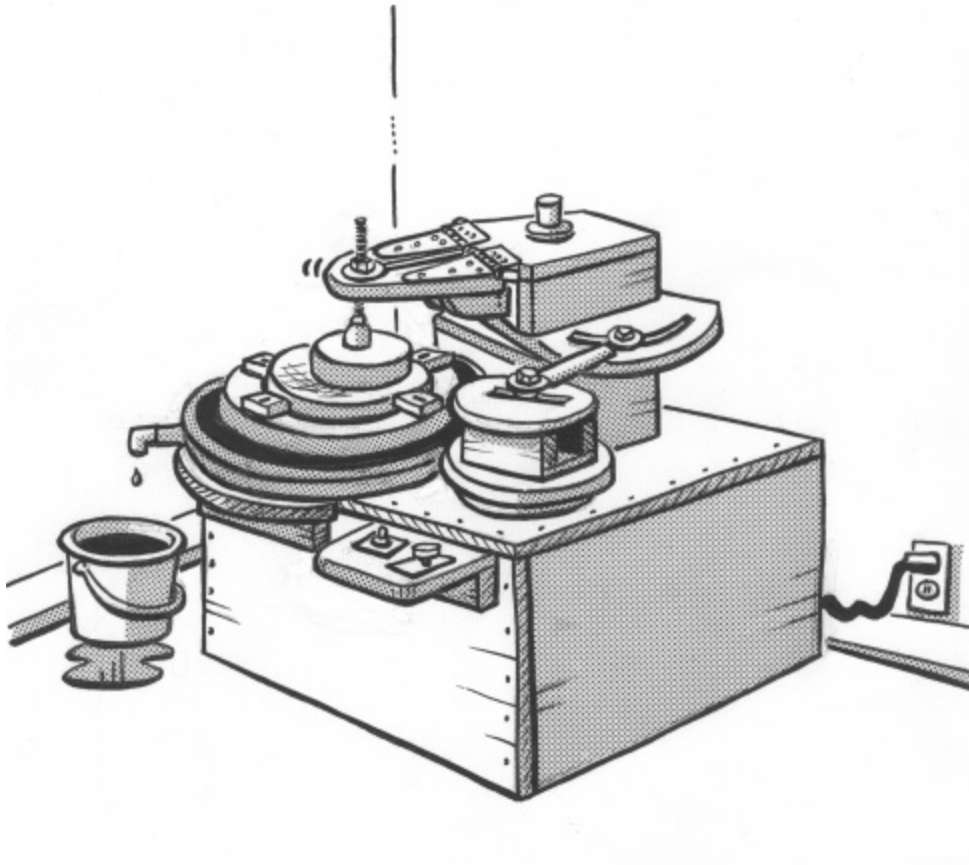


Mirror-o-Matic



# A Construction Manual For Converting The Mirror-o-Matic



Dennis & Bob Rech

# **A Construction Manual For converting the Mirror-0-Matic**

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Additional information, notices, updates and current  
e-mail list server information can be found at:  
[www.mirror-o-matic.com](http://www.mirror-o-matic.com)

This is plan set # Free pdf.  
Revision: 7/2002

## Introduction

The Mirror-o-Matic 20 is my response to the many requests for a larger version of the original Mirror-o-Matic. It has been designed to fabricate concave mirrors up to 17.5 inches. There is room to expand the turntable up to 24 inches so that 20 inch mirrors can be accommodated.

For the many builders that have already constructed the original Mirror-o-Matic, the design allows for the reuse of the entire power head assembly, eccentric, eccentric push rod, swivel and rod assembly and hinges. Even the one inch blower shafts can be reused if they can be removed.

The original Mirror-o-Matic had a turntable that doubled as a slurry drip pan. Because of the increased effort of removing larger, heavier mirrors on this new bigger machine, I have added a stationary drip pan under the turntable. This will allow washing the mirror in place and attaching a drain pipe to the pan.

The over-arm assembly has been modified to be more ridged and there is now a slot running the length of the arm to allow for tool positioning while figuring.

For those builders wishing DC motor drives, I have added a page showing one scheme to incorporate separate variable speed motors.

Even though the machine is bigger and capable of handling larger mirrors, the recommended electric motor size is still 1/4 to 1/3 hp.

The advantages of this machine are similar to the original. It can be built for \$300 to \$400. It is constructed entirely of 3/4 inch plywood and hardware store items. It needs no machined parts and only basic tools are required for construction. Although this machine is physically larger than the original, it is still very compact for a grinding machine with its capacity. It can be broken down for storage and transportation very quickly.

Have fun building and grinding and do not be afraid to modify and improve the design. Please keep me informed of your progress.

Dennis

## Use of existing parts.

In this conversion manual, I have deleted the pages for the entire powerhead assembly, the eccentric drive, the eccentric push rod and the swivel assembly. These parts are almost identical to the smaller original Mirror-o-Matic parts and will work as in the bigger machine.

The M-o-M 20 uses one inch shafts for the eccentric. If your original machine had one inch shafts for the eccentric, they can be reused. The M-o-M 20 should use one inch shafts. The 12 inch turntable pulley and the 8 inch eccentric pulley can be reused if they have one inch shafts.

If you are buying a new motor, use a 1/4 to 1/3 hp reversible rotation version. If you already have a 1/4 hp motor it will also work. With the torque multiplication provided by the double reduction belt system on the powerhead, either will have enough torque. Belt slippage may be a problem with big dry pitch laps and lots of quill weight. If so, there is room for a double groove pulley on the drive shafts. Notched belts also help. More than likely, if slippage occurs ythe powerhead can be pulled back hard against the belts and a wood screw run down through the powerhead base and the base box floor. This has always solved the problem for me.

A reversible motor is desirable if a big mirror and tool will be used. Usually, the turntable rotates clockwise which is the direction of the motor. The overarm is on the right of center which puts the overarm in tension. If it is compression, there may be some resonance. If you are using a mirror bigger than 17 inches, there may be interference between the overarm tool and the eccentric. If this is the case, reverse motor and turntable rotation and run the overarm on the left of center position. You will have unlimited room and will probably dribble slurry beyond the reach of the slop pan.

For smaller mirrors, the turntable is reusable. Definitely put adjustable cleats on it, however. Centering is important.

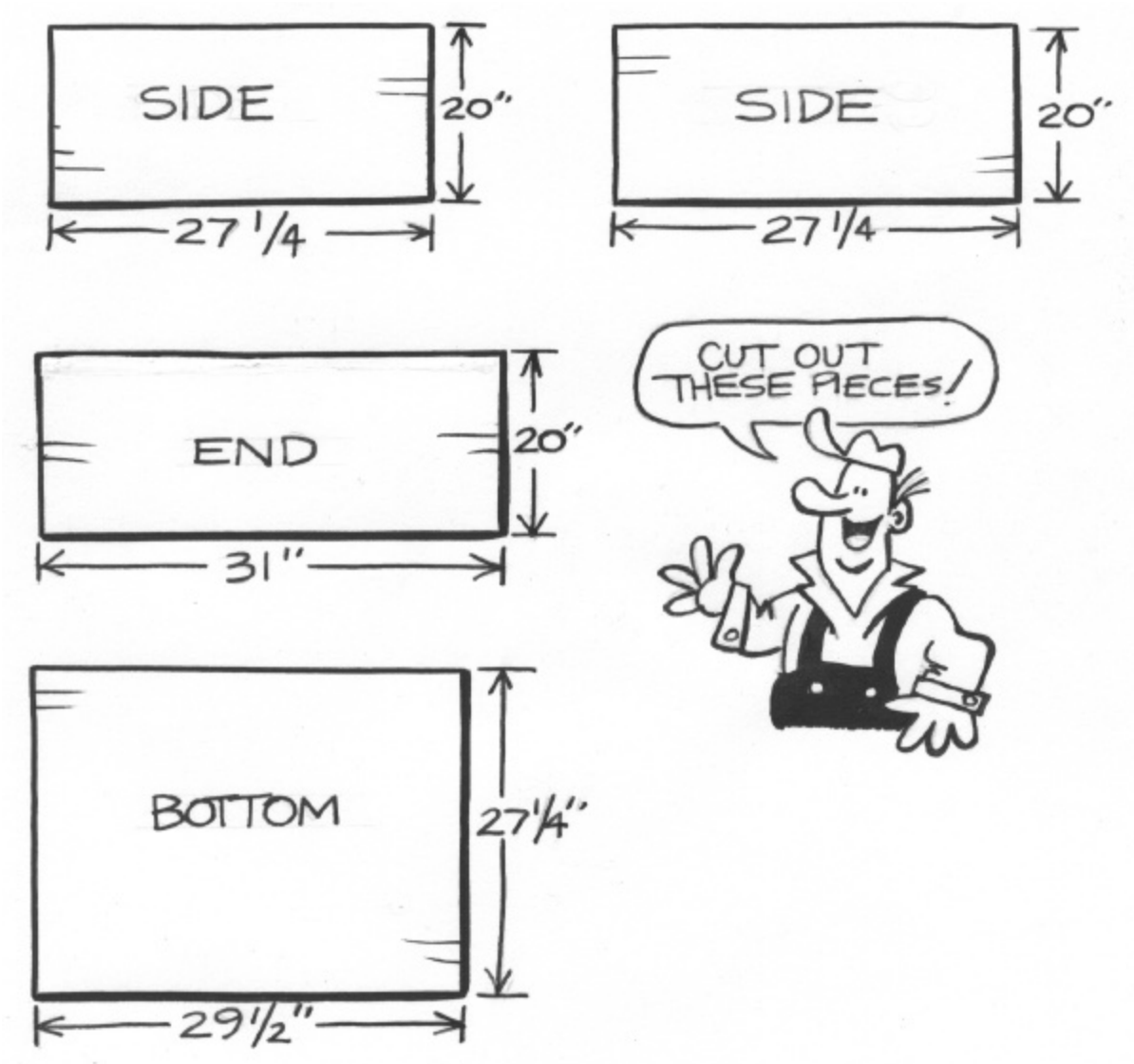
Please keep me informed of your progress. I always enjoy hearing from builders and users.

Dennis

## Building the Base Box

The base of the Mirror-o-Matic 20 starts with a simple three sided box with a bottom. The corners may be butted or mitered (adjust your cuts accordingly). Dimensions shown are for butted corners. The finished box should be 31 inches by 28 inches.

I recommend building the box and most other parts from  $\frac{3}{4}$  inch thick “cabinet grade” plywood. Seven ply birch works fine. So does the inexpensive generic hardwood sold by Home Depot. Typical fir construction plywood such as CDX grade is not very good because of the many voids which will compress when bolts are tightened into it.



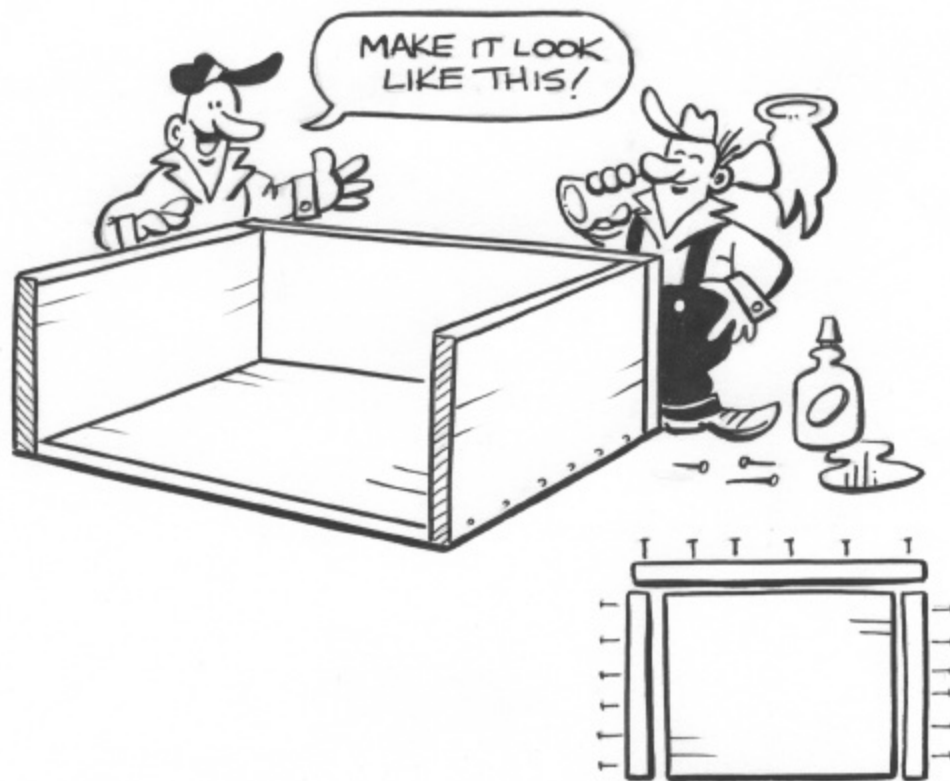
## Mirror-o-Matic

There is a fair amount of torque passing through the box, so be sure to glue all joints. I prefer using polyurethane glue. It is very viscous and swells slightly as it sets so small gaps will be filled. Align parts carefully. Once it sets, you will not be able to break the joints. Read the glue instructions for humidity requirements. Some glues require that the wood be dampened.

Use care, polyurethane glue will stain your hands and clothes a rich dark brown which will take a week to wear off.

Carpenter's glue or white glue such as Elmer's will also work.

Throughout the manual, all wood parts in this project can be nailed, screwed or clamped until the glue sets.

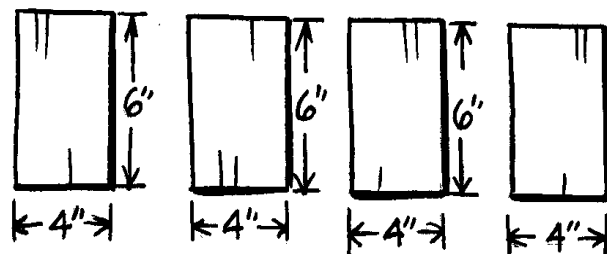
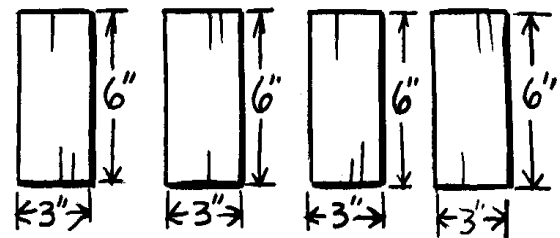
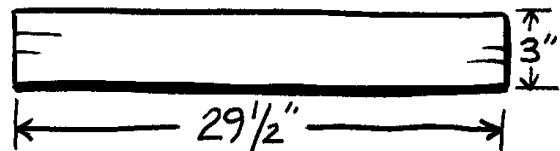
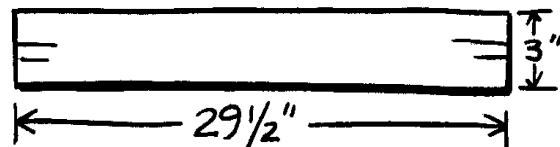


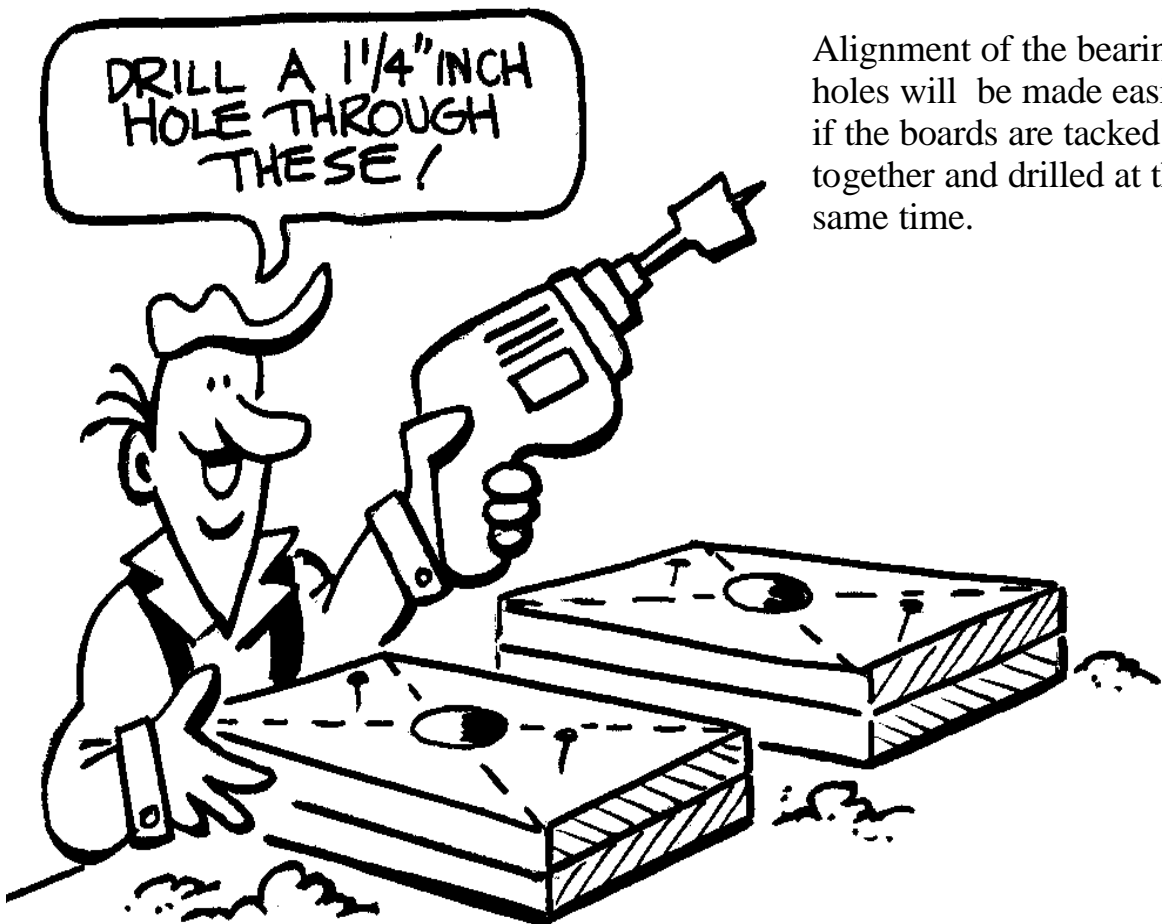
## Building the bearing boxes.

The turntable and eccentric shafts are carried in simple 1" diameter x 3 " long bronze bushings pressed into plywood boxes. These simple systems avoid having to buy expensive bearing assemblies. The length of the bushing prevents rocking and the need for self aligning bearings.

The drawings show constructing a plywood box. A solid piece of wood will also work if you have the ability to cut it out of a length of 4"X 6 inch stock. Take care to drill the 1-1/4" diameter hole square to the top of the box in both directions. Provisions have been made in the design to correct for small misalignments, however.

The 29-1/2" x 3" supports can be cut out of 3/4 inch plywood or 3/4" or thicker solid stock. Solid stock is the preferable material.



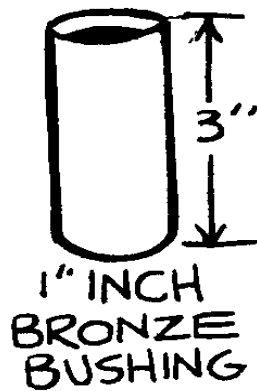
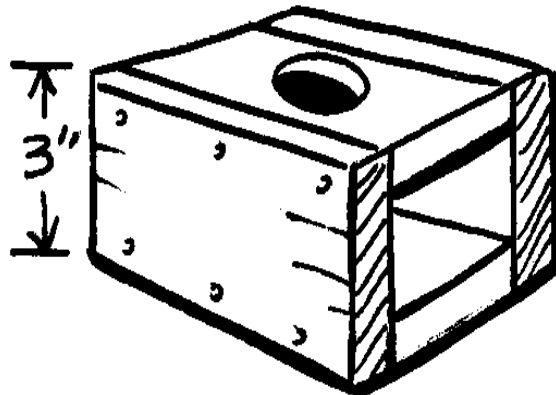


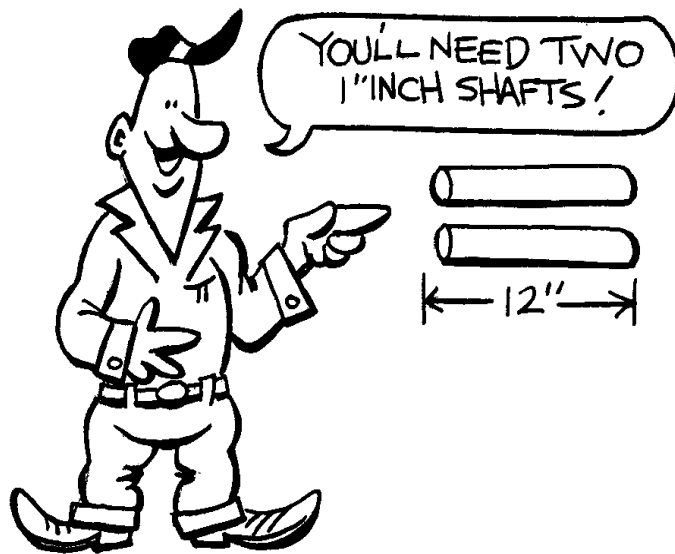




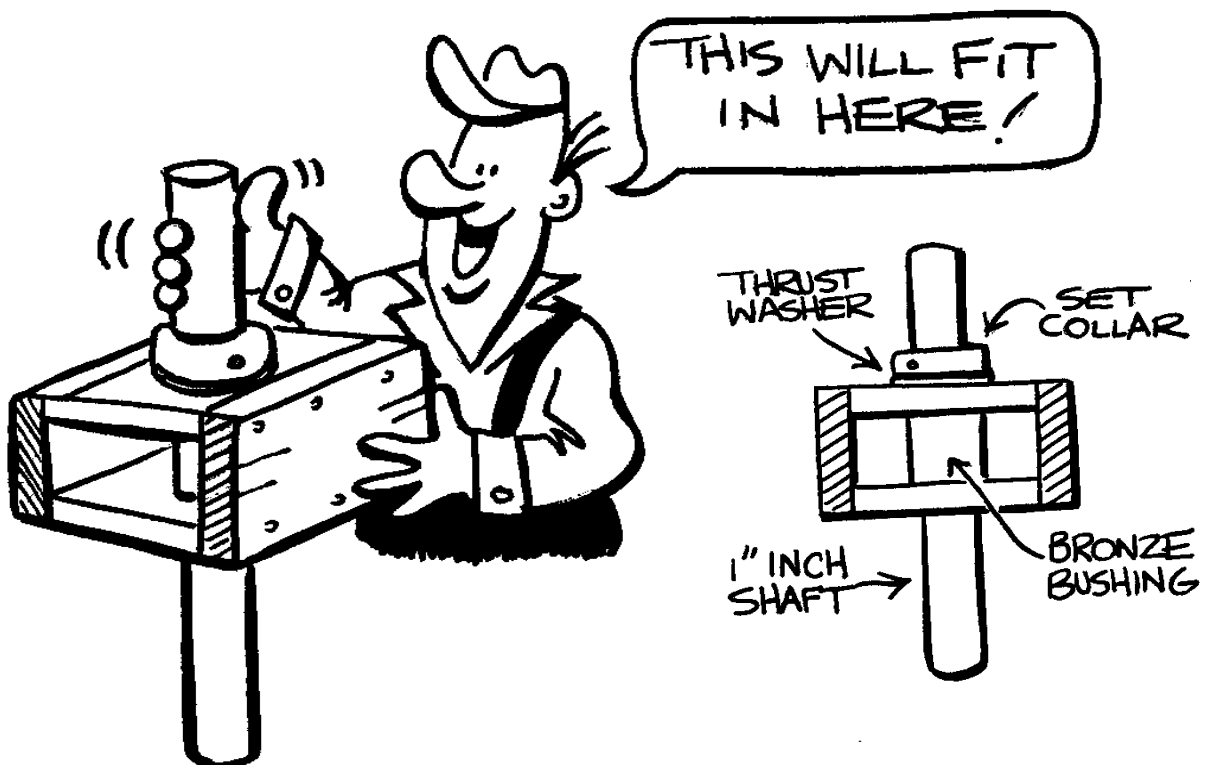
Glue and assemble the bearing box as shown. Check with a small builders square to assure that the top and sides are at right angles.

After the box sets up, smear some polyurethane in the 1-1/4 inch hole and insert the 1" x 3" long bronze bushing. If you cannot find a 3 inch long single bushing, two shorter bushings can be used. Insert a piece of 1 inch shafting into the bushings to hold them in alignment until the glue sets. Avoid getting glue inside the bronze bushing.

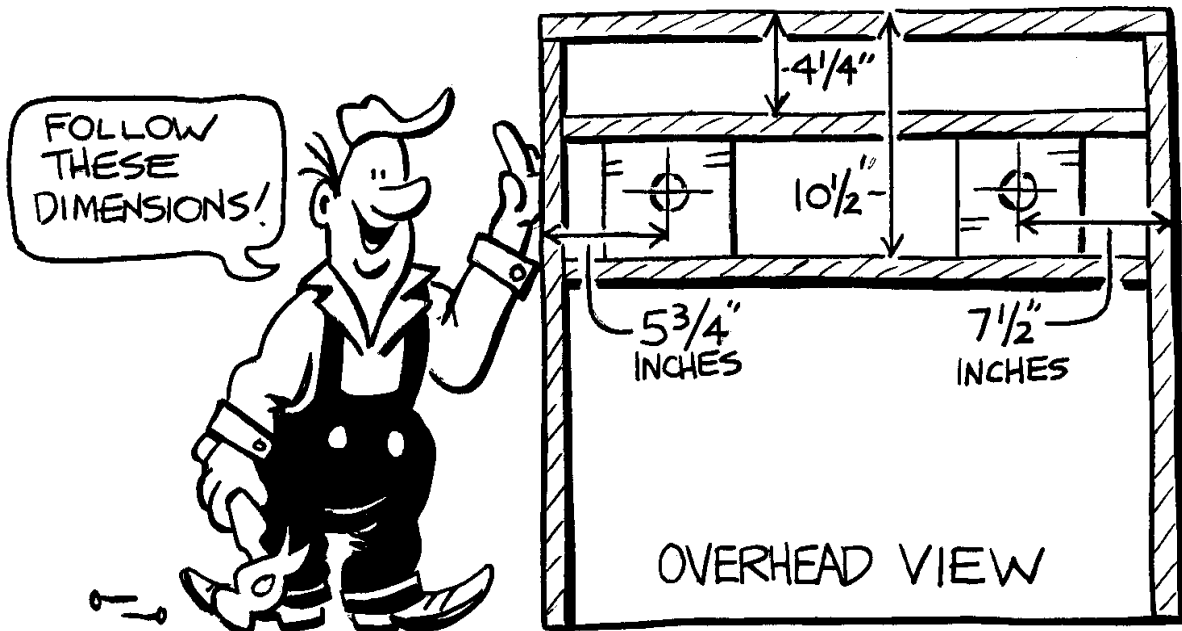




After the glue cures, loosely assemble the shaft assemblies as shown and insert into the bronze bushings . Lightly tighten the set screws on the shaft collars. This is a temporary trial fitting.



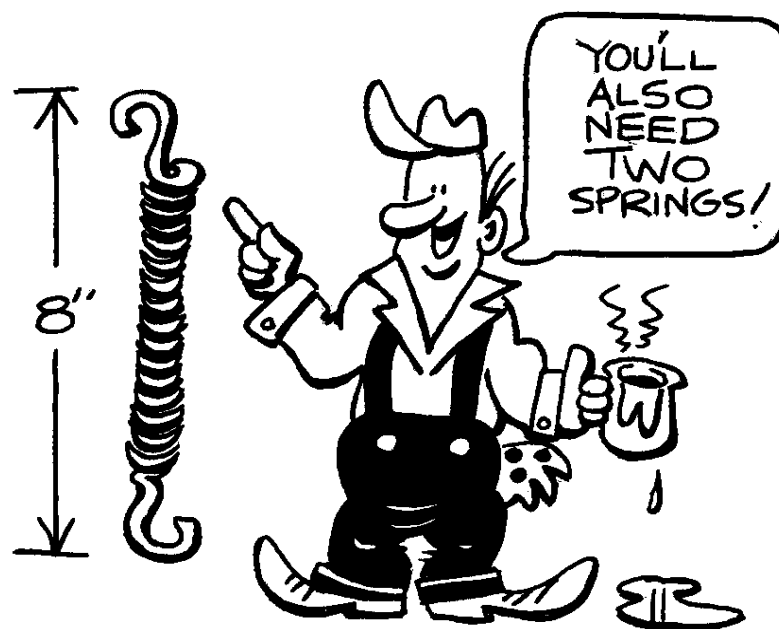
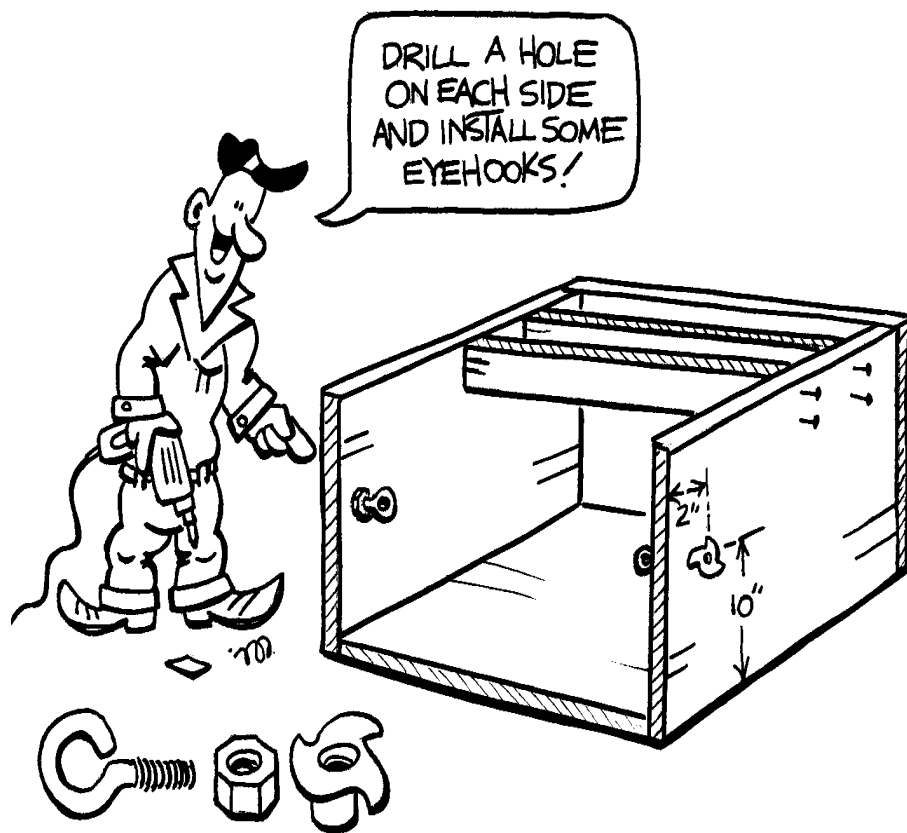
## Installing the bearing boxes into the base.

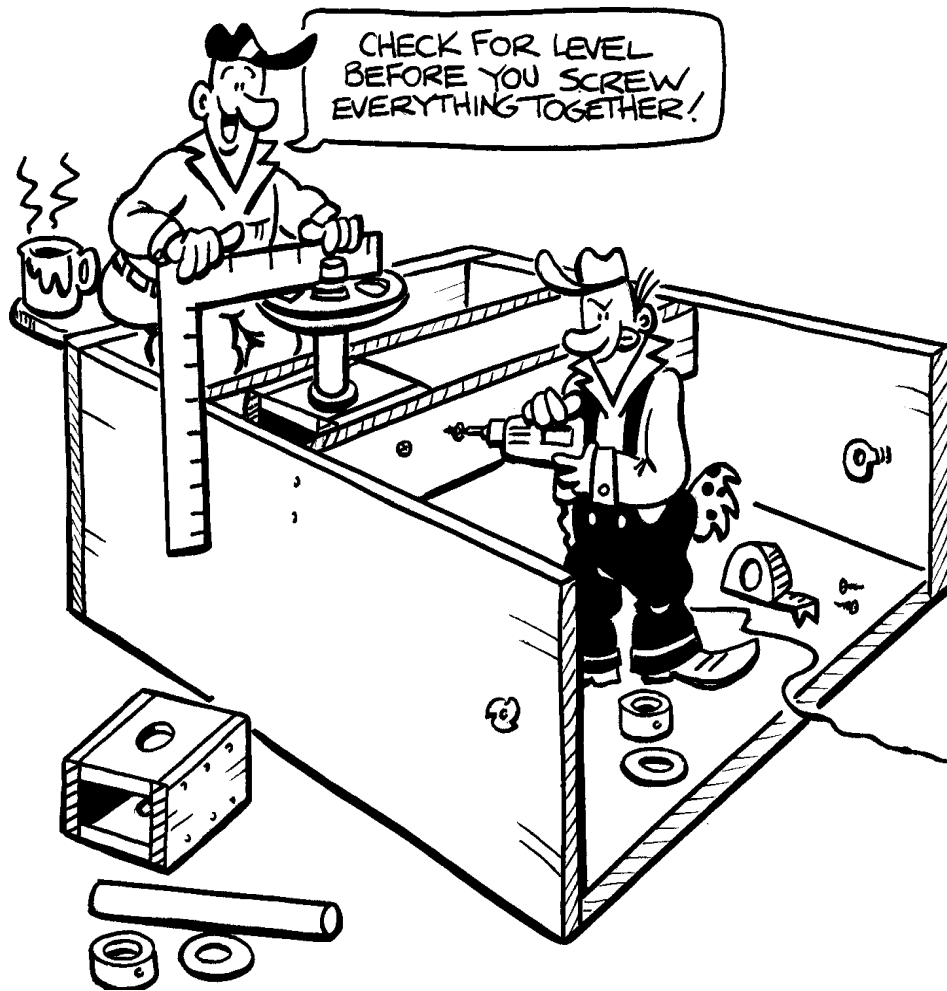


The previously cut 29-1/2" bearing box supports are next tacked into the base box. See the picture on the next page for a better overview of the process. Lightly tack or screw one support into place. Then set the second support the exact width of the bearing boxes. Do not set the nails or screws yet. They may need to be pulled and redone. Do not use glue. The supports can be adjusted up or down a bit to align the shafts. After everything is made square and plumb, additional fasteners can be added.



Drill holes for the 3-pronged nuts that will hold the spring eyebolts. I used 1/4 inch plated eyebolts. Size the 3-pronged fasteners and their holes as required. You can wait on the installation of the eyebolts until later to avoid scarfing your knuckles while working inside the cabinet on other assemblies. The springs will be attached to eyebolts in the power head assembly later.





Screw into the bearing box through a support near the end of one of the bearing boxes. Install a pulley on the shaft and tighten the setscrew. Check that the shaft is parallel to the box edge with a builder's square laid across the pulley. Pivot the bearing box on the screw until it is square. Once it is, add a second screw at the other end to hold it in position.

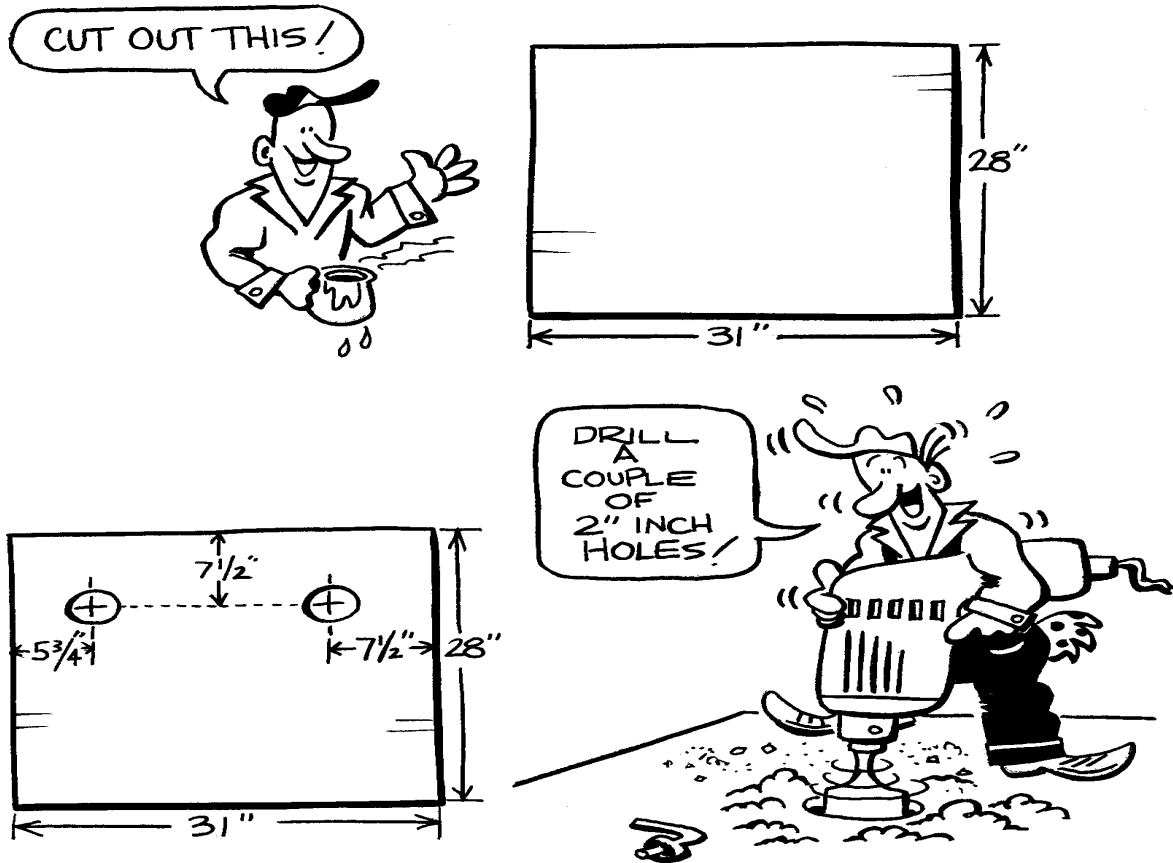
Check for square in the other direction in a similar fashion. Raise or lower one end of one support until the box is plumb in both directions.

Repeat with the other bearing box.

You may have to fidget back and forth with the adjustments a bit to get both shafts plumb.

Add several screws or nails to each bearing box and at the end of each support. An 8" block of 1"x2" wood can be nailed under the two supports for additional strength.

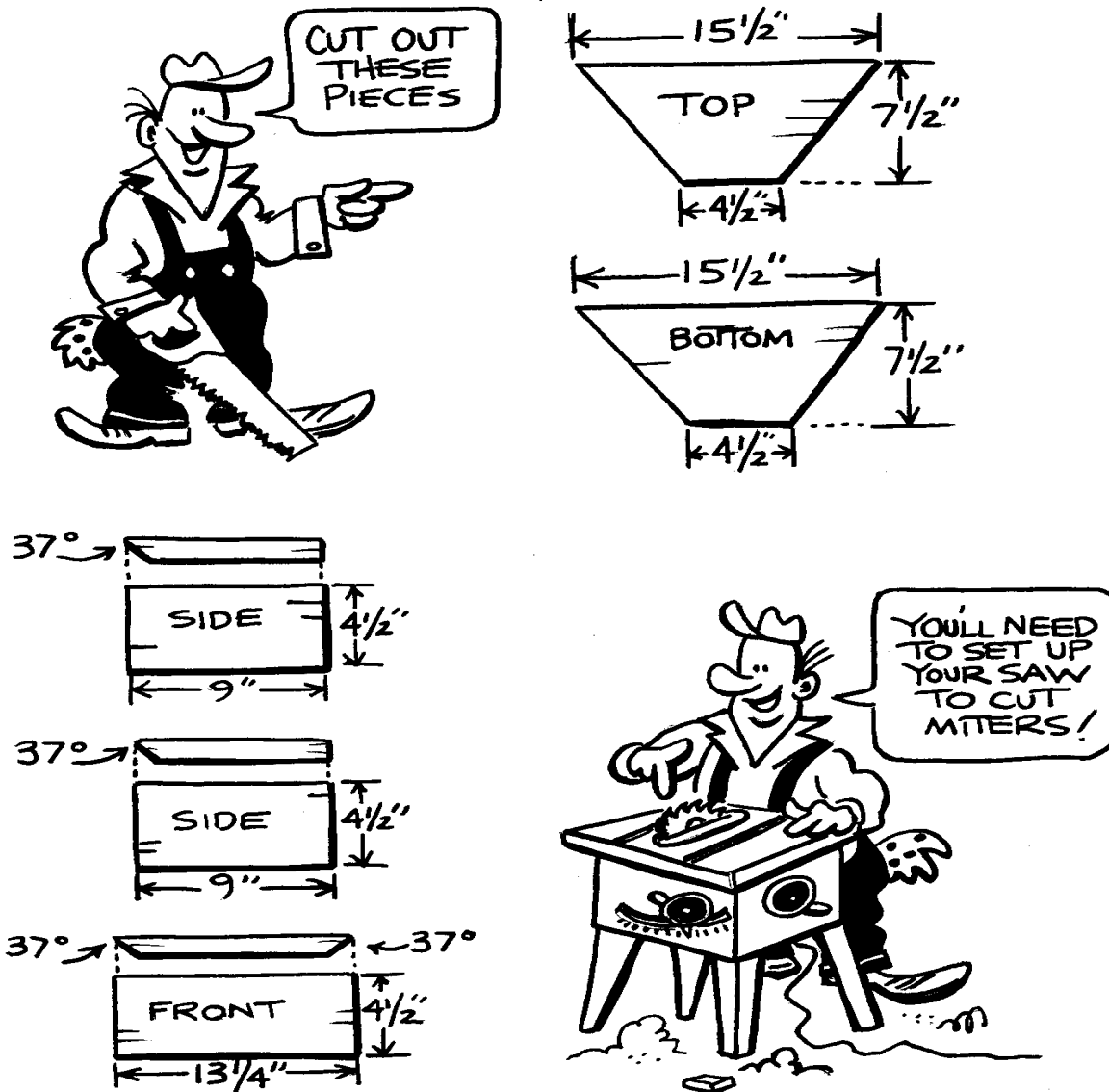
## Building the over-arm platform.



Cut the platform out of 3/4 inch thick plywood. Verify your base box dimensions prior to cutting. The platform should be the same size as the outside of the base.

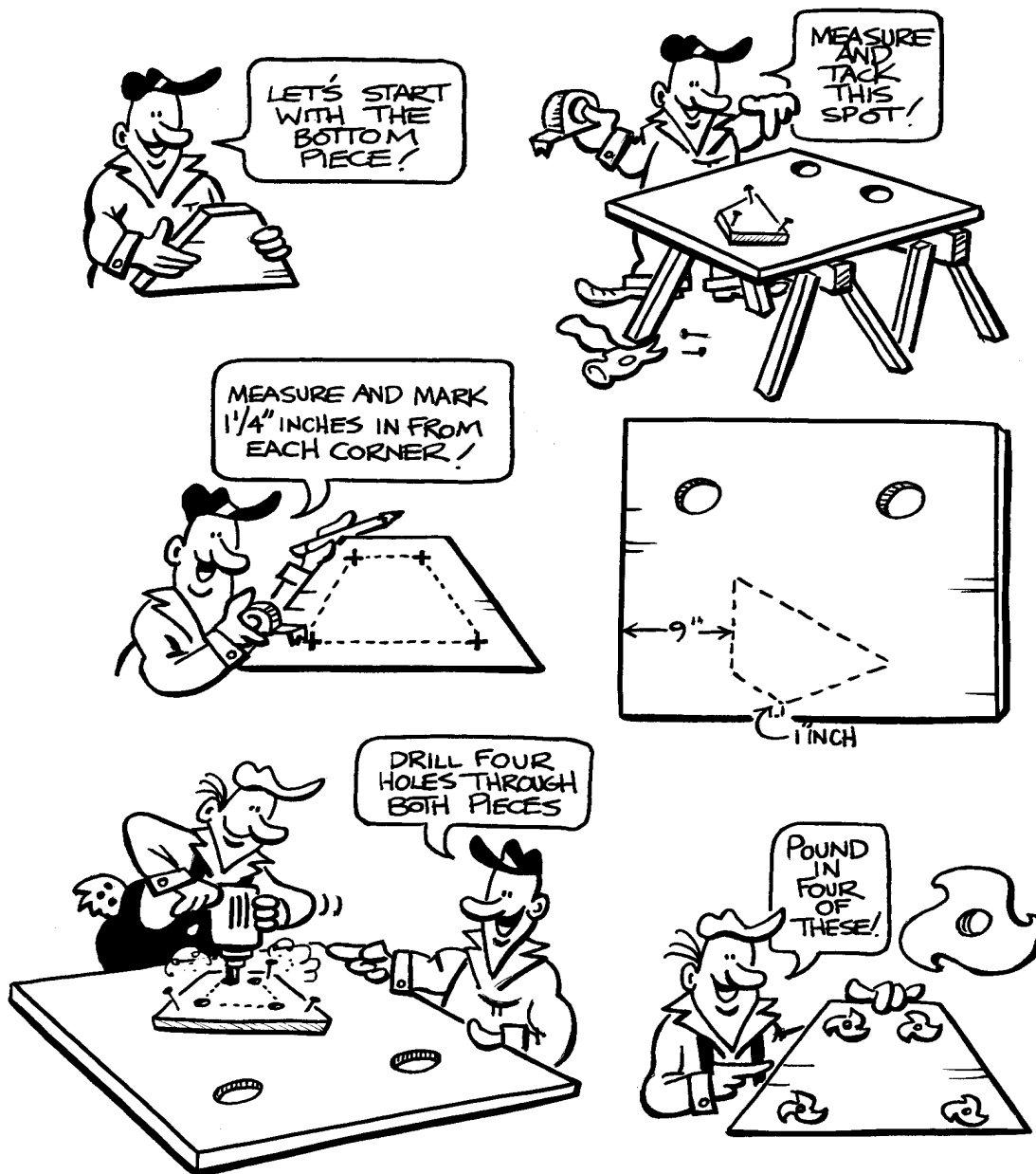
Verify the position of the shaft centerlines and drill the two inch diameter holes to match. If you are more than 1/4" off from the dimensions above, you should correct the location of the bearing boxes and supports. The platform layout is rather critical.

## Building the over-arm tower



Once again, cut these pieces out of 3/4 inch plywood. I apologize for the 37 degree angle and miter cuts, but it is necessary for the proper function of the machine. If the aesthetics are not important, butted square joints will work fine.

## Mirror-o-Matic



The over-arm tower will bolt to the platform with 5/16 by 2" hex head bolts installed from the underside of the platform. The 3-pronged nuts are installed inside the tower. Layout the base of the tower as shown. It is important that the tower edge is 9 inches from the side as shown and that it is parallel to that side. After drilling through both pieces of wood with a 5/16" drill, re-drill the tower base up to the size of the 3-pronged nuts (probably 7/16"). Hammer the 3-pronged nuts into the topside of the tower base. Trial test bolting the tower base to the platform before finishing the tower. It will be difficult to change later.



REMOVE THE  
BOTTOM PIECE,  
NOW!

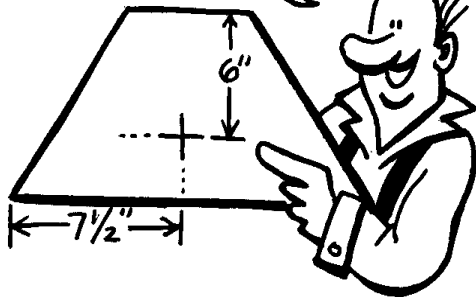


PLACE THE TOP PIECE  
ON THE BOTTOM PIECE  
AND TACK THEM  
TOGETHER!

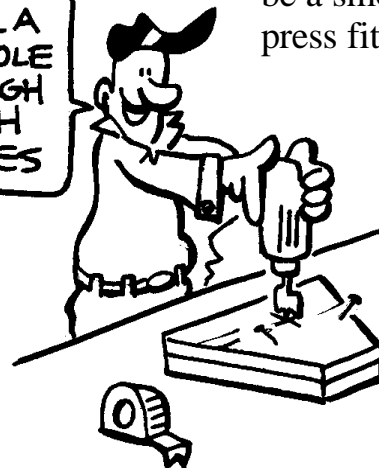


Check the accuracy of your drill bit on a piece of scrap plywood. The 1" diameter shafts should be a smooth press fit.

MEASURE  
AND  
MARK  
THIS SPOT!



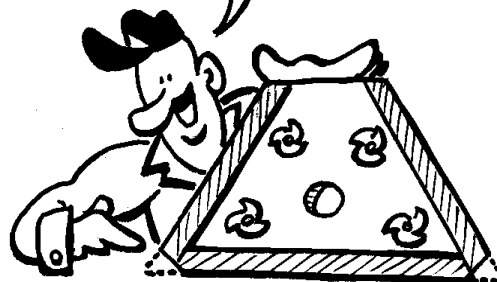
DRILL A  
1" HOLE  
THROUGH  
BOTH  
PIECES

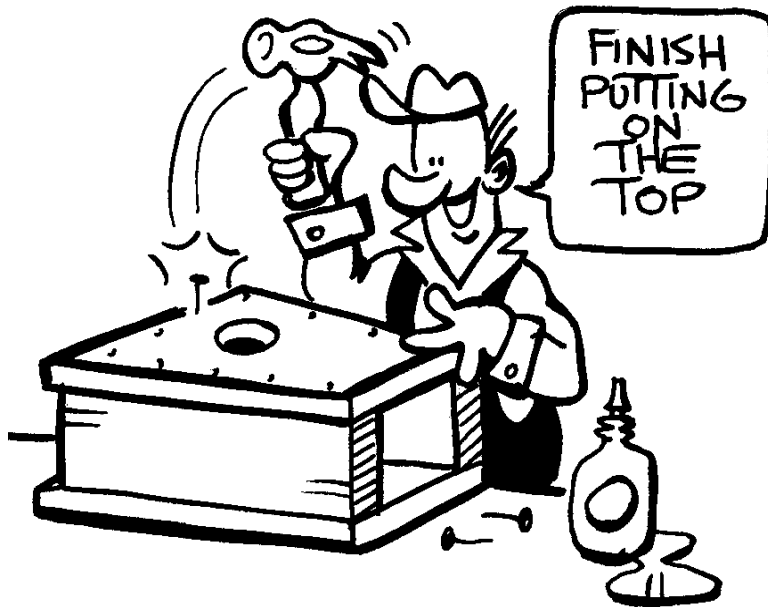


GLUE AND NAIL  
THE BACK AND SIDES  
TO THE BOTTOM PIECE!



YOU'LL NEED TO CUT  
OFF ALL THESE LITTLE  
TIPS WHEN YOU'RE DONE!

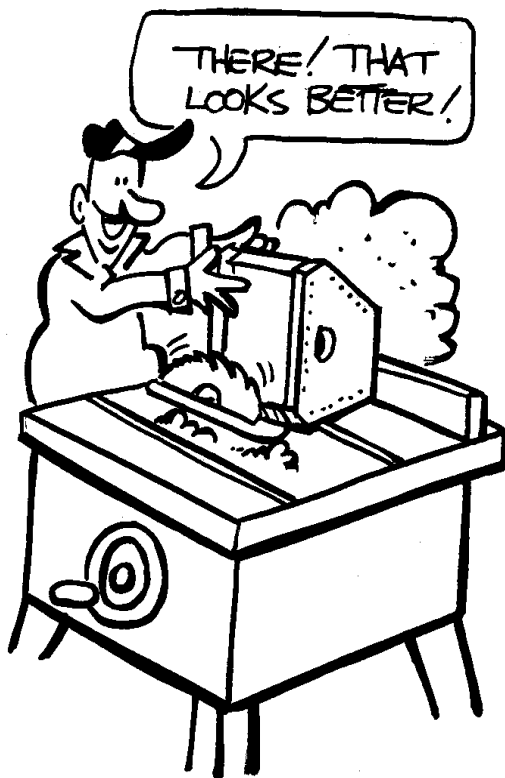




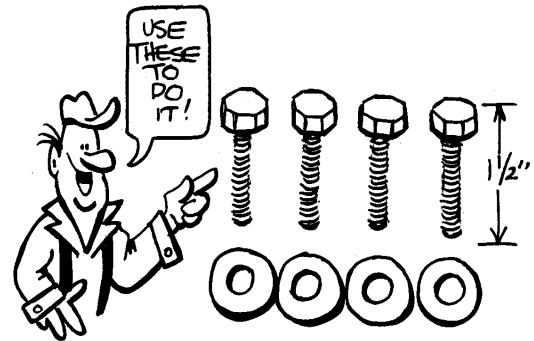
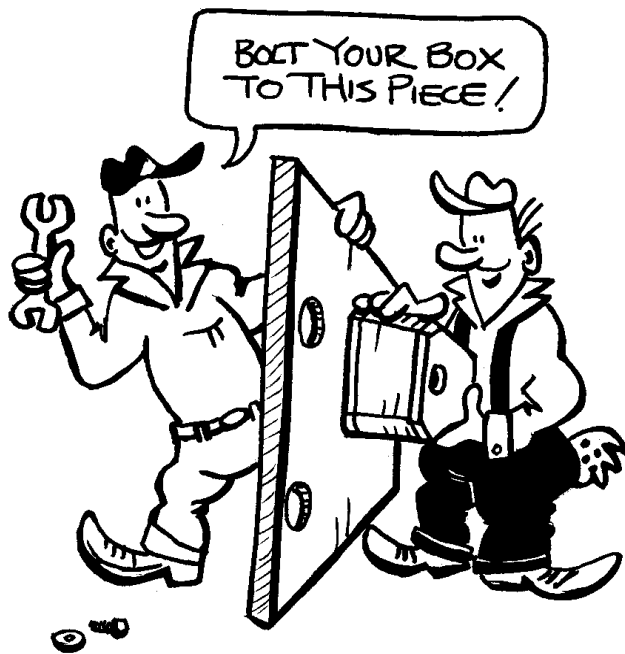
The pictures of the previous page and this one should be pretty self explanatory.

After gluing and before fastening the top to the tower, insert the 13 inch piece of 1" diameter shafting into the holes in the tower. Check that the shaft is plumb with a square against the top and shaft. Move the top slightly until the shaft is plumb.

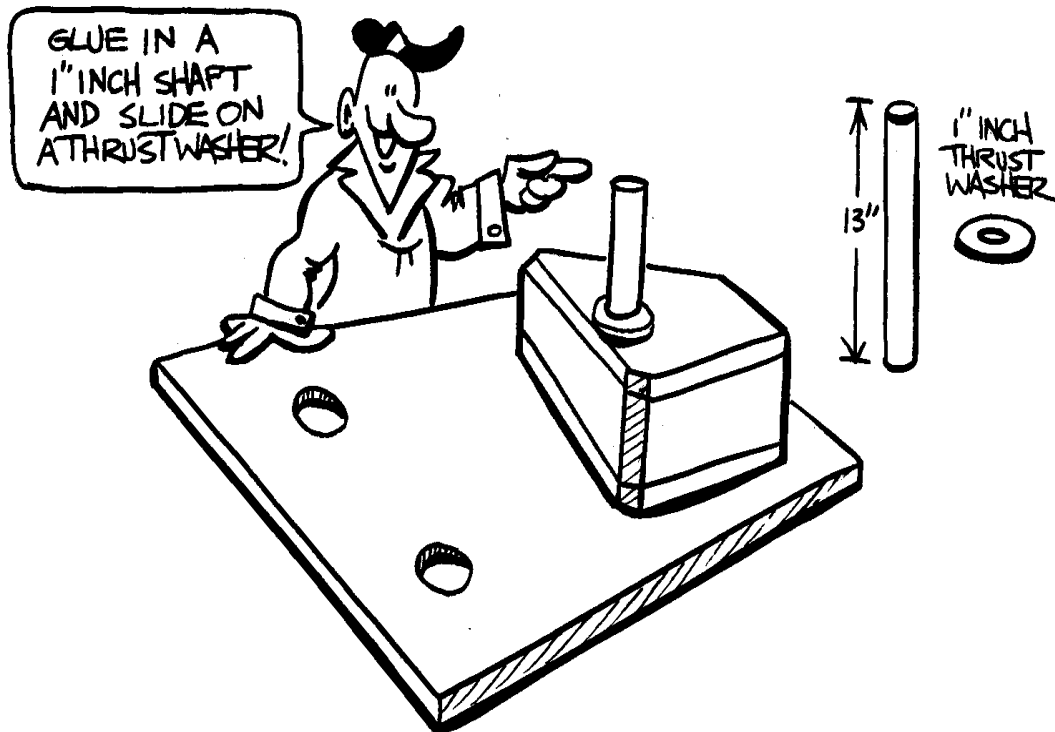
Fasten the top and remove the shaft.



If the corners of the tower look a little rough, now is the time to touch them up with a disk sander or saw.

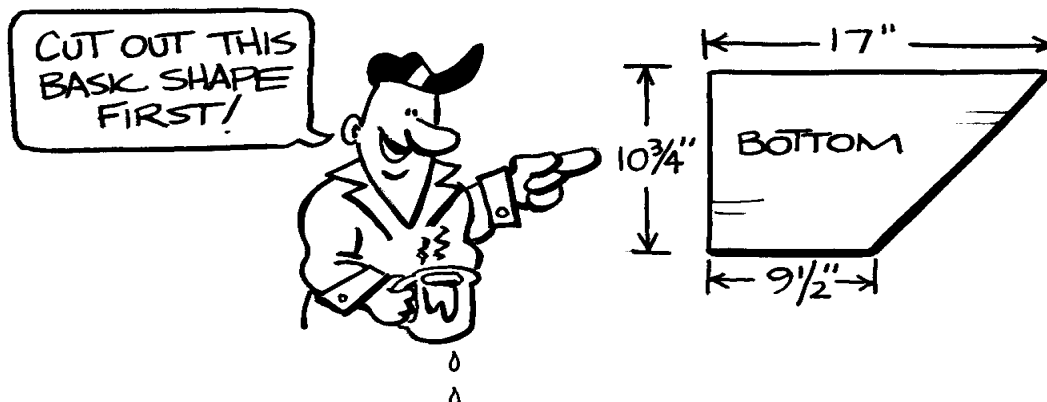
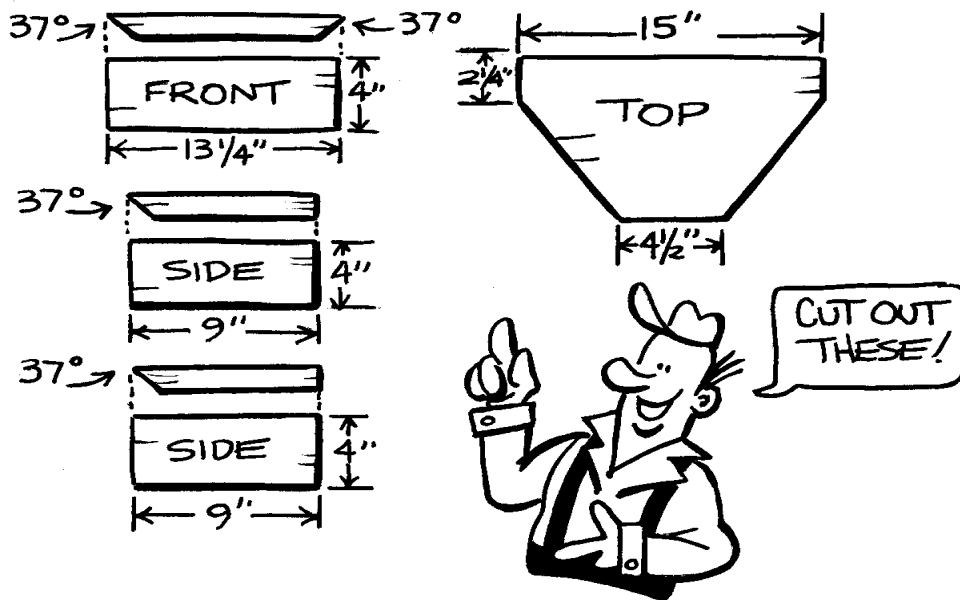


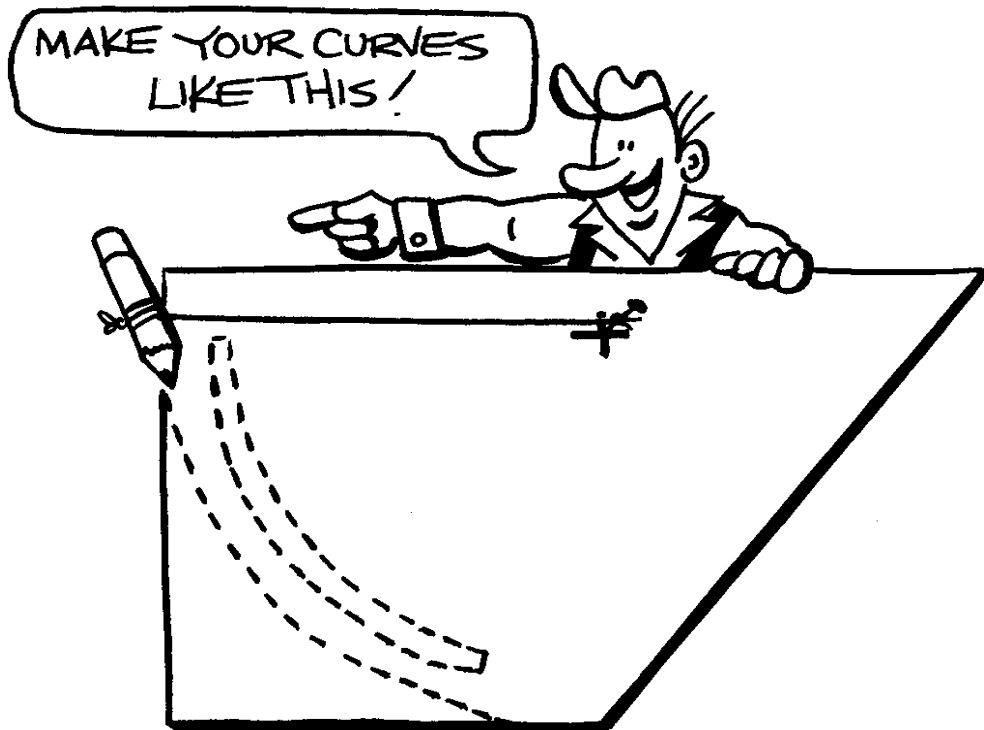
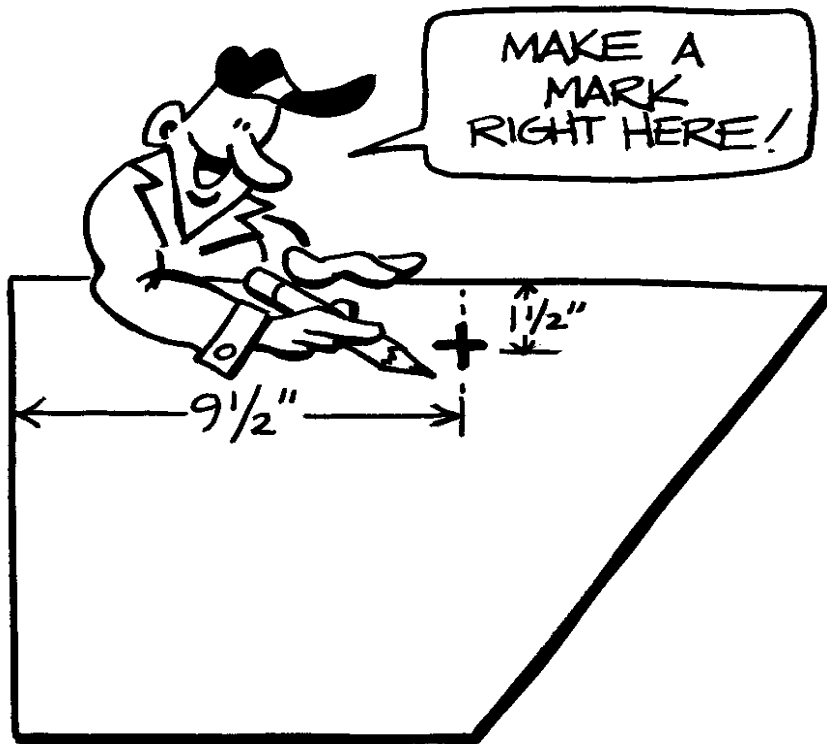
Coat the edge of the top and bottom holes in the plywood with polyurethane or epoxy glue. Insert the shaft into the holes. It should not protrude from the bottom. The shaft should be a snug fit. Once again verify that it is plumb. If not, pull the shaft out of the box, wipe the glue off and file the hole until a plumb shaft can be installed.

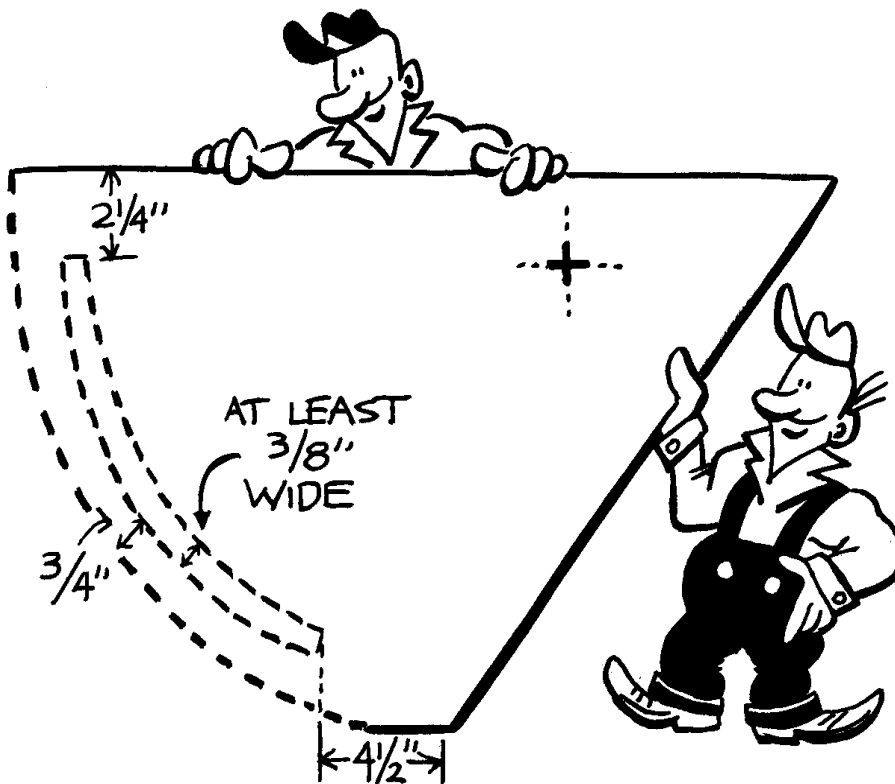


## Building the over-arm support.

Once again, sorry about the bevels.





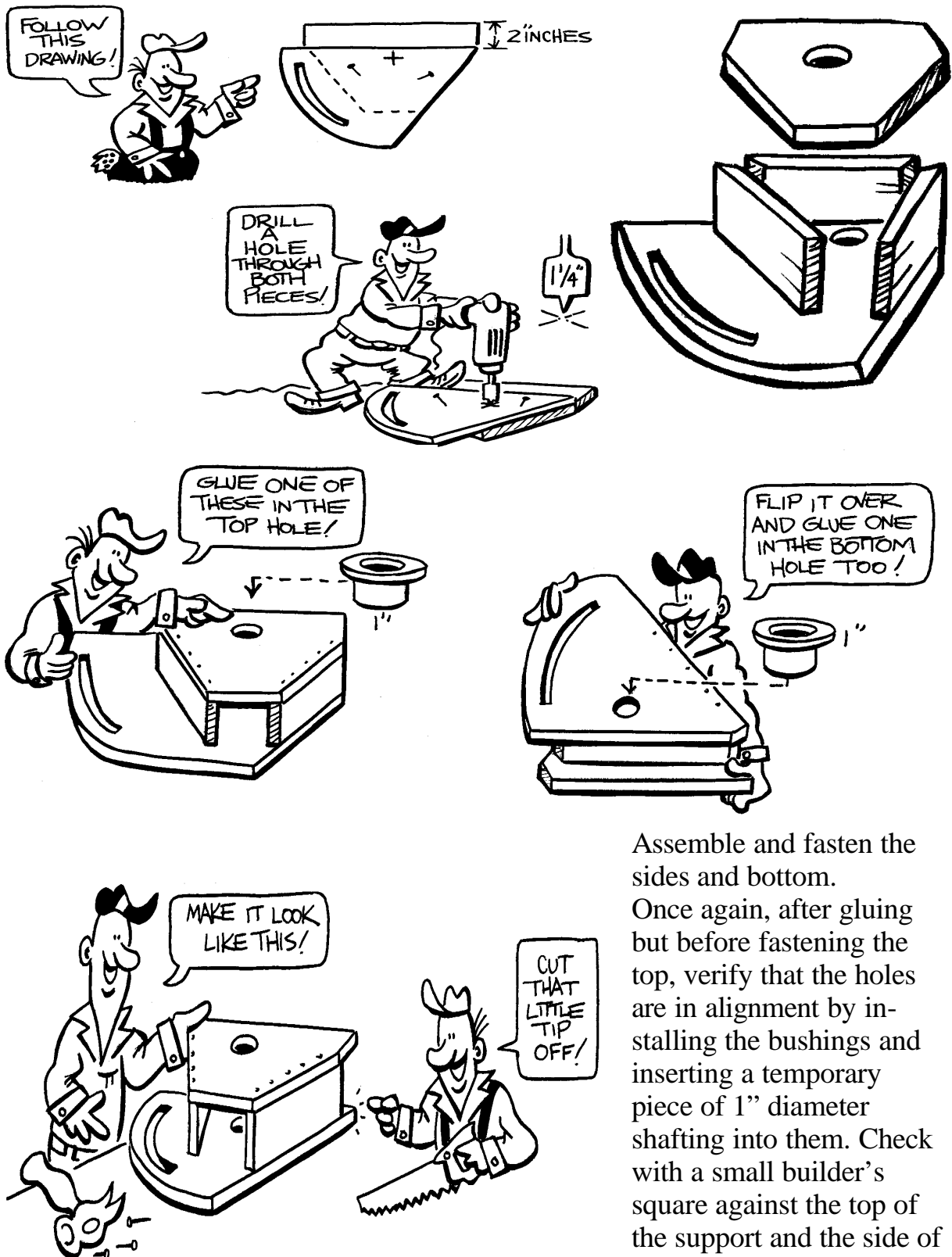


Cut the curves with a saber saw or router. A 3/8 inch bolt will slide in the slot as an adjustment for the over-arm position . It is important that the inside of the slot be smooth . Slide a 3/8 " diameter bolt the entire travel of the slot. If it hangs or grabs anywhere, sand or file that part smooth. Avoid making the slot too wide as this will cause a lack of positioning accuracy.



Temporarily tack the top and bottom of the over-arm support together as show. This will assure that the 1-1/4" holes to be drilled are in alignment. Before drilling, check that the bits cut accurate holes. Drill a piece of scrap and assure that the bronze bearings are a smooth press fit.

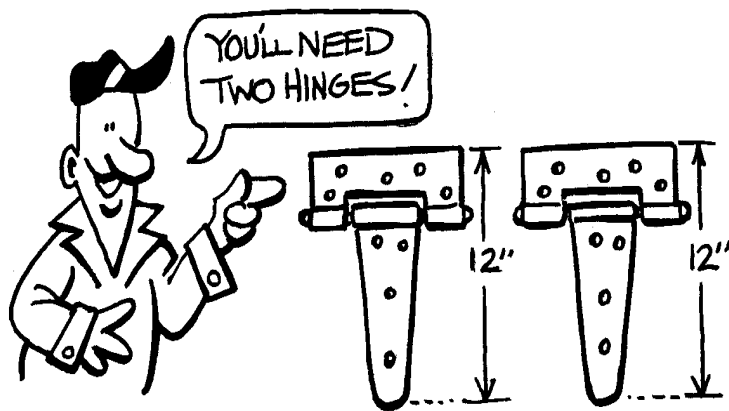
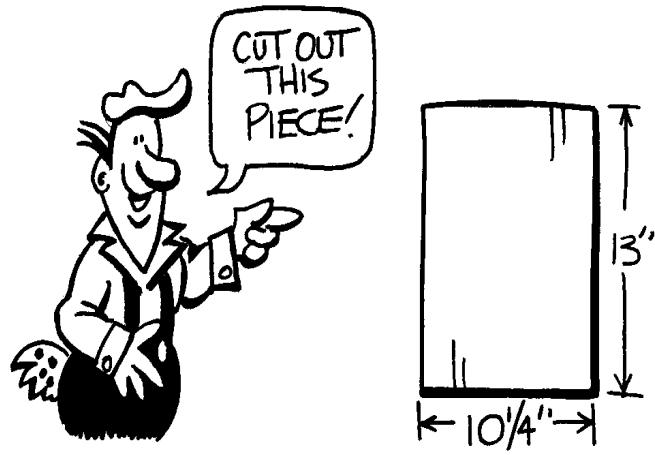
# Mirror-o-Matic



Assemble and fasten the sides and bottom. Once again, after gluing but before fastening the top, verify that the holes are in alignment by installing the bushings and inserting a temporary piece of 1" diameter shafting into them. Check with a small builder's square against the top of the support and the side of the shaft.

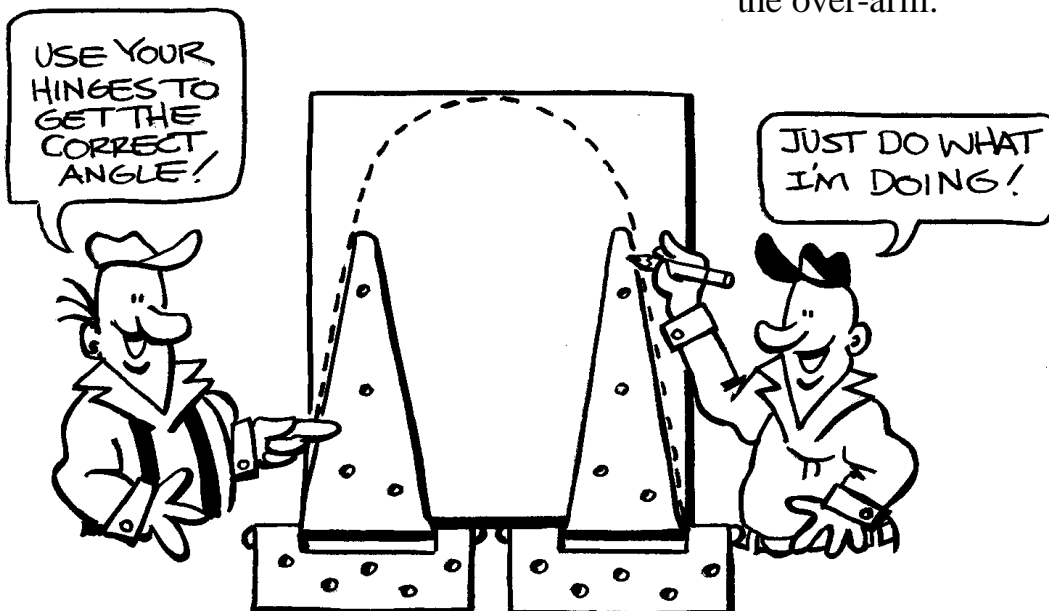
## Constructing the over-arm.

The over-arm on this machine has a double hinge assembly for extra rigidity. The Stanley hinges specified have a plastic bushing that removes almost all of the slop found in lesser hinges. Try to avoid substituting them.



Layout the hinges as shown. Butt them together and make sure that they are tight up to the base of the over-arm. If the hinges are not parallel, binding will occur when the arm is raised.

Trace around the edges of the hinges and construct a smooth curve to the end of the over-arm.





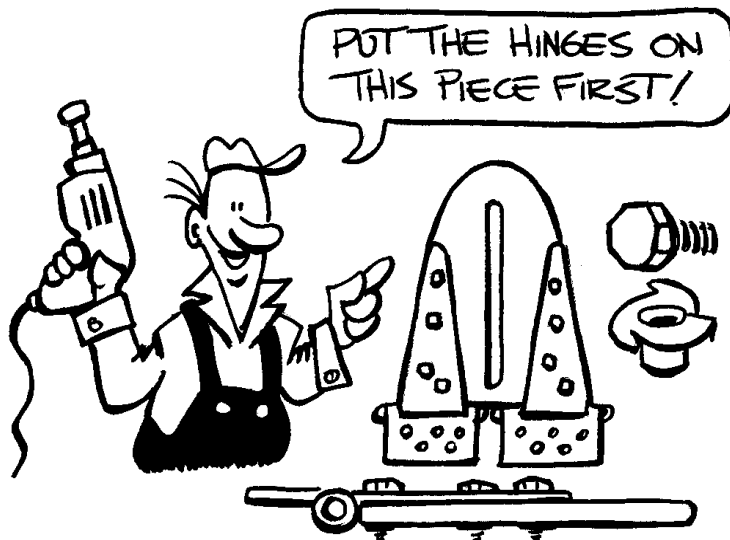
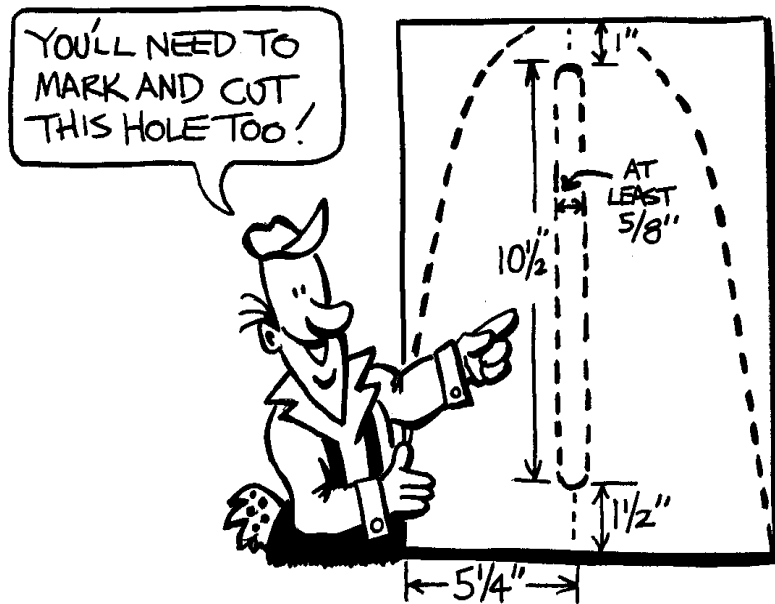
## Mirror-o-Matic

Mark the  $\frac{5}{8}$ " slot as shown and cut out the over-arm.

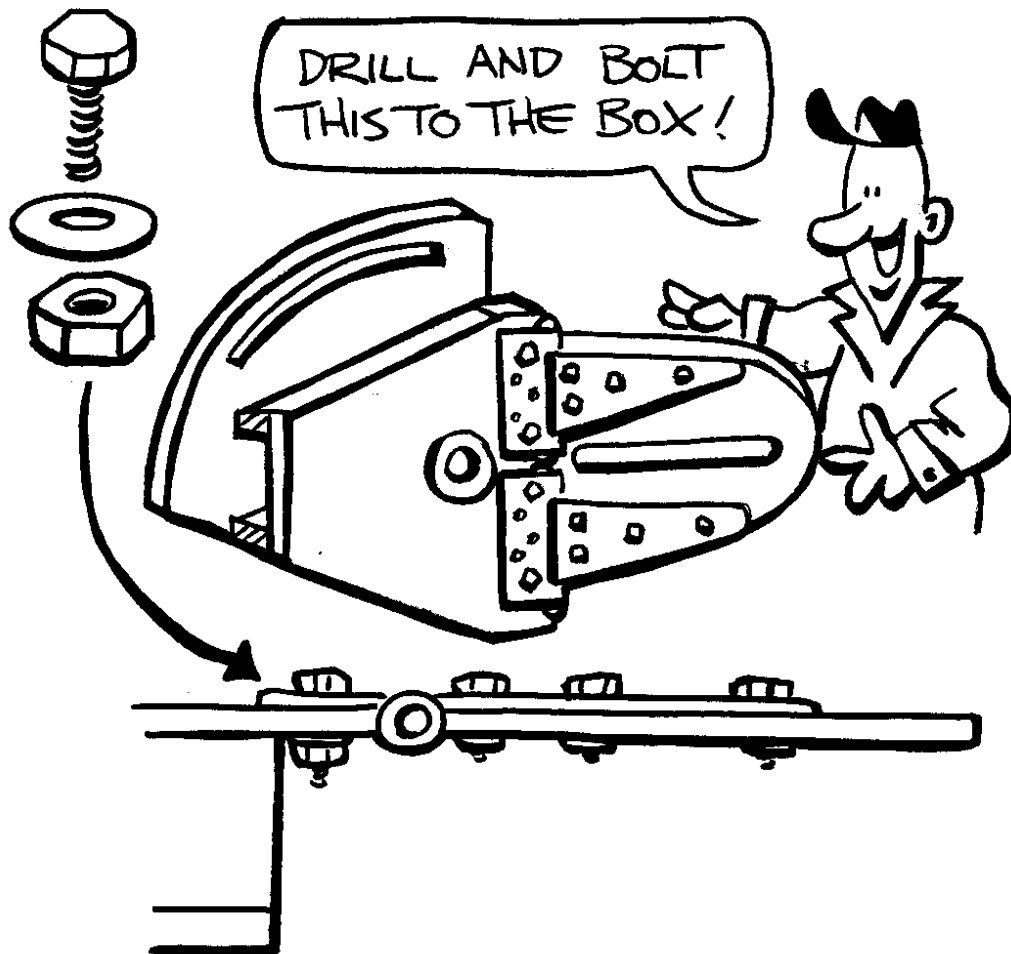
Use a saber saw or router and cut the slot. The inner edges of the slot should be smooth. Run a  $\frac{5}{8}$ " bolt or threaded rod the length of the slot and make sure that the slot is correct.

Sand or file until the bolt can slide smoothly front to rear..

The slot can be a bit wide too wide so the bolt can still slide after painting.

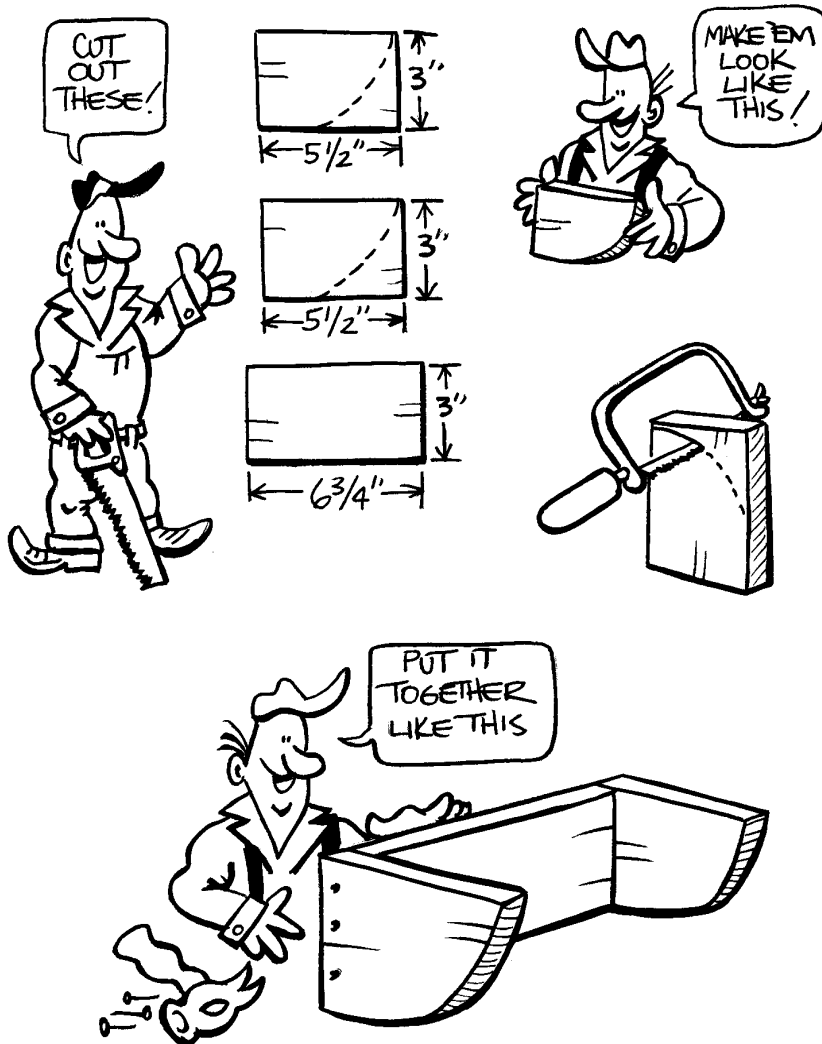


Place the hinges in position on the over-arm and drill  $\frac{5}{8}$ " diameter holes through the arm to match the holes in the hinges. Remove the hinges and re-drill the holes to the size required (usually  $\frac{7}{16}$ ") for  $\frac{5}{8}$ " 3-pronged nuts. Install the nuts in the bottom of the arm and bolt the hinges to the arm with  $\frac{5}{8}$ " x 1" bolts.



Use 5/6" x 1-1/4" NC bolts washers and nuts to attach the over-arm to the platform. Make sure to put a straight-edge across the rear of the hinges to keep them in alignment. The arm should lift and drop easily. If the hinges are out of alignment, re-drill some of the bolt holes slightly oversize and try again. If the arm has too stiff of a motion, it will not follow the mirror blank if the turntable is not perfectly flat.

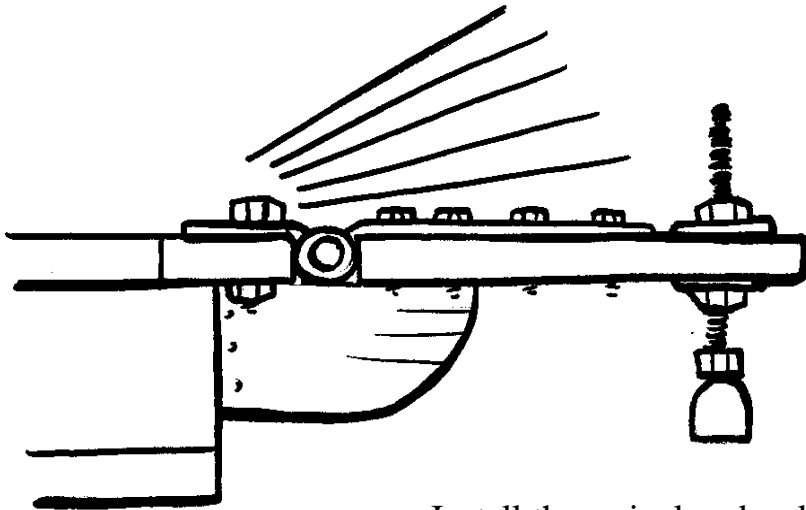
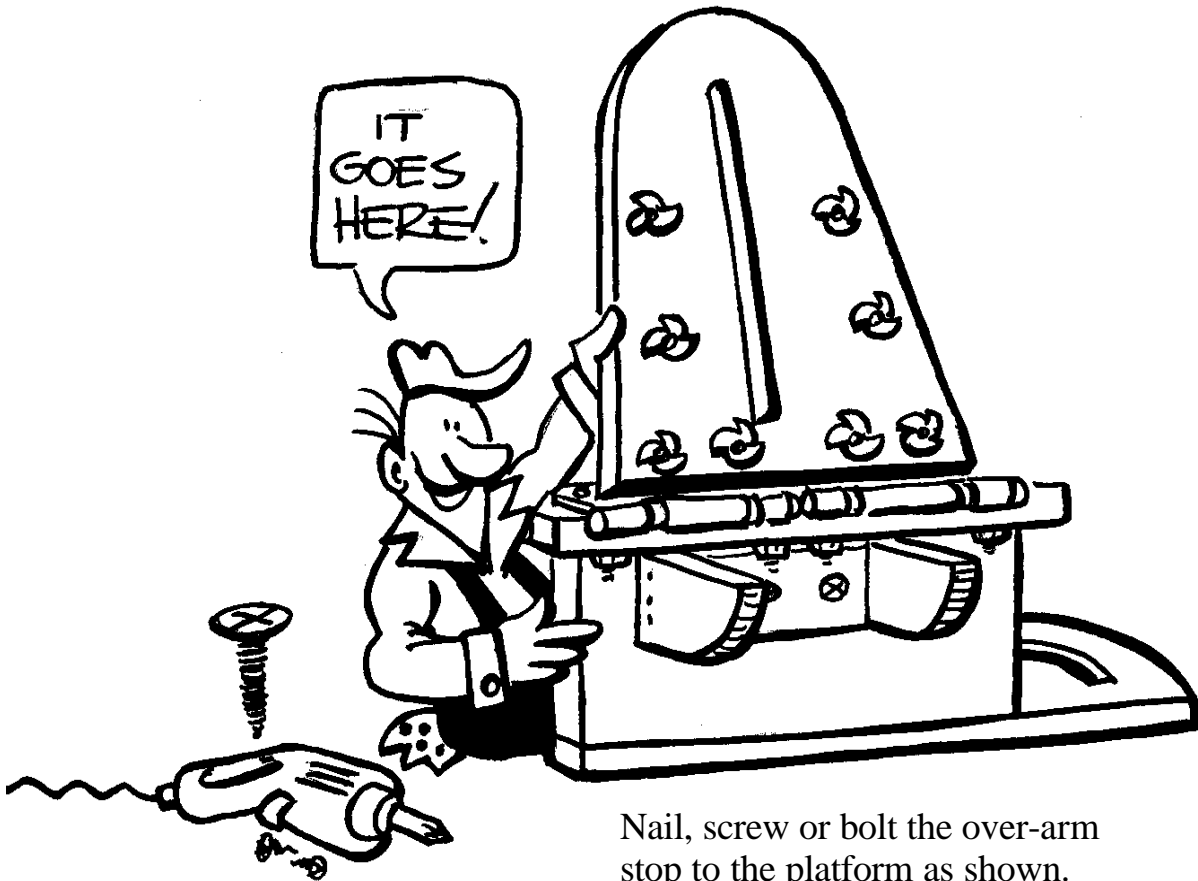
## The over-arm needs a stop.



A stop must be added to prevent the over-arm from accidentally being dropped onto the mirror below.

When grinding or polishing, never allow the slurry to dry out. If this happens, the tool and mirror will stick to each other. The energy in the turntable will toss the tool out and the swivel will crash to the mirror below.

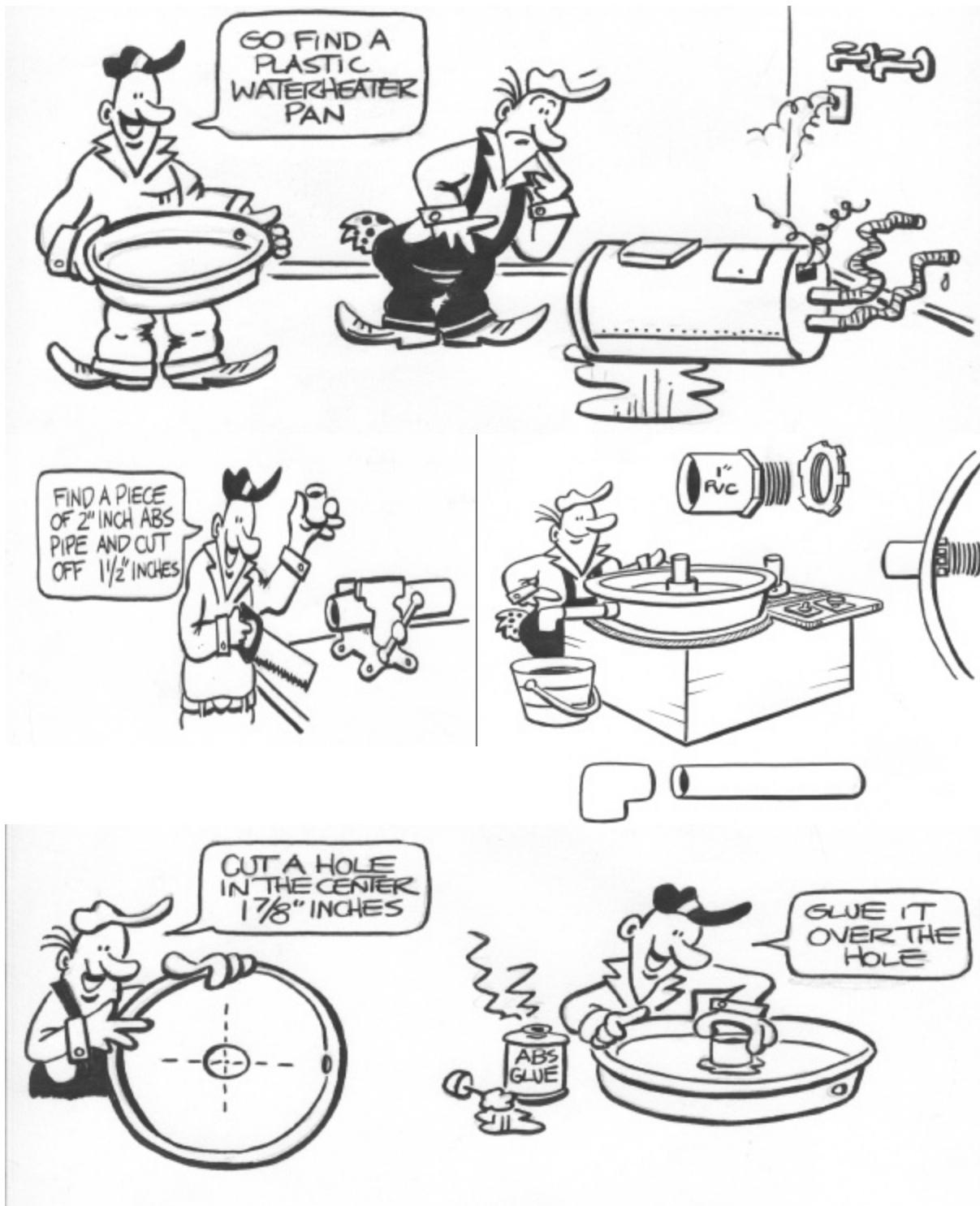
This stop will prevent this and accidental arm dropping from occurring.



Install the swivel and rod into the over-arm with 1-1/2 " flat washers and 5/8" nuts on each side of the over-arm.

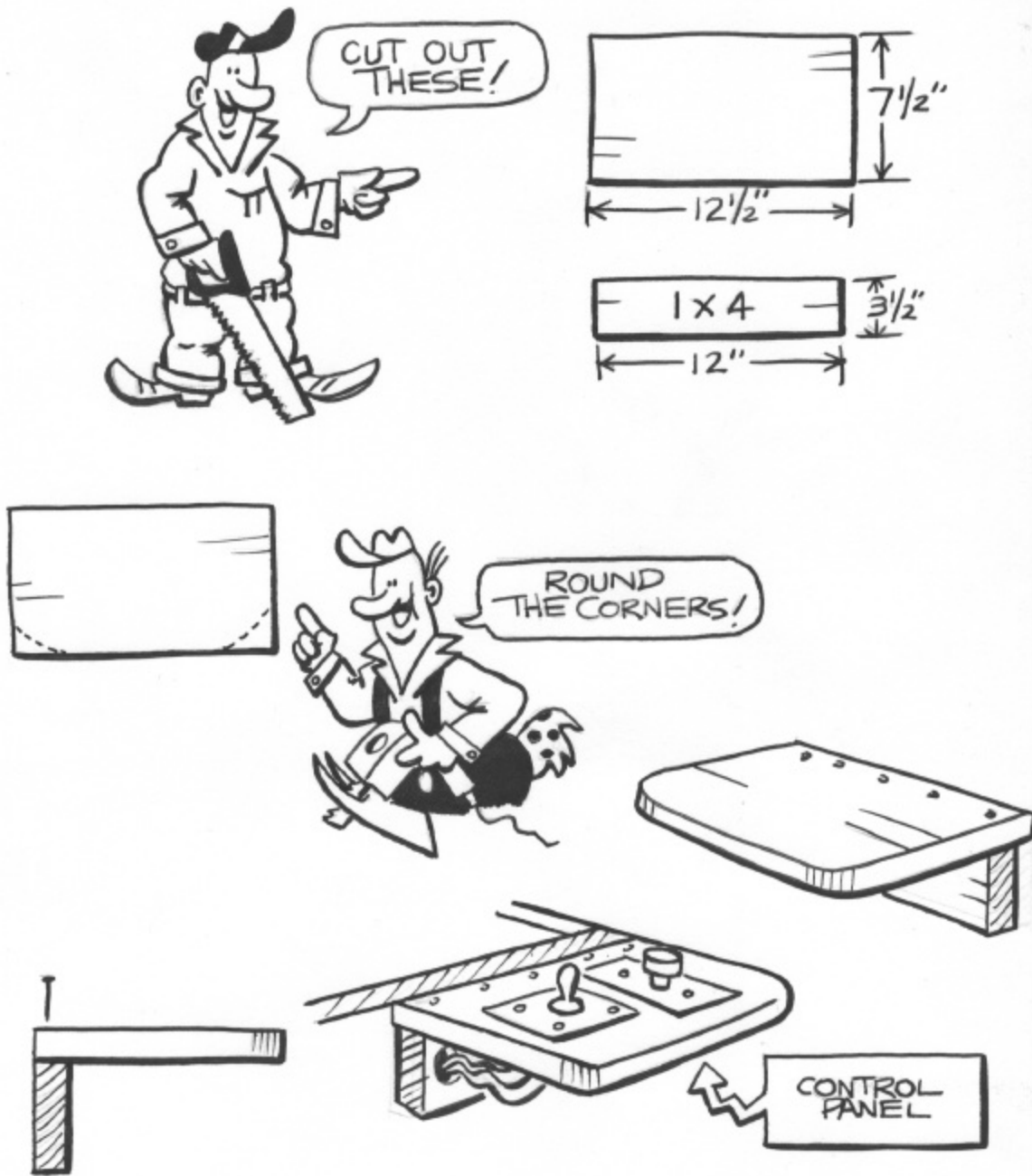
## Building a drip pan

I used a 24 inch plastic water heater pan from Home Depot. This is the largest pan that I could find and is the largest pan that will fit on this machine. The ABS pipe is glued to the pan with ABS pipe glue.

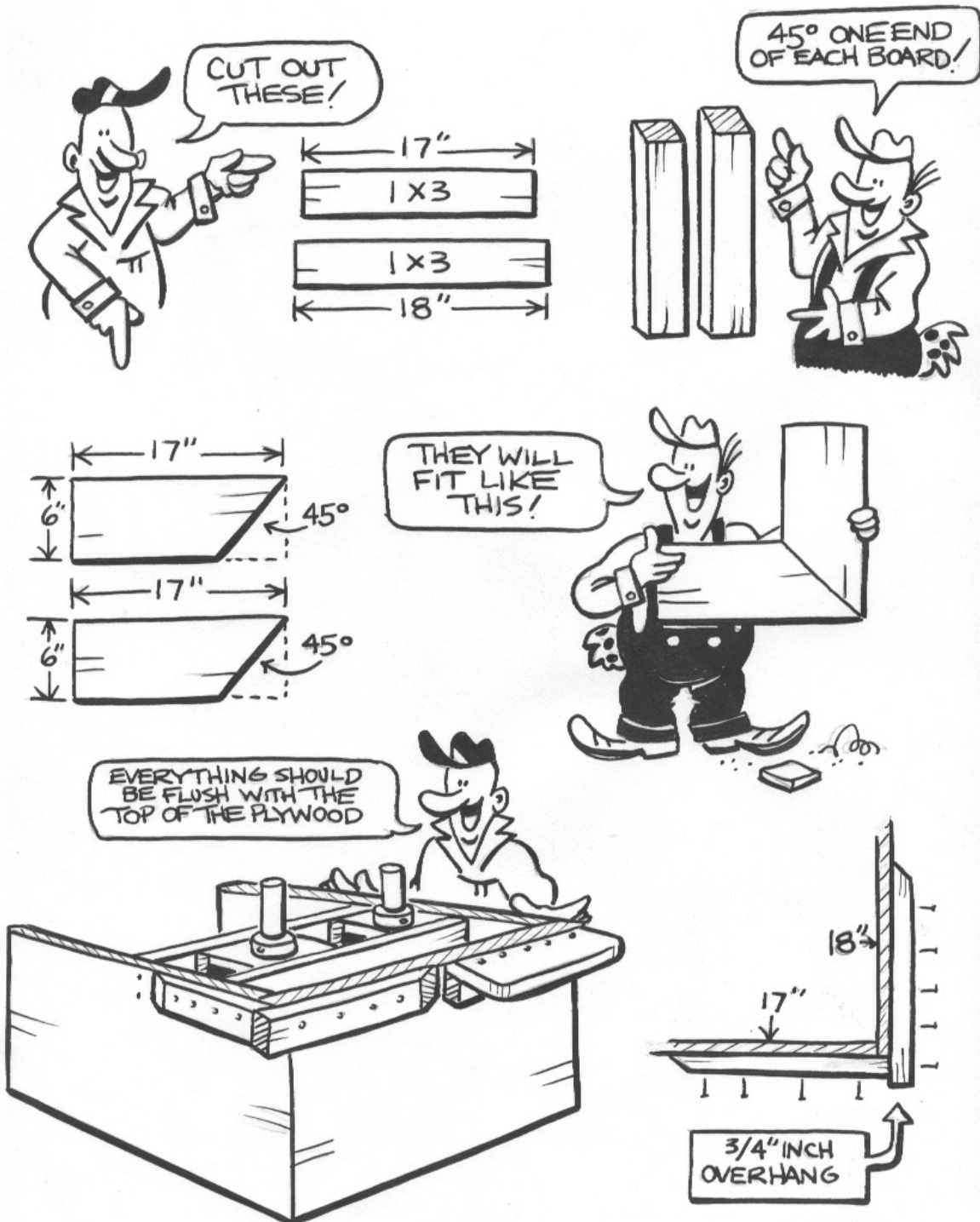


## Building the control panel shelf

This is an optional shelf where you can add an off-on switch, timers or speed controls.

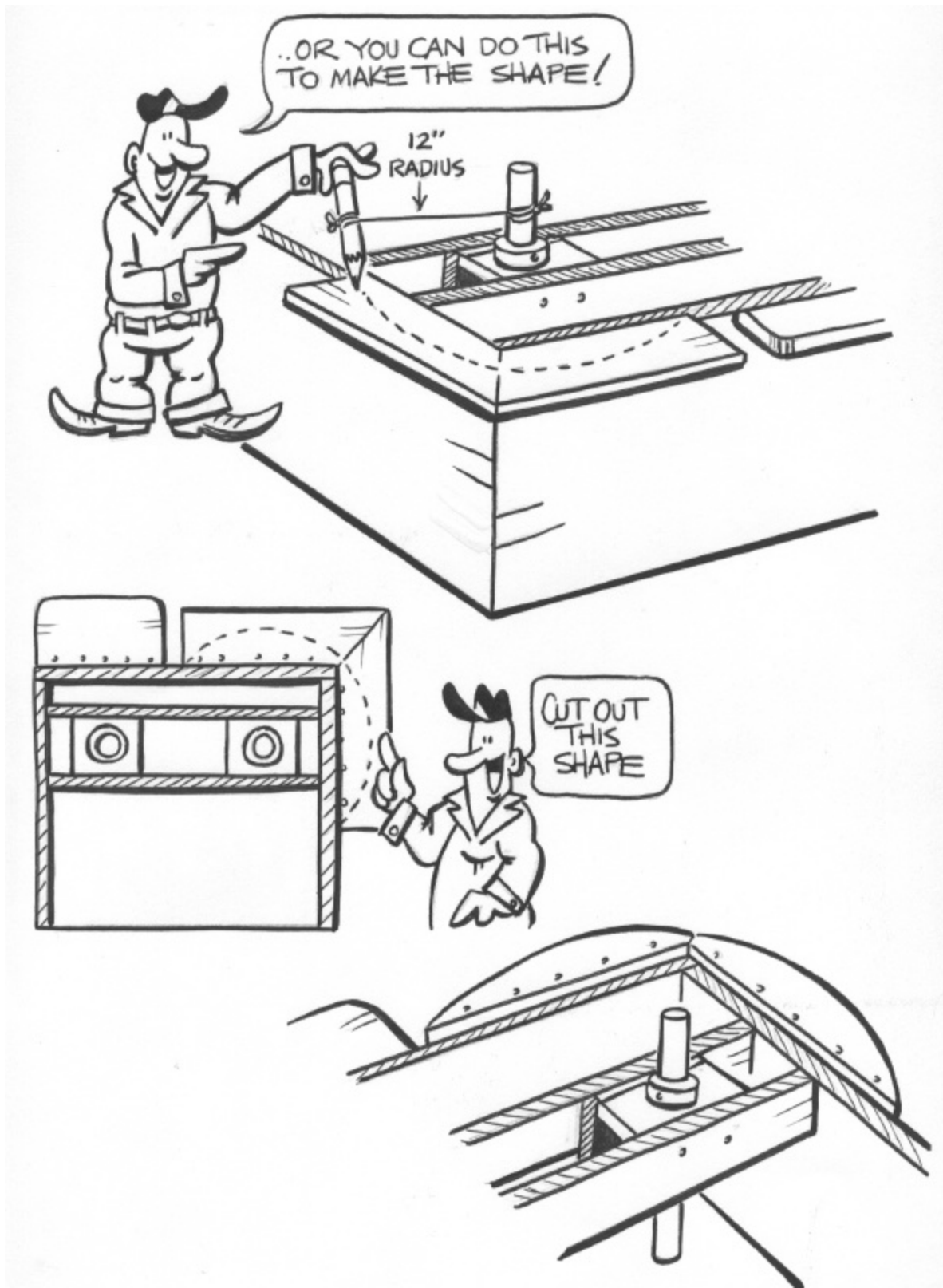


## Drip pan support and control shelf installation.

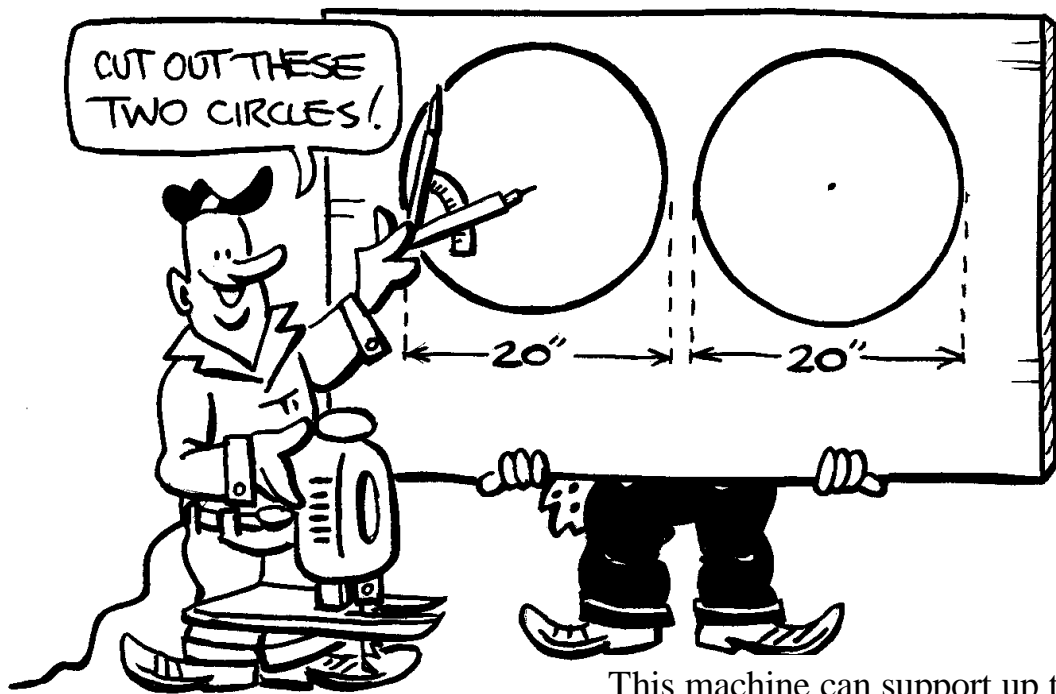








## It's time for the turntable



Paint all surfaces of the turntable with a waterproof resin before assembly. After assembly, caulk the seams to keep grit out.

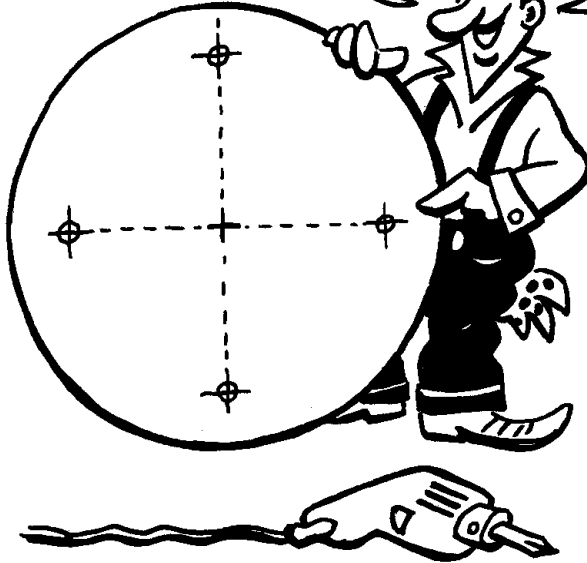
This machine can support up to a 24 inch turntable, although 20 inches is more practical. I would recommend a turntable 3 or 4 inches bigger in diameter than the mirror to be ground. A smaller turntable can be rested on a smaller supporting pulley. This results in less expense, a more rigid support and better containment of slurry.



Temporarily fasten the two circles together to assure alignment when drilling the holes on the next page.



MARK THE OTHER CIRCLE  
AND DRILL FOUR HOLES  
LIKE THIS!



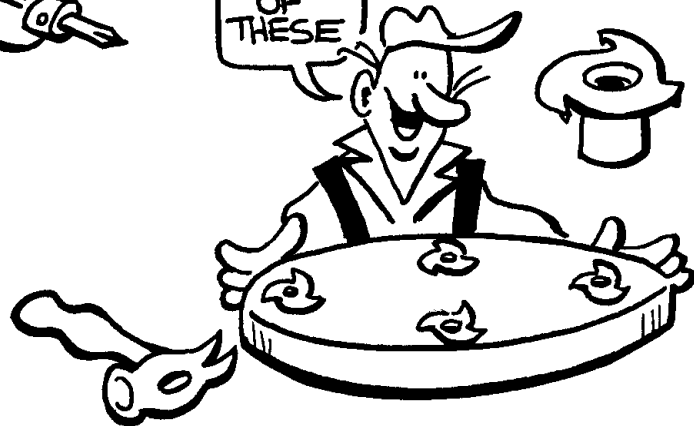
2 1/4"  
INCHES  
IN

Draw a line on the side of the two turntable pieces to aid in assemble later.

Drill 3/8" holes through both pieces. Place the holes as required for the placement of the hold-downs. The mirror and turntable size will determine exact location.

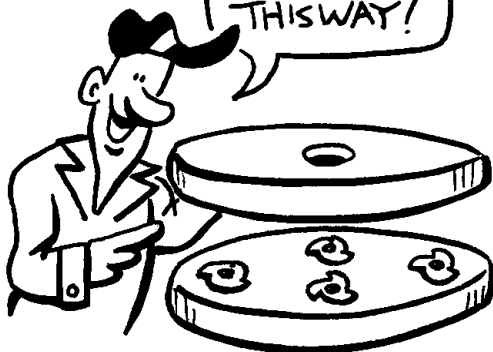
See the slotted blocks section a few pages aft for details

PUT  
IN  
FOUR  
OF  
THESE



Separate the two pieces and drill oversized holes (7/16") in the bottom piece to accommodate 3/8" pronged fasteners. If possible, sink the fasteners even with the surface to allow the turntable pieces to mate flush.

PUT THEM  
TOGETHER  
THIS WAY!



Realign the top and bottom of the turntable with the edge line and install 4- 3/8 inch bolts to assure alignment. Caulk the edge seam to keep grit out.

Fasten the top and bottom together with 1-1/4" screws installed from the bottom.



Temporarily insert a 1" ID x 3/4" bronze bushing into the hole. Check the face of the drive pulley hub to see if it is recessed enough to not touch the bearing face when the rim is touching the turntable. If so, glue the bearing into the turntable. If not, recess the rim of the bearing far enough into the plywood to allow the rim to touch. You can also use a bronze bearing without the shoulder.

You may have to add a plywood ring to the edge of the pulley if the rim still does not touch.

The turntable platter sits on top of the driving pulley that will be attached to the 1 inch turntable shaft.

One to three driving dogs will be attached to the bottom of the turntable. They will fit between the pulley spokes.

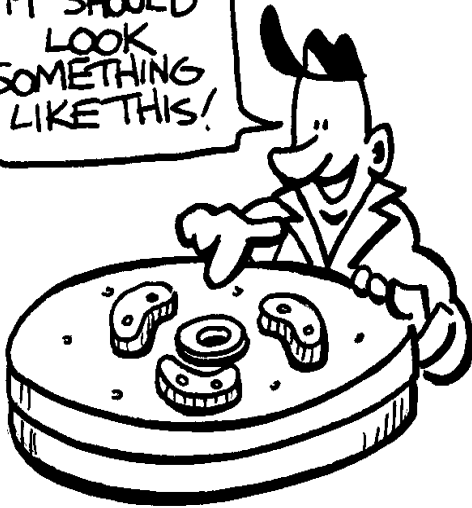
Center the pulley on the turntable with a short piece of shaft. Trace between the spokes onto a small piece of scrap wood and cut out the dogs.

Screw the dogs onto the bottom of the turntable while the pulley is centered by the shaft.

CENTER A 12" INCH PULLEY  
AND CUT OUT SOME DOGS  
TO FIT HERE!



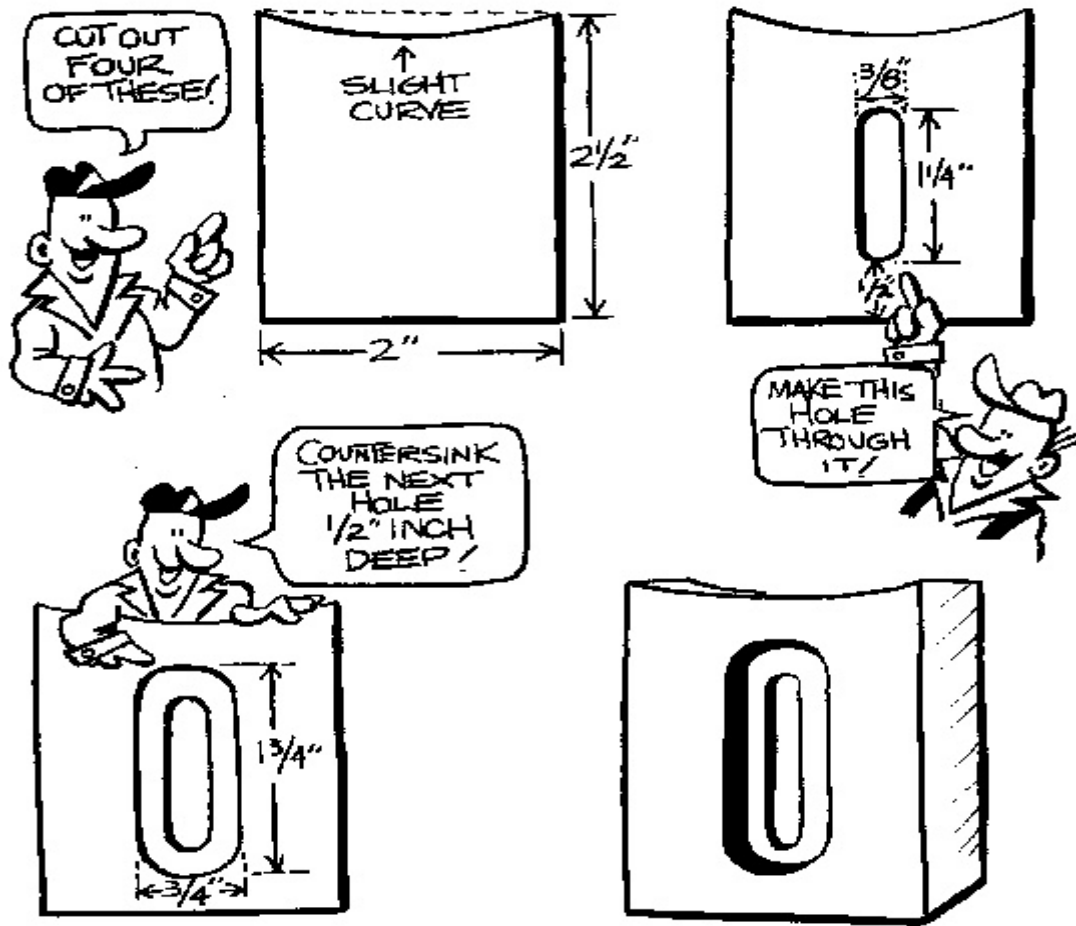
IT SHOULD  
LOOK  
SOMETHING  
LIKE THIS!



FLIP THE  
PLATTER  
OVER  
FOR THE  
NEXT PART!



## Mirror-o-Matic



The mirror blank will be held and positioned on the turntable with four slotted blocks. The slight curve should be of a smaller radius than the mirror and will assure that the blocks cannot twist on the edge of the blank.

Make the blocks of a size that will allow the mirror to be positioned on the turntable. A large mirror will need shallower blocks than shown.

For safety, you can countersink the slot as shown to hide the allen screw head which will fasten the block to the turntable. This will catch grit however. You can also cut the countersunk slot clear through to the rear of the block to allow grit to be washed out.

The sizes shown are recommendations. The size of mirror used and the spacing of the threaded holes in the turntable will determine block length.

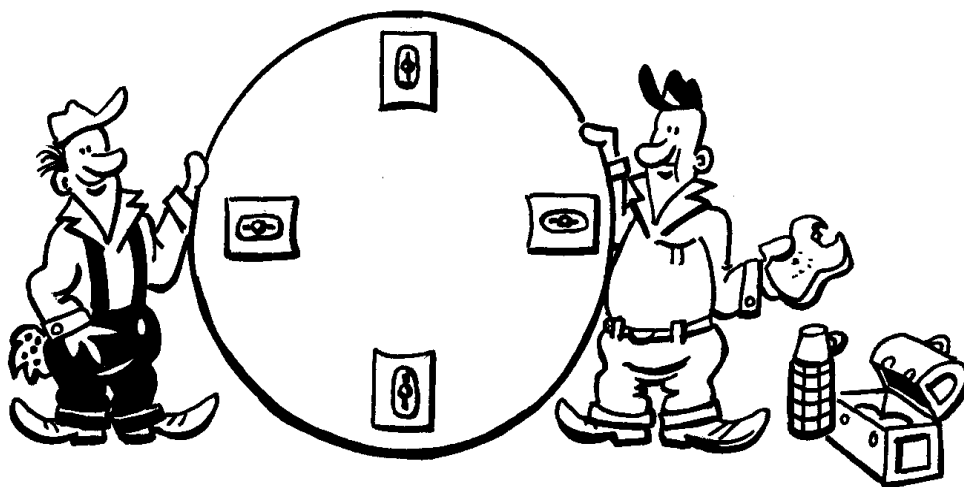
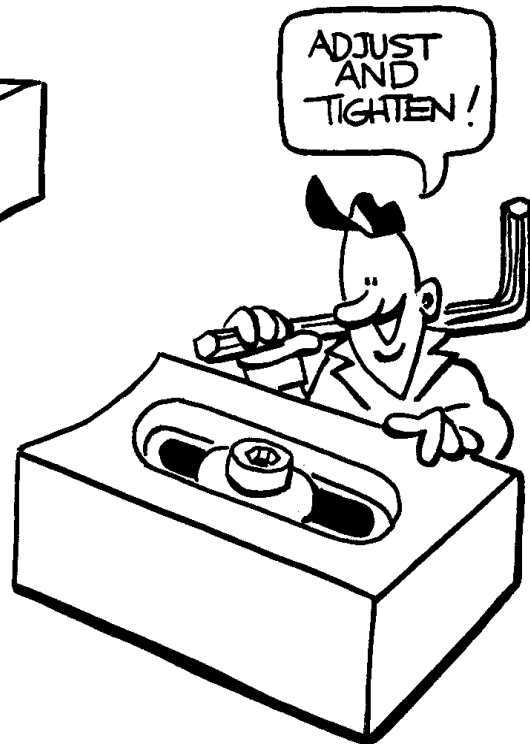
If the block length as shown above is used, the threaded hole layout in the face of the turntable should be about 3 inches larger in diameter than the mirror diameter. Multiple holes can be drilled in the turntable if desired. If there is a large range of mirror sizes to be made multiple block lengths may be desirable.

## Mirror-o-Matic

Adjust the block length, slot position and threaded hole position as required for your mirror diameter. Use 3/8 "x 1-1/2" allen screws and a flat washer to hold the blocks.



The mirror blank will be held and positioned on the turntable with four slotted blocks. The slight curve will assure that the blocks cannot twist on the edge of the blank.



## Optional DC Motor Power Head

Requests have been made for a power head with DC motors. I personally do not think that they are worth the trouble and expense.

The advantages are:

- 1: Pulley and belt switching is eliminated.
- 2: The speeds can be slowly ramped up and down.
- 3: The turntable and drives can be independently varied.
- 4: The mirror can be spun dried after washing.

The disadvantages are:

- 1: DC motors and controllers are expensive, noisy and may cause the wife's television to get all fuzzy.
- 2: They vary in speed with load. The rpm will float as the lap dries out.
- 3: If the AC motor and drives are running at the correct speed, why do you want to vary it?

Attached is a layout which will allow the existing power head frame to be used for DC motors. The turntable drive can be powered by any combination of belts and pulleys to get about 100 rpm as a top speed.

The eccentric motor is a geared head assembly running at 100 rpm. At least on stage of belt drive should always be used with a geared motor to smooth out the power and to allow a bit of slippage in case of tool sticking.

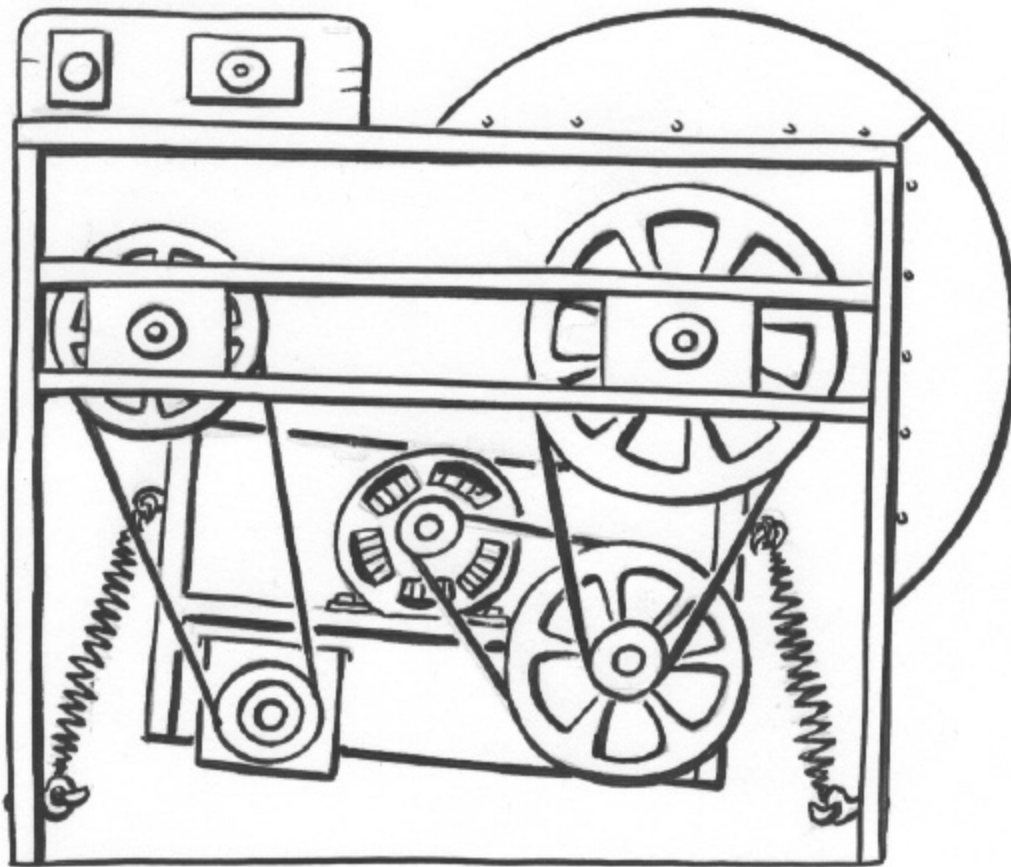
The belt will also take the eccentric side forces off the gear head which will prevent the gear head bearings from failing.

It is up to the builder to decide on DC motor controls. Variacs with a rectifier produce nice smooth power but will lose torque rapidly when run at low voltages. Light dimmers with a rectifier will work fine, but may introduce very jerky motion at very low speeds. Industrial controllers have high torque and smooth motion but are very expensive and may be electrically noisy.

All in all, I think that the simple Grainger AC motor is the best choice.



## Mirror-o-Matic



TOP VIEW  
OPTIONAL DC. GEAR MOTOR

This view shows a 100 rpm gear motor on the right driving the eccentric and a 1750 rpm standard motor on the left driving the turntable. The gear motor has a single stage of belt reduction in order to eliminate side bearing loads. The turntable has two stages of reduction. A single dc motor can also be used in place of the AC motor shown on the plans.

## Final Assembly Time

Install the one inch x 12 inch shafts into the bearing boxes with thrust bearings and collars. The shafts should stick up about 3 inches above the collars. They will be fine adjusted later.

If you wish, you can lightly grease or oil the bearings and shafts.

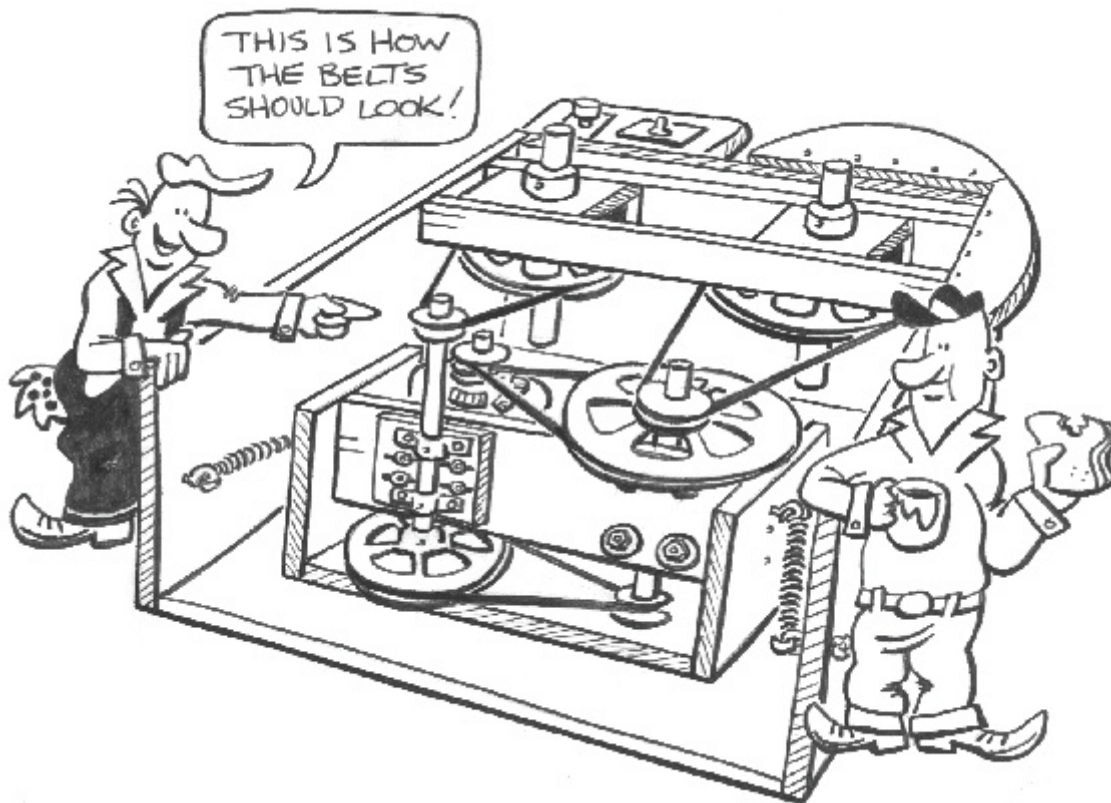
Install an eight inch pulley on the eccentric shaft and a twelve inch pulley on the turntable shaft. Tighten the set screws just enough to keep the pulleys from sliding off the shafts.

Set the power head assembly into the base box. Install the belts and adjust all of the pulley heights to make the belts run true.

Tighten all of the set screws.

Install the two tension springs.

Turn on the motor and make sure that everything is running smoothly.



## Mirror-o-Matic

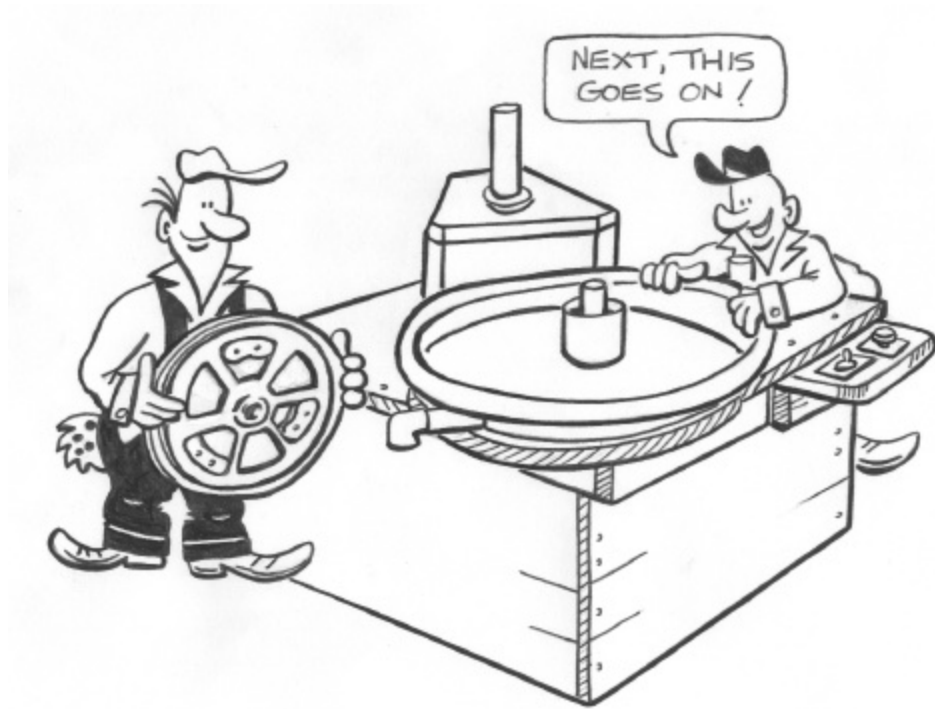
If you are happy with the way that the power system is working, you can complete the wiring to the control panel. I would advise using some sort of quick connector between the power head and the controls. It can be as simple as a wall plug. When adjusting belts and pulleys, it is nice to be able to remove the power head.

Install the over-arm platform. Countersink 1-1/2 wood screws about 8 inches on center around the perimeter. You may wish to install a couple of screws into the bearing box assemblies through the top of the platform to stiffen the bearing boxes.

If you have not yet painted the machine, now would be a good time to do so. I suggest a good porch and deck epoxy or other water proof finish. Mirror making can be a messy business.



## Mirror-o-Matic



Install the drain pan by screwing it down to the table in several places using wood screws and rubber washers or calking. If you want to avoid holes in the bottom, you can use some sort of side clip.

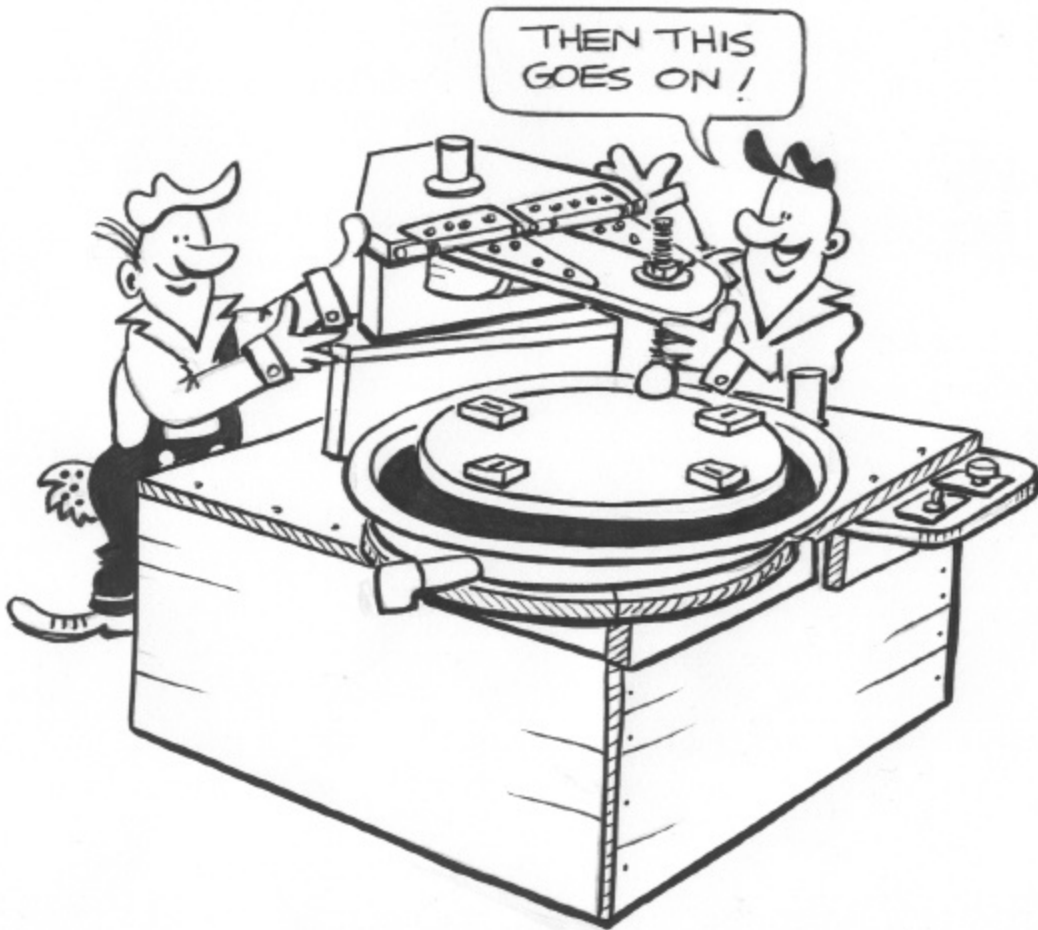
Next install a 12 inch pulley on the turntable shaft and tighten the set screw. Place the turntable on the pulley with the dogs engaged into the pulley spokes



## Mirror-o-Matic

Place a one inch inside diameter x 1-1/2 inch outside diameter x 1/8" bronze thrust washer on the one inch over-arm tower shaft. Slide the over-arm assembly onto the shaft. Install another bronze thrust bearing and one inch shaft collar onto the shaft to keep the over-arm from lifting up.

Check the over-arm assembly for smooth side to side operation.



## Mirror-o-Matic

Install the eight inch eccentric pulley and eccentric. Align the top of the eccentric with the top of the over-arm support curved slot.

Sandwich the rod end bearing on the over-arm side with large washers and install a 3/8 "X 2-1/2" bolt. Use a 3/8" nut with large washer or another 3 pronged t-nut and small piece of wood to tighten the bolt.

Set the eccentric end of the drive rod to zero throw by positioning it to the center of the eccentric. Position the swivel so that it rest over the center of the turntable. Tighten the bolts on each end of the eccentric rod.

Adjust the swivel height so that the swivel is several inches above the turntable.

Turn the machine on and make sure that there is no interference with moving parts. Turn the machine off and add about one inch of throw to the eccentric. Turn the machine on again. If all is working correctly, you are ready to start grinding.

Congratulations.



# Mirror-o-Matic

Revised 15 December 2002

## Parts List

Kit Item	# Req'd	Item	Location	Supplier	Part Number	Catalog Cost
Yes Note 1	2	1"X25" polished blower shaft (cut in two)	Turntable, Eccentric	Johnstone Grainger	L86-158 4C908	15.28 x 2 15.39 x 2
Yes	3	1" Set screw shaft collar - zinc plated	Turntable, Eccentric	MSC	87986642	0.61 x 2
Yes	4	1" id x 1-1/2" od x 1/8" bronze thrust washer	Eccentric	MSC	06455489	0.63 x 4
Yes	4	1 " id x 1-1/4" od x 3/4" long bronze bushing	Platter, Tool, Overarm support	MSC	35375575	1.49 x 4
Yes	2	1" id x 1-1/4" x 3" long bronze bushing	Bearing Boxes	MSC	35375633	5.69 x 2
Yes	4	3/8" x 1-1/4 bolts NC, nuts ,washers	Overarm	Hardware		0.15 x 4
Yes Note 2	12	3/8" pronged t-nuts	Overarm	Hardware		0.25 x 12
Yes Note 7	1	Pulley 12" x 1"	Turntable	Johnstone Grainger	L 36-792 3x941	15.74 x 2 14.36 x 2
Yes Note 3	1	Pulley 8" x 1"	Eccentric	Johnstone Grainger	L 36-780 3x929	9.34 x 2 7.66 x 2
Yes Note 5	2	Hinge-Stanley 10" # 14-52-52	Overarm	MSC Grainger	32836397 5J157	9.05 x 2 9.54 x 2
No	1	Assorted nails or screws	Thru-out	Hardware		1.00
No	1	Polyurethane or other type wood glue	Thru-out	Hardware		6.00
No	1-1/2	Plywood 3/4" Cabinet Grade	Thru-out	Hardware		45.00

### Notes:

1. Johnstone hollow shafting # B81-972 @ \$7.39 is also acceptable. Blower shaft is polished. It differs from drill rod in that it is slightly undersize to provide clearance for bearings. Graingers also provides blower shafting, but only in the one-inch size.
2. Pronged t-nuts are available by the box of 100 from MSC. Hardware stores such as Home Depot sell in bags of 3 to 5 nuts.
3. Pulleys and belts are also available from MSC at increased prices. The pulleys listed are Congress brand die-cast aluminum, which have a very flat face on one side for the turntable and eccentric to set on.
4. Prices listed are from current catalogs. Prices are subject to change.
5. The correct hinges are somewhat critical to proper operation. The Stanley 14-52-52 units specified should be used unless you wish to experiment. These hinges are very heavy duty with plastic bushings. Hinges that have 'play' will cause problems.
6. Springs were cut down units from Home Depot. Originally the springs were 12 inches long. Cut as required.
7. Grainger part # 3X943 @ \$18.47 is a 14 inch diameter Congress Sheave. You can substitute this for one of the 12 inch sheaves listed above. It will provide more support for the turntable. Any of the larger more expensive steel sheaves can also be substituted. The heavier steel sheaves are much stiffer and will be much less likely to have run-out.