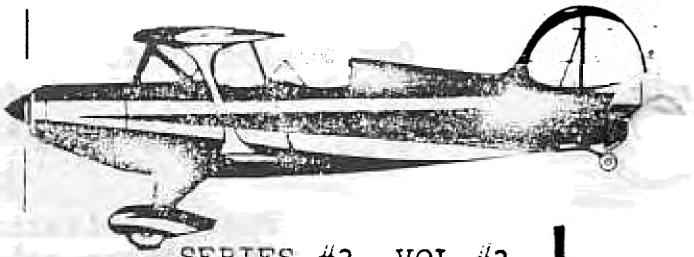


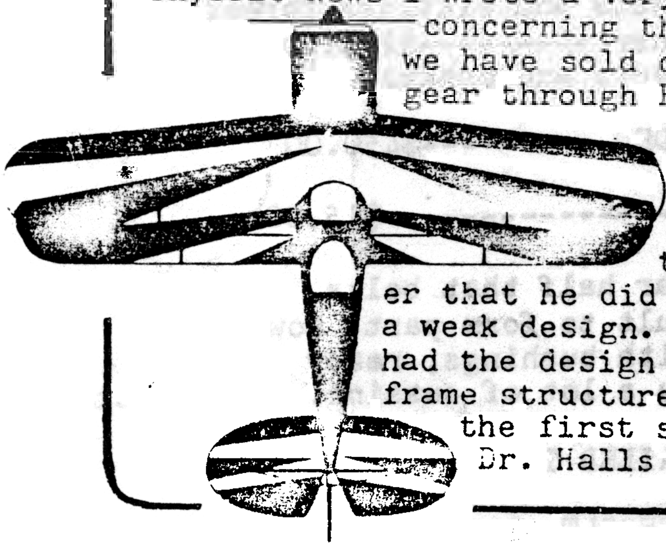
SKYBOLT NEWS

12026 S. TOMI DRIVE
TEMPE, ARIZ. 85044

SERIES #3, VOL.#3
Feb. 1978

HANGAR FLYING with Mac

Due to the recent feature story in Sport Aviation on Dr. Dean Hall's Skybolt, we have been deluged with phone calls regarding his use of the box section cantilever landing gear. This gear design was employed by Ed Marquart on his MA-5 Charger. In the pioneer days of aviation this design was utilized by Stinson. Prior to that time, probably only the Good Lord knows who else used it. Back in the Aug.-Sept. 1977 issue of the Skybolt News I wrote a very short article (also illustrated) concerning this gear design. Since that time, we we have sold quite a few sets of plans for the gear through Firebolt Aircraft and Supply Co.,Inc.



Just recently I was disturbed by a phone call from one of our "Brother Bolt Builders". He had called the Skybolt designer about the use of the gear and was told by the designer that he did not like the gear as he felt it was a weak design. "LET'S SET THE RECORD STRAIGHT". I had the design stress analyized by a competent airframe structures stress analysist prior to selling the first set of plans which had been drawn by Dr. Halls son Harold. Since the Skybolt plans seller (Designer?) is to my knowledge, not an engineer, I respectfully dis-agree with his assumption that the design is weak. At this point I must also state that this author is not a professional engineer either. Therefore I enlist the aid of a qualified professional when it comes to the design or re-design of primary structures. The objective of the gear stress analysis was to meet FAR Part 23 minimum requirements times 1½. The cantilever gear design meets that objective right on the nose but not without making a change in the wall thickness of the vertical tube support that connects the axle to the box section gear leg. We went from 1½" O.D. x .120 wall to 1½" O.D. x .134 wall to meet the torsional load requirements at very high gross loads (2000 lbs. or more) should the aircraft be subject to a rough landing situation at these high gross loads. Before we end this article I would like to point out the advantages and dis-advantages of the cantlever gear design as employed by Ed Marquart, Dr. Hall, yours truly and others. The only dis-advantage to date is the increase in weight over the plans type landing gear. The weight increase is however negligible when compared to the advantages. Actually the weight of the box section gear leg (the box only with no other tubes attached) is less than the tubes it replaces in the conventional gear (front leg,rear leg, streamline diagonal and bungee tube). The additional weight comes mostly from the tubes which make up the truss mounting within the fuselage and the rubber discs w/spacer washers that replace the "Old Style" bungee cords. The total weight increase is approx. 5 lbs. for the entire system. The advantages are as follows. 1. Less drag (approx. 4 lbs. at 100 m.p.h.) per leg w/ fairing. 2. The elimination of troublesome bungee cords 3. The probability of structural damage due to failure of the shock absorbing system is practically nil when compared to what often happens when a bungee cord breaks (busted wing tips, fabric, wing spars etc.). 4. The design as used by Dr. Hall moves the axles even further aft than we have been doing on the conventional gear which improves the landing and ground handling characteristics without fear of nosing over in the advent of heavy braking. 5. Easier to make belly skins since movable gear doors are not necessary in the area where we normally find the bungee cords. 6. In summation of the advantages I refer you to the articles written by Raoul J. Hoffman and re-printed by the E.A.A. in a "How to Series " book entitled "Engineering For The Custom Builder" $3.00 per copy, available from headquarters. In this book, there is an article on page 71 called "The Science Of Streamlining" in which he states "One item of the airplane that creates most of the drag is the landing gear". "The landing gear takes 20 to 40 per cent of the total structural drag". " Retracting the wheels not more than half their diameters will give higher drag than a low cantilever landing gear ". " Conventional landing gears - 6 foot tread and 3 foot height - give 40 pounds resistance at 100 m.p.h., which is reduced to 30 pounds if all fittings are faired ". I can't help but think that a 63_2015 airfoil section employed as a gear leg fairing on the cantilever landing gear is the ultimate gear configuration for a biplane fixed gear. We can get so close to retractable gear performance that it just doesn't make any sense to go the rest of the way and install a retractable gear with it's installation engineering complexities and great weight penalty. In closing this article I must make one other comment. In reading Raoul J. Hoffman's article you will notice a statement that will literally jump off the page it is written on and hit you right between the eyes. Dr. Hall please take note. " Tail skids are sketched in section 15, showing that the laminated steel spring design has a higher resistance factor than one low cantilever landing gear leg,properly streamlined." Mr. Hoffman was talking about a TAIL SKID. Now let's add a TAILWHEEL and a STEERING HORN arrangement with it's associated "Rube Goldberg" lash-up (No dis-respect Mr. Goldberg). You can readily see why I choose to install a full swivel retractable tailwheel on the Starfire and the Firebolt. It will be a long time into the future before I do an article on retracting tailwheels but if you wish to under take sucha program of your own you might start with the system used in the Staggerwing Beech of the 30's and 40's.

GOOD NEWS, BAD NEWS DEPARTMENT

Let's get the Bad News out of the way first and tell you that both Cleveland and Scott have raised the price of their products. Consequently, at Firebolt we have been forced to raise the price of wheels and brakes to $171.50 per set (6.00 x 6) and #3200 Scott tailwheels to $219.00

Now for the Good News. Starting April 15th. we will be distributing Stits covering products. With the Mar. issue of Skybolt News we will enclose a price list. Discount to Skybolt News subscribers is 15%. This new line of supplies will be stocked for immediate shipment by Firebolt Aircraft and Supply Co., Inc. P.O. Box 28321 Tempe, Ariz. 85282 or you can call me at Starfire Aviation for information (602) 968-2556 Don't forget the Flat Rib Stitching Cord that Stits handles. After using it, you'll never go back to the old style cord.

FIREWALL AND EXHAUST DEFLECTOR (THE EYEBALL CATCHER)

"Super Sanitary Engine Compartment". How many times have you heard or read that phrase ? " What the Judge see's, the Judge say's". Nothing in the world will evoke the super sanitary comment from the judging committee like a polished Stainless Steel Firewall and Exhaust deflector. They're so doggone easy to make I often wonder how we can sell so many at Starfire Aviation. The Feds allow 4 different types of firewall material to be used. I will list them in preferential sequence. 1. .015 Stainless Steel 2. .018 Terne Plate (lead coated steel) 3. .125 Asbestoes between 2 sheets of .020 Aluminum 4. 20 gauge Galvanized (weighs a ton) I prefer the stainless steel but have not been able to locate .015 with a #4B finish which is highly polished. Therefore I have opted for .018 in the 302/304 series stainless. It's beautiful stuff but you have to handle it with Kid Gloves since it scratches very easy. This plus the difficulty in drilling and de-burring may be the reason people shy away from using it.

To start the construction of the firewall we must first have a pattern. This can be found (to a degree) in your set of plans. On a sheet of cardboard or other suitable material, layout a vertical centerline and a bisecting horizontal line. From these 2 lines, lay out the exact location of the longerons (Frontal View). Now you can layout the lines as shown in the plans and the radius lines. Be sure that the finished dimensions of the firewall result in the flush match of the firewall and the longerons. See FIG.#1 In FIG.#2 you see the finished firewall as installed on the front end of the "Bolt". Fig. 2 leads us to the next piece that we install on the firewall. Instead of trying to form a flange on the stainless which results in a lot of beating, a heck of a lot of cussing and nothing worth looking at when you are through, I select to rivet a notched alum angle on the edge of the stainless sheet. This riveted flange results in not only something beautiful to look at, it results in a ridgid support for the "U" channel members of the cowling support as well as other sheet metal parts which must be attached to the firewall. The flange is made from 6063-T5 alum. angle, 3/4"x3/4"x .0625 thick. The notches are cut on 3/4" spacing with a 30 degree notching die. The length of the alum. angle is 104" to start. For about $10 you can buy a hand notcher.

If you select to buy the hand notcher be sure to use a pair of gloves or get a truck load of Band-Aids to patch your blisters. We start the installation of the flange by first drilling all the necessary holes in the notched edge of the flange. Use a #40 drill and de-burr the holes. The hole spacing is 3/4". Now we can use the notching tool and cut the notches half way between the holes. This results in the same spacing as the holes. An easy way to layout the notch spacing before you drill any holes is to take a divider set to 3/4" and scribe the centerlines of the notches. This also makes it easy to locate the holes. The installation of the flange starts at the top center of the firewall and continues down each side to the exhaust deflector opening. Since you layout of the firewall will probably result in a slight difference in the length of the flange on each side, I suggest that you stop the notching operation when you are approx. 6" from each end of the 104" angle strip. This will allow you to make spacing adjustments in the notches so they will come out even at the deflector opening. Therefore, start the notching operation at the center of the 104" This firewall centerline notch will also come in handy when installing and fitting the front coaming panel. It's always nice to know where the centerline of the airframe is hiding. As you can see in FIG.#2, I select to install the notched flange on the forward side of the firewall so all can see how hard I worked to make this beautiful contraption. You can also see that the flange faces forward. If you choose to install the flange on the aft side of the firewall which hides the notches, it will be necessary to cut the firewall 1/16" all the way around the outside edge. This will allow for the thickness of the flange material. If you install the flange on the forward face of the firewall the flange will be installed with the flange flush with the edge of the firewall. Regardless which side of the firewall you choose to mount the flange, the heads of the AN470AD-3-3 Rivets will be installed from the forward face of the firewall. The exhaust Deflector is constructed per plans and riveted to the firewall with solid monel rivets or monel pop-rivets. Of course stainless steel rivets can also be used for this job. If you use stainless steel pop-rivets try to get the type that have a stainless steel mandrel. During the course of construction you are going to get finger prints and smudges on your pretty new firewall and as your author found out, there are not many products that will do a good job of removing them without streaking the surface. At Starfire Aviation we use a product called ARMORALL. It does indeed do a fine job and leaves a beautiful finish. Spread it on with a soft cotton cloth in a back and forth motion (Do Not use a circular motion). Wipe off and polish with another soft cotton cloth in the same manner. You will find that Armorall is an excellent product to use on your tires and vinyl upholstry. Directions are on the bottle. Be sure to get one with the pump type spray nozzle.

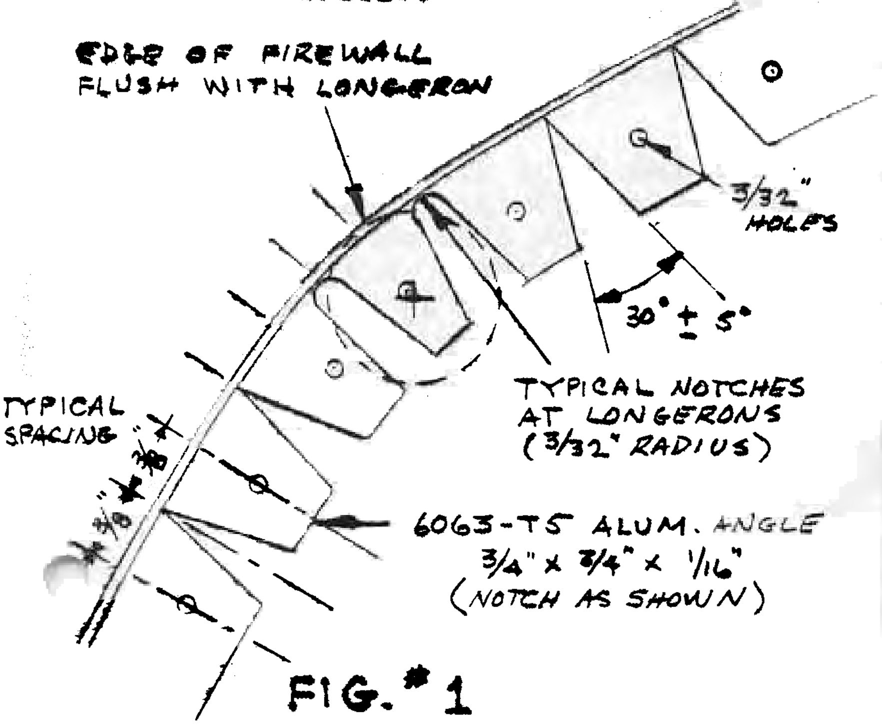


FIG.#1

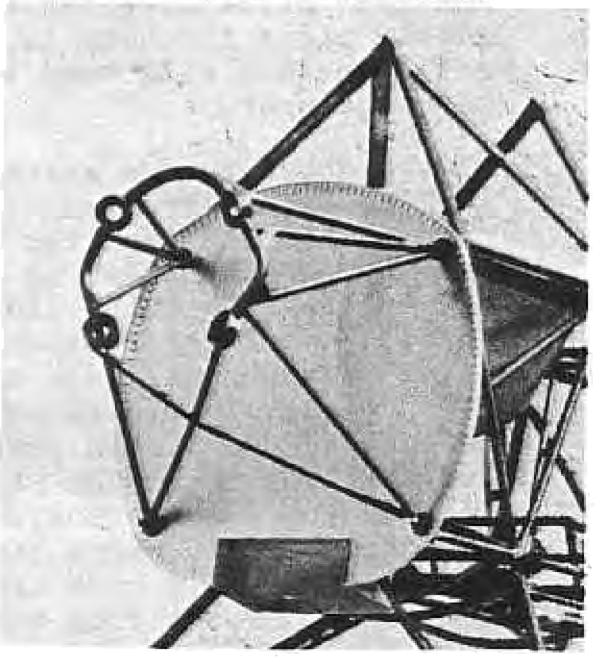


FIG.#2

If you want to take the easy road to a notched alum. flange for your firewall, you can purchase a 10 ft. length of Redi-Notch Alum. Angle from Starfire Aviation for only $20 plus U.P.S. charges. Shipping weight is 2 lbs. due to necessary size of the carton. The polished stainless is also available for $ 22 plus Greyhound Bus Freight Collect. Shipping Weight 12 lbs. approx.

WING CONSTRUCTION (PART 3)

In the Jan. issue I promised that we would drill the drag wire holes, install a rib, glue on a rib and the members of a compression station in the Feb. issue. Since the ancient proverb states that a picture is worth a thousand words, I offer the following Figures # 3,4,5,6,7 and8 to state our case.

FIG.#3 shows how the index lines of our drill block line up with the fine lines that we have drawn on the face of the spar. I have used a felt marker on the photo so that the index lines are pronounced for reasons of clarity. The level is placed on the top edge of the drill block as an insurance that the lines we have drawn on the spar are indeed accurate. The 2 vertical lines on the spar indicate the rib station. As you drill the 1/8" pilot hole for the wires, feed the drill very slowly since the hole is on an angle and feeding the drill in fast will tend to move it off course as it enters the spar.

FIG.#4 shows how we start to drill the final size holes for the wires. Previous to this time we have glued the compression station ribs in place using the alum or steel block method as shown in FIG.#5 You will notice in FIG.#4 how we set up a guide line with the fine string or heavy thread. A helper is standing to my left watching the level of the drill as I sight down the drill and the string line. In FIG.#4 we also see the compression members being clamped in place after gluing. The hole we are drilling in FIG.#4 will come out right through the edge of the compression member. Due to the design they have to so don't worry about it. Prior to drilling as shown in FIG.#4 I back drilled the pilot holes through the corner blocks from the other side of the spar.

FIG.#5 shows how we start to install the drag wire blocks at the compression station ribs. The metal block is clamped in place as an alignment device and acts as a back-up block so the rib won't move when we tack nail the blocks in place. There will be a small amount of stagger in alignment of the drag wire blocks since the wires run through the spars at different levels. The center of the drag wire block aligns with the center of the wire hole.

FIG.#6 shows how we pre-drill the drag wire blocks using a pin vise in our drill motor with a drill that is smaller than the diameter of the #19 x 1" cement coated nails that are used to hole the blocks in place while the glue is curing. After the glue has cured we pull out the nails. I drill 4 holes in each block at an angle. The holes are located at the bottom edge of the block and at the top approx where my thumb is located. Prior to gluing corner re-inforcement blocks I also pre-drill them. This makes the job much easier. In the case of the corner blocks used for re-inforcement,I, drive 3/4" #20 cement coated nails in all the way and set the heads with a pin punch.

In fact, I cut all corner blocks needed for a wing, pre-drill them in 3 places

put

I usually mix about 1 ounce of T-88 at a time.

FIG.#7 shows how the birch plates are installed where called for on the spars. Previous to gluing the birch plates in place I have used the drill block on top of the spar butt plates and drilled the 1/8" pilot holes. Next we cut and bevel the birch plates to fit the spar and drill a tack nail hole in each corner. The glue is spread on the birch plate after which it is put in place and the nails are driven in slightly (½" #20 nails). A pressure block coated on one side with plastic shiping tape or you can use wax paper, is put in place and clamps applied. After the epoxy has cured we remove the nails and back drill the pilot holes from the other side of the spar. Now the opposite side of the spar can be birch plated in the same manner. When the epoxy has cured we again back drill through the existing holes.

FIG.#8 shows a lower wing panel about 60% completed. You will notice at the spar butts a dark area where the butt plates attach. This area has been carefully varnished on both side of the spar as wellas the holes themselves with 2 coats of Stits Epoxy Varnish. We still have gluing to do at the butt ends so we were very carefull not to get any varnish on the areas adjacent to the location of the butt plates. The main reason I inserted this photograph is to show the spar bench and nearly completed wing as an accident waiting to happen. It would really be just that, an accident waiting to happen if I had not taken one certain precaution. What's the precaution you say. Notice the floor area at the trailing edge of the wing and you will see saw horses on guard to prevent a person accidently snagging one of the full rib trailing edges and snaping it off.We forewarn visitors to stay away from the area and anyone who lays a finger on an unfinished,or finished wing for that matter, gets hit with a baseball bat.

After all ribs have been glued in place we glue the rest of the birch plates on the spar followed by all of the necessary triangular corner blocks. When gluing the ribs in place we are carefull to remove excess glue that squeezes out where the rib crosses the top and bottom edges of the spar. I use a small stick and a rag that is dampened with lacquer thinner. Use lacquer thinner to remove un-cured epoxy from tools etc. The root rib is the last rib to be glued in place with it's associated parts after the spar butt plates have been bolted in place. We are now ready to build the aileron.

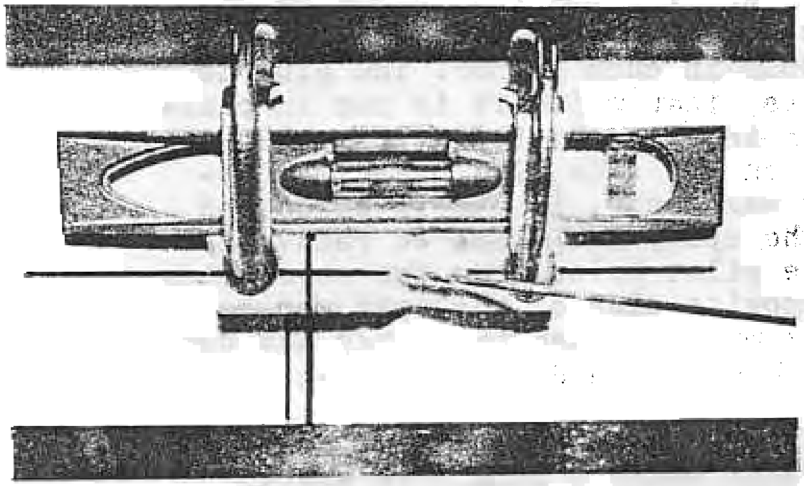


FIG. #3

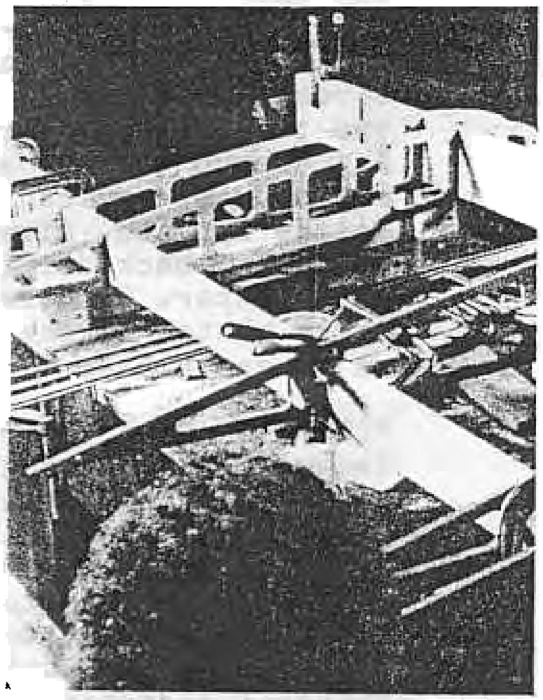


FIG. #4

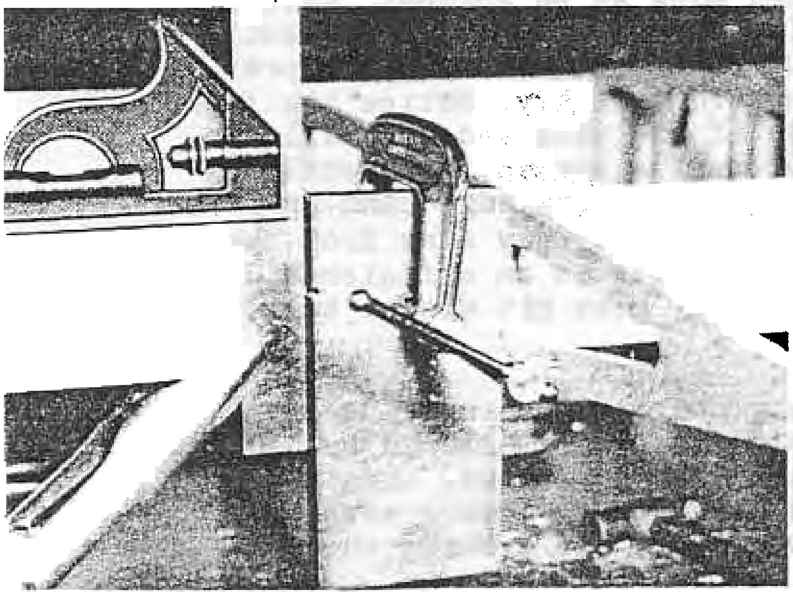


FIG. #5

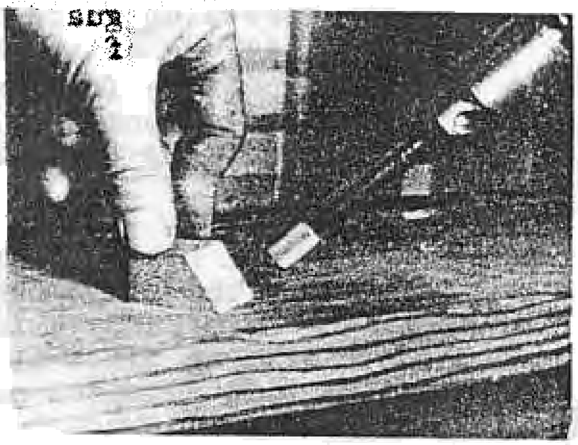


FIG. #6

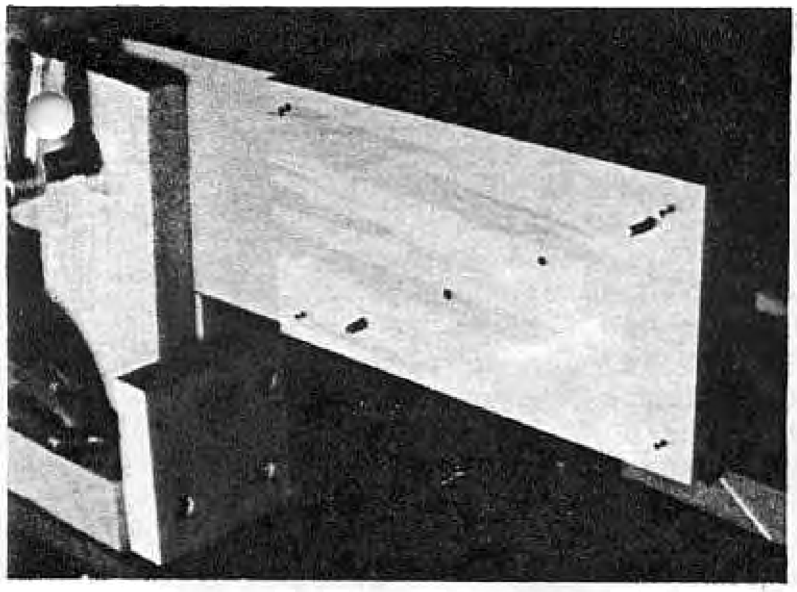


FIG. #7

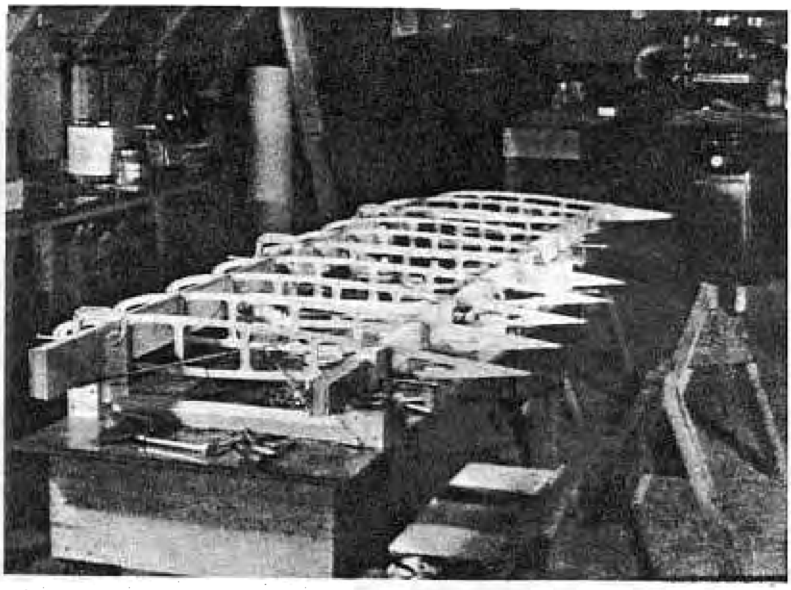


FIG. #8

LANDING LIGHT INSTALLATION

There's more than meets the eye in this modification to any aircraft. The load forces working on the leading edge of a wing are severe. Any opening that we cut in the leading edge must be re-inforced to meet this load requirement. A ¼" birch plate should be added to the front face of the spar at the opening. Additional false nose ribs must be installed. 3/4" angle flanges should be installed along the top and bottom edges of the birch plate as well as well as the contour edges of the false ribs. The angle flanges can be fastened with T-88 epoxy and ¼" #4 oval or round head screws to the birch plates and #6 machine screws with AN365-632 nuts & washers to the contour edges of the false ribs. The angle flanges can be made from 22 gauge cold rolled steel sheet and bent in a brake to form the 3/4" x 3/4" angle the same as we made for the fuselage formers. The flanges that are fastened to the contour edges of the false nose ribs can themselves be contoured by running them through a gear type crimping machine in the same manner as we put a radius on the fuselage formers. #8-32 nut plates can be flush riveted to the flanges for attachment of the lens frame as shown in FIG.#9 #14 wire and a 20 amp. circuit breaker or a 15 amp. plain fuse are used to feed the circuit and protect the wiring. Normally 2 lights are installed in the aircraft. One is set at an angle for taxing while the other is aimed to slightly lead the glide path angle. The final adjustment of the light beam is brought about by trial and error. The lights should be placed in a position so as not to blind the pilot from the glare and far enought from the prop so they will not give the illustion of pulsation. The lens is drape formed to match the leading edge. The lens frame should be flanged so that it seals tightly to the wing to prevent air leaks as well as moisture leaks. The recessed area that is provided for the light should be finished in flat black paint. The box that holds the light is made in 2 pieces that screw together. The rear box is made with an opening to fit the back side of the lamp and has flanges to attach to the birch plate. The front box is made to fit the the front side of the lamp and clamps the lamp to the rear box. The sealed beam lamp has a flange around it's circumference that allows the boxes you make to fit securely against the lamp. FIG.#9 shows an installation in a Skybolt that I photographed at Oshkosh. The above information and a little ingenuity are all that is required. In closing this brief subject I wish to add a comment or two. I have never been and still am not, an advocate of single engine night flying. Especially in a taildragger with a high sink rate. I do believe in the necessary navigation light requirements by the F.A.A. to cover VFR operation at sunrise and sunset. Call it chicken if you wish but make a survey of Skybolt, Pitts, Starduster and other similar aircraft owners. Ask them how much night flying they do ? At this point my box score is zero. " There's Old Pilots and There's Bold Pilots etc. etc. etc.--------"

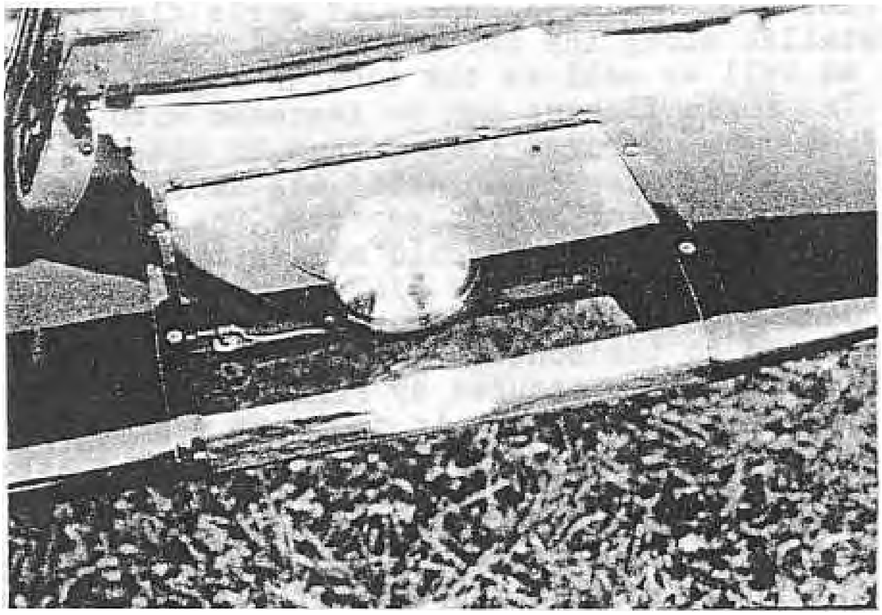


FIG. #9

THROTTLE QUADRANT INSTALLATION

There is nothing on the market either new or surplus that meets the requirement for a light weight,easy to install, smooth as silk to operate and eye appealing, in the military type of quadrant. Military surplus units are to big and weigh a ton. The highly advertised 2 and 3 lever units carried by most supply firms are abortions. They were designed on paper without any thought of installation problems. If you will permit me a moment of vulgarity I would like to quote a good friend of mine who has been a mold maker for 40 years and is confronted daily with engineering drawings from many of our largest corporations. " You can draw an a--hole on paper but you can't make it s--t ".

With the above in mind, you would be a lot better off to design your own quadrants. Now let's look at the objectives. 1. We want the inter-connecting push-pull rods between throttle quadrants and all other mechanical hook up devices on the outside of the fuselage (between the airframe and the sidewall skin)for easier inspection and service plus getting them out of the cockpit and passenger compartment. 2. They should be as light weight as is reasonable. 3. They should operate smoothly. 4. The friction locking mechanism should be designed so that individual levers when moved, do not move the other levers of the quadrant from their pre-selected position. 5. The spacing of the ends of the levers to which we attach the push-pull rods or other devices should be such that we can make attachments to them with off-the-shelf hardware items such as fork ends and 3/16" clevis pins.

In FIG.#10 we see a drawing of just such a quadrant. It will give you the necessary information with which to build your own. You can select to make a 2 or 3 lever unit. Some builders prefer to use a vernier control installed separately to control a constant speed prop. Most of us old fighter pilot types from yesteryear prefer to have throttle, prop and mixture levers all on the same quadrant. Take your pick. The drawing in FIG.#10 relates to a Throttle Quadrant that I have designed and which Firebolt Aircraft and Supply co. is tooling up to mfg. The hole spacing on the mounting plate is the same. The design provides for 3" of stroke when using the lower holes and $2\frac{1}{2}$" when using the upper holes that are drilled on the bottom ends of the levers.

In FIG.#11 we see a suggested location for the mounting of this design but you can re-locate to suit yourself. In FIG.#12 is shown a suggested method of constructing the push-pull tubes between the quadrants.

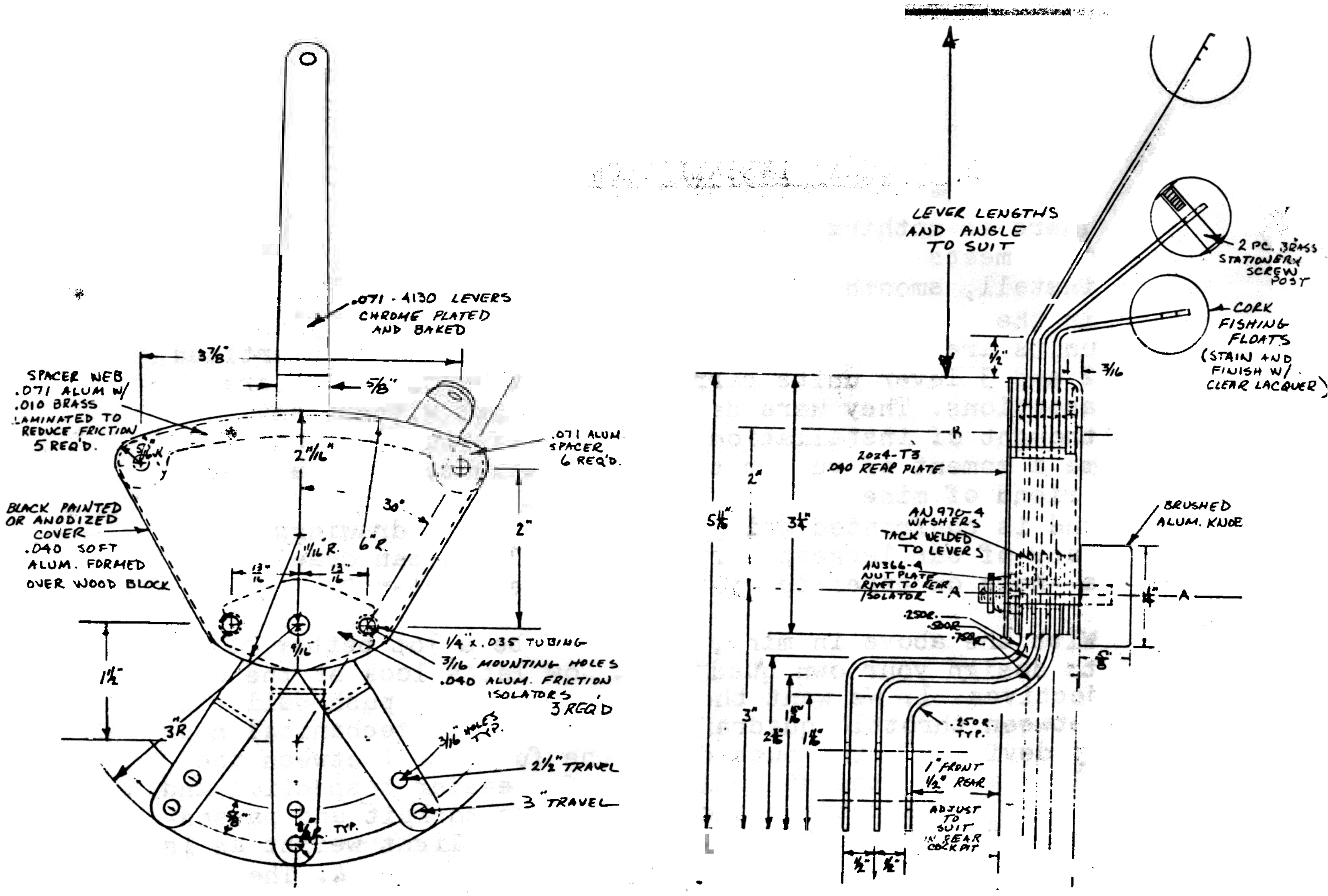


FIG. #10

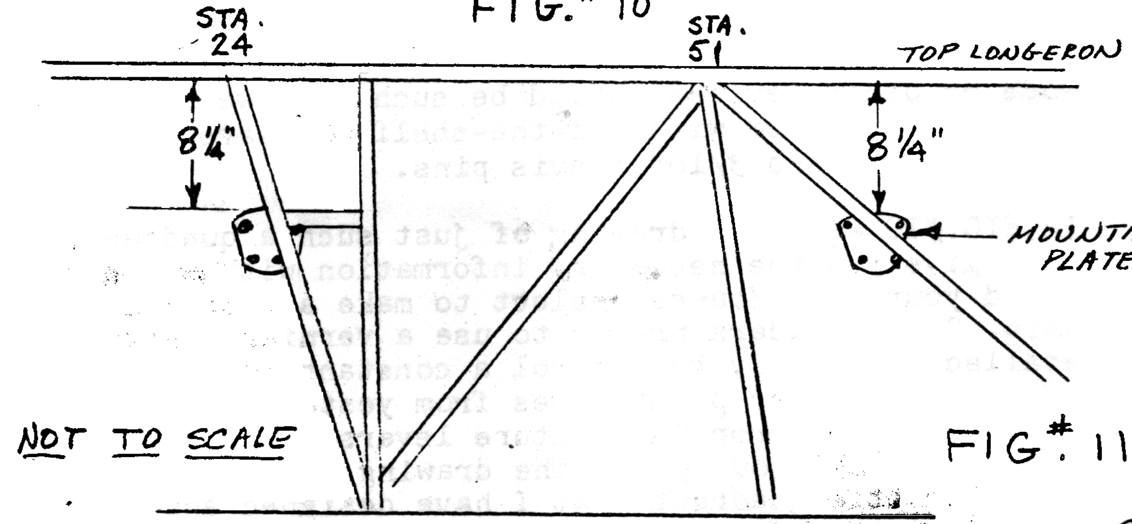


FIG. # 11

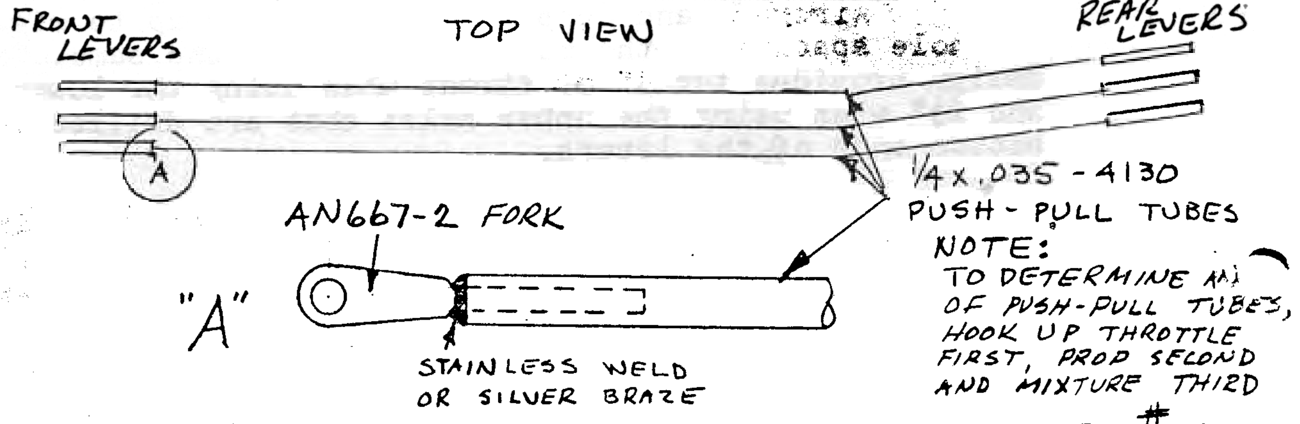


FIG # 12