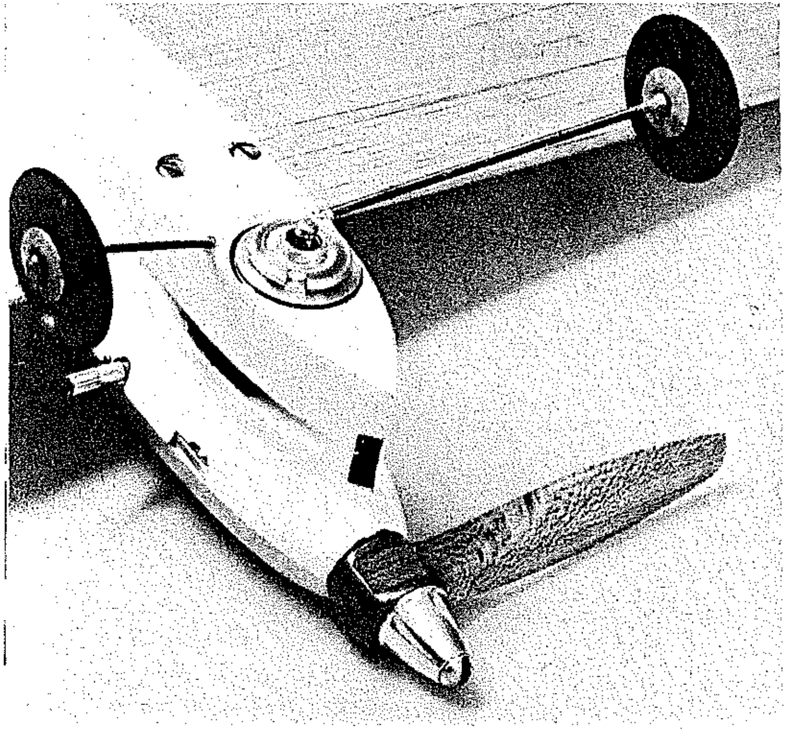

EAGLE 1

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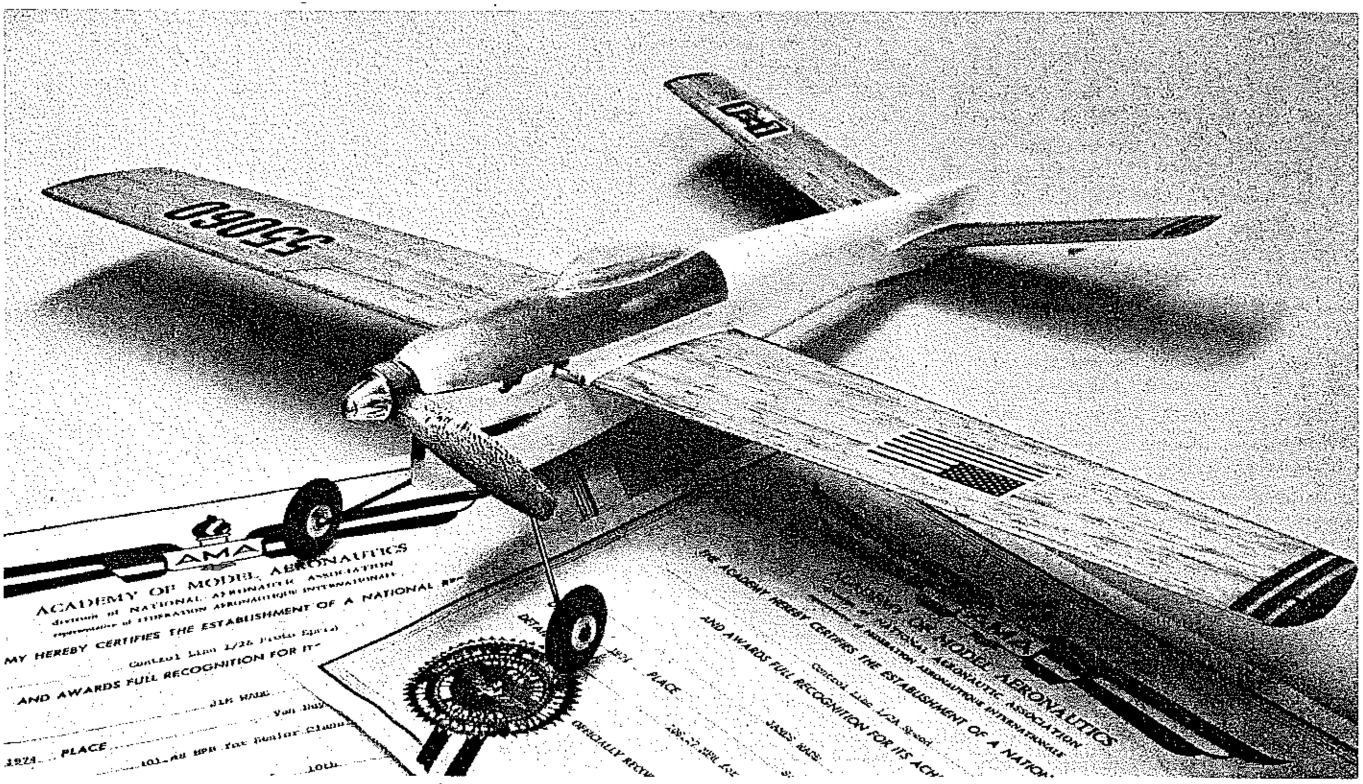
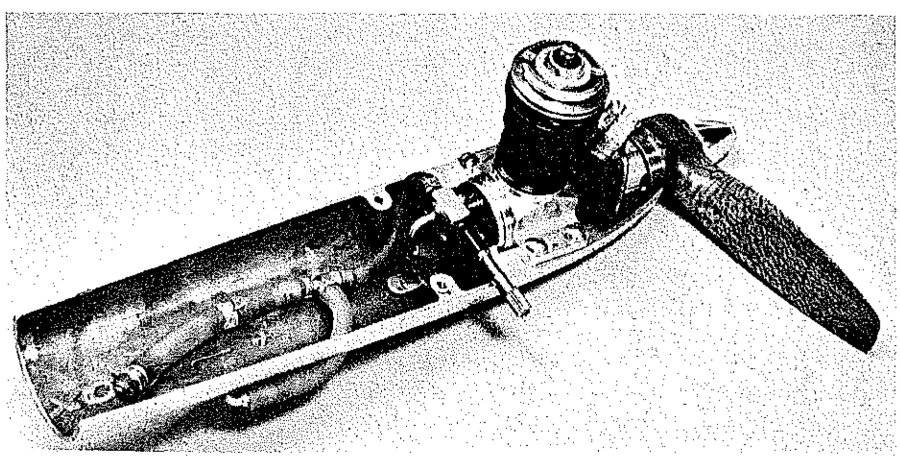
Together with a plan of the record holding model and comments on fuels, props and engines, the author reveals many valuable Speed 'secrets.'

Jim Wade

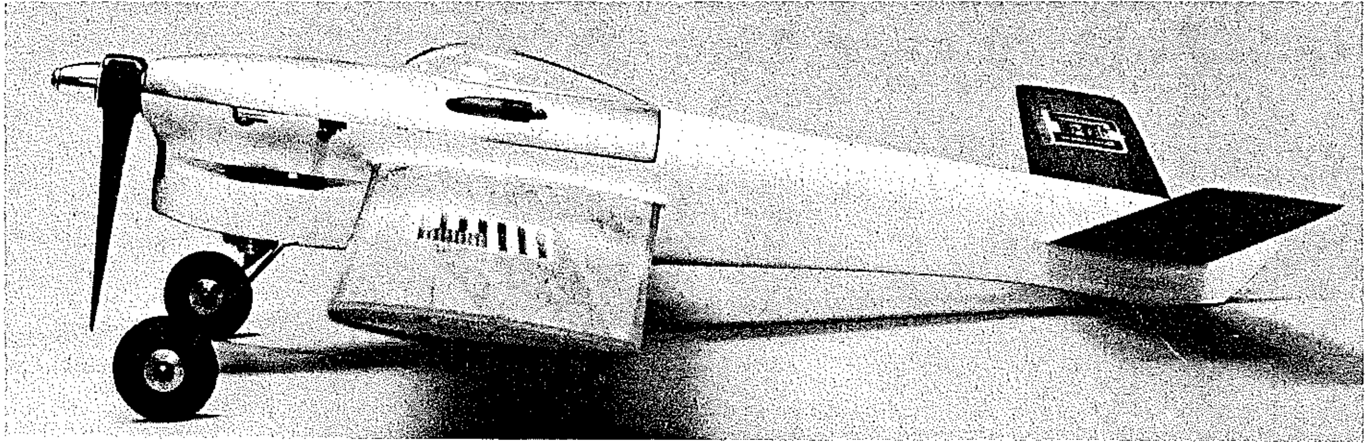
Left: Bottom view of cowl. Note bleeder exhaust opening and front air intake offset to one side. Bolts run up through pan.



Above: Eagle 1 holds both Senior 1/2A Proto Speed and 1/2A Speed record simultaneously.



Right: Record setting engine and prop in cut Cox speed pan. Note outside fill connections which avoid disassembly of model to fuel.



Side view of the record holder attests to the sleek and very clean lines and detail needed when you wish to go very fast. The fuselage is fiberglass and is commercially available.

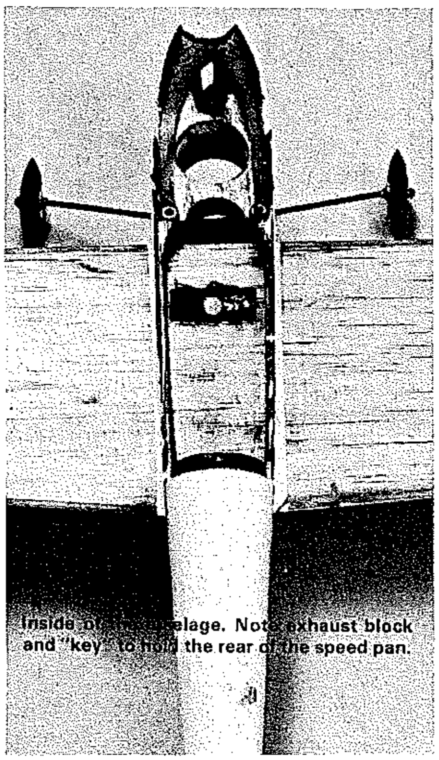
IT WAS IN 1974 that the two so-called unachievable Speed records were reached and surpassed. The 200-mph barrier in C and jet and 100-mph in the ½A Proto event.

The author has devoted the last two years to breaking the 100-mph barrier in ½A Proto. All the pieces finally fit together on December 1, 1974 when Eagle I set the new Senior Proto record at 101.48 mph! This surpassed my existing record of 98.64 mph, set with the same airplane earlier in the year. Eagle I now has the distinction of being the *first* ½A Proto (in any age classification) to break the 100-mph mark officially.

The lefthand propeller that had held the Proto record (and the Senior ½A Speed record at 108.27 mph) didn't seem to be accelerating fast enough in the first lap. So a prop with more blade area was tried. My hunch paid off; the new prop was three mph quicker to set the record. Lefthand props seem to be the accepted standard in ½A Proto, as all the current ½A Proto records (Jr. Sr. Op.) were set with lefthand props (at the time of this writing).

In this article I will cover all of my so called "speed secrets." Apparently many people do not agree with giving out their speed secrets. But, that's the way we all got started: someone cared enough to let us in on their years of experience. I've been fortunate enough to have had some of the most respected names in the speed circles (Dale Kirn, Jim Nightingale, John Newton. Jerry Thomas, Jerry Bradshaw, and many more) help me get started and contribute their ideas.

The main considerations in the design of the Eagle I were: (1) light weight—the quickest one out of the starting gate wins the Proto Speed event and it takes a light airplane to do it, under five ounces (the Eagle I weighs 4½ oz.); (2) smooth flying characteristics—anything other than straight and level flight will slow you down; (3) durable—the only way to find out how certain variables such as props, fuel, or engine changes will effect the Proto speed is to try them in the air and that means lots of test flights; (4) simple and functional—that's the key to being able to duplicate your performance. If something goes wrong you should be able to find the problem quickly and fix it.



Inside of fuselage. Note exhaust block and "key" to hold the rear of the speed pan.

The fiberglass/epoxy fuselage was used instead of slightly lighter balsa because of its superior strength, quick building time and extra room available inside. This fiberglass fuselage is now available in limited production. Write me for further details.

The tie-down system used to hold the Cox pan to the fuselage is a little different, but seemed the easiest way around several problems. If the tie-down bolts were brought straight down, either the shape of the fuselage or the exhaust outlets would have to be changed.

Actual test flights have proven that the angles and shapes shown for the exhaust outlets are essential to get the exhaust out of the engine/airplane. Then, done as shown, it's worth two-three mph. The exhaust ports of your engine should be facing to the sides (not front and back). This keeps the exhaust gases from recycling back into the engine (through the venturi or sub-piston induction). Also the front air intake (cut out in front of cowling) should be just big enough to get air to the venturi, not to the cylinder. This seems to keep the cylinder temperature constant in all kinds of weather.

The wing and tail are balsa lined with spruce. The selection of wood is important to keep the weight down. But, weight isn't as important as strength in the tail, so the hardest balsa you can find should be used there. A symmetrical airfoil section is used on the tail and the incidence set at 0°.

The airfoil on the wing is symmetrical with .015 positive incidence at the root and the tips at 0° incidence. No wing-tip weight is used because of the lefthand prop/engine combination.

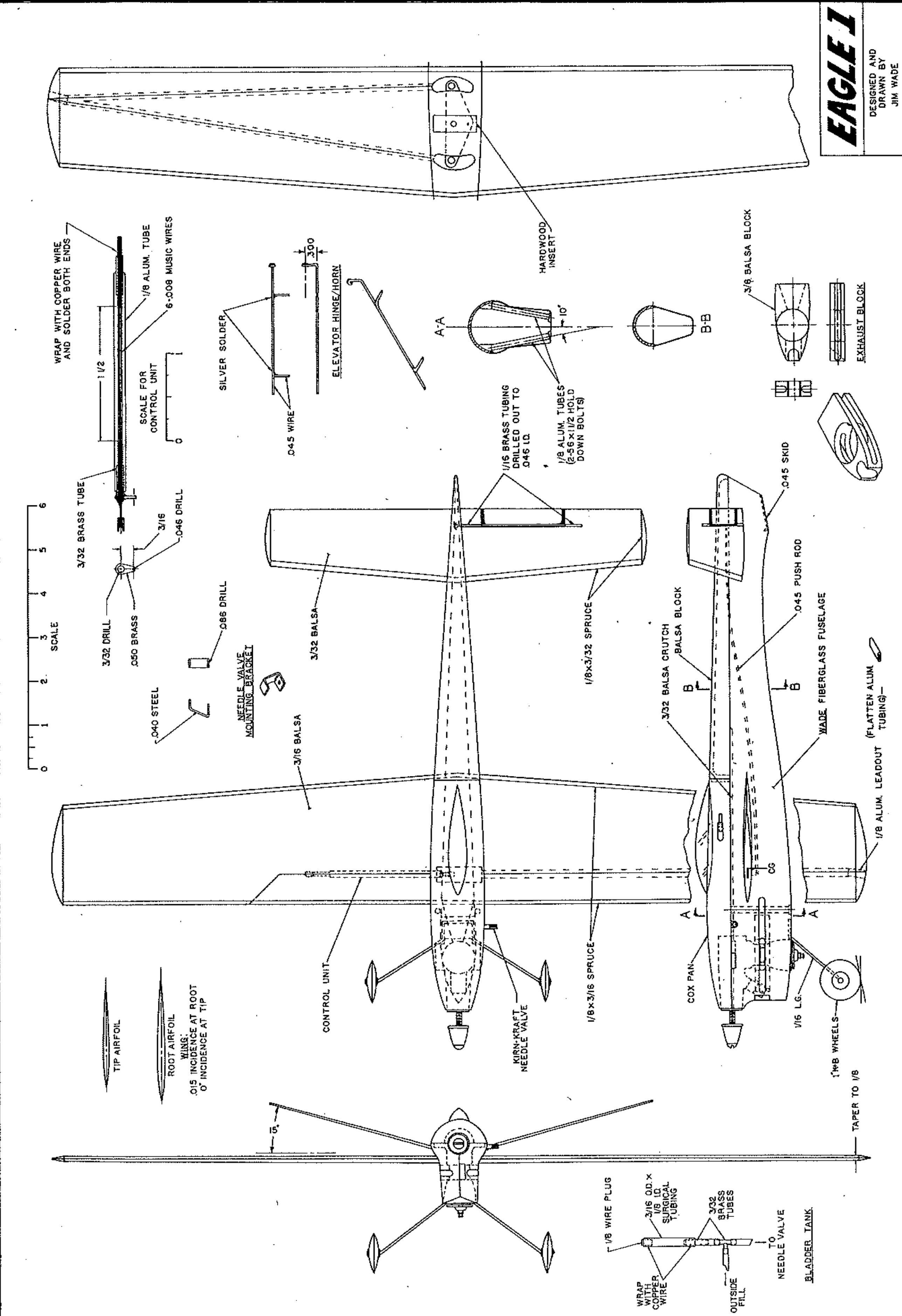
The hinge system used on the elevator is a little different. It consists of .045 music wire going through 1/16 O.D. brass tubes at each end for bushings. The brass tubes will have to be drilled out to .046 I.D. (#56 drill). The elevator horn is made by bending the .45 wire around another piece of .045 wire in two-three coils. Then grind away the coils until one is left. Elevator horn height is important and should be made exactly as shown for smooth control response.

A home-made torque unit was fabricated because a more durable and lighter weight unit was desired than the H & R ½A torque unit; however, if you're not out to set records the H & R unit will work OK.

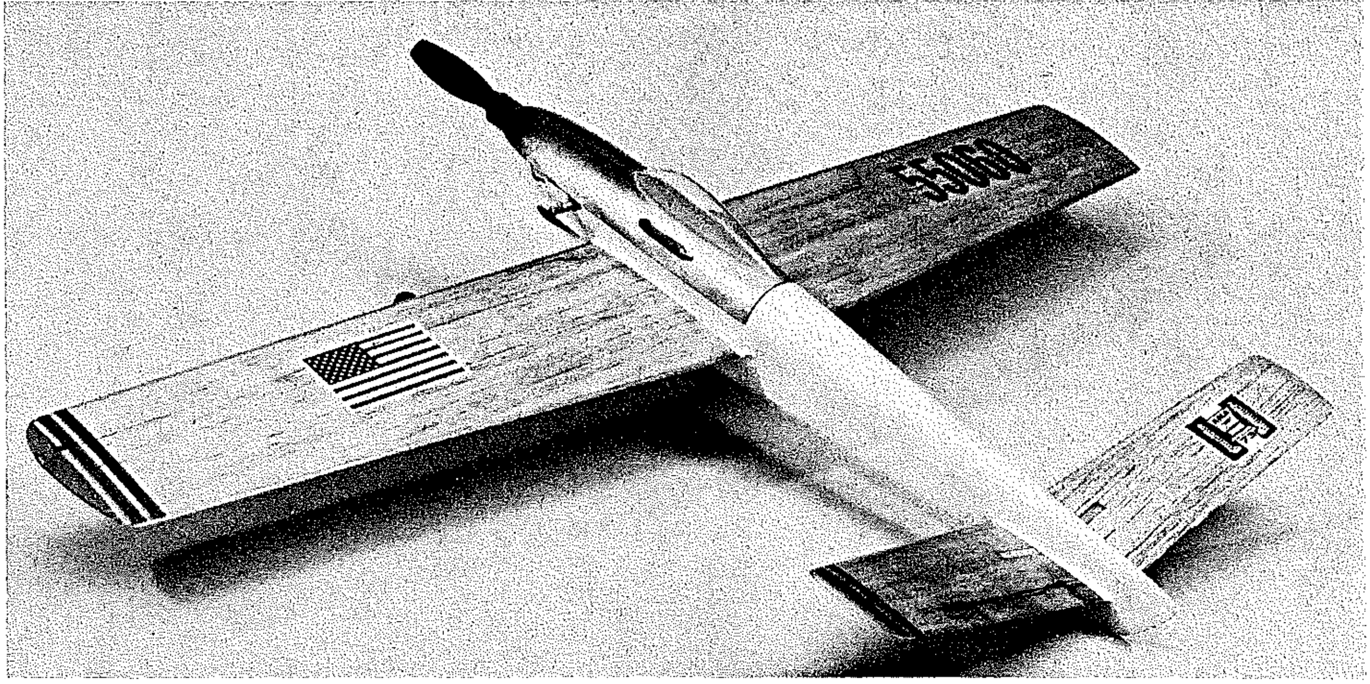
Both control systems are shown on the plans—Monoline and two-line. The Monoline system is less trouble to set up and fly. Now that tied-lines have been outlawed Monoline still has the slight speed advantage.

A bladder type tank was used to save weight. Also an outside fill is used to keep from pulling the airplane apart to refuel—which can come in handy on the flight line. The bladder is made of thin-wall surgical tubing 3/16 O.D. × 1/8 I.D. About 1 in. in length. Most medical supply stores carry the surgical tubing. A "T" inside the airplane is used for the outside fill. The "T" consists of two 3/32 O.D. brass tubes soldered together at right angles and a 1/16 hole drilled between them.

There are two reasons for not using a metal pressure tank: (1) A metal tank weighs more than a bladder, and weight—even ¼ oz.—is important; (2) when experi-



EAGLE I
DESIGNED AND DRAWN BY JIM WADE
HARDWOOD INSERT
WRAP WITH COPPER WIRE AND SOLDER BOTH ENDS
1/8 ALUM. TUBE
6-.008 MUSIC WIRES
1 1/2
SCALE FOR CONTROL UNIT
3/32 BRASS TUBE
3/16
.046 DRILL
3/32 DRILL
.050 BRASS
SILVER SOLDER
.045 WIRE
.300
ELEVATOR HINGE/HORN
A-A
10°
B-B
1/8 ALUM. TUBES (2-56×1 1/2 HOLD DOWN BOLTS)
1/16 BRASS TUBING DRILLED OUT TO .046 I.D.
3/8 BALSA BLOCK
EXHAUST BLOCK
.045 SKID
SCALE
.040 STEEL
.086 DRILL
NEEDLE VALVE MOUNTING BRACKET
3/32 BALSA
3/16 BALSA
1/8×3/32 SPRUCE
3/32 BALSA CRUTCH
BALSA BLOCK
.045 PUSH ROD
WADE FIBERGLASS FUSELAGE
(FLATTEN ALUM. TUBING)
1/8 ALUM. LEADOUT
CG
CONTROL UNIT
1/8×3/16 SPRUCE
KIRN-KRAFT NEEDLE VALVE
COX PAN
1/16 L.G.
1" WB WHEELS
TIP AIRFOIL
ROOT AIRFOIL
WING:
.015 INCIDENCE AT ROOT
0° INCIDENCE AT TIP
5°
TAPER TO 1/8
1/8 WIRE PLUG
3/16 O.D. × 1/8 I.D. SURGICAL TUBING
3/32 BRASS TUBES
TO NEEDLE VALVE
WRAP WITH COPPER WIRE
OUTSIDE FILL
BLADDER TANK



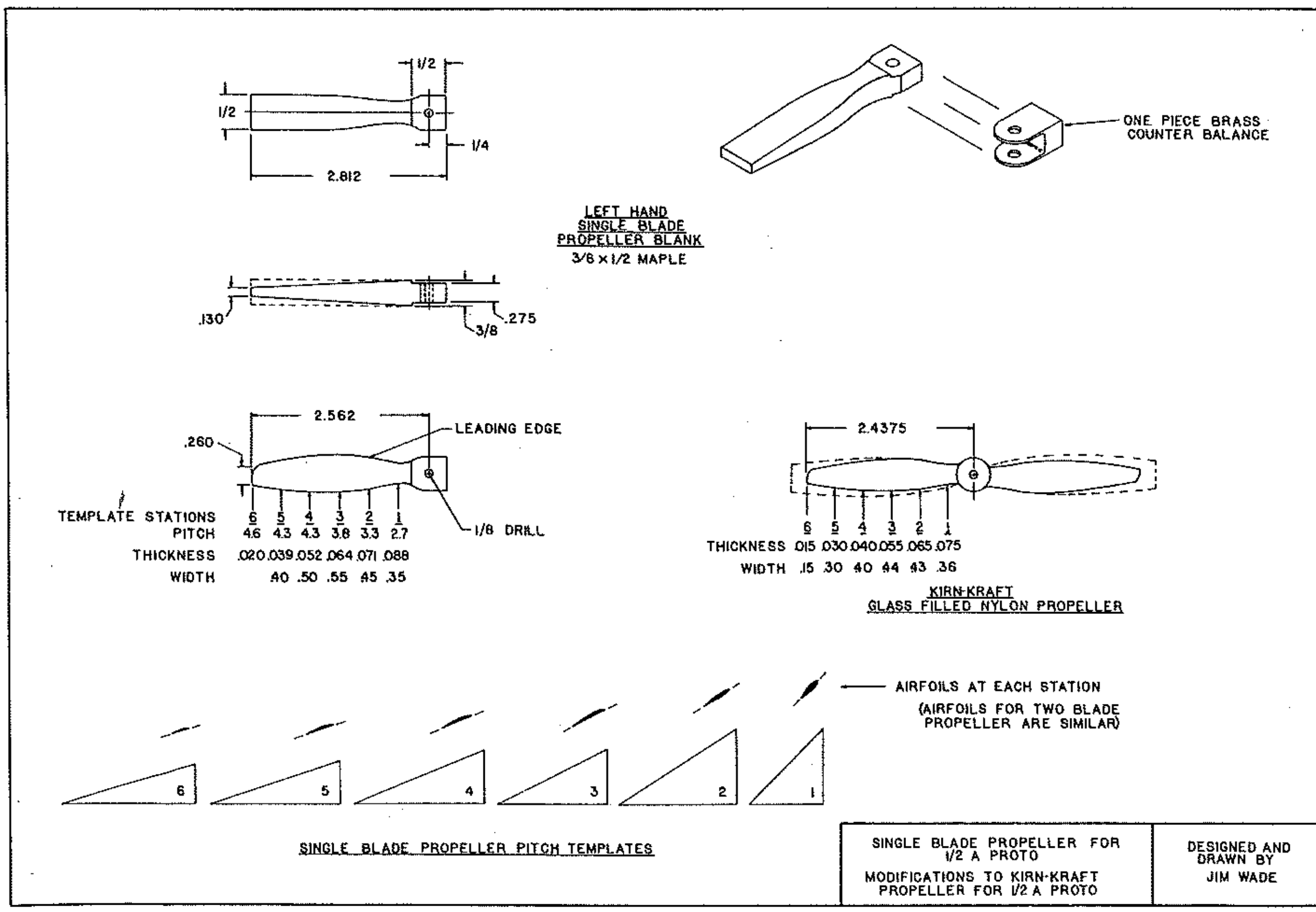
Rear quarter view of the Eagle 1 showing the large wing required in 1/2A Proto event. The "100-mile" barrier existed until December 1, 1974 when the plane hit speed of 101.48 mph.

Eagle I

menting with different weight props, it's difficult to get consistent engine runs with a metal tank. For instance: if you use a heavier than normal prop, the added weight at the nose would push the nose out, causing the centerline of the tank (in relation to the venturi centerline) to be more inside; which would cause the engine to run rich in flight. Switching locations of the tank within the fuselage will affect engine runs during flight. The more the tank is located to the inside of the flight circle centerline the richer the engine will run in flight. The further outboard of the centerline, the leaner it will run in flight.

The Dale Kirn remote needle valve assembly and a fuel collector ring are used so everything can be enclosed easily inside the cowling. The needle valve is mounted on a steel bracket that is soldered to the needle-valve block and bolted/glued to the pan.

If the alignment between the wing-tail-engine is correct you should come up with a very stable flying airplane. But that isn't enough—the fastest one off the ground

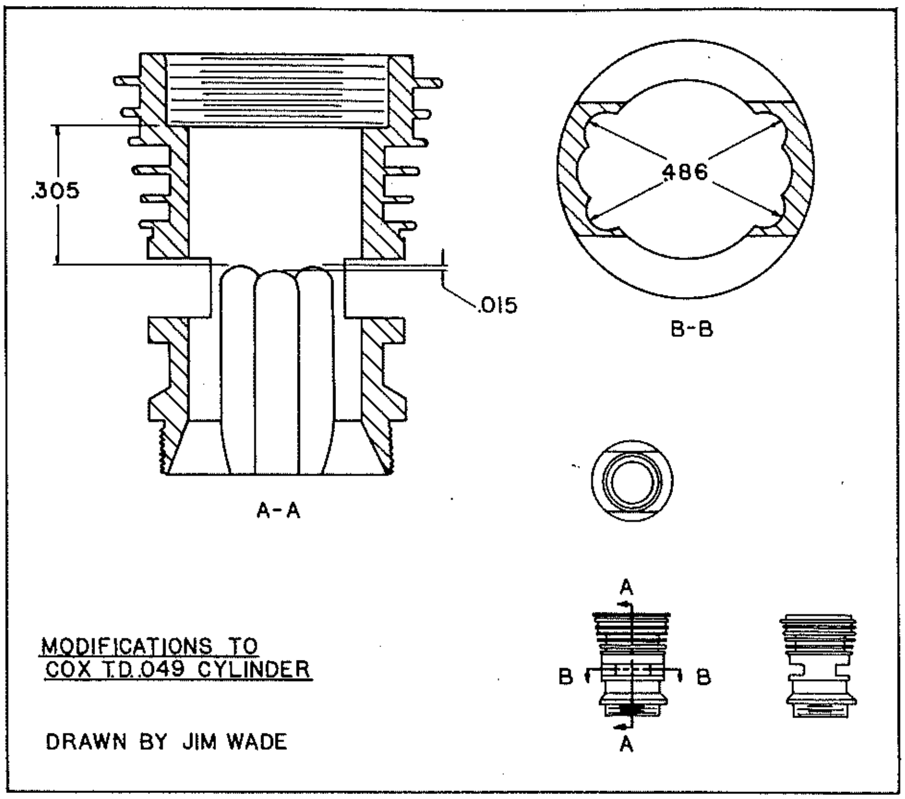


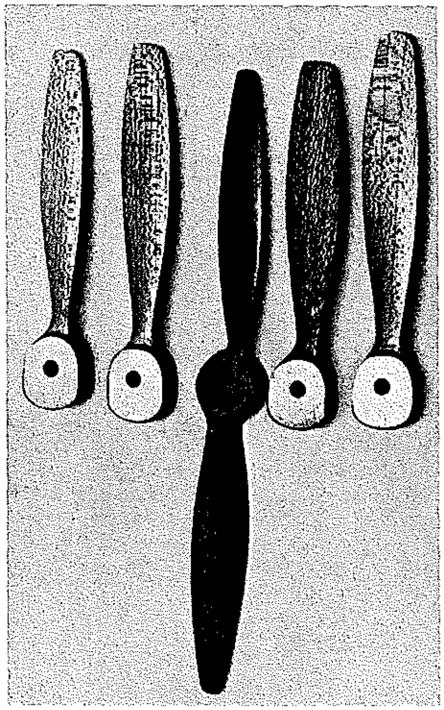
and flying smooth will still be the winner. So anything you can do to achieve that will help (but not without many hours in the practice circle with a pylon).

That covers the airplane fabrication part.

Props, Fuel and Engine

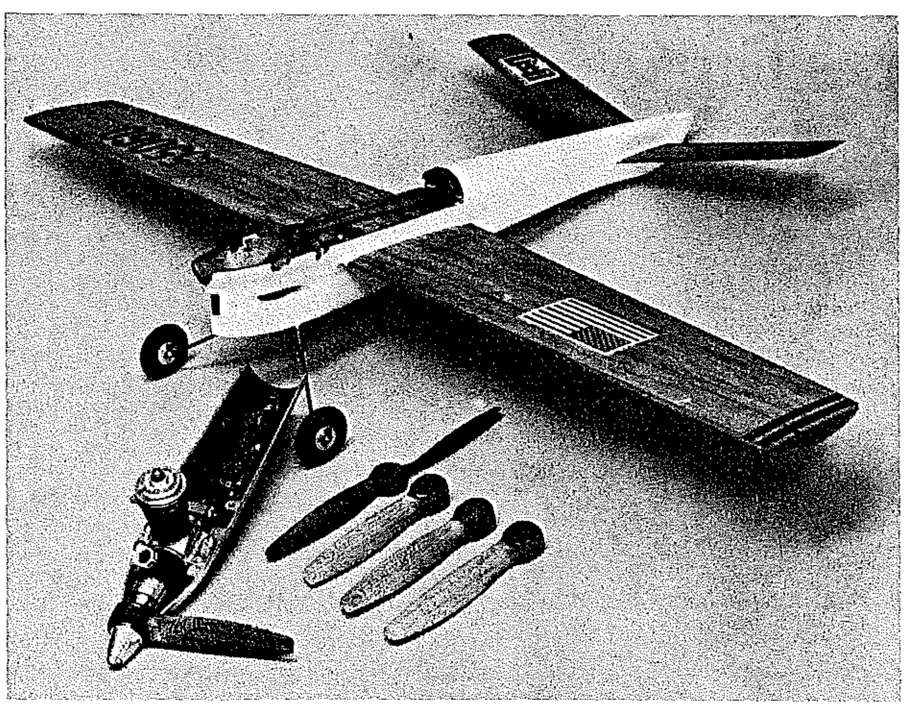
All Cox T.D. .049 engines are created equal. But, some are more equal than others. A few simple modifications and some time spent checking some critical areas can turn your run-of-the-mill production engine into an all-out record-setting engine.





Venturi: In order to fit the engine inside the fiberglass fuselage the venturi should be turned down to .300 O.D. For the record flight the venturi was opened up to .160 I.D. But, for more constant engine runs the I.D. should be kept around .140-150 I.D.

Left: A variety of different props is needed for varying weather conditions. Below: Eagle 1 with engine and pan removed. Lefthand props seem to be the accepted standard with 1/2 Proto since all records have been set with them.



Crankcase: The mounting holes (in the lugs) are punched out at the factory. This process sometimes twists the lugs slightly. So the bottom of the lugs should be milled to true them up. If this isn't done you could bind up a perfect fitting engine when bolted down on the pan.

The area where the back cover seats should be lapped flat with #400 wet or dry sand paper to insure that the back cover will seal.

If you use a mechanical or electric starter the front of the case (where the fiber washer will seat) should be lapped, to keep from galling the aluminum. Also some straight oil should be put in the front of the engine, before starting, to make sure there's lubrication when first turned over by the starter.

The plastic carburetor housing should be replaced often, as it tends to change shape with certain fuels and weather conditions, causing air leaks.

Crankshaft: The crankshaft and crank pin should be lightly polished with a felt wheel and polishing compound. This won't give any rpm gain but will extend the main bearing life.

There doesn't seem to be any difference in rpm between the different Cox crankshafts—the 1973 shaft had a larger I.D. hole in the shaft, .194 I.D. compared to the 1974 shaft, .177 I.D. My engine uses the 1973 shaft. But records have been set with the new shaft. The Open ½A Speed record was set with a 1974 shaft.

Crankshaft fit should be very "free." Usually, when the engine starts throwing some oil out the front, the crankshaft fit is just about right.

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Shark *(continued)*

extended to the landing position. Our only attempt resulted in liftoff after just 10 ft. of roll, but with a requirement for full right rudder to prevent an auger-in. Landings are soft and easy, with no tendency to float with the flaps moved to a landing position (at least 25°, but no more than 30°). Attempts to land with the flaps coupled, *i.e.*, travel of ± 15°, results in floating. With the flaps set at 25° in calm air, I have demonstrated stable approach and smooth touchdown from 200 ft. out *with my hands completely off the transmitter!*

If you like things different and exciting, you will enjoy the Shark 45 RC.

Construction

Because this is not exactly a beginner's model, we won't present step-by-step instructions. All wood parts are identified or coded on the plan so that, if you "reconstruct" a kit from raw materials you can mark the parts with a felt-tip pen for easy finding when you build. The wing is built exactly per the plans. However, don't use the control line plans, since one wing panel is a rib bay longer than the other. Not only will it look funny, but you'll also get bad roll trim! While the plans show the forward fuselage doublers laminated from several layers of ⅛" balsa, one may choose to use a single, thicker piece (say 3/8"), then taper as shown at the aft end. Complete the fuselage, attach the horizontal stabilizer, that beautifully long canopy fairing, dorsal fin, and the vertical stabilizer. For securing the hatch, use a 4-40 bolt tapped into a maple block at the front, combined with a dowel peg at the aft end.

Our model's fuselage was covered with silk and dope. One problem was encountered: The silk pulled away at the glue joint that runs the length of the dorsal fin. This is best overcome by slitting the silk and doping it down tightly at the junction. Where the gap results between the silk edges at the juncture, use resin and micro-balloons to form a small fillet.

We recommend that the fuselage be covered before the wing is installed and wing fillets added. With the wing aligned and epoxied in place, use epoxy or resin and micro-balloons to form a fillet. Cover the wing and horizontal stabilizer with Monokote or other heat-shrink covering. Be sure to cut and form a straight-edge at the root end. Mask this straight-edge, as well as the covering, then proceed to fill and finish the fuselage with your favorite finishing materials.

Acknowledgments: To Frank Williams, for drawing the plans; Bill McLaw, for the photos; Hobie Steele and Jack Dorman, for aid in construction. I hasten to add that all of the original was built by the author, but the model crashed as mentioned earlier. We also acknowledge the original beautiful Shark 45 design by Lou McFarland.

Eagle I/Wade

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Piston/Cylinder: The modification that seems to do the most good is changing the bypass timing and depth (see sketch). The *height* of the "outside" bypass grooves should be raised to .305 down from the glow plug shelf. Leave the middle groove alone. The *depth* of the outside grooves should be .486 measured diagonally. Again, leave the middle groove alone because it's already too deep. This should be done on a mill with an ⅛" ballend end mill. If you don't have access to a mill, a Dremel moto tool with an ⅛" carbide cutter will do the job.

The ball socket area of all Cox engines should be checked. If there is more than .003 play, the ball socket should be re-set with the Dale Kirn tool. After the engine is broken in and ready to run 70% nitro, the ball socket shouldn't have to be re-set, but still check it occasionally.

Piston/cylinder fit is very critical for top performance. A new piston/cylinder should be set up so the piston will slide up the cylinder about 1/32 above the glow-plug shelf before it sticks. After it's been broken-in this should increase to about 1/16-3/32 above the glow-plug shelf. All parts should be dry when checking piston/cylinder fit.

Varnish on the cylinder walls should be checked often during break-in and after *every* flight at a contest. This can be checked by holding the cylinder up to the light. A brownish color on the walls indicates varnish (caused by castor oil and some synthetic oils). To remove the varnish use an SOS pad.

The best break-in procedure seems to be: three to five minutes of ground running (short runs—1 minute at a time is best), then lots of flying time with about 30% nitro fuel and a small prop such as the Cox 4½ × 4 lefthand prop.

The fits I've described are all a matter of judgment on the engine builder's part. So, just let this be a guide and develop your own method for finding the fits.

Glow plug: The new type glow plugs are about 700 rpm faster than the old trumpet shape plugs, because of the increased compression and slightly different combustion chamber shape (cone shape and small squish band). Some people find a small gain in power by taking .015 to .020 off the bottom of the new plugs. I haven't, and the danger of bending the connecting rod (if the engine is flooded) isn't worth the possible small gain. The record flights were made with a stock plug with one .005 gasket.

Fuel: I've come up with a basic fuel that has worked well in all the weather conditions over the past two years. The "trick" synthetic oils have been tried, and I found it's still necessary to run some castor oil to keep things together. So, you can run your own trick oil but still run 4-5% castor oil. Here's the fuel used on the record flights: 70% nitro, 5% castor oil, 12% your favorite synthetic oil, 13% propyline oxide. This fuel seems to work best in the morning air while the humidity is still "high" (35-50%) (Calif. weather) and with the temperature around 72°.

Over the past two years I've come up with two lefthand props for Proto. One is a two blade cut from the Dale Kirn glass-filled nylon prop. This prop should put you in the 95-mph Proto time bracket. I always use this as a test flight at the contest to see how the weather is and if everything is working right. If the Proto speed isn't around 95 mph then something is wrong and it's time to find out what before you waste an official flight. The glass filled nylon is nice to work with; a rough file and knife are all that's needed to shape the prop. The outline shape is sanded first on both blades, then shape and thin the airfoil as shown on the drawings. Don't touch the bottom (backside) of the prop, just file the airfoil on the top (frontside) of the blades. The prop may seem a little thin but it was designed to flex. A couple of things to be careful about: the leading and trailing edges should be very sharp, and the high point of the airfoil should be about 25-30% back from the leading edge. To get the final finish on the prop use a knife blade to scrape the surface until smooth, then balance very carefully.

The second prop is my all-out effort and is worth 5-6 mph over any two-bladed prop I've ever tried. It's a wooden single blade of 5.124 dia. and progressive pitch up to 4.6 at the tip. The low pitch and large diameter is what gets you off the ground fast. Then in the air its designed to increase in pitch to give you the fast top end. This prop is carved out of 3/8 × ½ maple motor mount, and the counter balance is machined from brass. It's not difficult to carve a prop, just a little time consuming to do it right. First, the blank is cut to shape (as shown). The back of the blade is shaped first. This is done by cutting the wood away diagonally from the bottom back edge of the blank to the opposite side of the top of the blank. Before you go too far start checking the angles with the pitch gauges, and be very careful to keep the bottom half of the airfoil as shown. The top (front) side is done after the backside is completely finished. Cut away most of the excess material and finish the blade shape. Now the airfoil can be shaped and thinned, checking often to make sure the thickness and high point are in the correct place. The counter balance should be epoxied on after the blade is finished, then several coats of epoxy rubbed into the wood to protect it from fuel and chipping, because of the thin wood. The counter balance is then cut and slowly filed away until balanced. The static and dynamic balance should be watched very closely. Static balance is: having both sides of the prop balance out each other. In this case the counter balance should offset the weight of the blade. The dynamic balance is: keeping the center of weight of the blade and counter balance on the same center line. (side view, top view).

Both props were designed to work best in "high" California humidity (35-50%) usually in the morning air. So, if you like to put your flights in later in the day, something with more blade area would be a good idea.

That covers all of my so-called speed secrets. All of these ideas should be tried and maybe changed slightly to fit your situation before they can be of any benefit to you. (Jim Wade, 1853 Yettford Road, Vista, Calif. 92083.)

Single blade propeller blank/counter balance and finished prop. Low pitch and large diameter get it off the ground fast—that's imperative.

Wade's one-blader has progressive pitch up to 4.6 in. at the tip. The set-up shown for checking blade angles insures accuracy at stations.