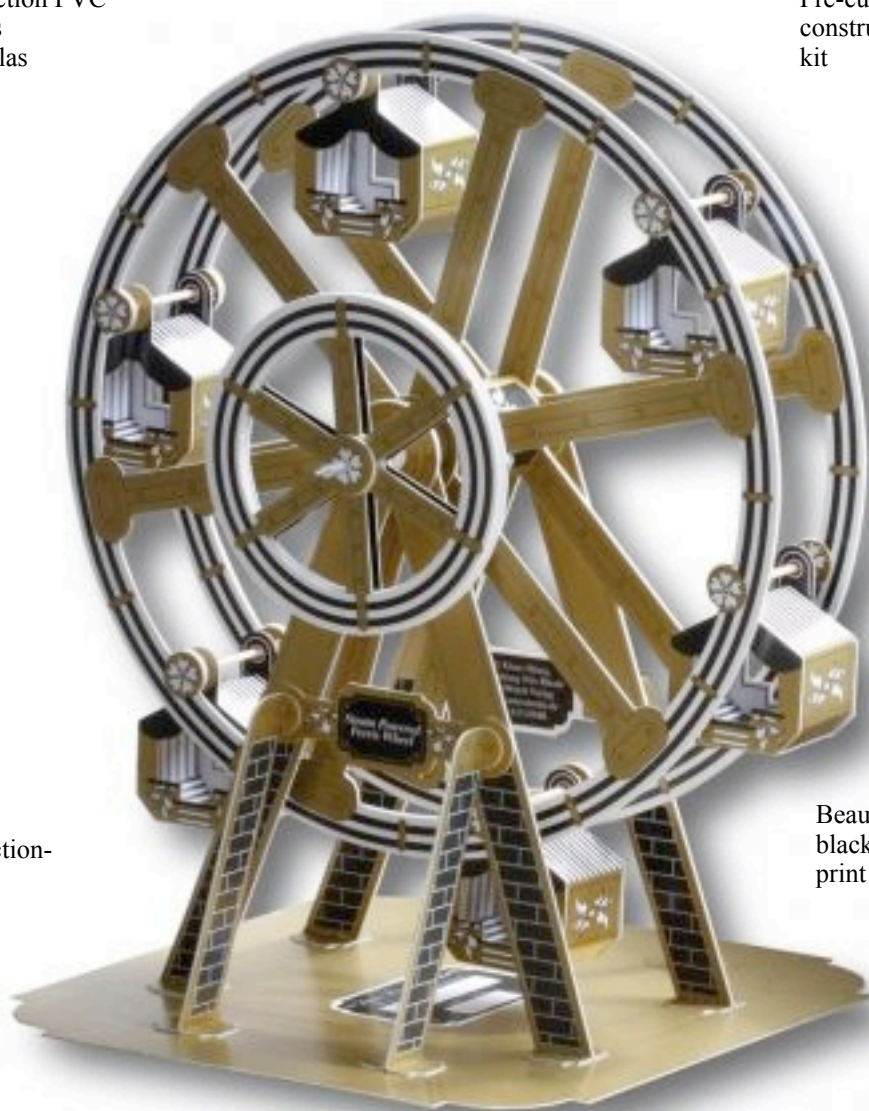


The Ferris Wheel

a complement to the AstroMedia Steam Engine

Low-friction PVC
bearings
6 gondolas

Pre-cut
construction
kit

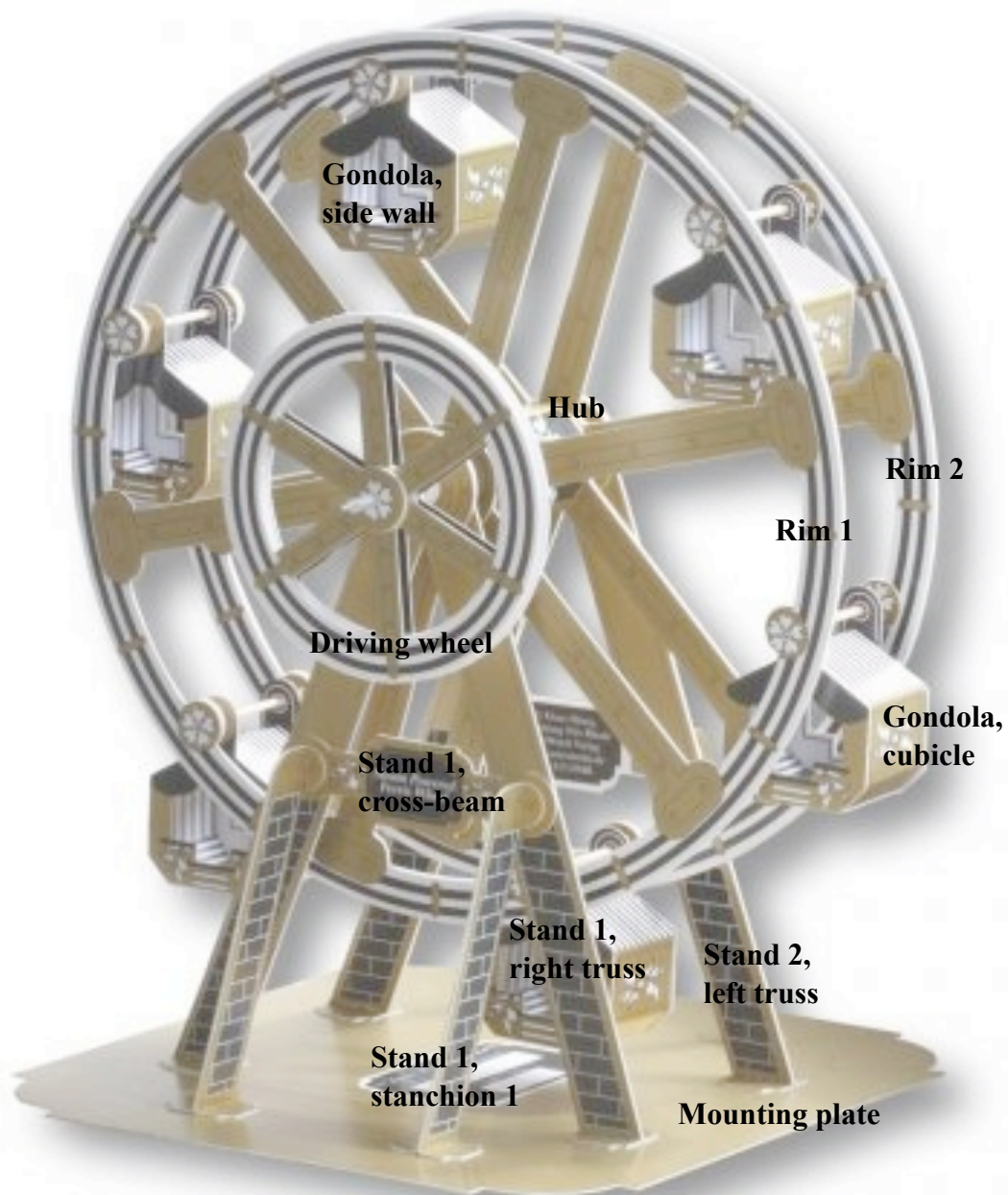


Sturdy
construction-
board

Beautiful
black and gold
print

AstroMedia

Translation: Andreas Schröer



The Ferris Wheel

Wheels with seats to take passengers up and down are much older than you would think: The oldest report mentioning such a device is from an English traveller who saw one in 1620 in the Bulgarian town of Plovdiv. For a long time these wheels had only six or eight seats and were operated by hand. Therefore it was important that the weight was evenly distributed. The first large ferris wheel was shown at the World's Columbian Exposition 1893 in Chicago. It was over 80 metres tall, had 36 gondolas for 60 passengers each, and could therefore transport up to 2,160 (!) people at the same time. It was constructed by the American engineer G.W.G Ferris Jr., after whom these wheels are now named.

This was the trigger for the construction of a number of ferris wheels in the old world as well, some of which are still in operation today, like the one built in 1897 in Vienna's Prater.

In the 20th century stationary ferris wheels lost their attraction until the London Eye started operating in the year 2000. At that time it was the tallest wheel in the world, measuring 135m. The current record holder is the Singapore Flyer, that can transport 28 people in each of its 28 gondolas to a height of 165m.

The AstroMedia Ferris Wheel follows in the tradition of tin models meant to be driven by toy steam engines that were produced for the children of wealthy families at the end of the 19th century.

To ensure the wheel can be driven by the moderate power of the AstroMedia Steam Engine, the construction minimises friction as much as possible and uses a gear reduction of 15:1. This means that the diameter of the driving wheel fitted to the ferris wheel is 15 times as large as the diameter of the one fitted to the crank shaft of the steam engine.

Contents:

4 pre-punched sheets of cardboard 0.5mm
1 pre-punched sheet of cardboard 0.4mm
1 spring steel axle 100mm x 1.5mm
2 discs d1.5mm x D15mm made from
1mm PVC
1 silicone tube d0.8mm x D2.8mm x 15mm
8 tooth picks
14 O-rings 1.5mm x 1mm
2 rubber bands 2 x 270mm, Ø172mm
1 construction manual

You will also need for assembly:

- * Standard solvent based all purpose glue, e.g. UHU, Evo-Stik Impact, B&Q All Purpose Glue. **Do not use water-based glue:** it softens and warps the cardboard, and doesn't stick properly to the printed surfaces. Solvent based glues also dry much faster.
- * A sharp knife with a fine point (thin carpet knife, craft knife, scalpel), to cut the thin holding tabs of the pre-punched parts, the tooth picks, and the silicone tube.
- * A cutting board or mat, made from hardboard, plastic, or wood. Self healing cutting mats are ideal as the material re-closes after each cut.
- * A pair of tweezers or small needle-nosed pliers can be helpful to hold small parts like spacers or the driving wheel.
- * For perfectionists: black, white, and golden pens to paint the edges of the cardboard parts and the wooden axles of the gondolas. These discretionary steps are not listed in the instructions.

Tips for successful construction - Please read before commencing!

- * In order to ensure good results and for straightforward construction, the building instructions have been broken down into chapters A to L, which are broken down further into smaller steps. Do not be worried by the long text - it is simpler and faster than it appears and helps to avoid mistakes. Read each step from the beginning to the end before commencing and allow yourself about 5 hours for the construction (depending on experience). The more care you take, the better the ferris wheel will work and look.
- * Every part has its name and/or part number printed on front or back. The part number consists of a letter and a number: the letter denotes the chapter it belongs to, the numbers denote the order of construction. The part number can be recognised by its rectangular frame, e.g. C2. Only remove the parts as you need them.
- * Places needing glue are marked in grey. On each of these grey areas you will find a part number followed by an arrow in a square:
K2 → The number denotes the part (or tab of the part) that will be glued in this place. On some grey areas you will find the symbol ↻. This means that the part will be glued to itself on this area. Please keep in mind that the glueing areas are slightly smaller than the parts that will be glued to them. This ensures that grey areas will be completely covered.
- * We recommend that you do not tear the parts out of the cardboard sheet, but cut through the thin connecting tabs to make sure that the edges stay smooth.
- * All folding lines on sheets 1-4 are prepared by perforations, the ones on sheet 5 are pre-grooved. If they are to be bent "forwards", you have to fold them towards you when looking at the printed side of the part. If they are to be bent "backwards", you need to fold them away from you. You get a straighter fold if you position the folding line over a sharp edge.

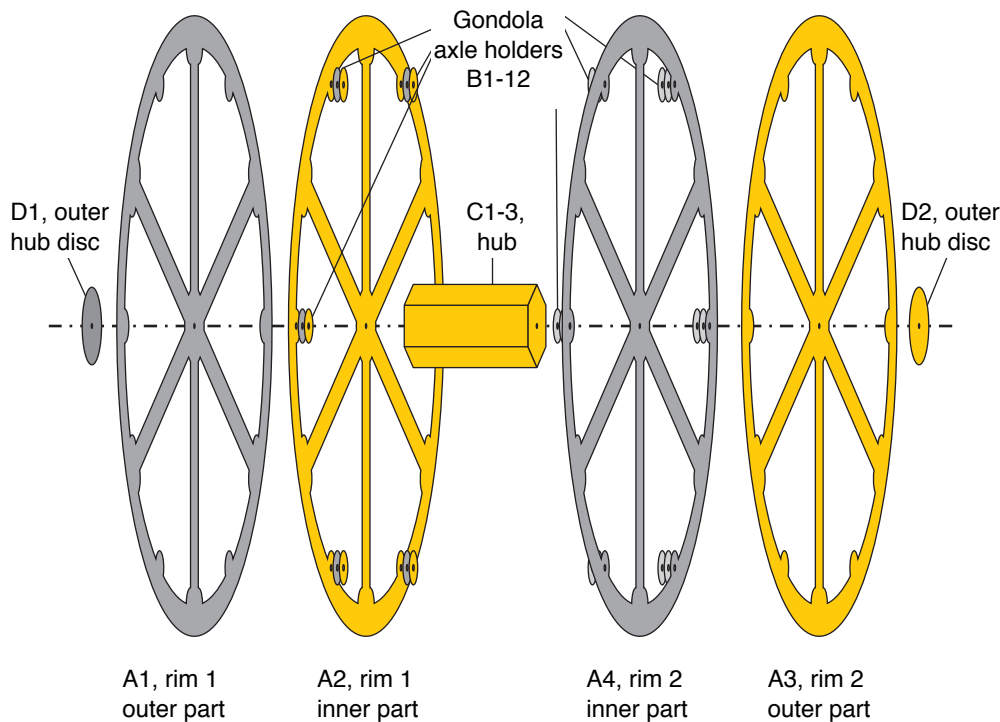


Fig. 1

Chapter A

The Rims of the Ferris Wheel

Step 1: Remove the outer part of rim 1 [A1, Bogen 1] from the cardboard sheet and push out the small bit in the centre hole, e.g. using the spring steel axle. Do the same with the inner part of rim1 [A2, Bogen 3] and also open the 6 small holes for the gondola axles which are located on the outer part between the spoke ends. Then glue both parts back to back, making sure that they are perfectly aligned. Take care that the rim doesn't warp during drying, for example by pressing it down with a book onto a hard even surface.

Step 2: Repeat step one with the outer [A3, Bogen 2] and inner parts [A4, Bogen 4] of rim 2.

Chapter B

The gondola axle holders

The 6 holes on the inner part of the two rims are not deep enough to hold the gondola axles securely in place. Therefore we need to reinforce each of them with 2 cardboard discs.

Step 3: Remove the small discs from the hole of the 6 inner axle holders [B1 to 6, Bogen 1], do the same with the 6 outer holders [B7 to 12, Bogen 1] and glue each inner holder on the back of one outer holder.

Step 4: Glue these two-layered axle holders onto the inner side of one rim, exactly over each of the 6 holes on its circumference. Take care that the holes don't fill up with glue.

Tip: The easiest and most accurate way to mount the holders: Cut off the tip of one tooth pick, push it through one of the holders, apply glue to the back of the holder, place the pick with the blunt end into the hole in the rim, and push the holder in place. Now the holes in the holder and the rim are perfectly aligned.

Step 5: Repeat the last two steps with the other inner [B13 to 18, Bogen 2] and outer holders [B19 to 24, Bogen 2] and glue them onto the inside of the other rim.

Chapter C

The Hub of the Ferris Wheel

The hub consists of a hexagonal block. It connects the two rims to form a stable wheel of defined thickness.

Step 6: Fold all grooves of the hub [C1, Bogen 5] backwards and glue the grey tab behind the opposite side to form a hexagonal tube.

Tip: Push one of the open sides of the hub against your worktop before the glue sets to make sure that the connection is well aligned.

Step 7: Fold the 6 glue tabs of hub cap 1 [C2, Bogen 1] backwards and test if it fits nicely into the end of the hub that shows the glue mark for [C2]. The non-printed side of the hub cap then faces inwards. One of the glue tabs is only half as wide as the others. This tab should be glued to the side where the hub itself is glued together, right next to its glue tab. Take the hub cap out again, apply some glue on the inside of the hub and put the hub cap back in place. Push this side of the hub against your worktop to make sure that the surface of the cap is flush with the rim of the hub.

Step 8: Fold the glue tabs of hub cap 2 [C3, Bogen 2] forwards and glue it into the other end of the hub following the instructions of Step 7.

Chapter D

Fitting of the Hub

To make sure the hub is exactly centred and square, we will use the spring steel axle as a tool.

Step 9: Open the small hole in the middle of the outer hub discs 1 and 2 [D1, Bogen 1; and D2, Bogen 2] and glue them onto the marked areas on the outside of the rims of the ferris wheel. Use the steel axle to check that the holes are aligned.

Step 10: Glue the hub onto the inside of one rim. The grey glue mark is hexagonal like the hub and shows how the edges should be aligned. Again, use the steel axle to align all centre holes by pushing it through the hub first. It is not easy to find the second hole, but with a bit of careful probing you should be able to stick the axle through. Then apply some glue and stick the end of the axle through the hole on the inside of one rim. Push the hub against the rim while the glue sets. Leave the axle in place and glue on the other rim using the same technique.

IMPORTANT: The spokes of the rims have to be exactly aligned. Check the alignment before the glue sets and turn the rims against each other if needed until the holders for the gondola axles are exactly opposite each other.

Tip: You can leave the steel axle in the hub. This saves you the fiddly work of sticking it through again later.

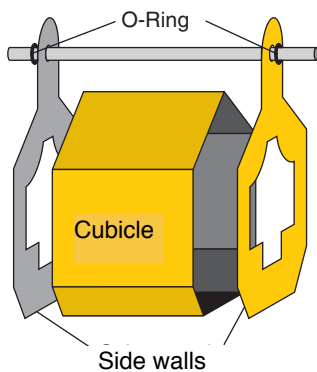


Fig. 2: Gondola

Chapter E

The Gondolas

The gondolas consist of two identical side walls and a cardboard ring that forms the cubicle. They are hung in between the rims of the ferris wheel by means of a wooden axle (tooth pick). To keep them from sliding sideways on the axle, they are held in place by small O-rings.

Step 11: Take the 12 gondola side walls [E1 to 6, Bogen 1; and E7 to 12, Bogen 2] out of the cardboard sheet and remove the cardboard from the window openings and from the small holes for the axle.

Step 12: Fold all grooves of the cubicles [E13 to 18, Bogen 5] sharply backwards and glue each of them together to form symmetrical 7-sided rings. Again push the sides of the rings against your worktop before the glue sets to ensure proper alignment of the edges.

Step 13: The backs of the side walls are printed in black with a grey line near the edge. This line is the glue marker for the edge of the cubicle. Hold a cubicle against a side wall and check that its edge lies exactly on top of the grey line. Only the part of the side wall that takes the axle should stick out. Now apply a generous amount of glue to the grey line on one side wall and stick it to one of the cubicles. Take care that the side wall sticks out evenly by about half a millimetre along the whole edge. Repeat this process with the other five cubicles and let the glue set. Then glue the remaining 6 side walls on the open sides of the 6 cubicles in the same manner.

Now the gondolas are ready to be fitted to the ferris wheel.

Step 14: Cut off the tips of 6 tooth picks and shorten them to exactly 41mm.

Step 15: Take one of these axles and push one of the small O-rings about 6mm onto one end. Push the axle through the two hangers of a gondola and push another O-ring onto the other side. Both O-rings should have the same distance from the ends of the axle and the gondola should be able to swing freely between them. Then glue the axle into two opposite holes on the inside of the ferris wheel rims. Do the same with the other 5 gondolas.

Now the ferris wheel is complete. In the next steps we will build the stand that will hold the wheel.

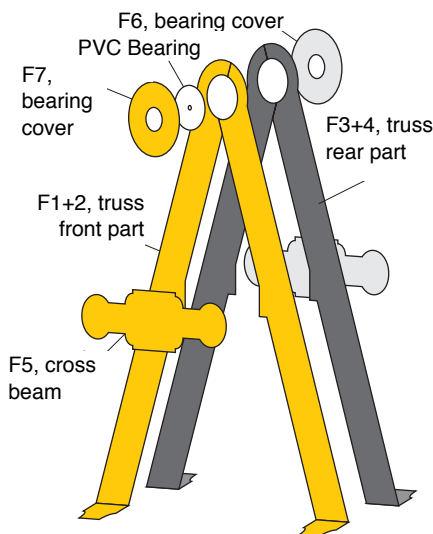


Fig. 3: Stand

Chapter F

Stand 1

Each stand consists of 2 trusses that are angled at 20 degrees to each other. They are held in the vertical by a cross beam and 2 stanchions. The rounded top of the stand houses a bearing disc made from hard PVC.

Step 16: Take the front part of the left truss 1 [F1, Bogen 1] and put it back to back onto the rear part [F2, Bogen 1]. The two parts are flush with each other except at the top where they look slightly different. This cutout makes it easier to connect the two trusses.

Step 17: Fold both foot tags forwards and glue both parts back to back. The protruding parts should not be covered in glue when you do this.

Step 18: Fold the foot tags of the front and rear part of the right truss 1 [F3 and F4, Bogen 1] forwards and glue them together in the same way.

Step 19: Put both trusses on your worktop so that their top parts form a round cut-out that will later house the round PVC bearing for the axle of the wheel. The protruding parts of each truss fit exactly to the ones of the other. The stand now looks like a capital "A" without the horizontal bar. **Don't glue the parts yet.**

Step 20: Put the cross beam [F5, Bogen 3] onto the designated glue areas of the stand to check that everything fits. The cross beam now forms the horizontal bar of the "A". Its lower edge should be flush with the small tabs on the inside of the trusses and its round outer edges should just touch the outer edges of the stand. This defines the correct angle between the trusses. Now glue all three parts together in this position and check the distance of the foot tags by holding them against the mounting plate. The tags should sit exactly on top of the grey glue marks on the plate.

Step 21: Glue bearing cover 1 [F6, Bogen 3] onto the round head of the stand. On the back you now have a recess for the PVC bearing disc. Check that the disc fits nicely into this recess and then glue it in. Glue the other bearing cover [F7, Bogen 3] on top.

Step 22: Fold the foot tags and the round head tags of the stanchions 1 and 2 [F8 and F9, Bogen 3] forwards and glue them back to back. Do the same with the stanchions 3 and 4 [F10 and F11, Bogen 3]. The stanchions will be glued to the stands later.

Chapter G

Stand 2

Stand 2 is identical to stand 1.

Step 23: Build stand 2 in the same way as you built stand 1 in the last chapter: Glue the two parts of the left truss [G1 and G2, Bogen 2] back to back as well as the front and back of the right truss [G3 and G4, Bogen 3]. Then glue them together with the cross beam [G5, Bogen 4] to form the capital "A".

Step 24: Glue the hard PVC bearing disc into the head of the stand with the help of the two bearing cover [G6 and G7, Bogen 4].

Step 25: Glue the stanchions 1 and 2 [G8 and G9, Bogen 4] of stand 2 back to back, do the same with stanchions 3 and 4 [G10 and G11, Bogen 4].

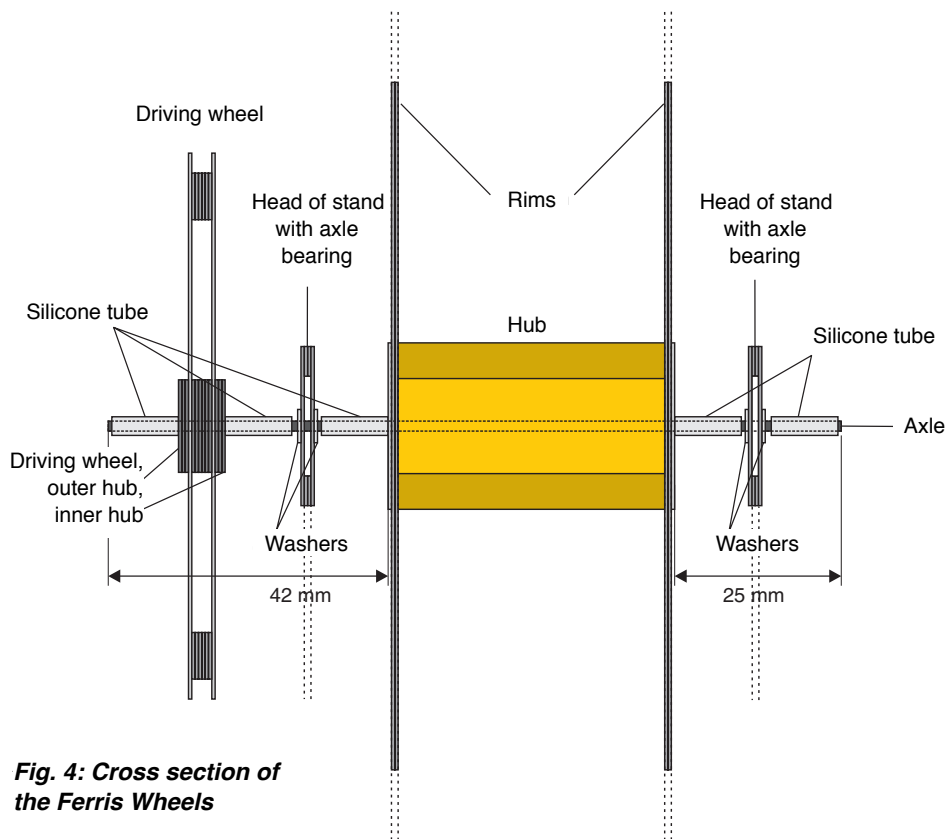


Fig. 4: Cross section of the Ferris Wheels

Chapter H

Fitting the Stands to the Mounting Plate

Tip: The mounting plate [H, Bogen 5] consists only of one layer of cardboard, which is sufficient for the ferris wheel to function properly. If you would like to reinforce the plate with cardboard, plywood, or MDF, so it has the same thickness and stability as the one of the Steam Engine, you should do that now, BEFORE you mount the stands. Also, it is a good idea to fill in the cartouche in the centre with your name and year of build now, before you carry on with the work.

Step 26: Glue one of the stands onto the designated glue marks. The cross beam should be facing outwards towards the marks for the stanchions. Align the stand as accurately as possible and prop it up if needed until the glue has set.

Step 27: Now glue the two stanchions of this stand first only to the round ends of the cross beam. Once the glue has set you can then glue them to the mounting plate, adjusting the stand so it is exactly vertical.

Step 28: Do the same with the other stand and its stanchions.

Chapter I

Fitting the Ferris Wheel

The ferris wheel turns with its axle in the bearings of the stands. To secure it on the axle we use short pieces of silicone tubing which are pushed onto the axle from both sides and clamp the wheel in place. Further pieces of tube make sure that the axle can't slip out of the stands and also that the driving wheel is secured on the axle and can turn the ferris wheel. To make sure that the silicone tubes don't come into contact with the PVC bearings (which would result in excessive friction), we also add little cardboard discs as washers (see Fig. 4).

Step 29: Cut the silicone tube into 5 pieces of 10mm length and remove the washers 1 to 4 [I1 and I2, Bogen 1; and I3 and I4, Bogen 2] from their cardboard sheets.

Step 30: If you haven't already done so, stick the steel axle through the hub of the ferris wheel and push two of the silicone tube from both sides and clamp the wheel in place. The axle has to stick out of the hub 25mm on one side and 42mm on the other (measured from the hub, not from the end of the silicone tube). On the longer end we will later mount the driving wheel. Now push the silicone tubes firmly against the hub of the ferris wheel to make sure that it rotates with the axle.

Step 31: Push a washer on each end of the axle and then stick the long end first from the inside through one of the bearing discs of one stand. Then stick the shorter end of the axle through the other stand. To be able to do this you will have to bend the stands outwards a bit.

Step 32: Now push the other two washers onto the ends of the axle, followed by two more pieces of silicone tube. Adjust these so that the width between the heads of the stands is about 65mm and the ferris wheel can turn freely without friction. The silicone tube on the short end should be about flush with the axle. On the long end the axle is sticking out by about 17mm. This is where the driving wheel will be fitted in the next chapter.

Chapter J

The Driving Wheel 1

To make sure that the ferris wheel won't turn too fast and the moderate power of the steam engine is enough to drive it, the gear ratio of the drive is set at 15:1. That means that the diameter of the driving wheel on the ferris wheel is 15 times larger than the diameter of the one connected to the steam engine.

The actual driving wheel is constructed from two identical half-wheels, driving wheel 1 (Chapter J) and driving wheel 2 (Chapter K). Each half-wheel consists of a rim (part 1) onto which the 12 inner parts (parts 5 to 16) are glued. Four of these inner parts form a complete ring so that in the end six layers of cardboard will separate the two rims. In the middle of each half-wheel is a hub, both in-between (parts 2 to 4) and on the outsides (parts 17 to 19).

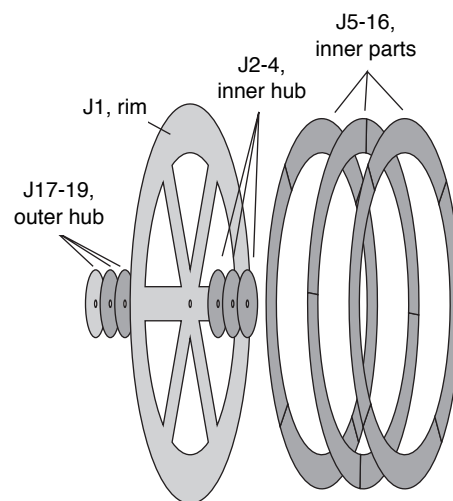


Fig. 5: Driving wheel 1

Step 33: Put rim 1 of the driving wheel [J1, Bogen 3] with the gold-printed side downwards onto your worktop. Glue the inner hub parts 1 to 3 [J2 to 4, Bogen 3] together, so they form a block and glue this block on the centre of the rim. Make sure that the holes in the centre that will take the axle are exactly aligned and stay free from glue. You can check this before the glue sets by pushing the rim onto the axle.

Step 34: Glue the inner parts 1 to 4 [J5 to 8, Bogen 3] onto the back of the rim so that they make up a complete ring. The inner edge of the rim (between the spokes) should be flush with the inner edge of this ring. After the glue has set, glue a second layer of inner parts (J9 to 12, Bogen 3) on top of the ring, with the joints slightly shifted. Again wait till the glue has set, then glue the third layer of inner parts [J13 to 16, Bogen 3] on top. Check several times in between that the half-wheel doesn't warp.

Step 35: Glue the outer hubs 1 to 3 [J17 to 19, Bogen 3] together, making sure that they are completely flush, and with the gold-printed disc on top. Don't glue the stack to the rim yet.

Chapter K

The Driving Wheel 2

Step 36: Repeat the procedures from Chapter J to construct the second half-wheel. The parts are all on Bogen 4 and have the same numbers, except that the letter J is replaced by K.

Step 37: Glue the two half-wheels back to back with the spokes being aligned. Make sure that the holes in the centre are aligned and check this by sticking the wheel onto the axle.

Step 38: Now glue the two outer hubs onto the driving wheel and stick it onto the axle before the glue has set. This way you can be certain that the wheel doesn't wobble. After the glue has set, push the last piece of silicone tubing onto the end of the axle and push it together with the one opposite firmly against the driving wheel to lock it on the axle.

The ferris wheel is now complete. It should turn quite freely so that it will turn a few times on its own after pushing it once. No excessive friction should be apparent at any point of the rotation.

Chapter L

The Small Driving Wheel

The small driving wheel only has one rim, we use the hub of the steam engine's fly wheel as the other one.

Step 39: Glue the 6 inner parts of the small driving wheel [L1 to 3, Bogen 1; and L4 to 6, Bogen 2] together to form one block. Again make sure that the holes in the centre are exactly flush, which is a bit tricky since the parts are quite small.

Step 40: Glue the two rim parts [L7, Bogen 1; and L8, Bogen 2] flush onto each other and then the block made from the 6 inner parts onto the grey glue mark.

Step 41: Remove the outer piece of silicone tubing holding the fly wheel on the crank shaft of the steam engine and fit the small driving wheel, the smaller block with the 6 inner parts first. Then secure the driving wheel in place with the silicone tube pushing firmly against it.

Tip: *If the free end of the crank shaft isn't long enough for the driving wheel to be fitted, just move all other silicone tubes on the crank shaft a bit.*

Step 42: Operating the Ferris Wheel: Start up the Steam Engine and stand the ferris wheel next to it so that the two driving wheels are exactly in line. Put the drive belt (rubber band) over both wheels and pull the Ferris Wheel away from the Steam Engine until the rubber band just starts to become tight.

And off we go!!

We wish you lots of fun with your Ferris Wheel. Maybe you have other ideas for models that can be driven by the steam engine? Give it a try and let us know about it. We are looking forward to your photos and videos!

Questions and Answers

The Ferris Wheel doesn't turn because the Steam Engine runs too slowly. What can I do?

- * Make sure that the Steam Engine is properly adjusted. Only with optimal adjustment will it run fast enough and supply enough power to operate the Ferris Wheel. The speed of the Steam Engine is a good indicator for the correct adjustment. Check the manual for the Steam Engine for hints of how to set it up properly.

The Ferris Wheel still doesn't turn although the Steam Engine runs properly. What can I do?

- * Remove the driving belt and check that the Ferris Wheel turns without any noticeable friction and that all gondolas can swing freely around their axles. Check that the axle of the Ferris Wheel can turn freely in its bearings. The silicone tubes should not rub against the bearings! Sometimes a small drop of oil helps.

Can I put small figures in the gondolas?

- * Of course! But you have to make sure that the weight of the figures in each opposite gondola is exactly the same.

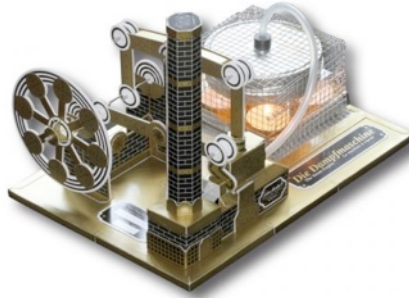
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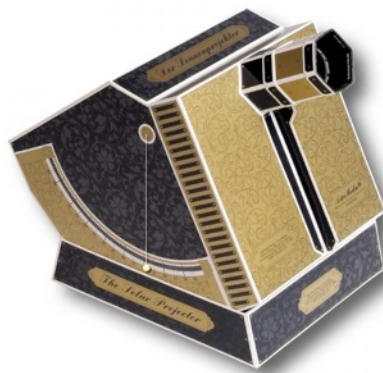
The Sextant



The Stirling Engine



The Stardial



The Solar Projector



The Magic Lantern

and many, many more