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MAY
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AIR TRAILS

MAY, 1942 — VOLUME XVIII NO. 2

15 CENTS PER COPY — $1.50 PER YEAR

A STREET & SMITH PUBLICATION

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The Cobra Strikes

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L to R, .30 cal., 50 cal., and shells for the Airacobra's 37-mm. cannon.

Joined by metal links, the cannon shells are fed into the removable magazine box.

These three P-39s pull out after a diving attack on the riddled target still partially screened by dust from the gun bursts.

.50-cal. machine guns in nose are also loaded with linked cartridges.

Off for the range, this Airacobra begins to retract its gear as it leaves the ground. Note cannon muzzle.

Clouds of dust rise from the huge targets as six P-39s dive with all their guns blazing.

Post-mortem. Instructor points out hits to pilots after a run on the target. Pilots train at Camp Skeel a month.

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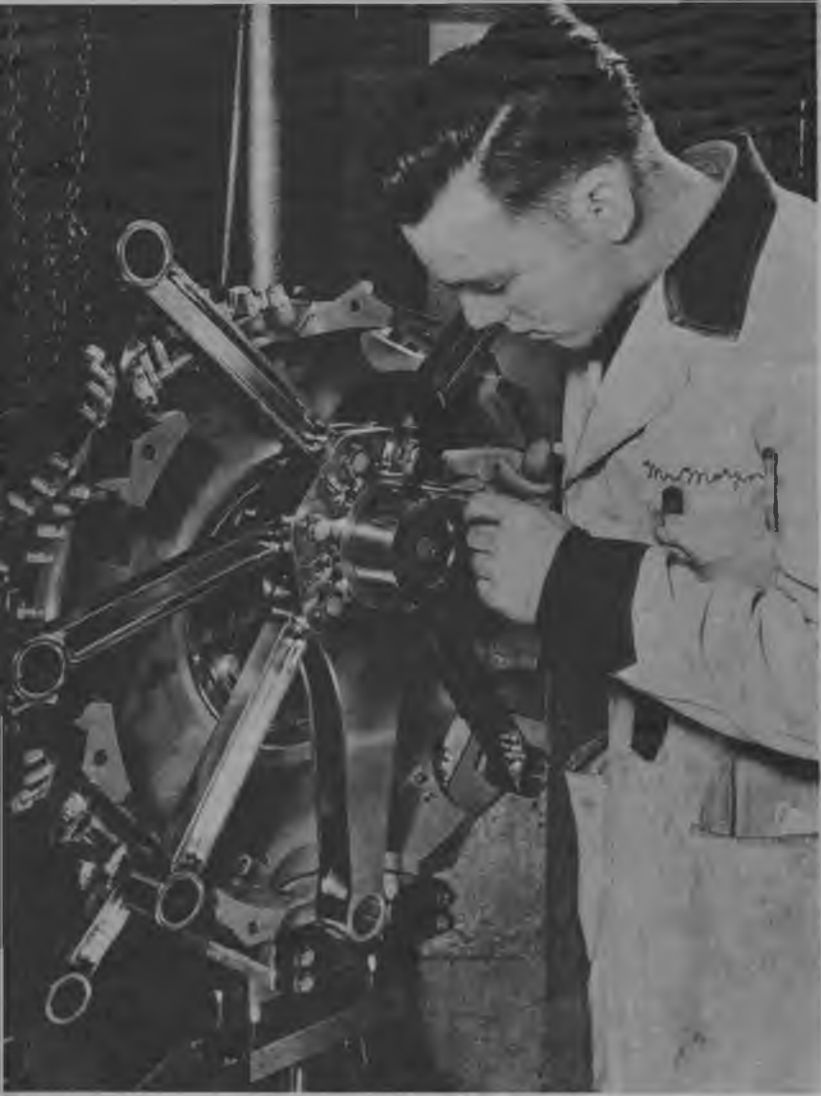
A. T. MAY, 1942

What do you mean, PRECISION?

BY H. E. LINSLEY

If you've wondered about tolerances in aircraft engines, how fine or how measured—here's how in simple terms.



Nothing short of perfection. Here an expert uses a micrometer gauge to check master and articulator rod assembly on a 14-cyl. Wright Cyclone engine.

THE entire system of mass production of interchangeable parts is based on the principle of manufacturing tolerances—that is to say, every dimension of a part is held to certain fixed limits above or below which it may not go. Thus, for example, if the desired diameter of a certain shaft is half an inch, it may be held to limits of plus or minus two one-thousandths of an inch; or in other words, the shaft would be accepted if it were two one-thousandths larger or two one-thousandths smaller than half an inch. The limits used depend, of course, on the degree of precision required and the type of service demanded, but it must be remembered that the smaller the limits the more difficult and the most costly the part will be to produce.

When parts are required to fit together, as a shaft in a bearing, the difficulty of "multiplied limits" immediately arises. Thus, taking the half-inch shaft as an example, if this is made half an inch in diameter (.500") and limits of plus or minus two one-thousandths (+.002") are allowed, it would be possible for the shaft to be as *big* as .502" diameter. Since a certain allowance must be made for clearance to permit the shaft to turn, say one one-thousandth of an inch (.001"), it is obvious that the *smallest* permissible diameter of the hole in the bearing must be .503". This size is known as the low limit of the hole. A manufacturing tolerance must also be provided for the hole by setting a high limit, and if this is to be the same as for the shaft, namely, four one-thousandths, then the largest size will be .507".

If the shaft is made to the high limit (.502"), and the hole to the low limit, (.503"), the one-thousandth-of-an-inch clearance will result in a nice easy fit, but when hundreds of parts are being made, this condition will not often occur, and it is possible that a shaft made to the low limit (.498") may meet a hole made to the high limit (.507"), resulting in a clearance of nine one-thousandths, which would be far too loose for accurate working. The remedy, of course, is to reduce the limits, but this immediately makes production more difficult and consequently more expensive.

It may be argued that if the limits were cut out altogether these troubles would be eliminated, but this is not possible when hundreds and even thousands of the same part are to be made by scores of different men in the shortest possible time. Even though a part were to be made to a certain exact size with great care and patience, it is probable that by the time this reached the inspection department the size would no longer be exact due to the difference in temperature. When heated, metals expand, and a part which measures exactly .500" in diameter at six o'clock on a cold morning may easily grow several ten-thousandths of an inch after lying for a few hours in a sunny corner. True, a ten-thousandth part of an inch is not very much, but it is sufficient to keep the size from being exact. Here again the necessity for limits becomes apparent, to take care of the changes in size between production and inspection.

For some classes of work where exactness is relatively unimportant, as for instance the outside diameter of a cylinder barrel, the limits may be as great as plus or minus ten one-thousandths of an *(Turn to page 58)*

Plug gauge for checking hole sizes. Short end marked "no go" should not fit hole; long end marked "go" should.

Johannsen block snap gauge for checking outside diameters. Once set, these "Jo" gauges are sealed tight.

DESIGN *for Daring*

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What's Your Question?

QUESTION: Could you please tell me the wing span and length of the following planes: Fokker D-23, Karigane 96, Blackburn Skua, Saro Lerwick, Vultee Vengeance, Douglas TBD-1, Curtiss P-36A, and Vought-Sikorsky OS2U-1? R. H., Fresno, Calif.

Answer: We do not have the complete figures on some of the ships mentioned, but here are those we have: Fokker D-23, Span 37 ft. 9 in.; Karigane 96, span 39 ft. 4¾ in., length 27 ft. 11 in.; Blackburn Skua bomber, span 46 ft. 2 in., length 35 ft. 4¼in.; Roc, span 46 ft., length 35 ft. 7 in.; Saro Lerwick, span 81 ft., length 63 ft.; Vultee Vengeance, span 48 ft.; Curtiss P-36A, span 37 ft. 3 in., length 28 ft. 8 in.

Question: Could you inform me if there are any glider organizations within the vicinity of Oakland, Calif.? J. Y., Oakland, Calif.

Answer: We suggest that you write to the Soaring Society of Northern California, 406 Sutter St., San Francisco, Calif., regarding glider clubs in your vicinity, or the Soaring Society of America, Inc., Box 71, Elmira, N. Y.

Question: Where can I purchase the instrument called "spacing dividers" used in air navigation to divide the course into equal time intervals? This same instrument can also be had with a special ground-speed arc. What is the price of it? H. W.

Answer: Sorry, we do not know the price of the above-mentioned instrument. It can be purchased from Air Associates, Inc., Bendix, N. J.

Question: Can you tell me if the aeronautical engineering course at Parks Air College is government approved, and are foreign languages required for it? M. B., Columbus, Ohio.

Answer: The engineering course at Parks Air College is approved by the educational authorities and graduates of it are recognized as full-fledged aeronautical engineers. For language requirements write directly to Parks Air College, East St. Louis, Ill.

Question: Could you tell me what are the requirements of an aeronautical draftsman and what is the best approach for obtaining a job in the field? G. N., Newport, Ky.

Answer: Most concerns prefer hiring draftsmen with some engineering experience. However, any person who is experienced in mechanical drawing and does his job well has a good chance of employment in the aviation industry. The usual approach is to file an application with the company, stating your experience, and inasmuch as there is a demand for this type of man, chances to obtain a position are pretty good.

Question: What is the streamlined object underneath a Curtiss SBC-4? A friend of mine said it was a bomb. I said it is an auxiliary gas tank because it has no fins. Could you settle our argument? Also tell me where to get a copy of the "Model Aircraft Handbook." J. P., Detroit, Mich.

Answer: The streamlined object under the fuselage of the SBC-4 is an auxiliary gas tank. You can get "Model Aircraft Handbook" from Thomas Y. Crowell Co., Dept. AT, 432 Fourth Ave., New York City.

Question: Will you please tell me how I can join the Air Youth of America Club? E. A., Paris, Texas.

Answer: For the above information, write to the Air Youth of America, 30 Rockefeller Plaza, New York City.

Question: Could you tell me what the present address of the Soaring Society is and who is its president? H. M. G., U. S. Marine Hospital, Boston, Mass.

Answer: The address of the Soaring Society of America is Box 71, Elmira, N. Y. Its president is Parker Leonard.

Question: How many blades have the propellers of the Flying Wing got? What is the speed of the following airplanes: Fokker D-8, Pfaltz, Spad 13, Albatross D-5, Sopwith Camel, SE-5, Fokker D-7, and Boeing P-26? R. Y., Brooklyn, N. Y.

Answer: The Flying Wing is equipped with two-bladed propellers. We cannot give you the speeds of all airplanes mentioned, but here are some of them: Pfaltz, 103 m. p. h.; Spad 13, 120 m. p. h.; Albatross D-5, 123 m. p. h.; Camel, Clerget engine, 113 m. p. h.; Fokker D-7, 116 m. p. h.; and Boeing P-26, 200 m. p. h.

Question: Can you please tell me if the U. S. army has adopted the following planes: the Skyrocket, Republic Thunderbolt and the Lockheed P-38? If it has, have these planes been put into mass production? C. G., Utica, N. Y.

Answer: Both the Thunderbolt and the P-38 have been adopted by the U. S. army air forces and are in mass production. Sorry, we have no information regarding the Grumman Skyrocket.

Question: In your January issue you mention in the Reviewing Stand the Aircraft Sketchbook, published by Aero-Publishers, Inc. I would like to have this book sent C. O. D., but do not know the publishers' address. Will you kindly let me know it? T. B., Minneapolis, Minn.

Answer: The address of Aero-Publishers, Inc., is 120 North Central Avenue, Glendale, Calif.

(Turn to page 65)

Thin Air Fighter

BY JOHN R. HOYT

Battles in the firmamental cold of the stratosphere are a coming possibility, with ships now being developed, but the most serious problems concern the pilot fighter. Let's look at the picture.

AT 38,000 feet it was cold, so cold that the pilot's streamlined interceptor left a long trail of thin white cloud in the sky. The pilot, keenly aware of the intensity of —67-degree weather, huddled down in his narrow cockpit, nervously fingering the trigger button. His eyes, watchful and alert, scanned the sector from which the stratosphere bombers were coming.

He did not look upward, figuring that this great height was the ultimate, the highest any fighter patrol would ever go. From that altitude he could scan an area of from ten to 30,000 square miles, depending upon the visibility—or from eighty to 240,000 cubic miles of air space! One little slice, or sector, was all he could guard, and yet he knew that the bombers could slip in easily if he failed to be continually alert in watching that one sector. In the stratosphere, objects disappear from sight with amazing quickness.

Without the slightest warning, a crash sounding like stones on a tin roof, and a shattering of the instrument panel jerked the pilot almost to his feet.

At the unbelievably high altitude of 38,000, he was being *dived upon!*

It meant that stratosphere bombers were coming, protected by fighters flying as high as 41,000 feet. It meant that in order to fly higher, the stratosphere fighter pilot could anticipate using pressure cabins or pressure suits in order to live in the low atmospheric pressures eight miles up!

The necessity of pressurized apparatus was brought out in recent experiments in pressure chambers, wherein altitudes of any height can be simulated. It has been found that liquids, when suddenly placed in atmospheres of lower pressure, release gas and bubble. For example, a glass of ordinary drinking water will effervesce if placed quickly at 25,000 feet.

It is well known that water boils at lower temperatures at mountain heights, due to decreased atmospheric pressure. Likewise, blood will boil at a lower temperature than normal when the pressure is lowered. As the blood is always at 98.4 degrees, there is a corresponding low pressure which will permit it to boil, and that pressure occurs at about 61,000 feet. It is easily seen that there are limitations of altitude to which man cannot venture without pressurized cabins.

"Man cannot live in low pressures above 41,000 feet," say the doctors who experimented with animals in pressure chambers. For years all such remarks, like "that's impossible," have been proved false. Yet this remark seems to be true: "Man cannot live above 41,000 feet without pressure apparatus." For example, a certain pilot claimed that he could hold his breath for a minute at sea level, and consequently there was no reason why he couldn't unbuckle his belt, bail out, and fall free to a denser atmosphere where he could open his 'chute safely. But when he tried to do this in a pressure chamber at a simulated altitude of only 30,000 feet, he lost consciousness before he so much as left the cockpit.

The hazard of flying at high altitudes—much more in the stratosphere—becomes apparent. A stray bullet through either the oxygen mask, the pressure chamber, or the pressurized suit would be fatal. The pilot, flying his ship at such an altitude, realizes this, knowing that his plane is many times as vulnerable as it is at anything below 41,000 feet. The reason for this was found to be the lack of alveolar oxygen and pressure. The alveoli, or air cells in the lungs, are capable of retaining residual oxygen when the pressure is normal (760 mm. at sea level). But at 40,000 feet the pressure is so low (152 mm.) that hardly enough residual oxygen is left to maintain consciousness for five seconds, should the oxygen supply fail. These problems are so great that it appears to some that stratosphere bombing or fighting is impracticable. Yet there are others who maintain that the nation that perfects stratosphere flying first will win the war. This, of course, cannot be decided on paper, and although we do not as yet possess any stratosphere fighters to prove it practically, there are many obvious drawbacks to the idea.

For example, the fighter pilot who found himself dived upon at 38,000

feet was operating under severe hardships. Not only was his alveolar pressure low, which induced fatigue and placed his life in constant danger, but the cold, thin air made flying difficult, especially turns and dives. Second, he knew that when the enemy plane dived past that it was his first and last attack. At eight miles up, a plane requires almost twice the altitude for a pull-out as at 5,000 feet or below. An enemy fighter pilot who misses on his first dive simply continues to dive—and get away. The first dive places him at an extreme disadvantage.

Also, the pilot knew that any turn in the stratosphere was being made at a higher air speed than was indicated, and that any attempt to increase the bank in order to turn faster would increase the wing loading. His plane would eventually go out of control and spin. But to recover from the spin would require from 3,000 to *(Turn to page 54)*

Voice From the Tower

BY WILLIAM FLYNN

Ever thought of making airport traffic control a career? Read the life and times of Senior Operator Bill Stockam.

WILLIS (BILL) STOCKAM is one of the senior traffic tower operators at San Francisco Airport. He is thirty-seven years of age, six feet tall, and weighs 200 pounds. A high-school graduate and a student at Leland Stanford University for one year, he has been employed in commercial aviation since 1930. After leaving Stanford, he was employed as a cigar salesman in San Francisco. His home was near Crissy Field, an early army port now abandoned. His natural curiosity in things aeronautical led to friendships with air-line personnel stationed at the Presidia airport in the city's residential district.

The air transport moved its base to the east side of San Francisco Bay. By chance, Stockam's company assigned him to territory there that included the San Francisco Bay Airdrome, the new home of his aviation friends. He renewed his friendships with his air-line acquaintances. Visiting the Bay Airdrome frequently, Stockam took less and less interest in his task of selling cigars. He accepted without hesitation an offer from C. V. Johnson to go to work as a passenger agent for United Air Lines in 1930. When the company moved to San Francisco Airport, Stockam went along. In 1933 the airport management took over a portion of the transport company's ground duties. Stockam was transferred to the city pay roll with other personnel. He became a tower operator in 1935.

To acquire the needed license to work in the control tower, Stockam was required to pass an exhaustive written and oral examination prescribed by the Civil Aeronautics Board and also qualify for a restricted radio telephone operator's license, issued by the Federal Communications Commission. Each year he must pass the same physical examination as required of commercial pilots to hold his license.

The written examination covered civil air regulations, meteorology, and radio operation. Five hours was required for completion of the 200 questions. The oral examination was given by a board whose members were representative of an air line and military aviation services; a Civil Aeronautics Board inspector; a field manager; and a civilian commercial operator. Practical and theoretical problems were propounded by the oral examining board members from their background of experience. All were concerned particularly with individual types of operations and generally with the duties of the tower operator under a combination of hypothetical circumstances and conditions. The proper answers weren't to be found in any set of ready-reference textbooks. They had to come from knowledge and experience, put together by common sense and sound judgment. The oral quizzing continued for one hour.

When Stockam picks up his radio transmitter to start an eight-hour daylight shift, he is required to weave the slow-flying Cubs and Luscombes, the fairly fast Fairchilds, Stinsons, and Fleets, and the high-speed commercial Douglas and Lockheed and Boeing transports using the field into a single thread of traffic that brings every plane into the wind on the proper runway for either take-off or landing without danger of collision with another plane or a ground *(Turn to page 52)*

Willis Stockam, left, talks to a landing plane via radiophone from control tower.

Airplanes Are Growing On Trees

The Langley, designed of mahogany veneer as army trainer, is fireproof, rivet-free, quickly made.

BY EDWARD FENTON

Plastic planes may revolutionize a lot of things. Read this for a clear, compact account of the process and advantages.

Planes by the yard. A giant log in a huge lathe is being shaved in one long continuous strip. This strip, wide as the log is long, is veneer base of plastic plywood.

AIRPLANES are growing on trees. That's not a figurative statement. They are. Our forests are producing an ever-increasing supply of aircraft material—because we have found a new way to use abundant wood in the air.

Of course, wood has always been used to a varying extent as an aircraft material. Many light airplanes have wing spars made of Sitka spruce, and today, as during World War I, armies of timber scouts are combing the Pacific Northwest for prime specimens of that not-too-abundant variety. Only the finest Sitkas are chosen, and even then the most expert sawing is necessary in order to get a product suitable for aircraft.

But the development of synthetic resins and of new methods of molding bonded plywood now make it possible to use for aircraft a vast supply of woods hitherto considered unsuitable. Such plywood can be used for jobs which previously required strategic metals. Wings, fuselages, tail assemblies can be made completely from plywood. In fact, when plywood construction is employed, nine tenths of an airplane can now be made from noncritical materials. Five "flying trees" have already been flown successfully. First of them was the Duramold-Clark monoplane, which won CAA recognition as long ago as 1938. Others, all of which took to the air more recently, are the Langley, the Morrow, the Timm and the Vidal Summit.

Though during the past few years wood has given way to metal as an aircraft material, engineers have always known that wood is strong for its weight—a high strength-weight ratio, they term it. Spruce, for instance, is stronger ounce for ounce than either high-tensile steel or duralumin, and wood has other qualities that make it suitable for aircraft. It is a poor conductor of heat and sound and thus can absorb vibration, but will not "ice up." Moreover, it is an easy material to work with. But wood has disadvantages, too. Because of the way its cells are arranged in longitudinal grains, it is stronger parallel to the grain than when normal to it. Its strength is also affected by its moisture content, variation of which may change its dimensions and thus make it unsuitable for high-precision work. Formerly its strength could not be controlled. *(Turn to page 63)*

War-

The Lockheed Ventura, developed from the popular Hudson bomber, features more power (nearly 275 m. p. h.) and a rear belly turret the Hudson lacked.

This striking flight photo of the new Boeing B-17E Fortress shows the many new features of this sensational performer of the substratosphere. This new heavy-duty long range bomber has added fin area for directional stability in making bombing runs in the thin air of high altitudes, new tail, top, and belly turrets and nose-gun positions

The Kittyhawk P-40D, later version of the Curtiss P-40 Tomahawk, boasts greater horsepower, better streamlining, and more fire power. Should do 400 m. p. h.

Red star raider. This Russian Ilyushin medium bomber, also known as the DB-3a, can carry over 2 tons of bombs long distances. Believed to be bomber of Berlin.

Bred Designs

The struggle for air mastery produces a constant flow of startling battle planes. Latest roundup of Allied types shows novel ideas.

The new Avro-Manchester bomber, though having only two engines, is one of the most powerful. The two Rolls-Royce Vultures of 2,000 h. p. each give this long-range bomber exceptional performance. Note top, tail and nose turrets.

Nose of the Avro-Manchester features two-gun turret above bombardier's post. Note long bomb-bay doors for ready stowage of huge bomb load. Ship has ninety-foot wingspan.

The Douglas A-24, is the army dive-bomber version of the navy's Douglas SBD-1 scout bomber. The split perforated flaps prevent tail buffeting in dives.

Photographic Beech for the navy. This JRB-1 cabin monoplane has a speed of 220 m. p. h. and a range of 1,000 miles. Carries own complete darkroom.

The Martin B-26 Marauder, two 1,750 h. p. engines, presents about the cleanest lines of any aircraft. This fastest medium bomber has top, nose and tail turrets.

New eyes for the army. The Curtiss O-52 observation ship. This flying greenhouse is also used in artillery spotting and on photographic missions. Crew of 2.

Aircraft Armor

It's not just steel plates set here and there. The armoring of our fighting planes is now a science.

BY JAMES L. H. PECK

Protection for the stinger. This released photo shows the deflecting armor plate in tail turret of N. A. B-25.

Born of fire. Armor plate developed by the Breeze Corp., Inc., is heated, then plunged into oil bath.

Two types of armor protection. Left, "booth" for bomber pilot and, right, plate armor for pursuit seat.

Tough stuff. This thin pursuit armor designed by Breeze stops all .50-caliber armor-piercing bullets.

WORLD WAR II combat planes are carrying more and heavier armament in the form of machine guns, aërial cannon, or a combination of both. These planes are also fitted with armor plating for protection against the weapons of other aircraft. It is a more-or-less vicious circle: one ship is provided with hard-hitting guns that are designed to pierce the protective armor, another war plane carries armor that is designed to stop or deflect the bullets of these hard-hitting guns. The use of armor plate is influencing gun design to a greater extent than any other single tactical consideration.

Armor is installed for the protection of the pilot and certain highly vulnerable parts whose destruction by gunfire might disable the airplane during flight. (Other security measures include the use of leak-proof fuel and oil tanks, bulletproof glass, and self-sealing tubing for fuel lines.) The ideal installation would permit the pilot and engines to be almost completely covered with armor, but this, of course, is highly impractical. Steel plate is quite heavy; its unlimited use on a pursuit ship or bomber would result in such a sacrifice in performance and bomb-fuel capacity, respectively, that the planes could not fulfill their missions efficiently. The designers are confronted with the problem of providing adequate pilot protection but, at the same time, using the weighty armor as sparingly as possible. The first approach to this problem has to do with making the armor of the toughest, lightest steel available.

Two types of plate are used for airplane armor, and each has certain advantages and disadvantages. The variety known as "homogeneous" plate is a solid piece of alloy steel which is of uniform thickness and hardness from the front, or face of the plate to the rear. Then there is "face-hardened" plate which is not of even consistency throughout, but whose face (that is, to be ex- *(Turn to page 55)*

The Mercury Mites take modeling seriously, judging by their clubroom complete with club photographs hung on the walls.

Murray Whittner's neat Stinson Reliant gas job typifies rising interest in scale gas. It's about time!

Big for Zipper A, this Madewell motor was tilted to fit. Photo from a Palm Beach club.

The Dope Can

BY GORDON S. LIGHT

MURRAY ELLIS uses linoleum varnish, Lin-X, for durable and attractive finishes on gas and rubber-powered models. Easy to apply—use a soft brush in a room with a temperature of about seventy degrees and free from dust. It takes about twelve hours to dry and there's ample time to brush out all bubbles and touch up bad spots. Readily brushed out to a thin coat, the added weight is negligible. Use the varnish as is; don't thin it. Lin-X can be applied over colored or clear dope. Ellis' technique is to use colored Silkspan, two coats of clear dope with a careful rubdown after the second, and then add a coat of varnish. Covering is far less brittle than a doped surface, but not soft or spongy. There's less tendency to warp and the varnish adds resistance to water, gas, and fire. Add striping, printing, and other fancy decorations before the varnish. You can't dope over it. Thinner will cut it but must be handled carefully. Lin-X is the particular brand of varnish Ellis happened to hit on. He points out there are probably many others equally good. Varnishes aren't his business—model supplies are. He runs a shop in Rochester, Minn. He's used Lin-X for a year. It had a rigorous test last year when his Sailplane was lost August 3rd at St. Cloud, Minn., and returned December 2nd by a hunter. This model had the linoleum varnish on it and came through in good shape.

Thousands of builders are turning out scale models of the fifty different types needed for the aircraft-recognition program. Modelers wanting additional information on any naval aircraft should contact James W. Croom, USN, Structural Division, Model Aircraft Section, Ground School, U. S. Naval Air Station, Pensacola, Florida. All information that doesn't fall into the "restricted" category will be supplied promptly. Navy Secretary Knox estimated 500,000 model airplanes are needed, and now is the time for the model builders to go to bat and do the job in a hurry.

During the winter Minneapolis Model Aero Club held building and flying sessions Saturday nights in a local gymnasium. Instruction and material were supplied free by the club. Meets were held in the University of Minnesota field house with a 108-foot ceiling and ample floor space. Indoor building gave the boys a chance to thaw out a bit between outdoor sessions. The annual winter highlight is the February gas contest. This year it was held on Lake Harriet, which is 1,500 yards in diameter. Club Secretary Harold Thomas of 29 Forest Dale Road, Minneapolis, would like to exchange news with other *(Turn to page 46)*

Two unidentified members of Milwaukee Gulls, Marshalltown, Iowa, with novel one-wheeler. From Jack Moralez.

This capable-looking Luscombe has over seventy flights on its log. An Ohlsson 60 job by Walter Suchma, Trenton.

Cyclone Scientific Mercuries took one, two, three at Mexican Nats in December. Strangely, three brothers (Gavito) won.

This 5½-foot Airacobra has a Gold Seal Ohlsson mounted amidships, driving a 12" shaft. By Al Geske.

George Mathaei, prominent West-coast modeler, and canard lost after eleven minutes.

Neptune

BY FRED TUXWORTH

The flying boat offers maximum water stability. Prop above wing is free from spray.

No crack-ups in water landings. Can safely alight on land. Note the tip floats.

Hydro gas models that really work are scarce. This Class B job is engineered for foolproof water take-offs and consistent flying with minimum repairs.

ANY model builder who has built and flown or even witnessed the flight of a successful model seaplane will undoubtedly say that it is the most interesting form of model flying; yet apparently it is the opinion of most model builders that the chances of getting a model seaplane to fly are slim. This opinion may be founded upon observation, but it is not necessarily true. Most model seaplanes at present are converted land planes, and these usually do not give very consistent performance even if successful. There are several reasons for this, the foremost of which is probably an inadequately protected ignition system.

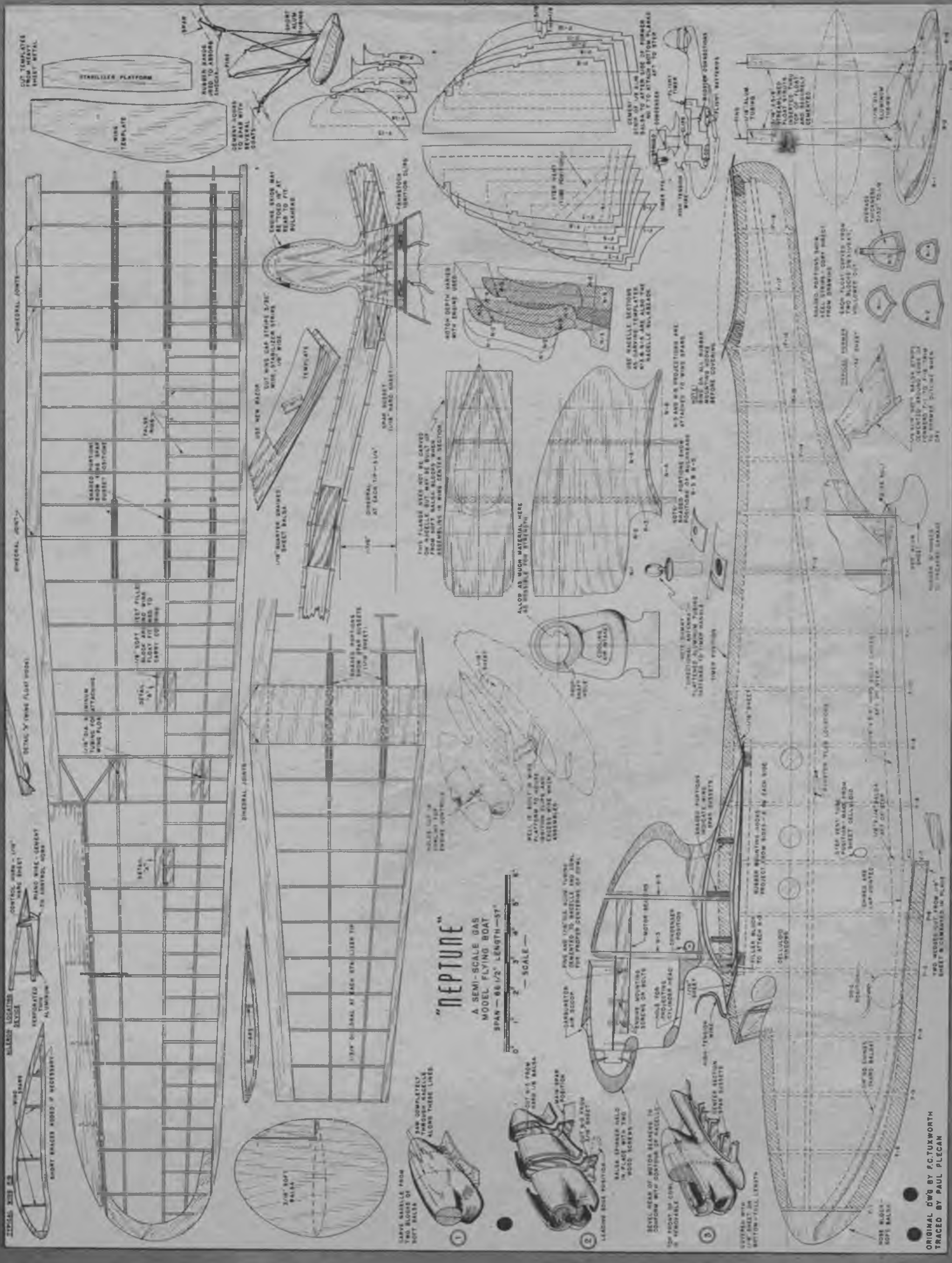
After several only partially successful plans had been devised and tried, this model builder finally resorted to designing a model—a seaplane from the bottom up with a dry ignition system as the prime objective. Even then the dual-purpose idea was not forgotten, for a retractable landing gear was installed. Only a few flights were made with the model as a land plane when it was decided that it was a shame to waste a successful seaplane on land with the chance of scarring up the bottom ever present. The wheels from then on were used only to demonstrate that they would actually retract, and finally, about a year later, when the model was rebuilt, the landing gear was completely removed as undesirable weight and dummy balsa wheels were cemented in the wheel wells merely to plug the holes.

DESIGN FEATURES

The model as it stands at present is one that was originally designed after quite a bit of experimenting with model seaplanes, and it has since undergone several changes. The flying-boat type was adopted for several reasons, one of which is stability on the water. No matter how faulty the adjustment at the take-off or how hot the landing, the model has all but a very few times ended top side up. The position of the motor and the shape of the bottom were designed to eliminate all possibility of spray striking the engine and propeller. It is obviously desired to keep the engine as dry as possible, but it was *(Turn to page 42)*

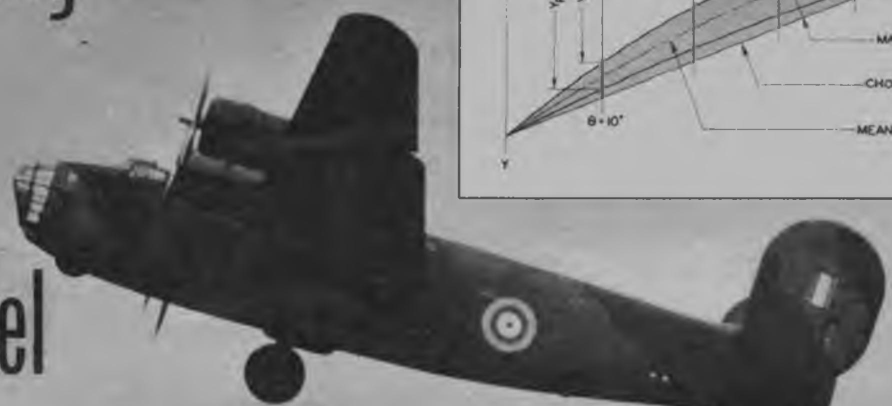
15c **FULL-SIZE PLANS** of this model may be obtained by sending fifteen cents to

AIR TRAILS FULL-SIZE PLANS, 79 Seventh Avenue, New York, N. Y.

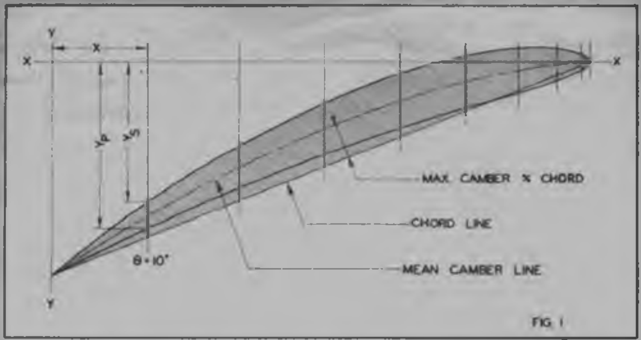


A Davis Wing for Every Model

BY HENRY COLE



Liberator features Davis wing. Rumored there is no scale effect.



Here is how to lay out the sensational Davis airfoil in any thickness for whatever model you are building, be it a radio job, a gas model, a glider, or even an indoor model.

WITH increasing wing and power loadings, model builders must seek more than ever new ways to increase the efficiency of their planes. Perhaps the greatest problem to overcome is that of wing design. Due to the scale effect and the inaccuracy of wing construction, great losses in lift and increases in drag result. Although these handicaps cannot be completely overcome, they can be greatly minimized by the use of Davis airfoils applicable to model use.

The Davis airfoil is a series of curves which vary according to the purpose of the airplane. The remarkable feature of the Davis sections is that they test 100 percent efficient, and rumor has it that there is practically no scale effect. Exact data on the performance of these airfoils is not available, but we can be fairly sure that airfoils plotted from the formulas are much better than those in common use among model builders today.

In developing this series of Davis sections for model use, we plotted dozens of airfoils from the thinnest indoor section to the thickest gas-model section imaginable. From these we selected the airfoils which were most applicable to use on indoor as well as outdoor models. When using these sections, model builders must realize that they cannot reap the full benefits of the airfoil unless they construct their wings accurately.

All the airfoils given in this article were derived directly from the formulas for the Davis airfoil by substituting the constants given with each airfoil. For the convenience of the average model builder, the airfoils were transformed to standard co-ordinates. The airfoils are presented with five-inch chords so that in many cases they can be used directly without plotting.

Airfoil No. 1 is designed for indoor use. Tests with indoor models have verified the fact that the maximum camber should be around forty percent of the chord. This Davis section should be the ideal airfoil for indoor models.

Airfoil No. 2 was included as a guide for glider builders. This section should have a very high lift drag without great sacrifice to the lift. Hand-launched gliders utilizing this section should attain high altitudes and still retain the slow, soaring glide of a high-lift section. The airfoil is also adaptable to fast, light models.

Airfoil No. 3 is adaptable to models with Topper-type wings. This section is unsurpassed for use in light rubber and gas models because of the high-lift and low-drag characteristics. Its only drawback is the lack of space for spars.

Airfoil No. 4 was developed to take the place of the NACA 6409. It has the same camber factor and thickness as the 6409 and, being a Davis section, should be more efficient. As demonstrated by the success of models using the 6409, this Davis section should be unexcelled for use on medium rubber and gas models.

Airfoil No. 5 is a high lift section for heavy gas and rubber models. It has ample space for strong spars and has the desired characteristics for a slow, soaring glide. It is possible to obtain sections much thicker than this, but NACA reports show that efficiencies drop off when the maximum upper camber exceeds twelve percent of the chord.

Figure 1 shows the method which was used in plotting these airfoils. First the constants A —B and B were determined and substituted in the formulas. By substituting values of Θ from 0 to 90 degrees, values for x, y_s and y_p were obtained. These values were then plotted to a convenient scale on the x and y axis. Any desired chord may be obtained by multiplying the values of x and y by a constant.

Figure 2 is a graph showing how the maximum thickness and camber vary with the constants. By reading values from the graph, the constants for any type of Davis section within the practical range may be approximated.

Example: To find the constants for an airfoil with a maximum upper camber of ten percent and with a maximum mean camber of five percent. Thickness $= H_{max}$ Camber $= A_{max}$

Thickness $= 2\ (H_{max} - A_{max})$

Thickness $= 2\ (10 - 5) = 10\%$.

Reading the graph on the thickness curve opposite 10 percent, we find that $B = 0.18$.

Reading the graph on the camber curve opposite 5 percent, we find that $A - B = 0.66$.

These values are substituted in the Davis formulas.

$$x = \sin\Theta\,[0.6366198\,(A - B) + B] - \tan\Theta\,[\{1 - (0.6366198)\,(\Theta)\}\,(1 - A)]$$
$$y_s = \cos\Theta\,[0.6366198\,(A - B) + B] - A\,[1 - (0.6366198)\,(\Theta)]$$
$$y_p = \cos\Theta\,[0.6366198\,(A - B) - B] - (A - 2B)\,[1 - (0.6366198)\,(\Theta)]$$

For simplification: $0.6366198 = \frac{2}{\pi}$

(Turn to page 65)

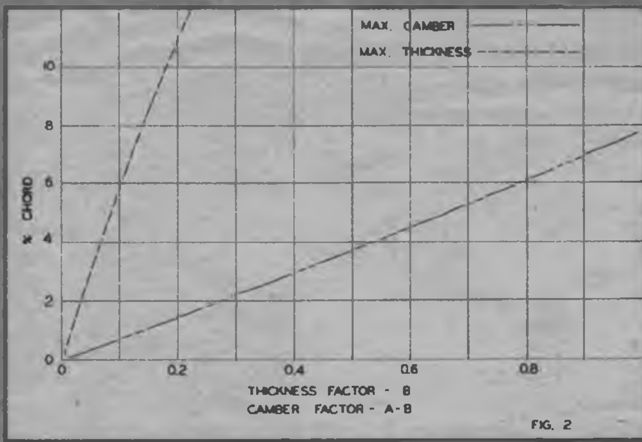
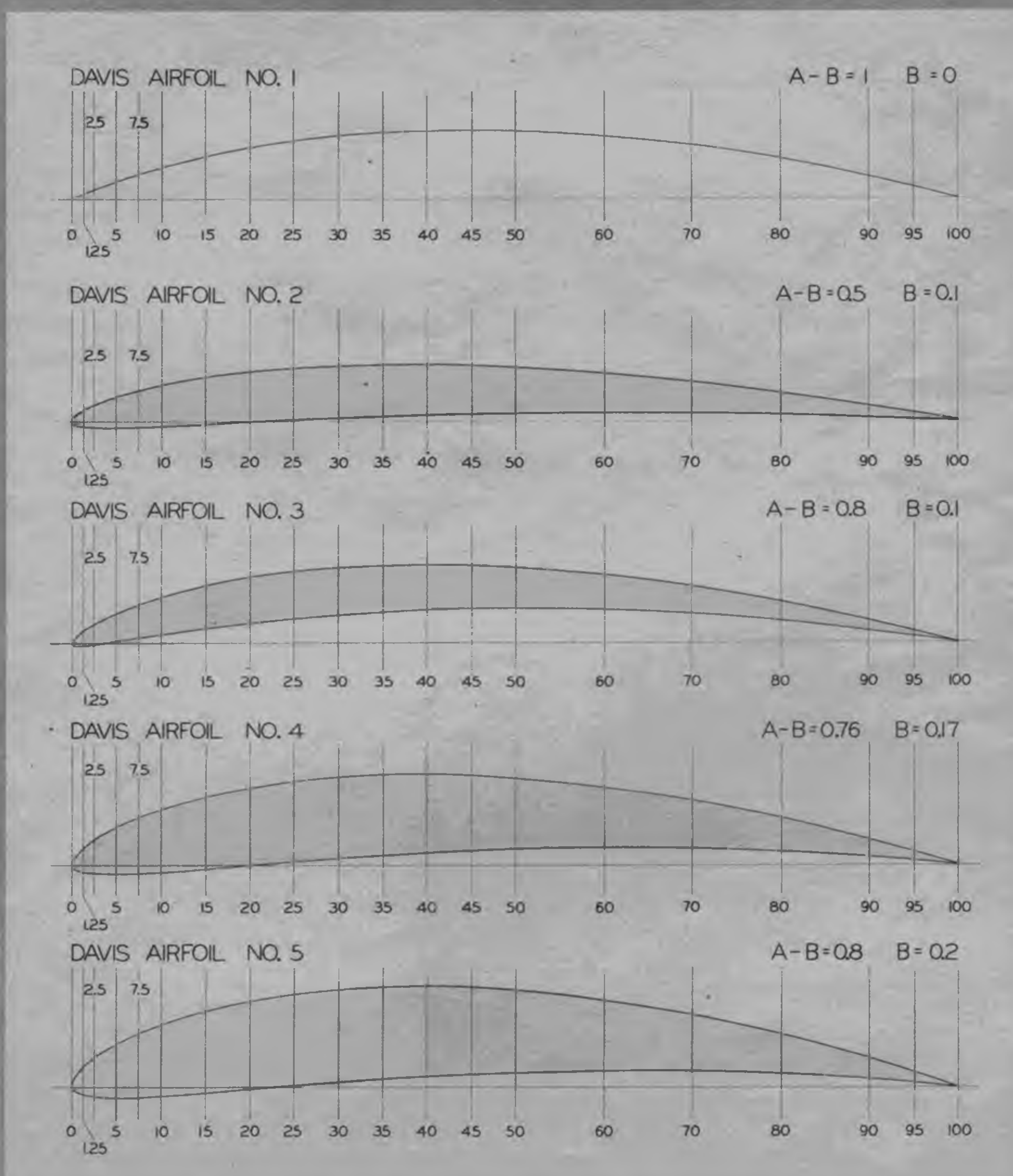


FIG. 2

	NO. 1		NO. 2		NO. 3		NO. 4		NO. 5		
% CHORD	UPPER	LOWER	UPPER	LOWER	UPPER	LOWER	UPPER	LOWER	UPPER	LOWER	% CHORD
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.25	0.82	0.82	1.29	-0.57	1.50	-0.27	2.08	-0.73	2.35	-0.77	1.25
2.50	1.08	1.08	1.88	-0.70	2.17	-0.14	3.00	-0.85	3.44	-1.04	2.50
5.00	2.08	2.08	2.78	-0.72	3.30	0.14	4.54	-0.93	4.85	-1.17	5.00
7.50	2.87	2.87	3.54	-0.60	4.31	0.52	5.50	-0.88	6.19	-1.08	7.50
10.00	3.82	3.82	4.07	-0.48	5.11	0.88	6.34	-0.75	[illegible]	-0.94	10.00
15.00	4.91	4.91	4.98	-0.26	6.51	1.64	7.74	-0.40	8.70	-0.58	15.00
20.00	5.87	5.87	5.80	0.00	7.50	2.25	8.88	0.00	9.77	-0.16	20.00
25.00	6.68	6.68	6.02	0.26	8.10	2.76	9.50	0.47	10.56	0.23	25.00
30.00	7.23	7.23	6.28	0.43	8.47	3.16	10.00	0.83	11.07	0.61	30.00
35.00	7.58	7.58	6.38	0.57	8.73	3.48	10.28	1.20	11.35	0.98	35.00
40.00	7.78	7.78	6.38	0.72	8.88	3.71	10.31	1.40	11.48	1.22	40.00
45.00	7.88	7.88	6.28	0.80	8.80	3.84	10.15	1.61	11.31	1.47	45.00
50.00	7.78	7.78	6.08	0.88	8.62	3.98	9.85	1.80	11.00	1.87	50.00
60.00	7.21	7.21	5.42	0.92	7.77	3.78	8.80	2.00	9.90	[illegible]	60.00
70.00	6.15	6.15	4.45	0.88	6.41	3.27	7.38	1.87	8.21	1.87	70.00
80.00	4.58	4.58	3.18	0.65	4.84	2.51	5.53	1.47	6.14	1.62	80.00
90.00	2.48	2.48	1.88	0.33	2.47	1.38	2.93	0.92	3.38	1.04	90.00
95.00	1.30	1.30	0.86	0.14	1.30	0.68	1.52	0.47	1.72	0.53	95.00
100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00



Mosca Flying Scale

BY H. A. THOMAS

A veteran of Spanish, Chinese, and Russian fronts, this stubby I-16 fighter makes an unusual flying-scale job.

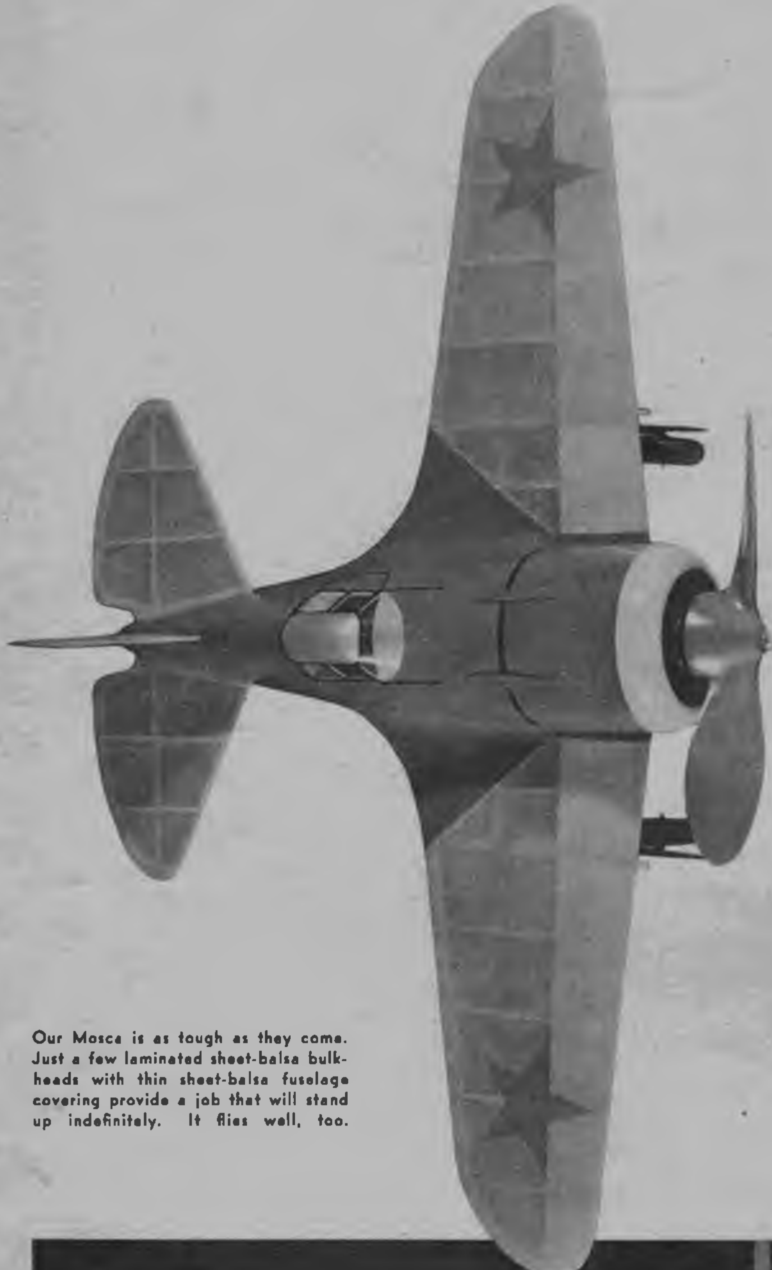
HAVING seen actual service on several war fronts, including the Spanish civil war, the doughty little Russian Mosca I-16 fighter is indeed a veteran. Reports have largely been favorable as to its performance, even though the blunt, stubby lines and the small dimensions contrast sharply with the sleek proportions of other pursuit craft. A big 700 h. p. Cyclone engine of American design and Russian manufacture is responsible for the huge cowl. Top speed is reported to be around 300 m. p. h., and the landing speed of 95 m. p. h. is not surprising for a plane of such limited wing area and span.

From the standpoint of flying ability as a scale model, the Mosca is not the very best selection, but for realism it is all that could be desired. The model is sturdily built, the fuselage being entirely sheet-balsa-covered. The large-size tail surfaces of the original permit the use of true scale proportions, the only deviations being increased dihedral and propeller dimensions.

The fuselage formers are cut from laminated balsa consisting of soft 1/16" sheet cemented to soft 1/32" sheet with the grain crossed. Spars are joined by cementing the 1/32" sheet reinforcement in place, and the complete spar is then cemented to the rear of Former B. Formers are assembled by means of the four stringers, and the soft 1/32" sheet covering is applied in sections. Cowl front is formed of layers of soft 1/8" sheet, the rear fuselage tip is a hollowed balsa block, and the cockpit top is also shaped of balsa. Dope fuselage and sandpaper lightly.

Assemble the ribs to the spars, attach the leading and trailing edges, fitting their inner edges to the fuselage sides. Attach the tips and the lower, triangular fairing pieces. Bend the landing-gear struts of .040 steel wire, and after adding the 1/8"-sq. braces to the wing frame, bind and cement the landing gear to the wing. Attach the hardwood wheels. Cover the upper leading edge to the spar with soft 1/32" sheet and sand the entire wing frames lightly. Make paper patterns of the wing fairings, trimming them until they fit perfectly. Cut the soft-balsa outlines and pin and cement them in place.

Tail surfaces are of conventional construction. They should be finished and covered with tissue before being carefully cemented to the fuselage. Wing and tail surfaces are covered with tissue, water doped, and are later given two coats of thin dope. *(Turn to page 60)*

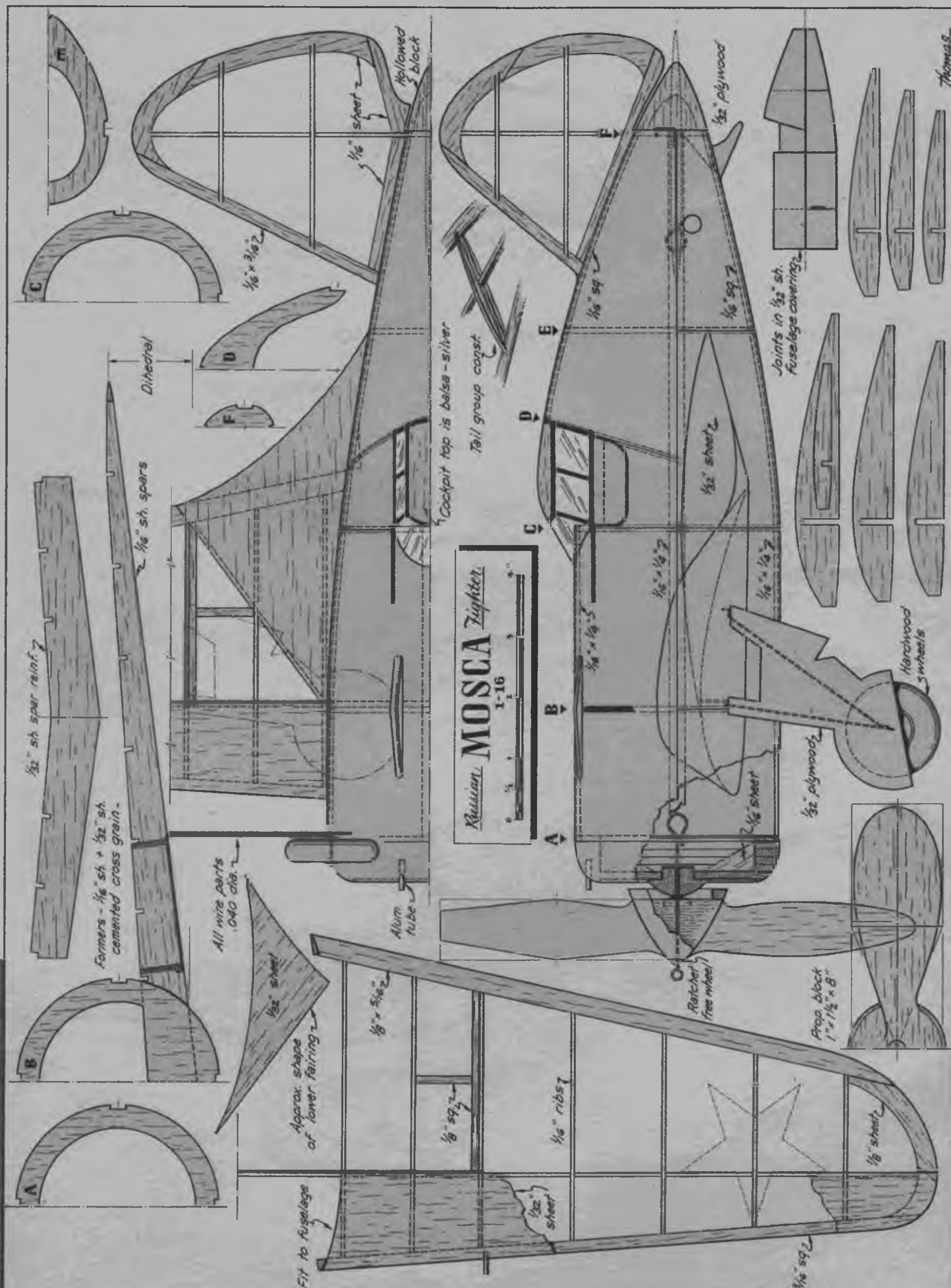


Our Mosca is as tough as they come. Just a few laminated sheet-balsa bulkheads with thin sheet-balsa fuselage covering provide a job that will stand up indefinitely. It flies well, too.

15c

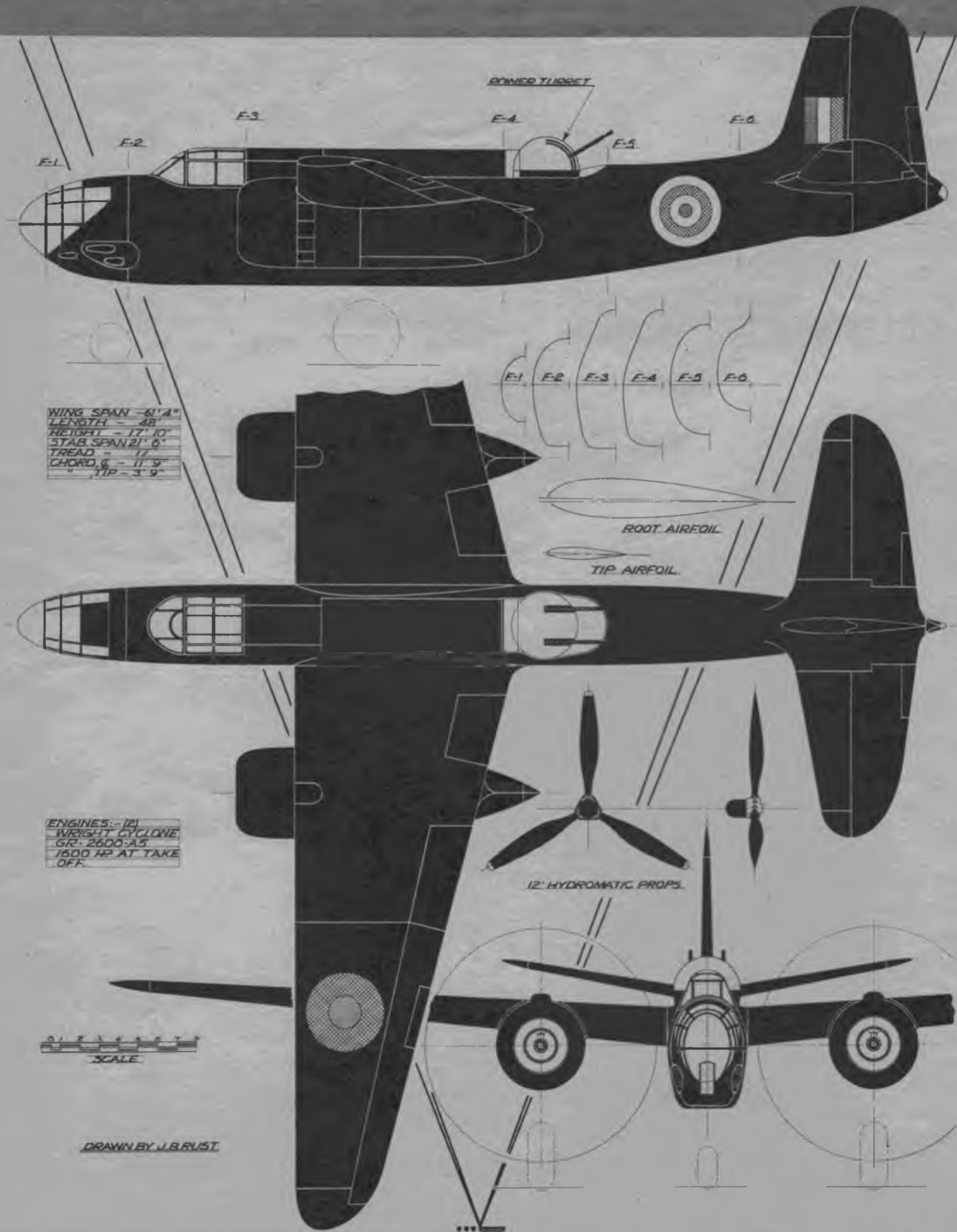
FULL-SIZE PLANS of this model may be obtained by sending fifteen cents to

AIR TRAILS FULL-SIZE PLANS, 79 Seventh Avenue, New York, N. Y.



British Night Fighter—Douglas Havoc

BY J. B. RUST



Ask Balsa Butch

Questions of general interest to model builders will be answered on this page; others by mail. Inclose a three-cent stamp to insure a reply.

Bob Overton, Oak Park, Ill.—The Arrow may be used in either Class A or B events. It has done fine contest work in both classes, and the Ohlsson 23 is an excellent motor for the ship. We're sorry, but the December, 1940, issue is out of print. Thanks for your compliment on hints, and we'll run many more of them from time to time.

John N. Scott, Reynoldsville, Pa.—We don't believe compressed-air motors are made any more, but you might write to International Model Products, 254 West 55th St., New York City. They manufactured one of the last motors of this type that we saw.

Edward Doyle, Philadelphia, Pa.—Seems as though we read of a similar idea to yours years ago in *Aero Modeller* (an English publication) but you may have a new slant. Work it out and send us a sketch. If it is workable and interesting, it may be considered for publication. However, remember that in modern contest jobs the ordinary rubber motors run for as much as two minutes, so govern yourself accordingly.

Norman McAvoy, Phoenixville, Pa.—Sorry, Norman, but we never published full-scale plans for the Herald. However, you may obtain a copy of the May, 1941, issue of Air Trails by writing to Mr. Clifford, Circulation Department, Air Trails Magazine, 79 Seventh Avenue, New York, N. Y. The charge is 15 cents.

Lowell Herley, Clearwater, Neb.—Yes, Lowell, the Buzzard Bombshell is complete in every respect, but we're sorry to say it does not include air wheels. You'll find plenty of wood, full-size plans, and plenty of material. It's a swell model, so you'd better hurry up and reserve yours early.

Charles Hithe, Jr., Oakland, Calif.—Gas models may be covered with bamboo paper, tissue, silk, double tissue or any of several commercial papers, including Pervel, Silkspan, et cetera. Large ships should be covered with silk, or a heavier paper. Medium-size ships may use light bamboo paper or double tissue, and small ships may use single rubber tissue. Cover your model in sections; for example, one side of the fuselage at a time, the top half of the wing, et cetera. There have been many hints published on the technique in past issues of Air Trails, but perhaps the best essay on the gentle art of covering may be found in the new Jasco catalog, obtainable for 5 cents from Jasco, 100 E. 10th St., New York City. G-Line flying is a sport wherein the gas (or rubber) powered model is flown in a circle about the modeler, who controls the flight by means of a double line attached to the side of the ship. This line terminates at one end in a control handle which is manipulated by the flier. Movements of this handle control the elevators of the model. Plans for the Luscombe gas job have never been published, to our knowledge. Why not enlarge one of the rubber-model plans?

C. W. Miller, Xenia, Ohio—Congratulations on your success with the Arrow. It was one of our most popular ships and it continues to attract much attention. We are sincerely sorry we never published full-size plans of the ship, but scaling of the mag plans should not be hard. We personally spent about two hours on the job and turned out a set of plans that are still being used around town.

Alan Roebuck, Washington, D. C.—The Super-Cyclone motor is manufactured by Aircraft Industries Co., Grand Central Air Terminal, Glendale, Calif. If you're ordering one, better hurry—we hear this concern is soon to devote all its time to defense contracts.

Doc Fowelas, Jr., Dyersburg, Tenn.—For an inexpensive Class A motor we might suggest you write to Marvin Manufacturing Co., 644 Vermont St., Royal Oak, Mich. They make (or were making) a fine Class A motor for $9.95, probably the least expensive motor in the class. Also try Microdyne Engines, Box 245, General Post Office, New York City. Better hurry, though—motors are getting scarce.

Sidney Mitchell, Canaan, Conn.—Sorry, Sid, the last we heard, the Perky was out of production. Defense work, y' know. It was a swell motor, too.

Bob Cory and Keith Braun, Fairmont, Minn.—According to the AMA gas-model rules, a model shall weigh *no less* than 8 ounces for every square foot of wing area. For example, the Buzzard Bombshell has an area of 6 square feet, so it should weigh no less than 48 ounces, or three pounds. Let's say that a Class C motor of .60 cubic inches displacement is used. Models must weigh *no less* than 80 ounces for every cubic inch of displacement. Now if we multiply 80 by .60 we get 48 ounces. Check the wing area of your model and see that it does not weigh less than the requirement, and figure out the weight allowed for your motor. The ship can weigh considerably more than the minimum requirements, of course. As to the 1942 AMA rules, we suggest you wait until the approved rules are released. They're still under consideration.

David Scale, Dedham, Mass.—An excellent Apache kit is sold by the Capitol Model Aircraft Co., 1613 E. New York Ave., Brooklyn, N. Y., at $1.25. Sorry, we don't know the name of the Boston distributor. Good luck with your model; we know it will fly like its famous namesake.

John Douglas, Jackson Heights, L. I., N. Y.—We've published plenty of model wing sections in the past. You can find excellent examples in any published plans. Write the Superintendent of Documents, Washington, D. C., for info on NACA wing sections.

Earl A. Harris, Jr., Collingdale, Pa.—The aspect ratio is the ratio of wing chord to wing span. For example, if the span is 60 inches and the chord 5 inches, the aspect radio is 12 (60 divided by 5). Get it? Generally speaking, the higher the aspect ratio, the more stable the ship. High aspect ratio is generally featured on sailplanes. A kit of the Gee Bee is marketed by Cleveland Model & Supply Co., Inc., 4508 Lorain Ave., Cleveland, Ohio. To our knowledge, the United States flying forces are not, as yet, using a helicopter of any type. The Sikorsky helio is believed still in the experimental stage.

Bernard Solar, Philadelphia, Pa.—In most ships with a pointed nose, the propeller is built into the point. In other words, the point is really the hub of the propeller. When propellers are so mounted, usually the tip of the point is ahead of the propeller hub, and this portion ahead is called the "spinner." Note the P-40 for an example of such mounting. It has been applied to both gas and rubber models.

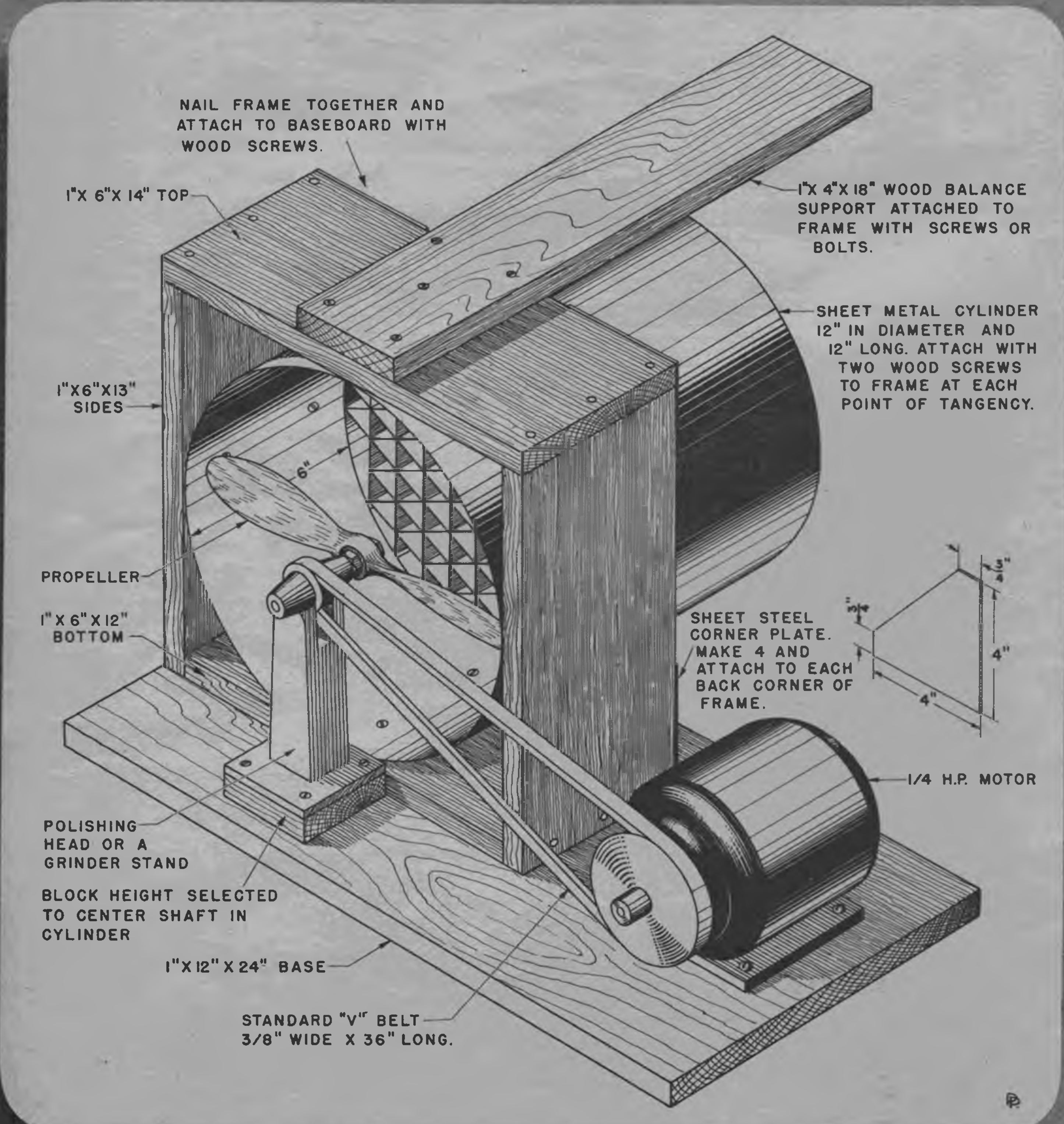
Bernard Mallon, Bayside, L. I., N. Y.—We would not advise using a Class B motor in the Buzzard Bombshell given with the subscriptions to Air Trails. Such a motor would greatly overpower the ship, unless it were carefully handled. However, if the motor you plan to use is of low power, you might try it, but *keep the power low* until you learn the tricks. The ideal motor for this ship is something around .19 cubic-inch displacement or less.

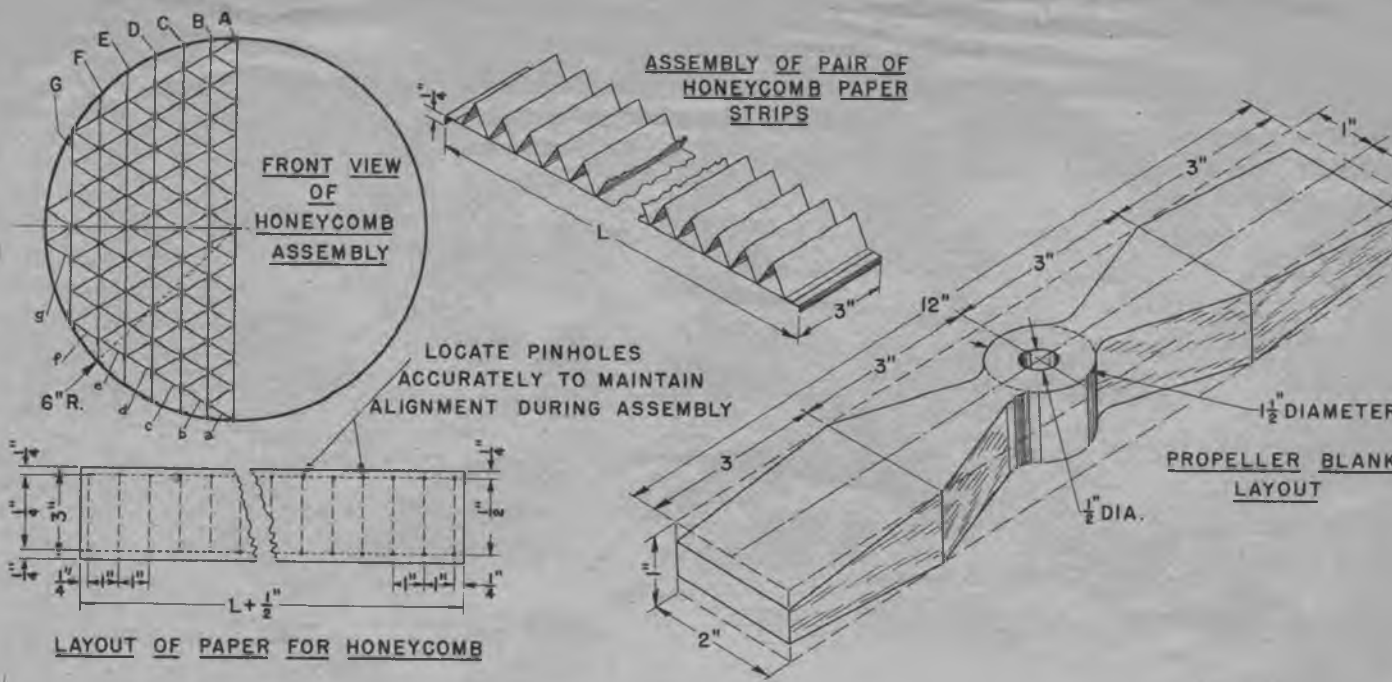
James Westwood, Chicago, Ill.—We suggest you write Bunch Motor Co., 6714 McKinley Ave., Los Angeles, Calif., regarding the knockdown kits on the Gwin.

Home-Made Wind Tunnel

BY R. C. CLIFFORD

Ideal for model clubs, this practical testing apparatus gives good results. If you have the motor, building cost is small. Next month: lift and drag balances.





THIS report covers the construction of a 12″ diameter wind tunnel. A drag balance and a compound lift-drag balance suitable for educational purposes to demonstrate and verify the laws of aerodynamics by laboratory methods will be given in the next issue. While this apparatus will give fairly accurate parasitic drag coefficients, the accuracy of lift and drag coefficients of wing sections or complete models will be limited by the accuracy of the model being tested and by some unevenness of air flow inherent in any simple tunnel having a pusher type propeller in front of the testing section. An 18x36″ wind tunnel and its apparatus, costing about twenty dollars, is recommended for obtaining fairly accurate basic design data. The air jet will develop an air speed of about 50 feet per second (34 m. p. h.) when the propeller is driven by a ¼ h. p. motor at a speed of about 5,500 r. p. m. The cost of construction is about five dollars, distributed as follows: motor pulley and belt, $1; polishing head $1; 5 board feet of wood, $0.50; 6 pounds of sheet metal, $1.50; miscellaneous paper, glue, screws, bolts, wire, et cetera, $1.

The propeller has a P/D ratio of 0.785 and should be carved by the usual half diagonal method from a block of hardwood shaped as shown by the detail. It should be carved right or left to suit the rotation of the propeller shaft. After carving an accurate pitch surface between diagonal corners, an elliptical blade shape 1½″ wide should be marked on the pitch surface to give an overall diameter of 11¾″. The back of the blade should then be carved in the blade shape to get Clark "Y" type blade sections. The finished propeller should be similar to an ordinary gas model propeller except that its blades are wider and it has more pitch. For best results the air jet should be operated at its maximum air speed, which is obtained only at the maximum propeller speed. The propeller given should provide a maximum air speed of about 55 ft. per sec. and stall the motor at about 5,500 r. p. m. Put the largest pulley on the motor that will drive the propeller without stalling or overheating the motor.

The honeycomb is made of a good heavy grade of drawing paper and is the most difficult part of the jet to build. Make several honeycomb units if necessary to get an accurate pair. On a drawing board accurately lay out the required pieces of paper in strips 3″ wide to the lengths L as given in Table 1 and as shown in the layout detail. Notice that pieces A, C, E, and G are centered on one of the 1″ division marks, while pieces B, D, and F are centered halfway between two of the 1″ marks. Bend the ¼″ glue tabs on pieces A, B, C, D, E, F, and G down 90 degrees over a sharp straight edge. Bend pieces a, b, c, d, e, f, and g on each 1″ bend line alternately up and down over a straight sharp edge. As shown by the detail, assemble the paper strips in two pairs each of Aa, Bb, Cc, Dd, Ee, Ff, and Gg. Place a piece A on a straight, soft white pine board and glue a piece on top of A by applying model-airplane cement (use smallest amount required to get a strong joint) to each bottom corner of piece a. Hold piece a in position on top of piece A until the cement dries, by driving pins through the alignment pin holes of both pieces. Repeat the process for Bb, Cc, Dd, Ee, Ff, and Gg. After all the pairs have been made, assemble them into two honeycomb units as shown in the detail. Start with Aa on the bottom and work up with Bb, Cc, Dd, Ee, Ff, and Gg. Apply cement to the top corners and mount the next pair on top, using pins in the alignment holes to secure proper alignment, and hold the paper together until the cement dries. Glue a strip of paper 3″ wide and 38″ long inside the metal cylinder 6″ from the front end. Place the two honeycomb units in place inside the cylinder and glue the ¼″ glue tabs to the strip of paper.

Have the sheet-metal cylinder made in a tin shop. Get an estimate before having the work done so that the price will not be skyrocketed upward. On a time-and-material basis of $1.50 per hour and $0.10 per pound, the cost of simple sheet-metal work is usually about $0.20 per pound of metal to have it bent to shape. The experimenter should do his own layout and assembly work on the bent-up channels or angles.

If a ¼ h. p. electric motor is not available for exclusive tunnel use, one should be borrowed from some other piece of equipment used (a washing machine or drill press perhaps). Wind tunnels operated for a hobby are not used enough to justify the purchase of a motor for them alone.

Other details are covered adequately by notes on the drawing. Detailed dimensions will have to be determined by the builder in each individual case to fit the available materials.

Table 1. Honeycomb Paper Lengths.

Basic Length L			
A	12″	a	24″
B	11 7/8″	b	22″
C	11 15/32″	c	20″
D	10 13/16″	d	18″
E	9 25/32″	e	16″
F	8 5/16″	f	14″
G	6″	g	4″

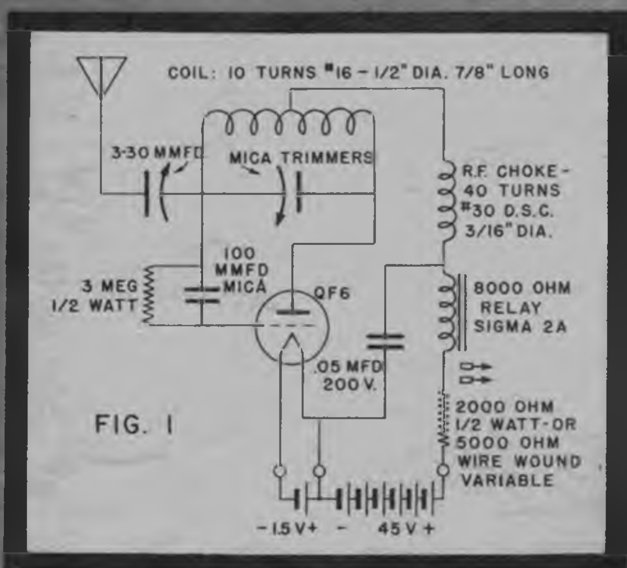
Add a ¼″-wide glue tab to each end of above pieces. Make two of each piece.

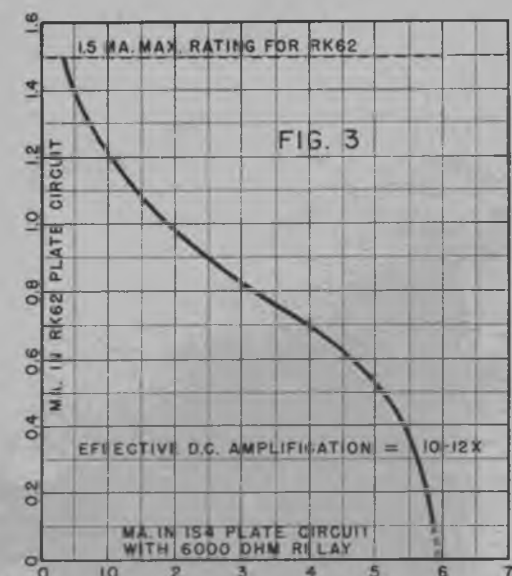
Ideas for Radio Control

BY CLINTON B. DESOTO

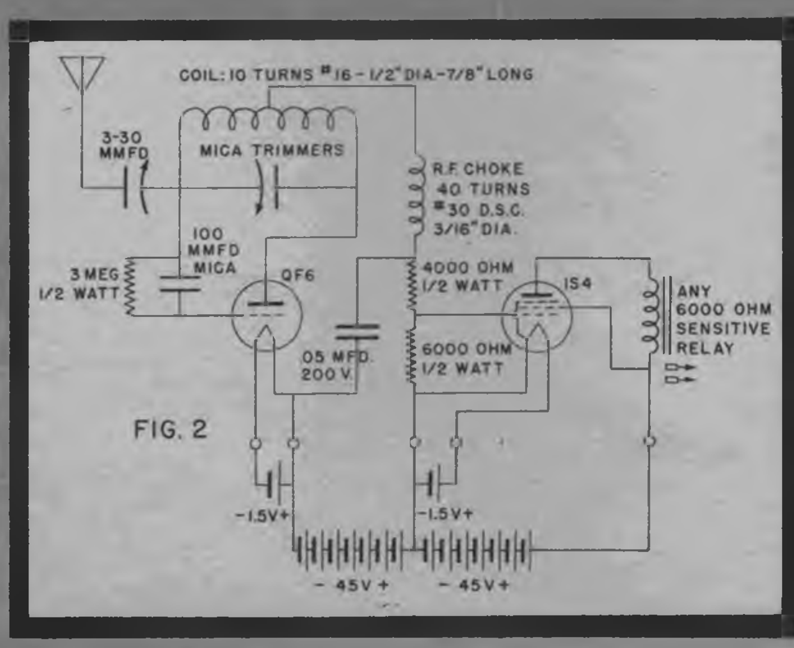
From experience, an authority gives you a bird's-eye view of the best, latest in receivers, plus tips. Next month: selectors.

Miniature radio-control receiver using new experimental QF-6 tube, built up on a Sigma relay. The center picture shows a standard RK-62 tube (equivalent to the QF-6), for comparison as to relative size. On the right is a bottom view, showing tie-lug terminal strip at bottom, r. f. choke in center, with plate bypass condenser underneath, and the coil and trimmer condensers situated right at the top.





Two-tube miniature radio-control receiver, using QF-6 tube and 1S4 direct-coupled direct-current amplifier. Total weight of the receiver, complete with tubes: 1 ¾ ozs. Using a special battery, a complete receiving installation including sensitive relay weighs only 16 ozs. Center shot shows size compared to usual match clip.



ENOUGH has been said and written about radio control by now so that anyone who attempts a new series of articles on the subject ought to be required to state his purpose in doing so.

The purpose of this series can be stated quite simply: It is to take up, one by one, the fundamental elements of every radio-control installation and to give a few general design notes, a thought-provoking idea or two, and an occasional practical operating suggestion. Some of the ideas will, perhaps, be wholly new to most readers; others, frankly, will only be variations on practices now accepted as standard. New or old, however, it is hoped that these ideas will prove stimulating and provocative to every reader, whether neophyte or veteran in radio control.

A basic element of any radio-control system is the receiver. It is the most vital element of all, the key to success or failure. It should be light in weight, and yet sensitive and thoroughly reliable. The starting point in design is to establish a compromise between weight and performance. Obviously, the lightest possible equipment must be used in a six-foot ship capable of carrying only a pound or so, and some sacrifice in range and even reliability can be made to keep the weight down. This means the simplest possible gear made of the lightest available materials.

On the other hand, it is just as pointless to put a Class A installation into a Class C ship. A larger ship can include structurally heavier equipment capable of higher performance. It is here that multitube receivers come into the picture.

Units representing both extremes will be described in this article.

New Miniature Tube

The heart of the receiver is the detector tube. A survey of the art shows that practically all progress in radio design has resulted from the development of new tubes. This is also true in radio control, and the first two units to be described are built around a tube so new that it is still known only by its experimental number.

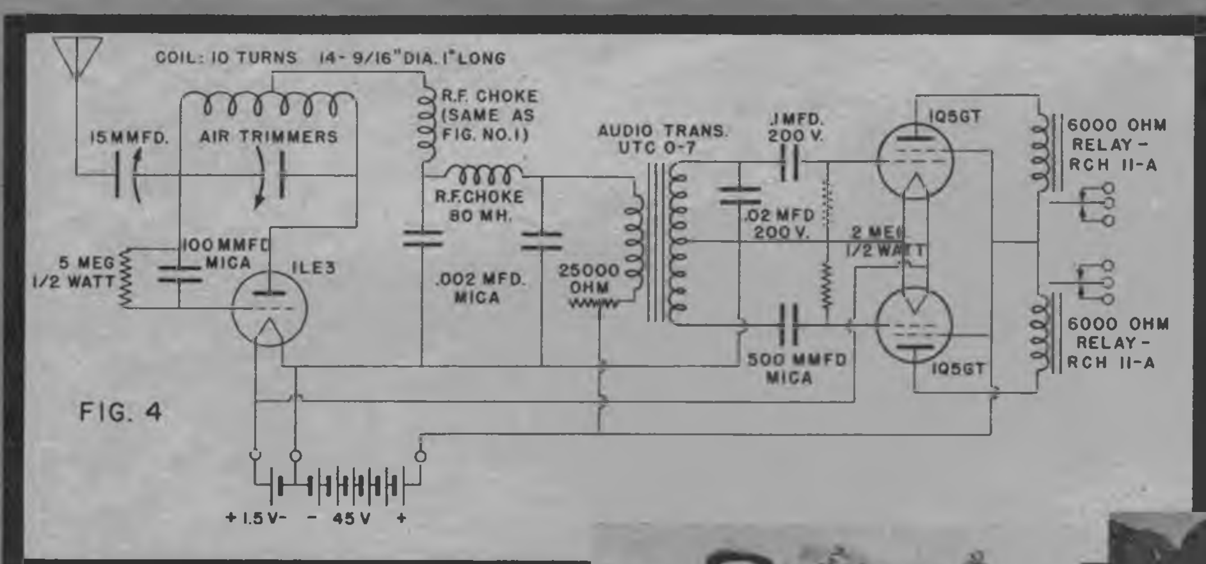
Examine Fig. 1. It should be familiar, for it is an orthodox circuit diagram for the Raytheon RK-62 tube—the gas-filled thyratron that has done so much to popularize radio control since it was first introduced in 1938. Wait a minute, though—the tube in that diagram is marked QF-6, not RK-62. That's right. The QF-6 is a miniature RK-62 recently developed by Raytheon and not yet assigned a regular type number. It is similar to its prototype, except that the elements are greatly reduced in size. It comes in a tiny glass envelope only ½" in diameter and 1¾" long, with wire leads that can be soldered directly into the receiver. A miniature "bearing-aid-tube" base is also supplied for those who prefer the conventional socket arrangement. In that case, the wire leads are soldered into the base pins and the glass envelope is cemented into the base. When thus assembled, the tube is 2⅛" long overall and $^{9}/_{16}$" in diameter. Its weight is about ¼ oz., as compared with 1¼ ozs. for the RK-62.

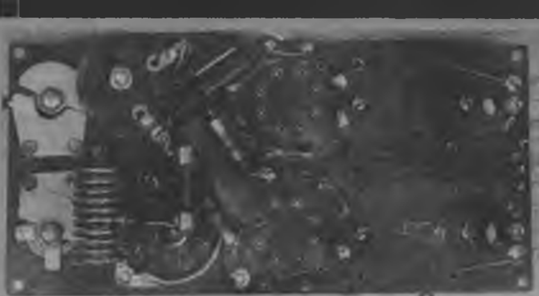
The small size of the QF-6 makes possible the construction of a complete receiver on the base of a sensitive relay (Sigma 2-A), as illustrated. The construction is very simple. A ½" hole is drilled just behind the back contact bracket to hold the miniature socket (Amphenol 78-51PT), which is cemented in place, and a five-lug terminal strip is attached with 4-36 screws in holes tapped in the bakelite base. The tie lugs on this strip provide battery terminal posts as well as wiring support for the remaining components. The two Isolantite-base trimmers (National M-30) are supported by their wiring, as are the oscillator inductance and the r. f. choke, which is wound on the body of an IRC F-½ 0.1-megohm resistor.

Total weight of the completed "relay-base" receiver is about 4½ ozs., of which 3 ozs. are in the relay.

In operation the QF-6 behaves like an RK-62. That statement should cover the situation, but it seems that a lot of model builders could use a few pointers on handling the '62s. Here are some general observations on the subject.

First of all, decide on the particular requirements of the job to be done and select circuit values accordingly. Then experiment to find the best values for the particular tube in use. Not only do QF-6s and RK-62s vary considerably as between individual tubes, but different conditions of operation require different values. Commercially built equipment is usually engineered to provide a compromise design fulfilling all ordinary requirements reasonably well, but for the home constructor who wants to get that "extra ten percent" in *(Turn to page 49)*





Dual-channel 3-tube radio-control receiver, utilizing audio selectivity. Superregenerative detector uses loctal tube, feeding "push-pull" beam-power relay tubes through tuned input filters. Air trimmers, mounted directly on sheet bakelite base, are used for stable tuning.

The Heinkels are here! A model like this giant at 1,000 feet or a bomber at 10,000, it's all the same to spotters. Rules should shorten flight durations.

For the Duration

With thousands of spotters on the lookout for enemy planes, gas models must be flown cautiously. How to avoid trouble.

BY CARROLL MOON

THROUGH some strange quirk of fate your writer is doing his bit in the defense program as a plane spotter out on Long Island, N. Y. Thrice weekly he arises, usually at an unholy hour, and hies himself to a large and exceedingly breezy field where he scans the skies for a period of two hours. During that time he occasionally spots an airplane overhead. Within a period of twenty seconds (according to army estimate) he has reached a phone and is engaged in the following conversation:

"Hello," says our hero. "Army flash."

After a few seconds a voice answers, "Army flash."

"Here's a report," says our hero modestly. "One plane, two motors, high, headed east, south from post, Floral post."

He has reported the observation, and the news has been recorded at the army center in New York. At times the conversation is even more abbreviated. When darkness is at hand (which is almost every time your scribe is on post) he merely reports, "Aircraft above."

Twenty-four hours a day this patrol goes on at hundreds of "spotter stations" throughout the country, and from the viewpoint of a constant observer it can be stated that the average watcher couldn't tell a ten-cent glider from a Flying Fortress. A plane is a plane and it's up to the army to worry whether or not it really means anything. The general run of modelers could tell whether or not the plane in question was enemy or friendly, but the majority of observers don't care. They report *every* plane they see, and thus occurs a great problem for model aviation.

We arrived early at our post one Saturday morning. In fact, we were more than an hour early and we basked in the sun, waiting our turn, when the eagle eye of the post observer on duty caught a glimmer in the sky. It was high and quite obviously a plane of some sort. He called it to our attention and squinted his eyes skyward. *(Turn to page 46)*

★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★

The Sharpshooter

This contest model features an airfoil-shaped fuselage for extra life. Does it help? Brother, this job has won a lot of meets.

BY JOHN WULLSCHLAGER

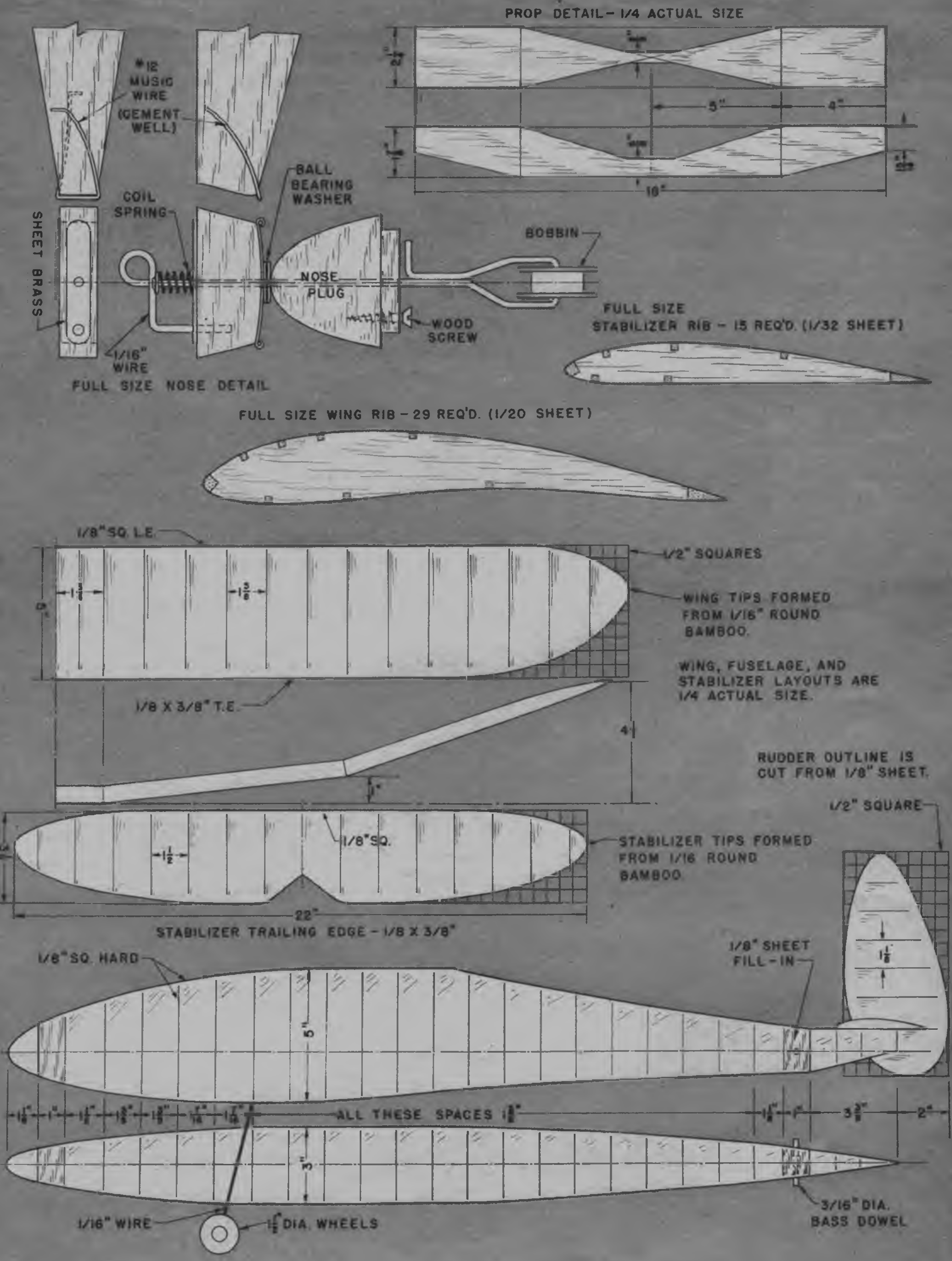
Does 3:30 in dead air, yet has skyrocket climb in wind. Airfoil fuselage, light wing construction, and concentration of blade area near prop tips are secrets.

AFTER a careful study of championship models in many contests, this particular model was designed as a combination of the best. To begin with, the fuselage is built to resemble an airfoil designed to create lift in flight, which is the secret of the plane's remarkable success. Its ability to catch weak thermals has proven itself in many contests. Another important point is the superlight wing, giving the model ballooning tendencies. You will notice the wing section is similar to the fuselage section, both giving lift. All ribs had the centers cut out to eliminate weight; this is a point to stress in construction. In making the tail, follow the ordinary procedure. The rudder is cambered to cause the model to turn to the right, which does away with rudder adjustments. The most important part is the propeller. It is a cross between the English and American type propellers. All the pulling area is at the tips, leaving very little resistance at the hubs. With an eighteen-inch prop of this design I developed a 2½-minute motor run and a steep climb.

In this design we have something which meets the demands of modern Wakefield contestants. It will conform to the Wakefield rules in any man's contest. Here you have a model that will average 3½ minutes in dead air, turn around and fly with the best of your so-called skyrockets or windy-weather models. It is truly a great contest model and has proven itself so.

In the first contest ever entered it established an unofficial world's record of 34 minutes and some odd seconds total for a three-flight average, only two of which were completed. First flight, unofficial, 15 minutes; second, official, 14 minutes some seconds; third, official, 19 minutes out of sight. The next meet entered was the Scripps-Howard Nationals. Again it was first in the open event, flying a total of over 22 minutes.

The last meet was at Alliance, Ohio, placing second with a total of 17 minutes, but losing the model on the second flight, *(Turn to page 61)*


PROP DETAIL - 1/4 ACTUAL SIZE
5"
4"
16"
#12 MUSIC WIRE
(CEMENT WELL)
BALL BEARING WASHER
COIL SPRING
SHEET BRASS
NOSE PLUG
BOBBIN
WOOD SCREW
1/16" WIRE
FULL SIZE NOSE DETAIL
FULL SIZE STABILIZER RIB - 15 REQ'D. (1/32 SHEET)
FULL SIZE WING RIB - 29 REQ'D. (1/20 SHEET)
1/8" SQ. L.E.
1/2" SQUARES
WING TIPS FORMED FROM 1/16" ROUND BAMBOO.
WING, FUSELAGE, AND STABILIZER LAYOUTS ARE 1/4 ACTUAL SIZE.
1/8 X 3/8" T.E.
4
RUDDER OUTLINE IS CUT FROM 1/8" SHEET.
1/2" SQUARE
1/8" SQ.
1 1/2
STABILIZER TIPS FORMED FROM 1/16 ROUND BAMBOO.
22"
STABILIZER TRAILING EDGE - 1/8 X 3/8"
1/8" SQ. HARD
1/8" SHEET FILL-IN
5"
ALL THESE SPACES
3"
1/16" WIRE
DIA. WHEELS
3/16" DIA. BASS DOWEL

Down The Runway

CONDUCTED BY AL LEWIS • EXECUTIVE DIRECTOR

Latest roundup of official aeromodeling news as compiled by the AMA, official headquarters of American model aviation.

These Russian children, pupils in the N. Shvernik Central House of Young Technicians, learn fundamentals of design from flying model airplanes. So school is fun.

SETTLE down, chum, for a long session, for here we come with news galore. First of all, you may have wondered what has been happening down in Washington with the consolidation of Air Youth and the NAA. Well, after everybody got together and worked up a special dish, all NAA aëromodeling activity emerged under NAA's Air Youth Division. The Academy is the technical section of this division and no longer has to worry about making both ends meet. For years the AMA has been struggling along trying to do a good job for all aëromodelers with nothing to finance it except the fifty-cent and one-dollar license fees and the two-dollar leader-membership dues. Even so, last year the AMA did the impossible and came through with colors flying and $111.53 in the bank, after certain items such as insurance fees were deducted. The income of the AMA was $12,611.25, of which more than three fourths was in the form of dues and license fees. The expenses totaled $11,463.07.

★ ★ ★

Nothing in the history of aëromodeling has ever approached the magnitude of the navy's 500,000 scale-model program. You know the set-up. The navy department, working along with the office of education, wants half a million accurate models of fighting aircraft of the United Nations and Axis powers. Schools throughout the country, newspapers, radio stations, su- *(Turn to page 64)*

★ ★

P-40E Shelf Model

BY RONNIE ALBERT

If you have trouble getting rubber and supplies, get out that knife and whittle this famous Curtiss. Balsa, even pine, will do.

For added realism, give your solid a coat of olive-drab, add star insignia.

OF the many pursuit ships now in active service on the battle fronts, the Curtiss P-40 is establishing itself as one of the greatest fighting planes in the entire world. From the Libyan deserts to the Malayan jungles, P-40 pursuit planes with crack American and British pilots at the controls are ridding the air of hostile aircraft.

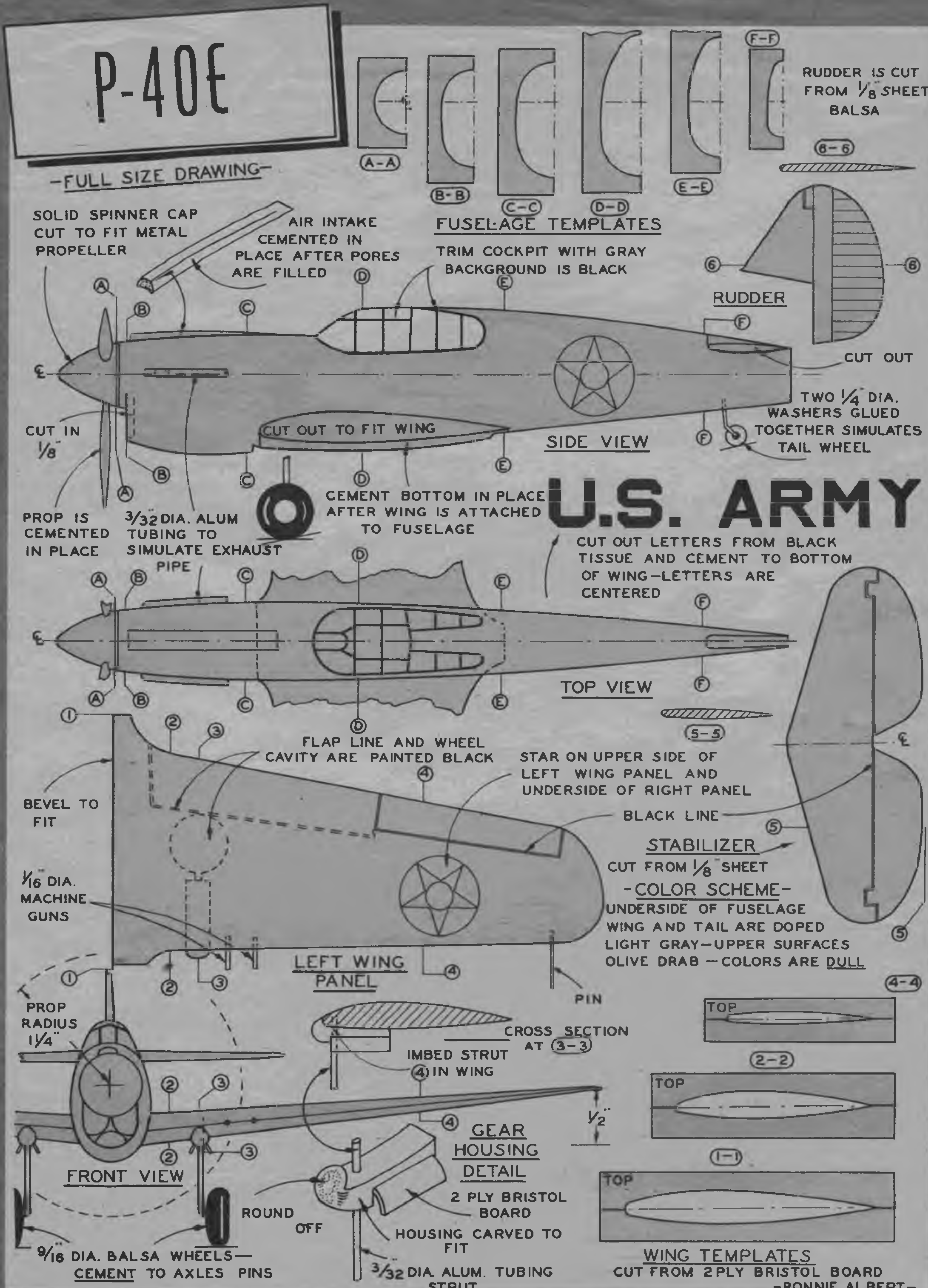
The most distinguished number of the P-40 series, of which there are six (A, B, C, D, E, and F), is the model E, because at this writing the F number is not in active service. All are fundamentally the same, with the variations being in the type engine used, fuel capacity, armament, and minor structural differences. The P-40E is the production model of the D number, being powered with the new American-built Rolls-Royce Merlin engine now being manufactured by Henry Ford.

Our scale model this month will be a quarter-inch-to-the-foot replica of this world-famous fighter, which results in a wing span of nine inches—a very convenient size for your desk or the dresser of your lassie.

Since the plans are full size, the exact size of the wood used should be taken from the plans by direct measurement. Start the fuselage construction by tracing the outline of a block of medium-grade balsa, leaving a 1/8" margin all around. After carefully studying the cross-section shape, with the aid of a sharp knife proceed to cut the outside corners until the fuselage appears to take the general shape. Next cut from three-ply Bristol board the fuselage templates, by placing these at the various templates positions, carefully cut and sandpaper the surface until it conforms with the template shape.

After you have your fuselage carefully sandpapered and checked to make certain that no bumps appear, cut out the bottom portion as indicated on the plans to make way for the wing. Apply three coats of clear dope, sandpapering between each coat with No. 00 sandpaper, and then start the wing construction.

You will note that the wing is made in two panels, left and right. Lack of space prevents us from presenting the right-wing panel, so trace the outline from the left panel. Before attempting to *(Turn to page 53)*


P-40E
-FULL SIZE DRAWING-
(A-A)
(B-B)
(C-C)
(D-D)
(E-E)
(F-F)
FUSELAGE TEMPLATES
RUDDER IS CUT FROM 1/8" SHEET BALSA
(6-6)
SOLID SPINNER CAP CUT TO FIT METAL PROPELLER
AIR INTAKE CEMENTED IN PLACE AFTER PORES ARE FILLED
TRIM COCKPIT WITH GRAY BACKGROUND IS BLACK
RUDDER
CUT OUT
TWO 1/4" DIA. WASHERS GLUED TOGETHER SIMULATES TAIL WHEEL
CUT IN 1/8"
CUT OUT TO FIT WING
SIDE VIEW
PROP IS CEMENTED IN PLACE
3/32 DIA. ALUM TUBING TO SIMULATE EXHAUST PIPE
CEMENT BOTTOM IN PLACE AFTER WING IS ATTACHED TO FUSELAGE
U.S. ARMY
CUT OUT LETTERS FROM BLACK TISSUE AND CEMENT TO BOTTOM OF WING-LETTERS ARE CENTERED
TOP VIEW
(5-5)
FLAP LINE AND WHEEL CAVITY ARE PAINTED BLACK
STAR ON UPPER SIDE OF LEFT WING PANEL AND UNDERSIDE OF RIGHT PANEL
BEVEL TO FIT
BLACK LINE
STABILIZER
CUT FROM 1/8" SHEET
-COLOR SCHEME-
UNDERSIDE OF FUSELAGE WING AND TAIL ARE DOPED LIGHT GRAY-UPPER SURFACES OLIVE DRAB -COLORS ARE DULL
1/16" DIA. MACHINE GUNS
LEFT WING PANEL
PIN
(4-4)
TOP
PROP RADIUS 1 1/4"
CROSS SECTION AT (3-3)
IMBED STRUT (4) IN WING
(2-2)
TOP
1/2"
GEAR HOUSING DETAIL
(1-1)
TOP
FRONT VIEW
2 PLY BRISTOL BOARD
ROUND OFF
HOUSING CARVED TO FIT
9/16" DIA. BALSA WHEELS— CEMENT TO AXLES PINS
3/32 DIA. ALUM. TUBING STRUT
WING TEMPLATES
CUT FROM 2PLY BRISTOL BOARD
-RONNIE ALBERT-

The Traveling Salesman

The latest news of the model industry, new products and developments. Dealers, this is your page. Use it to air your opinions!

ERNEST GAMARCHE, formerly director of Air Youth of America, is now associated with Simmonds Aerocessories, Inc., in New York City. . . . Comet Model Airplane Co. jumped the gun by being the first model manufacturer to produce kits for the official identification models, 500,000 of which Colonel Knox wanted to be built by the nation's air-minded youth. The U. S. office of education has already released through the schools the first twenty plans. Twenty more will follow, and then an additional ten. Ten thousand models of each design are wanted. All models have to be built on a scale of 1 to 72—one inch representing six feet on the actual plane. They do not include landing gear or propellers, and are to be painted dull black.

The plans, templates and other materials to the schools are so excellently done that craftsmen without previous model-building experience will have no trouble in building 'em.

The Model Industry Association announces that during the coming national meet in Chicago, beginning the week of July 28th, they will have their annual meeting and election of officers. The association will hold its annual trade show, open to the public, and this is a good time for our dealers to come out to Chicago and see the Nationals as well as contact all the manufacturers. There is nothing like a heart-to-heart talk with a manufacturer to speed up service a bit!

Ed Miller, chairman of the Model Industry Association Committee on Allocations of Raw Materials, is certainly doing a swell job. His committee has been doing quite a bit of work preparing briefs for the War Allocations Board in Washington, and the industry feels that some sort of help in procuring materials will be given. Of course, the committee's work will benefit everyone in the industry, and therefore your Traveling Salesman feels it is most kind of Comet Model Airplane to allow Mr. Miller (he is their Eastern branch manager) to spend the amount of time he does for the benefit of the association. *(Turn to page 44)*

British air gunners aim camera guns through standard service sights at identification models like these, which run on overhead rails to mimic real thing.

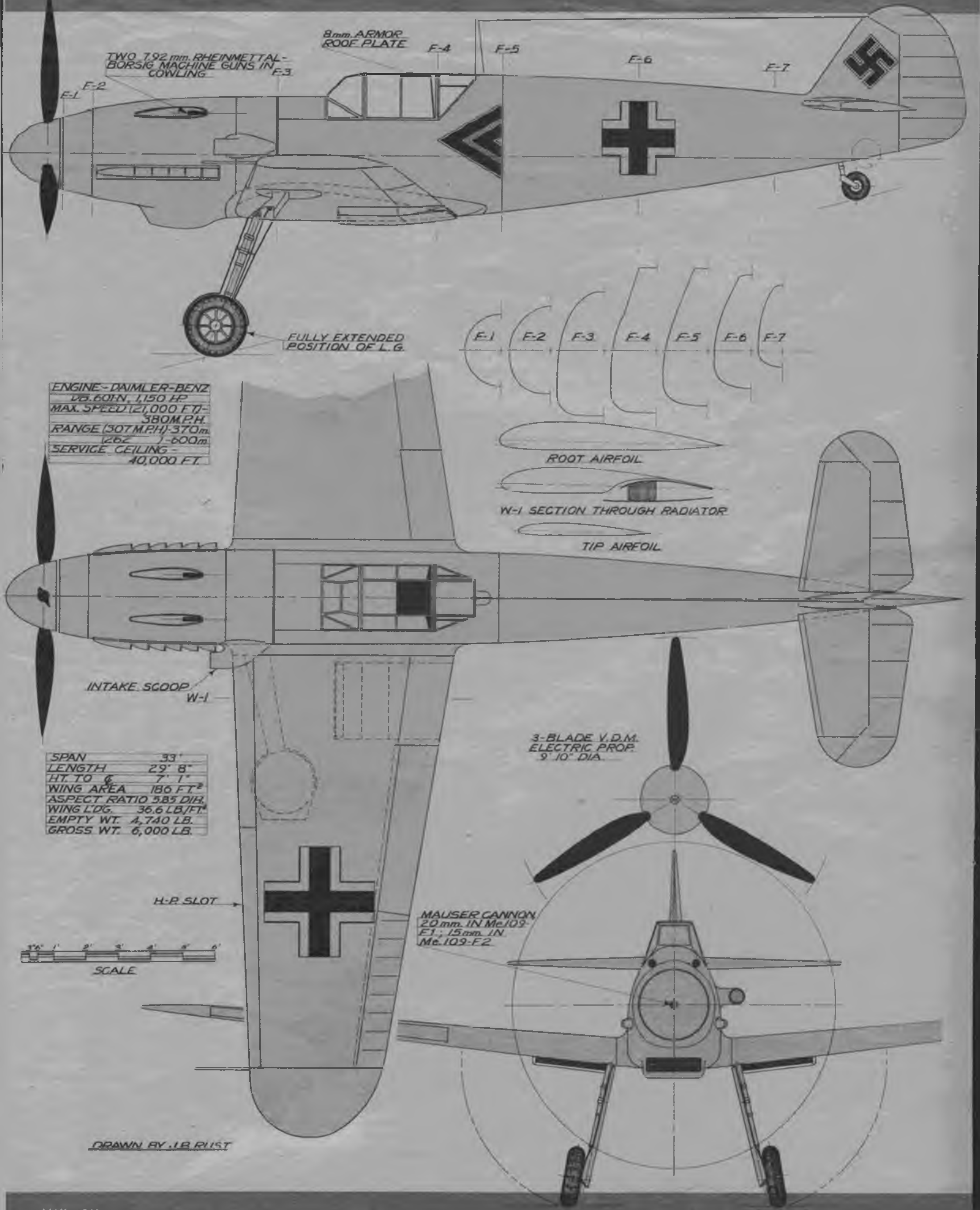
* *

Airacobra Pilot

For your interest we are itemizing various details of equipment of our cover pilot. In order, they are: 1. Small hooded light for map reading and interior visibility at night. 2. Earphone of radio-telephone unit. 3. Rubber knobs covering cabin-cover fixtures as precaution to prevent head injury in case of crash. 4. Door handles for auto-type doors on each side. There are also emergency latches for doors which allow them to drop completely away in emergency. 5 Window-lowering handle. 6. Mayo oxygen mask for altitude flying. 7. Quick-detaching plug for radio headset. 8. Parachute harness. 9. Quick-detaching coupling for throat microphone enabling pilot to leave plane without detaching his "mike." 10. Gun trigger set into control stick just under first finger. 11. Adjustable safety belt with quick-release buckle. 12. Sheepskin-lined suit for cold weather or substratosphere flying. 13. Manual gear for operation of landing gear if electrical system is injured in combat. The ship is the cannon-carrying Bell P-39.

Messerschmitt 109F—High Altitude Interceptor

BY J. B. RUST



Neptune

(Continued from page 22)

surprising to discover that enough spray on the propeller disk would cause the r. p. m. to drop just enough to keep the model from getting off.

The high aspect ratio (over 9) is used, because large boat designers have discovered it to be advantageous for the take-offs; and the large stabilizer (35 percent) with the inverted airfoil is used to offset any longitudinal instability which might be caused by the short tail moment arm. Twin rudders were decided upon to increase the effective size of the stabilizer and to help disguise its size. The ailerons are to aid in making lateral and directional adjustments, because washing in or out the heavily doped wing after completion is very difficult. The method of attaching the wing float was adopted as only a temporary measure, but it proved so successful that it was never changed. The first two flights of the model were made from a small pond, with both landings in a plowed field. No damage resulted. One float has even been knocked out of position on a take-off, but instead of interfering with the take-off it merely dropped completely free on the next impact with the water, and the model took off unhindered.

If you have never tried a model seaplane, you should. It isn't at all difficult. The take-off, though longer than that of a land plane, is much more interesting; and, like the landings, it is practically free of the danger of crack-ups. The flights can be as long as the body of water. Even should the model be forced to come down on land, it usually fares better than a land plane because of the turned-up nose and the lack of projecting landing gear.

CONSTRUCTION

The builder may at first be discouraged by a wood-covered hull. There is no cause for this, for it really isn't difficult. The hull is not planked, but merely covered with two-inch widths of 1/16" soft sheet balsa. This is made possible through the use of a large number of light formers. It is quite easy to form the covering, because they are close together. They also serve to make many water-tight compartments, almost any one of which would keep the entire model afloat if necessary. If in any place the hull curves are too sharp for wrapping a large sheet, short lengths of soft 1/8" sheet may be used between any two adjacent formers and sanded to shape later. This method is also used for repairs. Soaking the wood with water and pinning it on the hull to dry before cementing will also help on some of the sharper curves.

The hull is built in halves. The first half is completed, including the covering, before removing from the jig board. A small jig board just large enough to take the frame will make maneuvering easy while covering. The first half, because of the covering, will not become distorted when it is removed from the jig board, and the second half can be built directly upon the first half. The shape of the keel strips can be taken from the side-view drawing. These are cut from 1/16" sheet, with the exception of those along the actual hull bottom, which are 3/32" or 1/8" hard sheet. Two of each keel strip should be cut (one for each half). Making the formers is quite simple, because they are so thin. Transfer them as accurately as possible on 1/32" soft sheet and cut them out. A pair of sharp scissors may be used. On all formers except Nos. 17 and 18, which are cut from 1/16" sheet, a ring of balsa is cemented around the former. These rings are made from short strips of 1/2 x 1/8" soft balsa. Make the joints fairly accurate and use plenty of cement. The excess is trimmed off with a razor blade when dry. This provides a light, strong former that will not split or distort. Transfer the side-view outline and former positions to the jig board and assemble the first side. Cut the notches for the keel strips to fit while assembling. Place in the chines, which are hard balsa, and the soft 1/8 x 3/16" side stringer, which is mainly a brace while covering.

Start the covering by cementing a two-inch-wide strip the full length of the hull and then work up and down from it with successive sheets. The bottom should be covered with hard 1/16" sheet, and because of the compound curve forward of the step one-half-inch planks may be necessary. The slight hook at the step is made by cementing on wedgelike pieces of balsa cut from 1/8" sheet and cutting and sanding to shape after assembly. Cover enough over the wing position so that when you cut away the pieces can be used on the wing center section. Probably the most difficult part to cover will be that portion just above the water rudder at the joint between the tail-section covering and the lower hull planking. Butt the covering sheets together at this point, cement in soft balsa blocks, and sandpaper to a fillet. Cement the stabilizer platform in place before building the fillet. The platform is made from 1/16" sheet and is rectangular in shape. The fillet is built up with soft balsa blocks between the formers. Upon completion of the first half remove it from the board and set up the frame for the second half directly upon the completed portions. Cover the balance of the hull as before. It may be well to remind the builder that as each cell is covered over, care should be taken that all wood scraps, pins, et cetera are removed; otherwise this miscellaneous debris will cause a nasty rattle in the finished model. When the hull is completely covered, the celluloid windows, step-vent tubes (made from sheet celluloid) and nose block may be added. The nose block is made by cementing a soft balsa block to F-1 and cutting and sanding to shape when dry. It is advisable to reinforce the chines and keel forward of the step. This may be done by cutting a groove along each of these members and cementing in a strip of 1/16" square celluloid or bamboo.

The motor nacelle is carved from two blocks of soft balsa. Make templates from the section drawings given to aid in shaping. The shape of the nacelle may easily be changed to be better adapted to the engine to be used, or to the builder's taste. Carve and sand roughly to shape, then saw into three pieces along the lines indicated. Make bulkheads N-3 and N-5 and check to see that they fit. Refer to the side-view drawing and notice that these bulkheads fit between the pieces cut and not inside the nacelle. That portion of the carved block which is displaced by the bulkhead may be cut and sanded away. The position and alignment of the bulkheads need not be particularly accurate, for their bases may be shimmed with sheet balsa to fit the wing spars for mounting to the center section. When the nacelle block and bulkheads can be fitted together to the builder's satisfaction, the blocks may be hollowed out to about 3/16" thickness at the front, tapering to about 1/8" or 1/16" at the rear. The nacelle is then reassembled permanently with plenty of cement. Cut long slots in the sides of the nacelle for the motor bearers. Cement them into position and fill up any space left with the pieces first removed. When dry, trim off any projecting portions of motor bearers and sand nacelle to final condition. The wing is of multispar cap-strip construction.

Build the gulled portion as one long, straight section and the outboard panels as separate sections. Disregard the ailerons for the present. The cap strips are cut from 1/16" quarter-grained balsa by the method shown. As the ribs get smaller as they approach the tip, shorten the cap strips by trimming off only the trailing edge. An excellent wing section will result. The leading edge is left unshaped until after the wing is completely assembled, except for the tapered sections. These are tapered from 1/4 x 5/8" to 1/4" square at the tip. The trailing edges should be cut to shape before assembled. First cement the top cap strips to the leading and trailing edges, then turn over the frame and cement on the lower cap strips. When dry, locate the positions of the spars. Measure the distance between the upper and lower cap strips at these positions and cut the spars to fit. Slide them into position and cement. Use the forward part of the wing template for cutting the false ribs.

The spars are butt-jointed between the panels when the dihedral is established. Carefully check to be sure the incidence is the same in all panels. Gusset plates of 1/16" hard sheet go on both sides of all joints. The wing should be finally shaped now. When shaping is completed, paint over every joint with a thin mixture of glue and lacquer thinner. This coating provides very much strength. The ailerons may now be added. Cut the trailing edge and ribs away from the aileron position. Build up the aileron as shown from very soft 1/32" sheet and mount with strips of aluminum. The aileron location device is added after covering.

The nacelle should now be mounted on the center section. Build up the center section with blocks of balsa and plastic wood and sand to shape. Use moistened fingers or tools when working with plastic wood. The bottom of the center section and the hole in the top side of the hull are both covered with 1/16" sheet. Grommets should be placed in this covering for locating dowels.

The wing floats are carved each from two blocks of balsa lightly cemented together. Separate them when carved and hollow them out. The hollowing of the wing floats and nacelle is made quite simple if a small wood carver's gouge is used. Reassemble the floats and bring to final shape. The fittings for the floats are now put in the wings and should be spaced to fit the floats.

The stabilizer is built in the same manner as the wings. Locating dowels should be used between the platform and stabilizer.

Before covering, provisions should be made to keep all parts of the model afloat under all circumstances. This is done by dividing the wing into seven waterproofing compartments. Cement in small pieces of 1/32" sheet between the spars and across the cap strips at several positions in the wing to form solid ribs. These positions are at both sides of the nacelle or at the root ribs, the end of the gull panel, and somewhere near the center of each outer panel. While these bulkheads are not absolutely watertight, they will slow the flow of water so as to make the wing and engine, even if thrown clear of the fuselage, practically nonsinkable. Cover the wing and stabilizer with bamboo paper and the wood-covered portions with strips of Jap tissue. The nacelle should first be covered with crinoline for toughness, then with Jap tissue. Give the entire model four coats of clear aircraft dope and as many coats of pigmented dope as required for a satisfactory finish. Sand lightly between all coats. With a good base of clear dope a surprisingly small amount of pigmented dope will be necessary.

It is best to put in the ignition system just before the pigmented dope is applied. Use rubber-covered stranded wire. This does not strip as easily as most hook-up wire, but the rubber covering is desirable. If it isn't available, use spaghetti tubing (from radio shops) over all wires. Solder the condenser to the centers of the breaker-point leads. Cut a hole in the 1/16" sheet on the bottom of the center section and cement the condenser in place. Punch holes in the fire wall; push the leads through and attach to the engine. Bring the other ends of the leads through the bottom of the center section and cut off so that about four

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Neptune

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inches of wire project. Solder the ends of these wires so they are solid and can be pushed into the clips which are cemented to the hull.

Plug all holes as soon as the wiring is completed. Cut a hole into each compartment through the center section platform. These holes are covered later with bamboo paper and doped so that they may be cut into when desired. Solder the leads and attach the high-tension wire to the coil, mount it in a balsa-wood frame, and insert into hull and cement. It need not be mounted in the particular position shown; this is merely suggested. The timer is mounted as shown and its wires are pushed through holes in the formers. It is desirable to plug all holes accessible with cement when wiring is complete. The batteries are used to balance the model. They may be placed between any two formers under the wing section and wedged into place with balsa blocks. When the final position is located a tubular balsa battery box may be installed vertically in the hull with the opening to the outside. The open end of this battery box must also be covered with a piece of bamboo paper and heavily doped. Cover all soldered joints and bare spots on the wiring with cement. Take every precaution to keep the wiring dry.

There are a few hints on flying in which the builder may be interested. Use a low-pitch prop with plenty of area and open the engine up wide for the first attempt, for there is little danger of crack-up, and the model will need all its power to get off. The most successful combination used was to fly the model in a left circle with a little right water rudder to keep the take-off straight. It will probably not take off the first time, but will buzz around at top speed on the point of its step. Shim up the trailing edge of the stabilizer and try again. Keep this up until the model gets off. If it stalls, remove some of the shim and give it a little upthrust. Keep trying this until the model gets off and climbs normally. From this point on the adjustments are conventional. Remember, however, that the thrust line with reference to the center of resistance is in a quite different position than most thrust lines. If your engine should be dunked or heavily sprayed until it refuses to start or run correctly, give it a wash with denatured alcohol inside and out (pour it in through the ports and over the timer) and pour out the mixture of water and alcohol. Allow it to dry for a few minutes and try it again. This usually does the job.

If an outboard motor is available, the flying is much more interesting. You can be on hand to watch the landing; and you'll not have to climb any fences. And if there is an outboard motor around, a little warming up of the engine on the shore will usually make it yours to command; in fact, the greatest danger yet to a model seaplane is too many spectators with power boats to endanger the take-off. So you better do your test flying early in the morning.

BILL OF MATERIALS

Wood

- 4 sheets $\frac{1}{32}$ x 3 x 36", bulkheads, et cetera
- 8 sheets $\frac{1}{16}$ x 2 x 36" (soft), hull covering, et cetera
- 2 sheets $\frac{1}{16}$ x 2 x 24", hull, bottom
- 5 sheets $\frac{1}{16}$ x 3 x 36", wing ribs, spars, et cetera
- 1 sheet ⅛ x 2 x 36", fins, et cetera
- 1 sheet $\frac{3}{16}$ x 2 x 24"
- 1 sheet ¼ x 2 x 24"
- 2 blocks 1¼ x 5 x 8½" (soft), engine nacelle
- 1 block 1¼ x 3 x 4", hull nose block
- 2 blocks 1¾ x 1½ x 7", wing floats

Metal

- $\frac{1}{16}$" diameter piano wire (rubber hooks)
- .020 aluminum, rudder and fittings
- 2 coil springs approximately ¼" in diameter
- Small piece .015 sheet brass (ignition connections)
- 4 inches $\frac{1}{16}$" diameter brazing rod (ignition connections)
- 6 inches $\frac{1}{16}$" diameter aluminum tubing (wing float mounts and cowl location)
- 6 inches (approx) ⅛" diameter aluminum tubing with wooden dowel to fit for (wing and stab. locations)

Miscellaneous

- 2 sheets bamboo paper
- 2 quarts clear dope
- 1 quart colored dope (altogether)
- 1 strip celluloid 2 x 12"
- Screws, bolts, engine unit, timer, ignition wire and rubber bands as found necessary for engine mounting and fitting. Also three feet of fish line for wing float mounting.

The Traveling Salesman

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The Academy of Model Aeronautics has recently informed the Model Industry Association regarding motors sent by model builders to the respective factories for repairs. It seems that model builders return their engines to manufacturers for reconditioning, and since the latter are evidently tied up with war contracts and are understaffed, they do not seem to acknowledge receipt of the engines in some instances. The academy recommends that motor manufacturers use a penny post card to acknowledge receipt of the motors and advises the model builders to be patient, since it will take a little longer than usual to repair their motors. For the sake of the model builder, we echo this suggestion.

R. C. Sarsfield, proprietor of the Hobby House Hobby Shop in Denver, Colorado, has been called into the military service, but the business will be continued by his father. . . . Last month we told you about a special $2,000 fund needed by the Air Youth of America to send instruction booklets on model building to the manual training and industrial art teachers in the country. Most of that fund was raised, and at press time the following companies had contributed anywhere from $25 to $200 each: Ohlsson & Rice Mfg. Co., Los Angeles, Calif.; Rogers Motor Co., Philadelphia, Pa.; Testor Chemical Co., Rockford, Ill.; Comet Model Airplane Co., Chicago, Ill.; Scientific Model Airplane Co., Newark, N. J. We hope that other model companies will contribute good sums to this fund.

Air Trails readers have probably heard about the prize fund at the Academy of Model Aeronautics. This is how it works. Manufacturers, distributors, et cetera, were getting tired of receiving letters from various clubs and groups requesting prizes for contests. They did not know whether these were sanctioned or not, or whether they were authentic. Therefore, the Model Industry Association suggested that members contribute a flat amount to the Academy of Model Aeronautics annually, that money to be used by them to buy a large number of trophies, medals and the like which will be kept by them in stock. If a manufacturer gets a request from a group for prizes, that request is referred to the academy, who will give it due consideration, and issue prizes directly from Washington. For the information of the many clubs that will start soliciting prizes for spring and summer contests, the following companies, as of press time, have already contributed to the fund: Bay Ridge Model Airplane Co., Brooklyn, N. Y.; Polk's Modelcraft Hobbies, New York City; H. F. Auler Co., Milwaukee, Wis.; Stewart P. Elliott, San Francisco, Calif.; Rogers Motor Co., Philadelphia, Pa.; Comet Model Airplane, Chicago, Ill.; International Balsa, Jersey City, N. J.; Ohlsson & Rice Co., Los Angeles, Calif.; Airco Model Supply, Detroit, Mich.; Microdyne Engines, New York City; Herkimer Tool & Model, Herkimer, N. Y.; Testor Cement Co., Rockford, Ill.

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The Traveling Salesman

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Therefore, from now on instead of writing to the above companies for prizes, take the letter and send it direct to Al Lewis, Academy of Model Aeronautics in Washington.

No doubt sanctioned meets, run under academy rules, will get consideration.

To the many dealers who have requested information about staying in or going out of business during this war time, your Traveling Salesman can say that there is absolutely no reason for going out of business. Substitutes will be found for many items of which there will be shortages. More and more solid models will be made from sugared pine. This means that material such as balsa wood and the like formerly used for solid models will be converted to flying models. Covering tissues in the future will not be as good as the ones formerly used, such as Silkspan, et cetera, but even Silkspan is being made in white only. Of course, there is a predicted shortage of things like dope—but we predict substitutes and synthetic products.

Cliff Rogers showed us his new "60" in Philadelphia the other day. What a powerhouse! The shaft is one half inch in diameter, thinner shafts having twisted off. This job gets its power from two by-passes. These by-passes are cut into the inside of the cylinder wall so that the piston itself forms one wall of the by-pass. Previously, by-passes were built onto the outside of cylinders, but Rogers' method of "pouring" almost the entire engine in one operation enables him to use two by-passes and yet keep cost way down.

H. & F. has a large stock of "Streamlite" wheels on hand. . . . Miniature Aircraft Corp., 83 Low Terrace, Staten Island, N. Y., is giving away with each sale of their new Airacobra flying scale model fifty cents' worth of defense stamps. Mention Air Trails when you write for information about these free stamps, but do it before May 10th. . . . Ohlsson will put nearly all its effort into war work, not having a priority for their model motors. So, dealers, it might be a good idea to rush those orders. . . . Berkeley has plenty of thin music wire for control-line flying. Drop them a line, boys! . . . Polk's Modelcraft Hobbies, Inc., has a large stock of Silkspan available at wholesale prices to the trade. . . . Megow's Zomby sales are moving so fast that we'd suggest you three dealers who don't handle the Zomby climb on the band wagon as quickly as possible.

For The Duration

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Of course, we looked. There, very high, was indeed a plane. A quick look by these more or less experienced eyes indicated it was a model—a Comet Sailplane probably "on the loose" from a nearby model field. Flying at 1,000 feet or so it did look like a bomber, which might have been at an altitude of some 10,000 feet. The faint hum of an automobile on the nearby parkway added to the illusion. We looked for the vigilant watchman, but he was already at the phone. Only with some difficulty we convinced him that he had seen only a gas model heading for the final resting place of all lost models.

Consider what his report might have done to a well-organized program of plane spotting. Having no previous reports on the flight of the plane, New York headquarters would have indicated an "unknown" plane on its large-scale map of Long Island. Assuming that all domestic planes had been spotted, that one report would have raised a query. After another report, from stations farther along the line, it would probably have resulted in a call to the nearest air base and soon a pursuit ship would be prowling around to give the intruder a careful scrutiny.

We modelers might as well get down to cold, hard facts. For the duration those out-of-sight flights we so love are actually a possible source of harm, especially in the seaboard areas. In England, where civilian spotter squads have been on duty continually for some time, all gas model flying has been stopped. In fact, model flying of any kind has been curtailed greatly. The reasons are obvious.

At an altitude of 10,000 feet the average bomber is but a speck in the sky. The drone of its motors is a faint hum, hardly audible. At 15,000 feet the motor noise is inaudible. A model at 1,000 feet is, to eyes below, a potential bomber. It has wings, tail and is flying. At such altitudes it is almost impossible to tell the difference, at least for Mr. Average Citizen who is on spotter patrol.

There are several solutions to this problem which, after all, is important to national defense. The 1942 rules may prove to be the solution to the problem *if* they are adhered to. Short flights—precision flights—will be definitely the style in the coming year.

Another solution presents itself and should be quite in vogue among fliers in inland localities. When a club plans a contest, the director should contact local defense authorities who have charge of plane spotting. He should explain the contest, the possibility that model planes will be in the air overhead, and in addition to making the spotters aware of the event, he should offer to lend the spotter patrol an experienced modeler for the period of the contest.

Definitely the long cross-country flights are *out*. We trust we have explained the reasons for their elimination. Modelers are a distinct asset to this great country of ours, but flights by their planes might easily alarm an area. One more suggestion might be applied for these long flights. In the future whenever a model "hits a thermal" and is lost, it should be reported to the nearest air base. Call the post commander, report the presence of a model in the sky, the direction it was headed and give a brief description of the ship. Such a procedure would do much to allay false alarms.

The Dope Can

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clubs interested in furthering indoor building. Bob Toft (president of MMAC) graduates from the University of Minnesota in June, when he's coming East to work at Pratt & Whitney in Hartford, Conn.

Elm City (New Haven, Conn.) Gas Bugs claim credit for the first gas flights of 1942. About 1 a. m. four of the Bugs decided to go flying. At 1:50 Jean Woodward sent up his Buzzard Bombshell; Fred Haesche and Harry Lawlor let go shortly after. Fred Schmidt had motor trouble and his flight was postponed until next morning. These boys earned charter memberships in a new fraternity, the Nighthawks, open to Gas Bugs who fly by the light of the moon. Another unusual flight was turned in by William Paulson's prize Zipper. At a recent club meet it soared out to sea somewhere over Rhode Island. A few days later it was washed ashore at Block Island, R. I.

Private Walter J. Fromm, expert modeler from Chicago, has started a model club among members of the Seventy-second Field Artillery Brigade stationed at Fort Leonard Wood, Mo. . . . Private Bruno Marchi, connected with AMA headquarters in Washington, D. C., before the war, is stationed at Fort Richardson, Alaska, waiting for spring and warm model flying weather. . . . Joe Culver is actively boosting indoor models on

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The Dope Can

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the West coast. He was indoor champion back in 1929, winning the event at the national meet in Detroit. . . . Pennsylvania modelers lead the country in the scramble for the AMA national records with seventeen percent.

Galen A. Stephens of San Antonio, Texas, speaks for himself and many other Texans when he credits spoilers as the only effective way to stop OOS flights. Don't change the weight rules but encourage the use of spoilers.

Seems as though Stephens needn't worry. The rule gaining most favor is limiting flights to three or four minutes maximum on a fifteen-second motor run. Any flight over this limit will be credited with the maximum allowed unless the flight is over six minutes, in which case the entrant will be disqualified. Weight rules would remain the same. It will be up to the contestant not to lose his model. Models must not go on cross-country flights. Our air defense requires strict regulation of all aircraft—models included.

Carl Goldberg suggests the marathon contest for the problem of lost ships. The goal is to make the maximum number of flights of one minute or more within a given time. Maximum motor run is fifteen seconds. Flights of sixty seconds or more are credited. Builders would be limited to three flights an hour. Ties could be settled by determining who used the shortest total motor run. Only one model and motor may be used. Spoilers could be set for just over a minute and there is practically no danger of losing the model.

A field day in the field house in April for Indiana builders was the joint effort of Purdue University officials and the Aeromodelers, the college's model club. They've promoted building throughout the high schools of Indiana. The April contest was planned for the novice with only two types of models—all-balsa glider and simple rubber-powered stick—and no stringent rules. Each event was divided into junior and senior high-school groups with modelers classed as either expert or novice. Gordon Smith, 401 Russell St., West Lafayette, Ind., will gladly supply additional information on the university's model program.

Harry G. Vogler, Jr., of Pittsburgh, has worked out the details of a miniature motor registration scheme. Chief purpose is to reduce the number of motors lost and stolen. Every motor sold would have a registration card filed. When the motor changes hands—either through private sale or recognized dealers—the registration would be brought up to date. Serial numbers of missing motors would be sent to dealers, clubs, and contest officials. Owners would be notified if these motors turned up. Contest officials can help by listing engine numbers when registering contestants. It's an ambitious program. But Vogler's energy is practically unlimited in model matters. He's prepared to handle the bookkeeping and necessary paper work. Clubs and individuals are urged to write for registration cards. Address him at 1633 Duffield St., Pittsburgh, Pa.

Life has been simplified for some model builders. No longer will they flip coins to decide which contest to attend. Representatives from three States met at Pittsburgh recently to form the Tri-State Association of Model Aviation Clubs. A schedule of contests for Ohio, West Virginia, and western Pennsylvania starting early in March and continuing through November was set up without any conflicting contest within a radius of 100 miles.

The Aeroneers have several other outstanding members. Paul (Pop) Romak and his two sons, Paul and Earl, make up the famous Romak Tribe, which is a serious threat at any contest. Gordon Peterson has several national records to his credit. W. R. Davis started flying models in 1908 and learned to fly a full-scale job in 1912 in an old pusher. He flew in the last war. He's still flying models as an active member of the EBAA.

After a short lull the Tulsa-Kansas City boys resume their battle. The Tulsans resented being called "crummy." Gordon Walker reminds the Kansas City crowd that Tulsa brought back four trophies and three plaques from the Mississippi Valley Contest in 1941. How many did the KC boys bring home? Answer: one. Another "crummy" Tulsa builder is Don Emnick. His scale model won sectional honors in the Aeronca national contest and was entered in the finals. Tulsans are planning several spring contests, and the Kansas City boys will be invited as guests of honor. Maybe this will settle the feud. Remember, KC, that Tulsa has a rather successful background in model affairs. Alvie Dague, Roy Wriston, and other outstanding builders put it on the map with brilliant showings at the Nationals and important sectional meets.

Johnny Litchenburg, also, resents cracks about the builders in his city. He doesn't consider this as serious as the lack of interest in gliders. Here's the ideal model for the days of war priorities—no power plant and no expensive, hard-to-get materials.

East Bay Aeroneers Association of Oakland, Calif., hold an enviable portion of hydro records. They established five new ones at their official hydro trials last January. One of the most successful models to come out of the West is Don Foote's design, the Westerner. Powered with a Forster 29, weight is thirty-four ounces, and the area is about 540 square inches. A Westerner performed beautifully to set a Class B ROW of 1:36.4 for Bill Steese. After this exhibition Bill replaced the B motor with a Class A Dreadnaught of .19 cubic inch and set a Class A record of 1:08. Don is a top-notch designer. Correspondence from California rates him as one of the leading modelers.

Ideas For Radio Control

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performance the above is the only course.

For maximum sensitivity on weak signals, the following conditions must be met: (a) high series resistance in the plate circuit (or better yet, tap down on the "B" battery); (b) low idling (maximum) current; (c) loose antenna coupling; (d) maximum L/C ratio (large coil, small tuning capacity); (e) high grid-leak value.

These conditions result in high tuned-circuit impedance and operation of the tube near the "cross-over" point on its characteristic curve—both essential for maximum sensitivity. They apply in general for maximum *selectivity*, as well.

For maximum plate current change on relatively strong signals, however, the conditions must be reversed: (a) low series plate resistance (total including relay of 10,000 ohms for 45-volt battery); (b) high idling current; (c) tight antenna coupling; (d) decreased L/C ratio (smaller inductance, more capacity); (e) low grid-leak value.

The length of the antenna is a factor in considering antenna coupling as well as the antenna trimmer capacity. The longer the antenna (closer to resonance) the more it will load the detector, i. e., the higher the average or idling current. The lower the L/C ratio, the tighter the antenna coupling can be.

For maximum sensitivity use a variable series plate resistor or tap down on the battery, cell by cell, until the best operating condition is found (leaving only the relay resistance in series). Try various grid-leak values from 1 to 10 megohms, going up for sensitivity, down for maximum change. Where weight is unimportant, increase the plate-bypass condenser to 0.1 or even 0.25 mfd. Increase the size of the tuning coil until resonance occurs near minimum capacity (i. e., with no mica in compression between the trimmer condenser plates).

Two-tube R-C Receiver

The fact that the three top winners in the R. C. event at the 1941 Nationals used RK-62s probably is important only in relation to the accompanying fact that the Good brothers were not flying that year. Yet it is true that builders generally, and particularly the beginners, find it easier to get reliable, trouble-free operation from the miniature thyratrons than from any of the conventional triode circuits using only one tube.

Not that a single RK-62 represents a perfect arrangement, leaving nothing more to be desired. As in any radio receiver, additional stages of amplification will add to the performance. A d. c. amplifier tube such as that shown in Fig. 2 will step up the apparent sensitivity by ten or twelve times, in terms of percentage plate-current change.

There's nothing basically new about the use of d. c. amplifier tubes for this purpose, of course. Receivers employing them have been used in the past, but either they have proved tricky in adjustment or they have suffered the competitive handicap of excessive bulk and weight. The novelty in the two-tube assembly illustrated lies in the fact that it weighs about *half* as much as the lightest conventional one-tube sets! Yet it has greatly increased sensitivity (and consequent reliability), is easy to get operating properly, and is even more tolerant of battery condition than the single-tube outfits.

How does it work? Well, the circuit diagram (Fig. 2) and the plate-current curve (Fig. 3) tell the story. The principle is this: The plate current of the QF-6 (or RK-62, if used), flowing through the 6,000-ohm series resistance, establishes a voltage drop which is used to bias the grid of the 1S4 negative. At 1.5 ma. this bias amounts to 9 volts, which is enough to drop the plate current of the 1S4 to about 0.3 ma. When the plate current of the QF-6 drops to 1.0 ma. with signal, however, the bias on the 1S4 becomes only 6 volts and its plate current therefore rises to about 2 ma. By the time the QF-6 has dropped to 0.5 ma., the 1S4 is up to 5 ma.

Even a relatively weak signal will cause enough plate-current change in the 1S4 to operate a relay adjusted to pull in at, say, 1 ma., while a stronger signal will really slap the armature tight against the contacts.

The use of miniature tubes keeps the total weight of the receiver (less relay and batteries) down to only 1¾ ozs. A lightweight sensitive relay can be obtained that weighs about as much more (RCH 11-A). The battery problem (the d. c. amplifier tube must have its own plate and filament batteries) is ideally answered by the Burgess 4X2V60 radiometeorograph battery. This is a 90-volt "B" and 3-volt "A" unit weighing under 12 ozs. It is necessary to do a little rebuilding on the battery before use, removing the cover to solder in a 45-volt tap as well as bringing out separate pairs of leads from the two small "A" cells. Alternatively, two 5½-oz. V30BP's and two flashlight cells could be used, with a slight increase in total weight.

Construction of the two-tube receiver is elementary. Emphasis throughout is on lightness. A 1⅜ x 2" piece of 1/16" laminated bakelite sheet constitutes the chassis. The tube sockets (Amphenol 78-5PT for the QF-6 and 78-7P for the IS4) are cemented in place. The two bakelite-based mica trimmers (Hammarlund MEX) are supported at their junction by a projecting soldering lug eyeleted to the base. The r. f. choke is similar to that in Fig. 1 except that it is wound on the slightly lighter BT-½ resistor. A battery cable made up of different-colored lengths of No. 22 hook-up wire is wired permanently into the unit. (In installation, a three-inch loop should be left in the cable, so it will not transmit engine vibration to the receiver.)

As a refinement for precision adjustment (at an increase in weight), the 4,000 and 6,000-ohm resistors can be combined into one 10,000-ohm potentiometer (Centralab Sub-Midget ¾" dia.). Connect the 1S4 grid to the movable contact and set for optimum idling current. A further refinement would be to add another 10,000-ohm variable on the r. f. choke side and adjust for maximum sensitivity of the QF-6. (Refer to earlier comments on conditions for maximum sensitivity.)

Three Tubes and A. F. Selectivity

Multichannel operation when more than one control is used involves a new set of problems. The usual stunt in small models is to use a number of identical r. f. channels tuned to different frequencies within the 56-60 Mc. amateur band. This method, known as r. f. selectivity, has many advantages, but it is usually bulky, and the use of several channels introduces serious "cross-talk" problems, the selectivity of the tuned circuits being poor enough to make separation of more than three or at most four channels difficult.

The alternative is audio frequency (a. f.) selectivity, in which a single r. f. carrier is modulated by any one of two or more audio tones, according to the control function desired. These tones are separated after detection by filters that cause only the desired circuit to respond. It is the need for these filters in the receiver that has pretty well limited the use of a. f. selectivity to the largest installations, because they necessarily involve increased weight. Iron-core band-pass filters can't be made from balsa wood and silk!

There are ways to get around the problem, though. The circuit of Fig. 4 shows a simple and comparatively lightweight method of achieving dual-channel a. f. selectivity with standard equipment.

A self-quenched superregenerative detector—using a regular triode this time instead of a gas tube—feeds what appears to be a push-pull audio amplifier. Actually, the "audio amplifier" is a pair of relay tubes which rectify the audio modulation from the detected carrier, the resulting plate-current change operating relays. One tube will respond only to low frequencies, the other only to high. To accomplish this, each half of the push-pull secondary of the midget UTC "Ouncer" transformer is arranged to serve as an elementary audio filter.

The upper half (Channel 1) is tuned by the 0.02-mfd. condenser to around 100 cycles; it discriminates sharply, therefore, against the higher modulation frequency of around 4,000 cycles. The lower half (Channel 2), on the other hand, discriminates against the 100-cycle low-frequency modulation because the 500-mmfd. grid coupling condenser presents a series reactance of several megohms at that frequency, while at 4,000 cycles the resistance is less than a tenth of a megohm.

The 1Q5GT's, operating as square-law detectors, have a normal idling-plate current at 45 volts of approximately 3.2 ma. With 1.5 volts of audio signal applied, the plate current drops to about 1.5 ma., which is sufficient change to operate a sensitive relay reliably. Additional input will cause the plate current to drop still more, of course; at 5 volts it goes down to about 1 ma.

In preliminary adjustment, the 25,000-ohm variable resistor in the 1LE3 plate lead is set so that the detector cannot deliver more than 5 or 6 volts of audio without flattening off when the r. f. input is further increased. This provides a convenient "ceiling" which limits the selectivity required of the audio filters. A rectified signal of less than 1 volt will not work the relay; the detector, on the other hand, cannot deliver more than 6 volts or so. The operating range is therefore about 15 db. Since there is at least 25 db discrimination in the filter circuits, modulation on one channel can never cause the other to respond, eliminating cross talk.

The receiver is assembled on a 3 x 6½" piece of 1/16" laminated bakelite sheet. Despite their greater weight, air tuning condensers (National UM-15) are used because of better stability, lower losses and greater ease of adjustment. Some weight is saved by dismounting the condensers from their ceramic bases and reassembling on the receiver chassis itself. A special low-pass filter utilizing an 80-millihenry r. f. choke (Meissner 19-2709) is required to keep the interruption frequency out of the audio system.

The total weight of the complete unit, including tubes, is just under 14 ozs. Standard batteries can be used, although the heavier sizes are advised because of the increased drain.

Selection of more than two frequencies is not practical with simple filters such as those used in the receiver just described. However, a suggestion for possible experimentation is the use of an RK-62 as the detector in this circuit, with a relay in its plate lead responding when the carrier itself is turned on and off. This would, in effect, provide a third channel which might be used in an automatic restoring circuit, as a safety neutralizing device, et cetera.

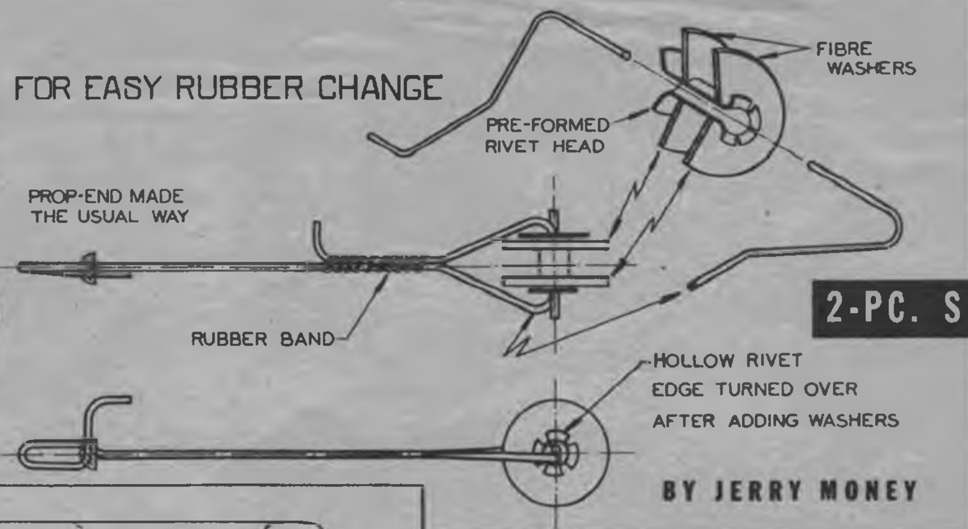
Additional filtration to cut down the high-frequency response might be required in that case to prevent hiss from actuating the high-frequency channel in the "carrier-off" condition. For that matter, all values shown in the diagram, including the filter capacities and grid-coupling condensers, are subject to experiment, for individual assemblies may be expected to vary widely.

That's still one of the significant facts about radio control—what works for one will not always work for all. Individual idiosyncrasies in assembling, wiring, tuning—or just plain cussedness in keeping after an obstinate hook-up until it's made to work. . . .

Whatever it is, it's all part of the fascination that makes radio control such a compelling hobby. Some day all these irrational little factors will be reduced to an exact set of engineering rules, but right now it's still an art so new that not even the engineers know all the answers—and it's up to us to find out for ourselves!

Hints

FOR EASY RUBBER CHANGE

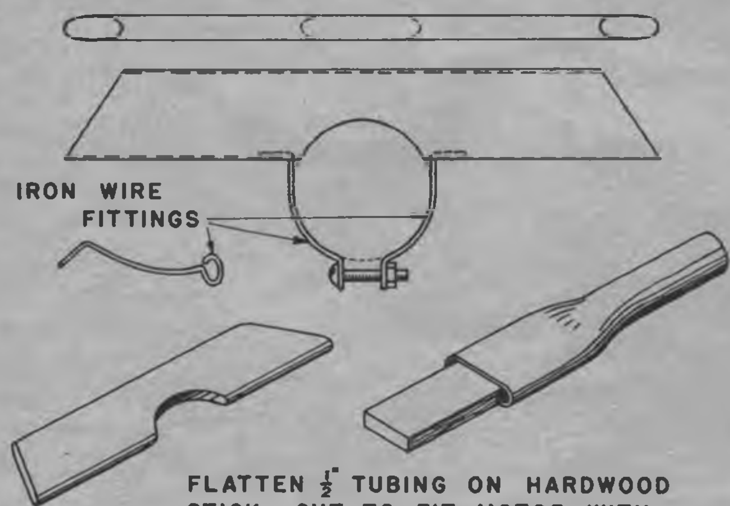


2-PC. SHAFT

BY JERRY MONEY

Above—You'd think someone would have doped this out before. The usual contest model shaft must have a closed hook, otherwise the pull of the rubber would straighten the hook and snap free. Hence, changing rubber was a chore, but this two-piece shaft permits a removable bobbin for looping on rubber. The bobbin eliminates knots.

Left—If you happen to own a Brown or a Bunch you can stop oily exhausts from making a shambles of the insides of the fuselage. This stack can be made in a jiffy and is well worth the effort, since oil seepage damages paper and balsa. Below—Here's how you can tell if she is really perking. But lay off Ma's sewing machine!



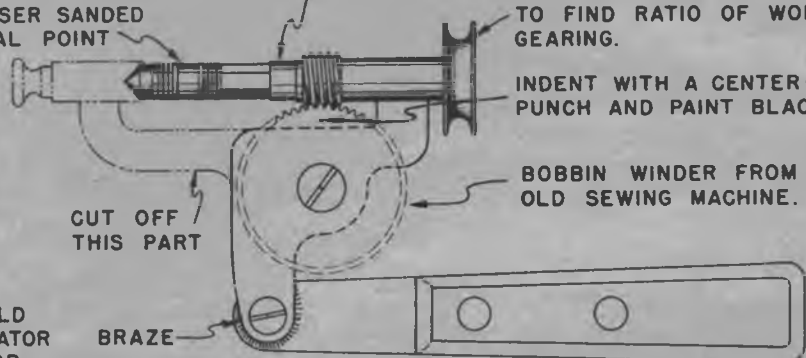
FLATTEN ½" TUBING ON HARDWOOD STICK – CUT TO FIT MOTOR WITH COPING SAW.

BY JOHN DALLAIRE

BROWN OR BUNCH EXHAUST

SIMPLE RPM INDICATOR FOR GAS MODEL ENGINES

BY MANLEY MILLS



WITH THE ENGINE RUNNING, HOLD THE ERASER TIP OF THE INDICATOR AGAINST THE END OF THE PROP SHAFT. USE A STOP-WATCH TO FIND THE NUMBER OF SECONDS IT TAKES THE LARGE GEAR TO MAKE ABOUT 4 COMPLETE TURNS. NOW MULTIPLY THE GEAR RATIO BY THE NUMBER OF TIMED TURNS, TO OBTAIN THE NUMBER OF ENGINE REVOLUTIONS DURING THE TIMED PERIOD. CALL THE RESULT "A". NOW DIVIDE THE STOP-WATCH READING INTO 60 TO GET "B". R.P.M. EQUAL A×B. FOR EXAMPLE, IF GEAR RATIO IS 130:1 AND GEAR MAKES 4 TURNS IN 5 SECONDS,– A EQUALS 4×130 OR 520. B EQUALS 60÷5, OR 12. 520×12 EQUALS 6240 – R.P.M. OF ENGINE.

Voice From The Tower

(Continued from page 16)

obstruction. There must be no snarls of delay or possibility of collision in the skein of traffic. A cool head and sound judgment are required.

While the radio telephone is his principal instrument of carrying out his job, Stockam must be prepared to transmit his orders by use of a light gun should the radio fail. He must, also, do more than conduct an authoritative monologue to keep traffic moving smoothly. He must be something of a good listener.

A room-width battery of receivers in his glass-walled office is tuned to a number of standard and assigned radio frequencies. They include one for itinerant pilots; one for the army, another for the navy, four for United Air Lines; two for Transcontinental and Western Air; one to monitor calls from the Oakland Airport tower across the bay. From any one of them may come a request for information or orders desired by a pilot approaching San Francisco Airport.

Between moments of listening and issuing orders, Stockam announces arrivals and departures of commercial air liners over the administration building loud-speaker system and answers the control-tower telephone. It rings frequently as student pilots and their instructors seek permission to practice precision landings.

Stockam handles his work without apparent tension or excitement—as do his fellow operators at San Francisco Airport, who are typical of the ten-score men who are pioneering the work of establishing their task as a profession. He seems to have adopted the system of taking care of one incident at a time in the order of its importance with relation to everything else that is happening at the moment. A problem, whose sequence of events covers less than sixty seconds, goes something like this:

A Douglas has finished loading at the passenger ramp and has been cleared to taxi to the take-off point. As it lumbers away from the gate, Stockam broadcasts the ship's Air Traffic Control flight plan.

Two Luscombes roll slowly from the apron in front of their hangar and halt at the taxi strip, awaiting an order to proceed. The order will include information concerning wind velocity and direction.

Approaching the northern boundary of the field is an incoming Douglas. Just east of the boundary is another Luscombe, about to complete the last ninety-degree turn of a precision landing.

Stockam calls the landing Luscombe, designating it by position, apparent maneuver, and field identification number that he has picked up with his binoculars. He informs the pilot of the location of the landing Douglas and instructs him to land well east of the runway.

Obediently the Luscombe pilot abandons his precision landing, momentarily guns his motor to pick up the required flying speed, and starts a new glide for a new "spot."

Pilots of the approaching Douglas are called, told they may land, that the runway will be cleared for them, advised of the position of the Luscombe, given the latest wind data, and informed their "gear is down." The last bit of information is just an added duty of the tower operator in the interest of safe operation. Pilots have been known to be a bit absent-minded as far as a retractable landing gear is concerned.

Next comes a call to the pilots of the departing transport. The co-pilot's "repeat" of the approved flight plan is checked and acknowledged. The ship is then given permission to take off after the landing transport has cleared the runway.

Stockam then calls the waiting Luscombes. A flutter of the ailerons on the light ships acknowledges the call and is a positive check for the tower operator that the receivers in the training planes are working. He then gives their pilots permission to taxi to their take-off point.

By that time the arriving Douglas has landed. The sequence concludes with instructions to its pilots to taxi to one of the field's six passenger gates for unloading.

Sometimes things do not proceed with such precision. Then quick decisions and orders are made and given to meet the momentary emergency. It is at such times that Stockam calls upon his own experience as a holder of a private pilot's license to avert disaster. He has piled up time on a variety of ships and knows their characteristics of performance and, consequently, can direct them with more skill and assurance. He also knows from practical experience the problems of the pilot that sometimes comes in handy—for the pilots. A case in point:

A variable wind of three to five miles an hour is blowing. It is about fifteen degrees across the runway. Such conditions provide an opportunity for the practicing pilots to sharpen their skill on cross-wind landings—and they are doing so. Suddenly the force of the wind increases to eight miles and shifts until it is almost ninety degrees across the runway. Stockam watches closely as the planes glide in for landings.

If he observes the pilots can't handle the conditions and their drift is getting a bit near the borderline for safety to themselves and their equipment, Stockam orders a general change in traffic to a new runway—and provides the pilots with ideal conditions, including a head wind.

Such is the work of a control-tower operator. Stockam doesn't know many of the pilots he orders about and gives his best to each of them. When they won't help him, he doesn't argue, forgetting one or two honest mistakes, but becoming tough with persistent violators of the rules that are established for the general good of all concerned.

The greatest help a pilot can give the tower operator is to make sure he knows the field's traffic rules and keep his radio receiver in working order, Stockam says.

"And the pilot might keep alert all the time," he adds.

When he has finished a shift, Stockam still keeps his mind on his job, although he doesn't concentrate on it. His hobbies are golf, horseback riding, and swimming, all good conditioners. In reserve in the hobby line he keeps amateur photography. He avoids alcoholic forms of diversion.

"You can't tear around nine months of the year and train for three and still pass that physical," he explains.

For his services, Stockam receives $200 a month. That wage rate, however, is going up, with tower operators more and more in demand. Some fields are paying as high as $300 to $350 a month. Stockam is allowed two weeks' vacation with pay a year, and is entitled to two weeks' sick leave a year with pay. The sick-leave allowance may be accumulated up to six months, according to years of service.

Deductions are made each month from his check for compulsory membership in the city retirement system and the municipal employees' health insurance system. The deductions total about six dollars per month.

Aware of his job's high physical requirements with special reference to vision, a minimum of 20/50 without correction and 20/20 with correction being required, Stockam expects to work as a control-tower operator for at least another ten years if nothing better turns up. But he expects something will, for commercial aviation after the war will have more responsible and better-paying positions for men of his training, background and experience.

And when the Stockams of commercial aviation today move up, someone is going to take their places. Those future tower operators, the "traffic cops of the air," will come from the ranks of the nation's airminded youths of today.

P-40E Shelf Model

(Continued from page 38)

shape the airfoil of each panel of the wing, first cut the taper as shown in the front view, into each rough wing panel. Cut from three-ply Bristol board the wing templates and form the airfoil in exactly the same fashion as the fuselage cross section is shaped. Carefully sandpaper the surface and then proceed to join both wing halves together, forming the required half-inch dihedral on each tip. Next apply three coats of clear dope to both upper and lower surfaces, sandpapering between each coat, and set the wing aside.

The stabilizer and rudders are made in exactly the same manner as the wing. The top outlines of both are cut after the front taper is shaped, and then, after sandpapering, the units are doped in the manner of the fuselage and wing.

As all of you will agree, the finish is what beautifies *any* model. With solid models, because they are built up from balsa, a very porous wood, it is necessary to coat the surface with more than three coats of dope. To insure that the grain does not show, wood filler may be applied before dope is used. However, the application of this is rather tricky, and the safest course is to cover the entire model with ordinary tissue paper, the type on rubber-powered models. To prevent the paper from wrinkling when corners are covered, cement small sections at a time, using a fifty-fifty mixture of dope and cement as an adhesive. After the surfaces are covered and the adhesive allowed to dry thoroughly, sandpaper the unit with No. 00 sandpaper until the paper "lap-overs" are removed. Next apply a few coats of very thin dope and finish off the surface with 10/0 sandpaper.

Now that you have all sections carefully sandpapered, the model should be assembled. Cement the wing in place and then carefully add the bottom portion of the fuselage, making certain that the joint is tight. After the cement is dry, cement the stabilizer in place and then add the rudder.

The propeller, which, incidentally, is a three-bladed unit having a diameter of 2½", is of metal. (Visit your local hobby shop.) The front portion of the fuselage nose is cut away at Station A-A. Commonly known as the "spinner," the interior of this section is cut away to make way for the propeller hub. The holes should be filled with slivers of balsa and the unit then cemented to the fuselage.

Next, the landing-gear housing should be added to the wing. The housing is carved from medium-grade balsa the shape shown, and cemented to the bottom of each wing panel. The gear covers are sections of three-ply Bristol board cemented to the housing sides at the indicated angle. The landing-gear strut, which consists of a length of $^3/_{32}$" diameter aluminum tubing, is embedded into the gear housing and wing. The axle consists of an ordinary straight pin cemented to the interior of the strut, which is filled with balsa. The wheels are now *cemented* to the axles. The tail wheel is very easily made by cementing two ordinary quarter-inch-diameter washers together. The fork is bent from an ordinary straight pin and cemented to the fuselage.

To obtain the warlike appearance, the under surface of the fuselage, tail and wing is doped light gray, while the upper surface is olive-drab. These same colors are sold by your local hobby shop as "sand and spinach."

The insignia should now be cemented to the wing and rudder, the "U. S. ARMY" letters added to the under side of the wing panels and the cockpit painted black and then trimmed with gray. The exhaust pipes, which are lengths of $^3/_{32}$" aluminum tubing, are painted black and cemented to the fuselage sides.

Thin Air Fighter

(Continued from page 15)

7,000 feet—enough to lose the fight to an alert enemy pilot.

The story is equally interesting from the other point of view. Suppose a fighter pilot were on patrol to intercept enemy bombers. This presupposes that he were equipped with a pressure suit or cabin in order to fly above 41,000 feet, where the bombers were coming in. He would be flying so near his ceiling that a dive made upon an enemy bomber would carry him far below it. By the time he climbed back up for a second attack, the bomber would be many miles onward—probably over its objective.

Such an attack in the stratosphere would not be feasible today because no single-engine fighters have been developed with pressure cabins.

The pilot prepares his take-off by breathing oxygen for thirty minutes to eliminate nitrogen from his blood (the air we breathe is four fifths nitrogen, approximately one fifth oxygen) and thereby avoiding the "bends" caused by the nitrogen bubbles being liberated at 25,000 feet or higher. Dressed in a specially constructed flying suit, light enough not to hamper his movements, yet heavy enough to retain body heat, he climbs into the plane and breathes oxygen immediately. His suit is connected to the battery. (The outer shell is made of wool, while the inside contains resistance wires that supply controlled heat.) It is so cold at stratosphere heights that clothing alone will not protect his body, because one loses more heat by exhaling than his body can supply. At —67°, the usual temperature above 40,000 feet, moisture in one's breath freezes and cracks audibly as one exhales.

In the perpetual, firmamental cold, pilots must be able to take it. If those bombers are to be stopped, the interceptor fighter is the only known method of stopping them. No anti-aircraft gun, no secret ray, no magic weapon has been developed. *Perhaps the answer to the problem is the development of a twin-engined, highly supercharged, pressure-cabin fighter* similar to the Bristol Beaufighter, now used at night in England with pleasing results. (The Beaufighter has no pressure cabins as yet.)

With his oxygen and electrical connections made, the pilot takes off. His plane bores upward at a mile-a-minute clip, so fast that he must breathe oxygen from the start, and so rapidly that his ears crack uncomfortably. Any slight cold—any sinus congestion—will bring on the tortures of the damned when the time comes to descend. Or, in case of being shot down, the sudden drop and rapid change of atmospheric pressure might be so painful as to cause fainting.

At altitude he sets his plane for economy cruising. Single-engine fighters would be severely handicapped, while a larger plane like the Beaufighter could patrol for hours. In such a plane, remote-control weapons would have to be used, as the crew would have to be pressurized also. This would present many engineering problems for free guns, although the fixed guns could be fired easily from remote control by means of electrical firing devices.

At the specified altitude the fighter pilot levels off. The tiring patrol begins, with every eye strained for that minute speck that streaks in from the horizon silently, irresistibly and menacingly. It must be found quickly or it will pass unnoticed at a speed of over five miles a minute. Thus, within the space of a minute and a half it could appear, pass beneath, and be gone.

When it finally appears, action begins. The pilot begins to ready his guns for business, hoping that no speck of light oil has congealed and jammed his guns. Every gun and bit of fire power will be necessary to stop the attacker, because recently a Flying Fortress came back with 1,500 holes in it, but still flying! The only solution is to bring every gun to bear and to "saw" the stratosphere bomber in two.

A single shell, for example, piercing the pressurized chamber, will snuff out the lives of every man aboard. And, as has been pointed out in Air Trails many times, the bomber is easy meat for a fighter pilot once contact has been made. With the fighter plane such as a Beaufighter, or even a Spitfire, delivering a withering cone of fire, a burst in one section of the enemy usually suffices.

In the thin air the brown, camouflaged wings of the enemy slip by and the pilot starts his run. With only a slight advantage of altitude he bores in for what must be a successful first attack. The sights bear on the enemy, and he holds the trigger button down. Shuddering at the recoil of a dozen guns, the fighter plane slows perceptibly. At over 400 m. p. h. it flashes past the tail of the bomber.

Ordinarily the pull-out would consume thousands of feet of altitude, because a pull-out of six G's would increase the wing loading so greatly that the stalling speed would be reached. The weight would exceed the lift, resulting in a downward movement, commonly miscalled "squash." Whatever the name for it, thousands of feet would be needed for the pull-out.

This time, however, the fighter fails to respond. The concentrated fire from the bomber has had its effect, and flames spurt from the engine. With not a moment to lose, the pilot begins to think of his parachute and bailing out to safety. Obviously, from a pressure chamber this would be impossible. He would roast if he stayed with the plane or suffocate if he jumped! But the hero of this particular fight was low enough—40,000 feet—not to need pressure. Quickly transferring his oxygen mask from the main supply to a small auxiliary tank on his chest, he leaps to safety. Without auxiliary oxygen he would have lost consciousness before he could pull his ripcord! Instead, he breathes as he falls, continuing to fall free for almost two minutes in order to lose 25,000 feet. That brings him into warmer, denser air—so vital to life and safety. As he falls, his speed diminishes from about 180 m. p. h. to a stabilized maximum of 119 m. p. h.

It is obvious that there is more to stratosphere fighting than we are aware of now. A pressure cabin is necessary above 41,000, but it is a vulnerable weapon. Pressure suits are bulky, uncomfortable, and even more vulnerable. A tear in the suit means death at high altitude. Also, jumping from either type plane would be a difficult problem. How practical is stratosphere bombing, or fighting? To bomb from 40,000 or 50,000 feet requires good visibility and low winds. But stratosphere winds are high, and vary according to the strata, or altitude. This would throw the bombing off considerably. Practically, such bombing would have value only as a nuisance, not as a devastator of military objectives. Again, armoring and arming a stratosphere plane reduces its ceiling. Armored portions of single-engine fighters would reduce armament, fuel, and consequently climb and maneuverability. The answer to that is a larger plane—the twin-engined fighter.

These facts are clear to the fighter pilot as he pulls his ripcord. The canopy blossoms out above him and he discards the auxiliary oxygen. To one side he sees his burning interceptor—and slightly beyond a stratosphere ship spins downward, its tail section shot away by a devastating cone of fire from the one long burst it received.

What kind of action night stratosphere bombing might bring about is equally interesting. With a radiolocator it might be possible to find the attacker, who would be groping in the dark for his objective and who could hardly hope to hit a military objective.

The sum of the analysis seems to be that stratosphere work, with all its attendant drawbacks and hindrances, is still in the very beginning of its usefulness and development. The future of stratosphere fighting will surely be limited by those drawbacks, and even in the best possible conditions it is hard to conceive how high-altitude work can begin to be as effective as bombing and fighting in the troposphere.

Aircraft Armor

(Continued from page 20)

posed to enemy fire) is of greater hardness than the rest of the plate. The former requires a less complicated heat treatment, is easier to adapt for mass production, and is somewhat less costly. This homogeneous armor, however, is not so durable because, when subjected to concentrated gunfire, the plate tends to shatter, "spall" (meaning that deep pits are made in the face of the plate by the bullets), and "button" (meaning that small, round pieces about the size and shape of a dime fall off the rear of the plate at the point where the bullet hits the plate's face). This occurs because of the uniformity of the steel and because the bullet impact sets up vibration within the molecules of the plate.

Face-hardened armor, on the other hand, does not show such tendency toward shattering under concentrated fire, nor does it spall or throw buttons as readily, but its disadvantages lie in difficulty of production. It is much harder to shape and form than is homogeneous plate, has an inclination toward warping, and requires a more complex heat treatment.

Face hardening is achieved largely through "carburization"—a heat treatment of the front, or face, of the plate, while that surface is kept in contact with a powder preparation which has a very high carbon content. Several plates are stood on end in a special steel heating box and the spaces between the plate faces are packed with the carbon powder. The box may weigh twice as much as the plates stored therein and some time is required before the armor is raised to the desired temperature. This ranges from 1,600° to 2,000° F. and the heat is maintained for more than a week in some cases. The plate is taken out, rolled, cut to shape, and left to cool for a day or so. It is then given a slow reheat and an additional case hardening.

The Breeze Corp., which is manufacturing a goodly portion of the armor used in American planes, has developed a more efficient and speedy heat process. Three separate heats can be carried out within twenty-four hours, and this new method entails more rapid heating in an electric furnace and a series of liquid salt baths within the furnace.

Both homogeneous and face-hardened armor contain about the same degree of resistance or "ballistic limit"—the point at which the armor just stops penetration—up to thickness of three eighths of an inch; plates of the same area weigh about the same. In plates thicker than three eighths inches some saving of weight can be gained by using face-hardened armor, and most aircraft plate is at least half an inch thick. American armor is said to be the lightest for its size and resistance in use anywhere in the world. It is, essentially, a nickel-alloy steel known as X-7440, and the formula is one of our services' most closely guarded secrets.

The second weight-saving measure, strangely enough, has to do with the location of the armor in the plane. It must be borne in mind that the real purpose of armor is to protect the pilot or other vital parts of the plane. This can be accomplished as efficiently by the plates' deflection of the bullet as though the bullet were stopped point-blank. A thin plate will serve its purpose, if so placed that bullets will hit it at critical angles—glancing blows at angles less than 45°—as well as a thicker plate located so that the bullets will hit at normal angles—more direct blows at angles greater than 45°. In certain types of planes it is possible to locate all the armor at critical angles and lighter plate can be used; in others, certain structural members make it impossible to place the armor on a slant and it must be installed at normal angles.

How do the designers know at which slant to install the armor? This is rather simply determined by figuring from which angles attack is most likely. In combat, attacks on either fighters or bombers are mostly from the rear hemisphere—the 180° area extending from beneath the plane up behind the tail and on up to a point directly above and behind the plane. In the forward hemisphere, around the plane's nose, attacks are most likely from points above the nose or well below the nose, rather than head-on. The plates are located accordingly, and if attacks come from other quarters, the plate is still capable of resisting the bullets, even if they hit at normal angles. If the plate cannot be installed at critical angles, a heavier piece of armor is used in this case. This is why armor on any given plane varies in thickness.

In the case of single-engined fighters with liquid-cooled engines, such as the Curtiss P-40F Hawk or the North American P-51 Apache, there is usually a comparatively thin plate set in front of the pilot. Single-engined, radial-powered ships such as the Republic P-43 Lancer and P-47B Thunderbolt or the Vought-Sikorsky Corsair are fitted with even smaller forward plates because the pilot is somewhat protected by the larger radial motor. (The frontal area of the liquid-cooled engine is much smaller and the pilot is much farther behind the engine; the closer he is to the engine, the more protection he gets.) The Bell Airacobra, on the other hand, requires a larger, heavier front plate because the engine is behind the pilot. But lighter armor can, therefore, be used on the lower half of the Airacobra pilot's rear because of the engine protection, whereas the other ships must armor the pilot's rear and seat heavily all the way down. Multimotored fighters and bombers must carry larger and heavier plate because the pilots are more exposed. Armor installations in bombers, medium and heavy and light types, are designed to protect crew members other than the pilots, but how this is done cannot be revealed for obvious reasons. These locations and thicknesses of armor vary according to the particular plane, and for this reason it can be said to be "custom made."

Clever designers have taken notice of how the "tumbling effect" of a bullet will detract from its penetrating qualities. This simply means that the bullet, as it passes through parts of the plane's structure, may be turned end over end and distorted in shape instead of continuing its spiraled flight. Auxiliary equipment can be designed and installed in such a way as to serve as baffles for the bullet and cause its tumbling. The nose wheel of a ship with a tricycle gear might serve as a baffle for fire from below the nose; or the landing wheels, when in retracted position, might slow up bullets considerably. Thus, by centralizing as much as possible the plane's flight crew and other vital parts within a specific area, they may all be adequately protected by a single, lighter piece of plate. A tumbling bullet possesses little penetrating ability, and its impact has little effect on even light armor because that impact effect is distributed over a wider area, and thus puts less stress on the plate.

There is still another way in which the armor's weight can be decreased without sacrificing pilot protection, but this, too, depends upon the structural features of the particular ship. If the structure permits, the plates are always placed as close to the pilot as possible. He can "hide" behind it better if he is closer to it because the area of the plate required for good protection varies directly as the square of the distance from the pilot to the plate; if a piece two feet square protects him when installed two feet in front of the seat, a piece of plate four feet square would be required to give him the same amount of protection if it could be installed no closer than four feet.

We have not yet succeeded in making transparent armor, but a new variety of bulletproof glass is being used on America's war planes that is the next best thing. The ballistic principles governing armor plate and bulletproof glass are different, although the ultimate purpose of the use of both is to stop bullets. When a bullet hits plate, it is split and shattered by the impact if it hits at normal angles, and is distorted and deflected off if it hits at critical angles. Bulletproof glass is used only in front center sections of the plane's windshield, and these wind screens are slanted for reasons of streamlining; many are curved as well as slanted. For this reason, most bullets will hit the windshield at critical angles and glance off. The exceedingly hard surface of glass further aids this deflection. There are several layers of glass between which are sheets of plastic materials. If the bullet happens to hit at a normal angle, the glass powders and stars two or three inches around the bullet, which embeds itself between the layers and the plastic.

Glass of this special type which is two inches thick will resist penetration of a .30-caliber rifle bullet at normal angles. Three-inch glass will resist a .50-caliber bullet point-blank at close range—a half inch of either face-hardened or homogeneous armor will do the trick at normal angles of impact—but because of the slant and shape of the glass wind screens, the probability of hits at normal angles is not high.

Another consideration is that of the airplane's vulnerability. In a recent Air Trails article I pointed out how the ever-increasing speeds of fighters and bombers influences their ability to withstand the enemy's gunfire. The speeds of a 400-mile-per-hour fighter or a 340-mile bomber is so high, as compared with the relative speeds of cannon and machine-gun projectiles, and compared with the firing rates of these guns, that bullet holes are seldom found closer together than three inches; in most cases, considerably farther apart than this. This dispersion of hits permits the plane to "take it" to an amazing degree unless a vital part or the pilot happens to be hit. When the pilot and vulnerable spots are armored, the plane is exceedingly difficult to down.

When the well-armored Nazi Messerschmitt 109F first appeared over the Channel, an RAF squadron leader reported that he kept close on the ship's tail for more than two minutes and literally emptied all eight of his Spitfire's guns into the cockpit of the German plane and the after part of its fuselage. The enemy plane kept maneuvering, its pilot apparently untouched, and it was not until one of the squadron leader's final bursts of fire shot away most of the tail that the Messerschmitt was put out of action. Another instance was that of one of our Boeing Flying Fortresses in action over the Philippines early in the battle of the Pacific. The ship completed her mission after encountering a swarm of Jap fighters and returned home in airworthy shape after being riddled with some 1,500 bullets—the holes were counted by mechanics—many of which left their spalls on the armor around the ship's cabin. The armor was so badly pitted that it had to be replaced.

In point of this, it has been suggested that armor should be installed as part of the fuselage structure; for example, in the place of a bulkhead where the plate could materially strengthen the structure. In certain types this might be done satisfactorily, but armor is not permanent. It must be easily accessible to armorers and mechanics for removal and replacement. The plate is always bolted to the fuselage structure, holes being drilled along its edges for this purpose. Special bolts are employed and flexible mountings such as rubber bushings like those on engine mounts are not used—contrary to some newspaper accounts. Firing tests have shown that such mounting is actually more harmful because of the "racking" effect, or vibration. Glancing bullets cause greater racking than those hitting at normal angles. The vibration thus set up has been found to be strong enough to tear the plate loose from the bolts. As soon as the plate shows signs of shattering, or as soon as a number of buttonholes or spalls are found in the plate, it is removed. It is not junked, but stored in the air depot until a sufficient quantity has been accumulated, and then it is sent to the foundry to be remelted.

Meanwhile, the men of the Army Armament Laboratory and the Naval Aircraft Factory—as well as several civilian projects—are experimenting constantly with a couple of varieties of "composite" armor plates and certain secret steel alloys. But workers in other parts of both these centers are engaged in stepping up guns' muzzle velocity and firing rate, and the gun-armor circle becomes more vicious and deadly as time goes on and new war lessons are learned. Increasing attention is being devoted to armoring parts other than the pilot's cockpit. The navy seems to be branching out even more than the air corps in this respect. Two certain types of navy fighters and dive bombers have considerable armor around their engines and have their leakproof gas tanks protected by thin plate. Still other armor innovations are under experiment, though these are necessarily very hush-hush. In the interim, American airmen who are carrying on "out there" are getting the best protection our ingenuity is capable of devising—and that's plenty good.

What Do You Mean, Precision?

(Continued from page 10)

inch, but where very close fits are required, as the fit of a piston pin in a connecting rod, the limits may be as close as one or two ten-thousandths of an inch. To appreciate just how small this is, it should be realized that the average human hair is about three one-thousandths of an inch thick. If, then, a hair were to be split lengthwise into three parts, and then one of these parts split again into ten parts, each one of these microscopic pieces would be one ten-thousandth of an inch thick. Such limits are by no means uncommon in the aircraft-engine industry, where accuracy is so essential to the smooth, unfaltering operation upon which the life of the pilot depends.

It is not uncommon to compare an aircraft engine with an automobile engine, and yet actually there are but few points of similarity between them. For overall precision and fine finish perhaps an extremely costly watch is the nearest approach, and yet so greatly does this differ in its action that it is difficult to make the comparison. The aircraft engine indeed is in a class by itself. It may be surprising to some to realize that at certain points the limits used on an automobile engine are actually finer than those on an aircraft engine, chiefly because of the fact that the very high temperatures encountered in aircraft engine operation make it necessary to make special allowances for the thermal expansion of the material. Indeed, when an aircraft engine is first started up, it frequently sounds quite loose until the proper operating temperature is reached. On the other hand, however, the quality of the finish and the closeness of the limits employed throughout the engine as a whole are immeasurably far above those required on even the finest of automobiles.

The size of the limits required controls to a large extent the manufacturing methods used. Thus limits down to plus or minus two one-thousandths may be held without much difficulty on an ordinary lathe, but for smaller limits it is usually necessary to resort to grinding as a finishing operation to remove the last few thousandths of an inch of material. For extremely close limits, an additional grinding operation using a very fine grinding wheel is commonly employed for final finishing, and this may be followed by honing or lapping with fine emery dust and oil.

All these operations add to the cost of producing the part, and they are therefore used only when necessary. For example, the parts for an ordinary door lock can be made to limits as large as one thirty-second of an inch, and the lock will still give entirely satisfactory service; were they made to limits of one thousandth of an inch, the lock would work equally well, but would cost several dollars to produce instead of only a few cents.

After the parts have been manufactured they must be inspected with the utmost care to be certain that every single dimension agrees with the blueprint, and it is here that many difficulties are encountered. Every machining operation in which material is removed produces a certain amount of heat and consequent expansion of the part, and care must be taken that the part is allowed to cool to the room temperature before being gauged. In some factories the entire plant is air-conditioned to a uniform temperature so that by the time sufficient numbers of parts have accumulated at a machine and are ready to be taken to the inspection department, they will be at factory temperature and may be gauged immediately. More often, however, only the inspection rooms are air-conditioned, and in this case it is necessary to hold the parts in these rooms for a few hours until they have reached room temperature.

The many gauges and instruments used for inspection are, of course, always at the same even temperature, but care must be taken that neither they nor the parts are held too long in bare hands, lest body heat cause expansion. For this reason, many gauges are fitted with rubber or other insulating material around the parts which will be touched by the hands. When air conditioning is not used, special precautions must be taken to see that neither the gauges nor the parts are left too near to steam pipes or hot or cold-air fans, and that full rays of the sun are not directly striking them, since any of these factors may affect the dimensions as a result of expansion or contraction.

Despite the fact that the gauges are made from the finest and hardest steels, continued use ultimately produces wear, and slight though this may be, it cannot be tolerated, particularly when measurements are being made in ten-thousandths of an inch. To halt this condition, therefore, every gauge is carefully checked at stated intervals against a master gauge. This interval may be as often as once every eight hours in the case of a gauge in constant use, or only once a week for gauges less frequently used. If a gauge should be accidentally dropped, it is immediately put aside and may not be used again until proven accurate by checking against the master.

Broadly speaking, gauges may be divided into two main classes, the fixed-dimension type and the adjustable type. On the former type, perhaps the most common is the plug gauge, which consists simply of a hardened steel plug mounted in a handle. This plug is carefully ground and polished to the exact size required and is used for checking the size of a hole. Usually two plugs are mounted on opposite ends of the handle, one being made to the high limit of the hole and known as the "Not Go" end, while the other is made to the low limit, and is known as the "Go" end. Both for purposes of economy and for easier recognition, the "Not Go" end is generally made quite short, while the "Go" end is made long enough to gauge the full depth of the hole. In some cases, particularly when it is to be used in a hole that does not go all the way through a part, a small groove is ground down the full length of the "Go" plug to permit the escape of the air which would otherwise be trapped and would prevent the gauge from going all the way down.

To use such a gauge, the inspector first carefully wipes it to remove any dust or dirt, and then gently tries to insert the "Not Go" end in the hole, being careful to hold it perfectly straight and not to force it; if this end goes in, the hole is larger than the permissible high limit and the part is immediately rejected; if it refuses to enter, he then tries the "Go" end. If this goes in, the hole is correct since it lies between the high and low limit, but if it refuses to enter, the hole is obviously too small, and the part is put aside to be returned to the shop and remachined. Gauges of this type do not *measure* the hole; that is to say they do not tell the inspector the exact size, they merely *check* that it lies within the specified limits, and for this reason must themselves be checked at frequent intervals to see that they have not become worn. A worn gauge may be brought back to size by chromium plating and regrinding, or may be ground down to some other desired size.

The adjustable type of gauge generally includes some kind of dial, graduated in thousands or ten-thousandths of an inch. The gauging points or "anvils" of the instrument are set to a master, and the dial is adjusted so that the pointer reads "zero." When the instrument is used, the position of the pointer in respect to the zero mark will indicate how much larger or smaller the part is than the desired size, and the inspector can tell from his blueprint whether this amount is permissible. Gauges of this type are available for either inside or outside measurements, and are operated in a variety of ways; some by an arrangement of levers connected directly to the pointer from the anvils and so arranged that the actual movement of these is magnified several times for easier reading. Thus an actual movement of one thousandth of an inch may move the pointer a whole quarter of an inch, although this is marked on the dial as a thousandth. This wider spacing of the graduation marks enables the inspector to make more accurate readings and cuts down the chances of errors. Others are operated by electricity, and still others by compressed air.

A type of gauge much used for checking lengths or outside diameters is the Johannsen snap gauge. This is a horseshoe-shaped instrument carrying two sets of pins or "anvils" in the open end of the jaws. These anvils are adjustable within a limited range, and the outer pair are set to a master to the high limit of the part, while the inner pair are set to the low limit. After setting, the adjusting screws are usually sealed with sealing wax to prevent tampering or accidental moving. A small brass tag is usually wired to the gauge, showing the sizes to which it is set, and this is stamped with the date and private stamp of the gauge inspector every time an examination of it is made. When a part is to be checked, it must pass between the first pair of anvils, the "Go" gauge, but not pass between the second pair, or "Not Go" gauge.

Not all gauges, of course, are as simple as those described above, although these types and variations of them constitute the greater part of all ordinary gauges. But even these are not as easy to use as might be inferred, and it requires considerable practice to acquire the right sense of touch essential in a first-class inspector. Particularly when very close limits are involved, it is easy for a careless operator to force a gauge, and thus pass an incorrect part, or by rough handling to damage the very expensive instrument itself, or to scratch and thus ruin a finished part which may be worth hundreds of dollars.

For the checking of gauges and masters, the tools most commonly used are small rectangular steel blocks known as Johannsen blocks, or more familiarly as "Jo" blocks. These are manufactured by a secret process, and are guaranteed to be accurate within two one-millionths of an inch. Some factories keep several sets of these for the regular use of the gauge inspectors, and retain an extra set carefully locked up, to be used only as a check on the regular sets. If this check shows a block to be worn, it is immediately sent back to the manufacturer for reconditioning, usually by hard chrome plating and relapping, or else replaced altogether. Since blocks of this type were first made by Johannsen, they are all commonly known by that name, despite the fact that similar ones are now made by several other makers.

A full set consists usually of eighty-one pieces varying in size by one ten-thousandth of an inch from .1001 to .101, and then by thousandths from .101 to .149. Nineteen of the remaining blocks vary from .100 to 1.000 in steps of .050, while the remaining four are 1, 2, 3, and 4-inch standards. With such a set it is possible to build up as many as 120,000 different gauge sizes. For one of these sets in the finest grade, that is with a guaranteed accuracy of two one-millionths of an inch, the price is about $1,000. Less accurate sets, guaranteed within four one-millionths, cost about $500. Special sizes can be made to order, but auxiliary sets of about twenty pieces are frequently supplied for very small dimensions, with the smallest only ten one-thousandths thick. Such blocks are probably the most accurate things made by man, and so smooth and flat are they that if two are slid together with a light pressure of the fingers it will require a straight pull of many pounds to separate them. The proper way to separate them is by sliding them apart, which may be done quite easily.

It is a surprising fact that two such blocks when properly "wrung" together—that is, slid over each other with a light pressure—will actually support a direct pull of over 200 pounds, despite the fact that there is only about one half of a square inch of contact area. This strange phenomenon has never been satisfactorily explained. One theory has it that the surfaces are so smooth that no air can be trapped between them, and that atmospheric pressure holds them together. Since this pressure is only about fourteen pounds per square inch, this would hardly explain why two such small blocks are able to support a pull of over 200 pounds. Another theory is that the faces are so finely finished that molecules at the surface are actually split, and that when two such surfaces are brought together they are held by the force known as molecular attraction. In order for these blocks to properly wring together, it is usually necessary to slide them between the thumb and forefinger, and this gives rise to the third theory, that they are actually held by the surface tension of the extremely thin film of oil thus deposited.

It is possible that all three factors contribute to this mysterious cohesive force, although the last appears to be the most likely, and a simple test will show how strong this force of surface tension is. If two flat plates of glass such as photographic plates are lightly pressed together, they will be found to cling very tightly, but if they are first dipped in water or oil they will stick so tightly that they can be separated only with the greatest difficulty, if at all, and it is usually necessary to slide them apart. It should be noted that while smoothness is necessary to obtain this condition, flatness is also equally important, and if the two surfaces do not make complete contact there will be no adhesion. The expression "smooth as glass" is frequently used to describe any very smooth surface, but actually these blocks are smoother than glass since their surfaces give a smoothness reading of about one and one half as against a reading of between two and three for good quality glass.

Not all inspection, of course, consists of gauging. There are other processes which determine the quality of the surface finish, X-ray inspections which examine the interior of the material, and magnetic inspection to discover cracks so small that they cannot be seen through a microscope. Some of these other methods will be described in future articles.

Mosca Flying Scale

(Continued from page 26)

Tail skid and wheel fairings are cut from $^1/_{32}$" plywood. The tail skid is cemented to the fuselage and the fairings are lightly bound and cemented to the landing gear. Patterns of the fairings should be cut from black tissue and later doped to the under surface of the wing to indicate the wheel wells.

Carve the propeller from a medium-hard balsa block. Dope it several times, sandpapering between coats to produce a smooth finish. The freewheeling fitting was purchased from a model dealer ready to install. Bend the propeller shaft and assemble the hardwood nose button, washers, and propeller.

Add such detail as windshield, gun barrels, gun fairings, et cetera. The original model had orange tissue wings and tail, olive-drab-painted fuselage, propeller and landing gear, yellow cowl front, and other details in black. Red tissue stars were doped to the wing.

Install a lubricated eight-strand motor of 1/8" flat rubber. Check all parts for alignment, balance and test-glide. Add slight weight to nose or tail if necessary. Make the first flights over grass or tall weeds to prevent damage while the model is being adjusted. Good luck!

BILL OF MATERIALS

2 1/16 x 2 x 36" sheet balsa
3 1/32 x 3 x 36" " "
1 1/8 x 2 x 36" " "
1 1/32 x 4 x 5" plywood
1 1 1/8 x 1 1/4 x 1" balsa block
1 1 1/2 x 1 x 8" " "
1 1/4 x 3/4 x 1 3/4" " "
1 1/16 x 1/4 x 36" balsa strip
1 1/8 x 5/16 x 36" " "
1 3/16 sq. x 36" " "
2 1 1/2" hardwood wheels
1 36" length .040 music wire
1 3" sq. celluloid
2 sheets orange tissue
7 feet 1/8" flat rubber
1 ounce olive-drab dope
2 ounces clear dope
2 ounces cement

The Sharpshooter

(Continued from page 37)

never to be returned. One remarkable trait not to be overlooked is the fact that not one flight in any contest entered was under 6 minutes.

CONSTRUCTION

The fuselage is very simple to construct. Select some hard 1/8" squares for longerons, pin to outline of full-size drawing and glue in cross members. When set lay second side directly on top of first side to insure accuracy, let stand till dry, then cut apart and place cross members where indicated. Fill in around nose with soft 1/8" flat balsa, using plenty of cement. Do the same at tail to reinforce rear hook, which is 3/16" basswood dowel. The nose plug is balsa, which is carved and sanded to shape and inserted with a 1/4" flat pine plug. Next bend landing gear to shape and insert as shown. Make wheels from 1/16" flat plywood, gluing small wood disks to hub to eliminate wabble, paint and attach, using small brass washers, with a touch of solder.

Select a medium-hard block for the propeller, making sure of proper dimensions. After carving, sand and give three coats of clear dope. Now very carefully cut into three parts, namely two blades and a hub. Next cement brass hinge to back of hub and brass fitting to front as indicated. Insert two No. 12 wire hooks, one through each side of hinge loop; refer to drawing. Now anchor wire hooks into blades and cement, taking caution blades are straight before cementing. Wrap cemented parts with thin stripes of silk and give two more coats of red color dope. Attach prop, bend hook as shown, using hard-rubber bobbin on hook.

Now for the wing. Lay out leading and trailing edges on full-size drawing, and cement in ribs, which should be cut out for lightness. The tips are 15" split bamboo, being bent in one piece, with the tips sliced as needed. When tips are glued in place and set, cut wing at points shown and block up for dihedral. Next cement $^{1}/_{16}$" square spars in place, using $^{1}/_{16}$" balsa gussets at joints. Sand entire wing and cover.

The stabilizer is very similar to the wing in construction, having no dihedral, of course. The area is 66" square to conform to Wakefield requirements. Refer to drawing for sizes of wood.

For the rudder, lay out the center spar, which is $^{3}/_{16}$" x 1/4" hard balsa. Next glue in unshaped ribs, and when dry sand to shape shown on drawings. Leading and trailing edges of rudder are 1/8" soft balsa.

Wings and tail are covered with outdoor tissue. Water-dope and then give three coats of clear nitrate dope. The fuselage is covered with silk. Give three coats of clear dope, sanding between each coat. When dry, give two coats of color dope, preferably yellow.

For the motor, use twenty-two strands of $^{3}/_{16}$" flat brown rubber and divide into three separate sections, ten strands in two of them and two strands in the third, each section about fifty inches in length when looped. Next tie all three together at one end, attach to a doorknob and braid. When finished, tie end with rubber to secure braid. Lubricate well before winding.

FLYING

The model may need about $^{1}/_{16}$" left thrust inserted in side of nose block. Original model flew without any incidence, which is good. The center of gravity falls at center of wing. Elevator is set straight.

Wind about one hundred turns with three-to-one winder, launch, and if directions were followed you will see a remarkable climb. Make all adjustments with wing and thrust line. Now really pack in a few turns and get to your car for a chase.

BILL OF MATERIALS

(All balsa unless otherwise specified.)

Fuselage

1 pc. 1/4 x 2 x 2" pine, nose plug
8 pcs. 1/8 x 1/8 x 36" hard
1 pc. 1/8 x 2 x 18" soft
1 pc. 1 x 1 1/4 x 2" nose block
1 pc. $^{3}/_{16}$ diam. x 2" basswood, dowel
1 pc. $^{1}/_{16}$ diam. x 24" steel wire
2 pcs. $^{1}/_{16}$ x 2 x 2" plywood
1 pc. 1 7/8 x 2 1/4 x 18"
1 ballbearing washer
2 .105 brass, 1/4 x 2"

1 pc. 1/16 diam. x 6" steel wire
1 1/8 diam. x 1/2" tension spring

Wing

2 pcs. 1/8 x 1/8 x 36"
6 pcs., 1/32 x 2 x 18"
12 pcs. 1/16 x 1/16 x 36"
2 pcs. 1/16 x 1/4 x 15" bamboo
3 pcs. 1/8 x 3/8 x 18"

Stabilizer

1 pc. 1/32 x 2 x 18"
10 pcs. 1/16 x 1/16 x 24"
2 pcs. 1/16 x 1/4 x 12" bamboo
1 pc. 1/8 x 3/8 x 24"

Rudder

1 pc. 1/32 x 2 x 18"
1 pc. 1/8 x 2 x 18"
2 pcs. 1/16 x 1/16 x 12"
1 pc. 3/32 x 1/4 x 10"

Miscellaneous

2 sheets outdoor tissue
1/2 sq. yd. silk
8 ozs. clear dope
3 oz. cement
90 ft. 3/16" flat brown rubber
1 oz. yellow dope
1/2 oz. red dope

Airplanes Are Growing On Trees

(Continued from page 17)

For many years, engineers knew that these disadvantages of ordinary wood were not present in plywood, which was formed by gluing thin strips in layers with the grain of each layer at right angles to the next. For generations plywood, or veneer, was used almost exclusively as a surfacing material. This use led the public to think of veneer as purely a decorative material. Actually, the inherent strength of wood is still present in plywood, but is distributed and controlled. True, the strength along the grain is cut slightly, but the former weakness across the grain is eliminated. Ounce for ounce, the material thus formed was still stronger than structural steel.

One major fault, however, held back immediate widespread use of plywood. No satisfactory foolproof adhesive was available. Vegetable and animal glues were employed, but it was found that they were weakened by moisture, age and decay. A few years ago, it was discovered that glues made from synthetic resins based on phenolic formaldehyde—bakelite—or urea formaldehyde were entirely satisfactory.

To complete the picture, methods were devised for molding the plywood, together with the unset bonding agent, into desired shapes. In typical process, thin laminations are built up on a form and spread with the resin. Then form and bonded plywood are placed in an air-tight rubber bag equipped with a valve. Air is exhausted from the bag so that it presses tightly against the inclosed material. Bag and contents are placed in a tank and subjected to steam pressure and heat until the bonding agent has set. There are variations of this method. In one, still experimental, heat is generated by a high-frequency electrostatic field; in another, the bonding agent is set while cold.

No matter which method is used, the adhesive is so firmly set after molding that it is stronger than the plywood itself. During stress tests the bonding agent has been the last material to fail.

The new Langley plane was built of mahogany veneer. Whole wing panels were formed at one time. The fuselage was molded into two sections and fitted together along the top and bottom center lines. Door apertures were sawn after the structure was completed. Thus, the result is an integral unit containing both structure and skin—a radical departure from the days when both parts were built separately to perform separate functions. A feature of the plane is its glasslike, rivet-free surface which cuts air resistance to a minimum and thus means a big increase in efficiency.

Designed for use as an army air corps training plane, the Langley takes off in 200 feet, lands at only 46 miles per hour and has a cruising speed of 125 miles per hour. Its weight empty is 1,410 pounds, of which only 160 pounds is represented by metal. This ship is so simple to construct that it could be turned out on a mass-production basis. Design changes are easy, since the molding forms can be quickly constructed from wood or sheet metal, thus eliminating the time, highly skilled labor and expense of metal dies. Like the Langley, the plywood planes developed by the Timm Aircraft Corp. and the Morrow Aircraft Corp. are made by what is called the "irreversible" molding process, a method also used in the old Duramold-Clark. In this process, the bonding agent, when once set, will not soften if again subjected to heat and pressure. By contrast, Eugene Vidal, former Bureau of Air Commerce head and a long-time believer in the potentialities of light planes, uses the "reversible" molding method. This permits the bonding agent to soften if the requisite heat and pressure are applied to the finished product.

In addition to landplanes, there looms the possibility that plywood will be used extensively for seaplanes. Recently the CAA approved pontoons constructed from plywood.

In compregnated wood and laminated wood, both blood kin to plywood, manufacturers see more new raw material for their requirements. Laminated wood—made like plywood except that the individual layers are laid with the grains parallel—may be used for spars or propellers. And it is possible that compregnated wood—which is either laminated wood or plywood molded under extremely high pressure—may yet be fashioned successfully into gears, nuts, bolts, screws and washers.

There is keen government interest in the military possibilities of plywood aircraft. The navy has already ordered twenty gliders to be made from the new material, and both the army and navy have asked for a large quantity of plywood training planes.

Photo Credit List

The following list shows the sources from which credited photos were obtained. Abbreviations: bot., bottom; T., top; U.L., upper left; U.R., upper right; L.C., left center; R.C., right center; L.L., lower left; L.R., lower right; Cen., center; T.C., top center; B.C., bottom center.

Page 6—All by International.

Page 10—Top, Curtiss-Wright Corp. photo.

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Page 20—Top, Rudy Arnold; Cent., Acme, Breeze Corp., Inc.; Bot.L. & R. International.

Page 24—Rudy Arnold.

Page 36—Top, Kulick.

Page 40—Sorfoto.

Page 42—Top, British-Press Combine; Bot., Rudy Arnold.

Down The Runway

(Continued from page 38)

perintendents and State commissioners of education, schoolteachers, model-club leaders, and youngsters who never thought of building a model airplane before have all been active in the program.

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A few moments ago we were saying that the Academy's troubles were over. By that we meant that the Academy was going to continue on just as before, licensing aeromodelers, sanctioning meets, homologating records, and acting as the governing body for model aviation in America. But instead of having to finance itself, the Academy will be able to draw upon Air Youth funds, which, according to all indications, should be more than enough to do the biggest job for junior aviation that even the most enthusiastic leader ever envisioned. To those leaders who have expressed some fears for the continuance of the Academy, we say: Take it easy, friends, the Academy is not going to be the "forgotten man" of model aviation. Instead, it is going to be able to do a bigger and better job than ever with a complete office staff for faster service and more aids to the local leaders. Well, enough for that. Let's get on to other things.

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Some years ago, in 1935 as a matter of fact, your column correspondent submitted a story to the New York *Times* on model aviation in which he predicted aerial torpedoes. These were gas-model airplanes carrying an explosive charge which would be directed by radio control from some "master" plane flying high in the clouds. When the story was turned down we never did find out whether the *Times* thought our prophecy was bunk or our literary style lacking in luster. However, it is with considerable pleasure that we present the following news item from Mowbray House's Industrial Publicity Unit of London, whose job it is to send out news about the war work of British industry and research, entitled "Bombs With Wings—They Fly Under Their Own Power." The object under discussion is nothing new to any imaginative model builder, but it came as a surprise to the uninitiated public:

"A device by which aerial torpedoes, bombs, and shells can steer themselves to their target under their own power has been patented in Britain. This self-propelling projectile is really a tiny pilotless aircraft, complete with engine, airscrew, gyrostatic controls, and so on. It also has a releasing device so that it may shed its wings at an appropriate point and so drop directly on the target.

"Launched by a catapult, this arrangement not only obviates transport of heavy artillery and repairs to rifling but gives a much greater range than that of artillery. When the impulse of the catapult launching is spent, the projectile flies on under its own power, maintaining direction, height, and balance by the gyrostatic pilot, operated either by the exhaust of the engine or by compressed air.

"Normally designed for about double the range of long-range artillery and for use in very large numbers, forty-pound units can be made at a cost of under $125.00 each, which, when all the maintenance and transport costs are compared, is cheaper than firing an artillery shell.

"But there is no reason why much heavier projectiles of higher precision and power, capable of hitting a city 100 to 500 miles away, could not be evolved from this beginning."

★ ★ ★

Rules, rules, rules. That seems to be about all one hears these days, and it certainly is sweet music to our ears, because the more interest that the model builders and leaders display in the regulations, the closer they will be to national activity. Before the outbreak of hostilities, everyone was worrying about higher wing loadings and higher power loadings which were considered the only solution to cut down the flight times of high-flying models.

With the declaration of war, farsighted model leaders and members of the AMA Contest Board realized that for model aviation, and particularly gas modeling, to continue during the emergency, the rules must be so devised as not to permit competition on sport flying craft to cause confusion in the army's interceptor commands or among air spotters. Since the all-out war effort would obviously put the pinch on model aircraft materials regardless of how high a priority rating they may be given, it is essential that all 1941 models not be disqualified from competition by drastic rule changes. So far, so good. Everyone seemed to understand after some explanation. But the biggest bone of contention seemed to come from the Contest Board suggesting the fuselage cross-section requirements and the strict ROG requirement for gas models be lessened.

What! Go back to optional launching? No cross section? But there was good reason. With the establishment of more military airports and local units of the Civil Air Patrol taking over the light-plane fields, many model clubs were losing their regular flying sites. Consequently, good take-off facilities were no longer available. In relation to the cross-section requirements, Contest Board members pointed out that new full-scale designs were calling for no fuselage (flying wings), motors buried in the wings, the use of tail booms instead of bodies, and other developments which made the conventional cabin craft obsolete. Why should gas modelers be required to build a cabin plane if coming designs did away with cabins? It was also pointed out that, unlike rubber-powered ships, the frontal area of a gas engine is enough to require the modeler to build some sort of a structure to house his engine. If he wants to hang it out in the breeze on a stick, he can, of course, but it is obvious that produces more resistance than streamlining the motor in a fuselage or burying it in a wing.

So that's why we say that the rules discussion of the past few months has been the most heated and the most interesting of all time.

Don't despair if the wartime regulations seem not to fit in with your own ideas. We are all fighting this war, and you can be assured that the Contest Board members of the AMA are interested in retaining as many of the pre-war rules as possible. But if we have to make changes—drastic or otherwise—for the duration, do not blame the Contest Board, blame Adolf.

Yours for more models and fewer Japs!

A Davis Wing For Every Model

(Continued from page 24)

Note: The formulas for x_s and x_p are identical. Therefore, for every value of x there will be a value of y_s and y_p.

Now substitute value of Θ in radians from 0 to $\frac{\pi}{2}$.

Any model builder with mathematical ability should be capable of plotting any type of Davis section which he may desire. A word of caution—when selecting airfoils, steer clear of sections with excessive camber and thickness because the boundary layer is very sensitive at low speeds and breaks off at points of excessive curvature. To find the value of x at $\Theta = 90$ degrees calculus is involved, so model builders unacquainted with higher mathematics should find the value for $\Theta = 89$ degrees and approximate the leading-edge position.

The airfoils presented in this article were designed for maximum duration of the types of models indicated. These sections cover the practical range for endurance models, and the formulas provide a means for obtaining any other airfoil which the builder may desire. The Davis airfoil, model builders, is the answer to all your airfoil problems.

What's Your Question?

(Continued from page 12)

Question: Please tell me the difference between an inside and outside loop. What is the armament of the Bristol Beaufighter? Do the bent-down wing tips of the Northrop Flying Wing move up and down? Why don't you have an article now and then on how to build and equip radio-controlled models? G. B. T., Nantucket, Mass.

Answer: In an inside loop the pilot is on the inside of the flight path, while in the outside loop he is on the outside of it. In the outside loop the airplane is dived down and passes successively through inverted flight, climb and back to normal flight. The Bristol Beaufighter is supposed to have four 20-mm. cannons in the fuselage and six 30-caliber machine guns in the wings. The wing tips of the Northrop Flying Wing do not move up and down. Articles on how to build and equip radio-controlled model planes have been published in the magazine. More are in preparation and will appear in the near future.

Question: What is meant by normalizing of metal, and what is it used for? A. P., Brooklyn, N. Y.

Answer: Normalizing is a process of heating steel to a temperature of approximately 1,600 to 1,650 degrees Fahrenheit, holding it at this temperature until it is uniformly heated and then letting it cool in still air. It relieves internal strain of the steel due to welding or forming, softens the metal somewhat while at the same time increasing its strength.

Question: Could you sell me the book, "Aeronautics Simplified," by Lieut. Ernest G. Vetter? What is the price of it? R. S., Leoneth, Minn.

Answer: Sorry, we do not sell books which are reviewed in the magazine. It can be obtained from Foster & Stewart, Buffalo, N. Y. The price of the book is $1.50, or you can get it free by subscribing to Air Trails.

Question: Will you please tell me the wing span, speed and armament of the Consolidated B-24 and the Boeing B-17C? H. D., Bridgeport, Conn.

Answer: The B-24 has a span of 110 feet, and the B 17C 193 feet. They both are rated as having a maximum speed in excess of 300 m. p. h. No information regarding the armament of these ships can be given out.

Question: Could you tell me where I could obtain three-view drawings of the Pratt & Whitney 750 h. p. Twin Wasp Jr.? I would also like to know where I can obtain ordinates for the NACA, CYN, and the Navy N-69 airfoils. P. G. K., Reading, Pa.

Answer: The Norman W. Henley Publishing Co., 2 West 45th St., New York City, publishes cutaways and three-views of aircraft engines at a cost of 50 cents each. Regarding ordinates of airfoils mentioned, write directly to the National Advisory Committee for Aeronautics, Washington, D. C.

Question: In your Reviewing Stand you mentioned a book called "Aircraft Mechanics Pocket Manual." Do you sell this book or must I purchase it directly from Pitman Pub-

lishing Co.? If this is the case, what is their address? L. E. W., Rantoul, Ill.

Answer: The address of Pitman Publishing Co. is 2 West 45th St., New York City.

Question: Would you please tell me the names of all American biplane dive bombers now in use. M. N., Buffalo, N. Y.

Answer: The only biplane dive bomber now ir use is the Curtiss SBC-4. All others are of the monoplane type.

Question: Please tell me something about the Guiberson Aircraft Diesel engine. Is it being used extensively, and where is it manufactured? R. V. B., Crafton, Pa.

Answer: The Guiberson Diesel engine is a nine-cylinder, air-cooled, radial motor having a stroke of 5.5 in., bore 5.125 in., a displacement of 1,021 cu. in. The compression ratio is 15 to 1. It develops 320 h. p. at 2,200 r. p. m. at sea level and 340 h. p. at take-off. Its weight is 640 lbs. On tests the engine consumed thirteen gallons of fuel oil per hour, and installed in an airplane it reached an altitude of 16,300 ft. and was still climbing at better than 500 ft. per minute on 75 percent power. It is still in an experimental stage and therefore not used much. The engine is manufactured by the Guiberson-Diesel Engine Co., 1000 Forrest Ave., Dallas, Tex.

Question: Is the Stuka dive bomber used for fighting? If so, how many men does it carry? W. R., Rockaway Park, N. Y.

Answer: The word Stuka is an abbreviation from German meaning diving and fighting aircraft. This name has been pinned on the Junkers Ju.87, while actually two types of German airplanes are Stukas: the Ju.87 single-engined and the Ju.88 twin-engined dive bombers. The Ju.87 is primarily a dive bomber with light armament and could not be considered a fighter, while the Ju.88 with its superior speed and greater number of guns is a fighter as well as dive bomber. The crew of the Ju.87 is from one to two, and that of the 88 from one to four, depending on the mission.

Question: Would you please tell me the highest speed and longest nonstop flight achieved by a light plane, and the name of the ship? E. M. S., Brockton, Mass

Answer: The longest nonstop flight in a light plane was made by John M. Jones, who flew his 50 h. p. Aeronca airplane from Los Angeles, Calif., to Roosevelt Field, N. Y., a distance of 2,785 miles, in 1938. The official speed record for light planes was established in April, 1939, by a German pilot, Max Brandenburg, who flew his low-wing Sturmer monoplane powered by a 53 h. p. Zundapp engine over 1,000 km. (625 miles) at a speed of 116 m. p. h.

Air Trails Advertisers May 1942

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While every precaution is taken to insure accuracy, we cannot guarantee against the possibility of an occasional change or omission in the preparation of this index.

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