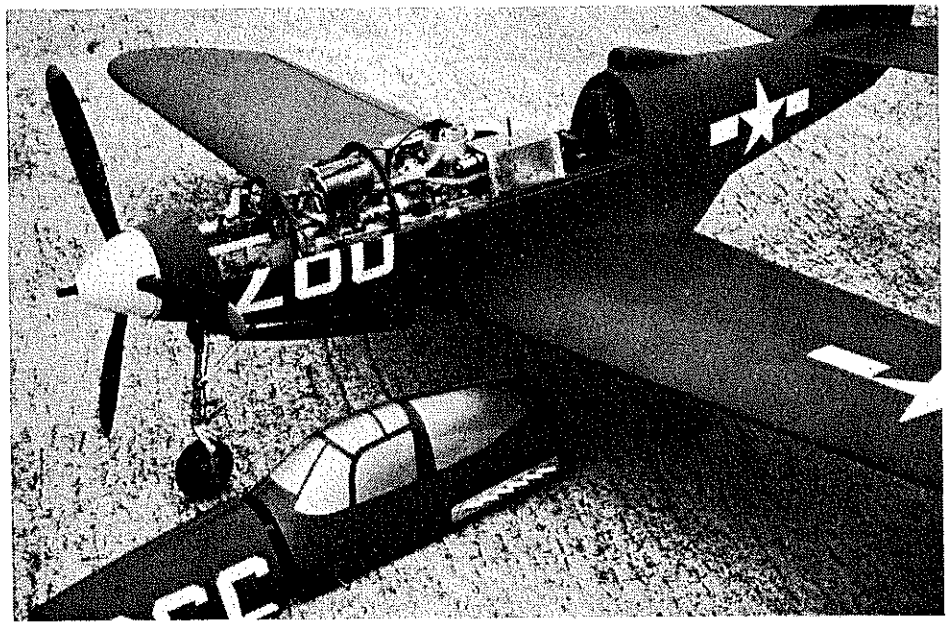
At the 1981 Nats, the NASA Special Achievement Award went to this bird: a P-39 Airacobra with the engine mounted behind the cockpit, water-cooled, and connected to the prop through a drive shaft. This CL Sport Scale model is indeed special.

3607

P-39 AIRACOBRA

Jack Stolly



Model sits on runway at Wright Field, where original P-39 made maiden flight in 1938. Enya .45 marine engine sits amidships (scale location); drive shaft extends forward to prop.

THE FIRST TIME that I saw a P-39 in flight must have been in 1941, near Wright Field. The sound of the engine, the speed, and clean lines were so different from the radial-engined "P-shooters" and biplanes that were so common in those days that I was awestruck. I have been fascinated by its unique design ever since.

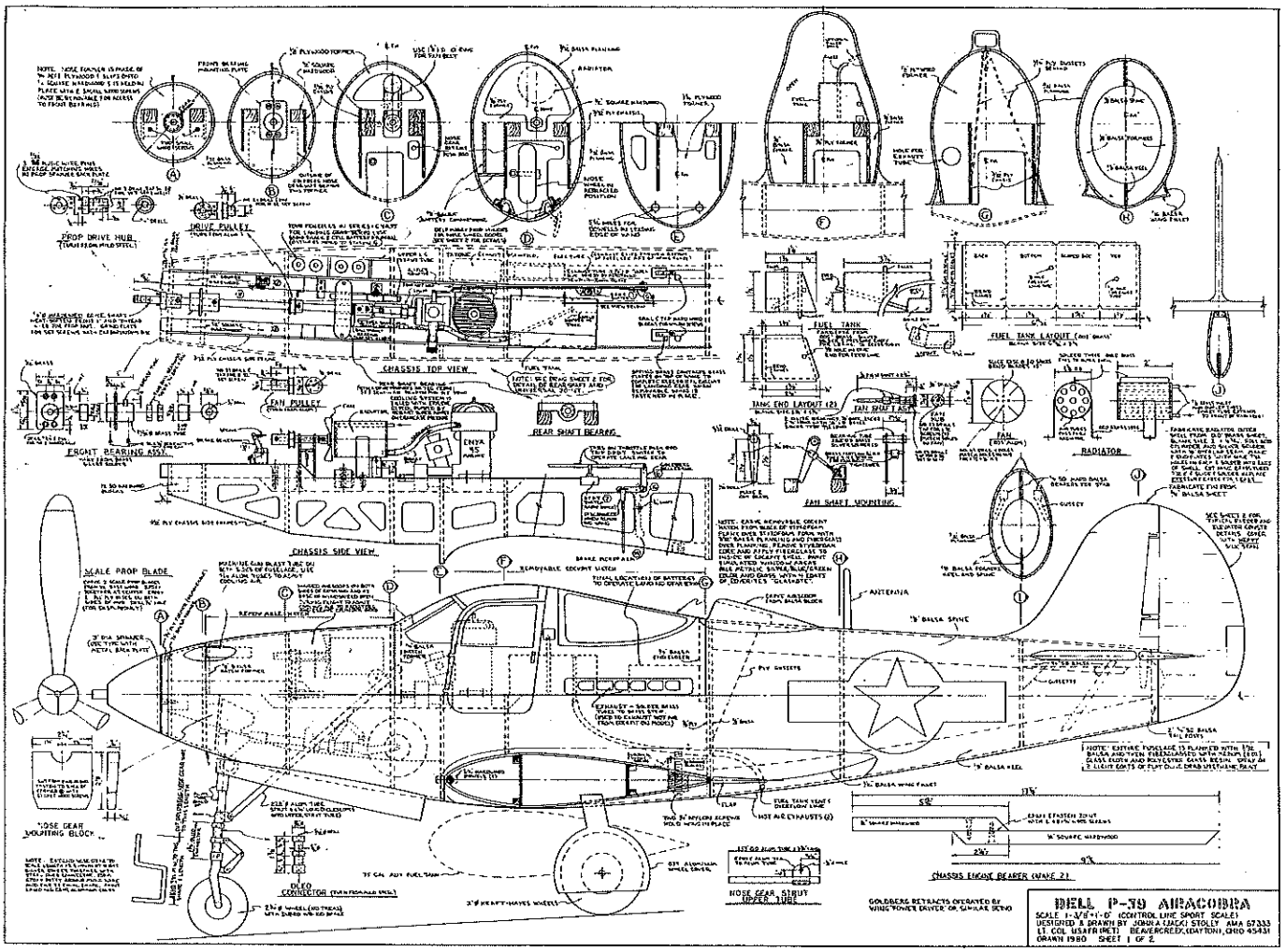
The P-39 was one of America's first-line pursuit planes at the time of Pearl Harbor in December 1941. It had made its initial flight in April 1938 at Wright Field, and by the time of the Pearl Harbor attack nearly 600 had been built. Its unique engine location (behind the cockpit) caused some concern at first, but experience showed that this was no more of a hazard in a crash landing than with an engine located forward of the cockpit. However, the P-39's spin characteristics could be quite a problem if proper recovery techniques were ignored.

The Airacobra saw combat throughout the world, particularly in the Southwest Pacific, Mediterranean, and Russian theaters. Because its engine was not equipped with a supercharger, the P-39 performed best below 17,000 feet, and it often was used at lower altitudes for ground strafing. When P-39 production ended in August 1944, Bell had built 9,584 of them, of which 4,773 were allotted to the Soviet Union. Russian pilots appreciated the P-39 with its 37mm cannon for its ground attack capabilities against German armored forces.

The model. Several years ago, when I decided to design and build a Sport Scale model of the P39, the concept was simple enough: air-cooled engine sticking out in the breeze up front, retracts, and throttle control. I'd had very good performance and lots of fun with a similar model, a P-51 Mustang built from Al Rabe's plans and equipped with retracts and throttle control. Then Sport Scale came along, and the Mustang started winning first place trophies in contests. But when it came to design time I just couldn't see those pretty Cobra lines being dirtied up with an engine sitting up there on the nose. It was decided to move the engine back to the cockpit area, like the real one, and air-cool it by leaving the windows out around the wind screen. Full-size drawings were started, and construction of the chassis and wing were proceeding almost concurrently with the drawings.

That's when I happened to run across an article in an RC magazine by some folks who had been experimenting with liquid-cooled engines and a flow-through radiator system.

Jack Stolly couldn't bring himself to hang an engine outside the P-39's nose, so he designed a remarkable radiator cooling system for the completely-enclosed engine.



The results they were getting convinced me to go to a liquid-cooled setup in the P-39, thereby allowing me to close the cockpit windows as they should be.

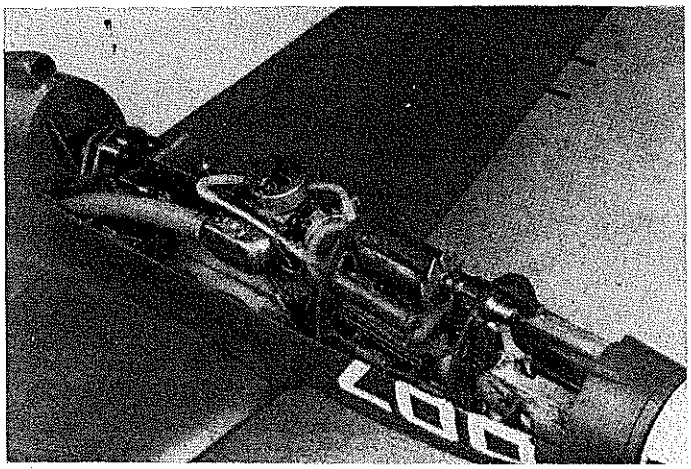
As luck would have it, I found that Goldberg retracts would just barely fit into the machine, so I didn't have to design and build my own as I did on the Mustang. The scale of the P-39 was sized so that a 3-in. diameter spinner and 3-in. diameter main gear wheels would be in proper scale. Too many times we see a good looking airplane spoiled by the wrong size wheels on the end of a piece of music wire. Landing gears should look like landing gears!

Before commenting on construction of the airframe, I'd like to describe the major systems in the plane and my learning experiences during the past year or so.

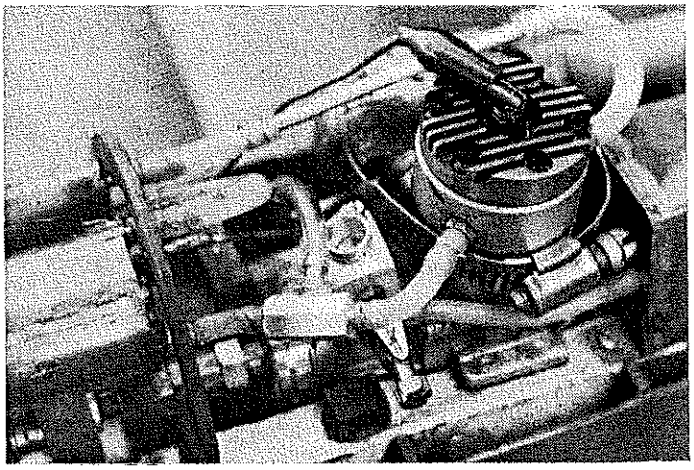
Cooling system. I was a little apprehensive about this, but everyone said it would work. Still, it took a lot of nerve to fire up that brand new Enya .45 the first time. I'd run it a minute or two and then shut it off to see if the radiator was getting the heat. On and on I went, getting braver all the time. As it turned out, the cooling system is the only thing in the airplane that has given me no problems. It works beautifully. However, when we decided to take it to the Texas Nats this past summer, I started thinking about that 100-degree heat and decided to add extra cooling capacity.

The extra radiator tank is mounted alongside the fan radiator in the area where the batteries for the landing gear servo are shown on drawing sheet No. 1. The batteries were moved back to sit on top of the chassis just in front of former G for better balance. The second radiator tank is detailed on drawing No. 2.

The Robart pumper has done its job well in pumping the coolant through the system. I don't know what makes these little things work or what's inside them, so to be on the safe side and to keep it as cool as possible, I mounted it between the cool outlet of the fan radiator and the inlet to the engine cooling jacket. I use undiluted antifreeze for fear that diluting with water may cause steam problems in the system.

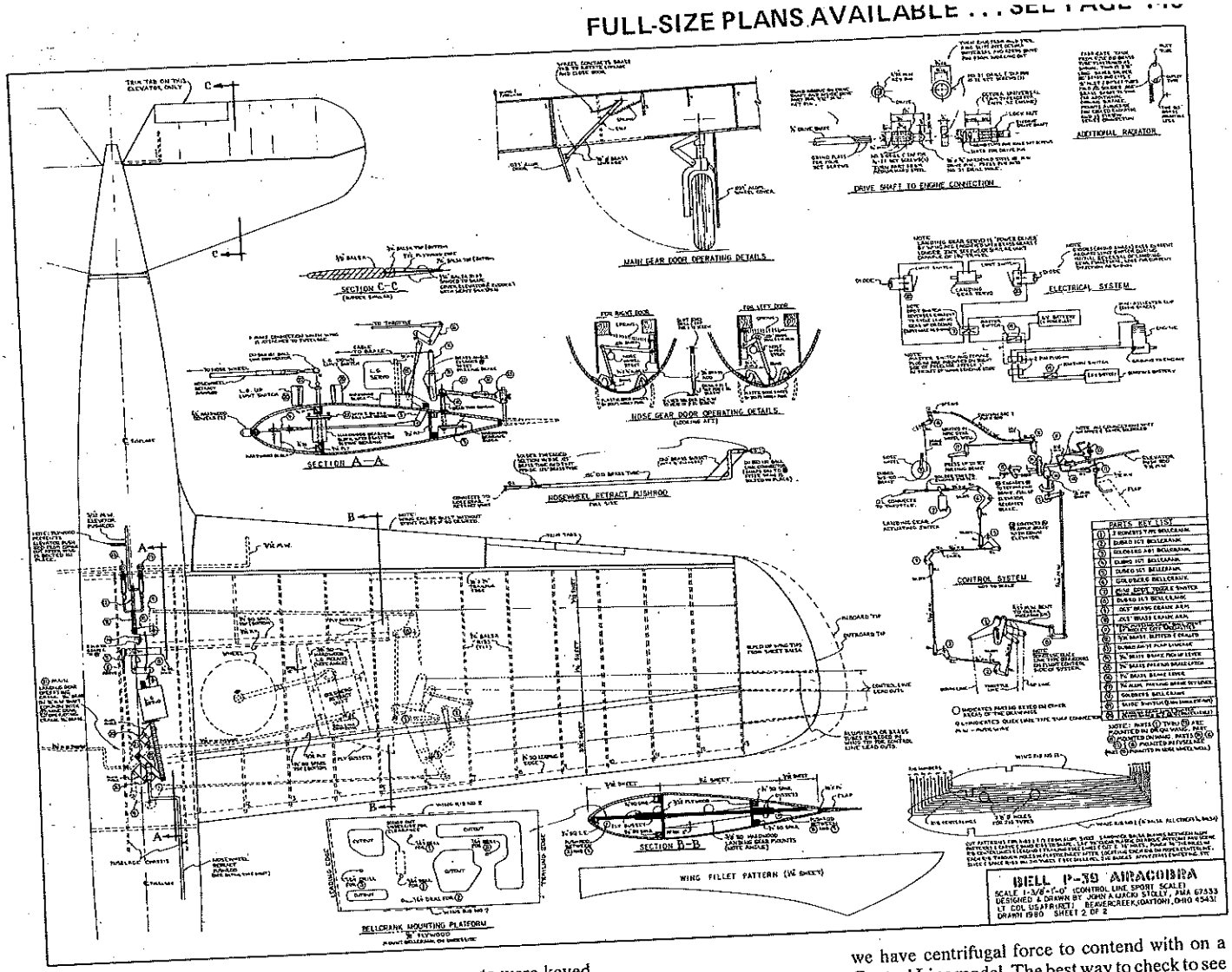


Left to right: landing gear servo batteries, exhaust tube, fuel tank, engine, radiators, fan. Tube ducts exhaust out bottom of plane.



Robart Super Pumper uses crankcase pressure to move antifreeze from radiator to engine. Note wire clamps at all tube connections.

FULL-SIZE PLANS AVAILABLE . . . SEE PAGE



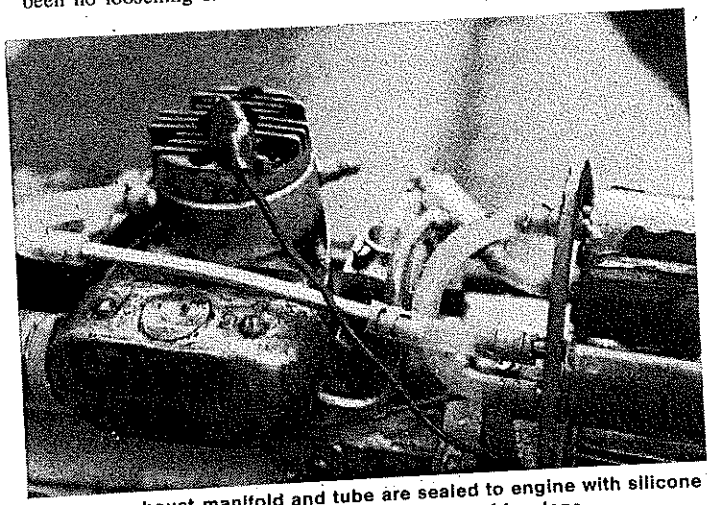
Drive shaft. Now here's where I had fun—and you will benefit from my experience. I started by using standard boat parts, off the shelf: 3/16-in. dia. drive shaft, screw-on universal, and front prop connection. Forget it! Then I started making drive shafts and various connection systems, all of which failed because setscrews and flats on the drive shaft just wouldn't hold. I finally made the ¼-in. drive shaft as shown on the drawings.

The connection at the rear of the drive shaft to the front universal part *must be keyed* as shown. The four big ¼-28 setscrews, alone, won't hold for more than a couple flights. The way it's shown on the drawings works fine, and there has been no loosening of the connection since the parts were keyed.

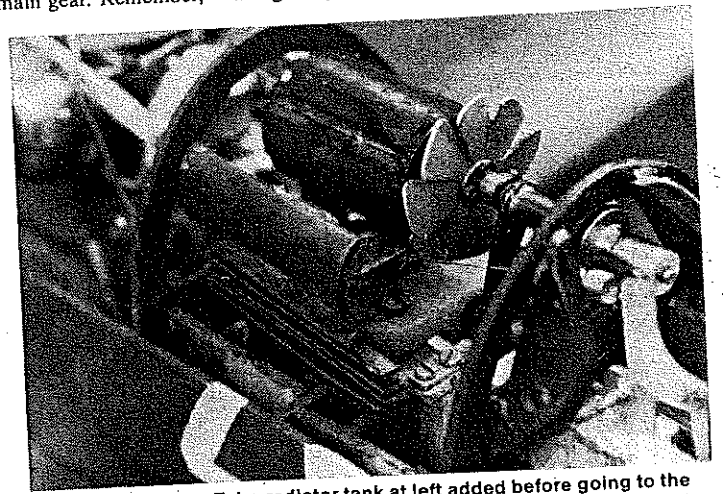
People are always asking about vibration with the long drive shaft. There are no problems here. There's no more vibration in this airplane than with a conventional engine/prop connection. In fact, the flywheel effect of the drive shaft seems to make things smoother than usual.

Retractable landing gear. As mentioned earlier, Goldberg retracts are used in the P-39. The nose gear strut will have to be extended in length as shown on drawing No. 1. The only other modifications were the addition of an extra helper spring on the nose gear and two more helper springs on the outboard main gear. Remember, we have centrifugal force to contend with on a Control Line model. The best way to check to see if you have enough strength to balance this force is to stand the airplane on its outboard wing tip, which will simulate one G of outward force, and operate and adjust springs until the gear works easily.

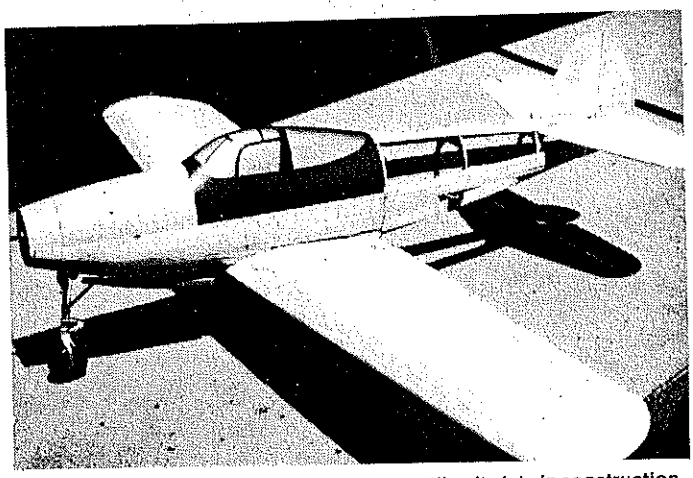
The landing gear operating servo is a Power Driver, manufactured by Wing Manufacturing Co. You should be able to order this through your local hobby shop. I modified mine to give it more power and travel by replacing the plastic jack screw with a longer brass-threaded rod. I also replaced the plastic gears with brass ones to give a higher gear ratio, and changed to a more



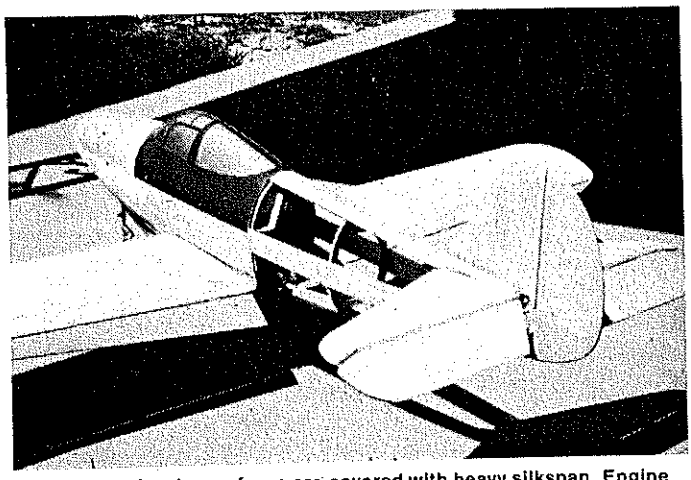
Tatone exhaust manifold and tube are sealed to engine with silicone sealer, to keep oil from contaminating inside of fuselage.



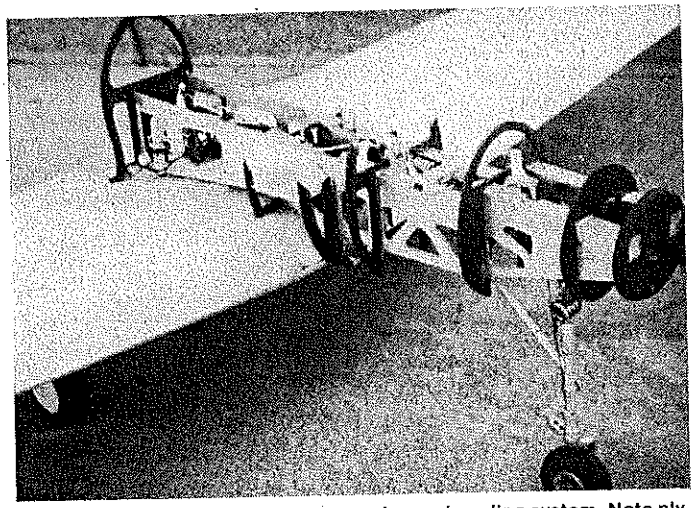
Fan and radiators. Extra radiator tank at left added before going to the 1981 Nats in Texas. Air passes over corrugated brass surface at bottom.



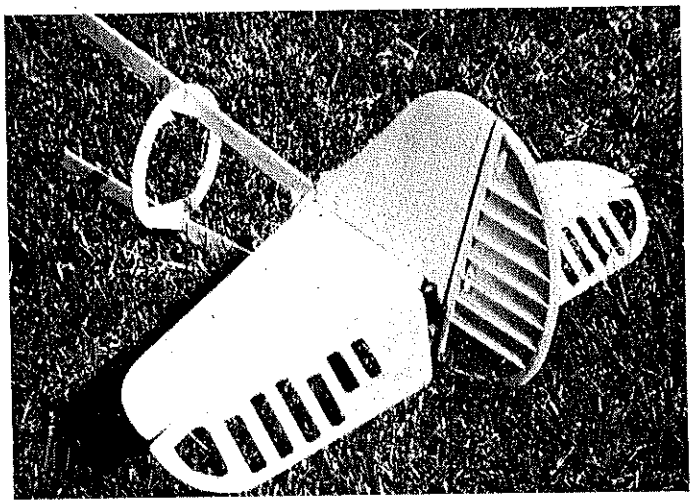
The aft fuselage isn't added permanently until quite late in construction. Elevator pushrod is installed and adjusted at this point.



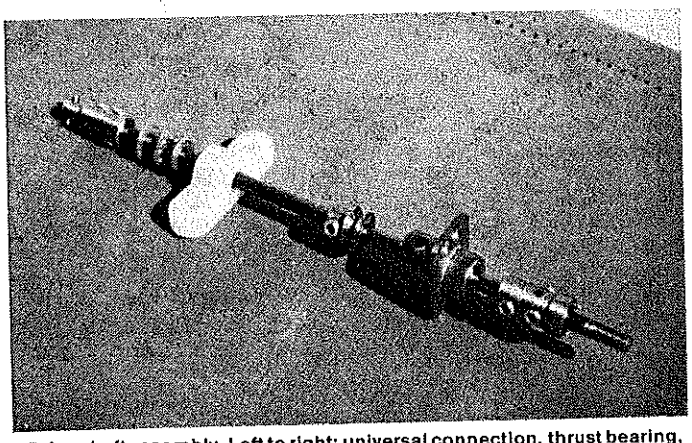
Rudder and elevator surfaces are covered with heavy silkspan. Engine and cooling system sit under the cockpit; bellcrank in wing.



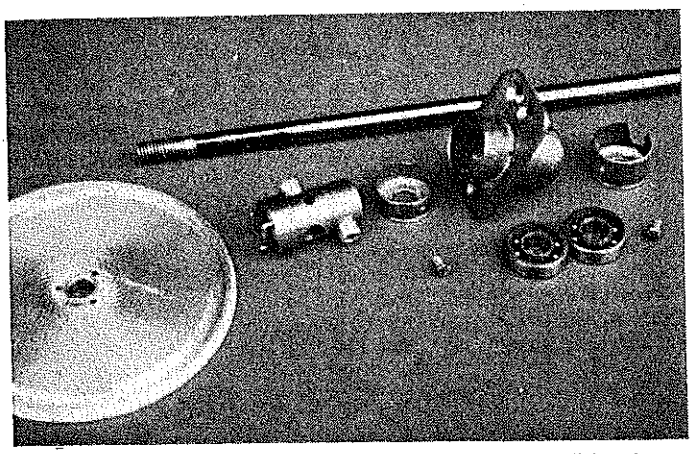
Forward fuselage ready to receive engine and cooling system. Note ply nose former, removable for access to forward drive shaft bearings.



Aft fuselage and tail, ready for joining to main fuselage. Plywood core and balsa rib construction is light, very durable.



Drive shaft assembly. Left to right: universal connection, thrust bearing, rear bearing block, pulley to drive radiator fan, front bearing, prop drive hub. This setup worked best of several tried.



Drive shaft and main front bearing disassembled. Two ball bearings used. Pins on prop drive hub match holes on prop spinner backplate.

powerful motor which I run on 6 volts. Operating all three landing gears off one servo takes a pretty powerful servo.

Another point to make here is that the gear retracts in near scale time instead of snapping or jerking up and down as you so often see on models. Flight judges should give you full points here for realistically operating retracts.

Control system. When you look at the plans and see the bellcrank located out in the wing, I know what you're going to say—he's out of his mind! Not to worry. This same system has worked perfectly in my Mustang for 11 years, and it works perfectly in the Cobra, too. The reason for this location is twofold. First, we can't have control lines running through the main gear wheel wells and interfering with things there. Secondly, it frees up that space inside the wing center section for our landing gear operating mechanisms.

The entire control system shown on drawing sheet No. 2 looks like Rube (not Carl) Goldberg, I know, but it works fine, and it allows us to do all of the following on only three control lines: release the parking brake when ready for takeoff, apply brakes when taxiing, advance and retard throttle, retract and extend landing gear at will, and operate the flight controls.

With this system you really don't need a helper to get started and fly. Just start the engine and let it sit there on idle with the parking brake set, go out and pick up the control handle, apply full up elevator to release the brake, and add a little power to taxi to takeoff position. Full down elevator applies the brake for stopping.

Electrical system. I don't know why people fool around with complicated mechanical and air-operated retract systems when something as simple as the one shown on drawing sheet No. 2 is possible. The key components are a good powerful servo and off-the-shelf stuff from a supplier such as Radio Shack. Of course this system wasn't possible until a decade ago when inexpensive mini diodes became available. These

allow reverse current to bypass the limit switches when operating the landing gear.

Also note that a master switch is shown in the circuit. This is absolutely essential to prevent accidental retraction of the landing gear and also to shut off the system when you may be adjusting lever throw, landing gear doors, etc. Please note, however, that you *must* turn it on if you want to retract the gear in flight. (This cost me dearly at the 1981 Nats when I overlooked it, in spite of a printed check list, and had to fly my best flight with the gear down. That blew a potential 20 points off a near-90 flight score.)

The electrical circuit scheme shows an exterior plug-in starting battery. However, since the drawings were made, I have eliminated the external starting battery completely. Instead, I just installed an extra pencell inside the plane which is turned on by an external switch and heats the plug continuously during flight. This gives an extra few hundred rpm at full throttle and no flood-out at *very* low idle. The battery lasts for half a dozen or more flights. Now, all we have to do to start is turn on the ignition switch and hit the starter.

Construction. Well, let's face it. To build this airplane you have to be half smart, half stupid, a good craftsman, and a lover of realism in Control Line flying. If you don't meet all of these qualifications, go on to the next article. For all who are still with me, here we go.

I don't have a whole lot to say about construction of the Cobra, because I detailed the drawings as complete as I could. Study the drawings, and they'll answer most of your questions.

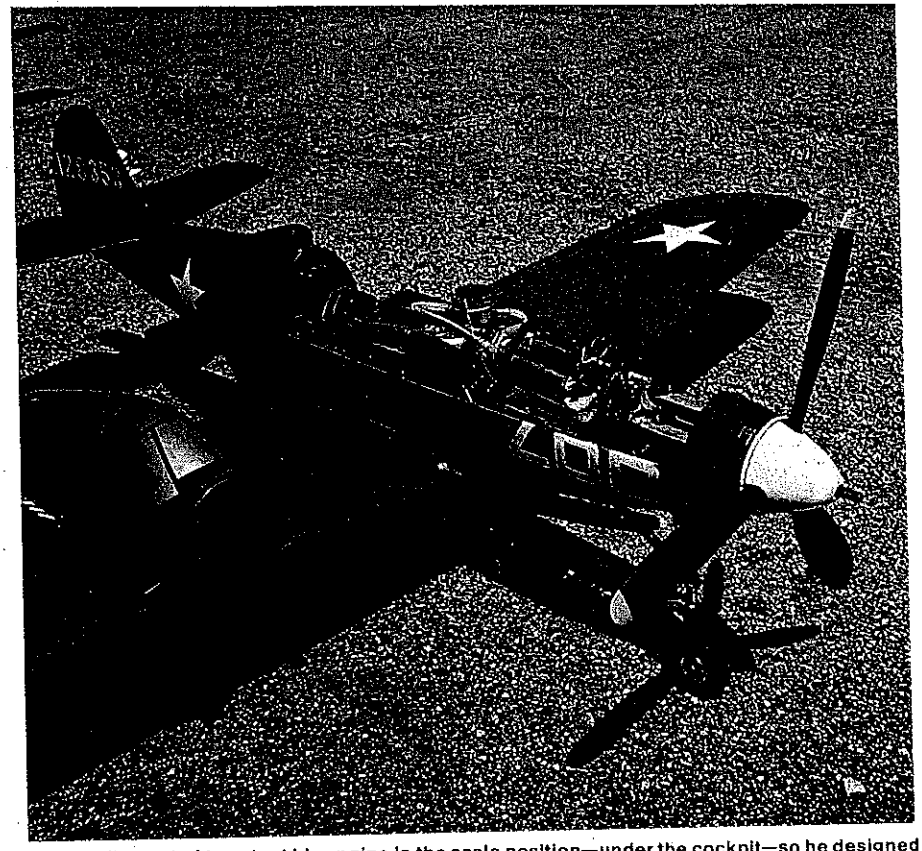
Note that the fuselage chassis is offset almost four degrees to the right. This was done for two very important reasons. First, it provides the necessary outward thrust for good line tension; second, it makes room for the exhaust manifold and exhaust pipe.

The wing is removable for two *very* important reasons. First, if you're going to a contest in one of those cramped four-wheel motorcycles that we have to drive these days, you can put the bird *inside* instead of having to strap it to the roof. The second reason for the removable wing is the most important: accessibility. On a Scale model of any kind, you have to be able to get to the operating parts and systems for repair and maintenance. You really don't want to have to cut into that beautiful fuselage or wing to get to a faulty servo, do you? That's why I've located the landing gear servo and other systems on top of the wing center section. If repairs or adjustments are necessary, just remove two bolts and release a couple of connections, and voila! There it is all exposed and ready to be fixed.

Wing construction is in the style of Al Rabe, which is a super way to build a straight wing. I use a couple of ⅜-in. O.D. aluminum tubes about five feet long to set the whole thing up. While the wing was still on the jig, I installed the landing gear. This makes it easier to check wheel alignment, strut length, etc.

I found it easier to build the fuselage back to former G and then mate it to the wing at this point, waiting until the very last to build the aft fuselage and tail section. You'll be picking the plane up and turning it over hundreds of times during construction, so why have the rear half of the airplane in the way during all this?

We all have our favorite ways to construct a fuselage, and I've seen 'em all—carved slabs, sheet, planks, fiberglass, molded balsa, etc. On this baby I ran across a composite method which worked out well. First, I cut 3/32 planking about 5/16 wide and went planking away. It's not all that hard. Then I rough-sanded and filled in all the bad places with DAP spackling compound (this is cheap and available from your local paint store.) This stuff is good, because it is water soluble and can be worked and smoothed into place with a finger dipped in water. After this glop dries, sand everything to final shape and apply 2-oz. glass cloth and polyester resin. After this has cured, sand smooth. Mix up a *thick* batch of DAP and water, and paint the whole fuselage to fill in any rough areas of the fiberglass job. Give it a final sanding, and spray on two coats of urethane paint. That's it. Lightweight, super strong and a beautiful finish.

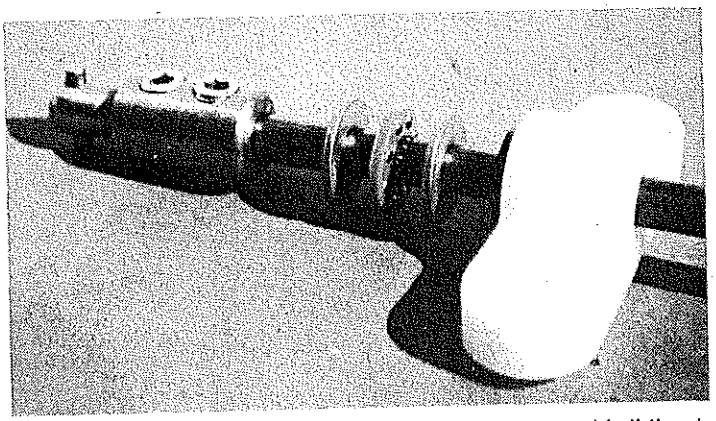


Jack Stolly wanted to mount his engine in the scale position—under the cockpit—so he designed and built a radiator system to cool the water-jacketed Enya .45 marine engine in his P-39. No wonder it took the Special Achievement Award at the 1981 Nats, presented by the National Association of Scale Aeromodelers! Several different drive shafts were tried and redesigned, too.

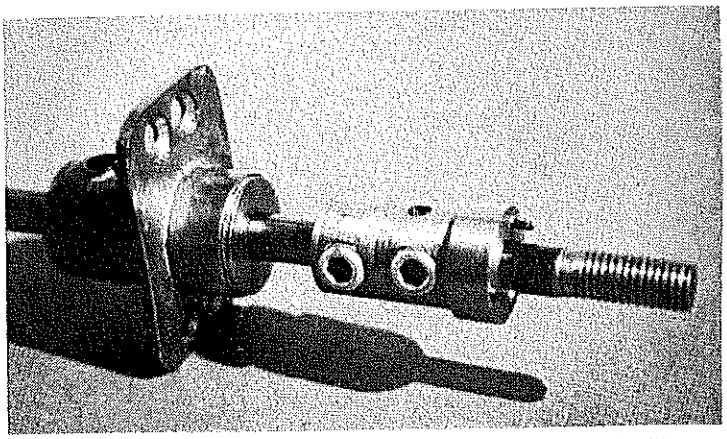
Flying the Cobra. Now comes the moment of truth. You've put all of this time and effort into building, and you're ready to get it into the air. White knuckles and shaky knees. "Non en persperiorum" (no sweat). This craft is a good flier.

When you're ready for takeoff, release the brake, and feed in power slowly until you feel the resistance of the retract switch against the throttle line. Let her build up speed for a half lap, and then gently ease in a small amount of up elevator, and she'll come off the ground in a most realistic manner.

Continued on page 132



Rear of drive shaft, showing universal with drive pin and ball thrust bearing. Nylon rear bearing block takes thrust, or drive pin would pull out of universal joint.



Front end of drive shaft shows main front bearing and prop drive hub with pins that engage prop spinner backplate.

the formation of a national organization for Control Line. A new try at a national coalition or organization will mean sacrificing some speed of progress for others and a great deal of individual identity for the groups (and possibly for certain of the leaders). In contrast, the Speed and Team Race fraternities have virtually nothing to lose by participation and a great deal to gain. It would be nice to see some type of organization moving to improve the declining Speed fraternity. If you are interested, send a S.A.S.E. to *Gazette*, 707 2nd Street, Davis, CA 95616.

Contest. Before ending, I would like to mention the Northwest Regionals at Eugene, OR May 29 and 30, 1982. This is the big shoot-out for the Northwest. Mike Hazel is the CD, and they are planning to have all Speed events for this year. Now is the chance for all you Speed modelers to support your event. For more information, send a S.A.S.E. to Mike Hazel, 1040 Windemere Drive N.W., Salem, OR 97304.

The next two columns will be a special FAI Speed series. It will cover both model design and engine setup. Happy Flying!

Gene Hempel, 301 N. Yale Dr., Garland, TX 75042.

P-39 Airacobra/Stolly

Continued from page 69

Right after breaking ground, push the throttle the rest of the way—and the gear is coming up fighter jock style. After initial climb-out, pull the throttle back to three quarters for cruise (use full power for climbing maneuvers). This makes for a more realistic flight. No tricky stuff and very stable.

I haven't looped it yet, but it tells me that it can, indeed, do a nice wide, realistic loop. My Mustang is the same weight with identical areas and movements, and it goes the loop in a most realistic fashion. (We're not trying to imitate the Stunt boys, because real airplanes don't do it that way, anyhow).

On my first flight with the P-39, I left the front cowling and cockpit section off to be sure of adequate cooling. Even without this extra nose weight it was still a three-wheel race car and took a whole lap before it built up enough speed to get into the air. Nose heavy! I moved the batteries back to station G, and it balanced perfectly. Because of the weight of the nose gear moving to the rear after retraction, it's even a better flier with the gear up.

Landings are easy with about half power. As soon as the main gear touches down, the nose drops, and you are finished flying—built-in no-bounce system. That's the way it's supposed to

be.

Some philosophy. My first Control Line plane was a Jim Walker Fireball in 1942. (Black market purchase with paper route money.) Several years and many models later, I breezed through Air Force Pilot Training with much help from my model flying experiences. In fact, while stationed at many remote and far-flung Air Force bases, I always found that many of my fellow pilots were model builders.

To me, Control Line flying is the nearest thing to flying a real plane. You have the feel of the plane in your hand. With throttle, brakes, retracts, and a heavy Scale plane, it's the same old feeling as bringing a real bird down final approach for a landing. I'm not knocking RC, but to me this is much more fun. Besides that, you get the satisfaction of designing and building your own bird. I feel sorry for guys in other modeling fields where they miss half the fun and satisfaction of being a modeler.

Recently my P-39 took first place at a Cincinnati, OH contest. I was struck with a certain amount of pride when the judges asked me which parts of the plane were not actually made by me, as I could truthfully answer, "Only the engine, wheels, prop and spinner, sir." My greatest satisfaction in modeling came at the Texas Nats last year when the P-39 won the NASA (National Association of Scale Aeromodelers) Special Achievement Award. This made it all worthwhile. To give credit where credit it due, however, none of this would have been possible without an understanding, helpful wife and "pit person." Thanks, Naomi.

Documentation. If you intend to compete with your P-39 Airacobra, you'll need three-view drawings, etc., as called for by the AMA rule book. One source is the *Historical Aviation Album* published by Paul R. Matt, P.O. Box 33, Temple City, CA 91780.

Space Shuttle II/Hux

Continued from page 72

the shuttle you'll find it to be one of the most interesting models around. One friend of mine has described the shuttle as a controlled falling body. That's pretty accurate. The design resists stalling, preferring a level sink. This larger lightweight model looks the most like it is actually flying rather than falling. Both this and the smaller one will immediately upright themselves from any attitude in flight.

Enough of Rockwell's design. Since many of you have expressed an interest in the larger shuttle, here are the plans. These 1/48 plans are quite similar to the original 1/72 drawings, but do pay careful attention to the differences. Use