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NOVEMBER, 1931



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3/32 x 1/4	.03	6 for .10	1/4 x 1/2	.04	8 for .30	1/20 x 2"	.06	
3/32 x 1	.05	8 for .20	1/4 x 3/4	.04½	5 for .20	1/16 x 2"	.06	
1/8 x 1/8	.01	6 for .05	1/4 x 1	.07	6 for .33	1/16 x 3"	.10	
1/8 x 5/32	.01	6 for .05	5/16 x 5/16	.03½	6 for .25	1/8 x 3"	.12	
1/8 x 3/16	.01½	11 for .15	3/8 x 3/8	.05	6 for .25	3/16 x 2"	.09	
1/8 x 1/4	.02	6 for .10	3/8 x 7/16	.05	6 for .25	3/16 x 3"	.15	
1/8 x 5/16	.02	6 for .10	3/8 x 1/2	.06	6 for .33	1/4 x 3"	.11	
1/8 x 3/8	.02	6 for .10	3/8 x 3/4	.06½	5 for .30	1/4 x 3"	.19	
1/8 x 1/2	.03	6 for .12	3/8 x 1	.10	3 for .25	3/8 x 2"	.16	
1/8 x 3/4	.03½	6 for .12	7/16 x 7/16	.06½	5 for .30	3/8 x 3"	.30	
1/8 x 1	.05	8 for .30	1/2 x 1/2	.07	3 for .20	3/32 x 2"	.07	
5/32 x 5/32	.02	6 for .10	1/2 x 5/8	.10	3 for .25	3/32 x 3"	.12	
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1/2 x 1/2 x 5	.01½
1/2 x 3/4 x 6	3 for .05
1/2 x 1 x 7	.02
1/2 x 1 x 8	2 for .05
3/4 x 1 1/4 x 10	.04
3/4 x 1 1/4 x 10	.04
3/4 x 1 1/4 x 11	.05
3/4 x 1 1/4 x 11	.06
3/4 x 1 1/4 x 12	.06
3/4 x 1 1/4 x 12	.07
1 x 1 1/4 x 12	.08
1 x 1 1/4 x 13	.10
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¼ jar light indoor models, per dozen	.01½c
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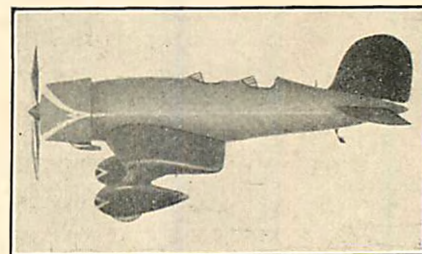
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Vought Corsair .20 Spirit of St. Louis .20  
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Add 5c when ordering separately.

## Featherweight Compressed Air Motors

Finished tank 3"x3"x20" with 3 cylinder motor mounted. Tested ready for use. \$7.25 complete.  
Tanks for all model airplanes. 3x3x20" price, \$4.00; 3x3x24", \$4.50; 3x3x30", \$5.00.

America's lowest price for a knockdown motor kit. All parts are ready to be assembled. They are drilled, formed and shaped to correct size. 1 set complete \$9.95.

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Orders will absolutely not be filled unless you comply with instructions below.

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4—Postage stamps. Canadian or Foreign Coin not accepted as payment.

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Make payment to Scientific Model Airplane Co., 277 Halsey Street, Newark, N. J.

6—Each and every article purchased from us is guaranteed to be of the highest standard.

7—All orders will be shipped 3 hours after receiving them.

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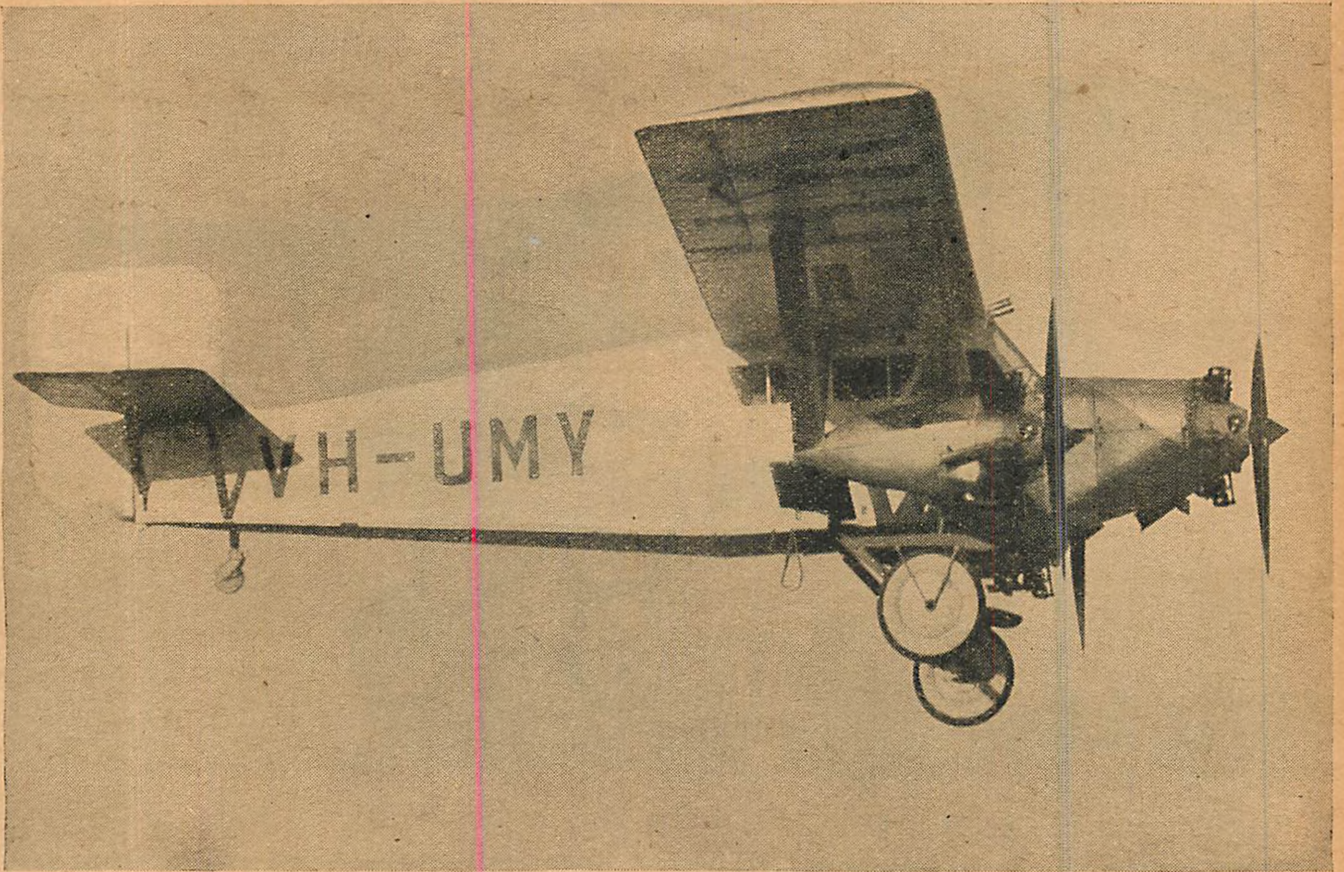
Send 2c stamp for latest summer catalog containing world's lowest model aeroplane prices.

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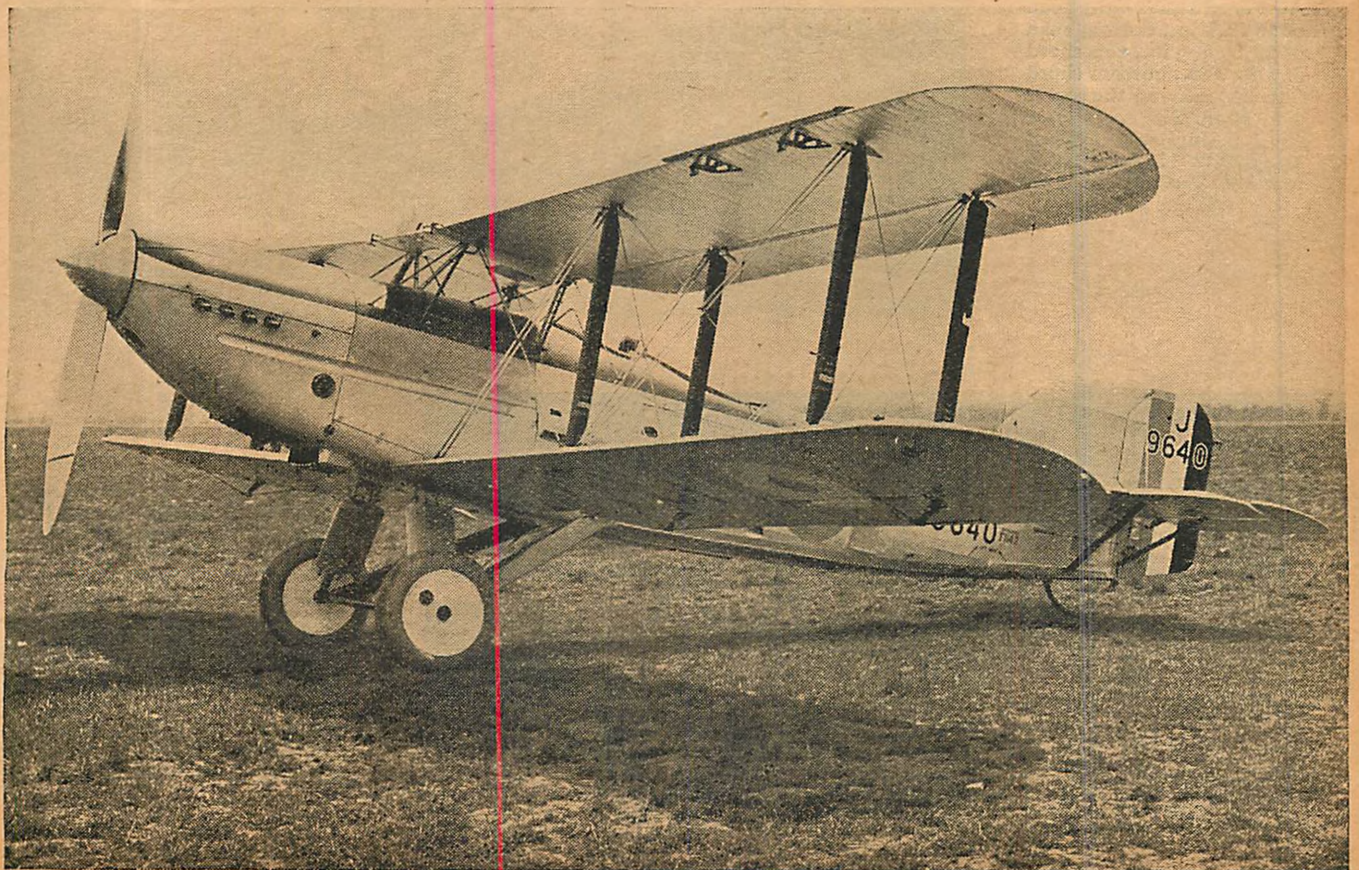
Dealers and Clubs: Write for Special Price List





One of Australia's outstanding passenger planes—the *Lascondor*, a seven-seater—is seen above. It is a tri-motored monoplane well adapted for flying conditions in that country

Below is shown a Fairey *III.F* two-seater general purpose type aircraft of the British Royal Air Force. It is equipped with a Napier *Lion* engine. Data concerning performance is a strict secret



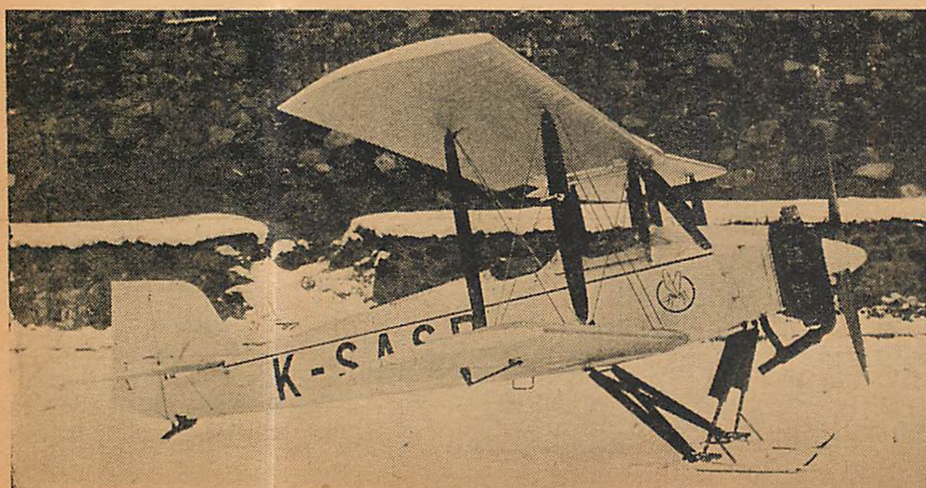




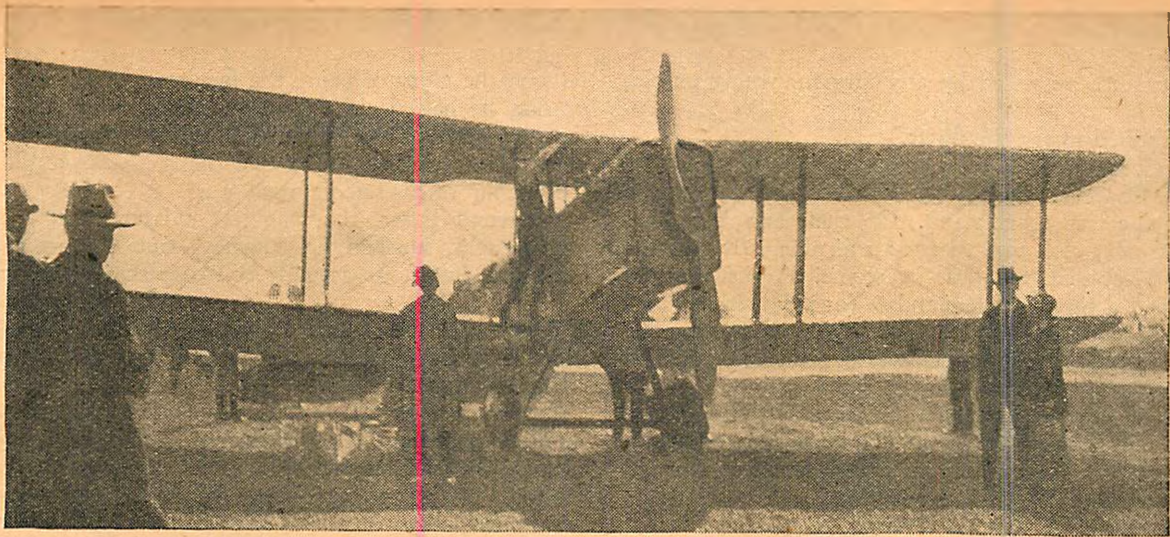
Formidable in appearance, the Gloster *Gamecock II* (above) is a single-seater fighter used by the Royal Air Force and the Finnish Air Force. It has a top span of 30 ft. 1 in., bottom span of 26 ft. 4 1/2 in., top chord of 5 ft. 3 in., bottom chord 5 ft. 2 1/2 in., and the gap is 4 ft. 10 in. The engine is a 450 h.p. Jupiter VI. Speed at 5,000 ft. 155 m.p.h. Armament consists of two Vickers guns



Retaining some resemblance to its wartime ancestor, the *Spad 91* (above) has all the earmarks of speed and good flying qualities. It is manufactured by the famous French Bleriot concern. At the left is the Finnish *Osakeyhtio Saaski II* light biplane equipped with skis. It has a top speed of 96 m.p.h. and a cruising range of 342 miles. It is equipped with a 125 h.p. Siemens Halske engine







The arrival of Parer at Mascot Flying Field, Sydney, Australia

# Never Give Up!

By  
L. Ryan



## Raymond Parer Defied Officialdom and Flew from England to Australia in 1919 in an "Unairworthy" Crate—Only to Lose the Prize!

**E**VEN if you know the stories of all the great flights in the history of aviation I am sure you have heard of few to equal that of Raymond Parer. He flew from England to Australia, a distance which has been covered by air only a few times since he made the flight in 1919. Although he was a penniless boy in his early twenties without any official help and so little outside financial backing that it was practically nothing, he came very near being the first man to make this great journey.

When Raymond first began to study airplanes he was just a boy at college. Out in the plains of New South Wales near the little town of Bathurst where the Australian gold-rush was at its height in the early days, he used to work in the college workshop building models of airplanes and gliders.

Raymond, even as a school boy, believed in the future of travel by air. Once he went so far as to travel in a patent machine of his own from the workshop roof to the college grounds! It taught him a lot about the difficulties of flying—in that particular machine anyway!

However, he did not lose his faith in airplanes. He continued to fly, to experiment, and to build models, so that by the time the Australian Government was ready to sponsor official aviation and to encourage its progress to the extent of offering \$50,000 as a prize for the first plane to make the trip from England to Australia, there was little that the boy did not know about flying. Of course, nobody knew a very great deal about air-travel at that time and no really long flights had ever been made.

It was only natural that Raymond should think of winning the prize.

Looking squarely at the circumstances and the difficulties

which lay before him, it would have been impossible to have found anyone so handicapped.

To begin with, he was very young. Too young, his father thought, to undertake such a venture and, although he was a well-to-do hotel owner in the city of Melbourne, he refused to give Raymond one cent towards the expenses of a world flight. He even refused to sanc-

tion the idea in any way. Raymond had not long before left school and had little or no money of his own—and money is one of the chief essentials.

It is needed for the purchase of fuel, spare parts, repairs, and at that time, even for the establishment of landing bases on the route. It was a pioneer flight and most of it was over country where flying was utterly unknown. There would be practically no air facilities whatever after the plane left Europe and began to cover the Eastern portions of Europe, the Dutch East Indies, etc.

**M**ONEY was not the only essential Raymond lacked. He had no airplane! He was in Australia and the flight had to start from England. To cap it all, one of the best known aviators at that time, Sir Ross Smith, decided to try for the Australian prize. He had everything that Raymond had not; unlimited backing, a most up-to-date Vickers Vimy, equipped with two Rolls Royce engines, a perfectly planned route with established bases, especially constructed landing grounds in the Far East, and two expert mechanics and his own brother as co-pilot.

All the odds were against Raymond Parer.

However, he still believed that he had a good chance of winning the government prize and beating his rivals because he had two of the most valuable assets possible to an aviator: untold courage, and the most complete knowl-



edge of airplanes possessed by any airman, young or old, in 1919.

He determined to try the flight.

First of all he found a companion to share the journey, his friend Observer MacIntosh. Then they raised the money for the trip to England. On their arrival in that country the next step was to get an airplane. It was not easy, but at last that, too, was overcome. A rich business man provided a tiny De Haviland 9 (one Sidderley Puma engine), and \$5,000! Even today, with air routes practically established throughout the world, such an equipment would seem small. It was enough for Raymond.

He and MacIntosh prepared to leave the flying field but their troubles were not over. The English Government forbade the flight. The craft was considered unairworthy!

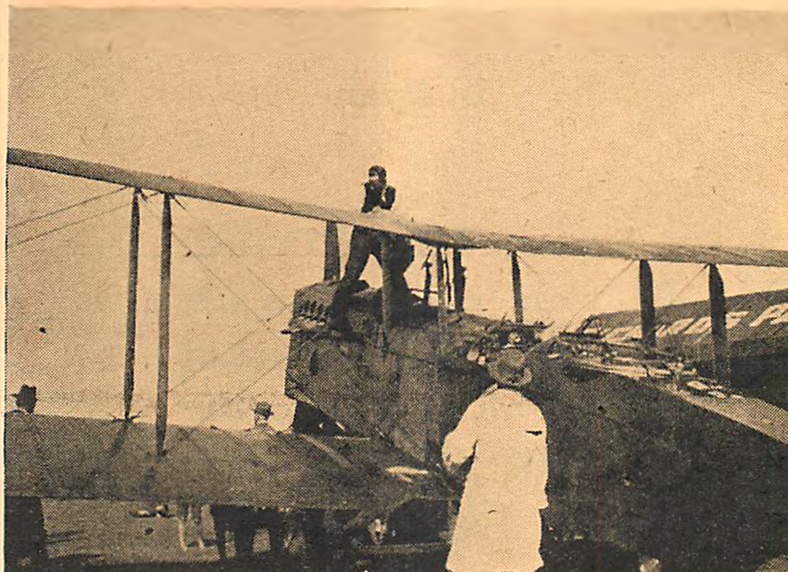
"You may not leave," the officials said.

"We are going," Raymond replied.

"If you do, you cannot win the prize. You are disqualified."

"Even so—we are going to fly to Australia," Raymond answered, although this was, naturally, the worst blow he could have had after all he had been through.

In spite of their poor equipment and insufficient supplies the boy and his mechanic reached the Dutch East Indies without any serious damage. In that part of the world it was necessary for them to land on race tracks and Raymond, forced to come down when a race was in progress, tried to avoid the crowds and crashed. He was not hurt, but the plane was badly smashed.



Refueling the de Haviland for its last flight

**M**ONEY was scarce and

Raymond and his friend tackled the repairs as best as they could. When they climbed back in the cockpit the craft was patched with old tins and pasteboard. It was scratched and dented in a dozen places, but the engine was sound.

Between Surabaya and Atamboea there was not a single bit of ground where a plane could land, and Raymond knew that he could rely on nothing but his courage and his intimate knowledge of aircraft to carry him through.

He reached the Timor Sea in safety. It was the worst part of the whole journey between Europe and Australia. So treacherous was it that warships patrolled for the protection of all the earlier flights, and even to this day aviators lose their lives there.

Raymond had no protection whatever. His fuel was almost gone. The sea was covered by heavy mist. Both MacIntosh and the boy pilot were exhausted.

However, they reached Australia! With only the slightest delay for rest, they set off once more and headed for the Mascot airdrome at Sydney.

They found that Sir Ross Smith had beaten them and won the prize! He had made the trip in twenty-eight days and twenty hours.

When Raymond first dreamed of this great journey he had set his old college on the plains as his goal. Whether

he won the glory of being the first man to fly to Australia or not, he had decided that he would pilot his plane to the very gates of the school at Bathurst! Although he was almost too worn out to handle the controls, he set off on the last lap of his self-imposed trip.

Raymond Parer, the youngest aviator ever to make a world flight, finished his journey—but the poor old De Haviland didn't. It actually fell to pieces on the way!

**E**VEN that didn't stop Raymond. He borrowed a little Avro from the Air Force and flew to St. Stanislaus college in that.

He never gave up! Practically without support of any kind, without any but the poorest supplies, over a route that had never been travelled, in a plane that was mended with bits of tin, and in places, with brown paper patches—he nevertheless made one of the longest flights in the world, and all but beat his rivals in speed!

The endurance of this boy cannot be properly understood unless it is compared in detail to the winning pilot. To begin with he had only one man to share the journey,

to repair and refuel at the landing bases, and to relieve him for sleep. There were four men in the Ross Smith plane, they had every convenience and no financial anxiety, besides having an infinitely larger and more comfortable craft. Even so, in 1919, Sir Ross and Sir Keith Smith were the greatest heroes of the air, and theirs was the longest air journey ever accomplished.

How much more wonderful was the feat of one boy, in a small De Haviland with one me-

chanic! Yet his flight was barely noticed because the officials had forbidden it.

Contrasted with present-day flights to Australia by such famous men as Wing-Commander Kingsford-Smith, Flight-Lieutenant Scott and others, Parer's effort stands out as a monument to determination to succeed over all obstacles.

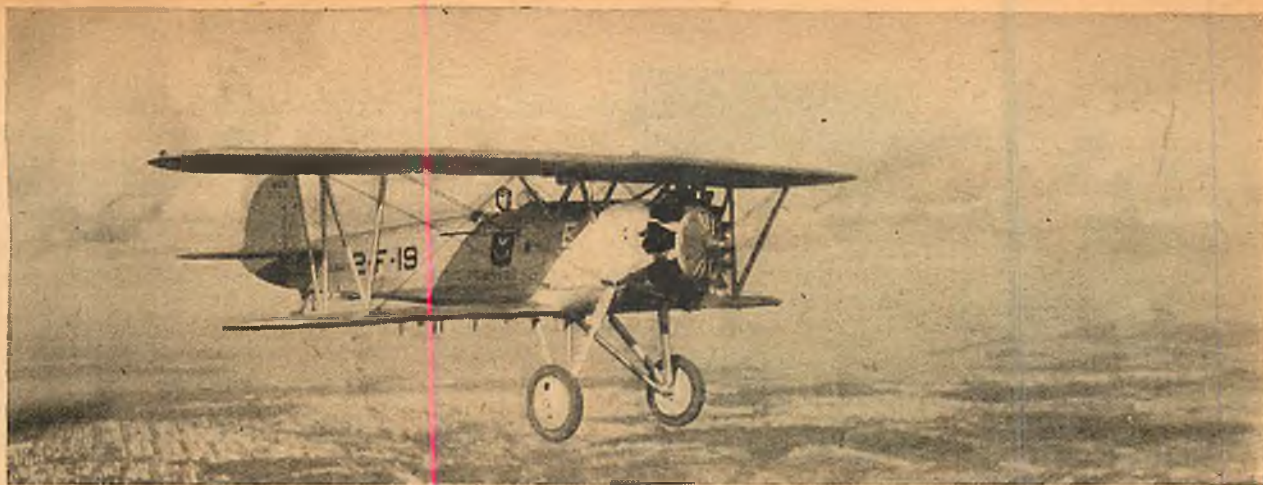
Compare Parer's old *De-H* with such well-equipped machines as Kingsford-Smith's famous Fokker triplane or Scott's modern Blackburn *Bluebird*, and you have some idea of the difficulties to be overcome by the young dare-devil.

**F**EW people realize the real test of the flight from England to Australia or vice versa. Both plane and personnel have to go through many changes of climate, some of them extreme changes, which play havoc with the engines and planes.

In addition to climatic difficulties there are the difficulties of terrain that has to be flown over, which includes everything from mountains, to deserts to impenetrable forests. A forced landing anywhere usually means long delays, with little chance of repairs being carried out, or more likely the end of the flight there and then.

Hats off to Parer!





A U. S. fighting plane—with little streamlining in order to gain visibility

# The Airplane Engine

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



## The Cooling System

(CHAPTER 6)

**F**UNDAMENTALLY, all internal combustion engines are cooled by air. An intermediate substance such as water may be used to convey the heat from the cylinders to the radiator, but once there the heat is further transferred to the atmosphere. However, certain definite methods of cooling have become well established in engine construction and they are labeled according to the substance which actually conveys the heat from the cylinder walls to the air.

Basically, however, the cooling systems may be classified under two heads—air-cooled and liquid-cooled. Under the first method will come the radial engines which are so popular at present and the older rotary engines of wartime fame. The liquid-cooled type will include all water-cooled, patent coolants such as Prestone, and the evaporative method which is sometimes known as steam-cooled.

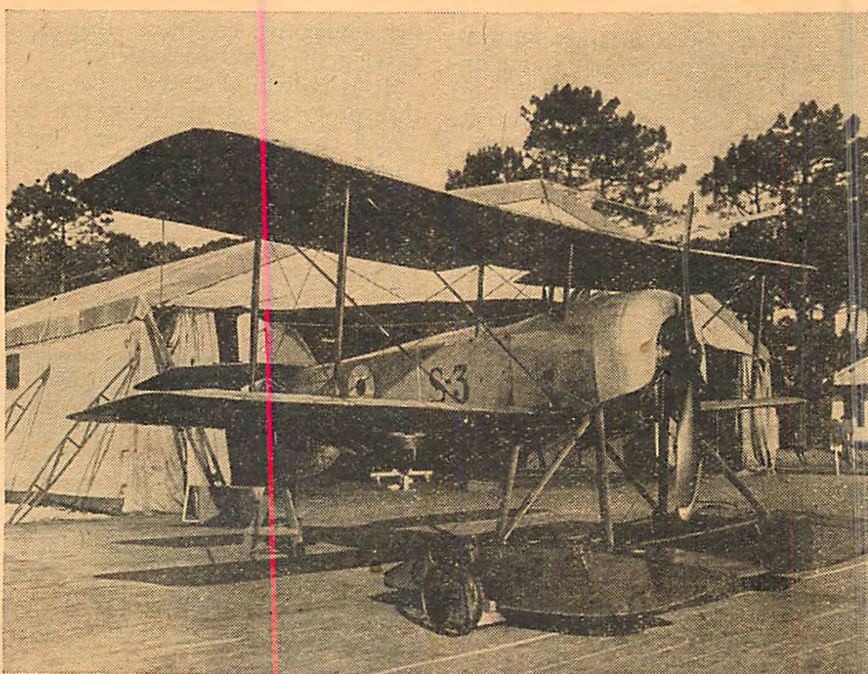
Long discussions concerning the relative merits of the water-cooled versus the air-cooled engine have been made, but no agreement has ever been reached. Many countries in Europe continue to use the water-cooled engine with excellent results. Per-

haps the best example of its use is the flight of Coste and Bellonte from Paris to New York. The United States continues to favor the use of the air-cooled radial engine.

It is only fair to state that each type of engine has certain advantages under favorable conditions. On the other hand, each of them has many disadvantages. The selection of the engine to be used should be determined by the use to which you desire to put the plane in which you install the engine.

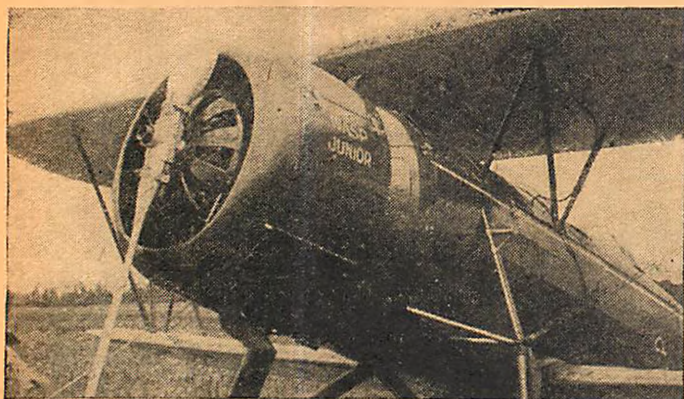
If the adherents of the water-cooled type of engine would use the expression "liquid-cooled," they would be more accurate and would have more possibilities on which

to base their arguments for the future development of that type of engine. In this discussion of the various types of cooling systems, the advantages and disadvantages of each will be covered. In this era of marvellous overnight developments it obviously would be unsafe to venture a prediction about the too-far-in-the-future power plant, but this article will attempt to give the various demands made on airplane engines. The reader will then be in a position to determine



A wartime Sopwith Pup—note how cowling is similar to that of today





The N.A.C.A. cowling

for himself the cases when it is desirable to make use of one type or the other.

In the first place, why is it necessary to make provisions for cooling the internal combustion engine? It must be remembered that the heat of combustion within the cylinder is tremendous. It often reaches a value of over 4000° F. Unless some of this heat is rapidly dissipated, it soon would melt down the cylinders and their pistons. As it is, the exhaust valve works in a red-hot condition all the time.

The difficulties of the engine designer now become apparent. If he could permit the engine to operate at the high temperatures of combustion, the resulting efficiency would be increased many fold because this added heat would contribute more pressure to the gasses which are pushing the piston downward.

It will be remembered that as much as fifty per cent of the heat units contained within the fuel is lost through the cooling system. There is at present, unfortunately, no way of eliminating the need for cooling. No metals are known, nor have any alloys been discovered, that will stand up under the high temperatures of combustion. The metals in use will either melt down or will become so distorted that they do not operate properly and an engine failure results.

**T**HE need for the cooling system not only reduces the engine efficiency, but it reduces the overall plane efficiency. If the engine is air-cooled, the increased size due to the cooling fins will add considerable head resistance to the forward movement of the plane in flight. On the other hand, if the engine is to be cooled by water, there is not only the added head resistance of the radiator, but there is the increased weight due not only to the plumbing but to the weight of the water as well.

The cooling systems on the internal combustion engine, then, becomes a necessary evil that is impossible to eliminate. The best the engineer can hope to do is to reduce the drag imposed on the plane in which the engine is mounted.

Another factor that enters into the cooling problem is frequently overlooked. It is that of the absorption of heat by the lubrication system. This particular heat results from friction, of course, but nevertheless unless the bearings are kept cool they will cause an engine failure quite as quickly as anything else. The heated return oil frequently becomes a considerable problem. If a large tank is provided, in

the normal course of events the oil will not be circulated again until it has cooled off. There are cases, however, in which it becomes necessary to pass the oil through a radiator in order to dissipate the heat into the slipstream.

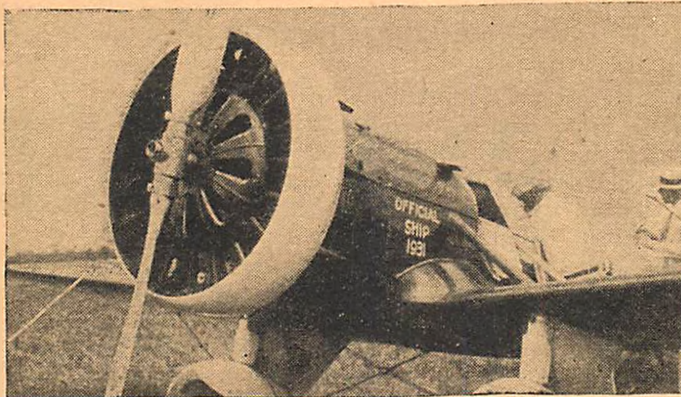
As a matter of fact, the old rotary type of engine was referred to as an oil-cooled engine because of its enormous oil consumption. It was, of course, nominally an air-cooled engine. Moreover, it was rotated around its crankshaft in a further effort to cool it. However, a considerable part of the heat absorption was performed by the oil which worked its way past the piston rings due to the centrifugal force. The vaporization of this oil took a considerable amount of excess heat from the cylinder.

**T**HE first successful internal combustion engine designed especially for an airplane was that of Charles M. Manley, who in 1902 not only designed but actually built it himself. It is interesting to note that this engine took the form of a five-cylinder static radial not in order to cool it by air, but because of the simplicity of design. As a matter of fact, Manley cooled his engine by water! Incidentally, power-weight ratio of this marvelous powerplant was only 2.5! This figure was not approached again for nearly twenty years. Manley was years ahead of his profession.

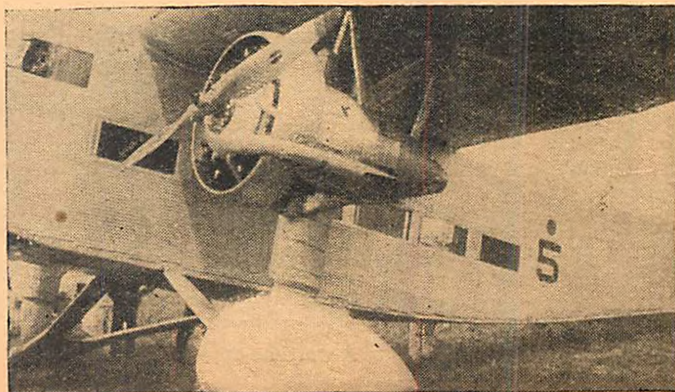
The Wright brothers carried on their early work with the normal in-line water-cooled engine which was not unlike the automobile engine of that era. It is clearly seen how the early development of the internal combustion engine was due to the advent of the automobile. Thus, the aeronautical industry must offer thanks to the engineers in the automotive field. Not only in the United States, but in England and Germany the progress of aviation engines followed along the lines laid out by

the automotive engineers; that is, they began to further develop the water-cooled engine.

It is only in France, under the leadership of Anzani, that progress was made in the development of the air-cooled engine. Later on such engines as the LaRhône, Gnome, and the Clerget were produced. The rotary engine was the result of efforts made to secure better cooling. This form of powerplant was constructed through the first half of the World War. At that time the demand for increased performance of fighting planes brought about a need for higher powered engines. The rotary type had

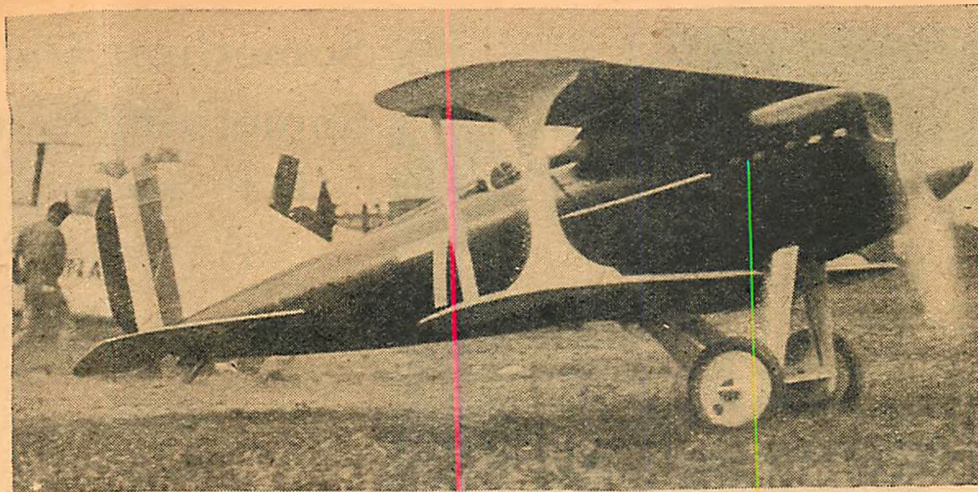


The Anti-drag Ring



The Anti-drag Ring on a Ford





Showing the streamlining of a racing plane (1923)

already been developed up to 130 horsepower at 1,250 revolutions per minute. Greater power could be obtained by greater speeds of rotation but this resulted in greater heat within the engine.

Several reasons prevented the further development of engines along this line. First, the gyroscopic effect of such a tremendous rotating mass in the nose of the plane very definitely limited its maneuverability. It is not unlike hanging a bicycle from a rope and turning the rear wheel until it is revolving at a high rate of speed. As we know, one's efforts to move the bicycle around freely would be considerably limited.

Secondly, the cooling fins on the cylinders were made of steel and failed to dissipate sufficient heat to the atmosphere to permit operation of the engine at the increased speed. In addition, the energy required to rotate the mass frequently absorbed as high as ten per cent of the total power.

Thirdly, the centrifugal effect on the engine was too much for the strength of the individual parts and they failed repeatedly at the higher speeds. The result of these efforts were to force France to the water-cooled engine. This led to the adoption of the Hispano-Suiza and the charms of this powerplant are still sung by former wartime flyers.

**T**HUS, the war ended with all nations concentrating on the further development of the water-cooled powerplant. At this time the United States Navy was building the airplane carrier, *U. S. S. Langley*. In order to land a plane aboard the flat deck of this vessel it was essential

that it have a slow landing speed. This meant a plane with a small wing loading, that is, small weight for the lifting surface. In 1916 Chas. M. Lawrence had designed and built a three-cylinder radial engine for use in the tiny "Sperry Messenger." This engine was so successful that the Army and Navy commissioned him to build a nine-cylinder engine along a similar design.

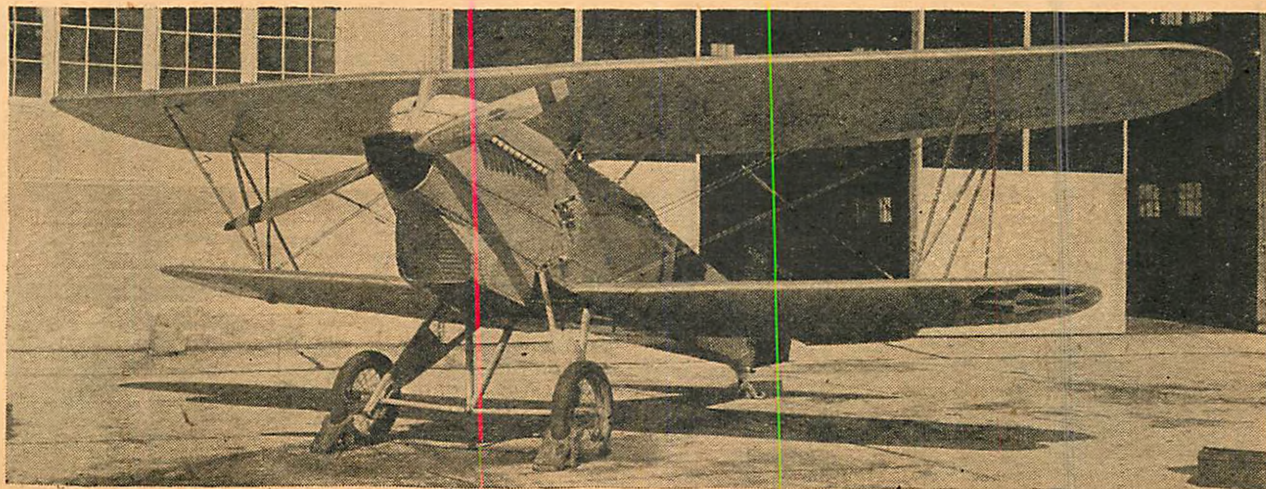
**T**HE result of these efforts was the predecessor of the now famous J-5 engine, the J-1. Continued operations in the fleet brought out defects for which remedies were

found. Fortunately, the Navy persisted in the use of the radial engine during that period in spite of its many failures. Its faith has been well justified, however, as the present reliability of this type of engine will plainly indicate.

Records kept by the Army Air Corps over a number of years indicated that approximately fifty per cent of all their forced landings were caused directly or indirectly because of failure of the cooling system. Perhaps vibration caused the radiator to leak, the water pump may have failed, the water jackets may have come unwelded, or a multiplicity of other faults may have caused a loss of water. This, in turn, caused the engine to heat up, resulting in a forced landing due to a burned out bearing or a frozen piston.

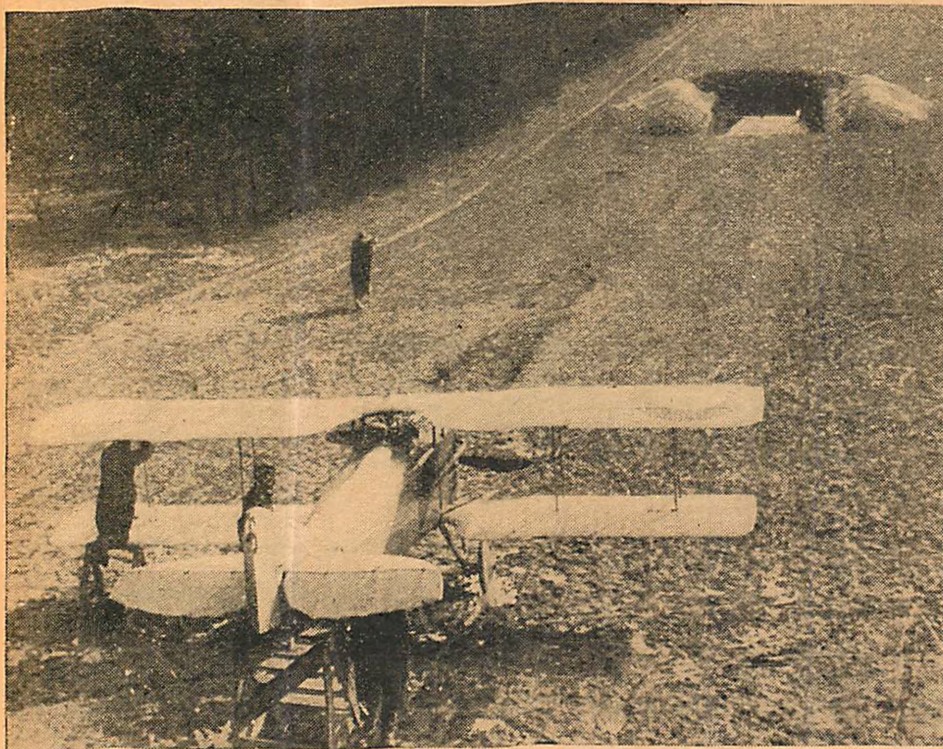
Even if the plumbing system operates properly the plane is forced to carry around an excessive amount of weight. Besides the radiator, there is the piping, the water jackets, the pump, and the weight of the water. These will add a total weight of from 100 to 150 pounds to the installation. Naturally, this increased weight will reduce the climbing and maneuvering qualities of the plane which must carry the load. In addition, it will materially decrease the ceiling of the aircraft—an important consideration in military planes or in transport planes which operate over mountainous country.

Thus, the elimination of the plumbing system of the water-cooled engine has increased the reliability of aircraft powerplants many times. However, there are other advantages. Having only a single (Continued on page 44)



Streamlining of a water-cooled fighter—note the drag presented by radiator





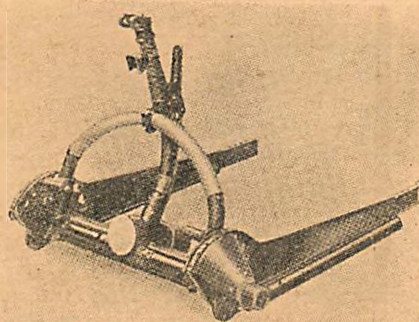
## Something Old, Something New in the Line of Aerial Armament



An actual war photograph (left) showing the pilot of a French Spad lining up his guns with the line of flight of the plane. Photograph was taken at La Noblette, Marne. The gun sights are trained into the butt, seen at the top right hand corner of the photo  
—Acme



Firing aft and under the tail



### The Fairey Gun Mounting

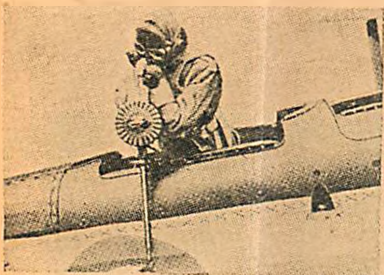
**T**HE Fairey gun mounting has been designed to fulfil the latest operational requirements of military and naval aircraft and to overcome the extreme difficulties experienced with the ring type mounting when used at maximum speeds on high-performance aircraft.

A greater firing area than has hitherto been obtained is covered by the new gun mounting, now making it possible to fire directly astern and also vertically upwards and downwards, as well as over the usual areas, including that forward and above the main planes. And, having few moving parts and being definitely locked in position, the new gun mounting enables a much steadier aim to be taken.

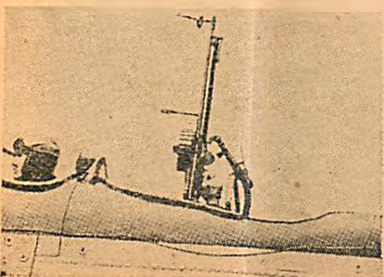
The modern Fairey gun mounting allows a saving of approximately fifteen pounds in weight, and being more compact, the space in the gunner's cockpit is not restricted as previously.

This saving is additionally increased, for, when not in use, the gun and mounting are locked in a concealed position within the top fuselage fairing astern of the gunner's cockpit, which is thus left entirely clear of obstruction by these fittings.

Much is gained in the way of overcoming parasite air-resistance by the more symmetrical shape and design of the Fairey gun mounting, the concealment of the gun and the neatness with which it can be installed in any fuselage contributing largely to this desirable feature.



Firing downwards, fully vertical



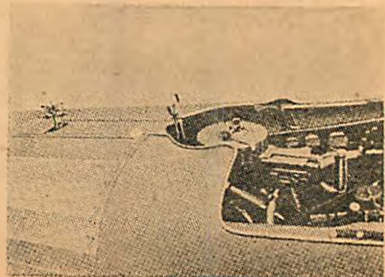
Firing upwards, fully vertical



Firing directly astern



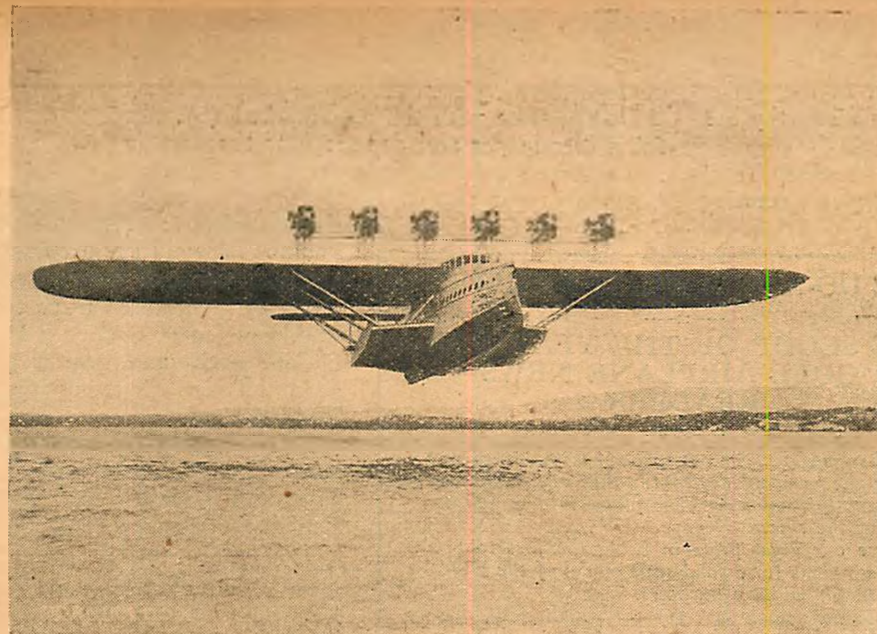
Forward and over the main wings



The gun stowed in the fuselage



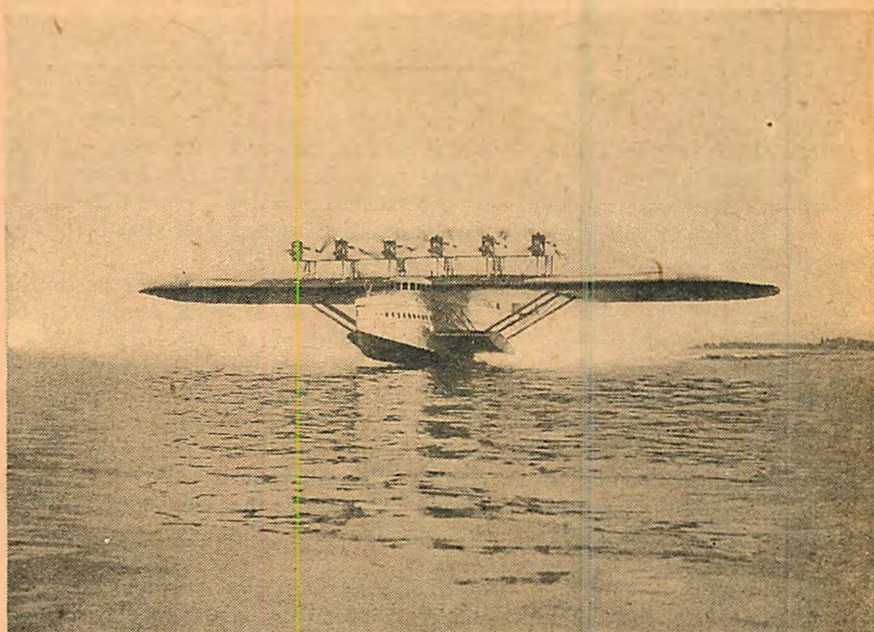
# How to Build the Giant Dornier Do-X As a Battle Plane!



**Fifteen Machine-Guns,  
2 One-Pounders,  
Torpedoes and Bombs  
Fitted to Scale Model  
of Monster German  
Craft**



**By  
Gus Anderson**



**S**CALE models are always a pleasure to construct. Not only do they prove the workmanship and skill of the builder, but also give him, or her, a general knowledge of the design and construction of real planes, for the scale model is constructed similarly to the large ones but proportionately smaller. Then also they make fine ornaments and if correctly constructed they will often sell for fancy prices. I might mention here that I refused \$500.00 for a model of a Curtiss Hawk and \$1000.00 for a Savoig-Marchetti S-55. But these were accurately made models, and were scaled to within 1-1000 inch. Wind tunnel models sell for as high as \$3000.00 and it often takes months to build one. Before we proceed with the instructions, on how to build this wonderful air liner you, no doubt, would like to know something about the Do-X.

Claude Dornier (the designer) was originally a partner of Count Graf von Zeppelin. In 1914 Count Zeppelin founded the Dornier firm. He placed at the head of it his collaborator and associate, Claude Dornier. Having been put on a broad financial basis, the new firm allowed Dornier to experiment with metal, with a view to constructing planes of that material.

The Do-X is constructed of steel and duralumin, and powered by 12 water-cooled Curtiss *Conqueror* engines, developing 600 horsepower each, or a total of 7,200 h. p. They are arranged in tandem, one tractor and one pusher.

**T**HERE are three decks inside the hull. The upper deck contains the navigating room, engine control room, a radio operator's room and the pilot's control cabin, located conveniently forward of the leading edge of the wing. The middle deck runs almost the full length of the hull and is given over almost entirely to passenger space. Just behind the collision bulkhead is a smoking room, a large lounge and a number of small cabins, also additional cabins, sleeping rooms, an electric kitchen and laboratories, and, still further back, quarters for some of the crew.

In the fuel deck, which is the bottom or lowest deck, are four tanks holding 790 gallons of gasoline each. Two tanks holding 450 gallons each and, in the wing, two tanks holding 80 gallons each, making a total of 4,220 gallons. For the trans-Atlantic flight she carried 6,170 gallons, provision having been made for that much gasoline. Provision also was made to carry 463 gallons of oil.



Every safety precaution has been taken in the design and equipment of the Do-X. It is not only airworthy but seaworthy.

The Do-X has a wing span of 157 feet, 6 inches. Total length is 131 feet, 4 inches. Total height, with running propeller, is 31 feet, 6 inches. Total wing area is 5,520 square feet. Maximum width of hull without lateral fins is 15.8 ft. Width of hull with lateral fins is 32.8 ft. Weight, empty, is 62,000 pounds. Weight, equipped, is 66,000 pounds. Gross weight, normal, 101,500 pounds. Maximum gross weight, 114,600 pounds. Maximum speed is 130 to 143 miles per hour. Cruising speed is 106 to 112 miles per hour. Normal fuel tanks for 12 hours cruising.

### How to Build the Model

Don't be hasty and before you cut anything be sure you are right by checking against the drawing and comparing it with the photographs. I cannot dwell too long on that point. It is essential to good work: Be sure that you have the proper tools—and that your knife is sharp. The model being constructed of balsa wood a sharp blade will cut clean and not leave ragged edges. Procure the best balsa wood obtainable, clear, light and straight grained. The material and sizes are given at the end of this article.

You will need some good quality aluminum paint, about 300 ribbon pins, about  $\frac{3}{8}$ " long, and about 300 regular sized pins. Get a spool of white thread (linen) for bracing wires, and a  $\frac{1}{2}$ " camel's hair brush. A dozen sheets of mixed sandpaper, rough, medium and fine, and last but not least, a two-ounce can of cement. In place of celluloid for the windows and portholes, black paint serves the purpose admirably. Also get  $\frac{1}{2}$  pint of clear dope and 5 cents worth of plaster of paris.

Follow each step carefully. We shall start with the fuselage (a). Take the block  $1\frac{3}{4} \times 2 \times 15\frac{3}{4}$ " and trace the shape of the fuselage on it with a soft pencil. Get your jack-knife and shape it out roughly. Before shaping to the line hold it on a level with the eye to see if it is fairly smooth and even. Carefully cut to within  $\frac{1}{64}$ " of the line. The balance of the shaping is done with sandpaper. First roughly, then medium, and finally with the fine paper. When the fuselage is correctly shaped give it four coats

of dope allowing each coat to dry separately.

Do the same with the roof marked (b). Shape it carefully. Sandpaper and dope it four times.

The next step is the main wing (d). Shape it carefully. Get the proper camber on the wing by checking against the drawing, and gradually smooth it down, then give that also four coats of dope. The object of giving each piece of wood four coats of dope is to fill all cracks and give it a good surface to apply the aluminum paint.

The fin and rudder are next. Shape them exactly as illustrated in (h). This piece is made from balsa  $\frac{3}{16} \times 1\frac{3}{4} \times 1\frac{7}{8}$ ". Now mark out the shape of the upper stabilizer (j) from the piece that is  $\frac{1}{8} \times 1\frac{3}{8} \times 6$ ". Make a good job of it and dope it well. The lower stabilizer is smaller than the upper, being only  $\frac{1}{8} \times 1\frac{1}{4} \times 1\frac{3}{4}$ ". So mark that out and sand it smooth. Give that also

four coats of dope. This piece is marked (k). Look on drawing for (o), that is the markings on the lateral fins or small wings under the large one. These are made from the piece that is  $\frac{1}{2} \times 1\frac{3}{8} \times 3\frac{5}{8}$ ". Shape it carefully and proceed as before on the others. Smooth, finish and dope.

**L**ET us do the engines now. There are 12 engines, but you will make the twelve from six blocks of wood  $7/16 \times 9/16 \times 1\frac{1}{2}$ ". Check your drawing for the shape and carve out carefully. After you have finished all of them draw in the radiator with black paint or ink. This gives it a smart appearance. Do all of this, of course, after you have doped them.

With the motors, naturally, go propellers, and there are a lot of them. These are all four-bladed. So get together twenty-four pieces of balsa  $3/32 \times \frac{1}{8} \times 1\frac{3}{8}$ ". Shape them out and when they are all completed put a slot in the center of one on top and a slot in the center of the bottom of the other. Stick a little cement on and press both together so you have a four-bladed propeller. Do this to all of them but give them only one coat of dope as you might warp them if you give them four coats. (For the benefit of you expert builders who wish to make a real nice model I might mention here that the Do-X props are laminated with mahogany and ash.)

As our various pieces are (Continued on page 14)

### THE DO-X AS A BATTLE PLANE!

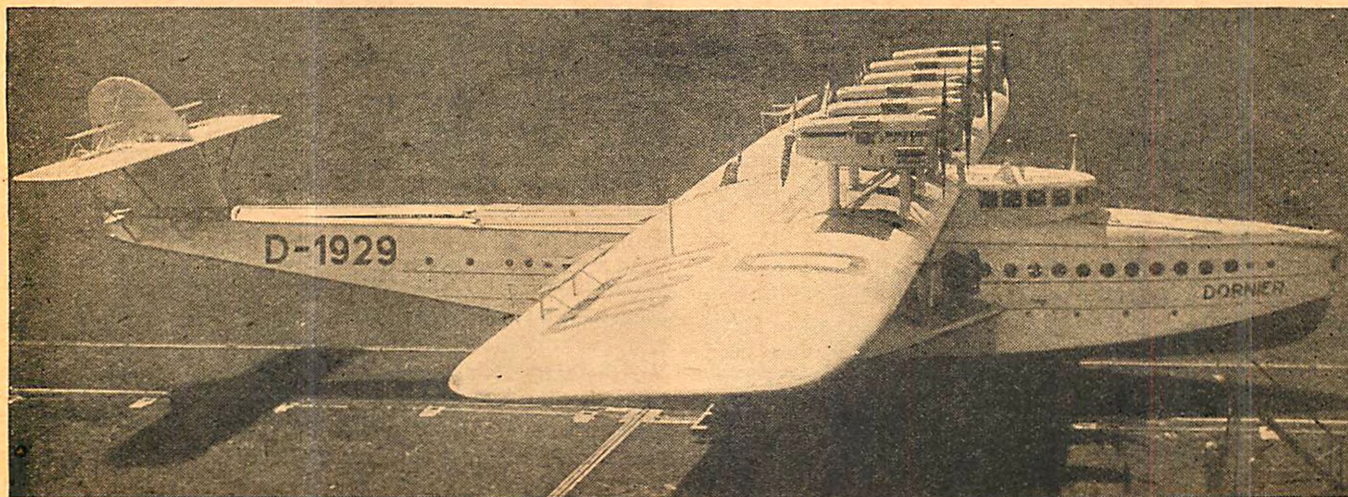
### THE SCOOP OF THE YEAR FOR MODEL AIRPLANE NEWS READERS

*No other magazine or newspaper has published one hint of the amazing equipment that over-night can transform this monster civil plane into a fighting terror of the skies.*

*Hence our great pride in being the first to present these plans for a solid scale model of the DO-X equipped for military purposes.*

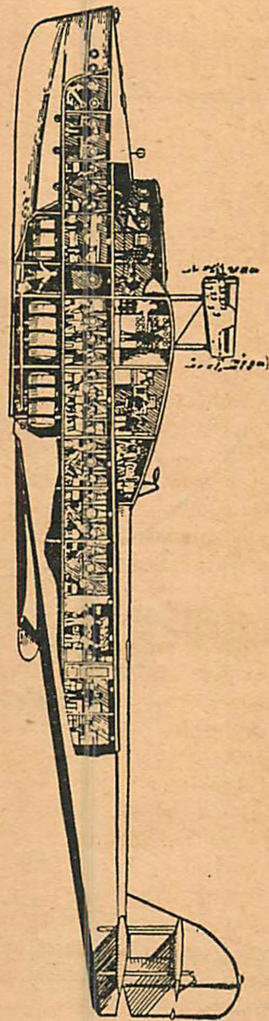
*While no actual data for the building of these guns, torpedoes and bombs is given in the text, the drawings show their scale size and positions. Simply follow the plans and make them all from balsa wood.*

THE EDITOR.

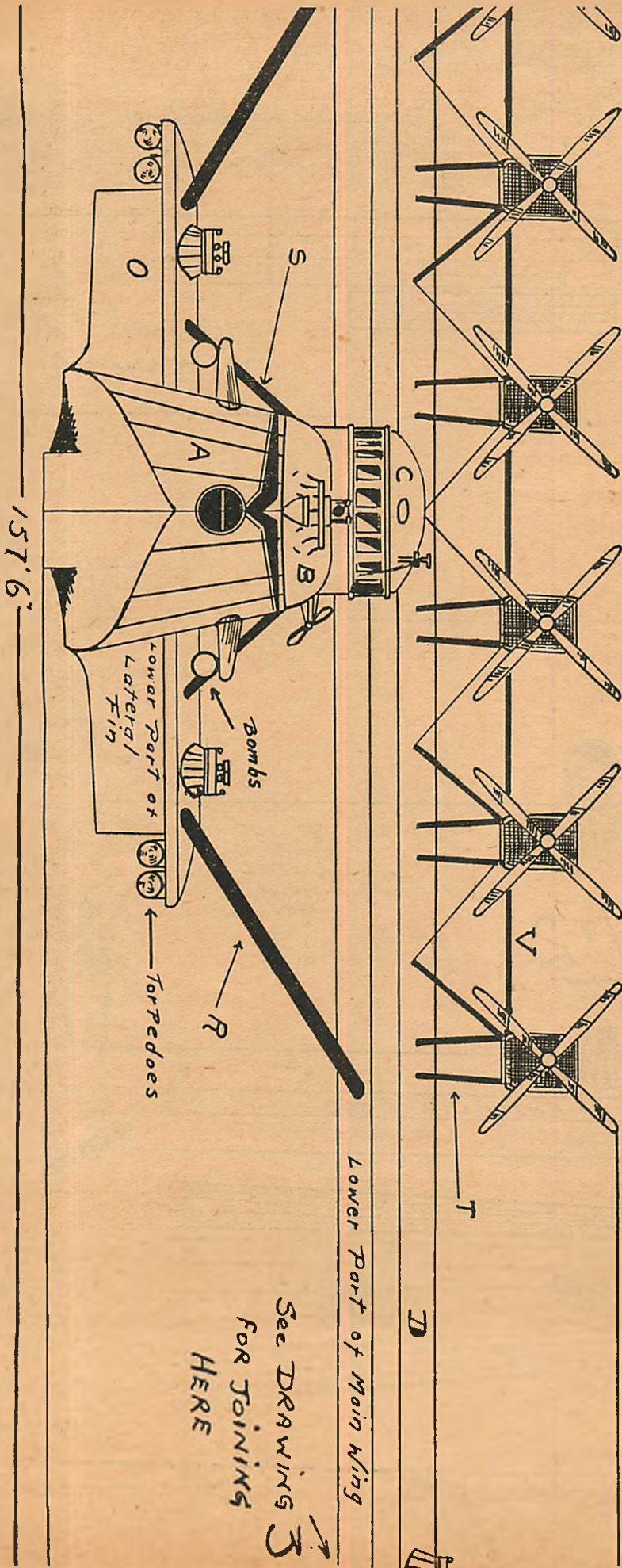




See DRAWING 2  
FOR JOINING  
HERE



No 1



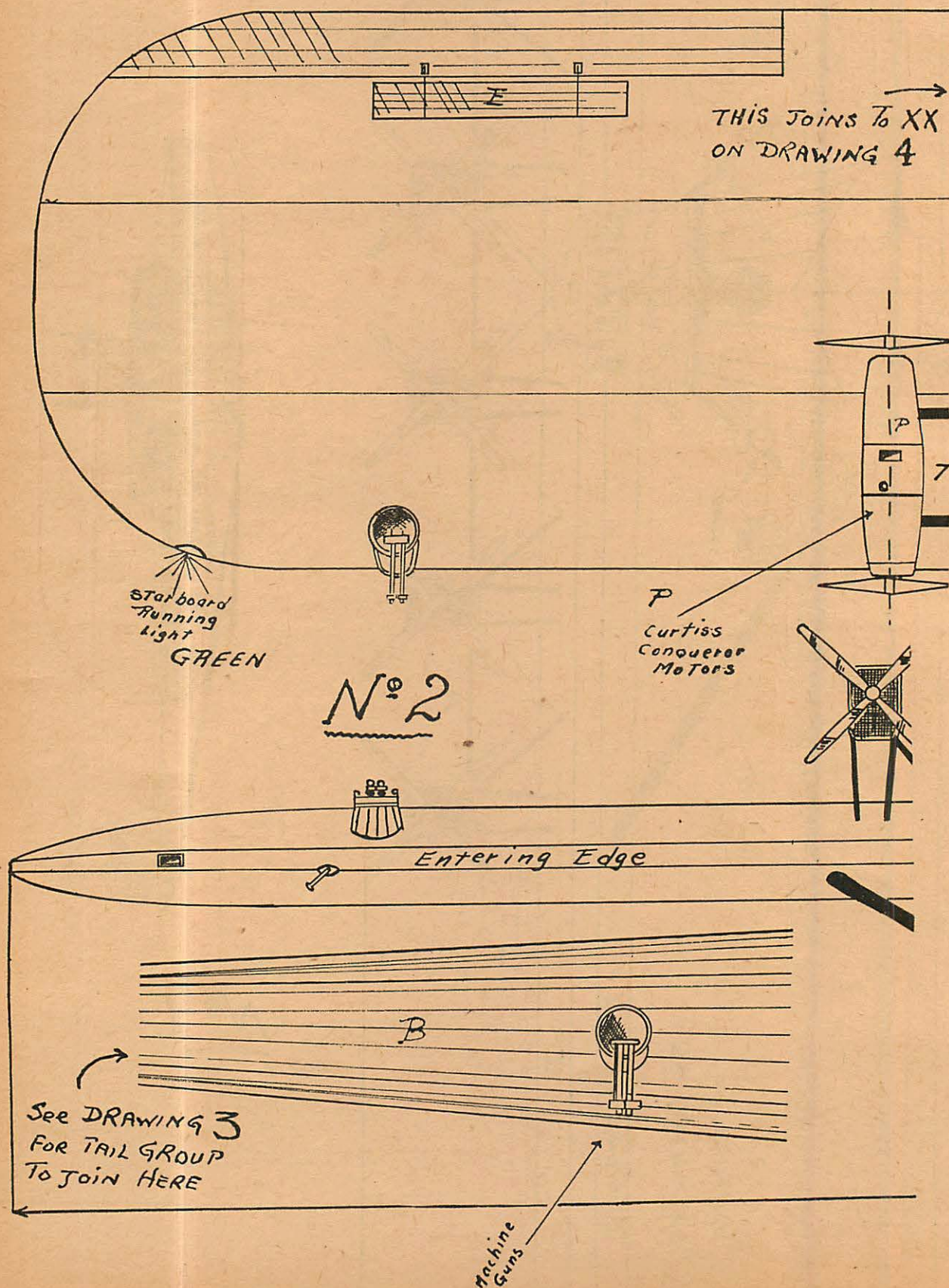
See DRAWING 3  
FOR JOINING  
HERE



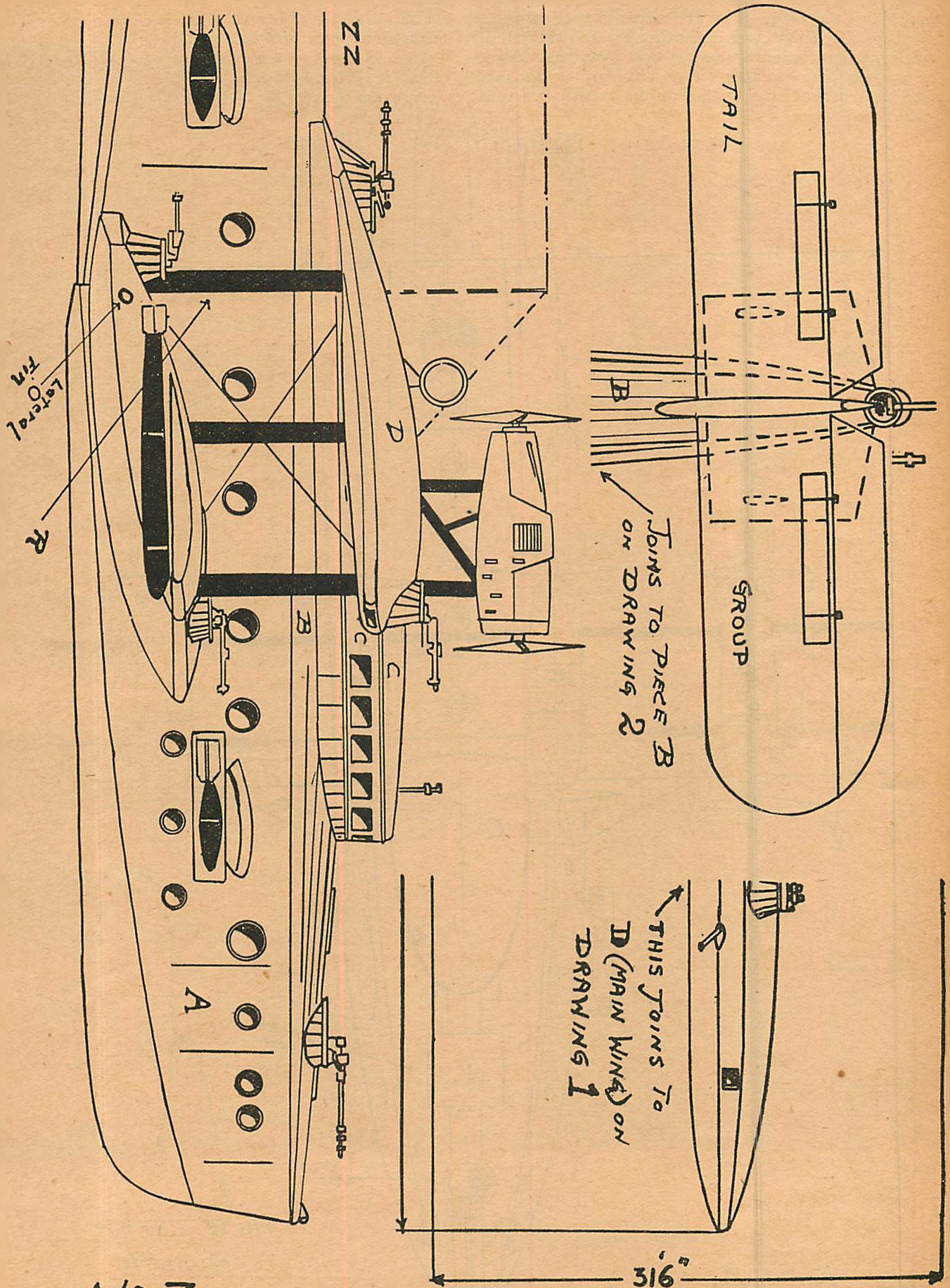
accumulating and taking shape let us take a look at some of the photographs. See how the cabin is fitted into the wing? Well, get the piece for the cabin,  $\frac{3}{4} \times 1\frac{1}{8} \times 1\frac{3}{4}$ ", and shape that out. Dope it and put to one side. Now, here is a point you must notice well. Above the ailerons you will see what appears to be an additional wing. That is an auxiliary aileron designed so that it is easier to operate the main ailerons of the wing. So now construct

a pair of these auxiliary ailerons. Get the two pieces of balsa wood,  $\frac{3}{32} \times \frac{1}{4} \times 1\frac{3}{4}$ ". Cut it and shape it—same as a wing. Lay them to one side after doping twice. Get four pieces,  $\frac{1}{16} \times \frac{1}{8} \times \frac{3}{8}$ ", for the horns (f). Shape them out and do the same with the four pieces,  $\frac{1}{16} \times \frac{1}{16} \times \frac{1}{2}$ ". These are the rods marked (g) and fit into the main aileron.

There are two auxiliary (Continued on page 16)







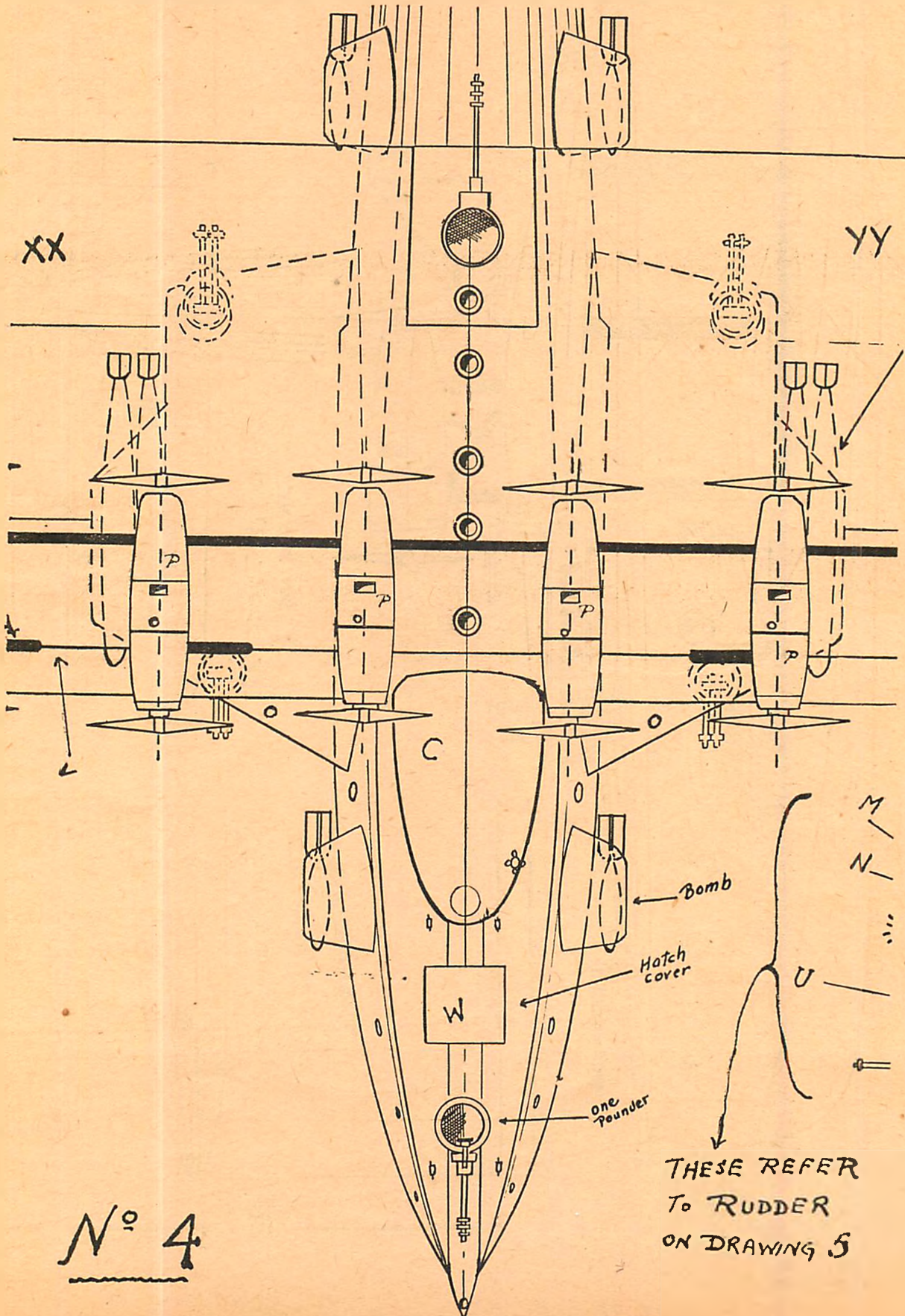
Nº 3



rudders between the upper and lower stabilizer. These are marked by the letter (i). The size for your model is  $\frac{1}{8} \times \frac{3}{8} \times \frac{3}{4}$ ". So get two pieces that size and shape them out. Sand them well and smooth—and dope them. Above the stabilizers are another set of auxiliary or balanced stabilizers similar in construction to the auxiliary ailerons.

The size is different but you make them the same as the others. The dimensions are  $\frac{1}{16} \times \frac{3}{16} \times \frac{3}{4}$ " and are marked on your drawing by (l). The horns (m) are  $\frac{1}{16} \times \frac{1}{8} \times \frac{3}{8}$ " and the rods are marked (n). The size of (n) is  $\frac{1}{16} \times \frac{1}{16} \times \frac{1}{2}$ ".

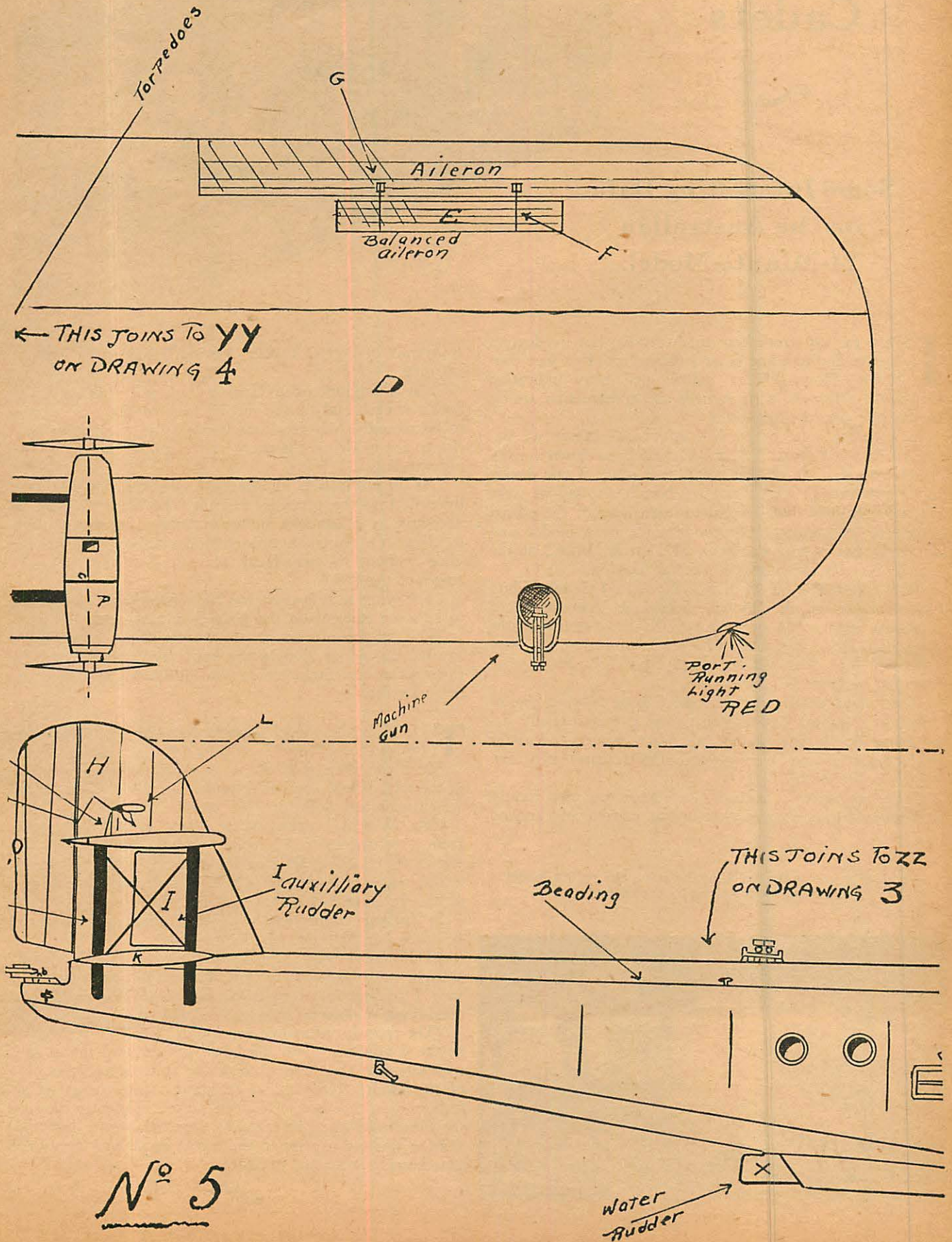
Now we come to the struts. (Continued on page 17)





Most of the larger parts have been made so we shall start with the inter-plane struts marked (r). These are attached from the lateral fins (o) to the under part of the main wing (d) and there are six pieces  $\frac{1}{8} \times \frac{3}{16} \times 2\frac{3}{4}$ ". Stream

line these pieces carefully. Sand paper them smooth and dope them twice. Six more struts marked (s) are from the lateral fin (o) to fuselage (a) and are  $\frac{1}{16} \times \frac{1}{8} \times 2$ " in size. Do the same with these (Continued on page 40)





# The American Sky Cadets



## Some Interesting Data on the Australian 24-Minute Model

**I**T'S a far cry from here to Australia, but by degrees we are finding some news jottings from that vast continent "Down Under" which give every indication that model airplanes, their records and construction are by no means confined to America.

In a recent issue of *MODEL AIRPLANE NEWS* we described how an Australian model had been flown for 24 minutes 30 seconds, and suggested that some of our American enthusiasts go after that time. Needless to say we were not only gratified, but amazed to learn later of the official record of 29 minutes 30 seconds made by a model constructed by Emanuel Feinberg, of Detroit, Mich., at the United States Championship meet at Dayton.

Now comes a letter from Mr. Norman J. Lyons, Chief Commissioner of the Model Aeroplane Association of Australia, giving us quite some details concerning the Australian model which flew for approximately 24½ minutes, and for which we are deeply grateful. Mr. Lyon's letter, in part, reads:

"The model described in the April issue (*Flying*, one of Australia's leading aviation magazines) was specially designed to attack the existing Australian record, and as far as Australia is concerned several new features were embodied in the model:

"The two piece 'T' section motor-stick was used for the first time as tests showed that it was capable of carrying

6 strands of 1/16" rubber, storing 1,200 turns without warping.

"Flat aluminum open Cans were used, with small 'S' hooks at each end of the motor, thus enabling the motor to be wound away from the model, and eliminating any risk to the model in the event of the rubber breaking during winding.

"As we enthusiasts in Australia alter the line of thrust by deflecting the propeller bearing, the front 'S' hook is necessary as it acts as a universal joint. It is my pleasure to claim for Australia this method obtaining the perfect glide without the possibility of a stall during the early stages of the flight.

"The wing section used has been found in this country to be more efficient on the glide than the Clark Y.

"The tail-group is set out on a boom at a negative angle as used on indoor models, the boom also allowing the fin to be set at any angle, either with or against the torque of the propeller."

**T**HAT is the model described in the April issue of *Flying*.

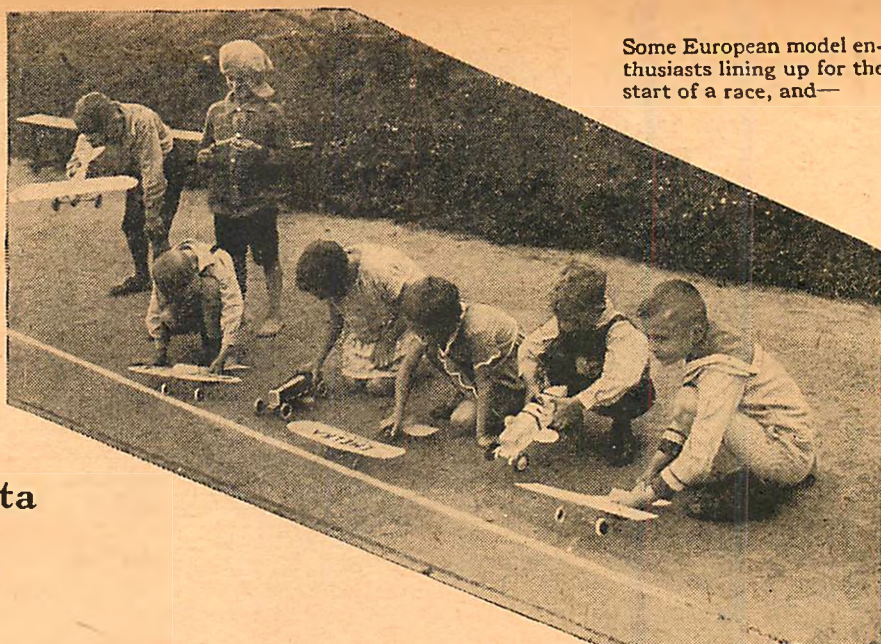
Mr. Lyon then goes on to describe the changes made in the model flown by Mr. Norman H. Wright, the model which remained aloft for 24½ minutes.

"Mr. Wright," writes Mr. Lyons, "increased the span from 41½ inches to 42 inches, and the chord from 4½ inches to 5 inches. The only alteration in the tail group is the shape of each unit—Wright increasing the height of the fin from 3¾ inches to 4 inches."

In further connection with the "Firefly," the model flown by Mr. Wright, Mr. Lyons adds:

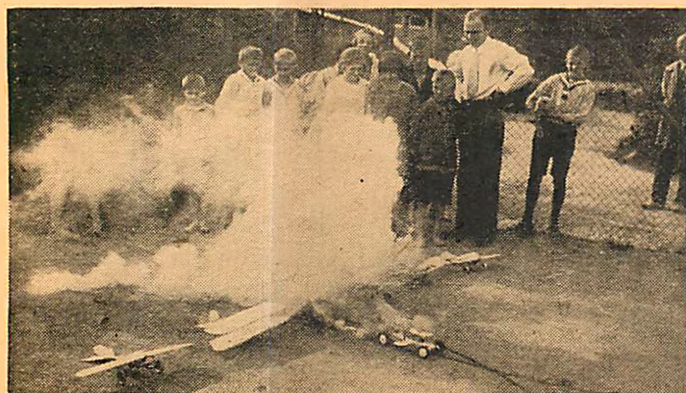
"This model was originally designed and built by Mr. Wright using my wing-section. He brought the original to me. I re-designed it to conform to the Wakefield Cup conditions, and from my plans he built the model. . . .

"The record, unfortunately, was not officially recognized as the conditions of all official flights demand that a representative of the Aero Club of the State, a representative of the Model Aeroplane Association of Australia and an independent time-keeper shall be present; the mean-time of the three watches to be taken as the official time. No notification was given prior to the flight, and consequently the time-keepers were not present."



Some European model enthusiasts lining up for the start of a race, and—

—here they are at the finish of the start, the rocket model having ended things by exploding





**P**ROFESSOR T. N. DE BOBROVSKY, head of the Aeronautical Research Laboratory, Secaucus, N. J., writes in to say that the winner of his "Flying Crate" test reports is Lawrence Skelding, 1327 Nairn Ave., Toronto, Ont., Canada. Skelding was awarded a compressed air motor.

"Skelding's report," writes the professor, "was the best. His model flew for 64  $\frac{3}{5}$  seconds. Paul Zavosky, Jr., of Payne, Ohio, reported a duration flight of 2 minutes, but his report was not clear."

The following is Skelding's own report to Professor de Bobrovsky.

"I completed my model in three weeks and the day of my series of test flights was a trifle cool with very little wind. I held my model about five feet from the ground and it glided downward slowly veering slightly to the right, and it made a stall or pancake landing so I moved the motor stick forward a little.

"It had a gliding angle of about five to twelve feet when properly adjusted. I wound up the motor about one hundred and fifty turns and hand-launched it, after experimenting with and flying smaller craft. The first thing I noticed was the tendency to yaw and slip while flying. I came to the conclusion that this was due to its being rudderless.

"It flew rather unsteadily for about fifty feet. It is not really necessary to move the motor stick to obtain good balance but this is the easiest way.

"I gave the motor 350 turns and launched the model. It still turned and yawed. The lateral stability was poor, the longitudinal stability good. The model climbed pretty high but I could not get rid of this zig-zag motion. When most other models with rudders and a dihedral angle are launched into a side wind, they are either swept along with the current or turned around sharply, resulting in a slip or a spin. However, with this tractor the slight breeze made little difference as there were no vertical surfaces for the wind to push against.

"I placed a small wedge of wood at the back of the motor stick. The first thing I noticed was how quickly the model climbed. I also suspended the motor stick higher up than it said in the plans. The only difference was that it responded more readily to the up or downward movement of the horizontal stabilizer.

"My model would not make a three-point landing and nothing I could do would induce it to make one. The

nearest I could get was a pancake landing.

"After I had conducted all these experiments I very carefully covered in the sides of the wings with silk tissue and tried them all over again. I held the model the same distance from the ground and released it. It glided straight down very slowly and made a perfect landing but not quite so far as before—about ten feet this time.

"I got the motor turning over at 100 r.p.m. and hand-launched it. It went straight and true directly across the roadway and landed on a lawn—no zig-zag now. I could still control my model to a certain extent with the stabilizer but it is much more effective to move the motor stick, too.

"I wound up the motor the same 350 turns and much to my astonishment the model showed very good lateral and longitudinal stability. It had a duration of exactly 64  $\frac{3}{5}$  seconds. When I put the block of wood under the wings this time the model climbed much quicker, and higher, because now it had ceased to turn and bank. The drag was missing.

"When I launched the model into a side wind the result was amazing. The model was whipped over on its back, buckling the top wing struts. This was because there was so much surface for the wind to push against. The model just about made a three-point landing after one flight but it wasn't a very good one.

"In my two years of model experience I find this one of the best and most instructive models I ever built, and I am anxious to know how other fellows went on with their 'crates.'"



**A** MODEL - MAKING enthusiast of Toronto, Canada, recently built an eight-foot reproduction of the *Graf Zeppelin*, filled it with gas, put a note in it asking the finder to communicate with him, and launched it. Watching it disappear over the trees, his friends told him he would never hear of it again, that he would have nothing to show for his pains. Many days later a note came from a trapper, camped near Fernie, British Columbia. He had picked up the model dirigible after it had traveled approximately 1,800 miles.

MODEL AIRPLANE NEWS would be glad to receive for publication a photograph of the builder of this model.



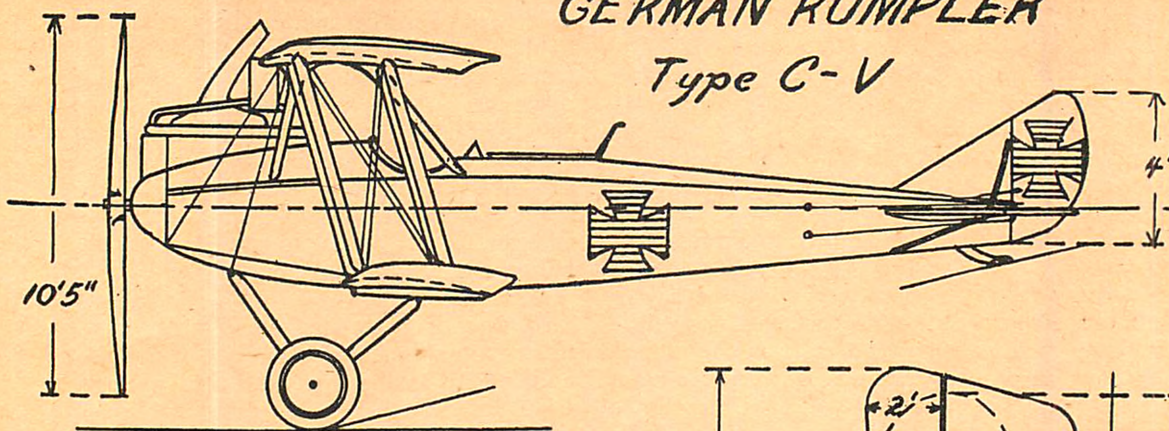
At the top of this group is Alfred Corfield, Edgewater, N. J., who has a fine collection of eleven models of his own making. He is exhibiting four of them in the photograph and no doubt has more by now

At left are two entries in the Atlantic City meet. The one further left is a compressed - air pusher model entered from Providence, R. I., while the other flew 5 min., 25-2.5 sec., only to be counted unofficial



## GERMAN RUMPLER

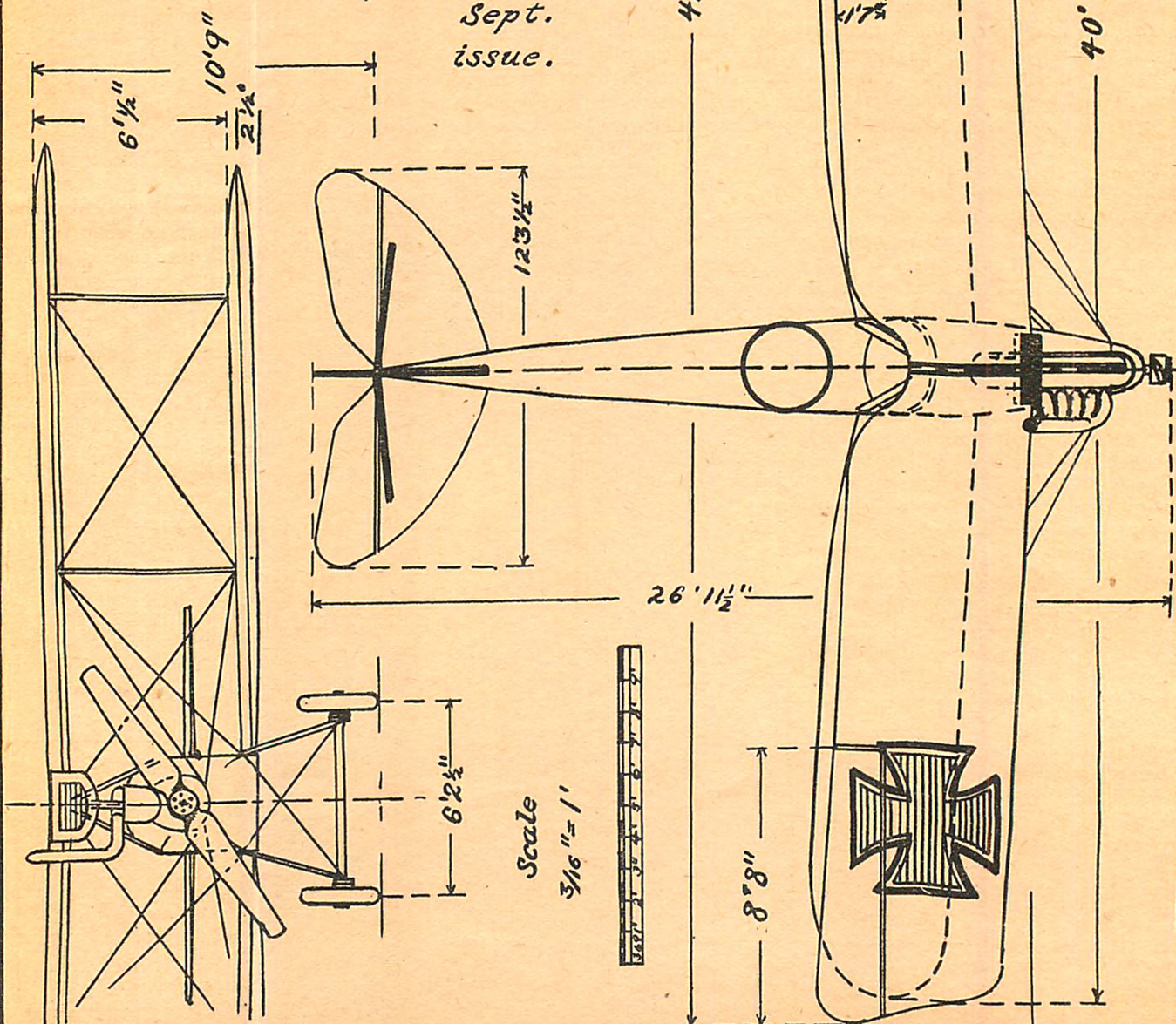
Type C-V



260 H.P. Mercedes Engine  
High Speed at 10,000 ft.-100 MPH.

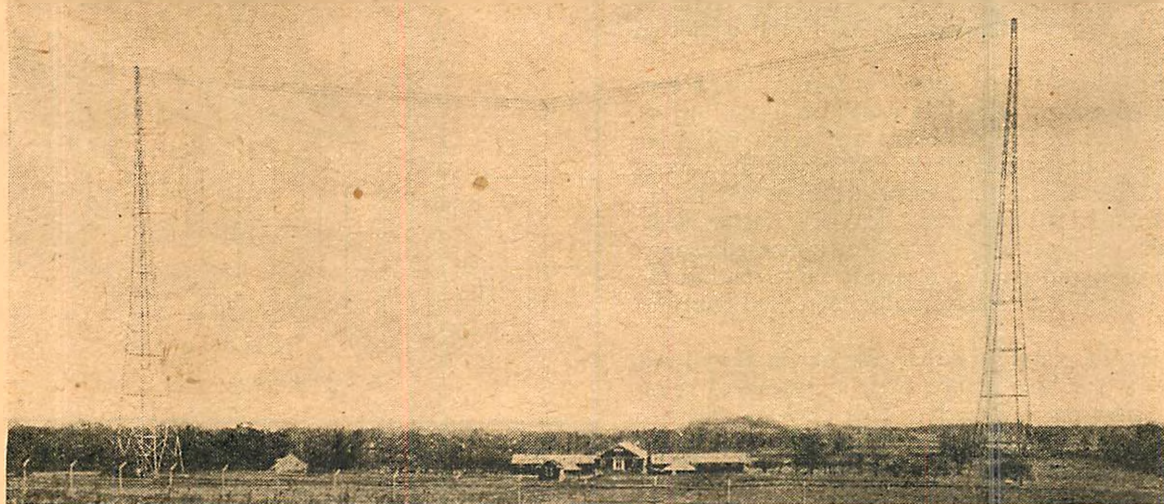
Color Scheme

German Camouflage as in  
Sept.  
issue.





# Special Course in Aerial Radio



The experimental ground station at Whippany, N. J.

Bell Telephone Laboratories

## Wave Length

**E**VERY radio operator is required to transmit within his allotted frequency, and to do this he must be able to check up on the frequency of the waves he is transmitting, and where necessary, adjust for any divergencies. Some of the factors bearing on wave frequency have already been explained in earlier articles, and these will not be dealt with again.

## Monitor

To know the exact frequency at which you are transmitting you will need some sort of a frequency meter. The instrument generally used is known as a Monitor. This is an instrument with which all operators who are considering radio seriously should get acquainted. A knowledge of the Monitor is often required in government examinations. If you have a government or commercial laboratory in your neighborhood, a friendly word with the supervisor will generally be sufficient to gain you an opportunity of studying one.

Obviously, before a Monitor can be of any practical use it must be accurately calibrated, and to ensure this I would advise the radio amateur to have it calibrated at a commercial station. Government requirements regarding the maintenance of an allotted frequency are strict, and any operator who neglects his duties in this respect is apt to lay in a store of trouble for himself.

With the Monitor correctly calibrated, the condenser dial setting for a particular fre-

quency will be known. To check your set you adjust the Monitor to the appropriate frequency, plug a pair of headphones into the filament jack, and start the set in operation. Assuming that it is somewhere near the proper frequency you will hear a heterodyne note in the telephones.

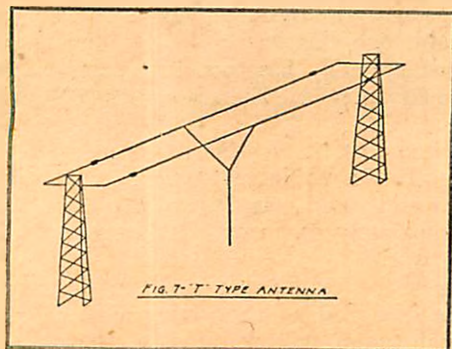
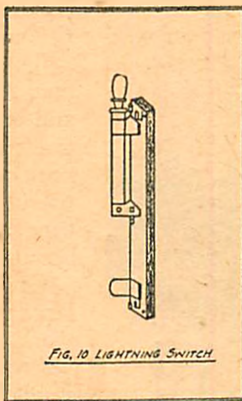
The heterodyne note has not been explained yet, as it is being dealt with in a later article, but if you can understand a super-imposed note that tends to blur the clearness of the signals being received, you will understand roughly what a heterodyne note is. More of this later.

You must then adjust your transmitter set until this extra overlapping note disappears, and you will then be operating on the frequency for which you have been testing. Don't forget to note the exact setting of your set.

## Quartz Crystal

During recent years a new element for controlling frequency has sprung into prominence. It is a substance found in the earth known as quartz crystal. The peculiar properties of a piece of quartz crystal lie in the fact that if it is mechanically vibrated, it will produce an alternating voltage of its own and will also vibrate if subjected to an alternating electric influence. Further, when compressed it becomes electrically charged and changes its shape slightly.

Its important feature, however, is that it creates its own vibrations when subjected to an alternating current, and the frequency of

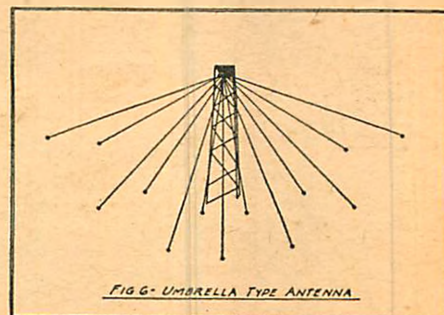


## Different Types of Antennae

(CHAPTER 6)



By Capt. L. S. Potter





these vibrations is quite independent of the inductance and capacity of oscillating circuits mentioned last month. In other words, the quartz crystal is a master oscillator and entirely controls the oscillations of the circuit in which it is placed.

So here we have a very important factor. Use a suitable piece of quartz crystal in a tube transmitting set and the individual oscillations of the tubes will have little bearing on the frequency. They will, of course, amplify the power but their own vibrations will be entirely controlled by the crystal. The only factor likely to affect the oscillations of a crystal is a marked change in temperature, and for this reason in large stations the crystal is kept in a thermostatically controlled temperature.

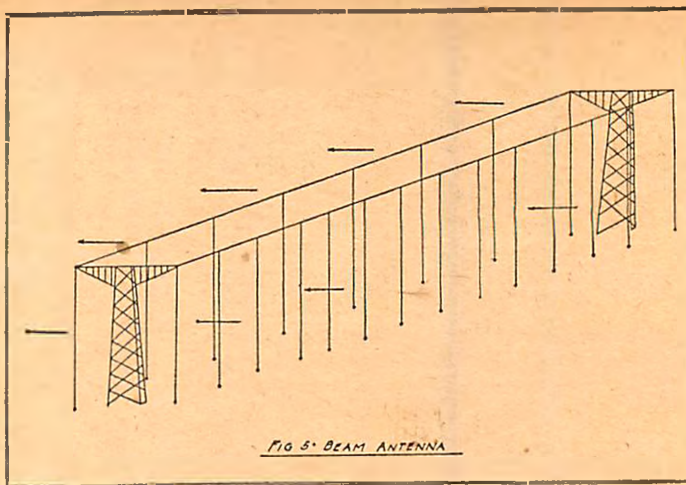
Sometimes the plates on either side of the crystal are kept a hair's breadth distance from it instead of being allowed to rest on it directly. This obviates any risk of the crystal breaking under compression, and prevents the plates from becoming oxydized and causing sparking which otherwise sometimes happens.

### Antennae

The type of transmitting antenna and its method of construction will have important bearings on the efficiency of the signals transmitted. So far nothing has been said in these articles of the antenna, or aerial, as it is sometimes called. This has been purposely omitted until we reached the present stage.

The types used will be governed by a variety of circumstances, but among the many kinds at present in operation, we have three reasons which directly govern the design of an antenna installation. Is it to be used for directional, transmitting or receiving purposes?

A transmitting station will need a higher and larger an-



tenna. The antenna used for reception need not be as large, in fact, there are definite reasons against it. The larger the antenna, the more outside interference it will pick up. Of course, the more it is reduced the smaller will be the intensity of current induced into it, but this can be amplified at another stage in the set.

Figure 1 shows a structure of unusual interest in the history of American radio. The little wooden shack on the right of the picture is the first commercial station built in the United States by Marconi. It was erected at Babylon, Long Island, about the end of 1900, and communications were established with ships at sea to a distance of sometimes sixty miles. The rate of transmission was about ten words a minute.

The site of such humble but momentous beginnings in radio now rests beside the Rocky Point Radio Station of the Radio Corporation of America, from whence messages are sent to all parts of the world at 150 words a minute.

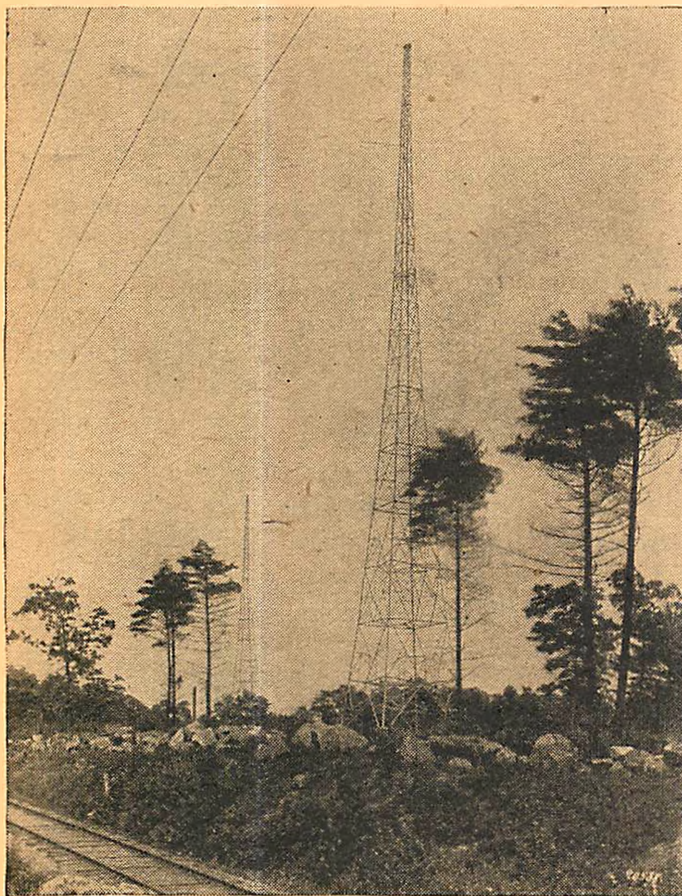
Figures 2 and 3 are photographs of other transmitting stations at present in operation. Figure 4 is a diagram of a transmitting antenna; Figure 5, a directional antenna used in the Radio Beacon service; while Figures 6, 7 and 8 illustrate different types of receiving antennae.

The long distance transmitting antenna must be situated so that, as far as possible, it is clear of all natural and artificial obstructions. The wires must be stretched taut. Any sagging or oscillating will seriously interfere with the wave length. For a general purpose antenna useful either for transmitting or receiving, the umbrella type as shown in Fig. 6, is probably one of the best because it has a minimum directional effect.

Obviously the factor of space available will have a large bearing on the antenna employed for amateur work. This is also a factor in installations on ships, where the type shown in Figure 7 is generally used as it allows the masts to act as supports for the wires. In airplanes, the single wire trailing antenna with weight is often used, although this has a distinct directional effect. The tendency lately has been to supersede this with a shorter mast antenna. The reasons for this will be discussed later.

It will be noticed that no mention has been made of the loop aerial. This is so intimately connected with directional radio and radio compass work that it will be dealt with separately in an article devoted to this branch of radio work.

Few people, perhaps, realize that it is possible to use the metal spring of a bed as a receiving antenna, yet this is so, although tuning will probably be difficult and signals from a local broadcasting station will probably be the only ones picked up.



Radio Marine Corp. of America  
The transmitting station at Marion, Mass.



A suitable ground connection improves all type of radio reception; in the majority of antennae it is essential. There are many ways of obtaining a good ground. The most commonly used, and probably the most effective, is a connection to the water pipe. The water pipe runs many miles under the earth and it is difficult to improve on this for an earth contact.

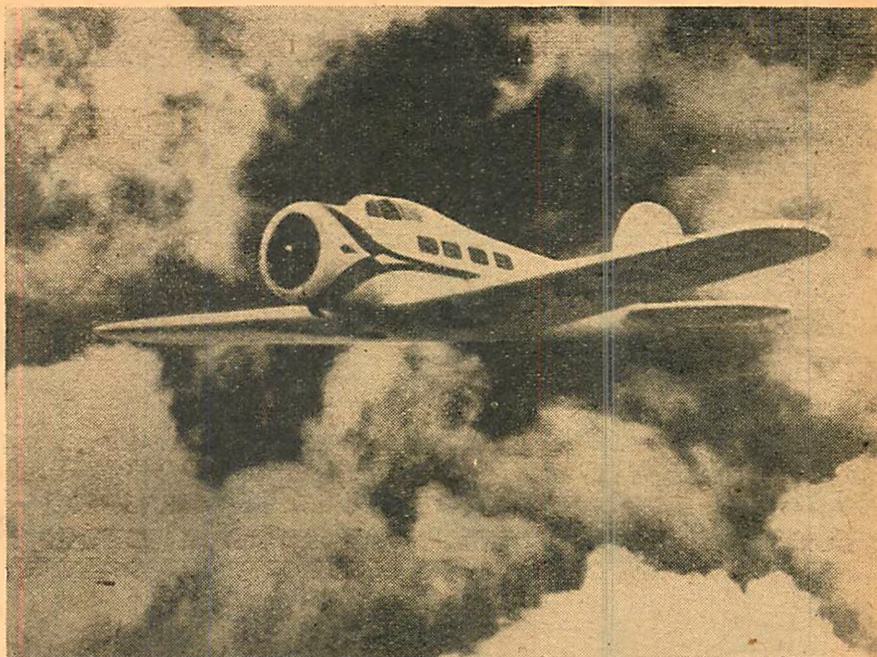
If no water pipe is available the ground connection may be made to a copper plate which is buried to a considerable distance below the surface, or to an iron post which has been driven six or eight feet in the ground. Do not forget to solder all connections to clean portions of whatever grounding medium is being used.

### Counterpoise

In the case of a transmitting antenna a counterpoise is often used in place of the usual ground connections. The reason for this is that the counterpoise does not increase the effective resistance of the antenna system at certain points as does the regular ground connection; and antenna resistance must be reduced to a minimum to get the best results in sending. A counterpoise is simply a network of wires erected immediately below the antenna, as shown in Figure 9.

The essential features of an efficient counterpoise construction are these. The wires must be directly beneath the antenna and preferably slightly overlapping the area covered by it. They must be completely insulated and should not make a ground connection at any point, and therefore should not be directly connected with any object through which a ground connection could be made. They should be as near the ground as possible without running the risk of causing obstruction to objects underneath. If they are eight or ten feet above the ground, this will usually be sufficient. The action of the counterpoise is to ground the antenna statically.

Up to this point in the course our articles have been mainly theoretical. This has been necessary for the sake



Thunder clouds—a Lockheed Orion—and radio, the guide

mitting antenna—one that will be inexpensive and simple to build, and comparatively easy to operate.

Do not forget that you must have a government license before you can set up any radio sending apparatus. There are radio inspectors in each of the following cities. You should apply to the nearest for full information before commencing an installation of this nature.

Boston, Mass. New York City  
Baltimore, Md. Norfolk, Va.  
New Orleans, La. San Francisco, Cal.  
Seattle, Wash. Detroit, Mich.

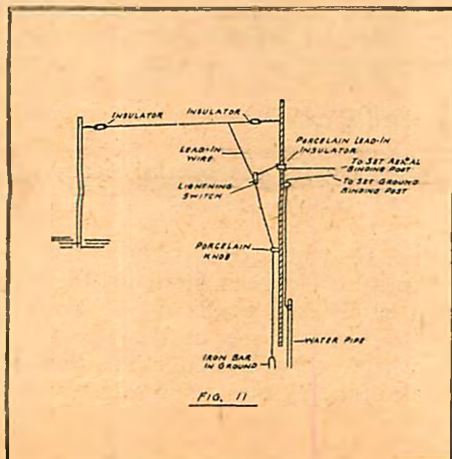
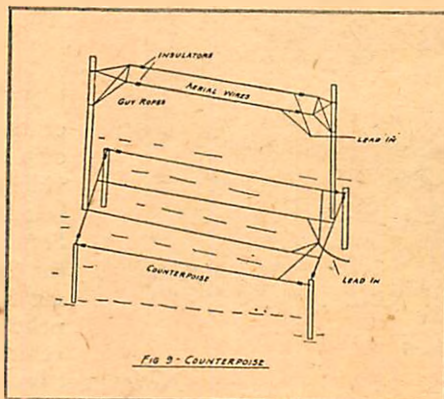
Chicago, Ill.

The beginner is advised to first set himself the task of erecting his aerial before he attempts the more complicated work of assembling a set. For those who have in mind anything of this sort, the following information will be useful.

The accessories needed will be supports, wire, insulators and a lightning switch (see Figure 10). The latter is included because the aerial we have in mind is for transmitting purposes. If it were to be used solely for reception, other forms of lightning protectors could be used, such as air-gap lightning arrestor, or a vacuum tube protector. In some localities fire underwriting regulations require the use of a lightning switch.

The first problem that requires a decision is the type and size of antenna to be erected. Obviously, with an amateur station this point will be largely governed by the amount of space available. The antenna must be as far as possible from live wires or telephone wires which may interfere with the efficiency of the radiating waves, and care should also be taken to avoid contact with branches of trees which act as earth conductors and considerably weakens the strength of the signals.

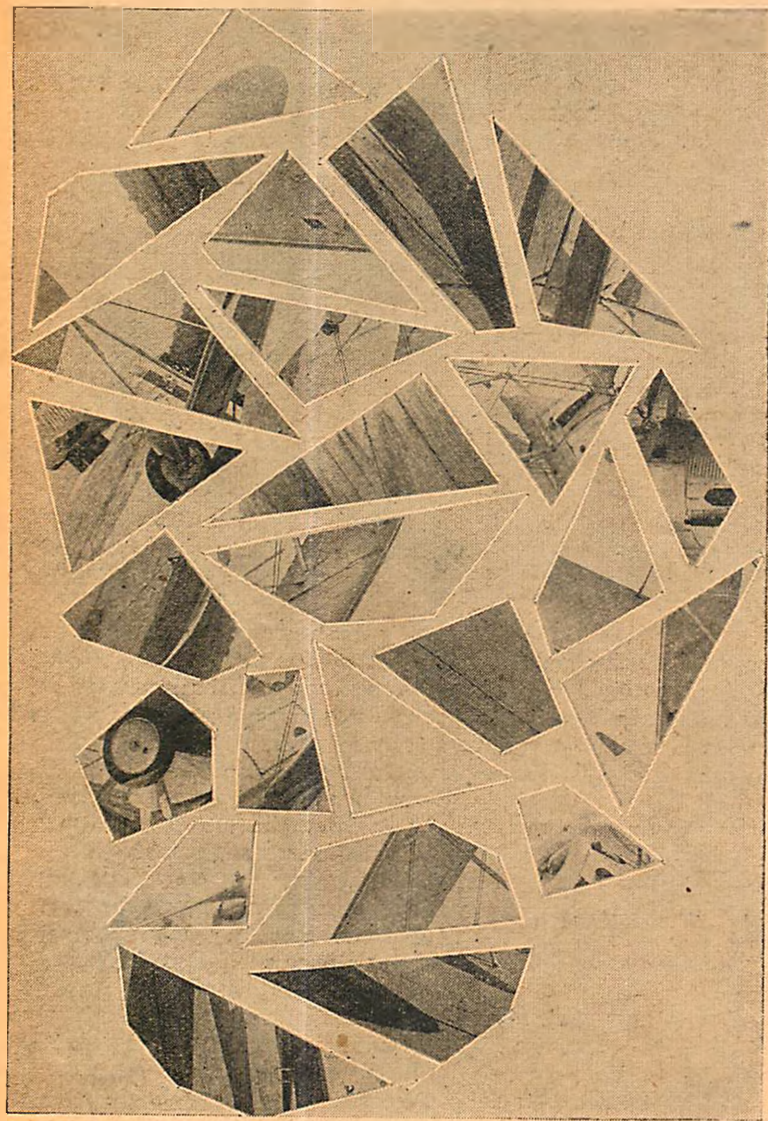
In order to make this description as simple as possible, we will assume that we have forty feet of clear space between our roof and the barn, or between our roof and the roof of a friendly neighbor. With a forty foot antenna the best wave length for transmission will be fifty metres; that is to say, with a forty foot aerial a maximum distance will be obtained (other (Continued on page 47)



of the reader who is aiming at sufficient knowledge to pass the radio operators' examination. Now, for the sake of those who are more interested in radio from an amateur's point of view, we will deal with the construction of a trans-



# LAST CHANCE TO WIN A



Scrambled Picture No. 5

**L**AST CHANCE TO WIN A FREE FLYING COURSE!  
We've screamed that at you on the cover of MODEL AIRPLANE NEWS, in the title at the top of this page, and again in the first line of this reading matter.

This has been done to impress you with the fact that you cannot afford to miss this great opportunity of a short cut to the realization of your ambition.

In case you haven't stopped to realize what such prizes as are offered mean to you in the sense of financial saving, allow us to point out that the average "ten hour's dual, and sufficient solo flying time to sit for your Private Pilot's License" as offered would cost you anything from \$500 to \$600, if not more. To assure yourself of this, write to a few flying schools and ask their terms. That should convince you!

Another question has arisen in connection with the return to school of many of our readers. The question is asked: "Will I have to leave school to take the flying course if I win first prize?"

The answer to that is "No."

## Enter Our Monster "Scrambled Picture" Contest and Start Your Career in Aviation



Any competitor winning the first, second or third prize will be allowed to choose his own time for taking the courses or flight, providing his time coincides with such courses being conducted at the *Curtiss-Wright Flying Service* school he designates. Similarly with the 200-miles Cross Country Flight. Providing the time designated by the winner of that prize coincides with Mr. "Casey" Jones' convenience, everything will be fine!

Now about back issues of MODEL AIRPLANE NEWS containing the "Scrambled Pictures." The first two pictures appeared in the September, 1931 issue, the second two pictures in last month's issue. Back copies of both of these issues (or any issue of MODEL AIRPLANE NEWS, for that matter) can be obtained from the Subscription Fulfillment Department, MODEL AIRPLANE NEWS, 570 Seventh Ave., New York City. Back issues cost 20 cents a copy, so please don't fail to enclose that amount in stamps or currency in your letter when you write for them. Also state definitely what issue you want, and give your FULL postal address.

About the "Scrambled Picture" contest itself:

**W**E think it necessary for the benefit of any newcomers, once again to repeat some of the pertinent points.

Chief among these is the matter of identifying the plane after the "jig-saw" picture has been fitted together. Remember—and you'll surely lose points if you don't remember—that just to identify one of the planes as a Curtiss Condor, or whatever it might be, means absolutely nothing unless you also identify the engine with which the



# FREE FLYING COURSE!

## WHAT YOU WIN!

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

## WHAT YOU DO!

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

plane is equipped.

Another important point is neatness. This includes such matters as how neatly the pieces of the "Scrambled Pictures" are pasted together, and how neatly you write, type or print the identification of the picture. All these things mean precious points—and points are what are needed to win the prizes!

AS for the fitting together of the pieces—that's easy. You will have noticed that each little piece on each photograph has a white line border. All you have to do is to cut out each piece and then fit them all together just like any of the hundreds of jig-saw puzzles you must have fitted together at some time or other. Each piece has a definite place in the complete photograph, so there is no mystery about it.

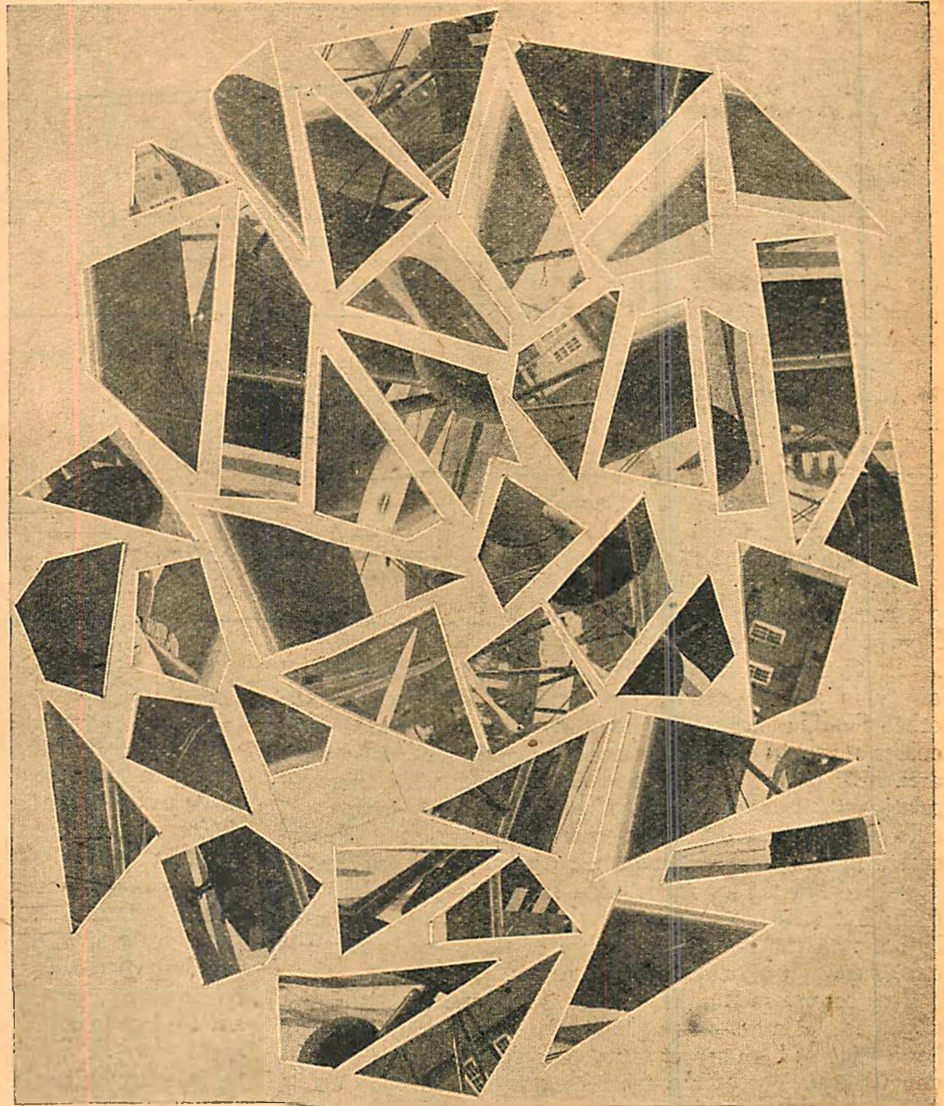
That seems to be about all to say for the present. Only remember that this is your last chance to enter the contest. If you have not filled in and mailed your entry blank, do so immediately. To be a bona fide competitor your entry blank and name must be listed with us.

Just as another aid to guide you, we are going to reprint the rules. Here they are:

## Rules

1.—There is no entry fee.

- 2.—No correspondence will be entered into concerning the contest.
- 3.—This contest is open to all readers of MODEL AIRPLANE NEWS, whether subscribers or otherwise.
- 4.—Members of MODEL AIRPLANE NEWS' staff and/or the employees of Good Story Magazine Co., and/or the Curtiss-Wright Corporation and its subsidiaries are not eligible for entry in the contest.
- 5.—The Judges' decision is final. The judges are Harold Hersey, publisher, and Capt. H. J. Loftus-Price, editor, MODEL AIRPLANE NEWS, and referee, Mr. C. S. (Casey) Jones, the Curtiss-Wright Corporation.
- 6.—The contest closes at midnight November 21, 1931. After that time no entries will be eligible for a prize.
- 7.—The names of the winners will be published in the first possible issue of MODEL AIRPLANE NEWS after the closing date of the contest.
- 8.—Should two or more persons tie for prizes, each will be awarded the prize tied for.
- 9.—In competing for the prizes, each contestant releases MODEL AIRPLANE NEWS, the Good Story Magazine Co., the Curtiss-Wright (Continued on page 42)



Scrambled Picture No. 6



# A Course in Airplane Designing

By  
Ken Sinclair

**L**AST month we discussed the light airplane, speaking mainly about its uses, advantages, and probable future. Now we'll go into the thing a little more from the engineer's point of view, and try to find out just what problems the light plane presents to the designer and how he solves those problems.

To put the whole thing in a nutshell, we might say this, a light airplane is a low-powered ship, having a large proportion of wing area to weight and a high aerodynamic efficiency.

The light airplane, having a motor of comparatively low power, must have a large wing area to carry the load. This means a fairly low cruising speed, comparative safety in a stall, and a slow landing. However, on the other hand, a light wing loading brings in several difficulties that the designer must solve. The necessary wing area may be secured by using a wing of wide chord in relation to its span; but this low aspect ratio means low efficiency due to the eddy currents, as we have learned earlier in this course. Again, the designer may use a wing of very high aspect ratio, with narrow chord and large span; but this method means that clever designing must be done on the internal structure of the wing to make it strong enough and yet not too heavy.

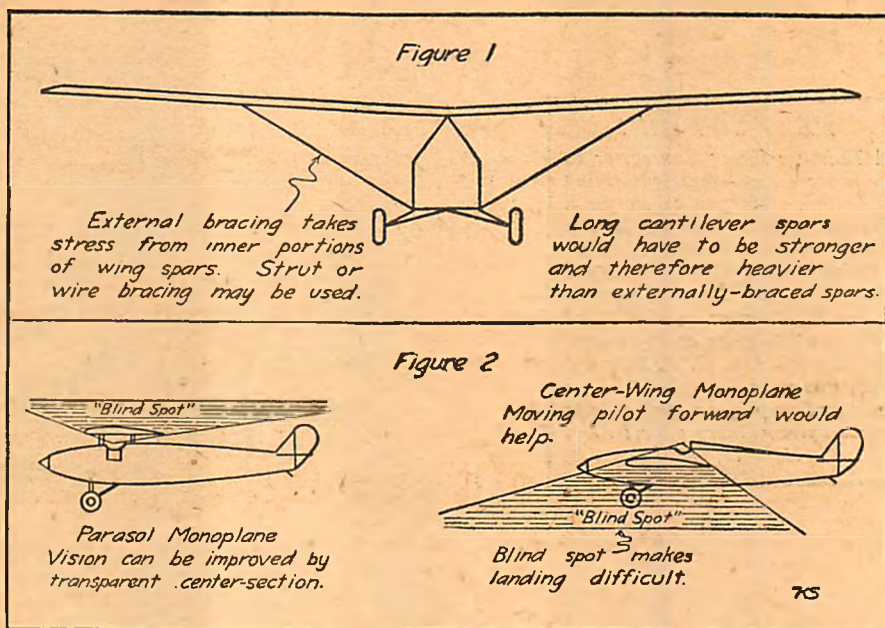
This second method, however, is the one that is generally used. Almost any light airplane that you see today has a wing of high aspect ratio. The designer usually keeps down the weight of the spars by bracing the wing externally by means of a set of struts or wires to the lower surface, as shown in Figure 1. Now it may be asked, "Why not use a full cantilever wing structure, since aerodynamic efficiency is the goal, and eliminate the turbulence and interference drag caused by that external bracing?"

The point is this; a cantilever wing (in other words, a monoplane wing that has no external bracing whatever) is admittedly heavier than a wing that makes use of a single system of bracing struts, both wings having equal strength. This because a very long, narrow wing, such as is used on light planes, would require very heavy spars at the root of the wing to stand the stresses of lift. However, in light plane design every pound of weight must be watched; and designers, so far at least, have found it more economical to use some external bracing and thus keep the weight down, even at the cost of a little extra drag.

It is entirely possible that a full cantilever light plane will come to the fore (at least one ship of this type is being built now) and that, perhaps, some designer will bring forward a method of building a cantilever wing that will reduce its weight a great deal.

So far, however, the light wing loading and large span have necessitated some outside bracing as a provision of strength with low weight.

The light plane must be highly efficient aerodynamically. The reason for this is more or less obvious. In light plane design we haven't very much power to squander in drag-



ging a cumbersome, inefficient machine through the air. Each pound of thrust must be made to do its full share of useful work; and the more smoothly the ship moves through the air the less drag there will be to overcome, and the more speed can be attained with a given motor power.

Right here comes a severe test of the designer's skill and knowledge of air flow. Interference effect—which will be discussed and explained in detail later on in this course—slipstream wash, wing tip eddies; all of these must be considered. The object in light plane design is to cut the drag to an absolute minimum—and to do this in a machine that is, structurally, as simple as it can be built.

Structural simplicity was mentioned last month. It makes for a cheap ship because it is naturally easier to build a simple airplane than to build a highly complicated one. It makes for light weight—a very important point—because a simple structure can be built to withstand all of the stresses with much fewer members and hence less weight than the more complicated one.

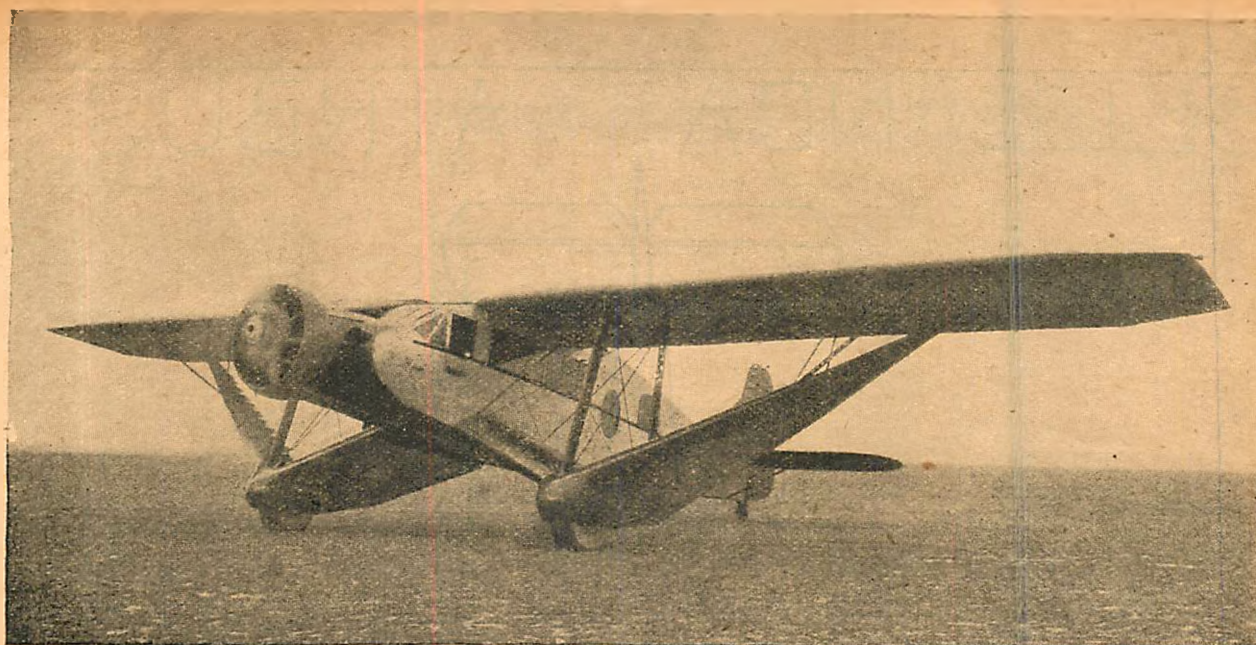
Here again the designer's skill is taxed to the utmost. He must have a complete knowledge of stresses and strains at his fingertips, so that he will put no members in the ship that do not do their full share of the work. There is no place in the light plane for "loafers," in other words, struts and spars that are not put there for a definite and particular purpose.

Of course, the whole construction and operation of the ship must be as simple as possible for the reduction of first cost, operating and repair costs, and weight.

In external design, the light (Continued on page 48)

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





The real thing—a Bellanca "Airbus" 12-Passenger Transport (Wright Cyclone)

## How to Build

# The Bellanca 12-Passenger "Airbus"

**T**HE *Airbus* was designed and built by the well-known Bellanca Aircraft Corporation of New Castle, Delaware, during 1930. It is a combination mail and passenger sesquiplane and many new features are incorporated in its design; a compartment in the two lower stub wings for mail, which has an area of sixty cubic feet, and therefore the loading and unloading is accomplished without interfering with the passengers, a pit under each seat for the travelers to keep their baggage, a lower airfoil section, not only serving as a lifting force but also as a landing gear. Either a Curtiss Conqueror, Pratt & Whitney Hornet, or a Wright Cyclone may be installed. The *Airbus* has a very high rate of climb and is one of the largest single-engined airplanes of today, being capable of carrying twelve passengers with a moderate load.

The model of this great plane is very easy to build. Much time has been taken in the designing of it in order to make it as light as possible and yet very strong and airworthy. The cost in building the entire model is as low as \$1.00. Ambroid is used for all connections. Follow instructions closely and take plenty of time and you will find you have constructed a perfect flying scale model.

### Wings

Obtain a piece of balsa wood 4" x 3' x 1/16" for cutting out ribs for all wing sections. Make ribs 1, 2, and 3 first by tracing them on the board and cutting out with a sharp razor blade. After they are made, cut the spars to the right length which are of 1/8" x 1/16" balsa wood. Lay ribs in place over plans and fit the spars in the slots made in ribs. When that is done apply plenty of ambroid to connections. Keep ailerons separate from rest of wing. When ambroid has dried

thoroughly attach dowels and make wing tips. Look over all sections to see that nothing is warped or out of place. Set aside to dry for a while and proceed to make lower wings and pants for wheels.

Make ribs 4, 5, 6, 7, 8, and 9, in like manner as others, using plenty of ambroid, and connect spars and cross braces. Be sure to make two left and two right wings. Install dowels and lay aside to dry.

Next carve out two streamline pants for wheels out of blocks of balsa 3/4" x 1" x 2". Use a small chisel, razor blade, rough and smooth sand paper, and then install wheels which may be either purchased or made. Use a piece of stout wire or pin for the axle. When that is completed, make holes for dowels of lower wings. The pants will then be ready for doping which is done later. See that wings fit them perfectly. Go over all wing connections with ambroid and then sandpaper all rough parts. The wings will then be ready for covering.

### Tail Units

Cut out ribs in same manner as was done for the wing. Make rudder, fin, stabilizer, and two elevators separately. The horizontal tail tips may be cut out of 1/16" balsa. Cut them in their curved shape so as it will not be necessary to bend them. Fit spars and braces in place as was done with the wings. Apply plenty of ambroid as the tail assembly must be very strong. See Number 6 plan for dimensions.

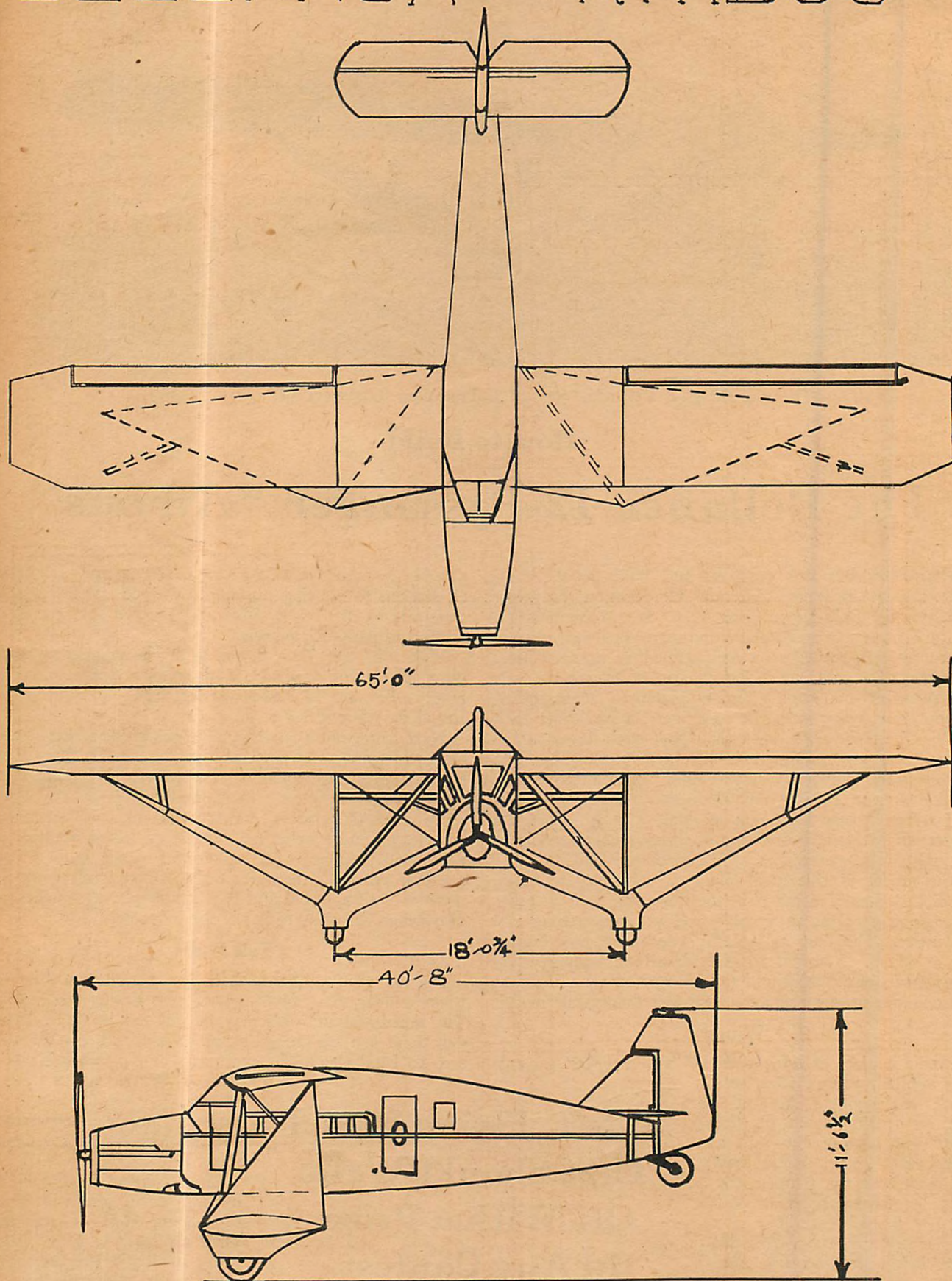
Next connect with ambroid the two small struts in center of leading edge of stabilizer. These are made of 1/16" balsa. Make small pin hole as shown in drawing. Next ambroid small strut between the two lower ribs of fin. Go over all units (Continued on page 39)

## A 2-ft. Flying Model That Should Walk Off With a Prize in Any Contest

By R. C. Morrison

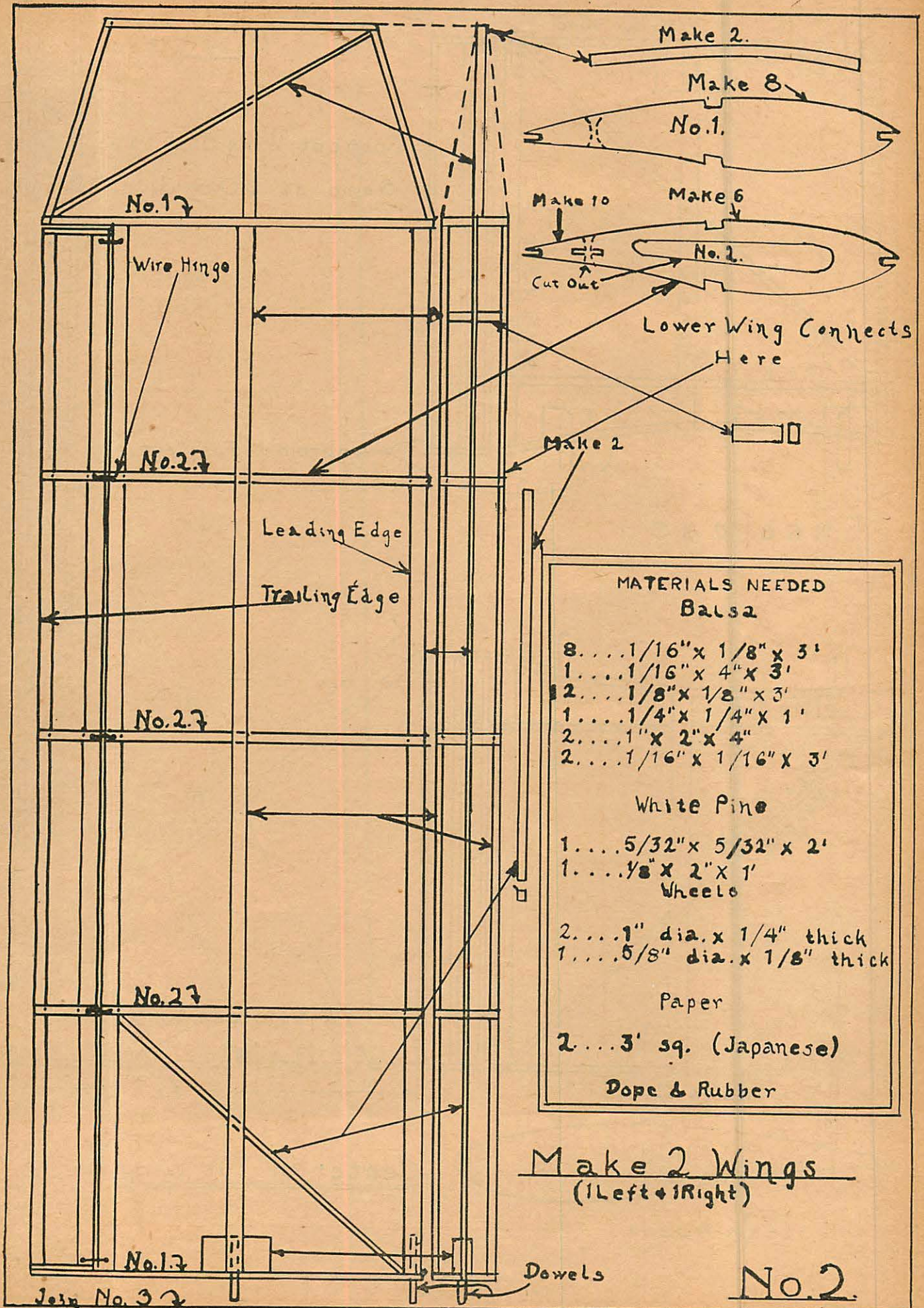


## BELLANCA AIRBUS

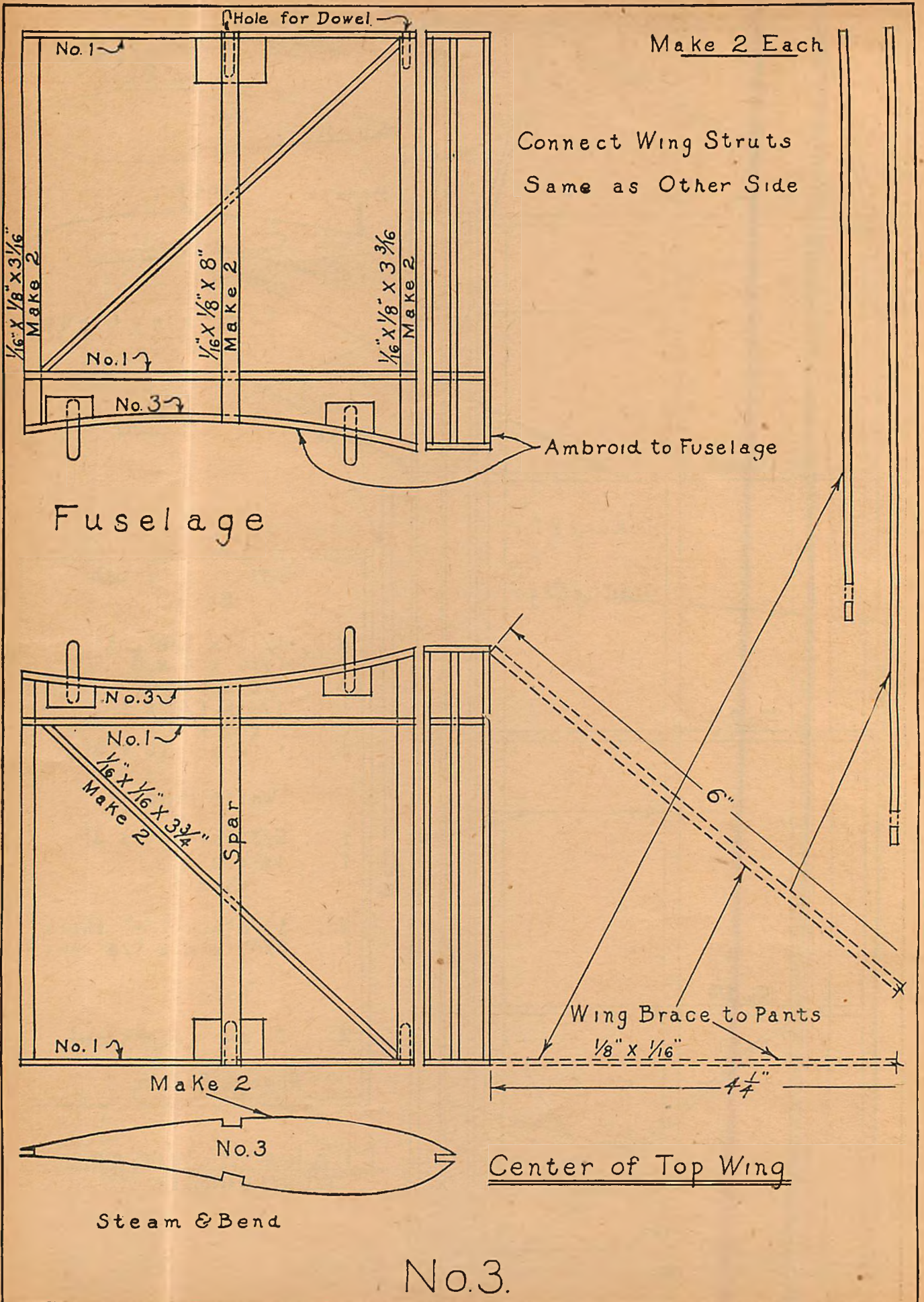


No. 1

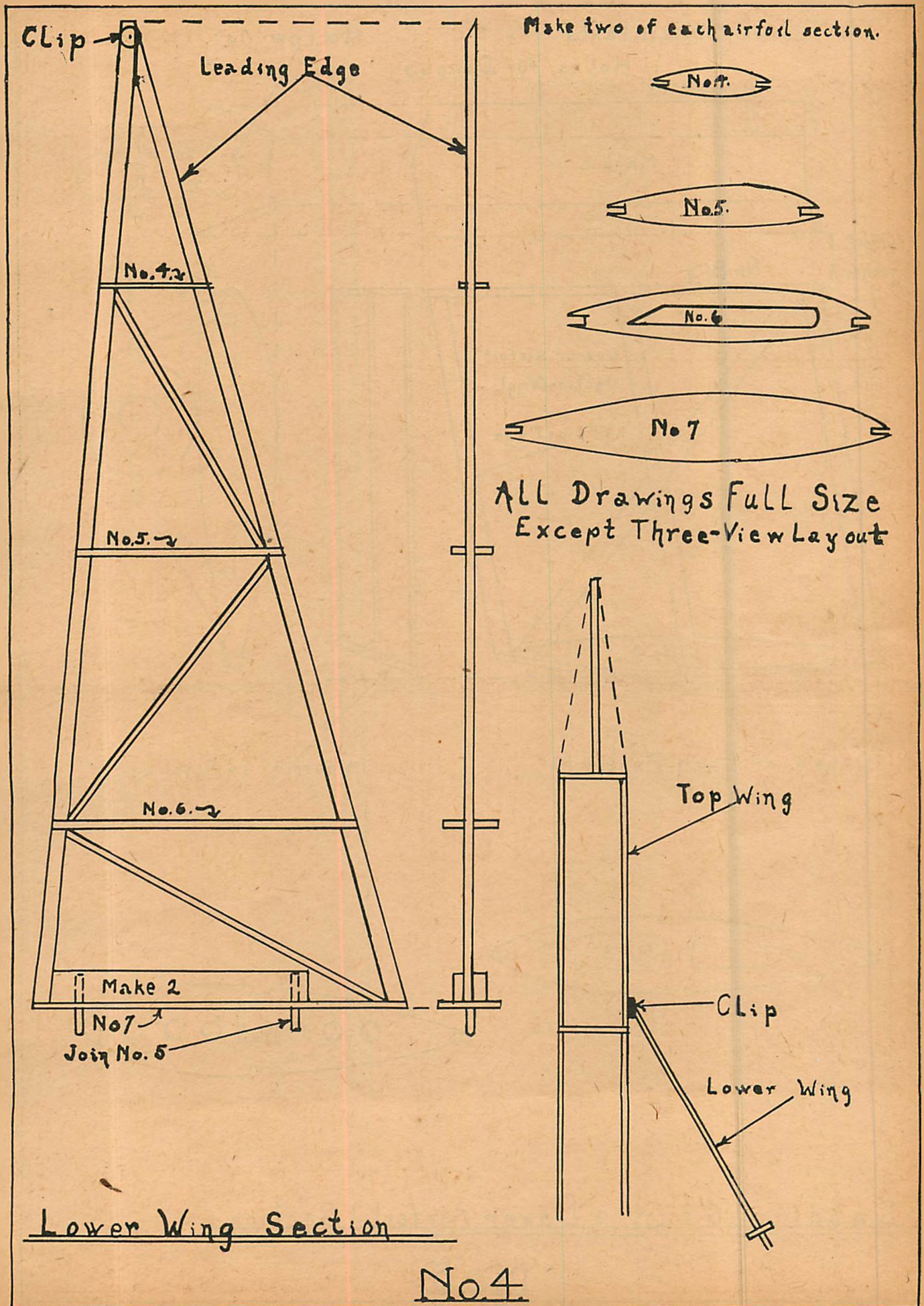




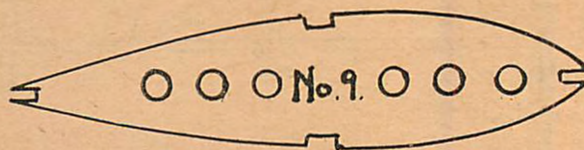
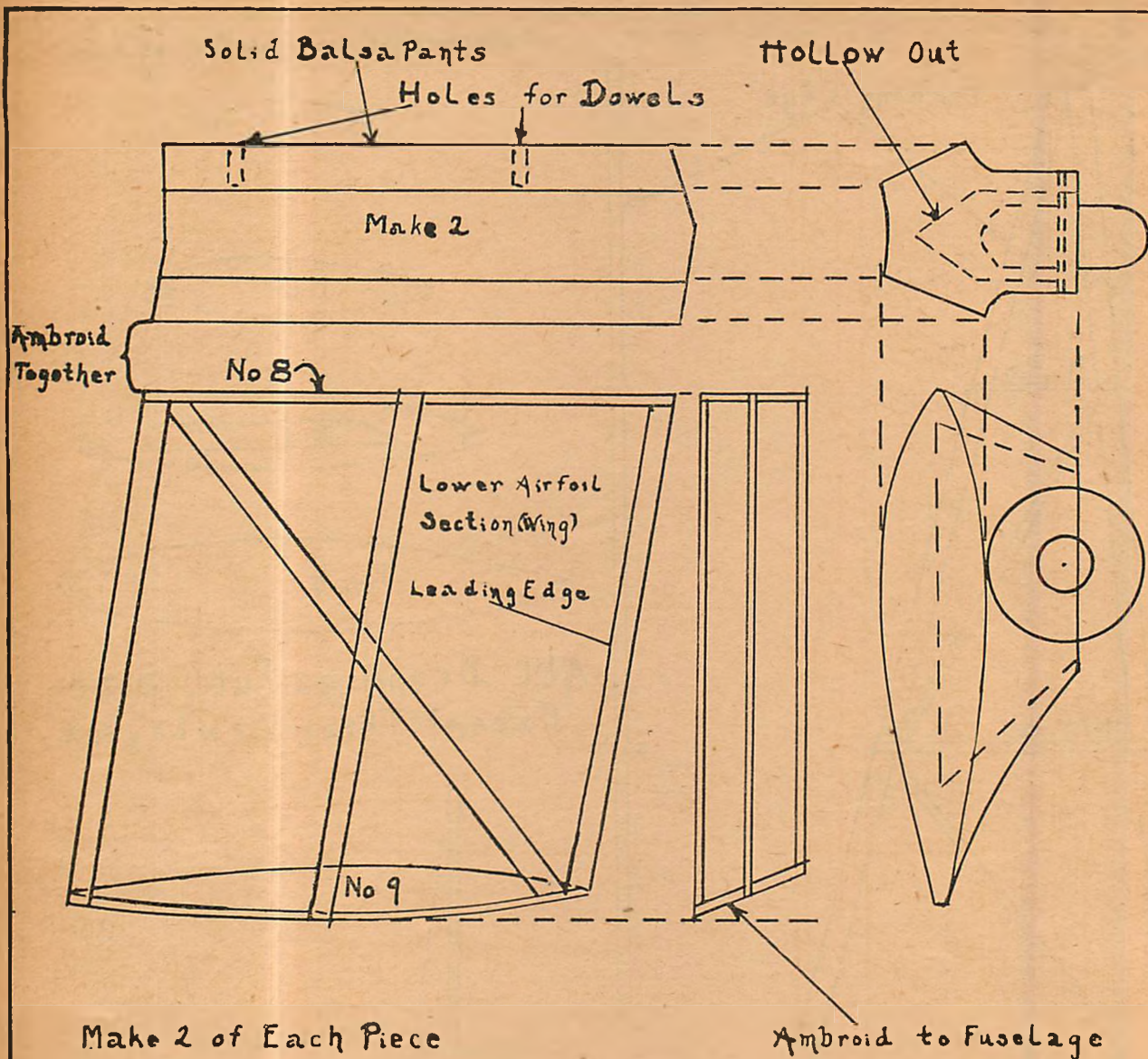








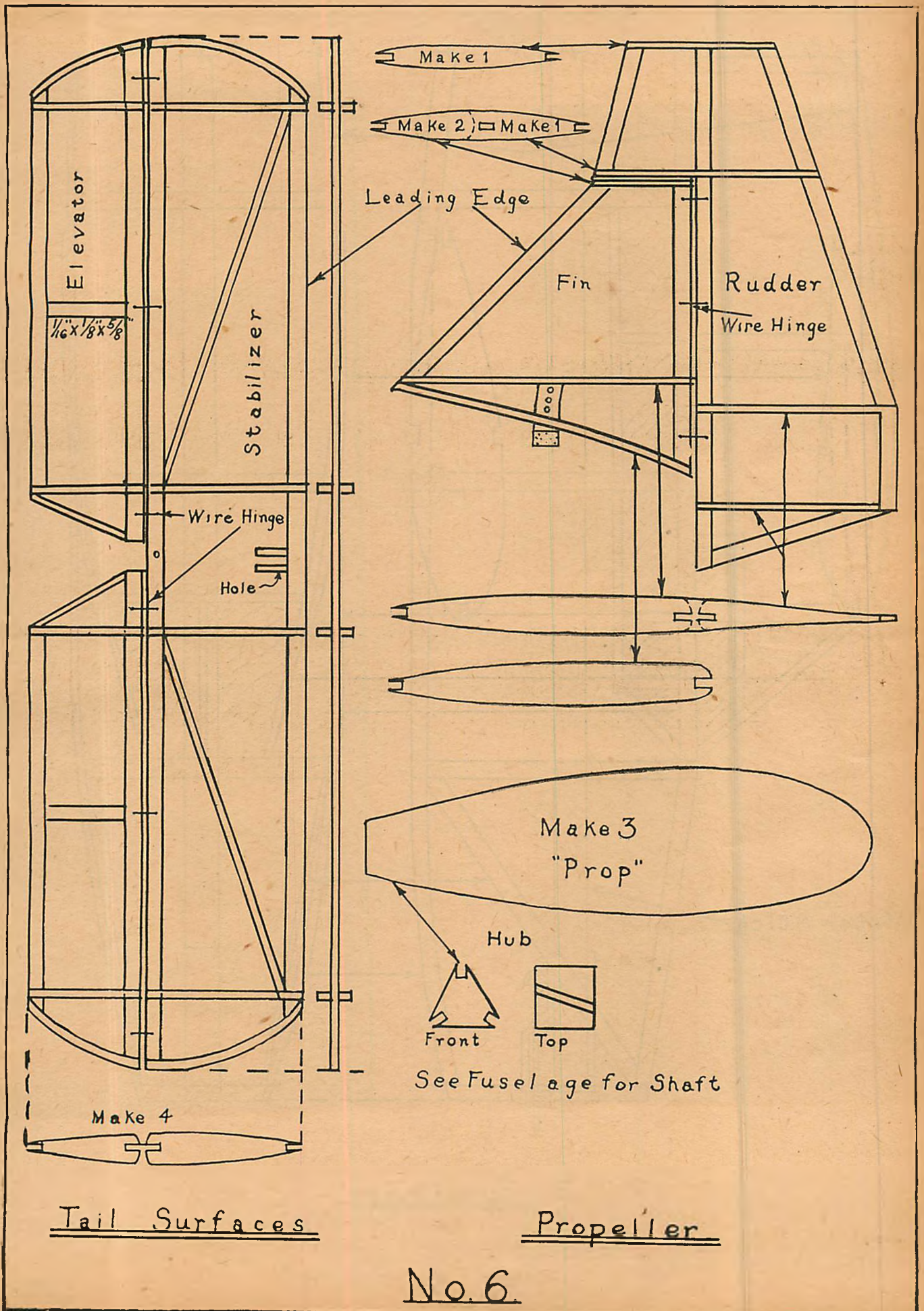




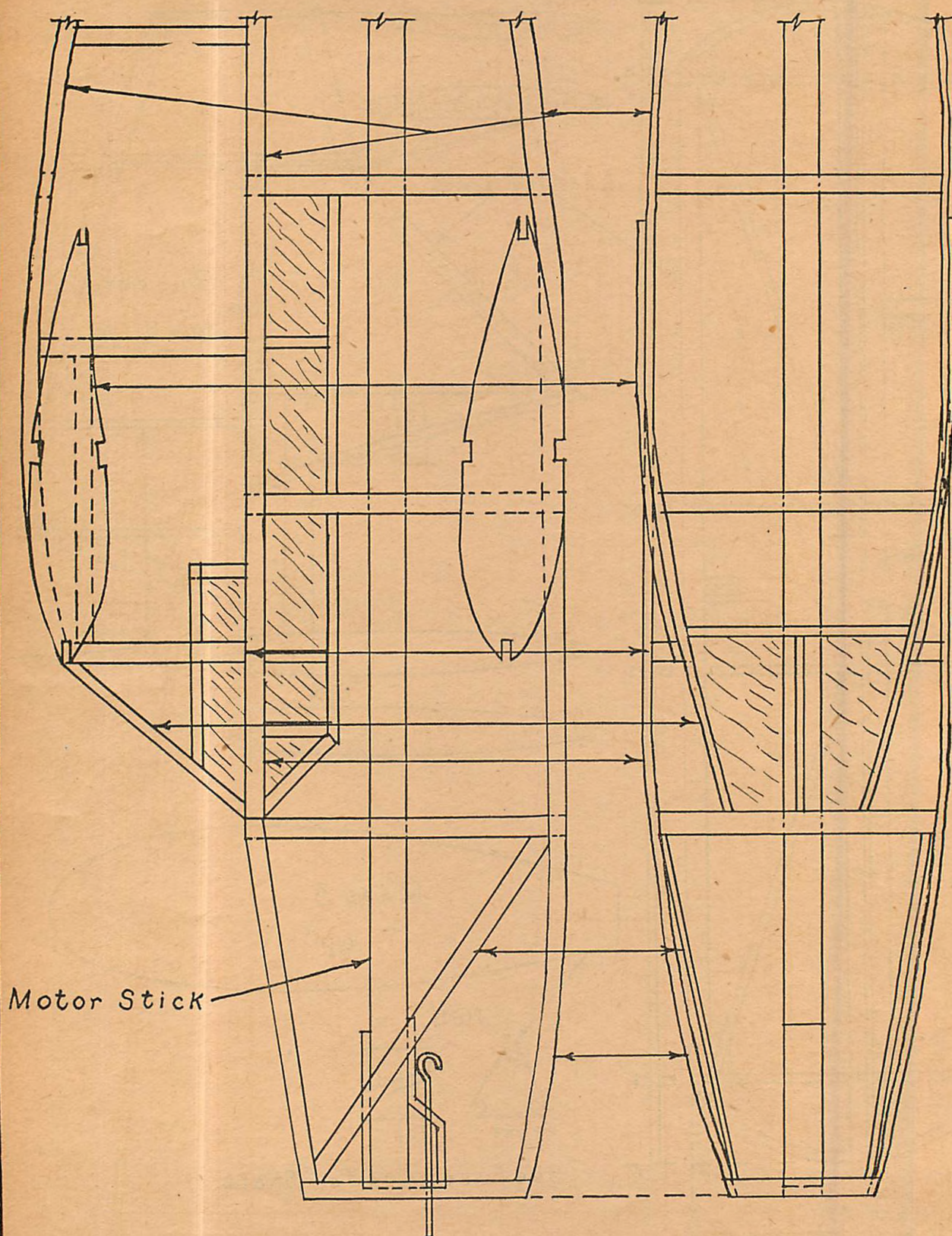
Landing Gear & Lower Airfoil Section.

No. 5.





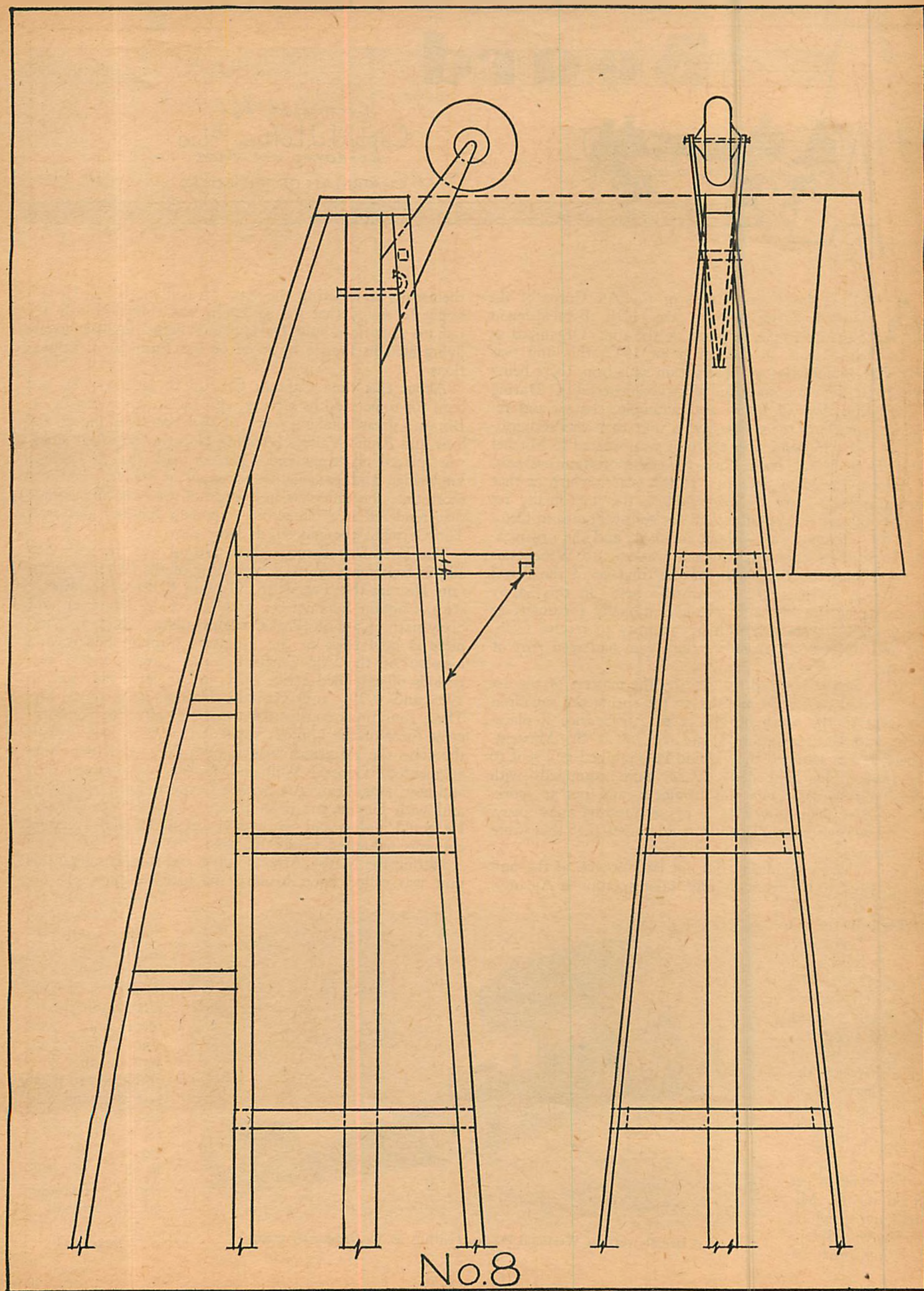




Fuselage

No.7.







# Aviation Advisory Board

Conducted by  
Capt. H. J. Loftus-Price  
EX-ROYAL AIR FORCE

CHAIRMAN OF THE BOARD



**A**MONG the famous units of the Air Corps of the United States Army, the 11th Bombardment Squadron takes a place at the top. Organized at Kelly Field, Texas, in the spring of 1917, this unit was originally intended as an observation squadron, there being at that time no contemplated bombardment units. During those hectic days of hurry and scramble, change and re-change, somehow there emerged a unit that was recognizable as such. In September the unit was ordered to Mitchel Field, Long Island, New York, for transportation overseas.

After a period of detention at this place, which at that time was little more than a mudhole, the unit finally received overseas orders and sailed for sunny France in October. The crossing was without incident, and the organization arrived in England, where it was sent to Winchester to train with the British under the tutelage of the Royal Air Force, at that time the world's best. In this happy circumstance the Eleventh was exceptionally fortunate, as the personnel were given an opportunity to receive training and instructions from warriors who had seen part of a war.

After instruction and training by the masters of the art for a period of several months, in the spring the squadron was sent to the south of France to Air Service Replacement and Concentration Depot No. 5 at St. Maxient, where it was assumed they would be equipped and sent to the front. This happened! They were equipped—with picks and spades, saws and hammers, and put to work. The nearest airplane was at Tours, a hundred miles away, and for a period the Eleventh could forget that they were Air Service.

This unhappy condition did not last forever, as the unit was ordered to the front in July, taking station at Amanty, a little French mudhole in the vicinity of Colombey Les Belles and GrandeCourt. The Eleventh, which had been changed into a bombardment unit, was to be a part of the First Day Bombardment Group, First American Army. In August they were equipped in time to get in on the St. Mihiel fray, in which they gave a splendid account of

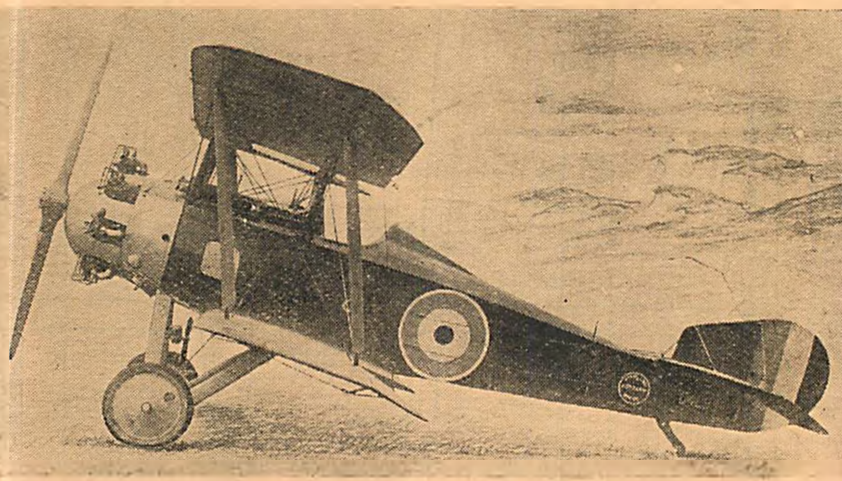
themselves considering the type of airplane used. Here it might be stated that the squadron was equipped with the famous American-built DeHaviland Four, known among flying men in France by more or less formidable designations.

About this time Captain Charles P. Heater, who had been for some months serving with the Independent Force, Britain's great bombing force, at that time working up the Saar and Rhine Valleys bombing German industrial cities, was placed in command. Heater had the experience, knowledge and personality for a great leader, and in a short time the unit was in a state of training and morale that rendered it a dangerous opponent for any air force. The Germans thought so, as later shown.

The First Day Bombardment Group was formed officially in September of 1918, consisting of the Eleventh, Captain Heater; the Twentieth, Captain Sellers; the Ninety-sixth, Captain Summerset; and the One Hundred and Sixty-sixth, Captain Parks, commanding. Captain Summers is now back in the infantry; Captain Sellers is a member of the Air Corps Reserve, having served two periods of extended active duty at Langley Field, Va., in 1928 and 1929; and Captain Heater is in civil life. These four units constituted the entire effective bombardment force of the United States at that time, and even at the time the Armistice was signed they had not been augmented. General William Mitchell, well known then and now, was Army Air Service Commander, First Army, and with him at the helm plenty of work was in store. He could and would work day and night, and everyone else was requested to do the same.

During the Meuse Argonne, first and second stages, this unit was called upon to carry its load of America's offensive gesture toward German power, and acquitted itself with honor. Severe casualties were sustained, but the effects were overcome. The highest spot in the Eleventh's record is the fact that any mission it was called on to perform was carried out, regardless of difficulties. It possessed as brilliant a

(Continued on page 43)



A British wartime Westland Wagtail with A. B. C. Dragonfly engine



# How to Build a Super-Light Wing

By Major H. W. Landis

(ARTICLE 2)

## Cantilever Construction for Models

**T**HIS article deals with a very light but strong cantilever model wing suitable for model planes having a total wing span up to four feet.

All compression members are made of balsa wood and cotton thread, the thread doped with a very light airplane dope after it is in position.

Sketch No. 1 shows the wing in plain view and indicates clearly the two main spars. These are kept in compression by the thread diagonal trusses shown in sketch No. 2A. The trusses are marked B1, B2, B3, B4, and B5. The figure following the letter denotes the number of threads in the truss; for instance, truss B1 has but one thread, while truss B5 has five threads, and so on as illustrated.

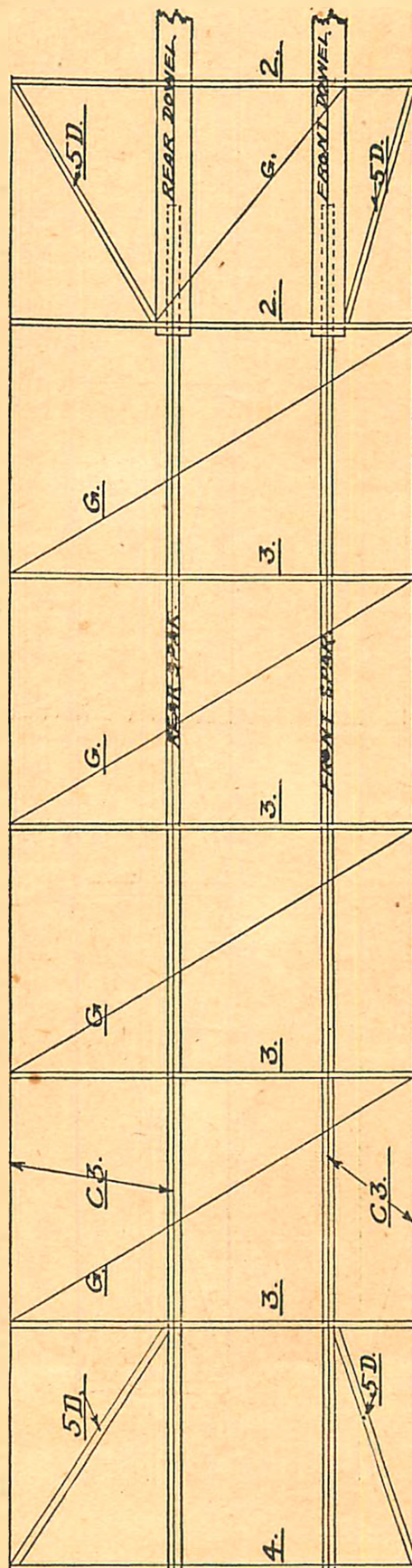
The spars can be made extremely small and light as all the bending moments are taken by the thread trusses in tension.

Drawing No. 2A indicates clearly that the tension action of the trusses places the spars in compression only. This is a much desired feature in any wooden structure, as wood easily stands a certain amount of push strains, while the same force pulling up on the piece would cause it to part.

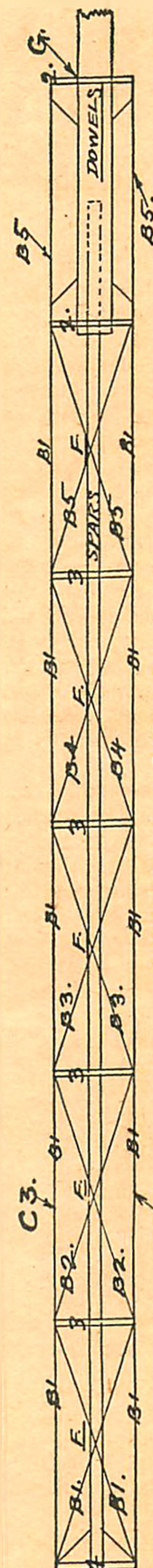
The dowels at the fuselage and of the wing panel are drilled to receive the very light spars indicated in sketch No. 5. It is intended that these dowels be fitted into light aluminum tubes passing through the fuselage from side to side, forming a neat, strong attachment for the wings and also creating a take-apart plane for portability.

The ribs marked 3 are made much lighter by punching holes as indicated in sketch No. 3 without detracting from their strength.

Sketch 4 shows the outboard end ribs marked 4 in sketch No. 1, and the two inboard ribs marked 2 in sketch No. 1



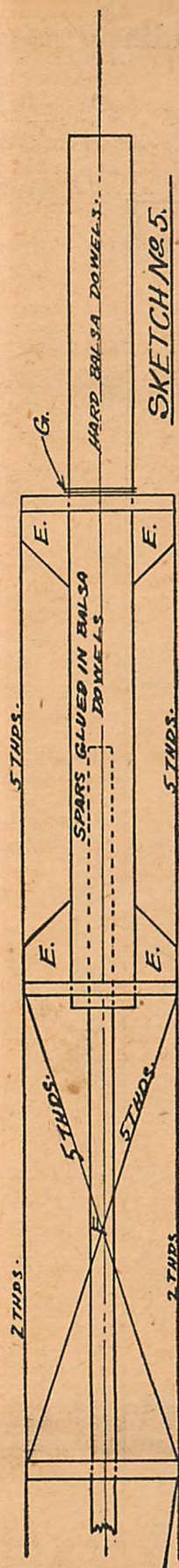
SKETCH NO. 1.



SKETCH NO. 2-A.

THIS DRAWING PERTAINS TO  
WING NO. 2.





SKETCH No. 6.

THESE DRAWINGS ARE OF  
WING No. 2.

are shown in sketch No. 2. Two of these ribs are required for each wing panel. The large holes allow the dowels to be firmly fastened to them by means of ambroid cement.

Diagonal compression members marked 5D are placed at each end to take the tension of the threads marked C3 in the leading and trailing edges. These wooden diagonals are clearly shown in sketches No. 1 and No. 6. Corner brackets are placed on the dowels and secured to ribs 2 and 2 indicated in drawing No. 1. An enlarged view of these is shown in sketch No. 5. They are denoted by the letter E.

The thread trusses are doped together at all intersections marked F. This prevents the entire structure from yawing out of shape and make for great rigidity.

The thread trusses end at point G in sketches No. 2A and No. 5. These are terminated by wrapping them several times around the dowel pins and dopping them in place.

The wing spars for a three-foot span model need to be  $\frac{3}{32}$ " in diameter. The round form is quite satisfactory. Such slender spars would never stand the strains imposed on them were it not for the tension truss design.

Thick wing sections are to be preferred in the construction of the internally braced wings. Either the U. S. A. 35a or the Clark Y sections may be used.

The U. S. A. 35a is an airfoil section known as a thick wing section. It is a high lift section very suitable for weight-carrying purposes used extensively in large planes of the bombing or weight-carrying type, and is well adapted to cantilever construction due to the great thickness of the section.

While the Clark Y is also ideally suitable for cantilever wings due to the fact that it also has a great depth, slightly increased speeds result with the U. S. A. 35a with the same expenditure of power.

Notice how the drag of the wing is taken by the tension threads G. It is best to place a reinforced leading edge on the wing consisting of a piece of tissue over the rib noses, as this will tend greatly to stiffen the structure in torsional stress.

The construction of a model box spar wing will be described in the next issue.





(Continued from page 27)

once more with ambroid and sandpaper ready for papering. Tail units are not hinged together until after covering.

The fuselage will be very easy to make if you follow instructions carefully. Take care that every strut is even and straight as any strut the least bit out of place will make a slight warp in the fuselage.

It is best to begin with the nosing and work to the rear. The fuselage is made in two sections, the bottom part, which is constructed first, being separated from the top by the two center longerons. First cut out nose piece with razor blade and then the side struts. These will be made of  $\frac{1}{8}$ " sq. balsa. Make two of each as shown in side views 7 and 8 and then cut notches at tips for longerons to fit. Four longerons are cut to size next out of  $\frac{1}{8}$ " x  $\frac{1}{16}$ " balsa or spruce. Ambroid all struts in place leaving nose pieces to be put on later.

The longerons may be bent without steaming. Lay the two sides on a flat surface to dry. Meanwhile cut the bottom and top struts and by that time the sides will then be ready for connecting. Put nose piece on first and work slowly towards the tail. Wait for preceding struts to dry before ambroiding next ones. Thread may be used in tying parts in place and can be cut when ambroid hardens. The tail strut will not be put on until top section is joined. The side struts of the top section are then ambroided to the longerons of the lower section just made.

Next put on top longerons and braces. While waiting for them to dry, make motor stick, using  $\frac{3}{32}$ " sq. white pine. Ambroid propeller shaft and hook and put a small

## The Bellanca "Airbus"



nail in the hook end so that the motor stick may be fastened to tail of fuselage. Lay the stick aside for a time while the fuselage is finished up. Ambroid all windshield struts made of  $\frac{1}{16}$ " sq. balsa in place. Also connect ribs, using plenty of ambroid. Cover end of fuselage with a piece of wood made from the same piece used for the ribs. This piece is for connecting tail surfaces to fuselage. Make tail skid and ambroid in place. Wheels may be purchased or made of balsa.

The propeller has three blades which are made separately and ambroided into grooves in a small hub. Because the Bellanca landing gear is so low, the propeller must be short so it will not hit the ground. Therefore, there must be quite a lot of pitch to get the same power as the larger ones. A chisel, razor blade, and smooth and fine sandpaper may be used. Cut the blades out of the rib wood and bend to fit grooves in hub. When the propeller is completed, insert shaft. Connect propeller to motor stick and then put motor stick in the fuselage through hole in nose piece.

All the frames are then ready to be covered, which comes next.

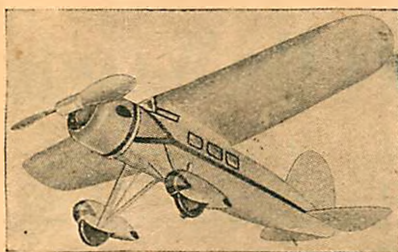
Japanese tissue will be sufficient for covering. Get a strong grade if possible. It is best to cover the wings in strips to avoid wrinkling. Colorless ambroid or dope may be used to attach paper. When all the parts have been covered, dope, using any

colors preferred. The tail surfaces are usually the same color as the wings. Right after doping place a weight at each end of part to keep it from warping. You will notice that the dope tightens the paper as it dries. Do not put isinglass in windows until plane is assembled. Leave an open space under nosing and tail of fuselage in order to hook and unhook the rubber motor.

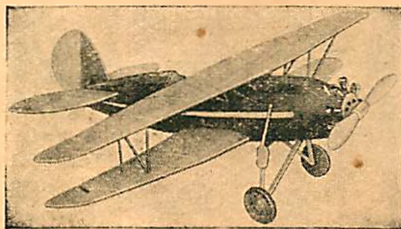
First connect tail units together by using paper or wire as shown in drawing. If paper is used, cut slots with razor blade in the  $\frac{1}{8}$ " x  $\frac{1}{16}$ " pieces where hinge will go and insert paper. The paper must be fairly stiff. Use a little glue to hold them in place. Before putting on left elevator, stick stabilizer through fin. Connect it with a small piece of wire to the trailing edge of fin. This is used as a hinge. The stabilizer will then be adjustable as well as the elevators. Ambroid fin to fuselage.

Next ambroid top and bottom wing stubs to ribs on fuselage. Also ambroid the four wing struts. Attach wheels to wing stubs with plenty of ambroid and when the cement dries, fit dowels of the rest of the wings in place. The upper and lower sections are connected together by a small round clothes clip. The wings will then be portable. Put on ailerons as was done with the tail assembly. Put isinglass in windows and the model will be finished.

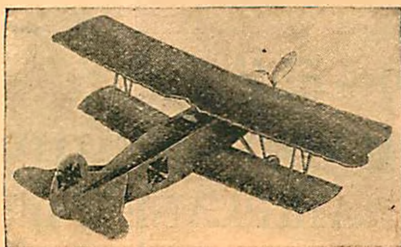
When flying the Bellanca Airbus, always have it facing the wind. Adjust the stabilizer and other controls to meet the flying conditions. The model, if built correctly, will take off under its own power and fly a hundred or more feet just like the real plane.



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(Continued from page 17)  
struts that you did with the struts marked (r). Engine bed struts (t) are  $\frac{1}{8} \times \frac{3}{32} \times \frac{1}{2}$ " and there are twenty-four of them. Four for each engine. There are twelve engine-bracing struts marked (y) and they are  $\frac{1}{16} \times \frac{3}{32} \times \frac{7}{8}$ " and fit between the engine bed struts fore and aft. Shape out ten bracing struts  $\frac{1}{16} \times \frac{3}{32} \times 1\frac{1}{8}$ ". These are for the engines and hold them rigid, fitting between them. These are designated on the drawings by (v). There are four more struts for the tail section (u). These are  $\frac{1}{16} \times \frac{3}{32} \times 1\frac{1}{2}$ " and are placed under the upper stabilizer through the lower one to the fuselage. Sand carefully all struts and dope them no more than twice or they will warp. The water rudder (x) is a piece of balsa  $\frac{1}{8} \times \frac{1}{4} \times \frac{3}{8}$ ". The hatch cover (w) is  $\frac{1}{16} \times \frac{9}{16} \times \frac{3}{16}$ ". Now we have all our parts finished. Check them carefully again and be certain they are smooth.

Now to the assembly of the Do-X.  
Take the fuselage (a) and the root (b). Get your cement and apply a liberal portion to one part. Fit the root on carefully and leave it to dry. Now do something else in the meantime. Get the engines and struts (t) (24 of them), also twenty-four ribbon pins. Look at your drawings and notice the angle and position of them. Apply a drop of cement to the end of the strut. Get a ribbon pin. Place the strut in position and at an angle push the pin all the way in and leave it. The strut is placed  $\frac{1}{4}$ " from the head of the motor and  $\frac{1}{16}$ " from the side. These dimensions are for all the engine-bed struts. Do this to all engines.

## The Dornier Do-X

Turn them on their backs, allowing the struts to dry thoroughly.

Take the fuselage again (a) and all parts for the tail section.

Attach first the lower stabilizer (k) by cement and long pins. Push the pins in at an angle so that they don't protrude. Next the fin and rudder (h) by cement and long pins. Next operation is delicate and care must be used. Take the upper stabilizer (j) and cut it in half. Allow for the width and contour of your rudder and fin. Now cement and using small ribbon pins attach it to (h) (or fin and rudder). Attach the empenage struts (u) now by cement and small pins—carefully. Do the same with the auxiliary or balanced stabilizers. Our tail assembly is now complete.

It is not necessary to use pins in attaching the rods (n) for auxiliary stabilizers. Just make a small hole and cement rods in place. Next we come to the lateral fins (o) and smooth off a section of the fuselage to which the fin fits. Measure from the nose of the fuselage  $3\frac{3}{8}$ " and put a mark. That is where the entering edge rests. Using a liberal amount of cement and six pins attach the fin so that the under part of fin or trailing edge is on a level with the step of fuselage.

Do the same now with the opposite fin. Let us now finish the cabin and attach

that. Shape it out as illustrated from the piece you have by hollowing out the bottom part so that it fits snug on root (b). The cabin is made from a piece of balsa wood  $\frac{3}{4} \times 1\frac{1}{8} \times 5\frac{3}{4}$ ". After shaping the cabin and repeatedly fitting it on top of roof (b), to see that it fits snug, get your ruler. Measure from the entering edge of the cabin—back  $1\frac{1}{2}$ " and cut away the wood from that line to the trailing edge at an angle. The main wing fits on top here. Understand it? Compare with the drawings as that explains it. Now if the cabin fits well, apply cement and ten pins (long ones) and leave it to dry.

While the cabin is drying return to the engines. Get the wing (d), measure in from the wing tip  $9\frac{7}{8}$ ". Draw a line from entering edge to trailing edge. This is your centre line. From both sides of this centre line measure from the entering edge  $\frac{1}{8}$ " and draw another line, lightly. This is the line to which the struts holding up the engines are attached. From the centre line measure  $\frac{3}{8}$ ". The first strut goes there. So mark it with a soft pencil. Measure to one side of that mark  $\frac{7}{8}$ " and make a pencil mark there. Ruler again. Measure from the line you drew parallel to entering edge another line  $1\frac{1}{16}$ " from entering edge. On this line go all the rear struts holding up or supporting the engines.

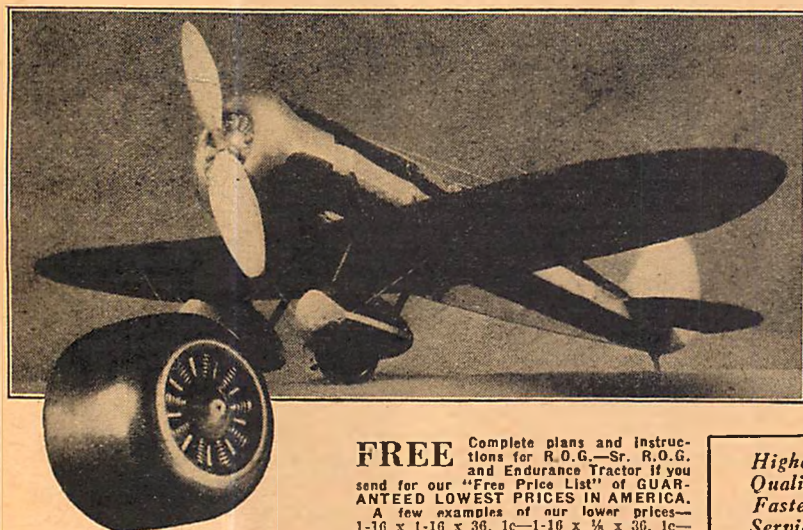
Place each engine supporting strut in its designated position and cement it. Insert small ribbon pins to make them doubly secure and rigid. Now take the struts marked on the drawings by (y) and put them in place by cementing and pinning (small pins). Next come the brac-

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ing struts between the motors marked (v). There are ten of them. Put them in position but don't cement them. Merely insert pins and see if motors are lined up straight from all sides. If so, then apply a little cement and push pins all the way in. Now attach the wing by putting long pins in—five on each side. Use cement first, of course. Always wipe off any excess cement that might be squeezed through sides so that it is smooth. Get the interplane struts marked (r) and attach them to the tip of upper part of fin (o) and under part of wing (d). You will notice that the last strut is longest so start with the middle strut and lay it in place. Mark or place a pencil dot  $5\frac{3}{8}$ " from the wing tip. Draw a line from entering edge to trailing edge on the under side of the wing. Regardless of the length of these struts, cut off so that they fit snugly from fin to wing. Now cement and pin all of them. They should now align straight. The same operation applies to the struts from fin to fuselage. These struts are all purposely longer than necessary because they are of different sizes or lengths. Just cut off the extra lengths after you have measured the distance from the fin to fuselage. Take the  $\frac{1}{8}$ " reed and either very carefully cut it in half or sand half of it away (lengthwise). This is for the beading that goes around the fuselage at point marked. Be careful in putting it on as it splits easily. If you have a small drill I would suggest you drill holes first and apply cement along as you go. Push the pins all the way in and let dry. On the cabin roof are four pieces more, two on each side of the centre line. You may

use  $\frac{1}{16}$ " reed for that. On the sides is the insignia that comes last.

Now look at your drawing and see where the bracing wires between interplane, empenage and engine struts are located. Get your linen thread and small pins. Wind the end of your thread around a pin and push in place. Next cut off the end of the thread that is left over. Draw the thread fairly tight and wind it around the pin. Push it in place. Do that to all

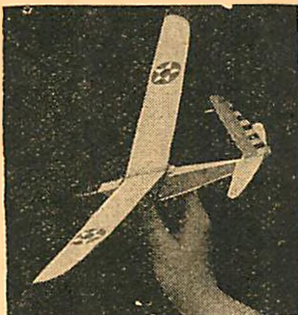
the bracing wires and do not dope or paint these threads.

Painting your model is a work of art and requires care. Do it neatly. On the motors, for vent holes, I would suggest black paint. The bottom of your model is black and the balance is silver. The lettering should be first blocked out and filled in with black paint. Do not forget that the radiator can be painted with black paint or ink.

### Necessary Material

- 1 piece balsa for fuselage,  $1\frac{3}{4} \times 2 \times 15\frac{3}{4}$ "—A
- 1 piece balsa for fuselage root,  $\frac{3}{8} \times 2 \times 15\frac{3}{4}$ "—B
- 1 piece balsa for cabin,  $\frac{3}{4} \times 1\frac{1}{8} \times 5\frac{3}{4}$ "—C
- 1 piece balsa for wing,  $11\frac{1}{16} \times 3\frac{13}{16} \times 19$ "—D
- 2 pieces balsa for auxiliary ailerons,  $3\frac{32}{32} \times \frac{1}{4} \times 1\frac{1}{8}$ "—E
- 4 pieces balsa for auxiliary horns,  $1\frac{1}{16} \times \frac{1}{8} \times \frac{3}{8}$ "—F
- 4 pieces balsa for auxiliary rods,  $1\frac{1}{16} \times 1\frac{1}{16} \times \frac{1}{2}$ "—G
- 1 piece balsa for fin and rudder,  $3\frac{1}{16} \times 1\frac{3}{4} \times 1\frac{7}{8}$ "—H
- 2 pieces balsa for auxiliary rudders,  $\frac{1}{8} \times \frac{3}{8} \times \frac{3}{4}$ "—I
- 1 piece balsa for upper stabilizer,  $\frac{1}{8} \times 1\frac{3}{8} \times 6$ "—J
- 1 piece balsa for lower stabilizer,  $\frac{1}{8} \times 1\frac{1}{4} \times 1\frac{3}{4}$ "—K
- 2 pieces balsa for auxiliary stabilizer,  $1\frac{1}{16} \times 3\frac{1}{16} \times 1\frac{1}{4}$ "—L
- 4 pieces balsa for horns for stabilizer,  $1\frac{1}{16} \times \frac{1}{8} \times \frac{3}{8}$ "—M
- 4 pieces balsa for rods for above,  $1\frac{1}{16} \times 1\frac{1}{16} \times \frac{1}{2}$ "—N
- 2 pieces balsa for lateral fins,  $\frac{1}{2} \times 1\frac{3}{8} \times 3\frac{5}{8}$ "—O
- 6 pieces balsa for motors,  $7\frac{1}{16} \times 9\frac{1}{16} \times 1\frac{1}{2}$ "—P
- 24 pieces balsa for propellers,  $3\frac{32}{32} \times \frac{1}{8} \times 1\frac{3}{8}$ "—Q
- 6 pieces balsa for interplane struts,  $\frac{1}{8} \times 3\frac{1}{16} \times 2\frac{3}{4}$ "—R
- 6 pieces balsa for interplane struts,  $1\frac{1}{16} \times \frac{1}{8} \times 2$ "—S
- 24 pieces balsa for engine bed struts,  $1\frac{1}{16} \times 3\frac{32}{32} \times 1\frac{1}{2}$ "—T
- 4 pieces balsa for empenage struts,  $1\frac{1}{16} \times 3\frac{1}{16} \times 1\frac{1}{2}$ "—U
- 12 pieces balsa for engine bracing struts,  $1\frac{1}{16} \times 3\frac{32}{32} \times \frac{7}{8}$ "—Y
- 10 pieces balsa for struts between motors,  $1\frac{1}{16} \times 3\frac{32}{32} \times 1\frac{1}{8}$ "—V
- 1 piece balsa for water rudder,  $\frac{1}{8} \times \frac{1}{4} \times \frac{3}{8}$ "—X
- 1 piece balsa for hatch cover,  $1\frac{1}{16} \times 9\frac{1}{16} \times 9\frac{1}{16}$ "—W
- 32 inches reed for beading around fuselage—Z
- 10 inches reed for beading on roof of cabin

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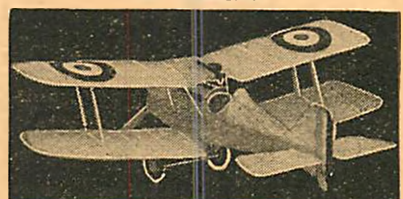


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(Continued from page 25)

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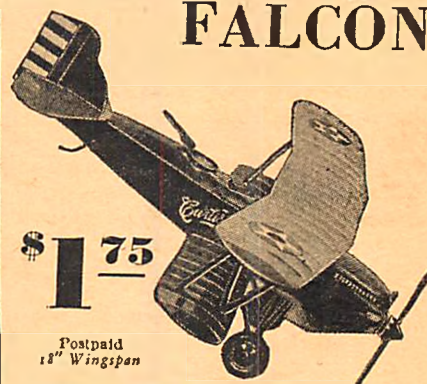
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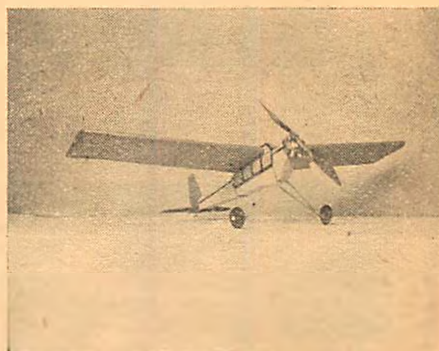
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## Aviation Advisory Board

(Continued from page 36)

combat record as any unit, being officially credited with the destruction of thirteen enemy aircraft, twelve successful raids on enemy territory, and many of its individual members being decorated by the United States, England and France. Each successful raid was equivalent to the action of much artillery, and this effect was felt far beyond the extreme range of artillery.

After the Armistice, the unit was ordered about and finally reached home in 1919. After a short stay at Mitchell Field, it was reorganized, many of the old members, being weary of war and its attendant miseries, having accepted discharge and the sixty dollars. However, many youngsters who had missed service because of youth began to enlist, and the unit was rebuilt and ordered to the Mexican Border, taking home station at Kelly Field, from whence it had started many months before. It left Kelly Field as an organization of the Army and returned a unit of America's fighting forces, a distinction that may be hidden from the layman but well known to any veteran.

During the years 1920 and 1921 not much happened to the Eleventh, that is, anything which may be called unusual. In 1922 it was ordered to Langley Field, Va., where it carried on under the command of Lieut. James Grisham. Arriving at Langley, it became again a part of the Second Bombardment Group, composed of those illustrious units which had made up the organization during the war. They were equipped with Martin Bombers, at that time the most menacing war machine in existence, and proceeded again to a state of training which would justify the record held before.

In 1923, General Mitchell, having secured two battleships—the Virginia and the New Jersey—prepared a strenuous program. He came down to Langley Field and took active charge, and only those who know him can appreciate what "active charge" by General Mitchell meant. Along with practice bombing, it was planned to move the entire Group from Langley to Bangor, Maine, between daylight and darkness. Old heads said it couldn't be done and lots of young ones argued. When General Mitchell gave the signal, the Group, under the command of Major John Reynolds, took off from Langley Field, twenty-seven ships strong, with enough tentage, rations and equipment for the establishment of a camp.

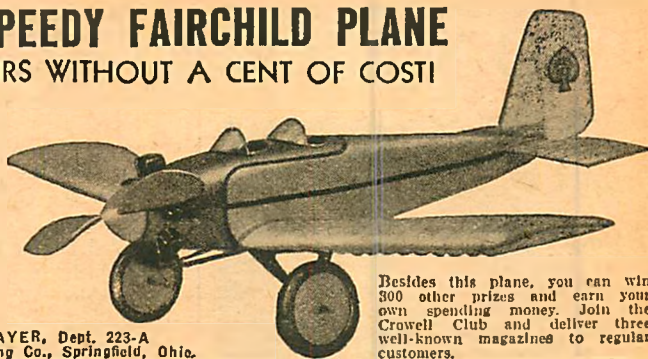
In September, everything being ready, the Group moved to Cape Hatteras to prepare for the sinking of the battleships. Two-thousand-pound bombs were carried and the ships were sunk, all of which resulted in much newspaper comment.

After this epic, the unit returned to Langley Field and rested for a week, and then again took up their training, which continued until 1926, when the Eleventh was placed on the inactive list, the personnel being sent to March Field, Riverside, Calif., and there assigned to the reconstituted 54th School Squadron.

The Eleventh was reorganized on June 1, 1928, with an authorized enlisted strength of 115. Rockwell Field is the present home station of this squadron

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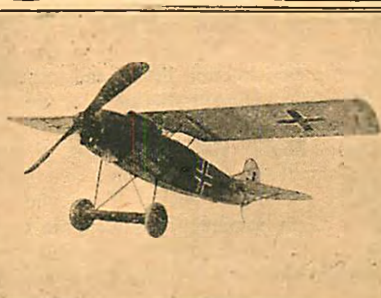
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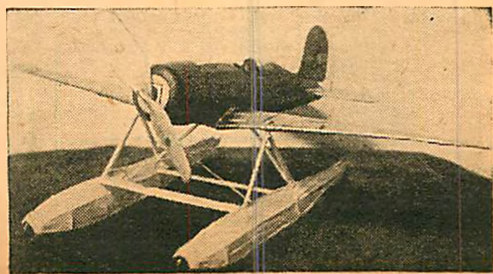
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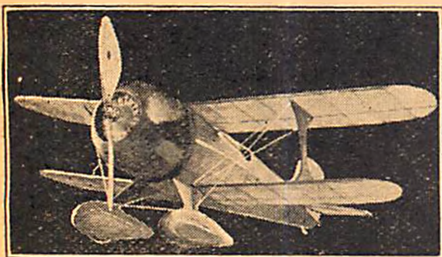
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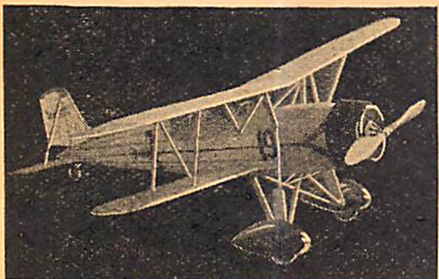
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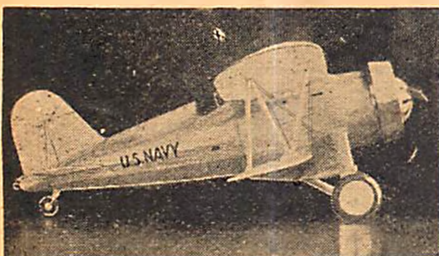


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## Airplane Engines

(Continued from page 9)

throw, or at most, a double throw crankshaft and a short crankcase, the air-cooled engine is inherently lighter. This again will increase the performance of the plane in which the engine is mounted.

The one big disadvantage of the radial air-cooled engine has been its large frontal area which increases its head resistance. As a matter of fact, this head resistance is not so great as was formerly thought. Actually, it is not much more than the resistance of the radiator of the water-cooled type of engine. Granting that water-cooled powerplants have contributed to many speed records, one might surmise that the water-cooled engine is far superior in the matter of streamlining. On the other hand, it must not be forgotten that this speed was obtained by using wing radiators which offer little head resistance.

Moreover, wing radiators are not practical for either commercial or fighting planes. Slight vibrations cause them to leak; therefore they are not suitable for straight commercial work. Their wide area makes them particularly susceptible to bullets in the case of the fighting plane; therefore they are not practical for military work.

Consequently, the special methods of obtaining speed from the water-cooled engines is not applicable, for other than speed or racing planes. On the other hand, the recent use of various types of cowling on the radial engines has reduced their head resistance many times. As much as twenty-five or thirty miles per hour have been added to the top speed of the planes so equipped. This has tended further to reduce the speed advantage formerly held by the water-cooled engine.

The concentrated mass of the radial engine permits it to be mounted in a plane having a comparatively short length. This is known as a short-coupled ship and will have a much smaller turning radius. This feature is particularly effective when made use of as in a fighting plane, for it will permit the air-cooled job to turn inside of a plane equipped with a water-cooled engine during a dogfight. This maneuver should result in victory for the inside-turning pilot.

One frequently hears about the poor visibility of a radial engine. On the contrary, the pilot is enabled to see between the cylinders—something he can not do when sitting behind a long, water-cooled engine. This point is used to advantage by naval pilots when landing aboard the restricted deck of an airplane carrier.

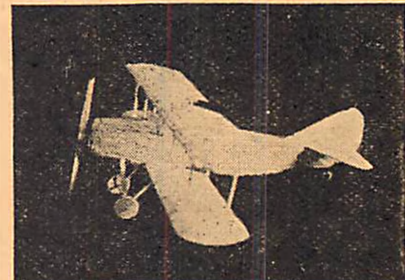
The radial engine is far easier to maintain than the long, complicated liquid-cooled engine. It is a simple matter, for instance, to pull off a cylinder from the radial engine. It is held in place merely by the holddown lugs. However, it is a far different proposition in the water-cooled engine. First, one must remove the camshaft and its housing which at best is a complicated job. Some of the older engines are made in blocks. That is, in order to pull one cylinder one must remove a block of at least three. Maintenance, then, is a complicated job.

Another fact that is frequently over-

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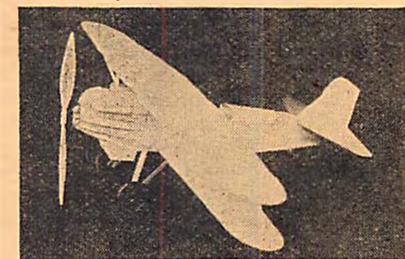


Untouched Photo of 24" Flying Scale S. P. A. D. Model after winning Indoor Eastern States Championships.

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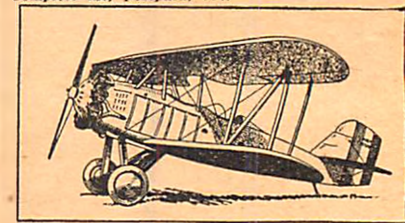


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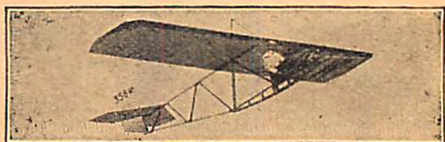
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looked is the ability of the air-cooled engine to warm up quickly. At first thought the value of this point may not be apparent. Consider it, however, from a military point of view. Suppose word reaches a squadron that a bombing raid is being made on a certain locality. The squadron is ordered to intercept the bombers. That means that they must get in the air in the shortest possible length of time. To do this safely the engines must be warmed up thoroughly and quickly.

The reason for this feature is, of course, that the cooling of the air-cooled cylinders depends on the constant supply of fresh air that results when the plane is actually moving through the air. The propeller alone does not provide sufficient cooling effect to the engine. On the other hand, before the liquid-cooled system is warmed, it must first heat the total amount of liquid in the system. This takes considerable time.

While the air-cooled engine very definitely appears to have the most advantages at the present time, will it maintain this position in the future? The trend in aeronautical engineering is distinctly towards larger and more powerful engines. Let us study the influence this will have upon the radial type of air-cooled engine.

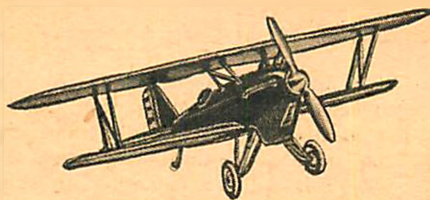
The nine cylinder design is a general favorite of the engineer. It happens that there is just space enough on the periphery of a circular crankcase to permit the nine cylinders. Of course, one might use more, say eleven cylinders, but the cylinder bore would of necessity have to be reduced. It is seen, then, that in the end no gain of power would have resulted. Another method would be to adopt a two-throw crankshaft and use two rows of cylinders. This has been done quite successfully on low-powered engines but it has been found difficult to cool the second row of cylinders in high-powered designs.

Still a third type of engine might be built. This would be either an in-line or Vee engine which was air-cooled. Many attempts have been made along these lines but none of them has ever been completely successful, although, low-powered engines can be adapted to this design and many of them are on the market today. However, up to date it has not proved practical for high-powered engines.

The alternative is to increase the power in the nine-cylinder radial type of engine that is giving such good service at the present. The dimensions of the cylinder may be increased slightly and will contribute somewhat to the total power. A better and more effective way would be to increase the revolutions at which the engine can safely operate. Since more piston strokes would occur each minute, more power would be delivered to the propeller.

If higher rotative speeds were used, however, the mass of revolving parts centered about the crankshaft end of the master connecting rod would set up tremendous centrifugal forces. To provide for these stresses it would be necessary to strengthen these parts far beyond their normal requirements. Thus, the favorable power-weight ratio would be decreased.

Another important limitation of the power of the air-cooled engine is the heat dissipation problem. As the power in-



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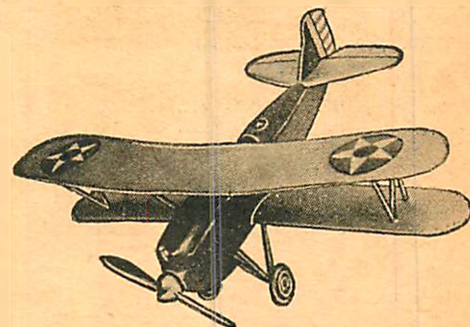
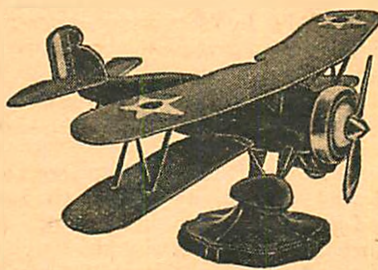
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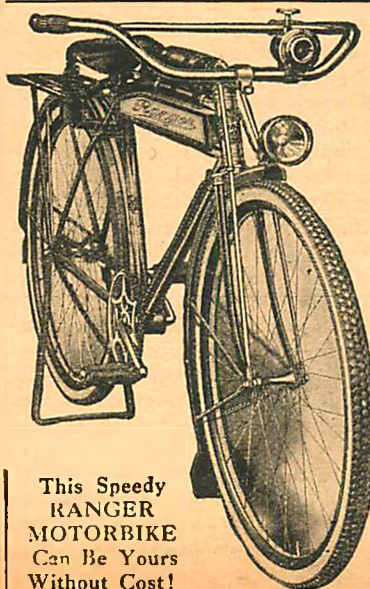
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creases, the heat increases because of the release of more heat units. As we have seen, designers frequently encounter these difficulties even at lower powers and, consequently, we can expect a temperature to be reached in the high-powered design where it will be impossible to cool the engine.

The result of this distinct limitation of the air-cooled engine would appear to force us back to the adoption of the liquid-cooled powerplant with the many disadvantages of the water plumbing system. However, if we could discover some liquid which would cool the engine efficiently and still have a smaller volume than water, we could eliminate much weight from the water jackets and the size of the radiator, to say nothing of using less weight of liquid. Moreover, the drag on the radiator would decrease proportionally.

Fortunately, such a liquid has been found after several years of investigation. Commercially known as Prestone, this liquid is ethylene glycol, a member of the alcohol family. It possesses a boiling point of 388° F. In other words, since it can be allowed to reach a higher temperature than water without boiling away or causing a vapor lock in the cooling system, a smaller volume of the liquid may be used.

The temperature of the coolant as it leaves a well-designed radiator will always depend on the atmospheric temperature and the cooling effect of the plane's speed. Therefore, no matter what the temperature of the Prestone as it leaves the engine, it will always be normal when it again is circulated into the cooling jacket. The engine will thus be properly cooled although working at a higher temperature than would be the case if it were using water.

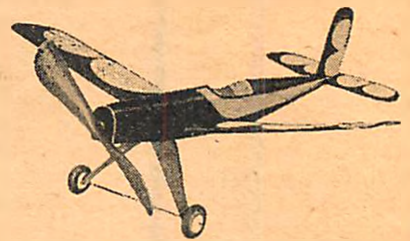
Because of the higher maintained cylinder temperature less heat will be transferred to the side walls from the gasses of combustion. Consequently, more heat units will contribute to useful work resulting in increased efficiency. Thus, increased economy can be had with the Preston-cooled powerplant. This, in spite of the fact that the hotter cylinder walls will expand the incoming gases and result in decreased volumetric efficiency.

The radiator can be decreased in this system to one-fourth the size necessary in the water-cooled engine. This will decrease the total drag of the aircraft as much as five per cent. An increase of speed is the result. In addition, this type of installation will weigh approximately 100 pounds less and this will give greater climb and higher ceiling.

It must be remembered, however, that the plumbing difficulties have not been eliminated. This is particularly important with Prestone, for the liquid is quite fluid and will search out cracks from which to leak. Another disadvantage is that Prestone is not available throughout the country. If a leaky radiator caused a loss of the coolant, it might be impossible to obtain a supply except at a great distance. Nor has the vulnerability to gunfire been reduced.

If the plumbing system is especially designed for the purpose, a steam-cooling system is very effective. This type of construction has met with great favor in England recently. When water absorbs a cer-

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tain amount of heat it will turn into a vapor. This steam also has the ability to absorb a further number of heat units. If led off from the tops of each cylinder jacket, it will not cause a vapor lock. Passing to a small air-cooled condenser the vapor will be cooled and again be reduced to water. Further cooling will bring its temperature back to normal and it is circulated through the cooling system over and over.

This type of design is distinctly different from the water-cooled system. Less volume of water need be carried. Smaller water jackets and a smaller condenser, a form of radiator, is necessary. Less weight and head resistance and its consequent advantages will result. One outstanding advantage of this system is its invulnerability to machine gun fire. If a bullet should pierce a jacket, only steam will be emitted. This would be equal to only a comparatively small volume

of water, and the engine would continue to perform satisfactorily.

Perhaps the future will disclose some cylinder and piston alloy which will stand up under the heat of combustion without the necessity of cooling. Then will the thermal efficiency of the internal combustion engine increase beyond the pathetically small twenty per cent that is common at the present. Then, perhaps, will the wild predictions of power and speed that are made so freely now come true.

The next article will deal with the various accessories used on the airplane and its engine. Among these will be superchargers, starters, reduction gears, and propellers. While not actually a part of the engine, they are equally important in that the engine is more or less useless without them. They permit the pilot to extract more power from his engine.

## Course in Aerial Radio

(Continued from page 23)

things being equal) if operations are conducted on a fifty meter band.

Do not forget in calculating the length of your aerial to include the lead-in wire. In this case, the length of the aerial between the two insulators, plus the length of the lead-in wire from the aerial to the set binding post should be forty feet. The aerial should be as high as possible to secure the best results.

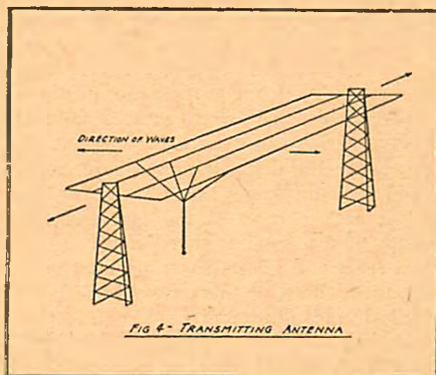
Stranded or braided copper wire will be the best for an aerial of this size, and when buying it see that you do not get a gauge smaller than No. 16 American Wire Gauge. No. 14 probably will be better, and some amateurs favor the use of solid enamelled copper wire, size 14 or 12. Solid wire is not such a good conductor as stranded wire; but the enamelled surface protects it from corrosion which so soon attacks bare wire and decreases its efficiency as an aerial.

Now let us study Figure II. We have used a single wire aerial because it is simpler to construct. A two wire aerial will give better results in transmitting than a single wire, and three wires will be still better. The principle of construction remains the same, but the wires must be spaced well apart. Measure out the wire to the correct length (not forgetting the lead-in wire), slip each end through a hole in the insulators, and twist it back round the wire so that it holds fast.

Next get two short pieces of wire and insert them through the remaining holes in the insulators. The other ends of these

pieces are then secured to the masts in such a manner that the aerial is held taut. If possible the wire should run parallel to the ground. If it is necessary to run it at an angle, make this as gradual as possible.

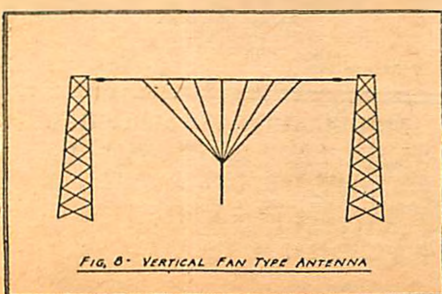
Next twist the lead-in wire to the end of the aerial lying nearest to the house, as shown in the example, and solder it on firmly. This lead-in wire must be connected to the middle post of the lightning switch. The lightning switch would be screwed on to the side of the house in actual practice. In Figure II it has been shown detached for the sake of clearness.



From the bottom post of the lightning switch run a length of thick copper wire down the side of the house, and connect to an iron bar or stake that has been driven in the ground. The planning of your aerial in this manner will prevent it ever becoming a menace during a storm. Instead, it will perform the functions of a lightning conductor and be a real protector.

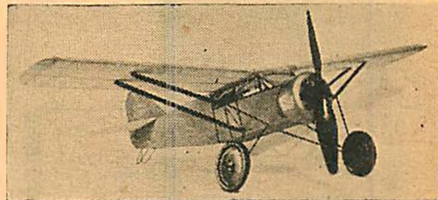
Bore a hole through a bottom corner of the window frame where it will be least noticeable and insert a porcelain lead-in insulator. A wire passes through this from the top post of the lightning switch and is connected to the aerial post of your set. From the ground binding post of the set a further wire is led and earthed by being clamped on to the water pipe in the manner shown. The set is now ready for testing.

Insulators form an important part of an



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antenna installation and should be used wherever necessary to keep wires from touching the outside of the house. The aerial masts must be strong enough to keep the aerial from sagging, as this interferes seriously with the maintenance of a proper wave length. Guy ropes should be used to strengthen where necessary.

If you are going to use two or more wires for the aerial, you will need a pair of spreaders to keep the wires apart. The lead-in wire will be similar to the one shown, with the addition of a second wire soldered to the other aerial wire and soldered again at its other end to the main lead-in wire, as illustrated in Figure 7.

The ground wire should be of No. 14 American standard gauge or larger and must run as directly as possible to the ground. The water pipe is the most approved form of grounding, and the wire should be clamped, not soldered. Gas piping is not allowed as a ground connection. These are points required in Government regulations and must be observed in all radio installations.

In a later article we will deal with the assembly of transmitting and receiving sets.

## Designing Course

(Continued from page 26)

airplane usually resembles the conventional ship more or less closely. Most light planes are monoplanes. Most of them are tractor ships; although a few are pushers and many engineers contend that the pusher is the logical thing.

In internal design, too, the light plane follows along conventional lines with some refinements and simplifications.

In most present-day light planes, the wings usually are built up of wood spars and ribs, covered with doped fabric and braced internally and externally by struts and wires. The spars, in these long, narrow wings, must be well designed. Very long spars have to be strong at their root portions in order to do their work without failure. However, weight must be kept down at all times; hence the designer must figure closely, and he must know the exact stress applied at each portion of the spar and the strength of the wood at that point.

Box spars and I-beam spar are most generally used. Both of these types have been explained and illustrated earlier in this course; but we'll just say that the box spar is one built up with spruce top and bottom portions and plywood sides tying these spruce portions together and providing a great deal of the strength. An I-beam is a solid beam having the sides hollowed out so that the beam, when viewed in cross-section, looks something like a capital I.

Several light planes employ spars of plain rectangular section; that is, solid spars that are not hollowed out, or routed, along the sides for lightness. It is for the designer, when studying the problems of design brought about by each individual ship, to decide which type of spar is best suited to his needs.

As for the light plane fuselage, steel tubing, welded into a light, strong structure, is most generally employed. Sometimes this fuselage has a triangular shape in cross-section. Sometimes, too, duralumin monocoque construction is employed. This last type consists of a duralumin shell, having no

longerons or compression struts, depending on the shell of metal for its strength.

Whatever system is used, the object of the designer is the same; to build a light, cheap, strong job that will last. The design of the fuselage is a complicated business, bringing in an appalling amount of mathematics, and is a matter of advanced engineering skill.

The control surfaces of a light plane are quite like those of a heavier ship; conventional rudder, flippers, and ailerons are used. However, the designer has to watch out for one thing in particular, flutter. In designing the light plane, with the main object of keeping down weight, we often have large control surfaces built up of small structural members. Often the designer finds that the control surfaces are not strong enough, or that they are not sufficiently braced. Then, when the ship is flown, a peculiar effect called flutter bobs up.

Flutter usually starts as the result of a dive; or sometimes after passing through a severe air bump. The cause is not yet quite clear, but it is probable that, with improperly braced surfaces, the dive or bump sets up an added stress and bends the structure slightly. This first bending sets up a change in the air stream, which in turn changes the forces on the surface. The surface is suddenly forced back beyond its original position, going further though, and another set of forces come into play, forcing it back.

Thus, by a rather obscure process, a violent oscillation, or back-and-forth movement, is set up. This oscillation may wreck the whole ship. Wings having poorly designed tips and ailerons have been known to be broken loose from the ship entirely by flutter. Thus we see that the designer can afford to take no chances, even while doing his level best to keep down weight, with improper bracing of control surfaces and the resultant danger of flutter.

However, the designer must not be content to stop with just aerodynamic and structural efficiency. He must consider the man who is to fly the ship. The plane must be stable and yet it must not be so stable that it is "stiff" on the controls. The private pilot wants a ship that will obey the slightest pressure on the stick; yet he wants a ship that almost will fly itself, if need be.

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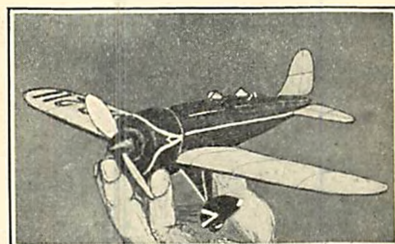
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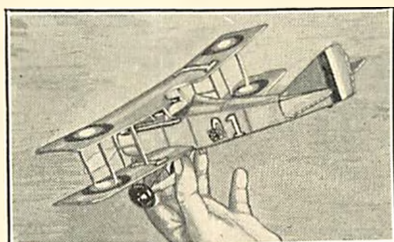
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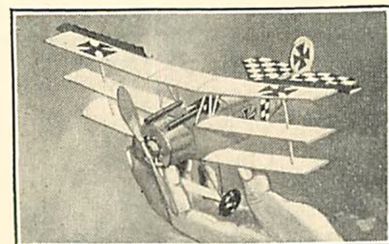
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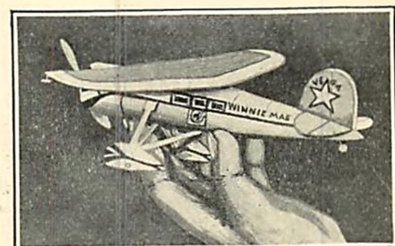
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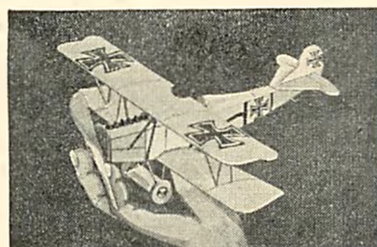
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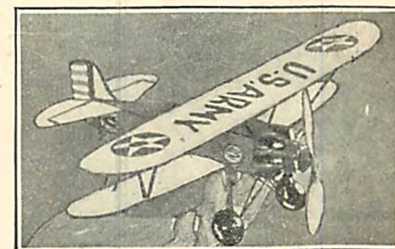
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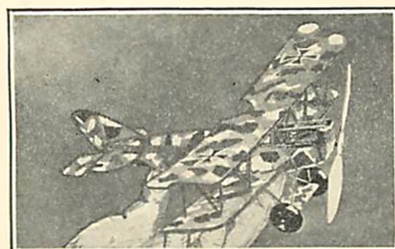


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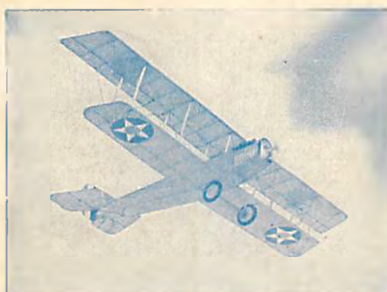
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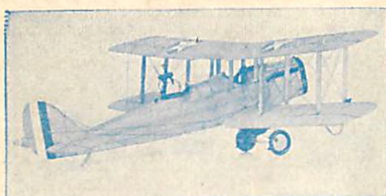
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