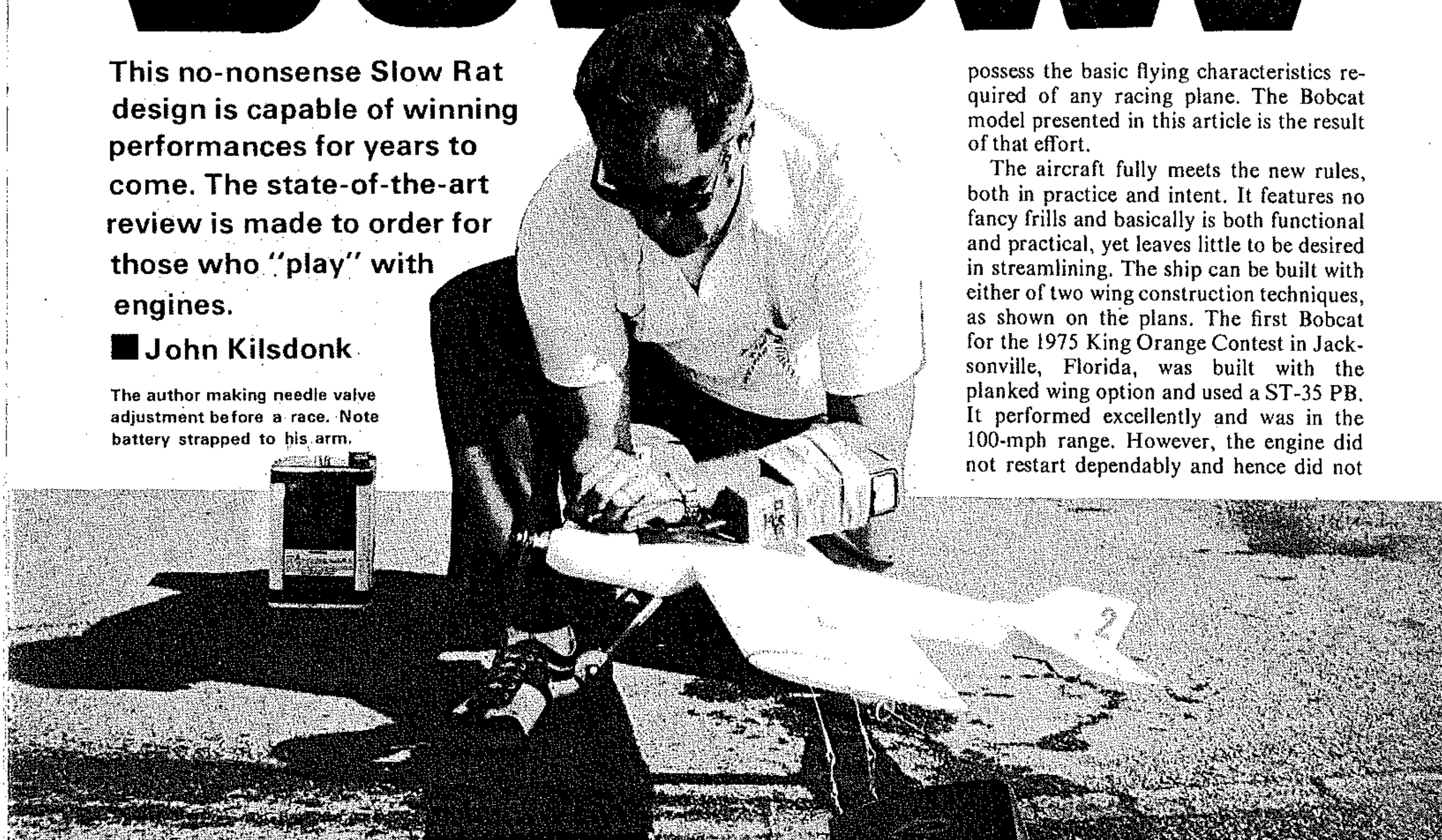
BOBCAT

This no-nonsense Slow Rat design is capable of winning performances for years to come. The state-of-the-art review is made to order for those who "play" with engines.

■ John Kilsdonk



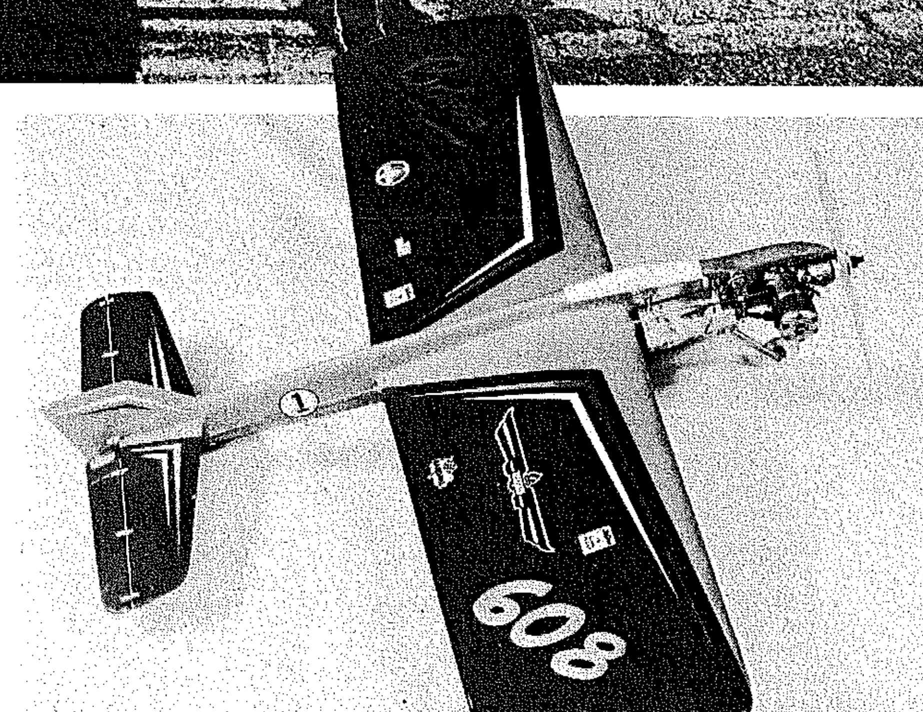
The author making needle valve adjustment before a race. Note battery strapped to his arm.

ACTUALLY, Slow Rat Race is not as new as it seems. It has been around for at least six to seven years that I am familiar with. It was called Sport Race, Slow Race, Novice Race, and many other local terms to designate it as being "slower" than Rat Race. The model requirements for this "new" event revert back to those which were initially used in the early days of Rat Race, although there were not any specific limitations on Rat Race models which did resemble the present Slow Rats.

During 1974-1975, the AMA CLCB (Controline Contest Board), with the input from the RAC (Racing Advisory Committee), put together a combination of all of the many local variations into a consistent set of national rules. The specific rules resulting from this can be found in the present AMA rule book.

Armed with these new rules I set about to develop a racing package which I hoped would be competitive in preparation for the 1976 Nationals. The first step, of course, was to refine a model design. The basic requirements of the model would be that it was rugged, as streamlined as the rules allow, easy to build, and it should possess the basic flying characteristics required of any racing plane. The Bobcat model presented in this article is the result of that effort.

The aircraft fully meets the new rules, both in practice and intent. It features no fancy frills and basically is both functional and practical, yet leaves little to be desired in streamlining. The ship can be built with either of two wing construction techniques, as shown on the plans. The first Bobcat for the 1975 King Orange Contest in Jacksonville, Florida, was built with the planked wing option and used a ST-35 PB. It performed excellently and was in the 100-mph range. However, the engine did not restart dependably and hence did not



A completed Bobcat. It can be built with sheeted wing, covered with Silkspan and dope, finished with clear epoxy, or wing may be a Monokote-covered open frame. There are pros and cons.

finish well in that race.

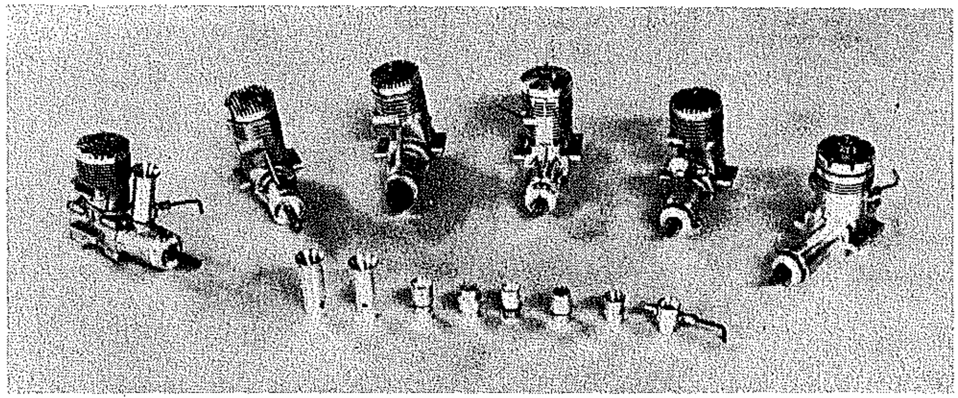
I was happy in that the model flew with no bad habits and did everthing required of a good racer. It tracked well, yet maneuvered excellently, and it slowed down well on the pit stops. It was all that I could ask.

During the winter of 1976, I set about to work on engines for this event. In June, I had the opportunity to race the model again at a contest in Dayton, Ohio. During a practice flight, the "up" leadout failed at about 110 mph. Instant disaster! I not only ruined an excellent HP engine but also "totalled" the ship.

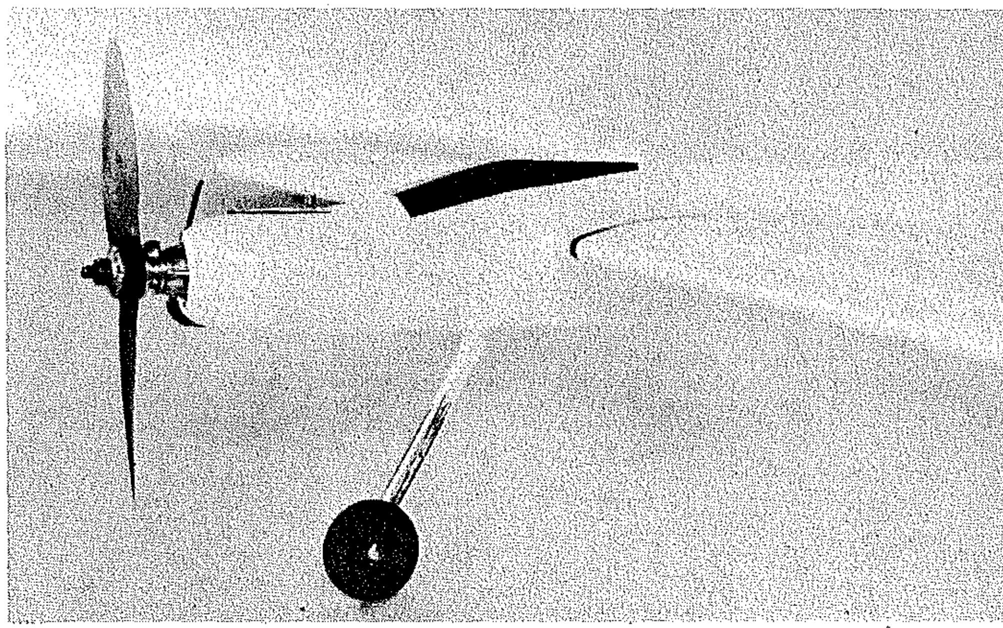
While the Nats were only a month away, I really had to put the design to the test. With barely enough time to build another Bobcat, it would have to be perfect, as I wouldn't have time to do much trimming. I then decided to try to build two of them, so I would have a backup in case of another disaster. I further decided to make them "open frame" and Monokote covered to save the finishing time.

In about three weeks I had two Bobcats built in between getting my Goodyears and Rat Racers in order for the Nats. I test flew the models the Saturday before the Nationals. Again, they both flew identical to the first one—perfect.

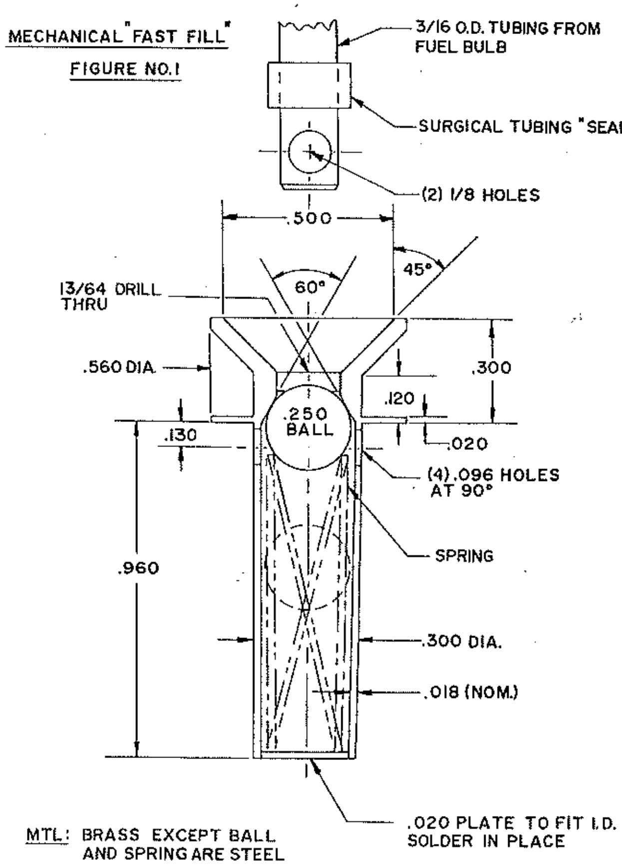
One had an OS engine and the other an HP. The OS model was the one that performed the best, both in air speed and pit stops. So I decided to concentrate on practicing with this model for the Nats, now 1½ days away. Well, disaster struck again, as the engine blew a wrist pin just after I finally had everything working the

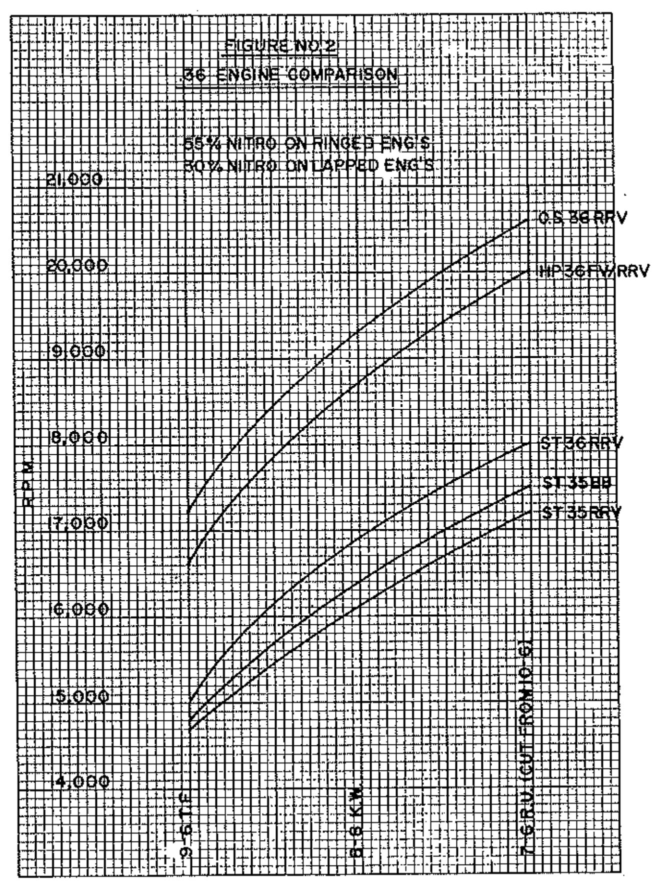


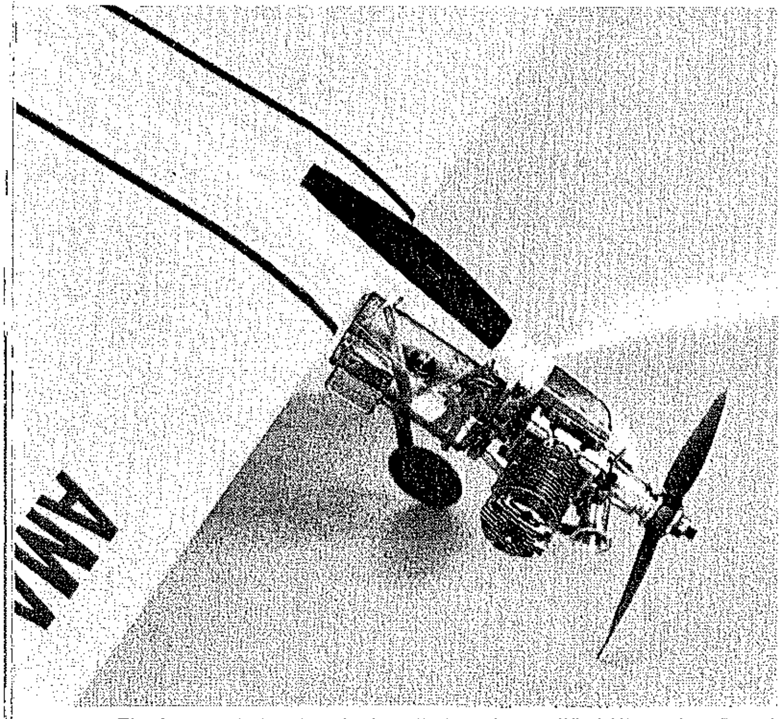
Some of the many combinations of power plants and venturi evaluated in the development process.



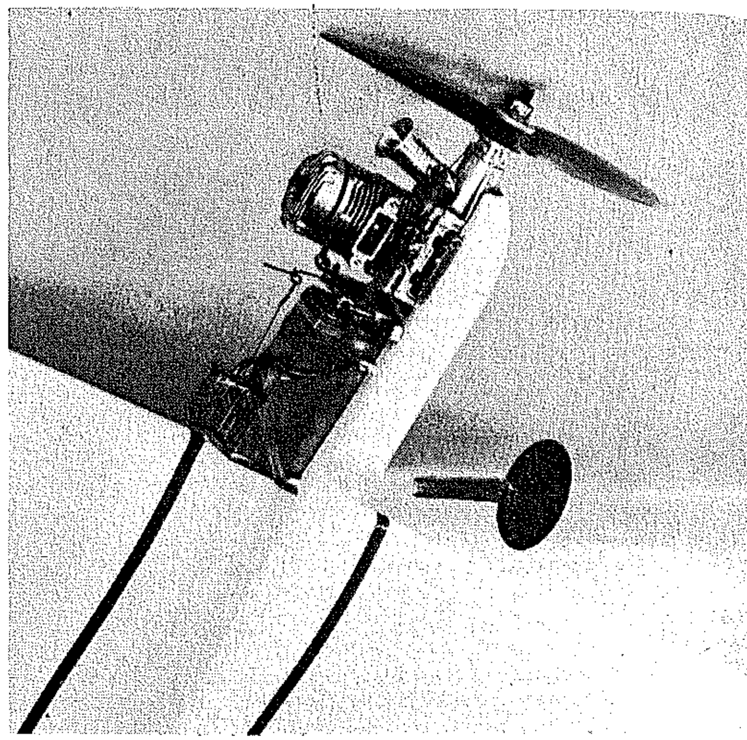
Nose and fuselage contours illustrate attention to streamlining. Engines used on the Bobcat turn an 8-8 fiberglass prop, pitched to 7 in., and slightly thinned, at 19,200 to 20,000 rpm.







The front end showing the installation of a modified HP engine. Based upon the results of the engine work described in the text, the author supplied sample .36 engines to World Engines and Midwest (H.P.).


The same engine installation viewed from the bottom. Shown, are engine shut-off mechanism and the tank. Note placement of landing gear.

way I wanted it to. That night, I rebuilt the engine and we spent Sunday afternoon getting it broken in and going right again.

Monday of Nats week was Slow Rat, and I thought I was ready. By now my nerves were becoming frazzled. But I got off really well in my first 70-lap qualifying heat, and everything was going fine until the pit stop. I signaled for the pit and my pilot, John Ballard, brought the Bobcat in perfectly, only to hit a tool box that one of the other competitors had inadvertently left in the landing area. This disaster put a very large hole in the outboard wing and rendered the model unflyable.

The judges conscientiously rescheduled the heat. Meanwhile, Dick Lambert and Paul Curtis helped me rebuild the wing with Hot Stuff, Devcon, popsicle sticks and Fast Cal. All of this turned out to be in vain since, when the heat was finally rerun, I missed the needle setting and finished in ninth place in the qualifying. Only the top eight were advanced to the finals.

After three unpredictable disasters, I definitely considered giving up Slow Rat. However, my perseverence paid off and at the Michigan Exchange Club's Annual State Meet Contest I finally got it all together and placed first with a time of 6:14, and that was with three pit stops as I ran out of fuel with two laps to go. The OS was really running well as it was clocked consistently at 14.8-15.0 secs (120 mph). Incidentally, Dave Adamisin place second in that contest with an HP-powered Bobcat with a 6:20 time. At this point, I was very gratified as almost one solid year of model and engine development finally paid off.

OK, let's get down to building the model. First, you must decide which wing construction you will use. Both are shown on the plans. After building Bobcats both ways, I must say that there are only slight advantages to either. The fully sheeted wing takes longer to finish, and is about one ounce heavier using Silkspan and dope, covered with clear epoxy. However, it is marginally more durable. If you're in a hurry or don't like to paint, go with the open-frame construction and Monokote. Remember, you will still have to paint the fuselage, stab and rudder, and the wing

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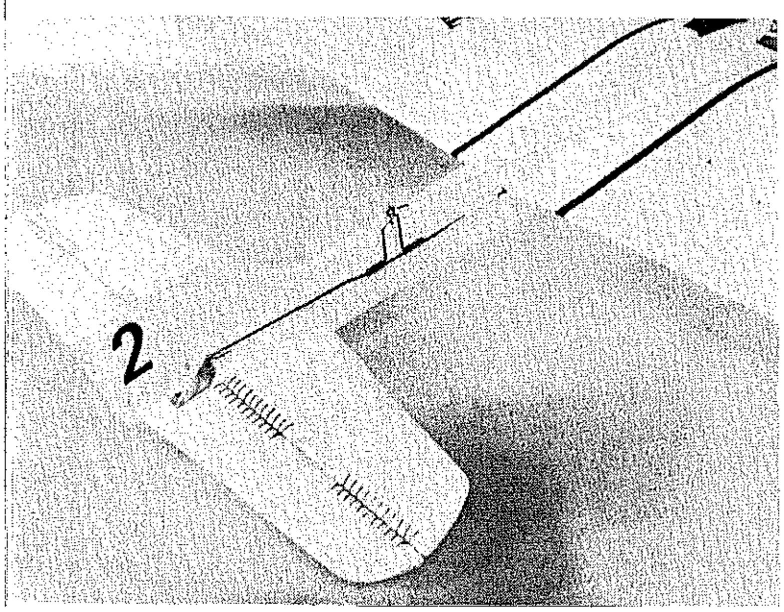
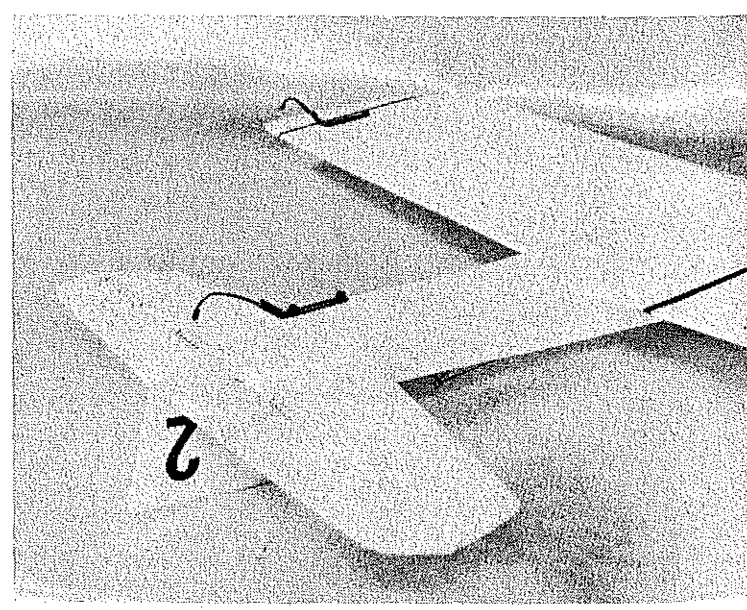
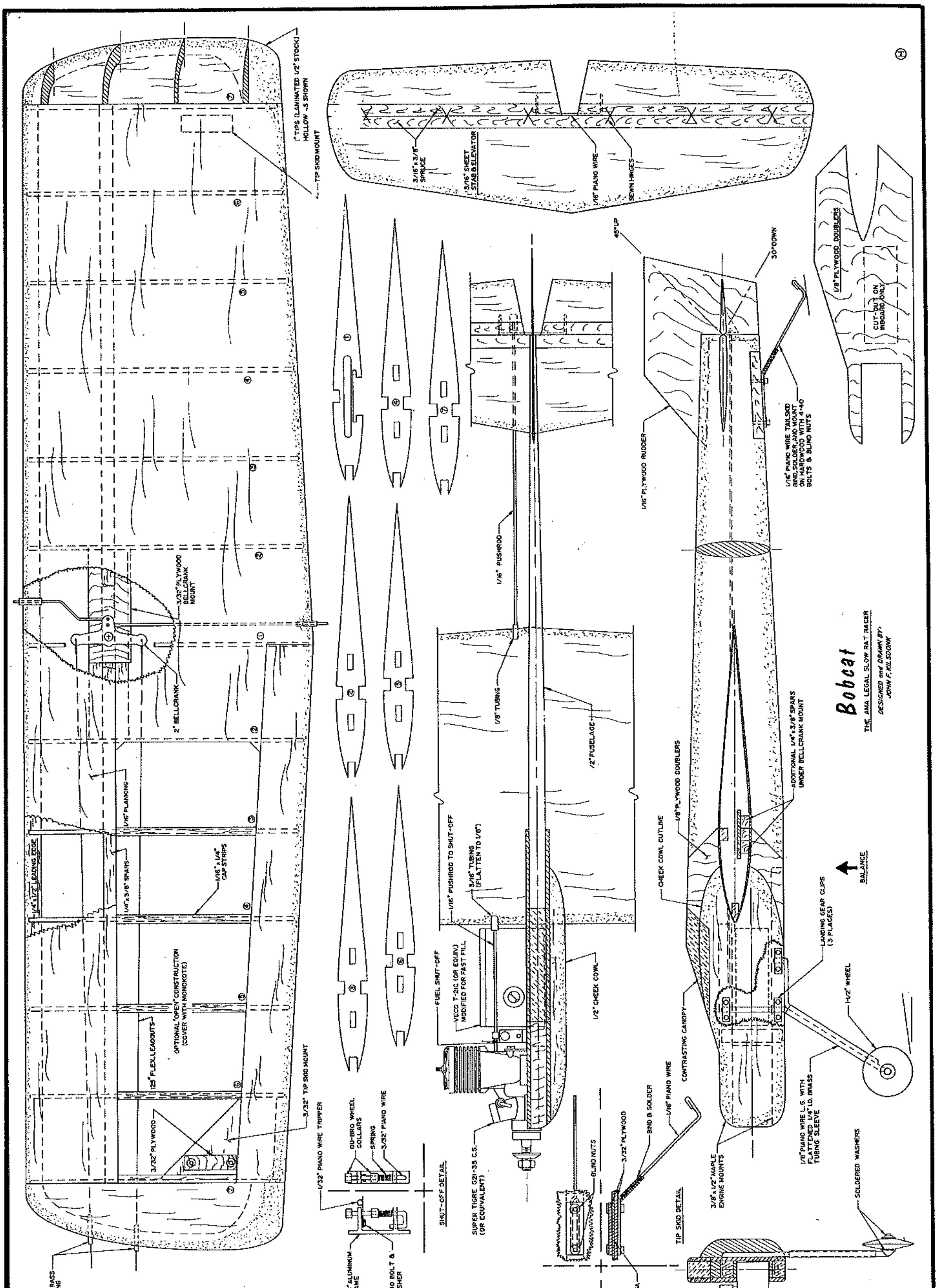


Top of the tail, showing the stitched "figure 8" hinging of elevator and the "puller" shut-off wire, wire wrapped, soldered, to pushrod.


Bottom view of tail surfaces showing the skids and their mounting technique. For consistency, no detail can be taken for granted.



FULL-SIZE PLANS AVAILABLE .... SEE PAGE 104 entries included Tom Laurie's Douglas XB-42 "Mixmaster," Fernando Ramos' Franco-Prussian Bloch powered troop glider, Warren Shipp's Uppercu-Burnelli UB 14 B, Chuck West's Westland Whirlwind, Walt Mooney's Canadair, George James' Dornier Pfiel, and Bill Stroman's Zeppelin "Staaken."

Preferred power included twin geared motors for the contra-rotating XB-42, CO^2 for the Bloch, Cox .020's on the Whirlwind, electric on the Staaken and Airspeed Ferry, and rubber on the Pfiel, Burnelli, and Canadair. Although most of the entries were plagued by minor problems, and failed to make the required 15-second qualification flight, such courage should be applauded! The event was won by the tri-motored Airspeed biplane, which had the advantage of being tested over the year and a half preceeding the contest. Second went to the ol' perfesser from San Diego, Walt Mooney, and the Canadair (rubber contained in the nacelles gave just enough run), and a rousing third to Stroman's Herculean effort, the Zep, which had to be R.O.G.'d due to pendulum stability controls; it needed just a tad more in the battery department. The four Astro .02's seemed to have more than enough potential to fly the eight-foot behemoth, which took off after about a 50-foot run.

Bleaching Dr. Martin: A nifty new way to get light letters and trim on a dark background comes from George James. George uses Dr. Martin's dye on white tissue (purple), and then, with a small brush and Clorox dye, bleaches out the unwanted areas. A Rapidograph pen is handy to do small letters and make the edges of the trim and large letters sharp. Try it next time you want an ultra-light job! I generally use the Pres Bruning method of sticking on opaque letters from color-doped tissue, using spray rubber cement, but that does add a bit of heavy to some models.

Until next time, thermals! Send ideas, pix, etc. We pay for those used.

Bill Warner, 423-C San Vicente Blvd., Santa Monica, CA 90402.

Bobcat/Kilsdonk

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tips.

The rib templates on the plans are designed with a no-nonsense airfoil that, when sheeted, meets the one-inch wing thickness rule. You need two of each rib, except for No. 1. Glue the ribs to the ¼ × ⅜" bottom spar and the leading edge. Any of the new cyanoacrylates (Hot-Stuff, Zap, etc.) are recommended for the entire wing construction. If you are building the open-frame construction, glue on the trailing edge sheeting, followed by the L.E., center section, and the rib cap strips.

The fully sheeted wing is completely sheeted on the bottom side, the bellcrank is installed along with the wing tip skid mounts and the blind nuts, and then the entire top is sheeted. Don't forget to install the pushrod(s) before installing the center top section of the sheeting.

The wing tips can be made from either 1" balsa or a double thickness of scrap ½" balsa left over from the fuselage plank. The tips are carved and hollowed out as shown. Glue them on with Titebond or epoxy. No wing tip weight is required. Finish sand all sheeted surfaces with 150 - 220 grit garnet paper, and the wing is done.

The fuselage, stab, and rudder are very straightforward. If you use the tank recessed in the fuselage as shown, install the outboard plywood doubler first, then cut

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cockpit coaming

Cockpit Coaming is extruded from flexible black vinyl material pre-shaped to fit around a corner. In two sizes, 3/32 and 3/16" dia. Price: 2 feet of each size for $1.95. **Strut Fairing** is extruded rigid vinyl in two sizes, 3/32 or 1/8" I.D., packaged in two 23" lengths. Price, each size: $2.25. **Fourmost Racing Products, 4040 24th Ave., Forest Grove, OR 97116.**

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MODEL AVIATION, 815 FIFTEENTH ST., N.W., WASHINGTON, D.C. 20005 out the slot for the tank. Then install the inboard doubler, and the landing gear. I use blind nuts on the engine mount and fuel shut-off mount, and coat-hanger wire with rubberbands for the fuel tank hold-down. I also prefer the hardwood tail skid mount and blind nuts as shown on the plans. After all of this is completed, the fuselage is glued on the wing, using either Titebond or epoxy, making sure that the fuselage is in the exact center of the wing and perpendicular to the L.E.

The cheek cowl, rudder, and stabilizer are glued in place, again with either Titebond or epoxy. Make sure that the tail surfaces are parallel and square as required.

I use ¾ oz. fiberglass cloth around the cheek cowl and K&B surfacing resin on all surfaces to be painted, followed by a coat or two of Hobbypoxy color. The open areas then are covered with Monokote or Solarfilm. The fully sheeted wing uses the same techniques; however, it is heavier than the "old-fashioned" method of 00 Silkspan, clear dope and talcum powder, followed by colored dope and one coat of clear epoxy.

The fuel shut off shown is similar to those used on my Goodyears, and can be fabricated easily from ⅜" aluminum plate. If you are lazy or in a hurry, a commercial (W-K or Kustom Kraft) can be substituted. The plans show a "pusher" type shut-off, which is what I prefer, because there are no solder joints; however, a "puller" type may be used, as used on the two models I built quickly for the Nats. Whichever method you prefer, it should be actuated only at full down elevator.

The Bobcat was designed around the 3-oz. old Veco T-21C tank, which is now manufactured by Fox. The tank is modified for either a Don's fast-fill or, if you use a "Uniflow" vent arrangement like I do, you will have to fabricate a mechanical fast-fill from brass bar stock, as shown on Fig. No. 1. The mechanical type provides a positive seal irrespective of tank pressure. The uniflow tank has been described many times, especially in Stunt columns, so I will not go into it here. However, it is far superior to conventional assemblies in engine consistency thoughout the flight.

One of the problems we encountered with the event was the restart on pit stops, due to fuel starvation in the engine because pressurization is not allowed. A prime in either the exhaust or intake would work, but proved to be inconsistent and time consuming. To overcome this, we developed the fueling system shown. By sliding a piece of surgical tubing up over the fuel fill pipe on the fuel bulb to act as a seal, when the bulb is pushed down into the mechanical fast-fill, all of the air escapes, either through the single tank vent or the fuel line. When the tank is full, the fuel therefore escapes through the same lines. Since the fuel is being pushed through a 5/32 ID pipe in the bulb, it cannot all be vented through a 3/32" ID (⅛" OD) overflow line (tank vent), and hence, some must go through the fuel supply line to the engine. With a little practice you will develop a "touch" to know how hard to squeeze the bulb during this period to delivery the proper prime to the engine. It probably sounds complicated but it really isn't, and it does work dependably.

The most complicated part of the Slow Rat project was the engine. We had tried most of the existing 35's and 36's in the course of flying and observing the many midwestern Sport Race events over the past years. Also, with our experiences in both Rat Race and Goodyear, it was obvious that we needed a .36 displacement engine that incorporated a ringed piston (for restarts), ball bearings (for durability), and Schnuerle porting (for maximum power). Obviously, nothing was commercially available at the time, so we had to develop something on our own.

The first approach was to use a basic Supertigre G-21-40 RRV engine that we had used with much success 9-10 years ago in Rat Race. While it wasn't Schnuerle ported, it did have the other two require-

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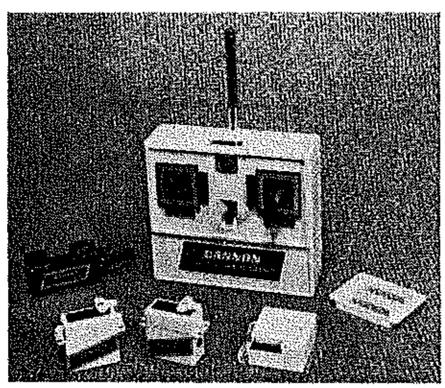

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ments. It worked out that, by using an X-40 (.700 stroke) crankshaft, the displacement could be reduced to .357—just what we wanted. As in any stroke change, the liner must be adjusted (upward for decreased stroke) to maintain the proper cylinder timing.

The hybrid ST-36RRV performed on a par with the standard ST-G-21-35 on 30% nitro. However, the ringed piston would allow us to run 55% nitro, still with dependable restarts. Therefore, we were able to show some improvement over the standard 35. All of the testing was done with a suction venturi. We also tried the same engine with a G-21-29 crank (.668 stroke), which lowered the displacement to .340, but this had only limited success.

It quickly became obvious that we still needed Schnuerle ports. We tried a barstock engine designed and built by Henry Nelson, using a ST lapped piston and crank. This ran extremely well, but obviously was too costly. We then looked at the OS-40SR and the HP 40, which we were using with such good success in Rat Race. I decided to attempt to destroke the 40 cranks on these to achieve a .36 displacement.

After about three weeks of failures and scrapped parts, I finally got a HP36FR together. It dramatically "blew the doors off" of everything else. We then proceeded to make both an OS36RRV and FV along with a HP 36RRV. All were successful, except for the OS36FV, which managed to keep throwing the crank bearings out of the front end. It turned out that the HP's required a new stoke of .667" ± .001" and the OS a .657" ± .001" for legal displacements. Again, the liners had to be shimmed on all of these. The HP36FV and RV essentially ran the same, while the OS performed slightly better than both of these.

The next step was to determine the maximum venturi choke area that we could get away with. Initially, we used a nominal .315" diameter with a stock ST spray bar going through the middle. We tried many different lengths and angles and eventually found that a .355" ± .005" diameter venturi with a 7° entrance angle worked about the best in flight testing, and we have since stuck with that. It is interesting to note that we measured a 400 - 500 rpm, or about 5-mph gain, between the .315" and the new .355" diameter.

I have had discussions with both John Maloney of World Engines and Jerry Nelson of Midwest (H.P.) concerning the production of these .36 engines. I have supplied both of them engines and specifications to forward to the respective factories. Meanwhile both Fox and K&B now are producing Schnuerle .36's, although neither are ringed and don't seem to restart consistently.

Since the 1978-79 rules for Slow Rat require quantity manufactured engines and parts, Fox and K&B may have a lock on the market, at least until either OS or HP come out with a ringed-piston, ball-bearing, Schnuerle-ported .36 engine.

We found that a basic 8-8 fiberglass prop (Bartel or Kelly) pitched to 7 in., and thinned down a little, provides the best performance. Our engines swing this prop between 19,200 and 20,000 static ground rpm.

Whatever engine you use either now or in the future, I think that you will find the Bobcat to be a very efficient no-nonsense model capable of winning performances for years to come.

Engine Technique/Jehlik

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year at the Nats. I examined his engine and found it okay. There was evidence of overheating. I suggested fabricating a tin can cooling shroud wrapped around the back of the cylinder and a little more nitro in the fuel. The overheating problem which created the power loss was solved.

Example: Air duct cooled engine. This is really the way to go for all enclosed engines. Harold debolt worked up a properly designed duct cooling system before 1950 that really hasn't been improved on. The principle is to control cooling air by forcing it to flow laminar all the way around the cylinder. He achieved nearly even cooling front to back. I really believe almost all enclosed engine models can and should incorporate air duct cooling.

Air/Heat Sink Cooling: Usually found in helicopters and RC cars. The picture shows a heat sink on a Cox Van. The heat sink does just what it says. Attach a mass of high heat transfer material (aluminum) with lots of fins, and it increases the "radiator" surface of the cylinder head. This enables engines to be operated in environments that don't provide high rates of air flow cooling. Heat sinks work pretty well, but care should be taken not to run such engines at absolute peak lean settings because the heat sinks do not transfer heat as rapidly as effective air flow. Consequently, they can exceed thermal limits and "burn up" pretty rapidly.

Water Cooling: Usually found in boat applications. The engine head fins are replaced by a water jacket; or a flattened water tube (cool clamp) is clamped around the cylinder head. Water cooling is interesting because it provides the opportunity to really cool the engine and control operating temperatures at all power settings. I'll bet we'll see some special water cooling application in planes and cars in the near future. The prospects of controlling operating temperatures with tuned pipe and short-run maximum-power events is too good to pass up.

Some thoughts on cooling.

1. Dirty engines run hot. If you let your engine bake oil and dirt on the outer surfaces, cooling air won't be able to pick up efficiently the heat off the metal surfaces. Clean the exterior of your engine after each flying session; it will stay clean!

2. Hot engines run with increased clearances and wear out prematurely.

3. Engines have a practical operating temperature "envelope" (minimum to maximum temperatures). The controlling factor is the maximum temperature the oil(s) in the fuel can tolerate and still do a proper job of lubrication. No, the percentage of oil in the fuel really doesn't help if the engine runs too hot! I've never seen a practical use for over 20% oil, *providing* the fuel contains at least 5% castor oil and the engine is not run over the thermal limit