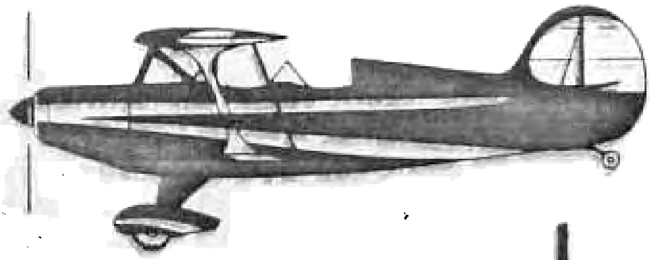

SKYBOLT NEWS

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SERIES#3 VOL.#4
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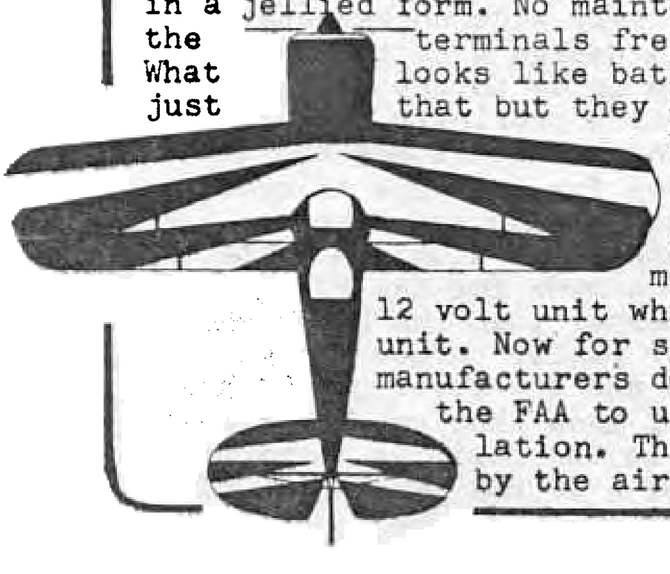
FIRST CLASS MAIL

TO:

HANGAR FLYING with MAC

You have probably been reading in recent months about a battery that has come on the homebuilt scene called the GEL/CELL. It is manufactured by the Globe Battery Co., Milwaukee,Wisconsin. In case you are wondering what a GEL/CELL is, a brief description is in order. The major difference between it and a common lead/acid battery is the electrolyte. The common battery uses acid in a liquid form whereas the GEL/CELL uses the same acid in a jellied form. No maintenance is required other than keep- the terminals free of corrosion and the case clean. What looks like battery caps on top of the case are just that but they are not removable. The battery we talking about measures 7 3/4" long x 5 1/8" wide x 7" high, actually 5/16" less in height than a standard PS6-9 but the same in all other measurements. The PS6-9 is a 25 amp. 12 volt unit while the GEL/CELL is a 30 amp. 12 volt unit. Now for some personal observations. Battery manufacturers do not and can not obtain a PMA from the FAA to use any battery in an aircraft installation. The PMA must be obtained from the FAA by the aircraft manufacturer (Piper, Cessna



Beech, Mooney etc.) I am always on the lookout for new (or old) products that can be used by the custom builder, that are airworthy. The GEL/CELL looked like a natural so I picked up the phone in early March and called the Globe Battery Co. I asked the following question. " Is your GEL/CELL battery designed specifically for aircraft as I have read in the ads in Sport Aviation magazine?" (Dealer Ad). Now anyone in his right mind knows what to expect in the form of a reply from the Sales Dept. whether their product is good or bad. Right ? Wrong in this case. The Sales Dept. was honest and candid in their reply. The GEL/CELL is an industrial battery designed for high vibration applications and has found wide ranging uses including the snowmobile and self-powered wheel chair fields. What I was reading in the ads was probably one persons interpretation. They went on to further state that no aircraft mfg. had as of the time of my phone call obtained a PMA to use this particular battery. However, Pitts and Great Lakes had previously received a PMA for the smaller 6 volt GEL/CELL which were used in series to produce 12 volts. I thanked them for the information and that ended the conversation. I would imagine that it won't be long before some of the mfg'rs. will get a PMA for the 12 volt GEL/CELL but in the meantime, "Why in HELL can't people tell it like it is ?"

Many of you probably have found out as I have that the PS6-9 battery is a marginal unit when it comes to cranking a 540 LYC. even when new. If the 540 gets a little temperamental you can bet your "sweet patooties" that the jumper cables are going to be required in short order. The GEL/CELL with it's additional 5 amps offers an advantage. How much of an advantage I can't personally say. What the expected life of the GEL/CELL is or it's dis-advantages are, only wide spread use and time will tell. I have tried to design a battery bracket for the GEL/CELL but have given up do to the design of the top cover of the battery which prohibits the use of a simple hold-down frame. The terminals are too close to the edge and there is no room for any type of cross straps. I therefore suggest that should you plan to use the GEL/CELL, that you install an aluminum battery box, properly supported, that is made for the PS6-9. Since the GEL/CELL is 5/16" shorter than the PS6-9 you will need a thick rubber pad or rubber padded blocks between the top of the battery and the cover of the box. Last but certainly not least, I know that you are really going to like the square hole in the positive terminal. "ANYONE OUT IN THE AUDIENCE GOT A COPPER CARRIAGE BOLT IN THEIR POCKET ?"

A STITCH IN TIME IS FINE.....BUT CROCHETING IS BETTER

by Jim Alexander

(Re-print from Chapter 443 Newsletter)

Darrell Todd 674 Ross Rd., Columbus, OH. 43213 a "Bolt" building partner of Jim Alexander has been kind enough to send us the following article that Jim wrote for the EAA Chapter 443 Newsletter. It is a timely tip for many and we are happy to pass it on.

"Rib stitching can offer more than enough challenges to one's patience and understanding even considering the best of circumstances, working around pulleys, brackets, push rods, bellcranks, electrical bundles and pitot lines. But the aircraft builder is in for a real soul trying experience when he rib stitches around wing construction such as is found in the Skybolt.

The problem lies in the compression rib design which occurs at every third rib. The compression loads are born by a 3/4" square member running from front spar to rear spar and glued to each side of a standard rib and centered on the rib reference line. In other words it's smack,dab in the way of the rib stitching needle!

Several of our attempts at beating the problem resulted in curved, spiraled needles, bent soft wire probes,etc. All were successful after a fashion, however, using these devices proved time consuming to the point of complete discouragement.

The problem was finally solved by the Crochet Method which was invented out of desperation. A 12" length of 1/16" brazing rod was flattened on one end and a hook was cut and filed into it to form something like a crochet hook. Another piece of weld rod was prepared and a two pronged "pickle fork" design was fashioned at it's flattened end...

After poking a hole with the pointed end, the rib stitching cord was doubled and stuffed thru the fabric at the proper location with the pickle fork and at an angle which would miss the offending compression member. From the opposite side of the wing the hook was thrust through the fabric after a hole was made with pointed end at a similar angle and manipulated so as to catch the loop of the cord held by the fork. The captured loop could then be pulled through and the process repeated..

Only a small amount of skill was needed to perfect the technique. Surprisingly, it proved to be almost as fast as conventional stitching. I am sure this solution could not be a first in the world of aviation; others have probably thought of it before. But it was a triumph to us and, hopefully worth passing on."

FIG.#1 tells the rest of the story.

Jim: If Wichita was still knocking out tube and rag kites, you could have sold your idea and retired.... Will someone please pass me the "Pickle Fork" ?

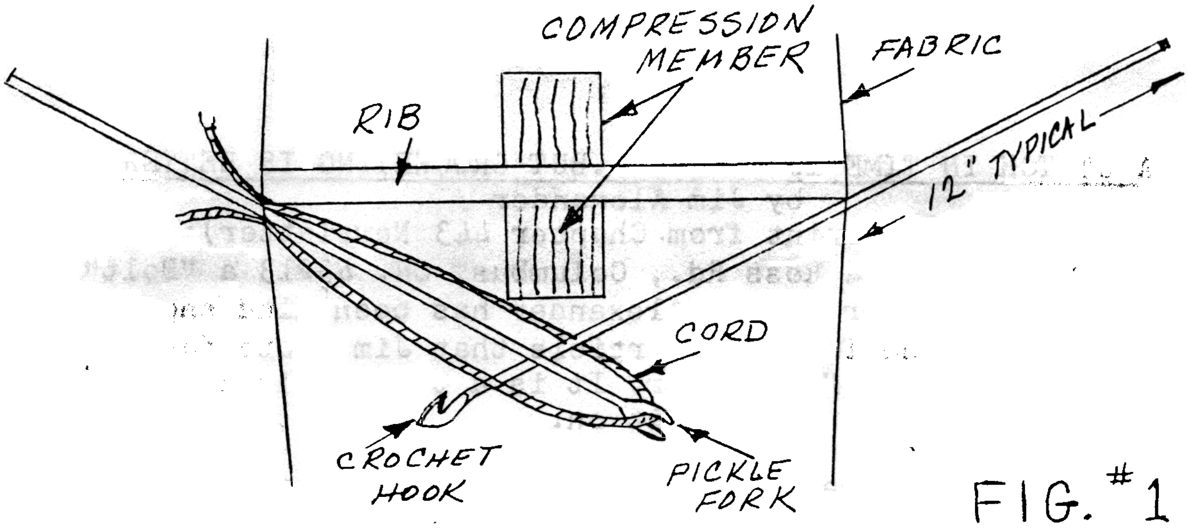


FIG. #1

ELECTRIC TRIM TAB INDICATOR

In Jan. 1977 issue I wrote an article on the installation of a Servo-Trim Tab control system. Included in the article was a drawing of a simple Trim Tab Indicator (mechanical) that attaches to a Vernier Cable Assembly. The Cable and Indicator all mounted together on a couple of pieces of tubing welded to the rear set frame. Some builders are mounting a Christen Wobble Pump/Fuel Selector Valve on the floor at the left front corner of the rear seat and consequently do not have room to mount the Trim Control and Indicator, because one component interfers with the other from an operational standpoint. Since most Custom built aircraft have electric systems installed we have in the Electric Trim Tab Indicator, a different approach to the problem of what to install in the way of an indicator.

In FIG#.2 we see an Electrical/Mechanical schematic of the system. I designed this system about 5 years ago but have never installed it. I was saving it for a special project that I am working on. The system operates on elementary electrical principles (the only kind I can understand). Take a GOOD LOOK at FIG.#2 and the way the potentiometer is mounted. This is a must. Whatever the total angle of travel in your system turns out to be, you must mount the POT so as to use the same number of degrees of travel at the beginning of the POT rotation or at the end of the POT rotation. Now to back up and start over with the description of the system.

The indicator itself is a converted fuel quantity gauge. One side of the Gauge is hooked up to 12 volts (+). The

The other terminal of the Gauge (–) is hooked up to the center terminal of the Pot via #20 insulated/ flexible wire. Depending on how you select to install the Pot will determine which of the 2 remaining terminals of the Pot is connected to ground. The Pot will now control the Gauge by varying the resistance of the negative side of the Gauge. To determine the size of the Pot required, we must first know how much resistance is required by the Gauge to produce full scale travel of the needle. Most Fuel Level Gauges are in the 90 to 150 ohm resistance range. If you connect the Neg. terminal of the Gauge directly to ground, the Gauge will respond by showing "FULL". To determine how much resistance is required to bring the needle of the Gauge back to "EMPTY" can be found out by contacting the Gauge mfg. or taking the Gauge to a TV repair shop and having the man put a variable resistance checking unit on your Gauge. Once we know the resistance required by the Gauge we must determine the size of the Potentiometer to use. First of all, the Pot. will be of 1 watt size. This size is not a matter of current capacity, but rather a matter of physical size which makes mounting the Pot an easier job. Secondly, to find the resistance of the Pot required, we use the following formula.

EXAMPLE

GAUGE UNIT IS 120 OHM UNIT

POTENTIOMETER LEVER WILL TRAVEL 60° (TOTAL)

POTENTIOMETER LEVER TO TRIM TAB LEVER RATIO = 1:1

$$\frac{270^\circ \text{ (TOTAL POT. RANGE)}}{60^\circ \text{ (LEVER TRAVEL)}} = 4.5 \times 120\,\Omega \text{ (OHMS)} = 540 \text{ OHMS}$$

POTENTIOMETER REQUIRED = 540 OHMS – 1 WATT

It will be necessary to re-work the face of the Gauge so the needle will point to marks or other ledgend that describes what the trim tab is doing. I suggest that you cover the exsisting face of the Gauge with some bright color Mylar which is available at any Hobby Shop. The ledgend on the indicator face is printed using "Press-Type" which is available from Art Supply Stores or Drafting Supply stores. You will notice that I intend to mount my Gauge on it's side so that the needle of the Gauge looks like the Trim Tab that it is indicating. There's one big advantage to this Trim Tab Indicator system.

When you look at the instrument panel or some other easy to see location, you can immediately see the position of the Trim Tab Indicator needle without twisting and turning your head to read it. The Elec. Indicator system is also lightweight enough to warrant it's use.

One point that I would like to make is that whatever the resistance required for the Pot., it may be necessary to change the mechanical advantage (length of operating levers) to coincide with a Pot. that is readily available. In the formula that we used earlier it was determined that a Pot of 540 ohms would be necessary, in order to use a 120 ohm portion of the Pot. in 60 degrees of rotation of the Pot. lever. The closest thing on the dealers shelf would most likely be a 500 ohm Pot. You might be able to get a 550 ohm unit but I seriously doubt it. A 550 ohm Pot would work very well in our circuit. However, a 500 ohm unit will also work well except that we will have to change the Pot. lever to trim tab lever mechanical advantage ratio. Instead of driving the Pot. lever through a range of 60 degrees of travel, we must change the length of the Pot lever (shorten it) to produce a Pot shaft travel of 65 degrees. This would give us a resistance measurement of 120.37 ohms. How do we get that you say? Use the following formula.

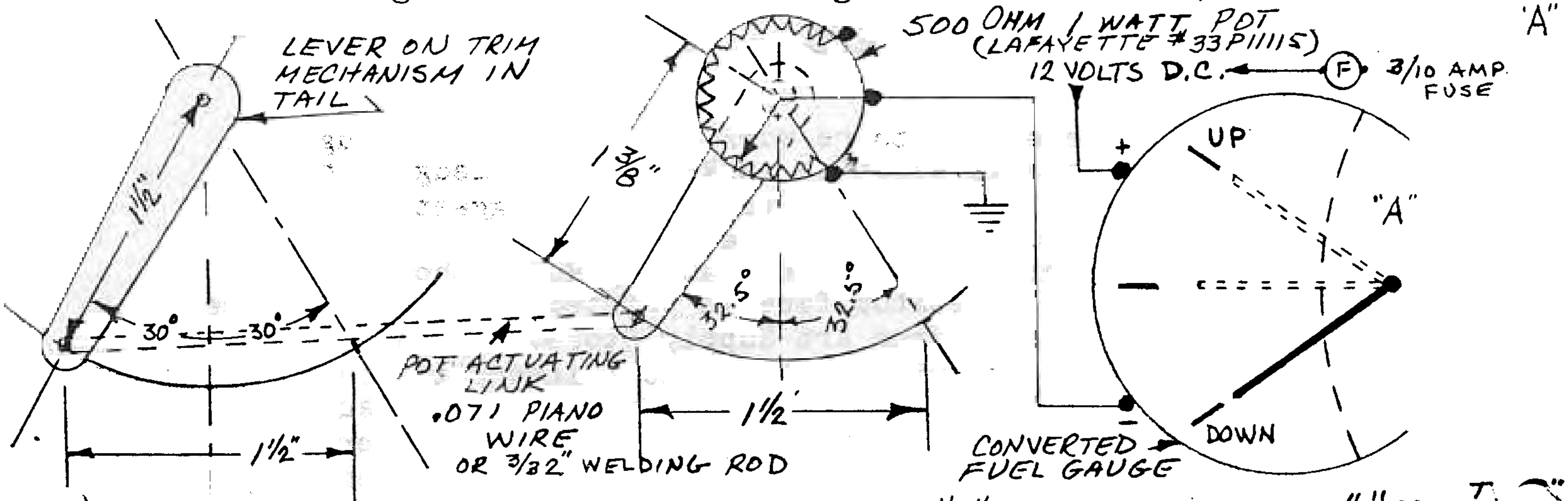
"PRESS-TYPE" (OUTLINE LETTER STYLE)

$\frac{500}{270}$ Equals 1.8518518 x 65 equals 120.37 ohms

If the original levers were each $1\frac{1}{2}$" long we would get a length of travel of $1\frac{1}{2}$" (Stroke) in 60 degrees. Since 65 degrees is roughly 8 % greater than 60 degrees we must shorten the length of the Pot. lever by 8%. This would give us a Pot lever length of 1.38" or 1 3/8"

NOSE

FIG. #2



MOUNT POT IN TAIL NEAR TRIM LEVER

NOTE: "A" USE "OUTLINE STYLE" "PRESS-T" ON INSIDE OF GAUGE LENS. PAINT OR COLOR INSIDE OF LENS AS SHOWN BY DOTTED ARC

UPPER WING CONSTRUCTION (PART ONE) THE SPAR SPLICE

Once again we come back to our "Good 'Ole" set of plans that leaves us in the dark. One of the most important aspects of constructing the wings is not shown. The Sweep Back Angle of the upper wing spars. If you are splicing your own spars it would be nice to know that the angle is 6½ degrees. Another measurement that is not shown is the spacing of the upper spars. Sure, the plans tell you that the spacing is 23 1/8" between centerlines of the spars at a point where the centerline of the ribs intersect the spars, but the distance between the aft face of the front spar and the front face of the rear spar at 90 degree angles would be one helluva lot more useful. That measurement is 21 31/32". This is the reason that you cannot use the lower wing spar racks to build the upper wing. Before we start the spar work for the upper wing you might just as well stop right now and make 6 spar racks the same way you made the racks that we show on Page 8 of the Dec.'77 issue. The only measurement that is different is the spacing mentioned above. The height of the blocks remains the same as well as the length of the base.

I am assuming that the 4 pieces of timber that you have in your posession are 12 feet long and the edges are <u>NOT</u> beveled <u>AND</u> the ends of the spars have NOT been tapered. To taper the ends of the spars and cut them to length before you make the splice is sheer folly. It can only be done with and industrial set-up like that which Spar Craft uses. If the spars have been beveled the job can still be accomplished but the task is much more difficult.

Before clamping the spars in the racks, be sure that the end you are going to splice has a nice smooth 90 degree cut. I am taking it for granted that you have your spar benches set-up for the sweep-back of the wing and that the butt joint of the 2 tables is perfect and the tables are level in all spots.

The next step is to place the spars on the spar racks and bring the ends together directly over the parting line that is formed by our 2 tables, where they butt together. Using a very sharp pencil (.05mm drafting pencil is good) layout a 6½ degree line on the top edge of the spars. Use the aft edge of the spar at the corner to layout the 6½ degrees. Now lay a <u>good straight edge</u> along the 2 lines you have just drawn (one on each spar) and check to see if they are indeed straight in line with each other. If they do not, stop right now and find out why. FIG.# 3 gives an illustration of our efforts up to this point.

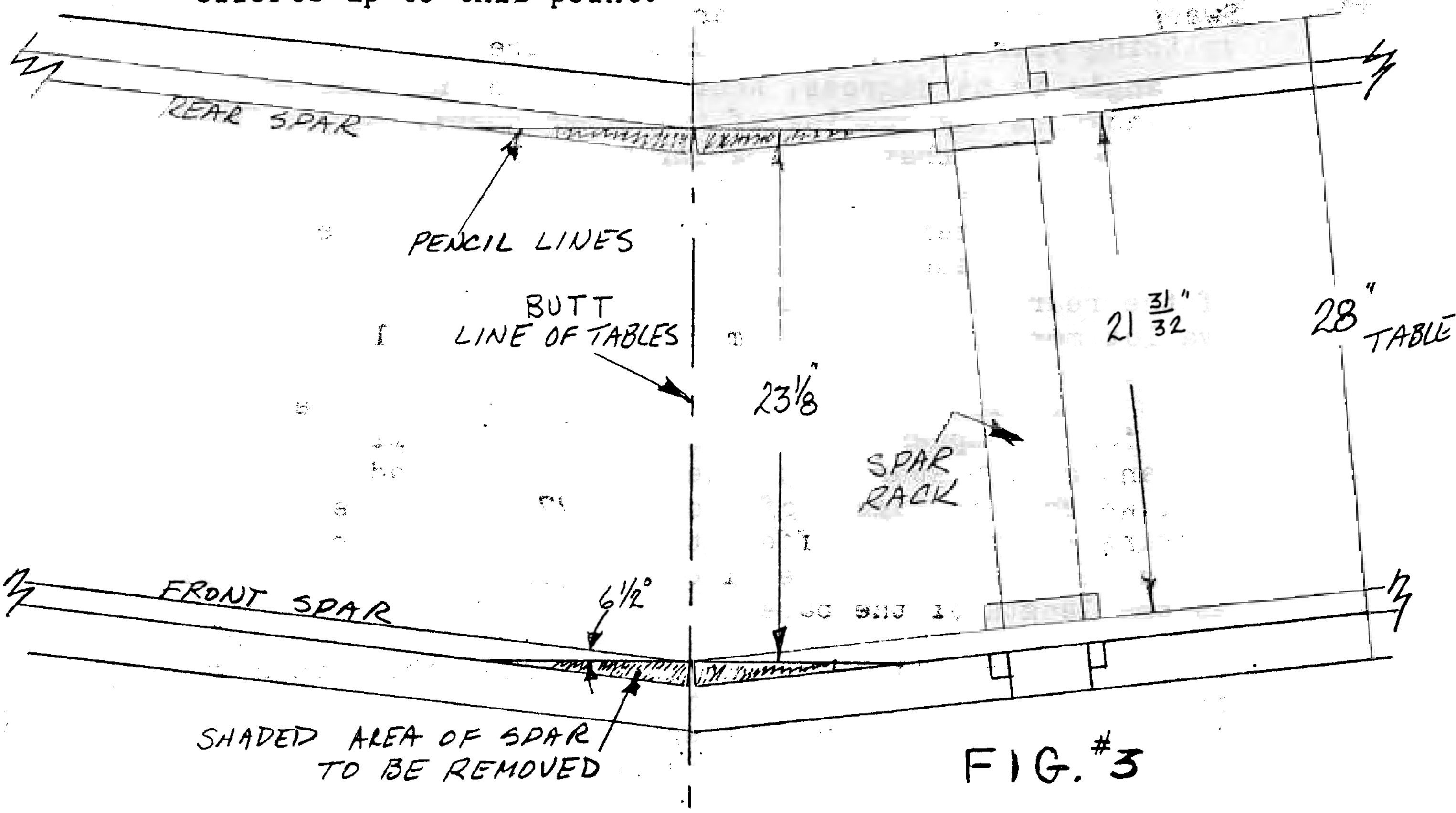


FIG.#3

Now that we have established the 6½ degree cut line on the top edges of the spars we must establish the same lines on the other edge of the spars. To do this we switch the spars from left side to right and vise versa as well as turning the spars over to expose the other edge. After we have gone through the same steps to pencil the 6½ degree lines, make some index marks on the spars at the edge of the spar racks so that we can remove and replace the spars on the racks at will without having to spend a lot of time re-aligning them.

The next step in the splicing operation will be to make the rough cut and remove the surplus wood that is shown in FIG.#3 by the shaded portions. I use a plain cross cut hand saw to remove the surplus portion after I have clamped some scrap blocks to each side of the spar. FIG.#4 shows what I mean. After the initial cut has been made with the hand saw I clamp the spar and the scrap blocks to the end of the workbench and finish the job with a hand plane. The blade of the plane must be kept super sharp. We use the pencil lines that we have made on the edges of the spars as a guide to the 6½ degree scarf that we are cutting. This planning operation is a slow and tedious thing with constant checking with a good straight edge to make sure that the surface of the scarf cut is true. To check the cut we hold a straight edge on the scarf area and sight under the straight to be sure that we cannot see any light under the straight edge. It helps to have a light in the background or a piece of white paper behind the straight edge.

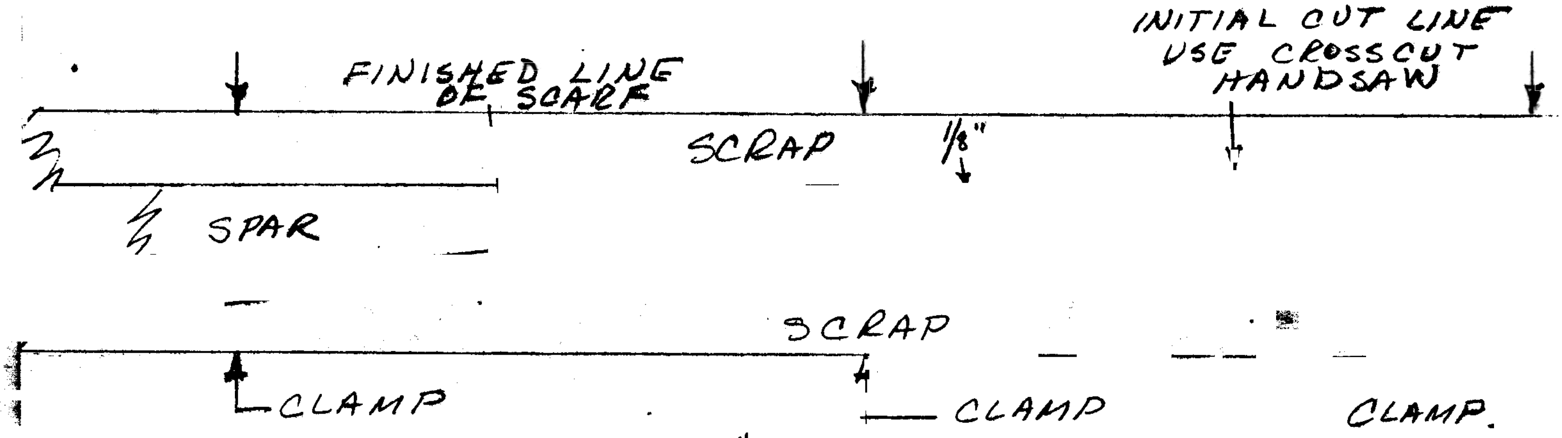


FIG. #4

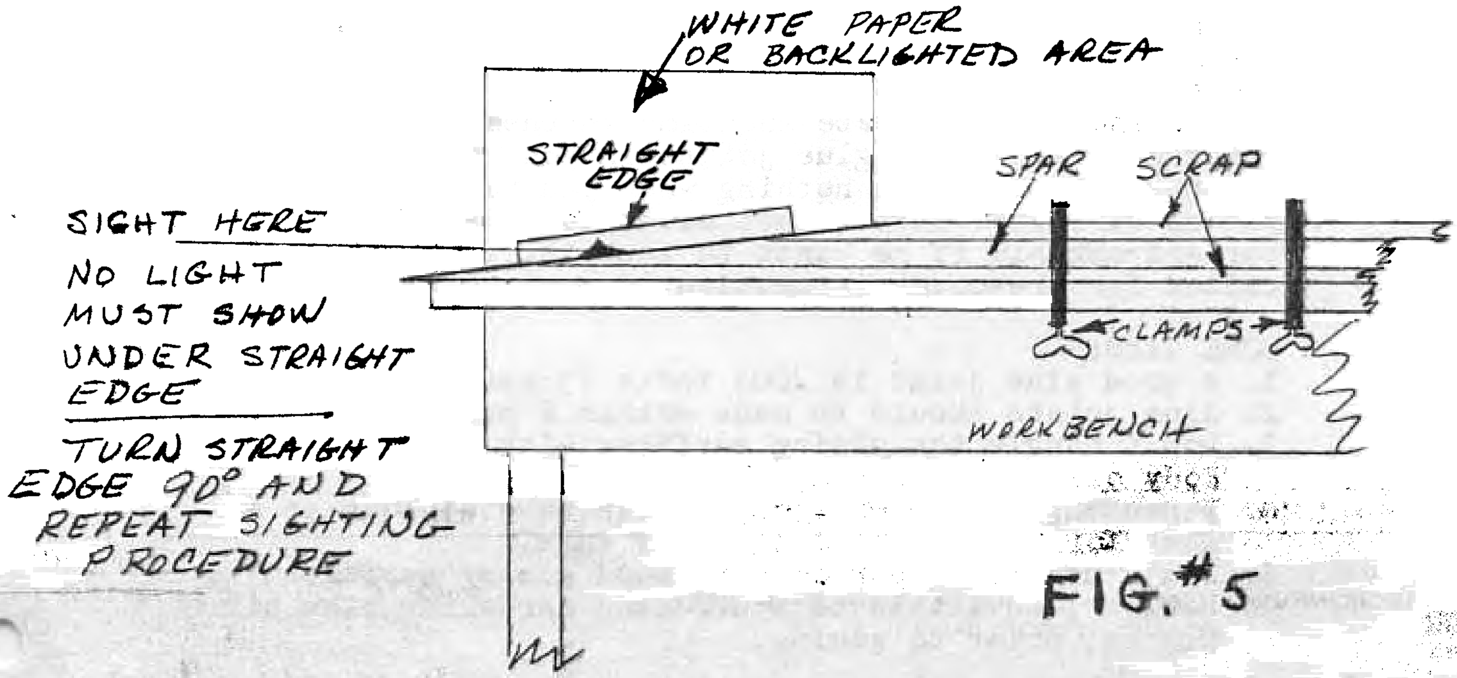


FIG. #5

It is imperative that you keep the scrap blocks in place as you plane the scarf of the spars in order to prevent rounding of the edge at the thickest part of the scarf and to avoid splintering of the knife edge portion of the scarf.

When the spars have been scarfed, they can be replaced on the spar racks. Now the re-inforcement blocks can be measured and scribed (the Vee shaped block). The narrow ends of the Vee shaped blocks should be approx. 1/8" thick when finished. In other words, we do not plane a knife edge on the Vee blocks. Once again, as you plane the scarf joint edges on the re-inforcement blocks, use a straight edge to be sure that you have a true surface. This also applies to the flat surface of the straight blocks that are used on the front sides of the splice joints.

Now that all pieces are ready to go together, finish beveling and tapering the spars. Put the spars back on the spar racks. At this time, the re-inforcement blocks are not beveled. This will be done after the glue joint has been made. You can now prepare for gluing. Get ALL of the clamps ready (open to approx. size) as well as the scrap blocks that you will use to protect the spars from the clamps. I suggest that you put a layer of plastic shipping tape on the surface of the scrap blocks that contact the splice blocks. NOW IS THE TIME TO MAKE 3 OR 4 TEST BLOCKS.

You are now ready to glue the spar splices. If you are using T-88 Epoxy the splice will not require high clamp-in pressures. As you clamp the joints together be sure to check against the re-inforcement blocks having slipped after the clamps have been applied. Re-check them frequently for the first 4 or 5 hours. Glue your test blocks and mark the date and time on them for future reference. Make good glue joints on your test blocks or they will tell you nothing when you test them for gluing strength. Save 1 test block for the FAA inspector and ask him if he wants to test it, at the time he called for pre-cover inspection.

SOME TIPS:
1. A good glue joint is .005 thick (joint accuracy) max. .010
2. Glue joints should be made within 8 hours after pieces are re
3. Don't handle the gluing surfaces with your fingers. Body oils can affect gluing strength.
4. Depending on temperature, It can take as long as 1 week for a glue joint to fully cure.
5. Don't use sandpaper on soft wood gluing surfaces. It is however, advisable to scuff sand hardwoods like birch plates, prior to gluing.

LOWER WING CONSTRUCTION (PART 4)

We are now ready to build the lower ailerons. One of the lower wing panels can be removed from the spar bench and stored while we utilize to spar racks for constructing the ailerons.

Place the aileron spars against the aileron opening in the wing and check for proper length and gap at the inboard end. Mark the location of the ribs to align with the matching ribs on the wing. You can now glue on the ribs and birch plates.

The next step, and a very important one it is, has to do with the mounting of the Aileron Hinges. Using small "C" clamps, we clamp the forward half of the hinges (Rod End Bearing Portion) in position on the aft face of the rear wing spar. The rear half of the Aileron Hinges are clamped in position on the aileron spar and aileron brought into position on the wing. Line up the hinge assembliesand put the hinge pivot bolts in place. At this point we examine the alignment of the aileron with the wing. Do the trailing edges match? Do the top and bottom surfaces of the aileron match the wing? Do you have enough clearance between the nose of the aileron ribs and the trailing edge of the wing ribs to install the gap fairing ? The thickness of fabric and surface tapes on the wing and the leading edge of the aileron will materially reduce the aileron gap clearance(Approx.1/8") This possible problem must be dealt with,NOW. If you feel that additional clearance is required, you can glue 1/16" or 1/8" (whatever is required) birch shim plates to the aileron spar at the hinge mounting point which will move the aileron rearward to give you the desired clearance. You can now drill the aileron hinge mounting holes.

Don't forget to glue in all of the necessary corner blocks the same as you installed them in the wing. The plywood leading edges can now be made and fitted. The upper plywood skin can be glued in place . Before doing so however, lay the bottom skin in place and mark with a pencil, all of the glue joint areas on the inside face. These are the areas that we do not want to varnish. The lower skin will go on last after we have balanced the ailerons since we will want to have access to the aft side of the leading edge stringer to attach lead weights. The aileron can now be varnished and the trailing edges installed on the wing and the aileron. Remember, we are going to use soft flat head rivets to install the trailing edges. I am assuming that you have at this point, already re-inforced the trailing edges of the aileron ribs with 1/8" birch the same as the wing ribs.

Review the Oct.'77 issue of Skybolt News (page 9). Be sure you have installed the fabric bracing diagonal members in the wings and ailerons. You can now install the wing tip bows. The lower wing panels you have just built should now be coated with at least 2 coats of Varnish. Stits Epoxy Varnish or Stits Urethane Varnish (2 parts) offers excellent long lasting protection. DO NOT INSTALL THE LEADING EDGES UNTIL THE WINGS HAVE BEEN SIGNED OFF FOR COVER BY AN FAA INSPECTOR.

BALANCING THE AILERONS

We jump ahead of ourself at this point and consider that the wings have been built, rigged and "I" struts made. At this time the ailerons (still un-finished) can be mounted on the wings in preparation for making the slave struts and balancing. See the Apr. '77 and June '77 issues of Skybolt News regarding Slave Strut and Slave Strut mounting Bracket construction.

In preparation for balancing the ailerons be sure that all ailerons move freely, the slave strut is installed and also moves without rubbing the wing or binding in any way. The aileron actuating link between the aileron and the bellcrank is dis-connected at the aileron. Place the un-finished lower plywood covers of the ailerons on top of the ailerons so that we use their weight in the balancing process. At this point, remove the slave struts. At a point midway on the aft side of the aileron nose stringer, drive a #20 wire nail part way into the stringer To this nail attach a short length of .020 or .025 wire. Now add weight in the form of pieces of steel or lead, whatever you have that is convenient, to the suspended wire until the aileron is perfectly in static balance. Record the weight used after weighing on an accurate scale. We can now determine what percentage of the ultimate weight that we use in the final balancing will be installed on either the upper or lower aileron. The total weight that is required for perfect static balance with the slave strut installed must be proportionally installed on both ailerons per the percentage formula that you have already determined in the first balancing operation. I suggest that you use 3/8" lead wire flattened with a hammer and screwed and epoxied to the aft side of the nose stringer. The necessary weights should be evenly distributed along the stringer. Placing the required weight as herein suggested will result in less total weight since we will be as far forward of the hinge point as is possible. After the ailerons have been covered and the final finishes applied, the ailerons will no longer be in perfect static balance which is the desired final results. In other words, the aileron now has a different resonant vibration frequency than the wing which prevents wing and aileron frequency coupling and very possible