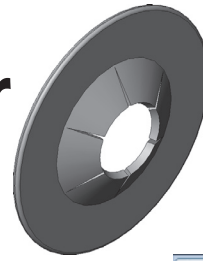


CO₂ Car Axle Retainer



A. Sketch.

Step 1. Click File Menu > New, click **Part Metric** and OK.

Step 2. Click **Top** (plane) in the Feature Manager and click **Sketch**  from the Content toolbar, **Fig. 1**.

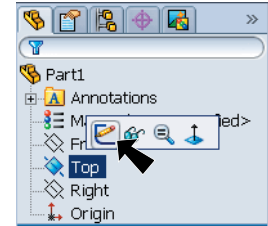


Fig. 1

Step 3. Click **Line**  (L) on the Sketch toolbar.

Step 4. Draw a line starting directly above the Origin  but do not draw the line to the Origin, **Fig. 2**. Draw a second line from the end of the first line at an angle to the right. Do not bring the angle line down to the Origin.

Use the inferencing line, the dotted line that appears when you draw the lines. Do not add any extra lines. If you make a mistake, use Undo, **Ctrl-Z**. Use **L** key to start and stop line.

Step 5. Click **Smart Dimension**  (S) on the Sketch toolbar.

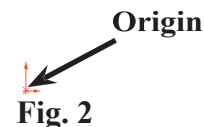


Fig. 2

Step 6. Add the dimensions as shown in **Fig. 3**. To Smart dimension click the line then move the cursor out away from the line and click. Key-in the dimension and press ENTER. Arrange the dimensions as **Fig. 3**.

Step 7. Dimension the angle between the top line and angle line **150 degrees** as shown in **Fig. 4**. To Smart dimension the angle click both lines then move the cursor out away from the lines and click. Key-in **150** for the dimension and press ENTER.

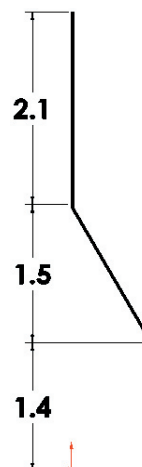


Fig. 3

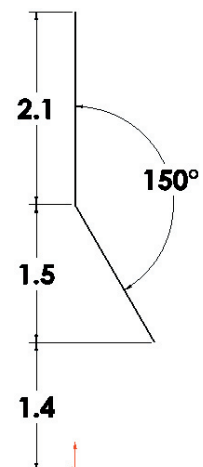


Fig. 4

B. Save as "RETAINER".

Step 1. Click File Menu > Save As.

Step 2. Key-in **RETAINER** for the filename and press ENTER.

C. Offset Entities.

Step 1. Click **Offset Entities**  on the Sketch toolbar.

Step 2. In the Offset Entities Property Manager set:

Distance to .3

Select chain, Fig. 5.

Click a line of the sketch.

The yellow offset spline should be on the right of the initial green lines, **Fig. 6**. If it is not, click Reverse. Click OK .

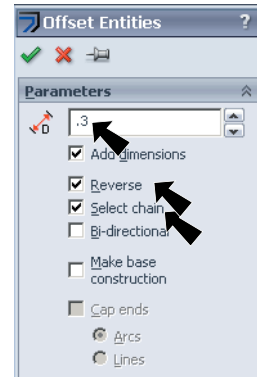


Fig. 5

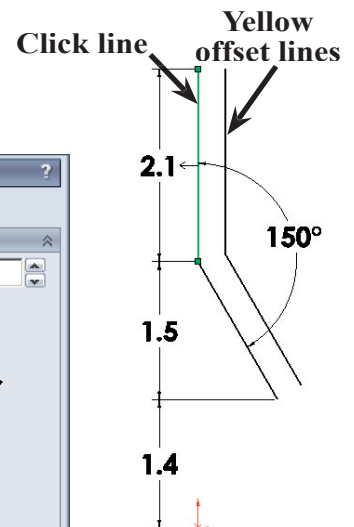


Fig. 6

Step 3. Save. Use **Ctrl-S**.

D. Connect Ends of Offsets.

Step 1. Click **Line**  (L) on the Sketch toolbar.

Step 2. Draw lines to connect the ends of the offset lines, **Fig. 7**. Do not add any extra lines. Do not leave gaps between lines. If you make a mistake, use Undo, **Ctrl-Z**. Use **L** key to start and stop line.

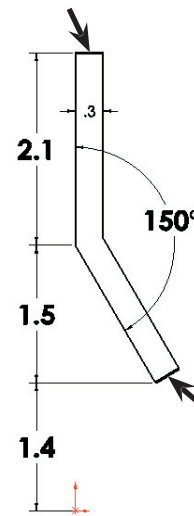


Fig. 7

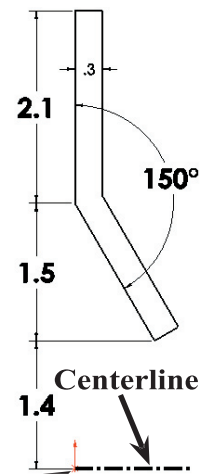


Fig. 8

E. Centerline.

Step 1. Click **Centerline**  in the **Line flyout**  (S) on the Sketch toolbar.

Step 2. Starting from the Origin , draw a centerline across the bottom of the sketch extending the centerline out past the sketch, **Fig. 8**.

F. Revolve.

Step 1. Click **Features**  on the Command Manager toolbar.

Step 2. Click **Revolved Boss/Base**  on the Features toolbar.

Step 3. Click OK  in the Revolve Property Manager, **Fig. 9** and **Fig. 10**.

Step 4. Click Zoom to Fit  (F) on the View toolbar.

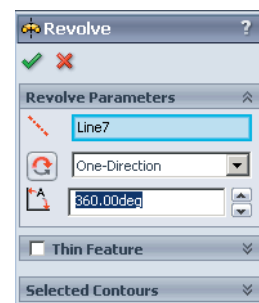


Fig. 9

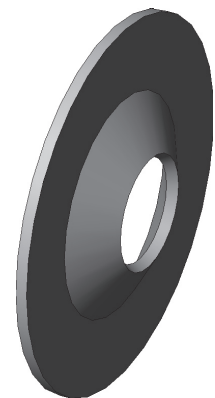


Fig. 10

G. Sketch Cut.

Step 1. Click **Left**  on the Standard Views toolbar. (Ctrl-3)

Step 2. Click the back face of the body and click **Sketch**  on the Content menu, **Fig. 11**.

Step 3. Click **Line**  (L) on the Sketch toolbar.

Step 4. Draw a horizontal line across through the Origin, **Fig. 11**.

Step 5. Press the Escape key to **unselect** Line.

Step 6. **Shift click** the line and the Origin to select both (Hold down shift key and click both line and Origin), **Fig. 12**.

Step 7. In the Property Manager under Add Relations, click **Midpoint** , **Fig. 13**.

Step 8. Click **Line**  (L) on the Sketch toolbar.

Step 9. Draw two lines as shown in **Fig. 14**.

Step 10. Click **Smart Dimension**  on the Sketch toolbar.

Step 11. Dimension the horizontal line **.3**, **Fig. 15**. To Smart dimension click the line then move the cursor out away from the line and click. Key-in the **.3** and press ENTER.

Step 12. Save. Use **Ctrl-S**.

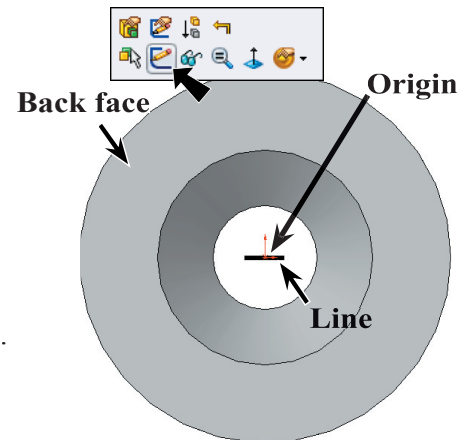


Fig. 11

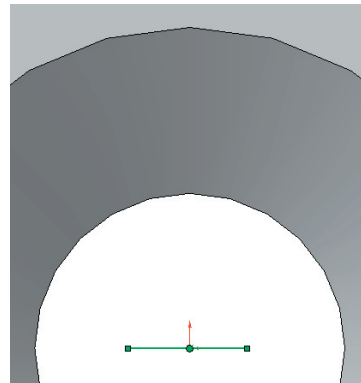


Fig. 12

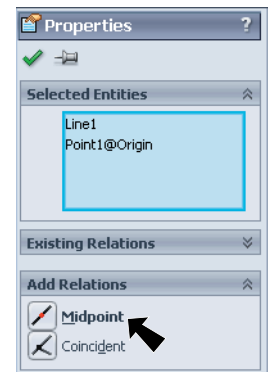


Fig. 13

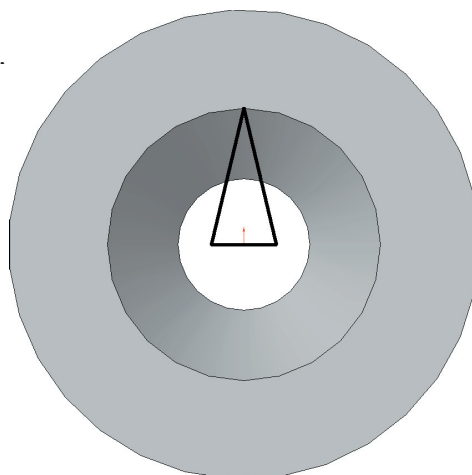


Fig. 14

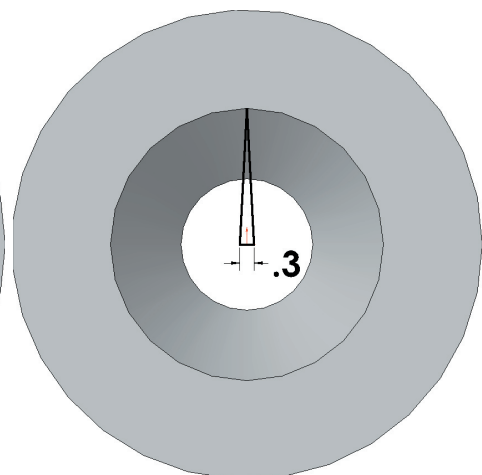
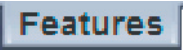
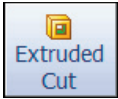


Fig. 15

H. Extrude Cut.

Step 1. Click **Features**  on the Command Manager toolbar.

Step 2. Click **Extruded Cut**  on the Features toolbar.

Step 3. In the Property Manager set:
under **Direction 1**
End Condition to Through All
click OK , Fig. 16 and Fig. 17.

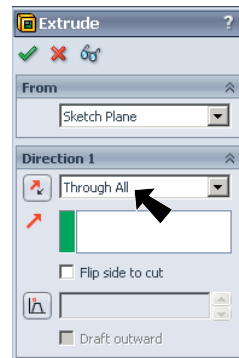


Fig. 16

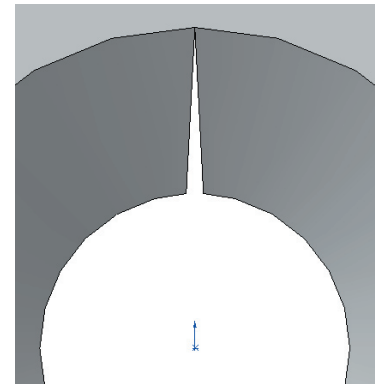


Fig. 17

I. Circular Pattern Cuts.

Step 1. Click **Isometric**  on the Standard Views toolbar. (Ctrl-7)

Step 2. Click View Menu > Temporary Axes.

Step 3. Click **Extrude1** in the Feature Manager (left panel) to select the feature, Fig. 18.

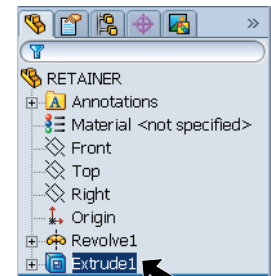


Fig. 18

Step 4. Click **Circular Pattern**  in the **Linear Pattern**

flyout  on the Features toolbar. Be sure to click the **flyout arrow**  to select Circular Pattern.

Step 5. In the Circular Pattern Property Manager set:

under **Pattern Axes** 
Click the temporary axes in the drawing, Fig. 19

Number of Instances  to 6, Fig. 20

Check Equal spacing, Fig. 20

under **Options**

Check Geometry pattern, Fig. 20

and click OK  in the Property Manager, Fig. 21.

Step 6. Save. Use Ctrl-S.

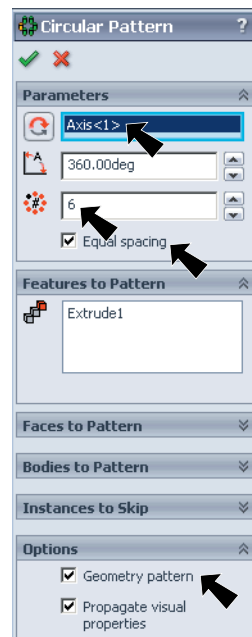


Fig. 20

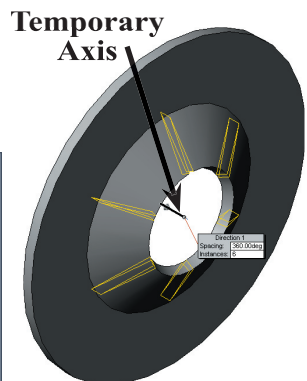


Fig. 19

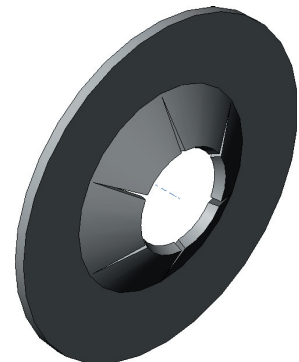


Fig. 21

J. Fillet Edges of Hub.

Step 1. Click **Fillet**  on the Features toolbar.

Step 2. Set the **Radius**  to **.13** in the Fillet Property Manager, **Fig. 22**.

Click the face on the edge of the retainer, **Fig. 23**

and click OK  in the Property Manager, **Fig. 24**.

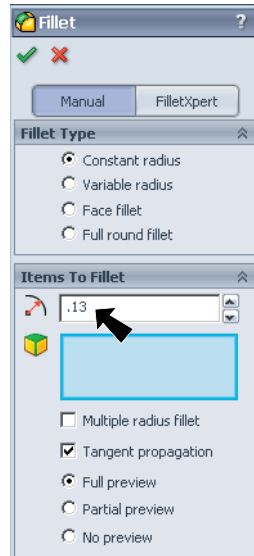


Fig. 22

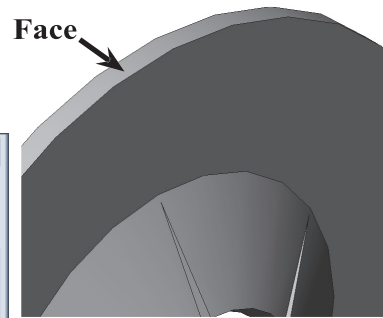


Fig. 23

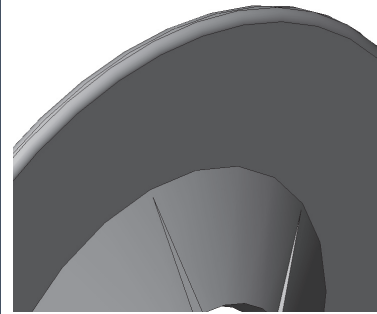


Fig. 24

K. Appearance.

Step 1. Click Edit Menu > Appearance > Material.

Step 2. Expand Aluminum Alloys, select **1060 Alloy**, **Fig 25** and click OK .

Step 3. Save. Use **Ctrl-S**.

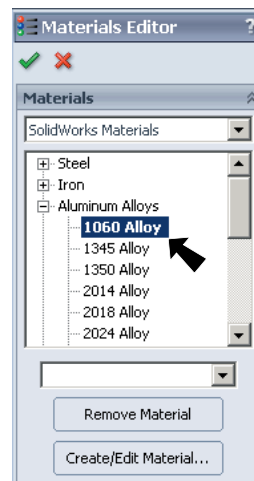


Fig. 25

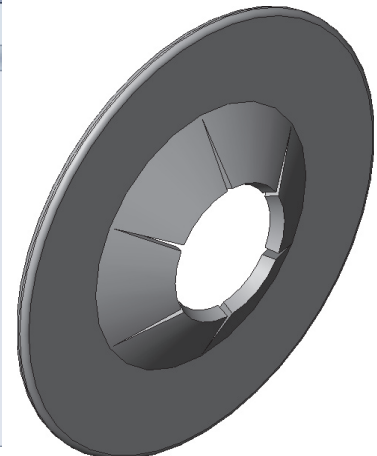
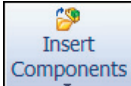


Fig. 26

L. Insert Washer and Retainer in Assembly.

Step 1. Click File Menu > Open. Select your **ASSEMBLY** file and click OK.

Step 2. Click **Insert Components**  on the Assembly toolbar.

Step 3. Click **Keep Visible**  in the Property Manager, **Fig. 27**.

Step 4. Click **Browse** in the Property Manager, **Fig. 27**.

Step 5. Select your **WASHER** file and click Open.

Step 6. Click approximately where the **washers** are positioned in **Fig. 28**.

Step 7. Repeat, and browse to place two **RETAINERS**, **Fig. 28**.

Step 8. Click OK  in the Property Manager when done.

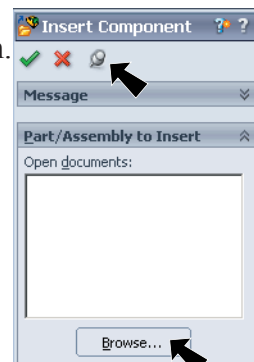


Fig. 27

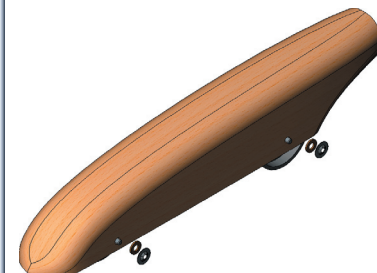
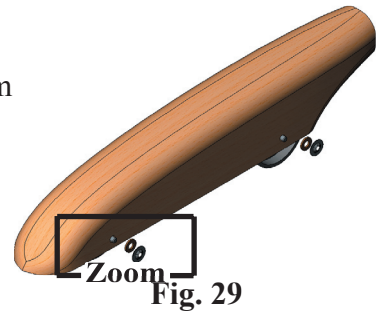


Fig. 28

M. Mate: Axle, Washer and Retainer.

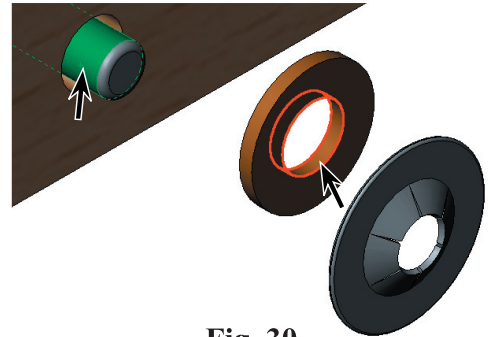
Step 1. Use the **Zoom to Area**  in the View toolbar to drag a zoom window around the **front axle, washer and retainer**, Fig. 29.



Step 2. Click **Filter Faces**  (X) on the **Selection Filter** toolbar at the bottom of the display, Fig. 4. If necessary use F5 key to display the toolbar.

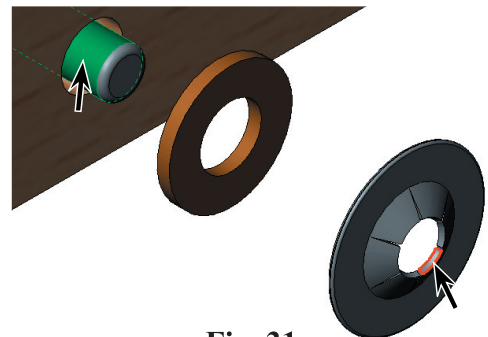
Step 3. Click **Mate**  on the Assembly toolbar.

Step 4. Click **cylindrical face of axle** and **inside cylindrical face of washer**, Fig. 30.



Step 5. Click Add/Finish Mate  in Mate pop-up toolbar to add a **Concentric** mate.

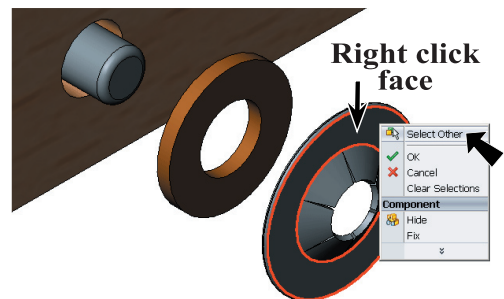
Step 6. If the washer slides up inside the body, first turn off **Filter Faces** (X) and click **Wireframe**  on the View toolbar. Drag the washer out to the end of the axle and click **Shaded With Edges**  on the View toolbar.



Step 7. Click **cylindrical face of axle** and **inside cylindrical face of retainer**, Fig. 31.

Step 8. Click Add/Finish Mate  in Mate pop-up toolbar to add a **Concentric** mate.

Step 9. **Right click outside face of the retainer** and click **Select Other** from the menu, Fig. 32.

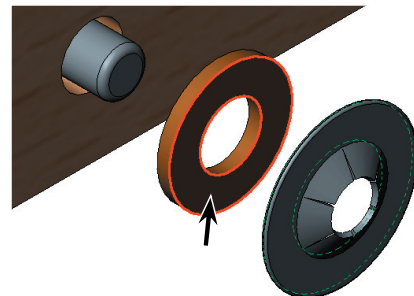


Step 10. Click **inside face of the retainer** and **face of the washer**, Fig. 33.

Step 11. Click Add/Finish Mate  in Mate pop-up toolbar to add a **Concentric** mate.

Step 12. Click OK  in the Property Manager when done.

Step 13. **Repeat the above Mates at the rear axle.** Use the **Zoom to Area**  to zoom window around the **rear axle, washer and retainer**.



Step 14. Click **Bottom**  on the Standard Views toolbar. (Ctrl-6)

Step 15. Use the **Zoom to Area**  in the View toolbar to drag a zoom window around the **end of front axle, washer and retainer**, Fig. 34. Click Zoom to Area  again or Escape to unselect Zoom to Area.

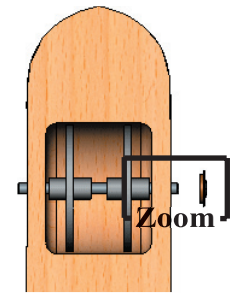


Fig. 34

Step 16. Drag the washer and retainer over next to the body, Fig. 35.

Step 17. Repeat at rear axle.

Step 18. Click **Isometric**  on the Standard Views toolbar. (Ctrl-7)

Step 19. Save. Use Ctrl-S.

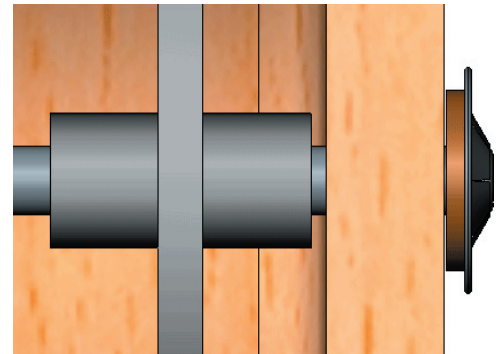


Fig. 35

N. Mirror Washers and Retainers.

Step 1. Click **Bottom**  on the Standard Views toolbar. (Ctrl-6)

Step 2. Click Insert Menu > Mirror Components.

Step 3. In the Property Manager set:
under **Selections, Mirror plane**:
Expand the Design Tree in the top left corner of the drawing area and select **Right** (plane), Fig. 36

under **Components to Mirror**:
In the Design Tree, click to select both washers and both retainers, Fig. 37

Check **Recreate mates to new components**, Fig. 36

Step 4. Click OK  in the Property Manager, Fig. 37.

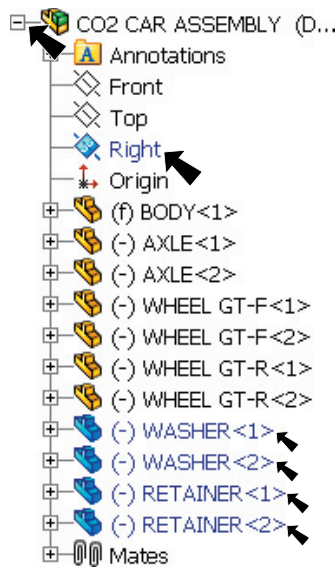


Fig. 36

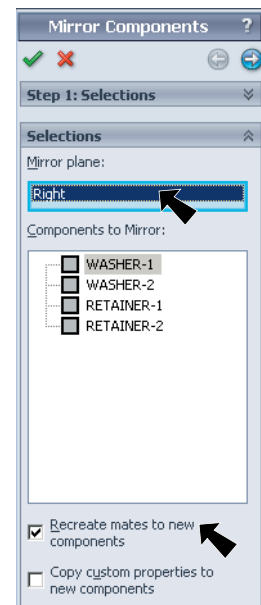


Fig. 37

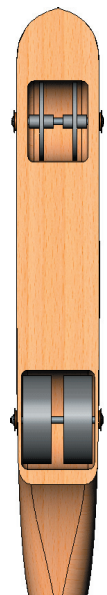


Fig. 38

Step 5. Save. Use Ctrl-S.

