(Photo by Jack Cox)

the KR-2

By
Jack Cox

IN A RECENT phone conversation with one of our EAA Designees, I asked, "What's hot in your area?"

"Foam!" was the reply.

"Foam", of course, translates into "KR-1" in home-built aircraft circles . . . at least this year. Nearly 5000 sets of plans have been sold for this tiny monoplane, which puts it into the company of the Bensen Gyrocopter, Jeanies Teenie, VP-1 and BD-5 as the all-time sales leaders in the build-it-yourself portion of the aviation world. Designer Ken Rand estimates around 100 are flying throughout the world with word of newly completed and flown examples coming in everyday.

The KR-1 is also extremely popular in nations other than the U. S. Approximately 1,000 sets of plans have been sold in Canada, which is amazing when one considers that as of the January mailing of *SPORT AVIATION* there were 2577 Canadian members of EAA. South Africa is also a hot bed of KR-1 activity and, proportionally, builders there are completing and flying theirs faster than anyone. Ken says of the 100 flying (as of mid-January), about ¼ of these are in South Africa.

The reasons for the worldwide appeal of the KR-1 are rather obvious: its basic structure is wood, the nearest thing to a universally available building material; it is powered by the VW engine, the nearest thing to a universally available powerplant; its foam/Dynel/epoxy secondary structure is novel and a relatively easy medium with which to work; the KR-1 is tiny and is pretty in a cocky, fighter-like way — characteristics that seem to have universal appeal; and it is a fast little airplane for the power. Last, and perhaps most significant, the KR-1 apparently can be built for one of the smallest outlays of cash of almost any aircraft flying. Certainly, it has few rivals in the miles per hour per dollar derby.

With the phenomenal sales of KR-1 plans and materials kits, it was only a matter of time until a two place version came along. The KR-1 was first brought to Oshkosh in 1972 and was back again in 1973. Shortly before the 1973 event, Ken and his partner, Stuart Robinson, completed the design and stress analyses on a two place bird and immediately upon Ken's return from Oshkosh, started construction of the KR-2 prototype.

The KR-2 was originally designed for the 1600cc VW, but because of the example of so many KR-1 builders going to larger and larger engines (from the KR-1's origi-

nal 1200cc engine), Ken and Stu decided to go right to one of the largest VWs available to them, Revmaster's 1834cc mill; the reasoning being that if they built the prototype to take that engine, it would be more than adequately stressed for the smaller 1600 and 1700cc VWs.

The KR-2 is in every way an enlarged KR-1. The tail is, in fact, the same on both aircraft, as are the landing gear legs, wheels and brakes. The basic, all-wood primary structure is essentially the same and the foam/Dynel/epoxy secondary structure is identical in its application to that of the earlier single placer. The changes consist largely of a widening and a five inch lengthening of the portion of the fuselage aft of the firewall to accommodate two people sitting side-by-side. A tandem seating arrangement would have resulted in less frontal area, but on such a tiny airplane the weight and balance problems would have been horrendous. The cabin is 38.5 inches in width at its widest point — O. K. for two average sized persons, but tight for a couple of members of the Pittsburgh Steeler's front four.

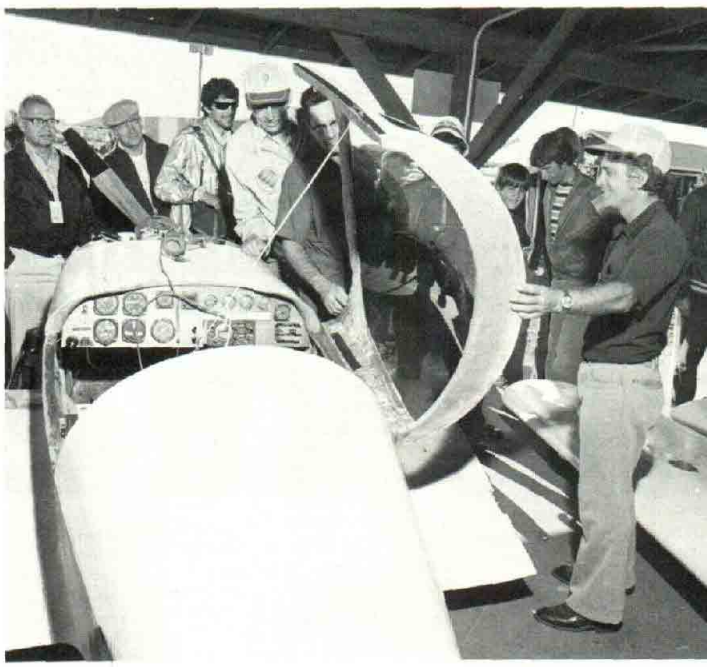
The structural members in the KR-2 are the same thickness as in the KR-1, which means that owing to slightly greater lengths of longerons, spars, etc. the KR-2 is not quite as strong as the single placer. The KR-1 is calculated to safely withstand 12 Gs and the KR-2 figures to take nine . . . at the 800 pound gross weight of the prototype (empty weight of N-4KR is 430 pounds).

The unique Rand-Robinson landing gear set-up (see drawings) is unchanged except that the spring bar is a foot wider and has a third hinge point.

The KR-2 wing has a span of 20 feet 8 inches and employs the rather thick RAF 48 air foil . . . which is to say it is a slightly larger version of the KR-1's 17 foot 2 inch wing. The construction technique is the same . . . the wings are built up right on the airframe, then the outer panels are simply sawed off. And from these panels the ailerons are sawed out and reinstalled after ¼" spars have been bonded in place and piano hinges have been attached. The KR-2 has an effective wing area of 78 square feet so that at a gross weight of 800 pounds the wing loading is just a shade over 10 pounds per square feet . . . about the same as a Cessna 150. The KR-2, however, is a much faster and very much cleaner airplane than a 150 . . . and this makes one wonder if the slippery little dude needs flaps of some sort. Conversations at Oshkosh with Ken and the fellows from Wicks Organ who built the second KR-2 seemed to indicate that the -2 is a real floater in ground effect. They said that even when you had the bird as slow as you dared on final it would still get down to the last couple of feet and just float . . . and float. The broad wing and broad flat bottom of the fuselage are allowed to get so close to the runway surface by the ultra short landing gear legs that the ground effect is really accentuated. It would probably be desirable at this point of the landing to be able to hang something out in the breeze to create a little drag, but it's hard to say what. That short landing gear leaves the trailing edge of the wing so close to the ground that conventional flaps — even a belly flap — would be making expensive, abrasive noises on every landing. I'm sure Ken and Stu consider the omission of flaps, spoilers or whatnot to be thoroughly in keeping with the concept of making the KR series as mechanically simple and light as possible. And it can be argued that with a stall speed of 42 mph the floating is going to be more of a nuisance than a hazard of any sort. KR-2 pilots are simply going to have to be more precise on speed control on their landing approaches than when they are in dirtier airplanes. It does seem reasonable, however, to advise KR-2 builders to make their first half a dozen or so landings on long runways until they perfect their technique.

(Photo by Lee Fray)

The author, holding canopy, and Ken Rand fit in the prototype KR-2 with ease. However, your editor is 5' 9" and weighs 150 pounds and Ken is shorter and lighter. 200 pounders are advised to bring a large shoehorn.



(Photo by Lee Fray)

Ken Rand, holding canopy, shows the cockpit of the KR-2 to several EAAers. The plane is in the Synthetics Workshop at Oshkosh for repairs.

The prototype KR-2, N-4KR, is powered by an 1834cc Revmaster, which is an otherwise stock 1600cc VW with 99mm cylinders. This particular engine is a single ignition version — it has a Bendix mag — and derives liquid sustenance through a Posa injector. Revmaster gives the engine a continuous rating of 60 hp at 3000 rpms, which is on the conservative side. With the props that have been tried thus far, Ken has been cruising the engine at around 3200 rpms and figures it is cranking out around 70 hp at that setting. The KR-2 is presently equipped with a Bernhard Warnke ground adjustable propeller (see article elsewhere in this issue) and some excellent performance figures are being obtained . . . like 180 mph at 3200 rpms

at low altitude and true airspeeds around 200 at higher levels. This is significantly higher than with earlier fixed pitch propellers.

Climb rates depend on the usual variables; the pitch at which the Warnke prop is set, take-off weight and atmospherics. Ken says to expect about 800 fpm with a standard prop, gross weight and a standard day. When he wants to show off, he can get 2,000 fpm with just himself aboard, 5 gallons of fuel and a climb prop. Ken was getting this during those steep climb-outs at Oshkosh last August.

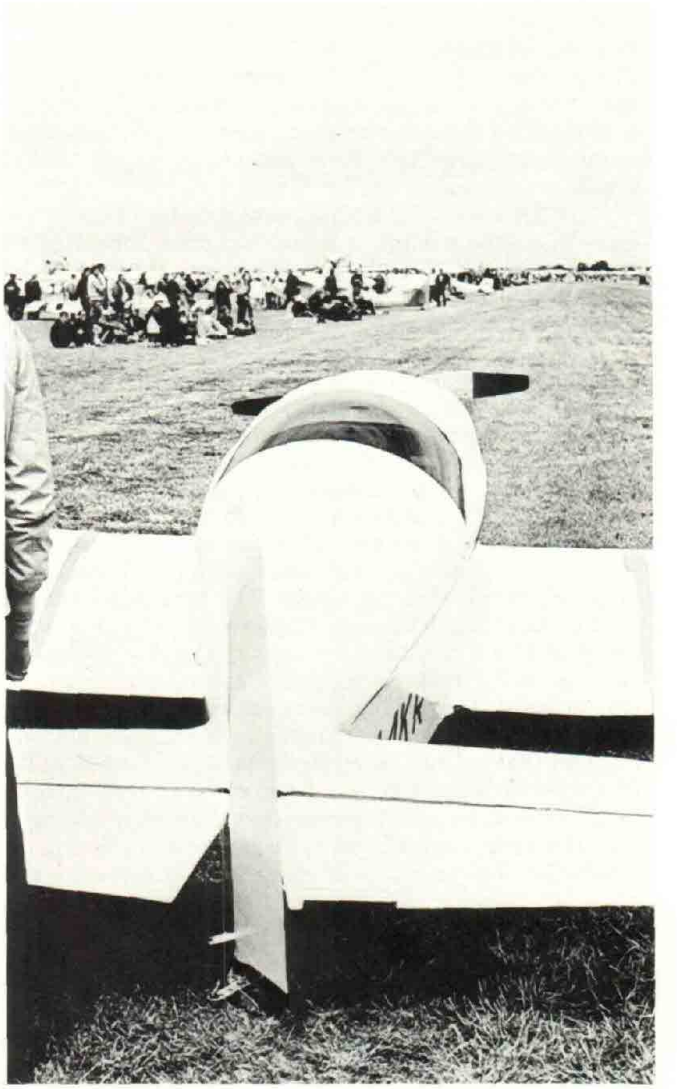
The KR-2 plans show an integral, foam and Dynel fuel tank ahead of the instrument panel with a capacity of 10 to 12 gallons — it's going to vary depending on just how it is built. N-4KR's fuselage tank holds 10½ gallons and before Oshkosh a second tank was built into the root of the right outer wing panel — just Dynel and epoxied up a foot or two of the cavity between the two spars. This aux tank proved to have a capacity of 14 gallons, so a total of 24½ gallons were available for the flight from LA to Wittman Field. With a break from the winds, the range figured to be over 900 miles! This set-up proved to be N-4KR's Achilles heel.

The prototype was completed in late May of 1974 and the first flight was made by Frank Baylor on June 1. Ken and Stu made the next flights. With Baylor hired part time to fly the KR-2 and Ken and Stu ready to take occasional turns at the stick, the required 75 hours were flown off in a period of just three weeks and the restrictions were removed by FAA. Then it was time to plan for Oshkosh.

It was at this point that the decision was made to add the wing tank and a radio in order to fly the plane to Oshkosh rather than truck it as had been done with the KR-1 the two previous years. A major stumbling block was the fact that the plane was not equipped with an electrical system and power to run the radio and transfer fuel from the wing tank to the fuselage main had to come from somewhere. Masters at improvisation that they are, Ken and Stu finally came up with a battery set up which, on paper, would allow transfer of the 14 gallons and intermittent use of the radio . . . like an occasional omni heading and a couple of minutes of tower communication. A trickle charger was taken along to recharge the battery at night.

Frank Baylor roared out of Meadowlark Airport headed eastward in the KR-2 and Ken headed out in his car. Everything went as planned until Baylor found a cloud area over Kansas forecast to be widely scattered going solid under him. This resulted in excessive use of the radio for navigation so that when it came time for fuel transfer, the battery was found to have pooped out. A letdown through the cloud deck was successful . . . right over a ranch airstrip some 20 miles south of Topeka, Kansas! To make a painful story short, the pilot overshot the strip and plunged down a 10 foot embankment, wiping out the gear. The only consolation was confirmation of the engineering data on the gear legs . . . they broke off exactly where calculations predicted they would when subjected to between 470 and 500 pounds of force. A sizeable hole was also made in the foam/Dynel skin on the top of the left center section and, of course, the prop was broken. N-4KR made it the rest of the way to Oshkosh via trailer.

Once at Wittman Field the battered little bird was immediately taken to the synthetics workshop shed where Ken and various volunteer helpers turned misfortune into an excellent "for real" class in foam/Dynel/epoxy application and repair. After a day and a long night's work, the plane was ready to fly again . . . and did. A taxi accident into, of all things, an FAA car, required another long night of patching up, but, again, the plane was flying the following day. (*An interesting footnote to this frantic activity was the revelation that, guess who, of all the people in this world today, is allergic to epoxy resin?? That's right, Mr. Foam and Dynel, himself . . . Ken Rand! After a couple of days of patching up the KR-2, his hands looked like they had been run through a sausage grinder. So, take it from the fellow with the scars, KR and W.A.R. builders, WEAR RUBBER GLOVES!*)



(Photo by Jack Cox)

The KR-2 is one slick little airplane as this rear shot clearly shows.

The trip back to Los Angeles was made using only the main fuselage tank and was uneventful. As of mid-January N-4KR had 132 hours TT and had been flown by a number of pilots.

With the tremendous number of KR-1 plans sold, Ken and Stu were in a position to come up with a rather elaborate set of instructions for building the KR-2. What one gets for $45.00 is a 64 page plans booklet rather than the usual sheets of engineering type drawings. The text is broken down into short, numbered paragraphs that lead the builder step-by-step through the construction of his KR-2. 25 drawings and 81 photographs are keyed to the individual paragraphs. What you have here is very similar to what educators call "programmed learning". It's principal advantages are the logical and proper sequencing of the building steps and the breaking down of work into small and relatively easy to accomplish tasks. The drawings contain the usual dimensions and also are frequently accompanied by a cutaway or isometric view to aid the builder in visualizing how the parts are supposed

to fit together. The pictures are especially valuable, particularly in showing how the foam and Dynel is applied. This section, incidentally, is covered in the greatest detail of anything in the booklet . . . the result, according to Ken, of all the questions they have been asked on how to apply the foam and Dynel and attain a good, smooth finish.

The KR-2 building manual contains drawings for two types of engine mounts, a wiring diagram, including the installation of VOR and communications antennae, a list of sources of materials, a listing of all the KR-2 materials kits and a couple of pages of Revmaster engine info.

The nine materials kits available from Rand-Robinson include the aluminum extrusions (main gear, bellcranks, pulley brackets, control hinges, etc.), the 4130 steel parts, wheels and brakes, axles, tires and tubes, tail wheel, canopy, A/N bolts, Slick magnetos and a large breakdown drawing to hang in your workshop for inspiration while you are building.

A number of firms now offer spruce kits for the KR-2 and several also offer with the package the necessary plywood, Styrofoam and epoxy. The Styrofoam call-out in the plans booklet is for: 12 pieces of ½" x 2' x 4'; 12 pieces of 1" x 2' x 4"; and 9 pieces of 2" x 2' x 4' foam. 30 yards of 48" wide Dynel cloth are needed and seven gallons of epoxy laminating resin are required . . . just to give you some idea of the quantities of this new building medium that go into an airframe the size of a KR-2. The total cost of these kits has been running well under a thousand dollars, which means that even after adding in the price of an engine, a prop, instruments, cables, paint, radios, etc., the total is still going to be quite reasonable when you consider that we are talking about a two place airplane capable of cruising up to around 180 mph, depending on the engine used.

The low cost and short construction time required to build a KR-1 or KR-2 (or several other of the less complex homebuilt designs) brings up a point that needs some airing on the pages of *SPORT AVIATION*. There is a degree of criticism of these more basic aircraft — and not just from our friend and critic, Peter Garrison. There are EAA members who feel that the low cost and building ease of these aircraft attract persons who do not possess the knowledge, skills and pride in craftsmanship to construct a safe flying machine. There are those who flatly state that such aircraft "ought to be banned" . . . although we haven't heard any constructive suggestions as to how or by whom this would be accomplished. Personally, I believe these are negative arguments and are not adequately thought through. The fact is that shoddy workmanship is not confined to any particular design or level of complexity. EAA has received Designee reports over the years detailing isolated examples of poor workmanship found in almost any homebuilt design you can call to mind. It has not been our experience that craftsmanship is the exclusive province of the affluent. Conversely, in fact, some of the finest workmanship ever lavished on a homebuilt airplane has been on VP-1s, Fly Babies, Jeanies Teenies and the like. Would any of you have stood at the gate at Oshkosh in 1973 denying entrance to Fred Keller's superb KR-1, an airplane that was strongly in the running for the Grand Champion award eventually won by Jim Butler's fantastic Midget Mustang . . . just because the KR-1 is quick and relatively easy to build?

In my opinion this matter should be approached positively. EAA does its best to promote high standards of craftsmanship, maintenance and pilot performance. We want to see **every** builder of **every** homebuilt and **every** restorer of an antique, classic or warbird educate and discipline himself so as to produce an aircraft that is soundly constructed, aesthetically appealing and safe to operate.

(More illustrations on Page 44, Text continued on Page 49)

THE WICKS ORGAN KR-2

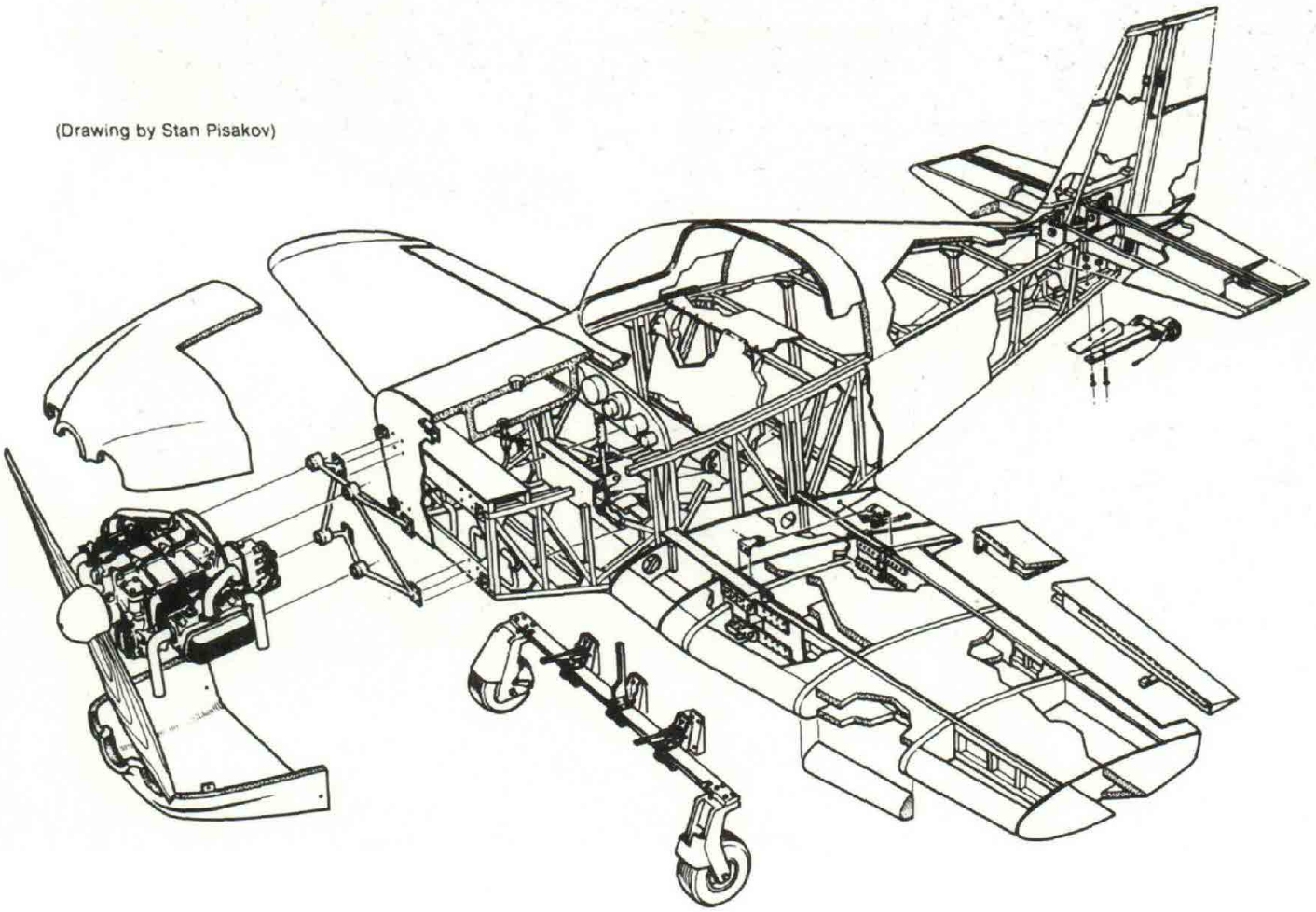
One of the surprises — and wonders — of Oshkosh '74 was the KR-2 built in 74 days by the Wicks Organ Company of Highland, Illinois. Constructed as a commercial venture to promote their materials kits for the KR-1 and KR-2, the tiny tan two-seater was started on May 16, 1974 and was flown for the first time on July 27 (although at Oshkosh a sign on the aircraft listed July 28 as the completion date). Wicks Organ employees Richard A. Haase (EAA 58611) and Mel Smith did the actual construction work and George H. Gibbons, company vice-president, did the initial test flight (and, due to insurance restrictions, has been the only one to fly the 100 or so hours the little bird has accumulated as of early February, 1975). It was flown to Oshkosh on a strict "there and back only" waiver to its previously prescribed operating limitations . . . thus giving Convention goers the unique opportunity to see two examples of a new design in its national debut rather than the far more common routine of the-prototype-this-year-and-a-plans-built-copy-three-to-five-years-later.

The Wicks' KR-2 also gave EAAers the opportunity to see an example of the design that undoubtedly will prove to be more representative of what builders will do with their own projects than Ken Rand's prototype. Prototypes are often cut and fit affairs intended to prove out the accuracy of the plans and are not noted for Grand Champion caliber finishes and interior appointments. More often than not, they also turn out to be the lightest examples of the design ever to be produced. Ken's N-4KR fits both descriptions.

Wicks' N-100MW was both more carefully finished and heavier than the prototype, the former at least partially responsible for the latter. A larger, heavier engine with a full electrical system, a simple but tasteful interior, heel brakes (rather than the prototype's rudimentary "grab the cable and pull" set-up), a slick exterior finish and craftsmanship worthy of the makers of fine pipe organs all contributed to an empty weight of 555 pounds — an increase of 125 pounds over the prototype. A major weight producer was the substitution of a built up seat bottom rather than the canvas sling used in Ken's N-4KR. The gross weight of N-100 MW has been upped to 1000 pounds.

If past history means anything, the 555 pounds empty weight of the Wicks Organ KR-2 is closer to what most of you builders are going to come up with than the 430 pounds of Ken Rand's prototype, no matter how much Ken implores you to "keep it light". Therefore, you better be prepared to go to the bigger engines available if you expect to get anything near the performance Ken gets with his featherweight. Wicks uses the 2100cc Revmaster which cranks out 80 hp while consuming about 4 gallons per hour. George Gibbons reports that he is getting a cruise speed of 140 mph and a balls-to-the-wall top of 165. Rate of climb is in the 800 to 900 fpm range. Significantly, this has been with the originally fitted propeller — no experimentation has been done to date, so, undoubtedly, some improvement can be expected with an optimum propeller. At least

(Drawing by Stan Pisakov)



THE KR-2 . . .
(Continued from Page 42)

There will always be an ocasional, isolated case of inferior workmanship, but this should not be used as justification to universally condemn a particular design or class of designs. I believe that if we concentrate on improving the minds and hands of the builder, we won't have to worry about the aircraft they produce. End of sermon.

And speaking of people, as opposed to machines, what about these fellows Rand and Robinson? Who are they? How did they get where they are today?

Ken Rand is, of course, the more widely known of the two. He serves as president of Rand Robinson Engineering, Inc., the company formed to market the KR-1 and KR-2 plans and materials kits. An extrovert's extrovert, Ken is the firm's spokesman, its PR man. He is an electronics engineer by training, having taken his degree from the University of Illinois in 1958. The big deal in employment in those days was aerospace, so Ken moved west to Los Angeles to work for Douglas. He remained with this firm until the big aerospace slump of the early 70s when he went with Zerox, his present employer. An airplane nut since childhood, Ken was an avid RC modeler for many years and evolved the foam and Dynel process from his models. He is a low time pilot, with a total of about 300 hours — most of which have been in the KR-1. Ken cites himself as proof that the KR-1 and 2 can be flown by relatively inexperienced pilots.

Stuart Robinson is virtually the Invisible Man. Involved in the project — now the business — from the start, he remains unknown beyond the Los Angeles area . . . by choice. He prefers to let ebullient Ken do the talking. Stuart is Vice President of Rand-Robinson and now works full time handling the plans and materials kits sales. He was also previously employed by Douglas. Stu graduated from the Northrop Institute of Technology with a degree in aeronautical engineering and is an A&P. Also a pilot, he has about 500 hours.

Ken and Stu are involved in several experimental projects such as:

* The KR-1A, an improved version of the KR-1. It will be beefed up to take the 1834 Revmaster, which punches out nearly twice the horsepower that was available on the original KR, the balanced ailerons of the KR-2 and 16 gallons of fuel in each wing. If this bird has the speed and range Ken thinks it will, then some F.A.I. records are going to be in jeopardy.
* A long winged KR-1 . . . 37 foot span, in fact. This is intended to be the homebuilder's alternative to the RF-4 powered sailplane. The high aspect ratio outer wing panels could be retrofitted to existing KR-1s. A larger rudder will probably be required, however.
* An amphibian, probably to be designated the KR-3 and . . .
* A VW twin.
* A 720 channel VHF transceiver with push button selection of frequencies and digital readout . . . fully FAA and FCC approved and selling for hundreds of dollars less than anything comparable on the market today.

What hath Foam wrought?