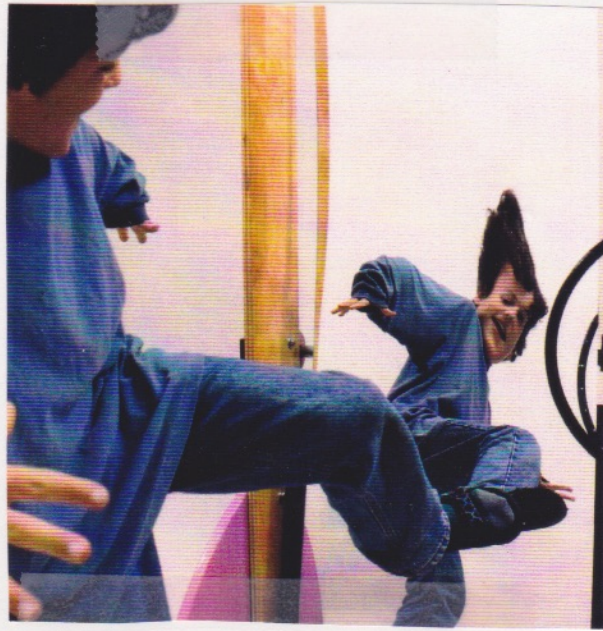


How to Build the

# MIRROR STEEROR



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## Introduction

I'm always looking for project materials, so when a friend offered me a large stack of Plexiglas mirror rejects I couldn't resist them. While trying to figure out what to do with them I took two pieces (8" X 24") and fastened them, side by side, to a board so that one curved in, the other out. The kids in my class got a kick out of this. They could see their faces in weird shapes, which was good for a laugh, but still left me wondering: could I design it so the kids controlled the mirror curvature? How about making it large enough so they could see their whole body?

In the basement I had a cache of old boat parts, among them a steering gear. Maybe I could use it as a controller for this gizmo. I just needed to figure out how to combine it with a large piece of surplus Plexiglas mirror. I made a frame to hold the mirror first, fastening the bottom of the mirror securely and letting the top slide up and down, between two small boards, as the middle of the mirror bulged in or out. It actually worked well this way. One person could stand behind the mirror and move it in and out while a friend, standing in front of the mirror, gained and lost weight rapidly!

Next I bolted my steering gear to a small 2" X 4" and clamped

it to the stand, moving it around until I could envision a mechanism to connect the mirror to the steering apparatus (see drawings). I had to experiment with the lengths and positions of the connector arms to get the mirror to move about 8" (at the middle) as the steering wheel moved through 5 1/4 turns. I worked these details out and set it up by our front door. It passed the front door test with flying colors and we received many comments about the crazy machine on our front porch. It is interesting to observe someone using the Mirror Steeror for the first time. Kids will go right up to it and turn the wheel. It doesn't take them long to realize the connection between the mirror and the steering wheel. Adults are more leery.

I've used the Mirror Steeror on the first day of my summer shop class. It is amazing how interested kids can be when I start with something funny. I guarantee the smiles and the laughter will more than compensate for the cost and effort of building it.



## Tools

To build the mirror steeror you will need to have and know how to use the following tools:

- a router for rounding corners and edges (can be done by hand)
- hand saw and/or portable circle saw
- a welder or take the one weld to a welder
- electric drill and drill bits
- dust mask, safety goggles
- tape measure
- square
- screw driver
- saber saw or band saw
- caulking gun
- crescent wrench
- hacksaw
- hand plane

## MATERIALS

### wood

- one 4' X 8' sheet birch plywood..... sides, stand, bottom,
- 25 1/2" X 23 1/2" masonite..... stand stiffener
- 8" piece of 2" X 4"..... holds conduit end
- 10" piece of 4" X 4"..... for steering box  
mounting piece
- 8' of 1" X 2"..... to hold top and bottom  
of mirror
- 2" X 2" X 20" ..... glued to back of  
mirror, holds eye bolt

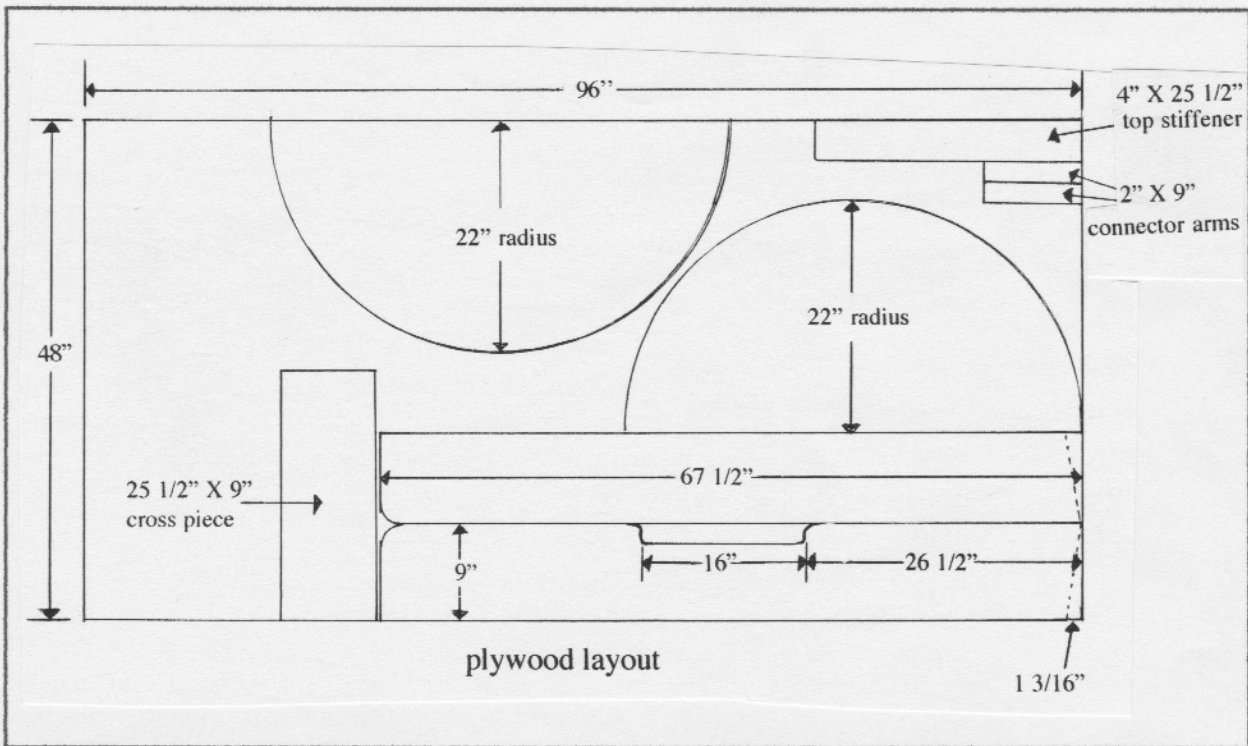
### miscellaneous

- 1/8" thick X 20" X 63" Plexiglas mirror, available from glass supply stores
- 1978 Toyota steering box, steering wheel and the splined rod the steering wheel fits on to (available from auto wrecking yards)
- 1" X 22 1/4" electrical conduit..... fits end of steering  
box
- 1 tube Sikaflex caulking..... bond mirror to 2"X2"
- 6 3/4" X 24" cardboard.....to wrap around  
steering box extension
- electrical tape.....tape over cardboard
- paint and/or varnish

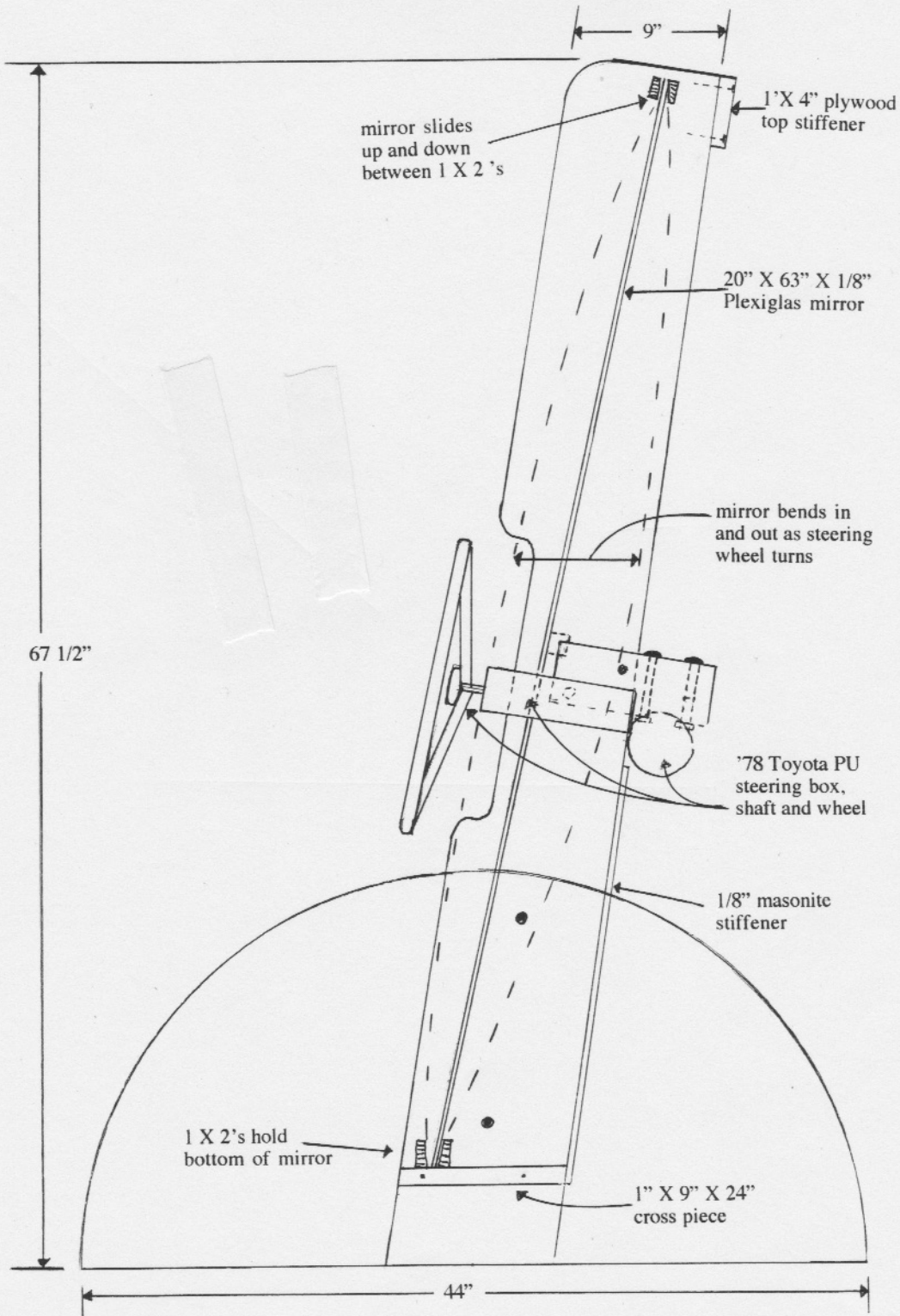
### nuts, bolts and screws

- twenty 2" sheet rock screws.....fastens mirror  
holders, top stiffeners
- twelve 1 3/8" sheet rock screws.....to fasten masonite  
stiffener to sides
- one 1" sheet metal screw..... locks connector arm  
to conduit

- four 5/16" X 2 1/2" carriage bolts.....fastens conduit holder  
with washers and nuts and steering box  
holder to sides
- two 5/16" X 4 1/2" carriage bolts..... fastens steering box  
with washers and nuts to 4" X 4" mount
- four 3/8" X 2" carriage bolts.....fastens sides to the  
with washers and nuts stand
- one 1/4" X 2" carriage bolt.....pivot bolt  
with washers and nylon lock nut
- three 1/4" X 2 1/2" carriage bolts..... fastens through  
with washers and nylon lock nuts connector arms
- two 1 1/4" X 1/4" carriage bolt.....locks conduit to  
with washers and nylon lock nuts steering gear, fastens  
pivot arm to eye bolt
- one 1/4" X 1 1/2" eye bolt, screw..... fits into 1" X 2" on  
back of mirror

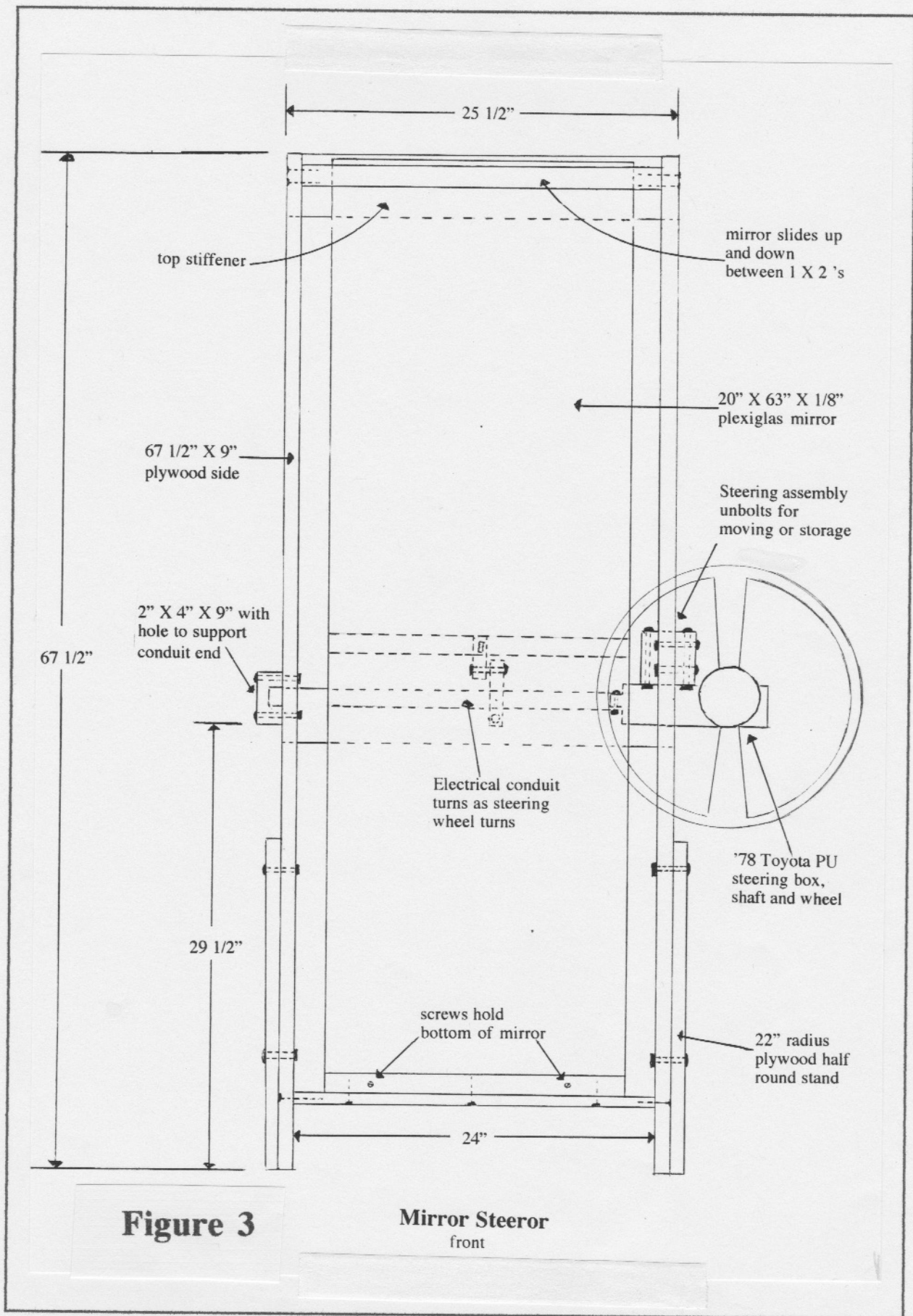


**Figure 1**



**Figure 2**

**Mirror Steerer**  
side



**Figure 3**

**Mirror Steerer**  
front

## Construction details:

1. Mirror preparation. Fasten the 2" X 2" X 20" to the mirror with Sikaflex caulking. The 2" X 2" should be centered 30" from the bottom of the mirror. Make sure there is a good layer of caulking in the joint and clamp gently together using wooden blocks on the mirror face. With the first Mirror Sterror I drilled through the mirror and used screws to provide positive fastening, but it was easy to crack the Plexiglas and the Sikaflex works without fasteners. Sand the side edges of the mirror smooth.

2. The steering box. Drain the oil from the steering box and make sure it is not leaking. Tighten the tension nut on the steering box so that the steering wheel stops turning when you let go of it. If it spins too easily some kids will whip the wheel first one way and then the other shaking the whole apparatus.

Cut 7 1/4" off of the splined shaft that came with the steering wheel and weld it (or take it to a welder) to the end of the steering box. Leave the splines for the steering wheel and weld the other end. Be sure the shaft extension is straight before welding it.

3. Build the half-round stand pieces according to the plywood layout drawing. These are made larger than might seem necessary for two reasons: to balance the weight of the steering box and to keep kids from climbing on the mirror steeror.



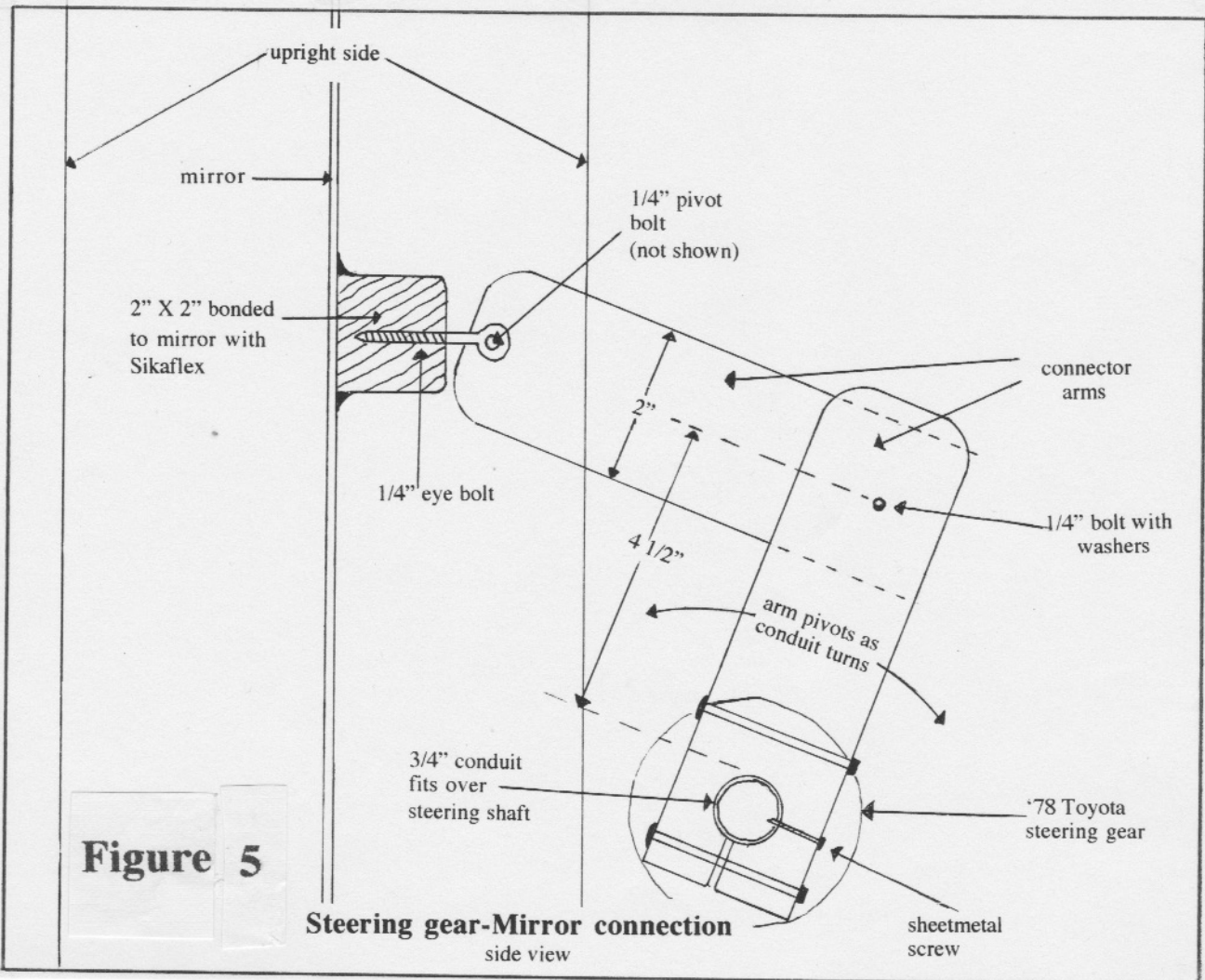


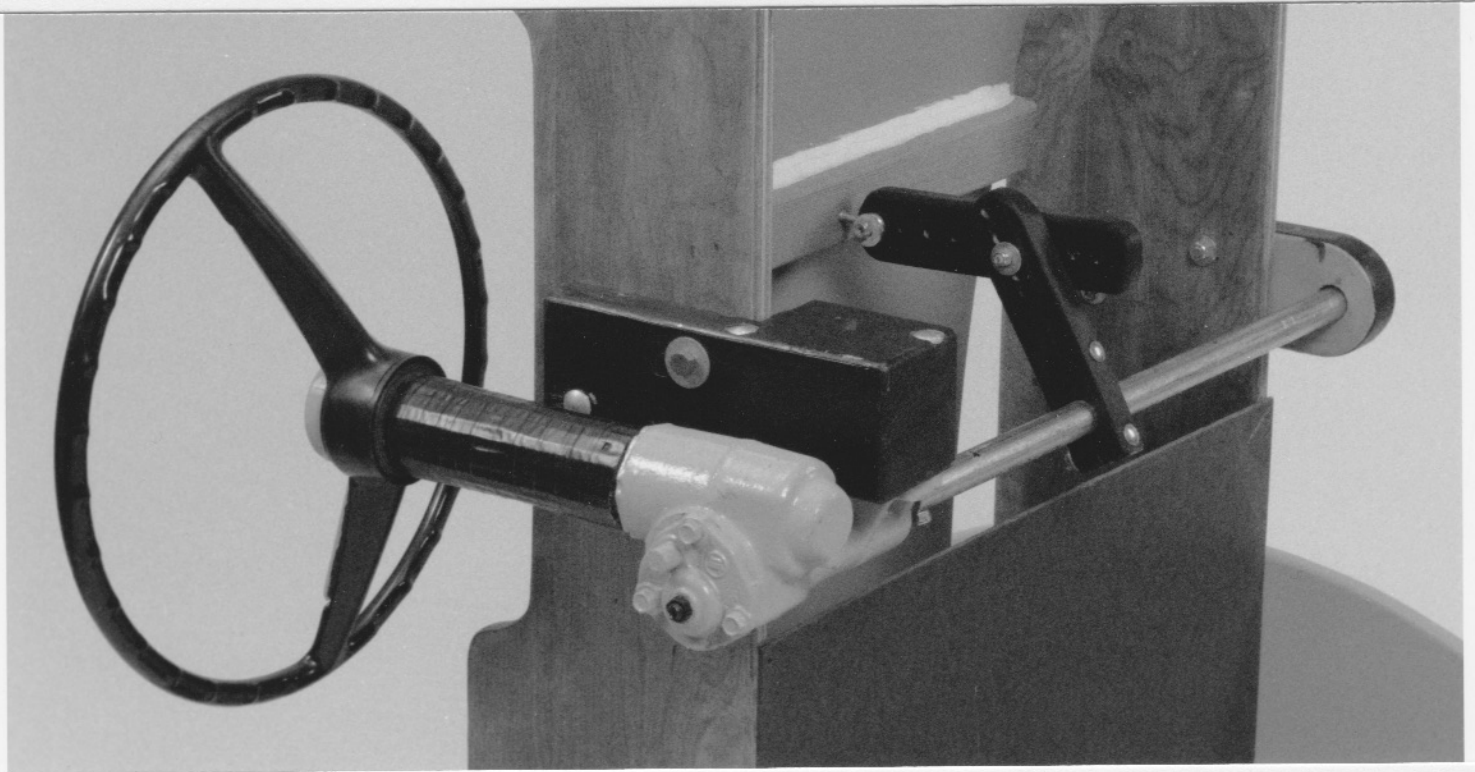
4. Build the frame to hold the mirror with the following pieces:
  - a. 67 1/2" X 9" plywood sides
  - b. 24" X 4" top stiffener
  - c. two 20" X 1" X 2" beveled bottom mirror supports
  - d. two 22 1/2" X 1" X 2" beveled top mirror supports
  - e. 22 1/2" X 9" lower plywood cross member
  - f. 25" X 23 1/2" masonite stiffener

Bolt the half round stand pieces to the frame. Figures 2 and 3. Build the conduit holder (figure 3) and fasten it to the stand opposite the steering wheel.

5. Install the mirror. Put the mirror in place and carefully drill 3/16" holes through the outside mirror holder and mirror. Install screws to hold bottom of mirror in place.

6. Make the connector arm pieces and fit them to the conduit. Fasten the conduit to the short steering box shaft with a 1/4" bolt (drill through both). Figures 5 and 6.





**Figure 6**

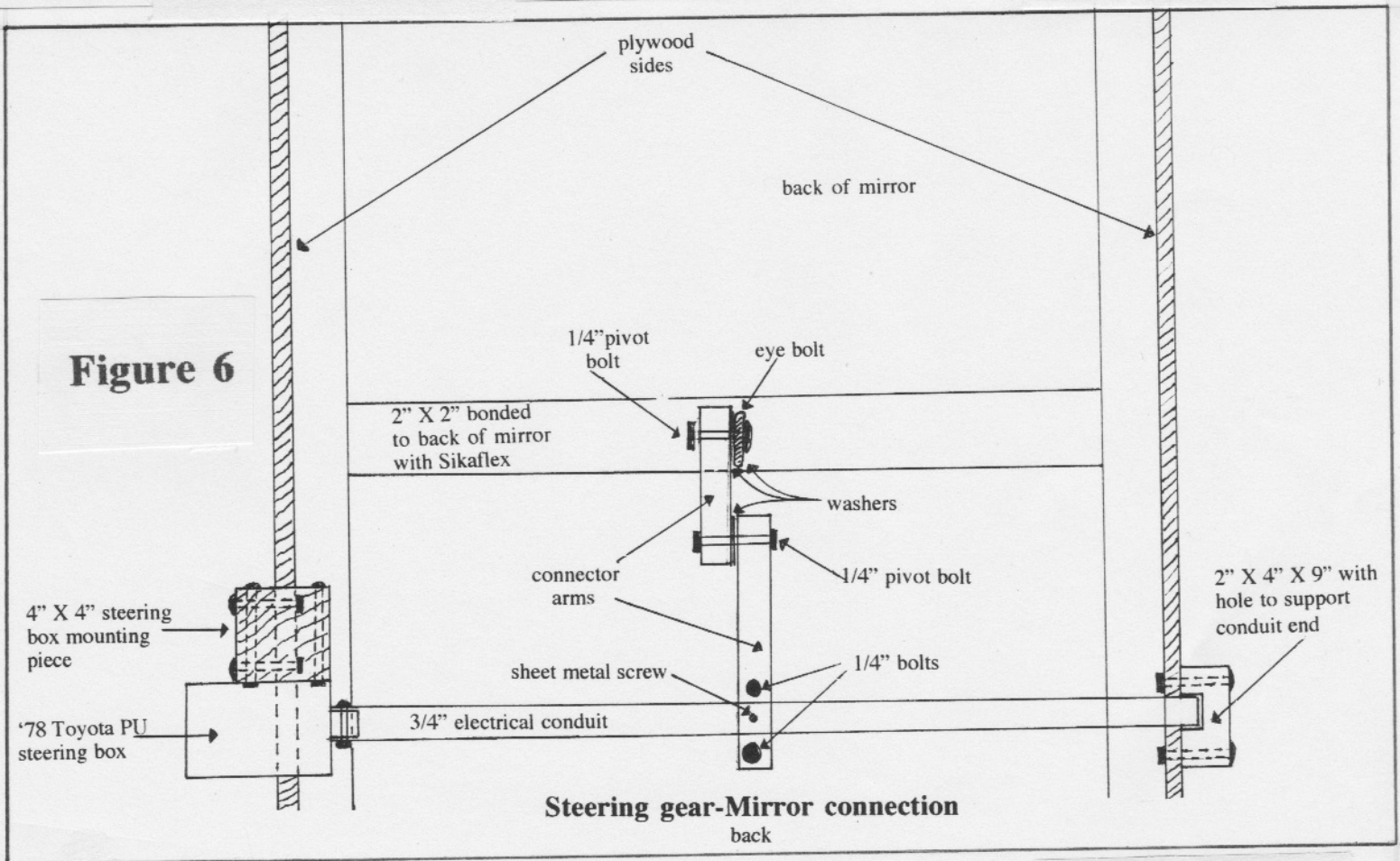
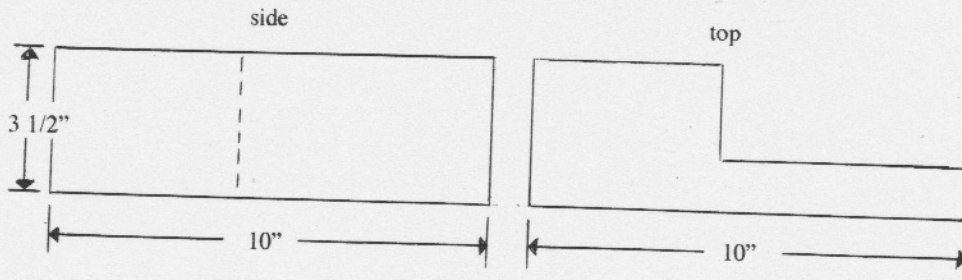


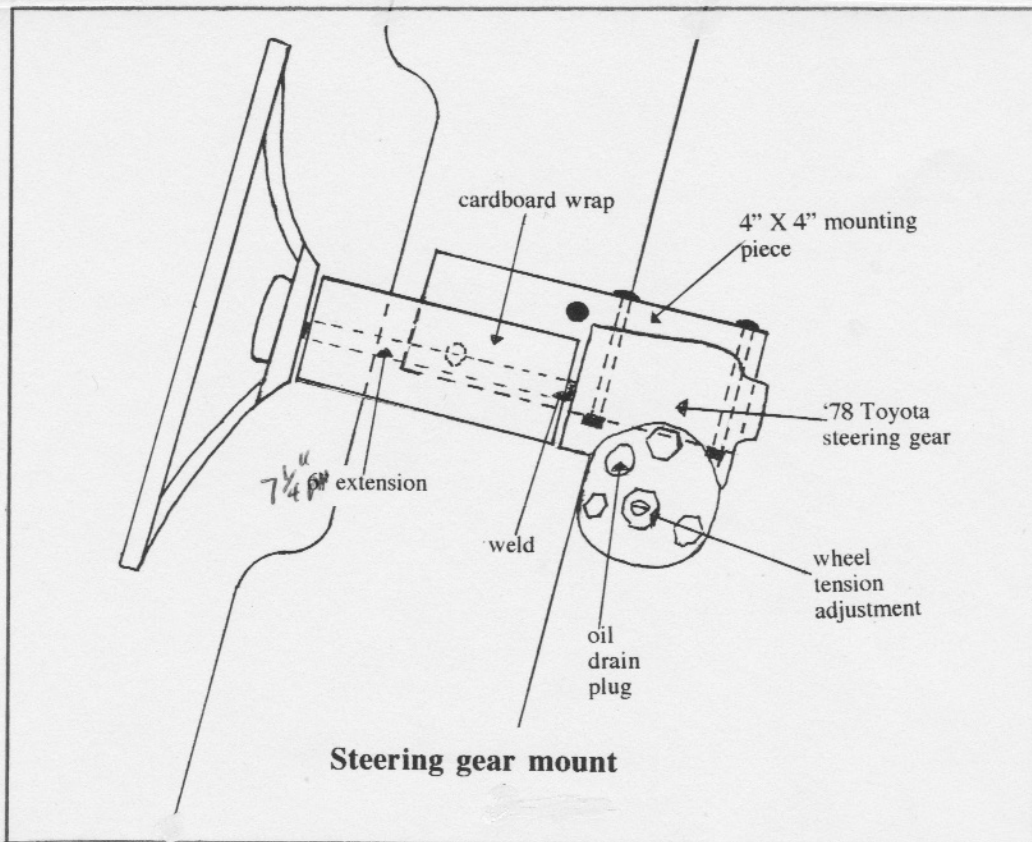
FIG 6



Steering box mounting piece

Figure 7

7. Make the steering gear mounting piece from the 10" X 4" X 4". See Figure 7 (above). Fasten the steering gear to it with 5/16" X 4 1/2" carriage bolts. Mount the steering gear mounting piece (with steering gear attached) to the upright side so the output shaft is 29 3/4" from the floor and the conduit is level. The conduit end should fit into the hole in the conduit holder.



Steering gear mount

8. Fasten mirror to top pivot arm. Place an eye bolt in the center of the 2" X 2". Be careful not to drill too deep and crack the mirror. Fasten to top pivot arm loosely with 1/4" X 1 1/4" bolt.

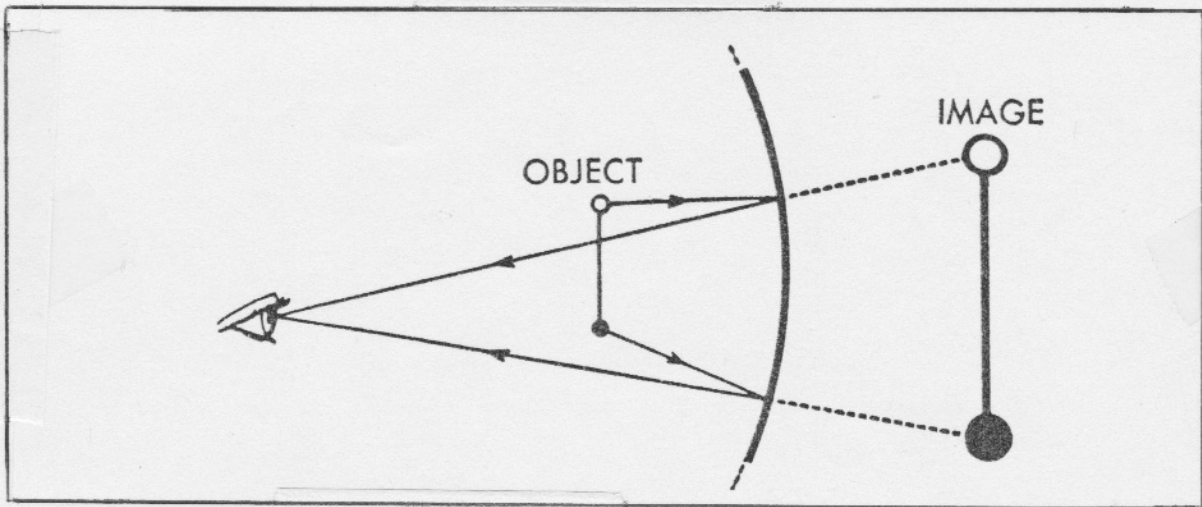
Except for paint or varnish this completes the mirror steeror. Test it and make sure everything works smoothly and then find some kids to give it the acid test. The more the merrier.

## Use

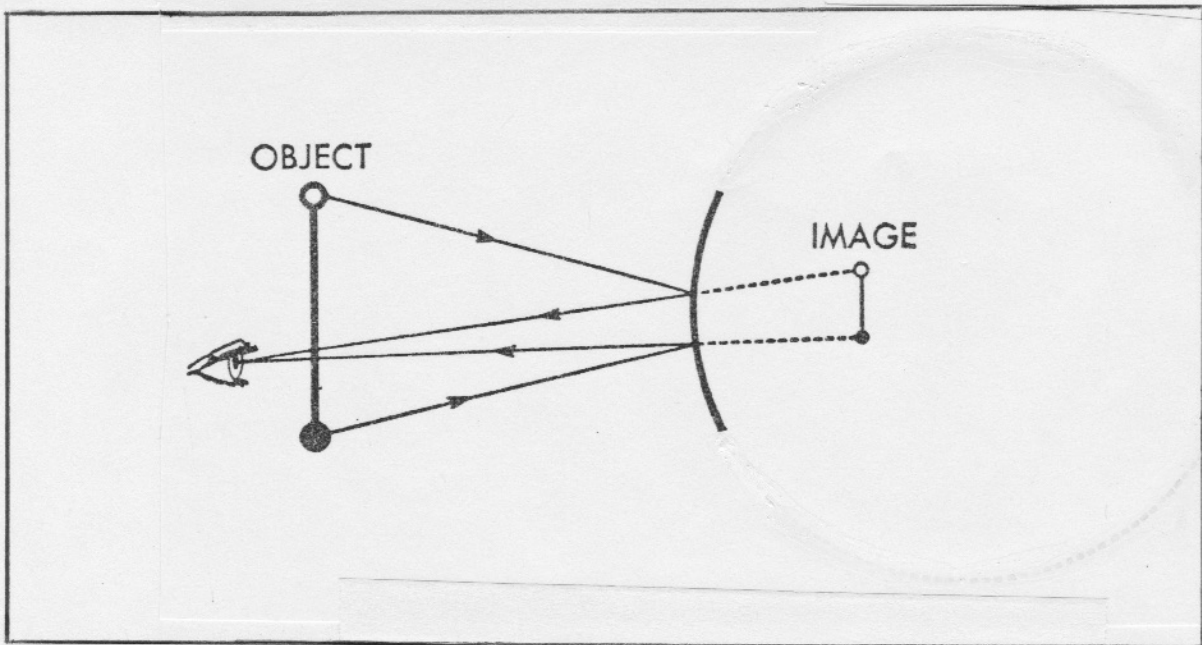
The Mirror Steeror is designed to be used under close adult supervision. Kids are mostly good about treating it carefully, however, occasionally a kid will push or pull on the edge of the mirror without turning the steering wheel. If they got carried away with this the mirror could crack. Try to set the mirror steeror up against a wall. Kids also like to look around back to see how the Mirror Steeror works. Occasionally they will want to play with the pieces that connect the mirror to the steering box. I'll say something like, "Sorry I don't want you to play behind the Mirror Steeror, I'm afraid you might get hurt."

**A NOTE OF CAUTION:** The Mirror Steeror must not face into direct sunlight. A concave mirror can focus the sunlight and cause a hot spot at the focal point. While highly unlikely, it is possible for this hot spot to cause burns or eye damage. The adult in charge of the mirror Steeror must never leave it outside or near a window unattended and should be aware of the position of the sun in relation to the mirror at all times.





Concave mirror (tall and skinny)



Convex Mirror (short and fat)

### How does it work?

The angle of incidence of light equals the angle it will be reflected. When the mirror bends toward you (convex mirror) the object appears smaller and behind the mirror, i.e. short and fat. The light follows the lines and arrows of the pictures above. When the mirror bends away from you (concave mirror) the image appears larger and behind the mirror.