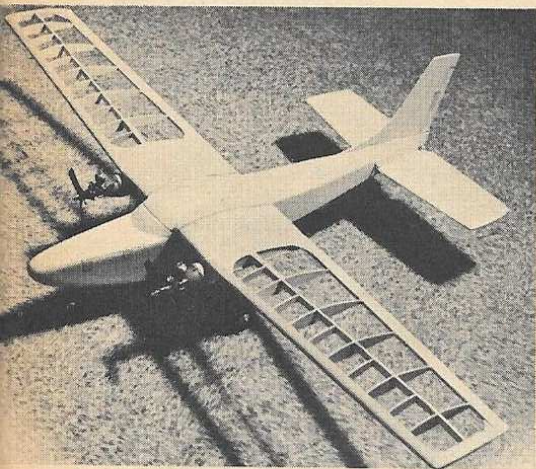


Snappy and exciting, our little twin presents a very challenging appearance in this head-on view through engine cowlings and fuselage section.



Light but sturdy construction is shown in this photo. Note receiver and battery hatch cut-out.

O.K. 2.02

By OWEN KAMPEN

► The O.K. 2.02 was conceived to fill the need for a good looking, small, scale-type twin that would fly well without resorting to extreme design concepts or "weirdo" configurations. This proved to be a larger project than first realized. At the time design work was started, I had neither seen nor heard of any existing .020 powered twin. This proved to be a boon, for I could start from scratch full of confidence and high hopes free of all "helpful" friendly suggestions as to why it wouldn't work. So I did.

To coin a phrase, "It flew right off the old drawing board"—that is, until the left engine quit and I was never quite sure of what happened next. Carefully picking up the remains, I went

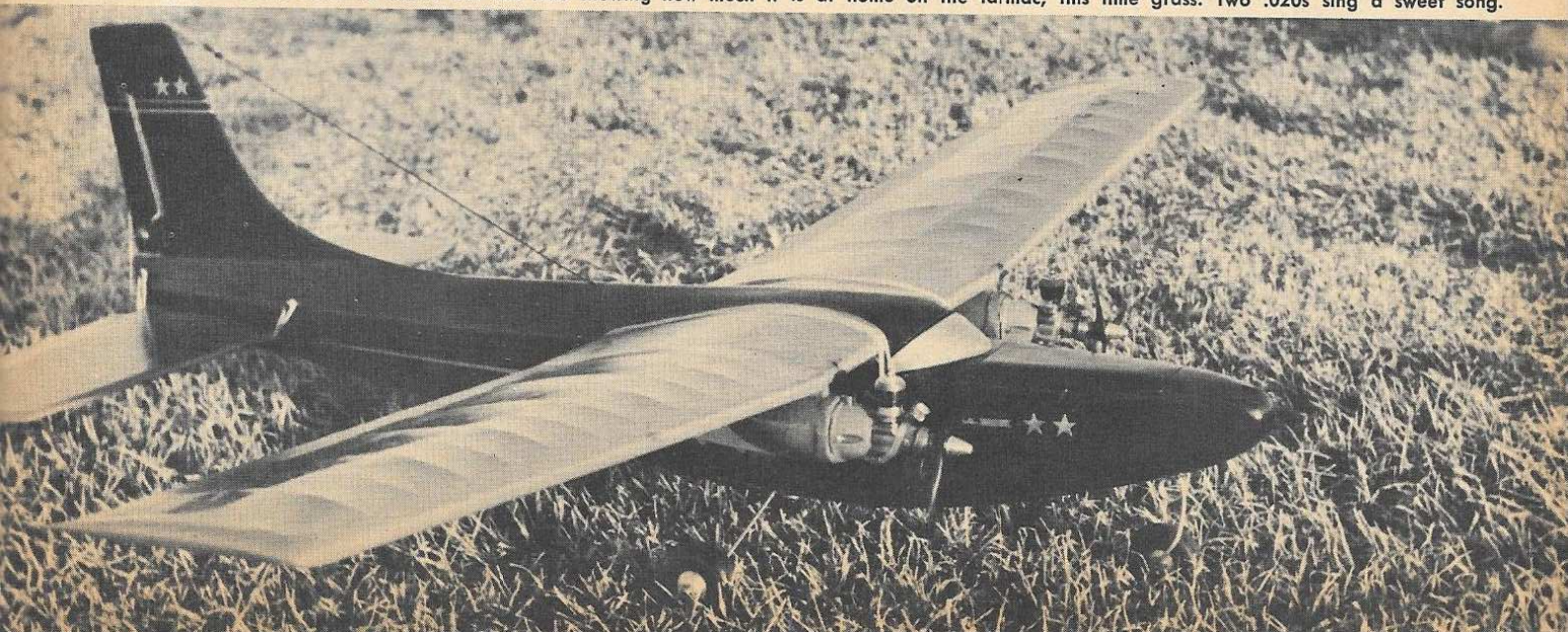
back to the old drawing board and pondered the problems and immediately came up with the obvious answer—I'd make it a single engine "twin"! Oh well!—at the time it seemed quite logical.

Now, after several months of shattered fingers, tempers and planes I, hereby, proudly offer the modeling fraternity the results of all this soul searching, suffering and self-denial along with some observations which stick fairly close to the truth. The first one, which is thrown in for free, is *never*, under any circumstances, mess with the little beasts in freezing temperatures—not even to meet a deadline.

In case it's not apparent from the photos, I'll spell it right out and go on record as saying, "I'm seriously concerned with the visual aesthetics of three dimensional form in design, as related to the classic precept that form follows function." What this really means is that I'm a "looks guy," but one who believes a good looking ship must also fly well and that the nice appearance should be a logical result of built in fly-ability. (Continued on next page)

SAGA OF OUR LITTLE .020 TWIN
MAKES EXCITING READING AND
IT, OF COURSE, MAKES SNAP-
PIER FLYING AFTER YOU HAVE
TAKEN ON JOB OF BUILDING IT.

Another view, much the same as above but this time showing how much it is at home on the tarmac, this time grass. Two .020s sing a sweet song.





Our author with both the engines firing up at great rate. He worked all through winter on project, heavy gloves couldn't have helped flying.



Part of the design and flying team, at left Carl Vogt, designer of throttle control that succeeded in taming down hot little .020 power-plants.

O.K. 2.02—Continued

I also like my planes to be strong enough to weather my occasional "pilot-lapses." The 2.02 lives up to all this and if you'd like to find out why and how, we'll now swing into the technical bit—some of which was actually figured out in advance.

Those of you already familiar with the problems of single-engine operation of a twin-engined plane are well aware that the off-center thrustlines and torque combine to cause all kinds of havoc on any twin where the engines are not mounted in tandem on the center line. For the uninitiated, here is what happens—one engine quits, the lack of thrust on that side, plus wing tip drag, plus the increased effectiveness of the thrust on the other side all add up—and when they add up, things happen very fast. The dragging wing drops, the other lifts more and moves forward faster, causing a deadly diving spiral, or as in some designs—a vicious snap over the top, each ending up with the same disastrous earth contact or prang. Torque compounds the problem by making it even worse when the left (#1) engine quits first (see starting procedure).

When one engine fails the pilots of real planes correct it by using trim tabs, ailerons, and a heavy foot (as an ex B-24 driver, I know). Larger, multi-twins depend on fast thumbs, throttles, ailerons and rudder. Good for them. With a small job, however, all we've got is a rudder and faith, and at times it takes a lot of each. This being so, the problems were approached from two directions—aerodynamically and equipmentally. Let's take them one at a time.

Aerodynamically speaking, the close set engines are an obvious must to help minimize the previously described effect of off center thrust lines. Side thrust on this plane did not prove as effective as hoped, though some is retained. This

may vary a bit with different models. Toe-in sub-rudders were also tried and proved ineffective. The tapered wing planform was chosen to cut down on tip drag and seemed to work well. This, coupled with the large-high fin and rudder plus the nacelle design in the 2.02 all prevent bad spiral diving traits while on one mill. The relatively short tail movement puts the oversized rudder to work in a hurry for fast recovery.

Another major factor in this tamed behavior is the choice of the shoulder wing location. This is a proven one in full scale aircraft and provides a dandy and most important advantage. It permits slinging engines *under* the wing so that most of the slipstream goes *under* and not over the airfoil. The latter only creates added lift when and where you least want it—unless of course you really enjoy hands off snap rolls.

In this design, the nacelles are put to work. Instead of just being something to hold engines, they also provide forward fin area for greater directional stability. There is also some possibility that they have an effect on the slipstream by combining with the flat sides of the fuselage and perhaps working something like vanes in a wind tunnel. I'm not certain on this point. The long nose also has its functional reason above and beyond sleek lines. It provides space up front to make it easy to achieve a forward C.G. without ballast. Finally, the widespread trike gear gives good ground stability and does a fine job of protecting the .02's on rough landings.

From the beginning, engines were a problem and Leroy Cox must take the blame for manufacturing mills that are too darn efficient for our purpose. While they lend themselves beautifully to the nacelle treatment previously described, it's really amazing to discover the wild harmonic vibrations twin Tee Dees can create. The .01's are a bit temperamental when teamed up; and,

the tiny props combined with extremely fast engine speeds do not help the torque situation either. Rich running and over-propping the .02's was not the answer as synchronization was rather "Raggety Andy" and at altitude one would often lean out with results that approached single engine flight. The little "beasts" had to be tamed, which leads us right into the equipment discussion and two new products (at least new at the time of writing).

Fortunately, fellow MARCS member, Carl Vogt, had been tooling around for some time machining simple and beautifully made .020 throttles from bar stock aluminum. These are manually adjustable and can produce an amazing choice of RPM's from full power to tick over. Once installed, they worked out just fine, for now test flights could be flown at reduced throttle speeds without the leanout problem. Equally great was the fact that perfect synchronization could also be achieved. (These will be available before this article is published—probably selling for about \$2.00.) I do not recommend that you fly the 2.02 without these unless V.T.O. performance is your cup of tea.

This was a giant step in the right direction, but a larger hurdle loomed and man, it really loomed—the electro-mechanical thing that moves the rudder. This became a real problem because with each test flight the rudder grew and grew to handle the single engine yawing. Escapements were the first choice, as they delivered plenty of punch but relays proved prone to that ol' devil 'vibration'. Then too, when sufficient throw was built in for single engine control the normal flight became extremely jumpy and jerky. O.K., you say, why not go to relayless proportional which will give you a little when you want it and a lot when you need it? I did. In theory, everything was fine, but by now that (Continued on page 38)

O.K. 2.02

(Continued from page 20)

rudder was approaching barn door size and proved too much for commercially available actuators. These devices work fine when used for the job they were designed to do, but in this case the call was above and beyond duty.

At last, good clean living paid off. Unbeknownst to me, Dick Adams of Janesville, Wisconsin, had finally finalized years of developing a three volt magnetic actuator which has great power and a low drain bonus. Hearing my loud cries of despair from forty miles away, he promptly and in person delivered a pilot model and ZOUNDS and EUREKA, it worked.

I know this is all going to sound terribly anti-climactic, but now the 2.02 flew good—like a little twin should. Overnight I became a successful designer.

Gentle turns were a joy to behold and single enginitus was conquered. Even at a, by now, glue and patch laden 1½ pounds, climb and glide were a thing of beauty. My family was delighted. No longer did I sulk around snapping at each and all. The snows of winter had been replaced by buds of spring and I could smile again. The obvious moral of this is "when you try and try again and still fail—GIVE UP." Only a nut would continue until he lucked out, and luck out I did. My final advice is to surround yourself with smart friends and you too can be a hot shot designer.

If there are any readers still left, we will now get to the balsa chopping bit which is going to be on the brief side as this plane, though easy to build, is not for beginners. Onward!

WING AND NACELLES: If you will first look at the plans, you will see that the wing is built in three sections with the center being extremely strong and rigid to handle vibration. Center ribs, spar, leading and trailing edges are assembled in the usual fashion and while still pinned down, the top 1/16th sheeting is applied. Butt join to the spar being sure to leave enough to overlap the nacelle cores.

When dry, the dihedral braces and nacelle cores are installed from the bottom, using white glue, and finally the whole

mess is covered up by the bottom sheeting. The nacelle halves can be rough carved from medium hard blocks or laminated. They go on each side of each core, flush with the wing leading edge. Now is the time to check downthrust and offset angles.

To make the motor mounts—trace the .02 tank base on ¼" pine and cut to shape. Drill holes to fit the tanks and install blind nuts, then attach to nacelles. Finish carving and sand to shape filleting with balsa putty.

If you haven't already done so, make the wing tip sections. No washout is required because of the taper. Now the whole bit goes together with 1½" of dihedral under each tip. Cover with silk and dope, and let it cure while we plunge forward. No, I didn't forget, the turtle deck comes later.

STABILIZER: This is a simple sandwich construction which is much more warp resistant than plain sheet and well worth a little extra effort. The short dowel gives extra strength for the hold down rubbers. Silking is optional here, but a must on the rudder.

FUSELAGE: Construction is straightforward with the sides being cut from medium soft 3/32 sheet. They soak up shock and vibration better than 1/16th and are worth the slight difference in weight. Contact cement works fine on the doublers and eliminates the long drying period. Start with center formers F2 and F4 and work toward the tail.

Use your favorite method of bending the nose gear, but don't use smaller than 3/32nd wire as this takes quite a pounding. My method works quite well and utilizes a 5/16 o.d. brass lamp fitting containing a set screw. This holds one short right angle bend of the wire while the loop is bent around a bolt of the same diameter. Both fitting and bolt are placed 2 to 3 inches apart in a vise, and strong outward tension is held, using power grip pliers while bending.

Three 'J' bolts hook this to ply former F1, which fits in the notch formed by the short doublers. The nose bottom, and rough carved nose block are added—the nose top is tack glued temporarily and the whole thing sanded to a smooth,

rounded contour. The top deck can then be removed and the hatch cut out. The ¼" square stringers on the hatch bottom insure a good fit and seat the hold-down pins. After the main gear is attached and torque rod installed, the bottom planking is applied and windshield block added. The fin is next. (Don't sew the rudder on until all surfaces are final doped.) Use the cut and fit method for the rear turtle deck sheeting—wetting the outside surface to help it curve to fit the formers.

After the wing hold-down dowels are in position, the wing can be held in place while the final turtle deck section is fitted. Use wax paper between formers F4A and F4B and also the windshield and F2A. Finish with balsa putty where necessary.

INSTALLATION: The actuator is sewed to removable slide F3A, as per manufacturer's instructions. With a double ended relayless receiver, or a single ended one, plus an add-on-switcher, the power supply for the whole works can be handled by three 1.25 volt nicads. Pencells are not advisable for this set-up. All connections must be carefully soldered with looped slack wherever feasible. (Twins are murder on tight, rigid connections and two of my flights came to grief because of broken battery box leads.) The torque rod must be free of bind or whip with bushings at each end.

The tail crank assembly determines rudder throw and also acts as a limit stop for the actuator.

Position the receiver and batteries to give a C.G. no further back than shown on plans. Moving it slightly forward will permit higher engine speeds, but with the incidences set up as shown, handling could become critical if carried too far.

FINISH AND TRIM: First, give the entire plane two or three coats of clear dope, followed by two to three of color with two more final coats of clear. Sanding sealer can be used over the sheeted areas for a smoother finish. The flying sections and nacelles are red with some orange or yellow added to match the Cox tanks. Fuse, fin and rudder are black. The windshield is silver and the twin theme is carried out with double stars and striping in gold. The stars are dime store variety—dope will dissolve their color so use Polaroid print coater or varnish over them.

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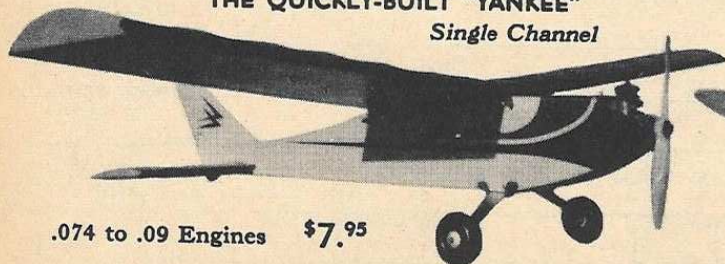
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STARTING AND FLYING: First adjust the glide fairly flat and fast with no flare out on touchdown. Though single engine operation is not critical—particularly at slower engine speeds—it's best to have the #2 engine (left one facing plane) quit first so it's only logical to start it first. As space is pretty cramped, the wire spring starters supplied with the .02's come in very handy.

Here is the most satisfactory procedure. 1. Start #2 and warm up. 2. Start #1 and do same. 3. Stop both engines and top off tanks. 4. Start #2 and throttle back so that 1/16th" or a little less of the exhaust port is open. 5. Start #1 and retard throttle slowly until all "beats" smooth out and both engines sing the same note. A 10 second or less starting interval can be achieved with practice. Intervals longer than 20 seconds are not advisable, but not critical. An overweight 2.02 will climb in a scale attitude at the above settings. More than that and you are on your own.

If directions have been followed and surfaces are warp free, the 2.02 will climb out like a big one and the sound is something special. Turns in either direction should be smooth, with no abrupt rocking or dropping of the nose. The plane has plenty of inherent stability, yet goes where you put it. Twins generally will react a little slower to signals, so learn to anticipate.

The pulser stick works fine for all normal maneuvers and full on and off take care of the rest—single engine included. This plane wants to fly—all you have to do is guide it.

VARIATIONS: In closing, I'd like to throw in a couple of variations on the basic design. Twin tails were considered in the original concept, and though harder to build, should prove most effective. For those of you who would like to fly engines wide open, I would suggest enlarging the plans 15% or 20%. This would create more space and lift to carry a Mighty-Midget installation. In any event, here is the O.K. 2.02, nice to look at and fun to fly.

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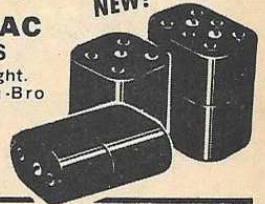
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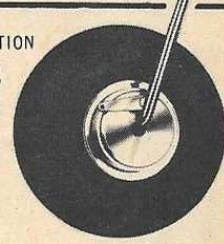


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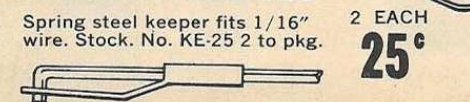


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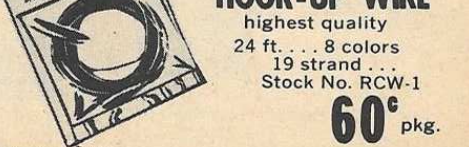
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