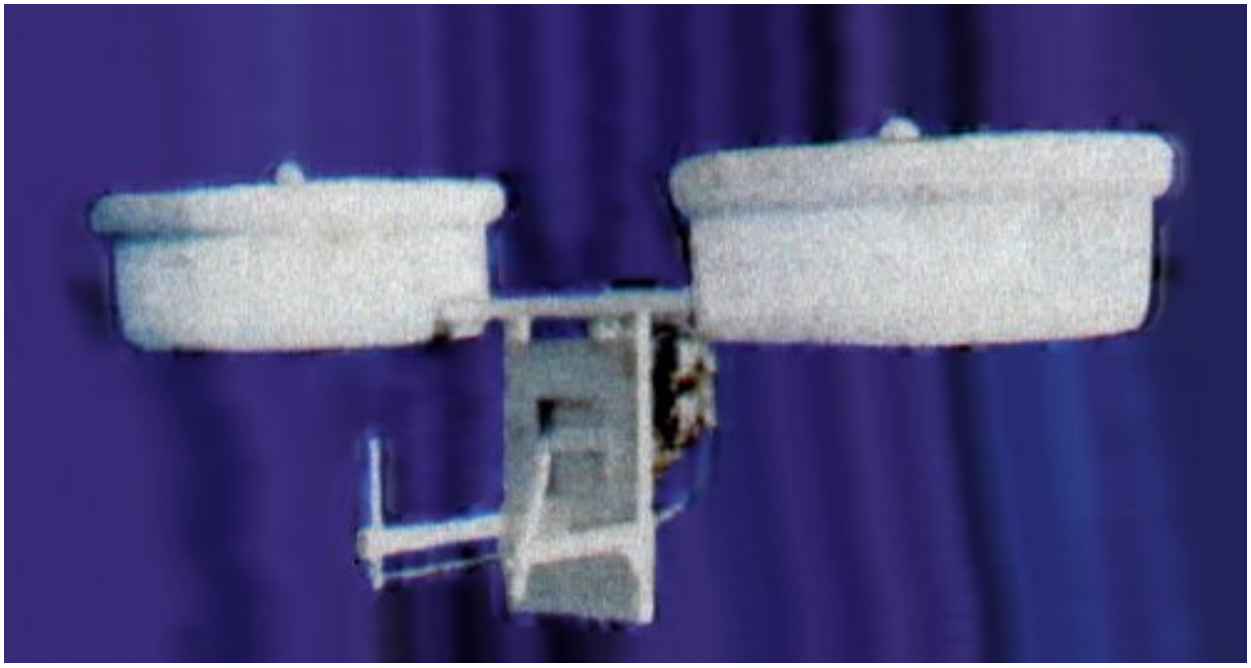
Building a Jetpack



SPECIFICATIONS:

Configuration---------- Ducted Fans
Fans ------------------ 2-36”, 4-Bladed
Disc Area Total ---------- 14.13 sq. ft.
Overall Height ------------------- 48”
Overall Width ------------------- 100”
Landing Gear ------------------- Feet

ENGINE:

Rotax 503 - 2 cylinder, 2 cycle, air-cooled, 50hp

FUEL:

Premium Unleaded Gasoline

PERFORMANCE:

Max Speed ------------------ 50 mph
Range @ 75% Power ------ 50 miles
Fuel Consumption -------- 3 gal/hr
Rate Of Climb ------------ 500 ft/min

CALCULATED DATA:

Power Loading ---------- 6.6 lbs/hp
Fuel Capacity ---------- 3 gal. US

WEIGHT & LOADING:

Gross Weight ------------------ 375 lbs
Empty Weight ---------- 125 lbs
Useful Load ------------------ 250 lbs

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Introduction:

This FLYING JETPACK is an incredible machine that uses vertical to forward flight capability allowing its pilot to fly and hover at will without the use of wings or fuselage. Control is achieved by shifting body weight and through vectored thrust. It is capable of carrying a 250 lb pilot. The top speed is approximately 50 mph and it can remain airborne for up to an hour !

You will be amazed at the simple design and that hovering flight can easily be achieved so easily. Just strap on this unique machine for the most exhilarating flying experience of your life !

Now you can enjoy going where you please whenever you want to.

Steps Required:

Construction Steps:

1) Backpack Unit
2) Engine Mounting
3) Drive System
4) Fan Duct Construction
5) Fan Blade Construction
6) Final Construction
7) Testing
Drawings:
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2) Back, Arm, and Shoulder Pads
3) Engine Mounting
4) Drive Chain Arrangement
5) Drive Chain Arrangement and Fan Hubs
6) Fan Duct Construction
7) Fan Duct Construction and Mounting
8) Controls and Control Surfaces
9) Control Linkage Detail
10) Fan Construction and Layout
11) Fan Construction Details
Engine Examples
Catalog Examples
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Tools Required:

Hacksaw
Hammer
Socket Wrenches
Open End Wrenches
Center Punch
Electric Hand Drill
Drill Bits
Jig Saw
Metal File
Vise
Pop Rivet Gun
Tape Measurer
Fine Tip Felt Marker
Allen Wrenches
Scissors
Razor Knife
Paint Brush
Sand Paper
Stirring Sticks
Resin Spreader
Optional Tools:
Bench Grinder
Drill Press
Band Saw
Metal Lathe
Metal Cutting Hole Saw (2 inch)
Table Saw
Belt Sander

Parts / Supplies Needed:

Note: All aluminum mentioned will be 6061 T6 variety
2lrx 2lrx 42lx aluminum tubing
1/6lnx 16llx 30ll aluminum flat stock
Qty 24 Œ 3/16ln Fiber lock nuts for aircraft bolts
1llx 2llx 24lx wood
Epoxy
Qty 50 - ¼ly Flat head metal screws
1/8lwx 2l8x 2l8x 76lx angle stock
1/16lxx 4l1 x 12l6 aluminum flat stock
1/16lnx 6l1 x 16l6 aluminum flat stock
Qty 4 - 3/16lnx ½l1 Œ shank length 1/8lt - aircraft bolts Œ shank only drilled
Qty 16 - 3/16lex 2-21/32ld Œ shank length 2 1/4lt - aircraft bolts Œ shank only drilled
Qty 4 - 3/16lex 4-21/32ld Œ shank length 4 1/4lt - aircraft bolts Œ shank only drilled
¼lix 2lix 76lx plywood for armrests / shoulder rests
¼lsx 16lxx 30lx plywood for back rest
2lsx 4lsx 72lx Grade A lumber (support beam)
Foam rubber Œ 4lb thick Œ enough to cover both armrests, shoulder rest, and back rest
Pop rivets
4 Engine mount bolts (hardened steel Œ with hole in head for safety line)
8 washers for engine mount bolts
8 rubber mounts for engine mount
4 double sprockets Œ No. 35-2 Œ 3/8lc pitch Œ 2lt
Two single sprockets Œ same size as the double Œ No. 35 Œ 3/8ll pitch Œ 2lt
 # 35 chain
Two hurst type bearings for fan shaft
3 sheets of 4™x 8™x 2lx hard foam
One high performance / light engine Œ 40-60 HP, with 5000 Œ 6500 rpms.

Construction Of The Backpack Unit:

Refer to drawing #1
Cut the 2x2 aluminum tubing to length to be used for the sides of the backpack unit.
Cut 2 pieces 30lc long (sides) and 1 piece 12lc long.
Cut the 12lg piece in half lengthwise to make 2 Œ 2lkx 1lk channels.
(These will be used to reinforce the engine mounting area)
Cut 2 pieces of 1/16ls aluminum plate stock to 16lcx 30lc.
(This will become the front and back of the backpack unit)
Cut a mounting bolt access hole in one of the pieces and pop rivet the piece left over in the same place on the other piece.
(This plate will act as re-enforcement for engine mounting)
Now put the sides and the 12le channels on a work surface as they would be assembled and pop rivet in place. Make sure to leave enough room between the reinforcement channels to put engine-mounting bolts. Bolt and rivet both sides using drawing # 1 as a guide. The bolts used here should go through both plates and the 2lex 2le tubing. Use fiber lock nuts on all bolts.
Close up the ends of the backpack unit by making two wooden pieces 1lex 2le x 12lx long. Epoxy these in place flush with the ends. Countersink flathead screws along each side to hold secure.
Cut the underarm rests and the shoulder rests from 2lox 2lo angle stock. The underarm rests themselves are to be 24lm long and the shoulder rests are to be 14lt long. To support these rests 4 triangular pieces of 1/16ls plate stock are needed. Refer to drawing # 1.
Bolt and rivet the arm and shoulder rests to the main body of the unit as shown in drawing # 1 using 3/16ln aircraft type bolts and steel rivets. (rivets are mainly to keep the metal from rattling between the bolts)
The pads for the underarm rests can now be fabricated from foam rubber and epoxy to ¼lo plywood of the proper size. These pads are to be covered by the material of your choice. But, first the foam rubber must be shaped to fin you body and to be comfortable when the machine is on your back. Once this is done the finished pads may be attached to the rests. Refer to drawing # 2.
Before you consider the job complete make sure there are enough bolts and rivets, that they are the proper length, and that fiber lock nuts and good aircraft bolts have been used throughout.
You may wat to consider at this point building some type of stand for the backpack unit to make working on the machine much easier. This can be accomplished by simply bolting legs to the bottom of the unit either table length o all the way to the floor. Or whatever works the best for you.

Engine Mounting: (drawing # 3)

Now that the basic backpack unit is complete and on a suitable stand the mounting of the engine of your choice may begin.

First determine exactly where the fan drive sprockets will be in relation to the support beam, which will show where the sprockets on the engine need to end up. Fit 2 double sprockets on the PTO end of the engine. These sprockets should be at least 2la in diameter and be the same size as the ones on the fan shafts. Each sprocket needs to be keyed and secured firmly to the shafts and using lock nuts and washers on both sides of the sprockets.

Once the location of the engine is determined the mounting holes may be drilled in the rear plate of the backpack unit. Make sure that you have made the holes through the second backing plate also. The holes should be the same size as the bolts used for mounting.
The engine that is used should be light and powerful and have between 40-60 horsepower. It should also run between 5000 and 6500 rpms.

Bolt the engine to the backpack unit as shown in drawing # 3. The bolt length and diameter will vary per engine used. Make sure that after the rubber mounts (one on each side of the back plate) and the large mounting washers are in place and the mounting bolts are snug that the bolts have used up most or all of the threads in the engine block. If this not the case, a longer bolt is needed.
When all four mounting bolts are secure the heads must be safety wired in such a way that there is no chance of the bolts coming out during operation.

Drive System:

The drive mechanism for this machine is really very simple and uses chain and sprockets. Multiple V belts and HTD type timing belts can also be used.
The sprocket size on the engine and the fan shafts should be the same, but can easily be changed to get more or less RPM at the fan or the engine. The sprockets used may have to be machined to adapt properly to your engine.

Details for the drive train and its alignment are found on drawings # 3, # 4, and # 5. Remember that the fan shaft sprockets need to be keyed and bolted through the shaft or the shafts threaded and nuts and washers used to keep the sprockets in place.
The bearings at the bottom end of the fan shafts need to be thrust type bearings to bear the load of the machine and its pilot properly.

A proper size hole will be needed in the fan duct for the drive chanin to pass through. Keep this in mind while building the duct. Drawing # 4.
Make two chain guards from 1/16ls steel stock sheet to be placed as per drawings on # 4, and # 5. These may be pop riveted in place using ¼li grip steel rivets placed 1la apart and staggered. These are to insure that if there is a chain failure that the pilot is protected against a slapping or flying chain.

Two fan hubs are needed and should be turned according to the dimensions on drawing # 5. These hubs need to be keyed and bolted to the fan shafts.
These hubs should be turned from a solid piece of cylindrical 6061 T6 aluminum 4lu diameter.

Fan Duct Construction:

3 sheets of 4™x 8™x 2lx hard foam are needed to complete both fan ducts.
Refer to drawing # 6 where there are some suggestions on ho to make the best use of the foam.

Cut 36 Œ 1/3 rd circle pieces (120 degrees) 2lg wide and 2ld thick.
The inside diameter of all these pieces will be 36ll.
The outside diameters will be 40ll and 44ll respectively.
After all the pieces are cut out, making sure to make square cuts in relation to the top surface, assembly may begin. Refer to drawing # 6.
Stack and epoxy each layer until there are 8 layers. The tip two layers are 4le wide so that the bell opening may be formed. This bell shape at the tip of the duct is the key to the dramatic performance of the ducted fan.
Now form the bell opening and the tapered skirt as shown on drawing # 6.
The left side of the drawing represents the inside of the duct.
After both ducts are formed and sanded the plywood inserts may be epoxied in place.
Refer to drawing # 7. These are for strength and reinforcement in places where there are stressful attachments of struts and where the support beam, chains and control rods pass through the wall of the duct. The fiber glassing of the ducts may begin as soon as they are formed and sanded and the plywood inserts are in place.
Cut pieces of 2.7oz fiberglass cloth that will cover the inside of the ducts. Approx. 10™x 20lx.
Apply the cloth to the inside of the duct using epoxy resin and a brush or squeegee. (DO NOT USE POOLYESTER RESIN ON FOAM, AS IT WILL DESOLVE IT). It is a good idea to refer to books on fiber glassing for helpful hints and methods.
Now do the outside of the duct system, overlapping the other work and inch or so and leave extra glass at the bottom on both sides. Get out all the bubbles.
Continue to add resin and sand till smooth, especially on the inside. Trim the bottom skirt to about ¼lo.
Cut holes in ducts as needed. Refer to drawing # 4, and # 7.

Fan Blade Construction:

There are several ways to go to obtain fan blades. Some propeller companies offer these types of fans ready to go. The fan type propellers that are made for some hovercraft are especially suited for high RPM lifting uses. The fans used on this machine should have the maximum number of blades and the greatest pitch available.

The alternative to this is to build the fans from scratch. They can be constructed from wood or composites. The composite method may be a little lighter while the making of wooden propellers is much more conventional.

Either way the patterns found in drawings # 10, and # 11 are the same.
If wood is chosen for the fans make sure to use laminates of some good, dry hardwood. Birch and maple are two types of wood that have been used successfully in the past for making propellers. Plastic resin glue of the powdered type is a good way to go for laminating the hardwood together.

Layout the laminations as shown in the drawing and glue together using wood clamp. Make sure the glue has cured completely before layout and carving. It is extremely important that the fans rotate in the same direction as the engine chosen and that the resulting thrust is downward. Props have been known to be carved backward.
After the fans are carved and balanced they may be given several coats of varnish or they may even be laminated with fiberglass cloth and resin. A coating of glass is preferable.
Drill mounting holes and rebalance fan. Add more resin to any light blades.
While making the fan blades it may be helpful to refer to a book on making propellers.
If making the fans from foam and fiberglass is the method of choice great care must be taken to achieve the strength need for this application.

Laminate layers of hard foam together using a slurry of micro beads and epoxy resin. The resulting disc will be 36ll in diameter and 4ld thick. Find the center of the disc and divide it into four equal parts. Use these lines as references for making all the other measurements. Refer to drawing # 10, and # 11 as the ¼le plywood discs are epoxied in place and shaping is begun.

Fan Blade Construction: (Continued)

Shape and sand fan blades till the correct results are achieved and then begin the fiber glassing process. The top of each fan is to be done first so the bottom glass, having the most pressure on it during use, will lap up over the top piece. A total of at least three laminations of glass on each fan is required. The leading edges of each blade will be overlapped and the trailing edges will extend behind each blade as per drawings. If unidirectional glass is used make sure each lamination is at 90 degrees to the next. Balance the fans using the method on the drawing. Add more resin to any light blade and rebalance. Drill and mount fans to their hubs. Spinners should be used to increase the efficiency of the ducted fan system.

Final Construction:

Go over all the work that has been done and make sure all parts are functioning properly and according to recommendations in this manual.
Check fan clearance between blade tips and the inside duct wall to see if there is between ¾lt and 1 ¼ld. If there is any less the blades may strike the walls. If there is any more the ducts will be inefficient during operation.
Make sure the chains are snug but not binding. If they prove to be to tight the shafts and their bearings may need to be slotted and brought toward the center to give slack to the chains. If they are to loose the opposite must be done. An idler sprocket could be put into the system if needed.
Check all nuts, bolts, and rivets to make doubly sure that all are tight and a sufficient number have been used.
The size and location of the fuel tank will be up to the builder. Make sure that if the tank is put below the engine that a fuel pump is used.
It is recommended that an engine shutoff switch be used and be placed near the left or right had for easy access.
It is also recommended that the control surfaces be spring loaded to return to center if the pilot takes his hands off the control levers.
The last thing that will be mentioned here in final construction will be the installation of the safety harness. There will be 2 leg straps, a waist harness, and a combination chest and shoulder harness. Each of these will have a quick release buckle and be made from strong safety belt webbing, attached securely to the backpack unit. The method for the attachment is shown in the last drawing.

Testing The JetPack:

After you are satisfied that everything is in excellent working order it is time to test the machines operation. All testing and run-up of this machine should be done under the most cautious conditions with at least one other person present.
A helmet should also be worn any time the engine and fans are in motion.
First the engine should be run-up with the chains off to make sure it is running properly. The backpack unit should be tethered and fixed to a stationary stand for this phase of the testing.
Next the chains should be replaced and the engine and fans tested for smoothness of operation as a unit.
If there is any unusual vibration the engine should be shut down immediately. The first run-up of the fans needs to be done at about 30% power.
If everything seems to run smooth at that speed then you may proceed to half power and then full power. Make sure the machine absolutely cannot leave the ground at this point in testing.
After success is achieved in the full power run-up you are ready to advance to semi tethered testing. Attach a cable or strong rope to a point between the ducts to a high object so that when you lift your legs while strapped in the machine you are suspended in mid air. This will prevent the unit from falling over during initial flights and hover testing. All further testing and practice flight can be made in this manner.

Method of control:

Both levers forward is forward
Both to the rear is backward
Both straight up is hover
Right lever back is right
Left back is left
Left lever forward and right lever back will spin you clockwise
Right lever forward and left lever back will spin you counter-clockwise
Throttle controls the altitude. Leave some lag time for the throttle to overcome the sink rate.
Just when you think you've got it under control you better practice some more.
Don't forget. Never fly higher than you would like to fall Good Luck !

Additional Suppliers:

Boston Gear
14 Hayward St.
Quincy, Mass. 02171
1.800.343.3353

Aircraft Spruce and Specialty
210 Truslow Ave.
Fullerton, CA 92632
(714) 870.7551 Order Line Œ 1.800.824.1930

Martin Sprocket and Gear
P.O. Box 91588
Arlington, Texas 76015-9990

Leading Edge Airfoils
331 South 14 th Street
Colorado Springs, CO 80904
(719) 632.4959 Catalog = $5.00

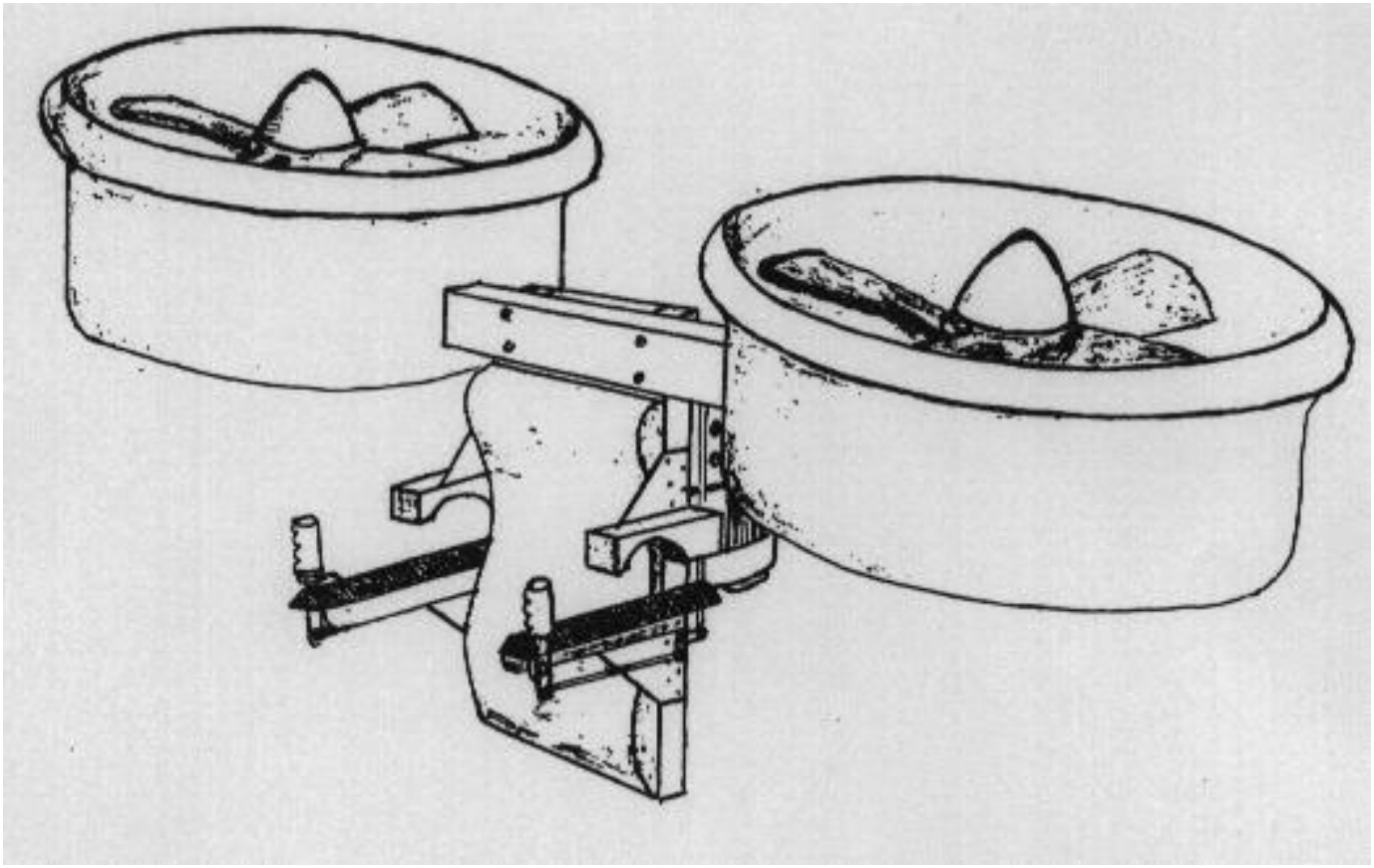
California Power Systems
790 139 th Ave.
San Leandro, CA 94578
(415) 357.2403

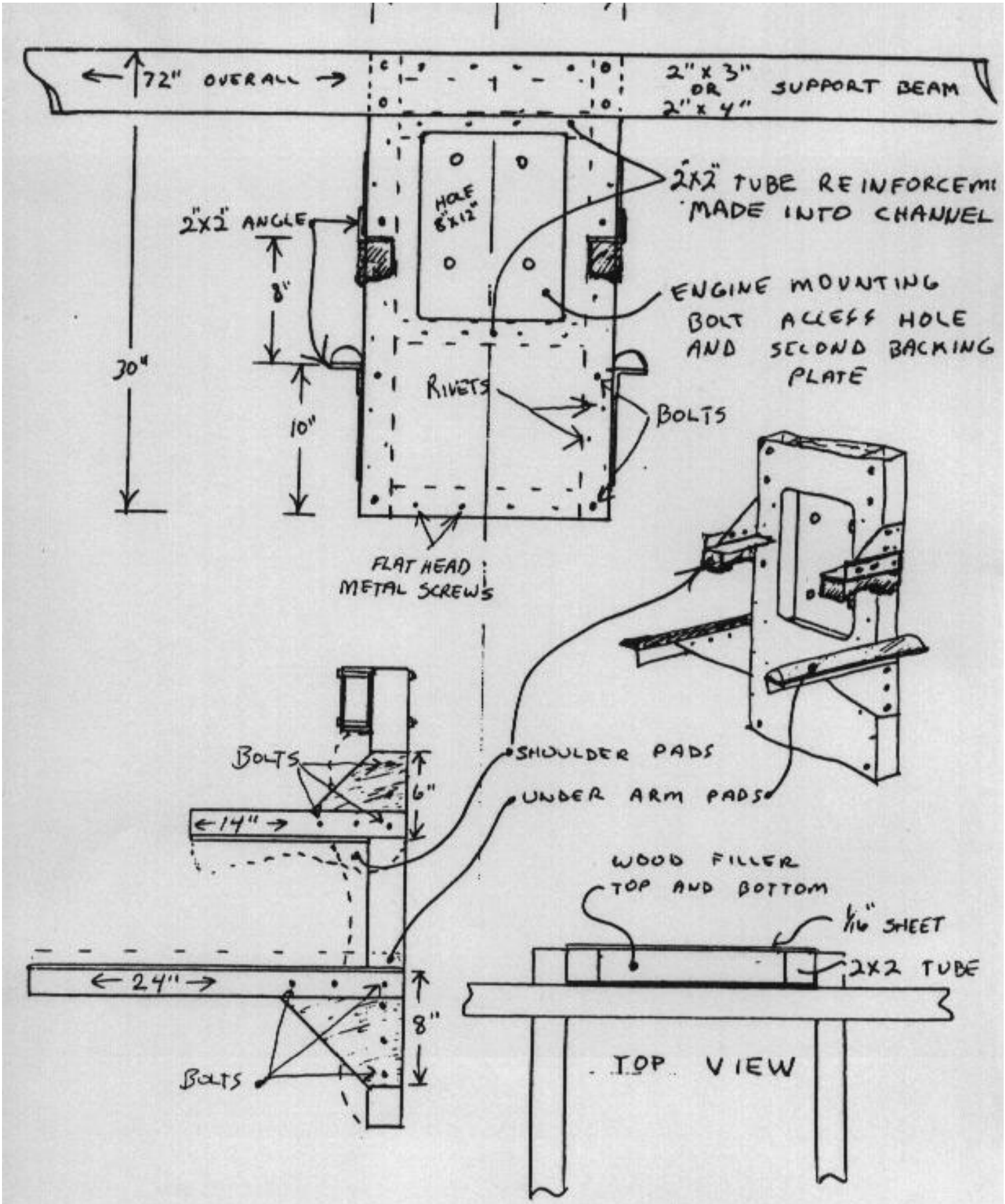
Wicks Aircraft Supply
410 Pine Street
Highland, ILL 62249
(618) 654.7447 Œ Catalog = $5.00

Kart World
1488 Mentor Ave.
Painsville, OH 44077
(216) 357.5569

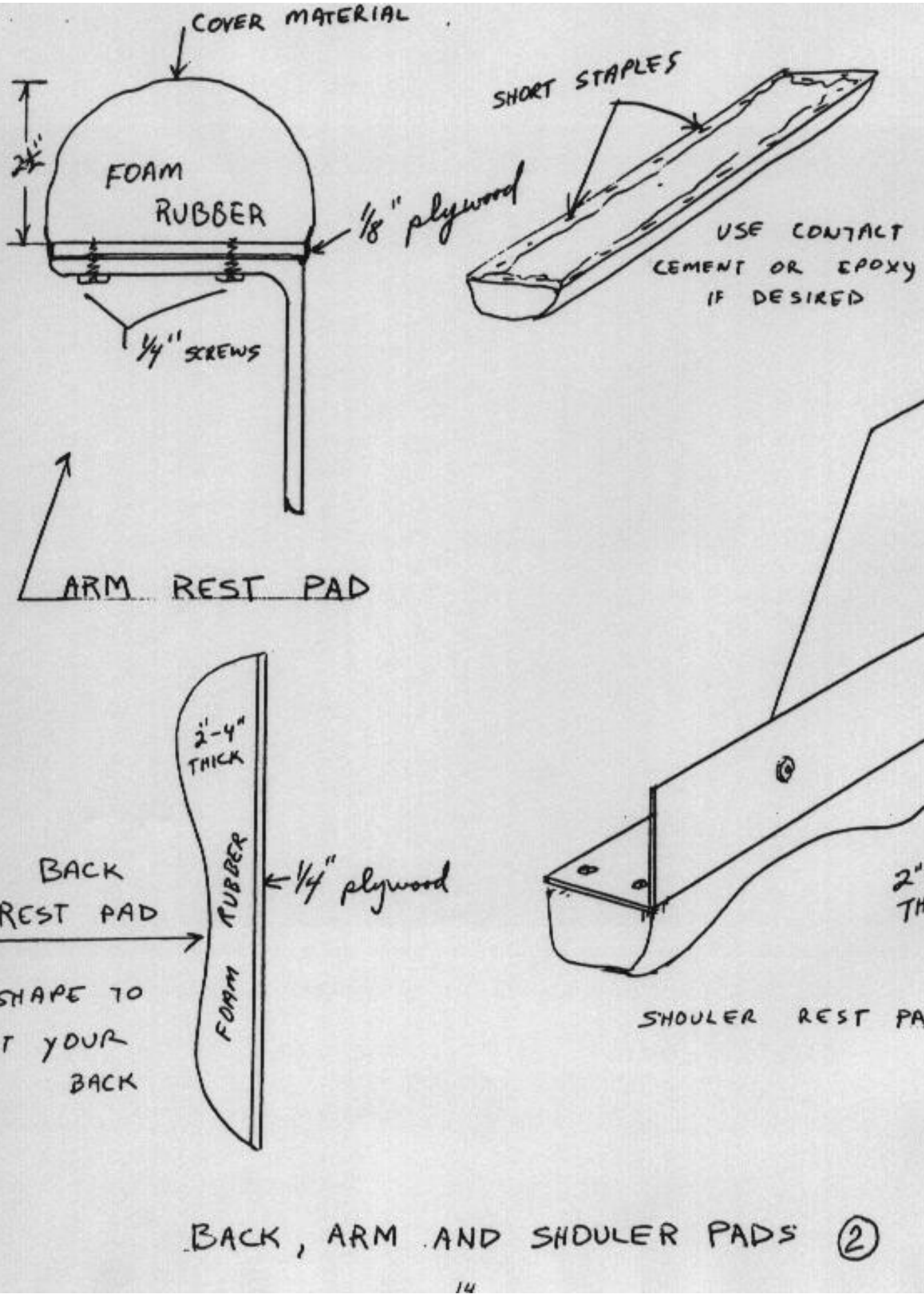
Central Snowmobile Salvage
P.O. Box 13188
2247 Shawano Ave.
Green Bay, WI 54307
1.800.558.6778 ; (414) 499.6001

Jetpack Blueprints

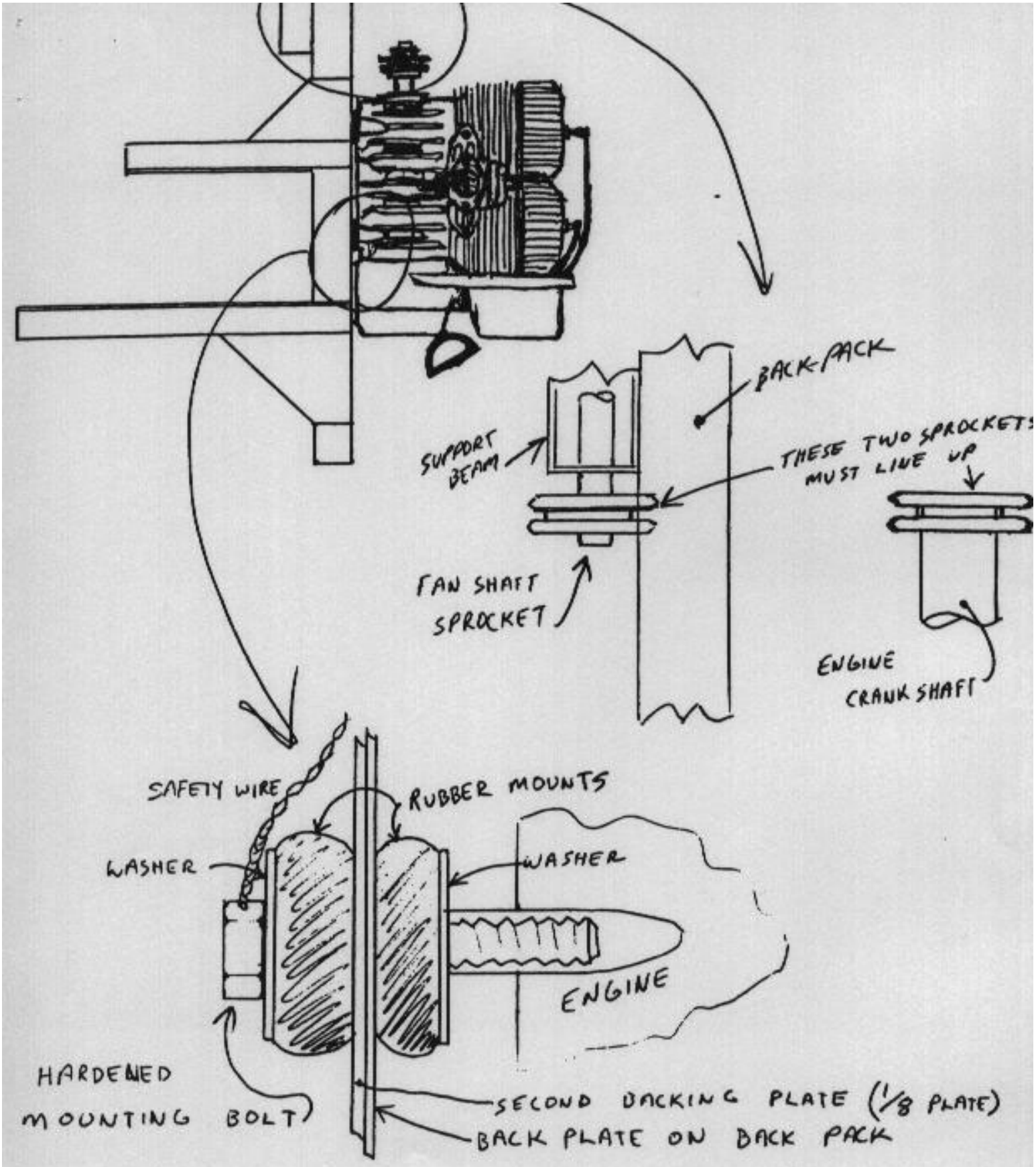




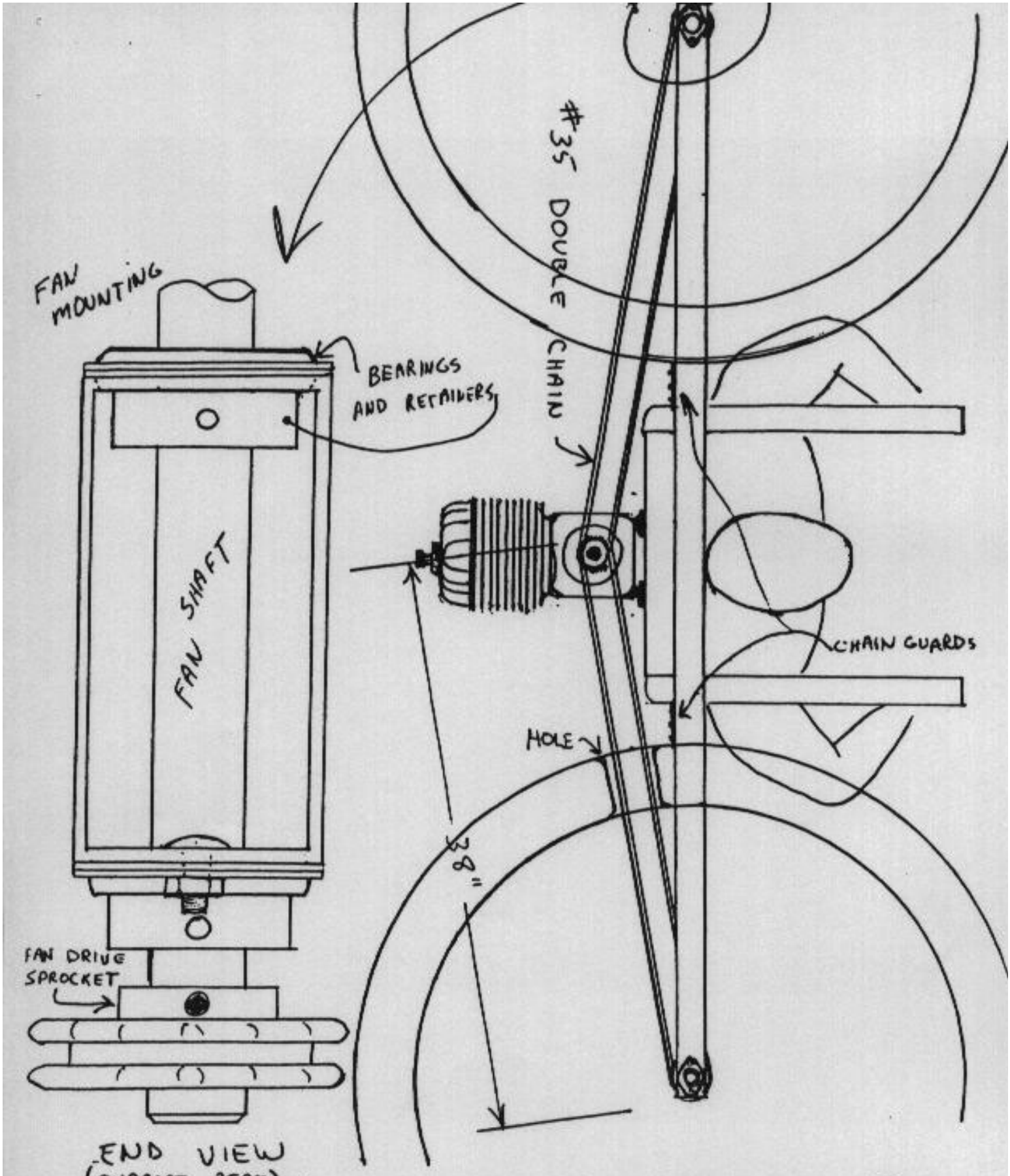
BACK-PACK FRAME (1)



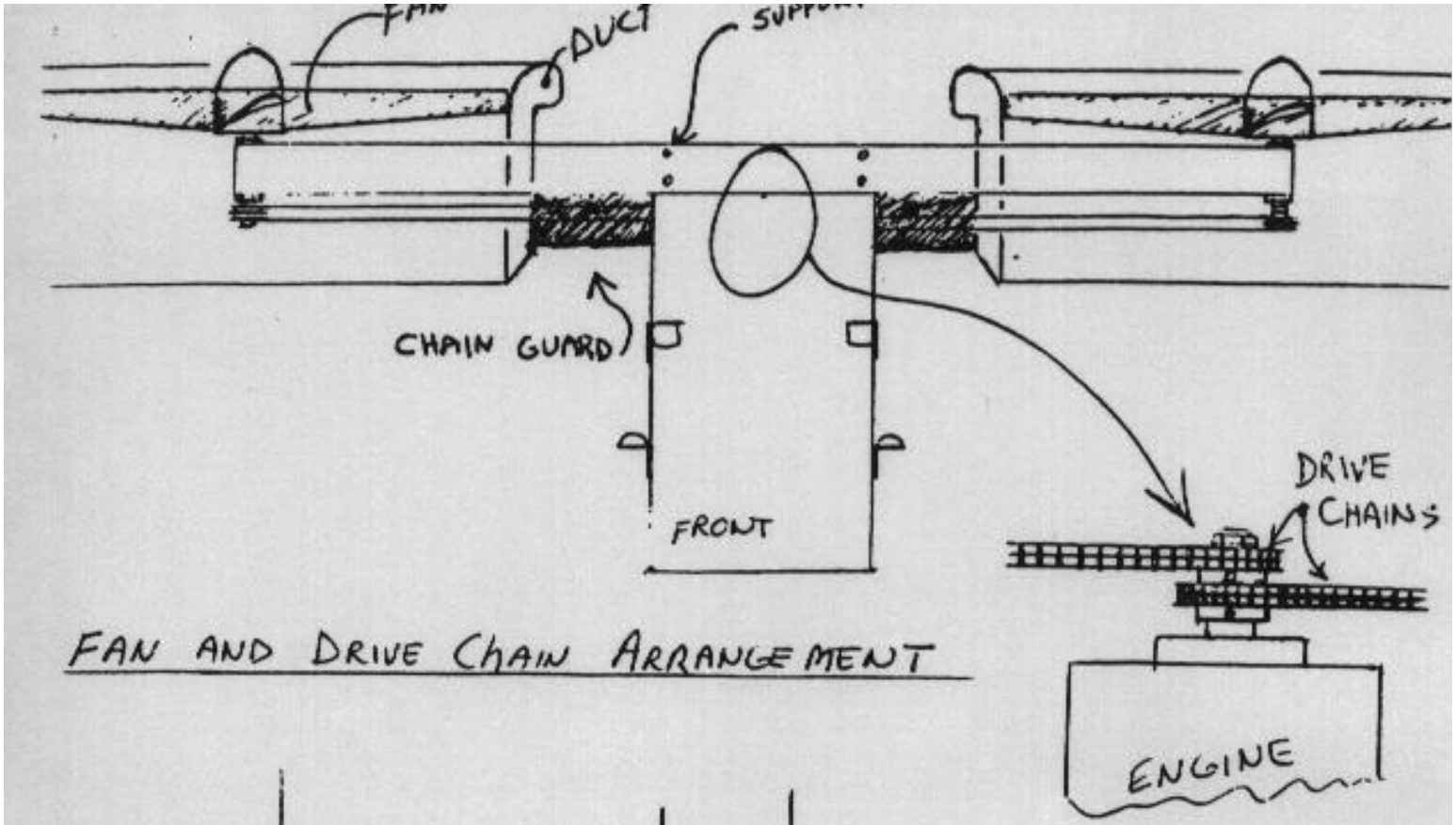
BACK, ARM AND SHOULER PADS (2)



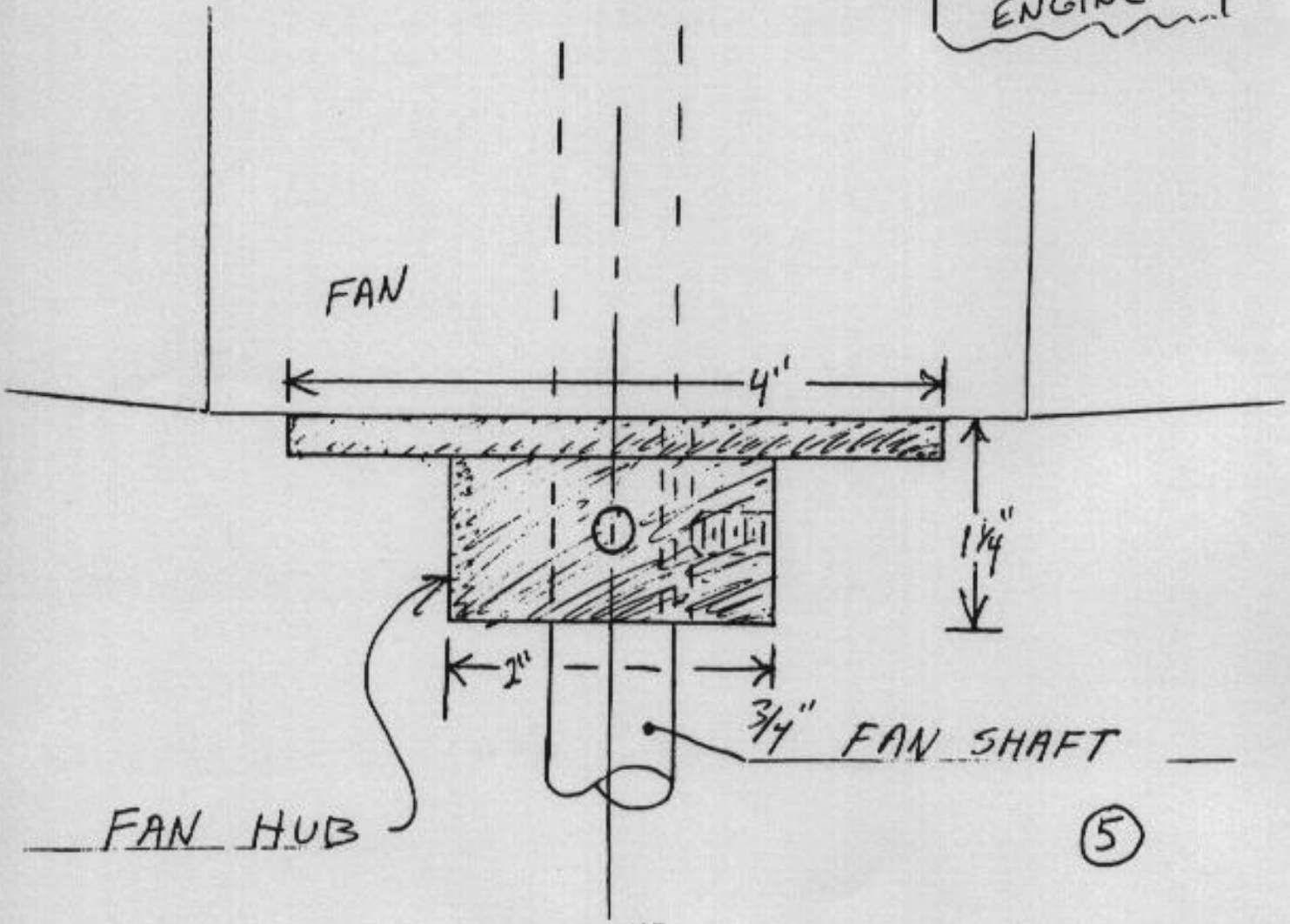
ENGINE MOUNTING (3)



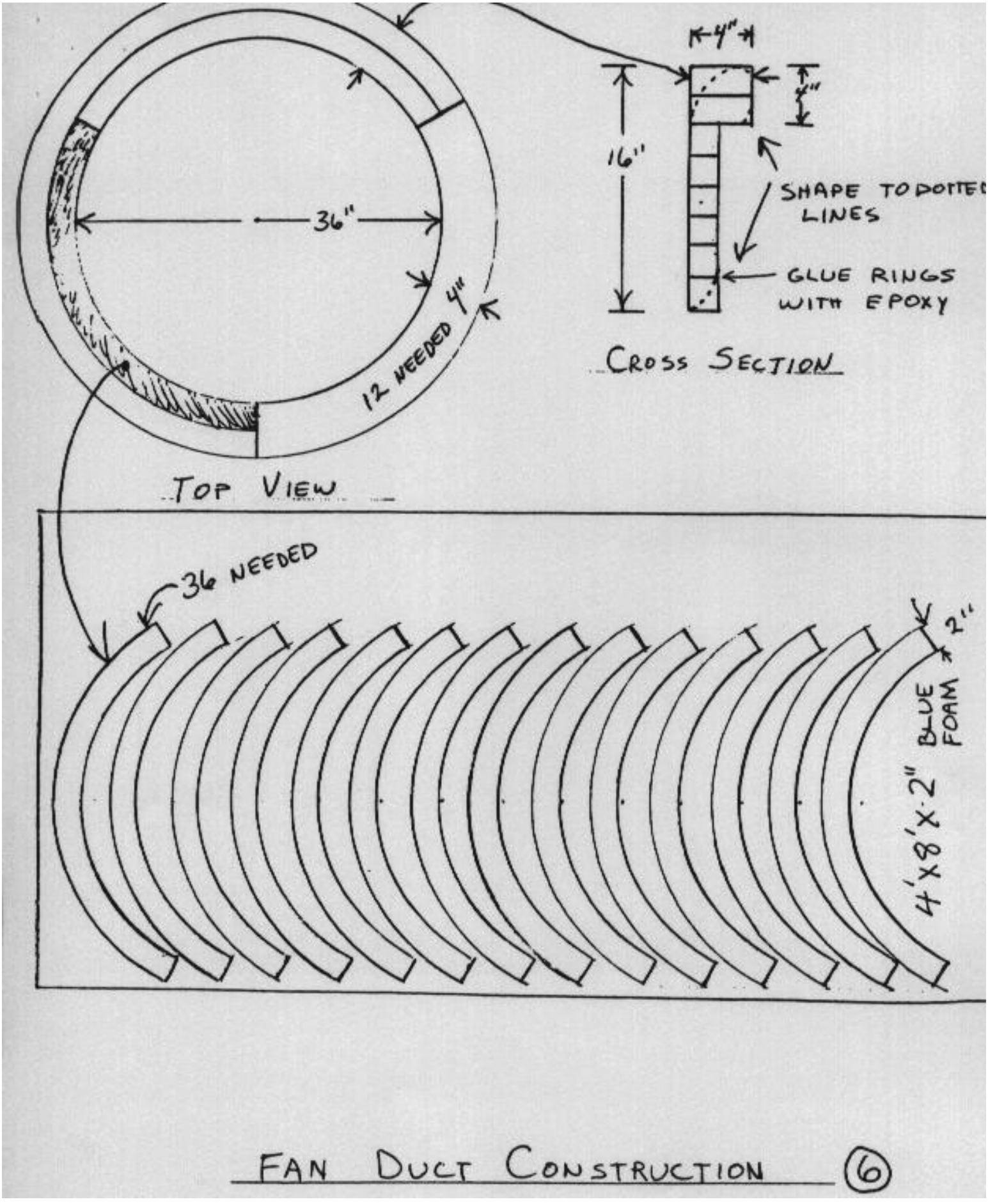
DRIVE CHAIN ARRANGEMENT (4)



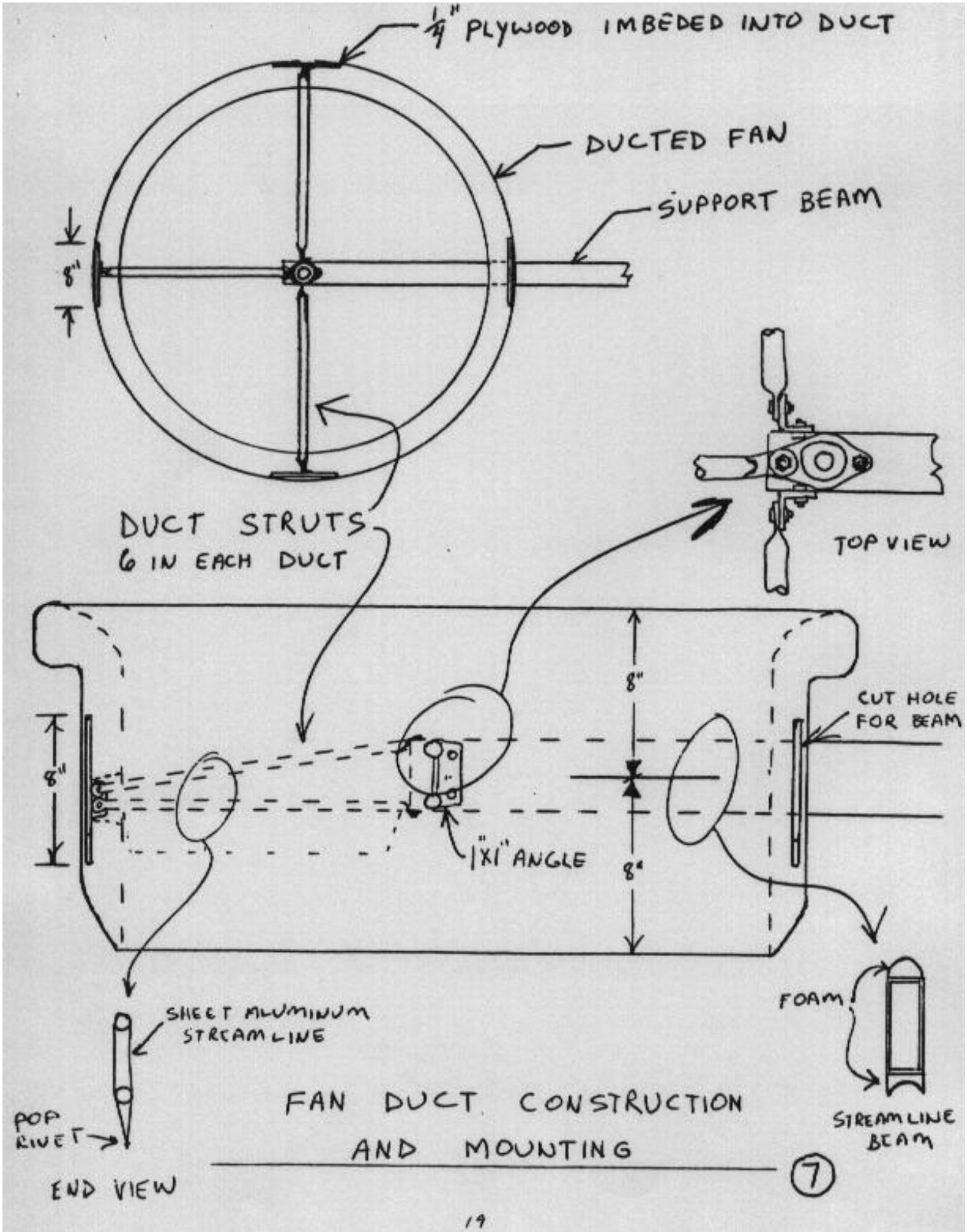
FAN AND DRIVE CHAIN ARRANGEMENT



(5)

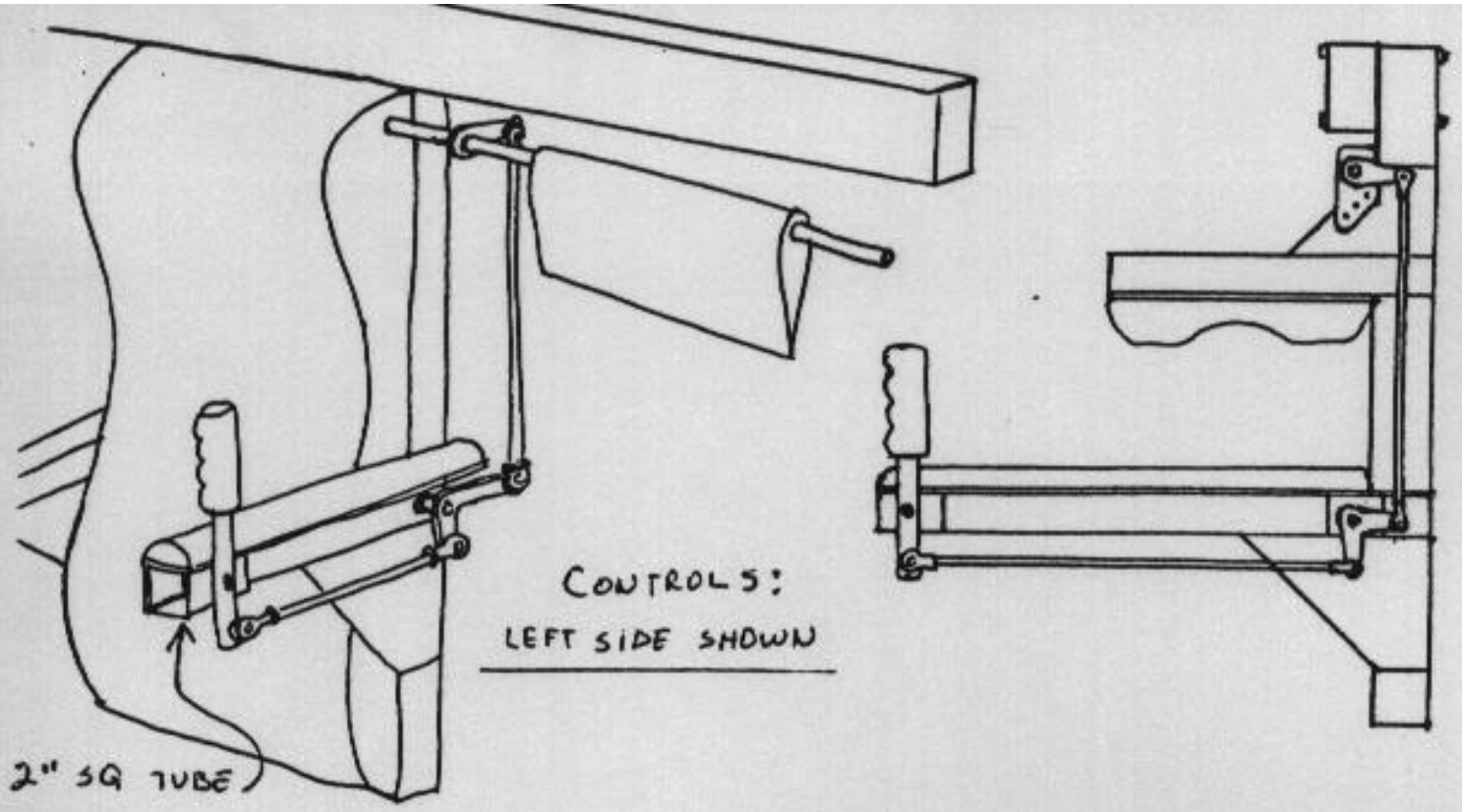


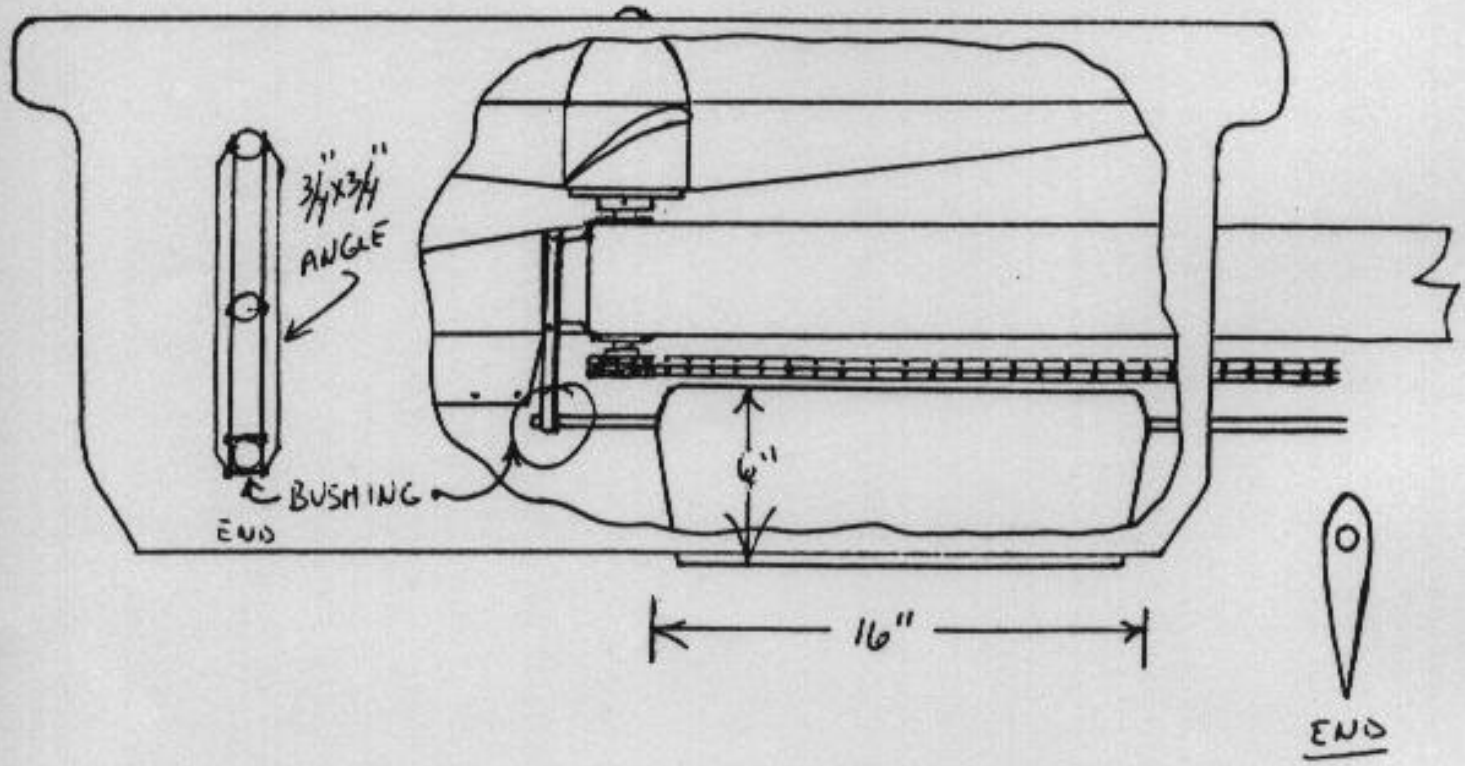
FAN DUCT CONSTRUCTION



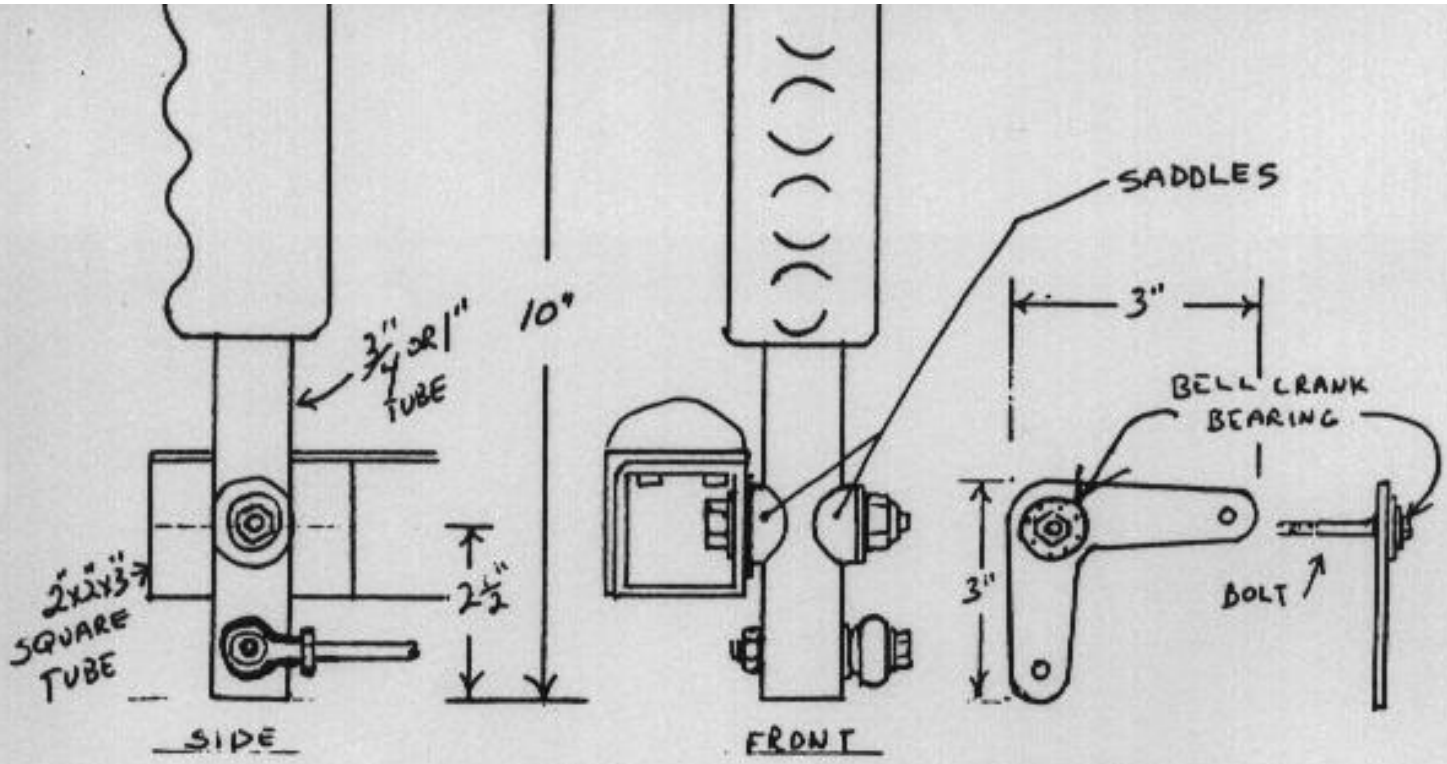
FAN DUCT CONSTRUCTION AND MOUNTING

(7)



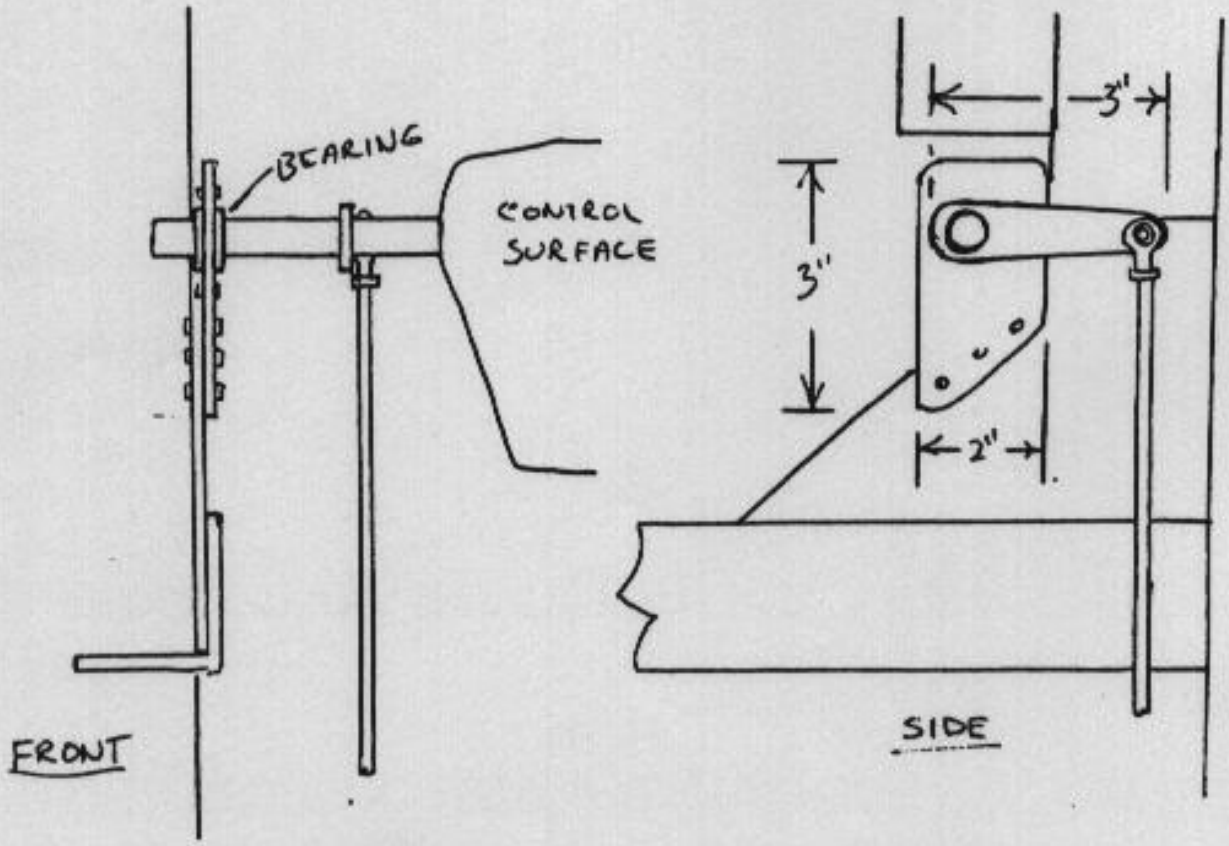


CONTROLS AND CONTROL SURFACES

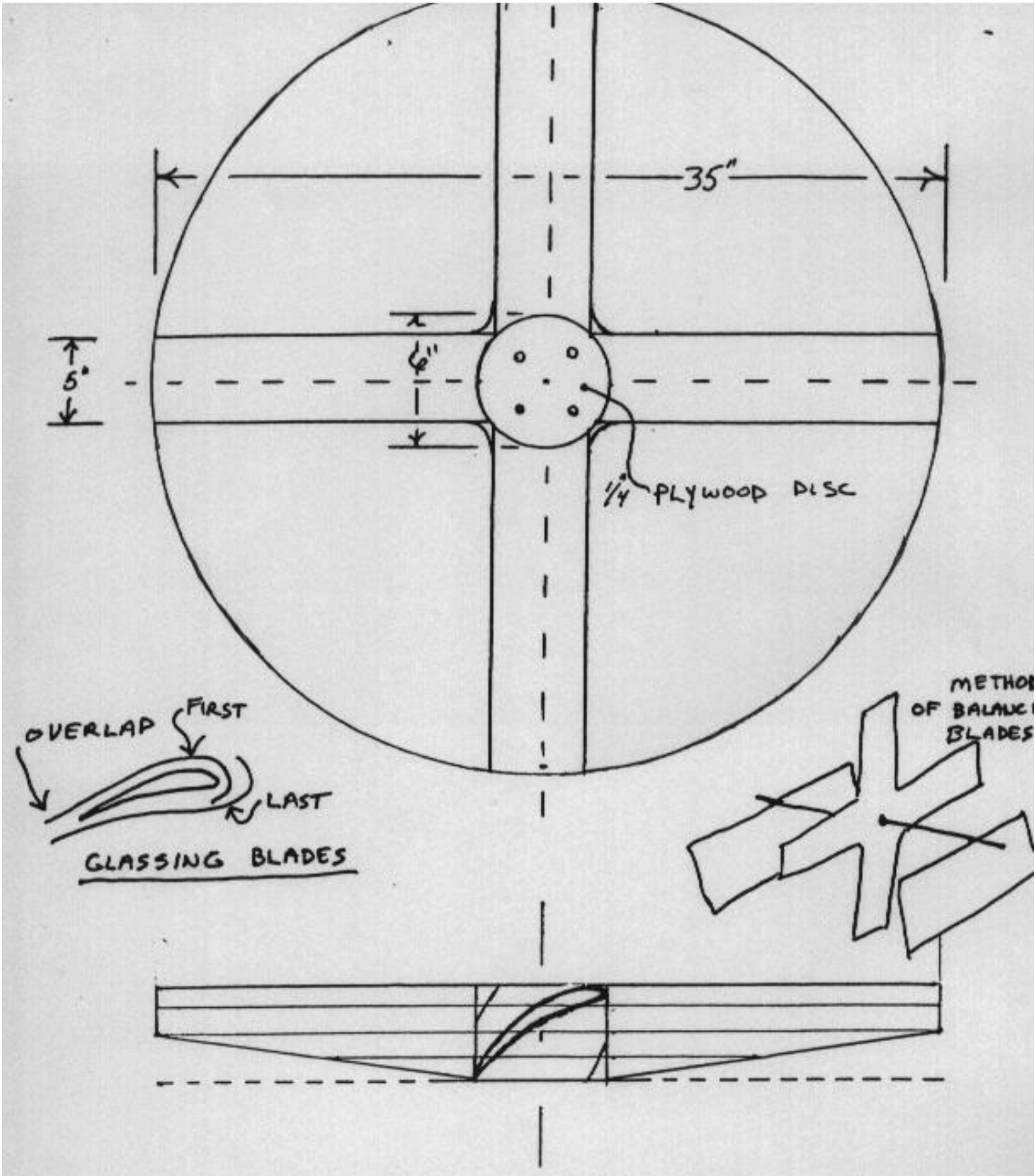


CONTROL STICKS

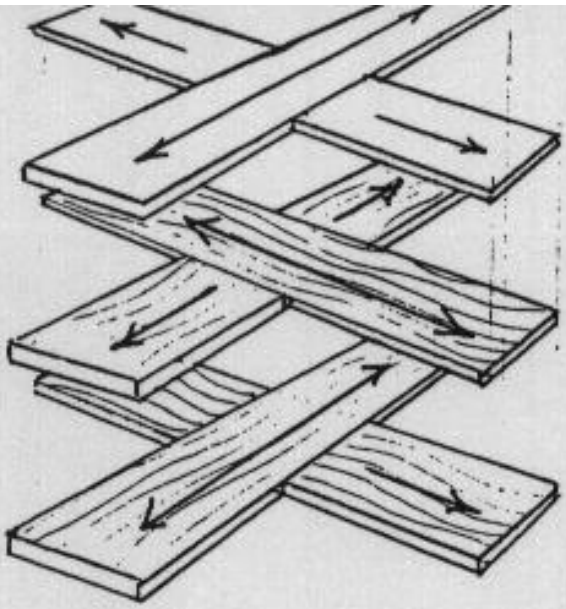
BELL CRANK



CONTROL LINKAGE DETAIL

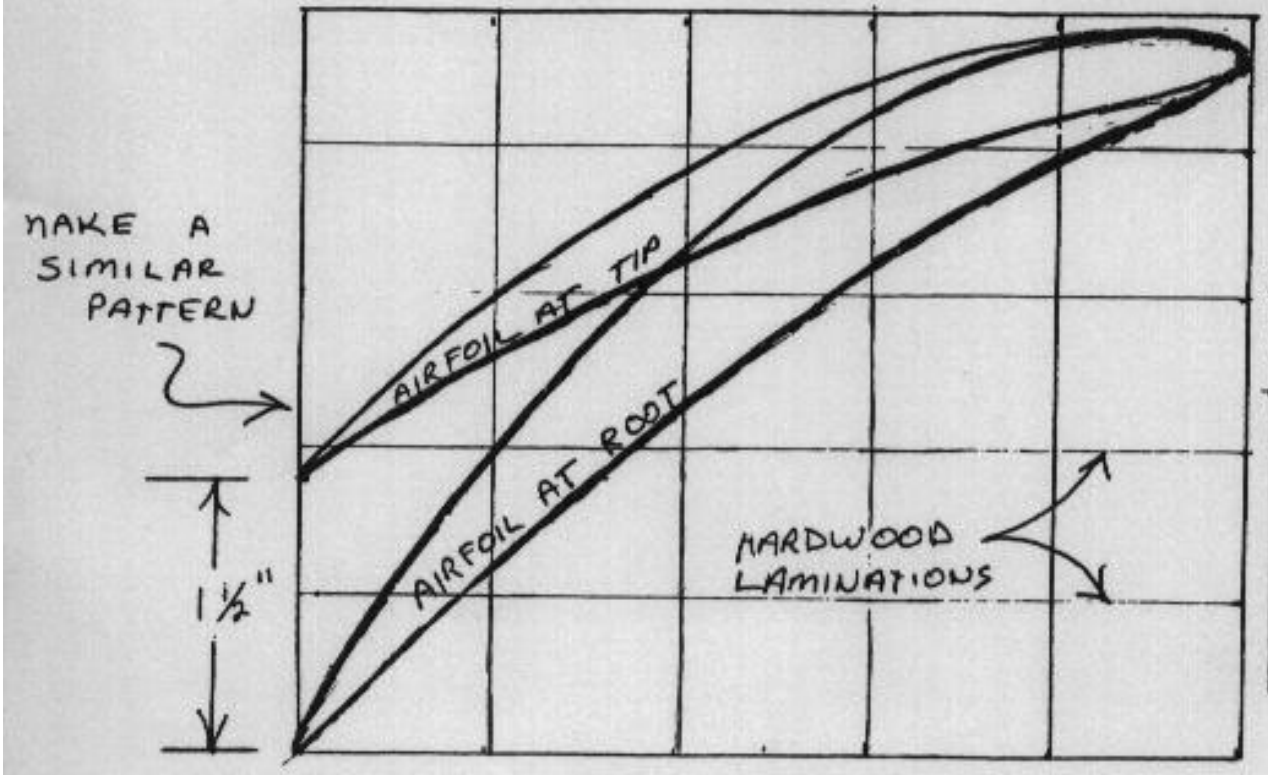


FAN CONSTRUCTION AND LAYOUT (10)

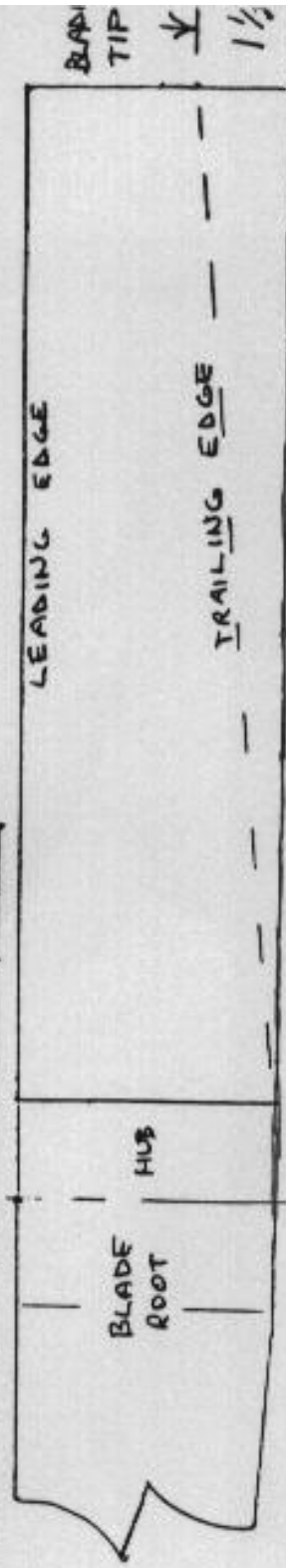


METHOD OF LAMINATION

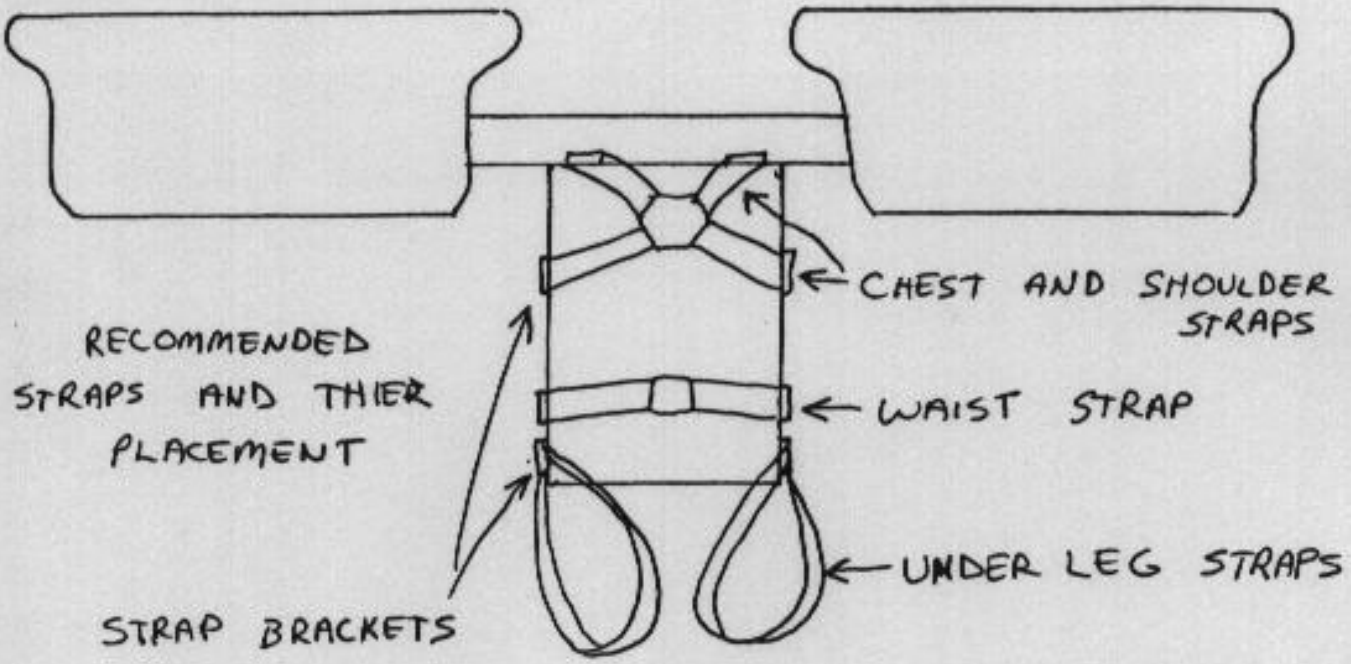
ARROW REPRESENTS GRAIN DIRECTION

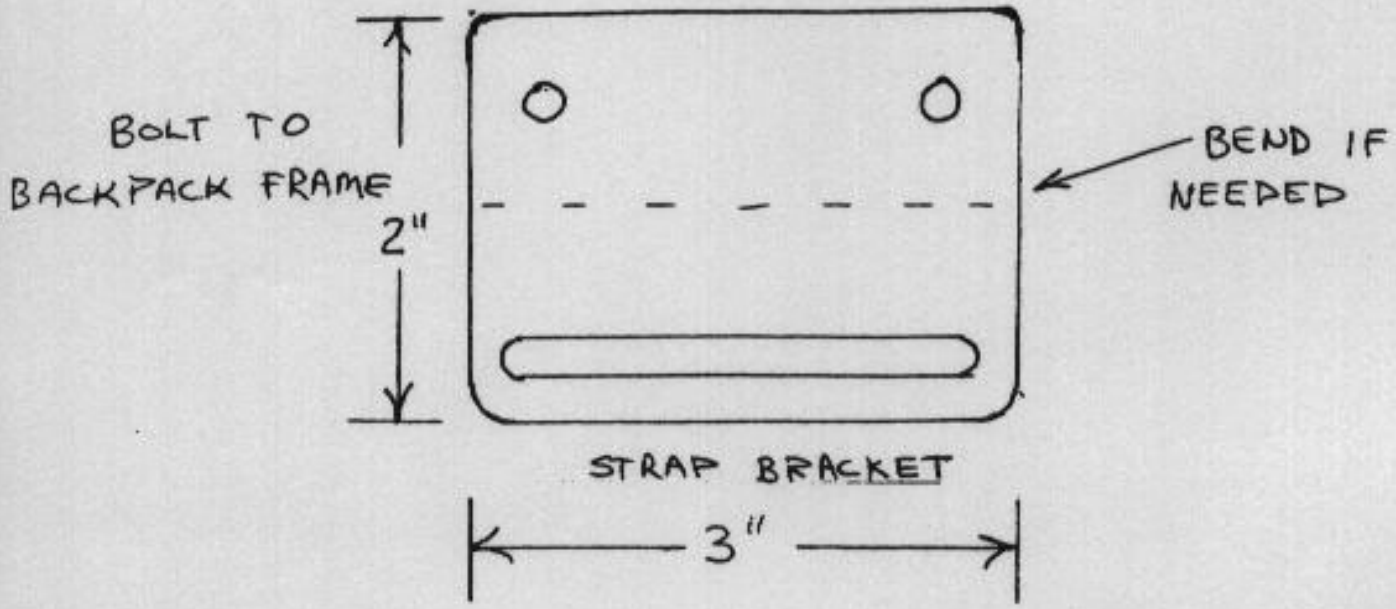


AIRFOIL PATTERN



FAN CONSTRUCTION DETAILS





HARNESS DETAIL

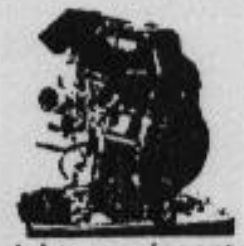
Other Options:

Here are some examples of engines that are available. Another source is Central snowmobile Salvage in Green Bay , Wisconsin. The address is given in the reference material.

As you choose an engine keep in mind your weight and power needs and also the availability of parts and service fo that particular engine.

ULTRALIGHT ENGINES

ROTAX 277 ENGINE Ⓡ



The Rotax 277 is the ideal engine for lighter weight ultralight aircraft. It delivers an amazing 27 HP at 6000 RPM and features shock mounted main bearings and a balanced crankshaft for smooth operation. High horsepower, compact design, reliability and light weight are important features of the Rotax 277 engine. It comes complete with a Bing 36MM (slide valve) carburetor, fuel pump, factory tuned exhaust, tool kit and owner's manual.

P/N 08-00100 $1138.00

ROTAX 377 ENGINE Ⓡ

The Rotax 377 is the ideal engine for high performance ultralights. It is manufactured with quality European craftmanship using the latest technology in two-stroke engine design. It produces 35 HP at 6250 RPM and weighs only 60 lbs. It comes complete with a Bing 36MM (slide valve) carburetor, fuel pump, factory tuned exhaust, tool kit and owner's manual.

P/N 08-00200 $1357.00

ROTAX 447 ENGINE P/N 08-00300 $1394.00

ROTAX 503 ENGINE Ⓡ

The Rotax 503 is one of the highest horsepower ultralight/homebuilt aircraft engines available, producing 46 HP at 6250 RPM. Ideally suited for powering heavier 2-place ultralights, small homebuilts or standard ultralights from high altitude bases. It comes complete with a Bing 36MM (slide valve) carburetor, fuel pump, factory tuned exhaust, tool kit and owner's manual. Wt. 67 lbs.

$1541.00

NEW ROTAX 532 ENGINE P/N 08-00450 $2389.00

KFM ENGINES Ⓡ

The KFM 107 is a 2-cycle, two cylinder opposed engine which is quickly gaining popularity for use on ultralights and sailplanes. The KFM 107 is currently the recommended engine for the Rutan Solitaire self-launching sailplane. All versions of the KFM 107 deliver 25 BHP at 6300 RPM and include an alternator and electric starter. While the KFM 107E is a direct drive engine, the KFM 107ER includes a reduction drive to increase propeller efficiency. The KFM 107ERU version allows the use of a V-belt reduction drive separated from the engine where a prop extension is required. All versions come with 10A alternator, geared electric starter, magneto, carburetor, fuel pump, prop hub, engine rubber mounts and a complete exhaust system kit. A six month limited warranty from date of delivery is provided on all KFM 107 series engines.

Engine	Drive	Wt. Lbs.	Part No.	Price
KFM 107E	Direct	41.2	08-00500	$1382.00
KFM 107ER	2.10:1 Reduction	48.5	08-00600	$1526.00
KFM 107ER	2.55:1 Reduction	48.5	08-00700	$1587.00

ROTAX REDUCTION DRIVES Ⓡ

Rotax reduction drives for all Rotax ultralight engines are available in an up or down configuration with a 2.0, 2.1, 2.3 or 2.5 to 1 reduction ratio. The reduction drives for the Rotax 377 also fit the Rotax 477 engine. Both gear and belt reduction drives are available. Specify type & ratio.

Rotax Engine	Reduction Drive		Part No.	Price
277	Gear	Up or Down	08-00800	$329.00
277	V-Belt	Up or Down	08-00900	$325.00
377	Gear	Up or Down	08-01000	$329.00
377	V-Belt	Up or Down	08-01100	$325.00
503	HTD-Belt	Down	08-01200	$338.00

ALL ROTAX & KFM ENGINES & ACCESSORIES ARE AVAILABLE - CALL OR WRITE FOR CURRENT PRICES & DELIVERY INFORMATION.

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Lift Fans

4 - Blade

Diameter	Price	Product Code
24"	$200.72	W24-4
26"	$212.27	W26-4
28"	$217.39	W28-4
30"	$222.50	W30-4
32"	$227.62	W32-4
34"	$232.73	W34-4
36"	$237.85	W36-4
6 - Blade		
24"	$294.11	201
26"	$296.67	202
28"	$301.79	203
30"	$306.90	204
32"	$312.02	205
34"	$317.13	206
36"	$322.25	207

Thrust Propellers

1 to 50 Horsepower

Thrust Props

2 - Blade

Diameter	Price	Code
24"	$106.58	208
26"	$109.97	209
28"	$112.53	210
30"	$115.09	211
32"	$117.65	212
34"	$120.20	213
36"	$124.47	214
36"	$140.66	215
42"	$163.45	216
48"	$214.63	217

3 - Blade

24"	$191.81	218
26"	$196.93	219
28"	$202.04	220
30"	$207.16	221
32"	$212.27	222
34"	$217.39	223
36"	$222.50	224
38"	$240.08	225
42"	$276.21	226
48"	$366.72	227
4 - Blade		
24"	$208.01	228
26"	$212.27	229
28"	$217.39	230
30"	$222.50	231
32"	$227.62	232
34"	$232.73	233
36"	$237.85	234
38"	$276.21	235
42"	$304.34	236
48"	$421.09	237
6 - Blade		
24"	$254.05	239
26"	$258.31	240
28"	$262.57	241
30"	$267.69	242
32"	$273.65	243
34"	$277.92	244
36"	$283.88	245
38"	$318.84	246
42"	$345.26	247
6 - Blade		
24"	$289.86	248
26"	$296.67	249
28"	$301.79	250
30"	$306.90	251
32"	$312.02	252
34"	$317.13	253
36"	$322.25	254
38"	$358.05	255
42"	$409.20	256

* Ask about our high pitch, low noise 48" – 50, 54" – 60 & 54" – 70 & replacement Webber propellers.