training of the specialist or executive. Study this course from month to month, master it in every detail and you will gain a fundamental knowledge of the how and why of airplane design which will be second to none.*

THE EDITOR.

A Travel Air "Mystery S"



"JIMMIE"

DOOLITTLE HAS SOMETHING TO SAY ABOUT MODELS

THE intense interest in the building of model airplanes by the youth of the nation as a result of the rapid strides made in the science of aeronautics, in airplane design and manufacture and in aerial transportation, has brought hundreds of requests from "air-minded" boys and girls all over the country, for blue prints, photographs and data of the famous Shell Travel Air "*Mystery S*" ship according to James H. ("Jimmie") Doolittle, noted aviator and head of the aviation activities of the Shell Petroleum Corporation.

"This widespread interest in model airplane building by the youth of the country is highly significant for two reasons," said Mr. Doolittle. "First, it is a tribute to those dauntless souls past and present who have dared all to further the science of aviation and in so doing have not only stript flying of many of its hazards but have put aviation on a sensible basis that has attracted to it the best types of young manhood and womanhood, and naturally the youngsters growing up have been drawn to aviation in this age of flying and are expressing themselves creditably through the worthy medium of model airplane design and building," he said.

"It is a well-established fact that youngsters work best and accomplish most at tasks that are intensely interesting. That being the case, aviation has through model airplane building furnished one of the best outlets for the constructive application of youthful enthusiasm.

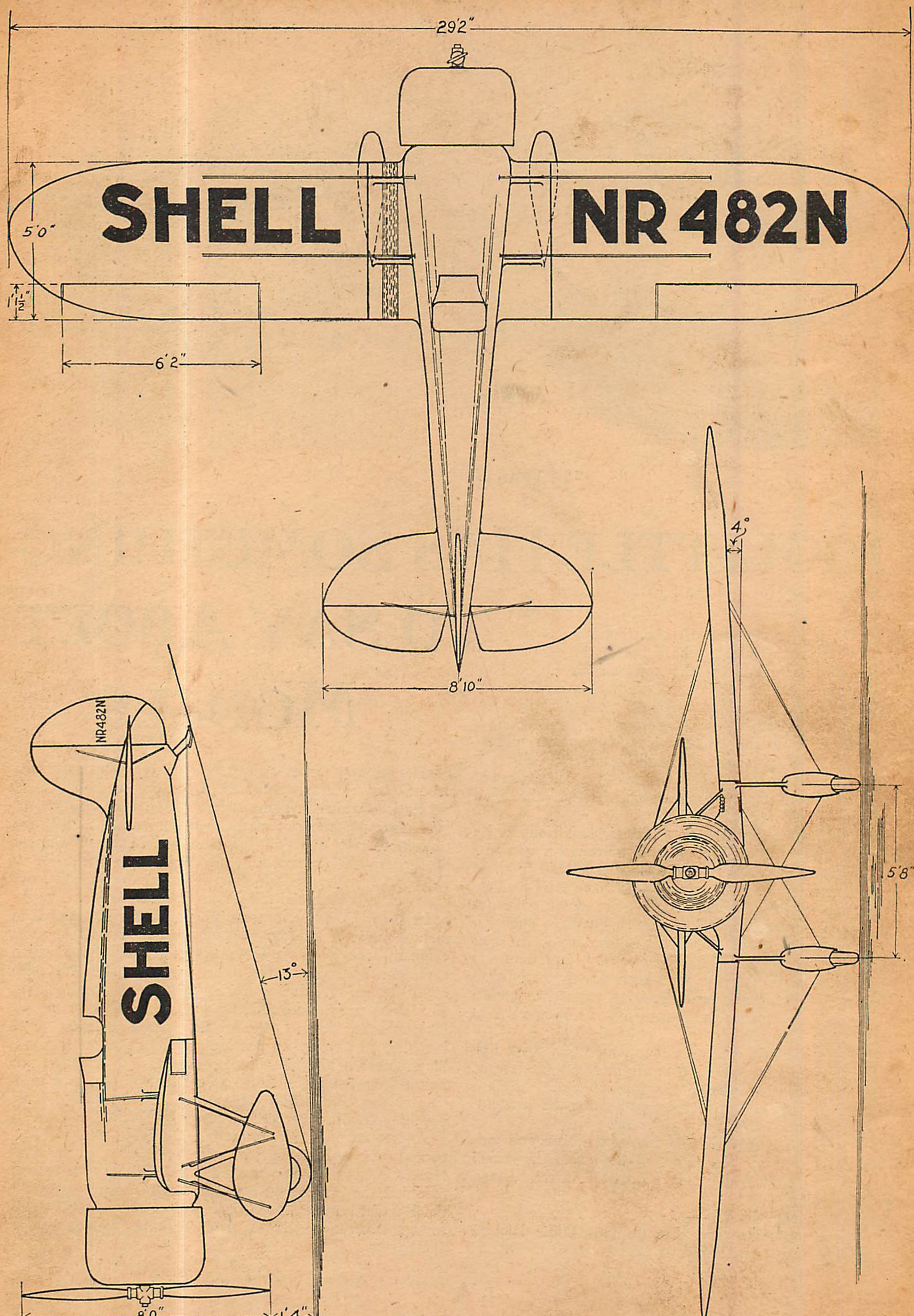
"The model airplane builders among the boys and girls of this country (and there is a growing list of the latter) are to be congratulated for their good work in the furtherance of aviation."

As for "Jimmie" himself—

At about the same time that Captain Eddie Rickenbacker, American "Ace" of Aces, was awarded the Medal of Honor, another ex-Army flyer of international fame, Lieut. (now Major) James H. Doolittle, was awarded a decoration, which in name stands as the most appropriate ever given by an appreciative government to a flyer for exploits of valor and skill. This was the Order of "Condor of the Andes," awarded by the Bolivian government to Doolittle for his deeds in South America while on leave status on a commercial mission to Latin America.

In 1926, Doolittle, representing a prominent American manufacturer of military airplanes, was demonstrating this company's products to the governments of the southern continent. His actions read like a page torn from the wildest of fiction. When one European demonstrator took the air in competition with him, Doolittle took off also and rode his competitor down to the ground. Later on, the tibia of both legs broken by an accidental fall, Doolittle took off, his crutches beside him in the cockpit, and flew over the Andes from Santiago, Chili, to La Paz, Bolivia. Army aviation of the United States flew high in the esteem of the people of South America as a result of Doolittle's actions.

Appreciative of his incomparable flying skill, Bolivia turned over to him the decoration of "Officer of the National Order of Condor of the Andes." As he is a Reserve officer at the present time, having resigned last year from the Regular service, Doolittle is authorized to accept this foreign decoration without first obtaining the consent of Congress.


29'2"
SHELL
NR482N
5'0"
1'1½"
6'2"
8'10"
NR482N
SHELL
13°
8'0"
1'4"
4°
5'8"

A Word Or Two About

"CASEY" JONES

A THUMBNAIL SKETCH OF AMERICA'S DEAN OF SPORTSMEN OF THE AIR

CHARLES SHERMAN JONES, affectionately known by his friends and the entire aviation industry as "Casey," was born at Castleton, Vermont, on January 11th, 1894, and is a graduate of Middlebury College. He made his first flight in 1911, and from that time on has been a sworn champion of the cause. Mr. Jones is the holder of Transport License Number 13, and has had many thousands of hours in the air.

In June, 1917, when the United States entered the World War, Mr. Jones joined the United States Army Air Service, attending the Army ground school at the University of Illinois, and receiving flying instruction at Wilbur Wright Field, Dayton. He was commissioned a first lieutenant. In October, 1917, he went overseas, attending the pursuit school at Issoudun and the gunnery school at Cazeaux. As soon as he had completed the regulation course for a combat pilot, Mr. Jones was sent to the Front for a period of experience with a French squadron. After three months he was recalled, to serve on the instruction staff of the school at Issoudun, which was in urgent need of trained and competent personnel.

Accidents were numerous in those days of stress and strain. Mr. Jones, who saw many a good messmate crack up, found his attention turning naturally to the principles of good flying. He assiduously studied the theory of flight, and eventually became one of the Army's soundest pilots.

Mr. C. S. ("Casey") Jones

Mr. Jones joined the Curtiss Aeroplane & Motor Company in January, 1919, at Garden City, Long Island, and completed the post-war organization of the Curtiss Exhibition Company, founded originally by Glenn H. Curtiss in 1910. Beginning in 1926, he was associated with the Curtiss Company as test pilot, also being in charge of sales promotion of airplanes.

Mr. Jones has been a successful competitor in practically all the National Air Races, starting in 1919, when he finished second in the New York-Toronto race. In 1921, he won the American Legion derby at Kansas City, and in the same year won two first places and one second at the National Air Races at Omaha. In 1922, at Detroit, he was second in the "On to Detroit" race, and in the Aviation Country Club race; in 1923 he won the "On to St. Louis" race, and took second and third places in the other events; in 1924, he won the "On to Dayton" race, and the Central Labor Union speed race; in 1925, he won two events at the National Air Races at Mitchel Field, and in 1926, took a first and a second at the Philadelphia National Air Races. Mr. Jones then abandoned racing until this year, when he won a race for cabin ships at the National Air Races in Chicago.

Until recently Mr. Jones was President of the Curtiss-Wright Flying Service, when he resigned to become Vice-President of the Curtiss-Wright Corporation, in charge of public relations.

They stopped dead in their tracks

THE MYSTERY OF THE SILVER DART

By RAY CREENA

Lieut. Ian Potter, nineteen years old and an outstanding flyer in the U. S. Army Air Corps, accidentally intercepts a wireless message in code while he is a guest at the home of Commander Stevens.

It is proved that it concerns the Silver Dart, a new mystery fighting plane secretly developed by the government, and the theft of which has startled the inner circle of official Washington, though it gives no indication to the world of its loss.

Rear-Admiral Beecham, of the U. S. Secret Service, concocts a plan whereby Ian ostensibly is to be discharged from the Air Service in seeming disgrace but is really freed to undertake a private flight to Bog Walk in the West Indies, which place is mentioned in the message. Once there he is to try to ferret out the thieves as quietly as possible.

In the meantime, Admiral Beecham sends disguised secret service men to learn the secret in the home of Commander Stevens. There they unearth a secret wireless receiving set, to which the intercepted message had evidently been sent. They arrest all servants and Commander Stevens is sent away on a special mission. Now the Secret Service is free to work. Taking possession of the set, they receive in code the information that a submarine is making for Hunt Bay in the Indies, fully equipped to take the Silver Dart *aboard.*

Immediately three of the U. S. Navy's swiftest cruisers accompanied by the aircraft carrier Saratoga *sail for Jamaica. Then the Commander at Guantanamo Naval Base is notified to meet Ian Potter's plane.*

With his friend, Ruddy Arnold, who borrows an old Fokker, Ian takes off for the tropics. They battle a bad storm on the way down. After the lull they look for the flight of Corsairs which were to meet them from Guantanamo. There is no sign and they are at a loss what to do, as their wireless set is now too weak for signalling.

They do not notice a speck in the sky creep from ahead and pass them. Suddenly there is a "whirrrrrrrrrr" . . . . .

FROM underneath and in front of the Fokker, and in less time than it takes to tell, a single-seater Vought *Corsair* Navy fighter seaplane shot up into a perfect loop, coming down over the Fokker and taking up a position ahead and slightly below.

The pilot of the *Corsair*—the commander of the Guantanamo Bay station, incidentally—looked back and waved. He waited for an answering signal from the Fokker. Ian saw the motion, opened the cockpit window and waved back. Then the commander motioned Ian to follow him and turned off the airline that Ian was making for Guantanamo Bay.

Not sensing what it was all about, Ian did not follow the *Corsair,* which plane was following a course that would take them about 25 miles east of Guantanamo.

The surprise and sheer fright of both Ian and Ruddy can be best left to the imagination when they saw the *Corsair* execute a perfect Immelmann turn—a maneuver which is a half loop and a roll that puts the plane at a higher altitude and flying in the opposite direction—and then come down again over the nose of the Fokker, but this time firing three short bursts from a machine gun.

Ian and Ruddy, above the roar of their engine, heard faintly the dull "rat-tat-ta-ta-tat—rat-tat-ta-ta-tat—tat-tat-ta-ta-tat," and looked at each other in amazement. Naturally, they could not know that the pilot of the *Corsair* was the commander or that he was firing only blank cartridges.

Ruddy said nothing. He could think of nothing to say, particularly as he noted the intense look of disappointment on Ian's face. He did not know that Ian was wondering if all his plans had gone wrong, and that possibly his mission had been found out by secret service agents of some other nation and that the pilot of the *Corsair* was one of these, threatening them with death in the skies.

DURING all this the *Corsair* was circling round the Fokker, the pilot beckoning Ian to follow him. Finally, Ian shrugged his shoulders and decided to see what was going to happen, anyway.

"Might as well see it to the end as be snuffed out in mid-air," he said to himself.

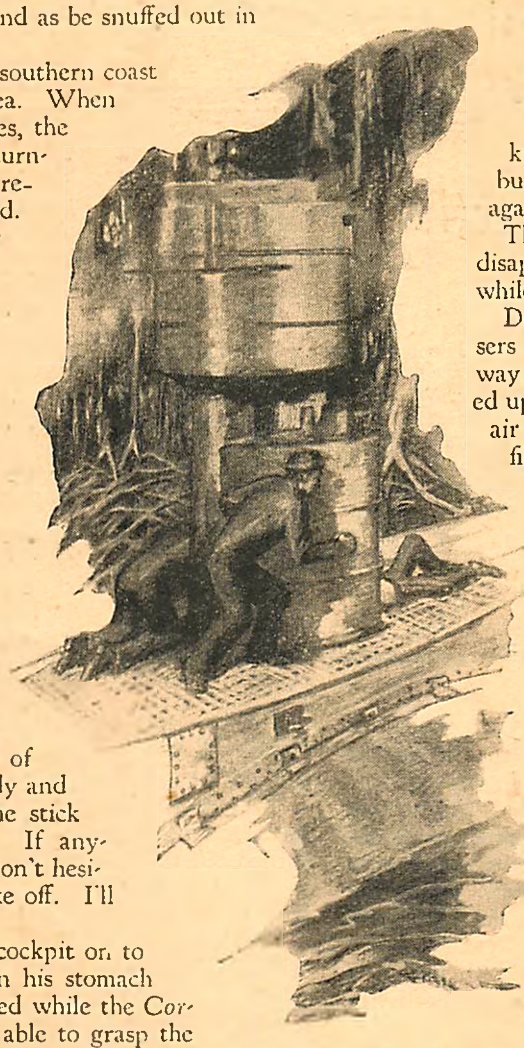
Soon both planes crossed the southern coast of Cuba and were well out to sea. When they had gone about thirty miles, the pilot in the *Corsair* once again turned around, waved to Ian, who replied, and motioned him to land. He put the nose of the *Corsair* down to lead the way.

Ian followed suit, and both planes made perfect landings on a sea that was not rough, but by no means calm. The *Corsair's* pilot jockeyed the plane to within hailing distance, and then yelled:

"Potter—climb out to your starboard (right) wing tip—I'll taxi up—and grab my wing tip and hold it. Important!"

Ian recognized both authority and friendliness in the American voice and immediately signalled that he would do as instructed. However, being a cautious sort of bird at times, he turned to Ruddy and said, "Here, Mournful, take the stick and stand by for instructions. If anything happens out of the way, don't hesitate. Give her the gun and take off. I'll be able to clamber back."

He then climbed out of the cockpit on to the wing and slithered along on his stomach to the wing-tip. There he waited while the *Corsair* was taxied up and he was able to grasp the wing. The commander switched off his engine, and Ian motioned Ruddy to let the propeller of the Fokker just tick over.



Stealthily they crept forward

Meanwhile, the pilot of the *Corsair* also had climbed on to the top wing and slithered out towards Ian.

"Sorry to scare the wits out of you," was his greeting. "I'm Commander Strangways of the Guantanamo group. Had to force you down like this as what I've got to say isn't for publication. Here, take these, you'll probably need 'em." He handed Ian the two revolvers and the ammunition.

"Well?" asked Ian, determined to let the other do the talking.

"Nothing much," replied Commander Strangways. "Just hell popping loose concerning the *Silver Dart*. . . ."

He then went into detail concerning the happenings of which Ian knew nothing, and explained what Admiral Beecham had said over the telephone.

"We've heard nothing yet from the *Saratoga,*" the commander went on, "but I imagine that she and the cruisers are now about 150 to 200 miles off Kingston."

They sat and discussed the matter for some time longer, and was ever there a stranger setting for such a discussion? Here were two men, each sprawled across the wing-tip of their plane, drifting in mid-ocean and surprising themselves at what they had done.

Finally Commander Strangways said:

"Well, that seems to be about all. Hang on before you go, I've still something else to give you."

He slithered back to the fuselage, climbed down to the main float and unhooked a bomb from the rack under the lower wing. This he took out to Ian, saying, "Here, you take this back to your cockpit while I hold the planes together."

This operation was repeated three times, and just before he gave the signal to let go, the commander said:

"So long, old man. Good luck. Heaven knows what identification might be needed but, in any case, be careful if you run up against any of their gang."

They shook hands, and soon the *Corsair* had disappeared on its way back to Guantanamo, while the Fokker headed direct for Kingston.

During all this time, of course, the three cruisers and the *Saratoga* had been plowing their way towards Kingston. The weather had cleared up sufficiently to permit observation from the air and, needless to say, the sky at times was filled with planes scattering in all directions and scouring the waters below for a sign of the submarine, which, apparently, held the secret of the missing *Silver Dart.*

Owing to the uncertainty of the position of the submarine when the wireless message concerning its orders to proceed to Hunt Bay had been intercepted, the commander of the *Saratoga* immediately had formulated plans to counter-balance the possibility of the submarine reaching Kingston before being spotted.

Commander Strangways was not far wrong when he told Ian that the warships were about 150 miles off Kingston, for it was at that very moment the commander of the *Saratoga* decided that there was more than a possibility the submarine would reach the port first.

He, therefore, called all the cruisers to within signalling radius and flagged out instructions for his prearranged plan. These instructions, in brief, were that cruiser 239 should patrol a course fifteen miles out and parallel to the coastline of Kingston harbor, cruiser 341 should follow a parallel course to that of 239 but three miles to port, and three miles astern. Three miles astern of 341 but on the same course exactly as that of 239, cruiser 274 should patrol. The *Saratoga* would take up a position behind 274 corresponding exactly to that of 341.

By this means, the lanes patrolled would form a parallelogram across the ship lane leading to Kingston. This lane, incidentally, had to be followed carefully owing to the great number of reefs and atols lying off the island itself.

If the submarine did enter Kingston harbor ahead of the warships, it was a case of "woe betide it" if it ever came out.

The cruisers signalled that the instructions had been received and understood, and then deployed to the previous positions and made for Jamaica, which they expected to sight within about four hours or so.

It was in this formation that Ian spotted the warships when the Fokker crossed St. Catherine's Peak, flying fast and at about 10,000 feet.

From this position the two companions in the Fokker also could see stretched out before them the famous old town of Kingston, with its wonderful land-locked harbor. To their right, as they approched Victoria Park in the center of the town and from which they would make for the municipal pier, they saw their objective—Hunt Bay.

Neither could restrain a smirk of triumph. They were now sitting side by side in the cockpit of the Fokker, and since leaving Commander Strangways, Ian had shouted into Ruddy's ear the principal details of the hunt for the *Silver Dart*.

However, the present moment was not the time for any action such as they contemplated. At least; they thought so. They had not reckoned with fate, though.

They were flying down King Street to the pier. About 1,000 feet below they could see the crowds, etched in brilliant relief by the sunshine, waving handkerchiefs and other things with which they hoped to be singled out by the airmen. That they were cheering there was no doubt, but, naturally, neither Ian nor Ruddy could hear it above the drone of the engine.

HOWEVER, for once Ian did not follow his natural impulse to make a quick but neat landing. He leaned over and yelled to his companion:

"Think I'll circle the pier once or twice and then make tracks for Hunt Bay, pretending that I'm just letting the whole waterfront and nearby towns get a good look at the old tank, but if we spot anything that looks like the *Silver Dart* or the submarine, I'll land in the bay."

Ruddy nodded and nearly landed in Ian's lap as that worthy put the Fokker into a vertical bank to circle the pier. Ian held her in that position during the second turn and then flattened out, making for Up Park Camp, the military quarter and then turning left to the Old Cross Roads prior to heading for Hunt Bay.

The old Fokker was virtually screaming with joy, as if it realized that there was a desperate mission ahead; the engine was roaring like a lion amuck.

Ian swung the plane in a wide arc, maneuvering in over Bog Walk from the north, and hence at the narrowest point of Hunt Bay. To the crowd on the Kingston waterfront, the plane was a mere speck in the sky. Naturally, to them this was the ending of a flight about which they had heard so much. Its real mission was, of course, unknown.

Even the officials who were waiting on the Municipal Pier to welcome the airmen officially smiled good-humoredly at what they took to be the pilot's human desire to do a little bit of showing off at the successful termination of his flight.

Thus, the consternation of the spectators can be imagined when they saw the Fokker dive suddenly as if in a spin, and heard faintly borne on the wind the noise of a spluttering engine.

"He's down!" went up the cry. "Heaven help them," said many among the crowd. "If they are down in the mangroves, that's the end."

IT WAS by no means the end.

While Ian and Ruddy were both scanning every inch of the bay, hoping to at last realize the objective of their long, hazardous flight, they could see nothing which would lead them to believe that they were on the right track.

The blue waters below them were as placid as a mirror. The slightest break of any kind would have been noticeable for miles around. The strain on their nerves as they peered down and around was becoming unbearable.

Disappointment and chagrin were evident in every move and bearing as Ian swung the plane round to return to Kingston.

Then, as if an electric shock had passed through them both, Ian and Ruddy sat bolt upright and their eyes nearly popped from their heads. Below them, set in bold relief by the sunshine, was the shadow of the tail group of an airplane jutting out from the thick mangrove swamp.

They scoured the heavens to make sure that no other plane was in the air, and then, quick as a flash, Ian jerked his throttle back and forth, making the engine sputter and then die out switching off. Both he and Ruddy made a mental picture of the position of the shadow.

Ian put the old Fokker into a sideslip and purposely flopped down in a very bad but safe landing, as if forced down. The forward speed of the Fokker carried them to within about fifty yards of the mangroves. What now?

To all intents and purposes, impulsiveness had cost them their objective, if their premise that the shadow they had seen really was the *Silver Dart*, as they hoped. Being marooned fifty yards from shore at the moment was no better than being miles away.

The bay was infested with sharks, so that to try and tow the Fokker to the edge of the swamps by swimming was out of the question. What to do?

They looked at each other, and the rueful expressions on their faces said plainly, "Well, a fine pair of mutts we turned out to be." Ruddy was first to break the silence.

"How about starting up the engine again and taxiing back to the pier?" he asked.

"No good," replied Ian. "That would spoil everything. It would put the gang who are holding the *Silver Dart* wise to the fact that they had been seen, and we'd waste much valuable time, during which they could destroy the plane or move it somewhere else.

"No. That's out," he added.

"Got it," flashed Ruddy. "I'll smash the sides off the radio set and we'll sit on the nose of the pontoons and paddle the old bus in, what do you say?"

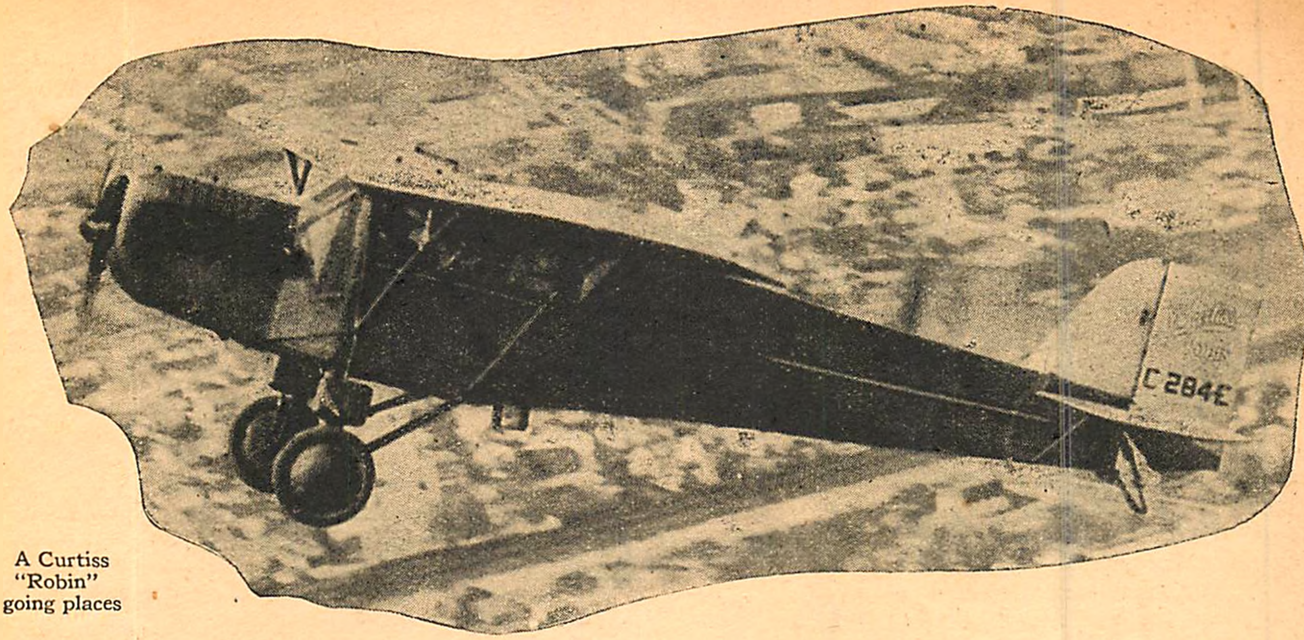
Ian grinned. "Mournful," he said, "sometimes you reach the peak of greatness—but only sometimes. Let's go!"

No sooner said than done. Ruddy scrambled across the top of the gas tank, wrenched off the sides of the radio set, scrambled back with them and soon each was seated on a pontoon, paddling as if their lives depended on it. Inch by inch the plane moved towards the swamp. The hot sun poured down on the two (*Continued on page 37*)

THIS MONTH'S COVER

Did you ever see anything so life-like as the Albatross D5A, and the Nieuport Scout in a scrap as portrayed for you by Ray Wardel? Mr. Wardel is one of America's foremost artists, and his experience in the U. S. Camouflage Section during the World War enables him to paint for you in actual colors war-time planes. Next month he portrays a Sopwith "Dolphin" and a Fokker D7 in combat.

THE EDITOR.



A Curtiss "Robin" going places

Special Course in Air Navigation

The Mainstay of Successful Piloting

By

Captain

LESLIE S. POTTER

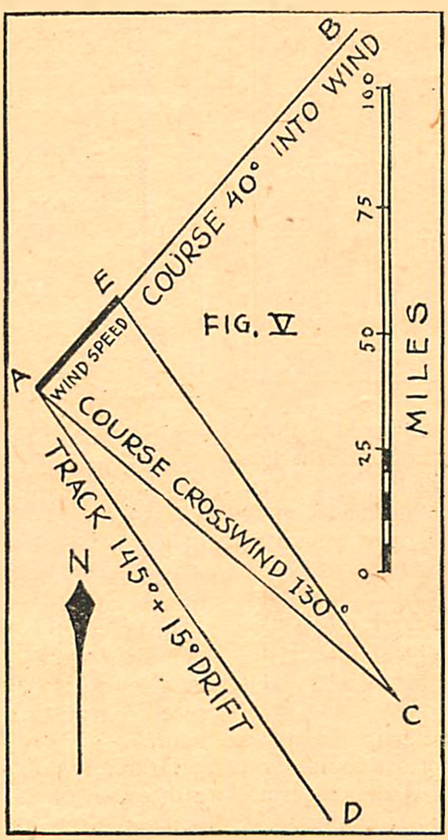
IN THIS series of articles, the author has endeavored to set out as clearly as possible, and in as simple words as possible, the art of navigation in the air.

Your interest in these will depend on your interest in flying, and whether you will consider yourself a pilot when you have learned to take a plane off the ground and bring it down again without breaking anything.

To those who do, these articles will be valueless, but to those who aspire to be more than fair weather pilots, to be able to fly from place to place without sole recourse to roads and railways, to be able to fly above the clouds with safety if they are too low to admit of safe flying beneath them, an intelligent interest in these articles will be of incalculable value.

If some of the points seem too elementary, do not pass them by, there is a reason for their inclusion; if some points do not seem clear, be patient, you will generally find some information further on that will clear them up as you proceed. Answer the questions at the end of each article and wait for their solutions in the next issue, and should you find any points requiring further explanation, send a letter with a stamped addressed envelope to the editor setting out your problems and a reply will be sent you explaining the points raised.

THE EDITOR.



A MONTH ago we dealt with the question of position lines and obtaining fixes by successive bearings. The information obtained by the fixes at different times, in conjunction with your knowledge of the course and airspeed given you by your compass and airspeed indicator respectively, will enable you to discover the windspeed and direction.

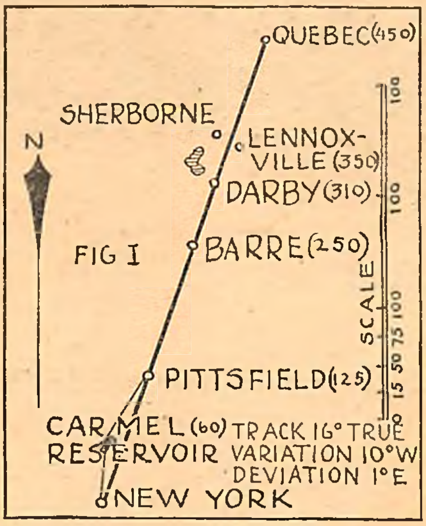
The method of working this out was explained two months ago in an article dealing with the triangle of velocities. You will realize how essential this knowledge of windspeed and direction is to successful air navigation, when I say that all the problems of air navigation conducted for the purpose of maintaining a course, have as their ultimate end the ascertainment of windspeed and direction. Whether you are obtaining bearings by celestial or terrestrial observations, the problem you are trying to solve is eventually always that of the wind.

If a mechanically operated instrument were produced today that would tell you accurately your windspeed and direction during flight, the major problems of air navigation would cease to exist. That being so, it becomes apparent that it is necessary for us to make use of all the methods existing today for ascertaining the wind velocity.

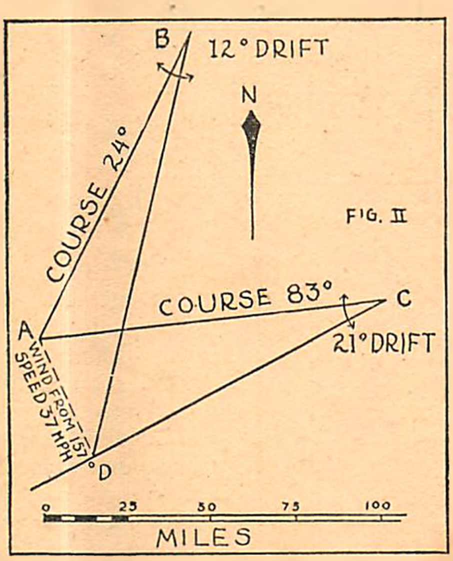
Obviously full use should be made of all the meteorological information available before a flight is started. The windspeed and direction should be ascertained, if possible, at the height it is proposed to fly before preparing your initial course. However, during any except very short flights the wind is unlikely to remain constant throughout the journey and at the different heights at which the plane may be flown. That being so, various of the methods of determining wind velocity during flight are given below.

Method 1. We will assume that you have obtained information as to windspeed and direction from the meteorological office before your flight and have used this information in preparing your course. The earliest opportunity should be taken to check this, and in order to gain accurate results you should gain, as near as possible to your departure point, the altitude which you propose to maintain during the flight.

The first prominent object over which you fly should be pin-pointed on the map and the time noted. Preferably one should be observed during the first ten and twenty minutes; but obviously this will depend on the nature of the country to be flown over. If your point of departure is near a large city such as New York, it would probably be difficult to pin-point any prominent object until you got clear of the congested neighbourhood, and this might take you longer than twenty minutes.



When made, however, the drawing of a line between this pin-point and your point of departure will give you your track. Should this coincide with the track you have laid down, then the course you are on will be the correct one. Should it not coincide, the correct windspeed and direction may be found by the method described in the article on the triangle of velocities.



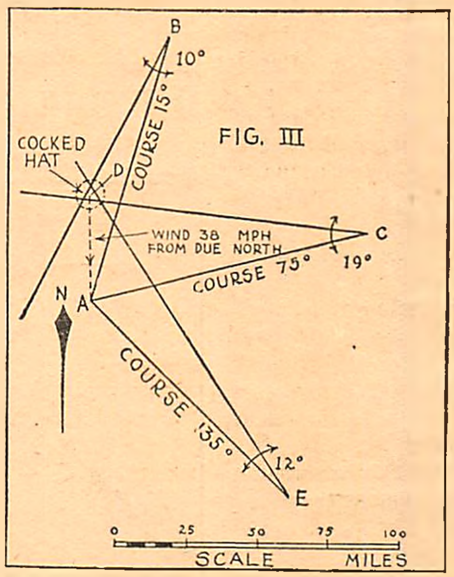
For instance, in Figure 1, we have considered a flight from New York to Quebec, an approximate straight line distance of 450 miles with a true bearing of 16°. You know the variation to be 10° West and the deviation to be 1° East, and from the meteorological office you have ascertained the wind to be at 20 miles per hour from 45° True. Calculations based on these figures will show you that the course to steer to make good this track of 16° T., is 22° T. which equals 31° by your compass (22°+10° Variation—1° Deviation) and that your ground speed will be 83 miles per hour.

The line that you have drawn over the map indicating your track shows that if you are on the correct course, you will pass about four miles east of the reservoir at Carmel (a distance of 60 miles), in approximately 45 minutes. At the end of this time you find yourself flying directly over the reservoir instead of to the east of it. You should draw a line then on the map connecting this position with your point of departure. This will show that your actual track has been 13° True or 23° Magnetic, although your groundspeed has remained the same. From these facts:

1. That you have steered 32° Magnetic (22° T. + 10° Variation) at 100 miles per hour airspeed.
2. That you have made good a track of 23° Magnetic at 83 miles per hour groundspeed you will find by a triangle of velocities that your windspeed has increased to 23 miles per hour from 73° Magnetic. It is an easy matter now with this data to set a fresh course for Pittsfield, where the wind may be checked again and the original track resumed.

It is a matter for individual choice at which places and how often the wind is to be checked, but it is always a good plan to draw a line representing the track, and note therefrom the principal places to be passed over and the estimated times of arrival at each. On the route illustrated in Figure 1, the wind might with advantage be checked again at Pittsfield and Derby, where the peculiar shape and size of Lake Memphramagog would stand out as a good landmark.

Do not forget that changes in height generally involve changes in wind, and incidentally, a glance at the map will show you the time and distance to be saved by a compass course over this route, as opposed to a route following roads or railways. The variation, incidentally, does not remain constant over the whole of this course, but any changes have been ignored for the purposes of this example.



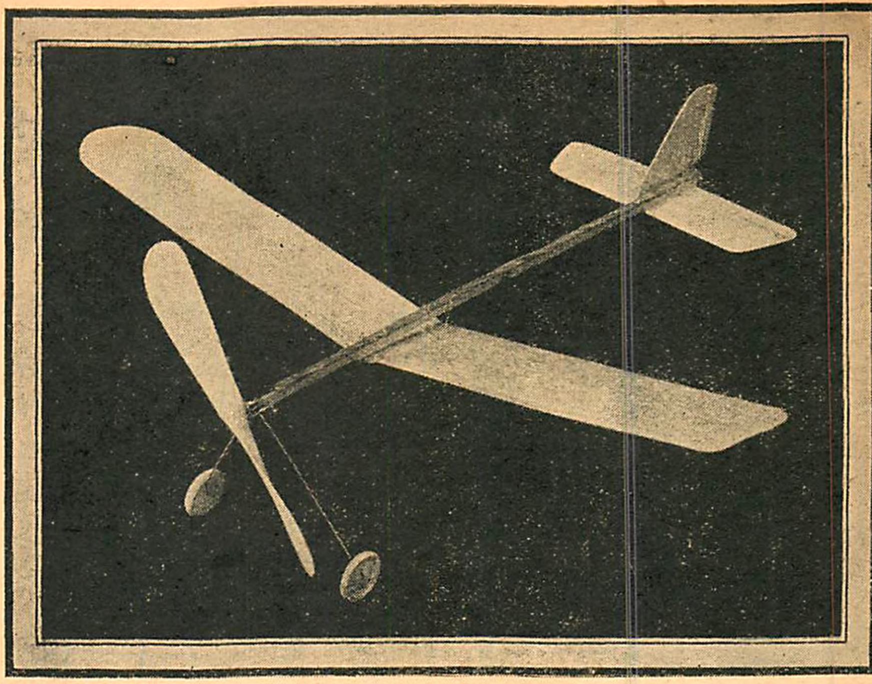
Method II. The double-drift method involves the use of the drift indicator, an instrument which was explained and described in detail in November's issue of Model Airplane News. In adopting this method you maintain a constant course in any direction desired, gazing through the eyepiece on to the drift wire and manipulating the instrument until objects on the ground are seen to be passing directly along the wire. You then note the angle of drift from the indicator. Now alter the course in any direction but not less than 50° and repeat the operation.

In Figure II, we have steered a course of 24° and found our drift to be 12° to port (left). We have then flown on a course of 83° and our drift was 21° to port. Our airspeed during this time has been constant at 100 miles per hour.

From any point A draw a line AB, 100 miles to scale in a direction of 24°, the first course. Then from the same point A draw another line AC, 100 miles to scale in the direction of 83°, our second (*Continued on page* 39).

How to Build The Grant "Minute Man"

By Chas. H. Grant



The Finished Model

THE Grant Minute Man, if we are to judge by its past performance, may be said to be one of the most remarkable performing all-balsa models ever designed. Recently, Thos. W. MacLean of Charlotte, N. C., with one of these models, made a flight of 1,500 feet, and six minutes duration, the model rising 300 feet.

It weighs about six-tenths (6/10) of an ounce. Before you begin your construction, study the plans carefully. The following materials and tools are needed:

(1). Two (2) sheets balsa 1/32" thick by 11" by 3" for the wings.

(2). One sheet of balsa 1/32" thick by 11" by 3" for stabilizer and fin.

(3). One balsa propeller blank 8" long with 10" pitch or one block of balsa 8" by 1⅜" by ⅝".

(4). One motor stick 3/16" by 3/16" by 18".

(5). One piece of balsa for ribs 3½" by 2" by 1/16" thick.

(6). Two hardwood wheels 1¼" in diameter.

(7). Two feet of 1/32" hard steel wire for the landing gear, propeller shaft and S hook.

(8). One foot of 1/64" hard steel wire (for wing clips, can, tail skid and motor anchor hook.)

(9). One washer for propeller shaft.

(10). One bearing or propeller hanger.

(11). One two inch thread rubber band (to hold stabilizer in place).

(12). Twenty feet of 1/32" square rubber thread, or (63) inches of 1/32" x ⅛" rubber.

(13). Two small tubes of water-proof cement (about ½ oz.) for cementing wing together, ribs in place, fin or rudder to motor stick and wire parts in place.

Necessary tools are:

(1). One pair of wire cutters.

(2). One pair of small, round nose pliers.

(3). One small pocket knife.

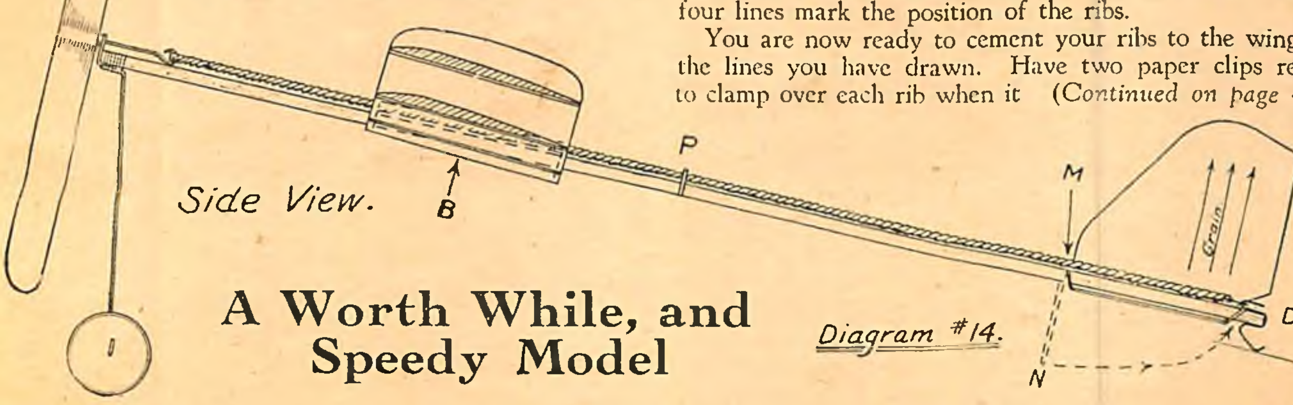
(4). One pair of compasses.

(5). Eight paper clips.

First construct the wing. This is made from two of the balsa sheets (1/32" x 3" x 11"). Select the two that are the nearest to being alike in weight and texture of the grain of the wood. Cut them, if necessary, so that each is eleven inches long and three inches wide. Now place one flat on the table and with a pair of compasses draw the quarter circle (X-Y) with center at (O) according to dimensions, diagram 1, thus rounding off one corner of your wing. Cutting away the wood outside these arcs creates greater efficiency. Place the other wing sheet on your table and round off the two opposite corners of the sheet as you did those of the first one. Be sure that the corners you cut away are the ones on the opposite end of the sheet, thus allowing the straight edged ends of the two sheets to be joined at the center of the wing. Now for the ribs. Cut four of them exactly to the shape shown in diagram 3 from your sheet of 1/16" balsa.

Now pick up the two wings and measure one inch in from the round end on the under side of each one. Draw a line straight across the wings from the front edge to the rear edge, at these two points (A) and (A¹) in diagram 1. Draw similar lines across the wings at points (B) and (B¹), six inches in from the rounded ends of the wings. These four lines mark the position of the ribs.

You are now ready to cement your ribs to the wing on the lines you have drawn. Have two paper clips ready to clamp over each rib when it (Continued on page 44).



A Worth While, and Speedy Model

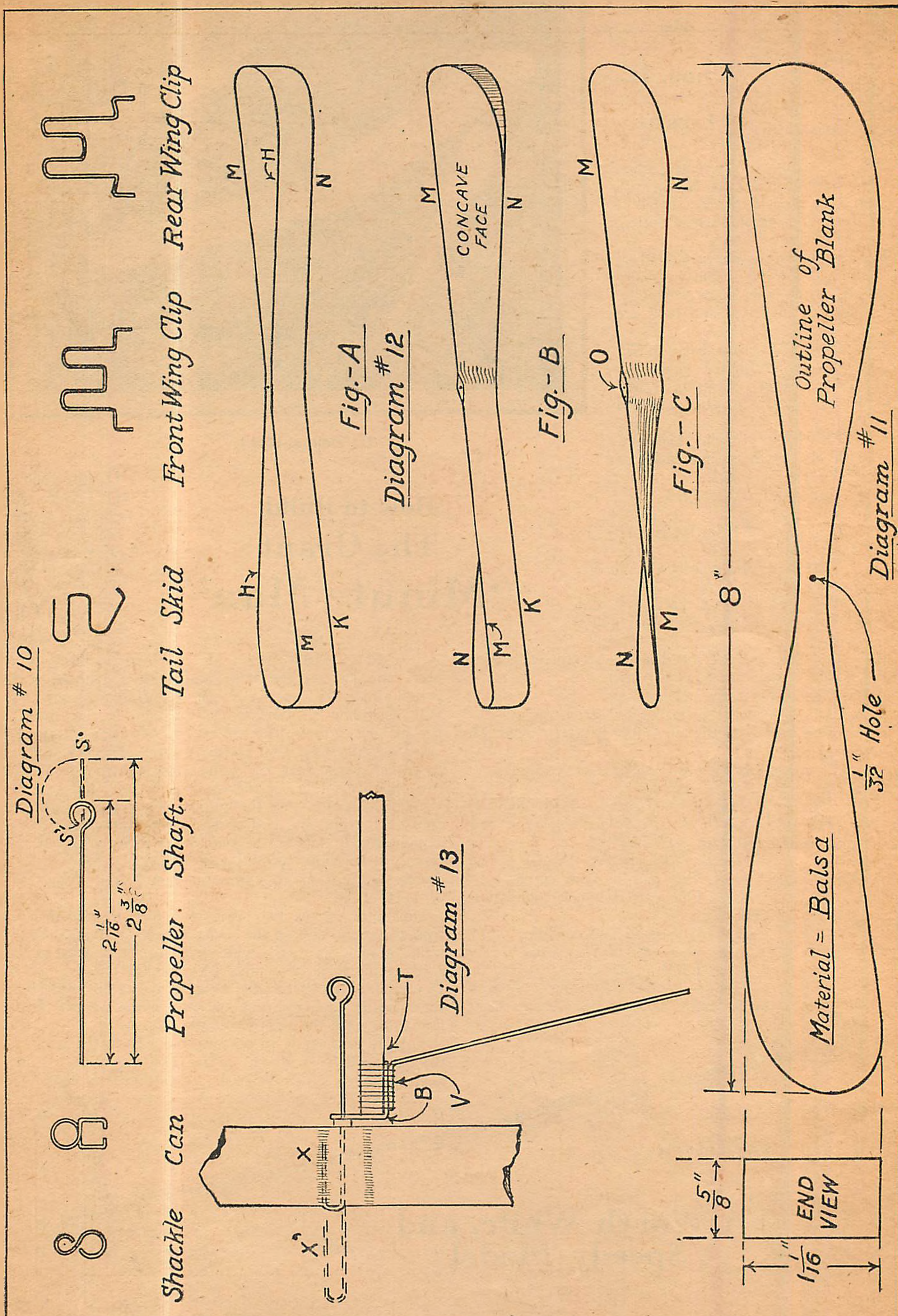
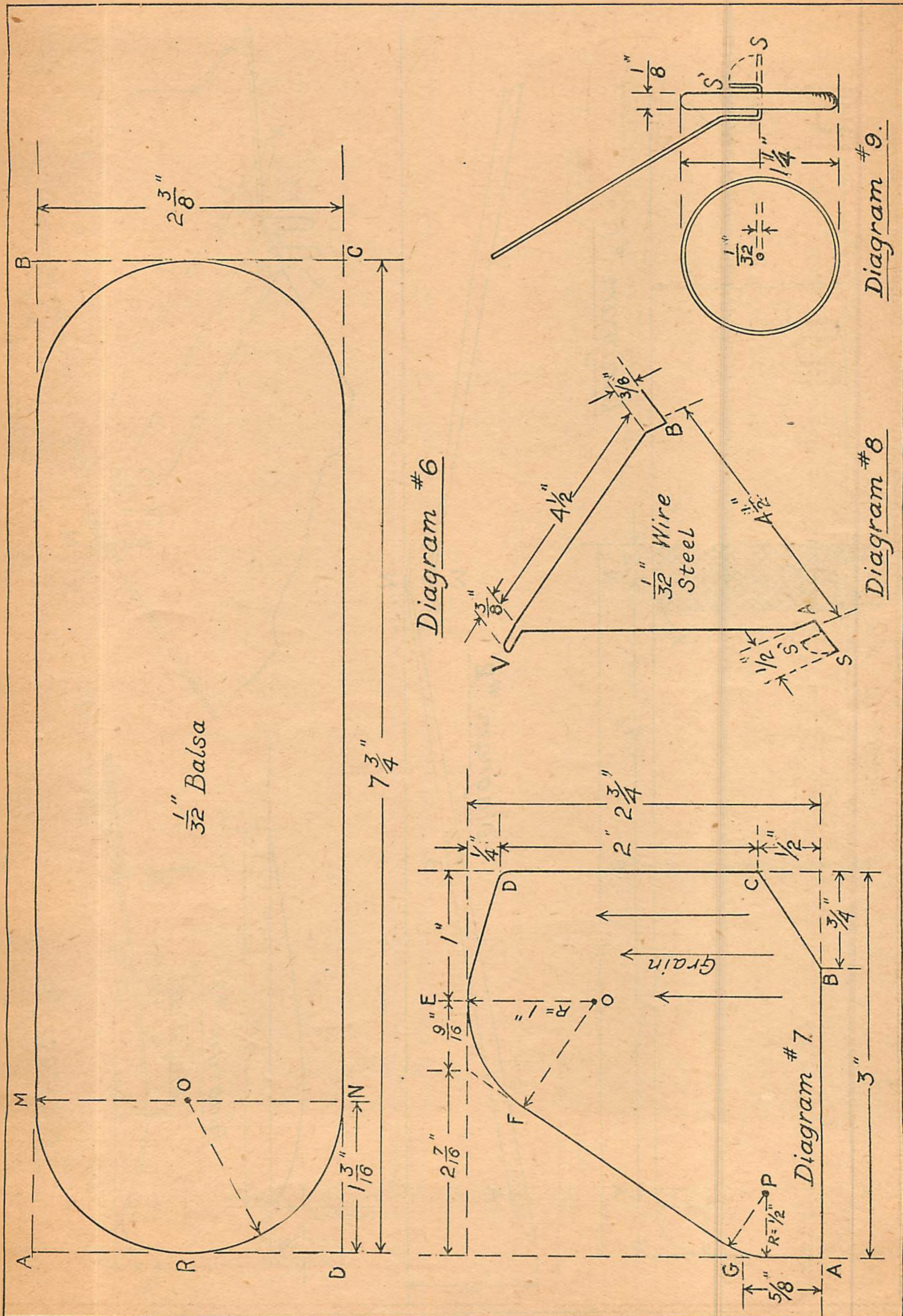


Diagram #10
Shackle
Can
Propeller Shaft.
Tail Skid
Front Wing Clip
Rear Wing Clip
2 1/16"
2 3/8"
S
S'
Diagram #13
X
X'
T
B
V
Fig.-A
Diagram #12
CONCAVE FACE
Fig.-B
Fig.-C
O
M
N
H
K
Outline of Propeller Blank
Diagram #11
8"
1/32" Hole
Material = Balsa
END VIEW
5/8"
1 1/16"



1/32" Balsa
Diagram #6
2 3/8"
7 3/4"
1 3/16"
A
B
C
D
M
N
O
R
Diagram #7
Grain
2 3/4"
2"
1/4"
1/2"
1"
3/4"
9/16"
2 7/16"
3"
5/8"
R = 1"
R = 1/2"
A
B
C
D
E
F
G
O
P
Diagram #8
1/32" Wire Steel
4 1/2"
3/8"
1/2"
A
B
S
V
Diagram #9.
1/8"
1 1/4"
1/32"
S

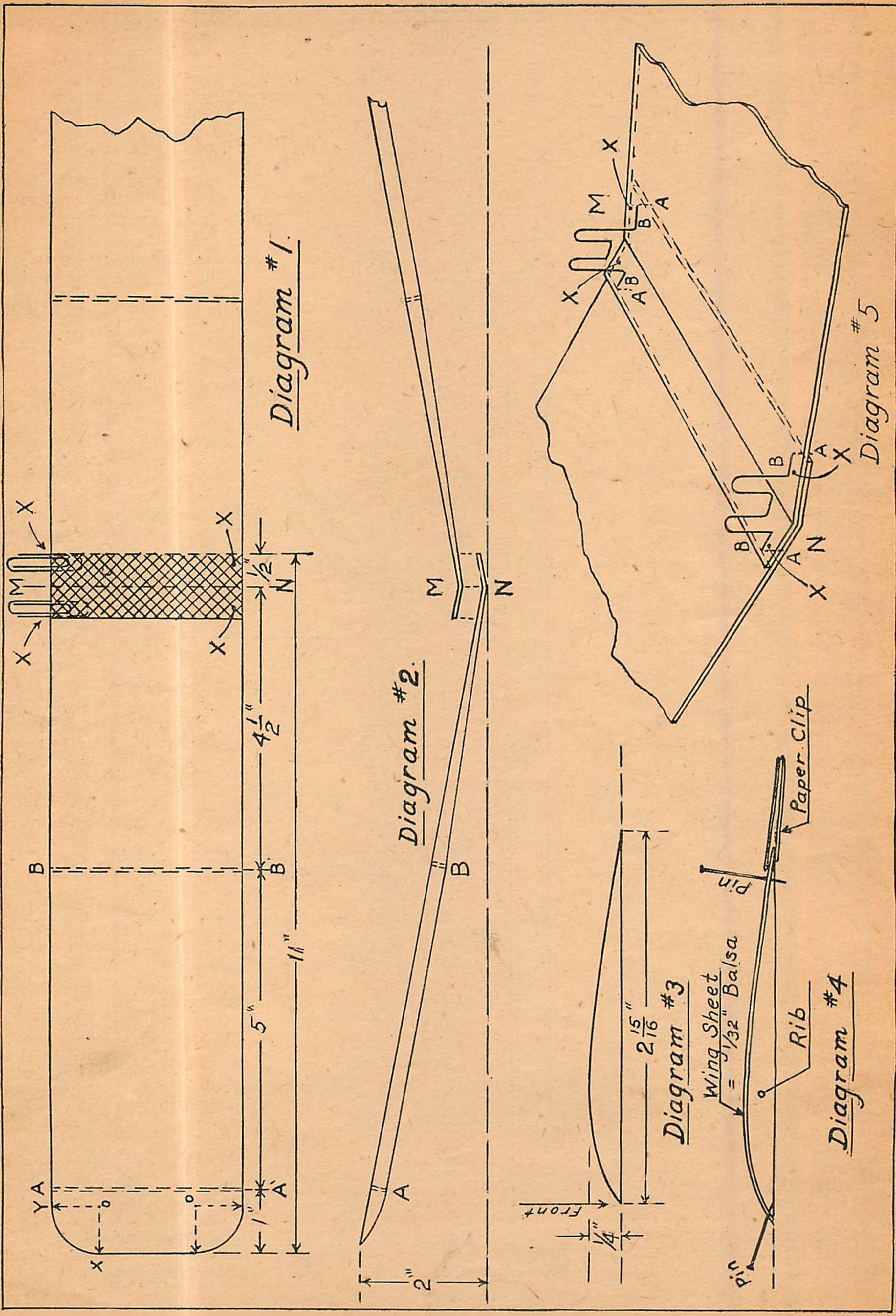


Diagram #1.
Diagram #2.
Diagram #3
Diagram #4
Diagram #5
X
M
N
B
A
Y
1/2"
4 1/2"
5"
1"
11"
2"
2 15/16"
1/4"
Front
Wing Sheet = 1/32" Balsa
Rib
Pin
Paper Clip

AVIATION ADVISORY BOARD

Conducted by Capt. H. J. LOFTUS-PRICE

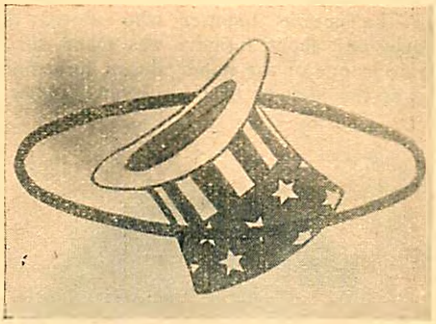
A RED devil thumbing his nose at his target (whatever the target may be) on the ground is the insignia of the 96th Squadron. The devil holds an aerial bomb with the other hand. The 49th Squadron insignia shows a wolf's head, mouth open, teeth bared. War is no gentle art, nor do these designs as a general rule depict pastoral scenes.

Yet not so grim are the insignia of the service squadrons of the Air Corps—those hard-working units charged with engineering and repair work for the group of which they are a part. A beaver—symbol of their busy life—is worn by the 59th Service Squadron. The 56th Service Squadron's insignia is a hawk with a broken wing, perched on a post, while that of the 66th Service Squadron shows a large gear wheel, with four smaller gears radiating from the master gear at 90 degrees intervals. This latter squadron is part

166th Aero Squadron
(War-Time)

of the Composite Group in the Philippine Islands, and the four smaller gears represent the four squadrons of a well balanced Composite Group—Pursuit, Attack, Bombardment and Observation.

Graphically representative are the insignia of the school squadron. Peering through a telescope, a broadly caricatured bird identifies the Air Corps Advanced Flying School, located at Kelly Field, Texas. This is an Observation school squadron and the telescope represents observation aviation. In one of the bird's claws reposes a brick—ancient means of defence. One must suppose that the Squadron's commanding officer at the time was an Irishman to thus depict this bit of "confetti."



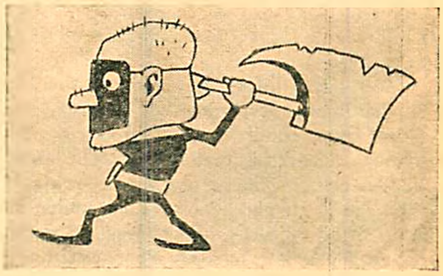
94th Aero Squadron, the famous "Hat-in-the-Ring" (Rickenbacker) outfit.

THE 40th School Squadron, a bombing school outfit, also at Kelly Field, has a wedge-shaped book, showing its student members that by hard study one may wedge his way toward successful graduation. On the book is a bat, symbolizing the nocturnal activity in burning the midnight oil. The body of the bat, appropriately enough, is an aerial bomb.

The Air Corps Tactical School at Langley Field, Va., has an insignia embracing all four types of military aviation. Four lightning streaks flash from the mailed fist of Mars. One streak parallels the horizon. That stands for Pursuit aviation, the mission of which is to fight aircraft in the air. Three other streaks flash downward towards the earth, and these stand for Observation, Bombardment and Attack aviation, which carry their destructive warfare against the ground troops. Included in this school's insignia is a lamp—the lamp of knowledge—appropriate for a school. The shield is divided in its background into green, the earth below, and blue, the sky above.

Another organization well known to airminded America is the First Pursuit Group, stationed at Selfridge Field, which also was at the maneuvers on the Pacific Coast. Its insignia is topped with the motto "Aut Vincere Aut Mori" (Conquer or Die).

This is precisely what Pursuit craft must do for, having no defensive armament to their rear, this type of plane



25th Aero Squadron
(War-Time)

must fight it out to the end in the skies. To turn tail would be to perish. Literally they must conquer or die. Below the motto of the First Pursuit Group is a shield with five stripes and five black crosses, representing the five squadrons which the Group had when it was in action and the five major engagements credited to the outfit for its World War service.

The 17th Squadron of this famous Group has for its insignia a snow owl diving on its prey. This bird symbolizes the Arctic weather experienced five miles aloft, at which altitude Pursuit aviation fights. The 27th Squadron's crest is a hawk diving to attack. The 94th Squadron's once was the old "Hat-in-the-Ring," but this has been changed to an Indian with mouth distended in a lusty war-whoop.

THE Aviation Advisory Board will endeavor to answer questions concerning model building and aviation in general, where the questions do not apply to contests being conducted by this or other publications. Address all questions to

The Aviation Advisory Board,
25 West 43rd Street
New York City

Enclose with your letter a self-addressed and stamped envelope to facilitate an answer. Space is limited and all letters can not be answered in these pages.

AVIATION ADVISORY BOARD

An artistic emblem is the Third Attack Group's. A shield contains a knight's helmet and a pair of wings, with the motto "Non Solum Armis" (Not by Arms Alone). As one young member of the Group explained, "The noise of the roaring planes, diving on a bunch of ground troops, scares as many of 'em to death as the bullets and bombs from the planes kill or wound." The insignia also contains nineteen black crosses, the number of enemy planes its members brought down in France.

IN THE Third Attack Group are also the 8th Attack Squadron, with an eagle, its wings extended and the Liberty Bell held in its claws; the 13th Attack Squadron, with a skeleton swinging a scythe, and the 90th Attack Squadron, with two red dice. The cubes have just rolled a "natural."

The Observation units, too, have their insignia. There is the Ninth Group's, stationed at Mitchel Field, L. I., which has a shield topped by a crest and standing on a scroll. The crest is a rattlesnake entwined about some cactus. Service with Pershing in Mexico justifies the design of that crest, while the wavy line running through the middle of the Ninth Group's shield symbolizes the Rio Grande.

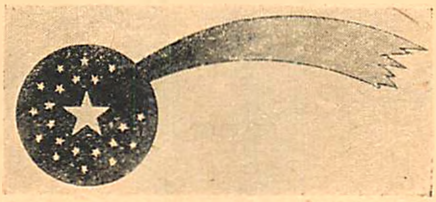
A quartet of crosses on the shield is for the four major engagements of the Group in France and for the fact that the greatest number of enemy planes brought down in any engagement was that number. The scroll simply says "Semper Paratus" (Always Ready).

Most catchy of all, probably, is the 11th Bombardment Squadron's insignia. It shows Jiggs, comic creation of George McManus, celebrated cartoonist. The portly Jiggs is bringing home the bacon—which in this case is an aerial bomb held under one arm. Strolling airily along, Jiggs is puffing on an important looking cigar, tilted at a cocky angle.

Another insignia which has been much photographed of late is that of the 95th Pursuit Squadron, stationed at Rockwell Field, Calif., owing to that outfit's activities at extremely high altitudes. This insignia shows a kicking Army mule whose name might well be Dynamite, judging from its dangerous appearance.

The domed National Capitol is the insignia of the Air Corps Detachment at Bolling Field, Washington, D. C. Carrying out the motif of its pictorial insignia this outfit has named each of its planes after a state of the Union. Whenever possible, in assigning a plane to a flight to a distant state, the Commanding Officer orders out a plane of corresponding name.

PAINTING of insignia on planes is usually done on the sides of the fuselage, back of the rear cockpit. In Bombers, however, they are shown on either side of the nose. They are bright colored against the somber, olive-drab tone of the plane, and hence show out startlingly to the trained observer. The untrained one is able to discern them when the planes are parked on the flying field, but it was hard to differentiate the insignia when the planes were flashing by over one's head at well over a hundred miles an hour.



22nd Aero Squadron
(War-Time)

The curious inquirer who started the questions about insignia was taken for a ride in one of the Bombardment formations over the vicinity of the airport. He was seated in the rear cockpit, out near the tail. On either side of him, flying in such close formation that their wing-tips almost brushed the tail group of his plane, were two other bombers.

20th Aero Squadron
(War-Time)

The nose of one bore a red devil thumbing his nose. Believe it or not, it was looking straight into the passenger's face. The plane on the other side bore a wolf's head, a menacing snarling wolf. Believe it or not again, one could see this wolf slavering at the mouth.

30th Aero Squadron
(War-Time)

Unil the formation loosened up, the ride was not particularly enjoyable. Insignia's *do* mean something.

Continuing our list of World War aces:

Italian living—(continued)	
Capt. Duke Calabria	16
Lieut. Scaroni	13
Lieut. Hanza	11
Italian—killed	
Major Baracca	36
Lieut. Olivari	12
Belgian—living	
Lieut. Coppens	30
Lieut. de Meulemeester	10
Belgian—killed	
Lieut. Thieffry	10
Russian—living	
Capt. Kosakoff	17
German—living	
Lieut. Udet	60
Capt. Berthold	39
Lieut. Klein	33
Lieut. Koennecke	32
Lieut. Balle	31
Lieut. Kroll	31
Corp. Rumey	30
Lieut. Schleid	30
Lieut. Laumen	28
Lieut. Boerr	28
Lieut. Huey	28
Lieut. Blume	28
Lieut. Arigi (Austrian)	26
Lieut. Fiala (Austrian)	23
Capt. Baunser	23
Lieut. Jakobs	22

(To be continued)

—o—

Other questions are answered as follows:

Dear Sirs:

Will you please tell me how the new wing slots on the entering edge of a wing work? Also, is a dihedral needed on a 20" built-up wing?

Yours truly,
FRANK MAUCK,
103 Maryland Ave., N. E.
Washington, D. C.

Answer:

The new ring slots are so fitted to the wing that when the plane is put in a position which formerly would cause a plane to spin, the slots move forward and increase the area of exposed wing surface; which, naturally, has been lowered by the increased angle of attack. Hence, the airflow is kept regular and the plane brought back to normal flying position.

It is always a good point to put dihedral in any flying model, as this increases the lateral stability.

Gentlemen:

I would like to get some data of the de *(Continued on page* **3)**

A SMOKING STAND FOR DAD

AN INEXPENSIVE AND EASY ARTICLE TO BUILD

By
EDWIN T. HAMILTON

NEXT time Dad looks for his pipe or cigars on his desk and then has to go look for matches and an ash-tray, get busy and build him this excellent smoking stand that conveniently holds such accessories in one place.

Mother, too, will be pleased with it, since it stands solidly on the table, and is not easily overturned as are other types of smoking stands. Besides, it is an attractive piece of furniture and will add to the beauty of the home.

This stand has been so designed as to permit its construction with a minimum number of tools. These tools are necessary:

Hand saw, hammer*, nail set*, plane, try-square*, screw driver*.

The tools with a star after them can be purchased in a "Five and Ten Cent" store for 10 cents apiece. A plane is not an absolute necessity, though it will save considerable work if the wood obtained is rough. While hand saws can be purchased in "Five and Ten Cent" stores, they would not do for this type of work. If you do not own a saw, any friendly hardware store, plumber, garage man or neighbor would be glad to help you out, and cut your wood to size, after you have laid it out properly.

Forty cents will cover the total cost of necessary tools, if you have none at all, and your lumber should cost you nothing.

The usual heavy shipping cases and boxes are constructed of 1" yellow pine. Its use is recommended, inasmuch as it is easily obtained and simple to work with. Secure the following lumber:

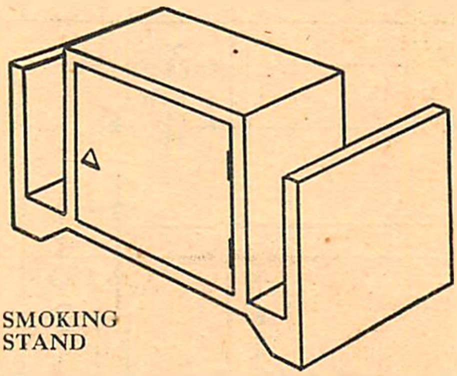
1 pc.—1" x 12" x 8' 8" long
1 pc.—2" x 4" x 8' long

The 1" lumber is cut in the following lengths:

1 pc.—14" long for the top
4 pcs.—12" long for the sides, back and door
2 pcs.—10" long for the magazine partitions
1 pc.—22" long for the base.

As each of the above measurements is exact finished size, it will be found best to cut the lumber a little larger, so that each board may be planed smooth and finished with a thorough sanding.

The 2" x 4" x 2' piece of lumber is cut in two equal lengths of 12" each. When sawing your lumber, use a try-square, marking with pencil the line on which you wish



SMOKING STAND

to saw. This insures straight lines and right angle corners.

Draw a line on one of the 4" wide sides of each of these pieces along their entire length, as shown in the plans under "Leg." These pieces are now beveled from this center line to the under edge, as shown in the end view of the leg. The cut is shown in heavy shading. This cut is made along the entire length of each leg. Run your try-square along it to see that the surface of the bevel is perfectly level and flat.

WRAP a piece of medium sandpaper over a square-cornered block and give both legs a thorough sanding. If the wood is exceptionally rough, they should be planed on all sides and ends before sanding.

The legs are now finished and should be laid away for future use. The top, which has been cut to size, should be planed on all sides if rough, and should then be carefully sanded. At this time, choose the best side of the board and mark it "Top" with a light lead pencil. The top edges of the board can now be slightly rounded. Do this work with your sandpaper as the curve of the edges must not be pronounced, but merely smooth enough to remove their sharpness.

The back is treated in the same manner, except that it must not have rounded edges. Use your try-square on all corners to see that they form right angles, and also along the surfaces of the faces and edges to insure their being flat and smooth. In finishing the back, care must be taken to see that the measurements of its width and length are perfect, as the back fits in between the top and base and the two sides of the assembled stand.

The two magazine partition boards have also been cut to size and should now be planed smooth if rough. If the stock you have obtained is good, a thorough sanding will suffice. Mark one of the 12" edges of each piece "Bottom." The edges of the bottom are left sharp, while the two ends and top of each partition board are slightly rounded, as was the top of the stand. Do this work with sandpaper. Do not make these edges round but merely take away their sharpness.

The base is treated in the same manner as was the top, except that all its edges are left sharp. Finish by planing if necessary, and give the entire board a thorough sanding. At this time choose the best side of the board and mark it "Top."

The two side boards are now squared up, planed if necessary, and finished with a careful sanding. One of these is now laid aside as finished but its duplicate, having the hinges attached to it, is not complete. Note the drawing in the plans under "Door." This shows how the wood is cut away to allow the hinges to rest flush with the surface of the wood. The same is done with one side board. Measure 2" from the top and bottom edges of the side board and mark. Measure a further 2" in from these impressions and mark again. Your hinge is 2" long and its width should now be measured. Let us say it is 1", as it must not be wider than this, for the door is only that thick and the hinge must accommodate that thickness.

Measure 1" in from the side of the board and draw two lines parallel to the side edge and between the marks you have made 2" apart.

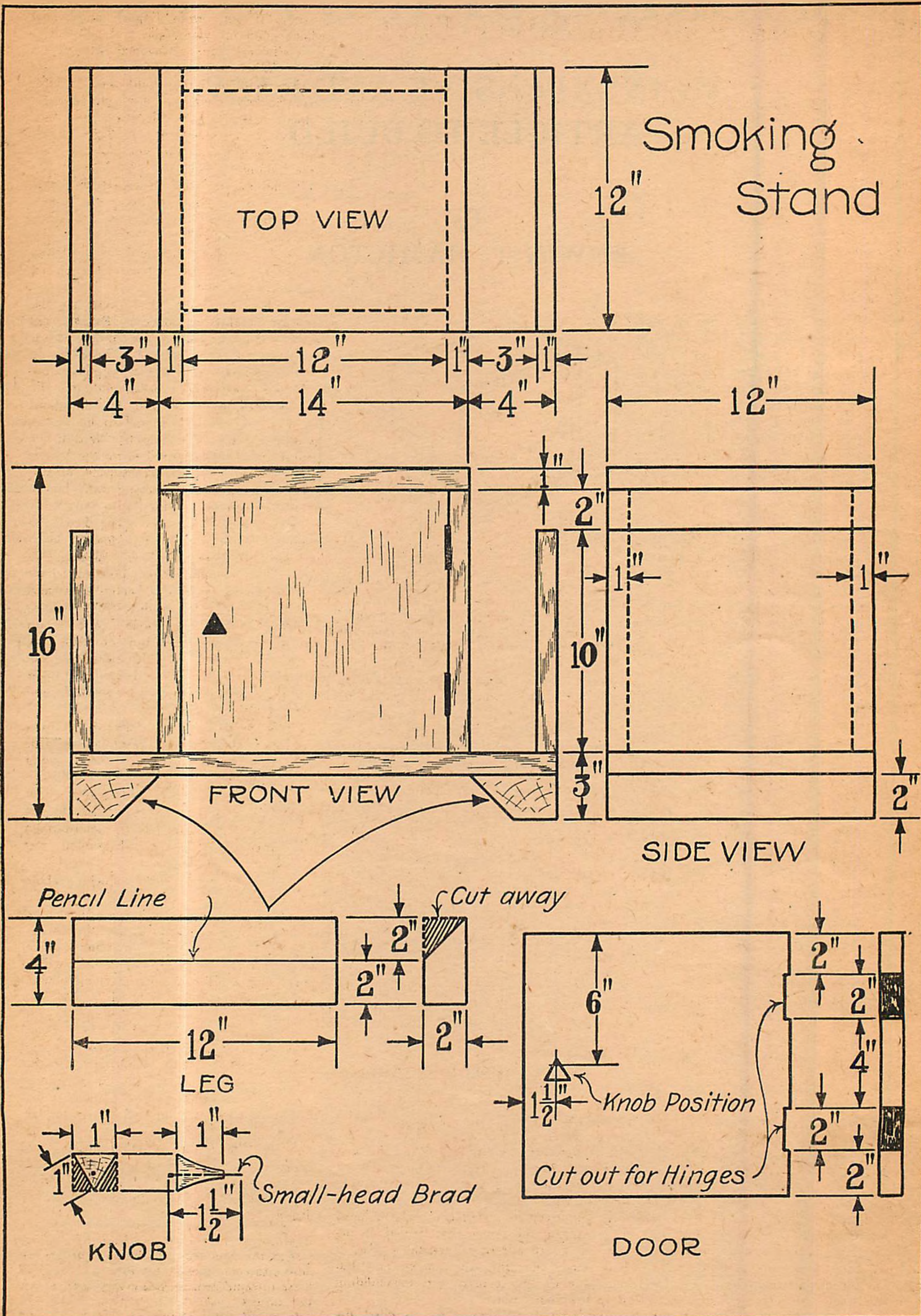
Press your knife blade in the wood along these marks, so that the wood will not split beyond them. Remove the wood until the hinge will lie in this cut flush with the face of the board. Do the same with the second marked place. Remove all splinters and finish with sandpaper.

All pieces for the stand are now finished with the exception of the door, which is not finished until the stand is assembled. As the door must have a snug fit, it is left until the assembling of the stand will permit perfect fitting.

Before proceeding with the assembly, check over each piece carefully as to dimensions and workmanship. Check each with the list given above. When found correct, the work of assembling may be started.

IN assembling the stand 2" long, small-head brads and carpenter's glue heated

(*Continued on page* 46)


Smoking Stand
TOP VIEW
12"
1" 3" 1" 12" 1" 3" 1"
4" 14" 4"
12"
16"
1"
2"
10"
3"
FRONT VIEW
1" 1"
2"
SIDE VIEW
Pencil Line
Cut away
4"
2"
2"
12"
2"
LEG
6"
1 1/2"
Knob Position
Cut out for Hinges
2" 2" 4" 2" 2"
DOOR
1" 1"
1"
Small-head Brad
1 1/2"
KNOB

The Mystery of the Silver Dart

(*Continued from page 26*)

men, and perspiration streamed from their faces and soaked their clothing, while mosquitoes nearly bit them to death. Hands, arms, ears and faces swelled while they watched.

Their labors, however, soon were rewarded. Five yards—two yards—one foot—and Ian reached up and grabbed a handful of mangrove leaves. They looked at each other and smiled from ear to ear—or what was left of their ears.

"Well, so far, so good," said Ian. "But, we'll have to move quickly. So far as I I can judge, we'll have about three hours in which to make the clean-up. From my knowledge of this territory gained during a study of the situation before we started the flight, there is no railway line or branch line to this spot.

"So far as we know, no one actually saw us come down in the bay. Therefore, those at Kingston cannot be sure and send a search party here direct. At the moment, no doubt, they're telephoning all over the place.

"I presume—hope so, anyway—that Beecham made arrangements with the Jamaican Government for us to have carte blanche in our actions. If not, there'll be the devil to pay. We'll have to take a chance, anyway."

Next moment both were shinning through the swamp, every minute risking possible death as they swung from branch to branch, precariously fighting their way through.

"Don't know what we'll do even if it is the *Silver Dart*," said Ian through clenched teeth. "There are bound to be two or three on guard and . . . good Lord! What dumb idiots we are . . . we forgot the revolvers!"

That stopped all conversation for some time as they clambered on. "Oh, well," contributed Ruddy presently, "fists are fists anywhere, old son, and they'll probably serve us better than guns."

A few moments after this and they stopped dead in their tracks. With open mouths they stared at the sight which lay revealed before them. They looked at each other but could not speak from sheer amazement.

There, in a haven made by nature and as perfect as ever could be made by man, moored to the mangroves with the water gently lapping its sides as if paying tribute to its sheer beauty, lay a sleek grey submarine.

But it was different. The narrow whaleback generally associated with submarines was missing. In its place and stretching from the conning-tower to the stern was what appeared to be a monster trough, which Ian and Ruddy, from their position, judged to have a draught of about two feet. The trough took up the whole beam of the submarine.

At a guess, the vessel was about 400 feet long, the trough itself about 350 feet of that. The submarine was moored with its nose inshore, and neither men could see the stern from where they were perched in the branches of the mangroves.

As it was, they had only about five yards more to go to be able to reach out and touch the vessel. Neither moved, however. They were spellbound. At last and in unison, they realized that something had to be done, and done quickly. Cautiously they crept nearer and nearer, and stopped near the edge of the mangroves.

There they conferred in low tones as to the best action to take. Ian was for making a bold and daring show of it. "Let's pretend we were forced down," he said, "and that we were clambering through the mangroves to possible safety and happened to come across the submarine. Then when the opportunity comes, we'll sock the lights out of whoever is in the way, and either smash up the machinery or do something to keep the submarine penned up here."

"That's all right in a way," replied Ruddy, "but how about the *Silver Dart?* While it will be O. K. if it is destroyed properly, think what a feather in our caps it would be if we could get her back safely to Washington."

Ian nodded. "That's also O.K., Sonny Boy," he said, "but tell me—where's the *Silver Dart?*"

Fate, a gentle breeze and the tide answered that question for them. Even as he spoke, the submarine swung against her hawsers and the breeze gently lifted a few branches of the mangroves. There, near the stern of the vessel, resting in the trough was a picture that was worth more than all of the gold in the world to them—the *Silver Dart.*

Ruddy nearly shuddered as he saw the blaze of determination light up in Ian's eyes. "Steady, old man," he counseled. "There's some time left yet, and don't botch things up by rushing. Let's creep aboard and if we're seen, we'll follow out your plan. There's no doubt now. This submarine is the 'W9' all right, and there's the *Silver Dart.* So let's play possum."

Ian signified his agreement, and they both stealthily lowered themselves on to the prow of the submarine. They walked the first yard or so in a manner bespeaking, "Thank heavens, civilization at last—we're saved," hoping that if they were seen, someone would shout or approach them.

Suddenly Ian gripped Ruddy's hand and held his finger to his lips for silence. From nearby came the sound of someone snoring. Like two cats they crept slowly forward, reached the conning-tower and separated to creep around it. Slowly they moved and quietly. When they reached the other side they stopped dead and watched. Stretched full length on the deck and fast asleep was a man. On the deck near him lay a rifle and a cutlass, and in a holster at his hip was a revolver.

Ian signalled to Ruddy and made signs that he would go forward and pounce on the man, while Ruddy should grab the rifle and cutlass.

It was over in a moment. Dazed both by sleep and the punch that landed on his jaw, the guard offered no resistance. Ruddy had seized the rifle and cutlass, and Ian had grabbed the revolver and was holding it in the man's ribs.

Ian wasted no time. He prodded the man with the revolver. "Listen, son," he hissed, "if you speak English and know what's good for you—talk, and talk quickly. Who are you? How many others are here? Where are they?"

The man, of large build and Mulatto color, looked blankly at Ian, blinked and gulped. However, the business end of a revolver is an excellent persuader at all times. Besides, Ian did not look as if he were fooling.

"M-me guard, sah," stuttered the man. "No onnerstan' good Inglitch. Me myself—no odders. Odders Kingston watch Big Machine Bird come."

Quick as a flash, Ian took in the situation and decided on a plan. He turned to Ruddy and said:

"Good. That's the real break we deserve. Tumble downstairs, Ruddy, old bean, and look around for some gasoline and oil. If you find any, bring it up pronto. I'll take care of this bright spark."

Ruddy needed no second bidding. He, like his companion, realized that the guard did not have enough brains to lie in the predicament he found himself. Within five minutes he had scampered down the bowels of the submarine and had returned, breathless but happy, and carrying with him a five-gallon can of gasoline and a can of oil.

"Plenty more where this came from," he panted. "Whole store of it down below." Ian grinned. His eyes were flashing like those of a champion boxer about to deliver the knockout punch to a beaten adversary.

"Oke," he said to Ruddy. "We'll have to take a chance. Fill up the *Dart*—strain the gas through your shirt doubled over about four times." Ruddy wasted no moments over this task, and having caught some of Ian's enthusiasm, was back and asking, "What next?"

"Find me some rope—halyard, for preference. It's thinner," said Ian. "This chap, whether he likes it or not, is going for a flight with me."

The halyard was procured, and Ian motioned the guard to precede them to the *Silver Dart.* He turned to the guard when they reached the plane and pointed over the stern of the submarine.

"See those pretty sharks mooching about there?" he asked. "Well, take your choice. A nice, quiet flight with me, or a nice, quieter morsel of tastiness for the sharks. The flight, eh? Good. Now then—quick. Sit astride that fuselage and lie forward on your belly and let your arms hang down."

The guard was quick to obey, and in a few moments he was bound securely, with no danger of falling off. The halyard was tied criss-cross from wrist to foot, and once round the waist, thence to the seat in the cockpit to prevent the guard slipping back and overbalancing the plane. It was Ruddy who sobered up sufficiently to flabbergast Ian for the moment.

"Everything's lovely in the garden," said Ruddy sarcastically, "but how in the blazes do you expect to take of with the *Silver Dart* resting on her pontoons on a dry deck?"

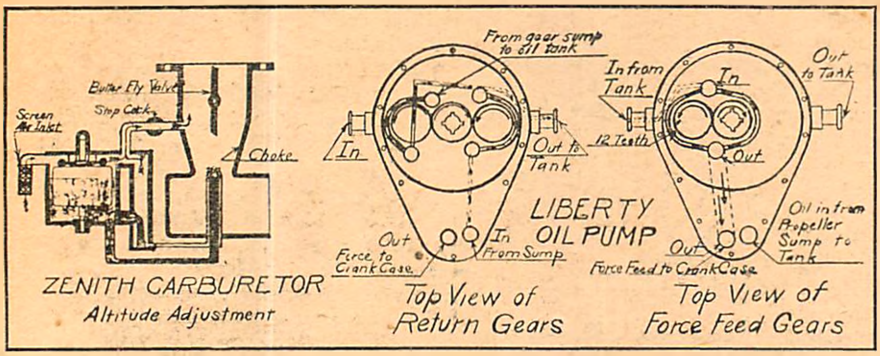
Is failure to be the result of all their efforts just as the goal seems to be in sight? Is the native to come out on top after all? Or will these intrepid airman find a way out? Don't fail to get your April Airplane News, on sale at all news stands on March 23 and only 15c. a copy.

Airplane Engines—What They Are and Why

(*Continued from page 6*)

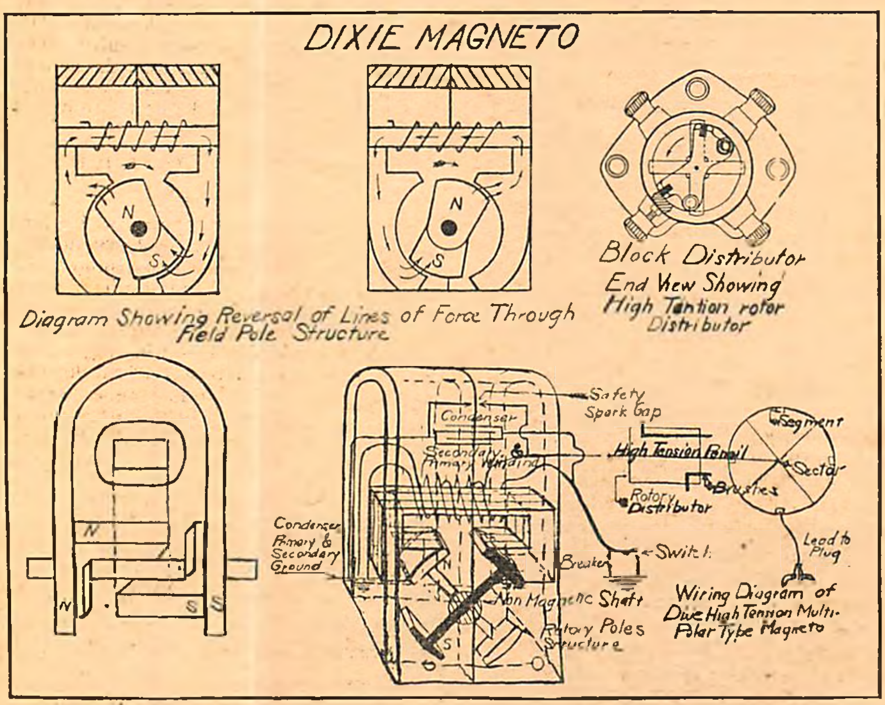
from fourteen to seventeen parts air to one part of fuel.

The mixture at different engine speeds must be kept nearly constant. Changes of temperature must be provided for. Economy of operation is paramount after reliability. The carburetor of an airplane engine is a sensitive instrument. Each carburetor is designed to supply the needs of each particular engine.



Ignition System. The magneto has come to be almost entirely depended on for this function. The Liberty engine uses a battery generator system which, fortunately, is now obsolete. The battery was a potent cause of fires due to its possibility of sparking during a crash. The name "Flying Coffins" was applied to Liberty-engined D. H.'s as a result of the frequent conflagrations.

For reliability's sake, two magnetoes are generally installed on modern engines. One fires the spark plugs on one side of the cylinders while the other magneto fires the



opposite set. The switch allows the pilot to use either magneto or both. Both are invariably used together in normal operation, as the increased amount of sparking gives a more thorough combustion of the fuel charge in the cylinder. This results in increased power and a smoother running engine. An increase of approximately seventy revolutions is obtained in this way.

The engine speed obtained by cranking or pulling the propeller through by hand is sometimes so slow that the main magneto will not generate a sufficiently hot spark to ignite the fuel. A high tension booster magneto is often provided to assist in starting the engine. This is a small magneto operated by hand, or it may be attached to the starter. It generates a shower of sparks which provide the initial ignition.

Lubrication. This was a problem that worried air-cooled engine designers for a long time. Broadly speaking, their lubrication is the same as that of water-cooled engines. An oil pump draws oil from a supply tank. It is sent under pressure to the various bearings and gears. Oil passes through holes in the crankshaft and is thrown from the crank to the cylinder walls. So far the systems are the same. A sump is provided between the two bottom cylinders to drain the used oil back into the circulating system. However, the pistons in the bottom cylinders are constantly drenched in oil. This difficulty has been overcome somewhat, but the plugs in the bottom cylinders are still more apt to foul than those in the other cylinders.

Better designed oil and piston rings have helped eliminate fouled spark plugs. In spite of these, however, when the engine is started up after a period of idleness, the bottom cylinders will discharge almost pure oil from the exhaust valves during the first revolution or so. In time, oil will penetrate the most carefully designed piston rings.

One method of defeating this characteristic is, when securing a plane after operations, to turn the propeller at such an angle as to leave open the exhaust valve of one of the bottom cylinders. In this way one cylinder will be kept free of oil, for it will pass on through and out the exhaust valve. Water-cooled engines have a sump or low basin in which the loose oil collects. From here the oil is pumped back to the main tank.

The theory of lubrication is that a thin film of oil should separate all moving parts. That is, no metal to metal contact is ever made between actual moving parts—always a thin coat of oil keeps the bearing surfaces apart. High oil pressures are required to force oil in between the close-fitting bearing surfaces.

The cylinder walls of the engine are particularly in need of oil. In addition to the friction caused by the reciprocating motion of the piston, the heat generated by the explosion of the fuel charge is terrific. This heat often runs up to 3,000 degrees Fahrenheit. Piston temperatures will run as high as 600 degrees. These walls are lubricated by splashing oil on them from the rapidly moving parts within the crank case.

An oil vapor is always present while the engine is turning over. The oil carries off the heat of friction and dissipates it to the atmosphere.

Generally speaking, as the oil in the system is consumed or lost, the oil temperature gauge will rise proportionately beyond its normal operating temperature. This is because the lesser amount of oil circulates faster. The oil pump then sends the oil back to work before it is properly cooled.

A good example of an engine operating without oil is when a plane is flying on its back or doing a series of slow rolls. The instant the oil pump suction is uncovered, no more oil passes into the circulating system. The oil pressure drops immediately.

Inverted stunts lasting approximately fifteen seconds are generally safe, but any exaggerated form of inverted maneuvering will result in lack of lubrication. Heating followed by expansion and seizing of the moving parts will occur. A forced landing results, to say nothing of the necessity of completely overhauling the engine. Of course, the system can be rigged so that it gets a continuous supply of oil, no matter what the attitude of the ship.

Further problems concerning the cooling system for airplane engines, in particular the air-cooled engine, are discussed by Lieut. Miller in a further absorbing and instructive article next month.

If you want the inside story of the evolution of the modern engine, don't fail to order the next issue of MODEL AIRPLANE NEWS *from your news dealer today. You can't afford to miss it.*

Aerial Navigation Course

(Continued from page 28)

course. From points B and C draw lines representing the angles of drift. That is to say, from point B draw a line at an angle of 12° to the line AB, as this was the angle of drift observed on this course, and from point C draw a line at an angle of 21° from line AC, as this was the angle of drift observed on the second course.

Now continue these two drift lines until they intersect at a point we will call D. Connect points D and A and the line thus formed, DA., will give you the direction of the wind and its speed to scale. In this example the wind is found to be blowing from 157° at a speed of 37 miles per hour.

One point to note is that in drawing your lines of drift, you imagine yourself looking back towards the departure point and from this position, starboard drift will be off to the right of the course and port drift to the left. Failure to remember this will give you an entirely wrong wind direction. If you have sufficient time a third drift may be taken as a check, but you will rarely find that the third line intersects exactly at point D. It will generally form a small triangle known as a "cocked hat" and the centre of this should then be taken as point D.

In Figure III, a course of 15° gives us a 10° drift to starboard; a course of 75° gives us a 19° drift to starboard and taking a third course of 135° for greater accuracy, we find the drift is 12° to starboard. Lines AB., AC. and AE. represents the various courses flown. From points B., C. and E., lines are drawn at angles of 10°, 19°, and 12° respectively, showing the drift suffered on these courses. These drift lines intersect at point D. forming a "cocked hat" as shown. Connect the centre of this with point A., and the line thus drawn indicates the direction from which the wind is blowing; in this case from due north. The length of the line DA., measured to scale, shows the windspeed as 38 miles per hour.

These and other methods to be explained may sound involved at the first reading but they do not need more than a little careful study before they become clear, and with a little practice become surprisingly easy to perform in the air. It has been my experience that there is more satisfaction gained in successfully navigating a plane on a cross-country flight by scientific methods than in any other phase of flying.

Method III. This method also involves the use of a drift indicator but is, perhaps, one of the easiest methods for the single seater pilot or the pilot who is doing his own navigating. The drift indicator is set to zero, and the plane is then flown in different directions until a course is found when objects below are passing directly along the drift wire. You are then either flying up or down wind.

It may be a little difficult at first if you are flying at any height and the wind is slight, to tell when you are upwind and when you are downwind, but a little practice and the observation of smoke on the ground will generally give you an indication. It is seldom that a wind changes its direction by 180° at any rate in the first few thousand feet.

When you are satisfied that you are flying into wind, note the compass bearing. This will give you the direction from which the wind is blowing. Note that the direction will be a compass bearing, not a true bearing. Then turn the plane at an angle of 90° so that you will be flying directly crosswind, and manipulate the drift indicator until objects are once more passing directly along the drift wire. A glance at the dial will tell you your angle of drift.

You will now know the wind's direction, the angle of drift and the airspeed—during all these operations you should have maintained a constant speed. From the table given in November's issue of Model Airplane News, which is reproduced here in Figure IV, for the sake of those who missed that issue, the windspeed in miles per hour may be calculated.

For example, if your angle of drift proved to be 15° and you had been flying at 100 miles per hour, your windspeed would be 27 miles per hour. It may be alternatively proved or checked as shown in Figure V, although this method would be beyond the abilities of a single seater pilot to perform since he could not leave the controls. In this diagram we assume that we were flying into wind on a course of 40°. When we turned crosswind to 130° our drift was 15° to starboard, and our airspeed during this time had been 100 miles per hour.

Angle of Drift	Airspeed—Miles Per Hour						
	60	70	80	90	100	110	120
5°	5	6	7	8	9	10	11
7°	7	9	10	12	13	15	16
9°	10	11	13	15	17	19	20
11°	12	13	16	18	20	22	23
13°	14	16	18	21	24	26	28
15°	16	19	21	24	27	29	30
17°	19	22	24	27	31	34	37
19°	21	25	28	31	35	39	42
21°	23	27	31	35	39	43	47
23°	26	30	34	38	43	47	52
25°	28	33	38	42	47	52	57

Figure IV.

Draw line AB. and length, in the direction of 40°, our course into wind, and another line AC., 100 miles to scale, at an angle of 130°, our course cross wind. Line AD. must next be drawn to represent our actual track, 145°, (130° + 15° Drift), when we were flying crosswind. This line may also be any length. Finally from point C. draw a line parallel to line AD. and continue it until it crosses the line AB. The point of intersection we will call E. The distance, measured to scale, will give you the windspeed; in this case 27 miles per hour which agrees with the table.

Next month we will deal with further methods of ascertaining windspeed and direction, and also of ascertaining groundspeed. It is desirable to know all of these, as different methods may be suitable to different circumstances, or one may be used as a check on the other.

ANSWERS TO LAST MONTH'S QUESTIONS

1. Simultaneous bearings on different objects can always be considered reliable if accurately taken, because no unknown or doubtful factors are involved. Successive bearings on one object should only be used when no other method is available as they involve the use of transferred position lines, which can never be considered completely accurate.

2. Deviation on 180° .... +3°
Deviation on 270° .... —8°
Change in deviation over 90°
Change in deviation between
—×—=6°
90 1
Reduction of deviation from 180° to 230° is 6° and the deviation on 230° is therefore .... —3°

Compass bearing .... 170°
Less deviation .... 3°
Less variation ....14° 17°

153°
180°

Reciprocal bearing .... 333°

THIS MONTH'S QUESTIONS

1. Explain why the accurate knowledge of drift or windspeed and direction is essential to successful air navigation.

2. You have steered a course of 35° and observed a 9° angle of drift to port. On a second course of 90° you find the drift angle is 20° to port. Your airspeed is 90 miles per hour. Find by the "double-drift" method your windspeed and direction.

3. In question 2 above, you decide to check your result with a third course of 155°. Here your drift is 10° to port. Prepare a diagram proving your answer to question 2, showing your third course and illustrating the effect of the "cocked hat."

4. (a) How do you ascertain wind direction by Method III?

(b) At an airspeed of 90 miles per hour you find your angle of drift to be 19°. Find your windspeed from the table in Fig. IV.

5. Your wind is from 315°. With an airspeed of 90 miles per hour you find that your angle of drift is 25° to port when you fly crosswind at 225°. Prepare a diagram similar to Figure V showing your windspeed. Check your answer with the tables in Figure IV.

Gliding and Soaring

(Continued from page 8)

Birds, like gliders, are able to land without much jar, since they are comparatively light. Howeevr, birds sometimes land in a peculiar way; by slanting their wings upward and approaching the ground in an almost vertical line.

This simply means that the bird is stalled, and is consequently losing altitude; but the span of his wing is great enough in proportion to his weight so that his descent is not too rapid.

Birds as Gliders. Birds doubtless began their flight, in the process of evolution, by gliding from one tree to another, much as flying squirrels do. They use gliding now, as the airplane does, as a method of losing altitude.

Birds as Static Soarers. Birds are extraordinarily proficient at detecting upward air currents. Although the smaller birds seem unable to soar, albatrosses, eagles, storks, buzzards, ravens, gulls and others commonly may be seen making figure eights over rising currents.

A bird, while proceeding in a circular path, does not maintain a constant angle of bank. When he is facing into the wind, or against it, he adjusts his bank so that the wind will neither ruffle his feathers nor drive him outside of the stream of air in which he is soaring. Frequently, birds soar almost sideways, wings into the wind.

Birds as Dynamic Soarers. Although the remarkable skill of birds is revealed by their ability for static soaring, a still greater skill lies in their ability to travel long distances by means of occasional upward currents. Sea gulls when they follow in the wakes of ocean liners, have various methods of relieving the tedium of long flights.

If the wind strikes the vessel broadsides, resulting in a rising current, the gull soars into the wind to gain height, then turns and glides in the direction in which the steamer is going until he loses his momentum. He repeats this process countless times.

If the ship heads into the wind, the wind continuously rushing downward to fill the partial vacuum left at the ship's stern rebounds, causing an upward current in the ship's wake.

Gulls have been known to soar for miles behind a steamer in such a wind, holding their wings motionless, being supported by the rising stream of air, and gaining forward motion by inclining the leading edges of their wings slightly downward. Shearwaters soar long distances by making use of the rising currents of air, at the surface of the water, caused by waves.

Conclusion. Birds are the master soarers. They are built for stability and grace of flight and are sensitive to every air current. If the airplane could combine the airworthy points of the bird, with its own tireless motor, it would be a splendid vehicle indeed!

Another absorbing chapter on Gliding and Soaring next month.

Airplane Designing Course

(Continued from page 20)

stream from the propellor does not strike the tail surfaces. They are operating in virtually "dead air" and, hence, are nearly useless. That is what makes the flat spin so dangerous. At times the ship itself tries to stay in the spin, with the controls actually working against the pilot, often with powerful forces!

Sometimes as much as 150 pounds pressure must be applied to the control stick to get it in a favorable position for coming out of the spin.

What makes a ship flat spin? That is somewhat of a moot point. There have been many different opinions put forth. It was announced, a few years ago, that monoplanes were incapable of flat spinning. Lately, however, several monoplanes have proved themselves capable of doing just that, thereby showing that something was wrong with someone's deductions.

It is evident that the flat spin is a form of autorotation. It is safe to say that it is an advanced form, since it follows a normal spin and occurs at a higher angle of attack. But just why should a ship in a normal spin suddenly decide to go into a flat spin? Usually there are a number of factors contributing to the change.

The distribution of weight has been generally accepted as an important factor, although this, too, has been disputed. Progression of moments has certainly a powerful influence. It should perhaps be explained that the term "Progression of Moments" refers to the moments set up about a definite axis by the rotation.

We have all swung a pail of water around and around until it was rotating in a horizontal plane, and yet the water remained in the pail. Centrifugal force held it there. And centrifugal force is nothing more than the tendency of a body to continue moving in a straight line once it has been started, and to resist any change of direction.

When a body is rotating it is continually changing direction; therefore a powerful force is set up. Now, in our spinning airplane, we have several bodies, the motor, gas tanks, structure of the ship, pilot, etc. All of these bodies resist the continual change of direction of motion as the ship spins, and all of them set up forces of varying strengths. These forces have a great deal to do with the flat-spin.

Since the location of the various bodies can easily be seen to have a lot to do with the forces set up, we find that the distribution of weight does, after all, affect the progression of moments. The subject is rather obscure at first, but the term really refers to the moments that these forces to which I have mentioned exert about some axis which is taken for reference. The basic part of it all is weight distribution.

It has been generally accepted that distribution of weight along the longitudinal axis of the airplane—along the fuselage—is conductive to bad spinning characteristics. Some years ago experiments were made (by the Navy, if I am not mistaken) in which boxes of sand were placed far back in the fuselage. The ship took off, climbed to a safe altitude, and was thrown into a spin. After several turns of a normal spin it began to spin flat, and refused, in spite of the efforts of the pilot, to come out.

The sand boxes, however, were fitted with doors which could be controlled from the pilot's cockpit, so that they could be emptied when necessary. It was found that when these boxes were emptied the ship came out of the spin readily! This ought to prove, conclusively, that weight distributed along the fuselage makes for bad spinning characteristics.

It has also been found that weight distributed vertically, such as placement of the gas tanks in the wing of a high wing monoplane, is helpful. It also has been demonstrated that weight carried in the wings, such as the wing motors of a trimotor job, is of great aid. These distributions of weight affect the spinning of a ship by governing its stability and also by their effect upon the progression of moments once the ship is in a spin.

It has been found that low wing monoplanes are likely to give spinning trouble. This is because of the concentration of weight, but it is entirely possible to overcome this tendency by well designed tail surfaces and a long tail.

If a ship—in this case, a biplane—is poorly rigged it is possible that trouble will be encountered with flat spinning. I have in mind a well known biplane, built several years ago, that could not be made to spin when properly rigged. Yet, if the wings were a bit out of line from poor rigging, the ship was found to flat spin easily. That case shows us that painstaking care when working on an airplane always pays big dividends.

It is possible, by advanced engineering, to design an airplane that will not spin at all. This is done by the general procedure of designing powerful tail surfaces, and by arranging the weights of the ship so that they will not be conductive to spinning. When a ship designed in this way is stalled it merely noses down of its own accord, without any tendency to fall off into a spin.

This is a valuable characteristic, but many engineers believe that a ship should be able to spin, but should be so designed that the pilot may bring it out of a spin instantly. Their argument is that when you design a ship that cannot be spun you also design a ship that is hard for the pilot to handle under certain conditions.

For example, we know that we can design a plane with very great stability. We can design a plane so stable, in fact, that it will definitely "fly itself." But here we run into trouble. If we have a ship that will fly itself—and they have been built—we have a ship that *always* wants to fly itself, and one that is very difficult to maneuver rapidly.

We can design a ship in which the pilot, try as he may, cannot make a three point landing! We can design a ship that cannot be turned without a very great deal of effort on the part of the pilot. We can design a ship that cannot be stunted to any extent. But when we do this we have designed a ship that is difficult to handle and may be, at times, actually dangerous.

For at some time or other the ship will

get in a tight place, such as coming down in the fog to find oneself in a canyon with a mountain looming up directly ahead, where, to save himself, the pilot has to resort to sudden and violent maneuvers.

Thus we find that pursuit ships, especially designed for easy and extremely rapid maneuvering, are not, as a rule, very stable. Commercial ships are more stable, but even these are sufficiently maneuverable for most purposes. We see, then, that although it is possible to design ships that will fly themselves, this is not done to any extent.

The engineers who believe that ships should be capable of spinning argue along the same lines, saying that when you have a ship that cannot be spun you have sacrificed something else of value to get that characteristic.

It is a fact that the more modern ships are liable to flat spin. It is also a fact that this flat spinning characteristic can, and is, taken out of the ship by careful designing.

That is what concerns the model airplane builder most. How can we keep our ships from spinning? It is entirely possible to design a model that will not spin. Many commercial airplanes on the market today will not spin unless deliberately rolled in a stall by the pilot.

Other ships on the market cannot be spun at all, as mentioned above. The model builder, however, is chiefly interested in designing his ship so that it will stall normally; that is, so that it will fall out of a stall with wings nearly level, and will show no tendency to spin. That is not hard to do.

As we learned last month, the most powerful single influence in controlling the ship in a stall is the rudder. Since all spins are the result of stalls, we can make use of this fact. We design a ship with a powerful rudder moment, which does not necessarily mean that it has a large rudder, but rather means that the rudder, if it is not large, is placed at some little distance from the center of gravity.

Then, with the powerful rudder holding the ship straight in a stall, we can be quite sure that it will not spin badly.

There are other ways. Remembering what we have learned in this article about the distribution of weight, we can design our ships so that they will resist spins by proper placing of weight. As shown in Figure 3, we can build a trimotor job, for example, with wing motors. This distributes the weight along the wings, and is helpful in preventing spins.

In line with this topic, I have for some time toyed with the idea of building a model airplane on the line of the flying wing, with the motor stick actually contained in the wing and with the propeller operated by gears. The tail, of course, would have to be placed on booms.

This kind of a job would cut parasite resistance to a minimum and would also be, if well designed, very stable. The difficulty lies in getting suitable gears for the prop. Most of those obtainable are either weak, subject to wear, or are far too heavy. Nevertheless, I'm passing the idea along, in the hope that some experimenter will try placing his motor inside the wing, across the entire span, and will be successful with it.

Going back to the distribution of weight, we have also learned that weight distributed vertically is of aid in the matter of spinning. This is shown in Figure 4, where we see the gas tank placed in the wing of a high wing monoplane. This, however, doesn't help the model builder, since he is rarely able to make use of gasoline motors.

As a general rule, however, these methods are not necessary, in model designing at least. A well-planned ship, with ample tail surfaces and a good degree of stability, will be found practically free from bad spinning characteristics. Freak designs, however, and experimental designs, often develop the most exasperating faults in regard to spinning.

I once built a fairly large model, with a wing of something like five foot spread and eight inch chord, that gave me a lot of trouble. The ship was a pusher, driven by a single rubber motor. It flew very slowly, so slowly indeed that it was often forced back by the breeze. The trouble was that it stalled if not adjusted properly, and, once stalled, it promptly went into a very flat spin, and came slowly down, whirling around as it came, until it struck the ground. The ship was a freak design.

Its weight was distributed along the longitudinal axis almost entirely. I tried putting on large rudders, a larger elevator, and several other things, without much success. Finally, as an experiment, I placed small weights on the wings, about half-way out from the fuselage. After that the ship did not spin at all, although the weights of course cut down its performance. That shows the effect of distribution of weight on spinning characteristics.

The Grant Minute Man

(*Continued from page 32*)

is in place, one at the front end and one over the rear end, or you may use pins as in diagram 4.

Take one of the ribs and smear the top curved edge with cement. Then press the rib into position directly on the line nearest to one of the ends, *the high point of the rib* to the front. Pull down the front and rear wing edges tight to the rib and push a paper clip over each end. (The large loop of the clip should be over the top of the wing.) This holds the wing down to the rib better than when the small loop is over the wing. (see diagram 4).

Take one of the wings and with the edge of a ruler, crease it straight across one end on the top or convex side, one half inch in from the straight, unrounded end as shown by line (M-N), diagram 1. Crease it enough by pressing down hard on the ruler and drawing it across the balsa, back and forth several times, but do not cut through the wood. Bend *up* the small one-half inch flap to about forty-five degrees. (See Diagram 2.)

Crease the second wing sheet in the same manner, on the top or convex side. The ends of each wing should look alike (M-N), diagram 2. Now the wings are to be joined at the center by overlapping the flaps and cementing them together as shown in diagrams 1 and 5. *The crease in each wing end should come exactly together.* To do this operation, cover both the turned up flaps with the waterproof cement, the top of one and the bottom of the other. The cement should cover the portion of the wing shown by the cross-hatched lines in diagram 1, on one wing and the corresponding bottom portion of the second half wing. The cement must be spread on very quickly and the two creased sections, diagram 2, pressed tightly together immediately as in figures 1 and 5. You now hold the cemented surfaces in place with four paper clips at point (X) in diagrams 1 and 5, *being sure that both wings slant upward from the point where they are creased, diagram 2, the ends being raised two inches as shown.*

Cut out the stabilizer from the third balsa sheet (1/32" x 3" x 11") to the shape shown in diagram 6. First cut out a rectangular piece 7¾ inches long and 2⅜ inches wide. (ABCD) diagram 6. Measure in from the sides (A-D) along (A-B) 1 3/16 inches and mark point (M). Now measure down perpendicularly at (M) 1 3/16 inches and mark point (O). Now place the point of your compasses on the point (O) and spread them, 1 3/64 inches, drawing the arc of the circle (M-R-N).

Do the same with the other end of your stabilizer and cut away the wood outside these lines. You should now have your stabilizer with the shape shown by the heavy line in diagram 6.

You have a small piece of the balsa sheet left from which you can cut out the fin and rudder. A very good way to lay out the outline of this on the wood, so that you can cut it to the proper shape is to put the balsa sheet directly under the drawing (diagram 7) so that it is centered properly over the wood sheet, *the grain running in an up and down direction.* THIS IS IMPORTANT. The arrows on the drawing show you the correct run of the grain.

Now when you have done this, prick holes through the paper and into the balsa wood with a pin, following the outline of the fin as shown by the heavy line in the diagram. When you have pin pricked the outline on the wood, draw the outline of the fin on it, following the pin marks. Then cut out the fin with a sharp pen knife as shown by the pencil line. This can best be done by cutting away the wood from the fin a little at a time.

This is made of the 1/32 inch steel wire, bent to the shape and dimensions shown in diagram 8. Make this carefully. Measure each length with precision, using the *round nosed* pliers to make the bends. When making the bends (A) and (B) diagram 8, use the points of the pliers and make the bends sharp.

The wheels are made from *hard wood,* 1¼" in diameter and ⅛" thick as shown in diagram 9. The shaft hole at the center is 1/32" in diameter.

When the landing gear is shaped and the wheels made, put one wheel on one end of the wire (S) and bend this end up sharply as indicated by the dotted line to (S^1) diagram 9.

You are now ready to make the wire parts so they will be ready when you finally start to assemble your plane. In diagram 10, you will see drawings of all the parts, full size. Shape them exactly as they are shown, making your bends with small, round nose pliers.

You can start with the propeller shaft. This is made of a piece of 1/32" (31/1000) steel wire two and three-eighths inches long. Next shape the tail skid from 1/32 inch steel wire as shown in diagram 10. The Can is made from a piece of the fine 1/64 inch wire, about one and ¼ inches long.

The wing clips also are made of the fine 1/64 inch wire, exactly the shape and size shown in the drawing, diagram 10. There should be two clips as shown, one with long legs for the rear of the wing and the short legged one for the front.

The motor shackle (or "S" hook) is illustrated in diagram 10, and is made of 1/32" wire and shaped exactly as shown in the drawing, which is full size.

The propeller is the most difficult task of all. First cut out the blank from a thick piece of ⅝" balsa with the outline as shown in diagram 11. When you have the blank finished, bore the shaft hole at the center 1/32 inch in diameter, as shown in diagram 11. You are now ready to cut the propeller from the blank.

Study the diagram and notice how it is progressively cut; first the concave face on one blade is shaped, then the concave face of the second. Then the convex face is shaped down to make the propeller blade the proper thickness, about ⅛ inch thick near the hub and progressively thinner towards the tips, where they are about 1/32 inch thick. Leave a hub at the center of the propeller as shown. It should now look like Fig. B.

Be sure that both blades are the same thickness and weight. Finish your work down with fine sand paper. The propeller should look like Fig. (C) when finished.

Our next step is to assemble the wire parts to the frame. The propeller bearing and landing gear are first attached to the front of the stick. To do this, put plenty of the cement on the front end of the stick and on the bottom, so that when the right angular propeller bearing (B) is pressed into place as shown in diagram 13, it will be held by the cement. Now wind about four or five loops of thread around the stick and bearing as at (T) diagram 13. Cease winding while you place the loop (V) diagrams 8 and 13 of the landing gear up into position for attachment against the bottom of the aluminum bearing (B), then continue winding the thread around the nose of the stick, but now, also around the loop of the landing gear while you are holding it in the proper position, (T), diagram 13.

Next put the Can on the stick at (P) diagram 14 with the loop sticking up above the stick as shown.

You now put the tail skid on the rear end of the motor stick at (D). As shown, the stick fits into the middle loop of the wire. Push it into it firmly with the motor hook on the TOP of the stick and the tail skid hanging down below it. Cover the wire with cement where it comes into contact with the wood in order to hold it tightly in place.

The fin or rudder can now be put on the stick by covering the right hand side (the side opposite to the one you face in the drawing) with cement and stick the rudder to it as shown in the diagram with the straight edge of the fin *flush* with the bottom of the stick.

While the frame joints are drying, attach the wing clips to the wing by forcing the short turned down ends down through the wood of the wing at the center. The front or short legged one is located ¼ inch from the front or leading edge of the wing and directly over the center crease, the prongs forced through the double thickness of wood where the two halves of the wing overlap as in diagram 5. The rear or long legged clip is located ¼ inch in front of the rear or trailing edge of the wing, the prongs or ends of the wire clip being pressed down through the wood of the wing. It should be directly over the center crease of the wing. When they are in position, cover the protruding prongs (A) and the shoulders (B) with plenty of cement and set the wing aside for them to dry.

When all the cemented joints of the frame have thoroughly dried, you can start the final assembly. First you hook the hook of the propeller shaft through the hole in the propeller bearing from the front side but not until you slip the small washer over the shaft so the washer will be between the propeller and the bearing, diagram 13.

The motor is composed of four strands of 1/32″ by ⅛″ rubber thread about sixty-three inches long, or sixteen strands of 1/32 inch square rubber (about twenty-one feet long). Put on 16 strands if the 1/32″ square rubber is used.

When the motor is completed, unhook the motor from the rear motor hook by unhooking the motor shackle from this hook. Now loop a rubber band around over the fin and rear end of the motor stick so it hangs from the stick just in front of the fin, M, diagram 14, then thread the motor through the can by slipping the motor shackle with the rubber still in place through the can from the front side. Then rehook the shackle with motor attached, to the rear motor hook. It should look as shown in diagram 14.

Put the stabilizer in place by resting it up against the bottom side of the stick directly under the fin and pulling the loop of the rubber band M-N, hanging from the stick in front of the fin down below the stabilizer, back under it and then looping it up over and around the rear end of the motor stick to the rear of the motor hook as shown by dotted line in diagram 14. Adjust the stabilizer so it is straight in position on the frame stick.

If the wing clips are secure and the cement on them dry, press the frame stick down into the slots of the clips so the short clip is toward the propeller or front end of the machine and about four or five inches from it. Now if the machine balances in a horizontal position when it is suspended on the tips of the two fingers placed on the center line of the wing and one on each side of the center of the wing, point B, the wing is in the proper position for stable flights. If not, move the wing along the stick until this condition exists.

Now you are ready to fly your "ship." Be sure the wing, stabilizer and fin are straight and true and not warped. Now wind up the propeller, putting at first about 325 turns on the rubber motor if you are winding it by hand. If you are winding it with a winder you may safely put 575 turns on the motor.

Dad's Smoking Stand

(*Continued from page 36*)

are used. A couple of handfuls of these brads and a small pot of the glue will be sufficient to complete a good job. Either clear your bench or a space on the floor which is level and smooth, so that this work may be done on a smooth, flat surface.

Follow these instructions carefully, for the procedure in assembling the stand has a great deal to do with the result. If certain pieces were attached at the wrong time, considerable trouble would be had in attaching those to follow.

We first attach the magazine partition boards to the base. This work should be done on the floor, using newspapers to guard against the stock marring the floor. The two partition boards are stood on their ends on the floor and the base board is laid across them. When in this position, check to see that they fit perfectly and that the length of the partition boards and the width of the base board are equal.

Remove the base board, coat the ends of the two partition boards and the base board with glue, and replace in position. The best side of the base board has already been marked "Top" and it is this side which is joined to the partition boards, and should, therefore, be coated with the glue where it comes in contact with the partition boards.

Drive the brads from the bottom face of the base board through its top face and in the partition boards. Space the brads about 2" apart. When nailing, test with your try-square to see that the partition boards and the base form right angles at their joint. It will not be necessary to use a nail set on these nails, as the legs cover them, but make sure that they are driven in flush with the wood. Do not touch the excess glue which will ooze out of the joints at this time, but allow it to harden thoroughly. After the brads are all driven in, test again with your try-square, see that it is perfectly assembled, and do not touch until the glue is hardened. However, we need not waste this time while waiting for the base and partition boards to harden. Stand the two side boards up on their ends in the same manner and place the top over their opposite ends, exactly as you did with the first assembly.

MAKE sure that the hinge grooves are in the position shown in the plans. Proceed to glue and nail in the same manner explained above. Test with your try-square and leave in correct position to harden.

Leave both these assembling jobs in position for twenty-four hours. The next operation is the attaching of the legs to the base. Lay the legs flat on the floor and place the base in position over them, testing to see that the length of the legs and the width of the base are equal.

Remove the base, coat the top of the legs and the portions of the base which come in contact with them, replace in position, and drive home the brads. These are driven from the side of the base marked "Top" through it, and in the top of the legs. Space the brads about 2" apart. Set aside to harden.

The back of the stand is next attached.

This fits between the two side boards and the top and base boards. Apply glue to all the edges of the back board and to the top, base and side boards where these come in contact with the back. Place the work on the floor on one of its sides, drive nails through the side into the back, turn it over and do the same through the other side.

Now stand it on the top and drive the brads through the base into the back, after making sure that the base is in correct position. Also, drive brads through the base into the side boards. Stand the work on its legs in normal position, and drive brads through the top into the back board. Test with your try-square to insure the side boards forming right angles with the base, as well as the back board forming right angles with it.

The entire stand is now assembled, with the exception of the door, and should be allowed twenty-four hours to harden thoroughly. While awaiting this we can cut the door knob, which is a simple process with a pen-knife. Obtain a 1" square block and cut it in a triangle each side of which measures 1" in length. Now shape its length as shown in the plans under "Knob." Finish smooth with sandpaper.

A small-head brad 1½" long is now driven through the center of the smallest end. It will not come out in the center of the hand-grip end, but this is not necessary. If small-nose pliers are handy, a common pin can be heated red-hot over your mother's stove, gripped with the pliers and slowly thrust through the knob from the small end.

Heating several times may be necessary. See that the pin goes through perpendicularly to the large face of the knob. When completely through, the brad can easily be driven through without fear of splitting the wood.

If this method can not be used, carefully drive the brad from the small end of the knob through it, and then pull it out and drive it through from the large end, as shown. The knob is not attached at this time, so place it away carefully.

When the excess glue from the joints of the stand has become hard we are ready to finish our work. Remove all excess glue with sandpaper or a blunt knife, taking care not to cut the wood. Fill all cracks, joints, nail set holes and wood blemishes with plastic wood. All nails which show should be countersunk with your nail set about ⅛" deep and their holes then filled. Give the entire stand a complete and thorough sanding, first with rough and then with fine sandpaper. We are now ready to fit the door.

The door has already been cut to size and should now be placed in position as it would be when shut. Fit the door, so that it will stay snugly in place when closed. While making these tests a small brad can be driven into the door at the point where the knob is attached, so that the door can be easily removed when the tests are completed.

Carefully study the drawing of the door shown in the plans under "Door." Note that one edge of the door is cut out in two places for the two hinges in the same manner in which the side was done.

The knob is now attached. Apply glue to the door and the small end of the knob and drive the brad in position. Use your nail set on it, countersinking it about 1/8". Now obtain a pair of hinges 2" long and not over 1" wide from any "Five and Ten Cent" store. Attach these in place on the door first, making sure that your screws are not over ¾" in length. Now attach the door to the side board, again testing it to insure a snug fit.

When the glue on the knob has hardened remove all excess and give the door a thorough sanding.

Fill the nail set hole in the knob with plastic wood, as well as any blemishes which the door may have.

The stand is now finished and ready for painting.

Three coats of white enamel are recommended for the inside of the stand. For the outside finish, as well as the inside of the door, any good lacquer is best, as such a finish covers all joints and gives a smooth, flat surface.

American Sky Cadets

(Continued from page 19)

not only furnished with complete plans and drawings, but also are given access to the company's exhaustive file of photographs to give them as clear an idea as possible of the plane which they are modelling.

Both young men find their work extremely interesting, although they say that the strict requirements laid down for the construction of the wind tunnel models make it necessary for them to exercise utmost care in their work at all times.

"Our work is not only interesting—and difficult, but it is educational at the same time," Dickert continued. "By reproducing miniature airplanes from the various engineering designs, we learn a great deal about aeronautical engineering principles. That, of course, is one of the big features of every type of airplane model building. All boys in the country who are constructing models in their spare time are learning about airplanes and airplane construction."

Both Dickert and Proctor plan to become aeronautical engineers some day, and thus apply to practical airplane design and construction the knowledge gained from model building.

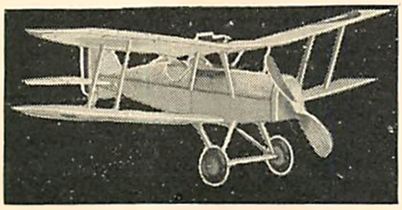
And, like the air mail pilot who goes for a plane ride on his day off, both Dickert and Proctor build models during their spare time at home.

To supply model construction material to the many boys and young men, the Boeing Airplane Company has developed a model bureau which is prepared to furnish drawings and photographs at cost.

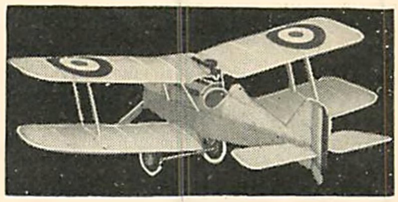
In preparation for the first drawings, Dickert and Proctor were asked which of the many types of Boeing aircraft should be used. Both suggested the famous Army pursuit plane, a model of which, built by William Chaffee, won the 1930 national contest.

RECORD HOLDING SCALE MODEL

Famous World War Plane



THE S. E. 5 "A"
24" Wingspan

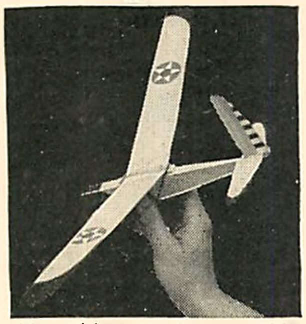


The construction set for this plane contains all the necessary parts and material: ribs cut, formers made, celluloid wheels, full size layout, exact scale blue prints and instructions. All wood parts are of feather weight BALSA. The S. E. 5 "A" is easy to construct and is by far the best flying scale model that can be built, holding the present record of 48 seconds. The S. E. 5 "A" has a gliding angle of 12 to 1, a ceiling of 60 feet—nothing like it has yet been produced in kit sets.

The S. E. 5 "A" is the plane that won for the Royal Flying Corps the supremacy of the air in the World War.

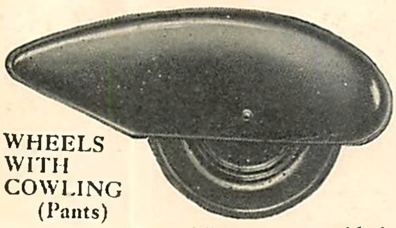
PRICE FOR KIT $3.00, postpaid.

HAWK
Soaring Glider



This 24" glider can be assembled in 30 seconds. All parts cut to size and shape. Cement and insignias and instructions are furnished. There are 2 complete sets for 2 gliders in this kit. Has recorded flight of one minute. PRICE FOR KIT $0.75, postpaid.

CELLULOID SUPPLIES



WHEELS WITH COWLING (Pants)

Special wheels and "pants" assembled, ideal for 24" models. These can be supplied in either bright red or black. Price, per pair $0.80

Postage 5c Extra

CELLULOID WHEELS

1⅞"	in diameter, per pair......	$0.40
1⅜"	in diameter, per pair......	.20
3"	in diameter, per pair......	.60

Postage 5c Extra

Blue Prints!
FULL SIZE and SCALE
24" Wingspan

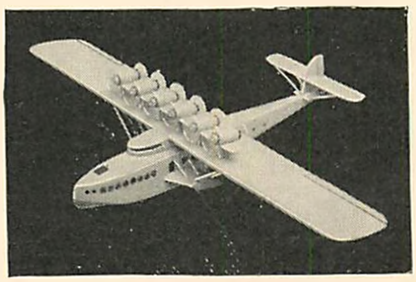
Curtiss Hawk P.6	$0.40
Curtiss Hawk P.3.A.	.40
Sea Hawk F.7.C.1	.40
S.E.5.A. Scout (1917)	.40
Vought Corsair	.40
Travel Air "Mystery Ship"	.40
Lockheed "Sirius"	.25
German B.F.W.	.25
Sikorsky (10 place)	.25
Ford Tri-Motor	.40
Stinson Detroiter	.40

SPECIAL SCALE PRINTS
(All 10" to 15" Wingspan)
Two plans on one blue print

Curtiss Hawk P.3.A. & Travel Air "Mystery Ship"	$0.25
Curtiss Hawk P.6. & Boeing Pursuit	.25
Boeing Model 80.A. & Curtiss Condor	.25
Sikorsky S.38. & Boeing Model 204	.25
Fokker D.7. & S.E.5.A.	.25
Supermarino Napier & Mercury Racer	.25
Wallace Touro Plane & Inland Sport Plane	.25
Keystone Bomber & Hall Aluminum Patrol.	.25

EXTRA SPECIAL SCALE PRINTS
Three plans on one blue print

"Avero Trainer," Bristol "Bulldog" Fighter and Cierva Autogiro $0.25



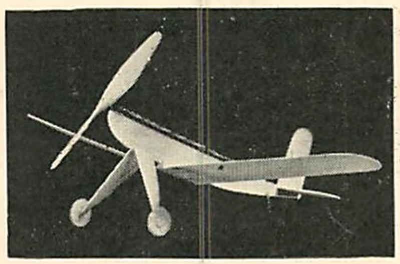
DORNIER "D-OX"

7 full size sheets of blue prints to build above "D-OX." All wood model, exact scale $1.50

"THE ENTERPRISE"

6 full size sheets of blue prints to build the WORLD'S FASTEST sail boat $1.50

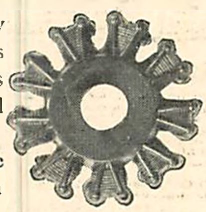
Gamecock
R. O. G.



ALL BALSA

Kit set contains everything cut out to size, all balsa. Easy to construct and fly. Has repeatedly gained altitudes of over 100 feet, with dead stick landings. PRICE FOR KIT, $0.75, postpaid.

CELLULOID MOTORS



9 cylinder dummy whirlwind motors like cut, 3 inches in diameter and very light.
Price 65c
Postage 5c Extra

5c

Brings you a complete illustrated booklet containing all models shown above and other latest model airplanes, and model airplane supplies. Full description of materials and equipment needed for each model. Every model is designed to fly when made according to our simplified plans of construction. Don't fail to send for it.

Hawk Model Aeroplanes

4944 IRVING PARK BLVD. DEPT. K1 CHICAGO, ILLINOIS, U. S. A.

ALL BALSA—AMERICA'S MOST EASILY CONSTRUCTED MODELS!

A new, all-balsa construction makes these Midland models superior to anything you have ever seen. Lighter—about two-thirds the weight of an ordinary model of the same size. Stronger—practically crash-proof. Better-looking and more realistic—smooth, sheet-balsa surfaces instead of wrinkled tissue sagging between ribs and longerons. Easier to build, because so much simpler. A job you can do in a couple of hours instead of a week. And *you* can do it. We've eliminated the question of skill.

Midland's all-balsa construction makes use of sheet balsa 1/32 of an inch thick for the wings and the sides of the fuselage. Balsa—almost as light as the paper it replaces, and infinitely stronger! The only paper is that used to cover the top and bottom of the fuselage and the tail.

No fragile, tedious built-up framework. Nothing to draw. Nothing to measure off. No nails to drive, no holes to drill. A ready-made, die-stamped aluminum propeller to save you the work of carving one and to prevent the failures due to poorly-made propellers. Struts of spruce and bamboo. Celluloid wheels, light and good looking. A shock-absorbing landing gear. Colorless, quick-drying model cement—the fastest-drying known. Rubber 10% more powerful. Landing wheels well forward to protect the propeller. Wings at a high angle of incidence for fast climb and minimum center of pressure travel. Tips "washed out" to reduce losses. Scores of other aerodynamic refinements seldom found in models.

You will find these models much easier to build, and, after you have built them, much more satisfactory to fly. Fewer trial adjustments longer steadier flights.

THE MIDLAND MODEL WORKS

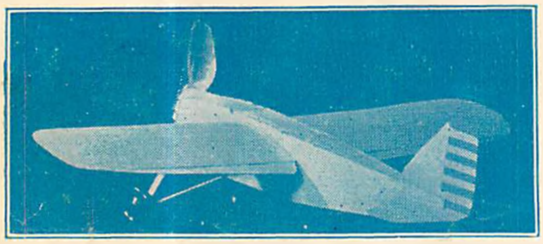
Box W, Chillicothe, Ohio

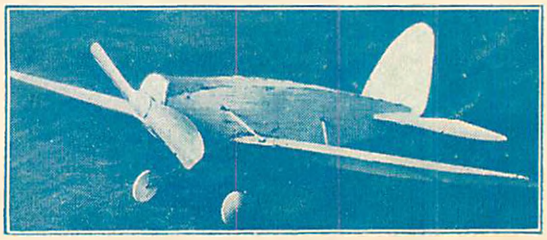
TAPER-WING COMBAT MONOPLANE—

An Unusual Value

An exceptionally graceful model of a center-wing combat monoplane, and the best distance flyer of the Midland group. Does 200 feet consistently. Can be hand launched or will rise off ground. Very easily built, and will stand hard use. Wing span 20 inches. Weight 8/10 ounce.

Complete set, with all material and full building and flying directions, postpaid in the United States and Canada $2.00





MIDLAND BABY BULLET

Wing span 15 inches. Weight 3/8 ounce. Flight range 140 feet or more.

A simple, easily-constructed r. o. g. model of a one-place low-wing sport plane. The propeller is only one-fourth as long as the wings, and much closer to true scale than in ordinary models. Propeller blades deeply curved for slow revolution and unusual duration.

Complete set, with all material and full building and flying directions, postpaid in the United States and Canada, only...... $1.00

Midland Army Biplane in Flight

Unretouched photograph

1 OUT of 10

Probably not one model airplane in ten ever gives its purchaser a satisfactory flight. Some failures are due to careless construction. Some are due to careless *design*—a carelessness sometimes so great that the model can not be made to fly under any conditions. But the majority of failures are due to the tremendous difficulty encountered in building many models.

The average model would be entirely satisfactory if it could be constructed with less skill, but it may be a sad disappointment to the ordinary model builder, who often finds that he has wasted both his money and his time on a set which only an expert can put together.

A simple and easy construction is the key-note of Midland design. We do not pretend that Midland models are *exact scale* reproductions, for such models are hard to build, unsatisfactory to fly. We do not claim that these models will break records, for record-breaking models are too delicate to build, too fragile to last. All that we say is that these models are pleasingly realistic, that they will fly well time after time, and that the average boy can build them. Why risk disappointment by purchasing a model advertised with extravagant claims of exact scale design and almost unbelievable flying ability? Buy a Midland model and get what you expect, and what you are entitled to have.

You are doubly safe in ordering Midland sets because nothing but actual, unretouched photographs are used to advertise them. Remember that any photograph of a Midland model shows it as you will get it—not merely as you would like to have it.

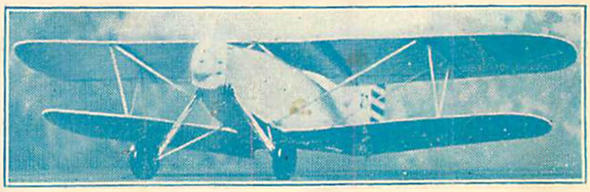
REALISTIC ARMY BIPLANE

This fast biplane fighter is a tremendously impressive model. Its trim fuselage and tapered, close-set wings give an impression of speed, and in the air it looks so much like a real ship that flight photographs of the model are usually mistaken for pictures of a full-sized airplane.

The wing spread is 20 inches, the weight exactly 1 ounce. The flight distance is close to 200 feet. Because of its greater wing area the Army Biplane gains a great deal of altitude. The average limit is about 50 feet, but we have photographed it when almost three times that high!

The top wing is in advance of the lower one, and at a larger angle of incidence. This results in the center of pressure of both wings being shifted *forward* when the model dives, *back* when it climbs. This is the exact opposite of the usual movement and gives the model unequaled stability. By far the best rough-weather flyer we have seen.

Harder to build than the monoplanes, but still much easier than any conventional built-up model. Complete set, with all material and full building and flying directions, postpaid in the United states and Canada. $2.50



ORDER NOW—USE THIS COUPON

The MIDLAND MODEL WORKS, Box W, CHILLICOTHE, OHIO

Gentlemen:

Enclosed find $........... for which send me your construction set for ( ) BABY BULLET ( ) COMBAT MONOPLANE ( ) ARMY BIPLANE. I understand that these sets will be sent postpaid in the United States and Canada, and that you guarantee any properly constructed model to fly as stated.

Name ....

Street ....

City.. State..................