SKYBOLT NEWS

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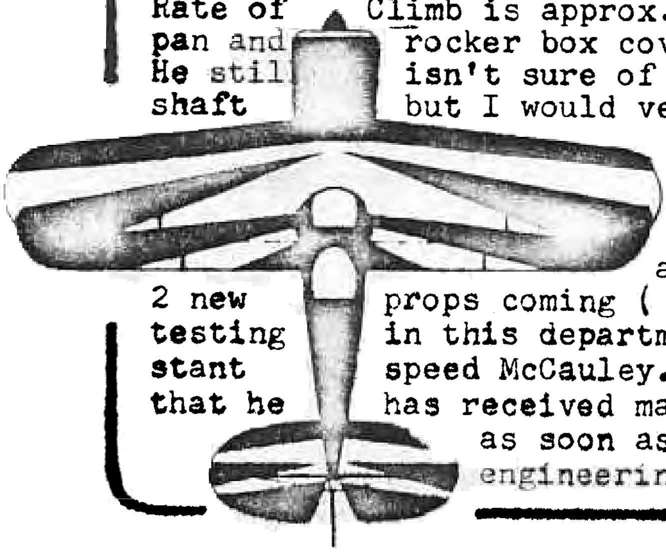
FIRST CLASS MAIL

TO:

UPDATES AND NOTICES

Due to the many requests about the Alum. Oldsmobile V-8 Eng. I have called Geo. Morse at Auto Aviation Development Co., 2004 Koopman Ave., Santa Cruz, Calif. Having just hung up the phone, I pass along the following information as a result of our conversation. He has now completed 120 hours of flight in his Skybolt with the above engine. Cruise speed at this time is 130 MPH at 23" of Man. Press. and 2300 RPM. Fuel consumption is running from 7.5 to 10.5 GPH. using a PS5BD Press.Carb Rate of Climb is approx. 1800 FPM. He has replaced the oil pan and rocker box covers (steel) with Alum. replacements. He still isn't sure of the Horsepower output at the prop shaft but I would venture a guess that it is in the 180 HP. range. He feels that the prop he is swinging is too large for the engine and that he is not able to turn the crankshaft at speeds that are capable with this engine. He has 2 new props coming (one is a 3 blade) and plans further testing in this department. His current prop is an 82" constant speed McCauley. He asked me to relay the message that he has received many inquiries and will answer them as soon as he can. There is still a lot of engineering to do to reach his goal of 260HP.



WEST COAST SKYBOLT FLY-IN

The West Coast Fly-In is progressing quite well at this time. In a letter to this writer, Marsh Freeman states that the owners of 12 flying "BOLTS" have responded along with a whole bunch of"nearly completes". He will be making another mailing in Jan. So far, there has been no response from the Pacific Northwest. Most of the replys have been from Southern Calif., New Mexico and Arizona. Keep an eye on these pages for the latest update.

RUDDER TRIM (BE PREPARED TO INSTALL A TAB

After talking to many Skybolt owners and viewing the field, it looks as though you might just as well prepare for installing a fixed tab or a controllable tab if you prefer. * Another way to go about it is to install a rudder trim control that regulates the spring pressure of the right rudder cable return spring.

It seems that no matter what the vertical fin offset is or whether the engine has down thrust and side thrust, you will require a constant small amount of right rudder in cruise power configuration.

You are in luck if you haven't yet covered the rudder. A small plate welded to the trailing edge and one rib makes a secure plate on which to mount the fixed tab. A couple of "2 lug Anchor Nuts"riveted to the backside of the plate makes an easy job of installing the tab if you decide that you want to and most likely will. Make the Tab at the same time so you have matched holes. Paint the tab during the painting operations and it will be ready for use at a moments notice. FIG. #1 shows how it all goes together.

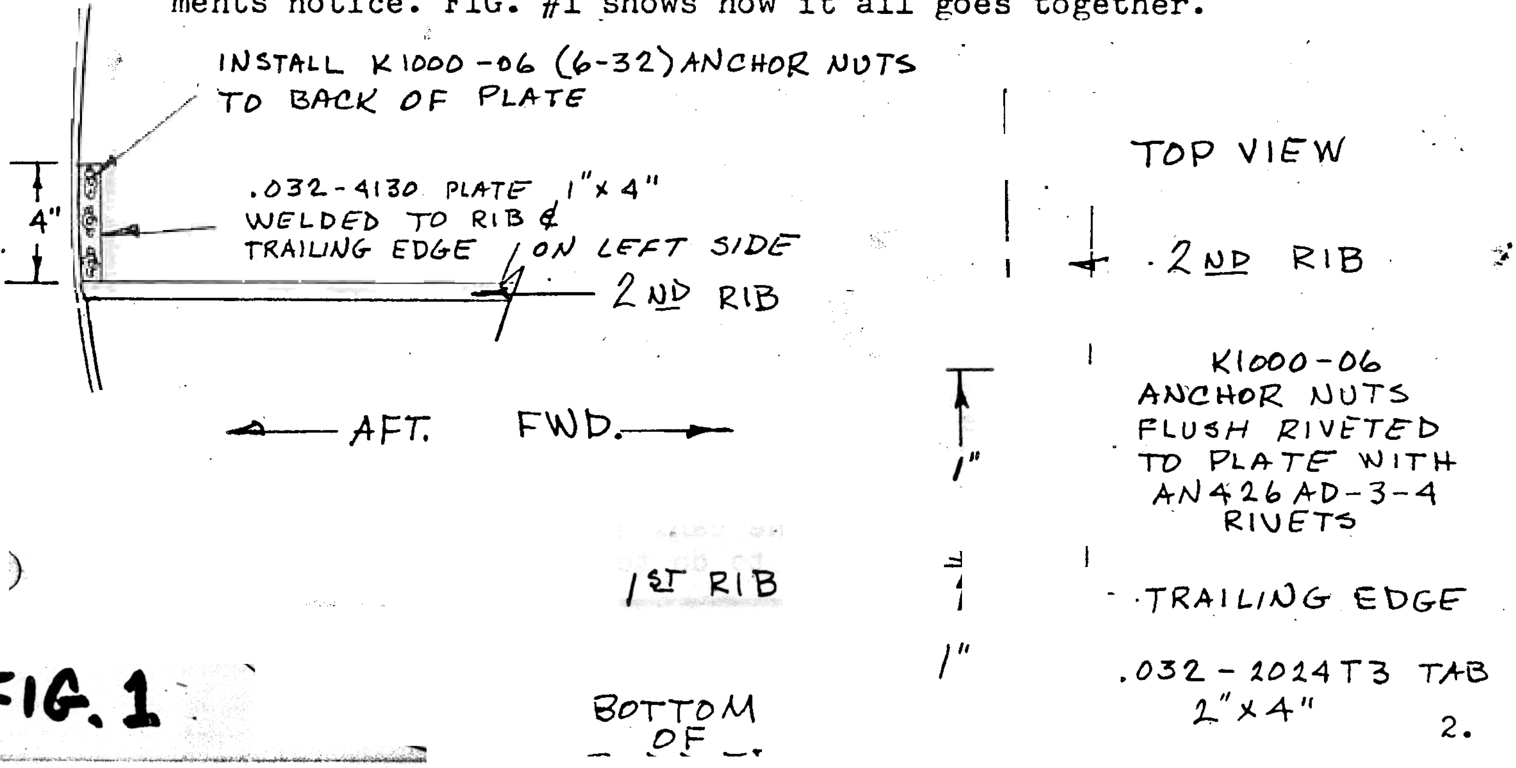


FIG. 1

While the Fixed Tab method is OK in a limited sense and I have taken the extra time to make a simple drawing as in FIG. #1, I prefer to go the Adjustable Rudder Spring Tension route. I reject the Adjustable Tab (remotely Adj.) since it adds weight and some complexity of mechanism. I'm sure that most of you are aware that a Fixed Tab is effective only at a given cruise power configuration. If you increase the power or decrease the power, we no longer have "Feet Off" trim. The same applies if we continue to move the Vertical Fin to the left. The Fin is in a fixed position and the end results are the same as for a fixed tab.Since we have plenty of Rudder area in the Skybolt, I prefer to leave the Vert. Fin on the centerline of the airframe. Torque is not a problem even with the larger engines that builders are using. Over the years I have seen aircraft with the Vert. Fin off-set so far that it resulted in a grotesque transition point where the fin meets the turtledeck. What all of this boils down to is that we are making comprimises in order to build a plane that has good cruise trim. While the offset of the Vert. Fin will help to accomplish some of our objective it will only do so much since the lower portion of the fin is operating in the turbulent downwash of the top wing, especially in Skybolts with open cockpits. To prove this point, have your front seat passenger hold his arms up and grasp the hand hold on the top wing while you are cruising. You will immediately feel the wind blowing down the back of your neck in the rear seat,dis-appear. The turbulent flow from the top wing, open cockpits and cabane struts do little to enhance the effectivness of the Vert. Fin off-set.

A potent factor in the desire of an airplane to turn left is the swirling slipstream of the prop that hits the left side of the fin and rudder. Fuselage design plays an important part in this respect and since the wings tend to dampen this effect a biplane has less tendency to do so as a result of this factor. At brake release on take-off, high power and low airspeed will show up as a decided left turn as the tail is raised. Some people call this "Torque" when actually what is happening is Gyroscopic Precession. Lower the tail and the aircraft will tend to go right. "Torque my eye". One more factor to add to "Gyroscopic Precession is the weight of the prop. The effect will be decidedly more pronounced with a heavy constant speed prop. Therefore, in high powered aircraft and as a standard take-off technique, we add power gradually and let the aircraft roll along in 3 point attitude until we gather speed. At this point as we lift the tail, the tendency to turn left will be greatly diminished.Due to the increased airspeed our rudder will be in full directional control. At this point I'll bring everything to a halt and let you read some "trim comments" from Dean M. Hall,M.D. of Fullerton, CA., then I'll be back for a final comment and drawing of a rudder spring trim control.

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November 14, 1977

Mac McKenzie
Starfire Aviation Inc.
910 Ho Ho Kam Drive
Tempe, Arizona 85281

Dear Mac:

I have some thoughts regarding the Skybolt that you might be interested in. These have derived partly from the continued flying and more aggressive aerobatics that I am doing. The first thought is that my elevator trim system is a little bit too effective. The servo part of it in particular seems to be a little bit too strong in some situations. This has not been a real problem, because it does not tend to push the controls to the stops, but recently while doing an inverted spin, I relaxed the stick in the neutral position and it spontaneously went back to the almost full forward position.

This may be relieved somewhat when I increase the horizontal stabilizer incidence from plus ½ to plus 1°. When this is done there will need to be a little less forward trim in both the upright and inverted flight modes. When we have done this, I will let you know again how the trim works. There has been no real problem with it but I have some concern that I would rather not have it so sensitive that it gets somebody into trouble.

My engine is mounted in the 0-0 thrust line. I have had to put a fair size rudder tab on. The rudder pressures are not excessive and so I have no objection to the 0-0 position. It does occur to me that a little more offset in the vertical stabilizer might be indicated. My vertical stab is offset 3/4" and I would recommend 1-1¼". This observation is confirmed on George's new 180hp Bolt even with offset thrust.

I am still getting some inquiries regarding the airplane and have referred some people to you regarding the landing gear system. Apparently I will be having a feature article in Sport Aviation in the February issue and this may bring more requests.

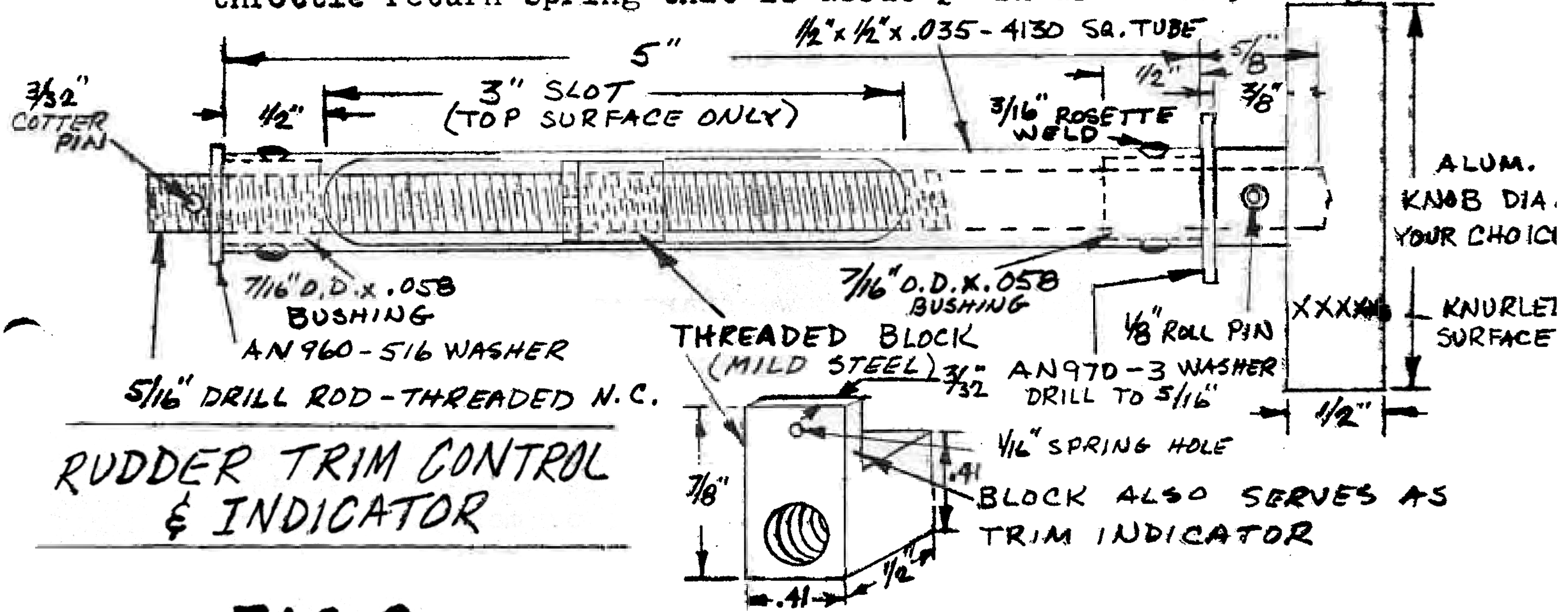
Yours truly,

Dean M. Hall, M.D.

DMH/cle

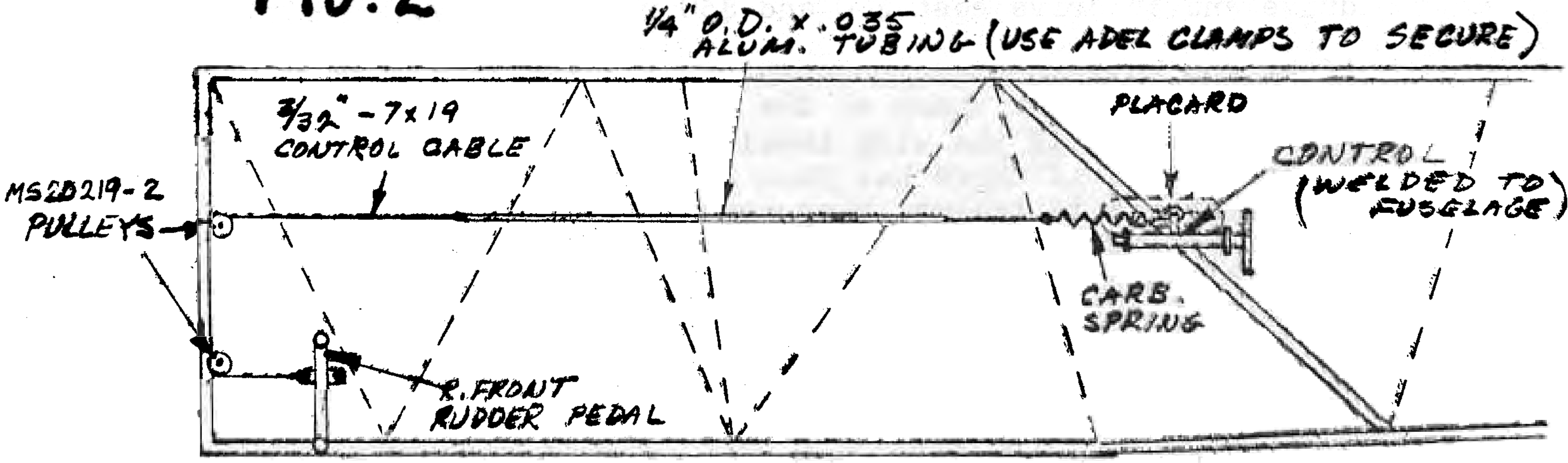
Dr. Hall has an adjustable rudder trim system in his "Bolt" but it has never really worked to well. It is operated by a Vernier Control cable. The spring that it controls is a torsional type, wrapped around one of the rudder pedal axles. I have written to him suggesting that he re-work it. I feel sure that once he has more range of control with his system, he will like it.

In FIG. #2 we see a simple Rudder Trim control system that regulates the return spring pressure on the right hand rudder cable. It is difficult at this point to tell you just what size spring to install since the frictional forces will vary from Skybolt to Skybolt. You might start however, by going to your local automotive supply store and buy a carburetor throttle return spring that is about ½" in dia. and 3" long.



RUDDER TRIM CONTROL & INDICATOR

FIG. 2



With just a small amount of additional work, the pulleys can be mounted in a canted position so the cable runs on the outside of the fuselage frame.

DRAG AND ANTI-DRAG WIRE TENSION

Several readers have written to ask about the proper tension of the Drag and Anti-Drag wires in the wings. Some builders are using wires made from 4130 rod that they have threaded themselves while others are using stainless steel wires that have been roll threaded. In either case, the Torque Method of tightening will produce proper tension. To start with, I am assuming that you still have the wing in question mounted on your Spar Bench and have used a set of Trammel Points to square the wing before you glued any ribs or compression members in place. While the spars are still clamped to the spar racks, (start with the center set of wires in lower wings) and evenly tighten the wires using a Torque Wrench. The 3/16" wires are tightened to 25 inch lbs. Next go to the outboard set and repeat the procedure. Then come back to the inboard set of 1/4" wires and tighten them to 60 inch lbs. All nuts are of the AN315 type. After all wires have been tightened, install another AN315 nut as a Jamb Nut and torque to the same value. I am also assuming that you have installed a compression member at the root ribs of the lower wings before proceeding with the tightening of the wires.

In the case of the top wing we start with the wires on each side of the center of the wing and proceed towards the wing tips, alternating from one side of the wing to the other as we go. Using the Torque Method, you will find that the wires will produce an even tone quality when plucked like a guitar string. A good set of Torque Wrenches is agood investment. Don't buy the "Cheapies". It's a waste of money. I prefer those made by Snap-on but there are other good ones available. To give you and idea of cost (They're not cheap) I paid $70 for my ¼" drive - 5 to 50 inch lb. wrench. My 3/8" drive and ½" drive cost $60 and $50 respectively.

After you have torqued the nuts on all wires, release the clamps holding the spars to the spar rack. Now, re-check the squareness of the wing involved with a set of trammel points to see if there has been any change. If there has been a change in trammel measurement, you must now go back to the beginning and re-tighten the wires in sequence without the spars being clamped in the racks. You must constantly check each bay with the trammel points as you proceed.

Since the AN315 type nut is about the same as an AN364 or AN320 with regards to the number of threads inside of the nut and the bearing face area, we use a Torque Value in the above process that amounts to 60% of the value of AN365 or AN310 Cad. Plated Nuts used on a bolt made from material of 90,000 p.s.i. strength.

NUT TORQUE

NOTE: The nut torque values listed below are for Cadmium plated, oil free threads. All values are in Inch Pounds.

SIZE	AN365 and AN 310 Nuts Tension type	AN364 and AN321 Nuts Shear type	AN 365 and AN 310 Nuts on 90,000 psi bolts	AN364 and AN320 Nuts 60% of preceeding column
8-32	12-15	7-9	20	12
10-32	20-25	12-15	40	25
¼-28	50-70	30-40	100	60
5/16-24	100-140	60-85	225	140
3/8-24	160-190	95-110	390	240
7/16-20	450-500	270-300	840	500
½-20	480-690	290-410	1100	660
Coarse Threads				
8-32				12
10-24				21
¼-20				45
5/16-18				100
3/8-16				170
7/16-14				280
½-13				520

Alum. tubing O.D. 3003-0 or 5052-0	Torque in Inch lbs.
1/4"	40-65
5/16"	60-80
3/8"	75-125
1/2"	150-250
5/8"	200-350
3/4"	300-500
1"	500-700

WING ROOT FAIRINGS

If we were building a Beech Bonanza our wing root fairing problem would be quite simple. In fact, the photo in FIG. #3 was taken of a well known Skybolt at Oshkosh '77 It shows a wing root fairing that would be perfect on the Bonanza but leaves a lot to be desired on a Skybolt. The science of streamlining has shown that where we have a flat sided fuselage with a 90 degree angle between the fuselage and the wing, we have minimum drag and no need for a fillet. When we have a rounded fuselage and dihedral angle, interference drag increases rapidly. Consequently we must clean up this area with the proper size wing root fairing. The fillet should extend from a point in front of the wing to a point aft of the trailing edge. The radius of the fillet should be ½ the thickness of the wing. In our case this is 2½".

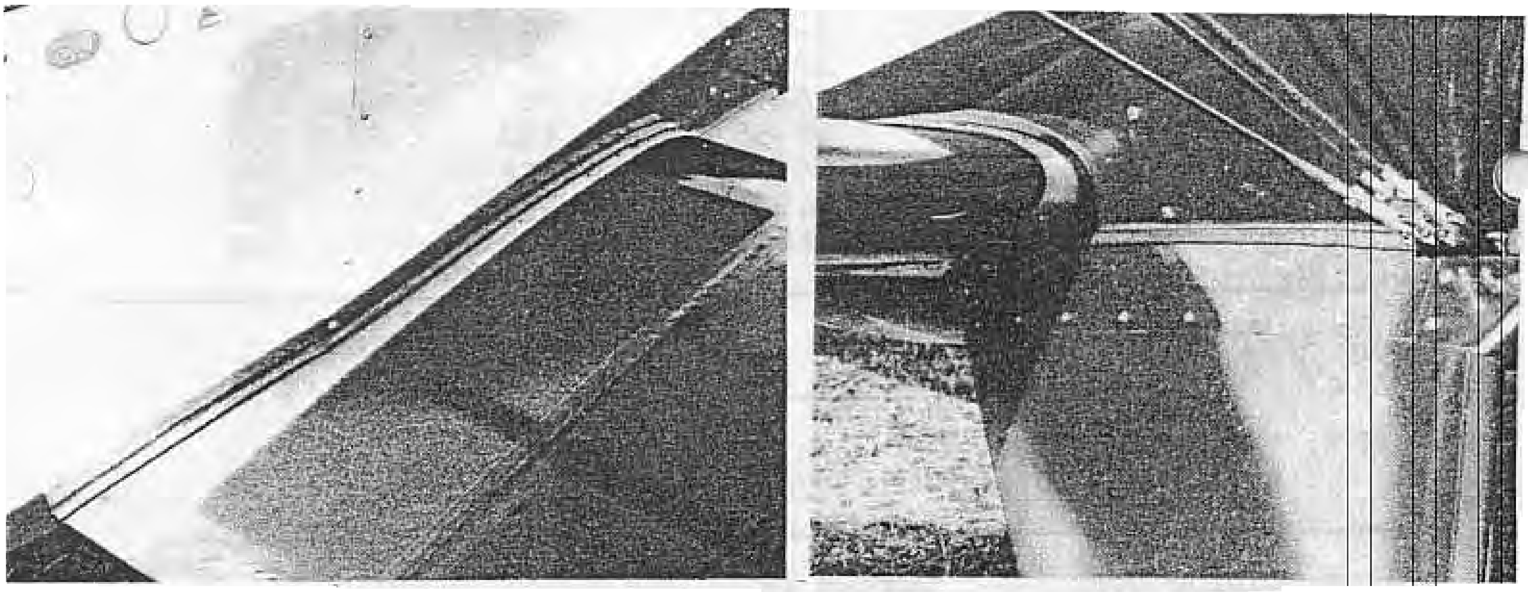


FIG. 3

With the above in mind lets start the construction of the fillet. You can go about it in a couple of ways. First, if you dislike metal forming you can make a lay-up fiberglass fairing. Secondly, we can make the fairing out of 3 pieces of alum. by the hand forming method.

The method that we will discuss here is the hand formed aluminum fairings. For those of you wishing to go the fiberglass route, you can obtain more information in the April 1973 issue of Sport Aviation magazine on pages 42 thru 46.

To start the hand forming method we must first make a heavy brown paper pattern while one of the lower wings is in place on the fuselage and the angle of dihedral is set at 2½ degrees. A sawhorse out near the tip or 1x4 stilts clamped to the spars will do nicely. Now we cut a piece of brown paper 12" wide by the length necessary to go from the rear landing gear fitting up over the wing and 12" past the trailing edge of the wing. Make an index mark on the leading edge of the wing and on the paper so we can constantly refer to them for alignment. In FIG.#4 you will notice that we cut a wedge or pie shaped piece out of the pattern at the leading edge. We now gradually move the pattern towards the fuselage shaping the fillet as we go until the pattern is overlapping the root rib of the wing 1",from leading edge to trailing edge. At this point we tape the pattern in place with masking tape. Use little pieces of tape in many spots. The reason that we have cut out the pie shaped piece is because it is impossible to stretch the metal in as many compound curves as we need all at the same time. Later on we will make a fill-in piece of alum. and weld it in the pie shaped area.

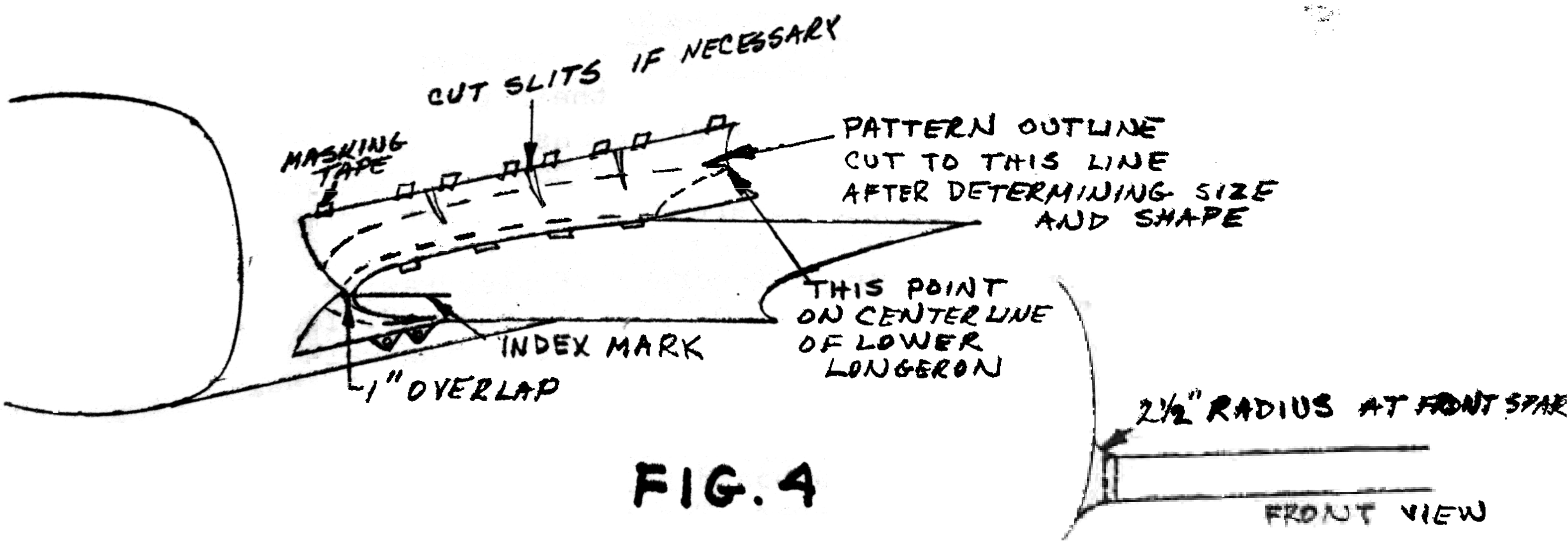


FIG. 4

After pattern has been made, lay it out on a sheet of 6061-0 x .040. Cut the piece 1" outside of the pattern line where it meets the fuselage. Remove wing from the fuselage and place it on a sawhorse. DO NOT CUT THE PIE SHAPED PIECE OUT OF THE ALUM. UNTIL YOU HAVE WRAPPED THE FILLET AROUND THE WING AND SECURED IT IN POSITION WITH #4 SHEETMETAL SCREWS.

After the fillet is made and it is installed on the wing to stay, we will use #6 Truss Head Sheet Metal Screws. Now that we have the alum sheet wrapped around the wing we start the process of shaping the radius of the fillet. To do this we use a rubber hammer and a piece of wood 5" in dia. and 12" long. To make the piece of wood easier to handle you can fasten a screen door handle or other "U" shaped bracket to it. Now place the wood block on the fillet and gently form the radius with the rubber hammer. If at anytime the metal becomes work hardened you can re-anneal it by first coating the surface with the black soot from your acetylene welding torch set to produce a sooty flame(Almost 100% acetylene) Now set the flame neutral and burn the soot off. Presto ! the aluminum is annealed.

After the fillet is formed we now cut and fit a piece of alum. to fit the pie shaped cut-out. This should be Heli-arc welded in place. Using auto body finishing techniques we proceed to finish the fillet. All low spots must be bumped out or filled with body putty and filed or sanded. The portion of the fillet that goes under the wing is nearly a flat sheet and easily made and screwed to the wing root. Prior to painting the fillet it should be scrubbed with etching solution and a Scotch-Brite pad. Next we spray on epoxy zinc chromate primer which is wet sanded after it is dry. The next application to make is one of auto body sanding primer which is also wet sanded between coats. When all areas are filled and smooth, paint it with your color.

DIS-CREPANCIES IN THE WING PLANS *** STARTING WING CONSTRUCTION

Those of our readers who are well into their project are well aware that a detail study of the plans is mandatory if you are going to stay out of trouble. Don't take anything for granted.In fact, here are the errors and omissions.

1. Sheet #7 ** In the upper left corner of the drawing it says "wing walk on left panel only", see sheet 9. You go to sheet #9,and nothing. You can install a wing walk on both wings and I highly rec-commend it. See Skybolt News Feb.'77.
2. Sheet #7** The dimensions for mounting the rear spar butt fittings shows that the outboard hole is located 5/8" down from the top edge of the spar. The designer did not allow for the bevel of the spar. If you mount these fittings per plans you will find that the top edges stick up above the spar.
3. The plan view drawing of the lower wing (Sheet #7) leads you to believe that all drag and anti-drag wires are ¼" dia. NOT SO. Only the first bay is ¼" dia. The rest of the wires are 3/16" dia.

4. Sheet #7** A serious omission in the plan view of the lower wing is,the corner blocks required at the inter section of the ribs and spars. The built-up wing rib design shown in the plans requires them on the front face of the front spar but the nose of the ribs should be re-designed so they may be in-corporated. Just consider the fact that approx. 75% of the lift of the wing is carried by the first 25% of the cord. Those of you who are building Spar-Craft supplied wing kits will find a generous supply of corner block material in the kit and must be used at 4 points on both the front spar and the rear spar. The plans type built-up rib is sure to end up with broken nose ribs after a hard aerobatic life. Just ask some of the guys who own Pitts. FIG. #5 shows how to make the built-up ribs and FIG. #6 shows where to put the blocks on routed ribs.
5. Sheet #7** and Sheet #6 ** The plans lead a person to believe that all you do is nail or rivet the trailing edges to the tips of the ribs without any other re-inforcement. In the first place, FORGET ABOUT NAILING THE TRAILING EDGES TO THE RIBS. Use soft countersunk rivets to do the job after you have plated each side of the tailing edge of the ribs with 1/8" Birch plywood. Carry the plate forward 1½".
6. Sheet #9 ** The plans call out a 3/4" x3/4" compression member to be glued on the root rib. Make the root rib the last full sized rib to be installed and put a compression member on both side of the rib. No compression member of any kind is shown on Sheet #7. Be sure to glue the compression members on the ribs absolutely level and centered on the MAC Line. It will prove useful when rigging.
7. Sheet #7 ** The only holes that should be drilled in the spars (this takes place after the spars have been positioned on the wing bench and leveled) are 1/8" pilot holes using the spar butt plates as templates. The wing mounting bolt hole stays 1/8" until the wing has been put in position against the fuselage for welding on the rear spar fitting. Of course the ribs are slipped on the spars and approximately positioned before the spars are clamped to the bench. You can now glue the ¼" Birch plates on the spar butts one at a time. When the glue is dried,"Back-Drill the plates using the pilot holes. Now put the Birch plates on the other face of the spars. When glue is dried, "Back-Drill these plates. DO NOT DRILL ANY HOLES FOR AILERON HINGES, BELLCRANK BRACKETS OR LANDING WIRE FITTINGS (These are in-correctly labeled Flying Wire Fittings on Sheet #7) The spar butt plates can now be installed by gradually increasing the drill size up to a Letter"C" size drill and then ream with a ¼" reamer. Don't get carried away with your job. remember the wing mounting bolt hole stays 1/8". Now pull the butt plates off and varnish <u>the area they cover only</u> . Don't forget to varnish the bolt holes with a swab or better yet, a pipe cleaner.

This Chapter on WING CONSTRUCTION will be continued each month until we have covered both upper and lower wings. Before we sign-off for this month I want to call out the length of the Drag and Anti-Drag Wires required for all wing panels. Lower Wings *** 4 ea. ¼" dia. x 39 3/4" ** 8 ea. 3/16" dia. x 44 1/8" ---- Upper Wing *** 2ea. ¼" dia. x 45" ---- 2ea. ¼" dia. x 50" . 4 3/16x45 4 3/16x50

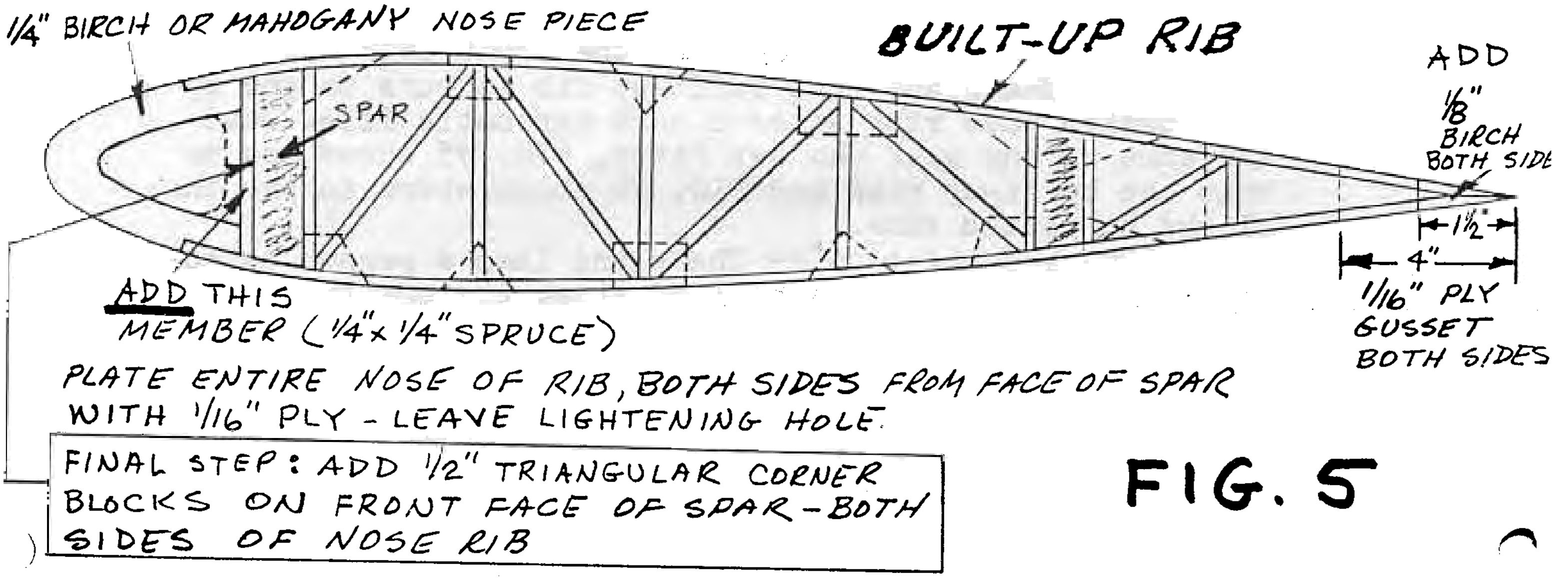
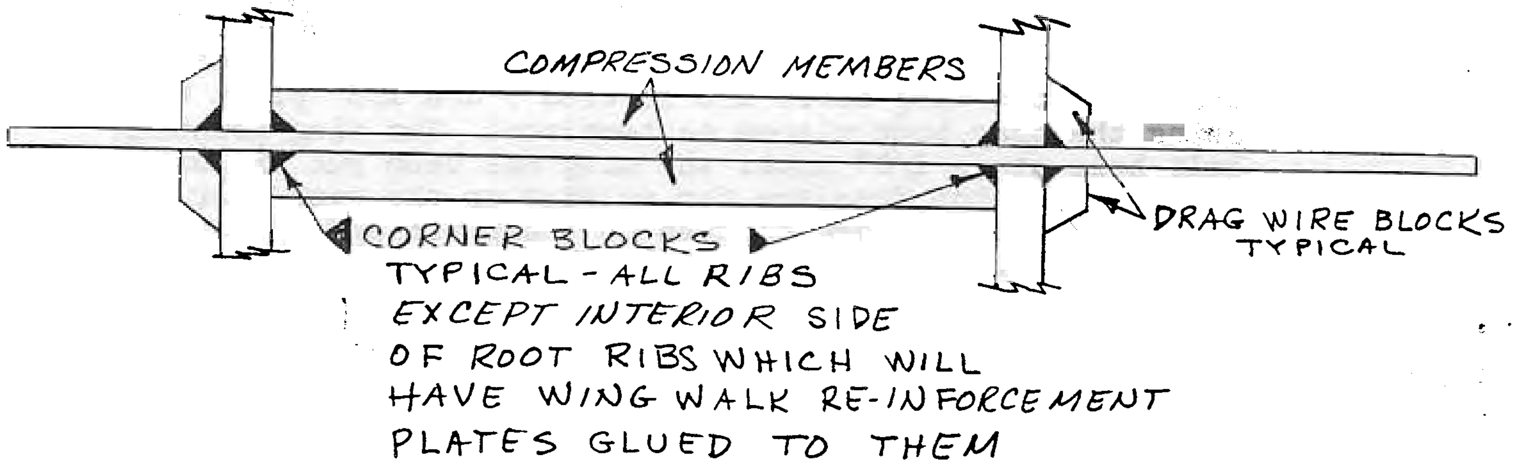


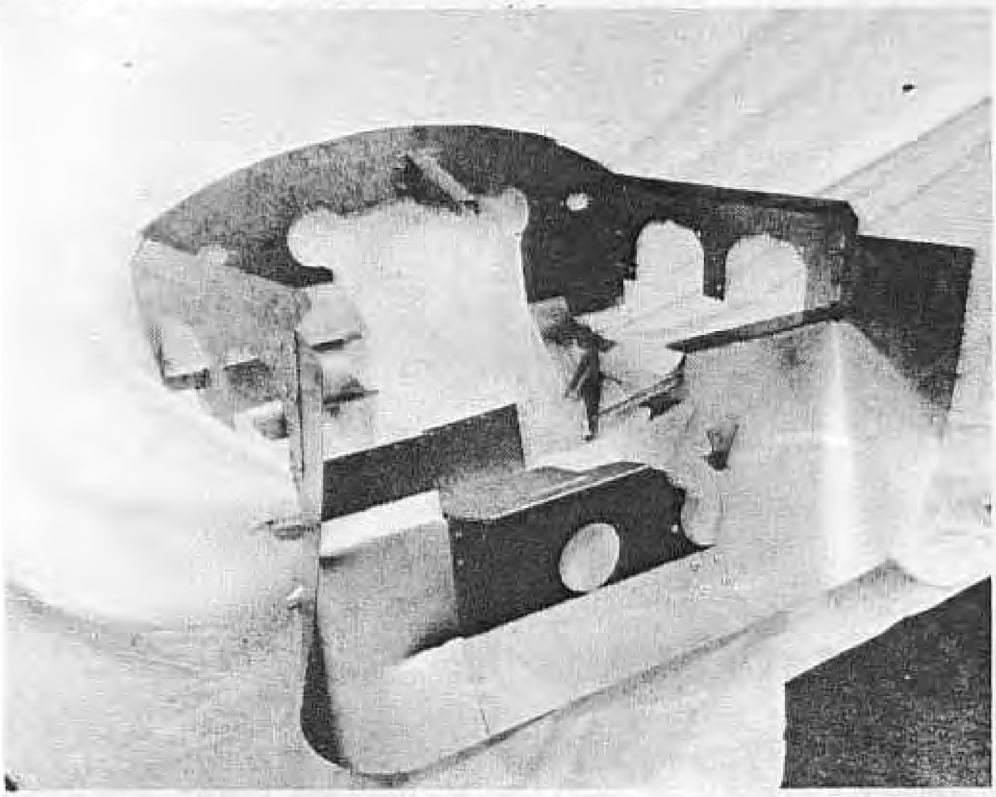
FIG. 5

F G. 6 TOP VIEW - ROUTED RIB INSTALLATION



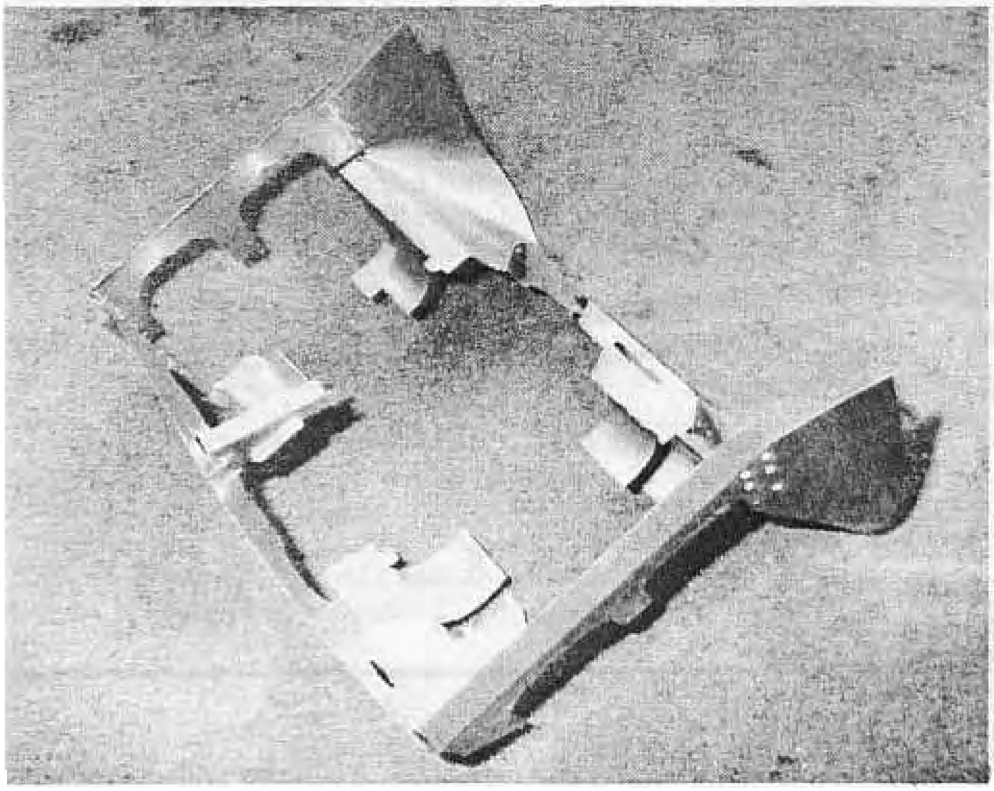
BAFFLING THE ENGINE FOR PROPER COOLING (PART 1)

The photos below show a set of Baffling for a 180 HP. LYC. There is extra metal around the nose bowl edges and across the top rear panels. This set of baffles is ready to mount on the engine, without the cowl panels in place. At this point we can bring the nose bowl into position and trim that area for fit. Once we get the nose bowl in place we can trim the top rear panel for fit. In the next issue we will go into more detail concerning cooling.



FRONTAL VIEW

FIG. 7



TOP VIEW

FIG.8