FORMING RIBS FOR THE T-18

By Dr. B. John Shinn

A. INTRODUCTION

I had always looked at formed metal ribs, bulkheads, etc. with a sort of envious awe. I dreamed of building my own all metal plane, but obviously the cost of special tooling would be too high and having things like ribs hydropress formed would also be too expensive.

But, then came the series of Sport Aviation articles on the T-18. Mr. Thorp made it sound like an ordinary guy could make acceptable ribs himself with only a soft hammer, a bucking bar and some wood form blocks. Besides that he mentioned an alloy, 6061T4, which could be formed without annealing. To me, all aircraft sheet aluminum had been ? (2024T4) which required considerable care even in bending straight line corners let alone compound curves. The interest mounted to the point that I was mentally stretching ribs with ease. I decided I'd just have to build the T-18.

Although the article in Sport Aviation ("Building the T-18", Part Three, July 14, 1962) was well written I feel that a look at my rib forming experiences might be helpful to those who are also new "tin benders".

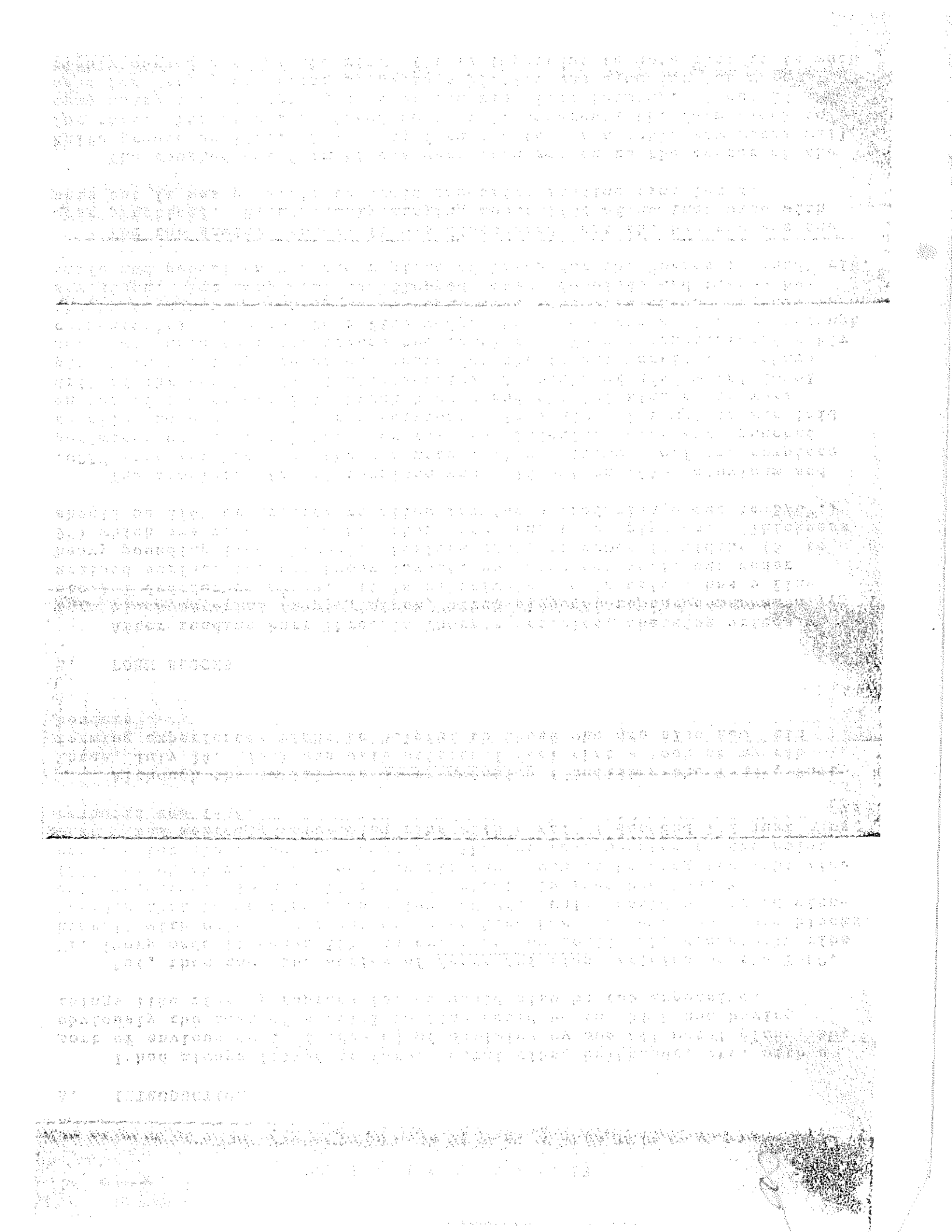
B. FORM BLOCKS

After reading Part Three in Thorp's articles, checking prices on form block material (maple, birch, birch plywood, tempered masonite, etc.) I dedided on birch. It is relatively low in price, has a fine grained surface for non-bumpy layout, and does not split out under heavy pounding like plywood. Besides that, it comes in widths (6" to 9") which are more manageable than large sheets of plywood. (Thickness should be 3/4" or greater to allow forming a good flange out to 5/8".)

The complete airfoil template was laid out on .040" aluminum and .025" (the thickness of the rib material) was trimmed off the complete perimeter of the template. Several 1/4" indexing holes were punched to align nose and center rib sections. This airfoil template was laid on top of two smooth 3/4" birch boards and the indexing holes were drilled through boards simultaneouslym A couple of 1/4" metal dowel pins held the template on one board for the layout marking. A sharp knife was used to trace around the template. Then a pencil (preferably carpenter's) sharpened to a fine wedge shape, was traced lightly through the knife groove. This made an accurate layout line which was easy to saw along. The template was "flopped" over, doweled, and traced by knife and pencil on the other piece of birch for the "opposite hand" rib.

For the sawing process it was discovered that the bandsaw was the most practical. By carefully staying about 1/32 of an inch wide with this cut it was possible to avoid excessive sanding time later.

The roughed out form blocks were then sanded to the center of the knife groove outline. A sanding disc mounted in a table saw works well for this. The disc was tilted so that it undercuts the form block to compensate for the spring back of the rib after forming. About 3° was used for "straight" sections while a 5° tilt was used for the more highly curved nose of the rib. (It is important to note that it is much



easier to make this spring back allowance with the initial sanding than it is to first sand to the line perpendicularly and then try to add the 3° to 5° undercut without over-shooting the mark.)

The edges of the form blocks were rounded to give the proper bend radius of 3/32". It was found that a small Stanley "surform" file made quick work of this with only a minor amount of sandpapering to smooth it out.

C. RIB BLANKS

For quick layout of the rib blanks a .040 metal rib blank template was made for the nose ribs and the center section ribs. (For the rest of this article we will concentrate on the nose rib fabrication since it is the more difficult). The airfoil template was laid on a piece of scrap aluminum and traced around for the nose rib section. A pair of dividers set for 7/8" was used. (Dick Cavin's idea of using a 3/4" radius washer for marking sounds better). By trimming this metal to the outer mark a 7/8" flange was left all around this nose rib blank. This blank was again placed under the airfoil section and the indexing (locating) holes punched through. The cut-out at the front of the nose rib was made in this nose rib bank template. It is strongly recommended that the cut-out in the actual ribs be made only after the rib has been formed. If it is made before forming it is almost impossible to prevent sharp double-back creases at the front edges of the nose rib.

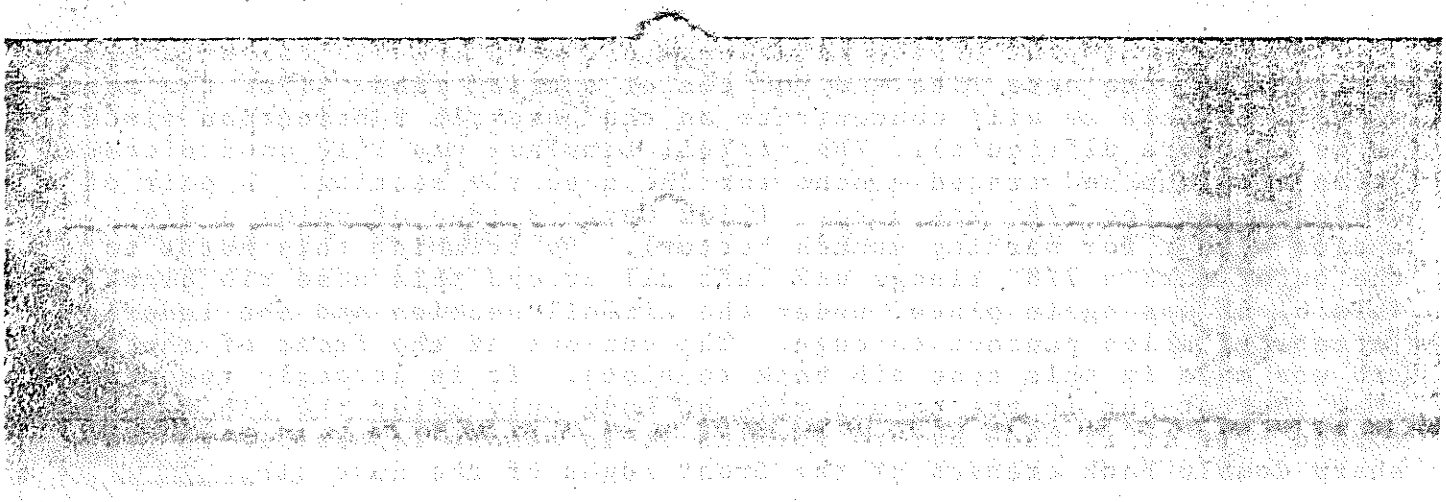
Holes were also punched through this template for the corner relief (as indicated on the prints) for the -1, -3, and -4 nose ribs. The -1 and -2 were close enough alike to use the same relief holes.

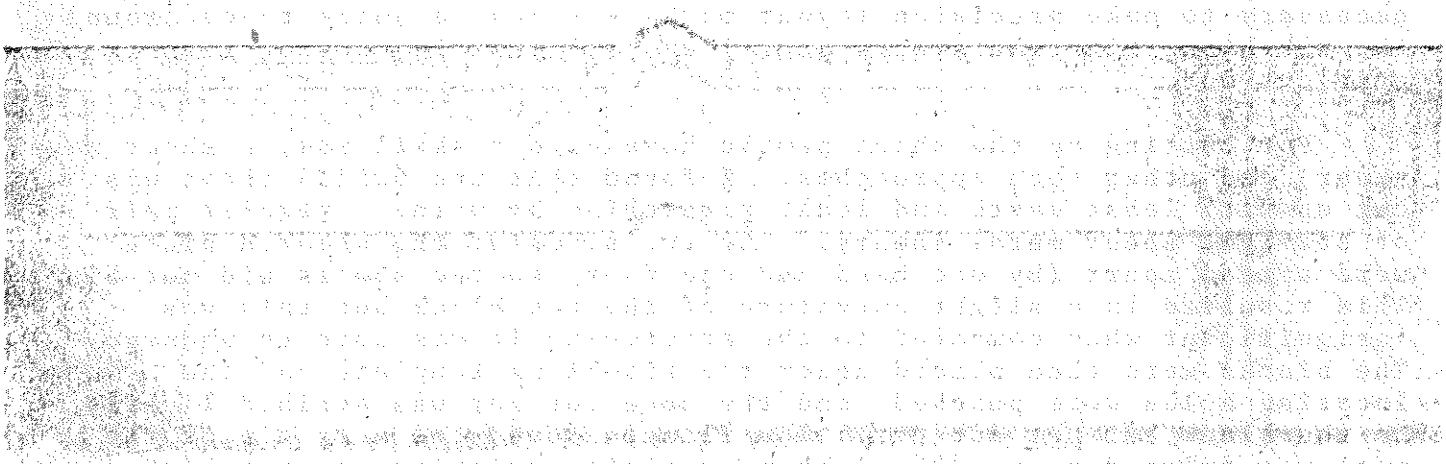
D. CUTTING OUT BLANKS

The 3' x 12' sheet of 6061T4 was unrolled on a rug in the family room (to prevent scratches) and a few quick trial and error layouts with the rib blank templates produced the most economical layout. A "grease pencil" was used for this since it has enough contrast to be visible and is easily wiped off when desired. Since the ribs were to be trimmed after forming and generous flanges were allowed it was not necessary to make precision layout marks --- just a quick trace around the rib blank with the grease pencil was all. Again, do not mark in the nose cut out.

For cutting up the sheet people have used a skill saw, a sheet metal shear, and other such approaches. I found that the 6061T4 sheet was cut up with least waste and least scratching by using a regular pair of straight sheet metal shears. The two sides of the sheared piece were spread apart (by one hand and one foot) so the shears did not bind. This resulted in a slight curvature of the new blank but this was insignificant when compared to the stretching it was soon to undergo. The blanks were then placed under the rib-blank template and the locating holes were punched, and the nose cut out was scribed lightly on the blank but not cut out. The flange around the very tip of the nose was trimmed to a 1/2" width to minimize wrinkles in this high stretch area. The appropriate relief holes were also punched.

The pile of rib blanks was ready for the forming operation.





was held behind the flange, and the hammer was aimed at the triangular gap formed between the bucking bar, the form block and the flange. Each pass of stretch forming was started at the nose and was progressively moved toward the back. After each pass a rubber mallet was used to tap the flange back to a 60° slant to form a new triangle gap to stretch inward.

Eventually some radial wrinkles began to appear. If not taken care of early they quickly develop into sharp work hardened creases which are almost impossible to beat down. To remove them I bent the flange over farther than normal (45° or flatter) and gently wiped out the base of the wrinkle with the rubber hammer. About three forming passes are needed to form out well beyond the 5/8" final flange dimension On the third pass I used much heavier blows of the hammer to wipe the metal into the triangle gap. The bucking bar was actually overlapped down on the form block to allow the full 3/4" width to be stretched.

The final forming operation is the only place I differed at all from Thorp's practice. I felt that I got better flanges if I <u>did not</u> try to slap down the remaining vertical flange. When I tried to do it I found that the already formed portion of the flange would tend to jack up away from the form block giving the appearance of severe spring back. I merely stretched the vertical flange so that it was out well beyond the 5/8" width and slapped down the wrinkles in the horizontal flange with the "slapper" solder bar.

The rib was then trimmed with aircraft metal shears to the desired width. Since there were quite a number of ribs in the wings and tail I made a 5/8" depth gage. It was made from a scrap piéce of the form block (birch) material with a right angle notch cut about 1" deep. At 5/8" up from the bottom of the notch cutout I drilled a hole and pounded in a sharpened nail - just far enough so that about 1/8" of the point protruded from the side of the notch.

H. MAKING LIGHTENING HOLES

Although the plans did not call for them, we felt that it would be a good idea to have lightening holes in the ribs. It allows you to see inside and string in navigation light wires later if desired. Besides, the FAA man can see inside after the wing is all riveted - you don't have to wait to let him look before you "close it up".

Some holes were 3" in diameter and others were 2". We made them with chassis punches. The "hole saws" from Sears could be used instead but they do not leave quite as clean a hole. The most important thing is to clean the burrs off the inside of these holes and then emery them to a smooth finish. Otherwise, a crack may result when the flaring process is undertaken - we found out the hard way.

The "flaring tools" were made on a lathe from 2" oak. There was a set for 2" holes and a set for 3" holes. The male part of the 2" set had a 2" dia. plug with a 45° flared skirt. The mating part was a ring 2" ID with a 45° flare at one end. The lightening holes were flared by inserting the plug through the rib hole into the ring. The plug was then given several "hard licks" with a rubber mallet. Presto! there is a really professional looking rib!