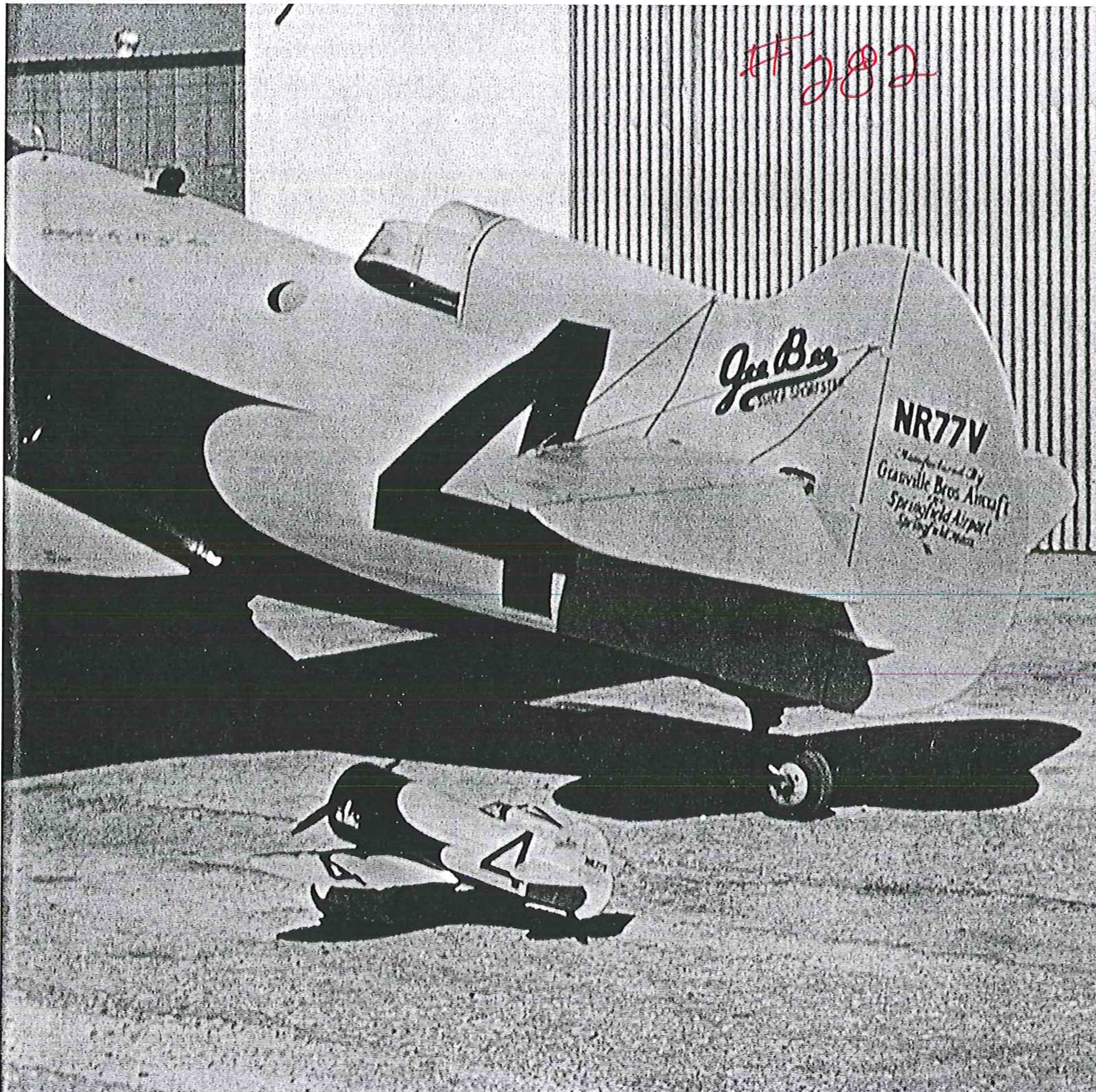
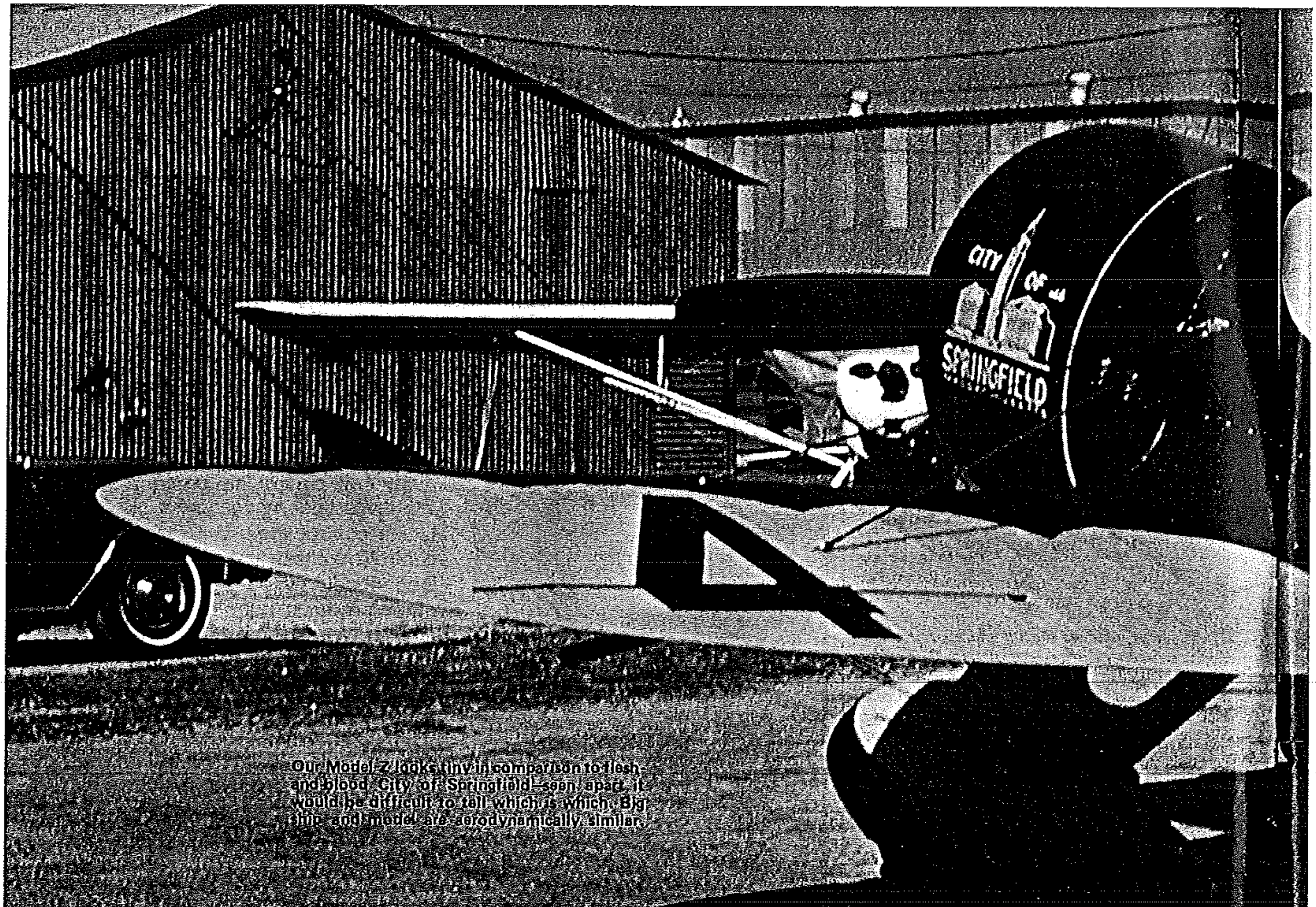
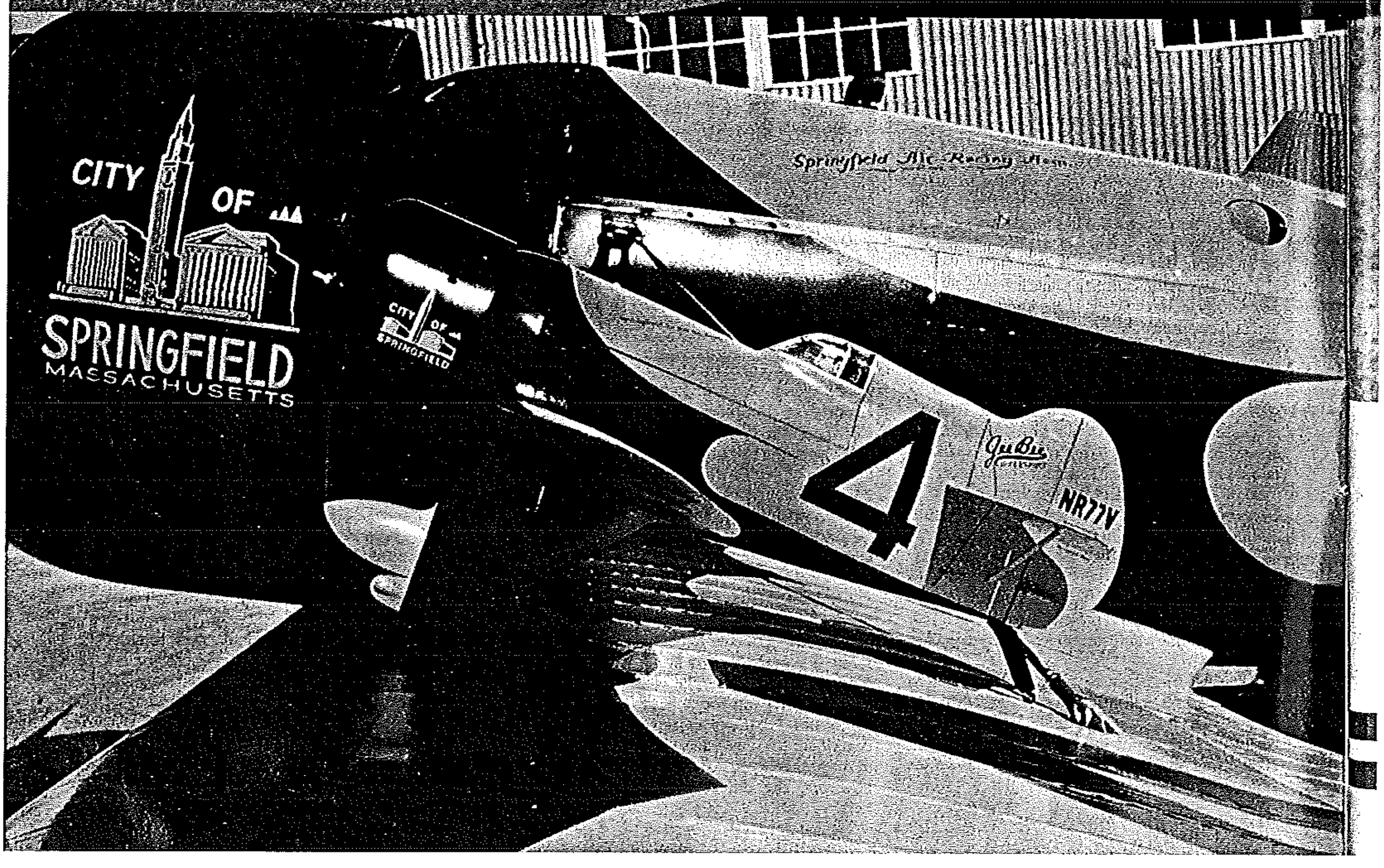


Photos by Granger Williams, Bob Wisniewski and Bill Hannan

Model GEE BEE·Z



Our Model Z looks tiny in comparison to flesh and blood City of Springfield—seen apart, it would be difficult to tell which is which. Big ship and model are aerodynamically similar.



Two GeeBees, two pilots. Right, Granger Williams, the Z in the article, and Bill Turner who had the GeeBee and Miss Los Angeles especially built—both of them are now flying.

For the dedicated scale man this 40-powered model is an exact scale version of the real "City of Springfield"—even to the aerodynamic set-up.

Granger Williams

THE history of aviation has produced only a few men with enough courage to gamble on their convictions. The Wright Brothers, Glenn Curtiss, Tony Fokker, Clyde Cessna, Giuseppe Bellanca, Don Douglas, Walt Beech, Jack Northrop were some. And the Granville Brothers. The Gee Bees were all remarkable aircraft that contributed greatly to the advancement of aerodynamic engineering. Many of the Granville's innovations were used in other aircraft for many years.

Yet the news media jumped on the misfortunes befalling those who built aircraft, blowing any mishap completely out of proportion to actuality. This expanding of news of accidents into catastrophy contributed most to the downfall of the Granville Brothers Aircraft Company. In all crashes involving Gee Bee aircraft, human failure or pilot error contributed most, with mechanical failures only a secondary factor. All Gee Bees aircraft, as originally designed and flown, were good airplanes. Only when modified with greater horsepower and fuel tankage did they get into trouble with stability problems. These changes were not authorized by the manufacturer.

Most people are under the impression that Doolittle was the only one to successfully fly the Gee Bee R–1 and that he only flew it one time in the Thompson Trophy race. In fact, the R–1 racer had been test-flown a number of times by Russell Boardman before Doolittle even saw the airplanes. Doolittle flew the R–1 several times before the Thompson race in qualifying the racer in the Shell event, and trying to establish the world's speed record. Other pilots who flew the Gee Bee racers, included Lee Gehlbach, Russell Thaw, Roy Minor and Jimmy Haislip. Lee Gehlback test flew the R–2 and flew it in both the Bendix and the Thompson races.

The first aircraft produced by the Granvilles in 1929 was a small two place biplane with side-by-side seating. Powered by a 60-hp Velie M–5 engine, one unusual feature was an adjustable wing flap, which could be changed in flight to various angles. This allowed an unusually low landing speed and still gave good flying performance. A factory was set up and the company turned to building model A Biplanes. Early in 1930, the All American Flying Derby was organized and sponsored by American Cirrus Engines, Inc. The planes entered would all be powered by the Cirrus engines sold by the sponsors. The Cirrus engine was four-cylinder in-line, manufactured in Michigan under English patents. In Springfield, the Granvilles made plans to enter a new plane in the All American Derby. An engineer, Bob Hall, had joined the Granvilles in 1929, and with the rest of the Granville organization, produced the first Gee Bee Sportster Model X. Many features of this airplane were carried on through the rest of the Gee Bee Sportsters and racers through 1934. (Bob Hall was to later turn his design talents to the World War 2 Grumman Aircraft.) Wing span of the Model X was 25 feet—single-place open-cockpit monoplane powered with an inverted Cirrus engine developing 95 hp at 2100 rpm. The wing shape was the same one used on all succeeding Gee Bee designs through 1933.

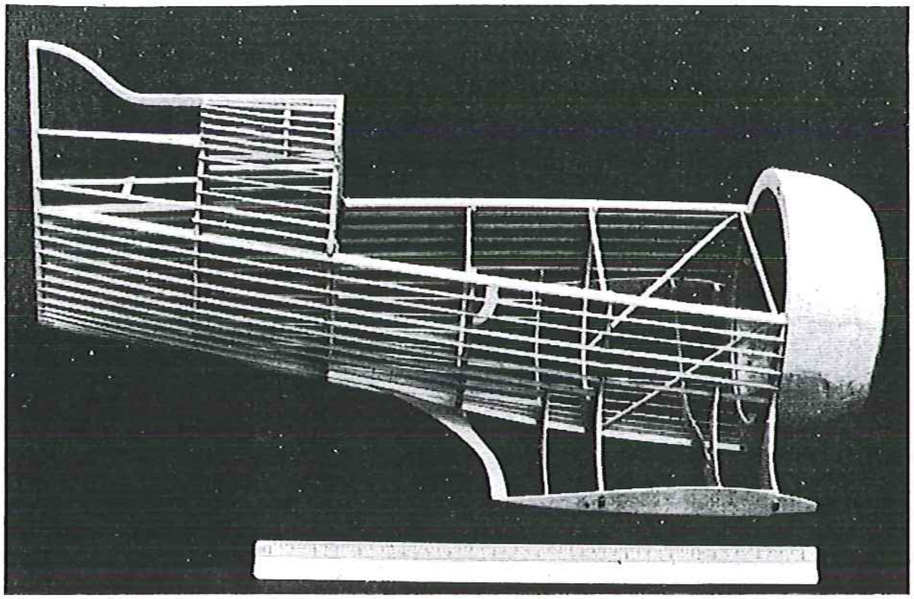
Pilot of the new creation was Lowell Bayles who had flown everything from Jennies to Ford trimotors. After the flying derby he was so impressed with the performance of the little sportster he bought it for his own use. It was a fast, safe, dependable sport plane. Production models of the Gee Bee X were fitted with engines

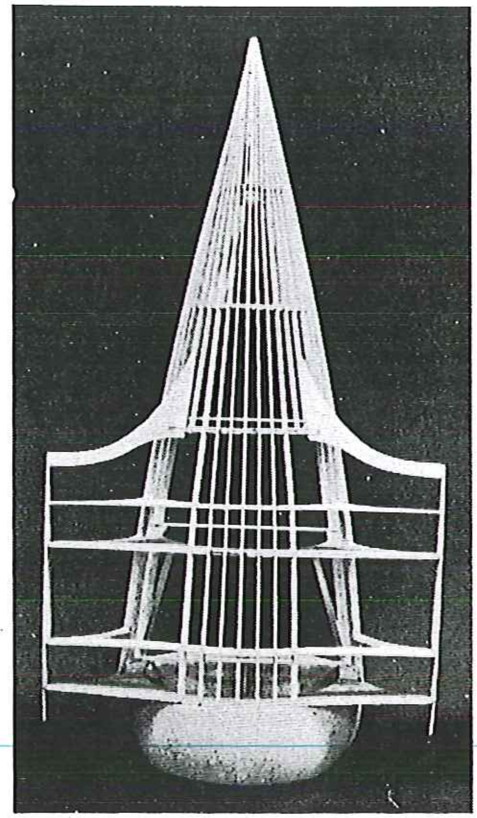
The late Bob Granville—of famous Granville brothers who manufactured the GeeBees—holds Henry Haffke's model of early in-line GeeBee Sportster. Henry, left, will have ¼-scale model Y in early issue.

The author wishes to dedicate this article to the memory of Robert H. Granville, who passed away on November 15, 1978. Bob had been a firm supporter of model aviation, and in fact, contributed information to this article.

In addition to helping modelers with research, he participated personally in the Rhinebeck "Golden Age" RC Scale events, serving as caller for Henry Haffke.

Bob authored a series of articles for the EAA magazine, Sport Aviation, dealing with the history of GeeBee aircraft, and also assisted with research on Bill Turner's GeeBee Z reproduction project. Had he lived only 10 days longer, he would have known of its successful flight. But then, perhaps he was watching. . .from the best seat in the house.

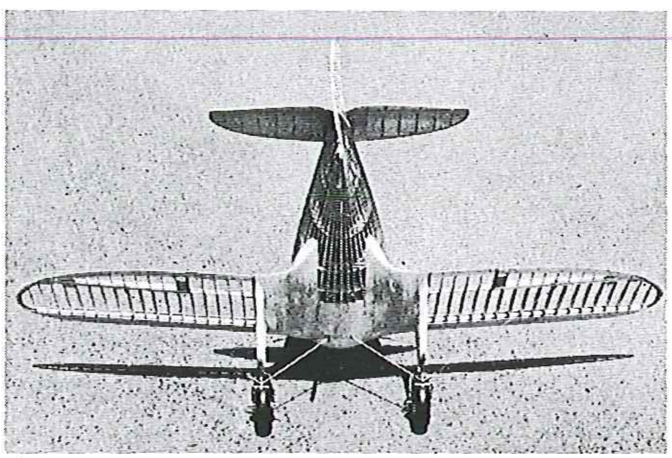




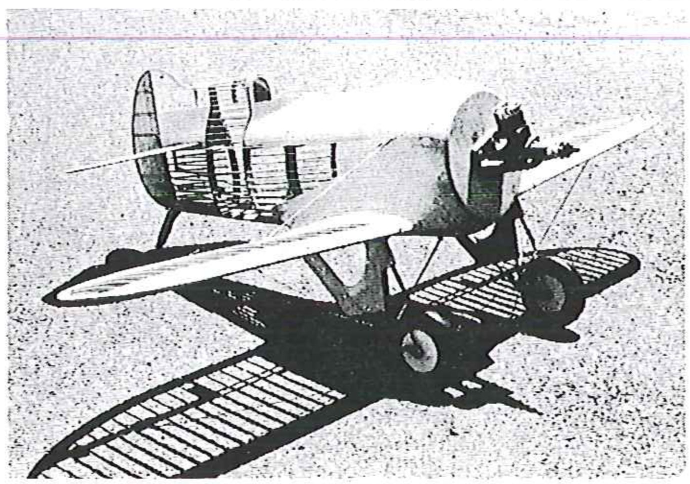
Most important factor in the excellent performance of Granger's Z is its light weight. Its structure is based closely upon Vern Clements' CL plan—Vern specialized in GeeBees for some 25 years. These side and bottom views of the basic fuselage show how root fairings tailor to fuselage.

including 95–hp Cirrus (model B), 95–hp Menasco (model C), 125-hp Menasco (model D), and 135-hp Ranger (Model F). Radial engined versions were powered with the 110–hp Warner (model E).

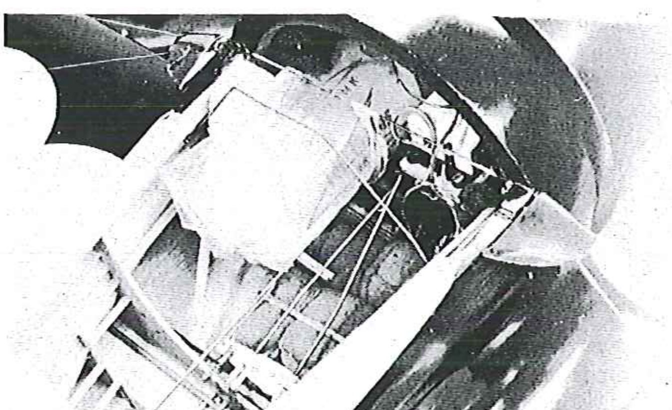
A new two-place Senior Sportster Gee Bee was designated model Y. It was larger than the D model by 20% and designed for the 210–hp Kinner, 215–hp Lycoming, 240–hp Wright J-6, or the Pratt & Whitney Wasp Jr. of 300 hp.



One picture truly worth 1000 words. Especially interesting is treatment of the landing gear arrangement and the functional scale rigging of the wires (Proctor streamlined wire and No. 2 turnbuckles) which brace the wing and take sideloads on the gear.

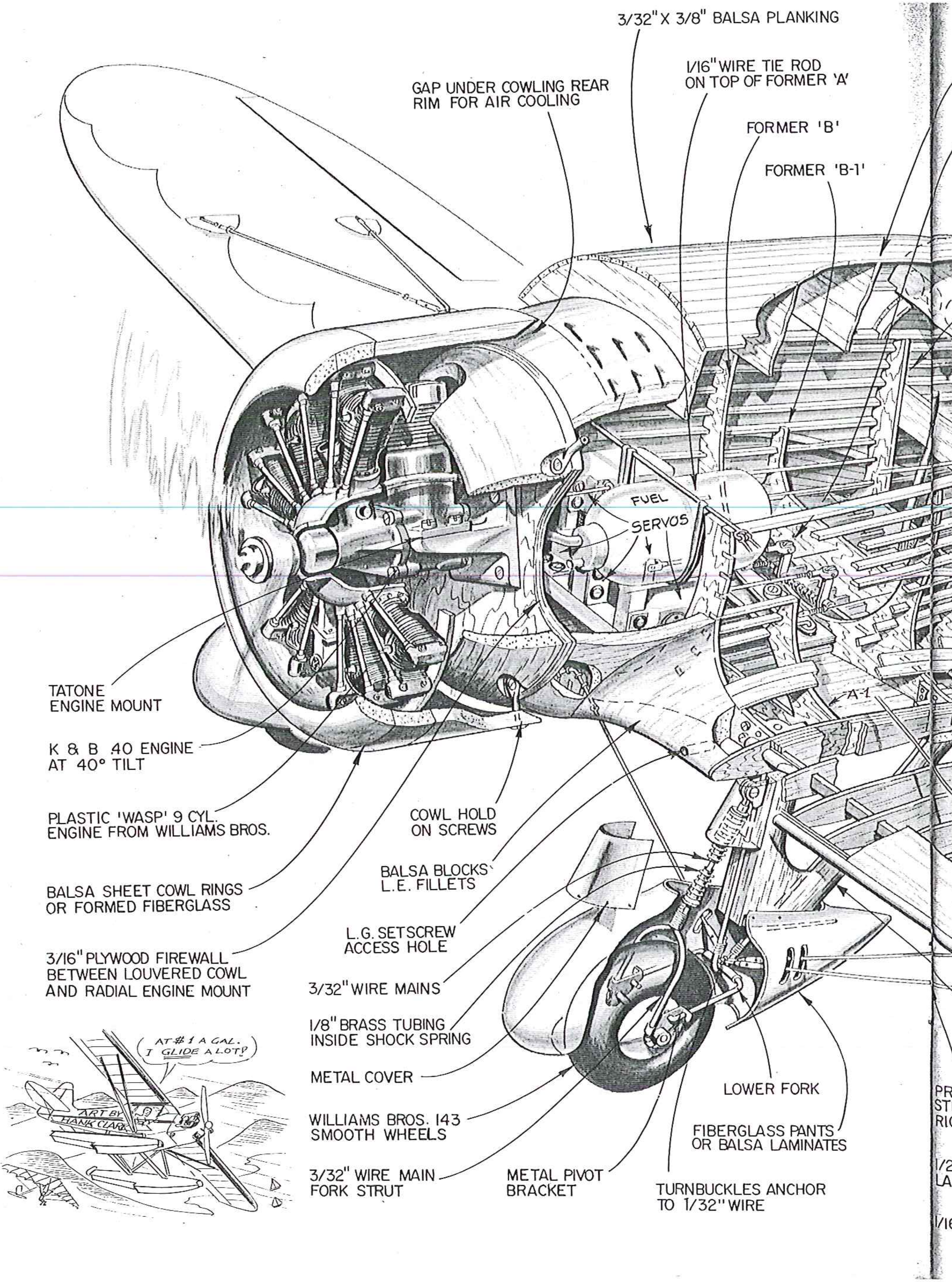


Ready-to-be-covered Z evokes a special feeling for the real aircraft. The K&B 40-sized series 71 is tipped 20 degrees to position the working cylinder between two dummy cylinders. Plenty of power on Zinger 11-5.

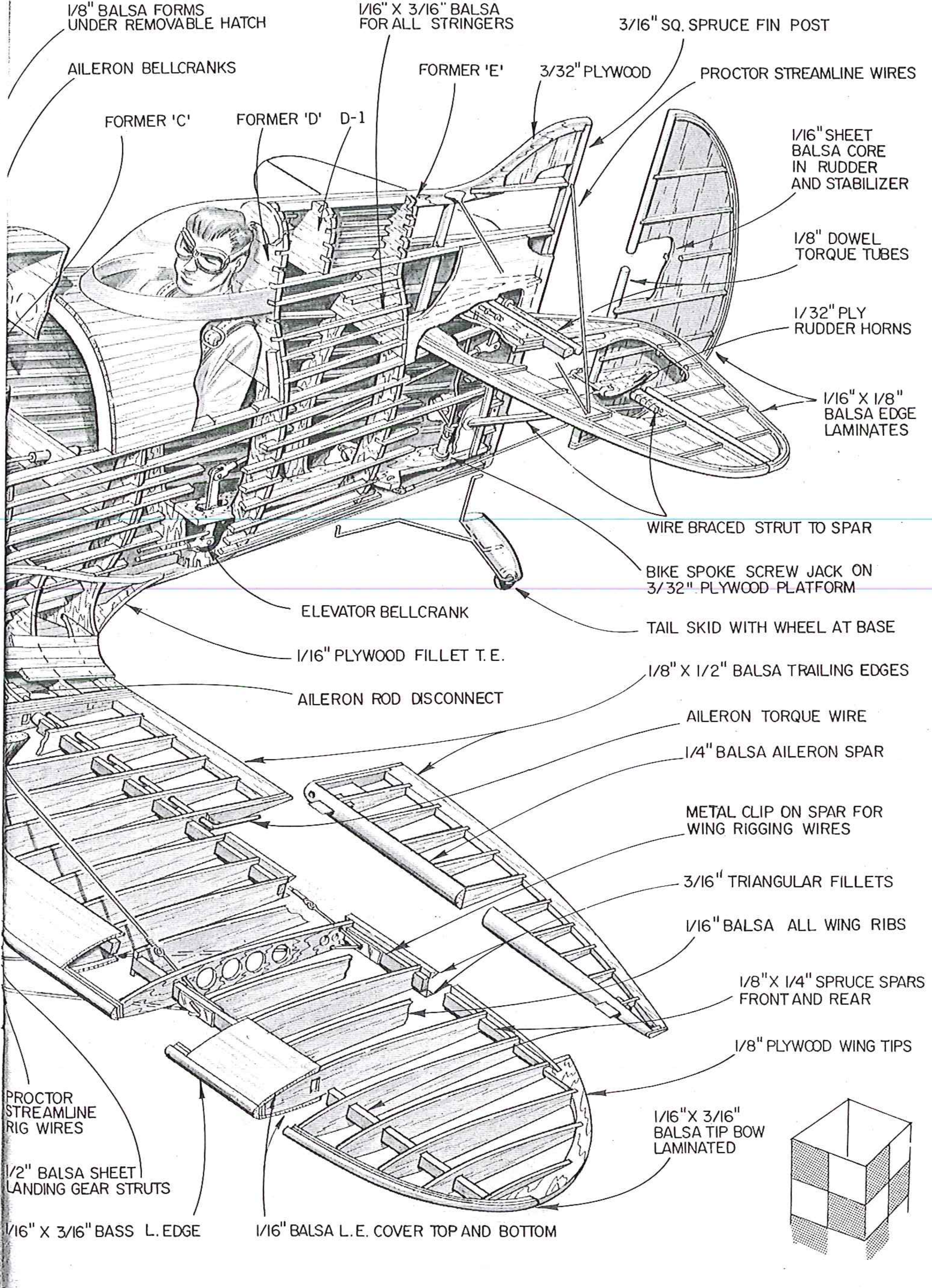


The outside of the GeeBee is exactly like its big counterpart but when Lowell Bayles looked inside he saw nothing like this! Servos for rudder and aileron are installed before 8-oz. tank is located, and underneath and to the side of the tank immediately behind firewall.

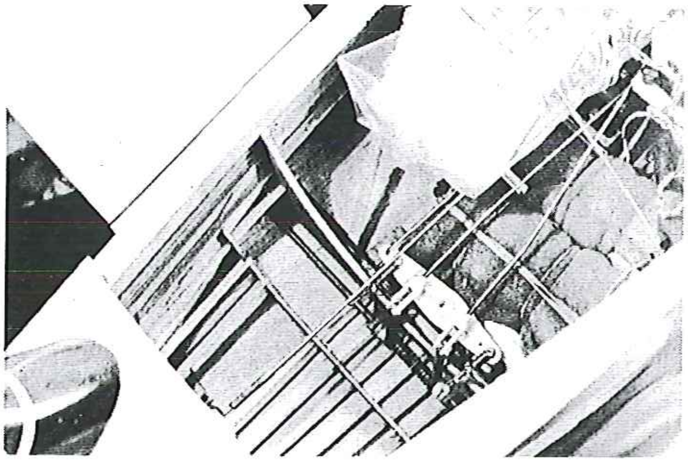
In a closer view many little details become self-evident. One is the tie rod which runs across the cockpit to the attach points for the wing wires. Front view of plan makes clear location of all four servos. Foam-wrapped battery pack appears at the extreme right of the photo.



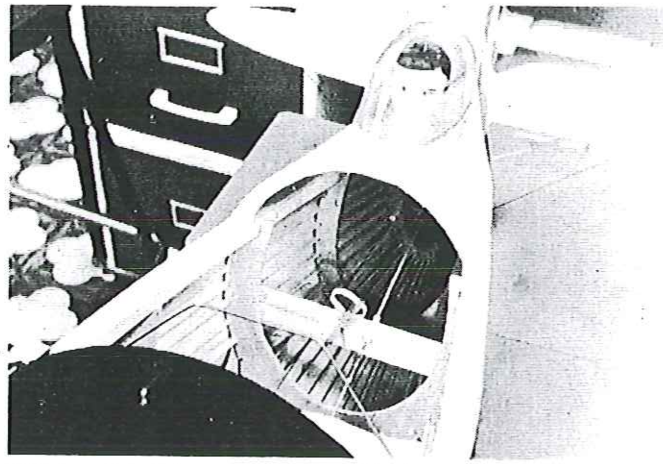
3/32" X 3/8" BALSA PLANKING
1/16" WIRE TIE ROD ON TOP OF FORMER 'A'
GAP UNDER COWLING REAR RIM FOR AIR COOLING
FORMER 'B'
FORMER 'B-1'
FUEL
SERVOS
A-1
TATONE ENGINE MOUNT
K & B .40 ENGINE AT 40° TILT
PLASTIC 'WASP' 9 CYL. ENGINE FROM WILLIAMS BROS.
BALSA SHEET COWL RINGS OR FORMED FIBERGLASS
3/16" PLYWOOD FIREWALL BETWEEN LOUVERED COWL AND RADIAL ENGINE MOUNT
COWL HOLD ON SCREWS
BALSA BLOCKS L.E. FILLETS
L.G. SETSCREW ACCESS HOLE
3/32" WIRE MAINS
1/8" BRASS TUBING INSIDE SHOCK SPRING
METAL COVER
WILLIAMS BROS. 143 SMOOTH WHEELS
3/32" WIRE MAIN FORK STRUT
METAL PIVOT BRACKET
TURNBUCKLES ANCHOR TO 1/32" WIRE
LOWER FORK
FIBERGLASS PANTS OR BALSA LAMINATES
AT $1 A GAL. I GLIDE A LOT!
ART BY HANK CLARK



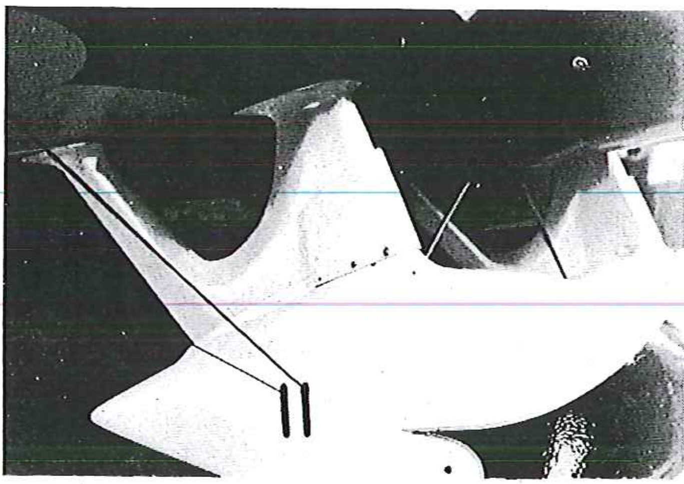
1/8" BALSA FORMS UNDER REMOVABLE HATCH
1/16" X 3/16" BALSA FOR ALL STRINGERS
3/16" SQ. SPRUCE FIN POST
AILERON BELLCRANKS
FORMER 'E'
3/32" PLYWOOD
PROCTOR STREAMLINE WIRES
FORMER 'C'
FORMER 'D'
D-1
1/16" SHEET BALSA CORE IN RUDDER AND STABILIZER
1/8" DOWEL TORQUE TUBES
1/32" PLY RUDDER HORNS
1/16" X 1/8" BALSA EDGE LAMINATES
WIRE BRACED STRUT TO SPAR
BIKE SPOKE SCREW JACK ON 3/32" PLYWOOD PLATFORM
ELEVATOR BELLCRANK
TAIL SKID WITH WHEEL AT BASE
1/16" PLYWOOD FILLET T. E.
1/8" X 1/2" BALSA TRAILING EDGES
AILERON ROD DISCONNECT
AILERON TORQUE WIRE
1/4" BALSA AILERON SPAR
METAL CLIP ON SPAR FOR WING RIGGING WIRES
3/16" TRIANGULAR FILLETS
1/16" BALSA ALL WING RIBS
1/8" X 1/4" SPRUCE SPARS FRONT AND REAR
1/8" PLYWOOD WING TIPS
PROCTOR STREAMLINE RIG WIRES
1/16" X 3/16" BALSA TIP BOW LAMINATED
1/2" BALSA SHEET LANDING GEAR STRUTS
1/16" X 3/16" BASS L. EDGE
1/16" BALSA L.E. COVER TOP AND BOTTOM



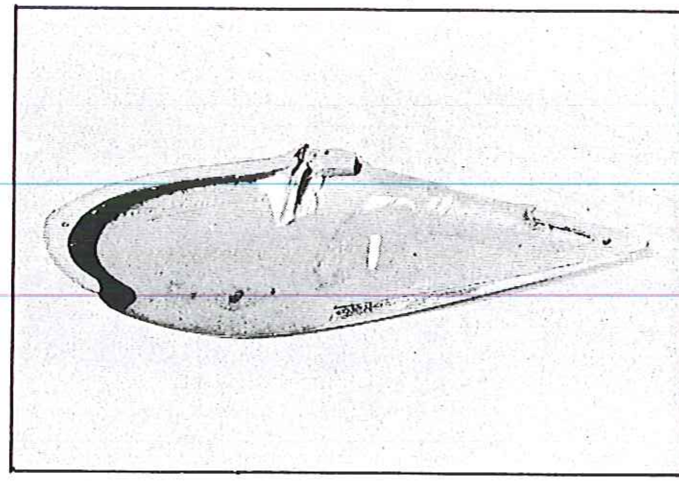
Rudder bellcrank with spring-loaded cables running aft to rudder, pushrod at extreme left of crank. Passing over it are two pushrods to engage horns attached to aileron torque tube—plan detail shows uncommonly simple coupling arrangement of inner torque tube to those in the wings.



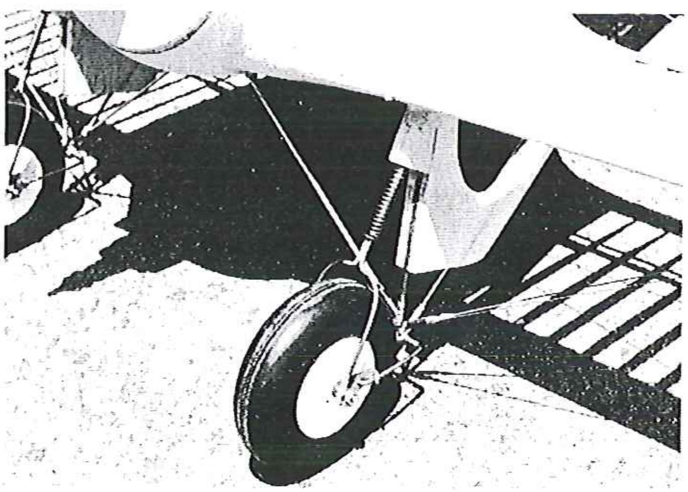
Rubber-scale builders will appreciate this photo, looking aft where the stringers permit an almost shell-like structure. When weight is important there can be no business of basic boxes and other popular crudities. Note bushed pushrod guide which also provides stiffening.



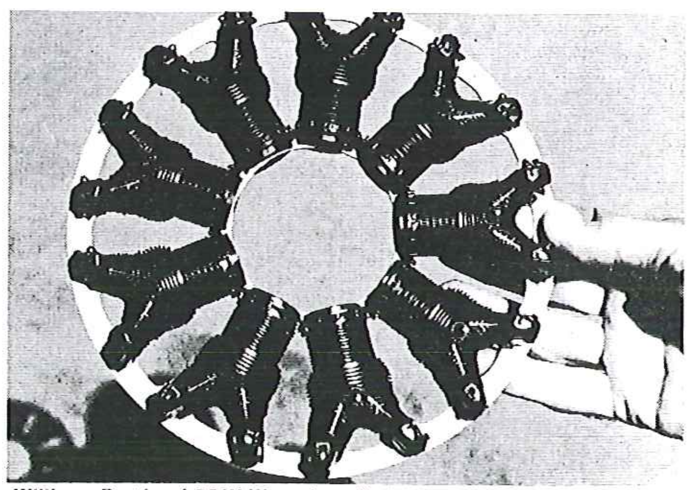
The way it was—and you clearly don't have to take our word for it. The shock strut covers are thin aluminum. Front view of plan shows cross sections for both built-up and balsa boots.



Pants can be hollowed balsa blocks, but Granger made his two halves by using plywood frames and two layers of glass cloth—halves screw together. Gear can be permanently fixed or detachable—details in text.



With help of this detailed photo and plans one can duplicate actual strut arrangement of the real aircraft—note shock-absorbing coil spring.



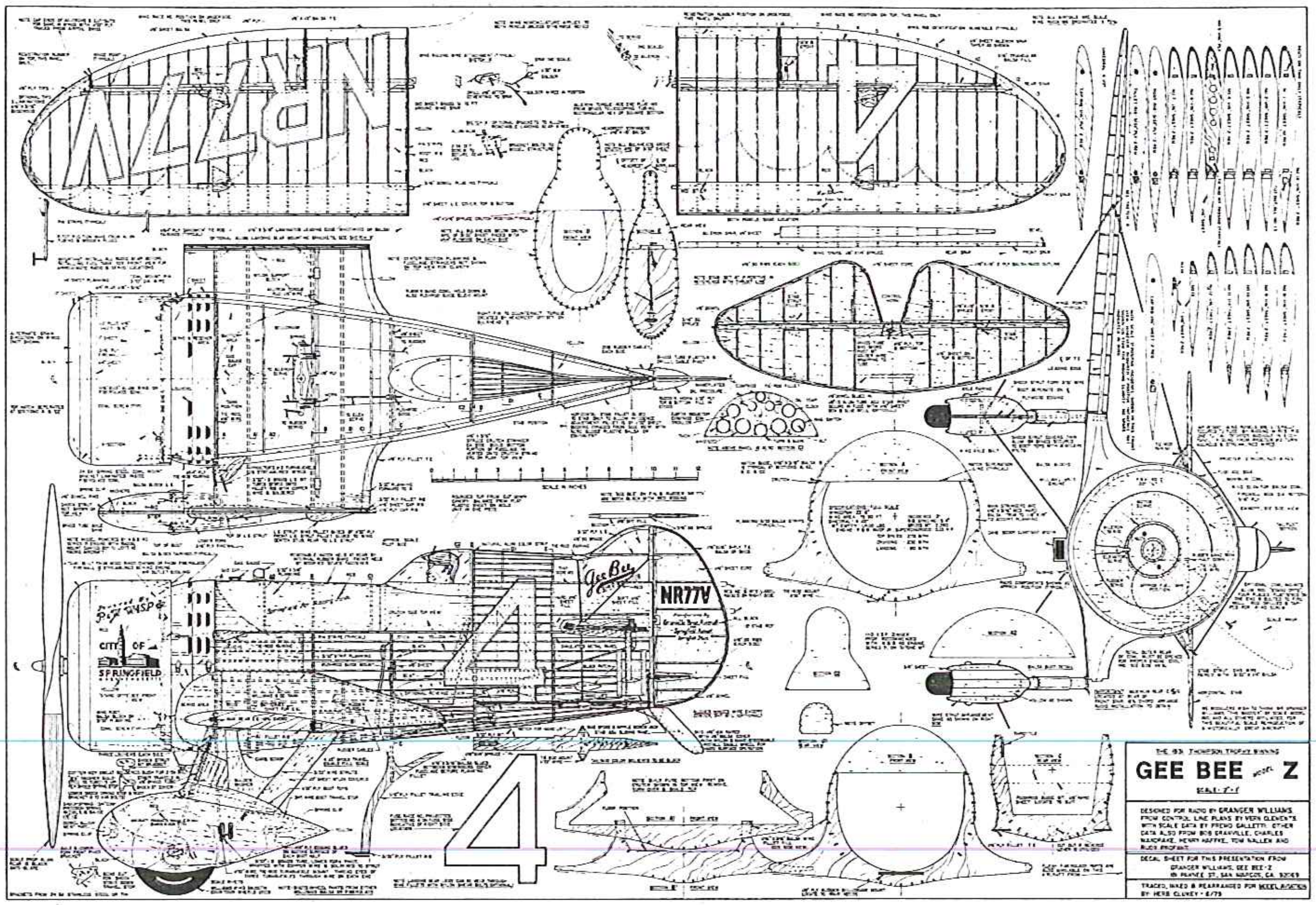
Williams Brothers' P&W Wasp Jr. cylinders are configured on just two rings, a very simple arrangement. The designer advises that the location of the center of gravity must not be behind 18% of wing chord.

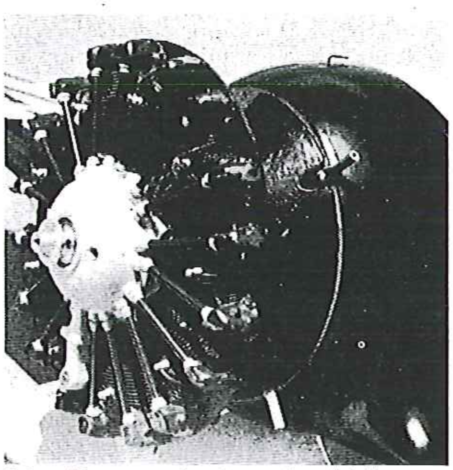
In 1931, Bob Hall and Zantford Granville designed a new plane, the first strictly racing model (model Z). Rolled out of the shop on August 22, 1931, the Gee Bee Z was constructed using some duplicate or modified parts used in building the model Ys. Powered by a loaned Pratt & Whitney Wasp Jr. engine that was used in the Laird Solution when it won the 1930 Thompson Race, the basic fuselage structure was welded chrome-moly tubing, and the wing was built of wood, using an M–6 airfoil.

The cockpit cover was an ancestor of the bubble canopy. The transparent section was fastened to a removable section of the top of the fuselage. This cover was placed on after the pilot was seated, and held in position by quick releasable fasteners inside the cockpit. Aircraft Product wheels and brakes were actuated by the full back position of the control stick, with directional brake control by the rudder pedals.

On the first day of the 1933 National Air Races, Bob Hall won the 25–mile race in a Menasco-powered D model. Zantford Granville was fourth in a 30–mile race, flying a Warner-powered model E. Mary Haislip in a Menasco-powered D, and Maude Tait in a Warner-powered E won second and third in two women's events. Lowell Bayles won the Shell qualifying event in the Z at 267.34 mph, a new record. Bob Hall was second at 213.86 in the model Y.

FULL SIZE PLANS AVAILABLE . SEE PAGE 128





Painstaking attention to engine details produced life-like P&W. Particularly note familiar trademark location, the case and shaft, as well as pushrod attachment to case. Plans show balsa ring cowl construction; Granger used two-layer fiberglass shell with aluminum ring in back.

Bayles won the 50–mile race in the Z. Bob Hall was in second place,until he hit a water tower and was forced to land with two feet of wing tip gone on the model Y. Bob Hall won the General Tire Trophy in the Z, and won the mixed free-for-all race, also in the Z. Maude Tait won the Aerol Trophy with the Y. Lowell Bayles won the Thompson Trophy race at 236.23 mph in the Z. Bob Hall was fourth in the Y. Not too bad for the first year of the Gee Bee racing group.

In November, 1931, a 750–hp Pratt & Whitney Wasp Sr. engine was installed in the Gee Bee Z for an attempt to set a new speed record. Several tries were made during November and early December to set the record, but propeller and engine problems kept them from completing the required four passes over the course. On December 5, Bayles flew the Z to about 1000 feet, and five miles from the course, went into a dive to gain speed. As he levelled out and roared through the course on the first pass, the airplane suddenly dipped from level flight and pulled up sharply. The right wing folded up and the Z rolled twice to the right before it crashed and exploded. The physical evidence at the scene, and motion pictures of the crash were inspected frame by frame, leading to the conclusion that a loose gas cap had started the trouble. Apparently the cap flew off striking the cockpit cover. The canopy shattered inward, blinding Bayles and causing him to lose control.

Designer Bob Hall said the Gee Bee was sensitive longitudinally and the added stress of the dip and pull-up caused the right wing to fall. Speed at the time was estimated in excess of 325 mph. This was the first of an unfortunate series of mishaps which were exploited by newspapers and hack writers seeking to capitalize on sensationalism.

Much of this information was adapted from the book "The Gee Bee Story," by Charles Mandrake, with additional information and corrections from Bob Granville.

Building the Model Gee Bee Z: If you are tired of the same old quickly-built, easy-flying, much-modified scale models that never look like the original airplane,you are ready to take the challenge of an exact scale model of an unusual airplane. You choose the Gee Bee racer because it intrigues you and everyone of the experts tells you it won't fly. If you are serious enough to make it exact scale, then I say welcome to an exclusive group of model builders and fliers.

If, on the other hand, you are one of those people who think that scale models will not fly

Granger and the Z. He recommends wheel landings, warns against 3-pointers. Describes modification to tires which enabled ship to take off concrete runways, a problem in the beginning. His comments on proper handling during the roll-out after touchdown are GeeBee lore.

unless you redesign them with bigger tails, different airfoils, shorter landing gear or some other abortive change, because you know more than the original designer, then forget it buddy, you and I do not talk the same language. You are afraid of the challenge that an exact scale model presents, or you are a lousy pilot.

This model of the Gee Bee Z is to exact scale proportions and aerodynamic layout. The flying stability is the equal of any good high performance model that has to be flown; it will not

Continued on page 106

fly Fast Combat now) and am wondering if you could pass this along to either Mr. Hempel, or Mr. Upton, or someone who has experience with jets.

What I primarily need to know is if there are any current designs for Jet Speed planes for which I could get plans. Also, which is most recommended: a Dyna Jet, or a Raven? Assuming they aren't kept secret, what are some of the reworking processes done on jets to make them faster (other than cutting off the air nozzle, and enlarging the holes in the flowjector on the Dyna Jet)? Does Curtiss Dyna still make the Dyna Jet?

Any information you may be able to supply me with will be greatly appreciated. Thank you very much.

Cam Dix
Ontario, Canada

We have put Mr. Dix in touch with Mike Langlois who did the wizard article on the CL Super Burp in the December 1978 issue. MA publishes occasional state-of-the-art articles on the more obscure types of models and competition, for just such purposes—to get the data down somewhere as long-lasting references. By now it is possible bellowing sounds are wafting across Cam's hometown of Don Mills, if not the entire province of Ontario. And, yes, we do understand that Curtiss still has Dyna Jets. Also, one of the discount advertisers has offered this item recently.

Likes Half-A Scale

Just a few lines to let you know that I think your choice of construction projects is excellent. I was particularly impressed with the Wildcat (do Bowers and Srull have any more of these around?) and the B-25 in the March issue. I would like to encourage you to publish additional Frank Baker multis—that A-26 looks very interesting.

J. C. Sloane
East Hanover, NJ

Alas, J.C., we don't. But we've got one in the works. Hurst is cooking up a Lockheed Air Express.

Gee Bee Z/Williams

continued from page 17

fly itself, but has no bad habits. Landings are best made as wheel landings. Do not try to three-point it. Quick rudder action on roll-out is necessary to avoid ground loops on asphalt or other hard surface, when the tail-wheel comes in contact. A small tail-wheel was built into the end of the tail-skid for use on hard-surfaced runways.

I was unable to fly the airplane off the asphalt or concrete until some special tires were made, by grinding a groove in regular tires and snapping on an O ring made of polypropelene. When this was done, allowing the tires to slide, no more takeoff problems were experienced. Full back-stick is required to keep the tail down as you push the throttle open. Then ease the stick forward as speed increases. The ship comes off, with a little back stick, in 30 to 50 feet depending upon wind condition. Special tires are not necessary on dirt or grass. The most important thing to remember about this model is not to allow the center of gravity (CG) to get behind the recommended 18 percent of the wing chord. This is at the back of the forward wing spar.

One of the full-size Gee Bee racers was lost in 1935 when the CG limits were ignored by the inexperienced pilot, who modified the aircraft to incorporate larger fuel tanks for the cross-country Bendix race. Unfortunately, the accident was blamed on the design of airplane by the news media. If you do not feel competent to test fly your model of the Gee Bee, find a good experienced scale model flier to help you. Believe it or not, most expert pattern fliers are not qualified to fly this airplane.

Construction: I started by cutting out the fuselage bulkheads. Below the top longeron, these bulkheads are made from 3/32 sheet balsa with 1/64 plywood glued on each side. Temporarily glue a ⅛×¼ strip of wood to the sides of the bulkheads at the top to hold them while they are being glued to the top basswood longerons. Pin these to your building board, and carefully align with a square or some other right-angle tool. The lower half of the fuselage is built upside down on the board. Glue the bottom center basswood stringer in place, and clamp or pin it to the bulkheads. Recheck the alignment. Glue in a couple of diagonal braces of ⅛×¼ basswood from the top of bulkhead #A to the bottom of bulkhead #D. Now you can lay in the rest of the medium-hard balsa stringers around the fuselage. Fill in between stringers with 3/32 balsa strips where indicated, as planking. Let this unit set for a day or two.

Cut the wing ribs out using the patterns shown. Do not change the airfoil shape or thickness; this is a racing plane, not a trainer. Assemble the ribs and spars in proper order and position. Cement leading and trailing edges in place and laminate the wing tips from basswood for best results. Cut 1/16 sheet balsa for the leading edge planking, and trim to fit well. Cement in place and sand the leading edge to proper shape. Install the aileron hinges, torque rods, plug-in dowels and flying wire fittings.

If your landing gear will not be removable, bend the shape for sewn or bolted attachment, and fasten to the bulkheads, then glue the plywood root ribs in place. Make sure they are both at the correct angle. If you want a removable landing gear as I did, make up the angle brackets of aluminum, and drill the gear and screw holes. Bolt them to the bulkheads and then bolt on the root ribs.

The shaped wing-root fairings from the front bulkhead back, are made of balsa block hollowed out, or of 3/32 balsa planking. Cracks or low spots are filled with Magic Patch or similar material. Make the front contoured section, between the 3/16 plywood firewall and bulkhead #A, out of balsa blocks or thick sheet stock. Hollow out to about ½ thickness. Remove the fuselage structure from the building board and cement the contoured section in place. Place waxed paper on the top longerons back to the #D bulkhead and pin the upper sections of the bulkheads in place. Plank the top of the fuselage back to the cockpit headrest.

If you do not build the adjustable unit indicated, cement the stabilizer at the positive angle of one degree. (Leading edge up to about 1/16".) Build up the vertical fin with laminated leading edge. My airplane spent so much time on its back during the asphalt takeoff attempts, that the upper fin had to be strengthened and repaired several times. Make the tail-skid movable with the rudder control, and install a small tail-wheel, if you expect to operate off a hard-surface runway. The scale landing gear shock system works well, made as per plan.

Install the engine with a radial mount to suit your engine. Mine was tipped 20 degrees to the right to position the working engine cylinder between two of the dummy cylinders of the scale engine. The 40-size series 71 K & B engine provides plenty of power with an 11–5 Zinger prop. The fuel tank is installed directly behind the firewall on the left side of the fuselage, after the aileron and rudder servos are mounted. Servos are installed directly behind the firewall under and alongside of the 8-ounce tank. The receiver is behind bulkhead #A, the battery pack located where it will balance the aircraft. Mine was behind the receiver, but with the extra weight of an adjustable stabilizer, it may have to be farther forward. Rubber bands hold battery and receiver in place, with plenty of foam wrap.

Lou Proctor's streamlined wire and #2 turnbuckles are used for the rigging. The upper rigging for the wings attaches to a piece of music wire across the fuselage longerons. Rig a degree or two of wash-out in both wings. There will be some flexing in the torque rods to the ailerons but no amount of sloppiness should be allowed. A 1/16 music wire pushrod, supported at the center, is used for elevator control. Cables with a small stiff spring are used on the rudder control. Rudder bellcrank length is not critical, but the link from the servo should be just outside of the cable attachment point. The top fuselage hatch is held in place at the back by an internal rubber band and the front with a modified Dzues fastener.

Wheel pants could be made from hollowed balsa blocks. However, I used two layers of fiberglass cloth with plywood frames that allow the pant halves to be screwed together. The cowling could be made up of balsa rings. I prefer two layers of fiberglass cloth, with an aluminum ring about 1/16 × 1/2 glassed into the back. Drill screw holes through it for attachment to the stand-off fittings fastened to the firewall.

The model was covered with natural Coverite except for the rudder, stabilizer and elevators which were covered with Silkspan. Several light coats of clear Sig dope were applied and sanded. Sig Cub yellow dope was sprayed on, with three coats lightly sanded. The weave of the cloth should still be visible when finished, except where metal covering is simulated (planking). Scalloping and numbers were masked off and sprayed with Sig black dope. Use one 1/16-in. wide red striping tape for separation of the black and yellow on scalloping and around numbers. The small lettering is generally black except for "Springfield Air Racing Association Inc.," "Powered by P&W Wasp," "Hartshorn Steel Tie Rods," "Supersportster" and "Aircraft Products Wheels & Brakes," which are red. Also there is red edging around "Gee Bee" and on the rudder "N77V."

Unless you are good at small lettering and striping, it is unlikely that you will come up with

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11. I certify that the statements made by me above are correct and complete.
CARL R. WHEELEY, Publisher

the proper style, size or color of decals or press type. I found only black lettering and a poor match of style. We will be able to furnish the decals, except for the wing numbers. Fiberglass cowling and wheel pants are also available from Bob Holman Plans. If you have questions, send an addressed stamped envelope with your letter and any reasonable minimum questions to: Granger Williams, Gee Bee Z, 181 Pawnee St., San Marcos, CA 92069. Please be patient and do not expect an instant answer.

The drawings presented with this article were traced from control-line drawings made by Vern Clements with scale data supplied by Premo Galletti. This long-time Gee Bee enthusiast and model builder won the control-line event at the Nationals several years ago with a Gee Bee R–1. Vern also built 1" scale gliders of the Gee Bees and launched them from hills to test his theories of stability, with excellent results. Control-line drawings of the Gee Bee Z (2" scale) and R–1 drawings (1½" scale) may be obtained from Vern by writing to him at P.O. Box 608, Caldwell, ID 83605. Include a stamped envelope for his price list.

Much of the full-scale Gee Bee information used in this article was taken from the book *The Gee Bee Story*, by Charles Mandrake, another Gee Bee enthusiast. If you are seriously interested in learning the facts, check your library or used book stores for a copy of this book, now out of print. Write to Charles Mandrake, P.O. Box 955, Ashtabule, OH 44004 for his new book, "National Air Races 1932." Send stamped envelope for his prices. Gee Bee information was also obtained from Bob Granville, Henry Haffke, Tom Nallen and Rudy Profant.

Rate and Roll/Herbert

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2) Assure that the aileron trim control on the front of your transmitter is in the center position and that the control stick remains centered during alignment.

3) Operate the dual-rate switch on and off while observing the aileron servo. It will slightly jump or change trim a small amount. To correct this condition, turn the adjusting screw on the 5K trimpot (B) in small increments with the jeweler's screwdriver until the servo no longer moves or jumps while you operate the dual-rate switch repeatedly. This completes the centering portion.

4) With the transmitter and receiver still on, and the trim switch still centered, hold the aileron stick to the far left position. Now operate the dual-rate switch and observe the aileron servo. In full rate, you will have your full normal travel since the trimpots are isolated from the circuit. By placing the dual-rate switch in the half-rate position, and adjusting the 10K trimpot (C), you can adjust the amount of the half-rate throw.

5) Allow the aileron stick to center itself again. Operate the dual-rate switch and observe the servo. If it changes trim, retune it as you did in Step 3 of these tuning instructions.

6) Place the dual-rate switch to the full-rate position and press the roll button. Observe the servo. It will move to the full-left stick position. Adjust the 5K trimpot (A) so that when you press the roll button, the servo moves the same distance as if you were to move the control stick to the far left position. This completes the roll adjustments.

Now you can switch to half rate, and by pressing the roll button, the result will be half the full servo movement or a slow roll. In the full-rate position and pressing the roll button will result in a full roll.

Wiring instructions for Circuit #2:

1) All of the instructions for Circuit #1 apply with the exception of the deletion of the 5K trimpot (B).

2) Install the roll switch, the dual-rate switch and fasten in the 5K trimpot (A) and the 10K trimpot (C). Refer to Fig. 2 for the following wiring instructions.

3) In this circuit you must unsolder the center wire or wires (if more than one wire is connected to this terminal, both must be spliced to the longer wire) control-stick pot, terminal #2, and splice a wire to the free end long enough to reach the center terminal of the spot dual rate switch. (Note: Make sure these wires are soldered well and the splice is well insulated by using heat-shrink tubing over the splice or good electrician's tape.)

4) Solder a wire to the left-hand side terminal of the dual-rate switch, that you have previously installed, long enough to reach the center terminal #2 of the aileron control stick pot. Do not solder!

5) Solder another wire to the right terminal of the dual-rate switch long enough to reach the 10K trimpot (C) (resistance terminal closest to the adjusting screw). Solder this wire to the trimpot.

6) Solder a 3-in. wire to the (wiper) terminal of the 10K trimpot (C).

7) Solder a 12-in. wire to the center terminal of the roll pushbutton switch and a 12-in. wire to the left or (closed) terminal of this same switch. Twist both of these 12-in. wires together to make a braid and route down to the bottom of the transmitter and over to the trimpots you have glued in.

8) Strip ¼-in. of insulation from the ends of the three wires you have just soldered. That is, the wire from the left terminal of the dual-rate switch, either one of the wires from the roll pushbutton, and the 3-in. wire from the (wiper) terminal of the 10K trimpot (C).

Twist these bare ends together and solder them to the center terminal #2 of the aileron control-stick pot.

9) Take the remaining 12-in. wire that is soldered to the closed (C) side terminal of the roll pushbutton and solder it to the (resistance) terminal at the opposite end of the adjusting screw of the 5K trimpot (A).

10) Solder a 3-in. wire to the #3 terminal of the aileron control stick pot. Do not disturb the wire that is presently attached to it.

11) Solder the free end of this 3-in. wire to the (wiper) terminal of the 5K trimpot (A).

This completes the wiring for Circuit #2.

Tuning Circuit #2:

1) Tune the 5K trimpot (A) for the correct amount of roll as is explained in the tuning instructions for Circuit #1.

2) When repeatedly operating the dual-rate switch from half to full, there may be some slight servo movement or jump. To correct this, you must mechanically change the position of the aileron control-stick pot in its housing.

3) Some transmitters have pots in them that you may rotate the entire body to center the servos. When I installed this set-up in the Kraft KPT4A, I found that the aileron pot could not be rotated. To change the trim on this radio, the set screw that tightens against the control pot shaft must be loosened.

4) With the aileron stick at neutral and the trim switch on the front of the transmitter centered, operate the dual-rate switch back and forth and observe the servo. If the servo moves while switching the dual-rate switch, rotate the shaft on the stick pot either clockwise or counter-clock-